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:	)	CASE NO. 13,586
APPLICATION OF THE NEW MEXICO OIL CONSERVATION DIVISION FOR THE REPEAL OF EXISTING RULES 709, 710 AND 711 CONCERNING SURFACE WASTE MANAGEMENT AND THE ADOPTION OF NEW RULES GOVERNING SURFACE WASTE MANAGEMENT	)	

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REPORTER'S TRANSCRIPT OF PROCEEDINGS

COMMISSION HEARING

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

Volume III - May 4th, 2006

Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Commission, MARK E. FESMIRE, Chairman, on April 20th-21st and May 4th, 2006, at the New Mexico Energy, Minerals and Natural Resources Department, 1220 South Saint Francis Drive, Room 102, Santa Fe, New Mexico, Steven T. Brenner, Certified Court Reporter No. 7 for the State of New Mexico.

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C U M U L A T I V E   I N D E X

April 20th-21st, May 4th, 2006
Commission Hearing
CASE NO. 13,586

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(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

APRIL 21st, 2006 (VOLUME II):

(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

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CUMULATIVE INDEX OF EXHIBITS

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(Continued...)

CUMULATIVE INDEX OF EXHIBITS (Continued)

Industry Committee	Identified	Admitted
Exhibit 4	814	813, 815
Exhibit 5	814	813, 815
Exhibit 6	814	813, 815
Rebuttal exhibit	812	813

* * *

Additional submission by the Division, not offered or admitted:

	Identified
Redline of subsections G and H summarizing changes testified to by Mr. von Gonten	601

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ALSO PRESENT (Continued):

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Chemical engineer, environmental engineer
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FORREST B. (BEN) THOMAS, PhD
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GLEN VON GONTEN
Senior Hydrologist, OCD

* * *

WHEREUPON, the following proceedings were had at 8:16 a.m.:

CHAIRMAN FESMIRE: At this time we're going to go ahead and reconvene the Oil Conservation Commission hearing on Cause Number 13,586, in the matter of the Application of the New Mexico Oil Conservation Division for repeal of existing Rules 709, 710 and 711 concerning surface waste management and adoption of new rules governing surface waste management.

There are a couple of housekeeping matters we have to address before we start.

First of all, is there anyone in the audience who would like to make a comment on the proceeding before the Commission before we begin?

Okay, seeing none, we'll continue to the next item of business, which will be housekeeping.

We intend to go from this time until approximately five o'clock this afternoon. We will have a one-hour lunch break somewhere around noon where it's convenient for the parties and we don't have an unnatural break in the testimony. We also intend to have two 10-minute breaks, evenly spaced, one in the morning and one in the afternoon.

So at this time I believe, Mr. Brooks, you're about to begin the direct examination of Mr. von Gonten?

MR. BROOKS: Yes, Mr. Chairman, honorable Commissioners.

Before we do that, Mr. von Gonten has prepared some additional exhibits, three of which are based on some additional investigation that we didn't get the results of till after the filing deadline. The other one, being a rebuttal exhibit, is something that came up in the first two days. We have furnished these exhibits by fax to opposing counsel, although we had some difficulty faxing them and Mr. Hiser didn't actually receive them until this morning. We have tendered them to him this morning, however.

I want to know if there's going to be objection to these exhibits and what the ruling is going to be, so the witness can use them in testimony if they're admitted.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: No objection.

CHAIRMAN FESMIRE: Mr. Hiser?

MR. HISER: No objection.

CHAIRMAN FESMIRE: Mr. Huffaker?

MR. HUFFAKER: No objection.

CHAIRMAN FESMIRE: And Mr. Sugarman?

DR. NEEPER: Our counsel can't be here this morning due to conflicts. We have been served and we have no objection.

MR. BROOKS: Very good.

CHAIRMAN FESMIRE: No objection being noted, they will be admitted.

MR. BROOKS: Okay, I have four copies left here other than my own, which I will distribute among the Commissioners up here, and the witness already has a copy in his notebook.

MR. VON GONTEN: David, could you provide me a copy of the official --

MR. BROOKS: What?

MR. VON GONTEN: My copy doesn't have everything.

MR. BROOKS: Oh, you don't have --

MR. VON GONTEN: No, no, no, I have a copy of the actual -- the black binder. I don't have a complete set of this, I just have my own notes, so in case they ask me any questions --

MR. BROOKS: Okay, what do you need?

MR. VON GONTEN: Well, the -- material and stuff -- that's fine, I'll get a copy --

MR. BROOKS: Okay. May I approach the witness?

CHAIRMAN FESMIRE: You may.

MR. BROOKS: With that, Mr. Chairman, honorable Commissioners, the Division calls Glen von Gonten.

CHAIRMAN FESMIRE: Mr. von Gonten, you've been previously sworn?

MR. VON GONTEN: Yes, sir.

CHAIRMAN FESMIRE: Mr. Brooks, you may begin.

GLEN VON GONTEN,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BROOKS:

Q. Okay. Good morning, Mr. von Gonten.

A. Good morning.

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

A. My name is Glen von Gonten.

Q. And by whom are you employed -- You've given the spelling of that to the court reporter, have you not?

COURT REPORTER: (Nods)

Q. By whom are you employed?

A. I'm a senior hydrologist with the Oil Conservation Division's Environmental Bureau.

Q. And are you here in the Santa Fe office?

A. I -- yes, sir.

Q. Would you briefly outline -- I know your résumé is in the file books before us, but would you briefly outline for the honorable Commissioners your background, education, experience as a hydrologist?

A. Certainly. For the past 15 months I've been working as a senior hydrologist with the Environmental

Bureau in the Oil Conservation Division.

Before that I was a supervisor in the New Mexico Environment Department's Hazardous Waste Bureau where I was supervising the Department of Defense group working on permitting a directive action at a number of Department of Defense facilities and federal facilities. I worked there for approximately five years.

Before that I was employed with the Department of Environmental Quality with the Commonwealth of Virginia, where I was in the RCRA permitting and corrective action program.

And before that I was employed as a geologist in a variety of positions, in a variety of companies in the oil and gas industry.

I have a bachelor's degree in geology and a master's degree in geology.

MR. BROOKS: Mr. Chairman, honorable Commissioners, we submit the witness as an expert hydrologist.

CHAIRMAN FESMIRE: Is there any objection from the parties?

MR. HUFFAKER: No objection?

MR. CARR: (Shakes head)

MR. HISER: (Shakes head)

DR. NEEPER: (Shakes head)

CHAIRMAN FESMIRE: Commission?

COMMISSIONER BAILEY: (Shakes head)

COMMISSIONER OLSON: (Shakes head)

CHAIRMAN FESMIRE: He will be so accepted.

Q. (By Mr. Brooks) Very good. Mr. von Gonten, have you been involved in the preparation or drafting of the proposed Rule 53?

A. Yes, sir, I have.

Q. And in what particular area was your attention most intensively directed?

A. I focused mostly on Rule 53.G, landfarms, and small landfarms, 53.H.

Q. Very good. And have you prepared a presentation explaining those portions of the Rule and the reasons behind them?

A. Yes, sir, I have.

Q. Okay, using the procedure I've used with the other witnesses, I will invite you to start your presentation, and I will interrupt you with questions from time to time but will allow you otherwise to make your own presentation.

A. Very good. Shall we shut the door?

I'll be talking about Rule 53.G, which are the specific requirements applicable to landfarms. 53.G consists of eight paragraph -- or sections, and deals primarily with commercial and centralized landfarms.

I'll also be addressing 53.H, which are the regulations specific to small landfarms.

53.G has eight paragraphs. The first is waste acceptance criteria.

Second is background testing for WQCC 3103 sections A and B, constituents. WQCC Regulations 3103 are the standards for groundwater of 10,000 TDS or less.

Section -- or paragraph (3), operation and waste treatment;

Paragraph (4), treatment zone monitoring;

(5), vadose zone monitoring;

(6), treatment zone closure performance standards;

(7), disposition of treated soils; and

(8), environmentally acceptable bioremediation endpoint.

G.(1), waste acceptance criteria, is fairly simple. Landfarms are to accept soils and drill cuttings predominantly contaminated by petroleum hydrocarbons. There is the additional requirement for G.(8), which is the environmentally acceptable bioremediation endpoint, that they accept contaminated soil that is less than 50,000 parts per million.

Q. Okay, I -- just for clarification, because it's not apparent on your slide, that does not apply if they are using the closure standards in G.(6), versus the bioremediation endpoint --

A. That's correct --

Q. -- correct?

A. -- there's a special requirement only for G.(8), for the environmentally acceptable bioremediation endpoint approach.

Q. Okay, continue.

A. As we have discussed in our previous testimony, chlorides must be restricted to less than 1000 parts per million, the soil must pass the paint filter test, and there is a provision that operators may accept tankbottoms on a case-by-case basis.

Q. Now would you explain why we did that?

A. Well, as -- the regulation states that -- we contemplated that there were areas of New Mexico where there were no nearby oil treatment plants. The proper procedures for dealing with tankbottoms would be to send the tankbottoms to an oil treatment plant so that any recoverable hydrocarbons could be recovered and there would be no waste, which of course is one of our statutory obligations.

However, we recognize that there are places in New Mexico where there just is no oil treatment plant nearby, or that it's at such a distance that you would spend more energy on gasoline, tanking -- or trucking the tankbottoms to be recovered that it wouldn't actually benefit the environment.

Q. Okay, and one other question. One of the commentors has taken issue with the use of the term "predominantly contaminated by petroleum hydrocarbons". Does that contemplate that there may be some other contaminants in this material other than petroleum hydrocarbons?

A. Yes, landfarms will be receiving oilfield waste from a large number of spill sites. Those will include up- and downstream -- upstream and downstream operations, refineries, oilfield services companies such as chemical supply companies and -- companies such as Schlumberger or Halliburton, and they deal with a large number of exempt wastes that might conceivably be spilled onto the ground and mixed with hydrocarbons.

We intended that only soils that are predominantly contaminated by hydrocarbons should be sent to a landfarm, but we recognize that there will be cases where the contamination will include a fair number of other constituents.

Q. Now these would have to be either exempt or non-exempt, non-hazardous, correct?

A. That's correct.

Q. Because of our general --

A. That's correct, we can't accept any RCRA hazardous waste.

Q. Okay. Is it still beneficial to landfarm some of these wastes, even though they may have some nonremediable constituents in them?

A. As long as they're predominantly contaminated by hydrocarbons, we think that it is.

Q. Okay. And do we have other things written into this Rule to protect against residual contamination from other things that may be in these --

A. Yes, we have a closure performance standard for the treatment zone that will address a fair number of other constituents.

Q. Okay, continue.

A. So to summarize our goal on the waste acceptance criteria, it was to accept oilfield waste which was predominantly contaminated with hydrocarbons. This includes waste from oilfield services such as refineries and upstream and downstream operations, and we want to exclude to the maximum extent practical chloride contaminated cuttings.

G.(2) deals with the requirements for background testing. Operators are required to establish background for TPH, BTEX and the entire suite of the 3103 constituents, sections A and B. As a constituent agency of the Water Quality Control Commission, we chose section 3103 constituents. That's in 20.6.2 NMAC. We chose the standards for groundwater of 10,000 milligrams per liter TDS or less.

Q. Okay, that's 20.6.2.3103 NMAC, right?

A. Correct.

Q. And that's a regulation -- or a rule adopted by the Water Quality Control Commission?

A. That is correct.

Q. Okay, continue.

A. G.(3) specifies the requirements for operations and waste treatment, and it's based primarily on our 1997 guidelines. Each cell should be bermed to control run-on and runoff of rainwater. There are some setback restrictions: 100 feet for boundaries, property boundaries, 20 feet for pipelines. There's a requirement that facilities apply the contaminated soil at eight-inch or less lifts.

Later on I will discuss that we're going to propose some changes to the language that would allow, as a more practical matter, 1000 cubic yards per acre, per lift.

Operators are required to disc the contaminated soils within 72 hours of receipt and bi-weekly thereafter.

Operators are required to apply moisture as required to control dust and to maintain bioremediation.

The application of microbes that are not native microbes requires a prior Division approval.

And there's a requirement that operators remove any free-standing water within 24 hours of a rainfall. prior to this there was a 72-hour requirement, and anybody in New Mexico knows there's not going to be any standing water in 72 hours, and our goal here is to make sure that there is no driving head that would cause any leaching of contamination from the treatment zone to the vadose zone.

There's also a requirement that the operators maintain the records.

Q. Okay. Other than the change from 72 hours to 24 hours on removal of water -- and there are some references also to biopiles in paragraph (3), right?

A. That's correct.

Q. But other than those two things, is all of paragraph (3) contained in the present surface waste management facility guide- --

A. With the exception that we change this to be eight-inch lifts, rather than the original six-inch lifts.

Q. Continue.

A. Moving on to G.(4), which specifies the requirements for treatment zone monitoring, operators are required to spread the contaminated soil in eight-inch or less lifts, they are required to conduct a semi-annual treatment zone monitoring for TPH and chlorides.

And there's the requirement that -- prior to adding an additional lift, that they have reduced the TPH concentration to less than 2500 parts per million, which we feel allows the operator to optimize the landfarm use while waiting for the final reduction of TPH concentration, and we think it will reduce the overall footprint of landfarms in New Mexico by allowing that, rather than requiring them to achieve a final closure standard before adding an additional lift.

There is, of course, the continued requirement to restrict chlorides to less than 1000 milligrams per kilogram. Landfarm cells are required to cease operations after reaching a maximum thickness of two feet, and we're going to propose language that would make that actually easier for the landfarm operators to track by adding language that says 3000 cubic yards per acre.

Operators are required to treat to G.(6) closure standards or remove the contaminated soils at closure.

There's a provision for other disposition on a case-by-case basis.

Moving on to G.(5), which specifies the requirements for vadose zone monitoring, operators are required to have a sampling program, they must take samples between three and four feet below the base of the -- below the original surface.

We recognize the validity of some comments that it would be better to have this at six inches rather than at 10 feet or three feet. However, we think that when you're dealing with farm implements it's very difficult to be precise. And to avoid issues of false positives, we specify that the vadose zone samples be taken practically between three and four feet, which we think is still protective, but it's practical.

Q. They're required to take a set of at least four samples in --
A. That is correct --
Q. -- each case?
A. -- four representative, independent samples.
Q. Okay, continue.
A. And I should point out at some point that that was -- that that schedule of four samples was based on our original draft, which specified a five-acre cell. We realize that if a cell is 20 or 30 acres, that four samples may not be sufficient.
Q. Okay, the Rule says at least four, does it not?
A. It does.
Q. Okay, continue.

A. There is a requirement for a semi- -- the semi-annual monitoring program requires four samples for TPH, BTEX and chlorides, as we said, between three and four feet.

And for the annual -- at least annually, the operator must, in addition to taking four samples for TPH, BTEX and chlorides, must also analyze for the 3103 metals and inorganics, which are not the entire sections (A) and (B) of 3103, but a subset of those two sections.

There's record-keeping requirements, and there's a provision for corrective action for releases. If an operator determines that the vadose zone has been impacted by a release from the treatment zone, they're required to report this to the Environmental Bureau chief, and the Bureau will make a decision on what appropriate corrective actions may be required.

Q. Okay. Now as to that corrective action requirement, that is triggered by any evidence above background, correct?

A. That is correct.

Q. But it doesn't necessarily mean that they have to dig and haul or completely remediate any contamination?

A. No, it means that we're supposed to stop operations, review operations, see what's going wrong. We think that landfarms, if properly operated, will not have a release. If they're not being operated correctly, then we need to find out what's not happening --

Q. Yeah --

A. -- as it should be.

Q. -- the statement you just made, yeah, I want to emphasize, because -- I want you to emphasize, because I believe that that's been raised in the comment. In your opinion, if a landfarm is properly operated, is a no-release standard realistic?

A. It can be achieved, yes.

Q. Okay. And would the Division make a decision on a case-by-case basis as to whether or not remediation of contamination that was found was necessary?

A. Yes.

Q. And they might simply require some change in the way the landfarm was operated?

A. It may range from actually re-sampling to changing operations to actually maybe closing the cell and digging and hauling and depositing all the contamination in a landfill.

Q. Thank you, you may continue.

A. G.(6), treatment zone closure performance standards. After reaching -- after the operator reaches the cell thickness of two feet, or approximately 3000 cubic yards per acre, the operator is required to continue treatment until the contaminated soil has been remediated to either the background or the following standards: benzene 0.2 milligrams per kilogram, BTEX 50 milligrams per kilogram.

Total TPH, as measured by total extractable petroleum hydrocarbons method 418.1, would be 1000 of that fraction, no more than 500 milligrams per kilogram can be GRO+DRO, and that's gasoline range organics plus diesel range organics.

The chlorides can be no higher than 1000 milligrams per kilogram, and the WQCC Section 3103 constituents must be close to either the background or to some specified landfarm soil closure standards. This closure performance standard is a walk-away standard. The operator is allowed to leave the contaminated -- or leave the soil, the treated soil, in place at this point, and we wanted to make sure that it was safe for human health and the environment, so we made rather stringent closure performance standards.

I should point out that our original closure performance standards were 100 parts per million for TPH, not really particularly defined by one particular method or another, and that landfarm operators have been able to meet that standard, but we increased it from 100 to 1000.

Q. Is that 100 TPH standard in our present guidelines?

A. It is in the present guidelines, it's not in the regulations.

Q. Continue.

A. Continuing with G.(6), the question has arisen, how did OCD determine the appropriate soil closure performance standards? Well, the constituent list was taken from the Water Quality Control Regulations, Section 3103. Closure to background is always allowed. There are areas in New Mexico where the native arsenic standard is higher than a particular -- a risk based number might be, and you must always allow closure to a background concentration.

Soil closure concentrations were risk based numbers borrowed from other agencies, primarily from NMED, and also based on OCD's experience with the issue of the chlorides concentration. I mentioned that we borrowed the soil concentration from other agencies, we didn't see any reason to re-invent the wheel. There's a large number of sources to go to when looking for a soil closure standard.

The benzene number of 0.2 was taken from NMED Petroleum Storage Tank Bureau's 2000 guidance, which is a tiered approach to underground storage tank releases. We looked at one of the tiers and selected one of them that we thought most closely approximated a landfarm, although we don't think that that guidance is particularly relevant overall.

The BTEX number was contained in our 1993 spill remediation guidance and was also proposed in our draft Rule 50, and we were consistent with that.

Q. Okay. Are benzene and BTEX -- are these benzene and BTEX levels at all difficult to achieve in landfarming?

A. No, not in our experience.

Q. Do -- the benzene and BTEX, are they remediated rather quickly?

A. They do.

Q. Okay, continue.

A. TPH, which is somewhat problematic, is total petroleum hydrocarbons, and we took that primarily from two sources, or took it from one source and confirmed it with another.

From NMED Solid Waste Bureau Regulations for special waste, which specifies that you must reduce petroleum-contaminated soils to 1000 parts per million TPH before you can dispose of it in a municipal landfill.

And we also looked at NMED's 2005 soil screening levels -- and I'll go through in some detail in a few minutes -- for 2500 parts per million for a new lift, and that's based on a waste oil speciation.

Q. Now we also used this residential -- those residential soil -- or NMED 2005 standards, to confirm our 500 DRO and our 1000 TPH standard --

A. Yes, it did, it also played into that as well.

Q. Now are those standards for remediating cleanup sites?

A. Those are standards which were put together by NMED's Groundwater Quality Bureau's voluntary remediation program and the Hazardous Waste Bureau, and they are for remediation of spill sites.

Q. Okay, continue.

A. And I should also point out that these numbers are, based our recent sampling events, achievable.

The 3103 constituents, Section 3103 consists of actually 47 constituents. Sections A and B include 42 constituents. There's a Section C, which we did not include in our proposed closure standards, which consists of an additional five constituents. And we went primarily to, again, the NMED's 2005 soil --

Q. Okay --

A. -- screening levels.

Q. -- you've moved to your 172 page.

A. Okay, I'm sorry. Okay, I should summarize, then, again.

Benzene came from the PSTB 2000 guidance, BTEX came from our 1993 guidance --

Q. Okay, I believe we already -- I believe you've already gone over that. I believe what you were doing just a minute ago was on page 172?

A. I was moving to 172 --

Q. Okay --

A. -- I'm sorry.

Q. -- go ahead.

A. Further, the question has arisen as, how did -- exactly how OCD determined the appropriate landfarm treatment zone soil closure performance standards for constituents or parameters other than TPH, BTEX and chlorides, given that landfarms may treat soils contaminated with a very large number of constituents.

As I mentioned, the constituent list came from 3103, Sections A and B only, excluding Section C. There are 42 constituents or parameters.

We also considered going to the toxic pollutants defined in the Water Quality Control Commission regulations definition sections, which includes 93 constituents or classes of constituents or isomers.

We determined that 3103 was appropriate, but the question is, how appropriate is it for soil closure standards? 3103 specifies constituents for the protection of groundwater, which is a major responsibility for OCD as a constituent agency of the Water Quality Control

Commission.

3103 lists 42 constituents in Sections A and B. 34 of 42, or approximately 80 percent, are known crude oil or produced water constituents, and in our opinion all -- or almost all are known waste constituents that you might find in an oilfield services site, such as a chemical supply company or upstream operations or downstream operations.

The next slide may not be very visible, and there's another one on page 175 that is a little more legible. This is -- I'd like to take a minute to walk through this table, which basically summarizes our review of 3103 as far as being an appropriate soil closure list.

The first column on page 175 -- I've duplicated the columns here for this display -- consists of 3103 constituents. Arsenic through benzo-a-pyrine is Section A; chloride through pH is Section B; and Section C, which we did not include, was aluminum through nickel.

And you notice that there are three other columns to the right, EPA 1995, EPA 2000, and TPHCWG 1998. These were three sources of information that we went to. The EPA 1995 is the Petroleum Refining Industry Sector Notebook, Exhibit 17. We went and just did a cross-check, and every time we found that a constituent was listed on Exhibit 17, it was checked off in that column.

The EPA listed for the petroleum refining industry 159 constituents on this one Exhibit 17. And you can see the overlap between 3103 and EPA's study.

The next column over is EPA 2000, which was the Oil and Gas Extraction Industry, Table 5, which was specifically produced water effluent concentrations. Again, this consisted of 47 constituents, and the common constituents found also in 3103 represented by a checkmark.

The next column is the Total Petroleum Hydrocarbon Criteria Working Group. In 1998 they did a study, and they also had 159 constituents. And Table 14 -- again, if it was found in 3103 we checked it off. This was Table 14. There were 10 other additional lists, but Table 14 dealt specifically with crude oil.

There's some yellow highlighting. The first light yellow highlighting, chromium III and chromium VI, are commonly speciated in a lot of studies however are not speciated in 3103. 3103 just lists chromium, it doesn't speciate it. And that was just put in for completeness when I was putting this table together.

The brightly highlighted eight other constituents -- cyanide; fluoride; 1,1-dichloroethylene; methylene chloride; 1,1-dichloroethane; 1,1,2,2-tetrachloroethane; and vinyl chloride -- were not found in the three sources that we went to.

The other problematic issue was sulfate. It was not found.

We don't think that TDS makes any sense for a soil closure standard, because you're dealing with 100-percent TDS. And pH also doesn't particularly make sense to include as a closure standard, and so that did not make it into the draft regulations.

Q. But all of the other constituents were included, the A and B constituents?

A. That is correct.

Q. Even though they are not checkmarked on this?

A. That is correct, they went with -- we proposed 3103 for consistency, and we also suspect -- or probably -- were fairly convinced that the other constituents that are brightly highlighted would reasonably show up if we were to do a survey on the MSDS sheets on oilfield services companies.

Q. Okay, the lines highlighted in green in the first column on the right-hand portion --

A. Those are Section C, and those were excluded. And those are for constituents that are relevant for crops.

Q. Now is each of these checkmarks -- does that indicate that the relevant study found or detected these -- the particular constituent in the waste stream that they analyzed?

A. That's correct.

Q. Now do the results that you've got in these tables, as far as what's contained in waste streams, do they correlate with the associated waste study that Mr. Price used in his presentation?

A. Yes, I didn't prepare a table for that for presentation, but yes, there was a strong overlap on the associated waste as another study that was put out there.

Q. And that's back on page -- I believe it's 161 of the -- no, 61 of the materials, I believe.

A. I believe that it was earlier than 61. The associated waste report is given on pages -- starting on page 17 of Mr. Price's testimony.

Q. Thank you. Okay, you may continue.

A. Well, we -- we're looking at 3103. We considered other sources or other references for crude oil, produced water and TPH constituents. However, the sources that we went to did not study oilfield waste services, and those, again, were EPA 1995, EPA 2000, and the Total Petroleum Hydrocarbon Criteria Working Group of 1998.

Q. Okay, are you going to go back and cover 177 through --

A. Yes.

Q. -- 181?

A. I'll need to switch over, I'm sorry.

Again, this is the table we've been looking at.

And the next table here is a summary table, rather complicated. I'd like to take another few minutes to walk through this.

This table actually lists the W- -- or the 3103 constituents in the first column, and then in column B is our proposed soil closure standards in G.(6). And the next columns are the sources for those numbers that we put into our draft rulemaking, were derived from, in yellow -- white/yellow highlighting.

We went primarily to NMED's 2005 soil screening levels, and we looked primarily at the -- we took the more protective concentration of either direct ingestion or dermal contact or the soil-to-groundwater pathway, which is a DAF of 1, using various sources, primarily NMED's 2005 guidance.

And there are some errors that I should point out. First, the table is correct, total mercury should be 334 in the closure standards in G.(6), and that is a typo. It says .105, I believe.

The next error is ethylene dibromide --

CHAIRMAN FESMIRE: Well, wait a minute, let's catch that again, I didn't --

THE WITNESS: All right, sorry.

MR. BROOKS: Okay now, honorable Commissioners, we will have a handout to prepare you at the end of Mr. von Gonten's presentation that will include all of these things, so...

CHAIRMAN FESMIRE: Okay.

Q. (By Mr. Brooks) Go ahead, Mr. von Gonten.

A. As I said, there was a typo in ethylene dibromide and another typo in zinc, and we have a redline strike presentation, which Mr. Brooks has referred to, to make this clear.

Again, the next two columns were the NMED data, and if we couldn't find it from that source, one of our sister agencies, we went to EPA Region 3, Region 6, and Region 9, and EPA's superfund soil screening guidance.

I did not include the soil screening guidance numbers from EPA's superfund, because it was not a look-up table. It was actually a software program that you run on the Web, and you would have to run through several different screens to get each number.

Each one of these sources, whether it was NMED or an EPA Region 3 risk based concentration or soil screening levels or preliminary remediation goal, is a very complicated table, look-up table, that has hundreds of constituents and provides the relevant information about each constituent and has several columns that we thought were appropriate. We took the most conservative again, with our goal being the early detection of a release -- or actually, this is not for release, this is actually for closure. We recognize that there may be some minimal amount of contamination, and we wanted to make sure that it did not exceed the most protective number that we could come up with.

Q. Okay, Mr. von Gonten, the -- most of the numbers that you have used come from the New Mexico Environment Department materials, do they not?

A. That's correct, most of them are actually from the protection of groundwater --

Q. And once again -- once again, are these the numbers generated by the Hazardous Waste Bureau?

A. Yes, they are.

Q. And they're used -- Or what is their use? We --

A. For a spill site remediation. It's RCRA facility investigation of solid waste management units and areas of concern. Most of these are historic spill sites or units which proactively manage hazardous waste but resulted in a release.

Q. Okay, the third column from the left on the chart, what are those numbers? What is the significance of those numbers?

A. Those numbers are the direct injection dermal contact numbers. In other words, this is what the concentration may be -- Concentrations in excess of this may pose a risk of -- either a carcinogen risk exceeding 1 in 100,000, or a non-carcinogen risk which would result in a hazard index of greater than 1.0.

Q. And are these the levels that NMED considers appropriate for soils and residential -- for residential use?

A. Yes, these numbers go into the total risk assessment that you would be required to conduct, and they would result if you pass these numbers not merely on an individual basis but on a cumulative basis, you would be granted no further action, or you would use that number to determine how much soil had to be removed.

Q. The fourth column, what is that -- what do those numbers represent?

A. The fourth column, NMED's 2005 DAF of 1 is for the protection of the soil-to-groundwater pathway.

Q. Now are those numbers derived from the Water Quality Control Commission water quality standards?

A. Yes, they start off assuming protection of groundwater to the Water Quality Control Commission Regulations, 3103 concentrations, and the soil numbers are back calculated.

Q. Okay. This is -- I expect the Commissioners already understand it, but it's taken me several weeks to understand it, so this may be the most difficult question I ask you. Up in the top heading of the fourth column it gives the statement, DAF 1. Would you explain to the honorable Commissioners what that means?

A. DAF of 1 means that it's a dilution attenuation factor, and it's set to 1, which is the minimal that you can set it to. It's a number that is used to -- basically dilution is a solution, is what the DAF means, and it means that in the saturated zone this accounts for dilution that is protected from the point of contamination entering the aquifer to the point of exposure or the point of compliance.

Q. Now once the polluting -- once the pollutant enters the groundwater -- which is the saturated zone, correct?

A. Correct.

Q. -- then it's going to spread out because it's in water, and -- is that the concept basically?

A. That is the concept, if you use a dilution factor such as NMED proposes for small-scale sites of 20, or EPA has recommended for small-scale sites of less than half an acre.

Q. So as the water spreads out in the aquifer, then, the p.p.m., parts per million concentration, is reduced compared to what it is when the pollutant first enters the aquifer?

A. Generally, yes.

Q. So if it gets to a well site further downstream from the point of entry, then would it be less concentrated -- you would expect less concentration than it would at the time --

A. Yes.

Q. -- the actual amount that enters the --

A. Yes, you would.

Q. Is that what the DAF is intended to adjust for?

A. That is what the DAF considers, assuming that you're not being protective of soil and that you're protecting groundwater only at a point of compliance or a point of exposure.

Q. Now a DAF of 1, does that mean that you don't adjust the number?

A. That's correct.

Q. So what you're saying there is, when you use a DAF of 1, then the standard that you apply to the soil is the same standard that you would apply to -- that's your water quality standard, it's the same as your water quality standard?

A. With the exception that you have to look at the leachability of that material in soil, and so the soil factor is not considered in the -- is considered in the

DAF. That's why there's a difference between the DAF of 1 and the 3103 constituent concentration given in the third-from-the-right column.

Q. So when the -- when NMED constructed these numbers without regard to the DAF, it had already adjusted for the ability of those constituents to move in the soil; is that correct?

A. That's correct, that's accounted for in the DAF.

Q. So the DAF is not intended to adjust for that; is that correct?

A. That is correct.

Q. There's also a concept called the retardation factor.

A. Yes, this is what is happening when you take the contamination from a source, move it through the unsaturated zone.

Q. Are these numbers already adjusted for the retardation factor?

A. Yes, they are.

Q. Retardation factor doesn't have anything to do with the employees who operate the landfarm?

A. Not generally.

(Laughter)

Q. Okay. Is there any particular reason why, in your opinion, NMED would use a DAF of 1 in most of our landfarm situations?

A. Well, they point out in their guidance, when they provide a column of a DAF of 1 and a column of a DAF of 20, which is their default scenario, that a DAF of 20 is for small-scale sites, it is not appropriate for large sites, and it is not appropriate for areas where you have shallow groundwater or karst or fractured caliche.

Q. Now in southeastern New Mexico is there a lot of karst terrain?

A. There is.

Q. Is there a lot of caliche?

A. There is.

Q. In your experience, is fracturing common in caliche?

A. It is.

Q. When they're talking about small sites, what do they -- you know, small -- how small is small?

A. EPA has used a half-acre site. Predominantly this is being driven by the UST program, in my opinion. However, there are some curves that EPA has generated that relate the size and the appropriateness of the DAF. But when you're talking about large-scale facilities, such as a landfarm, that go up to 500 acres -- which I calculated, I believe, a couple weeks ago, to be over 20 million square feet -- the appropriate number always converges to a DAF of

1 --

Q. Okay --

A. -- even ignoring the issue of macro-pores and fractured caliche and karst.

Q. Now some of our commentors have raised the issue with regard to these standard numbers that some of them are below the practical detection level.

A. That could be the case. And in any case, we would only hold the closure standard to the practical quantitation limit, and we would support the change that would make that clear.

Q. Okay, continue.

A. I've referred several times to the Environment Department's 2005 guidance, and these tables, Table 1 and Tables 2a, are taken from that guidance.

Q. And excuse me, this is on page 179, correct?

A. Yes, it is.

Q. Make sure everyone's with us. Continue.

A. And we use this table for a couple purposes, primarily for the new lift criteria and for the confirming or DRO+GRO closure standard of 500 milligrams per kilogram. And we notice that when dealing with TPH, researchers have commonly speciated TPH into more manageable fractions. There are several hundred TPH fractions -- or TPH compounds in total petroleum hydrocarbon, and it's just intractable to deal with individual constituents.

NMED apparently followed the Massachusetts guidance, generally, and they speciated into three fractions: the C11 through C22, which deals with aromatics; the aliphatic or straight- or branch-change hydrocarbons of carbon count C9 through C18; and C19 through C36.

They made some assumptions on what the relative percentage of each one of those fractions is in a petroleum product. Most of the spills that the voluntary remediation program and then the Groundwater Quality Bureau and then the Hazardous Waste Bureau deal with are actually fuel spills rather than crude oil spills. So they've speciated -- or they've looked particularly at common petroleum products such as diesel, fuel oil, kerosene and jet fuel such as JP-4, JP-6 and JP-8, mineral oil in an industrial setting, the dielectric fluids, a miscellaneous called unknown oil, and waste oil.

You notice that if the facility cannot specify what the oily material is from, they use the most conservative -- they consider it to be a hundred percent aromatics and therefore would be a high toxicity.

The waste oil we looked at assumes 100-percent long-chain hydrocarbons or longer-chain hydrocarbons, C19 to C36, and this is what we thought would be relevant for a lift of weathered contaminated soil after a couple of years in a landfarm. We would expect, from our experience, to see the short-chain hydrocarbons will have volatilized or biodegraded and the more recalcitrant long-chain hydrocarbons would be remaining.

And we noticed that for the residential -- moving down to Table 2a -- the residential concentration that was considered protective for direct exposure was 2500, and we selected this for our new lift criteria.

We also noted that when we're dealing with diesel, which is given by diesel number 2 and crankcase oil, that NMED came up with a 520-milligrams-per-kilogram number, and that was appropriate for our 500 closure standard.

Q. That -- in your opinion does the use of the 520 standard by NMED for diesel -- in your opinion does that confirm our 500 p.p.m. --

A. It is supported, and it does confirm --

Q. -- standard? Continue.

A. Well, we also looked a little closer at this Table 2a, and we noted that if you take the mean of those six concentrations given in the highlighted column, you'll come up on the right with the average mean being -- or the mean being 976 milligrams per kilogram, which we thought was very supportive of our 1000 milligrams per kilogram, which was based originally on the Solid Waste Bureau's TPH standard for special wastes.

Finally, we considered -- on the TPH issue, we were impressed by the Canada-wide standards for petroleum hydrocarbons in soil, 2001. It chose to fractionate the TPH constituents into four fractions based on carbon count of the short-chain hydrocarbons of C6 through C10, C11 through C16, C17 to C34, and greater than -35, and greater.

We think that the fractions 1 and 2 of the Canada-wide standards represent, to a large degree, the GRO+DRO fraction.

We noticed that they subspeciated the TPH fractions into exposure scenarios, land use, and they also noted there was a difference between soil texture. So you have a number of cells in this table. The highlighted ones are the ones that are for the protection of groundwater or surface water, and we thought that that was appropriate to consider.

We did some brief descriptive statistics on the Canada-wide standards, and we looked first at just the fraction 1 and 2, speciated for protection of groundwater. Those would be those yellow-highlighted cells above. And there were 15 cells -- if you look down at the bottom, you see the count equals 15 -- and they came up with a very conservative number of 187, which might have been supportive of our original number of 100.

But then we looked at the -- further to the right, the brightly highlighted fraction 1 and 2, and looked at the average of all 29 cells in basically the fraction 1 and 2 columns, and that came up with 419, and we thought that was supportive of our GRO+DRO fraction. It's not exactly the same, because the carbon counts are the same thing as what we would expect from an 8015 analytical test to resolve.

And for completeness we also looked at fractions 3 and 4, which are the long-chain, more recalcitrant hydrocarbons. And we noticed the average of those columns, jumping up again, goes from a very conservative number of 400 to a very high number of 6600 parts per million. We noticed that the mean was 2900 for residential and agricultural use, and that the mean was 2962, considering all land uses.

Q. Mr. von Gonten, in the mean in the third column from the left, that's 2400, right?

A. That is 2400 parts per million.

Q. Okay, did you say 2900, by any chance?

A. The 2900 is the -- if you look further to the right on the screen, you'll see 2962, which is for all land uses, which would be restricting it to commercial and industrial standards, and we did that for completeness.

Q. Thank you.

A. Jumping back now to the PowerPoint, let's see, this is where I got off track, I apologize.

So in summary, we looked at alternate references for concentrations or sources of constituents for crude oil, produced water, TPH constituents. We weren't able to find a good source for oilfield services waste, but we did see the associated wastes, so that would also support that.

During our outreach, when we talked with all concerned parties, and -- industry asserted that our proposed standards were not based on sound science and recommended that OCD adopt NMED's Petroleum Storage Tank Bureau risk based decision-making process.

Our takeaway from those outreach meetings was that industry was particularly concerned about two main issues: that the TPH soil closure standards simply could not be achieved, and that other soil closure standards should be limited to only BTEX, using a -- 10 times the tank program's Tier 1 concentration and specifically recommending that OCD allow small amounts of contamination to migrate below the treatment zone into the vadose zone.

Q. Okay, let me interrupt you and ask you about question 1. You're going to go into that later, are you not --

A. Yes.

Q. -- achievability?

A. Yes.

Q. But just in summary, does our data indicate that in the majority of situations in New Mexico, these standards would be achieved?

A. Yes.

Q. Continue.

A. Well, the question has to be asked, why did we eventually reject industry's recommendations to base all soil closure concentrations standards on risk based concentrations and to use their proposed bioremediation endpoint approach for TPH?

We rejected this proposal because [*sic*] landfarms up to 500 acres in size that handle large volumes of poorly characterized oil-contaminated waste and will be operational for many years should be allowed to contaminate the environment even in small amounts. Rule 53 is designed to prevent releases, not to permit releases. Our goal is that there should be no new releases as a result of operations.

As previously noted, we intentionally borrowed numbers from other sister waste-management agencies, such as the Environment Department's Solid Waste, Groundwater Quality Bureau and Hazardous Waste Bureaus because of similar waste streams, technology, administrative issues such as permitting requirements and environmental concerns such as the protection of groundwater.

The Environment Department's Petroleum Storage Tank Bureau's remedial action program is not the waste management program and deals primarily with small-scale UST accidental spills, not large landfarms at which operators will intentionally apply large volumes of contaminated soil.

We noticed that -- when doing our research, that every organization such as API or Massachusetts who looked into the appropriateness of using TPH during a risk based decision-making process found that it was extremely complicated because of the large number, from several hundred -- estimates from several hundred to several thousand individual hydrocarbon compounds and other heterocyclic compounds that occur in crude, plus the oilfield waste, make it very difficult if not impossible to characterize the risk based on a TPH number alone.

Industry's risk based approach would set oilfield waste management standards to as low a standard as could be justified using risk based numbers. No pathway, no risk. OCD chose to propose waste management rules that are based on best management practices, as Mr. Price pointed out in his testimony on the first day of this hearing.

Q. Now let me interrupt you about that "no pathway, no risk". I am assuming probably the Commissioners understand this -- we're not presenting this case to a jury -- but I didn't understand it at first, so would explain what a pathway is?

A. Yes, during the outreach meetings, the discussion about a risk based approach dealt with -- in part, with the idea that if there's no pathway or that the constituents have been released to -- been reduced to low concentrations, then there is no risk. Not that the compounds are not toxic, but that there is no risk because there is no pathway.

Q. And does the pathway refer to a predictable chain of events by which the pollution will make its way to a particular receptor?

A. Yes, there are standard scenarios, there's direct ingestion or inhalation or -- you can drink contaminated water or you can have dermal contact with contaminated soil.

Q. Okay, and --

A. There are a number of specific, well defined pathways that must be considered.

Q. Our approach is not based on identifying a specific pathway, then. Is our approach just based on preventing the release of these contaminants into --

A. That's correct --

Q. -- the environment?

A. -- our approach is no release, no risk.

Q. Continue.

A. We can see that there is no logical reason to allow even small amounts of contamination to be released from any surface waste management facility, regardless of whether it is a landfarm, landfill, oil treatment plant or evaporation pond.

The requirements for large scale treatment and disposal facilities should be much more stringent than those for a small scale spill site.

Rule 53.G -- or 53 -- is for surface waste management facilities, it isn't a spill set of regulations.

OCD rejected industry's proposed risk based approach because of the size of the surface waste management facilities -- up to 500 acres again -- the length of time -- these facilities will be operational for many years, perhaps decades -- and OCD determined that a best management practice standard is more appropriate for surface waste management facilities.

The question arose as why OCD rejected industry's recommendations to base all soil -- closure soil concentration standards on a risk based approach and to use the bioremediation endpoint for TPH.

Well, we simply disagree with industry's assertions that landfarms in New Mexico cannot achieve the

GRO+DRO standard of 500 milligrams per kilogram, based on its own experience with New Mexican landfarms. New Mexican landfarm operators commonly have been able to achieve the DRO standard that would meet the old standard of less than 100 parts per million.

Q. Okay, did the Environment Bureau conduct a study to -- a sampling study, to determine from the available evidence what levels of remediation are actually being achieved in New Mexico landfarms?

A. Yes, we were very concerned about the observations that were made that we might be getting false data or inaccurate data, so we went and conducted our own sampling events, three sampling events.

Q. Okay, then would you proceed to discuss the results that we --

A. This first slide we can skip. This is the old exhibit of -- on page 192, when we've provided counsel and the Commission with some replacement displays, exhibits.

This is a log-log scale that represents the results of our sampling event. OCD staff went out on three separate occasions and sampled the treatment zone at several landfarms in Lea County and in San Juan County. We asked the landfarm operators to take us to an old cell that was ready for closure, and we wanted to see if these could meet the standard that we had proposed.

Q. Now how did you select the landfarms that you sampled?

A. We coordinated with the district inspectors, and they made the arrangements with the local landfarm operators to visit the landfarms. We went out with the landfarm operators or their agents.

Q. And was the objective to get a random sampling?

A. Yes, it was. We -- the only direction we gave them is, take us through the oldest cell or cell that you're proposing for closure.

Q. Okay. And on this chart does each one of these diamonds represent a data point that is the amount of TPH identified in the sample from one particular landfarm?

A. Yes, we took a total of 21 samples. The X axis is the DRO concentration in milligrams per kilogram. We analyzed -- each soil sample was analyzed for TPH by method 8015-B modified; method 418.1, which gives you more of the concentration of the long-chain hydrocarbons; we also analyzed for chlorides.

Each data point there -- each sample therefore was analyzed in at least two ways for TPH. I don't know if I can actually -- Okay, I can --

Q. Okay, we didn't give you a pointer, so Mr. Price has gone to get you one.

A. Okay.

Q. But we don't to delay the Commission, so go ahead.

A. As you can see, this is a log scale, log scale, so this is a log log display. The data points here would represent that this particular sample was approximately -- probably below the detection limit of .1 parts per million, and on the 418 test was actually something like 5 or 6 parts per million.

Our data ranged from very low concentrations up to one data point exceeded on the 418.1 test more than 10,000.

We have plotted the proposed 500 milligrams per kilogram combined GRO+DRO. This chart would look the same if we combined the GRO plus the DRO, however GRO was non-detect in all 21 samples, so we're just plotting basically DRO. But if we were to change the label here it would be GRO+DRO and it would look exactly the same.

Okay, you --

A. The red line is the 500 milligrams per kilogram --

Mr. Brooks?

Q. Yeah, you pointed out that this is a logarithmic scale, correct?

A. Correct.

Q. So --

A. This is 100, this is 200, this is 300, this is 1000, 2000, 3000, and so on.

Q. So when you start looking at those numbers that are beyond the red lines -- for instance, there's one I see that's just to the left of the vertical red line -- go down to the next one below that -- that looks like -- just eyeballing it, that looks like it would be about halfway between 1000 and 10,000, which would make it about 6000 or 7000. What is it actually?

A. That's about 3000. This would be -- the red line is 1000, this is 2000, this is 3000.

Q. Okay, continue with your explanation.

A. So we were conducting this sampling event actually to determine whether we actually were able to achieve concentrations below several thousand. And our takeaway from the outreach was that the industry experts were convinced that if we were getting data that was less than 1000, that it couldn't be real data.

What we noticed is that on the DRO standard -- or the GRO+DRO, which is method 8015-B modified -- 17 out of 21 data points actually met that standard. On the 1000 milligrams per kilogram standard, on the long chain of the 418.1 test, we saw that 11 -- you add these up, there's 11 out of these 21 data points, so this is approximately the midpoint that shows you what is actually being achieved today in what we refer to as dry land landfarming.

These landfarm operators do not add moisture. They rely entirely on -- as far as we know, on natural rainfall. And as far as we know, they're not amending the contaminated soil with nutrients.

So this represents what's being -- what's happening today in New Mexico at old cells that are ready for closure and have been not subjected to any strenuous management techniques.

Q. Now did you prepare charts that summarize the --

A. Yes, moving on --

Q. -- results?

A. -- to the next one, this is a semi-log scale. Again, the concentrations of the diesel range organics are given here in a log scale going from the detection limit of .1 to a concentration here that would be 2000, 3000, somewhat less between four -- let's see, two, three -- between 3000 and 4000 parts per million.

Again, the 500 milligrams per kilogram line is shown here, and if you go up and read on it, you see that basically 80 percent of the data -- again, that's 17 out of 21 sample points -- actually met that DRO standard.

The next slide is the same information for the TPH or total extractable petroleum hydrocarbons as determined by 418.1. Again, the red line is 1000 milligrams per kilogram, and if you go up there you see that somewhat over 50 percent of the data falls less than the 1000 milligrams per kilogram.

If you were to look at -- What we have been told, or what we understood, is that if you were looking at numbers less than several thousand, say 4000 or 5000 or 6000 parts per million -- that would be two, three, four, five -- you would see that somewhere over 90 percent of the data is actually meeting a standard that we were led to understand -- or that we understood would not naturally occur.

So we're convinced, in summary, that landfarm operators were providing us with real data and that that data shows that they're able to achieve the proposed standards in many cases, but not all cases.

Q. Okay. And do our regulations -- or does our proposed Rule incorporate the concept that a landfarm can apply for alternative closure standards if it cannot meet the prescribed closure standards?

A. Yes, that language is in our Rule.

Q. And that would require notice to the community -- or to surrounding persons, to permit them to become involved --

A. That is correct.

Q. -- if they chose to do so? Continue.

A. Well, industry had proposed a bioremediation endpoint approach for total petroleum hydrocarbons. And after careful consideration we did have a problem with the proposal. We saw the potential for it, but we did see a problem.

And as Mr. Price testified on his -- on the first day of this hearing, we're aware that not all soils and drill cuttings predominantly contaminated by hydrocarbons are amenable to bioremediation in a landfarm. There are some contaminated soils that just will not -- are not amenable to bioremediation.

Therefore, we're requiring operators to follow an environmentally acceptable bioremediation endpoint approach that requires an 80-percent reduction in the TPH concentration, and this is specified in Rule G.(8), which I'll get to in a few minutes.

And our concern, again, was that as originally proposed, an operator could apply contaminated soil at a high concentration -- perhaps 50,000 parts per million -- follow all the procedures, and a couple years down the road it would have been reduced to 45,000 parts per million, and the rate of reduction contained in the definition would have been essentially zero, and that they could walk away leaving what we consider to be inherently wastelike material in the landfarm.

And so for that reason we specified an 80-percent reduction. And our sampling data indicates that this should be possible.

Q. Now --

A. And we're concerned when -- in addressing with this, to make sure that we set the bar high enough for operators that it was protective of human health and the environment.

Q. With a 50,000-parts-per-million standard for the unremediated waste and an 80-percent reduction, how much -- what would be the residual left at the time of the -- what would be the maximum residual left at the time of --

A. Assuming that you started off with 50,000 parts per million and achieved an 80-percent reduction, you would be walking away leaving 10,000 parts per million.

CHAIRMAN FESMIRE: Didn't know it was going to be a math quiz today, did you?

Q. (By Mr. Brooks) And did that play a part in our choosing the 80-percent number?

A. It played a part, yes.

Q. Okay. If we did not have a remediation number, a percent remediation number, then we could be left with residuals much higher than the 10,000 parts per million at the bioremediation endpoint --

A. Correct, our concern was that you might remediate it from 50,000 to 45,000, achieve only a 10-percent reduction, and you might be dealing with waste that simply wasn't amenable to bioremediation.

Q. Continue.

A. We based the rest of our proposed soil concentration standards on 3103 constituents, on NMED's 2005 soil screening guidance, soil screening levels. For WQCC 3103 constituents not considered by NMED, OCD considered various soil cleanup lists issued by EPA regions 3, 6, 9 and EPA's superfund.

And as previously noted, we determined from the onset that we should be consistent with other waste management programs such as ED's Solid Waste, Hazardous Waste and Groundwater Quality Bureaus.

Our goal with Rule 53 is to protect human health and the environment by ensuring through sensible waste management practices -- i.e., best management practices -- that operators will prevent pollution by ensuring that no new releases of oilfield waste occur as a result of the operations of surface waste management facilities.

So the question came up as to what assumptions did we make about closure standards, for landfarms particularly? And we assumed unrestricted residential land use during post-closure. People can be growing crops on these sites of these old landfarms, they could be raising crops, they could be putting water wells in. There's no restrictions.

Given the large size and large variety of contamination waste streams that may be handled at a landfarm, OCD chose conservative soil concentration standards. However, the most conservative standard would be to background.

OCD chose the more protective concentration of either direct ingestion, dermal contact or the soil-to-groundwater pathway, using the most conservative dilution attention factor of 1 taken from various sources, again Environment Department being the primary source.

This final slide is to kind of summarize what the waste exceptions criteria, the new lift criteria and the closure criteria are for each constituent.

The various constituents that we're looking at are specified in the first column, and the relevant criteria is given in the cells following. The waste criteria acceptance is not really based on the constituents, it is based -- except for chlorides, there is the requirement that facilities must pass the paint filter test, and you may accept tankbottoms on a case-by-case basis.

The TPH of 50,000 milligrams, however, is only for -- despite what this slide says, it is only for facilities choosing to implement the environmentally acceptable bioremediation endpoint approach specified in G.(8), it is not --

Q. Now this may not --

A. -- for all the other landfarms.

Q. This may not be the place to ask it, but I want to ask it so I'll go ahead. On the chloride standards, you relied on work done by Chief Price, correct?

A. That is correct.

Q. Now OCD did not do any investigation about the effect that chlorides would have on the landfarming operation itself, did they?

A. Well, that was something that we noted in our review of landfarming operations, but we didn't do a particular study on chlorides concentrations versus the positive or negative impact on the microbes.

Q. Our primary concern with chlorides was the protection of groundwater?

A. That's correct.

Q. And did we feel that the number we came up with, 1000, was a conservative number?

A. It is conservative.

Q. And OCD has never relied on -- to defend that number, on a contention that a somewhat higher number would be damaging to the landfarming process itself.

A. That's correct.

Q. Continue.

A. Again, the criteria for the new lift, the only one that really counts, other than the chlorides, is, the total petroleum hydrocarbon concentration should be reduced to 2500 milligrams per kilogram, and that was based on the Environment Department's guidance, specifically for waste oil, which we thought was approximately equivalent to weathered oil that you might find in a landfarm after several years.

And finally, the closure criteria, again, to summarize, is, benzene is .2, BTEX is 5 -- excuse me, 50 -- the 1000 milligrams per kilogram of TPH is taken from -- if you see the bottom footnote, the solid waste management regulations at 20.9.1.700 NMAC, Special Waste Requirements, which states that remediation shall be deemed adequate when the following conditions are met, and that condition is 100 -- or excuse me -- 1000 milligrams per kilogram.

Okay, that concludes G.(6).

Moving on to G.(7), which is the disposition of treated soils, the regulations require that if the treatment zone closure standards have been met, the operator may leave the treated soil in place, or dispose and re-use the treated soil in an alternative manner.

However, if the operator is unable to achieve the closure standards, then they must remove that lift of soil and dispose of it in an OCD-approved landfill, or may re-use and recycle in a manner approved by the Division on a case-by-case basis.

And alternative soil standards are possible on a case-by-case basis with public notice. And this goes back to your question, Mr. Brooks, earlier, and this is the section that specifies that that can be handled in an alternative manner.

G.(8) the environmentally acceptable bioremediation endpoint approach.

In our errata sheet that we handed out on the first date, we noticed that this should specify that this is in lieu of TPH requirements only. It is not for -- you still have to meet the 3103 constituents, the BTEX constituents and the chloride constituents. This is for TPH reduction only.

The concepts here are the bioremediation endpoint versus the environmentally acceptable bioremediation endpoint. There's a requirement for a detailed landfarm operations plan, there's a requirement for the operator to have dedicated landfarm cells to implement this approach. There's additional detailed information required and additional operational requirements.

As I mentioned, this is in lieu of the TPH requirements only.

Q. In that connection, of course, the bioremediation process isn't going to have any effect on the metals, for instance?

A. There may be some minor impact by the metals with microbes that I've read about, but largely no.

Q. Or the chlorides?

A. Or the chlorides.

Q. Now with respect to the benzene and the BTEX, if you've got a valid bioremediation endpoint, would you expect a no-detect on those?

A. We'd expect those to be very low.

Q. Okay, continue.

A. What -- I'd like to talk a little bit about the distinction here, about industry's proposed bioremediation endpoint and our environmentally acceptable bioremediation endpoint.

We took the definition that was proposed by the industry committee, and a bioremediation endpoint is when the TPH is reduced to a minimal concentration and the rate of reduction is essentially zero.

An environmentally acceptable bioremediation endpoint that we put in G.(8) requires that the TPH be reduced by at least 80 percent and the rate of reduction is zero.

Q. Now we do not prescribe the manner in which we would -- we do not prescribe in our Rule what would constitute a demonstration of bioremediation endpoint being achieved?

A. No, it will be -- the burden will be put on the operator to specify those details under a detailed operations plan.

Q. However, would we require -- would we have to have more data than just two sets of samples that showed no further deterioration in order to make that determination?

A. Yes, we would require a detailed statistical -- an analysis plan that would demonstrate that the rate of reduction is zero.

Q. Continue.

A. As I mentioned earlier, we're restricting the hydrocarbon loading factor to less than 5 percent or 50,000 parts per million, and we were concerned primarily with this approach -- we saw the promise of this approach, but we did have a concern and again that not all contamination that might go to a landfarm under Rule 53.G is necessarily amenable to bioremediation, and we wanted to see a reasonable amount of remediation has occurred. Otherwise, it should never have been put in the landfarm in the first place.

And our concern here is that if you start off with 50,000 and achieve an 80-percent reduction, then you can walk away at 10,000 parts per million. We're a little concerned about that, but we thought that we had to at least give this approach a chance.

We're looking at the number 80 percent, we quickly determined that 10 percent just wasn't adequate enough, it's not a meaningful amount of remediation, it's not a meaningful amount of reduction. It would still leave concentrations in place, potentially, that were inherently wastelike.

And we looked at a number of guidance documents to see what was actually achieved. We noticed that in the 1980s there was a lot of startup programs where EPA never finalized the reports, they had a lot of interim reports. But we were seeing that a lot of remediation could occur at very low concentrations.

But EPA summarized it in one of its UST guidance documents that more than 95 percent reduction was very difficult. Not impossible, it had been achieved, but it was generally very difficult.

And we also considered that EPA also has a land disposal restriction for RCRA hazardous waste. Before you can dispose of a RCRA hazardous waste at a RCRA hazardous waste landfill there are land disposal restrictions that you must meet, and one of those requires a 90-percent --

may require a 90-percent reduction, to meet the LDR standard specified in 40 CFR 268.40 through .49, which is subpart D.

We -- our own data indicated that this number would be achievable, an 80-percent reduction would probably be achievable. We do not have the information that allows us to be certain about this because we do not know what the starting petroleum hydrocarbon loading was on the samples that we analyzed, but the data persuaded us that they were achieving pretty decent bioremediation in most sites.

So --

Q. You're referring here to the data from our landfarm sampling study?

A. That is correct. We finally settled on an 80-percent reduction because it was setting the bar high enough that we thought it was protective of human health and the environment. We demonstrated to Concerned Citizens that the approach had actually succeeded, that it was a meaningful amount of remediation, and was not as stringent as the LDR standards and was not pushing the EPA envelope of 95 percent reduction.

The requirements for G.(8) include the requirement to submit a detailed landfarm operation cell -- landfarm operations plan, and the requirement that they implement this approach in a dedicated cell.

There are additional operational requirements. One is that the facility or the operator characterize the native soil, they characterize the contaminated soil, they specify detailed operating procedures and detailed management procedures.

In characterizing the native soil, which is essentially the vadose zone, we wanted to know a lot of detailed information. There's a long list here, but this information is not particularly expensive to get. And we're going slow. This is a -- has been referred to as cutting-edge technology, and we want to make sure we have all the information we need, plus a little bit more, rather than a little bit less.

Q. Specifically, why did we require native soil characterization?

A. This is a new approach, and we want to know not only what the impact is on the treated soil but what particular impact it might have on the vadose zone or the native soil.

Q. Is it possible that the soil in which the treatment will occur will be a mixture of the treated soil and the native soil?

A. Practically speaking, yes, there is going to be some mixing of the vadose zone and the contaminated soil applied in lifts.

Q. A plow is not a -- very much of a precision instrument, is it?

A. Not -- indeed not.

Q. Does Dr. Sublette's work support the proposition that soil characteristics are very significant in achieving a valid bioremediation endpoint?

A. I believe it does, my understanding is that it did.

Q. Continue.

A. Again, this is a list. We want to know the cell size, the soil porosity, the bulk density, the pH, the moisture content and, associated with that, the field capacity, organic matter concentration, soil structure -- by this we mean soil structure that you'd get out of a soil science textbook; it's descriptive -- measurement of the sodium adsorption ratio or SAR, the electrical conductivity or EC, the soil composition -- again from an agronomy or a soil science perspective -- soil temperature, the initial nutrient concentrations, carbon, nitrogen and phosphorous concentrations, and the oxygen content.

Of course, you need to characterize the contaminated soils. You need to know the petroleum hydrocarbon loading factor, which will have to be basically a running average of the TPH that is delivered to the landfarm cell, which may vary on a load-by-load basis.

Spills generally have very high concentrations in a central location, and the concentration of the contamination decreases from that center point.

We also want to know the BTEX concentration, the chlorides concentration, the 3103 constituent concentrations, soil moisture, pH.

We've deleted the requirement for the total organic carbon, because we considered it to be redundant after an outreach meeting.

And the API gravity, if available. Our understanding is that the bioremediation endpoint is strongly dependent upon the API gravity, and that information should be provided if available.

Other operational requirements or operating procedures. How are they going to till this? How are they going to maintain and track the hydrocarbon loading? pH maintenance, nutrients, moisture and TPH concentrations as new lifts are applied.

There's also the requirement for management procedures. We want to know how the operator is going to schedule the operations, the record-keeping procedures and sampling and analysis plan, the statistics which will be very important, general reporting and routine reporting, a report of the endpoint determination, and any closure and post-closure care plans.

Q. Now before you go on to that slide, let me ask this question, because it relates to the bioremediation endpoint. We're going to talk about small landfarms in a minute, registered landfarms, but why -- as I understand this section, G.(8) applies only to the permitted landfarms; is that correct?

A. That is correct. G.(8) is for a permitted -- either a commercial or a centralized landfarm --

Q. So --

A. -- that wants to implement the environmentally acceptable bioremediation endpoint approach.

Q. So the small landfarms would either have to achieve the closure standards or obtain approval for alternative closure standards?

A. That is correct.

Q. Why was the decision made not to include the -- not to authorize the bioremediation endpoint for the small permitted landfarm -- registered landfarms?

A. Practicality. We're dealing with two new issues that we have relatively little experience with. Small landfarms have not been in our regulations before, it's new. Neither has the environmentally acceptable bioremediation endpoint approach, and we simply thought that was something we were not comfortable with, we have too little experience to really administer it.

Q. Is it also true that we contemplate there'll be quite a few of these small landfarms?

A. There's the possibility of it.

Q. And is it -- can you achieve a bioremediation endpoint without careful and systematic operation of a landfarm?

A. No, that's contrary to the proposed bioremediation endpoint approach. It mandates that you have to operate the landfarm to a very high efficiency. You must apply moisture, keep the moisture content of the soil between certain levels, and you must apply nutrients, and you must till it quite regularly.

Q. And I should have said, is it -- you answered correctly, but just to make clear what we mean I should have asked you, is it possible to achieve a valid bioremediation endpoint if you have not --

A. No, that's --

Q. You'll get to an endpoint --

A. You'll get to an endpoint.

Q. -- but you'll still -- but will you still have at that endpoint, if you haven't properly maintained your landfarm, will you still have more of the constituents, of the hazardous constituents, than you would have if you'd gotten to a valid bioremediation endpoint?

A. Based on our understanding of it, yes --

Q. Is that --

A. -- we have no direct experience.

Q. Is that understanding consistent with Dr. Sublette's work that's been filed in this case?

A. It's based on my understanding of his work.

Q. Now if we have a large number of scattered sites, does that present a difficulty for us in monitoring these sites to be sure they are being properly operated?

A. Yes, the small landfarms will just be registered. We won't be going through a permitting process, and we won't have any control, therefore, on whether they were able to do all the things that are required that we've just covered over the last few slides, which is fairly extensive requirement. We would have no confidence, without having some sort of permit review process attached to the bioremediation endpoint approach, that they were actually doing it or that we would get routine reports that would document that they were doing so.

Q. As compared to the bioremediation endpoint approach, which is fairly complicated, does the -- having a flat closure number, like a benchmark number, does that help to keep the administration of this matter simple?

A. It does.

Q. Okay, you may continue.

A. The final slide is referred to as a rebuttal exhibit.

CHAIRMAN FESMIRE: Mr. Brooks, is it appropriate to go into a rebuttal exhibit prior to --

MR. BROOKS: Well, since we have prefiled testimony, I think it's -- I mean, not prefiled testimony but prefiled exhibits, I think that it will save the Commission time and subserve efficiency if we present a rebuttal point to the prefiled exhibits during our direct examination and possibly avoid having to call the witness back in the rebuttal stage.

We will do, however, whatever pleases the Commission.

CHAIRMAN FESMIRE: Mr. Hiser and Mr. Carr, Mr. Huffaker, do you all have any objection to going into rebuttal before we get to the case?

MR. HUFFAKER: No problem.

MR. HISER: If they want to object to the straw man, that's -- More power to them.

(Laughter)

CHAIRMAN FESMIRE: Okay, Mr. Brooks, continue.

Q. (By Mr. Brooks) Okay. In your review of Mr. -- of Dr. Sublette's work, does it appear that -- does Dr. Sublette's work appear to contend that the 80-percent remediation standard that we have put in for the bioremediation endpoint is not achievable?

A. I don't know that it says it's not achievable, it says that it's strongly dependent on the API gravity, that it is achievable, depending on several factors of which the API gravity is one.

Q. And when we received his material, did you undertake to try to apply the API gravity limitations that he suggested to the data that's available on New Mexico crude oil?

A. We were interested in this point, because it seems to be a very important point to the bioremediation endpoint approach as we understood it. And we thought that we would check to see if that information was available in our database.

Q. Okay. Would you then go ahead and explain what page 209 represents?

A. This is a chart based on a query of our database, production database. OCD staff queried the combined OCD ONGARD database, which reports production and associated API gravity with that production, what is referred to as a point of disposition, which, as I understand it, is that the -- or the custody transfer occurs of the crude oil. And the data that we got was for 2005.

It represents -- the area under the curve -- excuse me, the API gravity is the X axis, and on -- the cumulative production in barrels of oil is on the Y axis.

And you can see it ranges from essentially zero to a bit more than 9 million barrels. This could have been displayed in a histogram fashion. This is an X-Y curve. It just plots the API gravity associated with the cumulative production.

There were some 63,000 records, which exceeds the capacity to handle in Excel, so I had to take in the data worksheet by worksheet. And I summarized the production by every one degree API. In other words, between 10 and 10.9 I summarized the production, and that represents -- is represented by each dot being -- or each diamond being a midpoint.

If you look in the area right here, for example, this is 30, 32, 34. So this is the midpoint between 34 and 35, it's 34.5. This is 35.5.

And what this graph depicts is that the mode -- if this was a histogram, and it's not, correctly speaking, a histogram -- is approximately 38. This would be 40 and this is 38. So you can see the peak cumulative production here or the most frequently API gravity bin is around 38.

The average -- weighted average actually calculated out for all oil that was reported with an API gravity in New Mexico in 2005 to be 39.24. I think particularly noteworthy, you see that most of the production is associated with gravity between 30 and perhaps 50 or so. And it is -- very little production that is associated with API gravity of less than 30. And there's relatively a little bit more production -- less than a million barrels -- that is associated with very high API gravities of 50 and greater.

I truncated the data at 70, and I did not truncate any of the data on the log in, but there were very few reports of less than 10 degrees API.

Q. Applying the data that appear on your chart to the criteria for remediability that Dr. Sublette has provided, does that lead you to the opinion that a fairly large percentage of New Mexico remediations to the 80 percent will, in fact, be achievable?

A. There is a significant proportion that will be achievable based on that. However, we think that bioremediation cannot be just linearly related to the API gravity. It's -- a number of other factors come into play.

Q. Dr. Sublette's chart depicts a linear relationship, does it not?

A. It does. If I remember correctly, there's -- it's two curves. One is for a particular type of soil, I believe a clayey soil, and the other is for a loam soil or a sandy soil.

Q. And while I recognize that bioremediation endpoint is not your specialty -- perhaps it is Dr.

Sublette's -- you are aware of quite a number of other factors that might be involved in determining bioremediability?

A. My review of landfarming operations shows that it's a function of a large number of factors, soil texture, the original composition, the temperature, the amount of sunlight, how frequently it's tilled, the moisture content, application of fertilizer, bulking materials.

Q. However, you do recognize that the API gravity is a significant factor?

A. Based on what I read from Dr. Sublette's exhibits.

Q. And so based on the specific gravities that we're going to be dealing with, it would appear that they would not -- that much of the material would be remediable to 80 percent, in your opinion?

A. I think a significant fraction of contaminated soil will be 40 degrees API or higher.

Q. Okay. Have you finished your presentation, or are you --

A. The next thing we were going to do is either go into GH or go through the revisions here.

Q. Okay. Before we deal with the GH, then, have you prepared for the benefit of the Commission --

CHAIRMAN FESMIRE: Mr. Brooks, I was thinking we were drawing down, but if this is a good place to break, why don't we take a 10-minute break and come back at 10:10?

MR. BROOKS: I would suggest we probably have about 10 or 15 minutes more with this witness, but we'll do whatever the Commission pleases.

CHAIRMAN FESMIRE: Commissioner Bailey says we need a break now.

(Laughter)

MR. BROOKS: I'm not averse to it, Mr. Chairman.

(Thereupon, a recess was taken at 9:57 a.m.)

(The following proceedings had at 10:12 a.m.)

CHAIRMAN FESMIRE: Okay, let's go back on the record in Cause Number 13,586.

Mr. Brooks, you were finishing up your direct of Mr. von Gonten.

I do have a question before we start.

Mr. von Gonten, this rebuttal exhibit that you have marked as page 209 shows cumulative production in 2005 of just 9 million barrels. That's a little short, by about 51 million barrels, isn't it?

THE WITNESS: Chairman Fesmire, that would be just for that one histogram bar for that one range of API gravity. In other words, we're just between -- there was 9 million barrels of oil produced in New Mexico that we have a report of the gravity between 38 and 39 million barrels

-- 38 and 39 degrees API.

CHAIRMAN FESMIRE: Okay, so I -- That's not cumulative?

THE WITNESS: That is cumulative for that range between, say, 40 and 41, or between 41 and 42. The data -- if you look at the data points represented by the diamonds, that's the midpoint for a one-degree API range, like between 15 and 16 or between 30 and 34 -- excuse me, between 30 and 31.

This is a midpoint plot, and so that would represent, for example, on the screen, if you look here, this is the midpoint, I believe, for 36.5, so that's representative of between 36 and 38, and there was over 7 million barrels associated with that range of API gravity.

CHAIRMAN FESMIRE: Okay, so I'm just reading it wrong. Together it would sum to the 60 million barrels?

THE WITNESS: That's correct.

CHAIRMAN FESMIRE: Okay, I'm sorry. Mr. Brooks, you may continue.

Q. (By Mr. Brooks) Okay. So in other words, Mr. von Gonten, the -- each of these diamonds on here represents a number of barrels that were reported produced that had a particular API gravity?

A. It is associated with a particular range of API.

Q. And in order to get the total production that was reported with API gravities, you would have to add together the numbers of barrels for each of the diamonds on the chart?

A. You would have to integrate the curve, and this curve represented the data for which we had API gravities. Not all operators always reported the API gravity with its production. This represents approximately 59 million barrels. I believe that New Mexico produced closer to 65 million barrels in 2005, so approximately 10 percent of the data did not have API gravity associated with it in this database.

Q. And so the mode and weighted average that you computed up in the upper right-hand portion of the chart, is that the average API gravity for all of the production that was reported?

A. Yes.

Q. And what is the point that you're making with computing those averages?

A. Well, in response to a question that Mr. Hiser posed to Mr. Price, he asked what number -- what average API gravity would you have to have to achieve an 80-percent bioremediation endpoint? And Mr. Price answered that he didn't know, and I believe Mr. Hiser said it was approximately 40 degrees API.

Q. And is that consistent -- is that what's reflected in Dr. Sublette's exhibits that have been filed, approximately 40 API?

A. I believe so. It's an average, depending on the soil type.

Q. So the purpose of this chart, then, is to show that a large percentage of New Mexico crudes would fall within that range?

A. That's correct.

Q. Thank you. Mr. von Gonten, did you prepare a redline of subsection H of proposed Rule -- subsections G and H -- well, I'm sorry, I didn't realize H is on this. Let's go on and talk about H first, and then we'll -- after we've talked about everything, we'll go to the changes that you're now recommending.

Would you -- Let's see, what page are you on here?

A. This is actually taken from Mr. Price's testimony, starting on page 61 --

Q. Page 61 --

A. -- OCD exhibits.

Q. Okay.

A. And again, the point --

MR. CARR: Just for identification, did you say these are part of Wayne Price's exhibits?

THE WITNESS: Yes.

MR. BROOKS: Yes, part of -- behind Tab 8. It would be very close to the back of Tab 8, if you have an unnumbered -- one that's not page-numbered.

Give counsel a chance to find the slide before we proceed.

It's about three pages -- three pages from the back of the material behind Tab --

MR. CARR: We have it, thank you.

Q. (By Mr. Brooks) Okay. Would you then tell us about subsection H dealing with small landfarms?

A. Well subsection H is a new section in our Rule 53. It was not contained in the original Rule 711. However, we always had the exemption of 1400 cubic yards or less that didn't require a permit. This was in response to industry's comments during the outreach and during their submittals. They strongly argued that they needed a small landfarm, or a small landfarm is one of the types of landfarms that they proposed. And this summarizes what is contained in subsection H, starting on page 61 and 62 of Mr. Price's presentation, the overview.

The important points of subsection H are that operators may treat 1400 cubic yards or less and remain active for less than three years.

A small landfarm is defined as a centralized facility and will be registered rather than permitted.

They must register the small landfarm with OCD, they must provide proof of landowner -- prior proof of landowner approval to operate a small landfarm, they may only operate one active facility per operator per lease, they must meet the requirements of Rules 53.E.(1) and (2), which I believe are siting restrictions, they must post a sign specifying that this is a landfarm and that it has been registered, and operators may accept only exempt oilfield contaminated soils, excluding drill cuttings, generated as a result of accidental releases.

They must generally meet the waste management standards specified in 53.G, which are the commercial and centralized landfarms, and there are certain information requirements in their registration that they must provide.

Generally, OCD has set a lower performance standard for closure and operations in the small landfarms, section G -- excuse me, 53.H. Specifically, the closure requirement is basically to the same numbers for benzene, TPH and chlorides. However, these small landfarms are not required to monitor for 3103 constituents.

The closure requirements are very similar. They must re-vegetate the soils, they must remove any landfarm soils that can't be remediated to the closure performance standards, or they may return them to the original site or recycle and re-vegetate with filled-in native soil. And there is a requirement that at closure they must collect one single vadose zone soil sample from three to five feet below the middle of the treatment zone.

Q. And other than that, there's no requirement for vadose zone monitoring for small landfarms, correct?

A. That is correct. There is a final report requirement that says that the Division, after notice to the operator and opportunity for a hearing, if requested, may require additional information or additional investigation or cleanup activities.

Q. Okay. Now I want to ask you about a few of these requirements. First of all the 1400 yards, I believe -- 1400 cubic yards. I believe Mr. Price explained the genesis of that requirement in the --

A. That is a --

Q. -- the existing Rule 711.

A. That is a carry-over, and we've always had this in our guidelines. And the 1400 yards is -- I was not involved with, but it's my understanding it was based on a lift calculation that would fit the average pad size in New Mexico, wellsite pad.

Q. Now we do not have a maximum acreage limitation proposed for small landfarms, correct?

A. That's correct.

Q. But if they're only 1400 cubic yards, they're going to be quite small?

A. We would expect them to be. You could, of course, spread it out much more thinly and cover a larger area.

Q. Now if the Commission were to decide that a larger capacity limitation for small landfarms than the 1400 cubic yards is appropriate, would we then want the Commission to impose an acreage limitation?

A. Yes. We originally started off with the view that these would be very small, but if industry were to prevail upon the Commission to increase the total yardage from 1400 to a larger number, we would want to restrict the areal extent.

Q. Okay. Now I want to ask you about this provision that says they will provide proof of landowner approval. In accordance with our directive to do environmental justice, one of the things that we have been alerted to what we're supposed to do as an agency is to allow people who have a stake in things to weigh in on environmental issues; is that not correct?

A. That's correct.

Q. And one of those people would be surface owners, regardless of what their property rights might be or might not be, correct?

A. That's correct.

Q. We do not have a permitting process for small landfarms?

A. There's -- this is -- excuse me, outside the permitting process, this requires that the operator register it using a form EZ and provide us certain information that they're not -- we do not have a permit review process for small landfarms.

Q. And does that mean that OCD will not be reviewing the environmental suitability of the site for that purpose?

A. That is correct.

Q. Does surface owner approval give us some comfort that there probably are not serious environmental objections that we need to take note of?

A. Yes, we assume that the landowner is the person who is going to be most directly impacted by a small landfarm, and if they've given their written agreement, then we assume that they're going to be watching out for their land and their environment.

Q. If the operator believes that he has the right to use the land for that purpose without surface approval, does he still have the right to file for a permit, if he chooses to go that route, to give OCD an opportunity to review the environmental objections the surface owner might have?

A. Yes, if the landowner refused permission, then the operator would have the ability to apply for a 53.G landfarm for a centralized facility.

Q. Now whether or not the operator has a property right to use the property for that purpose, is that a concern that the Environmental Bureau of the Oil Conservation Division would be equipped to address?

A. Sir, repeat the question.

Q. Would the Environmental Bureau of the Oil Conservation Division be in a position to weigh in on or address the question of whether or not the operator has a property right to use that particular property for that purpose?

A. That's a bit outside of our scope.

Q. Thank you. One active facility per lease, what's the reason for that requirement?

A. We don't want the oil and gas industry to end up with hundreds of thousands of small landfarms. Concerned Citizens have expressed a particular concern with this issue, and we think that a certain number of small landfarms may be appropriate, or they shouldn't be completely random, and we thought it was a practical matter to restrict it to one operator per lease at any one time.

Q. Okay, I believe you've explained the rest of these criteria pretty well, but I wanted to ask you one thing. Since -- the requirement -- none of the provisions of subsection G -- Because of the opening sentence of subsection H, is it true that none of the provisions of subsection G will apply to small landfarms?

A. That's generally true. However, there are some requirements that they provide certain information that's contained to meet the waste management standards, and that would be, of course, the operations of the landfarms that are specified in 53.G, if you look at the second bullet on this slide.

Q. Right, and that would be -- we're going to prescribe at a later time which of those requirements are applicable under subsection H; is that correct?

A. No, that would be just registration. There's not another opportunity for us to prescribe anything.

Q. Well, we have not made up the form?

A. That is true, that is -- the form has not been finalized.

Q. Okay. It was back in G that we found that reference to alternative closure standards that we talked about, alternative closure standards --

A. Yes.

Q. -- for permitted landfarms? So that particular provision, then, would not apply to the small landfarms?

A. No, we intend that they should meet the standards that are specified -- rather limited standards specified in

H.(5). There's no alternative --

Q. However, they could still -- could they not still apply for an exception under the exception provisions in subsection -- I believe it's K?

A. Yes.

Q. Okay. Have you told us everything that we need to know about small landfarms at this point?

A. Yes, I believe so.

Q. Very good. Mr. von Gonten, do you have an opinion as to whether or not the restrictions that are placed on -- or the rules that are placed on permitting and operation of permitted landfarms and small landfarms in proposed Rule 53 are appropriate for the prevention of waste and protection of human health and the environment?

A. Yes, we think they are appropriate.

Q. Mr. von Gonten, in the materials behind Tab 11, which constitutes OCD Exhibit Number 11 -- I'm sorry, your materials -- yeah, that's right, the materials behind Tab 11, which are marked OCD Exhibit Number 11, were those materials either prepared by you or collected by you from sources on which a person in your field would normally rely to form conclusions --

A. Yes, they were.

Q. -- in your professional work?

A. Yes, they were.

MR. BROOKS: Mr. Chairman, honorable Commissioners, we offer Exhibit Number 11.

CHAIRMAN FESMIRE: Mr. Brooks, does that include the pages 192A, B and C?

MR. BROOKS: Yes, it includes pages 192A, B and C and page 209. It's my understanding there was no objection to supplementing the exhibits with those pages.

CHAIRMAN FESMIRE: That's correct. Mr. Hiser?

MR. HISER: No objection.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: No, sir.

MR. HUFFAKER: No objection.

CHAIRMAN FESMIRE: Dr. Neeper?

DR. NEEPER: No objection.

CHAIRMAN FESMIRE: Okay. OCD Exhibit 11, as amended, will be admitted into evidence.

MR. BROOKS: Pass the witness -- Oh, I'm sorry, my witness has pointed out to me -- may I indulge the Commission to present to you a summary of the changes -- I believe Mr. von Gonten has gone over them all in his testimony, but he has prepared a redline of subsections G and H that summarized the changes to which he's testified.

CHAIRMAN FESMIRE: Okay. Is there any objection to the addition of the errata sheets?

MR. HUFFAKER: No objection.

CHAIRMAN FESMIRE: Mr. Hiser?

MR. HISER: Is this the one that was previously circulated, or is this a new one?

MR. BROOKS: This is a new one, Mr. Hiser.

MR. HISER: Then since we haven't seen it, I guess we would object.

(Laughter)

MR. BROOKS: Okay, well, Mr. Chairman --

CHAIRMAN FESMIRE: Mr. Brooks, if that's the only objection, what do you say we remedy that pretty quickly?

MR. BROOKS: Exactly. May I approach counsel?

MR. HUFFAKER: Mr. Brooks, may I also have a copy?

MR. BROOKS: Okay. May I approach the witness to retrieve the book from the desk?

CHAIRMAN FESMIRE: You may, sir.

MR. BROOKS: Thank you.

CHAIRMAN FESMIRE: Mr. Brooks, if I understand correctly, this sheet that you passed out is simply a summary of the changes to the original draft that Mr. von Gonten has covered in his testimony; is that correct?

MR. BROOKS: I believe that he has touched on each of those matters in his testimony.

MR. HISER: Mr. Chairman, to the extent this is just a summary of what he talked about, we don't have an objection to that.

CHAIRMAN FESMIRE: Okay.

MR. BROOKS: May I approach the Commission?

CHAIRMAN FESMIRE: Hang on just a second, let's get everybody on board.

MR. HUFFAKER: CRI has no objection.

CHAIRMAN FESMIRE: Okay, Dr. Neeper?

DR. NEEPER: No objection.

CHAIRMAN FESMIRE: Okay, you may approach the witness, Mr. Brooks, and us.

(Laughter)

MR. BROOKS: And with that, I pass the witness.

CHAIRMAN FESMIRE: Mr. Huffaker?

MR. HUFFAKER: I have no questions of this witness at this time, Mr. Chairman.

CHAIRMAN FESMIRE: Mr. Carr, Mr. Hiser?

MR. HISER: I think that I'll probably start, and then if I miss anything I'll ask Mr. Carr if he has questions.

CROSS-EXAMINATION

BY MR. HISER:

Q. Mr. von Gonten, when you were going over your educational qualifications did you say that you received training as an engineer?

A. I had a job title as environmental engineer in

Virginia. In fact, my job title here in the OCD is actually engineer.

Q. Has your principal training been more in the area of hydrology?

A. I have a bachelor's degree in geology and a master's degree in geology and have worked with groundwater contamination for a number of years.

Q. Based on your work experience, what for you do you define to be as good or sound science?

A. Sound science includes a lot of thing. I think that the term means that you have to consider a large number of viewpoints in sound science.

Q. How do you -- Is it merely consideration of a large number of viewpoints, or how do you sort through a large number of viewpoints? Because if there are a large number, then there may be some disagreement on those viewpoints, would there not?

A. There would be potentially.

Q. Bringing me back to my first question which is, how do you propose to sort through those to determine what is the best answer?

A. That's based on our -- as a staff member, I'm constrained by policy and guidance internal to the Bureau and to the Division. I use my own professional judgment, based on my own experience.

Q. So your view, then, of the science is determined in part by what you perceive as the policy of your Division and Bureau in terms of the results you're seeking?

A. Sound science is independent of policy, but it is a consideration when we draft regulations.

Q. And what's your view of the role of anecdotal evidence in reaching a decision?

A. Anecdotal evidence plays a part; it should not be relied upon if you have the ability to research the matter and come to a conclusion.

Q. Now on slide 14 of your presentation -- and I don't know how easy it will be for you to put the stuff back and forth on. I've got two where I'm going to cover slides, and then I thought I would walk through the proposed Rule sort of in the same order you did, just to help the Commission understand how --

A. Give me a moment, and let's see what I can do. Slide 14, is that the one that starts off, landfarm treatment soil closure performance standards?

Q. Well, if I see it I can tell you if it's the right one.

A. I'll have to --

Q. Yes, that's the right one.

A. Okay. Just one moment, please, Mr. Hiser.

Q. Certainly.

MR. BROOKS: What page number, Mr. von Gonten?

MR. PRICE: 163?

MR. HISER: Mr. Price says he believes it's 163.

MR. BROOKS: I don't believe that's correct.

MR. HISER: Oh --

THE WITNESS: That's where it starts.

MR. BROOKS: Mr. Brooks says that's not correct.

(Laughter)

THE WITNESS: Is it the chart?

MR. HISER: Actually no, my question is about one of the statements on here --

THE WITNESS: That seems to be page 186.

MR. HISER: Page 186.

MR. BROOKS: Or 187 -- 186, you're right. Thank you.

Q. (By Mr. Hiser) Thank you, Mr. von Gonten. On this slide you explain that the industry committee has advocated the use of the NMED PSTB Tier 1 concentration and a factor 10 times that. I was wondering where in any of the submitted materials from the industry committee, in terms of rule revisions, that language appears or that concept appears?

A. That was -- that statement came from Dr. Thomas's PowerPoint presentation in one of the first outreach.

Q. In one of the first outreach. But is it your contention that that's still the position of the industry committee before the Commission?

A. I don't know. I have not reviewed all the exhibits submitted by the industry committee in detail.

Q. So you didn't review the most recent exhibits to be --

A. This slide was prepared before those exhibits were submitted. So no, I have not -- at the time this slide was prepared, I had not.

Q. Okay. On slide 21, which should be seven pages later --

A. This slide?

Q. Oh, you added some new ones. This is the slide where you speak about all soils -- not all soils and drill cuttings predominantly contaminated by hydrocarbons are amenable to bioremediation.

And since I've quoted for you what you stated on that slide, and I think you've said that twice in your testimony here, what example -- give me an example -- or what you're discussing as -- in being an example of a soil or drill cutting predominantly contaminated by petroleum hydrocarbons that would not be bioremediable.

A. Well, if it was contaminated by very long-chain hydrocarbons, it may not be amenable to bioremediation.

Q. And so --

A. An example would be a very weathered crude.

Q. So a weathered crude or perhaps asphaltics --

A. Correct.

Q. -- and all that? If that's the concern, why did you choose not to write your rule to address that particular concern?

A. The rule has to be practical and enforceable, and we cannot consider every possible exemption or possibility when making a rule.

Q. And so in this case you decided that the degree of over-inclusivity or under-inclusivity was acceptable to you, as --

A. I'm not quite sure I understand what you mean by that.

Q. In other words, that even though the issue is primarily the weathered crudes or the asphaltics, that you decided that, for example, your 80-percent test adequately addressed that?

A. I'm still not quite sure what your question is, but if I may take a stab at it, in addition to weathered asphaltics, we may have some spill that may have additional contaminants in the soil, and there is a possibility these contaminants could be toxic to the microbes.

So you might by screening that soil load determine that it was predominantly contaminated by hydrocarbons, but because you're not required to do an extensive waste characterization of every load, you might be poisoning your landfarm cell by a particular load.

Q. So your concern in that case, then, is other contaminants that may be present or along for the ride, so to speak?

A. Yes. It includes that, it's not restricted to that.

Q. Okay. One last sort of general question before we turn to the Rule provision. In your opinion, are the Lea County landfills properly operated landfarms? Excuse me, the Lea County landfarms properly operated landfarms?

A. They're properly operated for New Mexico in that the restriction here in New Mexico is that you have very little water rights. You have a lot of land and a lot of sunlight and a long amount of time. So as a practical application for commercial landfarms, I think that they are. We have not in detail inspected these landfarms to know on a day-to-day basis whether they're meeting all their requirements, because of staff limitations, among other things.

Q. Okay. Let's turn, then -- actually look at the text of the Rule the staff is proposing to the Commission for adoption, and let's start with G.(1), which is your waste acceptance criteria.

Now as I look at the proposed Rule language, you state that you're proposing to limit material that could be accepted by a landfarm to hydrocarbon-contaminated soils and drill cuttings; is that correct?

A. That's correct.

Q. Now throughout your discussion you talked about this large myriad of oilfield wastes that are going to make their way into the landfarm. And for example, you list a number of field service companies, various petroleum refinery wastes and all that. How exactly are those going to arrive in the hydrocarbon-contaminated soils and drill cuttings?

A. Well, spills are accidental releases, and we know that at one site you may have a mixture of, say, crude oil spill. It could be mixed with produced water. It could also be a combination. You may also be dealing with remediation of a historic site, which some things were dumped in one particular area without the -- more mismanaged rather than spilled or released accidentally.

Q. But in any of those situations, is it not true that the other oilfield wastes would be diluted to some extent, perhaps a great extent?

A. Perhaps to a great extent. Not necessarily, but perhaps.

Q. And that would have a tendency, then, to reduce the concentration that one might expect to find?

A. Of what?

Q. Of the other petroleum -- the other oilfield wastes?

A. Yes.

Q. You also proposed a limitation on hydrocarbons that enter the landfarm to less than 50,000 milligrams per kilogram.

A. For the G.(8) landfarms, the environmentally acceptable bioremediation landfarms.

Q. And that's an amendment to the proposal that the staff is proposing now?

A. If you look through G.(1) through G.(7), there is no requirement for the commercial and centralized landfarms to restrict their loading to less than 50,000. That restriction is found only in G.(8).

Q. And what's the -- assuming that that's limited, then, to G.(8), what's the basis for that limitation?

A. G.(8) is a -- as Mr. Price referred to, cutting-edge technology with which we have very limited or no experience whatsoever. So we are looking to make sure that we put appropriate constraints on that.

The 50,000 parts per million was recommended by EPA's guidance document entitled How to Evaluate Alternative Cleanup Technologies for Underground Storage

Tank Sites, a Guide for Corrective Action Plan Reviewers.

Q. And do you know if that's still, in fact, EPA's position?

A. This document is dated 2004, so I'm assuming that it is.

Q. So that's your basis, though, is this EPA document?

A. That was confirmed by several other sources.

Q. Would you like to identify those?

A. Well, the Army Corps of Engineers guidance, and I'm not sure about the date of that. It was a guidance document prepared for contractors in bidding for landfarm operations.

Q. And what's the basis that's used by the EPA and the Army Corps document for proposing the 50,000 limit?

A. One moment, Mr. Hiser.

The number 50,000 which was proposed by EPA appears to be based on the fact that higher concentrations than that may actually be toxic to the initial microbes because of the high proportion of the aromatics.

Q. Is that a concern that the landfarm won't work or that the landfarm would take longer to achieve its objective?

A. I think that it would not be effective landfarming operations, that you should have an optimal range on the total petroleum hydrocarbon loading, and that range has generally, in several sources, been 50,000 or less. I assumed numbers as high as 100,000, but that seems to be the upper-case limit for a landfarm, not for this --

Q. But you're aware of scientific literature, anyway, showing greater than 50,000?

A. I've -- for landfarm operations, yes.

Q. Now in the guidance document is that not, in fact, an underground storage tank document?

A. It is guidance for the underground storage tank corrective action reviewers, but it is specific to chapter 5, entitled Landfarming.

Q. Right, but if it's looking at underground storage tanks, what type of product spill would you think would be most commonly being evaluated?

A. Mostly gasoline and diesel and jet fuels.

Q. Okay. And would those have different characteristics than crude oil?

A. Yes.

Q. You also proposed a limitation on chloride of less than 1000 milligrams per kilogram, and did you have any basis for proposing on that limit, or are you relying on the work done by Mr. Price?

A. We relied on Mr. Price's research.

Q. And then did you rely on any other peer-reviewed technical materials in determining to reject Dr. Sublette's prior information that greater than 50,000 milligrams per kilogram could be treated, or are you simply relying on this EPA publication?

A. As I said, there were several that we would refer to as authoritative sources where EPA put these things out for not only internal and external peer review but for public comment. EPA, the Army Corps of Engineers -- at least two EPA documents were reviewed. This one is for the tank program that I've referred to. There's also guidance documents that EPA has put out for land treatment units under RCRA subtitle C. Guidance documents, not regulations.

Q. For RCRA subtitle C or hazardous waste facilities?

A. Yes, for land-treatment units -- that would be the same thing as landfarms -- permitted under RCRA.

Q. I want to go back to the 50,000-milligram-per-kilogram-of-hydrocarbon-contamination-for-the-soil limit for a minute, and you say you're concerned that the bioremediation endpoint may not be able to achieve this level of reduction -- I believe that's what you testified -- so therefore you propose this as a limit for G.(8) facilities?

A. Well, the 50,000 is specifically based on our review of guidance documents that says that to properly operate a landfarm you should restrict the hydrocarbon loading to no more than -- generally, than 50,000.

Q. If that's true, Mr. von Gonten, I'm troubled by why you apply that only to the bioremediation endpoint landfarms and not to all landfarms.

A. Landfarms, as we have -- our experience is that landfarms do not accept soils that we refer to as being that hot. During my inspection and sampling of the -- or the sampling events, I asked them about 50,000 parts per million, and everyone that I asked anecdotally told me that they didn't think they were having anything that high to begin with.

Q. And so this, then, is sort of based on anecdotal interviewing of the various Lea County landfarms that you went and spoke with?

A. The 50,000 number came from EPA.

Q. I understand that, but the --

A. But the --

Q. -- decision not to include it for the existing, what you call dryland landfarms, was based on your anecdotal --

A. It has not been -- waste -- detailed waste characterization has not been part of Rule 711, was not brought into our proposed Rule 53.G through -- G.(1)

through G.(7). We haven't felt that it has been necessary.

Q. So the staff's position is that for a dryland landfarm, that it's not necessary, but for a bioremediation endpoint where we're adding water, nutrients and a number of other steps, that it is necessary?

A. We're putting more sideboards on the G.(8) landfarms because we have no experience with them.

Q. All right. Now I believe that you answered in response to a question from Mr. Brooks that you're not imposing the 1000-milligram-per-kilogram chloride limit as the basis of any concern about the impact on the bioremediation at the landfarm itself, but rather it's a groundwater or freshwater concern?

A. Yes, and it's consistent with the other surface waste management facility requirements.

Q. And then you also agreed that there -- Well, we'll cover that later.

Let's move on to the G.(2), then, which is, I believe, your background testing.

A. Yes.

Q. Now I believe you said this before, but just for clarity's sake, are all the 3103 constituents a natural part of crude petroleum or its derivatives?

A. No.

Q. And so why are we testing for a number of these additional constituents?

A. Because those other constituents in 3103 are found commonly in what we would consider oilfield waste derived from other than crude oil spills.

Q. And so is it the Division's perspective that if a constituent could possibly be found, therefore it must be tested?

A. No. There were a large number of other constituents that might be constituents of concern. If you look at the EPA studies or the total petroleum hydrocarbon criteria working group, there are many more constituents that are found in crude oil than we listed in 3103.

Q. But you showed us that where there was any detect in any of these studies that you looked at and that detect was for a compound that also appeared on the 3103 list, you would go ahead and include that?

A. We included all of 3103, with the exceptions of TDS and pH, except for section C.

Q. Turning then to the operations provision, which is your -- I believe your G.(3), what's the purpose of the 24-hour removal of water from the landfarm? I think you said that that was to remove the driving head?

A. Yes.

Q. What would be the difference from the landfarm, from the ecological perspective, between 24 hours and 72 hours?

A. Well, we think there's a much greater likelihood that in 72 hours the water will have percolated through the treatment zone and leached out some constituents and perhaps driven them into the vadose zone.

Q. Okay, so you're concerned about materials going into the vadose zone?

A. Yes.

Q. Did the Division give any consideration to the fact that you've now required seven-day-a-week manning of the landfarm operation, as opposed to what may have been a five-day-a-week operation beforehand?

A. No, I don't believe we discussed that.

Q. Is it your intent to require daily manning of landfarms?

A. We believe that a landfarm operator will know when it rains in a county that has as sparse rainfall as we're dealing with in Lea and Eddy County, and they would be required, if they noticed there was a heavy rainfall, to go out and see if there was any ponding.

Q. So that translates as yes?

A. They don't have to have a man on site, no.

Q. Would they have to have someone on call?

A. Yes, they're responsible for the security and operations of the facility 24/7.

Q. And did you conduct any evaluation to see the difference and extent of leaching that may occur between a 24-hour and a 72-hour ponding event?

A. No, we did not.

Q. On treatment zone monitoring, which I think is your G.(4), can you clarify whether the eight-inch lift requirement applies to biopiles or landfarms?

A. This is for landfarms. A biopile would be constructed quite differently.

Q. And so even though sometimes landfarms and biopiles are sort of treated synonymously, this is not one of those cases?

A. Correct.

Q. What peer-reviewed information did you rely upon to reject the industry committee's recommendation to the staff of a 12-inch lift for condensate-only-contaminated soils?

A. I don't remember the 12-inch proposal. When was that submitted?

Q. It was in one of the outreach meetings.

A. I frankly don't remember that.

Q. So you didn't take any position on that, or --

A. We didn't -- I don't remember any discussion whatsoever. A 12-inch lift, however -- we're relying on practicality. We started off with a six-inch lift, which basically equates to a -- the term is a 12-inch harrow. So if you're looking for a 12-inch you're going to have to have much larger farm implements to get a 12-inch. It would be 24 inches on the harrow size.

Q. Well, I mean, do you have an opinion -- do you personally have an opinion as to the appropriateness of a 12-inch lift for condensate?

A. No.

Q. No as in you don't have an opinion, or no as in you don't believe that's appropriate?

A. No, I do not have an opinion.

Q. Okay, that is fair. And can you explain to us what the purpose is of the proposed 2500-milligram-per-kilogram requirement prior to adding a new lift? This would be --

A. Yes, I believe the old 711 rule required that they actually remediate the soils down to 100 parts per million before adding a new lift. We thought that was unduly restrictive on landfarm operations because we recognize that initially the TPH concentration is going to experience a rapid decrease and then will tail off until -- it eventually becomes very minimal with time.

And we thought that there would still be the opportunity for the landfarm operator to take another lift and yet still experience bioremediation in the lower lift, and we thought that 2500 was appropriate based on a review of NMED soil screening levels guidance of 2005 where the waste oil concentration for a residential scenario matched our mental image or our best guess on what we were dealing with as far as contaminated soils. The soils had been there for a couple of years and then weathered.

Q. Well, Mr. von Gonten, I guess I'm curious then. If the concern is the proper operation of the landfarm, what relevance does the NMED SSL residential level have to that?

A. It's a soil screening number for hydrocarbon-contaminated soil that we thought was appropriate for a landfarm scenario.

Q. I guess I'm still curious about that, because typically if one meets the NMED residential SSL, that means that I'm prepared to have a house and have my kid play on the land that's there --

A. That's correct.

Q. -- whereas this is an active landfarm facility. And so wouldn't a more relevant criteria be something having to do with whether you've achieved an appropriate level to facilitate moving to the next step of the landfarm?

A. We thought it was a practical number for taking the next -- accepting the next lift. We thought that there should -- you shouldn't choke the landfarm with lift after lift before a significant bioremediation had occurred. We looked for a practical number that would allow the operators the ability to continue their operations, but at a reasonable pace.

Q. So the fact that this is spuriously identical to the NMED number really doesn't have anything to do with what you were trying to accomplish?

A. No, Mr. Hiser, we looked at a number that we thought -- got it down to a number that was potentially risk based, and at that point we thought that it would be appropriate for the landfarm operator to add an additional lift.

Q. I see. One other, I guess, clarification point on G.(4). The two-foot thickness, is that applicable to biopiles, or is this once again only applicable to a landfarm?

A. It is for landfarms only.

Q. Okay. In the vadose zone monitoring, which we're now to G.(5), Commissioners, what was the basis that OCD used for three to four foot below the treatment zone as the location for the vadose zone monitoring?

A. Practicality. Our main concern here was that you're dealing with farm implements. If we could have set it at six inches and be practical and reasonable, we would have done so, because it should be a detection of a -- an immediate detection of a release.

Q. So your goals with this program is to immediately protect anything leaching from the landfarm zone into the soils below that?

A. Right, from the treatment zone to the vadose zone. And three to four feet was something that was appropriate, easily achievable and yet protective.

Q. And how are you proposing to determine an exceedence in the vadose zone monitoring?

A. It will be a comparison to background concentrations that they're required to establish in G.(2), I believe.

Q. Which is a good answer, but it begs lots of the details. How does one determine the background concentration?

A. Statistical comparison.

Q. A statistical comparison. Are we comparing that on a sample-by-sample basis, or are you proposing to look at means between sampling --

A. It would be most appropriate to use means. We've established a mean background concentration, and you're required to sample each cell -- or you're required to sample four independent samples.

Q. Now is that for both the initial background sampling and then the subsequent vadose zone monitoring? Would both be done a mean basis, or only the background sampling done on a mean basis?

A. It should be for the vadose zone as well as background.

Q. What do you personally believe, based on your experience here in New Mexico, will be the background for BTEX, using the total extractable method, 418.1?

A. I would anticipate it's very low unless you've sited your landfarm on a previously contaminated site.

Q. And are you familiar with the fact that organic matter may give BTEX readings?

A. Yes.

Q. Excuse me, also, I mean, TPH.

A. (Nods)

Q. Okay. Now are you familiar with Dr. Sublette's information that's been presented to the Division staff on the proper operation of landfarms?

A. Yes, somewhat.

Q. And do you agree that in general what he's been proposing represents good or reasonable landfarming practice?

A. Yes, many of his proposals are good practice.

Q. Doesn't those proposals require the addition of moisture for proper operation of --

A. Yes, the optimal landfarm operations, you would need to add moisture.

Q. Do you recall the approximate amount of moisture that Dr. Sublette recommended for optimal operation of a landfarm?

A. No, I don't remember that number.

Q. And if I were to tell you that it was between 60- to 80-percent field capacity, would that reflect your recollection?

A. That is what I've seen from not only Dr. Sublette but from other sources as well.

Q. Now as a hydrologist or a geologist, if we're keeping the landfarm soil moisture at that 60 to 80 percent of field capacity, would you expect that BTEX and chloride would migrate down into the vadose zone in the landfarm cell?

A. No, it shouldn't.

Q. And why would that be?

A. Well, the content there hasn't reached saturation, and so there will be some migration in the gas phase, but the actual leachate should not move.

Q. Would the gas phase show up in sampling of the vadose zone?

A. I would have to research that, I'm not sure.

Q. And what would be the impact of a storm event, perhaps one resulting in up to 24 hours of ponding on a landfarm that had been kept at 60- to 80-percent field capacity prior to that time?

A. Well, the area that would be ponded would quickly go to -- I would anticipate would quickly go to saturation in the area that is ponded.

Q. And would you expect to then find constituents from the landfarm in the vadose zone below that area?

A. You certainly would have the potential to do so under that scenario.

Q. And at that point would that not then trigger corrective action for the landfarm?

A. It might.

Q. It might?

A. If you have four samples and you establish the mean for that semi-annual event, and you took one of those samples in the area that is ponded but the other three samples were not, you may not statistically trigger.

Q. Okay, but if you did statistically trigger, then you would trigger corrective action?

A. Yes.

Q. Have you undertaken any investigation into whether landfarms that are being properly managed as the Division staff has proposed can consistently meet the standard without triggering corrective action?

A. No.

Q. Let's go to G.(6). This is the treatment zone closure standards. I believe that the basis for these standards is basically set forth in slide 12; is that correct? I think -- That's the one with the 3103 constituents in the left and then --

A. Yes.

Q. -- NMED and EPA --

A. Yes, the Excel spreadsheet.

Q. Yeah, you might want to put that slide back up so that we all have it to refer to.

MR. BROOKS: Page 174, I believe.

THE WITNESS: This one?

MR. HISER: No.

THE WITNESS: This one.

MR. HISER: Yes, that one.

MR. BROOKS: Okay, that's page 177.

MR. HISER: Thank you, Mr. Brooks.

Q. (By Mr. Hiser) Now did I hear you correctly in your testimony, that you said that your basis for choosing which of these standards applied was, you chose the most protective one?

A. Yes.

Q. So you didn't undertake any other evaluation, other than choosing which of the different numbers for the constituents would be the lowest?

A. That's correct.

Q. What was the basis that was used by the OCD staff in rejecting the industry committee recommendation where we recommended a tiered approach using residential SSLs or the DAF -- in favor of this DAF 1?

A. Well, our goal was to determine a release, a release that's actionable under regulations as defined. We're not interested in a risk based scenario because it ignores that you would potentially allow a release at some distance from the bottom of the treatment zone, which is something we're trying to avoid.

Q. Now is this -- okay, we're talking --

A. If I may continue to answer that question, sir? If I may continue to answer the question.

Q. Go ahead.

A. This is for waste management, this is not a spill remediation program.

Q. I understand that. My question, though, is that these are closure standards, is it not?

A. These are closure standards, yes.

Q. Okay. And so your position, then, basically is that you want these soils that are being treated to meet these -- the most stringent standard that you were able to find for background?

A. Correct.

Q. Correct? And then you also want to have nothing in the soils beneath it, period?

A. That's correct.

Q. Okay. Are you aware of any other agency that has taken that position for closure?

A. Closure standards, for example, in RCRA, which I'm fairly familiar, establish that there is a risk based concentration of soils that is allowable if there's been a minimal leak, for example, beneath a surface impoundment.

Q. Okay, thank you. Now you state in slide 15, which may be the one right before this, or it might be the one right after, somewhere in that area.

A. This one or this one?

Q. This would be in your PowerPoint presentation. And I think it's the -- Is that 14? There you go. Yes, it's this one. Now you state there in your answer that OCD rejects industry's concept of large landfarms up to 500 acres in size that handle large volumes of poorly characterized oil-contaminated waste.

In fact, aren't we only handling large quantities of contaminated soils and drill cuttings?

A. Yes, that's oilfield waste, that would be appropriate --

Q. That is a subset of oilfield waste, is it not?

A. That is correct.

Q. Now in this same situation, I mean, didn't Mr. Price earlier indicate that there is no reason for the OCD staff to review C-138s because you believe the industry had an adequate handle on the characterization of the waste issues?

A. I'm going to have to punt on that one. I don't remember -- I'm not familiar with C-138s.

Q. Okay. And so you neither agree nor disagree with Mr. Price, since you don't recall his statement?

A. I don't agree or disagree with him.

Q. If the Division believes that the industry is dealing with poorly characterized waste, would it not seem unusual, then, that you would be dropping the requirement for Division staff to review a C-138?

A. If I were familiar with the C-138 I could answer that question, but I'm not.

Q. You're just not familiar with the C-138 at all?

A. That's correct.

Q. Okay, we'll move on then. What's the scientific basis for your proposed 500-milligram-per-kilogram-TPH-GRO+DRO standard?

A. Our basis for it is that we realized when we were rewriting 711 into the new Rule 53 that the 100 TPH was probably too low, that that was very protective, and that if you do detailed analysis you may get a TPH of 100, and if you analyze it for other constituents, 8260 constituents, organic solvents, other organic compounds, you're not going to find anything.

And so we realized that it was practical to use TPH in a landfarm setting, because we're dealing with crude oil and a number of other constituents, but primarily hydrocarbons, and TPH is a very effective test method for that.

Going to 500, we wanted to pump it up a little bit. We thought that GRO+DRO actually would be much less than 500 most of the time, based on our experience.

Q. Well, if DRO+GRO is an adequate measure, why do you want to keep the total petroleum measurement as well --

A. Because --

Q. -- and doesn't it seem redundant?

A. -- 8015, which is what we're talking -- GRO+DRO, as determined by 8015-B modified, gets the short-chain hydrocarbons but does not adequately test the -- excuse me, the long-chain hydrocarbons that are captured by 418.1.

Q. And so I guess I come back to the question, is, why is it necessary to use both the DRO+GRO and then the long-chain hydrocarbon test, which is the total extractable or whatever --

A. Because one test does not get you the full spectrum of hydrocarbons.

Q. You're saying that the total extractable is not capturing the short chains?

A. That's correct.

Q. It's just going for the long chains?

A. I don't know at what carbon count it starts kicking in, but there is some overlap between 8015 and 418 as far as the constituents that they detect and report, but 418.1 does not get the shorter-chain hydrocarbons.

Q. Give me just a second here.

All right, I want to turn and talk about the 3103 constituents for just a second.

A. Do you want the Excel sheet back up?

Q. I don't know that that's really necessary, thank you.

Are the constituents on that list hazardous or toxic?

A. Depending on the concentration, yes.

Q. So it's a concentration question.

What about iron and manganese?

A. Excuse me, they may be listed as hazardous constituents by EPA.

Q. Okay. Let me then ask about iron and manganese. Are those on the 3103 list?

A. Yes.

Q. And are they hazardous or toxic?

A. Everything can be toxic.

Q. If I were to be fully encased in iron, I would agree with you that would be toxic. But in the concentrations that you would expect to find in oilfield waste, would you expect it to be hazardous or toxic?

A. I really haven't studied oilfield wastes to know what the concentrations in iron and manganese are. So I don't have an opinion as to whether oilfield waste would be toxic for iron and manganese.

Q. Okay. Now do you know why the Water Quality Control Commission included iron and manganese in their standards?

A. No.

Q. So you're just taking the standards and applying them over into this program?

A. Yes.

Q. And then if iron or manganese were to be present at levels above background or the treatment zone closure list that you have proposed, is it your anticipation that OCD would prevent closure of that landfarm?

A. Until we actually experience that, I don't know how to answer it, but I think that's the way the regulations read.

Q. And so it would then be your intent that the members of this Commission would have to hear an exemption appeal on that?

A. Yes, on a case-by-case basis, I believe so.

Q. So that the safety valve, if you would, on the staff's proposal is more hearings by the Commission on individual exemptions?

A. I'm not sure what you mean by safety valve.

Q. In other words, the safety valve where you have a closure where the choice is to dig up an entire landfarm because there may be slightly elevated iron concentrations. And that may or may not make much sense. The safety valve for that is for the landfarm operator to come to the Commission and request a public hearing on an exemption?

A. Yes, I believe so.

Q. And then you chose to use the DAF 1 factors rather than the residential soils for ongoing closure, just because the DAF 1's were more stringent; is that correct?

A. That's correct.

Q. Do you have any sense of how much more stringent that would make the OCD-proposed cleanup levels than, say, the NMED residential levels for --

A. That chart specifies that information. We can review it, but as a ballpark figure, no, it depends on the constituent.

Q. Let's talk a little bit about the DAF 1 values.

Now do you agree that the DAF SSLs are based on the assumption of an infinite source?

A. I believe that's correct.

Q. Okay. Do you anticipate there would be an infinite source in any landfarm?

A. Up to 500 acres, I believe, for modeling purposes would be considered an infinite --

Q. An infinite source is a source that continues on ad infinitum at a constant level of concentration.

A. Well, then that probably wouldn't be correct for the modeling purposes.

Q. Would that be appropriate for a small landfarm or a registered landfarm?

A. Rephrase the question, please?

Q. Yes, can you tell me whether the assumption of an infinite source is appropriate for a small landfarm?

A. Probably not.

Q. Do you know if the DAF SSLs are based on an assumption that the contamination is uniformly spread from the land surface to the water interface?

A. I don't know the detail to that, I don't know the answer to that question.

Q. Would you be surprised to know that that was, in fact, the case?

A. No.

Q. Is that the situation with landfarms, as the Division has proposed their Rules?

A. No.

Q. Does the -- Do you know if the DAF assumes any attenuation in the vadose zone?

A. My understanding from NMED's guidance, is that the DAF only considers attenuation in the aquifer.

Q. In the aquifer.

A. Not in the vadose zone.

Q. And would that be an appropriate assumption for hydrocarbons in the vadose zone and those land surface?

A. No.

Q. So that would make the DAF SSL 1 very conservative?

A. If you were looking at a small site, yes.

Q. Even for a large site, would that be conservative?

A. No, depending on the site characteristics, it may not be conservative -- well, it would be conservative enough, but you have to deal with macroporosity such as fractures and --

Q. So your testimony, then, is that there are times when you can have a DAF SSL of less than 1?

A. No.

Q. Well then in what way, if there is hydrocarbon attenuation in the vadose zone, would DAF 1 not be overly conservative?

A. Well, you're having a release, so it would never be conservative to say that you can't have a release from the treatment zone to the vadose zone.

Q. I'm asking you about the DAF, I'm not asking you about the appropriateness of the release.

A. Okay, rephrase your question, please.

Q. The question is, does the DAF 1 -- is that over-conservative for organic constituents like hydrocarbons that would tend to degrade in the vadose zone?

A. Protect -- Overly conservative for what scenario?

Q. Protection of groundwater.

A. It probably would be overly conservative for protection of groundwater alone.

Q. Is it not true that the Division in this case changed EPA's 12-meter aquifer thickness to 10 meters in concentrating and calculating your chloride values? Or is that a question I should have asked Mr. Price?

A. It is a question that you should have addressed to Mr. Price.

Q. Fair enough.

(Laughter)

Q. Is it not true that EPA, when it put together the concept of the DAFs, determined that a DAF of approximately

170 is protective of 90 percent of sites at a 0.5-acre size?

A. At a very small size, yes, that's what they proposed --

Q. And --

A. -- based on my understanding of that rather large document.

Q. Is it not true that NMED advises the use of a DAF of 20 for most purposes?

A. For most purposes, except areas of shallow groundwater or karst.

Q. And is it not true that Mr. Price advocated effectively the use of a DAF of 15 in his chloride calculations?

A. I didn't notice that, sir.

Q. You did not notice that in his presentation?

A. I don't remember it.

Q. Okay, thank you. What peer-reviewed information did you use to base your rejection of EPA/NMED's recommended DAF of 20?

A. We looked at the guidance document that they proposed, and they said that for very small sites, not commercial and centralized landfarms up to 500 acres, that a -- actually the curve indicates that a DAF of 1 is appropriate for large-scale sites. NMED's DAF of 20 is only appropriate for those areas that are small-scale sites. It is not appropriate, explicitly not appropriate, for areas with shallow groundwater or karst.

Q. I see. And so in large part, the Division's approach to this entire landfarm regulation is based upon the 500-acre landfarm?

A. That is what we have to consider that a commercial or centralized facility may be, as large as 500 acres.

Q. Mr. von Gonten, can you tell me how the EPA or the NMED soil screening level document talks about the handling of a large site? Is that specifically addressed in the guidance?

A. It's addressed, but I certainly don't remember the details of that. I was looking specifically at several charts.

Q. And so you don't really have any idea whether the 500-acre limit that you're talking about has any relationship to what's discussed in the SSL guidance?

A. For NMED?

Q. For NMED or EPA.

A. For NMED, it is designed for a spill site or a smooth investigation, not a landfarm.

Q. That is correct, but the question I asked you was the question of the source size. And you're working with a

500-acre assumption, but you don't know how the NMED document, the EPA document, translates a large source for purposes of applying the SSL?

A. The NMED document does not address large-scale sites.

Q. Does not?

A. Does not.

Q. That's your testimony?

A. That's my understanding of the 2005 guidance.

Q. Thank you. Is it not true that both EPA and NMED warn that the DAF SSLs are unduly conservative for constituents with absorption or degradation processes that are expected to significantly attenuate concentrations?

A. I would accept that comment. I'm sure that you can point to the source.

Q. And is it also not true that NMED states in the very document that you quoted to us that the inclusion of the SSL for a DAF of 1 is provided for the convenience of the user, and if data on hydrologic conditions are readily available, a site-specific DAF can be calculated, multiplied by the generic SSL for a DAF of 1 to provide a site-specific SSL?

A. I do remember that, yes.

Q. And so haven't you taken a numeric thing which is meant to be used as calculating site-specific situations and converted that into a standard?

A. We borrowed it for our own purposes --

Q. So you --

A. -- but again, our purpose was to make sure that there were no releases, given that there could be a certain very minimal amount of release --

Q. Have you undertaken --

A. -- I chose a very conservative number that was risk based.

Q. I'm sorry, I didn't mean to cut you off. Have you undertaken any evaluation of whether the DAF 1 values that you cited are higher or lower than the background?

A. No.

Q. So basically you're -- at this point you're not certain whether your standards are going to be background or DAF 1 for cleanup of a landfarm or closure of a landfarm?

A. That's site-specific information; we don't know that ahead of time.

Q. But if, in fact, the DAF 1 values were lower than most constituents were to be found, that would mean that effectively you're asking the Commission to adopt the background cleanup standard?

A. That's correct.

Q. And then you stated that for where the PQL is higher than the DAF 1 value, that you guys were planning to not require beyond the PQL, that's the practical --

A. That's usual --

Q. -- modification limit?

A. Yes, that's usual and customary. You can't hold people to something that can't be achieved.

Q. And where in your regulations, short of coming to the Commission to get an exception for that, would you find that discretion?

A. It's not in the regulations.

Q. Is this something the you anticipate the staff might be making a proposed change for?

A. Yes. We think, Mr. Hiser, that it could be addressed with a simple footnote.

Q. Now on the bioremediation endpoint, you had said that you had reviewed the EPA document and that the EPA document had said that finding greater than 95-percent reduction was difficult to achieve in a landfarm situation?

A. That's correct.

Q. Do you know what types of cleanup activities that was addressing?

A. Those were for landfarm operations that were primarily associated with spill remediation from UST sites.

Q. From USTs. And what type of materials would one expect to find in UST sites?

A. Fuels.
Q. Fuels, so diesel, jet fuel?
A. Correct.
Q. And are these not the lighter ends?
A. Yes.
Q. And so they would have the greatest opportunity to find a relatively high bioremediation efficiency?
A. Presumably, yes.
Q. And so would you expect to find those levels in crude oils and other oils with heavier or longer carbon chains?
A. No.
Q. What bioremediation methods, since you reviewed the EPA document on that, were recommended by EPA?
A. For what?
Q. For cleaning up spills.
A. This was basically a book which had a number of chapters. There's a number of different opportunities. Chapter 5 is specifically landfarming, but they dealt with other corrective measures, soil vapor extraction and so on.
Q. Okay. Did that include things like biopile usage as well?
A. I believe it did.
Q. Okay, let's -- on the bioremediation endpoint, can you explain to us what purpose is served by

characterizing the native soil?

A. Yes. The bioremediation endpoint, or the environmentally acceptable bioremediation endpoint, is something with which the Division has no experience. Therefore we're going to take a go-slow approach when promulgating new regulations for basically something that we're unfamiliar with. We want to know more information, perhaps, than is absolutely required at a minimum, because we don't want to go into this program not requiring enough information.

Q. And in what way is the underlying soil relevant to that?

A. It will be incorporated into the treatment zone in some degree.

Q. Isn't that true in an existing landfarm?

A. Yes.

Q. And so basically why, then, for the bioremediation landfarm, which if anything is more intensively and better managed than an existing landfarm, would you require additional information?

A. It's in the nature of a science project at this point. We don't have any other regulatory agencies that have adopted that, that we're aware of. It's not well described, and our abilities are fairly limited as far as doing research. So if you were to type in Google, bioremediation endpoint in quotes, you'd get a very limited number of hits, but most of those are related to this proceeding and this rulemaking. We have very limited --

(Laughter)

A. We have very limited experience with this, and we're going to want to have a great deal of information, not only on the soil, the native soil, but the contaminated soil as well.

Q. Mr. von Gonten, though, it seems to me that a reasonable question that one might ask is, given that if one elects to do the bioremediation landfarm where I have to do all this additional soil characterization, I'm subject to a whole bunch of science project requests from the OCD staff, why should I choose to do that and meet the additional burdens of proper management of my landfarm when I can otherwise simply revert over to the traditional landfarm and dump my stuff out on the land surface and run a plow through it and say I have landfarmed in a dry way?

A. Okay, that's a good point. I don't know that, in fact, the industry will, in fact, elect to do a bioremediation endpoint approach. But if they choose to, we're going to want to know a great deal about it.

Q. So in fact you're saying that the Division staff believes that it is more appropriate to recommend to the Commission that we adopt regulations that would tend to shift people away from better landfarm management, rather than to encourage them to use that better landfarm management approach?

A. I'll even put it in that way, Mr. Hiser. I would say that we're encouraging them to adopt the 53.G regulations as we've proposed.

Q. Regardless of what the impact on the incentives of the operators might be?

A. Yes, that's correct.

Q. What's the basis for the 80-percent reduction factor? You said that you're trying to make sure that there is, in fact, substantial reduction of the bioremediation context?

A. Yes, that's correct.

Q. And for that 80-percent reduction, I see that you've prepared what you characterize as a rebuttal exhibit which shows the rough percentages of crude that's generated in New Mexico; is that correct?

A. That's correct.

Q. Did you go the next step and evaluate what the average percent reduction is for each of those API gravities in the central thrust?

A. No.

Q. So although we have a nice chart, we still don't know whether or not we can actually achieve the bioremediation endpoint under your 80-percent reduction?

A. That's correct.

Q. Do you agree with Mr. Price when he stated that the 80-percent reduction of condensate would not be fully protective?

A. I don't remember him referring to an 80-percent reduction of condensate.

Q. Well, assuming that Mr. Price did, in fact, refer to condensate, would you agree with him that an 80-percent reduction would or would not be protective?

A. I would assume the condensate is going to be very high on the short ends --

Q. Yes.

A. -- and very high API gravity, and an 80-percent reduction of that would be very easy to achieve, in our opinion. But only an 80-percent reduction, if that was the only criteria that we have in G.(8), would not be protective. However, they're required to establish that the rate of reduction has essentially become zero. It's not merely an 80-percent reduction, that's the minimal amount.

Q. Is dilution preferable in treatment?

A. No.

Q. And on slide 24 you stated that OCD was assuming residential risk going into the future, and I think that maybe a couple slides after this one -- this is once again on your PowerPoint presentation.

A. Let's see, what were the assumptions? There, is that the one?

Q. Yes, there you go. For commercial landfarms, at least, wouldn't there be cases where an industrial land use exposure might be appropriate, given that they are owned and operated by a commercial corporation?

A. There's no restriction whether it would become eventually sold to a private land owner or to an industrial site.

Q. And so even though deep restrictions and similar institutional controls are widely used by sister agencies such as NMED, OCD is not interested in evaluating that?

A. My experience with NMED is that NMED did not accept a deed restriction as part of corrective action. It would be news to me. In fact, the bureau chief sent out a letter several years ago telling people that until the State of New Mexico gave its regulatory agencies authority to enforce a deed restriction, that they would require a residential scenario for all risk assessments.

Q. Okay. And so you're basing this position on your recollection of that NMED bureau chief letter?

A. Yes, and my experience with that bureau for five years.

Q. I just have a general question for you, and that is that -- why do you believe that the OCD staff undertook this extensive chloride monitoring exercise if, in fact, you're not allowing any chloride at all to the vadose zone?

A. You're saying that the vadose zone chlorides would be the background for a risk based number, which is 1000?

Q. Well, I believe that you testified that the Division's perspective was that there could be no release from a landfarm?

A. That is our goal, no release, and we have a specific numerical closure standard which is somewhat different than that concept.

Q. Well, but if that is your goal, what difference does it make what the chloride concentrations are that are being bioremediated up above it?

A. We do not want people to send chloride-contaminated material into a landfarm where we know it will not undergo any bioremediation. That's not appropriate waste management.

Q. Ah, well let's go back to that. We do not want people to send material to a landfarm that's chloride-contaminated because we know there's not going to be any bioremediation. So is your testimony now contrary to what you said earlier, that the hydrocarbons in that are not going to be remediated?

A. I don't remember saying that hydrocarbons would not be remediated, Mr. Hiser.

Q. I just believe you told me that there would be no remediation that occurred of waste that was sent to a landfarm with chlorides in it.

A. No, I said that the chlorides fraction of that contamination would not --

Q. So it's only the chloride fraction that you're concerned about. So there's no benefit at all to the environment, remediating the hydrocarbon portion, if you would --

A. There is --

Q. -- otherwise chloride --

A. -- you could argue that there is a benefit to it. But as waste management practices, we know that we do not want to have landfarms accumulating chlorides in the treatment zone.

Q. And so based on that policy decision that you and the staff have reached, you're not going to allow chlorides into a landfarm?

A. That is correct.

Q. In what was does establishing standards that are substantially more stringent than needed to protect human health meet OCD's mandate to protect human health?

A. It actually addresses the disposition of non-domestic waste --
Q. Disposition of non-domestic waste.
A. -- in our statutes.
Q. Okay. So your position is that you're just relying on a general prohibition on waste disposal?
A. No, it says that we -- actually that the Commission has the authority to establish regulations concerning the disposition of non-domestic waste, and that is what Rule 53 is about.
Q. And so basically you're saying that that provision allows you to establish a standard of essentially no release, no concern about risk or --
A. That is what we're proposing as -- yes, the statute does allow that.
Q. Okay. And I guess that would also answer the question about fresh water. You're just relying upon that statutory mandate, as you see it, that there should be no release from waste management practices at all?
A. How does that --
Q. Yeah, in other words --
A. -- fresh water versus nondomestic waste? I'm not following you.
Q. Okay the question would be, in what way does establishing standards that are more stringent than

necessary to protect fresh water advance the statutory goal of protecting fresh water?

A. It goes back to the other statutory --

Q. The other section?

A. -- the other section of the statute that I address.

Q. And did you consider how this proposal would prevent waste in the Commission's mandate, in evaluating this Rule?

A. Waste, specifically -- ?

Q. Waste being waste in the sense of the central mandate of this Commission to prevent the waste of the hydrocarbon resource.

A. We have encouraged, I believe, in our testimony that, say, tankbottoms would be sent to an oil treatment plant to prevent waste of valuable resources, that any recoverable hydrocarbons would be recovered.

But the waste as I believe you're referring to it deals with oil and gas production --

Q. Right.

A. -- as opposed to nondomestic waste.

Q. Okay, I want to end with just a couple questions about the Lea County data that you had prepared for --

A. Do you want me to pull those up?

Q. If you'd like, you could. Okay. Now what mechanisms do you believe are causing the achievement of the reductions that are being seen in these landfarms?

A. Landfarming operations include a number of processes. There's volatilization, there's bioremediation by microbial degradation, and some of the concentrations, probably, because it's becoming adsorbed in the soil particles.

Q. Okay, so some physical process and some biological process?

A. Some chemical as well, yes.

Q. Some chemical.

A. It's a combination of those factors.

Q. What about dilution with clean soils?

A. That would potentially result in the same apparent reduction.

Q. And is it your opinion that these dryland landfarms are truly landfarms, within the meaning of EPA's guidance and discussion of what a landfarm is?

A. There's several different sources for that, but yes, they are landfarms, they are for the treatment of petroleum contaminated soil.

Q. Do you have any sense of what the concentrations of nutrients, nitrate and phosphorous, might have been in Lea County?

A. Native in the soil, or --

Q. Native in the soil or present in the landfarm treatment zones?

A. I don't believe they're amending these things on a regular basis, but I did not ask that question directly of the landfarm operators when I collected these samples.

Q. And why has OCD approved this method of landfarming?

A. That has been usual and customary and was carried over from 711. It is appropriate, in our opinion, because it's achieving our goals.

Q. Okay. Now I believe that you testified very early on that one of the issues that the OCD staff had with some of Dr. Sublette's testimony was that you believe that greater reductions are achievable than he had represented to be the case in the landfarm?

A. What he referred to was that we -- during an outreach some discussion occurred, and we were saying that people were actually achieving in New Mexico lower than several thousand. Our understanding from Dr. Sublette was that reductions less than several thousand -- maybe 5000, 6000, 7000 -- were not possible.

Q. Okay. In fact, did you not say that it was your understanding that your landfarm operators would be routinely achieving 100-part-per-million closure standards?

A. Yes.

Q. Now if we look at your data sheet here -- and these were landfarm cells that were ready for closure -- what percent of them are achieving the 100-part-per-million standard that you represented was routinely achieved?

A. Well, we can go to the next slide, which is the DRO, and that would be approximately 50 percent.

Q. And that's if we use DRO. And your standard at that time was based on DRO or on total extractable --

A. They're allowed to use either method. My understanding is either 8015 or 418.1.

Q. Okay. But 50 percent of them were not able to -- or apparently of the cells that they believe were approvable under your existing 100-part-per-million standard, were not achieving that?

A. That's correct.

Q. Okay. If we were to go up to 1000-part-per-million, how many of them would still not be achievable?

A. Using the DRO?

Q. Yeah, using the DRO, since that's what you have on the screen.

A. If you were to go to 1000, they would be -- approximately 85 percent would achieve it, and 15 percent would not.

Q. Okay. But if we then were to switch to your other screen that shows total extractable --

A. Fifty-five percent would achieve it, 45 percent would not, on the 418.1 test.

Q. And does that seem to be a relatively high amount of non-achievement?

A. Yes.

Q. And so what does OCD's staff believe is going to happen to the non-achieving landfarms?

A. Well, they'll continue to -- if the standard goes in as suggested, they'll have to continue to treat these cells in the future. They may have to add water and nutrients.

Q. And what's the ultimate recourse that you're proposing if they're not able to achieve that?

A. If they're not able to meet the final closure standards, then our provisions are that they either remove it to a landfill or re-use and recycle in an alternate manner to be decided on a case-by-case basis.

Q. And on that case-by-case basis, is that a staff decision, or is that an exemption under subsection K?

A. I would have to refer to the language in detail, if you'll give me a minute.

Q. I'll certainly give you a moment.

A. Disposition of treated soils, G.(7).(b) states, If the operator cannot achieve the closure performance standards then they shall either remove all contaminated soil from the landfarm cell and properly dispose of it at a Division-approved landfill or re-use and recycle it in a manner approved by the Division. The operator may request approval of an alternative soil closure standard from the Division, provided that the operator shall give public notice of an application for an alternate -- alternative soil closure standards in the manner provided in paragraph 4 of subsection C of 19.15.2.53 NMAC. The Division may grant the request administratively if no person files an objection thereto within 30 days after publication of notice --

Q. So --

A. -- otherwise the Division shall set the matter for hearing.

Q. And so the net import of that is that the Division may grant an alternative soil closure standard unless a single person objects, at which point it then becomes a matter for the Commission --

A. That's correct.

Q. And so based on the limited Lea County data that you have, then potentially we'd have anywhere between -- up to 40 percent of all the landfarm cell closures could be potentially petitioning to the Commissioners for hearing?

A. That's possible.

MR. HISER: I have no further questions.

CHAIRMAN FESMIRE: Dr. Neeper?

DR. NEEPER: I have about 10 questions.

CHAIRMAN FESMIRE: Okay.

MR. BROOKS: Okay, do you want to sit over here?

DR. NEEPER: I can handle it from here, if that's comfortable for the Commission.

MR. BROOKS: Okay.

CROSS-EXAMINATION

BY DR. NEEPER:

Q. We have heard concerns of whether some of these standards were established in the appropriate manner to protect public health. In fact, does the Division have a mandate to protect more than health, in particular including the environment?

A. Yes, our mandate is to protect human health and the environment.

Q. Some of these standards were developed based on screening levels established by other agencies for spills. Let us consider a situation somewhere in the future when perhaps it's even been forgotten that a landfarm was a landfarm and some other use is about to be made of the land. And due-process sampling occurs, and we find -- and the people would find the concentrations would be in excess of those screening levels. Wouldn't it -- wouldn't that, then, trigger an investigation?

I can rephrase the question.

A. Please do, trying to work with you.

Q. Suppose we are at some point in the future and some other use is being made of the land. The land is sampled and the concentration of various of these contaminants is found to exceed the screening levels. Would that not, under due diligence, trigger an investigation?

A. If it was a property transfer, I would assume so.

Q. So in fact, examining -- or setting standards based on screening levels has some reasonable nature behind it?

A. Yes.

Q. Prevents difficulty in the future.

We have heard some concerns with the size of landfarms. If landfarms were required to be much smaller than the 500 acres, would that in any way affect the kind of standards we're trying to put on the...

A. If you were to restrict it to a much smaller size, say you were having a single landfarm facility of only five or 10 acres, I think we would have to revisit that, potentially.

Q. But you would say that the difference between 500 acres and 100 acres would not necessarily cause you to make a great change in your standards?

A. I don't believe so. I think 100 acres is a large facility.

Q. Very good. That brings us to the question of small landfarms, which under the proposed Rule are restricted to 1400 cubic yards of waste material. Could you give us an estimate we could picture in terms of how much that is? Would you be able to say, oh, that's about so many dumptruck loads?

A. I did a calculation for the proposed language that we've provided to the Commission, and a six -- excuse me, an eight-inch lift over one acre equates to actually 1075 cubic yards.

Q. But can you put that in terms of anything else, a picture that passes us every day, something we can see?

A. Oh, the number of dumptrucks? Well, the average dumptruck, for example, would be 10 to 12 cubic yards. So that would be between 80 and 100 dumptrucks.

Q. All right, so a small landfarm we could picture, even as allowed under the proposed Rule, might be handling something like 80 dumptruck loads worth of material?

A. I believe that's probably correct.

Q. Thank you. We have said that the small landfarm has no limit on acreage. Wouldn't it be appropriate to have a limit on acreage to prevent an operator from, say, spreading his 1400 cubic yards across 100 acres and diluting it to the extent to where sampling was almost impossible to get a meaningful result?

A. That's a good point, there is no restriction on the areal extent that the 1400 acres could be applied.

Q. But would you think it would be a good idea to have an areal limit?

A. Yes, I believe it would be.

Q. Thank you. We have heard some discussion regarding the thickness of lifts on a landfarm. In particular, I believe there was a comment about an eight- or a 12-inch lift. Characteristically, I believe in the past, OCD has specified six-inch lifts, and you are now amending that or changing that to allow eight-inch lifts, an approximation?

A. That's correct.

Q. Would the eight-inch lift be about the right amount to be thoroughly ventilated on a daily basis by the average barometric pressure oscillations, and therefore that be a very reasonable number?

A. I would have no idea.

Q. Thank you. Regarding the DAF of 1, there was a question whether that, in fact, was restricting operation to background. Does that restrict a measurement to a background standard, or does it simply mean that whatever material is released, by the time it gets to the aquifer, in the calculation it would not be further diluted?

A. The DAF of 1 does not account for the dilution of a contaminant in the vadose zone, according to my understanding. It only accounts for the transport from the point at which it enters the aquifer to the point of compliance with point of exposure.

Q. I think I can rephrase the question better. It does not necessarily directly relate to the concentration at the surface?

A. The dilution attenuation factor does account for the various processes as -- that occur as you migrate a contaminant through soil to groundwater. Otherwise, the number would be just the same as the groundwater standard.

Q. All right.

A. It is higher than the groundwater standard because of the attenuative processes, the retardation factor that occurs in the soil column.

Q. The current proposed Rule specifies four samples, but I believe not on any particular area?

A. That's correct.

Q. Would you think it wise to specify an area limit to the four samples?

A. Yes, I believe I mentioned this earlier. Our original draft specified that landfarm cells would be no larger than five acres. We got a great deal of comments on that, that that wasn't practical and it was unduly restrictive. So we took out the areal extent for a particular cell, but we didn't make a conforming change as far as the sampling protocols.

Q. With the four samples, or however many samples we have, you have suggested we would know the samples exceeded the standard -- whatever that standard might be, background or numerical standard -- by some statistical argument. Can you explain how you would know that? You implied it would be an average.

A. When people submit data for the closure, we're going to review the data --

Q. All right.

A. -- and we have not required background sampling to this date, is my understanding. But in the future, for a new cell, we will require that a background be established.

At closure the -- so we will have to submit their closure data, and we'll review it and we'll run some very simple statistics at that point.

Q. And if the average falls, say, within given error bars of your standard, then you would presume that the cell passes the standard

A. Specifically, I would say if the mean value of the four samples, for example, taken from the -- to demonstrate closure, did not exceed the numerical standard, for example, then -- or did not exceed background mean, we would assume that that's appropriate closure.

It's somewhat more complicated taking a mean value and comparing it to a numerical standard. You can do a straight-up comparison. Statisticians are not always comfortable with that. If your number is 100 and you have to ask, does 101, even if it is the mean value of that, statistically exceed, and we would have to look in a little more detail at the statistic test at that time --

Q. So --

A. -- for numerical standards.

Q. -- you are -- I think I understand you're saying, you would accept the mean in comparison with the standard, whatever the standard might be. But if you have any question about it, you would then use some kind of a statistical argument?

A. I think we would do basic statistical analysis, descriptive statistical tests, rather than using any particular -- or any comparison test, to look at the data to see if it clearly exceeds or clearly fails. There's a gray area when you start -- have to apply more sophisticated tests.

Q. But with four samples, and in particular in environmental sampling, could you not have a large variance so that, though your standard might be 100, you could have some samples of 20 and some samples of 200 coming together?

A. Yes.

Q. And then what can you do with a mean?

A. Well, you have to -- practically, we would probably look at the -- 95 percent of the confidence limit of the median. And again, you really are constrained by the power of your statistical test. If you don't have enough samples, you may not be able to make the demonstration.

Q. So if you can't make the demonstration, then the landfarm would fail the test and not pass?

A. Or we might conceivably send them back to take more samples.

Q. Okay. You had mentioned that the sampling was -- the sampling depth, was designed such that it could be done with farm implements. Would sampling of soils with farm implements be at all the ordinary case in the environmentally community?

A. I believe maybe you misunderstood me or I misspoke. The treatment zone is being treated with farm implements, and that is almost inevitably going to incorporate some of the uncontaminated soil with the contaminated soils because of the equipment that you're using.

We wanted a three-foot to four-foot interval, to specify a specific interval. They would sample that with other sampling equipment. You would use, you know, something like an auger or a split-spoon sampler to reach that interval and take that sample.

Q. But you're maintaining that with the use of an auger or a split-spoon, one could not sample reliably at a two-foot depth, that you'd have to go to three to four?

A. You could -- Yes, you could take samples at two foot. You could take samples at six inches, but we think that the chance of knowing, being able to tell, without the rather large possibility of a false positive is increased by going deeper.

But we didn't want to go too deep, and we thought three foot was practical. You can still use that with hand-operated equipment, you don't have to advance deeper, and yet it's close enough to the bottom of the treatment zone that we think it's appropriate for closure. Recognizing that theoretically six inches is better than three feet. We don't think it's particularly practical, though.

Q. There's been some concern that the volatile organics that are specified in our list for sampling might not be appropriate targets for sampling in oilfield landfarms. Could you explain to us why you expect some of those materials to get into a landfarm, if they're not common constituents of crude oil?

A. They're not common constituents of crude oil, however some of the constituents are found in crude oil. If you look at the table I've -- or the column I've provided on the total petroleum hydrocarbon -- or total petroleum hydrocarbon criteria working group of '98, a fair number of constituents were found also in 3103.

We do not know whether they -- we got more detailed investigation, whether they actually analyzed for all the constituents on 3103. It's only a positive detect. It doesn't mean that it's not there in crude oil. If they didn't analyze for it, we wouldn't know that.

However, we think that most of the soil that's going to landfarms will be predominantly -- must be predominantly contaminated with hydrocarbons, but we cannot exclude that there will be an admixture of other constituents --

Q. Is it --

A. -- so we thought --

Q. -- to say where those could come from --

A. They could come from any- --

Q. -- how could they possibly get into the stream?

A. They could come from spill sites on oilfield service company sites, they could come from refineries. It doesn't have to always be from a crude pipeline. There's service companies, there's chemical supply companies. All these people would be eligible to send any spills to a landfarm, an OCD landfarm, if they were predominantly contaminated by hydrocarbon.

Q. Your new version of the Rule that you passed out this morning with the corrections in it raised the mercury standard to 334 from a much, much smaller number. Do you have -- can you tell us where that came from? That's kind of a surprisingly large number for a heavy metal.

A. That number came from NMED soil screening guides in 2005. It was taken directly from that table. It was a typo in the draft regulations.

Q. Would we expect there to be a source of something like mercury, for example, in a gas plant?

A. I'm not familiar with the waste streams of a gas plant, but I don't think you could eliminate it.

Q. And finally, you have mentioned that -- I think all of the screening levels that you have used have considered particular exposure pathways, and that means to impact on humans one way or another?

A. Yes, the columns were either for dermal contact or a human receptor or through protection of the groundwater pathway to groundwater --

Q. So the concern has been really related to human toxicity?

A. That is what we restricted to that list, is just considering the human pathway.

Q. So would it be the case, then, that possibly we have overlooked other environmental impacts on the large scale of the land, particularly to plants and animals and even grazing animals that might become food for man?

A. Yes, we did not consider crops, we did not consider wildlife, we did not consider foraging -- cattle, for example. We did not consider that in that proposed standard.

Q. Or you also did not consider the impact, say, of petroleum hydrocarbons on the plants themselves?

A. That's correct, it was to human health.

DR. NEEPER: Thank you, no further questions.

CHAIRMAN FESMIRE: Mr. Brooks, I'm assuming you're going to have -- after the Commissioners, you're going to have some redirect; is that correct?

MR. BROOKS: I would expect to have some, your Honor.

CHAIRMAN FESMIRE: How long would it take?

MR. BROOKS: Probably not more than about 15 minutes.

CHAIRMAN FESMIRE: Okay. Would you have another witness after Mr. von Gonten?

MR. BROOKS: No, Mr. von Gonten is our last witness.

CHAIRMAN FESMIRE: Okay. At this time why don't we go ahead and break for lunch, come back at one o'clock. When we get back, Mr. Carr and Mr. Hiser, I guess you've got about an hour before you get to start your presentation. Okay?

See you all back here at one o'clock.

(Thereupon, noon recess was taken at 11:59 a.m.)

(The following proceedings had at 1:06 p.m.)

CHAIRMAN FESMIRE: Let's go ahead and go back on the record on Cause Number 13,586. I understand that in the cross-examination, Mr. Brooks, I left out Mr. Carr. I have to remember that he and Mr. Hiser do not represent necessarily the same parties.

So Mr. Carr, if you would like to start us off, it's all yours.

MR. CARR: I have a very brief cross-examination.

CROSS-EXAMINATION

BY MR. CARR:

Q. Mr. von Gonten, when you were testifying this morning after the break, you were testifying about Rule 53, subsection 8 [*sic*] that relates to small landfarms?

A. H, yes, sir.

Q. And when I was cross-examining Mr. Price, I asked him whether or not the 53.G standards are exempted for small landfarms and if we would only have to look at subsection H. It was my understanding that Mr. Price said that was true, that 53.G didn't apply to the small landfarms, that we looked at subsection 8.

This morning I understood your testimony to be that some requirements in 53.G might apply to these small landfarms. Could you tell me what they are?

A. I'm looking right now to see if that's in fact correct.

Q. Okay.

A. What the text of the Rule states, Mr. Carr, is that small landfarms are exempt from 53 except for the following requirements, and that those requirements are the subsections in H, which are registration, general operating rules, record keeping and small landfarm closure and final report.

Q. But all we have to do, then, is really look at subsection 8, that's --

A. Yes, sir, that's my understanding now.

Q. Okay, so when we look at J, which are closure standards, we don't look at those, we look at the closure standards in H.(5)?

A. That is my understanding, yes, sir.

Q. Okay. You've been testifying about landfarms.

Could you give me a definition of a landfarm? What is a landfarm?

A. Well, a landfarm is actually defined in our regulations, and I'll stick to that definition --

Q. Don't we call it a farm or a landfarm because it operates like a farm?

A. That's the general --

Q. And if --

A. -- perception.

Q. -- isn't it fair to say that if plants would grow in the farm, then we ought to be able to expect microbes to grow in the farm?

A. I don't know that I would accept that as being either correct or not correct. I'm saying the landfarming has to do with the similarities of the equipment that is used to actually till and turn the soil. The purpose of landfarming for bioremediation of petroleum hydrocarbons assumes that there are native microbes that are available in the soil, and they can use the petroleum hydrocarbons as a food source.

Q. And they would also need other things to function properly, the microbes, as -- to use this as a food source. They need moisture, they need other things of that nature?

A. That's correct, to maximize or optimize the bioremediation approach.

Q. Now you said this morning you went to Google and you got very few hits on bioremediation endpoint.

A. Using quotes around bioremediation endpoint --

Q. Did you look for dryland landfarm?

(Laughter)

A. No, I did not.

Q. Did you look for bioremediation of hydrocarbons?

A. I'm sure I searched for a lot of those terms.

Q. You would agree with me that although a bioremediation approach may be new to this agency, that the bioremediation of hydrocarbons has been studied, scientifically studied, for decades. Wouldn't you agree with me --

A. Yes.

Q. -- on that?

And would you agree with me that a landfarm is really the preferred method of treating hydrocarbon-impacted soils?

A. It's one of the preferred methods. You could use alternate methods such as incineration, for example.

Q. You talked about major mechanisms for dryland landfarms this morning, as I recall. And what we're doing now basically in southeastern New Mexico is dryland landfarming; is that right?

A. That's my understanding, yes, sir.

Q. You stated volatilization. What is that?

A. The lighter-end hydrocarbons, the lighter-end liquid hydrocarbons, would have a tendency to partition into the air due to volatilization.

Q. What about diffusion?

A. Diffusion occurs also through the soil pores.

Q. And what does that entail? Is that a natural process, or does that result from tilling and things of that nature?

A. It's enhanced by tilling, but it is a natural process that will occur, to some degree, because of the natural porosity.

Q. I think you talked about chemical degradation. What is that?

A. Chemical degradation is one of the things that, if you look at an overall review of landfarming, they talk about landfarming includes bioremediation, it includes physical and chemical degradation. I believe that the chemical degradation would be some breakdown of the hydrocarbon chain other than as facilitated by being utilized as a food source.

Q. What about adsorption into the soil?

A. That occurs.

Q. When that occurs do we have hydrocarbon building up in the soil, just adsorbing into the soil?

A. A certain amount of hydrocarbon will adsorb or absorb into the soil particles. I don't know that it builds up to a preferred concentration.

Q. But if it is there, in a TPH analysis you probably wouldn't see it; isn't that right?

A. No, that's not correct. You take a soil sample, and during the preparation of it that soil sample is subjected to solvent extraction. So to the degree that the solvent would also enter those pore spaces, it would to some degree liberate those hydrocarbons which are entrapped by that process.

Q. And so it's your testimony that a TPH measurement would show the hydrocarbons that had adsorbed into the soil?

A. To a certain degree.

Q. And to a certain degree not?

A. And to a certain degree not.

Q. When you have these hydrocarbons adsorb into the soil, if you have a buildup that will effect the hydrophobicity of the soil; isn't that true?

A. That's my understanding.

Q. And that would affect plant growth; isn't that right?

A. That's my understanding.

Q. And when we talk about the conditions that are favorable for plant growth, we talk about food and moisture and those sorts of -- and oxygen, those sorts of things. These are the same conditions that are needed for a microbe; isn't that right?

A. That's true.

Q. I think you also stated that bioremediation was one of the major mechanisms for the dryland landfarm?

A. That would be my understanding of the way that it's operated under those circumstances.

Q. Is it your believe that when you -- without water and without the addition of nutrients that you, in fact, really can have bioremediation as a major mechanism in these landfarms?

A. I would say that bioremediation will occur at a certain rate that is controlled by these other factors such as moisture and nutrient applications. Those maximize the rate of degradation to where the microbes could actually utilize the hydrocarbon as a food source.

Q. And is it your testimony that without these things, without moisture or the addition of nutrients, you have bioremediation occurring but just at a much slower rate?

A. I would believe so, and I believe that it's absolutely imperative to have some moisture based on a presentation I saw earlier this year.

Q. And that would limit -- the absence of water, the absence of nutrients, these other things that are generally not present in dryland landfarm, negatively impact the ability of bioremediation to occur?

A. It would -- I don't know that it shuts it off, that it's harmful to bioremediation not to have those things -- I guess if you don't have moisture then you stop the microbes -- but without those things they're not going to proceed at an optimum rate.

Q. Under the new Rule, the current practice of dryland landfarms that's going to be allowed, that's going to be authorized in the future is as it is now; isn't that right?

A. That's correct.

Q. And what industry committee is proposing is, in fact, an alternative that is true bioremediation, the adding of water and nutrients and these other things to make bioremediation work; isn't that true?

A. That's true.

MR. CARR: Thank you, that's all I have.

CHAIRMAN FESMIRE: Commissioner Bailey?

EXAMINATION

BY COMMISSIONER BAILEY:

Q. Let's focus strictly on small landfarms for a while. You testified that there would be a registration process that would require neither approval nor disapproval by the OCD.

A. That is correct, Commissioner Bailey.

Q. What happens if a Form C-137-EZ is submitted and there's no certification that the operator has a written agreement with the landowner?

A. Well, we haven't experienced this yet, so I can't say with absolute certainty, Commissioner, what we would do. But my understanding is that we would have to reject that, they have not followed the Rules, therefore they're not in compliance with 53.H. They have to register it, and that permission has to be included with that registration.

Q. None of these Rules pertaining to small landfarms would necessarily prevent the surface landowner from imposing its own rules; is that right?

A. Commissioner Bailey, as I understand it, the landowner has the opportunity to proactively assert his or her rights at any time. This Rule does not address the rights of landowners.

Q. And where it does not address fencing or environmental siting or a whole host of other things, that landowner would not be prevented from having its own separate site agreement, conditioning that approval for your registration, right?

A. Commissioner Bailey, yes, ma'am, I believe that to be correct.

Q. Many of the executive agencies charge fees for registrations. Do you contemplate charging a fee for registration to small landfarms?

A. Commissioner Bailey, I don't believe that we've proposed any changes to our fee regulations to address that contingency.

Q. H.(2).(a) talks about one active small landfarm per lease at any time. Can you define lease for me? Is there a definition of lease in the OCD Rules?

A. Commissioner Bailey, I don't know if there is a definition of lease that would apply specifically to this requirement.

Q. Okay. I would ask that the OCD develop a definition of lease, because your lease is different from my lease.

MR. BROOKS: Commissioner Bailey, I think the answer to the question is, no, there is not a definition of lease in the OCD Rules.

CHAIRMAN FESMIRE: Commissioner Bailey, could we on the record elaborate a little what the difference is -- what specifically you're talking about with the State Land Office lease?

A. A State Land Office lease is a contract between the lessee of record and the Land Office, issued for the exploration, development and production of oil and gas, helium, carbon dioxide, things of that matter, on specific tracts of land. Those specific tracts of land do not necessarily cover an entire reservoir or an entire pool or even designated pools. They are in a sense arbitrary designations within a section, and it's all based on section-township-range descriptions.

CHAIRMAN FESMIRE: How should we address those concerns in a Rule?

COMMISSIONER BAILEY: Whatever your definition of a lease is needs to be included in your Rule, because otherwise there's confusion over one farm per lease, what is that?

CHAIRMAN FESMIRE: Okay.

Q. (By Commissioner Bailey) (2).(c) talks about the types of materials that would be incorporated in a small landfarm. Those materials may or may not necessarily be generated on that lease, however you define that. Is transportation of that material covered elsewhere?

A. Commissioner Bailey, I don't believe that there is a specific requirement for the transportation between leases, whatever leases are, to the approved small landfarm. I don't believe that's addressed by this Rule.

Q. So this material could be brought in from distant locations to a small landfarm, potentially?

A. Commissioner Bailey, I don't see where it's prohibited from this, but my understanding was that it was supposed to be generally from the lease that the spill occurred, or nearby. They could be contiguous leases.

Q. That's an understanding, but it's not a requirement.

A. Yes, ma'am, you're correct.

Q. The closure requirements, going back to the agreement between the landowner and the operator, that agreement may address the preferred method of closure. Does OCD have a problem with the landowner getting involved in (5).(a), closure performance standards, as to the type of method?

A. Commissioner Bailey, our closure performance standard would be the minimum. If the operator and the leaseholder were to come to an arrangements that the standards would be more stringent, we would have no problem with that.

Q. Okay. And then we come to (5).(b).(i), which talks about re-vegetation of the soils remediated to the closure performance standards if left in place. What standards apply for re-vegetation of those soils? In Section J we were told clearly that the re-vegetation standards did not apply to small landfarms. Could you elaborate on what standards will be imposed?

A. Commissioner Bailey, 53.H does not specify in detail what the re-vegetation of soils would entail, as drafted.

Q. Should we have something like that?

A. Yes, ma'am, I agree with you, we should.

Q. And the big question. You've borrowed a lot of information from other agencies, Environment Department, EPA, et cetera. I know within your own department you have experts on plants and rooting and tolerance for different types of soils. Did you work with any of the botanists or biologists within your department, or with the Lea County extension agent, for setting any of these standards that would allow re-vegetation of the native species in the areas?

A. Commissioner Bailey, I did not personally get involved with that, and I believe that our restrictions on the Bureau level were that we did speak with someone on the issue of hydrophobicity, and Mr. Price did have a conversation with the Lea County -- retired Lea County extension agent. But that was the limit that I'm aware of.

Q. Do you know if a limit of 1000 parts per million of chlorides will allow re-vegetation to native species?

A. Commissioner Bailey, the chlorides concentration limit was addressed by Mr. Price, and he was more familiar with that information than I was, but my recollection is that 1000 is protective of some species, it is not protective enough for other species and they will be negatively impacted. Either their growth will be stunted or new seeds could not germinate at that concentration.

Q. Then is a post-closure land use not a factor in the re-vegetation standards that should be imposed?

A. Commissioner Bailey, are you referring specifically to small landfarms?

Q. Yes.

A. We anticipate that that will be addressed with the agreement with the landowner in detail. We're not proposing in our draft any detailed re-vegetation requirements for a small landfarm.

Q. Then how can you expect re-vegetation under your Rules if you didn't take into account the impacts on cattle or plants or -- and I -- I see a disconnect here.

A. Commissioner Bailey, I agree with you that there is a disconnect, that this has not been addressed in detail in this particular section 53.H.

COMMISSIONER BAILEY: That's all my questions.

CHAIRMAN FESMIRE: Commissioner Olson?

EXAMINATION

BY COMMISSIONER OLSON:

Q. I guess -- just wanted just to clarify something. I guess it's coming back to a question -- to some answers you had earlier as well as a question of Mr. Carr's.

So the current landfarms that are out there today operating under Rule 711 don't require the addition of moisture?

A. Commissioner Olson, I'm not that familiar with Rule 711, but my understanding is that if there's a requirement it would be a nuisance requirement to control dust.

Q. Okay. But then under this Rule they would be required to add moisture; is that -- Do I have that correct?

A. Yeah, Commissioner Bailey -- excuse me, Commissioner Olson, there is a requirement that they, in fact, add moisture as required for the control of dust, and to enhance bioremediation.

Q. Okay. Then under G.(3).(g), what is the rationale for having Division approval of microbes for enhancing bioremediation?

A. Commissioner Olson, as I understand it, this is a carryover from Rule 711 and the guidance. We're not prohibiting in any way the application of optimized or customized microbes for landfarming in New Mexico, but we think that this would require additional review and approval by the Division.

Q. Coming down to the treatment zone closure performance standards under G.(6), now as I understand this, the landfarm applications are in eight-inch lifts, then you could add another lift when you reach certain TPH levels, until you get up to the two-foot level.

And then when you're looking at this whole -- all these treatment zone issues with these individual constituents listed here, does that apply across the whole zone or just to the top lift, this applies? This is a standard that applies to the entire two-foot application at that point?

A. Commissioner Bailey -- excuse me, Commissioner Olson, yes, sir, it applies to the entire -- all tow feet in that lift --

Q. All right.

A. -- all two feet that have been applied by however many numbers of lifts, up to eight inches per lift.

Q. So it just doesn't apply when you need to add another lift, it applies to our end criteria; is that it?

A. Commissioner Olson, it applies -- it is a closure standard. The only criteria for a new lift is the chlorides over 1000 and the 2500 parts per million TPH.

Q. All right. And then I asked this next question of Mr. Price, but he referred it to you. So under the -- under G.(8), under the environmentally acceptable bioremediation endpoint approach, you have -- the term that's listed there -- it's 80 percent of reduction of the TPH concentration. Then it talks about the rate of reduction as essentially zero. Zero -- How do you define essentially zero?

A. Commissioner Olson, the concept of the bioremediation endpoint specifies that the concentration of total petroleum hydrocarbons will rapidly decrease and at some point will asymptotically approach a rate -- degradation of -- or increase degradation of zero. That will be determined statistically, and the burden is on the operator to propose it in the operations plan.

And this is in addition to a minimal reduction of that 80 percent. So if they achieve a 10-percent reduction or a 50-percent reduction and it no longer has any more potential for bioremediation, then we don't think that they've met the environmentally acceptable bioremediation endpoint.

Q. But I would guess just due -- through variations in sampling, it's never going to be really zero. You're always going to see some fluctuation, just based on where you sample within an area. You're going to have variations in TPH concentrations throughout the treatment zone profile, so it won't really be -- I wouldn't think it would ever be really zero, would it?

A. Commissioner Olson, that is something that we have considered, and we think that it could be very difficult to demonstrate that it's essentially zero for those reasons alone.

Q. Would it maybe be better to say that it's negligible instead of essentially zero? I mean, I guess when you put the word zero there, it makes it sound like it must be zero, so would negligible be a better substitution for that term?

A. Commissioner Olson, I wouldn't disagree with that. Negligible would be appropriate. However we, to the extent possible while addressing our own concerns, took the industry-proposed definition at an outreach meeting, and that was the term that was used by industry committee.

Q. Okay. Under item H, under the small landfarms, you're listing the C-137-EZ form. I notice in the other portion of this when you talk about the -- earlier in the regulations, it talks about the C-137, and it mentions the information that would be needed for this. Do we need to have some indication here of what information would be needed or what would be the minimum information you'd look at on a 137-EZ?

A. Commissioner Olson, I would agree with that. We have not drafted a Form C-137-EZ at this date, however. That is work remaining to be done.

Q. I guess maybe -- it just seems it might be helpful if we -- if the form wasn't developed, if there was some minimum level of information, I think that's the way the other portion of the Rule is for C-137, some minimum level of information that would be needed for the form. Just a comment.

And I think in your testimony you also talked about -- when referring to small landfarms, you are testifying that there -- if the Commission did look at some alternate yardage or volume limitation on a small landfarm, that there should be a -- some type of acreage limit that the area should be limited to for a small landfarm. Do you have any recommendation as to what that should be?

A. Commissioner Olson, we think it should be in the nature of one, two or three acres. We can't imagine that it would be larger than, perhaps, two and a half or three acres and still meet the definition of a small landfarm.

As I mentioned, I believe, a rule of thumb is that 1000 cubic yards per acre is equal to one six-inch lift. So if you limit it to 1400 acres, that only becomes 1.4 acres.

Q. Or 1400 yards, would be --

A. 1400 yards would be equivalent to about 1.4 acres.

Q. Okay. And you talked about some of the sampling you've at existing landfarms. How many of the existing landfarms have exceeded contaminant concentrations in the vadose zone underlying them so that they're -- we're showing that there was some significant migration from them?

A. Commissioner Olson, I have not been involved with the permitting or operations of the landfarms on a day-to-day basis, and I don't know the answer to that question.

Q. Okay. In reference to potential alternate remediation levels of the landfarms, can the Applicant propose an alternate cleanup level for the landfarm in their applications? I guess -- I see that this could come in later on as they're working through something. Is it possible if they propose that up front and then it's something that the Division would review at that point as part of the application?

A. Commissioner Olson, I don't think we specifically addressed that contingency or that possibility, but I imagine that we would consider it during the applicant's application for a 53.G landfarm.

Q. Because they can submit for an alternate cleanup level after they're already operating. I noticed that that provision was in here, and I would think -- I couldn't see why they wouldn't be able to do the same thing in their application up front, if they were proposing to do something different.

A. Commissioner Olson, we would certainly consider it, although we don't want to particularly lower the standard.

Q. All right.

A. We would have to consider their information provided in the application.

Q. Well then, that would be a subject, potentially, for a public hearing?

A. Commissioner Bailey, it would be -- I mean Commissioner Olson, it would be.

Q. Going to this issue of future land use, are you aware that there are currently oilfield production areas that have -- former oilfield production areas that have become residential housing areas?

A. Commissioner Olson, I was not aware of that, but it doesn't surprise me.

Q. You're not familiar with maybe the Shell Westgate contamination case in Hobbs?

A. Commissioner Olson, I am not aware of that site, that case.

Q. Well, maybe I'll just state, that's one I've worked on a lot --

(Laughter)

Q. -- and it was something that did become a housing subdivision in the future, which at one point was out of town quite a ways when it was in operation.

I guess I maybe have one more question. You talked about uranium a little bit in oilfield wastes. I haven't been familiar with a lot of any real problems with uranium in oilfield wastes. Is the Division aware of any?

A. Commissioner Olson, we have not analyzed for it, so I think the short answer is no, not in oilfield wastes. We may have been analyzing for it under an investigation that included groundwater contamination, but probably not. Uranium, according to my petroleum geology and petroleum engineering textbooks, is found in crude oil.

Q. I guess are you aware of any cases, any groundwater contamination cases, where uranium has been a point of issue for contamination of groundwater?

A. Commissioner Olson, no, sir.

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

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. Mr. von Gonten, now in the proposed Rule you talk about -- in landfarms, that they can remediate drill cuttings, but they can't remediate drill cuttings in small landfarms. Why the difference?

A. The difference is that the small landfarms is for primarily -- I'm fumbling a little bit here, sir -- in H we have specified that the operator of a small landfarm may only accept oilfield-contaminated soils, excluding drill cuttings, generated as a result of accidental releases from production operations.

Production operations here is not -- does not, as we have contemplated, include drilling a well.

Q. Okay. So the idea of a small landfarm is to encourage immediate cleanup of small spills, correct?

A. Commissioner, yes, sir, that is correct.

Q. Now you used the expression "science project" to talk about the TPH endpoint projects. Could you elaborate a little bit? Why did -- when you said science project, did you mean experiment?

A. Chairman Fesmire, the term science project is in reference to the fact that this approach, the bioremediation approach, is farm more scientific in nature than the usual and customary operations that are occurring in our dryland landfarms. There is a lot more information that is being generated and being analyzed.

It was -- perhaps originally started off as a science project or an experiment, but the term really is just in recognition that it's far more detailed than the amount of information that is needed and the amount of information or data that is generated.

Q. Well, will this data be used to evaluate the effectiveness of the technique, or -- is that why it needs to be kept?

A. Chairman Fesmire, the information that is being required has -- comes through several different sources: the industry committee in part, in part from other sources such as the Army Corps of Engineers. This information is what's needed to optimize a landfarm operation. And without knowing a lot of details, you cannot actually program your landfarm operations and know exactly how much carbon you need to add or nitrogen or phosphorous, whether you would be better off at 80 percent of your soil moisture content or 60 percent.

Q. So it's more of a requirement to properly manage the project, rather than to determine whether or not it's been successful; is that right?

A. Chairman Fesmire, I believe it's a combination of both. The bioremediation endpoint, as proposed, says that when you're done you have done everything the right way, and it is incumbent upon the operator to demonstrate that they have done everything the right way, that they have properly maintained moisture and amended the landfarm cell lift with the proper mixture of nutrients.

Q. Okay. One of the questions that was addressed to you today -- I think it was from Mr. Hiser, but it was before lunch so I don't remember for sure -- talked about whether we considered -- whether we, the OCD, had considered putting deed restriction requirements as part of this Rule. Was that evaluated or looked at?

A. Chairman Fesmire, that was not because deed restrictions are unenforceable in the State of New Mexico. The regulatory agencies do not have authority to enforce a deed restriction. It's simply a matter of enforceability. You cannot go in and say, You're violating a deed restriction and then you must go comply with that deed restriction, to a new owner.

Q. You mean unenforceable by the OCD?

A. Chairman Fesmire, I believe it's unenforceable by any agency in the State of New Mexico. There's no statutory -- My understanding from dealing with this same issue in the RCRA program with the Department of Defense is that there simply is not statutory authority for the State of New Mexico to have that power for itself.

CHAIRMAN FESMIRE: I think that's all the questions I have.

Mr. Brooks, do you have any redirect?

MR. BROOKS: Briefly, yes, Mr. Chairman.

REDIRECT EXAMINATION

BY MR. BROOKS:

Q. Mr. von Gonten, with the start of the cross-examination, quite a while ago now, Mr. Hiser asked you about sound science. Now -- and he also asked you about the use of -- or the value of anecdotal evidence.

Now would you agree that if you have -- well first of all, there exist sampling procedures and experimental procedures that are fairly rigorously defined in various scientific disciplines, correct?

A. That is correct.

Q. And if you have the benefit of studies that have been conducted under those rigorous guidelines, then they would be highly preferable to anecdotal evidence gathered without following those guidelines, correct?

A. That is correct.

Q. If -- and tell me if you agree with this -- if the assumptions are valid for the universe you're looking at -- in other words, a rigorously designed experiment might not be applicable because it made some assumptions that were inconsistent with the position -- or the situation in which you might be asked to apply it; is that not a possibility?

A. That is true. Experiments are designed with certain limitations, not the least of which is size and time and money, and may not consider all the possible factors that might go into that investigation.

Q. So -- and one of the factors that influences -- is one of the factors that influences landfarming in New

Mexico the arid climate?

A. Mr. Brooks, I believe that is correct, that moisture plays a very important role in the rate of biodegradation. If -- it could be considered a controlling factor. And it doesn't mean that biodegradation won't occur if you only have 10 inches of rain a year and are dependent only on that 10 inches of rain; it just means that it will proceed at a slower rate, so --

Q. So in terms of assessing what is appropriate in New Mexico, would it or would it not be appropriate, if you have scientifically recognized studies applicable to conditions different from New Mexico, to also consider anecdotal evidence taken specifically from New Mexico?

A. I believe it would be appropriate to consider that there's a difference between data that's generated, perhaps, from eastern Oklahoma and -- as was presented by Dr. Sublette, by the industry committee, in a study that was conducted in the State of New Mexico with New Mexico conditions.

Q. Even though that study might be less rigorous, it might be the best evidence you have?

A. I would prefer that -- If I were given a study that was conducted in New Mexico, versus a study that was conducted somewhere else, of course, we would prefer to take the New Mexico study.

Q. Now one of -- but we don't necessarily have that, right?

A. To my knowledge, no one has conducted any investigation on a rigorous bioremediation endpoint approach such as has been proposed by the industry Committee --

Q. Do you feel that --

A. -- for New Mexico.

Q. Do you feel that you were being an irresponsible scientist by using the data that you had from New Mexico landfarms as a significant input in your analysis?

A. No, we thought it was the appropriate thing. We had test- -- not testimony, but observations made by the industry committee during an outreach meeting that we decided we needed to find out whether that was correct or not.

Q. Now I noticed in Dr. Sublette's material that one of the studies he relied on was conducted in a marine environment. We don't have a lot of marine environments in New Mexico, do we?

A. No, not too many.

Q. Okay. Now we talked about dryland landfarms. Is there a reason why -- is there a practical reason why dryland landfarming may be an inevitable necessity in New Mexico, at least to some extent?

A. I think as practiced, and what is practical in New Mexico, is that New Mexico has a lot of land that is available that is not being currently being farmed for crops. That land could be used for landfarming operations, the limitation being that they're probably going to be working on a rather restrictive budget, but they have the opportunity for -- they have two things going for them, they have time and they have land. And bioremediation will occur as long as you have those two things, and some moisture.

Q. And this is a legal question, and I know you're not a lawyer, but are you aware that in New Mexico a person who owns land does not necessarily have the right to appropriate for use on that land groundwater that may be underneath that land?

A. Although I'm not a lawyer, I'm aware that the water rights issues in New Mexico are extremely complicated.

Q. Now ordinarily would it be possible with the rainfall we have in New Mexico to achieve the optimal moisture application to a landfarm without irrigation in most years?

A. I don't believe it would be.

Q. So from a practical standpoint there may be some benefit to landfarm- -- to dryland landfarming in the New

Mexico context?

A. It's certainly practical in that context that you can bioremediate or treat contaminated soils by bioremediation. It takes longer, but at least then the remediated soil doesn't have to go necessarily straight to a landfill.

Q. Now the anecdotal evidence, admittedly somewhat anecdotal, that you have assembled, does that not -- does that indicate that substantial remediation, presumably bioremediation, is, in fact, occurring?

A. Our data indicates that there is reduction of hydrocarbons, contaminated soils, to the standards we're proposing. What we don't know is what the starting point petroleum hydrocarbon loading factor was for the soils that we sampled. So we can't testify, even anecdotally, as to how much reduction occurred; we just know that the samples that we took were at that -- approximately at those concentrations.

Q. I believe, however, that you testified that you had a non-detect on the GRO fraction on those samples?

A. All 21 samples were non-detect for GRO.

Q. Would that indicate to you -- assuming you started out with crude oil in most instances, would that indicate to you that some fairly effective remediation was occurring?

A. I would assume that it was primarily volatilization of the short-chain hydrocarbons, the gasoline range organics, and some bioremediation as well.

Q. Okay, thank you. Now Mr. Hiser also asked you some questions that talked quite a bit about incentives. Now we don't have any agenda to encourage people not to do the best landfarming they can do, correct?

A. They're required to meet the closure standards, and to actually close out a cell they're going to have to meet the closure performance standards which we've specified for both ranges of TPH. They have an incentive to meet those standards, to meet -- to close the cell and take in additional loads of contaminated soil.

Q. And if they can't meet those closure standards, then they have to dig and haul their treatment zone soils, correct?

A. That is the impact of our regulations.

Q. Would that be quite expensive to do?

A. I believe it would be.

Q. So from an economic point of view do they have an incentive to achieve the highest amount of bioremediation they can?

A. Yes.

Q. And if they choose the alternative of the bioremedation endpoint, that actually allows the more lenient closure standard, right? In effect?

A. It does. You would be required to -- potentially, if you started off at the maximum concentration of 50,000 parts per million, demonstrated that you had reduced it to essentially a rate of reduction in the concentration to zero and had achieved an overall 80-percent reduction, yes, you would be able to close at 10,000 parts per million.

Q. So really, the -- arguably, the person who's operating under the closure standards has just as much incentive to landfarm as efficiently as possible as does the person who's operating under the bioremediation endpoint study?

A. Yes, he has a motivation to meet the requirements of our regulations.

Q. But we monitor it more closely under the bioremediation endpoint approach?

A. We anticipate that we would certainly look at the bioremediation endpoint approach very closely because we have so limited an amount of experience. All of our experience was really just from observations made by the industry committee.

Q. Okay, thank you. Now I want to move to the chloride issue, which I understand was not in the area of your expertise, but you were asked some questions about it.

Chlorides tend to be very mobile, do they not?

A. They're considered to be the most conservative compound.

Q. And without regard to this vadose zone monitoring, after you close the landfarm and you quit -- the operators quit maintaining it and moved away, you would expect that whatever chlorides were in that treatment zone would migrate to some extent, would you not?

A. There's the potential for migration. They may wick in the treatment zone or the upper part of the vadose zone, back and forth, but there is the potential that they eventually could leach through the vadose zone and reach groundwater eventually.

Q. But there's definitely a potential that they will invade the vadose zone, is there not?

A. Yes.

Q. So it's not accurate to say -- Well, would it be accurate to say, as I understood Mr. Hiser to suggest, that because you have vadose zone monitoring, there's no need for chloride limitation in the treatment zone?

A. We don't agree with that.

Q. And I think I -- my last question, I think in answer to that you articulated the reason, but is there anything you would like to add to that?

A. We're concerned that chlorides pose a direct threat primarily to groundwater, and there also -- may or may not be good for the environment as far as soil texture and things of that nature. But we think ultimately it primarily goes back to waste management. They should not be putting chloride-contaminated material into a landfarm. That's not proper treatment.

Q. Now Commissioner Bailey asked a question about did we consult with experts within our department? And your answer indicates to me that something might have slipped your mind, because do you remember meeting in my office with a soil specialist from the Mining and Minerals Division?

A. I was referring to him when I talked about the issue of hydrophobicity.

Q. Okay, and do you remember him characterizing our chloride standards as conservative?

A. Yes, he did.

MR. BROOKS: Okay. Because of hearsay reasons, I'm not going to ask you any more about what he did or didn't say, but that's sufficient, I think, for the moment.

Okay, thank you. Pass the witness.

CHAIRMAN FESMIRE: We'll allow recross, limited to questions that were asked --

MR. HUFFAKER: Nothing.

CHAIRMAN FESMIRE: Nothing? Mr. Carr?

RECROSS-EXAMINATION

BY MR. CARR:

Q. In your redirect there were questions about rigorous sampling that was needed so you could more closely monitor sites where a bioremediation endpoint was being employed?

A. I believe that Mr. Brooks was talking about the issue of sound science and talking about a science experiment.

Q. My question really is, you were talking about the various kinds of samples and data that you needed, and you talked about being able to more closely monitor a site where a bioremediation endpoint is used; is that not correct?

A. That is correct, that we -- because of our lack of experience and competence in this matter, we're going to want to gain as much experience and initially -- Let's say that this became usual and customary practice, that we would gain experience, and after a few years we would not be so interested in observing the data.

Q. And right now that involves more rigorous sampling that might be required at a later time?

A. We're proposing the sampling protocols that we've specified in here, that the burden will be put on the operator to tell us in a sampling and analysis plan how much is necessary. We don't have a good feel for how much is necessary at this point.

Q. Mr. von Gonten, where is the rigorous sampling that has been employed in the current dryland landfarms, say, in Lea County?

A. I wouldn't characterize it as being particularly rigorous.

Q. And so what we have now is with the current method. You're not having particularly rigorous sampling, but we're doing that if we're going to go to a bioremediation endpoint?

A. That's correct.

Q. Have considered perhaps employing the same sort of standards or tests for an existing dryland landfarm to get some sort of a baseline to see what's going on, really, when you look at the two?

A. No, dryland landfarming, or the way it's been practiced, we are confident, works well enough. We haven't had a great deal of information on the treatment zone, but our impression is that it's been working pretty well, and we didn't propose any of those changes when we drafted Rule 53.G.

Q. The way it happens now is, they take the material, they put it out on the soil, and they till it, but they leave it for a period of time; isn't that right?

Isn't time one of the factors that is necessary for one of the dryland landfarms?

A. Yes, anecdotally it was related to me, is that after there's a rainfall -- they're very brief events -- that their operators will generally go right out to the field and till at that point. They may not be tilling on a specified schedule.

Q. If you -- You would agree with me, wouldn't you, that time isn't necessarily on your side when you're trying to effectively manage or deal with hydrocarbon-contaminated soils?

A. I believe my opinion that I stated was that it should have -- Excuse me, let me back up.

If you're limited by water but you're unlimited by time, there's no problem from the perspective of a landfarm operator to taking two or three or four times as long to achieve a closure standard as they would if they were required to use a lot of perhaps very valuable water resources to optimize the rate of degradation.

Q. But isn't it true that just with the passage of time, that hydrocarbons can be sequestered in the soils and not be available thereafter for bioremediation?

A. That is possible. I'm not familiar with that concept in detail.

MR. CARR: That's all I have, thank you.

CHAIRMAN FESMIRE: Mr. Hiser?

MR. HISER: Very few questions.

RECROSS-EXAMINATION

BY MR. HISER:

Q. Mr. Brooks asked a somewhat tongue-in-cheek question about marine environment and how much the marine environment is present in New Mexico, correct?

A. Yes, he did.

Q. And that is with reference to a study that was presented by Dr. Sublette, I believe?

A. I'm not familiar with the particular study that he's referring to.

Q. And so you don't -- do you then have any knowledge about why or why not that would have been appropriate to refer to that study?

A. No.

CHAIRMAN FESMIRE: Mr. Hiser, may I ask, are we going to get a version of that study or a presentation of that study later?

MR. HISER: Yes, you will.

CHAIRMAN FESMIRE: Okay, thank you.

Q. (By Mr. Hiser) This is just an informational question. Does a bioremediation endpoint landfarm operator have the ability to switch at some point and just meet the regular closure standards?

A. We have no experience, and so we haven't addressed that particular contingency. I guess we'll have to deal with that on a site-by-site basis. But I would imagine that if you decided to say that your dedicated cell was no longer going to be dedicated to that approach, that you could continue to operate under G.(7) -- I mean, excuse me, G.(1) through G.(7), all the requirements for a landfarm other than G.(8).

Q. Well, why wouldn't it be appropriate for a bioremediation operator to switch to a standard, why don't you believe your closure standards under G.(6) are protective?

A. I'm sorry, state that again, please?

Q. Why wouldn't it be appropriate for a bioremediation operator to simply switch to the G.(6) standards if you believe those are protective?

A. I believe that he would be able to.

Q. Have you evaluated what the difference in cost would be between a dryland and a bioremediation endpoint under the standards proposed by the Division?

A. No, we have not undertaken any cost analysis.

Q. And I believe your testimony has been that the Division has found the -- as you call it, the usual customary dryland farms to be satisfactory in terms of hydrocarbon removal in New Mexico?

A. We have not closely scrutinized the landfarm operators, but our impression to this date has been that they are operating appropriately.

Q. And what is it about the bioremediation endpoint landfarm that would make it less protective than -- not talking about closure standards but just in general, what is it about the bioremediation endpoint operation that is different from the dryland operation that makes it of such greater concern to the Division?

A. Our lack of familiarity. We think that the approach as proposed is an excellent one. It actually would maximize it. We would anticipate, based on our data, that the bioremediation endpoint approach would achieve much less than -- before they achieve that rate of reduction approaching zero, that they would achieve much better degradation rates than we've observed.

Q. And so the concerns that you've expressed are not that you think that the endpoint that -- an appropriate endpoint would be achieved; it just is simply that you're not certain about what you're going to see?

A. We have no experience with this approach, and that is our primary concern.

And our concern also was that we saw a potential loophole in that someone may take some waste, apply it and say, I'm going to use the bioremediation endpoint approach, and not be able to achieve meaningful degradation, but -- achieve a rate of reduction of zero and walk away from that site. That would be disposal, not treatment, in our opinion.

MR. HISER: No further questions.

CHAIRMAN FESMIRE: Dr. Neeper?

DR. NEEPER: No questions.

CHAIRMAN FESMIRE: Okay. Anything from the Commission?

COMMISSIONER BAILEY: (Shakes head)

COMMISSIONER OLSON: (Shakes head)

CHAIRMAN FESMIRE: Okay, Mr. Brooks, I guess we're done with this witness.

MR. BROOKS: I believe so.

CHAIRMAN FESMIRE: And as I understand it, that's the end of your case?

MR. BROOKS: Except for some observations at the time of closing argument, that concludes the Division's presentation.

CHAIRMAN FESMIRE: Mr. Huffaker, yours was complete last week, wasn't it?

MR. HUFFAKER: It was.

CHAIRMAN FESMIRE: So Mr. Carr, do you or Mr. Hiser want to go first?

MR. HISER: If it please the Commission, what we thought we would do from the industry committee's perspective is just provide a very brief sort of overview of the areas where there is some disagreement between where the industry is and where the Commission is and the staff is, because that's not always easy to distinguish, and then turn it over to a series of our experts to actually make the technical presentation.

So the first presentation will be in the nature of just a demonstrative thing about these are what the issues are.

CHAIRMAN FESMIRE: Okay. Why don't you go ahead and begin then?

Is it going to take you few minutes? Would now be a good time to take a...

MR. HISER: Yeah, if you wanted to break for five minutes.

CHAIRMAN FESMIRE: Okay, why don't we go ahead and take the afternoon break for 10 minutes?

MR. BROOKS: We may end up needing another afternoon break before it's over with four more hours to go.

CHAIRMAN FESMIRE: I think that will depend on the Commission's break expert.

(Thereupon, a recess was taken at 2:06 p.m.)

(The following proceedings had at 2:17 p.m.)

CHAIRMAN FESMIRE: At this time we'll reconvene Case Number 13,586. Mr. Hiser, I believe you were up?

MR. HISER: Thank you, Mr. Chairman, members of the Commission.

As I indicated right before the break, the industry committee wanted to start off just by providing a little bit of an overview of where the committee was coming from, highlight for you areas of agreement that have been reached between the industry committee and the staff, which are substantial in number, and then just sort of highlight for you where the areas of principal disagreement are. We thought that that would be useful to the members of the Commission in terms of, as you hear the subsequent testimony, to really identify those areas where there's disagreement between the various parties.

It's also useful just to remember who all is the industry committee members. This slide represents the six -- I think it's 15 companies that are part of the industry committee: BP America Production Company; Burlington Resources Oil and Gas; Chesapeake Operating; Chevron, USA; ConocoPhillips; D.J. Simmons; Devon Energy; Dugan Production Corp.; Energen Resources; Marathon Oil Company; Marbob Energy Corporation; OXY USA; Occidental Permian; and OXY USA WTP; Williams Production Company; XTO Energy; and Yates Petroleum Corporation.

And I would hope that the Commission would take note that getting this many oil companies to agree on anything deserves some consideration, so...

We have been working together to try to come up with our recommendations, and basically the goals of the industry committee are to encourage the Commission to develop a regulatory program that's supported by sound or good science, to develop regulations that support the treatment of hydrocarbons and hence the long-term minimization of those risks, rather than simply warehousing them for future generations, and finally to develop a simple, straightforward risk based regulatory approach that facilitates proper waste management.

And the way that the committee is recommending that you do that -- and we're primarily focused, as the Commission has probably gathered by now, on the idea of landfarming -- is to look at three different types of landfarm situations.

The first is the small landfarm, very similar to what the Commission staff is proposing, which would be limited in size, would be temporary, and it's limited in terms of only accepting soils. And as the staff has pointed out, this tends to present a much more limited risk and is subject to a set of regulatory standards that are deemed to be protective.

For Tier 1 commercial or centralized landfarms, these are more permanent facilities, but they're also limited in the materials that would be accepted and present similarly limited risks and are hence subject to a more moderate regulatory review.

We're also regulating a Tier 2 approach, and in this the industry committee differs from the proposals of the OCD staff. And a Tier 2 approach would be a similar longer term landfarm, but one that could accept any treatable oilfield waste that may have less of a known risk or unknown risk and are hence subject to a more stringent regulatory review.

And for these landfarms what we're really hoping for is that the Commission will adopt a set of limited site-specific provisions that would allow some more flexibility without forcing everything into the exemption procedure under section K. And that's just because of the amount of burden that an exemption procedure places, not only on the industry but also on the staff which as to prepare for those provisions, for you as the members of the Commission that then have to sit through the hearings on them, and also on the public which has to then review a whole series of these things and determine which of those are worthy of review in the participation.

In terms of industry and OCD agreement, there are a lot of things that we agree on. We both agree that the bioremediation of hydrocarbons is desirable. It reduces toxicity, reduces the risk to fresh water, public health and the environment.

We agree fundamentally with the regulatory approach, with having small landfarms that are subject to a less stringent regulatory program, and then permitted landfarms which are appropriate for more stringent. And we strongly support the exemption of waiver process that the staff has built into subsection K.

We are in fundamental agreement with all the siting restrictions and requirements that the staff is proposing. After discussion, we felt that those are all appropriate and that they are do-able and workable and implementable from the industry's perspective.

We agree with the chloride loading approach, although not necessarily the exact numbers that the staff is approaching, but we agree that looking at chloride loading is an appropriate way of evaluating potential risk to fresh water.

On operational requirements, we find that we are in agreement with most of the operational requirements, and our testimony presented primarily by Dr. Sublette will talk about a few areas where there's disagreement.

And we don't disagree with much of the oilfield waste segregation and waste management and the handling of tankbottoms that the staff has recommended to the Commission for its consideration. In a few cases -- for example, our Tier 2 -- we have recommended that perhaps those segregation requirements be relaxed somewhat, but it's always with a corresponding increase in the monitoring and other protective measures that are being advocated by the industry at that time.

On the treatment zone and vadose zone, monitoring sampling schedules, we agree basically with the proposed monitoring schedule. There's some disagreement about where and some question in our mind about what purpose treatment zone monitoring zone serves, that Dr. Sublette will address with you.

And lastly we support, obviously, the bioremediation endpoint concept and basically the approach that's being taken for closure, although we have some question about the choice of the DAF 1 as being the primary driver for that.

Where then are the areas of some further discussion or disagreement?

I think the first is the idea of a Tier 1 or Tier 2 approach. The staff has favored a cookie-cutter or exemption approach, so sort of one size fits all, or else go for an exemption. The industry favors that cookie-cutter for a Tier 1, with a site-specific intermediate phase that would hopefully result in fewer things coming to the Commission in an exemption hearing.

On background testing we have some disagreement about which constituents are really of concern and the depth, and that has to do with how a landfarm actually operates, and how implementable that would be in practice.

On the operational requirements, we have a significant heartburn with the 80-percent reduction requirement. And Dr. Sublette will be addressing the reasons why that is specific to New Mexico.

On treatment zone monitoring, we don't believe that this is necessary, and that it doesn't serve any real point, because we're already monitoring what materials come into the landfarm, and we monitor it at closure. So we're not sure, outside of the bioremediation context, what advantage is gained from that intermediate monitoring of the treatment zone.

Lastly, on the corrective action approach, our proposed standard, you can see there, would be to use the highest of the practical quantitation limit, the background or the most stringent of the NMED residential or the DAF 20 SSLs.

And then for the small landfarms basically there is substantial agreement, with the exception that we believe slightly larger size, and the industry committee's recommendation to the Commission would be basically a two-acre small landfarm with a maximum depth of two feet, very similar to what the staff is proposing for that. And there's some minor disagreements on the TPH loading and how that is calculated, and once again Dr. Sublette will be providing that.

This next one just really puts those on the table to help you think about, you know, as you compare one or the other, cookie-cutter versus Tier 1, Tier 2. The chloride limits, where we agree on Tier 1 with what the staff has proposed, but for Tier 2 we propose that we use the models. And you've seen many of those models presented by Mr. Price. Dr. Stephens from the industry will present more modeling information and show you that that is a readily available tool that can give good information.

We have significant heartburn on the 80-percent TPH reduction, and we'll talk about the true bioremediation endpoint.

And also the industry committee now recommends a one-percent total residual TPH limit. And for those who are not used to the conversions from percentages to p.p.m., that would be essentially a 10,000-milligram-per-kilogram limit.

And lastly, we'll talk about the closure in some considerable detail. And Dr. Thomas, who's a risk assessor, will present some information about that to the Commission.

With that, I'm going to briefly turn to the three experts that the Commission will be hearing from. The first will be Dr. Dan Stephens. He is our expert in infiltration, vadose zone and groundwater issues, and he will be speaking extensively about the chloride issues, the chloride modeling, and work that was done by Mr. Price and his staff, will also talk to some extent about how that influences hydrocarbons.

And we also thought, and hope that the Commission will find it valuable, that it would be useful if we put that in the context of New Mexico, because we've seen, you know, things from northern Canada, we've seen things from Louisiana and all that. Well, what actually happens here in New Mexico, and how does that influence the Commission's decisions? And so Dr. Stephens will provide you a little bit of that New Mexico-specific context to help make your decision.

Dr. Kerry Sublette is our landfarming expert. He will talk about landfarming hydrocarbons and the extensive experience that he has in that. He will also give you an overview of the peer-reviewed literature. And as Mr. Carr pointed out, this is not a new area, but we actually have some decades worth of scientific and peer-reviewed studies on this. And he'll provide you with an overview of that, so that we hope by the end of his presentation you'll have a good feel for what bioremediation can and cannot do, what areas of toxicity it can eliminate, and what is the impact of other constituents on the bioremediation and how that would be handled in the landfarm context.

Dr. Ben Thomas will then be our final witness for the industry committee, and he'll be talking about how we use risk to reach appropriate decisions in developing a regulatory program, because you as the members of the Commission are really being asked to make a risk management decision for the citizens of New Mexico, and he will talk about the standards that are standard frameworks that we use to try to reach those decisions and help try to place each of these different things within that context in a way that we hope will help you reach a final decision on what would be the best regulatory approach.

And that will be the presentation of the committee, on behalf of the industry.

And Mr. Chairman, that completes our sort of brief overview, and we are ready to call our first witness, which will be Dr. Dan Stephens.

CHAIRMAN FESMIRE: Dr. Stephens? Dr. Stephens, were you here the day the witnesses were sworn?

DR. STEPHENS: Yes, sir.

DANIEL B. STEPHENS,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HISER:

Q. Dr. Stephens, would you state your name for the record, please?

A. Daniel Bruce Stephens.

Q. And could you explain to us your educational background and some of your work experiences?

A. I have a bachelor of science degree in geological science from Penn State University, I have a master's degree in hydrology from Stanford University, and a PhD in hydrology from the University of Arizona.

I've worked in between getting degrees, and after I finished my doctorate I went to New Mexico Tech. And I was a professor at New Mexico Tech for ten years, and for about three of those years I was chairman of the geoscience department. And during the time I was a professor I taught a number of different hydrogeology courses and did a lot of research on hydrology and desert environments, particularly related to recharge in natural environments.

I've published 30 or more papers in peer-reviewed professional journals, written several chapters for books, and I wrote one textbook called *Vadose Zone Hydrology* about -- oh, ten years ago now.

And began a consulting practice after -- during the time I was a professor, and that's pretty much what I do right now. We have a company in Albuquerque called Daniel B. Stephens and Associates, and there's about 100 people in our company, do mostly environmental and water-resources-related consulting.

Q. And Dr. Stephens, how much of your work has been done in the New Mexico area?

A. My research -- most of the research that I've done is in New Mexico, a lot of project-related work throughout the whole country though.

MR. HISER: Mr. Chairman, the industry committee would tender Dr. Stephens as an expert.

CHAIRMAN FESMIRE: Any objection?

MR. HUFFAKER: No objection.

MR. BROOKS: No.

DR. NEEPER: No.

MR. CARR: (Shakes head)

CHAIRMAN FESMIRE: From the Commission?

COMMISSIONER BAILEY: (Shakes head)

COMMISSIONER OLSON: (Shakes head)

CHAIRMAN FESMIRE: Mr. -- Dr. Stephens is so accepted.

MR. HISER: Thank you, Doctor -- thank you, Mr. Chairman.

Q. (By Mr. Hiser) Dr. Stephens, could you -- sort of as Mr. Brooks said, could you maybe give us an overview of what you're going to be talking about and set the groundwork for how we should think about hydrology?

A. Well, the testimony that I'm going to give is kind of highlighted herein these five points, the first of which deals with natural processes and how moisture moves in dry climates. I'll talk about how slow that water can move, a little water moves through the soil below the land surface.

I'll talk about the waste acceptance criteria and the need for flexibility there to allow for consideration of site-specific conditions.

I also have reviewed the information that's been available and find that the proposed monitoring strategy is on the excessive side, in my view, and the proposed soil-corrective action trigger is unreasonable, as are the closure criteria for the treatment zone and the landfarm.

MR. BROOKS: Mr. Chairman, I am not finding this slide in my book. And I'm not objecting, I'm just -- want to ask, is this a new slide, or is there something that has been -- or am I overlooking something.

MR. HISER: As far as we know, Mr. Chairman, all these have been provided. Were they in the Commission's book?

MR. BROOKS: This is the slide that I have, that's entitled Summary of Testimony. It has -- It has only three points, as opposed to five, and some of them are different. I'm not objecting, I just want to know if I'm -- if I should be looking somewhere else in the book.

(Off the record)

MR. HISER: Well, Mr. Brooks, if you could let us know if there's substantial differences --

MR. BROOKS: Yeah, assuming --

MR. HISER: -- and we can try to find --

MR. BROOKS: -- assuming that this is the only slide -- that this slide is the only difference, I have no objection.

You may -- my next -- the next slide in my book is entitled Natural Recharge.

MR. HISER: That's what ours is as well.

MR. BROOKS: Okay, well, I imagine it's just --

MR. CARR: I have one with three bullet points.

MR. HISER: Well, we are mystified.

(Laughter)

MR. HISER: It was not our intent to change at all.

CHAIRMAN FESMIRE: Yeah, ours has three bullets also.

MR. HISER: Okay. Well, hopefully we'll be back on the standard one with everybody else, and --

THE WITNESS: Pretty much the same material.

MR. HISER: Pretty much all the same material, so...

CHAIRMAN FESMIRE: Okay. You know what it is?

MR. HISER: What?

CHAIRMAN FESMIRE: Go back one. No -- well, if you add the two of them you get five bullets, but they're not the same.

MR. HISER: Yeah, I'm not sure. We definitely did not change anything, so it's a little bit surprising.

But anyway, with that object- -- with that comment noted, Mr. Brooks, let us know if there's anything else that's different, and hopefully there won't be.

MR. HUFFAKER: And may we have a copy of this one --

MR. CARR: Yes.

MR. HISER: Yes, absolutely.

MR. HUFFAKER: -- tomorrow at the latest?

MR. HISER: We certainly can.

Q. (By Mr. Hiser) Dr. Stephens, could you talk to us about the different ways that the groundwater in New Mexico may be recharged?

A. Well, there's classified as three different types of recharge processes, and by recharge what I mean is water that migrates downward below the land surface, through the soil, and reaches the water table and adds water to the aquifer.

There's three general types of mechanisms. One is mountain front recharge, another is local recharge, and another is called diffuse recharge. And a number of slides that follow illustrate these processes.

Q. Okay.

A. This is a picture that shows mountain front -- or snowpack in the mountains.

Maybe he's got the wrong file.

MR. HISER: I may have the wrong file. Let's see if we can do that, if it would be okay with the Commission?

CHAIRMAN FESMIRE: Sure.

THE WITNESS: Yeah, I think something is missing here.

CHAIRMAN FESMIRE: This obviously isn't a recent picture in New Mexico, is it?

(Laughter)

THE WITNESS: No, that -- Actually, that was in California, I think. That was a backpacking trip in the Sierras.

MR. HISER: There we go, this one has three, and hopefully that agrees with everybody's summary.

THE WITNESS: Okay.

MR. HISER: All right, and that's an operator error on my part, and I apologize, I got the wrong file.

THE WITNESS: Okay, so you all went through the definition of groundwater recharge on there too? That was a slide?

MR. HISER: Yes.

CHAIRMAN FESMIRE: Yes.

THE WITNESS: Okay. All right, so here's one of the types --

DR. BARTLIT: Could this be the right version of the original --

MR. HISER: Oh, yes.

THE WITNESS: Do you want back up and do them all again? All right.

Q. (By Mr. Hiser) This is the correct version.

A. The condensation, even a broader here, is that small landfarms pose low risk, flexibility should be afforded operators who utilize site-specific data, and the regulation should be internally consistent, reasonably protective and implementable.

Okay. So this is mountain front recharge where snowmelt occurs. As the water drains from the mountain it infiltrates the alluvial fans, and that water, then, replenishes the subsurface aquifers.

This is not an area, by the way, where we would put a landfarm.

Here's another area where we would not put a landfarm, areas where there's local recharge. Local recharge occurs basically where there's topography that allows water to concentrate and pool. In New Mexico we have arroyos, we have playas that concentrate the surface runoff.

And just as an illustration, the top figure shows the Rio Puerco, the South, which is around Bernardo area, and this is a fairly typical pattern for flowing water, at least to local recharge.

Below that is a thunderstorm kind of event -- actually, this is from central Arizona -- just showing a flash flood and an arroyo, and then it's a fairly temporal process that leads, nevertheless, to recharge of groundwater. These are not areas where we'd want to put a landfarm.

Q. And so, Dr. Stephens, the existing prohibition that's in the proposed Rules that would locate a landfarm at least 200 feet from these areas or 500 feet from a wetland would help achieve that result?

A. Yes. There's a number of factors that affect natural recharge. And this is a photograph I took from a sand dune on the Sevilleta National Wildlife Refuge that shows some of the variability in these factors that affect natural recharge.

For instance, you can probably get a sense that -- We're on a sand dune, obviously, but in the middle background is a strip of more dense vegetation. That's the Rio Salado. So there's alluvial materials along the Rio Salado that are different than dune sands. So there's a textural variation.

And the Rio Salado flows, the coarse sediments that form the bottom of that allow rapid infiltration and recharge to occur there.

Then there's a vegetation density effect. There's little to no vegetation on the sand dunes, so there's not much opportunity for the water that infiltrates to be extracted out except by direct evaporation. Whereas you can see on the floodplain of the Rio Salado probably 50-percent vegetation cover. Mostly saltbush in that picture, but on the active floodplain of the Rio Salado you see a lot of salt cedar, fairly well, heavily -- densely populated with vegetation except in the most active portions of the channel.

So this is a landscape that leads to variability in natural recharge due to a number of those factors.

Next? Okay.

Q. And could you summarize, then, some of the proposed siting requirements for landfarms that would impact their likelihood of affecting recharge?

A. Well, the siting requirements, I think, that are established would require a landfarm to be 200 feet from a watercourse. An active channel, an arroyo, for example.

And in effect, because you're not on an active channel in a floodplain or in an arroyo, you would be in an area where there would be diffuse natural recharge. Now my comment on that diffuse natural recharge, that is areas between channels where there's rain that may fall in wide areas and percolate down very slowly without any significant ponding or channelization or pooling of the water in local areas. And so this diffuse recharge, if you will, the quantity of it depends on a lot of factors, the vegetation, the soil and the topography, for instance.

And what people find, we go out to the field and do research on natural soil water movement, is that in many areas the water moves downward. And that would ultimately become recharge. But in some areas, water can move upward from the water table to the land surface. And likewise, there's some places where we don't find much water movement at all.

Q. Now Dr. Stephens, before we move off this slide, are all watercourses equal, or is there a difference between, say, a larger arroyo and a small erosion rill that might be found in a field, in terms of their impact on recharge?

A. Well, I wouldn't consider the rills, that you might see a little erosional rill, so to speak, as an area where I would look for focused recharge or localized recharge. I would look underneath well established, incised arroyos.

Q. And so if you were to be recommending to the Commission on siting restrictions a watercourse thing, you would think that we could look at the more established arroyos rather than temporary or transient features that might be present?

A. Right, some -- like the pictures I showed of the flash flood in Arizona and the Rio Puerco. The Rio Salado would be another good example.

Q. Would you like to give some examples of sites with diffuse natural recharge?

A. Yeah, here's one -- I'm sorry the lighting is kind of washing out some of these photographs, but actually you could see this site from the sand dune that I took a photograph of the Rio Salado area. That's the one that we have there.

CHAIRMAN FESMIRE: And that's --

THE WITNESS: Maybe it's in the back. At any rate -- Maybe it's behind the screen.

At any rate, I'll go on.

The Sevilleta National Wildlife Refuge had a variety of vegetation types, and this is pretty much a saltbush community, fairly common plant in New Mexico. Some consolidated sand here. The rainfall is about 200 millimeters per year.

And we set up some instrumentation in the least vegetated portion of this plot. You can see we've sort of been surrounded -- the instruments, little white caps, are neutron probes, intensiometers, a little weather station there, an evaporation station and so on. And we looked at the water balance and all that, primarily in the less vegetated part of this area.

And what we came up, using a variety of techniques, was a recharge rate of 2.5 to 8.4 millimeters per year.

Q. (By Mr. Hiser) And you also looked, then, at another site in New Mexico?

A. Here's one that -- yes, this is -- it's called the New Mexico State University ranch site. It has a slightly different texture, this is a sandy loam. And you can see some carbonate zones, they're the white bands in the trench that you can see there. They're kind of what you'd consider paleosoils or ancient soil horizons which accumulated carbonate, like a caliche, an early stage -- an earlier stage of caliche development. The grass and yucca and shrubs comprise the vegetation community.

There's about 230 millimeters a year. And the estimates of recharge here by Phillips and others -- Fred Phillips is a professor, distinguished reputation at New Mexico Tech, and especially in this area. He and his students and colleagues found about 1.5 to 9.5 millimeters per year of recharge occurring naturally.

And this is a site which, by the way, you can see -- the vegetation isn't all that dense. It's scattered shrubs and light grasses, but there's a mix of some bare soil as well.

Q. Are you aware of any sites in New Mexico where the groundwater actually flows upwards, instead of downwards?

A. Yeah, in fact, we worked on one in the Sunland Park area. It was an area where there was to be a landfill, a solid waste landfill, sited. And we found this particular -- it had about eight inches of rain, had about 50 inches of potential evapotranspiration, more consolidated sediments underneath it from the Santa Fe group and creosote vegetation.

Unfortunately, I don't have a picture of this site, but in this area we had some samples and determined their metric potential and concluded that, in fact, the evidence showed an upward gradient from depths of almost 40 feet. And this was a publication with Larry Coons and myself in 1994.

Q. And Dr. Stephens, what is the effect of those conditions on how we see chlorides in the subsoil, and can we use that chloride to help tell us about the way the water is moving through the ground?

I guess I skipped --

A. Yeah, I think you -- Before we get to that --

Q. Before we get to that --

A. -- let me summarize just quickly what we've just gone through, important points here being that vegetation is very important in evaluating recharge. The amount of recharge that we see in these diffuse natural -- where diffuse natural recharge occurs is on the order of millimeters per year. And that the landfarms are likely to be sited in such areas, where there's very low natural recharge occurring.

COMMISSIONER BAILEY: You're switching between millimeters and inches per year --

THE WITNESS: Yeah, I'm sorry about that.

COMMISSIONER BAILEY: -- on some of these slides. Could you standardize?

THE WITNESS: I could. It's 25 millimeters to the inch.

COMMISSIONER BAILEY: Thank you.

Q. (By Mr. Hiser) Okay, going back to my question, then, Dr. Stephens, could you talk to us a little bit about how these processes resolve the not seeing the chloride in the soil and what we can tell from looking at the chloride in the soil about the water behavior in that area?

A. Sure. Here's a study that was done by people at the US Geological Survey and the Texas Bureau of Economic Geology in 2004, and they looked at soils that scatter from California to west Texas and looked at the chloride distribution that occurred in natural environments.

I may try to use my light pointer, I hope I don't hit the gentleman in front of me.

But this -- the top two graphs show the chloride concentration as a function of depth below land surface. And on the left it shows sites from the Amargosa Desert in Nevada and Yucca Flat in Nevada, and on the right it shows Eagle Flat in Texas and a site in the High Plains, the Ogallala, in Texas.

It's interesting about both of these that at a depth of about three meters -- that would be about 10 feet or so -- we find a large concentration of chloride and, below it, low concentrations of chloride. So this is what has been called the chloride bulge.

We'll just focus on the top two pictures; but those who are interested in the bottom two pictures, it basically shows soil water potential, which is the dryness of the soil. And the more negative the soil water potential, the drier it is. And what you can see, those of you who really care about this sort of thing, this would be down around the wilting point of the plant. So it tells you that the desert plants are really active to depths of just a few meters, and they're taking out a lot of the moisture in that zone. And it's the same zone where the chloride concentrations are very high.

CHAIRMAN FESMIRE: What's a wilting point?

THE WITNESS: The wilting point is the suction of the soil at which the plant roots can't out-compete the soil for holding onto that water, and as a result the plants wilt. It's -- you know, it really works like -- you have a plant root, and it has a soil solution inside, and the plant root is like a semi-permeable membrane with a salt solution inside of it. And it creates what's called osmotic potential that will cause the fresh water outside to move into the root. And once that suction gets so low outside the plant root, because it's dry, there won't be any potential energy difference to get the water from outside the root across the semi-permeable membrane and into the root zone.

CHAIRMAN FESMIRE: Okay.

THE WITNESS: So the plant wilts.

These chloride profiles as a function of many different things, one of which is the texture of the soil, another is the amount of moisture that was applied, or the amount of moisture in the soil, rather, the vegetation type or its rooting depth, the amount of evapotranspiration for that particular plant.

Also you might guess that the amount of chloride that accumulates in a soil profile depends on how much water falls on the soil and how long that water has been applied to the soil surface.

Also it's a function of the proximity to oceans. The reason I bring this point up is that in the rain that falls there's about .3 of a milligram per liter of chloride that comes naturally, and the farther you are -- in this area. And the farther away you are from the ocean, the less chloride there is in the rainfall.

So it's kind of like sea salt that gets entrained in the winds and so on that is in small amounts, part of the rain that falls on the landscape. But over tens of thousands of years, or thousands of years, that small amount of chloride gets concentrated in the soil and creates a bulge. I'll explain a little bit more about that in a second, but the concentrations that you can see as a consequence of this process in a dry desert environment lead to natural chloride concentrations of up to 540 milligrams per kilogram at depths as shallow as about three feet.

One of the useful tools that the chloride profile affords is a means of calculating recharge, actually, and it's called the chloride mass-balance method, and it's just one of the techniques -- I won't get into it in any detail, but it's one of the techniques that is used to compute natural recharge that I showed you previously, Fred Phillips and others and so on, have used to compute natural recharge.

Q. (By Mr. Hiser) And so are these chloride bulges common in New Mexico?

A. Yes, this slide shows some sites in New Mexico where we looked at chloride bulges, if you will, in the -- well, you can see in the left-hand column, from the high plains through the San Juan Basin. And there's similar patterns.

The peak seems to occur at depths between, you know, two to 30 feet or so. The concentrations, if you computed the pore water concentration, would be perhaps up to 9000 milligrams per liter.

The peak concentration in the soil, if you took a soil matrix sample, would be different than the pore water sample. You'd get up to the 540 milligrams per kilogram. So this is a phenomenon that occurs throughout the southwest and in arid environments.

Well, to just summarize briefly how the -- what the interpretation of this is, if you're curious, is that 10,000 years ago we had quite a bit of rain, in the pluvial times. It was a different climate. We'd maybe like to go back to those days, use some recharge.

But about 10,000 years ago the ice age ended, and we became a little warmer and drier in our climate, and as a result there's less infiltration occurring. And so there's more uptake of water by the xerophytic plants, those plants that are like the -- that we find out here in New Mexico now.

So what we see is, from the bulge -- the water below the bulge, the soil moisture below the bulge, being low in chloride concentration, reflects generally older water that came in during the times of high rainfall and lower relative evapotranspiration. The chloride bulge is a reflection of the fact that the evapotranspiration dial is turned up, leaving a mechanism to just concentration that small amount of chloride that came in at .3 of a milligram per liter in the rainfall. It just continues to recycle and build up in there, leaving very little of the water to percolate downward.

Q. And so the bottom line is that as a result, we see a relatively small amount of water that actually passes through the root zone where it can then go down into the lower water table?

A. That's correct. I want to bring up one other thing. I didn't -- I didn't include a slide on this one, but there is another interesting study done by Bridget Scanlon and -- I've forgotten the other author, but they studied the distribution of natural soil water movement in west Texas around playas and between playa lakes. And what they found was that in these inter-playa areas, the areas of diffuse natural recharge, you could explain those chloride bulges best by upward moving water over long periods of time, thousands of years.

Q. So this is some information that you compiled, then, about the use recharge rates in the Southwest, and what does that tell you?

A. Well, I've summarized some of these studies -- there's one I didn't mention, that I probably will here -- just to give you an idea that there's a lot of consistency here. We're talking about studies throughout New Mexico where we see recharge rates of millimeters per year or less. In fact, that one study I mentioned that Scanlon worked on in the inter-playa areas in Texas was finding some recharge rates of the order of a third of a millimeter per year, something like that.

So pretty much a variety of researchers have come to pretty much the same conclusion, that natural recharge rates in areas of low precipitation are indeed very small.

Q. Now two of these, the ones at the bottom on the Ogallala aquifer in Portales and the one in Lea County, show somewhat higher rates. And is there a methodological difference, or why is there a difference for those?

A. Well, I think the Ogallala aquifer study at Portales that C.V. Theis did in 1937 and the Ogallala aquifer study by the USGS, Doug McAda, in 1984 -- these are regional studies, they're not local experimental plots like the ones I and my students worked on in Socorro and some of those Fred Phillips worked on as well.

So the larger the area, the more likely it is you're going to include some of those areas where there's localized recharge and flash-flooding that adds more water to the whole basin than would have occurred if it was only diffuse natural recharge. So you end up with a basinwide number that has perhaps some higher amounts of recharge that occur locally, but those wouldn't be areas where we'd put landfarms.

CHAIRMAN FESMIRE: Is that *the* Dr. Theis, the Theis equation?

THE WITNESS: You know, he didn't have a PhD.

COMMISSIONER OLSON: Oh, really.

THE WITNESS: I don't believe he did. But that is C.V. Theis, indeed, that's the man.

Q. (By Mr. Hiser) And if the recharge is as you identified here and with these numbers of millimeters per year, what does that tell us about travel time of constituents that may be dissolved in that water?

A. It's very slow. And I've just taken a simple example here where -- Let's assume we had a nominal amount of net infiltration. Net infiltration would be the water that falls below the root zone. It's not precipitation, it's not the infiltration across the land surface; that would be a much greater amount. But as the soils and the roots and the vegetation take the water out, some might escape out the bottom. That we call deep percolation or net infiltration.

And that would be -- Let's assume that that's a millimeter per year. Let's assume that the water content is 5 percent, assume we have 50 feet to the water table. Simple Darcy calculations, basically, with a unit hydraulic gradient, would tell us that it takes maybe 760 years for that moisture to move to the water table, if the gradient is in fact downward. So a long time.

CHAIRMAN FESMIRE: Is that linear? I mean, if net infiltration is 10 millimeters per year, will it take

76 years?

THE WITNESS: Correct.

Q. (By Mr. Hiser) And how does the vegetated surface affect the rate of discharge -- or rate of migration?

A. Well, under natural conditions we see the more vegetated the site, the lower the net infiltration. And likewise, it's -- this kind of concept or what we see in nature is relevant to how vegetative covers may be put on landfarms, because the more vegetation that goes in on top of the landfarm, the less moisture is going to be available for net infiltration and lower potential to have water from the landfarm move into the vadose zone that underlies it.

Q. Would that be true of a landfill cover as well?

A. Yes.

Q. Can you explain to the Commission what these charts are showing us?

A. This is probably one of the very first numerical models of simultaneous transport of water and salt that I'm aware of, done by an Israeli named Eschel Bresler in 1972, and it's a little -- perhaps a little complicated, but I think it illustrates some points. I know Bill -- Bill understands all this.

But the -- This is some experiments on bare soil. And on the upper left we have water content as a function of depth, and this is in response to infiltration. That is, there's some ponded water such that the soil at the surface is at porosity, 100-percent saturated, so it would be like 42-percent water content. And the wetting front moves down to some depth here, about 15 centimeters, and then you have the dry soil down below. So this would be the wetting front.

Now you have a layer of salt in this model, and so what you can see happened to that layer of salt during the process of infiltration is, the salt that was on the surface is now displaced and moves down to the wetting front, just behind the wetting front. That's in here. So this is a process of infiltration and the displacement of saltwater downward.

The next process that's important to understand is redistribution, and redistribution means that two things are happening simultaneously in the soil. First is that one part of the soil is draining and the other part of the soil is wetting. And that's what happens here near the soil surface. You can see in this next sequence, time, the water source is cut off, the soil near the land surface at shallow depths is drying out because the water content had been 42 percent, now it's down to 20 percent.

But the soil at depth -- here is 15 centimeters, this was 15 centimeters. The soil at 15 centimeters, which is here, has now gotten wetter. So that's -- demonstrates redistribution. And the salt hasn't moved all that much, down to about 40 centimeters or so.

That's the second important process, and it tells you that you can add water to the near surface and you can see the upper part drain, but the lower part will still infiltrate.

Then evaporation occurs, and the whole profile begins to dry. And nevertheless, as the whole profile is drying there's still water movement downward, and this is due to -- there's evaporation allowed out the top and gravity allowed to pull water downward. So this is --

COMMISSIONER BAILEY: Do the scales on the left match the scales on the right?

THE WITNESS: Yes, left and right do. But notice there's a scale change here from the first to the second and third rows. The first row has -- this is five centimeters, here to that first division, and it's 20 centimeters there.

I think this is a relevant slide to understand, in part because of some testimony that I heard today, in fact, is that there's no water movement at water contents field capacity -- or 80 percent or 60 percent of field capacity. That's just not true. This is highly relevant to the mechanism by which landfarms operate. And I'll get into this later on, but I hope you keep this slide in mind, that when you apply water to the surface it continues to move both upward towards the land surface and evaporate, and it can continue to move downward by gravity.

Something else that I anticipated might be an issue here was that water that's in the soil gets so concentrated and salty that it becomes a dense liquid, and as a result of that high density, it will start to sink like a rock or dive like a submarine. And I don't believe that's true.

It is true if we calculate the concentration, let's say, of the pore water -- if chloride were 1000 milligrams per kilogram, which is what you're proposing as a limitation, and let's say we had a sand -- and I'm using about 4.5-percent water content, which happens to be halfway between the wilting point and field capacity. It has a density of about 1.035.

Now 1.035 is a little bit more dense than seawater, perhaps, but it's still only three percent above the density of freshwater. That's not very much, that's not a big buoyancy contrast. Three percent is not a significant buoyant force.

More importantly, even if we were considered -- we did want to consider this as a significant mechanism, at 4.5-percent water content, the hydraulic conductivity at that water content is about 10 million time smaller than the hydraulic conductivity of a compacted clay liner in a landfill, in a solid waste or hazardous waste landfill. At $5X10^{-14}$ centimeters a second it would be like concrete. So there's very, very slow water movement when you get down to these low moisture contents in sandy soils.

In silty loams, on the other hand, they can retain a lot more water and they'll have a higher hydraulic conductivity, but the density isn't very great because the concentration factor isn't as significant.

Q. (By Mr. Hiser) And so that means that you wouldn't expect this water to fall any faster relative to other water?

A. No, not significantly.

Q. And so based on these observations, what does that tell us about the type of groundwater infiltration that we might see moving through a landfarm in New Mexico or the southwest?

A. Well, these points kind of summarize that -- first of all, that recharge is low in diffuse areas of natural recharge in the Southwest. Where we do have diffuse recharge under natural conditions, the travel time to the groundwater is very, very long. The more vegetation, the lower that amount of recharge and the slower the travel time.

And the last point is, I don't think we need to be concerned very much about the density of the pore fluid as it relates to landfarms.

Did you do modeling of landfarm operations to determine how the chloride might move?

A. Yes.

Q. And what were the -- what did you start off in terms of looking for a small landfarm? What were the modeling assumptions that you used?

A. We made some assumptions about the operation of the landfarm, and that is that the materials would be deposited on the soil surface, the natural soil surface. And one of the reasons why I spent so much time trying to explain the natural processes that go on in the vadose zone is because that is the setting upon which the landfarm is superimposed.

We put the landfarm on this soil profile which has been evolving over thousands of years in most cases, and we're going to operate it for three years. We're not going to put ponding on it. It's not going to be in an area of local recharge.

It's a small area, less than a couple acres, or less than .4 of an acre. And it's surrounded by native plants, which have rather tenacious root systems.

We're going to re-establish vegetation on the landfarm as part of the assumption about its operation, and after closure we're going to assume that the landfarm has become re-vegetated and gets back to -- close to the natural condition.

Q. And were these conditions chosen in part to replicate the requirements of the OCD proposal and the industry proposal?

A. Yes.

Q. And could you explain what's on this diagram?

A. I think you've seen this chart before during the stakeholder meeting. It just illustrates my understanding of biopiles and spread-and-disk-type landfarm cell operations, showing a couple of feet of waste material piled on top of the land surface or, on the right-hand side, disked into the land surface.

Q. And this, then, presents a model that you would use conceptually to look at how chloride might be transported from a landfarm into the groundwater?

A. Yes.

Q. Could you explain what's in this diagram or conceptual model?

A. In this chart, showing the area of the hydrocarbon in the landfarm, there's some moisture that may be -- or water that may be added from rainfall or perhaps from irrigation. Some of the water that's applied is transpired by the plants or is evaporated directly by low humidity and wind. And some of the constituents in the landfarm may volatilize, other constituents may biodegrade. In the vadose zone there are a number of transport processes that are important to consider if we're trying to predict what kind of chloride concentration might find its way into groundwater.

So this is conceptualization of the process by which leachate or water moving from the landfarm might find its way into the groundwater, by traversing the vadose zone.

Q. Can the chloride that might be present in the landfarm reach the groundwater table if there's no water in the vadose zone, or does it have to have water in order to move?

A. Well, you'd -- for soluble constituents, you'd need to have water. For volatile constituents, you'd need to have an air passageway. And so some volatile constituents by diffusion could migrate into the vadose zone, and what would happen is, they'd diffuse into the water phase or condense and find their way into the natural soils.

Q. And for chloride specifically, is that a water transport or a gas diffusion mechanism?

A. Chloride needs water transport.

Q. And then this talks about what you were looking at in terms of chloride concentration, how that recharge might occur conceptually?

A. Yes, and we're talking about recharge now being water which has actually gone all the way through the vadose zone and reached the water table, and it begins to mix with the groundwater. This is an aquifer shown in blue, the water table being the upper layer -- or the upper surface of an unconfined aquifer. And any chloride, for example, that comes out of the landfill would be spread over an area probably larger than the landfill where it mixes and disperses with water in the vadose zone.

Nevertheless, it will -- that is, the water coming out of the vadose zone, will enter the aquifer over some area and mix with the ambient groundwater as it's flowing.

It's -- The amount of mixing depends a lot on the aquifer characteristics such as the flow rate, the aquifer dispersion and the thickness of the aquifer.

Q. And if an aquifer is thicker, what does that do to the resulting chloride concentrations?

A. The thicker the aquifer, the more mixing can occur. The thinner the aquifer, the more constrained it is, and you'll get just a shallower distribution, if you will, of the constituents.

Q. Now what happens to the characteristics if you increase the groundwater flow rate in the aquifer?

A. The more flow of fresh water that comes into the mixing zone here, the more dilute the constituent becomes.

Q. Now is this next slide an example of how you took your conceptual site model and converted that to a mathematical model or a computer model?

A. Yes. This slide conceptually shows how we applied three different computer codes to predict the concentration in groundwater at a point adjacent to a landfarm. And what we can see here is how the computer model basically divides the earth -- or the vadose zone and the aquifer, into a number small cells.

And what we do is treat the problem in two parts. The first, we simulate water and solute movement -- that is, chloride movement -- out of the landfarm and moving downward one-dimensionally through the vadose zone using a computer code called HYDRUS 1D. This is a public domain free software that does predictions of how much chloride would move through the column of soil and enter the aquifer. We take that output from HYDRUS 1D and make that input into the groundwater flow model. Here we have groundwater flowing from left to right.

We assume an Ogallala aquifer only 10 feet thick. It's obviously in most places much thicker than that, maybe a hundred feet or so in many places, or more. And we allow this water from the landfarm to mix with the water coming in from the aquifer and predict concentrations in a well that fully penetrates the 10-foot thick aquifer. And that well is located immediately adjacent to the landfarm.

So the code we use to predict groundwater concentrations is a combination of two codes, really. One is for the flow of the water, called MODFLOW 96, and the other for contaminant transports is called MT3DMS.

Q. And Dr. Stephens, why did you choose this particular five-acre landfarm in locating the monitoring well where you did?

A. Well, I think the location of the monitor well is kind of the optimal location. That is, you'll get the highest concentration at this location, of any of the possible locations you could choose to be a point of compliance. And the codes are public domain models, anybody can use it, anybody can check the results.

Q. And the five-acre size, was that what the staff had used in their modeling effort?

A. To the best of my recollection, that's correct

Q. And admittedly very, very small type here, but is this the model input parameters that you actually used in your modeling work?

A. Yes. We're just trying to show here that we actually carefully considered and gave citations to provide a basis for every parameter that we used. There's physical properties of the aquifer. We indicated where there were assumptions or where it was based on some other information.

The soil properties are all listed here in this column. We looked at silty loams, clays, sands, loamy sands, and we've given citations for the hydraulic properties that needed to go into the models to make a prediction.

We also needed dispersive characteristics, hydrology, meaning primarily the aquifer, and vadose zone characteristics and -- just to make sure everybody knew where things came from.

Q. And what was the result of the modeling work you did? What did you predict?

A. This is the output at the monitor well at the edge, the downgradient edge, of the landfarm. If you recall from the stakeholder meeting, this is the exact same slide that we showed before.

For a variety of mixtures of sand and clay and loamy sand, no matter how we seem to twist the soil properties around, assuming we had a chloride source in this five -- actually, this particular slide is for a 2.5-acre landfarm. We had the landfarm operate for three years and removed the source after three years. And what we saw is that after 50, 60 years, or more than 80 years, the chloride concentration in the aquifer gradually increased. But it didn't increase up to a point which would be in excess of the groundwater standard, 250 milligrams per liter.

Q. And so in other words, the temporary landfarm, or a small landfarm as the staff has proposed, with -- even if it was larger, say in this case two foot thick and 2.5 acres, would not threaten the Water Quality Control Commission standard; is that what your testimony is?

A. Yes.

Q. And if the industry committee, which is proposing a two-acre, two-foot-thick landfarm, that would also be protective in this case?

A. Yes.

Q. What did you do next?

A. Well, we asked ourselves if 1000 milligrams per kilogram produced that result, which is concentrations of -- what was it, maybe a hundred or so milligrams per liter in the aquifer? -- what kind of concentration could you put in the landfarm that would cause the water in the aquifer to reach 250 milligrams per liter? That is, just get up to the groundwater standard. So we looked at, in this case, 2.5-acre landfills, a variety of vadose zone soil properties and aquifer types.

And what we conclude in the right-hand column is that somewhere you're talking about several thousand, a few thousand, up to 11,000 milligrams per kilogram, depending on the geology, could be applied in this case without exceeding the groundwater standard for chloride.

Q. And so would that increased concentration, then, give a landfarm operator more flexibility in terms of treating and managing waste at the landfarm?

A. Yes.

Q. And as long as they stayed within -- or less than these numbers here, then in your opinion that would still be protective of the groundwater?

A. Yes.

Q. And what did you do in this round of your model here?

A. In this case we assumed that there was a landfarm, but it continued to operate. We didn't remove it and haul it away or stop -- otherwise stop the infiltration after three years. In this case we let it go on in perpetuity. We called this a Class A landfarm in our previous proposal -- previous presentation.

We looked at areas that range from 2.5 to 5 acres, again for a mix of vadose zone soil and aquifer properties. And once again, we were looking at the concentration that we would see increasing in the aquifer. In this case concentrations increased up to maybe 100, 179 milligrams per kilogram. So we were -- Let me back up a second, I want to make sure this is -- I think I muddied this testimony here.

On the right-hand side is, for the Class A landfarm or permanent source, the amount of chloride you could put in the soil and just reach the 250 milligram per kilogram concentration. So we're looking at up to almost 1000 in this case, up to 2700 milligrams per kilogram.

Q. But it was less, reflecting in large part the larger size and other factors -- and longer time frame in which the chloride was present?

A. Yes, time was a big factor.

Q. Okay. And so based on your modeling analysis, what conclusions can you draw about the impact of landfarm operations on the WQCC standards?

A. Well, as I just mentioned, time is a big factor and the impacts to groundwater depend heavily on how long the landfarm operates. That is, how long the chloride does percolate down to groundwater, how long that goes on.

And the amount of impact depends on the soils. It depends on whether you have sandy soil or loamy soil or whether you have clay layers within the vadose zone or whether it's all one material. So the result depends on the site conditions.

But what we found with the small landfarm simulations -- that is, what we previously referred to as the Class B group, small landfarm -- there were some situations that 10,000 milligrams per kilogram could be protective of groundwater. It just depends on the site. It depends on the soil.

Q. Okay. Now did you then undertake some additional work in light of the vegetative and evapotranspiration characteristics of New Mexico to try to refine our modeling analysis?

A. Yes.

Q. And could you tell us about what you determined when you looked at that and the conceptual model that you assembled?

A. Yes, this is new work. I don't believe you've seen this since the stakeholder meeting. But what we were trying to do was to create a prediction that took more account of -- more realistic account of the establishment of vegetation, how that might develop over time. Because we realized that, you know, with the landfarm, during its operation there is no vegetation. But during the -- after closure, vegetation slowly establishes itself. And then once it's closed out, you would assume that the vegetation has reached some equilibrium condition, perhaps, with the surrounding native vegetation.

So we tried to look around for rates of deep percolation that would be reasonable, and we found a couple of studies, one of which I already mentioned, by Phillips and all, and Keese and others in 2005. The Keese study was from Texas, and they did some studies of percolation rates or natural recharge rates throughout Texas, and we borrowed one of the numbers from -- I believe it was Lubbock area.

We assumed in our conceptual model that this deep percolation rate would gradually reduce as the evaporation and the plants established themselves and the evapotranspiration increased. So over time the recharge rate, if you will, or the net infiltration below the landfarm we allowed to decrease as the plant community developed.

Q. And so the idea behind your first sub-bullet point, then, was, you were going back to when you talked with the Commission about the diffuse recharge zones in New Mexico where you've got a little bit of vegetation. This was an effort to sort of capture that concept and put it into this new model?

A. Yes.

Q. What other parts of your conceptual did you put in place?

A. Well this slide shows more or less how we populated that process, the net infiltration, and that is, during the period of time of active use, the three-year period where a small landfarm might be in operation, we used a recharge rate or deep percolation rate of 19 millimeters per year for three years.

Q. And how did you choose that 19-millimeter-per-year rate for the three years?

A. The 19 millimeters came out largely, I believe, at about -- if remember right, 60 or 80 percent of the field capacity. If you establish a constant water content in the landfarm material, that would be the net infiltration that would result.

Q. And is that also consistent with sort of the upper limit of observed recharge in the Ogallala aquifer on a regional basis?

A. Yes. In fact, it's -- you know, it's a little higher than the range that we've seen in the Ogallala.

Q. All right. And then after the three-year period when the landfarm has to be closed under the small landfarm proposal, what did you do then?

A. Well, then we allowed vegetation to re-establish itself. And I looked at all of the studies that -- and the table, one of the tables that you had, that I showed recharge rates of several different areas in New Mexico. And you know, 9.5 millimeters was probably at the upper end of those. Some of them were a fraction of a millimeter per year. But I chose the 9.5, thinking that was probably consistent with some of the research that I did in areas that had sandy soils and poor vegetation and some of the same studies that were done in the New Mexico State ranch site as well. So 9.5 was what we used for the next seven years in our simulation.

Q. You chose that number in part to be conservative in terms of how much water might be moving downwards?

A. That was the objective.

Q. And then after 10 years, what did you do?

A. Well, after 10 years we thought the vegetation might be re-established and the recharge rates. We tried a couple of different numbers that we thought might be reasonable. We used .8 of a millimeter to 2.5 millimeters per year, and those would be based on the studies by Phillips and others, and Keese et al., that I sited.

Q. And what was the result of that analysis?

A. For the two cases in the long term, basically the two cases were the same for the first ten years, but we changed the long-term recharge rate. As I say, in one case it was .8 of a millimeter, in the other case it was 2.5 millimeters per year.

And we found -- not surprising -- that it takes longer for the chloride peak to occur in groundwater when you have smaller recharge rates, you've got 1400 years and concentrations where -- what we found was, we could put 51,000 milligrams per kilogram chloride in the landfarm and still be protective of the groundwater standard at 250 milligrams per liter.

For the case of the somewhat higher recharge rate, the results show that 9500 milligrams per kilogram chloride in the landfarm would still allow protection to the groundwater standard.

Q. And this isn't the only, necessarily, closure standard, though, that a landfarm operator may consider in deciding what they're going to do, correct? It's just one of the factors?

A. Yes.

Q. And does this chart, then, sort of summarize graphically the -- what you found -- summarized mathematically in the previous table?

A. Yes, it's -- just to be analogous to what I showed at the stakeholders' meeting at an earlier slide, that you get these much smaller concentrations. If you have 1000 milligrams per kilogram in the landfarm, you really don't see much of an impact to groundwater with these very low recharge rates and allowing evapotranspiration and evaporative covers to evolve.

COMMISSIONER BAILEY: I'd like to point out something. Olson and I were not part of those stakeholders' meetings, so when you refer to those things we have no idea what you're talking about.

THE WITNESS: All right, sorry.

Q. (By Mr. Hiser) And so would it be your opinion, then, Dr. Stephens, that a chloride limit greater than 1000 milligrams per kilogram would be appropriate for a small landfarm, given these conditions present in New Mexico?

A. Yes.

Q. And what recommendations do you have?

A. Well, with respect to these small landfarms, developed vegetative covers and based on variable recharge modeling that we did, it makes sense to have perhaps a default number. Maybe 1000-milligrams-per-kilogram is a default number, but I think you'll see later on in my presentation, I don't think that's probably the right number.

But a Tier 2 approach would use site-specific data and modeling, just as I've done here, and I believe just as the OCD staff has done as well, to develop some site-specific standards that are appropriate for the geology and the hydrology and the nature of the operation.

Q. And so based on all the different simulations you did, both the initial set looking initially at the staff's evaluation, and your subsequent evaluation looking more specifically at New Mexico's specific conditions, what are your conclusions?

A. Well, I guess the buzz phrase that I think is appropriate is, one size doesn't fit all. In other words, one regulation is difficult to apply to all sites. The amount of chloride that you could tolerate in the landfarm, as we've seen from the simulations, could range from 1000 to 51,000 milligrams per kilogram, just depending on the site conditions.

And that's a huge range, and it really makes sense to me to recognize that and give some flexibility to the operator, maybe because he has a favorable site, to have different criteria imposed and use modeling -- call it risk based modeling -- to address how those groundwater standards would be met.

Q. Now did you have an opportunity to review the staff's proposal?

I'll repeat my question since you were distracted. Did you have an opportunity to review the OCD staff's proposed Rules?

A. Yes.

Q. Did you have any concerns with those rules?

A. Yes.

Q. Would you tell us about your concerns on the monitoring side?

A. Well, the first thought I had was that in looking at the monitoring strategy, it just seemed excessive to me. First of all, there's monitoring, if you will, on the material that's brought into the landfarm. There's a certification -- Thank you very much.

There's a certification requirement to make sure that the waste comes in, has chloride less than 1000 milligrams per kilogram.

Then the requirement is that every six months you make sure that it's still 1000 milligrams per kilogram in the landfarm.

And then finally, there's vadose zone monitoring underneath to make sure there's nothing detected below the landfarm.

And so I thought, well, you know, it's -- you have -- you're monitoring what comes in and you're monitoring what goes out. Why do you need to monitor what's inside? Except perhaps if you're looking at the bioremediation endpoint strategy where you need to keep track of the rate of degradation and whether you're approaching a steady state, if you will, on the residual contamination. So --

Q. Dr. Stephens, if we were using the bioremediation endpoint, however, would that be for all the constituents that OCD has suggested, for example, the BTEX and the chlorides and the 3103 inorganics and metals, or would it only be for a subset of those?

A. I think it's the subset, yeah.

Q. And that subset would be the BTEX and maybe total petroleum hydrocarbons in some form?

A. Yes.

Q. Did you have any concerns regarding the vadose zone monitoring and corrective action process that was outlined by the staff?

A. Yes, I did. The proposal that I've understood is that corrective action of some unknown type could be triggered if concentrations in the soil or the vadose zone underneath the landfarm detect anything. That's anything, at all, anything in the 3013 list, no matter how small. If it shows up, you need to do something about it, either change your operation, haul it away...

And to me, when I thought about that I said, you know, there's no other site I can think of that we've worked on where there's an effect, an anti-degradation soil requirement imposed. I just don't know where that -- I've heard of it in groundwater in other states, but New Mexico doesn't have a groundwater -- an anti-degradation groundwater standard.

So what this is tantamount to is saying we will not allow any constituent from the landfarm that isn't in the native soil already to be in the soil underneath the landfarm, no matter how small, no matter what risk, it just can't be there.

And as a result -- and I understood the testimony this morning about how flexible, you know, the Division would be in interpreting things on a case-by-case basis. But it's possible that the operation -- could be concluded that the operation should be terminated because something was detected in the vadose zone.

And as a result, that termination might be premature, even -- there's no harm to groundwater, there's no harm to anything else in the vadose zone, but the landfarm operation would have to be terminated. And one of the options would be that the landfarm material gets hauled to a landfill or someplace else, before the bioremediation process had an opportunity to be completed.

Q. Dr. Stephens, are you aware of the reason why the Water Quality Control Commission established a standard, for example, iron?

A. Well, the iron standard is generally considered a secondary standard. It's usually not a health-based standard. It's usually considered as a constituent which can stain clothing in high concentrations. Manganese does the same thing. If you're ever in Socorro and you look at the sidewalks down there and they're all reddish brown, they have a lot of manganese in the water. But that's the main reasons why iron is set to the standard that it is.

Q. And do you think it would be appropriate to trigger corrective action for a staining concern?

A. Not in my view, no.

Q. And what do you think is the -- sort of the existing policy and practice within the State on degradation of groundwater?

A. In my experience, dealing with dischargers or sites where groundwater standards are to be protected, is that the groundwater can be degraded up to the standard.

We've had in New Mexico a policy that's described as point of reasonable foreseeable future use. That's often viewed as a well, a groundwater well, at some point below, adjacent to or downgradient of, the point of a release, and it's in the groundwater.

And the policy is that -- this is in my experience, anyway, that we don't have an anti-degradation policy in this State, we have one that allows degradation up to the standard. And that's how groundwater quality regulations are practiced in New Mexico in my experience.

Q. And then continuing on with your experience as an environmental profession who has worked in the State with some of the other constituent agencies, working with the groundwater quality standards, if there is a potential problem and groundwater contamination is feared to be possible, what's the practice in terms of choosing the cleanup levels or how to regulate that situation?

A. Well, we have these abatement rules where -- let's say contamination has occurred and some action is necessary. The action would be necessary or a trigger would occur if groundwater, let's say, exceeded 250 milligrams per liter chloride.

What would you have to do if it was 300 milligrams per liter chloride? Well, you'd have to clean up to 250 milligrams per liter, and then you'd be done. You wouldn't need to clean up to 50 milligrams per liter, which might have been where it was a long time ago; you'd clean up to that standard. We do that in -- you know, whether it's the south valley of Albuquerque where you have solvents, or wherever it is. It's cleaning up to a standard, as opposed to background. It's just the way the water quality laws in New Mexico work, in my experience, at any rate.

And the same goes for soil. You might have a release in the soil, and how do you know you're done with your remediation? Well, you take soil samples, and just -- like we'll see a little bit later with the New Mexico voluntary cleanup program, you look at the soil concentration and you say, is this concentration high enough to cause an impact to groundwater that will cause an exceedence of the groundwater standard at some point of reasonable, foreseeable future use, being in a monitor well downgradient?

So this practice of setting a cleanup standard, a cleanup goal after contamination in soil has occurred, really recognizes the fact that some constituents are in the soil, they will be in the soil. And you could be finished with your soil remediation, as long as that which is left in the vadose zone isn't going to cause exceedence of a groundwater standard.

Q. Now Dr. Stephens, did you hear Mr. von Gonten discuss the site specifics -- or the soil screening levels and the dilution attenuation factor or DAFs?

A. Yes.

Q. Do you have any observations on the DAFs and, to some extent, his testimony on those?

A. This dilution and attenuation factor is a concept -- it's a convenient way of calculating impacts to groundwater. Or another way to look at it is to calculate what kind of soil contamination -- or what kind of soil concentrations could you have without contaminating groundwater?

The concept of a dilution and attenuation factor I have on a subsequent slide, but before we get there I could just try to show you the equation that we're dealing with here.

What this dilution attenuation factor really is, it says, here's the groundwater flow rate, into this box. Here's the rate at which water is going into the box from the vadose zone. Mix it around, and they become diluted. The concentration from the vadose zone mixes with the clean groundwater, and the amount of mixing and the concentration dilution depend on how much groundwater is coming into the box and how much vadose zone water is coming into the box.

And so that's what this equation says. It says 1 plus, and the ratio of the groundwater flow rate into the box divided by the vadose zone flow rate into the box. That's the dilution factor.

But another way to look at it is to say, this is an equation which is also equal to the concentration in the pore water in the vadose zone divided by the concentration in the groundwater that's leaving the box. That's pretty much what the dilution and attenuation factor is, so...

Let me go back to that. Could we go back to that a second?

Q. Oh, yeah.

A. What I want to point out is, if you see the second -- the first bullet where it says, Compute -- I'll use my pointer. It says, Compute dilution attenuation factor (DAF), equals 1 plus groundwater flow rate divided by the vadose zone flow rate. How could you get that equation equal to one?

Well, the only way to do that is to say the groundwater flow rate is zero. That's how the math works. Groundwater flow rate is zero. You can justify by this calculation a DAF equal to 1. Now that doesn't occur anywhere I've ever seen.

But what's going on -- how this dilution and attenuation factor is used in the New Mexico Environment Department's Hazardous Waste and Groundwater Quality Bureau's voluntary cleanup program is like this. The idea is to try to find, as I said before -- I mean, what soil concentration can you have present without causing a further degradation of groundwaters? What's your cleanup to -- how do you know when you're done cleaning up the soil? You're done cleaning it up when you're not going to cause an impact to groundwater above the standard.

So what do you have to do? You kind of go backwards. You find out what you need to clean up to in the groundwater, you make some assumptions of what the rate of vadose zone flow is and the rate of groundwater flow is, and then you find out what pore water concentration in the vadose zone you should have, and then you simply convert that to a soil matrix concentration based on bulk density and water content. And that's kind of how that calculation works.

Q. And this slide is sort of in the idea of a picture is worth a thousand words of how that concept works?

A. Well, I hope so. Yes, here is a -- this is the box I talked about, the saturated zone, the blue -- well, the box is really the purple color here, called the mixing zone, and the entire blue and purple comprising the saturated zone or the aquifer. The brown would be the vadose zone.

So let's assume we have a landfarm up here through which there's some steady infiltration that occurs at a constant rate in perpetuity, for all time, and it continues to leach chloride vertically downward through the vadose zone, and it mixes in some narrow portion of the aquifer. And also part of this equation is knowing how long the source is relative to the direction of the groundwater flow.

So these are aspects of this dilution and attenuation model conceptually, looking at the mixing that takes place in the purple zone, due -- a concentration coming in with the infiltration at some steady rate, mixing with groundwater that's clean, coming into the mixing box, and finding out what the concentration of the groundwater is that leaves the box.

Q. And what are the assumptions that underlie the whole DAF and the SSL model?

A. Well, I don't want to belabor these, but there's a couple of slides that highlight these, maybe for your reference.

But the first is, we assume that instead of a landfarm being present for three years or some finite period of time, it's present for the whole time, the salt load doesn't diminish, it just stays constant there, doesn't get flushed out, remains permanent there.

We assume that the concentration is uniform throughout the vadose zone and all the way down to the water table.

We -- It's assumed in developing this model that there's instantaneous partitioning between the liquid and the solid phases -- Next.

Q. Well, I want to back up. You say the contamination is uniformly distributed from the surface to the water table. That would mean if the water table was 50 feet down, like we've been assuming for purposes of the staff's proposal, that the landfarm would then be 50 feet thick?

A. Yes.

Q. Go on.

A. So although it's called a dilution and attenuation factor with respect to chloride, and DAF is equal to 1, there really is no attenuation whatsoever. We also assume -- it's either in the soil or in the aquifer.

The unconfined aquifer is homogenous and isotropic. We assume that the exposure point is a well located at the immediate downgradient edge. Not 100 feet away, not 200 feet away, not outside of some property perimeter, but right at the landfarm, for purposes of these calculations.

And lastly we assume that there's no separate phase liquid, that everything that's moving here moves as a dissolved -- in a dissolved water phase.

Q. And so that you have mercy on both your attorney and also the members of the Commission, a homogenous isotropic hydrologic property in an aquifer, in English, means what?

A. Means that the hydraulic properties don't vary from point to point, and they don't vary in direction.

Q. Okay, thank you.

CHAIRMAN FESMIRE: You picked the one thing I understood to ask him about.

(Laughter)

Q. (By Mr. Hiser) In this next slide, you've -- as a professional that's worked with the New Mexico

Environment Department's voluntary cleanup program, which was one of the peer agencies that Mr. von Gonten testified they looked at, could you tell us how they would look at setting a DAF or using a DAF in a cleanup level?

A. Well, this would be my understanding, at least. Let's -- I'll just take a hypothetical here. Let's assume that we have groundwater and it's just distilled water, there's really no constituents, no chloride in it at all, or no benzene in it in this case.

Say we have a leachate that comes out of the landfarm and is percolating down through the vadose zone, and it has 10 micrograms per liter in that pore water. Let's assume that did our math and the rate at which the aquifer is flowing and the rate at which the water is flowing in from the vadose zone are in a proportion of two to one. So we get a dilution attenuation factor of two.

If we work this out, you'd find that with the dilution factor of 2 and you put 10 micrograms per liter in, you'd get out 5 micrograms per liter. Now that 5 micrograms per liter would be below the standard. The standard is 10. I'm assuming that the leachate is just at the standard, 10 micrograms per liter for benzene. So we mix that in the aquifer. And after it's in the aquifer at the point of compliance, you'd find that the benzene was below the standards.

So presumably -- I can't speak for NMED personally, but as I interpret the rules of the game, no further action would be required because the benzene would be less than the groundwater standard.

However, I just want to point out -- maybe I'm getting a little ahead of one of my concerns, is that the benzene would be detected in the vadose zone. It would be present at 5 micrograms per liter. Not found at background, I'm assuming there's no other source of this benzene other than the landfarm materials. So it would be present above background and presumably trigger corrective action, even though, as far as far as NMED is concerned with the voluntary cleanup program, it might not trigger any action. So it's an inconsistency here.

Q. And so there would also be a concern, then, that that corrective action would take resources that could otherwise be devoted to another purpose and direct them to that corrective action?

A. (Nods)

Q. That was a yes?

A. Yes.

Q. Did you look at the OCD treatment zone standards, and what did you conclude about those?

A. Okay, going from the vadose zone concern now to -- upward into the treatment zone layer above that, closure can occur when benzene, BTEX, GRO+DRO and chloride meet the numbers that I'm showing here, .2, et cetera, including 1000 milligrams per kilogram. You can also close out the site when these 3103 constituents do not exceed background or do not exceed the applicable closure concentration criteria that are specified in the table you saw this morning.

The list -- and we heard this testimony from Mr. van Gonten -- of constituents in this soil closure standard list is based on the assumption that the dilution and attenuation factor is 1, except for chloride. Chloride is arbitrarily set to 1000 milligrams per kilogram. And sulfate, inexplicably, is set to background. I'm not sure why, but that's the way it is. All the other constituents in that list, I understand, are based on the assumption of a dilution attenuation factor of 1 that is associated with a look-up table and the New Mexico Environment Department's voluntary cleanup program.

What does the DAF of 1 mean? Bullet one. Groundwater does not flow. It ignores the vadose zone processes where some attenuation can occur of any constituent that's moving down, including chloride. Some of the chloride, although it's conservative, it will mix with water that's already present. It will spread over a larger area. Some mixing will occur as lateral spreading occurs in the vadose zone.

And more likely than not, that there's going to be a receptor in the groundwater. It's a well that's the point of compliance, but the DAF equal to 1 doesn't even give a well a chance to have any mixing occur, because with DAF of 1 the concentration in the pore water in the vadose zone is exactly equal to that which you want to have in the aquifer, no mixing, no dilution at all.

Q. Dr. Stephens, did you undertake a review of some of the literature available from EPA and other agencies on the use of dilution attenuation factors?

A. Yes.

Q. And is the information that you looked at typical of what would normally be considered by an environmental professional like you as you're approaching the question of a closure standard? In other words, is it the type of guidance that you would normally consult when trying to establish a closure standard for a client of yours?

A. Yes.

Q. And what did you find in that review?

A. Well, I want to -- if I could --

Q. You want to back me up?

A. Could I back you up?

Q. Feel free?

A. Do you want me not to --

Q. Go ahead.

A. Anyway...

MR. BROOKS: Excuse me, I'm not finding this slide.

MR. HISER: This is a rebuttal slide from some of the comments of Mr. von Gonten, so you do not have it.

MR. BROOKS: Okay.

CHAIRMAN FESMIRE: And it would be awfully difficult to object, given what happened earlier.

MR. BROOKS: I agree with that, I don't object to it, but I would like to be provided with a copy of it at the appropriate time.

MR. HISER: We will provide you with copies of all the rebuttal slides.

MR. BROOKS: Thank you.

THE WITNESS: Well, I just wanted to point out an inconsistency here in this list. The list has 3103 constituents that are established based on the dilution and attenuation factor of 1, with the exception of chloride and, as I mentioned, sulfate.

Let's look at the chloride. The chloride standard is 1000 milligrams per kilogram in the soil. What does that mean? That means approximately the concentration in the pore water might be 5000 milligrams per liter. It's going to vary depending on bulk density and so on, but it would be roughly 5000 milligrams per liter.

What you want in the aquifer is, say, no more than 250 milligrams per liter, which is going to give you a dilution and attenuation factor of really 20 to 1. So in this list you have a mix of constituents that have been established, the levels of contamination allowed in the treatment zone. Some of them are DAFs of 1, and chloride in effect is a DAF of 20.

And I'd also point out that the testimony that we heard this morning, that gets a little bit ahead of some other testimony, is that we will change the level of those standards if they're below that which the lab can quantify, below the PQL. Well, that's going to mean that you've picked dilution and attenuation factors that are all over the map, then. They'll all be different. So there's not really much standardization, actually at all. So there's a lot of inconsistencies in how that table evolved.

Q. (By Mr. Hiser) And as between the proposed DAF of 1 and 3103 constituents and the proposed DAF of 20 for chloride, which do you think is more appropriate for the vast majority of sites in New Mexico?

A. It would certainly be 20 or more.

Q. Going back to my original question about having reviewed the literature, what did you determine, based on that literature, was some of the nationwide guidance on the use of DAFs?

A. Well, these are quotes, and I don't know that we want to read them all, but you have them in your handout materials. And the EPA study that was one of the models that -- I'm sorry?

MR. HISER: Mr. Huffaker?

MR. HUFFAKER: Nothing.

THE WITNESS: The EPA study found that for half-acre source areas, a DAF of approximately 120 is protective of groundwater at 90 percent of the sites, and 95 percent of the sites would be protected at a DAF of 7.

For larger sites, the EPA found that a DAF of 10 was protective for a 30-acre source, and a DAF of 20 was protective for groundwater at a half-acre source.

CHAIRMAN FESMIRE: What should it be for a 500-acre source?

THE WITNESS: I don't know. Look up the table, there is a table, and we can just see what it shows. It might come up, actually, on a later slide.

Well, the New Mexico Environment Department pretty much concluded the same thing -- and these are quotations, actually. They believe that the DAF of 20 for a half-acre source area is protective of groundwater.

They also go on to say that if this default DAF is not representative of conditions at the site, then it is appropriate to calculate a site-specific DAF based on available site data. I think that's our point, we agree.

Q. (By Mr. Hiser) So it's really your conclusion that, given the amount of information that's known about DAFs, that in most cases the calculation of the site-specific DAF would be appropriate?

A. Yes.

Q. What does the guidance say about the use of the DAF of 1? Why is that provided in the look-up tables?

A. Well, my reading of it is -- and this is a quote, you can judge for yourself. But what it basically says, it's provided for convenience, it's a scaling factor. It says that if DAF is 1, then here's the concentration in the soil. But of course DAF isn't 1, because groundwater is flowing, and so there is a dilution that's going to occur. And all you need to do is figure what that factor is and multiply it by the 1, and you get your site-specific standard.

So they've included the DAF of 1 in that table for the convenience of the user.

Q. And then what do these concerns with the closure standards lead you to conclude about landfarms?

A. I'm concerned that this strategy will not lead to in-place closures. Recall that when the landfarm is full, treatment continues, the landfarm continues to operate until the benzene and chloride, BTEX and so on, are -- as long as they're above these criteria. And then the 3103 constituents in the landfarm have to be less than the greater of background or the list of those closure standards.

Now what the DAF of 1 also means, in effect, is that the pore water in the treatment system -- excuse me, the treatment zone, has to be equal to the drinking water standards. That's when you can close this site out. If you could put a suction device in the landfarm and produce water, that water has to meet the groundwater standards before closure can commence, if the DAF of that constituent is 1. That's pretty much what it says.

And also, if the site can't be closed, if there's any background criteria in the vadose zone -- excuse me, if there's any constituent in the vadose zone above background, you can't close the site either.

And if you go back to the slide I showed you earlier where there was -- I showed the processes of infiltration, redistribution and evaporation, it's almost certain, you cannot avoid -- think about this. You have this layer of soil that has been piled up or mixed, and you put that on the native land surface. It's going to rain, or you might add some moisture to it. I'm almost certain you cannot prevent, on a natural soil surface, any migration from just above that surface to just below it. It won't happen. There's going to be some. I can't tell you how much, I don't think it's going to be very much. But the standard of background is much too rigid. To be able to take a standard from the vadose zone underneath that and not expect anything at all to be detected is unrealistic.

So as a result of the expectation that you're going to treat the treatment zone to drinking water standards and have absolutely nothing found in the vadose zone underneath it, I think more likely than not you're setting up a situation where you're going to have to excavate that landfarm and haul it away, potentially. Even though there's mitigating circumstances that could be negotiated with the Division, that's a possibility. So I think landfarming doesn't have a strong future with these rules as they're written.

Now this slide kind of belabors the point I think I've made, but basically what it says is that there's some inconsistency between how the agency is viewing the treatment zone and the vadose zone. The treatment zone is an area where some treatment is occurring, but they're viewing it like a tank, and there's some kind of steel wall that separates it from the vadose zone below it.

But that's not the reality of the situation. The reality is, it's native soil. And what's being expected is to clean up the treatment zone to a level called the DAF 1 level, which is drinking water standards -- and that's suitable, that's acceptable. You could treat the treatment zone down to a DAF of 1, if that's possible -- which I don't think it really is -- but then the vadose zone underneath it can't have anything in it at all. Yet the treatment zone, it's perfectly fine and protective of groundwater to allow that to be present at a DAF of 1, but you can't even have the vadose zone at a DAF of 1. You can't even put drinking-water-quality water into the vadose zone in a strict interpretation of these Rules.

And I think the Division realized this already, and as I understood it, this point here that I want to -- that I had, not knowing the testimony that I heard this morning would be given, says that -- and here's the list, the 3103 constituents in NMED's proposed soil screening level -- or NMOCD's proposed screening level, on the right, which you can't see here but you can see on your handout, is that the yellow rows show where the laboratories tell us, these levels in the soil are so low we can't detect them. But all these are based on a DAF of 1, except chloride and sulfate. So a DAF of 1, the standard is so rigid the laboratories can't even detect it.

Q. Now Dr. Stephens, when you said not detect it, do you mean not detect it all, or not quantify --

A. Not quantified --

Q. -- it --

A. -- excuse me, not quantified in a significant way.

Q. And so in summary, your recommendations after reviewing the Rule are what?

A. Well, in summary I think the monitoring that's been proposed regarding treatment zone is excessive.

The trigger based on any exceedence of background in the vadose zone is tantamount to a non-degradation policy which is inconsistent with other agencies.

I don't think the DAF-equal-to-1 concept is supported by any science.

These soil screening levels that come out for many of the constituents can't be quantified.

And I think the OCD's Rules ultimately will lead to inhibiting the operation of landfarms, and consequently having to haul -- dig and haul to perhaps a landfill.

MR. HISER: Mr. Chairman, that pretty much concludes the direct examination we have of Dr. Stephens. Now we also have some rebuttal that he could do of, for example, Mr. von Gonten and Mr. Price's, which we'd be happy just to go into if that -- if you would like us to do so.

CHAIRMAN FESMIRE: I think that's probably the better way to handle it, as long as we've already gone over what they're rebutting.

MR. BROOKS: I agree.

CHAIRMAN FESMIRE: Mr. Carr, do you --

MR. CARR: I agree with whatever you and Mr. Hiser work out.

(Laughter)

CHAIRMAN FESMIRE: Mr. Huffaker, do you --

MR. HUFFAKER: I'm indifferent.

CHAIRMAN FESMIRE: Do the Commissioners mind going into the rebuttal?

COMMISSIONER BAILEY: (Shakes head)

COMMISSIONER OLSON: (Shakes head)

CHAIRMAN FESMIRE: Let's go ahead and do that.

MR. HISER: Well, Mr. Chairman, my witness was wondering if he could have a two-minute break to run to the powder room --

(Laughter)

MR. HISER: -- usurping Commissioner Bailey's role, I'm afraid.

CHAIRMAN FESMIRE: I just asked Commissioner Bailey, and she said she was okay. But why don't we go ahead and take about a 10-minute break? And we'll come back and then we'll go until somewhere between 5:00 and 5:30 or the end of his testimony, whichever comes first.

MR. HISER: Thank you, Mr. Chairman.

(Thereupon, a recess was taken at 4:06 p.m.)

(The following proceedings had at 4:15 p.m.)

(Mr. Sugarman present at this time.)

CHAIRMAN FESMIRE: Mr. Hiser, you were -- your witness was about to begin his rebuttal testimony?

MR. HISER: Correct.

CHAIRMAN FESMIRE: Let's go ahead and --

MR. HISER: If I can retrieve my witness, Dr. Stephens. Are we back on the record, Mr. Chairman?

CHAIRMAN FESMIRE: I think we're back on the record, aren't we? Yes.

MR. HISER: Well, if you say we are, we certainly are.

Q. (By Mr. Hiser) Dr. Stephens, did you have an opportunity to review the study to determine allowed salt content prepared by Mr. Price and members of his staff?

A. Yes.

Q. And did you come to any conclusions, having reviewed the study that Mr. Price and his staff conducted?

A. Yes.

Q. And would you like to share those with us and the Commission, please?

A. Well, the bigger picture topics that I'll elaborate on a little bit more fit into these categories.

I just consider the first one misrepresenting some of the prior modeling that was done.

Looking at lot of the typographical errors.

The inappropriate use of available data.

Other kinds of errors in calculations.

And then showing actually that the theme we feel is important to consider is that one size doesn't fit all, really does apply, even considering the approaches that the OCD staff have taken.

And that finally, you remember I had discussed that maybe 1000 milligrams per kilogram isn't a reasonable default chloride level. We did some calculations, consistently we find out maybe 2000 milligrams per kilogram is more reasonable and certainly protective of small landfarms.

Q. So the first thing that you indicated was a concern was the handling of prior modeling, and can you tell us what your concerns were there?

A. Okay. What I had heard in the presentation was that the OCD staff had considered four different models and took the results of the four models and averaged them, and that formed the basis, that average formed the basis for the chloride standard of 1000 milligrams per kilogram.

Well, I looked at some -- in some detail at the models --

MR. BROOKS: Excuse me, Mr. Chairman, the gentleman who prepared the input that Mr. -- that Dr. Stephens is commenting on is not in the hearing room. I'm wondering if we could perhaps go over something else and put off analyzing Mr. Price's work. I don't believe Mr. Price --

CHAIRMAN FESMIRE: Where is Mr. Price?

MR. BROOKS: I think Mr. Price will be back in a couple of minutes, so I think it would be helpful to us if Mr. Price could hear the criticism of his work.

CHAIRMAN FESMIRE: I think he's right, but I don't want to --

THE WITNESS: It's all his.

MR. HISER: Pretty much that's all we're going to address in the rebuttal, is the work of Mr. Price. We're happy to sit and wait --

CHAIRMAN FESMIRE: Okay.

MR. HISER: -- if that's the Commission's pleasure.

CHAIRMAN FESMIRE: Let me call upstairs and see if he's up there. There he is.

MR. BROOKS: Would you be so kind -- or Mr. Chairman, would you ask Mr. Hiser if he would show that first slide again so that Mr. Price can see it?

CHAIRMAN FESMIRE: Mr. Hiser, would you do that?

MR. HISER: We'd be pleased. Back two slides.

Q. (By Mr. Hiser) And Dr. Stephens, for the benefit of Mr. Price, could you summarize again what your concerns were from an overview perspective on the study to determine allowed salt content?

A. Okay. My classification, if you will, of the review comments falls into what I would consider misrepresenting the prior modeling, typographical errors, inappropriate use of available data, calculation errors, and then coming up with a chloride concentration which is too low, should perhaps be more like 2000 milligrams per kilogram, using consistent, correct calculations.

Q. Okay, thank you. And as we moved on, then, your first concern, which had been the use of the models, and why don't you explain to us what your concerns were about the use of the models?

A. Okay, what we had heard in Mr. Price's testimony and on the calculation spreadsheet that he provided was that there were four models that were used. The results were averaged, and those four numbers were used to form the basis that 1000 milligrams per kilogram chloride was a reasonable standard.

In looking at the models, although -- and I'll show you this in a second -- the equations look a little different at the beginning, they're actually identical. So two of the four models are really the same. So we're averaging the same number -- or the same model twice.

But actually, if you look closely, each of the models has slightly different input data as well. So not only do we have two models which are the same, each of the models has different input.

Perhaps a more appropriate approach to coming up with an average might be to take three independent models, if you will, and populate them with the same data, make the same assumptions, and then compare the outputs, average the output concentrations.

Q. And in this slide is this, in fact, one of the models that Mr. Price used?

A. Yes, this is called the EPA steady-state infinite source model. And the equations shown here, and the words shown here, are exactly as they appear in the spreadsheet that he used.

Now what I did in the red box is kind of translate them into an equation with symbols that says the risk based screening levels for soil equals 250 milligrams per liter, times the DAF, times the water-filled porosity, times the dry bulk density, that's the --

CHAIRMAN FESMIRE: Times?

THE WITNESS: -- rho sub b is the -- excuse me, water-filled porosity divided by the soil dry bulk density, thank you.

So this is how that equation would be written for the EPA model.

Q. (By Mr. Hiser) Okay. And then what is this slide showing?

A. Well, this shows the equation used by the ASTM chloride working group. And what they start out with is this equation, it says the risk based screening level for soil is equal to the risk based screening level in the groundwater times K_s divided by L sub F [*sic*].

If you make the substitutions for what those terms mean and start doing the math, you end up with this equation, which is exactly the same as the EPA equation.

Q. Which is this one here.

A. Which is that one. That equation is exactly the same as this one.

Q. And that led to your conclusion, then, that the EPA steady-state infinite source model and the one used by the ASTM chloride working group were, in fact, the same model?

A. Yes.

Q. Okay.

A. So I know I make a lot of spelling mistakes, and

I'm not the greatest speller, and I'm sure in my expert report you'll find some typos somewhere. I don't mean to pick on this point on its own, but in combination it's symptomatic. But I just want to point out that here's one page of others which have a number of typographical errors in the spreadsheet. Now spreadsheets aren't reports, maybe they weren't peer-reviewed. I'm not sure exactly what to make of it on its own, but perhaps it's part of a bigger issue.

Here is a portion of the spreadsheet that we looked at, and we try to calculate or check the references that were used, and here's a document called the USGS New Mexico State Engineer report 84-4062 that was used to develop data that was input into this API VADSAT model, one of the four models used to chloride at 1000 milligrams per kilogram. The title is shown here as Groundwater Recharge in the Southern High Plains, but the title on the document says "Projected water-level declines in the Ogallala aquifer in Lea County, New Mexico". A small point, typographical error, I'm not sure what. But it does perhaps add up, in my mind, to be part of the overall evaluation.

When we start looking at the data that went int these various models, we try to look at the spreadsheets and see where the data come from. And here you'll see a row -- this is for the API VADSAT modeling program. And this API VADSAT modeling program is very similar to the type of program that we used to come up with our calculations that I showed you for the Class A and Class B landfarms.

One of the pieces of data that's required is saturated hydraulic conductivity of the groundwater. This is the groundwater row. It says groundwater is 10 feet thick, there's no decay -- biodegradation happening, and the saturated hydraulic conductivity of the sand is .888 meters per day. Well, that equates to 2.9 feet per day. And this report -- it's alleged that the data come from the USGS source, 1984.

If you look in the report, however, it has 10 to 170 feet per day as a plausible, and in the model that was done of the Ogallala aquifer they actually used 16 to 155 feet per day, not 2.9 feet per day. So we're not sure where this number comes from.

Q. And for the members of the Commission who may not be modelers as much as you are, what would be the effect of the increase in the -- or using a hydraulic conductivity in the range of 10 to 170, or 16 to 155, versus one of 2.9 feet per day?

A. Well, this affects the dilution attenuation factor considerably. All other things considered equal, if we instead used -- instead of 2.9 we used 29 feet per day, 29 feet per day would be within the range but at the low end of the numbers shown here, and that would increase the dilution attenuation factor by perhaps a factor of 10.

Q. Did you find a similar issue with the porosity data?

A. Yes, this is -- there was the saturated hydraulic conductivity in the same row, the next item in that row is porosity. They used 30 percent, and the USGS report uses 35 percent. A small -- admittedly, a small difference, but I'd say it's undocumented. I don't know where it comes from.

Then we look at the different models and find that they used inconsistent data. One of the models, called the VADSAT model -- it's in Tab 3 of that handout -- uses three feet per day. Another model called the EPA infinite source model uses 40 feet per day. And we really don't know, but we've calculated based on the available information in the ASTM chloride working group model that the hydraulic conductivity seems to have been 61 feet per day. So here we have a 20-fold difference in permeability.

And permeability is one of the key factors that affects the amount of dilution. That controls how much groundwater is flowing into that mixing box where the blending with the leachate from the vadose zone occurs.

So the permeabilities seem to vary from one model to the other, as do areas.

We have a five-acre area in the VADSAT model, the EPA infinite source model and the DAF study, they all use the five acres.

And then here's one, the ASTM chloride working group model uses .001 acres, best I can tell. Nevertheless, we have a small landfarm of 1400 cubic yards which, if it's two feet thick, would equate to about .4 of an acre. That wasn't modeled at all.

Another input parameter -- this is part of the mixing concept as well -- the amount of recharge that's occurring. .38 inches per year was used in the VADSAT model. That's about -- What does come out to be? Probably 9 millimeters per year. It's used in these two models, but in the ASTM chloride working group model, it's 1.17 inches per year. I'm not sure why.

One of the models uses a gradient of .01. Now in my experience that's quite high. You don't often see a gradient of .01 in most groundwater environments. Usually it's at 10 times less than that.

And not unreasonably in the EPA infinite source model, they use .0023 as the hydraulic gradient. I don't know what they used in the ASTM with the chloride working group model; it just wasn't listed for us to ascertain.

The next group of comments deals with the equation. This particular equation that's shown here, this calculates the dilution factor in groundwater. It's called LF. And if you plug numbers into this equation, you will not -- you will not get anything reasonable. What you'll find is that is that you put 1.16 inches per year of recharge, .3 percent -- or 30 percent water content, and 1.5 bulk density into this equation, you'd calculate a chloride for the soil of 104,000 milligrams per kilogram, or a DAF of 2100.

So something's wrong with this equation, and I think it's just some parentheses that are not in the right location. But if you do the math through this equation, you won't get to these numbers.

Here's another nit-picky thing, but the recharge was -- in this particular -- this is the chloride working group Tier 1 evaluation. The recharge that was input is .25 centimeters per year, and that was multiplied by 10 to get 1.16 inches per year. Centimeters per year, converting to inches per year, really would come out to .98 inches per year, not 1.16. So there's an error difference of about 15 percent. Just sort of a conversion error.

Here's a math error that we think must have occurred somewhere, we're not sure exactly where. But using a DAF of 109, assuming that's correct, you can't get to 1938 milligrams per kilogram. What you do get is to 5450 milligrams per kilogram in the soil, from what we see anyway. Maybe we're missing something, but a DAF of 109 should allow you to have a much higher concentration in the soil than what's shown here.

This one's a little easier to see that there's something wrong in this interpolation scheme. This is the look-up table DAF, and I thought maybe we'd see 500 acres on here, but we don't.

At any rate, for the five-acre size what's done is to draw a horizontal line through here and say that the -- this is area, and these are the DAF values for different percentages of the sites. So take the 90th -- 90 percent of the sites have DAFs of these numbers.

So if the table has 4.6 acres and 11.5 acres and what you want to find is 5 acres, in this column you'd say, okay, well the number for the DAF should fall somewhere between 5.5 and 13, probably close to 13. But the answer that was found is 15. So it looks to me like there's some kind of error in how this interpolation was developed for a five-acre site.

Now here's an averaging error, we think. We tried to take the spreadsheet apart and see how possibly one could average these three numbers. The -- These are the four models. It's kind of off the screen here, but the four models give you results of 1000, 1183, I believe that's 1963 [*sic*] and 750.

And then compensating for some background concentrations we get numbers like 1000, 1153 and 1963 [*sic*], which -- you know, you say, how do you get those three numbers to be 1027? Well look at it. 1000, 1100 and then 1900. Shouldn't those three numbers be higher than 1000? Much higher than 1000?

What we tried to figure out was, in the algorithm that a zero was put into this row. And so if you took these three numbers, added a zero to it and divided by four, yes, you'd get 1027.

Probably what they should have done, using their calculations, was added, instead of 1000 plus 1153 plus 1953, should have added another 1000 and divided that by 4, and you'd get 1277.

Q. And so looking at that, other than perhaps falling back into our -- the professorial, Gee, looking at this I've got lots of comments, why is that a concern to the Commission, or what do you think may have befallen the staff as they were working through all these different models?

A. I don't know, really. I kid of think that what was revealing to me -- and I'm getting ahead of myself as well, but I heard in response to a comment at the last meeting that one of the reasons why the northern British Columbia vegetation study was used, rather than New Mexico or more southwestern or arid zones, vegetation, salinity-tolerance data, was, they didn't have time to look up more information. This was readily available.

And so it started to sink in to me after we looked at some more of these calculations, and this is where the typo stuff comes in, this is where -- you know, looking at spreadsheets and calculations and finding small mistakes comes in, and it looks like maybe they just didn't have enough time. Maybe there was some rush going on in trying to -- you know, spreading out thin staff on an important project, just didn't have the -- you know, time and resources to do -- as much as that needed to be done. I'm not sure how else to interpret it.

Q. Okay. What did you do next?

A. Well, we kind of looked at the information that was provided and tried to interpret it in the context of what kind of variability would you -- would their numbers show in chloride that could be in the waste acceptance criteria.

Here, for example, is, in the steady-state infinite source model, you see the ranges for aquifer hydraulic conductivity. That's the same as permeability, in essence. Those numbers that they've cited here range from 16 feet per day to 155 feet per day, and that's a considerable range but none of the numbers is unreasonable. But if you did use any one of those end-member numbers, you'd get quite a range of concentrations in chloride, which would be equally protective of groundwater, ranging from 400 to 6800 milligrams per kilogram.

So the chloride load, or the amount of chloride that you could put in the waste and still be protective of groundwater, is clearly dependent on a site-specific condition, namely the permeability or hydraulic conductivity of the aquifer.

This shows, too, that the amount of chloride in the waste depends on the area of the landfarm. And I think we have talked about this before, but if the landfarm area were two acres, sort of a square site, 295 feet on a side, instead of the five acres, then the OCD's allowable chloride in the waste would increase from 1183 to 1829 milligrams per kilogram, a 55-percent increase, just going from a five-acre down to a two-acre site.

Q. And a two-acre site is more representative of what the industry committee has recommended for a small landfarm?

A. Yes.

Q. What about shape? Does that have an impact on the answers that one receives?

A. Yes. In this slide what we're -- one of the variables in this calculation of a dilution factor is the length of the source parallel to the groundwater.

If you go back to one of the slides I showed that had a conceptual model of how this dilution attenuation factor worked, you'll see that one of the parameters is L. That is the length of the side of the landfarm parallel to the direction of groundwater flow.

So what you find here is, if you change that same area, five acres, but you make it 200 feet by 1000 feet, and you turn it on its side so it's more or less long -- here's the groundwater flowing this way, but the site is thin and wide relative to the direction of groundwater flow -- the amount of chloride that could be put in the waste zone increases to 2673 milligrams per liter, almost double -- more than double. So that's a variable, site-specific or operation-specific condition.

And then you can combine these as well. You could say, well, let's take the two-acre, we'll make it smaller, and orient it so that the narrow dimension is parallel to the groundwater flow direction, and you could increase the chloride allowance in the treatment zone up to 7000 milligrams per kilogram, using the same kind of model that is -- was used by OCD.

So all these factors can compound and lead to significantly increased -- significant increases in the amount of chloride that you could leave in the waste zone.

Q. And so Dr. Stephens, would it be partly your testimony that this tool could be used by the OCD staff to use a somewhat more site-specific approach to landfarms to set a more appropriate chloride limit?

A. Yes.

Q. Yes.

Q. And did you then do some revised calculations for the industry committee's proposed two-acre small landfarm?

A. Yes. What we did here is, we took the three models, and we assumed one of them was the same as the other, so we used the same basic models, if you will, kept the areas the same, kept the hydraulic conductivities and the gradients and the infiltration rates the same, and calculated what the chloride level should be, adjusted for background, much as OCD had done using their assumption of 50 milligrams per liter.

And what we find is, you get 1954 milligrams per kilogram. This would have been -- this is close to 2000 milligrams per kilogram -- would be compared to the 1000-milligram-per-kilogram standard that was calculated.

Q. And do you believe that this would be protective for a typical two-acre site here in New Mexico?

A. Yes, based on these data.

Q. And then did you do a revised calculation for the OCD's proposed 1400-cubic-yard site?

A. Yes.

Q. And what did you determine, having done the calculation using the same models that we did?

A. What we concluded is that perhaps 6000 milligrams per kilogram is protective, using all the same aquifer and vadose zone parameters, just decreasing the area to that corresponding to about 1400 cubic yards, you'd get about 6000 milligrams per kilogram chloride that could be in the waste, that would be protective of groundwater.

Q. Did you look at some of the evaluation of chlorides for plants and all in the information sources that were used?

A. Yes, I was curious, you know, this use of the northern British Columbia -- I don't know how far south of the arctic circle that is, but I was curious, you know, what is available in New Mexico? This is not my area of specialty, but I do know a little bit about desert plants and wanted to find out what would be readily available if I were asked to find out the salt tolerance of desert plants.

And to be honest with you, I gave this to one of our staff on one morning, and by the afternoon she had a whole long list of references which I'm showing here that could be useful. Maybe this is a tool that could serve a purpose for the Division here to take a look at.

Q. And so these would be the types of sources that you would anticipate that the Division would have consulted in trying to evaluate what would be appropriate salt levels for surficial soils in New Mexico for re-vegetation purposes?

A. Yes.

Q. What else did you note about the Scots pine and blue spruce?

A. Well, we tried to look at where some of these Scots pine and blue spruce might be found in New Mexico, and based on, again, sort of a quick computer literature search, we couldn't find any Scots pine in New Mexico.

Blue spruce, yes, we did find some that might -- in oil-producing counties. We did find some in San Juan and Otero Counties. These are low-salt-tolerant type of trees.

But some of the other oil-producing areas, there's more than 20 salt-tolerant plants that are tolerant for more than 12 millimhos per centimeter, just listing a few of the more common ones here and where they're found: saltgrass, alkali sacaton, crested wheatgrass, western wheatgrass, et cetera.

So there is some information that can be used here for establishing the probability of a good vegetative cover on a closed landfarm.

Q. And so your basic recommendation would be that in evaluating the closure standards, particularly for re-vegetation, that we should -- that more of these New Mexico or southwestern-specific sources and resources should be consulted?

A. Yes.

Q. Did you have any conclusions, really, based on all of the review of Mr. Price's testimony that you undertook?

A. Yes, my assessment is that -- looking over the technical basis for coming up with the 1000-milligram-per-kilogram standard for the landfarm, it just seems to me that it's based on unreliable information. There are so many calculation or small errors, I just think it's not very reliable.

And -- however, I mean, there's still a lot of benefit to be derived from the work. I think the methods are appropriate, just need to use the right data. And when you do use the right data and understand how many variables there are to adjust, it's pretty clear that it indicates that there's a need to develop some flexibility to come up with site-specific standards for chloride.

This is -- that's the end.

Q. Okay, that's -- now Mr. -- or Dr. Stephens, were you here for Mr. von Gonten's testimony?

A. Yes.

Q. And do you recall that in his testimony one of the questions on cross-examination that I asked him was whether or not material might leach from a landfarm?

A. Yes.

Q. And I believe that that question that I'd asked was basically assuming that a landfarm was operating with water capacity at 60 to 80 percent of field capacity, and I asked him that question. I believe that he opined or stated that in his opinion you could operate a landfarm at that capacity without having much, if anything, go out of the treatment zone into the vadose zone --

A. Yes.

Q. -- is that correct?

Do you share that opinion?

A. No.

Q. Would you like to explain to the Commission what your concerns are with that opinion?

A. The concern relates to the trigger for vadose zone monitoring. I think I tried to elaborate on this as I was going through my direct testimony, and that is, the constituents in the landfarm will migrate upward or downward or laterally, due to various processes. The downward movement is the key one we're looking at here, and that can happen two ways.

Volatile constituents can diffuse due to concentration gradients. Just open a perfume bottle here, you'll smell it over there. No matter what direction soil water is moving, it just diffuses and fills up a space due to concentration differences. Once that air with perfume in it contacts water it will partition back into the water, and a chemical analysis may be able to detect it, because that gas or that water has the constituents in that sample.

The other mechanism is by drainage and redistribution, those two processes that I've described. Gravity is always downward, no matter what. And it depends on whether the soil water movement is upward or downward, but more likely than not, the conservative assumption to make is that, water will be moving downward. And in that sense, it seems to me that if you have a vadose zone monitoring sample right underneath the contact with the landfarm material, after three years or more you will see something. One of the 3103 constituents, something above background, will be found.

And the conclusion could be, we need to remediate, we need to stop. And it's unfounded because there's no harm, there's no risk to the groundwater, which is the objective of the protection afforded by the vadose zone monitoring.

Q. Now Dr. Stephens, I want to back you up for a little bit, because when I asked the question of Mr. von Gonten he assured me that to the best of his knowledge, that at 60 to 80 percent of field capacity there was insufficient water in the landfarm to actually cause anything to move downwards. Do you not -- do you disagree with that conclusion?

A. Yes, I think specifically he said that because the water -- the soil wasn't saturated, no water will move from the landfarm down into the soil underlying it. That's just not true. We have water movement in partially saturated soils all the time. We don't need saturation to make water move through the vadose zone. It fundamentally happens every day. It's just physics, and it happens all the time in New Mexico.

Q. And so your concern is basically that as the Division has proposed the corrective action trigger for landfarms to the Commission, that it would be virtually impossible to operate a landfarm without triggering a corrective-action obligation?

A. It's very possible, that's exactly the outcome you could get, depending on where the vadose zone samples are detected, that's a possibility.

Q. Is there -- To borrow from Mr. Brooks, is there anything else that you're supposed to talk about that I forgot to ask you?

(Laughter)

A. Well, now that you've asked...

MR. HISER: Mr. Chairman, we would move of the exhibits and the written report from Dr. Stephens.

CHAIRMAN FESMIRE: What about the rebuttal exhibits?

MR. HISER: And the rebuttal exhibits.

CHAIRMAN FESMIRE: Okay, so we have a copy of the rebuttal exhibits.

MR. HISER: We will provide those tomorrow, I think.

MR. BROOKS: Mr. Chairman, it would be very helpful to us if we could have copies of the rebuttal exhibits this evening so that the witnesses whose testimony is being rebutted would have some time to look at them.

CHAIRMAN FESMIRE: Okay. Mr. Hiser, would you be able to do that this evening?

MR. HISER: We have no objection to providing rebuttal exhibits, although it will be dependent upon the Division to supply the computer and printer to print them.

CHAIRMAN FESMIRE: We can do that, I think.

MR. BROOKS: I think we can, provided that the format in which you have them is compatible with our equipment, which is outside my area of expertise.

CHAIRMAN FESMIRE: They're PowerPoint files, aren't they?

MR. HISER: They are PowerPoint --

CHAIRMAN FESMIRE: Yeah --

MR. HISER: -- files.

CHAIRMAN FESMIRE: -- that shouldn't be a problem at all, should it?

MR. BROOKS: Should not. But like I said, it's outside my area of expertise.

CHAIRMAN FESMIRE: Aside from the Division, is there any objection to the admission of the exhibits?

MR. HUFFAKER: Not if we can get copies soon.

CHAIRMAN FESMIRE: Okay, Mr. Sugarman?

MR. SUGARMAN: No, Mr. Chairman.

CHAIRMAN FESMIRE: Welcome, by the way.

MR. SUGARMAN: Thank you very much.

(Laughter)

MR. BROOKS: And by the way, to be more explicit, the Division has no objection, provided we can get copies this evening.

CHAIRMAN FESMIRE: Okay. With that, we'll admit the exhibits under that condition. I assume there's no objection from the Commission?

COMMISSIONER BAILEY: No.

COMMISSIONER OLSON: No.

MR. HISER: So that was the exhibits, the rebuttal exhibits, and then there was also a written report that was provided with the exhibits, and I guess we'd be moving that as well.

CHAIRMAN FESMIRE: Okay. Any objection?

MR. BROOKS: No objection.

CHAIRMAN FESMIRE: And those are numbered?

MR. HISER: Yeah, I believe so. Mr. Carr was the one that prepared the --

MR. CARR: They will be -- in -- they were prefiled. There were three tabs. One was the background and qualification, the other was PowerPoint slides, and the last one was a written summary of the presentation.

MR. HUFFAKER: That's what's being admitted?

CHAIRMAN FESMIRE: I'm not sure I've got a copy of them, but --

MR. CARR: They were in the notebook.

CHAIRMAN FESMIRE: They're in the notebook?

MR. CARR: Yes.

CHAIRMAN FESMIRE: Okay. Tabs 4, 5 and 6 in the notebook?

MR. CARR: Yes, sir, that's correct.

CHAIRMAN FESMIRE: Is there any objection to admission?

MR. HUFFAKER: No objection.

MR. BROOKS: No objection.

CHAIRMAN FESMIRE: They will be so admitted, and number -- What do we call your clients?

MR. HISER: We're the industry committee.

CHAIRMAN FESMIRE: The industry committee Exhibits 4, 5 and 6.

MR. HISER: We pass the witness.

CHAIRMAN FESMIRE: Okay. Mr. Carr, will you have any --

MR. CARR: No.

CHAIRMAN FESMIRE: -- rebuttal?

Mr. Huffaker, would you -- Cross-examination, Mr. Huffaker?

MR. HUFFAKER: I have a little.

CHAIRMAN FESMIRE: How long will it take, do you think?

MR. HUFFAKER: Ten to 15 minutes.

CHAIRMAN FESMIRE: Why don't we go ahead and finish yours and then call it a day?

CROSS-EXAMINATION

BY MR. HUFFAKER:

Q. Dr. Stephens, your studies were concerned with the impact -- the potential impact to groundwater; is that correct?

A. Yes.

Q. You were critical of some of the studies the Division did, as you've just testified, and in particular, some -- you had criticism of some of the input parameters, some of the use of formulas and some of the calculations that the Division made.

My question is this: Where can we find all the input parameters, formulas and calculations that you did for your model?

A. I think they're all listed in the table that's provided in the expert report as information presented at the stakeholder meeting. Just have to get the code and type in the input.

Q. Get the code and type in the input.

A. Right.

Q. Can you tell me what you mean by that?

A. Well, you would need to get the HYDRUS 1D code, you'd need to get the MODFLOW 96 code, you'd need to get the MT3DMS code and look at the table of input parameters and run the model.

Q. Where would we find the input parameters that you used?

A. In the table.

Q. Is that somewhere in the exhibits that we just admitted?

A. Yes.

Q. All right, thank you. Define recharge.
A. Recharge is the water that replenishes the aquifer.
Q. And when you say there's recharge of .5 millimeters or 19 millimeters per year, what does that mean?
A. That means -- it's the volume of water per unit area that would enter the aquifer.
Q. At the surface?
A. If we're talking about water percolating down from the vadose zone, yes.
Q. So it doesn't say anything about how much water would be percolating at any given point below the surface, does it?
A. On average, it would say that that's the -- that's the rate at which water is moving per bulk volume of soil. Through a bulk volume of soil, that's the rate at which water would move through it. It doesn't tell you how fast the molecules of water are moving.
Q. Well, millimeters to me is a measure of distance; isn't that correct?
A. Yes.
Q. It's not a measure of rate, is it?
A. Well, length per time is.
Q. So are you saying that -- if we have a rainfall

event and it provides, say, 10 millimeters of rain at the surface, it's your testimony that at some point in time that same 10 millimeters will pass through the vadose zone at 10 feet, 20 feet, 30 feet, 40 feet, 50 feet? Is that what your testimony is?

A. Absolutely not.

Q. What does an infiltration rate of, say, 10 millimeters per year say about the amount of water that will pass through the vadose zone at some lower level in the vadose zone?

A. Are you talking about the infiltration across the atmosphere/soil boundary?

Q. No, I'm talking about below the atmosphere/soil boundary, a future period of time.

A. So below the root zone?

Q. Yes, sure.

A. It's -- Okay, now I understand what we're talking about. What's the question again, please?

Q. What does an infiltration rate of 10 millimeters per year tell us about the amount of water that will be passing through lower levels of the vadose zone, say for instance, below the root zone?

A. If the rate of water flow below the root zone is 10 millimeters per year, then more likely than not, eventually that 10 millimeters per year through whatever area that is measured will find its way to the water table.

Q. And that's also true, according to your testimony, if we have a 10-millimeter-per-year recharge rate at the surface that will translate into -- ultimately, at some point in the future, a 10-millimeter infiltration rate below the root zone?

A. No.

Q. What will be the infiltration rate below the root zone?

A. Probably a few percent of that.

Q. All right, that's what I wanted to establish.

Now, you are a hydrologist but you are not a plant expert, as you testified, correct?

A. That's correct.

Q. What kind of contamination have you assumed, for the purpose of your testimony, is going into a landfarm under these proposed Rules?

A. The area I was asked to address was chloride.

Q. So you did not address in your testimony other contaminants, other than chloride; is that correct?

A. The focus was on chloride, but we also talked about water movement in general, we talked about other processes that go on, such as biodegradation and transformations and so on, but the focus of the calculations that I did was directed to the 1000-milligram-per-kilogram standard in the waste acceptance criteria.

Q. And I think I understood you to be saying, maybe not explicitly, but at least conceptually, that it's acceptable to you to apply non-remediable contaminants to land as part of these Rules, i.e., chloride is nonremediable, correct?

A. I'm not sure I understand what you mean.

Q. You don't have any conceptual problem with applying chloride to a landfarm, do you?

A. I guess I'm still not following what you mean by a conceptual problem.

Q. It's acceptable to you as a practice to apply chloride-contaminated soils to a landfarm?

A. As long as it doesn't impair the groundwater above the standards.

Q. And it's also acceptable to you, in concept, to apply other non-remediable contaminants to a landfarm, such as the NMED 3103 contaminants, correct?

A. I don't know that they're not remediable, if I understand the sense that you're speaking about. Maybe if you can define non-remediable.

Q. Are you familiar with the list of the 3103 contaminants that Mr. von Gonten testified that --

A. Many of them --

Q. -- should be tested --

A. -- many of the constituents.

Q. You are?

A. Yes.

Q. And area you aware of any of those that are not remediable in the landfarm environment?

A. Well, the chloride doesn't degrade on its own. It can leach and mobilize, it can get concentrated due to evapotranspiration. If remediation means to prevent it from moving to the natural environment, we have good evidence that the -- there's sort of a natural remediation process that goes on with native plants that accumulate the chloride and prevent it from getting down. Those chloride bulges have been present for thousands of years.

Q. Is arsenic remediable in a landfarm environment?

A. I don't know.

Q. How about chromium?

A. I don't know offhand?

Q. Mercury?

A. I don't know.

Q. Those kinds of inorganics and elements and metals you assume may be present in a landfarm as part of your testimony, correct?

A. It's not relevant to my testimony, but listening to the other testimony I understand that they may be there, but it really wasn't my testimony what was in the landfarm.

Q. Exactly, you weren't looking at those contaminants, were you?

A. No, I focused on chloride.

Q. And you weren't considering whether or not they would be remediated in a landfarm, were you?

A. No.

Q. And if you did consider the presence of those elements and metals in a landfarm, is there a level that would cause you concern?

A. Yes.

Q. But you haven't studied that either?

A. No. Well, not directly. I mean, you can -- again, you can look up -- I haven't studied, I mean, if you look up, just for example, the residential screening levels for the 3103 constituents, they're in a table. That's part of the testimony here. You can see what the concentrations are that would be protective of groundwater for all the constituents, and you can compare those to the OCD's proposed soil screening levels, if that's what you mean. I mean, that's certainly something I can do and have considered.

Q. But you haven't done it in this case?

A. Haven't done what?

Q. Considered the impact of those constituents on -- the potential impact of those constituents on groundwater?

A. Well, in a way I have because, you know, I've looked at all these standards that are proposed for closure of the landfarm, the treatment zone in particular, and I have considered them relative to, for example, the laboratory practical quantitation limits. We've looked at all these levels that are recommended for closure, compare them to what the laboratories can assess. I've also looked at ratios of how much lower the concentrations are that the OCD is proposing for closure, compared to what the residential screening levels are in soil. I have considered that as part of my thinking. Maybe I didn't bring it out directly, but those levels that are established in the table, in the voluntary cleanup program, are ones that the State of New Mexico Environment Department thinks are protective of residential uses, for all the constituents that are listed.

Q. And you haven't considered as part of your work in this case what level of those contaminants in the soil, in the treatment zone or the root zone, should be cause for concern, have you?

A. I can't agree with that. I think I have considered. I mean, I've looked at data. In fact, I looked at some of the concentrations that have been reported in oilfield wastes, I've compared it to concentrations that are in the soil screening levels established by OCD and NMED, the background concentrations of metals that might be expected in the environment, and I have thought about a lot of that.

Q. Where can we find that in the exhibits that have been admitted, your thoughts?

A. Well, one of them I presented, I showed you, for example, the practical quantitation limit table. The constituents are listed there. Portions of them are in testimony that was given by Mr. Price and others.

Q. Is that the answer to my question?

A. I hope so.

Q. Thank you. Now according to your testimony it is acceptable for contaminants that are of concern in this case to remain in the soil above background. You've testified to that, right?

A. Yes.

Q. So degradation of the soil is acceptable, or should be acceptable, according to your testimony?

A. Under conditions that it does not affect the -- and again, my testimony is relative to risks to groundwater. So with respect to that, with respect to groundwater standards, yes.

Q. How about with respect to soil standards?

A. I don't know of any soil standards other than the voluntary cleanup --

Q. So you haven't --
A. -- program.
Q. You have not studied that?
A. Haven't studied what?
Q. The effect of contaminant levels that you consider acceptable for groundwater impacts to soil.
A. Well, I thought we went through this. I did look at the table that NMED feels is protective -- soil concentrations that New Mexico Environment Department considers protective of groundwater for all the 3103 constituents.
Q. That's true. And the issue there is protection of groundwater?
A. And that's my area of expertise, yes.
Q. Yes, thank you.
Would you agree there's a level at which chloride is toxic to plants?
A. Yes.
Q. And would you agree that therefore there's a level at which chloride will affect -- or excuse me, will prevent effective re-vegetation of a landfarm?
A. Possible.
Q. And the determination of that level is not part of your work in this case, is it?
A. No, I haven't testified as to what level is

either toxic to plants or a level at which plant growth is impeded to some degree. I have heard the testimony and read some of the documents that Mr. Price has relied on, however.

MR. HUFFAKER: That's all I have.

CHAIRMAN FESMIRE: Okay. With that, we will continue this case, Cause Number 13,586, until eight o'clock in the morning, Friday, May 5th.

At the same time, we're going to continue Cause Number 13,589, the Application of Duke Field Energy [*sic*] Services for approval of an acid gas injection well in Lea County, New Mexico.

Before we adjourn, I'm going to ask, is there anyone here who wants to put a comment on the record in Cause Number 13,586?

Seeing none, we'll adjourn until eight o'clock in the morning. Thank you.

(Thereupon, evening recess was taken at 5:10 p.m.)

* * *

CERTIFICATE OF REPORTER

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

I, Steven T. Brenner, Certified Court Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Commission was reported by me; that I transcribed my notes; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL May 15th, 2006.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 16th, 2006

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:)
) CASE NO. 13,586
APPLICATION OF THE NEW MEXICO OIL)
CONSERVATION DIVISION FOR THE REPEAL)
OF EXISTING RULES 709, 710 AND 711)
CONCERNING SURFACE WASTE MANAGEMENT)
AND THE ADOPTION OF NEW RULES GOVERNING)
SURFACE WASTE MANAGEMENT)
)

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REPORTER'S TRANSCRIPT OF PROCEEDINGS

COMMISSION HEARING

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

Volume IV - May 5th, 2006

Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Commission, MARK E. FESMIRE, Chairman, on April 20th-21st and May 4th-5th, 2006, at the New Mexico Energy, Minerals and Natural Resources Department, 1220 South Saint Francis Drive, Room 102, Santa Fe, New Mexico, Steven T. Brenner, Certified Court Reporter No. 7 for the State of New Mexico.

* * *

C U M U L A T I V E   I N D E X

April 20th-21st, May 4th-5th, 2006
Commission Hearing
CASE NO. 13,586

* * *

(Continued...)

CUMULATIVE INDEX (Continued)

APRIL 21st, 2006 (VOLUME II):

(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

(Continued...)

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CUMULATIVE INDEX OF EXHIBITS

(Continued...)

CUMULATIVE INDEX OF EXHIBITS (Continued)

* * *

Additional submission by the Division, not offered or admitted:

* * *

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* * *

ALSO PRESENT:

ALAN ALEXANDER (Burlington Resources Oil and Gas Company)
Industry Committee

BRUCE BAIZEL
Oil and Gas Accountability Project

JOHN BARTLIT, PhD
New Mexico Citizens for Clean Air and Water

DAVID BAYS (Williams Field Service)
Industry Committee

MARVIN BURROWS
Hendrix

CARL CHAVEZ
Environmental Engineer, OCD

THERESA DURAN-SAENZ
Legal Assistant, NMOCD

(Continued...)

ALSO PRESENT (Continued):

KARIN FOSTER
IPANM

DENNY FOUST
Aztec District Office (District 3), NMOCD

RAND FRENCH (Marbob Energy Corporation)
Industry Committee

DAN GIRAND
Mack Energy Corporation

RANDY HICKS
Randy T. Hicks Consultants

SUZANNE P. HOLLAND (ConocoPhillips)
Industry Committee

FRANK KRUGH (Marathon Oil Company)
Industry Committee

LINK LACEWELL
BLM (Carlsbad)

MARK LARSON
Larson & Associates

BILL MARLEY
Gandy Marley

KENNETH R. MARSH
Controlled Recovery, Inc.

MARK MATHIS
Citizens Alliance for Responsible Energy

MARK E. MILLER
Daniel B. Stephens & Associates

RAY MOXLEY
Chevron

DONALD A. NEEPER, PhD
New Mexico Citizens for Clean Air and Water, Inc.

(Continued...)

ALSO PRESENT (Continued):

DENNIS NEWMAN (OXY)
Industry Committee

LISA NORTON
Yates Petroleum Corporation

YOLANDA PEREZ (ConocoPhillips)
Industry Committee

BRANDON POWELL
Aztec District Office (District 3), NMOCD

WAYNE PRICE
Environmental Bureau Chief, NMOCD

DEBORAH D. SELIGMAN
NMOGA

KELLIE SHELTON
Emerson

DANIEL B. STEPHENS, PhD (Hydrogeologist)
Industry Committee

KERRY L. SUBLETTE (Chemical/environmental engineer)
Industry Committee

FORREST B. (BEN) THOMAS, PhD (Toxicologist)
Industry Committee

GLEN VON GONTEN
Senior Hydrologist, OCD

* * *

WHEREUPON, the following proceedings were had at 8:05 a.m.:

CHAIRMAN FESMIRE: Let's go on the record.

There are a couple of housekeeping issues that we have to take care of before we start.

Let the record reflect that present at the May 5th meeting of the New Mexico Oil Conservation Commission, which is a continuation of Case Number 13,586, are Commissioners Olson, Bailey and Fesmire -- a quorum is present -- and that a quorum was present yesterday on the 4th also.

Is there anybody in the audience who wishes to make a statement this morning before we continue with the formal presentations?

Let the record reflect that there was no one present who wanted to make a statement at this time.

I believe we were about to being the cross-examination of Dr. Stephens.

Mr. Hiser, do you have anything to say before we start?

MR. HISER: Mr. Chairman, we've distributed copies of the rebuttal exhibits to the members of the Commission and to the court reporter. We have additional copies that are coming that we'll provide to the rest of counsel, and some additional copies for the Commission.

That includes the materials that were requested yesterday.

CHAIRMAN FESMIRE: Has everyone gotten a copy of those that needs one? Counsel and the Commission? Okay.

MR. BROOKS: Yes, your Honor, I have them, and my witness has them.

CHAIRMAN FESMIRE: Okay.

MR. CARR: And there are 15 copies somewhere between my office and here.

(Laughter)

CHAIRMAN FESMIRE: With that, going down the list I guess we'll start with Dr. Neeper on cross-examination. Doctor, are you prepared to do that?

DR. NEEPER: Yes, sir.

CHAIRMAN FESMIRE: Okay. Why don't you go ahead and...

DR. NEEPER: Thank you. I think it will be easier here because I see I'm seated behind the witness, and it's a little uncomfortable for the witness.

<u>DANIEL B. STEPHENS</u> (Continued),

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

CROSS-EXAMINATION

BY DR. NEEPER:

Q. Dr. Stephens, a fair fraction of your testimony dealt with the dilution attenuation factor, or the DAF, as it is called. Is that a parameter for modeling, or is that a measurable feature, hydrological feature, that can be measured?

A. You can calculate it from hydrologic information about the vadose zone, flow rate and aquifer flow through a certain volume of the aquifer.

Q. But it's not a measurable item that you can take a sample or set up an apparatus directly to measure, or it's not generally done that way; is that correct?

A. No, it's usually calculated from other measurements, hydraulic gradient, hydraulic conductivity, infiltration rate and so on.

Q. So for any particular site, one has to use one's best estimate, then, of what should be used?

A. You don't have to. I mean, all the parameters that are in the equation can be measured in the field. You could estimate them without going into the field, use your best judgment. You have more uncertainty about specifics of the site.

Q. The things you then mean that you measure would be items such as the hydraulic conductivity specifically to the site?

A. Yes.

Q. And you have mentioned that site-specific conditions should be considered in establishing what the limits -- the chloride limits would be on a site; is that correct?

A. Yes.

Q. Did you mean, then, that one should measure such parameters as the hydraulic conductivity and its vertical variation at that site?

A. For the most specific analysis, that's the best way to do it. However, it depends on the site. There may be measurements of hydraulic conductivity that are adjacent to the site or that are well established because of the aquifer's characteristics being fairly uniform from one location to the other where hydraulic properties are known.

So it would really just depend on whether you could rely on existing information reasonably, or whether you were out in an area that was sort of uncharted, maybe you need to have site-specific measurements to be reasonably certain about site-specific dilution attenuation factors.

Q. If you needed site-specific information, would that be an expensive undertaking?

A. Well, for me personally it would. But it depends on the level of the investigation and what's at stake. So it's all relative.

Q. Could you give us an estimate, say in comparison, a comparative dollar amount is, it would cost, say, $25,000 for the operator to acquire a bond, I believe is in the proposed Rule. Would this be a large expense or a small expense?

A. Well, again it depends. If we're talking about having to drill a well, that would mean -- what's the depth to the water table? Kind of a -- that would be a major expense --

Q. That would be a major expense.

A. -- a pumping well and conducting a test, that could be a few tens of thousands of dollars.

Q. All right. Does groundwater recharge often occur by flowing preferential pathways?

A. It can.

Q. It can. And does this affect contaminant transport?

A. In some areas where that preferential flow is occurring and it's continuous to the groundwater, it could affect impacts.

Q. Is this a generally recognized feature in unsaturated-zone hydrology?

A. It depends. It depends on the nature of the stratigraphy, it depends on the boundary conditions, and it depends on what type of heterogeneity we're talking about.

Q. So by that you mean it's a site-specific condition?

A. Generally, yes.

Q. But you made no mention of this at all in your presentation. Was that because you feel this would not occur in any of our sites in New Mexico?

A. Well, there's no reason to believe that there is a continuous preferential path -- if you're proposing that one exists -- it's not that -- it's not common at a scale where we're looking from the land surface down to the water table. That's very uncommon in my experience.

Locally, you could spill water on the ground and you could examine the behavior of the wetting front and you could find some instabilities, maybe, in the wetting front. But I wouldn't consider that as a phenomenon that propagates to the water table. It might be considered by some to be a type of preferential flow, but I wouldn't think it's of any major significance to transport.

Q. All right, I just want to make that clear so I'll ask you a very similar question again. You would say, then, that the flowing preferential pathways, based on your experience as a hydrologist, is not a major factor in contaminant transport to the aquifer?

A. I didn't say that. There's different types of preferential flow paths. On one end you could imagine a karst environment -- a pipe, going from the land surface to the water table. I don't imagine that would be a suitable site. I wouldn't recommend that as a good place for any kind of waste disposal operation.

On the other hand, if you have a stratified alluvial deposit, generally speaking, fissures that are propagating all the way to the water table are rather uncommon. They can occur but are rather uncommon. And in many places where they do occur, they silt up.

Q. You have said -- correct me if I'm wrong -- permeability is a key factor, and that the amount of chloride transport depends on the site-specific conductivity of the aquifer; is that correct?

A. Can you repeat it, please?

Q. All right, I understand from -- that you made the statement that the permeability in -- that would be in the vadose zone is a key factor and that the amount of chloride transport depends on the site-specific conductivity of the aquifer.

A. I don't know that I said anything about the hydraulic conductivity of the vadose zone except in the context of the density of the soil, water density, pore water density. We talked primarily about the infiltration rate, which would not be limited by the hydraulic conductivity of the vadose zone. That was more the context of the testimony, I think.

Q. Perhaps the question should be amended to the unsaturated hydraulic conductivity?

A. I think the answer would be the same, though.

Q. Very well. In comparison with your modeling studies, did you examine the unsaturated transport at any sites in New Mexico to depths of 50 feet or greater than 50 feet?

A. Can you say that again, please?

Q. Your -- You showed the influence of chloride on ground surface, the influence of that upon chloride in the aquifer, by modeling studies. You estimated that by modeling studies. And I am asking, did you compare your modeling studies with any actual measurements of transport over distances to 50 feet or greater in New Mexico, in the unsaturated zone?

A. No.

Q. Would it be common professional practice to validate a modeling study against available data?

A. Well, in some situations that is an appropriate approach to use. In this case we're trying to develop screening levels. And I think the approach that -- and the purpose of the modeling is appropriate.

The models have been, say verified, to be accurate in that they simulate the processes that they're intended to simulate. That's been done in the development of the code.

As to the application of the model to a specific site, that's where you get into validation, that's more of a site-specific exercise. But we're trying to -- My understanding is, we're looking at a very broad rulemaking here, not site-specific -- a prediction, but we're just trying to show how these models can be used broadly, and it's just premature to do validation exercises at any specific site for the purpose of rulemaking, in my view.

Q. I believe I understand you, so I will check that. You're saying that we can use the modeling to establish a rule, namely the minimum allowed depth to groundwater, but that if we were to do validation we should do that on a site-specific basis?

A. Yes to the part of your question about validation on a site-specific basis. If one had to really rely on the model predictions at a site, perhaps one could do a demonstration -- a field demonstration project if it was critical.

Q. But are we not relying on the model to give us an absolute limit in our Rule of depth of to groundwater? That's an absolute number that appears in the Rule?

A. Well, I don't know where the depth to water comes from in the Rule. I don't really believe that -- where that is specifically.

Q. Very good. You had suggested that it was perhaps burdensome for the operator to check the chloride content of incoming waste loads; did I understand this correctly?

A. No, no.

Q. You had said that New Mexico has no non-degradation policy for groundwater; did I understand that correctly?

A. That's my understanding too.

Q. Do you thereby maintain that a single entity should be allowed to pollute the resource to a limit of the standard, and thereby preclude any other economic development on that resource?

A. That's a value judgment, and I'm just interpreting the practice. The practice is pretty much as I described. It's my understanding we don't have an anti-degradation policy. Whether I like it or not is not the issue. It's a value judgment, a personal one, but we deal with the Rules on a daily basis regardless of our personal preferences.

Q. I have reference to two slides. In one slide you showed data, I believe, from Bridget Scanlon and other authors, and this related to the studies in the Amargosa desert and I think also data from Texas, in which you showed the moisture potential and the chloride content, and I believe you also showed the desert vegetation. Do you recall that slide?

A. That's correct.

Q. And did you have an accompanying slide that showed the vegetation on or near that site? I can't remember.

A. On which site?

Q. On or near these studies?

A. No.

Q. All right, the vegetation slides were strictly from New Mexico then.

A. I mean, I've been to -- I've been to most of these sites personally, but I don't have any...

Q. We have slides -- data here of both the chloride and the moisture potential as a function of depth. Is it correct that the chloride as shown effectively reduces the water availability to the plant? That is, by the osmotic potential?

A. Generally, yes.

Q. And so the plants that we would picture growing in this desert environment, would it be correct to assume that they are drawing whatever water is available? That is, if more water were available in the near-surface porosity, other kinds of plants or more plants would be growing? This is a water-limited biota there. Would that be correct?

A. That would be my understanding.

Q. And did you have an accompanying slide that shows numerically the salinity at a depth of three feet below ground surface?

A. I don't believe so.

Q. Is there any slide that shows the salinity at 540 parts per million at a depth of three feet?

A. Of chloride, you mean?

Q. Chloride, that's correct. It was up to 540. Would you regard there being any association between that value of the salinity and the type and density of vegetation on that site, combined with the moisture potential in the ground, or the moisture availability in the ground?

A. Well, probably the moisture is fairly low. That's typical of desert environments. And we have -- we saw some of the pictures of the desert plant communities. So generally water content is low, and that's what limits deep percolation.

Q. So if we were to increase that value of the salinity in some fashion, we would presume that we would stress that plant community even more; would that be correct? They're at the edge now?

A. Well, if you keep the water content the same and just add more salt to it --

Q. Yes.

A. -- it would be yes.

Q. Yeah, very good. You also had a slide of a water pulse explaining how a water pulse moves down. I believe it was data from Bresler. It explained chloride that first entered the land and then moved back upward. Can that slide also be shown?

In the slide we see an initial pulse moving downward, and then do I interpret correctly that as the surface dries, some of the chloride and the water moves back upward toward ground surface? Is that not what was being illustrated here?

A. Well, that wasn't my point, but I'm trying to see if you're right. It can happen, we've seen that in some of the other simulations, that the salt can move back upward.

Q. Well, in the three graphs on the right-hand side, the middle graph shows the peak of salt somewhere about the middle of the depth, 40 units, in centimeters, and the bottom slide, which I -- bottom picture, which I believe was at a later time, shows the peak back up near the surface?

A. Right.

Q. There is also a lower peak. Would that peak not be moving downward and continue to move downward as the potential gradient is downward at that point?

A. Right, it would probably slowly.

Q. So we would have --
A. Diminishing -- diminishing rates of --
Q. Diminishing rates --
A. -- because the water content is getting lower, and the conductivity is getting lower.
Q. We would have -- Some of the salt goes up, but also some of it is being pushed downward?
A. (Nods)
DR. NEEPER: That's correct, thank you.
No further questions.
CHAIRMAN FESMIRE: Mr. Brooks?
MR. BROOKS: Thank you.

CROSS-EXAMINATION

BY MR. BROOKS:
Q. Good morning, Dr. Stephens.
A. Good morning.
Q. I was interested in something you said, Dr. Stephens, this morning in response to Dr. Neeper's question, when you said that we were involved here in a rulemaking exercise and not in getting a perfect result from a particular site. Does not a lot of your testimony involve the conclusion that you cannot get a valid scientific result that applies to -- across the state, because there are so many local -- there are so many site-specific factors that have to be taken into consideration?

A. Generally what the testimony is, is that no two sites are alike, and it would be difficult to expect the same rules, if you will, or criteria to be imposed on each site with the expectation of a similar result.

Q. I remember the phrase "one size does not fit all" appearing several times in your materials.

A. Yes.

Q. And yet if what you said in response to Dr. Neeper is correct -- and that's my understanding of this proceeding -- the purpose of this proceeding is for the honorable Commissioners to establish some benchmarks that can be used for purposes of a rule that will apply except when there's a reason to make an exception to it; is that correct -- Do you correctly understand that's what we're doing here, that's the exercise we're engaged in?

A. Well, maybe that's what you're doing, but I think we're suggesting something different. I believe the idea is that instead of setting a fixed number -- let's say 1000 milligrams per kilogram -- and sitting on that one, what we're saying is that the conditions of the site are different, but put in place a set of tools that allow the regulators and the operators to use the agreed-upon set of tools to come up with site-specific standards. That's basically it.

It's not that we're trying to -- I don't think the focus is on the number, it's on the process. I don't think we disagree on the process, it's the number, the fixed number, and I think that's --

Q. Well --

A. -- when you talk about philosophy, that was -- I think that's the difference in philosophy, whether it's one number or whether it's a process that we're trying to agree on.

Q. Okay, let's talk, then, about the small landfarms. And I'm going to be talking about that several times in here, because I think some of your material that we're not clear whether we're talking about the permitted landfarms or the registered small landfarms.

The registered small landfarms, you understand, do not involve a permitting process, correct?

A. Yes.

Q. And an operator can set one up anyplace where the have the -- where they have the right to do so and they have the permission of the surface owner, correct?

A. That's my understanding.

Q. So the only way that the Oil Conservation Division can regulate those, as long as it maintains that structure, is to have across-the-board rules that apply to them, correct? If they're not going to have a permitting process. They don't have -- the Oil Conservation Division does not have an opportunity to review site-specific data and make a conclusion as to what is appropriate, within that type of structure?

A. Yeah, I'm a technical guy, I -- you know.

Q. Well, I understand that. Okay. So you're punting on that one?

(Laughter)

Q. Let me ask you another similar scenario, because your testimony is that New Mexico does not have a non-degradation policy, correct?

A. That's my understanding.

Q. Okay. Now if I understand these environmental concepts -- and I may use the wrong language because I'm not accustomed to dealing with them like Mr. Hiser is -- but as I understand, one approach to environmental regulation would be loosely termed non-exceedence. That is to say, the objective is to be sure that the quantity of the pollutant in the environment does not exceed the standards. Is that an accurate description?

A. Yes.

Q. For instance, if we follow that policy and our only focus is groundwater, then we would want to set the limit at the basis where, if it were -- if the limit of pollutant introduced into the environment were exceeded, then it would cause the quantity of that pollutant in the groundwater to exceed the applicable groundwater standard. Do you understand what I'm talking about?

A. I'm not sure what the question is.

Q. Okay, I'm just trying to describe what I'm talking about when I say non-exceedence. If we were following a non-exceedence policy, we would want to say you can introduce pollutants into the environment up to, but not to exceed, that quantity which, if it got into the groundwater, would cause the groundwater to exceed the applicable groundwater standard?

A. I understand what you're saying.

Q. Yeah. Okay. A non-degradation policy would mean you would prohibit introducing any pollutant into the environment in a quantity that would cause the amount of that pollutant in the relevant portion of the environment to increase.

In other words, if we were approaching it from a water perspective, you would prohibit introduction of a pollutant into the environment in such a way that it would increase the concentration of that pollutant in the groundwater, even though that was still below -- still below standards. Is that a correct understanding of non-degradation?

A. Well, generally, yes, but I'm confused about the pollutant. I mean, sometimes pollutant is a chemical which has already exceeded the standard, a chemical that might not necessarily be a pollutant.

Q. Well --

A. We have all kinds of chemicals in the water that are healthy to drink, and --

Q. But I'm assuming that if that's the case, then we're probably not going to regulate its introduction into the water. Would that be an accurate supposition? Unless there's some reason why we don't want it there?

A. It's just a semantic point that when you're talking about an anti-degradation policy, I think what you mean to say is that you're not going to introduce any chemicals that aren't already present --

Q. Okay.

A. -- or cause the chemicals that are present to increase.

Q. Okay. Well, I think we all understand. Perhaps I'm going to too great length to say what I want to say here.

My point is this, and this is the question to ask you. Once you have determined what your objective is, whether it's anti-degradation or whether it's -- or whether it is anti-exceedence, once you've determined what goal you're setting, then the scientific tools that you use are appropriate to determine how you get there, and what standards you would prescribe to get there, correct?

A. Yes.

Q. But there's nothing in the scientific tools that you use that can tell you whether your goal is anti-exceedence, anti-degradation or something in between; is that not correct?

A. Well, the science doesn't dictate the goals, policy --

Q. That's a policy matter?

A. It's a policy matter.

Q. And that is the -- those are the decisions that the honorable ladies and gentlemen at the front bench are appointed to make, correct?

A. Exactly.

Q. And if you were going for a non-exceedence policy with respect to groundwater -- no, wait. If you were going for an anti-degradation policy with respect to groundwater, you would have to identify the background in the groundwater, would you not?

A. Yes.

Q. And any introduction of a -- you don't want to say a pollutant -- a chemical in a concentration exceeding the background in the groundwater would constitute -- would tend to degrade it, correct?

A. That would be the interpretation.

Q. So a policy which allows anything more than that would be something other than a strict non-degradation policy, if it allows anything more than background?

A. Yes, I think I understand what you mean.

Q. Okay. Is it not true that the standards that are incorporated in this proposed Rule are in between? That is, they are not designed strictly on the basis of background, but they are also not designed strictly on the basis of exceedence; they hit an in-between level somewhere, right?

A. Well, as far as the vadose zone corrective-action trigger, if you will, I think --

Q. That's -- yeah, that's background.

A. That's background.

Q. But the closure standards are not?

A. But the treatment zone, yes, you're right. And as I understand it, there'd be a mix of -- well, some water would need to be down to drinking water level, some the chloride is going to be a few thousand milligrams per liter. It's a mix.

Q. Yeah. But background -- it's lower of background -- I mean, I'm sorry, higher of background or standard, whichever --

A. It's the greater of the background --

Q. It's the greater of the two.

A. -- or the list.

Q. So of course we're taking into consideration that my hypothetical questions were based solely on the idea of a groundwater-protective standard. And it's not solely a groundwater-protective standard; it's also a soil-protective standard. You understand that?

A. Absolutely.

Q. Okay. But since it's higher of background or the standard, it's always going to be -- it can be higher than background, but it never can be lower than the background?

A. Right.

Q. So it is not strictly an anti-degradation policy?

A. For the treatment zone that's correct.

Q. And it's not an anti-exceedence policy either, because it's going to be less than -- in many cases it will be less than an exceedence standard?

A. Could be.

Q. Okay. So we're dealing, then, in a realm where, if the Division's recommendations or something like them are followed, then the Commission is going to have to be making a policy judgment when it decides what specific standard to adopt, rather than a scientific judgment; is that not correct?

A. Well, with respect to a waste acceptance or treatment zone, yes.

Q. Okay.
A. Vadose zone is absolute, that's --
Q. Yes, I understand that.
A. -- that's a different problem.
Q. And with regard to the vadose zone, you understand that that's a signaling function as to which a case-by-case decision will be made on what action is required, and not an absolute standard that would require any particular action?
A. Yes, I understand there may be some flexibility afforded that could include a wide range of corrective actions, from operations to remediation.
Q. Very good. Thank you. Now I want to go back to something that I said a minute ago, because I believe I didn't finish it.
With regard to the small landfarms, I think you agreed with me that you're going to have to have some kind of across-the-board standard for chlorides and small landfarms, since they're not going to be individually permitted. Or was the question you punted on?
A. Well, I think I punted as to some of the policy aspects of it. But you know, it can depend on size, you can set up a process or a procedure that says, well, a small landfarm is -- you know, whether it's two acres or -- as is proposed by the industry, or 1400 cubic yards as

proposed by the agency. Somewhere in there, you get different --

Q. Yeah.

A. -- you're going to get different standards.

Q. You could have multiple standards, but --

A. Correct.

Q. -- if you're not going to have a permitting process, you're going to have to adopt some kind of standard.

A. And that could be flexible, depending on size and some perhaps general characteristics of the site.

Q. Yeah. Okay, now with regard to the permitted landfarms, it's my understanding that the industry committee, for whom you're testifying, does not disagree or does not take issue with the 1000-milligram-per-kilogram number for chlorides, as a general rule, understanding there can be exceptions.

A. I think for large landfarms that's one of the options that they would agree to.

Q. Okay. Now let me go through some things here in your presentation. Okay, now I'm not going to be going systematically through your presentation, unfortunately. I'm not as prepared as Mr. Hiser was yesterday when cross-examining Mr. von Gonten, so I may be skipping around.

But I believe you testified that vadose zone contaminants could move into -- or treatment zone contaminants could move into the vadose zone, even under unsaturated conditions; is that correct?

A. Yes.

Q. And so you disagreed with Mr. von Gonten's testimony that in a properly managed landfarm where ponding of fluids was -- well, ponding of liquids was prevented, that contaminants would not move into the vadose zone?

A. Yes. It really depends on the site-specific conditions, but it's possible that he's right. It's also very possible that -- and more likely they're not, you will find something below that interface.

Q. And you stated that that would prematurely terminate landfarm operations, which removes the ability to reduce toxicity of hydrocarbons by bioremediation?

A. Yes.

Q. And you -- I think we just asked about that. You understand that that trigger merely triggers a report to the Oil Conservation Division and a decision to be made, and it does not necessarily mean that remediation would have to be immediately terminated?

A. Well, it's my understanding it's called corrective action, if I have that --

Q. Right.

A. -- remember correctly. A corrective action, in my experience, could range from changing operations to trucking and hauling, so in some cases --

Q. In some cases it could?

A. -- it could.

Q. But it would not necessarily?

A. That's -- that's --

MR. BROOKS: Okay. My problem is, I have no way to refer to --

MR. PRICE: If you show it to Eric, he can find it.

MR. BROOKS: I guess this is the next one we wanted to look at.

MR. HISER: That's the main presentation or the rebuttal?

MR. BROOKS: It's in the original presentation. It says, Low recharge leads to long travel times through the vadose zone. That's -- I don't know that we really need to go to a lot of trouble to look for that one, because that is very simple. Let's go to the next one. That would be -- This one is the one I think we'd like to bring up.

MR. HISER: The one with Socorro, New Mexico?

MR. BROOKS: Yeah, it starts with Socorro, New Mexico.

Q. (By Mr. Brooks) Okay. Now you have a series of plotted recharge rates. Are those linear functions? That is, is the recharge rate going to be the same at various levels in the vadose zone?

A. Well, the recharge --

Q. I mean the speed of movement?

A. No.

Q. And is that going to be predictable, or is that going to depend on particular circumstances?

A. Well, if you had the data it could be predicted.

Q. Yeah, but would an average be of the -- over a given span, would an average result in a correct result?

A. That's best way we do it. I mean, when you're -- if you're looking at -- the rate at which -- this is -- Maybe you're getting a little confused with how fast water is moving down through the vadose zone and the recharge rate. There's different numbers.

The recharge rate, as we're looking at here, is really a rate -- a volume rate per unit area, which when you do the dimensional analysis comes out to a linear velocity of length per time.

Q. That's what --

A. So --

Q. -- that's what I was thinking.

A. -- across an area of the area of the aquifer, say in an acre, you have so many acre-feet per year coming into this acre. And you can divide -- do the math and come out with feet per year, or millimeters per year, or inches per year, whatever linear units you want to use.

Q. And that is a measure of the speed that the water moves -- that the water coming down from the surface moves through the vadose zone?

A. No, different numbers.

Q. Okay. You understand that the trigger for vadose zone corrective action is based on sampling it three to four feet in a permitted landfarm or three to five feet in a small landfarm, correct?

A. Was that three to five feet below the center of the --

Q. Below the --

A. -- waste treatment zone?

Q. Below the base of the waste treatment zone.

A. Below the base or the center?

Q. I think it -- I'm understanding the base.

A. Okay.

Q. Would it not take a period of time for the -- for any chemical to move from the treatment zone down to the testing zone?

A. Yes, it would take some time.

Q. And how long would it take?

A. Depends on how much moisture is added, it depends on the soil characteristics underneath the landfarm, depends on the process by which the chemical moves, whether it's by diffusion or advection, depends on temperature. A lot of factors that go into it.

Q. Okay, based on your recharge rate you've computed that it would take 760 years to reach groundwater at 50 feet.

A. Uh-huh.

Q. Wouldn't that suggest that it might take something like 95 years to reach three to four feet?

A. Yeah, you can interpret it that way. But keep in mind, it depends on where you are in the profile. Water will move faster down towards the chloride bulge, which is where a lot of the root zone is. So the water will move down faster than the recharge rate, and as it's moving down the plants take the water out. It's below that, and the chloride bulge probably is no shallower than three feet. It's probably in most situations deeper than that, which tells us the plant roots in a desert environment are typically deeper than that.

So the water that percolates down will start to get extracted, but as it's moving down it goes faster -- excuse me, as it's percolating down it goes slower, because the moisture is being depleted by the roots.

Q. But you did say -- you said it could take several years?

A. Sure.

Q. And you're not in a position, with the data you have, to estimate how long would it take in any particular situation with what we know now?

A. There's nothing we've presented that would allow me to tell you how long it takes water or chemical to move five feet to three feet below the landfarm.

Q. Could it very likely take more than three years?

A. You know, it's possible it could. It could take less, could take a lot less.

Q. Could it take as long as 20 or 30 years?

A. Some chemicals, that would be possible.

Q. Thank you. Okay, get this slide. This is from the rebuttal.

While he's pulling that up, you made a number of criticisms of Mr. Price's presentation on the ground of spell errors, did you not?

A. We all make them.

Q. Yeah, you know, spell check has greatly improved the receptiveness people have to my presentations, but would you stipulate that spelling errors don't have anything to do with the accuracy of the results?

A. No, I wouldn't. I think in -- taken in a whole, it helps form an image of the workmanship, if you will. I mean, a carpenter can make a chair, and a chair's a chair. But if you look at the fine details and say, well, how careful was he in making this chair? It's still a chair but, you know, it's not a fine chair.

Q. So you're advocating the principle that an English teacher I knew used to say, sloppy papers means sloppy minds?

A. Well, yeah, maybe so.

(Laughter)

Q. Okay, well -- Okay, let's look at this slide where there's apparently an interpolation error. If you corrected that error, what effect would it have on the result? Would it make the suggested chloride limit higher or lower?

A. Well, let's see here, we would get a -- for a five-acre site you'd get a DAF of probably about 12, so it would be lower.

Q. So it would make the chloride limit lower?

A. (Nods)

Q. Well, that particular error, if it has an effect on the result, makes the permissible limit higher than under the correct interpretation it ought to be?

A. Uh-huh.

Q. Okay. Now let's look at the slide on the bottom of that page. It reads, Averaging error. Were you present in the hearing room when Mr. Price testified on this presentation?

A. I may have been here, I probably was here. I'm not sure I heard everything he said.

Q. Do you recall that Mr. Price pointed out to the Commission at the time that that figure was incorrect?

A. You know, I don't recall that. He may have, and if I --

Q. Okay.

A. -- found the same mistake, then I apologize for bringing it up.

Q. You agreed that the industry committee has said that 1000 milligrams per kilogram is an acceptable benchmark number for permitted landfarms, right?

A. I think that's one option.

Q. And while you have many criticisms of Mr. Price's presentation, the results you get for a five-acre site are actually not that far different than his; is that not correct?

A. Well, when you use the same data you don't get different results. I mean, we're using the same tools.

Q. Okay, thank you. But of course you get a lower number for a two-acre site -- I mean a higher number for a two-acre site --

A. Yes.

Q. -- because --

A. You're talking about the waste acceptance chloride criteria?

Q. Right, that's what I'm talking about.

A. Yes.

Q. You get a higher number for a two-acre site, and that's because the more chlorides you put in, the more likely -- the more is going to get to groundwater?

A. Yes.

Q. The more you concentrate?

A. Yes.

Q. Now in computing the figure you recommended for the small landfarms, did you take into account -- Well, okay. This revised calculation for two acres --

(Off the record)

MR. HISER: Is this the proper one, Mr. Brooks?

MR. BROOKS: Yes, I believe it -- Yeah, that's the one.

Q. (By Mr. Brooks) You've got a -- This is a result for a two-acre site, correct, 1954?

A. Yes.

Q. And that's a result you basically agree with?

A. Yes, based on the work that we've done so far.

Q. And what result would you get for a five-acre site if you used that number?

A. If I used what number?

Q. If you used the same methodology. Would you get somewhere around 1000?

A. It's possible with these specific hydraulic conductivities and gradients. I -- Let me think. I will -- I can't tell you what the exact number is off the top of my head, but --

Q. It would be quite a bit lower than --

A. It would be lower.

Q. And if you used a 500-acre site, it would be a whole lot lower, would it not?

A. (Nods)

Q. Now going to the 2000, roughly, level for -- that you're recommending for the small landfarms, in arriving at that figure did you take into consideration the possibility of cumulative effect if there were a whole lot of small landfarms fairly closely spaced?

A. No.

Q. Is there any way with your modeling that you can do that?

A. Yes.

Q. But you would have to know how many, within what radius, would you not?

A. Yes.

Q. And given the fact that it's not a permitting process and the operators have great flexibility about location, is there any way you can know that?

A. Well, it's also my understanding there's only one per lease --

Q. Yes.

A. -- so they might be scattered fairly far apart.

Q. Or fairly close together?

A. Well, maybe.

Q. Okay. And that might be influenced by contamination from other facilities within your universe, would it not, also?

A. It's possible.

Q. Okay. There's only one other thing -- one other line of questioning I want to pursue, and that's -- with you, I believe, and that is about the treatment zone monitoring. Your testimony, I believe, was that you considered the treatment zone monitoring unnecessary and excessively burdensome, unless you were using the bioremediation endpoint approach?

A. That's correct.

Q. Okay. Now the reason for that is that you believe the sampling required of the material introduced into the landfarm would be adequate to avoid the building up of a load in that landfarm; is that correct?

A. Yes.

Q. But that simply could be erroneous, either because it wasn't adequately sampled, or because somebody was trying to -- since sampling is done by the generator, somebody was trying to skew it? It could work either way, right?

A. It's possible. Anything's possible --

Q. Have you read closure security provisions, financial assurance provisions, of the proposed Rule?

A. No.

Q. Okay. So if I were to tell you that the financial assurance that is required is dependent -- is based on the operator's closure estimate, then you wouldn't be in a position to say one way or another?

A. I don't understand your question.

Q. The bond that an operator is required to provide is based on his estimated closure cost under the Rule, if you'll accept that proposition.

A. Okay.

Q. If the operator is planning to close a landfarm in place, the cost of doing that is just going to be the cost of re-vegetating, right?

A. Well, he may also have some bioremediation endpoint sampling to undertake --

Q. Yeah, he may have some sampling -- well, he's going to have some --

A. Routine, you know --
Q. -- sampling because --
A. -- semi-annual --
Q. Right.
A. -- sampling and so on.
Q. Right. But the costs of the necessary monitoring and closing -- and re-vegetating would be quite small compared to the cost of digging out and hauling the waste, would it not?
A. More likely than not. Early on there may be some need to add moisture and bring water into the area for establishing -- germinating the seeds. I suppose that could be an additional --
Q. Well, isn't the cost of -- wouldn't the cost of digging and hauling, if you had to do that, be quite a lot higher than the probable cost of closing of the site?
A. Probably.
Q. Okay. So if you're building up a load of pollutants within the site, are you not building up a potential liability that is not going to be covered by that bond?
A. Well, I'm not sure about that, because -- I mean, the -- I think the cost -- if you're asking me, is the cost dependent on the -- is the cost to excavate and haul dependent on the concentration in the landfarm, I don't

think it is.

Q. No, that's not what I'm asking you. But the need for -- whether or not you would need to dig and haul would depend on the concentration of pollutants in the treatment zone, would it not?

A. I guess it could, because that might mean you're not able to -- If you can't establish vegetation, your option may be to -- one option you might want to consider is digging and hauling, might be your only option.

Q. Okay, my client has reminded me that I have one more line of questioning to pursue here.

In your testimony, as I understood it, you testified that the recharge rate very much affects or determines the speed with which the pollutants will move to the groundwater; is that correct?

A. Yes.

Q. And you also testified, if I recall, that re-vegetation slows down the recharge rate?

A. Right.

Q. Substantially, did you not?

A. Yes.

Q. Now did you take into consideration in doing those numbers and back-calculating the number -- the chloride numbers that you arrived from those regeneration, did you take into consideration --

MR. HISER: Original or rebuttal presentation?

MR. PRICE: Rebuttal

MR. BROOKS: No, original, original.

MR. PRICE: Original.

Q. (By Mr. Brooks) Did you take into consideration the possibility that the chloride rate itself would retard or prevent -- might retard or prevent re-vegetation?

A. I don't understand the question.

Q. Okay, let's get the slide out. You in several instances, did you not, used those -- yes, that's right, in several instances did you not use those recharge rates to back-calculate a permissible chloride number?

A. Well, it was part of a modeling analysis to determine how much chloride could be put in the waste -- not exceed groundwater standards.

Q. Okay. So what you have here is, you have a -- in your first column up there, you have a certain recharge rate, right?

A. Yes.

Q. And in the second column you have the time that it would take for the chloride body to reach groundwater at that recharge rate?

A. Yes.

Q. And in the third column you have what I understand to be a back-calculated chloride concentration at the start?

A. Yes.

Q. And the first of those numbers is 51,000 p.p.g. -- p.p.m.; is that correct?

A. Yes.

Q. Now Dr. Stephens, do you think re-vegetation would be possible in a site that had 51,000 p.p.m. of chlorides?

A. Probably not.

Q. What about 9500 p.p.m.?

A. I don't know. It's difficult there.

MR. BROOKS: Thank you, that concludes my examination.

CHAIRMAN FESMIRE: Mr. Huffaker, do you have a cross-examination of this witness?

MR. BROOKS: I believe Mr. Huffaker --

CHAIRMAN FESMIRE: Oh, I'm sorry, I --

MR. BROOKS: -- has already examined --

CHAIRMAN FESMIRE: -- I knew I was going to do that.

(Laughter)

MR. HUFFAKER: That's quite all right.

CHAIRMAN FESMIRE: Mr. Carr, I --

MR. CARR: You already called on me too.

CHAIRMAN FESMIRE: Okay, I slept, I apologize.

Commissioner Bailey, I guess, it's your turn.

EXAMINATION

BY COMMISSIONER BAILEY:

Q. The next to the last slide in your rebuttal --

MR. HISER: Give me just a second.

THE WITNESS: This one, Commissioner?

Q. (By Commissioner Bailey) Yes, you switched units of measurement on us again. All day long we talked about chlorides in parts per million or milligrams per kilogram. Could you please convert greater than 12 micromhos [*sic*] per centimeter to a unit we've been talking about?

A. Well, you have heard this unit before. It's in the testimony by Mr. Price when he talked about the concentrations or the salt tolerance of various plants in British Columbia, or northern British Columbia.

But 12 millimhos per centimeter -- it's probably over 1000 milligrams per kilogram chloride, but it's not a simple -- it's a site-specific or soil-specific calculation, depends on some of the soil characteristics. But in general, it's probably on the order of over 1000.

Q. Could it be over 5000 or --

A. Well, since it's greater than 12 millimhos, I mean, 12 millimhos -- again, I'm going from recollection and having seen a calculation like this a while ago. Some of the salt-tolerant plants are tolerant up to 16 millimhos or more, and so you're in the thousands-of-milligram-per-kilogram chloride range, probably. Probably, you know, 1000 or 2000 milligrams per kilogram. I'm estimating. The calculation can be done. I haven't done it, but it's kind of like off-the-top-of-my-head estimate.

Q. Repeatedly you indicate the role of vegetation in preventing transport of contaminants to the groundwater. Slide after slide after slide, you show us how important vegetation is as a factor. Not the only factor, but as a very important, critical factor in the protection of groundwater and the environment.

And I share your concern that you say in one of your slides that small landfarms -- or landfarms need help for re-vegetation and that OCD's proposed Rules may inhibit landfarming, leading to almost exclusive landfilling. So to me the area of re-vegetation is essential, and I'm frankly disappointed that there's not been more testimony on re-vegetation and what is possible.

You give this list, if you'd like to show it again, of grasses that are salt-tolerant up to this unknown amount of chlorides. Without the vegetation, then the rest of the arguments crumble, because the transport is very different.

I would like information on the potential for re-vegetation, given these limits that are given, particularly for small landfarms. You gave us a list of references, but no information that we need for this hearing.

The premise to rely on the low recharge to the aquifer, which is so greatly influenced by the vegetation, included in your conceptual models, included in almost every point that you make, is unanswered in my mind as to what the critical chloride content can be, should be, for re-vegetation, particularly of these small landfarms.

Can you offer me any information that you have not given before, as to the possibility of re-vegetation of these landfarms, specifically in southeastern New Mexico for native plants that can allow landfarming?

A. There's a number of points I'd like to respond to. You made a number of them, I'll try to remember them.

I think the best way to help you answer your question is to have in tandem an analysis done, just like we've done here, to compute what kind of chlorides are protective of groundwater at a particular site. Once you compute that level, then you work with a specialist in this area of botany, an agricultural extension agent, somebody who knows the local plant communities.

I've done experiments on how water moves in desert plant communities. But I don't study the plants, per se; I see what their effect is on the water. And I've looked at what some of the salt concentrations are in the soil, and the plants are doing fine at whatever soil salinity they've come to be in equilibrium with.

So I think the best way -- I mean, I can convert -- this is not -- millimhos per centimeter is just a unit of electrical conductivity, and it's an experimental relationship between chloride and electrical conductivity that should be developed for the specific soil. So again, it gets back to a site-specific -- you know, having some site-specific relationships, what plants are going to do well.

There are a lot of good vegetation studies that have been going on on copper-tailings piles, not in southeast New Mexico but southwest New Mexico; Tucson, Arizona; some other dry areas. These are specialists. But I can tell people why my experience and with analysis and tools what kind of chloride they should expect under these conditions, that someone could say, well, here's the appropriate mixture of plants that should be beneficial. That's just a little beyond my area of expertise, but I could use textbooks and, you know, go a little step farther than what we've gone here to help.

But one thing I want to clarify is that it's not a house of cards, that if the vegetation isn't there that there will be impacts to groundwater in excess of drinking water standards. It still depends on the soil, it depends on the site, even without the vegetation. But once you have a particular site, vegetation will always lower the recharge rate, compared to the unvegetated state in this climate.

So again, you can do simulations with or without evaporation and evapotranspiration in them and do different recharge rates, you can do experiments to compute recharge rates under vegetated and unvegetated conditions, test plots and so on. But the vegetation will in some cases cause water to move upward, in some cases it will just slow the rates to fractions of a millimeter per year.

But some of the studies that we did in Socorro, for example, that I cited up there, which had only a few millimeters per year, those were on permeable sand, floodplain sand of the Rio Salado. In between clusters, that test plot was probably half the size of this room, the one I showed with all the little white pipes sticking up, it's about half the size of the room and the vegetation was surrounding it. We put instrumentation in the center, and we were computing recharge rates of millimeters, several millimeters per year, and those were the same magnitude of numbers that were used in our models.

So for that setting with a sandy site, you still had low recharge rates. Had we moved the test plot over to vegetated sites, we would have gotten fractions of a millimeter per year.

So I think the modeling that we've done is fairly conservative in the sense of taking into account small amounts of vegetation. But it's true, when you vegetate the site things are going to improve even more than perhaps what we've predicted with some of the models.

COMMISSIONER BAILEY: That's all I have.

CHAIRMAN FESMIRE: Commissioner Olson?

COMMISSIONER OLSON: Yeah, I have a few questions.

CHAIRMAN FESMIRE: You have a slew of them.

EXAMINATION

BY COMMISSIONER OLSON:

Q. Dr. Stephens, as I understand, your modeling is based on uniform, isotropic, homogenous flow; is that correct?

A. In the -- Yes.

Q. And are you aware that we have large areas in the southeastern portion of the state that are -- have significant fractured caliche zones that underlie the surface at relatively shallow depth, about one to two feet?

A. Yes.

Q. And in those circumstances, we would have preferential fracture flow, so your model doesn't account for those types of circumstances that we have with some of the caliche in southeastern New Mexico?

A. Well, the sites I'm familiar with, that I've worked around, would be caprock in that area, Caprock, New Mexico, east of Roswell. And there, I think the caliches are very brittle. It's a late stage 4 or 5 caliche, which -- there are different stages of caliche, as you know, and it gets brittle and fractures.

But that's not a layer that persists to depth, it's a near-surface -- kind of a roof, if you will, the cap. And underneath it is the Ogallala, which may have some paleosoils and some carbonate horizons, but I'm not aware that some of those deeper paleosoils, if they're that state of caliche, are fractured.

Q. Well, we have other areas farther south of there in the Hobbs area, and even down through Monument, where there's pretty significant caliche zones upwards of 20, 30 feet thick, where there's only about a -- maybe a foot of soil up on the surface, and then in some of those areas groundwater could be as shallow as 30 feet or so under those caliches. So there's a pretty significant zone that's fractured, but this wouldn't -- this modeling wouldn't account for those circumstances, would it?

A. No, actually I don't think the model is likely to account for any one particular site. I mean, it would be hard to go -- Our modeling used, for example, 40 feet per day, hydraulic conductivity .0023 feet per foot hydraulic gradient. You know, you'd say, well, there's no site that's really like that. It's kind of an average site, but no one is really the average. There are sites with shallower, deeper groundwater, faster-flowing groundwater and higher/lower recharge rates, so the model's kind of generic. And you're right, it is site-specific.

But one of the things you need to remember about fracture flow is that fractures flow almost exclusively only when they're -- when the water is saturating the surface of the fracture. In other words, for a fracture to flow with water in it what has to happen is, that fracture needs to come to the land surface and you have to have sheet flow or ponding of water for that water to enter the crack. Capillary forces will otherwise keep the water from entering the crack, and the crack will actually be a barrier, a capillary barrier, if you will, to water entering it. So you have to have that condition.

And one of the things that would happen, I think, with a landfarm, if the landfarm were placed over open fractures, you'd have to have full saturation and ponded water underneath the landfarm in order for water to enter that fracture. Otherwise, it will just go into the porous media.

Q. Well, I guess I'm coming back to the issue that

Mr. Brooks had raised where for the small landfarms we are trying to set this -- like a one size fits all. I know that's --

A. Yeah.

Q. -- it's not the best way to look -- potentially look at this, but I think as a practical matter for these smaller types of systems it's the way that we need to look at it as a -- keep down the regulatory burdens as well for the operators.

So it seems that -- wouldn't it, in that circumstance, then, make sense to have the most protective level available for those types of sites?

A. Well, I understand the strategy and the point of simplifying the Rule for small landfarms. What the level should be should depend on -- where the site is located should depend on those features. I mean, it might not be an optimal site to put a small landfarm in a highly fractured, karstlike terrain.

But the depth to water shouldn't matter all that much. That's only going to affect the time which the contaminants take to get there. It's not going to have anything to do -- it's not in any of the calculations of DAF. The depth to water is a variable. It only affects when contamination, if it were to occur, will occur.

It can also be important in determining whether

-- the shallower the water table, the more likely it is the water's moving upward in really dry environments with a lot of native vegetation.

Q. Well, I guess along that same lines, if you have these caliche zones and fractures, then it's going to be harder for that deeper water to move up through those larger fracture systems than it would through smaller-diameter pores in the soil.

A. Yeah, it won't move up -- the water won't be liquid -- as a liquid conductor up through the fractures. It would go through the porous matrix if it were moving upward. There may be some vapor transport up through the fracture, however.

COMMISSIONER OLSON: I had a question on one -- I guess on one of your slides for the -- that you had for the model, and maybe I could show it to Mr. Hiser. It's the one on predicted chloride concentrations. This doesn't have a number on it, so I don't know how to tell other folks which one it is.

MR. HISER: Whereabouts in the presentation?

COMMISSIONER OLSON: It's about midway through, two-thirds of the way through --

MR. HISER: Okay, I think this is what you're --

COMMISSIONER OLSON: -- and it's called Predicted Chloride Concentration Which is Protective of Groundwater, and it's titled on the top of the table as Class B Landfarm, and then it says Source Removed After 3 Years.

Q. (By Commissioner Olson) I guess I'm a little confused by that. What do you mean by source removed after three years?

A. What we did was hauled it away, just carved it of the model, took the chloride that was in the -- took the landfarm, lifted it out of the model, and then just continued infiltration through the profile of the salt that had already percolated down below the landfarm.

Q. Well, I guess as I understand it, the sources would stay there even after three years, so this wouldn't really model the circumstance of a landfarm where the materials were left in place?

A. No, that's correct. That's why we did the two different simulations. This was the earlier work we did with the -- at the time, we were thinking a small landfarm might be two and a half acres or so, and one of the scenarios that we simulated was to assume, A, it's taken out after three years or, B, it's left in place. So there were some other simulations that were done in the leave-it-in-place scenario.

But subsequently, the more recent work we did that came near the end of the presentation, had -- instead of a constant recharge rate we left the waste in place and varied the recharge rate depending on how vegetation was established.

Q. Okay, so then -- just so I'm clear, then, this slide really isn't indicative of a lot of the circumstances we're going to have with waste being left in place. That's the --

A. Right.

Q. -- I've worked on a lot of landfarming issues, and I haven't seen anybody that's hauled them off when they're done.

A. Right, this is the haul-off scenario.

Q. Right, and that's not going to be the normal circumstance.

A. Probably not.

Q. Okay.

A. We just did the extreme, we did sort of the -- on one end we assumed it was going to be hauled off, on the other end we said it's going to stay there and not be vegetated, it will just keep raining and infiltrating through it. So here are the two end members that you get.

Q. Okay. I was just trying to understand what that was conveying.

I guess Commissioner Bailey brought up some of my concerns as well. This isn't just looking at the migration to groundwater. We've had significant areas of --

especially the areas I'm familiar with in southeastern New Mexico that have been -- I don't know, say significantly denuded just due to salts through a number of circumstances, whether it's leaks and spills, former drilling pits -- and the plant viability has been a major issue with a lot of folks, I know a lot of landowners, and it's been one for the Land Office, as well as private ranchers down there.

I guess you would agree that leaving higher salt concentrations in place are going to limit the viability of re-vegetating a site. Is that --

A. It can, but I guess it depends. And the "it depends" part is if any fill is brought in -- that's sort of clean fill -- or whether there's -- where the salt is. If moisture has been added and has displaced the salt down below the root zone, then the vegetation might be viable, more viable, just -- if it's very near the surface in the land-treatment zone.

So I guess it really depends on the distribution of chloride, where the seeds are. If the chloride is, you know, a foot or two down, then like you saw in the pulse, the Bresler 1972 model, you can see how water can move the salt downward, leaving low salt concentrations behind. So it really depends on the site, the way infiltration behaves and -- very much site-specific.

Q. Well, I guess at this point you don't have any other -- express the same concern, I guess, as Commissioner Bailey, that you don't have any information to provide to us on plant viability versus various salt concentrations? I mean, you gave us some lists of references, but you don't have any specific information to provide to us?

A. No, I was just trying to be helpful. I thought that, you know, here's a quick look. We really only did this, this week. And in going through -- preparing for today I thought, you know, it seems like there's a lot of information on desert plants, and here it is, I'm bringing it. And why wasn't it looked at? I think it's a good question.

And, you know, I'm not a plant expert. I can tell you what kind of salt loads I can expect for certain environmental conditions, based on modeling and my experience. But what kind of plant is going to grow best, I could only look up in the literature as well as the OCD staff. I'm not a botanist, as you know, but I think there are resources out there. I know some -- you know, there are some test plots in various parts of the state that deal with salt-tolerant plants.

There's a -- We have a U.S. Salinity Laboratory in Riverside, California. The deal with, you know, salt-tolerant plants. That's one of the publications up there, and this is one of the main lines of work those folks do.

So there are tools available. But it requires, perhaps, a specialist, maybe more familiar with the climates and soils of New Mexico, to go the next step.

Q. And then I guess, coming back to this concept that this is a "one size fits all" for small landfarms, it's my understanding from the OCD testimony that somebody wanted to do something different, whether they had a small landfarm or not, they have that ability to apply for an individual permit and seek different -- or alternate remediation levels; is that correct? So it doesn't limit parties to the salt levels in a small landfarm, it's just that they'd have to come back and look more at site-specific conditions?

A. I think, if I understand it, that's an option. But the way I also understand -- where the difficulty comes in, I think, logistically -- and again, I'm a technical guy, but where I'm trying to figure this -- how this would work, is that if someone were to protest or have an issue with that variance, or trying to get an alternative cleanup standard established, that modification would come before this Commission, as opposed to developing a procedure that kind of says, okay, you've already decided how this ought to work, let's do it over here with the technical folks.

But as I understand how it works now, it's not --

it will come before this Commission. They'll have to do technical work each time on the site, have question and answer, there'll be a lot more expense. And so I think that's the issue.

Q. And I want to clarify something. You -- and I think this is another one that Mr. Brooks had touched on. You were talking in your testimony about not being allowed to have any contamination in the vadose zone. Is that what your understanding of the OCD's proposal is?

A. Yes.

Q. And could you point out to me where that -- you're getting that interpretation?

MR. HISER: This is the Rule.

THE WITNESS: Okay, it's page 19, (5).(e), If any vadose zone sampling results show the concentrations of TPH, BTEX, chlorides or 3103 constituents exceed the background concentrations, then you have to notify the Bureau and submit a correction plan within 15 days.

Q. (By Commissioner Olson) Well, I guess I don't see where that says that you can't have contaminants in the vadose zone.

A. Well --

Q. It sounds like you have to notify the Bureau and somehow address this migration that's occurring, but I don't see where it says that you're not --

A. Well, it says --

Q. -- allowed to have them.

A. -- you have to -- it says, The corrective action plan, the next sentence, shall address changes in the operation of the land and a plan for isolating or remedying any existing contamination.

So you've got to do two things, you've got to say how you're going to change your operations, and you're either going to encapsulate what's there or remedy what's there. You have to do those two things.

So that's my interpretation. If anything's present above background -- and let's say there's no benzene out there, but you have a microgram per liter benzene in the pore water, you need to notify and then have some plan to isolate that 1 milligram per liter benzene and remedy it, or remedy it. That's -- You know, that's how I interpret it.

Plus when I heard the testimony, was -- by Mr. van Gonten, I think there was some clarification that -- well, confirmation in mind that that's exactly what they meant because of the discussion that, well, no pore water from the treatment zone will enter the vadose zone if it's managed properly, and that's what they're trying to do, is to prevent any releases. The OCD's concept of a release is no release to the soil below the treatment zone.

That's -- if I misunderstood that, I apologize, but that's my -- that's what I heard during the testimony, and that was my interpretation of the words that I read.

Q. But it doesn't say that you have to go in and clean up the vadose zone. It's saying that you have to take some action to remedy getting additional contamination into the vadose zone. Wouldn't that be a remedy, if you took some action in your operation and maintenance of the facility to make sure that additional contamination couldn't get down there? Wouldn't that potentially be a remedy?

A. If that's what you meant. But again, even -- Let's take the example of 1 microgram per liter of benzene getting into the vadose zone below -- and that's your -- that was triggered, you found that and you reported it.

Do you need to do anything else besides report it? Yes, you have to have a plan. The plan is, A, isolate or, B, remediate. That's what it says here. And so that means, okay, how am I going to isolate 1 microgram per liter? Well, there's a lot of engineering that you can do, but the point is, do you need to do it? It's not a risk to groundwater, and so, you know, why do it is the -- I think the point the industry is trying to make.

Q. Well, maybe I'll step back up to -- what's the purpose of the treatment zone?

A. I think the purpose of the treatment zone is to remove mass that's biodegradable and do it naturally.

Q. And it's to do it within that treatment zone?

A. That's a good question, what the definition -- I think -- the good question is, what is the treatment zone? Where is all the treatment occurring? And are you only allowing treatment to occur in the waste?

And I think in a lot of situations we allow treatment to occur throughout the vadose zone and the aquifer. In fact, for our domestic waste systems, we have what's known as soil and aquifer treatment, and that's how septic tanks work. Basically, you know, we recognize that there is some treatment that takes place, both in the leach-field, let's say, and in the soil below it and in the aquifer, that removes bacteria and virus in that case.

But if you're just dealing with the treatment zone as that layer of landfarm material, that's one thing. If it's some zone underneath it where the vadose zone -- the upper portion of the vadose zone, that could be another. It could be the entire vadose zone.

So it depends on what the treatment zone really is. I think it's difficult, it's going to be difficult to limit the treatment zone, really, to just the landfarm material.

And I think our point is, you should get credit for some of the treatment that's going to occur naturally in the vadose zone that underlies it.

Q. Well, I guess the overall purpose of landfarming is to treat oilfield wastes that are -- soils that are contaminated with oilfield wastes?

A. Yes.

Q. And I guess my understanding of the proposal is, if the -- I don't know, maybe it's a little bit of a misnomer in the way the terms are in here. The treatment zone is, I guess, technically considered the soils that sit on the surface, essentially. And it seems to me that the treatment zone is also the top three feet of the vadose zone, because the monitoring doesn't occur until three to four feet into the vadose zone. So there is an allowance in the Division's proposal for allowing a portion of the vadose zone to be used for treatment; is that correct?

A. I'm trying to see if they have a definition of treatment zone.

(Off the record)

THE WITNESS: You know, I don't believe the Division has defined treatment zone specifically in here.

But I think the answer to your question is, between the point at which there's the bottom of the landfarm and the vadose zone monitoring, some treatment effectively could occur.

Q. (By Commissioner Olson) Within that top three feet, right.

A. If it's not closer than three -- whatever it is, whatever the distance, two, three feet, yeah.

Q. Okay. And you talked about the Water Quality Control Commission regulations and the standards that are adopted in saying that there's not an anti-degradation clause for groundwater in the Water Quality Control Commission regulations; is that correct?

A. That's my understanding.

Q. Is there any limitation on the Oil Conservation Commission for not allowing degradation to groundwater?

A. I'm not certain of that.

COMMISSIONER OLSON: Okay. And I think I had a couple of questions, coming back to the actual industry proposal, and I'm not sure if you're going to be having witnesses that are going to be going through the actual proposal, or the witnesses are going to be mostly addressing the technical issues, Mr. Hiser?

MR. HISER: Mr. Chairman, Commissioner Olson, the plan is that our witnesses are mostly going to talk about the technical underpinnings of the proposal. Dr. Sublette will talk more about the practicalities of what's in the proposal.

And then the final presentation, which will be our closing, we're probably going to go more of a step by step to the differences between the industry proposal, regulatory language, and the staff's proposed regulatory language. And then we'll show how what Dr. Sublette or Dr. Stephens or Dr. Thomas said related to those.

But if the Commission thinks something else would be valuable, we could scramble and try to do something else.

COMMISSIONER OLSON: Because I'm just thinking, something -- I mean, that would be helpful -- I know you've given this proposal of Tier-1- and Tier-2-type sites, and I think I heard, you know, Dr. Stephens talk about the technical aspects of that, but I guess it might be helpful to hear some of the concepts of why you're proposing certain language.

And I see this concept of the Tier 2 sites, and this seems to be a -- largely rely on a lot of site-specific conditions, that's what that -- and a lot of modeling. And it seems to me that would be a significant issue for the State in terms of resources. You're looking at a lot of modeling, you're looking at a lot of staff time, so I just -- you know, I mean, it would be helpful to have somebody talk about some of these -- the overall issues of the proposal itself.

MR. HISER: Commissioner Bailey [*sic*], it might be possible for us during Dr. Sublette's testimony to maybe sit down with Dr. Stephens and have him put together a brief outline of what it is exactly on the modeling side is being proposed to be done as a model and what the parameters would be, to give you a sense of what type of effort would be required from the staff.

That's not something that we have prepared, but it's something -- He's giving me a "Yeah, sure" look --

(Laughter)

MR. HISER: -- that we might be able to try to put together, if that would be helpful, Commissioner.

COMMISSIONER OLSON: Well, I think it would be kind of helpful to maybe understand why the -- for certain areas that you think are important, why that you think they are important and how this would work, so...

MR. HISER: Okay, we will see what we can do, and then I'll get together with Mr. Brooks and Mr. Huffaker and Dr. Neeper and try to get that to them as well.

COMMISSIONER OLSON: Because one issue I see -- I don't know if Dr. Stephens can answer this, but I was looking on your proposal -- that's the redline strikeout version -- in -- I guess it's part of your prehearing statement, on page 24. There's this concept of permissible chloride levels for small landfarms. And then it says -- there's a small table there towards the bottom of page 24, which lists varying chloride concentrations for wastes for different environmental-sensitivity parameters, it's listing low sensitivity, medium sensitivity and high sensitivity.

And I was -- Maybe I missed something here, but I didn't see how those were defined, how you're defining those sensitivity areas and determining those criteria.

MR. HISER: Although I don't want to testify, so I will prepare for Mr. Brooks's objection on this, I really believe that in the sort of corrections that the industry committee was going to be recommending, we were probably going to recommend a single 2000 p.p.m. limit, based on what Dr. Stephens talked about, rather than that tiered approach, but I would need to consult with the technical folks to be certain what our position was.

But we were not planning to actually stay with that table that you see there.

COMMISSIONER OLSON: Okay, great.

MR. BROOKS: You notice I did not object.

(Laughter)

Q. (By Commissioner Olson) And maybe Dr. Stephens could answer this. I've seen this also in your proposal. It seems that -- I'm just trying to understand this. It seems like you're -- in the proposal here for corrective actions that industry has in the vadose zone monitoring, that you're proposing to do BTEX and chlorides and, I guess -- I don't know, it looks like it's not TPH. But is your -- is the concept to this that you have a couple of indicators for the vadose zone that would kick in more extensive sampling and analysis? I'm just trying to understand that part. That's -- Maybe that's something that Dr. Stephens can answer?

MR. HISER: Can you answer his question?

THE WITNESS: If I see what it is. I didn't have any direct input into this --

COMMISSIONER OLSON: Okay.

THE WITNESS: -- this part of the process, but maybe I can answer your question, if I see what language --

MR. HISER: Vadose zone monitoring.

Q. (By Commissioner Olson) I was trying to understand conceptually what industry was proposing here, because that's what it sounds like to me, but I just wanted to make sure I understood it correctly.

A. BTEX and chlorides -- well, the indicators, and then sampling for the 3103 standards if the indicator parameters are showing a potential problem.

Q. Okay. So instead of looking at --

A. -- the more expensive list right off the bat --

Q. -- the more expensive list, you're looking at that using an indicator. Okay. I think that's all I have.

A. I mean, chloride should be fairly mobile.

Q. All right.

A. More mobile than the others, BTEX would be more volatile, and -- I think it makes sense. Most of the other things of concern on the 3103 list are either metals, which are much less mobile than chloride, or solvents, which shouldn't be there in the first place, so -- or would be detected in, you know, the waste -- maybe certification.

Q. So this would allow for the more mobile constituents to be used as indicators, then?

A. Yes.

COMMISSIONER OLSON: Okay, thank you.

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. Doctor, who is the Committee for Science Based Regulation?

A. I believe that's a subset of the industry group.

Q. So it's still an active committee, and it's one of your clients?

A. You know, I'm not exactly sure who comprises it all.

Q. Okay. Your report dated April 12th, 2005, behind Tab 5, says it was prepared for Yates Corporation and the Committee for Science Based Regulation. Is that part of the people that you represent here today?

A. Yes.
Q. Is that another name for the industry committee?
A. In my jargon, yes, but -- the answer -- in my understanding, it would be yes.
Q. Okay, but they're not, as such, a party to this proceeding, or are they the industry committee, as such?
A. Hm, I'm not sure I'm the best one to answer that question.
Q. Well, it's -- it's your report that says it was prepared for them.
A. Well, that was my understanding of who the client was. As to whether it's a subset or whether there's some members that are not part of the industry committee, as you know, I'm not sure. But my expectation would be, if someone said the industry committee as you -- as we've been talking about it, this is a group within that, plus Yates Petroleum.
Q. Okay. They're folks that are paying you, though?
A. That's right.
Q. Okay, so your client is the Committee for Science Based Regulation, as opposed to the industry committee. I guess I'm just trying to understand who you work for.
A. I think it's all -- I think it's the broader group. I think they've all contributed, is my understanding, to supporting this effort.

Q. Okay. The reason that I wanted to clarify that is, I've got to ask you a question about your client. Would your client rather have a site-specific permitting procedure for small landfarms, or a process that's proposed in these Rules? I mean, do we need to permit small landfarms? Is that what you're telling us?

A. No, I don't think so. I just think they want some greater flexibility than what has been proposed in terms of a numerical standard on the chloride acceptance criteria.

Q. So you agree with us that we have -- that the small landfarm procedure is valid and should be used; is that correct?

A. The registration part of the process?

Q. Yes.

A. I think that makes sense.

Q. Okay. The only thing that you're arguing with is -- about that, is the specific chloride requirement, the maximum chloride requirement that we have in there?

A. Right.

Q. Now when you talk about a non-degradation policy, you're talking about the OCD's proposal for no new environmental contamination; is that correct?

A. Yes.

Q. Okay. And environmental contamination can include soil contamination, can it not?

A. It can.

Q. And do you believe that it's in the prerogative of this Commission to protect the soil as well as the groundwater?

A. You know, I honestly don't know the whole prerogative of the Commission, but before I started on this project my understanding as a -- more or less of a lay person and a hydrologist working in the state was that -- and I may be mistaken, but that the oil and gas Division was regulated -- or the oil and gas activities were regulated by the OCD, and the NMED regulated the rest of the State and its industries, both under the same umbrella of the Water Quality Control Commission standards that have been established. Loosely, that was my understanding of how the State enforced the water quality regulations.

Q. Okay. If I represent to you that, you know, to protect the environment is one of our mandates, is one of the things that we have to do, would you agree with me that the soil protection and the protection of the quality of the soil would come within that mandate, given that I represented to you that that was our mandate?

A. Well, I guess I'd have to ask what you're protecting it from.

Q. Okay. Chloride contamination, would that be a valid objective?

A. It would depend, in my mind, as to whether it's harmful to human health and the environment.

Q. Okay, is chloride contamination harmful to human health and the environment?

A. Not necessarily.

Q. Not necessarily.

A. Well, contamination, I mean, chloride concentration -- let me get this language correct. chloride concentration *per se*, or chloride *per se*, isn't necessarily harmful to human health and the environment in my understanding.

Q. Now you testified that you have a consulting firm of about 100 people; is that correct?

A. Yes, sir.

Q. And the process that you're talking about, the site-specific evaluation of landfarm proposals -- and at the time that I heard your testimony, I assumed that that included the site-specific evaluation of small landfarms. Is that -- We're getting back to the first question, the 2000 is the only -- the 2000 to 1000 is the only difference that you see in our two proposals; is that what you're telling me?

A. Well, there's differences also for large landfarms, treatment zone sampling and monitoring in the treatment zone, that's a difference.

Q. But are those things that you're suggesting to this committee, that the small landfarms need to be handled on a site-specific basis also?

A. Well, if you -- I think there would be few site-specific -- there probably would be few site-specific cases that you'd have to deal with if you raised the waste acceptance criteria from 1000. But I'm not advocating trying to do site-specific -- pushing it towards site-specific investigations. I'm not trying to that at all, for the small landfarm. But it's an option.

I think that's the -- that's the crux of the issue is, you know, on one hand let's make it easy and find a standard or a bar that we can easily or, you know, rigorously jump over --

Q. Uh-huh.

A. -- and the other is that, well, you know, we don't need to put the bar that high, you know? The bar should be only be this high. And it depends on the site.

And the flexibility is what I think is needed in the regulation.

Q. Okay. Doctor, I'm not exactly sure what you're recommending to us then. Are you recommending the higher standard, or the site-specific proposal, or some combination of the two?

A. That's a good question. I'd say if you have a -- if you were stuck on 1000 milligrams per liter, I would say that you really need to be offering some more flexibility to deal with some number other than that. If you moved off the 1000 milligram per kilogram, I'm not sure what the industry would do if that was presented to them, as far as an option for site-specific studies. I don't think that's been considered yet.

Q. Okay. If we stayed with the 1000 milligrams per kilogram, your recommendation to us, then, would be, you know, that we need to go to a site-specific procedure every time we wanted to install a small landfarm; is that correct?

A. No, if the waste acceptance -- if the waste were characterized as less than 1000 milligrams per kilogram chloride, no site-specific studies really would be needed. You'd have the registration process, and you'd be on your way.

But if you felt that, well, I've got 1100 milligrams per kilogram in my waste, do we need to come before the Commission, or can we figure an alternative approach that's going to be equally protective?

A. Okay, and the proposal is that they -- if they were to bring in a load of 1100 chloride waste, that they would have to go before the Commission, then, and that -- I think we're clear on that, isn't --

A. Potentially, yeah, that's my understanding of the testimony I heard.

Q. So --

COMMISSIONER BAILEY: Or to a landfill.

Q. (By Chairman Fesmire) Or to a landfill?

A. Yes.

Q. So they've got the two options there. I guess I'm not seeing the difference, because if they come before the Commission, that would be a site-specific investigation, would it not, involving, you know, to hopefully a lesser extent, the same kind of testimony that we've heard today?

(Laughter)

A. You want to hear this again now?

(Laughter)

Q. That's why I said hopefully to a lesser extent.

A. Right, we'd be brief. Right.

Q. So I guess I'm not seeing, you know, the difference. We have in this proposal a -- you know, a cutoff, and if you are above that cutoff it becomes a site-specific investigation, doesn't it?

A. Yes, but you don't need to go out to the field and collect data. You can get some of the information from surrounding areas, literature searches. There's, you know, a good level of information throughout the State, the State Engineer's office, the U.S. Geological Survey, from other sites that people have studied, to gather information to populate models.

Now the modeling effort is not a big effort. It might sound complicated -- there's lots of numbers and complicated graphs -- but it really is -- it's not that hard, you know? It's just a tool to use, that can be used on a regular basis with -- it is almost a cookie-cutter approach, rather than a cookie-cutter number.

Q. Okay.

A. And I think that's the idea.

Q. So can I condense the answer to my question to yes.

(Laughter)

A. Maybe if you repeat it.

Q. The question was, basically, are we not creating a process where -- you know, below the 1000 cutoff you've got a certain process, above the 1000 cutoff you've got a site-specific evaluation with notice to other people.

A. Yes.

Q. When you say protective of groundwater, what do you mean?

A. I mean protective of the groundwater standards.

Q. So anti-degradation, there's a gap between what we might consider protective in an anti-degradation-type environment and what you would consider protective, and that is the differential to the groundwater standard; is that correct?

A. Yes.

Q. And am I correct in clarifying the difference between the OCD's position and your position, in a related question, that the OCD basically is proposing a non-degradation-type procedure and you all are proposing maybe a controlled or a management of the waste to satisfy the water quality standards?

A. Yes, but I might add, it's possible that -- especially if you get to the dryland-type farming condition, you won't have any degradation of groundwater, anything appreciable or measurable. I mean, that's a possibility, so...

Q. But at the same time, if our objective were to facilitate re-vegetation and to protect the soil, that our process would be protective of that, and perhaps under certain conditions the industry-proposed process wouldn't be?

A. I think the simple answer to your question is yes. But it seems to me that that's a big step, to protect the soil from any condition that it's not in at present, regardless of whether it affects invertebrates, plants or groundwater quality.

Some change is -- maybe some nutrients are okay. Maybe, for example, nitrates. You add some amended nitrates to the landfarm to help with the plant growth, and some of that nitrate gets down into the vadose zone. Are you going to say, hey, we need to remediate or change the operation, because we've added some nitrate that wasn't here before.

I think the reasonable thing to do is, they'd say, no, of course not, you know. But again, we don't know who's going to be here at the time that decision has to be made. Nitrate can be a constituent of concern, and somebody might say, you know, I'm concerned about methemoglobinemia here in my community and any nitrate is not good.

So you know, I don't know how to anticipate that question, really.

Q. Could you go back to that word, micromemathemia?

A. Methemoglobinemia, it's called the blue-baby syndrome. It's why nitrate is a standard of 10 milligrams per liter of nitrogen or 45 milligrams per liter of nitrate.

Q. Okay. Now talking about, again, the monitoring in the small landfarms, you understand that the OCD proposal is to sample three foot into the vadose zone; is that correct? Three to four foot into the vadose zone.

A. Let me just confirm that, I want to -- I believe that's correct. Let's see, it says the operator shall monitor the vadose zone beneath the treatment zone -- this is page 19, (5).(a), sampling. The operator shall monitor the vadose zone beneath the treatment zone in each landfarm cell to ensure that contaminants do not migrate to the underlying native soil or to groundwater. The vadose zone shall be taken from soils between three and four feet below the cell's original surface.

Now I'm not sure if that's the -- this is where I get confused in the language, if it's the top of the surface of the bottom of the surface, cells -- the original surface would be on the ground surface, that if it's disked in it goes down two feet, and then you have a -- three foot below the land surface would only put it one foot below the two-foot disked-in depth. If it were disked in more than two feet with farm equipment, then it would be only inches away potentially. So I'm not sure where the -- It's not very specific.

Q. Okay. If I represent to you that it was intended -- that there was no intent that it be disked into the existing soil and that three to four feet was supposed to be down into the vadose zone, would that be an acceptable process to the industry?

A. I think it's going to be -- it would be -- it depends. You'd have to look at the specific conditions, but I think it would be a difficult one to accept. Wherever the contamination is in the vadose zone -- the biggest uncertainty lies with, say, vapor transport or something like that, and the fact that we're talking about background.

The vadose zone standard was set with language that's consistent with, say, the solid waste management regulations that I have some vague familiarity with, and the cleanup corrective action goals elsewhere. It's that you can -- that the contamination in the soil, or the constituents in the soil could be harmful at a certain level, and that level is that which would impair groundwater. It's with respect to groundwater, it's a point of compliance or potential foreseeable use. That's the way the WQCC rules, as I recall them, pertain to.

And likewise, you back up from that to, well, what impacts to soil could occur from a solid waste management facility, a land- -- even a landfill. And it's all with respect to groundwater contamination.

So even though there could be a small impact to soil, it's like, well so what? The "so what" is, well, does it impact groundwater at a point of compliance, a potential foreseeable future use in groundwater.

And you back up that calculation to say, okay, well this is a threshold, this is a target in the vadose zone we're going to shoot for. If the nitrate exceeds whatever this number is, then we're concerned, then we've established a trigger, at which time we remediate.

And the nice thing about the vadose zone process and the emphasis about the slow travel time is that you do have plenty of time to dig this out. It's not rocketing down to the water table, moving at tens of feet or hundreds of feet per year. It's very slow.

Q. Doctor, the point I'm trying to get is that slow that slow travel time. Assuming that the vadose zone is undisturbed and not disked -- and that, I think, is the intention of the regulation -- how long under, well, if the landfarm is well managed -- meaning, you know, water not allowed to puddle and managed according to these Rules -- how long will it take contaminants to get down to the three- to four-foot sample level in the vadose zone?

A. I could tell you, but I can't do it right here --

Q. Right.

A. -- but I could give you ballpark --

Q. Give me a ballpark then.

A. You know, I would say it could be on the order of -- well, for soluble constituents -- let's see. A few years maybe. You might see the leading edge of something.

Q. So a few years maybe under optimal conditions --

A. Yeah, really fairly dry, a fairly dry landfarm, you're not, as you say, puddling water on it. But the volatile constituents may come through sooner.

Q. Okay. But the volatile constituents, what direction would they be traveling?

A. Some of them would move upward into the atmosphere, some would move sideways, some would move downward.

Q. Okay. In a properly maintained landfill where they -- I mean landfarm, mercy -- you know, most of those volatile constituents we're not going to have a problem with in the vadose zone, are we?

A. I don't know. I think at the levels of analytical detection and the strictness of the criteria as background -- and let's assume benzene is not a naturally occurring constituent -- it could be a problem.

Q. Okay.

A. That's my concern, is the strictness of the background. And if the standard were written such that the concentration would be -- you could establish a -- for maybe a large landfarm, a vadose zone monitoring trigger that's site-specific.

Q. But if it does become a problem, that means we have a problem with the material that we've -- landfarming, perhaps it was not amenable to landfarming; is that correct?

A. Well, I don't think it's avoidable, that -- even though biodegradation is going on of benzene and other BTEX constituents, part of the biodegradation process -- as I view it, it's an integration of several processes, one of which is microbial degradation. But another is volatilization, and that's offgassing, so to speak, and --

Q. Doctor, if it gets down to three or four feet, doesn't it present a threat, then, to groundwater?

A. Not necessarily. It depends on the concentration. And once -- If you have very low concentrations, it's above background, that's triggered a response, a plan, an encapsulation or a remediation or hauling to a landfill potentially, or maybe just doing nothing except watering less. Don't know.

So it may create no risk to groundwater, but an action would be required. And that's the concern here.

Q. Okay, and isn't that what we're trying to accomplish with this Rule, is make sure that if an action is required we do it?

A. Sure.

Q. Now the assumptions used by the OCD are -- in drafting this Rule, are admittedly conservative, are they not? You've mentioned a couple of them. You said a conservative assumption is that water will move downward, and that was one of the tools that OCD has used in their analysis; is that correct?

A. Yes.

Q. Okay. And if you were going to protect the environment, wouldn't you want them to use conservative assumptions where they didn't have the opportunity to do site-specific evaluations?

A. Yes.

CHAIRMAN FESMIRE: Okay. Mr. Hiser, I have no further questions. Do you have a redirect?

MR. HISER: I do, and blessedly it's not very long, but I was wondering if this might be an appropriate place to take the break?

CHAIRMAN FESMIRE: It's okay with me. Commissioner?

COMMISSIONER BAILEY: It's always a good idea.

(Laughter)

CHAIRMAN FESMIRE: Why don't we reconvene at 10:20.

(Thereupon, a recess was taken at 10:10 a.m.)

(The following proceedings had at 10:22 a.m.)

CHAIRMAN FESMIRE: Let's go back on the record. It's approximately 10:20 on May 5th. We had just completed the cross-examination of Dr. Stephens, and Mr. Hiser was going to begin his redirect.

Mr. Hiser?

MR. HISER: Thank you, Mr. Chairman.

REDIRECT EXAMINATION

BY MR. HISER:

Q. Dr. Stephens, when you were evaluating constituents that you would do the modeling for to evaluate potential impacts on the groundwater, why did you choose chloride?

A. Well, chloride is not attenuated, it's not volatile, it's -- moves with the groundwater, it would be the most mobile of the constituents, more likely than not.

Q. And so if you were to choose a constituent that if placed on the land surface would have perhaps the greatest possibility of reaching the groundwater in the highest concentration, would that be a compound like chloride?

A. Yes.

Q. And Mr. Huffaker asked a series of questions about did you consider any metals at all. Would the metals have a greater or a lesser conductivity through the vadose zone and into the groundwater than chloride?

A. Well, the mobility of the metals would be less than that of chloride.

Q. So that if we saw a given concentration of chloride for a given unit in the surface, we would expect to see less of a metal starting from the same concentration of the metal on the surface?

A. Yes.

Q. And is the modeling that you're doing somewhat scalable? In other words, can I use what you've done with the chloride to help calculate, at least in a general way, what might be true of a metal or another constituent?

A. Generally, yes.

Q. Mr. Brooks had asked you a series of questions about the industry committee's proposal and whether the industry committee agreed with the 1000-milligram-per-kilogram chloride limit for permitted landfarms. Do you recall those questions?

A. Yes.

Q. And is it your understanding that the industry committee is agreeing to a 1000-part-per-million limit across the board, or is that their Tier 1 standard?

A. That would be the Tier 1, one of the options -- I think as I phrased it, it was one of the options they found acceptable.

Q. And the industry committee's Tier 2 standard, then, would be a more site-specific and potentially higher chloride acceptance level?

A. Yes.

Q. Now when you were doing the original modeling work that you did, that was based in part on trying to replicate the work of Mr. Price, did you evaluate more than one location as to where the level of impact would be in the aquifer?

A. Yes, we did.

Q. And where were those two locations?

A. Well, as I recall, we used one location immediately adjacent to the downgradient edge of the landfarm. And another was a well about 200 feet downgradient.

Q. Okay. And do you recollect what the difference was in the model concentrations between the well located at the downgradient edge, which was the one that the OCD staff was using to look at, and the one that was located 200 feet further away?

A. Not specifically, but it was much less. We did that maybe at the beginning of the year, but it would have been maybe five or ten times lower, perhaps.

Q. Okay. And so one of the questions that Mr. Brooks asked was about cumulative impact. And would that level of decrease that you saw in the concentration suggest to you that while there may be some cumulative impact, that may be attenuated rapidly over a distance?

A. Yes.

Q. Commissioner Bailey had expressed some concern about the re-vegetation issues that might appear on the surface. Is it your understanding that the industry committee supports a re-vegetation standard?

A. I think they do.

Q. And if the vegetation was slower to re-establish itself, as Commissioner Bailey expressed a concern, would that have any impact on the observed concentration within the groundwater, or would it only affect the time at which that observed concentration was seen?

A. I think it would have a bigger impact on the time, the delay.

Q. So it would have more of an impact, then, on when we would see the peak point in the groundwater, as opposed to how high the point would be?

A. Yes, I think so.

Q. Then your modeling showed that potentially for a 2-acre or a 2-1/2-acre landfarm that was a temporary facility that -- or even not a temporary facility, but one where the waste was closed on site, that levels of up to 9500 parts per million -- and you actually had one that was considerably higher -- could be left in place from a groundwater perspective; is that correct?

A. Yes.

Q. But you didn't recommend levels that high, did you, for that size of a landfarm?

A. No.

Q. And you recommended instead a level of what?

A. I believe it was 2000.

Q. And then Commissioner Olson had asked you a series of questions about karst and caliche issues and possible preferential transfer from the surface into the subsurface aquifer. Are you familiar with the siting restrictions that are proposed by the OCD?

A. Yes.

Q. And isn't one of the siting restrictions in there that you cannot place a landfarm in an unstable area? And if you need to check, that would be in the C section, I believe.

All right, so much for my recollection of where the siting restrictions are. Well, I had my finger in it to start with. It's E.(1) and (2) on page -- probably about page 11 or so of the draft.

MR. BROOKS: I believe it's page 12 of --

MR. HISER: Thank you, Mr. Brooks.

MR. BROOKS: -- in our notebook.

THE WITNESS: Okay. No surface waste management facility shall be located within 200 feet of any sinkhole --

Q. (By Mr. Hiser) If I could turn the page, just to get you -- Now of course I can't turn the page.

A. -- or within any unstable area.

Q. And is the unstable area defined in the earlier part of the regulations in the definitions under U, and I believe that would be at -- U, V, W -- my version doesn't have that.

MR. BROOKS: It's page 7 in our notebook.

MR. HISER: Thank you, Mr. Brooks.

THE WITNESS: Unstable -- An unstable area is an area that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all the structural components of a landfill. Examples of unstable areas are poor foundation conditions, karst terrains, with its characteristic surface and subterranean features as a result of dissolution of limestone, dolomite or other soluble rock.

Q. (By Mr. Hiser) And then it gives some examples of the typical physiographic features --

A. Yes.

Q. -- and all that.

Would these siting restrictions help address in part some of Commissioner Olson's concerns about where a landfarm might be located and possible preferential transfer?

A. Some of them, I believe so, yes.

Q. Now Director Fesmire asked you a series of questions about whether or not an operator could bring a site-specific provision to the Commission. Do you remember those kind of questions?

A. Yes.

Q. Do you believe that it's always necessary for anything that considers a site-specific area to go through a full hearing process in front of the full Commission, or can some of that be done with the staff?

A. It makes more sense to me to do it on a technical level with the staff.

MR. HISER: Okay, no further questions.

CHAIRMAN FESMIRE: There will be limited recross, limited to the subjects of the redirect.

Mr. Huffaker?

MR. HUFFAKER: I have nothing, Mr. Chairman.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: None, Mr. Chairman.

CHAIRMAN FESMIRE: Mr. Brooks?

MR. BROOKS: Nothing, thank you, your Honor.

CHAIRMAN FESMIRE: Dr. Neeper?

DR. NEEPER: I don't have any.

CHAIRMAN FESMIRE: Okay, anything from the Commission?

COMMISSIONER OLSON: Well, I just want to clarify something.

FURTHER EXAMINATION

BY COMMISSIONER OLSON:

Q. Dr. Stephens, you're not implying that most of Lea County, with caliche underlying it, is unstable area, unsuitable for landfarms, are you?

A. No.

COMMISSIONER OLSON: Okay, thank you.

CHAIRMAN FESMIRE: Mr. Hiser, I guess we're done.

MR. HISER: No re-redirect, thank you.

CHAIRMAN FESMIRE: Your next witness?

MR. HISER: Mr. Carr, I believe, will be leading the examination of Dr. Sublette.

CHAIRMAN FESMIRE: Dr. Sublette, you were previously sworn, were you not, sir?

DR. SUBLETTE: Yes.

CHAIRMAN FESMIRE: Mr. Carr, anytime you're ready.

MR. CARR: Thank you, sir.

KERRY L. SUBLETTE,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CARR:

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

A. Kerry Lynn Sublette.

Q. Dr. Sublette, where do you reside?

A. In Tulsa, Oklahoma.

Q. In this matter, by whom are you employed?

A. The industry committee.

Q. And what is your relationship with the industry committee? Are you working as a consultant?

A. I'm working as a consultant. I was asked to look at the proposed OCD Rule and comment on the science of bioremediation.

Q. Have you previously testified before the New Mexico Oil Conservation Commission?

A. No, I have not.

Q. Could you briefly summarize for the Commission -- review your educational background?

A. I have a bachelor's degree in chemistry from the University of Arkansas, a master's degree in biochemistry and microbiology from the University of Oklahoma and a master's and PhD in chemical engineering from the University of Tulsa.

Q. And briefly would you review your work experience for the Commission?

A. I've been with the University of Tulsa now for 20 years. Before the University of Tulsa, I worked for

Combustion Engineering in R&D and basically biotechnology for waste treatment. Since 1986 I've been with the University of Tulsa where I'm professor of chemical engineering and geosciences, as well as Sarkeys professor of environmental engineering at the University of Tulsa.

During that time period I've taught a variety of courses in both engineering and environmental engineering, chemical engineering and environmental engineering, as well as -- and actually specialized in courses in microbiology, et cetera. I've consistently done research in various types of environmentally related arenas, including bioremediation of hydrocarbons and landfarms, remediation of brine spills. Most of my work currently has to do with the restoration of sites following remediation of oil and brine spills.

Q. You are the director of the Integrated Petroleum Environmental Consortium?

A. Yes, sir.

Q. What is that?

A. IPEC is a consortium of four institutions, the University of Tulsa, University of Oklahoma, Oklahoma State University and the University of Arkansas. We're funded by the EPA Office of Research and Development as an EPA research center. Our specific mission is to -- through research, guided research and technology transfer, to improve environmental compliance with the domestic petroleum industry.

Q. Have you done joint research with EPA in the past?

A. In the past, and currently.

Q. And are you working with EPA labs in the State of Oklahoma at this time?

A. Yes, the Kerr Laboratory in Ada, Oklahoma.

Q. In fact, this week one of the reasons that we moved the hearing back was because you were making presentations to EPA?

A. That's correct.

Q. And they were presentations EPA requested you to make?

A. Right, invited presentations.

Q. And what was the presentation on Tuesday?

A. Are you talking about my presentation --

Q. Yes, sir.

A. -- or the --

Q. Yes.

A. Well, my presentation wasn't on Tuesday. But on Tuesday there was another presentation by the EPA in a special session referred to as Voodoo vs. Science, the Practical Application of Bioremediation. It's a very appropriate -- the topic at hand. And during the course of that session, various members of -- or various employees of the EPA referred to IPEC's bioremediation guidelines as good science.

Q. Behind Tab A [*sic*] in the exhibit book is a summary of your background and qualifications; is that true?

A. Yes, sir.

Q. And in this list you have set out your professional memberships and your publications?

A. Yes, sir.

Q. Since being retained by the industry committee, what have you done?

A. Well, basically I've looked at the OCD Rule and evaluated it against not only peer-reviewed literature but my own experience in terms of evaluating the science involved, as well as practicality, as well as evaluating possible means of -- or possible editing of that Rule that might make more sense as far as the science was concerned.

Q. And as a result of this work have you developed recommendations and a written report that you intend to present here today?

A. Yes, sir.

Q. Have you also participated stakeholder or outreach and other meetings between industry and the Oil Conservation Division and its staff?

A. Yes, sir. I've also provided a written document on recommended practice for landfarm operations to the OCD as well.

Q. In your work with the industry committee have you also participated in meetings with representatives of New Mexico Citizens for Clean Air and Water?

A. Yes.

Q. And could you tell the Commission what is the status of those meetings?

A. Well, I would describe them as ongoing. I've had a long series of conversations on the telephone with Dr. Neeper, followed by face-to-face visits, at least a couple, in which we kind of ironed out some of our agreements, and I would consider those conversations as currently ongoing. We had another meeting just last night.

Q. About two weeks ago, an agreement was reached and memorialized in a letter between the industry committee and the New Mexico Citizens for Clean Air and Water; is that correct?

A. That's correct.

Q. What is the status of that document now?

A. Well, last night we discussed additional areas of mutual interest and agreement, and we've now edited that letter to add additional topics to that letter.

Q. Dr. Sublette, in fact, these meetings were encouraged and suggested by staff members at the OCD; is that --

A. Yes --

Q. -- not correct?

A. -- that's my understanding.

Q. And as soon as this letter is finalized, is it your anticipation that it will be delivered to the Commission?

A. That's my understanding.

Q. You are familiar with the Application filed by the Oil Conservation Division in this case and their proposed surface waste management pools?

A. Yes.

Q. And you're now ready to review your work with the Oil Conservation Commission?

A. Yes, sir.

MR. CARR: May it please the Commission, at this time we would tender Dr. Sublette as an expert in chemical and environmental engineering.

CHAIRMAN FESMIRE: Is there any objection?

MR. HUFFAKER: No objection.

MR. BROOKS: No objection, your Honor.

DR. NEEPER: (Shakes head)

CHAIRMAN FESMIRE: No objection having been seen, Dr. Sublette will be so admi- -- so -- yeah, he can do it.

(Laughter)

MR. CARR: And Mr. Chairman --

THE WITNESS: I'm glad we had that translation.

MR. CARR: -- we're going to try and do it, we'd like to also use the narrative format with Dr. Sublette, if that meets your approval.

CHAIRMAN FESMIRE: Since there's been a precedent for that, I guess we'll go ahead.

Q. (By Mr. Carr) Dr. Sublette, you have prepared slides to present here today that summarize the -- your work and the conclusions that you've reached, have you not?

A. As well as the work of others, yes, sir.

Q. Let's go to the PowerPoint presentation, and I would ask you to go to the first slide, which is entitled Outline of Testimony, and review for the Commission the areas that you intend to cover in your presentation today.

A. Well, I want to start off by talking about the composition of crude oil and condensate in particular, because I'm going to be referring to various components of crude oil and condensate.

I want to talk about biodegradability and some of the fates of these compounds in landfarms. I'll talk about the relative biodegradability of different types of hydrocarbons.

We'll define bioremediation and talk about what is it that makes it work. We'll also talk about what happens in a typical landfarm, as well as what doesn't happen.

We'll talk about issues of bioavailability and this concept of the bioremediation endpoint, and we'll talk about the bioremediation endpoint as an environmentally acceptable endpoint. In particular, we'll talk about toxicity reduction, as well as TPH reduction.

Q. Okay, let's go to the next slide and address -- summarize the other issues that are --

A. And I'll follow that by basically reviewing the recommended practice for permitted landfarms treating petroleum hydrocarbons. This is basically a review of the document that I submitted to OCD.

I'll also talk about some of the requirements in the current Rule that I think are inconsistent with that recommended practice, and we'll talk about why.

I'll talk about bioremediation in the presence of chlorides.

I'll talk about also simplified recommended practice for small registered landfarms and what I think the benefits of those simplified rules may be for small landfarms.

And lastly I'll talk about closure standards for landfarms.

Q. Before we start, let's ask you to define certain terms and concepts that we're going to be using --

A. Sure.

Q. -- and if we could go to the next slide and talk about initially what is crude oil, what is in condensate, and what it is we're trying to get rid of?

A. Okay. First of all, can I request permission to stand?

CHAIRMAN FESMIRE: You may.

THE WITNESS: That's my typical mode, as well as I tend to talk with my hands, and I don't want to --

(Laughter)

CHAIRMAN FESMIRE: We will allow Dr. Sublette to go into professor mode.

THE WITNESS: Thank you --

MR. CARR: Mr. Chairman --

THE WITNESS: -- and if you have any trouble hearing me, let me know. But I don't think you will.

MR. CARR: And Mr. Chairman, as we go through this presentation, I know that the Commission is certainly willing to interrupt and ask questions as we go, and we would encourage you to do that, especially in terms of terms and other things, because the presentation sort of builds from beginning to end.

THE WITNESS: Yes, I would add to that, just please feel free to interrupt me at any time and ask a question. Okay?

I apologize in advance, this is a rather lengthy presentation, but I think there are some very important topics that we need to talk about here. So please, anytime you have a question just stop me and we'll address that question so it doesn't get forgotten at the end. Okay?

All right, so we're going to start talking about, first of all, components of crude oil condensate and talk about what it is we want to get rid of.

Basically what we have here is just a breakdown of various types of compounds that we find in crude oil. We're just starting up here with petroleum, dividing components into polar hydrocarbons and nonpolar hydrocarbons. And I'm going to say something about polar hydrocarbons later, so I'm going to define what I really mean by that.

The strict definition of a polar hydrocarbon is a hydrocarbon which not only encompasses or is not only made up of carbon and hydrogen but also contains oxygen, nitrogen and/or sulfur. And the reason that that's important is because those elements present in the molecule tend to give it very specific types of chemical and physical properties that are going to be important later in the conversation.

So there are a fair amount of these polar hydrocarbons that are present in crude oil.

And the nonpolar hydrocarbons, I'm not going to belabor or go through each one of these categories, but basically we've got several different groups of hydrocarbons here, based on structure, the structure simply being how the different hydrocarbons are arranged in the molecule.

Some of the more important ones that I want to point out are these that we refer to as monoaromatic hydrocarbons. These are the hydrocarbons -- or this group of hydrocarbons contains benzene, toluene, ethylbenzene, xylene. And of course as regulators you have a great deal of concern about these compounds because of their toxicity and because of their mobility in the environment, so I specifically wanted to point those out as well.

I've also got a couple of other ways that we talk about the composition of crude oil here that I want to talk about. In this particular one here, we've divided crude oil -- this is just six commons crude oils that we use as a basis for this data. We sometimes talk about crude oils in terms of fractions, gasoline fractions, naphtha fractions, kerosene, diesel, heavies, lubricating.

Notice that as we go -- also notice the carbon numbers here. Notice as the carbon numbers increase, what happens to the boiling points of these compounds. They get higher and higher. So these are what we're going to refer to later, these down here, as the heavy hydrocarbons, as opposed to some of the lighter hydrocarbons.

Okay. Just another visual illustrating in different ways that we might talk about the composition of crude oil, and I'm bringing in here how that composition varies with a parameter we've heard a lot about here, that's the API gravity. Here we're looking at diesel and several different crude oils here, and going left to right we're going from high API gravities to lower API gravities.

CHAIRMAN FESMIRE: These are examples, I mean --

THE WITNESS: These are examples --

CHAIRMAN FESMIRE: Okay.

THE WITNESS: -- yes, sir.

As we go from left to right, we're getting a larger fraction of heavy hydrocarbons. Notice that these saturated hydrocarbons, many of which are going to be fairly light and readily biodegradable, are decreasing in proportion as the API gravity goes down.

So the API gravity, because it reflects the composition of the crude oil to some extent, is an important parameter for us to use in talking about biodegradability, bioavailability and those types of issues, so I'll bring that up later.

Okay, this is another way of talking about the composition of a hydrocarbon mixture, in this case crude oil. Now what I have here is an example of what's called a gas chromatogram for a crude oil, and here's basically how a gas chromatograph works.

You have an injection oven, you have a column and you have detector In the injection oven, whatever you inject into the instrument gets flash-volatized and carried into the column as a gas. Inside that column it interacts with what's called the stationary phase, to the extent that some of the components in the hydrocarbon mixture like to stick to that stationary phase and others do not.

Those hydrocarbons all, though, eventually come out on the other end and are detected by some sort of detector, some sort of -- various types. This is probably a flame-ionization detector. But those hydrocarbons that have the least affinity, and the highest vapor pressures, I might add, are going to come out of the column first. The heavier hydrocarbons are going to come out of the column later because they have higher boiling points, more likely to interact with the stationary phase.

So what -- the outcome -- or the output of this type of analysis is a plot like this one. And what this represents, down here on the X axis here, this is retention time, zero time down here. And as time goes on, then, we're looking at a representation of what hydrocarbons come out of the column. So these are -- these spikes -- I'll say more about these in a moment, but these represent individual hydrocarbons. So these individual hydrocarbons, these are the light hydrocarbons, and they're going to come out of the column first.

Q. (By Mr. Carr) So the spikes are the light hydrocarbons?

A. Well, no, the spikes are individual hydrocarbons. The spikes at this end down here --

Q. At the lower -- at the lower --

A. -- at the low retention times, those are the light hydrocarbons. They're going to come out of the column first. And as the hydrocarbon basically gets heavier, gets larger in carbon number, bigger molecule, it has a higher retention time and it comes out later.

So as I said, each one of these spikes represents an individual different hydrocarbon. The height of the spike is proportional to how much of that hydrocarbon is actually present in that mixture.

So that's the type of information we're going to get out of this, some representation of what types of hydrocarbons are there and in what relative amounts are these hydrocarbons there.

When you see -- this is a fairly typical chromatogram for a light crude oil, and these very large spikes you see here, spaced in fairly uniform separation, is very characteristic of what's called the n-alkane series, or you might better know these as paraffins. So what we're doing is, we go from one spike to the other, one spike to the next, is, we're actually increasing the carbon number by one. And though I cannot tell you which one of these may be C6, for example, I could tell you the next one is C7, the next one is C8, the next one is C9, et cetera. So you've got these long chains of hydrocarbons. That defines the normal alkane.

Now I'm pointing these out because, as I'm going to show you in a few minutes, this is actually the class of hydrocarbons that the micro-organisms like the best in terms of utilization as a food source. Micro-organisms, unlike us, are going to eat dessert first. They're not going to eat what's good for them, necessarily, first. They're going to eat dessert first, and dessert is going to be those hydrocarbons that they have to invest the least energy in actually being able to use as a food source, and that's going to be the normal alkanes.

So it's very common, when you're analyzing, for example, a soil that's impacted by hydrocarbons, to look to see what happens to these big spikes. If you see these big spikes go down, that is an indication bioremediation is taking place.

Now down at the bottom here you see a lot of smaller spikes, and then on the right-hand side you actually see kind of a hump down here. What you're looking at in these smaller spikes are the other types of hydrocarbons that are present in this mixture. Primarily, these are going to be various types of branched hydrocarbons or, in some cases, cyclic hydrocarbons as well.

And the reason that you end up getting this hump down here at the higher retention times is, you know, a lot has been said about the fact that crude oil contains hundreds, maybe thousands of different compounds. One of the reasons for that is the number of different types of ways that you can arrange carbons in a molecule. And if you think about the number of carbons that are there, as that number of carbons increases, the different ways that you can arrange those carbons in a molecule also increases. In fact, it increases exponentially.

You can kind of think of it like with Tinker Toys. You know, the more of the little hubs you've got, the more different kinds of toys you can make.

And these are called structural isomers. And so these structural isomers, if they have the same carbon number but they differ in the way that the carbons are arranged or connected with each other, they tend to have some very similar physical properties, and that's why you see them kind of clumping up together and actually making kind of a hump in the chromatogram.

Now as these crude oils get heavier so that you have a larger fraction of the big hydrocarbons, the ones that have the larger number of carbon atoms, you'll see that hump actually get bigger.

Q. Okay, let's now look at the analysis of condensate.

A. This is a representation of the GC analysis for a condensate. And again, a condensate -- how we define a condensate is going to vary, but generally a maximum up to C20, but mostly with like the C6 to C9 range. As has been observed several times here, condensates tend to volatize quite rapidly, right? So when we put them into a gas chromatogram, because they have a very high vapor pressure, which means they're going to tend to evaporate very quickly, you see that they come out of the column very quickly too.

So this is a very characteristic type of chromatogram for a condensate. You're only seeing the light components because that's really all that's there.

All right, so crude oil is composed of a large number of different hydrocarbons, and hopefully I've convinced you we can group them into classes, and these classes are going to have similar properties. And as my presentation continues we're going to see, then, that these different classes may behave differently in the environment, not only in their interaction with soil metrics but also in terms of the bioremediation process as well.

So that's what I'd like to talk about now, is the bioremediation process, and talk about how it works.

Bioremediation is based on -- this is simple to say, but biodegradation of hydrocarbons. And the first question one might ask is, why do micro-organisms want to degrade hydrocarbons for us?

Well, they do so because they use the hydrocarbons as food. Right? That's their meat and potatoes. Or they can use it as a food source.

It shouldn't surprise us that there are lots of different kinds of micro-organisms in the natural environment that have evolved over millions of years to be able to use these hydrocarbons as food, and that's because hydrocarbons have been a natural part of this environment for millions of years. So Mother Nature has had plenty of time construct organisms that will be able to degrade those hydrocarbons.

Yes, sir?

CHAIRMAN FESMIRE: Doctor, just a quick question of semantics. Does biodegradation include volatilization, or are they two -- I mean, are they classified as two distinct processes?

THE WITNESS: Those are two distinct processes. In fact, I would not incorporate volatilization into the term bioremediation. Bioremediation means the action of the micro-organisms. Now while we're conducting bioremediation, other things can happen at the same time, but bioremediation only refers to the action of micro-organisms.

So basically when these organisms use hydrocarbons as food, the net result is the conversion of those hydrocarbons to carbon dioxide and water, and because the micro-organisms are using them as food and to support growth, you end up with more micro-organisms, all right? That's the process that we're trying to promote here. When we do bioremediation, we're trying to promote, facilitate the growth of micro-organisms on hydrocarbons.

Micro-organisms that use hydrocarbons, as I said, are very widely distributed in nature. I doubt that you can find a natural environment on earth in which you cannot -- you cannot find hydrocarbon-degrading organisms. They may not be active at the time. They've been found in polar ice caps, for example. There's no hydrocarbon for them to eat there, but maybe once upon a time there was, and they're just waiting for that to come back.

But soil, seawater, surface waters, groundwaters, all these types of environments are populated with micro-organisms that have the capability of utilizing hydrocarbons for food. That doesn't mean that they don't grow if there are no hydrocarbons; they'll use what they have. But they have the capability of, if hydrocarbons appear in their environment, of taking advantage of this new food source and actually being able to switch their metabolism around and focus on this new, abundant food source that's been made available to them.

All right, I'm making a point with this slide, and first of all I'll talk about the point and then discuss the experiment.

The point is that there are a wide variety of different hydrocarbon types that are actually biodegradable. Now this is the experiment that Mr. Brooks mentioned the other day when he was asking if there were any marine environments in New Mexico. This point that's made by this experiment, even though it does occur in seawater -- and I'll say more about that -- has to do not with the environment in which the degradation is taking place, it has to do with illustrating the variety of different types -- structural types of hydrocarbon that are actually biodegradable.

In this particular experiment what the researcher did was to take a crude oil sample and put it in seawater, so it's floating there on top of the water. He then supplemented that seawater with nutrients -- we'll talk later about what kinds of nutrients the micro-organisms might need, but basically sources of nitrogen and phosphorus -- then shook that crude oil with the seawater, and -- to facilitate the introduction of oxygen so that biodegradation can take place.

And what's shown here now, we talked -- we looked at those chromatograms earlier, and here are a couple more for you. These look a little bit different, because what's happened in this case is, the crude oil has first been fractionated into two different parts, the saturates and the aromatics. The chromatogram on the left is the before chromatogram for the saturates. The chromatogram on the right, the before chromatogram for the aromatic compounds.

Down below is the after, and this is after 14 days. Now that's as long as this particular investigator carried out this experiment, however the results are very clear. Remembering that each one of those spikes represents an individual type of hydrocarbon, you see that there are many different types of hydrocarbons that were present in these crude oil fractions that did undergo biodegradation. There's no disputing that.

Once upon a time, microbiologists were confused by results like this. And the were confused because classical microbiology involves trying to isolate organisms from an environment and taking it into the laboratory and studying it. They were confused because they were having trouble finding micro-organisms that are able to degrade all the different types of compounds that are present in crude oil.

In other words, you've got one organism being offered one type of hydrocarbon, and the answer is yes or now, it can use it as food. Well, very often the answer was no, when they knew that it actually disappeared in the natural environment.

What's understood now, though, is that the degradation of this group of hydrocarbons is carried out not by individual micro-organisms acting alone; it's carried out by a community, and there is cooperation among the different members of that community. For example, one micro-organism might carry out part of the degradation process, while another organism or group of organisms can finish the degradation process.

So individually they might not have the capability of using all these different hydrocarbons, but acting as a community they have the capability of degrading an extremely wide variety of different hydrocarbon types. These communities exist in all those natural environments we were talking about. They exist in the soil, they exist in surface waters, they exist in seawater, they exist in groundwater as well.

Okay, let's look at --

COMMISSIONER BAILEY: Question. Assuming a projected X axis on the saturates after graph, clearly there's a larger hump that's developed for the heavier carbons.

THE WITNESS: I'm glad you asked that question, because what I should have pointed out is, because the hydrocarbon concentrations are so much lower in the after-samples, these scales are not the same. The instrument basically had to be tuned to be more sensitive, to pick up those hydrocarbons. Those humps are actually there in the befores, but they're less discernible in the before samples. Very good question.

Q. (By Mr. Carr) Okay, let's go on to rates of biodegradation.

A. Well, hopefully I've convinced you that a lot of these different types of hydrocarbons are biodegradable, but different types of hydrocarbons are going to biodegrade at different rates. Again, I'm referring here now to a natural community, soil, seawater, surface water, et cetera.

Here's an example of some experiments done to compare rates of biodegradation of different classes of compounds by these communities. Top left corner here, these are normal alkanes. Right-hand corner, branched alkanes. Down here, aromatics. And these particular aromatics are monoaromatics, so BTEX, basically.

What you can see is, they're all biodegradable, the concentrations are going down with time as the micro-organisms are using them as a food source. But they degrade at different rates.

Notice that the normal alkanes, the ones I told you were the ice cream, notice how fast they can biodegrade. Basically the reason for that is, when a cell switches over -- when a micro-organism that can degrade normal alkanes switches over from using one food source to a hydrocarbon, in this case a normal alkane, it basically has to turn on the production of only three more enzymes. There are thousands of enzymes in a microbial cell. But to switch from something like glucose to something like decane, for example, it turns on the production of three additional enzymes. It has the genes for that, that gives them the capability of doing it.

And when that occurs in the environment, then the organism's system senses the availability of this new food, it induces the production of those enzymes, only three more. As you get to some of these other types of hydrocarbons, then the organisms basically have to turn on more genes to be able to utilize those hydrocarbons.

So that's one part of the explanation as to why normal alkanes biodegrade so quickly and so easily.

All right, I'm going to turn my attention now to the soil environment in particular, and I'll start with a question that frequently my students will ask me once I've convinced them that hydrocarbons are biodegradable and the organisms that degrade hydrocarbons are very widely distributed. The question is, then, if I have an oil spill, why doesn't the oil spill just go away by itself? Well, very good question.

But the answer is, first and foremost, the microbes need more than hydrocarbon in their diet. In particular, they have to have sources of nitrogen and phosphorous. There are other things they need, micronutrients, et cetera. These types of micronutrients are usually widely available in soil environments. But nitrogen and phosphorous are needed in very large amounts.

Like if we're growing up a house plant, occasionally we're going to have to replenish the nutrients in that soil, right, if we want our plants to grow well. What do we add? Primarily sources of nitrogen and phosphorous. You look at the composition of Miracle-Gro, for example. Those are the two major components. So these micro-organisms need nitrogen, and they need phosphorous to be able to degrade the amount of hydrocarbon we're giving them.

It's kind of this way. If you can imagine for every hundred hydrocarbon molecules that a micro-organism is going to use as food, it has to eat approximately 10 nitrogens and one phosphorous to support the utilization of that material. Otherwise, it cannot transform that hydrocarbon into the stuff that makes up a micro-organism. And micro-organisms, all biological systems, have very requirements for nitrogen and phosphorous in the biomolecules that make up the organism.

So if the bacterium is going to be able to grow and eat the hydrocarbons, it's got to be able to take something from this plate, something from that plate, and something from that plate. If it runs out of what's in the second -- one of the second two plates, it stops taking anything from the first plate, because the growth is going to stop, there's not enough nutrient to support that biodegradation or utilization any further.

Another factor is that microbes need oxygen. When we have a spill that takes place in soil we can certainly have environments, under the hydrocarbon spill for example, that in the absence of any intervention from us can become anaerobic. And even though there are anaerobic micro-organisms that will degrade petroleum hydrocarbons, they do so at slow rates. All right? Aerobic hydrocarbon degraders degrade much more rapidly than anaerobic hydrocarbon degraders. So there could be oxygen limitations.

There's also the limitation in terms of environmental conditions. The environmental conditions have to be right. Temperature, pH and moisture are the most common environmental -- or the most important, let's say, the most important environmental conditions in determining whether or not the micro-organisms are going to be growing and utilizing the hydrocarbon as a food source.

Just like that house plant we were referring to earlier. What happens if you don't water it? Mine die. The same is true of micro-organisms. If you don't provide moisture they're not going to be able to drain the hydrocarbons.

Now fortunately for us, they're a little more forgiving than a house plant. If moisture is low, they will basically go into a dormant stage. They will eventually start to die off, but slowly, more slowly than our house plant, so that they tolerate brief periods of time and when the moisture conditions are not right. And when the moisture conditions then become right, then they can wake up and start to degrade hydrocarbon again.

The last factor is, the microbes and the hydrocarbons have to get together. In other words, the micro-organisms and the hydrocarbons have to be at the same place at the same time, otherwise the micro-organisms cannot eat the hydrocarbons.

Now the way this works is that micro-organisms are always found in an aqueous phase. That aqueous phase may be a layer of moisture on a soil particle. That can look like a swimming pool to a bacterium. But when that layer of moisture where the micro-organisms resides comes in physical contact with the hydrocarbon, the micro-organism is capable of eating the hydrocarbon at the interface. In fact, that's one of the most common mechanisms by which this process takes place. So we've got to get them together in that type of environment if degradation is going to take place.

So if we have a spill and we have only the nitrogen or phosphorous that's naturally available in the environment, that is rarely going to be sufficient to support the degradation of that hydrocarbon. Oxygen could be cut off from the micro-organisms in the soil, moisture conditions may not be right. And in particular, the microbes and the hydrocarbons are only going to get together where? At the periphery of the spill. That's the only place that the moisture conditions can be right and the micro-organisms can be brought into physical contact with the hydrocarbons. So that's why when we have a spill of hydrocarbons it doesn't just go away.

So this kind of produces for us a shopping list of what we have to do to encourage bioremediation to take place. We need to make sure that the micro-organisms have enough nitrogen and phosphorous in particular in their diet. We need to make sure there's adequate -- adequate exposure to oxygen, to support aerobic hydrocarbon degradation. The environmental conditions have to be right, particularly in terms of moisture. And we have to facilitate the micro-organisms getting together with the hydrocarbon.

If we do all that, what we're doing is bioremediation. And as you can see, and this is -- I'll probably use this analogy several times -- that looks a lot like gardening, doesn't it? And that's because that's basically what it is. It's gardening. The same environmental conditions, the same nutrient conditions you need to grow plants, those are the conditions required by micro-organisms to be able to grow and utilize hydrocarbons. If those conditions aren't conducive to growth, no growth, no degradation. It's just not going to happen.

Q. Let's go to the next slide, and just summarize what it takes to grow a microbe.

A. Yes, sir, this is just a summary slide. Here we've got two different boxes for energy and carbon. In this case the hydrocarbon is going to provide not only a source of energy -- the micro-organism gets the energy from basically burning the hydrocarbon, it's basically a controlled combustion process that it generates energy from. It also generates carbon for growth to build more micro-organisms.

But in addition to that we need oxygen, as we were just saying. Nitrogen and phosphorous are the two big nutrients. Probably the next nutrient required in large quantities is going to be sulfur, but usually most natural environments are going to have adequate sulfur in the environment.

There are going to be various types of micronutrients, and in particular we have to have water. We have to have water so that the micro-organism remains hydrated. If it doesn't remain hydrated it's not going to function. We have to have water so that the micro-organisms can contact the hydrocarbon at that interface, and we have to have water in the system so also that these nutrients that we might apply in doing our good gardening can actually get to the micro-organisms, because that's how they get to them. They have to dissolve in water, and then the micro-organism comes in contact with that water, and in that way they can get these nutrients.

Q. Okay, let's now look at bioremediation of hydrocarbons in a landfarm.

A. This is a typical type of curve for describing what happens to hydrocarbons in a properly maintained landfarm, and basically this is a plot of hydrocarbon concentration versus time. And what is assumed in this diagram is that right up here at zero time I have created in that environment all the environmental conditions that are conducive to the growth of those micro-organisms. If I do that, and the micro-organisms them begin to degrade those petroleum hydrocarbons, it is very common to see a very rapid decrease in the overall concentration of hydrocarbon.

Now what's cut off on the slide here but hopefully is in your presentation, these are where the more toxic components of a crude oil, for example, or even a condensate -- these are where the toxic components are getting biodegraded. They're one of the first things to go. BTEX, for example, highly biodegradable, highly mobile. It -- the more -- in fact, there's a relationship between solubility and how fast -- solubility and water --

and how fast biodegradation is going to take place.

So early on here when conditions are right, we've got sufficient moisture, sufficient nutrients, et cetera, the temperature is okay, pH is okay -- get very rapid decrease in total of hydrocarbon concentrations, as well as -- this is the phase, let's say, in which the toxic components are going to be removed.

The rate at which this happens, the slope of that line right there, depends on what type of hydrocarbon we're talking about and those environmental conditions. You've heard earlier, I think in Mr. von Gonten's testimony, a pH range of 6 to 8 is optimal for biodegradation. But 6 may be different from 8, they may be slightly different. It's going to happen at both pH values, but the rates may be different.

Different types of hydrocarbons, here I'm referring to maybe a light hydrocarbon versus a heavy hydrocarbon. All these types of things are going to influence the slope of that line. But it always is going to look like that, it's just the scale is potentially going to be different.

Now I'd like to talk about what's happening down here because eventually, notice that the concentration of hydrocarbons is reaching some minimum value. Okay? And this diagram is approaching it asymptotically.

But basically what's going on here -- Well, first of all, notice that we're not down to zero; there are still hydrocarbons that are left. But we have reached an endpoint as far as bioremediation is concerned. At this point right here, assuming that the micro-organisms still have access to the nutrients that they need, temperature and pH are still okay, there's enough moisture -- assuming all those conditions are conducive to growth, what's happening here is that the process of biodegradation is becoming diffusion-controlled.

And I'll show you a diagram to illustrate this in a moment, but basically what I mean by that is, the hydrocarbons that are left are tied up into the soil particles, and the micro-organisms can only get to them if they diffuse out of that matrix. And I'll show you an example of what that looks like in a moment.

This tends to be the heavy hydrocarbons. They're the ones that have the greatest probability of interaction with the soil matrix. And the more the interact with the soil matrix, the more difficult it's going to be for micro-organisms to actually get to them. We say that there's a bioavailability problem. These hydrocarbons are much less bioavailable than were all the hydrocarbons that were initially degraded very rapidly.

But as I'll show you with subsequent data, even though there are hydrocarbons remaining right here, toxicity has been eliminated. And as far as toxicity is concerned, we don't have to worry about these residual hydrocarbons that are left there at the end.

This is a diagram -- first of all, I've reproduced for you here what the previous curves looked like so we can refer back to that. But this is a plot of two things during a landfarming operation. One is concentration of micro-organisms. The other is rates of CO_2 evolution. The CO_2 is coming from the destruction and mineralization of the petroleum hydrocarbons. They are respiring CO_2, just like you and I do. That's the end product of the combustion of materials we use for energy; it's the same for these micro-organisms.

So what you see associated with that rapid decline in the TPH concentration is a spurt in the evolution of carbon dioxide, as well as a rapid increase in the concentration of micro-organisms. And that's because the micro-organisms are growing on the hydrocarbon, they're utilizing that as food. And when they're growing, you start with lesser numbers and you get greater numbers.

But eventually, once we get down here -- and now the availability of hydrocarbon is much less -- notice that the rates of CO_2 evolution drop off precipitously, and the concentration of micro-organisms decreases precipitously as well.

The number of micro-organisms that are going to be found in the soil are going to be directly related to the availability of nutrients. If there's not enough nutrient available anymore to support the growth of all these micro-organisms, then they're going to start to die off. So you get a spurt in the production of hydrocarbon-degrading organisms, and then once the available hydrocarbon is gone, is no longer bioavailable, that number of hydrocarbon degrading organisms, then, drops back to basically previously -- what it was previously, before the hydrocarbon was introduced into the environment.

Q. Now you talked about heavy hydrocarbons becoming sequestered.

A. Yes, sir.

Q. Let's go to the next slide, and I'd ask you to explain what you mean by that.

A. Yes. By this slide I'm trying to illustrate some of the mechanisms by which heavy hydrocarbons can become immobilized in soil, and in doing so they're going to become potentially inaccessible to micro-organisms.

What we have represented in this diagram is a mineral particle and two different pieces here of organic matter. So the organic matter I'm referring to here is ordinary soil organic matter. I'm not talking about hydrocarbon here, I'm talking about the soil organic matter that normally exists in soils resulting from eons of degradation of natural compounds, dead squirrels, leaves, whatever that has occurred in that site over time.

That organic matter eventually starts to take on kind of a -- even almost a solid-phase-type property itself. But basically illustrated in this diagram is a hydrocarbon that I've illustrated here by this three-membered aromatic ring here, is just illustration.

One of the things I want to point out is, if you look in the mineral fraction or you look in some of this organic matter that has basically become glassy or rubbery over time, you're going to find some tiny little pores or cracks. Over time, these hydrocarbons can migrate down into those pores. And in fact, if that pore were to come in contact with even a very small amount of bulk hydrocarbon, that bulk hydrocarbon would actually get sucked in there by a process called capillary action.

So over time, some of that hydrocarbon gets down into these little cracks and pores, and by illustration here I've showed this hypothetical microbe here. You see how big the microbe is, as compared to the throat of that pore. This microbe cannot come in contact with that hydrocarbon. The only way that it could happen is if that hydrocarbon were to diffuse out of that pore. That's what

I meant when I was saying the process becomes diffusion-controlled. That diffusion process is very, very slow. It will continue over years and years and years.

The other type of interaction that can occur is that these hydrocarbons can become physically bound to the -- particularly the organic matter, but even potentially the mineral matter, physically bound to that organic matter in actually a chemical bond in which the hydrocarbon can be joined to that organic matter. If that happens, again, the hydrocarbon is no longer bioavailable to the micro-organisms.

Both of these processes increase in significance over time. The longer the hydrocarbon stays in contact with the soil, the more migration of hydrocarbon into these little pores takes place, the more association of hydrocarbons or their derivatives with the organic matter that takes place.

So the bottom line here is that not only does this describe what we mean by diffusion control of why the process slows down even though there are hydrocarbons there, it also is a word of caution, because the longer that hydrocarbon stays in contact with the soil, the less bioavailable the hydrocarbon becomes.

Q. Next slide.

A. Okay, if I can review just a little bit.

There are many, many microbes that can use hydrocarbons as food, and these microbes are very widely distributed in nature.

There are many types of hydrocarbons that can be bioremediated.

And as I said before, it's just basic gardening. And that really is what it's called landfarming, because the things that you do to promote the growth of microorganisms are the same things you would do to promote the growth of a crop as well.

When bioremediation reaches this natural endpoint, there are still hydrocarbons in the soil. But as I told you and as I promise you, I'm going to show you data to illustrate for you that toxic hydrocarbons at this stage have been eliminated.

Q. Okay, let's go to a term, bioremediation endpoint, that may not be all that readily found on Google, but it's familiar to you, is it not?

A. Anybody that works -- that does any sort of hydrocarbon biodeg- -- well, actually, I don't even have to limit it to hydrocarbons. Anybody that does an kind of landfarming of any type of degradable material is familiar with what's meant by the term bioremediation endpoint. That's the point at which bioremediation basically cease or becomes diffusion-controlled, again assuming that the micro-organisms still have available to them the right environmental conditions and the right nutrients. So they could use the hydrocarbons if they could get to them, but they can't get to them. That's the bioremediation endpoint.

And what I'd like to talk about is the environmental acceptability of the bioremediation endpoint.

What I'm going to use to illustrate this is a particular study. Chairman Fesmire will probably recognize this, but we did this in a stakeholders' meeting as well. But I'm using this particular study, as you'll see, not because it's the only one out there but for a number of reasons. One, it's a very comprehensive study. Another reason is that it was published in one of the most rigorously reviewed environmental journals in the world. That's *Environmental Science and Technology*. As well, in my research, I have found it referred to in EPA documents as a study of, quote, unquote, high scientific quality. Okay? So I'm picking -- those are the reasons I'm picking this out.

What these authors did was to investigate the effects of API gravity and soil organic matter on the bioremediation endpoint. As we said earlier, you know, the rates of biodegradation and the biodegradation endpoint are going to be affected by these factors. They're going to be affected by what classes of hydrocarbons are there, they're going to be affected by what the composition of the soil is.

We're going to talk about TPH endpoints.

We're going to be talking about toxicity at the bioremediation endpoint, as measured by three metrics. One is earthworm survival in the bioremediated soil.

The second is a table called microtox, which you're probably not familiar with, but it is a laboratory big-scale method that is used to screen toxicity in soils and waters. And basically the way it works is, you extract a soil sample with water, you add to that soil sample a particular type of marine bacterium that is phosphorescent. In other words, if it's alive and well it's emitting light. So what you do, then, is to see if there's any effect on anything that's in that water on the health of that micro-organism, as measured by how much light is emitted.

The third toxicity measure that the use was seed germination. These are the three most common ways of measuring residual toxicity in soil. They're not the only ways, but these are probably the three most common ways. Here's why.

Earthworm toxicity -- Well, let me start with microtox.

Microtox has the advantage of being very easy to do, you get very quick answers. The problem with it is that you're measuring toxicity to a bacterium. A bacterium is, at a fundamental level in terms of cellular structure, much different from you and I. It's called a prokaryote, versus you and I are eukaryotes, and basically the bacteria are in a class by themselves there. So they have a very different cell type than us.

So there's always a question as, how relevant is it to measure toxicity to a bacterium and trying to draw a correlation to potential toxicity to you and I or bunny rabbits or whatever. But everybody uses it because it's quick and cheap and it gets you an answer.

To overcome that limitation, probably the next most common way of measuring residual toxicity in soil is with earthworm survival. And the way this is done, you simply take a sample of soil that you would like to investigate and you add X number of earthworms to that soil, and then you basically seal it up so that they can't get out, even if they wanted to.

You come back usually 14 days later or 28 days later, and you see how many earthworms are still alive, and is there any evidence that the earthworms are going through their normal reproductive cycle? In other words, are they producing cocoons, do you see juvenile earthworms, you know, present in the soil?

Survival, percent survival, evidence of reproduction, all those kind of things are good measures of residual toxicity, because the way an earthworm feeds -- and it has no choice in the matter -- is to burrow through soil and have that soil pass through their gut and out the other end. So whatever is in that soil is being exposed to the inner workings of the earthworm. The earthworm is a eukaryote like you and I, so if we see toxicity in terms of earthworm survival, that's a red flag. Because if it's bad for the earthworm, it's probably bad for us.

The last measure, seed germination, gets to the issue of re-vegetation. Is there any residual toxic material that's going to inhibit the germination of seeds and the growth of plants?

So we look at the earthworms to look at toxicity to animals, basically. We look at seed germination to get an idea of toxicity to plants. And we do microtox because it's cheap and easy to do.

The other thing that these authors did that I'm going to review is, they also looked at leaching potential of bioremediated soil as well. So not only did they look at defining TPH endpoints, look at residual toxicity, they also looked at -- and trying to answer the question, what happens when this bioremediated soil comes in contact with water? What gets transferred to the water phase?

Okay, I've got a series of tables and histograms and things for you here, but these are kind of the overall results. And here I'm looking at the effect of API gravity in soil organic matter. And what you can't see on the diagram here is a carbon-number range, C11 to C44. These particular investigators utilized primarily that method to quantitate hydrocarbons. They used three different carbon number ranges. If you put those all together it's C11 through C44. So that's how we're measuring TPH concentration on the left-hand side here.

They used three different gravities of crude oil, 14, 30 and 55. They used organic -- excuse me, they used soil that differed basically in only how much normal, natural soil organic matter that it actually had. And they've basically chosen a couple of extremes here, very low and pretty high. I mean, we could certainly find soils in forest floors and peat bogs, et cetera, that are going to have much higher soil organic matter than that, but normally when we go out and dig a hole outside the building here, for example, and look at soil organic matter, it's going to be between those extremes.

So what we see here is, the red is the untreated, before any bioremedation took place. They've taken the soil, they've mixed it thoroughly with the hydrocarbon, and before they add any nutrients and create environmental conditions conducive to growth, let's measure what the additional hydrocarbon concentration is.

Then they introduced nutrients, maintained moisture conditions, adequate temperature, pH control, et cetera, and let the bioremediation process take place. Go through those phases that we were talking about, that rapid decline and the leveling out, and when it levels out that's defined as the bioremediation endpoint.

The blue bars here are what's left of these hydrocarbons after the bioremediation process has taken place. Notice first of all, there's a little bit of difference between whether we have .3 percent soil organic or 4.7 percent. That's because there are definitely -- number one, inter-access between hydrocarbons and soil organic matter. But compounded, too, is -- in terms of interpretation -- is that soil organic matter is very good for micro-organisms too. It provides trace nutrients, it helps to hold and maintain moisture, it helps to prop soil open, you get better aeration. So all those kinds of effects are in there.

But the bottom line in terms of this slide is that if you look at API gravity as a function of how much hydrocarbon is left after the bioremediation process, you can see that larger amounts of hydrocarbons left are API gravity 14, no matter which organic matter concentration we're talking about, then 30, and then followed by 55.

Why is that? Because as we go from 55 up to 14 we are increasing the proportion of heavy hydrocarbons. It's the heavy hydrocarbons that have the tendency to more associate with the soil particles and be difficult for the micro-organisms to get to. At the same time, they have the lowest water solubility. So all of those things combine t make their bioavailibility lower. So we would expect to see a higher TPH concentration at the bioremediation endpoint at the lower API gravities.

This is a similar plot, but what you're looking at here is a combination of two of the fractions -- not all three but just two -- C11 through C32, and that does not directly correspond to how we might define a DRO, but it's pretty close. So that's the reason that I did it.

So we're looking at the same thing here in terms of approximate DRO. And as you can see, even in terms of DRO there are significant concentrations of DRO hydrocarbons remaining at the bioremediation endpoint. Again, there is a relationship between API gravity and the concentration of hydrocarbons at that endpoint.

This is the same data presented to you in a different way. Percentage reduction at the bioremediation endpoint. And the reason that I'm presenting this data to you this way is because of the OCD's recommendation of a minimum of 80-percent reduction in TPH.

I've fractionated this out as to carbon number at, again, all three of the API gravities and two different soil organic matter concentrations.

First of all, notice that no matter what the API gravity, no matter what the soil organic matter, which carbon fraction shows the highest rates of degradation? It's going to be the lighter material. Okay? But at API 14 it's about 72, about 75, up to about 90 percent for an API gravity of 55.

As the carbon number ranges -- goes up, what do we see? Lesser percent removal of those particular carbon number ranges, again because the heavier hydrocarbons are more likely to associate with the soil particles, lower water solubilities, those combine to mean lower bioavailability.

Fortunately, this is not where the toxicity resides.

Next slide.

Q. Doctor, before you go on, on this slide if we look at the C11 to C22 bars -- those are the lighter-end hydrocarbons?

A. Yes.

Q. -- isn't that -- aren't those more typical of what you'd expect to see if you were dealing with an underground storage tank?

A. Yeah, if we were talking about -- you know, there was some mention yesterday of some data from an underground storage tank program about -- I hope I get this exactly right, but something like it was difficult to get more than 95 percent biodegradation. The implication was that you can get close to that. And the reason that comment was made was because in the underground storage tank program, you're dealing with fuels, you're dealing with low numbers of carbon atoms, you're dealing with lighter hydrocarbons, you're dealing with the hydrocarbons that are easier to biodegrade.

So as this slide illustrates, at the lower carbon numbers you definitely can get higher percentages of degradation at the bioremediation endpoint. But as that carbon number increase, as you can see, percent reduction on those different carbon numbers is going to decrease.

So to the extent that a hydrocarbon in a landfarm has various amounts of these heavier hydrocarbons, that's going to have a big influence on what the maximum possible reduction in hydrocarbon concentration is going to be. In other words, what that bioremediation endpoint is.

Q. Would you agree with me that if you are developing standards based or tied to underground storage tank regulations and standards, that you may be basing your standard on oranges, and you're actually in the field, in real life, applying it to apples?

A. I agree, it's inappropriate.

Q. Go on, please.

A. All right, well, I've just focused on hydrocarbons there in terms of TPH, and obviously we're all interested in the toxic component, which is going to be primarily represented by BTEX. So what happened to the BTEX during bioremediation of this hydrocarbon?

Again, I've got the soil organic matters here, the three API gravities. This is the -- I've isolated benzene by itself for obvious reasons, and then lumped the others, toluene, ethylbenzene, xylene, all together.

But in the untreated soil these are the benzene concentrations, and they're pretty much what you would expect. Notice as the hydrocarbon gets lighter, the API gravity gets higher, you have more benzene present in that hydrocarbon. Again, it becomes more -- similar to fuel spill, for example.

Look in the benzene concentration after bioremediation. By the method used by these researchers it was nondetect, less than .02 milligrams per kilogram.

In toluene, ethylbenzene and xylenes, again, trends that we would expect based upon API gravity before treatment. After treatment, again, nondetect.

Now going on to some of the toxicity data, we've shown that the BTEX is basically gone. That should eliminate all the toxicity, or the vast majority of it, let's say. What happens -- or what do the toxicity metrics say to us about these endpoints?

These are actually earthworm survivals, these are 14-day survivals, as reported by these researchers at the different API gravities. I've got one plot for .3 percent, one plot for 4.7 percent, because again the organic matter is not only going to affect microbiology, it's also going to affect the earthworms too. So there are going to be some differences here.

And instead of just showing you the endpoint, now showing you a time scale. The bioremediation endpoint in these experiments was around 12 months, but I'll show you how the survival is increasing as bioremediation takes place. Why is that? Because as bioremediation takes place, we're removing more and more of the toxic material. So as we would expect, conditions for survival of the earthworms gets better and better and plateaus out here at 100 percent in everything but the 55 gravity, and it's about 10 months. But even in the 55 gravity which, remember, had the highest concentrations of BTEX, it levels out at 100 -- or goes to 100 percent out here at about 12 months.

Similar type of data for the high soil organic matter. Obviously, though, the soil organic matter helped the survival of these earthworms. Why? It may not have anything to do with the toxicity of the BTEX, it may simply have to do with the soil organic matter provided micronutrients or a better environment for the earthworms. It's hard to say. But the bottom line is, survival goes to 100 percent very rapidly.

So this is best-case scenario, worst-case scenario. In both cases, at the bioremediation endpoint toxicity has been eliminated.

All right, this is microtox toxicity, and again we're looking at percent reduction in toxicity on the Y axis here, months of bioremediation on the X axis. And as measured by microtox as well we are seeing, as bioremediation takes place, there is a greater and greater reduction in toxicity in that soil. And as measured by microtox, at the low organic matter concentration toxicity has been eliminated at eight months, and at the high organic matter concentration toxicity has been removed at about five months.

These investigators also looked at the effects of bioremediation on seed germination, and here -- what we have here is two sets of histograms from both organic -- full organic matter concentrations. Untreated on the left, bioremediated on the right. They looked at the soil without hydrocarbon having been added, and then with the 14, 30 and 55 gravity hydrocarbons before treatment, and looked at percent germination.

With any sample of seeds it's very unlikely, even in the absence of anything that might be considered inhibitory to seed germination, that you'll get 100 percent. So that's why they're comparing this to an unimpacted control.

The ones with the stars here -- These are basically averages of multiple samples. The ones with the stars here are considered statistically different from the control. In other words, for this plant here, for oats, at 55 there was -- it was definitely less than the control for wheat, definitely less than the control. And that star right there has migrated a little bit. That actually should be above that red bar right there. So for wheat at an API gravity of 30, you could definitely see that there was an effect of the hydrocarbon on seed germination.

Same thing at a high soil organic matter concentration. Again, the stars mean that it's statistically different from the control. So definitely we were seeing, particularly at the higher API gravity, some effects on seed germination by these hydrocarbons.

But after bioremediation there is no discernible effect on seed germination. These average values here are basically statistically the same as the control.

Now I've added these slides. Mr. Price -- This is in response to your request, Mr. Price. These researchers did include some data on leaching potentials, which I did not present in the stakeholders' meeting, but Mr. Price requested this, so I've provided it to them.

Basically, these investigators looked at leaching potential in two ways. One is what's called a batch soil extraction. In other words, you just take a sample of soil, take a given amount of water and shake it around and then filter out the soil and see what you find in the water.

Notice this material right here, sodium azide. The reason for adding that, that's a biocide. So basically what they're doing is, they don't want to encourage any bioremediation while they're doing the extraction test. So they want to just see what's going to leach out into the water.

Column leaching studies are a little bit different. In this case we've got a glass or plastic column filled with soil, and the intent is to simulate what happens when water leaches down through that soil.

And in both cases they looked at these extracts in terms of TPH, BTEX, oil and grease, and metals as well.

I don't know if everybody is familiar with what oil and grease is or how that compares to TPH, but basically the technique for measuring TPH and oil and grease, the extraction technique or -- what am I trying to say? -- the total extractable technique is something like a 418.1, with silica gel cleanup for TPH. For oil and grease you don't do a silica gel cleanup.

The purpose of a silica gel cleanup is to remove polar material that might have been extracted with the hydrocarbon. So when you're doing TPH you're not wanting to see the polar plant material, for example. But with oil and grease you're looking at everything.

Okay, so these are some results. Again, this is the batch extraction results, and here we're looking -- what they reported was -- in detail, was the oil and grease concentration after one extraction, two, three, four, five extractions. Again, the different API -- initial API gravities, two different concentrations of organic matter. This is after the bioremediation process.

As you can see, these numbers are all pretty low here, especially when you consider, you know, oil and grease is probably going to get a little of that organic matter as well.

The other important observation is that in every case, TPH concentrations were less than 5 parts per million. BTEX concentrations, all totaled, were less than five parts per *billion*, and they did not detect any heavy metals in the extracts.

These are the results of the soil column testing. Again, look here, now looking at BTEX levels. These are in parts per billion micrograms per liter, looking at before and after bioremediation. And as you can see, there was -- in the untreated you could leach out lots and lots of benzene, lots and lots of toluene, ethylbenzene and xylene from these soils before treatment.

After treatment, in the bioremediated soil -- again, this is micrograms per liter -- benzene was below the detection limit of two micrograms per liter. They did pick up a little bit of toluene, ethylbenzene and xylene, most of them pretty low except for this value right here, but that's also -- in terms of parts per billion, that's also a pretty low number.

The other important observation was, again, they looked for heavy metals. No heavy metals.

All right. Well, I'd like to conclude this part of my presentation with these three tables, because what I've done is to use one particular study to illustrate for you what we mean by a bioremediation endpoint, what affects a bioremediation endpoint in terms of TPH levels, et cetera. But more importantly, I want to show you that toxicity has been eliminated when we have reached a bioremediation endpoint.

But that's just one study. And if I was you sitting there I would say, Well, did any- -- has anybody else seen this?

And what I've listed for you in these three tables is just some -- not all -- some of the peer-reviewed scientific literature in which investigators have looked at toxicity reduction after bioremediation and come to the same conclusions. Toxicity is essentially eliminated at the bioremediation endpoint.

You can see different types of hydrocarbon type that were used, different types of ways that they measured toxicity. You'll see seed germination, earthworm survival and probably the microtox in these lists as well.

Go on to the next one.

Again, different types of hydrocarbons, different types of metrics being used to measure residual toxicity.

And the last slide, again, just more -- now we're looking -- we've got some refined products in here too, as well as crude oil.

All of these studies came to the same conclusion again, that at the bioremediation endpoint toxicity is essentially eliminated by these metrics.

MR. CARR: Mr. Chairman, this probably would be an appropriate place to break the presentation for lunch.

CHAIRMAN FESMIRE: Okay. That having been said, why don't we go ahead and take a lunch break and come back at one o'clock, and we'll resume with, I guess, the second part of your presentation.

THE WITNESS: Yes, sir.

(Thereupon, noon recess was taken at 11:52 a.m.)

(The following proceedings had at 1:00 p.m.)

CHAIRMAN FESMIRE: At this time we'll reconvene OCD Cause -- I mean OCC Cause Number 13,586. Again, let the record reflect that all Commissioners are present, there is a quorum. And I believe, Mr. Hiser, you were about to begin the second part of Dr. Sublette's testimony?

MR. HISER: I believe that would be Mr. Carr.

CHAIRMAN FESMIRE: Or Mr. Carr, I'm sorry.

MR. HISER: We may have lost our projector here over the lunch hour.

(Off the record)

CHAIRMAN FESMIRE: Mr. Carr, anytime you're ready.

MR. CARR: All right, sir. May it please the Commission, before lunch we had just concluded a portion of Dr. Sublette's testimony, and he had provided a number of reference materials where removal of hydrocarbon toxicity in soil had been reported.

Q. (By Mr. Carr) I think at this point, Dr. Sublette, We're ready to go to a slide, the one that's on the screen.

A. Yes.

Q. Would you start there, please?

A. If I may, though, before I do, I'd like to ask the Commission if the had any questions that occurred to them over lunch that you wanted to ask?

CHAIRMAN FESMIRE: Commissioner Bailey?

COMMISSIONER BAILEY: (Shakes head)

COMMISSIONER OLSON: No.

CHAIRMAN FESMIRE: I don't think so.

THE WITNESS: Okay, good.

Well, this is a summary slide, I think with a lot of good information on it. This is what the Salinitro study says about the bioremediation endpoint.

What I have plotted here is percent removal of TPH-DRO as a function of API gravity, and I've got two lines on here. The two lines correspond to the two different soil organic matter conditions that Salinitro used. The blue one is the high organic matter, and the red one here is the low organic matter. So we can kind of think of that as creating a boundary, and with most cases probably falling in between those two lines, at least as far as organic matter is concerned.

If we were to use the proposed minimum percent removal that the OCD has proposed as far as DRO is concerned here, we can just draw a little dotted line across here and assume that that point right there represents our average case. Drop a vertical line to the X axis, and what that says is that as far as the bioremediation endpoint is concerned, anything with an API gravity less than about 45 cannot be landfarmed. Anything with an API gravity greater than 45 can be landfarmed.

So the Salinitro study would suggest that this material is going to be able to achieve that 80 percent minimum removal. Below an API gravity of 45, the Salinitro study would indicate that we're not going to be able to achieve that 80 percent removal.

Now Mr. von Gonten gave us some information yesterday concerning the API gravities of oils produced in New Mexico in terms of the volumes of those different oils. And if I recall correctly, in the area of about 37, 38 to about 41, 42 -- if I recall correctly, that would include most of the crude oils produced in New Mexico in terms of volume.

So then theoretically a spill of that material, or soils contaminated with that material, are not going to be able to achieve this 80-percent minimum removal. Which would imply that soils contaminated with most New Mexico oils are not going to be able to reach the bioremediation endpoint as prescribed by the 80-percent removal minimum.

Q. (By Mr. Carr) Dr. Sublette, do you --

A. Yes.

Q. -- do you have an understanding as to what may be the purpose of that 80-percent level, that cutoff?

A. Well, my understanding -- This is speculation, but my understanding is that the agency was perhaps uncomfortable with an open-ended type of endpoint, that reaching the bioremediation endpoint is a desirable thing but I think they were afraid of -- I think what was mentioned yesterday was like weathered crude oils and asphaltic material and things like that ending up in a landfarm, and therefore you could theoretically close it using a bioremediation endpoint and still have a pretty high concentration of your TPH.

But I think that you'll see as we go on here and we ultimately talk about closure standards, I think we have definitely addressed both of those issues for the OCD in terms of recommendations for closure.

Q. Let's go to the next slide.

A. Now that was Salinitro's study. But I wanted to show you some other data, again to convince you that Salinitro is not a lone voice out there in the wilderness making these types of claims.

Here's some data that comes from a Department of Energy bioremediation workshop from 2003. This comes from a document published by the Department of Energy as a result of that particular workshop.

And here we've got two different plots. This one is TPH by GC, and the other one I can't see here -- what -- TPH -- no, oil and grease, oil and grease. This is oil and grease. And as you can see, there -- as far as -- no matter how you measure the hydrocarbon concentration, there is pretty much a linear relationship between the API gravity and what the maximum percent loss is going to be.

And measuring TPH by GC, we're predicting here for 80 percent loss. Well, there it is again, about -- an API gravity of about 42. And I can't really see my axis over here, but I'm presuming that's about right there for 80 percent lost TPH measured by oil and grease, and again that's an API gravity of about 42, 43.

So this data is consistent with the Salinitro study. This is basically sense of the industry that was published by the Department of Energy.

So a quick review --

COMMISSIONER OLSON: Could I ask a question --

THE WITNESS: Yes, sir.

COMMISSIONER OLSON: -- a minute? Going back to these, you have a lot of these ones of a percent loss.

What time period do these occur over? I mean, it's just percent loss and API gravity. Is this over a specified --

THE WITNESS: A specified remediation endpoint.

COMMISSIONER OLSON: When it -- when it's -

THE WITNESS: Yeah.

COMMISSIONER OLSON: -- essentially reaching zero --

THE WITNESS: It is leveled out, yes, sir.

COMMISSIONER OLSON: Well, what kind of concentrations are you seeing when it's essentially reaching zero?

THE WITNESS: That did not accompany this particular data here. But in the Salinitro study they were seeing, you know, concentrations of up to 7000, 8000 milligram per kilogram at the endpoint.

COMMISSIONER OLSON: Okay, thanks.

THE WITNESS: Next slide.

Okay, a little quick review of the bioremediation endpoint and its environmental acceptability. Hopefully I've convinced you bioremediation of hydrocarbons in soil is going to eliminate toxicity, as measured by a variety of metrics. So my feeling here is, in the State of New Mexico as well as everywhere else, when it comes to hydrocarbon-impacted soils, you've got two choices.

You can landfarm that material. And if you landfarm that material, then you can eliminate toxicity.

Or you can landfill that material, and you have not eliminated toxicity, you've simply locked it up for some unknown period of time.

So which option is ultimately more protective? I would say landfarming is certainly more protective of public health and the environment.

Q. (By Mr. Carr) Okay, let's now look at your recommended practice.

A. All right, what I'm going to do now is review the statement of recommended practice that I had filed with the OCD staff. And as I go through here, I think you're going to be struck again with how much this sounds like gardening, or sounds like agricultural practice. And that's because basically it is. Again, you know, if it's good for your tomatoes, it's going to be good for the bugs eating the hydrocarbons as well.

Next slide.

All right, first of all what wastes are amenable to landfarming? Here we've got a list of basically four classes, and here I've adopted the industry's recommendations as far as tiers are concerned. Tier 1 and Tier 2, basically the recommendation is that if tankbottoms are going to be landfarmed, that's a Tier 2 situation. And what we would suggest for Tier 1 and Tier 2 are basically different -- potentially different closure standards for that material.

All right, a lot has been said about hydrocarbon loading. And I think, you know, 5 percent was the maximum that was suggested by the OCD.

Hydrocarbon loading basically affects rates of biodegradation, not really the efficiency -- I mean, not really endpoints but the efficiency of the process.

Biodegradation rates in a landfarm are going to correlate with the hydrocarbon interfacial ratio, interfacial area/mass ratio. Now what I mean by that is how much hydrocarbon surface is available in the landfarm, compared to the total amount of hydrocarbon mass. Another way of saying the same thing is, how well distributed is the hydrocarbon in the soil? Because if most of the biodegradation is taking place at that interface we were talking about, the more interface then the greater the rates of biodegradation.

So biodegradation rates are going to decrease with increasing hydrocarbon loading. That's a given. But that's a rate. That doesn't mean that if the hydrocarbon loading is above the 5 percent, for example, it's not going to work. It's just that, all things else being equal, it will be a little bit slower at 6 percent than it is at 5 percent or 4 percent. But it's a matter of rate.

Biodegradation rates are also going to decrease with decreasing API gravity, simply because as the API gravity increases, viscosity increases, and it becomes harder to simply mix it with soil. But it all has to do with creating that surface area. With 6 percent, 7 percent, 8 percent, we can adequately create surface area, but with a higher loading. That means less surface area for every incremental weight of hydrocarbon, but that just means slower rates. It doesn't mean it's not going to happen, it just means it's going to biodegrade slower.

Another part of the recommended practice to OCD had to do with organic matter. Blending organic matter into a landfarm lift soil is not absolutely required for successful landfarming, but it does have several benefits, not only in terms of rates of biodegradation but also, in my opinion, in terms of rates of re-vegetation following a remediation. Organic matter is going to improve moisture retention, extremely important in this type of climate. It's going to improve soil structure, and we're going to get better aeration, better diffusion of oxygen into the landfarm, and ultimately it's going to establish a fertility base to improve re-vegetation upon closure of the site.

Folks have already talked about pH, the optimum pH. I agree with what was said yesterday, I can't remember who said it, but the optimum pH is in the range of 6 to 8.

It is recommended that it be monitored monthly and adjusted if necessary. And to adjust the pH we can either acidify the soil if we need to or neutralize acidity, if we need to, with these types of materials. These, you might recognize, are readily available agricultural amendments. This is what the farmers use to adjust pH of soil, and we can use the exact same amendments to adjust pH in a landfarm if we need to.

Tilling. There are many benefits to frequent tilling of a landfarm. We're going to help maintain soil structure in the lift, that's conducive to good oxygen transfer. And remember, you know, good rates of biodegradation, we need a lot of oxygen available. So the more frequently we till, the more oxygen we're going to get into the soil.

The vertical mixing that takes place during the tilling operation is going to ensure that the entire soil depth and the lift spend some time in the uppermost active zone. That most active zone is going to be at the top of the lift. Why? Because it's in immediate contact with the atmosphere, so oxygen concentrations are going to be highest there; they're going to decrease as you go down in the lift.

If you till it frequently, then at the bottom of the lift those soils that may not in the last period have seen high oxygen concentrations potentially get brought up to the surface where they do see high oxygen concentrations, and we encourage greater rates of biodegradation.

We recommend that the landfarm lift should be at least twice a month, with a tillage depth that's equal to the depth of the lift.

Nutrients are absolutely essential to promote the biodegradation of the hydrocarbon. The most common nutrients, as we said earlier today, are nitrogen and phosphorous. The best sources of those nutrients are ordinary, common agricultural fertilizer, despite what some door-to-door salesman will tell you. Just going to the lows and getting 13-13-13 is great.

Optimum nitrogen concentrations, we have some recommendations here for what concentration range you want to keep that nitrogen concentration in, about 500 [*sic*] to 200 parts per million.

Optimum phosphorous 25 to 50.

And we recommend monthly monitoring using field kits. There are field kits that are available that allow you to check nutrient concentrations in soil very quickly, you get good, real-time information, and very, very inexpensively.

We do caution -- we always caution practitioners that, you know, if a little is good, a lot is not necessarily better, because a lot of -- the addition of too much fertilizer to the site is potentially going to be inhibitory, and that's what is indicated by this little graphic that you see here. This is oil and grease loss over here, versus nitrogen concentration. And as you can see, we reach a maximum here. That should be around about 200 or so right there. And above that, it actually can become inhibitory.

Moisture. Moisture is a big deal here right now. Optimum soil moistures for biodegradation are typically 60 to 80 percent of field capacity. I think someone, maybe Dan, mentioned that earlier today. What does that 60 to 80 percent of field capacity actually give you? It gives you plenty of moisture for the microbes to do their thing. But it also allows very large macropores in the soil to exist so that you get good oxygen transfer. If the site becomes saturated, then the site is going to go anaerobic during the time the site is actually -- is saturating. We suggest monitoring moisture and adjusting moisture as necessary, at least weekly.

Okay, as far as hydrocarbon analysis is concerned for operational monitoring -- I'm not talking about closure here, I'm talking about just the day-to-day or week-to-week monitoring of your site -- there are alternatives, very acceptable alternatives, to using laboratory-based methods for hydrocarbon analysis for monitoring purposes. In other words, if you're simply monitoring what's going on in the landfarm, it doesn't make any sense to go out there and take samples and send them to the laboratory to have a TPH, 418.1 or to have a 8015 or whatever. If you're not trying to close a site, you don't really need to do those types of analysis.

The EPA, through their SITE program, has identified and certified certain field kits that are out there and readily available, that they say produce results that are comparable to an 8015, and they are recommended by EPA as reliable. The document that I provided to the OCD staff has all of the different kits that were tested by EPA delineated in there, and the ones that the EPA determined to be reliable are identified in there. And what problems existed with the ones that were not certified is also outlined in that -- in the table in that document.

The other advantage of doing field testing is, you're getting real-time answers. Instead of taking a sample, sending it off to the laboratory -- and maybe you get it back in a week or two weeks or three weeks; you know what things were like a week or two or three weeks earlier, not today -- if I go out there with a field kit, I know today what's going on in my landfarm.

Now hydrocarbon analysis for lift closure, though, is going to be a little different. And later I'll talk about site closure, but right now I'm talking about lift closure. And again, I'm going to use the industry's tiered approach here, with a Tier 1 as being -- as the bioremediation endpoint is basically the hydrocarbon analysis for lift closure that we recommend.

For Tier 2, for which there might be some other specific risk based screening levels that are appropriate, depending upon to what went into the landfarm, we suggest a bioremediation endpoint as far as TPH is concerned, followed by the -- whatever other analyses are going to be required as appropriate for the waste that was being treated. I'm going to focus my attention on the bioremediation endpoint.

Documenting the bioremediation endpoint should be attempted when two conditions are met. Number one, the landfarm has been operated following recommended practice for a minimum treatment time -- important there, recommended practice, and I'll show you what -- the minimum treatment time here in a moment -- and when your field measures of TPH indicate that the lift is at or near the end of its treatment cycle. In other words, when the next measures tell you TPH seems to be leveling off and you have utilized the minimum treatment time, then it makes sense to spend money to try to close the lift. Okay?

Here's what we recommend in terms of minimum treatment times. Different for different hydrocarbon sources. Crude oil, tankbottoms, drill cuttings, TPH, DRO, we recommend minimum treatment months of 12 treatment months. Gas condensate, GRO, minimum of six treatment months. If we have a mixed waste that has both types or both categories here of hydrocarbons, the recommended metric for the bioremediation endpoint is the DRO and GRO, and again with 12 treatment months.

Here's the definition of a treatment month. We're not going to grow tomatoes, even in New Mexico, I don't think, in December and January because it's too cold. When we're doing bioremediation and the soil temperatures are low, you're not going to be getting much in the way of bioremediation either. So we introduced this definition here of a treatment month as defined as a 30-day increment in which the maximum 4-inch bare soil temperature is above 50 degrees fahrenheit.

In other words, for a 30-day period to count as a treatment month toward your minimum treatment months, it has to be warm enough in the soil that you can have some biological activity going on.

The bioremediation endpoint then can be

documented by two successive DRO or GRO measurements, whichever is appropriate, at least one treatment month apart, and shown that those are statistically the same.

Now at the time that I wrote this, one treatment month is what I had in mind. In the discussions that we've had with the environmental community here in New Mexico, we've reached agreement that perhaps we should make that two treatment months, to make it a bit easier to identify whether or not the TPH concentration has leveled off or not.

We recommend composite sampling of the landfarm, a soil representative of the average concentration of nutrients or hydrocarbons. It requires a composite sample, and a composite sample is just a number of discrete samples taken at random which are then mixed and blended together, and then you analyze that composite as opposed to analyzing all the discrete samples, and that gives you an average over the area in which you've sampled that section of the landfarm.

Each area of the landfarm lift with distinguishing characteristics should be sampled separately. If you've got areas with distinctly different waste types, hydrocarbon types, chloride concentrations, et cetera, should be sampled separately.

Distinctly different soil textures. Unlikely, but should be sampled separately.

Distinctly different drainage patterns. If you've got a site, you know, in which you have distinctly different drainage patterns, then they're going to behave differently as far as retention of moisture is concerned and should be sampled separately.

Next slide.

So then the question becomes, how many discrete samples per composite is recommended? Here we look to the agricultural industry to tell us the answer to this question. This is actually a figure that I got out of an OSU Ag Extension Service publication, and what we're looking at here is the results of an analysis for a field, agricultural field, for nitrate concentration, and looking at how many samples -- how many discrete samples do you need in the composite sample before you can have confidence that you're truly seeing the average concentration over the site?

And what's indicated here, as you can see, with small numbers of samples that's going to vary all over the place. But eventually, as you increase the number of discrete samples that goes into the composite, that levels out. And it levels out here at about 20 samples per composite. This is recommended practice in the agricultural industry, and it should be recommended practice in terms of sampling a landfarm as well.

Landfarm temperature. The landfarm operator obviously has very little control over temperature but needs to recognize that biodegradation rates are going to decrease as the soil temperature decreases. Thus the need to define a treatment month.

The operator also should expect that with lower rates of hydrocarbon removal occurring during these cold periods, there are going to be slower rates of nutrient utilization. So it might make sense, then, when it's cold, that you don't necessarily monitor nutrients as frequently as you do when it's warm. So there's less need for monitoring during that time.

But there's also less need for tilling during that time, because if the temperature is too cold to support bioremediation, you're not really going to be getting much in return for the effort and the energy you expend in tilling that site until it warms up again.

There's also some recommendations about adding a new lift. You know, after we've added one lift and we've encouraged hydrocarbon degradation to occur in that lift, once we add the next lift we can actually increase the rate of treatment of that second lift by tilling down a little bit and incorporating a couple of inches or so from the lift below.

And the reason for that is because that first lift is going to have high concentrations of hydrocarbon-degrading organisms. You remember the plot we saw with the hydrocarbon -- or the concentration of micro-organisms going up as the hydrocarbon was being degraded? That provides you with an inoculum from the lift below, into lift above. It's going to decrease what we call the lag time. The lag time is that time that passes where nothing really seems to be happening. It's really happening, but not enough of it is happening that you can see yet, and then it starts to take off. So you can decrease that lag time if you can incorporate some of the first lift into the second lift, some of the second lift into the third lift, et cetera.

So a quick review of recommended practice. What we need to do is promote effective -- What do we need to promote the effective bioremediation of hydrocarbon-impacted soils? We need nutrients, we need moisture, we need good aeration, we need the right pH, and we need warm temperatures. And as I keep saying *ad nauseam*, it's just gardening. If it's good for the tomatoes, it's good for the bugs.

In fact, when I make presentations to small producers in Oklahoma and Arkansas and elsewhere, I tell them the rule of thumb in operating your landfarm, if you ever have any question as to what I should be doing right now, look at that landfarm and ask yourself that question. If I was growing tomatoes here, what would I do? Would I water? Would I put in some organic matter? What would I do. Whatever the answer to that question is, that's the right thing to do for landfarming too.

Q. Now Dr. Sublette, I think yesterday even Mr. von Gonten agreed that landfarming was a preferred way to deal with hydrocarbon-contaminated soils. He also stated that to get a valid bioremediation endpoint, that you have to have a careful and systematic operation. Do you agree with that?

A. To get a bioremediation endpoint, no.

Q. It sounds -- It sounded like it was difficult to get a valid bioremediation endpoint. Is it that difficult?

A. It's just gardening. If you do the gardening right, you will get a bioremediation endpoint. If you don't do the gardening right, you're not going to get one.

Q. Have there been operators experience problems trying to get valid bioremediation endpoints in areas where this is allowed and encouraged?

A. Not to my knowledge.

Q. Is it difficult for a regulatory agency to monitor a bioremediation endpoint?

A. No. In fact, in other states it's -- as you're going to see a little bit later when we talk about statistics, we're recommending here even more of a statistical analysis of endpoints than other states use. In other states, once the operator thinks that they've reached the bioremediation endpoint, there are closure samples taken. And the state agency will recommend how those closure samples will be taken and how they're supposed to be analyzed, but there is not necessarily a requirement to document the fact that remediation is no longer taking place.

I prefer that option, and the reason that I prefer that option is that in most other states TPH closure standards for landfarms can theoretically be met by dilution, no remediation. So if you've got a hydrocarbon concentration that's below some limit, you're okay.

What I would prefer, and I think what is more protective of public health, the environment, et cetera, is to actually encourage the bioremediation of soils to achieve the lowest possible hydrocarbon concentration -- at that point you know you have removed the toxic components -- and to document that point.

But we're not talking about anything difficult here, we're talking about two sets of measurements instead of one.

Q. Isn't it possible to give operators simple guidelines they can follow that, if they do, they can easily reach --

A. I believe so.

Q. -- this endpoint?

A. I believe so.

Q. In the Rules as proposed, the industry committee is recommending that the agency encourage the use of bioremediation to a bioremediation endpoint. If that's adopted, is that the only test in these Rules or the only assurance they have that, in fact, those soils are being properly remediated?

A. Well, as you'll see when we talk about closure standards here in a bit, and through my discussions with the environmental community, we've reached agreements on a maximum residual TPH concentration as being -- or so as to be protective and to -- not only protective, but to also take -- take into consideration the concerns of the OCD about the potential open-endedness of this process in the hands of a disreputable operator.

Q. In your opinion, is allowing a bioremediation endpoint with a maximum residual hydrocarbon limit a better approach than simply setting these standards and requiring that --

A. I think it is, it's definitely more protective.

Q. If the agency adopts rules and regulations that require the 80-percent reduction of TPH, and if they use this benchmark approach that at we're led to believe it would be easier to administer, will the net effect be, in fact, discouraging the use of bioremediation?

A. I believe it would.

Q. When we were -- yesterday we were looking at the various factors, the major mechanisms, Mr. von Gonten was testifying, that happen in a landfarm, and we were talking about dilution, volatilization, all of those things.

In the current dry landfarm in New Mexico, is bioremediation a major mechanism? Is it actually occurring?

A. As I understand the concept of the dry landfarm, which I think is a misnomer, bioremediation is a minor component of what's going on.

Q. What's actually happening?

A. Well, basically -- I think the comments made yesterday were that you've got sunlight and time. Sunlight and time is not your friend when it comes to these dryland landfarms, because with more radiation, ultraviolet light, you've got a lot of photo-induced chemical reactions that are taking place, primarily with oxygen from the atmosphere.

The result is, oxygen gets introduced into the hydrocarbon molecule, chemically. It now becomes more polar, it now becomes more likely to strongly associate with the soil mineral particles. Both of those effects are going to lead to the hydrocarbon appearing to go away. I guess I forgot what -- I'm sorry, I said both. There's also photo-isomerization going on, hydrocarbons basically -- molecules getting linked together to form larger molecules.

So we've got the photo-addition or photo-isomerization going on, as well as this -- what they refer to as photo-degradation, but it's simply a chemical reaction; it's not really degradation in the sense of true bioremediation. It's not mineralization of CO_2; it's chemical alteration. And those chemical alterations are bad. And the reason they are is, when either one of those processes take place, the hydrocarbon is going to appear to disappear.

The answer you get when you try to do a TPH measurement depends on how you ask the question. Do we do an EPA 418.1, do we do an EPA 8015? How do we do this? Each one of those processes, every one of these, starts with an extraction. Some solvent is contacted with the soil, and the idea is, the hydrocarbon gets transferred into that solvent.

And then it gets detected, quantitated in some way, either through the absorption of ultraviolet light --

excuse me, not ultraviolet -- either through red light for the 418.1 or by GC, as we were seeing before, by using a gas chromatograph to detect the hydrocarbons.

Once these hydrocarbons become more polar and get stronger associations with the soil particles, it is less likely that you're going to extract them out of the soil in the first place. So if they don't come out of the soil and into the solvent, it's like they were never there.

And with a test like 418.1, the way that works is, you start with a freon extraction, and then you do what's called a silica gel cleanup. I think we mentioned that earlier. The objective of that is to take out polar material and just focus on hydrocarbon. Now the reason that's done is because there's a lot of polar material in soil, soil organic matter, that can get extracted with the freon, and you don't want to see that. You want to see hydrocarbon. But some of these polar materials in these dryland landfarms, if they do get extracted, are -- high probability -- going to be removed by the silica gel cleanup.

So you get much lower efficiencies of extraction. And if you do get extraction you're not going to see it with a 418.1 if you do the silica gel cleanup. And they're definitely not going to be seen by a GC. They probably, in many cases, will not even volatize and go into the instrument at all.

Q. Is it your testimony what the industry committee is recommending is a process that actually degrades hydrocarbon contamination in soil?

A. Yes.

Q. The current practice, I believe I understand your testimony, is that, in fact, what it actually does is makes hydrocarbons invisible to detection?

A. That's my opinion.

Q. If you go with the bio- -- and encourage bioremediation to a bioremediation endpoint, you're going to be actually eliminating, degrading the hydrocarbon --

A. Actually mineralizing and degrading the hydrocarbons.

Q. And if the agency has concern, they still, as -- we're recommending a maximum on the residual hydrocarbon concentration in the soil?

A. Yes, yes --

Q. And there still --

A. -- establishing a ceiling.

Q. And there still would be testing for BTEX?

A. Yes, absolutely.

Q. So they're -- those factors could address the concerns --

A. It should address all the concerns.

Q. The next portion of your presentation is a -- we address specific provisions in the proposed Rule and express our concern about those, so if we could now go to your slide that introduces that topic, Dr. Sublette?

A. May I make one more comment, though, concerning the dryland landfarms? The statement was made in here, and others have also confirmed this to me, it is their belief there is no nutrient addition. So that means the only nutrients that are available in that soil to support hydrocarbon degradation are what's present in the native soil that gets incorporated into the lift. And that's it. And I would venture to say in New Mexico that is a very small amount of nutrient.

So you just cannot -- absolutely cannot get biodegradation without sufficient nutrients being available.

Q. Let's go ahead now with problems with the OCD Rule.

A. Okay, some concerns I have about the OCD Rule as it's written basically have to do with the fact that I believe that they're inconsistent with recommended practice.

I think there are some unnecessary constraints on the use of the bioremediation endpoint approach for permitted landfarms. That's the 80 percent we were talking about.

Unnecessary restrictions, I think, on hydrocarbon loading.

Unnecessary requirements for characterizing the soil under the landfarm.

And unfortunately -- and this is a big one for me -- limiting the use of the bioremediation endpoint approach to permitted landfarms only. As you'll see later in my testimony, I think we should be shouting that to the rooftops to use this in registered landfarms, and to do it right.

There are some restrictions on chlorides that, at least in terms of the science of hydrocarbon biodegradation, aren't valid, and I'm only going to be addressing that aspect as far as the chlorides are concerned.

Q. Okay, let's look at the 80-percent TPH reduction.

A. Well, as I've basically already said, this is not supported by science, and we believe that bioremediation done correctly and true bioremediation -- this is going to prevent the use of a true bioremediation endpoint approach.

As I said earlier, you know, when the 80-percent limitation or maximum reduction was first recommended by OCD, I tried to dissect in my mind why. What is it that the OCD is concerned about? And one is the issue that I was just referring to here. Perhaps it's too open-ended and they have some qualms about that.

Well, we are now recommending, in negotiation with the New Mexico environmental community, to establish a maximum residual TPH at the endpoint of 1 percent total extractable petroleum hydrocarbons, either by 418.1 or an equivalent EPA-approved method. So there's a ceiling right there, in terms of total extractable hydrocarbons.

The other issue that I was aware of, through a conversation with Mr. Price, was the asphaltic material we were talking about. Is there a concern that too much asphaltic material is going to get into these landfarms? And I thought that was a legitimate concern.

So I thought that we need to make a recommendation there to -- that would limit the amount of asphaltic material and prevent the kind of thing that you were concerned about, Mr. Price, in terms of people trying to take large amounts of asphaltic material and basically dispose of it in a landfarm. So we were suggesting establishing a maximum visible solid-phase hydrocarbon standard.

Now initially, we were looking at 3 percent, 3 percent of the surface potentially covered by asphaltics. In negotiations with the New Mexico environmental community, we have now mutually agreed on 1 percent, with a

-- also a restriction on the maximum size of these particles, being half an inch.

I would like to address, too, why we think asphaltic material would even potentially end up in a landfarm. Even if you weren't trying to potentially dispose of something by a mechanism that you shouldn't, there are valid reasons why some of this material could get into a landfarm. And I'll tell you some of my own personal experience in dealing with asphaltic-type materials in Oklahoma.

If any of you have been on an old well production site, sometimes that there's -- after there's been chronic spills around the site, baking in the sun, it's almost like an asphalt parking lot around the well. Well, if you excavate that material, underneath that material is liquid hydrocarbon. And you've basically got a transition to solid-phase hydrocarbon on the surface to liquid hydrocarbon underneath. A lot of that liquid hydrocarbon is biodegradable.

So to whatever extent you're not successful in being able to separate that liquid hydrocarbon from the asphaltic material, some of that asphaltic material can legitimately end up in a landfarm while you are trying to be a proactive operator and actually biodegrade the liquid hydrocarbon that might have been associated with it.

So that's why we think there needs to be some sort of metric, some sort of standard here. And as I said, I think we've come to a good agreement with the New Mexico environmental community as to what that standard should be.

So it's my hope that by establishing these two criteria, that -- to address the concerns of the OCD as far as the bioremediation endpoint is concerned.

Q. When we look at this, the requirement is directed at reducing TPH, total petroleum hydrocarbons --

A. I'm sorry, I didn't catch that.

Q. This requirement, as stated, is to reduce total petroleum hydrocarbons, TPH.

A. Yes.

Q. Isn't the real issue that we should all be looking at eliminating the toxicity --

A. Yes.

Q. -- from what is left behind?

A. Yes.

Q. And so no matter how much TPH is there, if it isn't toxic, it's not going to hurt.

A. It's -- I'm going to give you one caveat to that, and I'm going to address that later, and I think it's an issue near and dear to Commissioner Bailey's heart in terms of re-vegetation. There's a potential issue there at very high hydrocarbon concentrations, and I will address that.

But in my mind, you know, the major goal in terms of being protective of public health and groundwater and the environment is to eliminate toxic components of that hydrocarbon.

Q. Okay, let's go to the next slide.

A. Well, I just -- this slide you've already seen before, but I just want to re-emphasize the that -- what sort of API gravities of crude oils are actually going to be amenable to a bioremediation endpoint if we have that 80-percent minimum removal. And as you can see, most of the oil produced in Okla- -- I started to say Oklahoma, sorry -- in New Mexico under these Rules that -- landfarm.

CHAIRMAN FESMIRE: Can we go back to that slide just a minute?

THE WITNESS: Yeah.

CHAIRMAN FESMIRE: I'm not suggesting that this is the way the Commission would go, but according to that, if we use your -- split the difference between the organic content of the soils and come in at, say, a 65-percent total reduction, we'd catch everything above about 25-degree oil, wouldn't we?

THE WITNESS: Uh-huh. Yeah, 80 percent is just too high.

CHAIRMAN FESMIRE: Would 65 percent be reasonable?

THE WITNESS: Well, it would certainly be more reasonable. I'd want to give it a little bit of thought, Mr. Chairman, but it would certainly be more reasonable than 80 percent. But I really think that setting the maximum of 1 percent total extractable is probably even more workable. Not only more -- not only -- I hope satisfies the OCD's concern, but also be a more practical way of defining the bioremediation endpoint relative to a standard.

Q. (By Mr. Carr) Okay, let's look at the requirement for maximum hydrocarbon loading of 5 percent.

A. Well again, this particular statement has to do with the requirement for the maximum hydrocarbon loading of 5 percent. It's my opinion that that is restrictive. As we were saying earlier, it's a matter of rates of biodegradation.

I really feel that the hydrocarbon loading is going to be somewhat self-regulating if the operator is actually understanding how this landfarm actually works. He's going to be balancing -- excuse me, he's going to be balancing the rate of biodegradation in their landfarm versus what the endpoint is going to be.

If they have a higher initial concentration of hydrocarbons in the landfarm, then unless they're doing things right they're going to risk running afoul of that 1 percent total extractable hydrocarbons we've talked about. There's a big financial penalty to pay there.

So that's what I mean when I say it's self-regulating. The landfarm operator is going to make a decision, say, well, do I want faster rates or do I want to be able to put more loading on there and still think I'm going to meet the closure standard?

Q. One other thing I might mention about that -- Can you go back to that? Just by coincidence, I think as Mr. Carr indicated, I came here from an EPA conference in Portland, listening to one talk at this particular conference about landfarming. And the statement was made -- it's true enough -- in 1994, I believe it was when the EPA made their first recommendations on landfarming of hydrocarbons, they recommended 5 percent, and that's probably why it's still around. 1994.

As this speaker indicated, with the chief EPA environmental guru chairing the session, So I think we all recognize now that that was overly conservative. And everybody agreed, overly conservative.

Q. All right, now we're looking at the requirement for analysis of native soils before the addition of first lift.

A. Yeah, this is kind of perplexing me. It is my opinion this is unnecessarily burdensome and not really relevant to the bioremedation process that's going to be going on in the lift soil. I would like to know -- and I still haven't really figured it out -- who is going to use this information, and what are they going to use it for? And I might add, why, then, is it relevant -- or how is it relevant to what's going on in the lift? I honestly can't figure that out.

Things like the soil temperature, for example. Soil temperature is obviously a transient thing.

Oxygen concentration? What does that mean? Do we mean the soil gas oxygen concentration? That's also a transient thing. Why would I measure it today when two hours later I'll measure it again and get a different answer? And what I use that information for? What decision would I make on the basis of that?

I really don't see any reason at all to do any of this, with one possible exception. You might want to know what the saturated paste electrical conductivity is at the site, because as you're going to see I'm going to recommend some closure standards based on that. You might want to know that you're not putting your landfarm on a really salty site. It may be naturally salty. But most of the rest of this I really can't find a use for.

Plus, there are terms in here that are vague. I don't understand what soil structure means. I don't understand what soil composition means. I mean, talk about an open term, you know. All the components of the soil? I'm sorry, I just don't -- I don't mean to be flippant, but I just don't understand why anyone conceived that this information would be necessary for conducting a landfarm.

Q. Okay. Now let's look at the endpoint.

A. Well, now we're talking about the small registered landfarms here, and the restrictions on closure of the small -- of the lift closure standards for the small registered landfarms of under 1000 milligram per kilogram total extractable, that's right, and TPH+GRO-DRO of 50.

Again, if you look at the DOE data, you look at the Salinitro data and ask yourself, you know, what -- with any reasonable concentration of hydrocarbons that you start off with in the landfarm, what is the probability that you're actually going to be able to meet those standards? It's very, very low.

So this is -- in my opinion, sticking to standards like that is going to eliminate the use of small landfarms for treating crude oil spills. Could probably still do condensate, but crude oil will be very difficult.

Another issue that I have is the size of the registered landfarms, you know. My initial impression was that this was too small, I couldn't see what the justification of that was. The industry has proposed two acres with two-foot lift, which would be about 6400 cubic yards, and my issue with the size of the landfarm has to do with the efficiency of use of resources, that if you can use a -- and here I'm primarily talking about a centralized landfarm that a producer might use.

If you can make more efficient use of your personnel, more efficient use of your large equipment -- you're going to need large equipment for tilling, et cetera -- better use of water resources is a biggie, better use of sources of organic matter -- I really think you're going to end up with overall increasing the efficiency of bioremediation if you can allow a larger small registered landfarm as opposed to one over there, and one over there, and one back over there. It's just going to be less energy -- less cost, less gasoline, diesel burned, et cetera, better use of resources if we can agree on at least a slightly larger size here. And I think a two-acre size is pretty reasonable.

The restrictions on chloride concentrations in the waste received at the landfarm, I'm going to address this issue with respect to only bioremediation of hydrocarbons. What effect does the chloride have on the bioremediation of hydrocarbons?

The literature would suggest, the science suggests, and my own personal experience suggests, that with respect to bioremediation of hydrocarbons, that limitation really doesn't make any sense in terms of bioremediation, and I'd like to illustrate why.

It is a very common misconception that soils that are impacted by chlorides are, quote, unquote, sterile. You probably have heard that before. But if you review the peer-reviewed literature, you'll find evidence of bioremediation of hydrocarbons occurring at concentrations above 1000 milligrams per kilogram.

You'll also find evidence that over time hydrocarbon-degrading organisms in a landfarm can actually adapt and become more tolerant of chlorides. And there are things that we can do in the way that we manage a landfarm that could help attenuate the effects of chloride and prevent significant impact on rates of biodegradation.

CHAIRMAN FESMIRE: Attenuate isn't the word you want there, is it?

THE WITNESS: Well, it is. I want to attenuate whatever effects of chloride there might be. I can minimize those or I can decrease those in the way that I manage the landfarm. And I'll illustrate that with a drawing here in a little bit.

This is one piece of evidence readily obtainable in the literature. This is a report of bioremediation of drill cuttings and soil. And as you can see, that we're getting -- this is -- I can't read that. Is that a TPH-GC or -- TPH-GC over here. And as you can see, there's definitely utilization of hydrocarbons going on. That's evident in terms of the total hydrocarbon concentration, in terms of TPH-GC.

It's also evidenced from the -- just looking at the chromatograms. Remember those spikes we were talking about? This is actually diesel that's in these drill cuttings. Each one of those spikes are those normal alkanes we were talking about. And what's shown here are some chromatograms that were provided by the researcher.

Here's the initial condition, and we go forward in time as we go from the top to the bottom. So as you can see, these spikes start to disappear, and then ultimately the hump starts to shrink as well. Definitely hydrocarbon degradation is going on there.

What was the chloride concentration? It was about 4000 milligram per kilogram.

This is some work of my own in Oklahoma. Here we were looking at three different sites that were impacted by hydrocarbon and a brine spill, so there's three different chloride concentrations here as you can see. As high as 3000 in one case, low as 1600. And what we were doing was applying various types of treatments, let's say, various types of -- in terms of fertilizer addition, hay, how we mixed it, et cetera, looking at rates of hydrocarbon degradation. And these are the hydrocarbon half-lives up here, the TPH half-lives at these hydrocarbon concentrations.

For similarly operated landfarms in the same area in Oklahoma, that were operated using only natural precipitation as a source of moisture, these half-lives are pretty close to what you would see in a landfarm that was only impacted by hydrocarbons and had absolutely no chlorides at all. So basically the chlorides really didn't have an effect here, as far as hydrocarbon degradation was concerned.

This is also the results of some of our work, looking at -- here looking at different classes of micro-organisms, and I won't belabor what these mean except these are groups of micro-organisms within which we usually find many hydrocarbon-degrading organisms. And here comparing an uncontaminated site, to a site impacted by oil only and undergoing bioremedation, and a site impacted by oil and brine undergoing bioremediation.

And what I'm attempting to show here is that the relative proportions of those groups that contain most of the hydrocarbon degraders actually increases in the presence of brine. The other way of saying that is that if the brine is having an effect -- if the chlorides are having an effect on the microbial community, they're having an effect on the hydrocarbon degraders, or the effect on the hydrocarbon degraders is less than it is on the other members of the community.

And lastly, the last study I'll show you, this is one also from Oklahoma, but it's not mine. This was the isolation of a benzene degrader from an oil-and-brine-impacted site in Oklahoma. And what you -- what's dropped off here -- This is rate over here, isn't it? No, benzene concentration as a function of time at different concentrations of salts in units of moles per liter. And what the observers -- or the researchers observed was, up to 1 molar there was absolutely no effect on rates of benzene biodegradation. Rates started to decrease as you went up from that.

Well, with a few simple assumptions one can calculate that a pore water concentration of 1 molar is about a chloride concentration in the soil of about 5000 milligrams per kilogram. So obviously there are hydrocarbon degraders, benzene degraders in particular here, that are present in these sites that are tolerant of salt.

Interestingly enough, they looked at the composition of this culture using DNA techniques and found that most of the benzene degraders were a member of the genus *Marinobacter*, which has been seen in the Mediterranean Sea, oil refinery effluents, deep ocean vents, offshore oil wells, common to environments that see salt and see hydrocarbon.

This is one of the things that continues to amaze me anytime we do any real DNA-type speciation of micro-organisms for any of these types of sites. You think the world is different. It's all the same. We've got the same organisms in a hydrocarbon-impacted site in New Mexico as you do in Oklahoma, as you do in Pennsylvania, as you do in Europe, Asia. They're the same organisms.

Q. (By Mr. Carr) All right, what is this slide?

A. This comes from the publication that the Department of Energy put out as part of the output from that bioremediation workshop that we were referring to earlier. Again, this is kind of a sense of industry collection of data, looking at oxygen uptake rates as a function of saturated paste EC.

This one right here, which represents maybe about 20 percent reduction in rates, is about a chloride concentration of about 1700 parts per million.

Lastly, there are ways to manage your landfarm if you do have high chlorides, to mitigate or attenuate potential effects of chloride on what's going on in the landfill -- excuse me, landfarm. And what I've indicated here is the active zone of a lift in a landfarm, and I've also identified on the left here -- it's hard -- they kind of dropped off. This we might identify as the most active zone in the landfarm. In other words, that's where -- that soil right there is in immediate contact with the atmosphere, so we're going to get greater penetration of oxygen into this layer than we do in this layer here.

So when we apply moisture in the day-to-day operation of our landfarm, one of the things that's going to happen to any chlorides is, they're going to be driven down toward the bottom of this active zone. And then when it dries out, they're going to be coming back up.

But if you apply moisture and basically lower -- essentially lower the chloride concentration of the most active zone, you're going to get no effect of chlorides in the area where you've got the highest oxygen concentration and the greatest rates of biodegradation.

Later on, when that dries out and those chlorides come back up into that most active zone, now they come along and till, and we take what was down here and put it back up here, and just repeat that cycle of tilling followed by addition of moisture, tilling followed by addition of moisture. And that kind of operating scheme can minimize whatever effects of chlorides there might be, again, on hydrocarbon degradation.

Q. All right, now for your summary.

A. Well, a quick review.

There's no scientific basis for restricting the bioremedation endpoint to just permitted landfarms.

I think the current TPH standards for registered landfarms cannot be met with crude oil.

Increasing the size of a registered landfarm, I believe, increases the efficiency in utilization of the resources.

There's not reason not to allow some flexibility in terms of hydrocarbon loadings.

And the reti- -- the requirements for extensive characterization of the native soil under the landfarm is unnecessarily burdensome, requiring collection of data that no one is going to use.

Further, chlorides do not sterilize soil. I'm not saying they don't have an effect on micro-organisms. They do. But they do not sterilize soil.

I can tell you my experience in Oklahoma is that when I have a brine spill in Oklahoma, we have serious brine in Oklahoma. I'm talking about chloride -- or excuse me, salt concentrations of up around 150,000 milligrams per liter in produced water. When I have a brine spill in Oklahoma and I immediately come along and sample that site, I find that the soil has not been sterilized, but I have decreased the concentration of microbes by about 50 percent -- and it's almost consistently 50 percent very time -- and then that concentration starts to go back up.

Bioremediation of hydrocarbons can occur at chloride concentrations greater than 1000 milligrams per kilogram.

The microbes can become adapted to elevated chlorides.

And as I said, the landfarms can be operated in such a way as to mitigate the effects of high chloride concentrations on hydrocarbon biodegradation.

And the method that I was talking about here, if you look at an ag extension publication on how to seed saline soil, you'll see I'm applying basically the same concepts that I was just talking about in terms of how to operate the landfarm with high chlorides.

Q. Dr. Sublette, members of the Commission earlier today were expressing concern about the impacts of particular chlorides on re-vegetation and on plant growth.

A. Uh-huh.

Q. Would this be a point in your presentation where you might address that?

A. Could I address that a bit later when I talk about closure standards? I think it kind of fits more in context there.

MR. CARR: You know, Mr. Chairman, I've learned in the last week or so working with Dr. Sublette, Dr. Thomas and Dr. Stephens, that you can tell people who teach, but you can't tell them much.

(Laughter)

MR. CARR: Let's go ahead.

THE WITNESS: Thank you, Bill.

CHAIRMAN FESMIRE: Mr. Carr, failure to follow your lawyer's lead is not entirely restricted to the industry.

(Laughter)

THE WITNESS: Okay. In the last part of the presentation here, before we talk about closure standards, I'll only talk about small registered landfarms.

In my opinion and experience, bioremediation should be encouraged, not discouraged, in these small landfarms.

And in addition to that, the regulations should be made as easy to understand and to follow as possible. In my opinion, this is going to pay dividends in terms of eliminating toxicity in landfarming, versus storing hydrocarbon-impacted soils in landfills.

The small registered landfarms, you know, we're talking about -- at least with -- even with the industry recommendations, less than two acres, less than three years of operation.

There is inherently less risk to the public, the groundwater and the environment by these small landfarms, so I think we can loosen up a little bit in terms of the regulations, and to provide guidelines that are easy to understand, as I said, I believe it's going to result in more bioremediation taking place. More bioremediation means less toxic hydrocarbons entering the environment.

Now in my organization, IPEC, one of the things that we do is in tech transfer, again, with the purpose of increasing compliance in the domestic industry, with a focus on the small producer, is, we provide guidelines for bioremediation that are easy to understand and easy to implement, basically cookbook methods.

You can look at these guidelines on our website. I think that there might have been a copy of these guidelines introduced to one of the stakeholders' meetings.

We address the issue of loading. Instead of asking the small producer to make some assessment of what the initial hydrocarbon is, we give him a guideline. The guideline is, the soil should not be wet with hydrocarbon. If it's wet with hydrocarbon, if it's glistening, that's too much hydrocarbon. You know, it needs to be diluted with uncontaminated soil, or you don't need to apply, you know, as much hydrocarbon. But that's just a rule --

that's a good rule of thumb. If it's wet, too much oil. If it's not wet, we're okay.

We recommend cheap fertilizers. 13-13-13, again, is the one that we're always recommending.

Instead of compelling a small producer to go out and measure nutrient concentrations, which they are likely to mess up anyway -- I'm talking about the small producers, okay? People without a technical staff. Instead of telling them to make a measurement and then make an addition based on that measurement, we have another scheme that calls for small incremental additions of fertilizer on a regular schedule, until -- we get to hydrocarbon monitoring down here -- until the sniff test tells them that the hydrocarbon is gone. All right.

We have worked this out to the point that for an average spill, even a less than average spill, could -- not going to be oversupplying fertilizer to the site. Because as we saw earlier, too much fertilizer can actually cause inhibition.

Now is that the most efficient process? The most efficient process is to measure the nutrients and meter the nutrients in. It gives you the highest rates of biodegradation. But if you're not so much worried about rate as you are result, this method works. It's a little slower, but it works.

We recommend they add nutrients in the warm months only.

We recommend the introduction of organic matter into the site, and we provide them guidelines on how much organic matter should be added. And that's very difficult to do, because soils are going to vary from one site to another, but we give them the rule of thumb and then we tell them, after you work in the organic matter it should look like that. That's the kind of soil, just looking at soil structure, you would want in your garden. That's what you want in your landfarm too. Add enough organic matter and till it in until it looks like that.

We advise them to till as often as they possibly can.

We emphasize moisture, the requirement for moisture and the requirement for monitoring moisture. We suggest two very simple ways that they might monitor moisture.

If any of you have house plants, you may have a little capacitance probe from Lowe's that you can just kind of stick into the pot and it tells you if it's time to water. Use the same thing in a landfarm. If it's time to water the house plant, it's time to water the landfarm too.

There's also the soil ball test which, when you take some soil, put it into your hand, try to make it into a ball, open up your hand -- if it crumbles, it's too dry. If it sticks together, it's okay.

So we use those methods to make a judgment call as to when it's time to add moisture.

We tell them not to start when it's cold. You can't start bioremediation when it's too cold for the bugs to grow. However, we give them at the same time guidance on what to do at that site to make sure that hydrocarbon does not migrate off the site until they're ready to start doing bioremediation.

And lastly, hydrocarbon monitoring is about a sniff test. If you can't smell the hydrocarbon, maybe it's time to try to close the site. At that point you can tell the small producer it's time to invest in a laboratory analysis of TPH using whatever the regulatory agency wants you to use, because if you can't smell the hydrocarbon you're likely to pass the test. Up to that point, it doesn't really make any sense to spend the money to do the testing.

Q. (By Mr. Carr) And Dr. Sublette, this --
A. Yes, sir.
Q. -- this practice, that is recommended by IPEC?
A. It's recommended by IPEC. And I would like to add, by the way, that IPEC has an industrial advisory committee that has input and approves -- has to approve

everything that we do. That committee is composed of about, I'd say, two-thirds of people from the industry, a lot of small producers as well as environmental professionals from both the major oil companies and the large independents.

But the rest of that committee are individuals from the Oklahoma Corporation Commission, which is charged with regulating oil and gas environmental issues in Oklahoma, the Arkansas Oil and Gas Commission, Arkansas Department of Environmental Quality, and the EPA -- there's a representative of the EPA in Osage County in Oklahoma, which is basically tribal area, so the OCC doesn't have jurisdiction. The EPA has jurisdiction.

So every agency that has jurisdiction over oil and gas issues, environmental issues, in Oklahoma and Arkansas is represented on that committee. They all have input to that, and they all recommend that and endorse that.

COMMISSIONER BAILEY: You said it was on their website. Do you have their web address?

THE WITNESS: I can get it for you.

COMMISSIONER BAILEY: Please do.

THE WITNESS: Yeah.

Q. (By Mr. Carr) And IPEC is an EPA research facility?

A. It's funded as an EPA research center by the Office of Research and Development.

Q. And you're a director, are you not, or the --

A. Yes.

Q. -- director?

A. Yes.

Q. And you have worked with these standards in the field --

A. Yes.

Q. -- as well, have you not?

A. Yes.

Q. What kind of a response have you received?

A. We've got a very good response, and I'd like to show you some of that.

I had another thought, Bill. You robbed me of it. Oh --

(Laughter)

A. -- the other thing I wanted to point out is, do you know how these materials are distributed? They're distributed on the Internet, they're distributed by our office, but the most effective means of distribution is, every field inspector in Oklahoma and Arkansas carries these in their truck and hands them out to producers.

Now we'll get to your question.

Q. Does it work?

(Laughter)

A. We have asked the field inspectors periodically to comment on the impact of these simple guidelines. What do you think -- what effect do you think they're having? And I've just reproduced for you here a few of these comments.

This one comes from the district manager at one of the district offices with the OCC:

Small operators have been afraid to bring up anything about remediation because they felt it was going to open up a can of worms costing them a lot of money. Now they're finally understanding the importance and are willing to clean up around their wellheads and take care of small spills. Using a visual aid such as the guidelines has made it so much easier to explain remediation to the operators, plus they have it to refer to when they need it.

Two field supervisors, OCC:

The program has been a great success getting these environmental teachings out to the operators. It has had a vital impact and has resulted in more compliance. I think the video was excellent -- we also have a video showing you how to do bioremediation -- the guidelines are a great help, especially to smaller operators. We need this program to continue.

Operators seem to understand the importance of cleaning up the soil more since IPEC materials have been out.

Another field inspector:

They (the bioremediation guidelines) play a good role in helping to diffuse tense situations with landowners when they can pull out the guidelines and read off what needs to be done. The landowners then realize that you know what you're doing and you have a plan.

I think this might be the last one:

A positive impact has been made in the Oklahoma panhandle because a lot of operators have never been -- a lot of operators have never been given any information of spill cleanups except to dig and carry or cover. Operators now have a more positive outlook on how to treat spills. They know that if they follow the recommendations of IPEC and be proactive about the spill, all enforcement actions of the OCC will be minimal.

That was the last of those comments.

So to summarize, I think that simplified approaches to bioremediation, simplified closure standards, can act in concert together with information handed out by the Commission, by the OCD, to promote bioremediation in New Mexico. And whatever you can do to promote bioremediation in New Mexico, true bioremediation, is going to result in less toxic hydrocarbon being introduced into the environment. Because we all know spills happen, we cannot prevent it.

CHAIRMAN FESMIRE: Doctor, do Oklahoma and Arkansas have rules regarding this -- the TPH endpoint?

THE WITNESS: Yes, sir, they do. And I'm more familiar with Oklahoma, but Oklahoma actually has a risk based closure standard. They don't, as I would -- even though they endorse and suggest and promote bioremediation, they basically don't require proof that you've done bioremediation to meet the closure standard. But the closure standard -- they encourage you to meet that closure standard by bioremediation. I'm just saying they're not policing whether you've actually done that.

However, they do have closure standards that are based on risk. And the way it works is, you evaluate certain factors, you evaluate things like what was the API gravity of the oil? Or, was it oil or condensate? How far are you from groundwater? How far are you from a drinking water well? How far are you from any sort of residential area? What's the soil type like? You know, what's the rainfall in your area? A number of different factors go into determining a risk number.

That risk number then goes to another table, and under that risk number you can look and see what are your cleanup standards? You have to clean up to this level TPH, this level as far as BTEX, benzene.

So it's based on risk.

CHAIRMAN FESMIRE: So this level of TPH, how do you have a -- I mean, if you -- it seems to me -- my understanding of the TPH is, you have an essentially zero rate of change, and that's the TPH limit. How do they -- how do they vary that?

THE WITNESS: That's what they don't monitor. They don't police the bioremediation endpoint except to encourage by all these different methods that this is how you reach it. And by the way, your bioremediation endpoint must be below this level, based upon the risk at the site.

CHAIRMAN FESMIRE: So -- I'm really not being argumentative, which I know is unusual -- that doesn't seem like a true TPH --

THE WITNESS: A true TPH?

CHAIRMAN FESMIRE: -- a true TPH endpoint method, then, to me.

THE WITNESS: Well, I'll agree with you, sir, that there is a hole in that. And the hole in that is the one that I'm recommending that you try to fill in New Mexico. The hole in that is that, if you were an unscrupulous operator and you wanted to meet closure standards, you could actually meet them without doing bioremediation. Let your imagination take you there.

So by establishing only a TPH limit, you can encourage bioremediation, but you have not policed to make sure that bioremediation was actually the method by which the closure standard was reached.

CHAIRMAN FESMIRE: Okay, so that brings me to my next question, which I'll talk about later.

THE WITNESS: Okay.

CHAIRMAN FESMIRE: I don't mean to interrupt you.

THE WITNESS: That's okay.

All right, wanted to make some observations about closure of landfarms.

Subsequent to protection of human health and groundwater and the environment, the ultimate goal of closure of a landfarm, in my mind, is sustainable re-vegetation.

If we have a landfarm and it meets closure standards, we can re-vegetate that soil in place.

If it doesn't meet closure standards or we just simply choose to do otherwise, we can remove that impacted soil or bioremediated soil and take it to a landfarm, but we're -- then we're going to have to still re-vegetate the original site.

We can potentially use that bioremediated soil for some beneficial re-use, but again that leaves behind a site that needs to be re-vegetated.

So no matter which one of these options we choose, we need to re-vegetate.

As far as appropriate closure standards are concerned, the bioremediation endpoint, hopefully I've convinced you, is protective for Tier 1. For Tier 2, in which there might be some other types of waste, other than simply hydrocarbon-impacted soils applied to the landfarm, there may be some other site-specific risk based screening levels that are appropriate. I'll let Ben Thomas have that discussion with you.

The bioremediation endpoint is protective of an environment if the site could be re-vegetated.

Now first of all addressing hydrocarbons. As far as hydrocarbons are concerned, there's really one issue with regard to re-vegetation that we have to be concerned with. Hopefully you saw the data, Salinitro study and the other studies that I cited. Removal of toxicity in terms of plants is pretty easy to do, but it does potentially leave you with the issue of hydrophobicity.

May I have the next slide?

Hydrophobicity is caused by a coating of the soil particles with a hydrophobic or water-repelling matter, like hydrocarbons, for example.

There are many soils, though, that are naturally hydrophobic. A major cause of hydrophobicity in soils is fire. The fire basically cooks the biomass and forces gaseous hydrocarbons down into the soil and converts them to a hydrophobic condition.

There are a couple studies that I want to point out here, and I can't remember -- Dr. Neeper can remind me. Dr. Neeper and I shared a lot of literature on this subject, and I can't remember if I gave this to him or he gave this to me.

But one particular study by Li, *et al.*, that occurred in the *Plant and Soil Science*, showed that bioremediated soil with 2 percent extractable hydrocarbons failed to support the healthy growth of plants. Not, though, because of toxicity. It wasn't toxicity, it was an inability of the soil to sufficiently hold water. So if you've got too much hydrophobicity or water-repelling tendency in the soil, the water tends to run through and doesn't reside there in the soil long enough that the plant roots can actually access that water.

Another study by Roy -- this was actually in Alberta -- looking at a bunch of old, weathered, oil-impacted sites in Alberta -- concluded that -- first of all, that hydrocarbon-induced hydrophobicity was relatively rare. They could only find, I think, about 14 of these sites in all the oil-producing area of Alberta.

Was that right? Dr. Neeper, 14, I think?

DR. NEEPER: There's points on the graph.

THE WITNESS: Yeah, points on the graph.

But anyway, they concluded that this was relatively rare and was probably a product of a combination of circumstances.

The properties of the crude oil. That makes sense to me. The heavier the crude oil, probably the more likely you're going to have hydrophobicity issues.

The dryness of the soil at the time of first contact.

And look at the third one, prolonged exposure to hot, dry weather. As in a dryland landfarm, for example.

So what can we do about hydrophobicity if we have a hydrophobicity problem?

In closing the site -- We're going to be talking about re-vegetation standards here. If you happen to have a severe hydrophobicity issue that was preventing re-vegetation, you can treat this. You can go to agricultural handbooks to learn how to treat hydrophobic soils, because as I said, a lot of soils are naturally hydrophobic.

So how do we do this? We add organic matter, hay or manure, for example. That increases the water-holding capacity of the soil, increases the contact time between water and the hydrophobic soil, making it more likely the soil is actually going to be wet by the water.

So the issues of preferential paths and not holding water in the soil that's produced by hydrophobicity is counteracted by adding organic matter which holds water in the soil, making that water, then, accessible to plant roots. Again, *if* it is a problem.

That brings us, then, to recommendations for appropriate closure standards. Some of these you've seen already, and I guess -- my bullets aren't on here, but...

Less than 1 percent total extractable petroleum hydrocarbons, that was the endpoint -- in addition to the bioremediation endpoint, that was the maximum total extractable petroleum hydrocarbons we were recommending, that provide a boundary on that bioremediation endpoint method for you.

An EC -- saturated EC of less than 4 millimhos per centimeter and an SAR less than 13, or site-specific conductivity and SAR recommendations based on current agricultural research or practice.

These numbers right here we have agreed upon with the environmental community of New Mexico. 4 is the upper limit -- I hope I say this correctly -- is the upper limit of salinity that has minimal effect on plant growth.

So we are establishing here as a closure standard a condition that is going to be guaranteed to be re-vegetated.

The other parts of the closure standard, again it says less than 3 percent coverage by solid-phase hydrocarbon. That's now 1 percent, with a size of a half inch.

And two years of unattended sustained vegetation. In other words, you can't re-vegetate the site today. You get a good crop the first year, and you walk away. It has to be sustained. It has to be on its way to full recovery. So it doesn't -- we're not suggesting that there's any particular length of time to establish that sustained vegetation, but once it's established you have to show it's sustained for two years before the site can be closed.

And then as I said, other particular site 2 [*sic*] closure standards that might be necessary.

Now in the agreement that we have reached with the New Mexico environmental community, we've gone even further to be very specific about that re-vegetation. And if I may be allowed to consult my notes, I can tell you exactly what that is.

Three native species from the same climatic zone, including one grass, with 70-percent coverage or coverage equivalent to background native vegetation on land unimpacted by overgrazing, fire or other intrusive damage -- other intrusive events damaging the native vegetation. And that's a pretty high standard.

So hopefully this addresses a lot of your questions, Commissioner Bailey, in terms of re-vegetation. I think with these closure standards we will meet all the conditions that would be required for healthy re-vegetation of the site.

COMMISSIONER BAILEY: Can you give me a rough estimate of what less than 4 micromhos [*sic*] per centimeter would translate to as parts per million chlorides, as we've been talking about?

THE WITNESS: Well, we initially were talking in terms of chloride. But as Dr. Neeper, I'm sure, will tell you tomorrow, and as I think Mr. Price has testified, the relationship between the electrical -- saturated paste electrical conductivity and the chloride concentration varies quite a bit.

But if I could consult my colleague back here, I know you did some calculations, Don. Would it be testifying if he coached me just a little bit?

CHAIRMAN FESMIRE: He gets a chance.

THE WITNESS: What do your calculations show you for micromhos?

DR. NEEPER: 500 parts per million.

THE WITNESS: 500. That was the -- if it was all sodium chloride?

DR. NEEPER: That's the chloride.

THE WITNESS: Yeah. If it was all salt, as opposed to the other natural materials that are also present that are soluble, that contribute to the electrical conductivity, it would be about 500 parts per million --

COMMISSIONER BAILEY: Thank you --

THE WITNESS: -- per --

DR. NEEPER: -- millimho per centimeter.

THE WITNESS: 500 parts per million, 500 milligrams per kilogram chloride in the soil.

Q. (By Mr. Carr) Now Dr. Sublette --

A. Yes.

Q. -- I think earlier today Commissioner Bailey was concerned about chlorides in the soil, and the question being, what do you do with those, how do you manage them, where do they go?

A. All right, well, that's a very good question. And I think your question related primarily to what the industry might consider a Tier 2 type of scenario and which basal and site-specific that they felt that they could add more than 1000 milligram per kilogram chloride to the site.

Well, then there's an issue of, then, when the site's closed, if you had 2000 milligram per kilogram chloride there in that site and your closure standard is this, how do you get from here to there?

Well, it's not an immediate jump. I mean, if you have 2000 milligrams per kilogram chloride at the time you finished doing bioremediation, all is not lost. It simply means, now you have to turn your attention to remediating the soil for chlorides, to effect those conditions. And that's very easy to do.

Chlorides being mobile, the only solution to remediating a high chloride concentration is to mobilize the chloride. In fact, IPEC publishes guidelines to this effect as well, as remediating brine-impacted soil.

The result is -- or the steps are, to increase water penetration by adding organic matter, potentially, or if you have -- think you have a sodicity problem and you're going to have trouble with that SAR, you can add gypsum to help relieve your sodicity problems.

But add amendments to the site, and what you're basically going to do is to promote the slow migration of chloride out of the site. Now by slow migration I mean, you want that chloride to go elsewhere, but you want it to go at such a rate and in such an amount it doesn't have a negative effect on the surrounding environment. And eventually the chloride concentration at your original landfarm site drops to levels that can meet these closure standards.

Does that address your question?

COMMISSIONER BAILEY: Yes, I'm just thinking practicalities of rainfall amounts and evapotranspiration in southeastern New Mexico.

THE WITNESS: It takes water.

COMMISSIONER BAILEY: Yes.

THE WITNESS: It takes water, there's no doubt about it, it takes water.

COMMISSIONER BAILEY: And we've had fire all over the state.

THE WITNESS: But everything takes water. Landfarming takes water, growing plants takes water, everything takes water.

Do I have -- Ah, one last slide, I think.

This is just an indication of why I think sustained vegetation is the ultimate closure standard, as illustrated by this nice little cartoon. We've got a food web illustrated here.

Everything derives ultimately from what we would call the producers in the ecosystem. Those are the plants. The plants are sustaining the rest of the ecosystem. Once you've re-established this part of the ecosystem, this part will follow.

So that is not only, I think, a very appropriate measure of an ecological endpoint, but also a very easy one to -- you know, everybody can agree, based upon the descriptors we've used here, what constitutes re-vegetation and what does not.

And that's --

Q. (By Mr. Carr) Let's go to your --

A. Oh, sorry. What?

Q. Let's go to the conclusions.

A. Okay. Landfarming eliminates the threat of toxic, mobile hydrocarbons in the environment.

Landfarming is a short-term and a long-term solution to the threat of toxic mobile hydrocarbons. Short-term, here I'm referring to the small landfarms again.

Landfarming is going to eliminate toxic, mobile hydrocarbons through treatment, not through isolation.

And I believe the regulations that will facilitate the use of landfarming will minimize landfilling of hydrocarbon-impacted soils.

And landfarming is not difficult. It is easy to do. You just need a little bit of know-how. If you know how to tend a garden, you know how to do landfarming.

Q. Now Dr. Sublette, you're familiar with the proposed surface waste management Rules proposed by the Division?

A. Yes.

Q. You're also familiar with the modifications to those Rules proposed by the industry committee?

A. Yes.

Q. If the Rules are adopted as the proposed -- with the proposed modifications, in your opinion would the resulting Rules be workable as a practical matter?

A. I believe they would.

Q. Would they protect human health and the environment?

A. I believe so.

Q. Would they be protective of groundwater?

A. I believe so.

Q. Behind Tabs 1, 2 and 3 in our exhibit book is the summary of your background and experience, copies of the slides you've reviewed, and a written summary of your presentation. Were those prepared by you?

A. Yes.

Q. Based on your experience?

A. Yes.

Q. Were they also based on the peer-reviewed literature that you have --

A. Yes.

Q. -- shown in your presentation?

A. Yes, sir.

Q. And is this the type of peer-reviewed literature that people in your profession rely on to reach and render opinions?

A. Yes, they do.

MR. CARR: May it please the Commission, I would move the admission of the industry committee Exhibits 1, 2 and 3.

CHAIRMAN FESMIRE: Is there any objection?

MR. BROOKS: No objection, your Honor.

CHAIRMAN FESMIRE: Mr. Huffaker?

MR. HUFFAKER: (Shakes head)

CHAIRMAN FESMIRE: Dr. Neeper, do you have any objection?

DR. NEEPER: No objection.

CHAIRMAN FESMIRE: Exhibits 1, 2 and 3 will be admitted.

MR. CARR: Now at the risk of being tarred and feathered I have to tell you that we do have two rebuttal exhibits. They're not like yesterday's. They address two particular issues. And I would, with your permission, follow the procedures I believe we've been following, pass those out now, and ask Dr. Sublette to briefly review those two things, and that would include our -- conclude our presentation.

CHAIRMAN FESMIRE: Okay. And then subject your witness to cross-examination.

MR. CARR: Absolutely.

CHAIRMAN FESMIRE: Okay. Is there any objection to that process?

MR. BROOKS: You said pass them out now.

MR. CARR: I will pass -- I have --

(Laughter)

MR. BROOKS: As long as that is done, there's no objection.

MR. HUFFAKER: Mr. Carr has had these for some time, apparently, but he hasn't given them to us before. I can't answer that question, Mr. Chairman.

MR. CARR: Well, you can look at them now.

This is the first one, entitled Estimating DRO Concentration in Bioremediated Soil with 1 Percent TEPH.

THE WITNESS: Now do we want to do both at one time or --

MR. CARR: Well, we can do both at one time, if that's how you'd prefer to do it.

And you do have slides?

THE WITNESS: Yes. Are we ready?

Q. (By Mr. Carr) Yes, sir. Would you go to the first slide? Identify first what this is and what your response is.

A. Well, basically I'm trying to be responsive here to an issue that you raised, Mr. Price. You asked me questions the last time we were together about what did I know about the relationship between totally extractable petroleum hydrocarbons and DRO. And I'm trying to address that for you.

First of all, if you try to go into the literature, the objective would be to try to find studies in which people have used both measurements, so they have them side by side and they know something about the API gravity. There's a limited amount of data that's available. All right? So I've taken another approach, and here's basically the way I've arrived at this estimation.

I took some data from the American Petroleum Institute, looking at 150 different crude oils worldwide, and looked at the gasoline fractions and looked at the diesel fractions, and basically tried to model those or come up with an equation to describe those.

I ended up, as you'll see, with a linear fit of the gasoline fraction data. And I had to do a polynomial fit of the diesel fraction data, versus API gravity, which if you think about it makes sense because with a very low API gravity you would have low diesel fraction, with a high API gravity you would have low diesel fraction.

I then made certain assumptions, and with the objective of trying to relate the DRO concentration in bioremediated soil to what would be a 1-percent total extractable petroleum hydrocarbon.

I first assumed all the GRO is going to be removed at the bioremediation endpoint.

Second assumption, that the removal of DRO -- I estimated from the Salinitro data. Okay? Which as you remember was pretty consistent with the DOE data as well.

I then also assumed negligible removal of hydrocarbons above the diesel range. Not entirely correct, but we do what we can.

All right, this is a plot of gasoline fraction versus API gravity for these 150 oils. As you can see, it does seem to be a nice little linear relationship.

Next slide is a similar plot, now, of diesel fraction versus API gravity. This was not quite as pretty, there's more scatter in it. But the best I could do was basically fit it with a polynomial equation. That's the line that you see right here.

So using the equations for those two lines, then, I can calculate gas fractions and diesel fractions as a function of API gravity.

Then you've seen this one already. This is the removal of TPH-DRO at the bioremediation end point, *à la* the study from Salinitro. So what I did here was to take a midpoint between that higher organic matter and lower organic matter line.

Well, this is basically what I arrived at. And unfortunately, the Y axis is kind of disappearing here on you, but this is the DRO -- estimated DRO concentration at a 1-percent total extractable petroleum hydrocarbon in bioremediated soil. This is the DRO on the Y axis here, plotted against the original API gravity of the hydrocarbon that was being remediated.

And if I can take you down to this region right here, which is the region that Mr. von Gonten showed us was where most of the crude oil in New Mexico comes from, take that up to the Y axis here -- I'm going to have to look at my screen to see exactly where that is -- around 2100. So for most of the crude oils in New Mexico I estimate that if you have -- at 1-percent total extractable hydrocarbon in bioremediated soil, about 20 percent of that is going to be DRO. So DRO is going to be around 2100 milligrams per kilogram when the TPH is 1 percent.

Now I went back and looked at the very small amount of data I could get out of the literature in which both things were measured, and that 20-percent number looks pretty good for this API gravity range. So I'm pretty confident that I'm in the right neighborhood here.

Q. All right, are you ready to go to the second exhibit?

A. Well, I started to ask Mr. Price if he had a question, but I guess I can't do that. We can talk later if you have a question about that, Mr. Price. I hope that answers the question that he --

Q. Dr. Sublette, would you go to the second exhibit.

A. Yes, sir, I --

(Laughter)

CHAIRMAN FESMIRE: It's kind of like dancing, Doctor, you've got to learn to fall occasionally.

THE WITNESS: I was trying to figure out who's leading here.

Q. (By Mr. Carr) And what is this?

A. Okay, this is kind of a statistical analysis. And basically what we were trying to do here, or I was trying to do, was -- the ultimate goal is to determine how many samples does it take to prove a bioremediation endpoint, statistically speaking. Okay? So that's basically what I'm trying to do here. And I'll kind of waltz through that.

I apologize for the techhie-speak here, but there are basically two things that we want to be able to do with a statistical analysis of TPH measurement. One is to detect a bioremediation endpoint.

Which means, as we have proposed it, we have two sets of samples, X number of treatment lengths apart, and this set of samples and this set of samples needs to be compared statistically to ask the question, are they the same or not?

The way of putting that concept forward in an equation is stated in the upper left-hand corner, which simply says that my null hypothesis is that there's no difference between the two means. In other words, I've reached a bioremediation endpoint. Alternately, I haven't reached the bioremediation endpoint, and the means are not the same. So the statistical test just tells you which one of those two statements is actually the true one.

So if my null hypothesis is that they're the same, and indeed that is true, and my statistical test tells me to accept that hypothesis, I've made the right decision.

If indeed it is true, but my statistical test tells me that they're different, then I'm going to reject it. Even though it's true, I'm going to reject it. That's called a Type I error.

So when I'm sampling the landfarm and I'm trying to detect a bioremediation endpoint and I make a Type I error, what is the consequence of that? The consequence of that is that I have not demonstrated a bioremediation endpoint. I didn't detect it. So as an operator, I have to continue treatment and continue to re-sample until statistically show that they're the same. Okay? So that's the consequence of Type I.

If the hypothesis is actually false -- in other words, if the true condition is that the means are not the same, but I accept that hypothesis instead of rejecting it -- in other words, I make another mistake here, but my mistake is that the hypothesis is really wrong, but I've accepted -- that's called a Type II error.

The consequence of a Type II error is that I have really not reached an endpoint, but I think I've shown that I have, so I'm going to end up closing my lift potentially prematurely.

Now in terms of the OCD, the type of error that probably you would most likely want to avoid, more than anything else, is that one right there. Eventually, if we make a Type I error, we can continue to sample and correct that. A Type II error, though, might result in a condition we wouldn't want to accept.

All right, go on to the next slide.

Then there's the issue of site closure. If I use this 1-percent maximum TPH -- TEPH, that we've been promoting here, then my null hypothesis would be this, that the true mean, or the mean hydrocarbon concentration in this site is less than 1 percent. All right? My null hypothesis -- or that's my null hypothesis.

My alternate hypothesis is, that's not true, it's actually greater than 1 percent.

So if indeed that is true and the mean is less than 1 percent and again I accept that, I've made the correct decision.

If I reject it again, I've made an erroneous decision. What is the consequence of that decision? I have failed to close the site, which means I have to continue treatment and sampling. Similar result as before.

If that hypothesis -- if the null hypothesis is actually false but I make a mistake and accept that it's true, again I've made a Type II error. What's the consequence of that? That I've actually closed the site with a TPH greater than 1 percent.

Okay? Everybody with me.

All right. Now here's what I want to accomplish. And I'll try not to be too obtuse here, but what I want to accomplish is to minimize the risk of making a Type II error. And at the same time, I want to ask myself, how many samples do I normally have to take to minimize the risk of a Type II error? That's the key thing I want to get out of this analysis.

I have to make some observations first of all. One is that if I do a statistical analysis of a set of composite samples, that those analyses are more likely to be normally distributed than a set of discrete samples. Now the reason that's important is because most of descriptive statistics is going to be based upon the assumption that any set of values in a group are going to be normally distributed. Okay, that's what the analysis is based on.

So if instead of taking discrete samples and doing a statistical analysis I do composite samples and do a statistical analysis, it's a more valid test. It's more likely to be a normal distribution.

The other thing that I observed is that the mean of a set of composite samples is likely to have a smaller standard deviation than a set of discrete samples. Again, that also increases the validity of the test. So this is why we have suggested that for closure or for documenting the bioremediation endpoint, that we take a set of composite samples, each composite composed of 20 discrete samples.

We recommend the use of a student T test. It's very well known, it's a widely used statistical test. We can use it to do two things:

Compare the means of two sets of data and ask if the means are the same or different, like comparing two sets of analyses for determining the bioremediation endpoint.

We can compare a mean of a set of data with a fixed number and ask are they the same or are they different? An example of this is comparing a set of TPH analyses to a desired endpoint like the 1-percent total extractable petroleum hydrocarbons.

For both of these types of analyses, we have to choose a desired level of confidence. Do we want to be right nine tens out -- nine times out of a hundred, ninety- -- excuse me, nine times out ten, 95 times out of 100, et cetera? Recognizing, though, that the larger the confidence that you want, the more samples you're definitely going to have to take, and the higher is going to be the cost.

Next slide.

All right, what I want to determine is what's called the power of the T test. The power of the T test is 1 minus beta, where beta is actually the probability of this Type II error. This is what I want to get at. What is this value, beta? I want a large power for my statistical test, so I mean -- that means I want a low beta. How do I go about it?

It's pretty complicated, it takes statistical software, and fortunately it's one of those things that you only have to do up front when you're trying to decide how many samples to take.

But you have to estimate what the standard deviation might be, fix alpha, which is the probability of a Type I error -- and we have recommended .1, means that the Type I error is going to be made only one time out of 10. But you saw the consequence. The consequence is not on the OCD, the consequence is on the operator.

We need to choose a maximum acceptable alternate mean if a Type II error is made. In other words, we need to think about this -- about -- you know, if we make a Type II error, how -- what is most likely to be the mean of -- the true mean of the population if I've made an error? In other words, I want to set that at some conservative level. In other words, I don't want to make a big error. In other words, I don't want to set that alternate mean at 2 percent, which means that if I make a Type II error it's most likely down around 2 percent. I want to set it back over here like 1.1 percent, so if I make a mistake, it's a small mistake. See what we're getting at?

I have to then estimate the number of samples, and then using statistical software I calculate the power, and then I repeat this calculation until I get the power that I need.

Next slide.

Or the power that I want.

Here are the results, or here are some of the results. With an alpha of .1, as we said before, estimating standard deviation at 5 percent, taking a fairly conservative alternate acceptable mean of 1.1 percent, then that gives us a power of .91 if we have three composite samples, which means the probability of doing -- of making a Type II error with a mean greater than 1 percent is only about 9 percent.

This 3 is the number of composite samples that the industry committee is recommending for not only determining the bioremediation endpoint but comparing the hydrocarbon concentration at a site to a specific endpoint.

We are in agreement on this issue with the New Mexico environmental committee. The only additional stipulation is, we have fixed the sample area or the sample unit, and that sample unit would be for a commercial landfarm when it -- and I might add that that's an EPA recommendation too.

For a centralized landfarm, operated by the industry treating their own waste, we think we can go to two acres on that, the reason being that the wastes in that site are going to be more well known and probably less heterogeneous than at a commercial landfarm.

So we're in agreement on the 1 acre for commercial landfarms and 2 acres for centralized landfarms, as the sampling unit. Now that means that for every commercial -- for the commercial landfarm, every one acre has to be sampled and shown to be either at its bioremediation endpoint or to have met the standard.

I think that's the last slide.

Q. Dr. Sublette --

A. Yes.

Q. -- were the last two exhibits prepared by you?

A. Yes.

Q. Based on your experience and peer-reviewed literature in this area?

A. Yes, sir.

MR. CARR: May it please the Commission, I would ask that they be marked -- and I will mark them during the next break -- Exhibits A and B, being Estimating DRO Concentration being Industry Committee Exhibit A, and Sampling for TPH being Industry Committee B. And I would move their admission.

CHAIRMAN FESMIRE: Is there any objection to the rebuttal exhibits, Industry Committee A and Industry Committee B, being admitted at this time?

MR. BROOKS: No, Mr. Chairman, no objection.

DR. NEEPER: No objection.

MR. HUFFAKER: No objection.

CHAIRMAN FESMIRE: Industry Exhibits A and B will be admitted.

MR. CARR: That concludes my direct examination of Dr. Sublette, and I pass the witness.

CHAIRMAN FESMIRE: Okay. Why don't we take a 10-

minute break and reconvene at five minutes after three?

(Thereupon, a recess was taken at 2:55 p.m.)

(The following proceedings had at 3:12 p.m.)

CHAIRMAN FESMIRE: Let's go back on the record. Again, this is Cause Number 13,586. It's 3:10 on Friday, May 5th. This is the continuation, like I said, of 13,586.

I guess Mr. Huffaker was going -- will begin the cross-examination?

MR. HUFFAKER: With your permission I will do that, Mr. Chairman.

CROSS-EXAMINATION

BY MR. HUFFAKER:

Q. Dr. Sublette, would you look at CRI Exhibit L? And I think that's in front of you there.

A. Yes.

Q. There's two documents in there. Can you take a look and tell me if you recognize those? What are they?

A. Yes, I do. Well, actually you have three documents in here.

Q. What are they?

A. One of the documents is the IPEC Guidelines for Remediation of Small Brine Spills. There's also IPEC Guidelines for Bioremediation of a Crude Oil Spill. And I also find in here copies of -- copies of a couple of interpretive cards that we include in the brine analysis kit that IPEC distributes.

Q. And are those among the documents you identified to the Commission in your testimony that IPEC issues to --

A. Yes, sir.

Q. -- small operators?

A. Yes.

Q. And have you yourself authored all or part of these documents?

A. Well, I was the principal author. But as I said, the industrial advisory board for IPEC has input and approval.

Q. And I think -- the third document you identified is in there is titled -- at least the version here, the first words on the page, near the end. are, How to Interpret Test Strip Readings; is that correct?

A. Yes.

Q. And could you tell the Commission briefly, what does that represent? What is that document?

A. Well, IPEC distributes a kit free of charge to small producers on -- to allow them to test for chlorides in the soil as a tool to use while doing bioremediation. And that test kit is based upon a strip that we get from Hock that is a colometric strip, that if you put it into a solution with chloride, the solution migrates up the strip, reacting with an indicator, and you take away from that a reading from the strip. It's on a zero to 10 scale, approximately.

And so this is simply explaining to the operator or the user of the kit how to interpret that reading in terms of two things.

One, there is a plot here of soil chloride concentration versus test-strip reading.

There's also a table here on how to interpret that test-strip reading in terms of the effects that the chloride concentration, as identified by that test, might have on a different -- a number of different forage crops.

MR. HUFFAKER: Thank you.

Mr. Chairman, I move the admission of CRI's Exhibit L.

MR. CARR: No objection.

CHAIRMAN FESMIRE: Any objection, Mr. Brooks?

MR. BROOKS: No objection, Mr. Chairman.

CHAIRMAN FESMIRE: Doctor?

DR. NEEPER: No objection.

CHAIRMAN FESMIRE: CRI Exhibit L will be admitted into evidence.

Q. (By Mr. Huffaker) Now Doctor Sublette, the Salinitro study that you referred to repeatedly analyzed soil contaminated by crude oils, correct?

A. That's right.

Q. And you in your presentation this morning and this afternoon have provided analyses of soil contaminated by crude oils and by condensates; isn't that correct?

A. No, sir, I don't think so. Do you mean soils contaminated by crude oil in brine?

Q. No, I think -- I'm trying to focus on the nature of the contaminants you were looking at, and I believe you were looking at soils that had been contaminated by, on the one hand, crude oils, and on the other hand by condensates; isn't that correct?

A. If you're referring to the recommended metric, that's the only place I can think of that we did that. The recommended metric for determining the bioremediation endpoint was different, depending upon whether you were talking about crude-oil-impacted soil, condensate-impacted soil, or a combination. Is that what you're referring to?

Q. Yes, that's correct. You did not testify regarding tankbottoms, did you?

A. No.

Q. And none of the references that you've presented in your tables of references of bioremediation studies -- none of those studied the bioremediation of tankbottoms, did they?

A. Not that I recall offhand.

Q. And you showed us a couple of slides that summarized Salinitro's findings regarding leaching. Do you recall those?

A. Yes.

Q. And you mentioned in connection with those -- and I think you had it written in red on them, that his leaching studies of crude oils found no leaching of heavy metals; isn't that correct?

A. No detecting of heavy metals, yes.

Q. All right. And you're aware that the crude oil that Salinitro was using in his study had low concentrations of metals. You're aware of that, aren't you?

A. Most crude oils do, so it wouldn't surprise me.

Q. And are you familiar with the tables from the EPA's associated waste study of tankbottoms that Wayne Price presented to the Commission in his testimony on the first day of this hearing, at pages 15 and following in his testimony?

A. Yeah, to some extent. I'd have to look at it to be specific, but I remember him talking about that, yes.

Q. Did you notice that that EPA-associated waste study of tankbottoms showed levels of metals in tankbottoms much higher than you would expect to find in crude oil --

A. If I --

Q. -- in some cases --

A. Yeah, if I recall correctly -- and I'm not sure I'm thinking of the right table, you can correct me -- but I think that table showed some pretty high concentrations of sodium, very high, did they not? Which indicates to me that there's a significant amount of produced water in those tankbottoms. My suspicion is that most of those metals came from the produced water and not from the crude oil.

Q. But they were present, the metals and the sodium in the tankbottoms, correct?

A. Well, as in what they defined as tankbottoms, yes, sir.

MR. HUFFAKER: That's all I have.

CHAIRMAN FESMIRE: Mr. Brooks, I guess?

MR. BROOKS: Want me to go next? Very well.

CHAIRMAN FESMIRE: Well, I don't know whether to ask Mr. Hiser --

MR. HISER: I have no questions, Mr. Chairman.

THE WITNESS: Are we finished with this?

CHAIRMAN FESMIRE: Hang on to it.

CROSS-EXAMINATION

BY MR. BROOKS:

Q. Okay, Dr. Sublette, good afternoon.

A. Hi.

Q. You're obviously a very intelligent scientist --

(Laughter)

Q. -- and I'm, one, not a scientist --

A. Do you object to that?

(Laughter)

Q. -- I'm, one, not a scientist, and two not very intelligent, so you're going to have to bear with me if I articulate things in a rather inartful manner, but I need to try to get you to explain some of those things down at my level. So please bear with me.

First place, you talked about IPEC. Now this is not a technical question. I didn't get down what that acronym stood for.

A. Integrated Petroleum Environmental Consortium.

Q. Integrated Petroleum Environmental Consortium. The IPEC doesn't have any relation to OPEC?

(Laugher)

A. Only in the oil universe, I guess.

Q. Okay. Well, now that I've clarified that. I want to establish some basic parameters about what we're talking about with the bioremediation endpoint approach as it is set forth in paragraph G.(8) of the proposed Rule 53.

Now you understand, do you not, that under Rule 53, under Rule 53.G.(6), an operator, if his landfarm achieves the numerical standards set forth in G.(6), can close the landfarm and leave the treated soils in place?

A. Yes.

Q. And under G.(7), if he's planned to do it that way, or -- this is the fallback position -- if he can get an approved alternative use or if he conveys the soil to a landfill, he can close under G.(7), correct?

A. I believe so.

Q. Okay. So the only reason that an operator would need to use G.(8) -- the only purpose of G.(8), as the rule is written, is to create a procedure whereby an operator can close and leave the treated soils in place, even though the numerical standards in G.(6) are not met, correct?

A. That's correct. May I comment on that?

Q. Yes, you may comment.

A. What I see in the Rules is a choice between bioremediation -- the bioremediation endpoint -- I'm talking about permitted landfarms now -- a choice between bioremediation and pretty much business as usual, as far as dryland landfarming is concerned. And I believe that you can meet the closure standards that you've laid out with dryland landfarming in terms of as you have defined them.

But as I testified, in reality you still have a considerable amount of residual hydrocarbon there in various forms in the soil, and I believe that that is undesirable.

Q. Okay, that leaps me ahead to a question that I was going to ask you at a later time, but I'll go ahead and ask it since you've brought that point up.

You were basing that to a great extent on the descriptive information that was given in Mr. von Gonten's testimony yesterday, are you not, as far as what is actually the business as usual in New Mexico?

A. To some extent, plus there's other things that I heard. But --

Q. But in --

A. -- in total, it's things that I've heard about dryland landfarming in the context of this case.

Q. You do not -- or do you have any field or empirical experience in New Mexico?

A. No, can you arrange some?

(Laughter)

Q. Probably. But my -- having said that --

CHAIRMAN FESMIRE: We have an environmental --

Q. (By Mr. Brooks) -- part of my question --

CHAIRMAN FESMIRE: -- engineer position --

MR. BROOKS: -- I don't want to interrupt you, Mr. Chairman.

(Laughter)

CHAIRMAN FESMIRE: I was just telling him, we have an environmental engineering position open --

(Laughter)

CHAIRMAN FESMIRE: -- if he doesn't mind taking, oh, about 90 percent of his salary in sunsets.

MR. BROOKS: Yes, I think 90 percent would be a conservative figure.

(Laughter)

Q. (By Mr. Brooks) But if you -- since you don't have experience in New Mexico, and you're basing this largely on what you've heard in this case, there's a certain amount of speculation involved, is there not?

A. Well, that's right, you have to take my comments in the context that I gave them. Assuming that these are the conditions under which they're operated, these are my conclusions.

Q. Okay. But to get back to what I was saying about the Rule, there is nothing in the Rule that would prohibit an operator from using all of your recommended procedures in closing his landfarm under G.(6) if he could meet the numerical criteria.

A. Now you're talking -- Well, no. If I'm understanding your question correctly, there's nothing to prohibit an operator from using bioremediation and closing under the other standards.

Q. From using every recommendation you've made?

A. Right. Because those standards will be very difficult if not impossible to meet in most cases.

Q. So that is the hinge of your testimony, is that those -- that we need the bioremediation endpoint, you're saying, because in a properly operated landfarm you cannot meet those standards? That's your -- you cannot meet the numerical standards of G.(6), that's --

A. In many cases --

Q. -- that's what --

A. -- you cannot.

Q. Okay. And that is a major premise of your testimony?

A. Yes.

Q. Okay. Now I had thought I understood you at the stakeholders' meeting, but it seemed to me that what you said in answer to Mr. Carr's question a little bit earlier qualified that to some extent.

I understood you to say that if the landfarm was not properly operated in accordance with your recommendations -- for instance, they did not have enough moisture, they did not use enough nutrients, et cetera -- that you could get a statistical test that would show that you'd gotten to the bioremediation endpoint when, in fact, you had not. Is that true, or is that not true?

A. Well, you have to take into consideration the other part of the definition of the bioremediation endpoint, because it presumes good practice.

Q. Well, I understand that. But let us say that an operator who had not been using good practice wanted to close before he had achieved the G.(6) standards, and he submitted a test that was designed to show that he had reached the bioremediation endpoint. Since he had not used good practice, would that be a valid test?

A. No.

Q. And it might well indicate that he had reached the bioremediation endpoint when, in fact, he had not, would it not?

A. Well, except that as I said, to even talk in terms of a bioremediation endpoint there has to be good practice. If there's not good practice, there's very little if any bioremediation, so a bioremediation endpoint doesn't mean anything.

Q. Well, perhaps we're using endpoint in two different senses here, but I still think -- Well, never mind, I believe you've answered the question.

Now in order for the Oil Conservation Division to determine that an operator is using good practice, we would have to regularly inspect the facility, would we not?

A. Well, I think you would have to periodically inspect the facility. I don't know how often that these facilities get inspected now, but I think the operator would have to have good records showing what they've done, what the results of the analyses have been for nutrients, et cetera, when they watered, how much water did they add?

And then I think a spot-check by the field inspector would be -- he'd be able to tell, I think, whether or not this is actually going on or not.

Q. Now your biggest criticism, you said, of the OCD's proposal was that it does not authorize the bioremediation endpoint approach to closure. And I'm going to say to closure, because I don't think there's anything in the Rule that prohibits or qualifies the use of anything else about your approach. It does not permit the use of the bioremediation endpoint for closure in the case of small landfarms; is that correct?

A. That was a big concern, yes.

Q. And now isn't it a valid point -- isn't it probable that there are going to be a lot more small landfarms than there are permitted landfarms?

A. Probably.

Q. And if that's not true, then we probably didn't need the small landfarm provision very much anyway, correct?

A. Correct.

Q. If people decide to go with all permitted landfarms.

So the inspection and monitoring burden on the agency is going to be a great deal larger in terms of ensuring that the proper practices are followed in the small landfarms, versus getting the same level of comfort in the permitted landfarms; would that not be a fair statement? Since there are more of them?

A. Well, there are going to be more of them, but I would venture to say that your field inspectors pretty much know who the good guys are, the people that they can count on to follow the rules if they say they're following the rules. So I don't think you have the entire universe of small landfarms to police.

Q. Okay. But you would concede that the inspection burden is larger for a smaller -- for a larger number of facilities?

A. But why would it be different if they're doing bioremediation or some other -- or dryland landfarming? Why would there be a difference here?

Q. Because we're relying on a test to determine when they can close, which is valid only if we know that those procedures have been followed. I thought we established that the test was valid only on that condition?

A. Well, that's true. But I think that if we all sat down and thought about it, we could think of some ways of streamlining that process for small landfarms that would make it a high probability that it was going to be done correctly.

Q. Okay. Well, but let me go one step further with this monitoring burden. Not only would the small landfarms be more numerous -- isn't one of the advantages of small landfarms, one of the reasons why industry wants the small landfarm option is because they will be closer to the production facilities and therefore require less hauling?

A. I'm sure that's one reason.

Q. And so in addition to being more numerous, they'll also be more -- dispersed over a wide area?

A. Possibly.

Q. And to inspect, they'll require a lot more driving time?

A. Well, I tell you -- I say again, ask your field inspectors if they know who the good guys are and the bad guys are, and I bet they'll say they do.

Q. Okay. Now let me ask you a question here about hydrocarbon loading. That's -- Another one of your major objections to our rule is 80-percent hydrocarbon loading, maximum -- or no --

A. -- I'm sorry --

Q. -- I'm sorry, the 5-percent hydrocarbon load -- loading.

A. Yes, I don't know if I'd classify it as major.

Q. Okay.

A. I think there's a need for some flexibility.

Q. Okay. You have agreed with the New Mexico Citizens, or your clients have, that -- I suppose I should say the New Mexico Citizens for Clean Air and Water, because I'm sure there are some citizens in New Mexico who might not agree to it.

(Laughter)

Q. You have agreed with Dr. Neeper's group --

A. Yes.

Q. -- that -- on a 1-percent or 10,000-parts-per-million maximum TPH for closing, right?

A. With bioremediation option, yes.

Q. Yes. And if you have a 5-percent hydrocarbon load and you do -- you go to a 1-percent closing standard, that works out mathematically to an 80-percent reduction, does it not?

A. That's correct.

Q. If an 80-percent reduction is not feasible in most instances, then don't you have a problem if you say -- if you start out with more than a 5-percent load and you have agreed that you have to get down to 1 percent for closure?

A. Well, it's going to depend upon what they're bioremediating. You know, if you're taking condensate, for example, you can expect higher levels of bioremediation than if you're looking at a lower API gravity. So the operator can look at the API gravity of the material they're bioremediating.

They can balance, then, how fast or what rate they want the bioremediation to proceed at, or how fast do they -- how quickly do they want to be finished, and balance that against what they know that the treatment standards are going to be and ask themselves that question: What initial hydrocarbon loading do I want to use?

Q. Well, but doesn't it still run into the fact that they're going to have to get below five percent if they're -- if they have to remediate more than 80 percent -- or if they can only remediate less than 80 percent and they have to close at 1 percent, they're going to have to start below 5 percent?

A. If you've got a heavy hydrocarbon, yes. But take a condensate, for example.

Q. Okay.

A. You're not going to have that issue. All right? You're going to be able to get a greater percentage of -- a greater maximum removal, let's put it in that language, with a condensate than with a heavy hydrocarbon --

Q. Up to maybe 90 or 95 percent, according to your testimony?

A. With a condensate, I think that's possible, yes.

Q. Okay. So you could go somewhat above 5 percent. Not a whole lot, still, though, could you?

A. Still, it's a little flexibility that I think the industry should have.

Q. Okay. You're dealing in New Mexico, if the data on our rebuttal exhibit 209 is accurate, with API gravities around 38, 39 range, and I guess according to your table which is shown in here somewhere -- and I believe it's back about page -- well, it's in here several times, but one time is on page 35 -- you could only get the 80-percent reduction in that if you had very good soils, if your table is accurate; is that correct?

A. Which one are you talking about?

Q. Your table on page 35.

A. Oh.

Q. If you follow a 40 API and you go up to your line, you're going to just about intersect your 80 percent, if you've got high-quality soils?

A. Well, if your definition of a high-quality soil is a high organic matter --

Q. Well --

A. -- the blue line is more representative of that.

Q. Thigh organic matter is what you would say is high quality for purposes of landfarming; am I right?

A. Well, in general, yes. But you've got to understand that, you know, the organic matter that was present in this soil is necessarily going to be different from the organic matter in other types of soils. All that we're really illustrating here is, there is an effect of organic matter. Exactly what that effect is going to be depends upon the nature of that organic matter and the other properties of the soil.

Q. Well still, if you're on that curve you're going to intersect it right about an API of 40, if your curve is correct?

A. If you're talking about the red line?

Q. The blue line.

A. The blue line, yes.

Q. Now in reality, though, you said there are other factors that -- other than just soil quality and API gravity that are going to influence --

A. Sure.

Q. -- standard bioremediation?

A. Of course.

Q. So to depict this as a linear relationship is an oversimplification, is it not, if the --

A. It's not -- It's not a misrepresentation of Salinitro's data. I did not mean to imply that every relationship between API gravity and percent removal of DRO is going to look exactly like that. This is the data at hand.

I also presented data -- similar data in terms of, I think, TPH-GC and oil and grease --

Q. Yes, you -- they're in your slides 36.

A. -- that showed the same type of trend.

Q. The next slide, if you'd put that up. It shows the same type of trend, but it shows that some of the data points are above the line and some of them are below the line?

A. Yes.

Q. And you get down around 30 API, and there's quite a few data points that are shown to be above the line, on the graph in the upper right-hand corner anyway.

Doesn't this, though, rather than showing -- Let's get back to the Chairman's point. This may show that the 80-percent is a little bit high, but doesn't it -- given the fact that you're remediating primarily crude oils and not real strong heavy-end hydrocarbons, doesn't it basically justify the conclusion that if you're doing your landfarming right, you should be up around -- at least up around 70-percent remediation?

A. For the API gravity of in New Mexico, you mean?

Q. Yes.

A. That's what this data would show. But again, you're not measuring TPH by oil and grease, you're not measuring TPH by whole integration GC. So the plot will look a little bit different, it will be shifted one way or the other depending upon what method that you're actually using.

The objective in showing this was simply that there was this relationship, and the more heavies that you had, the less removal you were going to get at the bioremediation endpoint.

Now your Rule does allow, as I recall, with approval, the landfarm may -- tankbottoms.

Q. Under certain circumstances, yes.

A. And so tankbottoms, by their nature, are going to have higher proportions of heavier hydrocarbons than the lighter crude oils you have here in New Mexico. So if you set some sort of arbitrary standard based upon the crude oils, then you're going to run up against problems, probably with tankbottoms.

Q. Well, let the record reflect that the Division does not advocate arbitrary standards, but --

(Laughter)

Q. -- doesn't -- where you're dealing with crude oil, doesn't your data tend to suggest that this standard -- maybe it's a little too high, but it's not arbitrary?

MR. CARR: Objection. I don't think that's a decision for counsel to make.

MR. BROOKS: Well, I was asking the witness --

(Laughter)

MR. BROOKS: -- for his opinion, if he has one.

CHAIRMAN FESMIRE: Yeah, I'll overrule it in that respect.

THE WITNESS: Well, in that I -- and you can educate me if you would, but in that I don't understand where the 80 percent came from, from my point of view where I'm sitting, it appears arbitrary.

Q. (By Mr. Brooks) Well, your data -- your data tends to suggest that there is a relationship between what you start with and what you're probably going to end with?

A. Yes.

Q. With a certain input you've got a predictable -- you have got a somewhat predictable percentage of --

A. You have a theoretical predictable number.

Q. Yeah. And you remember that all of the standards that are in this Rule are standards that are subject to the exception procedure?

A. Yes.

Q. Okay. I think I'll go on to another subject now.

On your slide number 56 you have listed the principal objections that you have to the OCD's proposed Rules.

A. In that I feel they're inconsistent with recommended practice, yes.

Q. Okay. My question about the first one, I've already asked you, that -- I believe that -- is the restraint not on the use of the bioremediation endpoint unless you qualify that as to being the bioremediation endpoint to closure, because everything else that you have justified -- that you have recommended in terms of trying to achieve the bioremediation endpoint, is not merely not restrained, but is encouraged by the rules that we --

A. Yeah, I think I pointed out in my testimony, I'm speaking here to that 80-percent minimum reduction.

Q. In fact, if you look at paragraph G.(3) of our draft and the corresponding paragraph, that's on page -- Let's see, it's actually on page 18 of our notebook.

A. You have to give me a second here. Can you give me that page number again?

Q. Page 18.

A. Okay.

Q. And compare it with paragraph G.(3) as the industry has proposed alternatively of -- behind -- well, actually I don't have a tab for it; it's on page 20 of the redline in the industry notebook. There are actually very few differences, right?

A. We'll have to wait until I have the other one --

Q. Okay.

A. -- to compare it to. You did say page 20, didn't you?

Q. Page 20.

A. Well, there's a lot of similarity, yes, sir.

Q. Okay. Now for instance, page 20, (3).(f) states, The operator shall add moisture as necessary, to enhance the bioremediation and to control blowing dust, correct?

A. Which document?

Q. Either one of them.

A. I'm not finding it right away, but I remember that.

Q. Okay. You agree with that, do you not?

A. State it again, please.

Q. The operator shall add moisture as necessary, to enhance the bioremediation and to control blowing dust.

A. Yes.

Q. Now I'm guessing that maybe the industry didn't consult you too intensively about its recommendations for changes to G.(3), because I'm guessing that you would have wanted that to say, Shall add moisture and nutrients as necessary, would you not?

A. That would probably be an oversight. I think the nutrients are definitely in here somewhere. It's definitely in the recommended practice --

Q. Okay, that gets me to another issue. There's a lot of stuff in their recommended practice, is there not?

A. Yes.

Q. And most of that is not in the industry's recommended alternative --

A. Well, I think you'll --

Q. -- draft?

A. -- I think you'll find that, if you at the industry's recommendations, that those concepts are in there generally, and the idea, I think, was to be left to the recommended practice document to be specific about what we believe the recommended practice to be.

Q. Now I know you were not at the first stakeholders' meeting that we held back last November, but I recall that -- at that time, that the Division stated that one of our purposes was to get away from guidelines and get the recommended practices into the Rule, and at that time that Mr. Carr stated that industry agreed with that approach. Are you aware that industry agrees with that approach?

A. Well, I believe so, but I --

Q. Okay, then why did you not incorporate your recommended practices into these -- into the industry's proposed amendments to G.(3), which would have made them applicable to all landfarms, and not merely to those that chose to use the bioremediation endpoint for closure?

A. Only because I was advised that the specifics had a separate document.

Q. Okay, thank you. Let's talk about native soil characterization. You said that's unnecessary, right?

A. I believe so, to a large extent.

Q. Now if you're correct that all the bioremediation occurs in the treatment zone, I guess I would tend to agree with you. But were you here when Dr. -- this morning, when Dr. Stephens testified regarding our definition of the base of the treatment zone or --

A. Yes.

Q. And do you recall his saying that you would be plowing up to two feet into the treatment zone -- into the subsoil --

A. I don't believe --

Q. -- when you spread the contaminated material onto the land --

A. I do not recall that at all.

Q. Well, I may have misheard, but that's what I understood him to say as a rebuttal to our point that you have a three-foot margin for your vadose zone tests.

A. What I understood him to say is that the area below the treatment zone might be looked at as a passive treatment zone, that you should not assume that if something were to enter the soil immediately under the impacted soil of the treatment zone, it's dangerous to assume that you will not get further degradation occurring in that zone. That is indeed established.

Q. Well, my point is merely that you can't have it both ways. You have yourself testified, have you not, that the character of the soil in which the remediation is occurring vitally affects the effectiveness of the remediation? Did you not say that?

A. Well, can I ask you --

(Laughter)

A. -- point to any one of those and tell me exactly what the relevance is?

Q. I can't tell you that. I'm not a specialist in bioremediation, Dr. Sublette.

A. Can you tell me what soil composition means?

Q. No, I can't.

CHAIRMAN FESMIRE: Doctor, you can ask him to rephrase the question, but I don't think questioning the attorney is --

(Laughter)

Q. (By Mr. Brooks) What soil characteristics would you want to know of the soil in which the bioremediation was going to take place, to determine how effective it was going to be?

A. In the soil where the bioremediation --

Q. Yeah, let's assume --

A. -- where the bioremediation was going to take place?

Q. -- we're talking about the soil in which the remediation was going to take place. Would you not -- or what characteristics would you think were important?

A. Well, the biggest ones would be like chloride concentration or the electrical conductivity, because I'd have to have the potential closure of the site in mind.

The other issue, big issue for me, would be soil texture. To the extent that I had a high clay content, I would automatically assume I was going to need to put organic matter into the landfarm to keep it propped open for aeration.

Those would be the two big issues right there.

Q. Okay, soil texture sounds to a great extent, to me, like structure and composition. I'm not an engineer, so I may be wrong, but correct me if --

Q. Soil structure means -- the proper definition of soil structure is that it is a description of the degree of aggregation of soil particles in the soil. It's not necessarily related to soil texture.

Q. Okay. Would you look at your slide number 75? Do you not use the word "soil structure" there in one of your --

A. Sure, and that's exactly what I meant by it too, the degree of aggregation, because we want good aggregation of the soil -- I mean, this is a highly structured soil right there, if we're talking in terms of soil structure, which means that there's a lot of defined agglomerates or aggregates of soil here, so that you have large macropores, so that you get good penetration of oxygen into that soil. And if that's where the degradation was taking place, you want large amounts of oxygen in that soil.

Q. Okay, let me go on, then, to your next point on slide 56. Go back to slide 56. Your next point on slide 56 about our Rule is unnecessary limiting of the size of registered landfarms. I'm skipping over limitation on bioremediation --

A. Okay.

Q. -- endpoint, because I already asked you about that.

Unnecessarily limiting of the size of registered landfarms. Now you testified, did you not, that they would be more efficient to operate if they were larger?

A. I believe so, in terms of just proper utilization or efficient utilization of resources, being both personnel, equipment and other resources you might need to effect bioremediation, like access to water, for example.

Q. Doesn't that tend to suggest that there should be more use of the larger permitted landfarms, and less use of the alternative small landfarms?

A. No, I don't think so.

Q. At what point does this greater efficiency of size play out? When do your economies of scale tend to be offset --

A. Well, I just -- I can give you an example. Let's suppose that I -- if I were to do just the 1400 cubic yards, I might put one landfarm over here and another landfarm over here. If one of them is closer to resources like water it would be to my advantage to combine the two, but now it's greater than 1400 cubic yards.

So I think it's reasonable to allow some increase in the size of that registered landfarm for those purposes. But I think the industry has recommended, like two acres. So putting a boundary on it. But it just allows, I think, some consolidation, allows more efficient use of resources. Or at least giving that possibility for that to happen.

Q. But you're not in a position to quantify that in terms of 1400 versus 6000 or 8000 or whatever specifically it is?

A. I think that basically -- I think in a previous stakeholder meeting, perhaps -- I think Mr. Price -- and he can correct me if I'm wrong -- might have said something about two acres as being -- they didn't want a small landfarm to be greater than two acres. I can't remember exactly where I heard that --

Q. Okay.

A. -- but -- and I may be wrong about who said. It wasn't you? Well, it was somebody.

So I thought, okay, if it's two acres in size, you know, how much soil could actually be treated in that landfarm in a three-year period?

Q. Okay, let's go on to your last point on slide 56, restrictions on chlorides which are inconsistent with the science of hydrocarbon degradation in soil. Now you did not express any opinion about the restrictions -- the appropriateness of the hydrocarbon restrictions, other than bioremediation?

A. Hydrocarbon restrictions?

Q. Chloride restrictions, I'm sorry.

A. Okay, can you restate? I'm sorry.

Q. You did not express any opinions about the appropriateness of the chloride restrictions for purposes of groundwater or vadose zone protection, did you?

A. No.

Q. You left that to Dr. Stephens?

A. That's correct. My only other comments had to do with re-vegetation.

Q. Right. And did you understand that the -- Were you here when Mr. von Gonten testified -- I believe it was he that testified -- that the Division did not design its chloride restrictions based on an assumption that it would interfere with bioremediation?

A. I'll have to admit, I don't recall that statement. However --

Q. Well, it was rephrased. It may not have been said in quite that way.

A. Okay. However, it is a common misconception that I deal with.

Q. Okay, I understand that.

Okay. Now let me go through some specifics in your presentation here. I'll try go get -- try to go fairly quickly so we can leave time for Dr. Neeper and redirect and get you out of here today, if possible, but --

A. Trying to get rid of me?

(Laughter)

Q. That occurred to me.

Now you've talked a great deal about -- Well, let's go to your slide number 37. You have said that bioremediation endpoint, when it's achieved, eliminates toxicity, right?

A. That's the evidence of the literature, yes, sir.

Q. And it leaves in place a considerable amount of long-chain hydrocarbons because they're not bioremediable;

is that correct?

A. It would be more correct to say heavy hydrocarbons.

Q. Okay. Again I'm not a chemist. Are those heavy hydrocarbons not somewhat wastelike in terms of their being a different coloration from the rest of the landscape and a different texture from the rest of the landscape?

A. That's your definition of wastelike?

Q. That is the way I'm basically using it, yes.

A. Well, my experience is that after achieving the bioremediation endpoint, just looking at the soil, it's very difficult to discern where the hydrocarbon contamination was and where it wasn't.

Q. Even before re-vegetation?

A. Yes.

Q. Okay. I already asked that one, I asked those.

What was the particle size standard that you said you had agreed to?

A. For asphaltic materials?

Q. Yes.

A. A half an inch.

Q. Do you know if that's going to be -- if there are going to be practical measures for achieving that in New Mexico, in view of the prevalence of a lot of caliche on the surface?

A. Well, it's -- In fact, Dr. Neeper and I discussed how this could be done, and there are pretty standard practices in the environmental industry for estimating things like the number of species of grasses or, you know, some sort of attribute of the surface of the soil.

And basically the easiest thing to do is to carry around in your truck a one-foot square, or a one-meter square, whatever you want to do, and the technique in environmental monitoring is to simply take that out on the site and throw it out there a couple of times -- or maybe three times, let's be statistically correct -- and look at what's inside and make a judgment call. I think that's something the field inspectors could easily do too.

Q. Okay, thank you. I'm not going to ask some of the questions my expert has so kindly prepared for me, because I would have to delay the Commission while I try to figure out what they're about.

(Laughter)

Q. There is one area, however, I feel it's very vital to cover, and this has to do with the availability of water. Much of your testimony is that, dependent on -- the procedures you recommend are dependent on the availability of water, correct?

A. Correct.

Q. Now are you aware of the difficulties in obtaining water for purposes of irrigation in New Mexico, both practical and legal?

A. Yes.

Q. And have you done any comparative studies on the economics if you have a -- have land that has water rights for irrigation, how waste treatment compares versus growing crops as the highest and best use of that land?

A. Could you please re-state that?

A. Well, let's say you have a tract of land that -- First of all, if you have a tract of land that doesn't have a water right for irrigation. You remember Mr. von Gonten's testimony that it would be very difficult to regularly add water in New Mexico if you did not irrigate. Do you agree with that?

A. I agree.

Q. Okay. So that all of the land in New Mexico that does not have water rights available to it for irrigation would then, in your opinion, be unsuitable for landfarming --

A. Yes.

Q. -- is that correct?

A. Yes.

Q. Now have you done any comparative studies -- Given that land with water rights is a very scarce resource in New Mexico, have you done any comparative studies on whether or not that land is actually going to be available for landfarming, in view of its value for cropland?

A. Are you asking me to compare the economics of a commercial landfarm versus raising a crop?

Q. I'm asking if you've done so.

A. No. May I make a comment?

Q. Yes, you may.

A. I understand that water is scarce in New Mexico, but I would ask the Commission to consider not eliminating the possibility of using bioremediation for those who have water.

Q. And is there anything -- that gets back to that first question, just about, that I asked you. What do you find in proposed Rule 53.G that would eliminate the possibility of using bioremediation?

A. Nothing offhand.

MR. BROOKS: Okay, thank you. Pass the witness.

CHAIRMAN FESMIRE: Dr. Neeper?

MR. BROOKS: I think Mr. von Gonten will give up his seat for you, Dr. Neeper. If he won't, I will give up mine.

CROSS-EXAMINATION

BY DR. NEEPER:

Q. Dr. Sublette, first we'll seek a small point of clarification. In your negotiations with me and with my group, you had referred to us as representatives of the environmental community. Would you agree that we did represent to you that we contact our environmental colleagues but that we are not empowered in any way to speak for them?

A. Yes, sir.

Q. And that was clear to you?

A. I recognize you're a subset -- your group is a subset of the environmental group.

Q. Yes. We're very honored with your consideration, but we're not empowered to speak for others.

CHAIRMAN FESMIRE: No more than they are the citizens of New Mexico.

(Laughter)

THE WITNESS: You're in front of me and you're very vocal, so that makes you the environmental community.

Q. (By Dr. Neeper) A second question of clarification has to do with the sampling. As we reached an agreement on sampling, was that agreement applying to the bioremediation endpoint --

A. Yes.

Q. -- option only?

A. Yes.

Q. Thank you. Your testimony has stated that for proper bioremediation activity, one needs 60 to 80 percent of field capacity of moisture. Do you -- this is a separate question from the previous one -- Do you know approximately how much moisture that would require in various parts of New Mexico --

A. No.

Q. -- artificial moisture?

A. No.

Q. You showed the Salinitro study on the toxicity of worms, and it was clear that prior to bioremediation the material was very toxic to worms. However, later on there is an absence of toxicity to worms. Does that necessarily imply an absence of toxicity to other species, post-bioremediation?

A. Not necessarily, but it's a good indicator.

Q. A good indicator.

A. Very commonly used indicator.

Q. Does the text in the Salinitro paper say that those authors thought that 40 to 95 percent of the BTEX in their contaminated soils was vaporized?

A. I don't recall that specifically, Dr. Neeper, but that wouldn't surprise me.

Q. Would you feel that that would be rather true in general, then, that that fraction could be lost?

A. Well, yes, in general. It's going to depend upon the concentration of the BTEX in the crude or the condensate, and the API gravity in terms of how that would partition. But there's always going to be some loss, yes.

Q. You showed some blue and red bar graphs of the Salinitro results, showing with the graphs approximately how much of the material was remediated or how much remained. Did that include, then -- the amount that was remediated, did that include whatever was lost by the volatilization, or was that representative only of the part that was remediated by the bacteria?

A. Well, it's pretty much the part that was remediated, because the lowest carbon number that Salinitro quantified, as I recall, was C11.

Q. So you feel that what was represented was not the volatilized fraction there?

A. Yeah, to a large extent, yes.

Q. The Salinitro study used seed germination as its measure of toxicity to plants. Does seed germination correlate -- or the toxicity to seed germination, does that correlate with later sensitivity of the plant to petroleum materials in the soil?

A. Well, to some extent it does. I think it's generally agreed that the greatest sensitivity that a plant exhibits is in seed germination and in the rooting of the seedling. So basically when we look at seed germination, you know, we're looking at one of the more sensitive parts of the growth cycle of the plant.

Q. Thank you. Is there an upper limit to the hydro- -- or to, let us say, the crude oil content of a soil that is being prepared for remediation, where the toxicity of the crude oil itself would inhibit or stop the bacterial remediation? In other words, could there be such a sample that would not be a candidate for bioremediation at all because it itself would kill the bugs that should be there to eat the oil?

A. Okay, I'll answer your question in two ways. One, if you anticipated that that was the case, you could always dilute it with uncontaminated soil.

But to answer the question from another direction, the original recommendations by EPA for a maximum 5-percent loading were actually based upon that presumption, that if you went higher you're likely to be inhibitory to the micro-organisms. And as I indicated earlier, most people now that that's too conservative. But that doesn't mean that there isn't some upper limit. There has to be an upper limit to everything.

Q. Thank you. You mentioned that it's possible for the soil to become hydrophobic, but one of your cures for that was the use of straw. If --

A. Organic matter in general.

Q. Or organic matter in general. If one were using organic matter to overcome the hydrophobicity, would one need to continue adding that organic matter through the indefinite future, or would that remediate the soil at some point for the indefinite future so you wouldn't have to keep adding it?

A. My opinion is that you need enough organic matter to overcome hydrophobicity to allow the plants to get established. Once the plants get established, the interaction between the root zone and the soil is going to continually release a polar organic material to the surrounding soil. I mean, the -- agricultural science has referred to the area under a plant as an island of fertility. I think once you build those islands of fertility, then it's sustained.

Q. Very good. I believe it was slide 35 that showed a relationship between the Salinitro TPH and the API gravity. I didn't have a number in my book, but I heard someone else refer to this as slide 35. It's got a blue straight line --

A. Blue line and red line? This one?

Q. That one will do; there are many versions of it.

Does the DRO as shown there represent Salinitro's information as presented, or was that your own adjustment of his data?

A. Well, Salinitro presented his data in terms of carbon fractions, and what I had to do was to combine two of his carbon fractions to get an approximate DRO. So if you went to that paper initially you would see those three fractions identified.

But since we are talking in terms of the metric DRO, I was trying to get a metric out of Salinitro's data that would be close to that, and it's very close, but I had to basically add two of the carbon fractions to get approximately a complete DRO range.

Q. Very good. And finally, we have heard discussions of monitoring of incoming waste. Would use of the IPEC chloride test kit allow monitoring of incoming wastes easily and conveniently by the operator so that he could use a simple field kit there and know the incoming chloride of his wastes?

A. I think so, yes.

DR. NEEPER: Thank you. No further questions.

CHAIRMAN FESMIRE: Commissioner Bailey?

COMMISSIONER BAILEY: Just a couple.

EXAMINATION

BY COMMISSIONER BAILEY:

Q. Your slides for recommended practices --

A. Yes, ma'am.

Q. -- for landfarms are very carefully labeled for permitted landfarms, but yet the practices, the processes, would also apply to any kind of landfarm, wouldn't it?

A. Yes, ma'am, at least in concept. All I'm suggesting is that for a small landfarm one could put those concepts in practice without being as specific as I'm suggesting for the permitted landfarms. Because the registered landfarms are much smaller in size, they're temporary, they represent a much lower risk than a centralized or a commercial landfarm.

So I'm simply suggesting that for a small landfarm, use the same concepts but less -- what's the word I'm looking for? -- decrease the complexity a little bit for the person who is not necessarily technically oriented to really understand, maybe, what the nature of some of these -- the recommended practice is.

And let's put them in kind of a cookbook. I'm kind of -- I'm prejudiced, but I like the IPEC cookbook. But that incorporates all of the concepts we've been discussing here in terms of recommended practice.

Q. Exactly. The cookbook does summarize each one of these, it just uses less technical terms --

Q. Correct.

A. -- but yet the process is the same --

A. Process is the --

Q. -- the terms are different?

A. Process is the same, it is scientifically valid.

Q. So that process can be used, and maybe the standards are the same, as far as --

A. -- closure?

Q. -- as far as re-vegetation?

A. Oh, yes. I think the industry is on record as supporting the same closure standards as we're recommending for permitted landfarms.

Q. Yes, but the processes to get there are the same as you recommended for a permitted landfarm?

A. Conceptually, yes. For example, we're not saying that in a small landfarm, particularly with a small producer, that the small producer needs to be going out to the landfarm and taking samples and analyzing them for nitrogen, for example, as -- to make a decision as to whether or not he's -- he or she is ready to add more nitrogen.

We can shortcut that a bit and give them a formula for doing small incremental additions, which will make sure that there's sufficient nitrogen available, sufficient fertilizer available, but not overdo it in terms of creating such a high salinity in the soil to be inhibitory to the bugs. So by following that little cookbook we can achieve the same thing.

And probably the process is going to be a bit slower, because we might, for example -- by doing it this way, we might be a little late sometime in adding our nutrients, whereas if we had been monitoring we would have known that, well, a month ago they were running low, and we should have added it then, but --

Q. Which does bring up the point next, is it reasonable to expect closure within three years for these small landfarms?

A. Yes, ma'am. Well now, the question of -- the definition of closure. Now I'm talking about closure in terms of TPH. In terms of re-vegetation, no. But when we're talking about three years, my understanding is, we're talking about operating it as a landfarm for three years. So at the end of three years, you're finished with the remediation, and now you're entering into the restoration or closure phases.

Q. And the size of the plot, the volume of material on the registered landfarm, is immaterial, really --

A. I believe so.

Q. -- when it comes to that?

One of your slides talks about over time the hydrocarbon-degrading organisms adapt and become more tolerant of chlorides. Is there any handle over what you mean by "over time"?

A. No, ma'am, except let me explain exactly what I mean by that. What I don't mean is that individual organisms start to become more tolerant of chloride. That's really not the case.

What happens is, you've got this community. And you have many members of this community degrading hydrocarbons and performing other functions in the soil. What I'm saying is, if there is chloride present in the soil, that community will over time adjust its structure so it becomes predominated by organisms that can tolerate these new conditions the best. The ones that can tolerate it the best are going to outcompete the other organisms.

So that's what I mean when I say that the organisms can adapt. It's really a community that's adapting, not a single organism.

Q. So it could be three years or five?

A. Or months, or months.

COMMISSIONER BAILEY: I think the rest of my questions are answered.

CHAIRMAN FESMIRE: Commissioner Olson?

EXAMINATION

BY COMMISSIONER OLSON:

Q. Yeah, I'll start off a little -- a couple questions, I guess. I don't have a whole lot.

I guess maybe I'll start with one of my favorite questions so far: How do you define "essentially zero"?

A. Statistically.

Q. I remember you talked about that, but I guess -- it seems like it's very subjective.

A. Well, not statistically, it's not. But I do like the word "negligible" too, that you mentioned yesterday, and I would see that as being equivalent.

But when we define the sampling in such a way as I was discussing earlier, that -- how we determine whether or not -- how the mean concentration of TPH, however we measure it, has changed over some particular time or not, by identifying a statistical test and identifying the number of samples and identifying the statistical parameters, that answers your question. Are they statistically the same or not the same? If they're not the same, then they're not the same.

Q. And then it's -- it's essentially based -- "essentially" --

(Laughter)

Q. Then it's based on -- Let me see if I understand you. It's based on three samples, you said, and the samples need to be a minimum of one month apart --

A. Well, originally we were --

Q. -- just two samples.

A. -- saying one treatment month --

Q. Right.

A. -- in our discussions with Dr. Neeper's group.

Notice I didn't say the entire environmental community that time.

(Laughter)

A. We have agreed that we can extend that to two months without any heartburn, and it gives them a little better comfort factor in terms of being able to detect small changes.

Q. But as it's going right now, it would be based on three samples, then --

A. Two.

Q. -- to each part?

A. Three composite samples at one time point --

Q. Okay.

A. -- three composite samples at the other time point.

Q. Okay, I was just trying to understand this. Thanks.

And you may not be able to answer this, but it was kind of -- kind of leaped at me in some of your slides, and I notice that -- I think maybe in the Rule -- maybe this is something the Division will really have to answer. I see everything is listing towards -- in the tiered systems and in the landfarming, towards exempt wastes, and you had listed it as exempt crude oils. Aren't there --

A. Did I?

Q. I'm not sure, that's what I thought I --

A. I meant to say exempt waste, if that's not what I said.

Q. Because I was thinking about -- it seems like the system is set up for the tier -- the tiered systems and the small landfarms, to take exempt oilfield contaminated soils, and I was wondering what happens -- You may not know this, but I was wondering what happens with the crude oil non-exempt potential soils, like from more larger scale gathering line systems --

A. Or from a refinery or something like that.

Q. Yeah, and essentially you've got the same materials, but would those then be not allowed to be landfarmed?

A. Well, that would definitely be a Tier 2 situation that you consider it on a case-by-case basis with site-specific criteria.

What I may have said, sir, was -- in terms of Tier 1, I was focusing on only hydrocarbon-impacted soils, okay, as opposed to --

Q. Right.

A. -- tankbottoms, for example.

Q. I was just thinking about some of those circumstances. I know there's a lot of spill sites that the Division deals with that are crude oil pipelines, which are actually in the non-exempt side, because they're after primary separation, so they're outside the -- technically outside the exemptions.

A. Yeah, technically it's outside the exemption. But still we're talking about crude oil --

Q. Right.

A. -- I think the same -- you know, everything I've said applies.

Q. I agree with that, I'm just kind of wondering from -- on technical issues related to the proposed regulations. Okay.

I guess the one thing that concerned me -- maybe I heard this wrong -- was, you seem to be implying that the dryland farming is not working correctly and posing some type of threats. Did I, I guess, hear that wrong?

A. Based on the way I've heard it described in this hearing, I believe it is problematic. I believe bioremediation is a minor component of what's going on there.

Q. But isn't that also true -- I guess from a lot of the data that you presented -- you presented a lot of data on percent reduction of TPH. That's not -- that data, was that at landfarm sites?

A. Are we talking about the Salinitro study?

Q. I guess I'm seeing -- you had a lot of different plots of TPH reduction.

A. The Salinitro study was a controlled laboratory study, so highly controlled conditions.

Q. So that was truly just bioremediation?

A. Yes, sir. And the two plots from the Department of Energy publication were actually from landfarm sites.

Q. And so those would include other mechanisms, the volatilization and UV chemical breakdown?

A. Theoretically. But landfarming as it is -- by recommended practice, is going to be of relatively short duration. We're not talking about more than one or two years. Overall, I think that is a fairly short period, compared to what I understand is the time in which some of these dryland landfarms are operated, and it's that extended time and extended exposure to ultraviolet light and dry conditions that concerns me, in terms of sequestering hydrocarbons in the soil. They're still there, but you're not seeing them.

Q. So are you saying those sites pose some threat to groundwater or fresh waters or the environment, public health?

A. I think that the -- again, I'd love to come do a study of these dryland landfarms. But in terms of toxicity, I couldn't really say. I suspect that a lot of the toxic components in terms of BTEX have volatized. How much residual BTEX there is, I don't know.

The one thing that leaps to mind, though, is, the high -- potential high concentrations of the hydrocarbons and modified hydrocarbons that remain in the soil, coupled with a long, dry exposure to hot sun, makes it much more likely that that soil is going to be difficult to re-vegetate.

Q. Well, I think that might be a big concern to industry. I know personally, when I was here for 17 years I worked on many hundreds of essential dryland systems, and I guess I didn't really see that there was problems occurring as a result of that. People were able to do it in a low-maintenance-type setting and essentially -- might turn it on occasion, but it was a relatively low-maintenance mechanism to achieve the standards. In some cases, the standard that they were -- actually in quite a number of cases, the standard that they were achieving was 100 part per million of TPH.

A. Well, you just have to ask yourself, by what mechanism was that standard achieved, and do you approve of that mechanism?

Now that said, I do want to make it clear that I think there is an application for dryland landfarming in New Mexico, and that's with condensate, because with condensate the dominant mechanism is volatilization. Plus those are light hydrocarbons, much less likely to sequester in the soil.

Q. Right. Well I guess, then, I don't see in either proposal, either the Division's or industry's, where water addition or moisture addition is required.

A. I believe it is.

Q. Maybe you could point that out to me, because I don't see --

A. I believe --

Q. -- how it's actually --

A. I believe that --

Q. -- required.

A. -- Mr. Brooks pointed it out to me. Maybe you can give me the reference real quick, Mr. Brooks, if you don't mind.

COMMISSIONER OLSON: I was looking at the Division's, at least for one --

MR. BROOKS: Yeah, it's in G.(3), which is on page 21, and I believe the language is the same in the industry --

MR. BROOKS: Well, actually, it's on page 18 of our notebook.

Q. (By Commissioner Olson) Because for small landfarms, one place I saw it was under -- I guess here I have it under --

A. H.

Q. OLSON: -- H.(3).

A. Yes, sir, can I direct you to page 24 of the industry's suggestions? Document under -- it would be under -- this is G.(8).(c).(iii) --

MR. HISER: That's operating procedures.

COMMISSIONER OLSON: Okay.

THE WITNESS: It includes, but not limited to, tilling procedures, procedures to maintain pH, monitor bionutrients, monitor and apply moisture and maintain at 60 to 80 percent of field capacity.

Q. (By Commissioner Olson) Yeah, and I guess I was coming back to the small landfarms, because at the same time you want to apply the bioremediation endpoint concept to the small landfarms as well. And I think this is -- I was seeing this as a little more stringent than what I think I was seeing under the small landfarms for -- You don't have a requirement there for maintaining that level of moisture, do you? Or am I missing something? Because looking on page 25, I think, is where -- at least where I found it, unless it's also someplace else in your document, under H.(3), it looks like.

MR. BROOKS: The last sentence, Mr. Commissioner, of H.(3).

THE WITNESS: Right.

COMMISSIONER OLSON: Right.

THE WITNESS: It's just not spelled out in as much detail as it was for the permitted landfarms.

Q. (By Commissioner Olson) Because the way I read this, it's saying -- the quote is that it's by watering and addition of bioremediation enhancing materials when needed. So that seems to imply to me that folks can still be doing dryland farming if they're getting sufficient rainfall or whatever and the system is progressing.

A. Well, if they're getting sufficient rainfall, then I wouldn't call it dryland landfarming.

But the -- what's introduced here is concept, conceptually. But it was also introduced in the setting of knowing that the OCD -- to permit a bioremediation endpoint for small registered landfarms, which is a major issue that we see. But we see it as one that requires a great deal of discussion and talking about how it's going to be implemented in that kind of a setting.

So you know, you could take the recommended practice and pretty much take all the concepts and lay them right on top of this, and that would be the industry recommendation.

Q. So you're saying -- are you saying, then, for small landfarms that you'd also need to maintain 60 to 80 percent of field capacity --

A. That would be the --

Q. -- for a small --

A. That would be the recommendation, yes, sir, if we're going to have bioremediation as the principal removal mechanism.

Q. Isn't that going to increase the operational activities at landfarms which now are essentially -- I'm familiar with a lot of landfarms; I can't recall to many that are actually doing any type of moisture addition. They might be doing it on occasion, but it's nothing regular. So I mean, it's going to be a major operational --

A. It's inadequate.

Q. -- change for industry.

A. I understand, but either you get bioremediation or you don't get bioremediation. This is how you get it. So if an individual, an operator, is not willing and able to operate the landfarm properly, there shouldn't be a landfarm at all.

Q. Well, I guess -- I mean, what I'm coming to, isn't that easier to do at more of a centralized, permanent facility than at scattered sites? I'm assuming that you'd have to be hauling water because a lot of those sites, there's not --

A. Well, I --

Q. -- water there.

A. -- that's one of the reasons I was suggesting that the small registered landfarm be increased in size.

Q. Well, and I may agree with you. I mean, two acres, the size may be more appropriate. But I've just seen -- even that, that's a lot of potential small, two-acre sites that are all spread around, which it seems to me that's a real burden on industry for maintenance of that type of an operation, versus at a centralized facility, so...

A. Well, they'll have another choice.

Q. Right. Okay, just a comment, I guess.

And I guess Mr. Brooks brought this up a little bit. Do you have any data for actual landfarming sites in New Mexico where this has been a problem I guess maybe even with the current Division requirements for landfarming in terms of achieving TPH levels?

A. Do I have any data?

Q. Yeah.

A. No, sir. All I have is the data presented by Mr. von Gonten, which -- difficult to believe --

(Laughter)

THE WITNESS: -- with all apologies.

(Laughter)

Q. (By Commissioner Olson) And then you may not know this then either, I guess, because you had some concerns on the limitations of -- for hydrocarbon loading, how many landfarm sites are actually taking more than 5-percent hydrocarbons?

A. I couldn't tell you that. I could only tell you that I think any time that you can get some flexibility in the Rules, I think it's good for everybody. You know, personally, knowing what I know about New Mexico, I can see people who are landfarming condensate-impacted soils as taking best advantage of that.

Q. Well, I guess -- Oh, actually, I did have one more that I think the Chair might jump on too.

One thing here that was pointed out to us, I guess in CRI Exhibit 11 on this issue of how to interpret test strips --

A. Uh-huh.

Q. -- if I look at this, it's indicating soil chloride concentrations which have a threshold effect on plants, and according to this it's -- the threshold value is the lowest level at which there's effects on mature plants, and it also inhibits seed germination.

It appears from this that most of the levels in the threshold value are in about the -- you know, probably 6 or less for the test strip readings which, if I look up on the table, is equivalent to about a chloride -- soil chloride concentration, at least at 6, at around 1000. So this seems to me to be indicating that IPEC's recommendations to operators is that you should be roughly below 1000 chloride for plant viability.

A. For closure, yes, sir. And that's what the industry is agreeing to. In fact, even more stringent, they're agreeing to a saturated paste electrical conductivity of less than 4 micromhos [*sic*] per centimeter.

Q. Because that sounds like a change from what Dr. Stephens was saying this morning on -- I guess he was talking about -- more on the migration issues than --

A. Yes, sir, I'm talking about closure for re-vegetation.

Q. Okay. And is your test strip's reading of 4, then, equivalent to the 4 millimhos per centimeter you're --

A. No, sir, this --

Q. -- you were talking about before?

A. These are kind of arbitrary readings. You have to -- Let me begin by saying that the test strips are actually from Hock, and the purpose of these test strips is to determine chloride concentrations in water. Okay? And so they have a particular scale that you can convert that to.

What we have done is to take those test strips and use those as a basis for determining chloride concentrations in soil. So we have established a certain volume of soil, a certain volume of an extracted solution, which is just water with a little calcium sulfate in it, and when you follow those directions -- and these kits come with basically pictorials to show you what to do, they come with sample cups with marks on them, soil to here, water to here -- if you follow those directions then those test strips correspond to these concentrations in soil.

So we've basically extended it from just being purely a water test to using it for a soil test.

Q. So shouldn't that also indicate there should be some limits on what would be accepted, then, for chloride levels? If that's going to be the closure standard, the chloride is not going to be attenuated or remediated. Shouldn't there be some limits on the --

A. Well, that simply means that --

Q. -- chloride concentration?

A. -- in terms of closure, when you have finished remediating the hydrocarbon, if the chloride concentrations or the conductivity is too high to support re-vegetation, no matter what waste you put on there, then your next job is to remediate the chloride. And there are mechanisms for doing that.

Q. But as I understand it, most of the mechanisms

I've been familiar with for chloride, just moving it from one place to another. Usually it's -- typically flushing it down deeper into the soil profile.

A. That's not what I'm proposing. If you read the IPEC guidelines, the IPEC guidelines favor promoting lateral transport of chlorides at a rate and to such an extent and over such a time that those chlorides do not negatively impact the environment they're going into. So in this case, in the case of chloride, dilution is the solution.

So if we can take that chloride that perhaps is concentrated here on this small landfarm and spread it out into a much larger area, then the concentration over that area as a whole then can become very low. And you'll see, if you read the guidelines, we recommend that you use the soil test kit just to make sure that things are working the way they should, that you're not moving chloride out of the site too rapidly. You want to move it out of there slowly, so that it gets as wide a distribution as possible.

Q. Well, this seems now that you're distributing your chloride over just a whole -- you're taking something that you're cleaning up, which might be in a small area, and now you're just essentially distributing chloride over a real large area; is that --

A. That is correct. But if I had a steak in front of me and I put salt on it and the whole saltshaker spilled on it, that wouldn't be a very good steak. But if I took that salt and gave it to a bunch of other people who had steak, then there's -- nobody has a problem.

Q. Kind of like salt.

(Laughter)

Q. I think this is --

A. If I could further comment on that, sir, this is basically the way the agricultural industry addresses salinity as well. If you go to an ag extension service, usually they'll all have some sort of publication on addressing soil salinity, because that's a very natural phenomenon.

Q. Uh-huh.

A. And the way that they suggest addressing soil salinity is just exactly the way IPEC recommends addressing salinity and a brine-impacted site.

Q. Well, most of that's -- that's agricultural practice, it's putting on enough water to push it down below your root zone.

A. Not necessarily, because it can come back to haunt you, it can come back up. It has to be properly managed.

COMMISSIONER OLSON: Okay. Well, I think that's all the questions I have for the moment.

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. Doctor, I just want to reiterate one of the things that he made -- one of the points that Commissioner Olson. That Exhibit L that comes from IPEC, which is the organization that you -- chair? Is that --

A. I'm the director.

Q. The director. Basically it shows that most wild grasses have a threshold of -- to chloride, of somewhere in the neighborhood of a reading of 6 on the chart, and that 6 corresponds to a chloride content of about 1000 parts per million, right?

A. Uh-huh.

Q. Okay. You talked --

A. Could I address that even a little further?

Q. Sure.

A. As indicated here in the footnote, these are the lowest levels at which an effect is going to be seen. It doesn't mean that the plant will not germinate, it doesn't mean that the plant will not grow, it just means you can see an effect.

Q. There will be some effect --

A. But once the plant --

Q. -- at 1000 parts per million?

A. -- gets established, it basically starts to remediate its own root zone, because when it starts to put down roots it opens up the cell structure -- or the soil structure, so that when you do get precipitation, it's going to preferentially flow through that root zone and continue to flush chlorides away.

Q. I understand, Doctor. Now you talked about a process called photo-isomerization --

A. Yes.

Q. -- and I think Commissioner Olson touched a little bit on this, but he didn't attempt to say that word.

(Laughter)

Q. Basically, that is -- is that another remediation process?

A. It depends on your definition, sir. If your definition of remediation is to mineralize the hydrocarbon -- in other words to convert it to harmful -- harmless products like carbon dioxide and water -- no, it does not happen that way.

Q. Okay. But what it does is converts that short-chain hydrocarbon into a long-chain hydrocarbon, which I think Dr. Thomas has talked in the past, and will probably talk in the future, about being non-toxic or less toxic; is that correct?

A. That is true. I would anticipate in terms of toxicity, there's probably not a problem, but without investigating I couldn't say.

Q. Okay.

A. The definite problem that's looming out there is re-vegetation.

Q. Okay. Now Mr. von Gonten's data, that you find -- unreliable, I guess, is the way to put it? -- how would that relate to photo-isomerization? Could that be a process that perhaps has resulted in these hundred-range --

A. Yes, sir --

Q. -- concentrations?

A. -- because it basically makes the hydrocarbons -- potentially makes the hydrocarbons disappear. They're still there, but by the method that you're using to look for them, you can't see them. It's like this cup is still here if I put it down here, but you can't see it by the method you're using to detect it. You can't detect it --

Q. Okay.

A. -- but it's still there.

Q. Okay. But basically it's been converted into a non-toxic by your -- your definition, I think; is that correct?

A. That would be speculation on my part, sir. I think there's a probability that the hydrocarbons have become even more immobile in the soil, which I think would lower toxicity. I think. But -- You know, I would love to get into one of these places and do some analysis of my own, if you can arrange it.

Q. We might be able to do that one of these days.

But the point I'm trying to make is that Mr. von Gonten's data, if we assume it is correct -- and having a lot of faith in Mr. von Gonten's work, I'm going to assume that it's correct because it's presented, you know, in an accurate way and I know the standards under which it was collected. But this could have been one of the processes that contributed to that result; is that true?

A. Well, let me qualify my previous statements. I didn't mean to say that I didn't believe that Mr. von Gonten went out and got this data and that that's the data that the laboratory gave him. I accept that. What I don't believe is that those reductions, quote, unquote, that are apparent were due to bioremediation --

Q. Okay.

A. -- and therefore in my definition that's not a landfarm.

Q. But his data could be accurate, just not as --

A. The data could be accurate, but I think it reflects a different fate in the landfarms than bioremediation.

Q. Now one of the things that you talked about earlier was that we should know who the good actors are, or the good guys are. But either way, the process that you're proposing, especially for small landfarms, is going to take an awful lot of -- it's going to be manpower-intensive with respect to the Oil Conservation Division, isn't it?

A. Well, again, I'm going here on what the field inspectors in Oklahoma and Arkansas tell me. They tell me there are producers they know they can rely on, that if the producer is telling me I'm doing X, Y and Z, they're doing X, Y and Z, and I don't have to check on them. But there are producers that I know -- maybe small fly-by-night outfits -- that I know are trying to skirt every regulation they possibly can, and I know that I've got to keep an eye on them.

Now if I could offer up a possible solution, is that if these bad actors, for example, have had some sort of action against them, you might take that into consideration in terms of either granting them a registration or in terms of how much oversight they're going to require.

Q. Okay. But the fact is that the answer to the question is yes, it's going to require some oversight, isn't it?

A. Do you think it's going to require more oversight than if they were not using the bioremediation option?

Q. Yeah, as opposed to the small landfarm -- dry landfarming?

A. I guess, sir, to the extent that you want to accept the dryland landfarming concept, if you accept that as permissible, I grant you that the bioremediation option requires more oversight. But it is also more protective.

Q. Now on some of your slides you say that the OCD proposals are inconsistent with recommended practice. What recommended practices are we talking about?

A. Specifically I'm referring to the recommended practice document that I put together, but that recommended practice is well recognized in the industry.

Q. Okay. So the IPEC document; is that what you're talking about?

A. No, sir, I'm referring to -- I put together -- I think it was after one of our first stakeholder meetings, as the result of a conversation, I think, that we felt we were being asked to explain what we mean by good practice, and I put together a document in which I went through various aspects of, you know, what constitutes recommended practice, which I kind of synopsized today in this presentation.

Q. Okay, so in addition to saying that you disagree with some of the things that the OCD is proposing, the OCD recommendations are inconsistent with your recommended practice; is that correct?

A. They're inconsistent with what is customarily taken as recommended practice for landfarms.
Q. Okay, and those recommendations, if I understand correctly, come from you?
A. Not completely. The document in which I laid these out comes from me, but I didn't make this stuff up.
Q. Okay, so -- but you do recommend those practices?
A. Yes.
Q. Okay. Now you've used the phrase "protective of groundwater". What do you mean when we talk about "protective of groundwater"?
A. Well, if there's no -- if we eliminate toxic materials on the surface, then there's no possibility that they're going to be mobilized and go somewhere else. So I'm lumping everything together there in terms of groundwater and the environment and human health.
Q. Now you talked a little bit about the phrase "good practices". How does OCD as a regulator ensure good practices in the TPH-endpoint definition?
A. Could you elaborate on that a little bit, sir?
Q. I think I'm getting back a little bit to the question I asked previously. How will the regulator ensure that these good practices are used in the TPH-endpoint-type remediations?
A. Well, in addition to the endpoint -- the input,

of your field inspectors, I think that if an operator is using good practice for bioremediation they're going to have records. Those records are going to show that they measured nitrogen concentrations, phosphorous concentrations, it's going to show when they made these additions, it's going to show when they evaluated the moisture content in the landfarm, what they did, how often they watered, how much water did they add, what was their tilling frequency, did they add any organic matter, how much organic matter did they have? They're going to have to have those types of records.

And since those types of records, I think, would be kind of difficult to create just spontaneously, I think we can have some confidence that if you have records, they're probably doing this stuff.

Q. Okay, and if they keep the records, the records are going to have to be inspected. Correct?

A. Uh-huh.

Q. Okay. Now when we're talking about small landfarms --

A. That could be part of the closure plan.

Q. Okay. When we're talking about small landfarms, have you done any kind of an estimate about -- or do you have any kind of a -- okay, let's use the word "estimate" -- how many small landfarms we could conceivably end up with?

A. No.

Q. If we used your 6400-cubic-yard definition or limitation on size, do you know how many small landfarms it would take in New Mexico?

A. Less than if you use 1400.

Q. Well, that's a given, but do you have any estimate on how many --

A. No.

Q. -- that would be? Okay.

And how much water would it take to water these 2-acre, 6400-yard landfarms?

A. I'm sure it would depend upon your location.

Q. Okay, in New Mexico, in southern New Mexico, it's a pretty warm place. How much water are we going to have to apply each application?

A. That's probably a question better addressed to someone like Dan Stephens.

Q. Okay, so you don't know how much water it would take?

A. Not offhand.

Q. Do you use any -- Do you have any of these two-acre landfarms in Oklahoma?

A. I've got various sizes, sir.

Q. Okay. So let's pick one that's about two acres.

Do you know how much water it uses?

A. No, sir, because in northeastern Oklahoma I usually rely just on natural precipitation, except in the last year or so when it's been kind of dry.

Q. Okay.

A. But I couldn't tell you off the top of my head how much water --

Q. Well, you've suggested a certain, if I remember correctly, wetting? Forty to 60 percent?

A. That's a moisture content --

Q. Moisture content.

A. -- of field capacity.

Q. Okay. Can you convert that to gallons, using the 6400-cubic-yard calculation?

A. Again, I think that's a question better addressed to Mr. Stephens, because what he would have to take into account for that is the local conditions and evaporation, and he would be better, I think, able to actually answer that question for a New Mexico setting.

Q. Okay. So basically we don't know, but it'll take a significant amount of water, right?

A. It'll take water, yes, sir.

Q. Okay. When you water one of these Oklahoma 2-acre sites, does it take one 100-barrel truck or, you know, half of a 100-barrel truck, or do you know?

A. Oh, usually I've got -- when I'm watering I've got a 1000-gallon tank on site, and if it's been pretty dry I may be adding maybe on the order of 150 to 200 gallons on the site, and that would be about approximately an acre site.

Q. Okay. So between 200 and 300 gallons on a two-acre site, right?

A. Roughly.

Q. Okay, and how often does that have to be watered?

A. Well, again it depends on weather, and --

Q. Right.

A. -- Oklahoma, we get a lot of rain in the spring and a lot of rain in the fall, not much rain in the summer.

Q. Yeah, assume that you had a whole year of summer.

(Laughter)

A. Well, it would be a fair amount, a fair amount of watering, and I would have to intensify the watering during the hottest periods.

Q. Okay. So basically, we're going to be trucking a lot of water to these small sites, to a 6400-acre site, aren't we?

A. Well, water is going to have to get there somehow.

Q. Okay. And this water will either have to be purchased or somebody will have to have water?

A. That's correct.

Q. Again, getting back to something that Mr. Brooks was trying to get to, water is expensive in New Mexico, so this is going to be a significant cost, isn't it?

A. Well, I'm sure it's going to depend on the setting, and I can't comment on the cost of water at various places in New Mexico. I can only say, though, that it is -- I understand the point you're making, but the point is, some people are going to have access to water. They should be allowed to do bioremediation. If you don't have access to water, then it's up to you as to what they do.

Q. Okay. Well, I'm going to -- since you understood the point I'm trying to make, I'm going to follow up on that. Small landfarms are intended to remediate spills as close to the spill as possible, as economically as possible. If we require those small landfarms to use the TPH method, it's going to require a significant amount of water, it's going to require a significant amount of attention, both from the operator and from OCD. Isn't that the kind of thing that should best be addressed at the larger landfarms?

A. I think that's up -- should be left up to the operator.

Q. What about the OCD?

A. Well, when I say left up to the operator, does the operator want to take on that burden, however you might define it?

CHAIRMAN FESMIRE: That's all I had.

Mr. Carr, do you have a redirect?

MR. CARR: Very brief.

REDIRECT EXAMINATION

BY MR. CARR:

Q. Dr. Sublette, we all agree water is an issue --

A. I'm sorry?

Q. We all agree water is an issue --

A. Yes, sir.

Q. -- isn't that right?

A. Yes.

Q. You understand that there are oil and gas operators in New Mexico that have water rights and access to water?

A. That's what I understand.

Q. And that -- isn't the industry's position simply that for those who do, bioremediation should be encouraged?

A. Yes, sir.

Q. If you have to truck water, maybe you won't have to dig and haul and truck it after the fact; isn't that right?

A. That's correct.

Q. Now when you talk about landfarming, you're really talking about bioremediation; isn't that right?

A. Yes, sir.

Q. Yesterday Mr. von Gonten talked about other major mechanisms in a landfarm. One of those was volatilization. Is that what you would call a different fate, another fate, not landfarming?

A. Well, volatilization occurs in landfarming to the extent that there are volatile hydrocarbons present. But the intent of landfarming is to maximize as much as possible the biodegradation of those hydrocarbons.

Q. Dry landfarms in certain areas are appropriate ways through volatilization to deal with condensates and light ends; isn't that right?

A. Yes, sir, I mean even under the best of conditions volatilization would be a major mechanism.

Q. I believe in response to one of Mr. Brooks' questions you stated there was nothing in Rule 53 that would prevent bioremediation; was that your answer?

A. It might have been, sir, I don't remember.

Q. Are there not requirements in Rule 53 that would make it more burdensome for an operator to pursue bioremediation?

A. Yes, sir, that's true.

Q. And wouldn't that discourage operators from --

A. Well, yes --

Q. -- exercising that as an option?

A. -- I believe it would.

MR. CARR: That's all I have.

THE WITNESS: Can I comment further on that question you asked me about water?

(Laughter)

MR. CARR: I have learned that the answer to that is yes.

THE WITNESS: I wanted to point out that it hasn't become clear. The industry is very cognizant of the water issue.

In fact, in the agreement that the industry has reached in terms of, you know, the points of agreement between the group represented by Dr. Neeper and John Bartlit, and the industry -- if I can just read from it, if I may, that in terms of water availability -- because the industry and environmental -- Don's environmental group, is agreeing -- the landfarm permitting process must include a demonstration of access to sufficient water to support the proposed landfarm operations program. Further, we agree and stipulate that there are requirements for the quality of that water, and we specify the quality of that water in terms of its electrical conductivity, its pH and its sodium adsorption ratio.

So we are very cognizant of the water issue and have repeatedly addressed that.

MR. CARR: That's all I have.

COMMISSIONER OLSON: I can't resist, can I ask a question?

CHAIRMAN FESMIRE: Sure. Where did I go wrong?

(Laughter)

FURTHER EXAMINATION

BY COMMISSIONER OLSON:

Q. Mine just goes back to that whole aspect of bioremediation, so if I understand what you're saying -- and this is my understanding of what's happening at a landfarm, a landfarm -- at a landfarm, bioremediation is just one aspect of what's occurring at the site?

A. It should be, in most circumstances, the principal activity or mechanism at the site. If there are going to be alternate mechanism -- volatilization is the other major mechanism. For light hydrocarbons it's going to be -- you know, if we kind of divide up the landfarming world, for very light hydrocarbons like condensate, you're probably going to get more volatilization than you are remediation. But for crude oils it's the other way around. You should be getting more -- much more bioremediation than you are volatilization.

Those I consider the two legitimate removal mechanisms for a landfarm. If the, quote, unquote, removal mechanisms do not fall under those two categories, in my opinion it's not a landfarm.

Q. Because that seems to me to be the misnomer in, maybe, the way this is worded, because it's -- the section is titled Environmentally Acceptable Bioremediation Endpoint Approach, and this is for landfarming. It seems to me it should be Environmentally Acceptable Remediation Endpoint, because it -- acknowledging that bioremediation is not the only mechanism that's occurring at the site.

A. Point well taken.

Q. Okay.

A. At least for condensates.

CHAIRMAN FESMIRE: We'll allow a very limited recross on the limited subjects of the redirect, the limited subject of the redirect.

Mr. Huffaker?

MR. HUFFAKER: Nothing.

CHAIRMAN FESMIRE: Mr. Brooks?

MR. BROOKS: Nothing, Mr. Chairman.

CHAIRMAN FESMIRE: Doctor?

DR. NEEPER: Nothing.

CHAIRMAN FESMIRE: Any other comments from the Commission?

COMMISSIONER BAILEY: No, thank you.

COMMISSIONER OLSON: (Shakes head)

CHAIRMAN FESMIRE: Mr. Carr, I guess we're through with your witness.

MR. CARR: We would ask that he be excused.

CHAIRMAN FESMIRE: It's okay with us.

(Laughter)

DR. SUBLETTE: I'm not sure how to take that.

(Laughter)

CHAIRMAN FESMIRE: Why don't we take another 10-minute break? We intend to go until seven o'clock this evening, for those who are interested.

(Thereupon, a recess was taken at 5:01 p.m.)

(The following proceedings had at 5:13 p.m.)

CHAIRMAN FESMIRE: Okay, let's go back on the record. It's 5:10 p.m. on Friday, May 5th. This is a continuation of OCD Cause Number 13,586. I believe that we were about to start the direct examination of Dr. Thomas.

Mr. Hiser, are you going to do it?

MR. HISER: Mr. Chairman, in the absence of Mr. Carr, I guess I will do the direct examination of Dr. Thomas.

CHAIRMAN FESMIRE: Oh, I'm sorry, before we start, Mr. Mathis has asked to make a statement on the record as, under our rules, is his right.

Mr. Mathis, would you like to begin?

MR. MATHIS: Sure. Stand up here or --

CHAIRMAN FESMIRE: You can sit in the chair there, if you want.

MR. BROOKS: You can sit right here.

MR. MATHIS: My name is Mark Mathis, I'm the executive director of the Citizens Alliance for Responsible Energy, and our group of more than 600 dues-paying members are all about protecting the government -- the United States of America's ability to produce abundant, affordable energy, because without that absolutely everything comes to a stop. So the work that you are doing here today, yesterday, tomorrow -- very important, difficult work. We wish to thank you on behalf of that. I'm not sure that I would wish that on people who have done me wrong; it's very difficult stuff. So thank you so much for what you're doing.

I think we can agree that the goal here is to come up with an appropriate level of protection for public health, for groundwater, for the surface. That's what this hearing and what these proposed changes are all about.

Along with that, CARE would like to submit that there should be some other subgoals. The ones that we are most interested in are that industry buy into this process, that industry feel like this is something that they can do, they can do efficiently and effectively, that it's good for the State of New Mexico.

And in order to reach that subgoal, there's a second subgoal, which is to avoid unnecessary regulation. If you have unnecessary regulation in the process, then you have pushback, you have mistakes, animosity. This is not good for the process. We want to find something that is -- that works very well for the people of New Mexico.

And then thirdly to do no harm. One of the great challenges in what you're doing is that you don't create an issue where you establish a whole set of unintended consequences. We're going to be very overly cautions, overly careful over here, but then that's going to create a whole bunch of unnecessary problems over here. So the goal, then, appropriate dealing with surface waste for all concerned.

So in order to get good working relationships, which is best for all, it's very important that as you go through this process that you create regulation that is very clear, understandable, straightforward. That's the beginning of getting industry to buy into it. They understand what's happening, the thing is very logical.

It's also, of course, very important that every decision that you make is backed by peer-reviewed, highly reliable science, because without that, then you don't have the confidence of the people who are going to have to implement the procedures that you're going to lay down for them.

And then, lastly, I would hope that the Commission will be taking a look at established standards that are adopted by other states around us that have similar conditions, procedures and practices that have been adopted by the EPA, so that it can be the highest level of confidence by the Rules that are established, so that you can get the highest amount of buy-in possible.

Now the Citizens Alliance for Responsible Energy is not a technical group. We do some research stuff, and we're going to be bringing actually a research report to you later this year on a different topic. But from what we have seen, it's our belief that landfarms should be the preferred method of treatment, that if the contaminants can be dealt with effectively on site, that that would be the best way to do that, and that landfills -- very important, but they should be reserved for those contaminants that actually present the most serious threat to groundwater, surface and to the public health.

If we run into a situation where the industry is having to truck large amounts of waste from sites, we've got a lot of consequences that are going to result from that. So that's our urging of you to make sure that, hey, if the waste can be appropriately treated on site, best way to go, do that. Avoid the additional trucking, because if we ramp up the trucking we have all kinds of other things that happen that are going to be a problem.

First, public safety. You've got the greater increase of traffic on the roads. And as that increases, especially large truck traffic, and especially on rural roads, what you find is that there will be accidents, there will be injuries, and depending upon the level of increased traffic we know statistically that there will be deaths. So as much of that as can be avoided, we should.

There's the additional economic and the hassle and inconvenience of you put more trucks on the road, more gravels on the road, as this gravel's coming up off somebody's tire breaking my windshield, breaking your windshield, and you're having to deal with that whole factor. So anything that we can do to minimize that traffic, I think, is a good thing.

Secondarily, the environment. One of the biggest issues that you are all very well aware of is dust. And when you have these big trucks driving down the roads in the oilfield, there's predominantly dirt roads, and so the people who live there have to deal with this dust in the air. A certain amount of that is unavoidable, but if we can avoid some of that then CARE believes that we should.

We're all very sensitive to the cost of fuel now, gasoline and diesel fuel up around three dollars a gallon, as we recognize it's a very precious resource, that as a state and as a nation we need to conserve. So we don't want to have additional traffic in that regard, as well.

And then also, the other thing that you have coming up off of that is emissions, when you have all this additional traffic on the road.

Also landfills, as I stated previously, they are an important part of the process, undoubtedly. We have wastes from the oilfield and wastes from other industries that need to be contained and done so effectively for the protection of public health.

So it is concerning to CARE that we were looking at a situation where possibly we might see -- based on the regulations that you adopt, we might see more traffic moving materials from oilfield sites to these landfills. And it's our belief that as you ramp up and increase the amount of material that goes into those landfills, that it's going to be much more difficult to give the proper attention to those contaminants that are truly the most dangerous. So we think that those sites need to be protected and we not bring a whole bunch of extra materials to those sites if it need not happen.

And finally, we should keep our eye on economics. If the Rules that are adopted for the State of New Mexico are logical, consistent, they make sense, you've got industry buying in, then you're going to have much more effective treatment of waste.

If they're not and the economic factor comes into play where you've got a lot more trucking of waste to landfills, then the industry is going to look at its own economic best interests and say, You know what? For future investment, you know, we can do better -- less of a hassle factor and less of an economic penalty on us, and we can do business in Oklahoma, Texas, Wyoming, other places. That's their right as a private company.

And as someone who lives in New Mexico, and the citizens of -- the members of CARE, we look at this and we think, hey, you know, we see that $2.2 billion that the industry brought directly to the State last fiscal year, and we would not want to send that investment elsewhere.

So just to sum up what I'm saying here, we think that the landfarming, when it's appropriate, appropriate protection of the surface, the public health, of the groundwater, that it be done on site -- that's the preferential choice. But as you consider these Rules, that you be very careful to follow sound science, peer-reviewed stuff, that you take a look at what the EPA is doing, what other states are doing, so that when industry looks at this they say, Okay, this makes sense to us, it's logical, it's clear, we can do this, we can do it effectively, we can minimize mistakes, and we can protect the health and well being of the people of New Mexico.

Thank you so much for your time.

CHAIRMAN FESMIRE: Thank you, Mr. Mathis.

Are there any questions of Mr. Mathis?

Thank you, sir.

COMMISSIONER OLSON: I have a question.

CHAIRMAN FESMIRE: Commissioner?

COMMISSIONER OLSON: I'm just not familiar with your group. Who --

MR. MATHIS: We are a new -- actually, we've just passed our first year anniversary, the Citizens Alliance for Responsible Energy. And what we do is, we're an informational organization. We take a look at all sorts of energy issues, be it oil and gas, it could be solar or wind power, biofuels, hybrid cars. Everything that falls under the heading, the umbrella of energy, we take a look at those things and we analyze them.

And we try to take this stuff that is often very technical and not easy to understand by the general public, and we try to present this information in as accurate a way as possible so that people can quickly and easily understand an issue as they become more aware of it, which we're seeing right now because of increased costs for fuels and other energy sources.

COMMISSIONER OLSON: So you're a nonprofit group?

MR. MATHIS: Yes, sir, 501.C.3

COMMISSIONER OLSON: Okay, thanks.

CHAIRMAN FESMIRE: Anything else from Mr. Mathis? Mr. Mathis, thank you very much.

MR. MATHIS: Thank you.

CHAIRMAN FESMIRE: With that, we'll proceed to the direct examination of Dr. Thomas, by --

MR. HISER: I'll be doing it.

CHAIRMAN FESMIRE: -- Mr. Hiser.

BEN THOMAS, III,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HISER:

Q. Dr. Thomas, could you please state your name for the record, please?

A. Yes, I'm Forrest Benjamin Thomas, III.

Q. And by whom are you presently employed?

A. I'm employed by a consulting company called E^x^ponent.

Q. And was E^x^ponent retained by the industry committee?

A. Yes, it was.

Q. And what were you asked to do on behalf of the industry committee?

A. Well, initially I was asked to comment and review issues of toxicity and the risks that are posed by the various materials that may be put into a landfarm.

Q. And could you summarize for us your educational background?

A. Yes, I have a bachelor's degree in biology and chemistry from Tulane University in New Orleans. I then went and got a master's and a PhD degree in pathology from the University of Texas Health Science Center at Houston, primarily at M.D. Anderson Hospital and Tumor Institute.

Pathology is the study of disease processes. I also have a background in toxicology, the study of toxic chemicals, poisons. And I have a background in risk assessment, which I'll discuss further.

I worked at M.D. Anderson, did postdoctoral work at M.D. Anderson in the biochemistry department. My wife and I were sitting in our apartment one day. She looked at me and she says, You know, now that you've finished all your degrees, I'm thinking about getting my degrees in psychology. Maybe you ought to think about getting a real job.

(Laughter)

A. So I said, Yeah, I've been thinking about that.

So I started to apply. And because of my background, my research background and interest and training, I was hired as one of the original six toxicologists for the Shell Oil Company, and I worked for 12-1/2 years at Shell as a toxicologist.

Because of the research that I had done at M.D. Anderson on a number of things that cause cancer and other adverse effects, they gave me assignments that put me in charge of -- well, they said, Gee, I see you've done work in polycyclic aromatic hydrocarbons. Well, those are in our oil products, so anything that deals with an oil, from E and P to refining, to marketing, that's yours.

Well, geez, you know, solvents, that's just a re-brand of some of the things that we distill. So solvents are yours. And with the hydrocarbon solvents also came chemical solvents.

They said that -- Gee, I see you've done work in leukemia and lymphoma. We've got a major case in front of the Supreme Court on benzene, so benzene is yours, and with that comes the other aromatics and olefins.

Oh, you've done work in trace metals. Anything that deals with a metal is yours. Mining, hey, that's just another form of metals. Synfuels, that's just another form of refining, so that's yours.

Radiation, gee, you've done radiation pathology, that's interesting. Anything that deals with radiation is yours.

So I ended up with about 2500 products of Shell's total 3000 products, and the other five toxicologists dealt with the rest.

(Laughter)

A. But the neat thing was that a lot of that was, in fact, not unique to Shell. So I did a fair amount of work representing Shell in trade associations, and eventually I became chairman of API's toxicology committee, American Petroleum Institute. I became chairman of their benzene toxicology task force. I became chairman of their cancer task force, carcinogenicity task force, and a variety of other task forces.

I became chairman of the butadyne toxicology research task group of what was then called the Manufacturing Chemists Association. I became chairman of the Asphalt Institute's toxicology work group, and several other various committees that I either participated on or chaired.

So in 1990 I was approached to become a consultant. They made me an offer I couldn't refuse, my wife said that she would shoot me if I refused --

(Laughter)

A. -- and as a result of that I became a consultant in 1990.

My focus primarily is in the area of health and environmental issues. I've worked a lot in terms of environmental contamination questions, a lot in terms of questions of, is an exposure to a toxic chemical high enough to cause an adverse effect?

I work both for government, I work for industry, I work for private individuals, I work for law firms. And so it's been a very interesting, challenging career, and I find I learn a lot virtually every day.

I've been very lucky in my work. I've worked in a number of regulatory arenas where health issues were one of the concerns, protection of ground was another concern, protection of environmental receptors was a concern. And so for that reason, I think the industry group here had heard of me before. Somebody recommended me, and they retained me to participate in this project.

Q. And so is it fair to say, Dr. Thomas, that you have a fair amount of experience with petroleum and petroleum toxicity?

A. I do.

Q. As well as other potential constituents that might be found in petroleums that are being produced?

A. I do.

Q. Or oilfield waste generally?

A. Yeah. I might also mention that in addition to my consulting work, I also am an adjunct professor at the University of Texas Health Science Center.

Q. And is part of your consulting work, or previously when you were with Shell or in one of your intervening steps, did you have an opportunity to work with the Louisiana Department of Natural Resources?

A. I did, as a consultant. I was hired by the Commissioner of Conservation with the Louisiana Department of Natural Resources to assist them with the health and risk based modification of what they call Statewide Order 29.B, which is how they receive and treat oilfield wastes in Louisiana.

Q. And as part of that, did you have an opportunity to pretty extensively review oilfield waste generally?

A. At my recommendation, the Louisiana Department of Natural Resources asked the industry to submit data on their 18 different categories of oilfield waste. And at that point the issue had been analyzed and determined that it was primarily -- that there several possible concerns.

One was metals and the other was the aromatics, low aromatics, particularly the volatile aromatics that could now be distributed to the air, transported to a nearby community, which was the issue that was driving this modification.

It turns out that this is the LDNR data set. It's the largest data set looking at the chemical composition and the characteristics of these oilfield wastes.

Q. And so you'll be bringing some of that experience to bear in this proceeding?

A. Yes.

MR. HISER: Mr. Chairman, the industry committee would submit Dr. Thomas as an expert.

CHAIRMAN FESMIRE: Is there any objection?

MR. HUFFAKER: No objection.

CHAIRMAN FESMIRE: Commissioners?

COMMISSIONER BAILEY: (Shakes head)

COMMISSIONER OLSON: No.

CHAIRMAN FESMIRE: Dr. Thomas's credentials are so accepted.

MR. HISER: Thank you, Mr. Chairman.

Q. (By Mr. Hiser) Dr. Thomas, would you like to give the Commissioner an overview of what you'll be discussing today?

A. Yes. Essentially, my role here changed as I got involved into the project. As I mentioned, I was initially retained to take and comment on the scientific issues regarding the toxicity of the materials that might be put into a landfarm or a landfill, and also the risks that that potential toxicity may pose.

As I started to get into that and review the rules that were being issued as drafts by the OCD, it became clear to me that there were a lot of gaps and holes in the OCD approach, just questions that I think have been echoed in the proceedings here by a number of different expert witnesses and even the Commissioners' questions.

As a result of that, the work became more and more looking at the potential role for ways to structure the regulatory development process. And I say regulatory development process, but I have to tell you that in my opinion the industry hasn't gone through this process either, and their recommendations, I think, are flawed in many ways as well.

Q. Thanks.

(Laughter)

Q. On behalf of everybody.

A. And so -- you know, so as a result, what I'm here to do today, essentially, is to talk about how many, many agencies on a worldwide basis are now approaching their regulatory development to evaluate the issues. And the process that I favor is one called risk based decision making. Okay?

Essentially, it's a formal step -- and I'll talk in more detail exactly what that is, but it makes sure that there's a consistent way to identify what is the issue that the regulatory agency is trying to deal with. Okay?

In this case, you know, one of the major things that we're trying to do is make sure that whatever actions that we take and decisions that we make, that we protect health and freshwater and the environment, and whoever that environmental receptor is, whether it be an animal or a plant or so on. Okay?

The risk based decision making process, I think, has a real advantage because it's very explicit. It's very clear exactly what the issue is with regard to this particular regulatory issue, and it makes sure that there's a series of steps that the agency goes through to say, That's the concern, this is the best way to handle it from a regulatory viewpoint. Okay?

And the neat thing is that that process is transparent. Once it's gone through and documented, which is a formal process, once that decision process is gone through in a formal way and documented, everybody involved in the entire thing knows exactly what we're trying to accomplish and why certain things were proposed and why certain things were not proposed? Okay? And I think that that's a real advantage that OCD ought to think about in developing regulatory recommendations, such as the Rule here.

I thought that this Rule would be really simple, because the issues seemed to be pretty black and white. You know, from my experience, and as I've mentioned before in testimony, this stuff is really not that toxic. Okay? And I'll get into that here. So -- can I have -- Well, I've got that slide.

So what I'm going to do in my presentation is, I'm going to talk about the relationship of the risk based decision making process with the proposed BDAT or best demonstrated available technology approach that OCD has adopted.

I'm going to talk about landfarming, and to some extent I'll repeat some of the key points that have been made by Dr. Sublette and Dr. --

Q. Stephens.

A. -- Stephens, thank you. I'm getting older.

CHAIRMAN FESMIRE: And he's not here, so...

(Laughter)

THE WITNESS: Yeah. And I'm going to talk about the hydrocarbon-contaminated soils and their properties and so on, and we'll talk about Dr. Stephenson's [*sic*] presentations with regard to how salt affects that process as well as poses potential threats to the groundwater.

I'm going to use certain examples of some issues and questions that became apparent to me as I tried to read and review and understand what the OCD was proposing in the surface waste management rule. And like I said, some of the very same questions, I think, have been addressed either -- or raised by some of the experts that have testified today and some of the questions that you have identified and asked in the cross-examination.

And finally, I hope at the end of the presentation that everyone has a very good idea what the risk based decision making process involves and why it has very specific, valuable advantages to OCD, and to the regulated community and to the people of New Mexico.

Slide, please?

Like I said, as I started this I looked at surface waste management rule, and for me this was probably the simplest of all the rules that are proposed -- being proposed and developed by OCD. Okay?

The surface waste management rule essentially addresses two types of facilities. Landfills we need to talk about first, because I consider a landfill a remedy of last resort. This is where you take things that cannot be economically recovered, cannot be effectively treated, and you bury it, and you bury it forever, because there's no more treatment, so whatever's there, how bad it is, it's now buried in the landfill.

Landfarm, on the other hand, is designed to treat hydrocarbon-impacted wastes -- soils. Okay? And I think that, for a number of reasons that have been discussed today, it is the method of choice. There are other ways to treat hydrocarbons like vapor extraction, but these are pretty complicated, highly technical and very expensive procedures to do.

So for me something simple like landfarming has a real advantage. As Dr. Sublette has mentioned, this essentially is good farming practices. It's a way to optimize the natural processes of biological degradation of these types of materials. So from the scientific data, landfarming, I think, is really great, because it very quickly destroys the toxic constituents of concern.

The residual hydrocarbons, as I'll point out and as has been pointed out before, are for a variety of reasons just not bioavailable. They don't pose a risk to health, they don't pose a risk to the environment because they essentially get trapped on the soil particles, in the organic material in the soil, in the crevices of the soil such that they're just not available and they don't migrate and they don't -- they can't be biodegraded further.

So as I looked at it, landfarming was really great because I like to treat soils that were hydrocarbon-impacted and didn't have to put them into a landfill, which I think is poor use of the land of New Mexico. To the extent possible, I like to minimize waste.

I mentioned that OCD has adopted this approach that they call the best demonstrated available technology, or what I call BDAT, so I'm going to -- I'll use BDAT in my presentations here.

In the industry meetings that I attended, somebody said one size fits all, and so I think all of the experts from industry have used that term in our presentations here. And it really is.

Essentially what it does is, it's a pure technical solution designed to say no release from a landfarm or a landfill, a surface waste management unit, is acceptable, and therefore there is no risk that's going to be allowed.

In my opinion, the risk based decision making process -- Well, I should say also that the BDAT approach as proposed, with the leachate system, the leak system and all the different things like that, is the same technology that environmental scientists and regulatory scientists use for the very worst of toxic materials. These are the things that you find in Superfund, and this is the type of technology that you use to bury them because you can't treat it, or it's too expensive to treat them.

My belief is that the risk based decision making process allows OCD to form a better technical basis to defend its decisions. Okay? There is a role for BDAT. I mean, there are certain situations, certain materials, where that type of Superfund control is absolutely necessary. Okay? The question is whether the materials here justify that degree of environmental control and disposal, and if so, why? What -- Again, what are we trying to achieve here? What are the questions we're trying to ask? What is the issue? And is this the best solution to address that issue?

You'll hear that that's the question that I come up with over and over and over again. Okay? That issues are either not addressed in the Rule, or it's unclear just what the objective -- the overlying objective really is

It's easy to say protect groundwater. Why? In most cases because the groundwater is going to be either drunk by somebody and it poses a health risk. Or the water is going to be used to irrigate, something like that. Or water is going to be used for fish to live in, and they may accumulate or have adverse effects. Okay? Those are the types of things where you protect fresh water. Okay? That's the reason why you do it.

It's not clear that -- when you just say protect fresh water, exactly which of those issues is the driving force. And therefore, how -- it's difficult for me to judge whether the proposed process -- which is kind of what the OCD has done, is, it's been more of a process rule -- whether the proposed process and the criteria and strategies and design elements are really appropriate to address that specific concern, because that concern is not identified explicitly. And you'll hear that over and over again.

Q. (By Mr. Hiser) Now Dr. Thomas, in your experience as an environmental professional and a person who's consulted with a number of regulatory agencies, have you seen that there's been any trend in how they approach the idea of like a BDAT approach or risk based approach?

A. I have. In the United States, for example, at the last count that I had, there were something like 26 agencies that have now adopted a risk based decision approach. Okay? Twenty-six agencies, and that's within the last eight, 10, 15 years.

So you know, in this slide -- I'm sorry, the next slide. You know, I essentially -- these agencies have considered BDAT approaches and have rejected them. And the reasons why they've rejected them, essentially, is, they actually find that BDAT is more expensive -- more manpower intensive, more expensive, and it's difficult to enforce. Okay? When you have no release, you're out there trying to make sure that that's the case. Okay? You're trying to make sure that the data are adequate, and the quality of data are adequate, to make the conclusion that, in fact, there's been no release. Okay?

In a lot of ways, the risk based decision making process, in my view, has become the gold standard for regulatory development. Okay? Again, more and more agencies, including -- EPA developed the technique, but including the NMED, you know, have all adopted risk based approaches. There's a reason for it, and hopefully in the presentation I give you'll understand what that reason is.

Risk based decision making, or risk based approaches, are not new. They've been around for 25 years. Okay? It's taken a while. And I should say that when you first look at it, it's pretty intimidating because it's formal process, and it says you not only have to consider that, but you've got to consider this, and then you've got to consider that, and so on. So it looks at the outset that it's pretty intimidating.

But in actual fact, it's pretty simple. You know, in fact, OCD has used a number of the risk assessment models for groundwater migration, you know, that sort of thing. It's one of the models that we use in risk assessment to evaluate that specific thing for that particular type of concern. Okay? So, you know, in a lot of ways they're already using risk based decision making, but on a very selective basis. And as you start to hear --

or I heard the testimony about why they chose this number versus that number. It's because this is a risk based developed number.

Where they're missing, however, is the guarantee that the number that they have selected from another agency, perhaps, is an appropriate number for the concerns that was driving their issue. Okay? For example, you know, it was surprising to hear that we have not done a survey of New Mexico plants and their sensitivity to salt. It was not done up front -- we've talked a lot about here -- because it wasn't an issue, it wasn't the issue that we knew that was going to be driving. Okay? So no survey was done. It was a lower priority or something. Okay? But it's that same sort of thing that I'm seeing throughout the proposed Rule.

There are other models of things like that, but they're all based on simple arithmetic. They're arithmetic models, they're not detailed integral equations and things like that, calculus.

Like I said, you know, the real advantage of risk based decision making is that it forces the decision maker, the regulator, and the regulated industry to think through the processes and to make sure that they understand what the issues are, so that when they make a proposal as what this is, or they make a proposal that we'd like an exemption for this, everybody around the table has a common understanding, well, that was said because of this concern. It wasn't said because that number looks close to that number and, yeah, it looks okay because, you know, 1100 is close to 1000. That doesn't work.

It doesn't work to say, you know, that 80 percent in your data, looks like that that's a little high. Why don't we reduce it to 60 percent? And now all we have is, say, 20 percent of oil-type materials, liquids, that are unlikely to be landfarmed.

There's a technical reason why you choose the criteria that you put into a rule, or guidance. Okay? But it's got to be clear to everybody. Otherwise, the industry doesn't know what to do, how to respond, how to come back and argue the issue when the issue isn't identified.

Next slide.

Q. Well, Dr. Thomas, why don't you go ahead and tell us a little bit more, then, about the specifics that would go into a risk based decision making approach and how that might influence how the Commission would look at the promulgation of the surface waste management?

A. That would be great. In order to understand it, I've got to define a couple of terms that appear at first to be synonyms, but they have very important technical distinctions.

The first term is "hazard", and that's essentially defined as the ability to cause an adverse effect.

And the second term is "risk". Okay? Risk is the probability of an adverse effect occurring.

Now that -- It's easy to throw out a definition, but let me give you an example.

If, for example, I step out in front of an oncoming bus, well, that clearly presents the hazard of being injured or killed. But if the bus is ten blocks away and I step out in front of it, the risk is pretty small.

And that's the way, essentially, that the whole system works, even with chemicals or oil, whatever it is. If there's no exposure, risk is zero. Okay? If there's no toxic chemical, no hazard, risk is zero. If there's a high hazard or a high degree of concern and the exposure to that chemical can be high, risk is very high, and it's probably something that the agency needs to address.

I mentioned that EPA developed risk assessment probably about 25 years ago. And the reason why they did it was because they started to realize that they can't base regulations on the fact that a chemical is a carcinogen, for example. You cannot just simply say, It's a carcinogen, I'm going to reduce the level to zero. They had to -- and this was a pretty important decision -- they had to demonstrate that the current level of exposure posed a risk -- first time that risk came up was in an OSHA decision -- that posed a risk to health, and that whatever the regulation or action that was being proposed reduced that risk. Okay?

And so EPA now started to say, Okay, if we have to justify our regulations on the basis of risk, then we need to have some way to start to quantify and to set priorities based on risk. Hazard is not going to do it. Okay?

So essentially risk assessment identifies the hazards of greatest concern. Once you're able to prioritize, you're able to say, That's the issue that we need to address, this is an issue we need to address, this one has so much lower risk, or no risk that's significant, we don't need to address that. We start to now be very effective in our use of manpower and resources. Okay? But again, the process is transparent.

I mentioned that the risk based decision making process provides a standard series of steps so that you can think through the issues and identify the issues of concern. Essentially, it provides a very formal framework on which to build a regulatory program. Okay?

I mentioned that BDAT -- there is a place for BDAT. Okay? But in the risk based decision making process, that is only one of several different alternatives, and you now have a very clear basis to say that that is the one that's required, that's the level of control and protection that is required for this material, for these reasons.

Q. Dr. Thomas, then do you want to give an overview of some of the questions that the Commission might want to consider in deciding whether they need to proceed with a regulation?

A. Yeah, it's a formal way of thinking through what the issues are and how serious the issues are. The risk assessment process that I work with a lot is toxicity, so I've used these particular steps as a way to show you the logic here.

The first step would be to identify the chemical or agent that's of concern. Okay? For example, benzene. Okay? The question is, well, who or what is specifically going to be exposed and needs to be protected from this particular chemical. Okay? And that is called a receptor.

Q. And even though it says "who", is that receptor necessarily a human being, or could it be an environmental actor like a bird or a fish?

A. Exactly, exactly. I started running out of space, but it -- who or what. Okay?

The question -- Another question is, well, if that's the receptor of concern, what is the likely pathway of exposure? Is it going to be inhalation of airborne vapor, or is it going to be ingestion of soil that's been contaminated, in drinking of groundwater? Is it going to be a child playing in the dirt and absorbing it through his skin? Is it going to be eating vegetables that have been grown in the garden that was irrigated with contaminated water? What is the pathway of concern?

And then what are the levels of exposure that are potentially able to be achieved? What is the dose for each pathway?

So once again, we're now starting to understand exactly what the issues are and starting to put in perspective just how important those different pathways are to our issue.

You consider then, what's the appropriate level of risk. Okay? I should say that when you evaluate the chemical, chemicals have a variety of toxic effects or adverse effects that may be of concern, everything from carcinogenicity to liver toxicity to reproductive toxicity, birth defects, mutation, all kinds of different things. It could be, alternatively, inhibition of seed germination or root growth, or it could be just the fatality -- the lethality that can be induced in an earthworm or a plant. All these different types of things are characteristic of the chemical. Okay?

And by the way, I'm a fairly loose speaker, so if you have a question or I say something that doesn't make sense, please stop me. Pathologists are very bad about blurting out words like methemoglobinemia --

(Laughter)

A. -- and it's almost without thinking. So please stop me and I'll try to do better.

It's important to realize that we always have risk, and so the real question here is, which of all the risks should we be concerned about? Okay? And based upon all the steps that we just talked about, you make the decision as to knowing now what the exposure levels and the chemical and all the different things like that, you're now able to actually calculate the maximum allowable concentration in something like soil or in water, such that the target risk is not exceeded. Okay?

We're talking -- and here are the terms that we're using in this process here, is an SSL, soil screening level. But that's what I'm talking about, what is the maximum acceptable concentration in soil, for that particular issue?

The risk based decision making allows a lot of flexibility. It recognizes that each site is unique. You know, not every site has the same soil types, different distances to groundwater, all the different things that we've talked about here in the hearing. And it gives the operator and the OCD options to deal with, or not to deal with, with regard to that uniqueness. Okay? It does it by essentially adopting three tiers.

And it's unfortunate that the industry comments also use Tier 1, Tier 2, to describe certain types of landfarms, but that's not the same tier that I'm talking about. They're related but not quite the same.

In the risk based decision making process, Tier 1 is the very conservative default. This is the -- you know, as far as the agency is concerned, these are the criteria that are protective in almost all situations. Okay? They're reasonable, but they're protective.

And so essentially they use these very simplistic mathematical models, estimates of dose exposure, estimates of migration to groundwater, all those different things, to define what the appropriate criteria are.

In the surface waste management rule here, this is the list of the contaminants and the -- either the NMED Tier 1 residential soil screening level or the -- it was lower than the DAF 1 SSL for protection of groundwater. Okay? Those are -- That's their equivalent to what the Tier 1 default criteria are.

Tier 2 is at the discretion of the operator, there are certain things about the site where they think this Tier 1 criteria -- they're just too stringent for the situation that we have here. The water may not be usable, for example, so the DAF 1 may not be the appropriate criterion. For a variety of reasons, Tier 2 criteria may be developed. And so essentially Tier 2 allows certain site-specific parameters, like depth to groundwater, to be used in the standard regulatory formulas and equations.

And I say that because -- understand that the data that you've seen so far, both Dr. Stephens and Chief Price, the models are standard regulatory models. They're designed for doing certain things, they make certain assumptions that may or may not be valid, and so on.

Tier 2 allows those same models, and only those models, but allows input. An appropriate site-specific DAF, for example, or depth to groundwater, or soil conditions and things like that, permeability, all that kind of stuff.

Tier 3 is -- allows the operator to propose actually site-specific data in models that they think are more appropriate to the issue. So it's not limited to the existing default regulatory models. Okay?

Now as you go from Tier 1 to Tier 2 to Tier 3, you generally get criteria that are progressively higher. And a lot of people misunderstand risk based decision making process. They say, all right, we're going to risk that away. Okay? We're going to get rid of risk. And in some ways that's true, because you're talking about increasing understanding of site-specific uniqueness.

But let me give you an example of what really is happening here. Even though the numbers are going up, they are equivalent levels -- they represent equivalent levels of risk. It's just because -- they're going up because of site-specific issues.

For example, suppose it takes me, because I walk with a cane, a full 64 seconds to cross the street. Okay? And suppose that bus that I talked about before -- you know, the regulatory agency said, you know, Ben takes 64 seconds to walk across the street. Hm. To be conservative, let's give him 75 seconds.

Okay, that bus is coming down, and it could be driven by a mad bus driver at 100 miles an hour. And if that's the case, to get Ben safely across the street from this point to that point, hm, that bus has got to be 10 blocks away. Oh, okay, site-specific information comes about.

Did you know there's a governor on the bus and it can only go 50 miles an hour, and there's a really good employee screening program and they don't hire crazy bus drivers, or blind, or take great pleasure running over people with canes. Okay? And in that case, to allow me to get from this side of the street to that side of the street with 75 seconds, that bus could be five blocks away. Same level of protection, but it's a different criterion. Okay?

Now if you start to really get very site-specific, Tier 3, and you start to realize that there are speed bumps all along the road, that that bus can't be going more than 20 miles an hour, two blocks gives me enough time to get across the street. Tier 3. Okay?

So even though it's gone from 10 to two blocks, it's the same level of protection. It's just taking into consideration site-specific data.

Next slide, please.

So let's talk about very specifically landfarming of petroleum hydrocarbon-impacted soils.

You know, the surface waste management rule was fairly specific about what types of materials can be put into a landfarm. Essentially it's soil and soil-like materials that contain crude oil, condensate, possibly tankbottoms in certain situations, and salt. Okay? And so what I'm going to do is kind of go through that.

I should point out that refinery waste and hazardous waste, such as the chlorinated solvents and PCBs -- that's the 3103 list of chemicals -- are not allowed by OCD to be placed in an OCD-permitted or -registered landfarm. They are not permitted. Okay? At least they shouldn't be. One thing, refinery wastes essentially start to blur the distinction between RCRA-exempt -- and that is OCD's responsibility and NMED responsibilities under RCRA.

So this is crude oil. And you've seen the illustration, top illustration on the right, from Dr. Sublette, but essentially I wanted to make several points.

One is that Dr. Sublette mentioned that crude oils are extremely complex. You know, we know that there are hundreds if not thousands of different chemicals that are present in crude oils.

But I showed you a second crude. The first is a very crude oil, which is an Indonesian crude. And as Dr. Sublette mentioned, this is a paraffinic crude, and the tall peaks that you see there making that little triangle are essentially -- many are alkane-type things, what the industry calls paraffins, increasing the chain length by one carbon at a time. Okay? Hydrocarbons, remember, are chemicals that contain only carbon and hydrogen. Okay?

And Dr. Sublette also mentioned that there are other chemicals or other things that could be in certain constituents of petroleum that may contain sulfur, nitrogen, phosphate, oxygen, those sorts of things. Those are no longer called hydrocarbons.

The second illustration there is something more akin to what you probably will see in New Mexico. This is San Joaquin Valley crude, and you'll notice that there a lot of different peaks. This is probably a naphthenic crude, it's probably an intermediate crude, what's called intermediate in terms of -- as opposed to heavy crude or light crude.

But what you're starting to see is how difficult it is for a gas chromatogram -- a gas chromatograph, to separate the individual constituents. Most of the constituents form that little hump -- and in this case a bigger hump -- because they're not able to be separated. And worse, they're not able to be identified with precision. Okay? We know about where these different things come. Some of them we actually can identify, but the majority we don't know.

As I recall, a chemical called 7,12-dimethylbenzanthracene is a known carcinogen in animals. Okay? But dimethyl groups can appear at the 1 -- or in this case 7 and 12 position, or the 1 and 12 position, 2 and 12 position, 3 and 12 position, 2 and 3 position -- There are 64 different isomers of dimethylbenzanthracene, many of which co-elute, so that what the laboratory identifies as 7,12-dimethylbenzanthracene may actually be a peak that's made up of a lot of different 7,12-dimethylbenzanthracenes and other constituents that happen to migrate very close. Very complicated.

And the only point that I'm trying to make is that because of the complexity, you know, it's a mistake to think that the number that you're getting from a laboratory is really the number that's really there.

Now does that make a difference, or is that important? And for the purposes of the regulations here, as I look at it, no. As we've already talked about, in spite of the complexity, there are ways to evaluate and to get an estimate of TPH, the various types of TPH and so on. Okay? But I just want you to see the different complexities of crude oil and some of the -- Didn't finish that thought.

The data says that only certain constituents are toxic. Okay? And we know that from a landfarming point of view, the toxic materials are -- as what Dr. Sublette calls candy or dessert for the microbes that are in the soil.

Second bullet point here is that crude oils have low acute toxicity, chronic toxicity and carcinogenicity in animals. I could add other types of toxic endpoints too, but essentially toxicity for crude oil is low. It's also low in toxicity to plants. Okay?

Now I need to put that in perspective because we all remember the Exxon Valdez and those poor seagulls that were dying. Okay? Well, it wasn't because of toxicity.

You may recall that what was happening was, the environmental people were washing carefully the feathers off with detergents and things like that, and the reason why is because it's not the toxicity that's of concern there; it was the fact that they were losing their ability to insulate their bodies from the cold and they were losing their ability to float on water because the oil had saturated their feathers. It's a physical phenomenon, physical adverse effect, not a toxic effect.

Same sort of thing with regard to plants. As Dr. Sublette mentioned, the problem with the plants is that you start to saturate soil with an oil, and it forms a barrier so that water can't penetrate it. It just rolls flat off. Okay? But it doesn't penetrate deeply. Okay? Oxygen doesn't penetrate. And as a result, the plants die. They start to wilt and die because they're just being suffocated and dehydrated to the point where they can't survive. It's a physical problem, not toxicity.

So conceptually it seems that this can't possibly be right, but in fact it is. Low toxicity potential for both crude oil and -- to both plants and animals.

Now that's not to say that crude oil and things don't contain toxic constituents because they do, and we've talked about those. And in order to make the third bullet point consistent with the second bullet point I point out that in crude oil toxic constituents are present, BTEX and naphthalene are present, but they're present at relatively low concentration, such that when you get an exposure to crude oil, the complex mixture that you see in the illustrations, both specific toxic constituents are at such low concentrations that you do not see adverse toxic effects.

Does that make sense?

Q. Now Dr. Thomas, before we leave this slide, some of the testimony that we heard from OCD staff members was that because this mixture was extremely complex and difficult to identify, we really had no idea what the toxicity of it was. But here you're saying that crude oils have a low toxicity, and so how do you know in a complex mixture like that, that it has a low toxicity? What's your scientific basis for reaching that conclusion?

A. Well, the issue is, what are people going to be exposed to? And in fact, they're exposed to the complex mixture, not to an isolated constituent of petroleum. Okay? And so from the toxicology point of view there are two ways to deal with it.

The best way is to do studies, to look at the toxicity of the mixture, and that's the data that I just reported to you. The toxicity of the mixture is low. No matter what the biological endpoint is, the toxicity is low.

There are groups of people who -- or experts, who will say, Well, let's take a look at that constituent anyway. Benzene is present at this level, and it has a potential exposure to a receptor at this level, and we know from those response relationships that characterize benzene toxicity or this type of adverse effect associated with benzene that this dose is required, this dose is this much or this percent of that toxic dose. Okay? So again, we're talking about risk put on an individual constituent level.

For the purposes of landfarming, we're concerned with some very specific things: protection of health, protection of fresh water, protection of environmental receptors and the environment in general. Okay? And for that we have data on the complex mixtures. As difficult and different as they are, the data are consistent. Okay? And that is that the materials that are of greatest concern -- in fact, we can probably go to the next slide -- the materials that are of greatest concern are what we call BTEX and naphthalene. Again, if I use terms of art that don't make sense, please stop me and I'll try to explain them.

Having talked about the complexity of crude oil, there are a number of ways to develop a measure or an estimate. And we've talked about essentially what these methods are as they -- as Dr. Sublette mentioned.

Essentially what do is, they take whatever the material is, whether it be water or soil, and they will extract it into a solvent. And then they will take that extract and they'll try to estimate what the petroleum hydrocarbon content is in that extract, or for the processing of that extract.

Two methods that we've talked about today, or during the hearings, is Method 418.1 -- and as Kerry talked about, this is extracted into freon-113, and it's quantified by the extent that the extract -- or the materials in the extract, can absorb infrared light at a specific wavelength. The wavelength is chosen because it correlates with carbon-hydrogen bonds, and these are hydrocarbons, so this is a good way to get an estimate of hydrocarbon.

CHAIRMAN FESMIRE: Doctor, is this method still used?

THE WITNESS: No.

CHAIRMAN FESMIRE: And why is that?

THE WITNESS: Freon was found to deplete ozone in the atmosphere, so the United States banned the use of freon, as did other countries. There are laboratories who still say they run the 418.1 method.

I talked to Dr. Duell, who owned a laboratory for a number of years, and he said in actual fact, there is a daily fine for being caught using freon. So some laboratories may be using freon illegally, other laboratories may be using a different solvent, and there are some laboratories who have identified some kits that are said to be 418.1-like, and they may be reporting the data on that basis. So we don't know for sure, because we haven't surveyed all the laboratories. But on the next slide, for example, I mention that the 418.1 has been withdrawn from the official EPA-approved method series, which is called SW-846. Okay?

The other method that we talked about is 8015M, which is modified. Essentially the method series doesn't specify what solvent to use. If you use 8015 and just send that to the laboratory, the laboratory will make a thought about what solvent they want to use, what extraction technique, sonication, 30 minutes of shaking, that sort of thing. They'll make that determination because that's part of their laboratory expertise. And then they'll run it through a gas chromatograph and use a flame ionization detector according to the method series, 8015 method.

But that gives you a very different way to measure petroleum hydrocarbons. Okay?

Go to the next slide.

So, you know, each -- I mentioned 418 really is no longer used officially. 8015 is an appropriate method and is an SW-846 -- part of the method series.

But carbon and hydrogen bonds absorb infrared and other things that will trigger an FID, a flame ionization detector. These are our methods of quantitation.

Here are three materials that contain no petroleum whatsoever, and yet if you -- in the old days when they were running 418.1, they found that grass had a TPH, a petroleum hydrocarbon content, apparent hydrocarbon content, of 14,000 parts per million. Pine needles, 16,000 parts per million. Oak leaves, 18,000 parts per million. Okay? And so it became clear that you can call it TPH, but not everything that's reported necessarily is petroleum. Okay? All these things have carbon-hydrogen bonds, essentially.

So TPH estimates by different methods -- and we've seen this before, we started to see that TPH by 8015 was not the same numerically as results from 418.1, and for a variety of reasons. You can't use different -- results from different methods and directly compare them. Okay? So you can't start off your bioremediation using 418.1 and then do an 8015 and get lower results and say, Ah, see what a great reduction I've done?

But that's possible under the Rules. The method is not specified in up-front documentation as to what this is and how we're going to do it.

Nor does it specify the quality of the information that we've got. For example, you know, instead of sending investigators and inspectors out to look at a landfarm -- You know, Dr. Sublette is right, they have a lot of documentation. Okay? They have reports from the laboratory if they request it that says, You know, that sample that you sent was a real problem for our technician. He had to dilute that extract down to get a result. Okay? And in doing so, he's now changed the quantitation limits, he's changed the ability to estimate how precise an estimate that is. Okay? He may have a higher TPH -- because they're now multiplying by the dilution factor, okay? -- than you might have in another sample, from the same spot, same sample, that wasn't diluted. Okay?

The point is that there's documentation out there that if they were required to submit that as part of the report to the OCD, the OCD staff could say, There's something strange here. Back then it was this, but now we're looking at this, and there's not enough time for that to occur, or this -- whatever. Okay? But it doesn't necessarily mean a physical visit to that landfarm. Okay?

And so your decisions are only as good as the quality of the data that you receive. And one of the things I'd recommend to the agency is to make sure that you have a very clear idea of what the data quality criteria are so that you can now start to say, Not do you need to give us the number -- that's only part of it -- you need to give us a report from the laboratory about this, this and that.

And maybe their QA -- internal QA report that says, you know, that sample was part -- used a standard curve that was three weeks old, and that -- hm. And, gee, back then we were using gasoline as our standard hydrocarbon so that we could get a milligram-per-kilogram calculation. Hm. But this material was more like oil, or more like diesel fuel. Okay? And the numbers that you get using those standards for comparison are entirely different. Hm. Okay.

So, I guess -- it's written in a number of reports and documents that what you report as TPH is determined by the method that you use. And I've said the same sort of thing before, and that is that you can't directly compare results from one method with another.

Now because toxicity data and data for risk determinations are available for common distillate fractions -- things that we know as gasoline and kerosene and diesel fuel and so on, okay? -- that -- there's been a move in the last few years to segregate total TPH. And I guess the term we're using here is total extractable petroleum hydrocarbon, or TEPH. But to separate that into subfractions. Okay?

And if you remember the gas chromatogram with all the nice little peaks and things like that, the gasoline-range fraction is the fraction that comes off the gas chromatogram between C6, which is n-hexane, and C10, which is n-decane, something of that nature. Those are two peaks in that pattern. And so from -- We probably ought to go back to that. So that as we take a look at the overall pattern of a -- Yeah, that one.

You know, the stuff that's on the left, the light-end stuff, is essentially gasoline. Okay? The stuff immediately to the right of that is kerosene, and to the right of that is essentially diesel fuel. Okay? To the right of that is oil, the things listed -- things in terms of motor oil. And then beyond about C40 you're talking about asphalt, asphalt-type materials. Okay?

And so there's been a move to -- ah, thank you -- so there was a move to -- I bet you'd tell me how to turn this on.

DR. SUBLETTE: Press the clip.

MR. HISER: Press the clip.

THE WITNESS: Clip?

DR. SUBLETTE: Yeah, just make contact with the --

MR. HISER: Try not to shoot the Chairman.

MR. PRICE: There's a risk associated with that.

CHAIRMAN FESMIRE: Why did you single me out?

(Laughter)

THE WITNESS: In Dr. Sublette's slide, he had -- benzene essentially was in this area here. This is the gasoline range, right along in here. Okay?

Let's go back to the other slide. Okay?

So as a result, the 8015 method is used because it gives that nice chromatogram. You start to see where the C6 is and see where C10 is, and so on. You can start to separate the total TPH pattern into subfractions that are equivalent to gasoline; diesel, which is a combination of kerosene- and diesel-fuel-range hydrocarbons; oil, which is about C28 to about C40; and asphalt, which are chemicals that are above C40. Okay?

Again, as you go from gasoline to asphalt, you're getting larger molecular-weight materials, very -- and as you can start to imagine, asphalt is pretty tarry and doesn't -- it barely flows in atmospheric conditions, and you can imagine what it does when you try to put it in dirt. So -- but these are some subfractions of what we call petroleum hydrocarbons or TPH. Okay? I've used the term TPH-GRO, but I probably will just talk about gasoline-range organics or diesel-range organics. This is what I'm talking about.

So one of the questions that I have is, you know, what is the TPH that we should be measuring? Okay? And that's really determined by the regulatory objective. Okay? There are times when we're looking at TPH as a way to evaluate the effectiveness of bioremediation. Okay? And we already know that it's the small ends that the bugs prefer. And so it's the BTEX, you know, which is in the GRO fraction, the gasoline-range fraction, it's naphthalene, which is just at the very beginning of the diesel-range fraction. Okay?

And so here are some subsets of what we call TPH that appear to give certain data that are better than just saying, I'm going to look at TPH total, the total pattern there. Okay? Because when we're trying to look at remediation, biological remediation, biodegradation, it's that GRO and our DRO. And we know that GRO also volatilizes out, so we'll have some losses from that. But at any one point we can take a look at those two measures and get a pretty good idea of just where we stand in our bioremediation process. Okay?

And so that pattern that Kerry showed, where you could take a look at what -- DRO, for example, you could take a look to see the initial decrease as the small fractions of the DRO get metabolized and degraded, to the point where you start to get higher, more complicated constituents that aren't degraded effectively. It plateaus off, bioremediation endpoint. Okay?

But GRO-DRO, I think, are better measures for -- I'm not familiar with the field techniques that he had, so I can't really comment on the field kits, but they sound like they probably are pretty good too, from what he was saying.

In any case, how do you measure and what are you going to measure? Really depends upon the regulatory objective that you're trying to address.

I was going to go into some more detail there, but I think that that's probably not important.

The first bullet there probably is out of place, but I wanted to make sure that I also address that question about what is a level of total petroleum hydrocarbon that really didn't cause concern from everything that I've seen. I've also used that 1 percent or 10,000-milligram-per-kilogram, 10,000-part-per-million, level. And the reason for that is that when I reviewed the scientific literature, there were a large number of studies that indicated that you could have 1 percent TPH, total TPH, in soil and really not affect either plant growth or groundwater quality. Okay?

Now in those studies they also -- there were some studies that talked about 3 percent, 30,000; 5 percent, 50,000 p.p.m. And we've heard some of that discussion earlier.

But I've used, you know, 1 percent here, 10,000, simply because that is consistent. And I have to tell you that the literature is deficient in that it doesn't give us a whole lot of detail as to whether that crude oil that they're talking about is a heavy crude or a light crude. Okay? So we don't have detail like that in these publications.

As I mentioned, the constituents of greatest concern from a toxicity and an environmental migration perspective are so-called BTEX compounds, these small aromatic things. Benzene, toluene, ethylbenzene and xylene, as I mentioned, are in the gasoline fraction. Naphthalene is in that -- is the lightest -- one of the lightest aromatics in the diesel-range fraction.

They are of concern because they are, in fact, volatile. Of course, that's also one of the advantages for biotreatment or landfarming. They're water-soluble. Hm. Potential posing of risk to groundwater, potential posing to groundwater being used in a shower, being used for cooking, being used for irrigation, being used for taking a bath, being used for drinking purposes. They're bioavailable.

And Dr. Sublette has talked about bioavailability as being an important determination as to whether or not a chemical can be absorbed by these bacteria, metabolized, I guess, as food, and then essentially destroyed.

Bioavailability is also important, from my perspective, because it also determines how much risk it poses to human health. These are small chemicals, well absorbed, easily absorbed, both by bacteria and people and animals. And as a result, they were things that I would focus on, and was also focused by the regulatory agencies who develop things like landfarming. Okay? These were the issues of concern.

Q. (By Mr. Hiser) And so Dr. Thomas, then, if we turn to landfarming, Dr. Sublette presented a number of studies showing that the toxicity tended to be addressed. Can you explain a little bit about the mechanism of how the landfarm actually addresses that toxicity?

A. Yeah. Yeah, I think it's important to have a visual image of what's really happening in landfarming. We're taking something like oil- -- hydrocarbon-impacted soil, and we're putting a layer of, let's say, six or eight inches -- inches of landfarm. Okay? This is our -- this is our treatment area that we've been talking about, this is the stuff that we're concerned about. Okay?

It's interesting to hear studies -- or hear a debate about whether 24 hours for water permeability or 72 hours is an issue, because I think that if you have a rainfall incident at your house, it's not going to take 24 hours for that water to soak into the ground. So for practical purposes, the water is going to go through that, it's going to penetrate through that 8-inch layer and go down deeper.

And that was one of the concerns that we had, you know, identified in the industry group where we early on started to say, Well, we're going to have some levels. I mean, it doesn't matter, because it's going to be remedied there by the bugs also, or it's going to be lost by volatilization. We already know that. I'm just looking at the water data and the salt-migration data. You see that volatility is an important factor.

But from the regulations as proposed, this is going to give us a real problem, because we may actually have to stop all the different things, institute remedial action, and the question is, Is that really important? Is it really necessary? Or is this just a part of the design of landfarms and what actually happens in a landfarm?

We can say that no release beyond the treatment zone, beyond our contaminated or impacted soils, but that's not going to happen. We're going to have some impact down there. It will be remedied, or it will be lost by volatilization, but it's quite possible that we'll see hits above the criterion. So is that criterion appropriate? Is it achieving what we really want to do? Are all questions that I think are valid questions.

So you've got this 8 inches of soil, say, in the landfarm. The operator is going to till it. And he tills it for a couple of reasons. One is, he wants to get that inoculum of soil bacteria well mixed into the hydrocarbon impacted thing. Without the bacteria, you don't have things.

Now the impacted soil also as bacteria but, as Kerry mentions, it's the stuff that's already in the soil that may have been acclimated, and there's a reason to till it and incorporate it in some clean soil that contains these acclimated bacteria and fungi.

Wait a minute. We've just taken clean soil and mixed it with our dirty soil. We have actually diluted our sample. We have diluted the TPH that we're about to measure. What is our hydrocarbon loading thing? Oh, well that's that concentration in the soil we're carrying before it's even accepted into the landfill. Wait a minute, we just diluted it. Boy, aren't we good? We've actually treated it from day one, and have got a decrease in our TPH, whatever our TPH criterion is. Okay?

Well, wait a minute. We're going to add organic matter and we're going to add water and moisture and nutrients, if they're needed. Hm. I wonder if that organic material is oak leaves and pine needles. Wait a minute. All that good stuff we just did from dilution, we've just undone with our organic matter. Start to see the complex- -- This is not as easy a problem as it's presented in many cases.

So when I take a look at landfarming, the real purpose of landfarming is to make sure that we promote the growth of micro-organisms that naturally and preferentially metabolize these small aromatic constituents, the ones that are toxic and of concern, as BTEX and naphthalene. And we have the data that says that when you do landfarming and you get bioremediation, the toxic constituents are destroyed and toxicity is eliminated.

So let me kind of re-frame this. So we've got the toxic BTEX and naphthalene eliminated. And we've got residual hydrocarbons that are really not effectively bioremedied. Essentially, they can sit there for years and years and years, and nothing's going to happen to them. Okay? Practically. We've reached that plateau.

But the data says that whatever these hydrocarbons are -- and we know from the analyses that we've done that these are larger, higher-molecular-weight constituents of the DRO fraction, they are the oils and they are the asphalt fractions that are constituents of the crude oil. Okay?

These things -- we also know from our studies that they're non-toxic. They are essentially -- because they're such big molecules, they're poorly soluble. They're certainly not volatile. And they're not environmentally mobile, because they're not soluble and they're not mobile. Okay?

These are the things that tend to adsorb to soil particles, tend to form complexes with the organic material in the soil, tend to form -- or accumulate in the crevices of the soil itself. They just sit there. Okay?

Q. And so, Dr. Thomas, then, is it safe to say that this represents the consensus of toxicological opinion in the United States, that these longer-range -- longer-chain hydrocarbons will not be a toxic concern?

A. Yeah, it's more than just the toxicological community, all the environmental scientists will agree that this is what's happening. And when they review the scientific literature, these are the conclusions that they reach. Okay? This includes EPA, it includes the other state agencies, it includes Indian lands, environmental agencies and so on, who develop risk based approaches.

So as a result of all this, the residual hydrocarbons that are in the soil after landfarming essentially pose no risk to health, they pose no risk to fresh water, they pose no risk to environmental receptors. Okay? They don't go anywhere such that there is a complete exposure pathway. Okay? Or if there is a complete exposure pathway, the hazards that are presented are not significant.

So as I look at all the data, it's my opinion that landfarming is an appropriate, and it's also a very cost-effective way, to treat hydrocarbon-impacted soils. It's probably the most efficient and effective -- cost-effective way to treat it and to remove the toxic elements, such that what's left ceases to be a concern from my point of view. And the question is whether OCD has other issues that they want addressed as part of their Rule.

Q. Let's talk about condensate, then, which is another compound that's commonly found in New Mexico.

A. Yeah. As Dr. Sublette mentioned, condensate -- the old name for condensate was natural gasoline, because it contains the constituents that are found in the gasoline fraction, gasoline-range organic fraction, and a smaller amount of the diesel-range organics, primarily from the kerosene-range part of that DRO fraction.

Again, the levels here, however, this is a -- these are volatile things in the ground that come up with natural gas, are condensed or exist -- or form a liquid at atmospheric conditions, but it's essentially gasoline. And because it's essentially similar to a distilled fraction of petroleum, these BTEX and naphthalene can be substantially higher in the relative mixture. Okay? Benzene, for example, was estimated to be as high as 3.6 percent by weight.

So the landfarming, as I mentioned, is an effective way to treat these low molecular weight -- lower molecular weight materials. They certainly eliminate BTEX and naphthalene. And as a result, whatever the residual hydrocarbon from condensate is, the data says it's non-toxic, poorly soluble, not environmentally mobile, does not pose risks to the -- health, fresh water or the environment.

Q. What other constituents might we find in materials in New Mexico?

A. Well, the constituents in crude oils are pretty much the same. They differ in their absolute proportions -- or their relative proportions and their absolute concentrations. The n-alkanes that are present in the dirty crude that we saw are also present in the San Joaquin Valley crude that we saw, but the other materials where higher concentrations and/or overlaps became more and more difficult to deal with from that gas chromatograph. Okay?

So the answer to your question is, hundreds of chemicals, if not thousands of chemicals, have been identified in crude oils. They're in all crude oils, but they just differ in their relative amounts.

Did I answer your question?

Q. You did.

A. Okay. Let's talk about sodium chloride.

Chloride has been mischaracterized in this meeting. As Dan Stephens talked about, chloride ion really is highly soluble in water. And when it's used by environmental scientists, it's really used not as a measure of a toxic material; it's used as an indicator of water migration. Okay? And as you listen carefully to Dan's presentation, he was using it as a measure of just where the water is going, and how deep and how fast and so on.

Toxicity of chloride salts is more related to the metal that the chloride is bound to, you know, rather than to the chloride. And so from a toxicological viewpoint, the conclusion is that chloride itself really is not toxic at levels that we've tested, and that can be pretty high, you know. So it's the sodium in sodium chloride that to a large extent determines its LD50 of 4000 milligrams per kilogram.

Q. LD --

A. Now that probably doesn't make -- that number and that expression doesn't make any sense. But this is kilogram body weight, first of all, so they assume a hypothetical man, for example, weighs 70 kilograms, about 154 pounds. Okay? It would take 70 times 4000 milligrams to kill half of the men of that size. So hypothetical receptor.

Q. And so to ask the Chairman's question for him, LD50 stands for what?

A. Sorry, lethal dose, 50 percent. So that if you give it to a certain number of receptors, the lethal dose that will result in the death of half of them is 4000 milligrams per kilogram bodyweight.

I'm glad you're looking out, when I use a term of art that may not be familiar.

The fact that chloride -- chloride in solution is an ion, a negatively charged ion, a Cl^-. Okay? The metals, however, are positively charged. So sodium 1^+ and calcium 2^+ and all that sort of thing.

Dr. Stephens -- in fact, we may -- go to the slide.

Dr. Stephens modeled the vertical -- the downward migration of chloride from a hypothetical small landfarm that had been sited according to OCD criteria. And what his model showed -- The models that he selected were the same ones that had been proposed by OCD staff, but the models that he used started to look at the vertical migration.

And the conclusion was that vertical migration, under the conditions and using the parameters and assumptions that were incorporated into the model, vertical migration is slow, hundreds of years.

And I might mention a couple things. He talked about a chloride bulge. Okay? A certain distance below the ground surface, that chloride just seemed to be increased. Okay? And the models that he uses are regulatory models. They're designed to be health-protective. Early on, regulatory agencies decided, you know, if we're going to make a mistake, we're going to make a mistake on the side of health. Okay? We're not going to make a mistake such that people could be hurt. Okay?

So the regulatory models are designed to be conservative, to overestimate exposure, to overestimate impacts to groundwater and so on.

The models that he used have no upward migration, only downward migration. Okay? And according to the models, at some point chloride is going to reach the groundwater. That's the assumption in the model. Okay?

So the chloride bulge poses an interesting problem, because -- and it's controversial, I have to tell you. There are people on both sides of the issue. But as best I can determine, the chloride bulge results because the upward movement of water balances the downward movement of water, and the water in the area in the middle become saturated and the chloride and the sodium start to precipitate out of solution. Chloride bulge. Okay?

This model would never predict a chloride bulge, because it's only the downward -- Okay?

Now there are probably areas in New Mexico where there -- the downward migration of water through the soil column is essentially complete from top to bottom, there is no vertical migration. Okay? But I just wanted to mention the fact that the models that he's using is a regulatory model, conservative, often used for a Tier 1-default-criteria-type calculation. But it doesn't necessarily mean it's the real thing.

In fact, this entire risk process, I should tell you, has a lot of assumptions that are not realistic. Okay? Early on when EPA developed these things, they found that they could say -- and issue press releases that says, EPA says that benzene is going to kill 2000 people in the United States in the next years, and we just posed regulation that's going to save 80 percent of them. Okay?

And there was a lawsuit from one of the environmental groups. EPA won.

But in the decision, Robert Bork -- you may remember from the Supreme Court hearing -- Robert Bork issued a statement that said, you know, EPA, your job is to make sure that health and the environment are protected, there's an adequate margin of safety for health and environment. He says, you know, it's really nice of you to tell us what -- all these 10^{-6} cancer risk numbers and things like that, but what we really need you to do is define what a safe level of exposure is.

Oh. So suddenly EPA got more interested in not just generating an abstract, hypothetical, 70-kilogram-man-type model. Okay? What they started to do was now take a look more carefully at the assumptions in the models that are used. Just how conservative are they? Are they overly conservative? And so on.

And I mention that so that you don't get the impression that these risk models are a true estimate of actual human health risk, actual human environmental risk or anything like that. It's a decision tool, it's designed to think through the issues in a standard, consistent way that everybody understands.

It may not be perfect, but this is the way we think through it. And it allows us now to identify, in rank order, the issues. Okay? But don't estimate -- don't think that this is designed to give us a real estimate of actual human health and the number of people that are going to die from cancer.

Let's go on.

Now Dr. Sublette talked about the soil ecosystem, and he talked about the biodegradation -- well, he talked about the -- soil ecosystem, and that is truly a system, not a single specie of bacteria that does all the work, but it's the population of micro-organisms in the soil that really does it.

Any perturbation causes a re-balancing of all those different species. Okay? And as a result, a re-balancing of the ecosystem. So adding oil to soil will cause a re-balancing. Having sodium in the ecosystem will cause a re-balancing. And this is just a standard of -- well understand -- adjustment and modification and a response to an agent that perturbates.

So petroleum hydrocarbons, water, fertilizer, salt, all these things cause perturbations, and we see changes in the ecosystem as a result.

Dr. Sublette pointed out that biodegradation as a process for petroleum hydrocarbons occurs even at salt concentrations -- or chloride concentrations, if you want to express it that way -- of 5000 parts per million and more. Okay. That it's a perturbation, but it doesn't necessarily kill everything. And he made that point quite clear.

So that there are -- phytotoxicity is not expected, for example, when you have an electrical conductivity of less than 4 millimhos per centimeter, or whatever is appropriate or may be appropriate for that specific and unique site.

Industry committee suggested that -- you know, agreed that a 1000-part-per-million Tier 1 limit would be acceptable for chloride. Okay? That, of course, was before they started to look at the same procedure that the OCD used, using the same models but now standardizing the input parameters. And using that same process that OCD used, the number came out not 1000 but came closer to 2000.

So in my opinion 2000 is an appropriate number. But it's something that, you know, needs to be addressed and understood as to what that number really represents.

Q. And so then, Dr. Thomas, you want to give us sort of an overview summary of the risks that you see, that the Commission should be concerned about as it evaluates this particular rule?

A. Yeah. You know, I think the evidence is pretty clear. Landfarming -- in the viewpoint of both me and other experts and the OCD staff, landfarming is an effective way to eliminate toxic BTEX and naphthalene, the toxic constituents of petroleum. Okay?

There are -- The residual hydrocarbons that are left after effective landfarming don't pose a risk in a risk based decision process. That is, they are protective of -- they don't pose a risk to health, fresh water or the environment.

Biotreatment of soils is great, because it means that the soils that remain, the stuff that contains hydrocarbons but they're really not toxic or environmentally threatening -- they don't need to be buried in a landfill forever. Okay? They can find beneficial uses and -- or be used or left in place. And that, I think, the real advantage is of the whole process here.

Like I said, when I started this process -- this project, I thought it was a real simple one where the good guys are going to win, because landfarming essentially gets rid of the bad stuff and it doesn't have to be put permanently into a landfill.

And I guess I should mention that landfills are not permanent? Okay? The design that OCD is proposing, according to OCD staff and the information that they've gotten from the liner people, the liners are probably good for 50 years, maybe more, maybe less.

What happens, now that you've depended upon an entire burial strategy of things that apparently are so bad and so of concern that you've got to bury it, as opposed to treat it or recover it? You've got to put it into this thing. What do you do in 50 years? And why do you do it?

Hm.

So, as I summarize this I think it's important to recognize that it's not the chloride, really, that's the toxic part of these salts. That's simply used as an indicator of water movement.

The industry committee has agreed to a Tier 1 chloride criterion of 1000 parts per million. And we've talked about that.

Let's go to the next slide.

Q. I think that really brings us, then, to -- from this risk-management perspective and as a toxicologist and environmental professional, what questions do you see that come out of the OCD regulations that the Commission should really think about as it considers how it wants to approach both the staff proposal and the industry counterproposal as it tries to reach a decision on what's best for New Mexico?

A. All right, let's go to the next slide.

I tried to get some examples of the problems that I was seeing. These are problems that I anticipate that OCD is going to encounter when they try to implement and/or enforce these regulations, and/or there are going to be problems that the Commission is going to be facing when you've brought a petition to give an exemption or to approve an alternative design, things like that.

So the issues -- or the questions and issues that

I identified was, TPH total; the 80-percent -- the requirement of 80-percent reduction of TPH total; questions about how you determine design equivalency; questions about metals; questions about DAF 1 versus DAF 20; criteria that are being selected for 3103 wastes. Okay?

And these are just some of the examples, and there have been other examples that have come up during the hearings today and yesterday.

Q. And so with respect to the TPH total issue, what's your concern and what's your recommendation?

A. Well, first of all, as I've mentioned and tried to point out, what you call TPH is really defined by the method that you use. And as a result, it raises the issue immediately of what are we trying to measure, and why are we trying to measure it? What is the most appropriate form of TPH, the most appropriate way to measure that TPH? Okay? What is our metric, in other words?

And then once we get the results, what do we do with it? How do we interpret that particular data?

As I look at TPH, one of the uses, as I mentioned before, is trying to evaluate the effectiveness of the bioremediation process. Okay? That, I think -- where GRO and DRO probably are the forms of TPH that are the most useful to make that judgment of effectiveness. So -- And that, of course, leads to that bioremediation endpoint.

Question about why TPH total? Because that's being required in the criteria based upon a total extractable petroleum hydrocarbon. First of all, the stuff that was left in the landfarm was not toxic, it didn't pose a risk to health or fresh water or the environment, either animals or plants. So what was the criterion?

And I guess Dr. Sublette also asked that very same question. He says, you know, is it because of discoloration? Man, when I look at the landfarms that have hydrocarbon there, the soil looks a lot like it was before it was contaminated. It doesn't necessarily discolor. But if it is discoloration or an aesthetic problem, hm, is that really a good basis to send this to a landfarm? Hm.

How do you interpret the results once you get it? Okay? How do we make sure that we're measuring petroleum hydrocarbons and not pine needles and oak leaves? Basic questions that I think have not really been addressed in the Rule here.

Q. What about with respect to the 80-percent reduction of the problematical TPH total measure?

A. Well, this has been addressed, or talked about, fairly extensively too. You know, as I first looked at this I said, I wonder where they got that 80-percent criterion? And having sat through all the discussion here, I still have no idea.

You know, it was suggested that, well maybe that's too high. Well, that's good. Are you that 70 percent really achieves your goals? Are you really sure that if you're concern is that this material, residual material, may have toxicity or present some sort of risk, are you really sure that 70 percent is a better number than 80 percent? How about 20 percent? How about 10 percent? What was your criterion? What are you judging? Okay?

So I guess that really was the concern I had, you know. We could leave it in the landfarm, but these materials will not degrade further. Okay? So landfarming -- why do we even go through it -- okay? -- if we're going to ultimately have to go into a landfill, just because we didn't get a full 80-percent reduction of TPH total.

So -- you know, it was pointed out that 40 percent -- according to OCD's data and survey, 40 percent of the liquids that are produced in New Mexico during that reference year, according to the Salinitro data and the other data, 40 percent -- might as well not even try to landfarm it, because according to their data, you're not going to meet that 80-percent criterion. 40 percent of the liquids produced in the State of New Mexico. Maybe 80 percent is too much to ask for. But why are we doing it in the first place? And of course, what was OCD's objective for that?

So these things -- same questions come up repeatedly. Okay? The questions are: What is OCD trying to accomplish? What is their metric? How do we interpret the results once we get them? Is OCD's criterion or standard appropriate, using that metric? Okay?

Over and over again, we came -- I kept coming up with these same questions that are unanswered in the Rule and have been unanswered in all the discussions we've had and all the hearings and meetings we've had.

A good example is design equivalency. You know, their BDAT approach essentially says no release is what we're going for.

You know, sometime in the future there's going to be some new technology or some new advance that somebody's going to want to propose to the Commission as an improvement.

We have no basis to say this is an improvement, because we don't know what the criteria are. All we know is that no release is the only thing that's acceptable. Okay?

Questions came up about degradation of natural resources. Hm. Is that better than degradation -- or some standard level that we have a comparison to, not-to-exceed sort of standard?

Well, degradation of natural resources could be defined, in the extreme, as one molecule above background. Is that what the agency mean? Two molecules? Ten percent? Fifty percent? A hundred percent above background? Ultimately, the agency is going to have to determine what that percent is, or what that criterion is. And suddenly we no longer have a degradation. Okay?

We may have -- because we now have a number not to exceed, because above that number we've degraded the natural resource. Hm. What's that number and what's it based on? Why are we doing it? How are we going to measure it? How do we interpret the data? And was it appropriate, the standards that we set? Why? Okay? And you start to see the questions that come up, and why the industry group would come up and say, you know, we've really got to address some of this stuff, because it just doesn't make sense. It doesn't make sense.

And it's not that the OCD staff have done a bad job. You know, working with them it's very clear they've worked extremely hard and they've done the very best they can do to develop a program.

What they don't do, they don't have the experience to say that we need the framework. To know where to put the muscles, we need the skeleton. Okay? And that's what risk based decision making does.

We talked about hydrocarbon, by the way, with design equivalency. But with a landfill we're talking about other things. And when these liners start to leak in 50 years, is our concern going to be the chloride releases, or is it going to be one of the 3103 materials? Is it going to be based upon concern about vegetation, or is it a groundwater problem? I don't know. And I suspect that if you really think about it, from your reading of the Rule, you don't know either.

Metals was another thing. You know, the metals are there for a number of different reasons. But -- Some metals are a natural part of -- they're constituents in petroleum. But a lot of the metals are there because this is soil. And soil impacts are the result of various geological processes, but essentially soil particles are insoluble metal salts. Hm. They're there as soil because they don't dissolve in the water.

So it's possible for sending this stuff -- Well, and I should say that if they're not soluble in water, in general these soils do not pose a risk to health, they're not bioavailable in animal systems, not in plants either.

Now that's not to say they don't contain some things that are soluble. There are some salts that are, in fact, soluble. And it's possible that the biological process here may digest and free up certain types of metals. But it's not total metal content that's of concern, it's the soluble metal content.

Just like with chloride, it wasn't total chlorine and chlorine salts that are perhaps insoluble. It was the chlorine concentration in the pore water, the water that's between the soil particles. That's really what the issue was. To get a soil concentration, we had to get -- do some specific manipulations.

So the question is, some metals -- salts -- are water soluble, and they represent a potential for groundwater contamination. They represent a potential for bioavailable -- if somebody eats the soil particle or drinks water that's come in contact with the soil particle, that is a leachate.

They are potentially toxic. Okay? They may be directly toxic because of direct ingestion or contact. They could be indirectly toxic. For example, accumulating in the fish that people eat, could be in the crops that people eat that use water for irrigation, and so on.

So the question then becomes, you know, what are the metals, which ones are of concern? Why are they of concern? How do we measure them? And so on. What do we do with the data? And so on. Okay?

OCD has adopted various soil screening levels from other agencies. And one question that I come up with is, are they appropriate? Do they really address the concern that we have with regard to what those metals can do and why we have to deal with them?

Even questions as simple as, Do we require whatever metal data that we get to be expressed on a milligram-per-kilogram wet weight or dry weight of soil? Because it will make a difference. Hm.

So my recommendation is that if you're going to measure metals, if they really are of concern in the biological and -- I'm sorry, the data that we've talked about today, the data from Louisiana, the data from EPA, the data from API, the data from the Gas Research Institute, have all looked at metal content, specifically both total content and also soluble or extractable, leachable content.

And the conclusion was that in all cases of metals that were analyzed, none of them were high enough concentration to be of concern from a health point of view. And I should say from an environmental point of view either. Okay? The levels -- the metals are not in a form that are bioavailable, in general.

So my recommendation was, if we're going to -- if we consider metals to be important and know why and what the pathways and so on, we should at least measure them as a leachate or an extractable metal, soluble metal content, not total.

Let's go to the next one.

DAF 1 and DAF 20 issues, I think, were adequately addressed by Dr. Stephens. You know, DAF 1 and the assumptions of DAF 1 are really pretty artificial. I mean, they are excessively conservative, excessively health protective or environmentally protective. And of the groups and agencies that do DAF calculations and say that these are the assumptions that you make, NMED says DAF 20 is their default. Not DAF 1 -- it's used for comparison -- but DAF 20 is their -- And as EPA said, you know, from the sites that they looked at, DAF 170 was -- covered the vast majority of their landfarms.

So we could use DAF 20 as a more reasonable default value for calculating Tier 1 criteria. We could use site-specific data.

We could read it from the chart. We have a landfarm this size, hm, use this DAF. Very simple.

DAF 1 appears to be overly -- overly conservative. Okay? And when I say conservative, for me it means that for a variety of reasons whatever is in that landfarm is not going to be in the landfarm long, it's going to be transported. One hundred trucks for a small landfarm of contaminated material was the estimate I heard yesterday. A hundred trucks of waste now going to a landfill because we have no other way to treat it, and it exceeds our criterion. Again, I hope our criterion is reasonable.

3103 wastes. You know, everybody agrees that these things appear in three reports, two from EPA and one from the TPH criteria working group. That was interesting, because things like PCBs are not natural constituents of petroleum. Chlorinated solvents are not natural constituents of petroleum. Acetone, not a natural constituent of petroleum. So where are these coming from?

And one of the things, when I went to take a look at the original reports, it's pretty clear that what happened was that EPA and the TPH criteria working group went out and they said, Hey, we want all the analytical data you've got on these types of materials. And they tabulated and compiled all the data.

We know from a lot of work in environmental -- from the environmental side, that a lot of times a solvent is used in the laboratory, and it miraculously appears in some other solvent that was being analyzed at the same time.

So I looked back at all the data from these sources and I discovered that it was a non-critical compilation of data. Okay? There are things there that -- you know, where they had some analytical data, they appeared to be so low as to probably be a lab contaminant.

Hm.

Ethylene dibromide, ethylene dichloride. You know, these were additives when gasoline was -- leaded gasoline was sold in the United States. These were lead scavengers in the lead package. Not a natural constituent of petroleum.

So I keep looking at this and I say, you know, some of these things I have no idea how they got into the sample in a report, and it appears in one publication but not the other one, or not this one over here. Okay? But -- you know, some of them I can't explain. But there are some that I think -- and I look at it and I say, you know, this is really not relevant.

Yeah, they're in the report, but there's been no critical evaluation of whether those materials are really relevant. And if they are, where are they in our Rule? If we're really that concerned about it, what are we going to do when we get a hit? Are you sure you want to do that? That's the problem that I keep seeing in the surface waste management rule.

My -- You know, I want to at least mention that the analysis of some of these things in 3103 -- for example, PCBs. One estimate that we got for an analysis of PCBs is about $1800 per sample, just for the PCBs. PCBs have a number of congeners, and they're reported in a number of different ways. It's a complex field -- almost as complex as crude oil. PCBs, $1800 per sample. Okay?

And many of these things, as was pointed out by Dr. Stephens, the proposed criterion is lower than the laboratory can reliably quantify. It's below the PQL. Okay?

Again, are we sure that this is an important issue for what we're trying to accomplish here, especially because they're really not allowed in a landfarm? They're not petroleum hydrocarbons.

My recommendation: Delete the 3103, or at least evaluate them and determine which ones are relevant and appropriate.

MR. HISER: Mr. Chairman, I see that we are like a minute and 40 seconds until seven o'clock, which is the hour that you had appointed, and I think that Dr. Thomas is probably within 10 or 15 minutes --

THE WITNESS: Probably less than that.

MR. HISER: -- or less, from the end of his direct testimony. And I guess I'd put it at the pleasure of the Chair and the Commission as to whether you want to try to finish him up on his direct right now, or if you'd like him just to cover this last little bit tomorrow morning when we meet.

CHAIRMAN FESMIRE: Well, there are a couple of people I'd better check with, one of them being the Commission members.

Do you all want to continue to the end of Dr. Thomas's direct testimony?

COMMISSIONER OLSON: I wouldn't mind finishing tomorrow, if that's something I could get you to --

CHAIRMAN FESMIRE: We've got to quit early tomorrow.

COMMISSIONER OLSON: I know. You think about 10 minutes, then?

THE WITNESS: I think at most. I could rush through it.

CHAIRMAN FESMIRE: Well, I've also got to check with my car pool.

(Laughter)

MR. HISER: That looks like a pretty stone face there.

(Laughter)

CHAIRMAN FESMIRE: Well, it's not as important as I once thought. I'm driving today, so --

(Laughter)

CHAIRMAN FESMIRE: -- let's go ahead and finish the direct testimony if we can.

THE WITNESS: All right.

MR. HISER: Thank you, Mr. Chairman.

THE WITNESS: All right. In that case, let's talk about the risk based decision approach and put it all together.

You know, like I said, I come across with similar questions over and over and over again as I read the Rule as proposed. The questions are really -- actually very simple. Okay? But they're easy to miss if you don't have a formal way to think through the issues.

My experience has been that risk based decision making provides really a great framework for developing regulations. The questions again are, what is our concern? What is our metric? How do we interpret the data? And what is the best regulatory action to take in order to address that issue?

The tiered approach -- These slides you've seen before, so I don't need to go over them again. But the tiered approach allows both the operator and OCD staff greater flexibility than BDAT in dealing with the unique differences between sites.

It doesn't say that a site -- that you have to do Tier 2 or Tier 3 by requirement. It says that there are certain situations where the operator may choose to get the additional data needed for Tier 2, or a whole lot of data, a very expensive program, needed for Tier 3. Okay? But once that data is collected and the process is gone through, there is a technical basis to justify or to deny their proposed alternative criterion.

Q. (By Mr. Hiser) And so is it your understanding that however inexactly that the industry committee's proposal -- which has a Tier 1 sort of cookie-cutter approach; followed by a Tier 2, somewhat more site-specific, and then the subpart K, sort of open-ended Commission exemption -- roughly reflects the tiers that you have here in terms of its concept?

A. I think it's better than the OCD version. But quite frankly, the industry hasn't given thought, either, to all the issues and the process of a risk based decision making effort.

Q. Okay.

A. So I -- it's better, but I don't like it yet.

Q. I'll take better, I guess --

A. Because --

Q. -- and leave it at that.

(Laughter)

A. -- the last time I worked for this group --

(Laughter)

Q. Moving right along.

A. All right. Well, so the risk based decision making process is logical. Okay?

CHAIRMAN FESMIRE: See previous dancing analogy.

(Laughter)

THE WITNESS: It's consistent, and it generates data that -- and opinions and things like that, that are technically defensible, which I think is really important.

Next slide, please.

Risk based decision making also is transparent. Like I said, when fully documented, everybody knows what the issues are. Everybody knows why we're selecting certain types of chemical analysis, everybody knows why -- the receptor and the pathways and things like that, so that they can start to make judgments as to whether or not it's worthwhile to develop a Tier 2 approach, or even a Tier 3 approach, even knowing that it's very, very expensive to go through those kinds of exercise, because it's going to require review by OCD staff.

But it's a paper review, to a large extent. It's a paper review. There may be issues that require decisions at the Commission level. Okay?

But once the system is set up, once the basic forms that are needed to be submitted are created, once it's clear to the regulated community that not only do I need the data, the value, I need the supporting documentation and this is what it is -- okay? -- once the laboratories understand that this is a new ballgame for oilfield waste, then we're all in better shape, because now we have a clear understanding of what our issues are, and we know why we're doing it, and we can do it in a very efficient, effective way.

Imagine, you're going to get 15 million different formats for your report. And it may be broken up into this operating plan and this management plan and this response plan and -- Okay?

Imagine how much review time you've got with unformatted, unstandardized report formats, unstandardized data requirements. Imagine how complicated it is to submit one of these things when you don't know what the issue is. Okay? You're starting to recognize why it's more manpower-intensive to deal with the BDAT approach, as opposed to a more formalized, risk-based approach.

So like I said, the risk based decision process initially looks more complicated. It's not. Once you start to actually go through it and you start to get comfortable with the steps that are involved in the risk based decision process, it becomes very simple and straightforward. And I think we'll be a lot more efficient than the ways that this current Rule is going to be implemented.

The other thing that I might mention is that the risk-based process also deals with questions of uncertainty. It tells us, and it very specifically says, you know, this is something we know and is well supported in the literature, and this is something that it's going to take us some time to get used to, and this is the reason why. Okay? But it deals with uncertainty specifically. Okay? So that, I find, is a useful discussion.

So as a result of all that -- We can go on.

The end of my presentation. I think -- and it's my bias, but it's also my experience and the experience of agencies around the world, including at least 26 in the United States -- that risk based decision making process is a valuable tool, and I think OCD should embrace it.

Q. (By Mr. Hiser) With apologies to the Chair and members of the Commission, a couple of just housekeeping things that we need to do.

Dr. Thomas, is Industry Committee Exhibit Number 7 a report of your academic credentials and work experience?

A. Yes.

Q. And is Industry Committee Exhibit Number 8 the slides and exhibits which you prepared and which you've used during this presentation?

A. I believe so.

Q. And Exhibit Number 9, then, is a report that you prepared using materials that would commonly be used by an expert in your field in preparing materials for testimony of this nature?

A. Yes, and it also gives references to support many decisions, I think.

Q. So that also provides additional details, should the Commission or Commission staff wish to consult it?

A. Yes.

MR. HISER: Then Mr. Chairman, we would move the admission of Industry Exhibits 7, 8 and 9, which is essentially the report, credentials and exhibits from Dr. Thomas.

CHAIRMAN FESMIRE: Is there any objection to the admission of those exhibits?

MR. HUFFAKER: No objection.

CHAIRMAN FESMIRE: Seeing no objection, we'll admit Exhibits 7, 8 and 9 for the industry committee.

MR. HISER: And we will pass the witness.

CHAIRMAN FESMIRE: Okay. At this time, we're going to go ahead and continue this case until eight o'clock tomorrow morning in this room. Let's just say the dress will be informal. It's going to be just hot.

We are also going to continue Cause Number 13,589, the Application of Duke Energy Field Services, L.P., for approval of an acid gas injection well until tomorrow.

We expect tomorrow to go, like I said, from eight o'clock until noon -- noonish, and adjourn.

The next time we will meet on this cause will probably be on the 18th, and I anticipate at least one day after that. 18th at nine o'clock in the morning, just so we can get complicated.

(Thereupon, evening recess was taken at 7:09 p.m.)

* * *

CERTIFICATE OF REPORTER

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

I, Steven T. Brenner, Certified Court Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Commission was reported by me; that I transcribed my notes; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL May 20th, 2006.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 16th, 2006

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:

APPLICATION OF THE NEW MEXICO OIL CONSERVATION DIVISION FOR THE REPEAL OF EXISTING RULES 709, 710 AND 711 CONCERNING SURFACE WASTE MANAGEMENT AND THE ADOPTION OF NEW RULES GOVERNING SURFACE WASTE MANAGEMENT

CASE NO. 13,586

ORIGINAL

2006 MAY 25 AM 8 51

REPORTER'S TRANSCRIPT OF PROCEEDINGS

COMMISSION HEARING

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

Volume V - May 6th, 2006

Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Commission, MARK E. FESMIRE, Chairman, on April 20th-21st and May 4th-6th, 2006, at the New Mexico Energy, Minerals and Natural Resources Department, 1220 South Saint Francis Drive, Room 102, Santa Fe, New Mexico, Steven T. Brenner, Certified Court Reporter No. 7 for the State of New Mexico.

* * *

C U M U L A T I V E   I N D E X

April 20th-21st, May 4th-6th, 2006
Commission Hearing
CASE NO. 13,586

* * *

(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

APRIL 21st, 2006 (VOLUME II):

(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

(Continued...)

C U M U L A T I V E   I N D E X   (Continued)

(Continued...)

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MAY 6th, 2006 (VOLUME V):

(Continued...)

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(Continued...)

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NMOGA	Identified	Admitted
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Additional submission by the Division, not offered or admitted:

	Identified
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* * *

Additional submission by NMCCAW, not offered or admitted:

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Letter of May 5th signed by Carr and Newman (industry committee), and Neeper	1398

* * *

A P P E A R A N C E S

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(Continued...)

A P P E A R A N C E S (Continued)

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By: ERIC L. HISER

* * *

ALSO PRESENT:

ALAN ALEXANDER (Burlington Resources Oil and Gas Company)
Industry Committee

BRUCE BAIZEL
Oil and Gas Accountability Project

JOHN BARTLIT, PhD
New Mexico Citizens for Clean Air and Water

DAVID BAYS (Williams Field Service)
Industry Committee

MARVIN BURROWS
Hendrix

CARL CHAVEZ
Environmental Engineer, OCD

THERESA DURAN-SAENZ
Legal Assistant, NMOCD

(Continued...)

ALSO PRESENT (Continued):

KARIN FOSTER
IPANM

DENNY FOUST
Aztec District Office (District 3), NMOCD

RAND FRENCH (Marbob Energy Corporation)
Industry Committee

DAN GIRAND
Mack Energy Corporation

RANDY HICKS
Randy T. Hicks Consultants

SUZANNE P. HOLLAND (ConocoPhillips)
Industry Committee

FRANK KRUGH (Marathon Oil Company)
Industry Committee

LINK LACEWELL
BLM (Carlsbad)

MARK LARSON
Larson & Associates

BILL MARLEY
Gandy Marley

KENNETH R. MARSH
Controlled Recovery, Inc.

MARK MATHIS
Citizens Alliance for Responsible Energy

MARK E. MILLER
Daniel B. Stephens & Associates

RAY MOXLEY
Chevron

DONALD A. NEEPER, PhD
New Mexico Citizens for Clean Air and Water, Inc.

(Continued...)

ALSO PRESENT (Continued):

DENNIS NEWMAN (OXY)
Industry Committee

LISA NORTON
Yates Petroleum Corporation

YOLANDA PÉREZ (ConocoPhillips)
Industry Committee

BRANDON POWELL
Aztec District Office (District 3), NMOCD

WAYNE PRICE
Environmental Bureau Chief, NMOCD

DEBORAH D. SELIGMAN
NMOGA

KELLIE SHELTON
Emerson

DANIEL B. STEPHENS, PhD (Hydrogeologist)
Industry Committee

KERRY L. SUBLETTE (Chemical/environmental engineer)
Industry Committee

FORREST B. (BEN) THOMAS, PhD (Toxicologist)
Industry Committee

GLEN VON GONTEN
Senior Hydrologist, OCD

* * *

WHEREUPON, the following proceedings were had at 8:00 a.m.:

CHAIRMAN FESMIRE: Let's go back on the record in Case Number 13,586. Let the record reflect it's Saturday morning, May 6th, at eight o'clock a.m. The cause before the Commission is 13,586. We were at a point where we were about to begin the cross-examination of Dr. Thomas.

MR. HISER: That is correct.

CHAIRMAN FESMIRE: Mr. Brooks, are you prepared to begin that?

MR. BROOKS: I believe that I am.

BEN THOMAS, III (Continued),

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

CROSS-EXAMINATION

BY MR. BROOKS:

Q. Good morning, Dr. Thomas.

A. Good morning.

Q. Well, I congratulate you, Dr. Thomas, it's obvious from your résumé and your testimony that you've had a very brilliant career.

A. Thank you.

MR. PRICE: You might say he also spells --

MR. BROOKS: Oh, Mr. Price wanted to point out that you also spell good.

(Laughter)

CHAIRMAN FESMIRE: It's going to be one of those days, huh?

Q. (By Mr. Brooks) I wanted to explore this approach a little bit that you have advocated, because I saw your presentation as being fairly general in a lot of respects.

You are advocating, as I understand it, that an environmental regulator should be asking only the question of, at what level will a particular release have adverse consequences to someone or something? And then on that basis you fix the regulation that is appropriate.

Is that the fundamental concept you're using?

A. That may be a little simplistic. I mean, that's part of the process I'm talking about.

You know, I used examples of the steps that -- in questions, receptor and all that sort of thing as an example.

What I'm really advocating is that the issue be thought of in a more formal process, so that we identify what the issues are, and then that could be an adverse effect on some receptor. But it could also be things -- I mean, the system is modified, but essentially what I'm just saying is that there's a formality of what the consideration should be for each type of issue, and that's really the approach that I'm advocating.

Q. Well, with toxicity you can, at least theoretically -- I say theoretically because not all the research has been done that could be done, right?

A. That's for sure.

Q. Although graduate students seem to feel that way when they're looking for a thesis topic. But you could theoretically, could you not, come up with a fairly objective, scientific answer if you take toxicity as your criterion for regulation. You could backstudy with all these models that we've heard about and say, Well, we've gotten to the level that -- of regulation that is necessary for this particular substance or component, because this is the lowest level at which it will have a toxic effect, right?

A. That's correct.

Q. So it becomes primarily a scientific inquiry?

A. In part.

Q. But --

A. Let me explain that. The reason why is because there are a lot of policy judgments that the regulatory agency creates. What is the target risk that's acceptable? How much conservatism or safety factor do we incorporate into dose that is toxic? You know, we don't want to, certainly, get right to that dose. So what kind of safety factor is involved.

Q. So --

A. It's not all pure scientific. There's a lot of regulatory policy and just common sense, professional judgement that goes into these sorts of things.

Q. So even if one accepts your -- even if one accepts your approach, toxicologist's approach to this thing, then science doesn't have all the answers; there's still a policy-making function involved?

A. Of course.

Q. But isn't there possibly a somewhat broader policy-making function? Let me suggest, for example, paper trash, office trash. And I understand there's biohazards involved with food wrappers, but office trash, what risk does that present?

A. You mean -- In my case, I find office trash is a real hazard for trying to walk around it and things like that.

(Laughter)

A. But you know, paper cuts, all kinds of things like that. But you used that example before. I think you're getting to --

Q. Yes.

A. -- to aesthetics and things like that.

Q. Right. Isn't that -- isn't aesthetics a value that people who are interested in environmental regulation are often concerned with?

A. Yes.

Q. For instance, with a very controversial topic in environmental regulation, mountaintop mining? That involves a lot of toxicity hazards to wildlife, right?

A. Yes.

Q. To fish?

A. Potentially, yes.

Q. Plants?

A. Yes.

Q. But when you really find out why there's so much opposition to it in a lot of places, isn't it not so much because of those things as because people like to see the mountaintops still there, so they can look at them?

A. Yes.

Q. So aren't we getting into an area of a whole lot of subjective judgment?

A. Could be.

Q. Okay.

A. Judgment is going to be required anyway, and all I'm saying is that that's a concern, and if the agency feels it's an appropriate concern then it should be part of the decision process.

Q. Very good. Okay. Now let me talk a little bit about best available control technology. And I may have misunderstood what you said, because -- well, what we've been using is BDAT, rather than BACT, so let's go back to our -- I have trouble with acronyms, I've tried to learn three a day since I've been --

(Laughter)

A. I called it BDAT.

Q. Okay. If I understood your testimony correctly, and correct me if I'm wrong, the only time when you feel that the BDAT approach is appropriate is if there either -- the BDAT itself is not -- well, no, let me back up.

The only time that I understand that you feel that the BDAT approach is appropriate to use is if even the BDAT would not give you the level of risk protection that you think is appropriate. In other words, there may be some activities that involve so much risk that you can't get down to an acceptable level of risk; is that correct?

A. Again that's, I think, simplifying my testimony. But I think what I testified to is that there are situations where BDAT is the appropriate action that should be taken, or policy that should be taken.

You know, the easy-to-see example of that is where you've got something that's really, really dangerous, and we need to essentially find some way to dispose of it in a way that people and animals and natural resources will not be adversely affected, and BDAT approaches may be appropriate for that.

There are situations where BDAT is the option of choice, perhaps not in terms of risk reduction, but the alternative actions pose so much more greater risk that this is the solution. Okay? But again, my basic message is that in order to evaluate that, you need to understand what the issues are not, because the landfill regulations and the things that are now likely to go into landfills, it's going to waste a lot of the valuable land to bury, permanently bury, is the idea. Okay. I think that there are better alternatives to that, landfarming being a fair example.

Q. Well, wouldn't somebody perhaps ask you if that is not a criticism -- so much a criticism of the BDAT approach as raising the point as to what constitutes the best demonstrated available technology? That is to say, if the best demonstrated available technology is over-using one of our resources, to wit, landfills, maybe it's not the best technology. Is that not one way of looking at it?

A. I think you could testify in my behalf.

Q. But other things equal, even if no substantial risk is presented, is there not a benefit in doing things better, if you can do them better?

A. It's possible. There are trade-offs in all decisions, and one of the trade-offs may be one of practicality, it could be one of cost-effectiveness, it could be, again, alternative risks that are raised because of the action. Okay? It doesn't necessarily have to be the risk associated with that particular decision. You know, reaching a toxicity endpoint, for example, may not be the criterion by which the decision is made.

Q. Thank you. Okay, let me ask you some more specific questions, then. You have done a lot of work on petroleum hydrocarbons, correct?

A. Yes.

Q. And we've heard testimony, some of it from you and some of it from other witnesses, that there are a very large number of individual substances --

A. Yes.

Q. -- that are classified as petroleum hydrocarbons, and they're usually found in mixtures?

A. Petroleum *is* a mixture.

Q. Yes, and you don't very often find -- unless it's been highly refined, you're not going to find one particular hydrocarbon. Even like a gasoline or a diesel is a mixture, right?

A. That's correct.

Q. Now the residual hydrocarbons that will be left in the landfarm after the bioremediation measures recommended by Dr. Thomas, these would be a certain group of hydrocarbons, right? They would have certain common characteristics?

MR. PRICE: I think you meant Dr. Sublette.

Q. (By Mr. Brooks) Dr. Sublette, I'm sorry. I'm sorry. After all Dr. Sublette's recommendations have been followed, you have a residual. That's going to be a group of hydrocarbons that have some common characteristics, right?

A. Correct.

Q. And some different characteristics?

A. I'm not sure what you're -- your question.

Q. Well, it's still going to be a lot of substances that are different in various respects within that mixture, are they not, even after the low ends are all remediated away?

A. Well, for the most part they're the same constituents that were present in the original material, crude oil or condensate.

Q. Could you give us any estimate of how many high-end hydrocarbons there are likely to be? How many substances are going to compose that mixture?

A. At different concentrations, you're going to have hundreds, even thousand compounds.

Q. Have there been any human health toxicity studies done on these high-end hydrocarbons?

A. Yes.

Q. And have you presented those results to us? I know we've heard the earthworm and microbe toxicity studies, but --

A. I didn't, but in my submitted comments I've provided a number of references that provide that kind of information. A lot of the work has been done by different industry -- different companies. They've been done by international laboratories, they've been reviewed by EPA. All these studies have been submitted to EPA, for example, under the Toxic Substances Control Act. They generally have been on refined products that the public would know as a kerosene, or an automotive diesel fuel, or crude oil itself, or things like that. So it's a pretty extensive body of literature.

The net result is, as I testified, the indications are that these high-end materials are low in their toxicity, by all the different types of adverse-effect endpoints.

Q. Okay, have they also been studied on -- effects on large mammals such as livestock or wildlife that might be in close contact with the land?

A. In some cases.

Q. But once again, you have not presented those studies?

A. I have not.

Q. Okay. Now the --

A. Let me correct that. I have not in my oral presentation. I have provided citations and references in the written comments.

Q. I know you've made some criticisms of the measure of total extractable petroleum hydrocarbons, but if it is measurable, if we assume it's measurable by alternative technologies that are being suggested, would that measure be valid as a marker for the existence of hydrocarbons generally that might be in any range?

A. That's what it's designed to do. It gives you an estimate of whatever -- depending on how the test is conducted, it would give you an estimate of what these mixtures of hydrocarbons are in total.

Q. Yeah, and is it probably the only non-specific test that's available?

A. No, there are a lot of non-specific tests available.

Q. For -- that would deal with hydrocarbons generally? Just --

A. No, there are a number of different methods. Yesterday oil and grease methods were talked about, 418.1 was talked about, 413 was talked about, and so on. Even

8015 was talked about, and that can generate a total.

Q. Well, my understanding was that 8015 was specific for a diesel range.

A. 8015 does an extract, and it gives you that gas chromatogram, that tracing all the peaks and so on, and you can actually get a total based upon what was extracted. Okay? But the utility that I saw was taking different parts of that chromatogram, the gasoline range organic section versus the diesel range organic fraction and so on.

Q. Okay.

A. But the peaks are all there.

Q. Okay, let me ask you a little bit about cumulative effects, and I go into this not so much because of hydrocarbons, because I understand your theory to be that these high-end hydrocarbons simply don't present a hazard. Is that your theory?

A. Did you want to be more specific with regard to exactly what you mean by cumulative effects --

Q. Well, I was --

A. -- and also by these hydrocarbons?

Q. Okay, let me back up. Let me ask -- I will go into the cumulative effects in a minute.

With regard to hydrocarbons, if I understand your testimony correctly, you're saying that the residual hydrocarbons, the ones that will be left in the landfarm, are not toxic, correct?

A. Very low toxicity.

Q. Okay, very low toxicity, but some. So you're not saying they don't present, in your terms, any hazard, just that they don't present any significant risk?

A. Well, they present hazards. I mean, at very high doses these will cause severe diarrhea, things like that. So I mean, there are -- I think it was mentioned before, generally, that anything can be toxic at high enough doses.

Q. Okay. Well then, let's talk also about the metals that -- you testified a considerable amount about the metals. There's no question that some of those have fairly significant toxicity if they're in large enough concentration, correct?

A. That's correct.

Q. In coming to the conclusion that these things did not present a risk in the landfarm scenario, did you consider the possibility of cumulative effects with regard to releasing these constituents into the environment, and other releases into the environment that might also be occurring of similar hazards?

A. I normally will do that as part of a risk based evaluation. That is an important thing that I think needs to be considered. It's not just an acute toxic effect but also the repeated exposure over an entire lifetime. Those sorts of things are evaluated. That's they reason why they develop risk based screening levels, because those are the issues, the exact issues, that are considered in developing those criteria.

Q. So you don't object to the idea -- you don't take exception to the idea of using risk based screening levels, even where very low -- even if they're very low and there's not a great deal of likelihood of a release? In other words, you don't object to -- Well, I need to be more specific here, because I'm asking a --

You would not -- if you felt we were using appropriate risk based screening levels, you would not object to using risk based screening levels for toxic constituents, even if you believed that they were not likely to be found in the landfarms in a significant quantity? Is that --

A. Well, that's kind of a policy decision. In concept, what I talk about as Tier 1 default criteria are these risk based screening levels. Okay? They're designed as, in fact, screening levels to make decisions.

You know, if you have a material -- or you have a material mixture that's put into a landfill, or maybe put into a landfill, or maybe in the environment, you compare against these Tier 1 screening levels as your first basic -- that's why they're called screening levels, is that --

to make a decision to make a decision as to whether that particular chemical is at high enough concentration to be of concern to the point where you need to have some sort of action taken.

Q. But I thought you took exception to the requirement of testing at all for these non-hydrocarbon constituents that are included in our list. Did I misunderstand you?

A. No, no. From the data that I've seen looking at metals and knowing that these other things are not natural constituents in crude oil, looking at the tabulations that were compiled by EPA and the TPH criteria working group and knowing that they were a non-critical tabulation, if it was ever reported, it was put in that list --

Q. And you -- yeah, I was going to say, you --

A. -- and because of those reasons, what I said is that if I had to give you a recommendation, I think that it's a waste of effort, both regulatory and in terms of expense and time and manpower and the industry, to require testing. Let's be reasonable as to what things we require companies to pay for, analytical data, and make sure that we know that there's a regulatory reason to submit that data, so the OCD staff have to review.

Q. Okay, let me then ask you -- I think I only have a couple more questions here, although my client is going through some things. He may have an additional question or so he wants me to ask you.

With regard to the chloride standards, did I hear you correctly on this? You said -- First of all, you said, as each witness has said, that the industry committee has accepted the 1000-parts-per-million chloride standard for the permitted landfarms, correct?

A. That's what we understand.

Q. But if I understood your testimony correctly, you understood that Dr. Stephens had developed a larger figure, even based on the five-acre size, and that was not my understanding of Dr. Stephens' testimony, so I wanted you to clarify.

A. Yeah, nor do I think that I mentioned five acres in my testimony. But --

Q. Yeah, I think you --

A. -- but essentially what I said was that the five-acre was an early estimate of what small landfarms would be proposed by industry. I think that their submission now involves something on the order two acres, and so that became more relevant to, you know, what the acceptable chloride concentration should be.

Q. And when Dr. Stephens evolved a number in the 2000 range, that was for the two-acre site size, was it not?

A. That's what I saw, yes.

Q. Okay. And --

A. The point was that what he did was, he now took two acres as the site size, or the unit size, he utilized the same procedure the OCD did -- that is, the same models -- but what he did, he standardized the input parameters; he didn't use different parameters in different models. Okay? And when he did that, he came up with a number closer to 2000 than 1000.

So I said, Well, okay, once you correct that procedure, you know, and get the right numbers for the appropriate-size landfarm, then it looks like 2000 would be a justifiable number. And I would think that the industry would say, well, if that's the justifiable number, then that's probably what they would do.

Q. Well, if --

A. My comment was that -- I can't speak for the industry, so I said that in my view, in my opinion, 2000 appears to be a more appropriate number.

Q. But that was for the two-acre size, was it not?

A. Correct.

Q. Thank you. Okay, speaking of the wastes that may go into landfarms, it is defined as petroleum-contaminated soil, correct? Predominantly petroleum-contaminated soil; is that correct?

A. Petroleum hydrocarbon, right.

Q. Yeah, petroleum hydrocarbon. Wastes generated in other phases of the oil industry, such as some refinery waste or oilfield service industry waste that resulted from spills, might be predominantly petroleum hydrocarbon-contaminated soils, might they not?

A. The answer is yes, if they are distilled from petroleum, then they would contain petroleum hydrocarbons.

Q. And those wastes that were not crude oil or condensate spills, they might well contain other constituents that you would not normally find in crude oil, might they not?

A. Correct. Now my understanding is that these would be RCRA wastes.

Q. Is that necessarily true? Would they necessarily be hazardous, under RCRA?

A. Well, I think that's a different issue.

Q. They would not be exempt, I agree with you, but would they be hazardous?

A. Well, my question is, why are they going into an OCD-regulated landfarm?

Q. Well, perhaps you misunderstand the nature of the OCD regulation. The OCD regulation extends to all phases of the oil and gas industry. Now we do not control the disposition of hazardous wastes, but we do control the disposition of non-hazardous, non-exempt waste.

A. Okay, I thought your hypothetical incorporated constituents that are possibly toxic additives, things like that, in these products that you're saying are spilled?

Q. That might be.

A. Why are they going into an OCD landfarm? If they are, in fact, RCRA-hazardous materials as you're hypothesizing, why are they going --

Q. Well, if they are hazardous -- if they are hazardous, they wouldn't be. But if they're classified as non-hazardous, they might, even though they weren't crude oils. But --

A. Well, it's probably because I don't know the -- in New Mexico, I don't know where OCD's jurisdiction ends and NMED's jurisdiction begins, it's probably --

Q. Very good --

A. -- a confusion.

Q. -- thank you.

If there were toxic materials in the residual hydrocarbon mix in the landfarm, would any hazards that they presented be reduced by -- if the TPH -- would they be lower at a lower TPH level than they would be at a higher TPH level?

A. Well, we don't need to talk in terms of hypothetical situations. What we have are analytical data and toxicological data that says that regardless of the constituents, the mixture does not pose a risk, it's not toxic. Okay?

So I mean, you can hypothesize that the concentrations are slightly increased when -- after landfarming and those processes are complete. But the results are, it's not toxic. And I don't need to look at an individual constituent to make that judgment, it's in the studies, in the literature.

MR. BROOKS: Okay, thank you very much, Dr. Thomas. And I believe that's all I have.

THE WITNESS: Thank you.

CHAIRMAN FESMIRE: Dr. Neeper? Or Mr. Sugarman? Whoever it is today?

(Laughter)

MR. SUGARMAN: Mr. Sugarman, and we don't have any cross-examination, Mr. Chairman.

CHAIRMAN FESMIRE: Okay. Mr. Huffaker?

MR. HUFFAKER: Nothing.

CHAIRMAN FESMIRE: Nothing?

Commissioner Bailey?

EXAMINATION

BY COMMISSIONER BAILEY:

Q. Your testimony consistently refers to landfarms, but you are premising this on bioremediated landfarms, or landfarms using bioremediation, aren't you?

A. Well, all landfarms have processes that are going toward the elimination of volatile materials and biodegradable materials. You know, what Dr. Sublette talked about yesterday was a really well-managed landfarming process.

But although I talk about landfarms, I'm not necessarily just talking about the bioremediation aspect of a landfarm. There's also volatilization losses, you know, and other processes that may go on, chemical conditions and chemical degradation that occurs, and so on.

Q. But you're not consistently talking about dry landfarming when you are making your statements concerning toxicity, are you?

A. Well, they do apply to dry landfarms as well. I mean, dry landfarms eventually -- maybe they're not very efficient, but they eventually will get rid of the volatile toxic, aromatic -- small aromatics.

Q. I'm curious about one thing -- several things. Just a small comment. When you talk about risk, is time not a factor? Because you've talked about levels, but you haven't talked about time as a factor in --

A. Yeah, in risk --

Q. -- petroleum --

A. -- we often talk about duration as a term of art.

But yes, it is a factor and it needs to be considered. I assume that your question has to do with duration of exposure.

Q. Yes.

A. Yeah, that's one of the factors that it's necessary to include. In one of my slides I in fact alluded to that because I said it's not acutely toxic, which refers to short-term exposure -- toxicity due to short-term exposure; chronically toxic, which means effects that result from repeated, long-time exposures over years or perhaps a lifetime; and then carcinogenicity, which is a slightly different process or adverse effect, but generally is thought to require long-term exposures, repeated exposures over a lifetime.

Q. Which leads me to the sodium chloride slides that you had. You say that chloride is highly soluble, but it's the sodium that is toxic.

A. Or calcium or potassium or magnesium or -- the toxicity really appears to be -- you can have the same chloride concentration but see different levels of toxicity, so it appears to be more related to the metal rather than to the chloride.

Q. Now is that for humans or is that for plants?

A. Both, both

Q. So you're saying --

A. -- and also animals.

Q. -- the chloride ion is not the toxic ion we need to be concerned about with re-vegetation?

A. Not from the toxicity point of view. It appears to be more dependent upon what specific chloride salt you're looking at. Okay?

Sodium -- I don't know how much chemistry you've had, but sodium is surrounded, I think, by about -- a shell of about 40 water molecules.

In medicine we talk about sodium as, wherever sodium is going, that's where water is going. And you start to realize that people who take a lot of salt in start to retain water, and as a result their blood pressure will go up, for example. So the body has a fairly careful way of controlling that sodium content of blood and body tissues. Okay? Because of that problem, that you'll start to actually swell because of water surrounding that -- essentially going with that sodium ion.

Q. So the chloride effect that we see on plants is due to a physical interaction, rather than a chemical interaction?

A. Well, as I think both Dr. Stephens and Dr. Sublette discussed, what you're really talking about is a solution of a salt. Sodium chloride, for example, would be the major one that I would expect in New Mexico, but -- a major one. And as I mentioned, the sodium tends to be surrounded by water molecules, and as a result it changes that osmotic pressure that allows water to get into the root of the plant.

So you are correct, the effect is primarily not toxicity, it's primarily sequestering the water in a form that's no longer available to the plant root. Essentially the sodium is competing for the water molecules.

Q. Okay. I am confused a little bit because your slides also show that the endpoint should be less than 4 micromhos per centimeter of chlorides.

A. Millimhos.

Q. Millimhos. Which is, as we've been told, an equivalent of about 500 parts per million of chlorides?

A. Yes.

Q. You're recommending up to 2000 parts per million --

A. Yes.

Q. -- of chlorides? And the only way to reduce that chloride concentration is through copious amounts of water to be applied to the -- plus hay, plus whatever else Dr. Sublette has in his --

A. Yeah.

Q. So in order to be effectively remediated for re-vegetation, it is essential that very large amounts of water be applied to any size landfarm, in order to effect effective re-vegetation; is that right?

A. Not necessarily. First of all, I was simply taking the testimony of other experts in making that 4-millimho-per-centimeter -- but that's not my recommendation *per se*.

But as we've talked about, or other witnesses have talked about, different plants have different salt tolerances. And in New Mexico, for example, there are a lot of salt-tolerant grasses and things like that, that the 4 millimhos is way below their level of tolerance. They can go much higher than that.

You know, the real message of my presentation was exactly what you're talking about -- okay? -- that there are a lot of things you can do procedurally and say, This is the criterion. Okay? In fact, that's essentially what we have, is a whole list of criteria that people have said, this is -- Okay?

And the point that I was making, I think, is the same point that you're making, that, wait a minute, if the concern is groundwater impact, then this is the appropriate criterion. But if our concern is re-vegetation, maybe we have a different answer. Okay?

And that's exactly the point that I'm trying to make -- okay? -- that these are the very things that a risk based approach, the framework that I'm talking about for the thought process, goes through and starts to -- because you're exactly right, it may be that we need a different number for New Mexico, but we haven't thought it through yet. And that number could be higher, it could be lower.

Q. I would like to point out that Dr. Stephens' testimony does include the use of rooting -- plant propagation does play an important rule, a very large factor --

A. Absolutely.

Q. -- in prevention of --

A. Absolutely.

Q. -- contamination of groundwater.

A. Absolutely, and that's exactly the type of discussion and thought process that I'm advocating here. Because these are not simple things, these are biological systems, and there are all kinds of different things that occur.

But until we really go through the process of thinking it through, we don't know what that number, the appropriate number, really is. Okay? We can give you best guesses based upon what we understand to be the issue of concern. But to integrate that is exactly what -- is exactly the questions that you're asking, or the right questions.

Q. Oh, and just on the comments on metals, you seem to discuss metals quite a bit. I'm just an observant backyard gardener, so I've seen the role of trace minerals and trace --

A. Absolutely.

Q. -- metals and the thriftiness of plants, where sometimes a petroleum spill could act as a fertilizer in adding necessary nutrients to certain types of plants, and other ways it may act as a toxic event, in overloading plants with certain of those metals or trace metals.

A. Probably not the metals in the toxicity that you're talking about. There's probably a physical sequestering -- or barrier for water and oxygen.

But you're quite right. And I'm not saying that metals don't have beneficial and adverse effects. They do. I mean, they're called essential trace metals for a reason. Okay?

What I was saying is that the Rule as written is advocating the analysis of total metal content, treating it -- taking a soil sample, treating it with a highly powerful acid so that every metal is now solubilized -- okay? -- and available now for chemical analysis. And the point I was trying to make is that, well, you know, from the biological point of view, it's the soluble metals that are beneficial and/or adverse. Okay? And so let's take a look at what we're really requiring here, and does it have real meaning in terms of regulatory policy?

COMMISSIONER BAILEY: Thank you for that clarification.

THE WITNESS: Thank you.

COMMISSIONER BAILEY: That's all I have.

CHAIRMAN FESMIRE: Commissioner Olson?

COMMISSIONER OLSON: Yeah, I just have a couple questions, Dr. Thomas.

EXAMINATION

BY COMMISSIONER OLSON:

Q. Are you implying that the Division's regulation is not based on risk?

A. No, no. What I want to make clear is, I'm not criticizing OCD and OCD staff for what they've done. I think that -- you know, having worked with the group now for a number of months, I can tell you they have worked extremely hard and have done a good job of giving advice and creating this particular Rule.

They have -- what I -- If I have a criticism, it's of the process. Okay? And it's the fact that they have selectively used risk sort of models, they have selectively taken risk based criteria from other agencies, they've done things like that. So in essence they have, in fact, considered risk.

What I don't see is the integration of the idea -- okay? -- and documentation of the thought process, so that the regulated community and the public have a good understanding of what they're proposing and why it's being proposed, why that number was selected -- okay? -- and have confidence that that number is appropriate. Okay?

For example, they've taken DAF 1. And although the public is not going to understand what DAF 1 is -- it's pretty artificial. When you go through the model and the assumptions of the model, it's really an artificial and, I think, overly conservative approach.

They've adopted risk based screening levels, residential screening levels. Okay? But if the concern actually was irrigation and crops accumulating toxic metals, for example -- okay? -- then that residential scenario is not the appropriate one to use. Okay?

So they have selectively used risk based approaches and parameters and so on. All I'm saying is that, you know, there's a lot that's not clear in the Rule as written, and I can't tell you what the group's primary concern was in a lot of parts of the Rule.

So it's a long answer to your question. The answer is, they have selectively used risk based approaches and risk based parameters and so on, but I'm still seeing a lot of holes that leave questions for me.

Q. Well, I guess there's a lot of selective use of parameters as well. I mean, it's a judgment call. The Division had developed an approach based on risk which I think they'd explained through a couple days of testimony, and I think -- the only difference I see is that there's some dispute over the actual parameters to be used, not that the approach is invalid in terms of looking at risk. It seems to be a dispute more over what numbers to use.

A. I think that's a fair comment. Like I said, the problem that I'm having is that the basis of their decisions do not give me a way to say that that number is, in fact, appropriate. You know, there are still so many undocumented possibilities that I don't know -- if I were trying to recreate a comment on any one parameter, I don't know what the issue was that said that that was the appropriate number to use, and as a result I wouldn't be able to issue comments on a specific parameter because I don't know what they were trying to protect against.

Q. So I guess I'd say at the same time, I've worked a number of risk assessments, and there isn't -- risk assessment is not an exact science, is it?

A. No.

Q. Okay.

A. No. And one of the points that I tried to make yesterday is that the value of the risk assessment is in the thought process -- okay? -- that at least we now have a way to set priorities and determine which issues need to be addressed and which issues don't need to be addressed so that we can better use our manpower.

But the other thing is that there's a section in the risk -- a formal risk assessment that talks about uncertainty. It says that these are the uncertainties that we have and what we know, what we don't know, and what we're going to accumulate data on to refine our regulatory approach.

And the third thing that the formal risk assessment does is that it deals with alternative risks. It says that, okay, this is the consequence of this particular thing, and it results in increased transportation risk and likely fatalities from traffic accidents, or perhaps exposures because an overturned truck at a schoolyard now has potential for exposing children to these material. And these sorts of things can be addressed and evaluated and put into perspective in the overall scheme of things in a consistent way. Okay?

But you're right, there's a lot of professional judgment, there's a lot of uncertainty. The models are not designed to predict actual health risk, for example, but they are a very effective decision tool, and that's why the system was developed in the first place, to help in the decision process.

Q. So I guess along the same lines, you've developed this tiered approach. And I think you were commenting that the OCD's approach was -- seemed too much like a cookie-cutter approach, but I see this seems to be also a cookie-cutter approach where Tier 1 is the same thing, it's just using different parameters. It's still the same cookie-cutter approach.

A. Oh, yeah, yeah. No, I mean, there are only certain options that the regulatory agency has --

Q. Right.

A. -- and all I'm saying is that other agencies around the world have found the risk based approach to be an effective skeleton to kind of guide that decision process.

Q. Because I guess I see that in the Division's proposal they do allow a mechanism for alternate proposals based upon site-specific information; isn't that correct?

A. That's correct.

Q. Wouldn't that be equivalent to, I guess, more along the lines of a Tier 2/Tier 3 approach that you're proposing?

A. Optimally, that's exactly what should happen.

Q. Okay.

A. But the problem is that the Rule as written is so unspecific on so many critical issues that coming in to the Commission for an exemption puts the Commissioners in, I think, an uncomfortable position of not knowing what the issue was that was driving that particular criterion that they're looking for an exemption for.

And as a result, it's asking the Commissioners to say, okay, that's fine, without having a good understanding as to whether they've just approved something that's going to be a serious impact that the OCD staff was trying to avoid.

Somewhere, I think, OCD staff have a good, professional understanding of issues and so on. It's just that the regulated community, you know, I think is at a disadvantage of coming in and providing the appropriate data to justify an exemption.

The process is there, and the process needs to be there. Okay? I'm just saying that there needs to be a little bit more specificity so that we know what kind of data are relevant to the issue, if we're going to ask you to make a decision.

Q. Well, I guess I just -- I guess on my side I just want to look at this. I don't see the same -- I don't see any -- much difference in the specificity in the Tier 2/Tier 3 approaches than what's in the -- what the OCD is proposing.

A. No.

Q. It's giving some generalities of issues that you need to address and not specifics.

A. I think you've having the same trouble with my testimony as I'm having with the OCD Rule -- okay? -- is that lack of specificity generates confusion.

If I perhaps can generate an example, the example that I would posit is some sort of new technology for a landfill design. Okay? And so if somebody has come up with a clay-based barrier instead of these films, and they think it has advantages because it's more permanent. Okay? And so they present data to you on saline and how saline is not going to penetrate this clay layer, and isn't this really great? Okay?

And so now the question is, is this an appropriate thing? And you don't -- and the Commissioners at the time are not aware that the primary concern here was not the salt; it was, in fact, a toxic material, perhaps a toxic metal. And there are no data that talk about the penetration of that metal through the clay. Okay? And so you're asked to approve this barrier, this new technology, based upon the data that were submitted, validly submitted, as an improvement. But because of lack of specificity, we didn't really understand that the concern for this particular landfill was metals, not salt.

Q. Well, I guess I've seen that throughout my 20 years of environmental stuff, that --

A. Yeah.

Q. -- things change over time as folks recognize new issues. And I think a lot of our issues with pits that have gone on over the years have been a real evolution, coming from unlined pits to single-lined and double-lined and et cetera. So I think that's just something that's going to have to come with time, I think, as we recognize more information is available that shows there's a problem with something.

A. That's true. And the point I'm trying to make is that it's possible to be very specific as to what information is relevant -- okay? -- before you're asked to make a decision.

Q. All right. And I guess one more thing. I was noticing in your slides you were referring to a Tier 1, Tier 2 and Tier 3 approach, but I don't see that in the industry's proposal. I see a Tier 1 and Tier 2 on my -- Is there a Tier 3 in there as well?

A. Yeah, I commented to the industry in their presentation, because I said, you know, that's going to generate confusion. Their tier number -- you know, I said can we change that to Class A, Class B or something like that, to get rid of that confusion? And it was a little late for that. They had gotten approval from their members for a certain terminology and so on. So I tried to emphasize that that's a little different than what they're doing.

Q. Okay, so if -- what the proposal -- it's just the Tier 1 and the Tier 2 approach, where the Tier 2 has more site-specific information; is that --

A. It's a little bit more complicated. I'm not sure I can deal with all of the technical issues associated with the industry comments.

I might mention that the three-tiered that I put up here is the approach that -- used by the regulatory agencies, developed by the EPA and the National Academy of Sciences, allowed a tiered approach to take into consideration more site-specific information.

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

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. Doctor, when you talked about the high-end hydrocarbons having a low toxicity, that didn't mean that they're benign? I mean, that doesn't mean that they have no effect on living organisms; is that correct?

A. That's correct.

Q. So if -- I was a little bit confused in your testimony where you might have been changing -- you made a statement that we have to remember that those high-end hydrocarbons are not toxic. You mean that they had a low toxicity, not that they were benign, correct?

A. That's correct. I should say that in my experience they have low risk, is really what I'm saying.

Q. Okay. Now you made some comments about the 50-year life on the liners and, you know, what we were actually accomplishing when we sequestered this material. And believe me, I share your concerns and I understand that.

But I want to combine your testimony with Dr. Stephens', with Dr. Sublette's. And we started talking about, you know, limited releases to the waters, especially in Dr. Stephens' testimony, and we didn't with that release bring it up to the water quality standards. Is that your understanding of what was testified to? In some of the modeling.

A. Didn't bring it up to --

Q. Didn't bring the water quality up to -- and when I say "up to", degrade it to --

A. -- degrade it to --

Q. -- the water quality standards. But at some point with multiple -- you know, multiple sources and multiple contamination events, aren't we treating the water quality standards as sort of a target?

A. Well, the water quality standards are set up in a variety of different -- for a variety of different reasons. It could be odor and taste, or it could be toxicity. And so at some point there's got to be a decision made as to what is degradation. Okay? And a lot of the regulatory agencies have developed these criteria -- well, EPA has developed these criteria as primary and secondary standards for water quality. They become targets -- okay? -- because that's what they're designed to be. They're a screening level. Okay?

Q. Well --

A. And we shouldn't exceed it.

Q. Okay. What happens when we achieve -- and I say that tongue-in-cheek -- when we reach those targets?

A. When we degrade water to those targets?

Q. Yes.

A. They are designed to be protective for the issue that they were issued for --

Q. Okay.

A. -- whether it be taste or toxicity.

Q. That was a poorly worded question to get to my point. Doesn't our standard then become a non-degradation standard?

A. Again, it depends on how you define degradation. Okay? I tried to point out that degradation may refer to one molecule above background, and it becomes very difficult to define that. But you now have background plus one molecule as your target.

Q. Well, when the water reaches the standards and, you know, if we continue to treat it the way -- for lack of a better phrase, the way the industry proposal would treat it, at some point we're probably going to reach those standards. And when we reach those standards, do we not then become a non-degradation state, for at least that site or that group of sites?

A. I'm not sure I understand your question in total, but essentially there is a degradation of the quality of the water. What we want to make sure is that the degradation is limited. Okay? Because degradation is going to occur. We're losing fresh water every day, worldwide. Okay? And so -- But to think that we can prevent all releases in the future, I think, is optimistic.

Q. Absolutely.

A. So that there is going to be degradation. The question is, what are we going to do about it?

Q. Okay, so --

A. And the best approach so far has been to set some target level that says, okay, we're not going to allow it ever to get above this, because this now presents a potential danger, or --

Q. Right.

A. -- we want to make sure we protect the health and --

Q. So I think we're agreeing, Doctor, we want to limit our releases to those that are necessary. And when we go to treat waste and sequester race -- "sequester race" -- sequester components, should we not lead the increase, the difference between background and our standard, that those releases that we can't control, and when we're disposing of waste, should we not be careful not to add to or lower the water quality in place?

A. I think that's a policy decision that the agency needs to make. Like I said, no matter what the policy is, the practical reality is that there will be releases. The question is, exactly, well, what are we going to do? How are we going to control it and make sure that we protect health and fresh water and the environment?

Q. Yeah. And if we plan for those releases and we plan, in essence, to reach our water-quality target on releases that we can control, are we not playing a dangerous game that one day is going to put us in a situation where we have to outlaw all releases?

A. I don't think you're going to be able to do that. But the point is that you're describing the function of the regulatory agency, absolutely. Those are appropriate strategies from a regulatory point of view. And I don't think the industry disagrees with that. I don't think the environmental groups disagree with that either. They're looking for that kind of guidance. The only thing that I'm suggesting is, let's make sure that we set numbers that are reasonable to achieve the objectives or the concerns that have been identified.

Q. Okay. Now Doctor, you gave us a definition of risk in one of your slides as the probability that an adverse effect will occur. And if I followed your testimony correctly, that adverse effect will occur to the receptors?

A. Well, that's a general definition. I think that's from the National Academy of Sciences. Their concern, from their -- their perspective was dealing with health risk, primarily, so in essence, in the context of a health-risk or environmental-risk approach, it's effect into a receptor.

Q. Okay. So in our risk based approach, we are balancing the risk to the receptor or the plant, animal or New Mexican who as to drink the water or use the soil --

A. Uh-huh.

Q. -- as opposed to what benefit? To whom does the benefit accrue of taking this risk?

A. Well, risks are there. It wasn't designed to look at benefit to the individual, other than the fact that you're reducing exposure and therefore the overall risk to that receptor. This was -- I'm really not sure what your question is, in order to answer it properly.

Q. Okay. Well, maybe if I sort of state my point and we can go from there. The risk involved in a risk based approach is to some party. The benefit of accepting that risk is to some party. In my opinion, in New Mexico, there's a difference between the party bearing the risk and the party gaining the benefit --

A. Correct.

Q. -- of this risk based approach?

A. That's correct.

Q. Okay.

A. Yeah, I think that you're exactly right, that the decisions that we're being asked to make have both benefits and adverse consequences.

Q. And so one of the functions of the regulator is to, to the extent possible, spread the risk or the cost to the party that receives the benefit; is that correct?

A. It's possible. But I think it's more policy than I think mandated responsibility.

Q. And BDAT is probably -- or in certain conditions, might be a better way to do that than the risk-based approach; is that correct?

A. No, BDAT, I think, is a tactical alternative. Okay? And all I'm advocating is that let's make sure that this sort of approach is appropriate for the materials that we're talking about in the landfarm Rule.

Q. Now you used the phrase "overly conservative", and then a little earlier in your testimony, in a different context, you used the phrase "safety factor". When dealing with risks to the receptor, to the -- well, let's leave it at receptor, the safety factor -- in essence, one of your arguments is that we're using an overly conservative safety factor; is that not correct?

A. It could be looked at that way, yes.

Q. Okay, but that too is a policy decision, is it not?

A. Exactly.

CHAIRMAN FESMIRE: Mr. Hiser, I have no further questions. Do you have a redirect of this witness?

MR. HISER: I do. Thank you, Mr. Chairman.

REDIRECT EXAMINATION

BY MR. HISER:

Q. Dr. Thomas, a couple of questions. And I guess perhaps we should tackle Chairman Fesmire's one right off. Would not, perhaps, one of the ways to reduce the risk of petroleum -- or oilfield waste, be simply not to have petroleum?

A. That would be effective.

(Laughter)

Q. And are there collateral consequences to not having a petroleum industry in New Mexico?

A. There are.

Q. And those might be issues such as employment or school funds or things of that nature?

A. That's correct.

Q. And do those things also have a risk?

A. Yes.

Q. And would that also need to be considered by this Commission as it's deciding how to handle this particular question?

A. It could be.

Q. Thank you. Now one of the questions that been asked repeatedly is the question of these long-chain hydrocarbons, and I think that Chairman Fesmire said that you're not testifying that they're benign, correct?

A. That they don't have potential hazards.

Q. That they don't have potential hazards.

A. Okay, the --

Q. Well, he asked you --

A. -- my testimony is that materials have hazards. Okay? For example, potential to cause diarrhea. Okay? And the question is -- for me, at least, let's start to look at that and determine whether that's a risk that needs to be evaluated and taken into consideration here.

Q. Okay. But let's put this back in the example that you gave originally of yourself crossing the street and the bus.

A. Okay.

Q. In the case of the long-chain hydrocarbons that Chairman Fesmire has expressed concern about, and Mr. Brooks, is that a bus that is imminently close to you two blocks away, ten blocks away or a hundred blocks away?

A. Well, you're dealing with the risk issue --

Q. Yes.

A. -- the hazard is being injured or killed by a moving bus. Okay, the hazard is being injured or killed by a moving bus.

Q. Right.

A. And now the question is, what do we do? Do we ban buses? Do we make sure that they don't move? Do we put a limit on the speed that the bus travels? What are the site considerations that we should consider to make that decision? Because there are benefits and costs of all those options.

Q. Okay. But I'm trying to get to my -- the analogy, okay? Chairman Fesmire has asked you, and you've agreed that there is some hazard to the long-chain hydrocarbons --

A. Yes.

Q. -- using that term correctly?

A. Correctly.

Q. And I'm now asking you to convert that to the risk as these would be placed in a landfarm, and then give an approximate analogy in your bus example of whether that would be more like a bus that is about to run you over, or more like a bus that's a number of blocks away.

A. I'm not sure I can use that same analogy.

Q. Okay, and why not? And what would you say to this Commission that's being asked to judge what to do about long-chain hydrocarbons? What is your professional recommendation to this Commission?

A. Well, my recommendation to the Commission is that the long-chain hydrocarbons do not -- from the scenarios that I think through, and knowing the toxicological properties of those -- of that residual hydrocarbon, don't pose any kind of risk to the health, environment or freshwater. They're just not bioavailable, they're not mobile, and so on, and further land treatment is not going to have any effect on them because they're not bioavailable.

So as a result, from my perspective, they cease to become an issue where I ought to spend a whole lot of my time professionally worrying about them, and I certainly don't think that they ought to be put into a landfill. Okay?

So my question is really, what are we doing, and are we sure that the things that have been recommended so far are doing the right things? Are they -- Is it purposely, or by -- as a consequence of what's being proposed, are we now increasing the number of landfills that are necessary to build in New Mexico? Was it really worth it? Was it worth all the alternative risks and consequences of that action?

Q. Thank you. Now Commissioner Bailey asked you a question about time, and I'd like you to reflect on time as that relates to landfarms and small registered landfarms. Small registered landfarms are present for a short durational period; is that correct?

A. That's correct.

Q. Now they at times be closed after three years of material left in place; is that also correct?

A. That's correct.

Q. Provided that the closure standards are met.

Is there an effect with time on the underlying groundwater resource where it may show some recovery because of changes in the inputs from the various cumulative impacts, as well as seeing a degradation?

A. Could you repeat that?

Q. Yes. In other words, is the system dynamic in the sense that you have both fresh water entering the system and salt and other water exiting the system at all times, or is it a static, that it is a single number, and we are only adding concentration to it?

A. I mean, it's a dynamic system, and so it's always changing. And I think the bioremediation endpoint was an attempt to actually start to quantify that and to make it into something that can actually be measured.

Q. Okay. And then just -- There's a bit of confusion, I think, throughout on the industry tier approach and the National Association of Sciences approach, tiered approach. And you've explained what the industry approach is. And although I know we don't want to go through this, I'm going to try to distinguish --

(Laughter)

Q. -- for the Commission the difference between your Tier 1 approach and the industry committee approach, and sort of how that's set up.

Your understanding is that the industry's Tier 1 approach is meant to be sort of there across the board, cookie-cutter -- the operator comes in and just chooses that, and then it can go forward and do whatever; is that correct?

A. In simplistic terms, yes.

Q. Okay. And then that the operators -- the industry committee's Tier 2 proposal which is reflected in here asks for some greater site-specific flexibility by the provision of greater site-specific information and consideration of a greater number of constituents?

A. That's correct.

Q. Okay. And then that the industry committee's Tier 3 approach, which is not labeled as such in their proposal, is actually the recognition of the staff's proposal in Section K, commission exemption and variance procedure?

A. That's correct.

Q. And then lastly I want to come back, I think, to what was your fundamental critique here, which is this question of consistency and how that creates confusion for the regulatory community.

Is an example of the problem that would be faced by the regulated community that if we were to come in and propose an exemption or a variance to the Commission, that we would not be able to tell what it is we're trying to protect for groundwater, because we have 3103 constituents at a DAF of 1, but chloride at an apparent DAF of 15, and so that creates confusion as to what actually it is we're trying to do?

A. If that's the issue you're coming before the Commission about, yes.

Q. But that would be an example of some of the problems that you've seen with the staff proposal here --

A. Yes.

Q. -- is that there's a lack of sort of overall conceptual consistency, and what are the risks that they're trying to identify and how they're trying to structure their protective measures?

A. Yes, exactly.

MR. HISER: Okay, thank you.

CHAIRMAN FESMIRE: Short recross, limited to the subjects of the redirect?

MR. HUFFAKER: No, thank you.

CHAIRMAN FESMIRE: Mr. Huffaker?

Mr. Brooks?

MR. BROOKS: No, Mr. Chairman.

CHAIRMAN FESMIRE: Doctor -- or Mr. Sugarman, I'm sorry?

MR. SUGARMAN: No, Mr. Chairman.

CHAIRMAN FESMIRE: The Commissioners?

COMMISSIONER BAILEY: (Shakes head)

COMMISSIONER OLSON: (Shakes head)

CHAIRMAN FESMIRE: Mr. Hiser, I think that's all we have with Dr. Thomas, unless you have something else.

MR. HISER: No, I think we've already moved the admission of his exhibits, so I believe we are ready to release you.

THE WITNESS: Thank you.

CHAIRMAN FESMIRE: Thank you, Doctor.

THE WITNESS: Thank you very much.

MR. HISER: Mr. Chairman, but for closing and perhaps responding to Commissioner Olson's request to explain exactly what the industry committee proposal is, that would conclude our case.

CHAIRMAN FESMIRE: Okay. It's a little early to take a break.

Doctor, I'm going to give you the choice. Would you rather break before your presentation or stop sometime during the presentation?

DR. NEEPER: I would rather break before, but give you all the invitation you wish to stop at places that --

(Laughter)

CHAIRMAN FESMIRE: Why don't we go ahead and --

MR. CARR: Mr. Chairman?

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: I have about a 10-minute presentation for NMOGA. It's sort of a follow-up. It doesn't get into any technical questions.

And in fact, I think of our five points two or three of them have already been addressed.

So I could present that right now, and then we could break, and I really do think we can finish it in 10 minutes.

CHAIRMAN FESMIRE: Okay. Doctor, with your permission, we'll go ahead do that.

DR. NEEPER: Go ahead.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: Thank you. At this time, Mr. Chairman, we would call Yolanda Pérez.

CHAIRMAN FESMIRE: Ms. Perez? Ms. Perez, I don't believe you have been sworn, have you?

MS. PÉREZ: Yes, sir, I have.

CHAIRMAN FESMIRE: Okay.

MR. CARR: And I'm passing out simply material that was prefiled.

MR. PRICE: Object.

MS. PÉREZ: I don't have any slides.

CHAIRMAN FESMIRE: Might I remind counsel and the witness that this is on the record.

(Laughter)

MR. BROOKS: Counsel didn't say anything, it was my client.

(Laughter)

YOLANDA PÉREZ,

the witness herein, after having been first duly sworn upon her oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CARR:

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

A. Yolanda Pérez -- Perez for those that can't roll the "r" very well.

(Laughter)

Q. Ms. Pérez, where do you reside?

MR. BROOKS: Has the witness been sworn?

CHAIRMAN FESMIRE: Yes.

THE WITNESS: Yes, I have.

MR. CARR: Yes, she has been.

MR. BROOKS: Continue, I'm sorry.

Q. (By Mr. Carr) Where do you reside?

A. East Bernard, Texas.

Q. And by whom are you employed?

A. ConocoPhillips Company.

Q. Would you briefly review for the Commission your background?

A. Yes, on June 4th, this June 4th, I'll be in the Oil and Gas industry for 30 years. I started with Unocal in 1976 as a field clerk and as a field clerk for three years. Then I went to work in the field as an operator, so

I was a field operator for 13 years, and then got transferred to our Sugarland office and was an engineer assistant for Unocal there for -- I think it was about five years.

Then I left Unocal, went to Conoco as a regulatory analyst. But in all my 30 years of experience I've always been dealing with regulatory in different aspects.

Q. Your current title is regulatory analyst?

A. Senior regulatory specialist.

Q. And you testified that in that role you -- What do you do?

(Laughter)

A. Well, as a senior regulatory specialist I work with management and the asset teams, outside members of industry, trade associations to develop company and industry positions regarding regulatory rules and legislative issues.

Q. And what is your relationship with the New Mexico Oil and Gas Association?

A. I'm the co-chair of the NMOGA Regulatory Practices Committee.

Q. Have you previously testified before the Oil Conservation Commission?

A. No, sir.

Q. Is Exhibit 1 a copy of your -- a résumé that was previously filed with the Commission?

A. Yes, sir.

Q. Are you familiar with the Application filed in this case by the Oil Conservation Division?

A. Yes, sir.

Q. Did you chair the NMOGA Regulatory Practices Committee meeting where the proposed surface waste management Rules were reviewed?

A. Yes, sir.

Q. And were you actively involved in participating in the preparation of the NMOGA comments on these Rules?

A. Yes, sir.

Q. And these comments were prefiled pursuant to Commission Rules?

A. Yes, sir.

Q. Who participated in the development of these comments?

A. The members of -- that are representative of the major and independent oil producers in New Mexico.

Q. And how do these comments relate to what has been presented by the industry committee?

A. Well, the industry committee was formed by just a number of companies, all of which are members of NMOGA. And then the RPC endorses those comments, but we basically more address the nontechnical pieces of the Rule.

Q. And are you prepared to present those nontechnical recommendations for NMOGA?

A. Yes, sir.

MR. CARR: We tender Ms. Pérez as an expert witness in oil and gas regulatory matters.

CHAIRMAN FESMIRE: Any objection?

MR. BROOKS: No objection, Mr. Chairman.

CHAIRMAN FESMIRE: Seeing no objection, rather enthusiastically --

(Laughter)

CHAIRMAN FESMIRE: -- Ms. Perez will be so accepted.

Q. (By Mr. Carr) Briefly summarize NMOGA's position on the proposed Rules.

A. NMOGA supports regulation by rule and not by guideline. We believe that appropriate rules are in the best interest of industry and the Division.

Q. What do you mean, by rule -- regulation by rules, not guidelines?

A. In the experience that we've had with guideline -- like with the pit rule, was that -- it seems that the guidelines were being enforced, versus -- because they weren't put in the rule. So we have -- you know, the guidelines to NMOGA seems to be that, just guidelines, but you know, something to follow, something to consider, but not the rule.

Q. It's not your position that every single requirement has to be reduced to a formal rule?

A. No.

Q. But it is that if you're going to enforce something, it should be --

A. That it should be in the rule, yes.

Q. What do you mean by appropriate rules?

A. Rules that are understandable, that industry would be able to understand why they're being asked to do something, and then to be provided with a tool to do that.

Q. Could you just summarize for the Commission NMOGA's concern with the Rules as drafted and proposed?

A. That, you know, they don't allow flexibility, and there may be unnecessary limits to disposal options, and by doing that it's going to require additional cost, with not -- I mean, it's additional cost to manage, without any additional benefit to the environment.

Q. NMOGA filed comments on proposed Rule 51.C, and that's the Rule that addresses transportation of liquid waste between -- by an operator between one lease -- on one lease between a tank battery or facility to another one owned by the same operator. What is the recommendation of NMOGA on that?

A. I believe that was Rule 51.A --
Q. Yes.
A. -- and that was that if an operator owns its own equipment, that they can transport between their leases.
Q. And was this recommendation set out on page 4 of the modifications proposed by the industry committee?
A. Yes, sir.
Q. What about Rule 51.C? What did that Rule -- what does that Rule --
A. 51.C was the C-133 that the operator will need to ensure that the transporter had an approved C-133, and that -- it's my understanding that OCD or Mr. Price agreed that it would be reasonable to post a list of the transporters whose C-133s have been revoked, on the website once a month.
Q. And the operators would be required to monitor that on a monthly basis?
A. Yes.
Q. Do you recommend that that recommendation be adopted into the -- or included in the final Rule?
A. Yes, sir.
Q. Let's go to NMOGA's recommendation on Rule 53.H, concerning one landfarm per lease.
A. Yes, sir.
Q. What is NMOGA's position on that?

A. That there are multiple wells on a single lease and that a lease covers several sections or non-contiguous lands.

Q. During the Division's case, they indicated that under the Rules it was their understanding that there would be an opportunity for an operator to seek an exception to this Rule if they have a large or non-contiguous lease. Do you recommend that that provision be included in the final Rule?

A. Yes, sir.

Q. Let's go to the recommendation concerning Rule 53.J.

A. Uh-huh.

Q. What does that Rule relate to?

A. It relates to the forfeiture of financial assurance and provides all amounts collected as a result of forfeiture of any financial assurance shall be deposited into the Oil and Gas Reclamation Fund.

Q. And what is NMOGA's concern about that?

A. That the Oil and Gas Reclamation Fund, a statutory fund that is set up to receive funding for the necessary personnel to survey the abandoned wells and make sure that everything is properly plugged and abandoned, like orphaned wells and stuff like that -- that that fund is kept at 1.5 and that putting these funds from the landfarms or the commercial or centralized landfarms is not going to necessarily mean that they're going to get that money, because if it's kept, then that money will actually go into something else.

Q. And do you recommend that if they're -- that these funds be segregated or kept in a separate fund that can be used for the purpose of these Rules?

A. Yes.

Q. Proposed Rule 53.J.(2) and (5) talk about financial assurances and re-vegetation, and they also require that plans to deal with those issues be approved not only by the operator and the landowner but also by the tenant.

It was indicated during the Division's case that there was no objection to deleting the reference to "tenant". Does NMOGA request that that be done?

A. Yes.

Q. What is NMOGA's recommendation concerning proposed Rule 53.I that addresses evaporation ponds?

A. We feel that evaporation ponds should be addressed in the pit rule.

Q. Has NMOGA received comments from members concerning the transitional provisions in Rule 53.L?

A. Yeah, yes.

Q. And what do those comments concern?

A. The provision as written provides that surface waste management facilities and operations prior to the effective of the new Rule may operate subject to those permits, that -- We are aware of situations where a company is waiting on a transfer of a property from the BLM and they have completed public notice and have responded to public comments, and so we request that the provision be amended to permit proposed facilities who have completed public notice and adequately responded to public comments prior to the effective date of the new Rule, be allowed to operate in accordance with such permits and orders and not be required to request an exemption to this portion of the Rule or to start over with the public notice.

Q. All we're saying is, if the approval process has been concluded but you're waiting simply on the transfer of a property interest, that they would also fall under the transitional provisions?

A. Yes.

Q. Does NMOGA adopt and support the recommendations of the industry committee?

A. Yes.

Q. Is NMOGA Exhibit 2 a copy of the comments that were filed on behalf of NMOGA, prefiled pursuant to Division Rule?

A. Yes.

Q. Is Exhibit 1 a copy of your résumé and 2 the NMOGA recommendations or proposed modifications?

A. Yes.

MR. CARR: Mr. Chairman, we would move the admission of NMOGA Exhibits 1 and 2.

CHAIRMAN FESMIRE: Any objection?

MR. HUFFAKER: I don't have any objection. I've got a question. I thought if we submitted comments pursuant to the procedural rules, they were in the record. Aren't they?

MR. CARR: Well, I don't know, and that's the reason we --

MR. HUFFAKER: I'd sure like to know.

MR. CARR: You know, we're -- under the Rules I want to be certain that what we filed for the industry committee and what was filed for NMOGA are in the record. I would agree with you, Greg, that they, under those Rules, are included, but I don't know if they're part of the record, and I'm just doing this as a kind of an assurance.

CHAIRMAN FESMIRE: Okay. I believe that anything filed in the case becomes part of the record.

MR. BROOKS: That would be my opinion also, Mr. Chairman.

CHAIRMAN FESMIRE: But to make sure that my interpretation doesn't put you on the line, is there any other objection to --

MR. BROOKS: No objection, Mr. Chairman.

MR. HISER: No objection.

CHAIRMAN FESMIRE: NMOGA Exhibits 1 and 2 are hereby admitted.

MR. CARR: And that concludes my direct examination of Ms. Pérez.

CHAIRMAN FESMIRE: Cross-examination, Mr. Huffaker?

MR. HUFFAKER: No questions.

CHAIRMAN FESMIRE: Mr. Hiser?

MR. HISER: No questions from the industry committee.

CHAIRMAN FESMIRE: Mr. Brooks?

CROSS-EXAMINATION

BY MR. BROOKS:

Q. Good morning, Ms. Pérez.

A. Good morning.

Q. I'm glad to -- well, I -- I understand you're no longer going to be with us after this proceeding?

A. No, sir, I'm --

Q. You're no longer going to be --

A. -- I'm leaving with a bang.

Q. -- going to be working --

(Laughter)

A. Well, maybe, maybe not.

CHAIRMAN FESMIRE: I'll give her something to remember.

(Laughter)

THE WITNESS: Uh-oh.

(Laughter)

MR. BROOKS: We've all enjoyed working with you, and we will miss you.

THE WITNESS: Oh, well I really appreciate that. I'll miss it too.

MR. BROOKS: I'm also glad to have had somebody up here who pronounces Mesavérde correct.

THE WITNESS: That's right.

MR. BROOKS: I always heard it called Mesaverde when I came up here, and then people started calling it Mesaverde, so we're going from bad to worse.

Q. (By Mr. Brooks) Okay, I just have a couple of questions.

A. Yes, sir.

Q. With regard to the comment about the Oil and Gas Reclamation Fund, Ms. Pérez, you evidenced considerable familiarity with that statute. Are you aware that the phraseology in the Oil and Gas Reclamation Fund is abandoned wells and associated production facilities?

A. Yes, sir.

Q. And is NMOGA taking a position on what the meaning of associated production facilities may be?

A. Yes, sir, we're -- Associated production facilities, to industry, is wells and the actual production facilities of -- where the tanks, separators, and that type of facility associated with that production.

Q. Now you're contending, then, that waste disposal facilities would not come within that definition? Is that your contention?

A. They do not, we do not feel they do.

Q. Okay, that would be a legal question though, would it not?

A. Yes, sir.

Q. Now are you aware that there is a statute in the State of New Mexico that states that all funds coming into the State Treasury that are not otherwise designated will be deposited to the General Fund?

A. No, sir, I'm not aware of that.

Q. Okay. And so if these funds were not otherwise designated, we might get in competition with the Medicaid people for the, perhaps.

A. Okay.

Q. Okay. Well, thank you.

And just one other question. On these facilities that are pending approval, I did not quite understand from your testimony what the status was that you were concerned about.

A. Well, from the information that we received from this certain operator, they've already gone through the whole process of getting this property transferred, and this permit in process has already been completed for this particular --

Q. Yeah. Could you provide to the Chief of the Environmental Bureau an identification of that facility so that we could evaluate the request? Because we -- I don't think we were specifically aware of one being in that status.

A. I don't have the name of the facility.

MR. CARR: Mr. Chairman, we can provide that, we'll find out.

MR. BROOKS: Thank you, that's all I have.

CHAIRMAN FESMIRE: Mr. Sugarman?

MR. SUGARMAN: Nothing, Mr. Chairman.

CHAIRMAN FESMIRE: Commissioner Bailey?

EXAMINATION

BY COMMISSIONER BAILEY:

Q. Do you watch the Legislature when it's in session and keep track of the bills that get introduced?

A. I -- We have a lobbyist that does that, and he communicates stuff to me, but I don't necessarily keep a close eye on that personally. I do -- I am aware, yes, ma'am.

Q. Are you aware of the number of bills that were introduced in the last session that tried to tap into the Oil and Gas Reclamation Fund?

A. Oh, I have been aware of that, but not the number, no, ma'am.

Q. Not a specific number, but --

A. But there are --

Q. -- there seem to be quite a few bills introduced this past session. But yet none of them passed, did they?

A. Not that I'm aware of.

Q. So there appears to be Legislative intent not to raid the Oil and Gas Reclamation Fund for activities other than what it was proposed to be. And since, as Mr. Brooks has pointed out, that's a question of legal terminology whether or not associated waste facilities are part of the original designation of this fund, I'll leave it at that. I just wanted to point out that there have been many attempts to raid that fund --

A. Yes.

Q. -- but none of them have passed by the Legislature.

A. Okay.

COMMISSIONER BAILEY: That's all I had.

CHAIRMAN FESMIRE: Commissioner Olson?

EXAMINATION

BY COMMISSIONER OLSON:

Q. Yeah, Ms. Pérez, I just had one question. Did NMOGA do any type of legal analysis the proper way, how you would set up a separate account under state laws? I mean, it's my understanding that only the Legislature can --

A. -- can do that.

Q. -- can designate accounts, so --

A. Yeah, that --

Q. -- was there any type of legal analysis done on that?

A. No.

Q. Okay. That's all I have.

A. It would have to -- I think we addressed it, it would be a legislative-type of issue.

COMMISSIONER OLSON: Okay, I was just interested in that, so thanks.

CHAIRMAN FESMIRE: Ms. Perez, on behalf of the Division I too want to say we're going to miss you. It's been nice working with you.

THE WITNESS: Thank you.

CHAIRMAN FESMIRE: That having been said --

THE WITNESS: Uh-oh, here comes the bang part.

(Laughter)

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. No. Given that the -- the Division's intent in limiting the number of small landfills to one per lease was to minimize the proliferation of these, to make sure that they were used just for the immediate cleanup of spills, you know, the idea being, the faster we can get in there to take care of this, the cheaper it is and the better it's going to be remediated, what would you recommend -- or what would NMOGA recommend, I'll ask you that as two separate questions if you want to divide it that way -- but what would you recommend that we limit -- how would you recommend that we limit the number of small landfills?

A. Landfarms?

Q. Landfarms. Mercy, yes. I'm sorry.

(Laughter)

A. Well, one way to limit the number of small landfarms is to increase the size --

Q. No --

A. -- but you're talking about per lease? Like if there's 100 wells on a lease, not to have 100 landfarms on the lease because of site remediation?

Q. If we were going to -- you know, and it's obvious from the number of comments that we've received that we're going to have to examine that provision. If we were going to change it, how would you recommend we change it?

A. I think the recommended language was that there -- let me see if I can find that. Well --

Q. And not just take it out, as recommended by --

A. Right, I understand your concern. I haven't thought about that, I guess. I guess I'm going to go back with an approach based on the size of the lease. If it's like, you know, over sections or whatever, that there would be allowed, and then it's -- depending on the size of the lease and the number of wells on the lease, so I would probably recommend a percent approach or some type of approach that was based on, again, the size of the acres of the lease and the number of wells on the lease.

Q. Well, what about the idea of one per map section per operator? Would that be something that NMOGA -- would be acceptable to NMOGA?

A. Well, in some cases -- I'm trying to think of -- look at -- I know what the -- you know, the section is, but I think a section can also consist of multiple leases --

Q. Right --

A. -- so --

Q. -- that's why I said per operator, you know, so each operator within a section --

A. -- a section -- That might be acceptable. That would probably be something that might be something that might be considered.

Q. Okay. Is there any other ideas that you would have, that the Commission could look at if they were so inclined on that subject?

A. On that subject? I have a lot of ideas, but on that subject, oh, okay. No.

(Laughter)

A. Maybe per spacing unit? You know, that's 320 acres. I mean, maybe one per -- or dependent on the spacing unit, but maybe even one per 320 might be something that could be considered.

Q. I was interested in your comment you support -- NMOGA supports regulation by rule, not guideline. Mr. Brooks got you to elaborate a little more on that. You said that it didn't allow flexibility when we regulated by guideline, when OCD regulated by guideline. Could you elaborate on that just a little bit?

A. No, sir, I think what I said was that we're trying to take the guideline and enforce it, so by enforcing it, it doesn't allow flexibility. The guideline should be that, you know, something that the operator -- you know, the tools that we're looking for to be able to be in compliance with your Rules, but -- give us something that we can go by, but don't take that and say that -- no, this is what you have to do. So that's what I meant by that.

CHAIRMAN FESMIRE: Okay. Mr. Carr, I have no further questions. Do you have a redirect?

MR. CARR: No, sir, I do not.

CHAIRMAN FESMIRE: Okay. Ms. Perez, thank you very much and good look in the Gulf Coast, I guess.

MS. PÉREZ: Okay, thank you very much.

MR. CARR: She's on her way to a dry hurricane season.

(Laughter)

MS. PÉREZ: And I'm on my way to the airport, so thank you for allowing...

(Laughter)

CHAIRMAN FESMIRE: With that, I need to do just a couple of minutes of housekeeping. I need the record to reflect that all Commissioners were present for this morning's session, including Commissioner Bailey, Commissioner Olson and myself.

Is there anyone who has -- who would like to make a public comment at this point for the record?

There being no one, we will take a break until 10 till 10:00, reconvene back here at 10 till 10:00.

(Thereupon, a recess was taken at 9:37 a.m.)

(The following proceedings had at 9:51 a.m.)

CHAIRMAN FESMIRE: Go back on the record. We're going to reconvene Case Number 13,586.

I believe, Mr. Sugarman, you were getting ready to present your first witness?

MR. SUGARMAN: Yes. Good morning, Mr. Chairman, Commissioner Bailey, Commissioner Olson. I am getting ready to present New Mexico Citizens for Clean Air and Water's first witness and only witness. That witness will be Dr. Don Neeper.

Before I begin an examination of Dr. Neeper, however, I have a couple of procedural, housekeeping measures that I'd like to take up with the Commission.

First of all, with the Commission's indulgence, while Dr. Neeper is giving the substance of his testimony, I will be asking him to present his testimony in narrative form, rather than by proceeding by question and answer, and I am hoping and assuming that that will be acceptable to the Commission.

CHAIRMAN FESMIRE: That's acceptable to the Commission. That's the way we've done other witnesses.

MR. SUGARMAN: Now another matter, Mr. Chairman. As you know, NMCCAW has prefiled a prehearing statement which has appended to it 24 exhibits, totaling some 26 pages. Those 24 exhibits are the only exhibits which NMCCAW wants to introduce into the record and have included in the record in this particular matter. However -- And I will move for the admission of those exhibits at the conclusion of Dr. Neeper's direct testimony, all together.

However, Dr. Neeper in his presentation this morning will be referring to certain illustrative slides in his PowerPoint presentation to help him explain matters to the Commission which might not otherwise be absolutely pellucidly clear, absent these illustrative slides. The illustrative slides are not being -- we do not seek to have the illustrative slides included in the record.

And as Dr. Neeper goes through his PowerPoint presentation you will see that some slides actually have -- are denoted as an exhibit. Those are parts -- those are one of the 24 exhibits that we want in the record. Some slides are not denoted with an exhibit number. Those are the illustrative slides.

And so I just want to make clear that although there's additional material here that you'll be seeing on the screen this morning, all of that is not exhibit material that we seek to have included in the record.

CHAIRMAN FESMIRE: Okay, is there one -- a set of just the exhibits for the court reporter?

MR. SUGARMAN: There is, there is. And I can make that available for the court reporter.

And at the same time, what Dr. Neeper has done is, he's prepared a full copy of the PowerPoint presentation. I know that this is thick. We're going to stick to our two and a half hours, that's our intent.

If I may approach, I would like to give each of the Commissioners a full copy of the PowerPoint presentation so that you can more easily see the material.

CHAIRMAN FESMIRE: You may. Does Counsel --

MR. SUGARMAN: And we have some for counsel as well.

CHAIRMAN FESMIRE: While he's doing that, Dr. Neeper, you've been previously sworn, have you not?

DR. NEEPER: Yes, I have.

MR. SUGARMAN: With that, Mr. Chairman, that concludes my procedural background matters. I'll begin the examination of Dr. Neeper right now.

DONALD A. NEEPER,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. SUGARMAN:

Q. Dr. Neeper, would you please state your full name for the record?

A. My name is Donald A. Neeper, N-e-e-p-e-r.

Q. And where do you reside, Dr. Neeper?

A. I reside in Los Alamos.

Q. And in what capacity are you appearing here this morning?

A. I am here as a designated spokesperson for the citizens' organization, New Mexico Citizens for Clean Air and Water.

Q. Dr. Neeper, what is your most recent employment?

A. The most recent employment was as a part-time person working in a consulting organization. I worked for two different consulting firms -- I occupied the same desk, the firm sort of changed hands within the building -- doing environmental consulting particularly on releases from disposal areas.

Q. And prior to that most recent employment, can you just briefly, for the Commission, summarize the education, training, experience that you have amassed over your career that qualifies you to testimony -- to testify as to the issues that are under the Commission's consideration this morning?

A. Yes, I'll bring you up on both my educational and my employment history that leads up to that recent spate of consulting efforts.

I have a bachelor of arts in physics from Pomona College, a master's and PhD in physics from the University of Wisconsin. I specialized in thermal physics, particularly in low-temperature physics for my doctoral thesis.

I then served in the military and had a few years of post-doctoral research, also in low-temperature.

I then came to Los Alamos and I spent 25 years employed by the Los Alamos National Laboratory. Part of that time was in supervisory positions. I spent roughly the first eight years in the modeling of thermonuclear explosives, numerical modeling, both using the numerical codes to do design-type work and developing the numerical codes themselves. These kinds of efforts were validated in explosions, both chemical explosions and the kind of explosions that were then done underground in Nevada.

I subsequently spent about eight years in solar energy engineering. In particular, our group was examining the engineering characteristics of passive solar buildings and active solar systems that involved quite a bit of modeling of buildings. For several of those years I was the group leader or supervisor of the group. And the validation of our efforts was against small test buildings that we built, actually little eight-foot-sized houses, structures, that when our codes could reproduce the results that we measured, we felt we were doing something correct with the codes.

I spent one year on sabbatical leave, teaching in the engineering college at Northern Arizona University, and returning from that I continued some work in solar energy and went on to do some work in heat transfer. That led me into -- accidentally --looking at oscillatory flow in tubes and the consequent heat and chemical transfer.

Somebody called asking of our solar work could be applied to soil remediation, and that got me into the question of fuel spills in soils. I then developed a research program looking at the effects of vapor transport in the ground. That led me to becoming the operable unit project leader for a RCRA facility investigation of four disposal units that contained both radioactive and hazardous wastes, among other things, particularly organic vapors. After working in that exercise, I took an early retirement from the Laboratory and then worked for several years part-time with the consulting firms that I have mentioned.

I am at present a guest scientist at Los Alamos National Laboratory. That means an unpaid person. I am still trying to complete that particular piece of research on vapor transport in the ground. It has led to about four peer-reviewed journal articles, none of which I think are really significant, because it's waiting for that fifth article which will nail down the actual impact and make an engineering tool, I hope, that's useful to somebody for predicting what you can do with particular chemical vapors in the ground.

I have spent 35 years as an occasional citizen advocate with this citizens' group for which I speak today. In association with that, I spent about three years on the Governor's blue-ribbon task force for water in New Mexico. I therefore became familiar with water issues. I had previously been somewhat familiar with water issues because I had owned a small farm in New Mexico, an irrigated farm in northern New Mexico, and so I understand what the issues are of irrigation; I had water rights on the acequia.

I spent three years on the governing board of STRONGER, which is a nonprofit -- it was funded by the EPA and with some funding from the American Petroleum Institute -- to review the regulations of the various states regarding how wastes were handled under the RCRA exemption and the adequacy of the various states' regulations. That brought me into contact with the regulations of other states. I served on the actual review team for three different states, one of which was New Mexico back at that time, and so I gradually got deeper and deeper into oilfield questions as a result of my environmental interest.

Professionally, I have only one remaining association. I'm a member of the American Geophysical Union.

MR. SUGARMAN: Mr. Chairman, NMCCAW would tender

Dr. Neeper as an expert witness in soil physics at this time.

CHAIRMAN FESMIRE: Doctor, have you ever testified before the Commission before?

THE WITNESS: Yes, I have.

CHAIRMAN FESMIRE: Were you not accepted as an expert in soil physics at that time?

THE WITNESS: I was accepted, sir.

CHAIRMAN FESMIRE: Mr. Sugarman, I think he's been previously accepted and will be so addressed in this proceeding.

MR. SUGARMAN: Thank you, Mr. Chairman.

Q. (By Mr. Sugarman) Dr. Neeper, at this time I will ask you to present your narrative testimony on the Rule that's under the Commission's consideration.

A. Very well. And I know it's not necessary to issue the invitation, but members of the Commission are invited to interrupt at any time with questions.

We have complicated issues that have been presented. I'm going to try to present as best I can a review of the issues and pull as many of them together as I can, rather than presenting just a cut-and-dried set of testimony as I would have done it two weeks prior to the hearing. So we're going to do a few of these things a bit on the fly. I'm going to clarify some issues as best I can.

We have heard issues of -- questions of what is the truth, or what is the scientific truth in some of these cases? And as a scientist, I bring up that you can't get all of the truth from any one person or any one book or any one article. There is this much truth that one person or one scientist or one article will see, and there's others over here. So you won't get all of the truth from me, and you can't get all of the truth from somebody else. You're stuck trying to assemble these truths in as best a fashion as a human person can. In the end, judgment has to carry the day because science can only go to a certain extent in giving factual answers to factual questions, but it can't answer policy.

I must now learn to operate someone else's machine.

In the philosophy of what we're presenting, we, I think in agreement with what I heard from the OCD witnesses, are regarding landfarms as a temporary remediation facility, and we would hope that after its use the land and the landfarm would be returned something toward its natural state. We're not trying to issue a purist opinion and say it should never -- be as though no one had ever been there. We're trying to say it should be returned to nearly its natural state.

As a reference for this, I noted the API said, Successful remediation suggests a landscape and ecosystem which have recovered sufficiently to support healthy and self-sustaining plant and animal growth, minimal erosion, negligible long-term impact, usable surface or subsurface water.

In essence, that's a better statement of my position.

And often at the bottom of some of my slides you will see a reference. That is not to make the slide a piece of data, that is to establish the credibility of whatever literature it is I'm looking at. So often these things I will have at the bottom -- in the usual scientific citation you would give the author and the citation, but I might be giving the author and the author's affiliation, because often the affiliation lends to the credibility of the author, and I'm using another author to, in a sense, lend credibility to my presentation.

We regard landfill as more of a permanent repository. It's something that's intended to remain secure and, if possible, to generate no releases throughout all human history following its closure.

Now no releases is a very purist kind of statement. Perhaps one should say minimal releases, because there's always going to be something that will creep out, particularly vapors.

But a landfill really is a subsurface sacrifice region. You're not intending that any human ever go back in there and use it again, or even to guarantee that it could be structural support for a building. But a closed landfill should not preclude some kind of future use of the land surface itself, or the surrounding land or air and water, by man or plants or animals.

We saw that there's three fundamental issues that have to be resolved in establishing the numerical limits that have been discussed in this hearing. One of those is the effects of salt that's remaining in or beneath closed landfarms. This seems to be a big topic of discussion.

Secondly, the effects of petroleum hydrocarbons and whatever contaminants may be associated with them also remaining in or beneath closed landfarms.

And finally, how do you go about measuring these things so that you know in the end, whatever happens is within the limits that you're prescribing?

So I'm going to try to proceed by an outline, and I will periodically come back to this outline just to try to say here's where we are, because there are so many different topics that come along. I'll try to deal with a topic one at a time, as best I can, and point a red arrow at the upcoming topic.

So the first topic I wanted to address is in the area of the science, before I go on to talk about exactly the Rules.

And the first topic in the area of science I want to address has to do with this issue of modeling, because we've had a lot of discussion on modeling, and I want to discuss it in terms of obtaining absolute answers or relative answers.

Modeling, in my experience, is very useful for ascertaining relative changes. For example, in this case, for comparing the effect of different chloride concentrations. I believe we've seen some examples of changing the amount of chloride on the surface of the ground and then noting the expected change at some depth in the ground. That is a very useful and appropriate application of a model.

But to provide an absolute prediction, where you know exactly what's going to happen, where the model is supposed to represent an absolute truth, a model has to use the input parameters, whatever they may be, as they vary. In this case you'd be concerned with how does something like the hydraulic conductivity vary with depth at the site? And if you're trying to get an absolute answer, you'd have to know that for that site, or for whatever conditions you're trying to establish.

So I brought up from the scientific literature what I thought was a related example that was not the same -- not trying to do the same thing, not trying to predict the transmission of salt through the ground, but it shows the kind of difficulty one can get into with modeling.

Here, taken from the literature, is a plot of the moisture potential -- that is, the suction that moisture creates in the ground. It's just like a sponge. If you soak some water up in a sponge and you put it up to your lips, you have to suck on the sponge to get water back out of it, and the ground behaves exactly the same way. The horizontal axis is the amount of moisture, and the less moisture that is in the ground, the harder you have to suck on it.

So there are some modeling equations in this that allow you to represent this variation with some equations, and that's what my Exhibit 1 shows, is that these modelers have found the appropriate parameters within those equations to be able to represent this variation very well. The points are the measured moisture potential, and the curve, I think, is their calculated moisture potential. They can represent the moisture potential very well.

Then you can go ahead with established correlations and represent the unsaturated hydraulic conductivity of the ground, which is what you need for --

if you're going to go on and model the transmission of water, particularly water containing chlorides. You either have to drill and measure that property throughout the ground, or you have to calculate it and assume that your calculation, your estimate is right.

So they used their very good representation of the moisture potential to calculate the unsaturated hydraulic conductivity, which is the dashed line.

They then said, well, let's revise that and peg it to a -- one type of measurement, and then they got the solid line. But then when they went and did measurements in detail, which are the centrifuge method -- you spin it; that's kind of the same thing as sucking on the sponge -- they got the dots.

In soil physics change by orders of magnitude. Everything you see is a logarithmic scale where things are changing by a factor of 10. And you would say in general, oh, we understand the physics, our estimate got the right shape of the curve, those are very close.

But if you look at the detail, you find that the estimate is off from the actual measurements by about a factor of 10 to 20. So it's very easy in subsurface modeling to have parameters that are not exactly right on target, and you have to take the modeling with that in view. You have to know that your modeling is representing a particular situation, which may not be the real situation.

So to represent -- provide an absolute answer, rather than a comparative prediction, the model has to represent all the relevant physics and all the conditions. Chloride transport may not occur according to uniform infiltration assumed in the models. And that's what these models have done for practical reasons.

A problem is that somewhere, very often, fluids in soils will flow along preferential pathways, they'll find the path of least resistance. And this depends on the scale at which you look.

If we were to look at the soil with a microscope, we would find the separations between some particles are bigger than others, and that's where the fluid would be flowing. If we look on the one-acre size, then we're looking for bigger kinds of cracks and bigger variations. But at whatever scale you look, there are going to be variations and the fluids will flow along those preferential pathways. And one of the problems with contaminant transport is that the contaminants keep showing up in the aquifers before anyone expected it.

The same thing happens with vapor transport going the other way. It has sometimes shown up on the surface of the ground long before anyone expected it, and that's because it was traveling in preferential pathways. This is an established concern within the science.

So the assumption that the chloride transport occurs as uniform infiltration sometimes represents reality, but sometimes it doesn't. And a quantitative prediction, if you're going to make one, would require on-site measurements and then investigating those measurements with various models to see if you could discern what is actually governing the transport.

And one of the things you might have to include is a dual porosity model, which would represent transport of liquids often by bursts. It rains, the rain finds the crack, and you get a saturated flow running down the crack, even though you have an unsaturated wetting front moving, in general.

This -- I'm familiar with some of this because this is the nature of my work, only I'm applying it to air flow, I'm not working in liquid flow.

I've cut this short. There are many scientific investigations of preferential flow we could bring in and bore you with it all day. I just brought in one example. You can go to the website and find that the American Society of Agricultural and Biological Engineers presents the leads to the library on their website. If you type in preferential flow, you get back literally these words:

preferential flow, water movement and chemical transport in the environment, and under that heading they have 72 papers, all of which I think are peer-reviewed literature. So it is an active topic in the field.

We make a conclusion, then, regarding the modeling that the proposed requirement for a 50-foot depth to groundwater, being based on modeling -- It's very valid modeling, there's nothing wrong with the modeling, but it's not necessarily protective for anywhere in New Mexico, and we need a Rule that's simple and you feel is protective anywhere in New Mexico, and if the operator has a good cause to find an exception to that Rule, he has room within the Rule to ask for an exception and build his facility as best he shows it apply.

We therefore are suggesting a 100-foot depth for surface waste facilities, except for small landfarms. Small landfarms are temporary in nature, they're small in extent, they're just likely to have a lot less impact. The operator needs someplace to take care of immediate waste. And so therefore we come to 100-foot depth. I'll subsequently bring up, under the design of facilities, another reason behind that 100-foot depth.

The next topic that is before this hearing is this topic, deep topic, of questioning the effects of salt and sodium and chloride in the soil.

The proposed Rule really is based on protection of groundwater, and the question of the impact of the salt on the surface of the ground has received rather minor attention in the hearing, and I appreciate the attention the Commissioners have given to it. They're certainly alert to the topic.

What happens, I think one can find generally in the literature, is, the sodium tends to replace the calcium on clay particles. That causes a loss of nutrients from the soil and it makes the soil what is called sodic, it loses its sponginess, it loses its ability to hold water, and it often becomes either powdery or caked.

The sodium itself is toxic to some plants, not all plants, and in various quantities.

I find it interesting to remember that our citizens' group 30 years ago started looking at the impact of street salting on pine trees in Los Alamos, because we were having quite a large-scale tree die-off, particularly wherever there was a storm sewer leading away from the road. One of our members had access to the source of neutrons there. He gathered -- did a big study gathering pine needles from all of the various affected trees and unaffected trees, did neutron activation analysis on the pine needles and found sodium, and found no exception where the tree was distressed and there was not a toxic dose of sodium in the tree.

So indeed sodium is toxic and is generally regarded as being the toxic part of sodium and chloride.

Chlorine. The chloride increases the osmotic pressure in the sense it increases the suction, and so you reduce the availability of soil water for the plants and you starve the plant of water.

However here I'm offering some testimony that is different from other testimony. I'm saying chloride itself also is sometimes toxic to plants, and in various quantities. It just doesn't have the notoriety of the sodium.

It very much -- the toxicity to both sodium and chlorine depends on the species of plant, but as I looked through the literature I found that barley, soybeans, citrus and grape seem to be related to chloride transport from the root to the shoot. Chloride seemed to be more primary in stone fruits, which we're not usually concerned with in the oil patch. Chloride toxicity in woody species is sometimes more severe than the sodium toxicity. And I picked this up from the U.S. Salinity Laboratory.

But the main feature of chloride, as I think other witnesses have agreed, is, it increases the osmotic pressure, making it just more difficult for the plant to get moisture.

This depends on the plant specie, and up we come with this term EC and SAR, and here we are with these bothering acronyms. We can't get away from them for a while, but one of my major efforts in preparing for this hearing is to try to bring this and the other language with which you're more familiar together so we can have one thing we can all agree on and work with it, as a convenience to the regulatory agency and as a convenience to the regulated industry. But first I have to bring the scientific language into some kind of correlation with the other -- what we might say more common language.

EC is electrical conductivity. The usual measurement of it is from liquid drawn from a saturated paste. You just make a little paste of the soil, you suck off the liquid with a vacuum and then you measure the electrical conductivity. You have a cup for it and you stick two probes in it.

There is also a hand-held device you can now get. It comes in a little box about the size of this computer. It operates on a battery, you can carry it with you in the field. You can form your paste in your cup, stick the device in and get an instant reading. So it's possible to use that as a field measurement if you want.

The sodium absorption ration measures the effect of the sodium on the soil. It's a particular ratio of sodium to calcium and magnesium. That requires, really, a laboratory test and becomes a bit more of a complication if you try to regulate on it, but we need to be aware of that effect when we try to say how much salt is too much salt.

This is the upper part of my Exhibit Number 3. This is the tolerance level of crops. You'll find this in many parts of the literature, and you'll find the same numbers. It's that many authors were taking it from the same source. By now it's probably hard to find the very original source.

But it's generally regarded that an EC value somewhere between 2 and 4 affects sensitive crops. By the time you're getting over 4 you're high for many crops.

Why the word "crops"? Most of the scientific literature, not surprisingly, is dealing with crop species, because that's where the economic interest is. You can find other species dealt with, but not nearly to the extent of crop species.

When I looked at the guidance for salt spills from the American Petroleum Institute, the statement was, the traditionally accepted objective criteria was for an EC of less than 4 units. So when people talk in the scientific terms they use those units, and we will try to look at the impacts and then say, What can we do that's perhaps more convenient for us?

This is a plot taken from the literature. This is Exhibit Number 4. It's one of any number you might find in the literature, and I took it from a review article, which itself was drawing from a wide variety of literature. But it shows the typical response.

As you increase the amount of chloride or the EC in the soil, you gradually increase the impact on the plant. For a while there's no impact on the plant, and then as you continue to increase the chloride, the yield of the plant -- its ability to grow, however you measure it, produce fruit, grow a stem, get leaves, whatever it does -- decreases.

This happened to be for corn, but many species of plant are shown with this same kind of curve, and the sensitivity simply depends on the plant and also, unfortunately, sometimes on the soil.

Very often, researchers will quote a thing they call the EC_{50}, naming this level of salinity at which the yield is down to 50 percent. In my estimate, by that time you have a pretty sick species, but it's something you can measure, at least; it's a measurable thing.

So this is my Exhibit 5. It is taken from the same document, a British Columbia, that the Oil Conservation Division witness -- he took some of his graphs, and I think Mr. Price even used this same graph.

Why is this relevant? It's not that these authors happen to be in British Columbia. They were tasked by a commission formed both by the oil industry and their civil authorities to give some guidance as to what to do about salt, both from oil industry and from highway salting. So they were again reviewing the worldwide availability of literature, not doing many of the experiments themselves, so the things they're reporting are not particularly items of their climate. It's a compilation of literature, and their report is valuable because they did the work of going through all the literature so somebody else doesn't have to.

The managed to draw up what they call and EC_{20} yield where you have a 20-percent decline in yield, or this EC_{50} yield where you have a 50-percent decline in yield, plotted up a dot for each of the many species they could find, and then said, How many of the species are being affected? And perhaps arbitrarily or perhaps under the instructions given to them, they tended to say when 25 percent of the species are affected, that's when we will try to set our limits for salinity.

And for the EC_{50} that is -- EC not being electrical conductivity but for a 50-percent decline in yield, their 25th percentile was at about this other kind of EC, electrical conductivity, units of 5.

They then surveyed what other governmental institutions had chosen or had considered for limits, and that appears in their tables under the top part of my Exhibit 6. They naturally looked at what other Canadian institutions or provinces would have picked, even as we would look at what other states pick.

What's important in this is where various other people in surveying their literature found soil going from fair to poor, say -- here the boundary from fair to poor, somebody has chosen somewhere at about 4 in the topsoil. In the subsoil they said, well, maybe 5 if you get down deep enough.

What I'm getting at is, if you peruse the literature, you keep running across these numbers of around 4 somewhere in the EC that people find.

These same authors continued to look at other sites. One of the interesting conditions I noted they had was a proposal that some places crop growth and yield had to be monitored for a minimum of five years. So people are recognizing that a long-term view is necessary for this.

And notice for unconditional use of the soil they were mostly looking at numbers like 2, very low numbers, and 5 for the SAR.

So as one goes through the literature you keep finding this EC of about 5 coming up, or somebody's trying to keep a site really clean, they'll be clear down to numbers like 2.

These same authors then looked at spiked samples. That is, instead of looking at the saturated paste they said, If we simply put sodium chloride in the soil, and we know how much we put in there, what happens?

They have some measurements from the literature on that. That then would be a little different from the amount of chloride you would get from an EC measurement, because some of the chloride doesn't come out when you deliberately spike the soil. And they drew their 25th- or 50th-percentile curves against sodium chloride, the totality, not just chloride in the soil. So now they're getting into units we can more easily understand, milligrams per kilogram.

I believe it was Mr. Price's slide that showed a point here for blue grama grass, and if we look on the IPEC scale that I understand was introduced into the record of the hearing yesterday, there is a range of sensitivities shown for blue grama grass. I tried to plot that range in red on top of this same grass, and if you look at the range, the bottom end of the range would be equivalent to a chloride of about 825 milligrams per kilogram. That's back into the units that are more easily talked about.

But that's what a 50-percent yield was. That's a pretty severely impacted plant.

Well, these -- again, the Canadian authors went on to look at various toxicity thresholds, not where we're stopping the growth by 50 percent, but they're looking at that kind in the curve. Where do we start to impact the plants?

And depending on the 25th percentile of species or what distributions they're choosing, you find quite a scatter in numbers. There's 425 for chloride, here's 510 for chloride if they're looking at mortality. But the only thing I point out is, you will find a lot of these numbers are less than 1000, you don't find them approaching 1000 for impact to species.

Now when you look at soil invertebrates, the worms or the bacteria that live in the soil, you will sometimes find much higher numbers. Here's for a decline in species of 50 percent, they're up in the 700s. Or for a lethal dose -- they put it as an X; I think it's a typo; I think they meant LD_{20} here for killing off 20 percent of the species -- you're up in the thousands. The critters down in the soil can withstand a lot more mistreatment than the plants can.

Well, these pictures were intended to give us a sampling out of the literature as a scientist would find it as he starts going through the literature. And what we find is that plants, or even some of the invertebrates, will suffer a growth or a population decline when your concentrations of chloride get below 1000.

So if we're thinking of regulating in terms of chloride, which seems to be the preference of OCD, then we have to start thinking that perhaps the 1000, which may in some circumstances be protective of groundwater, may not be protective of the ground surface. Or we find similar concerns expressed in terms of the EC language more as an EC of 4.

And the question is, how do we reconcile the EC and the chloride indicators? How can we get those two together? Because inherently and scientifically they are different.

I did my best. I looked at a list of damage to grasses, because grasses are of concern in New Mexico, and I looked at the EC of the paste, the saturated paste, as given by a U.S. Department of Agriculture publication. And at the EC -- or at the chloride that shows up on the IPEC, Institute for Petroleum -- excuse me, Dr. Kerry's [*sic*] institution is the easier way to say it -- on the handout that comes with his kit, because I think that's a very practical use. It's something that an operator can use in the field. And I tried to say, Can I possibly get these two together?

Well, I just toyed with it until I had multiplied USDA's value of the EC by 169, plotted that on the same graph with the chloride against the name of the specie, as shown for the threshold value, as given by the IPEC kit, and the two fit right together.

Now I suspect that's not accidental. I suspect that somewhere back in history these two data sets were actually the same and various authors, and as they've propagated along, have translated them back and forth. But we need some common way to talk about things, and this struck me, since those two agreed, maybe I could consider these two sensitivities to be the same, whether we express them as chloride or whether we express them as EC.

There are two dotted lines on here. The Canadian authors tested four different soils by spiking them and then measuring what is the EC, versus how much chloride was literally in the soil? The EC does vary with the soil type, and they got four lines within the range of these two lines, and we find that this variation happens to be right up the middle. I would suggest that unless we wanted to do a tremendous science project, it's probably as good as we can do toward getting EC and chloride together.

I would note, then, that an EC of 4, this often-cited value, happens at a chloride value of about 600.

And I should apologize here. When Dr. Sublette turned to me yesterday and he said, What did we find for an EC of 4? I said 500. I'm wrong, it was 600 on this graph. I was focused on the 500 for other reasons.

So here is a plot of thresholds against chloride or against EC, whichever way we want to talk about it. But at least it's grass specie, it's not necessarily native species to New Mexico.

One thing you don't find on here is alkali sacaton. That grows well in salt. You can take it out, I think, to an EC of about 16. It's a lot of chloride. It will grow. I have called several different county extension agents, they have assured me it's a useful specie for grazing when it's green and when it's fresh.

So it isn't that we couldn't find something to grown on salt-impacted soil in New Mexico. But I think our question is broader, can we get a broad range of species to grow on the soils after they have been contaminated by salt, and then how much contamination?

CHAIRMAN FESMIRE: Doctor, are any of those native New Mexico grasses that we'd find in a typical southwest oil site?

THE WITNESS: I am not the pathologist. That's why I was calling the extension agents saying, What kind of grasses do we want and what grows? And they would talk about wheatgrass, but maybe not necessarily tall. Bermuda grass is a foreign specie. Barley is a foreign specie, but it is used as a grazing specie. So those are not native New Mexican. Beyond that, I shouldn't say because I got beyond my expertise and my capability.

For the most part you don't find native New Mexican forage species in the literature, because that's not where the scientists have been attending; they've been looking at crops that sell. There are some out there. I just came across another publication showing many, many more species of grasses and shrublike plants this last week, but it's far too late to get it into the presentation. I don't know what all's in there. Just -- For the things I could find, it was hard to find definite statements.

Well, what I'm getting to from that slide is, if we wanted to get in the middle range of things, we might regard an EC of 4 and a chloride of 600 as a limit for many species on the ground. EC correlates with plant damage more often than sodium, because it addresses not only the toxicity of the plant; specifically, the EC is directly physically related to the osmotic pressure and to the reduction of water availability to the plant.

So I wanted to look at some situations actually in New Mexico to do what I could for New Mexico. I'm going to show the result, and then try to explain it, and then come back to the result.

I did some soil sampling, and all we need to look at, at the moment, is the horizontal axis, which is anecdotal. I call it undisturbed grass, or dense grass, sparse grass, dense snakeweed, sparse snakeweed, edge of snakeweed, and dead area. Those are qualitative terms, they are my terms. I'm going to show three pictures to try to illustrate what I mean by those terms.

I did sampling at two different sites, it doesn't matter what site we're looking at. This was one of them; it happens to be in Lea County. And when I say dense grass or unimpacted grass, that's out here where the camera is. This particular bare area was something like about a football field in size. I asked the rancher, just show me where you think there's soil-impacted land, I want to go do some measurements.

This is looking at what I call the edge of the bare area. Here is starting with kind of sparse snakeweed. The snakeweed gets a little denser, and suddenly you -- Whoops! The machine seems to have its own mind. The snakeweed -- or the grass picks up fairly rapidly out here in terms of its density. So we see a rapid change in density of the plants.

I then went looking downwind because the rancher said, Oh, it spreads -- the salt damage spreads in the downwind direction. And indeed in the downwind direction things were spread out a bit more. Here you can see the transition from bare area to what I would call sparse snakeweed to dense snakeweed, and now we're starting to get sparse grass, and pretty soon dense grass and bushes.

There was one of my sampling holes; I was sampling at about 4 inches depth under the soil.

Now I'll back up to the table that we really wanted to talk about.

Out in the bare area I was finding something like 3600 parts per million chloride, as measured by the IPEC sampling kit. It seemed fairly reliable, very useful as a field instrument.

In the undisturbed grass I actually measured a zero, non-detect. So I moved into a little more dense grass and I got a non-detect.

I come into the sparse grass and I was getting things in the range of zero to 100. And I said, What I want to do is find where the species are impacted, I want to get where the salt concentration is spread out. So I started doing things to try to move between sparse grass and bare ground or high concentration. I kept looking for where things were spread out.

And what happened was, even when I got down to where there was only sparse snakeweed, the first thing to grow, all I got were samples over 400. I finally get over to the edge of snakeweed where on side of the weed itself is bare ground, and I'm still getting some snakeweed that was down in the 250s to 100s. I found only spot out in the dead area that was under 400, and I found one place where something was living, and I got up into the 2000. There was a little tuft of snakeweed out there in the middle of the bury, and I went out and sampled it.

This does not sample every cause that could be impacting the plants. I have limited budget and limited capability; I could only sample for chloride.

What I can point out is an apparent strong correlation that correlation that totally surprised me. I thought I was going to get a nice spread here. I was doing everything possible to get spread, and with one exception I couldn't get anything growing above 400 out there. That doesn't mean that 400 is the limit, I'm sure, but it means that when I went to a salt-impacted site in New Mexico, that's what I was finding. By the time I was up here there was just nothing growing.

So I suggest that the standards for the near-surface soils should be based on the effects of sodium and chloride on the plants and on the soil organisms, and I'm calling that up in contrast to exclusively basing your standard on the threat to groundwater.

From the literature, we would find something like an EC of 4 and an SAR of 5 as to what other entities and organizations are choosing. To be safe, I was choosing a soil chloride in the middle at 500. I don't object if it's 600. I had to pick a number and I picked the 500 because all of my samples where anything was growing were under 400.

The thing I want us to remember is that in the literature, all the scientific investigations are done where the scientist is trying to check one thing at a time. He's adding only one stressor to the plant, and that's the chloride. So most of those literature investigations are done with well-watered soils. They're not also deliberately trying to starve the plant of water, just with the chloride.

That brings us down in the science question to, what about the impact of the petroleum hydrocarbons?

We have heard previously of the Salinitro studies on the bioremediation and toxicity. That is a key paper in the literature. Here in Exhibit 12 I bring up an abstract from one of the tables of that paper, and we've seen some of this data before in the hearing. I'm trying to suggest it isn't necessary to go through every number in the article.

What key things can we find? What we've heard said before. If you use a light hydrocarbon, you find smaller percent remaining. If you use a light crude oil, you find smaller remaining amounts, however you may measure them, TPH, gravimetric, oil and grease, or IR, in the soil. If you have a high organic, you probably sometimes may get a better remediation, and you may not. Here you get more remediation. Sometimes you do not.

I just listed what's remaining in the soil in the oil and grease column; I could have picked any other column. But we find -- starting from fairly impacted soils, 14,000 and 26,000, in the oil and grease we find quite a bit remaining in the soils. We're not down anywhere near the kind of 1000 limits that we're seeking to get with our diesel-range impact in a standard. There are other things remaining in the soil.

There's a couple places here where the author, Salinitro and company, Shell at least -- Shell is the first author's association, I think -- noted that duplicate samples had different -- widely different results, so they showed their results. These are very forthright authors. They had a 90 and a 60 percent here, an 88 percent and a 27 percent, with two duplicate samples. That's a hint of things to come, that it's difficult to get all things looking the same when you're doing soil sampling.

They showed plant growth. This was plant dry weight at 21 days. It's basically a seed-germination study.

They looked at corn, wheat and oats. Sometimes -- as I heard mentioned earlier this morning, sometimes you get an effect that's actually acting like a fertilizer. After the soil is remediated, some things will grow faster and better. And that occurred in this case, particularly for the medium-weight crudes.

Sometimes things don't grow as well. If you were an oat farmer with even light crude here, at 53-percent growth you would have been disappointed with that.

So you find that it's spotty. There isn't a guarantee. We're looking for a guarantee, and things are spotty. In fact, those authors concluded themselves that hydrocarbon phytotoxicity cannot be predicted, and it varies widely with oil and soil type, concentration and the plant species tested. And that leaves us with a conundrum as to how we can set regulations.

They noted -- they prepared their soils, they manufactured their contaminated soils by pouring known oil on them, and they noted that they lost 40 to 95 percent of the BTEX during the three-day interval while they were preparing their soils out on plastic sheets.

So I think this is a clue -- we find it elsewhere in the literature -- the BTEX just evaporates. When we do farming of BTEX-contaminated things, we're trading one form of pollution for another. In the southeast it probably doesn't count. In the northwest it's starting to count because we're starting to get basically photochemical smog in San Juan County now. People are noting high -- I have a senior moment and I can't say the word, oxygen 3.

DR. BARTLIT: Ozone.

THE WITNESS: -- ozone counts, and that's anecdotal. People are starting to complain to me, and I'm saying, Well, we have a lot of activity up there. It isn't all landfarms by any means, but it's something to think about. We may come to a time when we have to think about, do we really want to evaporate all of our BTEX?

Seed germination is what was examined in that study, and by the authors' comment, their duplicate soil samples sort of routinely had a 10- to 20-percent variation as they measured the hydrocarbon content.

This is a laboratory study. That's the kind of variation you're going to find in a laboratory study. I bring it up because we'll probably find bigger variations out in the field.

Chaineau studied bioremediation and toxicity, particularly. In agreement with Dr. Kerry's testimony, he noted that fertilizer and straw helped. His standard deviations were like 50 percent when he tried biopiles. He also used windrows outdoors that he tilled, and with the tilling he could get his variations down to 25 percent.

This is an exhibit drawn from the data in the Chaineau publication. He looked at the inhibition of seed germination and the inhibition of plant growth in these food species, and indeed if he remediated them for long enough, out to 480 days, he got down to very small inhibitions of seed growth.

Notice that they were totally toxic at zero time. So indeed, he is getting rid of toxicity, but not always. When you go back and look at the plant growth, with wheat out at 480 days, he's got a 21-percent impact on the growth of the plant, even though he's got a zero-percent impact on the growth of the seed.

It's this kind of variation out there that I think could drive a regulator to distraction in trying to find the right number to set.

Lee looked at specifically the toxicity of drilling fluids. These authors were looking for better or less toxic drilling fluids, so they looked at mineral oil, isomerized paraffin and diesel. And in our Exhibit 15 we copy their statement about phytotoxicity: Both of the isomerized paraffin and mineral oil, they developed extreme toxicity to lettuce. It was during the bioremediation. These suggest that -- they say -- that the degradation products, the breakdown products, were toxic to plant growth.

I called one of the authors and asked, Are you sure you had straight diesel and not some other drilling fluid with something mixed in it you didn't know about? She assured me, no, this is diesel, we keep finding this. Every time we look at diesel something funny happens during the remediation of diesel, we wish we knew what it was.

That is an anecdotal report from me; I don't have that a scientific report.

But there's another point to note in this. I think it's on my -- one of my slides. The hydrocarbon loss from diesel was extensive from the volatilization, and they say it's still extremely toxic to earthworms after they reach their treatability endpoint, which is still 4000 milligrams per kilogram.

Well, if it's pure diesel, that is a high number. But it's meaning they're not seeming to get below that. Now their endpoint was a drop in CO_2 production, and that's at 93 days. So they're not necessarily in total conflict with Dr. Sublette's testimony, because in general he was sort of saying, You've got to go a lot longer than the number of 93 days if you're going to get to what he calls the endpoint.

So what we're finding is some difference of opinion as to what's an endpoint, but it's a thing to be aware of, that there are uncertainties out there. And that's the best I can lead us to. When someone such as I scans the literature, you find variations and you say, What can be happening that we're not looking at? What do we not know.

Li group observed that when they -- they thought it was impossible to get the total extractable hydrocarbon to less than 1000 milligrams per kilogram, particularly if you had a high-molecular-weight crude oil. Certainly we've heard that here. But they said if you were as large as 20,000 milligrams per kilogram you might not affect the earthworms, you might not affect seed germination or initial growth, but that that didn't assess the plant growth.

They pointed out that your toxicity tests are generally done under optimum conditions of moisture and nutrients.

And then they bring up the question, maybe the reason we see a lot of these variations is that the soil is repellant to water, due to the hydrocarbons, and they say that might not be important when the soil is really moist, but it might become very important as the soil dries out.

They tested barley growth in a contaminated soil and in a bioremediated soil. They claim it had been bioremediated for three years. The major point they were trying to make is that toxicity is not the sole issue.

In our Exhibit 16, the top part of it, we reproduce their graph of barley growth. They show two graphs of -- what they measure is the shoot dry mass against the age of plant as it's getting towards some maturity out here at 50 days.

The two bottom curves are the contaminated soil and the remediated soil. They didn't get a difference. But in their control soil they got a good growth.

And they go on to try to relate this to the water repellency in the soil. What they did was add water to all of the soils in the same amount, whenever their control soil dropped below 20-percent volumetric moisture. They had a time-domain reflectometer in there, a tool that presumes to tell you how much moisture you've got in the soil.

And so they claimed all the soils were watered the same. They plot the moisture in their control soil, and then they also plot the moisture in the two lower curves, in the bioremediated soil, which is the circles at the bottom, and in the contaminated soil.

And what they noted was that the bioremediated or contaminated soils dried out in terms of volumetric moisture and got below the 1.5 megapascals of suction, which is generally regarded as the universal wilt point. And so they are saying maybe that is the difficulty.

In our Exhibit 17 we reproduce their graph of the water that they added to the soil and the leachate that they accumulated underneath the pan in which they grew the soil.

In the control soil, they leached only a total at the end of 100 days of about 5 percent of the water they had added. In the contaminated soil they leached 19 percent. In the bioremediated soil they leached 44 percent.

They said, Somehow this water in the bioremediated soil, and even in the contaminated soil, is finding the cracks, it's roaring down through the cracks, falling out the bottom of the pan, and never absorbing into the soil where the plant roots can get ahold of the water. They're asking, is that our problem?

They then took a little sample column of soil and said, Well, how long does it take for water, if we put water on top of that, to break the bottom of a sample? For their uncontaminated soil, it took -- universally, they said -- .6 of a minute. It didn't matter what the initial moisture content was of that little sample of soil.

When they worked with either the bioremediated or the contaminated soils, they found that initially it took longer for the water -- it took a minute, two minutes here -- for the water to soak through.

And finally, as the soil got well below 20 percent in moisture, it took longer and longer and longer for the water to break through. That is, something about the surface of that soil was not allowing it to be absorbed, apparently, at the top surface.

So they conclude that water infiltration in hydrocarbon-contaminated soils was dominantly along preferential flow paths, and they even suggested that land -- tests for land disposal should assess water adsorption as well as hydrocarbon content.

That adds a complexity. So can we look for some way to resolve the complexity?

CHAIRMAN FESMIRE: Doctor, would you be amenable to taking a five-minute break?

THE WITNESS: This is fine.

CHAIRMAN FESMIRE: Okay. Why don't we break for five minutes and come back at eleven o'clock?

(Thereupon, a recess was taken at 10:55 a.m.)

(The following proceedings had at 11:05 a.m.)

Dr. Neeper, I apologize for the disruption, but you may continue.

THE WITNESS: I think you for the disruption.

(Laughter)

CHAIRMAN FESMIRE: You and me both.

THE WITNESS: I previously showed you some material from Li, et al., who brought up the issue, maybe the problem with the plants they were growing was not toxicity to hydrocarbons, per se, but had something to do with how the soil was altered by the presence of those hydrocarbons.

Roy and associates studied the hydrophobicity on actual petroleum field sites in Canada -- I believe it was Alberta. Dr. Sublette brought up Roy's study as well. These were just sites out in the field, and the vegetation and the soil structure didn't have a simple relationship to the hydrophobicity, at least as Li noted.

Here we get into the acronyms again. I want to explain them because they simply become axes on the graph. Roy used the methanol -- ethanol-plus-water drop test as a measure of hydrophobicity and called it MED. You just need to think of it as, that's a measure of how the soil tries -- how much the soil tries to reject the water. It really asks, how much ethanol do you have to add to a drop of water before that drop of water will soak into the soil.

Likewise she used -- where we would like to say TPH, she used something called DEO, which was a gravimetric measure of the hydrocarbons in the soil after you did a methylene chloride extraction.

Here's a graph of some of her results, shown as our Exhibit 19. Each dot represents the hydrophobicity, measured as MED on the vertical axis, against what we might like to call some form of TPH measure, the DEO on the horizontal axis.

You can see that there's a scatter. There's an association but it's not simple, it's scattered all over. So I said, How can I find something simple that we can all deal with, like a TPH, and yet be assured that I'm not getting into a dangerous area in the hydrophobicity?

The hydrophobicity throughout many parts of the literature quotes an old association that was made, I guess, by the first author that looked at this kind of thing where he says, well, an MED of 1.2 is kind of where it goes from slight to moderate, and 2.2 it goes from moderate to severe. Since other authors used that, I asked myself, How can I get down to where it's always going to be under 1.2? Rather than asking industry to give me a zero, can I get something I can live with?

I noted that if I drew a vertical line at 2000 DEO, however that may relate to our TPH, I still wasn't there because about half the points back to the left of that 2000 line fell above the 1.2 and half of them fell below the 1.2.

In other words, it was difficult to find any kind of a unique correlation between the hydrophobicity and the total petroleum hydrocarbon remaining in the soil, even though we can all see the more hydrocarbon, the more likely it is to be hydrophobic. But you couldn't get just a single, simple answer out of that.

Was Roy testing the right thing? is a question. Well, Wallis evaluated hydrophobicity of non-petroleum-impacted soils. These are naturally hydrophobic soils. I believe Dr. Sublette mentioned they're hydrophobic due to burning of plant materials that grew on the ground. And Wallis simply used three tests.

One he called a repellency index which has to do with, Does it absorb ethanol? How much easily than water?

The MED test, like Roy.

And the water drop penetration test. How long does it take a drop of water to soak in?

This in our Exhibit 20, we simply give you a bar graph of the results of Wallis. You're not supposed to take home all these numbers and make sense out of them, that isn't the object. The object is to show that at these low values of hydrophobicity these weren't oil-impacted soils.

There's at least a little agreement among the three tests. The MED test is usually down here at non-detect. And if we were to use a test, we certainly don't want to be asking the operator to use some kind of test that gives you false positives. So if we were to use a test which seems reliable, based on Roy's work, it would be the MED test. We wouldn't be using the other tests.

It gives me the feeling there is a reliable test out there if we want one, and that would be the MED test. If we want to test hydrophobicity, we should look at the MED test or find something better, if we can find it.

All right, you have seen data in some ways in terms of an interpretation that scatters in all directions, plants grow or plants don't grow, seeds grow, seeds don't grow, you remediate a lot or you remediate only a small fraction of the hydrocarbon. Can we put a lot of it together?

There was an at-length review article by Sarah McMillan, and she confirms the lighter the oil, the greater the bioremediation in general. She looked at costs and found that landfarming and landfilling were the two lower-cost options.

This slide we've seen in other testimonies. This is the maximum amount of oil and grease she showed as a function of API gravity, and I got that in as an exhibit, not knowing what other exhibits would be, so it's still in the exhibit package.

These are her estimated costs, and on it I just draw a little red line. She showed her estimates for land treatment, which would be for landfarming and for landfilling, where in her estimate the cost sort of picks up where land treatment leaves off, but it's still not huge like a thermal-treatment type of treatment. The cost really depends on where you are and what's available to you, but these are the low-cost options out there.

Salinitro, who is the first author on that previous key study, also wrote a review article looking at the results of many bioremediation tests. I abstracted a pile of numbers, not for you to remember them all. I took the numbers that were in the tables in this, which is shown as our Exhibit 22 at the top, and tried to gather them according somewhat to whether they were looking at crude oils or other sources of the contamination.

I threw out -- just deleted all entries that had less than 160 days' remediation time, and said, What impression can we get from this as we look down? If they remediated long enough, something like a year or more, how much can they lose?

Well, here's an API of 14, they lost only 10 percent, we understand that.

Here's an API of 39 weathered -- that's a little like New Mexico -- they lost 80 percent. I believe that's what OCD was saying was kind of possible for New Mexico oils.

And then we find every other number in between. If we page down through this list where we get to oily waste, something like this may show up in commercial landfarms, you don't know the source, it's an arriving truck of some kind, and you find about any kind of number you want to measure here, you might look for.

But right in the middle of all this is about 50 percent. Some things can be remediated better, some things cannot.

Likewise, they looked at diesels. They got remediations as high as 95 percent, but not always, and if you want to know more about it, you'd have to go back to the original study. Sometimes 74 percent. Well, we know where most of the diesels are going. If you let it out in the open it evaporates.

They got so far down as to heating oil and bunker oils. Some of the heating oils evaporated well like diesel, the heavy bunker oils did not, and that's probably no surprise to anybody.

So what conclusion can we make?

Yes, light hydrocarbons remediate faster.

Remediation of BTEX is more evaporation than biological, we're just transferring pollution from soil to air.

We can find numbers anywhere between 40 and 90 percent that says crude oil might be remediated. The final TPH is often some number larger than 1000 -- that supports the conjectures we've heard that it's difficult to reach 1000 -- if the initial is greater than 10,000 -- that tends to support OCD's desire that the incoming concentration be held quite low. So we're faced with a scatter of data.

Toxicity is reduced, it may not always be eliminated.

Bioremediation can nearly always eliminate seed toxicity. Some plant growth may still suffer, and that may or may not be due to toxicity.

The studies by Lee suggested that a toxic compound is produced with diesel. It may not persist because it's not reported in longer studies.

We find that residual hydrocarbons can damage plants simply by causing the soil to repel water. And in our long-term result this may be something we have to look for. We do not have a lot of experience of looking in New Mexico whether we are creating hydrophobic soils out there. We may need to be aware of that.

There is not a simple relationship between the hydrophobicity and the petroleum TPH, so we don't get to hand you a simple answer, but we can say there is a simple test if we want to use it.

Now this begins to sound like there is no science regarding hydrocarbons. You might say there's no TPH that will avoid a wide variety -- all damage to a wide variety of plants, or that is guaranteed to avoid hydrophobicity.

You know the smaller the TPH, the better protection.

What can you come to? Well, if you look back through that, you'd come to a conclusion that 10 percent of the hydrocarbons is clearly too large. It's a large swat.

You might come to a notion that 1 percent is risky. And then you'd say, If I thought that were risky, why would I join with a part of the industry and be even acceptance of a 1 percent in a bioremediated landfarm? Well, I get a lot of other advantages with a bioremediated landfarm, so maybe I can afford that risk.

If you look at it, you'd say .1 percent is conservative and safe. That is where the OCD proposal is. You may or not be able to achieve that in all circumstances. The literature says sometimes you can, but it says sometimes you can't, and that seems to be what's being found out in the field as well.

So it looks like this, scientifically, is a conservative and protective proposal. This is a risky proposal but we can attach some guarantees to it. If you wanted to go another factor of 10 up, I think that's clearly too large.

Statistics and sampling. How do we know we get to .1 percent or 1 percent or 10 percent? How do you sample an area of ground? It's a question of how many samples do you acquire? At what interval across the ground do you take them? Because you're trying to assure that the contaminants in the landfarm are less than the regulatory limits. I think that's what you're trying to assure.

So how many? What is the spacing? Assurance. Those are statistical concepts.

Concentrations will vary from place and from sample to sample. We noted even in the laboratory studies, Salinitro said his samples -- he had mixed his samples in a cement mixer, and still he got a 10- to 20-percent variation.

Chaineau in his biopiles was getting a 50 percent. He'd go to the same pile, take a second sample and get big deviations. He'd get 25-percent consistency when he was tilling in windrows.

So even if the waste from the landfarm were from a single source, a single original place, mechanically mixed before treatment, we might expect spot-to-spot variations of probably something like 25 percent, because that seems to show up in the laboratory studies.

And so I say, But that would be an ideal case.

What might the variability really look like?

I made up a story for myself. A dump truck contains 20 yards of waste. That gives you about an 8-inch lift on a 90- or 100-square-yard-type area. An acre of landfarm could accept about 54 such truckloads in a lift.

Now if it were a commercial landfarm, the original concentrations of the waste would probably vary within each truckload, and the nature of the waste would vary from truckload to truckload. Somebody who's cleaning up a spill is going to get some clean soil on the edge of a spill, he's going to get some very dirty soil right in the middle of a spill. You've got all of that going into one place in the landfarm, and so even if the wastes were mixed, you'd expect a large variation in the TPH concentrations.

I just drew a picture. This an area of ground. For the moment I'll think of it as an acre, and if we discuss other things, we can think of it as any other acre. But the question is, if I go out and throw some darts here, how can I know that these three truckloads in that landfarm weren't really hot, as they say, and everything else is fine and we don't have three really hot areas?

If you take individual samples, you probably do not have a normal distribution. It's called normal distribution in statistical language, where you have a given variation, like an accidental variation about the mean. In fact, the EPA says it's unusual to encounter normal data in environmental sampling.

So if you take many samples in one acre and you composite them to a single sample, you're going to get a good estimate of the average throughout that. You're not going to know much about the variation.

So I put up an extreme example. Suppose for half of an area I have concentrations of 100 and for some other half I have concentrations of 900. If I mix those all together I'm going to get the average, which is 500, but that's not representative of either situation.

This is a slide from almost any statistics textbook. It says you have a mean. If you have a normal distribution the number of samples you would get scatter about that mean according to this curve. And if you specify an alpha, that tells you you have a certain percentage of your samples will show up out here. And if we specify an alpha of .1, five percent of these samples will show up out here, and five percent will be way low. So that's what we mean when we say an alpha of .1, if we have a normal distribution.

I got -- Just an illustration. If you had a standard error of .25 -- that's kind of sample-to-sample variation -- and an alpha of .1, and you just threw down the dots where each dot is the measurement and you do on it these 90-percent confidence interval error bars, and you had a mean of 1 there, it were all going to average to 1, what would the distribution look like?

Well, being statistical it didn't even come out even. There happened to be more dots fell on this side than on that side. And I didn't do this myself, I took it from an expert in statistics who works at the Educational Testing Service. But it just gives us a feeling for how things scatter about the mean, when we're talking about a 90-percent confidence interval, there's going to be some scatter.

So for regular landfarms -- and here I'm distinguishing a regular landfarm from a bioremediation endpoint landfarm; I want to be clear about that. I'm saying for a landfarm, all the commercial landfarms out there, I'm thinking we're not asking whether the average exceeds the standard, because they get truckloads of every kind, from every place, going all over. What we want to know if we could is whether any of the remaining waste exceeded the standard.

The best -- I wasted a lot of time trying to come up with a solution, I'm not a statistician. The best I could come up with is, let's set the standard so that fewer than 5 percent of the samples would exceed the standard according to the measured standard deviation. You get enough samples, you've got some deviation. In other words, you set your standard not at the mean but at that upper 95-percent point. You just set your standard at two standard deviations up. That would give the environmentalist a lot of confidence.

Now for landfarms with a bioremediation endpoint, we're really interested in whether the concentration is changing any longer. That's a major focus. There is an upper limit, but this is the key to the regulatory limit. And so we're interested in whether the change of the average indicates a change in the whole.

And so there I couldn't prove that my system was any better, and maybe it was worse, than Dr. Sublette's. You acquire a composite of many samples over a small area, and you acquire several sets of those composite samples at two different times, and you ask if the change of that given area is zero. And I think we came up with like an acre size to composite the samples.

MR. HISER: For a commercial landfarm?

THE WITNESS: Yeah. Yeah, we didn't get into the registered small landfarm. That's saying if you can get down to an average in a bioremediation with no change averaged out over an area, you've probably -- probably got there.

There isn't a perfect way to measure a small number of samples. Given the great diversity of materials expected in a commercial landfarm as contrasted with a centralized landfarm, it seems wiser to use a smaller sampling area for the commercial unit.

For a centralized unit, we would hope the operator knows what he's putting in there and gets a more uniform -- waste from a more uniform origin. Then you could go up to maybe two acres and sample over two acres.

We come, then, down to discussing in terms of this background, what does the Rule mean? Or what would the Rule propose? And the first thing I look at -- and now I'm actually discussing parts of the Rule.

The Rule -- the proposed Rule is $25,000 for a centralized landfarm, $50k for a blanket bond, $25k or estimated cost for commercial.

And we're caught trying to issue a caution here. The estimated cost for landfarm should be based on what has to be the ultimate. We've heard of it. It's waste removal and site restoration. And that needs to apply to centralized and commercial facilities.

We're waving a red flag here. I am not a construction estimator. I made up my own story of what I thought might cost because I want to have some idea. That's all this is. I am not proposing these are exact numbers, I'm saying this was my guess.

After having someone else make a phone for me, and I made a phone call, I said the waste acceptance, if you had to dump it, is $14. I just heard from a producer, well, he's found from a place where he can dump it somewhat cheaper.

So okay, I took a guess that a dumptruck is costing about $85 a yard [*sic*] for a truck of that size, that you could load just as fast as you could load with a row of trucks coming up for probably $1.50 a yard.

And I said we've got wastes two feet deep, a haul distance of 25 miles -- you pick any number you like -- and a round trip time, including loading, of an hour and 15 minutes. What does it cost me to empty an acre? I came up with a landfill fee of about $45,000, a truck cost of $17,000, a loading cost of about $4000 or $5000.

I said what does it cost me to restore the site after all that's done? Maybe $5000, you can put in a zero if you want. There's a tax, I looked up the Lea County tax if you're out of town and added that in, and I came up with something like about $75,000.

That is not a correct number, that's simply waving a red flag saying, our bond at $25,000 is not likely to come close, because this is one acre, not an unlimited number of acres. And so the bonding leaves me uneasy.

We would like to see the bonding include a realistic cost proportional to the area in some way of the landfarm. We, no more than other people -- we would rather not see that it costs -- if a landfarm ever did fail, we would rather not have to see it revert to the well-plugging fund.

We would firmly agree that landfarm operator should be allowed to show that his cost could be less than any kind of standard, and set his bonding accordingly.

Design of facilities.

This is the thing where our Rule is talking about the 50-foot depth to groundwater, based on the transmission of chlorides by infiltration. We've said we're uncomfortable with that, we would feel better with 100 feet. We've been on record throughout these proceedings as 100 feet.

And it came to me, there is another reason. It's far too late in the proceedings for me to bring it up, but it's within my technical background.

I have looked at the vapors from landfills. Now these were not good landfills with the kinds of liners that you are requiring, but I was tracking the vapors at 250 feet below the landfill. So had there been water down there, the vapors would have been dissolving in the water. There was no water, and there was no damage done.

But it gives me -- given the kind of layers you're putting in the bottom of the landfill, I'd feel more comfortable with 100 feet if we said no surface waste facility, except a small landfarm should have less than 100 feet to groundwater. The small landfarm should be exempted from that.

That simply brought that into conflict with another part in the proposed Rule, which is saying -- the Rule said if the depth is greater than 100 feet, the operator could propose an alternative based liner. I'm simply suggesting, all right, plug in a different number there, 125 feet if you like, to give him that option.

But I see a stronger "or" we'd like to offer him. If there is a geologic layer beneath the waste that provides protection equivalent to the prescribed base layer, I think that's what we'd really like. If you can encourage an operator to choose a geology that's more protective than what we're prescribing, let's lift the prescription.

I have had some questions with landfill design. The present proposed Rule specifies a 25-percent slope on the finished -- closed landfill. Industry proposal is for a 33-percent slope. And I have a little problem with allowing us to bury the wastes above the ground. This leaves you above ground level.

The Rule implicitly allows burial of waste any height above the ground. So if subsequently you had any erosion of that cap, it's going to expose the wastes to dispersal on the ground surface. If they're beneath the ground surface you're not going to have that dispersal, you're going to have some other problem.

But it has been my duty to walk on landfills that have failed -- or I would call them failures -- and at least no damage was occurring due to what happened to the caps. And therefore we suggest that wastes should not be buried above ground level.

The proposed rule allows the 25-percent slope. There is no one unique number that is good for everywhere. We suggest 8 percent, in agreement with the API publication that says, Erosion is a potentially severe problem if the slope is greater than 8 percent. That's probably as good an authority as we could find.

In the top cover design, the proposed Rule would require a gas vent layer of sand or gravel, 12 inches thick, above the waste. Commissioner Bailey, with great insight, at one point said, Wait, if we bury these wastes down there and they're salty, isn't that salt going to come up? That's a very insightful question. I have argued for some time for the presence of a capillary barrier, and it finally struck me, if this layer of sand or gravel were simply gravel, it would serve as a capillary barrier and we'd have it. It's already implicit in the Rule, if we change -- took out the words "sand or gravel" and just left "gravel".

Monitoring and sampling. How do the previous arguments relate to sampling?

The proposed Rule specifies four samples per cell, but "cell" is defined only as a confined area. The entire landfarm could be a cell.

Now most operators don't operate with the entire landfarm being a cell, but certainly I don't see a prohibition that an operator could not declare his entire landfarm to be a cell. He puts a berm around the cell, it doesn't matter what's in it, what -- if he has other berms inside it.

So we therefore suggest something -- some identifiable maximum cell area that's manageable. It's in the past been 5 acres, it could be 10 acres, but we suggest that a cell needs to be defined as limited in area so that you can define sampling better. Otherwise in principle, the Rule specifies you have four samples per landfarm, and I think in enforcement you'd have a hard time arguing your way out of that.

The Rule specifies sampling at three to four feet below the cell's original surface and comparison of test results with background concentrations. And there's been a lot of discussion about background concentrations. We can see that this could lead to arguments regarding statistical comparison of the variation that would occur in both your background and your monitor samples.

I've tried to deal with that and say, What could I suggest that might be simpler, that's acceptable? We would suggest the monitoring requirement be that no sample exceeds the closure conditions. If you're meeting closure conditions beneath the cell and meeting closure conditions at the cell, at least you've confined it, and you've gotten yourself away from the argument of whether you are one molecule away from background. And if the closure condition is safe enough at the cell, it's probably safe enough right under the cell. So we would be willing to concede that.

What leaves us uncomfortable is that the monitoring is allowed -- vadose monitoring is presently specified at a depth up to 4 feet below the cell. We suggest 2 feet, because by the time you detect something at 4 feet it's probably too late. You've contaminated a lot of soil. But more importantly, you're probably not going to detect it during the time when that landfarm is active, and your trouble is going to show up later.

We think you need to monitor closer, and we recognize there are arguments of, how can you be sure that you're getting a valid sample? The operator might not know where the bottom of the cell is. Well, he's supposed to know where the bottom of the cell is, because he's supposed to sample throughout the depth of his wastes, and he's supposed to know how much he put in there.

We might argue that as you start a cell you could put up a couple of cement-block monuments on either side and pretty well keep track of where you thought the bottom had been. But our suggestion is to try to get at a shallower depth to give you more valid sampling, an earlier alert, but to raise the level at which you break the standard. Get it up to closure standard, rather than holding it right at background standard.

We're proposing that four samples alone is unlikely to detect releases which will -- if they occur in the lifetime of the landfarm, they're going to occur at particular locations such as preferential pathways. All we can suggest is increasing the number of samples.

Now that gets more costly. But if we double the number of samples and halve the interval between events, we actually reduce the cost, because it costs you a certain amount to mobilize just to do the sampling.

So we would suggest that at least one sample at any place where you collect rainfall, but doubling the number of samples and halving the -- and reducing the interval between samples.

Why is that -- Why would you reduce the interval between samples? It's just that this transport occurs slowly, and so you may be safe enough to sample at a less frequent interval.

Based on the impacts to plant growth, we recommend the treatment zone closure standards for chloride not exceed 500. That's safe. We're not going to be upset if that goes to 600. We're trying to aim at that EC 4 point, and whether it's 500 or 600 is not terribly important as 500 was in the middle.

This does not prohibit an operator from accepting wastes with more chloride. If he has to detail-sample every load of incoming waste, we've laid a burden on him. But if he can average it out and spread it out so that he can meet, in the end, his closure standard, then he can accept waste up to the proposed waste acceptance of 1000, and he's still okay.

We're not interested -- we're not worried about the chloride in one load; we're interested in the final outcome of the landfarm, and we don't want to overly constrain the operator.

There has been discussion of all of the 3013-type chemicals that appear in OCD's list. There are standards there for BTEX, and there are standards for other volatile organic compounds.

Some VOCs may occasionally occur in landfarms, as we've heard in OCD's testimony. I'm saying, based on both the modeling and the pore gas measurements and the detailed measurements of subsurface pore gas movement that I've done, if you have VOCs or BTEX in the landfarm, those vapors are going to briefly diffuse down into the ground, and they're going to get carried back out as the barometric pressure changes. And the main thing is, they're going to be puffing in and out of there, in short distance, every day. That will happen when you add a new lift, because you've got a fresh source.

We don't want to trigger a false alarm, so we're saying it may not be necessary to test the vadose zone for VOCs and BTEX routinely, but prior to adding a new lift you should. You should know that you're not running this stuff down into the ground continuously.

What would happen? If they're so volatile as I say, how could they ever go down? Why wouldn't they just come back up to the atmosphere?

If you had a high organic carbon content in the ground, they would adsorb on the carbon, and then after a while you'd build up an inventory. And in the time it took you to remediate a lift, you might then have a detectible amount on the soil.

But when I was acting as an operable unit project leader, we sampled at depths to 300 feet, often at five-foot intervals, in a plume that healthwise you didn't dare breath, and we -- of those hundreds of samples, I think we picked up one where we could detect it on the soil.

They don't adsorb onto the soil unless you've got carbon in the soil, or certain minerals. And so right beneath the landfarm, yes, you're going to get some of those volatile compounds. But what I'm trying to say is, I'll trade quantity of sampling for a little quality of sample in the place we need it, and at the same time I think I can reduce the cost to the operator.

In treatment zone standards there is a proposed standard for lead, and that caught my eye. That's set according to human exposure. Humans do not graze on the land like cattle and wildlife. The Region 6 closure standard for lead is 56 milligrams per kilogram for mammalian wildlife, and we are suggesting that be set because really grazing is the most likely initial use of these landfarms afterward. We're not being overly restrictive. If we were to put in the standard for birds, you'd get a lower one.

This is a picture just showing the top half of a document and a picture of a table taken out of the document simply showing the avian standard was 11, the mammalian standard was 56 for lead, screening level. For plants it's up at 120.

Small landfarm. For a small landfarm we would suggest, as for other landfarms, the chloride standard should be the same at 500 or, if you wish, 600 milligrams per kilogram.

Small landfarms, again, we would suggest that sampling be done at 2 feet beneath the treatment zone. Clearly with a small landfarm we should know where the bottom of the soil was when you started.

And the Rule proposes a single sample be taken at 3 to 5 feet. That will just about guarantee you a clean sample, because if something's getting loose it won't get down there. So again we're back to suggesting a 2-foot sample.

Finally, we're discussing the bioremediation endpoint. We have specifically agreed, in discussing with the industry, that a permitted landfarm, using a bioremediation endpoint, might employ a 1-percent closure standard in lieu of the 80-percent reduction. Why would we do that, being environmentalists?

We're interested, really, in the outcome. We're interested in the 1 percent much more than how we got there. That's really what's motivating us. Recognizing that if you start with high concentrations or heavy oils, you're not going to get there. You're just not -- you're not even going to get to the 1 percent. We're focusing on the closure rather than the reduction.

We've agreed that an SAR closure for these landfarms might be 13 rather than 5 or 4, as we otherwise recommend. Why? Why would we take that SAR of 13? That's -- in our opinion, that's right at the death zone.

We're leaning on the fact that what's coming into a bioremediation landfarm is not pure salt, it is constrained by that EC of 4. I had talked with Mr. Price at some time of the advisability of getting an SAR standard throughout the state. His feeling was, if we have chloride control, we will have sodium control, and we don't need to lay on yet another standard. So I simply got away from it. The 13 is, I think, pushing the death zone, but if we can constrain the chlorides we shouldn't get the chlorides into the sodic condition in the permitted landfarm.

Now we have said that a permitted landfarm using a bioremediation endpoint might have asphaltic particles a half inch size covering 1 percent of the surface. Why would we agree to such a thing?

We're trying to get that in exchange for what we hope is superior vegetation that's going to result from soil amendments and water that we understand is going to be used in these landfarms.

We wouldn't regard that limit as acceptable in landfarms that don't have the maintenance, the water and the assurances that have to accompany the bioremediation endpoint. Let's take one step at a time.

We don't think you should just deny the possibility of trying the bioremediation endpoint, but you've got to have assurances that it's tried in the best possible way. If it proves successful, then we ought to look for compliance mechanisms of how then we can allow it in small landfarms. Presently small landfarms are basically uncontrolled. And so you can't go there now, you can't see how to achieve the compliance with the conditions that bioremediation endpoint requires.

So we're a little skeptical at this approach of whether it's going to work in the climate of New Mexico. We've heard discussions of, Is there water? Will it work? We're simply suggesting it should not be prematurely rejected. We're asserting that compliance with the moisture and closure conditions have to be financially assured. And I've given you an example of what that financial assurance might be. It could cost a lot of money to clean out an acre of land if you can't do it otherwise.

But we think -- industry is saying, We feel it's good enough and we'd be willing for you to try to make some assurances on that and get some water. If they can, then they should try.

Now we have a caution -- and we heard this caution come up in discussion yesterday -- that for the endpoint to be permitted -- and it is a permitted thing -- the operator must demonstrate that he is the one with access to the water -- it might be leased water, but he has to be the one with the access to it -- and that he can legally use that for this irrigation purpose. The State Engineer is sensitive to shifting purpose of beneficial use of water, I think.

We understand that if you were just to drive up to a ranch and begin loading water from their stock tank in return for money or something, that that would not be legal. That would have to be checked with the State Engineer.

But what we're bringing up is, OCD rules should not encourage a black market because OCD could say, That's fine, you're going to water your land, we will give you a permit to do it, but the State Engineer would have not cognizance of this, and OCD would have no cognizance of where the water was coming from. Somebody should have cognizance, and therefore we're asking that the permitting agency, which is OCD, assure that there's access to the water, that it's legal access, and can be used, and that's all. And if you've got the water, let's give it a try, let's see what happens.

We have to have the financial assurance. We see that that can vary according to the active area of the landfarm, the amount of area you've got open with wastes on it at any one time. We felt, just based on that little study I put together, maybe that amounts to $75,000 an acre, or the amount that's sufficient to cover -- this is the important -- sufficient to cover removal of the wastes and restoration of the active areas. Not the area that has not yet been opened, not yet put in the cells, you bond just the active area. But we feel it's very important to have financial assurance.

We haven't come up with the exact -- and how it will be achieved.

That concludes my presentation.

MR. SUGARMAN: And I'm going to -- I have just a couple of questions that I'm going to be asking Dr. Neeper now, but I'd like to take him outside for about 60 seconds, if I could, and -- so he's not blindsided by what I'm going to ask him.

CHAIRMAN FESMIRE: I'll allow it if there's no objection. It's the kind of thing that might raise a little bit of an inference of witness-coaching, but --

MR. BROOKS: The Division --

CHAIRMAN FESMIRE: -- is there any objection?

MR. BROOKS: The Division has no objection, Mr. Chairman.

CHAIRMAN FESMIRE: Mr. Huffaker?

MR. HUFFAKER: No objection.

CHAIRMAN FESMIRE: Okay, go ahead, Mr. Sugarman.

(Off the record)

Q. (By Mr. Sugarman) Dr. Neeper, at various times during your testimony you referred to variability in the data and uncertainty with respect to what you can expect to see in a landfarm; is that correct?

A. That's correct. You expect to see large variability in samples. You may not, but I think you have to prepare for that.

Q. And is it your opinion that landfarming is more or less experimental in nature in New Mexico?

A. Well, in New Mexico our so-called dryland landfarms, we have minimal experience with actual closure of those. So in a sense we're doing a real-time experiment. We have -- I believe -- I'm not aware of any that have been closed. There probably have been some, but I haven't visited any closed landfarms.

We don't know exactly how that's going to turn out when we try to close. Does that mean we shouldn't landfarm? No. But it means we're not sure what we're going to face when we come to closure condition.

Q. And given the variabilities and the uncertainties which attend this rulemaking, what is your expert opinion regarding the effort -- or rather the adequacy of OCD's proposed Rule, and do you feel that OCD's Rule is based on sound science?

A. I'll answer the second question first. I feel that OCD's Rule is based on sound science, even at the points when I argue with it. I have argued strongly with their justifying the depth to groundwater beneath all waste facilities being set at 50 feet, based on modeling. That modeling is sound science, as far as it goes; it just doesn't cover all of the conditions that might appear, and I'm therefore much more comfortable with a greater depth. But there was nothing wrong with the science that was done.

Given the wide variety of impacts of hydrocarbons on plants at the surface, they must have surveyed the literature or done something to come up with their .1 percent closure condition. I see that as very sound science. I also see it as conservative. You might be able to raise it in some conditions. I have agreed in a particular case to raise it to 1 percent. But I've put all kinds of caveats on that until we get experience with it and see where it goes. So the scientific literature clearly supports that.

We have not been regulating anything based on hydrophobicity, we don't have an established EPA test for it. We know scientifically there's a danger of it out there.

OCD has chosen not to regulate hydrophobicity. I could argue with them on that, but they can make an argument that they do not have a standardized test and they do not have enough science in hand to make a regulation based on that at this time. And they would give me the graph I showed of Roy's data and say, Are you going to set one number off of that scattered graph, because that's what the regulation is? And I'd have to say, You can't do that.

So OCD is, I think, in good places. I argue with them on some of the numbers, but I feel they're pretty sound.

Q. Dr. Neeper, towards the end of your testimony, Chapter 2, if you will, when you were talking about proposed regulation and you had gone past the science portion, you stated on a number of occasions that you have agreed with industry as to where certain standards ought to be set. Would you explain to the Commission what you mean when you say, We have agreed industry, and what the process is by which those agreements have been reached?

A. I can describe the process. I'd like the agreement to speak for itself, because otherwise you get my interpretation and their interpretation, and they should also be allowed to give their interpretation. But let me first, then, describe the process.

Somewhere -- I can't remember how it started, but we got to talking about the bioremediation endpoint and landfarms. And I was even more skeptical of it than I am now. And I shared my skepticism with Dr. Sublette, and we went through various iterations of discussing how can their interests as -- in the industry and our interest as environmentalists be joined? And we could come down to the proposed numbers that we came up with as saying, That's a place we can try; so long as we have those set of numbers joined together, we can try that.

For various reasons, there were attached conditions on which we did not reach a solid agreement, such as exactly how you go about the financial assurance -- I almost need to look at the piece of paper to see some of the other things, but we agreed that these things should be considered.

We agreed, for example, that financial assurance should be able to cover dig-and-haul-type removal, but that's the ultimate cure. But how to obtain that assurance within all the existing regulatory structure and the bonding limits that may apply to OCD's authority and whatnot, we couldn't solve those problems in that given amount of time.

So philosophically we have agreements in quite a number of areas, but we can't specify any numbers. But there are a few areas we could specify in numbers. Now neither one of us meant that a landfarm should go ahead, just take those numbers, and that's the totality of the regulation. Other conditions may apply.

What we wanted to say is, we can agree on that much of the numbers. And we as environmentalists think it's appropriate to try it if you apply all of the boundary conditions to it, all of the confining conditions, the water and the care and the tilling and the moisture and all those things you have to give to it. There's no way we should stand in the road of trying this. And so you can permit under those conditions, you can try it. It's down the road whether you can do this in any more general form, because those heightened closure conditions probably require more assurances or more experiences.

Q. And would it be fair to say, Dr. Neeper, that in some instances the agreements that you've reached with industry are for more stringent standards than OCD has proposed, and in some instances you've agreed to less stringent standards than have been proposed by OCD?

A. Within this realm of a particular bioremediated endpoint landfarm that has all of these assurances on it, we have agreed to 10 times OCD's limit for hydrocarbons. We don't know if that will work, but we're willing to see it tried if you can apply all the soil amendments and things that go with it.

Now likewise, we have all agreed to come in at about half of OCD's proposed limit on chloride. So in some cases we are more stringent than OCD, and in some cases we are more relaxed than OCD. In particular, we are more stringent than OCD on the chloride, and that is very important to me because chloride is a long-term permanent pollutant in the landscape.

Q. And just to clarify, when you say "we" in that answer that you just gave me, you're referring to who?

A. I am referring -- I have to think of which "we", because I was picturing the group of us sitting in the room. So subject to objection by industry, I would say the "we" there applied to the industry representatives and to the environmental representatives in the room.

Q. Now Dr. Neeper, are the agreements that you have thus far reached with industry embodied in a letter of May 5th, signed by Bill Carr for the industry committee, Dennis Newman also for industry committee, and yourself, that will be submitted to the Oil Conservation Commission?

A. That is correct.

Q. And is it NMCCAW's intent to continue to work with industry to reach further agreements or to see if there are further areas where agreements can be reached?

A. In this case and in almost all previous cases we have said we will try to go almost anywhere to talk to people, and so we would intend to continue talking to people here to see if there's anything further we can come up with.

We see real stumbling blocks in how you can apply the necessary financial assurance, for example, and there just isn't time to work that out.

So if we were to fold up and go home and say we'll never talk to anybody again, that would be totally outside the character of our organization.

Let me put that in a context. I think Dr. Bartlit would back me up on this, because it's all of his work. We've achieved a lot more in the air pollution area by talking to the engineers that run power plants than by taking everything through the regulatory apparatus.

MR. SUGARMAN: I have no further questions, but at the end of Dr. Neeper's testimony, direct testimony right now, I'd like to move for the admission of NMCCAW's 24 exhibits.

CHAIRMAN FESMIRE: Any objection?

MR. HUFFAKER: Not here.

MR. CARR: No objection.

MR. HISER: No objection.

MR. BROOKS: No objection, Mr. Chairman.

CHAIRMAN FESMIRE: The Exhibits 1 through 24 for the New Mexico Citizens for Clean Air and water will be admitted.

Is there -- Do we get to see the letter?

(Laughter)

MR. SUGARMAN: You will get a copy of the letter today, presumably.

CHAIRMAN FESMIRE: Okay.

Mr. Huffaker, we can begin Dr. Neeper's cross-examination. I would prefer, and I think Commissioner Olson would prefer, to put it off until the next meeting. I understand --

MR. HUFFAKER: I would prefer to put it off until I see the letter.

CHAIRMAN FESMIRE: Okay.

MR. HUFFAKER: That means the next meeting.

CHAIRMAN FESMIRE: Okay. Mr. Sugarman, at this time, if there's no objection, we'll go ahead and continue this hearing until the 18th of May.

MR. SUGARMAN: I don't have an objection to the process, but I am hearing something from Dr. Neeper here that he is not going to be available on the 18th of May.

CHAIRMAN FESMIRE: You can't be here, Doctor?

DR. NEEPER: No, sir. This hearing, as you know, has had multiple continuations. We have been pretty well prepared each time but we are now exhausted, and I have something in my calendar for that period that will not be interrupted. And following that period I have some surgery that also will not be interrupted.

MR. SUGARMAN: Mr. Chairman, would it allow us to go forward today if a copy of the letter were made available to the Commission members and to all parties right now?

CHAIRMAN FESMIRE: Well, I think Commissioner Olson has something that will not be interrupted. And we've got other folks that have got things that can't be interrupted.

MR. SUGARMAN: I hate to have -- Commissioner -- off the record, if we may? Commissioner Olson, how much time do we have right now? Have we exhausted all of our time for this morning?

COMMISSIONER OLSON: I've got a maximum of 25 minutes. I have to be in Albuquerque for a wedding.

MR. SUGARMAN: How much cross-examination do you have?

MR. HISER: Realistically, more than 25 minutes. I don't know how much Mr. Huffaker has.

MR. BROOKS: I have maybe one question, and I think that would be it.

CHAIRMAN FESMIRE: Doctor, would you -- Commissioner Bailey and Olson have a suggestion, if there's no objection from the parties, that -- would you all be able to prepare to cross-examine the doctor over a lunch break?

MR. CARR: You mean --

CHAIRMAN FESMIRE: Today.

MR. HISER: Continue right on?

CHAIRMAN FESMIRE: Yeah.

MR. HUFFAKER: We don't know until we see the letter. This is getting kind of silly, really. And it isn't any surprise to Dr. Neeper he wasn't going to finish today; that's pretty silly as well.

MR. BROOKS: Mr. Chairman, I would add that although we have a couple of things we'd like to clarify, the Division would waive cross-examination of Dr. Neeper to move things along.

CHAIRMAN FESMIRE: So -- If you all got a copy, would that be acceptable to you, or would you --

MR. HUFFAKER: I don't know, Mr. Chairman. I don't know. But I do want to object. We have this letter, everybody knows it's important, they hold it until twelve o'clock, then they pull it out and say we can't -- you've got to cross-examine us on it today, we can't ever come back. I object to that.

CHAIRMAN FESMIRE: Okay.

MR. HUFFAKER: That was premeditated, obviously.

MR. CARR: One, that was not premeditated. We've been trying to get this resolved, and even yesterday afternoon we were working on it. A draft of the letter, the original letter, was provided to everyone who was in the meeting after the hearing a couple of weeks ago. There are a couple of minor changes.

But I will tell you that Mr. Huffaker has not had an opportunity to review it, and to the extent that -- You can't ask him to comment until he has had that chance.

CHAIRMAN FESMIRE: Okay. Will we get a copy of the letter today?

MR. CARR: Mr. Sugarman?

MR. SUGARMAN: No, no, we -- Yes, I mean, you saw sort of a change in trajectory there, and --

MR. CARR: All right --

MR. SUGARMAN: -- and the letter is ready to sign.

MR. CARR: Okay. And I have the text of the letter that I can pass out unsigned copies. We have one that I have signed, and when it is signed -- and I'll make copies -- we can distribute it.

CHAIRMAN FESMIRE: But the text of the letter is the same letter that has been signed? I mean, that is the agreement?

MR. CARR: Yes. The letter I have -- I brought a bunch of them unsigned, to sign today --

CHAIRMAN FESMIRE: Okay.

MR. CARR: -- and they are exactly the same.

MR. SUGARMAN: As the signed letter.

MR. CARR: As the signed letter.

CHAIRMAN FESMIRE: Okay. Well, I think, you know, in light of -- well, the issues that Mr. Huffaker has raised, perhaps the best way to handle it is just to postpone the hearing until somewhere around May 25th, which is -- Is that a Thursday?

MR. BROOKS: May 25th is a Friday -- It's a Thursday.

CHAIRMAN FESMIRE: It's a Thursday.

MR. BROOKS: 26th is a Friday.

DR. BARTLIT: May I make a comment, Mr. Chairman?

CHAIRMAN FESMIRE: Yes, Doctor?

DR. BARTLIT: Let me just make a comment.

CHAIRMAN FESMIRE: Concerning the schedule?

DR. BARTLIT: Concerning the letter, the agreement.

CHAIRMAN FESMIRE: Must you?

(Laughter)

DR. BARTLIT: No, I mustn't do anything. It'll take about 20 seconds.

CHAIRMAN FESMIRE: Okay, what is it you wanted to say about the letter?

DR. BARTLIT: I just wanted to say that it was said that this was withheld as a plot, if you will, by coordination. That was not true. If it appears that way, I'm sorry, which puts me in the position of most of the political figures in this country today.

I do understand Mr. Huffaker has a legitimate -- to see the letter ahead of time is a perfectly appropriate requirement -- request -- and I'm sorry if we didn't get it out, but it was not any grand plan.

CHAIRMAN FESMIRE: Okay. Is the 25th acceptable to you all?

Mr. Carr, Mr. Hiser, is the 25th acceptable to you all?

MR. HISER: If Dr. Neeper will give me access to my calendar...

CHAIRMAN FESMIRE: Okay.

MR. SUGARMAN: Mr. Chairman, Dr. Neeper is signaling to me that the 18th, if it's available, would be a great day for us, 18th of may.

DR. NEEPER: May I speak, Mr. Chairman? It's not that it's not that it's convenient, it's another 500 miles of travel on that day, but if that's the day when all parties are here, in a circumstance that's looking bad I would rather not cause inconvenience for the other parties.

CHAIRMAN FESMIRE: Well, the 18th would be ideal because that's our normally scheduled hearing, and we have nothing else on the docket. So why don't we plan on reconvening on the 18th, then? Is that acceptable to you all --

MR. HUFFAKER: No.

CHAIRMAN FESMIRE: -- if you get a copy -- No.

MR. HUFFAKER: Mr. Marsh is not --

CHAIRMAN FESMIRE: Well --

MR. HUFFAKER: -- as you already know, is going to be out of state on the 18th.

CHAIRMAN FESMIRE: -- right, but we're -- we will have the deliberations after -- on the 18th we'll take the final arguments, with the exception of Mr. Marsh's, and then we'll reconvene at -- on probably the 25th to hear the last final argument from Mr. Marsh and begin the deliberations. Is that acceptable?

MR. MARSH: That's acceptable.

CHAIRMAN FESMIRE: Okay. Mr. Carr, is that acceptable to you?

MR. CARR: Yes.

CHAIRMAN FESMIRE: Mr. Brooks?

MR. BROOKS: Anything is acceptable to me.

(Laughter)

CHAIRMAN FESMIRE: Thank you for your flexibility.

Dr. Neeper?

DR. NEEPER: Did I understand you to say May 25th?

CHAIRMAN FESMIRE: We will go on the 18th --

DR. NEEPER: You'll go on the 18th.

CHAIRMAN FESMIRE: -- to finish your cross-examination and to begin closing arguments. The last closing argument -- We will then, when we hear all but Mr. Huffaker's or Mr. Marsh's closing argument, we will continue to the 25th, at which time we will hear the last closing argument and begin the deliberations.

The next subject we have to cover. Attorneys -- Prior to the beginning of the deliberation, we're going to ask the attorneys to submit proposed findings and to submit a copy of the last full draft of the proposed Rules with any changes you would want to see made.

The Commission intends to work through the draft section by section, and if we have a -- one document from each party showing their proposed changes, it would be much easier to keep track of the changes and accept or reject those changes and fully consider each change submitted that way.

MR. BROOKS: Mr. Chairman, because of -- I ask this question because of concerns you've expressed in the past. In what form do you want those changes? Do you want them in the form of a redline draft, or do you want them in the form of a list of specific changes to particular portions of the last draft?

CHAIRMAN FESMIRE: I would prefer a list. Is that acceptable to a Commission, or would you rather have a redline?

COMMISSIONER BAILEY: Redline is easy for me.

COMMISSIONER OLSON: I kind of like redline, yeah.

CHAIRMAN FESMIRE: I've been outvoted, it'll be a redline.

MR. BROOKS: Thank you, your Honor.

MR. SUGARMAN: From which -- the February twenty- --

CHAIRMAN FESMIRE: From the last complete draft, which I believe was February 27th?

MR. BROOKS: February the 27th was the last complete draft.

CHAIRMAN FESMIRE: Okay. So with that I'm going to ask, is there anybody who -- in the audience who wants to make a public statement on the record?

Seeing none, we will adjourn until nine o'clock a.m. on the 18th, and at the end of business on that day we will adjourn until Thursday the 25th at nine o'clock a.m. in this room. Okay?

Thank you all very much.

(Thereupon, recess was taken at 12:14 p.m.)

* * *

CERTIFICATE OF REPORTER

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

I, Steven T. Brenner, Certified Court Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Commission was reported by me; that I transcribed my notes; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL May 23rd, 2006.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 16th, 2006