STATE OF NEW MEXICO
ENERGY, MINERAL AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

ORIGINAL

APPLICATION OF THE NEW MEXICO OIL AND GAS ASSOCIATION FOR AMENDMENT OF CERTAIN PROVISIONS OF TITLE 19, CHAPTER 15 OF THE NEW MEXICO ADMINISTRATIVE CODE CONCERNING PITS, CLOSED-LOOP SYSTEMS, BELOW GRADE TANKS AND SUMPS AND OTHER ALTERNATIVE METHODS RELATED TO THE FORE GOING MATTERS, STATE-WIDE.

CASE NO. 14784 AND 14785

VOLUME 11

August 29, 2012
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Santa Fe, New Mexico

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THE COMMISSION:

JAMI BAILEY, Chairperson

GREG BLOOM, Commissioner

DR. ROBERT BALCH, Commissioner

MARK SMITH, Esq.

FLORENE DAVIDSON, COMMISSION CLERK

REPORTED BY: Jan Gibson, CCR, RPR, CRR
Paul Baca Court Reporters
500 Fourth Street, NW - Suite 105



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APPEARANCES

FOR NEW MEXICO OIL & GAS ASSOCIATION (NMOGA):

HOLLAND & HART, LLP
P.O. Box 2208
Santa Fe, New Mexico 87504-2208
505-988-4421
BY: WILLIAM F. CARR
wcarr@hollandhart.com

JORDEN BISCHOFF & HISER
7272 E. Indian School Road, Rd. Suite 360
Scottsdale, Arizona 85251
480-505-3927
BY: ERIC L. HISER
ehiser@jordenbischoff.com

FOR OIL & GAS ACCOUNTABILITY PROJECT (OGAP):

NEW MEXICO ENVIRONMENTAL LAW CENTER
1405 Luisa Street, Suite 5
Santa Fe, New Mexico 87505
505-989-9022
BY: ERIC D. JANTZ
ejantz@nmelc.org

FOR THE OCD:

GABRIELLE GERHOLT
Assistant General Counsel
1220 St. Francis Drive
Santa Fe, New Mexico 87505
505-476-3210
gabrielle.Gerholt@state.nm.us



74c39ca1-513f-489a-8d2f-73be6e6cb997

APPEARANCES CONTINUED

FOR INDEPENDENT PETROLEUM ASSOCIATION OF NM:

K. FOSTER ASSOCIATES, LLC
5805 Mariola Place, NE
Albuquerque, New Mexico 87111
BY: KARIN FOSTER
505-238-8385
fosterassociates@yahoo.com

FOR THE NEW MEXICO CITIZENS FOR CLEAN AIR & WATER:

DR. DONALD NEEPER and DR. JOHN BARTLIT
2708 B. Walnut Street
Los Alamos, New Mexico 87544
505-662-4592
dneeper@earthlink.net

FOR JALAPENO CORPORATION:

PATRICK FORT
P.O. Box 1608
Albuquerque, New Mexico 87103
patrickfort@msn.com

FOR NEW MEXICO WILDERNESS ALLIANCE:

JUDITH CALMAN
142 Truman Street, Suite B-1
Albuquerque, New Mexico 87108
judy@nmwild.org

FOR NEW MEXICO STATE LAND OFFICE:

HUGH DANGLER
310 Old Santa Fe Trail
P.O. Box 1148
Santa Fe, New Mexico 87504
(505) 827-5756



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APPEARANCES CONTINUED

FOR NEARBURG PRODUCING COMPANY:

JAMES G. BRUCE
P.O. Box 1056
Santa Fe, New Mexico 87504
505-982-2043
jamesbruc@aol.com

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EXHIBITS

(Note: In session at 9:00.)

CHAIRPERSON BAILEY: Good morning. This is a meeting of the Oil Conservation Commission on Wednesday, August 29th, a continuation of a hearing in Consolidated Cases 14784 and 14785. Before we get started this morning, Mr. Jantz has distributed a pile of documents. Would you like to introduce those as an exhibit?

MR. JANTZ: Sure. Those are the summary that Commissioner Bloom requested of Ms. Martin's review of the OCD documents along with the actual documents itself.

CHAIRPERSON BAILEY: Any objections to introduction of those.

MR. FORT: I don't have an objection. Are these the seven?

MR. JANTZ: Yes, sir.

MS. FOSTER: Just for the record, these are documents on the OCD website available for public review?

MR. JANTZ: Yes, except for the summary which is the cover page for each one that Ms. Martin created?

MS. FOSTER: No objection.

CHAIRPERSON BAILEY: They are admitted as



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OGAP Exhibit --

MR. JANTZ: Six, I guess.

MR. SMITH: There are five sections?

MR. JANTZ: Should be seven.

MR. SMITH: Is it might be a good idea for clarity of the record have them 6A, B, C, D, E, F and G and you need to identify which is which so everybody matches.

MR. JANTZ: Should I do that now for the record?

CHAIRPERSON BAILEY: I think it would be a good idea.

MR. JANTZ: Give me just a moment. AP 81, the Chevron Mark 13, is 6A. AP 78, South Fork Lakes Unit is B. AP 77, South Fork Lakes Unit is C. AP 94, Marbob Scratch State Corn Unit No. 1 is D. AP 68 Apache NEDU No. 527 is E.

MR. SMITH: 68 or 69?

MR. JANTZ: It's 68. On the summary that's incorrect. It should have been corrected to 68. AP 94. AP 62, Samson Livestock 30, F. AP 61 Chesapeake Herradura is G.

(Note: Exhibit 6A through G admitted.)

CHAIRPERSON BAILEY: Dr. Buchanan, you are under oath, a continuation.

DR. BRUCE BUCHANAN

after having been previously sworn under oath, was questioned and testified as follows:

DIRECT EXAMINATION

BY MR. CARR

Q. May it please the commission, would you state your name for the record, please?

A. Bruce Buchanan.

Q. Dr. Buchanan, you previously have testified in this case, have you not?

A. I have.

Q. At the time of that testimony you were qualified as an expert witness?

A. I was.

Q. And how were you qualified?

A. As an expert in soil science.

Q. Were you present for the testimony of Dr. Donald Neeper?

A. I was.

Q. What is the purpose of your testimony here today?

A. To clarify some ideas that were proposed by Dr. Neeper and try to clarify some of the statements that were made.

Q. Have you prepared additional exhibits for

presentation here today?

A. I have.

Q. Are you primarily going to be using slides that were previously presented?

A. I will.

Q. Are the new exhibits -- were the new exhibits prefiled in accordance with the rules of the Oil Conservation Division?

A. Yes, they were.

Q. During the hearing we have heard a great deal of concern about salt migration and its impact on plants. We have heard particular concern about the migration of salt toward the surface. I would ask you to refer to what is your first slide and respond to those concerns.

A. If we could go to the first slide. This is a study that was done at what's called the Mertz site. It was done by McFarland in the mid '80s. And what McFarland did is there were drilling pit contents buried in the fashion that pit contents would be buried and he used various depths of cover. This particular study he covered the pit contents with 36 inches of material, of soil material. After one month he measured a variety of things.

One of the things he was interested in was

the salts, so he measured them at zero to six inches, six to 12 inches above the pit contents, 12 to 24, 24 to 30, 30 to 36. He did it at one month and he did it at 20 months. I didn't include the data on this slide at the time we produced it, but he also later did a study that was published after 44 months.

This study, much like studies that I have done, studies that have been done in most of the western states, in Montana, North Dakota, South Dakota, Wyoming, Colorado, New Mexico, Arizona demonstrate that where a pit content or spoil materials that have been the subject of a lot of studies that are high in salts, that the salts migrate from those layers of salt and they migrate up. This study demonstrates that, and this is somewhat of a -- typifies what happens.

After one month, if you draw your attention to the chloride which is in the column -- first look at the picture to the left and then that represents the first month and then the chloride where the X is shows the concentration of the chloride, and just above the pit contents it's elevated. It's 14.4.

You would assume, and McFarland assumed,

that the value would have been about one. That's what the value was for the soil that was placed on top of the pit contents.

The sodium he measured was elevated and the electrical conductivity which represents the soluble salts -- if you can move that X over to EC -- the electrical conductivity which represents the soluble salts was also elevated. Twenty months later -- now I draw your attention to the picture on the right. Same type of situation, just later, and the salts migrated up about six inches. The chlorides were elevated. There might be a slight elevation from the six to 12-inch on the chloride. Might have been a slight increase in sodium. It's questionable. And then for the soluble salts, elevated at the six-inch layer.

Forty-four months later, and I just have that date in my head, but what McFarland found was that the salts migrated up about a foot, and that's what a lot of the data shows. That's what data that I have collected shows. This is what Dalhoff showed in Montana, Sandoval in the Dakotas. Craberhoff did some studies in North Dakota.

Those studies show that with a deep application of cover soil that the salts can migrate

up about a foot. Dalhoff's study was eleven years and the salt stopped migrating.

The statement in my testimony is that salts will migrate up and then they don't migrate any further and they do not migrate to the surface. I know of no study, no instance in my own work, where we have been able to see salts migrate ever to the surface.

The physics behind all of this support the hypothesis as to why the salts diffuse up from the pit content and support the notion that the salts continue to be flushed down, and that's why they don't migrate to the surface.

Q. In this example there's 36 inches of cover?

A. In this particular case of McFarland's study, he used 36 inches of soil.

Q. Would the upper migration of the salts in this situation render the soil unsuitable for plants?

A. No, the soils are suitable for plant growth.

Q. What is the soil cover recommended by the NMOGA amendments to the Pit Rule?

A. Three feet of cover material over the pit



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contents and an additional foot of topsoil, so there would be four feet of material. And my thesis would be that those salts in those situations with four feet of material would migrate up about a foot and they wouldn't migrate any further up than that.

Q. Let's go to the next slide. Would you identify this, please? This is from Dr. Neeper's presentation, Exhibit 5, Page 22.

A. Correct. This is a statement made. I want to break it down into three parts. The first part will expand that as salt is damaging to plants when the EC of saturated paste exceeds four. This is roughly 600 milligrams per kilogram of dry soil. "Much of the damage is due to the osmotic pressure added to the matric suction; therefore, plants are more sensitive to salt in dry soils."

This statement is partially true, but it's not true for most plants. It's not true at all for native plants and it really came out of agricultural. Let's just go to another slide that Dr. Neeper --

Q. This would be Dr. Neeper's slide that he presented, Page 21 of his presentation.

A. If you draw your attention to the center of the slide where on the bottom axis there's

electrical conductivity of four. Plants are limited, or there's a threshold value of four for plants. There are plants that the threshold value is less than four. If you will, go to the left. If you find alfalfa at about two, electrical conductivity of two, alfalfa is very sensitive to salts and the threshold value is lower than four.

If you draw your attention to the right, a plant like wheatgrass at the very far end, it says tall wheat grass and one nearby is bermudagrass, the threshold values are near seven or eight. Most of these are domesticated grasses or plants that we use in agricultural. Most agricultural plants would fall on that graph somewhere. Nearly all of the native plants will not be on that graph. They will be to the right of all of that. The native grasses, alkali sacaton which is commonly used in reclamation, western wheat grass, we have done studies to show that those plants, the threshold values are above ten. They are closer to eleven or twelve.

Studies have been done by numerous authors, particularly out of North Dakota, studying four wing saltbush, sagebrush, rabbitbrush, winterfat. These are commonly used in New Mexico.



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Their threshold values are up in the 20s -- 22, 24. So I take issue with the statement that an EC of four is the threshold value for plants. It is for some plants. It's not very representative of native plants. Native plants have much higher values and, therefore, these plants have adapted to these arid, semiarid conditions, and because they have they tolerate higher salt levels.

Q. Is it fair to say that the EC of four, therefore, is not the strict limitation as it has been portrayed, particularly for native plants that would be used for reclamation in New Mexico?

A. That's right. That's a very fair statement. A value of four would not be representative.

Q. Let's go back to Dr. Neeper's slide summary, Page 22.

A. Let's go to the bottom paragraph in this case. "Sodium is toxic, but also damages to soil structure when the sodium absorption ratio exceeds 15. In clay soils, SAR should be no more than five." There's no such thing as sodium absorption. It's actually sodium absorption is the correct way to write that. SAR represents the sodium absorption of the soil. It's the ratio of sodium to the

calcium magnesium. I think the formula was shown and it really doesn't matter. It's just, for our purposes, SAR is a representation of a relationship between sodium, calcium and magnesium.

The statement is that sodium is toxic. Well, anything is toxic if it's at a high enough level. Sodium is also not toxic. Sodium at lower levels is not toxic at all. It's common in soils and at some level to some plants it could be toxic.

When SAR was first developed in the '50s, it came out of the soil salinity lab, this ratio. It was just a mechanism -- it was some kind of an indicator that soil scientists could use this value and say, "Well, since we know the SAR, this is what we know." We do this all the time in soils.

What they said, what they thought they were saying was that SAR related to the ability of a soil to aggregate, so if the values were high, the thinking was that the soils were not very well aggregated. And if the values were low that the soils would be well aggregated. So it related to movement of water. As soils are aggregated, water moves through the soil quite easily. If soils are not aggregated, if they are disbursed, water doesn't move through very easily. So that's what this was

all about.

Q. Are you ready to go to the next slide?

A. I would like to say one more thing.

Q. All right.

A. They viewed SAR by itself. By the 1960s we realized -- soil scientists, not me -- I was in high school. But the soil scientists were realizing that SAR couldn't be used alone. It had to be coupled with electrical conductivity. So let's go to the next slide and talk about them.

Q. This is a new slide that you're introducing here today, correct?

A. This is a new slide.

Q. What is the source of this?

A. This is from the soil salinity lab and it was put together by Rhoades, John Rhoades in 1982. John Rhoades at that time was an employee of the soil salinity lab.

Q. This is a graph and a principle that's commonly relied on?

A. This is commonly relied on. A number of authors have addressed this issue of the relationship between EC and SAR, and they have been doing it since Rhoades started the work and through the '90s and even to some extent currently. And a

number of authors have put this relationship together, have studied it with soils. It's not theory. They use practical soil data and try to put the graph together.

This is a representation of that work. This is what that graph says. If a soil has a fairly high SAR and a very low EC -- let's use an example. If you will, kind of go to the corner and when the EC is about one there -- and this is of the water coming into the soil. If it comes into a soil that has an SAR at these values it's likely to disburse the soil and cause a permeability problem.

It says "area of likely permeability hazard." These soils have a permeability problem. These soils will disburse. That same soil with the SAR of 25 but with the EC of three or a soluble salt content higher than these soils are likely -- it says "area of unlikely permeability hazard." These soils will tend to stay aggregated.

So it's very hard to say that an SAR of 15 is this. You have to say, "Well, what is the electrical conductivity of the soil or the electrical conductivity of the water going into the soil?" Then we can start to address limitations. You can't look at SAR by itself and make a statement

without including knowledge of the electrical conductivity.

So first off, the statement of 15 or the statement of five isn't entirely correct. It misrepresents the situation. The situation is better represented when we know what the electrical conductivity is, and this has been pretty much the case since Rhoades published this in the '80s. I think that's really all I want to say.

Q. How would you fix a permeability hazard if you encountered one in a soil?

A. The permeability is just the ability of water to move through the soil. This is often measured by just putting water on the soil and measuring the rate at which water moves through the soil. It's also done by looking at how well the soil is aggregated. If the soil is well aggregated, regardless of the EC, regardless of the SAR, if a soil is well aggregated, and it can be aggregated -- some of the mechanisms, for example, would be high contents of organic matter. Organic matter causes soils to be aggregated.

Soils that are aggregated are permeable. If the aggregation is lost by a number of things, loss of organic matter, high salt content -- I

should have said high SAR and low electrical conductivity -- then that soil will lose its permeability.

We can manage that actually. We know enough about this that we can add organic matter and aggregate soils. We know we can do that. We can change SAR values. We can add calcium and magnesium and change the SAR value. We can add amendments to the soil and change the electrical conductivity of the soil.

So these are all manageable kinds of things. And I would say, and I think it just almost goes without saying, but when we select soils for reclamation we select a topsoil, we measure that soil ahead of time. We select soils that are suitable for topsoil.

I know that probably sounds stupid, but we don't just grab something and say, "Well, we get what we get and that's what we get and that's what we are going to work with." No. We know enough about soils, the physical properties and chemical properties so we have guidelines and we stay within the guidelines. By selecting and staying within the guidelines, we select topsoil that are suitable for reclamation.

Q. Using soil absorption ratio as a strict limitation or a strict determining of the toxicity of sodium, is that appropriate?

A. No, that's not appropriate.

Q. Let's go to Dr. Neeper's Slide 22 again. At this point let's look at that.

A. We are going to take the middle of this out. "Almost no plants survive overnight exposure to 1.5 megapascals of pore and osmotic pressure approximately 1,000 milligrams per kilogram of soil at 15 percent moisture."

Q. Is this statement correct?

A. No.

Q. Would you explain? You may want to go to Dr. Neeper's Slide 14 on moisture potential.

A. This was intended to represent a theoretical situation of what happens when water content diminishes in the soil and it's represented as the water content becomes less that the suction -- if you look at the Y axis it says suction in centimeters of water. That is the suction becomes greater. There's more suction on the soil; the water content will decline.

Let's spend a minute so you know what we are talking about because I'm going to go to another

slide that I think will represent this better. Let's go to this point right here and we will call that 35 percent water content. The suction is very low. As the suction increases, the water content decreases. As the suction gets very high, the water content is down around, we will say, 5 percent. That's what this graph is trying to depict. And it says in this region it's the absorption region. This is where water is absorbed to the soil particles. This happens somewhere around 1.5 megapascals.

Let's go to some real soils. I think I can show you this better if we go to the next slide.

Q. The first slide is a theoretical soil.

A. It is.

Q. What you have on this slide are actual soils --

A. That were measured.

Q. And you have had this exhibit prepared for presentation?

A. I did.

Q. All right. Let's review it.

A. This came out of a Ph.D. dissertation work. It says when this Y axis here -- I switched here so be careful. This is water content. This is

the suction, if you will. This is the potential. It's measured in negative megapascals. When there's very little suction in a sandy soil -- I'm sorry for saying this. I hate using pointers because it looks like I'm an old person.

Q. Dr. Buchanan, if you can see that far, you're talking about the green line.

A. I'm talking about the green line. That's the sandy soil. It's about 12 percent water with very little suction. As the suction increases, we reach a point called field capacity, and I'll talk about that in a second. Then the suction continues and the water content of the soil decreases until we get to a point called wilting point or 1.5 megapascals.

I want to emphasize to you that soil scientists just came up with words. They knew these water contents were at these megapascal suctions and they just arbitrarily came up with the word and said well, here we are going to call that field capacity. This is where we think water is held against gravity. And then gravity starts kicking in and moving and reducing the water content until we get down to a place.

And out of agricultural and out of using

some agricultural plants, some plants were observed to wilt at 1.5 megapascals and they said, "Oh, this is easy. That's the wilting point."

Then the water content continued to decrease, the megapascals if you will, increased to negative three, and now it's air dry. I don't want you to get too caught up with the field capacity, the wilting point. Just that these were words that we used so we could communicate with one another.

Let's go to the middle one, the red one. This is a loam. This is something that is common soil. At field capacity, at .03 megapascals, not very much suction, there's almost 40 percent water in that soil. As evaporation transpiration reduces that water content, the suction increases until we get to a place we call wilting point and there's about 10 percent water, maybe 12 percent. Doesn't matter. Then it gets to air dry and now it's maybe below 10 percent, three megapascals. Now the tension can get up to ten megapascals and it's maybe 8 percent water. And even at 100 megapascals, maybe it's three or four percent water.

Now, why am I spending so much time on this? Because I want you to realize what's happening with this water in a simple profile. We

do agriculture around field capacity. We like soils to be around field capacity. We irrigate. We maintain a fairly wet condition. We don't want it below a tenth of a megapascal.

In native natural soils we don't have that control. Soils dry out. As they dry, they reach certain points along that suction. Agricultural plants -- many, not all, but many -- wilt at 1.5. Native plants don't often wilt at that limitation.

I have done studies with -- I said this earlier in testimony -- ponderosa pine. Went down to three megapascals and was still surviving. There are grasses that will grow and not wilt at greater than three megapascals, upwards of four megapascals. So to make the statement that the wilting point and most plants or many plants if not all plants wilt at 1.5 megapascals, that's not a correct statement. That wilting point is just a place on a graph. That's all it is, and we know in using native plants and native plants in reclamation that they can exist and are not limited at even greater than 1.5 megapascals. They can go up to even three.

So when we see data, either in water content -- for example, if I were to tell you a soil has a water content of 20 percent, I really haven't

told you anything honestly other than the soil is at 20 percent. You say, "What kind of soil is it?" Well, if it's a clay, look at 20 percent. Let's see if I can do this.

So there's 20 percent. There's the clay. It's at 1.5 megapascals. But if it's 20 percent in a loam, wow, look at that. That's considerably less, and, in fact, there's quite a bit of water available at 20 percent in the loam but there's not very much available in the clay.

How about 20 percent in the sand? I can't even get to 20 percent. Sands, this particular sand and sands in general, can't hold that much water. There's not enough pore space to hold that much water. So when you know what kind of water content you have, it would be beneficial to know what kind of soil texture there was. Then you start to know whether the water is limiting or is not.

We are going to go to other slides. I've spent some time on this because I want to show you what happens when we look at some other soils and where they were measured at these low suctions.

There's one other thing I want to say about this. Excuse me. Let me get a drink here.

Q. Dr. Buchanan, we are talking generally

about the arid soils in New Mexico?

A. We are. What I was going to say is that when we are at field capacity, recent studies or more recent studies, the last ten or 15 years, have shown that there's about ten to 25 water layers on that soil particle.

Remember from high school we were taught that water is a pore molecule, has a positive end and a negative end. The positive end of a water molecule -- this is the positive end and this is the soil particle -- this is negative. There's a mass negative charge on that soil particle, particularly the clays in a soil. The sands, not so much and the silts not so much but the clays are very negative. This positive polar molecule moves over and is electrostatically connected or combined or attracted, and it is said to be absorbed to the particle.

I don't remember if I told you this or not and if I did, I'm sorry for repeating myself. Remember when you went to the drug store and got a band-aid? It was adhesive tape. You took the adhesive tape and put it to your skin. Your skin is one thing and the band-aid is another thing. That's adhesion.



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What's absorption? That's when skin is absorbed to skin or it's like a sponge. So that's where the word absorption comes in. So the water is absorbed to the surface of the particle.

What's on the other side of the polar molecule? A big negative charge. The next positive and the next positive. So we get about ten or twenty of these layers. As the water content goes down, what happens to these layers? They start coming off. We finally get down about five or eight layers at wilting point, about one and a half or three megapascal. We are only down about three layers of water.

We have talked about this, and I just want to reinforce it. At that point when we are at three megapascal, even at one and a half megapascals, we have very few layers of water on the soil. They are absorbed to the soil. They can't move. They are stuck electrostatically. That water starts taking on a different structure. It takes on the structure of ice. It becomes crystalline in nature. This water is not moving.

We have talked about that. We said this is beyond unsaturated flow. Over on the left side of that, that's unsaturated flow and that water is

at ten, twenty layers, and that water is moving around in the soil. But by the time I get to wilting point or three megapascals, I'm not moving water anymore. Is there water in the soil? Yes. Is it absorbed? Yes. What is in that soil pore is vapor. Dr. Neeper said that. I have said that. He is correct and I am correct and we are also both correct in the fact that vapor doesn't carry salt. The vapor moves. We know that. The vapor moves, but the salts don't move and this is really an important juncture to grasp.

I know this is a lot of detail, but it's all going to get -- it will all make sense here in a minute.

Let's also say that soils, about half of New Mexico is semiarid or an arid region. Another way to say that is about half of New Mexico we can't farm unless we irrigate, and that's a pretty correct statement. The rainfall is too low. Those soils were developed, exist. The vegetation that grows there is in an arid/semiarid region of the state. That's about half of the state. These arid and semiarid regions experience this wilting point every year. That's almost by definition, because those areas don't support domesticated plants. They go

down to wilting point. They get even below that. Not to great depths but in the upper few feet of the soils, those soils are dry. They are dry to the point that they wilt at 1.5 megapascals or even beyond 1.5 megapascals. That, we know. It's kind of an important part of what we are dealing with here in New Mexico. Let's move on.

Q. I want to be sure we have two points clear. First of all, as you move towards the air dry line and beyond, you get to a point where there is no longer liquid water, only a vapor?

A. Correct.

Q. And when you are in the vapor phase, salts cannot be moved?

A. Salts cannot be moved in the vapor and they can't -- there's really no mechanism to move those salts in that soil profile.

Q. At that point in time in that soil profile that's where the salts remain?

A. And that's where they accumulate.

Q. Now, talking about arid dry regions in New Mexico, the wilting point is there every year.

A. Correct.

Q. Native plants still survive?

A. They as I will survive, and that's why I

made the statement that the wilting point doesn't necessarily apply to native vegetation. These plants have adapted to survive under arid/semiarid conditions. It's kind of easy but they have just adapted and they survive under those conditions.

Q. Will this occur both in Southeast New Mexico and in Northwest New Mexico?

A. In both. Those conditions exist in both parts of the state.

Q. Let's go to the next slide, which is again one of Dr. Neeper's slides. This is his Page 35 which shows the results of his Caprock sampling. We will start with 34.

A. Dr. Neeper measured gravimetric moisture and he also measured moisture potential. I think we are all on the same page here. We know the difference. This is water content, moisture potential. This is that matric potential. This is that suction we talked about.

So let's quickly go to the top three, draw your attention to those and we will go to the upper left-hand corner. The gravimetric moisture content for this particular set of samples in this particular pit, Pit 5 Whole A, was more or less around 10 percent water content. If we knew the

texture we could say something about it and we will in a minute.

The next one, Pit 5 Whole B, the water content was maybe a little lower than 10 percent in some samples and a little higher than 12 percent or higher than 10 percent in some. All we are saying is this is the moisture content.

The last one, Pit 8 Whole C, the water content is somewhere around 10 percent and a little deeper in the profile it was around 16 percent. But let's draw our attention now to the matric potential. This is a measure of the suction on that water. The matric potential or what Dr. Neeper called moisture potential and expressed it in units of megapascals, in the first one, Pit 5 Whole A, the matric potential was greater than three. In one instance it was almost six.

Now, what do you know? What did we learn a few minutes ago and what do we know now? Those are fairly high matric potentials. Those are matric potentials that are representative of soils that are at or beyond wilting point. They are at maybe air dry. So what conclusion could you make from this? These soils were dry. They were very dry.

If that soil were a loam with about 10



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percent water content, this matches up with the matric potential of -- I'm sorry, I'm working backwards here. Given the water content, given the matric potential -- I'm just trying to guess what the texture is, and that's not necessary. We don't need to know that. That's not critical here at all.

But what is critical is these soils were experiencing and measured at the time they were measured, were measured with very high suctions, very high potentials, measured in megapascals.

Let's go to the next one. Up near the surface, the matric potentials were around three. As Dr. Neeper's sample was deeper in the profile, the potentials increased, and by the time it got down to 15 feet they were in the sevens, the eights and the nines. Very dry soil. Then the last one the scale, if I remember right -- I'm sorry, I don't know your name, but your head is in the way.

This particular soil was experiencing some pretty high matric potentials or moisture potentials measured in megapascals, 15, 20. So this soil is very dry. What was going on in this soil at the time? These soils were so dry that there was -- you would say there were very few layers of water attached to the particles, two, three layers of

water. Any water in that profile was in the vapor phase. We could make that statement.

Now, let's look at the chlorides in the soils. We are still at Caprock. If you will draw your attention to the top.

Q. We are on Page 35 of the presentation, correct?

A. We are, yeah, Page 35. Draw your attention to the top three representations of soil chloride measured in, I think it's milligrams per kilogram. The chloride content wiggled a little bit at the top and then it came down, and then at about eleven feet there seems to be a maximum level and then the next two samples were lower.

Let's go to Whole B, the middle one. It wiggles around. It comes down at about six feet and there seems to be an increase and then a decrease and then an increase and then it decreases again as though it might be accumulating at that depth of about ten feet.

The last one, Pit 8, the chlorides are coming down at about 11, 12 feet. There seems to be an accumulation and then it comes back again. Let's go to Loco Hills. Let's look at the moisture first. On this particular slide the way it's presented it

shows moisture potential on the top, three, and the chlorides on the bottom. The moisture potential, it increased up to about six and then it came back around one or two. Remember about one and a half is very limiting to domesticated plants. This is a dry soil.

Look at the next one. The scale changed but the matric potential gets as high as ten, 15. Very dry soil. Then the last one, the scale changes again so the bottom, the matric potential goes from zero to three, but the surface was less than .5. There might have been some moisture in that or it wouldn't be air dry for sure. But by the time it gets down almost to what appears to be about ten feet, the matric potential is around two, two-and-a-half megapascals and reaches over to three. So lower in the profile that soil was near three megapascals, two megapascals and that soil was dry.

Look at the distribution of the chlorides. In the first hole, in the bottom left-hand corner, the chloride contents starts out fairly low. I'm not so worried about the content as what I want to really stress is the distribution of the chloride. The chloride was low. It increased, seems to max

out at about 15 feet, thereabouts, and then it comes back and is low again.

Go to the next slide. The chlorides start out fairly low. They increase around six or seven feet and then it drops back, and then there's a bulge, if you will, or an accumulation at about 20 feet. Then below 20 feet it seems to come back.

Dr. Neeper's data is not too dissimilar from the data I collected. It's not too dissimilar from data collected by numerous authors. Wierenga has done studies with this. He has studied chlorides. Van Genuchten, one of -- it's Pete Wierenga. One of his students, Van Genuchten, studied these. A number of people, Brenda Scalon from Texas has studied these salt accumulations.

You intuitively know this. You actually do. If you are in New Mexico and you have ever dug a hole in New Mexico or driven somewhere in New Mexico you have seen a soil profile you have seen a white layer in the profile. I know some of you haven't seen that and you were busy going down the interstate, but some of us have seen that carbonate layer. We will call it caliche, we call it calcium carbonate. It's just nothing more than calcium carbonate. It's a salt that has accumulated at some

depth in the profile. Calcium carbonate is very insoluble. Because it's insoluble it doesn't move very far and it accumulates 20, 30 or so inches below the surface. It can accumulate and accumulate and it doesn't get deeper. It just accumulates and it's so accumulated it completely fills the profile and becomes hard and we call it a hardpan. Soil scientists call it a petri-calcic layer. No one knows what it means so we refer to it as caliche. It's a hard layer of calcium carbonate at some depth in the profile. Those salts have accumulated at that depth.

If a salt -- this is true -- if a salt is more soluble it can move deeper in the profile. It doesn't precipitate out as quickly. Calcium sulphate, we know that is gypsum. Calcium sulphate in years and years and years at looking at soil profiles, it is below the calcium carbonate. There's hardly ever an exception to that. It accumulates at depths below the calcium carbonate. It will accumulate maybe a foot or so below the carbonates.

There are places, not common -- it occurs in New Mexico but it's not common. But it's not common hardly anywhere in the United States but we

call this place White Sands and it's down by Alamogordo. There are places there where the calcium sulphate has moved down in the profile and accumulated and it will get fairly high concentrations of calcium sulphate. There are places in the Four Corners region of New Mexico where the soils have high levels of calcium sulphate. Those calcium sulphates have dissolved, have moved by the water and then accumulated at about 20, 30 inches in the profile. It varies and it varies for several reasons.

What's driving this whole thing? And I think it's important to know that. Climate. If it's a wetter climate, more water, the salts move deeper. The type of salt. If the salt is highly soluble, sodium chloride highly soluble, will move to greater depths than calcium carbonate. And then, of course, the texture of the soil. If the soil is sandy, water moves deeper in the profile. If the water is not so sandy, if it's clay, then the water doesn't move as deep. Same amount of water in a clay soil goes less deep than if it were a sandy soil. You know all of that.

So what drives this salt accumulation? Climate, chemistry and soil texture.



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Q. Let's go now to the slide you presented earlier from the ConocoPhillips study.

A. Yes, let's go to that.

Q. Slide 17-19 from the earlier presentation. Again, I would ask you to relate this study to what you have just discussed.

A. There's quite a bit of information on this. We have seen it before and if someone hadn't seen it before I guess it doesn't matter. It's important to the Commission so let's go briefly through this.

There were two holes dug. I sampled, personally sampled this profile, and I sampled it at various increments going down through the profile. One of the profiles was some distance away from the pit and where the well location was, and the other one was right at the well location, went right through the pit contents. So the red line represents the pit and the well site and going through the pit contents. The blue line is the native natural soil unaffected by the disturbance.

Let's start with the blue line. It shows that at about seven feet or somewhere around the 92 or 96 inches, that the soluble salts measured by electrical conductivity accumulated as measured in

comparison to the soils above, and then accumulated and then diminished and came back to a resident level deeper in the profile down about 12 feet or so. That's a native soil. That's what happens naturally.

If I had measured calcium carbonate you would have expected, if there was calcium carbonate in the soil, it would be higher in the profile. Gypsum would be a little higher above the salts. These are just an accumulation of soluble salts. This is a mishmash of soluble salts measured by the electrical conductivity.

What happened at the pit, at the drill site? The pit contents were left behind 40 years ago. The amount of material over the pit contents was about 20 inches. The salts migrated from the pit contents up and they got within about eight inches or so from the surface and then they didn't rise any higher in that profile.

Why not? Because there's a flux of water, rainfall, moving those salts down. There's a mechanism trying to move them up; there's a mechanism trying to move them down. They came to equilibrium and we know that, we have seen that, I have shown it in other data. I've shown it in my

own data. Salts will migrate up and they will come up to a certain point and generally they will move up about a foot.

Q. Now, was this a lined pit?

A. This was not a lined pit. This was 40 years ago. This had no liner in it. The pit contents go from about 20 inches down to 30 some inches, some 18, 20 inches thick. The salts migrated out of the pit contents. The soluble salts measured by EC, seemed to decline, seemed to accumulate at maybe four or five feet below and then really accumulated at about seven feet below and then diminished and came back to the resident level at ten or 12 feet.

What happened? What happened was there was no driver. Remember, climate, texture, chemistry. The chemistry is the chemistry. The texture is the texture. It was kind of a sandy loam soil. The driver was the climate. This is south of Bloomfield, New Mexico. It's in that 12 to 14-inch precip zone. That precip moved the salt down and then it ran out of water. That water became less and less. The matric potentials became higher and higher. The layers of water became thinner and thinner, and finally all that was left was vapor and

the salts precipitated out and now what was left was water vapor and the salts stopped moving.

What's interesting, notice that in the native soil they accumulated at about the same depth as did the site where the pit contents were. So a question could be asked well, what happens if you get more salt? Would it move deeper in the profile? You intuitively know the answer to this. You know that calcium carbonate accumulates at the same depth, and in fact, as you get more calcium carbonate it actually doesn't go as deep. It accumulates above.

But what this graph represents is that as there is more salt, it accumulates at the same depth. It just is more salt at that depth. Because the driver, the climate, is driving that down so deep and it just can't drive it any deeper. So those salts would accumulate there.

The blue line represents a soil that represents hundreds and hundreds of years of soil development, if not thousands of years of soil development. This is not something that was put out there yesterday. This is something that has developed over geologic time, and that's where the salts accumulated and that's why people like

Wierenga and Van Genuchten and stuff that I have done and stuff that Scalon has done and other people, they have shown that the salts accumulate. There's a reason, an explanation. Because the climate only allows that water to move so far.

That's why I went into the explanation of the water and the matric potentials and how the layers get thin and how we get out to matric potentials of three or four or five. That water is no longer liquid. It's crystalline at that point. It's attached to the soil particles and all that's left is vapor. Does vapor move? Yes, it does. That's an explanation of how water moves through the soil profile. It moves in the vapor phase. But the vapor doesn't carry the salt. The liquid has long since run out of liquid and the salts have long since lost the mechanism to be moved and that's why we see what we see. We see the salts accumulating at those depths.

Q. Dr. Buchanan, what we have in this slide is an example of what actually happens in the real world?

A. Correct.

Q. In your opinion, based on your work and the slides presented by Dr. Neeper, is this what

happens in Northwest New Mexico?

A. This is what happens in Northwest New Mexico.

Q. Does this happen in Southeast New Mexico?

A. The same thing happens in Southeast New Mexico.

Q. What happens is not dependent on the concentration of the salt in that pit; is that right?

A. Correct.

Q. It stays there?

A. It stays there, that's correct.

Q. Now, this shows that the salts do migrate up some --

A. Correct.

Q. -- to the surface?

A. Correct.

Q. They do migrate down until they hit equilibrium and there they form a bulge?

A. Correct.

Q. NMOGA is here with a proposal to amend the Pit Rule and we are talking about risk. If we have pit contents as we have here, is there any risk to groundwater from what's being proposed by NMOGA?

A. My testimony is that no, there is not a

risk to deep groundwater; that these salts will accumulate and will precipitate out before they get to groundwater, assuming that groundwater is at, say, 50 feet. They will go to depths of 12, 10 feet. It depends on the texture and the climate. They will have precipitated before they get to the groundwater.

Q. Looking at the information presented, are we going to be able to successfully and sustainably reclaim these sites?

A. There's one thing I feel strongly confident about and that is that yes, we can reclaim these sites. We have come a long way in reclamation. I have spent 40 years at it. I have spent the last ten just excited about the things that we have been able to do. Sites that I have worked on, designed the reclamation for have won national awards because of the outstanding reclamation. La Plata mine was recognized a few years ago as the outstanding reclamation in the United States. This week, I think in Colorado, a mine is getting an award, a national award for outstanding reclamation.

Reclamationists know how to do reclamation. We know that we need topsoil. We know

that we need cover soil. You need some distance between -- a lot of my world has been in the mining industry; that we need distance between the mining spoil material and something that provides really depth.

Three feet of material with one foot of topsoil is sufficient to be able to reclaim and sustain native vegetation, and native vegetation, we believe -- we believe that studies and work that we have done and it doesn't expand long, long periods of time, it spans 40, 50 years, but these are sustainable.

I'm not at all a supporter of non-natives because I don't believe they are sustainable so I don't recommend non-natives. I recommend native vegetation in native areas. That's what we are talking about here. The three feet of material, one foot of topsoil we can reclaim that. We reclaim it with natives and it will be sustainable. I am sure of that.

Q. Dr. Buchanan, you are familiar with the proposed amendments to the Pit Rule that are before this Commission or the recommendations of IPANM New Mexico and NMOGA?

A. I am.

Q. If they are adopted, do you have an opinion on whether or not Rule 17 as amended will be protective of the environment?

A. My opinion is it will be protective of the environment. We will experience salt movement but we will experience successful reclamation and it will be -- in my opinion, it will be protective.

Q. In your opinion does it pose risk to groundwater?

A. I don't believe it does. I don't believe it poses a risk because the salts naturally accumulate.

Q. Were NMOGA exhibits, Slides 1749 and 1752, prepared by you or compiled under your direction?

A. They were?

MR. CARR: At this time may it please the commission I move the admission of Slides 1749 and 1752.

CHAIRPERSON BAILEY: Any objections? They are so admitted as exhibits.

(Note: NMOGA Exhibits 1749 and 1752 admitted.)

MR. CARR: That concludes my direct examination of Dr. Buchanan.

CHAIRPERSON BAILEY: Cross-examination?

MS. FOSTER: I have one question for the witness.

CROSS-EXAMINATION

BY MS. FOSTER

Q. If we could go back to the last graph we have there. Thank you. Now, Dr. Buchanan, this was a pit that you studied that did not have a liner, correct?

A. That's correct.

Q. I believe that you stated to the Commission that you believe that salts with deep water could migrate. Would the migration pattern that you demonstrated here be any different if there was a liner directly below the pit contents, the 20 mil liner string reinforced?

A. I think initially, if I understand liners correctly, their intent is to keep water from moving down and there wouldn't be movement initially. In time, that profile would be identical with or without the liner. In time. Initially, it would look different because assuming the liner is intact and does what it's said to do there wouldn't be any water so there wouldn't be a mechanism to drive the salt down, but in time salt would move through and it would take on almost that identical profile.

Q. But the liner would effectively retard the migration for a couple years?

A. At least.

Q. So ultimately over a large span of time this is the profile that you would see?

A. Correct.

Q. I have no further questions. Thank you.

CHAIRPERSON BAILEY: Mr. Jantz?

MR. JANTZ: I think I will turn Dr. Neeper loose.

CHAIRPERSON BAILEY: Shall we take a ten-minute break?

(Note: The hearing stood in recess at 10:09 10:22.)

MS. GERHOLT: No questions.

MR. FORT: No questions.

MR. DANGLER: I have a few questions.

CROSS-EXAMINATION

BY MR. DANGLER

Q. It seems an odd place to start but just as predicate, do you know any good lawyers?

A. Yeah.

Q. Do you know some bad lawyers?

A. Yeah.

Q. Fair to say there's both kinds?

A. I guess that's fair to say.
Q. Okay. Do you know some good reclamationists?
A. Sure.
Q. Do you know some bad reclamationists?
A. Not many.
Q. Do you know some bad reclamation sites?
A. Oh, yeah.
Q. Fair to say reclamation has some good sites and some bad sites?
A. I couch that with timing. In earlier years we did a lot of bad reclamation. In more recent times we don't do bad reclamation very often. But it's -- we are capable of doing bad reclamation.
Q. And have you done a study of the reclamation sites in Southeast New Mexico or even seen one?
A. When you say study, I have seen reclamation in Southeast New Mexico, yes.
Q. Right. But as an overall study of all the sites, what's happened there?
A. No, not an overall study, no.
Q. I understand and I'm affirming your excitement about you can reclaim the sites. This is a can-do thing. We can do it, right?

A. Yes.

Q. That's considering using the best practices, correct?

A. Correct.

Q. Are your theories affected at all by bad practices, bad reclamation practices?

A. They are.

Q. And are your theories affected by other bad practices? Say areas of waste that are wet?

A. Say that again? Areas of waste?

Q. That are wet. The assumption all the way through is that the waste is dry but would that affect anything for you?

A. Just that they are wet. If you have four feet of material it's rather insignificant, but I wouldn't be too concerned about that as long as you can get -- if it's dry enough to get material on it. If it's wet enough you can't get material, then you can't get material on it. When you say wet, I think you are implying wet drilling materials. If they are that wet, you might not be able to get material on top of it.

Q. So that could impact it.

A. Could.

Q. But your safety barrier is really the four

feet?

A. Correct.

Q. If it wasn't four feet, that might be of concern to you?

A. It could be.

Q. You had to listen to a lot of the testimony here for the various dates of these hearings, correct?

A. I have heard testimony here, yes.

Q. Not all of it, but most of it. I think I have seen you here for a lot of it?

A. Maybe not all of it. Pretty much most of it.

Q. Okay. Were you here yesterday or --

A. I was here yesterday.

Q. So there appeared to be some testimony of some chloride movements that were a little bit unusual based on your modeling?

A. On my modeling?

Q. Right.

A. I'm not sure that statement is correct.

Q. Okay. It sounded like yesterday there was some information about chlorides getting --

A. I think there was modeling but it's not my modeling.

Q. Okay. I'm sorry, I'm not talking about the modeling, I'm actually talking about the pits that were studied that had liners that there was still some chloride movement.

A. Yes.

Q. That appeared to not follow the scenario that you set up? Is that not fair to say?

A. I thought -- I guess I don't agree with you that it didn't follow the -- are you talking about models where the chlorides were predicted to go into the water table?

Q. I'm talking about the case studies of sites where things went wrong where chlorides appeared to have gotten down lower.

A. Oh, okay. Yeah, that doesn't -- right. Okay.

Q. So does that make you question or rethink at all the static model that you created? And I don't mean to --

A. Not really, because if it's -- if the pit contents are dried and then the reclamation is successful, then I think the explanation that I gave is correct and I don't believe that the chlorides will move to the water table. Can chlorides move to the water table? Yes, they could move to the water

table if you get into a wetter situation or you are describing something different than this.

Q. Okay. So your level of confidence would go down in a wetter situation?

A. When you say wetter, are you talking about climate? You are talking about climate, right?

Q. Actually, I picked up the word from you. I think you had meaning for it and I don't know what it was.

A. I guess I was thinking of in a wetter climate there would be -- in a situation where the siting was closer to a riparian zone, for example, things would be different. If the siting were correct and the site was not near a riparian zone or a playa, then I think what I said would apply.

Q. So there are some outer parameters to your opinion that --

A. I guess there are some outer parameters.

Q. And those are helpful to us in trying to evaluate your opinion and also trying to create these regs. So what I'm understanding is there would be some concern -- you have some concern about the distance to riparian zones?

A. I would have some concern, yes.

Q. And you have some concerns if the

regulations were to be applied to a wet zone as opposed to the dry zones that you have described?

A. Instead of -- if you want to say that more correctly I would say in a wetter climate.

Q. And would it be fair to say that if the reclamation is done inappropriately, like one of the things that I listened for was, I believe, in your direct you testified about how we can test the soil, the topsoil, and we can put the right topsoil on the site, which is very encouraging and really optimistic. Is that done in every case? Is that required by our regs?

A. Pretty much. The regulations, both federally and state dictate how -- what's suitable for reclamation and what's not suitable and we make every attempt to stay within those guidelines.

Q. I don't have any other questions. Thank you very much.

CHAIRPERSON BAILEY: Dr. Neeper?

CROSS-EXAMINATION

BY DR. NEEPER

Q. Good morning, Dr. Buchanan.

A. Good morning.

Q. I will ask what questions I can freely and then at some point I will ask you to put some slides

back on the screen because I think that's the easiest way to discuss them if they are visible to everybody. You have said that this guideline number of an EC of four is inappropriate because the salt-tolerant species or the arid land species can withstand drier conditions or can withstand --

A. Saltier conditions.

Q. -- conditions where it's harder for the plant to get moisture. Now, are you suggesting then that the --

A. You're saying something here that's not exactly correct.

Q. Say what's correct.

A. You are saying salt and dry and putting that in the same context. Salt is one situation, dry conditions is another situation. We have a guideline that's called a threshold value for electrical conductivity. That's a measure of salt content.

Q. Correct.

A. All right.

Q. One effect of the salt then is to increase the osmotic pressure or reduce the availability of that water to the plant; is that not correct?

A. That's correct.

Q. And so in some sense, both dryness and salt content of the water add together in terms of what the effect is on the plant?

A. In some sense, yes.

Q. We are back to that guideline of four. You had said it was inappropriate. Are you suggesting then that in terms of regulation only salt-tolerant species should be considered? Or that, let us say, drilling or burial should occur only where salt-tolerant species are native?

A. It would help if you only ask one question at a time.

Q. One question at a time. In terms of the regulation then, should burial of wastes be allowed only where salt-tolerant species are native to the location?

A. Not necessarily.

Q. If then burial should be allowed in other areas but the guideline applies to the less salt-tolerant species, why is the guideline inappropriate?

A. Because the guideline leaves one with the impression that that is the one and only guideline for all situations and that's not the case. The guideline might work in one instance for one

particular condition or situation and that would be an appropriate guideline. But to say that that guideline should be used across the board, so to speak, is inappropriate. And that we know that there are species that can tolerate much higher values and that guideline would be inappropriate for those species.

Q. But you are asserting that we should allow the situation to become such that the salt-tolerant species would survive but maybe the others wouldn't. A regulation has to apply to all situations, does it not?

A. What I hear you saying is you are proposing species that are domesticated. I don't know that you know you are saying that because that's, in essence, what you are saying, is plants that have low salt tolerance, those for the most part are domesticated plants. There are very few native plants that have low tolerances to salt. Most of the reclamation species used today have higher threshold values than four.

Q. You are then presuming the site would be reclaimed and not simply grow back naturally; is that correct?

A. Yes, I think that's what I am proposing is

that the site would be reclaimed, yes.

Q. You have stated that you are familiar with the regulations; is that correct?

A. Correct.

Q. Does the regulation require reclamation with vegetation?

A. No, the regulations require vegetation, that's correct.

Q. You are stating that the regulation requires revegetation?

A. Requires vegetation, yes. Reclamation, right. That's right.

Q. Unequivocally you are stating that --

MR. CARR: This has been asked and answered.

DR. NEEPER: Very good.

Q. You have said in your testimony today that the ponderosa can survive greater than the 1.5 megapascal, correct?

A. That's correct.

Q. Wilt point. Have you looked at or studied any of the literature surrounding salt kill or regarding salt kill of ponderosa?

A. I don't know that I have looked at the literature. I have been involved in comments about

salt kill of ponderosa.

Q. Is it true that the sensitivity in ponderosa is from the sodium more than --

A. Yeah, I don't know if that's true or not, if it's from the sodium.

Q. Very good. Can we go to your slide of the Caprock data? Because you commented on this.

MR. CARR: There are two of them. Is this the one you want?

Q. It would be your first slide, and the next slide would be the potential. Let us see the previous slide. All right. This is the gravimetric moisture and we are seeing it is generally around ten and sometimes as much as 15 or 20 percent. In that region is the water mobile or is it absorbed such that you are in the boundary layer and it's immobile?

A. Just from the gravimetric moisture, just that information, and not knowing what soil texture it is, you don't know if that water is mobile or not because you don't know what the matric potential is at this point.

Q. Let's go to the next slide. We see the potential. Can I see the previous slide? The potentials are on the bottom of the slide. You

referred to these as showing extreme dryness.

A. I think I said they were very dry.

Q. Very dry. All right. Is that potential caused by the dryness?

A. That's an interesting question. Was the potential caused by the dryness? The potential is a measurement of the water content and the water content is low. It was caused by the lack of water. I guess -- that's just an unusual question. Was it caused by dryness? It represents dryness. It's caused by the lack of water.

Q. Didn't my testimony show that those potentials are caused by the salt content?

A. Salt content is part of that potential.

Q. Isn't it the major part?

A. I don't know that it is.

Q. All right.

A. I don't think if you just measure moisture potential you are measuring the potential at which that water is being held to that soil. And to say that it is entirely due to salt isn't known at this point.

Q. You pointed out that the bottom of the slides were labeled as moisture potential and you used the word matric potential?

A. Matric.

Q. You submitted to the Commission a piece of paper that said the total potential includes the matric potential and the osmotic potential; is that not correct?

A. Say that again. I produced a piece of paper? Are you talking about today or some other time?

Q. I am referring to a presubmission that you made to the Commission and served to all parties. I would be pleased to show it to you if I could approach the witness.

MR. CARR: Is this a document that's been placed in evidence?

DR. NEEPER: This document has not been placed in evidence.

MR. CARR: Then I object to it being used for cross-examination of the witness. It is not in evidence.

CHAIRPERSON BAILEY: I'm not sure what document you are talking about. Is this something that was given to the Commission?

DR. NEEPER: Yes.

MR. CARR: May it please the Chair, if submitting documents that we may use is tantamount

to admitting them, then that's an interesting position to take because it would then render any effort or any question about admissibility of an exhibit moot.

MR. SMITH: Did he testify to this document?

MR. CARR: No, he did not testify to this document and it should not be addressed in cross. There's got to be some order to the proceeding.

CHAIRPERSON BAILEY: If this document was not accepted as an exhibit, then it can't be used in cross-examination of a rebuttal.

DR. NEEPER: Very well. I will simply then restate the question.

Q. (By Dr. Neeper) Is it not common within shared technology to regard the total moisture potential as a sum of osmotic potential, matric potential and possibly anything else that should add to the potential?

A. Dr. Neeper, you didn't mean to say anything else. The matric potential is one part of this potential. Osmotic is another part. And they affect the total potential that that water is being held. That statement is correct. And you don't want to say anything else.

Q. Very well. And that potential affects the availability of the plant; is that correct?

A. That's correct.

Q. And then I will say is it possible that these extreme potentials are due to the salt?

A. I'm sure the salt may have some part of it, but to be the result of, as though you are implying that it's entirely due to the osmotic, I won't agree with that statement.

Q. At the site which you excavated with a trench, did you measure the water content above and below the pit?

A. We did.

Q. You have said --

A. We collected -- let me clarify that. We collected samples to measure gravimetric moisture at that site.

Q. And in your opinion was the gravimetric moisture so low that you were in the absorption region so that water motion did not occur?

A. Dr. Neeper, I can't answer that question. But unfortunately, we never got data. We collected the samples and the data was never able to be obtained because we lost -- I just don't want to get into it. We lost the sample. We didn't lose them

but for all intents and purposes for this Commission, we did not get the soil moisture data from those samples so I don't know what the soil moisture was.

Q. Very good.

A. That's all I can say.

Q. I have lost data, too.

A. I just didn't want that brought up is all.

Q. There was a question asked about wet climate, wet locations, and you said you preferred to think of wet climates. But within the proposed rule, is not siting setbacks from riparian zones greatly reduced?

A. I don't know about greatly reduced. I know there are sitings and there are siting requirements. That's what I know.

Q. Very good. And you had said that the federal regulations dictate what is suitable for reclamation?

A. What's suitable for soil.

Q. Soil.

A. There are recommendations -- actually, there are guidelines. I want to retract recommendations. There are guidelines that are used to determine the suitability of soil for topsoil.

Q. Very good. And is there anything in the regulations that would require following those guidelines?

A. Yeah. Yeah. There's a law. It says you will follow those guidelines and they are enforced and they are inspected and they require the industry to follow those guidelines. There's a law that says you will follow those guidelines.

Q. There's a federal law --

A. Called SMACRA. There's a law called SMACRA from 1977. The mining industry operates under that law and they are required to provide data to the regulatory agencies and say, "We have measured the topsoil and this is what we found. This is the data. These soils meet those criteria and we are going to use those for topsoil. These soils do not meet those guidelines and they won't be used for topsoil."

Q. And those guidelines also apply to the oil industry?

A. Well, not from SMACRA they don't. I guess I don't completely understand that, Dr. Neeper. I know it's being recommended. I know that there is a rule and there are statements in the rule and I would say I assume -- I hate to use that word but I

would assume that those guidelines would be followed and that if you are responsible in reclamation you are going to follow those guidelines because that's how you get successful reclamation.

Q. Is following those rules required by Rule 17?

A. I'm not sure I know. I guess I don't know.

Q. You had said that when you do have a buried layer, salt will move upward a certain distance and stop moving and it will basically move downward a certain distance and stop moving. The distance upward you have cited in the Texas study of about a foot, but within your own trench does salt move up to within eight inches of ground surface? So is the one foot distance applicable to the distance to ground surface with the rain and varying hydrology are at or does it get measured just from the top of the original?

A. Dr. Neeper, much of the work that has been done in this field that you are talking about, as I understand your question, much of the work has been done where the measurements have been taken from the barrier between where the salt is and then working upwards. So a lot of the data, Dawe, for example,

he emphasized the layers moving to the surface so that's how it's commonly recorded. That's how it's commonly done. Obviously, if there's less than a foot of soil over this layer of salt then it changes things, correct?

Q. Correct.

A. The work that was done by McFarland and some of the work that I have done, we have had the opportunity to have more than a foot of soil over the interface between the salt and the soil. McFarland's was three feet. Some of the studies that I have done have been in excess of three feet or in excess of three feet. In those instances the propensity of the data has shown that it migrates up about a foot.

When you find studies that have been done with less than a foot -- I'm sorry, I didn't mean to say that -- less than three feet, more like a foot or two feet -- and I have done those studies -- then it migrates up to some point but it does not migrate to the surface. The physics behind all of this are such that during rain events -- and I will say this and we need to be careful with this statement -- regardless of the depth of soil -- I don't like saying that, but in varying depths -- I will try not

to say regardless. In varying depths of soil, less than three feet, the salts will migrate up to a certain point and then those salts wanting to move up further are pushed back down through rain events. So there's this flux, if you will, going on.

Now, I haven't studied that flux. I haven't had the opportunity of just going out to take measurement after measurement. We have measured it a few times during the history of that site. In no instance -- I will tell you in no instance in those situations, regardless -- this time I will use regardless -- regardless of the soil depth has the soil ever migrated to the surface after a few years or a number of years, such as ten or even 15 years.

Will it migrate up? Yes. I think that's an important statement. Will it migrate to the surface? In my opinion, and my testimony and my experience and all the things that I have seen and the measurements I have taken, I have never seen it migrate to the surface, and I think that's an important statement.

I'm sorry, I know I didn't answer your question.

Q. Oh, I think you answered it. I think we

can get at the answer even better if we just look at your slide of trench study, because that's data.

A. Okay.

Q. Now, this shows the salt migration from the pit as coming up, you mentioned about eight inches, the last point before it reaches the native background situation.

A. Correct.

Q. Eight inches below the surface. The driver is from whatever is going on with the climate surface, as you mentioned.

A. That's one of them, for sure.

Q. The climate combined with the soil.

A. Combined with the texture of the soil, combined with the chemistry of the salts. I would help you but I don't even know how to use a pointer.

Q. I can use one but it shakes so much I can't keep it on the screen. It is this region I am discussing and the salt has moved within about a foot of the surface, up to eight inches at the leading edge.

A. Correct.

Q. And you have mentioned that the dynamics do not depend on the concentration. The same kind of motion occurs whether you had low concentration

or a high concentration. The blue line is the low concentration and the red line is a high concentration.

A. That's more or less correct.

Q. And so would it not be that if you had a much, much higher concentration in the pit you would have a much higher concentration up, let us say, at the eight-inch depth? It would be proportionate?

A. Interesting question. Let me just think about that for a minute. Let me just think about that for a minute. Dr. Neeper, part of what's driving my mind right now is where in the world are you going. The other is I don't really care. And then the other is what's -- I'm trying to get to what's the point here, and --

Q. I will be glad to explain that.

A. Well, I'll try to answer it without going there. In general -- I will just say in general -- if the salt concentrations were lower, the gradient would be less steep than it is. Does that make sense to you? Do you know what I'm talking about if I say that?

Q. Yes, the blue line?

A. I just said something and I want to make sure the Commission -- if the concentration were

lower in the pit contents, the steepness of that line would not be as steep as it is. And I feel I'm right in making that statement. If the concentration in the pit contents were higher, then the steepness of that line would be greater than what we observe. My testimony would be that at some point, in that situation -- now, realize here, we are talking -- this is 40 years of this business going on. This is not yesterday or two days ago. This is 40 days to create that gradient. And I would testify that the gradient could be steeper but it would still, at about eight inches, be the same. So did I answer your question?

Q. That answers the question.

A. Thank you.

Q. You are saying it would not increase the salt content at the eight inch depth?

A. That's what I would say is the salt concentration at the eight-inch depth would remain the same, but the concentration above the pit contents could be higher if the pit content concentration was higher.

Q. Very good. You showed the curve of SAR with regions of soil that were reluctant to receive moisture or less moisture receiving and where there

was less danger or no danger of moisture --

A. It had to do with the hazard of aggregation of permeability.

Q. Yes. And that if you increased the EC of the water, say by adding gypsum to the water as is done in reclamation, you can get water to go in those soils, even if you had --

A. Commonly done.

Q. Commonly done. But what is the EC of rainwater?

A. It varies, but fairly -- are you okay if I tell you it's very low or do you want a number?

Q. No, I don't want a number because it will vary a little bit.

A. I'm glad we agree on that.

Q. We can agree it's much, much less than one?

A. It is most often much, much less than one.

Q. Thank you. And so whereas a remediator could get water with gypsum into the soil, naturally if you had a higher SAR you could not get rain water -- would not be likely to get rainwater in?

A. What is sometimes done, Dr. Neeper, is they actually add gyp to the soil. Obviously, in a non-irrigated situation, if we have irrigation

water, my goodness, it's just amazing what we can do with irrigation water and all the stuff we can put in it. But what you are talking about is rainwater in this situation. It's not uncommon to add, in a situation where you are concerned about dispersion of soil, that things are done to the soil to reduce the dispersion.

One of the more common things that is done is to add organic matter to the soil and aggregate the soil so it is naturally, if you will, naturally because of the polysaccharides in the organic matter that aggregate that soil, maintain that aggregation, and then as the rainwater comes and it maintains the aggregation.

Remember what happens to -- well, I'm off lecturing now, aren't I? I won't -- I'm just going to chew up a bunch of time. There's no quiz at the end of this. You don't get a grade.

Q. The point is I think you have very well made the point that damaged soils can be remediated as you have done it, but is remediation required anywhere in Rule 17?

A. Let me address the Commission on this. This is so important. You do it right the first time. You don't build a box around it that you

can't live in, okay? So don't get too excited about remediating the soils and do this and do that. You start out doing it right in the first place. Now, is there -- I think the question was is there something in the regulations that requires you to fix the soil if it's -- good grief, don't even get there. Don't have that problem in the first place. Is there a requirement? Probably not. But if you have got failed reclamation you call me on the Madison River and if I feel like I want to quit fishing for a day I will give you advice. Otherwise you are on your own. And I shouldn't have said that.

Q. One of the later questions dealt with a liner. Have you watched a pit closure, a drilling pit closure, a temporary pit closure?

A. No. Pretty close, but no.

Q. With a liner in place and if it restricts liquid water that would otherwise move downward, would that not enhance to some extent the upward movement of the salt water?

A. Momentarily. Keep in mind, once that water moves, now you no longer have that water. You have this water, right? If that water moves and evaporates or transpires or is used by a plant

through transpiration, now that water is gone and you don't have it anymore so that's why I said momentarily.

Q. You had mentioned that as soils get dry the vapor becomes important and vapor does not move salt. Is there anything in the vapor and the liquid cycle that can move salt?

A. The liquid.

Q. Yes.

A. Liquid water can move salt.

Q. Is there a cycle in these arid soils by which the vapor is important in causing movement of liquid and thereby essentially causing movement itself? Where am I going with this? I can state you cited and mentioned papers of -- I think you mispronounced the name but Bridgett Scalon?

A. S-C-A-L-O-N.

Q. Okay. But that's where that question comes from.

A. So what's the question?

Q. Is there anything in the transmission of water from liquid to vapor and then back to liquid that could dissolve substances such as salt?

A. Yeah, yeah. I'm sorry, yes.

Q. And would that preferentially affect

things near the surface of the ground in the upper six feet, for example?

A. That's more complicated than that because of the temperatures. The temperature is a very important role in all of this and you are not taking that into account, so you are just taking a very simple situation and saying well, is that preferred at the surface. It's a lot more complicated than that and I'm going to say no, not necessarily.

Q. All right. Then just a final point. Of the papers that you submitted to the Commission, are the implications of all those withdrawn or denied? Because some of those were -- making me wrong, shall we say? Can the witness answer the question?

MR. CARR: I don't think the witness can answer the question. We filed and prefiled exhibits we considered using. We used those we felt were useful in presenting the case to the Commission. Those not filed and not in the record are not before the Commission.

DR. NEEPER: So the witness does not need to answer the question.

MR. SMITH: Let me clarify. To the extent they were filed, they will be in the record but they may not be admitted into evidence.

Q (By Dr. Neeper) I will ask one final question. It is straightforward. You have mentioned that the water and the salt with it stops moving. But mr. Mullins' model in his testimony had the continuous motion of the water, and we have seen movement beneath the pits where each pit was then investigated and reported in this hearing. What is the difference and why does that movement -- can that movement not continue? Mr. Mullins' model says it does.

A. He said water moved. Did he say it was liquid water that was moving?

Q. Unsaturated flow.

A. He said unsaturated, but was it liquid or not liquid? Was it vapor that was moving?

Q. By your terms it carried chloride so it must have been liquid.

A. I'm sorry, I heard just pieces of what you said and I didn't get it.

Q. It carried chloride so, therefore, we would assume it was liquid flow.

A. Okay. So what's the question?

Q. Mr. Mullins' model assumed that there would be continuing flow to depth. You have asserted that the flow stops. What is the

difference between these two views other than just the quantity?

A. If I remember right, Dr. Neeper, Mr. Mullins was asked if he included in his model the chemistry of the soil, and his answer was no, he did not -- I'm sorry, I said the wrong thing. He was asked if the chemistry of the salts was introduced into the model and he said no. His answer was no, that he hadn't included the chemistry of the salts. So the difference for me is that I said that the salt movement is driven by climate, texture and I don't know, but I'm sure climate was included in the model. It would seem very part and parcel to that.

The texture of the soil or some measure of the hydraulic conductivity of the soil, that's the second component. And the third component is the chemistry, and he said I didn't include the chemistry. So I think that could account for the difference.

DR. BARTLIT: Madam Chair, I wonder if I might ask a question? It relates to this cross-examination. It is this: Our team does not have able lawyers on its staff, as you know. We can ask reasonable and useful questions. And we have

done so. Before Dr. Neeper quits asking, I would ask if I could consult with him about some additional questions that he might ask more effectively. If that is not permissible, he could quit and I could ask some questions and I think that would be a less efficient use of everyone's time.

CHAIRPERSON BAILEY: Why don't we take a couple minutes for you to talk to Dr. Neeper so he can ask the questions?

DR. BARTLIT: I appreciate your indulgence. Thank you.

(Note: A discussion was held off the record).

CHAIRPERSON BAILEY: Dr. Neeper, do you have additional questions?

DR. NEEPER: I have an additional question, a set of questions.

Q (By Dr. Neeper) You have stated, I believe, that in saying do it right that revegetation is essential in protecting the soil and the groundwater and getting things back to normal.

A. Was that a question? Yes.

Q. Yes, that's what you meant by saying do it right the first time?

A. Correct.

Q. Is revegetation? And there was some confusion in your mind over whether revegetation was required in the rule; is that correct?

A. Correct. No, there was some other question you asked. I'm sorry, I'm confused here. Reclamation is required. It's recommended that these sites are reclaimed.

Q. I will pose then a hypothetical question. If revegetation and that form of reclamation is not required, what would make proper revegetation happen, the thing that you call getting it right?

A. This isn't your question, Dr. Neeper, but I'm going to answer it this way. You know, it doesn't really matter. I will submit to the Commission that it probably doesn't matter whether I know or don't know whether reclamation is required or not. I am here to testify and I'm going to tell you that reclamation can be done. If the Commission requires to require reclamation, okeydokey. If they don't, you are making -- in my mind, that would be a mistake. I am telling you that reclamation is important, reclamation can be done and it can be done successfully and sustainably.

So your question having to do with whether I know or don't know whether this is required, I'll

just answer that I guess I'm not absolutely sure that it's required. And then your question as to whether doing it right and if it isn't done right what do we do, we spank them, Don, and in the process they will get spanked a few times and they will learn to do it right. I'm convinced of that.

I'm sorry, I didn't mean to be so dramatic about that. But I have seen reclamation for 40 years. I'm the President of the American Society of Mining and Reclamation for the -- it's a society in the United States. I have, as Mr. Dangler said -- have you seen bad reclamation? And I know I am sitting here lecturing, but I want you to hear this.

Yeah, I have seen bad reclamation. I'm not an idiot. I've been around. I didn't get off the ship yesterday. I have been around for 40 years. But I have seen good reclamation and I know there are a lot of people in the world who know how to do good reclamation and we are going to start learning it and doing it and practicing and industry will come to doing it correctly. And they will be held accountable.

And down the road somewhere -- I really believe this and I know I'm not going to be living at that time -- down the road sometime they will be

held accountable and say that's not good enough. And somebody younger than I am takes my place in this society will hold them accountable and they will do it right. And people in this country are not going to stand for crappy reclamation. They are just not going to do it. Reclamation can be done correctly. We know how. It's 2012 and we know how to do it now. We are getting national awards for doing it correctly. We need to start following that example and we will. I believe we will.

I don't know if that answers your question and I'm sorry for going off and lecturing about what I really believe in, but I believe in reclamation and I think it's something that we are very good at.

Q. I appreciate from my heart what you call your lecture, and I would ask one little question. Do we know how to specify good reclamation? If somebody didn't know how, could you tell him how?

A. We know the formulas, Don. I'm sorry, Dr. Neeper. We know the formulas and the mechanisms that go into it. We have learned a lot and in many cases we have stopped making mistakes. Years ago -- I don't even want to tell you how many years ago but so many years ago I was working with a person and he said, "Well, I guess we pretty much know everything

we know about reclamation, we can stop doing research." I said, "Oh, my God. Are you kidding me?" That's like the guy at the patent office that says, "I don't want to work anymore because there's nothing left to invent." No, we will be doing this forever and continue refining and finding and unraveling some of the secrets that we don't know and understand. We have unraveled so many we are pretty good at it and we will get better at it, yes. Yes.

Q. No further questions, Dr. Buchanan. Thank you very much.

DR. NEEPER: I have a question. May I address the Commission?

CHAIRPERSON BAILEY: A question of the Commission?

DR. NEEPER: Yes, a procedural question.

CHAIRPERSON BAILEY: Yes.

DR. NEEPER: As I had mentioned and we had discussed, Dr. Buchanan did submit documents and it has been stated that they will become part of the record even though they are not in evidence. Some of those documents in effect call into question parts of my testimony. In reviewing that, I could see that many of those questions could arise perhaps

from incomplete explanations I might have given but I felt I could answer every question that was raised and clarified. The question is: Will that information be ignored by the Commission or might I rebut that information that is in the record but has not been submitted in evidence? That's up to the legal committee.

MR. SMITH: It will be ignored by the Commission.

MR. CARR: If Dr. Neeper would feel better, we will at this time withdraw any exhibit that was prefiled that was not admitted.

CHAIRPERSON BAILEY: There has been some discussion over what documents have been admitted and what documents have not been admitted. We need to ensure that the court reporter has a very accurate listing of what documents are and are not.

MR. CARR: May it please the Commission, I have discussed that with the court reporter and we are having copies brought of the exhibits that were admitted in today's testimony.

MR. SMITH: I think part of the problem is not just with the exhibits, Mr. Carr, that you have submitted. This has obviously been a long proceeding and to ensure that the court reporter has

the right exhibits, it seems to me, and I have had to do this before, it's a drag but I think a lawyer from each of the parties, you all should get together and make sure that you are in agreement as to what exhibits were tendered and admitted and you can either submit a list, all of you in agreement of each of your exhibits to the court reporter and to the Commission. Or if you would rather -- these are the only two suggestions I have. You may have other ones that are better. The court reporter does not have all the exhibits with her now but she is willing to come back up and meet with you all and go through those at some point in the very near future to ensure that she has all of the exhibits.

Those are the two things that I can think of. If you all have a better method, why, just let the Commission know what it is. But I think you need to determine how you are going to ensure that she has all the exhibits that you think she should have.

MS. FOSTER: When I submitted initially prefiled hearing statements, I submitted six copies to the Commission. Is one of those copies provided to the court reporter or do I need to recopy everything and give an additional book to the court

reporter?

MR. SMITH: You mean you submitted them in evidence or you submitted -- you are talking about your prefiling?

MR. CARR: Yes.

MR. SMITH: I wouldn't count on the prefiling. You want to count on what you have submitted to the Commission. If you neglected to submit one to the court reporter she won't have it because the Commission has not taken it upon itself to make sure that the court reporter has those.

CHAIRPERSON BAILEY: Why don't you mull this over over lunch and we will come back after lunch. In the meantime, the Commission still needs to ask questions of Dr. Buchanan to wrap him up. So we will defer a resolution to your question until the attorneys had a chance to think of the alternatives and the best way to ensure that the court reporter has the documents that are necessary. So in the meantime we have Commissioner Bloom, do you have questions of Dr. Buchanan?

COMMISSIONER BLOOM: Good morning, Dr. Buchanan. I think we might have covered this previously. But today you spoke about the importance of native vegetation and vegetation

reclamation efforts. Does the current rule, to your knowledge, specify that native plants be used?

THE WITNESS: I'm quite sure it specifies native.

COMMISSIONER BLOOM: I have not been able to find where in the proposed NMOGA/IPANM rule it specifies native plants be used. Do you know if that is in the proposed rule?

THE WITNESS: I remember being asked to contribute to that. I thought I wrote native and then there was some numbers as to that the percent of cover and then there was an address to the diversity of the cover. I'm quite sure it says native, but if you can't find it, you can't find it. So I could be wrong.

COMMISSIONER BLOOM: Do you think it should include native species?

THE WITNESS: Yes.

COMMISSIONER BLOOM: No further questions.

CHAIRPERSON BAILEY: Dr. Balch?

DR. BALCH: Good morning, Dr. Buchanan. I just have a couple questions. A couple of them might seem frivolous but please indulge me. If you could go to your Slide 19 and put it back up on the screen for reference. If you were to leave

instruction for some future graduate student 1,000 years from now or 2,000 years from now to do an off-site trench at that site, what do you think the results of their study would be as far as a profile?

THE WITNESS: Let me answer the easy one first. I think the blue line would be the same. I think the blue line represents hundreds of years of development, and I don't think 50 years from now is going to make any difference. If I'm right, and the climate doesn't change in the next 50 years, the soil texture is not going to change, the chemistry of the salts aren't going to change appreciably -- I think they are about the basic same salts. So the drivers are texture, climate and chemistry and I don't see them appreciably changing. I would think that that red curve would be very, very similar to the one we see today in 50 to 100 years from now.

DR. BALCH: If you had a bunch more time, archaeologists come along and say, "What are these features in the ground," what are they going to see in 1,000 years or 2,000 years?

THE WITNESS: I think the blue line will stay the same. Again, it's the conditions that drive all of this. In 1,000 years there might be -- I don't think the salts will be any lower. They

might be a little higher. Now, why I said that is the blue line represents the place climatically on a long climatic regime where those salts want to accumulate. That's what the blue line represents. So I think the red line would track that blue line.

DR. BALCH: Let me just be a little wider.

THE WITNESS: Okay.

DR. BALCH: Am I interpreting your answer correctly? The red line would become, over enough time, like the blue line, although the concentrations would be higher?

THE WITNESS: Correct. It wouldn't be superimposed on blue line, it would be over to the right. It just would be a similar shape to the blue line.

DR. BALCH: For New Mexico -- I think we studied the salt bulges extensively and also the literature. I probably asked you this question before. What is a typical depth range for a salt bulge in, say, Bloomfield, say the Raton Basin and out by somewhere in Eddy County?

THE WITNESS: If by chance those three locations had almost identical soils and identical climates, they would be very close to looking alike. In the Raton Basin, my concept of the Raton Basin is

it's a little wetter. And the climate has a little higher precipitation. So whether it's Raton or any other place, if the climate tends to be a little wetter, that bulge, that salt accumulation will tend to be a little deeper. If the soils are heavier textured, the accumulation will be higher in the profile. If the soils are very sandy, then the accumulation will be lower.

So you can apply those principles to Eddy County, Raton County, San Juan County. And there is a place -- you didn't ask this but there's a place if you get it wet enough that that would be substantially deeper than what we see here in a 14-inch precip zone.

DR. BALCH: Thank you. The last question I have for you is actually a follow-up on Mr. Dangler's comments. He brought up the well sites or the pits that were given in testimony by Ms. Martin yesterday, and I distinctly recall that most of those pits had groundwater that was shallow eight to 20 or 15.

THE WITNESS: Some were 40, I think.

DR. BALCH: Right, but relatively shallow groundwater. So my question for you, in the rule as modified, would the offsets from rivers, lakes,

ponds, et cetera provide sufficient protection to groundwater?

THE WITNESS: I do. I think that's the intent of the rule is to offset such that that groundwater is deeper and that's what happens in those offsets. That's my understanding of those offsets, that it's intended to offset in such a way that the groundwaters are deeper. And I don't know why this number sticks in my head, but it's something like 50 feet and deeper, and the 20-foot water tables wouldn't be -- how do I say this? Twenty-foot water tables wouldn't be the case. That's what you are trying to avoid is drilling where there's deeper water tables and that's the reason for the offset. I didn't answer that very well.

DR. BALCH: I think you did. You said you thought the offsets were protective.

THE WITNESS: I think they are protective.

DR. BALCH: Thank you. That's all my questions.

CHAIRPERSON BAILEY: I have a couple. We have talked about three feet of cover and then a foot of topsoil for ideal conditions for revegetation.

THE WITNESS: Correct.

CHAIRPERSON BAILEY: But yet there's not been any discussion over that three feet of cover. Are there any standards or specifications or courser material to be placed at the bottom of the three feet, how would you describe the best way to describe the three feet?

THE WITNESS: If I were doing this or you gave me a license to do something here, I would describe that three feet as root zone material. I wouldn't describe it as topsoil, I wouldn't describe it as cover soil. I would describe that as root zone material. This is the material that exists between the pit contents. This is where roots are going to grow, so in my mind it's properly called root zone material and there would be criteria for that root zone material. They will have to meet certain soil physical properties and soil chemical properties.

CHAIRPERSON BAILEY: What would you say those criteria should be?

THE WITNESS: I would, for the most part, I would follow the guidelines that are proposed by the State of New Mexico we refer to as MMD, the Mining and Minerals Division. They have guidelines

for topsoil. They call it topsoil and topsoil substitute. And these are materials that are used for reclamation and mining and they have guidelines. Those guidelines were -- I'm sorry. I was about to say work. Those guidelines work.

The topsoil guidelines are essentially the same. They might be a little more restrictive in regard to texture, for example; gravel content, for example; some of the physical properties, and I might consider rewriting those or I would review the state guidelines very carefully and I would get someone who understands this. You have those people in the state that work for the State and they know about these things and they know what those guidelines are and what those guidelines should be, and I would lean on them to help me write those guidelines.

I know that wasn't very specific -- I didn't give you numbers and things, but those guidelines exist and they exist in the state of New Mexico. Did that answer that?

CHAIRPERSON BAILEY: Yes, it did, but it raises a whole host of other questions. As you can hear from the audience response, yes. The suggested language for reclamation and revegetation

suggests -- and I will read to you what this says as part of the suggested language. "Reclamation of all disturbed areas no longer in use shall be considered complete when all ground surface-disturbing activities at the site have been completed and all disturbed areas have either been built on, compacted, covered, paved or otherwise stabilized." Blah blah blah. Compaction doesn't necessarily enhance reclamation, does it?

THE WITNESS: It surely doesn't. It's the biggest -- it almost is the biggest enemy to reclamation as almost anything I can think of. These plants have learned to adapt to this and that and salt and low water, but boy, they sure don't know how to handle compaction. Compaction is an enemy to reclamation and it needs to be resolved before you attempt reclamation.

CHAIRPERSON BAILEY: Those are all the questions I have. Thank you very much. Do you have any redirect?

MR. HISER: We do. Not very much and most of it goes to the last issue we were talking about.

REDIRECT EXAMINATION

BY MR. HISER

Q. I want to start with the issue Mr. Dangler

raised about the seven examples Ms. Martin presented yesterday. Is it your recollection from hearing her testimony and discussion that of those had to do with liner failure or compromise?

A. Right.

Q. There was considerable discussion whether that was in the operational phase or the post-closure phase.

A. Right.

Q. And if it was in the operational phase and you had water head on that, is that saturated flow, which might be different from what you've been discussing?

A. It's quite different. Saturated flow is quite different.

Q. Now, there's been a lot of concern as well about what is reclamation success, and I appreciate Commissioner Bailey reading some, but unfortunately not all of the reclamation success standard. If we may provide a copy of the actual proposal to Dr. Buchanan to take a look at that?

CHAIRPERSON BAILEY: Yes, certainly.

Q. One of the questions that I think Mr. Dangler was concerned about is how do we assure successful reclamation occurs and how do you,

Dr. Buchanan, give us, the public, and the Commission, reasonable reassurance that we are actually going to see good reclamation as opposed to bad reclamation. If we look at NMOGA Exhibit 1, Section 17 F-3 and we go down to C, which is the section that Commissioner Bailey was just reading, does this establish a functional standard for successful reclamation?

A. Yes. It implies there's monitoring. They monitor the vegetation and that provides a standard by which we can measure success.

Q. If I am a poor reclamationist so that I am consistently unable to achieve the standard, am I going to have a job?

A. Not for long.

Q. And so at some level will the market and just the needs of the companies to be able to complete the performance standard established by this rule require the use of good reclamation practices?

A. It does.

Q. One of the other questions that Commissioner Bailey spoke to was she talked about the compaction, compacted, covered and paved, and suggested that this was not appropriate for

reclamation; is that correct?

A. Correct.

Q. Now, is not this provision phrased in an "or" where you were given a couple choices of things that you were going to do? So, for example, if I were the landowner and I was trying to establish a driveway, would I want to use the reclamation standard that you were talking about for my driveway or would I want to cover and pave that?

A. So key to this is the post-use. If it's a driveway it's an entirely different situation. In fact, there's differences between wildlife and grazing. It's a different set of situations. If the post-use is wildlife, there's a different set of species that are invited to the party. If it's grazing there's another set of species. So even those things are different, so the post-use is really important here.

Q. Is it your opinion as an expert in this area that the functional standard that's been developed here is probably one of the best ways to achieve the balancing of the end use with achieving the good reclamation that we want to see?

A. Yes, I agree with that.

Q. Now, there was some discussion about the

guidelines of the MMD, which I think is the Minerals Management Division? I may not have that accurately.

A. Mining & Minerals Division of the Department of Energy.

Q. And you spoke that those guidelines were generally useful to you as a practitioner in the field. Are those guidelines useful to you because they are guidelines, or is there an issue with them becoming firm and inflexible law?

A. They are guidelines.

Q. So the most that you would want to see of anything like that is guidelines that are used to determine how to do the reclamation as opposed to inflexible regulation that you always have to follow this mixture?

A. It's clear that these, what are called regulations, and even the enforcement of the regulations are still considered regulations and guidelines.

Q. And the reason, in part that we have seen advancements in reclamation science is because we had things in the guideline and we did not freeze the science as of a certain year by a very prescriptive set of regulations?

A. Commissioner Bailey, you want to hear this. Because we should be very proud in New Mexico. We have been able to do some things in reclamation in New Mexico that other people haven't been able to do because of the flexibility of the regulatory people who have regulated mining regulation. We have done some things that were a little different, and they said, "Go ahead and try it" and we tried it and it worked and those have been adopted. Some other places and states haven't been as flexible as New Mexico has, so you work closely with those people.

Q. The last question I want to go to comes to the excellent question from Commissioner Bloom who was, I think, appropriately keyed off on your talk about how native vegetation is particularly important and the apparent absence of native in the performance standard that's been proposed.

Was one of the issues as we were looking at the drafting of the provision that we looked at the definitional problem of what is native? To refresh your recollection, does native have the problem of native to that 300 square foot plot of ground, native to the region, native to the state, native to the United States, and that if we don't

specify what level of nativeness we are looking at we find ourselves back in the straightjacket that we can't get out of?

A. Yeah. I had forgotten about that but that's how that was couched as to what really constitutes native and the idea is to avoid introduced species from the Mediterranean. That's what we are trying to get away from.

Q. Part of what we did, too, is to introduce the concept of the life form ratio, which is sort of the pre-existing -- return it to the natural mixture of forbs, shrubs and grasses and that will tend to establish a more native-looking community, even if there's a slight change in the species?

A. Diverse, sustainable, native kind of vegetation. But sustainability is closely associated with diversity; diversity is closely associated with sustainability. If you get one, you get the other. If they are predominantly species that are adapted to that climatic zone, we have experienced great success as opposed to species from distant climatic zones or non--- just climatic zones that don't represent what we are trying to do in this climatic zone. You just don't want to go far away from home -- the easiest way I can say is stay

home and get your seat. Don't go too far away. I know that's very -- but it's driven by the attitude of trying to accomplish success. That's what drives it.

MR. HISER: That concludes the questions, Madam Commissioner.

CHAIRPERSON BAILEY: Is there any other direct or rebuttal testimony to be had from the witness?

MS. FOSTER: No.

MR. CARR: That concludes NMOGA's presentation.

MR. JANTZ: We are done.

CHAIRPERSON BAILEY: All right.

DR. NEEPER: One question, Madam Chairman. We would like to accept NMOGA's offer to withdraw their prior submission that was controversial.

MR. CARR: We will withdraw the slides that were not admitted.

CHAIRPERSON BAILEY: That's in agreement. Are there any -- no public comments today? Okay. Then why don't the attorneys work out how they want to handle the exhibits.

MR. SMITH: I think when you work that out, it seems to me like it wouldn't be a bad idea

to have it -- do you want to have it on the record or do you trust each other?

MR. CARR: I would think what we could provide is within a week just a joint stipulation that these are the exhibits.

MR. JANTZ: I think that's probably fair.

MR. CARR: If we can't do that, of course we will have to come back but I bet we can do it.

CHAIRPERSON BAILEY: The record is now officially closed. September 17th for conclusions, findings, closing arguments. And then deliberations on the 24th.

MR. SMITH: And remember the findings and conclusions need to cite specifically to the record, the transcripts, the exhibits.

MR. HISER: We will have the transcript of the last bit in two weeks?

MR. JANTZ: Will it be publicly available?

CHAIRPERSON BAILEY: All transcripts are posted on the OCD website as soon as possible.

(Note: The hearing was concluded at 12:00.)

REPORTER'S CERTIFICATE

I, JAN GIBSON, Certified Court Reporter for the State of New Mexico, do hereby certify that I reported the foregoing proceedings in stenographic shorthand and that the foregoing pages are a true and correct transcript of those proceedings and was reduced to printed form under my direct supervision.

I FURTHER CERTIFY that I am neither employed by nor related to any of the parties or attorneys in this case and that I have no interest in the final disposition of this case.

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