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NUCLEAR REGULATORY COMMISSION

Title:	Crow Butte Resources, Inc. Marsland Expansion Area
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NUCLEAR REGULATORY COMMISSION

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ATOMIC SAFETY AND LICENSING BOARD PANEL

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HEARING

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In the Matter of: : Docket No.

CROW BUTTE RESOURCES, INC. : 40-8943-MLA-2

(Marsland Expansion Area) : ASLBP No.

: 13-926-01-MLA-BD01

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Tuesday, October 30, 2018

Crawford Community Center

1005 First Street

Crawford, Nebraska

BEFORE:

G. PAUL BOLLWERK, Chair

THOMAS J. HIRONS, Administrative Judge

RICHARD E. WARDELL, Administrative Judge

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P R O C E E D I N G S

8:00 a.m.

CHAIR BOLLWERK: Good morning. Let me begin by introducing ourselves. To my right is Dr. Richard Wardwell. Judge Wardwell is a civil engineer specializing in hydrogeological and waste disposal matters, and a full-time member of the Atomic Safety and Licensing Board Panel. To my left is Dr. Thomas Hirons. Judge Hirons is a nuclear engineer and a part-time Panel member.

My name is Paul Bollwerk, I'm an attorney and a full-time Panel member, and the Chairman of this Atomic Safety and Licensing Board.

Each of us is an independent administrative judge appointed by the five-member Nuclear Regulatory Commission as members of the Atomic Safety and Licensing Board Panel.

Members of the Panel are designated by the Agency's Chief Administrative Judge acting at the behest of the Commission to serve on three judge licensing boards such as this one that preside over hearings in which the Atomic Energy Act permits a hearing to be held relative to the construction or operation of nuclear power plants, the use of nuclear materials, and/or the storage of nuclear waste.

The Panel's administrative judges do not work for or with the NRC staff relative to the staff's own technical review of such licensing and enforcement matters. Rather, we're charged with deciding in the first instance what issues will be litigated in the hearing and, for those issues we find litigable, making a determination regarding their substantive validity in terms of granting, conditioning, or denying the requested license, or sustaining or modifying the proposed enforcement action.

Our decisions on hearing matters generally are subject to review, first by the Commission, the Agency Supreme Court, and then by the federal courts, including in appropriate instances, the United States Supreme Court.

This licensing board is here today to conduct an evidentiary hearing regarding the application submitted by Crow Butte Resources, Inc., in May 2012 requesting an amendment to its 10 CFR Part 40, that's Code of Federal Regulations Part 40, source materials license that authorizes the operation of its existing in situ uranium recovery, or ISR, facility near Crawford, NB.

Specifically, Crow Butte Resources asked that the Nuclear Regulatory Commission, or NRC,

authorize the operation of a satellite in situ recovery facility, the Marsland Expansion Area, or MEA site, which is located in Dawes County, NB, some 11 miles to the southeast of Crow Butte Resources' Crawford Central Processing Facility.

In November of 2012, the Commission issued a notice in Volume 77 of the Federal Register at page 71,454 outlining the process for becoming a party in a hearing contesting the Crow Butte Resources application.

In January 2013, the Oglala Sioux Tribe and a group consisting of three individuals and two organizations, collectively referred to as the Consolidated Petitioners, each filed intervention petitions challenging various aspects of the Crow Butte Resources application and the accompanying Environmental Report, or ER.

In a May 2013 decision, LBP-13-6, reported in Volume 77 of the Nuclear Regulatory Commission Issuances at page 253, the Board found that while the individuals and organizations affiliated with the Consolidated Petitioners had failed to establish their standing or legal interest in this proceeding, the Tribe did have standing, and it proffered two admissible Atomic Energy Act-related safety or

National Environmental Policy Act, or NEPA-related environmental contentions or issue statements. A decision the Commission subsequently affirmed in CLI-14-2, recorded in Volume 79 of NRC Issuances at page 11.

One of those admitted issues, Contention 1, raised NEPA and National Historic Preservation Act-related cultural resource concerns. Thereafter, with the June 2014 issuance of a portion of the NRC staff's draft Environmental Assessment concerning cultural resource matters for the Marsland facility, in October 2014 the Licensing Board granted an NRC staff dispositive motion seeking resolution of Contention 2 in its favor.

Entitled "Failure to include adequate hydrogeological information to demonstrate ability to contain fluid migration," the other admitted Tribe issue statement, Contention 2, as originally framed, challenged the adequacy of hydrogeological information in the Crow Butte Resources application on both Atomic Energy Act safety-related and NEPA-related environmental grounds.

With the issuance of the remaining portions of the NRC staff's draft Environmental Assessment in December 2017, and the staff's final

Environmental Assessment in April 2018, the focus of the environmental portions of Contention 2 shifted from Crow Butte Resources Environmental Report to the staff's Environmental Assessment, as reflected in Board rulings in March and July of 2018.

As a consequence, over the next several days, the concerns under consideration relative to Contention 2 will be, first, whether the descriptions of the affected environment are insufficient to establish the potential effects of the proposed in situ recovery operation on the adjacent surface water and groundwater resources.

Second, whether a description of the affective porosity, hydraulic conductivity, and hydraulic gradient of site hydrology -- hydrogeology, excuse me, is absent along with other information relative to the control and prevention of exclusions.

Third, whether an acceptable conceptual model of site hydrology adequately supported by the data presented in the site characterization has been adequately developed to demonstrate with scientific confidence that the area hydrogeology -- including horizontal and vertical hydraulic conductivity -- will result in the confinement of extraction fluids and expected operational and restoration performance.

And fourth, whether the staff's Environmental Assessment contains unsubstantiated assumptions as to the location of the aquifers in the ore-bearing zones.

With us today as parties to the hearing are Applicant, Crow Butte Resources, the NRC staff, and the Oglala Sioux Tribe. Let's have the parties identify themselves for the record, starting with Crow Butte Resources, then moving to the staff, then finally the Oglala Sioux Tribe.

MR. SMITH: Good morning, Your Honor, this is Tyson Smith, Counsel for Crow Butte Resources. At the table in front of me I have, starting at your right, Mr. Bob Lewis, Mr. Jim Striver, Mr. Doug Pavlick, and Mr. Walt Nelson.

CHAIR BOLLWERK: Thank you. NRC staff.

MS. SIMON: Good morning, Your Honor, this is Marsha Simon for the staff. Next to me at counsel table are Emily Monteith and Rob Carpenter. And in front of me at the witness table, again starting on your right, are Mr. David Back, Mr. Tom Lancaster, Dr. Elise Striz, and Ms. Jean Trefethen.

CHAIR BOLLWERK: Thank you, and for the intervenor.

MR. BALLANCO: Good morning, Your Honor,

this is Tom Ballanco representing the Oglala Sioux Tribe. With me at counsel table is David Frankel. Our witnesses are Mike Wireman, Dr. Hannan LaGarry, and live on the video tape, Dr. David Kreamer.

CHAIR BOLLWERK: Thank you very much. As outlined in the Board's October 3 issuance regarding the administration of this evidentiary hearing, because of the issues of the availability of tribal witnesses, the concerns will be presented in an order slightly different than what was presented above.

Specifically, Concern 2 will be dealt with first, followed by Concern 1, then Concerns 3 and 4, with the possibility that Board questions for Tribe witness Dr. LaGarry regarding his testimony on stratigraphy and containment pathways may come after the Board has finished with Concern 1 or after it has concluded with Concerns 3 and 4. We'll sort of play that by ear depending on how things are going.

Further, as we indicated during the May 6 teleconference with the parties, and we contemplate empaneling all three parties' witness panels at the same time to allow for more robust interchange of views in response to Board questions.

Also, while the Agency's 10 Code of Federal Regulations Part 2, Subpart (l), simplified

hearing procedures governing this proceeding contemplate that all questions for the parties' witnesses will be posed by the Board, from time to time we will pause to allows that parties to propose, and the Board to consider, additional questions for the Board to put to the witnesses.

And I think our plan at this point is generally when we're finished with a concern, at that point we will be looking for any proposed questions you all might have.

Finally, as part of our July 27 guidance on the conduct of this evidentiary hearing, we indicated that we would afford Counsel an opportunity to make brief opening statements. In that regard, in a moment we'll turn first to Counsel for the Oglala Sioux Tribe for its opening statement, followed by the opening statements of Crow Butte Counsel and of the NRC staff Counsel.

Before we do so, however, I wanted to mention another aspect of this proceeding. As the Board has noted in various issuances, including its February 8, 2013 initial prehearing conference scheduling order and the July 27, 2018 notice regarding this evidentiary hearing session, which was published in the Federal Register, Volume 83, at page

37,828, under Section 2.315(a) of Title 10 of the Code of Federal Regulations, presiding officers are authorized to entertain limited appearance statements from members of the public who are not otherwise party to the proceeding.

These statements, which are placed in the official Agency docket of the proceeding, are intended as an opportunity for members of the public to express their views about and may help the Board and/or the parties in their consideration of the issues in a proceeding.

At this juncture, the Board has received several written limited appearance statements and conducted a transcribed session in Chadron, Ohio this past Sunday afternoon at which approximately 20 members of the public were afforded the opportunity to present their views and concerns to the Board orally.

If, however, there is anyone here who would like to provide the Board with a written limited appearance statement, there are forms available in the back of the room that you can complete and place in the box on the table before this evidentiary proceeding adjourns. Or, if you prefer, you can submit a statement by mail, facsimile transmission, or email by following the instructions provided in the

Federal Register notice published in Volume 83 at pages 37,829-37,830.

As amended relative to the facsimile transmission number to be used in the Federal Register notice, which was published in Volume 83 at page 48,874, as well as the information flyer that's available at that back of the room.

And I would mention there are information flyers about this proceeding available at the back of the room. Please feel free to take one if you like, as well as small pamphlets that describe the Atomic Safety and Licensing Board Panel and what our authority and function is within the Agency.

In addition, I would observe that today we will be utilizing some technology that will aid the Board and parties in conducting a more efficient proceeding. This may involve some interchange between the Board and our Information Technology Technician, Joseph Deucher, who is sitting over to my right.

In particular, we anticipate using display technology as part of the evidentiary presentation, which will enable Counsel and those in the audience to observe the witnesses as they testify, as well as make the documentary information we will be discussing with the parties and witnesses more accessible and

understandable.

And as a consequence of the witness availability issues I mentioned previously, Oglala Sioux Tribe witness Dr. David Kreamer will be participating remotely from Las Vegas, Nevada via GoToMeeting both today and on Thursday.

Finally, as we begin today's evidentiary hearing, I would note that this is my cell phone, which is in my pocket, and I have turned it off. I would ask that all cell phones and similar electronic devices in the hearing room be turned off or placed on vibrate, and that any cell phone conversations be conducted outside this room. That will be the rule throughout this proceeding when it's in session.

Also, no food or beverages, other than water, are to be consumed in this hearing room while the hearing's in session, and I thank you for doing that.

Let's now turn to Counsel for the Oglala Sioux Tribe for the Intervenor's opening statement to whatever degree they wish to add such a statement.

MR. BALLANCO: Good morning, Your Honor, Counsel, experts, guests. I am Tom Ballanco, I am honored to be representing the Oglala Sioux Tribe on these important, this important contention.

At the outset, I'd like to say that the Oglala Sioux Tribe, and the Lakota People in general, are defined by nothing else than by their culture and their connection to a way of life that existed in this very place for generations, hundreds of generations.

There is no doubt, both in this proceeding and in every proceeding involving traditional Lakota lands, that the Tribe has been very interested in protecting its cultural resources and understanding the process of the proceedings and the rulings of the Board.

We do still object to dismissal of Contention 1, the cultural resources contention. We believe that it is the very definition of the trust responsibility for an agency to ensure that the known values of a tribal interest are protected through these proceedings.

Leaving that aside, I do acknowledge and want to thank this Board, NRC staff, and Counsel for Crow Butte for indulging these stumbles that we have made along the way. This is a new process, even though we've been doing it for some time.

I do acknowledge the Board has made many efforts to make our presentation possible, including Dr. Kreamer here via video conference this morning.

We do appreciate that, and we welcome you here and appreciate you being here.

Turning to the contention at hand, the Oglala Sioux Tribe believes that we do not have an accurate characterization of the hydrogeology involved in the Marsland Expansion Area. We believe that NEPA requires a thorough understanding of what is going on in the subsurface.

There is no doubt, I think, between those of us sitting at a table here that were mining to commence at the Marsland Expansion Area, as with every other in situ leach mining operation in the world, when it comes time to wrap up and restore, it will be impossible to return the aquifer to baseline premining levels. We understand that there will be ACLs.

Without trying to litigate or relitigate the strata findings, we do acknowledge that that process begins here. The reason that ISL mines cannot restore to premining conditions begins with the fact that we don't have a clear picture of what those premining conditions are and what the characteristics of the mining environment are before mining begins. And we'd like to see that become the manner in which licenses are granted.

We believe the NRC practice of issuing a

license prior to completing the NEPA process goes against the spirit of NEPA, and in fact, is contrary to federal law on the issue. We'll present experts that will demonstrate that the picture presented in the EA and the various reports from Crow Butte is incomplete and has not been subjected to the hard look standard.

We welcome your questions, and again, we thank you for engaging us on this subject. Thank you.

CHAIR BOLLWERK: Thank you, sir. And perhaps if, maybe Dr. LaGarry, the microphone that's in the middle, if you could just point that -- not yours but the one next to it. Could you bring that down a little bit? Unfortunately, it was kind of in the way there.

The microphones are fairly directional by the way, so if you have them in front of you, you're going to do just fine. All right, then Counsel for Crow Butte, please. I think we have a clear shot of you, so --

MR. SMITH: All right, good morning. On behalf of Crow Butte, I'd like to thank the judges, the parties, and members of the public for coming to Crawford this morning for these hearings. We welcome the opportunity to address the issues raised in the

one admitted contention and to answer questions from the judges.

As you know, Crow Butte submitted its application for the Marsland Expansion Area several years ago. That application included the results of intensive, in-depth site investigations and analysis of the proposed Marsland Expansion Area satellite facility. Since then, the NRC has conducted its own independent assessment of the application and performed the required analyses under the National Environmental Policy Act.

The NRC staff's Safety Evaluation Report documents the technical and safety aspects of the NRC staff's review and includes an assessment of Crow Butte's compliance with the applicable requirements of 10 CFR Part 40.

The Safety Evaluation Report concludes that the application complies with the standards and requirements of the Atomic Energy Act and the Commission's regulations, and that measures are in place to protect the public and minimize danger to life or property.

The NRC staff also completed a comprehensive Environmental Review, culminating in issuance of a final Environmental Assessment. Based

on its review of the proposed action, the NRC determined that the Marsland Expansion Area Satellite Facility will not significantly affect the environment.

As you'll hear from Crow Butte and NRC staff witnesses, the issues raised in the admitted contention have been the subject of extensive reviews. In contrast, the intervenors make only broad assertions regarding site hydrogeology and present only vague claims that additional or alternative analyses should be performed.

None of these alleged deficiencies calls into question the adequacy of the application, the Safety Evaluation Report, or the reasonableness of the Environmental Assessment.

As these hearings will demonstrate, Crow Butte has fully addressed those matters NRC regulations require to be addressed, including those raised in Contention 2. Contention 2 should be resolved in favor of Crow Butte and the NRC staff. We look forward to answering any questions you might have. Thank you.

CHAIR BOLLWERK: Thank you, sir. The NRC staff.

MS. SIMON: Thank you and good morning,

Your Honors. The NRC staff appreciates this opportunity to appear before the Board to present its case on this contention. The reasons discussed in the staff's testimony and exhibits, the staff's position is that the Environmental Review for the Marsland Expansion Area -- as documented in the final Environmental Assessment -- complies with the requirements of the National Environmental Policy Act and NRC's environmental regulations.

Because the staff has already outlined its position in detail in its initial and rebuttal statements of position, I will limit these opening remarks to touch on key points of the staff's position. But before I do so, I would like to briefly review some principles related to NEPA that inform the Board's consideration of the environmental aspects of this contention.

Under NEPA, the NRC is required to take a hard look at potential environmental impacts of a proposed action to inform its decision and to inform the public. This hard-look standard is balanced, however, by a rule of reason which requires agencies to address only those impacts that are reasonably foreseeable, not ones that are remote and speculative.

The staff is only required to provide a

reasonably thorough discussion of significant aspects of the environmental issues and need not address every effect that could potentially result from the proposed action. A NEPA document is not a research report. NEPA does not call for certainty or precision, but instead calls for an estimate of potential impacts.

In addition, the Commission has emphasized that licensing boards do not sit to flyspeck the staff's NEPA documents or add details or nuances. The purpose of a hearing is not to parse or fine-tune the staff's NEPA document, or to edit it to suit an intervenor's preferred language or emphasis.

If the staff's Environmental Review document on its face comes to grips with all important considerations, that is sufficient. With these principles in mind, I will briefly summarize key aspects of the staff's position on the four asserted deficits that comprise this contention.

First, the staff's EA and the MEA application provide a thorough description of the affected environment sufficient to establish potential impacts to surface water and groundwater resources. The staff describes in its testimony the information needed with respect to geologic setting, surface water hydrology, and groundwater hydrology consistent with

staff guidance in NUREG-1748 and NUREG-1569 and identifies where in the EA that information is provided.

The staff also notes that its discussions in the EA are based on descriptions and supporting information that are in the MEA application.

Second, although the intervenors assert that certain information on hydraulic parameters of aquifers was missing from the MEA application, the staff explains in its testimony where each of those parameters is discussed in the application, and that the information provided was sufficient for the staff's review.

Third, the MEA application and the EA present an acceptable hydrological conceptual model for the MEA that is adequately supported by extensive site characterization data. The staff's testimony describes the components of a hydrological conceptual model and identifies where they are discussed in the EA.

The staff also describes in its testimony the comprehensive subsurface investigation conducted by Crow Butte, as well as the reliability of the data and the methods used to obtain them.

With regard to the applicant's ability to

demonstrate confinement, the staff's testimony reiterates and amplifies the bases for confinement discussed in the EA and the multiple lines of evidence supporting the conclusion that ISR production fluids will be adequately confined.

Likewise, the staff's testimony reinforces the discussion in the EA in which the staff thoroughly considered various potential contamination pathways, including horizontal excursions, vertical excursions, leaks and spills, and preferential pathways such as faults.

Finally, the EA and the MEA application did not contain unsubstantiated assumptions regarding isolation of aquifers. The intervenors did not identify any such assumptions in either document, and in its testimony, the staff explains how statements related to isolation of aquifers are substantiated by extensive and reliable supporting information and data.

In summary, the staff's Environmental Review of the MEA, as documented in the final Environmental Assessment, complies with the requirements of NEPA and the NRC's environmental regulations. The staff has provided testimony in supporting exhibits that meet its burden of proving,

by a preponderance of the evidence, that the intervenor's challenges to the final EA are without merit.

It is also the staff's position that the MEA application provided sufficient information for the staff to make necessary safety findings under the applicable regulations. For these reasons, this contention should be decided in favor of the staff and CBR. Thank you.

CHAIR BOLLWERK: Thank you, appreciate all the counsels' opening statements clarifying your positions. Thank you very much.

All right, at this point let's go ahead and move on to the business at hand. The first thing we need to do is to get those witnesses sworn in and to admit the exhibits. What I'd like to do briefly is we'll go, use the order of Crow Butte, the staff, and the intervenor. And what we're going to do is swear in the witnesses, and then we will put in the evidentiary material.

We're going to do that by using the list that we provided you all, which lists all the exhibits, excuse me. And I'll simply identify them by number, the list will put into the transcript, which will have the other identifying information, the

title, and that way we'll have a clear record as to exactly what was admitted into evidence.

I should mention that I don't consider this the final list of exhibits. There could be things that happen during the next several days that would require putting additional evidentiary material in.

Also, when we issue the final exhibit list, I'd anticipate that that will include the Adams ML accession numbers in that list as well. And we'll probably do that about the same time as we adopt any transcript corrections and close the record. So that's the way I'd like to proceed.

So the first exhibit we're going to deal with is BRD001, which is the joint stipulation.

(Whereupon, the above-referred to document was marked as Exhibit BRD001 for identification.)

CHAIR BOLLWERK: And all these exhibits have been subject to a motion, or I should say that one was agreed to by the parties. The others have been subject to a motion in limine, so I'm simply going to indicate that that exhibit is identified for the record and admitted.

(Whereupon, the above-referred to

document was received into evidence as Exhibit BRD001.)

CHAIR BOLLWERK: Let's move on then to Crow Butte Resources. Did you want to introduce your witnesses again? I recognize you already did that once, but --

MR. SMITH: Certainly. For Crow Butte Resources, we have on the judge's right we have first up Bob Lewis, Jim Striver, Doug Pavlick, and Walt Nelson.

CHAIR BOLLWERK: All right, thank you. All right, gentlemen, I need all of you to raise your right hand if you would, please. And I need an affirmative response, an oral affirmative response to the question I'm going to ask you.

Do you swear or affirm that the testimony you give in this proceeding will be the truth, the whole truth, and nothing but the truth?

Let's just start at that end and just right down the line, yes or no.

(Witnesses sworn.)

CHAIR BOLLWERK: Thank you. All right, let's deal then briefly with the Crow Butte exhibits. And we're looking then at Crow Butte, we're looking at CBR001-R, CBR002 through CBR0004, CBR005-R, CBR006,

CBR007, CBR008-R, and CBR009 through CBR039.

(Whereupon, the above-referred to documents were marked as Exhibits CBR001-R through CBR039 for identification.)

CHAIR BOLLWERK: All those exhibits are identified for the record and admitted into evidence.

(Whereupon, the above-referred to documents were received into evidence as Exhibits CBR001-R through CBR039.)

CHAIR BOLLWERK: Thank you very much. Let's then turn to the NRC staff. If you could identify again your witnesses, please.

MS. SIMON: Certainly, Your Honor. Again, from the judge's right we have David Back, Tom Lancaster, Elise Striz, and Jean Trefethen.

CHAIR BOLLWERK: All right. Then if you all could raise your right hand, please. And again, I'm going to need an affirmative oral response from each of you to the question I'm going to ask. Do you swear or affirm the testimony you will give in this proceeding will be the truth, the whole truth, and nothing but the truth? Let's start on this end.

(Witnesses sworn.)

CHAIR BOLLWERK: All right, thank you very much. Let's deal briefly then with the staff's

exhibits, which are actually a little bit easier because it's NRC001-NRC017.

(Whereupon, the above-referred to documents was marked as Exhibits NRC001-NRC017 for identification.)

CHAIR BOLLWERK: Those exhibits are identified for the record and admitted into evidence.

(Whereupon, the above-referred to documents were received into evidence as Exhibits NRC001-NRC017.)

CHAIR BOLLWERK: Let's then turn to the intervenors. If you could please one more time for the record identify your witnesses, please.

MR. BALLANCO: Good morning, Your Honor. On the Board's right we have Dr. Hannan LaGarry, Mike Wireman, and on camera, Dr. David Kreamer.

CHAIR BOLLWERK: All right. Before I swear you in, I just want to talk with, for a second, with Dr. LaGarry. And as you all, as Counsel are aware, I'm sorry, not with Dr. LaGarry, excuse me. With Dr. Kreamer, I apologize.

Dr. Kreamer, Counsel are here aware that last night we got a late-night email saying that you were having some travel difficulties. Now, there was already a plan because of some conflicts that you had

to bring you in by video conference, by GoToMeeting, actually on Thursday. We're now doing that today as well. And we're glad to have you here with us, sir.

But one thing I do need to let you know beforehand is we're going to be very interested, sir, in making sure you're there in that room alone, or if anyone comes into the room, that you tell us about that. And I'm hoping that when we swear you in you're going to, obviously going to do that, all right.

And the folks here are basically using the evidentiary record. So again, this is not open time to go searching on the Internet for answers. My assumption is you're going to testify on the basis of what you've already told us, as well as the evidentiary record. And you understand that as well?

DR. KREAMER: That is correct. And I want to thank Your Honors for allowing your time. My flight was delayed about five or six hours. I was supposed to come in about 4:00 in the morning, and I would have been late for this hearing. I was delayed in the flight.

CHAIR BOLLWERK: All right. Let me just check with our IT person, Joe. Are we all right in terms of anything he needs to do to make the audio work better?

(Off-the-record comments.)

CHAIR BOLLWERK: All right, I don't know how your microphone is set up, but Dr. Kreamer, but maybe you could move it a little closer?

DR. KREAMER: Okay, is this better?

CHAIR BOLLWERK: Better? All right. Hopefully that's not going to be a problem with him dropping in and out, but we'll proceed on. All right, then. As I did before, I would appreciate all three of you gentlemen, if you could raise your right hand, please.

And I'm going to need an oral affirmative response to the question I'm going to ask you. And we'll go ahead, when I ask for those responses, we'll start with Dr. Kreamer, and then we'll move to the gentlemen here in the room.

Do you swear or affirm that the testimony you give in this proceeding will be the truth, the whole truth, and nothing but the truth? Dr. Kreamer?

DR. KREAMER: Yes.

CHAIR BOLLWERK: And gentlemen?

(Witnesses sworn.)

CHAIR BOLLWERK: All right, let's deal then briefly with the exhibits for the Oglala Sioux Tribe. And we're going to start with OST001-OST003,

then OST004-R, then OST005-OST008. OST010, OST013, OST014-R, OST015-R, OST016-R, and then OST017 though OST020.

(Whereupon, the above-referred to documents was marked as Exhibits OST001-OST020 for identification.)

CHAIR BOLLWERK: And those evidentiary materials are identified for the record and admitted into evidence.

(Whereupon, the above-referred to documents were received into evidence as Exhibits OST001-OST020.)

CHAIR BOLLWERK: And at this point, I think, unless Counsel have anything further, we'll go ahead and proceed with the testimony of the witnesses. All right, then, why don't we go ahead. I came within one minute of 8:30, so --

JUDGE WARDWELL: Very good, thank you kindly. Welcome, everyone. I'm glad you're here to go through some fairly technical discussions we're liable to have over the next few days. A couple comments I wanted to make before we get started is that time is of the essence. We've got a lot to cover. We have read all the prefiled testimony and the rebuttal testimony associated with it, so we're

well aware of that.

The questions we have are ones that just came up in regards to reading that information. As the questions are asked, I would encourage you all to be very succinct in your answer. We generally do not need a very long discussion of any particular question, but just ask the question that's there.

Oftentimes, and I can speak from my own personal experience as an expert witness, we tend to answer the question we want to answer and not the one that's been asked. And I would encourage you not to do that. If I do interrupt you, it's because it would seem to me that you're not addressing what's of interest for the Board.

And so I'll try to clarify that. It's probably, oftentimes it's going to be my fault that I haven't clarified exactly what I'm after. But don't feel I'm being rude; I'm going to stop you just for the sake of the time commitments we have here and to get us back onto addressing those particular items that the Board feels it needs some additional information on.

CHAIR BOLLWERK: Can I do one procedural thing before you begin? It struck me --

JUDGE WARDWELL: Do I have a choice?

CHAIR BOLLWERK: Well, probably not, actually.

JUDGE WARDWELL: Go ahead.

CHAIR BOLLWERK: But let me just read into the, we haven't really read into the record the contention we're doing, actually the language of the contention. Let me do that very briefly.

The contention we're going to be dealing with is OST, Oglala Sioux Tribe, Contention 2, Failure to include adequate hydrogeological information to demonstrate ability to contain fluid migration.

And the language of the contention reads: The application and final Environmental Assessment failed to provide sufficient information regarding the geological setting of the area to meet the requirements of 10 Code of Federal Regulations Part 40, Appendix A, Criteria 4(e) and 5G(2), the National Environmental Policy Act, and NUREG-1569, Section 2.6.

The application and final Environmental Assessment similarly fail to provide sufficient information to establish potential effects of the project on the adjacent surface and groundwater resources, as required by NUREG-1569, Section 2.7, and the National Environmental Policy Act.

And Concern 2, which we're going to deal

with first, challenges exclusively as a safety concern, the absence of the applicant's technical report, in accord with NUREG-1569, Section 2.7, of a description of the effective porosity, hydraulic conductivity, and hydraulic gradient of site hydrogeology, along with other information relative to the control and prevention of exclusions, such as transmissivity and storativity. Excuse me, did I pronounce that correctly? That's it.

JUDGE WARDWELL: Thank you. If it is a yes/no question, answer it as a yes/no question. We'll give you a chance to elaborate, more than likely, on it, but please stick with that. I'm not trying to bring up a series of questions that are then designed to trap you. I'll probably say beforehand where I'm going with a series of questions just so you know where it's going. So that's at least my goals of doing this.

The one other thing you'll notice is that several times I will refer to sections in the list of questions that I have. I have organized this, as has already been talked about, in regards to the various concerns that we are talking about, the four concerns.

So the first level of organization is those concerns, of which we're going to start off with

Concern 2 today, and then the subheadings that I end up addressing are really directly related to the prefiled testimony of the Oglala Sioux Tribe.

That's why, that's the reference for them, and I'll be saying those, if nothing more so that when I read the transcript, I know where I'm at in regards to the proceeding as it took place. And you might also yourselves find it useful to have those as a particular guideline.

But if you look at them, I think you'll see that it addresses the organization of the major witness or witnesses that are responding to a given concern, and that's the suborganization for that.

So with that said, I think we'll start right on in on Concern 2, and it's Dr. Kreamer's area that he provided the bulk of the testimony from. So we'll spend most of the time with him, probably the rest of the day.

It does deal, as Concern 2 does say, it's a description of the effective porosity, hydraulic conductivity, hydraulic gradient of the site hydrogeology is absent, along with other information relative to the control and prevention of excursions.

And I think I'd like to just get a, make sure that you and I are on the same page, Dr. Kreamer,

and I'll kind of try to paraphrase what I see is the heart of your testimony, and then we'll go in and certainly address most of the detail associated with it.

But as I look at it, I say, it seems to me that while you have other criticisms of the correctness and the thoroughness of the analysis performed by the applicant, it seems to me, is it not a fair assessment that the heart of your testimony is that the strata at the MEA is heterogeneous and isotropic, and these are as a result of fractures of the upper confining unit. Is that a fair assessment of the bulk of your testimony?

THE WITNESS: No.

JUDGE WARDWELL: Would you like to elaborate a little on that, if you could do it quickly without a long dissertation of?

THE WITNESS: Absolutely. I also want to say there is an echo, a delayed echo of what I hear. And so it's one of the --

JUDGE WARDWELL: Okay, I'm going to have to interrupt now. We're going to have to square away this audio before we can proceed much further. You're in and out. And it doesn't seem to appear as directional, but --

THE WITNESS: If I take off my audio, does that help?

JUDGE WARDWELL: I got to look to Joe for this one.

(Off-the-record comments.)

JUDGE WARDWELL: You have no other solutions with leaving the video in place, Joe, in regard to correcting that?

(Off-mic comments.)

JUDGE WARDWELL: Okay, try to elaborate now, Dr. Kreamer, see if that's any better.

THE WITNESS: Okay, there is a delay on my end. If I speak slowly, it works out. If I speak quickly, it all runs together and then you would get this sort of effect.

JUDGE WARDWELL: And is that a video thing, do you think, Joe, and that's why?

(Off-mic comments.)

CHAIR BOLLWERK: Can he speak slowly, you want to try that? Let's try that for a while, and if it doesn't, we'll go to straight audio.

JUDGE WARDWELL: Okay.

THE WITNESS: I'll try to be as quick as I can. You did embody half of what I said, that the area is not homogenous entirely.

CHAIR BOLLWERK: Let's just go to the audio.

THE WITNESS: But one of my major contentions --

CHAIR BOLLWERK: Dr. Kreamer, just wait one second, we're going to switch our -- switch the audio here.

THE WITNESS: Okay. I can also call up on my telephone.

(Off-the-record comments.)

JUDGE WARDWELL: Okay, why don't you go ahead and continue with your elaboration of your answer, you know, to my first question.

THE WITNESS: Generally there's an inadequacy in the number of tests. There was only one pumping test. The cone of depression didn't cover the entire site.

JUDGE WARDWELL: Okay, can I interrupt you, Dr. Kreamer?

THE WITNESS: Yes, you may.

JUDGE WARDWELL: Well, I already have anyhow, so. And that's what I meant by my introductory phrase, while you have other criticisms of the correctness and thoroughness of the analysis, and we will get into details, we're going to go

through all of the testimony, I just wanted to do a broad brush painting of what my overview was.

And so the topics you're now talking about I think are within that correctness and thoroughness of the analysis that you do have criticisms for, and trust me, we will get into them. But continue then with anything else that you might want to say in regards to the heart of your testimony.

THE WITNESS: No, the lack of (inaudible due to audio interference) energy is a major point.

JUDGE WARDWELL: Is it your position that the presence of those fractures within the upper confining unit are primarily established by the deviations of the type curve matching from the pumping test results, or are there other reasons that you see of justifying the presence of those fractures?

THE WITNESS: I think that's primary evidence.

CHAIR BOLLWERK: Okay, let's go, we're going to have to go to the cell phone then, Joe, if that's the only other option.

THE WITNESS: I have a landline.

CHAIR BOLLWERK: Any way we can get audio over the phone and do the video separately without the audio?

(Whereupon, the above-entitled matter went off the record at 8:43 a.m. and resumed at 8:48 a.m.)

CHAIR BOLLWERK: Let's go back on the record then. Thank you.

THE WITNESS: Your Honor, you have zeroed in on one major argument, yes.

JUDGE WARDWELL: Thank you. I'll start off on a broad-based, on the Tribe's Exhibit 003, which is Kreamer's testimony at 3, you claim that the statement in the exhibit Crow Butte 016, which is the pumping test report at page 6, stating that results of the previous testing indicate that, you probably use the phrase Basal Chadron, but as we have stipulations herein, we're going to -- the Board's going to call it the Basal Chadron Chamberlain Pass Formation.

Or we'll just use the abbreviations, the BC/CPF for designating that sandstone of the aquifer. Is relatively homogenous and isotropic within the current Class III UIC permit area. And you claim that it mischaracterizes the results of the previous testing.

And so I think my first question for you, Dr. Kreamer, is: how does this description of the Basal Chadron/Chamberlain Pass Formation at the existing facility have any bearing on the MEA aquifer

testing?

THE WITNESS: Well, in the previous testing a similar divergent from the place -- can you hear me adequately?

JUDGE WARDWELL: Again, the volume's okay. It ends up to be some enunciation and running together of the words. But that seemed to be almost acceptable.

THE WITNESS: I'll speak a little bit more slowly, hopefully that will help. In the previous tests in the Crow Butte area, there was a divergence from the Theis curve that was similar. At that time, the NRC asked Crow Butte with similar circumstances to do additional analyses, specifically leaky aquifer testing they did not ask to do at Marsland.

JUDGE WARDWELL: Okay. Thank you. How is homogeneity and isotropy of the Basal Chadron/Chamberlain Pass Formation related to vertical confinement? Does it have any relationship to it?

THE WITNESS: Yes, an interpretation of a pumping test, an aquifer test. The homogeneity assumption was crucial in interpretation of whether or not you have an adequate aquifer test.

JUDGE WARDWELL: Yes, thank you for that, but as a follow-up to that, I'm more interested in

what nature, who doesn't know anything about pumping tests, but just in the natural situation, the homogeneity/isotropy of the Basal Chadron formation, does that impact vertical confinement of any of the mining solutions that are put in there by nature, regardless of how anyone's going to try to analyze it or model it?

I'm interested in how would -- how does nature react, and how in regards to the homogeneity and the isotropy of that unit, in regards to its ability to be confined within that unit itself.

THE WITNESS: That's a good question, Your Honor. When you see a sudden change in the thickness of the Basal Chadron/Chamberlain Pass Formation, that could indicate a fault or a fracture. When you see lack of homogeneity, as indicated by the pumping test, that could indicate additional fracturing or leakage. And so all those factors lend themselves to an interpretation of lack of confinement.

JUDGE WARDWELL: Would you agree that the primary impact, though, from the homogeneity and isotropy is really in regards to the effectiveness of maintaining an inward gradient during operations and restoration?

THE WITNESS: No, sir.

JUDGE WARDWELL: And why not?

THE WITNESS: Even if there is an inward gradient, if there is lack of confinement or leakage, that could impact surface water resources and require analysis of what that effect would be.

JUDGE WARDWELL: And what water resources are you talking about?

THE WITNESS: Well, it would be anything in the upper Brule, the overlying Brule Formation. It would impact recharge rates to the Brule and any surface water drainage that would occur during storm events.

JUDGE WARDWELL: Again, let's back up a bit and first say if inward gradients are maintained, how would it get up through the upper confining unit if there's inward gradients established?

THE WITNESS: I assume by inward gradients, Your Honor, you mean gradients inward toward the production aquifer. Let's just call in the Basal Chadron for now, but I realize it's got a longer term. The inward gradient, if there is leakage, would draw water from above. It would diminish the Brule aquifer which overlies it.

And that's in communication in several places with the surface water resources, potential

surface water resources, and with the aquifer itself, the Brule aquifer.

JUDGE WARDWELL: In your review of the pump test analysis, did you see any signs of major fractures to the extent that that would actually be significant enough to draw down the entire Brule aquifer during the inward gradients that are established during production of the mining units?

THE WITNESS: Well, you said the entire Brule aquifer. The Brule aquifer has not been characterized adequately at all. And so it would be hypothetical for me to say that the entire Brule aquifer would be drained. There is significant leakage indicated by the single, solitary pumping test. And the Nuclear Regulatory Commission, with similar circumstances at Crow Butte, asked for leaky aquifer analysis, did not ask for leaky aquifer analysis in this case.

JUDGE WARDWELL: Okay. Thank you. NRC Exhibit 006, which is their Environmental Assessment, in Section 3.2.2.1 at 3-10 states that the Basal Chadron sandstone aquifer has not undergone significant chemical, physical, or biological change since its initial deposition as a stream deposit, and that the sands are relatively uncemented with calcite

and silica cement present only in minor amounts.

And they're citing Gjelstein and Collins, which I know I didn't pronounce right. But it's 1988, and you'll probably get a drift if you look up that particular cite.

And so I guess I'll turn to Crow Butte. And I was going to say this also in my introduction that I forgot to mention, but I will generally just call on the party in regards to any question and let you decide who you wish to answer it.

And so Crow Butte, do you agree with this representation, and if not, what evidence do you have to provide the Board that refutes this position of what the NRC stated in their EA? This is for Crow Butte, one of you. Sorry?

MR. PAVLICK: We agree.

JUDGE WARDWELL: Okay, thank you. Dr. Kreamer, do you agree with that representation, and if not, what evidence have you provided the Board that refutes this position?

THE WITNESS: The statement only has to do with the nature of the geology, it doesn't address secondary porosities or fractures. As far as the parent material, yes, I don't believe the authors of that particular documentation took a trip throughout

the entire aquifer. And the only evidence really that addresses that is the pumping test that shows leakage.

JUDGE WARDWELL: Thank you. Dr. Kreamer, do you agree that draw-down response was detected even 8,800 feet from the pumping well when pumping at a relatively low weight for a short timeframe compared to what would occur during operations and restoration?

THE WITNESS: I believe the pumping test had a restricted radius of influence. And the radius of influence did not cover the entire site.

JUDGE WARDWELL: Yeah, but my question was do you agree that it was 8,800 feet from the pump well, and with the pump well being at a relatively low rate for a short time, compared to what would happen at operations and restoration?

THE WITNESS: I believe that's correct, yes.

JUDGE WARDWELL: Thank you. NRC's Exhibit 006, again at 3.2.2.1 at 3-10, I should say, NRC states that because of the properties of, and let's, we will continue, I guess, with the way we're going, you just call it the Basal Chadron, and recognize that when we write our decision, we will be calling it the Basal Chadron/Chamberlain Pass Formation.

And, but for the sake of brevity here

we'll just use BC or Basal Chadron if everyone is in agreement with that. Speak now or forever hold your peace for that, but --

Anyhow, I'll start that over again. At that same section number that I just described, NRC states that because of the properties of the Basal Chadron sandstone aquifer are relatively unchanged since their deposition with a stream environment, they would retain their primary porosity, i.e., fractures have not formed and would not develop, and thus the groundwater flow and the lixiviant movement is much more predictable.

And so I guess I'll turn to NRC now and say: what evidence do you have to support this position that the Basal Chadron would retain this primary porosity and not develop fractures?

MR. BACK: Yes, Your Honor. The main evidence we have is looking at recent stream deposits. I mean, that's what these authors are saying, is that the sand as it was placed down at the time it was deposited is reasonably unchanged. And so if you go to alluvial or sand deposits today, you will not find fractures in those deposits, uncemented, as this is saying. So I mean, it basically is very fine in your hand.

JUDGE WARDWELL: But in that, you did not have any actual field data that you could turn to in regards to the MEA site. Is that correct?

MR. BACK: No, Your Honor. We look at the, we also look at the logs that geophysics -- geophysical data. I mean, there's a lot of data to talk about the lithology of the Basal Chadron, so --

CHAIR BOLLWERK: We are now off the record, please.

(Whereupon, the above-entitled matter went off the record at 9:03 a.m. and resumed at 10:59 a.m.)

CHAIR BOLLWERK: It is now about 11:00 a.m. local time, and we went off the record about 9:15 somewhat abruptly. And I want to sort of clarify what happened and make a brief statement about the situation.

There was an event, a situation, however you want to describe it. Some individuals were not pleased with how the Board -- the Board hearing, and that has been addressed I think. I appreciate Mr. Ballanco's help, as well as the help from some of the Tribal Council members who spoke with the individual, the individuals that were involved; also, the help from the Dawes County Sheriff's Department and from Chris Lamb and NRC security, who I think have

addressed the situation.

One thing I would like to say is that I understand that one of the concerns that was raised was about the cultural resources issue. We -- as I mentioned in the beginning of the proceeding, we did dismiss that some time ago, and Mr. Ballanco raised -- raised that issue. In his statement, he noted that they intend -- I believe intend to appeal that at the appropriate time.

The one thing I would say is that that is -- that is the process, and the -- if the Board is wrong or incorrect in that -- in our position, and there is an appeal taken, then the Commission, or it could be a federal court, will correct our legal error if that is the case. That's the way the process works.

I have been doing this long enough that that's what happens sometimes. If we are found by an appellate body to be incorrect, then that would be the process in this case.

The one thing that is important, however, is that appeal will not lie until this issue that is now before us is decided, and that is the Hornbook law within the Commission and, frankly, federal courts and most everywhere else, as far as I know.

So we need to get this -- this issue adjudicated, so that then that appeal can be taken. So just something just to bear in mind, so there's sort of a seriatim process that is involved here.

But, again, there is a legal process. And if we've made an error, then that will be rectified as part of that legal process.

So, again, my thanks to those individuals who were able to rectify the situation, so that we can continue. And so I hope that we can move forward to the conclusion of this proceeding after we've had a chance to talk with the witnesses.

I would add that this is a very technical issue, and I believe all of the witnesses we're going to hear from today, both from the tribe, from NRC staff, and from Crow Butte, bring a lot of technical expertise to this issue, and that's why we're interested in hearing what they have to say.

There is a process going on here that is going to involve some very technical but very important information, and we need to hear what those witnesses have to say, so our questions can be answered.

So with that, I think we can -- we can begin to move forward. Judge Wardwell, do you -- I

think you still had some questions.

JUDGE WARDWELL: Yes, I -- I do have a few. Where we left off, I was about ready to ask or point out that NRC's Exhibit 006, which is their environmental assessment, at Section 4.3.2.1 at 4-15, states that in 2011 CBR performed an aquifer pumping test at the MEA that involved pumping groundwater from the Basil Charon aquifer for 100 hours at about 27 gallons per minute.

This test resulted in a consumptive use of about 162,000 gallons of water, and CBR would also perform additional aquifer pumping tests to provide coverage in the southern portion of the MEA and to identify hydraulic boundaries.

I guess my question for NRC is, I wasn't quite clear on where the 162,000 gallons of water use came from pumping at 27 gallons per minute for 100 hours. Could someone elaborate on that a bit?

MR. BACK: Your Honor, that number came from the technical report. So we -- that number came from the technical report, so we didn't go back and question them on, you know, where the additional water was coming from.

JUDGE WARDWELL: And would someone from Crow Butte be able to clarify that then? Okay. And

why don't we do this? Just for -- for sake of moving along, if there is an issue that you think you need a little more time, can -- can I ask the attorneys for each party to document that we are going to get back to that later on, so that we can move along with the questioning and you can look up these other issues that may require some more review than we want to take while everyone pauses and wait for you to do that. And then get back to us when you have the answer.

And this is probably an excellent example for it. If you feel you need to do some calculations or look at a given document, fine, let's do that later. If, in this case, Mr. Smith could document that we're going to get back to this question later, the answer to this later, that's fine, and then we can move on with the questioning.

MR. PAVLICK: Yes, Judge Wardwell.

JUDGE WARDWELL: So are you ready to answer now, or would you rather wait and answer later?

MR. PAVLICK: We'd like to wait and check that number.

JUDGE WARDWELL: You say you'd like to wait?

MR. PAVLICK: Like to wait and check the number.

JUDGE WARDWELL: I think -- yeah.

MR. PAVLICK: Like to wait and check the number.

JUDGE WARDWELL: Okay. So we'll get back to that later. And then I'll just -- I am going to trust that each attorney for each party keeps track of these, and we'll try to do the same here. But I know I won't be able to, so you'll have to refresh my memory on -- on that later.

Staying with Crow Butte, what do you consider to be the primary goals of the pump tests? And if you could, introduce yourself because, again, I don't -- I don't pick out one. I want whoever answers it, until -- at least until the court reporter gets used to you, to say who is doing the response.

CHAIR BOLLWERK: In that regard, let me mention one other thing. It would be useful to the court reporter if you would sit in the same order. When you get up or have lunch, or whatever, don't shift around, so he can -- you'll be in the same place. That would be very helpful to him. Thank you.

MR. LEWIS: Your Honor, this is Bob Lewis, Crow Butte. I believe the -- to answer the question, the purpose of the pump test was to characterize the hydraulic properties and characteristics of the first

four mine units that were going to be developed by -- by Crow Butte.

JUDGE WARDWELL: And is that all you -- all you wish? Do you not also do -- do the pump test to indicate the conductivity of the aquifer itself in regards to how it is responding to a pump test?

MR. LEWIS: Yes. More detailed purposes would include identifying any boundaries to the system, any leakage characteristics, the degree of confinement, the radius of influence, as well as all of the hydraulic parameters of conductivity, storage, that would go along with the pump test.

JUDGE WARDWELL: And what parameters do you get out of a pump test? Do you get all types of soil parameters or what parameters do you end up getting out of a pump test?

MR. LEWIS: Primarily, the parameters that would come directly from the pump test would be transmissivity. The primary parameters would be transmissivity, storage -- storativity -- transmissivity, storativity, radius of influence, hydraulic conductivity.

JUDGE WARDWELL: Hang on just a second. I am -- I think -- Dr. Kreamer is not hearing him or --

MR. LEWIS: Can you hear now, Dr. Kreamer?

DR. KREAMER: I can hear you very clearly, but can you just speak directly into the microphone? I cannot -- I cannot hear the responses, and the questions are a little garbled. I can usually understand the questions, but the responses, unless they speak directly into the microphone, and even then it's kind of difficult.

JUDGE WARDWELL: Okay. Why don't you try to pull your microphone a little bit closer to you and see if that helps out. Let's --

MR. LEWIS: Is this -- can you hear me better?

JUDGE WARDWELL: Okay.

DR. KREAMER: That is better, yes.

MR. LEWIS: Okay.

JUDGE WARDWELL: What parameters directly come from a pump test analysis?

MR. LEWIS: The parameters that come directly from the pump test analysis would include transmissivity and storativity. Those would be the primary aquifer parameters that would come from the pump test.

JUDGE WARDWELL: Dr. Kreamer, did you hear that okay, and do you agree?

DR. KREAMER: Yeah. It was a little garbled, but I did get the -- I did get the gist, yes.

JUDGE WARDWELL: I heard Dr. Kreamer. Did everyone else? Did it come through the system? I guess we'll just move on.

Turning now to Crow Butte's Exhibit 001, R1, answer 29, at page 27, and this is the initial testimony. You stated that prior to testing activities Crow Butte installed 14 monitoring wells in the Basal Chadron of the -- the basal sandstone of the Chadron Formation.

Nine wells were placed in the Brule Formation, and -- and, let's see, oh, yeah, 14 wells were in the Basal Chadron, as I said, and nine were in the Brule Formation, for a total of 23 wells.

Then go on to say that Monitor 4 and BOW 4 were replaced with Monitor 4A and BOW 4A, respectively, prior to the pump test activities.

And my question for Crow Butte is: wasn't the pumped well CPW-1A also a replacement for CPW-1, resulting in a total of three replacement wells?

MR. PAVLICK: Yes, sir.

JUDGE WARDWELL: And just introduce yourself when you -- when you say --

MR. PAVLICK: Doug Pavlick for Crow Butte.

Yes.

JUDGE WARDWELL: So now -- so with those three replacement wells, that means the total number of wells that you had in for the pump test was 20 at the time of the pump test?

MR. PAVLICK: Doug Pavlick. Yes, that sounds correct.

JUDGE WARDWELL: Okay. In the same document, in the same Exhibit 001, answer 29 to page 28, to provide baseline groundwater elevation data for the pumping test. Static water levels were collected from all 12 wells in the monitoring network on November 12, 2010, from the Brule Formation and the Basal Chadron sandstone.

And for Crow Butte, if you -- if you looked at 12 wells, why weren't the other wells not also measured for water levels? Because there is, again, 20 wells available if I -- if I understood the math correctly. Is there a reason why you only sampled 12 of the wells for water level reads?

MR. LEWIS: This is Bob Lewis with Crow Butte. I believe at least a partial answer to that question is that in the work plan document for the pump test, it was estimated what the radius of influence of the test would be, and not all of the

wells within that radius of influence were considered formally monitored.

So I believe, in my recollection, if some of the wells did not have static water levels collected, it would have been the wells that were not within the pre-estimated radius of influence of the original test.

JUDGE WARDWELL: Okay. Thank you.

MR. LEWIS: For the production aquifer.

JUDGE WARDWELL: Okay. Thank you.

Continuing on with Crow Butte, if we could, will not additional site-specific pumping tests be performed for each additional mine unit in accordance with License Condition 11.3.4, as citing NRC Exhibit 009 at 19?

MR. PAVLICK: Doug Pavlick. Yes, Your Honor.

JUDGE WARDWELL: Now, are the purpose of these tests actually used to determine the updated transmissivity and storage coefficient, or do you have other uses for these pumping wells once you become operational?

MR. LEWIS: The additional pumping tests would provide more site-specific information on a more local scale for each of the mine units, but they would

provide -- generally provide the same estimates on a local scale.

JUDGE WARDWELL: During your operations, do you use results of the pumping tests to determine what pumping rates you're actually using in each individual well, both in regards to injection and also in the production well? Or do you use actual water level readings, or some other types of information to control your operational procedures?

MR. PAVLICK: Doug Pavlick for Crow Butte. Your Honor, we use a well field balancing scheme, so the production wells will pump at a rate that balances with the injection in the area, and also allows for the maintenance of a hydraulic bleed on the system.

JUDGE WARDWELL: Thank you. Now moving on to my --

DR. KREAMER: The end of that testimony was -- was cut out on this end. I'm not sure if a button was hit on the microphone or not.

CHAIR BOLLWERK: The mics are on all the time. So if you hit the button, that turns it off.

DR. KREAMER: He has to speak directly into the microphone or I can't hear him.

JUDGE WARDWELL: Could you repeat your answer then, please.

MR. PAVLICK: Doug Pavlick for Crow Butte? The production well flows are used -- are set in conjunction with the injection wells that surround it to balance the well field and also to maintain a hydraulic bleed on the entire mine unit.

JUDGE WARDWELL: Thank you.

Now moving into what I have labeled Section 2.1, looking at Opinion 1 that came from Dr. Kreamer's testimony discussing the mischaracterization of the hydrogeologic environment.

And I am now looking at a statement made in the Exhibit 003, which is this testimony at Section 2, Opinion 1 at 1, where it states that the Marsland hydrologic test report number 8, written in 2011, is deficient and mischaracterizes the hydrogeologic environment at the MEA site.

It goes on to say that much of the collateral -- collected pumping test data was selectively ignored. The solitary pumping test covered very little of the MEA site, leaving the majority of the site hydrogeologically undefined, and that the single pumping test was analyzed -- that was analyzed was influenced by conditions outside of the site boundary. And we're going to cover each one of those subtopics separately.

In regards to the first one, looking at Crow Butte's Exhibit 006, which is their technical report at Section 2.7.2.2 at 2-84, you state that drawdown in the Brule aquifer observation wells was indiscernible during the aquifer pumping test, which indicates that adequate confinement exists between the overlining Brule aquifer and the Basal Chadron production zone.

NRC, in their Exhibit 006, environmental assessment, under 4.3.2.1, at 4-6, 16, states that the storage in the confined aquifer is derived from the expansion of water and compression of the aquifer mixture, and it is far smaller than the specific yield.

And let me just start with Dr. Kreamer. Do you agree with the staff's statement of how confined water is released from storage in a confined aquifer?

DR. KREAMER: Yes, sir. Yes, Your Honor.

JUDGE WARDWELL: And how does this play out when we're dealing with an artesian well that is constantly flowing and discharging water at the surface. This is a hypothetical question. It's not a specific question.

Does this mean that the aquifer is

continually compressing and the water is continually expanding? Or how does that water get released from storage in a confined aquifer when we're looking at flowing conditions at the surface water -- at the surface?

DR. KREAMER: Is that a question for me, Your Honor? Dave Kreamer.

JUDGE WARDWELL: Yes. Yes, sir. Yes, sorry. Dr. Kreamer.

DR. KREAMER: Okay. Yes, that's -- there are two ecnozones in a confined aquifer that release water in storage. One is compression of the aquifer materials, and the second is a slight expansion of the water with reduced hydraulic head.

JUDGE WARDWELL: Okay. Thank you.

I'll go back to Crow Butte now. If the release of water from a confined storage is true as defined, doesn't it mean that it would be highly unlikely that there would be any response in the overlying aquifer Brule, unconfined aquifers from the short-term pumping of a confined aquifer, especially given the small amount of water that appears to be released from a confined aquifer?

And there was one other point I wanted to -- oh, and given the thickness of the overlying strata

that is there between the Basal Chadron and the Brule aquifer, which is the overlying aquifer.

DR. KREAMER: Absolutely not, Your Honor.

JUDGE WARDWELL: No, no. That's for Crow Butte. I'm sorry.

DR. KREAMER: Okay.

MR. LEWIS: Generally, if there is -- if there is not a significant amount of connection between the surface and the pumped aquifer, the shorter duration you would notice some drawdown. If the -- if the confining layer were competent, you would not.

So it really depends on the degree of the hydraulic connection how long it would take to observe drawdown in an overlying aquifer.

JUDGE WARDWELL: So was -- how do you know if your aquifer test was conducted over a long enough period to ensure that you would see any drawdown in the Brule, or is it a fact that the lack of drawdown in the Brule is -- is not a sign of anything dealing with confinement?

MR. LEWIS: Well, perhaps an example, if -- if the confining layer had the same properties as the production aquifer, being only 400 feet away from a pumped well, you would see a response in a matter of

hours in the same way you would see them horizontally in monitoring wells.

So we know that the confining layer, obviously, is more competent and less permeable than the material which makes up the production aquifer. And then there is some amount of -- of professional judgment in terms of how long the pump test would need to go on for an expected drawdown through a particular permeability of material.

I did not personally make those calculations, but in my experience five-day pump test is generally considered a longer duration pump test. And if you have significant connections with the surface, you would notice a drawdown under those conditions.

JUDGE WARDWELL: And what leads you to believe we have the significant connection to the surface at the MEA site?

MR. LEWIS: I -- I hope I didn't infer that. If there was a connection, you would have seen drawdown over a five-day period. So the fact we did not see drawdown in the overlying means there was not a significant connection.

JUDGE WARDWELL: I see. Thank you. And, Mr. Lewis, are you the author of -- of the pump test

reports, or the -- yeah, the signatory of those.

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: Thank you.

In your rebuttal testimony, for Crow Butte, Exhibit 033, answer 12 at 5, says, "From the pumping test results, CBR concluded that adequate confinement exists. For example, no drawdown was observed in the overlying Brule Formation observation wells during the test period. This observation supports the conclusion that adequate confinement exists between the overlying Brule Formation and the Basal Chadron production zone.

"In addition, drawdown data versus time were plotted for each observation well. Based on the character of the curves, it was determined that the confined aquifer analytical methods were appropriate for the analysis of the water level data." And you're referencing the pump test report, which I believe is your Exhibit CBR 016 at 11.

And my question for Crow Butte is: what do you mean by "the character of the curves"? What are you referring to with that?

MR. LEWIS: Your Honor, are you referring to the shape of the drawdown curves?

JUDGE WARDWELL: I am referring to your

statement in Exhibit 033 where you say that "In addition, drawdown data versus time were plotted for each observation well. Based on the character of the curves, it was determined that the confined aquifer analytical methods were appropriate for the analysis of the water level data." That's -- I'm asking, what do you mean by "the character of the curves"?

MR. LEWIS: The character of the curves were -- did not have any special or unusual shapes or conditions that would suggest a more sophisticated approach would be necessary to analyze the data.

JUDGE WARDWELL: And what is the shape of the curve now, and what would it look like if some -- if it was giving you a sign that something more elaborate should be used to do -- to interpret the curve?

MR. LEWIS: If -- if the system had unusual characteristics, boundary conditions, that would suggest a more sophisticated method might be necessary, the curves would deviate from what I would call a conventional curve, whether it be a Theis curve or being a conventional confined curve, or some other analytical curve that you can use to analyze the data.

JUDGE WARDWELL: Thank you. And we will look at some of those curves in a few minutes.

But I want to turn to Dr. Wireman to see if -- Dr. Kreamer, sorry -- if he had any -- has any comments in regards to the last few series of questions that I have asked Crow Butte in regards to how -- how relevant is the fact that no drawdown is observed in the Brule aquifer well as a sign of confinement? And what is his evidence for that, and how does it relate to -- generally relate to the character of the curves, keeping in mind, Dr. Kreamer, that we are going to be looking at those curves directly in a few minutes. But just as a general comment.

DR. KREAMER: Very good. I understand. When we were cut off before, we were talking about the nature of the aquifer's open rule and the Basal Chadron Chamberlain Pass Formation.

There were some statements made by NRC that it was not indurated. We have agreed-upon language that all parties agreed to saying that it was a sandstone, not sand. We also agreed that it was expected to be similar minerology to the CBR site, which it was never characterized as sand in the Basal Chadron.

The underlying assumption here, Your Honor, is that to use analytical models you assume

homogeneity and isotropic conditions. And we have agreed that that is not the case in either the Brule or in the underlying Basal Chadron Chamberlain Pass Formation.

Specifically, we said that the production zone has some localized channels, and a coarse grain sandstone interbedded within silt and clay beds of varying thickness. We have agreed as a group that the depths range from 850 for the Chadron to 12,000 -- 1,200 feet below ground surface, and that the thickness for the analytical assumptions, you assume that the thickness of the aquifer is consistent, and we have agreed as a group that the aquifer thickness is -- varies from 20 to 90 feet in thickness.

So, therefore, the transmissivities, which are a product of the hydraulic conductivity and the thickness have great, great error that wasn't reported.

And, lastly, the technical report on the hydrology said that a Cooper-Jacob semi-logarithmic drawdown was -- was done. Those results were not presented in the report. Jacob-Cooper is another analytical technique, similar to -- to the Theis method. It does also --

JUDGE WARDWELL: Yeah. We'll -- we'll

get --

DR. KREAMER: -- more ably show there is leakage.

JUDGE WARDWELL: Okay. Thank you, Dr. Kreamer.

I'm going to move into Section 2.1.1, which is still Opinion 1, but I want to spend some time talking about Basis A of what Dr. Kreamer presented in his testimony dealing with the initial pump test attempt.

And Exhibit 003 at 2 states that the Aqui-Ver, Inc., Marsland hydrologic test report number 8, which I believe is the one that we are talking about -- have been talking about -- that is Exhibit CBR 016 at page 10, only reported one of two pumping tests done on the MEA.

A second 19-hour test was not presented and was characterized as failed. The second test could supply -- and it's Dr. Kreamer's position that the second test could supply additional insight as to the hydrological conditions beneath the site. This justification for the test failure was poorly explained pump failure. If this occurred at the end of the test, the information recorded is still valid, according to Dr. Kreamer.

In rebuttal, CBR Exhibit 033, answer 11 at 4, says, "Analysis of the failed pump test data would not have been useful or insightful. The well CPW 1 test was terminated after only 10 hours, a small fraction of the time necessary to measure significant drawdown in more distant wells, and far short of the 4.3 days needed to reach all drawdown targets and terminate the test.

"Failed test well CPW Number 1 was also shown to be very inefficient, with an abnormally high drawdown that prevented more detailed -- more ideal pumping rates. Well CPW 1 was subsequently replaced by well CPW 1A for the final test."

And I guess my question to Dr. Kreamer is, do you agree that the inefficiencies, i.e. the poor hydraulic connection between the pumping well and the aquifer well, makes the use of the 19 hours of data pretty limited?

DR. KREAMER: No, Your Honor. I do not.

JUDGE WARDWELL: And why not?

DR. KREAMER: Well, increased drawdown could indicate, first of all, heterogeneities. The whole premise of the pump test is that the aquifer is homogeneous, isotropic, uniform thickness.

If I increase drawdown among the wells, on

early time periods particularly, it could show that you have a zone of low hydraulic conductivity.

JUDGE WARDWELL: Excuse me. Can I interrupt?

DR. KREAMER: As indicated --

JUDGE WARDWELL: Dr. Kreamer, can I interrupt you? We're going to get to that. I need to be more focused on my -- rather than broad-brush stuff, be focused on the question that I was trying to get to in regards to let's talk about this failed pump test. And why do you believe those 19 hours of data may be useful? That's really the heart of my question. I hope that clarifies it for you.

DR. KREAMER: I believe that whenever -- the single test that was done, it is bringing some influence -- did not even cover the majority of the -- of the site that we're considering. So essentially we did not hydraulically test more than half the site. And so, therefore, under those conditions, I believe that any information that is additional would give us additional insight.

I can't vouch for how valid that information would be, how useful it would be, it being that it wasn't presented, but it being that there is very, very limited information on just a small portion

of a much larger site, I would say that any additional information would be helpful for analysis.

JUDGE WARDWELL: Thank you.

Turning to NRC rebuttal at 014 Exhibit, answer 16 at 17, staff says that CBR recognized that "The pumping well in the first test was not hydraulically connected to the aquifer, and, therefore, that the data would not be suitable for a meaningful quantitative analysis of the transmissivity, storativity, and boundary conditions.

"For these reasons, we do not believe the results of the first test would yield any materially different useful information."

And so I guess I'll go to the staff, then, and ask, would not the drawdown in the -- in the Brule aquifer or even in the Basal Chadron aquifer during this test be of some use?

MR. BACK: Your Honor, not when it's repeated by a test, you know, tens of feet away that is run for a much longer time period. So -- so that's -- that's our answer.

JUDGE WARDWELL: And as far as you know, you -- as far as you know, CBR hasn't analyzed that data. And did you analyze -- did you look at the data to see whether or not it would be useful to also

augment the fact that only one other test is being conducted in the MEA?

MR. BACK: No, Your Honor. And it's not uncommon for an aquifer test to fail for one or more reasons. I mean, these wells are 1,000 feet deep. So trying to complete that and making sure you have a good connection, a good sand pack, I mean, it's difficult. So it wasn't a surprise that they had a problem with the well.

JUDGE WARDWELL: No, that's not my question. I'm sorry. I didn't make myself clear. I was wondering whether you analyzed what limited data there was to demonstrate that, in fact, it wouldn't be useful. And do you know if Crow Butte has analyzed that data and determined that it wasn't useful? And, if not, why not?

MR. BACK: No, Your Honor, we did not because we did not see a reason to, because the well aquifer test was essentially repeated under much better conditions.

JUDGE WARDWELL: Okay. Thank you.

And I guess I will verify that with Crow Butte. Mr. Lewis, I gather, did you look at that data and actually try to get some information out of it? Or did you just say, "Well, I've got a better test

here, so I'm not going to even look at that data"?

MR. LEWIS: We did look at the information. We didn't ignore it or -- we didn't present it, but we used it to refine our work plan when we reinstalled a new well. We did gather some information about the limited radius of influence from that test, and refined our projected pumping rate for the new test.

So we didn't ignore all of that information. The pumped well was installed immediately adjacent to the failed well. So we consider that to be a redundant test.

And the failed well was anomalous -- we couldn't control pumping rates properly. There was a pump problem as well as a possible well problem. Identifying exactly what was wrong, it was more than one thing. So it was better to just redo this test over than to try to make something out of information that we couldn't fully explain.

JUDGE WARDWELL: If I remember correctly, Mr. Lewis, I think staff and you had different descriptions applied to whether -- what was the cause of this pump test. And I gather your last statement made in regards to sometimes there is often many things that might have caused it is the -- is the

answer to that question.

MR. LEWIS: That's my opinion, yes.

JUDGE WARDWELL: Thank you.

Moving on to 2.1.2, Opinion 1, Basis B was data selectivity. And Dr. Kreamer, in his testimony, Exhibit 003, Opinion 1B at 2, says, "The report only analyzed select portions of the data from the single pumping test. The report did not present analysis of the complete data set. The data the report selectively excluded could demonstrate, if analyzed, the lack of confinement of the Basal Chadron aquifer production zone."

And I think I will ask Dr. Kreamer right now a very specific question, and that is, by the data you are claiming is selectively excluding -- excluded, are you referring to the deviations that show up on the pump test data graphs?

DR. KREAMER: Yes. In the main -- yes.

JUDGE WARDWELL: Okay. Thank you.

NRC rebuttal Exhibit 014, answer 17 at page 17, states that "Appendix C of the MEA pumping -- aquifer pumping test report presents drawdown and recovery response curves showing all data points for all of the observation wells used in the aquifer pump test."

It goes on in the same rebuttal exhibit, answer 18 at 18 to 19, that "We disagree with Dr. Kreamer. First, it is not clear what Dr. Kreamer is referring to as excluded data." And that's what just clarified with my question to him.

In that same rebuttal, they go on to say, "As discussed in answer 17 above, all of the data for the drawdown and recovery in the observation well was presented in the aquifer pumping test report."

And so -- and Dr. -- Dr. Kreamer, how do you believe that is excluded if all the data is actually presented in the graphs? And do you agree all the data was presented in the graphs?

DR. KREAMER: Well, it being that one -- one pumping test was excluded, as we discussed earlier, not all of the data was presented. But from that one pumping test, the data is there, but the analysis of the leakage, which has been done in other tests over in Crow Butte, was -- was not analyzed.

JUDGE WARDWELL: So may I -- may I --

DR. KREAMER: So it was -- and the other thing that was excluded, they said they did a Cooper-Jacob analysis, and that -- that, though, was not -- that was not included in the report.

JUDGE WARDWELL: Okay. We will get to the

Cooper-Jacob analysis, so -- in a while. So you can reserve any comments on that for a few more minutes. We'll get to that, but I want to -- I want to stick with just the regular Theis analysis for now and what is -- what is there on the data, in the graphs, and how that is selectively or not selectively used in regards to interpreting this information.

And so may I paraphrase for you what I hear you saying to make sure it's correct? What you're saying, the selectivity associated with the excluded data is the fact that those deviations, while they're available for you to look at, are not being incorporated into the matching of the type curves. Is that at least partially what you are referring to?

DR. KREAMER: Yes.

JUDGE WARDWELL: Okay. Thank you.

And why don't we pull up Figures -- at least one of the figures, C1 to C8 of CBR 016, Appendix C, and they're at PDF pages 80 to 86.

And we're looking at the graph here for the pumped well itself. And, Dr. Kreamer, in this particular instance, would you describe what you believe to be either excluded data or non-excluded data?

Is he able to see this, Joe?

DR. KREAMER: I do not have that here.

JUDGE WARDWELL: Joe, is he able to see this? Okay. Thank you.

Go ahead, Dr. Kreamer. I'm sorry, I interrupted you.

DR. KREAMER: This is one of the analyses. And the key part of this is the very long timeframes. That would be the far right-hand side. What you can see is there is a line that is slightly above the red line. That is the difference between the expected drawdown response and the actual response.

If this were drawn a little bit -- if the red line were drawn a little bit further to the left, that would be a greater gap in that line between the drawn line on the right-hand side on the red line below. The drawn line is very, very faint, but in this particular one you can see that there is a gap. What that means is that extra water came into the system from somewhere that was not expected.

JUDGE WARDWELL: And you would -- you would term that a late-time flattening of the curve? Would that be a fair phrase to apply to what the actual data looks like compared to the -- which are the X -- little X's that merge together into a solid red -- looks like a solid red -- broad red line

compared to at least we can see a -- it looks like a greenish solid line, which would be some type of what you would -- what you would expect to see. Is --

DR. KREAMER: That would be correct, Your Honor.

JUDGE WARDWELL: Okay.

DR. KREAMER: And it's a log-log plat. So that little space would be a little bit exacerbated because of the logarithmic scale.

JUDGE WARDWELL: Can we move on to Figure -- let's go to -- it would be Figure C. Let's see.

CHAIR BOLLWERK: Just clarify, that was C1, correct? So we're moving on now.

JUDGE WARDWELL: Yes, that was C1. Let's go ahead to -- let's come back to C2. Let's come back to -- keep going. Go up to C4. Yeah, go to C4.

Okay. This is -- this is -- this would be -- let's see. No, keep going. C5. I'll tell you what I want. Make it C -- monitoring, 7, which I don't know which that -- yeah, two more to go. There we go.

And let me stop -- that's good right there. But before I ask you something about this, Dr. Kreamer, I want to ask CBR, do you have any -- any modifications to what Dr. Kreamer said in regards to

the interpretation of the C1 graph, which I believe was the pumped well?

MR. LEWIS: Bob Lewis, Crow Butte. I would say that --

JUDGE WARDWELL: Let me rephrase my question, if I might, before you get into a long -- do you agree there is a flattening of the curve? There is a flattening in the late time period of the actual data compared to what the expected result would have been?

MR. LEWIS: There is -- there is a slight flattening of that curve. For the pumped well, analyzing the data from a pumped well due to well inefficiencies is not the best example. But, yes, that -- that is a slight flattening.

JUDGE WARDWELL: Okay. And what is the solid line called? Is that called a type curve or something like that? Would you call it something else, just so we can refer to it with an easier nomenclature than just that curve we expect to have?

MR. LEWIS: Yes, sir. That's an ideal confined aquifer curve.

JUDGE WARDWELL: I want a simpler term. I don't want a more exotic term. You can just call it a type curve?

MR. LEWIS: It is a type curve. Yes, sir.

JUDGE WARDWELL: You have no objections to that, do you, Dr. Kreamer, calling it a type curve?

DR. KREAMER: I do not.

JUDGE WARDWELL: Okay. Dr. Kreamer, how would you interpret what is presented here in monitoring 7, at graph C7? Dr. Kreamer?

DR. KREAMER: Who are you asking? Oh, okay, I'm sorry. I thought you were asking about Crow Butte.

What you can see here is you can see variations that you don't expect, a wiggle in the line. Again, on a Jacob-Cooper semi-logarithmic plot, this would show variations on heterogeneities that were similarly found in Crow Butte. They started off with analytical procedures, and then for cleanup they had to go to numerical, more calculated procedures rather than analytical -- the simplest analytical approach that is shown here.

JUDGE WARDWELL: My question was more -- certainly we see some wiggle, and I guess that's not surprising, is it, when you're dealing with any geotechnical groundwater issue to see that. But isn't there something else in regards to the early time period where it's not matching the curve as well as it

has later on? Dr. Kreamer?

DR. KREAMER: Well, typically, these things are matched in judgment of the people doing the analysis. And certainly the early time periods could have been matched, moving the entire curve, the red -- the red X's to the right, which would show the flattening again.

But, again, this is an interpretational thing. Sometimes the early data isn't as reliable, depending on the distance of the monitoring well. I think the key feature here, though, is it does show heterogeneities, and an assumption of using this whole approach is that the aquifer is homogeneous.

JUDGE WARDWELL: And where do you see the heterogeneity in this curve?

DR. KREAMER: The wiggle, sir.

JUDGE WARDWELL: Thank you.

Crow Butte, would you like to respond to Dr. Kreamer's interpretation of this graph?

MR. LEWIS: Bob Lewis, Crow Butte. My interpretation of that graph is this is a very typical response that you would find at a well located at this distance from the pumped well. It actually fits the type curve fairly well for analytical solutions and natural systems. I don't consider that to be unusual.

JUDGE WARDWELL: Bear with me for a second.

I'll stay with you, Mr. Lewis. Of all of these wells that you monitored, which would be -- and all of these wells are -- the ones that we're looking at in these curves, of course, are ones that were put in the Basal Chadron, correct?

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: And how many wells did we have in the Brule aquifer that you didn't monitor during the pump test? We know how many there were total of the 20, but I don't think we know how many of those you actually monitored during the test.

MR. STRIVER: Jim Striver, Crow Butte. There were two Brule monitor wells.

JUDGE WARDWELL: There's two Brule monitor wells that were monitored during this test.

MR. STRIVER: In addition to the one adjacent to the pumping test, so there are three total.

JUDGE WARDWELL: So we have three Brule wells that were monitored during this pumping test; is that correct?

MR. STRIVER: Your Honor, may we have a minute to verify that?

JUDGE WARDWELL: Okay. Why don't we -- why don't -- I don't want to give you more than half a minute, though. If you need more than half a minute, we'll come back to it later. I don't -- there is no -- there is no problem with just getting back to us later. It's more important to move along than it is to spend time sitting here with dead air because you'll just hear me talk because I'll get nervous if we're not filling the air with noise.

MR. STRIVER: Jim Striver, Crow Butte. There are three Brule monitor wells included in the pump test.

JUDGE WARDWELL: Thank you. Of those wells -- of the wells in the Basal Chadron, which do you consider to be wells that show early time deviations? Which do you consider to be late time deviations? And which do you claim to be normal responses?

MR. LEWIS: I would need some time to --

JUDGE WARDWELL: Okay.

MR. LEWIS: -- to answer that question.

JUDGE WARDWELL: Come back to us after lunch with -- that's a second item for you to respond to once we get back from lunch.

MR. LEWIS: Yes, sir. And can you repeat

that question?

JUDGE WARDWELL: Yeah. I would like to know, of those -- of Figure C1 to C8 in the pump test report, which ones of those data plots do you consider to be normal type curve plots? Which ones do you believe there was some late time flattening of the curve? And which do you believe were some early time deviations from the -- from the expected -- the type curve in those particular wells?

Dr. Kreamer, I've seen some testimony, and I can't recall it right now, but that stated that you considered all of the wells to be having deviations from the type curve. Do you -- was that a fair assessment of your opinion of these type curves?

DR. KREAMER: No. There were some that were very, very pronounced, and others that it was barely discernible. So, no, that's probably not as accurate. I consider the aquifer to be heterogeneous, and so you wouldn't expect all of the wells to show the same thing.

There are some wells that are perhaps closer to leakage -- leakage zones that show that deviation that we said, and others that are -- that are less so.

JUDGE WARDWELL: Thank you.

DR. KREAMER: Were you asking about the Brule as well?

JUDGE WARDWELL: No. No, because I believe they didn't -- that -- well, I'll ask it again, just to make sure. Crow Butte, was there no discernible drawdown in the Brule aquifer wells? Is that your position?

MR. LEWIS: Bob Lewis, Crow Butte. No, sir.

JUDGE WARDWELL: And, Dr. Kreamer, do you have any evidence that supports that there was drawdown in the Brule aquifer wells during the pump test?

DR. KREAMER: The heterogeneous nature that we have agreed upon, they were all groups of agreed upon that it's siltstone with isolated beds of sandstone, means that it's unlikely that with their monitoring wells placement that you would find anything.

So I am in agreement that there was no -- nothing indicated, but I also feel that the monitoring system in the Brule was not adequate, didn't show it. The underlying assumption is that it's homogeneous, isotropic, and that it -- that a well that would -- was placed -- a monitoring well that was placed in the

Brule, would actually have the ability to pick up drawdown.

And these are stringers of sandstones that are discontinuous, and so, therefore, the effect on the Brule aquifer I don't think was adequately characterized by three wells.

JUDGE WARDWELL: So your answer to my question was no?

DR. KREAMER: My answer -- the answer is no, I did not see evidence of drawdown from the data.

JUDGE WARDWELL: Thank you.

Crow Butte, in regards to recovery data -- and I believe these are on Figures C9 to C17 of the same exhibit, CBR 016 -- what did the recovery data show you? And do you want to start with any -- yeah, let's start with this one. It's the first one.

Let me start off with a simple question, just to make sure I am reading this correctly. The area to the left indicates -- the furthest area to the left indicates the time that the pump was shut off, and then the red dots pick up with data points at various time-ratio periods, but related to time; is that correct? That the pump goes off at the left-hand side and the right-hand side is your -- it's a longer timeframe since the pump was turned off, or have I got

that backwards. Crow Butte.

MR. LEWIS: I believe that's correct, Your Honor.

JUDGE WARDWELL: How do you interpret that graph?

MR. LEWIS: This graph is of the pumped well. I would not personally put a lot of weight on the pumped well analysis, although the recovery data is better. But I would say this fits reasonably a type curve for the confined aquifer.

JUDGE WARDWELL: But isn't -- there seems to be quite a large deviation, both on the left-hand side and on the right-hand side of the diagram; isn't there?

MR. LEWIS: That's not unusual for recovery data, Your Honor.

JUDGE WARDWELL: Okay. And why not? Why is recovery data like that, or is it just there it is? I have no problem with, well, it's just, there it is.

MR. LEWIS: I -- the physics of that, I -- I don't want to testify to right now. But I would just say that that is a very common appearance of the recovery curve.

JUDGE WARDWELL: Well, if it has anything to do with quantum mechanics, I don't want to hear

about those physics either, so we'll move on.

Let's switch to -- let's go to C10 and see if the same -- what that looks like. And what's your comments in regards to the recovery data here?

MR. LEWIS: I have the same comment, Your Honor.

JUDGE WARDWELL: Dr. Kreamer, would you like to comment on -- on both of these recovery curves? Dr. Kreamer, I'm sorry, would you like to comment on these -- these recovery curves?

DR. KREAMER: The deviations there show a break in the recovery, meaning that there is added water coming from somewhere. The other one, Graph C9, showed that better.

A lot of times you can ignore early data in some of these situations. There are some rules that are put down for these sort of things, but even if you violate those rules for some of the early data, the percentage error is very small as Crow Butte pointed out in Deridder. On page 63, it shows that there is very little error in some of the early data.

What this shows is it shows a break in the direction, what some people call a recharge boundary with water coming in that is unexpected. And the previous graph shows that much better.

JUDGE WARDWELL: Previous graph being which one now?

DR. KREAMER: C9.

JUDGE WARDWELL: C9? Go back to C9.

DR. KREAMER: C9, yes. There's two breaks in that, and one of the breaks is in the late data, as you pointed out, Judge.

JUDGE WARDWELL: Okay. Yeah. And both of these are pumped wells, right? Is that correct? One is the other old pumped well that you abandoned; is that correct, Mr. Lewis, for CBR?

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: Okay. Go ahead, Dr. Kreamer. Sorry to interrupt you. Dr. Kreamer?

DR. KREAMER: I'm just saying that the deviations from -- what they should follow is it should follow one straight line, which may be a little bit of -- of flange coming out in the early time periods to the left.

But what you see is you see two distinct breaks here, and that -- that means that the assumption of homogeneity that is the lynchpin of this one well analysis that didn't even cover the whole site is based on. It's based on that you can use the simplest method that's in hydrology and not do any

others.

You don't have to do leakage analysis or anything like that, and the data here clearly shows that there is a potential for leakage in -- in the one pump test they did, the solitary pump test they did conduct.

JUDGE WARDWELL: Thank you.

May I ask, Mr. Lewis, how he ended up analyzing the data -- the drawdown data? And we can go back to any one of the graphs that you want to happen to select, and you can describe it just to give us a handle of how you happened to pick that up and what did you focus your -- your analysis of that pump test data on?

MR. LEWIS: Bob Lewis, Crow Butte. Your Honor, in general, in looking at the -- the drawdown data, basically we analyzed that data with the assistance of the software package in this case. And the --

JUDGE WARDWELL: What was the name of that software package? Just if you know it.

MR. LEWIS: This was AquiferWin32.

JUDGE WARDWELL: I'm sorry?

MR. LEWIS: AquiferWin32.

JUDGE WARDWELL: Okay.

MR. LEWIS: And, generally, it takes its first cut at the data. It takes an automatic estimate using its own internal algorithms. But normally with professional judgment you may adjust the curve to fit the data better or worse because it uses a least squares type of analysis to do that, which does not always take into account the conceptual models that exist.

Second, we would correct for barometric pressure, if necessary. We went through that process, and that's described in the report. That would be done before the data are analyzed, actually. So that's the general process that we -- that I had went through.

Conceptually, I want to clarify that the conceptual model for this system is a confined aquifer, and it has been demonstrated at the CBO that that is the case. The leakage analysis that Dr. Kreamer referred to was performed on one of the tests out of the several that were performed, with the conclusion that it was unnecessary because transmissivity variations were the reason for the deviations from the type curve.

More importantly, Crow Butte is -- the Crow Butte operation is the biggest pump test that has

been conducted for the Marsland facility. It is -- drawdown at the Marsland facility has been observed as a result of pumping from Crow Butte at a distance of nine miles.

We know that the radius of influence of the Crow Butte facility at Marsland goes beyond 13 miles. So with that kind of a radius of influence, where we see drawdown at Marsland due to pumping at Crow Butte 13 miles away, you can make that calculation that that -- any recharge rate or leakage rate resulting is less than the pumping rate at Crow Butte of 200 gallons a minute, 250 gallons a minute.

That's a very small amount of leakage or recharge over a 13 square mile area radius of influence. So I feel very comfortable in saying that this is a confined aquifer system conceptually, so that's where I would start my analysis before I jumped into some other types of analysis for leakage, which don't have a conceptual basis in my opinion.

JUDGE WARDWELL: Can we go more specifically now to one of the graphs of -- let's take -- scroll up, Joe, until we hit monitor -- mon or monitoring well 7. There it is.

As I look at this graph, it is the green solid line, the type curve that was used by you in

deriving the transmissivity and storativity coefficients for this well.

MR. LEWIS: Yes, Your Honor.

JUDGE WARDWELL: And so aren't you basically selectively passing that line through some points and, to use another phrase, ignoring or bypassing -- maybe that's a better phrase than ignoring -- some of the other ones at the earlier time data here?

MR. LEWIS: I would agree, Your Honor, that the earlier time data in general is not as reliable as the middle and late time data.

JUDGE WARDWELL: First of all, please answer my question.

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: Then you can go on and elaborate because I never get the answer to my question. Does this -- have you not matched this through some data points and bypassed some others at an early timeframe?

MR. LEWIS: Yes.

JUDGE WARDWELL: See, I need that in the record when I start writing things. I can't deal with you going onwards to -- and then put in your words that you said yes to this, but I don't hear the yes.

So that's why -- it's not that I'm trying to ping you or anything. It's just I need that for the record.

So now go on with your explanation, if you wish.

MR. LEWIS: No. That's correct. I mean, the early time data on this type curve are given less weight than the later time information.

JUDGE WARDWELL: What is your justification for that?

MR. LEWIS: In general, the early time data is -- is skewed by storage effects and other inertial effects that later and early time data are not, or middle and late time data are not.

JUDGE WARDWELL: Dr. Kreamer, I believe you were alluding to something very similar to that with the early time data. Was that not correct, or did I hear you wrong earlier, 10, 15 minutes ago?

DR. KREAMER: Yes. It depends on how early the time data is. Sometimes the early time data drawdown is affected by the well bore itself and water filling the well bore. That is the near effects of the initial pumping.

So typically some of the early data is less reliable. I can't tell you that all of this early data should be thrown out. As a matter of fact,

I think some of the early data is -- is still usable.

JUDGE WARDWELL: And so you didn't do any analysis to determine how much of that should or should not be in regards to well bore storage? Dr. Kreamer?

DR. KREAMER: No. I did notice this gap in this monitoring well. No, I did not.

JUDGE WARDWELL: And, likewise, you mentioned that the wiggles in the graph that has been matched -- and I don't have access to the pointer, but if Joe can bring the pointer up and I can guide him to where I'm trying to point to you. There you go. Now go right up from there. Yeah, right to your -- now a little bit more to your -- now go down the graph, down the red -- follow the red guys down. No, follow the red guy -- up to the reds, follow them down.

Are those the wiggles? No, back up. Back up, Joe. This is ridiculous. We get this -- keep going up. There.

Are those the wiggles you're referring to, or are there some other ones that you're referring to, Dr. Kreamer? For your -- for your indications of heterogeneity.

DR. KREAMER: The arrow is really delayed here. Okay. I see the -- yeah, that wiggle right

there at WU10[2] that is being pointed out now, that flattening means that it hit extra water and then suddenly went back to its original trajectory.

So the flattening right there is extra water showing up somewhere.

JUDGE WARDWELL: Okay. And do you have any evidence to show whether or not this heterogeneity -- if this was representative of the entire Basal Chadron, would have any effects on the ultimate conclusions of either just the hydraulic parameters but also any confinement associated with the aquifer?

DR. KREAMER: Yes, Your Honor. Would you like me to elaborate?

JUDGE WARDWELL: No. I -- have you done -- yeah. I'd like to know if you can point me to the evidence you've submitted, or the analysis that you've conducted, that demonstrates there is a difference in the ultimate results of transmissivity and storage coefficient.

DR. KREAMER: Well, first of all, you gave Crow Butte a little bit of leeway in describing the other site, Crow Butte, and they said that the leakage analysis was no good and it was attributed to bad reagents and transmissivity. That's a very important term because what that means -- transmissivity is the

thickness times the hydraulic conductivity.

The whole analysis that they relied upon says that the thickness and the hydraulic conductivity is constant. So what he just said is with -- it is attributed to variations of --

JUDGE WARDWELL: I'm going to have to interrupt you here.

DR. KREAMER: -- they violated the assumptions of the analytical thing at Crow Butte.

Now, going back to this one here, again, what's key here is the assumptions of using the simplest model that students learn. First of all here, the Theis analysis --

JUDGE WARDWELL: Excuse me. Can I interrupt you, Dr. Kreamer? Dr. Kreamer?

DR. KREAMER: -- homogeneous --

JUDGE WARDWELL: Dr. Kreamer?

DR. KREAMER: And that wiggle there -- there are other things that show it more -- more definitely, other graphs that show it more definitely. But there are heterogeneities shown in this -- in this set of graphs.

JUDGE WARDWELL: My question to you was: what evidence or analysis have you performed that demonstrates there would be a change in the resulting

transmissivity from this particular plot had you incorporated your interpretation of this?

And it's -- and I believe we get transmissivity directly from this plot -- that's what I heard earlier today -- such that we're not multiplying hydraulic conductivity by any thickness. It is a measurement that we get directly from this plot, and so my question to you is: what analysis have you performed that demonstrates that this transmissivity value that has been selected would have changed dramatically enough such that it would result in a different conclusion relating to the hydraulic properties of the Basal Chadron? Have you done any?

DR. KREAMER: That's a good question. What the program does is what an experienced professional would do. They eyeball the curve match, and they would try and get the best curve match they can. This is not a great curve match, and certainly when you look at the transmissivity value in the legend, which has three decimal points of accuracy, that is something that we flunk students out all the time for doing that sort of thing.

JUDGE WARDWELL: Have you done -- have you done an analysis of your own that demonstrates that this transmissivity value changes dramatically if in

fact you were matching this curve? That's the question I'm trying to get answered.

DR. KREAMER: There are several different ways that I have gone through the curves. I have matched them in different ways. And the error, which is not really spoken about in the report, it can be very large. It's not so much in this graph, but in some of the graphs it is very large.

JUDGE WARDWELL: What graph here at the MEA did you draw an analysis of?

DR. KREAMER: I drew -- I drew curve matches in different places and came up with different transmissivity. I did not --

JUDGE WARDWELL: Here for --

DR. KREAMER: -- some rise of those in the handwritten document.

JUDGE WARDWELL: So you haven't submitted that as part of the evidence here in this hearing.

DR. KREAMER: I have not, Your Honor.

JUDGE WARDWELL: Okay. In regards to the flattening that occurs at later timeframes that we saw in I believe it was monitoring well 2 -- let's see if we can scroll up and see that. Not 2; make it 3. Right there. That's good.

Dr. Kreamer, what is -- what is your

interpretation of this flattening of the curve at the late timeframe?

DR. KREAMER: Your Honor, there is at least a 30-second delay. I'm still looking at 7 right now. Okay. I now have 3 on the screen.

You can see that the curve matched clearly. And if the early time were matched even more accurately, there would be even more decided deviation below on the left-hand side between the red line and the type curve, which is the solid dark line there.

That indicates that there is a water source, that there is a recharge boundary that occurs after a certain amount of pumping. And so this well clearly shows that there is some sort of water coming from some other place.

JUDGE WARDWELL: Thank you.

Crow Butte, do you agree with Dr. Kreamer's interpretation of this? And, if so, where is that water coming from?

MR. LEWIS: Bob Lewis, Crow Butte. Your Honor, I don't agree with the statement that that represents leakage. I believe that that flattening of the curve that you see on monitor 3, as explained in the pump test report, is due to variations in transmissivity, a thickening of the aquifer locally

and to the west primarily of the pumped well. And, again, that is explained in the pump test report itself.

DR. KREAMER: Your Honor, may I -- may I comment on that or --

JUDGE WARDWELL: Wait just a second, Dr. Kreamer.

DR. KREAMER: Okay.

JUDGE WARDWELL: Okay. Yeah, go ahead. You can respond now. That will work.

DR. KREAMER: The testimony just said is change in transmissivity. That is a thickening of the aquifer. The operating assumption for the Theis analysis is that the aquifer does not thicken or get less -- in other words, what was just said is that the basic assumptions of using the Theis methodology have been violated. That is essentially what was just said.

JUDGE WARDWELL: But haven't they matched up the vast majority of the data? And in that range, is it not suitable to match for that and come up with a coefficient associated with that which it matches with in regards to the transmissivity and the storage coefficient? Do you have any data that shows --

DR. KREAMER: Are you asking me, Your

Honor?

JUDGE WARDWELL: Go ahead. Go ahead.

DR. KREAMER: Is this a question for Dr. Kreamer?

JUDGE WARDWELL: Yes.

DR. KREAMER: Yeah. Being that just a small percentage of the data matches the curve, certainly you can use it to calculate transmissivity to three decimal points. I think that it's very poor practice, and it -- it is fairly meaningless in this regard. Transmissivity means absolutely nothing.

JUDGE WARDWELL: And, Crow Butte, how would you respond?

MR. LEWIS: Bob Lewis. Your Honor, one comment with respect to the three decimal places of accuracy. That's a software relic. What's reported in the tables in this report are not reported to three decimal digits. The tables and the results are what matter.

Secondly, I think I responded previously; I answered the question.

JUDGE WARDWELL: NRC, I've kind of left you out of here for a while. And I know you're -- you're very jealous of not being able to respond in some fashion. So I shall let you kibitz as you wish.

MR. BACK: This is David Back. This really takes us back to the -- to the relicensing hearing where we went through essentially the same curves, same -- same claims of leakage, but when we started looking at 30 years of data, the pumping at the main facility never impacted the overlying wells.

The staff believes there is heterogeneity within the Basal Chadron sandstone. I mean, depositionally, it is put down the sands with clay lenses. So we understand that.

When we look at these curves, we see several options. We see possibly a high transmissivity zone that it was hit, possibly the -- there is a clay that overlies the Basal Chadron. And when you pump, you can actually release water from storage in that clay. That might be creating this deviation from the -- from the Theis curve. So --

JUDGE WARDWELL: And which deviation? The early or the late time?

MR. BACK: The late time. The flattening of the curve. We saw that -- that was one of the plausible explanations in the previous aquifer test. So basically we are revisiting what -- what we did at the relicensing.

JUDGE WARDWELL: Don't we have to revisit

that?

MR. BACK: Absolutely. And that's fine. It's just that these same curves that we looked at there, there we had 30 years of data pumping and never seeing an impact in the overlying aquifer. And basically we had better confining conditions here than we did there.

JUDGE WARDWELL: But, again, that's of no interest here, is it? What's of importance here is whether or not the analysis is done correctly and whether the confinement exists. Whether there is -- whatever is happening up there is independent, is it not, of -- of what our obligations are in regards to showing that the MEA is performing as -- as you interpret it to perform when you reach your conclusion that in fact we are able to maintain control of a lixiviant and that the confinement of that aquifer is maintained during the pumping analysis; isn't that correct?

MR. BACK: Absolutely that is correct. I am really tying -- kind of tying off of Dr. Kreamer's preliminary discussion, bringing in the aquifer test from the -- from the relicensing. If you go to the EA, you know, our --

JUDGE WARDWELL: Back up with your

statement. What was that statement you just made? You are trying to do what to --

MR. BACK: Dr. Kreamer brought in the aquifer testing that was performed, saying that the aquifer testing -- there is a leakage calculation that was done on the main facility during that aspect because we -- they saw the same kind of reactions.

The staff requested that additional analysis be done on that leakage calculation, and what I'm saying is, the end result was that that wasn't leakage. We could demonstrate it wasn't leakage. We can demonstrate it's not leakage here through multiple lines of evidence, not just the aquifer test -- not just these curves. So --

JUDGE WARDWELL: Again, do you agree that because that was -- you -- the leakage analysis was performed in the previous site, that still does not relieve us from looking at the MEA site, correct, as it stands on its own as a given proposed mine site?

MR. BACK: That is correct, and that is why we had multiple lines of evidence that this is not leakage at the MEA site.

JUDGE WARDWELL: Have you performed a leakage analysis of the drawdown in the MEA in any of the MEA -- in the data of any of the MEA wells?

MR. BACK: Qualitatively, in the sense that the distance drawdown results clearly show that there is not leakage going to the Basal Chadron sandstone.

JUDGE WARDWELL: Okay. We'll get to that in a minute. But I want to fix the point one more time that you do agree that the MEA needs to stand alone and cannot count on either any performance associated with what has taken place at the existing facility.

MR. BACK: Yes.

JUDGE WARDWELL: Crow Butte, do you -- do you agree to that statement, that we -- regardless of whether there was homogeneity, in a perfect situation up at the existing site, that doesn't allow us to assume that it's perfect down at the MEA site? And, likewise, if the MEA site is showing heterogeneity, that doesn't necessarily mean that it's going to be up at the other site.

They have -- we cannot count on that other site to -- to make any conclusions. We have to rely on the data and the information and the evidence that is provided for the MEA site. Is that correct? Would you agree to that?

MR. LEWIS: I agree with that, Your Honor.

JUDGE WARDWELL: I'm sorry?

MR. LEWIS: Yes.

JUDGE WARDWELL: You do agree with that.

Dr. Kreamer, do you agree that we have to establish everything associated with the MEA site based on the MEA data?

DR. KREAMER: The word you just said was "everything." There are -- there are some analogies, but, yes, I do believe the MEA has --

JUDGE WARDWELL: There is always going to be analogies.

DR. KREAMER: The way you phrased it just now was a little bit different, saying that we -- I don't think we should exclude considering the other site, but I think that the bottom line is the MEA site has to stand on its own data.

JUDGE WARDWELL: So if the MEA does have to stand on its own data, us reviewing the pump test data from the existing site is a waste of our time; isn't it? It's not part of the record.

DR. KREAMER: I'm sorry. Say again?

JUDGE WARDWELL: Is it -- if, in fact, we have to rely -- you just stated that you agreed with everyone that the MEA site has to stand on its own; is that correct? That's what I just heard you say.

DR. KREAMER: That's correct, yes.

JUDGE WARDWELL: Okay. Thank you. We'll leave it at that.

I want to -- I want to fix one other issue with this flattening of the curves later on. Well, we'll get to that later.

Here we are. NRC, in your -- I guess it's your rebuttal, Exhibit 014, answer 18 at 19 to 20, another possible explanation is that the water -- this is in regards to the flattening of the curves -- that the water is being released from storage in the first several hundred feet of the aquifer -- aquitard immediately overlying the Basal Chadron Chamberlain Pass Formation.

And this was your statement earlier, Mr. Back, wasn't it, in regards to this coming out of that zone.

MR. BACK: Yes, Your Honor.

JUDGE WARDWELL: If that was correct, why didn't we see the flattening of that in all of the wells?

MR. BACK: It's a plausible explanation for why we're seeing this flattening. It might be that the sands -- that the Basal Chadron -- that basal sands going towards this well is more connected to the

clay rather than one of the lower sandstones. So it's -- again, it's just -- it's a potential explanation.

JUDGE WARDWELL: Do you believe the Basal Chadron is a sandstone or a sand?

MR. BACK: I believe it's a sand, and we can call it a sandstone, but the descriptions are more like a sand.

JUDGE WARDWELL: But didn't you stipulate, if my memory serves -- or serves me correct that it was a sandstone when we had those stipulations? So maybe I'm not remembering it correctly. I'd have to look it up.

MR. BACK: Well, it's classified as a sandstone, but it's not cemented. People call it a sandstone, but it's porous, like a sand.

JUDGE WARDWELL: Sandstone is porous; isn't it?

MR. BACK: But it's cemented, so it has a lot -- it's a much -- a much different composition.

JUDGE WARDWELL: And what lets you believe it is -- it behaves more sand-like?

MR. BACK: There is a description -- Josephine Collins, who you referred to earlier, described it as having very little change from when it was originally deposited, which they termed

diagenesis. The TR describes it as interbedded -- an interbedded material from a channel deposit, and then the grain size analyses, they did two grain size analyses, which suggests that it's -- it's not a sandstone but more of a sand. It's a fine-medium sand.

JUDGE WARDWELL: Crow Butte, any of the witnesses here have experience being on the drill rig while you were installing these wells and getting to see the material come out and have -- have an opinion in regards to the consolidation or cementation of the Basal Chadron as to whether it is a sandstone or a sand-like material?

MR. STRIVER: Jim Striver, Crow Butte. Yes, I have seen samples, both cuttings and attempted to make core samples from the Basal Chadron. I would consider it semi-consolidated in places, sand in most places. It's very hard to recover core from the Basal Chadron. It comes apart just like a sand you would see in a fluvial environmental today.

So it's closer to sand, but there are places where it's semi-consolidated.

JUDGE WARDWELL: Dr. Kreamer, what is your evidence that supports your statement earlier that it was a sandstone, the Basal Chadron?

DR. KREAMER: Well, I thought we were all in agreement. In the statement, we all agreed that it's a coarse grain sandstone interbedded with thin silt and clay beds of varying thicknesses.

But I think that we have to keep our eye on the donut, not on the hole here. I think can take you out to many unconsolidated, non-indurated sands, and show you fractures in them, decent sized cracks due to overpumping.

So I think the implication here is if you have a non-indurated loose sand with -- or clay, you can't have displacement. That's demonstrably false and can be shown to be false in many areas.

So the idea that sand that is semi-consolidated or not consolidated cannot fracture or these beds cannot be displaced, I think that -- that weighs into this, too.

But I thought we were in agreement that it was a coarse grain sandstone, and everybody agreed to that. At the previous site, there was no mention of sand. It was always sandstone for this particular formation.

JUDGE WARDWELL: If it was sandstone --

DR. KREAMER: Also, at the other site, there is major faults that have been seen in the

sandstone, great displacement and things like that.

So this is a continuous unit that is mineralogically -- that we have agreed is mineralogically and geochemically that -- similar to the other -- other place, the other place which characterizes the sandstone, has a major fault right on the boundary of it and has the ability to fracture. Even if it wasn't sandstone, it would have the ability to fracture.

JUDGE WARDWELL: And, again, clarify for me, if you would, whether or not the Basal Chadron is fracturable or has fractured. How does that relate to its confinement properties? How does that have any bearing on it?

DR. KREAMER: It's not --

JUDGE WARDWELL: Aren't we concerned more, if you'd bear with me, on what the upper confining unit is rather than the fracturability of the Basal Chadron?

DR. KREAMER: Well, again, if there is a fracture in the Basal Chadron, there is a possibility that it extends upward through what is called the confining unit. Confining units can be fractured. They can be leaky. So the term "confining unit" doesn't mean that it's absolutely confined.

I find that Mr. Back's analysis that the clay leaks in one place but doesn't leak in another place to be less likely than isolated secondary porosities that extend not only to the Basal Chadron Chamberlain Pass Formation but also upwards through what is called the confining layer to allow water from upper layers -- upper layers to move downward.

JUDGE WARDWELL: Thank you.

Here is a stopping point. We could go now -- we can stop now or go half an hour.

CHAIR BOLLWERK: All right. Judge Wardwell advises that this is a good stopping place for him, and so why don't we go ahead -- it's right at 12:30. If possible, I would really like, given the situation this morning, if we could do a 45-minute lunch, that would be much better than an hour. So, is that possible?

MR. SMITH: Your Honor, I think that might be difficult for us. You had indicated previously an hour, and we don't have lunch onsite. We are going to go back to the mine and then return. So we can -- we can certainly do our best, but there is some travel time involved.

CHAIR BOLLWERK: Well, we would appreciate it if you could get back here as quick as you can.

Once you're back, we're going to start. So enjoy your lunch. Be as prompt as you can, but we will definitely start by 1:30.

(Whereupon, the above-entitled matter went off the record at 12:30 p.m. and resumed at 1:31 p.m.)

CHAIR BOLLWERK: All right. Let's go back on the record, please. We completed our lunch break. We are dealing with concern number two under contention two. I neglected to ask you before, Dr. Kreamer, and I take it there's no one in the room with you other than yourself, right?

DR. KREAMER: No, no, and I have the door locked, as well.

CHAIR BOLLWERK: Okay. Very good. Again, if someone were to come in, that's fine. We just need to know that that's happening.

DR. KREAMER: No, the door is locked and no one will come in.

CHAIR BOLLWERK: Okay. Thank you very much. Appreciate that. All right. So let me turn it back to Judge Wardwell, who I think has a few more questions.

JUDGE WARDWELL: Okay. I'm about to proceed into 2.1.3, opinion one, basis C, the Cooper-Jacob methodology. Dr. Kreamer's testimony, Exhibit

003 of the OST at 2, opinion one, basis C, Cooper-Jacob, says that these analyses that were supposedly run by the Crow Butte did not appear in the report. The Crow Butte rebuttal at that next exhibit, 033, at A-13, that's answer 13 at six, says the results of the Cooper-Jacob semi-logarithmic distance drawdown analysis are shown in the pump test report at CBR016, Figure 18, at page 50 and discussed in Session 7.6.1 in the test report. And that cites again the CBR Exhibit 016 at 12 to 13.

And I ask CBR is that inclusive of all the Cooper-Jacob data and analyses that went into the plot represented in Figure 18, CBR016 at 50?

MR. LEWIS: Bob Lewis, Crow Butte. Yes, your Honor.

JUDGE WARDWELL: And where is the, is there early time data shown on that diagram, or is that not the type of diagram that would show such a thing?

MR. LEWIS: Bob Lewis, Crow Butte. This data is a single moment in time, and it's taken toward the end of the test.

JUDGE WARDWELL: That's what this plot did. You could plot it out for different time frames, right? But this is just a plot of that drawdown with

distance at a given snapshot of time, and you say that's near the end of the pumping test; is that correct?

MR. LEWIS: That's correct.

JUDGE WARDWELL: Okay. NRC014, rebuttal, answer 18, at pages 20 to 21 says that a Cooper-Jacob time drawdown analysis is not necessary to identify a recharge boundary. It would not provide -- went too far. It would not -- well, let me start over again because I lost the, I just zoomed too many places. Anyhow, oh, would not provide any additional information not already available from a Theis curve analysis because the Cooper-Jacob time drawdown analysis is an approximation to the Theis analysis.

Referencing the CBR025 at 90 to 91, it goes on to say the Cooper-Jacob time drawdown method was developed because it is easier to fit a straight line through the data than to fit the data, to fit the data than to the Theis type curve, not because the Cooper-Jacob method provides any additional information. Furthermore, use of the early time data might show deviations from a Theis curve that mimic recharge. However, for the reasons discussed in A-17 above, use of the early time data in the Theis or the Cooper-Jacob time drawdown analysis is inappropriate.

So I ask NRC are you basically claiming that the Cooper-Jacob is a shortcut analysis, rather than one that's a more detailed analysis to the Theis curve fitting?

MR. BACK: Yes, your Honor. There are two types of Cooper-Jacob analyses, but the one that involves time is a shortcut to the Theis method.

JUDGE WARDWELL: Thank you. And Crow Butte, do you agree with staff's statement that a Cooper-Jacob time drawdown analysis is not necessarily to identify a recharge boundary and will not provide any additional information not already available from a Theis curve analysis?

MR. LEWIS: It provides a different type of information, your Honor. It can identify boundaries more obviously on a straight line in some cases.

JUDGE WARDWELL: And what was your purpose for performing this analysis?

MR. LEWIS: Normally, both types of analysis are performed using analytical method and to see for consistency if the transmissivities were in the same range as the Theis method, which it is.

JUDGE WARDWELL: Thank you. And, Dr. Kreamer, do you disagree with the staff that the

Cooper-Jacob is a shortcut, rather than a more involved analysis of the pumping test data?

DR. KREAMER: Can I be heard? I'm trying to go on the phone now to avoid some of the problems we had earlier. Does this work?

CHAIR BOLLWERK: Yes, we can hear you, Dr. Kreamer.

DR. KREAMER: Okay. I can be heard. All right. Yes, the Cooper-Jacob is similar to the Theis equation. It's just that when you see recharge boundary, it's more obvious in the Cooper-Jacob analysis. And so by showing the Cooper-Jacob, it's got slightly different assumptions but, essentially, it's the same sort of analysis the Theis analysis is. Those two represent the very simplest type of analysis that can be done on an aquifer.

JUDGE WARDWELL: And does not this satisfy your concerns where you said the Cooper-Jacob analysis wasn't presented in any of the testimony?

DR. KREAMER: My concern was that recharge boundaries would be much more obvious. As you looked at the little wiggles we were discussing before in the Theis analysis, the diversions from a straight line would be, in the Cooper-Jacob would be much more obvious and those little wiggles would then have

greater import when seen in a different format.

JUDGE WARDWELL: I was referring to what I was reading in regards to your testimony where you said these analysis did not appear in the report. Do you now see where these are in the report? Does that satisfy that concern they are not in the report?

DR. KREAMER: No, I do not. I guess the figure that's up, I'm not sure were there a host of figures for all the monitoring well data. If that was presented, I did miss it. But I didn't see for a monitoring well a different Cooper-Jacob analysis.

JUDGE WARDWELL: There wouldn't be one for every monitoring well because aren't these data points that we're looking at in Figure 15 really the drawdowns from different monitoring wells? While you're pausing I'll ask Crow Butte that because --

DR. KREAMER: What is presented here is not, it's one form of a Jacob-Cooper but it's not the, it's not the typical form.

JUDGE WARDWELL: Crow Butte, would you like to respond? Is this a plot of different wells, drawdown from different wells at different distances away?

MR. LEWIS: That's correct, your Honor.

JUDGE WARDWELL: So each one of these

points is a different well?

MR. LEWIS: Yes.

JUDGE WARDWELL: Okay. And, Dr. Kreamer, you see where this is, Figure 18 of that pumping test; correct?

DR. KREAMER: I do see that. A typical Cooper-Jacob is not individual to different distances. It's one well with drawdown at that particular well, similar to a Theis.

JUDGE WARDWELL: Where in this diagram do you see the additional recharge boundary shown better than in a Theis?

DR. KREAMER: I'm sorry. You broke up on my phone here. Could you repeat, please?

JUDGE WARDWELL: Yes. In Figure 18, the Cooper-Jacob method, where do you see that the recharge boundaries are illustrated better than were illustrated at the Theis curve?

DR. KREAMER: Typically, the Cooper-Jacob would be time versus drawdown and not distance versus drawdown.

JUDGE WARDWELL: That didn't answer my question.

DR. KREAMER: Okay. I didn't hear you. Could you please clarify?

JUDGE WARDWELL: Yes. Where in this diagram does it show that recharge boundaries are better highlighted than would be in the Theis plots?

DR. KREAMER: In this sort of a plot, this is completely different from Theis. In a Theis, it's time versus drawdown. In this one, it's distance versus drawdown. A typical Cooper-Jacob would be time versus drawdown or U, a U term.

JUDGE WARDWELL: So in this diagram, it doesn't show recharge any better than the Theis or maybe even less better?

DR. KREAMER: Oh, yes, this one is inferior to even the Theis. A typical Jacob-Cooper that would talk about one well and its drawdown with time would then show the inflections from a straight line that would indicate some sort of boundary, whether it be a recharge boundary or a solid no-flow boundary.

JUDGE WARDWELL: And what's your basis for calling your version the typical Cooper-Jacob and this not being, which implies that Figure 18 is not the typical one?

DR. KREAMER: Oh, this has got very restricted data. You don't see all the drawdown information from each well. What the --

JUDGE WARDWELL: Excuse me. Can I interrupt? Can I interrupt? Can I interrupt?

DR. KREAMER: I'm sorry?

JUDGE WARDWELL: My question was what was your basis for calling this an atypical Cooper-Jacob and you using the phrase in a typical one it would show it? What makes this atypical compared to what the version of the Cooper-Jacob that you're thinking of that has time involved with it?

DR. KREAMER: Yes. Here are drawdown versus distance, and it only uses select information from a certain well here.

JUDGE WARDWELL: Let me rephrase it --

DR. KREAMER: In other words, all the --

JUDGE WARDWELL: I'm not coming across to you, so I'll make it simple. Would it be a better term to say one form of the Cooper-Jacob is this and another form is another one that you're thinking of, rather than applying possibly a pejorative adjective to the type of curve that we're looking at?

DR. KREAMER: You're breaking up a little bit, but I caught the gist of what you said, your Honor. I guess that would be a fair assessment but with the caveat that this is an unusual form. I'm writing a textbook on hydrology right now, and this is

a form that's very rarely used. And it actually obscures whether there are recharge boundaries just by its very nature.

JUDGE WARDWELL: Thank you. Crow Butte, would you agree with their assessment that this is an unusual one that you've provided us and there are more typical ones out there, another one that's more typical?

MR. LEWIS: No, your Honor. Cooper and Jacob, Cooper and Jacob had two different type curves. One was a distance drawdown plot here, the other is the leakage analysis he's referred to. This is not an inferior, it's just a different way of showing the information. And there's actually one use of this information that isn't useful in the Theis method, and that is this method can be used to calculate well inefficiencies, which can often be useful for various reasons.

So this isn't an inferior method. It actually provides some additional information if you decide to use it for that.

JUDGE WARDWELL: Thank you. NRC staff, would you like to comment on this?

MS. STRIZ: I'd like to comment. Your Honor, Cooper-Jacob distance time graphs are included

in their analysis. All the recovery analysis is Cooper-Jacob. I just wanted to correct the record. So if you go look at the Theis recovery, all of those have been fed by Cooper-Jacob method. It's all a straight-line analysis.

In addition, you have to be clear that the T over T prime axis, early time is on the right side, late time is on the left side. So as you get to T over T prime equal to one, that is the point where the period of the drawdown, which is T, is equivalent to the period of the recovery, which is T prime. So the axis is reversed.

So just for the record, these are Cooper-Jacob analysis of the Theis recovery curves.

JUDGE WARDWELL: Okay, Dr. Striz. Did you want to add anything, Mr. Back?

MR. BACK: No.

JUDGE WARDWELL: Okay. Give me a second, Dr. Kreamer, here. I just want to make sure -- so any, besides your statements where you say it didn't appear in the report, any other statements you made were in reference to the time versus drawdown Cooper-Jacob and not the Figure 18 type of Cooper-Jacob; is that correct?

DR. KREAMER: That's correct. I'm going

to try very carefully to speak without the headset. And if I talk over you, I'll look very carefully at your picture to try not to do that. Essentially, the Jacob-Cooper that NRC just referred to was only for the recovery data. And as you pointed out in the recovery data, the inflections off that line that indicate even in the recovery data that there's recharge boundaries.

But the Jacob-Cooper time drawdown analysis was not presented for the pumping test itself, just the recovery test, and that's my concern.

JUDGE WARDWELL: Thank you, Dr. Kreamer. And when I do try to stop you and I'm not being successful, if you see a big red and blue tight face of mine, that's my indication that I wish to stop you and clarify some things.

DR. KREAMER: I want to apologize. I mean no disrespect when I talk over you. Please, sorry about the audio.

JUDGE WARDWELL: I didn't attribute it to you. I attributed you to the delay in the times that we had. It is technology. It is Twitter, if I might paraphrase a football coach over the weekend or an equivalent to the Twitter anyhow.

Moving on to 214, opinion one, basic D,

analysis of monitoring wells two and eight. Dr. Kreamer, in his testimony, mentioned that -- and, again, that's Exhibit 003, item D, at page two -- that the report did not include analysis of pumping test data from water level changes at monitoring wells two or eight in the analysis, although these wells were reported to be in the radius of the influence of the pumping test and those water level changes were used to define the extended radius of the pumping well influence.

NRC, in their rebuttal, 014, answer 16 at 16, staff states that, due to failure of the initial attempts to perform a pumping test, CBR refined their design of the test by proposing different wells, specifically monitoring six and seven, be designated as the furthest wells to formally estimate the radius of influence. However, although CBR indicated that two and eight were no longer part of the formal network, these wells were still being monitored.

And so I guess I'll just ask Crow Butte, since there was still drawdown in two and eight, why weren't these considered part of the formal network? You know, what do you need, what kind of wristband do you need to get into being designated as formal monitoring network stuff?

MR. LEWIS: Bob Lewis, Crow Butte. Your Honor, we developed a work plan that was approved by Nebraska DEQ, and it was their definition of a half a foot of drawdown would be within the formal monitoring well network. And we made an estimate --

JUDGE WARDWELL: Who is they? You say they, they --

MR. LEWIS: Nebraska DEQ.

JUDGE WARDWELL: Okay.

MR. LEWIS: And so we made an estimate of what we thought would be the radius of influence prior to the test and included those wells as part of the formal well network.

JUDGE WARDWELL: And, in fact, I think we looked at some graphs of them, didn't we? Dr. Kreamer, does that pretty much address two and eight issue in regards to, in fact, they are actually there and the data is there, even though they're not part of the network because there's not enough drawdown there?

DR. KREAMER: Yes, it would have been nice to have that presented just to have more data, but I understand the response and I understand where they're coming from.

JUDGE WARDWELL: Thank you. Before I move on to 215, opinion one, basis E, MEA coverage from a

single pump test, that's what we're going to cover next. I'm going to stop and pause now to see if we have any catch-up on the old pieces of information we needed. We should have done that, I should have picked up on that --

MR. SMITH: Yes, your Honor, we have the answer --

JUDGE WARDWELL: Usually, my chair always keeps me in line for that, so I'm going to blame him for not keeping me in line on getting that.

CHAIR BOLLWERK: I was waiting for you.

MR. SMITH: I was ready, as well. I had my microphone in front of me. We have the answer to the two questions that you posited.

JUDGE WARDWELL: All right. Why don't we --

MR. SMITH: Mr. Pavlick is going to address the first one and Mr. Lewis the second one.

JUDGE WARDWELL: Great.

MR. PAVLICK: Doug Pavlick, Cameco. So your first question was regarding the 167,000 gallons, where did that come from. So that was the accumulated volume of flow from the pumping well during the pump test. It was captured in tanks and then transported to the Crow Butte site for disposal.

JUDGE WARDWELL: Well, wouldn't that change your pumping rate then, that you're pumping rate was different than what's reported there or the length of time that you were running the test? If that's the accumulated amount, something has got to be in error here.

MR. PAVLICK: It's equal to the 4.29 days that the test ran times the flow rate of the test of 27.08 gallons per minute.

JUDGE WARDWELL: Okay. Thank you. And now the second one.

MR. LEWIS: Your Honor, I looked at each of the monitoring wells type curves, and I had the following summary. Seven of the eight monitoring wells exhibited what I would call normal behavior. Monitor well number three had a flattening of the curve in late time. Monitoring well number two had very small drawdowns at a great distance and had more variability to the data in general. Monitor well number eight was also at a great distance with small drawdowns. It did display some early time deviations but also had very small drawdowns with greater variability.

JUDGE WARDWELL: And weren't we also going to talk about how many have early time frames?

MR. LEWIS: Thank you. There was an early time deviation in the pump well, which it was expected. I had some early time deviations in monitoring well number two and number eight, and those were the wells that were outside the formal monitoring network.

JUDGE WARDWELL: Thank you. Dr. Kreamer, if you want to, I won't ask you now whether or not you disagree or agree with their assessments of their characterization of those type curves. If you're interested in responding to that, just remind me of it when we meet again come Thursday and that will give you time to look it over and get back to see whether or not your comment are in regards to early and late time influences of those particular plots of data from the monitoring well of the pump test for various monitoring wells.

DR. KREAMER: I have no response at this time. I'll look at the data. Thanks.

JUDGE WARDWELL: Okay. So with that, the pot is right and we got a clean slate, right? We're all good. Moving on to, again, the coverage from a single pump test, Exhibit OST004, is that you, Mr. Wireman?

MR. WIREMAN: I'm sorry?

JUDGE WARDWELL: OST004? Is that your testimony or --

MR. WIREMAN: Yes, yes.

JUDGE WARDWELL: Okay. So I thought, oh, we had a different number here. Opinion three at four talked about limited site coverage with only one test, saying only one aquifer test has been conducted at the MEA. The aquifer test was conducted in May of 2011 and the CBR reports that the radius of influence estimated from the aquifer test was about 8,800 feet or about 1.6 miles, and the MEA extends for more than 7.2 miles from the northwest corner to the southeast corner. Therefore, much of the Basal Chadron has not been tested to determine if there's a hydraulic connection between the Basal Chadron aquifer and the overlying Brule.

I'll start off with CBR. Do you agree with the numbers, the values here for the radius of influence and the 7.2 miles from the northwest corner to the southeast corner?

MR. STRIVER: Jim Striver, Crow Butte. Yes, we do.

JUDGE WARDWELL: Thank you. NRC rebuttal 014, answer 21 at 23, said, based on the ROI of 8,800 feet, the pumping test covered approximately three

miles of the approximately 7.5 mile length of the MEA site. And then CBR rebuttal, answer 15 at seven to eight in regards to the claims that performing a single pumping test covered only a relatively small portion of the site is poor professional practice. CBR rebutted that their approach is consistent with industry practice and with NRC guidance, stating that any of a number of commonly-used aquifer pumping tests may be used, including a single-well drawdown recovery test, drawdown versus time in a single observation well, and drawdown versus distance pumping test using multiple observation wells.

And I think I failed to read Dr. Kreamer's response to this. I had Mr. Wireman's, but I believe, Dr. Kreamer, you also had some criticism of the one pumping test, and I just want to clarify for you that when you were, and I'll do the same to you, Mr. Wireman, when you were criticizing a single-well test -- excuse me. When you were criticizing only one pumping test, you weren't criticizing the analysis they were running but just the mere fact that they ran just one pump test out at the MEA site? Is not that correct, Dr. Kreamer?

DR. KREAMER: We actually don't like the analysis as well --

JUDGE WARDWELL: Please, answer the question.

DR. KREAMER: -- we're talking about the same -- I'm sorry.

JUDGE WARDWELL: Answer the question simply. It was a pretty simple question. You're going to have a chance to talk about the analysis. I just want to make sure --

DR. KREAMER: The answer is --

JUDGE WARDWELL: -- they're talking about --

DR. KREAMER: -- no, I don't agree. I do not agree that it was, our only concern was the radius of influence only covered a small portion --

JUDGE WARDWELL: Mr. Wireman --

DR. KREAMER: -- the analysis itself.

JUDGE WARDWELL: -- when you were referring to the single pumping test, it was a fact that there was only one pump test performed at the site and that you felt more should be done to cover the full range of the Basal Chadron in the MEA. Is that correct or not?

MR. WIREMAN: With regard to opinion three, that is correct.

JUDGE WARDWELL: Exactly. Thank you very

much. That qualifies it nicely. And I turn to CBR in saying when you were referencing in your rebuttal that you had single well drawdown and recovery tests and using the NRC guidance as justification for this, aren't you really mixing a couple of things because isn't a single-well analysis different than just conducting one pumping test out there? It's a form of analysis, rather than how many numbers of different tests of those single-well analyses you're performing out there; isn't that correct?

MR. LEWIS: Bob Lewis, Crow Butte. Your Honor, I believe the single-well pump test is a different methodology entirely, as you suggested, than a single-well pump test. Those types of analysis can be used for estimates of transmissivity and storage coefficient within the guidance, so that is the only reason that's in the rebuttal.

JUDGE WARDWELL: Okay. Thank you. Now, in regards to Dr. Kreamer's and Mr. Wireman's issue under this particular section of opinion one, basis E, is that Crow Butte, in their rebuttal, Exhibit 033, answer 15 at 78 said that the expectation is that additional site-specific pumping tests are performed as required as additional mine units are added. License condition 11.3.4, NRC009 at 19, states that,

as part of developing its well field packages for any new mine unit at the MEA, the applicant shall perform an aquifer pumping test for each new mine unit.

And I'll turn to CBR and ask you state in this rebuttal that the expectation is that additional pump tests will be performed. Isn't that really required, rather than an expectation? It's a license condition, isn't it?

MR. STRIVER: Jim Striver, Crow Butte. Yes, that might be, the terminology may be incorrect. That is a requirement that we would be conducting on each new mine unit.

JUDGE WARDWELL: Okay. Thank you. With that, Dr. Kreamer, and, again, you're going to have time to comment on the methodology. If you look over your testimony, you'll see, and I've said it as we started here we're going to cover every topic. I'm not concerned with your, at this point, with your objections to the analysis. I'm concerned with your concern about the fact there's only one test.

Comment on what is -- yes, I'll narrow it for you. What is wrong with the fact that there are going to conduct other pumping tests out there. They have to form others as each mine unit developed. Does that not satisfy your need for a better

characterization of the Basal Chadron Chamberlain Pass Formation?

DR. KREAMER: Your Honor, it's my understanding that what we're doing here is not only for the efficiency of mine operations but to see if there's excursion and if there will be safety enclosure. Under those conditions, looking just at the mine site and not the potential for movement both offsite and further on in the site I think is an important consideration.

Also, the pumping test measure was an aggregation of information and within the cone of depression and part of the cone of depression was outside the mining site. So the information that was actually developed, part of it was related to water that was drawn in from outside the mining boundaries.

And so I guess the short answer to that, which maybe I should have answered to start with, is I think that one single -- we don't call it a pumping test, we call it aquifer test. One aquifer test was insufficient because it didn't cover a large percentage. The majority of the site was not even evaluated.

JUDGE WARDWELL: Okay. Thank you. Mr. Wireman, would you like to add anything to that?

MR. WIREMAN: Yes, I'll add a couple of things. Thank you. First of all, I don't believe it's industry practice at all to only have one aquifer test for an area this size. Secondly --

JUDGE WARDWELL: But they are going to have more aquifer tests there.

MR. WIREMAN: But they won't go in the EA, so people will not know what the results of those are prior to mining. So it's kind of too late in my view at that point. They will get hydraulic parameters that they need for operation. That's true. It's important to them. But with respect to characterizing the groundwater flow in this area and evaluating the risk of this mining operation with respect to excursions or unwanted movement of contaminated water, those don't do any good. So they need to be done up-front.

JUDGE WARDWELL: Can I stop you right there, though? Because that's a good point. I want to get to them and then come back for the rest of yours.

MR. WIREMAN: Fair enough.

JUDGE WARDWELL: I was going to get lost if you started adding some others on top of it.

MR. WIREMAN: No problem.

JUDGE WARDWELL: Staff, how would you respond to that? Why shouldn't the applicant be responsible for characterizing most of the Basal Chadron, rather than just having one test in one area where you're starting the mine?

MR. BACK: Yes, your Honor, this is David Back. There's a lot of characterization data, actual borings and field measurements that are done throughout the entire site. And so from that standpoint, I mean, we still have a lot of data that might not have been influenced by the aquifer test by the zone of influence, but there's a lot of data that supports that we're seeing very similar conditions throughout the entire site. And you can see that in the geophysical logs, you can see it in the borings, you can see it in the water levels being relatively consistent. There's just a general consistency throughout the entire MEA.

JUDGE WARDWELL: Thank you, Mr. Back. Continue on, Mr. Wireman.

MR. WIREMAN: With respect to looking at borings and looking at some of the water levels, that doesn't really tell you a lot about the overlying Brule. The aquifer testing, if done correctly and if the right types of data are collected and analyzed, is

much, much better for telling you something about the potential for either drawing water downward from the Brule or the presence of pathways that would allow water to go the other way.

So the aquifer testing is critical for that reason. It gets at the potential for connection and the potential for moving water from one formation to the other. So for that reason and given the heterogeneities even within the Basal Chadron, and their testing indicates some significant hydraulic conductivity differences amongst these wells, that in itself, in my view, warrants doing aquifer tests. They know there's differences, and so that warrants an aquifer test in this area where they have very high transmissivities versus low. So to me it just makes sense.

JUDGE WARDWELL: I'll go back to staff now. What would technically happen if you got three or four pump tests down the road, mine units down the road, and it was determined that the pump test analysis demonstrated that you couldn't control lixiviant in that particular area, that you had to, you know, the pump test just showed there was too much leakage there or not enough some other confinement or the Basal Chadron was more impervious and you couldn't

draw stuff out of it because it was so tight, yet still could get off into the environment where it was confined in other parts? What would happen then?

MR. LANCASTER: Yes, this is Tom Lancaster. If it shows conditions different than what the data shows us, under license condition 9-4, they would be required to submit a license amendment with a plan for safe operations in those conditions.

JUDGE WARDWELL: Thank you, Mr. Lancaster. Moving on to 2.1.6, opinion one, basis F, offsite influences. Dr. Kreamer, Exhibit 003 at two, stated that the single solitary pumping test performed at the MEA was impacted by hydrogeologic influences offsite that were not part of the area to be evaluated. Because of the elongated nature of the MEA, the cone of depression's radius of influence for the solitary pumping test extended significantly offsite well past the boundaries of a narrow portion of the property. The pumping test drew water from these offsite locations.

And when we're talking about offsite or the boundary of the property, Dr. Kreamer, were you referring to the MEA or were you referring to some cross-section or something that demonstrated the limits of the Basal Chadron Chamberlain Pass

Formation?

DR. KREAMER: Your Honor, when I referred to offsite, I was talking about the radius of influence. If you look at the radius of influence of the pumping well, it extends, if you go at 8,000 feet that we've talked about before, it goes far off the sides of the site, which is an elongated site. So, essentially, we're drawing water not just from the site but from areas off the site. Therefore, the drawdown data in the monitoring wells was really a composite of onsite data and offsite data.

JUDGE WARDWELL: And by site, again, you mean the boundary of the MEA; is that correct? Is that what you're defining as the site?

DR. KREAMER: That is correct.

JUDGE WARDWELL: Okay. Thank you. CBR's rebuttal, 033 exhibit, answer 16 at eight, says that the aquifer test results are representative of average aquifer conditions over the radius of influence of the test, which includes the monitoring wells that were evaluated as part of the test. The fact that the radius of influence extends offsite to the east and west of the MEA boundary is irrelevant to the outcome of these testing results.

And I'll ask CBR the same question: what

boundary of the property are you referring to? Is that, again, the MEA black line area that is shown on several of the figures in the application, in your application?

MR. LEWIS: Bob Lewis, Crow Butte. Yes, your Honor.

JUDGE WARDWELL: Okay. And isn't your statement true that it's irrelevant or it certainly would be false, wouldn't it, saying it's irrelevant if, in fact, the radius of influence exceeded the boundary of the Basal Chadron Chamberlain Pass Formation? If you were pumping it so hard that you're now pumping other materials that are beyond the limits of the Basal Chadron, you're testing a different material, aren't you? Strata.

MR. LEWIS: Well, your Honor, unless the boundary of the site was circular, it would be impossible for the radius of influence to match the site boundary. I don't really see the relevance as the transmissivity measured at various monitor well locations show continuity across the site and are consistent.

JUDGE WARDWELL: Is there any spot where you believe the ROI does exceed the limits of the b Chamberlain Pass Formation, or how far, how wide is

the limits of the Basal Chadron, either side of, the centerline, if you would, of that stepladdered outline of your MEA?

MR. LEWIS: Your Honor, in some cases, roughly, the radius of influence would extend three to four-thousand feet offsite in some areas beyond the site boundary.

JUDGE WARDWELL: How far does the -- what I'm trying to get a grasp on is how far does the Basal Chadron extend to either side of the MEA?

MR. LEWIS: It's continuous throughout that area and beyond.

JUDGE WARDWELL: So there is no interruption with part of the shale coming up or anything else? It's Basal Chadron on either side of it for --

MR. LEWIS: Your Honor, approximately three miles to the northwest, the Basal Chadron does not exist. It pinches out stratigraphically. So, yes, there is a lateral boundary about three miles east, I'm sorry, northeast of the MEA boundary.

JUDGE WARDWELL: You give me --

DR. KREAMER: Could I make a request? When you don't speak directly into the microphone and it's not only yourself but also Mr. Wireman, I cannot

hear. It just goes off. Although you can hear it in the room, it doesn't carry to the sound system.

MR. LEWIS: Very well. Let me rephrase.

JUDGE WARDWELL: Let me just say how I'd like it rephrased. You said something about to the northeast or the northwest. Fine. But I need to also know east and west, the limit. Approximately, how far does it before it pinches out, if it does at all?

MR. LEWIS: Right. The Basal Chadron pinches out more than seven miles to the west and pinches out approximately three miles to the east.

JUDGE WARDWELL: Okay. Thank you. And that's from where? From the boundary or from the center line of the MEA?

MR. LEWIS: From the boundary.

JUDGE WARDWELL: From the boundary?

MR. LEWIS: Yes.

JUDGE WARDWELL: And have you looked at your radius of influence, that 8,000-foot one? Would that, in fact, be butting up against, in the area that you did it for, ME 1, would that radius of influence extend to that strata beyond where the Basal Chadron Chamberlain Pass Formation pinches out?

MR. LEWIS: I don't believe so, your Honor, no.

JUDGE WARDWELL: Dr. Lagarry, I was debating whether -- don't take up too much time, mainly because I'm going to get back to you. You're here all the time, so I'm leaving you for the caboose, if you will, of this train.

DR. LAGARRY: I look forward to it.

JUDGE WARDWELL: But I would like your opinion while we're on that subject of what is your knowledge base in regards to the extent of the Basal Chadron east and west of the laddered outline of the MEA?

DR. LAGARRY: There's three interpretations, your Honor. The first one and --

JUDGE WARDWELL: I would like the one that you would like to stand behind as a geologist as closest to truth.

DR. LAGARRY: The Chamberlain Pass Formation was deposited in a generally northwest - southeast trending trough. Some say it's erosional, some say it's structural. But the pinching out on either side is about what CBR says it is.

JUDGE WARDWELL: Thank you very much. Appreciate that. Sorry to let you think you were really going to get into some meaty things here. That will have to wait. I'm sorry.

DR. LAGARRY: Every dog has his day, your Honor.

JUDGE WARDWELL: But I appreciate the input. NRC, in their rebuttal, 014, answer 20 at 23, Dr. Kreamer's claim that water was drawn from offsite misconstrues the actual groundwater flow dynamics involved in pumping a confined aquifer, like the Basal Chadron. The changes to the potential metric surface, i.e. drawdowns, observed in the furthest monitoring wells are a response to the decrease in pressure caused by the pumping well and are unrelated to water movement from offsite.

In regards to this, there is one nagging question I still had in the back of my mind for you, Dr. Kreamer, and that is, while we talk about containment really of the mining fluids within the aquifer is what we're talking about when we're trying to assess containment, that really is slightly different than just calling this, and we often call that containment confinement. I think those terms do get interchanged somewhat in the various documents that I've seen related to this application. But do you believe that the Basal Chadron is and has remained a confined aquifer up to this point in the MEA?

DR. KREAMER: I believe there's evidence

of leakage through the overlying strata, so that would be lack of confinement.

JUDGE WARDWELL: But it's still a confined aquifer by hydrogeologic definitions, is it not?

DR. KREAMER: It has a high piezometric surface. So under that definition, yes, it could be called a leaky confined aquifer.

JUDGE WARDWELL: Well, in fact, the aquifer isn't leaking, but it's a confining layer above it that's actually doing the leaking, correct? It's the aquitard that's leaking, it's not the aquifer that's leaking.

DR. KREAMER: To not quibble too much, the confining comes from a high piezometric surface or the level of the piezometric surface, and it is above the top of the formation. Under that definition, it's confined. But by another definition, if there are leaky aquitards above and below, then it is not entirely confined. It's quasi-confined.

JUDGE WARDWELL: And in actuality, there's no such thing as a completely confined aquifer because every aquitard leaks to some degree, does it not?

DR. KREAMER: No, relatively speaking, there's some --

JUDGE WARDWELL: No, no, not relatively

speaking. Excuse me. Not relatively speaking. Every aquifer, to some degree, every aquitard, to some degree, leaks. It may be so small that it's insignificant, but it does leak, does it not?

DR. KREAMER: Under that definition, I would agree.

JUDGE WARDWELL: Okay. Thank you. Just to make sure we're all in the same line here. And I'm doing that to support you actually, that just because you're talking about lack of confinement you're not saying that it's not a confined aquifer because most people will think of it as a confined aquifer. That's where I was going with that question. That's why I wanted to make sure the records show that we understand there are two different types of confinements and we really ought to use containment and confinement and not mix the two, like at least I end up doing, not being disciplined enough to keep that on track.

But, anyhow, back to where I was. Now I'm back to this. You probably forgot what the rebuttal said. But, basically, it was, their rebuttal, NRC's rebuttal that you've, Dr. Kreamer, you've misconstrued the actual flow dynamics in that the changes in the potentiometric observed in the furthest monitoring

wells are a response to the decrease in pressure caused by the pumping well and unrelated to water movement from offsite. Do you agree with that statement?

DR. KREAMER: No, I do not. That's crazy.

JUDGE WARDWELL: Say again. Did he say that's crazy? Well, if you're just talking about me, I'll accept it, but I don't know about --

DR. KREAMER: When you bore the piezometric surface, water is released from the column of the aquifer underneath. If there was no movement of water, where would that water go? In other words, when you lower a piezometric surface anywhere through pumping, water is released and it's got to be released in some direction. So the statement that, yes, the piezometric surface went down but no water moved is antithetical to basic hydrogeology.

JUDGE WARDWELL: Thank you, thank you, Dr. Kreamer. NRC staff, would you like to clarify that? And I'll start off by just saying what about the constant head boundary observed in two wells that are, you know, that went off a fair amount of distance? The CP 1-A and the monitoring 3 and what about Dr. Kreamer's response? Do you want to tie both of them together?

MR. BACK: Yes, your Honor. David Back. First of all, his testimony was that water was moving from offsite. I mean, just a simple mathematical calculation will show you that pumping 25 gallons a minute, you're never going to get, you're never going to get water moving from that far away in four days. I mean, the other aspect of this is, as we testified earlier, the water is coming from, primarily from the expansion of water and collapse of the matrix, and it's not moving huge volumes of water from 8,800 feet away.

And so what we see, and this is why if a train runs over a confined aquifer, you see changes. I mean, you see changes long ways away that doesn't have anything to do with water movement. This is why when you see an earthquake you can see a change in well a thousand, you know, literally a thousand miles away. And so to think that those responses we're seeing 8,000 feet away are because of water movement from offsite, well, it's crazy.

JUDGE WARDWELL: Well, we've got two crazies. So if I may rephrase it another way, you're saying it is a more of a pressure drop than it is a water movement?

MR. BACK: Absolutely. That's exactly how

a confined aquifer response. That's why you see responses to such great distances. It's not water movement through the aquifer that's causing that.

JUDGE WARDWELL: Dr. Kreamer, one final response to that? And then all the crazies here will move on to something else.

DR. KREAMER: I think the distinction between what we're saying is only the water. Whenever you have a water level drop, water is released from storage. He just said that. Where does the water go if it doesn't move? It doesn't go up, it doesn't go down, it goes somewhere.

Now, the quantity of water when you don't have much of a piezometric surface change is small. But to say that there's no water movement is just not hydrology, and that's crazy.

JUDGE WARDWELL: Thank you. Moving on to 2.1.7, opinion one, basis G, the variations of aquifer thickness. OST Exhibit 003 at two states that under this section that the report does not make it clear if the actual aquifer thicknesses were used to calculate transmissivity or only the average aquifer thicknesses. Crow Butte, in their rebuttal at answer 17 at nine states, as stated throughout the pumping test report in a reference CBR016 at 5, 13, 14, and

Table 8, an average net sand thickness of 40 feet was used to calculate out transmissivity of the Basal Chadron Chamberlain Pass Formation sandstone at Marsland. Ore grade uranium deposits underlying the Marsland Expansion Area are located in the Basal Chadron Chamberlain Pass Formation, which averages 50 feet in thickness, typically 40 feet net sand. While there is some variability, the assumption is reasonably satisfied over the test area, and they reference CBR016 at 11.

So I'll start off with CBR in regards to this. Let me just start off with about what is your radius of influence of a production well during a mining unit operation? And let's say the maximum if it doesn't reach steady state.

MR. LEWIS: Bob Lewis, Crow Butte. It's within one nine-spot pattern. There's really no flare to that, so it's approximately 100-foot or less, 75 to 100-foot would be a good estimate.

JUDGE WARDWELL: And that's because you're only drawing off a small amount of net waters. Is that why the radius of influence stays fairly small?

MR. LEWIS: That's correct, your Honor. About a half a percent difference.

JUDGE WARDWELL: So while you're pumping

at higher rates, you're injecting it at 95 or whatever, 99 percent of it back in, and so is that a fair assessment of why that radius of influence is much less than when you're pumping at low rates for a pump test but for a long time?

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: Thank you. Isn't transmissivity, didn't I hear this morning that transmissivity is determined from the pumping tests and that hydraulic conductivity is back calculated from that? Why are we now talking and being so concerned about transmissivity being the multiplication of the thickness times the hydraulic conductivity?

MR. LEWIS: I'm sorry. I don't understand the context, your Honor. I think they're both important. Hydraulic conductivity is back calculated from transmissivity.

JUDGE WARDWELL: So we're really concerned about, because you really do most of your testing to determine transmissivity more than you have for hydraulic conductivity, haven't you?

MR. LEWIS: Your Honor, there is some direct testing of hydraulic conductivity from falling head permeameter tests or grain size analysis just to

be complete. But for purposes of talking about the pumping test, it's back calculated from transmissivity.

JUDGE WARDWELL: Okay. So in regards to why we're addressing it here then, if you were taking your and you have taken a hydraulic conductivity value from some other test besides a pumping test and coming up with a transmissivity, is it true you used an average thickness as you report in your rebuttal testimony of 40 feet net sand?

MR. LEWIS: Yes, your Honor.

JUDGE WARDWELL: And what's the definition of net sand? I haven't heard that before.

MR. LEWIS: Your Honor, when looking at the geophysical log of the production interval, we subtracted off the claystone thickness to make a net sand thickness. Since the claystone does not contribute to the transmissivity appreciably, it's essentially better than underestimating transmissivity using a larger thickness.

JUDGE WARDWELL: And where did this layer of claystone come from? Is that part of the Basal Chadron or --

MR. LEWIS: There are claystone stringers within the total thickness of the Basal Chadron

sandstone.

JUDGE WARDWELL: So the difference between the sand thickness and the net sand thickness if your estimation or at least an allocation, if you will, for the presence of some claystone stringers within that deposit?

MR. LEWIS: If they're present, yes.

JUDGE WARDWELL: Thank you. And does not your measured Basal Chadron thicknesses that you've gotten from your explorations performed at the site vary from approximately 20 to 90 feet over the site?

MR. STRIVER: Jim Striver. That is correct, your Honor.

JUDGE WARDWELL: And so I'll turn to Dr. Kreamer. Do you have any comments in regards to the use of the average thickness? Wouldn't that not seem to be a reasonable thing to do since you're coming up with average values anyhow with a pump test that extends over 8,000 feet and using an average thickness might not be such a bad idea, is it?

DR. KREAMER: I believe it is a bad idea, and let me explain why just briefly. If you use analytical methods and you get an average, that might be okay for production. But remember we're talking about closure. We're talking about the potential for

migration and a potential for risk and vulnerability. And if you look at the CBR site, the analytical methods, including a leaky aquifer test that Mr. David Back so highly touted as successful, when it came to closure, they weren't able to close it, but they have tremendous problems and, in fact, they had to abandon analytical models and go to a numerical model, a much more complicated numerical model.

And so I guess my concern with averaging transmissivities and taking an aquifer which pinches out, you know, offsite but goes from 20 feet to 90 feet, the average values, while good for production, might not be as good for the overall safety and calculations of risk and movement.

JUDGE WARDWELL: And that leads into another question I had with that. While the 20 to 90 seems like a long range of thicknesses initially, if, in fact, you look at that over the full length of the MEA, that 70 feet difference, it's still a pretty flat grade, isn't it? It's not like you're jumping off a cliff with this 20 to 90, is it? That's not a huge range for the distances we're talking is all I'm questioning.

DR. KREAMER: I hear what you're saying. So say if you had a constant hydraulic conductivity or

transmissivity, that hydraulic conductivity would be eight times faster or so, nine times faster, and that would mean the rate of movement would be calculated differentially, nine times different. But you got to remember that the site was not characterized in some of the places where it's thick. There were no pumping tests in some of those areas, and so the thickness of the formation becomes very important as far as leakage and things of that sort go.

JUDGE WARDWELL: Okay. Thank you.

DR. KREAMER: In other words -- let me just one other word of clarification. The difference in transmissivities could be reflective of a difference in additional water in a pumping test and leakage. And so that error, that uncertainty, is not calculated at all here when you average those different thicknesses.

JUDGE WARDWELL: Thank you. NRC rebuttal 014, answer 23, pages 26 to 27, talks about Driscoll 1986 discussing simplifying assumptions to analytical solutions used to determine aquifer properties under both equilibrium and non-equilibrium conditions, and they're referencing NRC Exhibit 016 at PDF page 3, 5. It goes on to say that with respect to how well these assumptions need to be satisfied in order to obtain

meaningful results, Driscoll states as follows, and this is a quote from that 016 PDF 3, these assumptions appear to limit severely the use of the two equations. In reality, however, they do not. For example, uniform hydraulic conductivity is rarely found in a real aquifer, but the average hydraulic conductivity as determined from pumping tests has proved to be reliable for predicting well performance. In confined aquifers where the well is fully penetrating and open to the formation, the assumptions of no stratification is not an important limitation. Assumption of constant thicknesses is not a serious limitation because variation in aquifer thicknesses within the cone of depression in most situations is relatively small, especially in sedimentary rocks.

So, Dr. Kreamer, how would you counter -- so let me start more basic. Are you familiar with Driscoll and the well test document that he has, and do you consider him a reasonable source?

DR. KREAMER: I am familiar with Driscoll, your Honor.

JUDGE WARDWELL: And how would you counter Driscoll's arguments in this case?

DR. KREAMER: Well, the quote you said talked about well production, and so, basically,

they're talking about average values for well production for a pumping well where you're trying to get quantity of water. I just finished a text this year on contaminant hydrology, and contaminant hydrology is totally different. A little heterogeneity can mean that contamination can move in a constrained preferential pathway really far, and the monitoring methods that are used in monitoring wells by the Nuclear Regulatory Commission that they allow right now allow screening throughout the entire interval. What that means is we have a contaminated zone. That well will draw clean water from some vertical elevations and dirty water from another, and it will be diluted.

And so even with that, at Crow Butte, when they were trying to get closure, the analytical models failed. They had to go to a numerical model because, first of all, because of the monitoring. So when Driscoll talks about monitoring wells, he's talking about screened monitoring wells, which are inappropriate in contaminant hydrology, high resolution vertical sampling of a norm.

And then the second part of that would be that what he's talking about there is well production, and that's the overall water that comes in and not the

ability of contaminants to maybe migrate. And, lastly, remembering that the injection wells are one the outside and the withdrawal well is in the inside of this array, if you do have leakage, that 9,500 balance that you're talking about where you're always pumping more than you're putting in sort of goes to pot because there's leakage, you're adding water to the system, and it's not as conservative to have injection wells on the outside. It would be more conservative to have one injection well on the inside and intercept wells on the outside. So leakage really would mess that up.

And so when Driscoll was talking about pumping in this regard, he was talking about well production and not contaminant hydrogeology.

JUDGE WARDWELL: But he was still discussing, wasn't he, the simplified assumptions to analytical solutions of well pumping aquifer testing analyses? This is where the quote comes from, does it not?

DR. KREAMER: Are you just talking -- I'm sorry. Yes, this is for pumping well from quantity of water and not pertaining to contaminant hydrology.

JUDGE WARDWELL: And he's talking about evaluating pumping tests, aquifer pumping tests, is he

not? It's not a general discussion of pumping, period. It's dealing with how do you analyze the results from pumping tests, is it not? I don't want to ask you. I'll ask the NRC. They were the ones -- let me ask NRC.

NRC, on your rebuttal, what is Driscoll discussing? I read here that your rebuttal says that Driscoll discusses simplifying assumptions to analytical solutions used to determine aquifer properties, so I assume that's what that quote refers to. Does it or does it not refer to that?

MR. BACK: Yes, your Honor, that's what it refers to, is the transmissivity of the aquifer.

JUDGE WARDWELL: I think, at this time, it would be worthwhile to call up some of CBR 8-R, and let's start off with 49 to 62. And these are various cross-sections. Well, this will be a good one -- let me think. Will it be now? No, go ahead. Go to pages 49 to 62. Go to 49 to start with, Joe. Yes, any one of these is fine. These are fine. In fact, probably you better go 50. This is fine, but it's too -- go to another one. Yes, this is a better one to look at, the one below. Fifty-one for now.

And these are -- let me ask CBR what these are that we're looking at here.

MR. STRIVER: Jim Striver, Crow Butte. Geological structural cross-sections that were constructed using geophysical logs that were drilled across the MEA property.

JUDGE WARDWELL: We're not looking at them now. I rather you left it the size you had it just to start with our discussion. That isn't the size we had it at. That's much smaller. Well, this is fine. We can live with this, I guess. We'll get out our magnifying glasses.

And is the bottom shaded level of each of those cross-sections the Basal Chadron Chamberlain Pass Formation?

MR. STRIVER: Yes, that's correct.

JUDGE WARDWELL: And then the unshaded portion above that is what? The upper confining unit?

MR. STRIVER: That's correct. The middle Chadron, upper Chadron, and the lower Brule.

JUDGE WARDWELL: And looking at this --

CHAIR BOLLWERK: To clarify the record, which figures are we looking at?

JUDGE WARDWELL: We are looking -- well, I can't read them now, but they are on --

CHAIR BOLLWERK: Can you go to 25 percent maybe? Is that where it was before?

MR. LANCASTER: Your Honor, it's 2.6-3.

JUDGE WARDWELL: All right. There we go.

MS. STRIZ: Which one is it? CC?

JUDGE WARDWELL: Yes, it is. We are now looking at --

MS. STRIZ: It's 2.6-3C.

JUDGE WARDWELL: Thank you. Is a horizontal scale of this the same as the vertical scale?

MR. STRIVER: No, it is not.

JUDGE WARDWELL: Approximately how much exaggeration is there?

MR. STRIVER: Let's see.

JUDGE WARDWELL: If it helps, you know, the distance between your two knuckles is about an inch, and if you lay that over that and then bring it up to the top is what I did.

MR. STRIVER: Correct. The horizontal scale is, the vertical scale is consistent as indicated an inch for a hundred feet. Horizontal scale is as indicated. It's not consistent, so it just shows here, like on the left you have 2,400 feet, on the right distance, it shows you what the distance is between, you know -- if we did it correctly across, not correctly but if we had the entire 2,400 feet, it

would be way off scale.

JUDGE WARDWELL: If it was an exaggerated scale is what you're saying, what would happen?

MR. STRIVER: It would be the geophysical log on the left would be clear off paper by a significant distance. So this is a relative view.

JUDGE WARDWELL: So it's certainly several factors, maybe not maybe as much as a factor of ten but it's somewhere between, there's some vertical exaggeration here. And what would happen? Not only would it be off the page, but would be the thickness of the Basal Chadron as it showed up on that as far as just the relative size of it?

MR. STRIVER: Okay. I don't understand your question, your Honor.

JUDGE WARDWELL: If you drew it to true scale both horizontally and vertically, what would be, how thick would be the Basal Chadron at that --

MR. STRIVER: It would be very thin.

JUDGE WARDWELL: Probably almost the width of a pencil possibly?

MR. STRIVER: It would be very thin. Yes, that's probably a good correlation.

JUDGE WARDWELL: So with that in mind, I think I'll turn to Dr. Kreamer and I think you have

stated earlier today, I think I heard you say, talk about abrupt changes with the level of the Basal Chadron and you have talked about the 20 to 90 feet of thickness differences. Without us going through all of these cross-sections here, what cross-sections do you suggest we look at on these pages, 49 to 62, demonstrating this, what you consider to be a very unlevel variable thickness strata?

DR. KREAMER: Your Honor, I don't have those in front of me right now. I can only see the one that's right in front of me. I don't have those pulled up, and I'm not prepared to really tell you --

JUDGE WARDWELL: So you didn't have the --

DR. KREAMER: -- that we all agree that this is localized channels, that there's silt, stone, and other things. So this is not a uniform strata.

JUDGE WARDWELL: And when you were commenting that this, that this thickness varies so much over the distance of the Basal Chadron, you didn't have one of these cross-sections in mind as backup evidence for demonstrating that large difference in thicknesses of this strata?

DR. KREAMER: I don't have that at this time. There were some that were greater changes than others. I'll be honest with you, I can't even read

the scale on this magnification in front of me, on the one in front of me, and I don't have those listed right now.

JUDGE WARDWELL: Yes, and I understand that.

DR. KREAMER: My recollection is that there's some that the change over the cross-section is more dramatic than others, the north -- south related ones.

JUDGE WARDWELL: Yes, and so what you're saying is you don't remember what you used to come up with a conclusion in your mind that the Basal Chadron had large dramatic changes in thicknesses? And if so, that's fine.

DR. KREAMER: I didn't write that down, and I don't have that in front of me. I can review that and then perhaps get that information to you later.

JUDGE WARDWELL: Yes. Why don't we do that? Keep that in mind. If you're interested in providing that evidence where you show these abrupt changes in the thickness of the Pierre Shale looking over all these cross-sections, and we can look at those when you bring it up on Thursday. Is that a suitable way to do it, Chair?

CHAIR BOLLWERK: That's fine.

DR. KREAMER: From what I can see the scale now, your Honor, it looks like there are 500-feet intervals; is that correct? No, is it 100-foot intervals between the cross-section size there?

JUDGE WARDWELL: Yes, it's 100-foot one. So if I put my knuckle over that, that expands about 200 and then -- well, it's gone. So if you divide the 200 --

DR. KREAMER: Quite frankly, looking at this, there's also, not the lines that have just been drawn but the actual geophysical log, you have data which are those squiggly lines that go down. And if you notice that there's variations in those lines, part of my statement there might have been related not only to those green lines that were drawn at the top of the Chadron formation were on the base of the Chamberlain Pass Formation but also on the basis of those geophysical logs that record electrical conductivity.

JUDGE WARDWELL: Thank you. Moving on to 2.1.8, opinion one, basis H.

CHAIR BOLLWERK: One question. Is this a good time for a break? Ten minutes?

JUDGE WARDWELL: Yes, I was just thinking,

I was thinking of three. I was going to try to get to three.

CHAIR BOLLWERK: Can you do this one by three?

JUDGE WARDWELL: If not, we'll interrupt it in the middle. Yes, this looks like a short one. And I can keep them short because these are very small -- anyhow, 2.1.8, opinion one, basis H, monitoring well screen intervals where Dr. Kreamer has said that, from Figure 2.6-9, that's CBR008 at 76, so if we can pull that up. That's CBR008 again at 76. The thickness of the Basal Chadron varies from 21 to 91 feet across the site. The screen intervals of the monitoring wells vary from 22 to 50 feet, given the possibility that these wells did not measure results solely from the entire thickness of that aquifer or, conversely, in part, measured water derived from formations other than the Basal Chadron layer.

And Crow Butte's rebuttal at 033, answer 18 at 9, monitoring wells installed as part of the pump test penetrated all or the majority of the Basal Chadron Chamberlain Pass Formation thickness and are sufficient to characterize the full thickness of the aquifer. In any event, given the relative large distances from the pump well to monitoring wells,

partial penetration effects in the observation wells are negligible.

And so I think I'll start off by asking Crow Butte were they fully penetrating wells in regards to both the pump well and the observation wells?

DR. KREAMER: I'm sorry. If you were talking to me, you were breaking up.

JUDGE WARDWELL: I was talking to Crow Butte.

DR. KREAMER: Is this a question for myself, Dr. Kreamer?

JUDGE WARDWELL: I was talking to Crow Butte. I was asking Crow Butte that.

MR. STRIVER: Jim Striver, Crow Butte.

JUDGE WARDWELL: I was asking the Crow Butte.

MR. STRIVER: Okay. Question is whether the monitor wells were fully penetrating the formations?

JUDGE WARDWELL: Right.

MR. STRIVER: The overlying Brule wells were not fully penetrating the Brule formation. They were placed in the sandstone in the upper Brule and the brownstone member of the upper Brule. In the

Basal Chadron formation, the intervals that were completed nearly were completed completely through the Basal Chadron.

JUDGE WARDWELL: Okay. And the well screens were set through that and no further --

MR. STRIVER: Correct.

JUDGE WARDWELL: -- either side of that? Thank you. NRC rebuttal 014, answer 22, pages 24 to 25, states that they opine that, based on the Figure 2.6-9 of CBR006, which, again, is the technical report, while a Basal Chadron ranges in thickness from 20, approximately 20 to 90 feet, those numbers do not reflect the thicknesses of the locations of the aquifer pumping test observation wells. Comparing CBR008, Figure 2.7-7 at 98 of the TR, which shows the locations of the Basal Chadron Chamberlain Pass Formation observation wells with Figure 2.6-9 at 76 showing the Basal Chadron Chamberlain Pass Formation thickness contours, all of the observation wells except for monitoring five are in areas where the thickness shown in Figure 2.6.9 is less than the 50 feet, is less than 50 feet, referencing, again, CBR008R at 75 and 97. Moreover, the completion reports provided in Appendix A of the aquifer pumping test report, and that's CBR016 at PDF 53 to 64,

indicate that all of the Basal Chadron observation wells were fully screened across the Basal Chadron formation.

So I guess I'll ask Dr. Kreamer, is it not, do you accept their testimony that the wells appear to be fully penetrating the Basal Chadron?

DR. KREAMER: They may be over-penetrating. I've done a quick search, pages 2 through 49, excuse me, 2-49 to 2-50 of the TR, that would be CBR006 at 98, 99, is one. And then page 55 at 2.6-3F, that's the line F through F prime, are some of the ones that you asked for before.

JUDGE WARDWELL: And what did you say about the fully penetrating one? I didn't catch any of that.

DR. KREAMER: The last testimony was a little bit broken up. When people don't speak directly, I mean just inches away from the microphone, I lose some of the testimony. If what I heard correctly is that these things, the monitoring wells are drilled and the screened interval is longer than thick, that indicates they have a potential to pull water from formations other than the Chamberlain Pass.

JUDGE WARDWELL: They testified that it was fully penetrating just within the zone of the

Basal Chadron, and the references that you can look up are the NRC014, answer 22 at 24 to 25 for the discussion of that.

DR. KREAMER: I read that discussion and, in fact, I included it in my textbook as an example of poor monitoring technique. It's poor monitoring technique not for pumping tests, but it's poor monitoring technique for contaminant hydrology or seeing if there's any excursions, those sort of things for closure. I can get you the reference in contaminant hydrology, if you would like.

JUDGE WARDWELL: That pretty much does it for this section. When we come back, we'll talk about, yes, we'll move on.

CHAIR BOLLWERK: So right now it's about five til three. Why don't we take a ten-minute break? We'll come back at five after three and continue on.

(Whereupon, the above-entitled matter went off the record at 2:55 p.m. and resumed at 3:06 p.m.)

CHAIR BOLLWERK: Let's go back on the record, if we could, please.

Well, you're just after the three o'clock hour, and I wanted to remind counsel that, when we finish with Concern No. 2, we will be allowing you a brief interval to put together, if you already

haven't, any proposed questions for us. And then, we'll have to obviously take a brief break and look those over, and decide which will be appropriate for the Board to ask. But I hope, again, you're maybe compiling those already to some degree, and we can keep that interval brief in which we are in the process of putting together the questions for our consideration.

All right. Let me, then, go back to Judge, turn back to Judge --

MR. SMITH: Your Honor? Your Honor, Tyson Smith for Crow Butte.

If you would indulge us, we have a minor correction or clarification that Mr. Striver would like to make to his earlier testimony regarding the interval thickness that was screened for the pump test.

MR. STRIVER: Jim Striver, Crow Butte.

Regarding the pumping test monitor wells, the completion intervals that were screens within the lower Basal Chadron, some of them didn't completely screen the entire interval of the lower, of the Basal Chadron, within just a few feet. And typically, that would occur when we have like a small, like a sand lens followed by a shale layer, and then, the main

sand body below it. So, the actual what would be called the top of the Basal Chadron would be here, where a monitor screen would be placed a few feet or a couple of feet below the top of what's considered the Basal Chadron. And then, the rest of the interval is screened to the base of the Basal Chadron.

CHAIR BOLLWERK: All right. Thank you.

Dr. Kreamer, I saw you moving around, and I want to make sure you heard that.

DR. KREAMER: No, I did not. I switched quickly to computer audio. I was trying to get my phone back online. I turn off my phone whenever I'm not here. I can switch to phone.

Can you hear me clearly on my computer?

CHAIR BOLLWERK: At this point, yes.

The second question is -- and I apologize for not recognizing you. There was a witness that hadn't come back. I thought that's what the problem was.

Do we need to repeat that for Dr. Kreamer? I guess that's the question.

JUDGE WARDWELL: Yes, it would be worthwhile.

DR. KREAMER: If you would repeat the question, I would be most appreciative.

MR. STRIVER: Jim Striver. Can you hear me, Dr. Kreamer?

DR. KREAMER: I can hear you, yes. Speak right into the microphone, please.

MR. STRIVER: Okay. This is regarding I have a clarification regarding the screened intervals of the Basal Chadron formation for the monitor wells that were used for the pumping test.

The screened interval in some of the monitor wells was not completely covering the Basal Chadron. A screened interval may be within a few feet of the top, what's considered the top of the Basal Chadron. And typically, how that, why that is done is, when like a sand lens right above the main Basal Chadron sand body is encountered, then we have another shale interval, the thin shale. Then, the top of the screen would be placed at the top of the main body of the Basal Chadron. So, what we consider the top of the Basal Chadron would be that first sand. So, we're not completely screening the entire interval of the Basal Chadron with all the monitor wells, but within a few feet.

DR. KREAMER: Thank you.

CHAIR BOLLWERK: I think with that, I take it he heard that, so we can proceed forward, however

you're ready, whenever you're ready.

JUDGE WARDWELL: Yes, I just have a few lingering leftovers from before the break, just to allow Crow Butte and, then, NRC to respond to my question to Dr. Kreamer in regards to variable thicknesses of the Basal Chadron.

What is your impression of the relative abruptness of any changes of the thickness of the Basal Chadron across the MEA site?

MR. LEWIS: Bob Lewis, Crow Butte.

Your Honor, I would agree with Dr. Driscoll's characterization that the use of average sand thicknesses are appropriate, given that the radius of influence of the aquifer test covers a broad area. The measurements of transmissivity at monitoring well locations are not point data. They represent transmissivity of a large portion of the aquifer that represents an average value at that point. So, just to summarize, I would agree with Dr. Driscoll's assessment that average sand thickness is appropriate for calculation of transmissivity and storativity.

JUDGE WARDWELL: I think that was a wonderful answer, but it wasn't my question, I'm sorry to say.

(Laughter.)

MR. LEWIS: Okay. I'm sorry.

JUDGE WARDWELL: My question was -- and I'll rephrase it because I think I wasn't very clear -- in reviewing the geologic sections that have been made through the site, what is your interpretation of the variability in the thicknesses of the Basal Chadron as it relates to any abrupt changes in it across the entire MEA? Is it abrupt? Is it there's a lot of sites of abrupt changes or is it a fairly level, constant thickness over the site, varying very gradually rather than abruptly? It's the abruptness; it's the degree; it's the slope, if you will, of the change in the thickness, is what I am interested in, which is what we were looking at before.

MR. STRIVER: Jim Striver, Crow Butte.

I would not say there are abrupt changes in the thickness of the Basal Chadron. It does have variable thicknesses within the range you spoke of. But, as far as going from 20 feet to 90 feet within a short distance, I do not believe we see that. I don't think that's a significant issue. I think it's fairly consistent across the MEA with some variability.

Now keeping in mind, may I add, that lots of times when that gross thickness is calculated, it's

including a thin sand lens or layer above the main Chadron. So, it may go from a 50-foot thickness up to where you have 5 feet of shale, and then, a 5-foot sand lens on top. And that's considered part of the gross thickness of the Basal Chadron. So, encountering that is not significantly affecting things, in my opinion.

JUDGE WARDWELL: Thank you.

Would anyone from NRC staff like to respond to that?

MR. BACK: This is David Back.

Yes, one of the other lines of evidence is the isopach map that is easier to look at than all the cross-sections. We've looked at the cross-sections, but the isopach is a thickness actually mapped out in an aerial form. So, it gives you a good visual on the thickness across the site and its variability.

JUDGE WARDWELL: And do you have a reference number for that figure?

MR. BACK: Yes, yes, yes, Your Honor.

JUDGE WARDWELL: And then, what is your interpretation of that as you look at that isopach map?

MR. BACK: Oh, it's that our interpretation -- I mean, we --

JUDGE WARDWELL: First, just for the record, so we've got it there, what is the figure number that you're referring to?

MR. BACK: It's in the TR, and it's figure 2.6-9.

JUDGE WARDWELL: Thank you.

Now what is your, as you look at that, what is your interpretation of the degree in change of aquifer thickness across the MEA?

MR. BACK: Well, at the north part of the site, it's 40-feet thick.

JUDGE WARDWELL: And I think what we're interested in is where the pump test was taking place in the 8,000-foot radius of influence, which is where this started from I believe.

MR. BACK: Right. So, it ranged from like 40 to 90 feet within the radius of influence, from what I recall our testimony.

JUDGE WARDWELL: And would you know what kind of grade change that results in, in abruptness, in degrees of abruptness? You know, what is the grade of the top of the Basal Chadron?

MR. BACK: Well, we really interpret that from the depositional environment being a stream channel. And so, laterally, it would be relatively

continuous and not very abrupt, but, vertically, you might have these clay lenses and such that are described within the TR and shown in the logs.

JUDGE WARDWELL: So, there could be some cases where it is reasonably abrupt, is what you're saying?

MR. BACK: Vertically, yes.

JUDGE WARDWELL: Okay. Thank you.

CHAIR BOLLWERK: For the record, that's a figure, I take it?

JUDGE WARDWELL: Yes.

CHAIR BOLLWERK: So, we're talking about CBR008-R? That would be the exhibit reference?

JUDGE WARDWELL: Yes, except we have to get a page. I don't know the page number.

CHAIR BOLLWERK: Well, it's figure 2.6-9, right?

JUDGE WARDWELL: Yes. It's probably -- no, it isn't a separate exhibit.

MR. SMITH: It's page 75, CBR0008-R, page 75.

CHAIR BOLLWERK: Thank you.

JUDGE WARDWELL: I was wondering when you were going to chime-in with some wisdom, Mr. Smith.

MR. SMITH: I'm trying to add value

wherever I can.

(Laughter.)

JUDGE WARDWELL: Okay. I think we're ready to move on to 2.3, "Opinions for Utilization of Alternative Pumping Test Methods".

Dr. Kreamer, Exhibit 003, Opinion 3 at 6, says, "Aqui-Ver, Inc., in its Marsland hydrologic Test Report No. 8, only presented one form of analysis for an MEA site. That is the Theis methodology." Although in their report they also refer to the semi-logarithmic Cooper-Jacob technique, which was not presented, and we've already clarified that it was, but there's also another form of the Cooper-Jacob.

So, I'll start off with just some general questions before referencing any other of the testimony. And I'll address this to you, Dr. Kreamer, if I might.

But I just wanted to get a feeling for how difficult or easy is it to determine the hydraulic conductivity of an aquifer or its transmissivity? They're pretty much the same. But let's talk hydraulic conductivity for an aquifer. And for that, I'd like to put it in the range of, what's the maximum range that hydraulic conductivity varies over all strata?

DR. KREAMER: That would be 14 orders of magnitude maybe.

JUDGE WARDWELL: Okay. So, it's a large number?

DR. KREAMER: Yes, sir.

JUDGE WARDWELL: So, hydraulic conductivity varies by a large amount? And then, as we get it down to defining pure types of porous media -- i.e., let's say we're just talking, we had a nice sieved sand. Would that always yield just one value of a hydraulic conductivity if you were testing it over a large area, even if it was composed of all the same particle sizes?

DR. KREAMER: No, sir.

JUDGE WARDWELL: And about how much might that vary? A couple orders of magnitude?

DR. KREAMER: It depends on the packing. In your hypothetical here you said the same grain size. If they were all the same shape and not angular, and things like that -- it would have to do with packing -- maybe an order of magnitude of 2 percent. Sandstone has got anywhere between magnitude -- because it's different in duration, because of its different potential fracturing and secondary porosity. So, that's many orders of

magnitude for sandstone, but, for sand, maybe one or two orders of magnitude.

JUDGE WARDWELL: Okay. And then, if you go away from that, and now we've got, as you said, either lenses in there or just the grain size distribution varies quite a bit through most sand deposits; it's not all one size or one distribution. So, we see all kinds of distributions. You would be up to many orders of magnitude difference, correct?

DR. KREAMER: Absolutely. Absolutely, yes. I agree that what we have is averages of what we've all agreed is a heterogeneous system.

JUDGE WARDWELL: So, what we do, we are doing quite a good job, if we aren't as geotech engineers, to narrow down hydraulic conductivity to half an order of magnitude, are we?

DR. KREAMER: Was that a question?

JUDGE WARDWELL: Yes.

DR. KREAMER: No, I disagree with that. I think that, from the standpoint of well production and pumping, I would agree. From a transport of potential contaminants where you can have preferential flow, the variety we're talking about is crucial to understanding risk. And so, if we're just talking about production wells and pumping, and how much they

can pump down lixiviant, that's fine. But if we're talking about pathways and where these things can go, and what the risk is to surrounding communities, and things like that, if we're talking about contaminant transport, these generalized numbers, average integrated numbers from a heterogeneous aquifer are dangerous.

JUDGE WARDWELL: But, still, if we're trying to characterize the aquifer beforehand, and we take a sample at one point and we take another sample at the other, do you agree there's potential to be the same type of material? And yet, at the two different points they can be an order of magnitude or different off, even though that's the truthful hydraulic conductivity at a given point, isn't that correct?

DR. KREAMER: In that type of -- yes, I would agree with you, Your Honor.

JUDGE WARDWELL: Okay. For the sake of argument, if the sandstone in the Basal Chadron formation was not fractured, would you believe that the Theis equation would be an acceptable model?

DR. KREAMER: No.

JUDGE WARDWELL: And why not?

DR. KREAMER: Well, sandstone can order several orders of magnitude, and you can look at two

different sandstones and they'll both be indurated and they'll both look the same color. They'll both look like they have the same grain consistency. But, when you actually do hydraulic conductivity testing on it, you can get several orders of magnitude from what looks like the same sandstone. So, I would have to state no to that.

And as far as the abrupt changes go --

JUDGE WARDWELL: Let me clarify for you. Let me clarify for you. I have switched a little bit because now I'm talking about -- the acceptable model I am talking about is in reference to evaluating pumping tests, which is what this section is dealing with, with your call for the criticism that only one type of pumping test method was used.

And my question was whether or not the sandstone was not fractured and was a true porous media with no fractures in it --

DR. KREAMER: Yes.

JUDGE WARDWELL: -- would the Theis model be an acceptable model, recognizing that now we are looking at not just a point value, but a whole volume area that is influencing the results of that test?

DR. KREAMER: Not necessarily -- oh, I'm sorry.

JUDGE WARDWELL: And so, I'm saying, would the Theis be acceptable for that, in your opinion?

DR. KREAMER: I'm sorry, I talked over the end of that question. Could you repeat just the end of that question?

JUDGE WARDWELL: Would you believe that the Theis equation would be an acceptable model for that situation, an unfractured sandstone?

DR. KREAMER: No, not necessarily, Your Honor.

JUDGE WARDWELL: Say it again?

DR. KREAMER: No, not necessarily, Your Honor. You could have a sandstone -- if you're saying if you assume that it's homogenous, yes, but sandstone which is unfractured and the same thickness, it could have a different genesis. It could have a different history. And you could have two sandstones in the same unit that would be totally different in their hydraulic conductivity. And so, if you make the assumption that it's homogenous and isotropic, yes, you could use that analogy. But, in reality, real sandstone systems, that's not always the case.

JUDGE WARDWELL: Is there anything like a homogenous aquifer? Does it exist?

DR. KREAMER: It depends. It depends what

your goal is. For pumping wells and things like that, there are things that are close enough to a homogenous aquifer --

JUDGE WARDWELL: That wasn't my question.

DR. KREAMER: Pardon?

JUDGE WARDWELL: Again, Dr. Kreamer, that wasn't my question. It wasn't close enough. I said, is there anything that's a truly homogenous aquifer?

DR. KREAMER: No. No, the nature of that, it's absolutely --

JUDGE WARDWELL: So, they're all heterogeneous in some aspect? Is that correct?

DR. KREAMER: The beginning of your question was covered up by your audio. It didn't hit the microphone.

JUDGE WARDWELL: We don't hit microphones here. It may have been my turning my head or anything. Just so you know, we're not pushing buttons or anything.

DR. KREAMER: I'm so sorry.

JUDGE WARDWELL: But let me say it a different way, in fact. At a certain scale, aren't all aquifers heterogeneous? And that scale may change between the aquifers, but for every aquifer, if you're dealing with a certain scale, is it not heterogeneous?

If we were looking at a pinpoint little area, and it's all I was concerned about, isn't it going to be heterogeneous in nature?

DR. KREAMER: I absolutely agree with you. If you consider all scales, there's scales where it has to be heterogeneous.

JUDGE WARDWELL: And likewise, at a large enough scale, if we were trying to evaluate the total flow of water through all of Nebraska, isn't it also essentially homogenous at a certain scale? There is some scale where it will act like a homogenous material, will it not?

DR. KREAMER: Not as a function of scale, Your Honor. If you looked at a whole, big aquifer, and it might -- are you assuming non-fractured and equal thickness? Yes, maybe.

JUDGE WARDWELL: And it's a porous media.

DR. KREAMER: But, if you're assuming --

JUDGE WARDWELL: It's a porous media.

DR. KREAMER: If you're assuming a large scale for a homogenous isotropic aquifer over a large scale for equal thickness, same genesis, yes, you might be able to say that it's near homogenous isotopic.

JUDGE WARDWELL: If we pumped enough of

the Basal Chadron and did it at the same volume enough different places, it may very well act as the same analysis, have the same result for each of those? Isn't that possible at a largest enough scale?

DR. KREAMER: I think it's possible, but it's not in the data that we have seen.

JUDGE WARDWELL: Where in the process of pumping you basically average out all the heterogeneities?

DR. KREAMER: In some systems, yes. In this system, no.

JUDGE WARDWELL: Well, I guess I'll ask it another way. You agreed that at a very small scale it will be heterogeneous. As we increase that scale, such that we're influencing more of the given porous media, would not the heterogeneity drop?

DR. KREAMER: Well, it depends on the structure. If you have at a larger scale fractures and things like that -- I think your hypothetical said no fractures. And so, yes, we would be moving in that direction if there were no structural features. But, when you go to a larger scale, then you get structural things that make it just as complicated.

JUDGE WARDWELL: Yes. Yes. Okay, that's fine. That's giving me, I think, the feedback that I

need on this.

So, and returns to now entering in fractures, let's start off with very small, disconnected fractures within this. Then, wouldn't the one point analysis still be heterogeneous? And probably, as we increase the scale, it would stay heterogeneous until we got to some point where those little, small, disconnected fractures start acting just like porous voids, and we'd be back to homogenous type of a situation if we were at that large enough scale? Isn't that a fair assessment?

DR. KREAMER: It depends on the orientation of fracture aperture, and that sort of thing. But your basic thesis here is correct, that if you have enough fractures that are in great enough numbers, you can begin treating it with an analogy to a porous media?

JUDGE WARDWELL: Thank you.

And I think I'll leave it -- that sets some baseline. That whole section was just trying to get some base feeling in the record of what hydraulic conductivity does, how much it varies, and then, what are we dealing with with the heterogeneities that we have to deal with.

So, the first real topic that came up, it

was the inappropriate use of the Theis equations for leaky aquifer analysis. And in your rebuttal, OST014, Dr. Kreamer, at 2-3, No. 5, you state that, "CBR does not address the omission of other forms of pumping test analysis, nor does NRC staff require more scientifically appropriate analysis. A leaky aquifer evaluation of pumping test data was not performed. Standard analytical methods such as the De Glee method, the Hantush-Jacob method, and the Walton method, or numerical analyses, were not performed or the more appropriate approaches indicated from the observed data. Analysis with these other methods would be consistent with the lack of confinement indicated by the departure from the Theis curve observed during a solitary pumping test."

And I'm going to start off with Crow Butte, if I might. How difficult is it to do a leaky aquifer analysis as opposed to a traditional Theis analysis

MR. LEWIS: Bob Lewis, Crow Butte.

Your Honor, it's not overly difficult to perform a different type of analytical analysis based on a different conceptual model.

JUDGE WARDWELL: And one being a leaky analysis wouldn't be particularly difficult?

MR. LEWIS: No, sir.

JUDGE WARDWELL: Or more involved?

MR. LEWIS: No, sir.

JUDGE WARDWELL: And did you try a leaky analysis once you showed the deviations from the Theis curve that you did receive?

MR. LEWIS: No, sir.

JUDGE WARDWELL: And why didn't you?

MR. LEWIS: The aquifer, the overwhelming preponderance of evidence is that this acts as a confined system; that there's no significant leakage in this system.

I mentioned earlier this morning the fact that the currently operating mine has a radius of influence of 13 miles that encompasses the MEA. We have over 20 feet of drawdown historically that has occurred at the MEA due to pumping at the Crow Butte facility. That's inconsistent with a leaky aquifer. If we have a leaky aquifer, the radius of influence of a 200-gallon-a-minute withdrawal from this mine will be substantially less, even at a small leakage rate, substantially less than 5-7 miles. So, in my opinion, that conceptual model simply didn't apply to the MEA, and all the other lines of evidence that we discussed this morning concerning transmissivity variations

being the more likely cause of the deviations from the Theis curves.

JUDGE WARDWELL: Would the leaky analysis be able to filter out the transmissivity variations within this?

MR. LEWIS: I'm sorry, can you repeat that?

JUDGE WARDWELL: Yes. Would the leaky analysis allow you to filter out some of the transmissivity variations in the inherent solution to the equations associated with it? Or are they --

MR. LEWIS: I'm sorry, I just don't follow, Your Honor. I'm not sure what the answer to that is.

JUDGE WARDWELL: Well, why don't you repeat to me what you just said in regards to transmissivity? And maybe I misinterpreted what you were saying when I asked that follow-up question.

MR. LEWIS: With regard to transmissivity at what point?

JUDGE WARDWELL: It was your last sentence before I asked a question. You went on and on about the previous side, and then, you said, with the transmissivity variabilities we see within it -- or something to that effect. What was that sentence

again?

Do we have any abilities to read back his last sentence he said before -- or has that gone by the wayside with modern technology?

Do you remember what you said about transmissivity?

MR. LEWIS: I don't believe I mentioned transmissivity, Your Honor.

JUDGE WARDWELL: Okay. Well, we'll move on. Maybe it will come up.

But I'll ask another question anyhow. But, still, if it doesn't take any effort, and certainly looking at the Theis curve, you would say, well, geez, I wouldn't mind checking that out. You didn't feel a need to do that?

MR. LEWIS: No, sir. I think that the analysis should be consistent with the conceptual model of the system from all lines of evidence. And if I was doing a leaky aquifer analysis, that would suggest that it is a leaky aquifer, that that is what I believe that that's the way I'm doing this analysis. And there's no evidence in my mind, given the variation in transmissivity to the west of the pumped well, that explains the flattening of the curve that we see in monitoring Well No. 3. There's no concept

that I would want to apply a leaky aquifer curve to that.

JUDGE WARDWELL: But wouldn't you be interested in a sensitivity analysis to say, okay, I'm starting off with no leaks? Gee, why don't I throw in a couple of leaks and just see how sensitive the system is to various assumptions, to comfort myself that, yes, I'm pretty confident of my conceptual model? But if, all of a sudden, I found that if I changed the amount of leakage by a half a percent, and, all of a sudden, the transmissivities changes by two orders of magnitude, I'd be concerned about that, wouldn't I?

MR. LEWIS: Well, Your Honor, I don't believe the transmissivities would change by that magnitude.

JUDGE WARDWELL: No, what I'm saying, it's just that's what it would show you, though, wouldn't it? And why wouldn't -- isn't that kind of standard practice to do sensitivity analyses whenever you're doing any modeling?

MR. LEWIS: No, sir.

JUDGE WARDWELL: And this is essentially modeling.

MR. LEWIS: No, sir, not for this system.

This system has a lot of --

JUDGE WARDWELL: What do you mean by "this system"?

MR. LEWIS: This system, the production aquifer in this region has a lot of information that classifies it as a confined system. Again, the most convincing piece of evidence is that this mine has a radius of influence of more than 15 miles. It encompasses the entire MEA facility. If you have any small amount of leakage --

JUDGE WARDWELL: Okay. You don't have to repeat that. I understand that.

MR. LEWIS: Okay. So --

JUDGE WARDWELL: So, by the answer to my question of "this system," you mean the conceptual model that is built for the Basal Chadron all through this area?

MR. LEWIS: Absolutely. And the types of leakage that we're suggesting exist, if those did, in fact, exist, the radius of influence of this mine couldn't, would be nowhere near that size.

JUDGE WARDWELL: And how do you know that isn't going to take place at MEA if, in fact, with the given geological information you have there, and the analysis of the pump test analysis there, that the

sensitivity of that isn't a little bit different, if not a lot different, than what has been shown before? And it seems to me that it would be prudent to take a look at that sensitivity, wouldn't it? I mean, just to prove that "the system" is still functioning down in your new area as you apply your application? Wouldn't you want to know that, as a professional, in regards to, all of a sudden, seeing -- protecting yourself from any things that are more sensitive where you happen to be having them now have a lot of geologic information that was never had before with "the system"?

MR. LEWIS: Yes, Your Honor, I understand. We had a similar situation in the previous hearing with the flattening of the curves, and we discussed the various reasons for this and that type of analysis. There was a leakage analysis applied at that time, and the conclusion of the partners involved was it was due to variations in transmissivity. I agreed with that conclusion.

So, we're in the same basic regional system here at the MEA. I have a similar situation that I'm in. So, again, I'm saying I need to do a leakage analysis when I know that there's a transmissivity variation here that explains this

situation, and I know that the leakage in this system is very low because of the large radius of influence of this mine. And I haven't touched on the hydrologic impact assessment, which is consistent with that analysis of drawdown. We calibrated another model using the Theis methodology that fits the data. So, all things considered, Your Honor, I am not willing to do a leakage analysis of the system that I am convinced does not have a significant characteristic.

JUDGE WARDWELL: I'm pondering your words, because I see -- I have an uneasy feeling there's some circular reasoning in there that I'll have to just contemplate more.

Would staff like to comment on this?

MS. STRIZ: I believe that it is plausible, exactly for the reasons that he's stated; that if there was a recharge boundary, that you would have seen it, given the drawdown from the main facility.

Also, you would have seen it in this pumping test. It wouldn't have reached out 8800 feet, nowhere near it, for the short period of time, if there had been significant recharge.

Now I do have a little intellectual curiosity. So, I did look at it, but I looked at it

from a different angle in terms of I was struck by the fact that the wells that showed recharge were very close to the pumping well; that that feature only appeared on the wells that were close to the pumping well. Could there be something about the pumping well that was affecting this and making it look like there was a recharge boundary?

In fact, I looked at the data and determined that, if you fit later time, because of the impacts of the well being so efficient, which means it had a lot of drawdown just because of the way it was interacting with the formation -- so, there was extra drawdown with that. And also, the wells were so close, so they could have been infected by vertical flow effects due to just the interaction.

And when I looked at that, I found that there appeared to be well effects for about 800 minutes, and that fully developed radial flow, which is the one requirement of a Theis equilibrium, non-equilibrium test, is that you have to be in radial flow before you can fit the curve. And I determined that it should be fit to late time because the drawdown that you see at early is due to well inefficiencies. And if you fit it to late time, miraculously, it comes up with a transmissivity of

about 700 feet squared per day and a storage coefficient that is much more in line with what you see in the rest of the aquifer.

So, if you look at, in particular, graph C4 -- no, excuse me.

JUDGE WARDWELL: Speak into your mic, or look it up, and then, speak into your mic.

MS. STRIZ: If you look at C3, I mean, immediately when you look at it, the transmissivity is much lower.

JUDGE WARDWELL: You're speaking of --

MS. STRIZ: The Theis drawdown --

JUDGE WARDWELL: -- CDR008 --

MS. STRIZ: Oh, it's 0016.

JUDGE WARDWELL: Or just, no, 016? 016?

MS. STRIZ: Yes.

JUDGE WARDWELL: The pump test report?

MS. STRIZ: Yes, graph C3. The transmissivity is much lower and the storage coefficient is not reflective of a confined aquifer, because it's only .0017, when we should be around 1 times 10 to the minus 5th.

And if you fit to the later time data, where the effects of the well are not impacting the drawdown, you get a value of somewhere around 700 feet

squared per day, and then, 1 times 10 to the minus 5th.

So, that was just my quick-and-dirty analysis of the wells close by that, when you fit the later time data, when it's truly radial flow, not impacted by the well, you get values of transmissivity and storage that are much more in line with the others.

JUDGE WARDWELL: Mr. Back, did you want to say anything?

MR. BACK: No. I agree with everything she said.

JUDGE WARDWELL: Turning to Dr. Kreamer, which of your suggested methods -- well, first of all, are you suggesting --

DR. KREAMER: I'm sorry, could you speak into the microphone? I'm sorry to interrupt, but I can't hear you.

JUDGE WARDWELL: Okay. Are you suggesting that, in regards to the various methods, are there any others besides those three that you mentioned, and then, the general category of numerical analyses?

DR. KREAMER: Absolutely. Absolutely. There's ones that I didn't mention there. Essentially --

JUDGE WARDWELL: Now wait a minute. Wait. No, no, no, no. No, didn't ask any -- or you gave me the answer to my question. Okay?

DR. KREAMER: Okay. Sorry.

JUDGE WARDWELL: So, those are the three that you're talking about as regards to what you would use if you were evaluating this data? Is that what you were saying?

DR. KREAMER: No. Those are the first ones I would use. Those are the simplest ones.

JUDGE WARDWELL: Okay.

DR. KREAMER: It's like simple method 1, Theis; simple method 2, leaky aquifer. There are wedge-shaped aquifer equations that are analytical. There are a number of other analytical approaches that could be used. These are the two absolutely simplest ones that could ever be used. And to do leaky aquifer analysis, that's fairly straightforward.

JUDGE WARDWELL: And that's what you --

DR. KREAMER: I want to mention one other thing, Your Honor. They keep saying in this analysis that the reason why you have these diversions, these apparent leaks, is because of inconsistencies in transmissivity; that the transmissivity varies, variation in transmissivity.

That alone is the opposite of the assumptions with the methods they're using. The methods they're using, the simple analytical methods assume the transmissivity does not change.

JUDGE WARDWELL: And what are the assumptions -- and you're speaking that you said two equations, two different methods, but I'm looking at three, the De Glee method, the Hantush-Jacob, and the Walton method, are the ones you proposed.

DR. KREAMER: Yes. Those are the ones I proposed in writing. I could probably go into greater depth in other proposals or aquifers that are not exactly horizontal. There are analytical methods --

JUDGE WARDWELL: I'm not interested in that.

DR. KREAMER: I just went through the simplest ones.

JUDGE WARDWELL: You've got to be cognizant of our time element here, Dr. Kreamer.

DR. KREAMER: I'm sorry.

JUDGE WARDWELL: I'm not interested in what we could do if we were in some other universe or some other planet or even if we were in the good old State of Maine. I'm interested in what we are doing right here in Nebraska, if we might.

So, you've raised three, and let's tackle those three. And then, maybe we'll tackle the universe later. But, of these three methods, do you know what assumptions are inherent with their solutions?

DR. KREAMER: Similar assumptions to the Theis equation.

JUDGE WARDWELL: What did you say? You were cut out.

DR. KREAMER: A leaky --

JUDGE WARDWELL: Excuse me. Start again, because you were cut out with a keyword. You said something about the Theis equation.

DR. KREAMER: Similar assumptions to the Theis equation with the exception that you have an overlying or underlying strata that leaks water. And therefore, the response of the aquifer to pumping shows the sort of things we're seeing in the diversion in the data we're seeing now. In other words, the leakage --

JUDGE WARDWELL: Okay. So, you still have the assumption of homogeneity. You still have the assumption of infinite lateral extent. You still have the assumption of constant thickness. All of those still are in the equations you proposed. The only

difference would be the leakage? Am I correct in understanding that?

DR. KREAMER: Exactly. What I propose --

JUDGE WARDWELL: Okay. Thank you.

DR. KREAMER: -- is going from simple 1 to simple 2 --

JUDGE WARDWELL: What do you mean by --

DR. KREAMER: -- but I also mentioned numerical.

JUDGE WARDWELL: What do you mean by numerical analyses? Are you referring to a finite element or a finite difference? Or, I mean, the others do use numbers, don't they? So, they're numerical analyses. What's your definition of that?

DR. KREAMER: Probably in this sense, the standard is mod flow, which is a finite difference model. And specifically, Your Honor, what I'm referring to is, if you look at the -- a lot of mention has been talked about the Crow Butte site and the big cone of depression that comes off that, and how that is characteristic. But, again, they used the numerical number for the closure. And the closure couldn't use analytical models because the conceptual model was wrong. And so, they used many, many iterations of a numerical model, a finite difference

model, to try and characterize why they weren't able to clean up the site like they were going to --

JUDGE WARDWELL: Okay. Well, we're not up there. That's fine.

For the numerical analysis here, don't you have to assume homogeneity also with any numerical analyses, if nothing else, just within the size of the elements or the size of the space between the differences and the finite difference? There still is that assumption of homogeneity at a certain scale, isn't it, with those models?

DR. KREAMER: At a certain scale, yes. But the whole idea of a numerical model --

JUDGE WARDWELL: Okay. Thank you.

DR. KREAMER: -- is to get away from that. In other words, from the geophysical logs, you could actually specify where the silt layer, the silt stone layers were, where the channels, where the heterogeneities are, and you could, in a 3-dimensional model, you could actually map those out as well as you could from the geophysical data. So, the whole idea of a numerical model is to get away from homogeneity isotropic. But, if you go down to a very small scale of one node, yes, around that node you assume that there's homogeneity, but that would only --

JUDGE WARDWELL: Yes, but, even in between them, in between your data points where you have information from your geophysical work, you're going to have to assume that it's a linear relationship or some homogeneity associated with the in between where you don't have any data.

DR. KREAMER: You're correct in that, but I might point out that the abrupt changes we were talking about had two wells over a great, great distance and a change in the thickness. And whether that thickness changed abruptly or whether it changed slowly over between those two -- they were thousands of feet apart -- is something that we don't know, either.

JUDGE WARDWELL: Does the fact that an aquifer -- let me rephrase what I was thinking, you not hearing what I was thinking yet, but I'm rephrasing it anyhow.

(Laughter.)

Does the fact that the aquitard overlying a confined aquifer is leaky mean that there is no containment?

DR. KREAMER: You broke up just a little bit. Could you repeat that one?

JUDGE WARDWELL: Sure.

DR. KREAMER: The aquifer, the aquitard overlying it?

JUDGE WARDWELL: Does the fact at a -- now I can't remember what I said. Does the fact that the aquitard overlying an aquifer leaks mean that there is no containment within the aquifer?

DR. KREAMER: It depends on the configuration entirely. If there were a secondary porosity like --

JUDGE WARDWELL: Let me interrupt. I don't want to hear your -- I'm going to rephrase it for you, so I can make it quicker then.

DR. KREAMER: Okay.

JUDGE WARDWELL: I know there's always something that will say, yes, I mean that will say, yes, there is no containment. I'm going to go the opposite way. Is it always true that, no matter what, if the aquitard above an aquifer leaks to any degree, that there is no containment?

DR. KREAMER: No, minor leaks, we generally characterize it as contained.

JUDGE WARDWELL: Right. So, we're now talking about, we can agree that we're talking about the scale of the amount of leakage that's occurring in regards to whether it really is going to be considered

a leaky aquifer or a need for a leaky aquifer analysis. Is that a fair assessment?

DR. KREAMER: That's pretty fair, and in this case it's diversion of the Theis curve we draw.

JUDGE WARDWELL: Right, and that's part of it also. And the same thing with the Theis curve. Thank you.

Can you point to any evidence that shows that at the MEA site -- that's why I wanted to fix the first point, so we could now get on to the second point. Is there any evidence that you have, that you can point to, that shows that the leakage is so extensive at the potentiometric levels, does not rise to the aquifer and it actually becomes an unconfined aquifer? Do you have any data that you could point to or analysis that you have performed, or anything like that, that demonstrates that we've got that issue here at the MEA?

DR. KREAMER: You're talking about the Chamberlain Pass, the Basal Chadron, and that the drawdown is such that it becomes unconfined? We call that, actually, a semi-confined aquifer. And the answer to that is there's no evidence of that.

JUDGE WARDWELL: But that isn't what I was asking. I'm asking, do you have enough leakage that

is so extensive -- and maybe I'm using the wrong -- probably I shouldn't use the fact that the potentiometric level drops. But do you have any evidence that the leakage is so extensive that the impacts to control of the mining fluids within the MEA is made impossible, such that there would be uncontrolled migration of those fluids? That's probably a better way to word the question.

DR. KREAMER: The limited analysis that was done with Theis indicates that that's a possibility. As far as an assured possibility --

JUDGE WARDWELL: Excuse me. If I could interrupt quickly?

The limited analysis with what? I didn't catch that word. That's why I just wanted to stop you quickly.

DR. KREAMER: The Theis diversion indicates that it's a possibility.

JUDGE WARDWELL: Okay.

DR. KREAMER: It depends on the configuration, where the leak is.

JUDGE WARDWELL: Thank you.

Crow Butte, are you familiar with these other methods that Dr. Kreamer is proposing? And is it true that the only difference between those methods

and what you did use was the leaky -- I call it the leaky aquitard analysis.

MR. LEWIS: Bob Lewis, Crow Butte.

Yes, Your Honor.

JUDGE WARDWELL: And you agree with the statements he's made about those particular methods, including any statements he's made on the numerical analyses?

MR. LEWIS: Yes, I agree with the differences between the analytical and the numerical solutions.

JUDGE WARDWELL: Thank you.

And I'll turn to NRC staff. Who would like to answer that? Or say that you have no comments? Fine, too.

MR. BACK: David Back.

Yes, we agree and have no further comments.

JUDGE WARDWELL: Dr. Kreamer, in your Opinion 3 at 6 -- that's Exhibit 003 and, likewise, your rebuttal at 014 at 2, and it's No. 4 -- you made a following discussion about saying that -- no, I don't have the -- I'll go ahead with it.

You say, "A false argument is made for using only a Theis analysis of the pumping test. One,

that it is argued that it is" -- I believe it's the Applicant that you're referring to when you say, "It is". I believe it's the Applicant "argued that it is a standard method and that, two, almost everyone uses it in an analysis of a pumping test, no matter whether the assumptions associated with its use are violated at night" -- oh, "or not". And it is both the Applicant and the NRC because you cite to both in CBR001 at page 15 and 29 and NRC001 at 16 to 18 and page 26.

You go on to say that, "This false argument, consistent with the lack of confinement, is demonstrated by departure from the expected Theis curve from the single pumping test, coupled with low permeabilities observed in the strata and nearly overlying the Basal Chadron formation, are indicative of and consistent with the existence of secondary porosities and fracture flow. Robust fracture analysis has not been performed by CBR nor required by the staff."

And I think my question for you, Dr. Kreamer, is, with the stipulations that we had that the unconfined -- that the upper confining unit is 360 to 400 feet of clay-rich middle and upper Chadron confining units that underlie 350 to 500 feet of the

Brule Formation and 400 to 160 feet of the Arikaree Group, is not the upper confining unit encountered at depths of excess of about 390 feet, if you just add the 360 with what's available, with what's in the Arikaree Group? Is that about where those depths -- we're talking about 400 feet in depth or so where the --

DR. KREAMER: Are you talking depths or --

JUDGE WARDWELL: -- where the upper confining unit is?

DR. KREAMER: -- or thicknesses?

JUDGE WARDWELL: Sorry? I stepped on you.

DR. KREAMER: Depths or thicknesses?

JUDGE WARDWELL: Depth. The depths to it.

DR. KREAMER: The depths to it? I believe that's consistent with the data, yes.

JUDGE WARDWELL: Let me verify that with CBR. Is that about the depth of the upper confining unit? I think that's what I did with the stipulations that we had in regards to the thicknesses of the various deposits that I read off.

DR. KREAMER: You said "depths".

JUDGE WARDWELL: Right, the depth to it.

DR. KREAMER: Okay. Now you're saying "thicknesses". I misunderstood.

JUDGE WARDWELL: Do you agree it's about that deep? The upper layer of the upper confinement unit?

DR. KREAMER: I thought you were referring to the thicknesses, and I agreed with that.

JUDGE WARDWELL: Okay. And I'm just wondering if you have any evidence that shows there fractured groundwater flow through that 360-to-500, 450-foot-thick clay-rich upper confining unit that is at depths of 390 feet or more, besides those that you have already brought up. That is, not fitting of the Theis equations, et cetera. We've covered all of that, and I understand your position on that. I just want to make sure there isn't something else that you'd like to offer in regards to evidence of fracture flow at that particular depth of the ground.

DR. KREAMER: You're absolutely right, Your Honor; if you don't do fracture analysis and you don't look for it, you won't find it.

JUDGE WARDWELL: Okay. Thank you.

Crow Butte's rebuttal of that, 033, Answer 19 at 10, says, "Crow Butte used appropriate analytical techniques for such aquifers, but, nevertheless, was prepared to use more complex analytical techniques, had it been necessary. It was

not."

And I was just curious in regards to what complex analytical techniques you were prepared to use, Crow Butte, and what preparations you had made.

MR. LEWIS: Bob Lewis, Crow Butte, Your Honor.

The concept of using a numerical model had come up. In the event that there was extreme heterogeneity or there were some boundary conditions that were unexpected, those would be some things that you might want to go to another level to get a better handle on reasonable estimates for transmissivity in aquifer parameters. But, 7 out of 8 monitor wells fit the normal-type curve. I don't believe that type of level of effort is necessary.

JUDGE WARDWELL: Thank you.

Dr. Kreamer, your testimony, Exhibit 003 at 6, said, "Both mathematical forms of analyses" -- that is the Theis the Cooper-Jacob -- "are considered the simplest forms of an aquifer pumping test analysis. They require the same fundamental assumptions to be fulfilled for accurate results."

And I guess is, isn't it fair to say that the vast majority of groundwater analyses start with Theis-Cooper-Jacob solutions and only alter the

approach if the results point to a clear violation of the assumptions, especially when in regards to the techniques you, sir, pointed out have essentially all the same assumptions as does the Theis and Cooper-Jacob analysis?

DR. KREAMER: Your Honor, that would be accurate for well flow, but for contaminant flow it would not be.

JUDGE WARDWELL: In that previous reference that I made, you talked about a robust fracture flow, and in your rebuttal at OST Exhibit 014, page 2, No. 4, again, repeating "A robust fracture analysis had not been performed by CBR nor required by the NRC staff. Fracture flow would also diminish the value of spatially limiting monitoring wells in a shallow Brule Formation whose interpretation depends on homogeneous layers and not discrete fractures."

And I guess I'm just clarifying it. Are you also, in regards to those other methods, suggesting that a fracture flow analysis be used for interpreting the pumping tests, or is that not appropriate?

DR. KREAMER: It would help give insight into the results from the pumping tests from well

flow. I think it's appropriate in this case. We obviously have heterogeneities in the formation of interest that we all agree on in our writing. And so, I think it would be a robust fracture analysis would clarify all these things.

If one fracture were to come down in the middle of one of their arrays, the amount of water they're pumping in versus pumping out could be compromised, and that would mean that this 95 percent safety net that they have might not work. And that's why suggest the fracture analysis is important in this case.

JUDGE WARDWELL: And what type of fracture data is needed to analyze fracture flow in this, which is basically in bedrock as opposed to soil? You wouldn't do it in soil. Correct?

DR. KREAMER: That's a good question, Your Honor. Essentially, what you do is, through -- there's several different ways to do this. Certainly, geophysics can help you. Down-hole TV monitoring can tell you the aperture size and the orientation of apertures. By connecting up different wells and different bore holes, you can see if there's a continuity in fractures. That's sort of the first step.

Lineament analysis on the surface, looking for lineaments on the surface are sometimes indicators of fractures below. There's several different approaches to use, and this even includes satellite information and high-altitude photography.

JUDGE WARDWELL: And so, this seems more like a geologic investigation as opposed to -- a geologic scientific investigation as opposed to any type of one system -- I hate to use the word "system" -- one robust fracture flow analysis analytical solution type of approach? Is that what you're saying --

DR. KREAMER: Yes. Most --

JUDGE WARDWELL: -- that this fracture flow analysis that you're interpreting encompasses lots of different things that you had pulled together and, then, interpret in regards to what you believe to be the flow through that system?

DR. KREAMER: Analytical solutions do not usually consider fracture flow because it's not homogenous and isotropic, although these can be hugely important in different circumstances.

I guess if your question is whether this could be quickly and easily done, a first analysis or fracture analysis would be very helpful at this

particular site.

JUDGE WARDWELL: And where would you get this information on this fracture characteristics of it? I think you're talking the density of them and the gap sizes and any sediment in them, and the fracture connectivity, and things like that, I kind of heard you say. How is one to get that information?

DR. KREAMER: There's several different ways to do it. Probably the cheapest is aerial photography to start off with, looking for lineament analysis. And then, there is bore hole work. Just TV monitoring, you can sometimes see the orientation and the aperture size.

The next is packer testing where you pack off a fracture. You identify a fracture. You put essentially a big balloon above and below, and you can do a hydraulic test on just that fracture and see what the characteristics, hydraulic characteristics, of the fracture are by isolating it.

But, yes, you're right; we're in a realm now where homogeneous isotropic doesn't fit, analytical doesn't fit, and Spandex Fruit of the Loom one-size-fits-all does not work.

JUDGE WARDWELL: And with this done, then is there a commercially available software or program

or analysis technique where you feed in this data and, then, they're able, through some flow algorithm, determine the amount of groundwater movement through this fractured system?

DR. KREAMER: There are ways to do that, but what's typically done is you identify what looks to be a large fracture and you do a packer test on it, isolating it, and doing a hydraulic test or a dye-tracer test between fractures to get the hydraulic properties of that fracture. So, it's usually step 1, step 2, step 3 sort of analysis rather than -- although the programs will give you a general idea if you have good bore hole analysis.

JUDGE WARDWELL: And then, how would you separate that out from the -- maybe I'll go quickly. Do you agree that the Basal Chadron is a porous material as well as a fractured material?

DR. KREAMER: A what material? I'm sorry.

JUDGE WARDWELL: Does the Basal Chadron behave similar to our granites in the great Northeast part of this country? Does it have, still has a porous media associated through it, even though the sandstone may be fractured? Is not that correct?

DR. KREAMER: Yes, you can have what's called dual porosity, that is, and even triple

porosity in some cases, where you have fracture porosity and, then, you have matrix flow in the rock itself, where it invites water, sort of like blotting paper.

JUDGE WARDWELL: And so, in fact, if you're going to do this, wouldn't you consider the Basal Chadron and Chamberlain Pass Formation dual porosity, which I think people have brought up the primary and the secondary porosity of this unit. And I believe, were they not, referring to the porous fraction of the flow and, then, the fractured part of the flow?

DR. KREAMER: Yes, I think it would be appropriate in this case. And again, the fact that it's coarse-grained sandstone, it's indurated; it's got silt beds and clays of varying thickness. And we've all agreed on that. I think it's an indicator that that's something that ought to be done to see if there is potential risk.

Again, my concern with fractures is how it might upset the injection rates and things like that and alter the simplified version of the Theis; and secondarily, and importantly, the contaminant flow would be on a whole different level than just simple analytical models.

JUDGE WARDWELL: Okay. Thank you.

We'll move on a bit to 2.4, Opinion 4, "Homogeneity and Isotropic Assumptions". And I think we've covered most of this. This is kind of a repeat from -- we've touched upon this an awful lot. So, there's only a couple of questions I've really got on that.

And that is, your Opinion 4 states, "The second major assumption inherent in this analytical mathematical Theis approach employed in the MEA hydrology report is that the Basal Chadron aquifer is homogeneous and isotropic and of uniform effective thickness over an area influenced by the pumping. This foundation requirement is violated and it's not consistent with the data in evidence. And again, this fundamental condition of accurate use of the Theis methodology is presumed, but is inconsistent with the evidence."

And I guess, in regards to that, you have already testified that your other methods that you suggested, while they would cover the leaky aspect of that, they still wouldn't dodge the assumptions of homogeneity and isotropic conditions within that. Is that not correct?

DR. KREAMER: That is correct.

JUDGE WARDWELL: Yes.

DR. KREAMER: That is correct, Your Honor.

JUDGE WARDWELL: And your basis, you mention that the transmissivities range from 230 square feet per day to 1780 square feet per day, and the values of storage coefficient range from 1 times 10 to the minus 3 to 8.32 times 10 to the minus 5. And you're stating that these are not consistent with homogeneous conditions. Homogeneity also means that the thickness of the formation is uniform, and it is not.

Okay. Those questions we've already answered.

In your testimony on page 5 of Exhibit 003, you say, "There is a large difference in the magnitude of conductivity, indicating the complete lack of homogeneity in the likelihood of a preferential flow path." And I was curious on what's your definition of a large difference in conductivity. We've already talked about that. I think we're fine with that. I'm more interested in your definition of a complete lack of homogeneity.

DR. KREAMER: Sure. Homogenous, you have the same hydraulic conductivity in two different places. If you drill down through the formation that

we're interested in, the Chamberlain Pass-Basal Chadron, you will hit, you will go from sandstone, and you'll go to claystone. That's heterogeneity. Now that's the definition of heterogeneity. And it's extreme heterogeneity when you go to a claystone, you know, to a stringer of completely different material.

JUDGE WARDWELL: Okay. Thank you.

In your testimony, Exhibit 003, at 6, you say, "The first major assumption inherent in this analytical mathematical approaches employed in the MEA hydrology report" -- and that's CBR016 at 15 -- "is that the Basal Chadron aquifer is confined and has apparent infinite extent. The presumption by the authors is not consistent with the data in evidence. The main foundation for the analytical approach was presumed, but inconsistent with the test data."

And I said I guess the question I have for you, Dr. Kreamer, is, with geosciences, is not the consistency between professional interpretations and the data extremely subjective and varies widely with professional judgment of the individual engineer or scientist?

DR. KREAMER: Well, that's true. I think we all agree. Hydrologists on both sides agree. The other side clearly said that the differences in the

data were due to transmissivity variation. And transmissivity variation, by its very nature, violates the assumptions of the methods they used. And so, I think that they agree with me that they violated the assumptions in what they did, and by their statement that the transmissivity varies. So, I don't think we're in disagreement here. I think we're in disagreement as to they don't think that these variations in transmissivity are important and that they can be ignored, and it still does not invalidate the methods that they used, even though it violates the assumptions.

JUDGE WARDWELL: I'll turn to CBR. Do you believe that you don't think the variations of transmissivity are important and could be ignored?

MR. LEWIS: Bob Lewis, Crow Butte, Your Honor.

Variations in natural systems are expected. There is no perfectly homogeneous system, as we've discussed earlier. The variability we see is typical in natural systems. It's not unusual. I would say this system is unusually homogeneous for natural fluvial systems. The transmissivities, hydraulic connectivities don't vary by orders of magnitudes. They vary by factors of 2 to 5 to 7.

That's relatively homogeneous, in my opinion. So, for purposes of practical application and developing reasonable estimates, which is what our purpose is, is to develop reasonable estimates of transmissivity, aquifer parameters, boundary conditions, that the analytical methods that we are using are completely appropriate for that purpose.

JUDGE WARDWELL: Thank you.

NRC Staff, would any of you like to comment on that?

MS. STRIZ: Totally agree. There is really only one well that I pointed out earlier, which was monitor 3, which was only 100 feet from the pumping well that I think was impacted by the pumping well effects. And so, they should have analyzed later time, and if they had, they would have come up with a value of transmissivity and storage coefficient very much in line with the others.

JUDGE WARDWELL: Thank you.

MS. STRIZ: And I think that was the effect.

JUDGE WARDWELL: Can you pull up table 8, CBR016? That's the pumping test report, and it's figure 3.1 -- I mean on page 31.

And now, we would like that a bit bigger,

so people can see it.

Dr. Kreamer, can you see that table all right? It's table 8.

DR. KREAMER: It just came up as you asked the question. So, there's a delay on this side, but I now see it.

JUDGE WARDWELL: Okay. In regards to the drawdown analysis, the Theis drawdown analysis, under hydraulic conductivity, it appears to me, when I looked at that, that it varied from 6 to 45 feet per day, with one of them high and one of them low, and the other six pretty consistent. Do you agree?

DR. KREAMER: The print is a little small, but, yes, I can see that, Your Honor.

JUDGE WARDWELL: Okay.

DR. KREAMER: I agree.

JUDGE WARDWELL: And then, in the recovery analysis, the permeability, the hydraulic conductivity went from 6 to 62 feet per day, one high, one low, and seven pretty consistent.

DR. KREAMER: Yes, that's true. The transmissivity is orders of magnitude, but yes --

JUDGE WARDWELL: Right.

DR. KREAMER: -- in order of magnitude.

JUDGE WARDWELL: Yes, I was just looking

at the hydraulic conductivity.

Okay. Thank you.

DR. KREAMER: And the storativity is two orders of magnitude.

(Pause.)

JUDGE WARDWELL: I apologize for pausing here, but some of these we've already answered.

On CBR, your rebuttal, 001, not rebuttal -- it's your original testimony -- 001 at R1, at 30, "Hydraulic conductivity values near the pumping well" -- and that's CPW1A and CPW1 -- "and monitor 3 were approximately 3 to 9 times greater than the hydraulic conductivities estimated for other observation wells in the pumping test area. An apparent higher conductivity boundary condition effect in these wells was indicated by the flattening of the drawdown or recovery curves."

But isn't this just opposite of what you hypothesized for rationalizing the flattening of the drawdown curves that you set in the pump tests in regards to what's stated in CBR016 at 13, where it's just the opposite, isn't it?

MR. LEWIS: I'm sorry, Your Honor, I don't follow.

JUDGE WARDWELL: In your testimony on page

30 of Exhibit 001, you're saying that the conductivity values near the pumping well were approximately 3 to 9 times greater hydraulic conductivities estimated for other observation wells in the pumping test area. You finish it off by saying, "An apparent higher conductivity boundary condition effect in these wells was indicated by a flattening of the drawdown and recovery curves."

It seems to me that what you said in your aquifer report, CBR016, at 13, says just the opposite in regards to interpretations of, I believe, the flattening. Do you see that?

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: Yes, sir; no, sir, or what did you --

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: Okay. So, I'm asking -- I'm at a bit of a quandary with that.

MR. LEWIS: I believe there may be a misstatement in terms of the hydraulic conductivity variability in that case. There is a lower permeability zone in the vicinity of the pumped well, is the intention of the statement.

JUDGE WARDWELL: Thank you.

NRC, in your rebuttal, 014, Answer 23 at

27, you state that the second assumption Dr. Kreamer questions is that "the aquifer is confined of an apparent infinite lateral extent. By definition, the Basal Chadron aquifer is a confined aquifer because, as explained in Answer 21 of our initial testimony, it's potentiometric surface rises above the top of the elevation of the aquifer."

And I guess a question for NRC is, is a confined aquifer necessary for operation of an ISR facility?

MS. STRIZ: No, it's not necessary, but it's preferred.

JUDGE WARDWELL: Is it a confined aquifer sufficient for the operation of an ISR facility?

MS. STRIZ: If it has sufficient transmissivity and doesn't have other features would cause a safety issue.

JUDGE WARDWELL: Not every confined aquifer is sufficient for operation of an ISR facility, then, if you've added these other caveats?

MS. STRIZ: Yes. I mean, if there's other issues that are unrelated to its transmissivity, it doesn't matter whether it's confined or not.

JUDGE WARDWELL: Thank you.

Yes, we've covered the infinite lateral

extent. Good shape.

CBR006, the Technical Report, Section 3.1.7, at 3-25, says, "As a conservative measure, the maximum groundwater velocity was computed using maximum reserve values for hydraulic conductivity of 61.7 feet per day and a hydraulic rating of 0.00048."

And I was curious as to what was the source of that value of hydraulic rating for the Basal Chadron and Chamberlain Pass Formation.

MR. PAVLICK: Doug Pavlick.

We'll need some time to answer that.

JUDGE WARDWELL: Sorry?

MR. PAVLICK: Could we have some time to --

JUDGE WARDWELL: Oh, yes.

MR. PAVLICK: -- answer that later?

JUDGE WARDWELL: Tomorrow or whatever, yes.

MR. PAVLICK: Thank you.

JUDGE WARDWELL: No problem.

We've got about, I think, a half-hour left to finish up Concern 2. Do you want to take a quick break now or plow on through? Because, then, once we get --

CHAIR BOLLWERK: If we plow on through, we

will take a break, then, while they do their potential cross-examination or additional questions. So, maybe that's better, yes.

JUDGE WARDWELL: Sure.

CHAIR BOLLWERK: And then, everybody can -- we'll take a break and do the questions.

I think Judge Hirons may have a couple of questions when you're done.

JUDGE WARDWELL: Sure.

Section 2.5, Opinion 5, is Analysis for Anisotropy where Dr. Kreamer challenged -- "The rigorous analysis of anisotropy were not demonstrated and undertaken for the EA or the hydrologic report, and the nature of directional hydraulic conductivity differences remains undefined and not quantified, particularly in the vertical direction."

Dr. Kreamer's testimony, at page 7, is saying, "Regarding to the lack of rigorous analyses for anisotropy, the Applicant, in its aquifer pumping test report, CBR016 at 18, with the acceptance by the staff's EA," referencing NRC006 at 70 and 255, "argue that no anisotropy exists in the small area of the MEA which underwent a pumping test, and it was based on a two-dimensional hand-drawn visual rendering with a few data points," referencing CBR016 at 48, "rather than

a standard serious data evaluation-based" -- yes, "a serious data-based evaluation. This is not consistent with the professional practice."

CBR rebuttal at 033, Answer 23 at 12, says, "The cone of depression at the end of the pumping test shown in figure 16" -- that's CBR016 at 48, and if we could pull that up, Joe, I'd appreciate it -- "utilized drawdown data from all monitoring wells. More detailed analyses of anisotropy are not necessary, given the lack of conceptual basis and the geometry of the depression cone."

And that's what we're looking at here in figure 16 on page -- and that is, yes, that is 48. And I'd just verify with Crow Butte -- yes, I don't have to. It says right there "figure 16". So, that is the figure you were referring to in your rebuttal, is that not correct, Crow Butte? Sorry, I need to look at you.

MR. LEWIS: Yes, sir. However, it's not hand-drawn. It's a computer diagram.

JUDGE WARDWELL: Okay. And how were those drawn? Are they least-squares to describe it? Was it a software? How was that created?

MR. LEWIS: They were created with a computer software program, Surfer.

JUDGE WARDWELL: Surfer? That's what you used? Yes?

MR. LEWIS: Yes, sir.

JUDGE WARDWELL: And how many data points do you have here? How many wells are you using? It's shown in green, right?

MR. LEWIS: I believe that's 11, Your Honor.

JUDGE WARDWELL: What's that?

MR. LEWIS: I believe that's 11 data points.

JUDGE WARDWELL: Do you have any analysis that demonstrates, with that range of wells, that you've got the accuracy to justify the position that anisotropy doesn't exist? Basically, I'm asking, what's the sensitivity of those contours, and could there not be more of an elliptical shape presented in there that didn't use least-squares or some designated algorithm, but, yet, could still match those contours, that would show some anisotropy?

MR. LEWIS: Your Honor, I believe you could use different contouring algorithms and get the same result. It's non-biased. It's not a hand-drawn diagram. So, there's not an inherent bias in the way those contours are drawn. So, my opinion would be,

no, it doesn't demonstrate anisotropy with a different gridding method.

JUDGE WARDWELL: And so, if I hear you correctly, then, you haven't performed any analysis to demonstrate that the number of wells or other data points are sufficient to provide the accuracy that you need to detect anisotropy? You just --

MR. LEWIS: No, I --

JUDGE WARDWELL: The program did its thing, and you said there's not much, if there is? I mean, there's a little egg-shape, but not much.

MR. LEWIS: Yes, sir, I did no other analysis.

JUDGE WARDWELL: I'll turn to Dr. Kreamer. Do you think their computer-drive plot -- I'm not saying you have to agree with the plot. I just want to say, if that plot was truth, do you think it shows anisotropy as drawn? Simply yes/no.

(No audible response.)

Can't hear you.

CHAIR BOLLWERK: Dr. Kreamer, can you hear us?

DR. KREAMER: I'm sorry, I muted. I muted, so I wouldn't have any background noise. I apologize, I didn't unmute.

JUDGE WARDWELL: Shame on you. That has never happened to any of us.

(Laughter.)

DR. KREAMER: It might be a more pleasant inquiry if I muted the whole thing.

(Laughter.)

But, in answer to your question in your hypothetical if this is an accurate representation, it looks fairly, it looks fairly isotropic, at least in the horizontal plane.

JUDGE WARDWELL: Would you like to comment more or just in regards to your professional opinion in regards to the wells and their distribution and the accuracy of that plot?

DR. KREAMER: Absolutely. There are three elements here that indicate that it may not be sufficient. The first is the number of wells. Statistically, that's a pretty low number.

Secondly, we just a second ago looked at the different hydraulic conductivities and the variation in transmissivities in different directions, and that indicates a certain amount of lack of isotropy. That, in itself, is an indicator of anisotropy.

But I think, importantly, if you go back

to the Crow Butte data and the pumping tests there, it's documented in the Crow Butte pumping test that they did have anisotropy. I think everybody was in agreement. There were two tests that showed definite anisotropy and, in fact, there was anisotropy in two different principal directions in the test at Crow Butte. So, the third line of evidence that there's a possibility of anisotropy comes from previous pumping tests over at Crow Butte.

But, if you just looked at this, it looks isotropic if you hypothesize that this is correct.

JUDGE WARDWELL: You mention that the numbers and the spacing of wells or something led you to believe there was some -- oh, no, it was -- I'm sorry -- it was your reviewing of the transmissivity values that you say demonstrated some anisotropy. And yet, I was wondering, I assume you mean that it's only some anisotropy in a directional sense, and not a vertical sense, because we didn't really have anything to resolve the vertical sense of that, did we?

DR. KREAMER: No, we did not.

JUDGE WARDWELL: Were you referring to some type of directional and, then, if so, what direction was it?

DR. KREAMER: Again, high-resolution

vertical sampling would have been able to tell us that, but we had screens that were fully penetrating. And so, therefore, these are averages of the heterogeneous aquifer. And so, no, we don't have any vertical information in this particular representation.

JUDGE WARDWELL: Right. And so, when you referred beforehand to the transmissivity values, you were referring only to directional, the horizontal directional, the XY, if you will, directional anisotropy, and not a vertical, because, as you say, you have no information for that?

DR. KREAMER: That is correct. That is correct, Your Honor.

JUDGE WARDWELL: Yes.

DR. KREAMER: And the hydraulic conductivities as well.

JUDGE WARDWELL: Did you see any -- what were the orientation of the primary axes in regards to those values that you look at in the table?

DR. KREAMER: Oh, in Crow Butte, they were actually almost in 90 degrees --

JUDGE WARDWELL: No, here. Here, here. Here, here. I'm not interested in -- if you mean Crow Butte, you mean the existing facilities. No, I'm

interested in the -- you said you looked, you saw the table of transmissivities that we had up there from --

DR. KREAMER: Yes.

JUDGE WARDWELL: -- the MEA that created this map that we're looking at here. Or were from the same MEA location as this map. And so, I was curious as to whether -- you said you saw some anisotropy and it's directional. I'm interested in what is the orientation of those axes of the anisotropy.

DR. KREAMER: I did not do analysis as to where the principal directions were. I considered this not enough data. But, if you look at the hydraulic conductivities for these different wells that are listed here, the hydraulic conductivities do vary and they're not the same directionally. But I didn't do analysis of the principal directions. I just thought that this was too sparse data. There's a paucity of data here, and I think the results would be suspect. I could do a principal direction analysis if you would like.

JUDGE WARDWELL: The NRC rebuttal at 014, A-24 at 29, "Similarly, if there's a significant anisotropy within a production zone, such as a large difference in directional conductivity" -- that's KX/KY -- "the aquifer test will show on elliptical

drawdown. As discussed in A-23 above, that was not apparent for the MEA aquifer pumping test. Finally, if vertical anisotropy exists within a production zone in an aquifer, that is KX and KY are greater than KZ, that is considered beneficial for ISR operations because it creates preferential horizontal flow."

I'll ask NRC, is anisotropy common in sedimentary rocks?

MR. BACK: Yes, Your Honor.

This is Dave Back.

JUDGE WARDWELL: And wouldn't it have to be pretty extensive anisotropy really to show up in the drawdown curves, given the limited number of wells?

MR. BACK: Yes, Your Honor. And moving away from the well, even if you have partially penetrating wells, like what CTS did, you lose the anisotropy effects in the horizontal direction.

JUDGE WARDWELL: Thank you.

Back to Dr. Kreamer. Do you believe that anisotropy is common in sedimentary rocks, the vertical --

DR. KREAMER: Yes, and particularly in this case. You talked about vertical. If we were to just look at the well logs where you have lenses of

clays and other things like that, that is a vertical anisotropy. So, there is vertical anisotropy, according to the well log data, although you couldn't tell it from this data here.

And also, there are geologic processes for how this was laid down. The genesis of this, a very common thing in streambed flows is imbrication. Should I explain imbrication?

JUDGE WARDWELL: Sure.

DR. KREAMER: Okay. If you have elongated particles in a streambed and the stream is flowing in one direction, they will lay down preferentially in layers pointing in a direction of the stream flow. So, imagine a lenticular pebble of some kind and a series of these. They would lay down not quite horizontally, but at a little bit of a slant in the direction of flow. That's called imbrication. That gives anisotropy usually greater horizontal hydraulic conductivity and less in the vertical direction.

Also, because of these layers here, you would expect maybe a horizontal conductivity to be an arithmetic mean; whereas, you would expect a vertical hydraulic conductivity to be a geometric mean.

JUDGE WARDWELL: Okay. Thank you.

If the horizontal was, in fact, greater

than the vertical, wouldn't you believe that to be an asset in controlling the lateral migration of production fluids during the mining operation?

DR. KREAMER: It would depend. Or are you speaking to me, Dr. --

JUDGE WARDWELL: Yes, I am, sir.

DR. KREAMER: Yes. Okay. I'm sorry.

It would probably bring more things vertical. It depends on how consistently horizontal the clay lens is, and things of that sort. Obviously, if they vary, it would not be, but that -- we're talking about well production; we're not talking about contaminant flow. The heterogeneities could greatly impact preferential pathways in a horizontal direction.

JUDGE WARDWELL: Okay. Thank you.

2.6 --

CHAIR BOLLWERK: Can I ask one question before you move on?

JUDGE WARDWELL: Sure.

CHAIR BOLLWERK: So, in BRD001, at 3 and 4, we had defined a number of terms. Anisotropy was not one of them. Is that something we need to think about or is that not critical?

JUDGE WARDWELL: Have we defined isotropy?

CHAIR BOLLWERK: So, it's just the opposite of? I see. All right, all right. You just defined it then. Thank you.

JUDGE WARDWELL: Did I define that correctly, Staff?

MS. STRIZ: Anisotropy -- so, if something is isotropic, at a point all the vectors, KX, KY, and KZ, will be equal, and if it's homogeneous, they will be equal in different locations. So, homogeneous and isotropic, all the vectors are equal.

JUDGE WARDWELL: I think what Chair Bollwerk was asking was -- we haven't defined anisotropy. We defined --

MS. STRIZ: Anisotropy, at a point, is where KX is different than KY --

JUDGE WARDWELL: Is where their --

MS. STRIZ: -- and different than KZ.

JUDGE WARDWELL: -- properties are different directionally?

MS. STRIZ: In different directions.

CHAIR BOLLWERK: We didn't define isotropy, either.

JUDGE WARDWELL: Okay. So, if we're going to define isotropy, then the variation in parameters in direction are zero, that they're all the same.

There are similar properties in all directions. Now did I define that correctly, Staff?

MS. STRIZ: Yes.

JUDGE WARDWELL: CBR?

MR. LEWIS: Yes.

JUDGE WARDWELL: Mr. Wireman, would you agree that we've defined isotropy, so that I don't go through the system --

MR. WIREMAN: Yes, I agree.

JUDGE WARDWELL: Anisotropy is the opposite. Okay. Good. Thanks.

MS. STRIZ: I would like to correct Dr. Kreamer. If it's vertical anisotropy, it's a harmonic mean, not a geometric mean, that's used to create the average conductivity through vertical layers.

JUDGE WARDWELL: And, Dr. Kreamer, would you have any comment on that? Or is that a nice fine-tuning of your statement?

DR. KREAMER: I'll accept that for now, but there are several textbooks that treat layered systems as geometric means. But I know where the doctor is coming from, and I will accept that modification at least now.

The point is the scale. If you take one individual clay layer, it is homogeneous -- I mean,

it's isotropic, because at that point it's isotropic. But, if you take the whole system, the vertical and horizontal conductivities are different. So, it's anisotropic. There's anisotropy when you look at the entire system.

JUDGE WARDWELL: But you do accept her position as stated, as you mentioned earlier? And while you might accept it, I don't, and I expect the two of you to be out here Saturday morning with dueling slides rules to resolve this thorny issue of harmonic versus the -- what did you say it was, Dr. Kreamer? Regardless --

DR. KREAMER: Geometric.

CHAIR BOLLWERK: Talk to the right crowd. Most of these folks probably know what a slide rule is.

(Laughter.)

JUDGE WARDWELL: Yes, that's right.

Okay. 2.6, Opinion 6, Discontinuity in the Basal Chadron Thickness. We have covered that before in depth.

2.7 was Opinion 7, Analyzing Selected Pump Test Data. We've addressed that.

And that brings me to a close of the questions I had on Concern 2.

CHAIR BOLLWERK: All right. Judge Hirons, you said you had a couple of questions?

JUDGE HIRONS: I have a couple of questions for Mr. Wireman.

The license condition 10.1.6 requires that an inward hydraulic gradient within the Basal Chadron sandstone be maintained during operation. Do you agree with that statement?

MR. WIREMAN: Could you read it again? I'm sorry.

JUDGE HIRONS: The license condition 10.1.6 requires that Crow Butte maintain an inward hydraulic gradient within the Basal Chadron sandstone when operating.

MR. WIREMAN: On a mine unit basis, yes.

JUDGE HIRONS: I'm sorry, on a?

MR. WIREMAN: I said on a mine unit basis, yes.

JUDGE HIRONS: Okay. Thank you.

I lost my place.

In Section A10 of its rebuttal testimony, the staff states that, "Any heterogeneity in the overlying aquifers is not germane to the confinement of the Basal Chadron sandstone." Do you agree or dispute that statement?

MR. WIREMAN: I don't think that's a black-and-white statement. I would say it depends. And I apologize for that answer, but it's not black and white.

JUDGE HIRONS: Okay. Thank you.

CHAIR BOLLWERK: Anything else?

JUDGE HIRONS: No, that's all I have.

CHAIR BOLLWERK: All right. I just had one question, and mine's for Mr. Lancaster. I want to get some clarification for a second.

You mentioned about, talked about the requirement for additional pumping tests and possibility of license conditions that could follow from that. And you kind of indicated that the license conditions would be imposed as appropriate. So, what kind of appropriate license conditions might follow from that?

MR. LANCASTER: Well, what I said was a license amendment would be required, according --

CHAIR BOLLWERK: A license amendment. I'm sorry, did I say --

MR. LANCASTER: Yes.

CHAIR BOLLWERK: That might result in a license condition or --

MR. LANCASTER: No, it's a license

amendment.

CHAIR BOLLWERK: You would actually amend the license?

MR. LANCASTER: They would have to amend the license if they want to operate in that mine unit.

CHAIR BOLLWERK: Let me circle back then. They would come to you and ask for a license amendment, which you would then grant? Is that the right process?

MR. LANCASTER: We would --

CHAIR BOLLWERK: I'm a lawyer, so I'm trying to --

MR. LANCASTER: It would be required per the license, License Condition 9.4 specifically.

CHAIR BOLLWERK: So, what kind of amendment would they ask you for, if they were -- I recognize that there's a lot of things that could go wrong, but what kind of things, in your experience, have you seen that they might come and ask for in terms of this license, based on the pumping tests that were run?

MR. LANCASTER: Well, if conditions are such that, you know, these wellfield packages that are submitted later after the license, right, has been issued -- and it has been issued -- these wellfield

packages, if in our review we find an issue that is a potential safety issue, that's where this would play in. And in order to proceed, they would have to amend the license to show that it's going to be a safe operation.

CHAIR BOLLWERK: Okay. Well, let me ask two questions. And if you need to talk with one of your lawyers, you can certainly do that. But I take it that we're talking about a license amendment and there are hearing rights that apply to license amendments. Would that be one of those instances? Wouldn't that would be the case?

MR. LANCASTER: That would be the case, from my understanding with talking with my lawyers. They can certainly chime-in, if they would like.

MS. SIMON: Your Honor, this is Marcia Simon.

Yes, license amendments in these cases are subject to request for hearing.

CHAIR BOLLWERK: All right. Then, I guess my second part of my question, then, is, for instance, could the NRC put a condition on their ability to operate within the new well area that they're trying to open up that, basically, says, no, you can't do that because there's a problem here?

MR. LANCASTER: Well, if it is shown to be that their new amended plan to operate is shown not to be safe -- and there are various options for NRC to make it so that they don't operate there. And one of those is an order from NRC. You know, if it's not going to be safe, they will not be able to operate in that mine unit, at that mine unit.

CHAIR BOLLWERK: And then, there could be other things besides that? That would be the ultimate, I guess, license condition in terms of their ability to operate, but there could be other things that could be imposed as well?

MR. LANCASTER: Yes, sure. Sure. You know, this would go into a very detailed technical review, and additional license conditions could come out of it specific to that mine unit or mine units, depending on what we're talking about. I mean, we could speculate here about various things that could happen, but it would be a review like this, a very detailed review.

CHAIR BOLLWERK: And in your experience, or the experience of any of the NRC staff witnesses, has there ever been an instance where you've actually told them they cannot, any of the ISR operators, that they cannot operate a particular mine unit, based on

these tests?

MS. STRIZ: I'm not aware of any, but I recently had a review where I did not license one particular mine unit because it was not fully characterized.

CHAIR BOLLWERK: All right. Thank you very much.

At this point, let's go ahead and give you all -- it's right at about 10 'til 5:00. Is 15 minutes enough time for your questions? All right. So, let's say about, let's say 10 after 5:00 maybe, to throw in an opportunity for a quick break.

So, we'll say 10 after 5:00, we would like to have any proposed questions back. We'll, then, take a quick look at those, and hopefully, come back probably promptly with any additional questions we need to ask. And then, I take it tomorrow we'll start with Concern No. 1. Does that make sense? All right.

JUDGE WARDWELL: It makes sense to me.

CHAIR BOLLWERK: All right. Unless anybody has another -- so, why don't we take a break until 10 after 5:00, and we'll be back then.

JUDGE WARDWELL: The only thing I would like to add, before I forget it, is that, starting tomorrow -- starting tomorrow -- I'm going to start

with Mr. Wireman as the second half of Concern 1, rather than Dr. LaGarry, just because Dr. LaGarry doesn't want to be anywhere but right here, and Mr. Wireman will not be here on Thursday, is my understanding. So, I want to make sure I get through his before I come back to you for Concern 1 later in the day.

MR. WIREMAN: Thank you for doing that, Your Honor. I appreciate it.

CHAIR BOLLWERK: All right.

DR. KREAMER: May I say something, too? This is Dave Kreamer.

CHAIR BOLLWERK: Yes, sir?

DR. KREAMER: I haven't even told my lawyers this, but my class tomorrow starts at 11 o'clock Pacific time. If you need me to be present video-wise, beginning through noon your time, I can be there before I go to class. We've already arranged that I'll be here for Thursday, and if you need me Wednesday morning, I do not teach -- I don't have to leave for class until 11 o'clock Pacific time.

CHAIR BOLLWERK: So, that would be 10 o'clock.

JUDGE WARDWELL: Noon. Noon here.

CHAIR BOLLWERK: Noon here? It's really

up to you.

Go ahead.

JUDGE WARDWELL: The answer to that, I think it would be advantageous for your party to be here, if you can, to comment on what Mr. Wireman's going to say. I don't have any questions for you directly, but, yet, there may be times, based on just normal operations, that you may have something to be able to contribute, and that's what we're here for.

DR. KREAMER: Okay. Well, Joe, if there's a different hookup for the technical part, please email me and let me know. I'll plan on being ready to go video-wise at eight o'clock.

And again, thank you for all the hooking me up with the audio here. It's not been easy, I know.

Thank you, Joe.

CHAIR BOLLWERK: All right. So, we'll take our break. The proposed questions, if any, will be presented to the Board at the end of it.

Everybody, the witnesses please stick around because who knows what will come out of that. So, we're not quite done yet.

Let's take a break.

(Whereupon, the above-entitled matter went

off the record at 4:52 p.m. and resumed at 5:17 p.m.)

CHAIR BOLLWERK: Why don't we go back on the record, please.

We're back after a brief break, and the Board has looked at the questions that were submitted, the proposed questions for the Board to ask that were submitted by the NRC staff and by the Oglala Sioux Tribe.

Before we proceed to those, however, I think we have an update from Crow Butte Resources about one of the questions that was sort of left in the -- what's the best way? I don't know.

MR. SMITH: Yes, Your Honor. This is Tyson Smith for Crow Butte.

And the question involved page 3-25 of Crow Butte Exhibit CBR006. There's a sentence that says, "As a conservative measure, the maximum groundwater velocity was computed by using the maximum observed values for hydraulic conductivity and hydraulic gradient, identified from baseline sampling and aquifer testing at MEA."

And Mr. Lewis here is going to explain the basis for that calculation.

MR. LEWIS: Your Honor, the 61.7 feet per day comes from the maximum transmissivity at monitor

well No. 2 during the pump test of 2469 square feet per day transmissivity, which was the maximum; average thickness of 40 feet over the aquifer gives 61.7 feet per day for the hydraulic conductivity.

The gradient, hydraulic gradient of .0048, was from the figure 14 of that reference, the pre-monitoring baseline water levels for the Basal Chadron aquifer, .0048 for the gradient.

CHAIR BOLLWERK: All right. Anything further?

(No audible response.)

All right. Thank you very much for your providing that information.

Let's move to the questions. And since Judge Wardwell has been the question person today, we're going to go ahead and let him ask the ones that the Board has decided to put forth.

Go ahead, Judge Wardwell.

JUDGE WARDWELL: Okay. I'll start off with asking the staff, does demonstrate containment in the Basal Chadron and Chamberlain Pass Formation mean that contaminated fluids cannot migrate to unwanted places?

MR. BACK: Yes, Your Honor.

JUDGE WARDWELL: Okay. Thank you.

Would you like to elaborate a little more or?

MR. BACK: Yes. It's constrained in the vertical direction, and it will be confined in the lateral condition, lateral due to the inward hydraulic gradients.

JUDGE WARDWELL: Doesn't that mean, if you answer yes to that question, doesn't that mean you would never get an excursion anywhere?

MR. BACK: Keep in mind, the excursions are still within the exempt aquifer. And so, when the staff looks at this, excursions are part of the program. They're not considered a spill or a release. And so, yes, it's unwanted to have an excursion, but it's not considered completely beyond the operations of the mine, of the facility.

MR. LANCASTER: Yes, and, you know, they are required to correct these excursions within the excursion monitor --

JUDGE WARDWELL: And this is Mr. Lancaster, is that correct?

MR. LANCASTER: This is, yes, Mr. -- yes.

JUDGE WARDWELL: Yes, I just wanted to verify that.

MR. LANCASTER: Right. No, no, no, I

understand.

JUDGE WARDWELL: You're not the first to forget.

(Laughter.)

Go ahead.

MR. LANCASTER: Well, you know, under license, they are required to monitor and detect the excursions down in, laterally, down in the Basal Chadron sandstone aquifer. And so, when they do detect it, they're also required, then, to increase the monitoring and go into corrective action by adjusting their pumping rates and their injection rates, and that has always been successful. So, excursions detected have been corrected. There's a history in all of our facilities, shall I say, that these excursions are corrected, and that program, you know, would make it so that excursions don't go outside of the license boundary.

Also, as required by the license, they're required to maintain an overall inward hydraulic gradient at the mine units. So, laterally, we don't expect excursions to be a problem. And vertically, I'm sure we'll get into this more, but we have this downward hydraulic radial and we've got confining units that are shown to be very confining.

JUDGE WARDWELL: Thank you.

MR. LANCASTER: Yes.

JUDGE WARDWELL: CBR, would you like to comment on those that demonstrate a containment in Basal Chadron, meaning that containment fluids cannot migrate to unwanted places?

MR. LEWIS: Yes, I agree with that interpretation.

JUDGE WARDWELL: Thank you.

And have you investigated likely flow patterns and/or preferential pathways along which contaminants may move, based on the results of the aquifer pumping tests? This is for Crow Butte.

MR. LEWIS: I have not from the results of the pumping test analyzed flow paths from the mine. That wasn't part of the analysis of the pump test.

JUDGE WARDWELL: And then, what would happen if, in fact, some of the mining fluids starting running through a preferential pathway, resulting in contaminants moving beyond what you anticipated them to move beyond?

MR. LEWIS: Hypothetically, if there was a loss of containment along a preferential pathway, that would be detected by the monitor well network, and as previously explained, it would increase the

pumping rate, pull that excursion back into the wellfield as part of their license condition.

JUDGE WARDWELL: And I'll repeat the question for NRC. Does NRC staff evaluate preferential pathways based on aquifer characteristics demonstrated by the aquifer pumping test?

MR. BACK: David Back.

No, Your Honor.

JUDGE WARDWELL: Thank you.

For the Oglala Tribe, you mentioned the use of mod flow as a numerical approach. Does mod flow simulate groundwater flow and contaminant transport through fractures?

MR. WIREMAN: Mod flow -- this is Mike Wireman -- mod flow has the capability to link groundwater flow with transport and fate of contaminants. That can be done. So, it's a linkage, two sort of separate models, but they're linked together. And so, the outcome of those models addresses both of those. So, the answer is yes. You can put layers in mod flow that are clearly characterized by preferential flow.

JUDGE WARDWELL: So, they would be characterized as fractures?

MR. WIREMAN: You could -- yes, it could

be fractures or other types of preferential flow.

JUDGE WARDWELL: How do the variability and aquifer thickness and transmissivity values affect CBR's or Crow Butte's ability to maintain inward hydraulic gradients, as required by License Condition 10.1.6?

MR. WIREMAN: Inward flow can be maintained within a mine unit scale. The issue we have has to do with the entire MEA area. And as you move progressively from one mine unit to the next, and you're done maintaining that gradient in the previous mine unit, within that mine unit that's done, there is still groundwater that has concentrations of contaminants greater than you want.

And the concern, then, is that those can move, and they won't be caught by the inward gradient of the active mine unit, or they could go beyond excursion monitoring in a preferential flow path and not be detected. And that movement is controlled by both the properties of the contaminant and the properties of the geologic material, including the hydraulic properties, transmissivity, and other storage coefficients, and all of those. So, yes, there is a control there.

JUDGE WARDWELL: Thank you.

In Answer 18 of its rebuttal testimony -- and that's Exhibit NRC014 -- the NRC staff identified three plausible explanations for deviations of the late time data. I think we talked about these and the Theis curves. And these include the increased transmissivity, which was Crow Butte's explanation; release of waters from storage, and then, well bore storage or near well bore effects. Do you dispute that the explanations identified by the staff are plausible?

MR. WIREMAN: No, I don't dispute that they're plausible.

JUDGE WARDWELL: Thank you.

Do you agree that the pumping well in an aquifer test can affect drawdown in close observation wells?

MR. WIREMAN: Yes, with the caveat that you have to define "close". Depending on the aquifer you're testing, close may be 10 feet or it may be 100 feet. So, that's kind of a gray area. Clearly, bole hole effects and pumping effects can have an effect on the aquifer for some distance out, but that distance is very site-specific.

JUDGE WARDWELL: Thank you.

Do you agree that such pumping well

effects on drawdown and close observation wells must be accounted for in the selection of the portion of the drawdown curve to be evaluated?

MR. WIREMAN: I agree that that needs to be considered, but I would not agree that you would ignore it.

JUDGE WARDWELL: Okay. Thank you.

CHAIR BOLLWERK: Is that it?

JUDGE WARDWELL: Yes.

CHAIR BOLLWERK: All right. And you're satisfied? You obviously felt you could handle those questions? So, we don't need to --

MR. WIREMAN: I'm fine with those, yes.

CHAIR BOLLWERK: All right. Very good. Thank you.

JUDGE WARDWELL: Way too professionally, though.

(Laughter.)

MR. WIREMAN: I'll check with Dave later.

(Laughter.)

CHAIR BOLLWERK: All right. Well, at this point, I think we're basically done for today. We've finished with Concern No. 2, subject to anything, any second thoughts that any of the Board, including Judge Wardwell, might have about anything that comes up

later.

So, the schedule for tomorrow, we're going to start again at 8:00. We want to make sure that we have a full day with Mr. Wireman. And I understand that Dr. Kreamer will be available from 8:00 until noon. So, that's actually a plus because we didn't expect to see him at all tomorrow. And, of course, Dr. LaGarry will be here as well for the Intervenors, as well as the staff and witnesses. And we do appreciate --

JUDGE WARDWELL: They'd better be here.

(Laughter.)

CHAIR BOLLWERK: We do appreciate your making yourselves available.

I know that, talking with Judge Wardwell, we got a lot of good information today. We're appreciative of your candor with the Board and the answers that you were giving us. So, it was definitely a useful exercise for us.

We actually made pretty good time. I think Judge Wardwell focused himself to some degree, given the incident this morning.

I would simply add, again, that I understand very well the passion that those individuals brought to the situation. Unfortunately,

this is just not the right forum. We really could not address their concerns here.

Having said that, I will mention for anyone that's interested, that the Licensing Board in the Powertech case, of which I'm a member, issued a cultural resources decision today. It's LBP-18-05, and you're certainly welcome to go out and look on the NRC website. We have a ruling with respect to cultural resources for the Dewey Burdock ISR facility that was issued today. So, that is something that's on the NRC's docket and mind as we go.

I would, again, like to thank Mr. Ballanco -- I don't know if Mr. Frankel was involved -- any of the members of the Tribal Council that might still be here, for helping to resolve that situation in a manner that I think was very appropriate; and also, our folks from -- Mr. Lam from NRC security, and, also, our deputies from the Sheriff's Office here in Dawes County. We very much appreciated your service to the Board in making sure the situation stayed at a low level and was resolved I think favorably. So, again, we appreciate it.

Again, we'll see you tomorrow at 8:00. We very much appreciate your efforts today, and we're looking forward to tomorrow. And I think Judge

Wardwell probably has some more questions -- maybe.

All right. We stand adjourned.

(Whereupon, the above-entitled matter went off the record at 5:37 p.m.)