STATE OF MICHIGAN

STATE OFFICE OF ADMINISTRATIVE HEARINGS AND RULES

In the matter of:	File Nos.:	GW1810162 and MP 01 2007
The Petitions of the Keweenaw Bay Indian Community, Huron Mountain Club, National Wildlife Federation, and Yellow Dog Watershed Environmental Preserve, Inc., on permits issued to Kennecott Eagle Minerals Company. _____/	Part:	31, Groundwater Discharge 632, Nonferrous Metallic Mineral Mining
	Agency:	Department of Environmental Quality
	Case Type:	Water Bureau and Office of Geological Survey

D R A F T T R A N S C R I P T

HEARING - VOLUME NO. XXII (22)

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Friday, May 30, 2008, 10:00 a.m.

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Lansing, Michigan

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MS. LINDSEY: Just for the record this is the cross-examination of Dr. Stone that we agreed to continue. And I'll just ask the attorneys who going to do the cross to identify themselves for you.

MS. HALLEY: Good morning, Dr. Stone. This is Michelle Halley with the National Wildlife Federation and the Yellow Dog Watershed Preserve.

MR. WALLACE: Bruce Wallace for Huron Mountain Club.

MS. LINDSEY: Can you -- you can hear us?

MR. STONE: Yeah, I can hear -- I can hear just fine.

MS. LINDSEY: All right. Thanks.

MS. HALLEY: Okay. We'll try not to keep you too long this morning, Dr. Stone. And thank you for joining us by telephone.

DAVID M. STONE, PH.D.

having been previously called and sworn:

CROSS-EXAMINATION

BY MS. HALLEY:

Q I'm wondering when you started working this project. When were you first asked to consult on this project?

A That would have been about a year and a half ago.

Q And what were you asked to do?
A I was asked to review the mix design for the backfill and to do the first round of laboratory testing to confirm that we could achieve the strengths that were required with the mix design.
Q So have you actually done benchmark testing of samples of backfill?
A Yes, we have.
Q And I believe you said you have a lab in Seattle. Is that where you did those tests?
A That's correct.
Q Okay. Now, I think maybe you testified about those when you were here, but you've read the backfill plan and the relevant portions of the mining permit application and the permit?
A Yes, I have.
Q Okay. Now, let me back up for just a second. Were you involved in developing the backfill plan for this project or did you come in after the plan was already developed?
A A combination of both. The initial backfill plan with respect to the primary and the secondaries and initial mix design and the strength requirements and all of that were already completed before I became involved with the project. The only step that I got involved in that advanced it further was doing the actual layout of the actual backfill

plant itself, so specifying the equipment and the physical layout of the equipment; you know, which equipment is on the surface, which equipment is underground; how we were going to mix it. So everything to do with the actual backfill plant itself. Once the backfill left the backfill plant that was someone else's responsibility.

Q Thank you. Whose responsibility was it?

A I couldn't tell you. I mean, it would have either been Golder or McIntosh. I don't know which.

Q Now, Dr. Stone, the permit; you said you read the permit. Does it actually include any strength requirement for the backfill?

A No, not that I'm aware.

Q Now, could you just -- you testified at some length about this when you were here, but could you give us a short refresher on the purpose of the backfill?

A Well, the main purpose of the backfill is to provide ground support to provide the safe extraction of the ore during the operation of the mine, and then it does play a secondary role in terms of providing the short-term and long-term support to the crown pillar.

Q Okay. Now, Dr. Stone, I think you testified a little bit about a paper that you wrote. It was published I believe in MineFill's 2007 proceeding report and it's called, "Factors That Affect Cemented Rockfill Quality in Nevada Mines"?

A Yeah, that's correct. Yes.
Q Okay. Now, you pointed out differences in mining techniques between what's going on in Nevada and the proposed Eagle, but I wonder if the things that you discuss in this paper are sort of generally known to be things that should be taken into account when one is designing and implementing backfill plans.
A Yeah, in general most of the issues that I raise in that paper would apply to any mine that's using backfill. And, you know, there are some issues that somewhat specific to Nevada and somewhat specific to the mines that are -- that I'm using as the examples in that paper. But in general, you know, the concepts that are in there that are discussed or the key concepts have application to pretty well any mine that uses backfill. The one big difference that we talked about when I testified earlier was the fact that the mines that I'm using as examples in there -- in Nevada are all underhand cut-and-fill mines and, therefore, they have a much, much higher strength requirement than what would be necessary at Eagle.
Q Necessary for the safety of the workers, you mean?
A Well, necessary for the safety of workers, number one; but also necessary in terms of preventing what you might call, you know, a bulk collapse in the backfill which would, you know, cause massive ore dilution in the stope being

extracted.

Q But at the end of the day, both types of mines have -- leave a big cavity underneath the surface of the Earth and if the point of the backfill is to support any crown pillar that's left, why would that -- why would those two scenarios then require different strength requirements?

A Because the underhand cut-and-fill mining is what we call in industry -- it's an entry form of mining. And what I mean there is that you have workers standing underneath the backfill. Whereas, in the Eagle concept generally that type of mining is what you would call a non-entry type of mining, which means that you don't have people standing in the stope while it's being excavated; you're using remote-controlled equipment to muck the ore out, so if you do have a rock fall you don't put people at risk. If you have a -- if you have a small failure in the backfill or a piece of backfill fallout and it lands on a piece of equipment, you're not putting people's lives at risk.

Q Right. I think -- let me rephrase my question. I understand those differences and that makes sense to me, but I'm still struggling with this notion that somehow the backfill strength requirements at Eagle are far lower than what you suggest in your paper. Setting the worker safety issue aside and looking at those two scenarios where you have a big cavity underneath the ground and you want to

support the crown pillar post mining, how are those scenarios any different? Why would one require a greater strength than the other if the goal is crown pillar support? Let's just talk about crown pillar support right now and not worker safety.

A Well, the irony of the backfilling scenario is that the vast majority of support that comes from backfill has nothing to do with the strength; it comes from filling a void. And there are a lot of mines around the world that use 100 percent uncemented backfill because, you know, once you fill that void the backfill is largely incompressible. And so it's a bit of a misnomer to tie the strength requirement to what's required to support the crown pillar. That's not where the strength requirement comes from. The strength requirement comes from preventing dilution when you're mining the secondaries and preventing that backfill from failing into the secondaries while you're extracting the ore. You're prevent -- you're trying to hold that backfill in place. That's where the strength requirement comes from and that may be why you're -- may be why it's not quite so obvious as to why the strength has to be so much higher when you're mining underneath the backfill.

If I can maybe draw like a simple analogy and maybe this won't make any sense, but, you know, when you go down to the beach and you see, you know, sand banks -- you

know, you can see vertical banks of sand sitting there holding themselves up just fine with no cement in it. It's just, you know, normal beach sand sitting there and it's a physical property of that media that it's able to support itself. But, you know, if you were to take out your bucket and shovel and tunnel into that sand your parents would come kicking and screaming and drag you out, because they would know that that's not safe, you know. So when you're mining underneath you have a much, much higher strength requirement for safety purposes.

Q In your Nevada paper, Dr. Stone, do you suggest a target strength of 4.8 megapascals or 700 psi?

A For underhand cut-and-fill mining, yes.

Q And at the Eagle isn't the MPA 1.5 or about 218 psi?

A Yeah; that's correct.

Q Okay. Thank you. Now, I want to talk about some of the factors you outline in your paper, the same paper. I'm assuming you have it or have a good recollection of that paper?

A I'm very familiar with it, yes.

Q Okay. Good. Now, you know, when I started looking at this it seems to me that cemented rockfill is a fairly complex type of substance and there are a lot of factors that are considered. Now, one of those is aggregate; the aggregate that's to be used in the cemented backfill; is that true?

A That's correct.
Q Okay. Now, do you have any idea where the aggregate that's to be used in the cemented Eagle is to come from?
A In general terms, yes.
Q Could you describe those general terms?
A My understanding is it's coming from a preexisting concrete aggregate quarry located about 35 miles from the mine site.
Q And have you actually seen any of the aggregate from that quarry?
A Yes, I have. Yeah.
Q Okay. Do you know what the end value -- otherwise, known as the distribution constant -- is for that aggregate?
A Well, the end value is something that we manufacture, so in this case the -- I'm going to think now. You're stretching my memory here. As we describe in the paper, you know, normally in cemented rockfill the -- concrete aggregate specifications are based on an end value of .5, and then as it shows in that paper in cemented rockfill we actually play with that end value a little bit in order to get some of the properties that we want out of that -- out of that -- out of the cemented backfill mix. And one of the things that we do is we lower the end value below .5 in order to get a backfill that will flow easily as opposed to rolling when you tip it into the stope. So --
Q So my question is, given the aggregate that's to be used

there, have you determined what the end value would be to accomplish flow ability?

A But it's not done in that manner. We manufacture the end value. I don't care what the end value is for the aggregate coming out of the -- out of the quarry; because what we will do is we will crush and screen that product in order to produce an aggregate grading that we want irrespective of what comes out of the quarry. So it's -- for us it's a manufactured product and that part of the backfill design has not really -- well, it was evaluated in the testing that I did. We looked at four different scenarios for four different gradings of aggregate and then recommended to Kennecott what we thought was the best grading, which was a -- I believe was a 65/35 course to fine split. But I couldn't tell you what the end value was on that. I've never plotted it out.

Q So you don't know?

A I don't know.

Q Okay. Now, isn't the top size of the aggregate very important as well?

A Yes; absolutely. Yeah.

Q And do you know what the top size of the aggregate coming in would be?

A The aggregate coming in? I couldn't tell you, but just based on my experience from what I've seen elsewhere, I

mean, it -- well, I don't know. I don't know what it would be.

Q Okay. Now, is the mechanical strength of the aggregate an important factor to consider?

A Yes.

Q Have you done UCS testing on the aggregate?

A No.

Q Is it important to know the durability of the aggregate? And my understanding is that it's the Los Angeles Abrasion Index Test that is generally used for that test?

A That's correct.

Q And has that test been performed on this aggregate?

A Yes, it has.

Q And what's the value?

A I believe it was around 18 or 19.

Q 18 or 19?

A Yes. That's my best recollection. I haven't read my report in a while, so -- do you want me to look it up?

Q If you need to, but if you remember 18 or 19, that's okay too.

A I'll look it up real quick.

(Witness reviews file)

Q Dr. Stone, may I ask you what report you're looking at?

A I'm looking at the laboratory report. Yeah, it was 19.2. I'm looking at the laboratory report that we provided to

Kennecott.

MS. HALLEY: Ms. Lindsey, has that been entered as an exhibit? Is it a part of the application?

MS. LINDSEY: This is not, no. This is -- if I may. Dr. Stone, is -- can you tell us a little bit about this lab report?

THE WITNESS: This report was conducted at the request of Kennecott in order to evaluate the strength of the proposed (COUNSEL REVIEWS FILE) mixes to make sure that the aggregate was suitable and that we could achieve the strength that they required at -- with the mixes that Golder had proposed.

MS. LINDSEY: No, this was not, to my understanding, part of the permit application and it has not been produced in this case.

MS. HALLEY: Has it been given to the DEQ?

MS. LINDSEY: Dr. Stone, do you -- to your knowledge, has this been given to the Department of Environmental Quality?

THE WITNESS: I don't believe it has; no. This is a -- right now this is an internal document between Kennecott and ourselves.

Q Now, Dr. Stone, when talking about backfill and developing backfill plans, is the water-to-cement ratio an important part of that consideration?

A Yes, it is.

Q And in the course of your testing have you come up with a water-to-cement ratio for the backfill at this mine, or a range probably more likely?
A We have recommended a water-to-cement ratio.
Q And what is that?
A One to one.
Q Okay. Do you know the moisture content of the aggregate?
A No. We did not measure the moisture content of the aggregate.
Q And do you have any plans for regulating the moisture content of the aggregate once it's on site?
A Yeah, that would have to be a -- that would have to be an operational consideration.
Q Is that described in the application or in the permit, any requirements about controlling the moisture in the aggregate, that you're aware of?
A No, because it's an operational detail.
Q Now, can variations in the water-to-cement ratio impact backfill strengths?
A Yes, they can. Yes.
Q And you said that you've developed a ratio of one to one. Is that set number or is that subject to change depending on a number of factors?

A Well, what we did was we -- when we ran our testing we ran it at a range of water-to-cement ratios and then we established what we felt was the optimal water-to-cement ratio; which, as I indicated, came out to one to one.
Q Right. But my question was, will it always be one to one, or could that change depending on variables at the site?
A It absolutely could change. And again, it's one of those -- manipulating the water-to-cement ratio in the backfill, again, is one of the operational -- one of the operational things that you will do in order to get the backfill to perform in different ways for different requirements. But there's -- the backfill that they use for the type filling will have a much lower water-to-cement ratio, probably something around .7 or .8 to 1. The 1-to-1 ratio just applies to the long -- the bulk filling of the long hole stopes.
Q I see. Are cemented rockfills that are batched with flyash binders, which is what's planned here from what the application says, more sensitive to variations in water-to-cement ratios?
A Generally less sensitive.
Q Now, is there an ASTM standard for testing the quality of the flyash binder?
A Yes, there is.
Q And do you believe it's important to test the flyash binder

occasionally?
A Yes.
Q And is that planned in the application or in the permit at Eagle?
A I don't recall ever seeing that in the permit or in the application; no. But again, it's -- that's an operational -- we would view that as an operational issue.
Q And would you -- well, never mind. I'm going to skip that. Do you believe -- I think it's clear from your testimony before that you believe it's important to monitor the quality of the backfill; is that true?
A Yeah. I mean, as I described before, it's pretty much essential in order to -- for a variety of reasons.
Q And there's an ASTM procedure for doing this; right?
A Well, there is an ASTM procedure for doing the strength testing as I described, and I showed you some photos when I was there testifying earlier. But I think my paper on the Nevada fills gets into a little bit more detail in terms of the other types of testing that would be the normal course of business of monitoring, you know, all of the components to the backfill. So you're -- you know, you're monitoring the aggregate. You're monitoring the water content of the aggregate. You're monitoring the quality of the cement. You're monitoring the quality of the flyash. There are instances where you have to monitor the quality of the water

that you use for mixing the backfill. So there's quite a broad scope to that program.

Q And conducting the cylinder test that you described; right?

A Yeah. Yeah. The biggest component of that monitoring program is the cylinders and the strength testing that I described in detail when I was -- when I testified in person.

Q Right. And your paper also talks about accumulative sums plots; that's important too?

A Yeah, and that's -- what that is is a method of seeing through the fog of all the data. As you can see in the paper there, if you do a -- if you just do a straight, you know, time-versus-data plot you can't see any trends in the data. For instance, if you used this so-called Q sums analysis, accumulative sums analysis, it allows you to see through that fog and you can distinguish trends.

Q Right. Now, was any of that discussed in the application or is it required by the permit, Dr. Stone?

A I don't believe that it's -- I don't believe that it's mentioned in the application, and I don't believe it's required by the permit.

Q So you would agree with me that the application and the permit contain little to no requirements about quality control of the backfill?

A From what I've seen and what I've read in the permit and the

application, yeah.

Q Now, is it your opinion that the cemented backfill would be permeable?

A Yes, it would be.

Q How permeable do you think? Just for a frame of reference, the porosity at the -- of the backfill at the Kidd Creek Mine which you testified about before is about 34 percent. Do you think that's in the ballpark here?

A Yeah, I believe the actual testing that we did on the actual Eagle materials came out to about 25 percent.

Q All right. And what about the uncemented rockfill in the secondary stopes? Even more permeable; right?

A Yeah, probably. Probably. Not a lot more, but it likely would be a little bit more, yeah.

Q And do you believe that at some point the cemented aggregate fill would be saturated with water when the mine is reflooded? I'm talking about post closure.

A Yeah, if you were -- if you were to reflood the mine post closure, eventually the rockfill would be flooded.

Q Now, we're going to talk about settling and some other things for a moment here. Dr. Vitton testified that at one to two percent settling of the backfill would be a reasonable approach to take here. And Dr. Blake in his testimony testified that he would certainly expect that in that range of settlement of the backfill. Do you agree with

that? Do you agree with Dr. Blake?

A No. I don't believe that the settlements would be that much. And the reason that my opinion differs from Dr. Blake and Dr. Vitton is that they were using settlement of surface piles of rock as their benchmark of the types of settlements you can get.

Q Well, Dr. Stone, that's not what Dr. Blake testified to, so I don't want you to sort of go off down the wrong track on that. He simply agreed with Dr. Vitton that the settlement of one to two percent of the backfill -- nothing to do with the surface; we're talking about the backfill -- he would certainly expect that to be the case. Do you think Dr. Blake was wrong?

A Are we talking about the uncemented fill or the cemented filled here?

Q No, we're talking about the cemented backfill.

A Well, I can tell you from my 30 years of consulting experience I have never, ever seen a mine that experienced anywhere near those types of settlements in a cemented fill. It's inconceivable.

Q So you think Dr. Stone is wrong?

A Dr. Blake is wrong.

Q Oh, I'm sorry. Right. I apologize for that. Dr. Blake. Okay. Now, --

A I absolutely believe he's wrong, ma'am.

Q Okay. Dr. Blake also testified that -- he also testified that he has "not seen that done with cemented rockfill" and that that in that instance we were talking about was a tight backfill. He said, "I have not seen that done with cemented rockfill." Is he wrong on that count too?

MS. LINDSEY: I'm going to object. I don't know if he can testify as to what Dr. Blake has seen, so I guess --

MS. HALLEY: Well, that's what Dr. Blake said.

MS. LINDSEY: I don't think that Dr. Stone can testify as to what Dr. Blake has seen. I guess what you could ask him, I suppose, is whether Dr. Stone has seen it done.

MS. HALLEY: No, I'm asking him if he disagrees with Dr. Blake's view that he clearly doesn't believe that this can be done with cemented rockfill.

MS. LINDSEY: Well, and I guess I'm objecting to it. It sounds like a mischaracterization of Dr. Blake's testimony. Did he say he hasn't seen it done, or he doesn't believe it can be done? Which I think are two different things. So you can ask him the question, but --

Q Okay. Let's try again, Dr. Stone. Dr. Blake in response to being asked about the viability of having tight backfill said, "I have not seen that done with cemented rockfill." Do you believe that Dr. Blake's point of view is wrong?

A I don't understand the question. How can I -- how can I question what Dr. Blake has seen? Now, are you asking me if it's possible to tight fill?
Q No, I'm asking you if you disagree with Dr. Stone's -- sorry -- Dr. Blake's opinion that this is not something he's seen done with cemented rockfill?
A He wasn't expressing an opinion. He said he's never seen it.
Q Do you agree or disagree?
A Again, the question doesn't make any sense. He wasn't stating an opinion; he was stating a fact that he's never seen it.
Q Okay. Even if Eagle can accomplish the tight backfill that we've discussed, does that resolve necessarily the questions about the hydraulic stability of the crown pillar?
A The hydraulic stability?
Q Yes. Whether or not water would be moving through the crown pillar. It's true that even if there's tight backfill, it doesn't necessarily mean that water won't be moving through the crown pillar; isn't that true?
A I would agree with that, yeah.
Q Now, Dr. Blake also agreed with an assessment that -- well, he didn't -- he made the observation that the comments on the proposed mine by Dr. Vitton, Mr. Parker and Dr. Bjornerud raised, that their concerns are legitimate. And

those are his words. And I'm wondering if you disagree or agree with Dr. Blake on that count. I believe you've had occasion to read Vitton, Parker and Bjornerud's reports; right?

A Could you refresh my memory as to what concerns he was referring to?

Q Well, what I'm -- I guess we need to back up. Have you read Dr. Vitton's, Mr. Parker's and Dr. Bjornerud's reports?

A Yes, I have. Yeah.

Q Okay. Now, Dr. Blake agreed that they raised legitimate concerns in their reports. Do you agree or disagree with Dr. Blake?

A Your question is too vague for me to answer. If you can -- if you can give me something specific I'm more than willing to express my view, but that's too vague.

Q Well, the reports that Dr. Blake referred to were the reports that were submitted by Vitton, Parker and Bjornerud on October 17th of 2007, comments that apparently you've read that the DEQ has had since October; those reports. I mean, I'm talking about the reports. Dr. Blake said that the concerns raised in those reports are legitimate. Do you agree or disagree with Dr. Blake?

A My recollection of reading those reports is that there's a number of different issues -- some connected, some disconnected -- in there and I can't make a -- I can't make

a simple assessment like that. So I can't comment.

Q All right. Dr. Blake also said in his testimony that, "There must have been some calculation done to suggest that the height of this backfill would be stable and that it would resist the effects of blasting." Now, particularly on the second part of that comment that "the backfill would resist the effects of blasting," he's assuming that there must be some calculations. Have you seen or done those calculations?

A I have reviewed the Golder calculations, yes.

Q But do they specifically address the effects of blasting?

A The normal --

Q Before you go off and explain it, can you just say "yes" or "no" so that I understand your answer very clearly?

A Sure. Can you repeat the question again?

Q Sure. Dr. Blake said in his testimony, "There must have been some calculation done to suggest that the height of this backfill would be stable and that it would resist the effects of blasting." Now, we've already heard from, I believe, Mr. Beauchamp about his calculations about stability. What I'm wondering though is whether or not those calculations took into account the effects of blasting. Have you seen or done these calculations that Dr. Blake feels must have been done in order -- for this project? Have you seen them or have you done them?

A Well, I -- let me think about this for a minute because it's not a simple "yes" or a "no."
Q I'm asking if you've seen or done calculations that take into account the effects of blasting.
MS. LINDSEY: And he's -- I think this is not a "yes" or "no" question. He's explained that this is a complicated -- and if you want him to explain; otherwise, I think the question is too vague.
MS. HALLEY: We're talking about calculations that do or do not take into account the effects of blasting.
A Well, the issue is that there is no specific calculation that is carried out by the engineers to make the backfill blast resistant. It's not a -- it's not a formula or a specific calculation; it's more a -- the application of concepts and principles to ensure that the material is blast resistant. And in that regard I have reviewed the Golder assumptions and the Golder calculations for the strength of the fill and by applying an appropriate factor of safety on that -- on those calculations they inherently make the material blast resistant. So that's why --
Q Do they anywhere in that analysis specifically address the effects of blasting?
A Well, as I just said, there is no method for doing a numerical calculation to make backfill blast resistant. It's a -- it's more of an operational mix design issue that

gets it to the point where it's blast resistant. So no, I've never seen any calculations and I don't know of anybody that's done any calculations that would ensure the backfill is blast resistant.

Q Is there any particular analysis other than this sort of generalized factor of safety idea that takes into account the effects of blasting? Did anybody actually sit down with a blasting plan and think about this in a disciplined way? Did anybody sit down with a blasting plan and do that?

MS. LINDSEY: To the extent he can answer whether anybody has, I think it's -- are you asking about what he's done or --

MS. HALLEY: I'm asking him does he know based on his involvement in the backfill arena.

A I don't know. I don't know if anybody has or not.

Q Have you?

A I have not; no.

Q And nobody you know has?

A Well, yeah. I haven't done it, and I don't know if anybody else has.

Q Okay. Thank you. Dr. Stone, you testified that -- let's see here -- that a lot of the big cemented rockfill operations are slowly -- one by one they're all switching over to paste. Could you explain why the cemented rockfill operations are slowly switching over to paste?

A The biggest driver is minimizing the surface footprint from mining, so by returning as much of the waste material back underground as backfill. And prior -- you know, prior to the introduction of paste, you know, ten, fifteen years ago there wasn't really another suitable backfill product that could meet the strength requirements that were required by -- you know, in cemented rockfill operations. So that's number one. And there is -- there are some cross factors there as well. There's some, you know, economic factors. And also, you know, ease of permitting. And there are risk factors with having, you know, tailings stored in surface impoundments. So it's a variety of economic and environmental drivers that are causing that.

Q And do you think it has anything to do with any of the problems that have been encountered with cemented aggregate fill?

A Absolutely not. I mean, it's got nothing -- it's got nothing to do with a need to replace cemented rockfill. It's all to do with a need to minimize the surface footprint from mining by returning the mined out materials back underground.

Q I see. Now, Dr. Stone, you testified that the aggregate would be "pre-screened and pre-proportioned." Is another way of saying it that it would be graded; is that what you mean by that?

A Yeah, it'll be crushed and then screened.
Q Now, where in the application is any of that discussed?
A I don't believe it's in the application. The crushing and screening part isn't in there, but the fact that the material is imported is in the application.
Q Now, the application also says, I believe, on -- this is DEQ Exhibit 25, which is page 32. And for your benefit, Dr. Stone, that is the text of the mining permit application, which I think Ms. Lindsey said you have there with you. I'm not going to be reading much from it, so you can probably just, you know, listen and get what you need. But it -- what it says about the aggregate is that it would be clean aggregate. But does it describe anything about the size of the aggregate?
A I don't believe so, no.
Q Now, you also testified, Dr. Stone, that some degree of segregation is inevitable. Does dumping this material from a height of about 100 feet lead to that segregation?
A It can, yes.
Q The process of the tipping and the dumping. Now, what are some of the problems that result from segregation?
A The main operational issue is dilution; when you mine out the secondary is having some of the segregated material fall into the secondary stope and become dilution.
Q So are you saying that segregation is the same thing as

dilution?

A Well, segregation can lead to dilution, so the segregated material is more prone to falling out when you take out the secondary.

Q I see.

A Because it's -- yeah.

Q Segregation, can it result in loss of strength or reduction in strength?

A Yes. That's the main concern with segregation, is that it doesn't have the same strength as the rest of the backfill.

Q And literature, in fact, has described severe problems resulting from segregation; right?

A Back in the early days of cemented rockfill, back in the early days of both Kidd Creek and Mount Isa, back -- they described having severe segregation problems.

Q Okay. Now I have a different question, sort of a different area. Now, you talked about the stacking up of the primary stopes; right? That's your understanding. They'll be sort of -- at the end of the whole thing would be stripes. We looked at a picture, I believe, when you were here of red and blue stripes, red being primary stopes, blue being secondary. Is that your understanding of how the backfill would work?

A Yes.

Q Now, has there been, to your knowledge, an analysis of the

ability of the bottom stope of a primary -- of a red stripe or a primary stope to support the weight of the other primary stopes that would be sitting on top of it at the end of mining? Have you seen any analysis like that?

A No, I haven't; no.

Q And in fact, you testified that the 218 psi is based on a self-weight of a 30-meter-high CRF stope; right?

A Yeah; that's correct; yeah.

Q Okay. But at the end of mining, wouldn't the primary stopes actually be about 600 feet tall when they're all stacked on top of each other?

A Yeah, something in that order. That's correct; yeah.

Q Now, this is again from the application, but it's very short, so I think we'll be okay. On page 37 of DEQ Exhibit 25, it says that, "The actual stope limits will be identified by stope definition drilling and sampling programs during operations." Is that -- do you -- I mean, if you don't have it there, that's okay. But do you have any reason to doubt that that's what the application says?

A No, I don't have any reason to doubt that; no.

Q So it seems that this -- the dimensions of the stopes might changed, according to the application, once operations begin. Is that your understanding of that -- what that sentence means?

A Well, the way I would interpret that is that the very simple

generic picture of these primaries and secondaries stacked up on top of each other looks good from an illustrative standpoint in terms of what the concept is. The reality is that this orebody, you know, is not a cube of rock. It's got all kinds of shapes and bends and twists in it and that the actual mine plan and stope layouts will have to follow the -- you know, they're have to follow the physical geometry of the ore.

So you're going to have some stopes that are going to inch way in. You're going to have other stopes that are going to -- they're going to swell out. And you're going to have some places where you might have 600 feet of vertical exposure and other places where you only have 200 feet. So it'll be a variable mix of stopes sizes and stope geometries.

Q Now, Dr. Stone, you also testified about a -- what's called a CMS system, which we've heard some other testimony about; the cavity monitoring system, which is a -- my understanding of it is that it's a sort of video camera, for lack of a better word, that helps to --

A It's a laser.

Q A laser. Okay -- that helps to define what's already been mined out and sort of the borders of everything; the borders of the ore versus the country rock, backfill versus country rock, that sort of thing; right?

A Well, no. All that the CMS does is -- if I could use the word -- it maps in 3-D the physical outline of an opening. So when the mining engineer designs a stope, you know, he has a 3-D line that he's working to that goes into the design of the production block. The stope is then blasted and that the actual physical -- you know, after-blasting and after-mucking-stope geometry will vary, you know, slightly from what the mining engineer put on paper. And they use the CMS system to get a very, very quick three-dimensional map of what the real stope -- what the hole in the ground looks like. And it's brought into a three-dimensional mine planning program such as AutoCAD or, you know, one of the -- whatever program that the mine is using, and so then you use that then to design the next stope.

Q Is that a requirement of the permit, or was it discussed in the application?

A Not to my knowledge, no.

Q Now, Dr. Stone, you said that acid -- acidic water and acid mine drainage -- you said that that's a post-mining issue and that it has caused problems at other mines in the past. Now, I wonder if you have seen anywhere in the application or in the permit how that post-mining issue is to be addressed.

A I haven't looked at any of the water quality stuff, so I can't speak to that. I can only speak to the section on the

mining as it relates to the backfill. I haven't read anything else.

Q Well, in the discussions of the backfill, then, has there been any discussion about how the backfill would respond to acidic water and that sort of discussion?

A In the permit?

Q Right, or in the application.

A Well, again, I can only speak to the actual mining section as it relates to backfill, and I don't recall seeing anything in there in those sections. Whether it's discussed elsewhere, I don't know.

Q Okay. Now, you also talked a little bit about sulfate attack. Do you remember talking about that?

A Yeah, I sure do.

Q And I just want to clarify one thing. The -- in your transcript, Dr. Stone, the word "heterogenite" is used, which was spelled there h-e-t-e-r-o-g-e-n-i-t-e. I think that maybe you were saying "ettringite"? Is that --

A Yeah, ettri- -- I can't even pronounce that word it's so awful.

Q But it's e-t-t- --

A Ettringite, which is a form of gypsum.

Q Right; e-t-t-r-i-n-g-i-t-e; right?

A Right; yeah.

Q Okay. I just want the record to be clear about what you

were really talking about that day.

A Yeah. I'm sure the court reporter had fun with that.

Q Right. No, no fault of hers. It's an interesting word. Okay. And I'm wondering if you believe that the conditions generally present in the mine would be cool.

A Cool? You're talking about temperaturewise or --

Q Yes, temperaturewise, cool.

A -- kind of a cool place to work?

Q Well, you might think that's the case, but I'm talking about temperaturewise. What would you expect the temperature to be?

A You know, that's a really good question, you know. There are some -- a lot of mining regions in the world, including Nevada, that are hot. They're very hot underground, because you have very active geothermal environments in close proximity to the surface of the earth. So I have no clue as to what the temperature would be underground in Michigan. I'm not familiar with the geology there to know what kind of a temperature grade you have there.

Q Okay. Would you expect there to be sulfates in the re-flooded mine?

A Sulfates?

Q Sulfates.

A I don't know. I don't know.

Q Silicates?

A Again I don't know. Silica comes from quartz. I don't know.
Q Comes from what?
A Did you say "silica"?
Q Silicates.
A Silicates?
Q S-i-l-i-c-a-t-e.
A No clue.
Q Carbonates?
A Well, you're going to have limestone in the --
Q Right.
A -- secondaries mixed in with the development rock, and that will produce carbonates.
Q Right. And of course water?
A Yeah.
Q Okay. Now, I'm having a hard time remembering exactly what you said when it came to the sulfate discussion. But have you ever heard of sulfate attack of cementitious materials?
A Yes, I have.
Q And what are the effects of that generally?
A It depends on what material you're talking about. But generally it's a swelling reaction, because the growth of those gypsum crystals is a -- causes an expansion, and so you get a weakening of the cemented materials as a result of that expansion process.

Q Okay. Now, I'm going to read you a section from the application that I find puzzling, and I'm hoping that you can help me understand it. It's DEQ Exhibit 25. It's on page 15. And I'll read it out loud for your benefit. And it says, quote:

> "Excess development rock will be stored in the TDRSA for approximately seven years. For the first three years of facility development, no stope backfilling is planned or required due to the sequential primary/secondary stope backfill plan, which will maintain mine stability during this period."

Could you decipher that statement for us?

A Can you read that over again, please?

Q Sure.

> "Excess development rock will be stored in the TDRSA for approximately seven years. For the first three years of facility development, no stope backfilling is planned or required due to the sequential primary/secondary stope backfill plan, which will maintain mine stability during this period."

A You want me to take a stab at that, do you?

Q Well, do you know what it means?

A Well, my interpretation of what they're saying is that it's going to take three years for there to be enough primaries to start backfilling. There's no place to fill for the

first three years.

Q Right. Well, I could agree with that up until a certain point. But then it says that it's not required because the backfill plan will maintain the mine stability during this period.

A Fortunately I didn't write that statement, and I have no clue what it means.

Q Fair enough. Do you have any understanding that the rockfill, either the cemented or uncemented, would be compacted in the stope?

A The only physical compaction that will take place will be when the -- both the primaries and secondaries are nearing -- the fill level gets up to the level of the brow that they're tipping from, and then at that point, you know, you're going to be out -- driving out over the top of the backfill to achieve the tight filling.

Q But the material that's dumped in and sort of would eventually form the bottom of a primary stope would not be compacted; is that right?

A No, it wouldn't; no.

Q Now, over time the mine water -- the water in the re-flooded mine is predicted to become saline. Do you have any idea of what the effect of that change in water chemistry might have on the rockfill?

A Are you -- you mean both for the cemented and the uncemented

or --

Q Each one.

A I can't imagine it would have any effect on the uncemented rockfill. What effect it would have on the cemented rockfill I really don't know. I'm not aware of anybody having any issues with the saline water impacting the quality of cemented rock. In fact, you know, most of the mines in western Australia -- and a lot of those mines do use cemented rockfill -- are in ultra-saline environments, which have -- I think it's something like 27 times the salinity of seawater. And I've -- and I do a lot of consulting work in western Australia, and even there I've never heard of anybody ever having any problems with cemented rockfill operating in those environments so --

Q Now, would you expect any shrinkage of the cemented backfill as it cures?

A Not in cemented rockfill. In other forms of cemented backfill, you can get shrinkage, but it's never been experienced, to my knowledge, in cemented rockfill. And that's one of the reasons why cemented rockfill is so popular for underhand cut-and-fill mining.

Q How long do you think that the cemented aggregate fill is necessary to remain intact based on your understanding of this site?

A Well, my understanding would be, because of the crown pillar

support issues, is that the backfill is designed to remain there indefinitely.

Q Now, are you aware of any studies of the long-term strength of cemented aggregate fill?

A Not of studies per se. The -- all I can point to is operational histories.

Q And I think you pointed out, Dr. Stone, that this -- the cemented aggregate fill started being used in the late 60's?

A That's correct, in the form that's envisioned for Eagle; yes.

Q So we have 40 years of data to draw on? Is that about right?

A Yeah, whatever -- yeah, whatever -- yeah, something like that. But actual backfilling process goes back hundreds and hundreds of years.

Q But this type of backfill began in the late 60's. That's what you said; right?

A Cemented rockfill, yeah; yeah.

Q Now, Dr. Stone, I believe you took issue with some of Dr. Vitton's and Mr. Parker's comments based on your perception that they were coming at things from a civil engineering versus a mining engineering perspective. Do you remember that?

A With respect to the block criteria, yes.

Q Now, how long do you think a civil engineer is -- what is

their time horizon when they're planning projects?
A I don't know. I'm not a civil --
Q You have a dual degree -- right? -- civil engineering and mining engineering; right?
A Sorry. What was that -- say that again.
Q You have a dual degree -- right? -- civil engineering and mining engineering; is that right?
A I'm sorry. I didn't catch it again.
Q You have a dual degree -- isn't that right? --
A Oh, sorry. Okay. Yeah.
Q -- civil and mining engineering?
A But I've never practiced in civil engineering. My whole career has been in mining.
Q I see. Do you have any idea what kind of time horizon a civil engineer is looking at when they're planning a project?
A Well, I don't know. I mean, it would depend on the type of a project. I mean, if you're designing a dam, presumably it would be hundreds of years.
Q Right. Okay. Now, given your answer that this backfill and the uncemented rockfill needs to stay in place indefinitely, do you think that there would be any long-term strength decrease in 50 years?
A Generally cemented backfill continue to increase strength with time, not decrease strength with time. So, you know,

we do all of our designs based on 28-day strengths, but the cement doesn't -- it doesn't stop curing and hydrating then. It -- that process continues on for many, many, many years.

Q Sure. So my question was, would there be any strength loss --

A I wouldn't expect any.

Q 100 years?

A I wouldn't expect any, no.

Q 200 years?

A Now you're getting out beyond my experience.

Q Well, you just testified that it needs to last indefinitely. 200 years is not an indefinite -- I mean, that's a pretty, you know, reasonable amount of time when we're talking about things like geology. So what do you think?

A I have no reason to believe that it would lose strength over time.

Q How about 500 years?

A I don't know. You're going --

Q So at 500 years you don't know?

A No, 'cause I don't know of anybody that's done it so --

Q Based on your knowledge and experience, what do you think?

A As I've already said, I don't see -- I don't know of any reason why it would lose strength so --

Q 1,000 years? What do you think?

A Again, it's well beyond the window that we would normally

design things to for a mining application.

Q Is it well beyond the window of what you've designed this mine to?

A I don't know.

Q Well, you helped design and test the backfill.

A I didn't design it. All I did was tested it.

Q Okay. You tested it, and you've reviewed the plan; right?

A I reviewed the plan, and I tested the materials. It's not my design.

Q Okay. I understand that. So based on what you know, it sounds like you're saying you don't know what would be happening with the backfill, say, 500 to 1,000 years from now?

A Yeah. I couldn't tell you.

MS. HALLEY: All right, Dr. Stone. Thank you very much. I believe I'm done. And I think Mr. Wallace may have a few questions for you.

MR. WALLACE: Yes, sir.

CROSS-EXAMINATION

BY MR. WALLACE:

Q Do you have a file with you, Dr. Stone?

A A file?

Q A file of materials that you've accrued over the past year and a half regarding this assignment.

A I have a -- yes, I guess I do; yes.

Q And that includes your report to Kennecott of the laboratory results; correct?
A That's correct; yeah.
Q Did you also provide a report to Kennecott on your view of the minefill design?
A No, I did not.
Q What other materials did you provide to Kennecott besides the study --
A Just the lab report.
Q Only that?
A Yeah.
Q And what does that consist of? How long of a report is that?
A I believe it's about 60 pages with all the appendices.
Q 60 pages? Okay. And does that include narrative as well as calculations?
A It includes narrative plus test results. There's no calculations.
Q I'm going to digress here for a minute, sir, and this doesn't concern you.

MR. WALLACE: But I'm going to move to strike the testimony of this gentleman. We were told there was no report. We, of course, had no deposition. There's only a very sparse description of his testimony. On March 7th a document was filed with this court, indicating that he had

prepared no report. No report was provided to us. And I think again we've been put in a position of being ill-equipped to deal with a highly technical witness for inexplicable reasons. I think his entire testimony should be stricken.

MS. LINDSEY: Your Honor, if I can bring you back to the purpose of his testimony, was to refute and to rebut the testimony of the Petitioner's exhibits. And if you'll remember -- this was a couple weeks ago -- that's exactly what he did. He was brought in specifically for rebuttal to the comments that Dr. Vitton and Mr. Parker made, and his testimony is very much rebuttal. There was no requirement, as we continue to say, to prepare reports or to produce reports. And if they were not part of the mine permit application, there was no requirement to produce those. And I don't understand how they can continue to say that they had no idea what he was going to testify about. It was purely rebuttal, and they've been given two weeks to prepare for a cross-examination of it, and there was nothing that was a surprise. The report is irrelevant to his testimony and the testimony that he gave.

MR. WALLACE: Well, it's just hard to say it's irrelevant, because we don't have the 60-page report. But his testimony -- expected testimony as listed on March 7th and filed with this court was "mine engineering; mining

plan; mine backfill materials and methods; stability of mine and backfill and blasting against backfill; potential for ARD; degradation of backfill; rebuttal as appropriate to Petitioner's experts' opinions within his area of expertise." So he testified to many areas, not just rebuttal, and he made specific reference on direct to having a lab -- a laboratory facility in Seattle that he used to test the strength of material, and he asserted that strength as part of support for his favorable opinion rendered in this case. And he's had a report, which we could have looked at over the past two weeks, we should have been able to look at since March 7th, which we've never seen.

MS. LINDSEY: And the report, they keep referring to it as a 60-page report. As I understand -- and, Dr. Stone, you can correct me if I'm wrong? Is much of that appendices or test results? Is that a large part of the report?

THE WITNESS: Yeah. It's a laboratory test report, so all it does is just talking the testing methodologies and the results.

MS. LINDSEY: And Dr. Stone did not testify to his results. He was asked about it on cross. On direct he did not testify to that. His opinion did not relate to those test results. This is purely -- the mine planning continues to go on and, if there's operational issues, that continues.

There is no requirement that that be -- what we're doing here is talking about whether the mine permit should be granted, and that they -- are issues that did he test the strength. He didn't testify to that in direct. He testified was the strength of 218 psi, which was in the application, sufficient in his experience and in his opinion. And that's what he testified to; had nothing to do with any subsequent tests about the backfill. And so it's irrelevant whether he's tested it. They asked him about it, and he talked about it on cross, but it's not relevant to the testimony that he gave.

MR. WALLACE: May we ask Dr. Stone when he prepared this report?

Q Dr. Stone?

A Yeah. Okay. It's dated January 2007.

MR. WALLACE: I see no reason whatsoever why they would submit to this court a statement that this expert had prepared no report, 60 pages of calculations and narrative.

MS. LINDSEY: The question, as I understood the witness disclosure, was, were reports prepared that we were going to rely upon in this case. Reports were not required to be prepared, and that was not something -- the question is, did we rely on it. We did not rely on his report in this case.

MS. HALLEY: Your Honor, may we ask --

MS. LINDSEY: If I may finish --

JUDGE PATTERSON: Let her finish.

MS. LINDSEY: There was no requirement at all that reports be prepared and that all reports be produced that anyone had done. The -- we did not identify a report because we were not relying on it, and it had not been part of the permit application. That's -- those were the reports identified. And their reports that their experts prepared had all been submitted to the DEQ in the comment process, and those are what, my understanding is, they've relied on. The reports we've identified are the reports that our experts have relied on and testified about in this case. Dr. Stone was purely rebuttal testimony. And if you remember, I was very careful to ask the specific questions of, "This is what Dr. Vitton testified. This is what Mr. Parker testified to. Do you agree? Why or why not?" And the rest of it was background so that we could get his credentials and we could understand the context of his testimony. But that was -- the purpose of his testimony was rebuttal. So we did not know particularly what he might need to testify to when we first prepared our witness list, because, honestly, there was no backfill expert on Petitioner's list. So we didn't know if they were even going to testify about this. But we put it on there because they had two experts who had commented on it as a portion of

their reports, and so we put him on there as qualified to testify about this should it become -- should it be raised. And when it was, that's what we presented. So there was never a requirement that we produce reports from experts that we were not intending to rely on.

MS. HALLEY: I'm sorry for interrupting before, your Honor.

JUDGE PATTERSON: That's all right.

MS. HALLEY: I wonder if we might be able to ask Dr. Stone if his opinions about the stability of the backfill were developed partially in reliance on these laboratory results. I'm assuming that's why they performed the tests.

JUDGE PATTERSON: You can ask him that.

MS. HALLEY: Dr. Stone, is your opinion about the stability of the backfill in part at least formed by these results of your lab tests and what's contained in this report?

THE WITNESS: The intention of the lab testing was to show that we could get the strength that we needed with the mix design. It's separate from the actual stability issues and stability questions. So I don't see the two of them connected. And also, like I said, we did the actual plant -- you know, got into the details of the plant.

MR. WALLACE: Well, your Honor, I mean, we could

go back and forth about what the, you know, record now consists of. But, you know, we have transcript of direct testimony. We know that he touted his laboratory and laboratory testing in that direct testimony -- his considerable testimony that is not focused simply on rebuttal of the testimony of our experts. This man was held out as an expert fairly enough, and his credentials and his facilities were emphasized, and he came into this court, and he said he believed this was -- would consist of backfill of a sufficient strength to maintain the crown pillar of this mine. And I think that he has a 60-page report and it wasn't given to us is inexcusable, and we shouldn't have to have this testimony remain in the record. I mean, that was the purpose of the disclosure, which was minimal and in this instance not correct.

MS. LINDSEY: Well, his testimony had absolutely nothing to do with the results. He keeps -- Mr. Wallace keeps referring to the results of his lab. Yes, he had a lab, and he talked about it, and he did testing. His opinion was based purely on the -- and I asked him specifically. "The mine permit application calls for a strength of 218 psi. In your opinion, is that sufficient?" His testimony was, "Absolutely." That they've tested to determine whether they can reach the 218 psi was never a question that I asked and was not part of his opinion. That

is an operational issue that obviously Kennecott's going to have to meet the permit application. This has been an issue that, you know, there's all these things in the permit application. They have to be able to meet them. This is operational. Can they meet that strength? And I did not ask Dr. Stone whether his test results -- what were the results of those and, you know, could that meet the strength. The question is, is the design of 218 psi -- because the opinion from Dr. Vitton and Mr. Parker was that that was insufficient. And I asked him, based on his experience and based on his education and experience, whether 218 psi was sufficient in this application." So the results of whether it can meet 218 psi is simply not relevant to his testimony, and I -- this is just a tactic to try to get this testimony out. It has nothing to do with what he actually testified to.

JUDGE PATTERSON: Well, obviously much of Dr. Stone's testimony is related to what he's terminated "operational issues." There are certain parameters and certain permit conditions have to be fulfilled. I don't see necessarily that this laboratory report has any direct relationship to his testimony at this point, so I'm going to deny the request to strike his testimony.

MR. WALLACE: Thank you, your Honor.

JUDGE PATTERSON: Okay.

Q Sir, are you involved with a company called -- is it Adanac or Adanac (pronouncing)?
A Adanac Moly Corp, yeah.
Q Yes. And what is that company, sir?
A It's a junior mining company based out of Vancouver.
Q It's a mining operation for molybdenum; is that right?
A Yeah. They're trying to build a molybdenum mine.
Q Has the mine been built yet?
A No.
Q And you're the president and chief executive officer of that company?
A I'm the CEO, yes.
Q And you serve on the boards of a number of other companies; is that correct?
A I do, yes.
Q How many other companies do you serve on the boards of?
A I believe there is at least five, maybe six.
Q And are these all publicly traded companies?
A They're all publicly traded companies, yes.
Q What's Formation Capital Corp? Is that one of those companies?
A Yes. They have a cobalt mine in Idaho that they're trying to permit and build.
Q Okay. And do any of these companies have anything to do with backfilling?

A Yes.
Q Adanac Molybdenum?
A Adanac, no.
Q But MineFill Services does?
A Yeah. We are a consultant to some of the companies that I serve on the boards of.
Q Have you ever done work for any Rio Tinto company before?
A Yes.
Q About how many times?
A Maybe a half a dozen.
Q And is the work you've done had to do with backfill or with other aspects of the mining industry?
A Would be backfill and rock mechanics, which are my two principal areas of expertise.
Q Does Rio Tinto have any mines that are using backfill that you advised on at this time?
A Boy, I'm going to have to think. I can't recall the last Rio Tinto backfill that they did. I'd have to go back and look through all the projects I've worked on to answer that.
Q How far back does your relationship with Rio Tinto go, sir?
A Maybe to, like, the early 1990's.
Q And on what kind of basis are you compensated for your work done in this case?
A It's a normal consulting fee arrangement, so it's an hourly fee.

Q And about how much have you been compensated so far, sir?
A I have no clue. I could not tell you. Are you talking about Eagle now or --
Q Eagle.
A Even that one I have no clue. It -- maybe $20,000 or $30,000 or something.
Q Does that include providing them with a 60-page report?
A Yeah. And that includes the cost of the lab testing and everything, yeah. The testing itself costs money.
Q Do you have a sense or have you calculated the volume of cemented rockfill that will be used to fill this mine if it's mined up?
A That was outside my scope.
Q You don't have any idea how much backfill is actually going in here?
A No.
Q You don't have any how much aggregate is going to be required?
A No.
Q You're aware that there are tunnels and drifts leading from the surface to the orebody; correct?
A Yeah. There's a decline, yeah.
Q And have you seen the plan that describes that decline and the kind of circular stairway of tunnels down to the bottom of the orebody?

A Only in a general sense. I've never looked at the specifics.
Q Okay. And you understand that those tunnels and drifts will create subsurface voids; correct?
A Yes.
Q And wherever there's subsurface voids created by mining there will be some measure of subsidence at the surface; correct, sir?
A I don't know if that's a -- that's an overly broad statement for me to agree with being a rock mechanics engineer. There is a depth -- there is a threshold depth that you would get down to where any drifting and tunneling would be imperceptible at the surface.
Q Okay. But that's not a depth that we're concerned with here; correct, sir?
A You mean that it would be below where we are now or --
Q It would be below that?
A I would say that it's well within what we're doing here. I mean, if you -- the mining voids are one thing, but the -- all the development work in the declines and drifts and adits and everything that form the development for the mine, we're working at depths well below where those voids and openings would have any impact on the surface.
Q Well, the voids and openings begin at the surface, sir. At that depth it's zero; correct?

A You're talking about subsidence, though, so -- saying that --
Q Is it true, sir, that no plan that you've seen exists whatsoever for backfilling the tunnels and drifts at the end of this mining operation?
A That's outside of my scope. I don't -- I can't comment on that.
Q And I gather you don't have any idea, then, approximately the cubic meters or cubic feet volume of tunnels and drifts that will never be backfilled here; is that correct?
A I have no clue.
Q And do you know that, at the end of this mining operation, the opening to the tunnel will be plugged?
A Again, it's outside of my scope. I'm not familiar with what the requirements are there.
Q So do you know anything about the capacity of anyone to monitor -- after the opening's been plugged, monitor convergence or any other aspects -- aspect of subsidence after this mine is closed?
A It's all outside of my scope, and I have no knowledge.
Q Do you know the convergence, should it occur in the drifts or tunnels -- in other words, the closing together of the roof and floor of the tunnels typically has some relationship to subsidence at the surface; correct, sir?
A It can.

Q But again, you don't know that there's any plan to measure convergence or predict convergence and resulting subsidence at this mine in this mine plan?

A As I indicated before, it's outside of my scope, and I have no knowledge.

MR. WALLACE: Thank you. I have nothing further.

MS. LINDSEY: Dr. Stone, I just have -- this is Sarah Lindsey, and I have a few questions for you following up on Ms. Halley's direct (sic).

REDIRECT EXAMINATION

BY MS. LINDSEY:

Q One of the things that she asked you about was the strength used in the paper that you talked about, your 2007 paper -- 2007 paper that talked about the Nevada mines and asked you to compare that strength. Can you tell us again whether you think that -- or explain to us whether you think the 218 psi here or the 1.5 megapascal is sufficient and then compare that to the strength required in the Nevada mine that you discussed in your article?

A Yeah. As I've indicated, you know, based on my experience and based on my review of the Golder calculations and based on the examples that I presented during my direct testimony, the 1.5 MPa design criteria is appropriate, in my mind, for this particular application and is well within industry-accepted -- an industry-accepted range. And, of

course, it's a very different scenario, as we've talked about many times now, from entry stopes where you're working underneath backfill where worker safety is paramount.

Q Okay. And another question was, you had testified earlier and Ms. Halley asked you about the strength for the stope and that the strength determination is for the basis of filling just the one 30-meter stope at a time; correct?

A Yeah.

Q Okay. And then she asked you about the fact that these primaries would be stacked sort of one on top of each other until you get to the end of the mine; right?

A Yeah.

Q Okay. Can you explain to us whether you think the 1.5 MPa is sufficient to support that entire column or explain to us why it is that you don't take into consideration the additional columns when you're determining the necessary strength?

A As was pointed out, the 1.5 MPa strength criteria is designed to provide a stable free face of cemented rockfill 30 meters high when you're extracting the secondary adjacent to a cemented rockfill primary. When you -- once you've mined out a level and go up to the next level and start mining primaries and secondaries on that, then the uniaxial compressive strength of the backfill actually becomes irrelevant because, at that stage, the backfill is confined.

And therefore there is no -- there is no mechanism for it to fail. And, in fact, I go back to the scenario that a lot of mines use, you know, 100 percent uncemented backfill. And that's exactly the scenario is that, when you're working on top of backfill, you don't need strength in it at all. So in an overhead mining situation such as envisioned for Eagle, you don't get this multiply effect of loading the stopes up below because the stopes are totally confined and the backfill has nowhere to go.

Q Okay. There was also -- you were asked some questions about a blasting plan in the backfill. My question is whether your testimony about the effects of blasting on cemented rockfill and its ability to withstand that blasting -- can you tell us generally what you're basing that opinion on?

A I'm sorry. Could you repeat the question, Sarah?

Q Yeah, I will. You were asked some questions about whether there was a blasting plan and whether it was necessary to develop a blasting plan to determine its effect on the backfill. And my question is, you gave some testimony a couple of weeks ago about your experience with blasting against the backfill or development plans. Is it your experience or is it your testimony that there needs to be a plan for blasting, or will the rockfill, in your experience, withstand various types of blasting? I mean, in your experience, is a plan necessary for blasting?

A Well, I guess the -- the answer to the question is kind of the inverse of what the thinking here is that the blasting plan relates to the design of the blast in the secondaries. And those blasts are designed not to impact the fill. The fill itself -- provided that we follow certain protocols and procedures so as to -- so as to, you know, minimize the impacts on the fill, the actual fill itself is kind of, you know -- how would I put it? -- it's inherently safe, you know, for that blasting in that environment because of the -- because of the -- because of the mechanical properties of the fill that are inherent in that type of a fill. It makes sense that -- so we design the blasting not to impact the fill. And it's a given that, if the fill meets a certain safety factor, it's generally -- from operating experience generally will always be blast-resistant in that regard.

Q Okay. You were also asked about the literature that describes problems with segregation. And Ms. Halley referred to the Kidd Creek Mine particularly. Are you familiar with those problems or at least the literature with respect to those problems?

A Yes, I am.

Q Okay. And is anything -- has anything changed since then or can anything be done to minimize segregation that was experienced there?

A Well, I believe in my direct I did address this in that, you know, the early days of Kidd Creek and Mount Isa when they were -- you know, first introduced cemented rockfill, there were a number of years where they learned a lot. And one of the things that they learned was about minimizing segregation. And one of the -- as I mentioned in my direct testimony, one of the key ways that we minimize segregation is by reducing the top size of the aggregate. At Kidd Creek back in those days, they used to use a 6-inch minus rock so that the maximum particle size in the backfill back in those days was -- you know, was 6 inches or more. Nowadays mines don't do that because they know that, if you go with a top size that large, you're going to get segregation problems. So most mines now will generally crush and screen their aggregate down to either a minus 2 inch or a minus 3 inch. And that eliminates -- it eliminates a good portion of the segregation problems. And then there are other operational things that you can do by playing with the mix design, as I had testified before, and also in terms of how you place this material in order to -- you know, in order to also minimize segregation.

Q Okay. You were also asked about sulfate attack on cementitious material. Do you remember those questions generally?

A Yes.

Q Is that, in your experience, a problem with cemented rockfill?
A It has no relevance to cemented rockfill.
Q Okay. Can you explain to us why?
A Well, because sulfate attacks in mine backfills always relate to the backfill itself being the source of the sulfate. And all of the instances of sulfate attack in mine backfill have been in mines that use tailings -- tailings as the backfill, either tailings as hydraulic fill or tailings as paste. And in this case, we're using aggregate. So the aggregate has no sulfates in it, so it's -- and it's measured rockfill. So there is no -- it's an irrelevant issue for Eagle.
Q Okay.

MS. LINDSEY: Thank you. I have no more questions.

MR. REICHEL: Dr. Stone, this is Bob Reichel. I represent the DEQ in this proceeding. I'd like to follow up on a few things raised during cross-examination.

THE WITNESS: Can you speak up? I can barely hear you.

MR. REICHEL: I'm sorry. Can you hear me now, sir?

THE WITNESS: Yeah. That's better.

MR. REICHEL: Okay. I apologize. I represent the

DEQ, and I want to follow up on a few of the items from cross-examination.

CROSS-EXAMINATION

BY MR. REICHEL:

Q Ms. Halley, I believe, asked you a series of questions directed to whether or not certain operational details of the backfilling process were specified in the permit application or the permit itself. Do you recall that?

A I do, yes.

Q Now, let me just touch on a few of those. I believe you testified that -- and just touched on this a moment ago -- that one -- in preparing the backfill that's being proposed here, the aggregate material that is expected to be brought to the site would be screened and crushed to meet certain desired characteristics; is that correct?

A Yeah; that's correct.

Q In your experience in the mining industry, is that sort of a process or method something that's widely used in the mining industry and generally -- is it widely used in the mining industry?

A Absolutely.

Q And is that sort of a methodology generally accepted within the industry as an effective means of controlling the quality of materials in the -- to be used in the backfill?

A Yeah. Because the backfill mix has a specification that you

are -- that you're attempting to achieve. So that's part of the specification.

Q And I believe there was also some discussion about moisture content; do you recall that?

A Yes.

Q And again is it your testimony that you -- well, in your experience in the industry -- in the mining industry, is the moisture content of materials to be used regularly monitored?

A The way it's done in industry, the practice is that it's a -- what I would call an observational -- it's an observational approach in that, if you -- let's say, for example, in the winter, if you got a lot of snow mixed in with the aggregate and that aggregate then got dumped down the raise into the backfill plant and that snow, you know, melts and then became part of the aggregate and made it wet, what would happen is that, when they start batching the backfill with that aggregate, they would start to notice -- and it's amazing how easy it is to -- how little changes are noticeable in the backfill as soon as it's batched. And so what they do is they have -- they'll have a setting in the backfill plant that will allow them to cut back on the water a little bit when the aggregate is really wet in order to -- in order to visually achieve a backfill at the desired consistency. And then when the backfill dries out, they'll

notice that the backfill starts to go dry, and they'll start to add more. So it's not a -- it's not a physical monitoring in terms of taking samples of aggregate and taking it to a lab and measuring the water content. It's done on a visual basis at the batch plant.

Q Okay. Thank you for clarifying that. But is the method that you've described, a visual observation and adjusting equipment in the cement plant -- is that a method that, in your experience, is or is not widely used in the mining industry?

A It's widely used. That's -- most backfill plants are set up that way, yes.

Q And in your professional experience, is that generally accepted as effective?

A Absolutely; yeah.

(Counsel reviews notes)

Q I believe you were also asked about -- my notes are a little unclear, so I may be misstating this but -- whether there was a method specified or procedure specified for monitoring the quality of the backfill. Do you recall being asked about that?

A In general terms, yeah; yeah.

Q Well, let me ask you this. In your experience in the -- strike that. Based upon your review of what is being proposed for the Eagle Mine project, what is your

understanding of what process, if any, would be used to monitor the quality of the backfill?

A I'm not sure I understand your question.

Q Okay. That was poorly stated. Let me ask you this.

A I mean, as to what's in the permit?

Q Do you have any understanding, sir, based upon your experience in the industry and using this kind of backfill material, cemented rock backfilling, as to whether or not there is -- there are any methods or techniques commonly used in the mining industry to monitor the quality of that during the process of backfilling over time?

A Yes; absolutely. Yeah.

Q And could you briefly -- you may have discussed this before. Could you briefly describe what those methods or processes are?

A Yeah. The principal method, as I described in my direct, was collecting cylinders -- ASTM cylinders of backfill -- the wet backfill product and curing them and then doing strength testing on them. And then we do periodic ASTM -- what's called an ASTM C109 strength test on -- mortar cube test on the cement and also on the flyash. And we will do either daily or weekly screens -- what they call a sieve analysis on the aggregate to measure the gradation of the aggregate to make sure that we're getting the right grading in the aggregate and make sure we have enough fines in the

aggregate and also periodically would test the mix water that's used -- if they're using mine water for mix water, we'd periodically test that and make sure that there's no deleterious materials in the mix water.

Q The methods or procedure you just described, are they or are they not widely used in the mining industry?

A They're widely used.

Q And to your knowledge, are they generally accepted as effective?

A They are indeed.

Q I believe you were also asked on cross-examination some questions about the use of three-dimensional mapping of the openings subsurface. Do you recall that?

A Yes.

Q And I think reference was made to a particular type or method of that. I think it's referred to as CMS; is that correct?

A The cavity monitoring system, yeah.

Q Just so I'm clear on this, is that -- is that the only means of doing three-dimensional mapping of a subsurface opening?

A No. There are -- there are other methods. And there are -- there are a number of vendors that sell these CMS systems. It used to be one vendor, but now there's a whole slew of them. And there are other methods that it can be done as well. It can be done by radar as well as laser.

Q Okay. But functionally is it or is it not the case that there are practices or methods widely used in the mining industry for essentially mapping out the subsurface openings as you've described?

A Yeah. Nowadays it's pretty much routine. So, I mean, it's an industry-accepted practice to do a CMS survey at the end of every stope.

Q And in your experience in the mining industry, is that sort of method generally accepted as an effective means of determining the opening size?

A Absolutely.

MR. REICHEL: That's all I have. Thank you, sir.

MS. HALLEY: I just have a couple more questions.

RECROSS-EXAMINATION

BY MS. HALLEY:

Q Dr. Stone, generally speaking, what would be considered a high strength on the megapascal scale?

A The highest strength backfill that I've ever encountered in my career was up around 8 to 9 MPa. So what would that be? That would be -- well, that is in psi. I can't think in psi.

Q That's okay. We can work in MPa's. That's all right. So 8 to 9 is the highest you've ever seen?

A Yeah.

Q And in your paper, where would you place 4.8 on the scale?

A That's -- from an industry standpoint, that's a pretty high -- pretty high strength. It certainly statistically would be higher than most mines would use.

Q All right. Now, I believe -- correct me if I'm wrong -- that you said before that the long-term and short-term support of the crown pillar was a secondary consideration for the backfill -- is that right? -- and that the main purpose of backfilling is to support the -- well, to provide the opening for the next stope to continue the extraction process?

A Well, I should clarify that I wasn't trying to pick that in terms of the importance. I guess being a mining -- mining engineer and a backfill consultant, the principal function from a mining engineering standpoint, you know, is providing the support and safety for mining the adjacent stopes. I wasn't trying to label them in terms of which one is more important than the other.

Q Okay. Now, the items that Mr. Reichel just talked to you about, the quality control of the backfill, the aggregate grading, the mixed water, the CMS system, are those described in the application or the permit? I just want to be clear. Are they included or not? Is there a description of those materials, the methods, the techniques -- are they included in the application?

A Not to my knowledge, they're not, no.

Q All right.

MS. HALLEY: No further questions.

MR. WALLACE: Nothing further, your Honor.

MS. LINDSEY: I have no further questions.

MR. REICHEL: Nothing.

JUDGE PATTERSON: Thank you again, sir, for being available. We'll end your testimony.

MS. LINDSEY: Thank you, Dr. Stone. I think we're going to disconnect now.

THE WITNESS: Okay. Thank you.

(Hearing adjourned at 11:53 a.m.)

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