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. XVI

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Monday, May 19, 2008, 8:30 a.m.

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Lansing, Michigan

Monday, May 19, 2008 - 8:45 a.m.

JUDGE PATTERSON: All right. Are we ready?

MR. LEWIS: We're ready, your Honor.

JUDGE PATTERSON: Okay.

MR. LEWIS: Intervenor Kennecott Eagle Minerals Company calls Kevin Beauchamp.

REPORTER: Do you solemnly swear or affirm the testimony you're about to give will be the whole truth?

MR. BEAUCHAMP: I do.

KEVIN P. BEAUCHAMP

having been called by the Intervenor and sworn:

DIRECT EXAMINATION

BY MR. LEWIS:

Q Would you please state your name and spell if for the record?

A Kevin Beauchamp, B-e-a-u-c-h-a-m-p.

Q Mr. Beauchamp, you are a professional engineer at Golder Associates; is that correct?

A Yes.

Q Can you describe your engineering qualifications, please?

A I have two engineering degrees. One is a bachelor's degree in mining engineering from Laurentian University.

JUDGE PATTERSON: I'm sorry. Where?

THE WITNESS: Laurentian University in Sudbury.

A The second is a graduate degree, a master's of applied science, in geotechnical engineering from the University of Waterloo.
Q Do you have any -- or hold any professional affiliations, Mr. Beauchamp?
A Yes. I'm a licensed professional engineer in the Province of Ontario. And I'm a member of the International Society of Rock Mechanics, the ISRM. I'm a member of the Canadian Institute of Mining and Metallurgy, the CIM. And I'm also a member of the Canadian Geotechnical Society, the CGS.
Q What year did you start at Golder Associates?
A 1997.
Q Did you have any experience working for mining companies before you joined Golder?
A Yes. I worked for four mining companies. The four included the Dome Mine, Kidd Creek Mine and Hoyle Pond Mine. For those three I actually worked underground. It was in various production-type roles. Some of the jobs that I would have done in those roles would have been typical production-type work, so tunneling, drilling, blasting, installing of ground support, those types of things.
Q Were those mines what have been referred to here as underground hard rock mines?
A Yes. They're underground hard rock mines. They're similar to the proposed Eagle Mine in that they use the same mining

methods. The Kidd Creek Mine, in particular, is very similar to the Eagle Mine in that it's a volcanic massive sulfide-type deposit. The fourth mine that I worked at was the Ruttan Mine. It's also very similar to Eagle. It's a volcanic massive sulfide underground hard rock mine that uses open stoping. At the Ruttan Mine I worked in an engineering capacity as the rock mechanics engineer.

Q What were your duties as a rock mechanics engineer?

A I participated in the mine design. I helped the mine planners in stope sizing, stope locations, boundaries. I was responsible for the ground control and stability of the overall mine.

Q And is that what has been referred to as a sulfide mine?

A Yes.

Q And turning to Golder, what's the nature of the work you do at Golder?

A Consulting engineering primarily participating in project-type work, various types of projects but primarily rock mechanics and mining and rock mechanics specific to underground hard rock mines.

Q In your position as a mining consultant with Golder, how many mines have you consulted to?

A More than 50.

Q Have you consulted or worked in mines as a consultant similar to the proposed Eagle Mine?

A Yes; yes. The majority of those -- of the mines that I work at are hard rock underground mines. And a lot of them are volcanic massive sulfide, so base-metal type mines as Eagle would be. And they use similar mining methods.

Q Where are these various mines that you consulted with located, Mr. Beauchamp?

A All around the world really; Europe, Africa, South America, Central America, the United States and Canada. A large proportion of them have been in North America and Canada and specifically in Sudbury.

Q How many operating mines are there in the Sudbury area?

A This slide here is a -- it's a graphic that shows the operating mines in Sudbury. This was run in a local newspaper at the beginning of 2007. But I'd say it is still current. There's --

Q Do each of the pictures that are pulled out represent a different mine there?

A Yeah. They each represent an operating mine.

Q And of those mines reflected in that picture, how many have you done consulting work for?

A I've circled them on the next slide. I think that there's 15 of those mines that I've consulted and done project work for.

Q And at these various Sudbury mines, how many have you done crown pillar stability analysis work for?

A Now I've put square boxes around the operations where I've done the crown pillar stability-type work that was done at Eagle. I've done the same type of work at those mines.

Q How many boxed ones are there?

A I think there is eight. There's eight different mines, but I think I should point out that these mines will have more than one crown pillar at each operation. So even though there's only eight, the number of crown pillars that I've assessed is significantly more. One project that I recall in particular I did about five years ago where I looked at the crown pillar stability for four different operations, and I think the number of crown pillars that were active at those four mines was 50.

Q And can you explain how is it that a particular mine could have a number of crown pillars?

A Each -- when I talk about a mine, I'm referring to one site. And that site is usually defined as having one method of access. It'll have one shaft or ramp or it might have a shaft and a ramp both. And that'll be referred to as the mine. But within the mine, they'll have different operating areas, different orebodies. And these orebodies could be separated by significant distances so that they have distinct roofs or crown pillars above each orebody.

Q Have you had experience in assessing crown pillars in the vicinity of surface bodies of water, Mr. Beauchamp?

A Yes, I have.
Q Have you assessed crown pillars for new mines --
A Well, I --
Q -- as well as post-closure?
A Yes. I've done a lot of work for closure purposes. Most of the crown pillars in the Sudbury basin, if that's what we're talking about in this case, it's a mature mining camp. They've been mining in Sudbury for a hundred years or so. And so there's a lot of established crown pillars. There are also new crown pillar areas in new orebodies that they're still just developing now. So I've done both. It's been predominantly established crown pillars or crown pillars that are established and they're looking to continue mining to maybe a reduced crown pillar thickness that I would have looked at.
Q In any of the large number of crown pillar studies that you've done or for which you've consulted, have there been any collapses of those crown pillars?
A Not after I was involved. I have looked at some crown pillars that have collapsed, but I wasn't involved before the collapse occurred.
Q Now, I want to turn to the various -- or to the work that Golder has done in connection with this Eagle mining project. And first of all, what have you reviewed in order to prepare for your testimony here today?

A I've reviewed my reports, the data in the reports. I reviewed the industry standards. I've reviewed the reports of others as they pertain to the geotechnical work that I've done.
Q Now, the reports that you referred to, were they submitted with the mine permit application pursuant to the requirements of Part 632 and the regulations thereunder?
A Yes.
Q Do the various reports include a summary of the data that you relied on for the analysis in the various reports?
A Yes.
Q How many reports did you complete, Mr. Beauchamp?
A I completed two reports and four technical memoranda.
Q And are they -- the various reports and technical memoranda listed on this slide?
A Yes.
Q And they include what we refer to Appendix C-2 to the mine permit application which is in Intervenor Exhibit -- Appendix C-3 to the mine permit application which is in Intervenor Exhibits 593, 78, 594 and 79?
A Yes.
Q Now, I'd like to turn next to asking you to describe the work that was done and the analysis reflected in the mine permit application Appendix C-2, Mr. Beauchamp.
A Okay. The first report we produced was issued in April

2005. The first section in that report dealt with the data review that we conducted at Eagle. We were primarily looking for data that was geotechnically important. We looked at the database that Kennecott produced. I went to the Eagle site a couple of times in the preparation of this report and looked at their logging procedures, talked to the geologists who were on site, looked at their core logging procedures, checked to see that they were using what I would understand to be the industry standards. I looked at the core myself, the core that was available at the time when I was on site. The borehole database included at that time for the April 2005 report 92 boreholes and over 8700 meters of drilling.

When we got this data, we looked at the data to see what the distribution of the boreholes were, how well it covered the orebody and the crown pillar. So how we did that was we took the borehole data, the actual location of the boreholes in space in a three-dimensional geologic modeling package, and we took a look at how dense the data was, where the boreholes were and, in particular, where there was limited data. And we did note in our report where we needed to look to get additional data as the project moved forward, and we made those recommendations.

Q Could you describe in a little more detail the geotechnical modeling that was done and is reflected in the mine permit

application Appendix C-2?

A Yes. The geotechnical model consists of two separate block models. One model is -- reflects the RQD and the other reflects the RMR or the rock mass quality. The way that these block models are created is you take the -- we took the geotechnical database from Kennecott. We calculated or used their data to calculate the RQD values or the RMR values down the borehole. So once you've done that process, you have boreholes with linear data in space. We then took a modeling software package that's designed to calculate block models, put a block model around the boreholes. The block size was one meter. And we used a geostatistical method called kriging to infer the values found in the drill holes to each of those one-meter blocks. And so at the end, we had a three-dimensional block model around the area that we were interested in, which was the mine and the crown pillar, that then defined what the RQD and RMR values were in those areas.

Q And again is the data you relied on for that modeling summarized in the various tables and figures in that report?

A Yes.

Q And is that what's some of that data is shown on this next slide, Mr. Beauchamp?

A Yes. This is a table from our report. And it lists all the boreholes that were included in the GoCAD model. And these

were all the borehole data that we received from Kennecott.

Q And at this time, was this a preliminary or I think you referred to it as a phase one part of this study?

A This is the phase one study, yeah.

Q And could you tell us what you did in terms of looking at rock strength?

A Yes. There's three methods generally for looking at the rock strength of different rock types. And they include the ISRM, the International Society of Rock Mechanics, field techniques. I have some further slides on these in a second. There's also point load testing. And there is laboratory UCS testing, which was in progress at the time of our April '05 report, but the testing program had not been completed at that time.

Q And does this next slide continue this explanation of the rock strength analysis, Mr. Beauchamp?

A Yes. This table is included in our report. And this is an industry standard table that's put out by the ISRM. What this describes is the field techniques that you'd use to assess the strength of rock in the field. So this describes in a qualitative way what you would do to the rock. So this is -- you can see indented with your thumbnail, hit it with a hammer, try to peel it with a knife. These were some of the things that I did while I was on site to get some ballpark of what the strength of the rock would be. And as

you can see in the last column, it gives you a range of what the -- what the UCS of the rock is that you're looking at.

Q And could you explain a bit more about the point load testing and how that relates to the uniform compressive strength testing for data?

A Yes. The ISRM field table, if you follow that, you'll get a range of what you would expect the strength of the rock to be. But there's only a moderate level of confidence that you'd have in that because it's a fairly crude approach. You're just hitting it with a hammer, for example. So there's point load testing that can be done. And it was done extensively at Eagle on the core. And what the point load testing entails is you have a point load testing frame where there's two steel platens. And you have a pump where you would close the platens together on a sample of core. And the testing machine would measure the load at which the sample fails. Okay. So that is what the IS value is that you see in the second column. So going through this table, the first column is rock type or the lithology.

MR. HAYNES: Excuse me. Before the witness starts testifying about the results of the point load testing, I'm going to object for a couple of reasons. One, lack of foundation, because the evidence that -- or the data that represents -- that is represented in Table 3, which is on page 7 of Appendix C-2, is not in evidence. The data

apparently is in the database that was compiled by Mr. Ware and sent over to Golder by Mr. Ware. We haven't seen the data. We haven't seen the databases. They haven't been provided to us. They aren't in evidence. And so there's no foundation for this witness to testify by opinion or summary from that data.

Secondly, the witness cannot -- should not be allowed to give an opinion based on that data under MRE 703, which requires the data for an expert's opinion to be in evidence before the expert gives an opinion. So for those reasons, I object to this witness being allowed to give an opinion based upon the data that are not in evidence.

MR. LEWIS: As Mr. Beauchamp testified earlier and as reflected in this table, this report does include, in fact, a summary of the data that was relied on by Golder in doing this analysis. And that summary and those -- that data is reflected in this table, your Honor. And it is a summary of what is rather voluminous data, as you might imagine. As to Mr. Haynes' reference to the recently revised Michigan Rule of Evidence on that particular point, that's not the Rule that applies to this forum, as I understand it. And we have been proceeding so far in this forum under the Rules of this forum, I think pursuant to your earlier rulings that, if a witness could -- was here to testify about a report that either he had prepared or he

could otherwise describe the report with sufficient detail, that we've been admitting these reports. As we've already discussed, these reports are required by law to be submitted pursuant to Part 632 and the regulations as a part of the mine permit application. But again the Rule, as I understand it, that applies to this forum is that an agency may admit and give probative effect to evidence of a type commonly relied upon by reasonably prudent men in the conduct of their affairs. And I believe that's exactly what we have here. We have a summary of the data actually relied on by Golder in these reports and that it is neither necessary nor practical to require that a very voluminous set of data be admitted in order to allow this evidence to be admitted, your Honor.

MR. HAYNES: Your Honor, a brief response. Section 75 of the APA doesn't apply here. Because first of all, the summary of the data that is contained in Appendix C-2 is exactly that, a summary. The data aren't appended to the appendix. They aren't attached. They haven't been -- they weren't provided to the DEQ from what we understand from the evidence thus far. They've never been provided to us. We have no opportunity now to question this witness or cross-examine this witness about any of the underlying data that form the basis of his probable opinions. So to say that a geologist, even a geologist with Mr. Beauchamp's

experience, or Jack Parker or Stan Vitton or perhaps Mr. Carter who is going to testify later, might use these. But that doesn't make them admissible without the underlying data.

Because -- and I think MRE 703 applies to these proceedings irrespective of Section 75. We have no -- we've had no opportunity to go back to see if the data represented by this chart and the opinions that I think that Mr. Beauchamp will be giving -- we have no basis to double-check that. They haven't shown their work. We don't know what the data are. And so -- and the experts thus far for the Petitioners have either used data out of the application that they were able to glean or field studies that they did or, in the case of Jack Parker and Stan Vitton and Marcia Bjornerud, we used the data that we had available and the photos of the eight cores. That's all we had. And they were meticulous in their use of that underlying data and showing their work. And now we have a situation where the witness is going to give us a summary based upon 92 boreholes, eight of which we've seen. And so for that reason also it's also more prejudicial than probative to allow this witness to testify to those -- to those issues.

MR. EGGAN: I would add, your Honor, that this same objection was raised to testimony offered by Ann Maest in my effort to offer her report into evidence in this case.

It was objected to on the basis of counsel's contention that the underlying data for that -- for that expert report was not available for cross-examination. And as a matter of fact, it was reports and documents that were already included in the comments. And so again I think we have a situation where what's good for the goose ought to be good for the gander here. This is an objection that they made to one of our witnesses in a report that we chose to submit. And the court agreed with them and sustained that objection. And we have not yet worked through the admission of that exhibit. And so I object on that basis.

MR. LEWIS: Your Honor, I would like to respond to that point. That is not correct. That is flatly incorrect. And as the court may well recall, my objection as to the attempt to get in the -- one of Ann Maest's documents -- and by the way, her other report did come in. But as to the one document that the Petitioners were attempting to offer to this court at that point, as I pointed out, aside from Ann Maest's analysis and work, there was included and appended to that report a separate summary of a report on a completely different subject matter, that being groundwater drawdown, appended to her report. And I objected on that basis. That is nothing akin to what we're talking about here where again this is a report submitted by law as required to the MDEQ. This is the information that, in

fact, the MDEQ relied on in the summaries of data in this report. So that analogy has no basis and, in fact -- and again I don't believe this court can do its job without having available to it the very reports, the very same summaries of information that were submitted to the MDEQ in the process of making its permitting decision, your Honor.

JUDGE PATTERSON: Mr. Reichel, do you have anything to add?

MR. REICHEL: No. I certainly have no objection to the admission of this. And I do believe that it's appropriately admissible. I don't believe that this tribunal has in this case or generally strictly adhered to MRE 704. In fact, the over-arching standard, as you well know, is that provided by the Section 75 of the Administrative Procedures Act.

JUDGE PATTERSON: I'm going to overrule the objection based on the Section 75 of the APA. Obviously Mr. Beauchamp relied on this information in formulating his opinion. And some of this is his own work. It's not just a recitation of --

MR. LEWIS: Yes, your Honor. Yes.

JUDGE PATTERSON: So I'll overrule it.

Q I'm not sure where we left off, Mr. Beauchamp. But if you recall, could you continue your -- if you haven't finished yet your description of the information shown in this table?

A Yeah. So just to recap, this is the point load testing data in this table. The first column is rock type. The next column is the average point load index, the IS value. And it's the load at which it takes to break the rock. We've done some statistics on the data that was collected during core logging, so we've also given the standard deviation, the number of tests and the UCS value to which that point load index relates to. So going back to the previous slide, this is a further -- or a second and more reliable way of determining the UCS of the rocks in addition to the ISRM field techniques.

Q And before we continue, Mr. Beauchamp, you told me last night about -- it was something that Mr. Ware had said about the UCS testing, I think it was, that -- and then you had talked to him and he had not recalled that correctly. Could you remind what that was?

A Yes. One of the responses we gave to the DEQ when they requested clarification was to describe the UCS testing program. So that's in one of my later reports. And that wasn't consistent with Mr. Ware's testimony. So following his testimony, Mr. Ware and I had a conversation. And, in fact, what is in my responses to the MDEQ is accurate.

Q Okay.

A And Mr. Ware can confirm after his time on the stand.

MR. HAYNES: Just for the record, can we clarify

what responses we're talking about? Is it Appendix C-2 or is it some other response?

THE WITNESS: It is -- we're talking about the July -- it's Intervenor Exhibit 594.

Q The KEMC Eagle responses dated July 7, 2006?

A Correct. It's also discussed in Intervenor Exhibit 79.

Q Thank you, Mr. Beauchamp. Now, did you also prepare a slide from the -- I believe it's from Appendix C-2 as well as to the RMR or rock mass classification?

A Yes.

Q And what does this show, Mr. Beauchamp?

A This is a slide that shows the RMR 76 table that was included in our C-2 report in Appendix B. And it shows the RMR formula, that it's a sum of five A parameters. And the table describes the values that are attributed to the five different parameters given the different -- the different areas that you're looking at whether that be intact rock strength, the RQD, the joint spacing, the joint condition or the groundwater.

Q And does the next table summarize the RMR results that you obtained for this phase one preliminary part of this analysis?

A Yes. So once the block model is created, as we described before, then we look at the results in the block model to determine what the inferred values are in different

locations throughout the mine that are of interest to us. So we would take the block model. And in the case here, I think, that we might have cut 10 or 12 different horizontal slices through the block model and looked at the RMR contours at each elevation through the mine. So this table reflects what was shown on those contours and what is included in the block model.

Now, the far left column is the mining method. At the time of this report when we first initiated this project, there was a preliminary scoping study done on Eagle. And it described three different mining methods at different elevations through the mine. This was just a preliminary mine plan.

Q These are methods that might be used?

A Correct.

Q Is that the idea?

A So this table looks at what the Rock Mass Rating was in the areas where this preliminary mine plan is considering the different mining methods. And it simply just summarizes what we saw to be the minimum and typical RMR's in each of these sections that I described. And it also calculates a Q equivalent, Q being -- there's two standard industry methods of calculating the rock mass quality. RMR is one and Q is a second parallel method. So we did both RMR in this chart as well as Q.

Q And is Q a parameter that's used in, I think what we've heard to referred earlier, as the scaled span stability analysis?
A Correct. Q is used for a number of approaches, and I'll cover those today.
Q And what's the range you have on there -- on this Table 8 RMR minimum and RMR typical, and could you just say what the range is for those two categories here?
A Well, in the RMR minimum column, the -- that range is from 60 to 70. And the RMR typical goes from 70 to 80.
Q And what does "typical" mean as opposed to the "minimum"?
A Minimum is the low-end value that you'd see in the area of interest on the contour that you're looking at. And typical would be more the mean or the average value in the area that you're looking at.
Q And if we go to the next slide, could you explain what this shows in terms of the analysis you're describing here?
A During logging an effort was made to orient the boreholes where possible. When you have oriented logging data, you're able to orient the discontinuities in the core in true space. We took that oriented discontinuity data and we assessed it using a technique called stereonet analysis. The stereonets that we created are in the appendix to our report. And this is a summary of what we saw in those stereonets as far as the major and minor discontinuity sets

in the areas of the mine that we were interested in.

Q Why did you need to look at this kind of data?

A This gives you an indication of what the rock fabric is going to be. And it allows you to look at -- look at what the support requirements -- the immediate support requirements would be in the tunnels that you'd be developing in those areas.

Q So this is for areas that would be assessed by people who have to work in these access -- what we've heard described as drifts and development workings and so forth?

A Yes.

Q And could you explain a bit what you looked at in terms of so-called features or discrete features that we've also heard some discussion about earlier?

A Yes. This is a section from page 11 of our report. The first paragraph discusses a discrete fault plane that was -- that was postulated in the scoping study that we looked at. So we knew the location of where this potential plane would be. So we included it in Figures 3 to 8 in our report. The next paragraph goes on to discuss other structural features that we were looking for. In our C-3 report that we will talk about later today, we're going to talk about the major structures table. This is -- the second paragraph is the early work that relates to the major structures table. So what we did was, in the database, we looked for these -- and

reviewed these broken, sheared and gouge zones. And again the way that we did that was we took the location of these along the boreholes, the intervals at which these occurred, put them in a three-dimensional geological software package and took a look at them in space and saw their relation to one another.

And the last paragraph just says that these features -- the potential feature that was represented in the scoping study is included in the figures in the report. But the current data density isn't sufficient to interpolate any of the broken, sheared or gouge zones that we saw in the database.

Q That was at that time?

A At that time. And we made the recommendation that that should be considered again when more data is available and particularly when there's some mapping data available when you develop underground.

Q In this report, the Appendix C-2 to the mine permit application, did you also consider and include some discussion as to the potential types of ground support which might be appropriate in the -- again the development areas, the areas where there would be human access in the mine plan?

A Yes. We did look at the ground support requirements. And I recommended three ground support classes be considered.

They're listed here. Class 1 has a rock mass quality greater than 4. So it would be fair to good rock. And what would be required in these areas would be spot bolting or pattern bolting.

The next category, class 2, would be poor rock that has a Q value less than 4 but greater than 1. And it would require pattern bolting, 4 to 10 centimeters of fiber reinforced Shock-Crete.

And the third category is for very poor or extremely poor ground conditions with a Q value of less than 1. We call that class 3 support. And that would be required for areas where you have this type of rock mass classification. And we recommended pattern support bolting, metal screen and 4 to 10 centimeters of plain Shock-Crete.

Q And again just to be clear, Mr. Beauchamp, what you're describing here, does it -- it does not apply to the so-called crown pillar stability analysis, does it?

A No. This is for the development in the mine, so the ramp, the drifts. There will be crosscuts into the ore, and it would be applicable for the crosscuts into the ore. But it's not directly applicable to the crown pillar.

Q Could you briefly -- we saw this once, but briefly show what you mean by these crosscuts and where they are and what the purpose is on the paper there?

A Yes.

Q And I don't know that we have new paper. I don't think that's an exhibit. So you can just draw perhaps in the upper part of that paper.

A Okay. So, Mr. Lewis, the request is for a diagram of the crosscut?

Q Yes, sir; yes, sir.

A Okay. So if you have block -- a stope block --

(Witness draws diagram)

A This is a stope block as laid out in the mine permit application. This width would be 10 meters. This height would typically be 30 meters. And this length would vary depending on the thickness of the orebody at that location in the mine. But this could be 50 meters here. And what the crosscut is is you'll have a development outside of the ore. And then the tunnel will turn into the orebody and you'll get a crosscut that will go through the orebody sort of like that (indicating). So it's the development. And I think that's why it's called a crosscut is because it cuts across the ore. And it would go from hanging wall to foot wall or foot wall to hanging wall.

Q And the purpose of that access is to do what?

A Is to gain access to the ore to the development areas of the mine.

Q Is that where -- is it from that area that the drilling to place the explosive is done?

A Yes. There's a development -- there's a crosscut located at the top of the stope. There's also another crosscut located at the bottom of the stope. So it would -- and the drilling would be in the material located between those two -- between those two crosscuts.

Q Okay. Thank you. So those crosscuts that you've just illustrated again in addition to what's been earlier described as these ramps and other access tunnels are the areas to which this ground support discussion here would apply?

A Yes. So as you're developing this crosscut, you would develop one round at a time, which is one length of drilling and blasting and removing of the blasted rock. That round length would probably be around 2 to 3 meters at a time. So you'd advance 2 to 3 meters and remove that rock. Okay? And then you'd install the ground support that I'm describing with the screen the Shock-Crete. And then, once that's completed, you'd go and you take another, and you just step across and step your development forward, and that type of technique would be used for the ramps, the drifts, the crosscuts, all those areas.

Q And are these methods you just referred to standard practices in the mining industry for underground hard rock mines?

A Yes.

Q And I believe your next slide also relates to these industry practices for reinforcement of access areas in mining operations?

A Yes. This is a standard industry support graph from a publication by Barton, where it has the -- this (indicating) is the geometry of the opening or the span; how big the opening is. This is the rock mass quality, the Q value. You could also have the equivalent RMR's here. So what this graph represents is you have smaller openings at the bottom and, as they get bigger, you go to the top. You have very poor -- exceptionally poor, poor, fair, good, very good and excellent rock mass quality, so your rock mass quality is increasing as you go to the right of the figure.

So what this figure represents in the crossed areas here is we have -- this is the sizes of openings that'll be created at Eagle, so we're in this band as far as the excavation spans. And it goes -- we've plotted it completely across the spectrum of possible rock mass quality that could be encountered, and this corresponds to rock that would potentially be stable with no support; however, due to health and safety considerations, we recommended this is our support class 1 in this area. This is our support class 2, and this is our support class 3, as described on the previous page.

Q And could we turn to the stope design, Mr. Beauchamp? And I

believe in your report you used an analysis called Mathew's Method, and could you please explain what that is and how it relates to the stope design?

A We received the preliminary stope design, and the purpose of using Mathew's Stability Method was to assess the stability of those sizes and orientations of stopes in the rock mass that we were expecting, the rock mass, in fact, that we modeled using the RMR block model. So this first slide here shows the derivation of Mathew's Method, so Q prime is again the rock mass quality. The prime just means that it considers the joint, water and stress reduction factor to be 1.

There's some adjustments, the A, B and C adjustments for stress joint orientation and for a gravity adjustment to arrive at the N value, which is commonly referred to as Mathew's Stability number. And then there's also a stope geometry parameter, which is the hydraulic radius, and it's simply the -- if you look at the wall of the stope, it's the area of that wall, so the width times the longer, divided by the perimeter so two times the height plus the length.

And if you get your N prime and your HR number, you can go to Mathew's Stability Graph, and you can locate that particular stope wall on the graph, and it'll give you an indication of whether it's going to be stable, if there

are plots are in this area; if it's going to be potentially in the cave zone, if it's in this area; or if it's in the unsupported transition, the stable-with-support zone or the supported transition zone here. So what we did was we looked at the proposed mine plan. We looked at what our -- to get -- we looked at the proposed mine plan to get the geometries and the location of the stopes. We looked at the RMR block model to infer what our expected rock mass quality was going to be, and we plotted where those stopes were on Mathew's Stability Graph as an indication of whether the stopes would be stable or not.

Q And what's the result reflected here or the conclusion?

A The conclusion was, if you go to the next slide, actually, that the stopes were expected to be stable. Support may be necessary. There were some stopes that were in the transition zone.

Q When you say "may be necessary," is that localized areas where poorer rock may be encountered, or do you mean the entire stope or what?

A If I can go back to the diagram, as you're developing across the stope, you'll be able to -- you will be mapping what the rock mass quality is in this crosscut, so you will have, you know, entire hallways of rock exposed. And there's a process where you'll go through and you'll do detailed geotechnical mapping. You'll look for what the fabric is

that I described in an earlier slide akin to the stereonet analysis, and you'll also look for any major structure that may have an influence on stability, and you'll do this as you go across the orebody. One you get the crosscut in place, if there's a reason to think that you may be in this transition zone, that would be when you'd come back and put in some engineering controls, e one engineering control would be cable bolts. So you'd put cable bolts into the ground from the crosscut, and you could do this at different lengths, so you'll end up with a bunch of these sets of cable bolt rings as you go across (drawing).

Q And that would be used if necessary or appropriate based on the conditions, then?

A Correct; the actual conditions that are mapped in that specific area.

Q And again, we're not talking about the analysis of the crown pillar stability at this point, are we?

A No. You do that in any of the stopes that you would develop in the orebody. That would be a standard process.

Q And again, at this point, as reflected in your slide, this was preliminary, and you were recommending further assessment at this time?

A Yes. We're recommending that additional work be done so, as more information becomes available, you'll revisit your geotechnical model. There's also going to be modifications

and changes to the mine plan as the project moves along. At this stage we were considering a scoping study that was what I would say a very preliminary mine design. There was not a lot of definition or confidence that that was in fact close to how the actual mine was going to be built.

Q And is this additional analysis and evaluation as the mine proceeds standard practice in the industry, Mr. Beauchamp?

A Yes.

Q Could we then turn next to the Crown Pillar Stability Assessment that was discussed and reported on in this Appendix C-2, Mr. Beauchamp?

A Okay. The Crown Pillar Stability Assessment that we completed considered two methods. These are the industry-standard methods for looking at crown pillar stability. They include the empirical scaled span method and Cpillar, which is a limiting equilibrium method.

Q Would you discuss, then, the empirical scaled span method for us, Mr. Beauchamp?

A Yes. It considers the important parameters that are going to influence the stability of the crown pillar, and those are primarily the geometry of the crown pillar, how big an opening you have under the crown pillar and how thick the crown pillar is and also the rock mass quality; how good the rock is in the portion of crown that constitutes the roof of the mine. So the empirical scaled span approach is based on

the back analysis of many hundreds, in fact, existing crown pillars. We looked at the geometry as we understood it at the time in this preliminary mine plan.

We considered in our scaled span that the crown pillar would be completely excavated underneath of it. So it's a very conservative consideration. The entire crown is going to be excavated, and there won't be any backfill used, was what we considered at this point. We got the rock mass quality from the GoCad geotechnical model, block model that we had put together. And at the end of this, we did make a note that, you know, this needed to be revisited, and this assessment presented in the C-2 report is ultimately superceded by updates hat that we had as we got a better understanding of what the actual -- we got better definition on the rock mass quality, and we got the next installment of what the proposed mine plan was going to be.

Q And I think we turn next to discussing the results of the empirical scaled span method, Mr. Beauchamp?

A Yes. So just a little explanation of what this graph is presenting --

MR. HAYNES: Your Honor, before the witness continues, I would like to place -- renew my objection that we discussed before, just so that -- for any opinions that this witness expresses based upon the data that we haven't been provided with that are buried in some computer program

either in Sudbury or in Negaunee; that the witness can't testify based upon that data.

MR. LEWIS: And Mr. Haynes may have a continuing objection, so far as I'm concerned as we go through these various reports.

JUDGE PATTERSON: Okay. That's fine.

Q Go ahead, Mr. Beauchamp.

A Okay.

Q Explain what this chart is, what it means and what the vertical, horizontal axes are and then what the line in the middle is, please.

A Yes. The vertical axis is the scaled crown pillar, so again it's the geometry of the crown, and it speaks to how thin or thick the crown is and how big of an opening is underneath the crown. So where you have very large scaled crown pillars, these are large and thin, and these are smaller and thicker to the bottom.

Q You mean smaller opening and thicker crown pillar?

A Correct; smaller horizontal extent underneath the crown and thicker crown pillar. In the horizontal X-access, this again is rock quality -- low rock mass quality on the left, high rock mass quality on the right. And each point that you see in the figure is an actual existing crown pillar.

Q From other mines, you mean?

A From other mines, yeah; from mines throughout the industry.

And if you look at each individual case, the points that are in the upper portion and to the left represent the cases that are more likely to be unstable, and the cases that are down and to the right would be cases that would be stable. This line divides the unstable from the stable areas in the graph, and we call that the stability line. Cases that plot on the stability line would have a factor of safety of 1. So the colored dots on the graph indicate cases that we looked at in the C-2 report. Okay? So we looked at two different rock mass qualities. This would be what we showed in the previous table as being the minimum and typical.

Q This is from the Eagle Rock data?

A Correct. And we also considered different thicknesses of the crown, you know, with some of the -- with thicker and thinner cases as the case may be. And you'll notice that there are a few cases here with the minimum rock mass quality and the thinnest crowns that plot on the unstable side of the stability line. They would have factors of safety of less than 1. But as you can see, they're very close to the line so not much less than 1. The majority of the cases that we looked at plot on the stable side of the stability line.

Q Were you assuming at that time again a completely open void under the crown pillar?

A Completely open void, which means that all the stopes on the

level were mined at one time, and no backfill was used, which isn't the case, I understand, in the mine permit application, where they're only going to open one stope at a time. The stopes will actually be much smaller than what we considered here, and they will in fact use tight backfill throughout the stopes under the crown pillar.

Q And what is shown in this slide, Mr. Beauchamp?

A This is a -- these tables represent the results that were plotted on the previous graph, and they -- each row in the table represents one case that we considered. The cases with low factor of safety have been arranged at the top. You'll see that these are very thin crown pillars. Only 25 meters was what we considered on the top line. You'll also notice that these are very large spans and lengths. They're all excavated at one time. On the top line we considered a span of 71 meters and a length of 113, and the result of that was that you ended up with a factor of safety of .82.

Q And you have a range of factors of safety there based on the various dimensions and thickness of the crown pillar?

A Right. The first three lines are less than 1 but not a lot less than 1. There's one, two, three, four, five, six, seven, eight, nine, then cases that are in the range of -- with a factor of safety between 1 and 2, and there is five cases that we looked at that have a factor of safety greater than 2.

Q And what's the -- you mentioned that this assumes an entirely open void, but is -- "T," the third column to the right, is that the -- does that reflect the assumed potential thickness of the crown pillar? Is that what that value is?

A Yes, it does. According to the preliminary mine plan that we were -- we had access to, we were considering thicknesses of the crown pillar that ranged between 25 and 65 meters thick.

Q And the final recommended -- crown pillar recommended by Golder and reflected in the permit condition is 87.5 meters?

A Yes.

Q Anything else on this slide, Mr. Beauchamp?

A No.

Q And I think we're ready now to turn to the -- a discussion of the second of the two methods you indicated are used for subject property stability assessments, the first one we talked about being the empirical scaled span method. And I believe this next one we're going to talk about is the -- is this the same, or are we going on to the --

A This is the second method, Cpillar limiting equilibrium analysis.

Q All right. And could you please describe this method?

A This method considers a rectangular geometry for the crown pillar and the thickness and looks at the rock mass rating

and the Hoek Brown fail criterion and considered a plug-type failure so that this -- the entire crown pillar would fail as a plug. The geometries that we used are the same as what we looked at in the scaled span from the same preliminary mine plan. We conservatively considered again that the full crown would be excavated at one time and there would be no backfill. The rock mass rating we looked at again was the typical and -- rock mass rating from the GoCad modeling. And again, we made the note in our report that this was the preliminary time through this, and in fact we superceded this Cpillar with another Cpillar run in -- that's presented in the C-3 report.

Q We had heard about this at -- let me clear. This second method of looking at crown pillar stability, you've got on here "considers plug-type failure." So does this second method consider a different type of potential failure?

A Yes.

Q Okay. And I believe that's the kind of failure, the so-called plug-type failure, that I believe Mr. Vitton and perhaps Mr. Parker had talked about earlier in reference, I think, to the Athens Mine?

A Yes.

Q And this modeling then specifically looked at that type of potential failure?

A Yes.

Q And is that standard practice to do this kind of analysis as well in the crown pillar stability assessment?
A Yes.
Q And then could we turn to the results of this analysis, Mr. Beauchamp?
A So these are the tables that summarize the CPillar analysis. These are right out of our report. And again it considers different top-of-crown elevations that give you different thicknesses, and the range of thicknesses that we considered in this case were from 25 meters to 45 meters thick.
Q And again, that -- for point of reference, that would -- that's the now 87.5-meter crown pillar?
A Correct.
Q Okay.
A The upper table is for an RMR of 75. The lower table is for an RMR of 85. And you can see that the factors of safety in both tables are greater than 2.
Q And again, for point of reference, you're considering large spans here which do not reflect how this mine will be mined, meaning one stope at a time and backfill. Is that also correct?
A Correct. The "X" and "Y" columns here are the horizontal extents, so in the top line, which has the lowest factor of safety being 2.7, the horizontal extents are 113 meters by 71 meters with a 25-meter-thick crown pillar.

Q And these factors of safety that you report here again with these assumptions about an open void and a much thinner crown pillar than the actual crown pillar in the permit, the factor-of-safety numbers all being above 2, some substantially above 2, what do they indicate about the likelihood of a potential plug-type failure based on this analysis?

A It indicates that a plug-type failure is not likely to occur.

Q And could we turn then to the discussion and recommendations in your Appendix C-2 report based on this preliminary phase-1 analysis, please?

A Yes. I've included two quotations directly from the discussion and recommendations found in our C-2 report with respect to the crown pillar, and I'll read them:

> "It will be required that additional rock mass quality information be collected underground, when access becomes available, and the crown pillar stability reassessed."
>
> "If the crown pillar is determined to be 'marginally stable'; i.e., with a factor of safety between 1 and 2; or unstable; i.e., with a factor of safety less than 1; it will be critical that all void areas beneath the crown pillar be filled with consolidated material; i.e., cemented fill; when mining

is complete."

Q And did you in fact, as has been, I think, inferred in earlier testimony, recommend a final crown pillar thickness in this report?

A No crown pillar thickness was recommended in the report. We looked at the crown pillars as described in the preliminary mine plan that we were reviewing at the time.

Q Did you also in this initial reporting do some preliminary calculations as to backfill strength, Mr. Beauchamp?

A Yes. I completed some calculations based on the stope sizes that we were looking at to get an initial minimum self-supporting backfill strength that would be required for the backfill to be self-supporting and would stand up in these stopes. I used two formulas. One is a straight gravity calculation, and the second is a formula derived by Dr. Mitchell. And the table described here in -- from our report includes the stope wall sizes that we looked at, and it calculates using both methods -- this (indicating) is the gravity. This is Mitchell -- using two different factors of safety, 1 or 2. It calculates what the backfill strength requirement would be for those backfill walls to be self-supporting. And it's only a couple of pages in the report, but the conclusion at the end is that, for initial design purposes, a backfill strength of 1.5 MPa, which corresponds to 218 psi, is what we were recommending as a

starting point for consideration in the backfill design.

Q And is that in keeping with generally accepted standard industry practices for this type of analysis?

A Yes.

Q As to further and additional analysis of the backfill material and strength requirements, was that done by others after this point?

A Yes.

Q And that's what we heard Mr. Stone talk about the other day, I believe?

A Yeah; correct. What is presented in our C-2 report is all that we were directly involved with.

Q And could we turn to then the 3-D mapping work that you did and which is reflected in the Appendix C-2 report?

A Yes. Near the completion of our C-2 report, McIntosh became involved at Eagle. I don't know exactly what the time frame was, but it was in this time frame they started to look at the mine design. And later, closer to when we issued our report in April, they provided us with a sequence for the stoping, the order in which the stopes would be excavated in the mine. And so we took that initial mining sequence, and we used a 3-D numerical modeling package that looks at the induced stresses, and this is a standard practice to do this.

So we took the mining sequence. We took the

geometries that were provided, and we looked at the induced stresses as you took the stopes out in the sequence that was prescribed. The two things that we looked for in the model were to look for areas of high stress where you have deviatoric stress, which would give you an indication of where you might have some rock mass failure due to high stress.

We also looked at areas of low stress, where you'd have low confinement in the areas around the mine, which may lead to some low-confinement-type issues with respect to stability. All the results for the map 3-D models are included in the Appendix, and the results of this modeling exercise were that no major issues were found. We didn't find large areas in the mine that would be -- that would -- were likely to have high stress problems, nor did we find any areas in the mine that were likely to have low stress problems. But again, we understood that this was still -- we're still at a very preliminary stage so, like in most sections in our report, we recommended that it be revisited when more information is available and specifically when you have information from underground available.

Q I think that completes our discussion of the Appendix C-2 report, Mr. Beauchamp.

MR. LEWIS: And, your Honor, at this time I'd like to offer this report. It's Intervenor Exhibit Number 2.

It's been referenced as the mine permit application Appendix C-2, and in our Exhibit Number 2 it is Bates range 102420-102526.

MR. HAYNES: I object for the same reasons that I've already stated this morning for the conclusions in this report that are based on data that aren't in evidence that we haven't had access to and this witness has testified to without our being able to cross-examine him based upon the data; lack of foundation, so on.

JUDGE PATTERSON: All right. You can reaffirm that, but I will admit it over that objection.

(Intervenor's Exhibit 2, Appendix C-2 received)

Q Now I'd like to turn to the next report, and I think you've characterized it as a phase 2 -- is that right, Mr. Beauchamp? -- of the analysis?

A Yes.

Q And it's also referred to or titled as Appendix C-3 to the mine permit application?

A Yes.

Q And could you start with the executive summary or the summary of what that report includes?

A Yes. In the executive summary at the beginning of this report, first page, first paragraph we described the work that we were doing, and we described the C-2 report as being a phase-1 geotechnical study. We described the report --

the C-3 report, in fact, as the phase-2 report, and we also indicate that there is going to be a phase-3 geotechnical study that will be completed when underground operations being at Eagle.

Q And could you explain the "data review" section of this analysis, the summary of that, please, Mr. Beauchamp?

A Yup. We received an updated geotechnical database from Kennecott to do the phase 2, the second part of our work. It was updated through the period from when we had received the last database. So if you look in our previous report, the C-2 report, in the data review we described to the day when we received the database from Kennecott, and I think that that was January 3rd, 2005.

Q And again, as with the Appendix C-2 report, does the Appendix C-3 report summarize the data that you actually used in the analysis and the various tables and figures to that report?

A Yes; yeah. So the data -- we received another copy of the updated data in September 2005. This included data on 109 boreholes and more than 17,300 meters of drilling. And we went through the same process as we did with the prior set of data. We looked at the spatial distribution of the data where we had coverage, where we would like to increase our coverage and get further data in the future and made recommendations about where we had some data limitations and

recommended that those be collected during operations of the mine.

Q Meaning, once underground?

A Once underground.

Q And could you explain the geotechnical modeling that you did that's reflected in this updated analysis, Mr. Beauchamp?

A We went through the same process again of creating two separate block models, the RQD block model and the RMR block model. It is the same process as before, where we calculated values down the boreholes, used GoCad to infer those values through a block model around the areas of interest in the mine. I think the important thing to note here is that this process is repeatable, and it's intended to be so, so when you get new data, you can take the data and go through the same process and update your RQD and your RMR block models to reflect the latest data as you collect it.

Q And is that type of updated modeling actually reflected in the permit condition we talked about earlier in these proceedings?

A Yes.

Q And was it recommended by Golder in its final reporting as well?

A Recommended by Golder and in the mine permit application.

Q And I think this next slide is a table like we saw from your

Appendix C-2 in which you've shown the updated borehole information; is that right?

A Correct. These are all the boreholes that were included in the geotechnical model. These are all the boreholes that we received. Everything we received was put into the RMR and RQD block models.

Q And again, you prepared tables in this report, summarizing the updated RQD data?

A Correct.

Q And is that reflected here?

A Yeah; yeah. These tables indicate the updated RQD summaries, yeah. Those two tables are directly from our report.

Q And at this point are you -- you talked earlier about the C-2 report in which you had considered various alternative types of mining that might be used. Has the type of mining to be used been refined or narrowed by this time?

A Yes. At some point -- and I don't know the exact date. But at some point McIntosh changed the proposed mining methods from the three reflected in the stoping study, which included longitudinal stoping, transverse stoping and cut-and-fill, and they are now only considering transverse stoping, so they have simplified it to one mining method approach.

Q Anything else we need to know about this table?

A I don't think so.
Q And then you also prepared an updated RMR summary in this report?
A Again, so same type of table that was presented in our C-2 report. I'll again note that these tables are intended to supercede the previous tables because they reflect a better understanding and increased understanding of the rock mass and an update of both the RQD and the RMR block models.
Q And the RMR typical values range from what to what, Mr. Beauchamp?
A The RMR typical is the third column, and it ranges from 70 to 80, and the RMR minimum ranges from 60 to 70.
Q And the next slide, could you explain how that relates to this analysis?
A Okay. This is something new that we did in the C-3 report. We had now over 100 boreholes, and we wanted to look specifically at the boreholes that were in the crown pillar area. So we used the software package, and we queried the boreholes. We considered a search area that can be described as the crown pillar area horizontally plus a 30-meter radius in addition to the crown pillar horizontal extent, and we took that area, and we looked at elevations 30 meters above and 30 meters below the 383-meter level.
Q Could you just illustrate that briefly just to make clear what you're talking about there?

A Sure. So we have the crown pillar -- and I'll just draw it as a circle. We have the crown pillar horizontally looking down on it. We increased this by 30 meters, so this is an increase in 30 meters' radius outside of the crown pillar. And then, if this is the 383-meter elevation, we projected this up and down 30 meters, and this volume was what we used to query the database. And any boreholes that had -- that intersected that search volume were identified as what we've been calling crown pillar boreholes. And there was 26 of the 109.

Q 26 in the crown pillar area?

A In this -- what we're saying is the crown pillar area.

Q Okay. So really, you've assumed that it's larger than it actually would be for purposes of the study?

A Correct.

Q That's the 30-meter addition?

A Correct.

Q And at a particular level, would that relate to the area for the study being 30 meters outside the orebody that is to be mined?

A Correct.

Q And you note on this slide, I think, Mr. Beauchamp, that you looked at this at slices or 30 meters above and below the 383-meter level. Now, we know that the final recommended mine elevation as recommended by Golder and also the DEQ and

its various consultants is 327.5.

A Correct.

Q Does this study effectively capture and characterize the crown pillar as it relates to the 327.5 elevation and the thicker 87.5-meter thickness of the crown pillar?

A Yes, it does. I could illustrate a bit more to explain that.

Q Okay.

A So if you take 383 and you add 30, you get to 413. And if you subtract 30, you get the 353. The mining is going to come to -- the phase-3 limit is 327.5, so the mining will come up sort of to here; right? This is where your last stoping is going to be, in there. All that this is is this is just a search radius to find out what boreholes are pertinent. It doesn't mean that we only looked at the data in that search radius. So any of these boreholes that go through here -- right? -- are all captured and identified by the search radius. And in fact, once the hole has been identified, we consider the entire length of the hole. We don't just consider the portion within the search radius.

Q Okay. Thank you. Is there anything else on that slide, Mr. Beauchamp?

A No, other than those are the specific 26 holes that we've listed in our report. Those were the holes that were found in the querying of the database.

Q Okay. And again, these slides are reflecting information as shown in these reports?
A Correct.
Q And what does it show as to what you talked about earlier as being these identified or the major structure assessment?
A Okay. So one of the things that we wanted to do in the geotechnical study was try to identify any major structure that could affect the stability of the crown pillar. So one way that we did that was to take a look at what was identified through the logging as area -- and included in the major structures table by Kennecott as significant areas of gouge, sheared or broken rock in the logging so --
Q That's what we heard Mr. Ware talk about the other day about the logging and how they did that?
A Correct; yes. So we looked at the major structures table, and the major structures table, if you recall from Mr. Ware's testimony, is a compilation from the full database of areas identified as having gouged, sheared or broken zones. We took that table and looked at what intervals, what portions are in the 26 crown pillar boreholes. Okay? We found 40 zones that were either gouged, sheared or broken. They were located in 22 of the 26 boreholes. There was 4 that were free of any structure -- major structure. And of these 40 we had 20 that were less than 10 centimeters in length.

We had 10 that were greater than 10 centimeters but less than a meter, and then we had 10 that were greater than a meter in length. And we identified those in our report in table 4, and I know that this table has been discussed in previous testimony. These are the boreholes of the 26 crown pillar boreholes that had major structural zones that were greater than a meter in length.

Q Are these the -- we've looked at this before and talked about it, but is this the table from which the DNR requested photographs of these particular cores?

A Yes, so --

Q And those are the photographs that Ms. Bjornerud and Dr. Vitton talked about?

A Correct. So these were the boreholes. These were the lengths of major structure that were identified by Golder's, by me through our assessment. We put them in the table that -- these 10 zones actually correspond to 8 different boreholes, and then my understanding is the DNR requested to look at these boreholes in particular, and then that request was then passed on and reviewed by others in this process.

Q So are these the largest areas of what you called structures in the crown pillar drilling area?

A Yes.

Q And could you tell us, Mr. Beauchamp, if we see a particular length in a zone -- like, there's one here, the fourth one

down, where it says "55 meters in length." And I believe you talked about this earlier. Probably Mr. Haynes talked with somebody about it. Does that mean there's necessarily a 55-meter vertical length of this zone in space?

A It means that the borehole had broken core for a 55-meter length. But I liked, when I was listening to Mr. Ware's testimony, his description of that, because I think that he held up this pointer and used this piece of standard as a -- to describe or illustrate the point. If you have a borehole, it -- you could have a fairly small area. But if that borehole goes sub-parallel to it, you could be in a limited volume for quite a length of the borehole. So when you look at the borehole length, it could be fairly long, but in space it could be fairly limited. The other part was we did look at this particular 55-meter length, as you should. And one of the things is that hole 60 is a twin hole of 62, and what that means is that they were drilled from the same location, and they were just off a little bit in their dip. I think that the holes for the most part are within 5 meters of one another -- 5 to 10 meters anyways; no more than 10 meters at the toe like they will diverge a bit as they go deeper. But these are twin holes and if you look, even from the major structure table, hole 60 only had a broken zone of 1.3 meters, and hole 62 had the longer zone of broken rock. The conclusion, from what I looked at, was

that hole 62 was drilling down a structure, and it was sub-parallel to that structure. In talking with Mr. Ware and based on the drilling reports, the drillers had trouble drilling that hole, because they were going from different -- they were encountering different geological interfaces going from one rock type to the other. And I think the part of the problem with the broken zone is -- the source of that is from the difficulty in the drilling rather than the poor rock quality that you might expect in that area.

Q What did you do with this major structure information then, Mr. Beauchamp?

A Okay. So the next slide is a screen grab. It's a printout from this geologic modeling package that we used. This is a package called Datamine Studio. And we used the boreholes, and we located the major structure for all 40 of the zones, the 10 that are included in the previous table plus the other 30. We located them in space, and you can see that they're marked here, "broken," "gouged," "broken," "gouged," "sheared." Okay? So we marked them down the boreholes and again took a look to see if there was any trends or any planar features that would indicate major structure by aligning them; seeing if there was any pattern to them or any spatial significance to how they were occurring in the crown pillar.

Q And what were the results of that investigation, Mr. Beauchamp?

A There was no alignment of these zones through the crown. We did see an increased frequency in the zones to the east and the northeast portions of the crown pillar.

Q Was that consistent with the -- both the RQD and the RMR block model?

A Yes. So what we did was, when we saw that there was an increased frequency there, we looked at our block models, and we were looking to see that our block models were in fact reflecting this structure, and they were. It was -- there was substantial agreement between our block models and this assessment. These structures were captures in that. So you would see -- in the same areas where we saw increased frequency of these zones, you'd see in our RMR and our RQD block models lower values to the east and the northeast of the crown pillar.

We also looked, as I mentioned in Section 3.8 from the C-2 report, for this discrete feature that was first mentioned in the scoping study. We have it plotted in our model, and so then we looked at where -- if you go to the previous slide, we took a look at where this was out here -- and it's, like, 15 meters out -- if there was any alignment through that area. And in fact, we didn't see -- it didn't substantially reflect any broken zones in the area where

this potential structure was.

Q Mr. Ware talked about that earlier too and indicated that the actual drilling out there showed to him that this so-called fault did not exist. Do you recall that testimony?

A I recall.

MR. HAYNES: Objection; mischaracterizes the testimony.

A I could characterize what I thought Mr. Ware said.

Q What did he say as to his opinion as to whether this fault existed?

A What I understood Mr. Ware to say was that he didn't find any evidence of this potential structure in the drill core that they had looked at.

Q And do you agree with that assessment?

A I agree with that assessment.

Q Did you nevertheless -- and I think you just indicated. Did you nevertheless include that structure or that fault in your figures? And if so, why did you do that?

A Well, the drilling information that we have at this point, the 109 boreholes don't support the existence of this fault. We are recommending that more drilling be done, so we didn't want this fault to be forgotten or not considered in the planning of the future drilling programs. So we really put it in the figures so that it would be topical and people

would remember it as an area and a target for future drilling and for future reconsideration.

Q And could we turn then to the -- to your updated crown pillar stability assessment, Mr. Beauchamp?

A Yes. So we did -- we used the same two approaches as we did for the C-2, the industry-accepted process for assessing the crown pillar. We used scaled span at CPillar. We did have updated information specifically on the bedrock surface elevation. We had an updated mine design from McIntosh, and we also updated our RMR and RQD block models to reflect the 109 boreholes that we had.

Q Did you do separate models with RQD data and with RMR data?

A Completely separate models.

Q Okay. And I think we'll talk about that more, but I just wanted to clarify that at this point. And I think your next slide has some more information as to the updated -- the points which were updated that you discussed earlier?

A Yeah. The updated bedrock surface elevation, we considered that to be at 415-meter elevation. It was based on an assessment we did of the bedrock intercept. So we had these 109 drill holes that are all drilled from surface. They all have an initial bedrock intercept point down the borehole. So we looked at all those points. We draped a surface over those points, and that was an interpretation of what bedrock was. We also got the interpreted bedrock surface from

Kennecott, so we had a second interpretation of where the top of the bedrock was, and those two models were consistent with another. We -- and they're -- in the area above the crown pillar, both of those models are in the 420's, 420 or above.

We selected, to be conservative, 415 as the top of the crown pillar, and that was the value that was used in the C-3 report. Now, in the C-2 report we used 410. We were even more conservative than the C-2 report. But now that we have this additional information and we went through this process, we're very comfortable that 415 is a conservative value for the top of bedrock.

Q And when you talk about "top of the bedrock," are you talking about the top of the bedrock which lies under what we've referred to as glacial overburden, which has varying thicknesses, I take it, at the surface?

A Correct; yes.

Q And as to the updated mine design, Mr. Beauchamp?

A Right. So we received this preliminary mine design from McIntosh in December of 2005. The top of the mining was at 357-1/2 meters, and the horizontal extent of the top level of mining was 50 meters by 68 meters. And again, in our assessments, we haven't used backfill when we've looked at the crown -- we haven't used backfill when we looked at the crown pillar stability assessments.

Q So at this point in the C-3 analysis, as in the C-2 analysis, you're still assuming a completely open void under the crown pillar?

A Yes, we're assuming that to be conservative; however, we understood at the time that -- and we still understand now that in fact the mine permit application is to use backfill in all the stopes. So we were aware of that, but to be conservative we assumed that no backfill would be used.

Q And then could we turn to the scaled span crown pillar assessment and the results of that assessment, Mr. Beauchamp?

A Yes. This is the updated scaled span assessment found in the C-3 report; again, top of the mining, bottom of the crown pillar; 357, a thickness of 57.4 meters for the crown pillar; full excavation of 68-meter-by-50-meter horizontal extent under the crown pillar; the RMR range from 70 to -- 70 being typical and 60 being low end. We calculated what the factor of safety would be for those cases.

Q And what are the conclusions?

A The conclusion is that the factor of safety would be 1.2 for an RMR value of 70. It would be -- a factor of safety of 1 would correspond to an RMR value of 66.4 and a factor of safety of 0.73 corresponding to an RMR of 60.

Q And then what did you do state as your conclusion under this table?

A

"The crown pillar is predicted to be stable when considering the typical RMR value of 70, factor of safety of 1.2. The factor of safety for the crown pillar is above 1 for RMR values greater than 66.4, which has a Q equivalent of 12.05. The crown pillar is predicted to be potentially unstable when considering the minimum RMR values of 60, factor of safety equal to 0.73."

Q And again, this is with a 57.5-meter crown pillar rather than the final recommendation of 87.5 and with a completely open void under the crown pillar rather than the individual 10-meter-wide stope mining with backfill?

A Correct.

Q And then the second type of crown pillar analysis you did I think which you indicated earlier relates specifically to the examination of the potential for the so-called plug-type failure, what were the results of that analysis?

A We looked at -- using the geometries -- the same geometries as for the scaled span, with an RMR of 60 we had a factor of safety of 3.65; with an RMR of 70, factor of safety of 6.4. And the conclusion was that:

"Results from the CPillar analysis indicate that the factor of safety for the crown pillar with RMR values of 60 and 70 are 3.65 and 6.40, respectively.

CPillar predicts that the crown pillar will be stable with RMR values of 60 or 70."

Q And again at this time with the assumption for your analysis that there would be a wide-open void under the crown pillar and a crown pillar thickness of only 57-1/2 meters rather than 87-1/2?

A Correct.

Q And could we turn then to your discussion and recommendations in the Appendix C-3 reporting, Mr. Beauchamp?

A Yes. So I'll read this quote that comes directly from our "Discussion and Recommendations."

Q This is page 14 of your Appendix C-3 report?

A Correct.

Q Okay. If you would, please.

A "The Scaled Span assessment is considered the industry accepted method of assessing overall crown pillar stability. The conclusion for the stability assessment was that the crown pillar is predicted to be stable with typical rock mass classification values, and that potentially lower values; i.e., less than 70; would be identified by KEMC prior to establishing the crown pillar. The KEMC mine design will start mining at the lower levels and progress upwards. Additional drill information will be collected as the mining front

approaches the crown pillar which will allow a better characterization of the rock mass quality of the crown pillar and the top of bedrock elevation. As more information becomes available, a further refinement of this crown pillar assessment can be completed before commencing development in the upper levels of the mine."

Q And you still did not make a recommendation as to final crown pillar thickness at this time?

A No recommended crown pillar thickness.

Q And based on what you just read from this report, now, the second report, Appendix C-3, in light of some of the testimony from the Petitioners earlier to the effect that Golder had recommended various different mining methods and crown pillar thicknesses as if you were suggesting that this could be done, no further analysis is necessary, do you agree with how they characterized your earlier reporting?

A No, I disagree.

Q Did you also look at, in this reporting, the potential for crown pillar deflection? And I think that would be relevant to this picture that Dr. Vitton, I think, portrayed earlier where there -- if there was a gap under the crown pillar there would be some kind of unraveling to surface. Did you, in fact, do some modeling of the potential crown pillar deflection?

A Yes. We did some modeling of crown pillar deflection. We also looked at the -- an unraveling assessment. They have that in the next slide. But I'll speak to this slide first. We were about to -- we were asked about the crown pillar deflection. It's not something that I've done a lot of in other mines with respect to crown pillar, because if the crown pillar is going to be stable in hard-rock mines, that means that it's not going to move very much at all. I don't expect an 87-1/2-meter-thick hard-rock crown pillar to move very much. However, we were asked about that specifically, and we had the numerical models capable of modeling the deflection.

Q Is it your understanding you were asked to do that specifically because it was required by the permitting regulations in this case?

A That's my understanding, yes.

Q Has that been your experiences in the Sudbury Mine?

A We don't typically do this modeling for crown pillars in the Sudbury Mines.

Q For the reasons you've just discussed.

A They're not necessary, yes.

Q Go ahead, Mr. Beauchamp.

A So we used two different numerical modeling codes. We used Map3D and Phase 2. We considered the McIntosh -- the McIntosh mine geometry, and we modeled what we expected the

deflections in the crown pillar to be. Those numbers, as I would expect, were very small. We looked at a variety of different scenarios to try to determine what the maximum deflection would be. So what I mean by looking at different scenarios is we looked at different geometries. We looked at thinner pillars.

We looked at -- you know, for the full extent of the crown pillar we looked at different stress regimes. In this case the lower stress regimes resulted in larger deflections because it allows it to -- this very thick beam of rock essentially to deflect a little bit more. We looked at different input parameters. We looked at, you know, a range of elastic modulus for the rock mass, for example, through these various scenarios that we considered and using both of the modeling software packages listed. We weren't -- we didn't find any scenario where the deflection would be greater than 2 centimeters.

Q And now could we -- could you discuss what you looked at in terms of the potential for this unraveling scenario that Dr. Vitton spoke about?

A Okay. In industry in the mines I work with it's a common topic for debate about, "How tight is tight backfill?" As was shown by Dr. Stone, tight backfill in most cases is very tight. It's actually in contact with the back of the stope. There is the potential, however, for it not to be completely

tight at all points across the cross-cut, so that leads to the discussion around, "Well, what if there's some small amount of vertical void left between the top of the backfill and the rock?" So the purpose of this unraveling assessment is simply to show what the potential height of rock above the stope could be impacted if you had a certain vertical void.

So what we have here is a 57-1/2-meter-thick height of rock or above the stope. In this case we're referring to the crown pillar. This (indicating) is the height of the vertical void, so this is how tight the backfill would be, so --

Q You're assuming different scenarios here?

A Each row is an individual scenario. Okay? So this (indicating) is the height of vertical void. This is how tight the backfill would be. And this is the height of the failure above the stope that would be -- that is possible, given that vertical void when you consider that the rock mass could unravel and in unraveling it would bulk. So each of these rows is an individual scenario. So the first row is mining to the 357-1/2-meter elevation. Backfill is tight to the stope, 57-1/2 meters of rock, no vertical void, no height of failure, no potential to unravel to failure to surface.

The next is if the height of the backfill is only

to 356.9 and you leave .6 of a meter vertical void, you could have a 2-meter impact as far as the height of failure above the stope back. And I've just went through, and without going through each one individually, I've considered different vertical voids, different amounts of space left between the top of the backfill and the back of the stope, the rock, and it's reflected by the height of the failure potential above that stope back before the rock, in fact, bulks and chokes itself off and there's no further void in which additional rocks can be displaced.

Q You also calculated for purposes of reference how deep this void would have to be in order to affect unraveling which could be expressed at the top of the bedrock?

A Yes, I have, but I can't recall the specific number off the top of my head, but it's a very large number. I would say that for an 87-1/2-meter crown pillar that that number would be 20 meters. You need 20 meters of space for that rock to unravel.

Q A 60-foot gap?

A Yes, on that order. I could do a quick calculation if we needed it, specific number.

Q I think that's good enough for our purposes now. And again based on your experience in the underground hard-rock mining industry, are these kinds of analyses -- when you've got what you consider to be a stable crown pillar, is this type

of analysis done?

A This unraveling assessment is done for closure purposes in mines. It's an important consideration when the mine is going to walk away from the property, and the regulatory agencies want some assurance that the voids or the spaces underground aren't eventually going to work their way up to surface. So this type of unraveling assessment is common in those cases as part of closure studies on crown pillars so that the mine can have a walk-away from those when they close up the properties.

Q And is this mathematical formula that you've used as reflected in this table the generally accepted industry standard for doing that kind of analysis?

A Yes.

MR. LEWIS: Your Honor, at this time that completes, I think, the discussion of that second report, and I would offer that report which is identified in the record as Intervenor Exhibit Number 2 -- it's Appendix C-3 to the Mine Permit Application, and the Bates range is 102527-102576.

MR. HAYNES: I'll object; lack of foundation; doesn't conform to MRE's 703; assumes facts not in evidence.

MR. REICHEL: No objection.

JUDGE PATTERSON: Okay. I'll make the same objection as I did previously. I'll overrule the objection

and admit it.

(Intervenor Exhibit 2, Appendix C-3, Bates 102527-102576 received)

JUDGE PATTERSON: Would this be a good time to take a break, Mr. Lewis?

MR. LEWIS: Yes, it would, your Honor.

JUDGE PATTERSON: Let's do that.

(Off the record)

Q Mr. Beauchamp, before we move on to the next subject, we talked about the -- we just finished up with the -- on that unraveling assessment that you discussed, and you indicated that is done in some cases. Is it done -- based on your experience, is it done in the industry for hard-rock underground mines where backfill is used?

A No, not typically; no.

Q And is that for the reasons we discussed earlier?

A Yes.

Q And what's your understanding, then, because we are using backfill here, as to why it was done for this permit application?

A I understand it was part of the application requirement.

Q Now I'd like to turn to some later reports that Golder prepared, and I think first Intervenor Exhibit 593, do we have a slide on that?

A No.

Q But in your Intervenor Exhibit 593, yes, that's an April 25, 2006 technical memorandum titled "Clarification on RMR Classification"; is that correct?
A Correct.
Q And what was the purpose of that memorandum?
A We received a memorandum from Sainsbury asking what RMR classification system we were using, so I just replied. It's a very short one-page technical memo. And I can read -- I could read it if you like. It's only a couple sentences.
Q Sure. Go ahead.
A "This memo has been prepared in response to the memo received from David Sainsbury, Itasca, dated April 18th, 2006. Mr. Sainsbury requested clarification on which RMR classification system was used for the Eagle Project geotechnical study. The standard used in this study was RMR 76. A typographical error was found on page 10 of the Golder Geotechnical Study dated April 28th, 2005." This was the C-2 report. "The value of the A5 parameter on page 10 is listed as 15 when, in fact, it would read 10. The remainder of the text and calculations were checked and were found to consistently use 10 in the RMR 76 standard."
Q And did that clarify for Mr. Sainsbury that question?
MR. HAYNES: Objection; speculation.

Q Did you subsequently discuss this with Dr. Sainsbury?
A No.
Q Did he ask for any further clarification on that particular point?
A No.
MR. LEWIS: Offer Intervenor Exhibit 593, your Honor.
MR. HAYNES: No objection.
MR. REICHEL: No objection.
(Intervenor's Exhibit 593 received)
Q And next I wanted to ask you about another technical report authored by you, Mr. Beauchamp. It's designated at Intervenor Exhibit 78. And is that an April 25, 2006 memorandum titled "Eagle Crown Pillar Discussion"?
A Yes.
Q And what was the purpose of that memorandum?
A The purpose of this memorandum was also to provide some clarification to David Sainsbury with regards to our first two reports, the C-2 and the C-3 reports.
Q So it was just clarifying or answering questions that he had as to those reports?
A Correct. There was no new work that was done as part of this technical memorandum.
MR. LEWIS: Offer Intervenor 78, your Honor.
MR. HAYNES: No objection.

MR. REICHEL: No objection.

JUDGE PATTERSON: No objection, it will be entered.

MR. HAYNES: I'll clarify that. I'm going to make my usual objection the court's already ruled on --

JUDGE PATTERSON: Okay.

MR. HAYNES: -- because this report contains more analysis similar to Appendices C-2 and C-3, so I'm going to restate my objection.

JUDGE PATTERSON: All right. It will be entered over objection for the previous reasons.

(Intervenor's Exhibit 78 received)

Q And I think we wanted to discuss next Intervenor Exhibit Number 594, Mr. Beauchamp, July 7, 2006 technical memorandum by you titled "Regarding KEMC Eagle Responses"; is that correct?

A Yes. This was a technical memorandum that we wrote. The format or the form of the memo is we've listed in bold the clarification request for the MDEQ. They're numbered 58 through 65, and we tried to in a concise way give a direct response to that request. So it's in the form of question/answer, question/answer through those points.

Q And I think let's identify for the record now also Intervenor Exhibit 79, Mr. Beauchamp. And that I believe is a July 7, 2006 Golder technical memorandum again by you

titled, "Regarding KEMC Eagle Clarification Discussion"; is that right?

A Correct.

Q And generally what was the purpose of that memorandum?

A That memorandum contains the context of the clarification responses that we gave to the DEQ. So both of the memoranda, Intervenor 594 and Intervenor 79, were both issued on the same day. One gave concise question/response-type answers, and Intervenor 79 gave more context or more discussion around those points so that they can be better understood, how all the answers fit together.

Q And then could we turn to a little more discussion about what was in these two memoranda, Mr. Beauchamp?

A Yes. So there were some questions around the rock strength that we considered in our C-2 and C-3 reports. And the questions centered around the uniaxial compressive strength laboratory testing that was done. So the program that was undertaken is described in Intervenor 79, page 10, and we describe what was done. The testing program was completed on May the 10th. There were samples that were selected by Kennecott. The objective of the samples was to provide a representative spatial and rock type or lithologic distribution through the orebody and crown pillar, and the summary of the UCS testing is provided in a table in the report.

Q And what does this information show, Mr. Beauchamp?
A This table shows -- the first column describes the rock type. PER is peridotite, SMSU is semi-massive sulfide, and MSU is massive sulfide. The next column is the point load testing UCS. This is the strength of each of these rock types that we considered in the C-2 and C-3 reports based on the point load testing. The next column is the results from the laboratory testing, and it gives a strength for each of the three rock types. The next column is the difference between what we considered using the point load results and what the laboratory results showed. And the differences are given in megapascals. The next column is the number of UCS tests done in each rock type, and we also did some statistics on the results to arrive at the standard deviation of the results that were given to us by the lab.
Q Now, Mr. Ware testified earlier about the Kennecott database and characterized the volume of data in there for the so-called point load testing and so forth. But is the purpose of this table to compare the point load testing and the uniform compressive strength testing?
A Yes. It's a verification of the point load testing that was done which is really an index test. The laboratory testing allows you to correlate the point load results with the actual laboratory results.
Q And I think the Petitioners' one or more witnesses

criticized the use of the point load testing here. So I want to ask you, what does this comparison of the results demonstrate as to the agreement between the point load testing and the UCS testing?

A There was substantial agreement between the results. As you can see, we used -- for example, with the peridotite we considered a strength of 120 megapascals based on the point load. The laboratory testing came back with a mean of 114 megapascals. So the difference was only 6 megapascals. The semi-massive we considered a point load of -- a strength based on point load of 111 megapascals. Laboratory came back slightly stronger at 113, but again the difference is only 2 megapascals. The massive sulfide, we considered 57 megapascals based on the point load. The laboratory testing came back with a mean of 52 megapascals for a difference of only 5 megapascals. So there was substantial agreement between what the lab predicted for UCS and what the point load predicted for UCS.

Q And despite the volume of data that's already been generated on the strength of the rock, has Golder nevertheless recommended additional continuing data collection and testing once underground and before -- and during the mining process?

A Yes; yes. The idea is that the number of samples here -- although sufficient at this stage, we're recommending that

additional tests be done to get a further understanding of the strength of the rock as soon as underground access is available.

Q And that's stated in these technical memoranda?

A It's stated here and also included in the mine permit application, I believe.

Q And what other issues did you address in these technical memoranda, Mr. Beauchamp?

A We looked at the sensitivity analysis. There were some questions from Sainsbury about whether we did sensitivity analysis. We, in fact, did, and so we described what we did in this report. It had been completed as part of the Phase 2 study, the C-3 report. And we did it -- specifically he was asking about elastic modulus and horizontal stress. With respect to horizontal stress, in situations where we were interested in high stress we considered k values, which is the ratio of vertical stress to horizontal stress. We considered k values of up to 3. In situations where we were looking at low stress, we considered k values down to 0.5. And we pointed out in the memo that this covered the complete range of in situ stress results published for Canadian and American mines that we felt were representative of the Eagle property.

Q And did you also have some discussion about the possibility of this sub-vertical fault that we've heard about earlier?

A Yes. We've provided some further description around our consideration of this potential fault. In the report I describe how we went -- we looked at the borehole data that was available, looked at where the potential fault was thought to have been in this scoping study, and we went through on a core-by-core basis and looked at -- according to where that should be spatially, we looked at those specific lengths of core. And the best or the -- I guess the best correlation we could come up with based on the actual data in the core records from the core logging was a small, thin zone of 2 to 5 centimeters of calcite clay fracture fill in one area, but again, there was no offset on this fracture in the core. And that was all we are able to find. So again we just restated that the current drill information doesn't support the location or characterization of this potential fault. We noted that potential structures may be in the crown pillar. We left the sub-vertical plane on the figures as a reminder for -- as a future drilling target once underground access is obtained.

Q And did you also discuss in these technical memoranda in response to these questions the Kennecott Mine schedule and the relevance of that schedule to the time and ability to gather additional data and further characterize the -- what would become the crown pillar once underground?

A Yes. From the very first report that we put out we've been

talking about what we're going to do or what we're recommending is done when underground access is obtained. At this point for the first time we had a more definitive mine schedule. It was a -- at this stage it's still a preliminary mine schedule, but we received that from McIntosh. And so in the technical memo we were able to, for the first time, put months to what we've been recommending. So this is reflected in this table. It's in the memo. And what this describes is, if you start the decline at month zero, you'll be able to actually start diamond drilling. The first opportunity to start underground drilling would be at month 15 from this vent drift on the 252 meter elevation. Then it starts with the lowest level of the mine. What I have, level 7 between 143 and 177, production would be scheduled to start at this -- at the lowest level at month 22. We've included the month -- projected month starting date for production on each of the levels through the mine, and finally at the bottom we have level 1, which is the first level of the mine and is actually located above the Phase 3 limit that we recommended of 327.5.

So this number here (indicating), 84, is the time from the first start of the decline to when you'd want to have the additional characterization and data collected. And you'd want to have the crown pillar stability reassessed prior to month 84. So if you look at when you could start

getting the data and when you need to have the data and assessment complete, you have 69 months in which to complete that work.

Q Based on your experience, is that sufficient time to do that?

A Yes. It's over five years.

Q And did you also address -- I believe it was in Intervenor 79 -- you further discussed in response to questions the -- another -- a probabilistic scaled span assessment?

A Yes. This is new work not included in the C-3 report. And the probabilistic assessment was done straight from the geotechnical database. And how the probabilistic assessment was done was, statistical data was directly from the database for all of the parameters in the RMR and Q compilations. So, for example, the RQD would be sampled straight from the database using -- it was mathematically called a Latin hypercube approach, to sample the data. So the full database, including areas where you had very low RQD or zero RQD and areas of the database where you have very high RQD, including 100, you would sample randomly what the RQD was, and you'd sample different spots. Okay?

Q There was some discussion earlier, Mr. Beauchamp, as to some of the RQD information did not get imported into the RMR calculations. And Mr. Ware and others have testified as to why that was, but for this probabilistic assessment did you

use all of this RQD data?

A All of the data was considered, even the data that had an RQD of zero and even the data that did not have open-joint data logged for those runs.

Q Okay.

A So it was all there. So this process goes through and samples. And it defines a distribution based on the hard data in the database for each parameter. So you'd have a mean and an upper and a lower bound, a distribution for the RQD, a distribution for the joint spacing, a distribution for the joint alteration, a distribution for -- which one am I missing now? RQD, joint spacing, rock strength -- sorry. Rock strength was the one. And also for the A5 parameter, that can't be queried from the database, so we considered an A5 parameter of 10 or 1 for Q.

So once all of these actual distributions taken directly from the database have been collected, we can then go through and calculate the RMR and the Q from those real distributions and get the mean and upper and lower bounds of the RMR and the Q, which is what we did. And then we use those values for RMR and Q to reassess the crown pillar using the scaled span. And those are reflected in this figure that is at -- that is included in Intervenor 79.

Q And what does these figures show, Mr. Beauchamp?

A So these three figures, this is for three separate

scenarios. So this is considered as one stope, so we're still working with a larger span than in the mine permit application. We're using a span of 17 meters and a strike length of 50. This is the two stope --

Q And the current dimension is ten meters on the width --

A Ten meters.

Q -- rather than 17?

A So this is using 17 and the current in the mine permit application is only ten. So this is again conservative. So this (indicating) graph is for the one stope scenario. This graph is for the two stope scenario, and this graph is for the full unsupported crown scenario. So if we go to the next slide, it's just a zoom in. What this graph represents is four different crown pillar thicknesses. And we're looking at 57 ½ on this line, 87 ½ on this line, which is the actual mine permitted thickness, and on this end I think we have 115 or 117 meter thick crown pillar. And the bottom line is the factor of safety, and the top line is the associated probability of failure given this factor of safety. So for the 87 ½ meter crown pillar, full unsupported crown --

Q This means no backfill?

A No backfill.

Q Completely open void?

A Completely open void using the probabilistic assessment you

get a factor of safety above two and a probability of failure of just a little better than 9 percent. Next slide? And the next slide reflects the single stope scenario, which in fact is the scenario that is again in the mine permit application. They're only going to mine one stope at a time before backfilling and getting to the next stope.

Q And again, assumes a wider than permitted stope width of 17 meter rather than ten meter?

A Correct. This considers 17. And again, the actual is ten meters and would be more conservative than this. This gives a factor of safety for an 87 ½ meter thick crown pillar of about five and a half and a probability of failure of virtually zero. This other the conclusion that we put in this report is that the 87 ½ meter thick crown pillar for a single stope, it had a factor of safety of 5.6 and a probability of failure that was negligible. I've clipped and pasted a portion of the text, and maybe I'll read that.

> "The crown pillar over a single stope span for the inferred rock mass conditions discussed above is inferred to exhibit factors of safety of 4.6, 5.6 and 6.4 for crown thicknesses of 57.5 meters, 87.5 meters and 117.5 meters, respectively. For this single stope span case, the computed probability of failure is negligible, approximately zero, for all analyzed thicknesses."

And at this time this was when we to be conservative recommended that the phase three mining limit be set at an elevation of 327.5 meters and having a crown pillar thickness of 87.5 meters.

Q And again, contrary I think to the implications that some of the Petitioner's witnesses have raised in these proceedings, was this the first time that Golder actually recommended a mining limit elevation and a crown pillar thickness?

A Yes.

MR. HAYNES: Objection to the form of the question. It's leading.

MR. LEWIS: My question is was this the first time, Your Honor. It's fair enough.

JUDGE PATTERSON: I'll overrule.

Q What's your answer?

A "Yes."

Q And had you in every report you prepared the Appendix C-2, Appendix C-3, and now this July 2006 report always recommended that additional data be collected once underground?

A Yes.

Q Did you have another slide on this point, or was this it?

A That was it for that point. This is the last slide here.

Q And what does this slide address?

A This is the factor of safety requirements for Eagle.

Q Were they represented in the reports, or is this a different subject at this point?
A They're discussed in all the reports that we did, different factors of safety and different language about that. This isn't --
Q And could you review this, then, please?
A So this slide is intended to clarify what the actual factor of safety requirements would be for the crown pillar. The Eagle crown pillar will be mined one stope at a time. Tight backfill will be put in place. There will be the opportunity to install engineering controls such as ground control, including cable bolts that will be available to the mine when they're developing the crosscuts under the crown pillar as I've diagramed. A factor of safety greater than two indicates a crown pillar that is self-supporting indefinitely without additional support. Okay? And a factor of safety between one and two indicates a crown pillar that is potentially stable but for which additional supports and backfill are recommended for long-term stability.
Q And are crown pillars with a calculated factor of safety between one and two commonly mined in these underground hard rock mines?
A Regularly.
MR. LEWIS: I have to offer at this point these

last two reports we discussed, which are Intervenor Exhibit Number 594, the clarification responses question and answer that Mr. Beauchamp discussed, and the final report, which was Intervenor Exhibit 79, which Mr. Beauchamp just reviewed.

MR. HAYNES: Same objection; lack of foundation, assumes facts not in evidence, allows the witness to testify contrary to MRE.703.

MR. REICHEL: No objection.

JUDGE PATTERSON: I will admit them over the objection.

(Intervenor's Exhibits 79 and 594 received)

Q Mr. Beauchamp, was there peer review of these reports you prepared?

A Yes.

Q Who did that?

A Trevor Carter.

Q He's with Golder?

A Golder. They were all -- the peer review was done internally at Golder. There was a number of people involved in different portions of the work. The reviewers would include Trevor Carter, Paul Palmer, Joe Carvalho to name three. It's standard practice within Golder's we have a protocol where all reports, figures, analysis need to be checked and approved by two qualified -- at a minimum of two

qualified people before we issue our work.

Q And was there also a review of your reports and conclusions by consultants for the DEQ?

A Yes.

Q And we've heard some testimony earlier from Mr. Wilson Blake, and we've heard some references to things said by Mr. Sainsbury. But I wanted to ask you in reference to their two final reports, if despite whatever disagreements they may have had with some of your reporting, whether they in their reviews agreed with your bottom line? Did they both agree that with a crown pillar thickness of 87.5 meters and planned additional drilling and characterization that this would be a safe crown pillar and the mining could proceed?

MR. HAYNES: Objection; calls for speculation.

MR. LEWIS: I'll read it to him, Your Honor.

JUDGE PATTERSON: All right.

Q In reference to Mr. Sainsbury's last report dated March 2, 2007, to Hal Fitch at the DEQ titled Summary of Technical Review Conducted on the Crown Pillar Subsidence and Hydrologic Stability Assessment for the Proposed Eagle Mine, on page two -- and by the way, this is Intervenor Exhibit Number 216.

MR. LEWIS: And I think this will be offered and admitted later, I think, Your Honor, with Mr. Sainsbury's deposition. So it'll be coming in at that point and I'll

wait until we have that exhibit on the table.

Q But on page two of that memorandum, Mr. Beauchamp, Mr. Sainsbury states,

"After review of the Eagle project mining permit application (Kennecott 2006) by the MDEQ, the proposed mine plan was revised" -- that's what he said -- he thought, apparently -- "to allow for mine development to begin limiting mining to elevation 327.5 resulting in a substantial 87.5 meter thick crown pillar. This approach will allow further field investigation and analysis to be conducted prior to mining above elevation 327.5 meter ensuring greater understanding of the actual rock mass response to mining prior to development of the final crown pillar. Based upon the geotechnical information provided in the Eagle project mining permit application (Kennecott 2006), a crown pillar thickness of 87.5 meters is considered sufficient to prevent any significant surface subsidence." He further states in this report, "As discussed in Sainsbury that's his report 2006D, mining should not be permitted above 327.5 meter until further detailed field investigation and an industry best practice analysis are conducted to determine the expected crown pillar subsidence and hydrologic stability."

Now, is that in fact what you recommended in your final report be done, Mr. Beauchamp?

A Yes.

Q And is that in fact what's reflected in the permit condition?

A Yes.

Q And as to Mr. Blake in reference to Respondent Exhibit Number 95, which has been admitted into evidence, dated June 2007, titled Review of the Evaluation of Crown Pillar Stability for the Proposed Eagle Mine, Mr. Blake states therein in his executive summary,

> "I concur with Itasca," that being Sainsbury, "and conclude that the phase three mining limit at the 327.5 meter elevation results in an 87.5 meter thick pillar that is stable. The additional field investigations and data analysis to be carried out will determine whether mining can take place above the phase three mining limit and if so will establish a stable crown pillar that precludes adverse subsidence and hydrogeologic effects. Hence, I recommend that the mining application permit for the Eagle project be approved."

Does Mr. Blake, therefore, also agree with the very same recommendations that you made in your final report?

A Yes.

Q Now, I'd like to turn to your -- to asking you some questions about some testimony by some of the Petitioner's witnesses on this subsidence question, which included Dr. Vitton, Mr. Parker and Dr. I believe it is Bjornerud. Have you reviewed their various reports?
A Yes.
Q Have you reviewed their recalculations of the RMR and their opinions as to crown pillar stability?
A Yes.
Q And do you agree with their recalculations of RMR?
A No; no. I don't agree with their recalculations.
Q Why not?
A I don't think that they were based on standard industry practice. The RMR re-logging was done only from core photos. I think that it's problematic to try to assess RMR using only core photos. Going through the RMR parameters, I believe that they agreed with the original A-1 and A-2 parameters, but then re-logged A-3 the joint spacing, which I think could be problematic. Because in assessing joint spacing, you need to know and be able to distinguish between natural breaks and mechanical breaks. Okay? And to do that you need to be able to know where the -- where all of the chalk markings are. Maybe some of the chalk markings weren't reflected in the photos or maybe you couldn't see them in the photos or maybe there was some mechanical breaks

reflected in the photos that were misinterpreted as natural breaks. And I think that the original logging done by the core loggers when they have the core laid out in front of them on the table would be able to best define what the actual joint spacing is and, therefore, have a more accurate A-3 parameter.

Going on to the A-4 parameter, which is the joint characterization, again, I think that you need to be able to have the core in your hand to be able to accurately do this. Sometimes it's challenging even when you have the core in your hand. You can get up really close to the surfaces and you scratch them and you feel to see if it's a stepped type of contact or whether it's smooth or rough. And to be able to see on the joint if there's any secondary mineralization. So again, I would have a lot more confidence in the team of geologists doing that firsthand as opposed to someone trying to do it from photographs alone.

There was also some re-logging or reassessment of the A-5 parameter. I know that there's been some criticism about our use of an A-5 parameter of ten. I think that the rationale for us using an A-5 parameter of ten is based on our experience. I walk underground in Sudbury mines that are very similar to Eagle on a regular basis, and I can see whether it's wet or dry. A lot of -- the majority of the development in these mines is very dry. It's dusty, in

fact. Sometimes it's not -- it's common industry practice that they employ water trucks to go around and wet the openings because you have ventilation and dust issues. So my experience with all of these mines that are very similar to Eagle and my understanding of the rock mass, which I understand to be very tight with respect to hydrogeology, is the basis of why I think that an A-5 parameter of ten is a very reasonable consideration to make. I understand the criticisms to some point, and I can think of portions of mines that are damp. And, therefore, I can also see how an A-5 parameter of seven would be reasonable. But I don't agree with A-5 parameters that are less than seven that would be indicative of water, like, large scale water problems, water under pressure in these mines. And I don't -- I don't agree with looking at photographs and making an assumption that those kind of conditions are going to exist. In fact, my experience is that they don't exist in the mines that I consult at. So when you take that on the whole and you look in detail parameter by parameter, I disagree with the re-logging of the RMR that was done.

Q On that last point, before we move on, if you assume instead of a A-5 parameter of ten, which I understand represents a dry condition, a moist condition, what would that number be?

A The A-5 would be seven.

Q And would that make any difference, this reduction by three

points in the total RMR scale, would it make any difference to the conclusions that you have reached and reported in your report?

A No. A reduction in three to the RMR's would change our typical -- from 70 to 67 would change our low end RMR from 60 to 57. That change wouldn't change our conclusions of our studies.

Q What about the fact that they had photos of only eight boreholes? Was that data set representative of the entire data set that you discussed earlier that you used in making the RQD models and the RMR model?

A No. I talked in the reports about how those boreholes were selected in that we went through a process of looking at the major structure that was logged in the boreholes. And those boreholes were the eight identified as having the largest broken gouged and sheared zones of all the boreholes that we looked at. So they were the eight that had the largest, longest sections of these types of occurrences. So they weren't representative.

Q And as we discussed earlier, those were the holes reflected in a table in your report, which the DNR had specifically requested?

A Yes.

Q And is your response to their claim that Golder did not include all the relevant data in their analysis?

A I don't agree with that. All of the data that was available was considered by us. We used the entire geotechnical database that was available at the time. And again, those dates are -- it's a date specifically availability. So at a point in time when we want to do the analysis, we have to take the database. We were given the database in its entirety, and we use all the data that was available at that time. And those dates are stated in our report.

Q Mr. Ware talked about this a little bit, and I don't want to belabor it. But could you explain briefly why not all of the RQD data was imported into the RMR numbers?

A Okay. The RMR, as we've talked about, is made up of five parameters. And one of those parameters is the A-4 parameter, which is the joint characterization. Okay? So in order to arrive at an A-4 value, you need to have logged a joint. You need to have that data in the database for a specific run in order to calculate the A-4 in order to arrive at an RMR. So there were runs within the database that did not have what they call open joint data. Okay? Now, there's two reasons why there may not be open joint data. One is that the RQD is very low, in which case they wouldn't log an open joint. The other case is that the RQD is very high, at a maximum being 100. And again, there wouldn't be open joint data logged for that run. Both of those cases exist in the database. And, therefore, this is

where we created two separate block models. We created the RQD block model and the RMR block model. The RQD block model we had 100 percent coverage. That is to say, we had RQD values for every run in the database. So when we did the RQD block model, it reflected all of the highs and lows, including the RQD's of 100 and the RQD's of zero. The RMR block model, however, because the data wasn't there -- we used all the data that was there, but the data wasn't there on which to calculate RMR. We chose not to invent data. We went with the data that was there. And we calculated RMR's for all runs where it was possible, and we created the RMR model. And once we had these two models, an obvious question would be is the RMR model biased by not including the high rock, the hundred RQD, or the low rock, the zero RQD? So we went through a process where, as I've described before, we cut sections through the model. We compared the sections, and they had substantial agreement. The conclusion, my conclusion, is that there was no significant biased between the RQD and the RMR models because of any exclusion -- or not exclusion. There was no bias because of any runs in the database where RMR could not be calculated.

Q And is the methodology that was followed in terms of not putting RQD values for which there was no open joint data into the RMR, is that the generally accepted industry practice?

A Yes.
Q Another point of criticism by one or more of the Petitioner's witnesses was that Golder should have used this different classification for RMR. I understand it was published in the literature at a later time, which was referred to as RMR 89 rather than the RMR 76 that you used. Are they correct that you should have used a different RMR classification system?
A No.
Q And why is that?
A What they were criticizing about was we were using an obsolete version of RMR.
Q That was their point of view?
A That was their contention. In fact, RMR 76 is the base reference for RMR in the industry. And it was -- it would have not been appropriate for us to use RMR 89 in this case. In fact, we should and did use RMR 76, because RMR 76 is what's used in the scaled span assessment. RMR 76 is what's used in the conversion between the Q value that we've spoke about and RMR. That relationship, the RMR equals nine long Q plus 44. That is in reference to the RMR 76 standard. So in the case for what we're using, RMR 76 was the appropriate version.
Q And they also took a position that you should have used what was referred to as the AB parameter of the RMR calculation.

Would it have been appropriate for Golder or necessary for Golder to have also used the so-called AB parameter?

A Yeah. The AB parameter is the adjustments for joint orientation. And it would not have been appropriate at this stage. That is an adjustment that is used to modify the RMR value for the rock mass in areas near excavations. And it would be premature for us to start modifying the RMR when we're not underground yet. There's no underground excavations. And the orientation -- the joint orientation has not yet been determined, let alone the excavations haven't been determined. So it would be premature to use that at this point.

Q In your experience in the industry, is that typically not done until operations begin?

A It's never done before operations. And I would say that it's not commonly done even in operations. You'd need particularly adverse joint orientations in which to actually use those type of -- that specific adjustment.

Q Again, based on the experience in the mining industry, your experience in the underground hard rock mining industry, your experience in characterizing crown pillars, both before mining and post-closure, how would you characterize the amount and quality of the data developed for this project for the determination of the crown pillar stability analysis?

A I'd characterize it as industry leading. There's 109 boreholes, which is extensive considering they're not yet underground. I would characterize the quality of the data as industry leading. Having been at the facility in Marquette, I think that their procedures and facilities up there are industry leading really. And I wasn't surprised to hear that they have some of the geology societies or the universities coming through to see their facilities and where they're doing, because it's really an example of industry-leading practice.

Q What are the input parameters to the scaled span analysis?

A The scaled span analysis, there is the crown thickness, the span of the opening under the crown pillar.

MR. HAYNES: Your Honor, I object. We're going over material that's already been testified to. We've been over the input analysis -- the input parameters for the scaled span analysis.

MR. LEWIS: It's just a foundation question to get me to the point, Your Honor.

JUDGE PATTERSON: Okay. Go ahead. I'll overrule.

A Okay. Well, there's a number of geometric, geometry-type input parameters, and there's also rock mass quality input.

Q And can you draw this, illustrate this?

A Yes.

(Witness draws diagram)

JUDGE PATTERSON: Mr. Lewis, how much more do you have? It's noon.

MR. LEWIS: Yeah. I think perhaps 15 minutes, perhaps 20.

JUDGE PATTERSON: Why don't we break for lunch now?

MR. LEWIS: Okay. That's fine.

JUDGE PATTERSON: Okay. Come back at 1:00.

(Off the record)

JUDGE PATTERSON: Everybody ready?

Q Mr. Beauchamp, I wanted to turn next to another opinion that the -- some of the experts for the Petitioners have offered and that being their apparent belief that this so-called in situ stress testing must be done before the development of the mine can proceed. And again based on your experience that you described earlier in these various underground hard rock mines, do you share that opinion?

A No.

Q Can you explain why not?

A The in situ stress has been considered in our assessment, a wide range of in situ stress, in fact. We talked about the K value, the lateral stress ratio versus vertical stress. And we've considered, like I said, a wide range from a K value of 0.5 to a K value of 3.0. This range takes into account all the published in situ stress measurements at

mines that we're aware of that are applicable to the Eagle Mine site. So it's our expectation that we've already considered what the in situ stress will be. There's no indication from drilling on the site that there's any abnormal stress. There's no core discing. There's no evidence of borehole closure. So there's no reason to believe that an abnormal lateral stress exists. And I guess lastly it's not the industry standard to do these types of tests from surface before you go underground. I can't think of one mine where they've done these kind of tests before going underground. The over-coring in situ stress testing is best done and commonly done from underground once you get some development underground.

Q Have you, in fact, recommended in your report that so-called in situ stress testing be done once underground for this project?

A Yes. We recommend that they do the tests.

Q And is that also reflected in the permit conditions?

A Yes.

Q Mr. Beauchamp, in your opinion based on your experience again and based on the testimony you've offered here today, is it your opinion that the current crown pillar design and the mine plan for additional drilling once underground is conservative?

A Yes.

Q Is it your opinion again based on your experience and the planning that you have done for this project that the current crown pillar design is protective of the environment?

A Yes.

MR. LEWIS: I wanted to note, which I failed to do, that Mr. Beauchamp's CV is Intervenor Exhibit 77. That's been stipulated for admissibility, I believe.

MR. HAYNES: That's correct.

MR. LEWIS: And finally I would offer for the court's use as we've been doing with some of these slides what I've marked -- that set of slides -- as Intervenor 623 again merely for demonstrative purposes not as substantive evidence but for the court's review if it would assist the court. And I've left a copy up here for you, your Honor.

JUDGE PATTERSON: Thank you.

MR. HAYNES: Subject to that understanding and subject to my earlier objections about the witness testifying without facts in evidence, I have no objection.

MR. REICHEL: No objection.

MR. WALLACE: Same position.

JUDGE PATTERSON: Okay.

(Intervenor's Exhibit 623 received)

MR. LEWIS: That completes my direct exam.

JUDGE PATTERSON: Okay.

MR. HAYNES: Perhaps Mr. Reichel ought to put his reservation on the record.

MR. REICHEL: Yes. I have no questions at this stage, but I reserve the right to ask questions based upon the cross-examination.

JUDGE PATTERSON: Okay.

CROSS-EXAMINATION

BY MR. HAYNES:

Q Mr. Beauchamp, good afternoon. My name is Jeff Haynes. I represent the National Wildlife Foundation and the Yellow Dog Watershed Preserve. Mr. Beauchamp, in reviewing your resume, which is Kennecott Exhibit 77, your resume contains a list of mines that you have worked in; correct?

A Correct.

Q Are these all the mines that you've worked in?

A The CV says "selected project experience."

Q Right. Are there other mines besides the ones listed here that you can recall that you've worked in?

A I can't recall.

Q All right. It appears that most of the mines you have experience in are in Canada; correct? Is that an accurate statement? Most?

A Most, yes.

Q And you've worked in mines also in Brasil, Ireland, Tunisia. But other than the Eagle Mine, you haven't actually had any

experience with any mines in Michigan, have you?
A No.
Q You haven't been inside any mines in Michigan?
A No.
Q You haven't measured stress in mines in Michigan?
A No.
Q You haven't determined whether mines in Michigan and in particular the Upper Peninsula of Michigan are wet or dry normally, have you?
A No.
Q Now, the -- on Kennecott Exhibit 623, which is your slide show that we just saw this morning, the second slide -- second page of that is this graphic with the Sudbury area mines and then the next two pages, 3 and 4, show the mines that -- in which you completed projects at; correct?
A Yes.
Q And I guess that's page 3. Page 4 talks about crown pillar projects at eight of those mines; correct? Is that -- is my understanding correct on that?
A Yes.
Q Yes. Now, none of those mines in Sudbury have gone through the process that the proposed Eagle Mine is going through under Part 632; correct? Those are all Ontario mines; correct?
A Yes.

Q So they're regulated by Ontario statutes and regulations and perhaps Canadian statutes and regulations; correct?
A Yes.
Q Not Michigan; correct?
A Correct.
Q You testified that -- if we look at page 4 of your, Kennecott Exhibit 623, you testified that none of the mines that you have been involved with in the Sudbury area have had collapses of the crown pillar once you've gotten involved; correct?
A Correct.
Q And you've been working in the industry for what? About 12 years now, 13, 14 years?
A My first mining job was an underground production job. That was in 1989. So that would be --
Q 19 years.
A Right. 19 years.
Q Okay. And again none of the mines that you've worked on have had collapses occur in pillars; correct?
A Correct.
Q But you testified that some of the mines that you're aware in the Sudbury have had collapses of the crown pillars before you got involved in working in the mines; correct?
A Correct.
Q How many?

A Off the top of my head, I would say two.
Q Which ones?
A The Totten Mine and the Nickel Rim Mine.
Q I see. Well, I'm looking at page 4 of your slide show. The Totten Mine says that -- at least the description here says it's currently undergoing a feasibility study. Do you see that?
A Yes.
Q So there's mining -- what's the feasibility study for if there's already been crown pillar collapse?
A The Totten and Worthington Mines were active on and off for probably a period of about 80 years.
Q I see. So the crown pillar collapse occurred?
A 1926.
Q I see.
A 1930.
Q How many decades after the mine started; do you know?
A No.
Q One decade, less than a decade, more than a decade?
A Maybe a decade, maybe more than a decade.
Q So based upon that particular mine, then, I don't know that you can generalize to all mines, but certainly there is the -- there is a history with that mine that the crown pillar collapsed ten years after the mine started working; correct? Give or take?

A Yes.
Q Okay. That's an important factor to consider when you're doing crown pillar stability analyses, isn't it? Other mines?
A Yes.
Q And you took those into account in your crown pillar stability analysis; correct?
A Yes.
Q Then if we look at the Nickel Rim South Mine, this is on the right-hand side of this page, is it not? It says "opening in 2009." Is that the right one, or am I looking at a different one from what you said?
A Yeah. I think it was the Garson Mine.
Q Oh, the Garson Mine?
A Yes. I think it was the Garson Mine.
Q And tell us about the crown pillar collapse in the Garson Mine.
A The crown pillar collapse was in -- was with a crown pillar that I don't have any direct experience with. However, I recall reading about a collapse that occurred near -- maybe 200 -- some distance from the head frame. I remember reading a report on that.
Q How many of the mines that you've been involved with have had subsidence of the surface caused by mining?
A Beyond the two that I just spoke about, noticeable

subsidence I would say none.

Q What do you mean by "noticeable"?

A Perceptible.

Q You, of course, have performed long-term analyses of subsidence in mines, haven't you?

A Yes.

Q And what's -- are those studies in the literature somewhere?

A Can you clarify your question?

Q Sure. I asked you whether or not you performed long-term analyses of subsidence in mines?

A Yes.

Q And have your conclusions been published?

A Published in our reports, yes.

Q I see. And what have your conclusions been concerning long-term subsidence -- long-term studies of subsidence in mines? That it occurs or doesn't occur?

A I don't understand the question.

Q Let me break it down. You know what subsidence from mines is, don't you? That is the surface of the earth falls in relation to the elevation of the rest of the surface; correct?

A Sure.

Q And subsidence -- by "subsidence," we mean subsidence -- the falling of the surface of the earth is caused by cavities under ground; correct?

A Yes.
Q Okay. We can agree on that so far; right? And you say you've studied the long-term -- you've done an analysis of the long-term subsidence in mines?
A Yes.
Q Okay. So my question is, what have your conclusions been based upon your studies?
A Well, depending on the results of the analysis, it would conclude that the crown pillar would be stable or unstable.
Q Oh, I see. We're back to crown pillar analysis. I'm just talking about general subsidence in mines for the crown pillar or rumen pillar or any other kind. Do you have a conclusion? Have you reached conclusions based upon your analysis, or is this a case-by-case thing that you do for each mine?
A We look at the stability of each mine individually.
Q I see. And you don't compare those mines that you're studying to other mines -- experience in other mines?
A Yes.
Q You do? Your answer is, yes, you do?
A Yes, we do.
Q That's an important factor -- right? -- the case histories of other mines?
A Yes.
Q Now, for your analysis for your work here for Kennecott, did

you consider the case histories of other mines in the Upper Peninsula of Michigan in terms of your analysis?

A Yes.

Q Which mines?

A The Athens Mine.

Q Where does the Athens Mine come into your analysis?

A It's a mine we're aware of. It's a crown pillar -- it's an example of a crown pillar collapse that we are familiar with. And we considered it in the assessment of the Eagle project.

Q Okay. And by "the assessment the Eagle project" or property, you mean Appendix C-2, which is the geotechnical analysis; correct?

A Yes; correct.

Q Appendix C-3, which is the subsidence report; correct?

A Yes.

Q The technical memoranda published in -- prepared in 2006; correct?

A Yes.

Q And that's it; correct? There are no other reports that you've done for this Eagle project; correct?

A None other than I put in my slide and the two reports and the four technical memoranda.

Q And where in those memoranda do you discuss the Athens Mine?

A Nowhere.

Q But you said you took it into account?
A We did.
Q Did you put it in your modeling results -- in your modeling program? Did you put any analysis of the Athens Mine in your models?
A We considered Athens-type collapse in the modeling we did. That was what I showed with the CPillar that considers plug-type failure.
Q Okay. But you said you considered the Athens Mine in your results; right?
A Yes.
Q You didn't put anything -- you didn't input anything from the Athens Mine into your models, did you?
A It was part of the consideration that we had when we -- when we did the analysis and when we were formulating the models. It was considered.
Q Let me ask it again. Let me break this down so you and I understand each other.
A Okay.
Q The Athens Mine collapse occurred when? In the 1920's. We know the distance that the crown pillar failed. We know how long it was since the mining had stopped in the Athens Mine. Were any of those values put into your models as inputs? It's a very easy question. "Yes" or "no"?
A What values specifically are you asking about?

Q Well, let me ask it more generally if I can't get the specifically. What values -- what data from the Athens Mine collapse was put into your models?
A The input to our models and all models in the industry that would look at crown pillar stability look at the specific geometries of the mine plan and the specific rock mass conditions at the site that is under consideration. So I don't -- in that respect, I don't understand. Maybe if you could give me a specific example of what you would consider putting in, I could tell you how it was considered in the models we did.
Q Mr. Beauchamp, I think I've asked the question three different ways. I'm asking if you used any data from the Athens Mine collapse in your models -- any numbers from the Athens Mine collapse --
A Any numbers?
Q Was that put in your model?
A Well, the Athens Mine crown pillar is not the same geometry as Eagle, to it wasn't appropriate to put in the Athens geometry.
Q Okay . So you didn't put any Athens geometry into your models. Is that -- that's what you're saying; right?
A Yes.
Q You say that you took the Athens Mine into account in your reports; correct?

A Yes.
Q Where in your reports do you mention the Athens Mine?
A It's not mentioned explicitly in the reports.
Q It's not mentioned at all in the text of your reports or the appendices or the modeling or the references; correct?
A Correct.
Q So it's -- you really didn't take it into account then other than in some intuitive sense?
A No. It was considered when we were looking at the crown pillar stability.
Q But it doesn't -- when I look at your reports, Appendix C-2, Appendix C-3 and the other four technical reports, I don't see the Athens Mine mentioned at all?
A Correct.
Q So it wasn't, in fact -- so someone, say, from the DEQ reading your reports or someone from, say, the National Wildlife Federation reading your reports would not find in your reports any mention of the Athens Mine?
A Correct.
Q So there's no way that we would know whether or not you took it into account just reading the reports, could there be?
A Just reading the reports, no.
Q Okay. And, in fact, in your reports, Mr. Beauchamp, you didn't take into account any other mines in the Upper Peninsula either their behavior or crown pillar

subsidence -- crown pillar collapses or subsidence or any other data from any other mines, did you?

A We did consider other mines. Part of the process before we really got into assessing the crown pillar stability was to take a look at experience in mines in Michigan. This included several mines. I would -- I know that the Athens Mine was a notable mine because of its prior history. But there's a number of other mines particularly in the Iron range that we looked at and considered, and it was all part of our assessment of the Eagle crown pillar.

Q All right. What I don't find, Mr. Beauchamp, in Appendix C-2 or C-2 or the our four technical reports is any discussion of those other mines. You didn't -- if you took them into account, it's apparently a secret to you?

A It's not a secret. But these reports are intended to describe the Eagle crown pillar. And I didn't think it necessary to describe the differences between the Eagle Mine and these other mines.

Q Nor did you find it necessary to discuss the similarities, did you?

A No.

Q That's apparently not important to discuss the similarities between the proposed Eagle Mine and other mines in the Upper Peninsula?

A Important to consider; not important to put in the reports.

Q So if it wasn't important enough to put in the reports, why did you even consider them?
A Well, we considered them so that we could establish whether they were particularly relevant to Eagle or not. And once we established that they weren't relevant, then they were irrelevant and we continued to consider them and think about them so that we're not missing anything in our assessment. But they're not -- the cases that we looked at are not relevant to the Eagle crown pillar.
Q If they aren't relevant, why did you keep considering them?
A Well, because I don't see why you wouldn't. Once you've read some papers and you understand what the geotechnical context, the geologic context and the mining context is at these mines, I mean, then it's already built into your considerations.
Q But we don't find that built-in consideration anywhere in your reports; correct?
A Not explicitly, no.
Q You can't read it anywhere in the reports; right?
A No.
Q Mr. Beauchamp, Mr. Lewis has graciously allowed me to use one of his exhibits that for some reason it's not on my system. I apologize. Otherwise I could do this perhaps a little more efficiently. But this is Exhibit 5- -- Kennecott Exhibit 594, which is your -- Golder's July 7,

2006, memorandum to Jon Cherry, Steve Donohue and Dennis Donohue. You testified about this; correct?

A Yes.

Q And this is basically the portion of the 91 questions submitted by DEQ to Kennecott that you got to answer; correct?

A Correct.

Q Let's take a look at number 58. The question is, "Provide data and the results from unconfined compressive strength UCS tests used to calibrate the point load test results." Do you see that question?

A Yes.

Q And looking at the paragraph -- by the way, you -- did you draft this or did someone else at Golder draft this?

A I wrote this.

Q All right. And it was then reviewed by who else at Golder?

A This would have been received by Trevor Carter -- Paul Palmer -- sorry. Hang on. I'm on the wrong -- there it is right there. It's co-authored by myself, Trevor Carter, Joe Carvalho and Rob Bewick.

Q All right. Number 58 which asks Kennecott to provide data and results from the USC tests. In the answer here, I don't see that there's any data provided in the answer. Do you see any data provided in the answer?

A No.

Q And I don't see any results provided in the answer. Do you see any results in the answer?
A No. They're provided in the parallel memo.
Q Let's go to the next page, number 59, which says, "Provide data and results from sensitivity tests to determine crown pillar behavior under a variety of possible horizontal stress conditions." Do you see that?
A Yes.
Q And you see the answer that you wrote -- do you see in the answer that you any data?
A No. The data isn't provided in this memo.
Q Okay. And do you see any results that are provided in this paragraph?
A No.
Q Number 60 says -- this is the next one -- "Provide data and results using a three-dimensional, non-linear modeling code to assess the stability of the crown pillar." Do you see that? If we could scroll down to that -- there we go. Thank you. The second paragraph, your answer says:

> "In the phrase three study, three-D distinct element simulations will be considered if the stability of the crown pillar does not meet the level of certainty that is acceptable."

Do you see that?
A Yes.

Q So for number 60 you didn't provide any data, did you?
A No, not in this memo.
Q Nor any results?
A No, not in this memo.
Q Did you provide the data at some other time to the DEQ?
A Those results were provided in a parallel memo.
Q Oh, the technical -- the Attachment 7?
A Yes.
Q Right.
A This -- there was two technical memoranda put out. One was just the objective of it was to be concise and just answer the question. So, for example, when we're talking about the UCS tests point 58, we discuss that those tests were, in fact, done, that the testing program was completed May 10th, 2006, gave some details about the nature of the testing program and say that a discussion of the USC laboratory testing program is included in the technical memo titled KMC Eagle clarification discussion dated July 2006, which is -- which we put out on the same day. And this report -- the purpose of this report was to be a more complete discussion of the topics around these clarification requests. And these do, in fact, include data and results.
Q Okay. Well, results anyway.
A No. Data and results.
Q Well, let's go back to -- let's go to number 61, which says,

"Provide data and results of a rigorous analysis technique that encompasses all of the possible failure mechanisms to determine stability of the crown pillar." Do you see that?

A Yes.

Q I notice in your answer to number 61 on this page and the next you don't refer to the -- to the geotechnical memorandum, do you? In the answer to number 61.

A No.

Q What you say in the end of the first paragraph is, "To this end, and when a full characterization of the crown pillar is available, the stability assessment of the crown pillar will be revisited and checked against a number of failure mechanisms namely" and then you list some of them; right?

A Yes.

Q So you didn't provide any data or results to question 61 at all. You just said, "We'll do this later"?

A Data and results are not presented in this memo.

Q You just said, "We'll do it later"; right?

A There is data and results in the -- in other documentation but not right here. And we also made the note that additional analysis will be done as reflected in the mine permit application when a further understanding of the crown pillar characterization is completed.

Q Well, it says that -- maybe I'm misreading this, Mr. Beauchamp. But what it says, "To this end, and when a full

characterization of the crown pillar is available." When is that going to be? When is a full characterization going to be available?

A Once underground access is available and further understanding of the crown pillar is gained.

Q Number 63 -- we're on page 4 of this memorandum -- says, "Provide data and results from analyses conducted using plasticity theory to predict shear and tensile failure of the rock mass." Do you see that?

A Yes.

Q And in the second sentence of your answer you say, "As discussed per clarification of number 61 and 62 above, a phase three study will be completed." Do you see that?

A Uh-huh (affirmative).

Q "Yes"?

A Yes.

Q So again you're saying, "We're going to do it later"?

A No. We're saying that we've done an adequate amount of work with regards to these considerations now but we're not going to stop there. We're going to gather further information once underground and we're going to complete another round of assessment of the crown pillar with this further understanding.

Q Right. And for number 63, you, in fact, did not provide data or results from a plasticity theory, did you?

A Can you rephrase the question?
Q Well, I'm reading the question.
A Okay.
Q The question. I'm reading the item 63. It says, "Provide data and results from analyses conducted using plasticity theory to predict shear and tensile failure to rock mass." It asks you for data, and then it asks you for the result of the analysis. It asks for two things; right?
A Yes.
Q You didn't provide either one of them here, did you?
A No.
Q 64 says, "Provide data and results from the Phase 2 model specifying ten three-noded triangle elements." You know, Mr. Beauchamp, for the life of me, I've been in this case now for some period of time. I have no idea what they're asking for there. Can you help us? What are they asking for there; do you know?
A Yes.
Q What are they asking for?
A They're asking details -- technical details of the modeling that was completed.
Q I see. And in your answer to number 64, did you provide the data for that modeling?
A Yes, in this memo and in the parallel memo that we issued the same day.

Q I don't see any mention of parallel memo and I don't see any mention in here of any data that were provided, do you?
A Not data, no.
Q Okay. Or results?
A We had already provided data and results in other -- in other reports. And that is what we're referring to in the response to that request.
Q Mr. Beauchamp, I've put up on the screen page 2 of Appendix C-2. This is the Eagle project geotechnical study. Do you have that with you?
A Yes.
Q Look at the first paragraph. It's on the screen, but you can also look if you have it with you, that's fine. The first paragraph talks about data organized in two Microsoft access databases. Do you see that?
A Yes.
Q And then at the end of the paragraph, the last two sentences say, "Some entries were found to be deficient in information." Do you see that?
A Yes.
Q Is that your conclusion or someone else at Golder?
A That's my conclusion.
Q And what entries were found to be deficient?
A When we looked at the database, there were entries in the database that didn't have all the data that we would have

liked to have had, a full geotechnical logging, for example.

Q I see.

A And what the deficiency is speaking to is this -- this evolution which is normal in industry where a project starts in at an exploration phase and they are logging mainly for geologic or economic geologic purposes. It's an exploration drilling program. They do some early holes. They might not and most properties in industry were not log a complete suite of geotechnical parameters. And then as the drilling program proceeds and they make the recognition that they might have something that's economically viable, it goes from a exploration program to a more detailed geologic definition program.

Q So it's standard in industry practice to have deficient data when you're logging these holes; right?

A Yes. In the early works when it's only targeted towards exploration.

Q The next sentence says, "A list of deficient date has been formulated and communicated to KEX personnel on site. Do you see that?

A Yes.

Q Who prepared the list?

A Me and my colleagues.

Q And who did you send the list to?

A That would have been to Andrew Ware and Steve Coombes at the

time.

Q How long was the list? Was it a page or was it 20 pages? Was it something in between?

A It wasn't very long. It was mainly a list of boreholes and intervals of boreholes where there was logging but not the full suite of geotechnical parameters that we would have liked to have seen. It was certainly in the early holes. And the purpose of the communication for me was just to double-check that we did get all the data and, yes, in fact, we did get all the data, and then to confirm with them that there wasn't any additional geotech data that we could use.

Q Let's go the next paragraph which starts "Geotechnical logging is completed in Marquette." Do you see that?

A Yes.

Q The fourth sentence at the middle of the paragraph says, "This is" -- let me back up. The third sentence says, "Logging procedures have been formulated and revised from 2001 to present." Do you see that?

A Yes.

Q The next sentence, "This has resulted in a marked improvement in the quality and completeness of the data over this period."

A Yes.

Q What was improved and why did it need to be improved?

A Well, that again goes to the point that I just spoke on

which is the early logging was done for exploratory purposes. And then they made changes, improvements, to the procedures to collect a more full set of data.

Q I see. And then did they go back and fix the deficient data in the earlier logging?

A They may have. I don't know if they went back and re-logged.

Q You never saw that they did that?

A Don't know.

Q So that bad data was just bad data?

A It wasn't bad data. It was --

Q I'm sorry. Incomplete data.

A Yes.

Q Let's turn to page 3 of this document. After a series of bullets, Mr. Beauchamp, we go to a full paragraph. The second sentence of it says -- I'm sorry. Let me back up. The paragraph says:

> "Based on the drill coverage currently in the database, there is limited data for the south end of the crown pillar, for the main decline (approximate 800 linear meters) and for the portal area. More information in these areas would be prudent when advancing this project beyond a pre-feasibility stage."

Do you see that?

A Yes.

Q And the limited data for the south end of the crown pillar, that would be important data to have, wouldn't it, when you're assessing the stability of the crown pillar?
A Yes.
Q Yes. When you're making it -- when you're doing a CPillar or a scale span analysis, wouldn't it be important to have data for the south end for one push -- for an entire side of the crown pillar?
A Yes.
Q That would be important, wouldn't it?
A Yes.
Q Did you ever get that data?
A Additional drilling was done following this and was included in the C-3 report.
Q I see. That's the 109 holes instead of the 92?
A Correct.
Q And you understand, Mr. Beauchamp, that other than the eight cores, the photos from the eight cores that were obtained from a Freedom of Information Act request to the Department of Natural Resources that our consultants have looked at -- other than those eight and the three cores that Kennecott provided to Wilson Blake, that the folks on this side of the room, my side of the room, haven't been able to look at any of the geologic data for the 99 other cores. You understand that, don't you?

A Yes.
Q Do you understand that they haven't been able to go out and look at the actual cores; correct? They haven't been able to do that?
A Correct.
Q They haven't been able to look at the data that went into your computer programs. You understand that, don't you?
A No. They -- the data that went into our computer programs is in our reports -- here summarized in our reports.
Q Summarized. Not all the geological data that Mr. Ware sent to Golder; correct?
A If we're talking about the voluminous amounts of data, no. This -- all the data is here, but it's in a more compact form.
Q You mean the summaries are here?
A Yeah. There's figures that describe the data. There's tables that describe the data.
Q But if Jack Parker wanted to look at the cores for, let's say, for example, hole 77, he wouldn't be able to find that in your reports, would he?
A The cores aren't in our reports.
Q And he wouldn't be able to find the data -- the geologic logging data for hole -- 77 may not be the right example. Let's pick a hole that they didn't look at -- photos they didn't look at. Hole 66 is not one of the -- not one of the

eight holes that's on Table 4 of C-3. Okay. He wouldn't be able -- Jack Parker wouldn't be able to look at your reports and then see if your reports accurately characterized that data, would he?

A He wouldn't be able to see the logging for that hole in our reports.

Q And so he wouldn't be able to check your work if that's what he wanted to do, would he?

A Yes. He could check our reports by going to the figures and the tables that provide the data on the rock mass, and he could redo the Cpillar. He could redo the scaled span. He could redo the -- Matthew's stability assessment. I mean, there's quite a bit. Like all the analysis that we did he could redo with the data in here.

Q With the summaries that are in here but not with the actual geophysical data, could he?

A The geophysical --

Q Geotechnical. Excuse me.

A Geotechnical.

Q Let me give you an analogy, Mr. Beauchamp.

A Okay.

Q Let's say you're there and you have a number of objects behind the panel there that I can't see. And you tell me there are four objects there.

A Right.

Q I have no way of seeing that. How can I verify that what you're saying is true? I can't unless I get behind the panel and see if there are four there or three or five; right?

A I guess to extend the analogy, if I gave you a table listing the four objects and then a figure with a picture of the four objects, then you'd have the data. But you couldn't see it for yourself, no.

Q Let's continue the analogy just a step further.

A Okay.

Q Let's say the objects behind your panel were red. Okay. But the underside was blue. And someone took a picture of just the red portion. And you said in your report there are four red objects. And I saw a picture. I would say, "Yes, there appear to be four red objects." But I don't know that they're red all the way around until I can pick up the objects and turn them over; right?

A Well, I guess that using your analogy the similarity in this case is that we had the entire object. We wrote down that they were blue on one side and red on the other. We put that in our report. And then your experts looked at the photographs that only saw the one color and said, "These objects are blue."

Q Mr. Beauchamp, you didn't include in your reports the core photos from 109 cores, did you?

A No, we did not.
Q Okay. And you didn't include in your reports the backup data that you analyzed to come to your conclusions, did you? The raw geotechnical data is not in your reports?
A The core logs are not in our report.
Q And neither are any notes from the drillers; correct?
A No. The driller's notes are not in our reports.
Q Okay. And you would agree with me, wouldn't you, that for someone to check the voracity of your conclusions, it would be important for that person to look at the cores, to look at the underlying geotechnical data and to look at the driller's logs? You would agree with me that that would be important for someone to check the voracity of your reports; would you agree?
A I think that, if I was going to check the reports, I'd redo the analysis. And all the data to redo the analysis is in our reports. If you want to try to go back and generate new logging, you couldn't do that from our reports.
Q Well, I'm just talking about looking at the original logging. In order to check your work -- if someone wanted to check your work to check to see if your conclusions are correct or incorrect or nearly correct, it's important, isn't it, for someone to be able to go back and check the original geotechnical data?
A No, I don't think it's important.

Q Oh, really.
A Let me qualify that a bit.
Q Please. I'm interested.
A I don't think it's important that you go back and you re-log 17,300 meters of core. I think it's important that you look at enough core like I did because I've been to the site three times. Every time that I went to the site, I look at the core that was available. And I matched it to what the logging was so that I had a level of confidence that what was being logged in a systematic way was accurate in the database. And I got an understanding that the nature of the geology, understanding of the nature of the fractures in the core. And to that extent, I think it's important. But I do not think it's important that you have access to all the data so that you go back and do everything all over again. I think that you just need to check it for yourself.
Q Let me make this a little more simple, Mr. Beauchamp. How many cores did you inspect when you were there?
A All of them that were available.
Q How many is that? One or 109 or something in between?
A The room where -- and they have two rooms in Marquette. But one of them is about the size of this courtroom. And they have tables that run sort of a full length. And they would have core laid out on both of these tables full length. So you would have -- I don't know -- how long is this

courtroom? Maybe 10 meters. You have -- I don't know -- tens of meters of core to look at, probably more than 100 meters laid out at one time. This is a rough estimate. I'm not --

Q That's fine. Your rough estimate is very informative.

A Okay. So that's the scale of which I would have reviewed the core.

Q I see. Do you remember which holes?

A Not offhand.

Q Okay. Was it one hole or was it ten or was it twenty?

A Oh, it was probably twenty.

Q Twenty holes. Okay.

A Probably.

Q You understand that Jack Parker and Marcia Bjornerud and Stan Vitton have been not been able to do that? You understand that?

A Yes.

Q So you had a distinct advantage over them in your analysis because you -- you said that you satisfied yourself that the data that you were using in your report was accurate based upon your sampling, let's say, of 20 cores; right?

A Yes.

Q Okay. And if someone outside of Golder wanted to double-check your analysis, someone on our side of the room, we haven't been able to do that. We haven't been able to go

to the core shed. You understand that, don't you? Right?
A Yes.
Q We haven't gone to the core shed to look at the 20 cores that you looked at to double-check your view of what the cores were and their quality. You understand that, don't you?
A Yes.
Q So there's no way that anybody on this side of the room could check your work. You understand that, don't you?
A I don't agree with that.
Q Because you think that they could just simply look at the summaries of data in your reports and redo the analysis based upon the summaries; right?
A And by using the information that's available to them to check against those summaries, to use their experience at other mines to check against their understanding of what the rock mass might entail. So I think that a combination of checking some data to see that the data that's in here is accurate and using their own personal expertise, they should be able to come to a conclusion.
Q So you want them to just invent the data from the core samples that you looked at; right? Because they haven't had an opportunity to look at them.
A I don't understand your question.
Q Well, you received data from Golder -- excuse me -- from

Kennecott first with 92 boreholes and then an additional 17 to make 109; right?

A Yes.

Q You received data via computer from Negaunee that had, as we saw Friday from Mr. Ware, just for a few of the holes several dozens of sheets of data; correct? Just for a couple of them. You received all that data through a computer -- some sort of a transfer; correct?

A Correct.

Q From Kennecott. And you put that data in various forms into your computer models; correct?

A Correct.

Q Okay. Now -- and what we saw Friday -- and the exhibits are maybe an inch thick -- the paperwork for the various tables that Mr. Ware testified about. Those are just a handful of the 109 holes; correct? You've seen those exhibits, haven't you?

A Yes.

A Yes.

Q Those are a handful of those holes; right? And yet you had first 92 and then 109 holes' worth of data to plug into your computer programs; right?

A Correct.

Q Okay. If I instructed Stan Vitton to check to see whether your modeling programs correctly output the answers, I

wouldn't have the same data that you had to let him check it, would I?

A Yes, you would, because the data that we took from these logs is summarized and presented in the tables and the figures in this report.

Q Not the summaries: the raw data. They wouldn't -- just agree with me. They wouldn't have the raw data; is that true?

A True.

Q Thank you. Let's go to page 5 of this report. Mr. Beauchamp, page five of Appendix C-2 in the second paragraph says -- it starts, "A series of algorithms have been created." Do you see that?

A Yes.

Q Could you explain for Judge Patterson what an algorithm is?

A It's just a mathematical calculation. It sounds fancy, but it really isn't. It's just math.

Q Just a formula; right?

A Yes.

Q And so you prepared these formulas -- created these formulas to calculate four of the five parameters in the RMR rating. Do you see that? Am I summarizing that first sentence correctly?

A Yes.

Q The third sentence of that paragraph says, "The majority of

the data in the 2004 database was found to adequately calculate RMR." Next sentence, "Of the pre-2004 data, roughly half of the data is lacking all or some of the data required to calculate RMR." Do you see that?

A Yes.

Q Did you use the pre-2004 data in calculating RMR's?

A Yes.

Q Even though it was lacking the data required?

A Where the pre-2004 data had a full geotechnical logging, we used all the geotechnical logging that was available, so, yes, we did use it.

Q Where it was available, but yet you just said -- maybe I misheard you, but you said that, where the data was not -- were not sufficient to calculate RMR, you nevertheless used it to calculate RMR.

A Sorry. I don't mean to ask again, but could you repeat your question?

Q Feel free. I don't mind if you ask me to ask the question again. Don't be concerned. This sentence says, "Of the pre-2004 data, roughly half of the data is lacking all or some of the data required to calculate RMR"; right?

A Yes.

Q Maybe I misheard you, but I thought you said that you nevertheless used that pre-2004 data to calculate RMR's.

A We used -- if you look at Table 1, which is up there, we

listed the holes that we -- where we -- that there was sufficient data to calculate RMR for the entire hole. We listed holes where there was RMR available for part of the hole, and then we listed the holes where there was insufficient data to calculate RMR. Okay? And you can see that some of the holes that were drilled -- and I'm speaking now about the early holes during the exploration phase of the project -- didn't have the complete geotechnical logging done, so it was those holes that we didn't include.

Q Oh, so this is the third column from the left, second from the right. So for those holes you didn't calculate RMR's?

A For those holes there's no RMR calculated, because there wasn't geotechnical logging to do the RMR.

Q All right. Let's turn to page 8 of this report. Mr. Beauchamp, Table 4 lists the A1 chart for RMR, and this is a table in which you take your point load strength index and megapascals -- by the way, what is a megapascal?

A It's a unit of pressure.

Q And that's a metric unit -- correct? --

A Correct.

Q -- that translates with a conversion factor to pounds per square inch?

A Correct.

Q So you took your point load strength index, and then you converted those to the A1 factor for RMR; correct?

A Correct.
Q Now, the sentence after this table says, "Point load testing data indicates that the intact rock strength of most rock types within and immediately around the Eagle deposit is moderately high with an A1 rating of 12 to 15." Do you see that?
A Yes.
Q Where do you report that -- all of that information? Where could I look that up?
A The point load testing data?
Q Yeah; yes.
A The point load testing data, if you go to Intervenor 79 --
Q Give me a date on that, would you, please?
A It's July 2006.
Q This is the geotechnical memorandum?
A Yes. Okay. That gives the UCS point load tests summary. I'll get to it here. Just --
(Witness reviews documents)
A Okay. So it's in two locations. If we're -- since we're on this exhibit, if you go to the previous page -- okay? -- at the table at the top, this table at the top, I went through this with Mr. Lewis, but I can go through it again, if you like.
Q You don't have to go through it again, Mr. Beauchamp. I think I can follow up with a question. On Table 3, for each

rock type you listed a number of tests, the quantity of tests in the fourth column from the left. Do you see that?

A Yes.

Q And then you have -- and then the UCS is really an average, is it not, the next column over?

A The UCS is a -- yes, it's -- there's a correlation factor that's used, and it's calculated from the point load index.

Q And that calculation was performed somewhere to get to this table; correct?

A Correct.

Q Where would I find that calculation?

A The form of the calculation is described on the preceding page, page 6.

Q And if I wanted to check to see that your work is correct, how would I be able to do that on Table 3?

A On Table 3?

Q Yeah. How could I check to see that that -- that these numbers are correct?

A Well, these numbers are taken directly from the -- it's a summary of what's in the geotechnical database.

Q The one that I have -- that our experts haven't seen?

A Correct.

Q So there's no way that we could check to see if these numbers are correct?

A Only insofar as you can look in the literature for typical

values for each of these rock types, because there are -- the actual strength of a rock is fairly consistent. If you have, for example, a peridotite that's occurring here in Michigan or one that's up in Sudbury or one somewhere else, if it is actually that rock, the strength of it could be fairly similar.

Q Could be?

A Oh, I'm sorry.

Q Well, Mr. Beauchamp, I'm looking at seventh line down where that says "peridotite." Do you see that?

A Yes; yes.

Q Somebody did 272 tests on the peridotite of the Eagle deposit.

A Okay.

Q Right?

A Yes.

Q So Kennecott did 272 tests on the uniaxial compressive strength of the peridotite at Kennecott, but my experts are supposed to go to the literature to determine if it's similar?

A Let me clarify.

Q I wish you would.

A If you go to the literature, you'll be able to see what a typical strength for peridotite is. And if you were to compare that to the value in our table, you could see if

that is consistent with the literature and the testing that has been done on that rock type.

Q Of course you can do that, Mr. Beauchamp. But in order to see if your tests actually reflect that similarity, we don't have a chance to go back and review your tests, do we?

A You don't have access to the geotechnical database, no.

Q Mr. Beauchamp, if we look, again, starting on page 8 of this exhibit, page 9 and page 10, which have the tables for A1, A2, A3, A4, these are tables 4, 5, 6 and 7; right?

A Yes.

Q In order for us to determine if your calculations of these A1 through A4 factors is correct, we'd have to look at the database, wouldn't we?

A Yes.

Q So just like for the A1, there's no way for us -- excuse me. Just like for the uniaxial compressive strength, there's no way for us to verify that your calculations are correct right now, is there?

A You don't have access to the database.

Q So we can't verify your calculations are correct, could we?

A No.

Q Now, on page 19, the RMR parameter A5, --

A Yes.

Q Do you have that?

A Yes.

Q See, you and I using the old-fashioned method of looking at the text are faster than the computer screen. I really appreciate that. A5, you say, represents the joint water condition. "Based on current information, the A5 parameter has been estimated to represent a dry joint water condition which corresponds to a rate near 15." Do you see that?

A Yes.

Q And that 15, by the way, is the one that you corrected later to say it's really a 10?

A It was a typographical error. We issued a technical memo to that effect.

Q Right. Because 15 is actually the value that's assigned -- the highest value that's assigned to A5 in the RMR 89 system, isn't it?

A It was a typo.

Q Answer my question, please.

A Sorry. 15 is the highest value that can be assigned to A4 in the RMR 89 system; correct?

A Correct.

Q Now, when you say "based on current information" in this sentence that I just read, what information is that, circa April 2005, the date of this report?

A The A5 parameter and my assessment that the A5 should be equal to 10 is based on my understanding of the hydrogeologic conditions at Eagle, which I characterize as

being a generally tight impermeable rock mass. It's also based on my experience, as I've testified earlier, in other mines with very similar geologic conditions to Eagle. Those mines -- my experience from those mines is that they are typically quite dry. In some cases they're dry to the point of employing water trucks to have to wet down the drifts and crosscuts to suppress dust.

Q Do you understand, Mr. Beauchamp, what will happen if this mean in fact turns out to be dry and the workers have to wet down the walls with water? Do you know what will happen then?

A Yes.

Q You'll create sulfuric acid -- correct? -- acid mine drainage; right?

A That isn't the first thing that comes to my mind, no.

Q It's the first thing that came to my mind, but that would happen, wouldn't it?

A Using water trucks is a common industry practice.

Q In sulfide mines?

A In sulfide mines,

Q Yeah, where there's massive sulfide that, under ordinary circumstances, if it gets wet and then dries, creates acid mine drainage; right?

A Acid mine drainage does occur at mines.

Q Thank you. Now, your assessment -- let me back up. You say

you've been to the site?
A Yes.
Q What? Three times, as I recall?
A Yes.
Q So you've located in physical space where you believe the crown pillar -- where the crown pillar is in relation to the various surface features?
A Yes.
Q Give or take; right?
A Give or take, yes.
Q Yeah. And you know that the Salmon Trout River is right over a portion of the crown pillar, isn't it?
A Yes.
Q And there are wetlands over the portion of the crown pillar; correct?
A Correct.
Q And so it's your testimony that, based upon your experience in other mines not located in the Upper Peninsula of Michigan, that this mine will be dry?
A Yes.
Q Notwithstanding that it's directly underneath a flowing river?
A It's my assessment that the A5 parameter being set to 10 is a reasonable number to set it to. There are mines in Sudbury, for example, that operate near bodies of water that

have dry excavations in development crosscuts.

Q And so you've extrapolated from your experience at Sudbury. What about your experience in mines in, say, Brazil? Would those apply here?

A Brazil, yeah; yes; yes.

Q But again, you haven't been inside a mine in the Upper Peninsula of Michigan, have you?

A No.

Q You don't have any direct experience, do you, with the water regime inside mines in the Upper Peninsula of Michigan, do you?

A Only insofar as I've been in mines that are very similar geologically. The fact that they're across the border -- I mean, they're geologically similar mines, so I think I do have some, yeah, experience.

Q Right. But -- that's fine. But you would expect, wouldn't you, that, if someone with experience being underground in the Upper Peninsula of Michigan might have a different view than you about the relative dampness or not of a mine in the Upper Peninsula?

A Sure.

Q By the way, didn't you testify -- maybe I misheard this. Didn't you testify that to be conservative you would have given the A5 parameter a 7 rather than 10?

A No. I think I said that it would have also been reasonable

to have an A5 parameter value of 10 -- of 7.

Q Of 7.

A 7 and 10 are both what I would consider reasonable values at this -- yeah, at this station.

Q And to do conservative modeling, wouldn't it be appropriate to use a value of 7 for this parameter rather than 10?

A 7 would be more conservative than 10.

Q And it's important in your modeling to be conservative, is it not --

A Yes, it's --

Q -- not unrealistic but conservative?

A It's important to be conservative, yes.

Q You never ran your models using 7 for the A5 factor, did you?

A Yes, I think we did. I think that we considered a range of RMR values, and that -- like I had stated previously, I think changing the -- what we said would be the median RMR of 70 and the low end RMR of 60, if you consider 70 going to 67 and 60 going to 57, that doesn't change the results -- the conclusions that we reach here.

Q I understand your conclusion. But just the math works that, if you change parameter A5 from 10 to 7, you drop the RMR by 3 in each case; correct?

A Correct.

Q Now, let's take a look at the next table on page 10, which

is Table 8. And there you list various portions of the mine -- excuse me -- of the rock mass based upon the type of mining. Is that a correct characterization of Table 8?

A Yes.

Q And you list the RMR minimum. That RMR minimum is what you got based upon your view of the Kennecott database; correct?

A No. These numbers in Table 8 come from our block model -- our RMR block model, and the figures for that are in the report. So again, without going through a long detailed explanation, we used the full database, calculated the values and the boreholes, created a block model -- sections of the block model. Those results from the block model are presented here, and that was the basis for the RMR.

Q Right. I understand. But in order to arrive at these figures with your RMR minimum from 60 to 70, you used -- you analyzed the full database; correct?

A Correct, we analyzed the full database.

Q And you have a range here of 60 to 70 for the different mining methods; right?

A Correct.

Q Now, the next column over says "RMR typical." Do you see that?

A Yes.

Q The results here were also derived from the full database; correct?

A Correct.
Q So without access to the database, no one could double-check to see that your results here are accurate, could they?
A Besides going to the figures -- if they wanted to check them against the figures for the block model, they could. If they wanted to recreate the block model, they need the database.
Q But to check them against the block model to verify that the block modeling is correct, you need the full database; right?
A Correct.
Q Let's go to page 13 of this report. Okay. Mr. Beauchamp, on page 13 of Appendix C-2 in Section 3.8, we're dealing here with discrete features; correct?
A Correct.
Q And you testified earlier that you located the potential discrete feature on the colored RMR cross-sections as the green -- I think it was the green line; is that right?
A It's indicated in our figures, yes.
Q Right. It's -- looking at, say, Figure -- just as an example, Figure 5, there's a nice solid green line before that Y-sects that figure. Do you see that?
A Yes.
Q That's the proposed -- that possible fault plane -- correct? -- that goes through the orebody -- that may go

through the orebody?

A Correct.

Q Now, I want you to look at the second paragraph of this section, which says:

> "Based on the information in the two Microsoft Access databases, there have been other discrete structural features identified in the Eagle deposit. These discrete features have been stored in a separate table of the database instead of being included in the main database."

Can you tell me what that's all about? Why did you pull those out?

A What it is, is there's a table that has been set up to query the main database and pull out the runs or the lengths of core that have been identified as broken, sheared or gouged. That data still resides in the main database, but it's also collected in a separate table.

Q I see. You queried the main database to pull out the features that are broken, sheared or gouged, and you stuck them in a separate table; right?

A This is the -- I think it's called the major structural table referred to in the C-3 report, yes.

Q It's called TBL major structures, I think?

A Yeah, something like that.

Q Right. Okay. Right. All right. And in this paragraph you

talk about the broken core zones 1 to 7 meters in core length. Do you see that?

A Yes.

Q When it says a broken core zone that's 1 meter, like, this (indicating) long, a meter long, to 7 meters, that's included in the separate database -- correct? -- separate table?

A It's in a table, yes.

Q Gouge zones are defined as 1/10 to 4/10 of a meter in core length; right? That is, 1/10 of a meter would be in English units -- what? -- about 3 inches to -- 4/10 would be about 12 inches? I'm sorry. I'm doing this conversion in my head. Right approximately?

A About, approximately, yes.

Q Okay. Approximately. And the shear zones are 1 to 4 meters in core length; right?

A The ones that are seen in the database, yes.

Q Right. Okay. Now, the next paragraph says in the first sentence, "These structural features identified during the logging" -- and by "these structural features," you mean the broken core zones and the gouge zones and the shear zones; correct?

A Yes.

Q The sentence says, "These structural features identified during the logging have not been incorporated into the GoCad

model." Do you see that?

A Yes.

Q Tell me why not.

A What that sentence is referring to is, just like -- if we're looking at Figure 5, we have a fault shown in the figure -- the GoCad figure. Those intervals weren't shown plotted in the GoCad figures in the back of the report. They were, however, as far as it relates to RMR and RQD, included in the block models -- the geotechnical block models.

Q Okay. But for Figures -- I want to make sure I'm doing this right -- Figures 3 through -- I know I'm going to get to 13 -- no -- 3 through 15, which are the elevation RMR's and then the cross-section RMR's --

A Yes.

Q -- the longitudinal sections -- right? -- none of these RMR figures contain the structural features, the gouge zones, the shear zones and the broken cores; correct?

A Yes. They're included in the RMR and RQD models. They aren't plotted as graphics in those figures.

Q Right. So the broken zones, the shear zones and the gouge zones aren't reflected in those Figures 3 through 15; correct?

A They're reflected in the RMR and RQD contours, yes, but not otherwise.

Q Well, then I misunderstood. You say here that those

features, the broken cores, the gouge zones -- broken zones, gouge zones and shear zones, aren't incorporated in the GoCad model; right?

A Yes.

Q And the GoCad model is what produced the RMR Figures 3 through 15, didn't it?

A Yes.

Q Well, if they aren't included in the model and the model produced these figures, then they aren't in the -- reflected in the figures.

A Okay. Maybe I can clarify by saying that the GoCad software was used to do the block modeling, and for the block modeling, those zones are included. The GoCad software was also used to produce the graphics that you see in these figures. If we're talking about Figure 5 again, the contours of RQD, which is a reflection of the block model results, do include those structures in the calculation of RQD. In RMR for the -- for those contours -- for the calculation of those contours for the calculation of those block models, those structures were included; however, they weren't --

Q Let me stop you for just a second. The -- is the block model represented anywhere in the figures here?

A That's the contours that you see. Those are sections through the block model.

Q Okay. But if you didn't incorporate the shear zones and the gouges and the broken cores, how are they reflected in the block model? Were they invented?

A They were included in the block model because these zones would have had, for example -- they would have had geotechnical logging in those runs. Okay? That geotechnical logging for the runs for those intervals where you have broken, sheared or gouged zones, the geotechnical logging for those zones is in the database. The full database was used for the block models. RQD's and RMR's would have been generated for those intervals and, just like I went through the story of explaining how those values down the boreholes were used to create the block model. The data for those intervals was in.

Q But that's not what this sentence says. The sentence here on page 13 says that those features weren't used in the GoCad model.

A Well, what that sentences says -- and I wrote it -- is that it's not included in the GoCad visualization as the feature above was. But this, again, to be clear, is just a graphics presentation of where that feature may be.

Q So again, I which -- maybe I'm confused here, but I just want to make sure so the record is clear, that broken cores, gouges and shears, then, aren't included in the graphics that appear in Figures 3 through 15; correct?

A They aren't included in the graphics. They are included in the contours of RMR and RQD.
Q And the contours are in the graphics?
A The contours are part of the figure. There was no explicit plotting of those intervals in those figures. They're only represented insofar as they're included in the RMR and RQD contours.
Q And the only way that we can double-check that to see if what you're saying is correct is to look at the database; correct?
A Let me think. Yeah, it goes back to -- yeah, having to go back to the database.
Q The next sentence here says, "The current data density is not sufficient to interpolate these features." What does that mean, --
A That means --
Q -- "the current data density"?
A Sorry?
Q "The current data density."
A That isn't a comment with respect to data density. That's a comment with respect to the density of these discrete features. There wasn't enough of them really to see much of a picture. If we turn to C-3, Figure 20 -- could we do that?
Q I'm there.

A Okay. Well, this is the figure where we plot all 40 now, because now we have more boreholes, and we have 40 intervals where there's these broken sheared and gouged sections. So this is a graphic that explicitly shows those intervals. But again, even with the increased data that we had for C-3 that we didn't have for C-2, we still couldn't see any trends in these broken, sheared or gouged zones. They didn't line up.

Q Right. And that's -- so if we wanted to check Figure 20 on Appendix C-3, the only way we could check that is to look at the database -- correct? -- to see if your conclusions are correct?

A Correct.

MR. HAYNES: Your Honor, I'm going to move into a different area. Perhaps we should take a break now.

JUDGE PATTERSON: Okay. Let's take a break.

(Off the record)

MR. HAYNES: Ready, your Honor.

Q Mr. Beauchamp, if we could turn to page 23 of Appendix C-2 -- all right. Section 5.4 of Appendix C-2, Mr. Beauchamp, talks about rock stress factors. Do you see that?

A Yes.

Q And the second paragraph of this section says, "Since there is no in situ stress data information available for the

Eagle deposit, the vertical stress estimated" -- and then you have a formula for that; correct?

A Yes.

Q That is, you estimated for purposes of your calculation the in situ stress based upon literature; correct?

A Correct.

Q Now, just so the record is clear, we've had various witnesses talking about in situ stress. Could you explain what is meant by in situ stress horizontal as opposed to vertical, as you understand it?

A Yes.

Q Go ahead.

A Vertical stress is the stress that acts in a vertical sense in the rock. It's --

Q In other words, gravity; right?

A Yes. It's typically equal to the weight of the overburdened rock at any point in the rock mass. The horizontal stresses are -- they act through the rock mass. There's a far field stress and, when you make excavations in the rock, those excavations are subject to the pressures in the rock.

Q And generally, for purposes of crown pillar stability analysis, you want to estimate the ratio of horizontal stress to vertical stress to see if they -- if, when you mine out from underneath the rock, the crown pillar will stay in place or any portion of the rock over the mine

expedition; correct?

A Correct.

Q That's the purpose of that exercise; correct?

A Correct.

Q And you don't have the in situ stress measurements for the Eagle formation right now, do you?

A No.

Q It's possible to get those now, isn't it?

A It's possible to take some stress measurements, yes.

Q If we can go now to -- starting on page 29, which is your crown pillar discussion, Mr. Beauchamp, there's a couple things I want to ask you about here. In this section you estimate -- this is on page 30 -- you estimate the top of bedrock to be 405 meters in elevation. That's at the bottom of page 30. Do you see that?

A Yes.

Q And I think you've testified in other -- you also estimated the top of bedrock to be 415 at spots?

A The 405 elevation was a conservative assumption that we used in the C-2 report.

Q "Conservative" meaning it's lower?

A Yes.

Q Which estimates a thinner crown pillar?

A Correct.

Q I see. And what's your current understanding of the top of

the bedrock?

A We evaluated the top of the bedrock using two sources of information. One was we took the 108 boreholes, looked at the borehole -- the top of bedrock intercept in each borehole --

Q 109 or 108?

A 109.

Q Okay. Thank you. You said 108.

A Sorry; my mistake. We took all of the boreholes, took the top of bedrock intercept for each borehole, which was a point in space, if you could imagine all these boreholes and they intercept rock. Each of these points defines the top of bedrock at that location. We then draped the surface over it in this geologic modeling software package, and that was one contour of our interpretation of the top of bedrock. The second source was a topographic bedrock interpretation done by Kennecott. We took both of those surfaces, and we compared them. There was substantial agreement between them. And then we assumed the top of bedrock for our crown pillar considerations to be more conservative than that at an elevation of 415 meters.

Q So the modeling used 415, not 405? Is that what you're saying, or the -- or you're saying that the two methods that's used developed a 415-meter top of bedrock?

A The C-2 report used a 405-meter top of bedrock elevation.

The C-3 report with increased data indicated a top of bedrock of 415 meters.

Q On page 31 you have two tables, Table 21 and Table 22. Table 21 uses an RMR of 75. Table 22 uses an RMR of 85. Do you see that?

A Yes.

Q And those specific RMR figures are taken, are they not, from your typical RMR for the crown pillar on page 29, where you say the typical RMR for a crown pillar was 75? I'm looking at the second paragraph in Section 6.1.

A Yes.

Q And that's where you got the 75 from, in Table 21?

A Let me just --

Q Take your time. I don't want -- this is not a memory test. I just want to make sure we're dealing with the same figures here.

A The RMR summary is on page 10.

(Witness reviews document)

A Okay. I found it. It's on page 30, Section 6.2.1, the end of the first paragraph, second-last sentence reads, "The typical RMR in the area of the crown pillar was estimated as 75 with an upper range of 85."

Q And that's based upon your reviews of the Kennecott database; correct?

A That's based on our RMR block model results.

Q Which is based on the Kennecott database; correct?
A Yes.
Q All right. You testified about Figure 28, and I'd like you to turn to that now, in Appendix C-2. Do you have that figure -- 28?
A Yes, I have it.
Q All right. Figure 28 is -- did you prepare this, or is this from the litigation -- Figure 28?
A Figure 28 was prepared by Golder.
Q All right. And you testified that the red line that trends from lower left to upper right is the stability line; is that right?
A Yes.
Q That is, the mines that appear below and to the right of the line have a stable crown pillar; correct?
A Most of the case histories that plot lower and to the right are stable. Most of the cases that are up and to the left are more prone to failure.
Q Right. And the case histories that you used are found where?
A They're found in the reference material to this method. This is commonly referred to as the Carter Method. It's a scale spanned assessment, and there is several papers in the literature publically available that describe this figure.
Q Okay. And I don't want to go through the exercise of

counting each point that's plotted there, but it appears to me that, give or take, about one-third of the plot of the figure -- one-third of the points here are unstable and about two-thirds are stable. Is that a pretty close estimate?

A I don't know. I've never counted them up and looked at the ratio on one side of the line to the other.

Q Okay. But less than half appear to be unstable and more than half appear to be stable; is that accurate?

A It looks like there's more stable side, yes.

Q More on the stable side. Okay. But there are many that are unstable; correct?

A Correct.

Q All right. And these are -- this is a review of mines around the world; correct?

A Correct.

Q So what you have done with this table with the two colored figures to the right -- there's a series of red, basically red figure straight up and down, and then there's a series of green and blue straight up and down. Do you see that? I'll point it out. I thought I could get through a day without my laser pointer, but I guess I won't be able to. We have a line of basically red points here; correct?

A Yes.

Q And that represents Eagle, does it not?

A Those were some of the geometries that we assessed.
Q And then the one -- the figure that's the green portion straight up and down, what does that represent?
A Those are also some of the geometries, the potential geometries that we assessed.
Q Okay. And for the green figure, this green series of dots, the legend appears to be -- appears to say that the -- your initial assessment of RMR 85. That's what those -- that's what the green figures represent; correct?
A I think so, yes.
Q So if there's an RMR of 85, you've calculated that the crown pillar will be stable according to this graph; correct?
A Correct.
Q All right. And if in your initial assessment of the crown pillar here for treatment equals 75, it appears that for some of your scenarios, that the crown pillar will be unstable with an RMR of 75. Is that an accurate interpretation of your graph here?
A Some of the scenarios we looked at plotted on the caving side of the line.
Q With an RMR of 75?
A Correct. But I'd add, if I could, going back to Table 21 and Table 2 that is the base data, really it's the numbers that go into this chart, that in this case we're talking about a preliminary mine design that has been superceded

and, in fact, doesn't reflect what's in the mine permit application. In this case we're looking at crown pillar thicknesses that range from 25 to 65 meters, and the mine permit application is 87.5. We're also looking at spans that go from --

Q Let me interrupt you for a second. The application doesn't say 87.5 meters-thick crown pillar. That was done later, not in the application, was it?

A The mine permit application indicates a crown pillar thickness of 87.5 meters.

Q All of your analyses here go to a crown pillar thickness of 57.5, don't they?

A No.

Q In C-2?

A No.

Q All right. So for Figure 28 some of your scenarios show with an RMR of 75 that the crown pillar will be unstable -- correct? -- for Figure 28?

A It shows that it plots above the stability line, yes.

Q In other words, it's unstable; correct?

A It's on the unstable side of the line, yes.

Q Okay. You testified earlier about the backfill discussion in Appendix C-2 which starts on page 36. Mr. Beauchamp, you don't have any independent knowledge about how tight the backfill is supposed to be at the proposed Eagle Mine, do

you?

A Well, I see backfill being placed on a weekly basis whenever I'm underground in mines that are planning -- that do currently employ the same backfill system as is planned at Eagle. So I see it being placed very tightly on a regular basis.

Q But you don't know for a fact in this case how tight the backfill will be placed, do you?

A No. But I can form an opinion based on what the plan is and seeing that technology successfully employed at existing operations.

Q I'm not asking for your opinion. I'm just asking whether you know how tight the backfill will be, and the answer is "no"; correct?

A No one knows until it's actually put in place.

Q Okay. In your backfill calculations you talk about a megapascal amount of 1.5. Am I recalling that testimony correctly? I'm looking at page 37 on your Table 26. You used a figure of 1.5 megapascals; correct?

A Yes; correct.

Q And you calculated that; correct?

A Yes.

Q All right. Do you know -- do you have any expertise in evaluating the ability of backfill to withstand the effects of blasting?

A Yes. I have experience with that.
Q Do you have any experience in how acid mine drainage will affect backfill?
A Insofar as mines in Sudbury would be subject to that effect, yes.
Q But you don't -- but not in terms of acid mine drainage in, say, mines in the Upper Peninsula of Michigan; right?
A I would say that there's substantial similarities between the mines in Sudbury and the proposed mine at Eagle.
Q You haven't seen any estimates in the mine permit application for the proposed Eagle Mine dealing with the shrinkage of backfill in the design, have you?
A Can you repeat the question? Sorry.
Q Sure. You haven't seen in the mine permit application any discussion of the extent of shrinkage of the backfill in the proposed Eagle Mine? There's nothing in the application about that, is there?
A I haven't seen it. I can't recall that I've seen anything to that effect.
Q All right. And you haven't seen anything in the application for the proposed Eagle Mine concerning the particle size distribution of the proposed backfill?
A I can't recall.
Q And haven't seen anything in the application that deals with the changes of the backfill strength based upon sulfide

oxidation? You haven't seen any of that, have you?
A I can't recall.
Q And you haven't seen any discussion in the mine permit application dealing with the settling of backfill? You don't recall any of that discussion, do you?
A Not specifically, no.
Q And you haven't seen any margins of safety calculated for the backfill design in the proposed Eagle Mine?
A Not beyond the factors of safety that I've considered here in my report.
Q Factors of safety for the crown pillar analysis; correct?
A No, in Table 26 in page 37 that you referenced I incorporated a factor of safety of 2 using two different formulations and then took the additional conservative approach of taking a strength that was in excess of what was a factor of safety of 2 using both approaches.
Q All right. And where would we find your calculations for all of this? Let me back up to Table 26.
A The formula are presented on page 36. The parameters in those formulas are the bulk unit weight of the fill which is fairly well understood in the industry, the height of the fill and the length of the proposed face. All of those parameters are in the table, and if you used the calculator in those formulas you could come up with exactly those numbers in the table, so I think you could get it all from

there.
Q Okay. And for -- this is the design for the primary stopes. The height you list here is 34.5 meters. Do you see that?
A Yes.
Q That's for each stope; correct?
A Correct.
Q How many stopes are there going to be?
A In what?
Q In the proposed mine. One stope? Two stopes? Fifty stopes? How many -- what's the total number of stopes?
A I can't recall. I can't recall the total number of stopes.
Q It's more than one, isn't it?
A Yes.
Q So your factor of safety is for each individual stope; correct?
A Correct.
Q Your factor of safety and your Table 26 doesn't take into account that there will be at least six stopes, one on top of the other for each -- for the backup; correct?
A Yes, it does take that into account.
Q Where? It just says the stope height is 34.5 meters.
A But that is the exposed stope height. So there will never be more than height exposed at any one time because as you go through, those levels will be completely filled and then you'll start a new level. And only that height would be

exposed on that level. So you're never going to have --
Q I see.
A -- anything exposed more than 34.5.
Q You're talking about the vertical exposure; correct?
A Correct.
Q Not -- that is, per stope when your mining the secondary stopes; correct?
A Correct.
Q Right? Your table doesn't take into account the strength of the backfill for purposes of calculating six stopes on top of one another when -- the strength of the backfill at the bottom of the bottom stope.
A No, it does not.
Q Mr. Beauchamp, let's turn now to Appendix C-3 which is the subsidence analysis report. Do you have that in front of you?
A Yes.
Q Let's go to page 2 of that exhibit -- excuse me -- that appendix. Are you with me?
A Yes.
Q All right. In the first paragraph in Section 2.0, "Update Geotechnical Data," that paragraph says in the last few sentences that -- it talks about the orientation of the boreholes. Do you see that?
A Yes.

Q For the pre-2005 boreholes it says that less than 51 percent are orientated. Do you see that?
A Yes.
Q What does that mean, "orientated"?
A This is the process of trying to get the orientation of the structure identified in the borehole in true 3-dimensional space. So when you -- when you're drilling and you -- I think the court the has heard the process where you push a tube through the rock and you come down and you retrieve the core barrel. When you retrieve that, you use what's called a wire line, and you send an orientation tool down the drill string. And it gets to the bottom of the hole, and it will often have like fingers and a plunger. So the fingers will touch the bottom of the core at the bottom of the hole, and it will take like an imprint of the shape of the bottom. The plunger will lock those fingers in place, send the wire line down, retrieve the tool, and then it's a weighted tool, so using that you can take a look at the shape of the core that was pulled out, the shape of the finger, and get a match and then identify what the bottom of the borehole is. So you take the core and you know what the bottom and the top are. You mark that on the core, and then that core is not oriented. So in the process of doing geotechnical logging you can then measure two things about a structure: You can measure the alpha, commonly referred to as the

"alpha angle," which is the angle of the fracture relative to the core axis. Then you can also measure the beta angle which is the rotation of the bottom of the ellipse to that structure to the top of the core. And with those two angles, you can then take the borehole orientation, take those two angles, and through some simple math calculate what the orientation of that structure is. So then you have oriented logging.

Q In other words, the orientation of the structure as it actually exist in the rock?

A Correct.

Q Because you're using the angle and the direction of the borehole as one of your factors, your parameters, and once you've oriented the structure in the borehole itself and you know the angle of the borehole, then you can determine the angle of the structure to 3-dimensional space?

A In real space.

Q Okay. And this sentence also -- or this paragraph also talks about of the 2004 data that it has 49 boreholes; 75 percent are orientated. Do you see that?

A Yes.

Q So as of February 2006, then, a large portion, something less than 50 percent of the boreholes weren't oriented; right?

A Well, less than 50 percent of the boreholes in the pre-2004

database were oriented and more than 75 percent of the boreholes in the 2004 database were oriented. And I should correct that. I don't mean to say the entire borehole, but we're talking about length of boreholes; right? 'Cause this is done on a run length basis and every time you do a run, you'd send this tool down and try to orient the core, and then your orientation follows the core as you arrange it in your logging facility in these V rails. So I think that that's speaking to the length of core being 75 percent oriented in the later work.

Q All right. I see that now. So for purposes of determining the actual orientation of the structures in real space in the rock, we're missing a great deal of data here; correct?

A No, actually that's quite good compare to industry standards. I may have made it sound like a simple process, but if, for example, when -- when they're done drilling this run and they get down to the bottom, the driller will pull up on the drill string. The purpose of pulling up is that there's a core lifter spring in the bottom of this drill tube, and it's -- it allows core to pass through in one direction, but when it goes to go in the other direction, there's sort of fingers there that clamp in. So it's a one-way door for the core. So it's coming down in the rock and it gets to the depth -- the appropriate depth. The core tube will be full of rock. The driller will lift up on the

core string a bit -- on the drill string, and the lifter will break the rock here. Okay? Then they'll pull the run out and come back down. In that process of breaking, you're not going to always have a surface that can be oriented. As an example, if the break is perpendicular to the hole so that it comes down and all the fingers are the same length, when you get the tool back up, you look at it and you think, "Well, that doesn't do me any good. I won't be able to orient that run." So you could try to orient 100 percent, and I would say that you're doing very well if you get more than 75 percent of it oriented.

Q And for those structures that aren't oriented, it's impossible, then, to tell without orientation what direction those structures are running; correct?

A Correct. You'd know the location of the structure along the drill string. You'd know the alpha angle, the angle of the structure with respect to the core axis, but you'd be missing one piece of information to orient it completely in space.

Q Right. Let's turn to page 8 in this exhibit. Mr. Beauchamp, on Section 3.4.2 on page 8 of Appendix C-3, the first paragraph here talks about the major structures table. Do you see that?

A Yes.

Q And did you do the queries here? Did you supervise the

queries that Golder did of the database?

A Yes.

Q In this paragraph you talk about the query indicating that there are 40 individual major structural zones. Do you see that?

A Yes.

Q And then there's a parenthetical. It says, "A total" -- and there must be a typo here. "A total 183 were recorded." Do you see that?

A Yes.

Q Explain to me the difference between 183 and 40. What's the parenthetical talking about here?

A The parenthetical is talking about, if I understand your question, that in the entire database of 109 boreholes there was 183 occurrences in the major structures table for all 109 boreholes. What we're looking at in 3.4.2 is the crown pillar.

Q I see.

A So we were specifically interested in the occurrences within the 26 boreholes of which there was 40.

Q Okay. Let me make sure I understand this. In the database that we don't have there were 183 major structures in all 109 boreholes?

A Correct.

Q Of the 26 boreholes that intersected the crown pillar, you

identified 40 major structures in 22 of those 26 holes?
A 40 total.
Q 40 total in the 26 holes; right?
A Yes.
Q And the major structures are gouged, sheared or broken; right?
A Correct.
Q And of those you picked -- you then selected based upon the data zones that are greater than one meter in length -- correct? -- to get Table 4.
A Correct. We put the zones one meter or greater into Table 4.
Q Okay. And you got ten zones -- right? -- in Table 4.
A Yes.
Q Of one meter or more in length; correct?
A Correct.
Q For purposes of your analysis here, does it matter if the zone is one meter in length or .95 meters in length? Is there a significant difference between those two?
A No.
Q What about to say .90 meters in length?
A No.
Q Why didn't you produce a table that had all 40 major structures identified in the 26 boreholes?
A I thought it was appropriate to point out the largest major

structural zones, and I made a table that included all of the zones that were a meter or longer.

Q Okay. So this is sort of illustrative more than anything else; right?

A Correct.

Q And you testified that someone from the Department of Natural Resources asked for the photos of these eight boreholes; correct?

A That's my understanding. They never asked me, but that's my understanding, yes.

Q Did you participate in sending the core photos on to the DNR?

A No.

Q And you also testified that your understanding was that these core photos were then examined by other agencies. Do you recall that testimony?

A Not particularly, no.

Q Well, that's what my notes say. Do you know anything about what happened to the photos of the eight cores after they were sent to the DNR?

A No.

Q Let's turn to page 11 of this report. Mr. Beauchamp, in Section 4.1, second paragraph, that paragraph talks about, "The new design has removed the upper level of stopes and now has the top of mining Level 2, 357.5 meter I elevation."

Do you see that?

A Yes.

Q So for purposes of Appendix C-3 you were evaluating the geometry of the mine stopping at 357.5 meters; correct?

A Correct.

Q Which is a -- is it 57.5 meters thick? 58.5? Which?

A 57.5.

Q Thank you. 57.5. Take a look at page 13, Table 6. It says 57.5 for the thickness. Mr. Beauchamp, on Table 6 this is your summary table for the scale span method -- correct? --

A Correct.

Q -- showing the factors of safety for a 57-1/2-meter-thick crown pillar; correct?

A Correct.

Q Now, your RMR's here -- this is in the seventh column over. Do you see the "RMR" column?

A Yes.

Q For an RMR of 70 you have a factor of safety of 1.2. Do you see that?

A Yes.

Q That's barely stable, isn't it, a factor of safety of 1.2?

A It's stable.

Q Barely; right?

A It's stable, and as I talked about earlier, crown pillars in the range of 1 to 2 are potentially stable on their own,

self supporting; however, we would recommend engineering controls such as cable bolts, backfill, to ensure the long-term stability of these crown pillars.

Q You know the size of the crown pillar at Eagle Mine, don't you?

A Yes.

Q What is the approximate size?

A There is no crown pillar there now, but the proposed crown pillar --

Q Well, the proposed crown pillar.

A The proposed crown pillar, according to the mine permit application, is 87.5 meters thick --

Q What are the aerial dimensions?

A -- with stopes 10 meters wide.

Q Okay. The crown pillar over all of the stopes will be what size? Length times width?

A The entire footprint of the crown pillar?

Q Yes.

A Okay. The question wasn't clear. The aerial --

Q Can you answer the question now?

A Maybe you should rephrase the question. Sorry.

Q What is the -- what are the dimensions, length times the width, for the footprint of the crown pillar as proposed?

A Well, I don't know that it is proposed in those terms.

Q Well, we have your analysis on Table 6. It appears to be --

the "s" is strike; is that right?
A Yes.
Q And the "l" is the length?
A Yes.
Q 68 meters by 50 meters; correct?
A Correct.
Q So that's, give or take, 200 feet by 150 feet, give or take, for those of us that deal in feet rather than meters?
A That's what it is meters, 68 by 50.
Q And so your analysis for the scale span deals with a crown pillar that is going to be -- proposed to be 68 meters by 50 meters for a footprint; correct?
A The analysis here is conservative in that it assumes full excavation of the crown pillar with no backfill.
Q I understand that. I'm asking just now about the footprint. 68 meters by 50 meters; correct?
A Correct.
Q And the RMR's here are calculated using your A5 parameter equal to 10; correct?
A Correct.
Q So for you a conservative model, as you testified to and use the A5 parameter 7, you'd have to drop these numbers by 3 each; correct?
A Correct.
Q So at that point with a 57.5-meter-thick crown pillar we

would have an RMR of 67 in one aspect -- correct? -- 63.4 in another and then 57 for another; correct? That's what the subtraction shows; right?

A Yes.

Q And so the factors of safety would be reduced accordingly; correct?

A Correct.

Q Let's turn, Mr. Beauchamp, to the Golder Geotechnical memorandum of July 7, 2006.

A The Intervenor number?

Q Oh, the Intervenor number is 79.

A Thank you.

Q Now, Mr. Beauchamp, this is the memorandum that was prepared by Golder following Dr. Sainsbury's comments on the mining plan in C-2 and C-3; correct?

A Correct.

Q And for this analysis you have 109 boreholes; correct?

A Correct.

Q Take a look at page 3 of this report. Under the "Crown Pillar Data Review" I'm looking at the third paragraph which says it's described in Section 2.0 of the Phase 2 Golder Study, February 2006." That, by the way, was Appendix C-3 -- correct? -- the Phase 2 study?

A Correct.

Q "Additional data on the crown pillar is required; however,

this information cannot be collected from surface at this time due to collar access restrictions." What are collar access restrictions?

A Collar access restrictions are places where you can't drill a borehole.

Q So you're saying here that Kennecott was not able to drill boreholes in certain spots in order to define the crown pillar because of the collar access restrictions?

A That's correct.

Q Do you know what those were?

A Yes. It was an area in the vicinity of the Salmon Trout Creek.

Q I see. The Salmon Trout River?

A Okay.

Q If we could turn to page 8 of this exhibit, page 8, Mr. Beauchamp contains your analysis of the factors of safety and the probabilistic analysis, probability of failure; correct?

A Correct.

Q You read into the record, in fact, your slide show included the first bullet on this page; correct?

A Correct.

Q -- which deals with a crown pillar over a single stope using factors of safety developed for the 57-1/2-meter, 87-1/2- and 117-1/2-meter crown pillar thicknesses; correct?

A Correct.
Q The second bullet deals with the stope span and the third bullet deals with the full unsupported span; correct?
A Correct.
Q The full unsupported span in your review would be a conservative analysis, would it not?
A It's a conservative analysis, yes.
Q And you also put up on the screen as part of your direct examination -- or had put up the charts, which are Figure 1 to this report, the three line charts. Do you remember those?
A Yes.
Q For those three charts could we go to page -- let me back up. Past the three bullets the first sentence of the next paragraph says:

"On the basis of these results and in order to ensure a factor of safety greater than 2 and a corresponding Probability of Failure of less than 5 percent for the initial mining layout arrangements for the worst case geometry conditions (full width, unsupported crown), the Phase 3 mining limit is recommended to be set at an elevation of 327.5 meters corresponding with a crown pillar thickness of 87.5 meters."

That's it in a nutshell, isn't it, to say, based

upon these factors of factor of safety of 2, probability of failure of less than 5 percent, we're recommending a crown pillar of 87.5 meters thickness; right?

A That should read probability of failure of less than 10 percent. That was another typo in our memo.

Q Oh, less than --

A 10 percent.

Q Oh, you didn't testify about that on direct examination.

A We didn't put that part of it in for that. That is -- it's restating exactly what is in bullet 3. So you clearly see by reading the bullet above that at 87-1/2 meters corresponds to a factor of safety of 2.1 and a probability of failure of 9.2. Those numbers are brought down to the text underneath, and it should read 10 percent.

Q Oh, I see. Not 5 percent?

A Correct.

Q Because if it read 5 percent, the crown pillar was -- if it says 5 percent, the crown pillar thickness for a factor of safety of 2 would have a failure of 4.8 percent -- right? -- in bullet number 3? Let me rephrase that. I'm going to rephrase that. To have a probability of failure of less than 5 percent, as it's stated here in the text, you'd have to have a crown pillar thickness of 115 -- 117.5 meters; correct?

A No.

Q If you have a probability of factor of less than 5 percent, factor of safety of 2?
A No. Only -- only insofar as you're considering the entire crown unsupported.
Q the worst case scenario. Worst case geometry conditions. I'm reading from the sentence following the bullets.
A Okay.
Q Okay? I'm just -- let's just talk about the worst case geometry conditions, which is what this sentence says; right?
A Yes.
Q If the sentence reads as it originally read, at 5 percent, in order to get a less than 5 percent probability of failure, you'd have -- and a factor of safety of more than 2, you'd have to have a crown pillar thickness of 117.5 meters; correct?
A I don't know because the 5 percent is a typo. It should have said 10. It says 9.2 right above it.
Q I understand that. Let's walk back for just a second. In the third bullet you deal with the worst case geometry conditions; correct?
A Okay.
Q "Yes"? Full width unsupported crown -- right? -- in the third bullet?
A In the third bullet, yes.

Q "Yes."
A Okay. Yeah.
Q That's a conservative analysis; correct?
A Yes.
Q And you've computed factors of safety for the various thicknesses of the crown pillar at 1.7 for 57-1/2 meters, 2.1 for 87-1/2 meters and 2.5 for 117.5 meters; correct?
A Correct.
Q If we look down to the paragraph following the bullet and we're dealing with a factor of safety greater than 2, we've limited the analysis now to 87-1/2 meters and 117-1/2 meters; correct?
A If your constraint is full width unsupported crown, yes.
Q I'm dealing with the third bullet here.
A Okay.
Q Right?
A Okay.
Q The worst case scenario, worst case geometry conditions, a conservative view; right? So a factor of safety of 2 limits you to 2 thicknesses based upon the third bullet, 87-1/2 meters and 117-/12 meters; correct?
A Correct.
Q Again, looking at the test as it's written, not with your correction here, but looking as written, --
A Yes.

Q -- five percent -- a probability of failure of less than five percent limits you then to a crown pillar thickness of 117.5; correct?
A If you're saying that you need a probability of failure of less than five percent, which is a typo in the text, then you go back to the third bullet. The only thickness in that bullet that has a probability of failure of less that 5 percent is 177.5 meters thick.
Q Now, before today, have you notified anybody of this typo?
A I was assess of it, but no.
Q You didn't notify anybody?
A No.
Q OKAY. So this report was then reviewed by Dr. Sainsbury; correct?
A Correct.
Q Reference by Wilson Blake; correct?
A Correct.
Q Presumably reviewed by someone in the DEQ. Would that be a reasonable assumption? ay.
Q If you don't know, you don't know.
A I don't know really.
Q Okay. That's fine. And if this is a typo which increases the probability of failure by a factor of 2, you didn't point it out to anybody before today?
A Correct.

Q Why not?
A Because it's inconsequential.
Q Inconsequential. It's consequential, isn't it, in terms of determining the thickness of the crown pillar, isn't it?
A Not at all.
Q Well, we just sent through the exercise, Mr. Beauchamp, of showing that if you have a factor of safety of 2 and a probability of failure less than five percent, you're limited to a crown pillar thickness of 117.5 meters: right?
A No.
Q That's pretty consequential.
A No.
Q That's what you just testified to, though. Based upon the text here, you would have to have a crown -- with the parameters that you set out in the paragraph following the third bullet, you'd have -- you'd be limited to a crown pillar thickness of 117.5.
A No.
Q That's what the text says, doesn't it?
A No.
Q Okay. Now, probabilities of failure; when you say probabilities of failure of 5 percent as the text says, that means, does it not, that out of every 20 days, one day the crown pillar is going to collapse?
A No.

Q And for ten percent, that means out of every ten days -- every tenth day the crown pillar is going to collapse; right?
A No.
Q On direct examination Mr. Lewis asked you if your work, the two appendices C-2 and C-2, and the four technical works were peer reviewed, and you testified they were peer reviewed within Golder. Do you remember that?
A Yes.
Q Being peer reviewed by your colleagues in the same firm is not exactly being peer reviewed, is it?
A It's a technical review of the work.
Q Okay. But your work wasn't reviewed by anybody outside Golder, was it, before you submitted it to Kennecott?
A No.
Q So it wasn't really peer reviewed, was it?
A There was a technical review by my peers.
Q It wasn't -- all right. Do you understand that by peer review we mean review by persons unconnected with your employer?
A I understand that to be third-party independent review.
Q All right. And your work before it was sent out to Kennecott was not peer reviewed by a third party; correct?
A Correct.
MR. HAYNES: Just a moment, your Honor, if I may.

Q Mr. Beauchamp, you spoke in the appendices C-2 and C-3 and I believe also in the July 7, 2006 memorandum about characterizing the crown pillar as mining progresses. Do you recall that?
A Yes.
Q And that's how you testified today too; right?
A Yes.
Q Your understanding of the mining plan is that the characterization will start when the mine is opened up at the bottom? Is that when the characterization starts?
A It could.
Q Where else could it occur?
A Well, as you're developing the ramp you could start your characterization once you've taken your first round into the rock, you start mapping it, you start doing geotechnical assessments as you're developing the mine, so --
Q "At the ramp," that's the access ramp?
A (No verbal response)
Q And what level does that come into; do you know?
A At surface.
Q Oh, I see. You start doing that at surface.
A As soon as you start making underground excavations, those excavations then are available to increase your understanding of the rock mass.
Q All right. Okay. Now, what you're going to be doing -- but

the proposal is to determine the characterization -- excuse me -- determine the characteristics of the crown pillar once the ramp is developed toward the orebody; correct?

A Yes.

Q And that would be done through drilling; right?

A Yes.

Q And drilling cores into the rock from the ramp as it approaches the orebody, presumably drilling upward toward the crown pillar; correct?

A Correct.

Q Would it be any more difficult to do that drilling from the surface right now? Wouldn't you get the same information?

A No.

Q You're just taking it from a different direction, aren't you?

A You're getting a different sampling, and you're being able to access areas differently than you would from surface.

Q Through the same method, though; right?

A Using drilling; correct.

Q And having the geologist then look at the drill cores and do the RMR calculations; correct?

A Correct.

Q Same kind of method you use if you're drilling from the surface.

A Correct.

MR. HAYNES: Nothing further. Thank you.

MR. WALLACE: Shall I start, Judge?

JUDGE PATTERSON: If you want to.

CROSS-EXAMINATION

BY MR. WALLACE:

Q Mr. Beauchamp, I'm going to ask you some questions that relate to Sainsbury's report and the Wilson Blake reports. If you want to look at the exact language, we can put it up on the screen. I think it would be faster if I read you a little bit and then ask you some questions and see if it works that way. But let me know if it's not working for you, if you want to see full language. And just to get the context on this, your first report, C-2, which went in the mining application was in April of 2005; correct?

A Correct.

Q Okay. And then you did another report in February of 2006 that was a subsidence report; correct?

A Correct.

Q And that was C-3; correct?

A Correct.

Q And then Dr. Sainsbury was brought in by the DEQ to take a look at your work; correct?

A Correct.

Q Okay. And he did a series of analyses of the work that you've done and submitted with the application; correct?

A I understand that he reviewed my work.
Q Okay. On April 18th, 2006, in other words a couple of months after your second report, Dr. Sainsbury submitted to you a document pointing out that -- a couple things. One was that you'd used the wrong number for A5; correct?
A I think if you're going to be asking me to verify his exact wording or stuff, we probably should look at what he's written.
Q Okay. Then we will. Could we look at Exhibit 3 to DEQ 97? Okay. This is Dr. Sainsbury's April 18th, 2006 report. And he points out first of all that there are two different Bieniawski's RMR classification systems; correct?
A Correct.
Q Okay. The older one, RMR 76, and then the newer one, RMR 89; correct?
A Correct.
Q All right. And he indicates they have different weightings to them and that you'd use the older one for some reason; correct?
A Correct.
Q Okay. And he was critical of you for using the older one, was he not?
A Correct.
Q And he also pointed out that a mistake had been made that you'd use a maximum A5 number of 15 rather than 10; right?

A There was a typographical error on one page that I sent Dr. Sainsbury a technical memo addressing that.
Q Okay. And he said that this resulted in an RMR of 105; correct?
A Correct that he said that or --
Q Yes.
A Correct that he said that, yes.
Q Okay. You disagree with that?
A I disagree with that.
Q Okay. Because it was merely a typo?
A Correct.
Q It was not a typo, though, that you'd used the outdated or the older RMR system; correct? He was right about that?
A I used RMR 76 which was the appropriate standard to use in this case.
Q And you didn't want to use the new standard because it gave greater emphasis to the A5 factor; is that true, sir?
A No.
Q It did give greater factors -- greater weight to the A5 factor, did it not?
A I guess it does, yes.
Q And that would give greater significance to the fact that you'd just decided unconservatively to use the largest dryness, wetness number you could use; correct?
A What was the question again, sir?

Q By using the older system, you could give a 10 without any data, but just assign a 10 because you've been in mines in Sudbury that you thought were 10's, and you thought that you could essentially get away with that, did you not, sir?
A I thought that assigning an A5 value of 10 was appropriate.
Q Okay. Not based on any data at all about this mine; correct?
A Well, based on my understanding of the hydrogeologic conditions of the rock mass.
Q Isn't it a fact, sir, you gave it a 10 to raise the RMR to as high as you could using that number?
A No.
Q Haven't you told us here your only basis was that you've seen dry mines in Sudbury?
A No.
Q You ignored the location of this mine underneath a river?
A No.
Q You didn't put that -- you didn't take that into consideration?
A I considered that, yes.
Q Did you yourself look at these cores, sir?
A Yes, I did.
Q Okay. When did you look at them?
A I was in Marquette on three occasions.
Q Okay. When was the first occasion?

A It would have been in 2004.
Q All right. And did you assign RMR's yourself?
A Yes.
Q And did you record that?
A I would have just -- I would have had some note taking while I was going through, yeah, sure.
Q Okay. And were they the same RMR's that the loggers used? Did you compare your RMR's to the ones that the loggers had established?
A Yes; yes.
Q and did you record that someplace? Were they the same?
A I don't think I recorded it, but I noted that there was substantial agreement between what I was getting for RMR's and what the loggers were getting for RMR's.
Q And did you review the drillers' logs?
A Yes.
Q And did you see when they lost water and when they gained water in the logs?
A That isn't in the drillers' logs. Okay. I --
Q We're talking about two different documents.
A We're talking about different documents now.
Q Okay. Did you recall -- did you look at the logs that were kept as the cores were taken out of the ground?
A I looked at a couple of those.
Q Okay. Out of 109 you looked at 2?

A Maybe, yes. I would have looked at those in the field while the drilling was taking place. I would have been on the site talking to the drillers, talking to them about their experiences really, looking at the type of notes that they keep, the type of data that they collect.
Q And drillers logs record whether water is lost into the rock when they're drilling; correct?
A It can, yes.
Q Okay. And did you make a tabulation of how many times that was recorded, how much water they lost into this rock?
A No.
Q Did anybody do that?
A Those logs would have been reviewed by Andrew Ware, for example. It would have been reviewed by people supervising the drilling. I wasn't directly involved with supervising the drilling.
Q Can you think of any good reason, in light of the controversy about these cores and the inspection of these cores and access to these cores, any good reason why the drillers' logs telling us how much water has been lost under the rock when they're drilling have been kept away from the Petitioners?
A Those drillers' logs -- I'm thinking just of other properties and maybe what the industry standard would be. I don't know that anyone beyond the person supervising that

drilling would look at those logs.

Q But there's been an issue here, as you know, for some period of time about whether, for example, the driller's logs reflected water being lost into the rock, because that tells us how porous the rock is, doesn't it, sir?

A What was the question? Sorry.

Q When a driller drills and he's putting water down into the hole to keep the drill bit cool, if he loses water, he notes that; right?

A Yes.

Q And that tells us something about the porosity of the rock, which is an issue in this case; correct?

A Yes. It would tell you something about the hydrogeologic conditions of the rock, yes.

Q And you've been aware for quite some time that Petitioners in this case not only wanted to see the driller's logs, they also wanted to see the core samples themselves? You know that, sir; right?

MR. LEWIS: Just objection to the form of the question, Your Honor. It assumes facts not in evidence. There's been no testimony or other evidence in this proceeding that any of the Petitioners requested any of this data before this contested case was filed. And I think Mr. Wallace is with his questioning is assuming that is the case. And there's no evidence of that.

MR. WALLACE: Well, you know, there's considerable testimony that they've looked at this data and we haven't. And I'm going to ask each witness we have here until this proceeding is over whether he knows why if this data supports their position in their application they don't just turn it over to us. And I'd like to start with him. He's the first one I've had a shot at, if he knows.

MR. LEWIS: Objection to relevance, then, Your Honor. We've had that motion. That motion has been decided. This line of questioning is not relevant to anything in this proceeding.

MR. WALLACE: It's opened up by the questions on direct with every witness. They have the data. We don't. And I'd like to know if he knows a good reason why.

JUDGE PATTERSON: I guess you can --

MR. WALLACE: And if he doesn't, he doesn't.

JUDGE PATTERSON: I guess you can ask him why, if he knows.

Q Why, sir, if you know, do you know any reason why the driller's logs and the actual core samples that are at issue in this case haven't been made available to Petitioners?

A I don't know why.

Q You've never been in a discussion about that?

A No.

Q And you looked at two of the driller's logs. You don't know

what they basically say in terms of water being lost into the rock or the crown pillar?

A I haven't looked at the large majority of driller's logs, no.

Q I just want to run through with you, sir, the issues for which Dr. Sainsbury criticized your work. All right?

A Sure.

Q And the first thing he criticized was at least reporting and reporting only the point load test; correct?

A It's point load test on the screen, yes.

Q Okay. And then he said more specifically, "The procedure used to determine the equivalent USC from the point load test result is based on a procedure no longer current within the mining industry"; correct, sir?

A That's what he says.

Q You disagree with him?

A I disagree with that.

Q And then he says under the next bullet point, "The horizontal stressed assumed throughout the stability and subsidence analyses have been underestimated"; correct?

A That's what he says.

Q You disagree with him about that?

A I disagree with him about that.

Q Okay. What were your estimates back then?

A We considered a range of k values from 0.5 to three.

Q But you didn't have any data?
A There have been no in situ stress measurements at Eagle.
Q Had you looked at the regional geology in terms of other mines in the area and particularly White Pine?
A Yes.
Q What did you learn in your White Pine investigation?
A That the k value at White Pine was approximately three?
Q Not ten?
A Not ten.
Q And did you look at the Athens Mine collapse?
A I looked at the Athens Mine collapse.
Q And what did you determine from the Athens Mine collapse that helped you in this?
A That it was geologically irrelevant compared to Eagle.
Q So on this criticism you think that Dr. Sainsbury was being unfair to you or he was wrong?
A He made his criticisms, and I feel like we have excellent answers to those criticisms.
Q Well, right now, sir, I'm asking you about the years 2004, 2005, 2006 when you did this work and submitted it into the public record in support of a mine application and whether his criticisms were valid at that time, just so you understand what I'm asking, not what you have done for this trial, but back when you filed the application. What about his criticism, "A sensitivity study is required to determine

the crown pillar behavior under a variety of possible horizontal stress conditions"? Was that a fair criticism?

A No.

Q You disagree with Dr. Sainsbury about that?

A Disagree with that.

Q Okay. And whom did you understand Dr. Sainsbury to be? Why was he involved in this at all?

A He was a reviewer of our work on behalf of the DEQ.

Q He was brought in as an independent reviewer; correct?

A That's my understanding, yes.

Q Then on the next page, page three, Dr. Sainsbury notes that, "Further detailed analysis using a three-dimensional nonlinear modeling code is required to assess the stability of the Eagle crown pillar." Did you think he was being fair when he made that criticism?

A No.

Q Did you ever talk to Dr. Sainsbury about his criticisms of your work?

A I believe I spoke to him once early in his review, and then we stopped any dialogue.

Q Okay. Did he back off of any of his criticisms when you talked to him?

A Not to my knowledge.

Q Under Modeling of Subsidence, Dr. Sainsbury said about your work, "In fact, no analyses were conducted using plasticity

theory to predict shear and tensile failure of the rock mass." And was that true, sir?

A No plasticity? The plasticity code that he's referring to was not used.

Q So he was -- was this an accurate criticism?

A He was talking about a specific numerical modeling code, and it was fair in that we didn't use that code.

Q But he says no analyses. He's not talking about a particular code here that I can see, is he?

A Well, we used a number of numerical modeling codes. We used Map3D. We used Phase 2, and CPillar is also a numerical code.

Q And you're saying that you did not use plasticity theory, and that's what he was referring to and that's true; is that correct?

A We did not use the code that he's referring to when he talks about plasticity theory.

Q You used another analysis using plasticity theory? Did you use some other analysis applicable to plasticity theory, another code, another approach?

A We used primarily elastic models.

Q If you recall saying this in February 2006 in your report you said, "Plastic deformations that propagate to the surface were not considered as these will not be possible with the proposed backfill program that KEMC intends to

employ." Do you remember saying that?
A If I can turn to it?
Q Okay. This is page 17 of C-3.
A Where on page 17, please?
Q Second paragraph, second sentence, "Plastic deformations that propagate to the surface weren't considered."
A What that's referring to is the unraveling assessment that I completed on the following page, page 18.
Q Okay. That has nothing to do with his allegation that you made no analysis using plasticity theory?
A That sentence that you're referring to where I say, "propagate to surface were not considered as these will not be possible with the proposed backfill program that Kennecott intends to employ," that sentence refers to the unraveling assessment on page 18.
Q All right. Let's turn down to the bottom of the page. Then Dr. Sainsbury says of your work here, "The long-term time dependent behavior of the Eagle crown pillar was not considered as part of the analyses"; is that true, sir?
A No. The long-term stability of the crown pillar was considered.
Q In C-2 or C-3?
A In both really.
Q So Dr. Sainsbury was wrong about that, you're saying?
A Yes; yes.

Q Then Dr. Sainsbury says also critically of your work, "A discrete sub-vertical fault plane that intersects the Eagle deposit has not been considered in any of the stability or subsidence analyses." Do you disagree with that?

A What he's referring to there is this potential structure that was first speculated about in the scoping study. And as I testified earlier today, no evidence of that structure has been able to be found in any of the drill cores that we've drilled. And I think that there's half a dozen or a dozen of them now through that area where the structure should be. And we haven't -- even though because we suspected that it may be there or it was brought to our attention that there was the potential for a fault there, we paid particular attention to that spatial area. And the best I could correlate it to was a two to five centimeter calcite filled fracture.

Q We understand you've done some work since you filed your reports with the mining application. But at the time that Dr. Sainsbury was criticizing what you filed and he said that this "sub-vertical fault plant that intersects the Eagle deposit has not been considered," was he correct about that?

A All the work that we did is reflected in these reports, and that's what I'm testifying to today. I don't -- maybe I don't understand the question about when we did the work,

but all the work was done for these reports.
Q So you just say that it's in there and you disagree with Dr. Sainsbury? He must have missed it? Is that what you're saying?
A It was a -- it was a clarification or a criticism, and I think that we have a good answer for that question.
Q He also says that, "The Society of Mining Engineers suggests that induced horizontal strain should be less than .005 for there to be no significant impacts to surface bodies of water for mining." Are you familiar with this standard set by the Society of mining engineers?
A Not particularly familiar with it, no.
Q You've seen his report, though, and that he points this out; correct?
A That number doesn't seem to be extremely relevant to me. I don't recall that exact reference.
Q Well, he's talking about a number that SME uses with respect to mining under surface bodies of water; correct?
A Like I said, I don't recall that specific quote. Maybe if you call it up here, I could take a read of it now.
Q It's right next to the hand.
A Okay. Is this an exhibit that I would have as a version of the reports that he's done?
Q I don't know if you have a hard copy of it. This is an accurate page of it.

A Okay. I don't -- I don't know specifically what he's referring to there.
Q This is his May 22nd, 2006, report which he made to Joe Maki and others.
A Okay.
Q Well, I've inquired of a couple other witnesses, but let's just put the context here. You know that this mine's going to be under a body of water; correct?
A Correct.
Q And apparently the SME has a suggestion about that -- correct? -- relating to measurement of horizontal strain; correct?
A Correct.
Q Have you seen this report before, sir?
A Yes. I've seen -- I've seen Sainsbury's reports. This particular format of it isn't particularly familiar, but I do have his reports, yes.
Q Okay. Well, after seeing his report, did you look this up to try to figure out if there might be a significant impact to a body of water as a result of the mining operation here if you didn't comply with the SME standard?
A Well, Golder's has done some work with respect to the hydrogeology, and also the stress-induced effects on the permeability of the rock mass. That was done primarily by Dr. Carter and Mr. Wozniewicz. I'm aware of the work. I

wasn't directly involved in the work.

Q So are you aware of whether anybody has gone to the SME citation here to figure out what this is about and whether it provides valuable information and guidance about mining under water?

A I don't have any direct knowledge of that. And maybe that question is better directed to someone involved in that aspect of the work.

Q I'll ask it again. But do you have indirect knowledge of whether anybody's followed up on this?

A No.

Q Then Dr. Sainsbury says,

> "In 1999 industry best practice for regional evaluation of crown pillar subsidence and hydrologic stability dictated that a detailed analysis of the mining-induced shear dilation along predominant joint sets to be performed."

Okay. And he indicated that that's required here; correct?

A That's what the exhibit shows, yes.

Q Okay. And do you agree with him or do you think that's is another invalid criticism by Dr. Sainsbury?

A I don't agree.

Q In light of Dr. Sainsbury's litany of criticisms, if I may use that term, did you take any revised action to correct deficiencies that he accused you of, or did you just feel

that they were all wrong, the ones we've listed?

A No. I considered the criticisms and we went back and looked at our work, mainly to satisfy ourselves that things were done appropriately and to give clarifications when requested by Sainsbury or by others.

Q Well, which of Dr. Sainsbury's criticisms led to further action by you to improve on your submission to the DEQ, if any?

A I don't think that there was any.

Q You really didn't accept what he had to say?

A We accepted it, but there was -- like I said, I think there was good rationale. We went through a rigorous process. We did have a typo that needed to be clarified. But the underlying work was solid and we just needed to provide some clarification on the questions that were being raised.

Q Now, are you aware that the following year in June of 2007 the DEQ asked Dr. Wilson Blake to review Sainsbury's report and analyses; correct?

A Correct.

Q Okay. And Dr. Wilson Blake was another independent reviewer for the DEQ; correct?

A Correct.

Q And you know that Dr. Blake agreed with Dr. Sainsbury across the board, didn't he?

A My understanding is that they came to the same conclusion.

Q Okay. And upon learning now a year later that the second independent reviewer by the DEQ, Dr. Wilson Blake, agreed with Sainsbury and the criticisms that he leveled at your submissions, did you then take any action to correct or change or improve on your submissions to the DEQ?
A No. And I don't think that Dr. Blake's views were completely the same as Dr. Sainsbury's, even though I do agree that they both reached the same conclusion.
Q Okay. And then you're aware that Dr. Blake did another report in December of 2007 in which he reviewed work by Dr. Bjornerud and Dr. Vitton and Jack Parker? You're aware of that?
A I think I'm aware that he did look at what they did, yes.
Q Okay. And Drs. Bjornerud and Vitton were critical of the RMR calculations made and recalculated them; correct?
A Correct.
Q Now, in light of -- and you know that Dr. Blake believed that the concerns raised by Drs. Bjornerud and Vitton were legitimate concerns; correct?
A My understanding is that he characterized them as good questions.
Q Did the work of Drs. Bjornerud and Vitton cause you to take any additional steps or re-look at any of your work, sir?
A Again, when these questions were asked, I think it's only natural that you go back and you take a look at what you've

done just if for nothing else just to satisfy yourself that everything is as you understand it to be and to prepare for any clarifications that you may be asked for.

Q Well, the Petitioner's experts were -- they came up with RMR's that were substantially lower than yours; correct, sir?

A Correct.

Q Okay. And I know you've testified that as others have now that they were disadvantaged because they couldn't pick up the cores because they didn't have the cores; right? They couldn't look at them because they did not have them?

A They did not have the cores.

Q Are you prepared, sir, to make any specific criticism of any specific calculation made by Dr. Vitton or Dr. Bjornerud in computing new and lower and let's say dangerous RMR's? I mean, I know you said that --

A Yes; yes. I can expand on that.

Q Okay. Which of their calculations can you point to as being incorrect? Have you analyzed them individually?

A Yes. I've looked at them in detail. And when I compared the logging done by Bjornerud to the original logging, I didn't agree with the re-logging based on the fact that the information that she had was limited. I mean, you're looking at photos. You're looking at photos and you're trying to say what the -- as an example, the joint

characterization is. So what that means is you're actually looking at a two-dimensional photo and the joint is represented on that photo as one line. So the only information you have is a line. And what they did with that data, that line, was say, "I think the joint infilling is this. I think the joint alteration is this. I think that the joint roughness is this." And they came up with numbers that were in some cases different than the original loggers. And I'm looking at the original logs and thinking to myself, "These are geologists who do this on a daily basis as part of their practice?" Some of them are Ph.D. level geologists. They have the core in their hand. They're able to look at the core and scratch it and say, "This is actually infilled, this joint, you know." And, yeah, there's a little bit of alteration or there isn't. And what is the shape of that fracture? They can run their finger on it, say if it's smooth or it's rough. And then they come up with what I would say are hard numbers that I would put a lot of confidence in. And they put the core back together and they put it in the box and then they take a picture of it. Okay.

Q They did that, sir. But you didn't do that, did you?

A No. But I went back to look at some of the core photos that would have been looked at when the re-logging was done. And I put myself in the shoes of Ms. Bjornerud and I said to

myself, "If all I had was this photo, do I actually think that I could get a better number than the geologist with the core in their hand?"

Q In other words, to critique Dr. Bjornerud you looked at photos and nothing more?

A When I considered the re-logging, I looked at the photos, yes.

Q Okay. You looked at photos, she looked at photos. And I think -- were you here when Dr. Ware testified or Andrew Ware testified?

A Yes; yes.

Q Did you hear him say he didn't actually disagree with any particular RMR's that our experts had calculated?

MR. LEWIS: Objection; form of the question. That is absolutely contrary to the evidence in this case.

Q Do you recall his saying that, sir?

A No.

Q And I'll ask you again. You've told me generally the advantages, and I guess I can't dispute that there are advantages to having the evidence that your loggers had. But can you tell us any specific calculation that either of our Petitioner's experts made that you think is wrong based on a hands-on evaluation? Or are you just generally criticizing them because they didn't have what they couldn't get?

A No. I am -- let's talk, then, about the A-5 parameter, which as we've talked about already I've considered an A-5 value of ten, which is generally dry conditions. It's also been put forward that an A-5 of seven, which is damp, is also reasonable. I think that both those two are reasonable given my understanding of the rock mass and my experience with similar minutes in Sudbury. Dr. Bjornerud, however, went and characterized large sections of those eight boreholes with A-5 values of four and A-5 values of zero. And I don't think that those numbers are reasonable. So --

Q Excuse me, sir. But if you thought that seven was reasonable, why did you use ten?

A Because I thought that it was a better characterization of what I expect when the development at Kennecott goes forward.

Q You wouldn't call that the conservative of the two choices, would you, sir?

A Seven is more conservative than ten. I felt that ten would be my engineering judgment of what the likely conditions would be.

Q And the way you find out most accurately what the best A-5 rating is, for example, to pump test, isn't it, sir?

A No. It's actually when you're developing underground like they will do you'll see if it's dry or not. And if it's dry, then you'll know it was a ten. If it's damp, it's

seven. And if you have any inflow -- and this is right on the RMR charts. It describes qualitatively how much water's coming in. You'll be able to adjust the A-5 parameter if in fact it isn't as we expect based on over a dozen mines in Sudbury that I've worked at. You'll be able to adjust it at that time long before you get the crown pillar established.

Q You and other witnesses have talked about the advantages of gathering data after mining begins. And I guess I want to ask you this, because the reason we went through this exercise is that you gathered certain data that was exposed to the DEQ, exposed to other experts, exposed to Petitioners and you were criticized by other experts with regard to your analysis of that data; right, sir? Criticized by Sainsbury, criticized by Blake?

A Yes, there was criticisms.

Q Okay. What review process will occur as to the data that you will gather after this process is all over in your mining? What way, if you know, will Kennecott invoke the Sainsburys of the world or the Blakes of the world or even the Bjorneruds or Vittons if the rest of the data is to be collected after the mining begins?

A Well, my understanding is that there is a mine permit that allows Kennecott to mine up to an elevation of 327.5 meters in the mine. And before going above that they will need to satisfy, I assume, the DEQ in the same fashion as they had

to satisfy them for the original mine permit. They'll have to satisfy the DEQ that the appropriate work has been done and the DEQ at that time will do what the DEQ does. That's starting to get beyond my area of knowledge.

Q You know that sulfide mining operations have, you know, been known to generate acid drainage; right?

A Yes.

Q And that's -- and do you know that's why there's a special statute here in Michigan requiring detailed information to be gathered and submitted to public view before mining begins because of the threat of acid mine drainage? You're aware of that?

A Generally aware, yes.

Q And you're also aware that when there are mine collapses it's generally because mining has already begun? Isn't that sort of a truism?

A Mines can't collapse unless they've begun.

Q Okay. And in fact, sir, isn't it true that after mining has begun in every instance that we know of mine collapse, after mining has begun and this supposedly superior access to information takes place, the mining companies, the mining engineers, the geologists have the superior access to information? In every instance of mine collapse, that superior access to later information has failed the mining company, failed the geologist, and failed the environment's

impact? You're aware of that, sir; right?

A Could you restate the question?

Q Well, I'll ask another question. You're personally familiar with a number of mine collapses; correct?

A I've looked at some mine collapses, historic mine collapses, yes.

Q Okay. And they took place after the mining company was in there with access to the information you're talking about getting later after this application process is over; correct?

A They happened after the mine began and had access underground, yes.

MR. WALLACE: Okay. I have no further questions.

MR. EGGAN: I have no questions.

MR. HAYNES: You're up.

MR. LEWIS: Oh, I was waiting to see if there was another round.

JUDGE PATTERSON: I was waiting for Mr. Reichel was going to exercise his reservation, or do you want to wait until Mr. Lewis --

MR. REICHEL: I have just a couple things I might follow-up on, but I will -- it's possible Mr. Lewis could do that.

MR. LEWIS: I've got just a little bit.

REDIRECT EXAMINATION

BY MR. LEWIS:

Q I just wanted to clarify, Mr. Beauchamp, you were asked some questions about a Sainsbury report. And according to my notes, that was May 22, 2006, report. And we had talked about this earlier. But again, just to clarify, we had looked at a couple technical memos by Golder both dated July 7, 2006. And did the information in those reports in fact respond to some of these concerns voiced by Dr. Sainsbury?

A Yes.

Q And I don't want to go through it again. I just wanted to clarify that.

MR. LEWIS: That's all I have, Your Honor.

JUDGE PATTERSON: Okay.

MR. REICHEL: Mr. Beauchamp, my name is Bob Reichel. I represent the DEQ. I'd just like to follow-up briefly on a couple things raised during cross-examination.

DIRECT EXAMINATION

BY MR. REICHEL:

Q I believe it may have been Mr. Haynes who asked you whether or not it was possible to take stress -- whether it would be physically possible to take stress measurements in the ground for mine development. Do you recall being asked that?

A Yes.

Q I believe you indicated it was possible; is that correct?
A It's possible. It's possible using a technique called hydrofraccing.
Q In your experience as a mine engineer and consultant, is that technique commonly or typically used in a situation such as this prior to development of a hard rock mine?
A No. I don't know of a single case where that technique has been used before the development of a hard rock mine.
Q I believe you were also asked on cross-examination whether in the course of your professional experience in the mining industry you had ever been -- had any experience with blasting -- subsurface blasting, I guess, backfilled stopes. Do you recall being asked about that?
A Yes.
Q And could you briefly describe what your experience has been in that regard?
A A lot of the mines that I have done work at use open stoping, the same mining method prosed for Eagle in the mine permit application. And in that mining method, when you use what's called a primary secondary stoping sequence, you mine out the primary stope first, you backfill it. And in the case of Eagle, that will be cemented rockfill, which is very common in the mines in Sudbury. So my experience would be that I see this mining method, I see this backfill type, and I see the type of blasting that is being proposed at Eagle

used on a regular basis without negatively impacting the stability of the backfill.

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

MR. HAYNES: Your Honor, I have, with Mr. Lewis' indulgence actually, a couple of more questions about the 10 percent, 5 percent typo that the witness identified just today. I sort of had to drop a whole line of questioning. If I could just explore that just briefly with the witness?

JUDGE PATTERSON: Okay.

RECROSS-EXAMINATION

BY MR. HAYNES:

Q Mr. Beauchamp, we're looking at Figure 1 of the July 7, 2006, report, which is DEQ Exhibit 72, Kennecott Exhibit 79. Do you have that?

A Yes.

Q All right. And I'm looking at the right-hand figure, which is the "full unsupported crown" -- right? -- on Figure 1?

A Yes.

Q Okay.

A What was the question? Sorry.

Q I'm getting to the question. You testified that the probabilistic analysis, the factors were a factor of safety greater than two -- correct? -- and a probability of failure of less than 10 percent -- correct? -- based upon the typographical error in the report in the text?

A Yes, that's what it should have read; ten.
Q Okay. All right. Mr. Beauchamp, on this figure, the factor of safety is on the left-hand Y axis; correct?
A Correct.
Q And it goes from one to two to three or four, five, six and seven; correct?
A Correct.
Q And the probability of failure is on the right-hand Y axis; correct?
A Correct.
Q And it goes from in increments of 3 percent, zero, three, six, nine, 12; correct?
A Correct.
Q So under the conditions that you set forth in the text following those three bullets on page eight of this exhibit, if we look at the probability of failure line, which is the blue line here; correct?
A No. That's the --
Q I'm sorry. That's the factor of safety. Factor of safety is the blue line. It's the bottom line on this graph. That blue line crosses the 2 percent line for the factor of safety somewhere in the neighborhood of something below 80 meters of thickness; correct?
A It looks like that from the graph, yes.
Q All right. It's about 88 or 87, in that range; correct?

A It looks like that.
Q I'm sorry. 78 or 77?
JUDGE PATTERSON: 78.
A It looks like 70-something from the graph, yes.
Q Okay. Less than 80; --
A Okay.
Q -- right? And if we look at the right-hand side, the right-hand Y axis, and go up to nine and we go across nine, the probability of failure red dashed line crosses the 9 percent line at approximately 87.5 meters, which is what the red dot is; correct?
A Correct.
Q If we go up to 10 percent on the probability of failure, you'd have to go to the left on the red line; correct?
A Correct.
Q Left and up?
A Yes.
Q And so at that point left and up from the 87.5 is where you'd hit the 10 percent probability of failure; correct?
A It would be left on the red line.
Q Which would be -- and if you take a line directly down from where the red line crosses the 10 percent line, which we don't have on the graph but we can pretty well approximate where that is, that line is going to fall on the blue line somewhere above 2 percent; correct? Do you follow me?

A I follow you, yes.
Q Okay. So under your conditions of the factor of safety greater than two and the probability of failure of 10 percent or less, the crown pillar actually could be less than 87.5 meters, couldn't it?
A The clarification I'd like to offer is is that those aren't the conditions that we've set forth. However, using that logic, if you want to discuss around a factor of safety of two and a probability of failure of ten, it appears from the graph that, yes, both of those lines cross at crown pillar thicknesses less than 87.5.
Q So your recommendation in the July 6, 2006, memorandum for an 87 ½ meter thickness actually makes the crown pillar too thick -- correct? --
A No.
Q -- under your factors?
A No.
Q That's the exercise we just went through, though, isn't it?
A Well, the error in your assumption is is that those are the strict criteria on which we're saying it's the proper crown pillar thickness.
Q Oh, I see. So --
A The paragraph underneath the bullets that you're referring to is just discussing what the -- what the probability of failure was for the 87 -- for the fully unsupported crown

and what the probability of failure would be for the fully unsupported crown.

Q Right. And those are conservative assumptions; correct?

A They're conservative assumptions.

Q So what you're saying, then, is the 87 ½ meter thick crown pillar is sort of a range? It's somewhere a little higher, a little more than that or a little less than that?

A No. It's a very definitive level at 87 ½ meters.

Q Okay. And definitive based upon the 10 percent probability of failure and a factor of safety greater than two; correct?

A No. It's definitive based on the current mine plan, which has the level right at 87 ½ meters. That's where the number comes from. And then the --

Q But that was your recommendation, wasn't it?

A What we did was we took the mien plan and we assessed what the -- if you look on this graph you'll notice that these dots are separated by 30 meters. That 30 meters is the height of a stope. So what we were doing was we took three scenarios, three cases where you would have different crown pillar thicknesses based on the level interval. And based on the results for the 87 ½ meter case -- and again, we could go back to the single stope which really is where we should be, because that's the mine permitted -- that's what's in the mine permit application really; right? It's one -- it's one stope. So to be honest --

Q But we're dealing with --
A -- about what we're talking about and to be accurate with the mine permit application, we should really be looking at the other graph. In which case, it becomes a moot point because the probability of failure that was assessed using the probabilistic assessment was zero for all the range of crown pillar thicknesses we assessed.
Q Understood. But we're dealing here with conservative modeling -- correct? -- conservative assumptions on the graph that we're looking at here, the full unsupported crown; correct? And conservative modeling is appropriate in this exercise, isn't it?
A Yes.

MR. HAYNES: Nothing further. Thank you very much, Mr. Beauchamp.

THE WITNESS: Okay. Thank you.

MR. LEWIS: Nothing further, Your Honor.

MR. REICHEL: Nothing further.

JUDGE PATTERSON: Thank you. Close enough to 5:00 to quit?

MR. LEWIS: Yeah, I think so. I've got a mess to pick up. So we may as well, if that suits the Court.

JUDGE PATTERSON: Okay. That's fine. See you tomorrow.

(Proceedings adjourned at 4:46 p.m.)

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