JOINT REVIEW PANEL PUBLIC HEARING

IN THE MATTER OF Application Nos. 1844520, 1902073, 001-00403427, 001-00403428, 001-00403429, 001-00403430, 001-00403431, MSL160757, MSL160758, and LOC160842 to the Alberta Energy Regulator

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GRASSY MOUNTAIN COAL PROJECT - BENGA MINING LIMITED

VOLUME 21

VIA REMOTE VIDEO

November 21, 2020

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(No Counsel)	For Ken Allred
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(No Counsel)	For Monica Field
S. Frank	For Oldman Watershed Council
A. Hurly	
C. Forster, CSR(A)	Official Court Reporter

(PROCEEDINGS COMMENCED AT 9:58 AM)

Discussion

THE CHAIR: Good morning, everyone. Just the usual reminder that live audio and video streams and video recordings of this proceeding are available to the public through the AER's website and YouTube.

Anyone in the virtual hearing room with their camera or microphone turned on will be captured, and images and recordings of you and your surroundings will be broadcast to a publicly available YouTube video. If you have any concerns about this, please contact counsel well in advance of the time you're scheduled to participate to explain your concerns. We will make best efforts to try and accommodate your concerns considering the need for an open and transparent public process.

Are there any preliminary matters before we resume questioning?

MR. IGNASIAK: Mr. Chair, it's Martin Ignasiak. Just something for the Panel's consideration, given that, you know, we've got an extra two days on the water section coming up on Monday and Tuesday. Most of our witnesses kind of assumed that this hearing would run through November and not into December. One thing we wanted to bring up for consideration -- and I know you'll have to get views from other parties over the next couple of days, but -- would be to combine the last two topic blocks. We're looking -- there's a pretty limited number of witnesses involved in these last two topic blocks, so we thought there might be some consideration given to combining them. And also a concern we've had from the beginning

is that splitting air from health is likely to lead to some issues during the conduct of cross-examinations because -- because the health discipline relies so heavily on the conclusions of the air assessment that's done, which, you know, is kind of standard within the environmental impact assessment world.

So for those reasons, we thought that there should be some consideration to -- to combining the two topic blocks, the last two into one session. And, you know, that would give us Wednesday through to Saturday, four days, to finish that combined topic block, which we think is achievable, given the estimates that have been provided.

So we just wanted to raise that. And I know you'll have to check with other parties and they'll have to think about it and check with their witnesses, but it's something we would urge the Panel to consider.

Thank you.

THE CHAIR: Okay. Thank you, Mr. Ignasiak.

So, yes, I'll want to seek the views of the other participants. I won't do that right now. They basically just heard that. So I'll maybe turn to them either later today or Monday morning to get their views on how that might impact them or not.

So anything else? Okay.

Mr. O'Gorman, you may continue.

GARY HOUSTON, DANE MCCOY, MIKE YOUL, MIKE BARTLETT, CORY BETTLES, DAVID DEFOREST, SOREN JENSEN, MARTIN DAVIES, LEIF BURGE, DAN BEWLEY, Previously Affirmed

STEPHEN DAY, NANCY GRAINGER, Previously Sworn

(Water, including surface and groundwater management, quantity and quality, selenium management and aquatic resources, including fish and fish habitat and fish species at risk)

Alberta Energy Regulator Staff and Panel Questions

Benga Mining Limited

MR. O'GORMAN: Thank you, Mr. Chair.

Q MR. O'GORMAN: Good morning, Mr. Houston.

A MR. HOUSTON: Good morning, Mr. O'Gorman.

Q And good morning, Benga panel.

MR. O'GORMAN: Ms. Court Reporter, can you give me a -- I don't see you on the screen, but how is my volume today?

THE COURT REPORTER: It's fine.

MR. O'GORMAN: Okay. Thank you.

Q MR. O'GORMAN: Okay. So let's begin. I'll ask you a couple of questions about sulphates, please. I'm going to start off by saying, in the interest of trying to save some time today, I might refer to registry documents for the record where they are but

maybe not haul them up if I ask you folks to confirm that you are aware of them and you agree with how I characterize them. Does that make sense, Mr. Houston?

A MR. HOUSTON: Yes. Yes, it does.

Q Just to save that bit of time to look some things up. And I'll start with one of those right now.

So in Addendum 11, which was Registry Document 13 -- and it started at PDF 458.

MR. O'GORMAN: But, Zoom Host, don't bring that up right now, please.

Q MR. O'GORMAN: You did submit to us a report, Biancan [phonetic] or Biancan report. It found that sulphates can be removed in a saturated backfill zone.

Mr. Jensen, you briefly touched on sulphate reductions yesterday. Mr. Jensen, I wonder if you can confirm that it is -- first of all, that you folks are aware of that document you submitted; and, secondly, would you agree that sulphate can be reduced in a saturated backfill zone?

A MR. JENSEN: Yes. Good morning, Mr. O'Gorman.

Yes. So I am aware of that document, and I do believe I briefly touched on this yesterday. So, yes, sulphate can be removed in -- in a saturated backfill zone, although I would add that it's not -- it's not necessarily desirable to go to reducing conditions that

are quite that -- quite that reducing.
Q Okay. Did you folks conduct any studies that inform what the potential sulph -- removal of sulphites might look like in your saturated backfill zone?
A No, we did not.
Q Okay. Not in the past. Ongoing, is that currently being tested?
A Not -- not to my knowledge, no.
Q Okay. If I were to ask you, in your sort of professional expertise, what sort of a percentage reduction of sulphates we might see in your saturated backfill zone once they're -- once they're -- you have them in place, is it the sort of thing where we might see less than 5 percent reduction, 20 percent reduction, 40 to 50 percent reduction? Do you have any sort of sense about what's reasonable to expect?
A Yeah. I mean, it would be on the low end, for sure. It would be -- it would be a -- close to 5.
Q Okay.
A You know, from what I've seen in the past, you know, I've seen a reduction of 1 to -- say, 1 to 200 milligrams per litre but not necessarily -- yeah. So -- so it's -- would be in that range.
Q And is your plan to -- pilot going to test this? Is that part of what you have designed for your pilot?
A I'm not aware of -- no, I'm not aware of any efforts to

pilot sulphate removal, but I guess that would be for Benga, maybe, to answer.

A MR. HOUSTON: Yeah, yeah. Not -- not specifically, Mr. O'Gorman. In fact, we would be concerned about the generation of sulphites -- or sulphite, sorry, yeah, hydrogen sulphite specifically, if -- if we started reducing sulphates too readily in the -- in the treatment process.

So my understanding -- and Mr. Jensen is certainly the expert -- is that the idea is to aim for an oxygen-reducing potential that nicely treats the selenates but doesn't dip too deep into the sulphates.

Q Okay. And would your plan -- in your pilot, will you be monitoring to see if this is happening?

A Yes, certainly. That's -- that's the idea.

Q Okay. Okay. Thank you.

What seems like a long time ago, Mr. Houston, I promised you we would come back and talk about the advanced oxidation process, so let's do that. There's a -- I'm not -- again, I'll refer to this reference.

MR. O'GORMAN: But, Zoom Host, you don't need to bring it up.

Q MR. O'GORMAN: Also in Addendum 11, it was -- which is Registry Document 313, on PDF 229, you did tell us -- and I'll actually read the sentence that's there. You said that Benga will: (as read)

... implement advanced oxidation processes with powerful oxidant like hydrogen peroxide injection or ozone addition, if necessary, to further the conversion of carry-over selenite to selenate.

Mr. Houston, can you confirm that that's -- and you actually read that statement into the record in your -- in your opening statement or beginning of this session, one of the two? Can you confirm that?

A I remember this statement, yes.

Q Okay. And I don't need to bring up that transcript.

So we want to understand this advanced oxidation process a little bit.

MR. O'GORMAN: I will ask us to haul up, Zoom Host, please, Registry Document 251, and it's PDF 257. This was the Addendum 10, package of responses on our water questions.

And can you scroll to the bottom of that picture, please. Zoom in a bit, and let's look at the bottom part of the -- of the -- of the figure. Maybe zoom in one more level. Great.

Q MR. O'GORMAN: Okay. So in Addendum 10, Mr. Houston, we received this figure showing conceptual layout of some of the -- some elements of the water treatment system. I wonder if you can -- I didn't refer to this earlier, but you have also referred to

there being a cascade that you planned to implement for the outflow coming out of the saturated backfill zone.

I wonder -- we were looking at this figure of where all the different pieces of this water treatment system are going to fit. I wonder if you can tell us roughly where both the advanced oxidation process system -- we'll talk about that in a sec -- and also the cascade that you referred to, where are they -- where do they go in here? Roughly, at least.

A So -- okay. They're not explicitly shown here, Mr. O'Gorman, and I -- I understand the concern about the space. I think one of the things that we have to understand is that by the time the SBZ is in service, that that part of the -- the pit is -- is filled and is starting to be reclaimed. So that -- that's not evident on the drawing, but -- so there is the potential to, you know, move some of that hardware, if you will, towards the SBZ and eventually even place some of that -- you know, these extra bits and pieces on top of the SBZ.

So, you know, as -- as we get into this stage of the operation, we actually have a lot of space for -- for the extra bits and species.

Q Yeah. When you talk about reclaiming the pit, I think the saturated backfill zone -- essentially, it starts there; right? So you are saying you might build some

of the pieces of the water treatment system over your SBZ?

A If -- if necessary, yes.

Q Okay. Let me see. You have in your various documents, going back to when we first received the -- the EIS a number of years ago and then somewhat evolving over time through different submissions we've received in response to information requests, heard about a number of different pieces of the potential water treatment system.

So we wanted to confirm our understanding of which of these you do plan definitely to implement as part of the post-SBZ treatment and which are still question marks. So I'm going to go through a list. While we're looking at this diagram, it's useful if you have -- well, if you would like to sort of suggest where they might fit or if they're already illustrated on here.

Metals treatment plant?

A That's an operational piece that -- that would be implemented based on how we see the -- the metals such as arsenic, and that would start to be informed with the -- the pilot project, and then we would continue to monitor arsenic. So that would -- that's an operational piece. We're not sure if it's going to be required or not.

Q Okay. A post-SBZ selenium treatment plant?

A Again, that would be an optional piece, and that would, you know, depend on the performance of the SBZ.
Q And would it be included in the -- like, as a part of the same structure as the metals treatment plant, or do you have to find someplace else to put it?
A I would think that in -- again, it would -- these things all are going to develop together, and so it would be something we would have to assess at the time. Do we need the full metals treatment plant? Do we need the full SBZ treatment plant?

By the way, we would also, at the same time, consider whether a gravel bed reactor might be a more appropriate step, and that clearly would have to be located north of -- well, on top of the SBZ, if you will, so ...

Q Yeah. Well, that was my next -- that was my next bullet, gravel bed reactors.
A Yeah.
Q So those are operational, I think you said. I'm sorry. Did you just say they go on top of the SBZ?
A They -- we would have to find space. They take up quite a bit more space, and so we would be looking at a site potentially on top of the SBZ.
Q Okay. How about the cascade system?
A The cascade system -- there's quite an elevation drop from the -- from the SBZ down into the polishing ponds

and the -- and the clean water pond, and then there's another significant drop from there down into Blairmore Creek. So we -- we would put cascading systems potentially in both of those, you know, channels.

Q Okay. So you would basically have a channel at the bottom of your SBZ. There's an extraction well, which takes up the water which has been sitting there being treated for some time, and it flows right down from there into those ponds; is that right?

A That's right. I'm trying to see what the -- these isometric lines, what the scale is there, but I think it's -- is that 20 metres?

Q Typically they would be 20, I think; right?

A Yeah. They're 20 metres? Yeah. So somebody with better eyes says they're 20 metres.

So you can see from the out -- outfall well from the SBZ you've got 20, 40 -- 40 or 50 metres of drop, which is a good drop in a short distance. So we could build a cascading system in there.

Q Okay. Next bullet, the advanced oxidation process.

A Again, that's something that's optional. It -- the -- and so I'm not a designer. I might throw this over to Soren, but these things come prepackaged, and I've seen the dimensions of the one that was installed by Teck at West Line Creek. So I think that could fit in -- in

the spaces in between here.

But likely we want to install that in a place where we've got the water in a pipe or in a -- you know, out of a pump, and so we would -- we would probably have to put that in between those two ponds somewhere.

Q Okay. And I don't think I heard you -- and I think we missed this part of the cascade system. Is that a definite yes, or it may be?

A It -- we need to drop that water those 50 metres, and so we'll need a cascade system just -- just to drop it into the pond with -- and absorb the energy in the water. So it -- yes.

Q Okay. Post-treatment holding ponds?

A Those -- those are those two ponds that you see there.

Q Right. And those are definite, not maybes?

A Yes.

Q Okay. Any other pieces of the post-SBZ water treatment system, or is that everything that we might consider that is either planned for sure or might be implemented?

A That -- that's all. The rest is basically pumps and pipes, Mr. O'Gorman.

Q Okay. Okay. And I suspect I know the answer to this, but for all of the items that you just said are to potentially be constructed at a later date, can you

confirm whether or not you have currently identified what the triggers would be for your decision to proceed with building any of those extra pieces of infrastructure?

A We have not, but as we discussed yesterday, that -- that decision mechanism will begin to be informed by the pilot project and -- and will be developed at that time.

Q Okay. Back to the advanced oxidation process. Let's just call it the "AOP". So can you confirm -- or, actually, can you tell me: You have said -- actually, can you confirm that its main objective is to convert selenite to selenate?

A That -- that is the reason that we would install it, is -- is to convert selenite. And -- and, I should say, other -- other species, organo species of selenium to -- to selenate, yes.

Q Okay. Any other potential benefits or uses of that system?

A I'm going to look across at my -- Soren -- Mr. Jensen maybe could add something on that.

A MR. JENSEN: Yeah. I mean, the oxidation step, obviously, the objective of re-aerating the water and also if -- if it's necessary, for example, to remove manganese, oxidation would help with that. See, other than that, yeah, nothing -- nothing really stands

out at the moment of, you know, expected parameters that we have to deal with.

Q Okay. Mr. Jensen, while you're up -- and, actually, Mr. Houston sort of referred to this as well. The system that you're familiar with at Teck, can you briefly describe it? I mean, is it a plant? What are its dimensions? What does this thing look like?

A Actually, I'm not specifically familiar with the unit they've installed at West Line Creek.

So I don't know. Gary, do you have some familiarity? I know conceptually how it works, but I haven't seen the unit myself physically.

A MR. HOUSTON: I -- I only have seen pictures of it. I'm not familiar with the operation at -- at the chemistry level, but it -- it was -- the unit that I saw at West Line Creek was attached to the side of a water treatment plant. It -- it -- I think there's a photo in one of the Teck presentations that shows it clearly. It would -- it would fit in between the ponds there, for example, if you're thinking about the size, Mr. O'Gorman.

Q Yeah. Well, I am thinking about a few things. I mean, I think you agree, Mr. Houston, the first we heard of an advanced oxidation process system was earlier this year in Addendum 11; right?

A Yes.

Q Right. And we haven't really been told any information about its potential effectiveness. It's literally a few lines in your response.

A And so I think the information that we do have that's pertinent to this case is the application that Teck has made of this technology at the West Line Creek and specifically for the purpose of removing selenium species at that plant. So we did include a paper. I believe it was in --

Was it in Addendum 11 that we included that paper?

Either Addendum 11 or in our August submission we -- we attached that paper.

Mr. Jensen will add to that.

A MR. JENSEN: Yeah, Mr. O'Gorman. I would like to add that it really is not our expectation that a unit like that will be necessary. So that's -- in my mind, that's the primary reason why you didn't hear about it before, is that it wasn't really proposed as -- it wasn't proposed as part of the -- our initial thinking around the -- the saturated -- the SBZ.

It came about in response to an IR that said, Well, what would you do in the event that, you know, we -- we saw selenide, organoselenium?

And, by the way, nitrite is another one that came to mind after you -- you asked me what else it would be useful for.

But it -- the expectation still is that this unit will not be required. We just -- we don't have any specific evidence that it would be necessary, but it -- it is a contingency measure.

Q Okay. So it's -- it's not just a contingency measure; right? But would you say that it is your main contingency measure if it turns out that you have selenite coming out of your 'S' -- of your SBZ, rather than the selenate that you're hoping for?

A Yeah, that's correct.

Q Okay.

A I mean --

Q And -- go ahead.

A I'll let you go ahead.

Q No, no, no. Please continue.

A Well, I'll just add that, you know, as far as the treatment process goes, it's -- oxidation is -- is a pretty standard unit -- unit operation. I mean, it's used everywhere in -- it's used for disinfection in municipal water treatment. Occasionally, a variety of that system is used for -- for treatment of ammonia. So it's not -- like, these aren't -- these aren't sort of exotic-type treatment units. So it's -- anyways, I would just add that for the record.

Q Are they expensive?

A I suppose that depends what you mean by "expensive". I

mean --

Q Well, I mean, one of the questions -- and I'll get to it a bit later, but I just want to clarify that the cost of adding on an advanced oxidation process to your water treatment system has not been factored into your -- your costs and your accounting and your project economics; right?

A MR. HOUSTON: So, Mr. O'Gorman, we haven't priced it out, obviously, but just looking at the size and the complexity of the unit that was installed at West Line Creek, I don't think it's going to have a -- well, it's going to be in the -- in the contingency factor of the cost estimate for the project.

And, again, as Mr. Jensen mentioned, our expectation is that it's a contingency plan and not likely something that will be required.

Q And recognizing that if it's, you know, a box that you have to buy and install up-front is one question, but if it were to be required on an ongoing basis, do you have a sense of the operational costs of adding it in for potentially long-term treatment if -- if it was required?

A Again, I wouldn't think it -- it would in the -- the contingency -- or not the contingency but the -- the margins of the operating costs for the project.

If -- if you would like, Mr. O'Gorman, I have

found the page that shows what the -- the advanced oxidation equipment looks like at West Line Creek. It's a photo in a presentation by Teck. Would that be helpful to look at?

Q Is it submitted? Do I remember seeing that?

A It is.

Q Right. Let's not --

A It is. Okay.

Q Let's not bother right now if -- just in the interests of time, if that works for you.

A I'll just say, it's at Document 503, PDF 45 -- sorry, PDF 60, and there's a photo there that shows the installation.

Q Great. Thanks.

MR. O'GORMAN: You don't have to bring that up, Zoom Host, but we'll look at that later, for sure.

Q MR. O'GORMAN: Okay. So with the AOP, recognizing it's a contingency if you have selenite -- and you believe you will not -- remind us why you would want to get rid of selenite if it turns out that it is coming out of your SBZ?

A And this -- this is exactly the issue they had at the West Line Creek plant, that the selenite and some of the organo species -- and, again, we have others who are more knowledgeable about this. But they -- the bioaccumulation is more aggressive, and our modelling

for the selenium site-specific objective would -- would need to be adjusted if that were the case.

Q Okay. Because sulphates only mitigate the uptake of selenate?

A Exactly.

Q All right. So what would happen if this Panel decided to not accept your proposal for a sulphate-adjusted, site-specific water quality objective for selenium? In that case, would the advanced oxidation process be moot, or would -- would it still be something you would consider?

A Well, so it -- it would still be a protective measure. We would have to look at how our selenium treatment through the SBZ needs to be modified to meet a more difficult bar, let's say, for selenium in Blairmore Creek. So we -- we would -- I'm not sure whether it would be necessary or not, Mr. O'Gorman. It would depend on how the project needed to be adjusted to -- to meet the -- the different objective for -- for selenium in Blairmore Creek.

Q Okay. I lost my place a little bit, but I did want to ask you if you, Mr. Houston or Mr. Jensen or Mr. Day, have a sense of how you're going to tell, with the selenium that you take out of your SBZ, what the speciation is between selenate and selenite?

A Well, you can -- you can test the water, Mr. O'Gorman,

and determine what the species are. We've done that with some of our column testing, and -- and I know that that's been done at Teck, for example, when they -- when they had the issue.

I wouldn't see that as an operating, real-time kind of thing that we would check, simply because the -- the process, as Mr. Jensen's pointed out, is fairly slow moving, and so if -- if there was pure selenate coming out of the SBZ at -- on Monday, we wouldn't expect that to change by Thursday. We would look at that speciation analysis as something you would do in a longer -- longer time frame.

Q Okay. And, Mr. Jensen, yeah, can you sort of confirm this: Is that a very easy, standard analysis on the speciation? Is it the type of analysis that you would have -- would have to do in a lab on-site versus sending off to a lab in Calgary or somewhere else?

A MR. JENSEN: No, it would definitely be done by an accredited lab off-site. It -- it's, I'll say, slightly -- slightly a specialized analysis, so it's -- you know, I'd say it's more and more commonly available, but it -- it's certainly no problem for an accredited lab to do that. But, no, you would not be able to do that on-site.

Q Okay. But as you said, Mr. Houston, I guess, your suggestion is you wouldn't worry about it in terms of a

daily reading. You would see it as a longer term?
A MR. HOUSTON: Yeah. Yeah. No, I think we would look at longer-term trends.
Q Okay. I'll go to my next package. Okay. I will now make a -- I'm going to refer to something.
MR. O'GORMAN: And, Zoom Host, we don't need to bring it up, but I'll read it into the record.
Q MR. O'GORMAN: So in the Addendum 10 response to an information request we issued -- that's Document 251, and it was on PDF 61 -- we'd asked you about the planned federal Coal Mining Effluent Regulations. Your response indicated briefly -- I'll ask you to confirm this -- that achieving the limit of 5 micrograms per litre at the point of discharge as -- as posed, you know, in draft form in the federal Coal Mining Effluent Regulations is something that may be achievable but would require further research and operational experience. And you did express concerns about those limits.

Do you, first of all, want to agree that that's what you told us, or should I pull it up?
A No, no. I do agree that's what we -- that's what we talked about in that response.
Q Okay. And one extra thing that we don't need to haul up, but, for the record, was in the federal government's hearing submission, Registry Document 542,

on PDF 25, Environment and Climate Change Canada did indicate that there was a target date for final publication of this regulation in 2022. Does that sound -- do you remember that, Mr. Houston?

A I -- I know that there -- they are still targeting to have that published in that time frame, yes.

Q Okay. So we'll let Environment Canada speak to their -- what's happening with that regulation, and that will happen next week.

But I would like to know if you -- you stand by your answer that you think you could achieve a level of 5 micrograms per litre of -- in the point of discharge from your site, if that's the level you were subjected to under these regulations?

A So up till now, we've talked about this 15 micrograms per litre and as -- as a -- the -- kind of a low level that we can expect out of the SBZ. I think if we look at the Teck graphs critically, we can say that the 15 is a conservative number, and we -- we could probably achieve less than that. And as Mr. Jensen said a number of times, that -- that may be through some up-front design of the water flow paths. It may be through some recycling or -- or other add-ons that we can -- we can do creatively with our SBZ.

I think the -- the truth of the matter is we're -- we think there's an upside there. We just can't

quantify it or prove it right now.

At the extreme, to achieve 5, I think, based on what we know of the technology right now, I -- I think we're going to have to look at some other technologies for concentrating a stream or -- or some -- some -- nobody wants to hear this, but dilution of the stream to achieve a 5 coming out of the pipe.

And when I talk about concentrating, I'm talking about some membrane technology or distillation or something else to treat a part of the stream and -- and then put that back in with the main stream to achieve a -- a lower number on -- on the main stream, main effluent stream.

I think that's where we would have to look to -- to get to that lower value.

Q Right. I mean, that response raises a lot of potential questions, Mr. Houston. We don't need to explore it in too great a depth, but this extra water that you would dilute it with, where would that come from?

A Yeah. No. I'm -- I'm thinking about taking a slip stream of the effluent and having some additional treatment step to maybe simply, you know, dilution or -- or, you know, something like that to -- to achieve a much lower level of selenium in that stream and then recirculating that to dilute the rest of the stream.

So it's -- it's just a way of concentrating the selenium or -- or, you know, providing extra treatment to part of the stream to achieve the overall effect of 5 micrograms per litre.

Q Okay. But you do acknowledge that that regulation would be a limit you would have to meet at the end of pipe of your responsibility, not --

A I --

Q -- diluted into the stream; right?

A Yeah. No, no. And that's -- that's the challenge. If it were diluted in stream number, I think that would be much closer to what, in fact -- I think we would meet that during many phases of the -- the project. It's -- it's the end-of-pipe number that creates the difficulties.

Q Okay. So --

A MR. JENSEN: You --

A MR. HOUSTON: Mr. Jensen wants to --

Q Go ahead, Mr. Jensen.

A MR. JENSEN: Yeah, Mr. O'Gorman. For what it's worth -- and I'm not sure of its relevance to these proceedings, but that -- the challenge we are discussing here is -- is common to -- to all coal-mine operations that would be affected by the pending Coal Mining Effluent Regulations.

And I will say, you know, in -- while, you know,

we participated in the consultation on the regulations at the time and -- and I asked Environment Canada for their -- you know, they declared that this is achievable, and, of course, it is. You know, with -- with enough time and -- and enough effort you can do anything.

But I would say this -- this is a common challenge that we do ask any coal operators otherwise out there, existing or future, because even the -- the limit proposed for the existing coal mines are down in a range that -- you know, it's 10 -- 10 micrograms per litre, and, really, to achieve 10, you probably want to operate at 7 to make sure you don't constantly exceed that. Same for 5; you probably want to operate as 3 as an operator. You don't want to be right at the limit.

So I -- you know, in as far as -- you know, it's -- it's achievable. I suggest that it's a common challenge across the industry.

Q Okay. So you don't think that 5 micrograms per litre, which would be the average you would need to hit at end of pipe, as I recall the regulation -- I am working from memory -- with a 10-microgram maximum grab sample, I think, that's not a project killer, from your perspective?

A It -- oh.

A MR. HOUSTON: I think I better answer that

one.

It's -- it's something we would have to look at hard, you know, if that were a condition of the permit. What we've proposed, Mr. O'Gorman, is -- is a project we think is protective of the aquatic environment, and so we've discussed all the pieces involved with that.

If that were a condition of the permit or -- or a level we had to meet with the -- the project, we'd have to look at what additional pieces we would have to bring to play and how that affects the project economics.

Q Okay. Okay. Let's move on. Very good.

So I want to talk a little bit about selenium again. We have a lot of conversation about selenium.

Let's -- I want to refer to some documents and, in the interest of time, see if you agree or if we need to haul them up and look at them.

Okay. So going back to your original EIS, Consultant Report 5, which was the Hatfield Consultants' report in Document Registry 42. In that document they stated that: (as read)

> A site-specific objective for selenium for the protection of aquatic life has been developed, linked to concentrations of sulphate, which at higher concentrations modifies and attenuates the uptake of

selenium present as selenite.
I assume you agree with that, Mr. Houston?
A Yes, yes.
Q Okay. So let's not bring it up.
In Addendum 11, Registry 313, on PDF pages 205 and 322 -- and we can pull it up if you want, but you did submit to -- you submitted that as both selenium and sulphate are expected to co-occur over the project life, you expect that when selenium concentrations are higher, sulphate concentrations will also be higher. Mr. Houston, do you agree with -- that you said that to us, and do you still agree with those statements?
A Yes. I don't think I need to refer to my experts, but, yeah, it's -- they're both -- they're both leaching out of the rock. And to the extent that the mobilization mechanism is common, we would expect that they would move in parallel.
MR. O 'GORMAN: Okay. Now we will haul up a couple of things, please, Zoom Host. We can look at Registry Document 89, and it's PDF page 198. This is Addendum 8. So I think we're at one of the last packages of staff information request -- can you make that a bit bigger? Actually, the first bullet at the top. If you go to the top of the -- on the second -- go up to the top of the page, please, Zoom Host. Okay. Good. The second bullet. I don't think this -- sorry.

Q MR. O'GORMAN: So the -- what I'm looking for is a reference to -- that concentrations of sulphate are predicted to increase in Blairmore Creek from a background concentration of 20 milligrams per litre to greater than 500 milligrams per litre. Does this show us, or did I give you the wrong reference? Oh, the bullets; right. It's in the --

A Yeah. It's in the first bullet.

Q There it is. So you agree with that?

A That --

Q That is what you told us at the time?

A I agree -- I agree that's what we told you, yes.

MR. O'GORMAN: Okay. Now we're in -- I think this is the same -- yes. It will be Registry 89. It's an appendix, but that's all -- it's all one document for 89, as I recall. We're going to jump to PDF 1021, please, Zoom Host. 1021, yeah. And down to the bottom of the page and let's -- yeah, the very bottom of the page. And if you blow that up bigger, please.

Q MR. O'GORMAN: This was the summary and conclusions of a report. As I recall, this was from Mr. DeForest, if I'm -- I didn't write that down, so I'm working from memory. And in his conclusions, he --

MR. O'GORMAN: And it scrolls over, if you let people read that, and then, maybe, Zoom Host, scroll to the top of the next page.

Q MR. O'GORMAN: And I'll suggest this said that: (as read)

> The study concluded that a predicted sulphate concentration of 529 milligrams per litre for Blairmore Creek at Node BC07. At that concentration, the proposed site-specific water quality guideline for selenium would be 10.6 micrograms per litre, which was above the predicted selenium concentration of -- in Blairmore of 7 micrograms per litre.

You -- do you see that there, and you agree that that's what we were -- we learned in the study, their conclusions?

A Yes.

Q Right. Okay. So, Mr. -- well, Mr. Houston -- or you can throw it to someone, if you like. So if your proposed treatment process in the SBZ does remove sulphate or if Benga is required to manage sulphate to lower levels because of concerns about potential impacts of sulphates on aquatic life in some of the receiving water bodies, tell us what that would imply for the level of treatment of selenium you would need to do to meet a proposed site-specific objective?

A So I'm going to jump in here, but I'm rapidly getting out of my area of comfort, Mr. O'Gorman, so I'm going to pass this off as we get deeper and deeper.

So what I -- what I heard Mr. Jensen say is that we don't expect a significant amount of sulphate reduction in the SBZ. So our expectation is that -- that there -- there wouldn't be an -- not accidental, but a collateral, unintended drop in -- in sulphate. We would -- we would have to change the operation of the SBZ to actively try to reduce the sulphate in response, I suppose, to a requirement that we do so.

My expectation is that the -- the water quality objective for selenium -- I would think that the -- the formula would still hold and that the requisite water quality objective for selenium, which is not a fixed number but a -- a number that's based on the sulphate concentration, would -- would reduce in -- in step with that lower level of sulphite.

Q Okay. And I do want to confirm: What we heard earlier was Mr. Jensen did agree that there is reason to believe and even some studies that talk to the potential for sulphate reduction to occur in the SBZ, but we don't have any evidence one way or the other that really says about how much of that might take place; right?

A And, in fact, my understanding of -- I'm looking at Mr. Jensen to jump in here, but my understanding is that we would manage the oxy -- oxygen reduction potential to cut off at selenium reduction and not --

not get deeply into sulphate reduction.

Mr. Jensen, do you want to just confirm that?

A MR. JENSEN: Yes, Mr. O'Gorman, that's correct.

And I believe I touched on that yesterday. It's -- we really don't want reducing conditions that get into the realm of sulphate oxidation -- sulphate reduction, excuse me, because of -- at that point -- at that point, we would be concerned about redissolving selenium in -- in various -- in sort of a -- in more -- or at least producing more reduced forms of selenium that could re-mobilize it.

So -- but it would take -- it would take -- we would have to really all -- dose methanol consistently for quite some time to -- to get to those sulphate-reducing conditions. So it's something we want to stay clear of; that's for sure.

Q Okay. Thanks, Mr. Jensen.

I'm going to come to this in a little bit, but I'm prompted to say now, sort of in response, you -- you -- and, Mr. Houston, probably, you do acknowledge -- we're going to look at some sulphate predictions that you gave us recently, and if it is not out of the realm of possibility that, in particular, from your monitoring program, you might discover there to be a -- negative impacts on aquatic life from the kinds of sulphate

levels that might be produced and you might be required to manage the sulphate down somehow, is that -- is that something you consider in the realm of possibility?

A MR. HOUSTON: Realm of possibility, it's -- I'm not sure.

I think -- I'm wondering if -- Mr. Day, if you can weigh in on the -- the possibility that these --

I guess, Mr. O'Gorman, you're -- you're thinking that the sulphate predictions in the water balance model may be not --

Q Well --

A -- not very accurate or --

Q Well, I'll tell you what. And even before Mr. Day jumps in on that, we're going to touch on this very shortly in my questions, and I will show a graph and what -- I will invite Mr. Day to -- and you to maybe respond to it when I show it because we --

A Okay.

Q -- will haul that up. Okay?

A Okay. Okay.

Q I did ask that question a bit out of order from my plan to taking you through this, so ...

A M-hm.

Q Okay. Let's move forward. Here's another document. We want to understand a bit more now about the proposed SSWQO, the site-specific water quality objective. For

people's reference, I might just use the abbreviation. I'm going refer to a document.

MR. O'GORMAN: We -- Zoom Host, don't bring it up unless Mr. Houston doesn't agree with it.

Q MR. O'GORMAN: So in the original Consultant's Report 5, Registry Doc 42, on PDF 124, you did -- was when you presented a water quality-based guideline or objective for selenium, which was, you know, based on sulphate concentrations; right? Do you agree with that, sir?

A Yes.

Q Okay. Take my word that I'm not, you know, making up the reference. I'm trying to save -- we're trying to save time a little bit here.

A It -- it's there somewhere.

Q Yeah. Yeah. I'll take responsibility if I got the reference wrong.

Okay. So earlier this year in Addendum 11 -- and I won't haul --

MR. O'GORMAN: Well, actually, I will haul this one up, Zoom Host. Can we see Registry 313, PDF page 322. And let's zoom in on the top figure. Okay, a little -- yeah, that works.

Q MR. O'GORMAN: So we can see -- so this was something you submitted in March. It was updated modelling. And now we see the sulphate line is the

orange line on here. There's a logarithmic scale on the right-hand side of that graph, and what this is telling us is that your updated modelling -- now instead of the 500 milligrams per litre that we read about in Mr. DeForest's report from your original EIS a second ago, I mean I see levels that range from 5 to 800 and reach a thousand. And I'm just curious if you can confirm that that's what you gave us.

A Just -- just a minute, Mr. O'Gorman.

Q Okay.

A So we're back, Mr. O'Gorman. I apologize for the lengthy discussion. We had talked about greater than 500 in the previous answer. This -- this specific graph was made to -- can you hear me?

Q M-hm.

A Okay. I wasn't sure.

This specific graph was made in response to a question about the seasonal -- seasonal nature of sulphate and selenium and the -- whether there would be a seasonal differential between the -- between the two that might put us offside.

I -- you know, I -- we agree that these numbers shown in this graph are higher than -- than the previous numbers we discussed, but we would also say that these -- these are based on, you know, both for selenium and for sulphate, some conservative

assumptions in the water model balance.

Q Okay. Well, of course, we do ask you to provide us with analysis that incorporates conservative assumptions, Mr. Houston.

I will put to -- and I don't know if you will know this answer or if one of your experts, but can you confirm that you folks are aware that the current established sulphate guideline for protection of aquatic life is 429 milligrams per litre?

A So, Mr. -- yeah, Mr. Davies will respond to that.

A MR. DAVIES: Good morning, Mr. O'Gorman.

Q Good morning, Mr. Davies. How are you?

A Better. Thank you.

Q Good. We'll be talking about your -- your resubmitted Nautilus study very shortly, so don't feel lonely.

A Oh, I'm not too lonely. No worries.

Q Okay.

A Yeah. With regard to the guideline for sulphate, it's not quite accurate that the -- that the guideline is 429. The guideline -- and I won't -- I won't refer to the document, but I know the Coalition submitted as their aid to cross the 2018 environmental quality guidelines, and you can look it up in that.

The -- the sulphate guideline basically adjusts for hardness up to a hardness of 250 milligrams per litre, and then above 250 milligrams per litre, the

guideline itself says you must define a site-specific number. And so the -- and that number, you know, recognizes essentially that this relationship between hardness and sulphate continues above the 250-microgram per litre -- or milligram per litre of hardness and 429-milligram per litre sulphate, but it recognizes that there's potential mixture toxicity issues with -- with hardness itself when you're trying to understand the effects of sulphate. And so, you know, the guideline asks you to develop a site-specific threshold that reflects the -- the higher hardness but also allows, through that site-specific testing, to assess whether or not the hardness itself is problematic in that water, in that site water.

Q Right. It's primarily osmotic stress you'd need to worry about in that case, if I understand correctly; is that right?

A Yeah. Like, first, it's -- well, it's a combination of things. I know the -- some of the -- the examples that are cited in the guideline derivation document are specifically oriented towards, you know, high concentrations of calcium and that sort of thing. But overall, when you're looking at sulphate, you are looking at other ions. It's really -- it's the overall osmotic stress. It's the combination of the ions. It's the mixture of the ions that's -- that's overall

quite important. The specific composition of individual ions contributes, but it's only a part of the larger story about how that mixture of ions actually behave is -- from a toxicology perspective.

Q Okay, Mr. Davies. I actually was going to immediately next talk about hardness and acknowledge some of what you had just said.

So, yes, the interaction of sulphate and that guideline, depending on hardless -- I'm sorry, on hardness, is something we'd need to consider, and that sulphate toxicity could be ameliorated by it.

And so you folks did do a study of that.

MR. O'GORMAN: And, Zoom Host, I'm going to ask you, please, to haul up Registry Document 251. That's Addendum 10. We're going to look at PDF page 67. So if I -- I'm working from memory. I think this was Mr. -- maybe Mr. DeForest's work again, but I might be wrong on that.

No, no, sir. This is an IR response, but I think it might have referred to Mr. DeForest's work. Oh, a Nautilus study. My bad. I'm told it was by Nautilus.

We're going to look at -- what part of that page am I trying to get you to focus on. If we zoom in -- yeah, there we see it. I think the -- right.

Q MR. O'GORMAN: So there was some testing done which suggests that for -- the most sensitive endpoints

for sulphate were around 700 milligrams per litre of sulphate, and that the species tested tolerated hardness concentrations greater than 834 milligrams per litre with no indication of osmotic stress. Does that look right?

A Yes, that's correct.

Q Okay. I could haul this up, or I could ask you to confirm that in other documents you submitted to us, you expected to see a predicted hardness in Blairmore Creek to be around 350 milligrams per litre?

A Yeah, that's right.

And if you're leading -- if I can take a guess at your next question and talk about the difference between these numbers, the difference between these numbers and the predictions for the -- for the creek is that the nature of this study is -- is a spiking study. Essentially what we do is we take site water, and we -- we spike it up with, you know, concentrations of -- of sulphate in this case -- up to about 1,500 milligrams per litre sulphate I believe we used in this case, and to try to make sure that the -- the nature of the counterions is consistent with what you see in the creek. That is spiked up with, in this case, a mix of calcium and -- and magnesium as the cations to -- to bring up that sulphate concentration.

And, of course, you have -- you can't just add

sulphate. You have to add sulphate in solution with some kind of counterions. Otherwise, it won't be dissolved. And so these spiking studies essentially spiked up the hardness to levels that are, you know, well above what you would expect in -- in Blairmore Creek because that was our way to get the -- get the sulphate essentially into -- into the solutions, the test solutions, so that we could test it.

So the tests, in that regard, represent a -- a much worse than worst case of hardness and solution relative to -- to the predictions.

Q Okay. But you are increasing hardness in Blairmore Creek to about 350?

A That's my understanding, yeah.

Q Okay. And you agree, I'm guessing -- and this might be you, Mr. Davies; it might be Mr. Bettles. I'm guessing it's you -- that increased hardness could result in calcite formation in Blairmore Creek?

A MR. BETTLES: Mr. O'Gorman, that might be, actually, a question for Mr. Day. I'm not a hundred percent sure. Steve Day?

A MR. DAY: Yeah, I could -- sorry, yes, I could answer.

I mean, so there will be -- I mean, there will be enough calcium in the water to -- so that we have to think about calcites formation, precipitation from the

water. But maybe -- so I'm going to push this to -- just to Mr. Jensen. Maybe you could speak to how -- how the effect of -- if we have to treat that, what that would -- what that effect would be.

A MR. JENSEN: Yeah. So I wonder -- I apologize. I did lose track of the exact question in the go-around here.

Q Well, I'll suggest to you -- I appreciate that, Mr. Day, and if you really want to talk about calcite treatment now, you can, but this isn't where I'm going with my questions right now. I think I will probably -- might return to ask a bit more about calcite formation later, but maybe we should return to that idea later if we need to. Does that work for you? Okay. It's not immediately relevant.

We're asking a general question of: Can increased hardness lead to calcite formation? I think the answer to that is generally yes; correct?

A MR. DAY: I can answer that. Yes, that will be the case.

Q Okay. That's all I really wanted to know there. We're going to return to it.

All right. So I just want to confirm: Based on some of these numbers that we've looked at and your new modelling predictions that would be -- admittedly, they're seasonal, Mr. Houston, but they did reach

significantly higher levels of sulphates projected than we were -- we saw four years ago in your initial work.

So if we were, as a Panel, to endorse the site-specific selenium guideline, that would mean that sulphate would have to be maintained above a certain concentration to ensure that it's always above your predicted -- your predicted selenium levels; is that right? In Blairmore Creek, in particular.

A MR. HOUSTON: As we talked about before, the two tend to go hand in hand, yes.

Q Right. In particular, you would need to maintain high sulphate levels to ensure that selenium stayed below it, below the sulphate?

A I -- I would say we -- we would want to avoid reducing the sulphate levels to -- to a level that would impinge on the selenium objective, yes.

Q Okay. And we looked at the study that you referred to in the IR response that I hauled up that suggested concentrations of sulphate of about 700 milligrams per litre for those most sensitive endpoints could be tolerated with few effects, but it would need to be confirmed through your aquatics monitoring program; is that correct?

A Yes.

Q Okay. And so if we look at the graph --

MR. O'GORMAN: We can maybe, Zoom Host, go

back to the figure that I asked as to -- the 313, PDF 322.

Q MR. O'GORMAN: And considering that the study referred to in your IR response showing potential -- you know, up to 700 sulphates you were good with, but we potentially might see quite higher than that here, how would that -- what would these levels of sulphates potentially impact aquatic organisms in Blairmore Creek --

A MR. DAVIES: And I --

Q -- (INDISCERNIBLE - OVERLAPPING SPEAKERS) expert ideally?

A I can speak to that.

A MR. JENSEN: May I -- if I may, Mr. O'Gorman, the -- the numbers you see represented here -- the model results you see represented here, they -- they represent an added level of conservatism over and above the numbers we issued that were based on -- on closer to average conditions.

The reason we use average conditions for water quality model results in general is that for a number of the source terms, they're derived based on -- on precipitation and percolation rates that are average. So that means that the source term -- the source terms are, you know, developed on that basis.

So when we start to move away from that basis in

our -- in our model results, we're generally hesitant about doing that for this precise reason, that it -- it does -- you know, strictly speaking, we should be developing sources now for every level of -- of precipitation and percolation rates.

So I don't want to get into the weeds on this, but I will -- I will say that there's a reason why we didn't -- we didn't present numbers this way in the first place, and it is that it adds an extra level of conservatism that, you know -- we -- that we're not necessarily -- I don't know what the right word is, but it -- it's not the level of conservatism we would choose and consider to be necessarily appropriate.

Q And if we -- yes. Actually, I was going say: And if we saw these levels of sulphates in Blairmore Creek, what do you -- how do you think the -- the little critters in there would respond?

A MR. DAVIES: Yeah. Well, the key -- the key life stage of concern with regard to sulphate here would be trout eggs, you know, leading to -- basically, the -- the egg to -- to fry stage. Those are sort of the anchors for the test. And those, I think, are, you know, an important part of -- of, you know, protecting Blairmore Creek.

So when you look at the -- the variation you see in this graph, I know it's a -- all these things are

full of log scales, which are really hard to interpret on the fly, but essentially these concentrations are predicted to vary here in this graph from about -- it looks like about -- you know, once you're up towards the top, about kind of 450, 500, something like that, up -- at the -- the end of mine life, anyway, there, they go up to around a thousand.

And the -- the numbers near the top reflect low flows. The numbers at the bottom would reflect high flows; right? Like, there's more dilution available at high flows and less at low flows.

For -- for trout in the stream -- and I'm thinking king of cutthroat trout and rainbow trout -- they're spring spawners. They -- you would expect to see the most kind of critical period for exposure of -- of eggs in gravels to be from kind of, you know, June-ish, if I understand correctly, that -- Mr. Bettles could confirm for me here, but my understanding would be from kind of June-ish to early August. And at that period of time, we're on kind of the falling leg of the hydro graph from the -- from high flows, working our way towards low flows.

So the most sensitive species in life stage to -- to sulphate would -- would likely be exposed to the lower end of these -- these numbers that are predicted here.

I would also say about the tests, as -- as you pointed out earlier, the -- the hardness in those tests was very high. And there might be some ways to repeat those -- you know, repeat the site-specific test for sulphate with a different set of counterions to try to more accurately reflect the -- the expected hardness level, like, you know, using sodium sulphate or something like that to try to get a more precise number for exactly this case. But when you look overall at the concentrations, the -- the fish, in particular, are, you know, outside of the egg stage, are quite -- and I'd say salmonids, you know, specifically are -- they're quite tolerate of sulphate. I think that may be because rainbow trout, cutthroat trout are, you know, part of the same genus as -- as specific salmon, right, and they're -- they're sort of, you know, built to manage osmotic stress by going to the ocean where it's, you know, obviously quite salty.

But the -- I -- I would say, though, that the concentrations in those couple years near the end of mine life are important ones to pay attention to, and there would need to be a close look at -- you know, if we're moving towards that and we are finding that the concentrations are moving up into this range, then, you know, you don't want to just take it for granted that everything's fine. You want to keep watching fairly

closely. If that's -- if that's helpful.

Q Sure. That is helpful, Mr. Davies. Thank you.

And I want to draw our eyes to one other thing, and I -- if I suggested to you that the sulphate levels today in Blairmore Creek are about 20 milligrams per litre, I think people would agree with that; right?

A It's around that, yeah.

Q Yeah. So we're looking at a substantive increase in projected sulphate levels in Blairmore Creek.

I wonder if other sources -- and, Mr. Davies, this is a question for you -- that might trigger other unexpected or unforeseen sorts of reactions, like a change in the makeup of the life that lives there to different algae and bacteria and fish food that is more adjusted to invertebrates that are more adjusted to high sulphate levels rather than what -- the levels they experience today?

A Well, in my experience, like, I've seen a lot of mine sites that have relatively high sulphate concentrations in their creeks. It's -- it's one of the sort of ironies of there not being a sulphate guideline until recently, is that because people didn't tend to look at it, the -- you know, you ended up having high numbers in quite -- quite a lot of places.

And so we've done a lot of environmental effects monitoring looking at -- looking at effects in, like,

benthic communities, benthic invertebrate communities, or periphyton communities, fish communities, in small streams that have experienced this kind of change in -- in sulphate concentrations.

And, honestly, I'm trying to -- I want to make sure I'm speaking clearly here. In the -- in all that monitoring -- and that's -- I don't know. That's 20-odd years of monitoring around mine sites -- we have seen effects of -- that we suspect are related to either sulphate or -- or TDS, like, total dissolved solids, just the overall effect of -- of, you know, ion load in -- in these small streams, but we -- we've seen them at concentrations up above a thousand. Like, we generally don't see effects on benthic invertebrate communities, generally don't see effects on -- you know, often it's -- it's juvenile salmonids that are using these -- these systems 'cause they're -- they're very small systems, and they're using them for spawning and rearing, but then they move out as adults into lakes or larger rivers.

We -- like I said, we do see it occasionally, but it's -- it's actually not that common, in my experience. It's not to say it doesn't happen. I don't know if that's too waffly an answer for you, but it's sort of my experience over -- you know, over several years of monitoring.

Q Okay. Well, I'll -- I'll accept that, and we'll move on.

So the sulphate and the selenium have this mutual interdependence in what your -- in your proposal where the selenium levels, I'll characterize it as, are acceptable because the sulphate levels are high. So, Mr. Houston, you might want to confirm: That's a general interpretation that -- that you agree with?

A MR. HOUSTON: Yes. I -- I would point out that with very few exceptions, there's some -- some space between those -- those two. So there is some allowance for the sulphate levels to be lower and still be -- still create a site-specific guideline that is -- is protective.

Q Okay. And in a similar sense, the higher sulphate level -- you're suggesting to us that the higher sulphate levels are okay because you're having higher hardness levels; is that also something you agree with that you are --

A Yes.

Q -- you are proposing? Okay.

A Yes.

Q And calcite -- potential for calcite formation, as a result of the higher levels, is at least a potential concern?

A On that one I'm going to have to defer to maybe

Mr. Day.

A MR. DAY: Yes, yes, that's correct. I agree with that, yeah.

Q So if we were concerned about the hardness levels and the calcification and we or some future regulator said that you've got to bring those hardness levels down, does the chain of effects cascade back to lower hardness? Now you are more worried about sulphates; better bring the sulphates down. Now you are more worried about selenium; better bring the selenium down. Are those all interacted in that way? Is that a fair way to characterize it?

A MR. DAVIES: Yeah. With respect to the interaction between the -- the toxicities that -- that we're concerned about, I would say that that is a -- a fair way to characterize it, with sulphate, I'd say, being the -- the key -- you know, the key variable in all of that, honestly.

Q Okay. This is a bit of a -- well, do you have much sense of the buffer that exists in that complex web of relationships between all these different sorts of impacts that might be triggered in Blairmore Creek of -- I recognize it's a -- kind of a qualitative question, and I'll let you react. Is there lots of leeway in these relationships where you can fine-tune any one of those hardness, sulphate, selenium,

potential calcite, down by up to 25 percent and not worry about it negatively impacting the other component -- the effects of the other component that it's related to? Like, are all of these very tightly linked? Is there a lot of wiggle room? Do you have a sense of that?

A MR. HOUSTON: So can we just have a little conference here before we give you an answer to that, Mr. O'Gorman?

Thank you.

Q By all means. And I'll acknowledge, I'm not giving you a strict, but conceptual question.

A Under -- understood.

Okay. Go ahead.

A MR. DAVIES: I'm sorry, Mr. O'Gorman.

Yeah. There's two -- two kind of steps to consider here. There's the relationship between hardness and sulphate and the relationship between sulphate and -- and selenium.

I'll start with the sulphate and the selenium. The -- as you can see in the -- in the site-specific objective, the concentrations of -- of sulphate that kind of drive the -- the objective up to levels that are -- that are protective of what's predicted are up to about 300, you know, something like that, 400. So we've got a fair scope, if -- if sulphate was brought

down, to still -- you know, for that -- sorry, for that selenium guideline -- or selenium objective to still be protective.

And I know we haven't talked about this, but there's -- I don't think there's an assumption that the selenium objective, if adopted, would just, you know, go up indefinitely with -- with sulphate concentrations either. So you might want to cap it at some point.

With regard to hardness and sulphate, as I was talking about earlier, the sulphate needs a counterion, and the hardness needs a counterion; right? You can't have -- you can't really have one without the other. And so if -- if there was a treatment going on for one or -- you know, for sulphate, you would, by necessity, be pushing down the hardness.

And I -- I believe that -- that the same would be true for -- for hardness and sulphate.

But maybe I'll flip that over to Mr. Jensen.

A MR. JENSEN: Yeah, that's correct. And when we look at -- at sulphate and hardness of sulphate and -- they do go hand in hand. So if you -- in fact, I've done this analysis for a number of sites and looking at the site-specific guidelines and, you know -- so when we look at -- at things like sulphate removal and, say, an eight years lime plant, reducing the hardness and the sulphate, they go hand in hand to

the point where the ratios stay above the guideline limits. So as you reduce hardness, you -- you're never in a situation where, all of a sudden, sulphate becomes an issue because the corresponding reduction in sulphate always stay above that sort of stepwise guideline that's been defined.

So it's in -- from that perspective, it's -- they inherently go together. So in terms of buffer, yeah, I mean, I'd say it's more than a buffer. It's -- it's just sort of an inherent relationship, if that helps.

Q And I suppose -- sure. And I suppose we have to also look at it and think about -- and this graph does illustrate, on top of these three interlinked components and potential impacts on the water, the seasonality aspects. Sometimes flows are high, and sometimes flows are low, and concentrations vary accordingly; right?

A MR. DAVIES: Yeah, that's correct. Although I think that the -- for the things that we're most concerned about, sulphate, hardness, and -- and selenium, like, the signal, I believe, in the creek is coming mostly from the effluent. And so if they're varying -- if they're consistent in the effluent, then, you know, mostly what you're dealing with in the creek is -- is, you know, concentrations moving up or down with dilution from ambient creek flow.

Q Okay. Okay. Great. Let's go to my next group of questions, which are more explicitly about the proposed sulphate-adjusted, site-specific water quality objective for selenium.

MR. O'GORMAN: I'm going to refer to a document. We can take those down, Zoom Host.

And my first document let's not bring up, but I will refer to it.

Q MR. O'GORMAN: In Addendum 10, Registry Doc 251 on PDF page 10, these were IR responses. Actually, I suppose that would have been -- if it's Addendum 10, that would have been Package 5. And I didn't write that down.

You did tell us that the site-specific guideline is intended to be a preliminary benchmark for assessing whether modelled selenium concentrations may pose an unacceptable risk to fish as represented by westslope cutthroat trout in Blairmore Creek, and once mining commences, monitoring data will be evaluated relative to the Blairmore Creek -- Blairmore Creek water quality guideline used to validate the guideline that was involved. And, if needed, an updated site-specific objective may be developed in the future from monitoring data. Do you agree that you said that to us?

A MR. HOUSTON: So my understanding, where

we've got "BC water quality guideline", that that means the province of BC, not Blairmore Creek.

Q Oh. Okay. Right. Sorry. I read it wrong.

A But other than that -- other than that, you did very well.

Q I struggled a number of times through this process knowing -- flipping back and forth between abbreviating BC and what was meant because they obviously are so relevant and next door to each other. So my bad.

Okay. Thank you, Mr. Houston.

So now we have some questions about -- about the approach to this guideline. So are we correct -- correct in assuming that while site-specific information on current selenium and sulphate concentrations is available to refine the proposed guideline, collection of data, such as water quality and selenium tissue concentrations, would be required while the concentrations of selenium and sulphate rise in Blairmore Creek?

A MR. DAVIES: Yeah, I think so. And it's -- I don't think it's just a matter of collecting data. Like, one of the challenges, I think, for this project -- it's -- it's sort of a mixed blessing -- is that the concentrations of selenium aren't really projected to increase in the creek for several years. And so if we're trying to do -- you know, collect more

data from biota for, you know, accumulation modelling and that sort of thing, we're dealing with several years of -- of the current situation. And the challenge with building a model, if you are trying to project forward, is that if you only have, you know, your baseline data, you know, it doesn't -- more data doesn't necessarily give -- it gives you more confidence and precision in what's going on in the creek right now, which -- it is important, and we do need to monitor that and collect a broader baseline for that, but it doesn't necessarily help you with your -- with your projections going forward.

That said, though, I do think that there are some more opportunities here to -- to, you know, further validate the -- the model that was developed. There's -- you know, there's stream side. You know, there's experiments you could do to -- you know, with experimental troughs or these sorts of things in the early days of -- of mine life to, you know, further describe the relationships that -- that we're talking about here in the -- in the guide -- in the objective.

And also, obviously, if the mine does move to a -- or when -- when the mine moves to a -- like, the pilot SBZ, you would hope that there would be an opportunity to, you know, do some tests -- direct testing with that -- that effluent looking at these relationships.

Q So, Mr. Davies or Mr. Houston, maybe, are you folks committing to implementing a plan for how you are going to monitor the various constituents needed to update on an ongoing -- you know, monitor and update the proposed guideline that you have put in front of us?

A MR. HOUSTON: We -- we have filed a draft aquatics monitoring plan, and it contains most of the components we've been talking about, Mr. O'Gorman.

And, of course, we're -- we're ready to work directly with the regulators to fine-tune that plan and -- and finalize it. So we are committing to a monitoring plan, yes.

A MR. DAVIES: Mr. O'Gorman, if I can expand on that a little bit.

Q Okay.

A Sorry. Yeah. If I could expand on that a little bit, the draft aquatics monitoring plan right now is -- it's quite high level, obviously, and that's, you know, intentional; right? We don't have a, you know, specific discharge point. We -- there's a lot -- there's a lot to still sort out, and -- and, you know, it -- it's part of the detailed design process, I would say, is -- is in tuning this in and figuring out not only what needs to be monitored going forward but what other data, you know, should be put together to support the -- you know, the -- the effects predictions that --

that have been made.

And my experience with -- with that is that the best process for that is really kind of workshopping it through -- through a process with regulators potentially bringing in others like the -- all of your AER and ECCC colleagues behind the curtain have lots of experience with -- you know, with this and -- and expertise. And I would think that we would want to do that very early on in the process, is -- is set up a -- a -- a process to -- to define what this monitoring should look like because the monitoring shouldn't just be monitoring. It should be really designed to collect data that can feed back directly to management; right? Like, that's why you should monitor, and this would be part of that.

Q Okay. So, Mr. Davies, I think from what you said, you would agree if I were to suggest to you that your current draft aquatics management plan does not really contain the kinds of information you'd need for how you're going to update the site-specific water quality objective?

A Yeah. Absolutely, I would.

Q Okay. Okay. Thanks for that.

I'm going to jump to the undertaking results that you filed, please, which --

MR. O'GORMAN: Zoom Host, this is CIAR 878.

So while it's coming up -- and thank you all for turning this around so quickly -- I will -- and we're going to go to page PDF 14, please.

Definitely -- and let's blow up the figure at the bottom of the screen, yeah, and blow it up and go down to the bottom. Maybe blow it up one more time so we can have a good look at those numbers and that -- those data points.

Q MR. O'GORMAN: Okay. Yes. Thanks for returning the undertaking in as quick a time as you did. We've given a quick check through the numbers and the figures. We don't have any real disagreements, maybe with some rounding errors. And I think I will suggest to you that you'd agree with me if I said that there was more a -- transcription errors than anything else and that your recalculations don't have a large impact on the previously submitted results. Is that a fair way to characterize this response?

A MR. DAVIES: Yeah, definitely, I would agree with that.

Q Okay. I think we've agreed that you are -- through the conversation we just had a few minutes ago, but I'll ask you to be clear. Are you proposing -- so all of this -- these results end up with a suggested -- sulphate-adjusted, selenium site-specific water quality objective. Are you asking this panel to accept this

SSWQO or a WW -- SSWQO, i.e., these particular numbers or the concept of one?

A Yeah. I can speak to it technically. I obviously can't speak on behalf of Benga, but I -- technically, what we've done here, I think, is -- is demonstrate that there is a clear and consistent relationship between -- between sulphate and -- and, you know, kind of a -- and -- and selenium uptake into the food chain, if I can be precise that way. This doesn't consider the nature of the environment that it's discharging to, and that's meant -- that's on purpose, right, the -- that that kind of adds to the conservatism because we are discharging to a lotic environment.

But when you specifically look at what should be adopted as an objective, I think there's a lot of other issues to consider. And one of them is, honestly, just the -- sort of the practicality of it, from a -- from a day-to-day operational perspective, that, you know, if you have a -- if you have an objective that is -- that requires an extra number to calculate it every time you -- you want to assess it -- that's both at the mine site and by regulators -- it does -- you know, it does make it a little bit more finicky. And I have seen situations where a -- you know, a relationship is made clear. A -- and then in the end, a -- a -- a single number is set that essentially, you know, captures that

relationship but makes it much easier for regulators to assess attainment and, you know, mine operators to assess attainment and that sort of thing.

If you want to be very precise about it, then I think this relationship is a -- is a good foundation for a -- a -- a selenium objective in the creek that specifically refers to sulphate. It's not -- this is not an uncommon approach. Metals and -- and hardness go along with this all the time. But I do think that that whole framework around the -- the objective is an important thing to, you know, consider practically and -- and sort of logistically.

So I hope I haven't muddied the waters with that, but from a technical perspective, I'm -- I'm not wedded to the line. I don't think that's necessarily the most important thing. It's -- it's how this relationship is captured within a -- a protective objective for the creek.

A MR. HOUSTON: If I could, Mr. O'Gorman, I tend to agree with my -- my colleague Mr. Davies. We understand that this -- the science that demonstrates the protective nature of what we're proposing needs to be translated into something that could be useful both from an operating management perspective and -- and a regular -- regulatory perspective. So we would fully expect that there would be some interpretation of the

results and then something -- some objective set down that's perhaps simpler to implement.

Q Okay. Thanks, Mr. Houston.

Okay. So I want to -- I'm going to -- so -- and, Mr. Davies, this will primarily be for you. I'm going to suggest something, in the interest of time, and ask you to agree with it and -- for the sake of, you know, everyone's understanding.

This is a figure that shows on the y-axis and, you know, enrichment function is plotted, which is a -- basically a level of how much selenium uptake occurs in the tissues divided by their concentration, and compared to on the x-axis, increasing sulphate concentration values, it shows tests that you did for particularly -- well, they're not listed for you. For an algae species, P. subcapitata; yes? Yes, Mr. Davies?

A MR. DAVIES: Oh, sorry. Yes, I agree. Yes.

Q And the key -- you know, well, maybe there are a number of keys, but, like, arguably, the most important piece of information that you pull out of this graph for future use in your objective is the slope -- sorry, the exponent on the 'X' value in your best-fit regression curve, that slope ends up being used later in the -- in the objective; right?

A Yes. Exactly.
Q Right. So the regression best fit of that line we see, to guide our eyes, is really the thing you're trying to draw from this graph, from this plot?
A True. Yes.
MR. O'GORMAN: Okay. And, Zoom Host, can we scan two pages down to see Figure 4? And I just want to establish down at the bottom -- you don't have to zoom in.
Q MR. O'GORMAN: So this looks very similar. It is for a different species, Lemna minor, but it's enrichment function versus sulphate. You do a regression analysis. The slope of, again, the 'X' curve, actually, you don't use in your objective. I think you only average the two algae species; is that right?
A Yeah. Yeah. And the purpose for that is that there aren't really aquatic plants in Blairmore Creek. There is only periphyton, which will be allable [phonetic] species.
Q Okay. And so drawing your eye to it, we see on the very low sulphate region one high point and then a -- you know, four other data points in the -- you know, ranging from, you know, 2 to 7 -- 600-ish kind of concentration that are all clustered lower; right?
A Correct.

MR. O'GORMAN: And we'll see the same relationships two pages later, Zoom Host, on Figure 6.

Q MR. O'GORMAN: And this was for a different algae species, if you scan down, S. acutus, and we see the same sort of relationship in this. This one, you do use the exponent on the 'X' to get the -- your current version of the objective; right?

A Correct.

Q Okay. So let's talk about these figures. And this one works as well as any other 'cause I think we agree they all basically show a very similar relationship.

So if you were an average person on the street who knew a little bit about data but didn't know much about selenium uptake in the tissues, do you think it's fair to say that you'd look at these five points on a graph and say, Well, you've got one really high one at this very low value of whatever it is you are measuring on the x-axis, and then once the x-axis gets -- once you get into, you know, above the very beginning of the graph, the other four results are all very similar and clustered in terms of where they are on the y-axis; is that something that you'd think would be reasonable to think from looking at this?

A Yeah. I think that's especially fair for the Scenedesmus result here that we're looking at, but it is true for all three.

Q I think all three sort of show one very initial, very high point, and then four that are not too dissimilar from each other at anything above the very lowest concentrations; right?
A True.
Q Okay. So you, of course, fit a regression analysis to these five data points and get very important data out of it, the exponent on that 'X' curve -- sorry, the exponent that we see above the 'X'. Would you agree that that one initial very high point is of overwhelming importance in dragging that curve, if you will, the regression analysis, to -- to give you your results on the shape of that curve and the slope of that curve?
A Yeah, we would say that it has a high leverage at that point there.
Q If we want to get technical, we would say it has high leverage. But it is a -- it's a very important point compared to the others, because if that one point was lower, the entire curve would get -- would look very different, and ...

Okay. So one of the things that someone might think when they look at this -- this very important set of data -- although there's five points -- is if I wanted to really flesh out this relationship, would I maybe want to better explore that region of the graph

and get more data points to really know what that curve looks like instead of relying on just one data point? Does that --

A Yeah. I --

Q Is that something that would be fair to think if I looked at this?

A Yeah, that would certainly be fair. I think that the experience that, you know, all of us have working with bioassay data is that setting the -- you know, you're setting the doses in your trial ahead of time, before you exactly know what the response is going to be, and you -- you know, there's always -- there's endless debates about curve fitting. But fundamentally, if you wanted to more precisely define this relationship, then, yeah, you could rerun these tests with a much larger number of series of dilutions and dose responses.

Q Yes.

A MR. HOUSTON: Can we just --

Q Go ahead.

A Can we just have a little consultation because I have another thought?

Q Sure.

A So I -- maybe this is the difference between the -- an engineer and, I guess, more of a scientist. For me, I was -- and what we were just debating, Mr. O'Gorman, is

our -- what we've stated is we're going to operate in that 200-plus range. I'm just picking 200-plus because it seems to be a place on the curve where -- and an engineer to -- to simplify this, because we don't understand all these fancy numbers, would -- might say that, you know, we could approximate that lower part of the curve as being linear, irrespective of the leverage of the first point, and if you got a whole bunch more points in there, you would still end up with an approximately linear relationship at the lower part of the curve if you -- if you did the fitting right. And that's where, I think, we're -- we're hoping to be operating.

So I -- I'm just questioning the value of doing a lot more research to get that back end of the curve between 0 and 100 more precise if we all agree that between 200 and let's say 500, we're looking at more or less a linear relationship, or we could fit a linear function in there just as easily.

Q Yeah. If you eyeball it, I'm not -- I would not disagree with that for all of these figures. The four data points that are not in the very low sulphate region all give you very similar values of enrichment function. So one of the ways you might react to that is to scratch your head and say, So why go to all the trouble of fitting -- of coming up with a sulphate

adjusted curve when basically, at whatever level of sulphate, you get a very similar enrichment function?

A MR. DAVIES: I suppose -- if I could respond to that, Mr. O'Gorman.

The -- it is quite consistent when you're up at these higher concentrations of sulphate, but when we're looking at -- you know, what we're trying to do with this slope, essentially, is figure out how -- how that sulphate may -- and how -- yeah, how does the -- the changes in sulphate may -- may relate -- like, sorry. Let me compose my thoughts briefly here.

Like, right now we have -- the Alberta generic guideline is 2 micrograms per litre. It comes from the BC guideline. The BC guideline derivation is -- you know, it's -- it's an interesting derivation. It's quite different than -- than your typical guideline derivations because it -- selenium acts very differently in the environment. We're not concerned about, you know, toxicity through the gills or anything like that. Like, the issues with selenium are really uptake in the food chain and accumulation in fish. And so there's -- there's sort of multiple considerations -- like, three considerations that -- that we need to think about: the concentration in water, the uptake into the food chain, and the potential for accumulation within the food chain in --

in kind of slow-flowing, highly sedimentary environments.

So when you look at the derivation of the guideline, it states numerous places that concentrations of selenium in water are a very poor predictor of effects because of these two other issues on top of concentration that really drive a lot of these issues around bioaccumulation.

And so the way they derive this 2-microgram-per-litre level is they -- they kind of broadly scan literature and they broadly scan background concentrations, and they sort of say, Well, 2 -- 2 looks to be broadly protective of -- of lentics, so slow-moving environments in -- in all cases.

And so when -- when we're looking at -- at this from the perspective of an assessment, this is not a lentic environment, and this is not an environment that -- like, this will not be a high-sulphate -- or a low-sulphate environment. And we know that those two things do -- and if you kind of think of them as sort of sliders that affect the -- the safe concentration of selenium in a creek, what we've done with this is we know that the sulphate will be higher, and so to properly capture that mixture-based potential for effects, we've tried to model that out. And -- and, you know, we -- so this -- this site-specific objective

that's proposed, the intent of taking the slopes, as you will have seen through the document, is to essentially understand how uptake into the food chain would change with increasing sulphate. And then, you know, we make -- we make some critical assumptions that the 2-microgram-per-litre level that's been set in the guideline is protective in low-sulphate environments. And then we extend, you know, using the slopes of these relationships, essentially, that -- that 2-microgram per litre value up with increasing sulphate concentrations because we know that those increasing sulphate concentrations will keep the rate of uptake into the food chain consistent.

And so one way to look at the site-specific objective is that it's essentially the equivalent of that broadly protective 2-microgram-per-litre guideline for lentic environments that has been kind of slid up to reflect the sulphate concentration, and it's meant to reflect the same -- the same amount of movement into the food chain that you would see, you know, in a -- if you were applying a 2-microgram-per-litre level. And that's why the -- the objective at these low concentrations of sulphate is the same as the -- as the provincial guideline.

We don't consider that second slider between lentic and lotic environments, slow flowing and fast

flowing environments, at all. We leave that out of the consideration. And -- and so what we're doing is essentially sliding up a -- a lentic guideline to -- to an objective value that we think is still reflective of that lentic 2 microgram per litre. It just ends up being higher because there's more sulphate.

But we -- we aren't taking into consideration at all that Blairmore Creek itself is not a -- an environment that is prone to accumulate selenium.

And I could reference figures and bring this stuff up, but I know we're -- it's Saturday, and everybody wants to go home, so I will -- I'll just, you know, say that if you do want to go to the fluvial geomorphology report in Appendix 2, you can see we have excellent -- like, uncommonly detailed creek morphology information for -- for these creeks because of the Fisheries concerns on the project. And you can see that -- that it is a purely lotic environment, and so you don't expect to see a -- you know, an equilibrium between selenate and selenite that moves towards selenite. You don't expect to see accumulation in sediments. And you don't expect to see that cycling that would accumulate higher and higher concentrations of selenium in the food web.

And so, like, that -- I guess the -- the rationale for it is that, you know, we have a -- a generic

guideline that we know is not representative of this environment. We know that we can describe one of those relationships that -- that modifies the behaviour of selenium and the uptake of selenium into the food web in this receiving environment, and so we're trying to reflect that in the -- in the assessment that we've made.

And as I -- as I've said before, you know, we're quite confident in -- in these relationships. They're very -- like, between the three species, they're very consistent. And I know we have, you know, highly reaching that one data point, but that one data point is generally consisting across three different tests of three different species as well, and it's consistent with quite a large body of literature. And Mr. DeForest could speak to that, if you like.

But essentially what we're trying to do is there's -- there's those two key sliders, and we're trying to, you know, basically use one of them to understand how sulphate would -- would -- would change the -- kind of the critical concentrations of -- of selenium in the environment that would lead to accumulation in the food web that you would be worried about.

Q Okay. Thank you, Mr. Davies.

I won't sort of try and hit on all of those points

in your response. I think we've established a couple of things that I did want us to establish about these curves and the importance of the slope that comes out of these curves for the guideline that you have presented.

I've asked you about the paucity of data in the low sulphate regime that would be better to define this curve. I also point out that all of the tests -- you know, they're all different, but they all have a -- the highest value of sulphates that were tested are all around 600 milligrams per litre.

I'm sure we can recall 15 minutes ago or so, we looked at some of the projected values of sulphates you might see that could potentially, admittedly, as you describe it, a conservative case, reach up to and above a thousand milligrams per litre. So we are wondering about why you don't have more data in that higher sulphate regime to help further define what the relationship might look like.

Do you have any sense of why you -- also, as well as not further exploring the low sulphate regime, you haven't further explored the high sulphate regime?

A Well, I'd say part of it is that those -- those higher sulphate numbers came along after these trials.

But I would say that the -- like, these are not really complex tests; right? Like, they are -- they

are repeatable, and they are -- they can be extended, you know, relatively quickly.

So it's -- if it is something that, you know, regulators want some more confidence about, it's not a challenging thing to do to extend those tests.

Q Okay. Is there a possibility that at higher sulphate regimes you might see -- in doing these kinds of tests, you might see things like sulphate, you know, toxicity issues slowing uptake into tissues, for example? You might see maybe sulphates having adverse effects on growth rates that would slow selenium up -- slow selenate uptake rates. Are those sorts of outcomes or possible -- things possible to see as why -- what you may be seeing in the high sulphate regime on a study like this?

A Well, I'll -- maybe I'll take a start at that, and then I'll -- I think I'll pass it over to -- to Mr. DeForest, actually, if he has any further comments.

Like, the -- particularly for Pseudokirchneriella, the -- the first allable species, it also was used in the sulphate trials, and -- and we -- and it's a very, very common species. There's a huge amount of data out there for that, sulphate effects on Pseudokirchneriella or -- or duckweed. And, you know, we're -- we're fairly confident that in these -- these lower ranges -- like, they're actually -- they're not really lower

ranges, but these ranges up into the -- I don't think in our sulphate tests we saw any effects on Pseudokirchneriella, that -- that I would need to go back and confirm against it, but I know in -- it's very common not to see kirchneriella -- or Pseudokirchneriella respond to sulphate.

That doesn't really get at your question, though, about whether or not it might change selenium metabolism, and so maybe I'll pass that over to Mr. DeForest.

A MR. DEFOREST: Yes. Good morning.

Yeah. I don't know too much about the effects of sulphate on algae, I have to admit, so I'm not sure I have too much to add here. I don't know if this is directly related to the question or not, but I think some of the reason we see the levelling off with the increasing sulphate concentration, the levelling off of the relationship with the enrichment function, is that the -- you know, sulphate competes with selenate for uptake, so as those sulphate concentrations get higher and higher, it becomes kind of a limiting step as to how much more mitigating influence you'll see from the sulphate. And just wanted to point that out.

I don't know if there's the possibility that you see a reduction in the enrichment function because of some effects of sulphate on the algae themselves, but,

again, I don't -- I'm not familiar with any studies that suggest that they're highly sensitive to -- to sulphate, so I can't speak to that directly, unfortunately.

Q Okay. And actually, Mr. DeForest, it's great that you jumped in because I want to wrap up this section of questions with a few directed at you, if that's okay. And I want to show something that we saw from you.

MR. O'GORMAN: So, could we, please, Zoom Host, see Registry Doc 89. And when you get in there, look at page --

Q MR. O'GORMAN: Actually, you know what? We might not need to -- I'll ask you -- I'll put this to you. This might be one that we can avoid going to it.

In here, would you say, Mr. DeForest, that -- I think you noted that modelled waterborne selenium and sulphate -- on page 1105 of CIAR 89, did you note that: (as read)

> Modelled waterborne selenium and sulphate concentrations do not substantially vary annually or seasonally.

And that was based on the original SRK modelling done back in the original EIS. I could haul it up, or you can tell me if you agree that that's something you would have --

A I agree. That sounds correct.

MR. O'GORMAN: Okay. So this is what I actually wanted to bring up, Zoom Host. And I'm almost done, folks.

Ms. Court Reporter, we will be taking a break very shortly.

Q MR. O'GORMAN: Let's please look at Registry Document 313 and PDF -- which is Addendum 11, PDF 1191 and also 1192. Okay, this is the figure we looked at earlier.

In Addendum 11 earlier this year, Benga updated modelling results to incorporate hydrology and monthly hydrology and climate change. Now I think we would agree we would see a seasonality effect in here.

You'll notice that there's a fluctuating sulphate --

Can we scan in a bit, please. Yes. 1191 that we're at. Okay.

Sorry, I got a big -- I got a bit off track there.

So is this the figure that shows us the fluctuating --

1192 is the one that I want, sorry. One more page down. Just -- yeah. The fluctuating sulphate-based selenium guideline. Sorry. My notes got a bit screwed up. I guess it could be one -- sorry, both figures are relevant, okay.

Mostly what I want to demonstrate is that in --

Mr. DeForest, in the original work that you showed us, you talked about the lack of seasonality, I think you said, was important and vary substantially annually or seasonally. Now we see some more recent results that were submitted to us that does show considerable swings with the different times of the year, and I wonder if that makes you think differently about your risk assessment?

A MR. HOUSTON: So, Mr. O'Gorman, if I could jump in before Mr. DeForest does. You know, we were asked to create these graphs showing the seasonality or potential seasonality.

I just wanted to point out that there is some flexibility in the treatment system itself. The SBZ, among other things, is a huge reservoir, let's call it, and so the ability to modulate the rate of return of treated water to the environment does exist, especially in the later years. So we can turn up and turn down the -- the flow rate or the pumping rate of the effluent out of the SBZ, and especially in the later years when -- when the volume of the SBZ is -- is so much -- so many times larger than required.

Yeah. I just want to make that point. Not to put too much stock in these -- these lines going up and down. It kind of assumes a steady-state flow out of the SBZ, and that's not necessarily the case.

Q Will you not have a steady-state flow out of the SBZ?
A We don't need to have a steady-state flow out of the SBZ. We can -- we can manage that up and down on a seasonal basis.
Q Okay. But to the extent, Mr. Houston -- and, Mr. DeForest, it's really -- it's directed at you, we did just, you know, earlier this year receive some new modelling results from -- from Benga.
A Yeah.
Q I don't need to haul them back up again, but they did show selenium levels -- potentially concentrations that, at least seasonally, hit the 10-microgeram-per-litre level. And the study that I referred to earlier did, on your behalf, look at selenium concentrations of about 7 micrograms per litre. If -- I think you agree that's -- that's the number you --
A M-hm.
Q -- looked at back then.

You comment on the validity and reliability of your earlier risk assessment conclusions to a world where we're seeing selenium hitting the 10-microgram-per-litre level that these results suggest might be possible?

A MR. DEFOREST: I could speak generally. I'd probably have to look back at the model to confirm that

what I recollect -- and I believe I conducted this exercise after seeing those more seasonal results -- was to understand how that could influence the model.

The sulphate concentrations were similarly fluctuating in a pattern similar to the selenium. So I think in terms of the model predictions, did not -- they did not change substantially because when the selenium concentrations are predicted to be higher, the sulphate concentrations are, likewise, predicted to be higher so that mitigating effects don't carry as -- carries along through -- through the model.

MR. O'GORMAN: I'm going to -- I think that is probably a good point for us to break, Mr. Chair, for -- for a lunch break.

Thank you, Mr. DeForest, Mr. Houston, and everyone else.

We can't hear you, Mr. Chair. No. Your mute is not on, but we're not hearing you. It must be on your end. Is your mic down on the side of your --

Would you like me to relay a message to the assembled masses, if you want to type it to me? I don't see anything from you.

I'm going to assume you're inviting us to take our lunch break now, and that we would reconvene at 1:00. Nod your head if that's what you want. Oh, 12:45.

So our Chair is asking that we take a lunch break

and reconvene at 12:45.

Any business before we close? Okay. Thank you, all.

PROCEEDINGS ADJOURNED UNTIL 12:45 PM

Proceedings Taken via Remote Video

November 21, 2020 Afternoon Session

A. Bolton	The Chair
D. O'Gorman	Hearing Commissioner
H. Matthews	Hearing Commissioner
M. LaCasse	AER Counsel
B. Kapel Holden	AER Counsel
K. Lambrecht, QC	Joint Review Panel Secretariat Counsel
T. Utting	IAAC Staff
E. Arruda	AER Staff
D. Campbell	AER Staff
T. Turner	AER Staff
T. Wheaton	AER Staff
A. Shukalkina	AER Staff
M. Ignasiak C. Brinker	For Benga Mining Limited
R. Warden T. Howard	For Ktunaxa Nation

K. Poitras	For Métis Nation of Alberta Region 3
Chief B. Cote	For Shuswap Indian Band
B. Snow	For Stoney Nakoda Nations
R. Drummond S. McHugh	For Government of Canada
A. Gulamhusein	For Municipality of Crowsnest Pass
M. Niven, QC R. Barata J. Nijjer (Student-at-Law)	For MD of Ranchland No. 66
B. McGillivray	For Town of Pincher Creek
D. Yewchuk	For Canadian Parks and Wilderness Society, Southern Alberta Chapter
R. Secord I. Okoye	For Coalition of Alberta Wilderness Association, Grassy Mountain Group, Berdina Farms

		Ltd., Donkersgoed Feeder Limited, Sun Cured Alfalfa Cubes Inc., and Vern Emard
	R. Cooke	For Crowsnest Conservation Society
	G. Fitch, QC C. Agudelo	For Livingstone Landowners Group
	M. Sawyer	For Timberwolf Wilderness Society and Mike Judd
	(No Counsel)	For Barbara Janusz
	(No Counsel)	For Jim Rennie
	S. Elmeligi A. Morehouse S. Milligan M. Boyce	For Alberta Chapter of the Wildlife Society and the Canadian Section of the Wilderness Society
	J. Gourlay-Vallance	For Eco-Elders for Climate Action
	L. Peterson	For Trout Unlimited Canada

R. Campbell	For Coal Association of Canada
(No Counsel)	For Alistair Des Moulins
(No Counsel)	For David McIntyre
(No Counsel)	For Fred Bradley
(No Counsel)	For Gail Des Moulins
(No Counsel)	For Ken Allred
(Not Present)	
(No Counsel)	For Monica Field
S. Frank	For Oldman Watershed Council
A. Hurly	
C. Forster, CSR(A)	Official Court Reporter

(PROCEEDINGS COMMENCED AT 12:51 PM)

GARY HOUSTON, DANE MCCOY, MIKE YOUL, MIKE BARTLETT, CORY BETTLES, DAVID DEFOREST, SOREN JENSEN, MARTIN DAVIES, LEIF BURGE, DAN BEWLEY, Previously Affirmed.

STEPHEN DAY, NANCY GRAINGER, Previously Sworn

THE CHAIR: Okay, Mr. O'Gorman. Whenever you are ready to resume.

MR. O'GORMAN: Thank you, Mr. Chair.

MR. O'GORMAN: Good afternoon, everyone. Let's, please, Zoom Host, bring up Addendum 10. That's Document 251, Package 5, PDF 50 -- 52.

Q MR. O'GORMAN: So I will start to speak to it. This was a question we had asked you, Mr. Houston, about, essentially: How long will you need to continue to treat water for this project? We've heard a number of estimates raised throughout the hearing, and there's no -- I mean, if I could characterize on your behalf, what I think I've heard you say is you don't have a good sense of that. Do you want -- is that an accurate way to describe how I've heard you, you know, talk about how long you're going to have to continue to treat water?

A MR. HOUSTON: That's right.

Q Okay. So in this document, IR Response 56(c), is that (c)? Right. We were asking you about processing after mine closure, and there's a number in here. If we scan in, please. Oh, it's at the very bottom of the page, where you gave us an estimate of 20 million over 25 years as your plans for continuing -- oh, it's at

the bottom of that, right, page. Is that -- approximately a million a year, is that a -- you know, for 25 years. And at the same time, as you just said through the hearing, you have said you don't have any real, good sense of how long it's going to go on.

So my question is: Given active management and treatment of elevated parameters of selenium and other potential contaminants of concern, it looks like it's going to be required for many decades; otherwise, if they're not treated, resulting in large increases in concentrations of selenium and other parameters over time. Can you tell us why, first of all, in Addendum 10, you came up with an answer to an IR that said it would cost you 20 million over 25 years? Or was the 25-year guess based on then?

A I -- I guess, Mr. O'Gorman, we don't know as much as we will know today, and so to -- to a certain extent, this -- this number is based on, you know, judgment.

I -- I would say that by the time we get to the end of mine life, we will know a lot more in terms the ex-pit back -- rock dumps are behaving. They will have been -- especially in the south, they will have been reclaimed. They will be operating for many years, as will the first phases of the SBZ be -- you know, be operating for many years. And so we'll get a better sense for that, and we'll be able to put a better

estimate on that when we get to the end of mine.

I would also say that if it looks like a bigger number, there would be some motivation to perhaps look at some additional mitigations that could be employed at that stage of the project to reduce that number, so -- but at this point, it's very much, you know, a -- I won't say a guess, but professional judgment.

Q Okay. And I will ask you, Mr. Houston: The number we received in this IR response of less than a million a year, it says at the bottom of the page, that did not include things like a potential metals treatment plant, a potential advanced oxidation process, and a range of other of those kind of thing -- contingencies that, you know, are possible from this project?

A Yeah. No. It's -- it's not an estimate based on operating specific pieces of equipment. It's -- it's really a -- a broad number.

And I would say that if -- you know, if we had a metals treatment plant and a lot of other hardware sitting there, that -- that you'd want to go back and look at the -- the source of the selenium and other things you're treating for and how can you -- how can you shorten that time frame by -- by making some changes to the -- the source of the -- of the issue.

Q Okay. And I guess if the -- it's possible that if you needed to do more than currently planned, the costs per

year, are they the sort of costs per year that might reach the prohibitively expensive stage for a company that's no longer mining that project?

A Again, I -- I think that as we get to this stage of the project and thinking about the Mine Financial Security Program where this number -- or a number very similar to it does show up in our estimate operating for a number of years. So that's part of the estimate that we'll be making and including in our Mine Financial Security Program annual reclamation estimates.

So, yes, as that number gets bigger, then -- then a company -- and even while we're operating, would -- would be, you know, motivated to look at what other measures could be put in place to accelerate that reduction of effort.

MR. O'GORMAN: Okay. And can we look at one last related point, please, Zoom Master. Can we call up Addendum 8? That's Registry Document 89, PDF 181. And I'm not sure if it will be near the top or the bottom of the page. Let's see when we get there. PDF 181, Registry 89. Right, 181. Great. Where is -- there it is. It's the very first thing that we see.

Q MR. O'GORMAN: Mr. Houston, you told us in this package that active management of the surge ponds are expected to be required beyond Year 2100, but it's not possible to reliably estimate the time horizon for

when the rate of weathering and selenium release will diminish to a point where you no longer need to actively manage.

Is that something you agree with?

A I'm looking for the word "2100" here.

Q It's at the very -- your first response at the top of the page, the first sentence of your -- in your response.

A Yeah.

Q Okay.

A So our -- our modelling -- our modelling -- and that's shown in all the graphs -- doesn't show attenuation over time simply because, you know, we haven't got a good handle on how to build that into the model. So the models do project out beyond 2100.

And so it's the second sentence there that I think we'd -- we'd be more comfortable with: (as read)

It's not possible to reliably estimate the time horizon when the rate of weathering and selenium release will diminish.

So that would be the -- the sentence to hang your hat on.

Q Okay. I won't haul up these results to illustrate, but, I mean, I guess I'd ask you if you agree that, yes, you said your models go to 2100. But those models produced results that showed elevated levels of

selenium and other constituents of concern to 2100 as well, at least in your early EIS documents and the ones we just looked at a few minutes ago. So do you support those model results that there's no reason to assume things just, you know, attenuate on their own after 2100 or --

A No. The -- the issue is that with -- without a mathematical relationship, we can't build that attenuation in the models. We do -- we do know, and we see from other examples of other mines, that -- that attenuation or reduction of the selenium loading does occur. It will -- it will -- it will happen. We have confidence it will happen. It's just without having a mathematical relationship we can hang our hat on, we -- we couldn't build that in the models. So the -- the models artificially show this perpetual horizon.

We -- we believe that there is tendency downwards. It's just we can't build that into the modelling.

Q Can I ask to throw one direct question at Mr. Day, please? I wonder if you can tell us: In your professional experience, do you have experience with mines that leach metals for a very long period of time, decades and longer?

A MR. DAY: Yes. Yes, Mr. O'Gorman. There are -- there are examples of European mines that have -- where there's a long history of mining where it

does go on for long periods, but -- but I'm not --
Q Hundreds of --
A Sorry. Go ahead.
Q Hundreds of years in some cases, even?
A In some cases, but I very much caution against comparing those often very high sulphide, highly metallic mines to -- to this project.
Q And I'm not trying to draw direct comparisons beyond -- to that. You know, as a professional in this field, that sometimes -- you'd agree with me, sorry, that metal leaching -- and we're not talking specifically about selenium -- can occur for a long time after mine closure. You agree with that?
A I can agree with that, yes.
Q Okay. Thank you.
Okay. That's good for that group. Thank you, gentlemen. Where was I? Oh, this one.
MR. O'GORMAN: Well, we can, take this down, Zoom Host.
Q MR. O'GORMAN: Okay. Well, Mr. Houston, you just raised the Mine Financial Security Program. So I wanted to have one or two quick questions for you about that, actually. So if we haul -- actually, I don't think I need to haul this up. I put it to you that you said to us in Addendum 8, Registry 251, Package 5. It was --

MR. O'GORMAN: Don't haul this up, Zoom Host.

Q MR. O'GORMAN: But it was on PDF 172, in an information request response. It says in there, and I'll ask if you agree: (as read)

> For the purpose of this exercise, Benga has prepared a hypothetical cost estimate to reclaim the mine site and associated facilities consistent with the intent of the Mine Financial Security Program, MFSP. These calculations are similar to other mining projects that are participating in the MFSP.

Does that sound right? You agree with that? You said that?

A MR. HOUSTON: Yes.

Q Great. Thanks.

Can you explain the methodology used to determine the contingency associated with the cost to reclaim the mine site and the associated facilities?

A So the specific line in the estimate that is labelled "contingency", is --

Q M-hm?

A -- is that -- I think it's just a straight percentage that's applied across the -- the estimate.

And so we -- we should be clear that this -- this is a pro forma estimate, if you will, and -- and that the -- as we go through, year by year, we'll be making

estimates that are based on actual progress and more sophisticated estimates of what -- the cost to reclaim the actual work that has been done. So those estimates will be done year over year and submitted to the AER as part of this program.

Q Okay. So it was a pro forma calculation, but you -- so I guess you're saying the sorts of things that you might need to add on for long-term treatment for a period of time to be determined weren't factored into your initial estimates and contingencies of what might be required and -- to comply with that program; is that right?

A I believe that we did have a line in there for -- let me just -- I'm just paging down here. So we have a line -- are we looking at PDF 5.33-8 on PDF page 180?

Q I didn't even haul it up on my own. We can, if you'd like.

A Well, we've got a care and custody line in there for $22 million, and that's that long-term annual cost that we were talking about.

Q Right. 22 million. Not per year, is it? Or is that what you -- I'm not looking at the number.

A No. That's the outstanding liability at -- at that point in time.

Q Okay. Okay. All right. Thank you.

Okay. Let's talk about the Oldman reservoir,

which is something that we've heard -- oops, okay -- we've heard some interest expressed earlier and through some -- some submissions and we asked you some questions about.

MR. O'GORMAN: We'd like to start by looking at page -- sorry, Addendum 11, Registry Document 313, and PDF 267, Zoom Host, please. One second here.

And the text I'd like you to look at -- do you see in here -- I need to find where it is on the page myself. One second. Right. I think it's the second paragraph that we -- if we're looking at the same thing, we would see -- if you scan in a bit on the top of that page, please, Zoom Host.

Q MR. O'GORMAN: Right. So the paragraph -- the first full paragraph we see says that results of the wildlife risk assessment indicate you applied a conservative application -- oops. My computer is trying to shut me down. I'm sorry. And I need to do something. My apologies, folks. I have this ongoing issue with Citrix trying to kick me out of my system.

Now, I'll allow you to read that paragraph. And it essentially suggested -- technology.

Okay. Essentially suggested that you use the 95th selenium concentration into -- as being .41 milligrams per litre. You see that?

A Micrograms per litre, Mr. O'Gorman.

Q Yes, micrograms per litre. Yes. I apologize. I got distracted.

Okay. So we see you used that value there.

Now I'd like to look at, instead, in -- go back a couple of pages to PDF 265. So, first of all, that value, what was that? Was that the incoming selenium concentration into the reservoir? Can you tell me what that value was?

A Just one minute. I'll -- I'll have to check. That -- that is in the reservoir, Mr. O'Gorman.

Q That would be the value in the reservoir. Okay.

A Yes.

Q So I think it says that you derive that from the water and load balance model results. We think, at least. Page 265 and down at the bottom. Please scan then to see what it says there. No. 265. 265. Okay. 265. There we go. And at the bottom of the page, not the table.

So the project's water and load balance model was used to estimate monthly loadings to Blairmore Creek and Gold Creek. The load estimates were derived from the scenarios submitted back in your original EIS, and then estimates of concentrations in the Crowsnest River -- you can read the text there. So that's all correct in terms of the work that you did; right?

A Yes.
Q Okay. Now I want to look at the same document. Let's go back to 267. Oh, actually, I don't think I need -- so the predicted concentration, we already established, was .41 micrograms per litre in the reservoir from the analysis that you did.

Now I want to go look at what's referred to. It says here that you used these results to inform this. We're going to look at your original EIS, Registry 42, Appendix 10B, please. Going to need PDF 261 and -- no, not that one. That one is opposed to your project, according to that comment that was just displayed.

MR. O'GORMAN: So we're back in CIAR 42, Appendix 10B, Zoom Host. And now -- no, no, no, no. It's the original EIS, so Registry Document 42, and in that Appendix 10B. Okay. And in this, we're going to go to page 261, please. Okay. Down at the bottom of the page.

Q MR. O'GORMAN: So these were the original selenium results that you apparently used, according to what we just read, that shows selenium increasing to a plateau of about slightly less than 7 micrograms per litre after about ten years and then carrying on for some time. Everyone agrees with that?
A Yes.
Q Okay. And then when we got updated modelling results

in Addendum 11 -- so let's go to Registry 313.

MR. O'GORMAN: It's the tab immediately next to it above, Zoom Host, Registry Document 313, yeah. And we're going to look at page 1191, please, which we may have seen before. 1191, yeah.

Q MR. O'GORMAN: And here we see mean monthly selenium concentrations increased to a plateau of between 4 and 11 micrograms per litre year 25 through 80, which is the final modelled year.

You agree with all that too, that this is what this is telling us?

A Yes.

Q Okay. So now we'd like you to help us understand. Could you clarify whether it was the mean or the 95th percentile model results that were used as an input to calculate selenium loadings into the Oldman reservoir? And which model results did you use? Did you use the ones that were shown in the original EIS back in Document 42 or these ones we're looking at right now?

A MR. JENSEN: I'm good to -- can I answer that? Okay.

Yeah. So, Mr. O'Gorman, it's -- for those calculations, what we looked at were the -- were the loadings that were -- that originated from the proposed project area and -- and would then report to Blairmore, and to Gold, to a lesser extent, and then end up in the

Crowsnest and then flow down to the Oldman River.

So what you see here, in fact, is, in spite of these graphs, the concentration calculations would be quite different, and that -- you know, that all goes back to my previous comment on -- on the level of conservatism shown here. The loadings in the two model scenarios are, in fact, the same.

So when we updated these -- at least as far as selenium goes, because, as you recall from our earlier discussion, the selenium loadings are based on mass considerations, so it's based on the presumption of a steady-state oxidation rate of sulphite minerals that then release sulphate and selenium.

So in as far as the sources go, having changed between these two model runs, it still -- it's still -- is true for both model runs that we have a -- have an ever-increasing volume or mass of waste rock that then delivers a, you know, corresponding volume or mass -- well, mass of -- of sulphate and selenium. So the only thing that changes between these scenarios is our assumptions around the timing of release into the environment and the -- the background hydrology. The loadings are the same. They're identical. So --

Q Okay.

A And even the release of the loadings are identical. So it -- anyways, that's -- and also, I mean, when you do

do a comparison, I think the most constructive one to look at is probably BCO1, which is the southernmost point. So that's where all project effects have been realized. So I think in this scenario here -- anyways, yeah. I won't --

Q I don't know if -- Mr. Jensen, I don't know if I heard you say you used mean loadings or the 95th percentile of the loadings.

A I believe we did use the 95th percentile of loadings, but with the -- I'd say with the footnote that when we do the -- there's very little difference in the model between the mean and the 95th percentile because it is all governed by -- by the mass of waste rock. So it really is just a difference in loadings that we might see from, say, natural background or -- which is very, very small. So it -- but it was the 95th percentile, strictly speaking.

Q Okay. Can we please look at -- we're in 3 -- yeah. Can we look at 313, which we're in, and PDF 1310. So this is a nice table. We're going to need to blow it up. And you guys might want to haul it up on your own screens there. These were some results that you gave us in March of this year. 11th row from the bottom should be selenium, if you see "selenium" there. I think you -- now we're going to scan over until we see the Blairmore Creek selenium concentration that was

used.
MR. O'GORMAN: And now we're going to -- that's right, Zoom Host. You've got it.
Q MR. O'GORMAN: We're looking for -- if you keep your eyes on where the Blairmore Creek -- the "selenium" line was, and we scan over to Blairmore Creek, the application value, I'll ask you to confirm --
MR. O'GORMAN: Can we blow it up one more, please, Zoom Host. I've got my eye on the value now, although now, of course, we'll lose it when we blow it up.
Q MR. O'GORMAN: But it is the 4.82 times 10 to the minus 3, would be the value used, according to this table. You see that number there, and you agree that that lines up with selenium, which is now off the screen?
A MR. JENSEN: Yes, we agree.
Q Okay. So we just want to confirm: This is used -- can you confirm that this is used for calculating the concentration entering the reservoir?
A MR. HOUSTON: Just one second. So, Mr. O'Gorman, just give us a few minutes just to formulate an answer.
Q Okay.
A MR. JENSEN: Mr. O'Gorman, I apologize for

the delay here. We are clarifying because this -- these numbers were handed up between various parties that were involved in these calculations.

So, yeah, I mean, this number appears to be consistent with the concentration we first -- you first took us to in Appendix 10B, where we showed that the concentrations of BC01, the downstream-most point in -- in Blairmore Creek, were slightly less than 5, as you pointed out.

And as -- as I testified to in my previous response, is -- well, yeah, that's the concentration measurement. What we're really interested in, when it comes to estimating effects on something like a reservoir, are the loadings. So we could have put a different number in here. It wouldn't -- you know, that, perhaps, would have been reflective of maybe, perhaps, the maximum concentrations that we've reported elsewhere. But it -- the loadings would have been identical. The model -- there's no changes to loadings in the model. So it's -- it's a little bit of apples and oranges we're looking at here.

Q Well, I guess, Mr. Jensen, this is the table you gave us to inform this assessment that we -- that you did when we asked you about the potential for risks in the -- in the reservoir, and the -- you know, you read the line a minute ago that said you used 95 --

95th percentile.

A M-hm.

Q Are you saying that that value, if it's -- you know, it's -- it's about 5 in the graph, and the graph we looked at earlier, that the mean is basically about the same as the 95th percentile? I'm not sure. Just -- we couldn't understand the calculation basis to -- and is this -- here's the question: Did you use a conservative value to calculate what the projected concentration will be in the reservoir?

A Yeah. Can I -- yeah. So, yes, I mean, we did. It's worth noting, though, when you -- we have to be precise about what we're talking about here, because I'll just restate: When we look at potential effects to a reservoir like the Oldman reservoir -- I won't say it again, I promise, but it -- we're looking at loadings. So what concentrations -- whatever they happen to be at any given point in time will tell us -- when we multiply that by flow, will tell us what the loadings are at that given point in time.

But when you say the 95th percentile in -- my interpretation of -- because that's what matters here. My interpretation of what we need to look at is: What are the 95th percentiles of -- of the cumulative loadings over that time? And so that's precisely what we looked at.

To -- to look at the 95th percentile of concentrations at any one given point in time would -- wouldn't give us any meaningful result at all. Like, it -- so -- so I'm not disputing that -- that we issued this table, but what I am saying, what we perhaps should have done is -- is to put the loading in there that -- that we estimated and clarified that that's the 95th percentile. I think that might have been list --

Q I mean --

A (INDISCERNIBLE - OVERLAPPING SPEAKERS)

Q Yeah. Mr. Jensen, we asked an information request for you to think about what the potential impact on the Oldman reservoir would be. You gave us this information --

A Correct.

Q -- that we are, I will admit, having a hard time figuring out what you gave us.

A So --

Q You should have given us loadings, maybe.

A Sorry.

Q Maybe you should have given us loadings.

A MR. HOUSTON: Can we just take a minute to confer again, Mr. O'Gorman, just --

Q By all means, please.

A So, Mr. O'Gorman, we're just trying to find a better way to explain this. So this number, the 4.82 times

10 to the minus 3, that -- that is from the original filings. And as Mr. Jensen mentioned, the loadings that inform that number are -- haven't changed. What has changed in the -- in the more recent information is that we were asked to project the loadings on a -- I think it was a monthly time step. So you get that -- the line that is -- well, it's more spurious, let me say.

What's important here is the loading. And if you take the loading -- or the 4.82 and multiply it by the -- the amount of flow from Blairmore Creek associated with that calculation, then -- then you get how much selenium that -- the actual loading of selenium. And -- and so that's what's been done here with these numbers. The loading's the same, and the concentration -- perhaps we shouldn't have put concentrations in here. Perhaps we should have put loadings. But we -- the concentration needs to be related to the flow rate and the appropriate time scale for that flow rate. So if it was an annual average flow rate that led to the 4.82 times 10 to the minus 3 concentration, then you have to multiply 4.82 times 10 to the minus 3 times the annual average flow rate to get the loading. I don't know if that's a clearer explanation.

Q That's fine for now. Thank you, Mr. Houston and

Mr. Jensen.

So I will go to my next set of questions about this issue. So can you tell us -- and I'm not sure who would be the right person, but I would appreciate it from one of the experts, please, Mr. Houston. Can you give us your estimate of what selenium concentration in the Oldman reservoir would be the threshold above which you would have concern with respect to the accumulation of selenium in fish muscle or egg or ovary tissue?

A MR. DEFOREST: Mr. O'Gorman, I think I can help answer that question.

Q Okay. Thank you.

A This is David.

Well, I mean, we can start with existing selenium kind of line values, I think, as a starting point for answering that question. We talked about the -- the BC, as adopted by Alberta, guideline of 2 micrograms per litre. That's intended to be protective of highly bioaccumulative sites, which includes lentic water bodies, such as a reservoir. And so even just to look at other values, I think we also talked about, sometime during this process, of the 1 microgram per litre being used as an alert concentration, which I would consider to be a -- quite a conservative value for the -- for water and dense protection of the accumulation of selenium and fish tissue levels into fish tissue that

could be at levels of -- could be of concern for toxicity.

And just to put another data point out there for a comparison, just -- I refer to the US Environmental Protection Agency has developed water base selenium criteria of 1.5 micrograms per litre for lentic waters and 3.1 for lotic waters, but -- so USEPA had a lentic criterion of 1.5 micrograms per litre.

In my opinion, I think those are protective values for lentic water bodies. If I -- I'm referring to the EPA number of 1.5 just as one point of comparison, just given the nature of how they did the calculation of that criterion value, which was based on compiling data from a relatively large dataset of field data from lentic water bodies with varying selenium exposure conditions and which -- some of those sites included reservoirs. And so based on that evaluation, that -- went into how they developed that lentic criterion of 1.5 micrograms per litre.

So just -- I guess to summarize, I think -- you know, I think the waterborne selenium criterion -- criteria or guidelines for -- in the order of 1.2 to 2 micrograms per litre are -- are conservative protective values.

Q In that type of environment, lentic environment?

A It's, yes, in a lentic environment.

Q Could you envision, Mr. DeForest, circumstances where there might need to be lower guidelines than that range you spoke about to be protective? In particular, I guess I'm wondering if you think there are, you know, mechanisms that play in reservoirs that might trigger the need for more conservatism?

A Well, there clearly are conditions in -- in reservoirs and lentic water bodies, in general, where you can have increased selenium cycling, the higher producing conditions (INDISCERNIBLE).

THE COURT REPORTER: I'm sorry. I'm having a hard time hearing you.

A MR. DEFOREST: Yeah. I apologize.

Let's see. Where I was at, I think, was there are conditions in reservoirs and lentic water bodies, in general, due to the longer selenium residence time and -- and cycling within those systems in the potentially increased reducing conditions, biological productivity. And in some cases, that can all contribute to higher selenium bioaccumulation potential.

It can be trickier in some reservoirs with -- with drawdown and how that contributes to biological productivity in selenium cycling, but whether that supports a more conservative value, I don't necessarily think so. I -- I tend to think of the -- the most sort

of high-risk systems being more stable, productive wetland-type environments that -- where maybe more conservatism would sometimes be warranted.

So I guess for Oldman reservoir, I'm not familiar with any -- any aspects of that reservoir that, I guess, would make me rethink whether a criterion or guideline on the order of 1.5 to 2 micrograms per litre would not be protected.

Q Okay. Thank you, Mr. DeForest.

MR. O'GORMAN: I'm going to call up something, please, Zoom Host. So 313. So we can -- okay. We're in 313. Let's go page PDF 269, please. Maybe let's look at the full page here.

Q MR. O'GORMAN: So there's a statement similar on this page. I don't remember if I saw this at the top or the bottom or the middle of the page. But maybe while we're looking for it, there is an assertion that we would expect selenium concentrations in the Oldman reservoir to diminish with time, and I guess I'm curious when -- we won't go back to look at the modelling results we've seen several times, but they did not show selenium concentrations coming from your project into the Blairmore River over a long period of time. And those were not shown to decrease; they stayed at a plateau.

So what's the basis for the statement in here?

Unfortunately -- someone help me out here. Is that -- where in this page -- but I'll -- you make the assertion that you'd expect to see them diminish over time? And I guess I'm curious where that comes from.

It's at the very bottom of the page -- I just got a note -- if we need to direct your eyes.

MR. AGUDELO: Mr. O'Gorman --

MR. O'GORMAN: 269, yes.

MR. AGUDELO: It's in the last bullet point of that page.

MR. O'GORMAN: Great.

THE COURT REPORTER: I am sorry; who was speaking there?

MR. AGUDELO: This is Cesar from the Livingstone -- or, sorry, Mr. Agudelo from the Livingstone Landowners Group.

A MR. HOUSTON: So, Mr. O'Gorman, I would suspect that's the same -- same discussion we had just a little while ago that although we have not built any degradation or diminishing aspect of the selenium loading in our modelling -- and that discussion you remember well. So I think this is the same -- same kind of statement that we -- we would expect that, as time goes on, the -- the loading in Blairmore Creek and -- and, therefore, the loading downstream would reduce naturally.

Q MR. O'GORMAN: Okay. I mean, as a general point, Mr. Houston -- and we had quite a few of these results, and we're going to talk about some of them a bit more as well.

But you had quite a few different modelling results for different parameters of concern that we asked you to consider. We certainly -- an element of what we need to consider for this project are not just what happens through the -- through the operation of the mine but in the period once the mine is closed.

So, I mean, as a general point, I'm not hearing you express a lot of confidence in the results that you developed and gave us to help us think about a whole range of different modelling projections into what's going to happen in the future, because we -- we can't make these up ourselves. You gave us results for -- and I'm, you know, not even pointing out specific ones, but long-term selenium, for example.

So help me understand if you have a lot of confidence in the results that we have for your -- the long-term modelling that we need to evaluate and think about. What happens when your mine is closed?

A So we have modelled, on a conservative basis, showing no attenuation over time. We have seen at other locations that there is attenuation. Logic tells me that there will be attenuation. I'm just -- it -- it's

not possible for us to put a time frame on that or to, you know, define it mathematically and model it. And certainly I agree with you to -- to defend, you know, that it would be one time frame over another.

So what we've committed to is -- is to maintain the site, the selenium-treatment equipment, and -- and water management until it's self-sustaining. And so that -- that may be a longer time or a shorter time. That's our commitment here, Mr. O'Gorman.

MR. O'GORMAN: Okay. Can we scroll to the top of the next page, Zoom Host, and go to the continuation of that bullet. You did it by accident earlier but -- 270, right. Is that ...

Q MR. O'GORMAN: That bullet that does talk about your expectations for the long-term decline of loadings or concentration in the reservoir makes reference to historic mines, and I think you were asserting, if I understand this, that historic mines gave you evidence of -- can you explain what you are trying to tell us on this? You know, it scans over two -- it spans over two pages, unfortunately, but what does -- what is the historic mining evidence telling us?

A MR. HOUSTON: Thank you for raising that.

No. The fact is that this site has had mining go on. And that was back in the '60s, as we've discussed.

And there -- there is waste rock as a result of those -- those activities, and -- and yet the -- the selenium that we see in -- in the water from the site is -- is not as high as you would have expected to -- to see from those mine waste sites.

We don't know what it was back then. We don't -- you know, we can't say that it's gone from 'X' to 'Y', but it does seem that that site has, over time, found its way to a -- you know, selenium loadings that are -- that are less than what we are projecting for the new mining activity.

Q And --

A It's qualitative, Mr. O'Gorman. I understand that. Absolutely, it's qualitative, yeah, information.

Q No, I get that. I appreciate you have to do -- you do have to try and come up with information, and I hope you appreciate that it's our job to think about it and try and understand it and get you to explain it to us because if -- if you draw the reference to the historic mining, I mean, I think could -- could I assert, and you'd agree, most of the historic mining there was underground and there were a few years of -- I think it was just a few years -- I'm working from memory -- of surface mining that was a pretty small fraction of the footprint of what your project would be. So would it be possible -- so, first of all, do you agree with

those two things that I just asserted?
A No. And, absolutely, we're going to be.
Q Okay.
A Disturbing a much larger site than -- than what was disturbed, yes.
Q Okay. For the record, I think when you said "no", you weren't disagreeing with what I said, were you?
A No, no. I was agreeing with you.
Q Okay. Okay. And we don't have the data from what selenium used to be. So this whole idea of reversibility -- and we're thinking about what happens to the Oldman reservoir over time -- there's not good -- it's qualitative rather than quantitative demonstration of that concept that you are offering us; is that right?
A That -- that's correct.
Q Okay. Will you commit to monitoring selenium or funding monitoring by others in the Oldman reservoir?
A Yes, we would agree to that. I -- I'm thinking of a seasonal monitoring, Mr. O'Gorman, as opposed to a daily monitoring.
Q Monitoring a general -- it's just, you know, how -- however your response or details, I agree, could be worked out.

How about collecting starting-point baseline selenium date prior to construction --

A Yes, we could --
Q -- as a part of that monitoring?
A We could do that, yes.
Q Okay. Thank you for that, Mr. Houston and others. Those are my questions on the Oldman reservoir.

I've actually gone, this afternoon, faster than I -- I thought I would at -- okay.

Yeah, let's ask this: I just have a couple of questions for you about the end-pit lake.

We heard big picture, over the course of this hearing, compared to the different iterations of things we have on the record over time. I think you would agree we have seen some of your proposals for what happens -- what does the end-pit lake look like, where does it flow, all of those sorts of questions have been a -- is it fair to describe them as a bit of a moving target over the iterations of submissions and questioning we've received and questions we've asked, and including into today's -- this week's hearing?
A I don't think it's a moving target so much, Mr. O'Gorman, as we had proposed in our original submission an option to have an outfall into Gold Creek. That was set aside after we had more work done on the instream flow needs, which -- which was filed in 2017. I don't think we, at any point, connected those two. I don't think at any point we said, Oh, we don't

think we need that option anymore. And -- and so that's come out more clearly in -- in these proceedings, but -- so I don't know it's a moving target or just we're all -- we're all getting onto the same page.

Q Okay. I didn't mean to say "moving target" in a pejorative sense. I -- if you interpreted it that way.

I do feel like pointing out, though, that as recently as just over a year ago -- I'm going to put this to you, and hopefully we don't have to haul it up. But in August 2019, in Registry Document 251, which I recall being Addendum 10, we asked you questions about the end-pit lake, and at that time, considerably longer -- later than what you just told me, when you decided to not proceed with this as an option, you gave us an answer in there, and it was on page -- where -- what page was it on? We did ask you about the end-pit lake, and we had an answer that it would drain into Gold Creek back in August of 2019.

And I guess I wanted to -- can you tell us why at that -- so, you know, coming into preparing for this hearing, we actually thought we might be asking you to explain a bit more clearly the discrepancy between that answer and then in Addendum 11, when you told us you weren't doing that?

A I -- so I would call that a quality control issue on

our side that we -- that we shouldn't have said that in 2019.

Q Okay. Okay. Fair enough. Those things can happen.

And so to confirm -- however -- right. There was something -- the reason why I even raised this, to confirm what's been discussed this week, I'd like you -- will the final design of the end-pit lake include horizontal drains to Gold Creek? And I'll tell you why I'm asking even before you answer, is because it seemed to us, listening to some of your earlier testimony -- and I don't have the reference to the transcript, but it seemed like you held onto this as a potential option. So I'm asking: Are you holding onto the option that the end-pit lake drains to Gold Creek, or is it not going to drain to Gold Creek?

A Our current proposal does not include it draining to Gold Creek, Mr. O'Gorman.

I think I -- I recall the discussion that we had, and -- and it was one of those hypothetical questions: What if? What if? What could you do? And at that point, I did say that, well, we could reinstate that kind of idea if -- you know, as one of the potential solutions, but it's not our current proposal to drain to Gold Creek.

Q Okay. So it is alive as an option for the future?

A I would expect we'd have to have a long discussion with

the Regulator before we implemented that.
Q Okay. Can you confirm whether or not the plans are that the end-pit lake, if it has -- if that seepage from the end-pit lake would flow towards Gold Creek?
A One minute. You're thinking about seepage from the base of the pit lake, not -- not the decanting that we talked about --
Q Correct.
A -- the other day?
Q Correct.
A Yeah. One minute.
Q Correct.
A I'm sorry. Sorry for the delay, Mr. O'Gorman.
Yes, we've modelled some seepage out of the end-pit lake into Gold Creek.
Q What sort of -- what's the anticipated travel time/residency time? How long does it take the water to get there, underneath that bed of rock?
A I think we have the fast answer and the precise answer. Let me -- let me get you the precise answer.
Q Fair enough. Although, at this point in the day, maybe the fast answer would be better. Sorry.
A Let's say in the order of a year -- many months to a year. Yes.
Q Great. Thank you, Mr. Houston.
MR. O'GORMAN: Zoom Host, can we please take

a look at Document 313, Addendum 11? It's a response to one of our -- our IRs, PDF 1219. That's it.

Q MR. O'GORMAN: So here we see, Mr. Houston, some model results you gave us. Year 0 is start of construction. We're looking at selenium concentrations in Gold Creek at different nodes. At the highest node, which is GC02, starting in about Year 20, your modelling produces a dramatic uptick -- not dramatic, sorry, I shouldn't use an adjective like that. But we start suddenly seeing some readings at GC02 of selenium levels in Gold Creek that increase out through time. We've just talked about sort of your long-term modelling. This is starting, you know, relatively long into the life of your project but then carrying on for some time. I wonder if you could just -- and I will also point out that, you know, if you look at the peak of that curve, it gets up to pretty much today's current allowable levels for selenium, right, of 2 -- 2 micrograms per litre; is that all -- you agree with all that, my reading of that graph?

A MR. HOUSTON: Yes.

Q Okay. Can you confirm that those results are representing -- or at least including the effect of uncaptured seepage from the end-pit lake through groundwater pathways but -- well, (a), that much?

A Yes, I can.

Q Okay. And is that the main driver of why you'd see selenium in Gold Creek?

Sorry, I'm going to correct that question: Is seepage, not just from the end-pit lake but potentially also from the central rock disposal area, the main drivers for why you would eventually see an increase in selenium in Gold Creek?

A MR. JENSEN: Yes. So, Mr. O'Gorman, it is. I can -- I can confirm that it does include seepage from the end-pit lake, but what you see there, the dramatic influx in concentrations corresponds to the time that we estimate that waste rock would be wedded up to field capacity. So at that point, we start to see seepage reporting from the waste rock mass itself and that report to the -- you know, start to migrate down towards the -- specifically for the central rock dump towards the southeast surge pond.

And so what you see there is the effect of that relatively small seepage bypass that we -- that we modelled bypassing that. So the seepage takes a route from the waste rock, down towards the southeast surge pond, and then the bypass you see at that location; that's what's -- end up reporting to -- to GCO1 -- 02 and GC01. And so that -- it's the effect of that bypass that's -- that predominates here.

Q Sure. And, of course, that seepage from the central

RDA, which is the one that -- and, actually, we might even look at a figure of this later but -- as a bit of foreshadowing, you expect that the CRDA drains towards Gold Creek. That is also, in your contact water capture modelling, the one that you set at an estimated 98 percent efficiency of capturing contact water flowing from there and not making it into Gold Creek; is that right?

A Yeah, that's right. Well, we are saying that that's the performance that's required between attenuation and seepage capture. Yes, that's correct.

MR. O'GORMAN: Okay. Okay. That's -- that's good for this graph, Zoom Host.

Q MR. O'GORMAN: I'm going to ask if I can ask you to agree with the -- my assertion that in the early modelling results from the original EIS back in Document 42 for long-term selenium concentrations in Gold and Blairmore Creeks that that we saw -- I really don't want to have to find the reference, but do you recall that in those days, when you did the modelling, you planned for there to be a bump from selenium -- of selenium from the end-pit lake into Gold Creek in later years, post closure? Does that ring a bell, or do we have to go look for it? It was in Appendix 10B of the --

A MR. HOUSTON: Yeah. Yeah. And that -- that

was that -- that outfall from the end-pit lake that -- because the numbers were slightly higher in that earlier modelling as well.

Q Right. It did. It got up to -- I'm working from -- I'm literally working from memory, but I think it hit .2 -- so two five or something.

A Yeah.

Q Okay. So here's my question: Now that you have the end-pit lake decanting into the SBZs, eventually making it into Blairmore Creek, would you expect to see long-term post -- have you done any new modelling, or would you need to, to reflect the now additional loading of whatever selenium might be in the end-pit lake working its way through the SBZs and ending up over in Blairmore Creek in the long-term post-closure period? Not just selenium, for that matter, but other contaminants?

A Yeah. Yeah. All the newer modelling has the water flowing in the right direction, so we -- we have included that in the more recent modelling that both -- not putting that water into Gold Creek and accounting for the decanting through the SBZ. So that has been included.

Q So it has all been accounted for, you're saying. Okay. Well, that's fair enough. I'll move on from that group of questions. Excuse me.

And where am I going? Right. I'm going here. What time are we at? 1:58. I think I'll get through this, and after I get through this set of questions, I might ask for a break to recalibrate on where we're at.

I'm going to continue to talk about the end-pit lake. Well, can you just give me 30 seconds, please? I just want to clarify something.

MR. O'GORMAN: Okay. You know what, Mr. Chair? Can we take a ten-minute break?

THE CHAIR: Certainly. It's 2:00, so let's resume at ten after 2.

(ADJOURNMENT)

THE CHAIR: Okay, Mr. O'Gorman, continue whenever you're ready.

MR. O'GORMAN: Thank you, Mr. Chair.

Okay. We are getting to the home stretch, folks, so...

I'm going to ask you a few questions now about groundwater, in case people thought that we were -- the groundwater folks thought that they would escape unscathed.

Zoom Host, can we please look at Addendum 11, Registry Document 313. And we're going to look at PDF 175, at the bottom of that page.

Q MR. O'GORMAN: Okay. So at the bottom of the page and then it spills over onto the top of page 176,

midway. I'll let you read that -- the first bit.
MR. O'GORMAN: Zoom Host, you can -- you can jump probably to -- to page 176, the next page, so we're able to continue reading.
Q MR. O'GORMAN: While I suggest that in this IR response, you suggested some potential investigative techniques to minimize --
MR. O'GORMAN: Show the top of that page, please, Zoom Host, sorry, so that it continues from the previous one.
Q MR. O'GORMAN: You suggested some potential investigative techniques to minimize seepage from the SBZs through things like site-specific characterization of fracturing, including seismic refraction profiles, lines of ground-penetrating radar, and use of drones to identify fractures.
Do you guys agree with that?
A MR. HOUSTON: That -- that's what we identified in this response, yes.
Q Great. Thank you.
MR. O'GORMAN: If we scroll down just four pages, Zoom Host, to 180.
Q MR. O'GORMAN: So a few pages later, you did state that the -- if you -- on here you should see basically you're telling us the final locations of your monitoring wells are going to target preferential flow

pathways, including more permeable fractures and bedrock zones to attempt to maximize the effectiveness of the monitoring program and particularly to early -- for early detection of adverse effects. Is that right?

A Yes.

Q Okay. And we're curious whether -- I'm sorry -- we're curious whether you're committing to employ some or all of those techniques you listed in that list we just discussed to characterize fracturing prior -- prior to finalizing the location of the monitoring wells.

A So yes. And I think what's important is that we're going to do what is practical and effective once we get into that stage. So once we've removed the -- the organics and cleared the way, so to speak, then we're going to use the techniques that we consider most effective to assess any fracturing in that -- in that area.

Q So you don't know which techniques yet, or do you know which ones you will -- you will commit to doing?

A MS. GRAINGER: Good afternoon, Mr. O'Gorman. It's Nancy Grainger.

There would be a combination of surface mapping of the fractures and then also borehole examination of fracture features, specifically looking for where we can see -- excuse me -- evidence of flow along fractures, and that's what we would be targeting in

groundwater monitoring.

Q Okay. And --

A I don't know if that's helpful.

Q Well, we'll carry on then, regardless.

I guess I'm curious to know about your -- Ms. Grainger, maybe this would be best for you. Tell us about your confidence level that the techniques you will use will successfully allow to you identify fracturing around the SBZs?

A Well, the downhole technologies are what I'm specifically interested in, so advancing boreholes and then either using flow meters or packer tests to look at where we see groundwater movement occurring in those boreholes would be -- and then we would target those zones specifically for monitoring.

The initial mapping from the surface, which I think was what we looked at initially, would give us indications of the primary orientations of the fractures that we would be looking for in the boreholes.

Q Okay. So that wasn't really what I asked. I'm curious about your confidence level that things like the GPR, the ground penetrating radar; the drones; the seismic refraction profiles, that those will allow you to find the faults?

A Mr. O'Gorman, I -- yeah, Mr. Youl is going to provide a

response.

A MR. YOUL: Yeah. Good afternoon, Mr. O'Gorman.

Q Good afternoon, Mr. Youl.

A Well, it's morning here.

Q Oh, right.

A Early morning here.

But we've had some good success with ground-penetrating radar across the site. We've used this on the rail loop as a supporting piece of information to the -- to physical bore lots, specifically looking at the different layers of sediments below the topsoil and organic layers, so the -- the siltstones, the sandstones, down to hard bedrock. That technique has been quite successful in -- in identifying those layers.

We've also used it across profiles -- across the raw water pond, helping with the information on the design of the dam wall and the foundations of that dam wall.

And we've also used it over -- I think I talked about this earlier -- the underground -- some of the underground workings, highlighting cavities and previous workings.

I should point out the company we've used for this does a lot of archaeological work, so they've got a lot

of really interesting experience. And what we haven't tried yet is three-dimensional ground-penetrating radar, so that's on our list of things to do going forward so -- specifically looking at the underground workings. And then once we clear the vegetation topsoil off the surface of the dumps or the dump areas, we would be looking to do some fieldwork with our geologists, so field mapping, isolating where the formations change, and then some judicious use of shell or penetrating boreholes and possibly augmented with ground radar.

So we're pretty confident, with the tools we've got, we'll get a good understanding of the fracturing and potential groundwater pathways.

Q Okay. Thanks, Mr. Youl. And, actually, I was going to turn to you next.

I could haul up the transcript, or you could save us all the time and tell me whether you remember not, so very long ago, discussing ground-penetrating radar with Mr. Yewchuk from CPAWS. And I think that conversation took place on November 16th.

A I'll take your word for it. Yeah.

Q He was asking you about whether you found historical mine tunnels on the site. And I can read from the transcript, and you tell me if you would have said: (as read)

A technique I was very interested in a few years ago was ground-penetrating radar, and we've used that over part of the initial pit area with considerable success, shown the areas have actually been partially mined.

You also said: (as read)

We've used GPR to identify areas of primary extraction and also areas where we've seen secondary recovery where sections of the seam have collapsed.

So does that -- do we need to haul it up, or do you agree that that's --

A No, no, no. I remember that. I pretty well remember that word for word, yeah.

Q It was word for word.

Okay. I wonder if you -- so our groundwater expert picked up on that and the relation to some of these -- what we were told here about GPR, in particular. If you can tell us, when did you do that on-site GPR work, Mr. Youl?

A From memory, we had -- we've had a couple of very short trials. They lasted a couple of days to a week. From memory, probably late 2017 into 2018, about that time period.

Q Okay. So I guess I'd like you to explain this --

MR. O'GORMAN: And if we can call up Addendum

10, Package 5. It's Registry Document 251, and it was a response to -- a response to IR 518. So Addendum 10, Package 5, PDF 111. So it's at CIAR 251, package -- yeah. Great. And PDF 111.

Q MR. O'GORMAN: So here we had asked you an IR about groundwater -- about groundwater transport and various other things. And at the bottom of the page, it starts with "with regards".

MR. O'GORMAN: So if we can blow up the bottom of the page, please, Zoom Host.

Q MR. O'GORMAN: And I could have also read, actually -- I skipped some of your transcript, but you did talk about identifying, Mr. Youl -- Mr. Yewchuk was asking you about identifying some of the -- I probably should have read this as well, identifying some of the old underground mining tunnels; that was a part of that conversation you had with him.

So I guess, you know, you talked about in this IR response -- well, can you just -- can you indicate for me whether information that you gathered from some of your ground-penetrating radar activities were used in developing this IR response, which came in 2019?

A MR. YOUL: I'm just quickly scanning through it. No, I don't believe it -- it was. The ground radar program was -- had a very specific focus. It wasn't so much groundwater. It was foundation

engineering for things like the rail loop and the dams and also trying it on the underground workings, which was an add-on, given the interesting information we were getting from the -- the foundation engineering work.

So it wasn't specifically targeted to groundwater, but I think going forward this could be a tool. It's not my area of expertise, but certainly looking at the refraction profiles that the surveys produced, there was a lot of useful information there. It needs a lot of filtering in -- you need really specialized people to interpret this data. But, yeah, it shows promise; that's for sure.

Q Okay. Ms. Grainger, do you know whether this is something you guys are planning to do? Is that your area of expertise?

A MS. GRAINGER: Unfortunately, it's not my area of expertise, so ...

Q Okay. Okay. Well, we can carry on. I chuckle whether I should call up this bit of transcript. This is ...

Actually, let's go ahead and call up -- it's on CIAR 313, so Addendum 11, on page 176. Yeah, very close to here. So before we agree that -- actually, no. Scan in a bit.

Mr. Houston, I actually didn't write down the transcript reference, but I'm going to ask if you

recall earlier this week -- I think you were in a conversation with Mr. Secord at the time, and I think he brought up, in a question to you, the idea of grouting, and you had a bit of a conversation about grouting. Should I find that transcript reference, or do you remember that there was some conversation that -- it wasn't a very definitive conversation about it, but do you remember that?

A MR. YOUL: Yes, I do.

Q I think it was Mr. Houston, actually.

A Sorry. I --

Q Mr. Houston?

A MR. HOUSTON: We -- I can't remember the specific reference. No, I can't -- I can't recall it exactly.

Q Okay. Well, at the time -- I will -- here was what I determined: Watching that exchange, you looked a little bit surprised at the -- when he brought up grouting. That may or may not be the case, but I -- this is where I remember reading about grouting, is that you folks on here have suggested in this IR response that one of the -- one of the things that you might do to deal with -- where is it on this page? It might be lower on this page, please.

One of the things that you considered --

A It's -- it's just above (b) there, if I -- it's the

point -- the bullet point just above (b).
Q Right. Right.
You suggested in an IR response to me that, if I -- if I understand this right, that you might consider to address faulting in the base of the -- in the pit, in the floor of the pit, sealing the -- the, you know, fractures by potentially, you know, some sealant or grouting. Is that right?
A We -- we talked about -- that we would look at that as a possible way to minimize seepage by grouting if -- if it's determined that that is something that could be done effectively.
Q I guess I'm curious: Do you have any examples of coal-mining operations that grout the floor of their mine pits to prevent seepage? Do you have any examples of that --
A No.
Q -- that you know of, Mr. Youl? Mr. Youl, have you ever seen that in coal-mining operations or any mining operations? Obviously, we're not talking about grouting and sealing dams; we're talking now about the floor of your pit.
A MR. YOUL: I haven't personally seen it. I have spoken to people who have been involved in mining through underground workings, and they've used that -- a pumped grout where there's, I guess, a lot

more common surrounded volume of grout they need, but I haven't seen it used in a more, I guess, broad sense under a dump, that sort of thing.

Q Yeah. I guess we're wondering -- go ahead. Sorry.

A MR. HOUSTON: No. I was just going to add, Mr. O'Gorman, that one of the things we've talked about from the get-go with this project is that we're not talking about the historical practices. And recognizing that selenium and -- and water management is one of the foundations of this project, we're -- we're looking at doing things possibly differently than they have been done in the -- in the past. So I -- you know, I -- what was done in the past may not necessarily dictate what's done in the future, I guess, is what I was going for there.

Q Okay. Well, anyway, I just wanted to ask a little bit about that.

I will ask groundwater questions here.

MR. O'GORMAN: Could we please, Zoom Host, call up -- we're on 313 still -- sorry, Addendum 11. Let's look at PDF 311. Let's look at the bottom-ish of that page.

Q MR. O'GORMAN: So we're looking -- focusing in on the south rock disposal area and the central -- yeah, that works. So I think we see that the two large formations we're all familiar with now of the central

and the south RDAs here; right? Everyone can see that, or Mr. Houston?

A MR. HOUSTON: Yes.

Q Great. So you'd agree that the -- both of those are relatively close to Gold Creek?

A Yes. They're on the east side.

Q Right, the east side.

The dotted blue line that starts at the bottom and we can follow it up, that's sort of a dividing line between which direction that groundwater is going to flow, and it's the line that, you know, tracks up -- actually, only a tiny bit of the SRDA is on the east side of it, but then the central -- it continues up and goes to the central RDA. And a healthy amount, let's call it, of the central RDA is on the east side of that -- that groundwater flow line; is that right?

A Yes.

Q Okay. So this figure shows proposed monitoring well locations. Sorry. And also, it shows, I think you'll agree, the southeast surge pond, which is the big purple blob next to Gold Creek, and we've talked about that before.

So we're seeing three monitoring wells on here. We see right next to the southeast surge pond MW19-16-7; right?

A Yes.

Q And then there's MW14-1 and 11-1 that are a little bit -- relatively near, MW14-1 at the bottom and 11-1 sort of on the upside of -- of the surge pond, if I can characterize it that way. Does that makes sense to you?
A Yes.
Q Okay. So I've covered that.
And I do want to also now look at a different picture, which is going back to the original EIS, so CIAR 42 and Consultant Report 3, please. And we're going to look at page 12 -- 112. So the original -- yeah, CIAR 42, Consultant Report 3. Registry Document 42, Consultant Report 3. Is that where we are, Consultant Report 3?
A I think we're in the wrong document here.
Q I think we are as well.
MR. O'GORMAN: So, Zoom Host, we're looking at the original EIS, Registry Document 42, within that Consultant Report 3.
A MR. HOUSTON: Is it the map of predicted groundwater travel time that you're looking for?
Q MR. O'GORMAN: It is. It is the map of predicted groundwater travel time on PDF 112, yes.
Mr. -- I mean, Mr. Houston, you obviously have the figure there in front of you?
A Yes, yes.

Q So I guess can I ask you: Although that figure is for long-term closure, it does illustrate the residence times, right, for the -- for groundwater flow to -- how you would characterize it -- to make it from that point to outflow in a stream?
A Yes.
Q Is that the idea?
A Yes.
Q Okay. Do you believe -- although that diagram was for long-term closure -- there's the picture -- do you believe that -- during operations that the residence times would be appreciably different?
A One minute, Mr. O'Gorman.
A MS. GRAINGER: I can answer that, Mr. O'Gorman. Yes, I think the residence times would be different during operations. This is the long-term closure scenario.
Q Thank you, Ms. Grainger.
How did you say my last name?
A "O'Gorman".
Q Good.
A I think I misspoke before, and I apologize.
Q Well, Mr. Niven weighed in on the -- his preference for Scottish surnames over Irish ones. I almost interjected at the time to have him removed from the hearing. I chose to ignore it, but I do feel an

importance and attachment to the 'O' in my surname.
A I'm sorry.
Q Okay. That was in jest, obviously, for the record.
Okay. So having demonstrated those -- and lost my place, of course, while I was joking. So we don't -- the southeast portion of the mine footprint, relatively short predicted residence times in groundwater, yes? In fact, the reddish blob that we see in the centre of that picture is some of the shortest potential residence time, and that's pretty close to where the surge pond -- the southeast surge pond would be sort of close, at least; right?
A That's correct, yes. And the red is 0 to 10 years.
Q Right. Obviously, we all know by now that Gold Creek is a sensitive surface water receptor in the same area; correct?
A Correct.
Q And -- oh, sorry. All right. Also, we've heard the adjacent landowners to the mine permit that are on that side discuss their concerns.
So now if we look back at what we were looking at the last time, the proposed monitoring network, which is the last document we had, CIAR 30 -- 313, page 311.
A Yes.
Q Okay. We're thinking about --
MR. O'GORMAN: So it's Registry Document 313,

page 311. It's the graph we had up literally right before this, the thicker. Right. And scan in, please, on -- around the purple southeast surge pond near the -- near the bottom just a bit so we can see a bit more clear. Great. Scan over on the page a bit to your right. Great.

Q MR. O'GORMAN: So we're looking at the density of proposed monitoring wells here. We've identified them a minute ago. Can you clarify whether you've committed -- I also see, for your benefit, the legend describes that little purple dotted area around the surge pond as --

MR. O'GORMAN: Well, let's scan down to see what the legend says about that line, Zoom Host. See the legend and over a bit to the other side? Oh, just scan a bit to the left, sort of.

Q MR. O'GORMAN: I think it's described as "proposed area for groundwater wells"; right? I think that's what you were telling us in this graph, if I -- if I'm reading it properly.

A MS. GRAINGER: That's what the legend says, yes.

MR. O'GORMAN: Okay. So let's scan back a bit to the -- to the right side of that page, please, Zoom Host.

Q MR. O'GORMAN: Can you clarify whether you've

committed to increasing the density of groundwater monitoring wells in this area? You know, these are what you've proposed. Are you proposing -- is this all you're proposing, or will there be more?

A MS. GRAINGER: This was a very preliminary indication of -- of potential distribution. To be honest, much of this was limited by -- you know, they're located in the generally downgradient direction of features and based on access which will need to be reviewed, because, as we describe in the documentation, the monitoring wells need to be placed close to potential sources, and -- and a pathway needs to be reviewed in terms of: Are these actually located at an appropriate distance and depth such that they would intercept the groundwater pathway before reaching a receptor?

So there's additional work that's needed to be done before this would be finalized.

Q Okay. Thank you, Ms. Grainger.

Mr. Houston, I guess, from a higher level, you would -- would you agree that this was one initial -- you know, what the monitoring wells might look like, but is this what you're committed to, or is the real plan on monitoring of groundwater still to come?

A MR. HOUSTON: So I think the plan on groundwater monitoring will be modified with the

detailed design phase. You know, the shape of that surge pond and the exact location needs to be finalized. And so I -- I expect that with that work and as that gets finalized, that groundwater monitoring wells could be located more precisely.

Q And if, in a potential approval condition, for example, were we to get to that point, you were to see proposed required minimum density of groundwater monitoring wells which were more dense than what we're seeing in this figure -- if you were to see that, how would you react to that?

A So my -- my understanding is that the cost of groundwater monitoring wells is -- is not that great. I wouldn't want to see, you know, an arbitrary design. I would rather -- I would rather have a situation where we could discuss that with the Regulator after the detailed design is done and agree on something that makes sense based on the -- the final design.

Q Okay. So I guess the -- I'll be honest; the extent to which this was made clear in some of the conversation we had this week about groundwater escapes me, so I don't think I'm treading over ground that we have already covered, but maybe I am. And if so, feel free to correct me.

But if I look at Monitoring Well 19-16-7, which is -- okay. Even if that's just conceptually

monitoring potential seepage from the surge pond, which, as we know, contains selenium -- selenium laid in the contact water and is -- I think we can at least characterize as being very close to Gold Creek. And knowing that we just looked at a graph of residence time of groundwater and that that area is one of the lowest designations you've assigned for residence time of groundwater, the question, I suppose, somewhat obviously, is: What confidence can we have that by the time you detect a problem, you have time to fix it before it gets into more heavy selenium loading into Gold Creek?

A So I -- I'm going to start this, and then if Ms. Grainger wants to chip in, she can.

So I -- I think that we heard from Mr. Youl yesterday or the day before talk about keeping that surge pond relatively empty and trying to favour having the water in the raw water pond, and that's just an operating matter.

So I think when we were looking at this, the -- the potential seepage from the off -- the out-of-pit storage pile was the more important aspect here, and that's why we've put that MW11-1 closer to the off-site -- or out-of-pit storage area, to detect any seepage that's coming directly from the rock pile.

So I -- I don't know if I'm getting to your --

your question here, but I think in our analysis the greater concern, from a seepage point of view, was the rock dump and not so much the surge pond.

Q Okay. And no -- nothing else for anyone to chip in on that question? You just alluded to it, Mr. Houston, so I'm not advising it, but ...

A I'm looking down the table, and she -- yeah. No. I -- I think we're good there, Mr. O'Gorman.

Q Okay. Thank you.

The last question in this topic.

MR. O'GORMAN: Let's go to the very -- the most recent Addendum 12, it's Registry Document 360. And we're going to look at -- so 360 document. You guys can find PDF 88 and look near the bottom of the page while we're waiting to see it on the screen. It's Registry Document 360, Addendum 12, and PDF 88. Great.

Q MR. O'GORMAN: So these were some commitments that you had made.

MR. O'GORMAN: I'm not going to ask -- don't bother blowing it up, Zoom Host.

Q MR. O'GORMAN: I'm sure it takes -- Mr. Houston, you and your team can see that on your computers --

A MR. HOUSTON: Yes.

Q -- where you are?

It shows commitments you've made in Addendum 12

around some of the issues I've been discussing here.

I guess, can you summarize first what you're committing to in terms of, you know, preventing seepage from the RDAs and the surge pond to keep selenium and other contaminants out of groundwater and ultimately out of Gold Creek?

A So just -- just focusing on the commitments that are -- are written in this table, as we heard Ms. Grainger say earlier, that -- and Mr. Youl as well, that before we start putting rock into the ex-pit rock dumps, our intent is to use various techniques to identify any fracturing and -- and to identify potential flow paths and that that initial work would inform the location of monitoring wells. And those would be located downgradient, obviously, of -- of the waste rock dumps. Similarly, we would locate down -- downgradient from the surge pond's monitoring wells.

And, you know, I know we only showed one well in each location on that conceptual drawing, but if -- if there were multiple flow paths of -- of interest, as I mentioned, a monitoring well isn't very expensive to install, and we would -- we would do -- we would install them at -- at logical locations, and that would be discussed with the Regulator, so -- and that's to detect quantities and the quality of water that is seeping from those structures.

The -- the construction of the waste rock dumps will -- will attempt to facilitate drainage from the waste rock dumps, including under drains using end-dumping techniques to get -- get a permeable layer at the bottom and collection ditches at the toe and underneath the waste rock dump to facilitate the drainage of that water and avoid pooling of water inside those -- those structures.

And then we have foreseen that seepage capture wells would be required, and those were located on that other drawing around the periphery, downgradient periphery of the surge pond. But, again, those would be located in logical locations based on what we understood of the groundwater migration pathways from -- from the waste rock dump areas primarily.

Q And you are not planning to put a liner at the bottom of that surge pond; is that right?

A Not at this point. A lot's going to depend on what we find when we do a more thorough investigation of the -- the base. A liner is a possibility or perhaps -- although we don't have clay on-site but some form of less permeable base on the -- on the pond. But that's going to depend on a more detailed investigation once we -- once we get in there.

Q Okay. I think we can move on from this area. Thank you, Mr. Houston and others.

So I'm going to move to my last substantive area of questions. I'm going to raise a different area at the end, so this isn't really -- but I will do that fairly -- potentially fairly briefly.

Well, I guess there's one pretty obvious topic that we haven't -- I haven't asked you about in my extended period of, you know, questions, and those would be the westslope cutthroat trout. So I've got a few questions to put to you on this. Obviously, this is an issue that's been discussed at length already this week.

MR. O'GORMAN: Let's start, please, by putting up Registry Document 44, which was Addendum 1. We're going to look at Appendix A3 in that package, and we're going to go to PDF 94, please. We should be looking for Table 4-1. So it's CIAR 44, Appendix A3, Zoom Host. Great. Let's blow that up a little bit, please. Not too big, though.

Q MR. O'GORMAN: So in this table you provided us with a table of predicted habitat changes over a period of 2017 to 2099 for all mine phases. We've got changes in total area-weighted suitability habitat for Gold Creek that indicate a modest reduction in habitat suitability for all bio periods. However, I think -- so you agree with that, if we can see the -- where on this table is that? There's Gold Creek habitat. The

different reaches are described here. And the reduction in AWS, where is it on this figure? Where should we be focusing our eyes?

A DR. BEWLEY: Hi, Mr. O'Gorman, this is Dan Bewley. Maybe I can help to describe this table.

Q Sure. Yeah.

A So the is reduction in habitat is -- you see for each period of the mine, you'll see a "Percent AWS" column. And this kind of goes back to our discussions yesterday. So that's the kind of average loss of habitat for each given by bio period. And we also -- that's a chronic measure, we also have a more acute measure, which is the one-month maximum loss of habitat.

Q Right.

A And this -- this is one of three tables. This is in average hydrological conditions. On the next table we -- we stress it under a sensitivity analysis in a dry year. And the table is extreme stress, drought year.

Q Okay. My challenge is I can't read these things anymore because my eyes are -- and I didn't remember where that was in this table.

So here's my question: It seems, though, that most of the reaches show a modest reduction, but Reach 5 shows a small increase. Is that right,

Mr. Bewley?
A That would be right.
Q Okay.
A And if you'd like me to explain that, I can.
Q Yeah. It's stated earlier, and we -- it's on page 91. A few days ago -- I don't think we need to go -- you did -- you have some text a few pages ahead of this that describe why Reach 5 is in a different -- I wonder if you could just, considering the trend we see for all the other reaches, tell us why Reach 5 is different.
A Sure. Zoom Host, can we go up to page 87 of this document, and can we kind of zoom in on the bottom figure, please. Thank you. And just scroll up a bit more.

So, yeah, at a high level, this, again, is a flow habitat graph for each of the bio periods. And what you can see is that, you know, the optimal amount of habitat is obviously when each curve peaks at its peak value. So this is fairly standard. Again, the point of a detailed flow assessment is to really -- you know, we're trying to capture how habitat exponentially declines down to zero flow. Okay?

Based on each curve's -- each life stage's habitat suitability to stream width, depth, and substrate, they will show varying responses to changes in flow. I -- if I remember rightly, with Reach 5, what you start to

see at a certain flow and above is that some of those life stages actually change above that zero flow.

So it depends on kind of what the flow is. If we lose a certain flow, you may actually get an inverse relationship with habitat. And that's kind of, you know, how these curves are captured.

Q Okay. And that's specifically what happens in Reach 5?

A Well, if you -- yeah. If you compare a kind of -- it's, like, a blue curve, "rearing juvenile WSCT". This slightly slants down in Reach 5, and you can see it's slightly slanting up in Reach 6. So it's all dependent on, you know, the changes in the hydraulics between the reaches, and they do vary based on our measurements and monitoring and analyses. There's going to be slight difference in reactions between the different reaches. Okay?

Q Okay. I guess what I'm curious about is: Why do we see that trend, that specific thing happening in Reach 5, when all the other reaches, the opposite trend evidenced itself?

A Okay. So for the flows in this reach -- like, let's just take a hypothetical example. Let's just say that at a flow of .6 in Reach 5 -- let's go up to the black line. Okay? I see a value of -- AWS of 3.0, okay, at a flow of .6. So when we talk about losing flow between the reaches, which I believe we're talking

about in Reach 5 as well, you're actually gaining habitat when you go from .6 to .5 to .4 to .3, and then you start to exponentially reduce inflow as we approach those zero-flow conditions.

So you can lose flow, if you follow the black line, and you will reach an optimum point, and then you will get down into that fast decrease. So it's -- essentially, you've got to piece together -- and maybe I could have done this in a more clear -- clearer manner. You've got to figure out: What is the starting flow? And, you know, if you're losing flow, you may actually increase for different life stages based on these curves that you see here.

Q That works, Mr. Bewley. Thank you.

A Okay.

Q Okay. Next question: Are we in -- we're in 44, yes, and we're in Appendix A3. So let's look at page PDF 95, just a few pages later.

Now, I think we are going to look at -- and you just referred to this, Mr. Bewley. You had normal flow. Then you had AWS tables for 1-and-10 and 1-and-20-year dry conditions in Tables 4-2 and 4-3; right?

A Correct. Yeah.

Q Okay. And we're talking about Gold Creek here.

So the individual -- in the 1-in-10-year drought,

if you look at the individual monthly time scales, it seemed like there were more worst-case habitat losses exceeding 10 percent -- they're in the range of 11 to 19 percent -- relative to average hydrological conditions, and they occurred for adult and juvenile rearing and spawning bio periods in Reach 8 and 9 and also Reach 6. Do you agree that that's what we see here?

A Absolutely. And that's the whole point of this sensitivity analysis. And, you know, I could say let's go down to the page below where we're stressing the habitat even more.

Q That's exactly what I was going to ask us to do. So if you went to the next page --

A (INDISCERNIBLE - OVERLAPPING SPEAKERS)

Q -- tell us how to think about --

A (INDISCERNIBLE - OVERLAPPING SPEAKERS)

Q So Reach 8 and 9 is right above Caudron Creek, and Reach 6 is Lille. So --

A Yeah.

Q -- so explain how it looks, then, under 1-in-20 here.

A So essentially what's happening here is between these different sensitivity analyses, we have more flow, obviously, in the average conditions. We lose a lot of the flow in the -- obviously, in the 1-in-10-year drought, and we lose even more flow in the 1-in-20-year

drought. And kind of if you compare just -- you can compare the baseline values between these different conditions, and what we're doing is, because we're losing flow as we get more extreme droughts, we're losing habitat. And as I've just shown you on those AWS codes, once you get closer to those very low flows and there's any residual impact on those flows because of the project, we are exponentially increasing our loss of habitat. Okay. That's the whole point of these detailed flow assessments.

Just to go back to your 9, 8, and 6 example, this is -- this is a big source of our concern, and extended monitoring efforts are definitely above Caudron in 9 and 8 and in 6 as well, at Lille. This is where we have those very low-flow environments.

And if you remember Mr. Houston's green spaghetti map, shall we call it, of the different kind of flow rates in different hydrological conditions, this is why we set up most of our monitoring in these kind of lower-flow transects, especially 9 and 8, because they are the lower-flow environments. We really want to characterize, you know, for any given flow, what do those stream hydraulics look like, stream widths, stream depths, and substrate.

So because any residual project impacts will be -- as you are seeing in these tables here, they will be --

there's -- there's more impacts on habitat that we potentially have to offset for in these lower-flow reaches, and that's why we're gearing up with the huge amount of monitoring that's going on in these low-flow reaches.

Q Okay. And I guess a 1-in-20-year drought, would you agree that it would not necessarily be unexpected to occur over the course of your mine, which runs for 23 years?

A It would be very low risk. I'm not going to say absent.

So let's just -- you know, what is a 1-in-20 drought? It's a -- it's a condition that has a 5 percent probability of happening in any one year. Okay?

What -- what would be the absolute worst-case scenario is if that would happen to occur in the late 2031s and early 2040s, which is kind of essentially that period when the flow impacts are estimated to be worse. So if you kind of overlay those two cumulative impacts, that would be when -- when the highest impacts would occur.

But, again, we're talking risks. You know, 5 percent on this average -- the 1-in-20-year condition against that short time frame. But there's -- you know, all these calculations that you see here, this is

kind of -- they feed into the -- the offsetting calculations and all the potential mitigation discussions that need to be had over the time.

But I would like to say, like, if there's any -- we've been talking about things like climate change and, you know, the monitoring and all that kind of stuff. This is where -- this is a good example, I would say, where we're actively adding conservatism in the different analyses that we're doing. We're -- we're really stressing the -- the habitat and the flows to see, you know, what that habitat losses may be and what may need to be done to kind of mitigate against seeing these losses.

Q Okay. And I guess I just -- one of the takeaways, if you were to scan your eyes around this table, you would -- you'd agree that in the -- in a -- in the 1-in-20-year drought conditions, you are showing for certain reaches and life stages almost a 20 percent decrease in habitat -- AWS habitat; right?

A Yeah. That -- that's correct.

Q And --

A Just to --

Q (INDISCERNIBLE - OVERLAPPING SPEAKERS)

A Yeah. And just to confirm, like, you know, it's -- some of our concerns regarding life stage have to do with, you know, when do the life stages occur?

So bear with me one moment.

Anything that kind of transcends into lower-flow months is -- is a big concern to us. It's -- you know, if you're doing calculations in May and June alone, it -- it's going to take those -- those flows. Whether it's in an average condition or a drought condition, there's still so much water in May and June, okay, that the impacts, if you are regarding those particular months, may not be so high.

We're really trying to dial in -- into the lower-flow months that -- you know, I think I was discussing with Ms. Janusz; if those droughts happen in summer for a longer period of time or are more extensive, these -- these sensitivity analyses that you see kind of give us a snapshot of if that occurrence were to occur, like, you know, how -- you know, if -- if -- the fire stage, say, for example, July, August, September, if we do lose some flow naturally to the climate, what might be the -- the impacts on the habitat? And these -- these tables kind of give us a snapshot through to -- you know, if climate change contributes to the picture moving forward.

Q Okay. So I guess I'm curious, given some of the predicted changes we see in the 1-in-10 and 1-in-20 drought-year scenarios here, that you do see predicted exceedances of a 10 percent reduction in threshold --

in -- in habitat under some of those scenarios. Can you explain why you -- in your overall assessment of the impacts on this value component, you didn't identify -- identify those reductions as being a significant change?

A MR. HOUSTON: If I could step in on this one, Mr. O'Gorman. The effects assessment is based on a -- after mitigations. This -- this analysis is before mitigation. So when we think about the offsetting plan that we're -- we've proposed, including, you know, putting the creek back into its -- its old historic channel and increasing overwintering habitat, those -- that offsetting plan increases the amount of habitat available in the stream, and so that -- that is -- that's why we call it "offsetting". It's a -- with that mitigation, we -- we can say that the effect will be not significant.

Q Okay. I guess we're wondering why -- I mean, I think you proposed that 10 percent was the threshold; right? So --

A After mitigation.

Q After mitigation. Okay.

Let's go to my next question here.

A DR. BEWLEY: Mr. O'Gorman?

Q Yes.

A Could I just add to that?

Q Yeah.
A Yeah. Just regarding the 10 percent, I can add some clarity there, or if you want to speed up. I do have a --
Q I --
A Sorry. The 10 percent average loss of habitat is -- is a -- it's been used in other detailed instream flow studies, one of which was the -- there's a landmark study in the South Saskatchewan River, Clipperton, et al., but they -- again, they used a 10 percent chronic loss of habitat as that first precursor to significant impacts on the -- the habitat. Okay?

Those guys also used more acute indices and, you know, one example might be a 25 percent loss of more instantaneous or weekly habitat. You are getting into kind of weekly time steps in that particular case. We've concentrated on a monthly time step in our data. So just to add some context to that.

Q Right. Okay. Let's move along and go to the next question. Without having to haul up and look at it, maybe, Mr. Bewley, you can -- if I suggest to you that your results show us that you have some of your greatest predicted habitat losses resulting from the project occur in the 2038 to 2042 time period, around when operations are concluding and decommissioning begins, would you agree with that, or do I need to haul

it up and have you explain it?
A No. I'd agree with that.
Q Okay. So can you tell us why the flow reductions are expected to be more prominent in that time period and, by extension, the potential impacts on -- on habitat?
A Can you just give me one small minute for that answer, please, Mr. O'Gorman?
Q Yes. Yeah.
A Thank you.
MR. O'GORMAN: You can probably take this down, Zoom Host. Although, you know what, leave it up because we might -- we might be circling through this a little bit more. My bad.
A DR. BEWLEY: Thanks for the wait, Mr. O'Gorman.

So I'm going to pass over to Mr. Jensen here, who produced those numbers. Thanks.

Q MR. O'GORMAN: Okay.
A MR. JENSEN: Yes, Mr. O'Gorman.

So the way, you know, flows are counted for or the difference in flows, I would say, is -- is proportional to -- to the estimated, you know, changes to the catchment. You know, as the mine progresses, it -- the catchments that are willing to develop mine footprint starts to encrouch -- encroach more and more on -- on the Gold Creek catchments. So by the time you are at

the extent -- at the ultimate extent of mining, that's when you also see the maximum rate of diversion away from -- you know, sort of the switch in -- in catchment from Gold over to Blairmore, which is what accounts for the -- for the reduction of (AUDIO FEED LOST).

Q And did you -- sure. Actually, it does, Mr. Jensen. I read that part of your -- your water modelling quite well.

But remind me whether or not progressive reclamation that you said you'll be doing factors into that in terms of, you know, those coefficients for the different pieces of that -- of the watershed and how the water flows. Does that change? Did you factor in progressive reclamation to those?

A Yes. We -- we --

Q You --

A We did. But, I mean -- so keep in mind that the last areas to be developed are those up in the northeastern section of the property. So that's why we see -- you know, so those, by extension, would also be the last areas to be reclaimed.

Q Okay. Okay. Tell us about -- Mr. Bewley or -- well, whoever is the right person for this. It might be you, Mr. Bewley. Tell us about what potential mitigations you could enact to ensure that flows remain at baseline in Gold Creek rather than undergoing some of the --

some of the losses that we see here.

A MR. HOUSTON: Additional mitigations to maintain the flow rates in -- in Gold Creek is what I understand you're -- you're asking, and --

Q Yes. And I mean above and beyond sort of, you know, what an offsetting plan -- I'm actually talking about maintaining the flows in Gold Creek.

A Yeah. Yeah. And so our offsetting plan, to be clear, is focused on habitat and -- which is what the fish experience, is the existence of the habitat.

Increasing flow rates in Gold Creek, the reason that the flow rates drop in Gold Creek and -- and that water somehow gets transferred over to Blairmore Creek is -- is an artifact of our water management program, which sees all of that treated contact water arriving in Blairmore Creek and -- and none of that being turned back to Gold Creek.

So we -- we haven't planned any mitigations to -- to put the water back into Gold Creek physically. That -- that overflow from the end-pit lake, which we, you know, recently discussed, was one of the thoughts in that direction, you know, and -- and, of course, making sure that all of the water from Caudron Creek south, you know, remains in the creek bed. You know, that -- that would be another mitigation in that area.

Beyond that, we -- we would be looking at

innovative or completely out-of-the-box solutions like potentially drilling a well or something that could feed into the headwaters of Gold Creek or something of that nature.

Q Yeah. I mean, we're, I guess, particularly interested in that time period of greatest reduction in habitat and flows, 2038 to '42 in your modelling; right?

A Yeah, yeah.

Q What if you get a drought year one of those years?

A Yeah. No. And so we've -- we've talked notionally about the -- 'cause we're not talking a lot of water in those upper reaches, and so we've talked notionally about, you know, drilling a well, for example, to have an additional source of water that could be available for Gold Creek, and that would not have any of the mine, you know, contact water concerns related to it.

So we have talked notionally about that, but, you know, that's not part of our application. It's just you asked me hypothetically what could be done, and that's one of the things we've discussed.

Q Okay. I'm going to ask you -- that's fine. I'm going to ask you if -- for this next question, rather than hauling it up, I'm going to suggest to you and see if you agree that in this document, if were you to look at page 103, not very far away, what you --

MR. O'GORMAN: So, Zoom Host, you don't have

to -- you might as well go to 103. Why not? But I'm going to -- I'm going to speak while -- while you do.

Q MR. O'GORMAN: We see in this -- where am I? I've lost my -- I've lost my place on the page. Sorry -- project effects are predicted to increase flows downstream of Reach 5. Now we're looking at Blairmore Creek relative to the baseline period beginning at construction, carrying on. Some of the flow gains of 10 percent or higher are predicted primarily during winter and some fall months during certain of the operation's years. And most months in 2042, including January, was when we see the largest individual monthly flow gain of 33 percent.

Does that all sound right, what I just said, in terms of what this graph is telling us?

A MR. HOUSTON: Yes, it does, Mr. Gorman -- O'Gorman. Now you got me doing it.

So, yes, it does. And -- and that modelling reflects a uniform discharge from the water treatment facilities. So the -- so the effect of that discharge is greatest in the lowest-flow months. And as we discussed earlier, they're -- there would be some flexibility to -- to manage that, if needed.

Q Okay. And why is the greatest increase in 2042?

A Mr. Jensen will answer that.

A MR. JENSEN: Yeah. So it's because in

2042, at least in this revision of the model, is when you have the greatest extent of unreclaimed mine developments, so that's where we are assigning -- because there's no evapotranspiration from mine working slide that we're designing at a greater runoff coefficient, and then as -- as the areas become reclaimed, we then, you know, reassign a natural runoff coefficient. But there's some residual areas, you know, that -- like, the high walls and whatnot, that remain at a higher runoff coefficient. So it -- the short answer is: It's the greatest extent of developed mine areas.

Q But it's strictly due to the changes in the runoff coefficients that get applied to the different little chunks of land in your model; right? It's not -- yes?

A Yes.

Q Right. Not due to --

A Well --

Q -- decommissioning of some water treatment structure, for example?

A Actually, I should say that, and then the water inventory. Because you'll see a reduction in -- in discharges as the various saturated zones are filling up. So we're accounting for not just a runoff but also the -- we're tracking the inventory of water on-site.

Q Not extra water flowing out of the SBZ?

A I don't know what you mean by "extra".
Q I don't know. Accelerated amount of discharge from the SBZ, for some reason, in that time period. Is this -- that's not why you're --
A No, no. No, it's not. No. It really is the -- so -- right. So the increase is due to the -- the runoff consideration.
Q Okay. Great.
A Correct.
Q That's what we wanted to know.
A Yeah.
Q Okay. Let's look at the next here. If I look at pages PDF 1 -- where am I at? So let's jump down to 105, and we're over a couple of pages. And from 105 through 107, which is the three -- I think the three different -- you know, irregular years and then the drought years.

Can you tell us whether these tables reflect the same sort of increases in flows in 2042, in that sort of time frame that we talked about on the other graphs?

A DR. BEWLEY: Hi, Mr. O'Gorman.

So with Blairmore it's obviously a different situation, as we've talked about. Flows are predicted to increase. So I think what we've got here are offsetting effects on flows that we're talking about. The project is scheduled to increase flows, but if we

then add stress or drought, then that -- the drought will obviously offset some of those flow increases that we see from the project. So there's a few things going on.

But generally, yeah, the two offset, which is why you don't see much in the way of reduction between the scenarios or increase, would be my answer at a high level, if that makes sense.

Q So if I asked you to explain sort of predicted changes in AWS resulting from some of those predicted increases in flows that we saw in the other -- other figure?

A Then, yes, it would be a case of going back to the relevant flow-stroke habitat curves and talking through those.

Q Okay. Do the increases in flows change your AWS results enough to produce a residual effect on the ecosystem that would be large enough for you to potentially characterize it as significant?

A Do you mean -- sorry. Would the habitat increase by more than 10 percent, or are you asking if there's some way of habitat reducing by more than 10 percent?

Q Well, you said that increased flows can decrease AWS; right?

A Oh, I see. Yes. The answer is: No, those increases in flow would not be realized as a stream condition where things are too turbulent and fast for the fish.

Essentially, what we find is that, yeah, the high-flow months, May and June, it's -- when they get into those much higher flow conditions, they're obviously a small -- relatively small part of the year.

It's the other ten months of the year where flows are lower where, you know, we are adding flow to a low-flow condition and improving the general habitat for the fish.

If -- if we get into, you know, crazy freshet events, normally, the fish are going to find some refuge where they hang out until those freshet flows have declined to a more adequate level.

Q That works. Thank you, Mr. Bewley.

Let's move on to a slightly different -- oh, I almost shut down my little guide to questions that I have.

MR. O'GORMAN: Zoom Host, can you please take us to Document 44, Appendix 3? What are we on right now? Document 44 -- is this Document 44, Appendix 3? It's late in the afternoon, so some of these -- so let's look at page 246, same document. Right. Got it. We see Table 3 here, comparison of some predicted changes. Can we blow it up a little bit, please, Zoom Host? Thank you.

Q MR. O'GORMAN: So now we see for some different bio periods, different times of the year,

Gold Creek and Blairmore Creek, predicted changes in water temperature compared to optimal temperature ranges for each bioperiod are summarized; right?

A DR. BEWLEY: Yes. Correct.

Q Okay. Ten pages before this --

MR. O'GORMAN: So on page 236 of this document, Zoom Host, please.

Q MR. O'GORMAN: So, yeah, on this page -- it may be easier for you to find it on your own version of it -- tell me if you agree that it's stated that projected increases in temperature with flow changed during egg incubation, plus .2 degrees Celsius for Gold and .05 degrees Celsus for Blairmore, are negligible relative to baseline water temperatures at this time. So warmer than optimal ranges for egg incubation by 6 to 9 degrees. And so I will keep going, and I'll ask you to confirm. It's in the middle of the fourth paragraph that I'm reading from: (as read)

> It is likely that relatively small predictive increase in temperature will result in incremental adverse effect on incubation, like earlier emergence. And the predicted decrease in temperature, negative .17 Celsius for Gold and point -- negative .25 Celsius for Blairmore, would only shift temperatures toward the species preferred incubation

range.
So you agree you told us that?
A DR. BEWLEY: Can I just have 20 seconds to discuss something, please?
Q Sure.
MR. O'GORMAN: Mr. Chair, while they're checking something, remind me where we're at for time. When did you want to take a break?
THE CHAIR: I would say anytime now would be a good time. So if you're just about done this section, fine. If not, we should probably still take a break in the next little while.
MR. O'GORMAN: Okay. I'm not done this section, but I realize I completely lost track of time. So I will try and look for a chance for us to take a break, but there will be questions after the break --
THE CHAIR: Okay.
MR. O'GORMAN: -- in the next, you know, 10 or 15 minutes.
Q MR. O'GORMAN: Sorry, Mr. Bewley. I ...
A DR. BEWLEY: All right. Thanks. Thanks for waiting.
Yes, generally that's what we agree. Mr. Bettles is more familiar with the biology.
I just want to point out that the whole -- you know, we've -- we've talked about differences in flow

conditions. Further up in the document, all this -- this temperature modelling that you see here is all based on, if you have a change in flow, how does that translate into change in the stream hydraulics that may control temperature? So one example is, obviously, if you reduce flow, you maybe reduce stream depth, and that may potentially warm things up.

The -- the flows -- the change in the flows and the hydraulics are very small. You can go and see the hydraulic changes with flow further up the document. And that's essentially what transcends down into this modelling that you see here in these -- these values.

Q Okay. Well, really, what I want to talk about is -- and I'm not sure if I pronounce this word properly -- hyporheic?

A Hyporheic.

Q I call it "hyporheic", my fisheries friend called it "hyporheic". So --

A Hyporheic.

Q So whichever way, you know the word that I'm talking about and that type of flow, the flow through subsurface sediment and porous space that's adjacent to a stream.

And so we're wondering about the potential for decreases in flow that are predicted for Gold Creek to lead to reduced hyporheic flow and the potential

implications of that, including, for example, if you did have that happening, would you have an increase in deeper groundwater, which would contain less dissolved oxygen into the spawning beds? So I'm going to ask you what you think about -- first of all, can you explain what you -- your understanding about hyporheic flows and their importance to the successful spawning of westslope cutthroat trout?

A I just talked to some of the hyporheic details, and then maybe Mr. Bettles will take over with the biology side of it.

If flows drop in Gold Creek, what you may find is the hyporheic flows increase. And by that I mean you will lose potentially more water from the surface channel that the fish care about into the gravels. And Mr. Houston has talked earlier this week about the reaches that we do see some flow loss through into the -- the gravel beds, and that's -- that feeds into some of the -- the engineering that we've had this week where -- and I've talked about it myself -- we think there's issues with debris falling into the channel, and sediment builds up behind it, which means that the water is now going through the sediment, where before the blockage it was above the channel bed. So that -- that issue feeds into some of the plans that we do have as part of the offsetting plan.

Just in terms of biology, Mr. Bettles, do you have anything to add?

A MR. BETTLES: Good afternoon, Mr. O'Gorman.

Q Good afternoon.

A Good afternoon.

Just to add to Dr. Bewley's component, just for some context around Gold Creek, Gold Creek is generally a fairly stable system when it comes to stream temperature. You know, obviously, you mentioned Caudron Creek is a very important contributor to -- to Gold Creek from the confluence from Caudron. But even upstream of that, even with lower flows, we're seeing a fairly consistent temperature regime, and I would think that given the modest sort of predictions of -- in terms of changes in flow that we're seeing, we're not a -- I mean, I wouldn't anticipate -- just from experience, that we wouldn't anticipate to see a substantive change in terms of stream temperature that would -- that would result in any sort of adverse effects.

Q Okay. But the paragraph that you describe in here isn't so much focused about potential impacted temperature but of lower dissolved oxygen; right? And what -- that's what I'm asking, really.

A Oh, right, right. So with dissolved oxygen, yes, as temperature decreases, obviously -- or as temperature

decreases, dissolved oxygen goes down as well. But I would -- I would argue that -- I can't speak to the depth of groundwater and where that gets -- comes into play on this. I think Dr. Bewley touched on that.

But given the -- if there's a slight shift in temperature, even if it slightly went up, you'd probably get -- most likely get a bit more of a -- more oxygen, dissolved oxygen, but I can't speak to the -- the actual -- what's actually happening to that in terms of -- but, again, what I can say is that the temperatures are generally fairly stable through the system. So even with any sort of shift, I don't -- I can't anticipate -- I don't anticipate dissolved oxygen will shift all that -- that much that would cause a problem.

Q So if I were to summarize, because I'm not sure I really heard it in there: If the project -- if the project impacts hyporheic flows near Gold Creek, what sorts of impacts might it have on westslope cutthroat trout?

A Well, it's -- I think if there's a shift in hyporheic flows, it's hard to say. I mean, the spawning -- if you're worried about spawning and incubation, I mean, the cutthroat actually -- they're fairly dynamic in their spawning. They don't always hit the same location. They move around a fair -- you know, from

year to year, from our experiences of monitoring in Gold Creek and -- and even Blairmore Creek, for that matter. So if there's a shift in hyporheic flow, I think that would depend on the -- on the location in terms of what -- where that would occur.

But generally where we're seeing spawning, from our surveys of where we think spawning is occurring, I believe we've observed spawning and pairing of a fish -- to be occurring in large numbers of fish kind of congregating in spawn -- for spawning during spawning window, that we wouldn't expect the change to -- any particular change to the hyporheic flows that would influence the spawning success.

Q Do you think there will be changes in the hyporheic flows, just --

A I can't say for sure off -- off the top of my head. I mean, our -- our instream flow assessment looks at total flow in the system, and it takes the total flow -- the surface flow and the -- and any sort of hyporheic or groundwater flow.

So maybe Dr. Bewley can speak to that sort of interaction in a little more -- in more detail than I can.

A DR. BEWLEY: I mean, Mr. O'Gorman, this feeds into, you know, discussions around monitoring -- continued monitoring and adaptive management down the

line.

We -- I should add that this, like every other document that we've produced -- this was produced back in 2016. We -- we now have seven stream gauges on Gold Creek, which I believe is one of the densest hydrometric networks anywhere in Alberta. It's seven stations in the space of 20 kilometres. That's one every 3 kilometres to monitor for what those flows are under different flow conditions. And that ties into, you know, reruns of the IFA calculations at some point, but also it sets the baseline for continued monitoring as those projects -- as the project residual impacts occur through time.

So we'll build heavily through our monitoring program that continues to evolve and -- and use that as a good reference.

Q Okay. In the page we were looking at, it was -- and I recognize, Mr. Bewley, this was produced in 2016. I mean, at the time, in 2016, in here, you suggest that there's the potential for the reduced flows, and I think there's a "could" -- could lead to lower hyporheic flow, and there's a potential for that to lead to impacts on the SWCT, particularly spawning and eggs. And I'm asking you if you think that's going to happen because you told us there you -- you know, it's a possible outcome, and you do tell us that flows are

going to be potentially reduced.

So I guess I just really want to know whether -- the potential of this happening, what's your sense of the likelihood of it? If it -- you know, you indicated it's certainly a possibility here. And if so, you know, the impacts that we might see on the trout, because I don't think I really heard that.

A MR. BETTLES: Mr. O'Gorman, it's Cory Bettles again.

I'll try to answer. I -- I think the risk -- I think the risk is low. I think we're talking about small predicted changes. Of course, I mean, we've -- we've modelled, obviously, different scenarios, sensitivities, and, obviously, as you move up into a different -- the higher, more riskier scenarios, you do get, you know, slightly increased changes. But I -- I would -- I would say that -- that, generally, I think the -- I would believe the risk is -- is low to changes to hyporheic flow. I mean, there's -- again, the changes that are predicted are not -- are not high, and I would -- I would think that, you know, there's ways that I think we might be able to -- to track that.

But, again, I said before, the -- the fish don't always spawn in the same location, and they -- they do shift around. And so it's -- it's something that we are monitoring. But I think ultimately, to your point,

the question you're trying to get an answer to is that I -- in my opinion, the risk is -- is fairly low.

Q Okay. You did talk about monitoring, so fair enough.

MR. O'GORMAN: Mr. Chair, I'm going to suggest I'm -- I have made good progress through my fish questions. I do have more. Maybe it would be a good chance for a ten-minute break.

THE CHAIR: Sure. It's just about 3:40, so let's break until 3:50.

MR. O'GORMAN: Thank you.

(ADJOURNMENT)

THE CHAIR: Okay. Go ahead, Mr. O'Gorman.

MR. O'GORMAN: Okay. Thank you, Mr. Chair.

Q MR. O'GORMAN: Okay. I -- in the interest of time, I might try and avoid hauling up references as much as I can through this next bit and ask if you just agree with some of the things that you've said.

So I think you'd say that you've confirmed in multiple places in the EIA that you expect the project will result in the reduction of groundwater discharge to Blair and Goldmore [sic] Creeks; right?

A MR. HOUSTON: That's correct.

Q And as stream temperatures during winter already reach near freezing temperatures, reducing groundwater discharge in the winter months will reduce temperature regulation provided by the groundwater -- groundwater

inputs and then potentially increase the likelihood of increased freezing in overwintering habitats. Do you agree with that?

A One minute, Mr. O'Gorman.

We would say, Mr. O'Gorman, that there are offsetting effects. If we look at Blairmore Creek, for example, we're talking about discharging treated water into Blairmore Creek year round, and that water would have been in the SBZ, which is essentially groundwater conditions from a temperature point of view.

So we -- we would think that, especially in Blairmore, that there -- there would not be an effect of cooling, that there would be enough discharge of water -- treated water that you wouldn't see that effect.

With regard to Gold Creek, you know, I -- I guess there may be a modest effect on the upstream reaches, although the impact on groundwater in those reaches is -- is fairly small. And then once you get south of Caudron Creek, it's really -- Caudron Creek maintains the temperature of the -- of Gold Creek, so it's very much regulated by that strong influx from -- from Caudron.

Q Do you agree, though, there would be impacts? Like, you know, whatever the scale of that impact is, that you are going to be reducing some overwintering habitat

by some of the changes in temperature from reducing the groundwater inputs? Whether that's a large or a small impact is a different question, but ...

A I think possibly a small impact on the reaches of Gold Creek, but outside of that, no, I -- there shouldn't be an impact.

Q Individual overwintering pools, for example, might be impacted?

A I'll get Mr. Bettles just to respond to that.

A MR. BETTLES: Thanks for the question, Mr. O'Gorman.

As we've, I think, highlighted through a few of the submission documents that we have, is that, you know, high-quality deep pool habitat is -- is obviously living in the system. But in those deep pool habitats, there's -- there's obviously a lot of open flow through there, and I would -- I would say that through our instream flow assessment that we conducted, our -- it showed that there was a very, very -- quite a small shift -- a small change in habitat suitability for those -- for that overwintering habitat in those areas. So I'd leave it at that, I think.

Q Is this -- thank you, Mr. Bettles. Is this something you're going to be monitoring? And specifically these potential impacts on small-scale overwintering habitats in pools from temperature change?

A There's been a lot of work done over the last few years by some research done by the University of Lethbridge that has -- has been very -- you know, has provided some good information. And, you know, given also the fragmentation disconnectivity that we've shown, even if you have good -- good-quality habitat in areas, if the fish can't get to it, that poses a problem.

So I think through the proposed offsetting that we've looked at, there are going to be opportunities to -- to do some monitoring, but that is obviously something that Benga needs to -- meet to that.

Q So my question was about monitoring of overwintering pools, impact from temperature change from reduced groundwater -- impact from reduced groundwater, and I -- did you -- how did you respond to that? Is that something you are or are not going to do?

A MR. HOUSTON: So let me maybe summarize: We are monitoring temperatures at the hydrometric stations that Mr. Bewley has mentioned, and so that's -- that's fairly dense. We will be monitoring the -- the overwintering habitat that we create, and the existing overwintering habitat is part of the offsetting plan. So both of those things will be monitored.

With respect to monitoring water temperature specifically in the overwintering habitat, I -- I'm -- I don't believe we've agreed to that, and I'm not sure

whether it would be instructive. I -- I don't know if the temperature difference would be something that would be, you know, significant to -- to monitor.

Q Okay. Thank you, Mr. Houston. Let's move on.

Let's talk about calcite, which was talked about earlier, and the potential for calcite formation. So without hauling up the reference again, if I can, would you agree that back in your original Consultant Report 6, you did identify that the baseline water chemistry in Gold and Blairmore Creeks had a calcite saturation index of 0.6, I believe, which would mean it would have the capacity for calcite to precipitate? But you did -- and I think -- first of all, does that sound right? We can haul up the reference if we need to but ...

This was -- okay. Well, maybe we should. This was something you told us in Registry Document 44, Consultant Report 6, PDF page 61.

A MR. BETTLES: Sorry. Can you just repeat the question just one more time, Mr. O'Gorman?

Q Okay. Well, I was actually trying to establish: Did you tell -- did you tell us there that the creeks had a calcite saturation index of .6, so had the potential, at least, for calcite to precipitate?

A We did say that in the -- in our assessment, yes; you're correct.

Q Right. And you went on to talk about the natural waters appearing to have no capacity to prevent it, so it was something that would need to be considered; right?
A Yes, that's correct.
Q Thank you.

So we talked about this earlier when we were talking about hardness, obviously. Tell us, Mr. Bettles, if -- tell us why we'd be concerned about calcite precipitation on the substrate in Gold and Blairmore Creek. What's the impact of that?
A The issues that raise with -- with calcite precipitation is, obviously, in filling of -- of interstitial spaces and -- and around spawning habitat, which would prevent fish from spawning and also would -- would potentially implicate productivity at lower trophic levels.
Q Once it starts to happen, is it easily reversible?
A I'm not a -- a chemist to be able to speak to the treatment of that. I -- I can't speak to if there's a treatment that can be applied after it's occurred in the -- in the creek itself.

But I might maybe defer this over to Mr. Jensen to speak to how you would treat the source of the potential. I think that would be the -- the risk component of it.

Q Mr. Jensen, you can speak to that, but I -- I mean, I'm not -- I'm very specifically saying: Once calcite has started to deposit on the base of those, but is it easy to then reverse that?
A To my knowledge -- I can't say for certain, but I -- I don't believe it's -- it's reversible once it's in. But, again, I'm not -- it's not in my area of expertise.
Q Anyone else?
A MR. HOUSTON: So --
Q Mr. Jensen, maybe, or --
A Yeah. So either Mr. Jensen or possibly Mr. Day could speak to calcite.

And I think we all agree, Mr. O'Gorman, that monitoring and early detection of tendency to form calcite is something that, again, we've -- we've agreed to do as part of our aquatics management plan. And then if we did see that occurring or beginning to occur, I think we'd want to look at some -- some chemistry to avoid or to mitigate or -- avoid, actually, formation of cal -- calcite.

So I think, Mr. Day, can you talk a little bit about that?

A MR. DAY: Yeah.

Mr. O'Gorman, I think there's a number of us that can contribute to this discussion. I'll say what my

kind of knowledge of this is. I'm sure Mr. Jensen will have comments, and -- and others might too.

The -- there has been research done in the Elk Valley on the use of antiscalants to -- to prevent calcite from precipitating directly in the -- in the creeks, and there's also been work done on thinking about how to -- how to use that to kind of de -- to sort of descale, if you want, as well. So that's -- that's a possibility.

Q Okay. Not seeing anyone else jump in.

MR. O'GORMAN: Can we please -- Zoom Host, this time I will haul something up on the screen. Let's look at Registry Document 69 and PDF 117. This was an early S -- IR response. So Registry Document 69. If we scan out. Right.

Q MR. O'GORMAN: Or, actually, do I -- well, actually, on this, in the response to the information request, you did state down at the bottom -- would you agree -- that: (as read)

> The predicted calcium carbonate hardness in Blairmore Creek downstream of the project during operations and closure will increase from a maximum background of 225 milligrams per litre to 367 or 471 milligrams per litre, depending on the mine phase and nodes.

Is that right?

A MR. DAVIES: Mr. O'Gorman, it's Martin Davies.

I can agree to that, yes, I think from a --

Q Great. Thank you.

So now I want to look at page 107, please. So are we seeing -- so you've told us the current background conditions are susceptible to calcite formation, although, admittedly, you said you didn't see any. You told us that the operation of the mine is predicted to increase hardness downstream of the project. And in this response -- in the response on this page, you indicate that the potential for calcite formation -- I won't -- you can read it on your own, probably, rather than trying -- us looking at it on the screen together, but I -- I would interpret you as saying that the potential for calcite formation to impact fish and fish habitat was considered low. And I guess I'm curious if you can explain that a little bit more. Why did you consider it to be low, given those other two things I just said?

A MR. BETTLES: Mr. O'Gorman, I'm not sure if we're on the right page. Maybe I'm -- maybe we're --

Q Are we on the right page? Let me check here, see if we can --

A MR. HOUSTON: Page 109, Mr. O'Gorman.

Q So I apologize.

Do you see it on there, where you said that in your response?

A MR. BETTLES: So, Mr. O'Gorman, the rationale for stating that we feel that the risk to calcite precipitation or formation on fish and fish habitat would be low is -- comes from the treatment -- water treatment and going through and contact water being captured through the water management processes.

And, again, I can't speak to the type of treatment that would be required to do it, but based on the treatment of that would ensure that the water -- any water would -- that would go into either Blairmore or Gold Creek would -- would not -- would be per -- would be treated and mitigated enough that when it was released, that it wouldn't prevent -- or prevent calcite precipitation.

Q Okay. I'm not sure I understand that, because you're -- are you projecting that the hardness goes up and there's more calcium carbonate and calcite to be precipitated?

A I'll -- I may have to push that over to -- to our geochemists or to the water management team on that. It might be a trigger that we need to talk about on that specifically.

A MR. DAY: I can -- I can take a shot at that, and then others can -- can try to help.

I mean, like, this is not something that will show up immediately. It's -- again, it's another one of those things that early on you can -- you can monitor and check mechanical indicators to show that you've got your -- got the calcite saturation index going up. And -- and it definitely wouldn't just spread downstream. You'd see it kind of forming near source, and you could -- you could pick it up with visual monitoring as well. So there's lots of opportunities to -- to catch it early on.

Q Okay. Tell us, someone, if it starts to happen, what's the impact on westslope cutthroat trout and their habitat -- mostly on their habitat, I guess? What happens? Describe it for us.

A MR. HOUSTON: So, Mr. O'Gorman, we think that the potential for calcite deposit is -- is primarily in Blairmore Creek because of the -- the contact water and the treatment for the contact water; that Gold Creek, in this respect, will basically stay in its current state, that there will be no changes in Gold Creek.

And so --

Q Okay.

A In Blairmore Creek, obviously, the deposit of calcite is -- is not something we want to happen, and we've included, you know, monitoring for calcite as part of

our aquatics monitoring program.

If -- if it should occur, I mean, one of the -- the good features of this project is that the -- the water's being gathered and controlled in one water management system so that addition of calcium treatment can be implemented, if necessary.

And I think I'm going to ask Mr. Jensen to talk a little bit about, you know, what kind of treatment that would look like.

A MR. JENSEN: Yeah. So treatment for calcite's relatively straightforward. It comes down to relieving the -- the calcite supersaturation, and there's two processes. One is offgassing any CO2 that's contained in the water, and at the same time, you need to have a nucleation material, so other calcite that the calcite can precipitate onto.

So it -- I mean, it's something that can be put in, for example, to those -- the ponds that we showed or that we discussed earlier that were shown on the map. It's -- it's relatively straightforward. Even a little bit of addition of acid or -- or certainly lime treatment would -- would relieve the supersaturation. So it's -- it's relatively straightforward and can be done in relatively short order when -- you know, as long as the water is in hand, which it is.

Q So are you saying you're going to do that from the

beginning, or is that an adaptive management response you will adopt at some point, based on monitoring?

A MR. HOUSTON: So we're going to monitor, and that is a response that we would -- we would apply if -- if there was either calcite forming or -- or a strong possibility that it could form.

I should remind you, Mr. O'Gorman, that we will be monitoring the -- the chemistry of the water as it's leaving, so we'll -- we'll be -- as part of our water chemistry monitoring be -- be also looking at the -- this issue, so -- even before we see calcite precipitation in the stream. But it would also be a part of our monitoring program of -- of the stream beds.

MR. O'GORMAN: Okay. Could we look at, Zoom Host, Registry Document 542, which was a submission from DFO, and PDF -- so it's 542. I hope that I gave you this in advance, and it's possible I did not. Right. And PDF 279.

Q MR. O'GORMAN: And there's a Recommendation 19 that we see right there. I will allow you to read it. It related to --

MR. O'GORMAN: Go back up, Zoom -- up a bit again, please, Zoom Host. Thank you.

Q MR. O'GORMAN: I would assume that you folks have read this before. We're curious whether you're

committing to adopting this Recommendation 19 from DFO about implementing a quantitative assessment of the potential for calcite precipitation and its effects on the trout and their habitat and suitability. I'm not sure whether -- you've considered whether you are committing to adopting that or not before.

A MR. HOUSTON: Yeah. One minute, Mr. O'Gorman.

So, Mr. O'Gorman, again, as I mentioned, we've been monitoring Gold Creek for four years doing the snorkel surveys, and, you know, there -- there doesn't appear to be a calcite precipitation problem in that creek, and we don't anticipate that anything we're doing would -- would lead to that.

With respect to Blairmore Creek, I think what -- what I have indicated before would stand, that we -- we will be monitoring the chemistry of the water. We will be monitoring the creek beds. And -- and should a calcite issue or the potential -- strong potential for calcite precipitation develop, as Mr. Jensen mentioned, the -- the treatment for calcite is -- is fairly straightforward and fairly quick to implement in the ponds that we have existing.

So I'm not sure what it means. (as read)

A quantitative assessment of the potential for calcite precipitation and its effects on

westslope cutthroat trout habitat should be completed.

That seems to apply to Gold Creek. And so I think we would need to discuss this further with DFO to understand exactly what they're -- they're looking for here.

Q Well, I didn't produce their -- their question and recommendation, obviously, so I can't speak to that, either. We thought it was interesting to see how you would react to it. But I'll move on from there.

A Okay.

Q You know, most -- so I think sort of -- about at the end of this thread, if I could summarize, you are saying you're putting a lot of emphasis on monitoring and treatment up-front, and yet you produced results that show this increasing hardness. And -- and I think you would agree that if the calcite precipitation starts to happen, you effectively can't unconcretize the stream bed, can you? It's not -- it's not a highly reversible effect; right?

A That -- that's -- that's correct, Mr. O'Gorman. It's not easy to reverse.

Q Okay. Okay. Let's carry on.

Although -- just one second. Sorry. Okay. We're good. Yeah.

My next question is -- it's about -- sorry,

gentlemen, it's late in the day, and I'm starting to fade.

Okay. I wonder if you can tell me -- right. So there was a discussion about this that took place earlier this week, I will remind you, about the monitoring of the declines in populations in Gold Creek -- arguable declines, the numbers. We had quite a bit of dialogue about that, as you'll recall, and I wonder if you can -- in both creeks. Sorry.

Remind us your views on -- 'cause I'm not sure it was entirely clear to follow that whole conversation. So tell us your view about the potential causes of observed population declines in both of the creeks in westslope cutthroat trout.

A So, first of all, Mr. O'Gorman, I think we all agree that it's difficult to count the fish and -- and get a perfectly accurate view of what the population is from year to year. It's a -- it's an estimate at best, and so what we've tried to portray in the information that we've put before the Panel is that we have done estimates year over year, and whether statistically significant or -- or defensible from a statistics point of view, what we do feel we're seeing in Gold Creek and in Blairmore Creek is a reduction of population, so -- and primarily from 2016 to subsequent years.

I'll let Mr. Bettles talk about -- and keep in

mind that we don't have a, you know, science to -- to support reasons for that reduction, so take what we're going to say as some hypothesis that -- that could be applied.

A MR. BETTLES: Thanks, Mr. Houston.

I would agree with that. Like, there's -- there are some hypothesis that we -- that are out there in terms of what we think may be -- may have occurred, but, I mean, it's -- there's certainly no definitive answer to that. What we -- what we do know from the data we've collected post-2016 is there was a decline. We -- we observed it in both Gold Creek and Blairmore Creek. So it wasn't -- wasn't site-specific or watercourse specific, though the numbers were obviously much lower in Gold Creek than they were in Blairmore Creek.

What we've been seeing since then through our snorkel survey work and we've -- as I've said in previous dialogue, that snorkel surveys have been the primary monitoring of the populations to this point, because when we started seeing the decline in 2017, we needed to confirm if the numbers that we were seeing were because of an actual decline or perhaps, like in Gold Creek, as we've said about fragmentation, that maybe the fish were just caught in different areas that we hadn't been looking at in 2016. So that's why

there's been this kind of evolution or adaptiveness to our program.

So to say why, there's a lot of factors that maybe could have played into it, but I'm -- I'm certainly not one to say exactly. These systems, I think, both have their own existing stressors that are in the systems and -- sorry, one second, please.

There's existing stressors, in particular Gold Creek, and I think they -- they seem to maybe be playing a role in sort of why the trout declines have been observed. They're much more -- the stressors are much more pronounced and evident in Gold Creek as they are in Blairmore Creek, but that's kind of why we -- we feel that doing some -- some work to try and fix those problems will actually be of benefit to them.

I'm not sure if that entirely gets to your question, Mr. O'Gorman.

Q No. That's fine.

So I'll put it to you: Do you feel that any of the works conducted by Benga in that time period had anything to do with potential observe -- observed fish declines?

A MR. HOUSTON: No. We don't see how anything we've done could have contributed to that.

Q And any releases that we might have heard about on the record in 2015-ish time period, would that have had a

potential contribution?

A The -- the releases that you may have heard of, the ones that were reported through the AER and investigated, occurred -- I believe they were in 2015.

Am I right on that? 2015. So, you know, we would have expected, if that was the cause, to see some effect in 2016 surveys.

Q So I guess I would say that the Panel, we've -- you know, in listening to some of the conversation and reading the submissions we've seen about concerns of potential impacts to westslope cutthroat trout that might occur as a result of the project and then looking at the mitigation and offsetting potential that Benga's proposed to address residual impacts, and given some concerns that we've been exposed to this week around the population counts of westslope cutthroat trout, whatever the cause of them, I guess we're curious, and I'm looking for a professional opinion.

So, Mr. Bettles, I think I'll tag you. In your professional opinion, is the current population in Gold Creek and Blairmore Creek, for that matter, resilient enough to endure a failure of any of the, you know, water management and habitat management mitigation measures that Benga has proposed to avoid becoming extirpated?

A MR. BETTLES: So you're looking for my

professional opinion on this? Let me start with -- let me start with Blairmore Creek. I think that one is a little -- slightly different.

The two systems are very different, and I can't -- I'll make that clear, first -- first and foremost. I mean, Blairmore is, as you know, above the -- the known barrier. You've got some hybridization that's occurred, albeit, from my knowledge, from the last time I've seen genetic data, that the hybridization numbers -- numbers are quite low, or the amount is fairly low, but it's still a hybrid population. It is more of a traditional trout system.

What we're seeing, that they're -- the numbers of fish that have been coming back quite -- quite -- quite aggressively the numbers are coming in. So I would say that that system is certainly reasonably resilient, from what we can tell so far, since we initially observed the decline and what we've been seeing up to this -- most recently last summer and -- and late fall period.

It certainly doesn't experience, from our perspective, the same existing stressors that are in there compared to Gold Creek, so I think Blairmore Creek is certainly a -- a fairly resilient stock in that system.

With respect to Gold Creek, there's -- there's a

lot of different things going on in that system that seem to -- currently, under existing conditions, seem to pose some potential challenges for the -- for the population. I think it's been well noted through some of the work we've done but also through the Benson 2019 thesis, which you've got a lot of -- a fair bit of disconnectivity fragmentation that is really, in my opinion -- and I think the literature -- the scientific literature points to this quite a bit as well, that it -- that it is a very -- it causes problems to -- to -- to populations of fish and that that -- that is certainly, I think, a pretty important aspect of why the population seems to be struggling there too.

I would also like to say that the temperature regime in Gold Creek, I think, itself, I think, is -- it's a much more stable system, but the temperatures are much lower, which does play a role in productivity in the system itself. But with -- and there's -- and there's other -- a lot of other stressors that are going on in that system that I think, compounding right now, are causing additional stresses to that stock in itself.

Having said that, you know, I think what we've noted, there's some things that could be -- could be fixed on that system that could improve the resilience of the population that's in there, and I think we've

highlighted that in our offset plan.

And one thing that's not in our offset plan is the additional fragmentation that we've observed higher up in the -- in the system where you have complete disconnectivity, even as of this last summer, where we -- and we know there's fish above this -- this disconnected area, and the fish can't move, and the -- the flows -- unless the flows come up but are -- whatnot, then they're going to be stuck there, and they just can't move around to the better habitats that are available to them.

So I think in the event of, you know, nothing gets done to this, that that -- that population will be struggling regardless, and I think Benga's proposal to try and fix some of these things would be of benefit to the population in Gold Creek.

Q Okay. Okay. Thank you, Mr. Bettles. I appreciate that.

Two last questions, one short, one maybe a little bit longer, on fish to wrap up the fish questions.

I think this will be a fairly simple one: Mr. Houston, can you -- so we don't need to haul it up. I'm sure you're aware that in their hearing submission, DFO went through an assessment of your project and indicated -- and I don't have their exact words written down, but in general I think you'd agree that they

characterized that it -- they would have -- I think they used the word "unlikely" to be able to issue you a SARA permit that you would need for this project to proceed because of potential concerns about impacts to critical habitat in Gold Creek. Is that your -- is that a fair way to characterize what they've said?

A MR. HOUSTON: I mean, those are the words that I read in their submission as well, Mr. O'Gorman. And I have to say, it surprised us a little bit because we had been working with DFO since early in the project to -- to understand what -- especially the offsetting, what measures, mitigations, what offsetting approach, and what design requirements needed to be built into the project to make this an acceptable project.

So we've been working -- and I believe that information's all on the record, that we've been working quite extensively with DFO for some time.

So those words were a little bit disconcerting to me, and I -- I guess we all would like to believe that there's, you know, a -- we know that there's additional work that needs to be done to make the -- the offsetting plan certifiable or -- or to make it to a stage that it's ready to be approved. And that's work that we've always understood needed to be done, once this process is over, to, you know, do the engineering on those offsets and get a very, very specific plan

and -- and, indeed, to also work on the monitoring program that goes with it.

So we understood all that work needs to be done, and -- and we're looking forward to getting back to that work with DFO and -- and, you know, putting forward a -- a final plan that is -- is approvable.

Q Okay. And I just want to really -- that was the lead-in to me wanting to clarify that we have a common understanding.

So you understand, correct, Mr. Houston -- Benga understands that the decision of this Panel, whatever it is, say, were we to decide under the Coal Conservation Act that the budget was in the public interest and to make a recommendation to the federal minister under Canadian Environmental Assessment Act, 2012, that we think, thumbs-up, the project should proceed, that that's not binding on DFO and their decision-making under SARA; correct?

A We -- we understand it's a separate approval that -- yeah. We understand they have the authority to approve or not our -- our application.

Q Okay. All right. Thanks. So thank you, Mr. Houston.

This one is for you, because it's a big overall wrap-up question, and those are your -- those are your bailiwick, as I understand.

So if I think about the whole range of sorts of

water and aquatic habitat issues that we've heard about this week and through four years of regulatory process, we've got some uncertainties about potential impacts at levels of selenium and what their impacts may be along with -- that's been discussed a lot. We've got some uncertainties around potential for sulphate toxicity, predicted concentrations. Some of the modelling used all this reaching in excess of a thousand milligrams per litre. We've got some exceedances of water quality guidelines for some other items, which we haven't even talked about today, but I'm actually going to come back to in my real, final wrap-up question for this panel. So maybe this is a bit out of order. My apologies. Again, it's late in the day.

We've got, you know, concerns about potential shift, maybe, in the phosphorous concentrations in Blairmore Creek that might shift the trophic status of that creek; that was raised in some of the hearing materials. We haven't talked about it in this part of the hearing so far, but it's been said.

There's potential for calcite deposition, you know, if -- in light of predicted hard -- increases in hardness.

I guess we're curious about whether you conducted, from your perspective, a real, thorough cumulative effects assessment of all of these issues on westslope

cutthroat trout and how, looking at all these uncertainties, we can have confidence as a Panel about what the possible impacts to the trout and their habitat are going to be?

A So the -- the critical habitat that has been identified is in Gold Creek. I understand -- and we'll talk about Blairmore Creek after that. So we have designed this project to have as small an impact on Gold Creek as possible. That means setbacks. That means not putting treated contact water into Gold Creek. There -- there's a lot of work that's gone into respect the nature of that habitat.

We have done it -- done extensive evaluation work of the westslope cutthroat trout in Gold Creek and especially the work that Mr. Bettles and his team have -- have done to understand the fish populations, the geomorphology, and -- and to understand the shortcomings of that critical habitat.

So I think from -- from where we sit, the westslope cutthroat trout in Gold Creek are going to benefit from this project, benefit in the implementation of the offsetting plan, cleaning up the -- or getting the creek back into the -- the original creek bed, adding some overwintering habitat, replacing the riparian habitat that we -- we will have to take out as a part of the -- the mining project.

But more importantly, they're going to benefit from having a company responsible for monitoring all of that work and -- and, if necessary, maintaining it or taking corrective action through a period that's going to last, you know, 30, 40 years, right through to the reclamation stage.

So I think that that is an advantage that, you know, many other populations of westslope cutthroat trout won't have. They're -- they're not being monitored regularly like that. They don't have a company that's managing them on a year-over-year, month-over-month basis. So I think there are a lot of benefits that this project brings to the westslope cutthroat trout population in Gold Creek.

With respect to Blairmore Creek, the habitat reduction is -- is not as great simply because the water flows are increasing in Blairmore Creek. We are talking about the sulphate and the selenium and the hardness changing, and we understand that, and what we are offering is to bring science to bear to ensure that we stay within safe boundaries to protect the aquatic environment in -- in Blairmore Creek. And we've proposed a number of contingency plans. What if this happens? What if that happens? And so we've proposed contingency plans for -- for the things.

And you've asked me earlier, you know, is a metal

treatment plan in or out? Is this in or out? Well, they're -- they're all operational items that we have committed to implementing, if necessary. The -- you know, we're also doing a lot of work that we can't put on the record right now related to reducing the impact at its origin, that is, avoiding the ex-pit dumps or -- or minimizing the ex-pit dump rock quantity.

So there's a lot of work going on. We understand the importance of this. We understand that eliminating the -- the issue at its source might be the -- the best path forward. And to the extent that we can do that, we're -- we're working hard in that area as well.

I don't know how to conclude this, Mr. O'Gorman. I --

Q You --

A -- rambled on a bit.

Q I mean, it was a question designed to give you the opportunity to ramble on and try and summarize it all for us, which I -- I think you took a good shot at, especially for 4:30 on a Saturday afternoon, at the end of a long week that your panel has been questioned.

So I do, gentlemen, have one other area to throw at you. It will also require you to sort of give me a bit of a comprehensive response.

Mr. Chair, I think maybe -- could we just take five minutes to talk amongst ourselves and make sure

that I have reviewed my notes to make sure that this last question I have really is the last one? And it is one that might take a five-minute response, so --

THE CHAIR: Okay. Yeah. That's fine. Let's take five minutes. We'll resume at 4:45.

(ADJOURNMENT)

THE CHAIR: Go ahead, Mr. O'Gorman.

MR. O'GORMAN: Thank you, Mr. Chair.

Q MR. O'GORMAN: Okay, folks. It's been a long two -- two-and-a-bit days of my questions. There's an entire area that I didn't ask you about, and I think almost no one has over the course of this last week, or it's been very minimally discussed, at least, which is all the non-selenium potential contaminants -- contaminants of potential concern.

So I considered going into those in depth, and I think what we decided to do is to give you sort of a holistic question on those. And I referred to them a minute ago, so you assumedly knew this is where I was going to go.

So I will read this. It's late in the day. I'm past the point of being able to freestyle my questions, so I'll just read. Water quality modelling results are presented by Benga in Registry Document 313. That was Addendum 11, Appendix 6.25, for Blairmore Creek and Gold Creek, and they predict exceedances of the 2018

Alberta guidelines for chromium, cobalt, ammonia, and nitrate and the Canadian environmental quality trigger value for phosphorous in oligotrophic systems. We've already pointed out and we've discussed that the modelling of selenium and sulphate concentrations in that appendix produces predicted mean monthly concentrations which are higher than those referenced by Benga in its derivation of the proposed site-specific water quality objective for selenium. It's higher than concentrations used in sulphate toxicity tests conducted by Benga. And on top of that, you've also produced Benga's produced predicted water quality in the end-pit lake. Predicted concentrations of various contaminants in there are a cause for concern. Several predicted contaminant concentrations exceed guidelines, sometimes substantially, including selenium, arsenic, cadmium, cobalt, copper, nickel, and zinc.

And I will clarify -- I said I wasn't going to freestyle -- but we are saying you predicted for all of those various contaminants a -- you know, constant exceedances but exceedances that vary at points in times above guidelines.

So this morning in response to one of my questions, we -- well, in various ways we heard Benga express some reservations about the modelling used to

produce the predictions in that appendix in Addendum 11, which was submitted just in earlier 2020. However, as we've noted before, conservatism is the underlying basis for our deliberations in this process. So I would like to ask two questions now, with that preamble, and I will read them both together.

How confident are you, based on your modelling results in Addendum 11 for Blairmore Creek and Gold Creek, that the predicted concentrations, especially ammonia and phosphorous -- but also all the concentrations, since all of the contaminants will be present together in the receiving environment -- how confident are you they will not represent a significant adverse effect to the aquatic environment, particularly to westslope cutthroat trout, during the years of operation and into the first years of post-closure? That's Part 1.

How confident are you, based on your modelling results that we've just discussed, for the -- in Addendum 11 -- sorry, for the end-pit lake that the predicted concentrations of contaminants of potential concern will not represent a significant adverse effect to the aquatic life in the end-pit lake that might, you know, be there in the foreseeable future?

And Part 3: Given uncertainties associated with the predicted concentrations and the potential

consequences to aquatic life, notably to the westslope cutthroat trout, would Benga deploy treatment from the start for these additional contaminants of potential concern that are predicted to exceed guidelines, and I mean from the start of operations? This would include metals and metalloids, such as arsenic, chromium, and cobalt, as well as ammonia and phosphorous.

Now, that's my question. I don't know if you want to take a minute to think about a holistic answer to that. You can, if you want.

A MR. HOUSTON: Let me take this, Mr. O'Gorman, and I think I've got all the parts here.

So I'll start by talking about ammonia. And that was brought up earlier this week. On -- on inspection we realized that we had included an overly conservative estimation of source ammonia in our -- in our modelling, and so we corrected that in a response to an undertaking earlier this week. We don't consider that ammonia will be something that should be on this list.

With respect to the other metals, let me say the exceedances are an artifact of quite conservative analyses. Conservative in our assumptions taken for the -- for the source terms, the -- the rates at which these metals will get into the water. Also, you know, conservative given some of the other things I said about, you know, trying to mitigate at the source

the -- the origins of some of these metals.

So with the conservatism, and given the nature of the exceedances, we consider at this point that it may be unlikely, or at least it's not certain, that we'll require a metals treatment plant.

We have talked about a pilot project to -- or pilot SBZ, I guess a field-scale pilot for the SBZ, and we talked with you, Mr. O'Gorman, about using that pilot as a point to inform us whether we need to work harder on a metals removal plant or -- or if it's -- remains something that's in the unlikely category.

As the project progresses, the -- the waste rock, which is the primary source for a lot of these things, and the SBZ, will develop not in one fell swoop, but gradually the waste rock will pile up, the -- the water -- the contact water will grow over more than a decade as we continue to mine and continue to build up the waste rock and then start to collect the contact water and treat it. So that -- that slow build-up will give us additional information to inform decisions around mitigation.

We don't consider that it's necessary to invest in a metals treatment plant from the get-go. We think it's something that very much is on the wait-and-see list. And we think that we can take time to develop our data more substantially and still implement a

metals treatment plant in time to avoid any -- any water quality issues in -- in the -- in the creeks.

As I mentioned earlier, Gold Creek is a little bit apart in that it's not -- it's not expected to receive significant contact water. A little bit through seepage, yes, but that itself will arrive over time, and the quantities are relatively small.

Blairmore we think we have time to review the need for metals treatment facility as -- as we continue to monitor the -- the results of our -- of our field-scale pilot and then the early days of the SBZ treatment process.

What is clear is that we have committed to install that facility, if it's necessary. What is clear is that we've got a good appreciation for what kind of a facility -- a facility it would be, and that that technology is readily available and readily understood.

So those -- those things are clear. That we have time to assess this situation further is also clear. And so we feel we've put forward a proposal that is low risk, is prudent, and which we feel we've made the commitments necessary to give -- give the regulator some comfort that we will implement those things when and if they are signalled to be necessary.

You asked about the end-pit lake. That -- that is in the same category but even a little bit further out

there. We have -- we have modelled some estimations of contaminants concerning the end-pit lake, which may in fact materialize. Again, we're not sure if they will. We -- we've taken some conservative assumptions, and we've identified that, yes, they may.

I think -- we think that our understanding of the inputs to our modelling, and base -- based on the general operation, will be much more clear as we move through the operating life of the mine, and we will be in a better position to assess whether that will occur, and what options we have to manage any elements of concern in the end-pit lake downwards. And that -- that would start with the design of that end-pit lake. It's not final right now.

But as we understand whether the assumptions we've made are conservative in the rest of the project, that will help us to understand whether we have to make some design adjustments on the end-pit lake to mitigate or avoid similar concerns in the end-pit lake.

It's -- it's not planned to be a fish-bearing lake, but we do understand that there will be life at the lake, and -- and that could include fish. So we do understand that. And the objective would be to arrive at an end-pit lake that is a healthy part of the environment. But we do understand that that's some years out, and that we have time to gather more

information, and we have time to adjust the design of that end-pit lake to arrive at a good conclusion.

We will be regulated through the life of this mine. I know you gentlemen understand that, and I -- we -- we look forward to working on all these issues and developing more precise strategies with the regulators as we -- as we move forward.

I think -- I think I've touched on most of your questions, Mr. O'Gorman. Let me know if I've left a gap.

Q No. From my perspective, that's -- if that's your answer, then that's all I'm going to ask you about, and I -- you touched on all the things as near as I could tell, yes, so ...

A Okay.

Q Okay. Well, allow me to conclude my bit. My -- my colleagues may have one or two quick questions for you.

But to Mr. -- to you, Mr. Houston, and the entire panel, it's been just over two days of a lot of questions from me. I do appreciate everyone's, you know, forthcomingness and taking the best efforts to dig into the information that I was trying to get from you to help us understand the impacts on this very important issue from your project. So thanks very much for the last couple of days.

A Thank you, Mr. Chair.

THE CHAIR: Thank you, Mr. O'Gorman.

Mr. Matthews, any questions?

MR. MATTHEWS: First of all, I just want to thank the panel for enduring this long week, and I know I personally gained a lot of key information that will help me. So, again, thank you.

And I have no -- no questions, Mr. Chair.

THE CHAIR: Okay. Thank you, Mr. Matthews.

Q THE CHAIR: I just have a couple of really quick follow-up questions based on things that came up.

So at one point Mr. Fitch was asking you questions about the underground workings and specifically about whether or not they would need to be plugged, and there was a bit of a dialogue about that. And I think I understood Mr. Youl to say that there would be -- would be plugged.

And, Mr. Houston, I think I understood from you that those portals would potentially be under, you know, 50 to a hundred metres of water kind of once the SBZ are established. And there was a bit of a discussion around the potential for those plugs to failure, so I just want to -- sorry, to fail. So I just want to quickly circle back to that.

If those plugs were to deteriorate or fail over time, what would be the consequences of that, from your

perspective?

A MR. HOUSTON: I muted myself.

Maybe I can start, Mr. Chair, and then Mr. Youl might have some additional thoughts.

I think we need to think about these plugs as substantial width of material. We wouldn't be talking about a -- you know, a -- a thin plug. We would talk about something with substantial widths to it.

If you talk about failure, again, we -- we should think about what the failure mode would look like. And I -- I would think that a catastrophic failure of one of those plugs would be an unlikely circumstance. That would be a -- all-on removal of the plug and essentially a bit of a hole in the side of our SBZ.

I would think that the more likely outcome would be some seepage along the -- the wall of the plug or something of that order. And that being the case, I think it would likely be small compared to everything else that we've been talking about.

Mr. Youl, do you have anything that you think you could add to that?

A MR. YOUL: Thanks, Mr. Houston.

Mr. Chair, no, I concur with what Mr. Houston said. These plugs would be engineered. They'll be exposed in the high wall for a period of time while we complete our mining operations, so be able to survey

those.

We understand the void space in the ultimate saturated backfill and, therefore, the amount of water pressure that's going to be exerted on -- on these plugs, so all the information that's needed to apply proper engineering principles to the design will be there, and they will be heavily engineered.

But as Mr. Houston said, it's conceivable that a little bit of leakage could emanate through -- through those plugs, and we can implement monitoring wells. We -- we already see seepage coming through those old workings down at the seep -- lower down the mountain, and that's being monitored. So we'll be able to intersect any sort of seepage through the original portals of that underground mine, which has all been mapped.

So I believe there are solutions there to eliminate or mitigate, and hopefully eliminate that risk.

Q Okay. And I would assume that there are -- would be water on both sides of the plug. Is that correct? Like, the water -- the plugs are submerged below the water table, so I'm presuming, you know, the portal shafts would fill up with water. And so it's not like the plug is holding back a big volume of water. There's water on both sides of the plug; is that not

correct?
A That's -- that's likely correct. There may be some portals higher up that drain, but certainly lower down, because of the interconnection of all of the old workings, you're right, yeah, there will be some plugs that will have water on both sides. But some higher up may -- may have drilled water just on the outside, but that will -- that will have a lot of pressure on it.
Q Okay. And if it was --
A And --
Q Yeah. If there was leakage, would it report to the portal where the seepage currently occurs, or do we know what would happen to that water?
A Yeah. We've got -- it's amazing, actually, the maps that are being produced even from that era which, as I've mentioned, we've tried to calibrate one with drilling and radar surveying, so we'll continue to do that and verify them. But they all connect back to a single portal.

So if you can imagine a single portal driven in the side of the mountain, this is old Beaujolais Mine, and then as it progresses up into the coal seams, they finger out into all different directions, but ultimately they all come back to a single exit.
Q Okay. Okay. Thank you.

Just one other follow-up question on something

that's just discussed recently, and that was the end-pit lake. And, you know, I think we're clear there's no plans to put fish in at -- at least at this point in time.

And it's never been explicitly said, but I would interpret that to be because there's some uncertainty that -- about the quality of the water being capable of supporting fish. Is that the reason, or is there a different reason?

A MR. HOUSTON: I think we would like to see a lake that has water qualities capable of supporting fish. We're -- you know, with the issues related to westslope cutthroat trout, I think it's a complex question that we -- we would want to discuss with the, you know, DFO and AER to see if they consider stocking a lake like that as -- as an additional risk to the westslope cutthroat trout. You know, if -- just we don't want to introduce a new issue into -- into that -- that discussion.

Q Okay. Thank you.

A Yeah.

THE CHAIR: Those are all my questions. Mr. O'Gorman was fairly thorough in his questioning, so there's not much left to be done.

So those are all the Panel's questions.

Mr. Ignasiak, any re-direct?

MR. IGNASIAK: No, sir. None. Thank you.

THE CHAIR: Okay. So thank you very much to this panel for -- for all the time this week.

So just two housekeeping items before we depart. So Monday morning at 9 AM we will resume with the direct evidence from other participants. We'll start with the Government of Canada, followed by CPAWS, and then the Coalition. That might be as much as we can get done Monday. There is some possibility, if things go quicker than expected, we might get to Mr. Rennie. And then there's also Timberwolf and Livingstone Landowners Group. But it seems a little more likely they will occur on Tuesday morning.

The other item is just to go back to Mr. Ignasiak's suggestion about potentially combining the air and the wildlife health risk sessions into one. We did take a look at this kind of over the lunch break. And while we agree there's probably some efficiencies to be gained, it's not clear that this would allow us to totally complete the hearing by the end of next week if everybody takes as much time as they currently asked for, and we didn't reduce any of those times. But we recognize it could go a little faster. So it seems like there's still a possibility we may have to sit on the Monday of the following week, and/or the Tuesday, even if we combined.

Having said that, there does seem to be some advantages to that approach, which I'll just kind of outline our thinking. In addition to what Mr. Ignasiak suggested, which was having the air and health risk witnesses on the same panel, that might be an advantage.

It would allow at least some of the panels in that later wildlife life health session to sit probably a bit earlier within the time frame that was probably originally contemplated for their witness -- witnesses. And it does keep the door open to completing the hearing next week, you know, if things go quicker than proposed. But the Panel is not making a commitment that that will happen at this point. There's just a few too many uncertainties.

So the Panel's open to this. We would like to hear from the other participants. It's late today, so what I'll suggest is if people want to send an email to the secretariat staff, that would be fine; otherwise, I'll re-canvass the parties first thing Monday, because, again, not everybody, I think, is even here this afternoon. So out of fairness, I would like to hear from the other participants.

So any questions about that?

Okay. With that, apologies for the very long day, but this panel is now done. So we'll see everybody on

Monday morning. Thank you very much.

A MR. HOUSTON: Thank you.

A MR. YOUL: Thank you.

(PANEL STANDS DOWN)

PROCEEDINGS ADJOURNED UNTIL 9:00 AM, NOVEMBER 23, 2020

CERTIFICATE OF TRANSCRIPT:

I, Claire Forster, certify that the foregoing pages are a complete and accurate transcript of the proceedings, taken down by me in shorthand and transcribed from my shorthand notes to the best of my skill and ability.

Dated at the City of Calgary, Province of Alberta, this 21st day of November 2020.

<Original signed by>

Claire Forster, CSR(A)
Official Court Reporter

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