MANITOBA CLEAN ENVIRONMENT COMMISSION

HEARING

VIVIAN SILICA SAND EXTRACTION PROJECT

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Transcript of Proceedings
Held at Mennonite Heritage Village
Steinbach, Manitoba
MONDAY, FEBRUARY 27, 2023

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MONDAY FEBRUARY 23, 2023
UPON COMMENCING AT 9:30 A.M.
MONDAY, FEBRUARY 27, 2023
UPON COMMENCING AT 9:30 A.M.

THE CHAIRMAN: The record I'll remind people to identify themselves before they speak. Let's get started. I will endeavor to start every day at 9:30 A.M. sharp, with the exception of March 6th here in Steinbach and March 13th in Beausejour where, on those days, we don't have a morning session. I would like to acknowledge that we're meeting here today on Treaty 1 Territory, the original lands of the Anishinaabe Cree Oji-Cree, Dakota and Dene People and on the homeland of the Metis Nation. I'd like to welcome all of our participants and the proponents of the project, Sio Silica and other people that are here as participants today, and observers. My name is Jay Doering and I'm the Chair of this panel that will be conducting the review of the Sio Silica Sand Extraction project. I'd like to now ask the members of the panel to introduce themselves and we will start on my immediate left.

MR. GILLIES: I'm Ian Gillies. Sorry, my volume seems to be pretty high. I've been a Commissioner with Clean Environment Commissions since 2017 and have worked on four panels now.

MS. STREICH: Hi, I'm Laurie Striech. I've been -- also been a member of the Clean Environment Commission since 2017, and this is the third project that I've worked on.

MR. JOHNSON: Good morning. My name is Terry Johnson. I've been on the Clean Environment Commission now for about six, seven years. As regards to a bit of my background, if you haven't seen it on the CV on the website, my wife Joan and I, and our family, were born and raised south of the little village called Matson, Manitoba where we farmed there. And during that period, I went to college and then also worked for Manitoba Hydro in the engineering and construction field for about 15 years. And then, after that, we -- we started up a full family farm operation and did so right up until our retirement.

THE CHAIRMAN: Thank you, Ian, Laurie, and Terry. Chairperson speaking. Thank you. So, the staff present today include the Commission Secretary, Peter Crocker. Peter, raise your hand please. Thank you very much. That's the person you will go to if there are issues to discuss. Our Commission's administrative assistant, Courtney Harmer is at the back. Courtney, where are you? I don't see a hand waving. She must -- oh, she is there, is she? Okay. Courtney is the person you would have met on your way into the room. We also have our legal counsel, Bill Bowles. Bill, raise your hand, please. There he is. Also at the table is Bob Armstrong, who is our writer. Bob, thank you. I'd like to now ask that you silence the ringers on your phones, including myself. That's my own cue. If you're a participant and you're speaking, I'll ask you to come up to the mic at the small table, here in front of me, and please remember to turn on the mic when you speak and identify yourself. The transcribing is being done remotely, so they're not -- they don't have the advantage of being able to see you.

Most of the hearings, as you know, will be here in Steinbach with a session in Anola and a week spent in Beausejour. The Silica Sand Extraction project is located near Vivian, Manitoba, and we hope to hear from the residents of that area, and their various communities that make up the area, over the course of the next three weeks.

In terms of a little background, we are

here today because on November 15th, 2021, the Minister asked us to hold public hearings to review the environmental impact statement prepared by then, Can White Sands, now Sio Silica Corporation for the Silica Sand Extraction project. We are guided by amended terms of reference issued to us by the Minister on January 13th of 2022, and under those terms of reference we are to, and I quote, "conduct a technical review of the *Environmental Act proposal* and the hydrogeology and geochemistry assessment reports, provide advice and recommendations to the Minister regarding potential environmental and health effects of the proposed sequential installation, operation, and decommissioning of Silica Sand Extraction wells for the Silica Sand Extraction project, hold public hearings to provide members of the public the opportunity for input, prepare and file a report with the Minister." These terms of reference define our scope and will guide this panel. But more specifically, for me, as Chair, they will help me to exclude submissions or questions that are outside our terms of reference or are repetitive in nature, limit questioning where participants have similar interests in the proposed development, and limit the duration of a submission. Our report to the Minister is to outline the results of the Commission's review, document what we heard and provide advice and recommendation for the Minister's consideration.

These hearings are scheduled to go on now for up to three weeks. We have hearings in Steinbeck this week and next week, one day in Anola, and the third day -- and the third week in Beausejour. We will hear presentations from participants seated at the tables here in this room. During the final week, we will hear remaining presentations, a rebuttal from Sio Silica, as well as closing arguments from all participants and the proponent. We have a lot to accomplish in the next three weeks. I need your cooperation to help things move in a timely manner. I will do my best to keep us on track each day, and I'm counting on you to do so as well.

Anyone who has an interest in this project is welcome to attend these hearings and is also welcome to make an oral statement. There is no requirement that you make a statement, but if you wish to do so, we ask that you let Courtney Harmer know, who I introduced at the beginning of my remarks, please let her know so that we are aware you wish to speak. The oral statement is a chance for you to give those present your personal knowledge, your views, as well as any concerns you may have about the project. I would like to note that you may give your oral statement in an Indigenous language, if you wish. We would ask, though, that you have someone that can translate for you for the benefit of those in the room and on the panel who may not speak that language. We also welcome statements in French, and again we would ask that you have a translator present. Members of the public who make an oral statement will not be subject to questioning. The panel may ask for clarification, but only if there are one or two things that we may not have understood. But generally, there will be no questioning of members of the public who make presentations.

I would also like to note that if there is anyone in your community, or generally from the area who is unable to attend sessions but wish to provide us with a written statement, they are more than welcome to do so. A written submission may be by way of a letter, an e-mail, or they can even go to our website and send us their comments directly. Although the Commission had previously indicated written submission from the publics were due February 13th, 2023, we will continue to accept them until the record closes on March 24th, 2023.

As mentioned earlier, all of our hearings are recorded. This is a requirement of the *Environment*

Act. Transcripts are produced as quickly as possible, but going to our website you can read copies of the verbatim transcript of whatever we heard on all previous days. We will be starting our morning sessions promptly, as I've indicated, so please be ready to go at those times. There'll be a short break in the morning and another one in the afternoon, and we'll do that and where there is an opportunity or an opportune time to make a break.

That's all I have to say by way of opening comments. Are there any questions on that so far?

Okay. I would now like to welcome Siobhan Burland-Ross, who's the Acting Director of Environmental Approvals to provide an overview of the provincial licensing process. Over to you, Siobhan.

MS. BURLAND-ROSS: Good morning. I'm Siobhan Burland-Ross. I am the Acting Director of the Environmental Approvals branch with the Department of Environment and Climate in Manitoba. And this presentation will be a very short summary of the environmental assessment and licensing process, outline where we are in the process and the role that these hearings will have in that process.

So, environmental assessment and licensing is required in Manitoba prior to the construction or operation of certain activities or developments, and that is required by the *Environment Act*. The classes of development regulation specifies which activities and which developments require a licence.

This Sio Silica Sand Extraction project is considered a Class 2 development under that regulation. And although there are three different classes of development listed in the class of development regulation, the assessment and licensing process is the same. All of the environmental impacts are assessed and considered prior to making a licensing decision. The significant differences are the cost of the -- of the application fee, and for Class 3 developments, the decision is made by the Minister, whereas for Class 1 and 2 developments, the decision is made by the Director of the Environmental Approvals Branch.

So, for this project, an *Environment Act* proposal was filed on July 23rd, 2021. This document outlines the proposed activities and identifies the potential environmental impacts of the project along with proposed mitigation measures. This proposal was posted to our department's online public registry, advertised in the Winnipeg Free Press and the Lac du Bonnet Clipper, and open for public comment for a period of time. The public was invited to review the proposal and to submit comments. At the same time, the proposal was provided to our Interdepartmental Technical Advisory Committee for review, and the deadline for submissions from both the public and the Technical Advisory Committee was October 7th, 2021. The comments that we did receive from the public and from the Technical Advisory Committee were provided back to Sio Silica for a response and placed on our online public registry. These comments included requests from the public for a Clean Environment Commission hearing for the project and because we received those concerns and those requests, a decision was made as to whether or not to recommend that a public hearing be held. Responses were provided to the department from Sio Silica, providing additional information to those requests, and these responses were also played on -- placed onto the public registry.

Following a review of all of the concerns raised through this assessment licensing process, as well as the additional information received, the Director of the Environmental Approvals Branch made a decision to recommend to the Minister that a Clean Environment Commission hearing be held. Subsequently, the Minister issued a terms of reference to the Clean Environment Commission to hold a public hearing, and on February 3rd, 2022, the Director of Environmental Approvals Branch notified the Clean Environment Commission that the hearing process could commence.

All of the information pertaining to the submissions and the reviews are available on our online public registry and that includes the proposal, any additional information submitted by Sio Silica in response to questions and comments from the public and the Technical Advisory Committee, along with the public and Technical Advisory Committee comments.

This project is File number 6119.00 on the public registry and is available for -- for anybody to look at.

Following the conclusion of this hearing, the Clean Environment Commission will file a report summarizing the hearing and recommendations to the Minister, and this report will be considered by the

Director of the Environmental Approvals Branch prior to making a licensing decision.

We look forward to the next few weeks and we will be listening. We're here to listen and we'll be taking into consideration everything that we hear. So, thank you.

THE CHAIRMAN: Chairperson. Are there questions for Siobhan on those handful of slides? I see none, so thank you very much.

Okay, we will now move to opening statements from the proponent and the participant and these will be approximately ten minutes in duration. And yes, I will be timing you so if you hit your ten-minute mark, you will see my hand go up.

MR. DUNCANSON: Good morning, Commissioners, Commission staff, and everyone here this morning. My name is Sander Duncanson. I am legal counsel for Sio Silica, and I'm pleased to be presenting the oral statement on behalf of Sio this morning. We don't have any formal presentation. I'll just make a few brief comments about what you're going to hear from Sio over the course of the rest of this week.

Appearing with me in the hearing is my co-counsel, Jesse Baker, who is sitting beside me at the front table. And as you can see, there are a number of other folks from Sio and their consultants who are here this morning as well, and you'll meet many of them over the course of today and the rest of this week.

We've all gathered together today, and for the next few weeks, to consider the environmental effects of Sio's proposed Silica Sand Extraction project. As we just heard from Ms. Burland-Ross, the Minister of Conservation and Climate referred this project to a CEC hearing because some local stakeholders requested that the project be fully vetted. And we fully respect the Minister's decision to refer this project to a hearing and we welcome the opportunity to get together and discuss this project in more detail with all of you over the course of the next few weeks.

This project is quite different than the Manitoba Hydro mega projects that the CEC has typically considered in its past hearings. Those projects affect large areas of forest, wildlife habitat, and aquatic ecosystems. This project that we're here to talk about over the next few weeks has a relatively small footprint, and it's located in an area that already contains extensive development and agriculture.

The project will consist of a number of individual wells, similar to typical water supply wells, that will be drilled and operated over a period of weeks in any given area before moving to the next area. These wells will be connected to some small mobile equipment and above ground slurry lines, but after the short period of extraction operations in each area, Sio will close the wells and reclaim the disturbed land, allowing it to return to how it was previously. As a result, the effects of this project on the surface environment will really be quite minor.

Sio hired a team of expert environmental scientists to review the proposal, you'll hear from the leads of that team later this week. And they concluded that the project will have minimal or no effects on key receptors like surface water, fish, soils, vegetation, and air quality. They similarly concluded that impacts of the project on wildlife will be negligible due to the small amount of vegetation that will need to be cleared for this project and the fact that Sio only proposes to clear vegetation outside of the breeding bird nesting season. For these reasons, very few of the comments from participants, the public, and the CEC's consultants to date have focused on these types of environmental effects on the surface. Instead, the focus for most parties has been on what will happen underground as a result of this project.

As I'm sure everyone in the room knows by now, Sio's wells will be designed to extract silica sand that is naturally occurring in this part of the province. As you'll hear later this morning, silica sand is a critical resource for many industries, and it is in short supply globally. But it exists here in a formation that's about 60 metres underground, which also contains an aquifer.

Sio is proposing to drill wells that will lift up a slurry of sand and water from this formation, removing a small fraction of the total sand that's contained in it. Sio will then separate the sand from the water at surface, run the water through UV treatment just to make sure that the water does not get any bacteria in it, and then it will re-inject that same water back into the formation where it came from. Sio will not be putting anything underground that was not there already, and the reinjected water will be reinjected with only the force of gravity. Sio will not be adding any pressure to the injected water. The net amount of groundwater that will be removed from the ground for this project will be similar, for example, to the operations of a golf course, and smaller than something like a gravel quarry.

As you'll hear more later today, the type of process that Sio is proposing is known as a room and pillar approach to mining, where minerals are removed underground to create small void spaces called rooms, and they are separated from each other to create what are called pillars. Room and pillar mining operations are common all around the world, including across Canada, and they are a proven and safe method to mine underground resources without causing the impacts of a big open pit mine.

Again, Sio went out and hired experts to make sure that its proposal was designed appropriately and that it would not cause any negative effects underground. The two main areas of focus for these studies were first geotechnical studies, which essentially look at the stability of the rooms and pillars created by the sand extraction given the types of underground formations that exist in the area, and second, hydrogeology and geochemistry studies, which look at the groundwater to make sure there are no negative impacts on groundwater quantity, flow, or quality. For both of those technical areas, Sio not only hired industry leading experts to assess the project's potential effects, but it also hired third party reviewers to look at the work of Sio's experts and confirm it was done appropriately. Sio's experts and the third-party reviewers determined that the project design was valid and that there would be no negative effects on groundwater. For the most part, the consultants hired by the CEC, and the participants during this hearing process, have validated the work performed by Sio's experts and their conclusions. As often happens when you get a number of different experts together, sometimes they don't agree on everything and that's something that we will let the experts speak more to over the course of this hearing. But Sio is confident in the work that it is done for this project, and it is confident that this project can be carried out in a manner that does not cause adverse effects on groundwater or other environmental components.

So, with that, I'll just finish by outlining who you'll meet from the Sio team this week and the order of Sio's presentations. After the opening statements are finished this morning, Sio will first give a high-level overview presentation about the project and its company to provide some context for the rest of its presentations. After that, Sio's technical experts and third party reviewer for geotechnical issues will present on the work that they did for the project and their conclusions, after which participants and the CEC can ask questions of them and Sio about any geotechnical related matters, and that's expected to last until sometime tomorrow. Then Sio's technical experts for groundwater will present on the work that they did for the project and their conclusions, both from a groundwater quantity perspective as well as groundwater quality, and again, participants and the CEC will then be able to ask questions of those experts and Sio about any groundwater related issues. And that's expected to start tomorrow and last likely until sometime Thursday. And then finally, once that's all done, Sio's lead environmental consultant, AECOM, will provide an overview of the rest of the environmental assessment that was done for this project, as well as why the project permitting was approached in the way that it was. And again, participants and the CEC will then be able to ask questions of AECOM and Sio about those matters, and really any other matters within the scope of this CEC process that were not already covered by the geotechnical and groundwater panels, including the overview presentation that Sio will provide later this morning.

So, Commissioners and everyone else in the room, thank you for taking time out of your busy lives to be with us here today, and later on this week, and the next few weeks. We are genuinely excited to be able to spend the next few weeks with you talking about what we think is a very important project for the province and its economic development in the future. Thank you.

THE CHAIRMAN: Chairperson. Thank you, Sander. Great opening example, ten minutes on the nose. Dennis, I believe you are up next. Just introduce yourself.

MR. LENEVEU: Sorry?

THE CHAIRMAN: Just introduce yourself.

MR. LENEVEU: Okay.

THE CHAIRMAN: (inaudible) ---

MR. LEVENEU: Good morning. My name is Dennis LeNeveu, and my background, I worked for 20 years at Atomic Energy of Canada. I started out as the industrial safety and radiation protection officer for the Whiteshell Nuclear Establishment. And then, I did work in high-level nuclear fuel waste management. I was the vault modeller. And after that, I did some consulting work including the IEA underground carbon sequestration project in Weyburn. And I was asked to help with this project. I've done some other intervention in the Energy East, and so I've been involved in this project as well. And now, I'll just go to my opening remarks.

The Vivian Silica Sand Project has been characterized by missing inadequate and misleading information, and -- from the outset -- and evidence from the outset. The project should never have proceeded to this stage without the information deficit being addressed. Two requests for the IAAC designation, that's federal, for the Vivian Sand Project have been denied. The reason for the first denial -- first denial on

November 16th, 2020 included the statement, "there is limited available -- information available to assess whether the Vivian Sand Extraction Project has the potential to cause adverse effects within federal jurisdictions or adverse direct or incidental effects. The limited project information has never been properly addressed." The second reason for denial on December 7th, 2021, included the statement, "Provincial and regulatory and legislation -- legislative mechanisms include provincial Crown consultations that will be carried out for the physical activities to understand the potential impacts to Indigenous peoples and their rights as recognized and infirmed under Section 35 of the *Constitution Act*." The Manitoba Department of Natural Resources in Northern Development, responsible for implementing the Section 35 consultations, has not responded to a request concerning the scheduling of the Crown -- provincial Crown Indigenous consultations. The hearing has been allowed to proceed without input from provincial Crown led Section 35 Indigenous consultation. Most of the evidence of the project detriment given in my public comment submissions and the submissions of others in the approvals process prior to the hearing, have not been addressed. Three motions before the information request, procedures from Our Line in the Sands, Manitoba

Environment, MSSAC, and myself, requesting delay of the hearings until rectification of material project deficiencies and completion of six material actions that could not be addressed in the IRs were denied. The 20 IRs requests documents from me, in the two rounds were inadequately answered or deemed irrelevant to the extraction proposal by Sio Silica confirming the completion of material actions requested in my motion were required. An IR dispute request filed by me with the CEC, that requested hearing procedures for resolution of IR disputes be followed was refused by the panel on the grounds that the issues could be addressed during the hearing. The missing information evidence required to resolve the IR disputes requires extensive field testing, data gathering, and analysis, that cannot be addressed by examination of Sio Silica witnesses during the hearings.

On January 24th, 2023, Sio Silica, after the closure of the IR process, filed a revised extraction plan that constituted a major project alteration. The revised plan was missing essential information such as cavity span resulting from various numbers of wells per cluster, separation, distance between extraction clusters, and proposed year of extraction. I submitted a motion requesting the data supporting the calculation, missing information for the revised plan be submitted by Sio Silica. The panel denied this motion, stating the issues could be raised during examination of Sio Silica witnesses. Missing information of the type requested cannot or will not be provided by examination of Sio Silica witnesses during the hearing. If the missing information that was not provided in writing for the IR request, and the requested information is not provided during examination of witnesses, there is no further recourse for such essential information to be provided.

In my opinion, the completion of the hearing schedule without delay has been given precedent over the requirement of the proponent to supply essential missing information and thus, damaging the entire process. The serious potential -- the environmental and public detriment from this project cannot be properly addressed in the hearing as presently constituted due to persistent lack of essential information. Nevertheless, I plan to proceed as a participant in order to go on record the evidence supporting the -- the potential detriment of consequences of the project.

The lack of information is a systemic problem that is beyond the powers and the mandate of the

CEC hearing to address. When I was engaged with the developer of the vault model for Canada's high level nuclear waste disposal (s), the funding and project management was from a third party independent waste management organization and not directly from the nuclear industry.

Similarly, project assessment throughout Canada should be managed by a third party government agency funded by the proponent. The agency would be responsible for hiring the technical expertise necessary to conduct the environmental assessments.

The systemic problem of missing information, and only information presented that is beneficial to the proponent, will persist until independent third-party funding is implemented for project assessments.

THE CHAIRMAN: Thank you very much. Also well in within time. Who is speaking for Our Line in the Sand?

Sorry, I should have identified myself too. It's the Chairperson. Byron, please take the mic. Hello?

UNKNOWN SPEAKER: (inaudible) ---

THE CHAIRMAN: Can you please come up to the table and take a microphone and identify yourself. I'm curious the nature of the intervention here. We're just doing opening statements.

UNKNOWN SPEAKER: (inaudible) ---

MR. HALKET: That's the mic? Good morning, everyone, Chair, CEC. I have a comment about that opening statement about the mining extraction. And I represent -- I am -- my name is Ian Halket. I'm a hydrologist. And I am with Peguis First Nation, and we have a number of concerns about this project, but one of them is the extraction process. And that is the room and pillar mining technique that was alluded to by the lawyers for a statement. And he said ---

THE CHAIRMAN: Ian, I'm going to -- I'm going to stop you. I don't believe this is the correct point in our -- in our schedule to be raising issues. You will have an opportunity, but right now, I would like to proceed with opening statements, please.

MR. HALKET: Well, I thought it was an unfairly false statement that was made.

THE CHAIRMAN: You can ---

MR. HALKET: I think (inaudible) should clarify that.

THE CHAIRMAN: Briefly.

MR. HALKET: Briefly, the comment was that it's a common and successful mining technique. It may be in a dry -- in a dry medium, but this is an aquifer we're talking about, that is wet. And this technique, according to our questioning of Sio Silicate (sic) before this, when they met with Peguis, this technique has never been tried before. And I think that's a very important piece. And the lawyer was alluding to the fact that this is a common and successful mining technique. It is not. According to our questioning of Sio Silicate (sic) about two months ago, three months ago. And I thought I would just make that statement right now because I think that was misleading, and it comes to the point of our second speaker, who was in his introductory remarks. Anyway, I leave it there. Thank you for allowing me to say those few words.

THE CHAIRMAN: Chairperson. Thank you, Ian. Over to Our Line in the Sand.

MR. WILLIAMS: Good morning, Mr. Chair and members of the panel. My name is Byron Williams of the Public Interest Law Centre. I'm appearing with my colleague, Chris Clawson, and this is a joint presentation on behalf of the Manitoba Eco-Network and Our Line in the Sand. And to the panel's left will be Mr. Grant -- Glen Koroluk, from the Manitoba Eco-Network, the second row there. And then, from Our Line in the Sand, are Ms. Janine Gibson and Ms. Tanzi Bell. And we're pleased to be here today and thank you for this opportunity.

Moving to Slide 2, we -- we can't start this presentation without emphasizing the importance of water, and the central importance of these aquifers to the community of Vivian, to the broader region, and to the well-being of our province. And whether we look at the language of Manitoba telling us that water is central to the wellbeing of our environment, our families, and our communities, or the language in the second and third quotes on this page from the Clean Environment Commission, just highlighting how important the Red River carbon it is as being the prime groundwater source for southeastern Manitoba.

From our client's perspective, healthy, sustainable aquifers are essential for the community and the province, and the stakes in this hearing cannot be higher. This is fundamentally important to the future of this region, to our client's communities and, to the province itself.

Mr. Chair, as we move to Slide 3, it's ironic and a bit disheartening to our clients in the course of this hearing how little reference is actually made to the *Environment Act* and so, we want to focus the attention of the panel to some key clauses from the *Environment Act* which guide your review. Obviously, the *Environment Act* is focused on ensuring that the environment is protected, not just for this generation, but for future generations. And underlying the *Environment Act* proposals and your mandate is (c) of 1 (1), which is "ensuring the utilization of existing, effective review processes that adequately address environmental issues".

And a key part of this hearing is in our client's submissions, you've been presented a very inadequate record by the proponent. You're not bound to accept that record. You're not bound to accept that there is enough information before you to make a determination and to fully assess all the environmental risks.

And we draw your attention to -- on Slide 4, important guidance from the Clean Environment Commission. This is from the Pembina Valley Water Cooperative review back in 2007, looking at Sandilands, looking at the source for recharge both for the Red River carbonate aquifer and the Winnipeg sandstone aquifer. And if you go to the second quote on this page, the Commission in that hearing said, "We have to have an integrated understanding of how this aquifer fits with its surroundings." We have to be mindful that that project, back in 2007, was setting a precedent for the region. Just like this silica extraction project is setting a very high-risk precedent for this region as well. And ultimately in that hearing, the Clean Environment Commission concluded it didn't have enough information in -- in respect to the sustainability of the water resources in the -- in the area and that was important guidance and clear indication that the CEC is not bound when it receives an impoverished assessment from a proponent, whether enabled by the department or not. Slide 5, we talk again about cumulative effects and the Class 2 projects. And that first quote on Slide -- Slide 5, again is from the Clean Environment Commission in the Pembina Valley proceeding. And it was saying that this region is too important. It's too important not to have future considerations or future projects come forward without a cumulative impact assessment. It said, "Cumulative effects should be considered in future assessments of this and any other development in the region."

There's so much going on in this region as the proponent adverted to. We can't understand the implications of this project for the region without understanding what else is going on in the region and what is reasonably foreseeable to go on. This is not radical. This is what the -- for Class 2 projects to have a cumulative impacts assessment, it's what the CEC recommended with regards to this region in 2007. It's what the CEC has recommended and is practiced on forest management plans.

On Slide 6, we outline fundamental concerns that have been raised about this process, raised by independent experts, including those retained by the Clean Environment Commission. On the first bullet, you see Arcatus talking about this project is being sadly, "A prime example of project splitting, abbreviated temporal scope, substantially smaller spatial scope, and exclusion of critical process -- project components." Just to give a sense of that, the first four-year planning horizon of, at the time, 1,680 wells, now less than that, could result in over 10,000 extraction wells over the next 24 years.

On the third bullet, you'll again see concerns about the process. This is from the independent expert matrix. Given that this project would set a precedent in the project -- in the province, and could lead to other projects in the same region, the absence of a cumulative impact assessment is an important deficiency.

Ultimately, as you see in the last bullet on this page, there's a conclusion, again from the CEC independent experts. That the project lacks the level of rigour that you would normally expect with the mining project.

Slide 7 tells us that these independent experts have identified significant risks with this project. Bullet 1, "A permanent change to the underlying geology at the sandstone layer." Bullet 2, "The -- the high risk that the shale aquitard separating the two aquifers will be unsupported and collapse." Bullet 3, 'Key concerns about the stability of the fractured and jointed limestone strati-bridge within the Red River carbonate." Slide 4 highlights the conclusions from Matrix, that there are two critical irreversible effects of the project in the hydrogeological system. Degradation of the Winnipeg Shale aquitard and increase in fracture density of the Red River carbonate. Collectively, the effect of the project in the independent view of Matrix is to increase the vulnerability of both aquifers.

Our clients ask, at Slide 8, how the CEC can properly assess the risks of this project. There's been no full-scale test of a well extraction cluster, no investigation of impacts related to groundwater quality related to the collapse of the shell barrier, and by there we're referring to the geochemical model, no commentary from Mines Branch in the Technical Advisory Committee process, no cumulative impacts assessment, no filing of a number of reports by Stantec.

Our clients, on Slide 9, take you back to the words of the independent experts in this proceeding. Independent experts tell us that one of the aquifers is to be extensively mined with a new and unproven technology, similar to what we heard from Mr. Halket. Hence, it is important to be cautious. Independent experts reminding us that relative to other proven techniques, this uncertainty justifies adopting a more precautionary approach. On the third bullet, independent experts reminding us that the importance of preserving the hydraulic isolation between aquifers is paramount -- paramount in a precautionary approach.

Just in closing, we go back to proverbs and they -- it reminds us that desire without knowledge is not good, and whoever makes haste with his feet misses his way. From our client's perspective, and throughout this proceeding, they will be making the point that the aquifer is too important, the risk is too great, and that this project should not receive an *Environment Act* licence.

Mr. Chair, with my little timer going on, for which I apologize, only seven seconds over, we thank you for this opportunity.

THE CHAIRMAN: Chairperson. Well, I could give you the good news. You actually had two slots, but you did it in one. All right. Well, thank you very much. Now over to the Municipal Silica Sand Advisory Committee. Who's speaking on behalf of MSSAC?

MS. BORYSKAVICH: Good morning, Mr. chairman, panel members. My name is Krista Boryskavich, and together with Orvel Currie and Micah Zerbe, we are legal counsel for the Municipal Silica Sand Advisory Committee. It's a group of eight municipalities within the project area, the rural municipalities of Tache, Sainte Anne, La Broquerie, Hanover, Brokenhead, Reynolds, St. Clements, and the City of Steinbach. MSSAC came together with the mandate to conduct an independent review and obtain information with respect to the impact of the proposed project in areas of municipal concern, including impacts on things such as municipal infrastructure, land uses, including any undue contamination, water quality, environmental impacts, including impact on the aquifer, and municipal services. While participating municipalities have identified multiple issues of municipal concern, including items such as potential increased traffic, dust control arising from the proposed project, amongst others, the primary issue of concern and the one that -- that we're going to focus on primarily at this hearing is the project's potential impacts on the aquifer and the municipal water supply.

So, the silica sand mining project that is the subject of this hearing is a long-term project that will be with us for decades. It's a project which will have a significant impact on the most valuable resource in the province, that is, the aquifer upon which the participant residents -- participant municipalities, I'm sorry, and many of their residents rely. So, this hearing, for them, is a matter of preserving a very valuable resource.

The participants' experts, and the CEC's own independent experts have identified shortcomings with the information presented by the proponent within the course of this process, some of which have been identified by Mr. Williams in his opening statement. We will address the shortcomings within the course of this hearing, but wish to highlight one specifically here, and again as -- as highlighted by Mr. Williams, namely the lack of analysis with respect to the long-term cumulative effects of the project.

It's critical, from the municipalities' perspective, that the impacts of this project are examined not just within the first four or five year period, but over the lifetime of the project, to ensure that all risks are considered and plans are put in place and monitored to address those risks. I -- I suggest to you that the ratepayers of these participant municipalities deserve that consideration.

So, to sum up, given the shortcomings in the information provided to date, it is the position of the participant municipalities that the proponent has not met its obligation to demonstrate that the project has minimal environmental or health safety risks, or that such risks are adequately addressed through long-term monitoring and response plans. The participant municipalities submit that until such shortcomings are addressed, it would be premature to recommend approval of a licence at this time. Thank you.

THE CHAIRMAN: Chairman. Thank you very much. Okay. I think we'll proceed then with the proponent, general introduction and geotech. Who from Sio Silicas is leading? Laura is standing, so I will take that as the cue.

Chairperson. While we're setting up, I will note we will have a -- a morning break, but as my pause was we're only 50 minutes into a three-hour session, so we'll try and break it about an hour and a half. So, for the proponents presenting, I'm not sure how that'll work, but we'll just play it by ear, if there's a natural break in there to stand and have a washroom break.

MR. SOMJI: All right. Good morning, Commissioners, participants, and the public. My name is Feisal Somji, I'm the founder and CEO of -- of Sio Silica. Just to start the presentation, just a quick safety meeting. Of course, we're all here in the middle of winter, no surprise. I hear the weather has warmed up considerably from last year. But just as a quick safety message, we're all driving, some of us considerable distances to get here for the course of this week and next and as well as to Beausejour, so please, check forecasts before you leave. Make sure you're in a good vehicle with good snow tires, that you're dressed for the weather, just in case you have to get out of your car en route, and have a good emergency kit, and please let someone know where you're going and what your ETA is, so that there is some support for you as you drive here and back.

Just a quick introduction of our -- the team that's here with me. You know, we've got, and you're going to see in the course of the next couple of weeks, a considerable amount of individuals. We've got, I think 16 or 17 individuals here, all the authors and -- and experts on the various reports and -- and analysis that we've done. Sio is a team-based company. We operate on a consensus. We have a lot of experts that have a lot of great strengths, we all have some weaknesses, and we support each other as long -- as we go along the way. So, what you'll see over the course of the next couple weeks is -- is three different panels. The panels are going to have a number of individuals. You may see us huddle often to -- to talk to each other before answering questions, and that's not because we're not confident, not because we're trying to put -- strategically think of an answer, it's because we all work as a team, we work as a consensus, and we all have our expertise along the way. So, on the flip side, you will have the opportunity to ask anyone here any question that you wish to.

Just an introduction to the team, myself here at the table -- myself, I -- I started my career with a BSc in biology and aquatic ecology. My intent was to be a commercial pilot at the time. I was flying up north, bush planes, when Chuck Fipke announced the discovery of diamonds, and flying all the guys in and out of mining camps. I ended up jumping ship and getting a job in a mining camp. After a year and a half of that, I went back to Vancouver, and said, you know, I'm not a bush guy and so, I got a job as an environmental manager, and that's how I started in this -- in this mining career. Through the course of that process working up north in diamonds, we created one of the first Indigenous joint venture partnerships and exploration services. Generally, my philosophy was the Indigenous groups get involved later when a project is discovered and -- and companies have tried to develop, but there's lots of opportunities for them to participate in the exploration phase.

Once Canada moved towards diamond production, I formed a three-way Indigenous partnership with the Dene, the Dogrib, and the Kitikmeot Inuit group. We formed the Aboriginal Diamonds group and we bid on the contract to value all rough diamonds being produced in Canada, and we won that. And so, we had a -- a great Indigenous partnership that looked to value all the rough diamonds being produced in Canada.

I went back to school, did my MBA and I've been working in the mining sector for 30 or so years. I went back to school, did my MBA, and have been working mainly in the business finance side, but my experience in the technical side comes from hands-on being in the field, and that's again why I rely on this great team behind me.

Quick introduction to Brent Bullen, who I think a lot of you guys have seen or heard in the various advertisements that we've been doing here and the YouTube series. Brent is our COO and our Director. I met Brent a long time ago when in school doing our MBA together. Brent comes from a very vast international experience in project development, be it for energy, for real estate, for development, commercial developments, schools, et cetera. One of the smartest guys that I know, he's a real problem solver, and he knows how to get to the bottom of what the problem is and find a suitable solution for -- for everything.

To my left, Laura Weeden. I met her -- she was a volunteer Girl Guide leader with my wife and getting to know her over the years. I saw she was a very smart, capable young engineer. She was winning all the Young Engineering Awards in Alberta. She -- we were lucky to have her join our team and she comes with a lot of energy construction project management background. She continues to work with a variety of volunteer groups and is a Chair of the Canadian Energy and Climate Nexus, which is looking at the environmental impacts of -- of energy across -- across Canada.

Sio Silica, who we are, we're a private company.

THE CHAIRMAN: Chairperson. Excuse me. We -- we neglected one teeny-weeny little thing, now that you've done introductions. We forgot to swear you in, so we will do that now.

MR. CROCKER: Commission Secretary. Just apologies for the beginning here. At the beginning, when people are going to be entering evidence into the -- into the hearing, we will ask them to swear or affirm. So, we will be doing that before every presentation going forward. So, when your other experts come up, we'll redo it with them, so ---

Do you, Feisal, Brent, and Laura, solemnly affirm that the evidence given by you shall be the truth, the whole truth, and nothing but the truth?

UNIDENTIFIED SPEAKERS: I do.

MR. CROCKER: Thank you.

MR. SOMJI: Thanks. So, Sio Silica, we were formerly known as CanWhite Sands. We're a Canadian company. There's been some questions about our shareholder base. We are, I think except for one shareholder, entirely held by Canadian individuals or -- or entities. We have our one project here in Manitoba which we are focused on, the Vivian Sand Extraction Project, and our goal is to bring this project into production, producing high purity silica sand, which is focused towards the green energy technology markets, primarily towards the decarbonization movement worldwide. Slide.

Our company values sustainability and protecting the environment. That's what we're here to talk about. It's always been our mandate. We recognize, we know, that the deposit that we are seeking to go after sits in a freshwater aquifer, we've known that since day one and we've spent a lot of years trying to figure out how to extract that sand without impacting the aquifer or the surface environments above it. And that is our goal. We respect the people, the community, and the environment, as we always have, and I think leading by example is how we should all behave and -- and hopefully we've managed to do that here in Manitoba.

We have a -- a very bold statement in our website. We want to be the most environmentally friendly mining operation regardless of commodity in the world. And I think we can do that. We can do that because of the way that we extract. We have no open pits. We have no large, underground operations. Because we move the sand in a slurry, we have no truck traffic, no dust. We have a simple wash process, and -- and you'll hear today how unique this deposit is in that for us to get to market, all it really requires is a wash with simple water and a magnetic separation. We recycle all our water, and so, at the net -- our net draw on the aquifer is very minimal as -- as Sander mentioned. So, we do believe in being one of the most environmentally friendly operations worldwide.

Our project is east of Winnipeg, down Highway 15 at the corner of 302, and that's where the -- the processing facility is looking to get established. And of course, as everyone has seen the various maps, production would happen to the south and southwest of that.

Just talking about the history of -- of the company. There's been a lot of questions about us using our product as frac sand for the oil and gas energy. Yes, when I came to Manitoba, that is what I was looking for. My last project was a gold project. Someone said to me in Calgary, 'You should look for frac sand'. I thought that was a great way for me to get involved in a Calgary-based project, Alberta-based, spend more time at home. I found some projects in Alberta, that they are now in production, producing sand for the energy business. I felt that looking at the industry, the best quality sand used in North America comes from Wisconsin. They put it on rail. They actually rail it right through Winnipeg and up to the Alberta basins where they get used. And there was no reason why Canada couldn't compete. There was no reason why Canada can't find a top quality or tier one frac sand for the energy business, instead of giving that business to the US. That chase led me out here to Manitoba, albeit my wife was hopeful I'd find it in Saskatchewan, being a Sasky girl, but I ended up here. And we originally looked up north where the -- the other frac sand, silica sand project is. And admittedly, I looked at it and said it's a -- it's a logistical game, we've gotta move it by rail, we've got to be closer to rail. As I was leaving

Manitoba, a friend of mine here in Steinbach said to me, you know, 'There is sand underground'. And so, that was the start of our hunt for the sand here, that we're here to talk about.

We were exploring, we were discovering. We were starting to work on the project as a frac sand company. In 2020, of course when COVID hits and the world slowed down, we had an opportunity to really look at the sand. What we found through the course of that year was it was a very unique sand deposit. It was a much higher purity in silica. But what you'll also hear is what's as important or more so, is the impurities. How much iron, how much phosphorus, how much other impurities sit in the -- in the silica. And that is the key component for things like batteries, semiconductors, solar panel, those are the things that they're looking for. And as we started to look at that, we realized that what you have here is a very unique deposit that is sought after all around the world, for all the various end products that are going towards the world hitting net zero carbon emissions.

Now as a business guy, they pay me a lot more than the frac sand (inaudible 01:18:12) as well.

So, for two reasons, from a business perspective and economic, there is no reason for us to be selling our products into the energy business.

From an altruistic process, you know, I want -- I, like everyone else here, want to see the world be less dependent on energy. We want to reduce our carbon emissions. We all want to move towards decarbonization and -- and the governments around the world are starting to talk about it and put mandates like the 2050 Accord in place to hit those. But what we also have to realize is we need the materials to do that. We need the input materials, we need the products, we need the technology, we need the know how to get there. And the world is going to move into a shortage of high purity silica, as importantly the impurities that are associated with it, and sitting here in Manitoba is a very pure product that has hardly any impurities that are going to be sought after all over the world. And I'm going to talk also later about how to bring that world here to Manitoba as part of our future growth. So, that was 2020.

In July 2020, we applied for the EAP, for the -- the processing facility. July '21, we have filed for the EAP for the extraction, which is what we're here talking about. And of course, we've all heard in November 2021, the CEC was announced.

In early 2022, we changed our name to Sio Silica and it was really a rebranding. We were rebranding ourselves to be a high purity silica company and project. We consolidated our subsidiary. Some of you might have heard of the company HD Minerals. A lot of our our claims were held under HD Minerals as a subsidiary. All of that has now been amalgamated into Sio Silica. So, CanWhite had to change its name to Sio. HD amalgamated into Sio. Slide please.

We've been in Manitoba now since late 2016. We've spent $35,000,000.00 so far, and primarily a lot of that -- that dollars was spent towards looking at how to extract the sand in a safe manner without affecting the aquifer whatsoever. We've done over 95 exploration, monitoring, and extraction wells, we've had 25-plus community and municipality meetings, and we've completed a variety of studies. The on-site investigation for vegetation, wetland, and wildlife, heritage resource impact assessments, hydrogeology and geochemistry assessments, geotechnical assessment, greenhouse gas emission calculations, 43-101 resource reports, traffic reports, and extraction project environmental assessments. And so, we -- we will be presenting with this team here, a variety of information, and data, and knowledge based on all of this work and all of these reports.

Let me just talk a little bit about what you have. We will pass this around, but initially, in this -- in this plastic bag is the raw material. This is the sand that sits under the ground. What you'll see is it's very white, it's very clean, but you'll see a few black flecks in there. What's interesting is when you look at most of the high purity silica projects around the world, the way I describe it is the impurities that are associated with it. It's like putting cream in your coffee. Once it's in, it's difficult, it's expensive. Sometimes you can't get that cream back out to get to a pure black coffee. In this case, the impurities sit as a pepper flake in a salt shaker. And that's why we can clean the sand up with just a water wash to get to the purity, and a low impurity level, that the world is demanding for things like solar panels, semiconductors, et cetera. And so, that's a sample of the -- the raw material. We'll also pass around the finished product, which you'll see is hopefully most of the black specks are out, and also some of the impurities lie in a kaolinite clay coating that just coats the sand grain and that gets washed out with simple water. And you'll hear Brent talk about how we capture that kaolinite because it is a salable product, as well.

We see that the raw material coming out of the ground is 99.85% silica. There's been a lot of questions about that, but we have done a variety of drill testing around the property. Stantec has vetted all of the work and -- and we are seeing, to our surprise, and of course excitement, that the quality is very consistent throughout the entire project area.

One of the things I'll also just mention is silica as a critical mineral. We all have heard about the hunt for lithium worldwide. We talked about that being a critical mineral for decarbonization and -- and lowering of greenhouse gas emissions, but there's a variety of other minerals that are also required and -- and silica is one of them. Australia has recently put it on their critical minerals list. The US now has -- has labelled it and it will move on to their critical minerals list shortly. We've had a couple of meetings now with the federal government and we're hopeful that Canada will follow suit and label silica as a critical mineral because it is, in fact, a mineral that is required worldwide for all governments to meet their mandates.

In terms of applications, I've mentioned it already, but this is a longer list of -- of what it's used for. Semiconductors, medical, food, solar panels, batteries, et cetera. So, what you'll see in here, which is not listed, is the energy sector, and again, although that was one of the reasons I came, it is not the reason why Sio Silica exists today.

Our resources are quite large. We've got a large land position. We have labelled it "Bru", "Den", and "Aly". They were just names that are in fact names of individuals that used to be with us and that no longer are. So, friends of mine that have passed away for whatever reasons. The project itself encompasses an area that has about 13 billion tonnes of sand in situ or below surface. When we look at our mining operation over the first four years, we're looking at taking out about 0.18% of the overall sand resource that's sitting here in southern Manitoba. Over a 24-year mine life, we're talking about 1.06%. So, again, I go back to that word, sustainability. We're not coming here to deplete the resource. We're coming here to responsibly harvest the resource. We're going to pull it out in a manner where we're not removing a very large percentage, less than 2% over a 24-year mine life, but what it does allow is for Manitoba and Canada to take a stage in the world seat of all things towards decarbonization.

When we look at -- at what the silica is used for, a lot of times you'll hear the word silicon and then you'll hear the word silica. Silica is the raw material. It's what we're talking about here, looking to extract. Silicon is the intermediary product that silica then gets transformed to. A variety of silicon materials like silicon metal, silicon carbides, fused silica, there's a host of them. Silicon metal, as an example, is then what goes to a semiconductor or a solar panel. Silicon carbide are materials that go into energy conversion materials. And so, what you have to do, and -- and sorry, and by the way, this silicon metal is produced by the sand here, from Manitoba and we'll pass this around as well for people to look at -- but what you need to do to convert silica to silicon is energy. And so, the three pieces that you need to have a successful silicon industry to then go into solar panels, semiconductors, is access to silica, you need energy, and you need transportation. And look at Manitoba, that's what you guys have right here. And so, our future vision for this company, and for this project, is to stop exporting silica from here out to Vancouver and overseas to Asian markets, over -- or East Coast up to Norway, Iceland where there's currently silica metal facilities operating. Those locations for those facilities are because of the energy rates -- energy availability, energy rates, and now as it's -- it's becoming very important, the source of that energy. Those energy are coming from renewable green energy sources like hydro -- geothermal and hydro. Manitoba has some of the lowest energy rates in the world at 30 megawatts or bigger, it's got green hydro energy, it's got silica, and it's got transportation. And so, our hopes are in the future, that we attract these companies to come here to Manitoba and start to produce semiconductors, solar panels, batteries here in Manitoba, providing an array of jobs and economic benefits. And that's -- that's the vertical integration story.

Some of you may have heard that we have been here with a company called RCT Solutions. They are a solar panel manufacturing company based out of Germany. They built a 2.2-gigawatt facility in Turkey, which is now the largest solar panel manufacturing facility outside of China. They are currently building a second facility, which is five times bigger, in India. And interestingly enough, they're completely funded by Canadian funds building in India. We have attracted them to come and look at Manitoba, and they are excited. They see the benefits. A ten gigawatt solar panel manufacturing facility based here in Manitoba would be about a three billion dollar investment. It would employ about 8,000 direct jobs and thousands of indirect jobs. And we see that as the first of several companies to come to Manitoba.

If I just go back to our little sand mine, if I call it that compared to the economic benefits and jobs that some of these solar panel guys will -- will eventually bring in, what do we do? We bring about $1.2 billion over 24 years to the -- to the province of Manitoba and that's in taxes, payroll, municipal charges, and that's over a 24-year mine life. Within the municipality that we will go into, it's about $2,000,000 to $3,000,000 a year of -- of taxable benefits. For the community and the province, over a 24-year period, we'll spend about $1.4 billion in operating expenses here in the province, and that is to hire all forms of supply services and supports that we would need over the life of the mine to support our operations. And that would result in a lot of small businesses that exist here to be able to expand, or entrepreneurs here in Manitoba, to finally get their dreams to come true and to -- and start their own company and build it from the ground up.

From local benefits, we would employ about 75 to 100 people full-time. We would have about 100 to 200 direct employment opportunities. We will build in some infrastructure to our facility, that means natural gas lines, power, cellular towers, et cetera, going out to our location, which would be an option for the local stakeholders to either tap into it and have the benefit of it, or not. It's not something that we would impose on anybody.

And of course, community involvements, we've tried to lead by example. We've been a sponsor of -- of a variety of events out in Springfield and in Southern Manitoba. We hope that people have seen that and we wanna continue to do that to help the communities in and around the project area growth.

So, with that, I'm going to turn it to Brent and he'll just walk you through the rest of it.

THE CHAIRMAN: So, Chairperson.

Maybe this is an opportunity for a five-minute stretch. We are almost an hour and a half in. How does that sound, Brent, before you get into it, rather than my interrupting you? Your call. I'm turning this one over to you. What do you want to do? How long?

MR. BULLEN: (inaudible) -- a break.

THE CHAIRMAN: Okay.

MR. BULLEN: Sure.

--- OFF THE RECORD ---

--- BACK ON THE RECORD ---

THE CHAIRMAN: Chairperson. Okay, I'd like to get back underway. We've had our break. I'll turn the floor back over to Brent.

MR. BULLEN: Okay. Everybody comfortable? I'm going to talk a little bit about the extraction and how we bring this sand to surface, and how we do it with air. We're going to show a small video, and it's actually just airlifting sand in an aquarium. It's very simple. It's done with very little air, but it'll show you -- when we go to the next slide, is that going to start the video?

UNIDENTIFIED SPEAKER: (inaudible) ---

MR. BULLEN: Because I was going to explain what they're going to see, okay, before we start. So, you're going to see a fish tank. On that, there'll be a plexiglass plate. In there, there'll be a tube. That represents well casing that you would have for a water well. I didn't take it all the way down to the sand because when you look from the side, I wanted you to see the extraction tube that goes inside of the casing, it's smaller diameter. That creates a space between the well casing of a -- of a water well and the extraction tube that brings the sand and water up. Inside that is a smaller tube that conveys the air. You'll see the air go down and immediately return to surface, and as it returns to surface, it brings the water up, and as the water comes up, we'll bring it down to the sand interface and we'll bring sand and water when it comes to surface. The air, water, sand all separate and the water goes back down this space between the tube and the casing of the wellbore. And that's what happens in the field. It's -- it's that simple. It should have audio, so we'll -- we'll go. Okay. I mean it's -- it's quite simple. That video is on our YouTube channel. There's a link that you can just QR scan in your handouts. But let's go to the next slide.

So, with our field operations, you know we've mentioned we don't have truck traffic. You know when we -- when we go out, we produce our sand, we move it in a wet slurry. The wet slurry is brought to the facility. So, we're not using truck traffic. So, there's always discussion about road -- that there's demand on the infrastructure. We don't do that. We don't have dust. The sand is produced wet, it's moved wet, and it's put into a working pile wet, and then it's brought into a facility and the facility itself is negative pressure. That means, where the sand is, it's actually negative pressure to the atmosphere. So, if there was any form of -- of exposure, the negative pressure keeps the sand contained. Then at loadout facility is, through contained pressure, put into rail cars that are then sealed and shipped, and that's how we produce, move the sand, and move it to market.

The returning groundwater to the aquifer -- what's really important about this slide, sorry, I'll get my little laser pointer, here, this is the facility portion of it and this is already approved in -- in our --

in our previous application. When we talk about what we're doing in the field, that's this area here. So, one of the real important things to look at right here is what we call the sand only, this is a sand break because this is what happens at the surface when we extract our sand. You know, we have a well cluster, the sand comes up, we immediately take the overs away, and then we do a filtration of the unders, and the unders are filtered out with a -- a press system that takes it out at very fine, and then it's filtered, it's UV shocked, and it's returned to the aquifer. The sand is conveyed wet into a pumping station that picks up the sand into this contained slurry loop. There is no possibility of water from a slurry loop going into an extraction component here. So, there is no ability at all for contamination from a recycled slurry loop line into the extraction line. Here we take the water, we do the filtration, pick off our fines, or overs, UV treat it, which is a precautionary process, and then we put it back into the wellbore. And as the previous video showed, we return it at atmospheric pressure. There's no pressure applied. The formation takes it naturally. If we go on to the next slide, please.

I spoke a bit about this in the previous one. You know, it's very simple. I mean, our whole process is simple. It's -- it's air, it's water, it's magnetic separation to clean our sand, it's UV treatment, which is one of the most environmentally friendly ways to look at sterilization of water. It doesn't involve chemicals. We use filter press to take the fines out. So, when we're done, we have a very safe, reliable way that's used around the world to purify water and that's what we're doing to put the water back into the aquifer. Next slide, please.

There's been a lot of questions about UV light, and the ability for UV light to actually do a -- a precautionary shock to the water or sterilization. The UV light, people talk about UVT, that's the transmissivity of how far the light will actually go into our material, and the systems that we're using have UVT efficiencies that are down to 38 and they actually have UVT efficiencies down to zero, because they're used in the food industry for things like maple syrup, apple juice, and the UVT is used to a zero UVT. So, it's very successful, it's very robust, it's been used all around the world, and it's not a new technology to deploy, but it's the safest one to eliminate chemicals. Next slide.

So, we've had a lot of questions and we get a lot of feedback, and so, we thought we would talk a little bit about why we did an updated mine plan and when we looked at our updated extraction plan. So, during the course of the development, we're always looking at efficiency gains and understanding the formation and the sand. And so, we were able to obtain sonar imaging and we were able to obtain increased efficiencies. So, we did that and that led us to what we call Winter 2022, which is actually January 2022. We knew that we had new data and so, we should actually look at a new geotech model. And so, we commissioned the -- the workings of a new geotech model which was done. That then triggered us to look at an update. So, we went in, we did an exploration program in the summer time, and we drilled more wells and got more data, and we updated our geological model. And that geological model being updated then gave us updated placements for wells. So, with all this data, we went back, and we updated our mine plan. We updated the mine plan, and we amended it, and then we had Stantec review it. And so, Stantec reviewed it and approved it. But all you have, is you have a live process of efficiency gains, which means fewer wells, better productivity. We had a better understanding of the vertical nature, and the nature of the wells with the sand down below, and we applied it, and we brought those new methodologies to the market and had them vetted by our experts. Next slide.

That gave us our updated extraction plan, which people have seen. So, when we look at our updated extraction plan, you know, the key takeaways here is we now have a plan that is, in the first four years, we reduced our well count by over 400 wells, and more importantly, we were able to amend and update our spacings from our single well clusters, to our two well clusters, up to our five well clusters. And so, it's just an implementation of the learnings that we had from the year before into our amended mine plan, but it's just more efficient and it's an updated use of how this applies within the geotechnical model that our geotechnical experts will talk to you about when they present.

So, I think really, between Sander's opening remarks and Feisal's remarks, you know, we have our team of experts here. These are leads. These are the authors of reports. These are the experts that produced reports and put them in place. You know, we brought them here to answer questions and to obviously question others, but you know, we have a very fulsome, very in-depth, robust, set of panels. And without going through each of them, all the CVs are out there, but all of our experts are here and we're making them available. So, with that, I had a very short portion of our opening presentation and I'll conclude. And well, I guess next, we'll be getting into the geotechnical panel and presentation.

THE CHAIRMAN: Chair. Very good, thank you. So, are we calling up your experts? Is that what's next? And we will swear them in.

MR. CROCKER: Secretary. So, affirmations of -- of the crew up front. Do you, Steve Bundrock, Arash Eshraghian, and Douglas McLachlin, solemnly affirm that the evidence that will be given by you shall be the truth, the whole truth, and nothing but the truth?

UNIDENTIFIED SPEAKER: I do.

UNIDENTIFIED SPEAKER: Yes, we do.

UNIDENTIFIED SPEAKER: Yes, we do.

MR. CROCKER: Thank you.

THE CHAIRMAN: And Chair. Just so I know, who's Steve? Steve. Arash? And Douglas. Okay, great, please proceed.

MR. MCLACHLIN: Thank you, chair. Good morning, Commissioners, everyone here. My name is Doug McLachlin and I'll be starting the presentation of our geotechnical panel. And we're here really to provide a background to all the work that has been carried out to date to develop the geotechnical model, all of the field investigations that were carried out, the analyses, and the recommendations as a result of that. We will also be talking about next steps because we understand there's more work to be done and that's come out with the reviewers have said there's been gaps, and we will talk about some of those things that we know need to be done for the next steps.

So, our focus today, as I said, will be the geotechnical assessment, geological engineering assessment, and -- and specifically, we -- we've been looking at the -- the room and pillar design. There's a cavity that is developed, and a lot of work has been done first of all to characterize the subsurface conditions, because that's absolutely essential. So, understanding the geological conditions has been so important, and then taking those conditions, looking at the rock quality and all of the testing that's been done, to develop a model that ensures the stability of those -- those rooms in that room and pillar design. So, we have together, done a lot of detailed analyses and that's been done by Stantec -- very detailed geotechnical analyses, and then, it's also been reviewed by third-party independent reviewers including AECOM's reviewers, including the CEC's reviewers, as well. And so, we'll talk about the results of those reviews. And then, in terms of recommendations for next steps, we will talk about that as well.

So as mentioned, my name is Doug McLachlin. I'm a geotechnical engineer with 38 years of experience in geotechnical engineering. I'm registered both in the Province of Ontario and also here in Manitoba, and have worked on projects here in Manitoba in the past, including this one. I lead the geotechnical practice for AECOM in Ontario, based in Mississauga, near Toronto. I'm a subject matter expert for geotechnical engineering and investigations and assessments, and I lead a team of experts on rock mechanics, tunnelling, mining, and so, I'll talk more about that in a moment.

To -- over to my far left is -- is Steve Bundrock. He's a professional engineer with 22 years of experience. He is registered here in Manitoba, Alberta, as well BC, Yukon, Northwest Territories. He's a principal geotechnical engineer with Stantec and he's also a subject matter expert and has worked on this project and also over 100 other projects related to mining and mining -- assessing the impacts of -- of mine -- mine developments. And then, Dr. Arash Eshraghian, to my left, is also a professional engineer. He's got a PhD in geotechnical engineering, and he is also a principal geotechnical engineer, and he's been responsible for carrying out all of the detailed analyses that have gone into the geotechnical assessment and design.

This next slide here, in addition to the work done by Stantec, there's also -- there have also been senior review within Stantec. So, there's a couple of colleagues there, Wilhelm Greuer, who has got a PhD and and he is a technical reviewer within Stantec, to -- to review the work. Karl Xiao, also PhD, geotechnical engineer. And then, the other two engineers here are from AECOM, so, they're colleagues of mine, we work together. Both of them did their PhD's at University of Western, in Ontario, and they focused on rock mechanics, and done a lot of the similar kind of assessments as Arash, using a similar kind of software. And so, all of us have gone through, reviewed that, and in addition, there has been a -- and also the CEC has had their experts, through Arcadis, engaged experts to review the work that's been carried out. And most importantly, all of the -- the experts and the third party independent review -- CEC reviewer has -- has confirmed and affirmed the work that was done by Stantec, that the approach -- approach that was taken is appropriate and it also demonstrates clearly that with that high -- very high factor of safety of two, and we'll talk more about that in our presentation, that the cavern, or the cavity, or the room will will remain stable for -- for the foreseeable future. So, we can talk more about that. And we're here to answer any questions you have. We look forward to working together. This is an interactive process and we appreciate this process, and the input that we've had from the experts, and from everyone in this -- in this process. We really appreciate your participation. Thank you.

MR. BUNDROCK: Steve Bundrock speaking now, I'm a senior principal with Stantec. My goal here in these next few slides is to discuss the design basis for the geotechnical engineering completed for the project, starting out with the geotech's view of the extraction process.

So, as most of you are likely aware, at the top of the formation here is quaternary till, that's underlain by what to us is a very important unit, the Red River Formation, the carbonate limestone. Below that, your extraction target in the Carman Sand member, and directly above that is Winnipeg Formation Shale. For your awareness, we have fractured limestone, which we've encountered in some boreholes along the contact with the till, and the competent limestone, so put my pointer to use here. So, fractured limestone occurring up here, competent limestone below that, based upon borehole data. In some cases, fractured limestone below that. The Winnipeg Shale and your Carman sand.

And from a geotech standpoint, we -- we view this as room and pillar mining. The extraction process generates a cavity, a void in the subsurface, in the sand, which we refer to as a room, and adjacent to that, we have what is intact sand. We've actually found that while it typically is identified as unconsolidated or poorly consolidated, we find sand that stands up at vertical or extra vertical, in many cases and very often stands up at 65 degrees. So, yeah, the extraction leaves a cavity that acts as a room, and then next to that, we have the pillar.

And for everyone's awareness, we talked about this a bit earlier, in fact, yes, there are many, many room and pillar mines in Canada and elsewhere around the world, including in this part of the world. These are just a few of the projects which Stantec has worked on recently in this part of the world. And also, for the group's awareness, it is not uncommon that room and pillar mines are constructed in environments that include saturated materials, that include weak materials, and that include high pore pressures, even during mining. In this case, we have the advantage that we don't have human beings underground and so, we do not need to fully dewater the deposit.

Okay. Moving on to the site investigations. Arash, later on, is going to talk about -- about the analysis. This is all the information that we used to build up our understanding of the geotechnical conditions. As far back as 2017, we are looking at the geotechnical conditions at this site, just one borehole initially. Later in 2018, we drilled three targeted boreholes based upon the results of that initial work. In 2020, there was another borehole drilled for geotech, and then three more, in 2021. In addition, it's very important to note that we also have a lot of geological boreholes. I was just looking at these again this morning to confirm my recollection of what we'd looked at that, in addition to these 46 boreholes, which were targetted to understand the resource and understand the area geology, we actually had some additional data that was collected on things like Geotech, descriptions of the rock strength, descriptions of the rock structure. So, 46 there used to build up the model. In addition, the model was built based upon more than 1,400 non-Sio Silica boreholes. These are of varying quality as far as how definitively they were logged. Some of them have good descriptors, others -- others -- others are just very, very general. But typically, they are all logged for geology, which gives us a good indicator of the continuity of the geotechnical structures in this area, right? Whether or not we have dips in the formations, whether or not the formations have lots and lots of structure or very little structure, where they occur, how thick they are, et cetera. And then, these eight geotechnical boreholes that I've already discussed, which included geotechnical core logging. We send a geotech engineer and/or senior geologist out, and they're at the rig, they're collecting core samples from the borehole, undisturbed samples, and they are using those -- they're describing them in detail to understand the lithology, to understand the structure. They're looking at jointing, they're describing the jointing, whether or not the jointing is healed, whether it's intact, whether it's infilled, whether it's rough jointing, or it's smooth jointing. All things which contribute to how competent the rock may be. We also do point load testing. We bring out a testing apparatus, which is calibrated annually, which we use, and we collect rock samples, many, many rock samples and I'll show some of that to you later on. We collect many, many rock samples and we do testing right out there in the field. We develop rock mass ratings, which is a description of the strength of the rock. And we, from that -- in turn, we calculate a geological strength index, which Arash uses in his modelling. And then, we conduct additional sampling, and for later, laboratory testing. In particular, we do a lot of tensile strength testing and unconfined compressive strength testing, which is done in accredited laboratories in Canada both by Stantec and also by Geomechanica, was one of the accredited labs that we used.

In addition, you probably all -- well, many of you maybe you have heard of this, we've done ATV, OTVs, that's acoustic and visual scans. We put a tool down the borehole, which scans the interior of the borehole and gives us very reliable indicators of what the structure looks like intact. And then, also, we did side scan sonar. Put a sonar scanner down two holes after extraction, and even after several months after extraction, to assess the interior of the cavity formed by extraction.

Okay. This plan view is intended to show you the 24-year mine plan, but even more importantly, to talk about the thickness of the carbonate. Yes, it is true that the carbonate tends to thin towards the east side of -- of the planned extraction area and it thickens towards the west. And just wanted to also show you that where some of our boreholes are -- geotechnical boreholes in purple. You can see the ATV, OTV borehole, which is culled out up here. The side scan sonars were done here. And also, we had surface monitoring which we carried out. So, we did high resolution, high accuracy monitoring of surface subsidence during -- during extraction, and immediately after extraction.

And now looking at the stratigraphy again, we've -- you've already seen this once, but just to reinforce the numbers that were developed based upon our review of not only of the geologic model, those many boreholes, but more importantly, based upon the geotechnical model which is narrowly focused on thoroughly understanding this -- these units. So, up to 35 metres of till at the top, 115 feet. And then, below that, again the fractured limestone, up to 40 metres of competent limestone below that. That's your sedimentary rock, that's your Red River carbonate. It does have some bedding, it does have parallel joints. In some parts of of Manitoba, and elsewhere in the Red River, you may also encounter some vertical joints. That's up to 40 metres thick again. Zero to five metres of fine-grained, clastic sedimentary rock down here, the Winnipeg Shale. And then, along with contact between the shale and the competent limestone, we also found there was some fractured limestone in those zones. And then, your sand, Carman sand member below that. Fine to medium, well sorted, well-rounded, poorly cemented sand.

And now, just by way of description of the geologic structure in the area, right? The fractures, the joints, the discontinuities that are found in the sand, which, on the one hand, they're your best friend if you're drilling a water well, because they -- that's -- your aquifer moves through these fractures. In the case of geotechnical engineering, fractures are typically not our best friend. We are looking for areas of competent rock. So, we're looking for what you see here in the middle. This, on the right-hand side is the actual optical presentation of what the inside of that borehole looks like. You can see the bedding in there. You can also see that it is almost exclusively intact through here. And then, this is the acoustic scan on the left-hand side. Again, you can see that it is almost completely intact. And by comparison, if you go to the top, here's the top of the member along the contact between the till and the competent limestone. This is the area where weathering has occurred overtime, and as a result, you tend to see discontinuities. You see these fractures that move through here. You can see the little red lines in the acoustic scan. You can see these darker lines, many of which are actually healed, but are both vertical and horizontal occurring in -- in this scan. And then, again down at the bottom along the contact with the sand, you can see some more fractures, most of these horizontal in nature, but again, it is a fractured zone.

And -- and for everyone's awareness, as geotechs, we tend to not rely upon this, and we'll probably talk about this quite a bit today, the fact that the geotech engineers, we did not rely upon this Winnipeg shale to provide support to -- to maintain our room and pillar mining method. We relied just upon the competent package here in the middle, this competent limestone, and so, we used a simplified version, what we believe is actually a very conservative version of the geology to complete our analysis with just a thick load on the top, which is the till, with the -- only the competent section of the limestone in between, and then the sand below that where your cavity occurs.

Okay. Just to give you a bit more information about what we do when we're out there at the drill, or in the lab, not too far from the drill. We're completing geotechnical logging and we're collecting information on particularly the -- the jointing is of great concern for us, all the discontinuities. From that, we -- we develop a rock mass classification. The rock mass classification is, in turn, used to develop the GSI, the Geological Strength Index, which is used for our modelling. Here's a list of the boreholes, the Geotech specific boreholes, the intervals that were logged. So, give you some indication of the amount of core that we logged. In some cases, we might not start logging right at the top of the borehole because we know very, very reliably from the geological and other drilling, that we're going to start out in till. We get very interested once we move from the till into the limestone and we log that sequence in great detail and with great attention. So, there's the length of our core logged, and you can see the GSI that's been assigned to it, which is based upon the Rock Mass rating. Some of you might ask about why we didn't calculate a GSI for these last three. We had actually completed all of our modelling for the report which is available -- the report which has been released. These holes, the final calculations on the GSI for this were not available when we did that modelling. We have since calculated those and all the GSIs in fact, are higher. They're higher than what we previously identified. They typically are at about 70. So, you can see also where we fall here in the Rock Mass Classification chart, which is used very commonly in underground mining, and other types of mining. We're in the good range and in upper range of GSI. And there is an image here, I know it's -- it's not extremely easy to see, but this is that competent section of the limestone. You can see it's all, for the most part, of similar colour. You can also see that it's predominantly intact. Some of these fractures are also mechanical fractures as indicated when we do an ATV, OTV. That shows us whether or not the drillers are drilling too aggressively and they're breaking up the core mechanically. And we found that well, that occurs pretty commonly, actually. So, ATV/OTV is just a very reliable way to more thoroughly assess it. I did bring along a couple of samples of that nice, intact, competent section of the limestone, which we can pass around later on.

Okay. Talking a little bit about the geotechnical field then laboratory testing results. We did show you our testing apparatus here. That's what a point load tester looks like. We have a geologist or a geotech engineer out at the rig completing that testing. They do both axial and diametral, which is across and along the long axes of the core. Gives you an idea of -- of the strength of the rock. And -- and we do that because we can do that with the -- with great accuracy, and it gives us just an awful lot of data points. It gives us a very thorough understanding of the strength of the rock. We're optimizing the data that we have available in every single borehole. In some cases, you might just collect four or five samples and send them off to the lab. In this case, you can see first borehole, we did 15 point load tests. Some bore holes, we did as many as 64 point load tests. And from those, we can do a correlation to UCS, which -- so, we can identify the unconfined compressive strength, which is used in modelling. So, we have those numbers which we deem to be very, very accurate. Then we also collect samples, and we send them off to an accredited laboratory. So, we send them to a third party accredited laboratory like Geomechanica and they complete some additional UCS, and they complete some tensiles, and -- and we're able to compare these tests to one another and further verify whether or not we did a good job of completing our point load testing, and whether or not they did a good job of completing their unconfined compressive strength testing. And then, you can see just here on the right, just wanted to give you an idea of -- of where we tended to fall. Bottom end of the range there on UCS, we had -- had something on the order of what? 34. Most of them tended to be higher values, so, up here in this strong range, 50 to 100 for strong rock, which is pretty consistent with what you might typically see for limestone in many parts of the world, including Manitoba.

And seismicity. Everyone here is probably aware of this, but Manitoba is a low seismic area. This is right from Geological Survey of Canada, the National

Building Code. Here at the project site, the peak ground acceleration is .002, and by comparison Vancouver, a high seismic area, .081, and Toronto .011. This is a 2015 map which we used in the 2022 report. We did check that there are newer values available. The 2020 National Building Code PGA is unchanged from previous.

The side scan sonar. For those you haven't seen this type of thing before, up here on the right, this is in plan view, so this is looking down on the cavity shape. You can see there's two different cavity shapes, axisymmetric here, and then a bit of a lenticular, call it a long, skinny shape. We saw this in one of the earlier bore holes and we saw a bit of additional movement in this direction later on. We expect that we will see different shapes. For modelling purposes, we did look at -- primarily at axisymmetric for stability analysis.

And we also did surface monitoring during and after extraction. We monitored at three boreholes from April to December 2021 using settlement gauges. The survey points were four to 20 metres away from the actual borehole. We were trying to avoid them being disturbed either by equipment, or other human activity, or from vibration from drilling. And they do measure deformations from zero to two millimetres -- or we did measure some zero to two millimetres of -- of movement. However, we have a one millimetre accuracy, which we understand is very, very high accuracy, and we've considered that no significant deformation is occurring, zero to very limited. And this just shows you relative to the borehole proper, you can see the monitoring points there for BRU 92-3, 92-2, and 92-8.

And with that, I'm going to turn things over to Arash Eshraghian, and he's going to talk about the analysis.

MR. ESHRAGHIAN: Thank you very much, Mr. Bundrock. My name is Arash Eshraghian with Stantec.

This slide presents a summary of our design basis and criteria, which is a summary of the principles, assumptions, and considerations that we used for evaluation of the stability of the cavity as a result of extraction of the sand. The life span of the project, the cavity lifespan, includes the operational life, means during the extraction of the sand, as well as many years beyond the extraction time. We -- we use a minimum stability requirement of 100 years after the extraction, and we believe that if the design provides a stable cavity for these hundred years, the -- the cavity will most likely be stable beyond those -- those years as well. Minimum factor of safety used for the stability evaluation in this case is two, which is a reasonably high factor of safety for this type of analysis. For example, for comparison, most extreme consequence dams, that if they fail, cause hundreds of loss of life, or widespread economic effect on the large area, they're designed for, the factor of 1.5. We -- we designed for factor safety two, considering the lifespan -- longest lifespan of the cavity. The extraction cavity geometry in the model is axisymmetry based on the side scan sonar data to date, and the depth of extraction based on the extraction plan is 20 metre within the sandstone material. The stratifications in the model, they're based on the geological model developed from hundreds of boreholes in the area, in the BRU area. But in the model, we didn't count on fractured zone of the limestone. We only count on the competent limestone as a bearing -- material. The limestone GSI, as we shown previously has design GSI 60. And we -- we know that the -- the site is located in a low seismic activity area and we don't believe that the -- the seismicity can control the stability of the cavity. You know, in addition to this, I should mention that we look at various failure modes that are normally applicable to the mining activity, similar mining activities, and we selected the most relevant failure modes for our case. Next slide, please.

We look at various failure modes and we identify two failure modes to be most relevant to the -- to our case, one is -- is the shear failure mode, and second is a bending failure mode. So, to simplify the -- the failure mode that we look at, the shear failure mode is -- is a condition that the load on a block of the limestone above the cavity overcomes the shear strength at the side of block. And as a result, the entire block can -- can move down and fall into the cavity. In order to control that -- that condition and -- and prevent this failure, we limit the size of the cavity to prevent the failure. So, therefore the -- the extensive advanced numerical modelling using FLAC software was completed to evaluate a safe span or the diameter of the cavity that provides a stable condition against this failure mode. We also completed extensive variation of the strength and -- and the thickness of the limestone to evaluate what -- what's the range of possible answers and -- and further understand the condition and the formation of the model. To further summarize the advanced modelling we completed, this slide shows the four steps that we used or what -- to complete our advanced model. The first step is to estimate some of the parameters that we required for the -- for the modelling, which include the -- the sandstone instrument parameter. The second is that -- was using those sandstone instrument parameters, we completed the -- estimated the long-term sandstone sloughing into the cavity. So, consider how much of the wall can slough into the cavity. And the third step is to evaluate the stability of the cavity against shear failure mode. And eventually, last part, we identify what's the minimum distance required between adjacent cavities or from cavities to adjacent structures that prevent any -- any effect of cavity on those adjacent structure. As an example, you see an output of FLAC model on the right side. What you're looking at is a section of -- of ground section on the model around the cavity. You don't see the limestone actually above. So, this is just to be focused on these two for presentation. You don't see the limestone above, you see the cavity, which is the result of side scan sonar data from Borehole 92-2. In this data, we see that part of the cavity is -- is backfilled by sloughing of the wall already, so, we consider that condition to be representative of the condition of the cavity during the scan. The vertical line here shows the

-- the depth along the axis of the -- of the cavity, and the horizontal line is the distance to the centre of the cavity. The colour code here is representative of the calculated factor of safety, local factor of safety at each location from -- from the model. So, what we did, we varied the -- the strength of the limestone until we could match the condition outside. That means, this overhanging portion of the -- of the cavity has a factor of safety one, slightly above one, it means it's marginally stable. That's what we saw in the BRU 92-2. And that -- that gave us the strength parameter. What you don't see here though, is next steps of the -- of the modelling, which was estimation of the -- how much of the wall may fall into the cavity with time. For that case, I can explain just that the cavity was assumed we -- we don't any -- any support from the disturbed sand. We assume that with this overhanging portion, it already falls off. And then we estimate again what's the local factor of safety with depth. And the area with factor safety two -- remember, our basis of design is factor safety two, the area of it factor safety less than two is understood that in long run it may fall into the cavity. So, the result it was five metre of the wall instability in long run, means the design life, which is 100 years or beyond. So, you see this -- this second line here that represents that what would be estimated long-term sloughing of the wall. Second slide.

Another failure mode that we look at was the bending failure mode. So, this is relevant to layered rock, means each -- each layer act -- may act separately for bearing the load. If the cavity is large enough, the layer closer to the roof -- on the roof of the cavity may start to bend due to the weight and load of upper layers, bend downward, and eventually break and fall into the cavity. But when this happens, two sides of the -- of this layer will stay -- portion of two sides will stay in place and act as a cantilever -- you can call it cantilever beam or cantilever layer, for supporting the upper portion. With increased size of the -- the cavity, this forces continues and eventually result in a -- in its shape, like this that you see in this figure. This is, again a section of -- a sketch of the section of -- of the cavity, that shows that this failure causes fracture or -- or falling off portion of the limestone. But we designed the size of this cavity, limit the size of this cavity, to limit the progress of these failures in the competent limestone. So, in this case the allowable size is limited in such a way that we still have competent limestone above the fracture zone as a result of these parts.

So, this was the summary of -- of the process, but we concluded that, by comparison of the failure mechanism for shear failure and bending failure, we concluded that the bending failure mode is actually the controlling the cavity size. We know that the limestone thickness and overburden thickness in the -- in the area that we -- we're extracting, varies, so and with increased limestone thickness, the span can be increased because you have more support. With increase of the -- the till, or overburden material, the span should be smaller. So, we look at the different combinations of these scenarios. So, each of these lines, they actually represent an analysis for that specific condition. For example, the first line is for limestone -- competent limestone thickness of 15 metre, with 25 metre of overburden thickness. And for that case, we estimated the long term allowable span to be 36, if I can read it from here correctly, it's 36 metre. But you remember that we -- we say we designed for long term, so we need to account for the failure of the wall as well. So, therefore, the allowable extraction time should be smaller than this long-term stability, and remember, our estimation used -- showed up to five metre of -- of failure at the wall. So, the diameter of the extraction zone should be 10 metre smaller than this maximum allowable long-term span.

Another condition that we looked at is the interaction between adjacent cavities. So, again, we used the numerical modelling FLAC and estimated the zone of area above each of these cavities that might be affected due to the extraction of the -- of the sand. And it turned out that the maximum zone of -- of effect around the cavity is 60 metre from the edge. So, from this edge, 60 metre from the edge might be affected if a failure happened for a failure of the cavity. We don't design for failure but in case a failure happens, it should be away from structures or from each other. So, therefore, we separate them by 60 metres -- separate the -- the extraction zones by 60 metres from each other so they don't interact with each other. And this is 60 metre in -- in long-term condition. In -- in extractions, you remember we need to add ten metre for -- for possible sloughing with time, so, it's 70 metre for -- for sloughing with time.

Okay. So, in summary, the analysis shows that we look at both shear failure and bending failure modes, and we conclude the bending failure is the controlling condition for -- for the stability of -- of this cavity. Well, we know that the extraction cavity may expand with time for the lifetime of the project, which is 100 years or beyond, we estimated what's the limit of -- of that failure of the wall, and we accounted for that in our -- our design. Based on this analysis, we can say that the -- the extraction cavities will be stable for the -- for the duration of the design of the -- the extraction cavity. But we also noted that we have number of recommendations to be followed by Sio Silica during the -- the extraction and that's if they do that, then the extraction cavity will be stable in time.

As part of the monitoring and as part of the design, the monitoring plan is an integrated part of our design. So, by monitoring plan we talk about the piezometers in the -- in the overburden and the top of limestone. We talk about surface monitoring, settlement monitoring, and also subsurface monitoring, to monitor the deformation of the limestone. So, in case an adverse effect is being developed, we are defined by these -- these instruments, so, these are the required instruments that need to be installed to ensure the stability of the -- of the cavity during extraction. So, all of these will be defined in trigger action response plans. So, they will be part of a trigger action response plan. It means the data from the instruments will be used and interacted with that TARP, and if a threshold, predefined threshold, in the TARP is being violated, some predefined actions will be taken to ensure the stability of the cavity.

So, some of our recommendations, we recommend that the extraction cavity should be limited to areas with the thinner -- thicker limestone, means thicker than 15 metre competent limestone. We recommend that Sio follow our recommendations of the specific design for -- for each location. And also, we recommend further investigation of multi-well extraction process. So far, Sio completed only single well extractions, and be aware of -- and we measure the -- the cavity development, but we would like to -- or we recommend to have a multi-well extraction measurement as well to better understand the cavity expansion.

In addition to that, the -- the drilling programs so far, they were including only vertical boreholes. So, far we -- we did ATV, OTV and logging of the -- of those boreholes. We didn't identify vertical joints or cross joints in the competent portion of the limestone. Although, we -- we see them in the higher zone beneath the till, or in contact with shale, but we don't see them in the competent limestone. But in order to further improve that understanding, we recommend multiple additional bore-holing with -- with inclined direction to identify if a vertical joint is placed in the cavity. We recommend a number of geotechnical instrumentation to be installed, and also we monitor -- we recommend monitoring them, and also, development of the TARP, Trigger Action Response Plan, for operation of the -- of this extraction. With that, I conclude this presentation. We welcome any questions and we're available to answer your questions. Thank you very much.

THE CHAIRMAN: Chair. Thank you very much. We did draw -- randomly drew for the order of questioning of the participants and Dennis you have first right, I believe. You look surprised.

MR. LENEVUE: (inaudible) ---

THE CHAIRMAN: I'll ask them? Okay, yeah, you ask them, yes.

MR. LENEVUE: (inaudible) ---

THE CHAIRMAN: Please -- please come

up to the microphone.

MR. LENEVEU: Thank you for that data. I'm wondering why it wasn't presented in the EAP or in any form up until this point, so we would have a chance to look at it? This is -- seems to be entirely new geotechnical data and I don't believe the independent review technical experts had a chance to look at it. I had prepared questions but some of the information you presented here is a bit perplexing. For instance, BRU 121 and BRU 146, those boreholes are outside your 24-year -- they're south, in the Carman Sands, outside your project area. So, why are you analyzing those so completely? I would imagine that DEN 216 is also fairly far south in the project area. Borehole 1017 BRU is quite far west. The only one that you analyzed where you'll start off is BRU 95-8. Can you just comment on that a little bit? Why -- why you were analyzing the geotechnical parameters of boreholes that are outside the 24-year project area? That is BRU 121-1 and BRU 146-1 in the EAP, in one of the figures, it shows both those wells are outside your project area, there's south -- one is around Ross and the other is even further south than that. And I don't know where DEN 216 is, but it'll be quite far south in the DEN area.

MR. BUNDROCK: Steve Bundrock speaking, Sir. So, Mr. LeNeveu, our understanding of the targeting of the geotechnical boreholes is that it's based upon, one, the results of the geological drilling first and foremost. So, we complete our geological drilling. Following that, we target geotechnical boreholes which are intended to capture the integrity of the cap rock throughout the possible project site. So, yes, we did develop those -- target those bore holes overtime. Some of those are further south, some of those are somewhat further east. You can see that they're scattered around the project area. We're in the process of confirming whether or not those two boreholes you've identified as possibly being outside the project site --

MR. LENEVEU: (inaudible) -- they are --

MR. BUNDROCK: -- whether in fact they are.

MR. LENEVEU: -- outside the area.

MR. BUNDROCK: Outside the 24-year.

MR. LENEVEU: Yes, so why did you (inaudible) ---

THE CHAIRMAN: Chair. Please -- please turn your mic on, Dennis.

MR. LENEVEU: Okay, that's -- that's fine. And just a couple other general questions before I go on to this. I saw a lot of data about the tensile strength and the geotechnical parameters for the limestone. I don't see any data for the sand. Did you -- and I don't see any information, for instance, for the slope stability, it's critical to get the internal angle of friction and the cohesion -- I don't see any data on that or any information on how you gathered it, and it almost seems that the data on the sand is missing. Oh, or I'm -- I guess I'm -- I'm sure it's there somewhere, but I don't see it.

MR. ESHRAGHIAN: Arash Eshraghian with Stantec. Yes, you -- you saw only the summary of the results. All these parameters that you're mentioning, they're documented in -- in the Stantec Geotechnical Assessment Report. In term of the sand or sandstone parameters, we have information from the side scan sonar data. We had information about the -- the parameters from SPT testing we did on site, and also we know the range of possible -- range of these type of sediments based on previous experience with similar projects. But the key point here was we back calculated the sandstone parameters from -- based on the advanced modelling that was completed to match the condition of site with side scan sonar data. That was the -- the presentation that I -- slide that I showed on advanced modelling, that showed you a sample of the result of that advanced modelling, that provided us an estimation of working or in situ strength of sand -- sandstone, specifically a possible cohesion between the -- between the particles, and also friction angles between the particles. So, that's the basis of -- of the sandstone parameters. They're back calculated based on these information.

MR. LENEVEU: You back calculated your input data from your observations of the slope and you didn't actually measure your data? Is that correct? You back calculated your data, you did not measure it? You did not take your sand samples into the lab and measure the internal angle of friction? I -- I don't see it anywhere, and I could maybe -- you back calculated cohesion, but did you back calculate internal angle of friction?

MR. ESHRAGHIAN: Yeah, Arash Eshraghian with Stantec. Yes, we measured the -- the geometry of the cavity, which is an indication of the possible parameters of the sandstone. Then we used that to back calculate the parameter. And we played with the parameters to -- to calculate the -- the strength of sandstone. This is a common practice, and we use back calculation method based on the observation of the site, based on the stability of the sidewalls, and -- and also the geometry of the sidewalls.

MR. LENEVEU: Into the lab and measure the data?

MR. ESHRAGHIAN: Sampling of an unconsolidated sand is -- has its own challenge and it's in this situation, it's -- it's common practice to back calculate the in situ parameter based on the measured geometry of the side scans from our data.

UNIDENTIFIED SPEAKER: (inaudible) ---

MR. LENEVEU: And I feel -- I don't hear you took -- took it into the lab. I'm going to go into my written questions. In -- in the public version of the Geotechnical report issued in the Sio Silica response to public comments of January 2020, Stantec recommends limited extraction to areas with competent limestone thicker than 15 metres. And I have the slide there. Is possible to bring it up? The -- the first slide. The Manitoba Groundwater Well Information report shows that all Sio Silica wells east of Highway 302 have competent limestone thicknesses less than 15 metres. That's east of 302, all the data that came from Manitoba groundwater, the limestone thicknesses are 15 metres, so they're violating the Stantec recommendations. For instance, BRU 92 -- and that should be BRU 93 -- oh yeah, BRU 92 and BRU 93 areas of the extraction plan are east of Highway 302. The BRU 92-8, 92-8, and 92-3 wells that are closest to that area, have limestone thicknesses 14.6, 14.0, and 14.2 metres, respectively. Now I think that those numbers are less than 15.

So, why is Sio Silica not following the Stantec recommendations for limestone thicknesses less than 15 metres, and starting your extraction in areas where the limestone thicknesses is less? And there's the data there, and you see it. I've only got three samples there, but they're -- they're all less than 15 metres in your BRU 92 and 83 areas, where you're extraction is going to begin. It's not 'til you get west of Highway 302 that you get limestone thicknesses bigger than 25 metres. So, why are you not respecting the Stantec limit of 15 metres for -- where no extraction should occur, and -- and starting your extraction in that area where the limestone thickness is less than 15 metres? I might point out that I've asked this question now many times. I started out asking it in August of 2021 in the public comments. It's been ignored all throughout the approvals process. I asked it again in my motion brief and again in my IRs. I asked it in my submission, and now I'm asking it again, and I've never got a satisfactory answer over a period of more than a year. And before this question was asked before we went to hearings, it's been consistently ignored. So, please can I have an answer now?

MR. BULLEN: Mr. LeNeveu, it's Brent Bullen from Sio Silica. A couple items in your question there. You've asked about previous datasets. They've been made available if you would sign an NDA. That's been made very clear to you. You've refused to sign an NDA, so they're appearing in the unredacted versions of some of the works, but they've made them available. We've made them available to the other proponents -- not proponents, but participants here, to be available.

With respect to your over (inaudible) -- on 92-2, 92-3, if you look, there's other wells within the area that actually show thicker limestone indications. We would confirm the 15 metre caprock thickness when we look at the lateral drilling into limestone at 14.4, 14.8. The work that was done was done during an exploration phase of the program. What we're talking about here is the commercial viability of moving forward and the standards that we would be upheld to, and we feel that the further proof of drilling into the limestone to prove up the thickness will prove up that the thickness does exist on the east side of 302 and is open to -- it's open to interpretation of data, but there is a verification process that takes place before we go into extraction to confirm that thickness. So, we're -- we're arguing about future production parameters which we've agreed to adhere to.

MR. LENEVEU: Yeah. He's quoted there -- comes from Manitoba Groundwater Well Information Reports, and the data for BRU 95-8 eight comes from the EAP, where there have core logs in the EAP and there's a detailed core log in BRU 95-8 that shows the first, about two metres, of limestone are rubble. And so, the competent thickness is less than your 15 metres. So, are you saying that the data from the Manitoba Groundwater Well Information Reports, and your data in the EAP for, well BRU 95-8 is incorrect? Is that what you're saying?

MR. BULLEN: Mr. LeNeveu, we're -- I'm not debating previous works that's been done or some logging that has been done, I'm debating your use of how you apply a timeline. We're talking about the methodologies and the standards that are being applied to take this project into production going forward based on the mechanical caprock calculations. The work that you're looking at was done during exploration phase, and we've said that you would have to look at, in the recommendations, additional drilling into limestone on angularity to confirm its caprock thickness. So, I'm not saying there's incorrect or correct data, I don't have those documents in front of me, so, I really can't say anything on either one of the ones from Manitoba records. But what I'm telling you is that there is indications that the caprock thickness does exist in excess of 15 metres east of the 302, which will be firmed up and confirmed as further work is done.

MR. LENEVEU: So, this data that you're talking about doesn't exist yet, whereas the data that I'm showing you does exist. This is very peculiar.

MR. BULLEN: So, Mr. LeNeveu, I guess to help your peculiarity, are you familiar with BRU 83? BRU 83 is east of 302 and just south of our project, and it has a limestone thickness of 17.7. So, respectfully, if you're going to apply irregularities, try and do it on a broad scope and pick up all the datasets.

MR. LENEVEU: Well, I went through all the data sets that I got from Manitoba Groundwater and you're talking about a new well, BRU 83? Well, I -- I don't see the data. Can you produce the data please? And where is BRU 83? BRU 83, from what I've got here, is a -- an area on the -- on that diagram, it's not a well, but are you referring to now data from a well called BRU 83? If so, where is that well and what is the data? Can you produce it?

MR. BULLEN: You should be able to go to mines and water and get the well construction data. It's been filed.

MR. LENEVEU: You don't have the data here -- you don't have the data here, and maybe you can produce it at some other time, but the point is there is data that's valid that shows limestone thickness of less than 15 metres. So, you may be able to find somewhere in that area, some limestone that's thicker than 15, but there's definitely some that are less than 15. So you cannot say with any confidence that you're not violating that extraction area -- or Stantec competent limestone thicker than 15 metres and you shouldn't be in that area. You should be -- should be sure of what you're doing. You should be west of 302. Well, okay, I -- I'm going to move on to the next question.

MR. BULLEN: Do I -- do I get to respond to your question, Mr. LeNeveu? Because you can't say with confidence that we shouldn't mine there when there's actual data on BRU 83, and it's unfortunate it's not in your hands -- I can't speak for your ability to get it from the public sources, but that it shows that limestone competency is thicker than 17 metres. So, applying the same standards that you're applying against us to say we can't drill there, we're saying there's data that allows us to drill there. And furthermore, we're stating that on an ongoing commercial viability, data thickness would be confirmed before extraction continues in an area, so you have a safety check.

MR. LENEVEU: You've produced a picture here of areas that you don't have data for yet, when the available data shows that the thickness is -- and you're going to put that -- layout forward based on data that you might find later? I -- I don't think that gives us a lot of confidence. And again, you're not producing the data for BRU 83, wherever it is. I -- I don't know where that well is. So, the data available that shows you have a problem here. Now, I think we have to move on because we're not going to resolve it here, obviously.

MR. BULLEN: Mr. LeNeveu, it's important, and it's important because we've come to this hearing to have a transparency and to try and work together on getting through these issues. So, are we allowed to do an undertaking to provide the 83 construction report to Mr. LeNeveu?

UNIDENTIFIED SPEAKER: Yes.

MR. BULLEN: No, I'm asking --

MR. LENEVEU: Oh.

MR. BULLEN: -- I'm asking counsel for us.

MR. DUNCANSON: Mr. Chair, I think we're -- we're in your hands. Sio is volunteering -- sorry, Sio is volunteering to undertake to file additional information in response to Mr. LeNeveu's question.

THE CHAIRMAN: Chair. I have no objection to that. Yes. And I'm getting a thumbs up from both the secretary and our legal counsel. Thank you.

MR. LENEVEU: New information. Let's go on to the next question. Can I go on to the next question?

MR. BULLEN: All right.

THE CHAIRMAN: Chair. Please.

MR. LENEVEU: Table 9 of the public version of the Stantec Geotechnical Report gives the long term cavity span for silica sand extraction well clusters depending on the limestone thickness and the overburden thickness. That Table 9 demonstrates it's 60 metre cavity span with five well clusters, specified for all well clusters in the extraction plan of June 2022 is invalid. Could you put up the -- the next slide please of Table 9?

And if you look at Table 9, there aren't any thicknesses or cavity spans up to 60 metres. And yet, that data was available in January. In -- in June, you put out a report where all the cavity spans were 60 metres. Then all of a sudden, in January, you changed it all so that -- but in January, the new plan doesn't give us cavity spans, it only give us the number of wells per cluster, varying from one to five. Now, five wells per cluster according to the extraction plan of 2000 -- in June of 2022, could result in a 60-metre cavity span, which, according to this table and the limestone and overburden thicknesses in the area from the well information reports, would be invalid. It would be above these limits. You'll see there in that table, the biggest value for the long-term cavity span is 50, and -- and that's for limestone thicknesses and overburden thickness that you will find in the area. So, what I'm wondering is how -- how can a cluster cavity span be limited according to the data from Stantec Table 9 during extraction operations, given that you can't see down there when you're extracting, and that your sonar scans are done afterwards? So, if you have five wells operating that normally in June apparently gave us a 60-metre cavity span, how would you know ahead of time when you're drilling, or while you're drilling, that you -- you haven't got up to 60 metres in their cavity, which is now apparently invalid? So, how -- how do you know you're keeping to within the data specified for Table 9 when you're extracting, when you can't see into the cavity?

MR. MCLACHLIN: This is Doug McLachlin from AECOM. Thank you for the question, Dennis. So, just as part of the process of design development, there was an update to the geotechnical model that came up and that was then published by Stantec in their latest report that made changes to the design requirements for the extraction design. That -- that design information was passed to Sio, and then they updated and modified their extraction design. And so, that's really why there was a -- a change in the approach. So, some of the previous work was superseded by the more recent assessment that was done, and that was -- that culminated in the submission of -- of Table 9.

So, the other thing is that as part of the ramp up to the -- the operations after the issue of the EA licence, there would be a lot of detailed assessment done on those initial extraction places - locations, extraction wells - and it is possible to extract sand, then put down a side scan sonar, look to see the geometry, make sure it's within the requirements of Table 9, and if you're getting close to that, you could stop at that point. So, there -- it's not like you -- you have to do all of the extraction at once, you actually have the option to stop, do a side scan sonar, and check to make sure that you're within the requirements on Table 9.

MR. LENEVEU: So, as you're extracting, you're going to stop periodically and take the time to do a side scan sonar, and then resume, and then do it again and again. How often are you going to do these side scans? I mean, you're -- you're extracting for five days apparently. Are you going to do a side scan sonar every day, and how long does that take? Would that -- wouldn't that push your five days way out, and are you going to do it for every well you do? I mean, that's an intensive operation when you're drilling up to more than 300 wells a year, and now you're stopping each one for a side scan sonar, what? Every day or every hour? And this is new information. All of a sudden, now you're telling me that during the drilling operations, you're going to institute a program of monitoring at periodic intervals with side scan data. Where did this come from? I -- I didn't see any reference to this procedure up -- up until you just talked about it. Now, did you just make this up?

MR. MCLACHLIN: Absolutely not. Doug McLachlin from AECOM. So -- so, it's always been presented in all of the documentation that a trigger action response plan would be developed as part of the process before moving into full scale extraction. And that process would require detailed instrumentation and monitoring. That is correct. And we've talked about that today during our presentation. That would include settlement monitoring, that would include extensometers that are constructed down into the limestone to make sure the integrity of the rock is maintained during the extraction process. It would also include piezometers. And as part of that, during the initial extraction, there would be -- yes, more side scan sonars would be taken to make sure that the design requirements shown in Table 9 are followed. That would be done initially to determine the, you know, the -- the conditions of the -- oh, one other thing I wanted to add is that for every location where there is an extraction well, there would be a detailed assessment of the thickness of all the units, including the overburden, including the competent limestone and down into the shale and the sandstone. So, we would have that information at each extraction location, and that information would also be used for a specific assessment of the stability at each and every extraction location.

MR. LENEVEU: So, who is going to do this detailed analysis and side scan sonar analysis during the production phase? Is -- is Stantec going to be there or the company that did it, and they're going to be employed on a continual basis to -- to do this detailed monitoring and side scan sonar? How -- how is this going to be achieved?

MR. BULLEN: Mr. LeNeveu, it's Brent Bullen from Sio Silica. As Mr. McLachlin pointed out, we've always talked about a trigger action response plan. So, to do side -- side scan sonar, it would require the use of the company that we've already identified to do work for us. We would actually have that data go to Stantec to get verified into the model. And so, you're always building into verification of your current geotech, new geo models. But it would be the existing company that does it and Stantec doing the review.

MR. LENEVEU: I'm not quite sure what I heard. A company's going to do the side scan monitoring and gather the data, and then they're going to send it to Stantec to be analyzed, and this is going to go on during production in the field while you're -- have to complete a well within five days? Am I hearing this right or ---

MR. BULLEN: No, you asked who was going to do what. So, the process is when you're going through a -- a trigger action response plan, you would have a set point when you were going to do a side scan sonar. We would shut production on that well down to do a side scan sonar. We've done it before, we'll do it again. FLODIM, the company that we use prepares the report. The report is actually done in a output parameter that is useful for input that we can analyze, but to further analyze and take those data points and put it into the model and the geotech for confirmation of what's been done, Stantec would do that, because they've done the geotech modelling. So, it -- it's quite simple. You start a well, you hit a trigger point when you're going to actually do a sonar on it, you do the sonar, once it's processed we would further have that implemented into the geotech model by Stantec. I mean, these are -- these are future developments of a trigger action response plan, but we've indicated that they would be part of the process to verify that you're operating within the parameters of the model.

MR. LENEVEU: What is your trigger to start this process of sonar scan and then sending data to Stantec? What is your trigger?

MR. BULLEN: You're -- the trigger response plan is actually a plan that usually is developed after this process of receiving a licence and before you go into production. It's a very standard process. We've identified it as being required beforehand. So, if you look at a trigger response plan and the side sonar scanning, you know we're not talking about doing it for every single well, but we've talked about step gating the startup of the operations. So, we're starting with single well pads in the first year. Then we go to two-well pads. We've done in one -- we've done single and two-well pads. We know that we do not go outside of the model parameters on a single well, so, we can easily pick a point in the trigger action response plan to do a side scan sonar prior to enough volume to be taken out to actually put you outside a parameter. But we're talking speculative on a future development of a trigger action response plan which we've undertaken to do. I mean, it's a very simple process that will be put in place by Stantec.

MR. LENEVEU: It -- it doesn't sound very simple to me. And -- and you've talked about it for one well and now, you're going to have up to five wells operating -- well, maybe not all the same time, but maybe three operating at once, and some sort of a trigger to stop those wells and then do a side scan sonar. I -- I mean, you said you've done it for one well but certainly, it's got to be a different procedure when you have multiple wells. This -- just, with all due respect, it sounds to me, you -- this hasn't been figured out. You don't really know what you're going to do. There's certainly no written plan or procedures for this. It sounds like it's going to be invented on the spot, somehow.

THE CHAIRMAN: Chair. I am conscious of the time, so we'll take the answer to this question and then we will adjourn for lunch.

MR. LENEVEU: Lunch?

THE CHAIRMAN: We can -- we will resume after lunch. Yes, I'm aware you have five questions, but Brent or someone over there, did you want to respond to that last question?

MR. BULLEN: Sure. Mr. LeNeveu, I

apologize, I was -- I was trying to find a question in there amongst your opinion on -- on where you thought our trigger response plan development would be. Perhaps you know, gather your thoughts on that, and after the break asked me the question again.

THE CHAIRMAN: Chair. Very well. We will -- we will resume at 1:30 prompt.

--- OFF THE RECORD at 12:39 P.M. ---
--- BACK ON THE RECORD at 1:30 P.M. ---

THE CHAIRMAN: All right, Chair, so it is 1:30. I'll ask everyone to retake their positions, please. So, while Peter is having a brief word with Dennis, I will note that the order of questions is Our Line in the Sand, MSSAC, Manitoba Eco-Net, followed by the panel, and if time permitting, the public. So, by my -- my reckoning, there are about six people still in the queue with three hours left. So, Dennis, if you can return to the microphone, I'm going to allot you of -- about a further 20 minutes to ask your questions. And I understand you will not be working from your written questions any further.

MR. LENEVEU: Mr. Chair, could I ask one question?

THE CHAIRMAN: Please.

MR. LENEVEU: I'm just wondering, I think a lot of the questions this morning, there was some -- some clarification we can do on the whole TARP process. I'm wondering if you'd just allow us five minutes for us to -- to kind of walk through a TARP process. I think it'll clear, like ---

THE CHAIRMAN: Chair. If it brings clarity, please proceed.

MR. BUNDROCK: So, Steve Bundrock with Stantec. Just talking briefly about the TARP process because Dennis was asking questions about that. We just wanted to reassure him that it's not unusual for a trigger action response plan to be developed after permitting has been completed. In fact, in many cases, the TARP is not fully formed until you're at the construction phase. And that process, at or near the construction phase, involves, first of all, identifying where extraction drilling would be carried out, and developing an initial estimate of the probable subsurface conditions, understanding the probable cap rock thickness, having an awareness of the caprock integrity in that area, understanding the overburden thickness, understanding the design parameters that -- that will impact the extraction. And so, therefore understanding the risk. Understanding whether or not you're operating on the margin of your risk or if you're operating in a very low risk area. And then based upon that geologic and technical data, which we all -- we described in some detail this morning, talking about the -- the geologic model from the 48 boreholes as well as the geotechnical boreholes, as well as the more than 1400 local boreholes, some of which you referenced earlier during that initial extraction process. We would expect that we would have instrumentation installed, and the precise nature of the instrumentation we've -- we've discussed, but we have not completely defined. However, it is things like, having piezometres downhole to understand changes in pore water pressure, having instrumentation such as inclinometres or perhaps tensiometres in place to understand if there are any changes happening in the subsurface if voids are opening up. Also, continuously monitoring for displacement at the surface most likely in multiple locations. So, you would end up with a very robust, thorough monitoring plan during initial, call it full scale or call it multi-well extraction. So, you'd have all of that instrumentation in place. It's not our expectation that there would be the case where they're instantaneously having three borehole drills drilling multiple wells at the same time. Instead, it would be a bit of a staged approach. Again, depending upon the risk at that specific location. And then -- and then once drilling had started again, using a conservative approach -- use a conservative approach while monitoring your instrumentation to confirm that conditions that the -- the borehole and any potential for subsidence or any other changes in conditions are thoroughly measured, and reported, and considered. Typically, you would at the 50% stage if you had reasonable confidence in those conditions. You would stop testing, or stop drilling, excuse me, and -- and you would go down hole and you'd do a side scan sonar survey. And there's a reasonable expectation that at 50% of extraction that you'd see 50% of -- of the void space developed. And if those conditions varied, you would adjust your plan accordingly. And then -- and then after that, you'd just continue through the process. If things are behaving predictably, then you would ultimately -- would start to back off of the nature and extent of the testing you do. But initially, you'd be doing very, very thorough testing. We actually do expect that process to be costly, and we expect that process to be relatively inefficient, and time consuming to start with. But it is actually part of the development process as part of the process of developing a trigger action response plan that's reliable and can be consistently applied overtime. And then -- and then over time as we continue to refine our understanding of the deposit, we -- we start to back off. And ultimately, you end up with a very refined and reliable trigger action response plan, which is accounted for the full range of possible behaviors in that area.

MR. LENEVEU: Thank you. Can you put up Slide 3, please? This shows the side scan sonar for Brew 92-8 (ph), which is the only well, I think, where water was returned -- actually returned by gravity flow. And the side scan sonar indicates vertical faces, which would indicate consolidated sand. And I'm going to ask a question about how you extracted for consolidated sand. But I just want to show the next slide before I ask the question. Now, this is from 1967, Norlica, and it's in this area in the Carmen Sands near Guru. And they ran into -- they were trying to extract sand with airlift and pressurized water. And they used a similar method, but they were in consolidated sands. And they bent their managed -- had their production pipe and the air hose so that you could bend it and send pulses of compressed air to loosen the sand, which it says, you can do this in the Sio Silica patent, says this. It says, you can both bend the air tube and the production tube when you have to loosen the sand, so that you can put the vacuum right up against the consolidated sand, send a repulsive air to loosen it, and then back off, and suck it up. So, we go back to the previous slide. So, I drew at the bottom there, a potential way to get it out with your production tube bending, and your air tube inside, and the pulse of air, which it says, you can do in in the patent, to loosen sand from that vertical face to keep moving it back and -- and then sucking it up. Now, my question is, for Brew 928 where -- see this is not the situation where you've got a slumping face and the sand falls in naturally. This is not a slump. So, this must be consolidated sand. So, my question is, can you describe the method to extract? Is this at all what you did or what did you do for Brew 928 to get that sand from that remote up to 30 feet away, vertical face?

MR. BULLEN: It's Brent Bullen from Sio Silica. I'll -- I'll answer this. Mr. LeNeveu, the -- the drawing that you've depicted there doesn't represent what we do. We don't have an articulating lateral extension on -- of our extraction tube. 928 was extracted entirely with vertical pipe, no articulation in the lateral movement.

MR. LENEVEU: Okay. And why don't you have this V-shaped, slumping picture that you show in all your handouts, where the cavity is shaped and -- and the sand is cascading down the slope as loose sand? Why -- why isn't that a picture in your side sand sonar. You've got a vertical face there, and an overhang. Don't you need consolidated sand to have a vertical face, and especially an overhang? I mean, if that's loose sand, you wouldn't have an overhang. Am I missing something here or can you please explain why you don't have a V-shaped cascading face coming right up to your tube like you show in your handouts?

MR. ESHRAGHIAN: Arash Eshraghian, Stantec. What you observe here, is not actually the -- the -- the extraction cavity immediately after the extraction. These two shape that you see here, the -- the -- the blue one is almost one month after extraction, and the red one is four months after extraction. What you observe immediately after extraction is the overhanging shape. And what you don't see here, is this flat area that you see here, is not end of extraction pipe location. The pipe is farther down, few feet farther down. The reason you see these flat surface here is, because side scan sonar data cannot penetrate the -- the disturbed backfield area of the sand. So, this surface is the suspended fines plus sand that has filled -- backfilled the void already. So, don't -- you know, this is not the bottom of extraction. So, in our presentation we showed you an earlier extraction cavity scan that showed relatively circular or -- or hanging wall here. But the bottom, you're not actually scanning here. It's farther down. And our estimation is that the disturbed sand zone in -- in this area, it has a 65 degree angle. So, it goes 65 degree angle. With time, the backfilling -- keep filling these up and -- and move -- move farther up, which includes failure of part of the -- the -- the shale into the cavity, and then you end up with a smaller void that's moving above. So, these are different times scanning. It's not the same, you know, just at the end of extraction scanning. And you know my understanding is, as -- as you explained, we don't have any suction ability like -- like this. It's just the, you know, the bottom of the extraction pipe is farther down and -- but the side scan sonar cannot -- cannot penetrate into the backfield material. So, this is backfield material actually.

MR. MCLACHLIN: This is Doug McLachlin.

MR. LENEVEU: Just a point of clarification. So, why didn't you have a side scan sonar showing the hole going -- sloping down like that? You -- you said it goes -- the production pipe was further down. So, that would get you your cone-shaped cavity. So, why -- why didn't this scan sonar show that cone shape?

MR. MCLACHLIN: So, this is Doug McLachlin. So, that is absolutely correct. They -- so, the extraction tube went all the way down to Elevation 229 below. But that scale ends to 200 because once the extraction tube is removed, and the sand comes in, it caves in and you can't get the sonar down to the very bottom to where it was previously, where you had the bottom of the extraction. So, you're unable to get down and penetrate into that with -- with the side scan sonar. So, you're actually only seeing a portion of the -- of the -- of the -- the angle on the side slope that you would be able to pick up.

MR. LENEVEU: Why is there an overhang on the top then? Or is that just the shale? And why do you have a vertical face?

MR. MCLACHLIN: It is the shale. The vertical one is the shale, and then coming down is the -- is the sand. So, that is correct.

MR. LENEVEU: But the -- the sand, the vertical face there is lower than the shale. The shale is the green line across, and then you have a vertical face of sand there. Why -- why do you have a vertical face of sand just below the shale if it's your -- it's supposed to be a cone-shape?

MR. MCLACHLIN: So, Doug McLachlin again. So, as we mentioned previously in the presentation, with the side scan sonar, we're able to actually measure the angle on the sand, and the sand actually has some cohesion. So, it actually stands up and that is something that has been considered. That was shown in the -- in the cross section of the FLAC model that showed not only vertical but sometimes overhanging slope, and that is the cohesion in the sand deposit. And then, the modelling that Stantec did, they looked at a long-term slope with a factor of safety of two of sloughing. And that's how they developed the maximum distance, and adding another 5 metres diameter on either side -- 10 metres -- sorry, 5 metre radius, 10 metres diameter, to determine the maximum size of a -- of a void.

MR. LENEVEU: That vertical face, does it not indicate there's sufficient cohesion to hold the vertical face that would require loosening of the sand?

MR. MCLACHLIN: So, this represents the maximum extent. So, when the sand is removed, that is the final slope of the sand. It stands up very, very, you know, a very almost vertical or sometimes sub-vertical or -- or -- or overhang. That's correct, yes. And -- and remember before you were asking why we couldn't take a sample of the sand up to surface? When it's removed up to surface, it's in a slurry format. So, one of the benefits with the side scan sonar, we can actually measure the angle of repose of that slope. And that's what -- that's -- that's what it looks like. It's -- it's very, very -- actually it's -- it's very stable. Even at those very steep slopes, it's maintaining a factor of safety of greater than one.

MR. LENEVEU: You don't have any earlier measurements that show that angle of slope? And what is the final angle of slope? I heard 31 degrees. Is that correct?

MR. BUNDROCK: Steve Bundrock with Stantec. Yeah, 31 degrees was the extremely conservative assumption that we used at the beginning of design for a very worst case scenario. It's a standard value that's used for saturated sands, angle of repose. However, we've found that there are a range of sand behaviours, including very, very competent behaviors. You identified vertical to extra vertical. Typically over time, we find that those do start to slough marginally and in -- in fill the void.

MR. LENEVEU: The slide I showed from Norlica, you never run across consolidated sand that requires you to pulse air to break it up? This is never encountered or going to be encountered? The patent says you have the capability to do this. Why would you have -- if you have the capability to do it, you'll never exercise this capability? I mean, they had to do it in 1967 in the same type of formation. So, the ability to either pulse air out of the air tube and even bend it to loosen the sand, that will never be used?

MR. BULLEN: Mr. LeNeveu, it's Brent Bullen of Sio Silica. We don't require articulating the end of the tube to a lateral movement. But, in the writing of a patent, we take into consideration alterations that could be used to the art that we're claiming to give us further protection of our intellectual property. With respect to the Norlica Silica sand, I mean, this is the first time I've seen the document, but that's not how we do it, and we never had to do it that way. The interesting thing about the sand, it exhibits non-Newtonian properties. It doesn't react like a typical sand when you're producing it. So, when you're looking at the caverns that are produced, we do that just through a vertical well with the simple airlift. We're not requiring to loosen the sand. We're not trying to jar it from being consolidated to unconsolidated. The formation itself gets its own energy and movement. And it's the differential of pressures that allow it to move to the extraction tube. But with respect to the Norlica, that's not our process, that's not what we do, and that's not our document.

MR. LENEVEU: Or haven't, or encountered any consolidated sand that would not simply draw by slumping into your -- into your -- in -- in your five years of experience, they've managed to always have consolidated, unconsolidated sand where you do not have to loosen it?

MR. BULLEN: That's correct.

MR. LENEVEU: Can we go to the next slide, please? Now, this is an illustration of the use of the frac slope, 2D and all the software, and I assume you're using the, I mean, it says you're using the frac software for slopes, stability of the sand, for long-term slope stability, and this software. And here's an example of a pillar, and it's a 2D analysis. And it's and they're progressively excavating a cavity on the right you see going up, and then sand starts to slump into the cavity. And to run this software you need input parameters. You need the internal angle of friction, and the cohesion, and shear bulk modulus. And you have -- you would get these parameter values by taking samples of sand to the lab and measuring it. Did you do this? Did you take samples of sand to the lab and measure internal angle of friction and cohesion? I hear you just did it by back calculation. So, did you take sand samples into the lab and measure cohesion and internal angle of friction? Yes or no?

MR. ESHRAGHIAN: Arash Eshraghian, Stantec. Taking sample, undisturbed sample of the sand deposit like this is very difficult. So, instead of that, because you need undisturbed sample to be able to -- to define the estimate parameter (phi) of undisturbed sand. And it's very difficult to take a sample like this. Instead, what is commonly used is to use the side scan sonar information and use the modelling to back calculate the estimate of the sand in situ to match the observed condition at site. So, that's what we did. And we think it's more reliable and conservative approach than trying to say, taking an undisturbed sand sample from a deposit like this that during the sampling you may break some of the -- part of the samples or underestimate. And this way you underestimate the in situ (phi) of the sand deposit. So, back calculation in our view, is more reliable approach for this case.

MR. LENEVEU: I'm sorry, I'm having a little trouble with your accent, but what I heard is, you back calculated. I -- I did not hear you say, you took the sand samples of the sand into the lab and did a measurement. And if you did, what was your internal angle of friction and your value for their cohesion? If you -- from data -- lab data, did you measure it? Rather than back calculate it, did you take a sample of sand into the lab and measure? Yes or no?

MR. ESHRAGHIAN: No sample was taken from the sand deposit. But, the back calculation approach, is actually a full in situ test of the sand parameter. And we believe the parameter recalculated this way, is more representative of the in situ sand deposit.

MR. LENEVEU: Take a sample of sand and measure it. This is the normal procedure. It's not that hard. Take a sample of the sand, you go to the lab and measure it. Why did you not do this? I mean, this is what this software requires, and you would normally measure it. Why -- why did you not measure a sample of the sand in the lab and get the data that way? And you only measure -- mentioned that you back calculated cohesion. I did not hear how you determined the internal angle of friction. Go to the lab to run -- to get the data properly, you have to go to the lab and measure it. You measure tensile strength in the lab. Why didn't you measure the other data necessary for the slope stability of this sand over the long-term? Because this is critical over the long-term that if that sand continues to slump, your cavity, I mean, there's 5 metres. It seems to be an arbitrary figure. I didn't -- I didn't see any reference to a calculation from this software that shows that this is how you determined the final slope over the long-term. I would have thought that a thorough job would have required -- you would have done a lab measurement and run the software with lab data.

MR. MCLACHLIN: Doug McLachlin. And just to add on to some of the things that my colleague has mentioned. When removing the sand from the formation using slurry, it comes up in a disturbed state. It's actually in a slurry. So, you can't measure the in situ condition. It's been disturbed. Sio Silica has gone to drilling companies requesting them to go in and drill cores of that sand, but as soon as you get into the sand with the drilling rig, it actually disturbs the sand. So, it's not possible to measure the in situ condition of the soil. However, as my colleague mentioned, by use of side scan sonar determining the actual angle of repose of that formation, you can get all the necessary information required to carry out the stability assessment, and that was what we discussed in our presentation. And it gives us the confidence and that's what came up with the recommendation that there should be an additional 10 metres additional allowable space for the -- the opening, and that was based on that detailed modelling done by using the side scan sonar. So -- so, it's -- it's a good question. It's a good question why was sand not taken. And that's because when drilling into that formation, as soon as it becomes disturbed, it's not possible to remove a sample. But as my colleague mentioned, the approach that he's used to actually have an existing slope, and to be able to measure it using side scan sonar, gives us even a far more clear idea of the actual in situ condition of that material, and it gives us great confidence in the outcome of the modelling.

THE CHAIRMAN: Chair. I'll note you have 10 minutes left and then we're going to need to move on to other questions.

MR. LENEVEU: In other applications, they've used sonic drilling to obtain a sample of the stand that they could analyze. It's a special device to draw out sand with less disturbance. And even disturbed sand, I mean, it's after all sand. I mean, you could still take it into the lab and measure it. And -- and so, and the other question I have is, all your diagrams show 65 degrees roughly, then I don't see any of that show 31 degrees, which would be a much bigger opening. So, if the

31 degrees is the conservative one, isn't -- shouldn't that be the number used to determine your slope stability rather than what you show in your diagrams with this arbitrary 5 metre -- if you had 31 degrees, it wouldn't be 5 metres, it'd be much more than that because you're 5 metres shows 65 degrees again. So, that's two questions. One, couldn't you have used sonic drilling? And the other one is, why do you not use 31 degrees for your long-term stability?

MR. BUNDROCK: Steve Bundrock with Stantec. Regarding sonic drilling, we do commonly use sonic drilling to try to collect undisturbed samples. In this case, even sonic drilling is not sensitive enough to collect an undisturbed sample. Nor would using direct push Shelby tubes collect an undisturbed sample. It's -- it's a very soft deposit. It's a saturated deposit. And so, it just -- it won't -- it won't return intact samples. We -- we can tell you quite reliably what that sample would return in the lab. You in fact, probably know this value somewhere between 31 and 33 degrees. That said, as mentioned earlier, we used an even more reliable approach, which doesn't involve any disturbed material, using the side scan sonar survey. Jump in.

MR. ESHRAGHIAN: Arash Eshraghian with Stantec. Just to answer the -- your last part of your question regarding 31 degrees, which versus -- versus 65 degrees, 31 degree is the angle of repose of a disturbed sand when there is no state to hold the material together. So, it's totally disturbed sand state. Based on side scan sonar, we realize that there is some cohesion between the sand particles that's caused the wall of the -- the cavity to be steeper than 31 degree. So, that -- that's the main reason with 65 degrees.

MR. LENEVEU: I just want to make one final remark. It seems that with this requirement for long-term monitoring, and there's a great deal of uncertainty in your analysis, is slope stability. And this is a situation where you can't be uncertain because the aquifers at stake. So, I just want to leave you with that situation or observation, that you must be certain about these things. And I don't think you've presented a case that shows you -- you are certain about the long-term slope stability of that sand.

MR. MCLACHLIN: This is Doug McLachlin. Can I just have a response to that? So, Dennis -- so, first of all, we did talk a lot about the --

TARP. So, the trigger action response plan. And there will be a lot more work that will go into that as part of the next stage. But given the amount of information that we have to date, given all of the water well records, all of the boreholes done for assessing the production, the geotechnical boreholes, the OTV, the ATV, the -- the coring, the cores that we've actually recovered, the side scan sonar, we have sufficient information at this stage to be very confident in the modelling that Stantec has done. And provided we move forward on that basis, which SIO has agreed to, we're confident that the production can be carried out safely with no adverse impact on the geology.

THE CHAIRMAN: Chair, thank you for that round of -- round of questions and answers. Our Line in the Sand, I believe, is up next. And I see a nod from.

MR. DUNCANSON: Mr. Chair, Sander Duncanson here. Just before we get to Our Line in the Sand, Mr. Bullen, this morning, gave an undertaking to provide Mr. LeNeveu with well construction reports. We have those available now. So, I will leave copies at the back of the room and provide copies to the Secretary and Mr. LeNeveu as well.

THE CHAIRMAN: Chair. Thank you very much. That was very expedient of you.

MR. KLASSEN: Good afternoon, Mr. Chair, Members of the Panel. This is -- before Our Line in the Sand begins, just for the purposes of -- can you -- yeah -- apologies and thank you for the prompt. Chris (ph) Clawson (ph) for Our Line in the Sand. Before getting into questions, just an administrative matter for the purposes of the CEC's record keeping, Our Line in the Sand and the Manitoba Eco-Network would like to make sure that the slides presented this morning are entered in the record and for the purposes of the transcript labelled as MBEN Hearing Exhibit 1, and OLS Hearing Exhibit 1. Thank you. Now, Our Line in the Sand does have questions for this panel. We would propose, however, with the consent of the panel, that these questions be posed by Mr. Ian Alcott. Mr. Alcott is a hydrogeologist engaged in this issue in support of Peguis First Nation. Peguis First Nation is a group that Our Line in the Sand has made efforts to collaborate with in this issue -- in this process for the sake of efficiency. And both groups have interest in the potential answers to the questions. And so, with the consent of the panel, I'd like to invite Mr.

Alcott forward.

THE CHAIRMAN: Chair. After some caucusing we will allow it. It is a little bit like introducing a new participant, but we will allow you the latitude.

MR. KLASSEN: Thank you, Mr. Chair.

THE CHAIRMAN: Chair. Ian, you have 30 minutes.

MR. ALCOTT: Good afternoon.

THE CHAIRMAN: Please read your name for the record. That was the Chair.

MR. ALCOTT: Ian Alcott. I'd actually like to start by following up on Dennis's last question about the angle of repose in the sand that you are using. And when I look at sand, and I look at wet sand, I don't -- I wouldn't take 65 degrees as an angle of repose. I would think that would be rather steep. I would prefer it to be down around that 31. As a matter of fact, this is saturated sand that we're talking about or will be. And I would imagine that that was probably around 15 degrees for saturated sand. Are those -- so, it seems to me that if we were to take a precautionary approach to this, that 30 degrees or even less for an angle of repose would be a much more precautionary approach. Agreed? Yes.

MR. ESHRAGHIAN: We agree that 31 degree is reasonable angle of repose for disturbed sand in the -- in the disturbed state. But in this case, based on the side scan sonar data, we see the sand is standing vertical or even hanging, which means there's a cohesion component into the sand deposit. And in fact, some people refer to this sand as sandstone. Implies that there is -- there's a state, additional state of cohesion into the sand. That -- that's the basis of a steeper sand slope assumption. So, we're not -- we're not talking totally disturbed sand. Of course, the portion of the sand that will slough and fall into the cavity, yes, that can be 31 degrees or even -- even flatter. But we're talking about the wall of the sand that is standing vertical or overhanging. The other point is that we're looking at the condition almost immediately after extraction or short time after extraction. If you compare the side scan sonar data you see that the actual cavity is start backfilling with other material. Sand and even after that back filling from the shale and -- and the caprock failure into the cavity. So, that's why we think our approach is -- is conservative and -- and reasonable.

MR. ALCOTT: I would agree that, yeah, at first, but we're talking about a 100 year into the future here. And I'm just wondering if you're modelling has taken that into consideration. That length of time for that sand face to be exposed to a water environment. And if -- if to me, I've come off beaches in the world because most of our beaches are sand, and I look at how sand works on there even in sandstone in places like Portugal, which are almost vertical, but there are signs all over the place, Please do not sit underneath these sandstones because they're continuously sloughing over time. And an exposed face like that, I would expect slowly over time, that it would start to take on an angle of repose that is much less than 60 degrees. That would be my -- my -- my sort of view on that. And I'm just wondering if you had modelled when you're doing your model, is it a static model? I mean, is it a time -- is it time sensitive? Or is it time, you know, does it take into account that we're looking at these pillars that are going to be hopefully there for hundreds of years so that we get no subsidence. And does the modelling take that into account?

MR. ESHRAGHIAN: Agree with your -- your statement, that if we have a vertical sand wall, and the sand fall back, and actually sand being removed, yes. With time, we end up with flatter and flatter slope. Maybe 31 degree, maybe even flatter. But in this case, after extraction we don't go back and extract again. And backfilling material and also backfilling as a result of -- of the drop off or -- or failure of the -- the shale and caprock into the cavity, will provide additional support. That's why we think it's different from assuming the total empty cavity case. So therefore, we don't foresee it to go as a 31 degree or 15 degree for long-term and we just rely on our FLAC modelling result to give us a guidance how far the -- the failure in the wall will progress. So, it's different from the -- the condition that you describe as -- as the shorelines and -- because the material being sloughed is keep moving away or there is unsupported area or -- or portion for the wall. Yes, in that case I agree, the material will -- will gradually flatten. Will be flatter than 31 degree even. But it's not our case.

MR. ALCOTT: I'm sorry I didn't ---

THE CHAIRMAN: Chair. I'm going to

remind you, please, to state your name for the person who's sitting in Toronto transcribing this, doesn't know who's speaking. Every time you push the button you need to state your name.

MR. ALCOTT: Ian here. I would look at the -- at the face of the -- of the slope as being unsupported, okay? Because it's -- I would expect it to be a full waters -- water space in the -- in the room if the -- so to speak. And therefore, I -- I would expect that angle of repose over time to lessen. And I'm wondering if you were to model this at 31 degrees or 15 degrees as worst case scenarios, what would that do to the spacing between the cavities?

MR. ESHRAGHIAN: The -- at the beginning of the -- the -- the design as we actually model 31 degrees because we were thinking about taking that approach that you mentioned. But with additional information from side scan sonar, we realized that, that would be overly conservative. So, we -- we relied on these additional cohesion of the sand. And the -- the distance you see between the cavities is based on these new data and new approach.

MR. ALCOTT: Ian. I didn't quite grasp that. Did you -- are you saying that we're -- the distance that you're using now between the cavities, 70 metres is based on the 60 degree angle of repose or the -- am I correct?

MR. ESHRAGHIAN: Arash Eshraghian, Stantec. Yes, the current distance you saw here is based on 65 degree angle, not 31 degree. So, the -- the required distance between cavities is based on these 65 degree, not 31 degree.

MR. ALCOTT: Ian here. Thank you. So, would you be able to calculate out the distance between the cavities if angles of repose over time were to alter from 65 degrees to say, 30 degrees or to 15 degrees? Because that's what we would expect in wet sand that's unconsolidated. But you're telling me that this sand is fairly loosely consolidated. It's not like a sandstone face, it's got a loose consolidation. So, I would expect over time, that that angle of repose may reduce. And therefore, as a precautionary statement or precautionary approach, what I would like to see is what the distance between cavities would become if we had say, a 30 angle -- 30 degree angle of repose or 31 degrees, and also a 15 degree angle of repose.

MR. MCLACHLIN: Thank you, Ian. Doug McLachlin. So, first of all, just to make it clear that the activity of extracting the sand causes disturbance, which causes the, you know, the creation of the void. Once the extraction is completed, there -- the -- all the equipment is removed, the borehole is -- is sealed off. There is no activity going on in that space to cause erosion like you would see on a beach as an example. So, there is no ongoing erosion or removal of that sand. So, what we see then is the residual slopes so far, all indicate very, very steep slopes. Okay, that's what we're seeing. And that's because even though when you -- when you start to disturb it, it becomes, you know, almost like a slurry, the actual final face, which you can determine based on side scan sonar, exhibits the cohesion of that sandstone. It's not a strong sandstone. You wouldn't be able to, you know, it's -- it's not strong like the limestone, but it still has strength. And so, one of the things that will be done over time will be continue to monitor that over time. So, there will be ongoing monitoring that's part of the -- the -- the TARP. And so, there will be ongoing. We've got one right immediately after extraction and one, you know, four months after extraction, there'll be ongoing opportunities to carry out that sort of an assessment to determine geometry. But everything that -- that Stantec has done and looked at, they've -- they've determined with the -- the FLAC modelling the distance expected, and it's expected to only extend another five metres beyond in terms of radius. In diameter, 10 metres. So -- and -- but part of that assessment will be the ongoing work that's proposed as part of the -- the trigger action response plan.

MR. ALCOTT: Ian here. So, you have noticed that there has been a 5 metre difference between when the room was created, shall we call it, or the extraction was created. And then a few months later, I think you presented in your diagram that it had moved a few metres, 5 metres to be exact or -- or that. And that's to me, that's after a few months, or a month, I'm not quite sure. Maybe we could put that slide back up. Could you please?

MR. ESHRAGHIAN: Arash Eshraghian with Stantec. Maybe it's easier to discuss on the -- on the slide. So ---

SPEAKER UNKNOWN: Here, or where do you

want to see?

MR. ALCOTT: That's the one I'm speaking of. And -- and speaking about the diagram on the lower right.

MR. ESHRAGHIAN: Arash Eshraghian with Stantec. What you observe here, is the result of calculation. It's not result of measurement in one month or two months' time. You see, these -- these sidewall failures dimension is result of calculation. But so far, they agreed with the measurement as well because we had side scan sonar one month of -- and four months after extraction, which showed that the actual sand cavity in the sand area has already backfilled. And the extension -- expansion laterally is less than of five metre expansion that we calculated. So, these are the side scan sonar data of 98-5, I believe. That's the -- that's the -- that's the geometry side scan sonar. That also gives us an indication of with time how things changes. And so far, they matches with our prediction. So, it's not more than 5 metre expansion.

MR. ALCOTT: Ian here. I wouldn't expect, like, I don't know if I'm understanding this correctly, but I wouldn't expect that the -- the slope, if this is what I'm looking at is the first phase and then four months later the second phase of it after four months, or is that what it is that you're showing me here, or are you just showing me loosening of the -- of the sand particles?

MR. BUNDROCK: Steve Bunrock, Stantec. Yeah, what you're seeing here, I mean, you might call it, it's -- it's a typical shape likely after some period of time. When we actually look at the side scan sonar surveys, we mentioned, you actually see completely vertical to extra vertical void shapes. This is a shape that we consider to be most representative of the shape of the void after some period of time, with all of the overhanging material having failed. We don't expect that to remain competent over time given the behaviour of sand. And then -- yeah, and -- and failing to some ultimate shape like this, it's 65 degrees. I mean, it's also important to remember that, that cavity is actually infilling. And so, we don't see this particular shape. We see that the -- probably as much as the bottom 2/3 or maybe all of the full height of the cavity has infilled with sand and other fines. The wall is -- is more supported than it would be if it were a fully open void.

MR. ALCOTT: I see that dynamic, but I would like to take it further and suggest that if you were then to -- and by the way, it's Ian here. If you were to look at a wet -- wetted medium that of sand that is loosely consolidated, I would expect that slope to be much less. And I do agree with you that it would infill to the bottom as the slumping continued and gravity did its work. But what would that -- there's two questions here that -- that -- that get me about this is, suppose it doesn't stop at 65%. Suppose this angle of repose moves to 31% or even more. Two things have happened is, you'll probably get a shallower cavity in terms of depth because of the infilling, but do you use your structural integrity or the -- the support to the layers above, to the shale and to the limestone layers, and to the unconsolidated materials, the tills on top of that? Do you start to lose the bearing strength of these pillars as they erode to say, a 31 or 15%? And so, that's why I'm asking, is if you're starting the mining on the supposition or the, I would say, your modelling is showing 65%, but is that not a very, very risky, I would put it, angle of repose to start with? Would you not be much more conservative by using and precautionary by using 31%?

MR. ESHRAGHIAN: Arash Eshraghian with

Stantec. So, what -- what you observing is a sketch is actually conservative assumption or representation of the modelling. So in fact, with sloughing the -- the cavity will be backfilled and there will be additional support. Therefore, that scenario of -- of sand going to 31 degrees or 15 degrees is not applicable. And also, the side scan sonar data so far confirm our estimation of expansion. So, we don't believe it's necessary to assume 31 degree angle. It's overly conservative assumption at this point.

MR. ALCOTT: Okay. I -- I think -- okay. Thank you for that response. I'm going to move on to another question and it's concerning -- actually, this slide, but I'd like to go back to slide number, I think it's 7 or let me have a look at the -- yes, Slide 7, please. Here you detail conceptually the geology of the -- of the strata that we're talking about, where the Carmen Sands are. They're overlain by a shale air, and then the limestone from the Red River Formation, and then some tills or unconsolidated materials. Could be glacial fluvial, whatever is in there. As I move on from there and I look at the geotech studies that you did in terms of the, shall we say, the strength of the overlying areas, and I'll move to the next slide here, which is on Slide 19. All of a sudden, in your analysis, you have, shall we say, negated the shale air. And you're saying that it's structurally unsound from what I gather from your presentation. And that it basically, has a no strands or real strands. And that you are basing now, your assessment on just the failure or the possible failure of the limestone layer above. My question here is, is what are we assuming here? Are we assuming that the shale will not stand up by itself once the cavity is opened? It has no strength? Because that's very concerning to -- to us in terms of the segmentation, or shall we say, of the two aquifers. The limestone is an aquifer above the sand layer aquifer, the Carmen Sands, separated by an aquitard, which happens to be that shale. And if that shale is presumably going to fail because of its weakness here once the cavities are opened, then the segregation that we see between the two aquifers is lost. That is very concerning to all of us because we -- so, my question is -- my question is, do you expect or are you assuming that, that shale layer is failing.

MR. MCLACHLIN: This is Doug McLachlin. In fact, the -- you're quite correct that the stability modelling assumes no strength from the shale. And therefore, you're correct that it is assumed that the shale could fail. It's not relied upon in any of the modelling that Stantec did. That is correct.

MR. ALCOTT: Ian. Thank you, Mr. Chair, those are our questions.

THE CHAIRMAN: Chair. Thank you very much. MSSAC, do you have any questions at this time?

SPEAKER UNKNOWN: Thank you, Mr. Chair and Members of the Panel. We had earlier canvassed this with our -- our friends from Sio Silica as well as with the Board Secretary and Board Legal Counsel. And I'm putting before you a proposal by MSSAC and Manitoba MBEN, the Manitoba Eco-Network. And we're asking that our cross examinations be adjourned until 9:30 tomorrow morning. And -- and with asking that request and understanding we're making the undertaking that all our geotech examinations will be completed. Currently, we estimate about two hours for MSSAC and about an hour and a half for our clients on the -- on the public record. And we expect to be finished well before -- well before three o'clock on -- on tomorrow afternoon. And the rationale is for the recommendation is one, that it will still keep the -- the -- the Commission on track for its schedule. It will allow our clients to -- and our legal counsel to review with our experts the material that's been filed today, including some new material, and -- and including some material, which we believe was formally on the confidential record, which appears to have been put on the record today. And so, we do have to show some care in -- in making sure that we're respecting our non-disclosure agreements. And we also believe it will allow for a more orderly cross examination. So, if -- if you looked at Mr. Williams's notes today, for cross examination, there would be 50 pages long. If you saw them tomorrow, they might be about 30. So, that's a bit of the efficiency that we're hoping to offer this -- this panel. And again, I can indicate my understanding from my learned friend from Sio Silica, he can speak for himself, but that they are not opposing this -- this motion. So, we're asking the Board to defer our crosses till tomorrow morning. Thank you for considering this.

THE CHAIRMAN: Chair. Sanders, is there -- you want to put something on the record?

MR. DUNCANSON: Thank you, Mr. Chair. I think my -- my friend did a good job summarizing our position. And I think Sio's primary considerations are -- are hopefully staying on schedule as best as we can, but also making sure that everybody has an opportunity to ask the questions that they want to. So, we're willing to be flexible so long as we stay on schedule.

THE CHAIRMAN: Chair. Thank you. Do Members of the Panel wish to ask any questions at this time?

EVERYONE: (No verbal response).

THE CHAIRMAN: Chair. So, we are not opposed to the motion. The panel is willing to grant you a deferral for both MB Net and MSSAC to move your questioning to tomorrow morning. Members of the Panel though, my -- with -- Peter was clarifying is, not questions on Byron's motion, but rather do we have questions ourselves that you wish to ask at this time? Or do you also wish to defer to later? Hartman, did I see your hand? Please proceed.

MR. HOLLANDER: Hartman Hollander. I'd like to start with a simple question. On Slide 8, you mentioned the word, Geological Boreholes. Can you explain your termination?

SPEAKER UNKNOWN: I'm sorry, can you restate that? We couldn't ---

MR. HOLLANDER: On Slide 6 -- Slide 8, sorry, you state the term, Geological Boreholes. Can you explain what you mean with the geological borehole?

MR. MCLACHLIN: Excuse us, could you restate what do you mean by geological borehole? We're trying to understand the ---

MR. HOLLANDER: Yeah. So, I would like to know what do you mean with this term? Because you talk here about 46 boreholes, and in the presentation this morning, on the Slide, Sio History in Manitoba and Activities, you talk about over 95 boreholes. So, what is a borehole? What is a geological borehole?

MR. MCLACHLIN: Doug McLachlin. So, there's different types of information that went into the development of the geological model that was then used as part of the geotechnical modelling and assessment. So, as -- as mentioned, there are, first of all, the -- the water well records that are available publicly. So, that went into it. There were also wells that were drilled for assessing the resource, which are not logged. So, they are -- they're drilled but they're not -- there's no core recovered from those. And so, that's another type of well. And then there are -- are also boreholes that recover core. And in one of those, there was also optical and acoustic monitoring of those as well. So -- so, it's all of that information was used to develop the geological model and the geotechnical model.

MR. HOLLANDER: Okay. Thank you. How many of these wells, of this 46 wells were supervised by Stantec during the construction?

MR. BUNDROCK: Steve Bundrock with Stantec. So, in the case of the geotechnical boreholes, seven of the eight were logged by Stantec. The actual drilling was not directly supervised by Stantec, but we did provide QP training for the -- for the team that was collecting the core. And then a similar process was used for the geological borehole drilling. We provided training and our QP signed off on collection of that data.

MR. HOLLANDER: It's a -- understand that I understand that also no professional engineer or professional geosciences was supervising any of these boreholes?

MR. BUNDROCK: Yeah, and in fact -- Steve Bundrock with Stantec. In fact, all of the drilling was supervised either by PGO or a professional engineer. In this case, they happen to be Sio Silica.

MR. HOLLANDER: Thank you. Hartman Hollander. So, on Slide 10, you talk about some of the thicknesses of your formations, which you identified. You showed that the shale is between zero and five metres. Can you let us know where you find no shale formation?

MR. MCLACHLIN: This is Doug McLachlin. So, this, the 0 to 5 metres was based on a -- our hydrogeology team provided input on information that was provided within the -- the whole area. And it's -- it's uncertain whether that information perhaps was not recorded by the water well driller, for example. So, we don't know for certain, but it -- it there are -- there are water wells, and there are some locations where it's not -- where it is not recorded as being present. There's no shale present.

MR. HOLLANDER: We had this question,

but similar ---

THE CHAIRMAN: Chair. Please state your name.

MR. HOLLANDER: Sorry. It goes out when someone else speaks, I see. Hartman Hollander. The next slide on Slide 11, you explained nicely that when you have fracture that's good for hydrogeology, not so good for geotech. And we see that there is a fracture zone just above the shale. Was this part of your investigation, your geotechnical investigation? Or did you say that this -- this part is failing nevertheless?

MR. BUNDROCK: Hi, Steve Bundrock with Stantec. Can you just repeat your question?

MR. HOLLANDER: On this slide in the middle, the Figure 4, you would see above the shale formation, a fractured limestone. You mentioned that this parts are not holding the strength which is required to hold the -- the hanging, in this case the hanging materials. So, the shale and the fractures. Was this part of your geotechnical model or did you expect that this is failing?

MR. BUNDROCK: Steve Bundrock with Stantec. We assume no strength for that particular occasion. We've basically treated at the same way that we treated the Winnipeg Shale.

MR. HOLLANDER: So, in the end, you expect that there's a failure in this direction, in this area?

MR. BUNDROCK: Steve Bundrock with Stantec. I wouldn't say that that's true. We've actually found that there's variability in this particular layer. Whereas the shale typically is found to be fissile and less competent, there's -- there's some variability in that contact area between the -- the overlying caprock limestone and the shale. In some cases, it -- it isn't actually highly fractured, but we used a conservative assumption in this case.

MR. HOLLANDER: Hartman Hollander. The right side of this one shows a couple of your images which you took. And the question is, you used some instruments or some, which can in the end scan this. Did you also use other instruments like geophysical methods to look further into the -- into the formations?

MR. BUNDROCK: In this case, besides borehole logging, sampling, lab testing, this was the only down hole survey that we completed.

MR. HOLLANDER: Hartman Hollander. We heard a lot of questions already regarding coring the sandstone. You said that it's not possible. I thought that most of you are working in the tunneling and in the mining area, and seeking shafts. And tunneling is generally done by -- by freezing areas when you -- when you have too much water. Why didn't you freeze the -- the sandstone and took quartz (ph) samples to analyze them in the lab?

MR. BUNDROCK: Steve Bundrock with Stantec. Yeah, that would be a potentially viable approach to extract undisturbed samples. However, in this case, it would also be really quite potentially destructive to the aquifer. Certainly invasive. It's a very time consuming process. It's a very costly process. And it involves the drilling of many, many wells.

MR. HOLLANDER: Yeah. I mean, you are

also looking for 20 years of -- of -- of -- of operations and you have done a couple of boreholes, 46 of them. And it would have been certainly nice. I understand your attempt to use a physical model and to try to back calculate, to estimate as you wrote here in your statement, the parameters. But certainly proving that these parameters are correct probably would help. Would Sio Silica be interested or would they consider to do this? To -- to test the value so that the technical -- geotechnical evaluation can be proven? Or is that not an idea?

MR. MCLACHLIN: This is Doug McLachlin. So, speaking with Sio, they actually did consider that at one point. But the whole process of going down, installing equipment to freeze that, the sandstone would be very -- just -- it would cause disruption as you go in there to -- to start to do that. It would be possible to do it, but it's not necessary to do it because we actually have the side scan sonar data that gives us direct evidence of the slope. And we don't require that level of investigation to do the freezing to -- to understand the behaviour of the sand. We actually understand it way better because we have evidence like -- essentially similar to a photograph -- photographic evidence of the actual side slope of the sand after the extraction has taken place. And so therefore, we don't require that -- that -- that -- to do that for -- for the information we need.

MR. HOLLANDER: Thank you for coming up with the word side scan sonar. That would be my next questions. On Slide 15, you show a nice round version of the sandstone, which you took out. And the issue with this is, it is just opposite what you have shown on Slide -- give me a second, on Slide 7. So, on Slide 7, that was probably the original understanding is that the largest take out is at the top and the smallest at the bottom, while the data which you show that prove just the opposite. Can you explain that and what has this for implication for your design process?

MR. MCLACHLIN: This is Doug McLachlin. So, the side scan sonar shows the slope after short -- a short time after extraction. And the slope that's shown back on page or on Slide 7, would be the long-term slope after it's gone back and sloughed into the hole. So, that would be the -- the sort of -- so, I mean, I think it's -- Slide 7 is -- is a -- a graphical representation of the longer term slope.

MR. HOLLANDER: Okay, thank you. When we go back to Slide 15, and we see they are not only the round one, the round shape, but also on the right side, a lengthy shape and the round shape. As far as I know, you have done three of these scans and two were lengthy and one were round. Can you explain why some of them are round and some of them are lengthy, and what this has for implication for the stability of the -- of the pillars?

THE CHAIRMAN: Chair. We'll take the answer to this question, and then we'll take a 10 minute break.

MR. MCLACHLIN: So, this is Doug McLachlin. So, yes, you're quite correct. There is some variability in the sandstone formation. And there's evidence of both, I'll say, symmetrical and asymmetrical cavities. And that would be something that would be taken on board as the trigger action response plan is developed, and more information is gained with, you know, moving into the production stage. And those sorts of analysis, that's exactly what we carried out at that point in time. So, to see if there's any modification that would need to be made in the assumptions in the model, and to make sure that they're -- the cavities are safe. So, that would be part of the next stage of -- of the project, okay?

THE CHAIRMAN: Chair. Thank you. We will regroup at 3:05 sharp.

(break).

THE CHAIRMAN: Chair. Uncharacteristically, I'm starting a minute late. Hartman, the floor is yours again.

MR. HOLLANDER: Hartman Hollander. I would like to continue with some questions to the data from the side scan sonar. The two pictures, which we see on the right side, once we're done after 3000 tonnes of sand extracted, the other one after 4200 tonnes extracted. What is the target of Sio Silica and what would have this impact in terms of the extension of each of the cavities?

MR. MCLACHLIN: Doug McLachlin. Sorry, could you just -- the last -- the question, could you just ---

MR. HOLLANDER: Well, the question is,

in the end, what is the -- the estimated size? What you want to develop from one of the cavities? And what is this meaning in terms of the extension of these cavities?

MR. MCLACHLIN: This is Doug McLachlin. So, at each extraction location, the size of the cavity will be different depending on the geology. So -- and -- and just keep in mind that in each location, the -- prior to extraction, there will be a logging to determine the -- the thickness of the overburden, the thickness of the limestone, the shale, and sand. And so, at each location, it follows Table 9. So, you need to look at Table 9. And it -- it'll be variable across the site depending on where on the site extraction takes place.

MR. HOLLANDER: I appreciate that Sio wants to do this certainly based on the situation, but I'm sure that there is some -- some expected withdrawal from -- from a borehole, and it would be nice to hear that whether this licence is area of 3 to 4000 tonnes? What we see on slide -- Slide 15 or whether that is substantially larger?

MS. WEEDEN: This is Laura Weeden from Sio

Celica. So, each location, depending on the geology, as Doug mentioned, it's going to impact the volume of sand that's removed. In our previous Seven Well Cluster Design, we had contemplated taking out up to 21,000 tonnes per cluster, which was up to seven wells. This remains very similar at this time, up to five wells now, not seven, because we have been able to take up to 4200 tonnes out of one well.

MR. HOLLANDER: So, in conclusion, the size of the cavity could be that what you have measured here?

MS. WEEDEN: Yes, it could. Yes.

MR. HOLLANDER: One discussion is always -- also what you presented this morning, how much material you will remove, and these two pictures here show that you are moving 20 feet in height, that the -- based on your drawing, which you did on Slide 10, that the formation is about 65 to 75 feet. That means, you would remove a bit less than 1/3. Is that correct?

MR. MCLACHLIN: Doug McLachlin. Could you just repeat slowly the question so we can understand?

MR. HOLLANDER: This picture, which you show there on this slide, shows that this -- this -- this cavity has a height of 20 feet. If you look at your information given on Slide 10, you say that the sandstone has a height between 65 and 75 feet. That means that about 30% of the aquifer thickness is mined out. Is that correct?

MR. BULLEN: It's Brent Bullen with Sio Silica. On this picture here that you're looking at on the slide, at the side scan radar -- sonar, sorry. What you have is, you have a base where you have less consolidated sand. I guess a -- a lighter sand and some suspended solids where the sonar can't penetrate. And so, we also touch sand at that point. So, once we stop extraction, there is a floor. And so, the sonar image is the image that we're able to obtain at the time, but we do show that there is disturbed sand below it. And so, there is a -- a portion of disturbed sand and less dense sand immediately below. And that's why the variation between what the sonar image is capable of capturing and what the animated graphic looks like in the anticipation of the void.

MR. HOLLANDER: So, when you say that you cannot exactly detect it, there's on Slide 19, you were -- a conceptual model, which you used for the geotechnical analysis. And you show that the cavity is underlain by sludged sand. How deep is this formation, this disturbed sand going? And did you measure that? These are the two questions.

MS. WEEDEN: So, the side scan sonar device, when it sees even like a murky water, it thinks it's a brick wall. So, we see a slightly different image than what we've detected. In the side scan sonar well, that we did actually run the tool, we removed sand down to 229 feet, then stopped and did the sonar image. And I believe, on the scale, it -- the scale only shows it goes down to around 200 feet in the image.

MR. HOLLANDER: So, if I understand this correctly, that the sonar image and your conceptual model is not the same, and this conceptual model is based on no data?

MR. ESHRAGHIAN: Arash Eshraghian, Stantec. So, the side scan sonar, gave us the information about the -- what you see as a cavity here, okay? So, that part is measured. The rest of the area that you see as a backfill here in this image, is based on the depth of extraction, which we knew how far, how -- how deep they went down. So, that established the bottom of area. And we do expect -- we do understand normally how much around that area was being extracted -- disturbed. So, usually 2 to five metre around that tip. So, that -- that bottom with -- that you see there in that figure, is an estimation of how much disturbance we expect, the cavity we have. So therefore, we connected that where we know the wall of the cavity is to that disturbance zone expectation at the base of the extraction. So, that's estimation of -- of the backfill area. So, that's how the model was developed.

MR. HOLLANDER: Okay. And then I try to conclude this. So, you use an unproven technology, which is new, which you have a patent on file. You have some understanding how sand would behave, but you have not measured the properties of the sandstone. You create a conceptual model to back calculate that and get exactly out what you have expected. Now, probably when I would do this kind of modelling, I would probably get the same idea.

MR. BUNDROCK: Steve Bundrock, Stantec. I don't think we agree with that conclusion. In fact, we started out several years ago with on about the stage that you're referring to there. Since then, we've collected a lot of data using borehole logging, using side scan sonar survey, which is accurately -- actually, quite reliable. The other down hole survey with the ATV, OTV, and -- and multiple rounds of modelling and sensitivity analysis.

MR. HOLLANDER: Yeah. I mean, the -- the ATV is for the boreholes in the limestone. Nobody discusses your good work and the limestone here. I think everyone agrees that the finding of 50 metre thickness as a minimum thickness for stability is something which -- which is questionable. Also the report of a cadence is just a question, what happens below in the sandstone? And unfortunately, the geotechnical report cannot give too many answers on that, if I see that correctly. You cannot answer whether the -- the shale fields, you cannot answer whether the fractured limestone fields, and you have also no exact measurements on this lodged area, which you are mining deeply.

MR. BUNDROCK: Steve Bundrock with

Stantec. We think that it's actually irrelevant whether or not the shale or the limestone, those lower units, fail, because we don't rely upon them for stability. In fact, we -- we assume that they're not providing us any strength. We're only relying upon the -- the upper section.

MR. HOLLANDER: I agree that this is correct for the geotechnical part, but it will play a big role in the hydrogeological part. Thank you very much.

THE CHAIRMAN: Chair. Are there any members of the public that wish to ask a question at this time? Otherwise, we will convene for the day. Let me be clear, it must be a question, not a soliloquy, please. You're going to have to come up and take the microphone, please.

MR. ALCOTT: Thank you. Again, it's Ian Alcott. I'm wondering if you could model for us the strength of that shale there. I know you're ignoring it in your analysis because you're concentrating on the limestone above, but I'd like to actually see the numbers on the -- on the shale. I think we all would. I think it would be beneficial because then we know if that layer is going to collapse or not.

MR. MCLACHLIN: Doug McLachlin. So, the assumption that we have made in our geotechnical assessment is similar to the assumption made by the hydrogeological team. And so therefore, that -- you can refer -- they will be discussing that during the water panel, which will follow, perhaps tomorrow. And they have considered the potential for failure of the shale in their hydrogeological assessment, and they will describe that, and -- and you can ask questions of the hydrogeology discipline.

MR. HOLLANDER: I'd like to correct that. They have not discussed the failure. They have discussed the degradation. There's a big difference.

MR. MCLACHLIN: Doug McLachlin. Well, we -- we passed on to them that -- that there's a potential for failure. So, I believe they can clarify that tomorrow if they're on the stand tomorrow, or they're on the panel tomorrow, I should say.

SPEAKER UNKNOWN: Go ahead.

MR. BUNDROCK: Steve Bundrock with Stantec. Ian, I talked with Sio and we'll take that under advisement. The -- the issue related to the actual strength of the -- the Winnipeg Shale to -- to assess that and -- and respond. Correct. Yeah.

SPEAKER UNKNOWN: Thank you.

THE CHAIRMAN: Chair. Are there any other members of the public that have a question at this time regarding the geotechnical? Please come up to the microphone. State your name and your question, please.

MR. FORTON: It's Roley Forton ---

THE CHAIRMAN: You got -- you got to push the button.

MR. FORTON: It's Roley Forton. I wasn't planning on coming, but there's a couple of questions that sort of arised. Everything you've done is always been on one well. You've indicated that in Table 9, the diameter will increase. What will the cavity look like with five wells operating? Because that's potentially the worst case scenario. And what is the zone of influence from a single well? How much are you relying on the cavity collapsing? Those are three questions, but they come to mind right away, before I forget them. I'm getting old. And if you -- if it's easier for you to display that tomorrow, that's fine.

MR. MCLACHLIN: This is Doug McLachlin. So, the -- the allowable spans in Table 9 are regardless of the number of wells. So, in other words, the -- Table 9 was developed and -- and it would still apply whether it's 1-2-3 or -- or more extraction wells. So -- and that's -- that's very important. And that's a very important part of the design as well. So, the -- that's -- that's the purpose of Table 9, would be to guide the production to make sure. So, if you got the size of -- of one of those caverns based on -- based on a certain geometry with one well, you'd have to stop, you can't go beyond that. So, in other words, the purpose of that is to guide to make sure that -- so, if the -- the -- the dimensions shown in Table 9 are irregardless of how many wells. And -- and in terms of the how would it propagate over time, that was the modelling that -- that was discussed earlier, it's assuming that instead of having sort of almost vertical slopes, they do slough back. And so, those are the additional 10 metres diameter shown for

-- beyond how far it would extend over time. So ---

MR. FORTON: Roland (ph), I'm confused then, why not just have -- I'm assuming that you need the maximum diameter to put in five wells. And that you've already done -- you anticipate what's going to happen. I can't imagine why you would go to diameter, like, you should be able to predict through your model when you would expect to be able to use five wells, three wells, two wells, based on the fact that you've got 18 metres between wells, 9 metres from the edge. Those are all part of your -- your predictions. You're also predicting whether there'll be a triangle square across. All these things, you've already predicted. So, I -- I -- I understand what you're saying, but it doesn't make any sense.

MR. MCLACHLIN: So, Doug McLachlin, and we were discussing this earlier. And maybe we can present something tomorrow that will help you to understand. But there was an earlier extraction plan that showed some dimensions. Then there was additional investigation assessment, and then a new extraction plan was developed. One of the reasons for the change in extraction and the reduction in wells, is that during this process, Sio has been able to achieve efficiency so that they can gain -- they can extract more sand out of a single well. So, what -- what Stantec is doing, is strictly a geotechnical assessment.

SPEAKER UNKNOWN: They go hand in hand.

MR. MCLACHLIN: That they go hand in hand, correct. So -- so, Stantec are saying to Sio, here is the maximum geometry that you can develop for this geology. And now, Stantec is going -- sorry, Sio is going back and doing what they can to try and minimize the number of wells required to achieve that, and they're gaining efficiencies. So, there have been changes through the process that we can present. We'll put together a slide tomorrow. I don't know if that's an undertaking. We'll put -- put together one or two slides to demonstrate the efficiencies that have been gained.

MR. FORTON: It's Roland. Because it doesn't make any sense right now, because for your method to -- to supply to the plant, you need a minimum amount of sand. So, you could have two wells operating side-by-side and really make it difficult for you to transport it. You -- you originated with seven wells for a reason. So, you could have -- you would never -- you would always have the minimum amount of sand. Now, you've gone to one and one, or one in five, two and five, two and three, all these combinations, and if I'm to have any confidence in what you're doing, you should be able to predict that every -- all the time. It's -- that's the purpose of your modelling. You want to verify your modelling through the test work that you want to continue to do. But your model is useless if you can't tell me when are you going to be using 1-5-6-7-2, clusters. All -- all of a sudden you -- you say you simplified it. You've complicated it, because you've brought in two clusters.

MR. MCLACHLIN: Doug McLachlin. So again, there's a difference between the geotechnical assessment that Stantec has done, and the production design that Sio is doing. And they -- you're correct, they have to match. And so, basically, what's happened with Table 9, it's given a very clear geometry to Sio and saying, in any individual area, this is how large the cavity can be. And it's up to them based on some of the work -- and we can present this tomorrow, on the work that they've done, they've come up with ways of reducing the number of wells to be able to gain the same geometry.

MR. FORTON: Excuse me, Roland. And the same volumes? Like, they're still looking at 20,000 -- 21,000 tonnes?

MR. SOMJI: Hi, it's Feisal here. Yeah, just to try to simplify it. So, if -- if Stantec says to us, you can pull out 20,000 tonnes in this cavern. We, in our extraction testing, originally managed to only get about 2200 tonnes per well. So, when we originally -- 2200 tonnes per well or per hole. And so, for us to get to -- close to 20,000, we said seven wells to try to get to close to that 20,000 tonne mark. As we advanced and got more efficient and understood how the sand behaved better, we have managed to get close to 4000 tonnes now out of each hole. But we're still restricted to that 20,000 tonnes. And so, now we're trying to get close to that 20,000 tonnes with less number of holes within the same cavern area.

MR. FORTON: Roland. That's fine, but you're still in the hole. And I don't mean to be repeating myself, but it -- what's remained consistent through the whole process is the 18 metres between. So, what is your zone of influence when you're pumping?

MS. WEEDEN: It's Laura from Sio Silica. So, when we hear zone of influence, that's a hydrogeology question, and that will be discussed in the hydrogeology panel. I do want to clarify that, that 18 metre spacing was originally set up when we were contemplating seven wells per cluster because we've reduced the number of wells in a cluster, and we hope to further reduce that in the future. The 18 metre spacing no longer applies within the cluster. At this point, we may have one well in a cluster, we may have two, and up to five, and that's dependent on the thickness of the caprock and the overburden. Because we've reduced the number of wells in the cluster, you're right, to satisfy the volume or tonnage that we aim to produce per year, we have to have more clusters running. Our original EAP stated up to seven wells may be operating at any given time. And it had been planned to operate those clusters at the same -- that cluster all at once. Now, because we might have to operate one well cluster, that means we might have to have more wells operating at the same time. So, instead of seven wells in one cluster, you might have seven clusters operating of one well. I know it's a little confusing. And so, we will try to develop a visual for this overnight tonight. But what I will say is that, because we changed the extraction plan, we developed a new operating plan, which we gave to AECOM to rerun on the hydrogeology side to confirm that we wouldn't change what was originally done from a hydrogeology perspective, which is what -- when it comes to the well or zone of influence that you're talking about. And so, that will be discussed in the hydrogeology panel when they do their presentation.

MR. FORTON: Thank you for that. I -- but it -- it -- it was relevant to this. So, in that -- when you look at the -- the -- the picture or the side -- the sonar, I'm looking at a sonar and -- and the one that you didn't show, showed it was from DN1, which again, was frustrating because you never listed it. You never -- I don't know where it is. But the slope is really well defined in the opposite way. You're coming in this way, it's coming in, in an angle completely opposite. Now, you also showed in that sonar and explained today that where you're actually obtaining this sand goes much deeper. You only see -- the only possible -- it's only possible to see where the cavity actually exists if there is any sand in suspension, the sonar can't show it. And so, you may, in this case, only see 1/3 of the cavity. And it -- without an explanation, we've got today, it was very confusing. So, if I understand correctly, you've gone to full 20 feet or 25 feet, you cannot extract any more sand from that than what you've got. Why did you stop? There's still suspended sand.

MR. BULLEN: It's -- it's Brent Bullen with Sio. We needed to image the cavern. And so, we elected to do so after we took a certain tonnage out. So, we -- we elected to stop production and then go in and do a -- a side scan sonar. And so, we chose originally to stop, you know, at -- at the 3000 tonne mark and then 35. And then I think we did the other one at 42. We stopped at 4200 tonnes. And the reason we stopped at 4200 tonnes on the well even though it was still producing, was that reduced our overall drill count on the project by 28.5%. So, when you're looking at drill count reductions, and you're -- you're showing the ability to turn the production on and off like a light switch, and we see vertical walls, there is a whole data group set that we were trying to get away and -- and take that away to go back into the modelling. So, that's why we chose those points to stop. I mean, we could have probably gone a lot further than the 4200 tonnes, but when we look at the cavern size, you know, you look at the topographical little area and it tells you what our radius are. You know, we're within the model of what's allowed for a space. And we were doing that with one well. But when we look at multi-well production, and

I was going to borrow your coffee, Laura -- sorry. So, I'm sorry, maybe it's not the best, but let's just say that Stantec says, this is the maximum void you can have. It's based on the radial diameter at the top. We know the depth of the formation. That's what you can take out. Now imagine -- I'm sorry, you got to think of this like a Slurpee, not just a -- a thing of water, but a Slurpee. Because there's some -- there's some -- the sand stands a little. So, if I put one straw on the side and I start drinking, it'll come down -- it'll come down. And then all of a sudden it doesn't seem to come down uniformly. But maybe I'll put two straws in the Slurpee, and I can take it down, or I'll put three. But I'm -- I'm only going to take this void space out and I'll pump this much material out, whether I do with one, two, or three straws, I can only make this void. And what we found with the -- with the formation and the properties of the sand, you have to allow the formation to help give you the sand when you're lifting it with air. And so, it's easier on the formation to look at more than one well to bring the sand up. So, instead of putting one down, one well down the middle and having this big cone and hoping that everything is going to come in, you might put two. Now you've created a -- a Bridgeport between but you've still controlled the shape. You do three -- you'll end up with a nice diameter. But that's -- that's why we've looked at multi-well. It's to maximize the amount of volume within the allowable space and to do it in a way that the formation reacts, because one well might not do it all, but you need to have maybe two or three within that footprint. And so, that's -- we have to stay within that void space.

MR. FORTON: Well, that's my point. You've got to avoid that if -- and I'll just arbitrarily 1/3, 2/3. How do you know? And -- and this has been brought up because you've got a -- a flurry -- a sand flurry that's 2/3 hidden. How do you know? How do you know when you've reached your volume or your volume dimensions? And the other thing is, you took this picture four months after. The bottom isn't much deeper. It's only three feet deeper. It's not shown on this slide. But if you look at the slides that were presented to the CEC question, there's only three feet deeper or four feet minimal. It's not close -- so, is this stuff staying in suspension for four months? I find that hard to believe. And if it's easier to -- to answer that question tomorrow ---

MR. BULLEN: No -- no, I -- we'll -- we'll answer it here.

MR. MCLACHLIN: So, Doug McLachlin. Thank you for the question. So, just to talk through this a little bit. So, this -- this side scan sonar, you're right, it cannot penetrate into disturbed sand. And one of the things that we're finding out through this process is that even after extraction, there will be a layer of disturbed sand. And that's there as a result of just the activity of disturbing, and then -- then maybe sloughing of the sides. That will -- that disturbed sand will be there and will continue to be there even after extraction is finished. And so, what is happening through this process is, it's -- it's a -- it's a learning process as to when you extract, when you get your certain amount of volume out, because that's really what you're looking at. It -- it's just -- it's a cavity and there's a -- it's -- it's a geometric, you know, volume, and then you can determine how much sand can come out of that volume. And Sio is -- is -- is assessing to see once they pulled out, how is the formation behaving, making sure that the allowable spans shown in Table 9 are respected, and how to get that amount out in most efficient way. And in some cases, depending on where, you know, where -- where in the formation you are, it might be a single well, others it might be multi-well. But I think if we can put together a bit of a -- a slide presentation tomorrow, several slides to show the differences that might be very helpful to explain that in more detail.

MR. FORTON: You won't get off that easy. I probably have more questions then. And that's fair because I think everyone here wants to get a grasp on what's happening. And in a simple -- and before you even start, you have to assure everybody that you're in a position that this is what happens in the best case scenario. You're starting, you know, obviously, starting with one well. But they -- you should at the end of this be able to tell us what's happening with five wells. Because -- and in -- if you're going, as the young lady suggested, four well -- four different clusters of one well, how is that going to work? It's not -- it's -- it's dynamic because then you have to feed your sand slurry going to the facility. You have to have enough water. You have to have -- so, they don't work independently. And so -- and let me bring up another point. And I'm not sure this is all -- when you -- when you showed the pictures that aren't here, but on it it had a graph and it showed the pumping rates. And in those pumping rates, you were able to -- to define what the water rate was, what the sand rate was, what the slurry rate was, what would the recycle rate was. How did you measure this? Because in their original proposal, that was one of the things you had to determine. And here we -- I was, much to my surprise, they had all these things to find, but no explanation. And -- and that's the whole problem with a lot of what you've presented. You present a graph or you present a figure and there's no explanation with it. When I was in grade 12, which was many moons ago, I could never have got away with that. I would have had to give the method, what you're trying to illustrate, your conclusions. You throw a graph up there that we have to interpret. The geology is not going to change over that 24, like, why is it a secret? The proponent is, and should be displaying all that information. This young man at the back should not have had to go to water resources to get that information. It's caused nothing but grief for you guys. Why you even brought it on is beyond me. And it's fundamental to whatever you're doing. You want to know what the cap space is. You want to know. And if you didn't know, the map you showed is very variable. And to me, if I was doing this, I would have drilled holes in every -- the first proposal you had, was only three sections. Every quarter section, drill holes define it. You know where you're at. I mean, you're proposing to do it for every well now, but -- and that's a very cautionary approach, but give confidence to people what you're doing and what the geology is. Even now, it's a graph of -- of colours that blend in together. It was specifically stated, don't do that. Have it graph so people can -- should be isobars there showing what the depth is. Give -- give some of the logs to verify what you're doing, not just -- and I'm ranting now, sorry.

THE CHAIRMAN: So, Chair. Your -- your time is certainly -- your 15 minutes is drawing to a close if it hasn't already.

MR. FORTON: If tomorrow you could define how you found those pumping rates.

MR. BULLEN: It's -- sorry, it's -- it's Brent Bullen with Sio. I was just going to respond. Those are very good points and really good questions. Like, we do have a whole hydro team that's going to come talk about the -- the water side of it. The gentleman that are up here are talking about the geotechnical side, and that's just the way they broke it. So, it's not -- it's not to withhold or not share information, it's just that the -- the experts on the water side, you know, when you're talking about your influence and your pumping rates and so forth, they'll have their opportunity to present. And -- and -- and ask him at that time. It's just, these gentlemen are on the geotechnical side.

MR. FORTON: No, I understand that, but the -- in order -- and they explicitly stated, in order to do their -- they needed to do the geology or the geological portion of it as well. And what I'm hearing today is a struggle to get that information. And to me, it's fundamental to -- to both sides of what you're doing.

MR. BULLEN: I agree. And that's why when Mr. LeNeveu -- well, I agree. That's why Mr. LeNeveu asked about the well, it was obvious, we don't know what information he did or did not obtain through Public Information Act, but you know, we made it available to him, and in short, after the break, so he would have it to make his own decisions. So, it wasn't a withholding, it's just -- we just didn't know he'd have it.

MR. FORTON: One last question. The -- the -- I was referring to the map going back and forth. So, when it crosses -- when you're going this way and it crosses you're 65 degrees, is that the maximum you can go?

MR. ESHRAGHIAN: Arash Eshraghian, Stantec. Can we go back to that slide? Maybe it's easier.

SPEAKER UNKNOWN: Where do you want me to go?

MR. ESHRAGHIAN: Go to the (inaudible) section. So, this is -- this is our estimation of the cavity plus the disturbance. That's what you're referring to, about the -- the 65-degree angle here. Is that ---

MR. FORTON: That's what -- that's what I meant. When those two points meet, that's what you're defining, is the maximum width of the -- what you got your it's dangerous. Well, it's been a long day. One of the two. That's what I'm saying. When you reach that point, that'll be the maximum width no matter how many wells, no matter what. You've reached your point where it will -- their safety zone.

MR. ESHRAGHIAN: Yes, that's 65 degrees, the assumed maximum dimension of that cavity. Of course, if they can't extract it with one well, they will put two there, right? Depending on the allowable size. If your allowable size is, like, say 40 metre, of course you have wider base. Therefore, they can put more than one well into this.

THE CHAIRMAN: Chair. Roland, I think you've had your 15 minutes and then some. Are there any other members of the public that wish to ask a question? Going once, going twice, okay. We are adjourned for the day. Thank you for the active engagement. I think some members at the front have agreed to take on some homework. So, we'll look forward to what you bring back tomorrow and we will reconvene at 9:30 and pick up where we left off with the geotechnical analysis. Thank you all. Have a great evening.

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