JUNE 22, 2023

CLEAN ENVIRONMENT COMMISSION REPORT

ON THE VIVIAN SAND EXTRACTION PROJECT

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June 22, 2023

Honourable Kevin Klein
Minister of Environment and Climate
Room 344, Legislative Building
450 Broadway
Winnipeg, Manitoba R3C 0V8

Re: Sio Silica Project

Dear Minister Klein,

The panel is pleased to submit the Clean Environment Commission's report on the technical review and public hearing with respect to the Sio Silica Project.

Sincerely,

John Doering, Chairperson

Ian Gillies

Terry Johnson

Laurie Streich

Manitoba

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Foreword: Considering a Project Without Precedent

In November 2021 the Minister of Environment and Climate asked the Clean Environment Commission to review the Environment Act Proposal for the Vivian Sand Extraction Project. Specifically, the terms of reference directed the commission "to review The Environment Act proposal and the hydrology and geochemistry assessment report and provide advice and recommendations to the minister regarding potential environmental and health effects of the proposed sequential installation, operation and decommissioning of silica sand wells for the silica sand extraction project."

At the same time, the commission was asked to provide members of the public with an opportunity to voice their thoughts regarding Sio Silica Corporation's project. Roughly a year and a half later, the commission has heard from many Manitobans on this project, including those who wrote the 290 written submissions the commission has received, the 50 individuals who spoke at sessions of hearings designed for public presentations, and those who represented the groups that took part in the commission's hearings as official participants.

Members of the review panel listened to and read extensive amounts of material generated by the proponent, by participant groups and by the general public. Panel members were assisted in their understanding of the highly technical material by independent experts retained by the commission for the purpose of helping in this process.

After this lengthy review, members of the panel are unable to state with confidence that all potential environmental effects of this project have been fully considered and that adequate detailed plans have been prepared for preventing or mitigating these effects. This is not to disregard the work of the professional engineers and scientists who carried out assessment activities on behalf of the proponent. Rather, the uncertainty that remains about this project is largely a result of the unique nature of the Vivian Sand Extraction Project.

Silica sand is a strategically important resource, which is in high demand as the world transitions away from fossil fuels to renewable energy systems. Currently, around the world, silica sands are mined in open-pit operations. In contrast, Sio Silica proposes to mine silica sand using a novel approach known as airlift, in which air pumped down wells into a layer of loosely consolidated sand will draw up a mixture of sand and water. This airlift method is an established method of extracting water from wells, but to the commission's knowledge has never been used to mine silica sand. Compared to conventional open-pit mining, the approach has potential environmental and economic advantages which make it worth judicious review.

The proponent proposes to extract large amounts of silica sand, as much as 1.36 million tonnes per year for four years, from as many as 1,200 extraction wells in a production zone near Vivian, in southeastern Manitoba. As no evidence has been found that very large amounts of sand have been mined from deep underground (60 to 70 metres) before, there are no parallels that can be looked at in considering the Environment Act Proposal (EAP) prepared by Sio Silica. The proponent has carried out test drilling and test extraction and has created models of the geology and hydrology of the area. Sio Silica retained one team of professional technical consultants to prepare their EAP, and then retained a second team to review the work of the first consultants. There is no question that considerable effort and expense has gone into assessing the potential impacts of this proposed project. But the validity of predictions about the risks of this project cannot be tested by looking at the actual impacts of similar projects elsewhere, because there are no similar projects elsewhere.

The uncertainty resulting from a project that is essentially experimental in nature is a greater concern when we consider that the proponent intends to carry out these activities, over the long term, within aquifers that are a source of drinking water for towns and residences and water for agriculture and industry in a region that is home to some of the most rapidly growing communities in Canada.

Questions about the effect of the project on groundwater quantity and quality were central to this hearing process. Of the two categories, quantity concerns are somewhat less pressing, given the proponent's plan to reinject most of the water following treatment (minus an estimated 15 per cent that is expected to remain with the sand when it is sent for processing, which will then be lost to evaporation). Even in this case, though, the prospect of climate change bringing more variability in precipitation does raise the issue of what might happen in future drought years. Added to this is the growing population of southeastern Manitoba, where new homes and businesses are continually and rapidly being added. The regulatory regime in Manitoba places priority on domestic water use as opposed to industrial.

Water-quality issues drove most of the public concern and most of the scrutiny from participant groups and the general public. Again, because this type of project has never been done before on such a scale, we are left with uncertainties, some of these concerning its long-term effects. Introduction of dissolved oxygen into the groundwater, through the injection of air into the sandstone aquifer, could cause some change in the chemical composition of the water. The proponent believes these will not be significant. The collapse of the layer of shale immediately above the sand into water-filled voids created by the project brings further potential for changes in the chemical composition. Again, the proponent believes these will not be significant. The project would create some 1,200 new wells, all of which would need to be decommissioned and permanently sealed to prevent future contamination. These would be permanent potential pathways for groundwater intrusion into two aquifers used for drinking water, should these future seals degrade.

One fundamental question raised by this proposal is that the project would connect two aquifers: the Red River Carbonate (limestone) aquifer and the Winnipeg Sandstone aquifer, in which the sand-mining is planned to occur. Creating hundreds of large voids in the sandstone formation by removing sand is expected to cause the layer of largely impermeable shale above the sand to collapse. This shale currently acts as an aquitard, separating the sandstone aquifer below from the carbonate aquifer above. The collapse of this shale would therefore connect the two aquifers. The proponent has stated that the aquifers are already connected via hundreds of wells throughout the region, but each one of the newly created voids would have an area far larger than all the existing wells combined. The proponent furthermore claimed that since the water quality and hydrostatic heads (a term referring to the pressure of the groundwater) in both aquifers in this region are similar, there would be minimal mixing and water quality would not be impaired. Participants and presenters in the hearings raised the question that this may run counter to Manitoba's Well Standards Regulation: ". . . a person must not construct or seal a well or test hole in a manner that allows the interconnection or mixing of groundwater between the Winnipeg Formation and any overlying aquifer." Assessment of the applicability of this regulation to the construction and sealing of wells for this project was not within the Clean Environment Commission's Terms of Reference for these hearings, but it is central to the project moving forward and is a matter on which many members of the public and the commission need to see clarity.

Another area of uncertainty surrounds the long-term geotechnical effects of creating hundreds of these large voids. The proponent has shown that in a test extraction, removing the sand has resulted in the collapse of portions of the limestone layer immediately above the shale layer. The proponent has stated that what is known as "competent" limestone – found immediately above the weaker, lower layer of fractured limestone – has the ability to span these voids without collapsing up to the Quaternary till overburden. But again, with hundreds of voids being created, what are the risks that some of them will be created in areas where the limestone is not as strong or is weakened by vertical fractures or other anomalies that can weaken the rock mass? If extraction occurs in such weakened areas, what probability can be assigned to the risks of subsidence or collapse of the surface and creation of new pathways for contamination of the aquifer?

To raise questions about uncertainties is not to say that the risks identified by participant groups or members of the public are likely to occur. The proponent's conclusion that the project will have no significant negative effects on the environment, however, is based on a relatively small number of tests carried out in a relatively small portion of the project area. It is also based on the assumption that plans for water treatment, water return and well-sealing will function reliably in real-world conditions during operations. The commission is of the opinion that, given the stakes involved and the magnitude of the project, greater certainty is required before proceeding to full-fledged development of this project.

The proponent indicated during the hearing that it is willing to conduct inclined drilling to reveal whether or not vertical fractures or cracks exist in the limestone layer. This is the kind of additional information that would raise confidence levels. There was also discussion during the hearings of the possibility of the proponent conducting additional sonar examinations of the cavities both during extraction and continuing after extraction to verify predictions about the long-term stability of the cavities and the limestone. Additional sonar examinations of the voids already created by test extraction would help to verify predictions of long-term stability of the limestone. Additional pump tests to verify the groundwater model on which the proponent's effects predictions were based would also provide more confidence, as would additional testing of the effects on water quality.

Beyond this, recognition that this is essentially an experimental project would be a way of underlining the need to reduce uncertainty. Approaching this project with careful preliminary steps – which we are describing as a "step-wise approach" – would provide for an opportunity to better understand the potential effects. Data from a smaller number of extraction wells than the 1,200 referenced in the EAP would provide an opportunity to more fully consider and assess risks such as subsidence, shale collapse and the potential effects on water quantity and quality.

That this is an experimental project is underlined by the fact that significant changes have been made to the plans since the EAP was submitted in July 2021. At that time, the proponent expected to drill up to seven wells per cluster. Subsequently, after discovering that the amount of sand that can be extracted per well is greater than was originally expected, the extraction plan was changed to allow for up to five wells per cluster. As well, as a result of further studies of the thickness of the limestone caprock layer above the sand, the proponent changed the boundaries of the project site, shifting much of it to the west, where the limestone caprock is thicker. A conservative approach would enable the proponent to more fully understand the application of its technology to this resource in this environment.

The effects assessment in the proponent's Environment Act Proposal was accompanied by brief descriptions of a large number of monitoring and mitigation plans, although drafts of some of these plans were submitted only a few weeks before the hearings began. Proceeding on a step-wise basis would allow these plans to be fully fleshed out, so that specific matters to be studied and specific triggers for specific mitigation actions could be identified. While finalizing these plans, the proponent could build relationships with the community in which this project is intended to operate. With input from Manitoba Environment and Climate, including the branches responsible for groundwater management, environmental licensing and enforcement, from the branch of Manitoba Economic Development, Investment and Trade responsible for mines management and from local municipalities, mechanisms for community input into monitoring and reporting could also be developed before an application for a longer-term project is considered.

Ultimately, the Vivian Sand Extraction Project is envisioned to last for 24 years or more, generating nearly 10,000 extraction wells. In view of the potential effects on a water resource that serves tens of thousands of Manitoba homes, farms and businesses, getting it right at the beginning is essential before anything of this magnitude should proceed at full scale.

Chapter One
Introduction

1.1 The Manitoba Clean Environment Commission

The Manitoba Clean Environment Commission is an arms-length, provincial agency established under the authority of The Environment Act (1988), wherein the commission is mandated to provide advice and recommendations to the Minister of Environment and Climate*, and to develop and maintain public participation in environmental matters. In the context of a review such as that undertaken for Vivian Sands Extraction Project, this includes holding open hearings to allow members of the public to provide input on the Environment Act Proposal (EAP) prepared by the project's proponent (Sio Silica Corporation) and to state their opinions to the hearing panel.

*For the sake of clarity, this report refers to the provincial department by its current name, Manitoba Environment and Climate, except where directly quoting documents that use an earlier name.

1.2 The Project

The Vivian Sand Extraction Project is proposed to extract silica sand using wells drilled through various layers of sediments and rock to reach a formation, known as the Winnipeg Sandstone, or Winnipeg Formation, lying approximately 60 metres below the surface. Using a process known as airlift or air-injection, the proponent intends to draw sand and water from this formation to the surface. The proponent intends to drill approximately 1,200 such wells, in clusters of up to five, on private land south and west of the village of Vivian, on plots of land to the west and east of Provincial Road 302. The project site comprises 633 hectares (1,564 acres), within the Rural Municipality of Springfield. Drilling and extracting sand from these wells is planned to occur from spring to fall for four years, during an estimated 250 days per year, depending on weather.

Once the sand and water are brought to the surface, the proponent plans to separate sand from the water and transport it via a slurry pipeline containing a sand/water mixture to a nearby processing facility, where it will be further cleaned, dried and loaded for train shipment to customers. This facility has been licensed separately following a review by Manitoba Environment and Climate. After suspended sediments are removed, the water brought to the surface with the sand is to be disinfected through a process of exposure to ultraviolet (UV) light and then fed by gravity into the cavities created through extraction.

While this hearing process focused on the four-year Vivian Sand Extraction Project, the proponent intends to continue mining sand from the Winnipeg Sandstone formation for an additional 20 years. Sio Silica has stated that if it receives a licence for the initial project, it will later apply for a series of approvals to cover the intended 24-year production period.

Silica sand from the Winnipeg Formation has a high degree of purity. The proponent has stated that this sand is valuable for use in many industries, including manufacturing electronic products, solar panels, computer chips, batteries, fibre optics, medical products and aerospace products. Sand is also used for fracking in the oil and gas industry.

1.3 The Proponent

Sio Silica Corporation is a Canadian company, headquartered in Calgary. The company was incorporated in 2016 under the name CanWhite Sands. In 2016 it began exploration in Manitoba and in 2017-18 it acquired mineral claims through its subsidiary, HD Minerals. In 2022, the company changed its name to Sio Silica and amalgamated with its HD Minerals subsidiary.

1.4 Terms of Reference

On Nov. 15, 2021, the Minister of Environment and Climate wrote to the Clean Environment Commission (CEC) to request that the commission hold public hearings on Sio Silica's application for an Environment Act licence for the Vivian Sand Extraction Project. The letter noted that, during the public review of Sio Silica's application, requests had been made for a CEC hearing on the project. The minister directed the commission to carry out a hearing in accordance with section 6(5)(a) and (b) of The Environment Act and in accordance with the commission's Process Guidelines Respecting Public Hearings. The letter instructed the commission to provide advice and recommendations to the minister and provided the commission with terms of reference for the hearings as follows:

Terms of Reference:

"1. The CEC will conduct a technical review of the Environment Act proposal and the hydrogeology and geochemistry assessment report and 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.

2. In providing advice and recommendations, the CEC will provide members of the public the opportunity for input regarding the CanWhite Sands silica sand extraction project proposal at a public hearing in a location consistent with the affected community.

The CEC review should begin as soon as possible and be completed by March 15, 2022."

A subsequent letter extended the time frame for the CEC's hearing, noting that the Environment and Climate departmental review of the project was still on-going. This letter directed the CEC to proceed in a timely manner, once the department's environmental review process was complete.

1.5 The Hearings

Public hearings were held over 12 days, from Feb. 27 to March 15, 2023, in Steinbach, Anola and Beausejour. Weekday hearings were held in Steinbach and Beausejour, during which the proponent and participant groups presented information and were questioned. Two evening sessions, in Steinbach and Beausejour, and a Saturday session, in Anola, were scheduled to provide members of the public with the opportunity to make presentations. Written submissions were welcomed and the hearing record closed on March 24. Hearing transcripts were placed on the public record on the commission's website.

During the hearings, 21 individuals gave testimony, including 13 representing Sio Silica and the consultants it hired to prepare and review its Environment Act Proposal. Five participant groups took part in the hearings and five individuals gave testimony on their behalf. During the weekend and evening sessions, 50 presentations were given by members of the public. The commission also received 290 written submissions from members of the public. As a result of these hearings, the commission has gained greater understanding of the project's potential environmental and health effects.

1.6 Section 35 of Canada's Constitution

Section 35 of the Constitution Act (1982) stipulates that "[t] he existing Aboriginal and treaty rights of the Aboriginal peoples of Canada are hereby recognized and affirmed." While Section 35 is not an environmental statute, it does require consultation with Aboriginal peoples whose rights may be impacted in some fashion by a project. The obligation to initiate and carry out consultations with respect to Section 35 belongs to the province and/or Canada, depending on the nature of the project under consideration. The Government of Manitoba, through the Department of Indigenous Reconciliation and Northern Relations, not the Clean Environment Commission, conducts such consultations. The commission hearings played no role in formal Section 35 consultations regarding the Vivian Sand Extraction Project, although the commission's process can play a role in gathering input relevant to the consultation process.

1.7 The Report

This report is divided into 12 chapters describing the process, the proposed project, the areas of potential effect on the biophysical and socio-economic environment, plans for monitoring and follow-up, the commission's notes on other issues raised in this process and the commission's conclusions and recommendations. Within these sections are summaries of the matters discussed by the proponent in the Environment Act Proposal and in the hearings, summaries of concerns raised (under the heading "What We Heard") and statements of the panel's thoughts on these matters (under the heading "Commission Comment.") Recommendations to the minister follow in Chapter Twelve: Conclusions and Recommendations.

Chapter Two: The Licensing Process

2.1 Needed Licences and Approvals

The Environment Act sets out the environmental review and licensing process for developments in Manitoba. Developments are designated as one of three classes in The Classes of Development Regulation (Manitoba Regulation 164/88), with Class 1 developments generally smaller and less complex and Class 3 generally the largest and most complex. The Vivian Sand Extraction Project was designated a Class 2 project. The regulation specifically classifies "mines, other than pits and quarries" as Class 2 developments. To obtain the licence, the project must be assessed in accordance with the process outlined in The Environment Act.

Sand extraction is proposed to occur within mining claims issued to Sio Silica under provisions of The Mines and Minerals Act and under borehole licences issued under Part 3 of the Drilling Regulation. A closure plan will be developed and submitted to the Manitoba Mines Branch in accordance with the Manitoba Mine Closure Regulation 67/99 General Closure Plan Guidelines (Section 8.9.)

The project also requires water rights licences for extraction of groundwater under The Water Rights Act and injection permits, under The Groundwater and Water Well Act, for return of water to the sandstone aquifer.

2.2 Manitoba's Review Process for an Environment Act Licence

Sio Silica (then known as CanWhite Sands) submitted its Environment Act Proposal (EAP) to the Environmental Approvals Branch of Manitoba Environment and Climate on July 23, 2021. The proposal contained information required in the Environment Act Proposal Report Guidelines, which lay out the kinds of information required in an EAP. According to these guidelines, environmental assessments typically contain the following:

- Executive summary
- Introduction and background
- Description of proposed development, including construction, operation, maintenance, and decommissioning, if applicable
- Description of existing environment in the project area
- Description of environmental effects of the proposed development
- Description of the human health effects of the proposed development
- Mitigation measures to protect the environment and human health, and residual environmental effects

- Follow-up plans, including monitoring and reporting

- Conclusions

Following receipt of the proponent's EAP, a Technical Advisory Committee (TAC), with representatives from the departments and branches of government responsible for environment, natural resources, health, land-use planning, agriculture, infrastructure, municipal affairs and mining, was given the opportunity to provide comments on areas of potential concern. The comments were placed on the public registry. The EAP was made available online and advertising was placed to invite the public to comment on it.

2.3 Role of the Clean Environment Commission

The commission's role in this process is to make recommendations and provide advice on possible environmental and health effects of the proposed sequential installation, operation and decommissioning of silica sand extraction wells for this project. In making its determinations as to the effects of the project and its recommendations, the commission relied on information and viewpoints received from many sources:

- the Environment Act Proposal

- the review by the Technical Advisory Committee

- public comments submitted during the department's EAP review

- responses to two rounds of information requests (IRs) prior to the hearings

- revised project plans submitted by Sio Silica as part of this process

- technical experts retained by the commission

- submissions and presentations provided during the hearing by the proponent, participants and the public

- testimony by expert witnesses and questioning of expert witnesses

- written presentations submitted by members of the public before and during the hearings and received up to March 24

The commission was required, under the terms of The Environment Act, to submit its report to the minister within 90 days of the closing of the record for the hearings. In the case of a Class 2 development, such as the Vivian Sand Extraction Project, under The Environment Act, the director of the Environmental Approvals Branch is the usual decision maker, although the minister may make the licensing decision, after providing written notice.

After considering this large amount of information, the commission concludes that the majority of the potential environment impacts have been identified. Due to the novel nature of the Vivian Sand Extraction Project, and limitations in the data and models presented, the commission concludes that areas of uncertainty remain. Specifically, while the nature of the risks related to this project has been identified, our understanding of risk probabilities is insufficient for a project that involves extensive drilling and extraction in aquifers critically important to a large number of people in southeastern Manitoba. Accordingly, the commission's recommendations to the minister include calls for additional studies, monitoring and mitigation planning. These recommendations are listed in Chapter Twelve: Conclusions and Recommendations.

Chapter Three: The Public Hearing Process

3.1 Clean Environment Commission

The panel assigned to conduct the public hearings on the Vivian Sand Extraction Project consisted of John (Jay) Doering (chair), Ian Gillies, Terry Johnson and Laurie Streich.

3.2 Public Participation

This report uses two terms to describe members of the public who took part in the process: participants and presenters.

Participants are groups or individuals who were substantially involved in the process. Participants took part in the pre-hearing process, during which they reviewed the proponent's EAP, and sought further information through two rounds of information requests (IRs). Participants were present throughout. Many participants were represented by legal counsel. Participants were able to ask questions of the proponent and in turn, when they presented evidence they may have been questioned by the proponent. Some of the participants hired their own experts to review the proponent's EAP. Participants were:

- Dennis LeNeveu
- Manitoba Eco Network (MBEN)
- Municipal Silica Sand Advisory Committee (MSSAC)
- Our Line in the Sand (OLS)
- Rural Municipality of Springfield

What the Frack Manitoba was also granted participant status, but withdrew on the first day of hearings.

3.3 The Pre-Hearing

Following the filing of the EAP on July 23, 2021, the Manitoba government placed the proposal on the public registry and placed advertisements in The Winnipeg Free Press (Aug. 7) and The Lac du Bonnet Clipper (Aug. 12) inviting public comments. Public responses were open until Oct. 7. Within government, a Technical Advisory Committee (TAC) reviewed the EAP and comments were placed on the public registry by Oct. 22. The Clean Environment Commission was issued its terms of reference on Nov. 15, 2021, and directed to conduct hearings and report by March 15, 2022. Following a request by the commission that its process not begin until the TAC and public review were completed, the Minister of Environment and Climate revised the timeline for the hearing and directed the commission to proceed in a timely matter once the departmental review was completed. On Feb. 2, 2022, following the proponent's response to the TAC and public comments, the commission was notified that the departmental review was complete.

To prepare for a hearing on the EAP, the commission engaged technical experts to review the proponent's assessments of geotechnical and hydrogeological aspects of the project as well as to provide an overview of the overall EAP. This review occurred over the spring and summer of 2022 and the experts' reviews were made available on the commission's website in September 2022.

Groups and individuals wishing to take part as participants in the hearing had until January 30, 2023, to apply to the commission for participant status. The commission held two pre-hearing meetings, on Oct. 14, 2022, and Jan. 19, 2023, with representatives of the proponent and the participants. The purpose of these meetings was to discuss procedures and timelines for the hearing. All motions were addressed in writing.

In advance of the hearings, a process of information requests (IRs) occurred, in which participants asked questions about specific matters in the proponent's EAP and the proponent provided answers. Two rounds of IRs took place, with questions submitted in October 2022 and January 2023. In all, 143 IRs were made in the two rounds, with many IRs containing a list of related questions. The proponent's responses to the questions, including the questions themselves, are posted on the commission's website.

During this pre-hearing period, the proponent released further information, including a revised plan for extraction of the sand. The revised plan used the same technology, but changed some of the drilling locations. A revised assessment considered the potential effects of the project in light of these boundary changes and found no changes to the assessment conclusions. The proponent accompanied this revised extraction plan with new data developed through underground sonar of the spaces created by test extraction of sand. Draft management plans related to progressive well abandonment, waste characterization and management and groundwater and impact mitigation were also provided.

3.4 The Hearings

Hearings began on Feb. 27, 2023, in Steinbach and continued from Monday to Thursday in that city until March 9. A one-day hearing of public concerns was held in Anola on Saturday, March 11, followed by three days of hearings, March 13-15, in Beausejour. One evening session was held in each of Steinbach and Beausejour to provide opportunities for public presentations.

Hearings followed a formal process. All speakers swore or affirmed that they would tell the truth. The hearings began with formal opening statements by representatives of the proponent and the participants. Next came panels of representatives of the proponent and its technical specialists, who gave presentations on the company, project overview, permitting process, environmental and health matters and geotechnical, hydrogeological and geochemical issues. Each presentation by the proponent or its experts was followed by a period of questioning by the representatives of the participants and members of the panel. Next, the commission's technical experts gave presentations on their technical reviews and answered questions from the proponent and participants. After that came presentations by the participants, who were also questioned.

After all the participants spoke, the proponent presented a rebuttal. During the final two days of the hearings, closing addresses were delivered by the participants and the proponent.

In addition to hearing 50 oral presentations from the public, the commission received 290 written submissions.

After the close of the hearings on March 15, the record remained open until March 24, in order for the proponent and participants to provide the written version of their closing remarks.

3.5 Access to Information

All information presented to the commission during the hearings is available on the commission's website (www.cecmanitoba.ca). This includes background documents, presentations, verbatim transcripts and written submissions.

Chapter Four:
The Vivian Sand Extraction Project

4.1 Overview

The Vivian Sand Extraction Project is intended to extract sand with a high level of purity from below ground. The sand is found in a formation known as the Winnipeg Sandstone. High-purity silica sand can be used in manufacturing a variety of products, including solar panels, lithium-ion batteries, fibre-optic cables, smart glass, tires, medical and dental supplies, electronic devices, computer chips, aerospace and automobile components, ceramics and low-iron glass used in building envelopes. Sand is also used in hydraulic fracturing, or fracking, to release oil and gas from rock formations. The proponent states that the sand to be mined is among the best available sources of high-purity sand in the world, with 99.85 per cent purity in its raw form and processed purity greater than 99.9 per cent. The proponent intends to produce up to approximately 1.36 million tonnes of silica sand per year for four years.

Because this sand is found at depths of approximately 51 to 76 metres, it is not feasible to extract it using an open-pit method, which is the technique commonly used in the industry. Instead, the proponent intends to drill holes into the Winnipeg Sandstone and use a technique known as airlift to raise the sand to the surface. The Winnipeg Sandstone formation is an aquifer covering a large area of southeastern Manitoba. Pumping compressed air down through a production tube within the well will cause water and sand to be drawn back up the well as the air rises to the surface. The sand is loosely cemented in the formation and in test wells has been brought to the surface using this technique.

The proponent intends to separate most of the water from the sand and direct the sand into a system of pipelines, containing a slurry of sand and water, which will take the sand to a nearby processing facility. At the processing facility, which has already received an Environment Act licence and was not a subject of investigation in these hearings, the sand will be further purified, dried and prepared for loading onto rail cars. Water in the slurry pipeline will remain in the pipeline throughout the extraction season. Approximately 85 per cent of the water brought to the surface is to be directed separately to treatment. After suspended solids are settled out, the proponent plans to use ultraviolet (UV) light treatment of the kind used in water treatment plants and return the water to the extraction wells.

Reaching the Winnipeg Sandstone formation will require drilling through three layers of sediments and rock. Closest to the surface is the Quaternary Sediments layer, consisting of glacial till and clay. Next is the Red River Carbonate formation, consisting of limestone. Between the Red River Carbonate and the Winnipeg Sandstone is a thinner formation known as the Winnipeg Shale. The Red River Carbonate is, like the Winnipeg Sandstone, an aquifer. Both of the aquifers are used for domestic, agricultural and commercial purposes in the region. Most wells in the area are in the Red River Carbonate. The Winnipeg Shale is known as an aquitard, meaning that is a relatively impermeable layer that separates two aquifers. A small amount of water is located within the shale.

The proponent's extraction plan calls for approximately 1,200 such wells to be drilled over four years in clusters spread out over a project site of 633 hectares (1,564 acres). The project site is south of the village of Vivian, with extraction areas located on both sides of Provincial Road 302, though the majority of the area is to the west of the road. The proponent has extensive mineral claims, amounting to 85,000 hectares (210,000 acres), mostly in an area running south from Provincial Trunk Highway 15, east of Provincial Trunk Highway 12 and south to Provincial Road 302. The proponent's plan is to continue extracting sand for 24 years, though the Environment Act licence currently being sought is just for the first four years. The proponent has stated that it intends to apply for an alteration of its Environment Act licence for the remainder of the project's lifespan.

Figure 1: Conceptual illustration of geological layers. (Courtesy of Sio Silica.)

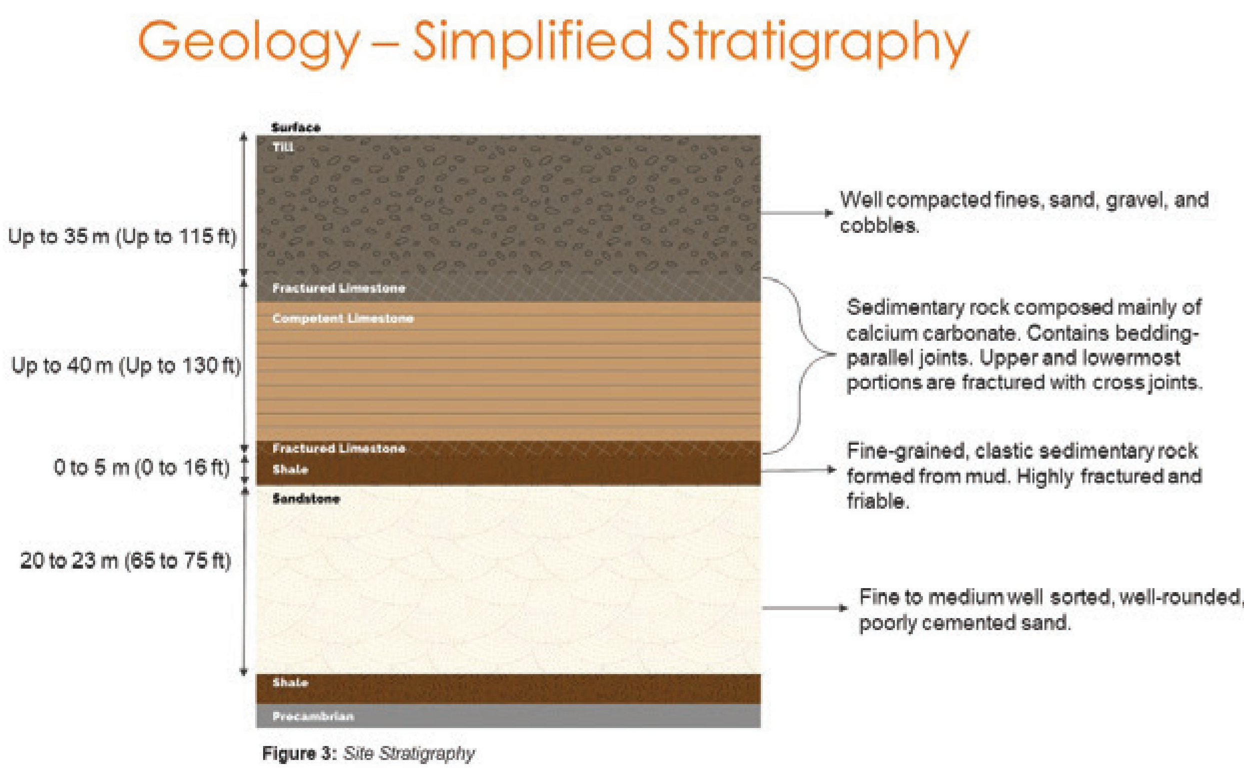
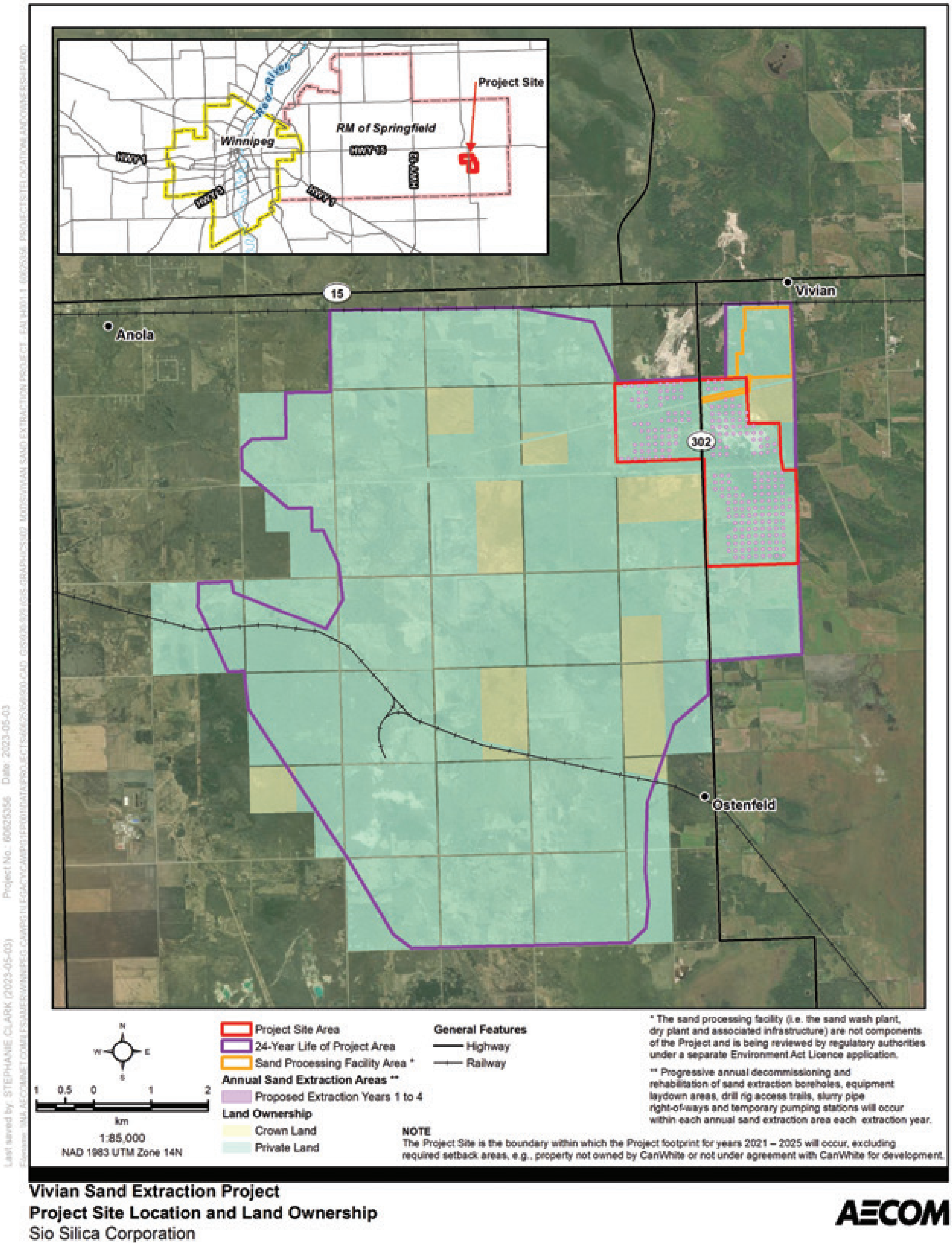


Figure 2: Original project site outlined in red and shown in relation to Winnipeg and RM of Springfield. Full 24-year project site outlined in purple. Modified project site is discussed in Chapter Six. (Courtesy of Sio Silica.)



4.2 Overview of Major Issues

The EAP for the project considered potential biophysical and socio-economic effects of the project. In the hearings for the project, and during the pre-hearing period of information requests, the majority of the attention focused on the potential for effects on the quality and quantity of groundwater available to users in the area. In examining this matter, participants, presenters and those who sent in written statements discussed a number of geotechnical, hydrogeological and geochemical issues.

Geotechnical matters are those concerned with the behaviour of earth materials, such as rock and soil. Geotechnical questions for this project focused on the potential for these materials to move, crack or slump in response to the drilling and extraction of sand.

Hydrogeology is the study of groundwater and includes examinations of how water flows through aquifers. Hydrogeological issues related to the project included effects on the amount of water available to users in nearby wells and the effect of removing the shale layer that separates the Red River Carbonate and Winnipeg Sandstone aquifers. Hydrogeological discussions also focused on the modelling used to understand the nature of groundwater flow, water pressure, recharge rates and change in water levels within the aquifers.

Geochemistry is the study of the chemical composition and reactions of earth materials such as rocks and soils. Geochemical issues raised by participants and presenters included the potential for oxygen introduced through the airlift process to change the chemical composition of the groundwater and the potential for changes to the groundwater chemistry as a result of the collapse of the Winnipeg Shale into the sandstone aquifer.

These issues will be discussed at greater length in the chapters to follow, as will matters such as air quality, noise, light and quality-of-life concerns.

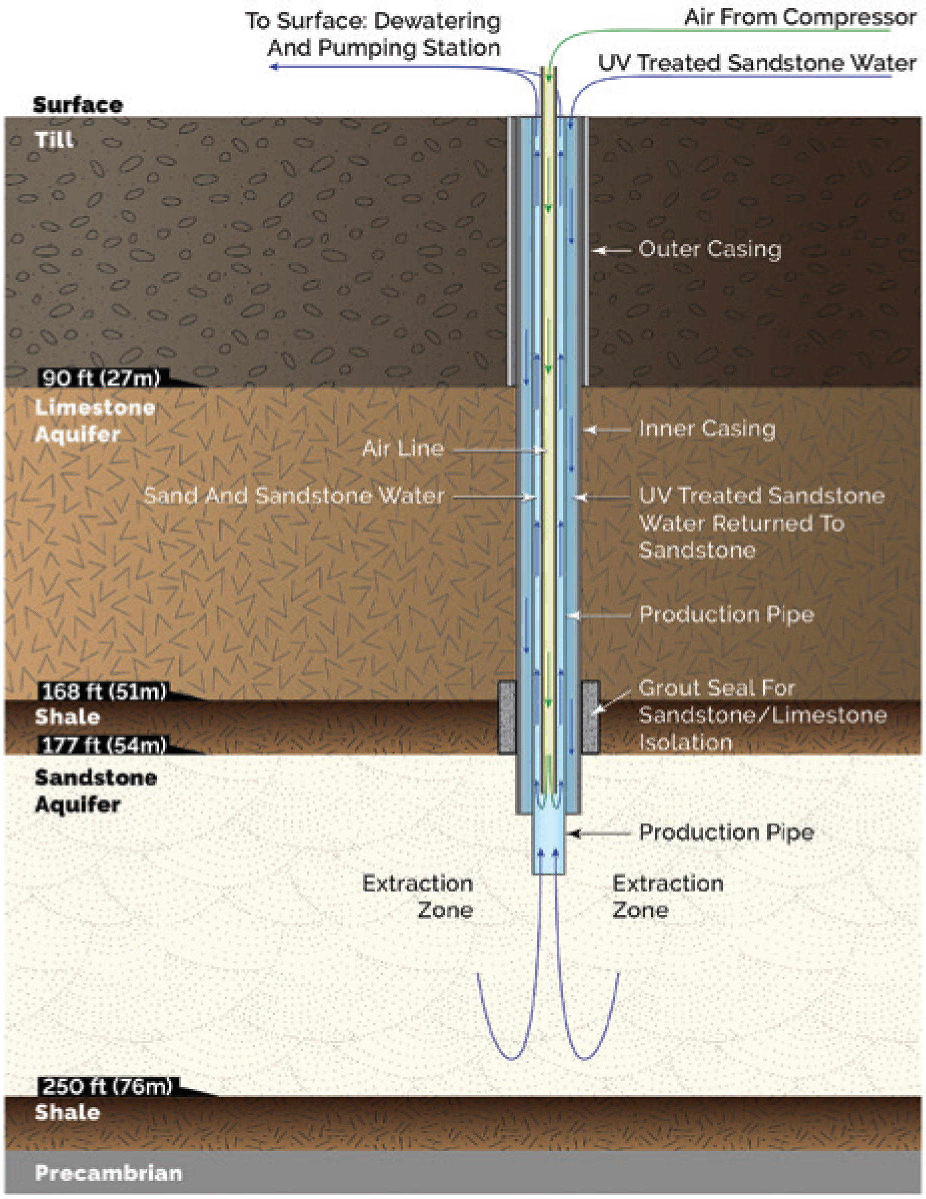
4.3 Sand Extraction Method

Sio Silica intends to extract sand from the Winnipeg Sandstone formation through approximately 1,200 wells drilled in clusters of one to five wells. The proponent intends to extract sand from each well for approximately five days, after which the wells will be capped and sealed. In the first year of operation, the company intends to extract more than 1.1 million tonnes of sand, increasing to a goal of 1.36 million tonnes per year in the following years.

The company intends to drill wells between eight and 16 inches in diameter* (20.3 to 40.6 cm) and install a well casing to seal off the surrounding rock. A production tube will run down the centre of the well. Between the production tube and the well casing will be a donut-shaped ring of space known as an annulus. In the airlift method of sand extraction, which the company plans to use, compressed air will be blown down a line in the production tube. The air will then rise back to the surface through the production tube, bringing both water and sand with it. Airlift is a common technique in water wells, but it has not been used before as a method of mining sand. The proponent plans to extract sand from each well for approximately five days, with several wells operating at one time. Water that is reinjected into the well after treatment will go down through the annulus to be returned to the sandstone aquifer.

*While Manitoba government style uses the metric system, measurements of well diameter and water pumping were typically reported in Imperial units. In these cases, this report employs Imperial first and the metric conversion after.

Figure 3: Illustration depicts compressed air sent down a line in the middle of the production pipe. Air will return to surface, bringing sand and water with it via the production pipe. In the space outside the production pipe, the treated water will be returned to the aquifer. Note the geological layers and depths. (Courtesy of Sio Silica.)



According to the proponent's plans, extracting sand will create voids in the Winnipeg Sandstone, produced either by a lone extraction well or multiple wells extracting from what will become a common void. Extraction of sand is planned to reach a depth of up to 25 metres below the top of the sandstone. The maximum diameter of these voids will depend on the thickness of the Red River Carbonate layer above, with thicker layers of "competent" limestone allowing for larger diameters. In this context, "competent" refers to limestone that is not substantially weakened by cracks and joints. In places where the competent limestone is 25 metres thick or more, the maximum allowable extraction zone, according to the proponent's research, will have a diameter of 40 metres at the top and 21 at the bottom. In places where the competent limestone is 15 to 20 metres thick, maximum allowable extraction areas will have a diameter 22 to 25 metres at the top and three to six metres at the bottom. (The calculation of maximum allowable void is also influenced by the thickness of the layer of glacial till and clay near the surface, known as Quaternary Sediments). The proponent said it will not extract sand in places with less than 15 metres of competent limestone. Spacing of well clusters will be determined by the need for a minimum distance of 60 metres from the outer edge of one void to the outer edge of another void. Each well cluster is expected to produce, on average, 21,000 tonnes of sand.

Sio plans to extract sand from April to October, depending on weather. Extraction is planned to occur on a 24/7 basis during this period. Well cuttings (clay and rock brought up in drilling the wells) and overs (larger objects, such as calcified sand) are to be stored on site adjacent to the wells until disposed of in accordance with applicable regulations. After each well is finished extracting sand, the production pipe will be removed and the well will be capped. The proponent has prepared a plan for well abandonment, discussed later in Chapter Ten: Management and Mitigation Plans.

4.4 Sand Transport

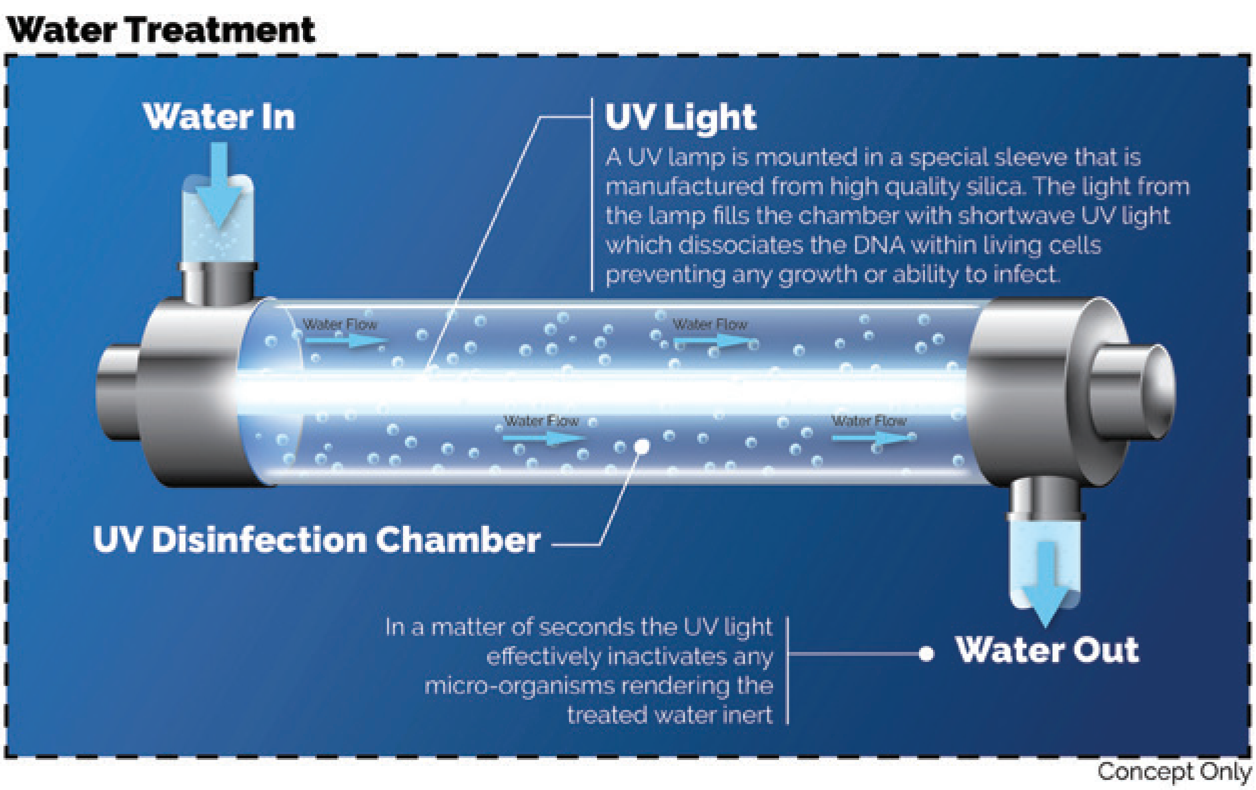
According to the proponent's plans, when the sand and water mixture is brought to the surface, it will pass through screens to capture larger objects, such as pieces of calcified sand, known as "overs." From there, the sand and water will be pumped to a dewatering station where the sand and water will be separated, although this initial separation will not completely dry the sand. The separated water will then be pumped to a treatment station (described in Section 4.5 Water Treatment). The sand will be directed to a slurry pipeline, where it will mix with additional water for transport to the processing facility. At the beginning of each season, the company plans to extract an amount of water necessary to operate the slurry loop and continue using this same water throughout the season. At the processing facility, remaining impurities will be removed from the sand. The sand will be dried before being loaded for transportation. Because the sand still contains water when it arrives in the processing facility and this water will evaporate, not all water extracted from the aquifer will be returned to the extraction wells.

The slurry pipelines will be moveable as extraction locations are changed over time. Each cluster is planned to have two slurry lines (a line leading to the processing facility and a return line). These lines will be 500 metres to 3.5 km long, depending on the location of the extraction cluster. Pumping stations will be needed every 500 metres along the slurry pipeline to maintain the flow of slurry. Lines are to be above ground, and where necessary to cross roads, such as PR 302, they will cross under the road using culverts. The slurry line will also need to cross Manitoba Hydro transmission rights-of-way. When extraction is completed in one area, the proponent plans to dismantle the slurry line and move it to the location of the next year's extraction.

4.5 Water Treatment

In order to kill any organisms that may have been introduced to the water, the proponent plans to treat the water that has been separated from the sand before it is reinjected in the wells. The water will be treated with ultraviolent (UV) light, which will require that suspended solids are removed from the water. To accomplish this, water will go from a collection tank to a clarifier and pass through multiple layers of sand filtration. To remove smaller solids, the proponent plans to add a substance known as chitosan – a natural polymer derived from crab and shrimp shells – to the water. These particles will bond with the chitosan, allowing them to be further filtered out, along with the chitosan. Chitosan is used for clarifying water in potable water treatment plants, swimming pools, sewage treatment plants, industrial waste treatment facilities and storm water treatment facilities. Once the suspended solids have been removed using chitosan and a cloth filter, the water will be treated with ultraviolet light. The UV-treated water will be returned to the aquifer through the annulus of the wells. The sludge resulting from removal of suspended solids will be stored and sent to a waste facility.

Figure 4: Conceptual illustration of UV treatment. (Courtesy of Sio Silica.)



Chapter Five: Community and Indigenous Engagement

5.1 Community Open Houses/Meetings

The proponent held in-person and virtual events in communities in the region beginning in May 2017 with a meeting in Anola. Community meetings were held in La Broquerie, Anola and Richer on April 9, 10 and 11, 2019. During the period of pandemic restrictions, virtual public meetings were held on May 26 and Dec. 15, 2020, and Aug. 24, 2021. Advertising was placed in local and Winnipeg newspapers and some 5,800 flyers were sent out in the local area to publicize meetings and open houses. An additional in-person meeting was held at the Anola Community Centre on Nov. 29, 2021. The proponent's technical experts in fields such as hydrogeology were available at this meeting.

5.2 Local Government Meetings

The proponent held 22 meetings with the Rural Municipalities of Springfield, Brokenhead, Reynolds, La Broquerie, Hanover, Taché, and East St. Paul and Towns of Beausejour and Ste Anne between Dec. 17, 2019, and Nov. 30, 2022. In discussions with the RM of Springfield, where the project is located, topics included movement of the slurry pipelines and the impact of abandoned wells.

5.3 Indigenous Engagement

The proponent held discussions with Brokenhead Ojibway Nation (June 14, 2021, and July 14, 2022) and Peguis First Nation (July 13, 2022), the Manitoba Metis Federation (Dec. 7, 2021), the Southern Chiefs Organization (June 1, 2022) and Treaty One Development Corporation (March 2021).

What We Heard: Community and Indigenous Engagement

Several participants and presenters stated that the level of engagement was not sufficient for a project of this magnitude. The fact that community engagement began before the EAP was filed was also a concern to some presenters, who felt the public did not have an adequate opportunity to understand the project at that time. Some community residents who attended open houses said these events lacked detail on the project. One presenter, who lives adjacent to the site, said the proponent only contacted her after she spoke out at an open house. A number of presenters viewed the proponent's communications and engagement efforts as purely promotional, rather than an effort to understand community views. Several presenters discussed the proponent's focus on jobs that could be created by manufacturing industries attracted by the presence of the resource. It was felt that this diverted attention away from open discussion of the community's concerns regarding the project's potential impact. The panel heard some presentations from community members who supported the project because of its economic benefits or the potential for creating products for low-carbon energy generation. Some spoke of it as a way of helping Canada make the transition to a lower carbon economy. Others spoke of the potential for future employment in the region for their children.

During the hearings, the commission heard that the proponent had been in discussion with Peguis First Nation regarding contracting to provide monitoring services for the project. The representative of Peguis who made this announcement said the first nation was supporting the project and added that this was the first Clean Environment Commission hearing in which Indigenous communities had not applied to take part as participants.

Commission Comment: Community and Indigenous Engagement

While it appears that the proponent did hold a number of meetings in the communities near the project site and with Indigenous communities and organizations in southern Manitoba, this engagement effort appears to have been hampered by a lack of up-to-date information. The proponent was still working out details of its proposed extraction activities when it began engagement. Some important information, such as the revised extraction plan and the drafts of some of the monitoring and management plans, was only available shortly before the hearings began. Engagement is hampered when such important information is not available to the community.

As to the content of the open houses and meetings with local governments and Indigenous communities, it is not clear what issues were raised and what were the outcomes of these meetings. The proponent presented no detailed summary of the issues that were raised and information that was provided. Documenting engagement activities in such a way would allow a better understanding of the proponent's commitment to engaging the community. While it is understandable that pandemic restrictions may have hampered some engagement efforts, it became clear from some of the written and in-person presentations that the proponent's communication with the community was poorly received by many people. In the presentations and comments received by the commission it became evident that some of the information circulating in the community consisted of misinterpretations and misunderstandings of the actual components of the proposal and associated activities.

The proponent needs more effective two-way communication to develop a more effective engagement process tailored to the audience. Communication efforts are most effective when they provide technical information in a manner that can be understood and be relatable to the on-the ground situations.

Further information on the company's commitment to engagement is required, as well as an explanation on how the agreement with Peguis First Nation fits into its monitoring and communication planning.

The commission encourages the government to include a requirement for a local advisory committee in any authorization or licence granted for the project. Such a committee should include either a subcommittee or a separate committee for municipal concerns. The interactions of this committee should be available to the public, through posting on a website of minutes of meetings and other information. The proponent and community spokespeople should jointly lead this committee, with government representatives as ex-officio members to provide guidance on regulatory and technical issues. Any significant changes to the project should be introduced to this committee for review.

Chapter Six: Project Area and Assessment Boundaries

6.1 Assessment Boundaries and Site Description

The proponent assessed effects based on three spatial boundaries: the project site, the local project area and the regional project area. The project site occupies 633 hectares, and is where the proponent plans to carry out project activities, such as drilling wells, extracting sand, building access trails and transporting sand through the slurry line. The boundaries of the project site were changed following the development of a new extraction plan, which was released in January 2023. The original site occupied land on the east and west of Provincial Road 302, south of Vivian, with the portion to the east extending approximately 1.6 km further south than the portion on the west side. The modified project site still contains land on both sides of PR 302, but the portion to the west of that road is located farther south and parts of the east-side portion have been eliminated from the site.

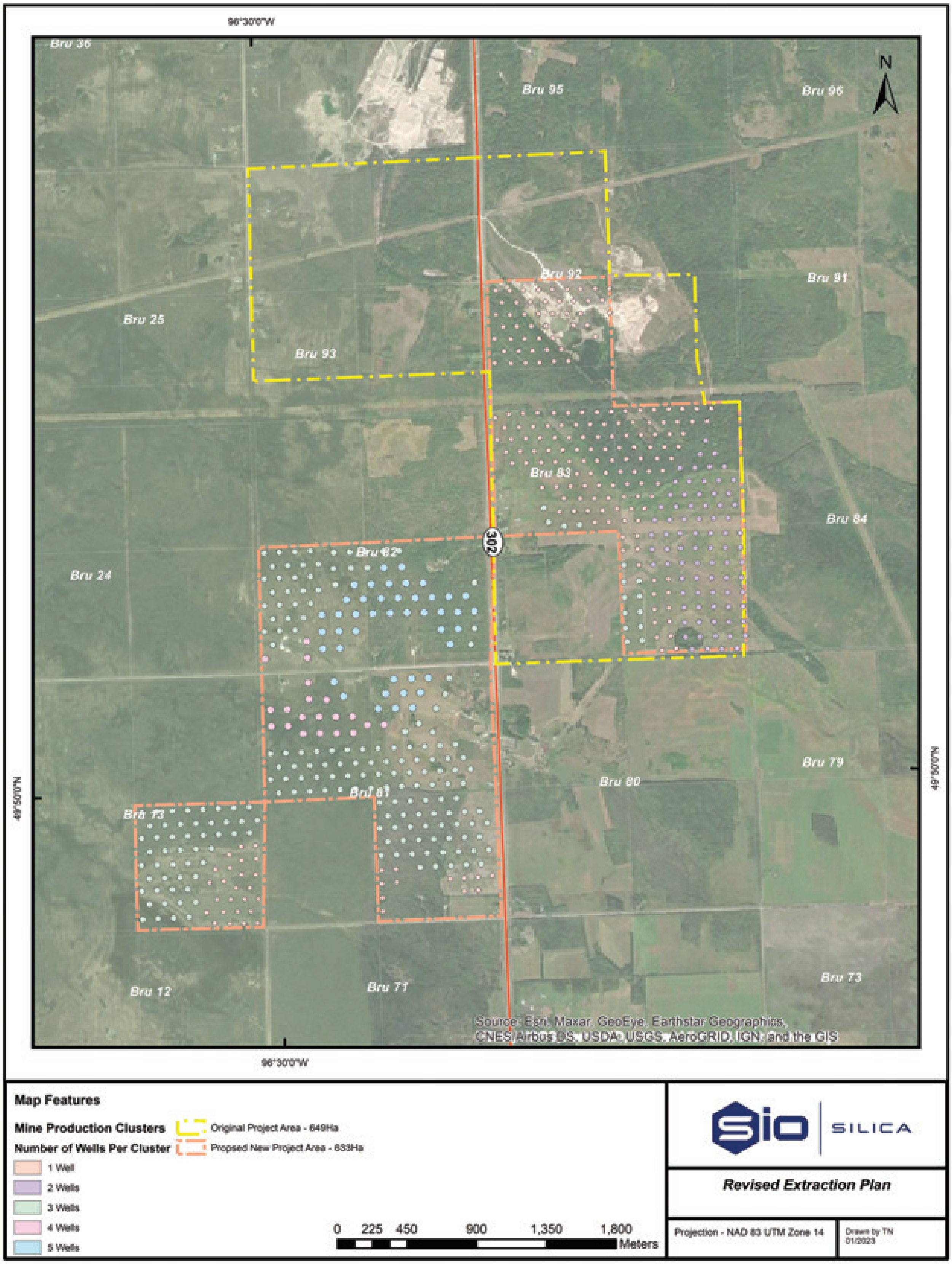
The local project area is the area within two kilometres of the project site, and takes in areas that would be directly exposed to project impacts, such as noise and habitat loss. The village of Vivian falls within the local project area. The regional project area is the area within 10 kilometres of the project site. The Town of Anola and the villages of Ostenfeld and Ross fall within the regional project area.

While the proponent also intends to build a processing facility adjacent to the nearby CN Rail line, along with a rail loop for loading train cars, those developments were not part of this EAP. The location of the planned processing facility is within the local study area, but not part of the site for the extraction project. The processing facility has already been licensed through a separate process, not involving the Clean Environment Commission.

In assessing potential effects on groundwater, the proponent studied a larger area. The proponent developed conceptual and numerical models for regional groundwater flows in an area of approximately 3,200 square kilometres. This area is bounded on the east by the Sandilands, on the southwest by the Seine River, on the northwest by the Red River Floodway and the Red River and on the northeast by Hazel Creek.

The project area lies within the Steinbach ecodistrict of the Interlake Plain ecoregion, which is located within the Boreal Plain ecozone. The ecodistrict receives an average of 510 mm of precipitation per year, mostly

Figure 5: Yellow border indicates area of originally planned project site. Light red border is area of modified project site, as of January 2023. Dots are sites of well clusters. (Courtesy of Sio Silica.)

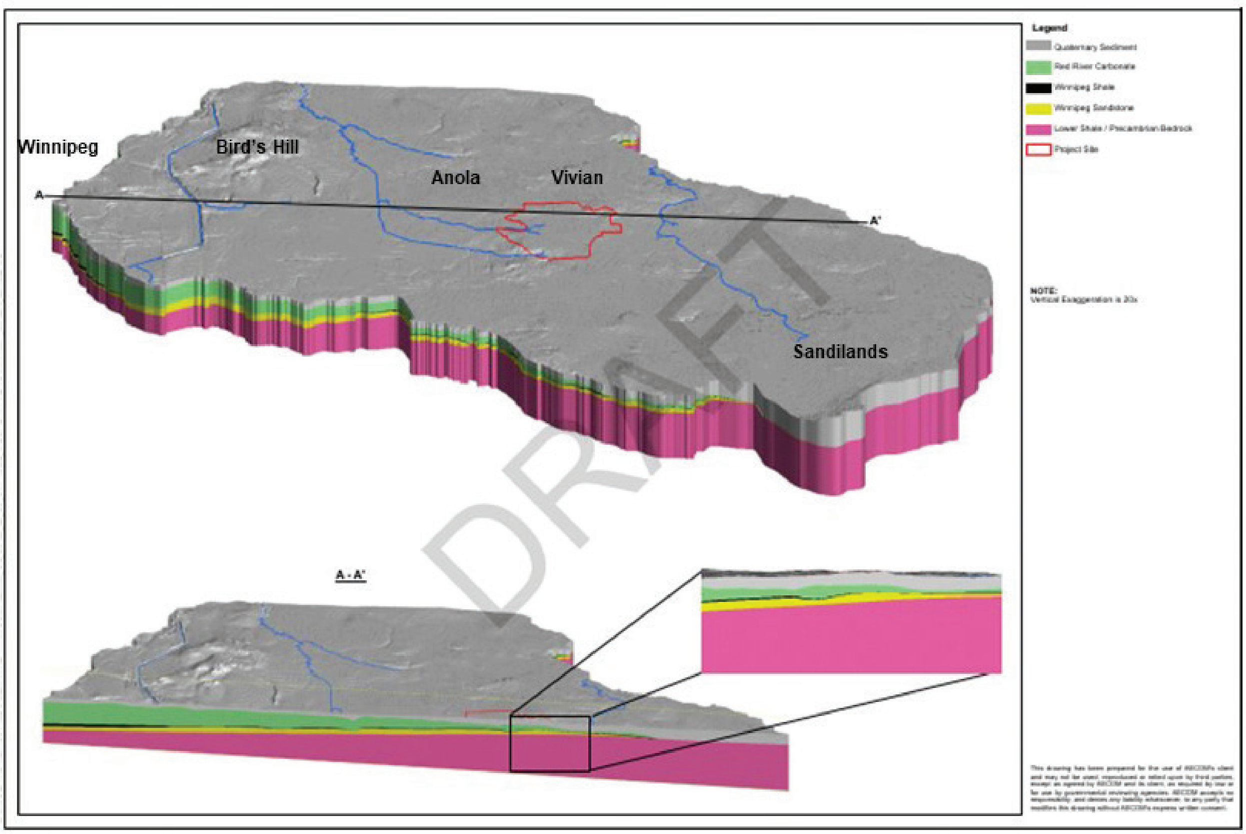


as snow, and has vegetation dominated by trembling aspen with some balsam poplar, with an understory of species such as willow and red-osier dogwood. Much of the Steinbach ecodistrict is agricultural land. Within the 633 hectares of the project site, 43 per cent of the land is previously disturbed, either agricultural land or previously developed, while 51 per cent is forested.

The ecodistrict is mostly flat, with gentle slopes in places that are characteristic of ancient glacial lake bottoms and lake shores and some gentle undulations of glacial till (rock debris from ice age glaciers). The land slopes gradually toward the Red River at a rate of about one metre per kilometre. Sandy and ridged terraces occur in parts of the ecodistrict, typically at sites of ancient glacial lakeshores.

Below ground the geological layers consist of Quaternary Sediments (gravel, clay and glacial till), Red River Carbonate (limestone), Winnipeg Shale and the unconsolidated sand and sandstone of the Winnipeg Sandstone. Below that is the ancient granite bedrock. These layers can be visualized as tilted gradually downwards to the west. To the east, in the Sandilands area, there is only the Quaternary Sediments layer above the granite bedrock. Moving gradually westward from there, the limestone, shale and sandstone layers first appear relatively close to the surface.

Figure 6: Overhead view and cross-section of region used to model groundwater. Grey is Quaternary Sediments, green is Red River Carbonate, yellow is Winnipeg Sandstone. Thin, black layer is the Winnipeg Shale. (Courtesy of Sio Silica.)



6.2 Temporal Boundaries

While the proponent plans to seek approval to continue the project for 24 years, this Environment Act licence application was only for the first four years of extraction. The proponent, if successful, intends to apply for a licence alteration to expand the project onto other land in the following years. Sio Silica has extensive mineral claims, amounting to approximately 85,000 hectares, most of it running in an uneven band from Highway 15 to the point where Highway 12 bends and becomes Provincial Road 203. Accordingly, the EAP only looked at potential environmental effects of the first four years of this project.

What We Heard: Project Area and Assessment Boundaries

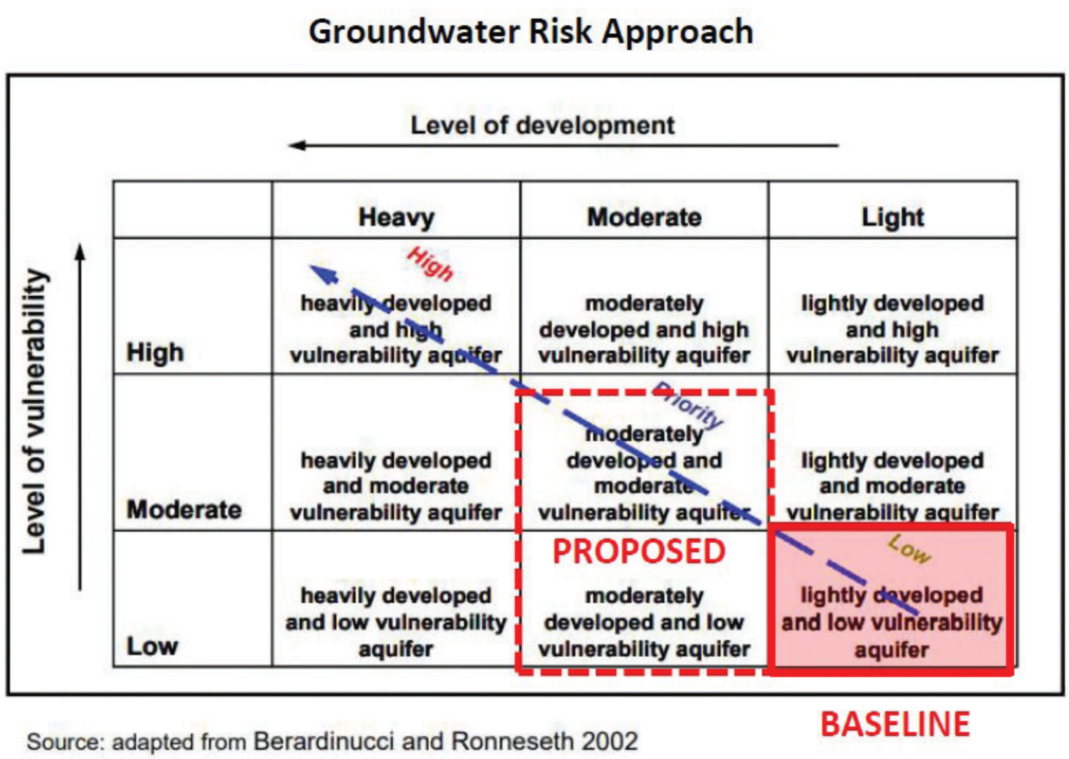
The panel heard many concerns about spatial and temporal boundaries in the EAP. Regarding spatial boundaries, a witness for Manitoba Eco Network and Our Line in the Sand (MBEN/OLS) discussed the boundaries of various regional hydrogeological studies carried out in the past. Two studies (Wang, 2008, Kennedy and Woodbury, 2002) had boundaries running south to the U.S. border, east to the Canadian Shield and north to Lake Winnipeg. In support of the argument for a larger study area, the expert noted that several significant environmental effects of past developments affected groundwater in or near the domain of the proponent's groundwater model. Near Winnipeg, groundwater levels decreased by seven metres as a result of the construction of the Red River Floodway in 1964. In that same area, the front between saltwater and freshwater moved eastward following the disruptions caused by building of the Floodway. More recently, an area near Steinbach experienced a drawdown of two metres in the level of groundwater as a result of urban development.

Concerns about overdevelopment and salt intrusion led to development of aquifer management plans in other locations in Manitoba in the 1990s and early 2000s, including Winkler, Oak Lake (near Virden in western Manitoba) and the Assiniboine Delta aquifer (covering approximately 3,900 square kilometres around Carberry). The Southeast Regional Groundwater Management Plan was completed in 2010 by local stakeholders with coordination and support provided by what was then called Manitoba Water Stewardship, drawing on a three-dimensional digital model for groundwater flow completed in 2008. Models such as these can be used as tools to evaluate recharge areas and recharge volumes, local and regional water tables, potential water levels and the impacts of proposed developments on groundwater. Such groundwater management plans are intended to foster collaboration between water users and allow for planning of future growth so that it will not threaten the sustainability of the groundwater system. Within the proponent's study area, the Rural Municipality of Springfield, currently home to approximately 16,000 people, completed a study in 2019 for a new municipal groundwater supply capable of supplying up to 40 litres per second (approximately 630 U.S. gallons per minute). At the time of the study, the population of the rural municipality had grown by 1.8 per cent per year for five years. Given this growth in demand and the evidence of past groundwater effects over large areas of southeastern the MBEN/OLS advocated for a larger study area for water effects and for assessing effects over the project's full lifespan. In its rebuttal, the proponent argued that planning for sustainable yield of an aquifer is a responsibility of the Groundwater Management Section of Manitoba Environment and Climate.

The four-year time frame of the EAP was discussed by many participants and presenters, who argued that the entire 24-year life of the project should have been the subject of the review. Many of these speakers also argued that the proponent should have been required to have a section of the EAP dedicated to cumulative effects. The proponent noted that a cumulative effects assessment was not a requirement of the process for a Class 2 development under The Environment Act. The MBEN/OLS argued that the Clean Environment Commission itself has called for greater emphasis on cumulative effects in past reports, including the 2007 report on the Pembina Valley Water Cooperative Supplemental Groundwater Supply System. In that report (focusing on a plan to draw groundwater from a region in the Sandilands and transport it by pipeline to the Pembina Valley), the commission stated that cumulative effects should be considered in future assessments of other developments, as "ecosystems in the area are currently affected by other developments and activities in the region and consideration of the additive effect of another impact needs to be addressed." In 2013, the commission's report on the Bipole III Transmission Project noted that "cumulative effects analysis should be the most important section of an environmental assessment report. It is where the residual or lasting effects of the project are described."

The MBEN/OLS presented an illustration that incorporated effects of the project with potential future development in the area. At present, they argued, the project area is lightly developed and has a low-vulnerability aquifer, placing it in a "low-priority" category for the level of risk to groundwater. With additional development in the area and the effects the project will have on the Winnipeg Shale aquitard (discussed in 7.1 Geology and Topography and 7.3.3 Water Quality) the area moves to a higher priority for groundwater risk.

Table 1: Conceptual table showing current low aquifer vulnerability and low development of region, with arrow illustrating increased risk as development increases and potential threats to aquifer are created. (Courtesy of Our Line in the Sand/Manitoba Eco Network.)



Many public presenters and writers of submissions expressed concern about the exclusion of the subsequent 20 years of extraction and the sand-processing facility from the EAP. Many of them referred to this as "project splitting," and referred to the use of this term by the commission's independent reviewer. The term "project splitting" refers to viewing components of large developments separately, so that the entirety of their impacts is not viewed.

Commission Comment: Project Area and Assessment Boundaries

Concerns about the limited scope – both spatial and temporal – of this EAP underline the need for cumulative effects assessments to be a required component of such proposals and for greater government involvement in groundwater planning.

Academics and environmental assessment practitioners all agree that cumulative effects are best dealt with at the regional level through planning that addresses ecological thresholds and development limits and includes on-going monitoring. The proponent raised this point as well, regarding discussion of planning for aquifer sustainability. However, often when a project is proposed, no regional plan exists and in such cases project-level cumulative effects assessments are used as the next best tool to assess long-term environmental effects.

The proponent also noted that the EAP guidelines did not include a requirement for a cumulative effects assessment. They are correct that it is not a requirement of the guidelines, but not including such an analysis leaves an information gap for the assessment of the long-term environmental effects and necessary mitigative actions for this project. The Canadian Environmental Assessment Agency defines cumulative effects as referring to "the combined effects from past, present, and reasonably foreseeable future activities and natural processes. Specific definitions vary among different parties and under different legislation and policies, but the term generally refers to effects that may be individually minor, but collectively significant." (https://www.canada.ca/en/environment-climate-change/services/cumulative-effects.html) Without such an assessment, the full effects of a project cannot be determined with confidence.

Cumulative effects assessment is not dependent on the size or permanence of a project. All effects add to those that already are experienced or can be predicted. Project-level assessments identify effects from the entire project within its operating area over the life of the project and take into consideration the influence of other activities in the area that have happened, are on-going or have been proposed.

A cumulative effects assessment assesses effects on valued ecosystem components (VECs). Aspects of the biophysical or socio-economic environment are designated as VECs because they are a specific element of concern (such as the shale aquitard) or because they encompass characteristics of a particular ecological community (such as a bird species that represents a forest type). The cumulative effects assessment includes the local effects (those caused by the project) on the VECs, as well as effects caused by other actions outside the project. Best practice is to have local community input into the assessment process, especially the selection of VECs. Doing so helps to identify the components that are of the most concern to the community.

The proponent intends to have two other development components in the immediate area: a sand-processing facility and a 3.5-km rail loop for loading the sand onto rail cars. The effects of these in addition to those of the extraction project should be taken into account, along with other impacts of developments in the area. This would provide a longer-term and more complete assessment of the environmental and health effects. A cumulative effects assessment covering the entire 24 years of the project is required to understand the short and long-term environmental effects. Such a document can be compiled while additional technical studies are being conducted.

A wider scope of study would address other concerns regarding the scope of the EAP, as demonstrated by discussions of project splitting, water consumption and long-term geological effects.

The term "project splitting" can be interpreted in two ways. The first is that a single project, such as the extraction project, is split into smaller projects or intervals and licensed progressively and separately without assessment of the project as a whole. This would apply to the current approach, where it is proposed that the project be licensed for four years with future amendments. A cumulative effects assessment for the whole project would address the issue of the overall effects of the project not being considered in the EAP.

The second interpretation of project splitting refers to the separation of interrelated components. During the hearing, the proponent characterized the processing and extraction projects as separate, independent projects, thus justifying their being licensed separately. It seems obvious, though, that they are very closely interconnected. It is hard to imagine that the processing facility would be viable without sand being produced in the immediate area and it seems equally obvious that processing the sand and loading it onto the adjacent CN rail line is what makes the investment in extracting sand in this area viable. The commission provides no comment on the legislation allowing licensing of separate projects. However, a cumulative effects assessment would take into consideration the additive effects of all three components on the environment and human health.

Discussions of water consumption by the project also pointed to the need for greater planning of groundwater use, in order to better assess potential impacts of projects such as this. In its 2007 report on the Pembina Valley Water Cooperative Supplemental Groundwater Supply, the Clean Environment Commission recommended that no further development take place until a watershed plan was developed. Following that, under the direction of a local steering committee, the Southeast Regional Groundwater Plan was developed, though it is not known if that plan was incorporated by the government into its planning. In addition, the Rural Municipality of Springfield conducted a groundwater study in 2019 for its development of supplemental water supply.

Though much research on groundwater resources in the area has been carried out over recent decades, a lack of coordination in groundwater planning has made it hard to consider the full effect of projects. In these hearings, the panel has learned of disparate estimates of recharge rates for the aquifers and a variety of boundaries that have been used to study the aquifers. It is imperative that the government standardize the benchmark for comparison for the boundary conditions and the recharge rate or range for the aquifers so that the effects of this and future projects can be measured consistently. Modelling should include the assessment of the higher and lower ranges for recharge, not just the average. Without consistent criteria, it is extremely difficult to assess the effect of any project on the sustainability of the aquifer. In addition, the commission encourages the government to provide an up-to-date status of the aquifer that takes into account experienced and predicted climate effects and experienced and projected development.

Several participants discussed the long-term change this project will cause to subsurface geology, especially considering the scale of the full 24-year project. Their arguments will be discussed in a later chapter. Taking a longer view than that in the proponent's EAP, which focused only on the first four years of the project, would reflect the reality that capital-intensive mining projects are planned with a long term in mind. In hard-rock mining, it is common for major developments to last for multiple generations, as seen in several of Manitoba's northern mining communities. Conducting a cumulative effects assessment over the 24-year period would address these long-term effects.

Chapter Seven
Effects Assessment (Biophysical)

7.1 Geology/Topography

Creating large voids in the Winnipeg Sandstone by extracting sand has the potential to cause impacts on geology and topography. The voids are expected to cause the collapse of the Winnipeg Shale layer, which would be a permanent geological change. Without the sand for support, at least some of the overlying "incompetent" limestone is also expected to collapse into the voids. If the voids created by sand extraction exceed the carrying capacity of the remaining competent limestone layer it will also collapse into the cavity. Such a failure of the limestone could result in change to the surface topography as layers of rock subside into the spaces below. Geotechnical assessments were carried out to determine the potential for such a failure to occur.

The proponent carried out a program of drilling 46 vertical boreholes to identify the geological layers and build a geological model of the area. Eight geotechnical boreholes were drilled to allow the proponent to characterize the ability of the layers below to support the load resulting from removal of the sand. The proponent tested samples of the rock cores from these boreholes to determine their rock-mass rating and geological-strength index, measures of the strength and solidity of rock. The proponent conducted an acoustic and visual scan of one borehole to identify structures and did four sonar scans of two extraction cavities in order to identify the shape of the cavities after extraction of sand. The proponent also gathered information from a large number of other boreholes in the area in order to characterize the geology of the area, including mapping the thickness of the carbonate (limestone) layer. Generally, this layer is thicker to the west and thinner to the east. In much of the project site, the layer of "competent" carbonate (non-fractured rock) is 15 to 20 metres thick.

The geology of the area consists of the following strata, in order from the surface to the deepest below ground:

- a layer of compacted till, sands, gravel and cobbles that is up to 35 metres thick (Quaternary Sediments)
- a layer of limestone that is fractured at the top and bottom and competent in the middle and is up to 40 metres thick (Red River Carbonate)
- a layer of shale that is up to five metres thick and is highly fractured and friable (Winnipeg Shale)
- a layer of loosely cemented sand that is 20 to 23 metres thick (Winnipeg Sandstone)
- a layer of shale
- the Precambrian bedrock

Figure 8: Geological formations and their interactions with the Vivian Sand Extraction Project. (Courtesy of Sio Silica.)

Eon	Era	Period	Geologic Unit	Member	Lithology	Role/Impact on Stability
Phanerozoic	Cenozoic	Quaternary			Diamicton (Till)	Overburdern Load
	Paleozoic	Orodvician	Red River Formation	Selkirk, Cat Head, Dog Head Members	Carbonate (Limestone)	Supporting Caprock
					Shale	Not Supporting
			Winnipeg Formation	Carman Sand Member	Sand	Target Extraction Zone
				Equiv. Ice Box Member	Shale	Not Drilled
				Black Island Member	Sand	Not Drilled
Archean					Granitoid	Not Drilled

Laboratory tests were carried out to determine the unconfined compressive strength (UCS) rating of the limestone. In 12 such laboratory tests, the average score of the competent limestone was 68, on a scale in which a score of 50 to 100 is considered strong. The proponent also carried out a larger number of field tests to estimate UCS. Samples from five different boreholes were estimated to have UCS scores of 68 to 98.

The proponent analyzed the potential for two kinds of potential failure of the limestone layer: shear failure and bending failure. In shear failure, the load on a block of competent limestone directly above the cavity overcomes the resistance of the limestone and the entire block drops down. In bending failure, the assumption is that each layer of limestone may act separately in bearing the load and the lowest layer – the roof of the cavity – will begin to bend as a result of the weight of the layers above. In this case, the lower layer will break and portions will fall into the cavity, leaving unbroken rock closer to the edge of the cavity. Shear failure would lead to a large block of the cavity roof caving in, while bending failure would lead to collapse in the centre of the roof, with intact beams of competent limestone remaining in place along the edges. Bending failure was determined to be the failure mode that would control project planning, in that bending failure would occur before shear failure would. Using a kind of geotechnical modelling software known as FLAC (Fast Lagrangian Analysis of Continua) the proponent estimated the maximum roof spans, given varied thicknesses of competent limestone and of the Quaternary Sediments above. That produced a table showing maximum thicknesses for extraction cavities in locations with competent limestone thicknesses of 10, 15, 20 and 25 metres and Quaternary Sediments thicknesses of 25 and 35 metres. In addition to not extracting sand in places where the competent limestone is less than 15 metres thick, the proponent stated an intention not to extract in areas of karst limestone – limestone that has been eroded by dissolution, leaving features such as fissures and sinkholes.

Table 2 : Maximum cavity spans, based on thickness of competent limestone and Quaternary Sediments layer. (Courtesy of Sio Silica.)

Competent Limestone Thickness (m)	Overburden Thickness (m)	Long-term Allowable Limestone Unsupported Span (Diameter) (m) (Notes 1 and 2)	Extraction Disturbance Zone Dimensions (notes 3 and 4)	
			Top Diameter (m)	Bottom Diameter (m)
10	25	26	16	0 (Note 5)
	35	24	14	0 (Note 5)
15	25	35	25	6
	35	32	22	3
20	25	43	33	14
	35	40	30	11
25	25	50	40	21
	35	47	37	18

Notes:

1) Bending (Tensile) is the controlling failure mechanism to determine the long-term allowable span.

2) Single beam maximum long-term allowable span is 7 m. Average competent limestone bedding thickness is 0.7 m.

3) Extraction zone side wall slope of 65°.

4) Extraction depth is 20 m.

5) The long-term diameter of the extraction cavity is expected to be 10 m larger than the short-term diameter.

6) Due to possible long-term cavity expansion, limit the extraction zone to the long-term allowable unsupported span.

7) Extraction in areas with only 10 m of competent limestone is discouraged due to competency uncertainties.

Depending on how much the sand sloughs off over time, the size of the cavity is expected to increase after extraction is finished. When initial work began on the project in 2018, the proponent's experts assumed that the side walls of the sand cavities would shift until they ended up at a natural angle of repose of 31 degrees. This assumption was based on the hypothesis that the sand was not cemented together. Later testing led to the conclusion that the sand is weakly cemented and would form side walls of approximately 65 degrees. Side-scan sonar taken inside two extraction cavities showed that immediately after extraction, the walls of the cavities were vertical or overhanging. Over time the overhanging and vertical sand is expected to slough off to the bottom of the cavity. In order to estimate the long-term shape of the cavity, the proponent determined a numerical value of the strength of the cohesion that holds the sand together. This was determined using FLAC computer modelling and physical tests, known as penetration tests, of the strength of the sand layer. In penetration testing, a rod is advanced through a layer using measured hammer blows. The number of blows required to advance the rod a short distance indicated that the sand layer was as hard to push the tool through as rock. Once a numerical value for cohesion was established, the proponent estimated that the sand should achieve approximately a 65-degree angle.

Modelling of the strength and cohesion of the sand layer led to the conclusion that at least 60 metres of intact sand are needed between cavities in order to maintain stability (with a safety factor). In order to ensure that there is at least 60 metres of intact sand, the proponent plans to ensure that the initial extent of intact sand is at least 70 metres. That allows for widening of the cavities as the sand reaches its final angle. The proponent described this as similar to the "room-and-pillar" mining carried out in many hard-rock mines, in which an ore body is mined out in a way that leaves intact walls of rock to act as pillars supporting the roof over the vacated space. The intact sand between the extraction zones would act as pillars to hold up the limestone layer above.

Sonar scans showed that, four months after extraction of sand, the layer of shale above the sand had collapsed into the void, as had some of the bottom portion of the limestone. The proponent stated that layers of competent limestone above the fractured limestone are expected to remain secure. This conclusion was based on the various strength tests carried out on the limestone.

The potential for surface subsidence was examined through the use of five settlement gauges placed four to 20 metres away from three boreholes. The settlement gauges measured any change in the surface from April to December 2021, following test extraction of sand. The gauges, with an accuracy of plus or minus one millimetre, recorded zero to two millimetres of surface deformation. The proponent stated during the pre-hearing Information Request phase that it plans to conduct tests for surface subsidence before, during and after extraction activities.

The proponent intends to develop a plan known as the Trigger Action Response Plan (TARP) to guide responses to potential environmental effects on geology and topography. The plan, which the proponent intends to develop after receiving a licence for the project, would designate findings that trigger specific responses, such as stopping extraction and using video or sonar to determine if the limestone caprock is at risk of collapse.

What We Heard: Geology and Topography

The Clean Environment Commission contracted with consulting engineers to examine the proponent's EAP and supporting documents. The commission's experts were concerned about a modelling assumption used by the proponent – that the geology of the project area was homogeneous. However, the commission's consultants agreed with those of the proponent that given the design parameters described above (regarding maximum spans, a minimum of 15 metres of competent limestone and an initial 70-metre distance between cavities) the project would not result in significant adverse impacts to the surface, such as sinkholes and subsidence if the assumption of homogeneity is true. This conclusion refers only to the impacts at the surface on topography, and does not refer to the potential impact on groundwater resulting from the collapse of the shale layer into the cavities. Those concerns will be discussed in Section 7.3.3 Groundwater Quality.

Participants focused many questions on the proponent's estimates regarding the stability of the sand pillars remaining after extraction. A member of the public questioned the use of the "room and pillar" description of the mining procedure, saying that this was not appropriate for mining in which the "pillars" would consist of sand, rather than hard rock. If the angle of repose of the sand ended up being much smaller than the expected 65 degrees, it was suggested that the length of the roof spans in the cavities would be greater. That, in turn, would put greater stress on the limestone and potentially lead to more failure of this layer. Participants asked whether the proponent could have extracted sand from the formation in order to conduct laboratory tests to determine the degree of cohesion. The proponent replied that such a test would not be feasible, as the sand's cohesion would be destroyed in extracting it.

A great deal of discussion was generated by an illustration depicting the size of one well cavity four months after extraction, as indicated by the proponent's side-scan sonar. This scan indicated that the shale layer above the sand had failed and fallen into the cavity, along with a portion of the lower part of the limestone layer.

The Municipal Silica Sand Advisory Committee (MSSAC), representing several nearby municipalities, engaged an engineering consulting firm to review the proponent's EAP. The MSSAC's professional geologist questioned the way the proponent characterized the limestone caprock of the Red River Carbonate. Whereas the proponent has characterized this layer as horizontally bedded without vertical jointing, the geologist stated that much carbonate caprock in Manitoba contains vertical and sub-vertical jointing. These vertical joints are a reflection of a geological history in which the rock was subjected to many geological processes that may have fractured or weakened it. These include:

- basin-wide uplift and tectonic processes
- exposure, erosion and karst processes (referring to landscapes where rock has been dissolved by water, creating fissures, sinkholes and other features)
- glaciation and isostatic rebound (in which landscapes that had been depressed by the weight of ice age glaciers slowly rebound)

These processes create vertical joints, as illustrated by photographs of vertical joints in limestone visible in locations such as Hecla/ Grindstone Provincial Park. Such vertical fissures, if they are present in the limestone caprock at the project site, could reduce the capacity of the caprock to bridge the spans above the cavities where sand has been extracted. The geologist also raised questions about the cementing of the sand in the layer where extraction is planned. If the sand is less uniformly cemented in some locations, that could affect its ability to maintain the expected 65-degree angle in the cavities, leading to a longer cavity span as the sand slumps further. The sonar the proponent used inside two boreholes to examine the shape of the cavities could not penetrate the sediment-filled water at the base of the cavities, so it was incapable of determining what angle the sand was at below that level.

An expert testifying for the MBEN/OLS also spoke about the potential for vertical fractures in the limestone layer. Noting that the 35-metre spans would be as long as three normal-sized city buses, the expert said the forces exerted on the unsupported limestone over these spans could either cause vertical fractures to form or could expand existing vertical fractures, which could then have the potential to become pathways for surface water to reach the aquifers.

Experts for participants questioned assumptions about the homogeneity of the geological structures. These assumptions, they said, could best be addressed by a more robust program of exploratory borehole drilling, including inclined drilling, to better characterize the condition of the limestone and the presence or absence of vertical fractures. The proponent committed, during the hearings, to carrying out inclined drilling.

The MBEN/OLS later argued that the proponent's assessment of the project should have considered the shale aquitard as a Valued Ecosystem Component (VEC) of the environment. In environmental assessment, the effects of a project are considered by assessing effects on specific VECs as elements of specific concern or as proxies representing a particular aspect of the environment. Because of the role of the shale aquitard in keeping the carbonate and sandstone aquifers separate, it helps to protect the two aquifers from contamination and allows for them to be managed separately.

Commission Comment: Geology and Topography

The panel notes that the stability of the carbonate (limestone) layer is essential to questions about surface impacts, such as subsidence, and to those regarding groundwater quality. The groundwater implications will be discussed later in 7.3.3 Groundwater Quality.

In its modelling and production planning, the proponent has assumed that a relatively homogenous limestone structure exists across the entire initial 633-hectare project area. The proponent has characterized the carbonate layer using results from 46 vertical boreholes. Core samples from this type of borehole are not considered to be a reliable gauge of the existence and frequency of vertical jointing. Technical experts for the proponent confirmed this in testimony, undertaking to drill additional inclined test boreholes once the required licences have been secured to begin production. In the absence of additional data to raise the level of confidence that the carbonate formation in the production zone has been properly characterized, the risk of mine failure is difficult to determine. The proponent's analysis indicated that ensuring a minimum over the long term of 60 metres of intact sand between extraction voids will provide enough support to prevent subsidence, but the panel notes that there was no long-term monitoring data to show that voids created in testing have not continued to expand. The panel notes that creating a large number of extraction wells across a relatively large surface area increases the possibility of mine failures should the carbonate layer be more heterogeneous than is currently portrayed.

The commission observed the absence of comments from the Mines Branch during the TAC process. This project will require approval under The Mines and Minerals Act as well as The Environment Act. Although the extraction plan has been prepared by credible professionals and reviewed by commission experts and the hearing panel, as well as experts engaged by participants, none of these parties is the regulator. Without input from Mines Branch, it is unknown whether the proposed extraction plan will meet the requirements under the Mines and Minerals Act. Should the Mines Branch have concerns, it could require additional studies or alterations that may influence environmental and health effects. It is imperative that, before proceeding further, the Mines Branch be consulted to confirm whether it has provided an approval in principle.

In the absence of input into the review process from Mines Branch, the commission has carried out its review based on the knowledge gained through the hearing process. Should such input lead to adjustments to the extraction plan, conclusions in this report may need to be reassessed.

The panel is of the opinion that further exploration is needed to verify the proponent's prediction of a 65-degree angle for the sand slopes in the cavities. This may be a valid prediction in places where the sand is partially cemented, but as in the case of the carbonate layer, the possibility of heterogeneity in the sand layer needs further examination.

The proponent made a number of references to its Trigger Action Response Plan (TARP) plan as a key tool to ensure that the project does not cause limestone collapse. This plan should be spelled out in greater detail for the public to be confident. Assuming the plan provides the proponent with early warning information in order to stop extracting from a cavity, it may prevent limestone collapse. The plan must describe responses if extraction in a weak area results in a substantial collapse, as well as indicating what the response will be if a collapse occurs 25, 50 or more years in the future.

The panel agrees that the project needs to be considered using a long time frame. The changes it will create in the underlying geology are essentially permanent. Will the sand walls of the cavities slowly degrade? Will the caprock above progressively degrade if a void expands over time? Four months after extraction, when the follow-up side-scan sonar was taken, may not be a long enough time to have confidence that all of the gradual below-ground changes have finished. The proponent has argued that the sand will not be extracted nor water returned with sufficient force to disturb the remaining sand in the walls; therefore, it is likely to retain the cohesion and strength that will prevent it from declining past the expected 65-degree.

The panel and its consultants were concerned that the proponent did not provide more analysis on possible consequences of mine failure. As one consultant retained by the commission noted, even in the case of a project using a well-understood and frequently used technology, such as an earth-filled dam, a proponent will analyze the consequences of a failure, however unlikely it might be. It would be useful to know what the proponent's response would be if a failure were to occur as a result of human error or unforeseen circumstances, such as a cavern collapsing to the surface. The proponent referred to Trigger Action Response Plans (TARP) to be developed in the future, but these were not available at the time of the hearings.

In discussing what kinds of actions might be included in the TARP, an expert testifying for the proponent gave a number of examples of monitoring that might be carried out during extraction. Various instruments for detecting changes in pressure or cavity shape could be installed underground. Continuous monitoring at the surface could be used to detect any surface displacement. Sidescan sonar might be carried out when extraction has reached 50 per cent of its target for a given well. These measures would be planned for each extraction area based on the specific subsurface conditions, such as the thickness of the competent limestone in that area. Should this project proceed, the panel encourages such measures to provide a greater level of confidence in predictions of project effects on geology and topography. The government, using its best judgement, should decide whether the area monitored in this manner is sufficient to provide an appropriate assessment of the effects on the carbonate aquifer or if an expanded monitoring regime is required.

These and other questions about long-term impacts need to be resolved with additional testing in order to provide greater confidence for Manitobans concerned about a project that will permanently alter the geology of two important aquifers. A recommended plan to address these and other concerns will be presented in Chapter 12: Conclusions and Recommendations.

7.2 Soils

The proponent plans to remove vegetation in places within the project site for well sites, pumping stations, dewatering and water treatment facilities and access trails. These trails are planned to be four metres wide in most places and eight metres wide in some places to allow for trucks to turn. Well-cluster sites are expected to be up to 0.28 hectares in area. A substantial number of pieces of equipment, including drilling rigs, pumps, light stations and dewatering stations, will be moved around the site. As such, there is the potential for disturbed soil to be subject to wind or water erosion. The proponent has committed to use access matting to help preserve the ground and plans to revegetate disturbed areas as quickly as possible after project work moves to a different part of the site. The proponent will develop an Erosion and Sediment Control Plan, which will describe how such measures will be carried out.

Commission Comment: Soils

Members of the public expressed concern about impacts of surface activities, such as clearing of vegetation and moving of heavy equipment. The panel noted that the first four years of the sand extraction project are planned to occur on private land and that some of this land has already been impacted by gravel extraction operations, with resulting impact on both surface soil and vegetation.

7.3 Groundwater Issues: Overview

Issues related to groundwater dominated the hearings on the project. Broadly speaking, these can be grouped into two categories: quantity issues and quality issues. Quantity issues were related to the amount of water to be extracted along with the sand and whether drawing a large amount of water from hundreds of wells per season would affect neighbouring wells drawing on the same aquifer. Water-quality concerns related to the potential effect of combining waters from the carbonate (limestone) aquifer and the sandstone aquifer, the potential changes to the water resulting from the presence of collapsed shale in the water-filled cavities, the potential effects of air being pumped down the wells changing the chemistry of the water in the aquifer, and the potential for contamination of the groundwater prior to its being returned to the aquifer.

Testing and Modelling of Groundwater

A key challenge in assessing potential impacts on groundwater is that, by definition, it is hidden away underground. While it's conceptually easier to visualize the potential impact of clearing a forest or damming a river, effects on groundwater are inherently more difficult to visualize. Groundwater flow and quality are understood through gathering data on existing and purpose-built test wells. Hydrogeologists, who specialize in the study of the flow of groundwater and the interactions between groundwater and the surrounding rock and soil, work to determine the direction of flow (up and down as well as horizontally), the speed of flow (known as conductivity), the ability of the rock or soil to hold water (known as storativity) and the rate at which an aquifer recharges through rain and snowmelt. They use a variety of different kinds of tests to estimate these measures. One kind of test is known as a "pump test." In a pump test, a well is pumped at a specific rate and the effect is measured in one or more surrounding wells in order to estimate the properties of the aquifer. A "step test" is one in which the rate of the pumping well is varied, typically by beginning at a low rate and increasing the rate by a set amount at a regular interval of 30 minutes to two hours. In a "slug test" a set amount of water is rapidly added to or taken from a well and observers measure how long it takes for water in the well to return its normal level.

To assess impacts of a project such as the Vivian Sand Extraction Project, it is necessary to develop a computer model of groundwater and validate that model by comparing it with actual well data. Then, once a model has been validated, it can be used to simulate what will happen if a certain amount of water is pumped from an aquifer. The validation process is critical to assuring model reliability.

7.3.1 Groundwater Modelling

In order to assess potential impacts of the project on groundwater, the proponent developed a model to understand how groundwater moves, the rate at which it is recharged, the pressure of the water within the aquifers and other parameters.

To develop this model, the proponent used regional geological maps, federal and provincial government databases of boreholes, measurements of groundwater elevation taken from local domestic wells and other data. Approximately 2,500 observation wells in the area provided information on groundwater elevations. The proponent developed a regional-scale model covering an area of approximately 3,200 square kilometres (roughly 80 km by 40 km). This model domain was bounded to the east by the Sandilands area, where the aquifers are recharged by precipitation, on the southwest by the Seine River, on the northwest by the Red River and

Red River Floodway and on the northeast by Hazel Creek. Within this area, groundwater flows to the northwest. The project site is at least 10 kilometres away from the nearest point on any of the boundaries. The boundaries of the groundwater model were selected to represent where water enters the system and where it is discharged into water bodies. To the west of the Red River, groundwater flows generally northeast. Groundwater west of the Red River is more saline than the groundwater in the project area. Within the area of the groundwater flow model there were, at the time of the EAP's filing, nearly 11,000 registered wells, approximately 1,600 within the regional project area and 400 within the local project area.

The proponent developed a numerical model of the groundwater system in order to make predictions about effects of pumping water out of the sandstone aquifer and connecting the sandstone and limestone aquifers with extraction cavities. The numerical model was created using software called FEFLOW, which is commonly used in the industry. The numerical model allowed for calculations of groundwater levels, draw down, groundwater flow paths and other parameters. The proponent tested the validity of the model by comparing results it predicted to actual historic data and to results generated by test wells.

The proponent created one well to conduct a series of step tests and a constant-rate pumping test. In the step test, the well was pumped at various rates (from 373 to 421 U.S. gallons per minute) for two to 2.5 hours. In the constant-rate test, the well was pumped continually at 372 gpm for 72 hours. (In the hearings and the documents under consideration, measurements for water were often in U.S. gallons, with one U.S. gallon the equivalent of 3.8 litres.) Effects of this pumping were monitored using four piezometers (instruments for measuring hydraulic pressure in groundwater) located in a well 89.3 metres from the pumping well, and making groundwater measurements in five monitoring wells located 338 and 1,211 metres from the pumping well and three domestic water supply wells located 491 to 960 metres from the pumping well. This network of monitoring wells allowed the proponent to estimate the zone of influence of the test well, and thereby that of the planned extraction wells. In response to concerns that only one pump test was carried out, the proponent noted that two EAPs for water projects in the area that will draw a larger amount of water than the Vivian Sand Extraction Project (one for the RM of Springfield and the other for the City of Steinbach) were also supported by a single pump test.

The proponent calibrated the numerical model to determine its likely accuracy. Calibration is a process of adjusting the parameters and boundaries used in the model so that the model matches historically observed groundwater conditions, such as the elevation of water in approximately 2,500 monitoring wells. Several statistical measures were used to assess the accuracy, including mean error, normalized root mean square error and correlation coefficient. Essentially, these are statistical measures to determine how close the model's simulated numbers for parameters such as groundwater elevation come to the actual observed numbers in the database. According to the proponent, the normalized root mean square error and correlation coefficient measures both showed that the model had a level of accuracy that was higher than industry standard. The mean error measure indicated a less accurate fit, but the experts testifying for the proponent attributed this to clusters of wells close to the Red River where effects of the construction of the Floodway affected groundwater elevations. In testing its model, the proponent also conducted a sensitivity analysis. Such an analysis is intended to determine which parameters are the most important for the model to derive accurate predictions. By running simulations with slight changes in the values of various parameters, the sensitivity analysis indicates which parameters will affect the results the most. The sensitivity analysis showed that the two parameters that must be most accurately characterized are hydraulic conductivity and recharge.

Estimates in the EAP regarding the amount of drawdown that would be experienced by neighbouring well owners and the recovery time of these wells were based on simulations using this numerical model. The proponent has proposed conducting additional pump tests prior to development of the project and intends to establish a network of groundwater monitoring wells.

What We Heard: Groundwater Modelling

An expert retained by the commission to review the EAP expressed several concerns about the validity of the proponent's groundwater modelling. A central point was that the modelling was not based on enough data because the proponent conducted only one pump test and five slug tests and that these do not provide information that is representative of the wider area. The drawdown area from the pump test would amount to about three square kilometres, so to extrapolate from that test to the 3,200 square kilometre model area requires the assumption that conditions in the aquifer are the same over large areas. The expert questioned the use of one assumption used in building the model – that geological conditions are homogeneous throughout the area – noting that other studies of the area have found heterogeneous (varied) geology.

Concern was raised about the validity of the boundaries for the model and about the historic studies used. A map showing the proponent's comparison of simulated groundwater elevations versus observed groundwater elevations indicated a large cluster of wells near Winnipeg where the simulation was at least 10 metres lower than the observation and a cluster near Birds Hill where the simulation was at least 10 metres higher than the observation. Such pockets of concentrated inaccuracy suggest a poor fit near the boundaries. The use of data from many different sources over several decades was a concern. Data from the 1980s were combined with data the proponent gathered from its test wells in 2020/21. Doing so assumes that the older observation wells would still provide the same data 30 to 40 years later. Another suggested conceptual shortcoming of the model was that as a result of over-simplification there is the risk of a flaw known as equifinality, which is where more than one solution can arrive at the same answer. Additional data-gathering is required in such cases, in order to determine which set of parameters provides the correct fit. The commission's expert also said there was a systematic error in the way the proponent's model estimated groundwater head (a term referring to a measurement of water level in a well). The commission's expert found that in comparing simulations using the proponent's model to actual results, groundwater heads were systematically over-estimated below 275 metres above sea level.

The expert retained by the MBEN/OLS compared the proponent's groundwater model with the models developed for the RM of Springfield's additional groundwater supply (2019), for the Southeast Regional Groundwater Management Plan (SRGMP) (2010) and in the Kennedy and Woodbury study of 2005. The proponent's model estimated water use at 200 litres per person per day, where the Springfield study estimated

300 litres and the SRGMP estimated 500 litres. The expert witness also questioned the figure the proponent's model assigned to recharge, the key factor in evaluating a sustainable use of water. The proponent's model assigned a figure of 620,000 cubic metres per day to recharge, where the Springfield study applied less than 33,000 cubic metres and the Kennedy and Woodbury model applied 164,160 cubic metres. Using a much higher figure for recharge allows the daily use of water to be a smaller percentage of recharge. The proponent's model area excluded areas to the west where there are concerns about saltwater intrusion into the aquifer as well as areas of heavier development to the south.

Commission Comment: Groundwater Modelling

As indicated above, many questions were raised during the hearing process regarding the adequacy of the proponent's hydrogeological testing.

The panel concludes that additional testing and data collection are required to provide confidence in the modelling. Pump tests and slug tests should be carried out in extraction areas some distance from the previously tested site. This would help to confirm or disprove the expectation that effects of extraction will have the same effects throughout the project site.

A recommended plan to address these and other concerns will be presented in Chapter Twelve: Conclusions and Recommendations.

Given the growing population in southeastern Manitoba that is dependent on groundwater and the potential future effects of climate change, an up-to-date assessment by government of aquifer sustainability would be helpful for assessing effects of this and future projects. The variations in boundaries used by groundwater studies in this area and in the numbers assigned to aquifer recharge rates point to the need for the government to standardize these benchmarks for understanding aquifer sustainability.

During the hearings, the panel heard debate between the proponent and participant groups regarding the concepts of "industry standards" and "state of the art" or "academic research standards." Experts testifying for the proponent said the statistical tests used to calibrate the groundwater model showed that it was considered a very good fit by industry standards. But it was argued by other experts that a project that is essentially experimental must meet a higher standard.

The standards that this project is measured against should be determined by the government. An updated assessment of the state of the aquifer as well as standardization of the benchmarks could alleviate some concerns. This could be assisted by the execution of aquifer management planning as authorized by The Groundwater and Water Well Act. Given that Manitoba's recently completed Water Management Strategy has a mission to meet environmental, social and economic needs, today and in the future, setting a standard for groundwater testing and modelling is an appropriate job for the government.

Manitoba's Water Management Strategy

In November 2022 the Manitoba government released its new Water Management Strategy. The strategy was developed following the release in 2017 of the Manitoba Climate and Green Plan. That plan led to the creation of an Expert Advisory Council, which in 2020 was tasked with providing recommendations on a modernized, coordinated water management strategy. An engagement process of surveys and in-depth interviews with key stakeholders and water experts led to the creation of the strategy.

The strategy lists 11 focus areas in support of its vision of "healthy waters that support resilient, thriving ecosystems, communities and economies for generation of Manitobans" and its mission of "the stewardship and protection of Manitoba's waters to meet environmental, social and economic needs, today and tomorrow." Beneath the 11 focus areas are 47 strategic objectives and action plans that describe how Manitoba will achieve these objectives.

Among the focus areas are "meet the water supply needs of current and future generations sustainably," "protect the quality and quantity of groundwater" and "improve the coordination of water management and governance across watersheds, basins and aquifers." The stated goals of the Water Management Strategy suggest that all developments that pose risks or claim to have beneficial impacts on water resources deserve a high standard of judicious review.

The full text of the strategy is available online at https://manitoba.ca/sd/pubs/water/water_mgmt_strategy2022.pdf.

7.3.2 Groundwater Quantity

The proponent stated that risks to groundwater quantity will be minor, seasonal and reversible. The carbonate and sandstone aquifers in the area adjacent to extraction are expected to recover 80 per cent within two days of extraction activities. The remaining 20 per cent of recovery is expected within 20 to 80 days. The proponent's conclusion, based on hydrogeological and geotechnical assessment involving field investigation, data analysis, numerical groundwater modelling and geotechnical modelling, is that drawdown effects will be localized. Beyond 1,500 metres distance from the extraction wells, the proponent expects little or no effect once the groundwater has been reinjected. During a pumping test, existing domestic wells near the project site showed little to no decline (0.02 m to 0.77 m) in water levels in the sandstone or carbonate aquifer. Within a network of observation wells, water levels declined by up to 8.5 metres (in the Winnipeg Sandstone aquifer) and 1.5 m (in the Red River Carbonate aquifer) at a distance of 89.3 m from the pumping well. Drawdown effects were largely restricted to the project site boundary, but minor effects are anticipated to extend beyond it during and immediately following operation of extraction wells close to the boundary.

The slurry loop will require an estimated 1,325 cubic metres of water to operate. This water will be extracted at the beginning of each season and continuously reused. During sand extraction, the proponent intends to separate most of the water from the sand and direct this water to a treatment process prior to re-injection to the individual extraction well. Some water, amounting to approximately 54 cubic metres (14,265 U.S. gallons) per day, will remain with the sand as it is sent to the slurry loop. The proponent has stated that during extraction, up to 540 U.S. gallons per minute of sand and water mixture will be pumped from the aquifer (with individual wells producing 40 to 120 U.S. gpm each). At full production, the proponent states that water lost to evaporation would amount to 54 cubic metres per day (10 U.S. gallons per minute), based on 85 per cent of water being re-injected. The proponent characterized the annual amount of water use as less than that required by a typical golf course.

The proponent plans a buffer of 100 metres between extraction wells and any existing homes or water supply wells. With reinjection of water into the aquifer, the proponent states that wells greater than 1.5 km from the project site are unlikely to be affected. For wells that are affected, the majority are expected to experience a maximum drawdown of one to five metres, for a short period of time during and after extraction. Wells with the pumps located five metres or more below the piezometric surface (the level at which there is sufficient hydraulic head for the pump to function) are not expected to be affected. In the event the project affects water in neighbouring wells, measures will be developed to avoid and/or mitigate any well interference issues as required by The Water Rights Act. This could include providing water, typically as a temporary measure, lowering the pump of a well affected by drawdown or drilling a new well.

What We Heard: Groundwater Quantity

An expert retained by the MSSAC noted that there is seasonal variability in groundwater recharge, with a lag of as much as eight months for water levels in the aquifer to respond. As a result, depending on when water is taken from the aquifer, it may take longer for natural recharge to return conditions to normal.

An expert retained by the MBEN/OLS raised concerns about the numbers used for aquifer recharge in the proponent's groundwater model. The proponent's model used a much larger figure for aquifer recharge than did two other studies of groundwater in southeastern Manitoba. If the figure for recharge is too high, it is easier to see a project's use of groundwater as sustainable. However, the expert for the MBEN/OLS also agreed with the proponent's calculations regarding the capacity of the aquifer to meet the project's groundwater demands sustainably.

Public presenters concerned about potential impacts on quantity and quality of water spoke of the rapid growth in southeastern Manitoba. One presenter, noting growing demand for water and need to prepare for droughts, noted that the entire region's population is approaching 100,000. The presenter calculated the value of residential property in southeastern Manitoba at $17 billion and said the government must protect this investment by protecting the aquifer. It was noted by members of the public that Manitoba's Water Management Strategy gives domestic water use the priority over industrial use. Written submissions also discussed recent droughts in Manitoba, with one resident saying they had already reduced the size of their garden in order to cut water consumption and another saying that the most recent drought year (2020-21) had already caused a loss of well pressure.

Commission Comment: Groundwater Quantity

Based on current water usage in the area and modelling provided, it appears that the project is not likely to cause a significant impact on the quantity of water available to other users, assuming the proponent is able to return 85 per cent of the water it extracts, as planned. This does not mean there are no concerns at all regarding quantity. Variability in recharge rates from season to season and year to year should be considered. An amount of withdrawal that is insignificant most years might be significant in a serious and protracted drought. Placing the project's expected water usage in context with other withdrawals of water and with forecast growth would help Manitobans to better predict the longer-term effect of the project. Population growth in the region, combined with provincial water policy that gives the highest priority to domestic uses of water, suggests that projects such as this are best assessed using a framework of regional water plans. The government should set the benchmarks for recharge and water use to be used in modelling the impacts of developments on groundwater.

It is also worth noting that even if the project's water consumption is not significant on a regional and long-term basis, it does present the possibility of short-term disruptions in the immediate area. The proponent expects the majority of wells within 1.5 km of extraction activities to have a maximum drawdown effect of one to five metres and that within two days of the end of extraction, these wells will recover 80 per cent. That suggests some very close wells are likely to experience greater drawdown. It also suggests at least a temporary inconvenience for a number of nearby residents. These calculations of the effect on neighbouring wells are likely to depend on the ratio of water to sand extracted, which the proponent expects to be 1:1. If a higher proportion of water is extracted, these drawdown effects may be greater.

The proponent must have a comprehensive plan to address drawdown in wells close to the sites of extraction. The proponent should strive to inconvenience nearby residents to the least extent possible. The proponent has stated that it intends to monitor groundwater elevations continuously so that operations can be stopped if water levels reach pre-determined impact thresholds. In the event that availability of water is affected, the proponent has committed to providing potable water at its expense. The proponent also, during the pre-hearing Information Request phase of this review, committed to carrying out a multi-well test after issuance of a licence. The proponent plans to begin extraction with clusters of a single well or two wells and use information generated from these first extraction activities to test design assumptions and groundwater models. This indicates a realization on the part of the proponent that more information is required to build confidence, especially among members of communities dependent on the groundwater in this area.

On-going monitoring of the aquifer levels is required to confirm assumptions about effects on the aquifer and to identify problems should they occur. This is expected to be covered in detail in the proponent's Water Management Plan, discussed in Chapter Ten: Management and Mitigation Plans.

A recommended plan to address these and other concerns will be presented in Chapter Twelve: Conclusions and Recommendations.

7.3.3 Groundwater Quality

The proponent predicts the project to have a minor and temporary effect on groundwater quality. This prediction is based on the plan to carry out a number of steps to prevent contamination.

- Casing is to be applied in each well and grouted in place to keep the Red River Carbonate and Winnipeg Sandstone aquifers separate.

- Drilling and sealing (decommissioning) wells will be carried out in accordance with applicable guidance documents such as "Constructing and Sealing Wells in Manitoba" (Province of Manitoba, 2018) and Environment Act licence requirements. This is intended to prevent surface water contamination of the aquifer.

- Water separated from the sand is to be subjected to ultraviolet (UV) treatment before it is reinjected in the wells. The proponent states that this water will not come into contact with any contaminants, and UV treatment will be carried out as a conservative measure for any pathogens such as bacteria. Suspended solids that would otherwise make UV treatment ineffective will be removed through sand filters, followed by the addition of a substance derived from shrimp and crab shells, known as chitosan, which bonds with the smallest particles and allows them to be filtered.

- A Waste Characterization Plan will be implemented to identify any rock or soil materials that have the potential to generate acid or contribute to leaching of metals after exposure to oxygen in the air. This will include testing drill cuttings from the various layers (Quaternary Sediments, Red River Carbonate and Winnipeg Shale) and storing or neutralizing any of those that have a chemical composition that makes acid generation or metal leaching possible.

Metal Leaching and Acid Rock Drainage

Rocks containing sulphides, such as pyrite (an iron sulphide with the chemical formula FeS_2), can generate acid rock drainage when exposed to water and oxygen. The resulting chemical process of oxidation releases sulphuric acid and metal oxides. This acidic runoff can release metals from rock, including iron, selenium, arsenic, manganese and copper. If it reaches drinking water sources, such as aquifers or surface water used for drinking, it can affect health and safety of those who consume the water. If this water drains into creeks and rivers it can disrupt the growth and reproduction of aquatic plants and animals and affect any infrastructure, such as water pipes, in contact with the water.

Acid rock drainage is a common form of water pollution in areas where there are abandoned mines that have left large rock pits or slag piles behind. Mine reclamation projects often involve adding alkaline materials to neutralize the acidity and applying uncontaminated soil, planting vegetation and stabilizing slopes to reduce the infiltration of surface water to the potentially acid-generating material.

The proponent collected 20 water-quality samples and duplicates from several monitoring wells, including three private wells. Thirteen water samples were sent for isotopic analysis. Analysis found that the water currently has very little oxygen in it and is fresh, meaning it has very low dissolved solids – both in the sandstone and the carbonate aquifers. The proponent sought to determine what would happen to the water from the sandstone aquifer after it was brought to the surface through the extraction process, exposed to oxygen from the atmosphere and reinjected into the wells. Modelling indicated that the water, if left at the surface, would become oxidized, resulting in metals such as iron precipitating out in reaction to the oxygen. However, the proponent's experts said oxidizing reactions in the aquifer would not be possible, because such reactions would require both an unlimited supply of oxygen and abundant sulphide materials (pyrite). In a saturated below-ground environment, there would not be enough oxygen and the rocks have low levels of pyrite.

In order to assess the risk of acid rock drainage (ARD) and metal leaching (ML), the proponent conducted tests of the materials brought to the surface in test drilling. The focus of testing for acid rock drainage and metal leaching is to prevent run-off from waste rock at the surface becoming unsuitable for aquatic life if it reached surface water or harming drinking water if it were to re-enter the aquifer. The proponent's laboratory testing of rock materials indicated that the samples from the Red River Carbonate and Winnipeg Sandstone layers are not potentially acid-generating, because they have very low levels of sulphide materials. Some of the Winnipeg Shale samples were classified as "uncertain," meaning that it's not certain that the material could neutralize acidity and maintain a neutral pH. Waste material from the shale layer, therefore, will need to be managed in a way that protects groundwater quality. The proponent estimates that each of approximately 1,200 wells over the four years of the project will generate approximately 0.15 cubic metres of shale waste and 0.66 cubic metres of carbonate (limestone) waste. Nine samples (three each from the carbonate, shale and sandstone) were sent for laboratory testing. The samples were taken from four boreholes. Two of three shale samples sent for testing were found to have small concentrations (0.6 per cent and 1.3 per cent) of pyrite, which was not found in the carbonate or sandstone samples. The mining industry standard for sampling calls for three samples to be tested for a project generating up to 10,000 tonnes of waste rock. The proponent estimates that the project will generate a total of approximately 3,600 tonnes of shale and limestone waste rock combined, in contrast to traditional mine sites where there may be millions of tonnes of waste rock in tailings piles.

The shale layer was a particular focus of studies into the potential for ARD and ML. Black shale present at the former sand quarry site on Black Island, near Hecla Island, has high levels of pyrite and a high potential for metal leaching, with elevated levels of cobalt, lead, silver and arsenic. The Winnipeg Shale found within the project area was not found to contain elevated metal concentrations. In shake-flask tests, in which samples were shaken under oxidizing conditions for 24 hours, it was found that selenium could be released from the shale at levels exceeding drinking water guidelines. Based on these results, the proponent intends to carry out a Waste Characterization and Management Plan, in which rock waste will be tested and managed to avoid run-off.

In response to concerns about acid rock drainage, the proponent noted that the water had a neutral pH – that is, it is not acidic. The limestone that is likely to enter the cavities from above contains calcite ($CaCO_3$), which reacts to acid by forming bicarbonate, which is alkaline. The limestone would thereby buffer any reaction and prevent an increase in the acidity of the water. In response to concerns about the effect of oxygen in the cavities leading to reactions that would leach metals from the rock, the proponent said such reactions would be unlikely given that the sandstone is fully saturated. Acid rock drainage and metal leaching requires unlimited amounts of oxygen and plentiful sulphides, the proponent said. Even with some increase in dissolved oxygen, there would be limited oxygen in the saturated cavities.

The proponent also examined the water-quality effects of mixing water from the two aquifers. Because the water in the sandstone aquifer has lower iron concentrations, if the mixing of waters causes the water from the sandstone to enter the carbonate aquifer, it could result in lower concentrations of iron in groundwater taken from the carbonate aquifer. If water from the carbonate aquifer enters the sandstone aquifer, a slight increase in iron in the sandstone aquifer could occur. Concentrations of other substances stipulated in drinking water guidelines, including chloride, calcium, magnesium, arsenic and uranium, would decrease with higher concentrations of water from the sandstone aquifer entering the carbonate aquifer. (Most drinking water wells in the area draw water from the carbonate aquifer.) Water in the sandstone aquifer has higher levels of manganese, so if concentrations of sandstone water exceed 70 per cent, the level of manganese may exceed drinking water guidelines for aesthetics.

Mixing of waters between the two aquifers would depend on changes in gradient between the two aquifers. At present, the proponent said, both aquifers have mostly horizontal gradients. The connection created by eliminating the shale aquitard at each cavity would cause some exchange of water, as a result of localized changes in pressure in the aquifers. The proponent's experts said a new equilibrium would be reached in a matter of days or weeks, which would return the gradients in both the carbonate and sandstone aquifers to a primarily horizontal direction. In other words, it was predicted that there would neither be a large-scale or long-lasting flow of carbonate water down into the sandstone nor a large-scale or long-lasting upwelling of sandstone water into the carbonate.

The proponent argued that because both aquifers are fresh, keeping them separate is not critical. Both aquifers are fed by the same recharge area in the Sandilands approximately 10 kilometres to the east and have similar properties in the project area. Past issues regarding saline water entering the carbonate aquifer from the sandstone have occurred farther west, near the Red River, where upward gradients have pushed the saline water up through boreholes that have connected the two aquifers. More than 1,000 wells near the project area connect the two aquifers, the proponent argued, and they have not resulted in water-quality impacts.

Wells will have a PVC casing to keep them separate from the surrounding rock and will have a grout seal to keep the carbonate and sandstone aquifers isolated. However, the collapse of the shale layer, as revealed through the proponent's sonar, will result in connections between the aquifers. Manitoba Well Standards Regulation 215/2015 prohibits constructing or sealing a well in a manner that allows interconnection or mixing of groundwater between the Winnipeg Formation (sandstone) and any overlying aquifer. While the project will result in new connections between the carbonate and sandstone aquifers, the proponent's assessment indicates that water in the two aquifers has very similar properties. The proponent notes that the aquifers are already connected by many existing wells, including 215 wells in the RM of Springfield.

What We Heard: Water Quality

The commission contracted with a hydrogeological consulting firm, to examine the proponent's assessment of groundwater issues. The groundwater engineering experts raised a number of issues regarding the EAP and the models used to predict the effects of the project. The experts raised a number of questions regarding the proponent's hydrogeological investigations. These included:

- Testing was inadequate given the size of the basin, approximately 3,200 square kilometres. One aquifer test was carried out, covering an area of about three square kilometres.
- The model for groundwater assumed homogeneity of the aquifers, whereas experience and literature reviews indicate that they are not homogeneous.
- The proponent's hydrogeological assessment assumed that the shale layer acts as effective barrier (aquitard) between the carbonate and sandstone aquifers. Pump-test data indicate that the shale is a leaky barrier, as drawing down water in the sandstone aquifer leads to drawdown of the carbonate aquifer.
- The proponent's assessment did not consider the hydraulic effects of removing the sand and creating large cavities that will fill up with water. How this will affect storativity (referring to the volume of water that can be released from an aquifer) and conductivity (referring to rate of flow in an aquifer) was not assessed.
- Questions remain regarding the calibration of the model. In places in the basin, the water level underground is several metres different from what is predicted by the model. The industry standard approach for creating a groundwater map is to create it for a specific short period, whereas the proponent's model was made using new data as well as historical data from decades ago.
- The EAP did not consider the possibility that poorer-quality water could be drawn into areas that currently have good-quality water. Brackish (saline) water exists in the Winnipeg Sandstone formation near the Red River.
- The groundwater model does not consider potential pathways opening up through the limestone aquifer as a result of the project.
- The groundwater model systematically overestimated groundwater heads (a term referring to underground water pressure) for elevations below 275 metres above sea level.
- Assumptions regarding the ability to keep the aquifers separate, through measures such as a grout seal to separate the limestone and shale layers, are called into question by the expectation that the shale layer will fail and fall into the extraction cavities. Because the hydraulic head is greater in the sandstone aquifer, in time there will be upward mixing as water is pushed up through the openings created by removal of the shale layer.
- In testing of rock samples for acid rock drainage potential, the proponent did not take duplicates of any of the samples in order to reduce uncertainty.
- The proponent's assumption that the project will generate only 3,600 cubic metres of waste rock per year may turn out to be low, in which case more samples may be needed.
- The EAP did not adequately consider the dissolved oxygen that will be introduced

into the water as it is brought to the surface using the airlift method. Though not all this dissolved oxygen will remain in the Winnipeg Formation sandstone, it has the potential to change the redox state in the aquifer. (Redox refers to chemical processes – such as rust – that cause the transfer of electrons from one substance to another.)

An expert witness presented by the MBEN/OLS found the proponent's assessment of short-term water quality effects to be appropriate. The addition of oxygen through the airlift method would have a minor effect locally (with some precipitation of iron and manganese) near the extraction wells. The expert added that his review of the potential direct effects on water quality did not include an examination of the potential results of the Winnipeg Shale entering the water-filled voids.

The MBEN/OLS expert spoke at greater length about the potential for long-term indirect effects of the project, given that it would drill and cap approximately 1,200 wells in four years, and up to 10,000 should it continue for the 24-year lifespan. The expert predicted that the proponent's plans are unlikely to contaminate the aquifers if all mitigation measures are implemented, but the risk increases with the number of wells. Every well drilled through an aquifer creates potential pathways for contamination, which could result from damage to the well plug, well casing, cement fill between the casing and the rock formation and weakness between the rock formation and the cement fill. As the expert put it, it is unlikely that the drilling and abandonment of thousands of wells will be 100 per cent compliant with the proposed well design and abandonment plan, due to unforeseen technical issues (such as unexpected quality issues for the cement or casing). The expert also noted that the project area is up-gradient (upstream) from most of the well users in the region. The groundwater in the project area is currently at low risk of being contaminated, being located in a lightly developed area with aquifers at low vulnerability. Creating many new potential pathways raises the groundwater risk. Given that nearly half of the project site is currently used for agriculture, there is the risk that, at some point in the future, manure will be spread on parts of the site, creating a possibility of contamination if well seals degrade over time.

The expert also discussed the nature of uncertainty in assessing future environmental effects. Practices considered appropriate at one time may turn out to create new problems. As an example, the expert cited Ontario's problem of "legacy wells" – old, shallow wells left over from oil-well drilling in the 19th century. When these wells were abandoned, the iron used as casing was valuable and so the companies removed the iron and filled the holes with rocks. Decades later, it was discovered that the rocks were not a good seal and so, starting in the 1950s, cement was poured down the holes. But it turned out that the cement degraded over time and the seals are again a problem.

The MBEN/OLS expert also discussed the increased connection between the carbonate and sandstone aquifers that would be created by the project. While it is true that there are hundreds of existing wells that connect the two aquifers, each of those, assuming a standard diameter of six inches (15.24 cm), connects the aquifers over an area of roughly 0.02 square metres. The collapse of the shale layer as indicated by the proponent's sonar of one test cavity created a connection between the aquifers of some 491 square metres (based on a 25-metre diameter). Creating hundreds of such interconnections essentially removes the ability to manage the carbonate and sandstone aquifers separately downstream of the region of interconnection. The MBEN/OLS also noted that Manitoba law enshrines the importance of keeping aquifers separate. The organization's representative cited Manitoba Well Standards Regulation 215/2015: "…a person must not construct or seal a well or test hole in a manner that allows the interconnection or mixing of groundwater between the Winnipeg Formation and any overlying aquifer." The representative also cited Manitoba Drilling Regulation 63/92 under The Mines and Minerals Act: "A licensee shall drill and abandon a borehole in such a manner as to prevent the vertical movement of fluids between permeable water-bearing zones penetrated by the borehole."

The MBEN/OLS expert spoke on the loss of portions of the shale aquitard. Reducing the ability of the shale aquitard to keep the carbonate and sandstone aquifers isolated calls into question the effect of regulations intended to preserve the ability of government to manage the two aquifers separately. Currently, the proponent's studies show isotopic differences between the water in the two aquifers, resulting from differences in the way the aquifers are recharged. With the shale aquitard punctured at the many extraction sites, the water will be mixed. Without the aquitard, both aquifers are more vulnerable to contamination, because contamination in one may lead to contamination in the other, depending on the direction of groundwater flow. A representative of the group argued that there is no evidence to support that any specific amount of shale collapse is acceptable.

Hearing participant Dennis LeNeveu raised questions about impacts on water quality resulting from the proposed airlift approach to mining the sand. He expressed concerns that the oxygen could be introduced into the water in the aquifer and that this could result in leaching of metals found in the rock, including selenium. He also asked about the potential for microbes in the air to be introduced into the aquifer. Noting the fossil-fuel powered drills and air compressors used in the process, he raised the question of the effect of substances found in exhaust from fossil fuels being introduced into the aquifer. (In response, the proponent stated that airlift drilling is common in water well drilling and has not resulted in wells contaminated by substances in exhaust.) Mr. LeNeveu, as well as the authors of several written submissions from the public, expressed concern about the potential for contamination resulting from a chemical that may be used in the Sio Silica processing plant. A polymer called polyacrylamide is expected to be used in the plant to clarify the water removed from the sand in during processing. Polyacrylamide decays to a substance called acrylamide, which is hazardous to health. If the polyacrylamide enters the slurry loop that will travel back and forth from the extraction site to the plant, leaks from the slurry loop could result in spills of water containing acrylamide. Mr. LeNeveu also raised the concern that introducing oxygen into the aquifer could support the growth of iron bacteria. These bacteria, found in the soil, live off the energy produced in the oxidation of iron and can plug up wells and plumbing and make water unsuitable for drinking. One written submission recommended that to reduce the risk of iron bacteria all drilling equipment must be kept from contact with the ground when not in use.

Public presenters during sessions in Steinbach, Anola and Beausejour spoke on the importance of clean water for human health and the irreversible nature of the interconnection that would be created between the two aquifers. The rapid growth of southeastern Manitoba was underlined by several presenters, who spoke of the growing population of domestic, commercial, industrial and agricultural groundwater users in the region. Several public submissions referred to a 1981 report that described the Vivian area as containing areas of high groundwater vulnerability, based on permeable surface deposits and uncertainty around conductivity between these deposits near the surface and the carbonate aquifer.

The Manitoba Government's 2022 Water Management Strategy was referenced by several members of the public both in written and in-person submissions. They noted that the strategy's vision is to support "healthy waters that support resilient, thriving ecosystems, communities and economies for generations of Manitobans." One of the major focus areas of the strategy is "Protect the quality and quantity of groundwater."

A number of public presenters and writers of written submissions expressed concerns about leaching of metals, whether as a result of oxidation of waste rock at the surface or the addition of oxygen to the aquifer in the extraction process. Several submissions expressed a general concern with the environmental record of the mining industry and opposed the idea of mining a product within an aquifer used for domestic water.

Several presenters cited examples of water contamination from other jurisdictions, including the Walkerton, Ontario, water crisis of 2000. In that incident, E. coli from manure contaminated a municipal water-supply well, leading to seven deaths and many cases of illness. The operators of the water treatment and supply system in that case were ultimately charged with criminal offences in relation to their operation of the system and pleaded guilty to the charge of "common nuisance."

Concerns about possible effects on surface water, resulting from spills from the slurry loop or equipment, were expressed in several submissions.

Commission Comment: Water Quality

The apparent conflict between this proposed project and Manitoba's well standards regulations, raised by participants, must be resolved by government before this project can go forward. The proponent has argued that the rule against allowing water from the sandstone and carbonate aquifers to mix does not apply in this case, because in this area both aquifers contain fresh water, of similar quality. If that is the case, a ruling by the government is required to make that clear, especially as it relates to the regulation regarding interconnection or mixing of groundwater specifically from the Winnipeg Formation.

Water quality was the most passionately discussed topic during the hearings and understandably so, as these aquifers are the only source of drinking water for many of the presenters. The panel heard many presentations that included phrases like "water is life." Indeed, given the way Canadians proudly identify their country as the most freshwater-rich in the world, it is not surprising that there would be concern about a project that proposes to drill approximately 1,200 wells and extract millions of tonnes of material from within an aquifer.

While some of the risks identified by presenters and participants at the hearing may have low probability of occurrence, there are uncertainties regarding the project's effect on water quality. The source of much of the uncertainty arises from the experimental nature of the project. No evidence has been found that airlift well technology has been used on such a scale to mine material from underground. We cannot point to the prior results of similar sand-mining projects elsewhere, either to allay fears or to learn from mistakes. Key questions that were raised in the hearings were:

- Will creating hundreds of cavities in the sandstone aquifer, which propagate upwards into the shale and fractured limestone until competent limestone is reached, change the properties of the aquifer?

- In the event the region experiences a serious, prolonged drought during this project, will the predictions of quick recovery of neighbouring wells still hold true?

- What will be the effects of shale collapsing into potentially hundreds of extraction cavities?

- What will be the effects of dissolved oxygen reinjected into the aquifer?

- Given that the project involves approximately 1,200 wells, how confident can we be that that no harmful micro-organisms will be injected into the aquifer along with the air?

- Will the filters being used to remove suspended solids from the water (a step necessary for UV treatment) become clogged or degrade in performance and affect the ability to treat water?

- Will the UV treatment be successful?

- In the long term, how confident can we be that sealed wells will not fail and open pathways for contamination?

- In the event that the limestone layer above one or more cavities fails, will this enhance pathways for contamination of the aquifer as a result of ponding due to surface subsidence?

The expert who brought up Ontario's "legacy wells" problem raises a central question about evaluating environmental effects. When we consider questions like this, we can identify "known unknowns" – that is, questions we can pose, questions we know we want answered. With known unknowns, we can identify facts that we need to gather and topics in need of field or laboratory testing. A more vexing issue is raised by "unknown unknowns." These are things we don't know, and we don't know even that we lack this knowledge. The people who tried to solve Ontario's legacy wells in the 1950s knew they had a problem of leaking wells. What they didn't know was how the concrete they poured in those wells would react over time. Their unknown unknown became a problem for people in southwestern Ontario today.

The other Ontario well issue that came up during the hearings points to another issue of managing risks and unknowns. Many aspects of the Walkerton water disaster are different from the matter we are examining. In Walkerton, a municipal water well was very shallow (less than seven metres below grade) and less than 100 metres from a cattle operation. And in Walkerton, serious human error was involved in failing to test the contaminated aquifer. But with 1,200 wells creating potential future pathways for contamination, the unknowns include what future uses this land will be put to and who will be responsible in the future to inspect these well sites and test well water. We don't know if decades later this land will be farmed more intensively, creating sources for contamination. We know that human error and uncertainty are encountered in all areas of endeavour. The challenge for this panel has been assessing the probability of errors and the probability of errors with serious consequences. While the Walkerton water disaster resulted from a very different scenario than this project, one of the conclusions of the Honourable Justice O'Connor in the Report of the Walkerton Inquiry is relevant here. Commissioner O'Connor concluded that a cornerstone of an effective system of protection for drinking water was to ensure a multi-barrier approach. Protection of drinking water sources was suggested to best be done on a watershed basis as a component of a comprehensive approach to all water sources. (The Honourable Dennis R. O'Connor, Report of the Walkerton Inquiry: The Events of May 2000 and Related Issues. http://www.archives.gov.on.ca/en/e_records/walkerton/index.html)

The proponent should be required to undertake a risk assessment to identify the level of risk and how it will be addressed in the long term. Such an assessment should consider the probability of significant negative outcomes, including worst-case scenarios. As an example, an expert retained by the commission noted that a proponent planning to build an earth-filled dam – a well-established technology – will assess the probability of and response to a dam failure, even though this may be extremely unlikely.

If the Government of Manitoba is to fulfill its obligations under the Manitoba's Water Management Strategy, we must ensure that future generations are not affected by decisions made today. For this project to proceed without burdening future generations with a potential threat to their water, we must ensure that sufficient testing appropriate to the potential consequences of engineering failures has been carried out. We need to know that systems for injecting air and treating and reinjecting water can operate reliably on a large scale without harmful effects on water chemistry or introducing contaminants. We need to know that shale collapse will not have a harmful effect or significantly change the water chemistry. We need a greater level of confidence about the geotechnical stability of the caprock. If this project is to proceed safely and with confidence that there will be no significant adverse effect, it must be treated as a prototype, operating in a limited capacity as something less than a fully licensed development and something more than a program of test wells.

The proponent's plan for mining silica sand has some attractive features. If the sand extraction can be done safely according to engineering plans and where the geological and hydrological consequences do not introduce unacceptable long term risks, the project would appear to be less damaging than open-pit alternatives. It is difficult to find the right balance between economic growth, environmental care and social well-being, and this is made more difficult by the challenges of outcomes far in the future. More knowledge is essential to inform government in finding that balance.

Accordingly, the commission recommends that additional sampling and study is required to provide further confidence regarding the effects of the shale collapse on water quality, provide a more robust assessment of pathways for contamination, provide further confidence regarding the effects of oxygen infusion, and assess whether adjustments to modelling will be required. Before it begins operation, the proponent must develop a groundwater monitoring plan that describes the number and placement of monitoring wells, which parameters of the water will be tested, and how these tests will be conducted, and what actions will be taken should problems be detected. The plan for well abandonment should address procedures for sealing wells to prevent contamination of the aquifers by surface water and should indicate what actions will be taken if contamination does occur.

A recommended plan to address these and other concerns will be presented in Chapter Twelve: Conclusions and Recommendations.

7.4 Air Quality

Potential sources of impact on air quality are dust and emissions from drilling rigs and mobile equipment. The proponent plans to use an excavator, two drilling rigs, two water trucks and two grouting systems during construction and site set-up. More equipment is planned for the operational stage, including 10 diesel extraction rigs, 16 slurry pumps, 20 water pumps, eight light plants, two diesel generators, eight cyclones, two excavators and various trucks. All will generate nitrogen dioxide, carbon monoxide and sulfur dioxide as a result of emissions. They would not all be operating simultaneously.

In addition to fuel emissions, dust has the potential to impact air quality. Dust could be generated by the movement of the vehicles on the site. Dry silica sand could impact air quality if left exposed, but the proponent states that dry silica sand will not be left exposed at the project site. Sand will be wet and within the slurry pipe en route to the processing facility. Large pieces removed from the sand, known as overs, are planned to be stored in containment before being used later in well sealing or being removed from the site. As this hearing focused only on the proponent's application for an Environment Act licence for the extraction project, storage of sand at the processing facility, which has already received an Environment Act licence, was not discussed.

Steps to be taken to reduce impacts on air quality include minimizing the idling of vehicles, applying water to gravel roads as necessary to control dust, and ensuring proper maintenance of equipment. Based on these measures, the proponent assesses the impact on air quality as minor to negligible.

What We Heard: Air Quality

Several public presenters and writers of written submissions expressed concern about the presence of silica sand at the site. Silica sand is known to be a cause of silicosis, a type of lung disease caused by breathing in tiny pieces of silica. Workers in construction, countertop fabrication, foundries, ceramics manufacturing and mining and fracking can be at higher risk of silicosis. Several presenters reported that during the proponent's preparations for the project, walkers and children on bicycles accessed the property and came upon piles of unattended sand that had been extracted during the proponent's testing. The proponent, in its rebuttal, stated that access gates to the site had been vandalized and showed a photograph of a sand pile that had been covered with tarps. Regarding both air quality and the greenhouse gas impact of the project, some presenters asked if the proponent could use electrical power for more of its operations, such as the air compressors and water pumps.

Commission Comment: Air Quality

The commission notes that gravel pits are already active throughout eastern Manitoba. Dust-suppression practices exist to reduce the impact from these activities and from vehicle traffic on gravel roads. Given that silica sand will be stored at the processing facility, concerns about the effects of this material are not expected to arise on the extraction project site.

7.5 Greenhouse Gases and Climate

The proponent estimates that the project would generate approximately 6.8 million kilograms of CO_2 equivalent per year through the various kinds of equipment used. Extraction rigs would be the largest contributor to the greenhouse gas total, adding more than 2.4 million kg. Two different kinds of drilling rigs would contribute just under 1 million kg in total.

At 6.8 million kg per year, the project's greenhouse gas emissions would amount to just under 0.03 per cent of Manitoba's greenhouse gas emissions for 2019. Based on that, the project is deemed by the proponent to have a negligible impact on greenhouse gases and climate.

What We Heard: Greenhouse Gases and Climate

The commission heard from some public presenters who noted that one of the potential uses for the silica sand is the manufacture of solar panels, which are necessary to reduce the fossil fuel consumption of the power generation industry (in jurisdictions where electricity is generated primarily by fuel burning). These individuals were among the small number of presenters who spoke in favour of the project. The proponent has listed solar panels as one of the uses for high-purity silica sand. Prior to the hearings, Sio Silica announced discussions with a German firm that could lead to a solar panel manufacturing plant in Manitoba.

Several other public presenters characterized the proponent's advertising of its intentions to sell the sand for such technology as "greenwashing." Some of these presenters also raised the question of the sand being sold for use in fracking. It was suggested by at least one presenter that if the project were approved, the proponent should not be allowed to sell the sand for fracking. The proponent noted that manufacturers of solar panels, communication technology, and other such products pay a higher price for high-purity sand than fossil fuel companies pay for fracking sand. The proponent would therefore have an incentive to sell the products to customers other than the fossil fuel industry.

Commission Comment: Greenhouse Gases and Climate

The panel sees the opportunity to reduce greenhouse gas emissions through greater use of solar power as important. The panel accepts the proponent's undertaking at the hearings to make best efforts to reduce GHG emissions and would support efforts to electrify more of the project's operations. However, the panel does not have the authority to make such recommendations on a case-by-case basis. The panel does not have the authority to make any recommendation about the sale and use of silica sand.

7.6 Noise

Noise from the project has the potential to impact nearby residents and wildlife. If the project is approved, drilling, pumping and extraction will be carried out continuously, on a 24/7 basis, during the extraction season. The nearest residence to a planned well cluster area is 133 metres away.

To reduce the impact of noise, vegetation clearing will be minimized as much as possible, a 100-metre setback from residences will be maintained and idling of vehicles will be kept to a minimum. The proponent also plans to use noise-mitigation measures, such as portable noise barriers, as required.

Impacts of noise on wildlife are expected to be moderate in the vicinity of project areas, where disturbance of vegetation and human presence would also have a localized effect on wildlife. Overall, noise impacts are assessed by the proponent as minor to moderate.

What We Heard: Noise

Many presenters, including several members of a family living immediately across the road from the project site, expressed concern about the impact of project noise. The commission heard from many area residents who said that the relatively undisturbed quiet of the area is one of the things they value greatly about their homes. Presenters were especially concerned that project activities would occur on a 24/7 basis throughout the extraction season. The continuous operation of drilling and extraction rigs and the various pumps and compressors was noted by many presenters.

7.7 Surface Water

The proponent states that, because there are no permanent water bodies on the project site, if approved, the project will have a negligible impact on surface water. No surface water will be used and no water will be discharged on the surface. Potential effects on surface water are related to clearing vegetation, leveling and compacting soil and disturbing the ground at well cluster sites, pumping stations and access trails. Removing vegetation can potentially affect surface water if it leads to more sediment reaching water bodies, but given the absence of permanent water bodies or wetlands on the site, this is not expected to be the case.

To avoid effects on surface water quality, the proponent plans to construct drainage ditches along access trails and disturbed areas to maintain natural drainage patterns. Portable toilets will be installed to prevent potential contamination. An erosion and sediment control plan will be implemented for the project.

The proponent's Waste Characterization and Management Plan, which is being developed to prevent acid rock drainage and metal leaching, is intended to prevent leaching of metals from waste rock produced by the project, and thereby prevent run-off of such metal from reaching any waterbodies. The proponent intends to test these rock wastes and will store the shale rock waste – the material with the greatest potential for metal leaching – in ways that will keep it from being exposed to moisture.

What We Heard: Surface Water

Participant Dennis LeNeveu and several members of the public who made written submissions expressed concern about the potential for leaks from the slurry pipeline. As the project expands over time, the length of the slurry pipeline is expected to increase. It will contain a large amount of water that will be continually circulated to the processing facility and back to the extraction sites. Concern was expressed about the use of the polymer polyacrylamide in the processing facility, which is hazardous to health when it breaks down into acrylamide. One recommendation was for the water in the slurry pipeline to be tested regularly. The proponent's management plans call for daily inspection of the pipeline.

Commission Comment: Surface Water

The greatest potential for an impact that could reach surface water sources is likely the slurry pipeline, which the proponent has stated will be up to 3.5 km in length as extraction areas stretch a greater distance from the processing facility. The commission notes that the proponent has stated it plans to inspect the slurry pipeline daily.

7.8 Fish and Fish Habitat

Since there are no permanent water bodies on the project site and assuming application of the erosion and sediment control plan, no impact on fish and fish habitat is expected.

7.9 Vegetation

If the project is approved, clearing access trails and spaces for project components such as well clusters will involve removal of vegetation. Based on the revised extraction plan submitted in January 2023, 51 per cent of the 633-hectare project site consists of natural vegetation. Each well cluster will have a footprint of 0.2 to 0.28 hectares. Over the four-year lifespan of the project, the proponent plans at least 200 well clusters, so that may be approximately 20 to 30 hectares. Other cleared areas will include the slurry line, which will have a two-metre width, and the access trails, which will be four metres wide in most places, with eight-metre widths in some locations to allow large vehicles to turn. Some areas will need to be cleared for pumping stations along the slurry line, but these are relatively small (63 square metres).

To reduce the impact on vegetation, the proponent says it will minimize clearing to the extent feasible. The proponent committed to use access matting to help prevent disturbance. Disturbed areas will be allowed to revegetate naturally, augmented by a native seed mixture and native plantings where needed. A revegetation monitoring plan will be implemented to determine the success of revegetation and determine if follow-up seeding or planting is required. Dust-control measures implemented to address air quality will also help reduce the impact on vegetation. Because of the relatively small area to be cleared, the impact on vegetation is assessed by the proponent as minor within the project site and negligible within the local project area.

Commission Comment: Vegetation

Any project involving substantial amounts of vegetation clearing and moving heavy equipment has the potential to spread invasive species. It’s important to make sure that equipment moved to the site does not bring with it seeds from invasive species. Equipment should be cleaned before being brought to the site to prevent spread of invasive species. Replanting and reseeding need to be carried out successfully to keep invasive species from spreading on the site.

7.10 Wildlife

Vegetation clearing, noise and light are the potential pathways for impact on wildlife. The proponent assessed the impact of the project on wildlife in the context of the larger regional project area, on the grounds that wildlife populations (such as deer) are not measurably affected if only a small number of individuals within a small area are affected. Nearby alternative habitat exists for wildlife displaced by clearing or noise within the project site. As well, the proponent states that the project site currently is sub-optimal wildlife habitat as a result of existing disturbances and fragmentation (such as agricultural fields, roads and quarries). Noise generated by the project has the potential to influence wildlife behaviour by making some species avoid the project site, but the proponent states that it is unlikely to have an effect in the larger regional project area because noise will not be substantial beyond the project site and the adjacent local project area. Light pollution from the well clusters and work areas is expected to influence wildlife behaviour by making some species avoid the project site. An increase in traffic resulting from the expected 35-45 employees, plus delivery and service vehicles, also has the potential for a minor increase in wildlife collisions.

To reduce impacts on wildlife, vegetation clearing will take place outside of the spring and summer months, to the extent possible, in order to avoid disturbing breeding birds. Fully shielded directional lighting fixtures are planned in order to focus light specifically on work areas and minimize light pollution. Measures discussed earlier regarding minimizing the impacts on vegetation are also expected to reduce impacts on wildlife.

7.10.1 Species of Conservation Concern

The project site has some areas of habitat that could support species of conservation concern. The proponent's assessment stated that there was a moderate to high probability of barn swallows (rated as threatened) residing in the project site, as the originally planned project site contained buildings, which are the preferred nest location for barn swallows. It is uncertain if the modified project site as designated in the January 2023 revised extraction plan contains buildings. Little brown bats (rated as endangered) were considered to have a moderate to high probability of occurring at the site, either for maternity roosting in tree cavities or foraging, though there are no caves at the site that could serve as hibernacula.

Eastern whip-poor-will, golden-winged warbler and red-headed woodpecker (all rated as threatened) were considered to have a low to moderate probability of occurring in the project site, as they have some suitable habitat within the site. The eastern whip-poor-will is a ground-nesting species that prefers semi-open forests or patchy forests that are regenerating from disturbance, while the golden-winged warbler prefers mature forest where canopy gaps create a patchy shrub layer. The red-headed woodpecker is associated with a variety of habitats, including forest edges, treed agricultural areas and pastures and in Canada its range is mostly in southern Manitoba and southern Ontario. The project site is located within an area that has been federally designated as critical habitat for the golden-winged warbler and red-headed woodpecker.

Some species of conservation concern that have little suitable nesting habitat at the site, such as the common nighthawk, short-eared owl and Canada warbler, were considered to have 10 to 20 per cent probability of being observed at the site.

Effects on species of conservation concern could be caused by vegetation clearing at the site, which is currently 51 per cent forested, predominantly trembling aspen, and by noise and light disturbance causing them to avoid the area.

Commission Comment: Species of Conservation Concern

Information used to determine the surface and wildlife impacts was based solely on desktop studies. No on-the-ground surveys were conducted to verify the published information. The proponent should conduct pre-disturbance surveys to determine the presence and distribution of flora and fauna in the area and identify critical habitats. In recognizing these habitats, every effort should be made to avoid their disturbance and connections to neighbouring habitats.

Chapter Eight: Effects Assessment (Socio-economic)

8.1 Labour Force and Employment

The proponent estimates that 35 to 45 people will be employed in project activities such as site-clearing, well-drilling, extraction and assembly and relocation of project components such as the slurry line and water-treatment facilities. An additional estimate of 100 to 120 indirect jobs could be created to support the project's activities.

8.2 Infrastructure and Services

The proponent's EAP notes the potential for a minor increase in pressure on local emergency services (police, fire and ambulance) as a result of the potential for accidents on the site or as a result of travel to or from the site. Solid waste generated at the site will be transported by a licensed local contractor to a licensed local landfill. If there is more waste than a local landfill can handle, it will be transported to the Brady Road landfill in Winnipeg.

What We Heard: Infrastructure and Services

Some written and in-person presentations expressed concern that as the extraction area expands over time it will encroach upon the City of Winnipeg's aqueduct and Manitoba Hydro's Manitoba-Minnesota Transmission Line. A letter from the City of Winnipeg indicated that as of now the city has no concerns about the project, but would like to be consulted should the slurry line cross the aqueduct. Other presenters expressed the concern that if the project causes subsidence it could damage roads in the area. A representative of the Municipal Silica Sand Advisory Committee (MSSAC) expressed the concern that area roads could also be damaged by transportation of heavy equipment, including drilling rigs. The MSSAC representative also spoke of the potential for increasing pressure on emergency services in the community.

8.3 Land and Resource Use

Portions of the site being used by the project in any given year will not be available for other uses, though after work has moved on to another portion of the site, those areas may be available. Land within the project site is all privately owned and the proponent will negotiate access agreements with landowners.

What We Heard: Land and Resource Use

Several people who made written or in-person submissions expressed concern about the effects of the project on property values. Damage to wells, or fear of damage to wells, could lower property values near the site, as could the aesthetic impact of light, noise and vegetation clearing. Concerns were expressed about the impact of the project on insurance rates for landowners whose property is used by the project.

Several presenters stated that parts of the project site had been used recreationally for walking or cycling. Construction and operation of the project will eliminate this recreational use of the land.

8.4 Human Health

The proponent assessed human health effects resulting from increased traffic, dust and noise as negligible.

What We Heard: Human Health

During the public presentations at Anola and Beausejour, the panel heard several area residents express concern about the physical and mental health effects of dust, noise and traffic. Residents were concerned that the 24/7 nature of operations would destroy their sense of peace and quiet. Written presentations noted that the assessment of health effects did not consider the mental health effect of a major development generating noise, light and traffic. Residents also spoke of the noise and visual impact of the processing facility, which has already received an Environment Act licence and was not part of this review. Several presenters expressed concern about the presence of silica sand, noting that breathing tiny particles of silica can cause silicosis. While the proponent has said there will be no dry silica sand on site and has stated that sand extracted will be go directly into the slurry pipeline to be taken to the processing facility, presenters spoke of the fact that silica sand had been left on the site following test extractions.

Commission Comment: Human Health

If indeed all sand extracted is sent directly into the slurry pipeline, the risk posed by silica sand at the extraction site is expected to be minimal. However, as with many aspects of the project, that depends on everything going according to plan. If the project proceeds, extraction is likely to begin before the plant is operational. As a result, an interim plan is required to address the handling, storage and transportation of extracted materials in the short-term. Proper control of the site is required for environmental protection and health and safety of workers and residents.

It may be reasonable to expect that there may be some malfunctions or accidents that will result in sand being spilled or piled in the open. We heard little about planning for such malfunctions. Further details are required to ensure that mitigation measures are satisfactory to protect the environment and human health. Furthermore, the assurance that sand on the project site will be wet and contained does not refer to the processing facility, where the sand will be dried prior to being loaded in railcars. Since this related project was not discussed in the EAP or in the hearing process, there was no opportunity in this hearing to pursue questions about potential health impacts of the processing facility.

8.5 Indigenous and Treaty Rights

The proponent notes that the project site is entirely located on privately owned land, where access for uses such as hunting or foraging is only allowed with permission. A relatively small amount of wildlife habitat will be affected on the 633 hectares of the project site, which is currently 51 per cent forest land and 43 per cent agricultural land. As well, there are no permanent water bodies, so the project does not affect fish or fish habitat. Based on these points, the proponent says that the project has no effect on Indigenous and treaty rights.

8.6 Heritage Resources

The proponent committed to submit the modified project site boundaries to the Heritage Resources Branch for review. If areas of concern are identified, a qualified archaeologist will conduct a Heritage Resources Impact Assessment (HRIA). Given that nearly half of the project site is agricultural or developed land and that there are no permanent water bodies on the site, the site is not considered to have a high potential to contain heritage resources. Within the originally proposed project site, five areas of concern were identified by LiDAR, a kind of remote-sensing technology that employs lasers. These areas of concern were well-defined ridges, higher points or topographic anomalies. Such elevated features are considered to be potential travel pathways or resource extraction areas. An HRIA was carried out in these areas, consisting of an on-site visual inspection and shovel testing (excavating a pit 45 cm by 45 cm down to the subsoil at approximately 40 cm depth), and no archaeological artifacts were discovered. Twenty shovel tests were carried out.

8.7 Traffic

With 35 to 45 employees during construction and operation, the project is expected to cause a minor increase in traffic. In addition to regular commuting by employees, equipment deliveries and waste removal will cause periodic truck traffic. Workers accessing different well cluster locations will travel within the project site along PR 302 or along municipal road 42E. Depending on where employees live, commuting routes to the site will likely be on PTH 15, PTH 12 or PR 302. The proponent expects approximately 25 per cent of workers at the site will commute from each of Winnipeg and Steinbach. Others will come from smaller nearby communities such as Anola, Vivian, Beausejour, Ste Anne and Richer. Traffic is increasing in the area as the population of the Rural Municipality of Springfield and other RMs grows.

8.8 Aesthetics

The project is expected to have a minor adverse effect on aesthetics as a result of light, traffic and vegetation clearing. The proponent states that aesthetic impacts will be limited by minimizing clearing of vegetation to the extent possible and maintaining minimum setback distances around homes and communities. Unless otherwise indicated in a landowner agreement, statutory requirement or licence requirement, project components will have the following setbacks:

- 100 metres from a dwelling and the dwelling's drinking water well
- 100 metres from a hamlet
- 50 metres from a private property line
- 100 metres from any Manitoba Hydro utilities

The aesthetic impact of the processing facility was not discussed in the EAP, as it has been separately licensed.

What We Heard: Aesthetics

As with noise impacts, the aesthetic impact of the project was discussed by several presenters during the portions of the hearings set aside for public presentations in Steinbach, Anola and Beausejour. The possibility of light impacts, as a result of the 24/7 operation of the project, was raised by presenters. Removal of trees has the potential to increase aesthetic impacts by making project activities and equipment visible off site. The panel also heard references to aesthetic impacts of the sand-processing facility, including large storage buildings and sand stockpiles. The cumulative effect of growing development was brought up by many presenters and writers of submissions, who noted grain-handling and rail-siding developments, new housing developments and increased traffic as factors that were already having an aesthetic impact in the area.

8.9 Accidents and Malfunctions

A variety of materials expected to be at the project site have the potential for adverse environmental effects in the event of spills or malfunctions, including diesel fuel, lubricants, oils and hydraulic fluids. Such spills, depending on the type and quantity of substances, could affect air, surface water, groundwater and soils, resulting in effects on vegetation, aquatic resources and human health and safety. An accidental release of slurry or return water could occur as a result of a break or crack in the slurry or water return line.

Steps listed in the EAP to reduce the risk of spills and discharges include:

- using self-contained, above-ground storage tanks for diesel fuel
- using groundsheets and drip trays to catch all fluid during draining or pumping of oil or fuel and ensuring absorbent material is available, if needed
- safe handling and storage of waste oils, fuels and other hazardous materials in accordance with regulations
- notifying Manitoba Environment and Climate immediately if a reportable spill occurs
- inspecting storage sites regularly
- training of personnel on fuel- and chemical-handling and spills and stationing of spill kits for easy access by employees
- servicing and repair of equipment at the processing facility, where possible
- pre-shift inspections of vehicles and equipment and daily inspections of the slurry and water-return lines

The presence of fuel and other flammable material at the site creates the potential for fires and explosions, which could cause the release of environmentally harmful substances as well as causing harm to people and property. A number of fire-prevention steps are outlined in the EAP, including providing appropriate fire-prevention training and equipment; storing, transporting and disposing of flammable materials safely, in accordance with regulations; ensuring emergency communication equipment is available; and restricting smoking to designated areas.

Transportation accidents have the potential for environmental effects (in addition to effects on human health) if they result in spills of fuel, waste or other materials. The proponent notes that the use of a slurry pipeline to transport sand to the processing facility (where it will be loaded onto train cars) eliminates the need for truck transport of sand, reducing the risk of road accidents.

What We Heard: Accidents and Malfunctions

An expert witness for the Manitoba Eco Network and Our Line in the Sand (MBEN/OLS) spoke of the need to consider the probability of accidents and malfunctions on a large, multi-year project. Each of approximately 1,200 wells proposed in the four-year life of the project (as well as the thousands of additional wells planned for the full 24-year-life of the project) would create a potential pathway for contamination, in the event that hazardous materials are released onto the ground. A robust plan that anticipates worst-case scenarios is needed at the onset for such a project.

Commission Comment: Accidents and Malfunctions

The commission agrees that worst-case scenarios must be assessed to provide the greatest level of protection possible for the environment and human health. A risk assessment that considers probabilities and worst-case scenarios should be required. A larger view of the subject of "Accidents and Malfunctions" should address the possibility of and response to pipeline spills, failure of the water-treatment system, failure of well seals and other subjects. Further comments will be provided in the chapter related to the proponent's management and mitigation plans, along with recommendations for an overall plan provided in Chapter Twelve: Conclusions and Recommendations.

Chapter Nine: Closure and Decommissioning

The proponent stated in the EAP that it would develop a series of plans after receiving an Environment Act licence. Matters to be incorporated into the Closure Plan would include:

- sealing and decommissioning of extraction wells and well-cluster sites
- removal and disposal of infrastructure (such as slurry and water-return lines, pumping stations and generators);
- removal of sand overs/fines (some to be used in well decommissioning)
- removal of surface and well-drilling equipment
- removal of propane, fuel and oil tanks
- testing and, where necessary, remediation of contaminated soils
- re-grading and contouring of previously disturbed areas
- revegetation of disturbed areas to restore the landscape to native conditions to the extent feasible

Grasses and forbs (flowering plants other than grasses and sedges) would be expected to grow on the site within the first few years of closure. Trees and shrubs would be expected to be evident within five to 10 years.

Chapter Ten: Management and Mitigation Plans

10.1 Overview

Several plans affecting management of matters that could result in environmental impacts were discussed in the EAP and during the hearings. The EAP stated that the proponent planned to develop these plans during the construction, operation and decommissioning phases of the project. Key points that the plans would include were listed in the EAP, but the plans themselves were not present for detailed review. Drafts of three of these management plans – the Progressive Well Abandonment Plan, the Waste Characterization and Management Plan and the Groundwater Monitoring and Impact Mitigation Plan – were submitted in February 2023.

10.2 Waste Characterization and Management Plan

The focus of this plan will be the storage and disposal of waste from the mining process in a way that prevents environmental harm, such as metal leaching (ML) and acid rock drainage (ARD). The plan refers to waste from the mining process, such as drill cuttings and large objects (such as calcified sand concretions) extracted along with the sand. The plan will be developed under guidance from a geochemist and include rules for testing of waste for geochemical properties that could lead to metal leaching and acid rock drainage if exposed to air and water. Matters that the proponent expects to describe in detail in the plan include:

- a summary of the characteristics of each type of waste material to be extracted
- protocols for identifying, sampling, characterizing and managing waste
- definitions of appropriate end uses for each type of waste, in categories such as Potentially Acid Generating (PAG), Uncertain, Non-PAG, Metal Leaching (ML)
- descriptions of measures for mitigating ML/ARD and impacts on the environment
- descriptions of protocols for monitoring quality of surface water and groundwater to assess performance against the plan's objectives
- procedures for documenting and reporting information on matters such as soil quality, surface and groundwater quality, geochemical testing, volume of waste generated
- procedures for review and modification of the plan

A draft of this plan was submitted in February 2023. The draft describes the collection of samples of different kinds of waste rock, with greater amounts of sampling before extraction and in the early stages of operations. Before operations and in early stages, one sample will be taken for each 2,000 tonnes of Quaternary Sediments, one for each 700 tonnes of Red River Carbonate and one per 200 tonnes of Winnipeg Shale. During operations, planned sampling frequency is one per 5,000 tonnes for Quaternary Sediments, one per 2,000 tonnes of Red River Carbonate and one per 500 tonnes of Winnipeg Shale. Samples will be collected from well cuttings and from extraction-well clusters and bagged in amounts of two to three kilograms. Characterizing the samples according to potential for acid rock drainage and metal leaching is to be carried out under the supervision of a qualified professional. Any materials designated to have potential for acid generation or metal leaching, or designated as uncertain, are to be stored in a way that limits contact with water. If there is contact with water, the water is to be treated. Red River Carbonate and Winnipeg Shale are to be stored in covered bins or mobile tanks for hauling to a licensed landfill or waste disposal facility.

10.3 Water Management Plan

The proponent intends to develop a Water Management Plan that will describe use, monitoring and protection of water. The plan will provide a more detailed water balance, comparing how much water is extracted to the amount that is reinjected after treatment. Factors that influence how much water the project uses will be examined to establish the plan, including the ratio of solid to liquid in the slurry pipeline and the amount of water the pipelines require to operate. The plan will specify elements that require on-going monitoring, including pumping rates, groundwater use and reinjection rates. While this plan is primarily focused on monitoring of water quantity, the Groundwater Monitoring and Impact Mitigation Plan (discussed later in this chapter) includes measures for monitoring water quality.

Components of water monitoring under this plan will include:

- a groundwater and surface-water monitoring network of flow meters and water-level monitoring devices
- monitoring of water levels, pressures, stored quantity and flows during and after extraction operations
- assessment of the efficiency of groundwater return, based on volume of sand extracted
- inspections of water-management infrastructure, including that used in extraction, transport and storage
- monitoring of water to confirm the effective pumping rate from each extraction well and the resulting zone of influence on groundwater quantity around project operations
- mitigation measures to avoid or minimize impacts
- a framework for reporting

10.4 Progressive Well Abandonment Plan

The proponent intends to develop a plan for the abandonment of wells following extraction. Because the proponent plans to extract sand from each well for approximately five days, wells will be abandoned in stages while drilling and extraction is going on elsewhere. The Progressive Well Abandonment Plan will describe how wells are closed to ensure protection of groundwater, with closure of wells consistent with industry standards and the requirements of The Groundwater and Water Well Act and its regulations and with the borehole abandonment requirements of The Mines and Minerals Act. Procedures to be used in abandoning wells will include:

- placement of a mechanical plug within the well casing, between the sandstone and limestone aquifers, to isolate movement of water
- placement of a bentonite (a kind of clay) plug above the mechanical plug
- placement of several feet of cement plug above the bentonite plug
- placement of layers of bentonite and pea gravel or a bentonite grout to 1.5 metres (described as five feet) below the surface
- a 1.5-metre cement cap at the top, with topsoil/organics placed above to allow for vegetation to grow
- detailed logs of each abandoned well, with GPS coordinates and the depth of each layer recorded

A draft of this plan was submitted by the proponent in February 2023. It lays out in more detail the steps to be taken to seal abandoned wells, including test wells, monitoring wells and extraction wells, and the time frame for sealing wells. Extraction wells and boreholes are to be sealed within one year of installation after they are no longer required for operations. Operational monitoring wells, which are intended to be used to monitor performance of operations, are to be sealed within one year of the end of sand extraction from nearby well clusters or following completion of post-extraction monitoring. Long-term monitoring wells are to be sealed following completion of post-extraction groundwater monitoring, which the proponent estimates will be five years or more after the end of extraction.

10.5 Groundwater Monitoring and Impact Mitigation Plan

This plan will include a framework for surveying existing domestic water wells and monitoring quantity and quality of groundwater during and after operations, as well as responding to complaints from well owners. It will establish parameters to be monitored, locations to be monitored and frequency of reporting. It will also develop mitigation measures, which may include setback distances, modification of extraction operations, lowering of pumps in affected wells or providing alternate water supply.

Monitoring components of the plan will include:

- establishing regional and local groundwater-monitoring well networks to monitor wells completed in the Quaternary Sediments, Red River Carbonate and Winnipeg Sandstone layers
- evaluating proposed project activities in advance to determine potential effects on water wells
- a survey of water wells within the zone of influence, including location, construction, condition, performance and water quality
- monitoring of the zone of influence of extraction wells and any impacts on quantity or quality of water
- mitigation measures to avoid or reduce any impacts

- provisions for developing monitoring reports
- a procedure for addressing concerns and complaints of well owners

A draft of this plan was submitted in February 2023. The proponent intends to invite well owners within the zone of influence (1,500 metres for wells in the sandstone aquifer, 800 metres for those in the carbonate aquifer) of project operations to take part in a water-well survey prior to operations. Monitoring wells are to be established in the Quaternary Sediments, Red River Carbonate and Winnipeg Sandstone aquifers in each section where extraction is to occur. At least one monitoring well is to be installed between extraction wells and any private water-supply wells. The draft lays out the frequency of monitoring in the various wells and the data to be collected in the monitoring wells. The draft plan also lays out a summary of groundwater sampling to be carried out before, during and after operations. Samples are to be analysed daily by an accredited laboratory for the following parameters: pH, specific conductivity, alkalinity, hardness, acidity, total suspended solids, nutrients, dissolved organic carbon, major anions, dissolved metals and total metals. The document lays out thresholds for mitigation action regarding quantity and quality of water.

10.6 Erosion and Sediment Control Plan

The purpose of this plan is to prevent or control erosion and control water on the project site so that sediment is not introduced into streams, ditches and low-lying areas. The proponent intends to apply measures to all aspects of the project, including clearing and construction, development and operation of wells and placement of the slurry pipeline. Management practices in this plan will include:

- modifying work when weather increases the risk of erosion and sedimentation and phasing the work to limit the exposure of soil to erosion
- maintaining existing vegetation as much as possible
- installing, inspecting and maintaining silt fences and other erosion-control devices
- replacing topsoil and restoring it to the original condition and stabilizing soil as soon as possible after construction
- maintaining natural drainage patterns as much as possible
- placing excess material from excavation in a location where it won't be a source of siltation to any wetland areas
- suppressing dust

10.7 Environmental Emergency Response Plan

The proponent intends to develop a plan for identifying and responding to environmental accidents and emergencies arising from equipment failure, human error or natural causes. This plan will also identify preventative measures and mitigation measures in the event of such accidents. Roles and responsibilities of employees, training requirements, communications and investigations of emergencies will be described in the plan, which will address emergencies including spills, fires, extreme weather, erosion emergencies and wildlife emergencies.

10.8 Revegetation Monitoring Plan

This plan will be developed to determine the success of revegetation and whether reseeding or replanting is required. If reseeding is required, it will be with a native seed mixture. The proponent plans to discuss with Manitoba Environment and Climate strategies for ensuring that revegetated areas can benefit species such as the golden-winged warbler.

10.9 Heritage Resources Protection Plan

As mentioned in 8.6 (Heritage Resources), the proponent will develop a plan to guide actions to be taken if heritage resources are found on the site. This will include stopping work, contacting the Historic Resources Branch and having an archaeologist record the discovery.

10.10 Closure Plan

This plan will outline rehabilitation, mitigation and monitoring activities during the closure phase of the project. Closure cost estimates and financial assurances are required in a closure plan.

What We Heard: Management and Mitigation Plans

Concerns were expressed that the management and mitigation plans lack sufficient detail to confirm that the proponent's practices will be capable of identifying and mitigating potential environmental impacts. Specifically, the plans do not indicate how the proponent would mitigate large-scale hydraulic connections between the carbonate and sandstone aquifers should those connections have a negative impact on groundwater. While the proponent indicated it intends to develop more detailed plans following project approval, the independent expert retained by the commission considered that an approach more suited to a project for which interactions with the environment are already well understood, such as a conventional mine. Regarding the plans for well closure, the expert noted that the proponent intends to apply techniques that are used to close conventional groundwater wells. However, such techniques will not avoid or repair the large breaches in the shale aquitard that are expected. Given that preventing aquifer mixing is the goal of some of Manitoba's well regulations, a preliminary opinion on the adequacy of the proponent's closure plans may be a necessary step before any authorization to proceed.

Representatives of the MSSAC raised the question of on-going community involvement in the project if it is licensed to proceed. Speaking as a representative of the MSSAC (a participant group representing several municipalities in the region), the mayor of the RM of Taché recommended that any approval of the Vivian Sand Extraction Project be conditional. He compared it to the way the RM's council approves requests from residents to keep chickens. After being approved to keep chickens, residents are required to return to council later, at which point council ensures that they haven't caused problems for neighbours. Noting that he has heard from residents who are against and in favour of the project, he recommended creation of a long-term monitoring committee, with representatives from neighbouring municipalities. Such a committee would help to protect residents' interests.

Many presenters raised concerns about the capacity of the proponent to respond to a worst-case scenario, in which aquifers are contaminated and nearby communities lose access to safe water. In both in-person and written submissions, members of the public expressed doubt that, in such a situation, the proponent would be able to provide a large number of people with clean water for as long as the aquifer remained contaminated. Several submissions referred to problems in other jurisdictions (including Alberta's "orphan well" problem) in which governments were left to clean up after a mining or oil company had left an area contaminated and then gone out of business.

Commission Comment: Management and Mitigation Plans

Although outlines of the various management plans were provided in the EAP, few details regarding concrete actions were available until late in the hearing process. The proponent argued that these plans are generally not compiled until a licence issued. In most cases, that is the process. Because of the unique nature of this project, though, it was difficult to determine if the identified effects would be appropriately mitigated without the ability to review more complete plans. The draft plans that were issued provided greater clarity regarding the mitigation measures the proponent intends to take, but without more details on each plan, many information gaps still remain.

The panel considers that reviewing drafts of each of these plans is an important part of assessing the environmental and health effects of the project, especially long-term effects. These plans should also be readily available to the public.

The commission recommends that drafts of each of the management plans be provided to the regulator and the public prior to the project proceeding. On-going monitoring and management of this project will require community involvement. A mechanism for such involvement is described in Chapter Twelve: Conclusions and Recommendations, which will also address needs for additional studies.

A closure plan is not required under The Environment Act for an environmental licence, but is required under The Mines and Minerals Act. Access to a draft closure plan (not including financial figures) would help in understanding potential long-term effects, but such a plan was not available for the panel to review.

Chapter Eleven: Other Observations and Comments

Coming to an understanding of the proponent's proposals and the potential effects of the project on the environment was made more challenging for all parties as a result of certain process and other concerns.

11.1 Participant Assistance Program

One of the challenges was the lack of a Participant Assistance Program for these hearings. The Participant Assistance Regulation under The Environment Act allows for qualifying public organizations to access funds to help them make meaningful contributions in hearings of this nature. Typically, participants use these funds to engage legal counsel and experts with experience in the subject matter. There was no Participant Assistance Program funding made available for these hearings.

The commission retained experts to review the hydrogeological and geotechnical aspects of the EAP and to consider the EAP as a whole. The reports of the commission's experts were made available to the public in September 2022. However, hearing-process protocols limited the review to the evidence put before the commission, such as the work done by the proponent's consulting engineers and scientists. Participant groups, on the other hand, are able to bring other experts, studies and findings that may provide the hearings with different perspectives. Participant groups indicated that without participant assistance funding they were not able to canvass all the relevant issues and were restricted in the scope of their studies. Additional information of this sort might have been helpful to the commission panel.

11.2 Environmental Assessment Guidelines

For many years, through most of its reports, the commission has been encouraging the department to improve and clarify its environmental assessment guidance to proponents. Although a short guide is available for the preparation of an EAP, it is limited in topics and level of details and does not reflect current environmental assessment best practices. While all project proposals should be reviewed carefully, projects with a higher potential for negative impacts and significant consequences require more specific attention and rigorous review. The current project under review would have benefitted from greater involvement of the regulator early on. A review in tandem with Mines Branch could have addressed some of the geotechnical issues much earlier in the process. Guidance tailored to the project that indicated the required types and depth of information needed to make an informed assessment of the environmental and health effects would have filled many of the information gaps that were found. This could have allowed for a more complete and efficient process, with the possibility of speeding up the review process.

Consideration should be given to upgrading the guidance document and including cumulative effects as one of the topics that needs to be covered in an EAP. Prospective applicants should also be advised that the guidelines provided are a starting point and that additional information may be required during the review process.

Applicants also bear some responsibility in providing the appropriate information so that the regulator can make an informed assessment. The guidelines are just that – guidelines – and represent the minimum that is required. Going beyond the minimum will provide the regulator with greater confidence in the mitigation of project effects on the environment and human health.

11.3 Financial Security

Another issue raised in the hearings was the question of a financial security, like that required for traditional mining projects. This is something outside of the commission's terms of reference for this hearing, but it is a question that was raised by many people in the community, who wanted assurance that the proponent, if issued a licence for this project, would provide a security to ensure it would be able to restore and secure the site after closure.

In the commission's recent review of environmental liabilities related to mining operations, it was clear that future unanticipated events have not been appropriately addressed in the past. The commission suggests that consideration be given to requiring a substantial security or possibly two securities – one for the known risks associated with decommissioning and a second substantial security to address potential significant failures in the future. These securities could be captured either in the scope of approvals under The Mines and Minerals Act or under The Environment Act.

11.4 Defining Aquifer Parameters

During this review, the panel was made aware of a number of studies of groundwater in southeastern Manitoba, conducted at different times for different purposes. Variations in boundaries and in numbers assigned to aquifer recharge in these studies made it difficult to assess the proponent's conclusions about the project's potential impact on the sustainability of the aquifer. Given the growing population in southeastern Manitoba that is dependent on groundwater and the potential future effects of climate change, an up-to-date assessment by government of aquifer sustainability would be helpful for assessing effects of this and future projects. The government should set the benchmarks for recharge and water use to be used in modelling the impacts of developments on groundwater.

Chapter Twelve: Conclusions and Recommendations

The commission advises that significant conditions be required for the project to proceed. Our reasoning is that, despite the geotechnical, hydrogeological and environmental studies the proponent has carried out in preparing its Environment Act Proposal, the commission does not have sufficient confidence that the level of risk posed to an essential source of drinking water for the region has been adequately defined. This conclusion is based on the novel characteristics of this project, which uses a technology that has never been used for such a purpose; on limitations in the proponent's testing and modelling; and on the critical importance of maintaining the quality and security of aquifers that provide drinking water to thousands of residents in growing communities in southeastern Manitoba. If the project proceeds, moving in careful steps may provide important knowledge to prevent negative effects to the aquifers and other components of the environment. To some extent, the proponent is already planning for a stepped process, with a commitment to begin extraction using single-well or two-well clusters. The commission also advises that legal questions raised during the hearing must also be resolved before the project can proceed.

The commission considers that the mining approach proposed by Sio Silica does have merit if the risks posed to the quality of water in the affected aquifers can be better defined and the management of those risks can be adequately addressed.

The commission therefore recommends that:

1) The government seek a legal opinion with respect to sections 2(e) and 3(1) of the Well Standards Regulation under The Groundwater and Water Well Act and section 6(1) of the Drilling Regulation under The Mines and Minerals Act, regarding the interconnection between the Winnipeg Formation and any overlying aquifer, including aquifers within the Stonewall, Stony Mountain or Red River Formations.

2) If work on this project continues, it should be done on a step-wise basis to improve the level of confidence that no significant adverse effects will occur to impair the quality and quantity of water available from the affected aquifers. While the commission defers to the expertise of qualified professionals to design a detailed step-wise program, the following considerations should be taken into account:

i.) As a general principle, full-scale production should only proceed if and when the body of scientific and engineering evidence confirms that the risks are adequately understood and manageable.

ii.) The proponent must add to the body of evidence relating to the possible heterogeneity of the geological structures in the production area so that the risks of subsidence and propagation and impact of extraction voids over time are defined to a higher level of confidence. This must include inclined drilling in order to determine if vertical fractures exist in the limestone that could affect the stability of the layer.

iii.) The proponent must carry out full-scale well-cluster extraction tests in order to provide information on the potential effects of extracting the planned 21,000 tonnes of sand from a single cluster. This should be completed from several clusters in different parts of the project area.

iv.) During extraction tests, cavities must be monitored to determine their likely long-term shape and size and establish whether they are likely to continue to grow over time. A representative number of cavities reflecting the potential variability of geological conditions should be monitored to indicate that the cavities have remained stable over time.

3) The minister appoint a project monitoring committee with membership from municipal and provincial government departments to receive and assess relevant information as the proponent undertakes step-wise development. This should include member(s) of the affected municipal government(s), senior leadership from Environment and Climate, and technical experts from the government related to mining, groundwater and environmental licensing and enforcement. The committee should be provided with additional resources and technical expertise as required. The guiding principles for the monitoring process should include:

i) sharing of scientific and engineering findings between the proponent and the monitoring committee;

ii) regular, defined reporting requirements by the proponent to the monitoring committee, and;

iii) regular, defined reporting jointly by the monitoring committee and the proponent to the public.

4) The proponent be required to complete the following detailed plans and distribute them for comment. In so doing, it is recognized that these plans may continually evolve on the basis of additional information, as it is available.

i) Waste Characterization and Management Plan

ii) Water Management Plan

iii) Progressive Well Abandonment Plan

iv) Groundwater Monitoring and Impact Mitigation Plan

v) Erosion and Sediment Control Plan

vi) Environmental Emergency Response Plan

vii) Revegetation Monitoring Plan

viii) Heritage Resource Protection Plan

ix) Trigger Action Response Plan(s)

x) Closure Plan

5) The proponent demonstrate the full-scale performance of water-treatment processes for the re-injection of the water that has been separated from the extracted sand.

6) Extraction be planned and operated in a manner that is compliant with the engineering limits suggested by the proponent's experts, required by the Manitoba government and/or as amended based on more data-gathering.

7) The proponent be required to carry out a risk assessment that considers the probability of worst-case scenarios (collapse of the limestone layer leading to sinkholes, failure of well-sealing) and the consequences of these scenarios and what the response would be to remediate such damage.

8) A cumulative effects assessment for the full 24-year life of the project be carried out and its impact be considered in light of other existing and foreseeable projects in the area.

Appendix A:
Terms of Reference
Clean Environment Commission
Hearings on Vivian Sand Extraction Project

MINISTER OF
CONSERVATION AND CLIMATE

Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

NOV 1 5 2021

Serge Scrafield
Chair
Clean Environment Commission
305-155 Carlton Street
Winnipeg MB R3C 3H8
Serge.Scrafield@gov.mb.ca

Dear Serge Scrafield:

In accordance with section 6(5) of The Environment Act, I hereby request the Clean Environment Commission (CEC) to conduct a public hearing regarding the proposed CanWhite Sands Corp. silica sand extraction project.

I am requesting that the CEC review process begin as soon as possible, and I have provided a review mandate and Terms of Reference to guide your exercise as enclosed. Additionally, I am requesting a final report with recommendations, including on licensing conditions, in accordance with section 7(3) of The Environment Act. The CEC may ask for clarification on this request at any time.

Please contact Laura Pyles, Acting Director, Environmental Approvals Branch, regarding information obtained through the environmental assessment process should you wish to discuss this request further.

Warm regards,

Sarah Guillemard
Minister

Enclosure

c. Laura Pyles

Terms of Reference

Clean Environment Commission Review of

CanWhite Sands Corp. Silica Sand Extraction Project Environment Act Proposal

Background

On July 23, 2021, CanWhite Sands Corp. submitted an Environment Act Proposal for the sequential installation, operation and decommissioning of silica sand extraction wells to remove water and silica sand from groundwater at various locations on private land within the R.M. of Springfield.

The water from the silica sand slurry brought to the surface from the wells would be separated from the sand on site, undergo UV treatment and returned down the wells. The separated silica sand would be transported to a previously proposed sand processing facility using a slurry transport line operating in a loop system. The proposal includes a comprehensive hydrogeology and geochemistry assessment report and independent third-party review.

During the public comment period, requests for a Clean Environment Commission hearing were made by members of the public. The Rural Municipality of Springfield formally requested a Clean Environment Commission Hearing and provided a certified Resolution of Council in that regard.

Mandate of the Review

In accordance with section 6(5) (a) and (b) of The Environment Act, the CEC, at the request of the Minister of Conservation and Climate, shall conduct a technical review and a public hearing to consider the potential environmental effects of the proposed CanWhite Sands silica sand extraction project.

The CEC shall conduct the hearing in general accordance with its *Process Guidelines Respecting Public Hearings*.

The CEC will provide advice and recommendations to the Minister in the form of a report pursuant to section 7(3) of The Environment Act and in accordance with the following terms of reference.

Terms of Reference

1. The CEC will conduct a technical review of the Environment Act proposal and the hydrogeology and geochemistry assessment report and 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.

2. In providing advice and recommendations, the CEC will provide members of the public the opportunity for input regarding the CanWhite Sands silica sand extraction project proposal at a public hearing in a location consistent with the affected community.

The CEC review process should begin as soon as possible and be completed by March 15, 2022

Appendix B: Presenters

Arklie, C. Hugh	Private
Barkh, Mohsen	Recens Mine Water Consulting Services for Sio Silica Corp.
Bell, Tangi	Private
Belluk, Brent	Private
Benjamin, Marcel	Private
Boitson, Lorraine	Private
Boutin, Louis-Charles	Matrix Solutions Inc. for OLS/MBEN
Bullen, Brent	Sio Silica Corp.
Bundrock, Steve	Stantec for Sio Silica Corp.
Burland Ross, Siobhan	Manitoba Environment and Climate
Burnett, Madeline	Private
Clubb, Lindy	Private
Cole, Ted	Private
Deduke, Peter	Private
Dyck, Gary	Private
Eaglewoman, Medicine	The Bear Clan
Elemine, Cheibany Ould	AECOM for Sio Silica Corp.
Eshraghian, Arash	Stantec for Sio Silica Corp.
Fars, Emily	Private
Fuhl, Glen	Private

Galvin, Taylor	Private
Gawluk, Rusty	Private
Gerrard, Honourable Dr. Jon	Private
Gibson, Janine	Private
Gifford, Marlene	AECOM for Sio Silica Corp.
Hamill, Jocelyn	Private
Hollander, Hartmut	PorousTec for CEC
Harvey, Miln	AECOM for Sio Siica Corp.
Hughes, Nichola	Private
Klein-Sesser, Pauly	Private
Klos, Lily	Private
Langstaff, Pamela	Private
LeNeveu, Dennis	Environmental Consultant
Mackling, Al	Private
Maize, Anessa	Private
Maluzynsky, Julian	Private
Mann, Jason	KGS for MSSAC
McLauchlin, Douglas	AECOM for Sio Silica Corp.
Mendela, Irene	Private
Meuzelaar, Tom	Life Cycle Geo, LLC for Sio Silica Corp.
Mills, Ryan	AECOM for Sio Silica Corp.
Mustard, Georgina	Private
Mustard, Kiara	Private
Mustard, Ryder	Private
Mustard, Wesley	Private

Mustard-Leonard, Rochelle	Private
Neufeld, Erin	Private
Novak, Maximillian	Private
Nylen , Janet	Private
Panchoo, Katelyn	Private
Poirier, Armand	Mayor, Regional Municipality of Tache for MSSAC
Ralke, Valerie	Private
Redekop, Doug	Private
Romaniuk, Gloria	Private
Samoiloff, Clifton	AECOM for Sio Silica Corp.
Schreyer, Honourable Ed	Private
Skillen, John	Private
Smith, J. Bert	KGS for MSSAC
Somji, Feisal	Sio Silica Corp.
Speer, Darryl	Private
Sutherland, Mike	Peguis First Nation
Symbol, Richard	Private
Therrien, Patrick	Private
Tymko, Cathy	Private
Walls, Shandy	Private
Whyte, Carolyn	Private
Weeden, Laura	Sio Silica Corp.
Wiatzkia, Gerd	ARCADIS for CEC
Wiens, Matthew	Private
Ziemski, Sue	Private

Appendix C: Written Submissions Received

Adam, Jackie	Public
Albo, Kevin	Public
Allan, Garth	Public
Anania, Nicolas	Public
Anderson, Nan	Public
Ana, Darlene	Public
Appleby, Jim	Public
Araujo, Vanessa	Public
Arklie, C. Hugh	Public
Attas, Robin	Public
Bais, John	Public
Bauer, Leiah	Public
Bell, Acksanna	Public
Bell, Tangi	Our Line in the Sand
Bell, Tim	Public
Bennett, Brenda	Public
Berard, Kristin	Public
Billekop, Jody	Public

Blahitka, Travis	Public
Bohn, Lori	Public
Boonstra, Sandi	Public
Buelow, Wendy	Public
Brian, David	Public
Boiteau, Jared	Public
Borchasdtwa, Harold Rev.	Public
Broeska, Jonathan	Public
Broesky, Trevor	Public
Brolly, Janice	Public
Burbank, Pat	Public
Burau, Tatjana	Public
Burland, Elaine	Public
Byers, Craig and Jolene	Public
Cail, Virginia	Public
Campbell, Judith	Public
Carriere, Jerry	Public
Chan, Walter	Public
Cherry, Mark	Public
Cibula, Ralph	Public
Cook, Sandra	Public
Copp Catherine	Public
Copp, Joyce	Public
Cross, Abigail	Public
Culleton, James	Public

Darragh, Alden and Sally	Public
Decebal-Cruz, Alexander	Public
Degagne, Jeanette	Public
Deley, Chris	Public
Derksen, Risa	Public
Derraugh, Gillian	Public
Derraugh, Jayse	Public
Derraugh, Verne	Public
Dienstbier, Suzanne	Public
Dopheide, Kymberley	Public
Douglas, Lukas	Public
Doupe, Taomi	Public
Druzyk, Mavis	Public
Dube, Gerard	Public
Dudych, Darlene	Public
Dudych, Darlene and Julian	Public
Dugas, Jeanette	Public
Duma, Diane and Allen	Public
Duplak, Gail	Public
Eggett, Michael	Public
Erickson, Heather	Public
Eirikson, Alana-Dawn	Public
Eschenwecker, Ralph	Public
Evans, Nicole	Public
Everett, Grant	Public

Everett, Keena	Public
Fast, Tatianna	Public
Fefchak, John	Public
Fell, Lloyd	Public
Freynet, Carol	Public
Freynet, Chloe	Public
Freynet-Gagne, Kateri	Public
Friesen, Kaitlynn	Public
Fortin, Roland	Public
Funk, Steve	Public
Garrod, Helen	Public
Gavel, Aline	Public
Gavran, Claudia	Public
Gawrluk, Linda	Public
Gehrs, Paul	Public
Gerrard, Jon	Public
Gibson, Janine	Public
Giesbrecht, Edwin	Public
Ginter, Joel	Public
Graham, David	Public
Gretziner, Tannis	Public
Gruber, Brittany	Public
Guttormson, Garth	Public
Hajzler, Josef	Public
Hajzler, Mila	Public

Hajzler, Sita	Public
Hajzler, Teresa	Public
Hajzler, Tony	Public
Hanson, Marlene	Public
Hartle, Meagan	Public
Hartle, R	Public
Hartje, Ernst and Gail	Public
Harvey, Shirley	Public
Hayes, John	Public
Henderson, Derek	Public
Hiscott, Alex	Public
Hunter, Anna	Public
Ingram. Laine	Public
Innes, Janice	Public
Jackson, Linda	Public
Jaques, Susan	Public
Johnson, Brenda	Public
Johnson, Emily	Public
Jovel, Carlos A.	Public
Jovel, Dinorah	Public
Karman, L	Public
Kehler, Laura	Public
Kellett, Brent	Public
Ketola, Karra	Public
Kettner, Shawn	Public

Kister, Joe	Public
Klassen, Valerie	Public
Kociuk, Larry	Public
Kok, Bram	Public
Korortkov, Alex	Public
Kozakowaki, Shana	Public
Krasulja, Taylor	Public
Kroeker, Tim	Public
Krause, Doug	Public
Kulczycki, Brian	Public
Kulczyski, Carol	Public
Lalonde, Karen	Public
Langendo, Gail and Werner	Public
Langstaff, L	Public
Langstaff, Pamela	Public
Langstaff, Shawn	Public
Lapointe, Monique	Public
Laroque, Paul	Public
Latocki, Barbara	Public
Latocki, Nancy	Public
Lazarenko, Leah	Public
Lemoine, Eric	Public
Lenton, Sheila	Public
Lessard, Gilles	Public
Letain, Audry	Public

Lyons, Maureen	Public
MacDonald, Marilyn and Alan	Public
Maddaford, Colleen	Public
Maddaford, Thane	Public
Marchildon, Thierry	Public
Marcolete, Florence	Public
Marcoleta, Lianed	Public
Marcoleta, Lucien	Public
Marion-Akins, Margaret	Public
Mast, Meghan	Public
May, Sonya	Public
McClelland, Chelsea	Public
McCulloch, Tracey	Public
McGowan, Ian	Public
McGowan, Peter	Public
Mendelsohn, Phil	Public
Miller, Deanne	Public
Miller, Mark	Public
Miller, Susan	Public
Mueller, Sarah	Public
Mulock, Barbara	Public
Murray, Myrna	Public
Mustard. Hunter	Public
Mustard, Joshua	Public
Mustard, Lanigan	Public

Naayen, Druanne	Public
Nathaniel, Ernie	Public
Nathaniel, Kiara	Public
Nathaniel, Lynette	Public
Nelson, Jeff	Public
Newman, Cheryl	Public
Nylen, Janet	Public
Okoro, Samantha	Public
Orebanjo, May	Public
Papillon, Pierrette	Public
Payment, Jane	Public
Pinnell, Nancy	Public
Dr. Pip, Eva	Public
Plikett, Pierce	Public
Plischke, Jonathan	Public
Popoff, Amanda	Public
Pratt, Lois	Public
Pritchard, Angeline	Public
Ptak, Monica	Public
Putro, Donny	Public
Pytel, Monica	Public
Rempel, Eric	Public
Reyes, Jannica	Public
Richter, Andrea	Public
Roberts, Greg	Public

Rodrigues, Gabriele	Public
Romaniuk, Gloria	Public
Rosentreter, Hillary	Public
Roshka, Tamara	Public
Rosmus, Patricia	Public
S. Spen	Public
Salchert, Katharina	Public
Salinas, Evelio	Public
Scammell, Sean	Public
Schmidt, Jennifer	Public
Scott, Madi	Public
Sellen, Larry	Public
Sherlock, Carolyn	Public
Sherwood, Diane	Public
Shymko, Kelly and Deb	Public
Simmons, Barbara	Public
Simmons, Brad	Public
Singh, Koha	Public
Smith, Bert	Public
Smith, Jody	Public
Sontag, Ellen	Public
Sontag, Jerry	Public
Speer, Darryl	Public
Speers, Elizabeth	Public
Stanwick, Greg	Public

Stanwick, Roslyn	Public
Steinhilber, Christina and Herbert	Public
Sturbym Shaun	Public
Taras, Wayne	Public
Thornsteinson, Gerri	Public
Tibbetts, Jane	Public
Tinkler, Kara	Public
Tomiak, Sarah	Public
Wachniak, Doraine	Public
Walker, Ian	Public
Walls, Tom	Public
Wastle, Rick	Public
Wasylik, Judith	Public
Wasylishen, Penny	Public
Weiss, Alison	City of Winnipeg
Whyte, Carloyn	Public
Whyte, Derek	Public
Whyte, Kelly	Public
Wiebe, Jaclyn	Public
Wiens, Matthew	Public
Worden, Elizabeth	Public
Wood, Charles	Public
Young, Eric	Public
Zaharia, Jim	Public

Zalusky, Kim and Vince	Public
Ziemski, Sue	Public
Zurawasky, Andy	Public
Zurawasky, Tricia	Public

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