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# Written Submission from the Saskatchewan Environmental Society and the Nuclear Transparency Project

# Mémoire de la Saskatchewan Environmental Society et du Projet de transparence nucléaire

In the matter of

À l'égard de

**Denison Mines Corporation**

**Denison Mines Corporation**

Licence Application to Prepare Site and Construct for Denison Mines' Wheeler River Mine and Mill Project

Demande de permis pour la préparation de l'emplacement et la construction du projet de mine et d'usine de concentration d'uranium Wheeler River de Denison Mines

**Commission Public Hearing**

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# COMMENTS TO THE CANADIAN NUCLEAR SAFETY COMMISSION REGARDING WHEELER RIVER PROJECT PROPOSAL OF DENISON MINES CORP. AND THE REVIEW BY CNSC STAFF

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## 1. INTRODUCTION

The current evidentiary record for this matter is insufficient to support final determinations on the questions before Commissioners. As such it would be premature for the Canadian Nuclear Safety Commission (CNSC) Tribunal to render a decision on the Environmental Assessment or issue any licences at this time.

Important outstanding issues include the potential contamination of the region with toxic substances, the pathways through which contaminated water could move from the region containing uranium ore to the near surface underground water and to surface waters, and inadequate plans for management of toxic waste. Information gaps prevent evaluation of the best way to mine the Phoenix deposit and to judge the risk of failure to restore the environment. There remains a need to better examine the risks to the environment and human health from the proposed project and from alternative ways of mining.

In our review, concerns are identified relating to:

- lack of transparency in the environmental impact assessment process;
- information gaps that prevent evaluation of the best way to mine the Phoenix deposit and to judge the risk of failure to restore the environment;
- alternative mining solutions;
- methods proposed to enhance uranium recovery;
- the pathways through which contaminated water could move from the region containing uranium ore to the near surface underground water and to surface waters;
- inadequate plans for management of toxic waste;
- restoration of the quality of water in the aquifer near the earth's surface;
- the use of a new approach to sediment quality, and its validity compared to standard approaches;
- restricted public access to information;
- concerns about the models used to predict effects of the project;
- the criteria for acceptable levels of toxic substances following remediation;
- lack of a comprehensive evaluation of the cumulative impacts from climate change, mining, and other industrial developments in the region;
- lack of consideration of pollution effects thousands of years into the future;
- inadequate analysis of the effects on children, pregnant women, elderly, and other especially vulnerable people;
- the absence of analysis of the effectiveness of remediation of environmental damage from previous Denison projects; and
- need for a better plan for monitoring of the environment and human health, and for sharing of information and consultation with the public.

The 1993 report of the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan[1] stated:

***"Residents of the Athabasca region should be able to hunt, fish, harvest plants, drink the water, and use the land throughout the region without fear of being poisoned by past, present or future mining activity."***

[1] Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan. (1993). Uranium Mining Developments in Northern Saskatchewan: Dominique-Janine Extension, McClean Lake Project, and Midwest Joint Venture.

We recommend a more robust assessment of the Wheeler River proposal that clearly places it within the larger regional context of existing and proposed uranium mining and milling operations. This would be in the public interest and conform to the vision of the Panel in 1993.

For this intervention, the Wheeler River Project proposal documents have been reviewed by a multi-disciplinary team consisting of Dr. Carroll Chubb (PhD in Physiology and Biophysics and Postgraduate Diploma in Toxicology) who addressed human health risks and Mitchell Bauche (Engineer-in-training, Master of Sustainability – Energy Security) who addressed in-situ recovery mining technologies and groundwater, both representing the Saskatchewan Environmental Society. Nuclear Transparency Project founder Pippa Feinstein (JD, LLM) addressed procedural and access to information issues and ecotoxicologist and NTP contributor Dr. Shamaila Fraz (MSc, PhD) addressed environmental risks to non-human receptors. This enabled us to bring several different perspectives and areas of expertise to the task.

## 2. CONCERNS OVER HEARING PROCEDURE AND ACCESS TO INFORMATION

### 2.1 Hearing Procedure

It appears there are five distinct decisions required of the Commission Tribunal at this time: first, a determination on Denison's requests for confidential treatment for seven technical documents; second, a determination relating to the Environmental Assessment (EA) for the proposed Wheeler River project; third, a decision on whether to grant Denison a licence to prepare the site for the Wheeler River project; fourth a decision on whether to extend Denison's licence to include construction of the Wheeler River project; and fifth a decision relating to the sufficiency of consultation with Indigenous Nations and communities.

Each of these decisions must be made according to their own distinct legal tests, and must each be made in turn. Only once a confidentiality finding has been rendered can a final evidentiary record be provided to intervenors and decision-makers. Licenses cannot be considered before final determinations are made relating to the proposed project's environmental assessment. A considerable lack of procedural clarity has arisen in the absence of direction from the CNSC's Registry or Commissioners relating to the order or procedures for each of these distinct decisions.

For other CNSC-regulated projects, it is common for many of these distinct determinations to be made separately. For issues two to four above, separate hearings are most often convened, each with their own public intervention timeframes. However, in this case, all determinations have been lumped together in a single hearing for which the public has received approximately four months to prepare its interventions. Even this four-month timeframe is misleading however, as CNSC staff's Environmental Assessment, Denison's confidentiality application, and their licence to construct application have only been available for the last two months. Technical and regulatory materials such as the groundwater monitoring plan and proposed licence terms have been available for one month or less. This is an exceptionally tight timeframe for public reviews of such a broad and all-encompassing hearing.

The timeframe is rendered all the more unreasonable by several issues relating to the accessibility of the current evidentiary record as well as the process for requesting additional information of Denison. We will discuss each of these issues more in turn.

As of time of writing, there are 15,601 pages of evidence before Commissioners and intervenors for this current hearing, 9,539 pages of which can be found on the CNSC Registry's webpage for these proceedings. While several proposed monitoring plans and management programs are uploaded

separately, there are also several uploaded files containing multiple documents which are too large and unwieldy to effectively navigate. While CNSC staff reference packages include Tables of Contents with links to each document included in single PDF files, Denison's materials do not. The most shocking example of this is a 6,062-page PDF posted online by Denison which contains all its supporting documents for its EIS. Its size renders it effectively inaccessible to the public for several different reasons. First, it is impossible for many people with older or less powerful computers to download a file of this size at all. Second, this document has no table of contents and is filled with numerous one or two-page long letters as well as technical reports that span several hundred pages each. As such, there is no way to know what this enormous file contains without going through it page for page. Third, for those with computers powerful enough to download the document and perform keyword searches on it, the document's size alone renders it effectively unsearchable as each search can produce hundreds if not thousands of results over multiple documents. Denison's rationale for releasing their documentation this way is baffling, but CNSC staff's acceptance of this practice is at least as concerning. While information disclosure is important, ensuring its accessibility and usability is just as crucial for transparency.

### 2.2 Information Gaps

All this being said, despite the length of the evidentiary record in this matter, a considerable amount of crucial information about the proposed project is still not on the public record. The following list outlines the most serious information gaps in Denison's EIS and supporting materials:

1. The chemical names, properties, concentrations, and proportions for the various substances that would be used in Wheeler River's operations remain unknown. In particular:
    a. It remains unclear what Denison means by "environmentally friendly polymers" for use in its processes.[2] This is a subjective evaluation, not a true scientific description;
    b. It remains unclear what chemicals will be used in various steps of the ISR processes more broadly. Neither chemical names nor environmental properties are provided for the solid propellants and gas injection used for permeability enhancement,[3] nor the flocculants noted as part of the chemicals for use in the project;[4]
    c. Chemical names and material descriptions have not been provided for wastes (including laboratory wastes) expected to be deposited in the industrial landfill, whose size is vague (50,000-100,000m$^3$).[5] Some examples of wastes also raise more questions than they answer, in the case of radionuclide contaminated wellfield piping made of double-walled high-density polyethylene piping which has a half life that would be inconsistent with the proposed mine's lifespan;
    d. Neither constituent names nor quantities are provided for the precipitate expected in the industrial waste water treatment plant process precipitate ponds[6] (which will be immense with a total volume of 150,000m$^3$ and will be exposed to the elements and wildlife);

    Without this information it is impossible to understand or assess the project's potential environmental effects relating to contaminant pathways or waste management. This is a glaring gap and significant transparency concern.

2. The wellfield design (e.g., the pattern of wells on the surface, distance between wells, orientation of wells, and number of pumphouses) has not been finalized and no interim design

[2] pp. 2-7 and 2-14 of the EIS
[3] p. 2-22 of the EIS
[4] Table 2.2-4 on p. 2-71 of the EIS
[5] pp. 2-50 and 2-54 of the EIS
[6] p. 2-50 of the EIS

possibilities have been disclosed.[7] Without this information it is impossible to understand or assess the facility's physical footprint and potential effects of the wellfield on terrestrial species.

3. There is a general lack of detail to maps of the proposed Wheeler River project, the local study area, and regional study area that frustrate public understandings of what is being proposed for the site, as well as what will be monitored and assessed off-site.

4. It remains unclear what would happen in a situation in which effluent held in a pond may require further treatment in order to meet all the necessary criteria for its release. Without this information it is impossible to understand or assess potential effects to the environment of holding ponds.

5. Residual effects for valued components and key indicators are assigned a rating on a scale of low, moderate, and high. This is highly subjective as well as insufficiently detailed. Residual effects assessments are missing a breakdown of uncertainty predictions from various sources (this could include descriptive errors, data aggregation errors, professional judgment errors, measurement or sampling errors, and model uncertainty if models were used for estimation). The confidence in predictions of adverse effects should also be supported by Stressor-Response Analysis for each contaminant of potential concern, or COPC, (for example NOEC, LC50 or LC10, cumulative effects predictions), but is not in the EIS. For partial reversibility, it would be more logical to refer to specific acceptable threshold criteria (such as a reversal to 70-80 percent of documented baseline conditions). Without this quantitative information, it is impossible to understand or assess potential residual effects of the proposed project.

6. There are no timespans given for the storage of construction-related wastes in the Construction Waste Laydown Area, nor the storage of radiologically and other contaminated wastes in the Industrial Laydown Area, nor hazardous and uranium-containing wastes in the Hazardous Waste Storage Pad. The EIS merely states this will be "temporary." Without an estimated period of time, the potential environmental effects and sufficiency of mitigation measures are impossible to understand or assess.

7. There are no estimated total volumes for water (per annum) expected to be used for each phase of the proposed project. While water use volumes are provided for certain activities, such as well drilling and the mining solution, they are not for others such as permeability enhancement and the various miscellaneous uses associated with the project. Total water volumes would give a picture of the project's total and cumulative effects on water quantity, which is currently impossible to understand or assess.

8. There is no estimated total volume (per annum) provided for effluent expected to be emitted by the Industrial Wastewater Treatment Plant. This effluent will be deposited into Whitefish Lake and as such should also be accompanied by dilution factors including predicted low flow conditions. Finally, total estimated amounts for water expected to be recycled in this process should also be disclosed. It is impossible to understand or assess potential effects to Whitefish Lake and the local ecosystem without this information.

9. There is insufficient information to support Denison's assertion of a 446-year half-life for the single layer geomembrane proposed for its permanent landfill. The study they claim supports their conclusions was only conducted in a laboratory, with an assumed constant temperature of 20°C (which will be impossible at the proposed Wheeler River site) and did not consider the

[7] p. 2-14 of the EIS

inclusion of any radionuclides.[8] The appropriateness of Denison's landfill design is impossible to understand or assess without more information.

10. There is virtually no information available discussing the exact designs for process ponds, waste storage, or effluent discharge lines. They may have single or double liner systems with or without leachate collection and leak detection liners. Further, there are no specific assessments of the appropriateness of their designs. Information should be provided to facilitate the understanding and assessment of their designs that examines temporary and long-term use and includes reference to the specific chemicals and other materials that will be held. Information relating to leak detection and resistance to leaching should also be provided.

11. It remains unclear whether there will be mitigative measures to limit or stop the emission of fugitive dust from the proposed project. Without this information it is impossible to fully understand or assess emissions to air.

12. It remains unclear why songbirds, migratory birds, and bird species at risk were excluded from consideration as ecological receptors which are sensitive to noise disturbance. Without any rationale for their exclusion, this constitutes a significant information gap in the EIS.

13. The same is true but even broader for bats, insects, amphibians, or reptiles which do not appear to have been studied or surveyed in the area and are entirely missing from Denison's assessment at all. No rationale is provided and this gap prevents our ability to understand or assess the project's potential impact on the local ecosystem.

14. The comparative analysis of ISR methods against alternative mining techniques (such as open pit, jet boring, surface boring, micro tunnel boring); and associated ore processing is not sufficient.[9] At a minimum, the following information should be provided:
    a. Quantitative comparisons of land use (in hectares) between mining techniques. This should also include land uses at each project phase;
    b. Quantitative comparisons of excavation volumes (in tons or cubic meters) for each mining technique as well as the expected COPCs that could be released by each method into groundwater. This is especially important because it appears that only ISR requires efforts to mitigate effects on groundwater quality (with other mining techniques involving little to no interaction with groundwater quality);[10]
    c. Quantitative estimates of total groundwater and surface water consumption (in cubic meters), as well as recycling volumes, should be provided and compared for each mining technique;
    d. An exact and comprehensive list of chemicals used by each type of mining technique (including names, quantities, environmental properties, and mode(s) of disposal) should be compared against one another;
    e. The potential impacts of the release of these substances associated with each mining method should also be characterized and compared against one another. This should include potential impacts of releases to groundwater, surface water, soil, and air;
    f. Comparison of waste quantities, waste types, and management methods associated with each mining technique;

[8] See the Koerner et al.'s 2011 study discussed on pp. 2 – 54 of the EIS
[9] Table 2.10-3 of the EIS on pp. 2-122 and Appendix 2C of the EIS
[10] Table 2.10-3 on p. 2-122 of the EIS

g. Comparisons of the potential environmental effects of each mining technique on valued components including representative species and their habitat;
h. Comparison of effects on water quality in the near surface aquifer at the mining site, as well as plans to restore the water quality in this aquifer (at least to baseline values);
i. Direct quantitative comparison of remediation requirements for each mining technique along with rough cost estimates and documented or estimated success rates between remediation types;
j. A comparative analysis of mining solution options for ISR mining, such as neutral leaching, bioleaching, weak acid leaching, and $CO_2$-$O_2$ leaching, acid leaching, and alkaline leaching and
k. A comparative analysis of permeability enhancing techniques and their consequences for groundwater contamination.

Without this information, it is impossible to understand or compare the current ISR plans for Wheeler River against any alternatives. Further, as the first proposed ISR project in the region, this information is particularly important.

15. Direct precipitation appears to have been selected as an on-site ore processing method despite there being "little to no industrial history" of it being used for ISR projects.[11] There is no discussion or evaluation of its appropriateness for use at Wheeler River or the prudence of its use environmentally. As such, it is impossible for the public to understand or assess this method.

16. Denison claims Whitefish Lake south has certain characteristics that make it the best receptor for effluent.[12] However, no descriptions of its depth, flow rates, or assimilative capacity are provided, let alone a description of why these characteristics would be best suited to receiving effluent. Without this information, the appropriateness of Whitefish Lake as a receiving body for eluent is impossible to understand or assess.

17. The EIS asserts no residual effects to surface water from the project, referencing specific criteria which are not provided or otherwise described. It is impossible to understand or assess the accuracy of this claim in the EIS or the adequacy of these criteria without access to them in this section.[13]

18. There are no regional baselines provided for surface water chemistry in the EIS, frustrating a comprehensive understanding of potential project effects to surface water and preventing our ability to understand or assess cumulative effects to regional surface water over time.

19. There is no discussion or information (including any modeling) in the EIS or Appendix 8E relating to the assimilative capacity of Whitefish Lake and Russel Lake for identified contaminants of concern. Without this information, it is impossible to understand or assess the adequacy of Denison's liquid effluent objectives. For example, discharge concentrations of chloride, cadmium, copper, uranium, and zinc appear likely to exceed long-term benchmark criteria with reference to background or induced water quality or both. Concentrations of lead-210, polonium-210, radium-226, and thorium-230 are also predicted to exceed these benchmarks. However, dilution factors or the assimilative capacity of receiving waters specific to these substances and concentrations have not been provided. Including dilution factors or assimilation capacities for sulphate, chloride, TDS, molybdenum, arsenic, selenium and zinc would be especially helpful.

[11] Appendix 2C on p. 93
[12] Table 14 of Appendix 2C on pp. 100-102.
[13] p. 7-106 of the EIS

20. The EIS admits "predicted exposure levels may affect lower trophic level aquatic biota on a population or community level within some isolated lakes in the SSA" and that "limited significant risks to aquatic biota" are predicted around the Key Lake area[14] without discussing any of this further. These predictions indicate long-term adverse effects on a larger scale than the study site area. More information is required to explain these potential effects and describe potentially affected lower trophic level taxa and species.

21. The Wheeler River documents mention many different criteria relating to toxic effects. A short summary of the goals of remediation, including the anticipated time to achievement of those goals should be provided. The public should have an opportunity to understand how many generations stand to be affected and to comment on the reasonableness of proposed remediation timeframes.

22. No sample sizes are provided to contextualize the analyses of baseline soil chemistry The relevant CCME guidelines should also be available here for context and comparison.[15]

23. Baseline chemistry for lichen and blueberry similarly does not have any sample sizes or regulatory criteria provided to contextualize the data. There is also no rationale provided for only having three permanent sampling plots for all blueberry and lichen.[16]

24. It remains unclear why supporting technical studies (Omnia, 2020) did not determine the "relative abundance" (i.e., the percent composition of a species relative to other species in the area as a measure of how common or rare that species is in that location or community) for determining the baseline studies of most wildlife species (caribou, moose, pine marten, mink, and muskrat). Change in relative abundance and distribution of wildlife species is a measurable parameter for the human environment, however, raising concerns about the consistency of Denison's approach to this issue.[17]

25. Direct and indirect interactions of the project on plant species of conservation concern have not been addressed in the EIS despite the fact that Appendix 9B to the EIS identifies numerous lichen species on site with Saskatchewan Conservation Data Centre rankings, including S1–critically imperiled/extremely rare: Mealy forked cladonia; S2–imperiled/very rare: Red-fruited pixie-cup, Greater sulphur-cup, Chalky ramalina, Common freckle pelt; and S3–Vulnerable rare to uncommon: True Iceland lichen, Boreal pixie-cup, Powdered funnel lichen, Organ-pipe lichen, British soldiers, Crinkled snow lichen, Green starburst lichen, Gray starburst lichen, Hooded sunburst lichen. The abundance, distribution and habitat of terrestrial and arboreal lichen should be included in the EIS.

26. Toxicity reference values (TRV) do not consider the sensitivity of eggs or early life stage terrestrial birds, mammals or fish, nor do they acknowledge life-long multi-generational exposures of ecological receptors. This is not consistent with a conservative approach to assessing environmental effects and it deprives the public of a comprehensive understanding of environmental risks.

[14] p. 8-111 of the EIS
[15] Table 9.1-4 on p. 9-54 of the EIS
[16] Tables 9.2-6 and 9.2-7 on pp. 9-86 and 9-87; Figure 9-90, p. 9-84 of the EIS
[17] p. 5-14 of the EIS

27. Alaskan clubmoss (with a SKCDC ranking of S2) is the most predominant rare plant species observed in the proposed Wheeler River project area with a total population area of 3140 $m^2$.[18] However, there is no discussion of how the proposed project would lead to habitat loss of this species. Nor is there information concerning potential recovery or compensatory efforts. It also remains unclear whether the loss of this species would be limited to the project area or whether there could be indirect effects extending out to the local or regional study areas.

28. The EIS describes the rock above and below the ore zone as a "discontinuous envelope" that isolates the ore zone from the surrounding rock, but not continuously. It also asserts barriers including sulphide cemented rock and clay alteration zones providing natural barriers around the ore, however these do not enclose the ore body. In the absence of any supporting data, it remains unclear how these layers could sufficiently contain the mining process-related contaminants, despite being discontinuous.

29. There is no discussion in the EIS of the potential for changes in overlaying sandstone units as dissolved solids are removed from the ore zone. Nor is there any discussion of how the changes in these stress conditions may affect the permeability of the overlying rock.

30. Neither the clay content of the basement rock nor its chemical composition are provided in the EIS. This denied the public the ability to understand how potential interactions between this rock and the acid mining solution may impact the migration of fluids from the ore zone.

While this list could go on, the issues identified above illustrate how many fundamental aspects of the Wheeler River proposal are not being explained for the benefit of public understanding or being supported with technical specifics and data. These gaps should be filled to improve the evidentiary record for the benefit of the public and CNSC Commissioners before this matter proceeds.

### 2.3 Denison's Application for Confidentiality

On August 15, a request for confidentiality by Denison was posted to the CNSC's Registry page for the current hearing in this matter. The application, itself is dated from August 8, requested that seven documents be removed in their entirety from the public record for this matter: the groundwater protection and monitoring plan; the facility description manual; wellfield containment design criteria; well design criteria; civil earthworks design criteria; security management program; and preliminary decommissioning cost estimate and financial guarantee memorandum.

We contacted the CNSC Registry in mid-September to ask when or whether Commissioners would release a publicly accessible decision on Denison's application. We also asked whether there would be any opportunity for intervenors to submit comments relating to the application. We were told that public comments were not invited in this instance and that a decision had not been rendered. No further information was provided.

We began to draft comments on Denison's confidentiality application for inclusion in these submissions and then learned in mid-October that CNSC staff had prepared their own comments on the application at the request of the Registry.[19] As such, we have also addressed CNSC staff's

[18] Appendix 9D, p. 123. (Note: S2 status is defined as, "*At high risk of extinction or extirpation due to a very restricted range, very few populations, steep declines, threats or other factors*.")

[19] It should be noted that while intervenors were notified by email of the inclusion of other intervenors' submissions to the Registry webpage for this hearing, we were not notified of the posting of CNSC's submissions relating to confidentiality. We found this document by consulting the webpage for another matter. For future reference, where email updates are sent to intervenors for Registry uploads, this practice should extend to all types of uploads.

submissions in our comments below. However, it should be noted that CNSC staff submissions lacked any substantive discussion of rationales for its agreement with Denison to withhold most of these materials in their entirety. Similarly, their submissions fail to address public interests in the disclosure of the information contained in these documents: even in cases such as the groundwater-related documents discussed below, CNSC staff never raise or consider the option of redacting sensitive information from a plan while disclosing the rest. The CNSC has a mandate that includes a responsibility to publicly disseminate technical and scientific information.[20] Approaching issues of requested confidentiality with this duty top of mind (and explicitly incorporated into its discussions and evaluations of applications such as these) would constitute a meaningful step toward greater transparency.

### *2.3.1 Public Access to Denison's Groundwater Monitoring Protection and Monitoring Plan*

In late September, we saw a groundwater monitoring plan had been posted to the list of materials for this hearing.[21] It remains unclear whether this is the same plan as the one discussed in Denison's confidentiality application. CNSC comments, which were drafted after the disclosure of this plan do not address its posting either. This confusion could have been avoided if there were a clearly communicated process for determining issues of confidentiality for this hearing. Regardless, the comments below still set out the public interest in disclosure.

According to Denison, the Groundwater Protection and Monitoring Plan:

> sets out Denison's framework for safeguarding the quality and quantity of groundwater resources throughout all phases of the Project, including preparation, construction, operation, monitoring, and decommissioning. It identifies potential risks to groundwater systems, informs ISR wellfield operations, and prescribes monitoring protocols and mitigation measures to address those risks.[22]

The company then argued very broadly that this plan "contains sensitive information regarding the location of the Project infrastructure, as well as Denison's proprietary remediation and monitoring methodologies and wellfield design and operations."[23] They asserted, without providing much detail of their rationale, that "public disclosure of these details could compromise the security of the infrastructure, undermine the effectiveness of protection measures, and reveal commercially valuable strategies to competitors." Without more explanation, this argument remains very opaque and raises several immediate and concrete questions. For example, how would disclosing environmental monitoring methodologies (which are generally based on widely known best practices from industry and academia) undermine the effectiveness of related environmental protection measures? The largest CNSC-regulated nuclear generating facilities (Bruce, Pickering, and Darlington Nuclear Generating Stations) disclose exact monitoring locations, monitoring frequencies, and sampling results online. What is unique about uranium mining infrastructure that the same cannot be done in that context?

Finally, Denison noted their plan is a "dynamic document," essentially a work in progress that is likely to change as the project progresses. The company argued that "premature release could result in outdated or incomplete information being misinterpreted, potentially hindering regulatory processes,

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[20] *Nuclear Safety and Control Act*, section 9(b).
[21] Again, we were not notified of its upload by email but happened across it while consulting the webpage for a different matter.
[22] Denison confidentiality application, p. 2
[23] Denison confidentiality application, pp. 2-3

and jeopardizing the progression of the Project."[24] Here, it is important to note that there is a significant amount of information provided in the EIS that Denison notes is subject to change as the project progresses. However, the current hearing process, eliciting guidance from CNSC staff and comments from intervenors, has the potential to improve the efficacy and comprehensiveness of Denison's proposals. Further, it is not uncommon for monitoring plans at the early stages in a project review to be subject to change. Commenting on drafts can still be a beneficial exercise that significantly enhances the comprehensiveness and transparency of a proposed project.

REGDOC 2.9.1 sets out the requirement for environmental monitoring plans. Its description of groundwater protection and monitoring plans is as follows:

> Groundwater protection is an inter-related system of initiatives, processes and activities with the overall goal of protecting the quality and quantity of groundwater by minimizing interactions with the environment from activities associated with a nuclear facility, allowing for effective management of groundwater resources.
>
> The applicant or licensee shall implement a groundwater protection program in a graded approach, appropriate to their circumstances, to:
> - prevent or minimize releases of nuclear or hazardous substances to groundwater;
> - prevent or minimize the effects of physical stressors on groundwater end uses; and
> - confirm that adequate measures are in place to stop, contain, control and monitor any releases and physical stressors that can occur under normal operation.[25]

According to the REGDOC, these programs must be developed on a site-specific basis and should consider:
- identification of sources of contaminants of concern;
- investigation of releases under normal operation and source characterization
- site characterization;
- assessment of groundwater end-use;
- assessment of groundwater vulnerability;
- development of a groundwater monitoring program; and
- risk management (as required).[26]

It is difficult to imagine which of these aspects would meet Denison's assertion that all this information should be redacted due to commercial, scientific, and technical sensitivity. CNSC staff also found Denison's rationale for withholding the document in its entirety "may be insufficient."[27] CNSC staff admitted that several portions of the plan were already on the public record in identified sections of the EIS. However, CNSC staff ultimately still appeared to accept the reasonableness of Denison providing a high-level summary of its plan, rather than the full (or a redacted version) of the document.

We submit that there is a strong public interest in disclosing environmental protection and monitoring plans to the public as a general rule. The exact location of sampling points, sampling methodologies (e.g., grab samples or other methods), sampling frequencies, and the public reporting of results (as disaggregated data) are all required for the public to be able to understand how nuclear facilities interact with the environments in which they are embedded. This kind of information should be

[24] Denison confidentiality application, pp. 2-3
[25] REGDOC 2.9.1, section 4.5
[26] REGDOC 2.9.1, section 4.5
[27] CNSC staff submission on confidentiality application, p. 3

considered distinct from any categories of proprietary information which may more reasonably be considered to include specific lab equipment or software used, the exact dimensions of specifically designed pipes or wells, or any subcontracting relationships. While this latter information may reasonably be redacted from publicly accessible versions of plans, environmental data (and the information required to understand and interpret it) itself should always be considered subject to disclosure in the public interest.

### *2.3.2 Facility Description Manual*

Denison explained:

> [t]he Facility Manual provides a comprehensive breakdown of the facilities located at the Project site that are associated with the mining and processing of uranium. It includes technical specifications, operational functions, and interrelationships between site facilities to support safe, efficient, and compliant operations.[28]

Denison argued the reference drawings and diagrams in this document "constitute Denison's proprietary intellectual property" and that "[p]ublic disclosure of these materials would enable competitors to replicate specialized designs, processes, or configurations developed through significant investment, thereby conferring an unfair commercial advantage." Finally, they believed disclosure during the hearing would constitute a "premature release" of "outdated or incomplete information being misinterpreted [and] create operational security risks, and disrupt the orderly advancement of the Project."[29] CNSC staff in their review agreed that the entire document could be withheld, though provided no discussions of their reasons.[30]

While certain detailed drawings of specifically designed equipment and processes may be proprietary, if novel and responsible for unique advantages, it is also true that the public cannot understand or assess the environmental effects of facilities if their physical footprints are not clear. Further, in order to be able to understand the proposed project, the public needs to have access to diagrams and maps outlining the physical footprint of the mining and milling operations in relation to specific ecological features (including waterbodies, groundwater flows at various depths, and identified or potential species habitat). The lack of maps in available materials in this hearing has frustrated our reviews, and these types of maps should not be considered proprietary.

### *2.3.3 Wellfield Containment and Well Design Criteria*

Denison explained that these documents "[establish] the engineering requirements and specifications governing the development of the wellfield and associated containment systems for the extraction of uranium deposits."[31] Both documents "[set] out the standards, methodologies, and best practices that must be adhered to in the design and implementation of the wellfield," and "the related ancillary equipment."[32] These criteria are broadly claimed by Denison to:

> [contain] sensitive technical information that, if disclosed publicly, could create security, safety, and operational risks. It includes the capacities, configurations, and operational tolerances of critical infrastructure, which could be exploited to cause intentional damage,

[28] Denison confidentiality application, p. 3
[29] Denison confidentiality application, p. 3
[30] CNSC staff submission on confidentiality application, pp. 4 – 5
[31] Denison confidentiality application, pp. 4 – 5
[32] Denison confidentiality application, pp. 4 – 5

> unauthorized access, or disruption of water supply. Public release may also expose proprietary engineering methodologies and site-specific data developed at significant cost, giving competitors an unfair commercial advantage. For these reasons, disclosure could compromise both the security of the [wells], wellfield and Denison's business interests.[33]

For both the wellfield and well design criteria documents, CNSC staff disagreed that national or nuclear security interests were at stake, but agreed that commercial, technical, and scientific information in the plan justified it being withheld from the public in its entirety, with a high-level public summary sufficing for disclosure.[34]

Again, we submit that while certain detailed drawings or descriptions of specific-designs or equipment and processes may be proprietary, if novel and responsible for unique advantages, it is also true that the public cannot understand or assess the environmental effects of facilities if their underlying design basis and physical footprints are not clear. In order to be able to understand the proposed project, the public needs to have access to diagrams and maps outlining the physical footprint of the mining and milling operations in relation to specific ecological features (including waterbodies, groundwater flows at various depths, and identified or potential species habitat). The lack of maps in available materials in this hearing has frustrated our reviews, and these types of maps should not be considered proprietary. Further, there is still no comprehensive description in the public record of all substances (chemical or radiological) expected to be used in mining and milling processes. Nor are there detailed rationales to support infrequent and sparse groundwater monitoring on-site. This information may be contained in this document, and if so, should not be considered proprietary as it directly relates to the public's ability to understand and assess essential environmental interactions of the proposed project.

### *2.3.4 Civil Earthworks Design Criteria*

Denison explained, the:

> Civil Earthworks Design Criteria establishes the engineering standards, specifications, and methodologies governing the design and execution of earthworks for the Project. It defines the technical requirements for grading, drainage, fencing, and other site preparation activities, ensuring compliance with applicable regulatory frameworks and industry best practices.[35]

The company claimed that: "[t]he Criteria contains detailed geotechnical data, site-specific design parameters, and proprietary construction methodologies that are integral to the Project's development" and that "[p]ublic disclosure of this information could compromise site security, enable competitors to replicate specialized designs and techniques developed through significant investment, or expose potential vulnerabilities in the Project's infrastructure."[36]

Leading it to argue that "[m]aintaining confidentiality is essential to safeguarding the Project's commercial value, operational security, and the integrity of its construction activities."[37] CNSC staff agreed, noting that the document "included information on nuclear security elements," and finding that Denison's public summary of this document would suffice for public disclosure.[38]

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[33] Denison confidentiality application, pp. 4 – 5
[34] CNSC staff submission on confidentiality application, pp. 6 – 8
[35] Denison confidentiality application, p. 6
[36] Denison confidentiality application, p. 6
[37] Denison confidentiality application, p. 6
[38] CNSC staff submission on confidentiality application, p. 9

Again, as argued for the two documents discussed above, any aspects of this plan that detail or illustrate activities' effects on the local environment should be disclosed to the public – especially activities that affect drainage and the relation of these works and local surface water and habitat features on-site. Such information should not be considered proprietary as it directly relates to the public's ability to understand and assess essential environmental interactions of the proposed project during early site preparation and construction phases.

### *2.3.5 Wheeler River Preliminary Decommissioning Cost Estimate and Financial Guarantee Memo*

Finally,[39] Denison requested to withhold in its entirety "an overview of the preliminary decommissioning plan, as well as the cost estimate and financial guarantee mechanism for the Wheeler River project, based on the proposed assets and activities."[40] Denison asserted that this document "contains sensitive information, including asset-specific details, cost assumptions, and financial security arrangements, the disclosure of which could provide competitors with strategic insights or undermine Denison's negotiating position."[41] Denison also explained the memorandum "includes correspondence with the Saskatchewan Minister of Environment, which is not intended for public release" and that "[p]ublic disclosure could compromise commercial confidentiality and create unnecessary risks to the Project's financial and operational planning."[42] CNSC staff agreed, noting that the document "contains proprietary and commercially sensitive information," and finding that Denison's public summary of this document would suffice for public disclosure.[43]

REGDOC 3.3.1 delineates the required basis of a cost estimates for decommissioning work to include the following:

- assumptions and exclusions;
- boundary conditions and limitations – legal and technical (e.g., regulatory framework);
- decommissioning strategy description;
- end state of the facility;
- stakeholder, public and Indigenous input/concerns;
- facility description and site characterization (radiological/hazardous material inventory);
- waste management (packaging, storage, transportation, and disposal);
- used fuel management (activities included in a decommissioning project);
- sources of data used (actual field data vs. estimating judgment);
- cost estimating methodology used (e.g., bottom-up);
- basis for determining contingency, estimating uncertainty and risk;
- discussion of techniques and technology to be used;
- schedule analysis; and
- uncertainty analysis.[44]

It is difficult to understand how much of this could be considered too sensitive for public disclosure. In the current proceeding, from the existing evidentiary record, it remains unclear whether ISR mining (as Denison proposes it) is even remediable. Further, Denison is making a case for the permanent disposition of varied hazardous and radiological wastes in an enormous industrial landfill that will

[39] We are not submitting comments advocating for the disclosure of Denison's Security Management Program as we recognize this program may contain a much higher degree of sensitive security information not directly related to environmental performance of the proposed project.
[40] Denison's confidentiality application, p. 8
[41] Denison's confidentiality application, p. 8
[42] Denison's confidentiality application, p. 8
[43] CNSC staff submission on confidentiality application, p. 12
[44] REGDOC 3.3.1, section 13.1

require monitoring in perpetuity. There is an immediate public interest in understanding how these significant liabilities will be managed by the company and not offloaded unfairly onto the public. This is especially true in the context of uranium mining and milling which, more often than not, abandons mining sites without comprehensive remediation on the assumption that these facilities are remote enough that (along with advisories) they will not pose immediate dangers to a high volume of regular visitors.[45]

The REGDOC also provides guidance for working documents, noting:

> [t]he cost estimate for decommissioning should provide that, if impacts of proposed operations are difficult or impossible to estimate with precision, a credible worst-case scenario must be used. The cost estimate should not assume drawdown of nuclear substances or hazardous waste during operations. A "decommissioning tomorrow approach" must be applied, assuming that the facility is shutting down overnight, and the cost estimate must be based on the state of the facility and inventories at the time of shutdown. A credit for salvage of materials or equipment is not allowed. For the purpose of the cost estimate, they must be considered as waste.[46]

Finally, it provides:

> The cost estimate for decommissioning must cover the entire decommissioning project, including, as applicable, the need for post-closure licensing, monitoring, surveillance and maintenance, and institutional control.[47]

For the purposes of the current Wheeler River project review, which is meant to span multiple of phases of the proposed project, more detailed accounts for its financial guarantees and plans for decommissioning are very important. In this context, further information disclosure would be in the public interest. Information should be disclosed that includes: how costs were determined to cover future waste management technologies and monitoring; soil, geological, and groundwater remediation; stakeholder and rightsholder engagement; types of data consulted in the development and continued revisions of the proposed financial guarantee; and a discussion of whether or which of these sources would be publicly accessible going forward. Ensuring there are sufficient funds to cover requisite work at all phases of the proposed project is a matter of crucial public interest and requires more transparency. This would be distinct from more sensitive information such as exact financial arrangements and partners or detailed financing strategies.

## 3. REVIEW OF ISR MINING AND ITS APPLICATION AT THE WHEELER RIVER PROJECT

Around the world, uranium is recovered by several mining methods, including open-pit, underground, heap leaching, and in-situ leaching (to be referred to as in situ recovery for consistency).[48] The formation of uranium deposits is influenced by factors such as geological structures, sedimentary processes, rock types, and fluid interactions.[49] The ISR mining method is well-suited for uranium deposits situated within aquifers and characterized by high permeability.[50] Compared to other mining methods, ISR is considered highly efficient and economical, with some important

[45] This was the basis for the most recent decision to remove the Beaverlodge site from CNSC oversight.
[46] REGDOC 3.3.1, section 13.1
[47] REGDOC 3.3.1, section 13.1
[48] Li & Yao, 2024
[49] Mukherjee et al., 2023
[50] Li et al., 2023

environmental advantages.[51] One disadvantage to uranium mining is the high variability of uranium deposit characteristics, which poses a challenge for creating a universal ISR mining strategy.[52]

ISR uranium mining produces uranium by injecting a mining solution into the ore zone to dissolve the ore (uranium compounds), then pump it to the surface where it can be processed. Four types of leaching solutions are used in the industry: acid, alkaline, neutral, and bioleaching. Acid solution is suitable for low carbonate content deposits; alkaline for high carbonate content (and low pyrite); neutral is broadly applicable; and bioleaching, which is versatile and especially effective when pyrite and sulfide content is high.[53] The Wheeler River Project (WRP) plans to use an acid solution.

A common barrier to ISR mining is low permeability, which makes fluid transport slower in the ore zone, inhibiting recovery. Enhanced permeability methods, which will be discussed in Section 3.5 below, is a way that the industry is overcoming the low permeability barrier.

The following sections discuss ISR uranium mining around the world, groundwater risks, remediation, suitability for the WRP, and permeability considerations.

## 3.1 ISR Mining Around the World

Currently there are many ISR mines around the world, with certain countries having several ISR mines. Kazakhstan, Australia, USA, and Czechia are among the countries with notable ISR uranium mines. Below is a summary of some relevant information on particular mines:

### *3.1.1 Kazakhstan*

ISR mining began in Kazakhstan in 1970 after successful testing. It continued to grow, giving companies new opportunities to recover uranium. Before the year 2000, hard rock deposit mining was twice as productive as ISR. Now almost all uranium mining is by ISR. In Kazakhstan, deposit depths are typically around 100-300m and as deep as 800m. A unique characteristic about Kazakh mining is the fast process that allows new mines to be developed in three years compared to approximately six years elsewhere.[54]

*Inkai Mine* is Cameco's joint venture ISR mining project. There, an acidic solution is used for recovery in a 'closed loop recirculation system' that reintroduces production water into injection wells. The pumping system also ensures less water is injected than produced to maintain the correct inward pressure gradient. Baseline groundwater here is not potable due to high concentrations of radionuclides and dissolved solids.[55]

To monitor groundwater surrounding the mining zone, monitoring wells are installed above, below, and outward from the mining zone.[56]

[51] Li & Yao, 2024
[52] Ibid
[53] Ibid
[54] World Nuclear Association, n.d.
[55] Ibid
[56] Ibid

### *3.1.2 Czechia*

Stráž uranium deposits are found in sedimentary rocks and within important aquifers, one of which is drinking water quality.[57] An environmental disaster occurred at the Straz pod Ralskem ISR mine in the 1990s, leading to more than 370 million $m^3$ of contaminated groundwater. The remediation project costs were expected to be about CZK 40 billion in 2010 (equivalent to $2.9 billion CAD in 2025) and remediation efforts were expected to continue until 2035.[58]

Contamination occurred from the uranium bearing aquifer leaking mining solution upward past an overlain aquitard (60m thick) and into the above Turonian aquifer, a potable water source. Although only about 0.5% of contamination has migrated into the above aquifer, a long-term, expensive and challenging remediation process aims to restore the water quality in the affected groundwater.[59]

Remediation efforts are influenced by economic factors and new technologies.[60]

### *3.1.3 Summary of Additional ISR Mines*

Additional to the above descriptions, Li and Yao (2024) provided a recent review of in situ leaching for uranium mining and included descriptions of the following mines, shown in Table 1.

Table 1: List of ISR Uranium Mines

| **Country** | **Mine Name** | **Mining Solution Type** | **Mine Description** |
|---|---|---|---|
| Australia | Beverley Uranium Deposit | Sulfuric acid leaching | Australia's first uranium mine to use in situ leaching with sulfuric acid; commenced operations in 2001. |
| Australia | Four Mile Uranium Deposit | Weak acid leaching | A significant discovery near Beverley, it uses weak acid leaching and is part of the Beverley and Beverley North collective. |
| Australia | Honeymoon Uranium Mine | Acid leaching | The second Australian mine to adopt in situ leaching technology, it resumed production in 2019 after a period of suspension. |
| Kazakhstan | Katco Mine | Acid leaching | The world's largest in situ leaching mine, it uses a 3D reactive transport model to optimize extraction. |
| Kazakhstan | Zarechnoye Deposit | Acid leaching | This project introduced nanofiltration technology to recover rare metals as valuable by-products, increasing the deposit's economic value. |
| Russia | Dular Mine and Khiagda ISL | Not specified | These mines use the "Smart ISL Site" digital mining system to automatically monitor and optimize the extraction process, reducing operating costs. |

[57] Kopecky & Slezak, 2002
[58] Ekert & Mužák, 2010
[59] Ekert & Mužák, 2010
[60] Kopecky & Slezak, 2002

| | | | |
|---|---|---|---|
| United States | Smith Ranch-Highland, Lost Creek, and Nichols Ranch | $CO_2$-$O_2$ leaching | These operational projects in Wyoming transitioned from alkaline leaching to the more modern $CO_2$-$O_2$ method. |
| China | Erdos and Songliao Basins | $CO_2$-$O_2$ leaching | Projects in these basins are currently in a trial phase, using $CO_2$-$O_2$ leaching to efficiently extract uranium from low-grade, high-carbonate deposits. |
| India | Tummalap-alle | Alkaline leaching: sodium carbonate and sodium bicarbonate | This mine, which holds 49% of India's uranium reserves, uses alkaline leaching for its carbonate-hosted deposit. |

**Takeaway**: There are examples of ISR mines using a neutral mining solution ($CO_2$-$O_2$) instead of alkaline or acidic, as shown in the U.S. and Chinese examples provided in the table above.

### 3.2 Risk of Groundwater Contamination

Groundwater contamination from mining activities is the most harmful impact of ISR mining. Contaminants have many avenues into the natural environment during the ISR process: surface spills, mechanical failure of wells, and migration of contaminants away from the contained ore zone.

#### *3.2.1 Surface Spill Incidents Worldwide*

A significant incident in ISR mining is contamination through surface spills. In Bulgaria and Ukraine, surface spills have led to contamination at ground level. In Bulgaria, the surface land was intended to be reclaimed for agricultural use after mining operations ended. At the Devladovo site in Ukraine, surface spills of nitric and sulfuric acid led to heavy contamination of surface soils.[61]

WISE Uranium Project also reported on the Crow Butte ISR mine in Nebraska, where an acid transport truck overturned during winter conditions, leading to a small acid leak at the crash site.[62] This webpage contains a long list of *license violations and reported events* at the Crow Butte mine, with common incidents including monitor well excursions and evaporation pond liner leaks.

**Takeaway**: the time of year for transporting hazardous chemicals like acid mining solution will be an important consideration for the WRP, especially considering the distance and quality of roads to reach the mine.

At the Beverley ISR mine in South Australia, surface spills were commonly reported incidents. Over a span of six years (2007 – 2012) some examples of surface spills included:

- a flooded creek led to the shearing of a valve that led to a spill;
- a failed filter canister resulted in a spill;
- a fence post pierced a liquid waste transfer pipe resulting in a 580L spill; and
- an injection pipeline split allowing 500L of solution to leak.[63]

[61] WISE, n.d.
[62] Ibid
[63] Government of South Australia, n.d.

**Takeaway**: That is not an exhaustive list of incidents from the report and that incident report is for only one of many ISR mines using similar practices and procedures. This stresses the importance to safeguard against spills when transporting mining solutions and hazardous substances. Regulators should look critically at the proponent's strategy for mitigating this contamination.

### *3.2.2 Contaminant Transport Through Hydrostratigraphic Units*

The EIS states that concentrations of mineralization (uranium and heavy metals) measured in groundwater in the overlying sandstone are orders of magnitude lower than in the ore zone, indicating low mass flux from the ore zone into overlying rock layers.[64] Figure 7.3-11 demonstrates this difference in concentrations and acidity with three metrics: pH, Total Dissolved Iron, and Dissolved Uranium.

**Question**: What about concentrations of other heavy metals/COPC?

### *3.2.3 Freeze Wall*

The EIS emphasizes that the freeze wall is a tertiary safety system to prevent contaminant transport away from the mining area. There is limited information available on freeze wall applications at ISR mines globally. A preliminary review found no cases of freeze walls being used in ISR mines in Russia, China, Kazakhstan, or Australia—all major uranium producers via ISR mining.

Freezing applications have been used in the uranium mining industry in Saskatchewan. For example, Cameco has used the Artificial Ground Freezing (AGF) technology at the Cigar Lake Mine, where the ore deposit and surrounding rock are frozen to reduce the movement of groundwater and radon gas and to increase the mine cavity stability during mining.[65]

One of the few applications of using AGF—specifically for contaminant containment— is at the Giant Mine, a gold mine in the Northwest Territories, which is currently in its remediation phase until 2031.[66] Its freezing approach is not the same perimeter-box-design, as planned at the WRP. However, it is a practical example of underground freezing for the purpose of containing contaminants and can be monitored for lessons learned.

**Takeaway:** There are limited case studies or applications of using freezing for containing ISR mining areas.

**Takeaway**: The freezing methods used at Giant Mine may provide an opportunity for learning.

## 3.3 Groundwater Remediation

### *3.3.1 Challenging Groundwater Remediation Process*

After mining operations finish, the mix of injection fluids and dissolved rock in the ore zone must be restored to a safe water quality. In order to properly restore the groundwater to an acceptable quality, several remediation strategies should be considered to evaluate their suitability and effectiveness.

[64] p. 7-42 of the EIS
[65] Cameco, 2024
[66] CIRNAC, 2021

WISE Uranium Project summarizes the phases of remediation:

1. Injection stops and pumping continues, leading to clean groundwater migrating inward into the contaminated area.
    - **Note**: this would be ineffective in the WRP case, when the freeze wall would inhibit inward migration of clean groundwater (assuming the ore zone area has consistent contaminant concentration across the total area).

2. Recirculation of the pumped liquid: first, treating the pumped liquid by reverse osmosis at the surface and then recirculation into the ore body.

3. Add a reducing agent to the injection liquid and allow metals (uranium) to precipitate.

4. Continue until conditions are steady and uniform.

WISE Uranium Project goes on to explain the problems with this approach:

- some chemicals like radium are still mobile even during the reducing stage and so can't be effectively controlled;
- if conditions are changed later, the contaminants could be remobilized
- it takes a long time; and
- not all parameters can be lowered enough.[67]

One variable to consider is hydrodynamics of the aquifer. One study on remediation of an ISR mine that used an alkaline solution found that both *chemical* and *microbial stabilization methods* did not sufficiently immobilize the contaminants, possibly due to limited mixing of the stabilization solutions in the ore zone.[68]

**Takeaway**: groundwater hydrodynamics must be carefully studied to understand the mixing capacity in the contaminated mining area. A threshold amount of mixing may be required between the remedy solution and the contaminant liquid. What hydrodynamics studies have been done by the proponent?

Another, more conventional remediation technique, is called *groundwater sweeping*— where clean water is pumped into the mining area consistently to replace the contaminated water over time[69]— and considered an effective remediation method by Borch et al. (2012).[70] Another method is to stimulate the growth of naturally occurring microorganisms that reduce uranium. This method has been found to temporarily reduce uranium but not permanently, with evidence of re-release happening again after treatment ends.[71]

In Wyoming, injecting reductant $H_2S$ was unsuccessful in reducing uranium, manganese, or iron after groundwater sweeping. This same study reported "Low concentrations of target species at monitoring wells outside the mined area appear to indicate that in the long term, natural attenuation is likely to play a major role at reductively immobilizing residual (after remediation) concentrations of U(VI) thus preventing it from moving outside the mined area."[72]

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[67] WISE Uranium Project, n.d.
[68] Ruiz et al., 2019
[69] Ibid
[70] Borch et al., 2012
[71] Newsome et al., 2014
[72] Borch et al., 2012

**Question:** What natural conditions are needed (e.g., microorganisms) to contribute to this natural attenuation, if it is to be relied upon in the long term?

### *3.3.2 Unattainable Objectives*

A criticism of the ISR mine remediation process is the unrealistic objectives for contaminant concentrations post-remediation. A study from the U.S. Geological Survey reported that in 27 ISR mines in south Texas, all mining areas (referred to as Production Authorization Areas, PAA) had their restoration goals amended for at least one element after operators had followed guidelines and made significant efforts to remediate. They reported that in 68% of mining areas, the final value of uranium concentrations exceeded the baseline level. Selenium also remained higher than objective levels in 55% of cases.[73]

**Question:** In summary, uranium and other contaminants' remediation levels were not met consistently. What lessons can be learned from these failures and considered at the WRP?

#### *3.3.2-1 Cost to Remediate*

One constraint to reaching the objective contaminant levels is the cost of remediation. A common legacy among ISR mines worldwide is the absence of proper budgeting for remediation. The IAEA reports that insufficient remediation budget is one of the main public concerns related to ISR and the uranium mining industry in general (2016).

**Takeaway**: It should be the responsibility of both the proponent and the CNSC to outline remediation objectives and together determine a reasonable budget for achieving these targets. Budgeting should beware of underestimating costs, considering the many ISR remediations that failed to reach targets.

## 3.4 Wheeler River Geology and ISR Mining Application

This section discusses the new application of ISR mining in the Athabasca Basin. According to Wood (n.d.), it is set to be the first ISR mine in an unconformity-type uranium deposit.

### *3.4.1 Mining Solution Interaction with Ore Zone*

The ore zone is made up of uraninite sulfides, nickel arsenides, aluminum phosphate sulphate minerals, oxide, carbonate and clay minerals, and quartz.

**Question:** What is the carbonates content? It must justify the use of acid as the solution.

### *3.4.2 Geology Around the Ore Zone*

#### *3.4.2-1 Overlying Rock*

The EIS describes the rock above and below the ore zone as a "discontinuous envelope" that isolates the ore zone from the surrounding rock, but not continuously. It states that natural barriers above/below the ore zone include sulphide cemented rock and clay alteration zones, resulting from hydrothermal alteration. However, these do not enclose the ore body.

[73] Hall, 2009

**Question:** How can these layers sufficiently contain the contaminants, despite being discontinuous?

The overlying rock deposit is sandstone made up of quartz and clay and underwent silicification, resulting in lower permeability and making it prone to brittle fracturing.[74] The EIS states that there is significant fracturing, friability and unconsolidation in the overlying sandstones and that they have been "faulted and fractured, which affects the movement of groundwater through these units."[75]

**Question:** "Affects" as in increases?

A study on the impacts of mined-out areas determined that new and evolving stress conditions in the overlying rock result from mining. The changed stress conditions make the rock prone to creep (downward movement of rock due to gravity) and fracture— potentially increasing the fluid conductivity in the overlying rock. In summary, stress conditions change, so more fractures may form and in turn, fluids can move more easily.[76]

**Question:** Over time, as dissolved solids are removed from the ore zone, the stress conditions will change in the overlying sandstone units. How will these stress conditions affect the permeability of the overlying rock?

#### *3.4.2-2 Basement (Underlying) Rock*

According to Figure 7.3.2 in the EIS, the basement rock below the ore zone is made up of pelite, graphitic pelite, and quartzite. A preliminary investigation into the chemical reaction between sulfuric acid and these rock types indicates that the acid mining solution would have varying effects on the mineralogy of the basement rock. Pelite contains several minerals including $Si0_2$, $Al_2O_3$, and FeO, at 64.13%, 19.63%, 6.85% compositions (global medians), respectively.[77] Pelites with clay content that contain aluminum and iron are susceptible to dissolution (the aluminum and iron contents) in reaction with sulfuric acid,[78] while quartz ($Si0_2$) is more resistant to sulfuric acid and would not dissolve (Mendoza, 2014). Graphitic pelite, which is pelite with high graphite content, is not increasingly susceptible to dissolution. The third basement rock type is quartzite (large quartz composition, which is resistant to sulfuric acid).

**Question**: What is the clay content of the basement rocks and what is its chemical composition? How might the interaction between this rock and the acid mining solution impact the migration of fluids from the ore zone?

### 3.5 Permeability

ISR mining is best when permeability is larger than 0.5 - 1.0 m/d but sandstones are typically lower.[79] In chapter 7 of the EIS, it states that hydraulic conductivity tests in the ore zone have not yet been completed.[80] Permeability is one of the most critical characteristics that impacts the viability of an ISR uranium mine, along with hydrogeological conditions, and selective leachability.[81] Traditionally, ISR

[74] p. 7-25 of the EIS
[75] p. 7-26 of the EIS
[76] Chen et al., 2023
[77] Forshaw & Pattison, 2023
[78] Bibi et al., 2014
[79] Wang et al., 2023
[80] p. 7-34 of the EIS
[81] Seredkin et al., 2016

mining was limited to only high permeability zones but with permeability enhancement technologies, there are more opportunities even in low permeability zones.[82]

### *3.5.1 Permeability Enhancement*

The EIS discusses that permeability enhancements will be employed to improve recovery. The proposed methods are mechanical, propellant (a.k.a. blasting) and hydraulic permeability enhancement. According to the EIS, propellants can cause up to 8,000psi instantaneously on detonation. It also claims hydraulic fracturing (fracking) can range up to 15,000psi. However, that is the high end of the range, which may be needed only in very high pressure/density rock. This is misleading to readers, providing the high end rather than a range of fracking pressures that might be suitable at the WRP.

**Recommendation:** Determining fracking pressure is complex but various sources indicate that for shallow foundations like 400m deep sandstone, a range of 2,000-10,000 psi is likely. The EIS proposal to use Blasting Enhanced Permeability (BEP) should be reviewed for its potentially problematic high pressure. Careful study should be undertaken to understand the Fracture Initiation Pressure (FIP) and Fracture Propagation Pressure (FPP) of the ore zone.

#### *3.5.1-1 Blasting-Enhanced Permeability (BEP)*

By review of available literature, it would be reasonable to assume that blasting-enhanced permeability (BEP) will be used. While fracking has proven to be ineffective for permeability enhancement for ISR,[83] BEP has shown to be an effective way to increase permeability in low permeability sandstone uranium deposits.[84] BEP enhances permeability and reduces mineral particle size, both contributing to better mineral recovery.[85] The "reformability" (how easily its permeability can be altered) of a sandstone by BEP was assessed by,[86] concluding the following ranking of suitability:

1. Most suitable: medium sandstone, argillaceous sandstone and siltstone;
2. Medium suitability: coarse and fine sandstones; and
3. Unsuitable: sandy mudstone.

**Question:** What composition and grain size is the sandstone at the WRP and is it suitable for BEP?

## 3.6 Recommendations

In this review of the ISR mining technique proposed for the Wheeler River Project along with the EIS, it is recommended that the CNSC review the following concerns:

1. **Remediation Challenges**: Remediation of the contaminated zone is slow, complex, and often fails to meet target contaminant levels, especially in ISR mines. Hydrodynamics and natural attenuation play key roles, but require thorough study and realistic expectations. The remediation budget should be determined early and should consider that ISR remediation efforts often run over budget.

[82] Wood, n.d.
[83] De Silva et al., 2018
[84] Yuan et al., 2019
[85] Li & Yao, 2024
[86] Wang et al., 2023

2. **Groundwater Contamination Risks:** Evidence from other ISR mines shows that surface spills are a frequent and serious issue in ISR mining, with incidents reported globally due to equipment failure, environmental conditions, and poor transportation planning. The CNSC must scrutinize spill avoidance strategies and ensure seasonal and logistical risks are addressed.

3. **Permeability and Enhancement Techniques:** The EIS states WRP's low-permeability sandstone may require blasting-enhanced permeability (BEP). Careful study should be undertaken to understand the Fracture Initiation Pressure (FIP) and Fracture Propagation Pressure (FPP) of the ore zone. The use of BEP should be reviewed for its potentially problematic pressure range in the ore zone geology. Further, the proponent should state more appropriate pressure ranges to compare BEP and hydraulic fracturing (fracking), to not mislead readers.

4. **Geological Considerations**: The WRP is the first ISR mine in an unconformity-type deposit, and its discontinuous overlying sandstone and potentially reactive basement rocks raise concerns about containment and chemical interactions. The discontinuous natural barrier and stress-induced fracturing may increase permeability and allow for contaminant migration.

5. **Contaminant Migration and Containment**: The freeze wall proposed for containment is a novel approach with limited precedent in ISR mining. The Giant Mine offers insights for learning, but its design is different from the WRP.

## 4. ECOLOGICAL ISSUES

Our comments relating to environmental impacts of the proposed Wheeler River project are divided into three sections below: the first concerns gaps in the cumulative effects assessment in the EIS and discusses how access to Environmental Risk Assessments for nearby uranium mining and milling operations would help to fill these gaps; the second relates to information gaps and concerns over environmental monitoring plans and proposals; and the third details concerns with the selection of Valued Components in the EIS. Each will be discussed in turn.

### 4.1 Cumulative Effects of Uranium Mining and Milling Infrastructure in the Region

There are many significant gaps in information relating to Denison's cumulative effects assessment. The EIS itself contains no data or technical information quantifying any potential cumulative effects in the area or region. Further, there is no rationale provided for the lack of consideration given to several potential effects that might merit more study. To supplement the lack of information from Denison, we sought other sources of regional environmental monitoring and study: the Eastern Athabasca Regional Monitoring Program (EARMP) and Environmental Risk Assessments (ERAs) for the Cigar Lake, McArthur River, and Key Lake operations. The EARMP data was posted proactively online and contained some helpful background contamination concentrations. Their sampling locations made it difficult to attribute specific results to potential sources of emissions, but these values were still helpful to fill in context, where missing from the EIS. Access to ERAs proved more difficult.

In mid-September, we requested from Cameco access to the full text of their current ERAs for the Cigar Lake, McArthur River, and Key Lake operations. These were the closest uranium mining and milling sites to the proposed Wheeler River location. REGDOC 3.2.1 requires the full public disclosure of ERAs by mining and milling facilities,[87] however to date Cameco has never complied with this

[87] Section 2.2.4

requirement.[88] Cameco refused us access to these ERAs in this instance as well. The company referred us to their website for ERA summaries and posted environmental data. We consulted their website where we were not able to find any helpful information. Neither their ERA summaries nor limited data posted online were sufficient for us to understand the respective operations' interactions with the environment. There were no descriptions of local species and habitat; no list of all contaminant pathways or comprehensive description of all contaminants of potential concern; no maps with images of each operation in relation to local geological, hydrological, or other ecological features; and insufficient descriptions or context were provided to facilitate an understanding of the data they posted relating to the releases of treated effluent into local surface water. As a result, between the deficiencies in the EIS and external sources online, there is a significant lack of transparency relating to potential cumulative effects associated with the proposed Wheeler River project.

### *4.1.1 Public Disclosure of ERAs*

REGDOC 2.9.1 delineates the required contents for ERA. It explains:

> An ERA is a systematic process that identifies, quantifies and characterizes the risk posed by contaminants (nuclear or hazardous substances) and physical stressors in the environment. It is a practice or methodology that provides science-based information to support decision-making and to prioritize the implementation of mitigation measures.

The REGDOC also notes that ERAs, along with routine monitoring programs, "serve as the basis for control and monitoring of releases, environmental monitoring, and any supplementary studies."[89]

ERAs describe the facility's activities and characteristics and identify how these interact with the local ecology and in which the facility is embedded.[90] Potential exposures to people in the vicinity of the facility are also canvassed and modelled. This in turn requires a survey of local land uses and the local ecology and the ways both could potentially be affected by the facility and its operations. The ERA then assesses the significance of each identified interaction, effect, or risk.

More specifically, ERAs must include:

1. Physical descriptions of the facility (e.g., dimensions of all structures at the site above and belowground) as well as descriptions of any ways in which these structures impede or affect the flow of local surface and groundwater;
2. Emissions (e.g., gases) released into the environment;
3. Effluent (e.g., liquids) released into the environment.[91]

Maximum quantities and flow rates are required for descriptions of releases. Further, while representative receptor species can be selected for identified environmental effects or risks, more comprehensive canvassing is still required of species present in local ecosystem.

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[88] For Cameco's licenses issued since 2017 (when this requirement in the REGDOC became effective) the failure to post ERAs would also constitute a non-compliance with their licensing basis.
[89] Section 4
[90] REGDOC 2.9.1 actually requires two types of overarching study in an ERA: "systemic, scientifically defensible" methods that identify, quantify, and characterize risk posed by nuclear (i.e., radioactive) and hazardous (i.e., chemical) substances and physical disturbances (stressors) on representative non-human biota" in Ecological Risk Assessments (EcoRA) and human biota in Human Health Risk Assessments (HHRA).
[91] Ibid, section 4.1.1

It is unclear how any (let alone all) of this kind of information can be considered proprietary and not subject to public disclosure. ERAs are a crucial site-specific foundation for responsive nuclear regulation. The REGDOC explains that ERA "predictions establish the basis for the CNSC's compliance program for that facility or activity." The initial ERA for a site, informed by real data collected in site-specific surveys, establishes an ecological baseline for the facility. As ERAs are updated on a five-year cycle, they add to the data that forms the basis of the ERA, increasing the depth of knowledge about the facility's environmental footprint, and tracking how this may change over time (given any changes to operations or the surrounding environment). In this way, the CNSC explains ERAs "[remain current and [become] an increasingly more powerful site-specific tool."[92] The REGDOC also recognizes that ERAs comprise primary inputs for making predictions about the future performance of facilities as well. All of this should be transparent.

In the context of the current hearing, if the Wheeler River ERA could be measured against the ERAs for the closest uranium mining and milling operations, the public could gain a sense of potential cumulative effects of uranium mining in the area. The 1993 Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (referenced at the start of this submission) took this cumulative approach. We agree it would be the most responsible way to understand the proposed Wheeler River project.

### *4.1.2 The Wheeler River Project's ERA*

Denison completed an ERA for the proposed Wheeler River project in June 2025. This document was uploaded to the CNSC Registry's materials for this hearing on August 15, 2025. The ERA focused on constituents of potential concern (COPCs) predicted to exceed specific screening thresholds. This ultimately led to an assessment of radioactive and non-radioactive hazardous liquid releases of arsenic, cadmium, chromium, cobalt, copper, molybdenum, selenium, uranium, vanadium, zinc, sulphate, and chloride. Assessments of uranium-238 and radon were added as members of the public had indicated an interest in understanding releases of these substances, should the Wheeler River project be approved. The ERA also provided a project description and description of the local natural and physical environment (producing an ecological baseline for future reference). In her review, Dr. Shamaila Fraz found several areas where the ERA filled in several of the EIS' more significant information gaps. The ERA proved crucial for her assessment of potential environmental effects of the proposed Wheeler River project. If Denison can disclose its ERA, why does Cameco still refuse?

### *4.1.3 Wheeler River Cumulative Effects and the Need for Access to other ERAs in the Region*

Were all ERAs made publicly available, we would be able to conduct our own parallel cumulative effects evaluation. The lack of publicly available ERAs is a significant transparency concern.

For example, cumulative effects to air quality are defined very narrowly in the Wheeler River EIS. Only the impacts of increased local traffic on Highway 914 are assessed. There is no analysis relating to potential cumulative effects on air quality should McArthur River and Key Lake operations become active again (as they are expected to in the near future).[93] Cumulative effects for noise are noted in the EIS but again confined to traffic.[94] The Eastern Athabasca Regional Monitoring Program is meant to capture cumulative effects of mining in the region, but is not referenced in the EIS. We reviewed this data; however, it is impossible to tie sampling results conclusively to specific emitters. Access to

[92] REGDOC, section 4.1
[93] p. 6-43 of the EIS
[94] p. 6-73 the EIS

the full ERAs of nearby mines and mills would detail their releases to the air, as well as provide a five-year baseline for ambient air quality around the operations. This would be helpful to measure against Wheeler River predictions and allow a better understanding of the larger environmental context of uranium extraction in the area.

Cumulative effects are also defined very narrowly for groundwater in the Wheeler River EIS. Ultimately the EIS finds there would be no significant residual effects to groundwater quantity and negligible effects to groundwater quality.[95] Key Lake, McArthur River, and Cigar Lake operations were deemed too far away from the Wheeler River site to include in the EIS cumulative effects analysis. However, the EIS does note that these other operations employ grounding freezing technology to alter local groundwater flows around mining areas. It would be in the public interest for Denison to further explain and provide data for why regional groundwater flow would not be cumulatively impacted by an increasing number of operations using ground freezing technology along the same and nearby uranium deposits. If we were able to access the ERAs for these other mines and mills, we would be able to better understand how each may be impacting groundwater flows and groundwater quality. These ERAs' characterization of groundwater flows and conditions would help the public to understand the connection (or lack thereof) between hydrological systems located around and between the various mining and milling operations in this area.

The EIS did consider Key Lake's operations in its assessments of potential cumulative effects to surface water. However, the EIS asserted cumulative effects were not expected to be significant. The rationale or technical basis for this finding was not clear: both Wheeler River and Key Lake drain into Russell Lake, however Russell Lake is hardly discussed in the EIS. Denison cites Key Lake ERAs from 2013 and 2020 in this section of the EIS, though no information from these ERAs is provided. This shows how other ERAs are important for the understanding of the Wheeler River project. Where they are part of the evidentiary basis for this current proceeding, they should be made publicly accessible. Were the ERAs to be made publicly accessible, we would have access to comprehensive lists of contaminants of concern at Key Lake as well as surface water conditions (including water quality and flow). The nature and quality of the connection or overlap between Key Lake and the proposed Wheeler River site would also be clearer. In the absence of this information, it is impossible to gauge potential cumulative effects to surface water.

Key Lake operations were also considered relevant in the cumulative effects assessment relating to fish and fish habitat. However, again these are not discussed in any detail[96] and Denison's ability to discern and distinguish between contributors to cumulative effects remains unclear. Ultimately, Denison did not deem it necessary to assess the relative significance of potential identified cumulative effects to fish[97] and no monitoring of cumulative effects on fish was proposed in the EIS.[98] The same limited approach was employed for sediment quality in the EIS: Key Lake was the only identified potential source of cumulative effects in this area.[99] These potential cumulative effects were not considered significant, and thus no monitoring of cumulative effects was proposed.[100] The evidentiary basis for these findings remains opaque, and there are no detailed descriptions of exactly what potential cumulative impacts there could be between the Key Lake operation and a potential Wheeler River operation. Public access to the Key Lake ERA would allow the public to understand potential connections and cumulative impacts on fish, fish habitat, and sediment quality.

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[95] p. 7-106 of the EIS
[96] p. 8-166 of the EIS
[97] p. 8-168 of the EIS
[98] p. 8-275 of the EIS (Note: general monitoring of fish health would still be performed around the Wheeler River site.)
[99] p. 8-227 of the EIS
[100] pp. 8-229 – 8-230 of the EIS (Note: general monitoring of sediment and benthic invertebrates would still be performed around the Wheeler River site.)

For terrain, soil, and organic matter/peat, cumulative effects are characterized as insignificant in the EIS. The potential for cumulative effects with the Gryphon Mine project were noted but not discussed in any further detail.[101] No other reference was made to other mining or milling sites (current or proposed).[102] The Wheeler River ERA included a study on contaminants of potential concern measured in plant tissue at the proposed Wheeler River site. Cumulative effects for vegetation were limited to cyclical fires and budworms as well as other land uses including mineral exploration. Any impacts of other uranium mines and mills were not explicitly included in this analysis.[103] The potential for habitat to regenerate was used to assert that cumulative effects will not be significant.[104] The cumulative impacts of contaminants in dust were considered insignificant because (while present) it was not expected to "alter the integrity" of the vegetation.[105] Regeneration was also assumed for listed species, which may be contrary to regulatory requirements to protect individual protected plants.[106] All mining and milling operations in this region interact with soil and vegetation, many remove them as overburden for mine infrastructure and tailings. Understanding similarities and differences between how this is done at different sites, and what their effects are would be of benefit to the public. This information would be available in ERAs, and thus facilitate a greater understanding of the potential for any cumulative effects.

For selected ungulates, furbearers and woodland caribou, noise, habitat disruption, human encounters (traffic and collisions) and unlikely interactions with spills are cited as potential effects. However, interaction with the numerous, open and expansive processing and settling ponds are not. Cumulative effects to wolverine and other furbearers are not considered significant because regional populations will still be sustainable or available to contribute to ecological functions.[107] However, this may not be sufficient for wolverine, given its protected status. The same ecological function threshold is applied to caribou habitat and mortality change to determine cumulative effects will not be significant.[108] ERAs for other uranium mining and milling operations would discuss impacts on identified species and their habitat in more detail. Measuring expected operations at Wheeler River against real-world conditions documented in the ERAs for these other sites would better indicate any potential for cumulative impacts. It would also be easier to understand potential population-level effects with a comparison of how species may be encountering and interacting with multiple mining and milling operations.

For selected raptors, migratory birds, and bird species at risk, there is no consideration in the EIS of potential contact or interaction with the numerous and expansive processing and settling ponds. Denison generally relies on its own assertions that ISR mine footprints are smaller than conventional mines and thus inherently mitigate adverse environmental impacts.[109] This highly relative approach can frustrate the assessment of the proposed Wheeler River project in its own right. Effects on raptors are acknowledged to be long-term, but fully reversible with remediation after decommissioning, with no change expected to their overall population.[110] The evidentiary basis for this recovery remains unclear. Cumulative effects are generally determined to be not significant and nearby uranium mines and mills were not considered in the cumulative effects evaluation. Concerningly, no follow-up studies are proposed for these species to verify EIS predictions.

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[101] p. 1085 of the EIS
[102] p. 9-59 of the EIS
[103] p. 9-141 of the EIS
[104] p. 9-142
[105] p. 9-144
[106] p. 9-146
[107] p. 9-300
[108] pp. 9-303 and 9-3016
[109] p. 9-368
[110] pp. 9-384 – 9-386

The finding of insignificance here is also concerning as Denison admits elsewhere that there will be 100% habitat loss for bald eagle and osprey in the project area and 50% habitat altered in the local study area.[111] Further, there will be a 100% habitat loss for waterbirds in the project area and 31.1% habitat alteration for waterfowl in the local study area.[112] For upland game birds, habitat loss in the project area is expected to be 100%, while 28.3 % of habitat in the local study area will be altered. 100% of the BS19/24 Graminoid bog /Graminoid fen located in the regional study area and would be lost.[113] For migratory songbirds, 100% of habitat in the project area would be lost, while 30.16% of their habitat would be altered in the local study area.[114]

Habitat alteration and loss for bird species at risk also appears serious. For example, common night hawk would experience 100% habitat loss in the project area and 30.16 % altered habitat in the local study area. Importantly, the BS19/24 Graminoid bog /Graminoid fen discussed earlier is located in the regional study and would be 100% lost.[115] Short eared owl would experience 100% habitat loss in the project area and 26.2 % habitat alteration in the local study area.[116] respectively. Yellow rail would experience 100% habitat loss in the project area and 24% altered habitat in then local study area.[117] Rusty Blackbird would experience 100% habitat loss in the project area and 24% altered habitat in then local study area.[118] Olive side Flycatcher would experience 100% habitat loss in the project area.[119] Denison claims these values are not concerning if taking a regional (rather than local) perspective, but does not provide any literature or data to support this stance. Denison's materials do not discuss how the project's impact on habitat for protected species would affect any permitting requirements for the project relating to species at risk.

Finally, of significant concern is the fact that no species of bats, insects, amphibians, or reptiles appear to have been studied or surveyed in the Wheeler River EIS. This frustrates any attempt to get a sense of potential cumulative effects to food webs and ecosystems more broadly.

## 4.2 Environmental Monitoring

### *4.2.1 Access to Environmental Monitoring Plans*

In early September, we reached out to Denison's designated contact person responsible for fielding public questions relating to the Wheeler River EIS. We explained we were trying to get a better understanding of the environmental monitoring plans planned for all phases of the Wheeler River project. We had become confused as the plans proposed in the EIS did not align clearly with Denison's plans posted by CNSC staff to the Registry.

We noted references to the following types of proposed monitoring plans in the main text of the EIS:

- Liquid effluent monitoring plan;[120]
- Fish and fish habitat;[121]
- Air emissions monitoring plan and groundwater monitoring plan;[122]

[111] Table 9.4-8 on p. 9-382 of the EIS
[112] Table 9.4-12 on p. 9-394 of the EIS
[113] Table 9.4-14 on p. 9-399 of the EIS
[114] Table 9.4-16 on p. 9-406 of the EIS
[115] Table 9.4-20 on p. 9-422 of the EIS
[116] Table 9.4-22 on p. 9-428 of the EIS
[117] Table 9.4-24 on p. 9-432 of the EIS
[118] Table 9.4-26 on p. 9-436 of the EIS
[119] Table 9.4-28 on p. 9-442 of the EIS
[120] p. 2-105
[121] pp. 8-160 – 8-170

- An environmental monitoring plan and woodland caribou monitoring plan;[123]
- Monitoring of sediment and benthic invertebrates;[124]
- Construction/geotechnical monitoring;[125]
- Soil salvage monitoring;[126] and
- Soil quality monitoring during Wheeler River operations.[127]

In contrast, the monitoring and management plans which were posted online by the CNSC Registry on August 15, and September 2 included an Environmental Monitoring Plan, Effluent and Emissions Monitoring Plan, and Biodiversity Management Plan. Some of the parameters in these plans aligned with the list of monitoring plans EIS. However, this was far from comprehensive and there were several gaps. We also noted that it remained unclear whether further plans will still be formulated or released.

We asked whether Denison could confirm whether the plans listed on the Registry's webpage to date were comprehensive and meant to constitute all the monitoring plans noted in the EIS. Denison's response remained vague:

> The plans listed on the Registry's website is not a comprehensive list of all the monitoring plans for the Denison Wheeler River Project. All environmental monitoring plans fall within the Environmental Management Program and are only listed on the CNSC registry site or they were referenced in Denison's or the CNSCs Commission Member Document. Additional plans not listed on the Registry's website fall under the Biodiversity Management Plan: Construction Phase Species at Risk Monitoring Plan, Pre-clearance Wildlife Monitoring Plan and the Caribou Mitigation and Offset Plan. Additionally, the Environmental Effects Monitoring Plan, as noted in the EMP, will align with the requirements of the Metal and Diamond Mine Effluent Regulations (MDMER) under the Fisheries Act.[128]

We asked whether there would be a specific Environmental Assessment Follow-up Plan posted online (noting this is a requirement for the project's EA). We also noted that a future Woodland Caribou Conceptual Management Plan was still promised in Denison's Biodiversity Management Plan and asked whether there would be any other monitoring plans still to be developed. Denison responded:

> The Caribou Mitigation and Offset Plan has been developed and submitted to the Saskatchewan Ministry of Environment and CNSC for review. Denison will not have a specific follow up monitoring plan document, all EA commitments (compliance monitoring and follow up plans) and legislated monitoring requirements (i.e., MDMER) are built into various plans within in the Environmental Management Program. Follow up requirements will be included in the site annual report.

Finally, we asked whether Denison was planning to publicly release all environmental monitoring plans for the Wheeler River Project in advance of the public hearing for this matter, and if not, which plans would be held back and why. Denison responded by noting:

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[122] p. 2-106
[123] p. 2-107
[124] p. 8-230
[125] p. 9-60
[126] p.9-61
[127] p. 9-61
[128] Denison correspondence, October 14, 2025

> Through the CSNC licence process, Denison must demonstrate that programs and process are in place to address EA commitments and compliance requirements within the overarching Environmental Management Program. Compliance to the Program is audited through annual inspections by the CSNC and the Province of Saskatchewan. Results are reported and available through regular reporting mechanisms. Plan level documents that are captured within Environmental Management Program were posted on the CSNC registry if they were referenced in the CNSC staff review of the licence application.

All these responses still leave significant questions about exactly what monitoring plans will be developed for the Wheeler River project and what they will contain. It is concerning that several of these monitoring plans will not be released to the public or include any opportunity for public comment.

**Recommendation:** that Denison provide a comprehensive list of all environmental monitoring plans for the Wheeler River project and that each plan is publicly disclosed with an opportunity for public comment.

### *4.2.2 Comments on Available Environmental Monitoring Plans or Descriptions Thereof*

#### *4.2.2-1 Groundwater*

A groundwater protection and monitoring plan was uploaded to the Registry webpage for this hearing on September 26. When we saw the plan in early October, it was too late to organize a fulsome review. As such, these comments relate to information about groundwater monitoring in the EIS. From the EIS description, it appears there will only be one upgradient and two downgradient wells used for monitoring ground water contamination from leachate of domestic landfill and that monitoring will only be undertaken semi-annually.[129] This does not appear sufficient, and more locations as well as seasonal (i.e., at least quarterly) monitoring would be more protective of the environment.

It also appears that temperature, hydraulic response, Electrical conductivity, pH, oxidation reduction potential, sulphate, dissolved uranium, chloride, and tritium would be monitored but not necessarily in all the wells and at all times. The list of parameters being analyzed at any given location and time is not given and is said to be rationalized for each Project phase and area (e.g., surface facilities versus mining area versus freeze wall perimeter).[130] Further, there are ambiguities in monitoring design such as the use of phrases like "a meaningful period" to convey frequencies. Technical details are also missing relating to statistically established background levels.

#### *4.2.2-2 Air Quality Monitoring*

The draft air quality monitoring plan has not yet been finalized. However, the outline given in the EIS indicates several significant gaps. For example, the following information is still missing from the public record: the list of parameters being analyzed; sampling locations; and sampling frequencies during each of the project's phases (construction, operation and decommissioning). The names of metals, radionuclides and other COPCs that would be monitored for each air quality component like dust fall, suspended solids, and ISR process stacks, are also missing.[131]

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[129] See pp. 2-52 and 7-111 of the EIS
[130] pp. 7-110 – 7-711 of the EIS
[131] It is not clear if what metals or radionuclides listed in Table 6.1-15 (p.6-26 EIS) would be monitored in each component.

### *4.2.2-3 Noise Monitoring*

There appears to only be one single ecological receptor location in the whole project area for Denison's acoustic assessment (as described in the relevant technical supporting document). Given the expansive size of the project footprint, a single location is insufficient for a noise study that claims to be comprehensive. Further, the methodology of this study is unclear: exact levels of noise remain unknown, "daytime" and "nighttime" levels and timeframes remain unclear, and avian species of concern are excluded from the study without a rationale for doing so. These information gaps indicate an insufficiently determined baseline condition for the project that should be improved before the project progresses. In addition, there are significant gaps in the information provided detailing how noise will be monitored going forward, should the Wheeler Project be approved. Like monitoring for baseline conditions, noise monitoring should detail multiple locations, monitoring frequencies and durations, and the rationales behind these proposed monitoring methods.

### *4.2.2-4 Fish and Fish Habitat Monitoring*

Only one sample per lake is being proposed for determining the baseline for benthic invertebrate chemistry for lakes within the Local Study Area.[132] This seems insufficient. In addition, the EIS notes:

> Fish health is expected to be resilient to changes in surface water quality in the context of this assessment, as COPC meet protective criteria even at the extreme low water scenario. Therefore, under applicable mitigative measures and average flow conditions, the contextual resilience of the aquatic system to respond to change is considered to be great.[133]

These criteria are not likely to be truly protective as they have not been developed considering lifelong exposures of fish or multigenerational exposures to low concentration of COPCs like metals. It might be too early to infer about fish health and resilience without considering thee contextual factors relating to their exposure. It might be more reasonable to predict long term health of aquatic ecosystems by monitoring effluent quality, surface water quality, and climate change influences on water quality over the life of the project (i.e., 35 to 40 years) with consideration of both direct and indirect effects.

Denison also undertakes to monitor fish health, fish habitat, and benthic invertebrates every three years in all phases of project. However, no rationale is provided for this sampling frequency. The exact duration of monitoring activities over the decommissioning phase also remains unclear.

At the same time, it is difficult to assess fish monitoring plans when fish presence in surface waterbodies remains uncertain. For example, it remains unclear from summaries of Denison's fish species surveys (presence or absence) whether lake sturgeon, goldeye, smallmouth bass or common carp are found in Wheeler River. Further, the presence of fish species was generally provided for the local study area, but not the regional study area. There was also more limited information relating to how the surveys determined the presence of any special status or at-risk species in the regional study area. The EIS stated that "[n]o species at risk were identified as part of baseline assessments or through engagement with LK (local knowledge) or IK (Indigenous knowledge) holders" but more detailed information or methodologies were not provided.[134] Finally, as the proposed Wheeler River project would continue to affect surface water through groundwater contamination release for

[132] Table 8.4-5 on p. 8-199 of the EIS
[133] p. 8-161 of the EIS
[134] p. 8-134 of the EIS

centuries into future, there should be some discussion about how the presence of certain fish species may change over this time.

### *4.2.2-5 Effluent Monitoring*

There are considerable information gaps in this plan:

- no mining chemicals for ISR use or industrial chemicals for ore processing are listed for monitoring in water.[135] It remains unclear whether this means that all the processing chemicals used for mining and ore processing are not expected in IWWTP effluent. The Wheeler River ERA mentions that a screening list of COPCs were used at the initial stages to select the final COPCs of the effluent.[136] As such, this information is known and should be publicly disclosed;
- no Action Levels or specific steps to mitigate elevated concentrations of chemical and radiological constituents in treated effluent are provided;
- no specific sampling locations are provided;
- no values for proposed licensed Derived Release Limits are provided; and
- no duration for the sampling campaign or the monitoring plan itself is noted.

It is concerning that the EIS and the Wheeler Rover ERA indicate a proposed maximum effluent quantity of phosphorous in Industrial Wastewater Treatment Plant effluent of 10 µg/L, as this is the upper limit of the reference criteria.[137] According to EIS, the CCME long-term criteria and interim Ontario Provincial Water Quality Objective (OPWQO) for total phosphorous is 4-10 µg/L.[138] The EIS should have compared this proposed release threshold against total phosphorous limits on release, partitioning to sediments, sediment retention capacity, and assimilative capacity of the Whitefish Lake. In the absence of this work, the appropriateness of this release criteria is unsupported.[139]

In the decommissioning phase, the ERA notes:

> groundwater remediation is planned which will involve injecting water into the mining horizon via the injection wells and then recovering the water via the recovery wells and processed in a water processing plant. This process would continue until the recovered water meets acceptable groundwater quality decommissioning objectives.[140]

Both the Wheeler River ERA and the EIS seem to confirm that discharge to Whitefish Lake during decommissioning is expected. However, it remains unclear exactly what COPCs are expected to be present in this effluent at the decommissioning phase. The EIS lacks information on this aspect and only provides predicted effluent water concentrations of the COPCs for the operation phase.[141] More information about monitoring during the mining horizon remediation is needed. This should include how the thawing of the freeze wall will be monitored as well as process water treatment and release.[142]

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[135] Table 2, p. 7 of the Effluent Monitoring Plan
[136] pp. 3.2 of the Wheeler River ERA
[137] See: p. 2-45 of the EIS, p. 3.6 of the ERA. It is not clear if this is dissolved phosphate or total phosphorous.
[138] p. 8-63 of the EIS
[139] Note: the ERA states, "OPWQO total phosphorous reference criteria is not relevant to ecological health;" however, we are unable to find this reference online (See: https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives?utm_source=#section-13). Further, sufficient scientific evidence exists that algal blooms associated with low ratios of nitrogen to phosphorus lead to lake eutrophication (Schindler et al., 2016) and negative impacts on ecosystem (Khan et al., 2005; Alexander et al., 2017).
[140] p. 3.2 of the Wheeler River ERA
[141] Table 8.2-9 on p. 8-87 of the EIS
[142] p. 8-75 of the EIS

The minimum unionized ammonia (which is a more toxic form of ammonia) should be monitored in effluent, but does not appear to be part of Denison's effluent monitoring plan. The expected upper bound effluent concentration of unionized ammonia at Wheeler River is 0.0106 mg/L which is not very far from the CCME long-term benchmark criteria of 0.0156 mg/L.[143] If this is indeed a gap in the monitoring plan, it would indicate that the current approach is not conservative enough.

It also appears as though the treated Industrial Wastewater Treatment Plant effluent (which will be released into Whitefish Lake) will contain 2600 mg/L of sulphates. This is roughly six times higher than measured baselines. Leachate from gypsum waste can release sulphates, which could alter lake water pH and chemistry. Considered alongside predicted levels of phosphates in Industrial Wastewater Treatment Plant effluent (expected to be close to the short term and long-term screening criteria of 0.004-0.01 mg/L), management and mitigative efforts will need to be strict and proactive to avoid eutrophication of the lake.

Finally, more information about the biological testing aspect of effluent monitoring is needed. More discussion of the acute lethality test for rainbow trout and daphnia magna is required, as well as sublethal testing on fathead minnow, early life stage salmonid, ceriodaphnia dubia, lemna minor, and freshwater alga. Whole life cycle assessment or multi-generational studies should also be more clearly factored into effluent thresholds and monitoring due to potentially very long-term direct and indirect effects of the project on aquatic life.

### *4.2.2-6 Surface Water Monitoring*

Surface water quality monitoring will involve annual grab samples during the construction phase and quarterly grab samples during operations.[144] However, no sampling frequency (or any sampling at all) is discussed for the decommissioning phase. The total duration of the monitoring program for surface water is also missing from Denison's materials.

Denison undertakes to monitor collection ponds and release ponds as well as near field and far field surface water collection points. However, there is no information relating to the specifics of these monitoring plans. A comprehensive list of COPCs and physico-chemical factors (including pH, temperature, and conductivity hardness) should be provided, along with the frequency and duration of monitoring.

Portions of the EIS downplay the releases of copper from the proposed Wheeler River project.[145] However, it is clear that copper will be high in a number of lakes in addition to Whitefish Lake.[146] In particular, copper levels are predicted to exceed the reference criteria in Kratchkowsky Lake, McGowan Lake, Russell Lake and the inlet to Icelander River for future centuries.[147] Monitoring plans need to be more detailed in how they will measure for copper and how treatment and permissible concentrations will adequately protect the most sensitive aquatic biota that may be exposed. More specifically, a highly sensitive analytical method should be developed to determine analytical

[143] p. 3.6 of the Wheeler River ERA
[144] Appendix 16C of the EIS at pp. 19-21
[145] The EIS states, "predicted surface water concentrations at all locations are expected to be below water guidelines for the protection of aquatic life, except for copper where baseline concentrations exceed the FEQG (due to the copper analytical detection limit being equal to the FEQG) and an incremental increase in concentration is predicted such that the predicted copper concentration (0.0006 mg/L) would be greater than the FEQG of 0.0002 mg/L under baseline conditions, indicating a slight increased level of risk to the most sensitive aquatic biota" (p. 8-99).
[146] See: Table 8.2-14 on p. 8-100 of the EIS
[147] p. 8-212 of the EIS

detection limits for copper. This method must in turn be validated with blanks, spikes, and internal standards and calibrated with a suitable number of replicates.

### 4.3 Concerns Relating to Valued Components

We have several methodological concerns with Denison's categorization of Valued Components (VC) in its EIS. First, soil is not considered a VC in its own right during the post-decommissioning phase of the proposed project despite the fact permanent waste disposal on site will include heavy metals, radionuclides, and plastics.[148]

Second, groundwater is not considered a VC in its own right, but rather identified as a contaminant pathway. This is not an ecologically comprehensive or responsible approach. Groundwater will come into contact with contamination in the operation, decommissioning, and post-decommissioning phases. Long-term groundwater quality will continue to be affected but future uses of groundwater in the long-term are unknown. The assumption that groundwater will only be of concern as it transports contaminants to surface water ignores the importance of maintaining its own quality as a water source. Denison's approach also fails to consider shallower groundwater and wetlands potentially affected by surface operations of the Wheeler River project.

We have several concerns relating to Denison's methods for selecting and defining valued component species. In particular:

- no species names are provided for terrestrial invertebrates, aquatic macrophytes, or lichens;
- For four amphibian's species (northern leopard frog, Canadian toad, wood frog, and boreal chorus) a fish model will be used to represent early sensitive life stages (e.g., eggs and tadpoles),[149] but the specifics of this model are not discussed;
- It is unclear which salmonid species would be used for assessment of adverse effects on fish early life stages;
- The criteria and rationale used for the exclusion of browse from terrestrial plant VCs is vague;
- It remains unclear why the ecological conceptual site model does not integrate exposure of both white sucker and northern pike as they are both selected as VCs for the project;[150] and
- It remains unclear why aquatic biota are not included in identified groups of ecological receptors. For example, white sucker and northern pike are not included amongst the species expected to be exposed to non-radiological contaminants.[151]

Finally, we are concerned by Denison's practice of selecting "surrogate species" for key indicators. For example, yellow rail was used as a surrogate for the key indicator VC species of horned grebe.[152] Common nighthawk was used as a surrogate for the key indicator VC species of bank swallow.[153] No justification for the selection or uses of these surrogate species was provided. This is a concern as the surrogate species selected in both instances differ in significant ways from their respective indicator species. Fundamental questions remain unanswered such as: what is the relationship between surrogate and each VC species being represented? How may monitoring a surrogate provide protection for the VC being represented? There is a need to show that the surrogate could be "an

[148] Table 5.6-1 on pp. 5-22, 5-24 of the EIS
[149] pp. 5.10-5.11 of the Wheeler River ERA
[150] p. 5.31 of the ERA
[151] See: Figure 5-2 on p. 5.33 and Table 5-9 on pp. 5.41-5.43 of the Wheeler River ERA
[152] Appendix 9D p. 2-5
[153] Appendix 9D p. 2-4

early warning of change" for the species it represents, and that it has a degree of sensitivity and responsiveness that is suitable to represent the VC species.[154] This does not appear to be addressed in the EIS or its appendices at all.

## 5. RISKS TO HUMAN HEALTH

### 5.1 Human Health Risk Assessment

There are problems with the human health risk assessment for the proposed Wheeler River Project. The Environmental Risk Assessment document[155] evaluates some human receptor groups including a future permanent resident (adult and one-year old) and a fisher-trapper at Russell Lake.

Further analysis of the risk to humans should:

- address exposures of the fisher-trapper to toxic substances associated with Whitefish Lake;
- provide adequate analysis of the risks to children, pregnant women, elderly, and others who are especially vulnerable;
- give more consideration of risk of toxic effects, such as impaired kidneys, mutations, and birth defects; and
- give more consideration to pollution effects thousands of years in the future.

CNSC needs to consider risks over a longer period. Some analysis of risks to health and the environment includes "future centuries" and some analysis is limited to the period of 38 years, with the "post-decommissioning" period in years 23-38. Risk analysis should consider thousands of years into the future. Movement of toxic substances from groundwater in the region containing uranium ore to surface water is expected to occur over a very long period. Climate change is likely to expose some minerals to alternating submergence in water and exposure to dry conditions, which could result in changing levels of toxic substances like arsenic in water. How likely is it that radium levels in lakes will increase over decades, as was observed in the Beaverlodge area after mining ended?

### 5.2 Some Additional Risks of Exposures to Toxic Substances

As support for the planned perpetual storage of some toxic materials at the proposed Wheeler River project site, evidence is cited for the landfill being effective for about 400 or 500 years. In Section 4, problems with the evidence cited by Denison Mines for the containment materials in permanent landfills are described. The anticipated time to failure of the landfill containment materials raises concerns that the toxic substances will be released into the environment as the materials in the structures confining the toxic waste break down. Research is needed on better ways to manage the toxic waste materials.

Waste management plans for the proposed project include removal of some toxic materials from the site during the operations and decommissioning phases of the project.[156] To what locations would this toxic waste be moved and how would it be stored?

The assessment of risks of environmental contamination with toxic substances did not adequately consider risks associated with climate change. The ensemble of climate change models was used in the assessment predictions to the year 2081, while the toxic waste stored on the site is expected to remain there for thousands of years.

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[154] Caro & O'Doherty, 1999
[155] Final EIS, Appendix 10-A, provided by Denison and prepared by Ecometrix
[156] EIS section 1.6 and CMD 25-H-9, Vol. 1 Submission from CNSC Staff, p. 12

The Wheeler River assessment considered the possibility of 24-hour probable maximum precipitation of 49.4 cm. However, consideration of flooding of the site from heavier precipitation and snow melt would be appropriate. Climate change is expected to increase evaporation and precipitation. In Texas during Hurricane Harvey during a 4-day period, the area that had the greatest precipitation received about 154 cm and a wider area received more than 100 cm of precipitation. What levels of precipitation and snow melt are climate change models predicting for northern Saskatchewan during the next tens of thousands of years? Is the site of the proposed project likely to be flooded in a way that results in spreading of toxic materials from the site to a wider region?

The proposed Wheeler River Project would contaminate aquifers. Through how wide a region do these aquifers extend? Insufficient evidence has been provided regarding whether the water quality in aquifers and associated surface waters can be restored and maintained.

### 5.3 Criteria for Acceptable Levels of Toxic Substances after Decommissioning and Remediation

After decommissioning the contamination of the land, surface water, and air should be maintained near the baseline levels existing before the project or at healthier levels.

In the Wheeler River documents a variety of criteria for adequate control of toxic substances were mentioned. Some information in Denison documents suggests that if toxic substances in land and water are brought to levels below limits in various government standards, then the situation is good enough. However, this would result in a substantial increase in exposure of people living in the area to toxic substances. Much of our information on toxicity is from situations with exposure to one toxic substance, such as information from most animal experiments. With exposure to elevated levels of many toxic substances, there is a greater risk to health than from exposure to elevated levels of one toxic substance. For people who are especially vulnerable, exposures without detectable effects in healthy adults can result in harmful effects.

The water quality in the aquifer close to the surface is valuable for the people living in the region. This aquifer can be used for well water for drinking and other purposes. Drought and fire may make this aquifer more important in the future for the quality of life of people living in the region. The restoration of quality of groundwater located relatively close to surface (about 100 m or less below surface) should be considered an important criterion for successful remediation during and after decommissioning.

There is a need for more baseline data. Some need for additional baseline data was noted in the CNSC staff's Wheeler River documents. Additional data needed include more detailed information on levels of toxic substances in plants and animals used for food and medicines. For example, wild rice is mentioned as a food, and toxic substances in this food should be evaluated. Also, Indigenous people mentioned consumption of animals trapped for fur. What are the baseline levels of toxic substances in these foods, and what levels are expected as a result of the proposed Wheeler River project.

### 5.4 Health of Local People

Plans should include more measuring of the baseline indicators of the health of people in northern Saskatchewan and monitoring of changes. Evaluation of human exposure to toxic substances based on exposures to toxic substances in air, water, land, food, and medicine is important. The consultation process and measurement of samples of food have provided a more precise basis for this type of evaluation of human exposure to toxic substances. Better information is needed on

exposures of humans from activities (such as swimming) and materials collected and used for food and other purposes.

In addition, indications of human exposure to toxic substances can be obtained by examination levels of toxic materials in their urine, feces, blood, breast milk, nails, and breath. Radiation from individuals can be measured. Particular tests are appropriate for each toxic substance. Evaluation of deformity and levels of selenium in hair and nails are among the tests that have been used in studies of selenium exposure.[157] Measurements of radon (a breakdown product of radium) in breath have been used as an indication of radium exposure.[158]

### 5.5 Problems with Prediction of Levels of Toxic Substances after Decommissioning and Remediation of Site

Much of the basis offered for licensing depends on models, monitoring, and changes to be made in response to monitoring. There is not sufficient evidence that remediation will be able to restore the area to a healthy environment that supports healthy people. Without more evidence of ability to restore the land and water after ISR mining with acidic mining solution, the Wheeler River Project should not be licensed.

In the EIS, the review of mining options and mining solution options did not make clear how the proposed use of ISR with acidic mining solutions contrasted with other options. Only two mining solutions were evaluated (acidic and alkaline), although there are other options. Further work is needed before the CNSC can rule on whether the proposed Wheeler River Project should be licenced. Much of the approval from the CNSC staff was for the construction phase of the project, and not for the operations or decommissioning. Once the proposed production, storage, and transport of toxic materials is evaluated, it may be obvious that a serious contamination of the environment is likely.

We did not find in the CNSC staff documents a review of the scientific and technical literature relevant to assessing the likelihood that an ISR mining operation using acidic mining solution will be successfully remediated. An evaluation informed by a review of scientific literature would also contribute to determination of the best options for mining method, mining solutions, and restoring the environment.

Although some aspects of the performance of Denison at Elliot Lake were included in the CNSC evaluation of the Wheeler River proposal, we did not find a consideration of the environmental degradation associated with Denison's Elliot Lake operation or with its other mining operations.

### 5.6 Problem with Argument for Putting the Wheeler River Area at Risk of Environmental Contamination

The EIS (Section 1.3) argues that due to the climate crisis, more nuclear reactors should be built to produce electricity. However, there are many other ways to meet energy needs that are much less expensive, faster to deploy, and less risky than new nuclear reactors.[159] Also, when peace is threatened, as it is currently, nuclear reactors become a liability. Therefore, while it may be reasonable to maintain the nuclear reactors currently in existence, it may not be appropriate to build new ones or send uranium to countries that have not signed or not adhered to the Treaty on the Non-Proliferation of Nuclear Weapons.

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[157] ATSDR, 2003
[158] ATSDR, 1990
[159] IEEFA, 2024

Denison asserts the Wheeler River project is a response to an expected global increase in nuclear energy infrastructure over the next few decades. The need for the Wheeler River project and its underlying purpose is to address a perceived increase in global demand for uranium as fuel for new and existing nuclear power reactors.[160] However, only "high case projections" for uranium demand by the IAEA are cited in the EIS,[161] while lower IAEA projections are ignored. Denison cites climate change and an international population increase as further reasons for increased energy production demand. However, alternative strategies for meeting and managing future energy demand via increasing energy efficiency, use of alternative energy sources, and energy storage are not considered.

There is currently no regular, designated public engagement opportunity federally or in Saskatchewan for members of the public to provide funded interventions to address energy planning, conservation, and desirable sources of energy. In the absence of such a process, these issues should be treated very carefully in this current hearing. Based on the information reviewed for this intervention document, there are great risks to the environment and human health from the proposed Wheeler River Project. There is not enough information on the record in this matter to responsibly assess the need for uranium. As such, the issue should be treated very carefully in this current hearing.

### 5.7 Cumulative Effects of Damage to the Environment in Northern Saskatchewan

Mining and logging have degraded the environment in northern Saskatchewan. The baseline conditions measured in anticipation of proposed Wheeler River mining and processing operations will be for a region already damaged by earlier projects.

Because of the anticipated expansion of mining related activities in northern Saskatchewan and Manitoba, there is a need for a comprehensive review of the historical effects of projects and the risks of anticipated future projects. Because of the history of serious contamination to the environment by uranium mining in Saskatchewan, there is a need to determine what mining is needed. Unnecessary mining should be avoided, to protect the environment and human health. Study of the history of effects of mining on the environment in northern Saskatchewan and of anticipated projects in the region should also investigate ways to restore a healthy environment that supports human health.

### 5.8 Need for More Scientific and Technical Research and Analysis of Literature

Due to the increasing interest in mining projects in northern Saskatchewan and the contamination left from earlier mining, the capacity for scientific investigation of the ecology of this region and the health of its people should be enhanced in Canada. This can be done through funding of positions and research at universities and other institutions, such as the National Hydrology Research Centre, the Global Institute for Water Security, and the Saskatchewan Research Council.

Among the studies needed are:

- baseline health studies of people who live in northern Saskatchewan;
- a program to collect and analyze data on indicators of community health for communities affected by mining activities. This data should facilitate the formulation and implementation of strategies to remediate and protect health; and

[160] p. 1-22 of the EIS
[161] p. 1-19 of the EIS

- because of plans to employ local people at mining and processing operations, epidemiological studies will also need to evaluate occupational effects on workers and former workers at mining and processing operations.

Consideration should be given to providing for the costs of scientific research in support of monitoring of the environment and human health and additional work dealing with managing the effects of mining on the environment and human health for thousands of years. Will these funds come from the Canadian government, the Saskatchewan government, or mining companies?

## 6. DENISON'S PROPOSED PUBLIC AND INDIGENOUS INFORMATION PROGRAM

On August 15, a proposed Public and Indigenous Information Program from Denison was uploaded to the Registry's online materials for this hearing. Should the Wheeler River project be approved, this program would delineate and structure Denison's interaction with the public. As the Wheeler River EIS only has a few pages dedicated to discussing its past engagement and plans for future engagement with non-Indigenous publics, we are focusing on their uploaded program document as the main means by which we can provide observations and recommendations to increase transparency.

### 6.1 Encouraging Two-Way Communication

Denison states the purpose of their plan is to, "support… the development and maintenance of meaningful relationships in relation to the Operation" and "ensur[e] that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities are effectively communicated more broadly."[162] These are important purposes that merit inclusion in the plan. We would also propose that two-way communication be included here as an important purpose and integral aspect of the company-public relationship. While the scope of the draft plan includes an undertaking to provide "opportunit[ies] for two-way sharing of information," this wording is ambiguous and decentralizes two-way communications. Including two-way communication in the purposes section of this plan would better ensure it as a foundational principle of Denison's approach to public engagement, and better recognize the value of feedback and information from public and Indigenous rightsholders to the company and its operations.

**Recommendation:** That a commitment to two-way communication with the public and Indigenous rightsholders be included in the plan's purposes.

### 6.2 Introducing a Framework for Public Engagement

The proposed plan undertakes to provide "opportunities for engagement," permitting the public and Indigenous rightsholders to provide comments to the company and ask questions. Denison in turn may realize "opportunities to address comments, concerns and questions." This wording is vague, as "opportunities" in this context lack concrete frameworks. There is no language in the plan that specifically encourages the reception of public and Indigenous rightsholders' communications nor is there any language specifically requiring that Denison provide responses to such communications when received. We recommend the inclusion of stronger and more concrete language to structure how communications may be elicited and responded to. Denison should also provide general timeframes for initial responses to queries or comments it receives.

[162] p. 1

**Recommendation:** That Denison include stronger language in its plan to encourage the public and Indigenous rightsholders to submit queries and comments and provide a general timeline for when people may expect initial responses to their queries.

### 6.3 Revisiting Public Interest and Perceptions of Risk

Denison proposes that the extent of its program should be commensurate with public perceptions of risk and the level of public interest in the Wheeler River operations.[163] However, the plan does not provide any concrete criteria for how Denison will assess the public's perception of risk or interest. These are highly subjective terms that allow Denison to exercise a significant amount of discretion with regards to how they will approach the implementation of their proposed program. This language also places an unfair burden on the public and Indigenous rightsholders to continually communicate their ongoing interests or concerns with specific aspects of the facility and its operations. At the same time, the public and Indigenous rightsholders cannot know exactly what information is being collected and maintained by Denison if it is not routinely being disclosed. In the context of this information asymmetry, it is particularly inefficient and unfair to rely on the public to constantly determine the parameters of disclosure. These concerns have more recently been recognized by CNSC staff who have proposed in a discussion paper that public information and disclosure programs no longer be developed according to expressions of public interest or perceptions of risk.[164]

Instead, we would submit that the public and Indigenous rightsholders be understood to always have an interest in understanding how the Wheeler River operations interact with the environment in which it is embedded. Proactive disclosure of environmental monitoring data, descriptions of operational changes or disruptions, and public dose calculations should be the default.

**Recommendation:** That the plan should not rely on expressions of public interest and perception of risk to determine the scope of disclosure, but rather promise proactive disclosure of environmental monitoring data, descriptions of operational changes or disruptions, and expected public dose.

### 6.4 Diversifying Conceptions of Interested Publics

Denison explains the focus of its plan is to communicate with those living closest to the proposed Wheeler River project site. The plan is meant for "the Indigenous groups and members of the general public located in the regional area surrounding the Wheeler River Operation, particularly the communities or reserves in closest proximity to the Operation."[165] This regional area corresponds to the Northern Saskatchewan Administrative District and includes land leases in proximity to the proposed project site.[166]

The plan also includes a list of target audiences for its plan, among which are:

- "Interested Party: A person or entity with an interest of concern in relation to a Denison activity. (This term is often used interchangeably with the term stakeholder)."
- "Non-Indigenous Community of Interest: A municipality or other non-Indigenous community located near the existing transportation infrastructure utilized by the Operation. A Non-

[163] p. 1
[164] See: DIS-24-05, Proposals to Amend REGDOC-3.2.1, Public Information and Disclosure - DIS-24-05, Proposals to Amend REGDOC-3.2.1, Public Information and Disclosure: https://open.canada.ca/data/en/dataset/c192390b-1c09-489f-9b73-6de73c59795b/resource/3f1be301-3cd0-4747-a8fb-c2f3fc2a969c
[165] p. 4
[166] Figure 3 on p. 4

> Indigenous COI may experience efforts by Denison to offer employment, training, and business opportunities in connection with the Operation and therefore may experience positive socioeconomic impacts as a result of the Operation."[167]

The distinction between the two categories remains unclear. However, reading all these portions of the plan together, it does not appear as though Denison has included or considered non-regional interested communities or civil society. While the focus on locals is important and understandable, non-local organizations should also be included. This is because broader civil society organizations can have diverse expertise and interests in the Wheeler River project that can also benefit local populations.

For example, the Saskatchewan Environmental Society (SES) has an interest in broad environmental issues within the province and has a long history of engagement with nuclear infrastructure in Saskatchewan. While not limited to the local region, the SES has a clear interest in the Wheeler River project. Its unique perspective allows it to bring unique considerations and expertise to its engagement on the proposed Wheeler River project that would be of benefit to Denison and local populations as well as the wider province. The same is true for the Nuclear Transparency Project (NTP). NTP's interest in public information and disclosure practices by all Canadian-regulated nuclear facilities means it would also have an interest in these practices at the Wheeler River operation. Its broader transparency focus means its engagement on related issues, and its expertise in this area, can similarly benefit Denison, locals, and the broader regulatory community. Should the project be approved, both organizations would also require access to Wheeler River information in order to remain informed of operations and continue to engage with the facility and Denison in an informed manner.

**Recommendation:** That the plan include in its target audience civil society organizations more broadly, and not narrow these down to purely local or regional organizations.

### 6.5 Communicating Known Effects Rather than Managing Perceptions

There is a considerable focus in the plan on addressing public perceptions of risks associated with the proposed Wheeler River operation rather than simply communicating the facilities' known effects. The plan states that "communication tools and methods outlined throughout this Program provide information related to Denison's activities and help address perceived environmental, health and safety risks to the target audiences." It continues:

> [a]lthough the activities associated with mining and milling involves certain risks, they can be minimized through proper planning, a continual focus on safety, innovation and adherence to environmental and safety regulations and industry best practices. Furthermore, misconceptions exist regarding risks associated with nuclear energy production and uranium mining and milling, which communications distributed as part of this Program are also intended to address.[168]

This focus in this section on managing public attitudes toward nuclear infrastructure is an inappropriate goal for any nuclear facility's public information program. These programs are meant to constitute a transparent and objective source of public information about the operations and measured effects of licensed operations. CNSC REGDOC 3.2.1, which provides the Commission's

[167] p. 5 (This second category of person is further discussed with specific regional organizations named on p. 10 of the plan.)
[168] p. 7

guidance for public information and disclosure protocols, states:

> The primary goal of the public information program, as it relates to the licensed activities, is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities are effectively communicated to the public.[169]

The REGDOC thus affirms that Denison should not use its public information and disclosure program to focus on managing public conceptions. Rather, the program should be designed to efficiently share information with the public about the facilities' operations and their known and potential effects.

**Recommendation:** That Denison remove references to managing public conceptions of mining and nuclear infrastructure from its public information and disclosure plan

### 6.6 Gauging Public Interests and Concerns

Denison's plan notes public opinion polling, surveys, and media coverage of the Wheeler River project would be used as sources of information to "obtain public and media opinions regarding the Operation"[170] and "gauge public understanding of, and support for, uranium mining and milling in Saskatchewan."[171] While gauging opinions about the Wheeler River project this way is acceptable and consistent with REGDOC 3.2.1, it would be inappropriate (as explained above) for Denison to use its public information and disclosure program to gauge or influence support for uranium mining and milling more generally. Further, we submit that public comments received by Denison and the CNSC relating to the Wheeler River project (over the course of its operating life, should it be approved) should also be included as a source of information from which Denison would gauge public opinion.

**Recommendation:** That Denison include comments received from the public as inputs for gauging public opinions about the Wheeler River project.

Further, we submit that comments received from intervenors in this current hearing should form the initial basis of Denison's understanding of public opinions and concerns with the proposed project. Should the current Wheeler River project be approved by the Commission, this current hearing process would constitute the most significant Commission-supported opportunity to learn about and express thoughts relating to this project for decades to come. This hearing is producing a rich public record of intervenors' numerous concerns and recommendations. These are coming from a broad cross-section of members of local communities, civil society, and Indigenous rightsholders. This record is likely to constitute the most comprehensive source of information relating to public opinion relating to the proposed project and should constitute the baseline for gauging public opinions about the Wheeler River project, as well as structuring future public engagement and information efforts by Denison.

**Recommendation:** That Denison use the content of interventions in the current hearing process to form its baseline understanding of the opinions and concerns held by the public and Indigenous rightsholders.

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[169] Section 2.1
[170] p. 11
[171] Section 4.2

### 6.7 Expanding the Scope of Routine Disclosures

Denison's plan undertakes to provide its "Environmental Social and Governance (ESG) Reports" online for public access. However, the exact contents of these reports remain unclear. The only explanation provided by Denison indicates these documents will be "easily understandable information on Denison's safety and environmental performance, as well as Denison's community involvement and human resources practices."[172] The lack of detail here renders detailed comments difficult, however, the qualifier of "easily understandable" potentially signals at a lack of technical information. As this is the only document Denison has committed to publicly release, we are concerned there will be a deficit of publicly available data and technical information released to the public.

Further, the plan is silent on certain documents the CNSC requires licensees to disclose. For example, REGDOC 3.2.1 clearly states:

> The public information program shall provide open and transparent means and access for the public to obtain desired operational, environmental and safety information about the licensed facility or activities. As part of this program, if a licensee is required to conduct an environmental risk assessment (ERA) and/or a probabilistic safety assessment (PSA), the ERA and a summary of the PSA must be posted on the licensee's website.[173]

**Recommendation:** That Denison's disclosure protocol explicitly ensure the full Wheeler River ERAs and summaries of its PSAs will be posted to its website, and that periodic updated versions of these documents will be posted as they are published.

Denison's plan provides a list of what it refers to as "non-routine communications" which may be posted online. The list includes the following:

- Impacts from dangerous weather or natural disasters, such as earthquakes, fires, or floods;
- Substantial operational developments, including labour disputes or proposed expansions to facility design or operation;
- Non-routine releases of radiological and/or hazardous materials to the environment;
- Planned or unplanned disruptions of facility operations;
- Results of environmental monitoring programs; and
- Any other events that may have effects beyond the Project-area that could be of public interest or attract attention from media.[174]

This list roughly mirrors a suggested list of types of disclosure recommended in REGDOC 3.2.1.[175] However, the extent of disclosure in Denison's plan remains unclear, as they are labeled "non-routine" without explanation. Further, the use of equivocal language (the use of "may" as a qualifier for disclosure) introduces further uncertainty about the extent of disclosures the public may expect. Elsewhere, the plan notes that Denison will base its communication frequency on "the type of information needed to be communicated."[176] This section also fails to note how disclosure need will be determined or defined, admitting that "non-routine communications [would be] shared on a case-by-case basis."

[172] Section 3.1.2.2
[173] Section 2.2.4
[174] Section 3.1.4
[175] Section 2.3.2
[176] Section 3.1.3

These sections, when read together, all seem to indicate that if no information other than Denison's ESG reports is disclosed, Denison would still be complying with its plan. This would not be in keeping with REGDOC 3.2.1 nor would it achieve the conception of transparency promoted in the REGDOC.

**Recommendation:** That the list of disclosures in section 3.1.1 of Denison's public information and disclosure plan be made mandatory and routine.

Finally, there remain significant uncertainties and ambiguities relating to Denison's potential disclosure of environmental monitoring data. The introduction of their plan notes disclosures will include "[s]ummaries of discharge of contaminants of potential concern against licence limits for treated water released to the environment as part of normal operations.[177] However, this is not noted anywhere else in their public information and disclosure plan or their disclosure protocol. Further, as noted above, the body of the plan states "results of environmental monitoring programs" would be considered non-routine disclosures and may or may not be publicly disclosed at all.

We strongly advocate for public access to the real-time release of machine-readable and raw (i.e., disaggregated) data. While averaged data can hide concentration spikes, raw data can provide the public with a better understanding of the ongoing and dynamic interactions between facilities and the ecosystems of which they become a part. The disclosure of raw and real-time data can also support people to make informed decisions about their proximity to these facilities in any given moment. Pathways for machine-readable public data disclosure can be automated, thus not demanding too much effort by nuclear operators.

**Recommendation:** That Denison's plan undertakes to routinely disclose machine-readable raw data in real-time.

### 6.8 Expanding the Scope of Non-Routine Disclosures

Denison's plan is silent on the content of publicly released event reports for planned and unplanned events. At a minimum, we submit that the following information should be included in event reports publicly disclosed by licensees:

- The date, time, and duration of the event;
- Location of the event;
- Any measured releases to the environment on- and/or off-site. Here, concentration and/or activity (preferably in sieverts or grays in addition to becquerels) and volumes should be provided. If no measurements are taken, reasons for this should be provided along with estimated release concentrations and volumes;
- Relevant licence limits, i.e., facility-specific Action Levels, Derived Release Limits as well as applicable regulatory environmental standards or release limits; and
- A description of any mitigation and follow-up monitoring efforts, including any available monitoring data.

**Recommendation:** That Denison's publicly-available event reports include: the date, time, and duration of the event; location of the event; any measured releases to the environment on- and/or off-site. Here, concentration and/or activity (preferably in sieverts or grays in addition to becquerels) and volumes should be provided. If no measurements are taken, reasons for this should be provided along with estimated release concentrations and volumes; relevant licence limits, i.e., facility-specific Action Levels, Derived Release Limits as well as applicable regulatory environmental standards or

[177] p. A-1

release limits; and a description of any mitigation and follow-up monitoring efforts, including any available monitoring data.

### 6.9 Contacting Denison

REGDOC 3.2.1 requires Denison to provide contact information for the person(s) responsible for the program and disclosure protocol.[178] Denison's plan notes generally that its Chief Operating Officer is responsible for the plan, while its Corporate Social Responsibility Director and Corporate Social Responsibility Coordinator would implement and manage the plan day to day.[179] This also seems to relate more to CNSC staff's point of contact for the plan itself.

We would recommend that Denison identify a designated staff person to be listed as the point of contact for public inquiries. Denison's disclosure protocol, which would be posted for public access online, is silent on this issue but would be a good place to post this contact in addition to Denison's website.

**Recommendation:** That Denison's website and public disclosure protocol include a designated contact person to whom the public can address any comments, question, or concerns.

## 7. CONCLUSION AND SUMMARY OF RECOMMENDATIONS

### 7.1 Conclusion

No licence for the Wheeler River Project should be issued at this time by the CNSC. There are substantial information gaps in the application, and the evidence available suggests the project would result in severe damage to the environment.

The geology of the Wheeler River area in combination with the proposed mining methods are very likely to result in contamination of aquifers, and how far this contamination would eventually extend was not clear. The application claims that contamination of the surface waters will be remediated, however experience from other ISR mining operations using acidic mining solution suggests that failure of remediation efforts is probable. Restoration of the quality of the groundwater near the earth's surface should be a goal, because continued access to drinking water from wells is important for people living in the area in the future.

A legacy of contamination of soil and sediments can also be expected. This is partly due to limitations in the proposed toxic waste management.

Contamination of the environment can affect the exposure to toxic substances and radiation of people living in the area both directly and due to their use of local water, plants, and animals for food and other purposes.

A Wheeler River mining proposal could be considered by the CNSC when better information on risks to the environment and human health from various options have been examined.

[178] REGDOC 3.2.1 at Section 2.2.7
[179] Section 2.5.1

## 7.2 Summary of Recommendations

### *7.2.1 Recommendations to the CNSC regarding the Wheeler River Project*

**No Licence:** The CNSC should **not** grant a licence for Wheeler River Project proposal at this time.

**Improve Transparency**: In Section 2 of this intervention, there is an explanation of ways the transparency of the environmental assessment process can be improved.

**Address information gaps** that prevent the evaluation of the best way to mine the Phoenix deposit and judge the risk of failure to restore the environment.

Some of the most serious gaps:

- A more extensive comparative analysis of ISR methods against alternative mining techniques is needed. This includes comparative analysis of mining solution options and of permeability enhancing techniques and the consequences for groundwater contamination.
- The chemical names, properties, concentrations, and proportions for the various substances that would be used in Wheeler River's operations.
- More detailed explanation of the site and of the off-site monitoring locations, so that public can better understand what is being proposed.
- Clarification of the criteria used for the claim that there will be no residual effects on surface water. A short summary of the goals of remediation, including the anticipated time to achievement of those goals would be helpful.
- More detailed assessment of residual effects for valued components and key indicators. This should include a breakdown of uncertainty predictions from various sources.
- More specific information on waste management plans, including estimated duration for "temporary" the storage of wastes. Also, for hazardous waste that is removed from temporary storage, information on the locations to which it would be moved should be provided.
- A discussion showing that CNSC staff have assessed the appropriateness of the designs for process ponds, waste storage, and effluent discharge lines. Better evidence to support the efficacy of containment of waste materials in the proposed landfill.
- More information on hydrological aspects above and below ground and how proposed mining practices are likely to alter the movement of water and other substances. More estimates of volumes for water expected to be used for each phase of the proposed project should be provided.
- An estimate of the total effluent volume expected to be emitted by the Industrial Wastewater Treatment Plant and of amount of water expected to be recycled in this process.
- A more detailed description of Whitefish Lake south (depth, flow rates or assimilative capacity), along with an explanation of why it is best suited to receiving effluent.
- To evaluate Denison's liquid effluent objectives, a discussion of the assimilative capacity of Whitefish Lake and Russel Lake for identified contaminants of concern. Among the concerns are discharge concentrations of chloride, cadmium, copper, uranium, zinc, Lead-210, Polonium-210, Radium-226, and Thorium-230.
- More information regarding measures to limit or stop the emission of fugitive dust from the proposed project.
- Discussion and evaluation of the ore processing method.
- Further explanation of how the risk to sediment quality was evaluated and how it compares in validity to other approaches.
- More information regarding EIS statement that "predicted exposure levels may affect lower trophic level aquatic biota on a population or community level within some isolated lakes in the SSA."

- More information on whether computer models used to predict effects of the project are available to scientists around the world and the views of experts regarding the limitations and strengths of these models.
- A comprehensive evaluation of the cumulative impacts from climate change, mining and other industrial developments in the region.
- Consideration of pollution effects thousands of years in the future.
- More information on the levels of toxic substances in plants and animals used for food by people.
- Information on baseline and future levels of toxic substances in people living near the proposed project and their health.
- More adequate analysis of the effects on children, pregnant women, elderly and especially vulnerable people.
- Analysis of the effectiveness of remediation of environmental damage from previous Denison projects.

**Improve plans for monitoring and sharing information with the public:** Better plans are needed for future monitoring of the environment and human health, and for sharing of information and consulting with the public.

### *7.2.2 Recommendation Regarding Groundwater Quality Remediation Goals*

The quality of ground water close to the earth's surface should be restored to close to its baseline levels or healthier levels. Access to drinking water through wells is important for future residents of the region.

### *7.2.3 Recommendations Regarding Mining Technique for the Wheeler River Project*

1. **Remediation Challenges**: Remediation of the contaminated zone is slow, complex, and often fails to meet target contaminant levels, especially in ISR mines. Hydrodynamics and natural attenuation play key roles, but require thorough study and realistic expectations. The remediation budget should be determined early and should consider that ISR remediation efforts often run over budget.

2. **Groundwater Contamination Risks:** Evidence from other ISR mines shows that surface spills are a frequent and serious issue in ISR mining, with incidents reported globally due to equipment failure, environmental conditions, and poor transportation planning. The CNSC must scrutinize spill avoidance strategies and ensure seasonal and logistical risks are addressed.

3. **Permeability and Enhancement Techniques:** The EIS states WRP's low-permeability sandstone may require blasting-enhanced permeability (BEP). Careful study should be undertaken to understand the Fracture Initiation Pressure (FIP) and Fracture Propagation Pressure (FPP) of the ore zone. The use of BEP should be reviewed for its potentially problematic pressure range in the ore zone geology. Further, the proponent should state more appropriate pressure ranges to compare BEP and hydraulic fracturing (fracking), to not mislead readers.

4. **Mining Solution Options:** A comparative analysis of mining solution options for ISR mining, such as neutral leaching, bioleaching, weak acid leaching, and $CO_2$-$O_2$ Leaching, acid leaching, and alkaline leaching is needed.

5. **Geological Considerations**: The WRP is the first ISR mine in an unconformity-type deposit, and its discontinuous overlying sandstone and potentially reactive basement rocks raise concerns

about containment and chemical interactions. The discontinuous natural barrier and stress-induced fracturing may increase permeability and allow for contaminant migration.

6. **Contaminant Migration and Containment**: The freeze wall proposed for containment is a novel approach with limited precedent in ISR mining. The Giant Mine offers insights for learning, but its design is different from the WRP.

### *7.2.4 Recommendations to the CNSC Regarding Uranium Mining in Northern Saskatchewan that are Not Specific to the Proposed Wheeler River Project*

**Uranium production limitations:** Uranium mining to supply some existing nuclear reactors can be justified. However, building new nuclear reactors would not be a wise way to deal with climate change because alternative approaches that combine energy efficiency, renewable energy, and energy storage cost less, are quicker to implement, and less risky. To reduce the risks to the environment and human health, uranium production should be limited.

**Evaluate mining effects in northern Saskatchewan:** A comprehensive study of the cumulative environmental effects of past and proposed mining in northern Saskatchewan should be conducted.

## 8. ACKNOWLEDGEMENTS

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### 8.1 Organizations Producing this Intervention

The **Saskatchewan Environmental Society** (SES) is a non-profit, registered charity that is committed to supporting sustainable living and sustainable resource use in Saskatchewan. We work with, and on behalf of, communities, organizations, businesses, and policy makers to encourage informed decision-making that moves us towards sustainability. SES's current action areas include sustainable energy and climate solutions, water protection, resource conservation, biodiversity preservation, and reduction of toxic substances. Our work in Saskatchewan is carried out in Treaties 2, 4, 5, 6, 8, 10, and our office is in Saskatoon on Treaty 6, the traditional territory of Cree Peoples and the homeland of the Métis Nation.

The **Nuclear Transparency Project** (NTP) is a Canadian-registered not-for-profit organization dedicated to supporting open, informed, and equitable public discourse on nuclear technologies. NTP advocates for robust public access to data and other types of information and helps to produce accessible analysis of publicly available information, all with a view to supporting greater transparency in the Canadian nuclear sector. NTP is comprised of a multi-disciplinary group of experts who work to examine the economic, ecological, and social facets and impacts of Canadian nuclear energy production. We are committed to interdisciplinary, cross-sectoral, and equitable collaborations and dialogue between regulators, industry, Indigenous nations and communities, civil society, members of host and potential host communities, and academics from a variety of disciplines.

## 9. LIST OF ABBREVIATIONS

AGF – Artificial Ground Freezing
BEP – Blasting Enhanced Permeability
CCME – Canadian Environmental Assessment Agency
COI – Community of Interest
CNSC – Canadian Nuclear Safety Commission
COPC – Constituents of potential concern
EA – Environmental Assessment
EARMP – Eastern Athabasca Regional Monitoring Program
EIS – Environmental Impact Statement
ERA – Environmental Risk Assessment
ESG Reports – Environmental Social and Governance Reports
FEQG – Federal Environmental Quality Guidelines
IAEA – International Atomic Energy Agency
IK – Indigenous Knowledge
ISR – In-situ recovery (or in-situ leaching)
IWWTP – Industrial Wastewater Treatment Plant
LC10 – Lethal Concentration 10%
LC50 – Lethal Concentration 50%
LK – Local Knowledge
MDMER – Metal and Diamond Mining Effluent Regulations
NOEC – No observed effect concentration
NTP – Nuclear Transparency Project
OPWQO – Ontario Provincial Water Quality Objective
SES – Saskatchewan Environmental Society
TRV – Toxicity Reference Values
VC – Valued Component
WRP – Wheeler River Project

Note: SKCDC – Saskatchewan Conservation Data Centre
SKCDC rankings include:
S1– critically imperiled/extremely rare;
S2 – imperiled/very rare; and
S3 – vulnerable rare to uncommon.

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CCME Canadian Water Quality Guidelines: Cadmium. https://ccme.ca/en/res/cadmium-en-canadian-water-quality-guidelines-for-the-protection-of-aquatic-life.pdf

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