Canada's Nuclear Regulator

Environmental Assessment Report:
Rook I Project

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Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

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Executive Summary

Background

NexGen Energy Ltd. (NexGen) proposes to construct and operate a new underground uranium mine and mill on the Patterson Lake peninsula in the southwestern Athabasca Basin in northern Saskatchewan, approximately 130 km north of the Northern Village of La Loche. The site is in northern Saskatchewan, on Treaty 8 Territory (1899), and the Homeland of the Métis, and is within the traditional territories of the Dene, Cree, and Métis peoples.

The proposed Rook I Project includes underground and surface facilities to support the mining and processing of uranium ore. The main components include an underground mine, an onsite mill to process an average of 1,300 tonnes of ore per day, surface facilities to support the short- and long-term storage of waste rock and ore, an underground tailings management facility, water-handling infrastructure and an effluent treatment circuit, and additional infrastructure to support mining activities.

Under the *Nuclear Safety and Control Act* (NSCA), a licence from the Canadian Nuclear Safety Commission (CNSC) is required to prepare a site for and construct a new uranium mine and mill (Rook I Project).

Environmental assessment requirements

CNSC staff conducted an environmental assessment (EA) of the Project in accordance with the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). The Rook I Project is subject to CEAA 2012 because it qualifies as a designated project as per section 31 of the *Regulations Designating Physical Activities.* The Commission must ensure an EA is complete in accordance with CEAA 2012 and make an EA decision to determine whether the proposed project is likely to cause significant adverse environmental effects before a licensing decision under the NSCA is rendered.

This EA report summarizes the assessment conducted by CNSC staff, including the information and analysis on the potential environmental effects of the Project, and CNSC staff's findings on whether the Project is likely to cause significant adverse environmental effects, after taking into account the implementation of mitigation measures.

CNSC staff prepared this EA report with expert advice from the following federal authorities:

- Environment and Climate Change Canada
- Natural Resources Canada
- Health Canada
- Transport Canada
- Fisheries and Oceans Canada

CNSC staff also consulted with the Province of Saskatchewan to ensure regulatory collaboration and to harmonize environmental assessment processes to the extent possible. Potentially impacted and interested Indigenous Nations and communities provided input to CNSC staff in the development of sections of this EA report related to information or concerns in respect to potential project impacts on rights, interests, culture, or traditional uses, as well as Indigenous

Knowledge. Furthermore, this EA report was informed by comments submitted throughout the EA process by Indigenous Nations and communities.

Scope of the assessment

CNSC staff analyzed potential environmental effects that the Rook I Project, throughout its entire lifecycle, according to the scope of factors determined by the Commission in its 2019 EA Scoping Decision, including paragraphs 19(1)(a) to (h) of CEAA 2012. The Commission also determined that the EA was to consider Indigenous Knowledge and community knowledge, in accordance with subsection 19(3) of CEAA 2012.

Indigenous consultation and engagement

As an Agent of the Crown, the CNSC recognizes and understands the importance of meaningful consultation and engagement and building relationships with Indigenous peoples in Canada. CNSC staff conducted extensive consultation activities with the identified Indigenous Nations and communities to ensure their full participation in the regulatory review process, including the CEAA 2012 EA process. CNSC staff ensured that the concerns of Indigenous Nations and communities were heard and addressed by NexGen and the CNSC in a meaningful way. CNSC staff consider that the consultation and engagement process for the Project has been meaningful, reasonable, responsive, and followed best practices, and note that this process is ongoing and will continue through to and including the Commission hearing. CNSC's final assessment, conclusions and recommendations with regards to the adequacy of consultation will be summarized in the supplemental submission to the Commission prior to the Part 2 hearing.

In addition, NexGen has worked bilaterally with several of the identified Indigenous Nations and communities to negotiate commitments and long-term agreements that address their specific concerns to mitigate potential impacts to their Indigenous and/or Treaty rights. CNSC staff believe the Project's potential impacts on Indigenous and/or Treaty rights have been adequately identified and will be mitigated to the extent possible. The supplemental submission that the CNSC will be providing to the Commission prior to Part 2 of the hearing that will include CNSC's conclusions and recommendations on potential impacts to Indigenous and Treaty rights.

CNSC staff's Consultation Report for the Project provides all details, records and information regarding the consultation and engagement process conducted with Indigenous Nations and communities for the Project to date.

Follow-up monitoring program

Should the Commission determine that the Project is not likely to cause significant adverse environmental effects, or that such effects are justified, CNSC staff recommend that NexGen be required pursuant to paragraph 53(4)(b) of CEAA 2012 to further design and implement an EA Follow-Up Monitoring Program to verify the accuracy of the EA predictions for the Project, determine the effectiveness of measures taken to mitigate the potential adverse environmental effects and support the implementation of adaptive management measures to address unanticipated adverse environmental effects. Further to this determination by the Commission, other environmental monitoring will be required under permits, licences and authorizations that may be issued, as part of regulatory oversight for the Project.

Summary of Potential Effects of the Project

The Project has the potential to interact with environmental and human components in various ways. CNSC staff have reviewed NexGen's assessment, including identified mitigation and follow-up monitoring program measures, and considered expert advice from federal and provincial authorities, as well as comments from Indigenous Nations and communities. Taking all this into account, CNSC staff have found that there are sufficient grounds on which the Commission may conclude that the Project is unlikely to result in significant adverse environmental effects.

Recommendations

Taking into account the implementation of the proposed mitigation measures, follow-up monitoring program measures and commitments made by NexGen to Indigenous Nations and communities, CNSC staff recommend that the Commission conclude that the Rook I Project is not likely to cause significant adverse environmental effects.

These findings are contingent on the recommended EA Conditions (table 12.1) and EA Commitments (table 12.2) proposed throughout this EA Report. Included in the proposed conditions is a recommendation from CNSC staff that NexGen's list of identified mitigation measures, follow-up monitoring program measures and agreed upon commitments with Indigenous Nations and communities, as documented in NexGen's Commitments Report, become an enforceable condition that is set out in the Commission's decision.

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1.0 Introduction

NexGen Energy Ltd. (NexGen) is proposing to construct and operate a new underground uranium mine on the Patterson Lake peninsula in the southwestern Athabasca Basin in northern Saskatchewan, approximately 130 km (155 km by road) north of the Northern Village of La Loche. The site is in northern Saskatchewan, on Treaty 8 Territory (1899), and the Homeland of the Métis, and is within the traditional territories of the Dene, Cree, and Métis peoples.

The proposed Rook I Project includes underground and surface facilities to support the mining and processing of uranium ore. The main components include an underground mine, an onsite mill to process an average of 1,300 tonnes of ore per day, surface facilities to support the short- and long-term storage of ore and waste rock, an underground tailings management facility, water-handling infrastructure and an effluent treatment circuit, and additional infrastructure to support mining activities. For further information providing an overview of the Rook I Project, the project components and activities, please refer to section 3 of this report and to section 1.1.3 of staff's Commission Member Document (CMD 25-H12).

This Environmental Assessment (EA) report summarizes the assessment conducted by the Canadian Nuclear Safety Commission (CNSC) staff to inform the Commission's decision on whether the proposed Rook I Project is likely to cause significant adverse environmental effects, including any adverse effect to Indigenous peoples. Indigenous interests, as described within this EA report, refer to any change to the environment on the health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes and any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

1.1. Environmental assessment requirements

On May 2, 2019, following NexGen's submission of the Project Description (PD), the CNSC issued the Notice of Commencement of a federal EA for the proposed Rook I Project pursuant to CEAA 2012. The Project is subject to an EA under CEAA 2012, as it constitutes a designated activity under item 31 of the *Regulations Designating Physical Activities*:

> **31** The construction, operation and decommissioning of a new uranium mine or uranium mill on a site that is not within the licensed boundaries of an existing uranium mine or uranium mill.

The CNSC determined that it is the responsible authority (RA) for this Project pursuant to paragraph 15(a) of CEAA 2012:

> **15** For the purposes of this Act, the responsible authority with respect to a designated project that is subject to an environmental assessment is
>
> **(a)** the Canadian Nuclear Safety Commission, in the case of a designated project that includes activities that are regulated under the Nuclear Safety and Control Act and that are linked to the Canadian Nuclear Safety Commission as specified in the regulations made under paragraph 84(a) or the order made under subsection 14(2);

On August 28, 2019, the *Impact Assessment Act* (IAA) came into force, repealing the CEAA 2012. Subsection 182 of the IAA outlines transitional provisions for the EAs of designated projects commenced under CEAA 2012 for which the CNSC or National Energy Board are responsible authorities (RAs) and for which a decision statement has not been issued:

> **182** any environmental assessment of a designated project by the Canadian Nuclear Safety Commission or the National Energy Board commenced under the 2012 Act, in respect of which a decision statement has not been issued under section 54 of the 2012 Act before the day on which this Act comes into force, is continued under the 2012 Act as if that Act had not been repealed

The CNSC informed NexGen on August 29, 2019, that the EA process for the proposed Rook I Project would continue under CEAA 2012, as a decision statement had not been reached before the implementation of the new Act.

As a federal authority under CEAA 2012, the CNSC is subject to section 7 of CEAA 2012:

> **7** A federal authority must not exercise any power or perform any duty or function conferred on it under any Act of Parliament other than this Act that could permit a designated project to be carried out in whole or in part unless
>
> **(b)** the decision statement with respect to the designated project that is issued under subsection 31(3) or section 54 to the proponent of the designated project indicates that the designated project is not likely to cause significant adverse environmental effects or that the significant adverse environmental effects that it is likely to cause are justified in the circumstances.

As the responsible authority under CEAA 2012, the CNSC is required by s. 22 of CEAA 2012 to ensure that:

> **(a)** an environmental assessment of the designated project is conducted; and
>
> **(b)** a report is prepared with respect to that environmental assessment.

Pursuant to subsections 27(1) and 52(1) of CEAA 2012, after taking into account the EA report, the CNSC must decide whether the designated project is likely to cause significant adverse environmental effects as set out in section 5 of CEAA 2012.

If the CNSC decides that the Project is likely to cause significant adverse environmental effects, it must refer the Project, pursuant to subsections 52(2) and (3), to the Governor in Council for determination as to whether the significant adverse environmental effects are justified in the circumstances.

If the CNSC decides that the Project is not likely to cause significant adverse environmental effects, pursuant to section 53 it must establish the conditions in relation to environmental effects with which NexGen must comply, including mitigation measures and a follow-up program.

The CNSC conducted the EA in consultation with Environment and Climate Change Canada (ECCC), Fisheries and Oceans Canada (DFO), Health Canada (HC), Transport Canada (TC), and Natural Resources Canada (NRCan) as federal authorities (FAs) having specialist and expert information, or knowledge needed to support the conduct of the EA in the following areas:

- ECCC: species at risk, migratory birds, effluent discharge, surface water
- DFO: fish and fish habitat
- HC: human health
- TC: navigable waters, transportation activities
- NRCan: geology, seismicity

These FAs, along with CNSC subject matter experts and a representative from Clearwater River Dene Nation and Métis Nation - Saskatchewan formed the Federal-Indigenous Review Team (FIRT) for the Project.

Given the proposed location of the Project, it is also subject to the EA requirements of the Government of Saskatchewan under *The Environmental Assessment Act* (EAA). The provincial ministries provided support upon request on areas within their expertise and within the scope of their regulatory responsibilities, particularly Saskatchewan Environmental Assessment Branch (SKEAB).

NexGen submitted an application requesting a licence to prepare site and construct a uranium mine and mill at their Rook I site. As detailed in the CMD 25-H12, to which this EA report is appended, this application is subject to a regulatory decision under the *Nuclear Safety and Control Act* (NSCA). Subsection 24(4) of the NSCA requires that, prior to granting a licence, the Commission must be satisfied that the applicant is qualified to carry out the project and that they will in doing so, make adequate provision for the protection of the environment. Although the licensing decision is specific to the first licensing phase (licence to prepare site and construct), the EA considers all phases of the facility's lifecycle. A decision that the Project will not likely result in significant adverse environmental effects, or that those effects are justified in the circumstances, does not grant permission for any activities beyond activities described in a licence. An EA decision under CEAA 2012 does not authorize project activities; rather, the Commission must determine that the project is not likely to result in significant adverse environmental effects before it may grant a licence under the NSCA. Pursuant to section 26 of the NSCA, a licence is required for site preparation and construction activities.

The Commission's decisions for the Project under CEAA 2012 and the NSCA also trigger the Crown's duty to consult, and where appropriate, accommodate Indigenous Nations and communities, whose potential or established rights and interests protected under section 35 of the *Constitution Act, 1982*, may be impacted by the proposed Project. These decisions will all be made following a two-part hearing planned for November 19, 2025 (Part 1) and February 9-13, 2026 (Part 2).

The full details and records related to consultation and engagement activities with Indigenous Nations and communities are contained in a separate report, titled *"CNSC Staff's Indigenous Consultation Report for the NexGen Rook I Environmental Assessment (EA) and Licence to Prepare a Site and Construct Application"* (herein referred to as "the "Consultation Report"). This can be found in appendix C of the CMD 25-H12 and provides key information and recommendations to date, as well as next steps regarding the Indigenous consultation and engagement activities conducted by CNSC staff in relation to the EA and Licence to Prepare a Site and Construct application for the Project. The Consultation Report also provides information about NexGen's engagement activities to date as per the requirements and guidance of REGDOC

3.2.2: *Indigenous Engagement* (herein referred to as REGDOC 3.2.2) and will form part of CNSC staff's submissions and recommendations to the Commission. Key consultation activities related to the EA process under CEAA 2012 are summarized in section 9 of this report. An update on consultation activities with all identified Indigenous Nations and communities, as well as updated issues tracking tables and Rights Impact Assessments (RIAs), will be submitted to the Commission as part of the CNSC staff's supplemental submission prior to the NexGen Rook I Part-2 hearing.

1.2. Environmental assessment process and timeline

The CNSC, as RA, conducted the various stages of the EA process under CEAA 2012 for the proposed Rook I Project. These stages are presented in figure 1.1. The timeline associated with the Rook I Project EA process with links to related documentation can be found in table 1.1.

Figure 1.1: Environmental assessment process conducted by the CNSC under CEAA 2012

Stage 1: EA Determination

During stage 1, the CNSC determined whether an EA was required for the proposed Rook I Project. NexGen submitted a PD for the proposed Rook I Project. CNSC staff assessed the PD against CNSC's *Generic Guidelines for the Preparation of and Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (herein referred to as the CNSC Generic Guidelines), as identified in CNSC REGDOC-2.9.1 *Environmental Protection: Environmental Principles, Assessments and Protection Measures*, (herein referred to as REGDOC-2.9.1). On May 2, 2019, the CNSC deemed the PD complete, and issued the notice of commencement of a federal EA process for the Rook I Project pursuant to CEAA 2012.

Stage 2: Project Description

Stage 2 consisted of 2 main steps: a public comment period on the PD, and a Commission decision on the scope of the EA. A public comment period held from May to June 2019, allowed Indigenous Nations and communities and the public to review the PD submitted by NexGen. In February 2020, the Commission issued a decision on the scope of the EA, taking into account the comments received from Indigenous Nations and communities and the public related to the PD.

Stage 3: EIS Technical Review

Stage 3 started in June 2022, with the submission of a draft Environmental Impact Statement (EIS) by NexGen and consisted of 2 main steps: a public comment period on the draft and a FIRT technical review. In advance of the public comment period, the CNSC granted $409,079 in funding through its Participant Funding Program (PFP). The purpose of this funding is to support Indigenous Nations and communities, members of the public and interested parties in the review of NexGen's draft EIS.

CNSC staff conducted a 30-day conformity review to ensure that the information submitted was in accordance with CNSC's Generic Guidelines and then the draft EIS was posted for a 90-day public comment period from July 2022 to October 2022. Concurrently, CNSC staff and the FIRT undertook a 120-day technical review of the draft EIS and its technical supporting documents, which included ensuring that the requirements of CNSC's REGDOC-3.2.2 and REGDOC-2.9.1 were met.

In November 2022, CNSC staff completed the initial technical review and produced consolidated tables of FIRT comments, including information requests (IRs) and *Advice to the Proponent* comments, and provided these to NexGen for response. Multiple rounds of iterative review occurred between November 2022 and November 2024, whereby NexGen provided responses to IRs, which the FIRT assessed and provided follow-up requests for outstanding information for NexGen, as demonstrated in table 1.1.

Once NexGen provided complete and sufficient responses to all comments and information requests, they submitted a revised final EIS on November 29, 2024. CNSC staff have reviewed NexGen's final EIS and all supporting documents, including NexGen's responses to IRs to ensure that all changes had been incorporated into the final EIS. CNSC staff deemed NexGen's final EIS complete on January 28, 2025.

For more information on the technical review process methodology, see section 3.4 of this report.

Stage 4: EA Report Drafting

In stage 4 of the EA process, the information contained in the final EIS and supplemental resources and documents (such as technical supporting documents, responses to information requests) were used to prepare this EA report.

Stage 5: Hearing and Decision

During stage 5, the CNSC will hold a two-part public hearing to consider NexGen's application for a licence to prepare a site for and construct its Rook I project. As a prerequisite to the licensing decision, the Commission must first make an EA decision to determine whether the proposed project is likely to cause significant adverse environmental effects.

During Part 1 of the hearing, the Commission will consider oral and written submissions from NexGen and CNSC staff, related to NexGen's application. During Part 2 of the hearing, the Commission will consider oral and written interventions from Indigenous Nations and communities, members of the public and other interested parties.

In advance of the public hearing, the CNSC granted $464,979.93 in funding through its PFP. The purpose of this funding is to support Indigenous Nations and communities, members of the public and interested parties to 1) review CNSC staffs' and NexGen's submissions to the Commission 2) participate in the hearing process, and 3) provide topic-specific interventions to the Commission

Pursuant to rule 19 of the *CNSC Rules of Procedure*, persons who have an interest or expertise in this matter or information that may be useful to the Commission in coming to a decision are invited to comment on NexGen's application.

Stage 6: Ongoing Oversight Monitoring and Compliance

Should the Commission issue a licence to prepare site and construct, and in future to operate, and decommission the Rook I Project, CNSC staff will verify compliance through desktop reviews and inspections, including the review of environmental monitoring and follow-up reports. CNSC staff will report on the status of the project during updates provided as part of the Uranium Mine and Mills Regulatory Oversight Report or another appropriate mechanism.

Table 1.1: Timelines associated with the Rook I EA process

Activity or step in EA process	Date
NexGen submitted the **Rook I Project** description – **Notice of Commencement issued for Project**	May 2, 2019
Public comment period on Rook I Project description (30 days)	May 2- June 1, 2019
Commission hearing and decision on the scope of the proposed Rook I Project	February 20, 2020
CNSC Notice of participant funding for the public for reviewing and commenting on the draft EIS	May 2020
NexGen submitted a draft EIS for the Rook I Project	June 13, 2022
CNSC staff performed a conformity review of the draft EIS (30 days)	June 13 to July 12, 2022
CNSC webinar – CNSC regulatory review process	September 2022
Public comment period on the draft EIS (90 days)	July 14– Oct 12 2022
The FIRT completes initial technical review of the draft EIS and deems draft EIS incomplete (120 days), transmission of FIRT IRs to NexGen	Nov 16, 2022
CNSC completes review of public comments and transmission of public comments to NexGen	Dec 20, 2022
NexGen submits responses to IRs from FIRT and CNSC completeness review passes	Nov 14, 2023
The FIRT completes a technical review of NexGen's responses to IRs and deems incomplete	Feb 12, 2024
NexGen submits Revised Draft EIS	May 22, 2024
The FIRT completes review of revised Draft EIS and all IR responses deemed acceptable by CNSC staff	Nov 18, 2024
NexGen submits Final EIS	Nov 29, 2024
CNSC deem Final EIS complete	Jan 28, 2025
Notice of participant funding offering (2)	March 10, 2025
Notice of Public Hearing	March 11, 2025
Revised Notice of Public Hearing	August 20, 2025

These steps are documented on the Canadian Impact Assessment Registry (herein referred to as the Registry - formerly the Canadian Environmental Assessment Registry) for the project (Reference Number 80171).

1.3. Purpose of the environmental assessment report

The purpose of the EA report is to summarize the assessment conducted by CNSC staff, including the information and analysis considered by CNSC staff in reaching its findings on whether the Project is likely to cause significant adverse environment effects, after taking into account the implementation of proposed mitigation measures. The report also includes recommended conditions, based on key mitigation measures and follow-up measures for the Commission to consider in their decision.

This EA report is designed to reflect the scope of the EA decision by the Commission and address requirements of CEAA 2012 (see section 2.1). The Commission will consider this report and comments received by Indigenous Nations and communities and the public when issuing an EA decision for the Project under CEAA 2012. In short, the report content is structured as follows:

- introductory chapters, providing an overview of the project, regulatory requirements and existing site conditions (section 1, section 2, section 3, section 4 and section 5)
- predicted changes to the environment that could be caused by the Project (section 6)
- predicted effects on VCs from changes to the environment (section 7)
- assessment of accidents and malfunctions, effects of the environment on the project, and assessment of cumulative environmental effects (section 8)
- views expressed by Indigenous Nations and communities, including their key issues and concerns, co-developed by interested Indigenous Nations and communities (section 6, section 7 and section-8)
- Indigenous consultation and engagement and key issues and description of Indigenous and/or Treaty rights that could be potentially affected by the Project (section 9)
- public engagement and key issues raised during EA-specific engagement activities (section 10)
- follow-up monitoring program (section 11)
- CNSC staff findings and recommendations (section 12)

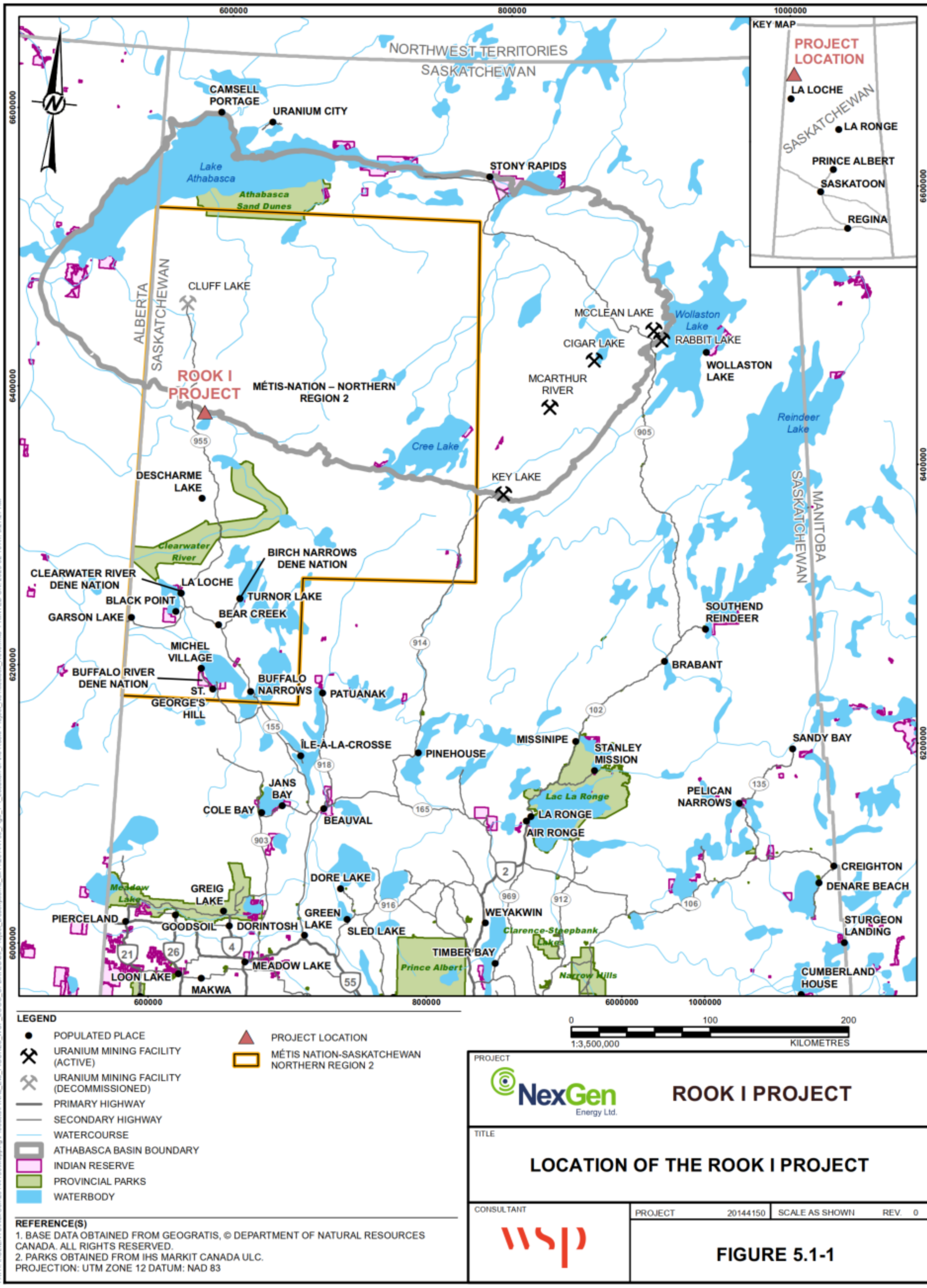
2. Project overview

NexGen is proposing to develop a new uranium mining and milling operation located in Northern Saskatchewan, approximately 130 km north of the Northern Village of La Loche. The Rook I Project would produce up to 13.6 million kilograms (Mkg) of U_3O_8 annually with a projected mine life of 24 years. The proposed project would include an underground mine and surface facilities to support the extraction of uranium ore and the production of uranium concentrate. The project would span a 43-year period, where construction phase is expected to take place over approximately 4 years, operations phase is anticipated to last approximately 24 years, followed by decommissioning and reclamation (closure) phase with an expected duration of 15 years. Section 4 of this EA report summarizes the alternative means considered by NexGen for the Project. Additional Project details can be found in section 1.1.2 of the CMD 25-H12 and the following sections provide a brief overview of the Project.

2.1. Project location

The Project is proposed to be located in Saskatchewan’s Athabasca Basin approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon. The project falls within Treaty 8 Territory (1899), and the Homeland of the Métis, and is within the traditional territories of the Dene, Cree, and Métis peoples. Figure 2.1 depicts the Project location in Saskatchewan.

Figure 2.1: Project location



2.2. Project components

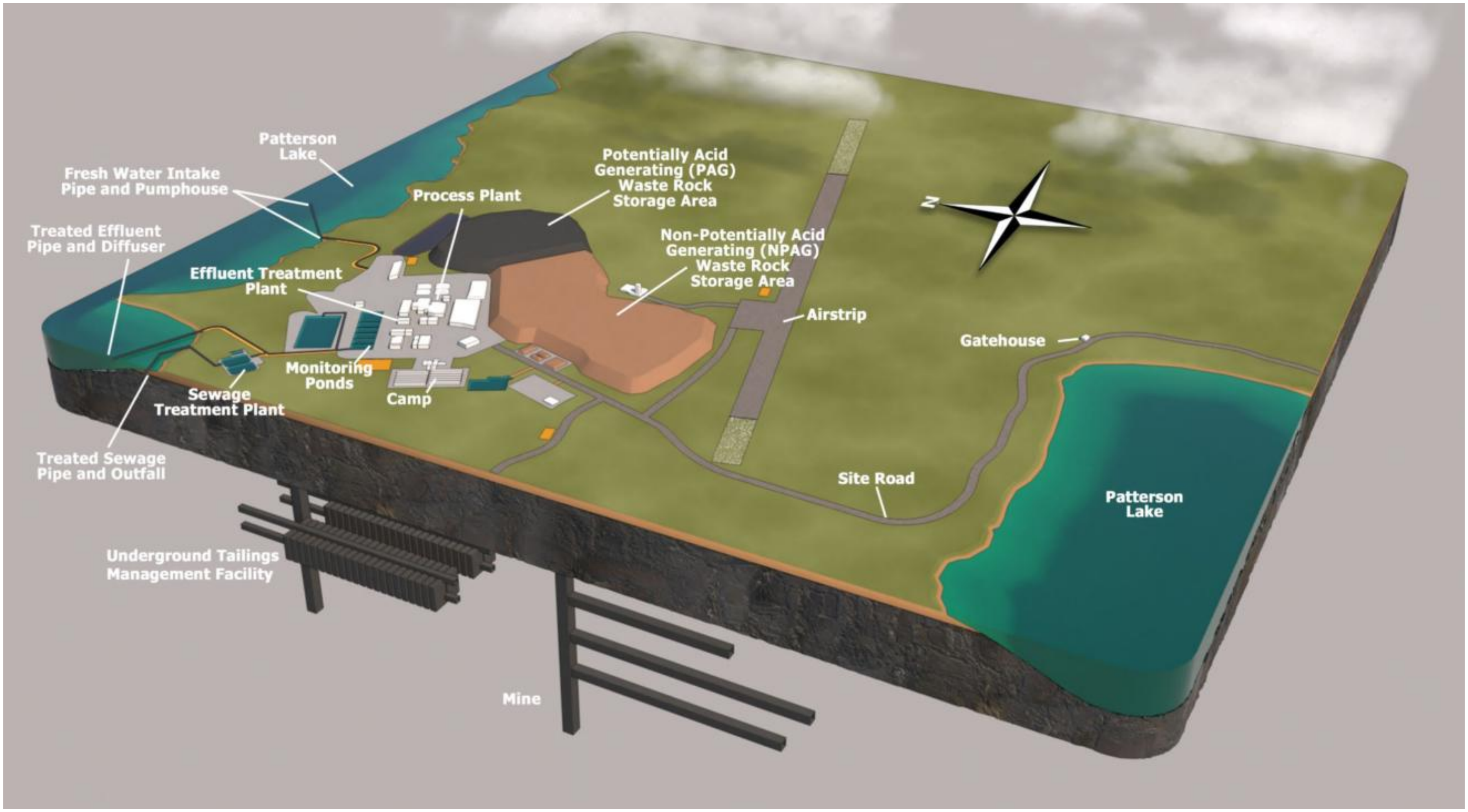
The main Rook I Project components and descriptions are listed in table 2.1. Figure 2.2 illustrates the proposed geographic locations of the proposed Rook I Project components.

Table 2.1: Descriptions of the main Rook I Project components

Project component	Description
Mining	The underground mine includes all the components required to access, extract and support mining and the underground tailings management facility (UGTMF) storage. Long hole stoping is the primary mining method for both the production and development of UGTMF chambers.
Processing	Uranium ore processing for the Project would include acid leaching, solvent extraction, uranium precipitation and calcining to extract the uranium concentrate product.
Tailings Management	The tailings management system would include the paste plant, paste delivery system, production stope backfilling, and UGTMF.
Mine Rock Management	The ore storage stockpile, special waste rock stockpile, potentially acid generating (PAG) waste rock storage area (WRSA) and non-potentially acid generating (NPAG) WRSA will be used to store the different classifications of mine rock at the surface.
Site Water Management	Site water management would include infrastructure related to water supply; surface water management; mine dewatering; effluent treatment, monitoring and release; and sanitary sewage collection, treatment and release.
Conventional Waste Management	Conventional waste management includes infrastructure and processes used for the collection, storage, handling, processing and disposal of conventional waste streams. This includes domestic waste, industrial waste, hazardous waste and low-level radioactive waste (LLRW).
Supporting Infrastructure	On-site surface infrastructure required to support mining and milling includes worker accommodations; maintenance shop and warehouse building; wash bays; airstrip* and associated infrastructure; power supply and distribution; fuel storage; information technology and communications; site roads and gatehouse.

*In July 2025, CNSC staff became aware that NexGen had started the construction of a temporary exploration airstrip. NexGen has advised CNSC staff that this temporary airstrip is separate and distinct from the work done in support of the Rook I project and have indicated that the temporary airstrip has clear and independent utility in supporting NexGen's regional exploration programs.

Figure 2.2: Project components and site layout



2.3. Project activities

Table 2.2 lists the key project activities that would occur during each phase of the Rook I Project. The table also shows the approximate expected duration of each project phase.

Table 2.2: Rook I Project activities and duration by phase

Project phase (planned duration)	Project activities
Construction (4 years)	• Establish the gatehouse. • Upgrade existing access road and develop selected site roads within the Project footprint. • Install the camp. • Construct the on-site airstrip and associated infrastructure. • Clear and grub the mine and mill terrace areas. • Strip topsoil layers, subsoil material, and organic materials and stockpile for future reclamation. • Use cut and fill excavation to create mine and mill terrace areas. • Establish waste and water management infrastructure. • Develop surface infrastructure to support underground activities. • Establish the exhaust shaft and production shaft and begin underground development. • Begin construction and commissioning of the process plant. • Develop and commission other infrastructure and services in preparation for Operations.
Operations phase (24 years)	• Mine development, production mining and UGTMF development. • Operation of processing plant. • Tailings management. • Mine rock management. • Site water management. • Waste management. • Operation of mobile fleet.
Decommissioning and Reclamation (i.e. Closure phase) (15 years)	• Active closure: Active decommissioning, water treatment and reclamation activities (5 years). • Transitional monitoring stage: Control of the site is transferred to the Province of Saskatchewan for management (10 years).

3. Assessment methods and EA report approach

In order to assess the effects to the environment from a project and for CNSC staff to perform their analysis of the submission by NexGen, the following basic elements needed to be in place:

- the scope of the environmental assessment (section 3.1 of this report)
- the identification of valued components that were deemed important and for which effects would be assessed (section 3.2)
- the spatial and temporal boundaries of the project (as related to environmental effects) (section 3.3)
- the consideration of Indigenous Knowledge (section 3.4), and
- the analysis methodology followed for the EA process (section 3.5)

3.1. Scope of the environmental assessment

Scoping is a procedural step in the EA process under CEAA 2012 that establishes the boundaries of the federal EA. The scope identifies which elements of the proposal to consider and include in the EA, and which environmental components are likely to be affected.

Subsection 19(2) of CEAA 2012 requires RAs to determine the scope of the factors to be taken into consideration in the EA of a proposed project. On February 20, 2020, the Commission issued a decision on the extent of information to be included in the EA. The decision took into account the comments received from Indigenous Nations and communities and the public related to the project description, as well as CNSC staff recommendations. The Commission determined that the proposed project must include the factors mandated in paragraphs 19(1)(a) to (h) of CEAA 2012:

- the environmental effects of the designated project as per section 5 of CEAA 2012, including the environmental effects of malfunctions or accidents that may occur in connection with the designated project and any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out
- the significance of the effects referred to above
- comments from the public and Indigenous Nations and communities that are received in accordance with CEAA 2012
- mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project
- the requirements of the follow-up monitoring program in respect of the designated project
- the purpose of the designated project
- alternative means of carrying out the designated project that are technically and economically feasible and the environmental effects of any such alternative means
- any change to the designated project that may be caused by the environment

In addition, CNSC staff recommended that the EA for the Rook I Project should consider Indigenous Knowledge (IK) and community knowledge. For the Rook I Project, the EA considered potential environmental effects on areas of federal jurisdiction in relation to subsection 5(1) of CEAA 2012, including:

- fish and fish habitat, migratory birds (5(1)(a))
- a change that may be caused to the environment that would occur on federal lands (5(1)(b))
- with respect to Indigenous peoples, an effect of any change that may be caused to the environment on:
  - health and socio-economic conditions
  - physical and cultural heritage
  - current use of lands and resources for traditional purposes
  - any structure, site or thing that is of historical, archaeological, paleontological or architectural significance for Indigenous peoples (5(1)(c))

In accordance with subsection 5(2) of CEAA 2012, the EA also considered:

- changes other than those referred to in paragraphs 5(1)(a) and (b), that may be caused to the environment that are directly linked or necessarily incidental to any federal decisions pursuant to other legislation (5(2)(a))
- effects other than those referred to in paragraph 5(1)(c), of any changes that may be caused to the environment, referred above, on health and socio-economic conditions, physical and cultural heritage, or any structure, site, or thing that is of historical, archaeological, paleontological, or architectural significance (5(2)(b))

Federal EAs consider the potential adverse effects of a proposed project on species at risk, pursuant to subsection 79(1), and (2) of the *Species at Risk Act* (SARA) and their critical habitat:

> **79 (1)** Every person who is required by or under an Act of Parliament to ensure that an assessment of the environmental effects of a project is conducted, and every authority who makes a determination under paragraph 82(a) or (b) of the *Impact Assessment Act* in relation to a project, must, without delay, notify the competent minister or ministers in writing of the project if it is likely to affect a listed wildlife species or its critical habitat.
>
> **79(2)** the person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans.

These subsections require that any authority who is required to ensure that an EA is conducted must ensure that the EA considers whether the project is likely to affect a listed wildlife species or its critical habitat, and if the project is carried out, must ensure that measures are taken to avoid or lessen any adverse effects on those species. This must identify the adverse effects of the project on the wildlife species listed in Schedule 1 of the SARA and associated critical habitat. Species listed under SARA are protected from being disturbed, collected, harvested, captured, killed, or exported. Under SARA, over 400 species have been identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as being at risk in Canada and require special management considerations, including appropriate surveys and setbacks on lands where species have been recorded.

Effects on species designated by the COSEWIC and provincially designated species of concern are also considered in the assessment process, as well as species of interest identified by Indigenous Nations and communities and the public.

Transport Canada highlighted that NexGen must adhere to the requirements of the *Canadian Navigable Waters Act* (CNWA) and conditions outlined in any CNWA approval(s) that may be granted by the Minister of Transport for the Project, to ensure that no significant residual adverse effects to navigation occur.

If the watercourse crossings, water intake, and effluent discharge/intake pipeline and diffuser are constructed as minor works, NexGen must follow the mitigations outlined in the CNWA Minor Works Order. Should a CNWA approval(s) be required for any of the in-water works, mitigation measures will be developed during the regulatory phase and included as terms and conditions in the CNWA approval(s).

Given the Rook I Project is in the Southwestern Athabasca Basin region of Northern Saskatchewan and is also regulated by the province of Saskatchewan, the following provincial permits may be required:

- approval to construct a pollutant control facility
- permit to construct a facility to handle hazardous substances or waste dangerous goods

Notwithstanding this, it is NexGen's responsibility to identify and comply with all applicable regulatory requirements, both federal and provincial.

Other Views Expressed sub-sections are included in section 6, section 7, and section 8 to provide summaries of the views expressed by federal authorities, where applicable, with respect to each potential effect on the environmental component or VC under review.

These sections also capture key issues and concerns heard in writing or verbally through technical meetings or engagement and consultation activities, as well as how NexGen will be mitigating or managing such concerns, because of commitments, or as requested by CNSC staff and other federal and/or provincial authorities.

3.2. Selection of valued components

A valued component (VC) is a component that is considered to be ecologically, culturally, socially, or economically significant. These are the components for which effects from the project will be assessed. Characterization of the existing environment includes the identification of VCs by NexGen, government agencies, Indigenous Nations and communities, and the public.

The VCs selected by the CNSC are presented in table 3.1. and were selected based upon CEAA 2012 and SARA legislative requirements. A review by CNSC staff and the FIRT of existing information, baseline data analyses, consultations with Indigenous Nations and communities and consideration of IK yielded the list of equivalent species and ecosystems of interest presented in table 3.1. The equivalent NexGen-identified VCs are also presented in table 3.1.

Table 3.1: Rationale for CNSC-identified VCs and their equivalent NexGen-identified VCs

CNSC-identified VCs	Species and ecosystems of interest identified by Indigenous Nations and communities	Equivalent NexGen-identified VCs	Rationale
Effects identified pursuant to subsection 5(1) of the CEAA 2012			
Fish and fish habitat (5(1)(a))	• Arctic Grayling (*Thymallus arcticus)* • Bait fish/Minnows *(Phoxinus Phoxinus)* • Burbot *(Lota lota)* • Catfish *(Siluriformes)* • Herring *(Clupea harengus)*/Cisco *(Coregonus artedi)* • Jackfish *(Trachurus symmetricus*)/Northern Pike *(Esox lucius)* • Pickerel *(Esox)* /Walleye *(Sander vitreus)* • Lake Trout *(Salvelinus namaycush)* • Yellow Perch *(Perca flavescens)* • White Sucker *(Catostomus commersonii)* • Longnose Sucker *(Catostomus Catostomus)* • Lake Whitefish *(Coregonus clupeaformis)*	• Lake Trout • Lake Whitefish • Walleye • Northern Pike	Project-related predicted changes to water quality and quantity, and discharge of treated wastewater to Patterson Lake/other nearby lakes and rivers could adversely affect fish and fish habitat.
Transboundary environmental effects: GHG emissions (5(1)(2)	• Air Quality	• Greenhouse Gases	Project-related predicted changes to GHG emissions could contribute to global climate change.
Migratory birds (5(1)(a))	• Common Goldeneye (*Bucephala clangula*) • Mallard (*Anas platyrhynchos*) • Common Loon (*Gavia immer*)	• Olive-sided Flycatcher *(Contopus cooperi)* • Mallard	Project-related predicted changes to surrounding terrestrial environment could adversely affect migratory birds and their habitat.

CNSC-identified VCs	Species and ecosystems of interest identified by Indigenous Nations and communities	Equivalent NexGen-identified VCs	Rationale
	• Bank Swallow (*Riparia riparia)* • Barn Swallow (*Hirundo rustica*) • Red-throated Loon (*Gavia stellata*) • Horned Grebe (*Podiceps auritus*) • Red-necked phalarope (*Phalaropus lobatus*) • Yellow Rail (*Coturnicops noveboracensis*) • Whooping Crane (*Grus americana*) • Osprey (*Pandion haliaetus*) • Peregrine Falcon (*Falco peregrinus*) • Short-eared Owl (*Asio flammeus*) • Great grey Owl (*Strix nebulosa*)	• Common Goldeneye • Rusty Blackbird *(Euphagus carolinus)*	
Indigenous uses: Current use of lands and resources for traditional purposes (5(1)(c)	• Medicinal plants • Traditional use plant species (Traditional plant species used for food, medicinal, ceremonial or other purposes) • Fish (see fish and fish habitat)	• Indigenous land and resource use by indigenous peoples	Project-related predicted changes to surrounding terrestrial and aquatic environments could adversely affect the use of lands and resources for traditional purposes by Indigenous peoples.
Effects identified pursuant to subsection 5(2) of the CEAA 2012			
Human Health (5(2)(b)) (Includes Indigenous peoples Health*) (5(1)(c))	• Harvester • Resident • Worker	• Human health	Project-related predicted changes in water quality and air quality could adversely affect the health of Indigenous peoples, the public and workers.

CNSC-identified VCs	Species and ecosystems of interest identified by Indigenous Nations and communities	Equivalent NexGen-identified VCs	Rationale
*applies to both 5(1) and 5(2)			
Wetlands (5(2)(b))	• Canadian Toad (*Anaxyrus hemiophrys*) • Northern Leopard Frog (*Lithobates pipiens*)	• Canadian Toad • Wetland Ecosystems	Project-related predicted changes to water quality, and disturbance of terrestrial environment, could adversely affect wetlands, which are difficult to restore and play an important role in ecosystem function. Also related to other federal decisions.
Terrestrial biota (5(2)(b))	• Spruce Grouse (*Canachites canadensis*) • Rabbits/Snowshoe Hare (*Lepus americanus*) • Moose (*Alces alces*) • American Marten (*Martes americana*) • Beaver (*Castor*) • Red Fox (*Vulpes vulpes*) • Mink (Lutreola) • Canada Lynx (*Lynx canadensis*) • Coyote (*Canis latrans*) • Wolverine (*Gulo gulo*) • Fisher (*Pekania pennanti*) • Muskrat (*Ondatra zibethicus*) • Squirrel (*Sciuridae*) • Weasel (*Mustela*) • River Otter (*Lontra canadensis*) • Barren-ground Caribou (*Rangifer tarandus groenlandicus*)	• Moose • Grey Wolf • Black Bear • Beaver • Mallard • Common Goldeneye • Upland ecosystems • Riparian ecosystems • Traditional use species	Project-related predicted changes to the terrestrial wildlife and vegetation, and disturbances to the terrestrial environment, could adversely affect the terrestrial environment beyond the boundaries of the project site. Also related to other federal decisions, including *SARA*.

CNSC-identified VCs	Species and ecosystems of interest identified by Indigenous Nations and communities	Equivalent NexGen-identified VCs	Rationale
	• White-tailed Deer (*Odocoileus virginianus*) • Black Bear (*Ursus americanus*) • Grey Wolf (*Canis lupus*)		
Species at risk	• Woodland Caribou (*Rangifer tarandus caribou*) • Little Brown Myotis (*Myotis lucifugus*) • Olive-sided Flycatcher (*Contopus cooperi*) • Rusty Blackbird (*Euphagus carolinus*) • Beautiful Sedge (*Carex concinna*) • Northern Myotis (*Myotis septentrionalis*) • Common Nighthawk (*Chordeiles minor*) • Barn Swallow (*Hirundo rustica*) • Ashton Cuckoo bumble bee (*Bombus ashtoni*) • Yellow-banded Bumble Bee (*Bombus terricola*) • Transverse Lady Beetle (*Coccinella transversoguttata*) • Nine-spotted Lady Beetle (*Coccinella novemnotata*)	• Woodland Caribou • Little Brown Myotis • Olive-sided Flycatcher • Rusty Blackbird	Project-related predicted disturbances of terrestrial and aquatic environments could adversely affect species at risk and their critical habitat. There are no fully aquatic SAR (i.e., fish) identified within the vicinity of the Project.

3.3. Spatial and temporal boundaries

Spatial boundaries define the areas within which a designated project may cause direct or indirect environmental effects. Temporal boundaries define the timeframe during which an environmental effect may occur in relation to a designated project's activities. Defining spatial and temporal boundaries allows a frame of reference to be established for identifying and assessing the environmental effects associated with a designated project.

3.3.1. Spatial Boundaries

The spatial boundaries for the proposed Rook I Project were determined by CNSC staff to be appropriate for each selected environmental compartment (atmospheric and acoustic environment, geology and groundwater environment, aquatic environment and terrestrial environment), and associated VCs (including human health and Indigenous land and resource use). Effects on the VCs are caused by changes to the environmental compartments, which may originate from project activities. Consistent with the CNSC Generic Guidelines, the following spatial boundaries identified by NexGen were considered for each environmental compartment:

- **Site study area (SSA)**: The SSA is the Rook I Project footprint (the area where all project activities are proposed to be undertaken, including facilities, buildings, and infrastructure)
- **Local study area (LSA)**: The LSA is the area existing outside the SSA, where measurable changes to the environment may be anticipated due to project activities. These changes may occur during any phase of the project, either through normal activities or from possible accidents or malfunctions.
- **Regional study area (RSA)**: The RSA is the maximum area within which the potential effects of the project may interact with the effects of other projects and activities (or anticipated projects and activities), resulting in a potential for cumulative effects.

It is important to note that a maximum disturbance area was also a spatial boundary consideration for certain assessments (e.g., terrain and soils, vegetation, wildlife and wildlife habitat, indigenous land and resources use, and other land and resource use) to address uncertainty in the final design of the project.

Table 3.2 summarizes the spatial boundaries for the Rook I Project for each environmental compartment. Maps of the spatial boundaries for each environmental compartment are provided in figures 3.1 – 3.14, as illustrated in NexGen's final EIS.

3.3.2. Temporal boundaries

Project phases define the time periods for which likely project-specific and cumulative effects would be considered. In the Commission's scoping decision, the Commission directed NexGen to consider the longest period of potential effects when defining temporal boundaries, as outlined in section 5.2.2 of the CNSC Generic Guidelines. The temporal boundaries for the proposed Rook I Project, identified by NexGen, were consistent with the CNSC Generic Guidelines and determined to be appropriate by CNSC staff to be appropriate. The following temporal boundaries were considered for the EA:

- **Site Preparation and Construction phase** (4 years): When physical activities relating to site preparation and construction occur, including activities such as installing necessary supporting infrastructure, inactive commissioning, systems testing, and transportation of construction materials.

- **Operations phase** (24 years): Includes all activities associated with mining and processing ore, tailings, waste rock and domestic waste management, hazardous materials, water management, release of treated effluent, site maintenance, progressive reclamation, and transportation of staff and materials.
- **Decommissioning (active closure) phase** (5 years): active decommissioning and reclamation activities that occur post-operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetation disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional monitoring stage.
- **Post-closure (transitional monitoring) phase** (10 years) that includes monitoring and reporting activities that occur post-active closure that would continue until monitoring and reporting verifies that the performance criteria have been met.

Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval, the land would be transferred back under provincial management though the Institutional Control Program.

In certain circumstances, the duration of effects may extend beyond specific phases of the Project, including Closure, depending on the physical, biological, social, and/or cultural properties and resilience of VCs and intermediate components. Under these circumstances, effects from the Project that may occur well beyond Closure, were also assessed using a far-future scenario, that encompasses the long-term period during extremely slow migration of COPCs from the UGTMF and waste rock storage areas to the environment (i.e., more than 5,000 years).

Table 3.2: Spatial boundaries for each environmental compartment considered in the EA

Environmental compartment	Spatial boundaries		
	SSA	LSA	RSA
Atmospheric environment (see figure 3.1 and 3.2)	Synonymous with the Project footprint	90,000 ha	640,000 ha
Geological and hydrogeological environment (see figure 3.3 and 3.4)	Synonymous with the Project footprint	Includes the SSA and is defined as the area where direct changes to the physical-chemical groundwater environment because of the proposed Project would be expected. Defined by the Clearwater River watershed boundary up to the Naomi Lake outlet.	Encompasses NexGen's Arrow deposit and defined by the Clearwater River watershed boundary upstream of the Mirror River confluence.
Surface water* environment (see figure 3.5)	Synonymous with the Project footprint	Includes the SSA and is defined by the Clearwater River watershed boundary to just downstream of the Naomi Lake outlet.	Defined by the Clearwater River watershed boundary upstream of the Mirror River confluence.
Aquatic environment* (see figure 3.6)	Synonymous with the Project footprint	Includes the SSA and is defined by the Clearwater River watershed boundary up to the Naomi Lake outlet.	Includes the LSA and is defined by the Clearwater River watershed boundary upstream of the Mirror River confluence.
Terrestrial environment* (see figures 3.7, 3.8, 3.9)	Includes the Project footprint which covers 228 ha and includes the access road and bridge, and all proposed mine site infrastructure and features.	Is defined by a 500 m buffer around the maximum disturbance area.	Includes the LSA plus Forrest Lake, Beet Lake, and Naomi Lake and the watershed east and north of the confluence of the Clearwater and Mirror rivers.
Human health* (see figure 3.10)	Equivalent to the Project footprint, which includes all proposed mine infrastructure and facilities, the access road, and accommodations where workers reside while at work.	Encompasses the LSA for the aquatic and terrestrial environments and defines the expected extent of the direct and indirect effects from the project on selected receptors. Includes the spatial extents of potential air quality effects and provides local context for assessing the residual effects.	Encompasses the RSA for the aquatic and terrestrial environments but also includes Lloyd Lake. Provides broader scale context for Project effects and assesses cumulative effects, if applicable.

Environmental compartment	**Spatial boundaries**		
	SSA	**LSA**	**RSA**
Land and resource use*, ** (see figures 3.11, 3.12)	Synonymous with the Project footprint and includes the access road and bridge, all proposed Project infrastructure.	Includes the LSAs for the terrestrial and aquatic environments and human health RSAs, for a total area of approximately 125,679 hectares	Encompasses the RSA for the aquatic and terrestrial environments as well as the traditional territories of the directly affected Indigenous nations and communities and covers an area of approximately 43,577 km2.
Socio-economic environment* (see figures 3.13, 3.14)	Synonymous with the Project footprint and includes the access road and bridge, all proposed Project infrastructure.	Includes the LPA communities that are either along Highway 155 or have close ties to Patterson Lake.	Includes the LSA and the Northern Saskatchewan Administrative district as defined in *The Northern Municipalities Act, 2019.*

*Spatial boundaries selected were influenced by Indigenous and/or Métis Knowledge

** CNSC staff’s assessment is broader than provincial borders where applicable and includes any additional information shared by Indigenous Nations and communities

Figure 3.1: Site, local and regional study areas – Air Quality

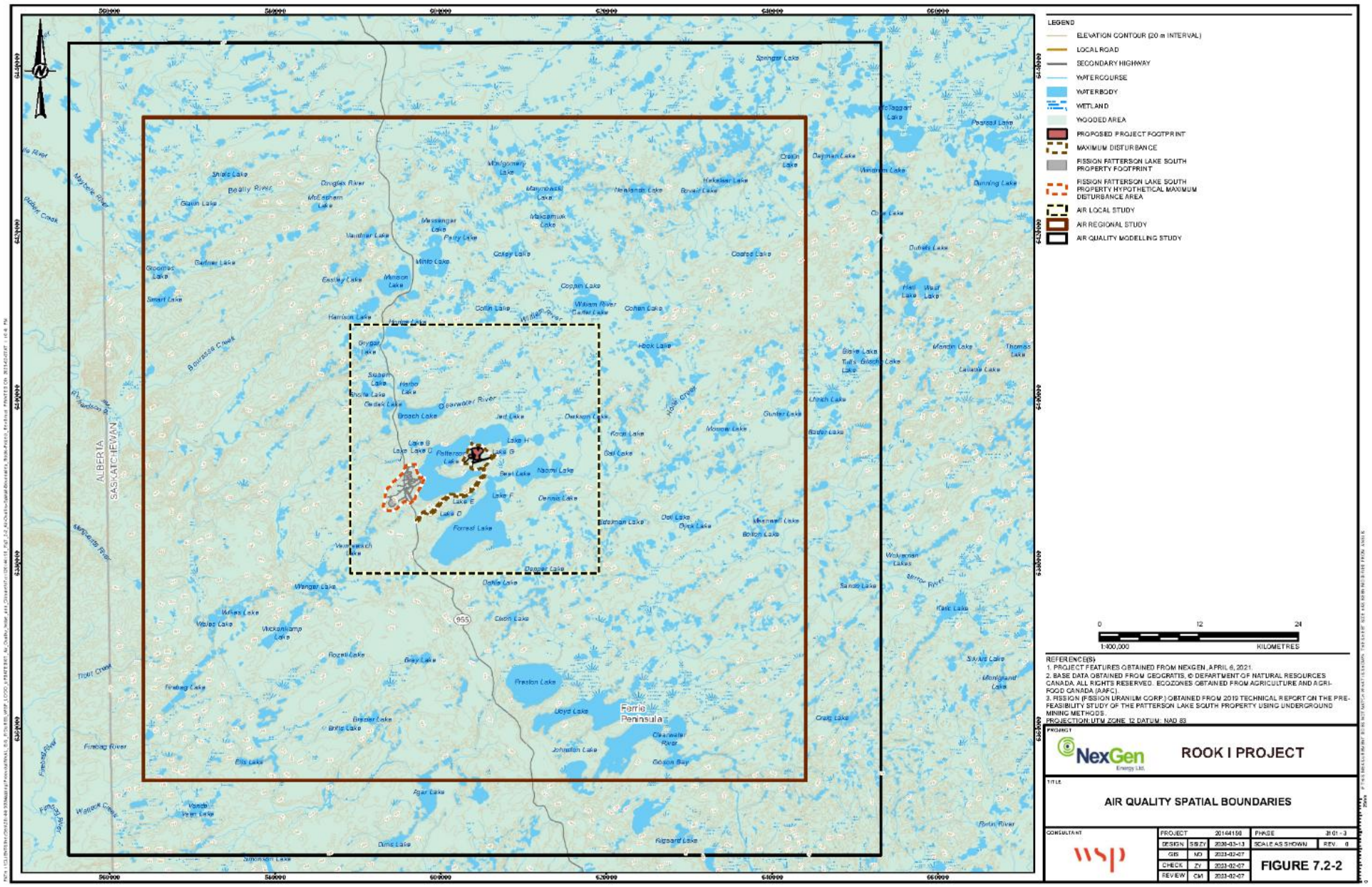


Figure 3.2: Site, local and regional study areas – Noise

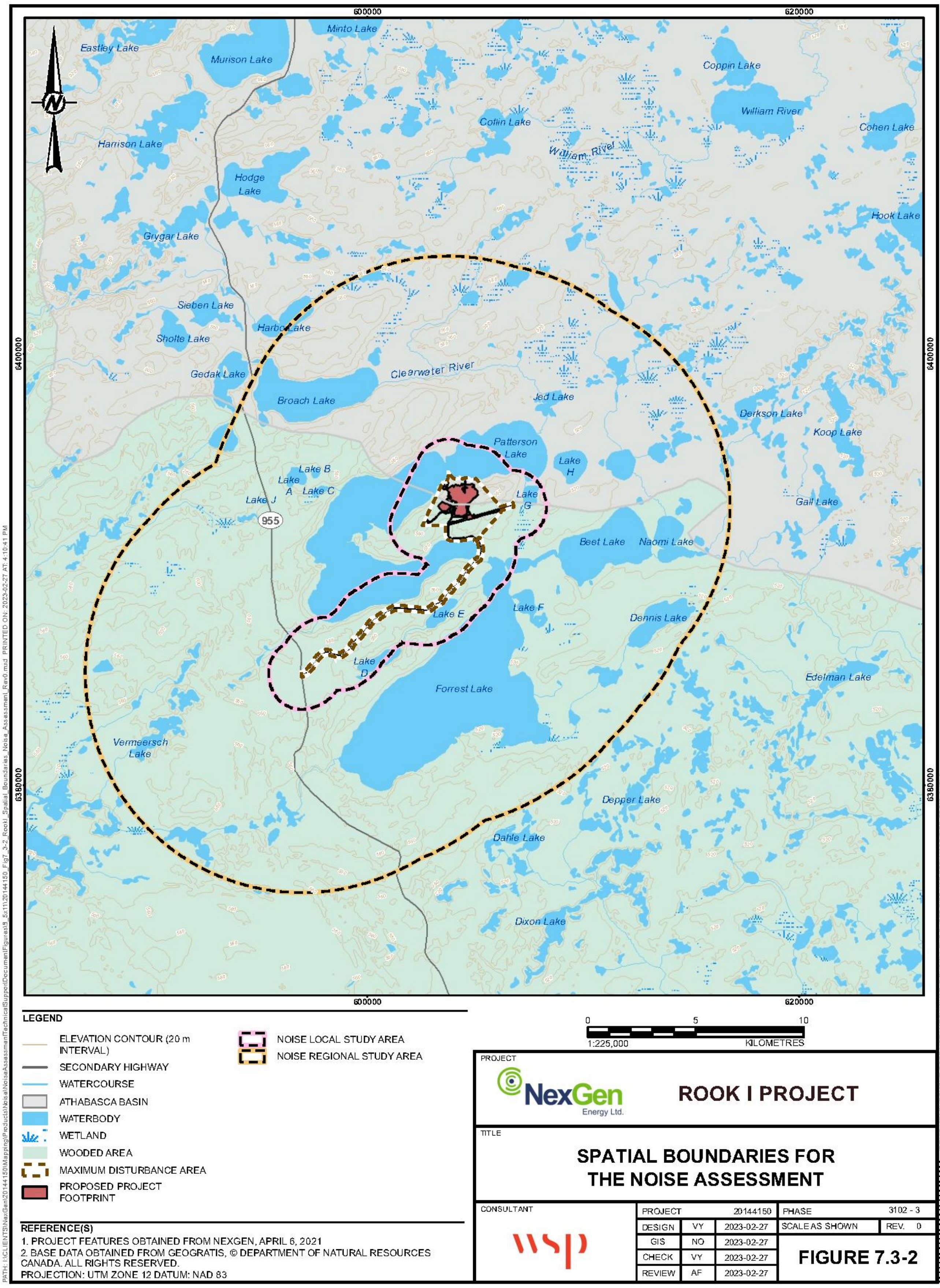


Figure 3.3: Site, local and regional study areas – Hydrology

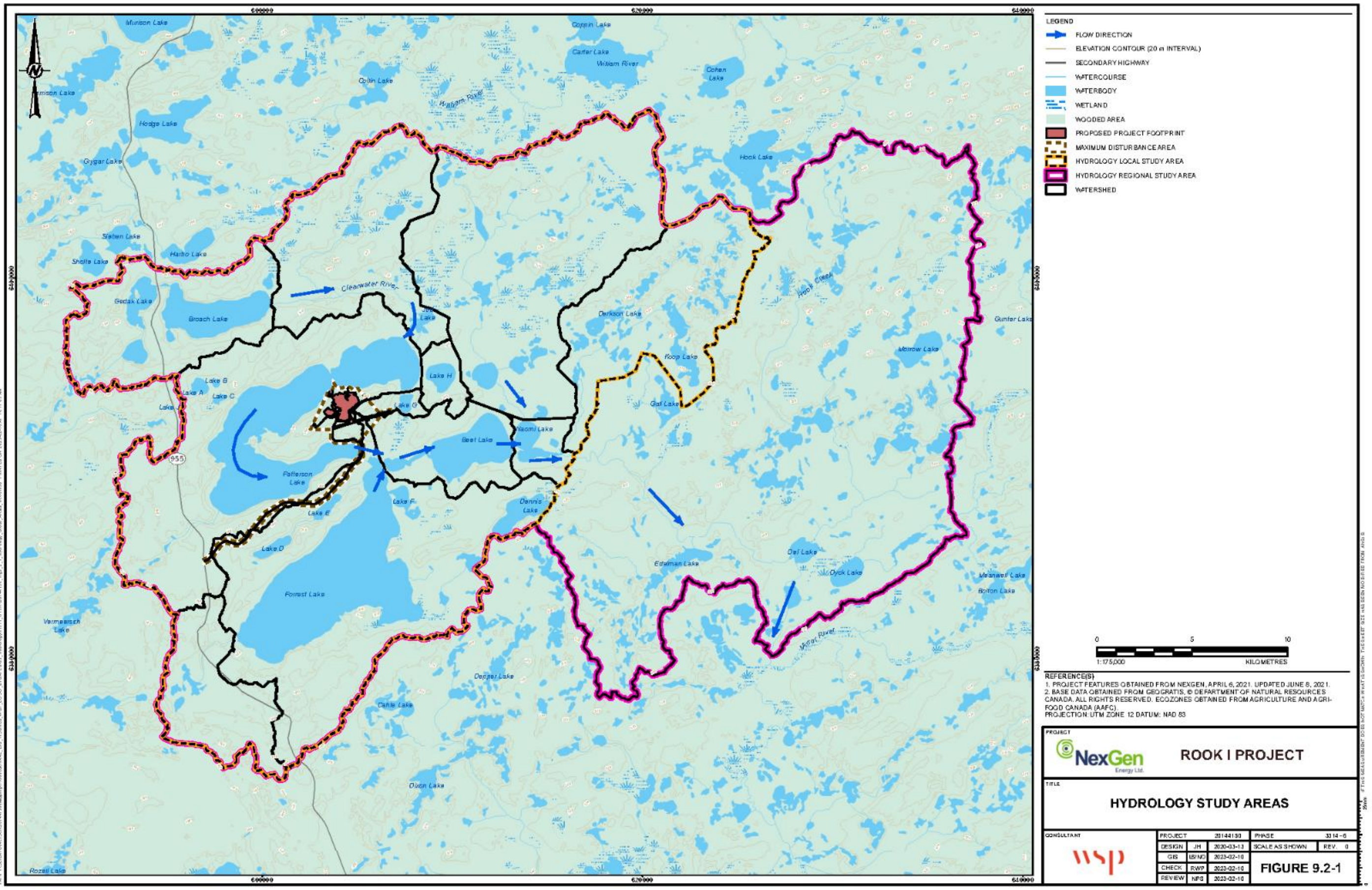


Figure 3.4: Site, local and regional study areas – Hydrogeological

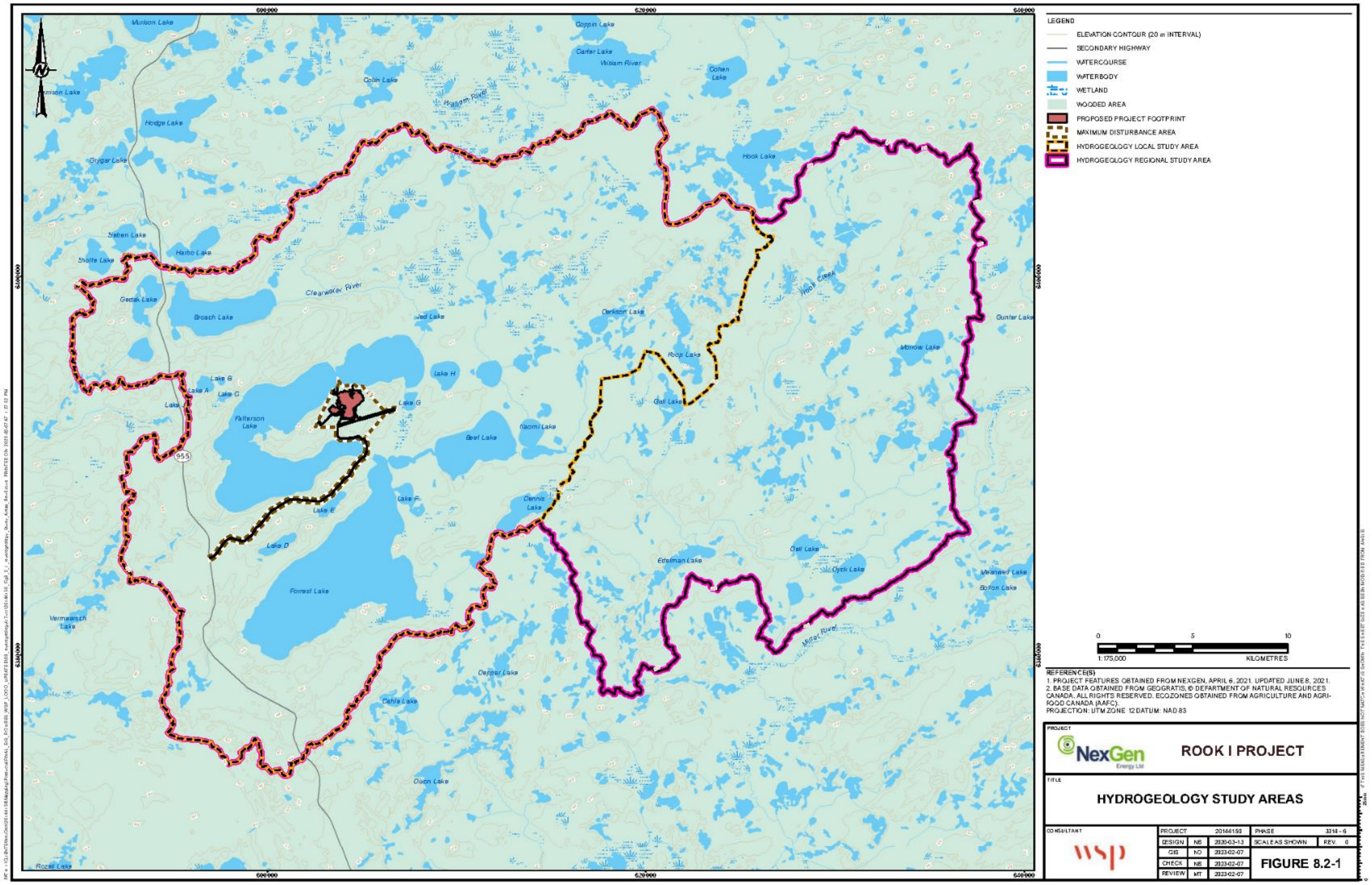


Figure 3.5: Site, local and regional study areas – Water and Sediment Quality

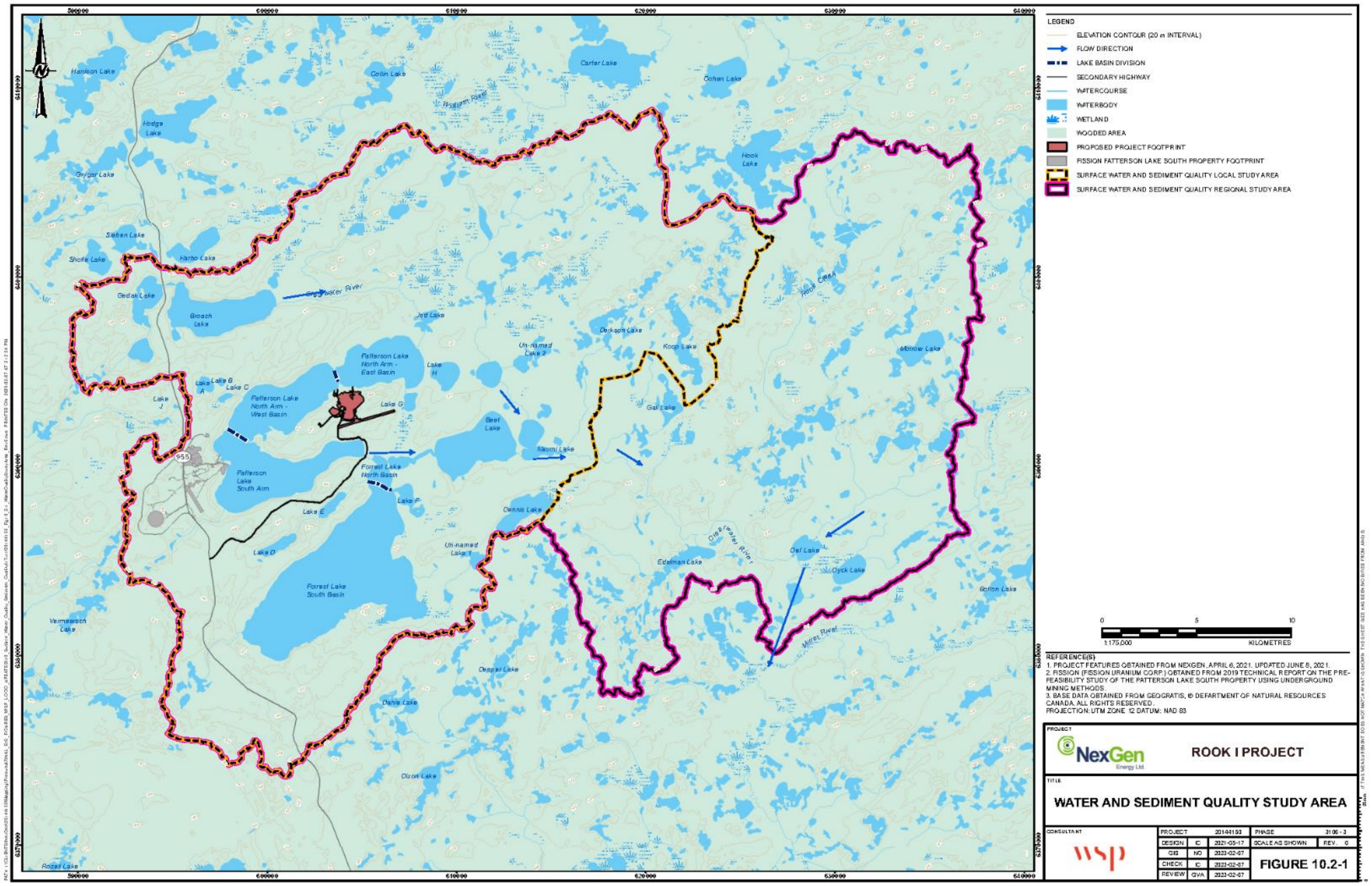


Figure 3.6: Site, local and regional study areas – Fish and fish habitat

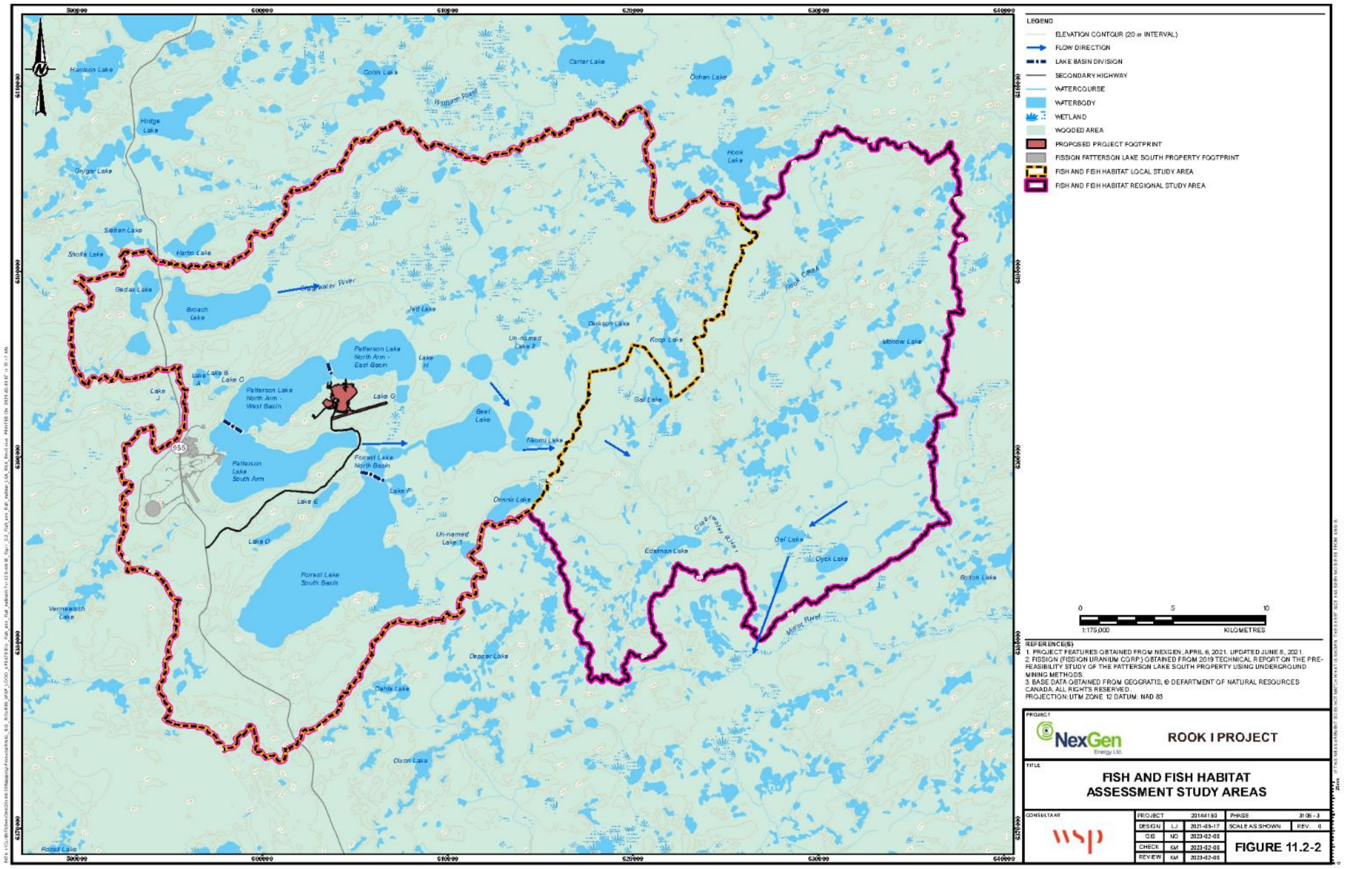


Figure 3.7: Site, local and regional study areas – Terrain and soils

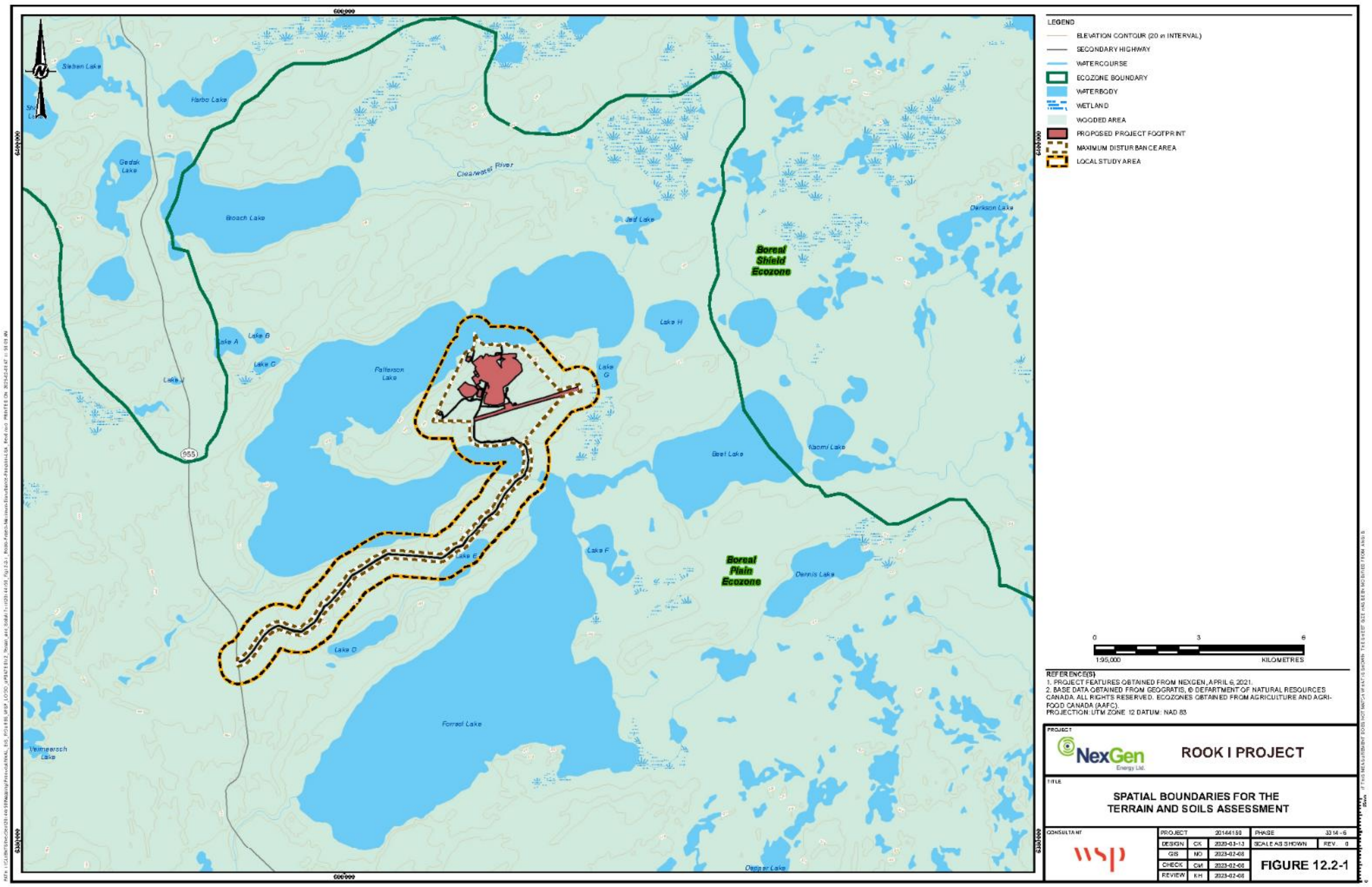


Figure 3.8: Site, local and regional study areas – Vegetation

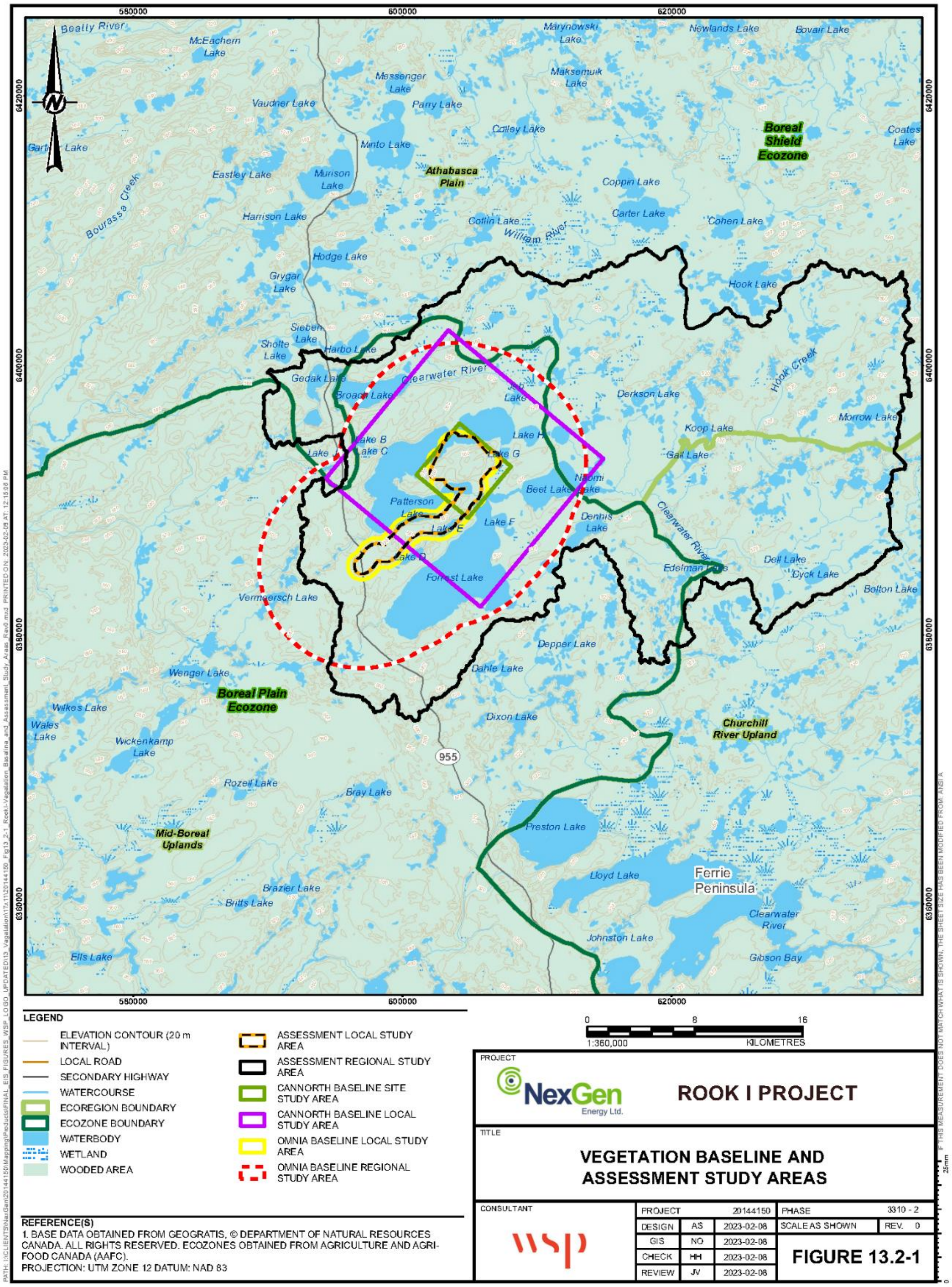


Figure 3.9: Site, local and regional study areas – Wildlife

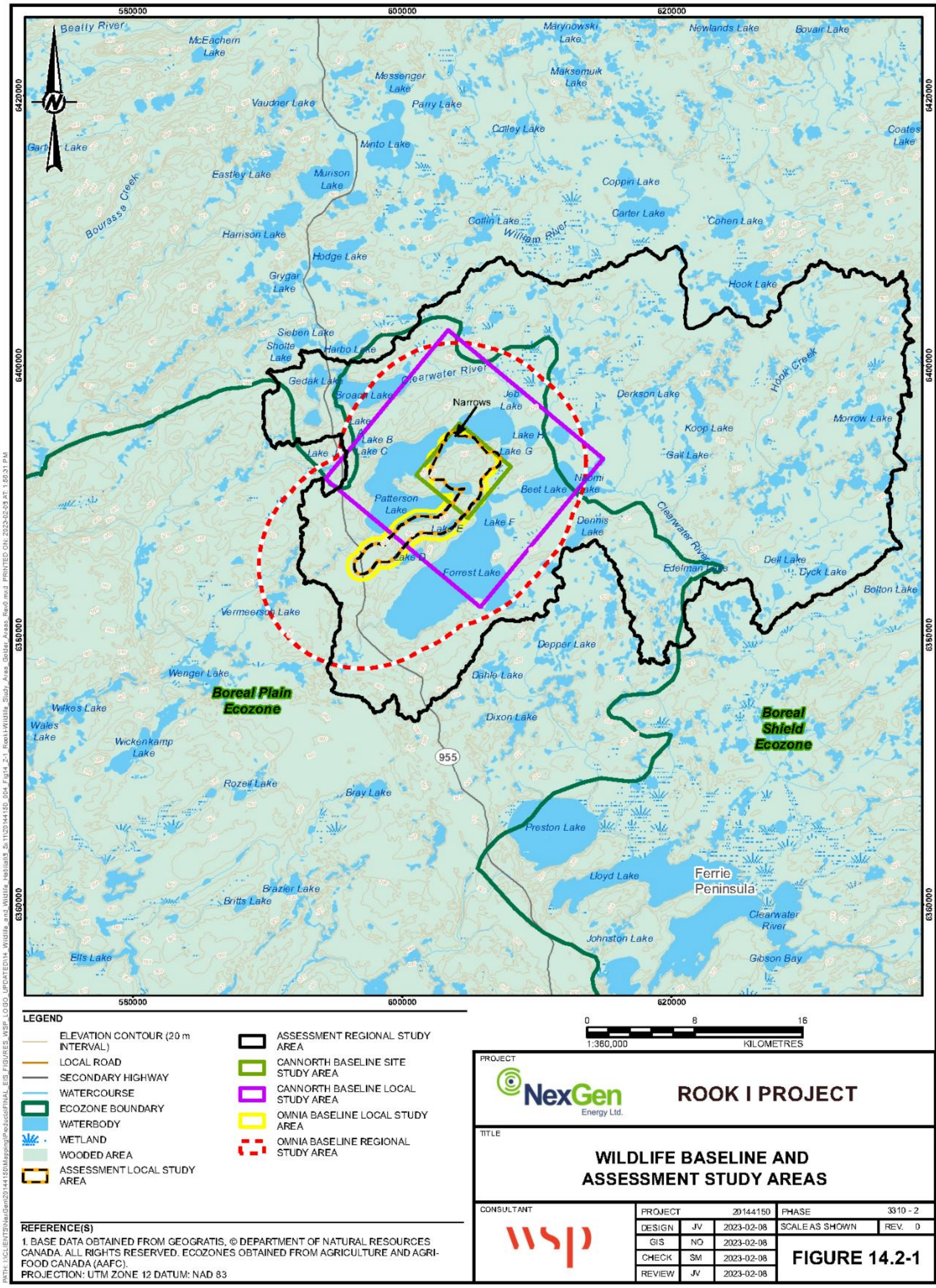


Figure 3.10: Site, local and regional study areas – Human health

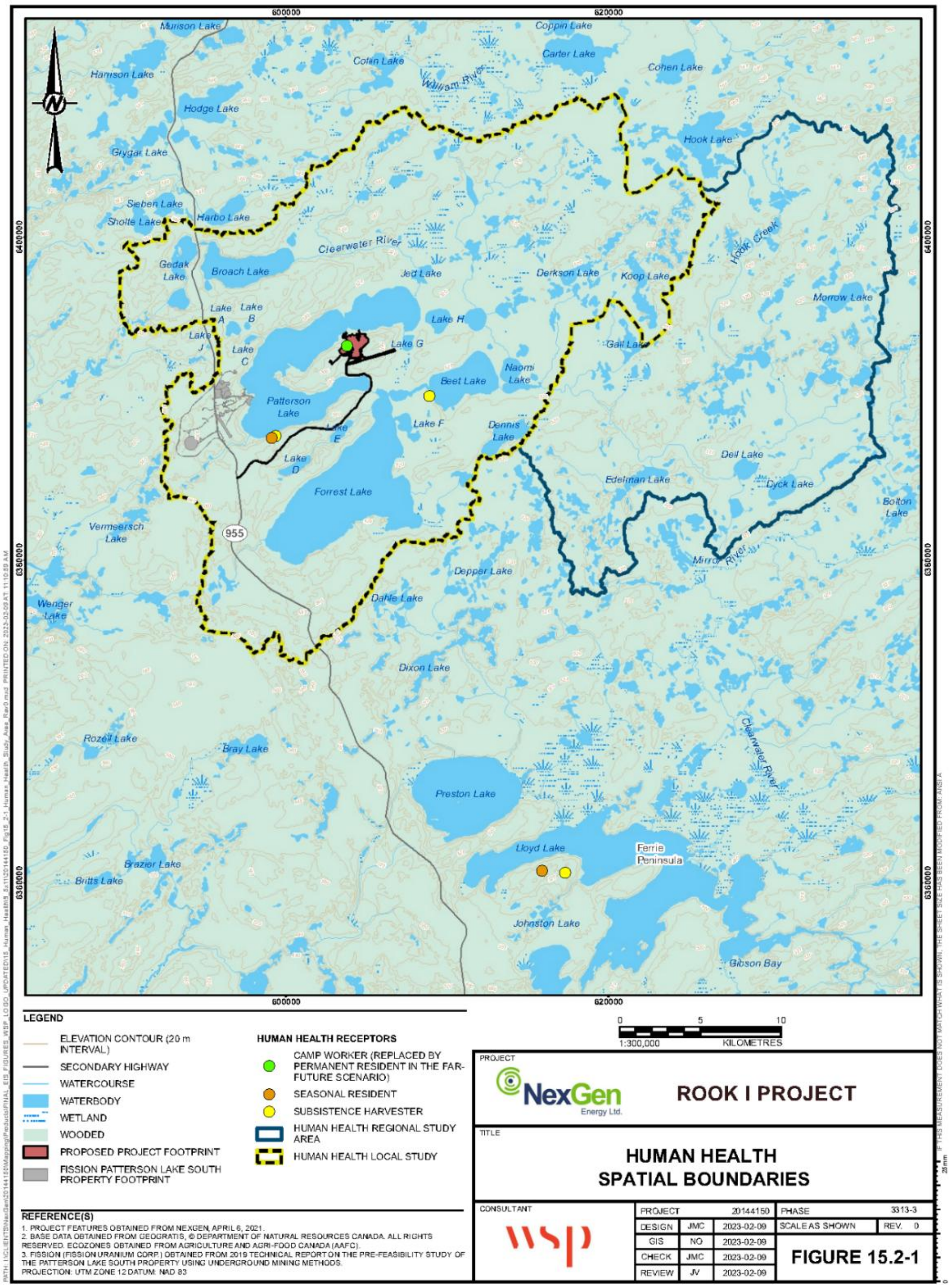


Figure 3.11: Site, local and regional study areas – Indigenous lands and resource use

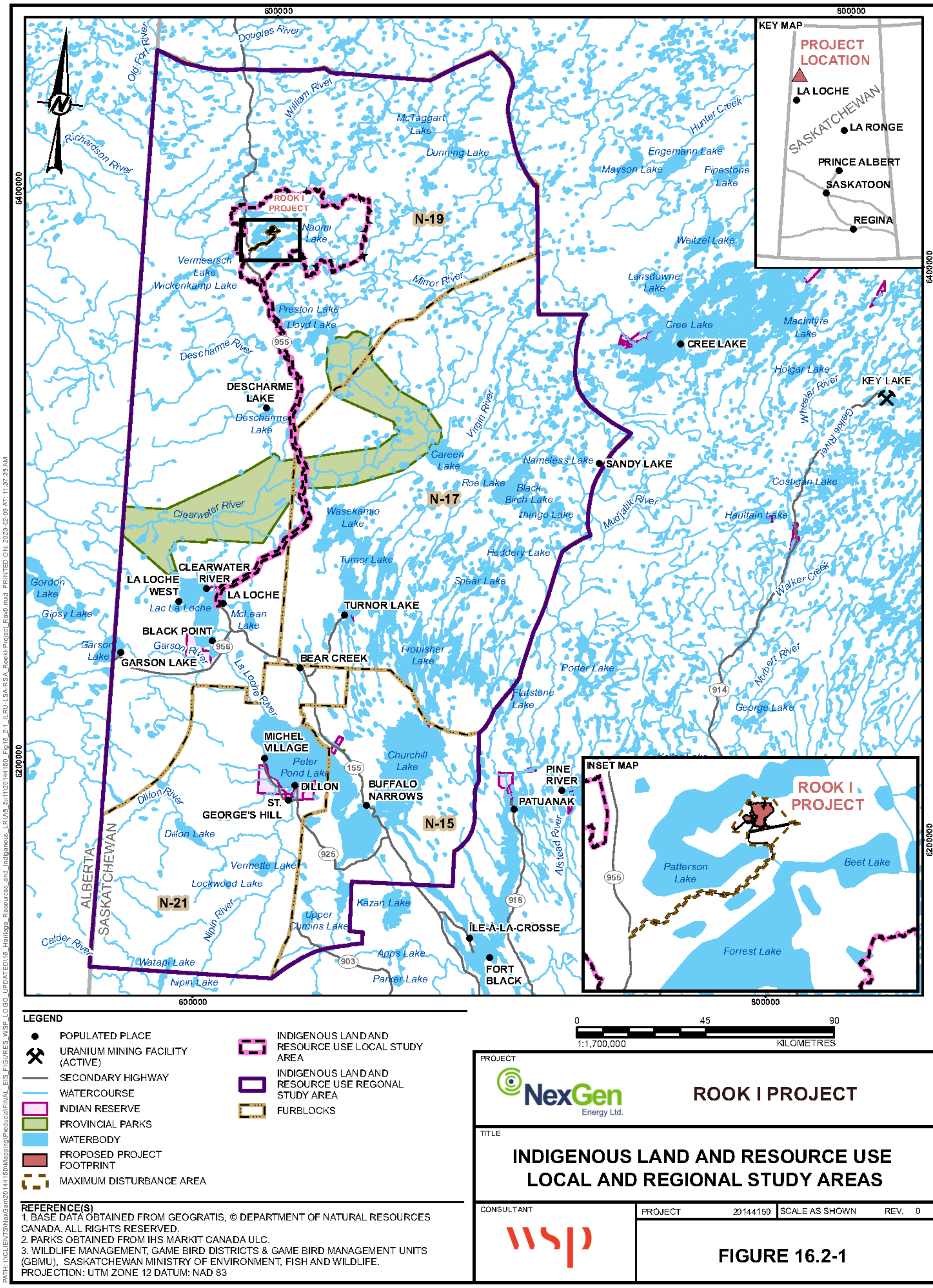


Figure 3.12: Site, local and regional study areas – other land and resource use

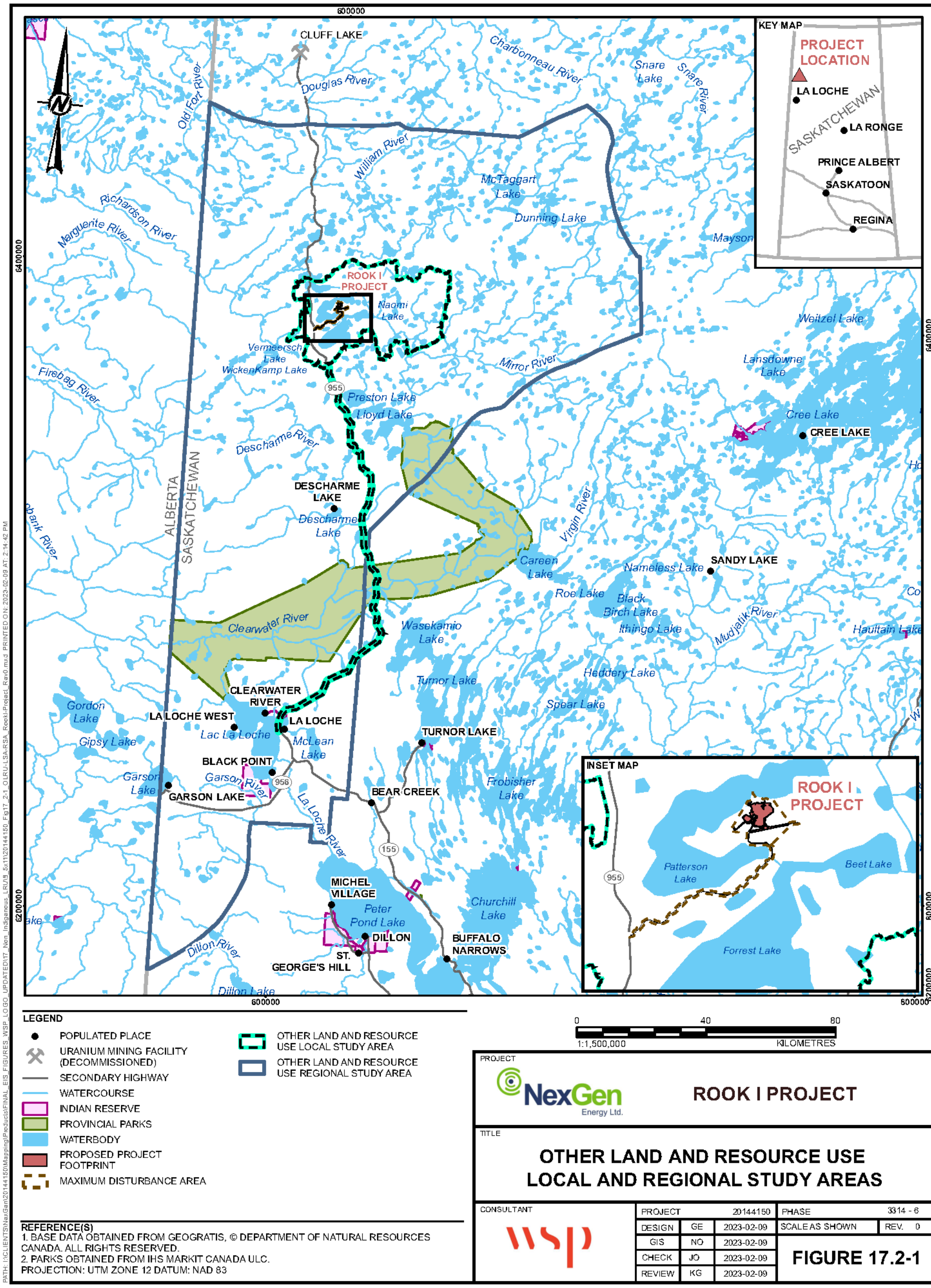


Figure 3.13: Site, local and regional study areas – Economic environment

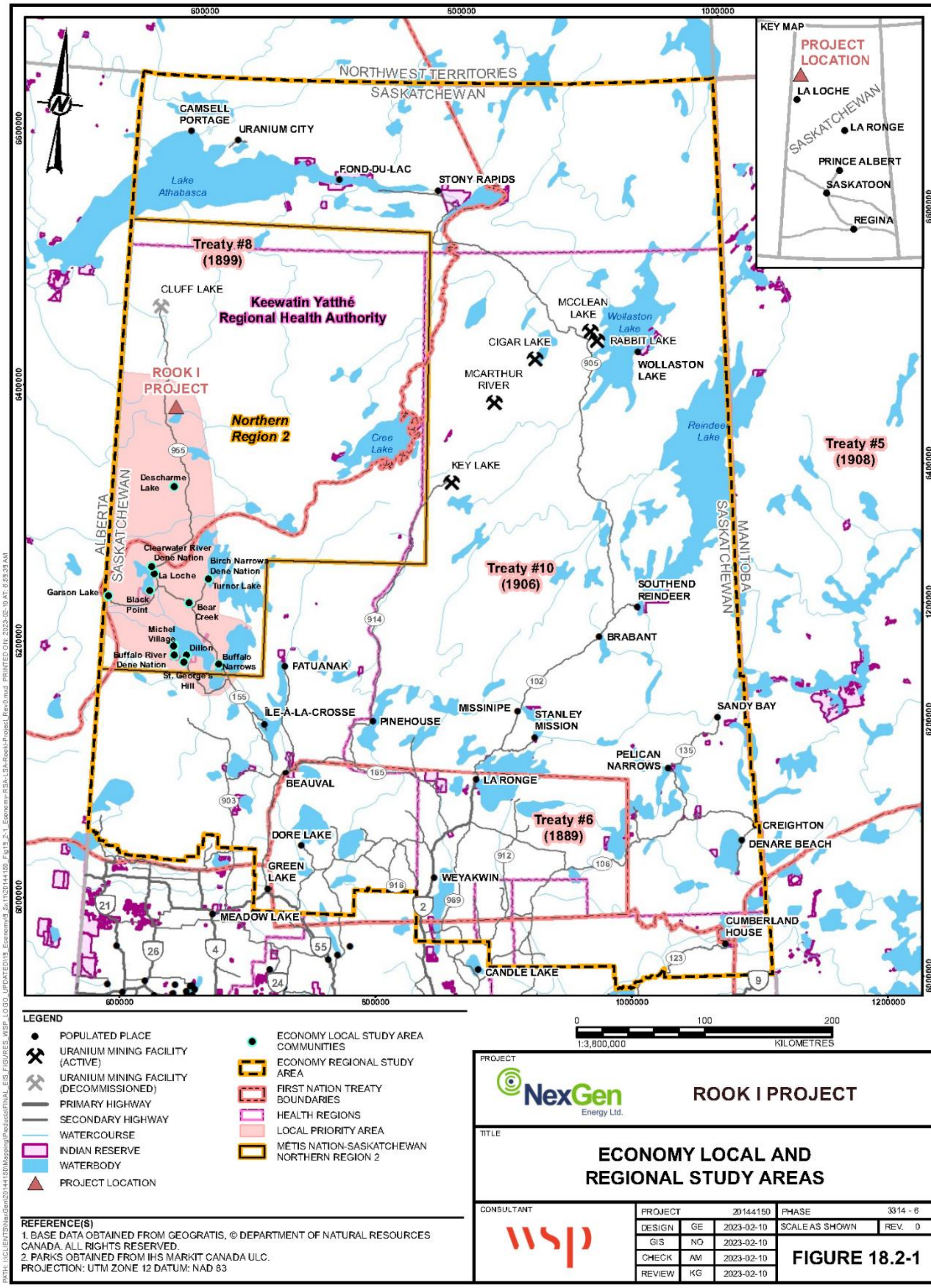
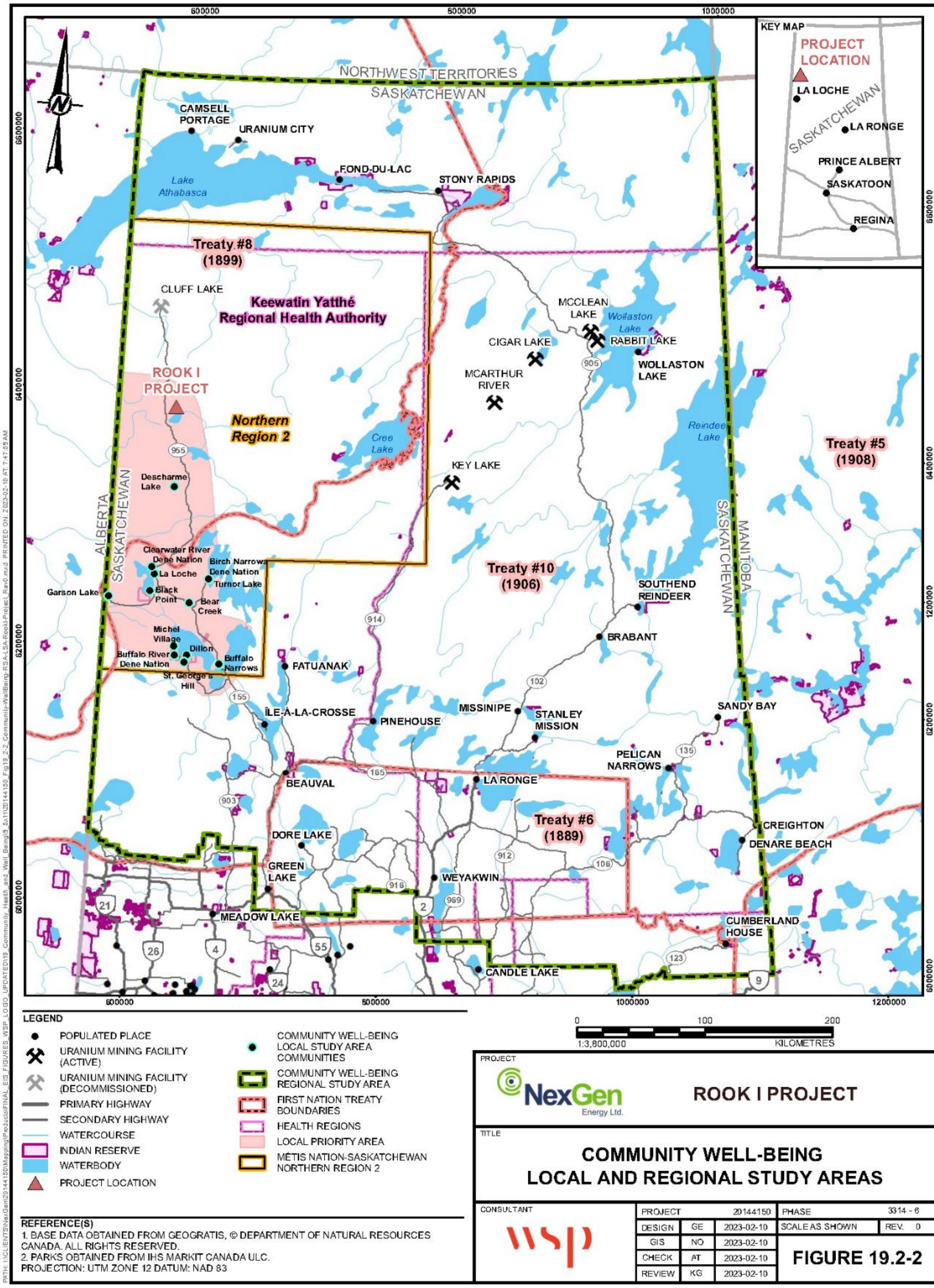


Figure 3.14: Site, local and regional study areas – Community well-being



3.4. Consideration of Indigenous Knowledge

NexGen completed their environment and effects assessment and selection of the VCs considering feedback provided during community information sessions, Joint Working Group (JWG) meetings and engagement with Indigenous Nations and communities including Indigenous Knowledge (IK), Métis Knowledge (MK), and Traditional Land Use Studies (TLUs).

IK and MK were used to determine which traditional land use activities occur in the area, such as hunting, fishing, trapping and navigation (boating), camps of particular importance to local Indigenous Nations and communities and confirmation that the Project Area contained cultural and/or heritage resources. NexGen helped fund and support the completion of community-led TLUs for Indigenous Nations and communities. NexGen worked collaboratively with each Indigenous Nation and community on how their knowledge would be used, managed, and protected and their preferred approach and methods for incorporating IK/MK in the EA.

The IK and MK studies helped NexGen identify and refine their list of VCs for socio-economic and biophysical components during initial JWG meetings, improve understanding of existing conditions for species' habitat and diet preferences, calving areas, and local harvesting practices, and traditional food consumption in the Project area, especially in terms of frequency and diet composition collected from information provided by Clearwater River Dene Nation (CRDN), Métis Nation of Saskatchewan (MN-S), Birch Narrows Dene Nation (BNDN), Buffalo River Dene Nation (BRDN) and Ya' thi Néné Land and Resource Office (YNLR). CNSC supported and provided funding to Athabasca Chipewyan First Nation (ACFN) to complete a regional IK and TLU study to provide more information about ACFN's land use and interest in the region, including in relation to the Project where appropriate.

NexGen considered concerns shared by Indigenous Nations and communities in the evaluation of all environmental components, and potential effects of the project. Concerns included: changes in the abundance of animals and fish; air and water quality; decreased access to the Project area; noise; potential for accidental release of pollution; specific locations where medicines and plants are gathered; the safety of drinking water downstream of the treated effluent; the UGTMF method and its safety for animals and human health, to name a few.

CNSC's evaluation of NexGen's consideration of IK/MK in their environmental and effects assessment are described in more detail in section 6, section 7 and section 8.

Other Views Expressed sub-sections are also included in section 6, section 7, and section 8 to provide summaries of the views expressed by Indigenous Nations and communities, where applicable, with respect to each potential effect on the environmental component or VC under review. These sections capture key issues and concerns heard in writing or verbally through technical meetings or engagement and consultation activities, as well as how NexGen will be mitigating or managing such concerns, because of commitments, or as requested by CNSC staff and other federal and/or provincial authorities.

3.5. CNSC analysis methodology

3.5.1. EIS Technical Review Process

Stage 3 of the EA process, as described in section 1.2, is the EIS technical review. The purpose of the EIS technical review is to assess whether the proponent has adequately assessed the potential impacts of the project, for the purposes of subsequently assessing the significance of adverse effects on environmental components and related VCs. The information provided by the proponent should be sufficient to allow for the evaluation of both the accuracy of the predicted EA findings and the effectiveness of the identified mitigation measures.

Led by CNSC staff as RA, the EIS technical review is completed by the FIRT. Upon determination that a draft EIS has met the CNSC's Generic Guidelines (i.e., it is deemed to "conform"), a full technical review of the EIS commences. Where gaps are found, or additional information is required during this review, FIRT members (subject matter experts) create IRs, and any questions or comments that are directly related to the EIS or EA process (i.e., not necessary to make a determination of effects of the projects on the environment) were provided to NexGen as *Advice to the Proponent*. The CNSC EA lead collates and edited all IR and advice inputs prior to sending the conclusions to the project proponent.

The scope of CNSC staff's technical review of NexGen's submission was to assess whether there were any significant adverse effects expected from the project, based on consideration of the requirements and guidance in REGDOC 2.9.1, REGDOC 3.2.2 and relevant CEAA guidance, including:

- Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012 - Canada.ca.
- Technical guidance for assessing cumulative environmental effects under the *Canadian Environmental Assessment Act*, 2012.
- Technical Guidance for Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012 - Canada.ca.
- Technical guidance for assessing physical and cultural heritage or any structure, site or thing that is of historical, archeological, paleontological or architectural significance under CEAA 2012.
- Technical guidance for assessing the current use of lands and resources for traditional purposes under CEAA 2012.

CNSC staff have reviewed various sources of information to complete the EIS technical review and conduct its analysis of the potential for adverse effects from the Project. These included:

- the draft EIS submitted by NexGen in June 2022, revised draft EIS submitted in May 2024 and Final EIS submitted in November 2024
- NexGen's responses to IRs from the CNSC and the FIRT during the EIS technical review and related supplemental information
- NexGen responses to comments received from the public and Indigenous Nations and communities
- advice from expert federal departments and provincial ministries
- IK/MK and land use studies from CRDN, MN-S, BNDN, ACFN, and YNLR

CNSC staff also reviewed NexGen's Rook I Project Federal Commitments Report (the commitments report), a document that captures all mitigation measures, follow-up monitoring program measures and other commitments made by NexGen to the public and Indigenous Nations and communities throughout the EA process. CNSC staff examined this information to ensure that all key issues and concerns that have been brought forward to date by Indigenous Nations and communities and the public have been addressed.

Throughout the technical review of the EIS, IRs from the FIRT and their responses from NexGen resulted in NexGen incorporating additional mitigation and follow-up monitoring program measures into the revised and final EIS document. NexGen's Commitment Report, which is an evergreen document, will continue to be updated to capture any additional commitments made by NexGen during public hearings, and any actions directed by the Commission to NexGen.

Following resolution of all IRs, CNSC staff accepted the Final EIS and drafted this report. Any outstanding issues from the review have been addressed as commitments or will be resolved using EA Conditions, proposed later in this report and summarized in table 12.1. Should the Commission issue a licence, the Commitments Report will be included in the Licence Control Handbook as part of the licensing basis for the project.

The conclusions from CNSC's review are captured in section 6, section 7 and section 8, for all the environmental components evaluated.

3.5.2. Comments received during EIS Technical Review

The comments received from the public and Indigenous Nations and communities as part of the 90-day public comment period on NexGen's draft EIS were addressed as part of the EA process. Comments directed to NexGen were addressed and resulted in changes to NexGen's final EIS. Comments directed to CNSC staff were taken into consideration in their analysis. Tables presenting the disposition of comments addressed to the CNSC and to NexGen, respectively, are posted on the Canadian Impact Assessment Registry (CIAR) Internet site.

Of the 9 submissions received during the public comment period for the draft EIS, the primary tailingcommenters were Indigenous Nations and communities, except for two submissions (Saskatchewan Environmental Society and Canadian Environmental Law Association). Submissions were received from CRDN, BNDN, BRDN, MN-S, ACFN, YNLR, and the community of Ile-a-la Crosse. Issues and concerns raised by all Indigenous Nations and communities can be found in sections 6, section 7 and section 8, as *Views Expressed.*

3.5.3. Determination of Likelihood for Significant Adverse Environmental Effects

CNSC staff assessed the likelihood of the Project to cause significant adverse environmental effects, following the application of mitigation measures, in accordance with the CNSC Generic Guidelines, CNSC's REGDOC-2.9.1, *appendix A*, and the Canadian Environmental Assessment Agency's (now the Impact Assessment Agency of Canada) *Operational Policy Statement: Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under CEAA 2012*.

The approach used by CNSC staff was to assess each predicted, residual adverse effect in three steps:

- step 1: determining whether the residual environmental effects are adverse
- step 2: determining whether the residual adverse environmental effects are significant
- step 3: determining whether the significant adverse environmental effects are likely

The related *Technical Guidance for Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012* defines residual effect as: *"…an environmental effect of a project that remains, or is predicted to remain, after mitigation measures have been implemented. The determination of whether a project is likely to cause significant adverse environmental effects relates to the residual environmental effects."*

In step 2, the residual adverse effects were characterized using the following assessment criteria:

- magnitude: severity of the adverse effects
- geographic extent: spatial reach of the adverse effect
- duration: length of time of the adverse effect
- frequency: rate of recurrence of the adverse effect
- reversibility: degree to which the environmental conditions can recover after the adverse effect occurs
- timing: consideration for the time of year that a project activity is undertaken

CNSC staff also considered the context for all residual adverse effects across all the criteria listed above. Context refers generally to the current state of the environment or of the VC and the sensitivity and resilience to the change caused by the Project.

The definitions and limits used to assign the level of effect for each rating criterion are presented in appendix A. CNSC staff used the tables in appendix A to help determine the significance of the effects which combines the degree (low, moderate or high) of the residual effect of each criterion.

CNSC staff considers effects to be **not significant** where the residual effects after mitigation measures have been implemented are low, moderate or high in magnitude; localized in geographic extent; short-term in duration; and are fully or partly reversible.

CNSC staff considered effects to be **significant** where the residual effect after mitigation measures have been implemented would be high or moderate in magnitude; regional in geographic extent; long- or medium-term in duration; and irreversible.

Where CNSC's determination of not significant was contingent on outstanding requests made to NexGen through the EIS technical review, CNSC staff have recommended EA Conditions to the Commission. These EA Conditions are included in the sub-sections of Predicted Changes to the Environment (section 6) and Predicted Effects on Valued Components (section 7). Tables detailing the CNSC's predicted degree of residual effects can all be found in appendix B.

CNSC staff analysis and findings are based on the final EIS which is a culmination of all the revisions and additions that have been made because of the analysis, IRs and comments submitted during the EA process.

4. Purpose of the project and alternative means

4.1. Purpose of the project

The purpose of the Project is to construct, operate and decommission a uranium mine and mill. NexGen has indicated that the proposed Rook I would provide uranium supplies for the increasing demands for electricity and help the Government of Canada and Saskatchewan's obligations and commitments regarding renewable energy and lower carbon emission electricity generation.

NexGen undertook an analysis of alternatives to the project to examine different ways to achieve the purpose of the project. NexGen evaluated various energy types (fossil fuels and renewable energy) as well as locations. The analysis served to validate that the preferred alternative is a reasonable approach to meeting the need and purpose of the project.

4.2. Alternative means to carry out the project

"Alternative means" are the various technically and economically feasible ways under consideration by the proponent that would allow a designated project to be carried out. The alternative means should be considered by the proponent as early as possible in the planning of a designated project. EA documentation must clearly explain and justify the methodologies used to identify, assess and select alternative means. The CNSC's Generic Guidelines and REGDOC-2.9.1 outline requirements and approach to conducting an alternative means assessment for a CNSC-led designated project under CEAA 2012.

4.2.1. Proponent's Assessment of Alternative Means

This section presents NexGen's assessment of alternative means to carry out the Project. In addition, this section includes a summary of public and Indigenous comments received regarding the Rook I Project alternative means assessment and CNSC staff analysis and findings. CNSC staff analysis and findings are based on the final EIS which is a culmination of all the revisions and additions that have been made because of the analysis, IRs and comments submitted during the EA process.

4.2.1.1. Mining method

Primary mining method

Two different alternatives for the primary mining (i.e., extraction) method were considered:

1. Open pit
2. Underground

The following criteria were considered during the assessment process:

- Surface area disturbance, potential effect on plant, fish, and other wildlife populations and habitat
- Potential effect on Patterson Lake
- Potential effect on surface or groundwater
- Design and reliability

- Construction risk and complexity
- Operational risk and complexity
- Flexibility to develop new areas
- Operating cost
- Closure cost
- Change in land use
- Worker safety and human health

Alternative 1 (open pit) was eliminated due to the proximity to Patterson Lake limiting the maximum size, and limitations of the ore depth that could be exposed sterilizing a significant portion of the target ore body or requiring a combination with underground mining to recover the full extent of the target ore. Moreover, the stripping ratio would likely be uneconomic, and the design would be complicated by poor ground quality, seepage from Patterson Lake, and the presence of aquifers or high-water tables. Furthermore, underground mining reduces surface disturbance and waste rock volumes compared to the open pit.

Underground mining method

Three alternatives for underground mining method were considered:

1. Caving
2. Long hole stoping
3. Cut and fill

The following criteria were considered during the assessment process:

- Surface area disturbance
- Potential effect on surface water or groundwater
- Design and reliability
- Flexibility
- Capital cost
- Operating cost
- Employment opportunities
- Worker safety and human health

Alternative 2 (long hole stoping) was considered by NexGen to be the most favourable due to its suitability for the geometry of the target or body and flexibility to adapt to changes in the ore body targeting and mining new target areas. Furthermore, long hole stoping minimizes the effects on the surface and tends to be safer than cut and fill, which were aspects valued among Indigenous Nations and communities and local communities.

4.2.1.2. Processing

NexGen assessed the following project alternatives relating to processing:

- Process plant location

- Process stripping method
- Final product type

NexGen considered on-site and off-site process plant locations and selected on-site after evaluating several advantages and disadvantages, including the ability to control the design process and store tailings underground, and the removal of the requirement for high-volume, long-distance ore transport which would result in increased carbon emissions. NexGen selected strong acid stripping, followed by uranium peroxide precipitation as the favorable process stripping method, and U_3O_8 as the final product due to higher quality effluent, easier waste management, and simpler handling requirements for reagents, as well as community concerns regarding health impacts and potential spills of yellowcake.

4.2.1.3. Mine waste storage

NexGen assessed the following project alternatives relating to mine waste storage:

- Mine waste storage – tailings
- Mine waste storage – gypsum
- Mine waste storage – waste rock

Based on alternative assessment and sensitivity analysis, NexGen has decided on underground tailings storage with paste at location U-4 as it does not require a surface storage facility, which generally have a negative perception among Indigenous Groups and local communities, and underground storage complies with best practice for new tailings facilities to minimize the volume of tailings and water placed in external facilities. Underground storage with tailings in UGTMF was selected for gypsum due to lower operational complexity and the potential for gypsum to reduce the binder requirement in the cemented paste tailings (CPT). The storage of gypsum with the tailings stream is considered standard practice in Saskatchewan. For the storage of waste rock, segregated, NPAG unlined, PAG engineered source control and lined storage was selected as it is predicted to have a reduced potential to affect Patterson Lake water quality, and additionally it exceeds Saskatchewan Environment and Resource Management guidelines for waste rock management while achieving lower costs for lining, having the potential to be progressively closed during Operations, and would have reduced potential for requiring long-term water treatment.

4.2.1.4. Supporting infrastructure

NexGen assessed the following project alternatives relating to supporting infrastructure:

- Power supply type
- Fuel delivery method
- Camp location
- Airstrip location
- On-site road alignment

NexGen has selected an on-site liquified natural gas (LNG) power plant for power supply, fuel delivery by truck, the west location for the camp location, the central west-east alignment for the airstrip location, and a southwest alignment for the on-site road. The LNG power plant was chosen to allow NexGen a higher degree of control of the reliability of power supply, maintenance, and outages, as well as for a lower complexity and capital costs compared to connecting to the grid. Furthermore, LNG was selected over diesel as a fuel source based on better air quality and lower GHG emissions. This alternative is a conservative approach for determining effects in the EA while further evaluations are being completed on incorporating a hybrid power system with renewable energy, which if implemented, would result in fewer environmental effects. Fuel delivery by truck was selected based on lower costs, less surface area disturbances, and more feasible logistics compared to the alternatives of air or pipeline transport. The west camp location was selected to reduce the overall Project disturbance area, while the central west-east airstrip alignment was selected to minimize cut and fill construction requirements and limit effects on additional watersheds, and due to its proximity to other infrastructure without limiting potential future expansion. The southwest on-site road alignment was chosen primarily due to the higher percentage of existing roads and trails that could be utilized, and to avoid technical challenges associated with the northeast alignment requiring construction and maintenance over steeper grades and/or multiple switchbacks.

4.2.1.5. Water management

NexGen assessed the following project alternatives relating to water management:

- Effluent treatment technology
- Treated effluent discharge location
- Fresh water supply – source
- Fresh water supply – location
- Sewage treatment technology

NexGen has selected two-stage precipitation using lime as the effluent treatment technology due to its simple and reliable design, its robustness and adaptability to changing conditions while meeting environmental protection requirements in terms of water quality and discharges to Patterson Lake. The effluent discharge location of the North Arm – West Basin at optimal depth was selected as it best aligns with feedback from Indigenous Nations and communities on avoiding key fish habitats and installations around the shorelines of Patterson Lake. The simulated optimal depth of approximately 10 m is estimated to have favorable ambient currents to promote mixing, and the pipeline alignment would intersect a section of shoreline that is not suitable for fish spawning except for yellow perch, where the spawning habitat is only marginally suitable. Fresh water supply will be sourced from Patterson Lake surface water as this will reduce traffic, GHG emissions, and operating costs despite the higher complexity of construction compared to trucking and will be more reliable in the long-term than deep groundwater. The location for the source was selected as North Arm – East Basin, ~700 m from shore due to lower risk of potential influence from treated effluent discharge and higher anticipated operational reliability compared to alternatives. A sewage lagoon was selected as the sewage treatment technology due to simple and reliable design during construction and operation, ease of expansion, and relatively low health and safety risks to workers.

4.2.1.6. Conventional waste

NexGen assessed the following project alternatives relating to conventional waste:

- Domestic waste
- Industrial waste
- Hazardous waste
- Low-level radioactive waste (LLRW)

NexGen selected on-site incineration as the primary waste disposal method for domestic waste, industrial waste, and LLRW, as the availability of off-site facilities to accept various waste types/volumes could not be confirmed at the time of the assessment. Based on information available, this method provides relatively greater certainty and flexibility for managing this waste stream and was deemed the most conservative for the purposes of NexGen's EA. Off-site repurposing/recycling was selected as the primary hazardous waste disposal method due to feedback from local communities encouraging NexGen to decrease the amount of material requiring disposal in a landfill. Disposal options for all types of waste will be reconsidered, as necessary, as the Project advances and additional information becomes available.

4.2.1.7. Decommissioning demolition waste

NexGen assessed the following project alternatives relating to decommissioning demolition waste:

- Clean waste
- LLRW
- Hazardous waste

NexGen selected underground disposal for both clean waste and LLRW, as Indigenous Nations and communities and community feedback value backfilling material underground to minimize effects on the surface. Furthermore, the future availability of off-site disposal and/or recycling could not be confirmed at the time of the EA. Off-site disposal was selected as the primary method for the decommissioning and disposal of hazardous waste. As the project advances, and additional information becomes available, options will be reconsidered as necessary.

4.2.2. Views Expressed

NexGen held technical meetings with concerned Indigenous Nations and communities which included specific discussions on potential Project alternatives. NexGen considered information provided by Indigenous Nations and communities in the alternatives assessment for the Project. Key themes NexGen considered in the alternatives assessment included environment, health and safety, traditional land and resource use, community well-being, and socioeconomics as discussed in Section 4 of the Rook I EIS.

4.2.3. CNSC Staff Findings

In collaboration with the FIRT, CNSC staff reviewed NexGen's Alternative Means Assessment against the *Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012*, CNSC's Generic Guidelines and REGDOC-2.9.1. Based on its review of NexGen's analysis, CNSC staff are satisfied that NexGen has adequately assessed alternative means of carrying out the Project in accordance with applicable guidance documentation, and for the purposes of assessing the environmental effects of the proposed Project under CEAA 2012.

5. Geographic setting

The area of the proposed Rook I Project is currently subject to activities supporting regional exploration programs, environmental baseline and monitoring programs for the proposed Project, and field investigation programs to support Project design. NexGen currently has an exploration camp with access to a maintenance shop, laundry facility, first aid tent, sewage treatment plant, and water treatment plant. Power is supplied by diesel generators. A trail from the existing exploration camp to the Arrow laydown allows all season access to the area of the Arrow deposit. There is a drum storage tent and a temporary storage tent at the laydown area. The area of the proposed Project also includes fuel storge, silt fencing, and a fire suppression sprinkler system established during the fire season.

5.1. Biophysical environment

The Rook I Project is proposed to be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system which drains to the Mackenzie River watershed. The project area is characterized by a sub-arctic climate. Winters are long and cold, and mean ambient temperatures range from -18℃ in February to a high of 17℃ in July. The area surrounding the project is characterized by drumlins, lakes, wetlands, rivers, streams, and muskegs with ground surface elevations ranging from 583-480 metres above sea level (masl). The area of the proposed Project contains approximately 92 active mineral dispositions, issued to 12 companies. The Arrow deposit is estimated to contain a total of 209.6 million pounds triuranium oxide (U_3O_8) contained in 2,183 kilotonnes grading 4.35% U_3O_8. The cumulative thickness of the units overlying the basement rock at the Arrow deposit is between 90 m and 120 m, with approximately 60 m of glacial overburden overlying sedimentary rocks with some bedrock outcroppings.

The Project is located within the Boreal Plain Ecozone of the Mid-Boreal Uplands Ecoregion, while the broader region of the Project intersects the Boreal Shield and Boreal Plain ecozones. Commonly harvested species in the area include moose, black bear, and beaver. Fish species in the area are characteristic of northern temperate waterbodies and watercourses in Saskatchewan.

Groundwater flow directions in the glacial drift are predominantly toward local surface water and drainage features, with flow in the proposed underground mine being towards Patterson Lake. There is a divide south of the Project site where groundwater flows north to the north of the divide, and south to the south of the divide, with both ultimately discharging to Patterson Lake. Lateral flow in shallow bedrock is predominantly from west to east, with flow towards the south in the northern Project area. Generally local groundwater flow is similar between shallow bedrock and glacial drift. Groundwater flow in deep bedrock is predominantly from west to east, and towards Paterson Lake local to the proposed underground infrastructure. The vertical groundwater flow direction is downwards in high topography of the Project site, transitioning upwards in the area of the proposed underground mine and UGTMF.

Air quality within the LSA and RSA was established through baseline field study and desktop study. Measured sulphur dioxide, nitrogen dioxide, and particulate matter (PM)2.5 concentrations generally remained below annual provincial standards. $PM_{2.5}$ only occasionally exceeds 24-hour provincial standards from wildfire smoke, and local activities may contribute to short-term ambient sulphur dioxide levels above the Saskatchewan Air Quality Model Guideline. Modelling background concentrations of PM2.5, PM10, total suspended particulates, carbon dioxide, nitrogen dioxide, and sulphur dioxide indicated concentrations characteristic of a rural setting and close to or lower than prescribed levels.

5.2. Human environment

Within Saskatchewan, the proposed Project is located 41 km north of Clearwater River Provincial Park, 141 km south of Athabasca Sand Dunes Provincial Park, and 29 km north of Preston Lake Wildlife Refuge. The Clearwater River has been designated as part of the Canadian Heritage River Systems. The Project is located 38 km east of Marguerite River Wildland Provincial Park and 51 km southeast of Richardson River Dunes Wildland Provincial Park in Alberta. The proposed Project site is north of the inactive commercial forestry zone and 80 km south of the Cluff Lake Mine, which closed in 2002. The Cluff Lake Mine is in a long-term monitoring and maintenance phase. Currently, only 0.5% of the area encompassing the Patterson Lake watershed surrounding the Project has been influenced by human developments. Paladin Energy Limited (formerly Fission Uranium Corp.) has proposed the Patterson Lake South Property, which is planned to also be located on Patterson Lake, approximately 5 km from the proposed Project. The proposed Project is located on Provincial Crown Land within Treaty 8 territory and the Métis Homeland, and adjacent to Treaty 10 territory. The closest federal lands to the Project are Clearwater River Dene Band 222 (120 km south), English River First Nation Cable Bay Cree Lake 192M and 192N (130 km southwest), Cree Lake 192G (130 km southwest), Turnor Lake 193B (135 km southeast), and Clearwater River Dene Band 221 (140 km south). The local priority area (LPA) consists of communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize employment opportunities. As of 2016, 96% of residents within the LPA were identified as being Indigenous.

The Project is located within the SK2 West administration for woodland caribou and adjacent to the boundary of the SK1 caribou conservation unit. Large-bodied fish in the area are commonly targeted by recreational and subsistence fishers. This includes Arctic grayling, burbot cisco, lake trout, lake whitefish, longnose sucker, northern pike, walleye, white sucker, and yellow perch.

6. Predicted changes to the environment

6.1. Atmospheric environment

The proposed Project could potentially cause changes to the atmospheric environment through:

- Changes to air quality due to an increase in emissions, including dust, particulate matter (PM2.5 and PM10), NO_2, SO_2, CAAQs, due to project activities during construction and operations phases, and mobile and stationary combustion sources during closure phase.
- Increase in noise, including exceedances of federal guidelines (i.e., ECCC and HC).

CNSC staff assessed and concurred with NexGen's assessment of Project activities that may interact with air quality and the acoustic environment and cause residual effects, during construction, operation and decommissioning activities, as detailed below.

6.1.1 Greenhouse Gas Emissions (GHG)

NexGen estimated the direct and indirect Project GHG emissions as a transboundary effect utilizing the methodologies outlined in ECCC's 2021 Draft Technical Guide Related to the Strategic Assessment of Climate Change (SACC Technical Guidance) where applicable. Direct emissions included stationary (e.g., diesel generators, propane heaters) and mobile (e.g., on-road trucks and vans; off-road heavy equipment like graders and dozers) combustion sources.

The project is expected to be required to report annually to the federal Greenhouse Gas Reporting Program, as it is likely to exceed the annual reporting threshold (i.e., > 10,000 tonnes CO_{2e} per year). However, such emissions would only account for a small fraction of total national (0.02%) and provincial (0.3%) emissions.

6.1.1. Description of the existing atmospheric and acoustic environments

The local study area (LSA) for the air quality assessment was defined as a 90,000 ha (900 km2) area centred on the Project. The LSA is the area within which air quality effects due to the Project may be highest and can be predicted or measured with reasonable certainty. The LSA encompasses the local lakes surrounding the Project (e.g., Patterson Lake, Broach Lake, Jed Lake, Forrest Lake, Beet Lake, Naomi Lake) that are important to the assessments of other disciplines.

6.1.1.1. Atmospheric environment

Project-related activities can alter air quality through the emissions from fossil fuel combustion and mining and milling activities. Changes in air quality could influence biophysical VCs and intermediate components (i.e., surface water and sediment quality, fish and fish habitat, terrain and soils, vegetation, and wildlife and wildlife habitat) and socio-economic VCs (i.e., human health, Indigenous land and resource use, and other land and resource use). The baseline monitoring program included particulate matter (i.e., TSP, PM10, PM2.5), NO_2, CO, and SO_2. Regional air quality monitoring data from other programs at four remote locations outside the air dispersion modelling domain were used to supplement data collected in the LSA and were used to additionally characterize baseline air quality conditions. Background concentrations of the compounds being evaluated are indicative of a rural setting, relatively unaffected by outside influences on air quality.

Assessment criteria for potential air quality effects (table 7.2-1) and adopted background measurements (table 7.2-9) are presented in the EIS and will allow for a comparison once activities take place within the project area. Criteria air contaminants (CACs) that have applicable provincial or federal ambient air quality criteria and would be emitted directly from the project include nitrogen oxide (reported as NO_2), sulphur dioxide (SO_2), sulphuric acid, carbon monoxide (CO), particulate matter (PM)2.5, PM10, and total suspended particles (TSP).

6.1.1.2. Acoustic environment

An assessment of noise was conducted by delineating a maximum disturbance area around the Project footprint (site study area) consisting of 228 ha, with a maximum disturbance area of 981 ha, a local study area (LSA), consisting of 6,629 ha, and a regional study area (RSA), consisting of 61,544 ha. The LSA and RSA are composed of primarily forested landscape interspersed with water bodies and wetlands. Existing anthropogenic noise was characterized to be mainly from Highway 955, mineral exploration activities, recreational uses such as hunting and fishing, and Indigenous land and resource use.

A baseline noise survey was undertaken at three locations within the LSA and RSA to measure ambient noise levels: north shore of Forrest Lake, south shore of Patterson Lake, and general forested area. Baseline average noise levels (Health Canada, 2017) measured at these locations were 33 dBA, 46 dBA, and 30 dBA, respectively. These measurements consider daytime and nighttime noise levels, with a 10 dBA adjustment to the nighttime noise value to account for higher disruptiveness than daytime noise (Health Canada, 2017). Primary contributors to ambient noise levels were identified to be birds, wind in vegetation, power boat and fishermen, and wildlife activity such as footsteps, howling and vocalizing.

6.1.2. Proponent's assessment

NexGen's assessment considered air quality and the acoustic environment as intermediate components that were evaluated to facilitate the assessment of potential effects of the Project on receptor VCs. Air quality and acoustic environment assessments provided information that was used to support VC assessments, such as human health, surface water and sediment quality, wildlife and their habitat, Indigenous and other land and resource uses. Intermediate components are not assessed for significance.

NexGen concluded that the residual effects to air quality and the acoustic environment are unlikely to have significant adverse effects on receptor VCs. More information on each project related effect and the residual effects evaluation can be found below and in the EIS sections 7.2 and 7.3.

6.1.2.1. Air quality

Existing air quality conditions in the Project Area have been established by NexGen through field studies and predictions using dispersion modelling to evaluate how the anticipated project activities may change existing air quality conditions, and what the effect of these changes may be on people and the biophysical environment, such as soil and vegetation quality. Air quality from the Project and from the Patterson Lake South Property (RFD case) proposed by Paladin Energy Limited (formerly Fission Uranium Corp.) is predicted to result in detectable changes from existing conditions. However, most of the CACs (i.e., nitrogen dioxide, sulphur dioxide, sulphuric acid, carbon monoxide, and PM2.5) are predicted to remain compliant with the SAAQS throughout all phases of the Project within the RSA.

Short-term concentrations of 24-hour PM10 and 24-hour TSP are predicted to be above the SAAQS, but the exceedance frequencies remain low, and the exceedance areas are localized to the Project. For example, the maximum frequency of exceedance of 24-hour PM10 is 2.7% (10 days per year) and occurs during Construction. Maximum exceedances predicted in areas outside of the disturbance area, where PM10 concentrations are higher than the SAAQS, are 279.1 ha during Construction. The maximum distance from the exceedance area to the disturbance area is 1,185 m for Construction.

Residual effects were predicted to be in a negative direction, reversible, continuous (duration 4 years during construction, 24 years during operations, and 5 years during active closure), and with a high probability of occurrence. In general, in all Project phases, the residual effects were predicted to be limited in geographic extent and mostly infrequent.

Through implementation of appropriate mitigation measures and follow-up monitoring, NexGen anticipates that air quality will be managed throughout all Project phases. Therefore, NexGen determined that the Project residual effects to air quality would not result in a significant effect to any VC (table 6.1).

Table 6.1: Summary of site air quality residual effects (adapted from EIS)

Constituents of Potential Concern	Averaging Period	Criteria	Construction		Operation	
			Max. Off-Property Conc.	% Of Criteria	Max. Off-Property Conc	% Of Criteria
Total suspended particulates (TSP)	24-hour	100 µg/m³ (SAAQS/ AAAQO)	170.9 µg/m³	170.9%	94.8 µg/m³	94.8%
Particulate matter (PM_{10})	24-hour	50 µg/m³ (SAAQS/ AAAQO)	132.6 µg/m³	265.3%	51.0 µg/m³	102%
Nitrogen dioxide (NO_2)	1-hour	79 µg/m³ (CAAQS 2025)	218.6 µg/m³	276%	141.9 µg/m³	179%

Notes: d/y – days per year; h/y – hours per year; n/a – not applicable; Max. = maximum; Conc. = concentration

Criteria: Ontario Ambient Air Quality Criteria (OAAQC); Saskatchewan Ambient Air Quality Standards (SAAQS); Alberta Ambient Air Quality Objectives (AAAQO); Canadian Ambient Air Quality Standards (CAAQS 2025)

6.1.2.2. Acoustic environment

The proponent's results suggest that noise levels during construction and operations at the nearest receptor location (R-48) which is closest to the mine site, are predicted to be slightly higher than the existing (baseline) values but comply with the ECCC (2009) and HC (2017) guidance levels. For the farthest receptor location (R-07), which is farthest from the mine site in a north-east direction, noise levels during construction and operations are predicted to be well below the measured baseline and lower than the ECCC (2009) and HC (2017) guidance levels. When cumulative noise levels from the potential Patterson Lake South Property, that is approximately 7 km away, are considered in combination with either Project construction or operations activities, noise levels are predicted to be compliant with HC and ECCC guidance for receptors in the RSA.

An analysis of the predicted noise levels at the nearest (high noise) and farthest (low noise) receptor locations and the noise thresholds published by ECCC (2009) and HC (2017) are provided in table 6.2 below. Cumulative noise levels from the project construction/operations have also been included for comparison purposes.

Table 6.2: Predicted noise levels at the nearest and farthest receptors compared with noise regulatory guidance/thresholds.

Projet phase	Nearest (high) noise receptor (R-48), dBA***	Farthest (low) noise receptor (R-07), dBA	ECCC Noise Threshold	Health Canada Sleep Disturbance Analysis
Existing (baseline)	39	26	45	40
Construction	41	14	45	40
Cumulative – construction	43	26	45	40
Operations	41	7	45	40
Cumulative – operations	43	26	45	40

*ECCC (2009). Environmental code of practice for metal mines. Daytime and nighttime noise levels averaged, with 10 dBA adjustment for nighttime noise levels.

**Health Canada (2017). Guidance for evaluating human health impacts in environmental assessment – Noise.

***There are no receptors at location R-48 who may sleep, so HC sleep disturbance threshold does not apply

6.1.2.3. Atmospheric Residual Effects and Monitoring

Residual effects for construction and operation phases are expected to be most apparent as compared to the closure phase. These residual effects are predicted to diminish following the active closure stage and are predicted to be similar to levels measured during existing (baseline) conditions. The proponent has proposed monitoring, follow-up, and adaptive management measures to verify if environmental noise levels are consistent with or less than model predictions in the EIS and confirm if the air quality and noise emissions, propagation modelling, and other assumptions used in the EIS were reasonable. Monitoring will also be conducted to verify compliance with regulatory noise thresholds (ECCC 2009, HC 2017, etc.) and to confirm air quality EIS predictions and the absence of clear tonal components in noise emissions, or provide information to inform additional mitigation measures, if necessary (adaptive management). Follow-up monitoring will also be done to identify unanticipated negative effects on the environment.

NexGen proposed that noise levels would be measured at a minimum of three terrestrial receptors (locations) for a 24-hour period using integrating sound level meters. The current baseline monitoring program that monitors meteorological parameters, nitrogen dioxide, sulphur dioxide, TSP, and PM2.5 would be continued, likely with some modification through the licensing and provincial permitting processes, through all phases of the Project.

Finally, Environmental Committees (one per primary Indigenous group in the area) composed of NexGen and Indigenous group representatives would be established to provide oversight on the environmental performance of the project and to verify that regulatory and environmental performance commitments for the project are implemented.

6.1.2.4. Potential mitigation measures

NexGen has proposed the following measures to mitigate the potential adverse effects from identified project activities on air quality and noise. CNSC staff have assessed the mitigation measures proposed by NexGen and have concluded that they are adequate to manage potential adverse effects to air quality and noise. Mitigation measures for air quality and noise proposed by the proponent for each of the project components / activities are summarized in table 6.3 and table 6.4.

Table 6.3: Proposed mitigation measures to address effects on air quality.

Construction and Operations Phases
▪ Primarily use LNG, which generates lower emissions per unit of energy produced than diesel, for on-site power generation
▪ Evaluate opportunities to reduce fuel combustion requirements of infrastructure and equipment, to the extent practical, during detailed design
▪ Optimize haul routes to reduce fuel consumption and emissions from equipment
▪ Recover heat from the LNG power plant exhaust and use to heat other process and ancillary buildings, to the extent practical
▪ Use pollution control technology on process plant exhaust stacks with preventative maintenance and stack testing, as well as adaptive management, if necessary
▪ Use Tier 4 diesel mobile equipment for underground operations, whenever practical, with applicable mine ventilation airflow rates specified by Canada Centre for Mineral and Energy Technology, when available
▪ Apply water and/or suppressants to site roads, access road, and airstrip, as necessary

▪ Use dust suppressants that minimize environmental risk and are government approved for use
▪ Limit idling of vehicles and equipment to the extent practical
▪ Limit vehicle speed on unpaved site roads to reduce fugitive dust during Construction and Operations
▪ Use and maintain emissions control devices on combustion-based equipment
▪ Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design
▪ Identify and implement procurement criteria to confirm stationary and mobile engines meet applicable performance standards
▪ Implement a Project-specific Environmental Protection Program (EPP)
▪ Implement a Project-specific Environmental Monitoring Program (EMP) that includes ambient air monitoring
Closure Phase
▪ Primarily use LNG, which generates lower emissions per unit of energy produced than diesel, for on-site power generation.
▪ Optimize haul routes to reduce fuel consumption and emissions from equipment
▪ Apply water and/or suppressants to site roads, access road, and airstrip, as necessary. Use dust suppressants that minimize environmental risk and are government approved for use
▪ Use and maintain emissions control devices on combustion-based equipment
▪ Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design
▪ Limit idling of vehicles and equipment to the extent practical
▪ Identify and implement procurement criteria to confirm stationary and mobile engines meet applicable performance standards
▪ Implement a Project-specific EPP
▪ Implement a Project-specific EMP that includes ambient air monitoring

Table 6.4: Potential mitigation measures for noise for each project component/activity.

Project component/activities	Mitigation measures/environmental design features
Noise during construction and operations	
Land clearing, site preparation, construction of facilities and infrastructure	Enclose and dampen equipment in process buildings where sound levels are expected to exceed approx. 80 dBA where feasible. Install internal combustion engines with muffler systems. Install noise dampening structures in power plant/generator facilities, install silencers in surface and underground venting equipment (fans). Road maintenance to minimize ruts and reduce noise emissions from vehicles. Project-related health and safety program.
Underground shaft and underground operations	
Power generation	
Underground operations	
Camp, maintenance shop, offices	
Site traffic, transportation of personnel and materials to and from the site	
On-site airstrip	
Explosive blasting	
Noise during closure	
Removal of infrastructure	Enclose or dampen equipment in in-process buildings where sound levels are expected to exceed approx. 80 dBA where feasible. Outfit internal combustion engines with muffler systems. Install noise dampening structures in power plant/generator facilities, install silencers in surface and underground venting equipment (fans). Maintain roads to minimize ruts and reduce noise emissions from vehicles. Implement project-specific health and safety program.
Site restoration and revegetation of facilities and infrastructure	
Removal of power generation plant	
Removal of additional infrastructure such as but not limited to worker camp, maintenance shop and offices	
Site traffic, transportation of personnel and materials to and from the site	
On-site airstrip	

6.1.3. Other Views Expressed

6.1.3.1. Indigenous Nations and Communities

During consultation and engagement activities with Indigenous Nations and communities, concerns regarding changes in air quality were raised by CRDN, MN-S, BNDN, YNLR, and ACFN.

CRDN, which affirms that it consents to the Project and that its concerns have now been appropriately accommodated, had previously requested clarification on whether contaminants of potential concern (COPCs) in interstitial air are tracked, as well as clarification on the calculation and definition of relative risk levels for greenhouse gas (GHG) emissions. NexGen has clarified that in general, terms such as “low”, “minor”, and “negligible” indicate that Project effects are not expected to be harmful to people or the environment, and further information on the rationale to determine Project effects for the atmospheric environment may be found in EIS Section 7 [Air Quality, Noise, and Climate Change].

MN-S, which affirms that it consents to the Project and that its concerns have now been appropriately accommodated, had previously recommended that all objectives for screening against Ambient Air Quality Objectives (AAQO) be entirely health-based. Further, MN-S had previously recommended that all COPCs acting within a non-threshold level of toxicity be included for further assessment, regardless of whether they exceed AAQOs. NexGen has maintained that the ambient air quality criteria selected for the air quality screening of COPCs are appropriate. NexGen used a precautionary approach for screening COPCs, following standard best practices for Human health risk assessments (HHRAs). The criteria used in the HHRA were in accordance with current science and regulatory requirements, and NexGen has stated no additional consideration of guidelines is required for the final EIS.

MN-S had previously emphasized that intermediate components, such as air, should be considered and discussed within the EIS when selecting boundaries for Indigenous land and resource use. Given that IK evidence demonstrates that air quality is extremely high in the Study Area, MN-S had previously asked if the ERA reflects these high-quality air conditions rather than those already impacted by activity. NexGen has confirmed that the information requested was considered when defining the spatial boundaries for assessment and is provided in Draft EIS Section 16. The definition of the local study area and regional study area for the Indigenous land and resource use valued component were defined to include predicted effect on supporting intermediate components. Additionally, the Nation questioned why short-term exposures to air quality pollutants were not included in the HHRA. NexGen has maintained that further quantitative assessments for nitrogen dioxide, particulate matter, and uranium are not required as the screening assessments showed that only minor, short-term, reversible effects to human health could potentially occur. NexGen has committed to implementing a monitoring program to measure ambient air concentrations to maintain human health.

BNDN was concerned that NexGen does not specify how it will monitor air contaminant concentrations during all phases of the Project. BNDN’s position is that continuous on-site ambient air monitoring for all contaminants of concern (including particulates, metals, dioxins and furans (D&F) compounds, and radionuclides) is the only way to truly assess the Project's impact on air quality and compliance with government standards. BNDN believes without proper on-site monitoring Project-related air contaminant exceedances will be possible. BNDN critiqued the use of diesel power generators and recommended that NexGen replace them with the Best Available Technology Economically Achievable (BATEA) to mitigate GHG and air pollutant emissions. The Nation also requested that NexGen include GHG emissions related to fuel hauling and freight in its GHG emissions model. These issues have been discussed through a workshop conducted between NexGen and BNDN and follow up communication, where BNDN stated these comments have been addressed. NexGen has noted that local infrastructure requires the temporary use of diesel during construction and has committed to measures such as the use of emission control devices on combustion-based equipment and implementing procurement criteria to confirm stationary and mobile engines meet applicable performance standards, to mitigate effects associated with diesel power generators. NexGen has also committed to implementing a net-zero framework and periodically reassessing alternative technologies. NexGen has further noted that emissions related to Project support activities are not assessed, consistent with the federal GHG reporting program for individual projects, but Project-specific mitigation measures are expected to minimize GHG emissions to an acceptable degree.

BNDN emphasized that the results of modeling for the residual effects assessment for air quality should be analyzed with reference to relevant regulatory standards. For the assessment itself, the Nation noted that NexGen did not include radon or other radionuclides, metals, or Dioxins and Furans (D&F) compound emissions where it should have. Of particular concern to BNDN is the lichen-caribou-human food chain, which is vulnerable to the bioaccumulative effects of airborne radionuclides. NexGen has disagreed that D&F and radionuclides are required to be included in the residual effects assessment as no annual criterion is available, however NexGen has confirmed that radionuclide and D&F concentrations were modelled and assessed, and maximum concentrations expected do not raise health or environmental concerns. Furthermore, NexGen has committed to a Regional Traditional Foods Study with Indigenous Nations and communities in the region and further developing details of monitoring programs during permitting and licensing to address concerns of bioaccumulation.

BNDN also expressed concerns about NexGen's air dispersion modelling, which did not take variable conditions, such as wildfires, into consideration. BNDN was also concerned that NexGen's air dispersion model did not properly account for cumulative effects, specifically in relation to the Patterson Lake South Project. The Nation recommended the halting or modification of project construction and operations during wildfire events, given their ability to start wildfires or exacerbate particulate exceedances. NexGen has stated that a risk-based, graded approach would be taken to prioritize worker health and safety. NexGen will modify site activities or provide personal protective equipment in the event of wildfires, however shut down of site activities will not occur unless unacceptable risks to worker or public health exist.

BNDN also recommended that NexGen consider the impacts of sulphur dioxide emissions from Alberta oil sands operations in its cumulative effects assessment and requested that NexGen develop a GHG emissions offsetting plan. NexGen has noted that the development of such an offsetting plan is outside of the scope of the CEAA 2012*,* but NexGen supports discussion within the Environmental Committee to identify opportunities for further GHG reductions.

Finally, BNDN requested clarification on what the total Project Hazard Quotient (HQ) was compared to for the risk assessment for each medium, including air, to which NexGen confirmed that the total HQ was compared to a benchmark of 1 for all pathways, while individual pathways used an HQ value of 0.2.

YNLR underscored that maintaining air quality over the long-term is very important to them and that they expect NexGen to design and implement monitoring programs with their active participation. YNLR is especially concerned about how the Project will impact air quality not just for humans, but also for wildlife and the broader ecosystem. YNLR expressed concerns about increased air traffic and dust from Highway 955 and recommended that strategies be implemented to mitigate air quality effects, given the lifespan of the project. YNLR also requested clarification on the methodology for air quality effects in Section 7. NexGen has confirmed that Project activities would result in changes to local air quality, and as such effects to people, wildlife, and the environment were evaluated within the EA. Results generally showed that effects due to changes in air quality and noise would be minor, with the exception of woodland caribou; NexGen has committed to working with provincial and federal regulatory agencies and local Indigenous Nations and communities to develop a Caribou Mitigation and Offsetting Plan (CMOP) to prevent significant adverse effects to woodland caribou. NexGen has acknowledged that maintenance of Highway 955 is outside of NexGen's control but has committed to discussions with the Saskatchewan Ministry of Highways to develop a road upgrade and maintenance agreement, which will be required to be in place prior to Construction. On the methodology for air quality effects, NexGen has clarified that concentrations of Project air emissions are predicted to reach background levels or 10% of the applicable air quality criteria at the RSA boundary. NexGen has acknowledged that Project engagement will continue with YNLR throughout the Project life.

Athabasca Chipewyan First Nation (ACFN) requested that NexGen include a summary of ACFN-identified issues relating to predicted concentrations of COPCs in air modeling. Specifically, ACFN offered suggestions for improving air dispersion modelling such as using a three-year period to enable comparison with federal air quality standards (CAAQS); reevaluating predictive modeling data for air to identify bioaccumulative and persistent substances; using complex mixtures in the screening process for COPCs and updating the HHRA and ERA accordingly; and employing World Health Organization (WHO) air quality guidelines (AQGs) to identify air-related COPCs. NexGen has noted that the ACFN has not presented any specific issues related to spatial and temporal boundaries and predicted concentrations of COPCs in the air, and completing individual assessments for each Nation is outside of the scope of the requirements of an EA under the *Canadian Environmental Assessment Act, 2012.* NexGen has confirmed that the five-year modelling assessment used was provincially mandated by the Province of Saskatchewan, but the data included multiple possible three-year periods that could be used to approximate the three-year monitoring data called for in the CAAQS, and the highest predictions have been compared to the CAAQS and summarized in table 7.2-12 of Draft EIS

Section 7.2.5.1.1.2 (Air Dispersion Modelling Predictions). NexGen maintains that no re-evaluation of predictive modeling data is required, as the environmental risk assessment used best and standard practices to screen COPCs, including applying maximum predicted or observed concentrations and utilizing the most conservative applicable guidelines. The screening guidelines used by NexGen focused on Canadian guidelines based on the protection of health.

ACFN also requested clarification on how the air dispersion modelling study is representative of long-term exposures and enquired as to whether NexGen will monitor snow quality to confirm non-negligible residual effects from air emissions. The Nation recommended that NexGen update the ERA to include soil screening values using the 2006 Canadian Council of Ministers of the Environment (CCME) guidance for metals associated with air deposition of total suspended particles. ACFN also asked NexGen to provide scientific evidence showing that mitigations for fugitive dust and constituent emissions will prevent dust and other emissions from impacting plant species. Beyond plant life, ACFN remains concerned about the ability of air emissions to acidify lakes and rivers. NexGen has stated that the use of conservative guidelines and worst-case data in the five-year simulation generated a scenario representative of possible maximum long-term air quality conditions, and NexGen has confirmed that the EMP includes sampling snow quality near the Project site. NexGen has confirmed that the latest CCME guidelines were used to screen predicted soil quality from air deposition (CCME 2024).

NexGen has indicated in Draft EIS Section 13.4.2 (Secondary Pathways) that dust deposition rates form the project are predicted to be much less than rates shown in the scientific literature, and any changes are expected to be negligeable. NexGen has committed to monitoring dust deposition and other constituents to determine the effectiveness of mitigation and adapt if necessary. On the acidification of lakes and rivers, NexGen has predicted low acidifying emissions, indicated by total H^+ equivalent of approximately 10% of the criterion of 0.175 t/d, and the pH values of the rainwater in the Project site indicate that potential for acid deposition issues is low. NexGen has committed to continuing to monitor and report pH values of rainwater, and Section 7A2.1 of Final EIS Appendix 7A will be updated to include H_2SO_4 emissions in the total H^+ equivalent calculations and the monitored pH value of rainwater.

6.1.3.2. Federal Authorities

HC raised questions about cumulative noise effects and community engagement, and the inclusion of airstrip noise as a source of “infrequent but impulsive noise” when evaluating noise effects. HC stated there were no outstanding issues related to noise provided that all management, monitoring, and mitigation measures were implemented. Specifically, they referred to NexGen’s commitments to: 1) implement an Indigenous and Public Engagement Program to effectively engage with communities on Project activities, effects, mitigation, and monitoring to keep people involved and provide opportunities for feedback, 2) install noise dampening structures in power plant generating facilities and install silencers in surface and underground large vent fans, 3) implement procedures to reduce noise, dust, and light levels, 4) maintain roads to minimize ruts and reduce noise emissions from vehicles, 5) establish a Project feedback and grievance mechanism to record and action issues identified by local priority area residents, and

6) monitor noise emissions from Project equipment and activities during Construction and Operation.

HC sought clarification on the potential risks to human receptors with respect to air quality. These included clarification on the modeling of background concentrations for air quality parameters, project-related dust associated with on-site material handling and transportation, impacts of short-term exceedances of air-quality for human health, predicted short-term exceedances of air quality parameters, and proposed management, mitigation, and monitoring plans. HC encourages the use of all available mitigation measures that are technically and economically feasible (e.g., use of Tier 4 engines) to ensure that air pollutants (i.e. PM and NO_2) and possible adverse effects for off-duty workers are minimized. HC also supports monitoring dust, total suspended particles (TSP), nitrogen dioxide (1 hour), particulate matter (24 hour), uranium in TSP, PM10 and PM2.5 for comparison to the CAAQS and applicable standards. HC recommends that NexGen interpret these monitoring results using current health-based air quality values (e.g., CAAQs, WHO Global Air Quality Guidelines) and assess the need for additional mitigation for the protection of human health. HC also recommends that monitoring results are fully integrated into the Project's Effluent and Emissions Plan and EMP, and to use adaptive management measures to address uncertainty with modelled predictions.

NexGen has made commitments to reduce the impact of air quality contaminants on human health, including implementing a Project-specific EPP and Project-specific Effluent and Emissions Plan, limit idling vehicles, evaluate opportunities to reduce fuel combustion requirements of infrastructure and equipment, use Tier 4 diesel mobile equipment for underground operations when feasible, use and maintain emission control devices on combustion-based equipment, use pollution control technology on process plant exhaust stacks with preventative maintenance and stack testing with adaptive management where necessary, identify and implement procurement criteria to ensure stationary and mobile engines meet performance standards, maintain mobile mining equipment and vehicles and operate within equipment parameters, optimize haul routes to reduce fuel consumption and emissions, apply water and/or suppressants to roads and airstrip as necessary, and conduct monitoring to verify ERA predictions, support ongoing management to protect human health, and refine risk assessment models to inform management and mitigation.

ECCC recommended that NexGen complete a carbon sinks assessment separate from the land-use change estimate, provide additional information on carbon sink removal, and use a more robust (Tier 2 or 3) approach for estimating emissions related to land-use change. ECCC also recommended that NexGen refrain from comparing the Project's GHG emissions to provincial and federal emissions and recommended that the Net-Zero Framework align with the SACC Technical Guide. ECCC stated that the main emissions source from the Project include land-use change, stationary combustion for heating and electricity generation, mobile equipment, and waste incineration. When reviewed annually, land-use change is expected to be the largest source of GHG from the Project, but ECCC noted that the draft EIS and IRs lack details related to estimated emissions from land-use change. Therefore, the emissions may be underestimated as NexGen used a Tier 1 approach instead of a Tier 2 or 3 approach which are more robust, detailed, and appropriate for the size of the Project. ECCC noted that LNG generators will be used over diesel generators, and that there may be further mitigations of GHG emissions as a hybrid system (e.g., wind and solar) is under consideration for the future. NexGen has committed to implementing a Net-Zero Framework, including annual reporting on GHG emissions, and periodically re-assessing alternative technologies and practices to reduce GHG emissions.

CNSC staff are satisfied that other views expressed in this section have either been satisfactorily resolved through consultation activities with Indigenous Nations and communities, the EIS technical review, or will be addressed during the ongoing regulatory process.

6.1.4. CNSC Staff's Analysis

CNSC staff have reviewed NexGen's assessment and determined that while the identified changes to air quality (e.g., from vehicle/equipment use, operations) will be long lasting due to the nature of the project, they are expected to be of low to moderate magnitude and not cause significant changes to the atmospheric environment, taking into account the implementation of mitigation and follow-up monitoring program measures. Follow-up monitoring will also be used to confirm model predictions and ensure the environment remains protected. Air quality feeds into other assessment endpoints (e.g., terrestrial, aquatic), so the residual effects for air quality do not require significance determinations of their own.

With respect to acoustic (noise) environment, CNSC staff have reviewed NexGen's assessment and determined that some minor increases in noise levels are expected during the construction and operations phase in comparison to baseline conditions, particularly for the nearest receptor. CNSC staff conclude that the mitigation measures proposed by NexGen are appropriate and will help attenuate the noise to some extent. CNSC staff also note that monitoring will be conducted to verify compliance with regulatory noise thresholds (ECCC 2009, HC 2017, etc.)

6.1.4.1. Greenhouse Gas Emissions (Transboundary effect)

CNSC staff assessed NexGen's GHG assessment and found the assessment and methods of assessment to be adequate. CNSC staff verified that GHG emissions have been calculated for the most GHG intensive phases of the proposed project with results indicating that emissions are low relative to both national (0.02%) and provincial (0.3%) total emissions. GHGs will be further evaluated under licensing through a BATEA for air emissions and treatment technologies and techniques assessment.

Considering the currently available information and NexGen's commitments, with respect to transboundary implications of GHG emissions and their potential to contribute to the Government of Canada's ability to meet its environmental obligations and its commitments in respect of climate change, CNSC staff conclude that the project is not likely to cause a significant adverse effect.

6.1.5. CNSC Staff's Findings and Recommendations

CNSC staff have reviewed NexGen's effect assessment of the atmospheric environment, related to the air quality, acoustic environment and greenhouse gas emissions and confirmed that

NexGen conducted a comprehensive analysis of these effects and that identified mitigation and follow-up monitoring program measures are adequate.

6.1.6. Issues requiring Follow-up

CNSC staff have requested that NexGen provide additional analysis in future licensing reviews. In future ERA updates and/or updated licensing document submissions, CNSC staff expect NexGen is to consider Tier 2 or Tier 3 approach for the assessment of carbon sinks and land-use change emissions. In addition, during the project lifespan CNSC staff expect NexGen to continue to evaluate monitoring and mitigation measures to track and minimize air pollution and, where practical, implement any newly identified mitigation measures that are technically and economically feasible. CNSC staff also expect NexGen to implement a Net-Zero Framework and to reassess alternative technologies and practices to manage GHG emissions, as well as to implement GHG management strategies to reduce emissions to the extent practical. CNSC staff expect NexGen to quantify and report project GHG emissions on an annual basis, following the Greenhouse Gas Reporting Program (GHGRP).

6.2. Geological and hydrogeological environment

6.2.1. Description of the environment: geology and hydrogeology

6.2.1.1. Studies conducted by the proponent to characterize baseline geology and hydrogeology

Characterization of existing conditions by the proponent was based on regional studies of the southern Athabasca Basin and extensive project-specific data. The project-specific data includes:

- drilling records and samples from exploration, geotechnical, and environmental boreholes
- geophysical data
- previously published geologic data sources (i.e., mapping and the literature)
- hydrostratigraphic, hydraulic, geochemical, groundwater chemistry and calibration with numerical models

6.2.1.2. Characterization of baseline geology

NexGen's Rook I Project centers on the Arrow deposit (figures 6.1 and 6.2), a high-grade uranium deposit that is located adjacent to Patterson Lake in the southern Athabasca Basin of northern Saskatchewan. This deposit is hosted by veins that formed in northeast-striking, near vertical southeast-dipping brittle-ductile high-strain zones in the Paleoproterozoic (2.5–1.6-billion-year-old) basement rocks that are composed of granite or gneiss (figure 6.2).

The lithologic units within the regional study area (RSA), which are broadly divided into the Paleoproterozoic to Cretaceous bedrock and Quaternary surficial deposits, are described as follows:

Bedrock (figures 6.1-6.4):

Paleoproterozoic basement rock of the Taltson Domain: this unit, which is encountered between -150 and 430 masl, is composed predominantly of granites or gneisses that are heavily deformed with steeply dipping shear and fault zones. The main fabrics and contacts observed within the crystalline basement rocks in the vicinity of the Arrow deposit are all northeast-striking, southeast-dipping.

- Paleoweathered Paleoproterozoic basement rock (regolith): this 20 -200 m thick unit is composed of weathered material derived from the Paleoproterozoic basement rock beneath.
- Mesoproterozoic (1.85-1.54-billion-year-old) Athabasca Sandstone bedrock: this unit, which reaches up to 400 m in thickness, is composed of sandstones that are unconformably overlying the paleoweathered basement rock
- Devonian (419.2-358.9-million-year-old) bedrock: this unit, which reaches up to 60 m in thickness, is composed of carbonate-rich interbedded sandstone, siltstone, and mudstone, likely belonging to the Elk Point Group
- Cretaceous (145-66-million-year-old) bedrock: this unit, which reaches up to 100 m in thickness, consists of an upper unit of green to grey-black, fine- to medium-grained quartz sandstone interbedded with fissile mudstones, and a lower unit of brown, fine- to coarse- grained quartz sandstones crossbedded with minimal mudstones likely belonging to the McMurray Formation.

Surficial deposits (figure 6.5):

- Quaternary (2.58 million years-present) glacial drift and till deposits: This 10 - 200 m thick unit is composed of glacial deposits that are derived from both the crystalline basement rocks and the Athabasca Sandstones. These glacial deposits are divided into two sub-units, an “upper overburden” generally located above the water table with higher sand and boulder content, and a “lower overburden” generally located below the water table with higher fine sediment content.

Figure 6.1: Bedrock Geology

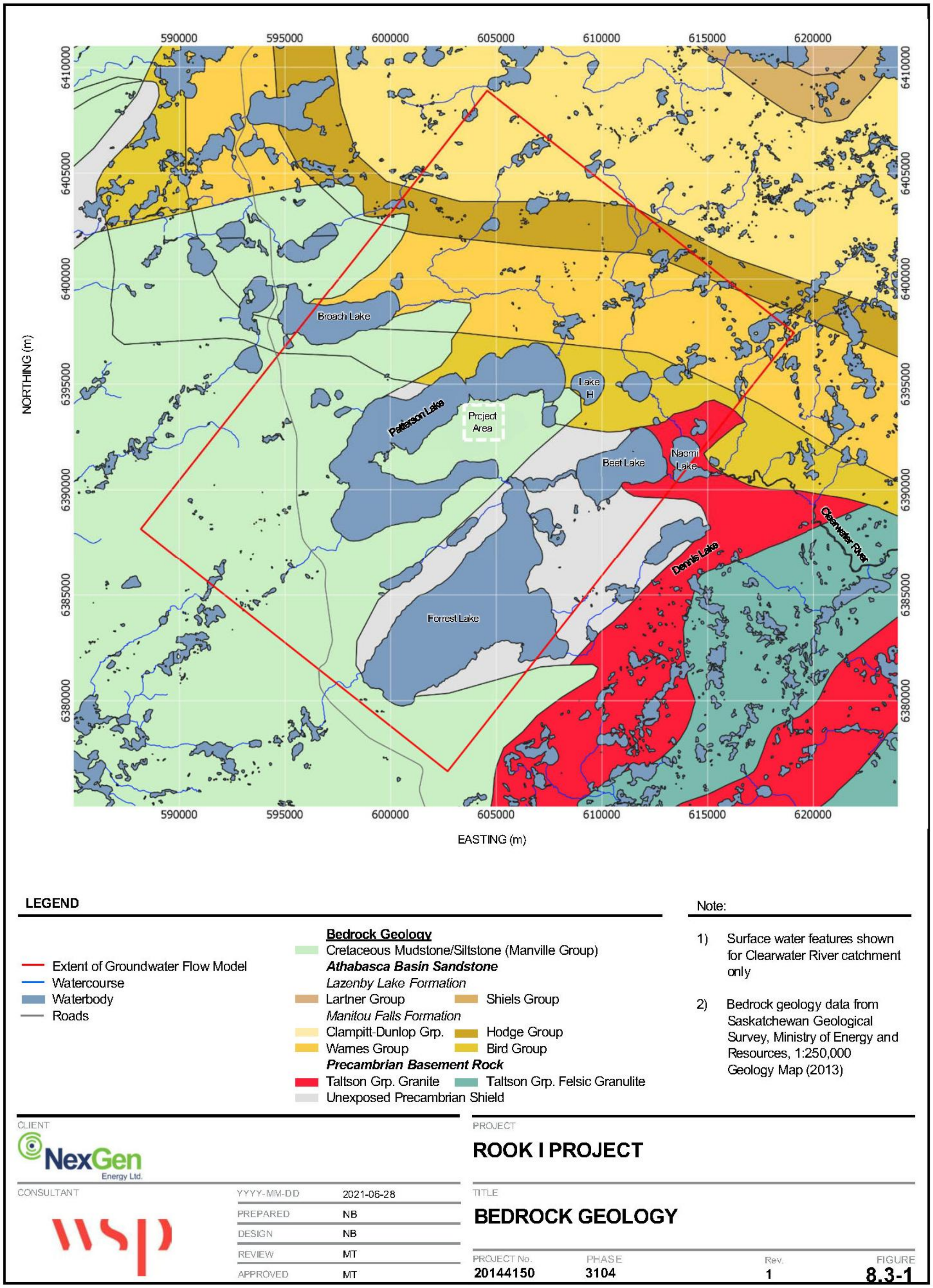
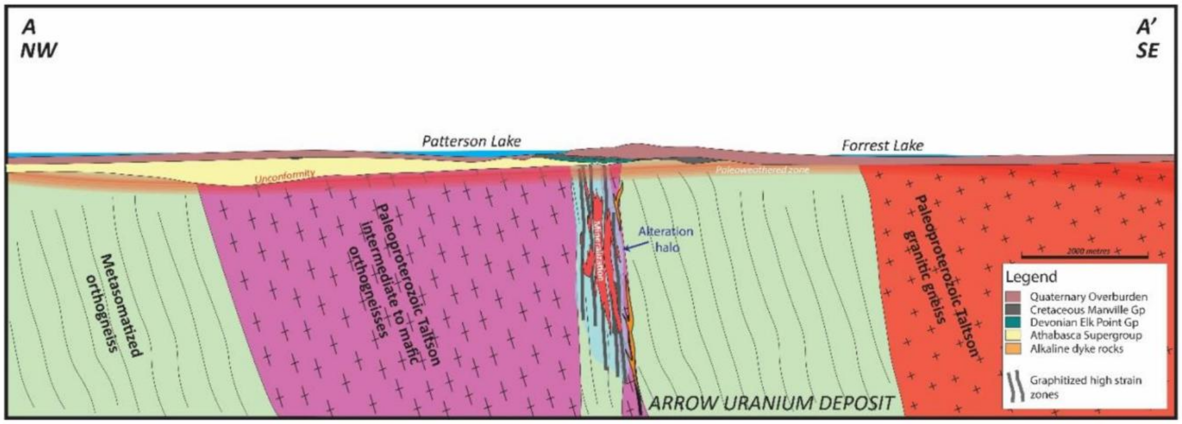
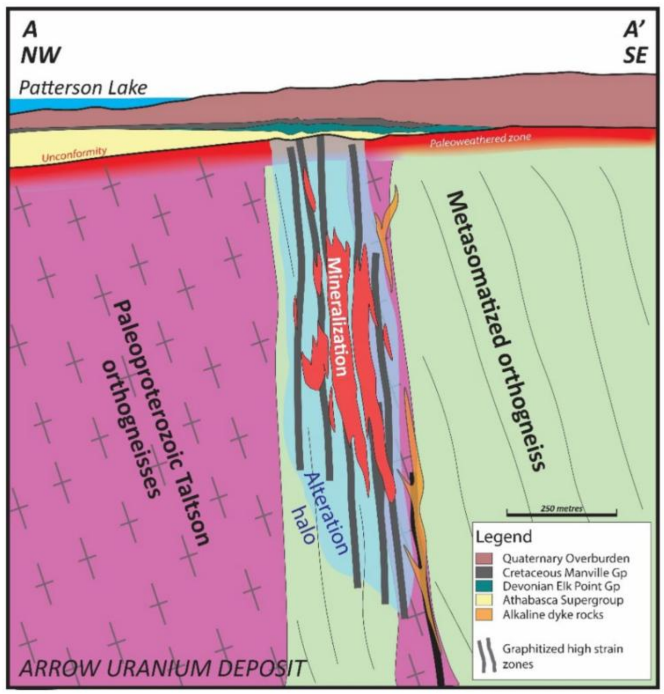


Figure 6.2: Arrow deposit. No indication of vertical exaggeration applied.



Schematic Southwest-Northeast Long-Section through the Arrow Deposit Showing Regional Study Area Sedimentary and Basement Geology, Structure, and Zones of Uranium Mineralization



Schematic Southwest-Northeast Long-Section through the Arrow Deposit Showing Regional Study Area Sedimentary and Basement Geology, Structure, and Zones of Uranium Mineralization

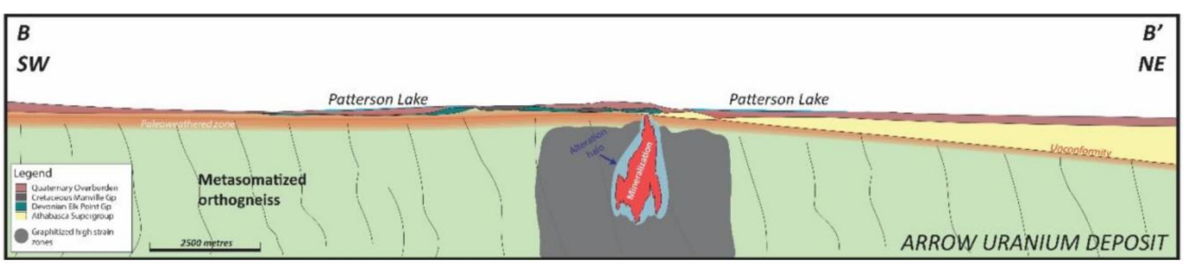


Figure 6.3: Geologic cross section A-A’. Faults and Shear zones are indicated by nearly vertical lines.

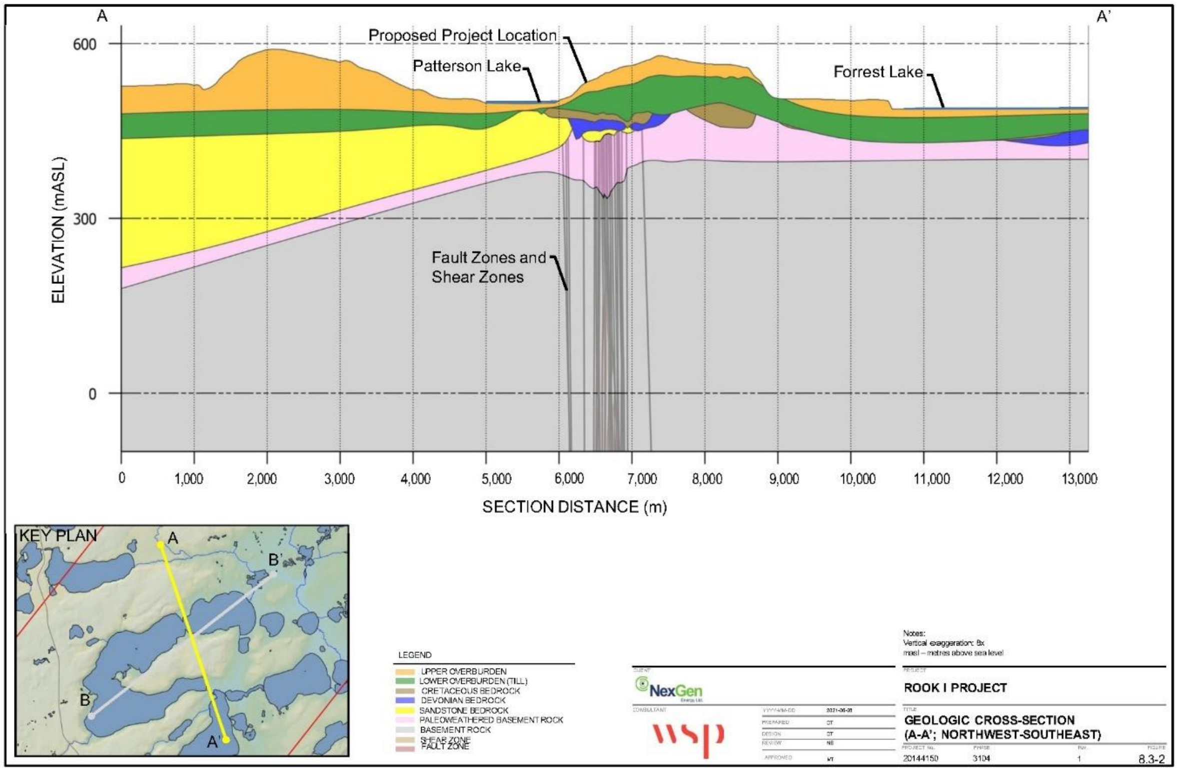


Figure 6.4: Geologic cross section B-B’.

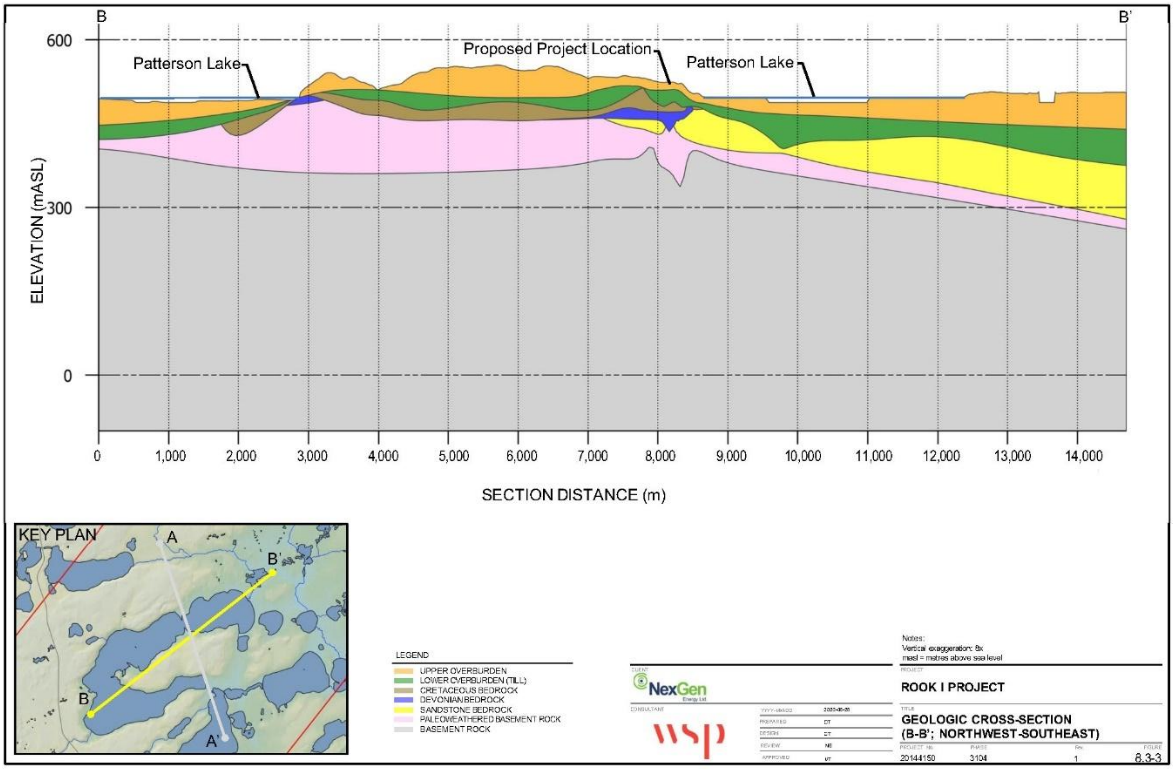
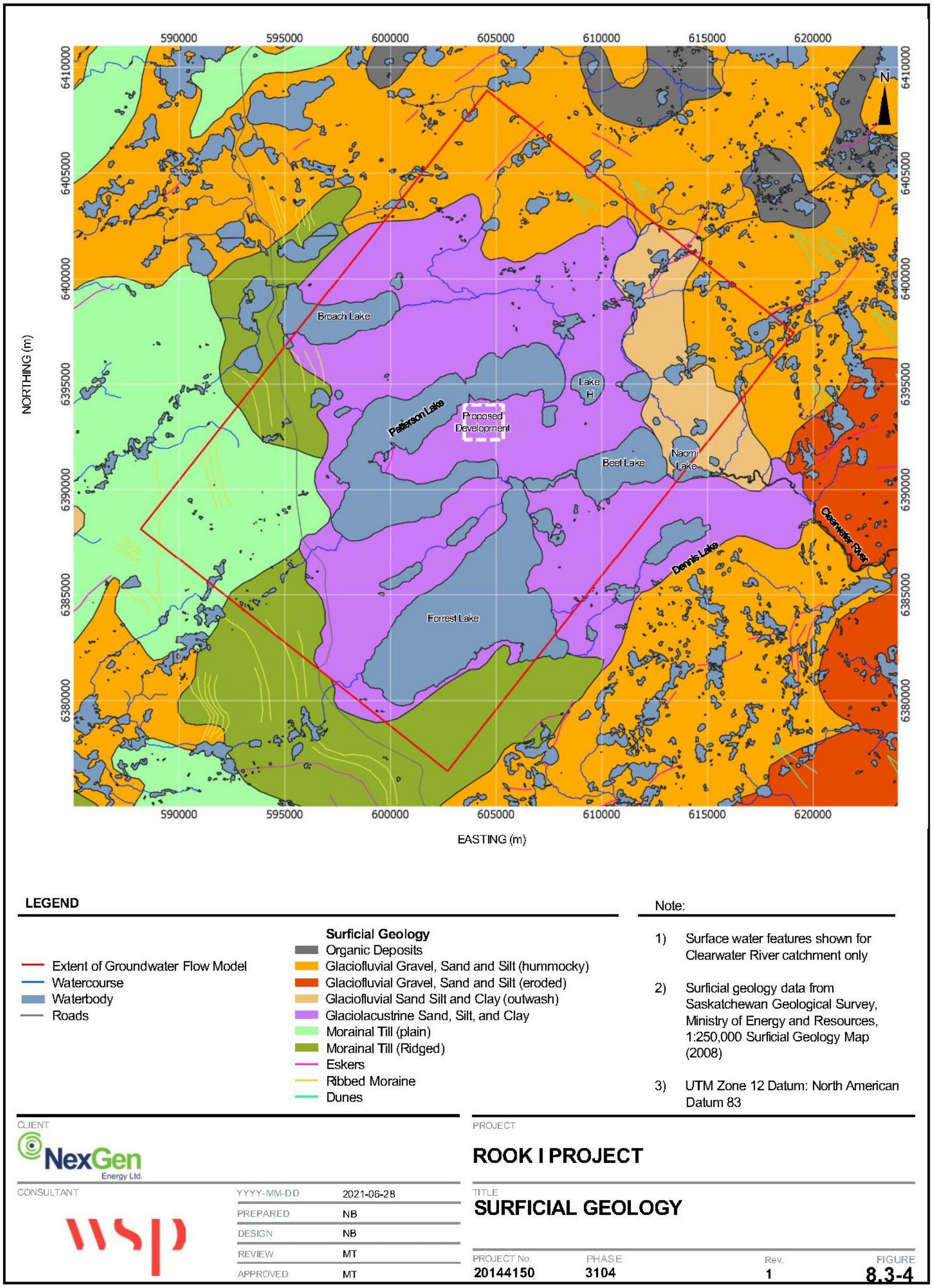


Figure 6.5: Surficial Geology.



6.2.1.3. Characterization of baseline hydrogeology

Hydrogeological stratigraphy of the site assimilates with the geologic units as described above. Figure 6.6 shows the conceptual site model of the site developed by the proponent. The baseline static groundwater head is shown as well.

Baseline groundwater flow conditions

Groundwater recharge in the study area primarily occurs through the infiltration of atmospheric precipitation into sandy glaciofluvial deposits, as well as seasonal leakage from surface water bodies—particularly near lakes and along riverbanks where fracture zones are present.

The regional groundwater flow system can be conceptualized in three types:

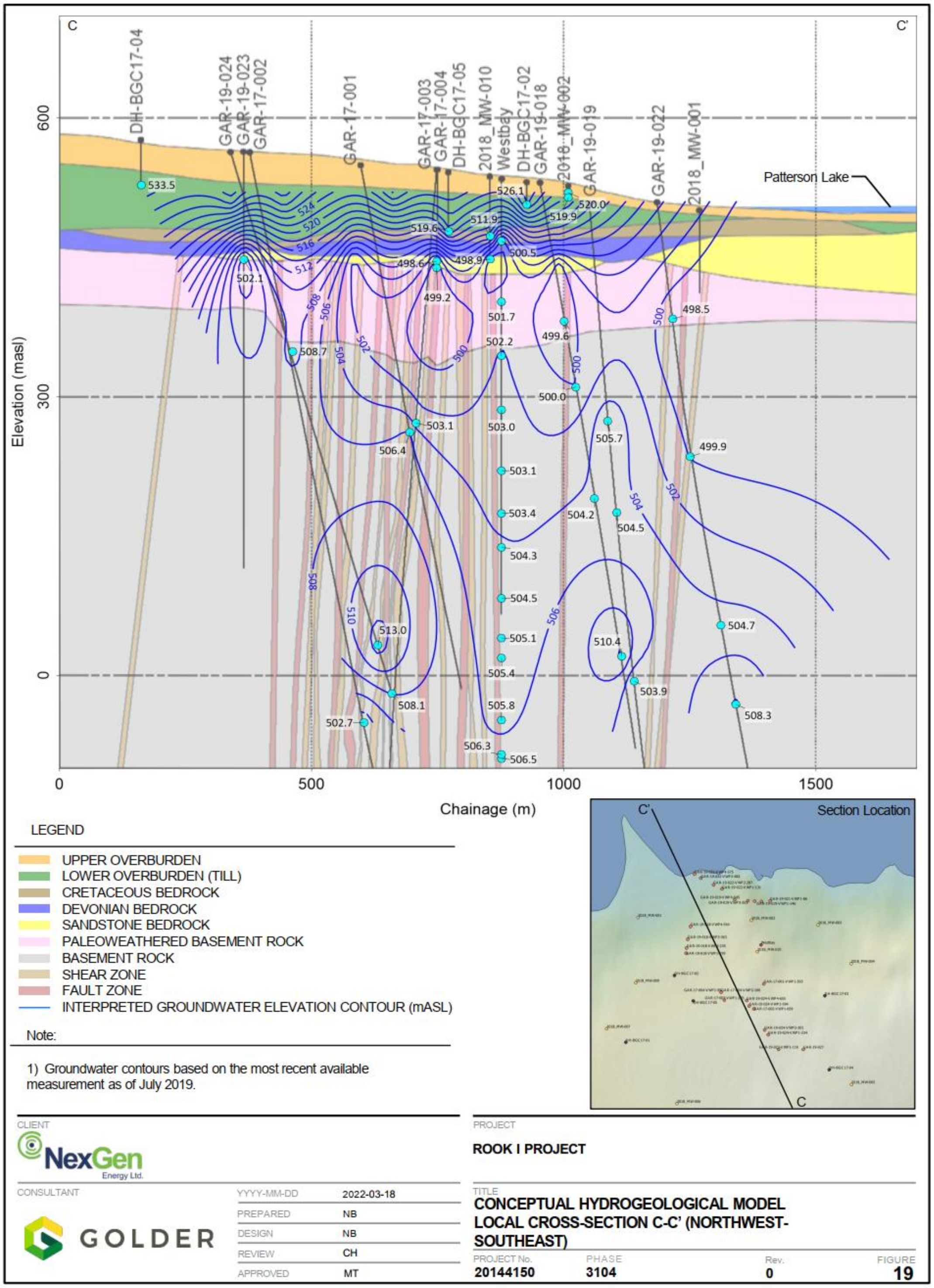
- Local flow within shallow aquifers, driven primarily by surface topography
- Intermediate flow within deeper confined aquifers, characterized by longer travel paths
- Regional flow, governed by the tectonic structure of the basin

Shallow groundwater generally flows toward the Clearwater River, while deeper groundwater migrates from the basin margins toward its central areas. Fault structures introduce complex hydraulic connections between aquifers, influencing both horizontal and vertical flow patterns.

Within the glacial drift deposits, groundwater moves toward nearby surface water bodies such as Patterson Lake. A prominent groundwater flow divide exists south of the proposed mine site, situated on a peninsula, which directs shallow groundwater both northward and southward into the lake. Similarly, in the shallow bedrock, groundwater exhibits an overall west-to-east flow direction, though it is locally redirected by topographic gradients to converge toward Patterson and Forrest Lakes. This flow pattern also features a divide south of the mine, mirroring that of the glacial drift, with groundwater split and directed northward and southward toward Patterson Lake.

In deep bedrock, the groundwater maintains a general west-to-east flow, with the steepest hydraulic gradients located west of Patterson Lake, driving groundwater toward the lake.

Figure 6.6: Hydrogeological stratification and static water head distribution



The vertical component of groundwater movement reveals additional complexity in the flow regime. In the region characterized by a topographic high located to the south of the proposed mine, the groundwater flows downward, driven by the elevation difference. This downward movement transitions to an upward flow in the area directly beneath the proposed underground mine and UGTMF. This shift reflects the influence of both the local topography and the subsurface geological features. Notably, the presence of structural elements such as fault zones and shear zones significantly affects the simulated groundwater elevations. These structures manifest as areas of reduced groundwater pressure in their vicinity, suggesting enhanced conductivity compared to the surrounding basement rock. As a result, they serve as preferential pathways for groundwater movement, channeling flow from the mine horizon—the depth at which mining activities would occur—toward discharge points in Patterson Lake. This interplay between structural geology and hydrology highlights the critical role that faults and shear zones play in shaping the groundwater flow regime in this region.

In summary, the baseline groundwater flow regime around the proposed mine site is a complex system influenced by topography, geological layering, and structural features. The glacial drift directs flow toward local surface waters like Patterson Lake, with a clear divide splitting the flow north and south. The shallow and deep bedrock layers exhibit a west-to-east trend, modified by local divides and water features, while vertical flow shifts from downward in high areas to upward near the mine, guided by conductive structures. These insights, derived from the simulation results of the CSM, provide a basis for understanding the predevelopment groundwater dynamics in the area.

Baseline chemistries for groundwater and waste rock

The Rook I Project area exhibits a distinct geochemical stratification across its hydrogeological units, shaped by depth, lithology, water–rock interactions, and the regional mineralization setting. Key units include the glacial drift aquifer, the basement rock aquifer, and several waste rock domains associated with mine development and tailings management.

The glacial drift aquifer hosts fresh, low-salinity groundwater dominated by calcium-bicarbonate ($Ca\text{-}HCO_3$) chemistry, indicative of modern recharge and limited geochemical evolution. Monitoring conducted between 2017 and 2020 across 34 piezometers showed median concentrations of bicarbonate at 39 mg/L, calcium at 7.0 mg/L, and chloride at just 0.18 mg/L, while sodium exhibited high variability (up to 45 mg/L). Iron (mean 0.25 mg/L) and manganese (mean 0.320 mg/L) levels reflect localized redox conditions. Overall, the aquifer has low trace metal and total dissolved solids concentrations, with minimal evidence of anthropogenic influence, making it a suitable baseline for future environmental monitoring.

In contrast, the basement rock aquifer contains more geochemically evolved, higher-salinity groundwater of Ca-Cl and Na/K-Cl types, suggesting prolonged residence time and extensive water–rock interaction. Median concentrations of calcium, sodium, and chloride are 65 mg/L, 76 mg/L, and 270 mg/L, respectively. These values, particularly the elevated sodium and chloride levels (with maxima of 2,200 mg/L and 17,000 mg/L respectively), highlight a shift toward salinization consistent with deep, confined aquifers undergoing long-term geochemical interaction. Metal concentrations were significantly elevated compared to shallow groundwater. Elevated levels of iron (mean 4.3 mg/L) and strontium (mean 13 mg/L) and naturally occurring radionuclides such as radium-226 have been detected, consistent with the area's uranium-bearing geology. This deeper system serves as a key reference for assessing potential subsurface impacts from mining activities.

Geochemical characteristics vary significantly across mine-related waste rock units. The proposed UGTMF area is composed primarily of semi-pelitic gneiss (SPGN) and intermediate orthogneiss (INT), exhibits low to moderate acid generation potential. Total sulfur ranges from 0.01% to 2.7% (median 0.18%), with low carbonate content (<0.5 kg $CaCO_3$/t) and a neutralization potential (NP) of 4–8 kg $CaCO_3$/t. Humidity Cell Tests (HCTs) show that low-sulfur samples (<0.24%) maintain near-neutral pH, whereas high-sulfur samples acidify quickly and release sulfate and metals such as molybdenum. Although radiological and heavy metal risks are generally low, scattered or localized distribution of sulfur-rich zones may suggest the need for targeted management.

The Mine Development Area (MDA), encompassing the mineralized core, presents elevated risks for acid generation and metal leaching. Sulfide content ranges from 0.02% to 3.3%, with carbonate buffering capacity below 0.83 kg $CaCO_3$/t. Over 40% of samples are classified as potentially acid generating (PAG), and HCTs show pH values as low as 3.6 in high-sulfur samples. Significant leaching of uranium, molybdenum, selenium, and radium-226 (up to 100 Bq/g) was observed. Although silicate minerals dominate the rock matrix, their buffering capacity is limited and more dominant in low pH conditions. Elemental correlation analysis revealed a strong positive correlation between cobalt and total sulfur content. Both molybdenum and selenium exhibited associations with sulfide minerals in high-sulfur samples. No significant correlation was observed between uranium and sulfur content, suggesting that uranium may primarily exist in discrete mineral forms, such as crystalline uraninite (UO_2). The MDA represents the area of greatest concern within the project in terms of acid drainage, heavy metal enrichment, and radiological risk. The proponent indicated that waste classification and segregation strategy would be implemented, with PAG materials isolated and managed separately in lined waste rock storage facilities with oxidation control measures.

The special waste rock in the Mine Development Area (MDA), located in fault and shear zones with localized uranium enrichment (0.03%–0.26% U_3O_8), presents a unique risk profile. While most samples are non-PAG due to low sulfide levels (<0.1%), they contain elevated concentrations of uranium, molybdenum, and selenium. Data indicates that uranium, molybdenum, and selenium enrichment in special waste rock is more pronounced than in MDA samples. HCTs show pH values between 5.6 and 6.6, with radium-226 concentrations reaching up to 66 Bq/L in leachates. Neutralization is driven by silicate weathering, with NP values between 2.5 and 40 kg $CaCO_3$/t, but is insufficient for long-term stability. Accordingly, this material requires separate storage and robust containment to mitigate environmental risks.

By contrast, the Shaft and Portal Area, composed of basement rock and minor sedimentary lithologies, exhibits low environmental risk. Sulfur content is minimal (<0.02%), pH ranges from 5.5 to 9.6, and radionuclide and trace metal levels are negligible (e.g., Ra-226 <0.3 Bq/g). These properties make the material suitable as low risk backfill or for use in closure applications.

Overburden and cover materials, including glacial tills and shales, also demonstrate very low sulfur (<0.01%) and metal content, with pH values ranging from 6.5 to 8.2. Their low reactivity and slow weathering rates suggest minimal potential for acid generation, making them appropriate as reference materials for baseline conditions or use in site closure designs.

Across all units, results from HCTs confirm that rocks with low sulfur content (<0.18%) remain geochemically stable, with near-neutral pH maintained through silicate dissolution. In contrast, high-sulfur materials (0.19%–3.3%) undergo acidification within weeks to years, accompanied by the release of sulfate, metals, and radionuclides. The highest contaminant mobility was observed in samples from the MDA, necessitating strict classification and containment strategies. The Shaft/Portal and Overburden areas are relatively low in this respect. These findings inform waste management planning, material segregation, and long-term monitoring to ensure environmental protection and compliance throughout the project lifecycle.

6.2.2. Proponent's Assessment

6.2.2.1. Effect of the Project on Geology

There is no dedicated section in the EIS that dicusses the effects of the Project on the geology. However Appendix 8A of the EIS contains a geology supplement that provides a summary of the utilization of geological information for the assessment of potential Project effects to sediment transport, hydrogeology, and terrain and soils, and refers to the corresponding EIS section [10] where more details can be found. Table 6.5 describes the potential effect pathways, project components and environmental design and mitigation. Measures to mitigate the impacts on sediment transport, terrain and soils, and hydrogeology are discussed in EIS sections 10, 12, and 8, respectively.

6.2.2.2. Effect of the Project on Hydrogeology

The proponent developed and calibrated a three-dimensional numerical groundwater flow model to represent the conceptual hydrogeological model, using target groundwater levels and baseflow data (i.e., the portion of streamflow sustained between precipitation events) for calibration. The model was established to accurately represent current (i.e., pre-development) conditions.

The objective of the groundwater flow modeling was to develop and calibrate a model that reflects the existing conditions at the project site and extends to the Regional Study Area (RSA). The calibrated model was used to predict the impacts of the project at various stages (construction, operation, and closure) on groundwater inflows, drawdown levels, and flow paths, with a particular focus on groundwater pathways from the mine waste source areas to Patterson Lake.

To achieve these objectives, the proponent first developed a conceptual groundwater model to simplify and organize the site's hydrogeological features in a manner suitable for modeling. The conceptual model retained sufficient complexity to ensure that the resulting numerical model could adequately reproduce real groundwater behavior and meet project requirements. Based on this conceptual model, the proponent built and calibrated a three-dimensional numerical groundwater model to best represent groundwater flow under existing conditions. Subsequently, simulations using the calibrated model were conducted to generate groundwater flow results representative of project application cases. The development and calibration process for the model is documented in detail in the "TSD XIV Groundwater Flow and Solute Transport Modeling Report" [14].

Table 6.5: Potential effects pathways, project components, and environmental design and mitigation

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
HG-01	Project components/activities that may influence surface water elevations and flows during **Construction, Operations, and Closure**: ▪ underground shaft and mine development ▪ underground operations	**Groundwater inflow to underground mine:** ▪ Groundwater inflow may affect surface water elevations and flow rates	▪ **Isolate mine workings** from groundwater inflows that could occur through high permeability strata (i.e., Cretaceous sandstone) with a hydrostatic liner in the shaft ▪ Design, maintain, and monitor a mine dewatering system to manage the flow of **groundwater inflow**	Primary pathway
HG-02	Project components/activities that potentially change groundwater quality during **Construction, Operations, and Closure**: ▪ site preparation activities ▪ handling and storage of waste rock, special waste rock, and ore	**Seepage from the WRSAs during Construction, Operations, and Closure:** ▪ Seepage from the WRSAs may cause changes and alter groundwater, surface water and sediment quality in Patterson Lake	▪ **Segregate PAG material** from NPAG material and store separately ▪ **Contain and divert runoff and seepage from PAG** waste rock, special waste rock, and ore to the effluent treatment plant ▪ Implement a Project-specific **Mine Waste Management Plan** ▪ Implement a Project-specific **Environmental Protection Program** and a Project-specific **Environmental Monitoring Plan** that includes groundwater monitoring and adaptive management, if necessary ▪ Develop and implement a **Detailed Decommissioning and Reclamation Plan** to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway
HG-03	Project components/activities that potentially change groundwater quality **following Closure**: ▪ storage of waste rock in the WRSAs	**Seepage from the WRSAs after Closure:** ▪ Seepage from the WRSAs to Patterson Lake may adversely affect groundwater, surface water, and sediment quality after Closure	▪ Use **engineered cemented paste backfill and tailings** to control source concentrations ▪ Include **engineered source control** layering in the PAG WRSA ▪ Install **engineered cover system** on PAG and NPAG material during reclamation ▪ Develop and implement a **Detailed Decommissioning and Reclamation Plan** to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway
HG-04	Project components/activities that potentially change groundwater quality **following Closure**: ▪ storage of cemented paste tailings in the UGTMF and cemented paste backfill in the mined stopes	**Seepage from the UGTMF and backfilled production stopes after Closure:** ▪ Seepage from the UGTMF and backfilled production stopes to Patterson Lake may adversely affect groundwater, surface water, and sediment quality after Closure	▪ **Apply binder** to reduce permeability in cemented paste backfill and tailings ▪ **Engineer the tailings geochemistry** to control source concentrations	Primary pathway

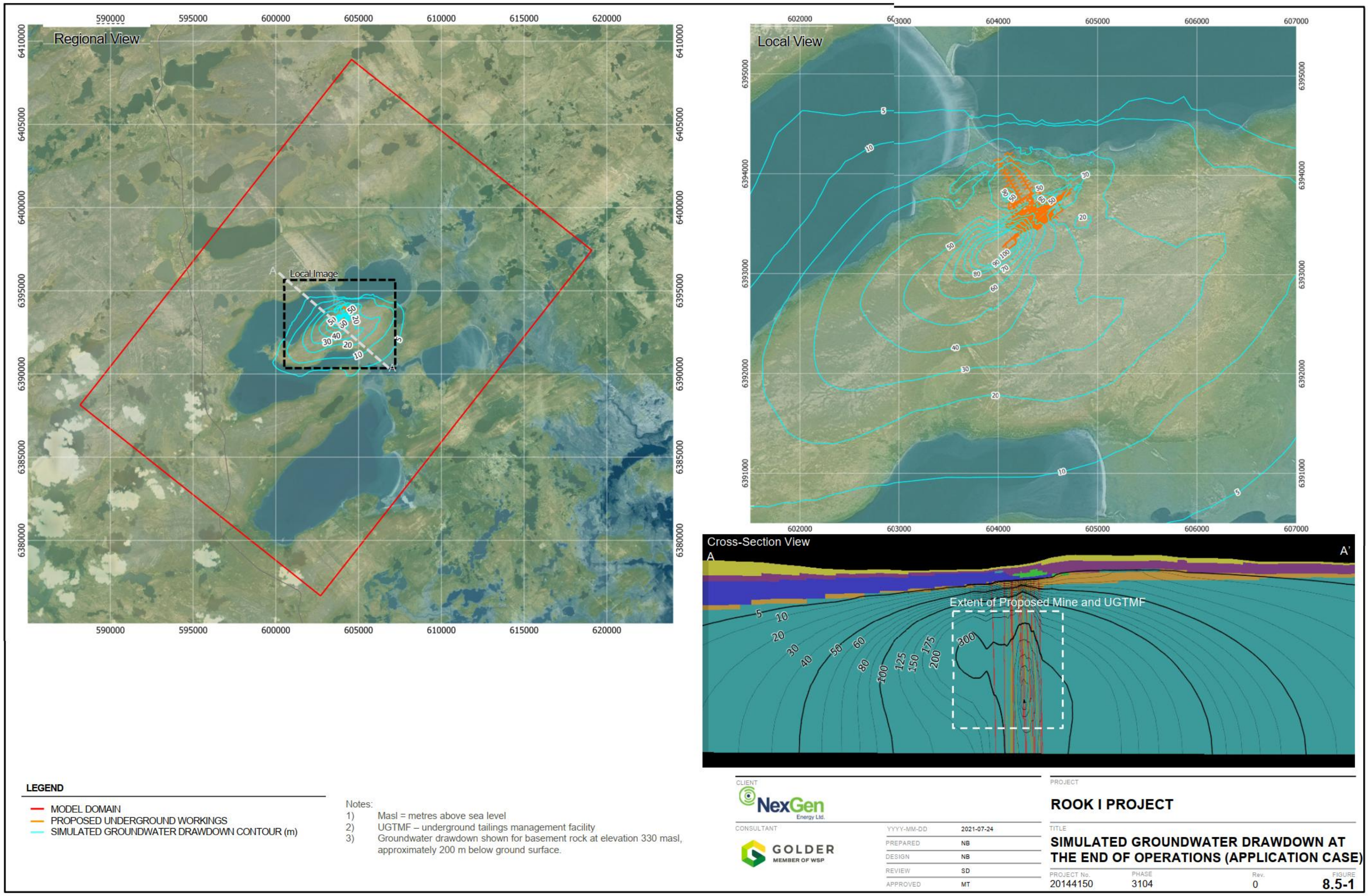
Effect on groundwater Flow

In the EIS for the Rook I project, the Residual Effects Analysis is a key component in evaluating the potential long-term impacts of mining activities on the groundwater system. Through the development of three-dimensional groundwater flow and solute transport models, NexGen assessed the impacts of project activities at different stages (construction, operation, closure, and long-term) on groundwater levels, flow directions, velocities, and water quality.

Groundwater Levels

During the operational phase, seepage from the mine will result in depressurization of the surrounding bedrock, manifested as declines in groundwater levels at monitoring points (i.e., groundwater drawdown shown in figure 6.7). Simulation results show that by the end of operations, the area of groundwater drawdown (represented by the 5-meter drawdown contour) in the bedrock near the upper part of the mine extends approximately 2 kilometers to the north, 4 kilometers to the south, and about 3.5 kilometers to both the east and west. Vertically, the depressurization is primarily confined to the bedrock layer, as the overlying sandstone aquifer has higher permeability. Around the mine site, the maximum simulated drawdown within the sandstone layer is less than 5 meters. Assessment results indicate that the lowering of groundwater levels is mainly restricted to the bedrock layer. During the closure and long-term periods, model predictions suggest that the groundwater system will gradually recover. Localized areas may continue to experience long-term changes, such as the bedrock layer needing a longer time to recover in groundwater level because of its comparatively lower permeability that delays this process. The shallow region near the ground surface will recover quickly due to the high permeability and recharge. Therefore this is not a concern for the shallow groundwater level.

Figure 6.7: Simulated groundwater drawdown at end of operation



Groundwater Flow Patterns and Rates

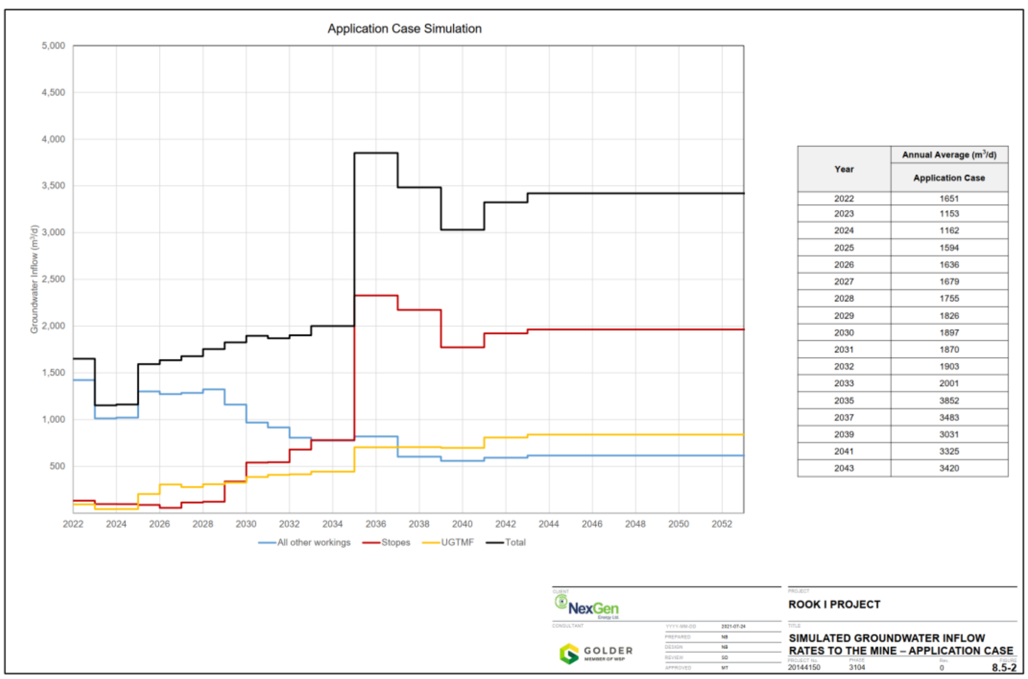
Groundwater Inflow to the Mine Site

Simulation results shown in figure 6.8 indicate that within the first 13 years of operation groundwater inflow rates range from approximately 1,200 to 2,000 m³/d, primarily entering other underground infrastructure areas (excluding the UGTMF and mining backfill areas). By the end of the 13th year of operation, as new mining stopes are opened, the inflow rate increases to approximately 3,900 m³/d. From 2041 onwards, groundwater inflow stabilizes at around 3,500 m³/d, with 60% of the inflow sourced from the mining stopes and 20% each from the UGTMF and other underground facilities. The proposed pumping capacity is 7080 m³/d, providing a good safety margin against higher-than-expected inflow.

Baseflow from surface waste rock storage areas and ore/special rock stockpiles

During operations, groundwater seepage will be collected, treated, and discharged into Patterson Lake. Assuming that all seepage groundwater originally infiltrates from the surface within the Patterson Lake catchment area, this process results in a net-zero effect on the overall water balance of the surface water system. Model estimates suggest that the current groundwater discharge rate from the Patterson Lake watershed is approximately 68,300 m³/d, whereas the peak groundwater inflow rate into the mine site is about 3,900 m³/d, representing only around 6% of the total surface water discharge.

Figure 6.8: Simulated groundwater inflow rate at end of operation



Year	Annual Average (m³/d)
	Application Case
2022	1651
2023	1153
2024	1162
2025	1594
2026	1636
2027	1679
2028	1755
2029	1826
2030	1897
2031	1870
2032	1903
2033	2001
2035	3852
2037	3483
2039	3031
2041	3325
2043	3420

Groundwater Flow Paths and Transit Times

During the construction and operational phases, groundwater seepage from the PAG Waste Rock Storage Area (WRSA) will be collected, treated, and ultimately discharged. Therefore, impacts on surface water will primarily occur during the post-closure period. After closure, groundwater originating from underground sources (UGTMF) will migrate upward through faults and shear zones, then flow laterally within the sandstone layer, and ultimately discharge into Patterson Lake (figure 6.9). Leachate from above ground WRSAs will reach waterbody in a comparatively faster rate in postclosure stage (figure 6.10).

- The vertical length of the subsurface pathway is approximately 260 meters, while the horizontal extent within the sandstone layer is about 1,000 meters.
- The overall cross-sectional area of the fault conduit is approximately 34,400 m², and the sandstone conduit is about 350 meters wide and 20 meters high.
- The groundwater transit time from the upper mine area to Patterson Lake is estimated to be approximately 1,000 years.
- Seepage from the WRSA is expected to take about 43 years to flow northward into Patterson Lake, and approximately 77 years to flow southward (figure 6.10).

Figure 6.9: Simulated particle tracks released from underground sources that indicates groundwater flow pathways

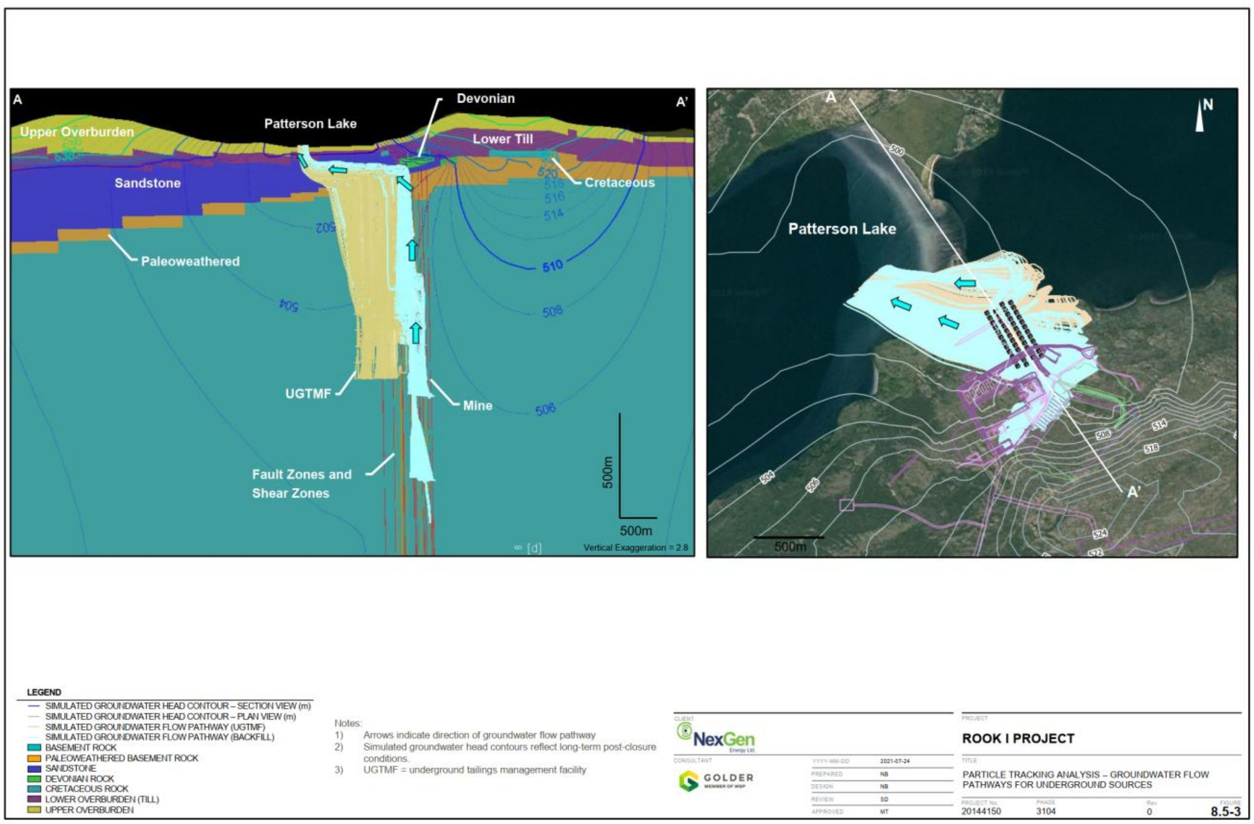
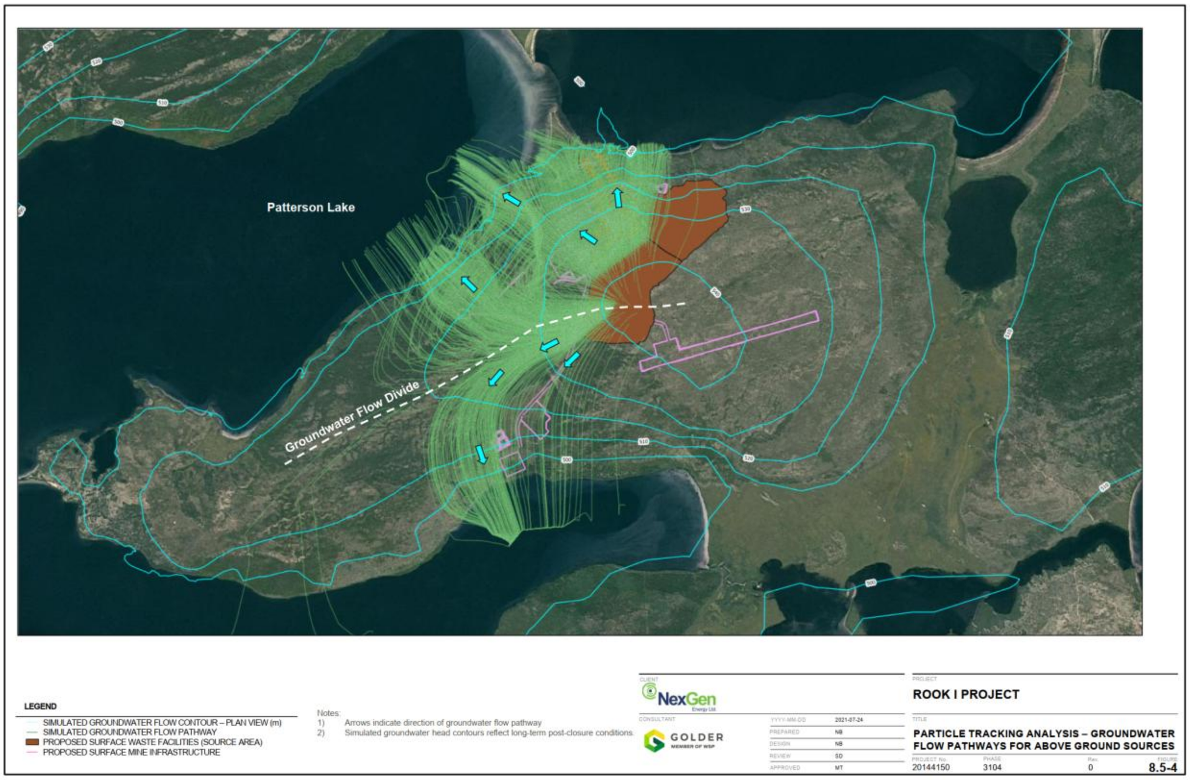


Figure 6.10: Simulated particle tracks released from above ground sources that indicates groundwater flow pathways



6.2.2.3. Effect on groundwater quality

For the Rook I Project, residual effects on groundwater quality primarily originate from the continued release of contaminants from source areas following mine operation and closure, including theUGTMF, reflooded mine workings, surface WRSAs, and underground wall rocks. Model simulations indicate that these source areas influence groundwater quality mainly through mechanisms of solute diffusion and hydraulically driven solute transport. Key chemical constituents include:

- Major ions: sodium (Na^{+}), magnesium (Mg), calcium (Ca), chloride (Cl^{-}), sulfate (SO_4^{2-}), bicarbonate (HC03-)
- Metals: iron (Fe), manganese (Mn), molybdenum (Mo), strontium (Sr), uranium (U), cobolt (co) and copper (Cu)
- Radionuclides: lead-210 (Pb-210), radium-226 (Ra-226), thorium-230 (Th-230)

Simulated transport pathway results show that contaminants will migrate slowly northward along groundwater flow paths and may eventually reach receptors such as Patterson Lake or other watershed outlets. Due to the low hydraulic conductivity of the bedrock at the project site, solute migration primarily occurs along fault zones and locally developed high-permeability sandstone units. These pathways are limited but represent a risk of channelized contaminant transport.

Peak solute load rates and sensitivity simulation results for groundwater pathways are provided in table 6.6. Figure 6.11 illustrates the variations in solute load rates from various source areas (such as the surface waste rock, UGTMF and reflooded mine workings) reaching Patterson Lake, particularly for copper, uranium, and radium. In the early stages of the simulation (around 100 model years), solute load rates reach the receptor (i.e., Patterson Lake) quickly and remain stable throughout the simulation period, assuming an infinite source condition.

For certain solutes, such as uranium, the arrival time of solute loads from underground mine site and UGTMF at the receptor is approximately 10,000 years. For other solutes, solute loads from underground backfill and waste rock sources are relatively balanced, such as sulfate, calcium, and strontium.

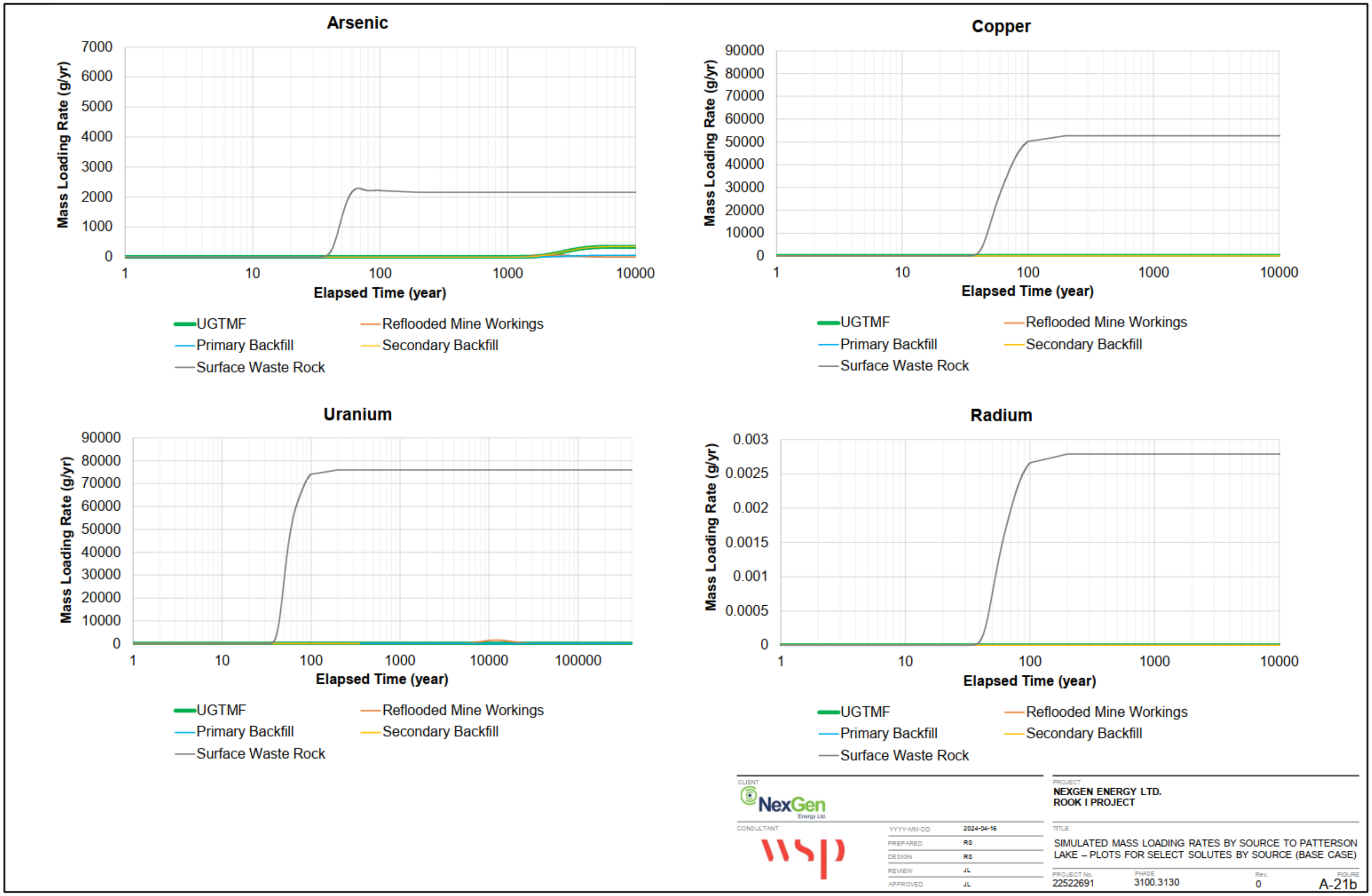
Table 6.6: Simulated peak solute mass loading rates for various application cases

		Solute																	
		Silver	Aluminum	Arsenic	Boron	Calcium	Cadmium	Chlorine	Cobalt	Chromium	Copper	Fluorine	Iron	Mercury	Magnesium	Manganese	Molybdenum	Sodium	Ammonia
Application Case Peak Mass Loading Rate (g/yr)		210.6	812,669	2,918	20,756	5,376,000	89.78	13,030,000	32,209	472	52,879	163,880	604,519	38.93	2,362,000	48,220	175,901	2,463,000	115,559
Percent change relative to Base Case	SR1 – Bedrock K	0.90%	0.00%	3.00%	2.80%	1.10%	0.10%	-1.50%	0.00%	0.20%	0.00%	-1.50%	0.20%	0.00%	0.00%	0.00%	2.80%	2.60%	-1.50%
	SR2 – Fault zone K	2.20%	0.10%	6.20%	8.40%	7.10%	0.60%	-1.40%	0.00%	1.70%	0.10%	-1.80%	0.40%	0.00%	0.00%	0.00%	25.30%	23.90%	-1.90%
	SR3 – UGTMF tailings K	0.10%	0.00%	11.20%	0.30%	10.10%	0.30%	0.40%	0.00%	1.00%	0.10%	0.40%	0.00%	0.00%	0.00%	0.00%	14.60%	13.50%	0.40%
	SR4 – Backfill K	0.80%	0.10%	7.10%	0.50%	12.90%	1.00%	1.50%	0.00%	2.90%	0.10%	1.00%	0.00%	0.00%	0.00%	0.00%	42.60%	40.30%	0.80%
	SR5 – Fracture zone area	3.10%	0.00%	0.00%	11.30%	-2.90%	0.00%	-2.80%	0.00%	0.30%	0.00%	-2.90%	0.60%	0.00%	0.00%	0.00%	0.00%	0.00%	-3.00%
	SR6 – Upper bound UGTMF source	0.30%	0.10%	17.10%	0.10%	0.20%	0.80%	0.00%	0.00%	37.90%	0.10%	0.00%	0.00%	0.00%	0.00%	0.10%	15.30%	8.70%	0.00%
	SR7 – Upper bound backfill source	1.60%	1.70%	10.40%	0.10%	3.70%	1.30%	0.20%	0.00%	24.20%	0.10%	0.30%	0.10%	0.00%	0.00%	0.00%	130%	8.00%	0.10%
	SR8 – Upper bound waste rock source	47.00%	48.00%	40.40%	38.10%	27.20%	51.60%	46.40%	53.10%	46.60%	49.80%	46.90%	49.60%	48.90%	47.80%	51.00%	0.50%	2.90%	47.10%
	SR9 – All upper bound sources	52.30%	51.00%	107.10%	39.10%	57.40%	56.30%	48.70%	53.20%	160%	50.30%	48.70%	49.80%	48.90%	47.90%	51.30%	284%	85.20%	48.40%

		Solute																	
		Nickel	Nitrite	Nitrate	Phosphorus	Lead	Lead-210	Polonium-210	Radium-226	Radium-228	Selenium	Sulphate	Strontium	Thorium-228	Thorium-230	Uranium-234	Uranium-238	Vanadium	Zinc
Application Case Peak Mass Loading Rate (g/yr)		28,441	1,066	1,023	1,171	638.8	3.081×10^{-05}	5.24×10^{-07}	0.002796	2.38×10^{-09}	2,779	34,200,000	28,880	1.18×10^{-09}	0.03176	4.191	77,582	3,082	22,544
Percent change relative to Base Case	SR1 – Bedrock K	0.00%	-1.50%	-1.50%	-1.50%	0.20%	0.00%	0.00%	0.00%	0.00%	0.60%	1.10%	3.80%	0.00%	0.00%	0.50%	0.50%	4.00%	0.00%
	SR2 – Fault zone K	0.00%	-2.10%	-2.10%	-2.00%	3.10%	0.10%	0.10%	0.00%	0.00%	7.20%	7.30%	6.50%	0.00%	0.00%	1.10%	1.10%	6.80%	0.00%
	SR3 – UGTMF tailings K	0.00%	0.40%	0.40%	0.30%	1.20%	0.00%	0.00%	0.00%	0.00%	3.50%	5.20%	0.10%	0.00%	0.00%	0.00%	0.00%	0.60%	0.10%
	SR4 – Backfill K	0.00%	0.60%	0.50%	0.60%	5.40%	0.00%	0.00%	0.00%	0.00%	12.50%	11.80%	0.20%	0.00%	0.00%	0.00%	0.00%	0.50%	0.10%
	SR5 – Fracture zone area	0.00%	-3.00%	-3.00%	-3.10%	0.00%	0.10%	0.10%	0.10%	0.00%	0.00%	0.00%	8.70%	0.00%	0.00%	1.90%	1.90%	8.80%	0.00%
	SR6 – Upper bound UGTMF source	0.20%	0.00%	0.00%	0.00%	185.40%	0.00%	0.10%	0.00%	0.00%	0.80%	0.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.40%
	SR7 – Upper bound backfill source	0.10%	0.00%	0.00%	0.00%	119.60%	0.20%	0.20%	0.10%	0.00%	12.00%	3.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.10%	0.20%
	SR8 – Upper bound waste rock source	53.50%	47.20%	47.30%	47.10%	10.90%	0.00%	0.00%	0.00%	0.00%	32.40%	36.00%	35.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.10%
	SR9 – All upper bound sources	54.10%	48.30%	48.30%	48.20%	556%	0.40%	0.50%	0.30%	0.00%	67.80%	58.00%	35.00%	0.00%	0.00%	0.10%	0.10%	1.30%	51.40%

Shading indicates range in values:
minimum (-3.1%) maximum (556%)
UGTMF = underground tailings management facility; K = hydraulic conductivity.

Figure 6.11: Simulated mass loading rates by source to Patterson Lake



6.2.3. Other Views Expressed

6.2.3.1. Indigenous Nations and Communities

CRDN had previously raised concerns of permafrost thaw and if COPCs would infiltrate groundwater due to the thawing of permafrost and increased hydraulic connectivity. NexGen has stated that the hydraulic conductivity of groundwater was not assumed to be impeded by permafrost, as the Project is in the sporadic scattered discontinuous permafrost zone and no permafrost was encountered in baseline soil surveys.

MN-S had previously noted a lack of clarity concerning cumulative impacts to groundwater from nearby future developments as groundwater drawdown from the Project activities is predicted to extend 2-4 kilometres from the Project site, but it is not evident if groundwater drawdown from a reasonably foreseeable future development case will overlap or cause additional impacts to NexGen’s groundwater drawdown. NexGen has noted that the simulated drawdown in the upper horizon does not overlap with the Patterson Lake South Project area, and overall Patterson Lake represents a strong boundary for the groundwater flow system, minimizing changes in groundwater elevation and flow directions. The total groundwater flow to Patterson Lake may be affected by the concurrent development of the two projects, however NexGen does not expect cumulative effects due to the collection, treatment and discharge of Project groundwater inflows to Patterson Lake mitigating reduction in baseflow. Furthermore, NexGen has confirmed that seepage pathways for the Project and Patterson Lake South Project will not overlap, therefore, groundwater affected by the two projects is not expected to interact in the groundwater environment. MN-S had previously noted that the residual effects for groundwater indicated a negative change to groundwater elevation but a neutral change for groundwater flows and direction. MN-S had also indicated that groundwater elevation influences flow and direction and questioned the differing conclusions reached as part of the groundwater effects assessment. NexGen clarified that the assessment of changes to environment resulting from changes to the hydrogeological environment predicted no significant residual adverse effects to any VCs.

BNDN indicated their concerns that through continual loading of elevated concentrations of COPCs, that groundwater could be adversely impacted for thousands of years based on NexGen’s Application and Reasonably Foreseeable Development Cases contained in the EIS. BNDN requested that the CNSC require NexGen to obtain BNDN’s approval for their groundwater monitoring plan. Additionally, BNDN expressed concern that utilizing cemented paste backfill and cemented past tailings in the underground operations could adversely impact groundwater quality for centuries into the future. NexGen confirmed that they are committed to working with BNDN on additional mitigation measures to address the continual loading of elevated concentrations of COPCs. NexGen has stated that obtaining written consent prior to the implementation of groundwater measures is impractical, however the program is part of the EPP, which NexGen has committed to discussing with BNDN through the Environmental Committee.

NexGen has committed to pumping cemented paste tailings directly into chambers within competent basement rock and not backfilling cemented paste into underground working areas until the areas are no longer used, thereby not increasing risk to underground workers. Furthermore, NexGen has committed to working with the Implementation Committee to organize community meetings to further discuss safety concerns should BNDN request it. BNDN also indicated that because of the UGTMF, that elevated levels of copper and cobalt predicted to occur in the EIS will be a result of groundwater migration from the UGTMF and are concerned of the potential impacts related to groundwater from the UGTMF. BNDN are also concerned that mine-affected groundwater is predicted to reach Patterson Lake in 43 years and questioned whether groundwater monitoring will be carried out to determine if impacted groundwater predictions remain accurate. NexGen is currently developing an adaptive management plan to manage copper loading from the potentially acid generating waste rock storage area to Patterson Lake and has committed to monitoring seepages and runoff quality at waste rock storage areas during operations. Following closure, transitional monitoring would verify that performance criteria have been met by NexGen, and long-term risks would be addressed. NexGen has confirmed that groundwater monitoring would be performed to ensure that impacted groundwater predictions remain accurate and aligned with EA predictions. BNDN noted they had general concerns regarding groundwater quality and potential impacts to groundwater. NexGen has committed to further presenting and discussing Project effects through workshops coordinated by the Environmental Committee to address continued concerns, and NexGen has supported engagement between the BNDN and the CNSC regarding potential effects to BNDN Aboriginal and treaty Rights.

Upon review of their issues and concerns identified in the EA Report, BNDN identified additional concerns including that there is no uranium mining precedent for underground tailings storage and as such long-term structural and containment performance is uncertain. BNDN requested NexGen provide engineering studies from similar facilities, use a phased approach with a test cell before full-scale deployment, and employ a verification timeline to evaluate system performance early. BNDN raised concerns that the placement of tailings may cause ground movement, triggering rock failures or instability. They have recommended that NexGen establish a geotechnical monitoring system, ensuring extensometers, stress meters, and micro seismic sensors are installed, tested and operational before tailings deposition. BNDN noted concerns about cracking, radon gas release, or tailings failure due to the degradation of binders over time because of chemical, microbial, or mechanical factors. They have requested that in-situ curing trials are conducted, and a performance verification plan is developed before additional tailings are placed to assess long-term chemical durability.

BNDN has requested long term tailing monitoring, containment, and treatments plans to mitigate leaching and the mobilization of heavy metals and radionuclides from paste degradation. They have also suggested that NexGen includes sulphate resistance and thermal effects in CPT due to risks of sulphates in tailings and temperature during curing degrading cementitious materials. BNDN also raised concerns that heat may cause thermal cracking in CPT, damage rock, or strain ventilation and recommended that NexGen conduct thermo-mechanical modeling, evaluate cooling systems and incorporate heat management into ventilation design.

BNDN has found that the response plan for tailings liquefaction, bulkhead failure, or roof collapse is insufficient and requested that NexGen conducts a Failure Modes and Effects Analysis (FMEA), install and test secondary egress, and establish drill schedules. They also noted that current hydro models lack regional and transient calibration and groundwater may destabilize tailings and accelerate reactions; as such BNDN recommends NexGen conduct pump tests for aquifer characterization, improve solute transport modelling with numerical models, and more robustly address climate risks such as extreme rainfall. BNDN has requested that NexGen engineer cover systems for PAG and NPAG rock to prevent seepage from WRSA. BNDN identified concerns regarding water inflow during shaft sinking or outside frozen zones delaying work and increasing exposures, noting that risks exist despite the use of ground freezing. Finally, BNDN requested NexGen conducts advance probe drilling and permeability testing, ensures that water management systems are in place before mining advances, and follows best practices from Athabasca Basin shaft projects.

YNLR have indicated their concerns for potential contamination of groundwater because of the Project. YNLR also raised concerns about potentially contaminated groundwater from the proposed potential Patterson Lake South project local study area reaching the local study are of the NexGen Rook I Project and vice versa. YNLR indicated their concerns that potential impacts to groundwater seems to be significant over time and space and that discharge of potentially impacted groundwater is of high concern to YNLR members. YNLR noted their support for groundwater monitoring but also suggested a risk assessment be conducted and contingency plans developed should residual impacts be greater than predicted. Addressing concerns regarding groundwater contamination, NexGen has committed to minimizing potential Project effects to groundwater and surface water through an Environmental Management Program and supporting processes containing monitoring and mitigation plans in addition to environmental design features. NexGen has confirmed that groundwater from the Project is not predicted to overlap with groundwater influenced by the Patterson Lake South Property, and cumulative effects of seepage are considered in the surface water quality assessment. NexGen has acknowledged concerns regarding potential impacts across time and space but has disagreed that the effects would be significant; effects on groundwater are considered by NexGen to be local and would reverse over time following Operations. Finally, NexGen has committed to developing additional measures beyond future monitoring to address concerns regarding residual impacts.

ACFN recommended that the environmental risk assessment extend to 77 years when groundwater influences from the waste rock pile are predicted to discharge to the south end of Patterson Lake and would overlap the reasonably foreseeable future development case. NexGen has noted that far-future Project effects have been assessed, and the projection encompasses long-term effect on human health and ecosystems to model a precautionary representation of the maximum potential changes to surface water quality.

6.2.3.2. Federal Authorities

ECCC suggested that there is a risk of potential residual effects to aquatic life from the Project based on the information provided. The proposed mitigation measures of lined waste management areas and the use of an underground tailings facility still allows for seepage of contaminants to groundwater and transport to Patterson Lake. Therefore, NexGen has committed to providing a Monitoring Follow-up and Adaptive Management Plan that will include groundwater quality and quantity monitoring, monitoring discharge and surface water quality in the receiving environment and monitor effects on fish and fish habitat to apply adaptive management when necessary.

6.2.4. CNSC Staff's Analysis

CNSC staff and FIRT members conducted a comprehensive review of the effect assessment of geology and groundwater, covering the following topics:

- Characterization of baseline geological and hydrogeological conditions.
- Evaluation of the potential impact of the Project on the geological and groundwater environment (quantity and quality) for each phase of the Project.
- Mitigation measures developed for each phase of the Project to eliminate, reduce, or control adverse impacts on geology and groundwater environment.
- Follow-up and monitoring tailored for each phase of the Project to verify the accuracy of predictions and effectiveness of mitigation measures.

CNSC staff raised an IR pertaining to the consideration of geology as an intermediate component. The proponent was requested to provide justification for its exclusion of geology as an intermediate component. The proponent explained that while geology per se was not fully assessed as an intermediate component, assessments of effects on key components related to geology have already been included in the EIS. The proponent also provided further discussion on the potential linkages of geology to certain valued components and intermediate components, and how geology has been considered within the Project design and the EIS (refer to Appendix 8A Geology Supplement in the EIS).

During the review process, CNSC staff put forward IRs requesting additional information, clarifications, and further analysis specific to the effect assessment for groundwater and geochemistry source terms. In response, NexGen addressed these comments satisfactorily and revised their Environmental Impact Statement (EIS) documents accordingly.

CNSC staff and other FIRT members raised concerns over design and implementation of the groundwater monitoring program to ensure that groundwater quality remains unaffected during operations and post-closure phases. Key areas of concern included the placement of monitoring wells along groundwater flow paths to effectively capture potential contaminant migration, the selection of monitoring parameters and sampling frequency, and the use of monitoring data to support adaptive management. In response, NexGen acknowledged the importance of groundwater monitoring, and committed to submit the detailed designs as part of future licensing applications. The response outlined that the monitoring well network would be installed along the groundwater flow direction in downstream zones from WRSA and UGTMF towards Patterson Lake. NexGen confirmed that specific monitoring parameters, frequencies, and well locations would be submitted as part of future licensing applications (licence to prepare site and construct).

In terms of model construction and validation, CNSC requested the proponent to provide detailed technical justifications for the groundwater flow model, e.g. assumption of boundary condition settings and discretization methods. The proponent replied that its model adopted a rectangular grid system based on site-specific hydrogeological characteristics, and that the boundary conditions were rigorously validated.

Regarding groundwater inflow under extreme scenarios, CNSC staff requested NexGen to further clarify the prediction of maximum inflow rates under unconventional conditions such as increased fault conductivity or ground subsidence. Through sensitivity analyses, the proponent demonstrated that when fault conductivity increases by five times, the groundwater inflow could reach 6,246 m^3/d by the 13^{th} - 15^{th} year of operation. To further assess the risk, the proponent also simulated an extreme scenario where exploration boreholes unintentionally intersect underground tailings facilities, predicting that the daily inflow under such circumstances would increase by 2,000 m^3/d. The proponent emphasized that the current drainage system design capacity (7,080 m^3/d) has fully considered such extreme scenarios and is equipped with multiple safeguard measures, including backup pump sets.

Regarding the solute transport model and its source term derivation, CNSC staff requested the proponent to provide more robust technical justifications. For the influence of subsurface temperature, the proponent predicted, based on regional geothermal gradient data (25–35°C/km), that the underground operational environment temperature would remain in the range of 20–30°C, which is generally consistent with the laboratory testing conditions (20–22°C), and thus considered that no temperature correction was necessary. Regarding the influence of redox potential, the proponent's simulation analysis showed that under pH 10–12 conditions, uranium migration is mainly controlled by the solubility of calcium uranyl oxide ($CaU_2O_7 \cdot 3H_2O$), and that the omission of this control mechanism in the current model in fact results in a conservative overestimation of the source term. As for the release mechanism of uranium from waste rock, the proponent confirmed through mineralogical analysis and an 18-month humidity cell test that uranium mainly exists in the form of crystalline uraninite (UO_2), and its release process is primarily controlled by oxidative dissolution mechanisms.

CNSC staff noted that the proponent's waste rock source term prediction model lacked supporting derivations for key parameters and original experimental data. In response, the proponent submitted a supplemental report providing complete humidity cell test data, geochemical characterization of waste rock, and detailed explanations of the calculation methods. The proponent explained that the model input values were conservatively extrapolated based on HCT test results, with parameter adjustments informed by mineralogical analysis.

CNSC staff noted the proponent relied on an engineered layered design to mitigate potential acid rock drainage generation from the PAG waste rock storage area. The design aimed to emplace PAG waste rock in 5m lift with interval layers of compacted fine grain material to restrict oxygen ingression. Regarding oxygen transport in the waste rock pile (IR 243), CNSC requested the proponent to provide the complete report from Okane (2020). In response, the proponent submitted the Okane (2020b) technical report (Appendix A), which provides a detailed description of the 1D model construction and scenario analysis for oxygen transport in the waste rock pile. Model comparisons indicated that the engineered barrier design (layered cover with fine-grained materials) can reduce the post-closure infiltration rate to 65–85 mm/year, and by limiting the gas conductivity (3×10^{-14} m/s), oxygen transport would be dominated by diffusion, with oxidation occurring only within the top 3 meters of the waste rock. Climate sensitivity analyses showed that variations in infiltration rates remain within a controllable range, and that the liner has no significant impact on overall site hydrology.

CNSC staff have found that NexGen's effect assessment related to geology and groundwater [10, 11] provides sufficient information to characterize baseline geological and hydrogeological conditions; the geological model and groundwater flow/transport model are adequately developed; the potential impact of the Project on geology and groundwater for each phase of the Project (as outlined in table 6.8) has been appropriately assessed; the mitigation measures (as outline in table 6.8) proposed for each phase of the Project are suitable. Given the uncertainties inherent in geological model development and hydrogeological analysis, CNSC staff consider the EA follow-up monitoring which the proponent committed to, is necessary. CNSC staff also noted that future developments in the site will be able to provide more data for verification of the hydrogeological flow and transport models provided in the current EIS. The updating of hydrogeological conceptual site model and the overall safety case will be necessary in future licensing stages (licence to prepare site and construct).

6.2.5. CNSC Staff's Findings and Recommendations

CNSC staff have reviewed NexGen's effect assessment of the geological and hydrogeological environment and conclude that NexGen conducted a comprehensive analysis of these effects and that identified mitigation and follow-up monitoring program measures are adequate.

6.2.6. Issues requiring Follow-up

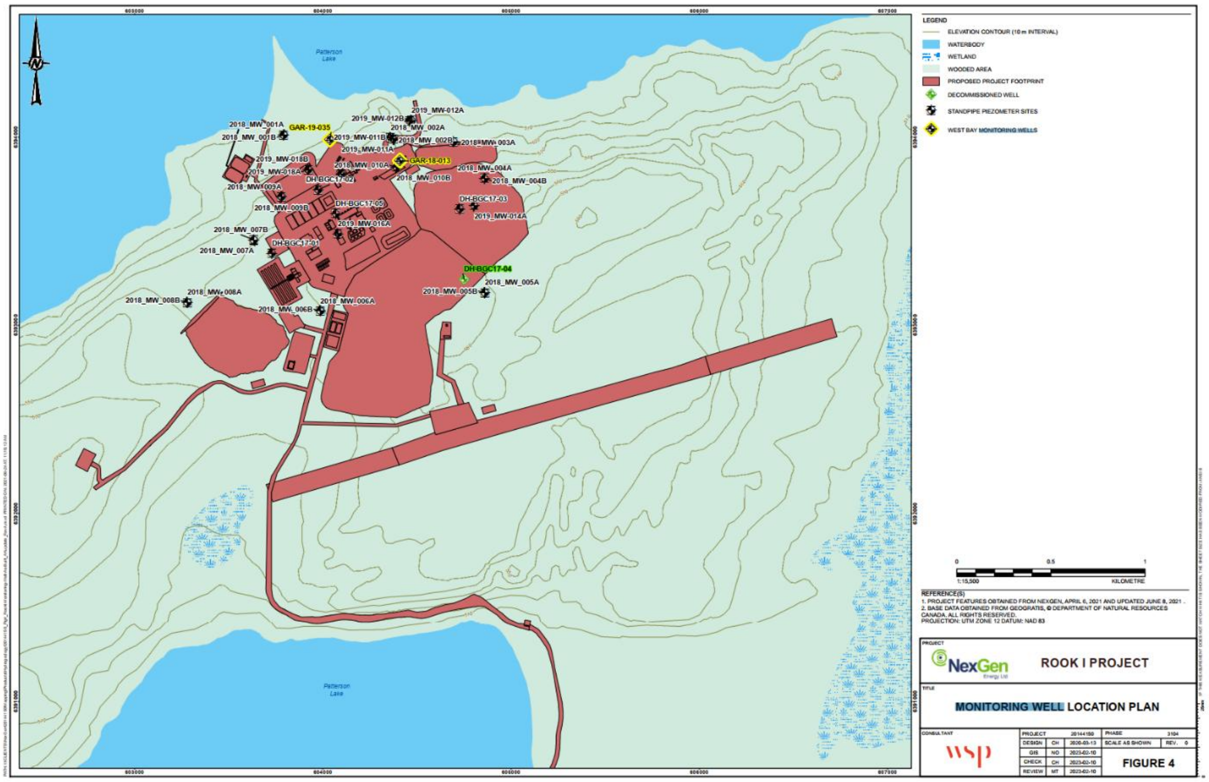
6.2.6.1. Groundwater protection and monitoring program

The proponent indicated that the plan for monitoring groundwater quantity and quality as a part of the Project would be detailed in the EMP and has committed that the EMP will be ready for CNSC review and approval in following licensing stages (licence to prepare site and construct). The groundwater focus of this plan is establishment of monitoring systems to evaluate the effectiveness of groundwater protection controls. Groundwater monitoring targets were selected under the plan to achieve the monitoring objectives detailed above. These targets include monitoring of groundwater elevations and quality in the bedrock and overburden to monitor the effects of the following:

- dewatering during construction and development of the shaft, underground mine, and UGTMF
- seepage from the WRSAs
- seepage from the process and mine terrace areas, including the fuel and reagent storage areas and equipment such as diesel fuel generators (i.e., in the event of a spill and non-routine events)
- seepage from the area of the effluent treatment ponds (in the event of leakage)

CNSC staff noted NexGen has monitoring wells as shown in figure 6.12 for sampling of groundwater in the hydrogeological baseline investigation. It is also noted that these monitoring wells need further refinement and optimization in consideration of CSA standard 288.7-23. Most importantly, monitoring well locations should cover the predicted COPC plume extents.

Figure 6.12: Monitoring well locations in hydrogeological baseline investigations (Annex III: Hydrogeological Baseline Report)



6.3. Aquatic Environment

Hydrology, surface water quality and sediment quality represent intermediate components in the EA. They were selected based on how changes could influence the health of fish, plants, wildlife, and the people that use natural resources. Information from these assessments were used to support valued component assessment such as fish and fish habitat, vegetation, and wildlife and wildlife habitat.

6.3.1. Description of the existing surface water hydrology of the aquatic environment

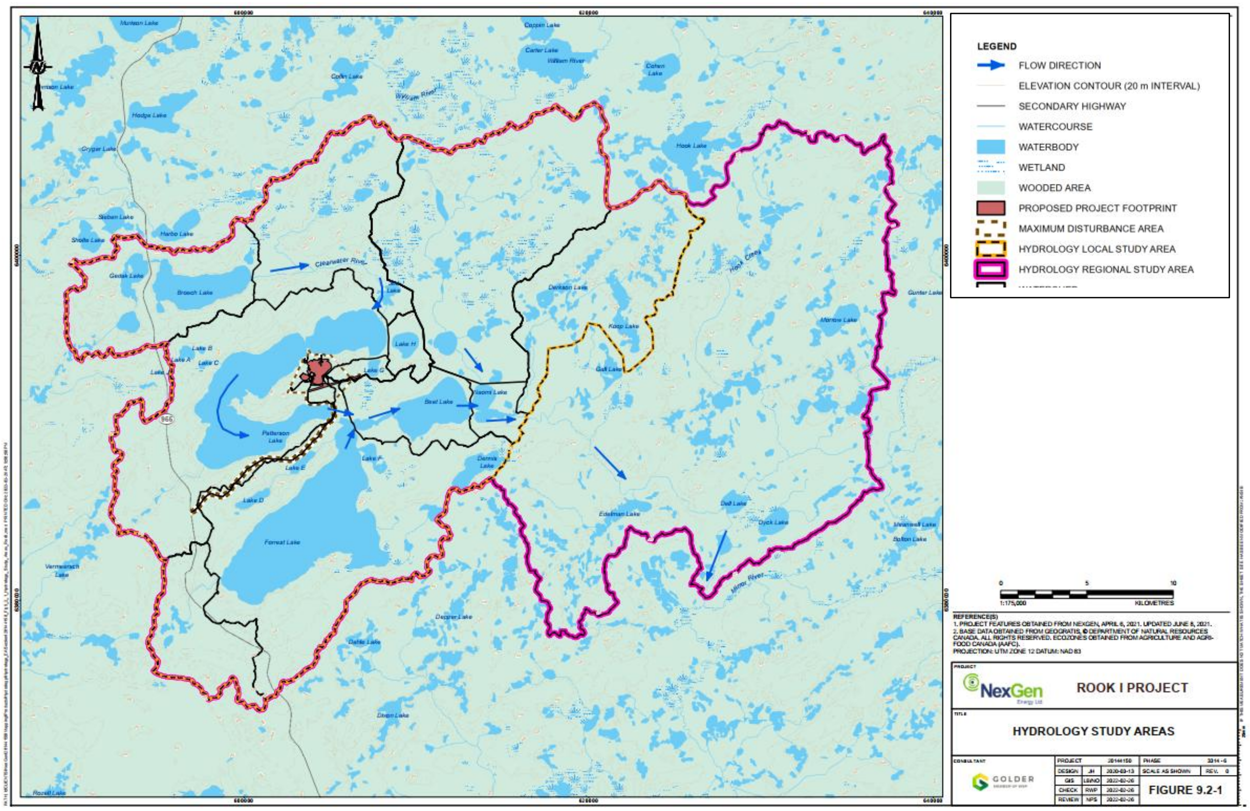
The assessment of the aquatic environment was conducted within two defined study areas: the LSA and the RSA. The LSA represents the spatial boundaries of the Clearwater River watershed most likely to experience direct environmental effects from the proposed Project and extends from the river's headwaters to the outlet of Naomi Lake covering approximately 685 km² (to the orange dotted boundary in the below figure). There are five larger lakes in the LSA including Broach, Patterson, Forrest, Beet, and Naomi lakes, as well as several smaller waterbodies including Lake G, Lake H, and wetlands. The proponent selected the extent of the LSA since it includes the waterbodies (i.e., lakes, ponds or wetlands) and watercourses (i.e., streams, creeks or rivers) where direct Project-related changes would be expected and likely to be measurable (i.e., the receiving environment). The RSA encompasses the LSA and is defined by the Clearwater River watershed boundary upstream of the Mirror River confluence, covering a total area of 1,076 km² (purple dotted area in

Figure 6.13 below added to the LSA).

6.3.1.1. Description of the existing surface water hydrology

The hydrology LSA and RSA spatial boundaries used in this assessment were consistent with those applied to other components of the aquatic environment, such as fish and fish habitat, surface water and sediment quality, and followed CEAA guidance. See figure below, taken from EIS figure 9.2-1.

Figure 6.13: Local and Regional Hydrology Study Areas (adopted from section 9 of EIS)



Extensive baseline monitoring programs were completed over the period from August 2018 to September 2020 to characterize the hydrology, geomorphology, stream channel parameters, stream hydraulics and fluvial sediment transport of Clearwater River and its tributaries in the RSA. A summary of waterbodies, watercourses, baseline hydrological monitoring stations (evaluation nodes) and measured parameters, can be found in table 6.7 below which are considered in hydrology assessment. Detailed characteristics of the waterbodies and water courses considered in hydrology assessment can be found in table 9.3-2 and table 9.3-3 of EIS. In addition, NexGen completed bathymetric mapping of lake depth contours for Patterson Lake, Broach Lake, Lake G, Lake H, and Beet Lake, and Naomi Lake to generate baseline bathymetric maps and establish water surface elevation (WSE)-volume relationships for Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, and Naomi Lake as well as Lake G and Lake H. Historical and current climate data for the period January 1979 to August 2019 and August 2018 to October 2020 was obtained from European Reanalysis (ERA) databases and Rook I meteorological stations. The baseline characterization conducted by NexGen provides key insight into the environmental conditions that are relevant to understanding the potential effects of the Project on aquatic ecosystems. For more detailed information, please refer to the Aquatic Environment Baseline Report (annex V.1) of the EIS.

The proponent developed a regional hydrological model for RSA and fluvial sediment transport model for the Clearwater River below (i.e., downstream of) Patterson Lake to characterize existing conditions and predict Project effects on surface water hydrology which were developed and calibrated based on measured data collected during baseline studies. The models were used to broaden the range of conditions compared to what could be measured over the baseline monitoring period to include a longer period and greater range of conditions, including extreme conditions such as drought and floods.

Table 6.7: Water bodies, watercourses, drainage areas and baseline hydrology monitoring locations (adopted from section 9 table 9.2-2 of the EIS)

Hydrometric Station ID	Hydrometric Station Name	Watershed Area (km2)
HL-WB-MS-01	Hodge Lake	52.6
CR-WB-MS-01	Broach Lake	56.4
CR-WB-TI-01	Lake H	7.36
CR-WB-TI-02	Lake G	3.75
CR-WB-MS-02	Patterson Lake	264
CR-WB-MS-03	Forrest Lake	445
CR-WB-MS-04	Beet Lake	473
CR-WB-MS-05	Naomi Lake	685
HL-WC-MS-01	Hodge Lake outflow	52.6
CR-WC-MS-01	Clearwater River below Broach Lake	56.4
CR-WC-MS-02	Clearwater River above Patterson Lake	121
CR-WC-MS-03	Clearwater River below Patterson Lake	264
CR-WC-MS-04	Clearwater River below Beet Lake	473
CR-WC-MS-05	Clearwater River below Naomi Lake	685
CR-WC-MS-06	Clearwater River above Mirror River confluence	1,076
CR-WC-MS-07	Clearwater River below Mirror River confluence	3,300

Hydrometric Station ID	Hydrometric Station Name	Watershed Area (km2)
CR-WC-MS-08	Clearwater River at the Lloyd Lake Outlet	4,370
CR-WC-MS-09	Clearwater River at Warner Rapids	9,590
CR-WC-TI-01	Tributary Inflow above Forrest Lake	34.8
CR-WC-TI-02	Tributary Inflow to Naomi Lake	134
CR-WC-TI-03	Tributary Inflow downstream of Naomi Lake	67.5

NexGen developed site-specific future climate projections for the Project based on results from a multi-model ensemble representing different levels of greenhouse gas emissions. The 2050s (i.e., this includes the years 2041 to 2070) was selected as a reasonable upper bound in terms of climate change during the Project lifespan. The mean projected monthly changes in air temperature and precipitation for the 2050s relative to a historical climate period of 1981 to 2020 were incorporated into the hydrological model. In the mean climate change scenario, temperature, precipitation, lake evaporation, and evapotranspiration are all projected to increase, while sublimation would decrease due to a shorter snow-covered period.

6.3.1.2. Description of the existing surface water and sediment quality

The LSA and RSA boundaries used in this analysis were consistent with those applied to other components of the aquatic environment, such as hydrology, fish, and fish habitat, and followed CEAA guidance

The conditions for surface waterbodies in the LSA were determined from baseline studies conducted between 2015 and 2020. These baseline water quality conditions provide important context for evaluating the potential impacts of the Project. Understanding the natural state of the waterbodies helps identify any changes caused by Project activities, ensuring that any impacts can be detected and appropriately managed. The water quality of the lakes and streams within the LSA reflects characteristics typical of Canadian Shield waterbodies. These include:

- High water clarity
- Near-neutral pH levels
- Seasonal variability in surface water temperatures

Surface waters in the LSA were characterized by low concentrations of dissolved solids, with calcium and bicarbonate being the primary ions present. Most waterbodies are oligotrophic, with low nutrient levels, except for Lake G, classified as mesotrophic due to higher phosphorus concentrations. Indigenous Nations and communities described historically clear, clean waters in Patterson Lake and surrounding lakes. However, some community members reported deteriorated water quality and fish health since exploratory drilling activities began, discouraging traditional fishing practices. Overall, concentrations of ions and metals, including those identified as COPCs, were generally below established water quality guidelines. However, some naturally elevated levels of certain COPCs were observed in the waterbodies and streams within the LSA. Natural exceedances of iron, manganese, lead, nickel, and arsenic were noted in certain waterbodies, including Patterson Lake, Naomi Lake, and Beet Lake. These exceedances align with regional natural ranges, except for iron in Naomi Lake, which exceeded regional maximums.

Baseline studies conducted from 2018 to 2019 provided insight into sediment quality within the LSA's surface waterbodies. The upper sediment layer (0–2 cm) typically consisted of varying mixtures of coarse sand, fine sand, and silt, with the proportions differing across waterbodies. Sediment composition varies by location, particularly within Patterson Lake. Patterson Lake North Arm – East Basin had primarily fine sand and silt while the North Arm – West Basin had fine sand and silt dominate in deeper areas, with coarse sand near the shoreline. South Arm had primarily coarse sand near the lake outlet. The total organic carbon (TOC) content, which measures the amount of organic matter in the sediment, ranged widely from as low as 0.24% in Beet Lake to as high as 25.8% in Naomi Lake. Generally, lakes with coarser sediments (such as sand) had lower organic content, while lakes with finer sediments (such as silt) had higher organic content. In sediment, metal and radionuclide concentrations were generally low and below thresholds in most areas, however elevated levels were noted in specific locations. Arsenic in Patterson Lake North Arm – West Basin and Naomi Lake exceeded multiple sediment quality guidelines in the baseline samples, polonium-210 exceeded thresholds in Patterson Lake North Arm – West Basin, and vanadium exceeded thresholds in Naomi Lake. Local Indigenous groups highlighted concerns about potential contamination, noting diseased bottom-feeding whitefish in Patterson Lake, possibly linked to sediment quality issues.

The baseline characterization conducted by NexGen provides key insight into the environmental conditions that are relevant to understanding the potential effects of the Project on aquatic ecosystems. For more detailed information, please refer to the Aquatic Environment Baseline Report (Annex V.1) of the EIS.

6.3.2. Proponent’s Assessment: Aquatic Environment and Surface Water Resources

6.3.2.1. Hydrology

The pathway analysis performed by NexGen assessed the potential adverse effects of the Project on surface water hydrology, identified mitigation measures, and evaluated whether these measures could effectively reduce or eliminate residual adverse impacts. Potential Primary (i.e., effects are greater than negligible and require further detailed assessment) effects pathways are detailed in table 6.8. No potential Secondary (i.e., mitigation reduces effects to negligible levels) effects were identified. Potential effects with no pathway (i.e., mitigation results in no effect on hydrology) such as Construction, Operation, and Closure of culverts and changes in flows during Closure are not considered further in this EA but are described in section 9 table 9.5-2 of the EIS.

Table 6.8: Potential adverse effects pathways for surface water hydrology (adapted from section 9 of the EIS).

Pathway	Project Phase	Effects Pathway	
Primary	Construction, Operations	Diversion of natural watercourses and drainage areas	Project activities and footprint may divert site runoff from its natural course and change drainage areas
Primary	Construction, Operations and Closure	Changes in water balance and hydrological processes	Activities may affect basin yields (i.e., and in turn affect waterbody WSEs and watercourse flows) through changes in water balance and hydrological processes in the upstream contributing area
Primary	Construction and Operations	Changes in flows	Changes in watercourse flows during Construction and Operations may cause erosion downstream, alter stream channel sediment transport and stream channel parameters and affect shoreline integrity.

Residual Effects Analysis

The predicted changes to receiving environment surface water hydrology was assessed based on four measurement indicators (waterbody water surface elevations (WSE), watercourse flow rates, stream channel parameters (e.g., wetted area) and fluvial sediment transport), identified for hydrology assessment, for the primary pathways identified in table 6.8 under four assessment cases, i.e., application case and three reasonably foreseeable development (RFD) cases that include effects of climate change. The effects of primary pathways on hydrology were calculated numerically by integrating these pathways into a hydrological model developed for each phase of the Project. The approach used quantitative analysis and logical reasoning to describe anticipated changes to each measurement indicator caused by the Project and RFDs as the net result of changes in the contributing watershed associated with the identified primary pathways. The changes in measurement indicators for surface water hydrology were estimated relative to the Base Case conditions to the Application Case and RFD Case conditions including climate change scenarios (2041-2070) to describe the residual effects and are discussed below. The changes to measurement indicators are summarized for the key evaluation nodes, that coincide with existing or planned hydrometric monitoring stations, on waterbodies and watercourses downstream of the Project. The receiving environment waterbodies carried forward for the residual effects analysis included Patterson Lake, Forrest Lake, Beet Lake, Naomi Lake and Clearwater River.

Water Surface Elevations

The effect of the Project on water surface elevations of waterbodies in Application Case and RFD Cases including climate change was assessed for Patterson, Forrest, Beet and Naomi Lakes (Table 6.9). The predicted WSE in the lakes is expected to increase, however, the magnitude of the change both in mean monthly and annual estimates are predicted to be small (<0.05m) with the maximum predicted change of 3.5% (0.03m) for RFD case including climate change and unlikely to be measurable. The changes to predicted range of WSE (i.e., the variability) are also not likely be differentiated from existing conditions for all assessment cases.

Table 6.9: Changes in mean annual WSE relative to the Base Case (adopted from table 9.7-1 of EIS)

Application Case	**RFD Case Scenarios**		
	RFD Case	**Climate Change**	**Total (i.e., RFD Case including climate change)**
Ranges from 0.2% (0.002 m) annual increase at Beet and Naomi lakes to 1.0% (0.008 m) at Patterson Lake (low magnitude)	Ranges from 0.4% (0.004 m) at Beet and Naomi lakes to 2.2% (0.017 m) at Patterson Lake (low magnitude)	Ranges from -0.01% (0.000 m) annual decrease for Beet Lake, and 0.33% (0.004 m) annual increase for Naomi Lake to 1.6% (0.013 m) at Patterson Lake (low magnitude)	Ranges from 0.4% (0.004 m) annual increase for Beet Lake to 3.5% (0.028 m) at Patterson Lake (low magnitude)

Base Case: *hydrology represents existing conditions*; Application Case: *hydrology represents the Base Case plus the potential effects from the proposed Project*; RFD Case: *Application Case plus the Patterson Lake South Property (under historical climate)*; RFD Climate Change Scenario: *represent effect of climate change (2041-2070) without the inclusion of Project or Patterson Lake South Property effects*; RFD Case (including climate change): *combined effects of the RFD Case and climate change scenarios.*

Watercourse Flow Rates

The effect of the Project on watercourse flow characteristics (mean maximum and minimum daily flows and mean annual flows) was assessed at Clearwater River below Patterson Lake, Beet Lake, Naomi Lake and above Mirror River confluence in Application Case and RFD Case Scenarios including climate change. The predicted flows in Clearwater River below are expected to increase during both Application Case and RFD cases in response to a net discharge of water to Patterson Lake from Project activities. However, the percent increases in predicted flows are too small to be detectable at any of the hydrometric stations and would be difficult to distinguish from existing conditions. Under climate change scenario, predicted mean annual flows and mean annual maximum daily flows are expected to increase at evaluation nodes with mean annual minimum daily flows depicting a predicted decrease. The mean monthly flows are also predicted to increase except fall and early winter months. In RFD Case including climate change, flows in the Clearwater River are also expected to increase in response to climate change and, to a lesser degree, developments. The quantitative estimates of the percent changes are shown in table

Table 6.10.10. The predicted changes are low in magnitude.

Table 6.10: Changes in flow characteristics relative to the Base Case (adopted from table 9.7-1 of EIS)

Measurement Indicator	Application Case	RFD Case Scenarios		
		RFD Case	Climate Change	Total (i.e., RFD Case including climate change)
Watercourse mean annual maximum daily flow	Ranges from 0.7% at Clearwater River above Mirror River confluence to 1.4% at Clearwater River below Patterson Lake (low magnitude)	Ranges from 0.1% at Clearwater River above Mirror River to 2.6% at Clearwater River below Patterson Lake (low magnitude)	Ranges from 3.2% at Clearwater River above Mirror River confluence to 8.0% at Clearwater River below Patterson Lake (low magnitude)	Ranges from 3.9% at Clearwater River above Mirror River confluence to 9.7% at Clearwater River below Forrest Lake (low magnitude)
Watercourse mean annual flow	Ranges from 0.7% at Clearwater River above Mirror River confluence to 1.6% at Clearwater River below Patterson Lake (low magnitude)	Ranges from 0.7% at Clearwater River above Mirror River confluence to 3.1% at Clearwater River below Patterson Lake (low magnitude)	Ranges from 3.4% at Clearwater River below Beet Lake to 6.2% at Clearwater River above Mirror River confluence (low magnitude)	Ranges from 4.9% Clearwater River below Naomi Lake to 7.5% Clearwater River below Patterson Lake (low magnitude)
Watercourse mean annual minimum daily flow	Ranges from 1.0% at Clearwater River above Mirror River confluence to 1.6% at Clearwater River below Patterson Lake (low magnitude)	Ranges from 1.6% at Clearwater River above Mirror River confluence to 3.4% at Clearwater River below Patterson Lake (low magnitude)	Ranges from -3.1% at Clearwater River above Mirror River confluence to -0.3% at Clearwater River below Patterson Lake	Ranges from -2.0% at Clearwater River above Mirror River confluence to 3.0% at Clearwater River below Patterson Lake (low magnitude)

Measurement Indicator	Application Case	RFD Case Scenarios		
		RFD Case	Climate Change	Total (i.e., RFD Case including climate change)
			(low magnitude)	

Stream Channel Parameters

The effect of the Project was assessed at Clearwater River below Patterson Lake, Beet Lake, Naomi Lake and above Mirror River confluence in Application Case and RFD Case including climate change. The predicted increase in flows downstream of the Project may result in small changes in Clearwater River channel parameters. The predicted changes in river channel parameters using wetted areas were found to be a maximum of 5.7% which is for RFD Case including climate change (see tableTable 6.11.11) and are not expected to be large enough to be detectable or large enough in magnitude to change how the watercourses are used by humans for navigation, may in fact slightly improve navigation, and are well within the range of natural variation. Therefore, changes in Clearwater River channel parameters are not expected to affect navigation for Indigenous land users, resource users and recreationists.

Table 6.11: Changes in Wetted Area at the Mean Annual Flow for relative to the Base Case (adopted from table 9.7-1 of EIS)

Application Case	RFD Case Scenarios		
	RFD Case	Climate Change	Total (i.e., RFD Case including climate change)
Ranges from 0.3% at the Clearwater River below Beet and Naomi lakes to 1.2% at the Clearwater River below Patterson Lake (low magnitude)	Ranges from 0.4% at the Clearwater River below Naomi Lake to 2.3% at the Clearwater River below Patterson Lake (low magnitude)	Ranges from 1.1% at the Clearwater River below Naomi Lake to 3.5% at the Clearwater River below Patterson Lake (low magnitude)	Ranges from 1.5% at the Clearwater River below Naomi Lake to 5.7% at the Clearwater River below Patterson Lake (low magnitude)

Fluvial Sediment Transport

NexGen assessed the effect of the Project on fluvial sediment transport for the Clearwater River below Patterson Lake along the reach from Patterson Lake to the north end of Forrest Lake. Changes in sediment transport relative to the Base Case were assessed at one location in the Upper Reach and in both North Channel and South Channel of the Lower Reach (see table 1.12).

Erosional losses are expected in the Upper Reach with increased flows; however, these losses are offset by sediment deposition in the lower reaches. The net balance for the entire reach was negative, which represents a net loss of sediment from the reach to downstream areas, but this negative net balance is predicted to be of a similar magnitude as the Base Case for both Application Case and RFD cases. All assessment cases resulted in negligible changes in net transport of sediment for the Clearwater River reach between Patterson Lake and Forrest Lake compared to the Base Case, which would not be detectable.

Table 62.12: Fluvial Sediment Load in the Clearwater River below Patterson Lake relative to the Base Case (adopted from EIS)

Assessment Case	Median Annual Maximum Daily Flow (m3/s)	Longitudinal Cumulative Mass Change (ton/year)					
		Upper Reach	% Change	Lower Reach			Net Balance
				North Channel	South Channel	% Change	
Base Case	1.89	-86	-	27	36	-	-23
Application Case	1.92	-88	2%	28	37	3%	-23
RFD Case	1.95	-90	5%	29	38	6%	-23
Climate change scenario	2	-93	8%	31	40	13%	-23
RFD Case including climate change	2.05	-97	13%	33	41	17%	-23

Mitigation Measures

NexGen has proposed measures to mitigate adverse effects on surface water hydrology (tableTable 6.13.13). CNSC staff agree with the mitigation measures proposed by NexGen.

Table 6.13: Proposed mitigation measures to address effects on surface water hydrology

Residual Effect #1: Diversion of natural watercourses and drainage areas
Construction and Operations Phase
• Limit the Project footprint to the extent practical using practices such as: ○ designing an efficient infrastructure footprint ○ optimizing the use of cleared areas for Project activity ○ using existing road infrastructure, including existing access road and bridge crossing ○ storing tailings underground

◦ divert water away from site facilities through design and the establishment of berms and grading
• Break drainage areas into smaller catchment areas to limit large areas of runoff and reduce the potential erosive energy
• Base ditch geometry and erosion protection on analysis of predicted peak flows and incorporate climate change effects so that the channels have sufficient capacity
• Use engineered containment and conveyance of PAG waste rock runoff and seepage to the PAG Runoff Collection Area
• As part of reclamation activities, complete contouring of disturbed areas to minimize erosion, re-establish drainage, and encourage the growth of vegetation.
• Implement sedimentation and erosion control best practices and standard mitigation (e.g., temporary sediment ponds, silt curtains, sediment traps) during all Project phases.
• Implement progressive reclamation and revegetation of disturbed areas no longer required
• Implement a Project-specific EPP and a Project specific EMP
• Implement a Project-specific Mine Waste Management Plan.
Closure Phase
• As part of reclamation activities, complete contouring of disturbed areas to minimize erosion, re-establish drainage, and encourage the growth of vegetation
• Implement sedimentation and erosion control best practices and standard mitigation (e.g., temporary sediment ponds, silt curtains, sediment traps) during all Project phases
• Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned
• Develop and implement a Detailed Decommissioning and Reclamation Plan to decommission and transfer the site to the province under the Institutional Control Program.
Residual Effect #2: Changes to hydrological processes and water balance
Construction and Operation Phase
• Recycle and reuse of process water to reduce freshwater intake and release to Patterson Lake, to the extent practical
• Adhere to guidance from regulators such as DFO as to the allowable rate and timing of water withdrawals from the point of supply.
• Confirm discharge meets water quality discharge criteria prior to release to the environment
• Implement progressive reclamation and revegetation of disturbed areas no longer required
• Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned.
• Monitor flows before and after Construction to quantify the change of flow and its effects to the aquatic environment

• Implement a Project-specific EPP and a Project specific EMP.
• Implement a Project-specific Mine Waste Management Plan.
Closure Phase
• As part of reclamation activities, complete contouring of disturbed areas to minimize erosion, re-establish drainage, and encourage the growth of vegetation
• Implement sedimentation and erosion control best practices and standard mitigation (e.g., temporary sediment ponds, silt curtains, sediment traps) during all Project phases
• Reclaim and revegetate areas
• Develop and implement a Detailed Decommissioning and Reclamation Plan to decommission and transfer the site to the province under the Institutional Control Program.
Residual Effect #3: Changes in flows
Construction and Operation Phase
• Avoid placing soil stockpiles near waterbodies and near natural drainage features
• Minimize areas of vegetation clearing and soil disturbance
• Minimize steepness and length of slopes of disturbed areas and stockpiled soil
• Discharge water to the watershed of origin, to the extent practical
• Adhere to guidance from regulators such as DFO as to the allowable rate and timing of water withdrawals from the point of supply
• Provide adequate contact water storage capacity to allow controlled rate of release during both routine and non-routine operation scenarios.
• Use erosion control measures as required
• Implement progressive reclamation and revegetation of disturbed areas no longer required
• Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned
• Monitor flows before and after construction to quantify the change of flow and its effects to the aquatic environment.
• Perform routine inspection and maintenance of water containment and conveyance structures to limit the risk of road wash-out or sediment release to the environment
• Implement a Project-specific EPP and a Project-specific EMP.
• Implement a Project-specific Mine Waste Management Plan.

Monitoring and Follow-up

The EPP, EMP, and related monitoring activities will be implemented to verify the accuracy of predicted effects, assess the effectiveness of mitigation measures in protecting aquatic environments, identify any unexpected impacts, and apply adaptive management strategies as needed.

Monitoring and follow-up programs are proposed by NexGen for surface water hydrology to the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Monitoring follow up programs proposed to address residual effects related to surface water hydrology is in tableTable 6.14.14. In addition, NexGen will maintain continued hydrometric monitoring and data collection initiated for baseline studies to extend the baseline monitoring period and available data. Selected hydrometric stations would be monitored during the Project phases using remotely operated telemetry stations, which could be used to verify the receiving environment predictions of minimal changes in flows and water levels during the proposed Project duration in the future. Proposed remotely operated stations being considered include the following:

- Clearwater River below Patterson Lake
- Clearwater River below Beet Lake
- Clearwater River below Naomi Lake
- Clearwater River above the confluence with the Mirror River
- Clearwater River below Broach Lake

CNSC staff agree with the monitoring follow up measures proposed by NexGen.

Table 6.14: Follow-up program measures for effects on surface water hydrology.

Residual Effect #1: Diversion of natural watercourses and drainage areas Residual Effect #2: Changes to hydrological processes and water balance Residual Effect #3: Changes in flows
• Confirm effects predictions and address uncertainty in predictions that are associated with baseline data collection and modelling. • Evaluate the effectiveness of mitigation actions and reclamation and modify or enhance them as necessary through monitoring and developing updated mitigation measures, if needed. • Identify unanticipated negative effects, including possible accidents and malfunctions; and • Contribute to the overall continual improvement of the Project and assure the local communities the potential Project effects have been minimized.

6.3.2.2. Surface Water and Sediment Quality

The pathway analysis performed by NexGen assessed the potential adverse effects of the Project on surface water and sediment quality, identified mitigation measures, and evaluated whether these measures could effectively reduce or eliminate residual adverse impacts. Potential effects were categorized as follows:

- **No pathway**: Mitigation eliminates effects on surface water or sediment quality.
- **Secondary pathway**: Mitigation reduces effects to negligible levels.
- **Primary pathway**: Effects could be greater than negligible and require further detailed assessment.

Mitigation measures and environmental design features, outlined in table 10.4-1 of the EIS, informed the pathway analysis. NexGen is also required to implement an EPP, and this program would periodically assess mitigation performance and identify any additional mitigation needed, as well as trigger potential adaptive management measures. After considering mitigation measures, the screening analysis concluded that some potential environmental pathways, particularly those related to sediment quality, could be excluded. However, the outcome of the analysis identified several primary pathways that could negatively affect surface water quality and were therefore further assessed in the EIS, including:

- Deposition of fugitive dust and criteria air contaminants (e.g., particulate matter, metals, radionuclides, sulfur, nitrogen oxides) on local waterbodies.
- Direct discharge of treated effluent and sewage into Patterson Lake during construction, operations, and closure.
- Seepage from Waste Rock Storage Areas (WRSAs) into groundwater, potentially flowing into Patterson Lake during construction and operations.
- Runoff and seepage from WRSAs and groundwater from underground workings (including the UGTMF) into Patterson Lake after closure.

Residual Effects Analysis

The residual effects analysis examined changes to water quality from the Project (Application Case) and cumulative effects from the Project and Patterson Lake South Property (RFD Case), compared to baseline conditions (Base Case) and established Project-specific thresholds. The methods used by NexGen to determine the COPCs and to develop the Project-specific thresholds are summarized in section 10.2.8.2 and section 10.2.8.3 of the EIS. Sensitivity scenarios were also evaluated (i.e., a reasonable upper bound scenario for the application case, and a climate change scenario of the RFD case). The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure), however the assessment of surface water quality effects for the far future was based on surface water quality modelling that spanned 400 years, including the 43-year project timeline and 357 years after Closure.

Surface water quality

Surface water quality effects were numerically modeled for each phase, integrating primary pathways. Project and cumulative effects were assessed based on changes to COPCs within the Local Study Area (LSA), which represents the predicted area where direct and indirect impacts on surface water quality are expected to be detectable. Further downstream, beyond the confluence of the Clearwater and Mirror Rivers, changes to surface water quality are expected to be negligible (the regional study area). For the Application Case, residual effects were assessed using both the Near-Field Water Quality Model (NFWQM) and the Regional Surface Water Quality Model (RSWQM). For the RFD Case, only the RSWQM was used, as no cumulative effects were identified within the near-field zone (i.e., Patterson Lake South Project's planned effluent discharge is located further downstream).

Predicted trends in COPCs, including nutrients, major ions, trace metals, and radionuclides, were used to classify residual effects for the three surface water quality indicators (water quality, drinking water quality, and productivity status) at key waterbodies within the LSA. Figures summarizing COPC trends over time are provided in Appendix 10A of the EIS. For each measurement indicator, the various surface water constituent concentrations measured were compared to the respective thresholds. Thresholds were generally chosen by NexGen to represent the lowest chronic water quality guidelines available.

During the lifespan of the Project (from construction to closure), in both the Application Case and RFD Case, contaminant of potential concern (COPC) concentrations are expected to increase locally. However, these predicted increases would remain below established thresholds for all measurement indicators. However, for the NFWQM sensitivity analysis, which included variations of effluent flow rates and TDS concentrations, the chloride concentration is predicted to be marginally above the threshold of aquatic life (i.e., 120 mg/L) for the last 14 years of Operations (maximum annual average of 134.9 mg/L) and for the Active Closure Stage (maximum annual average of 158.2 mg/L). This conservative upper bound scenario is considered to be unlikely, however, if granted a licence, NexGen will be required to perform monitoring to guide adaptive management of effluent treatment if concentrations trend in this direction over the course of Operations.

In the far-future projections, for both the Application Case and RFD Case (which represents a cumulative effect scenario), seepage from the potentially acid-generating (PAG) Waste Rock Storage Area (WRSA) could result in a very slow release of COPC metals and radionuclides into the surrounding environment via shallow groundwater. Under this scenario, cobalt and copper concentrations are predicted to marginally surpass surface water quality thresholds. The far-future projections for cobalt and copper show that the elevated concentrations are likely limited to Patterson Lake (see table 6.15 below). In the RFD Case, there is a small incremental change to COPC concentrations in the far future, including cobalt and copper, which would be sourced from runoff from the Patterson Lake South Property above-ground tailings management facility into the South Arm, and the flow through loading of runoff from the Patterson Lake South Property covered waste rock storage facility, which drains to the North Arm – West Basin. Groundwater inputs from the Rook I project are expected to be the main source of increased

COPC metals, such as cobalt and copper, in Patterson Lake. To address this, NexGen has stated in the EIS that source control measures for the PAG WRSA would include reducing oxygen exposure to the waste rock and installing a cover system to minimize water infiltration. These measures are expected to reduce the mass of contaminants entering Patterson Lake through groundwater and result in long-term metal concentrations lower than currently predicted.

To further assess potential risks from cobalt and copper, hazard quotients were calculated for effects on aquatic life. NexGen calculated that cobalt values would remain below conservative chronic aquatic benchmarks values. Copper would also remain below conservative chronic aquatic benchmark values when a site-specific assessment was performed (see appendix 11a of the EIS). This site-specific risk assessment relied on biotic ligand models and multiple linear regression models and provided results for the application case, the application case upper bound scenario (sensitivity analysis), and the RFD case (cumulative impacts from the Patterson Lake South project). The Biotic Ligand Model and Multiple Linear Regression Model estimate copper's bioavailability—and therefore its toxicity—for specific species by accounting for factors that influence toxicity, such as the hardness of the surrounding water. As a result, unlike the fixed TRVs in the EcoRA, the no-effect and low-effect thresholds change over time depending on variations in ambient water conditions. It was determined that adverse effects on fish, invertebrates, and plants are unlikely because predicted copper concentrations in all scenarios, including the upper bound scenario (sensitivity case), were below the lowest low effect concentration for the most sensitive species. The only exception to this was during periods of dry climate conditions in the unlikely upper bound scenario where concentrations are predicted to occasionally fluctuate marginally above the low effect threshold. It is important to acknowledge the inherent uncertainty in far-future projections due to the long timeframe modeled (tens of thousands of years) and the conservative assumptions used in the groundwater solute transport model. This uncertainty would be managed by NexGen adaptively throughout the Project's lifespan. More on effects to aquatic biota can be found under section 7.1 of the EA report.

Key information from the surface water quality assessment was carried forward to other disciplines for consideration in the assessment of VCs. The water quality results, particularly for projected cobalt and copper concentrations in the far-future scenario, were carried forward in the ERA. The results of the ERA were subsequently considered in the fish and fish habitat VCs (section 11), vegetation VCs (section 13), wildlife VCs (section 14), human health VC (Section 15), Indigenous land and resource use VC (section 16) and other land and resource use VC (section 17).

Table 6.15: Application Case Summary Statistics for Selected Constituents in the Far Future for Patterson Lake (From EIS: table 10A-12)

Constituent	Unit	Project Threshold	Minimum - North Arm – East Basin	Minimum - North Arm – West Basin	Minimum - South Arm	Average - North Arm – East Basin	Average - North Arm – West Basin	Average - South Arm	Maximum - North Arm – East Basin	Maximum - North Arm – West Basin	Maximum - South Arm
Total ammonia (as nitrogen)	mg/L	n/a[(a)]	0.026	0.028	0.026	0.029	0.031	0.031	0.042	0.082	0.13
Un-ionized ammonia (as nitrogen)[(b,c)]	mg/L	0.016	0.000073	0.000077	0.000072	0.000025	0.000027	0.000027	0.000072	0.00014	0.00023
Nitrate (as nitrogen)	mg/L	2.9	0.018	0.016	0.017	0.019	0.018	0.021	0.031	0.064	0.11
Phosphorus (total)	mg/L	0.020	0.0051	0.0051	0.0054	0.0053	0.0052	0.0058	0.0057	0.0059	0.0072
Chloride	mg/L	120	0.39	0.72	0.77	0.44	0.83	0.86	0.60	1.3	2.0
Hardness	mg/L	n/a	12	13	15	13	14	16	17	28	45
Sulphate	mg/L	128-218	1.5	2.3	2.4	1.8	3.1	4.0	6.9	23	48
Cobalt	mg/L	0.00078[(d)]	0.000065	0.000091	0.00012	0.00020	**0.0010**	**0.00083**	0.00032	**0.0015**	**0.0011**
Copper	mg/L	0.0020	0.00012	0.00015	0.00019	0.00035	0.0017	0.0014	0.00054	**0.0024**	0.0019
Uranium	mg/L	0.015	0.00014	0.00041	0.00052	0.00040	0.0024	0.0020	0.00067	0.0034	0.0026
Radium-226	Bq/L	0.11	0.0051	0.0040	0.0055	0.0070	0.0044	0.0071	0.0085	0.0052	0.011

a) Project threshold for ammonia considers the proportion of total ammonia that is un-ionized ammonia.
b) Function of total ammonia, pH, and temperature.
c) The average seasonal pH and average monthly temperature of samples were used to calculate the fraction factor.
d) Federal environmental water quality guideline (FEQG), variable based on hardness concentration in the surface waterbody; guideline value shown based on a hardness value of 52 mg/L as $CaCO_3$, which is the lowest hardness applicable to the guideline (Environment Canada 2017; Government of Canada 2021).
Bold values represent concentrations that exceed the Project threshold.
Bq/L = becquerels per litre.

Productivity status

The productivity status of waterbodies is projected to remain oligotrophic (low in nutrients and productivity) throughout the Project lifespan and in far-future scenarios, consistent with existing conditions. However, it was predicted for the reasonable upper bound sensitivity scenario that the project may cause a temporary increase in nutrient levels in the North Arm – West Basin and South Arm of Patterson Lake, shifting them from a low productivity (oligotrophic) state to a moderate productivity (mesotrophic) state for a period of time. This change is expected to last for 25 to 27 years, depending on the area. However, other water bodies downstream are not expected to be affected and will stay at their current low productivity levels. Eventually, all water bodies should return to their original state. It's important to note that the modeling used may overestimate nutrient levels because it didn't account for how algae might absorb some nutrients, so these changes are likely to be smaller than predicted.

Sediment Quality

As mentioned above, after considering mitigation measures the screening analysis concluded that the potential sediment quality environmental pathway could be excluded in the EIS as a primary pathway. However, details on the sediment quality screening and assessment can be found in the ERA (TSD XXI). As described in the ERA, the preferred benchmarks for sediment quality are from Burnett-Seidel and Liber (2013), with NE2 and REF values specific to Saskatchewan waterbodies. REF values refer to areas upstream of mining or milling activities or within nearby drainages. Exceedances of REF values indicate elevated metal concentrations in sediments downstream compared to natural background conditions. NE2 values represent areas with elevated concentrations but are not expected to significantly affect benthic invertebrate abundance, richness, or evenness. Concentrations below NE2 values indicate benthic invertebrate community metrics downstream are not expected to differ significantly (less than 20% difference) from natural background conditions. Thompson et al. (2005) and CCME also provide sediment quality guidelines with two tiers. The lower of each are defined by with Lower Effect Levels (LELs) and Interim Sediment Quality Guidelines (ISQGs), respectively, where concentrations below these levels indicate no adverse effects are likely. Exceedances of these benchmarks suggest further investigation is warranted but do not necessarily indicate adverse effects. Exceedances of Severe Effect Levels (SELs) (Thompson et al.) and Probably Effect Levels (PELs) (CCME) are more likely to cause ecological harm, with SELs representing concentrations that most benthic organisms cannot tolerate, and PELs representing concentrations that adverse effects are expected to occur frequently (more than approximately 50%).

As presented in the ERA, based on comparison of maximum predicted sediment quality in Patterson Lake North Arm – West Basin in the Application Case and Upper Bound sensitivity scenario against the REF values from Burnett-Seidel and Liber (2013), only arsenic and molybdenum would exceed the REF values. However, they do not exceed the NE2 values, indicating low risk. Arsenic would exceed the REF value in Operations, while molybdenum would exceed the REF value in the far-future projection for the reasonable upper-bound sensitivity scenario. Arsenic and molybdenum were considered sediment COPCs for further quantitative assessment in the ERA and were included in HQ calculations. There were no HQ exceedances of these parameters in the ERA for all receptors in all project phases.

The maximum predicted upper bound concentrations of lead-210 and polonium-210 in sediment in Patterson Lake North Arm – West Basin exceeded the LEL values from Thompson et al. (2005); however, they did not exceed the SEL values. While exceeding the LEL does not necessarily indicate that adverse effects would occur, it indicates that further assessment is warranted. Radionuclides in the uranium-238 decay series (uranium-238, uranium-234, thorium-230, radium-226, lead-210, polonium-210) were considered sediment COPCs for further quantitative assessment in the ERA. There were no HQ exceedances of these parameters in the ERA for all receptors in all project phases.

Mitigation Measures

NexGen has proposed measures to mitigate adverse effects on surface water and sediment quality. CNSC staff agree with the mitigation measures proposed by NexGen, however CNSC staff has also proposed additional measures. See table 6.16 below.

Table 6.16: Proposed mitigation measures to address effects on the surface water and sediment quality

Residual effect #1 **Water quality of the receiving environment (water quality, drinking water quality, productivity status)**
Reduce discharge/drainage to surface water pathways: • Maximization of the recycle and reuse of process water to reduce both freshwater intake and Project discharges to Patterson Lake • Site-specific ETP and STP to reduce COPCs in contact water and domestic sewage and greywater so that treated water can be discharged to Patterson Lake • Design and construction of diffuser/outfall in the receiving environment for the ETP and STP discharges away from sensitive or unique habitats, to the extent practical, and to provide effective mixing of the treated effluent and limit the area of the receiving water expected to have elevated concentrations of COPCs, and ensure flow does not interact with sediment • Robust site-wide water management procedures to identify contact water on site, its collection, and a process to determine whether treatment is required prior to release to the environment • Treatment of any mine-affected discharge water to below the effluent release targets prior to being discharged to the receiving environment • Limit project footprint/area of clearing and disturbance to extent practical, and ensure water storage capacity to manage runoff and seepage from disturbed areas • Appropriately manage stockpiles and ensure proper erosion control measures • Implementation of Project-specific management plans (e.g., Mine Waste Management Plan), monitoring programs (e.g., Effluent and Emissions , EMP), and a Preliminary Decommissioning and Reclamation Plan to reduce the potential for the receiving environment to be affected by Project activities during the lifespan of the Project and after Closure (e.g., aerial emissions and their deposition, surface runoff, direct discharge).

Residual effect #1 Water quality of the receiving environment (water quality, drinking water quality, productivity status)
Reduce air to surface water pathways: • Optimize haul routes to reduce fuel consumption and emissions from equipment • Apply water and/or suppressants to site roads, access road, and airstrip, as necessary. • Use dust suppressants that minimize environmental risk and are government approved for use § • Limit vehicle speed on unpaved site roads to reduce fugitive dust during Construction and Operations • Establish and enforce speed limits on site and access roads to reduce dust production • Evaluate opportunities to reduce fuel combustion requirements of infrastructure and equipment, to the extent practical, during detailed design • Primarily use liquified natural gas for power generation • Optimize haul routes to reduce fuel consumption and emissions from equipment • Use and maintain emissions control devices on combustion-based equipment • Limit idling of vehicles and equipment to the extent practical • Identify and implement procurement criteria to confirm stationary and mobile engines meet applicable performance standards • Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design • Implementation of Project-specific management plans (e.g., Mine Waste Management Plan), monitoring programs (e.g., Effluent and Emissions , EMP), and a Preliminary Decommissioning and Reclamation Plan to reduce the potential for the receiving environment to be affected by Project activities during the lifespan of the Project and after Closure (e.g., aerial emissions and their deposition, surface runoff, direct discharge).
Reduce groundwater to surface water pathway • Segregate PAG material from NPAG material and store separately • Contain and divert runoff and seepage from PAG waste rock, special waste rock, and ore to the effluent treatment plant • Use engineered cemented paste backfill and tailings to control source concentrations • Apply binder to reduce permeability in backfill and tailings • Install engineered cover system on PAG and NPAG material • Implementation of Project-specific management plans (e.g., Mine Waste Management Plan), monitoring programs (e.g., Effluent and Emissions , EMP), and a Preliminary Decommissioning and Reclamation Plan to reduce the potential for the receiving environment to be affected by Project activities during the lifespan of the Project and after Closure (e.g., aerial emissions and their deposition, surface runoff, direct discharge).
CNSC staff recommendations for additional mitigation measures
• CNSC recommends NexGen explore mitigation and adaptive management plans for acid rain/lake acidification from both project sources and cumulative effects sources, if future data collection indicates a risk. See follow up monitoring commitment below for more details.
• CNSC recommends NexGen explore mitigation and adaptive management plans for COPCs in LSA lakes from both project sources and cumulative effects sources if future data collection or

Residual effect #1 Water quality of the receiving environment (water quality, drinking water quality, productivity status)
modelling indicates a risk (e.g., combined risks to aquatic environment from Rook I and Patterson Lake South Projects during far future). See follow up commitment below for more details.

Monitoring and follow-up

Monitoring and follow-up are proposed by NexGen for the surface water and sediment quality to verify the accuracy of the predicted effects and effectiveness of proposed mitigation measures.

The EPP, EMP, Effluent and Emissions Plan, and related monitoring activities will be implemented to verify the accuracy of predicted effects, assess the effectiveness of mitigation measures in protecting aquatic environments, identify any unexpected impacts, and apply adaptive management strategies as needed. The Project's EMP will include surface water and sediment monitoring in Patterson Lake and other waterbodies within the LSA. The EMP builds on the baseline water quality monitoring program and will evolve to address Project changes or new data, ensuring compliance with regulatory requirements such as the Metal and Diamond Mining Effluent Regulations. Monitoring stations will cover key locations, including Patterson Lake, downstream waterbodies, and reference lakes. Additional monitoring will focus on air emission deposition in small lakes and groundwater influences on Patterson Lake. Data will measure general parameters, COPCs, and constituents required by regulations, supporting adaptive management and mitigation strategies, particularly for groundwater-related risks to Patterson Lake. The surface water quality monitoring program will align with the Metal and Diamond Mining Effluent Regulations, the federal Fisheries Act, and conditions outlined in authorizations from the CNSC and Saskatchewan Ministry of Environment.

CNSC staff agree with the follow up measures proposed by NexGen, however CNSC staff has also proposed additional measures. See table 6.17 below.

Table 6.17: Follow-up program measures for effects on the aquatic environment and surface water resources

Residual effect #1 **Water quality of the receiving environment (water quality, drinking water quality, productivity status)**

• monitor for water and sediment quality changes in the receiving environment as a result of Project activities
• verify that the site contact water management infrastructure is operating as designed and evaluate the effectiveness of the surface water protection controls in place
• verify the predictions of the EIS and confirm that the aquatic ecosystem in the receiving environment is protected
• confirm the adequacy of the study areas (i.e., confirm that effects do not extend beyond boundaries)
• track the trajectories of constituents that were identified in sensitivity analyses, such as chloride, so that these constituents can be proactively and adaptively managed
• evaluate the effectiveness of reclamation and other mitigation actions, and modify or enhance as necessary through monitoring and developing updated mitigation, if needed
• identify unanticipated negative effects, including possible accidents and malfunctions
• contribute to the overall continual improvement of the Project.
 	
Water quality monitoring for the Project may be divided into two parts:
  ◦ site contact water monitoring, which includes the Project processes as well as the area directly affected by the Project footprint, and monitoring of treated effluent to verify discharge criteria is met prior to batch discharge and release to Patterson Lake (i.e., upstream of the final point of control)
  ◦ the surface water receiving environment monitoring (i.e., Patterson Lake and downstream).

CNSC recommended follow up monitoring
• As a follow up action and commitment, NexGen has been requested by CNSC staff to collect water quality data for wetlands in the vicinity of the project activities (see EA commitments report). Although there were no predicted effects on wetlands modelled in the EIS, and thus NexGen had not collected wetland data for the purposes of the EIS, additional baseline data was requested in order to help assess any unexpected impacts from the project in the future (as the baseline levels will help assess any changes). NexGen has committed to this follow up monitoring and will include the results of the data collection in future reports.
• CNSC has recommended a follow up commitment for NexGen to include follow-up monitoring for all relevant pathways (e.g., air, effluent, surface water, runoff, rain and snow precipitation, groundwater) and contaminants of potential concern (COPCs) (e.g., SO_2, NO_x, sulfates, nitrates, pH) that may contribute to lake acidification, as this was flagged as a potential cumulative effect from Alberta Oil sands emissions, and of concern to Indigenous communities. This environmental monitoring data is to be incorporated into the future ERAs to model and assess potential cumulative effects related to this risk. Based on future results, mitigation or adaptive management may be required.
• CNSC has recommended a follow up commitment that NexGen incorporate the Patterson Lake South project's most up to date model outputs (for all project phases and pathways) into the Rook I

Residual effect #1 Water quality of the receiving environment (water quality, drinking water quality, productivity status)
model for the RFD case in the next iteration of the ERA after the Patterson Lake South project data is publicly available. This is to demonstrate that the cumulative effects analysis was performed conservatively. Any increased risks found through this analysis, if any, would require NexGen to assess mitigation or adaptative management plans.

6.3.3. Other Views Expressed

6.3.3.1. Potential Impacts to Surface Water Quality

Indigenous Nations and Communities

CRDN had previously indicated that they had overarching concerns regarding exploration and mining activities taking place at Goráchághı tu [Patterson/Forrest Lake] and they were concerned about the potential contamination of the entire Des Nëtthé̜ [Clearwater River]. CRDN had previously indicated that harvesters had noted changes to water quality since exploratory drilling on Goráchághı tu have taken place. In addition, CRDN harvesters had previously expressed doubt that radioactive and drilling contaminants will not impact Goráchághı tu and downstream environments. NexGen noted that changes to the availability and quality of fish for harvesting were assessed in the EA pathway analyses and has committed mitigation measures including Project-specific Groundwater, Effluent, and EMPs, installing effluent and sewage treatment plants, and avoiding critical or sensitive habitat to the extent practical during construction. NexGen will establish an Environmental Committee to monitor environmental performance of the Project and will provide funding for full-time independent Indigenous Monitors to address concerns and minimize adverse impacts to surface water quality.

MN-S had previously identified concerns with how NexGen was selecting COPCs for their environmental risk assessment. MN-S had indicated that it was unclear if COPCs that exceeded water quality objectives at end-of-pipe treatment, but met water quality objectives in the mixing zone were excluded from further assessment. MN-S had previously made it clear that using dilution in surface water as part of their ecological risk assessment was not best practice. MN-S had also previously expressed concern that NexGen was relying on design criteria and road access management controls to mitigate any release of uranium or other COPCs from an accident near surface water bodies such as the Clearwater River. NexGen confirmed that end-of-pipe concentrations of COPCs are predicted to be higher than chronic Project threshold, but below acute toxicity levels for fish and has committed to developing a comprehensive monitoring plan including surface water quality. As acutely toxic COPCs would not be released to the environment, NexGen has maintained that their assessment, including the use of dilution, is appropriate. NexGen noted that to address increased road use and mitigate the release of COPCs from an accident, upgrades to existing access roads are planned.

BNDN found that NexGen's modeling and conclusions concerning surface water quality were inadequate and significantly understated the potential impacts of the Project on surface water quality. BNDN noted that the EIS understates the acid generating capability of the waste rock produced from the Project and raised concerns that water quality will be irreversibly impaired in Patterson Lake. BNDN noted that Patterson Lake is oligotrophic with extremely limited buffering capacity, making it particularly susceptible to acidification and dramatic changes in water quality from the mine effluent. BNDN also noted that many lakes in the region suffer from algae blooms, and that the addition of nutrients to the lake from project effluent could cause similar impacts in Patterson Lake. NexGen has maintained that impacts of the Project on the environment have been adequately assessed and noted that the methodology used was deemed acceptable by provincial and federal regulatory agencies. NexGen has committed to mitigation measures for potentially acid generating materials including and storing them separately from other material, implementing source control and installing a liner for the storage area, installing an engineered cover system during reclamation, and containing and diverting runoff and seepage to the effluent treatment plant. In addition, BNDN members are concerned that utilizing cemented paste backfill and cemented paste tailings in the underground tailings management facility (UTMF) will have the potential for long-term impacts to surface water. BNDN members are concerned that any impacts to surface water quality are highly likely to have adverse impacts to human health and traditional practices. NexGen has committed to pumping cemented paste tailings directly into chambers within competent basement rock and not backfilling cemented paste into underground working areas until the areas are no longer used, thereby not increasing risk to underground workers. NexGen has noted support for continued engagement between the BNDN and Crown regarding potential effects to BNDN Aboriginal and treaty Rights. Furthermore, NexGen is open to further discussions regarding surface water effects, including the potential for follow-up presentations.

YNLR noted their members are very concerned about the potential for impacts to surface water quality that may arise from the Project. This includes concerns that surface water quality may be impaired and raised concerns about the long-term ecological health of Patterson Lake. NexGen has acknowledged the importance of surface water quality to YNLR and has committed to developing an EPP containing several mitigation and monitoring plans and utilizing adaptive management to provide a structured and flexible approach to maintaining water quality.

ACFN requested that NexGen include an assessment for the potential acidification of lakes and rivers to capture results from emissions from the Project that may deposit contaminants of potential concern to surface waters. NexGen has predicted low acidifying emissions, indicated by total H^+ equivalent of approximately 10% of the criterion of 0.175 t/d, and the pH values of the rainwater in the Project site indicate that potential for acid deposition issues is low. NexGen has committed to continuing to monitor and report pH values of rainwater, and section 7A2.1 of Final EIS Appendix 7A will be updated to include H_2SO_4 emissions in the total H^+ equivalent calculations and the monitored pH value of rainwater.

In addition, ACFN requested clarification if climate change induced effects on surface water temperature were assessed for the residual and cumulative impacts for the Project, to which NexGen noted that they were not included in the scenarios assessed, however they were not expected to influence the findings of the EA should they be found. Lastly, ACFN recommended that NexGen adjust the Project life to align with outputs included in their predictive modeling related to waste rock seepage which may impact the surface water quality at Patterson Lake and constitute a risk to human health. NexGen has assessed long-term effects on human health using a far-future projection, which encompasses effects beyond Project closure. ACFN requested that surface water quality data compilations and related analyses be revised so that updated data points and more robust approaches are used in the surface water quality data study. NexGen has maintained that the methodology used is appropriate and that setting half of the detection limit substitutes for non-detect data represents an overestimate and a conservative approach.

Federal Authorities

TC noted that project activities are subject to the *Canadian Navigable Waters Act* (CNWA) but determined there are no significant residual effects to navigation in Patterson Lake from water intake and effluent discharge. If the water intake and effluent discharge pipeline and diffuser are constructed as minor works, no mitigations, other than adherence to the requirements of the CNWA Minor Works Order, will be required. The Minister of Transport is of the opinion that minor works are likely to slightly interfere with navigation. Should CNWA approval be required for any of the in-water works (water intake and effluent discharge pipeline and diffuser), mitigation measures will be developed during the regulatory phase and included as terms and conditions in the CNWA approval(s).

ECCC noted that some rating curve formulae did not match the plotted lines, which was corrected. ECCC pointed out that potential residual effects to surface water quantity would be mitigated by a robust hydrometric monitoring program, which would reduce uncertainty of the discharge estimates, allow for updates to be made to the water balance models, if necessary, and determine if further actions are required to mitigate any adverse effects. The Proponent has committed to a robust hydrometric monitoring program which includes stations measuring lake water levels, visiting field sites (5 per year) to monitor rating curve applicability and backwater, under-ice flow measurements.

ECCC also noted that thallium has the potential to be a parameter of concern, and therefore recommended it also be included as a parameter for follow-up and monitoring of effects. For Radium-226, measures to reduce predicted concentrations to meet the project environmental release target of 0.37 Bq/L should be identified and implemented. ECCC recommended the implementation of a robust surface water quality monitoring program that includes all COPCs. ECCC also recommends that the EPP explicitly include details related to water management and monitoring of COPCs associated with the airstrip, west bermed runoff collection area, and explosives storage area. NexGen has committed to an EMP which includes surface water quality sampling in the receiving environment where there is exposure to effluent and would take place four times a year. NexGen has also committed to an Effluent and Emissions Plan which would include sampling effluent in ponds to confirm they meet release targets, and monitoring components to meet Metal and Diamond Mine Effluent Regulations (MDMER) requirements at the final point of discharge at the licensing stage (licence to prepare site and construct).

ECCC noted potential residual effects to surface water were possible if a pump failure were to occur during an extreme storm. The Proponent has committed to an Emergency Preparedness and Response Program and a Ground Transportation Emergency Response Plan as mitigation measures for this event.

6.3.3.2. Potential Impacts to the Aquatic Environment

Indigenous Nations and Communities

BNDN raised concerns regarding the potential accumulation of phosphorus in Patterson Lake and the associated effects on oxygenation in Paterson Lake. Areas of high oxygen are necessary for overwintering species of cultural importance, such as lake trout and reductions in oxygen levels could reduce overall habitat availability for these species. NexGen has noted that the inclusion of a small-bodied fish is unwarranted, as they are represented in the assessment of lake whitefish, but their inclusion will be considered as a sentinel species for environmental monitoring should an Environmental Effects Monitoring fish population study be triggered.

BRDN, which affirms that it consents to the Project and that its concerns have now been appropriately accommodated, had previously indicated their members were concerned about potential Project impacts on water quality and how this may adversely impact fish and fish habitat. NexGen has noted that the predicted effects would be within the resilience and adaptability limit of VCs and therefore the Project is not predicted to have significant adverse effects.

6.3.3.3. Potential Impacts to Sediment Quality

Indigenous Nations and Communities

MN-S had previously indicated that Lake whitefish is an inadequate fish to use to predict COPCs concentrations in sediments as they do not behave in the same manner as other fish species, such as Burbot, that may be potentially impacted due to COPC concentrations in sediment given they are more sedentary and move smaller distances. NexGen noted that northern pike was selected to represent burbot as a primarily piscivorous benthic-dwelling fish in addition to lake whitefish. Additionally, NexGen completed an aquatic health assessment to evaluate the potential magnitude of effects on sensitive aquatic species, which showed that potential health effects on burbot would be minimal and within the range of variability observed in unexposed populations.

BNDN requested that a baseline survey for sediment quality and characteristics be completed on a section of the Clearwater River between Broach Lake and Forrest Lake to determine the health of an upstream area from Patterson Lake that is likely used for spawning runs for important fish species. NexGen maintained that sufficient baseline has already been collected focused on downstream waterbodies and other areas potentially affected by the Project. However, NexGen has committed to conducting a baseline environmental effects monitoring program and will be open to discussion with the BNDN regarding potential sampling activities. BNDN indicated concerns that runoff from the Project footprint may cause adverse impacts to sediment quality, which in turn may affect human health. NexGen confirmed that site runoff was identified as a potential primary pathway to be assessed and has committed to mitigation measures including monitoring and treating site runoff, eliminating significant adverse effects to ecological or human health. BNDN observed that sediment pathways did not appear to be calculated in the HHRA and indicated that exposures and associated health risks should be quantified for all complete human health exposure pathways, including sediment. In response to this concern, NexGen quantitatively assessed incidental ingestion and dermal contact with sediment exposure pathway, as included in the Final EIS. Lastly, BNDN noted that concentrations in sediment were based off concentrations in water in the EIS and that not collecting baseline sediment data adds a level of uncertainty to the environmental risk assessment. NexGen clarified that baseline sediment quality was collected and used to verify modelled concentrations.

YNLR are concerned changes to groundwater and surface water quality predicted for the receiving environment based on the sediment quality assessment raised concerns regarding the long-term ecological health of Patterson Lake. NexGen has noted that changes to groundwater quality are not expected to significantly affect VCs, but NexGen committed to developing an adaptive management plan to manage copper loading to Patterson Lake in the far future.

ACFN requested an explanation of why project thresholds for sediment quality were not selected for COPCs with existing guidance thresholds readily available. NexGen noted that the selection of COPCs was driven by the environmental risk assessment screening, and thresholds were not included for sediment quality constituents which did not screen in as COPCs. NexGen has maintained that each non-COPC sediment constituent poses a negligible risk to aquatic biota or other users. ACFN requested that sediment quality data compilations and related analyses be revised so that updated data points and more robust approaches are used in the sediment quality data study. NexGen has maintained that the methodology used is appropriate and that setting half of the detection limit substitutes for non-detect data represents an overestimate and a conservative approach. ACFN asked for clarification if sediment concentration data was standardized to particle size for the sediment quality data analyses. NexGen confirmed that sediment quality data were not standardized to particle size, but particle size distribution was reported for each sample taken in 2019 and 2020. ACFN questioned why sediment quality was not considered as a Project effect for the life of the Project. NexGen noted that Project-related changes to sediment quality were not assessed past Closure as the discharge of treated effluent to Patterson Lake would end during the Closure Phase. Lastly, ACFN recommended that the screening process to identify COPCs associated with sediment be re-evaluated to consider complex mixtures as per HC guidance and identify individual COPCs and mixture-based COPC classes that reflect similar target organs and effects and that the new COPCs are contained in an updated HHRA and environmental risk assessment (ERA). NexGen has maintained that the ERA used best and standard practices to screen COPCs and focus the assessment on constituents with the potential to affect VCs and receptors, and therefore no re-revaluation is needed.

6.3.4. CNSC Staff’s Analysis

6.3.4.1. Hydrology

CNSC staff have reviewed NexGen’s effect assessment of surface water hydrology and the aquatic environment, related to changes in flow characteristics, water levels or surface water elevations, stream channel parameters (e.g. water depth and wetted area) and rate and nature of fluvial sediment transport in receiving surface water environment due to project activities as well as climate change. CNSC staff confirmed that NexGen conducted a comprehensive analysis of surface water hydrology effects and identified mitigation and follow-up monitoring program measures that are acceptable. CNSC staff concurs with the proponent's conclusion that any residual effects resulting from changes to hydrology are not predicted to result in significant effects to VCs, taking into account identified environmental protection design, mitigation and follow-up monitoring program measures.

However, NexGen has been requested to provide additional information for CNSC staff review and approval during the CNSC licensing stage (licence to prepare site and construct). NexGen is expected to provide an updated PMP estimate or confirm whether the current PMP is valid, or conservative based on analyses of up-to-date storm database.

6.3.4.2. Surface water and sediment quality

The assessment predicted residual effects on surface water quality due to change in water and drinking water quality constituent concentrations. However, with the implementation of appropriate mitigation measures and the effects being characterized as low magnitude, localized, and can be further reduced through adaptive management, the residual effects on surface water and sediment quality are predicted to not cause adverse effects to VCs. CNSC staff have reviewed NexGen's models and predictions for effects to surface water and sediment quality and confirmed that NexGen conducted a comprehensive analysis of these effects. CNSC staff also concluded, taking into account input from other federal departments, provincial ministries, Indigenous Nations and communities and the public, that the identified changes to surface water and sediment quality are expected to be negligible due to the implementation of mitigation measures and will not cause significant changes to the surface water and sediment quality measurement indicators. However, during CNSC staff's assessment of the EIS several topics were discussed that warranted further discussion and further information from NexGen. Some of these topics were the appropriateness and completeness of baseline data (especially for wetlands); the exclusion of the sediment pathway as a primary pathway; clarification on dose benchmarks, molybdenum thresholds, sulphate thresholds, and sediment thresholds; cobalt and copper levels in surface water in the far-future and the TRVs used; impacts on trophic status; and the conservatism of cumulative impact assessment on water quality.

Sediment pathway in the EIS

CNSC staff requested additional details on why sediment pathways were excluded in the EIS as a primary pathway. NexGen clarified that this was due to mitigation measures reducing effects to negligible levels for this pathway. NexGen clarified that the model used for the environmental risk assessment (ERA) submitted as a technical supporting document in the EIS (TSD XXI) considered multiple pathways to potential effects on receptors and environmental media (e.g., water, sediment). The ERA evaluated the potential for significant adverse effects on aquatic and terrestrial populations and communities resulting from any changes to sediment quality and concluded that there would be limited risk of adverse effects to aquatic life, wildlife, and humans. Therefore, although not listed as a primary pathway, the risks from sediment were still assessed and are presented in the ERA. CNSC staff accepted this response and concluded that the sediment pathway was adequately characterized and assessed in the EIS and supporting documentation (EIS TSD XXI).

Surface water and sediment baseline data for wetlands

Related to sufficiency of water and sediment quality baseline data, as a follow up action and commitment NexGen has been requested to collect water quality baseline data for wetlands in the vicinity of the project activities. Although there were no predicted effects on wetlands modelled in the EIS, and thus NexGen had not collected wetland data for the purposes of the EIS, additional baseline data was requested to help assess any unexpected impacts from the project in the future (as the baseline levels will help assess any changes). NexGen has committed to this follow up monitoring and will include the results of the data collection in future reports.

Copper and cobalt levels in surface water in the far future

CNSC staff have reviewed the proposed project and have found that the EIS and supporting documentation demonstrate minimal impacts from copper and cobalt on the aquatic environment through the water and sediment quality pathway. While projections for the far future indicate minor exceedances of guidelines for cobalt in Patterson Lake North Arm – West Basin and Patterson Lake South Arm, and for copper in Patterson Lake North Arm – West Basin, these exceedances have been thoroughly evaluated.

For cobalt, the ERA submitted as a technical supporting document in the EIS (EIS TSD XXI) concluded that there would be no adverse effects on aquatic life as all estimated hazard quotients (HQs) for cobalt were less than 1 for all aquatic receptors. For copper, slight exceedances of the HQ value of 1 were observed in the model in the far future. NexGen conducted a more detailed aquatic health assessment using site-specific models (see Appendix 11A in the EIS). The results indicated that under the upper-bound scenario, predicted water quality values remained below the benchmarks for the most sensitive fish and invertebrate species (i.e., all HQs < 1). The only exception to this was during periods of dry climate conditions in the upper bound scenario where concentrations are predicted to occasionally fluctuate above the low effect threshold, however this scenario is considered unlikely and is very conservative. These results indicate minimal risks to aquatic receptors from the planned project activities.

Regarding copper loading from the potentially acid-generating waste rock storage area to Patterson Lake in the far future, NexGen is developing an adaptive management plan. This plan aims to reduce uncertainty and manage risks associated with this pathway.

Furthermore, under licensing (licence to prepare site and construct) requirements, an ERA will be updated every five years, or sooner (e.g., if a significant change occurs in either the facility or activity that could alter the nature of the interaction with the environment within the ERA predictions), to confirm predictions. If future monitoring indicates that the modeling did not capture risks or if there are unforeseen impacts, mitigation measures or adaptive management actions would be required to address these issues. This ongoing monitoring process ensures that the health of the environment will be maintained throughout the life of the Project and beyond.

Trophic status of surface water

CNSC staff requested additional information regarding lake eutrophication during the operation of the project. The EIS reported that a potential change in trophic status in Patterson Lake, from oligotrophic to mesotrophic conditions, could occur under the Application Case based on total phosphorus (TP) projections, however this change is limited to the upper bound scenario only. No trophic level change is predicted for the Reasonably Foreseeable Development Case. CNSC staff relayed their expectations to NexGen that eutrophication will be monitored and prevented to the extent possible during the operation of the project.

NexGen has confirmed that the application of best available technology and techniques economically achievable (BATEA) for wastewater treatment during the life of the Project will be used. This ensures that concentrations of contaminants of potential concern (COPCs), including phosphorus, are kept as low as reasonably achievable (ALARA). CNSC staff will be reviewing NexGen's BATEA documentation during the licensing phase (licence to prepare site and construct). Further, surface water quality modeling results are based on conservative assumptions to ensure a robust and precautionary approach to environmental protection. Preliminary documentation submitted from NexGen indicates plans to use the chronic threshold for phosphorus in the BATEA assessment (0.01 mg/L), which aligns with the upper boundary of oligotrophic trophic status. NexGen will aim to meet this concentration at the edge of the mixing zone, minimizing potential impacts to Patterson Lake.

In addition, ongoing environmental and effluent monitoring will be conducted throughout the life of the Project. The ERA will also be updated every five years to incorporate new data, evaluate the effectiveness of mitigation measures, and ensure adaptive management practices are in place. Should the ERA indicate a potential effect related to phosphorus loading, the proponent will be required to conduct additional analysis and potentially enact mitigation measures to mitigate these effects.

Molybdenum guideline used in the EIS

CNSC staff requested more information on the less stringent water quality threshold that was selected for molybdenum in the EIS. NexGen explained that they used the Saskatchewan provincial molybdenum guideline (31 mg/L) preferentially over the more conservative CCME federal guideline (i.e., 0.073 mg/L) because the CCME guideline remains interim and because the provincial guideline has been derived from recent data following the CCME protocol. The CCME molybdenum guideline is based on limited data and is intended as an interim measure pending further research and for this reason NexGen initially selected the Saskatchewan provincial guideline as a project threshold. However, based on feedback from Environment and Climate Change Canada (ECCC) and CNSC, NexGen changed the Project threshold from the Saskatchewan province-specific guideline for molybdenum to the BC MOE guideline of 7.6 mg/L (BC MOE 2021) in the revised EIS. The regulatory rationale for this change is because the BC MOE guideline is more conservative than the Saskatchewan Water Security Agency (SWSA) guideline and is derived from recent data following the CCME (2007) protocol using broader species, ensuring more conservatism at the EIS stage of the project. Nevertheless, the expected concentrations of molybdenum in the receiving environment are all well below both the provincial guidelines and the CCME guideline indicating very low risks from molybdenum.

Methylmercury assessment in the EIS

Another topic of concern heard from Indigenous Nations and communities was surrounding methylmercury. CNSC staff determined that NexGen has appropriately considered mercury in the ERA based on the current understanding of mercury methylation and its associated risks. Although mercury concentrations in Patterson Lake are marginally below the screening value, the projected sulphate levels from the Project are not expected to significantly contribute to mercury methylation. This is because mercury methylation occurs under anaerobic conditions, which are unlikely to prevail in Patterson Lake, particularly in the oxygenated portions of the water column. As long as both mercury and sulphate guidelines are met, the risk of significant methylmercury production remains low, ensuring protection for both human health and the aquatic ecosystem.

Furthermore, NexGen has committed to comprehensive monitoring throughout the life of the Project, which will include water and sediment quality testing, as well as assessments of aquatic biota such as benthic invertebrates and fish. This monitoring will provide valuable data on the potential for mercury accumulation and enable adaptive management in response to any observed changes. Additionally, should the applicable Metal and Diamond Mining Effluent Regulations triggers be met, a study investigating mercury levels in fish tissue will be conducted. NexGen's commitment to ongoing monitoring and adaptive management ensures that any potential risks are identified and addressed promptly, with appropriate actions taken based on monitoring data.

Surface water cumulative effects

CNSC requested further details on the conservatism of NexGen's RFD case (which covers cumulative impacts with the potential Patterson Lake South project) assessment and to provide information on how using the assumptions in the EIS are conservative to determine cumulative effects on water quality, and how it respects the precautionary approach. Since detailed plans for the Patterson Lake South project were not yet available at the time of submission of the Rook I EIS, NexGen made informed assumptions about its potential environmental effects. These assumptions were based on data from other uranium mines in the region, as well as predictions from NexGen's own Project models. NexGen also stated that they used assumptions based on modern best practices, including geochemical similarities to the Project, use of BATEA principles, and adherence to ALARA standards. For example, it was assumed that similar practices as those used in NexGen's Project, such as treating water to very high standards before releasing it into the environment, would also be applied by other projects. Therefore, to estimate how runoff from the Patterson Lake South project's facilities might affect water quality, NexGen assumed it would be similar to the high-quality treated water released by its own Project. This approach provides a practical and realistic way to evaluate potential impacts, even without detailed information about the Patterson Lake South project. NexGen deems this approach robust and defensible, while acknowledging that future cumulative effects assessments and project-specific details will be required as the Patterson Lake South Property advances through regulatory phases. CNSC accepted NexGen's response, as at the time of receiving the EIS report, Patterson Lake South project data was not publicly available, therefore NexGen's approach to assess cumulative effects on surface water and sediment quality was sufficient and met the requirements of CEAA. As described above, cumulative effects for the RFD Case are similar to the application case indicating a low chance of impacts from cumulative effects as most COPCs will remain below conservative chronic benchmarks under all scenarios modelled. However, given the interest in cumulative effects from the Indigenous Nations and communities, and the expectation that the Patterson Lake South Project data is expected to be publicly released, CNSC has recommended a follow up commitment that NexGen incorporate the Patterson Lake South Project's most up to date model outputs for all project phases and include all predicted pathways (for instance the Patterson Lake South project's far future groundwater pathways) into the Rook I model for the RFD case in the next iteration of the ERA once this data is publicly available, in order to demonstrate that the cumulative effects analysis was performed conservatively and the conclusions remain valid. Any increased risks found through this analysis, if any, would require NexGen to develop mitigation or adaptative management plans.

Another potential cumulative effect of concern to Indigenous Nations and communities was the potential for emissions from Alberta's oil sands operations to cause acidic deposition from sulfur dioxide through rainfall and snowfall, which could contribute to increased lake acidification. NexGen's activities, such as air emissions, effluent discharge, and seepage from the PAG WRSA, could combine with the impacts of oil sands emissions and further increase lake acidification risks. CNSC staff analyzed this issue and concluded that the potential cumulative effect is unlikely to result in significant adverse environmental effects. The rationale for this conclusion is described below.

The Saskatchewan air quality guideline outlines two criteria for determining if a facility's emissions warrant regional acid deposition modeling:

1. Combined emissions of SO_2, NO_x, and ammonia (NH_3) must exceed 0.175 tonnes per day (t/d) of hydrogen ion (H^+) equivalent, calculated using specific formulas.
2. Facility emissions must account for more than 5% of the baseline emissions in the region.

Preliminary screening for NexGen's project found that the total H^+ equivalent from all acidifying emissions was about one-tenth of the Provincial 0.175 t/d threshold. Following consultations between NexGen and the Saskatchewan Ministry of Environment, it was determined that due to the low emissions of SO_2, NO_x, and sulfuric acid, acid deposition modeling was unnecessary for the project. To further support predictions of low risk from acid deposition cumulative effects, NexGen conducted rainwater pH monitoring at the site from September 2018 to October 2020. The results showed an average pH of 6.36, which is less acidic than typical unpolluted rain (pH ~5.6). Given the relatively low acidity of rainwater at the project site, the potential for acid emissions to cause acid deposition issues is considered low.

However, CNSC staff acknowledge concerns from Indigenous Nations and communities on this topic and have provided recommendations for more EA follow-up monitoring requirements and commitments to NexGen to ensure there are no unexpected risks as the project progresses. CNSC staff expect NexGen to include follow-up monitoring for all relevant pathways (e.g., air, effluent, surface water, runoff, rain and snow precipitation, groundwater) and contaminants of potential concern (COPCs) (e.g., SO_2, NO_x, sulfates, nitrates, pH) that may contribute to lake acidification. This environmental monitoring data should be incorporated into the next ERA to model and assess potential cumulative effects related to this risk. NexGen is also expected to explore mitigation options and adaptive management strategies to address potential environmental impacts based on increasing acidification levels in lakes if future monitoring data indicates risk. Additionally, CNSC staff note that if a license is granted, other environmental monitoring programs such as those required under the EEM program, will assess aquatic health indicators that could be affected by acidification, potentially triggering further mitigation or adaptive management actions. These monitoring actions will help refine the risk assessment to ensure lakes in the project area are protected from acid deposition and acidification.

CNSC staff have also reviewed NexGen's updated Geochemical Characterization of Waste Rock report as part of the EIS and are satisfied with the updated dataset on baseline geochemical information for waste rock stored on the surface. CNSC staff also noted NexGen's proposed engineering measures to mitigate potential acid generation during surface storage, including the segregation of PAG and NPAG waste rock and the use of low-permeability horizontal layering to limit oxygen ingress and precipitation infiltration into the waste rock pile. These measures will further help protect the environment from potential lake acidification risks associated with the project.

In summary, the assessment predicted residual effects on surface water quality due to change in water and drinking water quality constituent concentrations. However, with the implementation of appropriate mitigation measures and the effects being characterized as low magnitude, localized, and can be further reduced through adaptive management, the residual effects on surface water and sediment quality are not predicted to be cause adverse effects to VCs. CNSC staff have reviewed NexGen's models and predictions for effects to surface water and sediment quality and confirmed that NexGen conducted a comprehensive analysis of these effects.

6.3.5. CNSC Staff's Findings and Recommendations

CNSC staff have reviewed NexGen's effect assessment of the aquatic environment, related to hydrology, surface water and sediment quality and confirmed that NexGen conducted a comprehensive analysis of these effects and that identified mitigation and follow-up monitoring program measures are adequate.

6.3.6. Issues requiring Follow-up

As part of licensing reviews, NexGen is expected to submit some additional information for CNSC staff review and acceptance. During the licensing phase (licence to prepare site and construct), as part of BATEA documentation package, NexGen is expected to optimize the design of their water treatment plant, as well as refine environmental release targets, as per the requirements of REGDOC-2.9.2. NexGen is also expected to provide an updated PMP estimate or confirm whether the current PMP is valid, or conservative based on analyses of up-to-date storm database.

6.4. Terrestrial environment

6.4.1. Description of the terrestrial environment

The proposed Project is located within the southern Athabasca Basin, in the Firebag Hills Landscape Area in the Mid-Boreal Upland Ecoregion of the Boreal Plain Ecozone of Saskatchewan. The dominant terrain in the local study area is glaciofluvial (78.8%), followed by water (13.7%), fen peat (3.9%), and anthropogenic disturbance (3.7%). Upland soils in the area are dominantly Brunisolic soils that have developed on sandy glacial till and glaciofluvial deposits. While the area is primarily an undulating to hummocky upland landscape, the lower areas and depressions are typically poorly drained and contain organic and Gleysolic soils developed on sandy till deposits. No permafrost was observed during baseline studies.

A baseline soil sampling program in 2018 and 2019 investigated soil chemistry and reclamation suitability. Soils showed acidic pH levels although these were deemed natural to the area and thus not a limiting factor for reclamation success. Electrical conductivity (EC) and sodium adsorption ratios (SARs) were rated as good for reclamation suitability. In contrast, the cation exchange capacity (CEC) was low, indicating that soils have a naturally low supply of, and ability to retain nutrients for plants, and a low buffering capacity against soil acidification. Among the analyzed metals, boron, sulphur and uranium concentrations exceeded soil quality guidelines for the protection of environmental and human health by the Canadian Council of Ministers of the Environment (CCME). Analyzed radionuclides in soils were either below detectable levels or measured at levels below guideline limits for the management of naturally occurring radioactive materials (NORM). Taking into account the soil texture, course fragment content, ease of salvage, and depth of soil horizons, both the mineral topsoil and subsoil are considered to have poor reclamation suitability despite being capable of supporting local ecosystems.

The boreal forest landscape is heterogeneous, having been influenced by a variety of natural disturbances including wildfires that result in a mosaic of burned and unburned areas that can fragment the habitat. Ecosystems in the region are mainly upland deciduous, mixed, and coniferous forests dominated by jack pine. On the local scale, uplands represent 76.7% of the area whereas wetlands account for 19.5% including swamps, bogs, fens, and water. Riparian ecosystems, which are a subset of both uplands and wetlands, cover 7.3% of the local area. Small areas of anthropogenic disturbance (3.7%) are also present. The area supports a number of traditional use plant species, including jack pine, mosses, blueberry, and bog cranberry. A complete list is available in the EIS table 13.3-5.

No federally listed plant species were observed during 2018 baseline plant community surveys, however, a total of six provincially tracked plant species were observed: Beautiful Sedge (*Carex concinna*), English Sundew (*Drosera anglica*), Hudson Bay Sedge (*Carex heleonastes*), Northern Lady-fern (*Athyrium filix-femina* var. *angustum*), Scheuchzer Cotton-grass (*Eriophorum scheuchzeri*), and Water Lobelia (*Lobelia dortmanna*). Moreover, a review of the provincial HABISask database identified an additional species, Heart-leaved Twayblade (*Listera cordata* var. *cordata*) within approximately 1 km of the local study area.

6.4.2. Proponent's Assessment

6.4.2.1. Terrain and soils

To assess the residual effect of alteration of soil and terrain conditions, the proponent employed the following measurement indicators:

- Quantity and distribution of terrain units: measures the quantitative change in area of terrain units within the maximum disturbance area[1].
- Quantity and distribution of soil map units: measures the quantitative change in area of soil map units within the maximum disturbance area.
- Soil quality: provides a qualitative assessment of the change in soil quality (i.e., productivity) in the maximum disturbance area with respect to alterations in soil chemistry, reclamation suitability, erosion susceptibility, acidification, permafrost, and compaction.

In terms of quantity and distribution of terrain and soils, the proponent assessed the residual effects using the conservative assumption that terrain and soils in the entire maximum disturbance area would be altered. Following this approach, the disturbance size is predicted to be a total of 980.0 ha, entailing 897.8 ha of new disturbance and 82.2 ha of existing disturbance. Among the newly disturbed area, glaciofluvial terrain is the primarily affected unit with 874.2 ha lost, followed by fen peat with 23.6 ha lost. The newly disturbed area contains different mineral and organic soil units which will be lost.

Various mitigation measures are proposed to address the residual effect, which are outlined in table 6.18. Notably, it is proposed to minimize Project overlap with wetlands and fen peat terrain. The actual anticipated footprint, estimated as approximately 25% of the maximum disturbance area, is predicted to disturb only 5.5 ha of fen peat terrain, reflecting 5.5 ha organic soil area. Moreover, the proponent plans to limit the footprint by using existing cleared areas and roads and by storing tailings underground.

Progressive reclamation during operations and reclamation during closure are predicted to reverse effects on disturbed terrain and soil map units and provide productive soils to support the establishment and succession of vegetation communities with similar function to natural ecosystems. However, the establishment of some reclaimed vegetation ecosystems such as mature forest types are predicted to require more than 60 years beyond closure. As well, effects associated with permanent features such as the waste rock storage areas (WRSAs) are irreversible and would result in a permanent change to natural terrain and soil units. Nevertheless, over time, these areas are expected to provide functional substrates for soils and the establishment of early seral vegetation communities.

For soil quality, the proponent noted that the only relevant aspect was the suitability of disturbed soils for reclamation. The reclamation suitability of mineral soils is largely limited by texture and

[1] The maximum disturbance area (981 ha) is four times larger than the anticipated Project footprint in order to address uncertainty in the final design of the Project so that adverse effects are not underestimated.

given the course texture of upland soils in the Local Study Area (LSA), reclamation success would depend on measures taken to mitigate effects on soil quality. Proposed mitigation measures include soil handling that minimizes loss and degradation (e.g., direct placement) and stockpiling for long-term storage. The proponent noted that seed banks in salvaged topsoil are valuable for natural revegetation during reclamation. Based on this, reclaimed soils are expected to provide similar ecological function to natural soils and result in the establishment of early seral vegetation communities within 5-10 years. Monitoring programs would be implemented to evaluate the effectiveness of mitigation measures.

In summary, the proponent concluded that residual effects are predicted to be negative, long-term, certain to occur, and reversible; except for the WRSAs which will be permanent features with irreversible effects on terrain and soils. More detailed information can be found in the EIS section 12.5.

Table 6.18: Proposed mitigation measures to eliminate, reduce, or control potential adverse effects on terrain and soils (prior to residual effects characterization)

Alteration of soil and terrain conditions
• Implement an EPP including site water management procedures that include monitoring seepage from waste rock storage area
• Develop and implement a Preliminary Decommissioning and Reclamation Plan
• Limit the Project footprint to the extent practical, using practices such as designing an efficient infrastructure footprint, optimizing the use of cleared areas, and storing tailings underground
• Minimize areas of vegetation clearing and soil disturbance
• Implement progressive reclamation and revegetation of disturbed areas where non-permanent facilities have been decommissioned
• Use of erosion control measures as required
• Avoid placing soil stockpiles near waterbodies and near natural drainage features
• Design slopes for long-term stability and minimize steepness and length of slopes of disturbed areas and stockpiled soils
• To the extent practical, work in sensitive areas (e.g., erosive soils) scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation
• Site access road realigned during Project design to avoid a wetland
• Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss
• Where soils are prone to wind erosion, tackify, cover, seed, and/or apply water during periods of high erosion potential

Alteration of soil and terrain conditions
• Implement an EMP that includes monitoring for soil quality to determine if Project activities influence soil chemistry
• Implement a Mine Waste Management Plan
• Use and maintain emissions control devices, reduce fuel combustion, and limit idling of vehicles and equipment
• Reduce fugitive dust generation through limits to vehicle speed on unpaved site roads
• Apply water and/or dust suppressants to site roads, access road, and airstrip as necessary
• Conduct regular equipment maintenance
• Contain and divert runoff and seepage from potentially acid generating (PAG) waste rock, special waste rock, and ore to the effluent treatment plant

Table 6.19: Follow-up program measures for effects on terrain and soils

Alteration of soil and terrain conditions
• Slope monitoring to assess terrain stability completed during land clearing, site preparation works, and construction of facilities
• Perform routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of washout or sediment release
• Soil quantity and quality monitoring during site clearing, contouring, and excavation activities for signs of admixing, compaction, and erosion
• Monitoring of soil transport and stockpiling activities for signs of erosion
• Monitoring of dust deposition
• Monitoring of soil chemistry

6.4.2.2. Vegetation

To assess the residual effects of direct loss and terrain alteration on vegetation, the proponent employed the following measurement indicators:

- Ecosystem availability: changes were estimated quantitatively by calculating the change in Ecological Land Classification (ELC) units associated with each ecosystem.
- Ecosystem distribution: changes were estimated qualitatively by examining changes to the size and distribution of ecosystem patches.

- Ecosystem condition: changes were estimated qualitatively using scientific literature with respect to dust deposition, moisture and sunlight, and competition with invasive species.
- Traditional use plants habitat availability and distribution: changes were estimated quantitatively for habitat availability by calculating differences in the occupancy of each traditional use plant species, and changes were estimated qualitatively for distribution by examining changes to the size and distribution of habitat patches.

In terms of ecosystem availability, the proponent assessed the residual effects using the conservative assumption that vegetation in the entire maximum disturbance area would be altered. Following this approach, the Project is predicted to contribute to a loss of 868.4 ha of upland ecosystems (1.2% of Regional Study Area, RSA), 27.8 ha of wetland ecosystems (<0.1% of RSA), and 39.6 ha of riparian ecosystems (0.4% of RSA).

Changes to upland ecosystems are predicted to be limited to five ELC units. The largest absolute change is for "burned Jack pine/lichen" (720.4 ha lost), but this is also the most common ecosystem in the area and several analogous habitats remain available, such as the "unburned Jack pine/lichen" or "Jack pine/blueberry/lichen". The largest relative change is for "Black spruce/Labrador tea/feathermoss" with a predicted loss of 11.5 ha representing 8.9% change in the RSA. This ELC unit is relatively uncommon, yet 118.3 ha will remain available in the RSA.

Changes to wetland ecosystems are predicted to be limited to four ELC units. The largest absolute and relative change is for the "Labrador tea shrubby bog" with a loss of 16.6 ha representing 1.3% change in the RSA. Yet, more than 1,000 ha of this wetland type remain available in the RSA. Moreover, disturbance associated with permanent facilities (e.g., WRSAs) is not anticipated to occur within wetlands.

Changes to riparian ecosystems are predicted to be limited to five ELC units. The largest absolute change is for the "Labrador tea shrubby bog" with a loss of 10.4 ha, although close to 1,000 ha remain available in the RSA. The largest relative change is for "Black spruce/Labrador tea/feathermoss" with a predicted loss of 9.8 ha, and only 86.8 ha remaining on the RSA scale. Disturbance associated with permanent facilities (e.g., WRSAs) is not anticipated to occur within riparian ecosystems.

With respect to ecosystem distribution, the proponent stated that decreased connectivity would occur at the local scale around the maximum disturbance area, noting that the Project is in an area of aggregated existing linear and non-linear disturbance. Also, the majority of the maximum disturbance area (77%) was disturbed by fire in 1990 which has led to a relatively homogenous vegetation community. Most upland ecosystems remain abundant and well-connected across the RSA. The least common upland ELC unit disturbed by the Project is "Black spruce/Labrador tea/feathermoss" which is distributed along shorelines of Patterson Lake and other lakes in the area. Disturbance of this ELC unit would slightly increase the inter-patch distance on a local scale but is not expected to affect regional connectivity. Similarly, existing wetlands are mostly distributed along shorelines, notably an extensive organic wetland to the east of the existing bridge crossing the existing access road. Project components were redesigned to minimize effects on wetland distribution, but the access road would be widened to 10 m while maintaining alignment. The access road widening would also result in minor changes to riparian habitat. Yet, since these wetland and riparian areas are in close proximity to existing disturbance, additional fragmentation would be limited and localized. Lastly, the Project would not change the density of linear features in the RSA.

For ecosystem condition, the proponent noted that forest near development can be affected by edge effects such as ingress of invasive species or changes in moisture or sunlight. These can result in structural changes in forest stands that extend to about 50 m from disturbance. Likewise, edge effects can alter wetland species abundance and richness. One provincially tracked plant species (Beautiful Sedge) was observed in upland within the maximum disturbance area, however, four additional occurrences of the same species were observed elsewhere with no direct effects anticipated. Moreover, six rare plant species occurrences were recorded in wetlands and riparian habitats but not in the maximum disturbance area: English Sundew, Hudson Bay Sedge, Northern Lady-fern, Scheuchzer Cotton-grass, Water Lobelia, and Heart-leaved Twayblade. The proponent specified that known rare plants would be clearly marked and avoided where feasible, with appropriate setback distances. Where disturbance is unavoidable, the Saskatchewan Ministry of Environment (ENV) would be consulted to determine the best course of action. Furthermore, one species of noxious weed (Narrow-leaved Hawk's Beard, *Crepis tectorum*) and one species of nuisance weed (Dandelion) designated under *The Weed Control Act* were identified in disturbed areas during baseline surveys. Introduction and spread will be mitigated through an EPP and monitoring of designated weed species. In summary, effects on ecosystem condition are possible, but predicted to be within resilience and adaptability limits.

Various mitigation measures are proposed to address the residual effects, which are outlined in table 6.20. Progressive reclamation would occur in areas no longer required, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during active closure. Reclamation is predicted to reverse effects on disturbed upland ELC units and to support the establishment and succession of vegetation communities reflecting boreal forest upland. Young seral forest communities are anticipated to be established within 6-20 years, and mature forest within 60-80 years. Additional reclamation activities would be implemented to focus on restoration of existing linear anthropogenic disturbances (e.g., seismic lines). However, while permanent facilities of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of natural upland; thus, effects on 73.1 ha of upland are considered permanent and irreversible. In addition, while wetlands would be reclaimed to the extent possible in an attempt to achieve no net loss of wetland functions, the loss of wetlands – including those with riparian potential – is conservatively assumed to be permanent because fens and bogs cannot be restored with confidence. Nevertheless, any disturbed wetland types remain well-distributed outside the Project footprint.

With regard to traditional use plants, availability of their habitat is expected to be decreased by 298.1 ha (1.0%) in the RSA while remaining abundant on a regional scale. The largest predicted changes are associated with common boreal forest plants such as blueberry, jack pine, and bog cranberry. Within the LSA, the occupancy of 24 traditional use plants would be reduced based on the removal of the maximum disturbance area which is a conservative overestimation. Most are anticipated to re-establish quickly following removal of disturbance, except for those species that occupy wetlands (e.g., Pitcherplant, *Sarracenia purpurea* ssp. *gibbosa*) as it is uncertain if wetland plant composition will be similar following restoration. The Project would also result in localized changes in plant habitat connectivity, although the habitat is predicted to continue to be self-sustaining and ecologically effective.

In summary, the proponent's analysis found that no unique upland, wetland, or riparian ecosystems would be lost due to the Project, and no unique traditional use plant species would be lost either. Changes to the availability and distribution of upland, wetland, or riparian ecosystems, including those that support traditional use plants, are predicted to be localized. The proponent concluded that residual effects are predicted to be negative, long-term, certain to occur, and reversible; except for the WRSAs which will be permanent features with irreversible effects on vegetation, as well as wetlands which are assumed to be irreversibly disturbed. The overall residual effects are predicted to be not significant for the vegetation VCs. More detailed information can be found in the EIS section 13.5.

Table 6.20: Proposed mitigation measures to eliminate, reduce, or control potential adverse effects on vegetation (prior to residual effects characterization)

Direct loss of vegetation
• Implement an EPP including site water management procedures that include monitoring seepage from waste rock storage area
• Implement an EPP including actions to prevent, detect, and control areas with prohibited, noxious, and nuisance weeds and invasive species
• Implement an EMP that includes monitoring for soil quality to determine if Project activities influence soil chemistry
• Implement an Effluent and Emissions Plan
• Implement a Mine Waste Management Plan
• Develop and implement a Preliminary Decommissioning and Reclamation Plan
• Mark clearly with an applicable setback distance and avoid known rare plants; where disturbance to rare plants is unavoidable, compensation would be considered following discussion with and guidance from regulators
• Limit the Project footprint to the extent practical, using practices such as designing an efficient infrastructure footprint, optimizing the use of cleared areas, and storing tailings underground
• Minimize areas of vegetation clearing and soil disturbance
• Implement progressive reclamation and revegetation of disturbed areas where non-permanent facilities have been decommissioned

• Use of sedimentation and erosion control measures as required
• Site access road realigned during Project design to avoid a wetland
• Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss
• Design and maintain a mine dewatering system to manage the flow of groundwater inflow
• Use and maintain emissions control devices, reduce fuel combustion, and limit idling of vehicles and equipment
• Reduce fugitive dust generation through limits to vehicle speed on unpaved site roads
• Apply water and/or dust suppressants to site roads, access road, and airstrip as necessary
• Conduct regular equipment maintenance
• Implement best management practices and mitigation such as spill prevention
• Contain and divert runoff and seepage from PAG waste rock, special waste rock, and ore to the effluent treatment plant
• Install and operate an effluent treatment plant and sewage treatment plant to reduce release of constituents of potential concern (COPC) to the environment
• Confirm discharge meets quality criteria prior to release and locate treated effluent diffuser away from sensitive or unique habitats
• Install engineered cover system on PAG and Non-PAG material during reclamation
• Use native species or non-aggressive, non-native species for revegetation
• Procure clean construction materials and procure seed mixes that work to avoid the introduction of noxious weeks
• Promote natural propagation and regeneration to enhance reclamation along the access road and other Project rights-of-way
• Adhere to the Federal Policy on Wetland Conservation to have no net loss of wetland functions
Terrain alteration for vegetation
• Minimize steepness and length of slopes of disturbed areas and stockpiled soils
• Work in sensitive areas (e.g., erosive soils, wetlands) scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation
• Reclamation to include contouring of disturbed areas to encourage vegetation growth and blend with the natural surrounding topography

Table 6.21: Follow-up program measures for effects on vegetation

Direct loss of vegetation
• Surveillance to identify and manage new occurrences of species designated by *The Weed Control Act* as prohibited, noxious, and nuisance weeds
• Monitoring and follow-up during construction to delineate potential activity restriction guideline setbacks for rare and provincially tracked plants
• General environmental monitoring to evaluate changes to vegetation including traditional use plant species
• Reclamation monitoring such as for treatments to be used during revegetation
• Wetland function monitoring surveys including water level, water quality, and sediment quality sampling

6.4.3. Other Views Expressed

6.4.3.1. Potential Impacts to Terrain, Soils and Vegetation

Indigenous Nations and Communities

CRDN members were previously concerned that impacts from the Project may result in vegetation being contaminated, thus raising concerns related to human health. NexGen confirmed that emissions, deposition of contaminants, and discharge of treated effluent were assessed as potentially affecting human health through ingestion, and mitigation measures will be implemented to ensure emissions and effluent discharge will be in accordance with provincial standards and license conditions.

MN-S had noted that there is a disconnect between field studies and assessments, given that the number of traditional plant species listed is less than the number observed during baseline surveys. NexGen noted that baseline and assessment study areas do not align, however this is common practice due to differences in methodologies for grouping plant species. MN-S had previously noted that it was unknown if soils investigations were completed to describe soil characteristics in the Project study areas. NexGen has confirmed that soil investigations were completed at a total of 118 sites. MN-S had noted concerns of Project-related dust and its potential impacts to vegetation as a pathway of effects to humans and wildlife. MN-S had also previously indicated a number of additional pathways, including secondary pathways, that should be considered concerning potential impacts to vegetation. NexGen updated the Final EIS Appendix 2B to provide key mitigation efforts for this pathway. NexGen has noted that secondary pathways, including fugitive dust and vegetation changes from particulates, are not expected to contribute to cumulative effects and cause minor changes relative to existing conditions or guideline values. Therefore, residual effects for secondary pathways have not been considered. MN-S had also previously requested NexGen include results from supplemental vegetation inventory and rare plant surveys in the EIS. NexGen has clarified that additional rare plant studies conducted in 2021 found no additional rare plant species, and therefore no update was required to the Draft EIS. MN-S had also previously questioned the omission of Lesser Duckweed (*Lemna minor*), despite it being a provincially listed species observable within ecosite BP25. NexGen has clarified that due to taxonomic changes, all *Lemna minor* observations in the project area have been changed to *Lemna turionifera* (Common Duckweed), a species that is not provincially tracked. MN-S had previously noted a concern that the EMP for vegetation was not identified. MN-S had identified that reclamation activities should be completed such that vegetation communities present at the time of disturbance would be reestablished and also indicated it was not clear which vegetation species would be used for reclamation and asked NexGen to confirm the completion of surveys for non-vascular plants or lichen Species of Conservation Concern. NexGen confirmed that the development of environmental monitoring details for the Project would occur outside of the environmental assessment process, and involve engagement with primary Indigenous Nations and communities, including MN-S. NexGen has stated that while all reasonable efforts will be made to reestablish vegetation communities representative of existing conditions, the terrain would have changed as a result of the Project and the effectiveness of such a reclamation is uncertain. NexGen has confirmed that surveys for non-vascular plants were not conducted as no plant species at risk or critical habitat, including lichen, were listed in the regional study area.

BNDN indicated that the Project will result in habitat loss and alterations, including alterations to vegetation communities. The alterations will have impacts on wildlife. BNDN also noted that Project-related particulate matter may result in increased particulate deposition on vegetation, which in turn will have adverse impacts to human health and wildlife. Further, BNDN is concerned that Project-related dust will also deposit on traditionally important vegetation communities. BNDN requested that NexGen develop a follow-up monitoring program for sensitive vegetation communities. NexGen has committed to two monitoring objectives including evaluating the effectiveness of the environmental protection measures and to identify unanticipated effects, however, NexGen has noted that challenges exist in defining suitable monitoring methods for monitoring impacts of habitat alterations on wildlife densities. NexGen has committed to minimizing fugitive dust and thereby particulate deposition on vegetation through environmental design features and measures provided in table 7.2-10 of EIS section 7.2.4 and will explore further mitigation efforts should localized exceedances of guidelines occur. NexGen has confirmed that details of monitoring programs will be developed during permitting and licensing, and follow-up monitoring can be discussed with BNDN during this process.

YNLR noted that the 43-year anticipated lifespan of the Project will mean restoration of vegetation communities will take decades to reestablish. As such, YNLR recommends that NexGen undertake offsetting of impacted vegetation. YNLR indicated that NexGen’s use of only three vegetation ecosystems is too coarse and may miss important vegetation communities. YNLR noted that they believe that predicted effects, and effectiveness of mitigation on vegetation is critical to understand if such measures are working as intended and as a means to identifying adaptive management that may be required to maintain the ecological health of Project-area forests. NexGen has confirmed that a key Project goal is to mitigate effects to the environment including minimizing impacted vegetation. Additionally, NexGen's preliminary objective for Closure is to design the landscape to allow for unrestricted traditional use as soon as practical. NexGen has maintained that the selected VCs have resulted in a comprehensive assessment of vegetation, by applying a fine-filter approach, which assessed effects on species identified as important by Indigenous Nations and communities, in addition to a coarse-filter approach, which assessed effects on ecosystems more broadly.

ACFN requested that NexGen re-evaluate the predictive modelling data for soils in the ERA to identify bio accumulative and persistent substances with respect to the Canadian Environmental Protection Agency (CEPA) Persistence and Bioaccumulation Regulations. NexGen has maintained that no re-evaluation is required, as best practices were used to screen for COPCs. Concerning invasive species, ACFN asked NexGen to provide scientific evidence that plant species that predominate pre-disturbance plant communities (e.g., lichens and feathermosses) can be reestablished within boreal forest reclamation sites. NexGen has noted that mosses can be effectively reclaimed using the spreading of moss clippings on reclaimed areas, and approaches are detailed in the *Peatland Restoration Guide* (Quinty and Rochfort 2003). Scientific literature on lichen propagation is limited; some successful techniques are detailed in research trials completed by Ronalds and Grand (2018) and Rapai et al (2023), and additional site-specific research would be conducted.

ACFN noted that NexGen plans to use non-native plant species in reclamation and asked that NexGen explain how it will prevent each of those plants from becoming established within the reclaimed plant community. NexGen has clarified that the intent is to use native plant species, however flexibility is necessary should the use of native species be impractical for ensuring successful reclamation. Potential non-native plants would be non-aggressive and non-invasive species and would be early successional plants that establish quickly and decrease soil erosion. ACFN asked whether NexGen would carry forward the invasive species pathway in its assessment of project effects. Additionally, ACFN requested justification for the prediction that impacts on availability of upland and riparian ecosystems are reversible, given that many predominant species, including traditional plant species, are difficult to reestablish in reclamation. NexGen has found the occurrence of invasive plant species to be limited to existing disturbed upland ecosystems and committed to mitigation measures to minimize the introduction of noxious and nuisance weeds near the Project footprint. Therefore, invasive species are predicted to result in negligible effects and NexGen maintains a detailed assessment of this pathway is not required. And finally, NexGen has noted that the continued re-establishment of plant communities in the boral forest after intense disturbances such as forest fires have exemplified a high capacity for resilience and adaptation of plants in upland and riparian ecosystems.

6.4.4. CNSC Staff's Analysis

6.4.4.1. Terrain and soils

CNSC staff have reviewed the proponent's residual effect assessment for the alteration of soil and terrain conditions and deemed the measurement indicators as appropriate for the assessment of residual effects. CNSC staff's analysis confirmed that the proponent conducted a comprehensive analysis of these effects and that identified mitigation and follow-up monitoring program measures are adequate.

6.4.4.2. Vegetation

CNSC staff have reviewed the proponent's residual effect assessment for the direct loss and terrain alteration for vegetation, and the valued components of upland, wetland, and riparian ecosystems, and traditional use plant species. CNSC staff deemed the measurement indicators as appropriate for the assessment of residual effects. However, CNSC staff had several information requests that are discussed below.

As for the assessment boundaries, CNSC staff noted that the RSA was selected to provide a watershed-based context for interpreting local effects of the Project. Given that the RSA is used to evaluate the availability and distribution of vegetation in upland, wetland, and riparian ecosystems, CNSC staff requested further rationale for the appropriateness of the watershed-based RSA for all vegetation valued components. The proponent responded that the spatial boundaries of the RSA were selected to be complementary to the assessments for air and water that potentially affect vegetation. The RSA was also used to assess cumulative effects from the Patterson Lake South Property and fire factors which are more appropriately assessed at the regional scale. CNSC staff deemed this response as acceptable.

With respect to upland ecosystems, the statement that effects are permanent and irreversible for upland ELC units covered by permanent facilities (e.g., WRSAs) stood out to CNSC staff. Certain upland ELC units are uncommon in the LSA, and it was unclear whether these would be affected. Thus, CNSC staff requested information on which ELCs are located in areas that are planned to be covered by permanent facilities. The proponent confirmed that permanent WRSAs would be located on the common Jack pine/lichen (burned) ELC unit which comprises 58% of the LSA. The proponent further noted that an alternative assessment was conducted to evaluate options for permanent facilities (e.g., WRSA) that included environmental considerations. CNSC staff were satisfied that the permanent facilities would not irreversibly disturb unique or uncommon ecosites.

For wetland ecosystems, CNSC staff commented that the discussion of the effects pathway of "surface water flow changes" does not acknowledge that seemingly isolated wetlands can also be connected hydrologically through groundwater. Therefore, CNSC staff requested an evaluation of predicted effects on wetland hydrological connectivity in the context of vegetation. The proponent responded that the Project is predicted to have no measurable effect on wetland hydrological connectivity. This is because the glacial drift material at surface in the LSA is highly permeable, and as such, the water surface elevation of riparian wetlands adjacent to waterbodies is expected to be primarily controlled by the water surface elevation of the adjacent waterbody. During operation, there is a predicted 5% reduction in groundwater discharge to riparian wetlands distributed between Patterson Lake, Forrest Lake, and Lake G. However, the reduction in baseflow would be mitigated by increased surface water level in Patterson Lake and the Clearwater River below Patterson Lake, as well as in Forrest Lake. Moreover, one isolated wetland, a black spruce treed bog, is located perched on a hill slope adjacent to the existing access road approximately 30 m above Patterson Lake. This wetland is the only wetland located in the LSA that is not a riparian wetland. Due to the elevation, this wetland is not expected to interact with the Project under current conditions or during the Project lifespan. CNSC staff found this answer to be acceptable and agreed that given the limited effects on wetland hydrological regimes, effects on vegetation in this respect are negligible.

With respect to rare plants, CNSC staff's analysis found that the spatial boundaries for the 2018 vegetation baseline assessment differ from the actual EA boundaries, and therefore it was unclear whether rare species were adequately captured in baseline surveys. Furthermore, the baseline surveys were only completed in one year which may underestimate the presence of certain rare plant species, such as annuals depending on a seed bank. CNSC staff also pointed out that the limited amount of rare plant observations was used as a rationale to use an ecosystem-based approach to their assessment. Thus, CNSC staff requested further rationale for the selection of an ecosystem-based approach for rare plants including a discussion of uncertainties related to this approach and baseline data. The proponent responded that the assessment applied both a coarse- and fine-filter approach to the selection of vegetation valued components. The coarse-filter approach ensures that biodiversity is assessed and managed at the vegetation and wetland ecosystem level, while the fine-filter approach assessed effects on 28 traditional use plant species as well as rare plants. Conducting extensive regional surveys on rare plants would require extensive resources and would not change the mitigations required to minimize indirect effects. The proponent further clarified that a precautionary approach was used to address uncertainty by identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when a range of outcomes were possible. Baseline survey methods for rare vascular plants followed provincial survey standards focusing the intensity of surveys on the anticipated Project footprint where there would be the potential for direct losses. Therefore, there is low uncertainty in the potential for direct loss of rare plants. The proponent also explained that additional rare plant studies were conducted in the anticipated Project footprint in 2021, but no additional rare plant species were found. CNSC staff found this response to be acceptable, also taking into account the mitigation measure that known rare plants as well as previously unidentified species (e.g., chance find during construction) would be clearly marked and avoided where feasible, and the ENV would be consulted to determine the most appropriate course of action.

In terms of COPC in vegetation, CNSC staff remarked that the spatial extent for the deposition of fugitive dust emissions is assumed to be concentrated within 500 m of the Project footprint.

However, a cited study[2] concluded that dust generated from a haul road was found to decrease lichen cover up to 1 km, indicating that lichen is a sensitive species to dust deposition. Moreover, the Environmental Risk Assessment (ERA) concluded that COPC relevant to dust and particulates exceeded screening values. CNSC staff requested an evaluation of predicted effects of total suspended particulates (TSP) and particulate matter PM_{10} and $PM_{2.5}$ on lichen to verify assumptions. The proponent responded that the cited study was completed in unforested, subarctic tundra, whereas the Project is located in the boreal forest where dust would not disperse as far due to the presence of trees. Average annual dust deposition rates from the Project at the boundary of the maximum disturbance area are predicted to be below any rates reported to have effects on vegetation and lichen. Furthermore, air quality modelling indicated the criteria exceedances for PM_{10} would occur mostly over the Patterson Lake North Arm, with minimal changes expected for terrestrial vegetation. Baseline air quality monitoring, including particulates, would continue into construction, operations, and decommissioning to verify predictions. CNSC found this explanation to be acceptable.

Related to this topic, CNSC staff noted in the ERA that aquatic macrophyte shoots and roots were sampled at Lloyd Lake along with sediment, however, the COPC data was not discussed beyond a comparison of modelled and measured concentrations. CNSC staff requested that the proponent present information on the macrophyte sampling campaign including measured COPC concentrations in shoots and roots, along with an explanation on how this information was considered in the EIS. The proponent clarified that *Carex* sp. (sedge) were collected in multiple waterbodies in addition to Lloyd Lake and that baseline data is available in Appendix C of EIS Annex V.1 (Aquatic Environment Baseline Report). Further, the measured baseline data for aquatic macrophytes were used to validate the bioaccumulation factors (BAFs) used in the modelling. The measured baseline data were compared against the predicted macrophyte concentrations using the BAFs from publicly available regional data from other uranium mines in northern Saskatchewan. There was generally good agreement between modelled and measured macrophyte data. CNSC staff found this response to be acceptable, but to ensure accuracy and completeness, staff recommended to update the ERA to indicate that macrophyte sampling was conducted in Lloyd Lake, as well as Broach Lake, Jed Creek, Patterson Creek, Beet Creek, and Clearwater River. NexGen included his update in the Final EIS submission.

Taking into account all of the above information, CNSC staff's analysis confirmed that the proponent conducted a comprehensive analysis of these effects and that identified mitigation and follow-up monitoring program measures are adequate. CNSC staff conclude that residual effects on vegetation VCs are not significant.

6.4.5. CNSC Staff's Findings and Recommendations

CNSC staff have reviewed NexGen's effect assessment of the terrestrial environment, related to the terrain and soils, and vegetation, and confirmed that NexGen conducted a comprehensive

[2] Chen, W., et al. (2017). Does Dust from Arctic Mines Affect Caribou Forage. *Journal of Environmental Protection*, 8, 258-276. DOI: 10.4236/jep.2017.83020.

analysis of these effects and that identified mitigation and follow-up monitoring program measures are adequate.

Taking into account the implementation of mitigation measures (table 6.20) and recommended follow-up program measures (table 6.21), CNSC staff conclude that the Project is not likely to cause significant adverse effects on vegetation, including upland, wetland, and riparian ecosystems, and traditional use plants.

7. Predicted effects on valued components

7.1. Fish and Fish Habitat

7.1.1. Description of the existing fish and fish habitat in the aquatic environment

Fish and fish habitat conditions in the LSA and RSA were evaluated for several waterbodies, including Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, and Naomi Lake, and sections of the Clearwater River mainstem. In total, seventeen fish species were documented within these waterbodies. The most abundant large-bodied species captured included white sucker, lake whitefish, yellow perch, longnose sucker, northern pike, walleye, burbot, and lake trout. Commonly captured small-bodied species included trout perch, spottail shiner, and lake chub. This species list is characteristic of northern temperate waterbodies and watercourses in Saskatchewan (Langhorne 2001). Of the seventeen species identified, none were classified as species with a designated conservation status by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2021), aquatic species listed under the *Species at Risk Act or* would be considered rare or unique to the area based on a review of Saskatchewan's Conservation Data Centre taxa lists (SKCDC 2021a).

Four fish species (i.e., lake trout, lake whitefish, walleye, and northern pike) represented valued components (VCs) in the Environmental Assessment (EA). The selection of these four VCs was based on the respective roles and linkages of each species in the ecosystem and food web, the high traditional and cultural importance of these species to local communities, and the species' presence within nearby waterbodies and watercourses. Additionally, these VCs were selected because they are strong indicators of broader species assemblages and ecosystems and therefore are suitable for assessing both potential population-level effects and determining potential Project effects on overall biodiversity.

Lower trophic level communities such as plankton and benthic invertebrates were also characterized. Phytoplankton and zooplankton biomass and abundance was typically low in the sampled lakes, which is characteristic of northern oligotrophic lakes. Phytoplankton and zooplankton richness (i.e., the number of taxa present) and diversity were both moderate to high. The average density and richness of benthic invertebrates was also low and within the range typically observed for northern oligotrophic lakes, whereas diversity was moderate to high.

Fish tissue samples from northern pike and lake whitefish in flesh and bone were collected in 2018 and 2019 to be analyzed for radionuclides and trace metals for baseline characterization. Sample locations included Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, Naomi Lake, Clearwater River Nearfield, and Lloyd Lake. Currently, few guidelines exist for parameter concentrations in fish. Selenium levels measured in the flesh samples were compared to the U.S. EPA selenium criterion for fish muscle (flesh) of 11.3 ug/g dry weight (U.S. EPA 2016), which ensures protection of fish embryos. Other parameters were considered as baseline data and not compared to guidelines as none currently exist.

For northern pike, all flesh samples collected during the surveys had selenium concentrations below the 11.3 ug/g guideline (U.S. EPA 2016). For mercury, mean concentrations in flesh and bone samples from Naomi Lake, Clearwater River Nearfield, Llyod Lake Inlet and Hodge Lake were higher than other water bodies in the area and above the 0.5 ug/g recommended level by HC for safe consumption by humans. Although mean mercury concentrations in northern pike flesh from Patterson Lake was below 0.5 ug/g, two samples were above the HC recommendation.

For lake whitefish, all flesh samples collected during the surveys had selenium concentrations below the 11.3 ug/g guideline (U.S. EPA 2016). Mercury concentrations in fish flesh samples from all sampling areas were also below the 0.5 ugh/g HC recommended safe consumption level by humans (GS 2015).

The baseline characterization conducted by NexGen provides key insight into the environmental conditions that are relevant to understanding the potential effects of the Project on aquatic ecosystems. For more detailed information, please refer to the Aquatic Environment Baseline Report (Annex V.1) of the EIS.

Fish and fish habitat are protected under the federal Fisheries Act. In the Fisheries Act, “fish” is defined as fish species that occur in the area surrounding the Project and includes eggs and juvenile stages of fish. The definition of “fish habitat” in the Fisheries Act is “water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas.”

The Project has the potential to cause adverse effects on fish VCs primarily through changes in surface water quality resulting from operational discharges and long-term solute transport from the underground tailings management facility (UGTMF) and waste rock storage areas (WRSAs). In addition, the Project could affect fish and fish habitat due to direct habitat loss and disturbance associated with the development of a freshwater intake, treated effluent diffuser, treated sewage outfall, and associated pipelines in Patterson Lake. Changes to water flows and water levels resulting from site water management activities and altered surface runoff conditions also have the potential to affect fish VCs. CNSC staff concurred with the proponent’s assessment of Project activities that may interact with fish and fish habitat that could cause residual effects.

The assessment endpoint for fish and fish habitat VCs is a self-sustaining and ecologically effective fish population. Measurement indicators identified and used to evaluate changes on this endpoint for the fish VCs are habitat availability (i.e., habitat quantity and quality), habitat distribution (i.e., habitat arrangement and connectivity, habitat fragmentation), and survival and reproduction.

Mitigation measures that can be applied to the project activities to minimize potential changes and residual adverse effects are described below.

7.1.2. Proponent's Assessment

The pathway analysis performed by NexGen assessed the potential adverse effects of the Project on fish and fish habitat, identified mitigation measures, and evaluated whether these measures could effectively reduce or eliminate residual adverse impacts. Potential Primary (i.e., effects are greater than negligible and require further detailed assessment) and Secondary (i.e., mitigation reduces effects to negligible levels) effects pathways are detailed in table 7.1. An evaluation of Project-related effects on surface water quantity is presented in the EIS hydrology assessment (see EIS section 9). Potential effects with no pathway are not considered further but are described in EIS table 11.4-1.

Table 7.1. Potential effects pathways for fish and fish habitat (adapted from EIS).

Pathway		Effects Pathway	
Primary	After closure and in the far future	Changes in surface water quality from WRSAs and UGTMF after Closure	Runoff and seepage from the WRSAs and groundwater flow from the UGTMF may alter surface water quality in Patterson Lake after Closure and adversely affect fish habitat availability, survival, and reproduction
Secondary	Construction, Operations and Closure	Disturbance at river crossings	Movement of heavy equipment and infrastructure across the Clearwater River at the existing access road crossing location may adversely affect fish habitat availability, survival, and reproduction
		Altered site drainage affecting water levels and flow	Altered site drainage, runoff, and discharge may cause changes to water levels and flows and channel/bank stability in downstream waterbodies and water courses and affect fish habitat availability and distribution
		Water use affecting water levels and flows	Water supply requirements (potable and process) for the Project may cause changes to water levels and flows and channel/bank stability, which can affect fish habitat availability and distribution
		Changes to sediment transport	Changes to water flows may alter channel sediment transport conditions in the Clearwater River downstream of Patterson Lake, which can affect fish habitat availability and distribution
		Sediment release	Sediment release during in-water construction and from ground disturbance may alter fish habitat availability, survival, and reproduction in downstream waterbodies and watercourses
		Air and dust emissions affecting water quality	Air and dust emissions, including emissions of criteria air contaminants and fugitive dust, and subsequent deposition (e.g., particulate matter, metals, and radionuclides) may cause changes to surface water quality, which may adversely affect fish habitat availability, survival, and reproduction in local waterbodies and watercourses

Pathway		Effects Pathway	
		Loss or alteration of fish habitat	Physical loss or alteration of fish habitat in Patterson Lake from the Project footprint, including the freshwater intake, treated effluent diffuser, treated sewage outfall, may affect fish habitat availability
		Disturbance during in-water construction	In-water construction and related activities for the freshwater intake, treated effluent diffuser, and treated sewage outfall can cause injury or mortality to fish, including fish eggs, and disturb fish habitats in Patterson Lake, which may adversely affect fish habitat availability, survival, and reproduction
		Impingement and entrainment of fish in the freshwater intake	Impingement and entrainment of fish in the freshwater intake may cause injury or mortality to fish and affect the survival of fish
		Habitat disturbance from treated effluent diffuser	The area of water turbulence around the treated effluent diffuser may affect local fish habitat availability in Patterson Lake
		Public access affecting survival	Changes in public access to recreational fishing areas on the Clearwater River and in Patterson Lake, and increased density of people (e.g., Project staff and contractors) in the area, may affect the survival of fish
		Project activities affecting water and sediment quality and aquatic health	Project activities and discharge (e.g., treated effluent and treated sewage discharge, runoff from the Project footprint, air and dust emissions, and runoff and seepage from the WRSAs) may cause changes to water and sediment quality and adversely affect fish habitat availability, survival, and reproduction
		Nutrient changes from Project activities	Project activities and discharge (e.g., treated effluent and treated sewage discharge, runoff from the Project footprint, and air and dust emissions) may change nutrient concentrations in the aquatic receiving environment, and affect fish habitat availability, survival, and reproduction

7.1.2.1. Residual Effects Analysis

Predicted effects on fish VCs from changes to surface water quality are described for the far-future projection that considers the long-term, slow migration of hydrogeological mass load inputs from certain areas of the Project site following Closure. The approach used to characterize potential effects on fish VCs and associated measurement indicators was quantitative where possible; however, the approach was primarily qualitative. Changes in measurement indicators for fish VCs were estimated relative to the Base Case to describe the following residual effects.

Habitat availability

The residual effects assessment for fish VCs indicated limited potential for changes in habitat availability due to exposure to predicted copper concentrations in Patterson Lake North Arm – West Basin after Closure and in the far future. Changes to health of lower trophic level communities (e.g., plankton, benthic invertebrates) and forage fish (e.g., lake whitefish) due to exposure to copper could alter the available food supply for fish, and consequently the quality of available habitat for fish VCs in Patterson Lake. Zooplankton are an important food source for pelagic fish; therefore, direct toxicological effects on zooplankton could alter habitat quality for pelagic fish (e.g., lake trout and walleye). Similarly, benthic invertebrates exposed directly to potential toxicants in water or sediment are a key food supply for fish feeding on the lake bottom; therefore, direct toxicological effects on benthic invertebrates could alter habitat quality for bottom-feeding fish (e.g., lake whitefish). Forage fish, including lake whitefish, are an important food source for piscivorous fish; therefore, direct toxicological effects on forage fish could adversely affect habitat quality for upper trophic level consumers such as lake trout, walleye, and northern pike.

Potential residual effects on fish VC habitat availability are expected to be reduced in magnitude and duration following implementation of mitigation measures. In consideration of all assessment factors, the predicted effects to habitat availability are considered to be possible, meaning that the changes may occur but are not likely.

Habitat distribution

No adverse effects on habitat distribution in the LSA and RSA are predicted to occur as a result of predicted changes to surface water quality in the aquatic receiving environment after Closure and in the far future. While there is some potential that exposure to copper could result in negligible to low magnitude effects on the available food supply for fish, no change in the viability of habitats for use by fish in Patterson Lake is expected at the predicted magnitude of effect. Therefore, fish would be able to continue using the habitats present, and move between habitats, to carry out their life processes (e.g., spawning, rearing, overwintering), and no effects on habitat arrangement or the spatial distribution and movement of fish in Patterson Lake are expected to occur.

Survival and reproduction

Effects on the survival and reproduction of fish VCs could directly occur as a result of exposure to copper in the water column or indirectly due to changes in habitat availability resulting from potential effects on the lower trophic food base for fish, as described in EIS section 11.5.2.4.1. The effects associated with both mechanisms (i.e., direct exposure and changes in habitat availability) were then considered when describing the resulting residual effects on the survival and reproduction of fish VCs.

Potential residual effects on fish VC habitat availability are expected to be reduced in magnitude and duration following implementation of mitigation measures (table 7.2). In consideration of all assessment factors, the predicted effects to survival and reproduction are considered to be possible, meaning that changes in habitat availability, habitat distribution, survival and reproduction may occur but would be unlikely to be measurable. The overall incremental effects from the Project would not have a significant effect on the maintenance of self-sustaining and ecologically effective fish populations.

7.1.2.2. Mitigation Measures

NexGen has proposed measures to mitigate adverse effects on fish and fish habitat (table 7.2). CNSC staff agree with the mitigation measures proposed by NexGen.

Table 7.2: Proposed mitigation measures to address effects on fish and fish habitat

Residual Effect #1: Changes in surface water and sediment quality
• See mitigation measures in section 6.3.2.2 (Surface water and sediment)
Residual Effect #2: Disturbance to fish habitat
• Employ a crane to move heavy equipment and infrastructure across the Clearwater River only in instances where loads exceed the legal rating or capacity of the bridge and options for reducing load size/weight are not feasible or practical (e.g., dismantling equipment, breaking down a load into smaller units)
• Minimize the footprint of work areas adjacent to the Clearwater River, and associated ingress/ egress, to limit the area of disturbance. Fording of the Clearwater River, or activities that could result in a direct disturbance to the bed or banks of the river, would not occur
• To the extent practical, construct work areas to avoid critical or sensitive habitat (e.g., riparian zones) following best practices and regulatory requirements
• Design in-water components of site water management infrastructure (i.e., proposed freshwater intake, treated effluent diffuser, and treated sewage outfall) to minimize the potential for adverse effects on the aquatic environment and such that discharged flow does not interact with sediment, to the extent practical
• Where possible, schedule in-water activities to avoid work during DFO's Saskatchewan Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2013a). Restricted activity periods for fish are as follows: o fall/winter spawning fish in northern Saskatchewan with lake trout present (1 September to 15 July) o spring spawning fish in northern Saskatchewan without lake sturgeon (1 May to 15 July)

• Employ construction methods that avoid or minimize the potential to cause injury or mortality to fish or disturb nearby habitats, to the extent practical. Assemble in-water structures on shore, where practical, and float into position in Patterson Lake, and then submerged and anchored on the lake bottom
• Construct in-water developments in adherence with the conditions of any permits or authorizations that may be issued for the Project from the appropriate regulatory agencies
• Implement DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2019b) to minimize potential adverse effects on aquatic resources
• Install appropriate erosion and sediment control measures, as required. Regularly inspect erosion and sediment control measures to confirm they are functioning as planned, and perform any required maintenance, as needed
• Confirm heavy equipment (e.g., crane) used on site is properly maintained and is free of leaks o Inspect loads to be moved across the Clearwater River for leaks
• If an upgrade to the existing Clearwater River bridge is required, avoid any permanent disturbance below the high-water mark of the Clearwater River
• Implement a Project-specific EPP
• Develop and implement a Preliminary Decommissioning and Reclamation Plan to decommission and transfer the site to the province under the Institutional Control Program
• Locate proposed treated effluent diffuser away from sensitive or unique habitats, to the extent practical
• Locate the diffuser discharge ports above the lake bed to avoid or minimize erosion
• Discharge pumped contact water through an engineered diffuser to minimize effects from changes in velocity
• Develop appropriate discharge flow rates and monitor treated effluent flow to address erosion concerns
Residual Effect #3: Changes to hydrological processes and water balance
• See mitigation measures in section 6.2.2.2. (Hydrology)
Residual Effect #4: Sediment release from terrestrial environment
• See mitigation measures in section 6.4.2.1. (Terrestrial Environment)
Residual Effect #5: Air and dust emission affecting water quality
• See mitigation measures in section 6.1.2.1. (Atmospheric Environment)

Residual Effect #6: Risk of fish injury or mortality
• Locate the freshwater intake in an area and depth of water that avoids sensitive or unique fish habitats, to the extent practical
• Locate the intake screen above the bottom of the waterbody to prevent entrainment of sediment and aquatic organisms associated with the bottom area
• Design and install a fish screen on the freshwater intake in Patterson Lake to avoid or reduce entrainment or impingement of fish. Pump intake screens would be designed in accordance with DFO's Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995)
• Develop and implement a Preliminary Decommissioning and Reclamation Plan to decommission and transfer the site to the province under the Institutional Control Program
Residual Effect #7: Change in access for Indigenous and other land users
• See mitigation measures in section 7.4 (Indigenous uses)

7.1.2.3. Monitoring and Follow-up

The EPP, EMP, Effluent and Emissions Plan, and related monitoring activities will be implemented to verify the accuracy of predicted effects, assess the effectiveness of mitigation measures in protecting aquatic environments, identify any unexpected impacts, and apply adaptive management strategies as needed.

Monitoring and follow-up programs are proposed by NexGen for the fish and fish habitat to verify the accuracy of the predicted effects and effectiveness of proposed mitigation measures. Monitoring program measures proposed to specifically address residual effects related to fish and fish habitat are in table 7.3. CNSC staff agree with the follow up measures proposed by NexGen.

Table 7.3: Follow-up program measures for effects on fish and fish habitat.

Residual Effect #2: Disturbance to fish habitat Residual Effect #6: Risk of fish injury or mortality
• Monitor for changes to fish and fish habitat, including lower trophic level community conditions (e.g., benthic invertebrates), in the receiving environment as a result of Project activities • Verify the predictions of the EIS and confirm that the aquatic ecosystem in the receiving environment is protected. • Evaluate the effectiveness of mitigation measures and modify or enhance as necessary through monitoring and developing updated mitigation, if needed. • Identify unanticipated negative effects, estimate spatial extent of effects, and support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects. • If applicable, monitor and evaluate the success of any fish habitat offsetting measures constructed for the Project.

- Contribute to the overall continual improvement of the Project

7.1.3. Other Views Expressed

7.1.3.1. Indigenous Nations and Communities

Fish and Fish Habitat

CRDN had previously indicated they had overarching concerns regarding exploration and mining activities taking place at Goráchághı tu [Patterson/Forrest Lake] and they were concerned about the potential contamination of the entire Des Nëtthḗ [Clearwater River]. CRDN previously indicated that harvesters had noted changes to water quality since exploratory drilling on Goráchághı tu have taken place. In addition, CRDN harvesters had expressed doubt that radioactive and drilling contaminants will not impact Goráchághı tu and downstream environments. NexGen noted that changes to the availability and quality of fish for harvesting were assessed in the EA pathway analyses and has committed mitigation measures including Project-specific Effluent and Emissions Plan and EMP, installing effluent and sewage treatment plants, and avoiding critical or sensitive habitat to the extent practical during construction. NexGen has established an Environmental Committee to monitor environmental performance of the Project and will provide funding for full-time independent Indigenous monitors to address concerns and minimize adverse impacts to surface water quality.

CRDN had also noted their concerns that operations from the Project may adversely impact fish and fish habitat which may impact the quantity and quality of fish available for harvesting. NexGen noted that such impacts were assessed using access to the area available for land and resource use and availability of fish and wildlife for harvesting as measurement indicators. NexGen committed to mitigation measures including Project-specific Effluent and Emissions Plan and EMP, installing effluent and sewage treatment plants, and avoiding critical or sensitive habitat to the extent practical during construction.

MN-S had previously identified concerns with how NexGen was selecting COPCs for their environmental risk assessment. MN-S had indicated that it was unclear if COPCs that exceeded water quality objectives at end-of-pipe treatment, but met water quality objectives in the mixing zone were excluded from further assessment. MN-S had made it clear that using dilution in surface water as part of their ecological risk assessment was not best practice. MN-S had also previously expressed concern that NexGen was relying on design criteria and road access management controls to mitigate any release of uranium or other COPCs from an accident near surface water bodies such as the Clearwater River. Noting that NexGen makes no mention of aquatic invasive species, MN-S had asked how NexGen will monitor aquatic environments until decommissioning and asked NexGen to detail its EMP for aquatic species. NexGen confirmed that end-of-pipe concentrations of COPCs are predicted to be higher than the chronic Project threshold, but below acute toxicity levels for fish and has committed to developing a comprehensive monitoring plan including surface water quality. As acutely toxic COPCs would not be released to the environment, NexGen has maintained that their assessment, including the use of dilution, is appropriate. NexGen noted that to address increased road use and mitigate the release of COPCs from an accident, upgrades to existing access roads are planned. Finally, NexGen has clarified that the invasive species management plan will be developed during licensing (licence to prepare site and construct). ECCC also recommended that the Environmental Protection Program explicitly include details related to water management and monitoring of COPCs associated with the airstrip, the west bermed runoff collection area, and explosives storage area.

MN-S had also previously noted that given Burbot's unique physiology, use of habitat and feeding habits that they should have been selected as a fish species VC to more fully assess baseline information and knowledge gaps for the EIS. MN-S identified that using one forage fish species may be inadequate to assume how other forage species may retain COPCs. NexGen has maintained that the selective VCs are representative of burbot physiology, habitat, and feeding habits, however NexGen is open to discussions regarding future monitoring activities. NexGen completed an aquatic health assessment to evaluate the potential magnitude of effects on sensitive aquatic species, which showed that potential health effects on other forage fish species (namely, burbot) would be minimal and within the range of variability observed in unexposed populations. MN-S also requested more information regarding effluent release and how mixing zones and temperature changes in water may attract fish and affect refuge type habitat and use. NexGen committed to capturing and storing treated effluent at ambient temperatures prior to release to Patterson Lake such that it is not expected to result in changes to water temperatures or volumes that would affect fish. MN-S also noted concerns that the ERA identified benthic invertebrates as the most sensitive endpoints for copper exposure in Patterson lake's north arm. NexGen has noted that the predicted effects would be within the resilience and adaptability limit of VCs and therefore the Project is not predicted to have significant adverse effects.

BNDN recommended that that small-bodied fish be included in the assessment of fish and fish habitat as small-bodied fish account for unique ecological niches and roles in aquatic ecosystems. In addition, BNDN noted concerns regarding potential adverse impacts to fish and fish habitat from various Project operations. NexGen has noted that the inclusion of a small-bodied fish is unwarranted, as they are represented in the assessment of lake whitefish, but their inclusion will be considered as a sentinel species for environmental monitoring should an Environmental Effects Monitoring fish population study be triggered. NexGen has committed to multiple environmental protection and monitoring measures to minimize impacts to fish and fish habitat.

BRDN, had previously indicated that their members were concerned about potential Project impacts on water quality and how this may adversely impact fish and fish habitat. NexGen confirmed that Fish habitat availability, habitat distribution, and survival and reproduction were all measurement indicators in the EA and effects on fish and fish habitat as a result of changes to water quality were assessed.

YNLR noted their members are very concerned about the potential for impacts to surface water quality that may arise from the Project. This includes concerns that surface water quality may be impaired and raised concerns about the long-term ecological health of Patterson Lake. YNLR requested that NexGen add oligotrophic species (longnose and white suckers) to the list of VCs, given their historical, cultural, and ecological significance. NexGen has acknowledged the importance of surface water quality to YNLR and has committed to developing an EPP containing several mitigation and monitoring plans and utilizing adaptive management to provide a structured and flexible approach to maintaining water quality. NexGen noted that detailed scoping and development of an EMP, including the decision to add oligotrophic species, would occur during licensing (licence to prepare site and construct) and monitoring mechanisms would be established through the Environmental Committee with primary Indigenous Nations and communities.

YNLR indicated their concerns that development of the Project would lead to increased harvesting pressures to area fish populations and that harvesting pressures to fish were not assessed as a result of increased access and use to reach a significance determination with respect to the fish and fish habitat valued component (VC). In addition, YNLR noted that species of cultural significance were not identified as a VC. NexGen noted that the effects of the increased density of people near the project were considered across various assessments, and that the selected VCs represent important ecosystem processes that occupy similar niches, ecological spaces, and functional roles as the omitted culturally significant species. Furthermore, NexGen completed an aquatic health assessment to evaluate the potential magnitude of effects on sensitive aquatic species, which showed that potential health effects burbot would be minimal and within the range of variability observed in unexposed populations.

ACFN requested clarification if climate change induced effects on surface water temperature were assessed for the residual and cumulative impacts for the project.

7.1.3.2. Federal Authorities

ECCC requested additional information on how climate change was considered, particularly how projected changes in extreme precipitation were considered, the range of climate change projections used to assess risk levels, and how climate change was considered in the design of water management infrastructure. ECCC noted that the proponent must design infrastructure above a 100-year storm or there is a potential risk that their water management infrastructure will be overwhelmed in an extreme storm event and release mine contact water. NexGen has committed to design cross-drainage structures to provide a conveyance for the maximum instantaneous flow resulting from a 1:100-year 24-hour storm event. NexGen also committed to developing a Climate Action Framework focused on climate resilience, to monitoring and considering climate risk on surface water management structures, monitoring greenhouse gas emissions during all project phases, and implementing a net-zero framework.

ECCC requested additional information on contingency planning concerning tailings storage and management before underground spaces were ready to receive backfill as they posed a potential risk to aquatic biota. In response, NexGen provided information on where tailings will be directly pumped to the paste plant for processing before being directly pumped to the mined-out underground, and clarified how tailings will be managed to prevent the movement of contaminants. NexGen also provided clarification regarding how tailings will be managed or stored if there are any issues with the UGTMF, paste delivery system, or paste plant and confirmed that processing may need to be halted if tailings cannot be deposited into the UGTMF.

NexGen also confirmed that an additional storage contingency system or management plan will be devised in the event there are any issues with depositing tailings into the UGTMF.

ECCC recommended that NexGen provide more details on their selenium bioaccumulation modelling methodology in the updated ERA during licensing (licence to prepare site and construct). NexGen provided more details on their selenium bioaccumulation modelling methodology in the updated Final EIS.

ECCC also raised concerns regarding potential risk for residual effects to aquatic life due to the proponent using the outdated Federal Environmental Quality Guideline (FEQG) formula for iron**.** ECCC recommended that NexGen re-calculate iron FEQG based on the latest guidance to determine if baseline exceedances are present. If baseline exceedances occur, then iron should be included in the exposure assessment of the ERA and sediment quality modelling for the sediment quality assessment. After re-calculation, NexGen should also update mitigation and monitoring plans accordingly. In response to this concern, NexGen updated the iron FEQG calculations and submitted as part of their revised final EIS. No further work was required based on the updated guideline.

ECCC recommended NexGen provide an updated monitoring well location plan, as without adequate placement there is the potential for residual effects to fish and fish habitat via contaminant seepage/migration into Patterson Lake. ECCC noted that there is a very limited number of monitoring wells located between the potentially acid generating (PAG) area and Patterson Lake and suggested planning for additional monitoring wells between the PAG area and Patterson Lake (regardless of the use of a liner for the PAG Area). ECCC also recommended the ongoing testing of waste rock to inform potential mitigations to water quality from PAG material. For the non-PAG area, ECCC recommends including monitoring wells for the south side of the operations. ECCC recommended that the development of a detailed commitment to address the issues prior to commencing any work/activities at the project site will be key mitigation and follow-up measures. NexGen has committed to monitoring groundwater quantity and quality, including background wells located upgradient from the project. The EMP will include sampling groundwater quality to detect potential COPCs and groundwater monitoring targets would be established under the plan to monitor the effects of dewatering during construction and development, seepage from WRSAs, process and mine terrace areas, and area of effluent treatment ponds. NexGen has noted that the current monitoring and follow-up plan is conceptual and shows the minimum level of monitoring anticipated for water quality and groundwater monitoring locations, and details will be finalized in the Effluent and Emissions Plan and EMP.

DFO also noted that predicted impacts to fish and fish habitat include habitat loss due to the development of the freshwater intake, treated effluent diffuser, sewage outfall and associated pipelines in Patterson Lake. DFO noted that the proponent should review DFO's Projects Near Water website to ensure they comply with the *Fisheries Act* and that a request for review to DFO should be submitted for the impacts described, or any other impacts on fish and fish habitat that cannot be avoided or mitigated. NexGen has made commitments to adhere to guidance from regulators, such as DFO, as to the allowable rate and timing of water withdrawals from the point of supply, and to locate the treated effluent diffuser away from sensitive or unique habitats to the extent practical.

DFO requested that the proponent update their blasting assessment to reflect a 50kPa maximum overpressure threshold for impacts to fish. NexGen predicted that the peak pressure levels will be below the 50kPa threshold and therefore will not result in a residual impact to fish.

DFO requested NexGen clarify if there were wetlands within the study area that could be fish habitat. NexGen responded that riparian wetlands were considered in the assessment of impacts, and they predicted no impacts. However, ECCC has identified potential risk to wetlands from the Project. This is due to inadequate wetland baseline data, a lack of information on wetlands in the hydrological assessment, and lack of water quality and sediment quality baseline data. ECCC recommends that the Proponent commits to multi-year, multi-season baseline data collection for wetlands to assess potential effects to hydrology (i.e., flow rates, water levels), wetland habitat availability, and terrestrial and aquatic receptors. ECCC also recommends conducting a comparative analysis between relevant wetlands in the study area and Patterson Lake to confirm water quality data to confirm Patterson Lake samples are an appropriate substitute. ECCC recommends that prior to commencing any work or activities at the Project site, NexGen provides additional analysis based on conclusions derived from this additional data. NexGen has committed to a follow-up program that includes sampling water levels, water quality, sediment quality, and monitoring wetlands within and next to the Project footprint and representative wetlands within the LSA.

7.1.4. CNSC Staff’s Analysis

The predicted effects on fish habitat availability and survival and reproduction are expected to be negligible to low in magnitude and likely not distinguishable from natural background variability. Exposure of aquatic biota to maximum copper concentrations would be limited spatially to the North Arm – West Basin of Patterson Lake and temporally limited to dry climate years when there is a lower natural runoff to the lake. The predicted effects are considered possible, meaning that the changes may occur but are not likely permanent in duration and are irreversible. The effects of the Patterson Lake South Property on surface water quality during the far future are not expected to result in any changes to these effects predictions for fish VCs.

7.1.5. CNSC Staff’s Findings and Recommendations

Taking into account the implementation of mitigation measures and recommended follow-up program measures, as well as input received from Indigenous Nations and communities, CNSC staff conclude that the Project is not likely to cause significant adverse effects on the fish and fish habitat valued components.

7.2. Terrestrial Biota

7.2.1. Description of the environment for terrestrial biota and species at risk

The assessment of wildlife and wildlife habitat used the same spatial boundaries as vegetation, which consists of a local study area (LSA) of 2,832 ha and a regional study area (RSA) of 107,491 ha, except for woodland caribou which included an additional spatial boundary based on caribou home range of 43,521 ha, and SK2 West Caribou Administration Unit (SK2 West) of 48,287 km^2. Temporal boundaries considered in this assessment were based on a 43-year period from initial construction to the end of decommissioning and reclamation (closure) and included the following project phases: construction (4 years), operations (24 years), and decommissioning and reclamation (closure) (15 years). The assessment of potential effects on wildlife and their habitat was also informed by other assessments such as those for vegetation, terrain, soils, hydrogeology, hydrology, surface water quality, sediment quality, air quality, and noise. These topics have been covered elsewhere.

Eleven wildlife species and their habitat were selected as valued components (VCs) in this Environmental Assessment (EA): woodland caribou, moose, grey wolf, black bear, beaver, little brown myotis, olive-sided flycatcher, rusty blackbird, common goldeneye, mallard, and Canadian toad. The selection of VCs was based on factors such as but not limited to their potential interaction with the project, sensitivity of the VCs, conservation status, and feedback from Indigenous Nations and communities. Certain species listed under SARA species that were not selected as VCs were assessed using surrogate species using similar habitat or niche in the project area.

Some of the wildlife VCs selected for assessment represented conservation values that extend beyond the species itself, functioning as an indicator, umbrella, or keystone species, which are highly interactive and have a large influence on the ecosystem. Woodland caribou, for example, may act as an umbrella species and improve conservation prospects for other wildlife inhabiting the boreal forest, such as but not limited to insects, birds, and small mammals. Also, this species has a large home range and specific habitat requirements that can serve as surrogates for the conservation of co-occurring species. Similarly, conservation of predators such as grey wolf can have substantial benefits to other biodiversity elements where predators act as keystone species. Keystone species are species whose addition to or loss from an ecosystem leads to major changes in at least one other species. Highly interactive species such as moose represent key food resources for humans, predators, and scavengers in the boreal ecosystem, and can have strong influences on the dynamics and persistence of caribou populations. The EIS has adequately considered these aspects in the assessment.

Identification of wildlife VCs included federally and provincially listed species at risk (SARA) that have a potential to interact with the project. Four federally listed species at risk were selected as VCs for the assessment: woodland caribou, little brown myotis, olive-sided flycatcher, and rusty blackbird. Seven other federally listed species under the SARA with a potential to occur in the LSA were not selected as VCs because they are represented by other species or ecosystems: northern myotis, common nighthawk, barn swallow, Ashton cuckoo bumble bee, yellow-banded bumble bee, transverse lady beetle, and nine-spotted lady beetle. A screening level assessment was completed for conformance with the *Species at Risk Act*. Not all provincially listed species were represented as VCs because they were deemed to be affected by the project to the same degree or were represented by other species.

Baseline surveys conducted in 2018 and 2019 showed that woodland caribou were observed at four locations, most frequently in open bog and black spruce/Labrador tea/feathermoss habitat. A herd of approximately 150 to 200 caribou was reported in March 2020 by the Clearwater River Dene Nation (CRDN) between Lloyd Lake and Preston Lake in the project area.

Similarly, moose baseline surveys showed that this species was present in a variety of habitat types during winter and summer, including along roads and other anthropogenic features.

Baseline studies confirmed that the grey wolves and black bears were detected using roads and trails in the RSA. Surveys also detected beaver and beaver sign along shorelines of waterbodies in the LSA and RSA, including runs and feeding marks, active, and inactive lodges as well as beaver dams at two waterbodies near the project site.

Little brown myotis is an endangered bat species VC under Schedule 1 of the federal SARA due to large population declines caused by white nose syndrome (fungal infection). Critical habitat for this species has been partially identified for hibernacula in some parts of Canada and it was assumed that the likelihood of hibernacula near the project area was low. Nevertheless, suitable potential roosting habitat was identified and mapped through baseline surveys completed between late May and early October 2018, and again between early May and late September 2020. Several other bat species such as the Eastern red bat and Northern myotis were also detected.

Breeding bird surveys of bird species VCs such as the olive-sided flycatcher, rusty blackbird, common goldeneye, and mallard, were detected throughout the LSA and surrounding area around Patterson Lake. The population of these species are assumed to be stable based on the availability of suitable nesting habitat in the project area (LSA and RSA).

Canadian toads were detected in several different ecosite / vegetation cover types in the LSA, including open water, late-stage regenerated upland and wetland, shrubby bogs and fens.

7.2.2. Proponent’s Assessment

With respect to the impacts on these wildlife VCs, several project-related activities would interact and potentially impact them in a variety of ways discussed below. The key measurement indicators used were habitat availability (quantity and quality), habitat distribution (arrangement and connectivity), and wildlife survival and reproduction.

Residual Effects Analysis

A summary of potential effects pathways and proposed mitigation measures for wildlife and wildlife habitat are summarized in table 7.4.

Table 7.4: Summary of potential effects pathways and proposed mitigation measures for wildlife and wildlife habitat

Project component/activity	Effects pathway	Environmental design features and mitigation measures
All project phases (composite)		
Land clearing, site preparation, and construction of facilities and infrastructure. Process plant. Operations, mining and ore processing. Roads, airstrip, camp, maintenance shop and offices. Handling and storage of waste rock, special waste rock, and ore. Sewage treatment plant and water storage and effluent monitoring ponds. Transportation of personnel to and from the site. Removal of infrastructure. Reclamation and revegetation of facilities and infrastructure.	Habitat loss: direct removal or alteration of soil and vegetation could impact wildlife abundance and distribution.	Avoiding wetlands when constructing site access road through realignment. Limit project footprint to the extent possible through optimization of site layout/design. Minimize areas of vegetation clearing and soil disturbance. Optimize use of clearing equipment to minimize surface disturbance, soil compaction, and loss of topsoil. To the extent possible, work in sensitive areas (i.e. erosive soils, wetland features, and fish habitats) would be scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation (e.g., spring freshet). Implement progressive reclamation and revegetation of disturbed areas. Develop a Caribou Mitigation and Offsetting Plan (CMOP) in collaboration with indigenous communities and government agencies. Develop and implement a project-specific EPP, including restricted activity periods to limit impacts on denning animals and migratory bird nesting sites. If bats or birds are observed nesting, roosting, or hibernating, then do not disturb them to the extent possible, and contact authorities for guidance on safe removal or relocation.
	Habitat alteration: alteration of final terrain and soil conditions, and/or composition of plant species (including invasive species) which could alter the ecosystem and adversely affect wildlife habitat availability, distribution, survival and reproduction.	Minimize areas of vegetation clearing and soil disturbance. Minimize steepness and length of slopes of disturbed areas and stockpiled soils. Contouring of disturbed areas to minimize erosion, re-establish drainage, encourage vegetation growth, and blend with the surrounding natural topography. In sensitive areas, avoid work during periods of high flow volumes which can cause erosion/sedimentation (e.g. spring freshet). Implement progressive reclamation and revegetation of disturbed areas.

		Develop a caribou mitigation and offsetting plan in collaboration with indigenous communities and government agencies. Use native species or non-aggressive / non-invasive species for revegetation. Adhere to the Federal Policy on Wetland Conservation (i.e. no net loss of wetland functions). Implement an EPP and actions to avoid and limit invasive plant species.
	Sensory disturbance: Sensory disturbance such as bit not limited to the presence of people, air traffic, lighting, dust, smells, and noise can alter wildlife movement and behaviour, and adversely affect wildlife habitat availability, abundance and distribution.	Enclose and dampen equipment in process buildings, where feasible. Use and maintain noise suppression (e.g. mufflers) on vehicles. Maintain overflight altitudes of >300 m above ground level to the extent practicable. Limit idling of vehicles and equipment. Limit light pollution, using downward orientation or shielded fixtures and use of amber light (spectrum >500 nm), and limit blue spectral light, and avoid white lighting, to the extent feasible Apply activity restriction guidelines for sensitive species.
	Injury and mortality from clearing: Vegetation removal and grubbing during site preparation and construction may result in injury or mortality to individual wildlife with low mobility (e.g. denning black bears or marten), and destruction of nests, eggs or individuals of migratory birds (incidental take).	Avoiding wetlands when constructing site access road through realignment. Limit project footprint to the extent possible through optimization of site layout/design. Apply activity restriction guidelines for sensitive species. If vegetation removal is required during the black bear denning/hibernation periods, conduct bear den presence/absence surveys and wildlife tree surveys prior to clearing activities. Implement restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods. Minimize habitat creation and human-wildlife interactions through design e.g. screening vents and preventing potential entry into rafters/attics.
	Increased predator access: Increased access for predators (wolf and black bear) and prey may increase predator risk and decrease survival and reproduction for caribou and moose.	Use existing road infrastructure, including existing road and bridge. Progressive reclamation and revegetation of disturbed areas.

	Air emissions: Fugitive dust emissions and associated constituents such as metals and radionuclides may cause changes in air, soil, and water quality, and result in inhalation and/or ingestion (food sources) exposure, which can adversely affect wildlife health, survival and reproduction.	Apply water and/or suppressants to site roads, access road, and airstrip, as necessary. Limit vehicle speed on unpaved site roads. Implement progressive reclamation and revegetation of disturbed areas. Implement a project-specific effluent and emissions plan.
	Soil contamination from emissions: Deposition of suspended solids in criteria air contaminant emissions (i.e. acid inputs) may change soil quality and vegetation and impact wildlife habitat availability and distribution.	Use and maintain emissions control devices on combustion-based equipment. Conduct regular equipment maintenance. Limit idling of vehicles and equipment to the extent practical. Use liquified natural gas for power generation. Implement project-specific EMP that includes ambient air, water quality, and aquatic organisms, and applying adaptive management, if necessary.
	Treated effluent discharge: Release of treated effluent into Patterson Lake may cause changes to surface water and sediment quality and adversely affect wildlife health, survival, and reproduction through contact and ingestion of water, and aquatic food sources.	Install and operate an effluent treatment plant (ETP) to reduce release of COPCs (major ions, metals and radionuclides) to the environment and discharge treated effluent to Patterson Lake. Locate the effluent diffuser away from sensitive and unique habitats to the extent practical. Design the effluent diffuser to provide effective mixing and dilution of the effluent in order to limit the area of the receiving environment affected by mine discharge. Design the effluent diffuser/outfall such that the discharged flow does not interact with the sediment. Treat ore processing water, and monitor/treat site contact water, if necessary. Monitor treated effluent flow and quality.
	Surface water quality from runoff: Changes in surface water quality from contact with surface facilities and infrastructure could adversely affect wildlife health, survival, and	Implement progressive reclamation and revegetation of disturbed areas. Implement mine waste management plan. Implement EMP.

	reproduction through ingestion of water and food sources.	
	Water quality from waste rock storage areas (WRSAs) and underground tailings management facility (UGTMF): Runoff and seepage from WRSAs and groundwater flow from UGTMF may alter surface water quality in Patterson Lake and adversely affect wildlife health, survival and reproduction.	Use engineered cemented paste backfill and tailings to control source concentrations. Apply binder to reduce permeability in backfill and tailings. Implement source control through engineered layers, and installation of a liner for the PAG WRSA. Install engineered cover system on potentially acid-generating (PAG) and non-potentially acid-generating (NPAG) waste rock piles during reclamation.
	Surface flow changes: Changes in surface water levels, flows, and drainage areas could affect soils and vegetation, and wildlife habitat availability and distribution.	Limit project footprint to the extent practical using practices such as but not limited to optimizing use of cleared areas, using existing road infrastructure and designing efficient infrastructure footprint (e.g. building clustered together). Avoid placing soil stockpiles near waterbodies (maintain 150 m buffer) unless required for temporary storage. Minimize areas of vegetation clearing and soil disturbance. Minimize steepness and length of slopes of disturbed areas and stockpiled soils and use erosion control measures where needed. Routine inspection and maintenance of water containment and conveyance structures.
	Physical barriers: Surface pipelines and snowbanks on site roads and the access road could decrease habitat connectivity and adversely affect animal distribution.	Design above-ground infrastructure so that the need for wildlife crossing structures is minimized, such as small to moderate diameter pipeline conveyance systems directly along the ground and/or small ditches. Snow clearing along access road to incorporate road pull-outs at regular intervals to provide refuge for wildlife. Progressive reclamation and revegetation.
	Power line injury/mortality: Electrocution by or collisions with power lines may cause injury or death to birds.	Design power lines to meet avian-safe standards in compliance with applicable laws, regulations and permits to prevent electrocutions such as but not limited to cover jumper wires, conductors, and equipment, discourage perching and prevent collisions through use of markers to enhance visibility of lines in movement corridors and staging areas.

	Vehicle collisions: Collisions with vehicles, buildings, equipment, and aircraft on site, and vehicles travelling to and from site may cause injury or mortality to wildlife.	Implement project-specific EPP, including: Providing wildlife with right of way, Advising staff, contractors, and visitors to take all reasonable precautions to avoid wildlife collisions, Identifying wildlife use areas and movement corridors/crossings along access road, and using signage in high wildlife areas, Maintaining gaps in road berms and snowbanks to facilitate wildlife crossing and escape routes, Stopping and reporting when wildlife is observed on or adjacent to the road, Reporting any wildlife collisions, Adjusting speed limit in accordance with road conditions, including wildlife use of road.
	Wildlife attractants: Wildlife could be attracted to the project site due to potential attractants such as but not limited to food waste, sewage, dust suppressants, explosive powder, runoff ponds which may increase human-wildlife interactions and change in predator-prey relationships, which can affect wildlife survival and reproduction.	Implement project-specific EPP, including: Prohibition against feeding wildlife, On-site ponds would be fenced or fit with animal egress matting or ramps, Measures to deter wildlife such as the use of noise cannons or bangers, Collect domestic and industrial wastes and store in wildlife-proof containers, incinerate on site, or transport off-site for recycling or disposal at licensed disposal facility, Minimize habitat creation and human-wildlife interactions.
	Exposure to contaminated water: Direct contact or ingestion of water from water storage and/or treated effluent monitoring ponds can cause adverse effects on wildlife health, survival and reproduction.	Conduct wildlife patrols during water bird nesting periods (late April to mid-August), and the northern and southern migration periods to monitor effectiveness of deterrents and apply adaptive management as necessary. Implement progressive reclamation and revegetation of disturbed areas. Implement project-specific effluent and emissions plan and project-specific EMP.
	Atmospheric emissions affecting habitat: Radiological and non-radiological emissions may change soil quality and vegetation	Implement project-specific EMP that includes ambient air monitoring and adaptive management based on ambient air quality standards.

	ecosystems and affect wildlife habitat availability and distribution.	
	Changes to groundwater quality from seepage: Runoff and seepage from the WRSAs may cause changes in groundwater quality and transfer up the food chain, adversely affecting wildlife health, survival and reproduction. Changes to soil quality from seepage: Runoff and seepage from the WRSAs can change soil quality and affect vegetation, which can affect wildlife habitat availability and distribution.	Segregate PAG material from NPAG material and store them separately. Implement source control (i.e. construction using engineered layers) and installation of liner for PAG WRSA. Install engineered cover system on PAG and NPAG material. Engineered containment and conveyance of PAG waste rock runoff and seepage to PAG runoff collection area. Implement project-specific mine waste management plan. Implement site water management procedures under an EPP.
	Harm from use of dust suppressants: Ingestion of chemical dust suppressants may adversely affect the health, survival, and reproduction of wildlife.	Use water as dust suppressant to the extent practical. Apply water and/or chemical suppressants to site roads, access road, and airstrip, as necessary. Use chemical suppressants that minimize risk to the environment. Implement project-specific EPP with processes for dust suppression.
	Harm from altered ice conditions: Treated water discharged through the diffuser may change the timing and thickness of ice formation and timing of ice thaw, which can increase risk of some wildlife breaking through the ice and affect survival and reproduction.	Develop the final effluent treatment plant diffuser design such that it would avoid effects on ice cover.

It is noted that most, but not all, environmental design features and mitigation measures discussed in table 7.4 would likely minimize impacts on wildlife and wildlife habitat. Some impacts, however, such as those on caribou, wetlands and birds are expected to remain and have been carried forward as residual effects summarized in table 7.5.

Table 7.5: Summary of residual effects of the project on wildlife and wildlife habitat

Residual effect # 1	*Woodland caribou habitat loss*: The habitat area lost as a result of the project is in a habitat range that already does not meet threshold of a minimum 65% undisturbed habitat necessary to support a self-sustaining population of this species.
	Woodland caribou habitat alteration: Alteration of terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape, and adversely affect woodland caribou habitat availability and distribution, and survival and reproduction.
	Woodland caribou sensory disturbance: Sensory disturbance resulting from the presence of people, lights, dust, smells, and noise can alter woodland caribou movement and behaviour, and adversely affect caribou habitat availability and caribou abundance and distribution.
Residual effect # 2	*Loss of wetlands*: Removal of wetlands in the project study area and reduction in function of wetlands in the local study area could impact wildlife, their survival, and reproduction.
Residual effect # 3	*Sensory disturbance for migratory birds*: Noise, light and human disturbance is predicted to have little effect on migratory birds or unique migratory bird habitats.

Effects on biodiversity was evaluated based on the assessment completed for the wildlife VCs, several of which were selected because they are ecological indicators of broader species assemblages and ecosystems. The effects on little brown myotis, for example, are representative of effects on late successional stage forests that support many wildlife species and high levels of biodiversity. Wildlife biodiversity is strongly linked to the extent, connectivity, and fragmentation of ecosystems in the landscape. This includes vegetation biodiversity at all levels of organization, from genes to landscapes, and ecological processes through which these levels are connected in the RSA. It is anticipated that the project and the foreseeable Patterson Lake South project will remove 2,318 ha (3.1 %) of upland vegetation in the RSA and many of these changes are predicted to occur within burned ecological areas with structural diversity and relatively high species richness for both vegetation and wildlife species.

Loss of wetland ecosystems, excluding open water, is predicted to be 55.7 ha (0.4 % of RSA), which may disproportionately affect biodiversity even though this loss is smaller as compared to the change in upland ecosystems. Therefore, this anticipated loss of wetland, however small, is considered as an adverse effect on wildlife.

NexGen concluded that the residual effects of the Project are expected to result in no significant adverse effects to terrestrial biota. More information on each project related effect and the residual effects evaluation can be found below and in the EIS sections 20, and 24.

Mitigation Measures

The mitigation measures proposed by NexGen for terrestrial biota are summarized in Table 7.4 of this report and identify key measures to reduce impacts on wildlife and wildlife habitat. For instance, NexGen has committed to siting infrastructure within previously disturbed or low-value areas to the extent possible, minimizing vegetation clearing and soil disturbance, and implementing progressive reclamation and revegetation of disturbed areas. To avoid disturbing wildlife during sensitive periods, pre-clearing surveys and activity restrictions will be applied, supported by species-specific measures for woodland caribou, bats, amphibians, and migratory birds. Other commitments include minimizing project-related noise and light through equipment design, maintenance, and light pollution controls; reducing wildlife-vehicle collisions through signage, speed limits, and road design; and adjusting air traffic operations to avoid sensitive caribou habitats where possible. Wetlands will be avoided wherever feasible, with buffer distances applied where disturbance is unavoidable. NexGen has also committed to a CMOP, no net loss of wetland function, if necessary, and species-specific measures for birds and bats, including avian-safe tower designs and protection of Common Nighthawk and Barn Swallow habitat. At decommissioning, NexGen will remove project components and implement reclamation activities to restore wildlife habitat.

CNSC staff have reviewed these measures and identified additional mitigation and follow-up requirements which are outlined in Table 7.6. For instance, a CMOP satisfying the requirements of the federal Woodland Caribou Recovery Strategy as well as the Province of Saskatchewan's offsetting framework must be approved by CNSC staff. In addition, an acceptable light pollution mitigation plan, including lighting design, must be submitted as part of CNSC licensing (licence to prepare site and construct).

Monitoring and Follow-up

To ensure mitigation is effective and adapted where necessary, NexGen has committed to an extensive monitoring and follow-up program. Monitoring will be used to verify that mitigation measures are effective, to identify any unexpected effects, and to guide adaptive management over the life of the Project. Programs will focus on both broad wildlife recovery and species-specific concerns. For example, caribou offsetting and habitat measures will be tracked to ensure they are meeting the objectives of the federal Recovery Strategy and provincial offsetting framework. Similarly, monitoring for birds, bats, and amphibians will address risks from lighting, towers, and construction activities, with results feeding into updates to mitigation plans where needed. Monitoring will also be carried through to decommissioning, with a focus on ensuring that reclaimed areas return to self-sustaining conditions that support vegetation and wildlife habitat.

Data from monitoring programs will be reviewed and reported regularly, including in the Environmental Performance Report, and will be used to adjust practices if outcomes are not being achieved.

Indigenous Knowledge and perspectives will be integrated into monitoring through Environmental and Implementation Committees, and collaborative planning. This will support Indigenous-led oversight, co-development of monitoring programs, and transparency in reporting.

Table 7.6: Proposed additional mitigation and follow-up measures to address residual effects on terrestrial biota and species at risk

Residual effect #1
• Mitigation #1: NexGen shall submit a revised Caribou Mitigation and Offsetting Plan (CMOP) that meets the federal recovery strategy for Woodland Caribou. The plan must be approved by CNSC staff.
Residual effect #2
• Mitigation #2: *If* the detailed design shows a greater potential disturbance to wetland ecosystems (regardless of the size), *then* NexGen will prepare and provide CNSC (and ECCC) a wetland mitigation and offset plan prior to any wetland disturbance, that includes a discussion on these impacts, what mitigations are to be used, how they would be implemented to reduce Project effects on species at risk and migratory birds, and how these effects would be monitored.
Residual effect #3
• Mitigation #3: NexGen shall develop an acceptable light pollution mitigation and monitoring plan, including lighting design, as part of CNSC licensing. Design of lighting should be developed taking into consideration potential impacts on migratory birds, and health and safety of workers, and security requirements, as applicable. Mitigations should be implemented year-round to accommodate winter resident migratory birds.

7.2.3. Other Views Expressed

7.2.3.1. Potential Impacts to Terrestrial Biota and Species at Risk

Indigenous Nations and Communities

CRDN had previously requested that NexGen share its invasive species management plan. The Nation had also asked how NexGen would minimize the impacts of light and noise pollution on the migration patterns of wildlife. NexGen has clarified that the invasive species management plan will be developed during licensing (licence to prepare site and construct), and detailed information on proposed mitigation methods for noise pollution can be found in Draft EIS section 7 [Air Quality, Noise, and Climate Change].

MN-S had previously questioned the data collection methods and survey results, particularly the number of nighthawks reported and methods for gauging the size of bat populations. Noting that the study area for birds is different from that of waterfowl and raptors, MN-S had underscored that this could impact the findings for different wildlife groups. NexGen clarified that the Automatic Recording Unity (ARU) data represents species occurrences for nighthawks, and high calling rates in a given area indicate the area is consistently used but cannot estimate the number of individuals. NexGen noted that the Alberta protocol for recording bat population could not be followed exactly due to logistics of the area but is confident detection methods met the requirements for baseline data collection. The Nation had expressed concerns about impacts to wildlife and connectivity and asked how NexGen will mitigate those impacts. On habitat availability and use, MN-S had previously asked whether the classification of caribou habitat is consistent with the Omnia (2018) report and, therefore, the EA and suggested that NexGen determine habitat use and availability based on seasonal or year-round use.

NexGen noted that mitigations and monitoring regarding connectivity will be developed in detail during licensing (licence to prepare site and construct) as part of the Environmental Management Plan. NexGen has confirmed that the woodland caribou classification is consistent and based on Government of Saskatchewan habitat mapping and confirmed that wildlife sampling including considerations of habitat use occurred across different habitat sites and seasons to support the development of habitat sustainability models. MN-S had also asked NexGen to explain the correlation drawn between the rusty blackbird habitat and that of the olive-sided flycatcher and its relevance to the EA, to which NexGen clarified that the implied correlation was an error and will be corrected in the final EIS. With respect to the methodology, MN-S had requested clarification on methods for the residual effects analysis and asked why the lack of available information for certain species was not addressed within baseline studies, and why more up-to-date provincial wildlife regulations were not used. MN-S had noted that there are no measurement indicators for resilience and adaptability, despite the analysis for determining residual effects being based on species' resilience and adaptability limits. MN-S emphasized that the assessment should consider both real and perceived impacts, to reflect that knowledge of the land and resource use is just as valuable as scientific data collection. NexGen clarified that Project pathways with the potential to have a greater-than-negligible impacts were carried forward to the residual effect analysis. NexGen maintained sufficient information for species were available for use in the Draft EIS and confirmed that up-to-date provincial guidelines were used and the Final EIS will be updated to include references to the more recent regulations. NexGen noted that ecological context was considered with residual effects criteria to determine significance, and changes in measurement indicators were examined in the context of trends, existing conditions, and resilience to assess cumulative effects. NexGen has maintained that perceived impacts have been considered and valued equally to scientific data collection.

BNDN underscored that it expects NexGen to exercise reasonable caution to protect highly sensitive and culturally important species to the Nation. Specifically, BNDN asked NexGen to develop a wild foods monitoring program to monitor radionuclides in culturally significant species (e.g., woodland caribou, moose, and blueberries) and other species which BNDN and other Nations identify. NexGen has initiated a Regional Traditional Foods Study with primary

Indigenous Nations and communities and has committed to discussing the inclusion of Traditional Food tissue samples with the BNDN.

Habitat loss for woodland caribou is of particular concern. BNDN emphasized that they are concerned the EIS underestimates the amount of woodland caribou habitat effectively lost due to project-related sensory disturbance and associated indirect effects, given both scientific research and BNDN knowledge. Additionally, BNDN is concerned that the Project will increase predator presence and access, public access and hunting pressure, and road mortality risk for caribou and other wildlife. BNDN asked NexGen to commit to monitoring ungulate and predator densities within the RSA, and to monitor wildlife mortality resulting from project infrastructure and operations. The Nation wants to be meaningfully involved in mitigation and offsetting plans, including but not limited to culverts for aquatic connectivity, wildlife crossings, and fencing to prevent road mortalities of the Canadian toad, as well as the installation of compensation habitat structures from tree removals, such as bat maternity roost boxes. NexGen has confirmed that a CMOP is required and has been submitted and since approved by the Saskatchewan Ministry of Environment. The Plan, which is subject to requirements under both provincial and federal approval, is predicted to make residual adverse effects to woodland caribou not significant and engagement with Indigenous Groups and regulators will continue to occur through its development. Details of monitoring plans will be developed during permitting and licensing (licence to prepare site and construct) and discussed with BNDN.

YNLR expressed concerns about the cumulative effects on woodland caribou and emphasized that it wants to be involved in any future decisions regarding woodland caribou conservation and, specifically, the development of an offset plan. YNLR emphasized that this plan must be finalized and agreed to before construction begins. YNLR noted an inaccuracy that indicates the assessment is not reflective of IK of caribou habitat and range. NexGen has confirmed that the EIS included comprehensive assessments of cumulative effects, and the CMOP will be open to Indigenous engagement and submitted prior to construction. Furthermore, NexGen has acknowledged the accuracy and has revised the Final EIS document to better align with IK. YNLR offered detailed feedback on the methodology for VC selection, noting that the method of choosing a handful of species to represent an entire ecosystem could lead to erroneous results, because each species has its own ecological niche.

YNLR supports the selection of the grey wolf, moose, common goldeneye, beaver, and Canadian toad as VCs and expressed concerns about increased pressures on these species due to road mortality, hunting, and other human-wildlife interactions. NexGen has noted that avoiding redundancy was just one of several factors for selecting appropriate VCs, and that avoiding redundancy aligns with widely accepted approach supported by regulatory guidance. NexGen has maintained that the selected VCs are appropriate. NexGen has further clarified that changes in public access to hunting areas and increased population density in the area affecting wildlife reproduction and survival was evaluated in the EA, and upgrades to road access are not expected to result in measurable change to existing hunting access, while mitigation measures (e.g. not allowing employees to hunt within the mine lease boundary) are also expected to minimize potential effects to wildlife. For YNLR, the woodland caribou is a culturally significant species and therefore should be given special consideration for the assessment, to which NexGen agrees.

YNLR questioned the selections of little brown myotis, olive-sided flycatcher, and rusty blackbird, as well as the exclusion of leopard frogs and other amphibians. NexGen noted that little brown myotis were included as VCs due to their representation of effects on late successional stage forests and northern myotis. Olive-sided flycatchers were included due to their representation of songbirds, habitat-related effects on spruce grouse, and insectivores with potential to be impacted by environmental contaminants through their ingestion of insects. And rusty blackbirds were selected due to their representation of effects on horned grebe and yellow rail, birds occupying wetlands and wet forests, and insectivores. All of which have been recorded in the RSA and are federal species at risk. Leopard frogs and other amphibians were excluded in favor of the Canadian Toad due it its confirmed presence in the RSA. YNLR is especially concerned about the introduction of invasive plant species into forest ecosystems and believes that invasive species monitoring is critical to maintaining ecological integrity. NexGen has committed to a Project-specific EPP including actions to prevent, detect, control and monitor invasive species.

YNLR noted that effects on the resident moose population would be significant, and that habitat loss in general would impact species at risk, calling into question NexGen's methodology for determining statistical significance. As such, YNLR highlighted that any wildlife habitat that is destroyed should be offset, just as fish habitat must be under federal law. NexGen noted that rationale to support the significance of Project effects can be found in Draft EIS sections 7 to 19 and maintains that information within those sections supports the determination of significance. NexGen has confirmed the goal of the project is to minimize effects to the environment such as habitat loss and mitigation plans are being developed, such as the CMOP. Ultimately, YNLR found the analyses overly optimistic and underscored the need for open, transparent, and statistically robust monitoring programs and follow-up to ensure accountability, including meaningful dialogue with Indigenous Nations. NexGen has emphasized that the company has conducted engagement with local Indigenous Nations and communities, regulatory agencies, and stakeholders, and has disagreed that conclusions are overly optimistic, citing the conservative and comprehensive approach taken to the environmental assessment.

ACFN requested that NexGen clarify which species were included in the ERA and that NexGen describe which species will be monitored and how predictions will be verified. NexGen noted that caribou, moose, grey wolf, black bear, snowshoe hare, beaver, muskrat, little brown myotis, spruce grouse, rusty blackbird, common loon, red-throated loon, and mallard were included in the ERA and that the EPP and supporting documentation will outline wildlife monitoring where required to evaluate the effectiveness of environmental protection measures and verify assessment endpoints are maintained. Impacts to fisher and marten are of interest to ACFN, as well as the mortality risk for smaller wildlife in the VC risk assessment. Project effects on fisher are represented by grey wolf and black bear, which use similar habitats, and effects on marten are represented by woodland caribou and little brown myotis. NexGen has noted that overall, no significant adverse effects were predicted for smaller wildlife VCs, and mortality risk is described in detail in various Draft EIS sections titled "Survival and Reproduction." ACFN also had suggestions for improving the Habitat Suitability Indices (HSI) for moose and questioned how NexGen will monitor habitat availability for woodland caribou. ACFN requested the NexGen quantitatively assess changes in wildlife habitat quality and quantity, identify movement corridors due to loss of habitat between Patterson and Forrest Lakes, and explain how it will assess wildlife use of reclaimed habitat in follow-up programs. In terms of mitigating impacts, the Nation requested that NexGen provide scientific evidence that strategies for mitigating fugitive dust and constituent emissions coating plant leaves will be effective, particularly for sensitive species.

Further, ACFN asked NexGen to clarify how it will assess mitigation effectiveness for smaller species which are underreported or unknown. NexGen has confirmed no modifications to the Habitat Suitability Index (HSI) are required as ACFN's suggestions were already incorporated, and the aforementioned CMOP will include monitoring. NexGen noted that changes in wildlife habitat quality and quantity assessed compared to predevelopment conditions are outside of the scope of the EA requirements, but the Base Case conditions largely reflect factors prior to development. The movement route at the narrows of Patterson Lake was the only route identified by NexGen, and the use of reclaimed habitat and effects to underreported species will be assessed in the EPP and supporting documentation. NexGen has clarified that dust deposition rates from the Project are predicted to be much less than rates shown to cause effects on plants in scientific literature and any changes would be negligible but has committed to monitoring dust deposition and other constituents to apply adaptive management if necessary.

Federal Authorities

ECCC stated that residual adverse effects of moderate magnitude, geographic extent, and duration may occur due to the use of intrusive search methods (i.e. nest searches) and the clearing of vegetation during the migratory birds breeding window. The ability to detect nests in most habitats is very low while the risk of disturbing or damaging a nest is high. If nest searches are required, ECCC recommends they are carried out by skilled and experienced observers, using appropriate methodology for activities that would take place in simple habitats, or conducted when surveying for conspicuous structures (e.g., Great Blue Heron or Bank Swallow nests, or cavity nesters) to minimize disturbance. NexGen has committed to pre-clearing wildlife sweeps being conducted by qualified professionals.

ECCC noted that residual effects of low geographic extent, moderate magnitude, and high duration (permanent) to wetlands from the project activities can occur if avoidance and mitigations do not result in No Net Loss which can result in residual effects on migratory birds. ECCC highlights the importance of key mitigation measures NexGen has committed to, particularly adhering to the *Federal Policy on Wetland Conservation* to have a No Net Loss of wetland functions tracked in the EPP and a follow-up monitoring program. ECCC also recommended that a Wetland Mitigation and Offset Plan be developed if the project is predicted to result in impacts to wetlands. ECCC emphasized the importance of the development of the five monitoring and management plans (EMP, EPP, Biodiversity Action Plan, Effluent and Emissions Plan, Decommissioning and Reclamation Plan) to mitigate effects on migratory birds and SAR. With respect to the mitigation, ECCC noted the importance of integrating the measures in table 14.4-1 in the final EIS into these monitoring and management plans.

ECCC also raised concerns that soil and bank erosion, noise or sensory disturbance, and potential surface water and sediment quality effects from the project can have residual effects on migratory birds or SAR. NexGen has committed to mitigating potential effects from soil and bank erosion by avoiding periods with high flow volumes in sensitive areas to the extent practical, design stream crossing structures to limit bank disturbance, install effective erosion and sediment control measures and keeping them in place until all disturbed ground as been stabilized, minimize duration of exposure to disturbed soils through interim re-vegetation, avoid placing soil stockpiles near waterbodies and maintaining a 150 m buffer around waterbodies/courses, and regularly inspect erosion and sediment control measures, soil stockpiles, and monitor high sedimentation areas. NexGen has committed to adaptive management as a key mitigation measure to reduce residual effects on migratory birds and SAR from noise and sensory disturbance. NexGen has also committed to a series of mitigation measures to reduce effects of water and sediment quality on migratory birds and SAR, including adding fences or animal egress matting/ramps to lined contact water ponds, conducting wildlife patrols during migratory bird nesting and migration period, applying wildlife deterrents (e.g., cannons or bangers) where needed, and regular monitoring to evaluate effectiveness of deterrents and water quality.

The project is expected to increase the mortality risk for migratory birds and species at risk (SAR) through collisions with infrastructure, buildings, vehicles, and aircraft on site. ECCC noted that if setback distances are not applied for some migratory birds and SAR, and if measures are not put in place to avoid nests, roosts, and residences, there is the potential for residual effects. NexGen has committed to key mitigation measures to reduce these residual effects. With respect to the communication tower, NexGen has committed to locating the tower away from wetlands or other high suitability habitats, minimizing guy wires and installing markers for visibility, limiting tower lighting, and following avian-safe standards to prevent electrocution. NexGen has also committed to apply activity restriction guidelines for sensitive species (e.g., timing/setback distances) established by the Government of Saskatchewan, to the extent practical, awareness training for staff, giving wildlife the right of way, identifying wildlife use areas, reporting observations, adjusting speed limits, minimizing habitat creation and wildlife interactions, training workers to prevent the spread of disease (e.g., white-nose syndrome), and not disturbing observed species (e.g., bird or bat nests, roosts, hibernation) to the extent possible. ECCC raised concerns that Common Nighthawk may nest on roadways or other disturbed areas in the project area where there is high traffic, and NexGen has only committed to avoiding nests "to the extent possible" which may result in moderate residual effects. ECCC noted that the above stated mitigation measures to avoid collisions are important for Common Nighthawk. Additionally, ECCC noted that NexGen may be required to apply for an airport permit under the *Migratory Bird Regulations, 2022* to scare migratory birds with a firearm or aircraft, or to kill and take them, if those birds are within the perimeter of the airport and considered a danger to aircraft operations.

ECCC raised concerns about the effect that light pollution has on migratory birds and SAR, including resident species that are present year-round within the project area. ECCC noted the importance of implementing mitigation measures year-round. NexGen has committed to mitigating light pollution by limiting the use of decorative lighting and solid burning or slow pulsing warning lights, orienting lights downwards or using shielded fixtures and limiting their use, using amber light instead of white light and limiting blue spectral light, and turning off lights when not in use (e.g., motion sensors), to the extent possible/feasible.

ECCC notes that residual adverse effects of moderate magnitude, moderate geographic extent, and high duration, frequency, and timing are anticipated for boreal caribou from project activities if mitigation measures, including offsetting, are insufficient or not aligned with the attainment of the objectives set by the federal amended Recovery Strategy. Given the ecological context of the project location including the critical habitat status, the habitat function and quality and the population status, the project residual adverse effects are at the lower end of high risk with respect to the survival and recovery of boreal caribou. ECCC acknowledges that NexGen has developed an offset methodology for the project to manage effects to caribou in the draft interim CMOP which outlines a goal of No Net Loss, or Net Increase, in caribou habitat with a proposed offset ratio of 9:5:1. However, ECCC indicates that the method used to calculate the effects of the project on critical habitat, which is used in the total offset calculation, underestimated the amount of destruction of critical habitat and does not align with the amended federal Recovery Strategy. Moreover, the Proponent's conversion methodology (from hectares to kilometers) likely underestimated the kilometers of restoration required to achieve the total amount of offsetting in hectares of critical habitat. Based on risk factors of the project and its specific context, ECCC advised that the ratio could be as high as 20:1 to be consistent with the federal amended Recovery Strategy. ECCC acknowledged that the CNSC will require NexGen to finalize the CMOP before commencing activity at the project site and ECCC is available to work with the Proponent on the CMOP. ECCC recommended that the CMOP includes a revised total amount of habitat to be offset to reflect the amount of critical habitat affected by the project, an analysis of which biophysical characteristics for caribou will be directly and indirectly impacted by the project, provide offsetting objectives in hectares, articulate percentage of total offset commitment dedicated to on-the-ground restoration activities, and implement a robust follow-up and monitoring program with key indicators/thresholds. Finally, the Proponent's allocated offset should be implemented through direct restoration with any research and monitoring completed as supplemental to the main restoration activities.

7.2.4. CNSC Staff's Analysis

7.2.4.1. Woodland Caribou

Alteration and/or Loss of Habitat

CNSC staff have reviewed NexGen's assessment of habitat loss and alteration for woodland caribou and concur that the Project will result in residual effects. The Project is located within the SK2 West Caribou Administration Unit, where cumulative anthropogenic disturbance already exceeds the 35% threshold for maintaining a self-sustaining population, as outlined in the federal recovery strategy. NexGen's assessment acknowledges that the Project will contribute to further habitat loss and alteration, including changes to terrain, vegetation composition, and ecosystem connectivity.

NexGen has committed to developing and implementing an updated CMOP, that is aligned with the Government of Canada's Amended Recovery Strategy for Woodland Caribou, Boreal Population, in Canada and developed in collaboration with Indigenous communities and Saskatchewan Ministry of Environment. The plan will include offsetting measures, progressive reclamation, and monitoring to ensure effectiveness. CNSC staff support this commitment and recommend it be formalized as an EA condition.

Additional mitigation measures include minimizing the Project footprint, avoiding wetlands through road realignment, and implementing progressive reclamation. These measures are considered appropriate to reduce the extent of habitat loss and alteration.

Sensory Disturbance

CNSC staff agree with NexGen's conclusion that sensory disturbances (e.g., noise, light, human presence) could affect caribou movement and behaviour. NexGen has proposed mitigation measures such as activity restrictions during sensitive periods, noise suppression, and light pollution controls. CNSC staff considers that the measures are sufficient to mitigate the identified effects. A light pollution mitigation and monitoring plan is recommended as an EA commitment.

7.2.4.2. Wetlands

CNSC staff have reviewed the predicted loss of wetlands and concur with NexGen's conclusion that while the area of wetland loss is relatively small (0.4% of the RSA), the ecological function of these habitats may be disproportionately affected. NexGen has committed to adhering to the Federal Policy on Wetland Conservation, implementing progressive reclamation, and avoiding wetlands through design.

CNSC staff recommend that if detailed design reveals greater wetland disturbance than currently predicted, NexGen should prepare a Wetland Mitigation and Offset Plan. This plan should be submitted to CNSC and ECCC for review and approval by the CNSC prior to any wetland disturbance occurring and is recommended as an EA commitment.

7.2.4.3. Migratory Birds

CNSC staff have reviewed the assessment of sensory disturbance and mortality risks to migratory birds and species at risk and found NexGen's mitigation measures to be appropriate. These include:

- Implementing restricted activity periods and pre-clearing surveys.
- Designing lighting to minimize light pollution and bird disorientation.
- Designing power lines and communication towers to be avian-safe.
- Conducting wildlife patrols during nesting periods and migratory periods.
- Avoiding and mitigating disturbance to nesting birds.

CNSC recommend that NexGen develop a light pollution mitigation and monitoring plan as part of licensing (licence to prepare site and construct) and recommend it be included in NexGen's EA commitments.

7.2.5. CNSC Staff's Findings and Recommendations

Taking into account the implementation of mitigation measures and recommended follow-up program measures for the terrestrial biota assessed in this section, as well as input received from Indigenous Nations and communities, CNSC staff conclude that the Project is not likely to cause significant adverse effects.

These findings are inclusive of terrestrial species at risk listed under Schedule 1 of SARA. CNSC staff will work with ECCC to ensure that measures taken by NexGen will be consistent with applicable recovery strategies for the identified species at risk.

In order to ensure that the aforementioned assessment conclusions remain valid, CNSC staff recommend that the Commission include EA Conditions, should it issue a licence. If accepted, NexGen will be required to address the EA Conditions EA2, and EA3 in table 12.1 related to IRs carried over from the EA Review into licensing (licence to prepare site and construct). CNSC staff's assessment conclusions are contingent on the establishment of the EA Conditions EA2 and EA3 for all listed species at risk, and particularly for Woodland Caribou.

7.3. Human Environment

7.3.1. Description of the human environment

The human health environment is well described in section 5.2. The human health assessment focused on a local study area (LSA) of 685 km2, which represents the area of the proposed Project where direct environmental effects would be most likely to occur, and a regional study area (RSA) of 1,076 km2, where cumulative effects may occur. The RSA includes the LSA and extends from headwaters of Clearwater River to the confluence of the Clearwater River and Mirror River and includes major waterbodies along its course including Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, Naomi Lake, and Lloyd Lake, as well as their contributing watersheds.

The evaluation of residual effects for both radiological and non-radiological exposures involved an environmental risk assessment (ERA) which included a human health risk assessment (HHRA) and an ecological risk assessment (EcoRA). The ERA was prepared to be compliant with the Canadian Standards Association Group (CSA) N288.6-22 *Environmental Risk Assessments at Nuclear Facilities and Uranium Mines and Mills* along with the requirements for an ERA as outlined in section 4.1 of Regulatory Document-2.9.1: *Environmental Principles, Assessments and Protection Measures*

7.3.2. Proponent's Assessment

An environmental transport and pathways model (IMPACT) was used to evaluate the effects of COPCs on the local environment including human and ecological receptors.

The human receptors selected for the HHRA included:

- camp worker (adult) at Patterson Lake camp residence
- subsistence harvesters (adult and one-year old) at Patterson Lake, Beet Lake and Lloyd Lake
- seasonal residents/lodge operators (adult and one-year-old) at Patterson Lake
- future permanent resident (adult and one-year-old) at Patterson Lake

7.3.2.1. Human Health (Public): Radiological and Non-Radiological COPCs

Radiological:

The radionuclides of the uranium-238 decay series (U-238, U-234, thorium-230 [Th-230], radium-226 [Ra-226], Pb-210, polonium-210 [Po-210]) and radon were included by NexGen as COPCs. Due to public and regulatory interest, NexGen decided to include these radionuclides for modeling without conducting a formal screening.

For human receptors mentioned above, the incremental radiation dose during all project phases was predicted to be below 1 mSv/year for the application case, the reasonable upper bound sensitivity and the reasonably foreseeable development (RFD) case.

The maximum radiation dose for the critical receptor (subsistence harvester) (1 year old) eating traditional food gathered at Paterson Lake South was predicted to be 0.1 mSv/year for both the application case and the reasonable upper bound sensitivity scenarios. The main contributor to the total dose would be from Polonium 210 in the traditional food diet.

For the far projection, the maximum dose was also estimated to be 0.1 mSv/year for a future permanent resident living at the decommissioning and reclaimed project site following closure.

If dose constraint of 0.3 mSv/year is applied, the dose to subsistence harvester (1 year old) would be less than dose constraint for the application case, the reasonable upper bound sensitivity, and the RFD case and well below the dose limit and the dose constraint.

With respect to the far-future projection (e.g., a future permanent resident living at the decommissioning, reclaimed project site following closure), would receive a dose up to 0.07 mSv/year which is well below both the dose limit and dose constraint.

For an on-site receptor, the proponent included a camp worker as part of the Human Health Risk Assessment. The incremental radiological dose to the camp worker from all radionuclides in the uranium-238 chain, including radon, is predicted to be 0.58 mSv/year for the application case, and 0.59 mSv/year for the upper bound sensitivity scenario; both of which are below the dose limit for a person who is not a nuclear energy worker (NEW) of 1 mSv/year. The primary contribution to effective dose is radon exposure. The assessment is conservative in that it assumes that the camp worker spends 100% of the time indoors.

Non-radiological

The non-radiological HHRA focused on COPCs that exceeded screening values in air and water based on predicted atmospheric and aqueous releases (i.e. treated effluent, treated sewage, site runoff, and solute releases to groundwater) from the project as well as COPCs predicted to exceed screening values in soil and sediment. Receptors, including camp worker, were assumed to consume traditional foods such as fish, game and harvested foods from within the LSA. The measurement indicators used to assess potential effects on human health included hazard quotient (HQ), which is a ratio of the predicted exposure (daily dose) to a non-carcinogenic COPC relative to the toxicity reference value (TRV), and, for carcinogenic COPC, incremental lifetime cancer risk (ILCR), which is the predicted increase in lifetime cancer risk from exposure to a carcinogenic COPC related to project activities, and represents risk above the background cancer risk.

Non-carcinogenic (toxicological) risks were evaluated using HQs for cobalt, copper, molybdenum, and uranium as measurement indicators. Project HQs were compared to an acceptable HQ value of 0.2, which was exclusive of background and consistent with HC guidance on human health preliminary quantitative risk assessment (PQRA) (Health Canada, 2021). The non-radiological HHRA, using conservative upper-bound sensitivity scenarios, concluded that releases from the project would not result in significant adverse effects on any human receptors during the lifespan of the project. All non-carcinogenic COPCs remained below the acceptable risk level (HQ) of 0.2 per exposure pathway for all receptors for the one-year-old and adult age groups.

Cancer risk, measured as ILCR, for arsenic was estimated and compared against the negligible cancer incidence level of 1 in 100,000 recommended by HC (2021). Incremental cancer risk was predicted to exceed the negligible cancer risk level of 1 in 100,000 for the relevant human receptors in the LSA just outside the project footprint, but did not exceed the negligible cancer risk within the RSA of the project. Based on a conservative assumption of high consumption of traditional foods including fish and game harvested from the project footprint and the LSA, the predicted arsenic ILCR was calculated to be 4 in 100,000. This estimate was compared to a baseline cancer risk of 69 in 100,000 for a reference subsistence harvester based on the selected regional background conditions. As such, the arsenic ILCR for this receptor from the Project was considered to be a small portion of the existing baseline cancer risks.

7.3.2.2. Human Health (Workers): Non-Radiological and Radiological COPCs

The potential radiological and non-radiological impacts of the project on the health and safety of all other workers, in particular, Nuclear Energy Workers (NEWs), during normal operations and during accidents and malfunctions, were initially excluded from the EIS. The rationale provided by the proponent was in reference to CSA N288.6-12, as NEWs are not considered in the Standard. CNSC staff noted that the CSA standard addresses environmental risk assessments for

Class I nuclear facilities and uranium mines and mills. It is agreed that the CSA standard does state the following in section 1.6 (Receptors):

> *NEWs are covered under the radiation protection program and health and safety program in place at the facility and therefore not considered in the Standard.*

However, there is currently no radiation protection program or health and safety program in place, since the Rook I Project is currently undergoing the EIS review process.

Therefore, an IR was raised, requesting the proponent assess the potential radiological and non-radiological impacts of the project on the health and safety of all persons on-site, during normal operations and during accidents and malfunctions (persons on-site in this context are NEWs and persons who are not NEWs who may incur occupational exposures).

In response to the IR, the proponent developed Appendix 15A of the EIS, which summarizes the assessment of the following for the Project:

For radiological hazards:

- radiological exposure assessment for underground workers;
- radiological exposure assessment for the process plant and paste tailings preparation workplace;
- radiological exposure assessment for the low-level radioactive waste incinerator; and
- radiological exposure assessment for accidents and malfunctions.

For non-radiological hazards:

- workplace exposure to diesel and crystalline silica dust;
- hazard analysis reports; and
- human factors engineering documentation.

Radiological hazards

Regarding NEWs, predicted doses across all phases of the Project are below CNSC's effective and equivalent dose limits.

Radiological exposure to NEWs are expected to occur in three (3) work environments: the underground workplace, the process plant and paste tailings workplace, and the low-level radioactive waste (LLRW) incinerator workplace. The radiological exposure assessments included the expected exposure pathways of inhalation of dust and radon, as well as external exposure to gamma radiation from the Uranium-238 decay chain.

Potential radiation doses of NEWs that could work in a variety of work activities associated with underground mining tasks (i.e., proposed underground development and associated mining activities) were assessed, and annual effective doses to NEWs are approximately 2 mSv to 12 mSv. Raisebore operators may receive a maximum annual effective dose of 12 mSv under steady state operations, which is below the CNSC's regulatory effective dose limit of 50 mSv in a one-year dosimetry period.

The assessment of potential radiation doses of NEWs in the process plant and paste tailings workplace determined annual effective doses to NEWs ranging from approximately 6 mSv to 13 mSv. Process operators may receive a maximum annual effective dose of 12.07 mSv (residue/paste area) and 13.18 mSv (grinding area) under steady state operations, which is below the CNSC's regulatory effective dose limit of 50 mSv in a one-year dosimetry period.

Finally, the assessment of potential radiation doses of NEWs in the LLRW incinerator workplace includes incinerator operators and maintenance staff. However, it is expected that operation of the incinerator would not occur 24 hours per day; therefore, these workers could have other duties not exclusive to the LLRW incinerator. Therefore, the proponent assessed the radiation exposure risks to an operator following an analysis of waste incinerator activities and determined that annual incremental effective doses would be very low (i.e., approximately 0.11 mSv (base case) and 0.3 mSv (sensitivity scenario)). These dose estimates are also well below the CNSC's regulatory effective dose limit of 50 mSv in a one-year dosimetry period.

Non-radiological hazards

The potential non-radiological impacts of the project on the health and safety of all workers during normal operations and during accidents and malfunctions, is included in Appendix 15A of the EIS. It is expected that worker health and safety will be required to be covered under the licensee's Occupational Health and Safety program/policy under legislation of the Province of Saskatchewan, if a licence is granted. CNSC staff will assess the proponent's proposed programs for conventional health and safety as part of the licencing process.

7.3.3. Other Views Expressed

7.3.3.1. Indigenous Nations and Communities

CRDN had previously noted that levels of stress and perceptions of stress affect health and can worsen physical and mental health outcomes. As such, CRDN had recommended that NexGen work with the Nation to establish risk thresholds for a Health Impact Assessment that will enable the identification and mitigation of perceived risks amongst community members. Additionally, CRDN had requested the inclusion of several key missing indicators for wellbeing, including mental health, functional health, and public health. The Nation also previously requested clarification on the methodology for calculating and communicating levels of risk to human health. NexGen has noted that the perception of Project effects was considered within the assessment of Indigenous land and resource use (Draft EIS section 17). NexGen has committed to engaging directly with Indigenous Nations and communities throughout the Project lifespan regarding ways to minimize perceived effects. NexGen has clarified that the indicators for wellbeing were based on likely community interactions with the Project and include both mental and physical health; therefore, NexGen is not proposing any changes to indicators used. Finally, NexGen has clarified that terms such as "low," "minor," and "negligible" levels of risk indicate that Project effects are not calculated to be harmful to human health.

MN-S had previously expressed concerns with the HHRA, including which COPCs were included, the methodology for evaluating toxicity interactions, inconsistencies with the HC policy on incremental cancer risk, and a lack of specifics on residual effects from arsenic. The

Nation had noted that the HHRA should form an integral part of any robust and holistic assessment of community wellbeing and requested that the analysis of community wellbeing be updated to that effect. NexGen has maintained that the methodology for completing the HHRA was appropriate, applying a precautionary approach, appropriate guidelines, and health-based screening for COPCs. NexGen has noted that the HHRA and effects to human health were considered in the assessment of community wellbeing. Further details on the rationale to determine Project effects can be found in Draft EIS sections 7-19.

MN-S had also sought clarification on how NexGen is defining “acceptable” levels of risk to human health and recommended that NexGen clarify the effects of radiological exposure on human health. NexGen emphasized the promotion of health, safety and well-being of people and the environment to achieve acceptable levels of risk and exposure. MN-S had also previously requested the inclusion of a detailed comparative review of health guidelines from multiple jurisdictions to guarantee the consistent application of those guidelines. NexGen has stated that no additional consideration of guidelines is required, as the guidelines used were in accordance with current science and regulatory requirements, the most restrictive of federal or provincial guidelines were used, and health-based guidelines from other jurisdictions were used when no federal or provincial guidelines were published.

BNDN identified issues with the Human Health Conceptual Model, recommending that the model include dermal contact with surface water and groundwater and account for variable conditions, such as wildfire season. NexGen clarified that dermal contact was explored as a potential exposure pathway in the HHRA. The Nation also requested further discussion of several topics, including the potential impacts of Dioxins and Furans compound (D&F) emissions, radon, and other radionuclides on human health, as well health hazards associated with molybdenum and uranium and cancers associated with airborne radionuclides and bioaccumulation. NexGen has stated that no health concerns regarding D&F were identified as no exceedances of the 24-hour Ontario Ambient Air Quality Criteria were modelled. NexGen has stated that radon and radionuclides are not required to be included in the residual effects assessment as no annual criterion are available but confirmed that they were modelled and assessed in the environmental risk assessment.

NexGen noted that the molybdenum HQ slightly exceeds 0.2 for terrestrial animal ingestion, but the total molybdenum HQ is less than 1 indicating no risk to subsistence harvesters from exposure. Regarding cancers associated with airborne radionuclides and bioaccumulation, NexGen has initiated a Regional Traditional Foods Study and committed to discussing further details of the monitoring programs to be developed during permitting and licensing (licence to prepare site and construct). For all human health exposure pathways, including sediment, BNDN also requested the quantification of exposures and associated health risks, which NexGen has completed and included with the Final EIS submission in TSD XXI. Stating that runoff can adversely affect human health, the Nation recommended that chemical concentrations exceeding guidelines in runoff be classified as COPCs as part of the environmental risk assessment. NexGen has stated that mitigation measures to minimize effects from site runoff essentially eliminated site runoff as a pathway for release of COPCs to the environment and has committed to verifying this prediction during Operations.

BNDN underscored that indicators used to assess Community Wellbeing do not adequately consider Indigenous indicators of wellbeing. NexGen has clarified that current indicators used are consistent with requirements under CEAA, 2012 and that results were presented to BNDN for feedback in December 2022 where no concerns were raised. Highlighting the differences between provincial and federal risk benchmarks, BNDN underscored that the Project presents potentially unacceptable risks when interpreted using more conservative (i.e., provincial) benchmarks, particularly when it comes to arsenic. NexGen selected the less conservative federal guideline to represent a negligible risk rather than a benchmark, and risks of cancer range from negligible to low.

BNDN has raised concerns about the concentrations of copper and cobalt in fish during the post-closure period. Predictive modelling suggests that these contaminants will be elevated in Patterson Lake during post-closure and remain elevated for hundreds or thousands of years (due to groundwater migration from the UGTMF). Despite this risk, there is no plans for monitoring concentrations of metals in fish tissues at this time. BNDN also noted that approximately 67% of tailings placed in production stopes may expose workers to radioactive and toxic material and has requested that potential health and safety impacts on workers are properly assessed, risks and mitigation strategies are documented clearly, and backfilling effects are incorporated into overall mine ventilation and safety planning. BNDN has concerns regarding the radioactivity of tailings and the release of radon gas due to cracks in CPT and long-term buildup underground, therefore they have requested modelling for radon transport and underground ventilation to mitigate risk. BNDN raised concerns that airborne contaminants are not well monitored and noted that NexGen should implement real-time air quality monitoring systems, dynamically adjust ventilation based on exposure data, and share monitoring data with safety teams. Furthermore, BNDN noted the lack of specialized training and suggested a structured training and competency assessment program tied to UGTMF milestones is implemented. Finally, BNDN is concerned that the reliance on temporary surface storage may increase exposure to dust and radionuclides, and as such contingency plans should be implemented.

NexGen confirmed that a multiple account analysis determined that the UGTMF as the lowest risk option for contaminant migration from tailings. NexGen has committed to the development of an adaptive management plan, to be provided during licensing (licence to prepare site and construct), to further mitigate effects associated with tailings storage. NexGen supports further discussion with BNDN regarding mitigation measures. Finally, NexGen has confirmed that ongoing monitoring will be addressed within the Decommissioning and Reclamation plans and noted that a surface water monitoring is part of the EPP, while independent Indigenous monitoring programs have the opportunity address further BNDN monitoring requests.

YNLR sought clarification on whether qualitative and quantitative data on human health effects from other uranium mining projects have been factored into the assessment. NexGen has confirmed that the HHRA considers data and experience from other Canadian nuclear projects.

ACFN recommended that NexGen adjust the Project lifecycle to align with outputs from predictive modeling, which indicate project-related contaminants may present risks to human health by contaminating Traditional Foods. NexGen has assessed long-term effects on human health using a far-future projection, which encompasses effects beyond Project closure. ACFN requested that NexGen demonstrate the methodology is representative of predicted risks to human health by providing a comparative analysis of the predicted risks of exposure from the project-only scenario versus the scenario which accounts for exposure to baseline conditions and project-related effects. NexGen has noted that all hazard quotients (HQs) can be compared to a benchmark value of 1 if all exposure pathways are considered. Consistent with HC guidance, a benchmark HQ value of 0.2 per medium was applied, and the total project HQ can be calculated by adding together the "Base Case" and "Incremental Project Risk" rows for each COPC in table 5-18 of section 5.4.1 of Daft EIS. The total HQs are all below 1, indicating no predicted significant adverse health impacts. Additionally, with reference to the HHRA, ACFN requested an explanation of how the air dispersion modeling study is representative of long-term exposures. ACFN also requested the inclusion of available federal human health assessment guidance documents and confirmation that these were used to conduct the HHRA. NexGen has clarified that the air dispersion modelling study, which considers a simulation from a five-year meteorological modelling period, was added to a mandated background concentration and summarized to include 1-hour, 24-hour, and annual maximum predicted values. The model employs conservative guidelines and maximum possible emission rates to capture worst-case health impacts. ACFN also requested the inclusion of available federal human health assessment guidance documents and confirmation that these were used to conduct the HHRA. NexGen has confirmed that the methods used are based on guidance provided by the CNSC (2021), the CSA Group (2010, 2020) and HC (2010, 2021)

7.3.4. CNSC Staff's Analysis

The following provides a review analysis of section 15– Human Health of the Project's EIS and the associated technical support documents (Environmental Risk Assessment – TSD XXI and Worker Dose Assessment.

A summary of some key IRs related to the review for Human Health, including HHRA for non-radiological, radiological and effects to workers are provided below.

Analysis of each potential effect on the environmental compartment or VC

CNSC staff have reviewed the proponent's assessment of potential non-radiological and radiological effects from the Project on the Human Health VC and raised a number of IRs for further clarification and justification.

Radiological

CNSC staff requested the proponent to clarify why the radiological exposures due to ingestion were modelled for certain receptor groups, namely seasonal residents and lodge operators, assuming average food consumption rates, while for the other groups (camp workers, subsistence harvester, and permanent resident) their exposure was based on the assumption of a high food consumption rate. The proponent clarified the rationale for the dietary intakes stating that the intent was to select diets that reflect different ways people may obtain Traditional Foods from the local study area (LSA) and regional study area (RSA); therefore, it was desired to have an average diet to reflect a person who would be ingesting a typical portion of Traditional Foods diet and a high diet to reflect a person who would be ingesting a higher proportion of Traditional Foods. It further explained that the establishment of the food consumption rates within the Traditional Foods diet was informed by engagement held during development of the Draft EIS with primary Indigenous Nations and communities and communities (e.g., Joint Working Groups) in 2019 and 2020, and with the CNSC, ENV, and Saskatchewan Health Authority in 2021.

In the draft HHRA, the proponent had initially compared the predicted radon exposure to a camp worker against an air concentration limit of 60 Bq/m^3, stating this was a CNSC limit. Therefore, an IR was raised, as there is no such CNSC limit. In addition, the proponent's assessment of exposure to radon progeny was not included in a total annual dose, which should be compared to the CNSC regulatory effective dose limits. The proponent subsequently revised the EIS and reported the effective dose assessment results for the camp worker from all radionuclides combined, including radon progeny, and compared to the corresponding effective dose limit for a person who is not a NEW of 1 mSv/year [12].

As discussed in section 7.3.2.2, the potential radiological and non-radiological impacts of the project on the health and safety of all other workers (in particular, NEWs) during normal operations and during accidents and malfunctions, were excluded from the draft EIS. Therefore, an IR was raised to address this deficiency. In response to the IR, the proponent included a new Appendix 15A of the EIS, which summarizes radiological and non-radiological effects on the health of NEWs and persons who are not NEWs (i.e., non-NEWs) during normal operations and through the potential occurrences of accidents and malfunctions. The proponent's responses to the IRs were accepted by CNSC staff and incorporated in the final EIS, along with revised supporting worker dose assessments.

CNSC staff also reviewed the proponent's assessment of Human health (public) in the draft EIS and TSD XXI ERA and sought clarification through a few IRs.

The raised IRs on the radiological COPCs did not identify any associated potential effects, except clarification on the monitoring follow-up.

This was to clarify in both section 15.8 of the EIS as well as in section 8.3 of the TSD XXI status of the targeted traditional food study, and how it will be used to help validate the consumption of traditional foods used in the HHRA.

For the Draft EIS section 15.8 (Monitoring, Follow-Up), NexGen provided adequate information updates on the engagement with Indigenous Nations and communities on the Regional Traditional Foods Study design. This includes the goals of beginning of the project in 2022, follow-up engagement continuing in 2023, and completion in 2024.

With respect to the information in Draft EIS TSD XXI (Environmental Risk Assessment), NexGen explained that the existing Traditional Foods diet used was based on the First Nations Food, Nutrition and Environment Study (FNFNES) (Chan et al. 2018, 2019).

Furthermore, NexGen noted that engagement completed in support of the progression of the Regional Traditional Foods Study being proactively undertaken in collaboration with Indigenous Groups will be documented in revised EIS section 2 (Indigenous, Regulatory, and Public Engagement) and revised EIS TSD I (Indigenous Engagement Report). NexGen's disposition of this IR was found to be acceptable by CNSC staff.

Non-Radiological

With respect to the non-radiological IRs and their associated potential effects several IRs were raised by CNSC staff and dispositioned by NexGen.

CNSC staff requested NexGen to clarify the selection of "infants" and "toddler" receptors which were grouped together with one-year-old receptors. NexGen confirmed that they have appropriately considered the infant and toddler age groups of human receptors in accordance with the federal guidance. There are also differences in how infants, as an age class, are classified in the CSA N288.1-20 (CSA 2020) and HC (2021), and this HHRA used a harmonized age class to assess the same receptors for both radiological and non-radiological HHRAs. The CSA N288.1-20 definition of infant is based on the ICRP Publication 71 (ICRP 1996), whereas the HC 2021 PQRA guidance document, which is referenced in CSA N288.6-22 (CSA 2022) defines "infant" as zero to less than 6-months and "toddler" as six months to less than five years old. NexGen's disposition of this IR was found to be acceptable by CNSC staff.

CNSC staff had concerns regarding the lack of a bounding scenario of a failure of a stack scrubber in the mill, potentially resulting in an uncontrolled release of uranium and other particulate matter to the environment. NexGen provided information on the hazard identification analysis, specifically related to process containment and gas cleaning/filtration system failure, and calciner wet scrubber failures, which would be bounding, and included information on how these hazards would be managed by regular, preventative inspections, testing, and maintenance, and ambient air monitoring. This disposition was found to be acceptable.

CNSC staff requested that NexGen provide information regarding the potential risk to human health from a bounding scenario of spill of uranium concentrate in the mill. NexGen provided information on several scenarios that included uranium-bearing materials in the process plant which were considered in the hazard identification screening process, such as but not limited to: an ore spill; process vessel and piping system failure; a facility fire; process containment and gas cleaning and filtration system failure; and calciner wet scrubber failure. The likelihood of these scenarios to occur will be controlled through management controls such as, but not limited to, ambient monitoring, secondary containment, process sumps, redundant temperature/reagent controls, building ventilation, and spill and emergency response planning. These scenarios are also adequately bounding and, therefore, acceptable to CNSC staff.

Mitigation measures

Risk assessments performed by the proponent specific to worker health and safety are to be used to confirm the design basis for the Project; including confirmation or modification of design assumptions such as design of ventilation or other engineered controls, time management and radiation work planning, intended to keep worker exposures ALARA. The assessments included radiological exposure assessments for the underground mine, process plant, and paste processing and delivery systems. Controls identified by the proponent in the risk assessments are to be used to eliminate, prevent or reduce the potential risk of elevated radiation exposures to workers, and would be implemented with consideration of the hierarchy of controls. Examples of controls include facility, equipment and process design; safe work practices and training; and personal protective equipment. In addition, risks to worker health and safety will be managed through processes outlined in the Integrated Management System Manual and its supporting programs; specifically, the Health and Safety Program and the Radiation Protection Program.

For members of the public via radiological COPCs, there is no potential for a residual effect from the Project to human health via the considered pathways (e.g., radiation, inhalation and ingestion). Therefore, no specific mitigations measures were proposed. However, additional monitoring is noted in the follow-up program below.

With respect to non-radiological COPCs, there are no potential residual effects anticipated on members of the public via the oral, dermal, and inhalation pathways of exposure. Therefore, there were no specific mitigation measures proposed. It is noted that a monitoring and follow-up program has been proposed by the proponent, which would be implemented to identify unanticipated effects to inform adaptive management, as appropriate.

7.3.4.1. Follow-up program

The proponent highlighted that the monitoring of radiation exposures to NEWs throughout all phases of the Project will be done using personal dosimetry equipment. Doses will be routinely tracked and compared to CNSC regulatory dose limits. The processes for classifying NEWs and managing worker dosimetry will be included in the Radiation Protection Program.

For radiological aspects of the HHRA, NexGen will also focus on collecting data to verify ERA model, and data to improve predictions when the project starts, as well as working with local Indigenous Nations and communities to complete a traditional food study to help validate/modify dietary assumptions made in the HHRA.

With respect to non-radiological exposures, the proponent has proposed a monitoring and follow-up program which includes an EPP, EMP, Effluent and Emissions Plan, and a Regional Traditional Foods Study, which would be implemented to verify the effects' predictions and effectiveness of mitigation measures on human health, and also to identify unanticipated effects to inform adaptive management. Key components of the human health monitoring will include air and noise, surface water, sediment, and soil sampling program, and a sampling program for fish tissue, benthic invertebrate tissue, as well as country foods such as blueberries. It is anticipated that the EMP would be developed in accordance with the applicable federal and provincial requirements.

7.3.5. CNSC Staff's Findings and Recommendations

CNSC staff find the proponent's assessment to demonstrate that the predicted annual effective and equivalent doses to workers during construction, operation and decommissioning of the proposed Project will not exceed the applicable dose limits prescribed in the *Radiation Protection Regulations*.

For radiological residual effects to the Human Health, based on the residual effects characterization and determination of significance, the results of HHRA suggest that radiological residual effects to members of the public are negligible.

With respect to non-radiological residual effects to Human Health, a characterization of residual effects and determination other their significance, it can be concluded from the results of the HHRA that non-radiological residual effects to members of the public are negligible. Taking into account the implementation of mitigation measures and recommended follow-up program measures, as well as input received from Indigenous Nations and communities, CNSC staff conclude that the Project is not likely to cause significant adverse effects on human health.

7.4. Indigenous Uses: Current use of lands and resources for traditional purposes

This section describes the potential effects of changes to the environment caused by the Rook I Project on the current use of Indigenous Land and Resource Use (ILRU) for traditional purposes by Indigenous peoples, including effects to fishing, hunting, gathering, trapping and the use of lands and resources for cultural and ceremonial purposes (referred to as heritage resources herein). The proposed Project could cause residual adverse effects on Indigenous lands and resource uses from changes to the environment through:

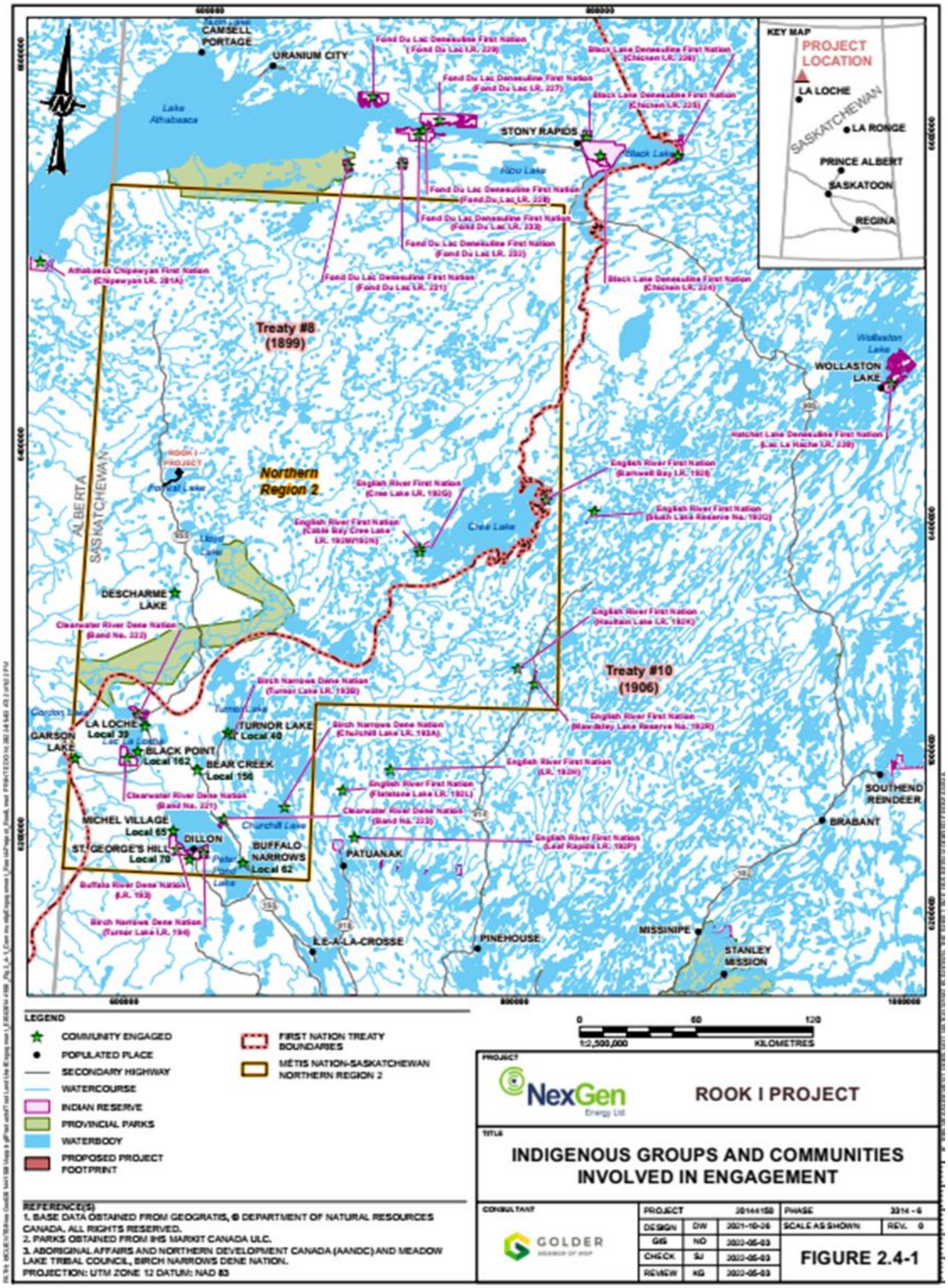
- changes in quality and quantity of hunting, fishing, trapping, and gathering activities as a result of the Project
- changes in access to lands and waters available to conduct traditional harvesting and cultural activities as a result of the Project
- changes in the number of known heritage resources including any of those of historical, archaeological, paleontological or architectural significance as a result of the Project

7.4.1. Description of the existing environment

Understanding the current use of land and resources for traditional purposes by Indigenous peoples requires the knowledge of traditional and contemporary activities of local Indigenous Nations and communities, including hunting, trapping, fishing, gathering and cultural/ceremonial activities carried out by First Nations and Métis peoples for traditional purposes in the Site Study Area (SSA), as well as the Local Study Area (LSA) and Regional Study Area (RSA).

The Project is located along the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. The Project falls within the boundaries of Treaty 8 Territory and lies within "No Hoe Neneh" the traditional lands of CRDN, Treaty 8, the Homeland of the Métis, and is within Nuhenéné, the traditional territory of the Athabasca Denesuline First Nations. The closest federal lands to the Project site consist of Indigenous reserves, including Clearwater River Dene Band 222 (approximately 120 km south), English River First Nation Cable Bay Cree Lake 192M and 192N (approximately 130 km southwest), Cree Lake 192G (130 km southwest), Turnor Lake 193B (approximately 135 km southeast), and Clearwater River Dene Band 221 (140 km south). Figure 7.1 provides an overview of Indigenous Nations and communities location in relation to the Rook I project.

Figure 7.1: Indigenous Nations and Communities location in relation to the Rook I Project



There are no permanent communities that are located within the immediate proximity of the Project area. The closest community by road is the Northern Village of La Loche, which is located approximately 130 km (155 km via road) south of the Project. Provincial Highway 955 starts from the community of La Loche and runs north to the decommissioned Cluff Lake mine (located 80 km north of the Project site) that was operated by AREVA Resources Canada (now Orano) from 1979 until 2002. Year-round vehicle and heavy equipment access to the proposed Project would involve upgrading the existing all-season access road from Highway 955 to the Project site.

The study areas for ILRU were based on the combined extent of the related atmospheric environment component (air quality, acoustic environment), human health, vegetation and wildlife, geology, groundwater and hydrology, surface water quality, and fish and fish habitat VCs. The broader regional area surrounding the Project is largely undisturbed by human activities and infrastructure, and approximately 0.5% of the regional area (i.e., 1,000 km^2) encompassing the Patterson Lake watershed has been influenced by human development. Most human-related disturbances in the regional area include linear features such as Highway 955, cutlines, seismic lines, trails, and cleared areas for exploration activities. The Project Site Study Area's for ILRU direct physical disturbance covers an area approximately 2.3 km^2 while the Local Study Area (LSA) is approximately 1247 km^2, and the Regional Study Area (RSA) covers approximately 43,577 km^2.

The LSA and broader RSA are accessed and used by several Indigenous Nations and communities for traditional, cultural and/or ceremonial activities. The primary Indigenous land use activities carried out within the LSA and RSA by Indigenous land users include hunting, trapping, fishing, and sustenance, medicinal and ceremonial plant gathering. There are also recreational and traditional resource user leases in the LSA and RSA. In addition, there are also important cultural heritage sites in the LSA and RSA, such as archaeological sites, historic travel and canoe routes, seasonal camps and traplines, all of which have cultural significance to Indigenous Nations and communities. Several of the Indigenous Nations and communities that CNSC staff have engaged and consulted with throughout the EA and regulatory review process have identified the importance of protecting the existing environment as well as historic cultural sites within the LSA and RSA so that they can continue to hunt, trap, and fish and carry out their traditional activities safely into the future.

7.4.1.1. Clearwater River Dene Nation (CRDN)

CRDN (Treaty 8) is located in northwestern Saskatchewan. The main settlement, Clearwater Village situated on I.R. 22 is adjacent to the Northern Village of La Loche and their reserve lands are the closest in proximity to the Project, at approximately 120 km in a straight line to the south and 155 km by road. The Project is located within "No Hoe Nenuh" which is the traditional territory of CRDN that encompasses the upper reaches of Churchill River in the south, west into Alberta, and north to the southeastern shoreline of Lake Athabasca. CRDN has a long-established presence in northwestern Saskatchewan and northeastern Alberta and CRDN maintains that it is the most directly impacted First Nation in relation to the proposed Project. The Indigenous Knowledge (IK) that is contained within NexGen's EIS from CRDN was also shared with CNSC staff by CRDN for the purposes of the EA process. The information provided in CRDN's Indigenous Rights and Knowledge Survey (IRKS) for the Goráchághı tu/Pelican

Lake (Patterson/Forrest Lake area) indicates that the LSA and RSA are essential core hunting areas for large game such as moose, fishing areas, and gathering areas for berries and medicinal plants. CRDN ancestral connections to the Nation's traditional lands near the Project site run deep and Patterson Lake is a main waterbody within CRDN traditional lands which is integrally connected to the Clearwater River (Des Nëtthë) as it flows south and west and ultimately joins the Athabasca River in Alberta and flows north into the McKenzie River. The core part of CRDN's traditional lands that are most intensively utilized and occupied by CRDN families are situated within the Des Nëtthḗ (Clearwater River) watershed that has been continuously utilized and occupied by CRDN ancestors and descendants for at least several centuries. Given the centuries of Denesųłiné births and burials which have occurred within No Hoe Neneh these lands are understood to be sacred to CRDN members. Given the Nation's longstanding presence on traditional lands, there are numerous ancestral burial places within No Hoe Neneh, many of which have still not been recorded.

CRDN has indicated that there are a number of members' cabins in the LSA and RSA, which include "past, current and future planned structures north of the Clearwater River". Cabins mapped in the LSA, and maximum disturbance area are at Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, Dahle Lake, and along the Clearwater River. CRDN members have been living, travelling, hunting, trapping, fishing, gathering and carrying out other cultural and/or commercial activities in their traditional lands, including the Goráchághı tu/Pelican Lake for thousands of years. These activities, and the resources that support them, are key to maintaining CRDN's strong connection to their No Hoe Neneh today and for future generations. CRDN members highlighted the importance of species including moose, fish, birds and wildlife in their diet and culture. Moose hunting locations and harvesting camps have been mapped near and around Patterson Lake and in the LSA and RSA while other noted mammals harvested and trapped in the immediate vicinity of Goráchághı tu/Pelican Lake included woodland caribou, rabbit, black bear, muskrat, beaver, porcupine, and marten among others.

One of the heaviest concentrations of contemporary harvesting by CRDN members is in the RSA in the region between the Clearwater River north to the Douglas River, approximately 70 km north of the proposed Project, where members use lakes and rivers on both sides of the highway for traditional activities. Closer to the Project site, CRDN participants identified fishing locations near the SSA and in the LSA at Patterson Lake and in the smaller lakes and creeks close to the Project site including Forest, Beet, Preston and Lloyd lakes all withing the same watershed in the LSA and RSA. Noted fish species harvested included from Patterson Lake and within the surrounding lakes in the RSA includes arctic grayling, northern pike, lake whitefish, cisco, lake trout, burbot, walleye, and suckers. It is believed that all waters within CRDN traditional lands are also understood to be connected to the underground hydrology which include muskegs and the importance of clear, clean water and its value is essential to Denesuline culture. Clean water is described as inextricably connected to CRDN livelihoods, practices, customs and spirituality and many CRDN members are concerned about the impacts and contamination resulting from the Project.

Plant and berry harvesting areas were also mapped in the LSA around Patterson Lake to the proposed Project site by CRDN. Several CRDN members have increasing concerns about being displaced by government and/or industry to leave cabins located within exploration lease areas which surround Goráchághı tu/Pelican Lake. A location such as Goráchághı tu/Pelican Lake where plant medicines, berries, or moose have been intensively and continuously harvested for generations beyond memory, is inextricably linked to innumerable stories and teachings which are integral to CRDN's history, heritage and identity. CRDN had concerns that the loss of such a place may contribute to the erosion of Denesųłiné ecosystem knowledge, stories, lore, teachings, and customary practices.

7.4.1.2. Métis Nation Saskatchewan (MN-S) – Northern Region 2 (NR-2)

The Project site is located within Métis Northern Region 2 (MN-S NR-2) in northwest Saskatchewan which extends geographically from Cree Lake in the east to the Saskatchewan-Alberta border in the west, and from Buffalo Narrows in the south to Lake Athabasca in the north. Métis citizens from NR-2 have strong ties and interest in the Project area and several key Métis communities with whom NexGen and CNSC have been engaging with throughout the regulatory process within MN-S NR-2 includes the Métis Locals of La Loche, Buffalo Narrows, Turner Lake, Bear Creek, Michel Village, St. Georges Hill, and Black Point who access the Project area via road traveling north on highway 955 from their communities.

The MN-S NR-2 Traditional Land Use and Diet Study that was supported by NexGen and was shared with CNSC staff by MN-S included information in the form of interviews, maps, and tables on the traditional use and occupancy, trail and travel networks, seasonal camps and harvesting areas throughout NR-2 and in proximity to the proposed Project. The study provided by MN-S NR-2 identified hunting, fishing, trapping and medicinal plant and berry harvesting sites throughout both the LSA and RSA and near Patterson Lake and several other lakes along the highway 955 corridor. In addition, the MN-S NR-2 also shared that there are culturally important current use and historical sites located within the LSA and RSA, including transportation travel routes, seasonal campsites, and gathering sites that are used for knowledge transfer and Métis teachings. These cultural activities related directly to the Métis peoples' traditional dietary habits, dependence on traditional foods and harvesting for medicinal purposes and essential to Métis identity.

MN-S members had concerns that the Project could impact their ability to hunt, trap, gather and fish and traditional country foods diet including moose, rabbit, grouse, ducks, fish, berries and plants is critical to MN-S NR2 members. In addition, the LSA provides harvesting locations which are also important for the collection of natural medicines. Rat root and birch bark are collected and used for medicine, as is birch syrup, the harvesting of which continues to be passed down in the area. MN-S also shared that the Patterson Lake area remains a cultural important area for the Métis where culture is passed down to youth through their knowledge of the land and their shared language that provides a sense of community and permanence. Informed by its experience with the Cluff Lake mine, several MN-S members were concerned with respect to the perceived contamination and decommissioning that took place for Cluff Lake and were worried that Patterson Lake will end the same way causing fear and avoidance behavior for its members from harvesting within the Project area.

7.4.1.3. Birch Narrows Dene Nation (BNDN)

BNDN is a Denesųłiné First Nation band located in Treaty 10 and the community of Turner Lake is located approximately 135 km in a straight line to the southeast and 230 km by road from the Project. BNDN members have occupied the lands of "Dene Nene" or "Land of the People" in northwestern Saskatchewan since time immemorial in accordance with their own laws and system of government. BNDN has 3 reserves, one at Turnor Lake (IR 193B) which adjoins the village of Turnor Lake, Saskatchewan and is the main reserve for BNDN. Churchill Lake (IR 193A) is at the junction of Churchill Lake and Frobisher Lake, and Turnor Lake (IR 194) is on Peter Pond Lake east of Dillon, Saskatchewan. BNDN members continue to hunt, fish, gather and trap on the lands throughout our Ancestral Lands across northwestern Saskatchewan. The lands, waters and resources throughout their Ancestral Lands are essential to the well-being and survival of BNDN's way of life including associated knowledge, land use, occupancy and culture.

Important fishing locations were identified in the LSA and RSA including Patterson Lake, Forest Lake, Preston Lake, and Lloyd Lake. Other lakes that are located further afield which are of importance to BNDN residents to harvest fish from include Descharme Lake, Careen Lake, Proudfoot Lake, and Turnor Lake. BNDN identified values related to fishing including trails and a cabin site used while recreational fishing areas within the LSA and RSA. BNDN members fish several lakes in their traditional territory but outside the LSA which includes commercial fishing, winter fishing, and subsistence fishing.

BNDN also shared that harvesting plants for food and medicine are important activities for many BNDN members within the LSA and RSA, and important aspects of BNDN cultural life. Water is also considered medicinal and is often an ingredient in traditional medicines. BNDN identified two blueberry gathering sites, a portage location, water monitoring sites and drinking water locations within the LSA. Hunting and trapping still play and important role in BNDN culture and identity. BNDN members hunt large and small game throughout their traditional territory, including moose, deer, and birds. Moose are considered a current staple, and BNDN members previously relied in the past on caribou, but they have become increasingly rare in the region. BNDN members use the LSA and RSA for hunting and continue to trap in the RSA as it is an important source of food and furs for community members including fisher, beaver, muskrat, mink, lynx and marten. BNDN also shared concerns around Indigenous land use practices influencing the community and sense of place, spirituality, ceremonies, knowledge transmission, place names, travel routes and habitation sites.

7.4.1.4. Buffalo River Dene Nation (BRDN)

BRDN is a Denesųłiné First Nation located in Treaty 10, and their Dene ancestors traditionally occupied territory in northern Saskatchewan that extended from Lake Athabasca to the north, Ta Touie Lake to the east, Cold Lake to the south, and the Athabasca River to the west. The BRDN's current reserve land is Buffalo River Dene Nation 193 situated approximately 84 kilometres northwest of Île-à-la-Crosse, on the western shore of Peter Pond Lake near Dillon, Saskatchewan. The Project is located approximately 190 km to from the main BRDN reserve in a straight-line distance and 330 km by road and is within BRDN's traditional territory. There is limited documented land use by BRDN in the LSA, with most of the usage occurring in the RSA. BRDN members have hunted or currently hunt in the LSA and RSA and site-specific hunting and trapping values were 25 km from the Project site.

7.4.1.5. Athabasca Denesųłiné (AD)

Black Lake (Treaty 8), Fond du Lac (Treaty 8), and Hatchet Lake Denesųłiné First Nations (Treaty 10) are collectively termed the Athabasca Denesųłiné (AD) and are represented by the Ya'Thi Néné Lands and Resources Office (YNLR). Fond du Lac First Nation is the closest AD

First Nation to the Project and is located approximately 180 km in a straight-line distance to the northeast or approximately 1,335 km by road. Black Lake is located approximately 260 km in a straight-line distance to the northeast or approximately 1,230 km by road. YNLR asserts that treaty rights are practiced within the RSA and that the project area overlaps the southwestern extent of the AD's traditional territory, in Nuhenéné and that the AD generally access their traditional territory in the vicinity of the Project by means other than road.

The land use information shared with NexGen and CNSC by YNLR indicates that some AD members access and use the RSA for hunting, fishing, trapping and gathering activities, and that there are important cultural overnight travel routes and sites located in the RSA. Barren-ground caribou remains the most important resource for the Athabasca Dene people and members continue to harvest barren-ground caribou for subsistence and cultural purposes. Although the barren-ground caribou herds currently do not travel far enough south into the Project area, YNLR also indicated that other large game species are harvested in the RSA including moose. The protection of woodland caribou is also of the upmost importance to the AD and they have expressed concerns that the increased levels of traffic and human disturbance will have on the decline of the species. Other traditional land use activities practiced by YNLR members in the RSA included harvesting of small game, fish, and berries as well as overnight sites and historical travel routes. Current sites, such as cabins and culture camps were not documented in the LSA or RSA by the YNLR.

7.4.1.6. Athabasca Chipewyan First Nation (ACFN)

ACFN is a Denesųłiné First Nation with a primary community in Fort Chipewyan in northeastern Alberta, approximately 223 km north of ełídlįkǫ́ę́ (Fort McMurray); reserve lands on the south shore of Lake Athabasca, on the Athabasca Delta, and on the des nedhé (Athabasca River) in Alberta. ACFN is a Treaty 8 First Nation descended from the K'ai Tailé Dené, or the "people of the land of the willow," who hold deep ties to their lands and resources across present-day northern Alberta, northern Saskatchewan, and the Northwest Territories. ACFN has constitutionally protected Aboriginal and treaty rights that extend throughout their ancestral homelands. Fort Chipewyan is closest ACFN community to the Project and is located approximately 160 km to the northwest in a straight-line distance or approximately 620 km by road including a portion of a winter road.

ACFN's Ancestral Lands encompass a large section of the boreal forest in present-day northern Alberta and northwestern Saskatchewan, with traditional activity focused throughout the northwest corner of the Athabasca basin. ACFN members have used and continue to use areas within the Athabasca basin with concentrated land use around łuezą́n tué chogh (Carswell Lake), łuezą́n túaze (Cluff Lake), thai tué (Sandy Lake) and Lake Athabasca within the RSA for a variety of subsistence, cultural, and traditional purposes. ACFN reported that community members rely on territory in Saskatchewan for subsistence including moose hunting and berry gathering as well as fishing in areas in the RSA. ACFN members noted hunting for moose and caribou on the Saskatchewan side of the traditional territory is particularly important to ACFN as it is relatively undisturbed in comparison to the Alberta side. Notable transportation routes included Highway 955 and a route paralleling Highway 955, and routes through and around Lake Athabasca in the RSA. ACFN also identified N22 and N23 traplines, that are in the RSA on the south and north side of Lake Athabasca respectively, that have been held by multiple generations of ACFN members. Cultural/Spiritual values noted by ACFN are concentrated within the RSA along the south shore of Lake Athabasca, and surrounding Beaverlodge Lake including the decommissioned Beaverlodge (neé Eldorado) mine.

7.4.1.7. Other Indigenous Nations and Communities

Willow Lake Métis Nation (Alberta) and the Mikisew Cree First Nation (MCFN, Treaty 8) have recently expressed interest in the Project. WLMN have shared that the Project may have the potential to impact land users in the region as the Nation has asserted Métis rights in the Project area. However, CNSC staff have not been provided any information to ILRU that is carried out near the Project area or within SSA, LSA, or the RSA by WLMN. Both Nations have indicated that they do have concerns and utilize the region downstream of the project in Alberta to hunt, trap, fish, gather and carry out ceremonial purposes. MCFN has indicated that Nation members do not practice in the Project area, however, areas in Saskatchewan, including the Project area, are increasingly important to Nation members given the development pressures on MCFN's traditional territory in Alberta. The CNSC is open to receiving additional information and details regarding each Nation's ILRU in the region should each Nations be willing to share additional land use information and data specific to the Project area.

Information on how the CNSC has been consulting and engaging with the identified Indigenous Nations and communities is included in the Consultation Report, located in appendix C of the CMD 25-H12.

7.4.2. Proponent's assessment

NexGen's assessment on ILRU included both the direct and indirect effects of the Project on the biophysical environment, which in turn may potentially impact access to, and/or the quality and quantity of, hunting, fishing, trapping and gathering activities, and the use of lands and resources for cultural and ceremonial purposes. These changes were assessed based on the spatial (SSA, LSA and RSA) and temporal nature (construction, operation, and decommissioning) of these potential interactions between Project components and activities and the ILRU VC. The pathway analysis identified potential Project-related effects on ILRU, mitigation measures for these potential Project-related effects and determined whether the potential Project-related effects could be sufficiently mitigated such that they are not expected to cause a residual adverse effect. NexGen's ILRU VC focused on land and resource use by the CRDN, MN-S, BNDN, and BRDN. In addition, Fond du Lac Denesųłiné First Nation and the Black Lake Denesųłiné First Nation of the Athabasca Denesųłiné, showed interest in the Project, and are represented by Ya'thi Néné Lands and Resources (YNLR). ACFN, as well as Willow Lake Métis Nation also have indicated that they have rights and interests in the area that may be potentially impacted by the Project.

The LSA and RSA for the Indigenous land and resource use VC were defined to include predicted effects on supporting intermediate components (e.g., noise, air quality) and VCs (e.g., fish and fish habitat, traditional use of plants, wildlife and wildlife habitat). The Indigenous land and resource use LSA includes the areas surrounding Patterson, Forrest, Beet, and Naomi lakes, plus the Highway 955 corridor between the Project site and the community of La Loche. The Indigenous land and resource use RSA included the four fur blocks closest to the local communities (N-15, N-17, N-19, and N-21) and captures the broad traditional use activities and patterns of Indigenous Nations and communities in the region. More specifically, the LSA and

RSA for Indigenous land and resource use were developed to reflect the spatial extent of anticipated direct and indirect Project effects on supporting intermediate components and VCs, along with known and documented land use patterns by several Indigenous Nations and communities' traditional territories across the region (NexGen, 2025).

In relation to access to and/or the quality and quantity of hunting, fishing, trapping and gathering activities, NexGen did not predict any residual effects from the project due to changes in the biophysical environment on ILRU, after the implementation of proposed mitigation and follow-up monitoring program measures. Within the SSA, restrictions to land available to conduct ILRU are expected to begin in construction, continue through operation and end when reclamation of disturbed areas is completed in decommissioning. NexGen determined that the Project will likely result in localized and temporal disturbances to ILRU and access to lands and resources used by Indigenous Nations for traditional purposes would be reduced within the maximum disturbance area by 981 ha or 0.7% of the broader LSA. The effect is expected to be minor due to the currently limited amount of ILRU activity occurring within the maximum disturbance area combined with other commercial trapping areas available in close proximity to the site.

Throughout all phases of the Project, monitoring and communication would be key to creating positive working relationships that would facilitate open communication with local Indigenous Nations and communities and local land users such as the N-19 Trappers Association among others. Additionally, the Project is not predicted to restrict access to and between the lakes in the Indigenous land and resource use in the LSA. To minimize the quantity of land that is disturbed by the Project, NexGen has reduced the proposed Project footprint to be developed within previously disturbed areas, to the extent possible, including roads currently used for exploration activities.

In relation to the potential effects on the availability of fish, traditional use plants and wildlife for harvesting and availability was also assessed by NexGen for ILRU. The results of these assessments were then considered within the context of Indigenous land and resource use to determine how changes in the availability of resources harvested may affect hunting, trapping, fishing, and gathering activities.

The Project may result in changes to the availability of fish, plants, and wildlife for harvesting because of increased competition for resources important to Indigenous land and resource use through changes in access and the presence of the Project workforce during construction and operations. NexGen determined that the Project could change the availability of fish, plants, and wildlife for harvesting through the potential for increased access, which could result in increased competition for resources due potential improvements to Highway 955 and increased traffic and familiarity to the region. Workforce members will be transported to/from site via a fly-in/fly-out in 2-week rotation and will, therefore will help to reduce fishing pressure on local lakes. The main Project site entrance would also be gated to control public access to the Project site, which would also limit public road access to local plant harvesting and hunting opportunities and road access to Patterson Lake for fishing. Project-induced changes to fish quantity in Patterson Lake are expected to be negligible and the abundance and distribution of fish species were not expected to be detectable due the project.

Effects on current resource availability to terrestrial resources including plants, and large game were determined to be low in magnitude, local, and reversible, as most large game hunting and gathering within the Project area is sparse to infrequent and most of the large game hunting take place outside the LSA. Effects on resource availability of the aquatic and terrestrial species were, therefore, not expected to affect subsistence hunting, trapping, and gathering because the effects were anticipated to be of low magnitude and reversible.

Overall, the Project is expected to have a small, local effect on Indigenous land and resource use although irreversible for traditional plants in small areas of potentially affected wetland ecosystems where effects are assumed to be permanent. Indigenous land and resource users are concerned about the potential exposure to contamination of hazardous waste to surface water and groundwater due to underground tailings, plants and soils due to air emissions, and overall, impacts to traditional foods including fish, moose and berries and plants. These concerns may thus impact perceptions around the overall quality of the resource use for land users in the region. Potential effects are predicted to begin in operation and cease when reclamation activities have been completed in decommissioning when Project components are removed, and activities cease. Some perceived risks may be strong enough to cause land users to avoid practicing ILRU activities in areas proximal to the Project due to perceived health concerns. A human health risk assessment was conducted to consider both radiological and toxicological risks to humans, including Indigenous resource harvesters who consume high proportion of traditional foods close to the Project site and included exposure to ILRU and high consumption of traditional foods.

The HHRA predicted no significant adverse effects associated with exposure to non-radiological and radiological COPCs. Local Indigenous communities have also expressed concerns related to increased bioaccumulation of contaminants in fish tissues due to project-related effects, therefore NexGen has committed to supporting additional Indigenous led monitoring in the aquatic environment relevant to the list of identified COPC's over the life of the project to monitor changes in concentrations in fish tissue over time. Changes in fish tissues concentrations will be assessed through comparison of construction, operation, and decommissioning results to pre-development baseline conditions. NexGen has committed to monitoring the health risks from fish consumption by comparing fish tissue data collected during operations from their EMP against applicable human health risk-based maximum permissible concentrations and working with local Indigenous Nations and communities to complete a traditional foods study before construction begins to help validate/modify dietary assumptions made in the HHRA that can used to compare to baseline moving forward.

NexGen also assessed the potential effect of changes in access to cultural and heritage resources and considered both the spatial and temporal boundaries in determining the potential effects to known Heritage Resources. Potential Project-related effects for Heritage Resources were limited to the areas where ground disturbance will occur and primarily, in the immediate SSA where the main Project infrastructure will be located (130 ha): a large level upland where the airstrip will be located (17 ha); shoreline area along Patterson Lake along the access road to site (33 ha). Based on defined criteria for a Heritage Resource Impact Assessment (HRIA), an HRIA was completed that assessed areas with heritage resource potential within the Project footprint and three general study areas during the baseline studies based on defined criteria for an HRIA by Saskatchewan's Heritage Conservation Branch (HCB).

In total, 180 ha were assessed, and no heritage resources were identified in the survey area. Following a review of the HRIA, the HCB confirmed that the HRIA met the requirements of section 63 of The Heritage Property Act, and no further assessment was required. NexGen determined that given the low number of Heritage Resources within the Project site, the likelihood of this residual effect is considered low and residual effects on heritage resources will occur infrequently. Any changes to the Project (i.e., expansion of the Project Area or the addition of new infrastructure proposed) that might affect heritage resources will be required to be submitted to the HCB for their review, and additional HRIAs may be required. Completion of the impact assessment and implementation of the chance find procedure is expected to protect archaeological and heritage resources.

Indigenous land users may also experience indirect effects through disturbances from traffic, noise, light, air quality changes, changes related to the relationship to the land, and increased competition for resources to increased traffic and safety concerns in the area as was included in NexGen’s assessment. These indirect impacts in the decrease in quality of resources and land user experience may be considered to represent important losses of land and resource use and cultural connections for some individuals. NexGen deemed changes to the perceived experience of land users would be limited and that proven mitigation measures from the mining sector in northern Saskatchewan will be applied to traffic disturbances, noise, air quality, and increased competition for resources and therefore the effects are expected to be localized and reversible. NexGen’s potential effects were predicted to begin in construction, continue through operations, and cease when reclamation activities have been completed in decommissioning when Project components are removed, and activities cease. NexGen determined the residual adverse effects for the perceived suitability of lands and resources are expected to be moderate in magnitude, limited in geographic extent, and reversible, and the conclusion relative to changes to ILRU is not significant. NexGen proposed mitigation strategies that have been successful in similar settings and other mining operation across northern Saskatchewan such as management of noise, traffic, dust, and competition for resources and additional engagement on mining. NexGen acknowledges that continued land and resource use activities are critical to local Indigenous Nations and communities, and necessary to maintain a social licence to operate. NexGen has committed to mitigations to improve perceptions on the quality of resources and cultural landscape and would include environmental committees with Indigenous Nations, an independent Indigenous monitoring program, Indigenous and Public Engagement Program to communicate results from the Project and independent environmental monitoring, and commitments contained within the benefit agreements such as monetary and human resources to support community-related initiatives in areas such as cultural and traditional values for ILRU.

7.4.3. Views expressed

Several Indigenous Nations and communities raised concerns with the Project’s ability to affect their ILRU throughout the regulatory review process. Several Indigenous Nations and communities shared, and their views expressed that relate to ILRU are presented in the section below.

7.4.3.1. Indigenous Land Use

CRDN has previously shared that a location such as Goráchághı tu/Pelican Lake (Patterson Lake Area), where plant medicines, berries, or moose have been intensively and continuously harvested for generations is inextricably linked to the stories and teachings which are integral to CRDN's history, heritage and identity. Since CRDN harvesting activities are discontinued when an area is deemed to be unclean, the appearance of the drilling barges resulted in an immediate cessation of fishing activities on the lake as was reported by a number of CRDN harvesters in 2014 and again in 2016. More harvesting cessations at Goráchághı tu/Pelican Lake were reported in the 2020 IRKS interviews. CRDN members also noted experiencing loss of access to longstanding harvesting areas, loss of access to longstanding trails and travel routes, and loss of access to cabins and harvesting camps. NexGen has committed to establishing a closure landscape that would be accessible for unrestricted traditional use by Indigenous Nations and communities as a decommissioning and reclamation objective. Continued ability to participate in Indigenous land and resource use activities, which considered the importance of intergenerational knowledge transfer, was included as an assessment endpoint. NexGen noted that changes to the availability and quality of fish for harvesting were assessed in the EA pathway analyses and has committed mitigation measures including Project-specific Groundwater, Effluent, and EMPs, installing effluent and sewage treatment plants, and avoiding critical or sensitive habitat to the extent practical during construction.

MN-S Northern Region 2 (NR-2) members had previously shared concerns about accessing existing traplines in proximity to the potential mine site. MN-S NR-2 members expressed the need for locals to control the land, not industry, as industry leasing the land from the province it restricts access to their traplines and cabins. MN-S had previously requested that NexGen work with MN-S to develop fishing policies that consider both fisheries protection and traditional use activities for the project. NexGen has committed to accommodation measures including limiting the project footprint to the extent practical and controlling public access to the site.

BNDN members emphasised that fishing is important for subsistence, survival, livelihood and is an important part of community and cultural life. These values are connected to the traditional territory and rely on BNDN members having unimpeded and undisturbed access to the territory. BNDN also highlighted the importance that place names have in connecting contemporary members with the history of their people and in knowledge transmission. This knowledge transmission often requires access to the land and uncontaminated resources. Additional values related to cultural continuity included a cabin site, teaching areas, a gathering site, and Dene place names. BNDN members identified an important site known as the dancing ground where the Dene people would gather to celebrate, hunt and fish. NexGen noted that the importance of intergenerational transmission of knowledge was considered in the assessment of changes to access to Indigenous land, and changes to availability of fish, plants, and wildlife for were measurement indicators for the assessment of Indigenous land and resource use.

BRDN has previously shared concerns about project access limitations to lands and resources, and implications this would cause to transmitting IK to younger generations. BRDN has also shared concerns about the ability to harvest country foods and implications surrounding food security and community well-being for those using the land for food harvesting. BRDN also raised concerns with respect to noise due to truck traffic and how that may impact animals in the region. NexGen confirmed that the importance of intergenerational transmission of knowledge was considered in the assessment of changes to access to Indigenous land, and changes to availability of fish, plants, and wildlife for harvesting as well as changes to sensory disturbance were measurement indicators for the assessment of Indigenous land and resource use. NexGen has committed to accommodation measures including limiting the project footprint to the extent practical and controlling public access to the site. Furthermore, results generally showed that effects due to changes in air quality and noise would be minor, and while maintenance of Highway 955 is outside of NexGen's control they have committed to discussions with the Saskatchewan Ministry of Highways to develop a road upgrade and maintenance agreement to minimize noise.

YNLR raised concerns that NexGen did not fully include and consider their IK and land use studies in the area and would have liked NexGen to support a more detailed land use study so that they could both contribute to a baseline of ecological knowledge and cultural use in the Project area. YNLR noted concerns that the Athabasca Denesųłiné traditional territory and documented traditional use, while recognized by the proponent to a degree, does not appear to be considered fully within the environmental assessment (EA) process. YNLR noted that the availability of wildlife, fish and traditional land use plants will not be sustainable as the result of the Project and conclusions regarding local resource users should be reconsidered. NexGen committed to continued engagement with YNLR throughout the Project lifespan including formalized agreements to support the inclusion of IK in Project materials. NexGen has acknowledged the potential overlap with the Athabasca Denesųłiné traditional territory within the RSA was omitted and has since included the information in the final EIS. NexGen maintained that the methodology used to conduct the EA resulted in an accurate characterization of potential effects on people and the environment but has supported robust-follow up monitoring to ensure impacts on local resources are minimized.

ACFN indicated that further uranium mining exploration or development in the study area is anticipated to have potential adverse effects on their treaty rights and add to the ongoing cumulative effects in the region. NexGen confirmed cumulative effects of the Project; previous, existing and approved projects, and RFDs were assessed for the Projects with similar effects on the same VCs and intermediate components. ACFN traplines north of Cluff Lake are ancient to ACFN members and have a network for harvesting and spiritual values. Respondents spoke of the unwelcoming atmosphere and feeling that Alberta-Saskatchewan has created with people being territorial over traplines and individuals requiring hunting licenses for the Territories and Saskatchewan. One respondent who has used the N22 trapline for 30 years indicated that once they pass away, they have been told they will not be able to pass along the trapline to a family member as the trapline will revert to provincial ownership and be open to Saskatchewan residents only. This will end the transfer of knowledge of this trapline for ACFN members and may impact the livelihood of younger generations. NexGen has committed to establishing a closure landscape that would be accessible for unrestricted traditional use by Indigenous Nations and communities as a decommissioning and reclamation objective. Continued ability to participate in Indigenous land and resource use activities, which considered the importance of intergenerational knowledge transfer, was included as an assessment endpoint.

ACFN also shared concerns that NexGen did not provide enough capacity funding to support meaningful engagement on the Rook I Project to complete a land use study. ACFN was unable to determine potential impacts to treaty rights early in the EA process through independent and objective review of the project impacts on ACFN's land use in the region. ACFN has also expressed concerns that Indigenous Knowledge and land use from ACFN had not yet been included or considered in NexGen's EIS and that a fulsome consideration of ACFN's Indigenous Knowledge and land use was needed to assess the impacts the Project may have on ACFN's rights. NexGen noted that in their opinion that capacity funding for a full land use study agreement with ACFN is not warranted as the Project location is located outside of the ACFN Homeland (ACFN 2010) and traditional territory (ACFN 2012), and therefore NexGen maintains the Project is not anticipated to directly affect ACFN land. However, NexGen has committed to developing an engagement agreement with the intent to allow discussions of the Project and NexGen activities where ACFN may be directly or indirectly affected. NexGen further noted that available information, including information provided by ACFN, did not demonstrate that the ACFN have documented traditional land use activities within any of the Project local study areas. CNSC provided funding to ACFN to conduct a regional IK/TLU study, including the project area. The results of the study did not demonstrate any direct use in the project area, however CNSC staff continues to work with ACFN to better understand and address any concerns in relation to the Project.

7.4.3.2. Landscape Fragmentation and Changes to Terrestrial Environment

CRDN had previously expressed concerns regarding habitat degradation and species decline resulting from the Project. CRDN members highlighted the importance of species including moose, fish, birds and wildlife in their diet and culture. The observed decrease in animal populations within CRDN traditional lands up north, reported by CRDN members since 2014, is a matter of particular concern reported by the Nation's hunters who find that they are having to travel further and further away to maximize the success of their efforts to procure moose meat for household. Some CRDN community members felt that habitat destruction and degradation and resultant species declines had already occurred at Goráchághı tu/Pelican Lake due to exploration activities and that they were anticipated to be exacerbated by the more than two decades of active uranium extraction and milling operations that are being proposed.

CRDN had also previously shared concerns that the provincial government and proponents of industrial and extractive projects are inclined to characterize exploratory endeavors as low impact activities which do not warrant consultation with potentially affected Indigenous communities. Yet the range and extent of reported mineral exploration disturbances have physically affected CRDN traditional land use, and the customary activities of members include no hunting/access signage, harassment, access roads, drilling pads, camps, cutlines, clear-cutting, waste and garbage, noise/lights, traffic, and wildfires. NexGen has committed to mitigation measures to minimize Project effects to the environment, Indigenous land and resources, and ecological and human health. This includes continued engagement with CRDN, environmental protection and monitoring plans, and minimizing the project footprint to the extent practical. Project-specific and independent Indigenous monitoring programs will support reaching environmental objectives during the Projects lifespan. NexGen maintains that cumulative and residual effects were comprehensively assessed.

MN-S had previously shared concerns that moose have moved further away because there is too much activity in the area, and one member noted that not only are there are fewer fish in the lakes, but coyotes are also venturing into the community now because there is less food for them to hunt. NexGen has committed to developing details for an EMP during licensing (licence to prepare site and construct) with mechanisms for wildlife surveillance and independent Indigenous monitoring to observe and address changes in movement routes.

BNDN emphasizes the importance of hunting and trapping to the culture and subsistence ways of life for members of BNDN. Their study highlighted that there are key hunting and trapping locations throughout their territory and many members travel north to hunt and beyond. BNDN notes that moose and caribou are important resources for BNDN hunters. NexGen has committed to establishing a closure landscape that would be accessible for unrestricted traditional use, including hunting and trapping, by Indigenous Nations and communities as a decommissioning and reclamation objective. NexGen noted that changes in public access to hunting areas was evaluated in the EA, and upgrades to road access are not expected to result in measurable change to existing hunting access, while mitigation measures (e.g. not allowing employees to hunt within the mine lease boundary) are also expected to minimize potential effects to wildlife. Furthermore, NexGen has committed to developing a CMOP which is predicted to make residual adverse effects to woodland caribou not significant and includes engagement with Indigenous Nations and communities through its development.

7.4.3.3. Surface water and groundwater Contamination

CRDN had previously expressed apprehension that the project may adversely impact or contaminate the aquatic environment, waterways, fish, and fisheries, affecting their traditional way of life, including water use, fishing, and land harvesting practices tied to No Hoe Neneh. The proposed Rook I uranium mine and mill is situated in the upper reaches of the Des Nëtthé̂ [Clearwater River] Watershed. Goráchághı tu/Pelican Lake is a main lake which is an integral part of Des Nëtthé̂ [Clearwater River] system – the big/wide river which flows through the greater part of CRDN's traditional lands. All the waters within CRDN traditional lands are also understood to be connected to underground rivers which include muskegs. NexGen noted that changes to the availability and quality of fish for harvesting were assessed in the EA pathway analyses and has committed mitigation measures including Project-specific environmental monitoring plans, installing effluent and sewage treatment plants, and avoiding critical or sensitive habitat to the extent practical during construction. NexGen will establish an Environmental Committee to monitor environmental performance of the Project, will provide funding for full-time independent Indigenous Monitors, and will continue to address concerns and minimize adverse impacts to surface water quality.

For CRDN members, it was previously stated that an operating uranium mine and mill would increase the risk of above and below ground waters being contaminated with radioactive materials, heavy metals, and other toxic elements through industrial process water use and release, accidents, malfunctions, and other unplanned events. CRDN Denesuline standards for clean water, air, and ground differ from western scientific and government-approved standards. CRDN had emphasized that they cannot be invalidated and dismissed in the regulatory assessment process as ‘perceived misconceptions. CRDN Denesuline ‘perceptions’ of contamination (i.e. unclean conditions) are actual impacts (observed and experienced) although in regulatory processes such perceptions are typically dismissed as unfounded (perceived) by western scientific definition. NexGen has committed to engaging directly with CRDN throughout the Project lifespan regarding ways to minimize perceived effects of the project.

A massive fish decline is reported to have occurred at Goráchághı tu/Pelican Lake following exploratory drilling which took place on the lake, sometime during the late 1970s and 1980s (while Cluff Lake Mine was in operation). Deformities in fish that were caught at the time were also noted. NexGen noted that perception of Project effects was considered within the assessment of Indigenous land and resource use, and that perceived/observed impacts have been considered and valued equally to scientific data collection. NexGen has committed to engaging directly with CRDN throughout the Project lifespan regarding ways to minimize perceived effects of the project.

BNDN members have shared that they have experienced negative changes related to fishing in recent decades, including an increase in diseased or unhealthy fish being caught and that fish in Patterson Lake are diseased and that this could be attributed to the contamination caused by the drilling and mining activities. BNDN has also raised concerns about contaminants spreading through the water system and spreading via interconnected lakes and rivers, notably downstream through the Clearwater River system. NexGen confirmed that Project effects on local and regional waterbodies and watercourses were assessed. Primary effects pathways assessed included deposition of fugitive dust emissions on waterbodies, deposition of criteria air contaminant emissions on waterbodies, discharge of treated effluent, discharge of treated sewage, seepage from the waste rock storage areas during construction and Operations, and runoff and seepage from the waste rock storage areas and underground tailings management facility following Closure. Furthermore, NexGen has committed to mitigation measures including Project-specific environmental monitoring plans, installing effluent and sewage treatment plants, and avoiding critical or sensitive habitat to the extent practical during construction. NexGen will establish an Environmental Committee to monitor environmental performance of the Project, and will provide funding for full-time independent Indigenous Monitors, to address concerns and minimize adverse impacts to surface water quality.

7.4.3.4. Increased Access & Changes to Access

CRDN members had previously shared concerns about being displaced from Goráchághı tu/Pelican Lake as a result of NexGen’s exploration activities. CRDN members had also noted experiencing loss of access to longstanding harvesting areas, loss of access to longstanding trails and travel routes, and loss of access to cabins and harvesting camps. The presence of so many outsiders within No Hoe Neneh has resulted in an unknown number of CRDN members constraining their customary activities or removing themselves from the Patterson Lake area for reasons of emotional, spiritual, and physical safety. CRDN had also previously noted that with all the mineral exploration activities taking place up north, traffic on Cluff Lake road (955) is reported to have steadily increased, and the heavy traffic and activities are chasing the animals away making it necessary for hunters to travel further and further out or north. CRDN members also noted that travel up north is not as quiet and relaxing as it once was. NexGen has committed to establishing a closure landscape that would be accessible for unrestricted traditional use by Indigenous Nations and communities as a decommissioning and reclamation objective. Continued ability to participate in Indigenous land and resource use activities, which considered the importance of intergenerational knowledge transfer, was included as an assessment endpoint.

MN-S requested additional information related to the ongoing management and maintenance of Highway 955 given this is an important travel route to access traditional use areas. MN-S also shared that the Métis had strong kinship and familial ties to the area and that knowledge shared through oral history may be potentially impacted. Both CRDN and MN-S expressed concern that the Clearwater River is a culturally important river and waterway and must be protected. NexGen noted that development of the Project Ground Transportation Emergency Response Plan would occur during licensing (licence to prepare site and construct) and involve engagement with MN-S. NexGen has also acknowledged that maintenance of Highway 955 is outside of NexGen's control but has continued discussions with the Saskatchewan Ministry of Highways and has developed a road upgrade and maintenance agreement.

BNDN members' have concerns with respect to the disruption of the sense of place due to increase in traffic, human activity, and garbage, as well as changes to valued landscape features, as a result of the potential Project. Increases in traffic in the region and beyond due to Project activities and non-Indigenous recreational users impeding the ability of BNDN members to access preferred hunting, fishing and trapping areas is a real concern. BNDN also raised concerns on the potential to the loss of access to cabins, campsites, and travel routes due to avoidance and the installation of Project gating and other security measures and therefore the ability and opportunity of BNDN members to transmit cultural knowledge to future generations. NexGen noted that according to emails exchanged with BNDN, concerns regarding the disruption of sense of place were addressed in a workshop conducted with BNDN in December of 2022. NexGen has committed to mitigation measures including limiting the Project footprint to the extent practical by optimizing area cleared and using existing infrastructure, and implementing progressive reclamation to minimize effects associated with cultural continuity.

BRDN shared concerns about safety of truck transportation, including the number of trucks on the road, and spill response and who will be responsible for cleanup if spills do occur. BRDN has also raised concerns about increased development and industrial activity leading to increased competition with non-Indigenous recreational land-users for hunting and fishing in the region. BRDN is also concerned about cumulative access restrictions within BRDN traditional territory. NexGen confirmed the potential for accidental spills due to traffic accidents were assessed in the EIS and noted mitigating factors including future upgrades to existing access roads, speed limits for the access road and Clearwater River Bridge crossing, clear signage and the issuance of no-travel orders in unsafe conditions. Furthermore, NexGen has committed to developing a Ground Transportation Emergency Response Plan. Finally, NexGen has noted that continued ability to participate in Indigenous land and resource use activities, which considered the importance of intergenerational knowledge transfer, was considered in the assessment of land use and NexGen has committed to mitigation measures to limit the Project footprint and minimize access restrictions within BRDN territory. These mitigation measures are intended to address concerns regarding competition with non-Indigenous land users.

YNLR indicated that hunting and trapping pressures may increase on several species due to the presence of work camps and increased access to the Project area. NexGen noted that predation by wolves is the dominating limiting factor to woodland caribou populations and increased hunting pressure is not expected. The project is not expected to increase access for humans and predators as an access road to the Project area already exists, and mitigation measures such as the installation of a gatehouse and not allowing employees to hunt within the mine lease boundary are expected to minimize potential effects to wildlife, including moose and grey wolves.

7.4.3.5. Legacy Impacts and Fear and Avoidance

CRDN members had noted that the perception of uranium contamination/radioactivity at Cluff Lake Mine in the present day is widespread within CRDN and the La Loche community and other Indigenous communities in the north. CRDN and other Indigenous Nations have noted that even if it looks nice and green on the surface, members are very aware of what's underneath the ground and caution avoidance of the area. Although the Cluff Lake Mine area was declared 'safe' according to current regulatory standards (some twenty years earlier), for many CRDN harvesters it still does not meet Denesuline standards of what is safe or clean. NexGen noted that perception of Project effects was considered within the assessment of Indigenous land and resource use. NexGen acknowledged that continued land and resource use is critical to local Indigenous Nations and communities and has committed to engaging directly CRDN throughout the Project lifespan regarding ways to minimize perceived effects of the project.

MN-S NR2 members had previously indicated that they do not believe that the Cluff lake mine was properly decommissioned and therefore do not trust the government's requirements as they pertain to the proposed NexGen Project. They questioned the manner with which the Cluff lake tailings pond was decommissioned, and they do not trust the method used and want to know if there is radioactive contamination on the surface of waste rock. Informed by its experience with Cluff lake the community has many concerns, the biggest of which is its distrust for the industry, an industry which in their opinion refuses to explicitly state the dangers involved with uranium extraction. In general, members believe that the deaths of those who worked at the mine were a result of exposure, and that the high cancer rates throughout the community are also a result of exposure to uranium in dust, water, animals and plants. MN-S NR-2 community members have also noticed a change in the quality of meat and pelts. Members have noted increased contamination in the food, especially from further north while others expressed a fear of eating fish, rabbits and moose from the north due to the legacy issues of Cluff lake. NexGen noted that a detailed Project Decommissioning and Reclamation Plan would occur during licensing (licence to prepare site and construct) and involve engagement with MN-S through the Environmental Committee. Independent Indigenous monitoring and discussions with MN-S throughout the Projects life through the Environmental Committee will result in an accurate understanding of Project effects and can inform progressive reclamation and adaptive management. NexGen assessed multiple pathways that may adversely affect human health through food ingestion including emission and deposition of fugitive dust, radon, criteria air contaminants, and suspended solids as well as discharge of treated effluent and site runoff and committed to implementing a series of mitigation measures to minimize impacts on human health and the surrounding environment.

7.4.3.6. Community Health and Socio-Economic

CRDN members had previously reported concerns that there was a noticeable rise in cancer cases within the La Loche community-at-large which was attributed to mine-related employment and the transport of milled uranium (yellowcake) through the Northern Village of La Loche during Cluff lake operations and people are concerned the same may happen again. Of the many stories which circulate within the community about Cluff lake mine, the story most often told is that the benefits of the project for CRDN were negligible. There was no compensation for loss of use and short- and long-term damage to the land and, in the end, only a handful of people were employed, most in menial jobs. NexGen noted that key findings for incremental lifetime cancer risk are negligible to very low, and cumulative effects on human health are predicted to be not significant. Furthermore, NexGen has committed to implementing a Radiation Protection Program to keep worker radiological exposures as low as reasonably achievable, as well as an EPP to monitor and characterize Project emissions and environment quality to continually improve environmental protection performance. NexGen has stated that training, employment, and business opportunities for local communities closest to the project were made a priority to maximize value in a way that makes a positive impact environmentally, socially, and economically. This includes commitments to implement a recruitment strategy to confirm that the Local Priority Area (LPA) residents understand access to Project employment activities, working with local communities to address recruitment and retention barriers, working to deliver certified and accredited training and recruitment programs and providing qualified local residents with first preference for employment and training opportunities. NexGen's long-term target is 75% of the Project's workforce being composed of LPA residents.

BNDN members expressed concern that existing mines and exploration activities in the region are contaminating waters in the territory. For instance, BNDN members described how they avoid drinking from the area around Patterson Lake due to mineral exploration activity. BNDN expressed concerns that harmful uranium dust could be released into the air, and that uranium waste could lead to cancer and other illnesses and impact the mental health of BNDN members. NexGen has acknowledged the importance of surface water quality and committed to developing an EPP containing several mitigation and monitoring plans and utilizing adaptive management to provide a structured and flexible approach to maintaining water quality.

Several Indigenous Nations and communities have shared concerns about potential exposure to contamination of surface and groundwater, soils, waste sources, and fish species. Such perceived risk to the environment may lead to avoidance of areas adjacent to the Project and potentially limit access to treaty-protected activities. Several Indigenous Nations and communities have all raised concerns for potential contamination to the water and lands from accidents, malfunctions, land disturbance and traffic that may impact traditional land users' perception of health and safety of harvesting plants and animals. NexGen has committed to engaging directly with primary Indigenous Nations and communities throughout the Project lifespan regarding ways to minimize perceived effects.

7.4.3.7. Environmental Monitoring

Several Indigenous Nations and communities have expressed that they wish to be more involved in NexGen's follow-up and EMPs to better understand potential effects and input into the management of the monitoring and follow-up activities in relation to the Project site. NexGen has committed to collaborating with several interested Indigenous Nations and communities on mitigation, monitoring and follow-up measures for certain aspects related to their concerns around ILRU including providing support to include IK/MK into their monitoring plans on the biophysical environment in relation to the Project.

NexGen has also committed to working with a number of the Indigenous Nations and communities to address concerns related to safety and willingness to harvest within the proximity of the Project, including developing an independent EMP that is conducted by Indigenous monitors that would sample the aquatic and terrestrial environment in the Project area and LSA and possibly the RSA to ensure the protection of water, lands and traditional foods with the Indigenous Nations and communities whose traditional territories are located closest to the Project.

7.4.3.8. Noise and traffic

Several Indigenous Nations and communities have identified concerns regarding sensory disturbances while practicing land use activities. Sensory disturbances may include visual and auditory disturbances due to increased access, mining and exploration activities, increased road activity and visual changes to the environment. These sensory disturbances may also result in a decrease in ILRU due to the perceived risks and impacts to the environment on traditional food sources and therefore decreased connections between families, communities and the traditional land and resource use activities. NexGen confirmed that changes to sensory disturbance were measurement indicators for the assessment of Indigenous land and resource use. NexGen has committed to accommodation measures including limiting the project footprint to the extent practical and controlling public access to the site. Furthermore, results generally showed that effects due to changes in air quality and noise would be minor, and while maintenance of Highway 955 is outside of NexGen's control they have committed to discussions with the Saskatchewan Ministry of Highways to develop a road upgrade and maintenance agreement to minimize noise.

7.4.4. CNSC staff Analysis

CNSC staff have reviewed NexGen's assessment of potential effects to ILRU due to decreased access and to the quality and quantity of hunting, fishing, trapping and gathering activities, including ceremonial practices, during all phases of the Project and considered the views shared by Indigenous Nations and communities. CNSC staff have also reviewed and considered all of the Traditional and Indigenous Knowledge (IK/MK) and local knowledge that was provided in NexGen's EIS, as well as IK/MK documents and maps that have been shared directly with CNSC staff that were requested to remain confidential.

CNSC staff have travelled to the Project site and region on several occasions, visited multiple communities, met and engaged directly with a number Indigenous land users, Elders, and leadership from several Indigenous Nations and communities potentially impacted and/or interested in the Project to hear and work towards addressing their concerns. In addition, CNSC staff have also reviewed the mitigation measures that were proposed and applied by NexGen in atmospheric and acoustic environment, geology and groundwater, aquatic environment, terrestrial environment, and human health sections as well as the follow-up commitments made by NexGen for the Project.

The Project's effects to ILRU are predicted to be primarily indirect effects to the quality of the perceived experience and may affect the sense of solitude due to perceived effects and hazards related to road safety, waste and contamination of traditional foods. The effects of potential changes to the health of Indigenous Nations and communities were assessed for issues related to changes in air quality, noise levels, visual quality, human health and perceived contamination of traditional foods. When taking into consideration the combined magnitude, geographic extent, duration, and context of the potential residual adverse effects on Indigenous health, and the mitigation measures to address effects on exposure of the traditional land user, CNSC staff have determined that these residual effects are negligible and are is not likely to cause significant adverse effects to human health as the magnitude of effects are expected to be low.

If granted a licence by the CNSC, NexGen is required to implement an EMP that is compliant with Canadian Standards Association for nuclear facilities and mines (CSA N288.4). The EMP will focus on providing data to verify the predictions made by the ERA, to refine the models used in the ERA, and to reduce the uncertainty in the predictions made by the ERA (section 10). The EMP will include collection of surface water, sediment, plants, and soil samples as well as fish tissue, benthic invertebrates, and other traditional foods in collaboration with potentially affected Indigenous Nations and communities. NexGen has also established Environmental Committees for CRDN, BNDN, CRDN and MN-S and has committed to hiring full-time independent Indigenous monitors for each of these Indigenous Nations and communities to stay actively involved in monitoring the environmental performance of the Project and to verify the parties are implementing the regulatory and environmental commitments made in respect of the Project. NexGen has also committed to working with local Indigenous Nations and communities in efforts to complete a targeted baseline traditional food study to help validate or modify the dietary assumptions made in the human health risk assessment during operations. Additional monitoring programs will also be established to confirm the effectiveness of mitigation for VCs in relation to land and resources Indigenous peoples rely upon.

The Projects effects of potential changes to the physical and cultural heritage of Indigenous Nations and communities were also assessed for issues related to the loss, change, or alteration of archaeological and heritage resources of the current use of lands and resources for traditional purposes of cultural/spiritual sites. When considering the studies completed and mitigation measures proposed and applied to Heritage Resources, CNSC staff conclude that there will be no residual adverse effects to changes in access to cultural and heritage resources for ceremonial purposes. With respect to potential effects on other cultural resources including archaeology, and considering Indigenous Nations and communities' views, CNSC staff conclude that the proponent's mitigation measures listed and their commitments table to follow the guidance under the *Saskatchewan's Heritage Property Act* (Government of Saskatchewan 2017) pertaining to archaeology sites, built heritage sites and structures of historical and/or architectural interest, and paleontological sites will mitigate any potential effects. NexGen has completed the required archaeology assessments in accordance with provincial regulations and has also committed to a chance find procedure that would mitigate potential effects of the Project on any unknown cultural and heritage resources. Any changes to the Project (i.e., expansion of the Project Area or the addition of new infrastructure) that might affect Heritage Resources must be submitted to the HCB for their review, and additional HRIAs may be required. NexGen has also committed to notifying interested Indigenous Nations and communities should any additional artifacts be discovered of undocumented archaeological resources, through established environmental committees with primary Indigenous Nations and communities.

7.4.5. CNSC Staff's Findings and Recommendations

Taking into account the implementation of mitigation measures and recommended follow-up program measures, as well as input received from Indigenous Nations and communities, CNSC staff conclude that there are grounds for the Commission to find that the Project is not likely to cause significant adverse effects on access to and quality and quantity of hunting, fishing, trapping and harvesting activities, or effects on access to cultural sites of importance to Indigenous peoples. The effects significance determination table for ILRU can be found in appendix B.

CNSC remains committed to working with Indigenous Nations and communities to collaborate on follow-up and monitoring activities for the Project, as well as enhance engagement, outreach and information sharing regarding uranium mining and related environmental, health, safety and regulatory measures to mitigate and protect ILRU in the Project Area region and build trust with Indigenous Nations and communities moving forward.

8. Other effects considered

8.1. Effects of Accidents and Malfunctions

8.1.1. Proponent's Assessment

The proponent carried out an assessment of effects of potential accidents and malfunctions on site, and of potential traffic accidents along the mine-related transportation route, on health and safety of public and/or the environment through hazard identification and screening, environmental design feature and mitigation evaluation, risk measurement, and risk evaluation. Among 93 identified potential accidents and malfunctions on site, six bounding scenarios were identified and carried forward for detailed analysis including risk evaluation. Table 8.1 below outlines six on site bounding accident and malfunction scenarios, whereas table 8.2 outlines five main traffic accident scenarios, and NexGen's proposed mitigation measures, including their risk characterization.

Table 8.1 On site bounding accidents and malfunctions, proposed mitigation measures, and risk characterization

Type of Accident and Malfunction	Description	Mitigation Measures	Risk Characterization
Traffic accident and aquatic release of uranium concentrate and radioactivity	Identified as a bounding potential accident during operation, where a truck transporting packed uranium concentrate is involved in an accident including: a rollover, collision, or run off road at or near the access road bridge crossing of Clearwater River could result in a release of uranium concentrate into the surface water at this location and subsequent downstream transport of radioactive material resulting in potential impacts on surface water, sediments, aquatic species, wildlife, and human health.	Mitigation measures proposed by the proponent include: • upgrades to the existing access road to address increased use • traffic control measures such as speed limits • travel management plans • spill and emergency response planning • driver training	Probability: highly unlikely Severity of consequence: moderate Overall risk: low
Traffic accident and aquatic release of fuel and hazardous chemicals	Identified as a bounding potential accident during construction, operation, and decommissioning, where an accident involving a vehicle transporting fuel and hazardous chemicals, including a rollover, collision, or run off road at the site access bridge crossing of Clearwater River could result in aquatic release of fuel or hazardous chemicals into surface water resulting in potential impacts on surface water, sediments, aquatic species, wildlife, and human health.	Mitigation measures proposed by the proponent include: • upgrades to the existing access road to address increased use • traffic control measures such as speed limits • travel management plans • spill and emergency response planning • driver training.	Probability: highly unlikely Severity of consequence: moderate Overall risk: low
Solvent extraction fire or explosion	Identified as a bounding potential accident during operation whereby damage to equipment or vessels containing uranium-bearing solutions in the solvent extraction building result in fire or explosion and release	Mitigation measures proposed by the proponent include: • adequate engineering design control • fire suppression system in solvent extraction building and on site fire protection system	Probability: unlikely

	uranium to the environment and expose members of the public to airborne uranium.	• no potential sources of ignition or static electricity in the solvent extraction building • regular and preventive inspection, testing, and maintenance programs • emergency preparedness and response program • air quality monitoring program	Severity of consequence: minor to moderate Overall risk: low
Tailings transfer pipe or pump failure	Identified as a bounding potential accident during operation whereby the failure of tailings transfer pipe, or pump could result in the release of tailings and radioactivity to the environment, and then result in potential impacts on groundwater, soils, vegetation, and wildlife	Mitigation measures proposed by the proponent include: • adequate engineering design control • secondary containment at locations where a pipe rupture could release tailings to surface • emergency power system • comprehensive pipeline monitoring, inspection, and maintenance programs • effective environmental protection, and emergency preparedness and response programs	Probability: likely Severity of consequence: minor Overall risk: low
Untreated effluent transfer pipe failure	Identified as a bounding potential accident during operation and decommissioning, which could result in the release of untreated effluent from the piping system to the environment affecting surface water, soils, vegetation, and wildlife.	Mitigation measures proposed by the proponent include: • adequate engineering design control • comprehensive pipeline monitoring and leak detection system • emergency power system • adequate inspection and maintenance programs • effective environmental protection, and emergency preparedness and response programs	Probability: likely Severity of consequence: minor Overall risk: low
Acid plant tail gas scrubber failure	Identified as a bounding potential accident during operation, whereby the failure of acid plant tail gas scrubber could result in the release of acid gas to atmosphere resulting in potential impacts on air quality and human health.	Mitigation measures proposed by the proponent include: • effective sulphur dioxide gas detection system in the acid plant • implementation of regular and preventive inspection and maintenance program • ambient air quality monitoring • emergency preparedness and response program	Probability: likely Severity of consequence: minor to moderate Overall risk: low to moderate

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Table 8.2: Traffic accident scenarios, proposed mitigation measures, and risk characterization

Type of Traffic Accident	Description	Mitigation Measures	Risk Characterization
Traffic accident and aquatic release of uranium concentrate or other hazardous materials	Traffic accidents during construction, operation, and decommissioning where a vehicle transporting packed uranium concentrate or other hazardous materials, is involved in a rollover, collision, or run off road at the junctions between the Clearwater River and Highway 955, the Canoe River and Highway 155, the Beaver River and Highway 155, and at a small bay in the south part of Churchill Lake next to Buffalo Narrows. Such an accident could result in a release of uranium concentrate or other hazardous materials into the surface water at these locations and subsequent downstream transport of radioactive or hazardous materials resulting in potential impacts on surface water, sediments, aquatic species, wildlife, and human health.	Mitigation measures proposed by the proponent include: • traffic control measures such as speed limits • travel management plans • environmental protection and emergency preparedness and response programs • driver training	Probability: highly unlikely Severity of consequence: moderate Overall risk: low
Traffic accident and terrestrial release of uranium concentrate or other hazardous materials	Traffic accidents during construction, operation, and decommissioning where a vehicle transporting packed uranium concentrate or other hazardous materials, including a rollover, collision, run off road could result in a release of uranium concentrate or other hazardous materials on land (during summer and winter seasons) causing potential impacts on groundwater, soils, vegetation, and wildlife.	Mitigation measures proposed by the proponent include: • traffic control measures such as speed limits • travel management plans • environmental protection and emergency preparedness and response programs • driver training	Probability: likely Severity of consequence: minor Overall risk: low
Traffic accident and atmospheric release of uranium concentrate or	Traffic accidents during construction, operation, and decommissioning where an accident (with and without fire) involving a vehicle transporting packed uranium concentrate or other hazardous materials, including a rollover, collision, run off road could result in airborne	Mitigation measures proposed by the proponent include: • traffic control measures such as speed limits • travel management plans	Probability: unlikely (typical weather condition) to highly unlikely (worse-case weather condition)

Type of Traffic Accident	Description	Mitigation Measures	Risk Characterization
other hazardous materials	release of uranium concentrate or other hazardous materials causing potential impacts on air quality and human health.	• environmental protection and emergency preparedness and response programs • driver training	Severity of consequence: minor Overall risk: low
Vehicle-human collision	Collisions between a project-related vehicle and a member of the public within the communities along the transportation route could result in injury or death of the person	Mitigation measures proposed by the proponent include: • traffic control measures such as speed limit and adjustment • travel management plans • the right of way for the public • emergency service program • driver training	Probability: highly unlikely Severity of consequence: Major-Catastrophic Overall risk: moderate
Vehicle-wildlife collision	Collisions between a project-related vehicle and wildlife along the transportation route could result in wildlife mortality.	Mitigation measures proposed by the proponent include: • traffic control measures such as speed limit and adjustment • travel management plans • the right of way for wildlife • identification of wildlife areas or movement corridors and crossings • driver training	Probability: very likely Severity of consequence: minor Overall risk: low

Of the six on site bounding scenarios, five were determined to be low risk taking into account proposed mitigation measures. The potential failure of the acid plant tail gas scrubber was deemed to be low to moderate risk. However, given that the risk would be managed with gas sensors, regular inspections and maintenance, and on-site emergency response, and minimal off-site exposure, no additional mitigation was deemed necessary. For the five main traffic accident scenarios, four were determined to be low risk taking into account proposed mitigation measures while the vehicle-human collision was found to be moderate risk. Given the proposed safeguards and mitigation measures, this risk was deemed to be tolerable and as low as reasonably practicable.

In the draft EIS, the proponent did not assess the potential radiological effects of accidents and malfunctions on the health and safety of workers. As per CNSC staff's request, the proponent assessed the effects of potential accidents and malfunctions on workers' safety including estimates of radiological dose through hazard identification, screening, risk measurement, and risk evaluation. Of twenty-two potential radiological hazards, five hazard scenarios were identified as bounding scenarios for more detailed risk analysis including dose calculation as is shown in table 8.3 below. The dose acceptance criteria for all scenarios listed in the table are the dose limits for Nuclear Energy Workers stipulated in the *Radiation Protection Regulations*. For all scenarios listed in the table, the predicted worker doses are below these dose acceptance criteria.

Table 8.3: Bounding accidents and malfunctions for workers safety assessment, proposed mitigation measures, and risk characterization

Type of Accident and Malfunction	Location	Likelihood	Predicted Worker Dose	Estimated Effects Consequence	Overall Risk Rating
Vehicle accident including rollover, collision, resulting in fire and dusting	Access Road	Likely	0.70 mSv	Moderate	Moderate
Process vessel including leach tanks and piping system failure	Mill processing facility	Highly unlikely	0.048 mSv	Negligible	Low
Solvent extraction fire or explosion	Solvent extraction building	Unlikely	2.17 mSv	Minor	Low
Failure of tailings/ paste pipes and pumps	Paste plant and paste delivery/ Underground tailings management facility	Likely	0.017 mSv	Negligible	Low

Type of Accident and Malfunction	Location	Likelihood	Predicted Worker Dose	Estimated Effects Consequence	Overall Risk Rating
Ventilation disruption and radon accumulation in the mine	Underground mine	Unlikely	4.92 mSv*	Negligible	Low

* Conservative value provided. Values range from 0.000034 mSv to 4.92 mSv

Of these bounding scenarios, all doses are less than the regulatory limit for Nuclear Energy Workers (20 mSv), and only the vehicle accident including rollover, collision, resulting in fire and dusting scenario was deemed to be a moderate risk. Given that the risk would be managed to be as low as reasonably practicable by implementation of proper emergency response plans and radiation protection plans, this risk was deemed to be tolerable, and no further mitigation was deemed necessary by the proponent.

Overall, based on the assessment of accidents and malfunctions, the Proponent anticipated that potential effects could be addressed through engineering design and compliance with regulatory requirements and industry best practices that reduce risks associated with the hazard scenarios to as low as reasonably practicable. Based on this assessment, the risks of accidents and malfunctions were characterized as tolerable.

8.1.2. Other Views Expressed

Indigenous Nations and Communities

CRDN had previously noted concerns that an accident or malfunction would be devastating for the Nations members and traditional lands. In addition, CRDN had previously indicated that an operating uranium mine and mill could increase the risk of surface and groundwater containing COPCs and being released as a result of an accident, malfunction or unplanned event. NexGen found that of 6 most hazardous scenarios out of 93 accident and malfunction hazard scenarios, five were determined to be low risk overall. The acid plant tail gas scrubber failure was deemed to be low to moderate risk but would be managed to be as low as reasonably practicable and deemed as tolerable with no further mitigation measures necessary.

MN-S requested NexGen complete a hazard scenario related to vehicles be included in the EIS. NexGen indicated that vehicle malfunctions and three types of accidents leading to vehicle fires were assessed, which showed that risks would be low to moderate, with mitigation resulting in the risk to be as low as reasonably practicable. MN-S noted concerns of materials being hauled from Highway 955 and Highway 155 at Green Lake to the Project site and that there were no mitigations provided for reducing the potential for accidents on this stretch of road. NexGen confirmed that the spatial extent of transportation risk was appropriately assessed, as accident rates on larger highway systems are lower than on smaller roads and very few incidents have been reported despite hazardous chemicals being transported through freeways on a national scale, and effects in the area are similar to those assessed for Highway 955 and Highway 155 while being more accessible to response transportation. MN-S indicated that in the event of a traffic accident resulting in a release of uranium concentrates, fuel or hazardous chemicals pose a risk to the environment, as well as a risk to initiating a fire or explosion, beyond the aquatic environment, which poses additional risks to the environment and human health. NexGen confirmed that these potential hazards including the consideration of fires have been considered and either possess low risk or would be managed to present as low as reasonably practicable risks. MN-S noted concerns that the proposed mitigations contained in the Ground Transportation Emergency Response Plan did not specifically mention Indigenous land and resource users in order to maintain the safety of Indigenous land and resource users utilizing Project area roads. NexGen noted that Indigenous land and resource users and Indigenous trappers are mentioned in the plan, and detailed development of the plan will occur during licensing (licence to prepare site and construct) and involve engagement with primary Indigenous Nations and communities.

BRDN indicated concerns regarding the safety and truck transportation, including the number of trucks on the road that would increase the risk of an accident, and any subsequent spills that may result. NexGen confirmed the potential for accidental spills due to traffic accidents were assessed in the EIS and noted mitigating factors including future upgrades to existing access roads, speed limits for the access road and Clearwater River Bridge crossing, clear signage and the issuance of no-travel orders in unsafe conditions.

BNDN indicated concerns that pipeline leaks could cause localized flooding and radiation exposure, and recommended that NexGen use pressure sensors, automated shutoff valves, and fiber-optic leak detection, and additionally verify infrastructure functionality before operation begins.

YNLR supported NexGen's consultation with Indigenous peoples regarding accidents and malfunctions. YNLR noted concerns about the increased traffic between La Loche and the Project site and the increased risk for vehicle accidents as well as accidents with wildlife. YNLR also noted concerns on how the increase in traffic may impact moose in the Project area. YNLR inquired if the associated increase in traffic as a result of the Project will be considered to impact air quality and noise in the EIS. YNLR also inquired if dust along Highway 955 from the increase in Project-related traffic would be mitigated/controlled in the same manner as the Project-area roads. NexGen has committed to implementing mitigation measures to minimize potential effects of accidents, including the development of a Ground Transportation Emergency Response Plan, providing pedestrians, cyclists, and wildlife right of way, advising staff and contractors to reduce speed when wildlife is observed on the road, and providing training on how to drive safely along the transportation route in order to avoid collisions with wildlife such as moose. NexGen has committed to having discussions with the Saskatchewan Ministry of Highways to develop a road upgrade and maintenance agreement to mitigate dust.

8.1.3. CNSC Staff's Analysis

In reviewing the proponent's assessment of accidents and malfunction in the draft EIS, CNSC staff advanced 20 information requests (IRs) [9] among which eight IRs are related to on site accident and malfunction assessment and twelve IRs are related to the transportation accident assessment. The proponent provided satisfactory responses to the IRs [9] [10].

As described in section 8.1.1, the proponent initially did not include an assessment of potential radiological and non-radiological impacts of the project on the health and safety of all persons on-site, during normal operations and during accidents and malfunctions (persons on-site in this context are NEWs and persons who are not NEWs may incur occupational exposures). The proponent was requested to identify all associated hazards and screen them as to potential risks for bounding scenarios [9] for workers' safety. In response, the proponent revised the EIS with Appendix 15A, providing a summary of radiological and non-radiological effects on the health and safety of workers, including potential effects of accidents and malfunctions (Appendix 15A2.4).

CNSC staff found the proponent's revision to the EIS [11] and assessment of Accidents and Malfunctions to be appropriate. Potential accidents and malfunctions during construction, operation, and decommissioning of the project and their potential impacts on human health and safety, and the environment were identified, characterized, and evaluated by the proponent through a systematic approach. The dose acceptance criteria, the methodology for the assessment of radiological consequences, and the calculated dose rate to both on-site and off-site workers are adequate. CNSC staff concur with the proponent's conclusion that the risk of the project associated with accidents and malfunctions is characterized as tolerable, taking into account the design features, the proposed mitigation measures, and the emergency response procedures.

8.1.4. CNSC Staff Findings and Recommendations

Taking into account the implementation of mitigation measures and emergency response procedures, and the views and concerns expressed by Indigenous Nations and communities, CNSC staff conclude that NexGen's assessment of potential accidents and malfunctions associated with the Project are not likely to cause significant adverse effects on health, safety of workers and the public, and on the environment.

There are no issues requiring follow-up for this component area. CNSC staff will work with NexGen to ensure NexGen communicates spills, and other accidents and malfunctions to identified Indigenous Nations and communities on the Project and provide follow-up engagement activities as part of their Emergency Response Plan.

8.2. Effects of the Environment on the Project

Pursuant to section 19(1) (h) of CEAA 2012, the EA of a designated Project must take into account any change to the Project that may be caused by the environment, including extreme and periodic weather events. These factors may damage project components and increase the potential for accidents and malfunctions (section 8.2).

8.2.1. Proponent's Assessment

The proponent carried out an assessment of potential adverse effects of the environment on the Project [9]. The assessment focuses on the effects of potentially significant natural hazards and climate change on the Project. Accidents and malfunctions, which are not caused by natural hazards, are assessed separately.

8.2.1.1. Assessment of Effects of Natural Hazards

The assessment of potential effects of natural hazards on the Project included risk assessment of how natural hazard may affect project infrastructure and activities during different phases of the project and included the following steps:

- Natural Hazard Scenario Identification that involves identification of pertinent natural hazards and hazard scenarios that may affect the Project infrastructure and activities.
- Environmental design Features Evaluation that involves identifying environmental design features, planning (management practices) and other mitigation to avoid or minimize the risk of hazards.
- Risk Measurement that involves the classification of each hazard scenario according to the likelihood (e.g. almost certain to highly unlikely) and consequence (severity) (e.g. negligible to catastrophic) to arrive at an overall residual risk level associated with each hazard scenario. The criteria for this qualitative risk measurement can be found in table 22.4-1 and table 22.4-2 of the EIS.
- Risk evaluation that involves assigning overall residual risk levels (e.g. Low to High) to each hazard scenario to determine the required additional mitigation measures to lower the severity of the potential effects of the hazard on the Project. The criteria for this qualitative risk evaluation can be found in table 22.4-3 and table 22.4-4 of the EIS.

Through the process, the proponent identified the following major natural hazards (identified in table 8.4), potentially impacted project components, and the corresponding environmental design features of the Project to mitigate any effects on the Project. Where applicable, proposed mitigation measures, residual risk levels after implementation of environmental design features and mitigation measures, also identified as in table **Error! Reference source not found.**8.4 below. The impact of current climate and predicted future climate in the region on the evaluation of project design parameters related to weather related hazards was also considered and is discussed in the next section.

Table 8.4: Potential effects of the environment on the Project

Natural Hazard	Hazard Scenario	Project Component/ Activity	Environmental Design Features and Mitigations
Seismic events	• Damage to or failure of structural stability of Project infrastructure on surface • Damage to or failure of structural stability of underground mine workings • Damage to or failure of structural stability of the WRSAs	Mine and mill buildings, infrastructures, and equipment	• NexGen's Rook I Project in Northern Saskatchewan is located in the region of Canada with the lowest seismic activity. There is a low probability that a major seismic event would occur in the area of the Project. • NexGen will appropriately design all buildings and other mine and mill infrastructures to meet the standards of the latest edition of the National Building Code of Canada (NBCC 2020), which are expected to mitigate any risk from seismic events.
Wildfire	• Danger to worker safety, discomfort, and unhealthy working conditions due to smoke inhalation • Loss of access to the site • Fire reaching primary fuel	Mine and mill buildings, infrastructure, equipment	Forest fires are likely in the project location. NexGen will appropriately design facilities and operate the site in accordance with Fire Protection Program to be developed specific to the project. NexGen will consider the projected increase of forest fire frequency and severity due to climate change. NexGen will also have Emergency Response Program that will include information on how to prevent and suppress forest fires near the Project that include fire guards, on-site emergency response equipment and fire water system. This information has not yet been provided and will be

Natural Hazard	Hazard Scenario	Project Component/ Activity	Environmental Design Features and Mitigations
	and liquified natural gas storage tanks and the surface explosives magazine • Damage or loss of Project infrastructure • Loss of reclaimed areas		reviewed during future phases of CNSC's regulatory processes, prior to licensing to operate. NexGen's Emergency Preparedness and Response Program for the Project will provide detail and clarity regarding fire response plans for all fire related hazards.
Major precipitation events	• Impeded movement • Flooding in building areas • Water Management Infrastructure overflow • Mine Inflow Event • Slope Stability failure (Ore and Waste Rock Storge) • Erosion of the engineered cover (WRSAs)	Mine buildings and site infrastructures (e.g. site water infrastructure, Ore and Waste Rock Storage Areas, Mine Shaft and Underground workings)	• NexGen will manage risks associated with major precipitation events through design criteria and management practices. • Project related buildings and structures will be designed in accordance with NBCC 2020 to prevent flood damages to infrastructure. • NexGen will consider major precipitation events in the design of water management infrastructure so that contact water and non-contact water are appropriately managed to prevent uncontrolled releases to the environment. • NexGen will design the site water infrastructure to maximize the diversion of non-contact surface runoff away from developed features. • NexGen will ensure runoff in contact with potentially contaminated areas will be captured, collected, and directed to site runoff ponds and collection areas, followed by monitoring and treatment, prior to planned releases. • NexGen will design all ponds, collection areas and collection systems for mineralized contact water to accommodate a PMP of 24-hour precipitation event. • NexGen will design diversion ditches for non-contact water to accommodate a minimum of 1:100 year 24-hour precipitation event. • NexGen will design WRSAs and special waste rock and ore storage stockpiles with a stable slope angle (4:1) and appropriate water

Natural Hazard	Hazard Scenario	Project Component/ Activity	Environmental Design Features and Mitigations

			drainage, collection and storage features to mitigate risk of slope stability failures due to extreme precipitation.
			• The risk of erosion of the cover system for WRSAs is reduced by design slope, progressive reclamation and establishment of vegetation on cover system.
			• NexGen will implement mitigation measures during all phases of the project to avoid and limit the effects of major precipitation events on site water infrastructure and underground min workings, including but not limited to the following:
			  ◦ Maintain channel integrity of diversion and collection ditches
			  ◦ Routine inspection and maintenance of containment and conveyance structures, and local erosions of cover systems
			  ◦ NexGen will have an Emergency Preparedness and Response Program for the Project that will include processes for responding to and mitigating the effects of major precipitation events, etc.

Drought	• Inadequate water supply • Drought condition affecting revegetation	Mining, processing and waste management water demands and site reclamation activities (e.g. revegetation)	• NexGen will manage drought through design criteria and water management processes. • NexGen will implement design features that will limit the Project footprint to the extent possible to minimize areas of reclamation. • NexGen intends to recycle process water, thereby reducing the demand for a fresh water supply • NexGen will undertake water management planning periodically to optimize water usage. • NexGen will collect and treat groundwater recovered from underground mine workings that will ensure more water released to Patterson Lake than withdrawn. (construction & operation phase) • NexGen will develop Preliminary and Detailed Decommissioning and Reclamation Plan that reflects mitigations necessary to avoid and limit the effects of drought on revegetation efforts that include progressive reclamation and revegetation using native and drought resistant species.

Natural Hazard	Hazard Scenario	Project Component/ Activity	Environmental Design Features and Mitigations
			• NexGen will apply adaptive management to verify reclamation objectives are met.
Severe Snowstorms	• Impeded Movement • Pond Overflow • Building Collapse	Mine and mill buildings, mining activities and site water infrastructure	• NexGen will manage risks associated with Severe Snowstorms through design criteria and management practices. • NexGen design of surface water management systems will include consideration of snow accumulation and site drainage would be designed to divert or collect runoff under 100-year flood or PMP events as appropriate to the facility. • NexGen will design buildings according to appropriate codes such as NBCC 2020 (Part 4) to withstand design snow load. • NexGen will control movement of vehicle traffic as well as aircraft during severe snowstorms as Canadian Aviation Regulations and Standards • NexGen will have an Emergency Preparedness and Response Program that include an emergency prevention and response process for heavy snowfall events.
Extreme temperatures	• Extreme Cold • Extreme Heat • Heat Fluctuations (Freeze-thaw Cycle)	Mine and mill buildings, site infrastructures, pipes and equipment and machinery	• NexGen will select suitable equipment and design systems for the Project to enable operation under extreme temperatures. • NexGen will design the ventilation system for their underground mine considering maximum working temperature as per NexGen's ventilation design criteria documentation. • NexGen will design HVAC and power systems in accordance with building codes and standards that are used to design and construct infrastructures appropriate for local climate to mitigate risk of overwhelming capacity of HVAC and power systems. • NexGen will design, construct and operate project infrastructures including pipes and equipment to be resilient to extreme cold as per standards designed for regional weather. • NexGen will design WRSAs cover systems to withstand cold climate and increasing temperatures as per design and construction guidance

Natural Hazard	Hazard Scenario	Project Component/ Activity	Environmental Design Features and Mitigations
			manuals such as '*MEND Report 2.21.4A Design, Construction, and Performance Monitoring of Cover Systems for Waste Rock and Tailings*' and '*MEND Report 1.16.5c Cold Regions Cover System design*'. • NexGen will implement mitigation measures during all phases of the project to avoid and limit the effects from freeze-thaw cycles such as winterization of mechanical equipment, routine inspection and maintenance of site infrastructures (e.g. roads, airstrips and WRSA).
Tornadoes/ Severe Thunderstorms	• Tornado Damage • Lighting Damage • Soil Erosion	Mine and mill buildings, site infrastructures, waste management	• NexGen's Rook I Project is located withing the F0 to F1 zone where the occurrence of tornadoes of magnitude greater than F1 is very rare. Tornados classified as F01 or F1 are not expected to cause any significant damage to Project infrastructures. • NexGen will appropriately design all buildings and other mine and mill infrastructures to meet the standards of the latest edition of the National Building Code of Canada (NBCC 2020), which are expected to mitigate any risk from tornados. • NexGen will manage risks associated with Severe thunderstorms or tornadoes through design criteria and management practices. • NexGen will design facilities according to appropriate codes such as NBCC 2020 to mitigate any risk from tornado, lightening damage. • NexGen would vegetate the cover system of WRSAs (NPAG and PAG) to reduce the potential for soil erosion from wind and water. • NexGen will have an Emergency Preparedness and Response Program that includes emergency prevention and response procedures for tornados and severe thunderstorms • NexGen will develop Preliminary and Detailed Decommissioning and Reclamation Plans that reflect mitigations necessary to avoid and limit the effects of major precipitation events or high winds on cover systems of WRSAs.

The proponent assessed the estimated risk level associated with natural hazards (Table 8.4) on the Project, after considering the potential effects of future climate change, and implementation of environmental design features and mitigation practices. The result of the assessment indicates (shown in Table 8.5 below) that the overall risk associated with most natural hazards are low, except for wildfires and extreme temperatures, where the overall risk level is moderate.

Table 8.5: Summary of estimated risk level associated with natural hazards on the Project (adopted from table 22.7-1 of the EIS, p.22-42)

Natural Hazard	Project Phase	Likelihood	Consequence	Risk Level
Wildfires	All phases	Unlikely to Likely	Minor to Major	Low to Moderate
Drought	All phases	Highly Unlikely to Unlikely	Negligible to Moderate	Low
Major precipitation events	All phases	Highly Unlikely to Very Likely	Minor to Moderate	Low
Severe snowstorms	All phases	Unlikely to Very Likely	Minor to Moderate	Low
Tornados / severe thunderstorms	All phases	Highly Unlikely to Likely	Minor	Low
Extreme temperatures	All phases	Unlikely to Likely	Negligible to Moderate	Low to Moderate
Seismic events	All phases	Highly Unlikely	Minor to Moderate	Low

In summary, the proponent's environmental design features and mitigation measures related to extreme weather events: major precipitation events, drought, extreme temperatures, severe snowstorms, tornados and severe thunderstorms include using engineering best practices and meeting current regulations and building codes. The proponent will design site water management infrastructures (e.g. ponds, ditches, collection areas) for contact water (runoff that comes in contact with potentially contaminated areas of the Project Area) to safely collect, convey and store 24-hour PMP extreme precipitation event with sufficient design freeboard. The design of site surface water infrastructure for diversion or collection and conveyance of non-contact runoff will be based on the 100-year 24-hour rainfall event design criteria. The special waste rock, ore storage stockpiles and Potentially Acid Generating (PAG) Waste Rock Storage Areas (WRSAs) runoff collection areas will be designed to be self-contained by perimeter berms to retain contact runoff from a PMP event besides additional continency ponds to provide flexibility for site surface water management during extreme weather events.

The Proponent expects that potential effects of the environment on the project during all phases (construction, operation, decommissioning and closure), particularly for seismic events and extreme weather events, could be addressed through engineering design and compliance with industry best practices. Based on this assessment, adverse effects of these events on the project's components and activities during all phases of the project is unlikely and residual risks to the Project are assessed to be low as presented in table Table 8.5.

8.2.1.2. Assessment of Effects of Climate Change

The proponent carried out an assessment of potential adverse effects of climate change on the Project. Note that effects of climate change were also considered as part of the effects assessment for each valued component (e.g. fish and fish habitat, etc.) or intermediate component (e.g. water quantity and quality, etc.) and are discussed in section 6 and section 7 and more details can be found in the EIS. The assessment in this section focuses on the effects of climate sensitive natural hazards on the Project with consideration of climate change during all phases of the project. The climate change assessment by the Proponent was conducted in the following steps:

- Development of climate change dataset (current and projected future climate)
- Evaluation of climate-infrastructure interactions of the Project
- Assessment of Climate Vulnerability of Project Activities

Climate Change Data and Trends

The proponent developed local and regional climate change datasets to evaluate Project design parameters considering current and projected future climate trends. The site-specific climate projection data is based on percentiles of multi-model ensemble of 24 different Global Climate Models (GCMs) and three emission scenarios, represented by representative concentration pathways (RCPs): RCP 2.5 (low emission), RCP 4.5 (moderate emission) and RCP8.5 (high emission) of the Coupled Model Intercomparison Project Phase 5 (CMIP5) of each climate variables obtained from ClimateData.ca prepared by Canadian Center for Climate Services. The climate model projections data comprises statistically downscaled modelled baseline (1981-2019) and future time horizons of 2050s (2041-2070) and 2080s (2071-2100) in line with the estimated project lifespan (43 years). The estimated timeline for construction is 4 years (2023 to mid-2026), 24 years (mid-2026 to mid-2049) for operation followed by Closure, which will take approximately 15 years.

To understand how climate is projected to change in the area of the Project, the proponent derived future changes in climate statistics of probable maximum precipitation (PMP), rainfall statistics (across durations and return periods), evapotranspiration, and extreme rainfall and snowmelt events whose details can be found in Appendix 22A5 of the EIS. For example, table 22A-22 and table 22A-23 present probable maximum precipitation and projected changes in IDF curves, respectively. The proponent assessment of climate data at the project site shows that the projected future climate extremes indicate a future that is likely to be warmer and wetter on an annual basis. The annual temperatures and annual precipitation are projected to increase by 2.4°C and 3.2°C and by 7% and 8%, in 2050s and 2080s, respectively. The one-day PMP values are projected to increase by 12% and 16% in the 2050s and in 2080s respectively. The 100-year, one-day rainfall events are projected to increase by 2% and 14% by 2050s and 2080s respectively. The annual potential evapotranspiration is expected to increase by 11.1% and 13.6% by the 2050s and 2080s respectively. The 100-year, one-day extreme rainfall and snowmelt events are projected to decrease by 0.4% by 2050s and increase by 4% by 2080s. The overall effect of climate change on wildfires is difficult to predict, but it can be conservatively assumed that fire intensity may increase due to warmer temperatures, in addition to frequency increasing due to additional lightning storms and longer fire seasons each year.

Climate-Infrastructure Interactions

The proponent assessed the interaction of potential climate events (e.g. extreme precipitation, extreme temperature, high winds, lightning, storms, changes in snowfall) with different surface and underground infrastructure components of the Project. The proponent identified all Project infrastructure components (e.g. surface drainage infrastructure, buildings, ore and waste storage areas, etc.) and all potential weather related or climate sensitive natural hazards that include temperatures (extreme heat, extended cold spell, freeze-thaw cycle), precipitation (major precipitation events and severe snowstorms) and extreme events (droughts, high winds and wildfire). The proponent then identified whether climate-infrastructure interactions exist for each infrastructure components by assessing whether the weather-related natural hazard will have any impact on the project component without considering any mitigation measures. The proponent finally presented the mechanism of the interaction and the associated climate impacts for each component where climate-infrastructure interactions are identified. The presented climate-infrastructure interactions by the proponent are based on the detailed climate dataset that describes the current and projected changes in mean temperature and precipitation, along with background information on changes in the extreme weather events. Further details on climate-infrastructure interactions for Surface and Underground Infrastructure of the Project are included in table 22B-1 and table 22B-2 of the EIS respectively.

Climate Vulnerability of Project

The proponent assessed climate vulnerabilities by project activity based on findings of climate - infrastructure interactions. The assessment of climate vulnerability of Project activities identified the climate vulnerabilities of the physical works and activities during all phases (Construction, Operations, Decommissioning and Reclamation or Closure) of the project by considering how the Project activities associated with any infrastructure or component identified in the climate - infrastructure interactions (table 22B-1 and table 22B-2 of the EIS may be vulnerable to climate. The vulnerabilities have been identified for climate events such as major precipitation events, drought, wildfire, etc. relevant to each phase of the project based on current and projected climate conditions. The vulnerability assessment also provided description of the identified vulnerabilities as well as the mitigation measures to withstand projected climate conditions. The outcome of climate vulnerability assessment is reported in table 22B-3 of the EIS which provides an overview of the identified vulnerabilities by physical work or activity associated with the

Project. In the assessment, the proponent noted that the impact of climate change on Project activities varied with the project phases. The short time frame for the construction phase means the potential for meaningful interactions with the climate trends outside of the normal seasonal variation experienced in the region is expected to be small and so is the vulnerability. However, the proponent determined that there is a greater potential for meaningful interactions with the projected climate trends in both the climate mean and extreme weather events during Operation and Closure, and in the longer-term after Closure.

Overall, based on the assessment of effects of climate change related hazards that will affect the project, the Proponent expect that potential effects will be addressed through consideration of the predicted changes in climate conditions that could occur during its lifecycle into the environmental design features and mitigation measures identified in Table 8.4 and through engineering design and compliance with codes and standards that provide sufficient margins of safety to prevent damage to Project infrastructure from climate sensitive hazards. The design of site water management infrastructure for contact water using 24-hour PMP event as design criteria is expected to consider uncertainty related to climate change and expected to provide adequate provisions to manage any potential increase in extreme precipitation events. The proponent will also incorporate additional climate change provisions into the 1:100-year 24-hour design storm event in the design of non-contact water collection and conveyance system. The design of Project Infrastructure and operation of the site will take the projected increase of wildfire frequency and severity due to climate change into consideration. In addition, although the mitigation measures have the potential to reduce climate risks, the proponent will monitor their performance through an ongoing monitoring and surveillance process. As a part of incorporating climate change into the continual improvement process for the Project, the proponent has developed Climate Adaptation Framework based on guidance from Mining Association of Canada. The framework will be used by the proponent to develop climate adaptation strategy for the Project that will include conducting detailed quantitative climate change risk assessment, identification of adaption pathways and timing of their implementation and developing monitoring and surveillance plan to improve climate resilience of the Project.

The proponent also will apply and iteratively update their adaptive management plan over the project lifetime and will integrate results of monitoring programs to verify effectiveness of resilience and mitigation actions and manage the unexpected outcomes so that they can proactively mitigate or prevent adverse climate effects on the Project. Moreover, NexGen's Climate Adaptation Framework would be used to support future climate risk assessments for the Project and the proponent has committed to identify and manage the projected climate risks as a part of their continual improvement process for Operation and Closure through the Climate Adaptation Framework and development of climate adaptation strategy. Based on this assessment, adverse effect of climate change on the project's components and activities is unlikely and the associated residual risks is assessed to be low.

8.2.2. Other Views Expressed

8.2.2.1. Potential Impacts as a result of climate change

Indigenous Nations and Communities

MN-S had previously noted that the climate change analysis contained in the EIS was qualitative and high-level and that some of the assumptions made regarding climate change effects may be too simplistic. MN-S also noted that monitoring programs do not consider climate change. MN-S had previously raised questions of whether the warmer effluent being released, interacting with the potential for climate change to also raise water temperatures, to affect lake trout habitat sooner than predicted. MN-S had previously indicated it was not clear if the risk measurement and evaluation for tornado damage considered climate change. NexGen noted that a quantitative climate change assessment was conducted with estimated prediction incorporated into the hydrology assessment. NexGen committed to conducting detailed scoping and development of EMP details during licensing (licence to prepare site and construct) including Indigenous engagement. NexGen committed to capturing and storing treated effluent at ambient temperatures prior to release to Patterson Lake such that it is not expected to result in changes to water temperatures or volumes that would affect trout. Finally, NexGen confirmed that the effects of climate change were considered in the assessment of all weather or climate-related hazards.

BNDN noted concerns that NexGen's EIS acknowledged the Project's contribution to climate change through GHG emissions however, the Project has not committed to a climate change offset plan such as other mining projects in Canada have. NexGen noted that the development of such an offsetting plan is outside the scope of the *Canadian Environmental Assessment Act, 2012*, however the Project will be subject to provincial and federal GHG reporting requirements and limits. NexGen is supportive of discussion with the BNDN for further GHG reduction mitigation.

YNLR indicated they believe that the Project increases impacts to woodland caribou and that impacts from the project will combine with predicted impacts from climate change to further adversely impact caribou habitat. NexGen has committed to developing a CMOP through engagement with the Saskatchewan Ministry of Environment, federal regulatory agencies, and primary Indigenous Nations and communities to meet legislated requirements and align with the goals of potentially impacted Indigenous Nations and communities.

ACFN identified data and assessment gaps, and methodological deficiencies in climate change data components that render the assessment of the effects of climate change unreliable. ACFN requested that the future climate predictions include the full extent of climate change expected during the Project lifespan. ACFN also requested clarification if climate change-induced effects on surface water temperatures included climate change scenario. NexGen has maintained that assessment of the effects of climate change is accurate; in addition to the independent assessment of climate change effects relative to the Base Case, four sensitivity scenarios were modelled to account for uncertainty in projections and quantify sensitivity of the model to the range of potential climate change effects. NexGen confirmed that projected climate change predictions include the anticipate Project lifespan and the monthly climate change factors developed for the 2050s include data from 2041 through 2070. NexGen noted that climate change induced effects on surface water temperature were not included in the scenarios assessed, however they were not expected to influence the findings of the EA should they be found.

8.2.3. CNSC Staff's Analysis

CNSC staff have reviewed the information provided in the EIS on effects of the environment on the project. CNSC staff confirm that the proponent has identified all relevant natural hazards at the project site that include seismic events, wildfires, major precipitation events, severe snowstorms, high winds (tornado/severe thunderstorms) and extreme temperatures, and that their potential impacts on the project performance (project activities and infrastructure) are described, and appropriate environmental design features and mitigation measures identified to address the potential adverse effects. The proponent's assessment also considered climate change in design features and mitigation measures to account for effects of future modification of climate sensitive natural hazards.

8.2.3.1. Seismic Events

In the review of the proponent's assessment, CNSC staff put forward one information request (IR-202) with regards to the effects of seismic events on the Project. The proponent provided clarification on the inconsistent information on probability and return period for the seismic event considered for the Project. The proponent satisfactorily responded to the IR. CNSC staff found that the proponent's proposed design features and mitigation measures for all phases of the Project are acceptable and expected to sufficiently mitigate the risk from seismic events in the area of the project.

8.2.3.2. Wildfires

CNSC staff have reviewed NexGen's assessment of effects of wildfires on the project that included consideration of climate change. CNSC staff have confirmed that NexGen conducted a sufficient assessment of wildfires at the project site and that the identified design features and mitigation measures are acceptable and will be adequately addressed through the CNSC's regulatory processes.

Provincially, under Section 20(1) of Province of Saskatchewan's *The Wildfire Act*, northern industrial and commercial operations must prepare and submit to the minister for consideration a wildfire prevention and preparedness plan. The province has indicated that there were no outstanding review comments related to this topic area and that they will review the facility's emergency response plan as part of permitting, under the *Environmental Management and Protection Act, 2010*.

As part of the CNSC's licensing process CNSC staff have reviewed NexGen's preliminary fire protection program and fire protection assessments. Once available, CNSC staff will review the updated fire protection assessments to verify that NexGen has met all applicable regulatory requirements, including those outlined in CNSC regulatory documents and referenced codes and standards, as well as detailed fire protection design and construction documents.

Given the federal and provincial regulatory oversight related to fire protection, CNSC staff are satisfied with NexGen's assessment of wildfires.

8.2.3.3. Drought

CNSC staff have reviewed NexGen's assessment of effects of drought on the project during all phases of the project and confirmed that NexGen conducted a sufficient assessment of drought at the project site and that identified design features and mitigation measures are adequate.

8.2.3.4. Major Precipitation Events

CNSC staff have reviewed NexGen's assessment of effects of major precipitation events such as severe rainstorms, snowmelts or flooding on the project during all phases of the project and confirmed that NexGen conducted a sufficient assessment of hazard scenarios related to major precipitation events at the project site and that identified design features and mitigation measures are adequate. NexGen plans to design surface water management infrastructure based on the 100-year return period, 24-hour precipitation event (non-contact runoff) and 24-hour PMP extreme rainfall event (for mineralized contact runoff) that consider uncertainty related to climate change. These design criteria are acceptable to CNSC staff to ensure adequate capacity for diversion, collection, conveyance and storage of contact and non-contact runoff generated at project site during major precipitation events expected during the lifetime of the project. In the review of the proponent's assessment, CNSC staff and other Federal Indigenous Review Team (FIRT) participants reviewed the NexGen's estimates of 24-hour PMP as well as proponent's approach to factoring climate change into the 24-hour PMP and 100-year precipitation in the design of water management infrastructure and reiterated the estimates to be updated or revisited during the licensing phase (licence to prepare site and construct), i.e., prior to the initiation of licensed activities (construction) as the final estimates are required at detailed design stage of the project (IR -47 and IR-76). NexGen has been requested by CNSC staff to commit to address this concern through additional analyses, as applicable.

8.2.3.5. Severe Snowstorms

CNSC staff have reviewed NexGen's assessment of effects of severe snowstorms on the project during all phases of the project and confirmed that NexGen conducted a sufficient assessment of severe snowstorms at the project site and that identified design features and mitigation measures are adequate.

8.2.3.6. Tornado and Severe Thunderstorms

CNSC staff have reviewed NexGen's assessment of effects of tornado and severe thunderstorm on the project during all phases of the project and confirmed that NexGen conducted a sufficient assessment of tornado and severe thunderstorm including lightning at the project site and that identified design features and mitigation measures are adequate.

8.2.3.7. Extreme Temperatures

CNSC staff have reviewed NexGen's assessment of effects of extreme temperatures on the project during all phases of the project and confirmed that NexGen conducted a sufficient assessment of extreme cold, extreme heat and heat fluctuations at the project site and that identified design features and mitigation measures are adequate.

8.2.3.8. Climate Change

The proponent's climate change assessment identified the relevant climate variables, climate sensitive natural hazards and used appropriate emission scenarios and assessment time scales that takes in to account the different phases and lifespan of the project. The assessment is also based on site specific downscaled climate projection data derived from multi-model ensemble GCMs that capture uncertainties in climate projections. CNSC staff have reviewed the Proponent's identified climate-infrastructure interactions and the subsequent assessment of climate vulnerabilities of Project activities as well as the proposed environmental design features, mitigation measures and ongoing monitoring and surveillance process and found these to be acceptable to mitigate the potential adverse effect of weather events and climate change. CNSC staff will also review NexGen's proposed climate adaptation strategy, once developed, for adequacy and ensure its implementation to further improve climate change resiliency of the Project as part of the CNSC's licensing process.

In summary, CNSC staff have found the proponent's assessment of Effects of the Environment on the Project to be appropriate and in line with REGDOC-2.9.1 Environmental Protection: Environmental Principles, Assessments and Protection Measures (Section A.3.9) and best practice guidance such as Mining Association of Canada's *"Guide on Climate Change Adaptation for the Mining Sector"*. CNSC staff concurs with the proponent's conclusion that the project components or activities are not likely to be adversely impacted by seismic events, major precipitation events, severe snowstorms, tornado or severe thunderstorms, extreme temperatures and climate change taking into account the environmental design features, proposed mitigation measures and emergency preparedness and response program and ongoing monitoring and surveillance process.

8.2.4. CNSC Staff analysis and findings

CNSC staff are satisfied with the proponent's assessment of Effects of the Environment on the Project related to natural hazards and climate change pertinent to the project. The proposed environmental design features, mitigation measures and emergency preparedness and response program and ongoing monitoring and surveillance process are appropriate to account for the potential effects of the environment on the Project. CNSC staff conclude that the Project is not likely to cause significant adverse effects on health, safety of workers and the public, and on the environment taking into account the implementation of mitigation measures, design considerations, and emergency preparedness and response program and ongoing monitoring and surveillance process, and the views and concerns expressed by Indigenous Nations and communities.

There are no issues requiring follow-up for this component area.

8.3. Cumulative Environmental Effects

The proposed project could cause cumulative effects, in combination with the environmental effects of past, existing and reasonably foreseeable projects or activities, on the following intermediate components and VCs (only includes the VCs where cumulative effects from the reasonably foreseeable developments (RFD) have been identified):

- Air quality, noise and GHG emissions
- Surface water / Aquatic environment
- Terrestrial environment

NexGen's cumulative effects assessment evaluated the contribution of effects from the Project in combination with previous, existing, and RFDs or activities in the region that may overlap spatially (i.e. in the same geographic area) and temporally (i.e., over time). RFDs can be defined as activities in the region that have not yet been approved, developments and activities that are currently under application review, or that have officially entered a regulatory application process.

NexGen's cumulative effects assessment considered all primary pathways that were likely to result in detectable changes in measurement indicators and subsequent residual effects on VCs after the implementation of environmental design features and mitigation.

8.3.1. Air Quality and Noise

8.3.1.1. Proponent's assessment of environmental effects and mitigation

NexGen's RFD case consisted of modelling assessment of the Project emissions during operations combined with the operations emissions from the Patterson Lake South property. Air quality from the Project and from the Patterson Lake South Property is predicted to reflect detectable changes from existing conditions. However, most of the CACs (i.e., nitrogen dioxide, sulphur dioxide, sulphuric acid, carbon monoxide, and PM2.5) are predicted to remain compliant with the SAAQS throughout all phases of the Project within the RSA. Noise-emitting activities during construction and operations of the Patterson Lake South Property are expected to be similar to noise-emitting activities during the Project Construction and Operations. The duration of cumulative noise effects for the RFD Case would be a maximum of 15 years.

Mitigation measures proposed by NexGen are detailed in tables 6.3 and 6.4, and EA Follow up program measures in section 6.16.

8.3.1.2. CNSC staff analysis and findings

CNSC staff have reviewed NexGen's cumulative effects assessment for air quality and noise, and CNSC staff have confirmed that NexGen conducted a comprehensive analysis of these effects and that identified mitigation and follow-up monitoring program measures are adequate. CNSC staff have verified that NexGen had identified applicable projects and activities that could cumulatively interact with the project effects. The analysis considered climate change impacts and emissions to air from project activities and noise associated with the operations emissions from the Patterson Lake South Property. These cumulative effects did not change the predicted noise levels when added on a logarithmic basis and therefore do not change the assessment results based on HC and ECCC guidelines.

CNSC staff agree with NexGen's conclusions that the risk is low with no cumulative effects anticipated. In addition, CNSC is satisfied with NexGen's cumulative effects assessment as it relates to how NexGen considered and addressed concerns regarding cumulative effects raised by Indigenous Nations.

CNSC staff conclude that there are no anticipated cumulative effects to the atmospheric environment. The Project's follow-up monitoring will verify these conclusions.

8.3.2. Surface Water / Aquatic Environment

8.3.2.1. Proponent's assessment of environmental effects and mitigation

Potential cumulative effects to the aquatic environment and the receptor VCs, fish, fish habitat and fish health are through surface water and sediment quality exposure pathways during the operation and decommissioning phases. Therefore, cumulative effects were primarily assessed through effects to the intermediate components, surface water quantity, quality and sediment quality.

Cumulative effects including those from the Project, the Patterson Lake South Property, and climate change, are anticipated to be similar during the Project lifespan and in far-future projections and the only threshold exceedances are for copper and cobalt in the far future in Patterson Lake (as can be seen in table 10A-24 of the EIS). While uncertainties are inherent in climate change predictions, the analysis suggests that its impact on surface water quality would be minimal.

Another potential cumulative effect of concern to Indigenous Nations and communities was the potential for emissions from Alberta's oil sands operations to cause acidic deposition from sulfur dioxide through rainfall and snowfall, which could contribute to increased lake acidification. NexGen's activities, such as air emissions, effluent discharge, and seepage from the PAG WRSA, could combine with the impacts of oil sands emissions and further increase lake acidification risks. However, preliminary screening for NexGen's project found that the total H^+ equivalent from all acidifying emissions was about one-tenth of the Provincial 0.175 t/d threshold. Following consultations between NexGen and the Saskatchewan Ministry of Environment, it was determined that due to the low emissions of SO_2, NO_x, and sulfuric acid, acid deposition modeling was unnecessary for the project. To further support predictions of low risk from acid deposition cumulative effects, NexGen conducted rainwater pH monitoring at the site from September 2018 to October 2020. The results showed an average pH of 6.36, which is less acidic than typical unpolluted rain (pH ~5.6). Given the relatively low acidity of rainwater at the project site, the potential for acid emissions to cause acid deposition issues is considered low and was not considered for further quantitative assessment in the EIS. More on CNSC's analysis on this topic can be found below.

Table 8.6: Reasonably Foreseeable Development Case Summary Statistics for Selected Constituents in the Far Future for Patterson Lake (From EIS: Table 10A-24)

Constituent	Unit	Project Threshold	Minimum - North Arm – East Basin	Minimum - North Arm – West Basin	Minimum - South Arm	Average - North Arm – East Basin	Average - North Arm – West Basin	Average - South Arm		Maximum - North Arm – East Basin	Maximum - North Arm – West Basin	Maximum - South Arm
Total ammonia (as nitrogen)		mg/L	n/a[(a)]	0.027	0.036	0.057	0.030	0.040	0.066	0.044	0.090	0.16
Un-ionized ammonia (as nitrogen)[(b,c)]		mg/L	0.016	0.000075	0.000099	0.000016	0.000026	0.000035	0.000057	0.000075	0.00016	0.00029
Nitrate (as nitrogen)		mg/L	2.9	0.019	0.026	0.053	0.021	0.029	0.062	0.033	0.073	0.15
Phosphorus (total)		mg/L	0.020	0.0051	0.0051	0.0057	0.0054	0.0053	0.0060	0.0057	0.0060	0.0074
Chloride		mg/L	120	0.40	0.84	1.2	0.46	0.94	1.3	0.62	1.4	2.4
Hardness		mg/L	n/a	13	16	25	13	17	28	17	31	56
Sulphate		mg/L	128-218	2.1	8.2	25	2.8	9.8	30	8.1	28	72
Cobalt		mg/L	0.00078-0.0008[(d)]	0.000067	0.000098	0.00015	0.00020	**0.0010**	**0.00086**	0.00031	**0.0015**	**0.0011**
Copper		mg/L	0.0020	0.00013	0.00016	0.00022	0.00035	0.0017	0.0014	0.00053	**0.0024**	0.0019
Uranium		mg/L	0.015	0.00015	0.00047	0.00065	0.00041	0.0024	0.0021	0.00066	0.0035	0.0027
Radium-226		Bq/L	0.11	0.0057	0.0041	0.0068	0.0074	0.0045	0.0082	0.0089	0.0058	0.014

a) Project threshold for ammonia considers the proportion of total ammonia that is un-ionized ammonia.
b) Function of total ammonia, pH, and temperature.
c) The average seasonal pH and average monthly temperature of samples were used to calculate the fraction factor.
d) Federal environmental water quality guideline (FEQG), variable based on hardness concentration in the surface waterbody; guideline value shown based on a hardness value of 52 mg/L as $CaCO_3$, which is the lowest hardness applicable to the guideline (Environment Canada 2017; Government of Canada 2021).
Bold values represent concentrations that exceed the Project threshold.
Bq/L = becquerels per litre.

8.3.2.2. CNSC staff analysis and findings

CNSC requested further details on the conservatism of NexGen's RFD case (which covers cumulative impacts with the potential Patterson Lake South project) assessment and to provide information on how using the assumptions in the EIS are conservative to determine cumulative effects on water quality, and how it respects the precautionary approach. Since detailed plans for the Patterson Lake South project were not yet available at the time of submission of the Rook I EIS, NexGen made informed assumptions about its potential environmental effects. These assumptions were based on data from other uranium mines in the region, as well as predictions from NexGen's own Project models. NexGen also stated that they used assumptions based on modern best practices, including geochemical similarities to the Project, use of BATEA principles, and adherence to ALARA standards. For example, it was assumed that similar practices as those used in NexGen's Project, such as treating water to very high standards, established through the BATEA process, before releasing it into the environment, would also be applied by other projects. Therefore, to estimate how runoff from the Patterson Lake South project's facilities might affect water quality, NexGen assumed it would be similar to the high-quality treated water released by its own Project. This approach provides a practical and realistic way to evaluate potential impacts, even without detailed information about the Patterson Lake South project. NexGen deems this approach robust and defensible, while acknowledging that future cumulative effects assessments and project-specific details will be required as the Patterson Lake South Property advances through regulatory phases. CNSC accepted NexGen's response, as at the time of receiving the EIS report, the Patterson Lake South project data was not publicly available, therefore NexGen's approach to assess cumulative effects on surface water and sediment quality was sufficient and met the requirements of CEAA.

As described above, cumulative effects for the RFD case are similar to the application case indicating a low chance of impacts from cumulative effects as most COPCs will remain below conservative chronic benchmarks under all scenarios modelled. However, given the interest in cumulative effects from Indigenous Nations and communities, and the fact that the Patterson Lake South Project data is expected to be publicly released at a later date, CNSC has recommended a follow up commitment that NexGen incorporate Patterson Lake South Project's most up to date model outputs for all project phases and include all predicted pathways (for instance Patterson Lake South project's far future groundwater pathways) into the Rook I model for the RFD case in the next iteration of the ERA once this data is publicly available, in order to demonstrate that the cumulative effects analysis was performed conservatively and the conclusions remain valid. Any increased risks found through this analysis, if any, would require NexGen to develop mitigation or adaptative management plans.

Another potential cumulative effect of concern to Indigenous Nations and communities was the potential for emissions from Alberta's oil sands operations to cause acidic deposition from sulfur dioxide through rainfall and snowfall, which could contribute to increased lake acidification. NexGen's activities, such as air emissions, effluent discharge, and seepage from the PAG WRSA, could combine with the impacts of oil sands emissions and further increase lake acidification risks. CNSC staff analyzed this issue and concluded that the potential cumulative effect is unlikely to result in significant adverse environmental effects. The rationale for this conclusion is

described below.
The Saskatchewan air quality guideline outlines two criteria for determining if a facility's emissions warrant regional acid deposition modeling:

1. Combined emissions of SO_2, NO_x, and ammonia (NH_3) must exceed 0.175 tonnes per day (t/d) of hydrogen ion (H^+) equivalent, calculated using specific formulas.
2. Facility emissions must account for more than 5% of the baseline emissions in the region.

Preliminary screening for NexGen's project found that the total H^+ equivalent from all acidifying emissions was about one-tenth of the Provincial 0.175 t/d threshold. Following consultations between NexGen and the Saskatchewan Ministry of Environment, it was determined that due to the low emissions of SO_2, NO_x, and sulfuric acid, acid deposition modeling was unnecessary for the project. To further support predictions of low risk from acid deposition cumulative effects, NexGen conducted rainwater pH monitoring at the site from September 2018 to October 2020. The results showed an average pH of 6.36, which is less acidic than typical unpolluted rain (pH ~5.6). Given the relatively low acidity of rainwater at the project site, the potential for acid emissions to cause acid deposition issues is considered low.

However, CNSC staff acknowledge concerns from Indigenous Nations and communities on this topic and have provided recommendations for more EA follow-up monitoring requirements and commitments to NexGen to ensure there are no unexpected risks as the project progresses. CNSC staff expect NexGen to include follow-up monitoring for all relevant pathways (e.g., air, effluent, surface water, runoff, rain and snow precipitation, groundwater) and contaminants of potential concern (COPCs) (e.g., SO_2, NO_x, sulfates, nitrates, pH) that may contribute to lake acidification. This environmental monitoring data should be incorporated into the next ERA to model and assess potential cumulative effects related to this risk. NexGen is also expected to explore mitigation options and adaptive management strategies to address potential environmental impacts based on increasing acidification levels in lakes if future monitoring data indicates risk. Additionally, CNSC staff note that if a license is granted, other EMPs, such as those required under the EEM program, will assess aquatic health indicators that could be affected by acidification, potentially triggering further mitigation or adaptive management actions. These monitoring actions will help refine the risk assessment to ensure lakes in the project area are protected from acid deposition and acidification.

CNSC staff have also reviewed NexGen's updated Geochemical Characterization of Waste Rock report as part of the EIS and are satisfied with the updated dataset on baseline geochemical information for waste rock stored on the surface (see EERR on geological environment for more information). CNSC staff also noted NexGen's proposed engineering measures to mitigate potential acid generation during surface storage, including the segregation of PAG and NPAG waste rock and the use of low-permeability horizontal layering to limit oxygen ingress and precipitation infiltration into the waste rock pile. These measures will further help protect the environment from potential lake acidification risks associated with the project.

In summary, the assessment predicted residual effects on surface water quality due to change in water and drinking water quality constituent concentrations. However, with the implementation of appropriate mitigation measures and the effects being characterized as low magnitude, localized, and can be further reduced through adaptive management, the residual effects on surface water and sediment quality are predicted to be not significant. CNSC staff have reviewed NexGen's models and predictions for effects to surface water and sediment quality and confirmed that NexGen conducted a comprehensive analysis of these effects.

CNSC staff conclude that there are no cumulative effects to the aquatic environment, including surface water quantity and quality and benthic invertebrates, fish, fish habitat or fish health. The Project's follow-up monitoring will verify these conclusions.

8.3.3. Terrestrial Environment

8.3.3.1. Proponent's assessment of environmental effects and mitigation

Terrain and Soils

For terrain and soils, there was no RFD case assessed due to negligible potential for cumulative effects. The proponent provided the rationale that the residual effects on terrain and soils are predicted to be confined to the maximum disturbance area, or within the LSA in the case of soil quality which can be affected by deposition of dust or particulate matter. The only notable RFD project is the Patterson Lake South Property, whose hypothetical maximum disturbance area is located approximately 4.8 km away. When considering 500 m buffers (e.g., LSA boundaries) from both projects' maximum disturbance areas, then the effects would not spatially overlap. Moreover, it was expected that the Patterson Lake South project would likewise implement appropriate mitigation measures and adaptive management to minimize contributions to cumulative effects.

In terms of climate and natural disturbance factors, the proponent stated that an increase in temperature and precipitation could shift the soil thermal regime. Longer growing seasons can alter ecological succession by increasing carbon and nutrient exports to the soil, resulting in higher soil productivity. This could have a positive effect on the ability to sustain vegetation communities. Alternatively, increased precipitation can also raise groundwater levels, leading to the removal of solutes from soil and thus decreasing nutrient availability for plants. In addition, forest fires can remove vegetation and increase erosion potential. Fire can alter the distribution of soil nutrients, and their loss can negatively affect the natural regeneration of vegetation.

Vegetation

For vegetation, the proponent assessed the RFD case taking into account the Patterson Lake South Property and associated additional trails, roads, and facilities. The combined assessment of both projects found cumulative effects of low magnitude at the regional scale. The RFD case predicted a total loss of 2,318.2 ha of upland, 55.6 ha of wetland, and 102.6 ha of riparian ecosystems in the RSA. In other words, around 96.9% of uplands, 99.9 % of wetlands, and 98.9% of riparian areas remain intact in the RSA in the RFD case. Incremental effects were predicted to occur from construction through the end of active closure and the time required to establish mature upland ecosystems, for a duration of maximum of 95 years assuming complete temporal overlap of ecosystem loss. Despite minor reduction in ecosystem connectivity regionally, most upland, wetland, and riparian ecosystems are predicted to remain abundant and well connected across the RSA.

Traditional use plant habitat is predicted to be reduced by 744.0 ha in the RFD case, affecting mostly common species such as blueberry, jack pine, and bog cranberry. The RFD case also predicted a decrease for five traditional use plant species that would not have been disturbed in the Application case (Rook I Project only); these are Nagoon berry, dewberry, dwarf birch, hard-stemmed bulrush, and swamp red currant. However, the change in availability of these species is predicted to be less than 0.1 ha and habitat remains available. Overall, around 97.5% of traditional use plant habitat remains intact in the RSA in the RFD case.

In terms of climate and natural disturbance factors, the proponent stated that a longer, warmer growing season can overall increase forest productivity but can also affect ELC units with specific nutrient and moisture regimes that may be less resilient to climate changes. Moreover, heat waves, droughts, and weather patterns can increase the risk and frequency of forest fires. Large, stand-replacing fires are a driver of forest composition, structure, and function. However, the proponent noted that forests within the RSA may be resilient and likely to return to the same state post-fire. Yet, as the fire-return interval decreases, forest resilience is reduced which can affect overall distribution. Furthermore, wetlands are sensitive to changes in precipitation and temperature, but it is anticipated that increased annual precipitation would offset potential water deficits from higher temperatures and evapotranspiration, overall being within natural variability. Lastly, whether traditional use plant species are affected by climate changes depends on the niches they occupy; for example, fire-adapted species (e.g., jack pine, blueberry) could benefit from regenerating habitat whereas species with very specific requirements (e.g., pitcherplant) could be less resilient.

In summary, the proponent concluded that the overall residual effects from the RFD case for vegetation are predicted to be not significant. More detailed information can be found in the EIS section 13.5.

8.3.3.2. CNSC staff analysis and findings

CNSC staff have reviewed the proponent's cumulative effect assessment for the alteration of soil and terrain conditions, and the direct loss and terrain alteration for vegetation. CNSC staff's analysis confirmed that the proponent had identified applicable projects and activities that could cumulatively interact with the Project effects. It was noted that most upland, wetland, and riparian ecosystems are predicted to remain abundant and well connected across the RSA.

CNSC staff raised one information request for traditional use plant species. CNSC staff noted that Indigenous Nations and communities have expressed concerns related to Project activities and potential cumulative effects. CNSC staff noted the statement that effects of previous and existing developments and activities have negatively altered habitat availability and habitat distribution of traditional use plant species. Given the existing disturbances, it was unclear to CNSC staff what the magnitude of effects was compared to a "baseline natural state" of the habitat (i.e., before any disturbance). Thus, CNSC staff requested information on the cumulative magnitude of existing and proposed disturbances, as well as on indicators of when species are considered not self-sustaining and ecologically effective anymore.

The proponent responded that the magnitude or state of the environment prior to any disturbance is beyond the EA scope, but that the Base case assesses the existing conditions that represent cumulative effects of historical and current environmental pressures. The proponent further explained that quantitative critical thresholds, such as the amount or distribution of habitat required for self-sustaining and ecologically effective traditional use plant populations, are rarely known with certainty. Rather, applying resilience, adaptability, and existing conditions provide important ecological context. Using a weight-of-evidence approach, it was determined that habitat for traditional use plants remains abundant, well connected, and distributed in the Application and RFD cases, and it is predicted that traditional use plants would continue to be self-sustaining and ecologically effective. Examples of changes that might be considered significant include permanent effects over a large geographic extent, exposure to COPC that causes permanent changes to survival and reproduction of a population, and habitat loss and fragmentation that disrupts population connectivity. However, the assessment of traditional use plants indicates that none of these conditions would occur from incremental and cumulative changes to habitat from the Project. CNSC staff found this answer to be acceptable, also taking into account that overall, around 97.5% of traditional use plant habitat remains intact in the RSA in the RFD case.

CNSC staff deemed the proposed mitigation, monitoring, and follow-up measures as appropriate to address potential cumulative effects on terrain, soils, and vegetation. CNSC staff conclude that cumulative effects on vegetation are not significant.

8.3.4. Terrestrial Biota

8.3.4.1. Proponent’s assessment of environmental effects and mitigation

NexGen’s analysis of the RFD Case considered combined effects from the Patterson South Property, and for woodland caribou the RFD evaluation included qualitative analysis of predicted effects from forestry in the southern unit of the SK2 West. In the RFD Case, a precautionary approach was taken by assuming a maximum disturbance of an area approximately four times larger than the currently anticipated footprint for the Rook I Project, and approximately six times larger than the currently anticipated footprint for the Patterson Lake South Property. The assumed period of residual effects from the Patterson Lake South Property completely overlaps with similar effects from the Project, a maximum duration of 95 years.

NexGen noted that activities from both the Rook I Project and Patterson Lake South Property that would have potential to affect terrestrial biota include land clearing, site preparation, construction of facilities and infrastructure, handing of ore and waste rock, changes to water and air quality, and other activities supporting mine construction, operation and closure.

Under existing conditions, woodland caribou is not considered to be self-sustaining in the SK2 West range in Saskatchewan. The provincial management threshold limiting the disturbance to 35% has been exceeded and therefore, any amount of incremental habitat loss from any development is considered significant to woodland caribou. NexGen has committed to offsetting residual effects through the development of a CMOP. In the RFD Case, a loss of 1.3% of suitable caribou habitat is expected in the caribou home range, with less than 1% expected to occur in SK2 West. NexGen was unable to quantify the loss of suitable caribou habitat from forest harvest as the projected amount and layout of future forest harvest is not publicly available. With the implementation of the CMOP, NexGen has concluded that the contribution of Project-specific adverse residual effects are predicted to be not significant.

Cumulative habitat loss for all other wildlife VCs in the RFD Case is expected by NexGen to be less than 3.5% of suitable habitat in the RSA. NexGen has committed to progressive reclamation of habitats during Operations and Closure. Habitat distribution for all VCs in the RFD Case is expected to remain well connected through the RSA, and despite variability on effects for individual animals, overall, all VC populations are expected by NexGen to remain ecologically effective and self-sustaining.

Climate change is projected by NexGen to decrease the availability of wetlands and moister ecosystems and could exacerbate losses in wildlife habitats. Upland ecosystems could become drier and more prone to forest fires, exacerbating effects on wildlife VCs. NexGen's predictions of climate change induced effects are uncertain, but they anticipate that all VCs except for woodland caribou would remain self-sustaining and ecologically effective.

The RFD Case is expected to increase landscape fragmentation, but biodiversity in the RSA is predicted by NexGen to be maintained similar to existing conditions. Effects on biodiversity are anticipated to be low in magnitude and the geographic extent of effects would be within the maximum disturbance area for the RFD Case. Residual effects are predicted by NexGen to be mostly reversible over long term for all ecosystems that would regenerate after reclamation; however, loss of wetlands is conservatively assumed to be permanent and irreversible, but wetlands are expected to remain well connected in the RFD Case.

NexGen concluded that residual, incremental and cumulative effects resulting from the Project, previous and existing developments, and the Patterson Lake South Property on wildlife and wildlife habitat would be not significant for all VCs.

Table 8.7: Summary of Suitable Habitat Loss by Valued Component (From EIS: table 14.8-1)

VC	Life Requisite (seasonal requirement)	Habitat Suitability Rating	Base Case Area in RSA (ha)	Application Case Change in Area (ha)	Application Case % Change	RFD Case Change in Area (ha)	RFD Case % Change
Woodland caribou	All seasons	High	2,821.0	-7.5	-0.3	-13.2	-0.5
		Moderate	2,540.9	-24.6	-1.0	53.7	2.1
		Low	72.5	-0.3	-0.4	-1.4	-1.9
Moose	All seasons	High	12,556.8	-56.7	-0.5	-308.9	-2.5
		Moderate	58,996.2	-732.0	-1.2	-2,085.2	-3.5
		Low	12,655.0	-26.5	-0.2	-57.7	-0.4
Grey wolf	Snow-Free period	High	36,245.2	-146.8	-0.4	-389.1	-1.1
		Moderate	4,716.3	-68.1	-1.4	-217.5	-4.6
		Low	47,515.9	-731.9	-1.5	-1,847.4	-3.9
	Winter	High	11,555.4	-82.0	-0.7	-231.4	-2.0
		Moderate	3,408.7	-32.3	-0.9	-61.0	-1.8
		Low	54,638.4	-731.9	-1.3	-1,847.4	-3.4
Black bear	Spring	High	1,464.8	-63.2	-4.3	-195.2	-13.3
		Moderate	10,252.0	-42.1	-0.4	-77.7	-0.8
		Low	76,679.6	-841.5	-1.1	-2,181.1	-2.8
	Fall	High	54,795.6	-759.3	-1.4	-1,886.1	-3.4
		Moderate	161.5	-23.3	-14.4	-41.6	-25.8
		Low	32,212.7	-128.4	-0.4	-369.8	-1.1
Beaver	Beaver lodge	High	1,529.3	-7.4	-0.5	-21.6	-1.4
		Moderate	1,583.8	0.0	0.0	0.0	0.0
		Low	30,285.8	-28.8	-0.1	-179.1	-0.6
Little brown myotis	Roosting	High	127.8	0.0	0.0	-27.1	-21.2
		Moderate	989.5	< 0.1	0.0	< 0.1	0.0
		Low	21,080.7	-114.7	-0.5	-313.2	-1.5

VC	Life Requisite (seasonal requirement)	Habitat Suitability Rating	Base Case Area in RSA (ha)	Application Case Change in Area (ha)	Application Case % Change	RFD Case Change in Area (ha)	RFD Case % Change
Olive-sided flycatcher	Nesting	High	3,750.6	-4.1	-0.1	-19.5	-0.5
		Moderate	20,896.1	-90.3	-0.4	-235.1	-1.1
		Low	45,035.8	-450.8	-1.0	-1,436.3	-3.2
Rusty blackbird	Nesting	High	403.0	-0.2	-0.1	-0.2	-0.1
		Moderate	516.5	-0.1	0.0	0.0	0.0
		Low	13,528.2	-31.0	-0.2	-49.1	-0.4
Common goldeneye	Nesting	Suitable	13,103.9	-3.5	-0.0	-114.6	-0.9
Mallard	Nesting	High	29,103.9	-142.1	-0.5	-520.6	-1.8
		Moderate	96.8	0.0	0.0	0.0	0.0
		Low	44,236.6	-45.1	-0.1	-99.6	-0.4
Canadian toad	Breeding	Suitable	15,325.8	-27.0	-0.2	-47.1	-0.3

Note: Base Case area for woodland caribou is for the caribou home range rather than the wildlife RSA. Habitat suitability modelling for common goldeneye and Canadian toad rated habitat as suitable or unsuitable.

RFD = reasonably foreseeable development; RSA = regional study area; VC = valued component; <= less than.

8.3.4.2. CNSC staff analysis and findings

CNSC staff have reviewed NexGen’s assessment of habitat loss and alteration for woodland caribou and concur that the Project will result in residual effects. The Project is located within the SK2 West Caribou Administration Unit, where cumulative anthropogenic disturbance already exceeds the provincial management threshold of 35% for maintaining a self-sustaining population, as outlined in the federal recovery strategy. NexGen’s assessment acknowledges that the Project will contribute to further habitat loss and alteration, including changes to terrain, vegetation composition, and ecosystem connectivity.

NexGen has committed to developing and implementing an updated CMOP, which will be aligned with the Government of Canada’s Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada and developed in collaboration with Indigenous communities and Saskatchewan Ministry of Environment. The plan will include offsetting measures, progressive reclamation, and monitoring to ensure effectiveness. CNSC staff support this commitment and recommend it be formalized as an EA condition.

CNSC staff agree with NexGen's conclusion that sensory disturbances (e.g., noise, light, human presence) could affect caribou movement and behaviour. NexGen has proposed mitigation measures such as activity restrictions during sensitive periods, noise suppression, and light pollution controls. CNSC staff considers that these measures are consistent with best practices will be sufficient to mitigate the identified effects. A light pollution mitigation plan is recommended as an EA commitment.

Taking into account the CMOP, NexGen's ongoing commitments to collaborate with Indigenous Nations and communities, mitigation measures and the ongoing compliance oversight through the CNSC's regulatory framework, CNSC expect the contribution of Project-specific adverse residual effects to be not significant.

8.3.5. Views Expressed

Indigenous Nations and Communities

CRDN members previously shared their concern that cumulative impacts of substantial and growing projects and mineral exploration activity will severely limit their ability to practice continued and use of the region around and north of Patterson Lake. CRDN had also previously noted that the provincial government and proponents of industrial/extractive projects are inclined to characterize exploratory endeavors as low impact activities which do not warrant consultation with potentially affected Indigenous communities. However, without advance information from the Indigenous Nations and communities who are affected and whose members are intimately familiar with the traditional lands involved, there is no basis for assuming that the planned industrial activities will have little or no impact on their rights. NexGen confirmed cumulative effects of the Project; previous, existing and approved projects, and RFDs were assessed for the Projects with similar effects on the same VCs and intermediate components throughout the EIS. The Patterson Lake South Project was deemed an RFD based on NexGen's selection criteria. NexGen has committed to a variety of engagement methods with Indigenous Nations and communities and has noted that engagement with communities within the Local Priority Area (LPA) as foundational to the development of the Project. Engagement activities include the implementation of an Indigenous Public and Engagement Program to communicate regularly and reach early resolution to concerns raised.

MN-S members shared their concern that cumulative impacts of substantial and growing projects and mineral exploration activity will severely limit their ability to practice continued use of the region around and north of Patterson Lake. NexGen confirmed that exploration activities in the area of the project, including those conducted by NexGen, were assessed within the EA in addition to previous, existing and approved projects, and RFDs. NexGen has committed to establishing an Environmental Committee to monitor environmental performance of the Project, continued engagement with MN-S, and further mitigation measures to minimize adverse effects on access to Indigenous land and resources.

BNDN members have concerns that cumulative impacts of substantial and growing projects and mineral exploration activity may limit their ability to practice continued use of the region around and north of Patterson Lake. BNDN members are concerned that the Rook I Project could contribute to cumulative effects in the region and study participants voiced frustration at historical and ongoing alienation from the territory caused by numerous sources, including the development of mines and mining activity within their territory. (e.g. Cluff Lake Mine). BNDN is concerned that NexGen's cumulative effects assessment did not include enough detail to capture the potential cumulative effects in a scenario where the Rook I Project and Patterson Lake South Project are both approved. BNDN noted concerns regarding potential adverse impacts to fish and fish habitat from various Project operations. NexGen noted that several effects pathways related to cumulative effects and Project effects on local and regional waterbodies and watercourses were assessed. NexGen has committed to Environmental Monitoring, Groundwater Protection and Monitoring, and Mine Waste Management plans and has further noted that the aforementioned concerns regarding cumulative effects from multiple industrial projects and changes to water quality in Patterson Lake and connected waterways were discussed and resolved through the Environmental Committee. NexGen has committed to further work with the BNDN through the Environmental Committee to address future concerns.

BNDN noted that the EIS entirely excluded the impacts of sulphur dioxide emissions from the Alberta oil sands that has already led to lakes in the region already exceeding critical acidity loads. The significant underestimation of the potential for acid rock drainage from mine waste rock on site compounds the risks of severe changes to the lake through acidification. concerns regarding potential adverse impacts to fish and fish habitat from various Project operations. BNDN is concerned that NexGen's cumulative effects assessment did not include enough detail to capture the potential cumulative effects in a scenario where the Rook I Project and Patterson Lake South Project are both approved.

BRDN raised concerned about cumulative effects from other industry in the region (e.g., the Project, Fort McMurray oil sands developments) such as impacts to air quality and its effects on human health and the environment, as well the Patterson Lake South project which is also located on Patterson Lake. NexGen confirmed cumulative effects of the Project; previous, existing and approved projects, and RFDs (including the Patterson Lake South Project) were assessed for the Projects with similar effects on the same VCs and intermediate components throughout the EIS, and exploration activities in the area of the project were assessed within the EA. NexGen has committed to establishing an Environmental Committee to monitor environmental performance of the Project, continued engagement with Indigenous Nations and communities, and further mitigation measures to minimize adverse effects on the environment and human health.

YNLR has conducted their own cumulative effects analysis, in accordance with accepted federal parameters, of the area around NexGen's project. While both the YNLR and NexGen analyses concluded that there would not be significant residual and cumulative effects in its EIS, YNLR believes that the spatial scope of NexGen's analysis is too limited to adequately address the cumulative environmental effects that are likely to result from other reasonably foreseeable future activities in the area. YNLR raised concerns about potentially contaminated groundwater from the proposed Patterson Lake South project local study area reaching the local study are of the NexGen Rook I Project and vice versa.

ACFN indicates that further uranium mining exploration or development in the study area is anticipated to have potential to direct and adverse effects on their treaty rights and add to the ongoing cumulative effects in the region.

8.3.6. Issues requiring Follow-up

CNSC staff expect NexGen to include follow-up monitoring for all relevant pathways (e.g., air, effluent, surface water, runoff, rain and snow precipitation, groundwater) and contaminants of potential concern (COPCs) (e.g., SO_2, NO_x, sulfates, nitrates, pH) that may contribute to lake acidification. This environmental monitoring data should be incorporated into the next ERA to model and assess potential cumulative effects related to this risk. NexGen is also expected to explore mitigation options and adaptive management strategies to address potential environmental impacts based on increasing acidification levels in lakes if future monitoring data indicates risk.

CNSC has recommended a follow up commitment that NexGen incorporate the Patterson Lake South Project's most up to date model outputs for all project phases and include all predicted pathways (for instance the Patterson Lake South project's far future groundwater pathways) into the Rook I model for the RFD case in the next iteration of the ERA once this data is publicly available, in order to demonstrate that the cumulative effects analysis was performed conservatively and the conclusions remain valid. Any increased risks found through this analysis, if any, would require NexGen to develop mitigation or adaptative management plans.

9. Indigenous consultation and assessment of impacts to Indigenous and/or treaty rights

The common law duty to consult with Indigenous Nations and communities applies when the Crown contemplates actions that may adversely affect potential or established Indigenous and/or treaty rights. The CNSC, as an Agent of the Crown recognizes the obligation to fulfill the duty to consult and where appropriate accommodate and ensures that it upholds Indigenous peoples' potential or established Indigenous and/or treaty rights pursuant to section 35 of the Constitution Act, 1982 when it makes licensing decisions under the NSCA. The contents of the EA report address the requirements for the licence to prepare site and consultation on the EA report is required to fulfil the Crown's constitutional obligations.

This section of the EA report summarizes the Indigenous consultation and engagement activities conducted by CNSC staff and NexGen to date. The full details and records related to consultation and engagement activities with Indigenous Nations and communities are contained in the Consultation Report, appended to the CMD 25-H12 as appendix C.

9.1. Asserted or Established Indigenous and/or Treaty Rights in the Project Area

The NexGen Rook I Project is is situated within Treaty 8 Territory and the homeland of the Métis, and within the traditional territories of the Dene, Cree and Métis peoples. Treaty 8 covers the northwestern quadrant of Saskatchewan, through northern Alberta and into northern British

Columbia, extending to the Northwest Territories to the west and the north, with the southern and western border extending to central and eastern Saskatchewan. The Project is located in Saskatchewan’s southern Athabasca Basin approximately 640 km northwest of Saskatoon and is accessed from Highway 955.

The following Treaty 8 signatory First Nations have been consulted and engaged on the Project:

- Clearwater River Dene Nation (SK)
- Black Lake First Nation, Fond du Lac Denesuline First Nation and Hatchet Lake First Nation, which Ya’thi Nene Lands and Resource Office (YNLR) represents
- Athabasca Chipewyan First Nation (AB)
- Mikisew Cree First Nation (AB)

Given the Project location’s proximity to Treat 10 territory and the overlapping of traditional territories, the following Treaty 10 First Nations have been consulted and engaged on the Project:

- Birch Narrows Dene Nation (SK)
- Buffalo River Dene Nation (SK)

Given that the Project overlaps the homeland of the Métis, Métis Nation-Saskatchewan Northern Region II (MN-S NRII) has also been consulted on the Project. In addition, in May 2025, Willow Lake Métis Nation (WLMN), expressed an interest in the project to the CNSC. In response, CNSC staff responded and offered to consult and engage WLMN on the Project.

No communities are located within the immediate proximity of the Rook I property. Travelling by existing roads, the closest community to the Project is the Northern Village of La Loche, which is approximately 155 km away. Calculated using a straight line, the closest communities are approximately 120 km from the site, with Saskatoon 640 km to the southeast. The federal lands within a 140 km radius of the Project area are First Nations’ reserve lands and do contain permanent residences.

This determination is a preliminary assessment that can be adjusted based on information received from Indigenous Nations and communities throughout the lifecycle of the Project, should it proceed.

9.2. CNSC Staff-led Consultation Activities with Indigenous Nations and Communities

In order to fulfill the CNSC’s consultation obligations for a decision rendered under the NSCA and CEAA 2012 on the Rook I Project, CNSC staff sent early notification letters regarding the expected Rook I application to all identified Indigenous Nations and communities and have continued to provide multiple opportunities for consultation, engagement and collaboration with Indigenous Nations and communities regarding their concerns and interests related to the Project. CNSC staff provided multiple opportunities for dialogue through phone calls, correspondence, community workshops, tours, as well as virtual and in-person meetings with leadership and community representatives, as well as through the provision of funding and capacity support. CNSC staff have also encouraged and facilitated the participation of the identified Indigenous Nations and communities in the Commission's public hearing process to advise the Commission of any concerns they may have and proposed resolution to those concerns. Additional information about the specific consultation and engagement activities with each Indigenous Nation and community can be found in section 4 of the Consultation Report.

9.2.1. EA Specific Consultation and Engagement Activities

CNSC staff provided a number of project specific opportunities for participation in the CEAA 2012 EA process, as described in *Public Participation in Environmental Assessment under the Canadian Environmental Assessment Act, 2012*.

These included:

- an opportunity to review and comment on the PD and inform the scoping decision
- an opportunity to review and comment on the draft EIS
- opportunity for participation in the FIRT
- review and inform the CNSC regarding NexGen's responses to comments and concerns
- participation in technical discussions
- invitations for sharing of IK for inclusion and consideration in CNSC documentation
- collaboration on input into the EA report and subsequently, CNSC staff's Consultation Report
- the development of consultation protocols and Terms of Reference to outline agreed upon steps and activities for collaboration and consultation on the EA and regulatory review process

These opportunities are reflected in table 1.1, along with links to information on the Registry.

9.3. CNSC Staff Findings and Recommendations

CNSC staff have aimed to conduct a thorough consultation and regulatory process for the NexGen Rook I Project. All identified Indigenous Nations and communities were provided with multiple opportunities to participate in the regulatory review and consultation process and funding was offered to support their participation. Indigenous Nations and communities who have raised issues and concerns related to the Rook I Project were offered opportunities to collaboratively develop sections of the EA report and Consultation Report and issues tracking tables contained within the Consultation Report.

CNSC staff will also continue to engage and collaborate with all identified and interested Indigenous Nations and communities to work towards addressing and responding to any outstanding concerns with regards to the Project. CNSC staff will involve NexGen in these discussions and consultation activities as appropriate.

CNSC staff's findings and recommendations with regards to consultation and potential impacts to Indigenous and/or Treaty Rights will be provided as part of CNSC staff's supplemental submission, prior to Part 2 of the hearing.

10. Public engagement

This section of the report is focused on CNSC staff's EA-specific public engagement activities. Details on all public engagement activities conducted by NexGen and CNSC staff with respect to the Rook I Project are provided in section 4 and appendix C of staff's CMD 25-H12.

Pursuant to section 24 of CEAA 2012, as RA, the CNSC must ensure that the public is provided with an opportunity to participate in the EA of a designated project. For CNSC-led EAs, when and for which steps in the EA process, the opportunities are to be provided. The breadth and timing of public participation is at the discretion of the CNSC.

The CNSC provided 3 formal opportunities for the public, Indigenous Nations and communities, and government reviewers to participate in the EA process for the NexGen Rook I Project. Notices of these opportunities to participate were posted on the Registry, as well on the CNSC's website and they were sent out directly to the distribution list for the Project, which included interested Indigenous Nations and communities. During these opportunities, comments were solicited on:

- the Rook I Project Description (May 2 to June 1, 2019)
- the Rook I Draft EIS (July 14 to October 12, 2022)
- the Rook I EA report (this report, November 29 to January 28, 2026)

In addition to the formal opportunities for participation, CNSC staff responded to Rook I related inquiries (telephone calls and e-mails) as they were received, throughout the duration of the EA process. CNSC staff also maintained the project Registry, posting regular project updates and bulletins, all relevant documentation as it was received, and sent these updates via email to the distribution list.

This EA report includes the CNSC's findings and recommendations and as demonstrated in previous sections of the report, was informed by comments received from the public, Indigenous Nations and communities and government reviewers.

10.1. NexGen -led public participation activities

NexGen held a number of public information sessions and site tours across northern Saskatchewan starting in 2015 through to 2025. NexGen also organized other forms of Rook I Project-specific engagement and outreach activities, including but not limited to:

- posting and publishing information including key milestone events and engagement activities on NexGen's website. Posting of project-related information through its social media accounts on X, Facebook, LinkedIn, and Instagram. Joint Working Group (JWG) meetings/information sessions with Indigenous Nations and communities residing in the local priority area. JWG breakout sessions on specific topics of concern requiring more detailed quarterly newsletters on project updates sent to Indigenous Nations and communities in the region numerous site visits to the Rook I Project site participating in regional open house events in northwestern Saskatchewan with federal and provincial regulators from 2022-2025 virtual meetings (TEAMS, Zoom) in 2020-2021 due to COVID-19 pandemic in-person leadership meetings with elected officials including mayors and councillors regular update meetings with local Indigenous leadership

- emails to and letters to communities and interested parties including notifications of the draft EIS submissions and responses to questions submitted

NexGen also developed Project materials and Executive Summaries of both the Project Description and Draft EIS in Cree, and Dene. In addition, a number of interviews and meetings were conducted with regional businesses, municipalities and other interested parties. NexGen also completed public outreach and communications out using local radio stations, digital and social media, local print media, quarterly community newsletters, and by mail to reach a variety of audiences.

10.2. CNSC-led/attended public participation activities

The NSCA mandates the CNSC to disseminate objective scientific, technical and regulatory information to the public concerning its activities and the activities it regulates. CNSC staff fulfilled this mandate to the public in a variety of ways, including in-person outreach events and open houses, virtual webinars, Project specific update emails and bulletins, social media, and funding opportunities throughout the regulatory process. In the case of Rook I Project, in-person engagement for the Project was often conducted in collaboration with NexGen and the province, specifically Saskatchewan Ministry of Environment, and Saskatchewan Environmental Assessment Branch (SKEAB) as they each have key oversight roles and provide interested parties with information relevant to their roles in regulatory approvals in Saskatchewan in uranium mining and milling.

10.2.1. Open house and outreach events

CNSC staff participated in a total of 5 public outreach and open house events across northern Saskatchewan with NexGen and the province of Saskatchewan on the Rook I Project throughout the regulatory review process. Travel restrictions resulting from the COVID-19 pandemic, prevented CNSC staff from completing in-person outreach events in 2020 and 2021. The community outreach events took place on June 20-24 of 2022, June 12-16, 2023, May 27-30, 2024, November 19-22, 2024, and September 23-24, 2025. CNSC staff also participated in several other in-person relationships building events with Indigenous Nations and communities and the public across northern Saskatchewan including sites visits, multiple in-person leadership meetings, and virtual meetings from 2022 to 2025.

The main concerns raised by attendees at the 3 open house events to CNSC staff are listed below:

- positive economic opportunities associated with the Project for the broader region
- concerns that certain communities may have more opportunity that others in the region for jobs and economic opportunities
- questions on job and training opportunities for youth in the north

- safety concerns with respect to increased traffic on the roads and opportunities for improvements to roads across the northern Saskatchewan due to the Project
- questions around transportation routes and concerns around potential spills and accidents and malfunctions
- concerns with land users maintaining their traditional way of life and culture
- health concerns around radiation and cancer rates and general community health
- concerns the protection of the environment including water, fish, and wildlife for future generations
- request for additional independent Indigenous environmental monitoring in the local area by communities
- concerns around cumulative effects of potentially having two mines on the same lake
- concerns emergency services and lack thereof as communities in the region are already lacking proper infrastructure at health centers and staffing
- questions regarding whether public/community concerns will be taken into consideration when the Commission is making a final decision on this project

10.2.2. Updates to the NSEQC

In addition, the Northern Saskatchewan Environmental Quality Committee (NSEQC) was also identified as potentially having an interest in the Project. The NSEQC has representatives from the majority of the northern municipal and First Nation communities located in the Northern Saskatchewan Administration District. CNSC staff participated in 5 Northern Saskatchewan Environmental Quality Committee (NSEQC) meetings that took place from 2022-2025 to provide updates to the NSEQC on the proposed mining projects undergoing EAs across northern Saskatchewan.

The main concerns discussed and raised by NSEQC members at the events to CNSC staff included the following:

- specific questions on underground tailings storage and challenges and how safe it is in relation to other mining methods
- opportunities for northern communities and businesses to be involved
- concerns with respect to downstream effects on water, fish, wildlife, and communities
- questions on other mines in the region and cumulative effects due to two new mines and mills and exploration activities taking place in the northwest.
- general questions on timelines of proposed mine and mining activities in the region

CNSC staff also hosted 1 webinar for the Project on September 13, 2023. This webinar provided an overview of the CNSC's regulatory review process for licensing and EA, provided an update on the NexGen Rook I Project, information on how to get involved in the process and allowed time for questions from attendees. In total 49 people participated in the webinar and the webinar was also recorded, for those unable to attend.

Questions and concerns discussed and raised by members at public at this webinar included the following:

- discussion on general timelines of upcoming public review periods including the draft EIS and final EIS documents and Commission hearings
- CNSC licensing and EA regulatory integrated approach
- questions on what determines if a nuclear project environmental assessments are conducted under CEAA 2012 vs IAAC legislation
- questions on harmonization of the provincial and federal EAs

A second webinar is planned for the fall of 2025 and will discuss CNSC's EA assessment and conclusions, provide an update on the upcoming Commission hearings, along with information on how to get involved and intervene in the hearing.

10.2.3. Email Updates

CNSC staff provided regular updates to all those who have participated and/or expressed interest in the regulatory review process for the proposed Project, in the form of project bulletins that are distributed to all those signed up through the Project distribution list. These bulletins were also handed out in-person and open house events. Project bulletins were developed and sent to interested parties in the summers of 2022, 2023 and 2024 and planned fall of 2025. The bulletins included Project updates, major milestones, next steps of the process, as well as-information on how to stay informed and contact information for CNSC staff.

10.2.4. CNSC Participant funding program

CNSC staff encourage the public to participate in the CNSC's regulatory process and Commission hearings. The CNSC offered assistance to interested members of the public, Indigenous Nations and communities, and other interested parties, through the CNSC's Participant Funding Program (PFP), to review and participate in the CNSC's regulatory process for the Project. The CNSC supported 3 separate participation opportunities in the EA through its PFP.

In 2020, the CNSC announced it was awarding $49,500 to Clearwater River Dene Nation (CRDN) to support its participation in a Terms of Reference for the Project and its continued participation in the EA process.

On May of 2020, the CNSC announced it was offering up to $150,000 under its PFP to assist participation of members of the public, Indigenous Nations and communities, and other interested parties in the in the review of the NexGen's draft EIS. A total of $409,079 was awarded for this phase of funding to the following 7 recipients:

- Clearwater River Dene Nation
- Birch Narrows Dene Nation
- Buffalo River Dene Nation
- Métis Nation-Saskatchewan
- Ya'thi Néné Land and Resource Office

- Athabasca Chipewyan First Nation
- Saskatchewan First Nations Center of Excellence
- Saskatchewan Environmental Society
- Canadian Environmental Law Association

In March of 2025, the CNSC announced it was offering up to $250,000 under PFP to assist to assist participation of members of the public, Indigenous Nations and communities, and other interested parties in the remaining steps of the EA process, licence application review and Commission hearing. Based on recommendations from the Funding Review Committee, the CNSC awarded a total of $464,979 for the second phase to the following recipients:

- Clearwater River Dene Nation
- Birch Narrows Dene Nation
- Métis Nation-Saskatchewan
- Ya'thi Néné Land and Resource Office
- Athabasca Chipewyan First Nation
- Buffalo River Dene Nation
- Mikisew Cree First Nation

11. Monitoring and Follow-up Programs

The purpose of the monitoring and follow-up programs are to verify the accuracy of predictions in the EA, determine the efficacy of the mitigation measures in place to reduce adverse environmental impacts from the Project, ensure regulatory compliance, and communicate findings with Indigenous Nations and communities, government organizations, and other interested parties.

NexGen's environmental assessment follow-up monitoring will include regulatory compliance monitoring (monitoring to confirm implementation of approved design standards, mitigation, approval conditions and NexGen commitments) and/or follow-up monitoring (testing the accuracy of effects predictions, reduce or address uncertainty, determine effectiveness of mitigation, provide feedback to operations for modifying or adopting new mitigation designs, policies, or practices).

NexGen is committed to providing public information related to activities throughout all phases of the project. NexGen's Indigenous and Public Engagement Program will provide the platform for disclosing information and maintaining relationships with Indigenous Nations and communities and other people and groups interested in the project. The Indigenous and Public Engagement Program will contain a grievance mechanism to monitor and respond to complaints and concerns, which will inform the development of follow-up monitoring measures. NexGen has also committed to using adaptive management to improve knowledge through an iterative process and seeking engagement and feedback within this process. The adaptive management approach is described in the Integrated Management System (IMS) manual.

Within the IMS, NexGen is developing monitoring and management plans related to environmental protection. If the project is approved, monitoring and follow-up programs and management plans will be developed as the project moves through the permitting and licensing processes. NexGen has stated they will consider input from Indigenous Nations and communities, regulatory agencies, and the public in developing these monitoring and follow-up programs.

NexGen's monitoring and follow-up programs will be managed under the IMS and carried out during the Construction, Operations, and Closure phases. Conceptual monitoring and follow-up programs have been developed for the following areas:

1. Air Quality (EIS section 7.2)
2. Noise (EIS section 7.3)
3. Climate Change (EIS section 7.4)
4. Hydrogeology (EIS section 8)
5. Hydrology (EIS section 9)
6. Surface Water Quality and Sediment Quality (EIS section 10)
7. Fish and Fish Habitat (EIS section 11)
8. Terrain and Soils (EIS section 12)
9. Vegetation (EIS section 13)
10. Wildlife and Wildlife Habitat (EIS section 14)
11. Human Health (EIS section 15)
12. Cultural and Heritage Resources and Indigenous Land and Resource Use (EIS section 16)
13. Other Land and Resources Use (EIS section 17)
14. Economy (EIS section 18)
15. Community Well-Being (EIS section 19)

Details of the preliminary monitoring and follow-up program for each area is in EIS Appendix 23B.

NexGen is also working with several Indigenous Nations and communities to implement independent environmental monitoring to verify project performance and determine if mitigations and controls are effective in protecting the environment. NexGen has committed to providing funding for the life of the project for a full-time independent Indigenous monitor from CRDN, MN-S, BNDN and BRDN to provide unrestricted environmental monitoring opportunities, including independent environmental sampling, subject to the Indigenous Monitors complying with appropriate health, safety, and other site-specific policies. The Indigenous monitor would report openly and without restrictions to community members of identified Indigenous Nations on the performance of the project.

CNSC staff will review the detailed follow-up and monitoring plans as they are developed, to ensure consistency with the commitments and predictions provided throughout the EA process, and to ensure that measures are in place to prevent any potential adverse environmental effects from the Project.

12. CNSC Staff Findings and Recommendations

In preparing this report, CNSC staff took into account NexGen's EIS, its responses to IRs and comments, and the views of government agencies, Indigenous Nations and communities, and the public.

The environmental effects of the Rook I Project and their significance have been determined using assessment methods and analytical tools that reflect current accepted practices of environmental and socio-economic assessment practitioners, including consideration of potential accidents and malfunctions and the potential for cumulative effects and Indigenous Knowledge shared.

CNSC staff assessed the likelihood of the Project to cause significant adverse environmental effects, following the application of mitigation measures, in accordance with the CNSC Generic Guidelines, CNSC REGDOC-2.9.1, and the Canadian Environmental Assessment Agency's (now the Impact Assessment Agency of Canada) *Operational Policy Statement: Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under CEAA 2012*. CNSC staff's recommendations related to significant adverse effects are contingent on the establishment of the EA Conditions listed in table 12.1.

CNSC staff recommend that:

- the Commission conclude that, taking into account the implementation of proposed mitigation and follow-up monitoring program measures, the Project is not likely to cause significant adverse environmental effects as defined by CEAA 2012.
    - the Commission's decision should be based on the description of effects under subsections 5(1) and 5(2) of CEAA 2012, as well as the scope of factors defined in paragraphs 19(1) (a) to (h) of CEAA 2012, as determined in the Commission's decision on the scope of the EA.
    - the 3 EA Conditions listed in table 12.1 below and described in sections 6 and 7, along with NexGen's commitments as identified and included in the document titled "NexGen Rook I Project Federal Commitments Report" become enforceable conditions that are set out in the Commission's decision.

Table 12.1: List of proposed EA Conditions

EA Condition Numbers	EA Report chapter	EA Condition
EA1 LCH section G.5 and related appendix D.1	Environmental Protection, Aquatic Environment (See section 6.3)	The licensee shall collect and submit additional baseline wetlands water level and water quality data. The licensee shall also submit the plans for wetland monitoring over the lifecycle of the project to assess potential effects due to the Project and to verify conclusions of EIS.
EA2	Environmental Protection, SARA	The licensee shall submit a revised woodland caribou mitigation and offset plan that utilizes site-specific information to evaluate effects to woodland caribou and includes a plan for habitat offsetting. The plan must ensure

EA Condition Numbers	EA Report chapter	EA Condition
LCH Section G.5 and related Appendix D.1	(See section 7.2 of the EA report)	that measures are taken to avoid or lessen any adverse effects to woodland caribou and monitor those effects. The plan shall be consistent with the Government of Canada's Amended Recovery Strategy for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada.
EA3 LCH Section G.5 and related Appendix D.1	Environmental Protection, SARA (See section 7.2 of the EA report)	The licensee shall submit plans for the monitoring of adverse effects of the project on listed wildlife species and their critical habitat over the lifecycle of the project.

Facility-specific conditions can be found in section 1.2.3 of the CMD 25-H12 and section G (General) of the licence and the associated LCH.

For commitments specific to Indigenous Nations and communities, additional information can be found in the Consultation Report.

In addition, CNSC staff are proposing a Licence Condition for Indigenous engagement which includes requirements for NexGen to report annually on their engagement activities and progress on implementing their commitments to Indigenous Nations and communities. The proposed Licence Condition includes EA follow up actions that address issues and concerns raised by Indigenous Nations related to their practice of Aboriginal and treaty rights recognized and protected under section 35 of the *Constitution Act,* 1982.

Table 12.2 outlines the list of EA commitments that NexGen will be required to include in their updated document "NexGen Rook I Project Federal Commitments Report" submission.

Table 12.2: List of Additional EA commitments

EA Report chapter	EA Commitment
Aquatic Environment (section 6.3)	At the licensing phase (licence to prepare site and construct), NexGen to incorporate the following into the EPP or EPP supporting documents: a. Manage all potential airstrip contaminants and substances, including, but not limited to, glycol and fuel, appropriately to avoid any adverse effects to fish and fish habitat. Confirm that any airstrip runoff containing glycol, fuel, or any other contaminants will be collected and managed appropriately. b. Monitor the explosives storage area for seepage and spills and to confirm effective containment of explosives c. Identify and implement best practices for use, storage, and management of nitrogen-based explosives to avoid the introduction of explosives and the residues into the aquatic environment.

EA Report chapter	EA Commitment
Aquatic Environment (section 6.3)	During the licensing phase (licence to prepare site and construct), as part of physical design/BATEA documentation package NexGen to provide to CNSC staff for review and approval an updated PMP estimate or confirm whether the current PMP is valid, or conservative based on analyses of up-to-date storm database.
Aquatic Environment (section 6.3)	During the licensing phase (licence to prepare site and construct), as part of BATEA documentation package, NexGen to optimize the design of their effluent treatment plant, as well as refine environmental release targets, as per the requirements of REGDOC-2.9.2.
Atmospheric Environment (section 6.1)	During the project lifespan, NexGen will continue to evaluate monitoring and mitigation measures to track and minimize air pollution and, where practical, implement any newly identified mitigation measures that are technically and economically feasible.
Atmospheric Environment (section 6.1)	During the licensing phase (licence to prepare site and construct), NexGen to provide a summary of carbon sinks and land use change emissions using either a Tier 2 or Tier 3 approach assessment.
Terrestrial Biota (section 7.2)	IF the detailed design shows a direct/indirect disturbance to wetland ecosystems, THEN NexGen will prepare and provide CNSC a wetland mitigation and offset plan, as a reference document in the EPP or EPP supporting documents, that includes a discussion on these impacts, what mitigations are to be used, how they would be implemented to reduce Project effects on species at risk and migratory birds, and how these effects would be monitored.
Terrestrial Biota (section 7.2)	NexGen to develop an EPP supporting document that would detail light pollution mitigation measures (including adaptive management) that would form part of the Project electrical design criteria. Design of lighting should be developed taking into consideration potential impacts on migratory birds, and health and safety of workers, and security requirements, as applicable.
Cumulative Environmental Effects (section 8.3)	NexGen to monitor or estimate airborne emissions of the acid precursors NO2 and SO2 from Project sources as per the Effluent and Emissions Plan as well as ambient air quality measurements of NO2 and SO2 as per the Environmental Monitoring Plan. NexGen to also monitor pH and alkalinity in treated effluent as per the Effluent and Emissions Plan as well as pH and alkalinity in snow, groundwater, wetlands and waterbodies listed in the Environmental Monitoring Plan. As part of annual reporting, NexGen to review the results of the Acid-Sensitive Lakes component of the Canada-Alberta Oil Sands Environmental Monitoring Program to determine if there is a potential for cumulative effects from the Project and oil sands emissions. Based on future results, mitigation or adaptive management may be required.

EA Report chapter	EA Commitment
Cumulative Environmental Effects (section 8.3)	Prior to the licensing phase (licence to operate), NexGen to review the Fission Uranium Corporation - Patterson Lake South Project EIS and compare the model outputs from that project to the assumed outputs in the Rook I Project EIS Reasonably Foreseeable Development Case. If any model outputs are greater than what was assumed in the Rook I EIS Reasonably Foreseeable Development Case, NexGen to incorporate those outputs into the next iteration of the Environmental Risk Assessment. Should any increased risks be discovered through this analysis, NexGen will assess whether additional mitigation measures or adaptative management will be required to keep Project effects levels protective of people and the environment.

Appendix A. Environmental effects rating criteria

Table A.1: - General Assessment criteria for significance determination

Assessment criterion	Effects rating definitions		
Residual adverse effect	**Low**	**Moderate**	**High**
Magnitude* severity of the adverse effect*	VC-Specific	VC-Specific	VC-Specific
Geographic extent spatial reach of the adverse effect	Site-specific Within the Project Study Area	Local Within the LSA	Regional Within the Regional Study Area
Duration length of time a VC would be affected by the adverse effect	Short-term/Temporary Effects that occur within the construction phase OR that occur within one generation or recovery cycle of the environmental component CULR**: Effect lasts less than one complete seasonal round (<1 year)	Medium-term Effects that extend through the operation and decommissioning phases (from 2 to 50 years) OR that extend to one or 2 generations or recovery cycles of the environmental component CULR**: Effect lasts less than one generation of land users (< 25 years)	Long-term Effects that extend into abandonment and beyond (>300 years) OR that extend for 2 or more generations or recovery cycles of the environmental component CULR**: Effects last for more than one generation of land users (> 25 years)
Frequency rate of recurrence of the adverse effect	Once Occurs once during any phase of the Project	Intermittent Occurs occasionally or at intermittent intervals during any phase of the Project	Continuous Occurs continuously during any phase of the Project
Reversibility degree to which the environmental conditions can recover after the adverse effect occurs	Reversible Reversible within the lifetime of the Project, or after project decommissioning and reclamation	Partially Reversible Partially reversible within the lifetime of the Project or after project decommissioning and reclamation	Irreversible Persists after project decommissioning and reclamation
Timing* ** consideration for the time of year that a project activity is undertaken	Inconsequential Timing of predicted project activities is not expected to affect sensitive activities	Moderate Timing of predicted project activities may affect some sensitive activities	Unfavorable Timing of predicted project activities will affect some sensitive activities

*Magnitude effects rating definitions are VC-specific. The list of VCs and the definitions of the effects ratings for each are to be determined on a Project-specific basis.

**CULR = Current Use of Lands and Resources for traditional purposes

*** Timing is a VC-specific consideration, applied to fish and fish habitat, where disturbance may occur during sensitive life stages, and for the current use of lands and resources for traditional purposes, which may be affected seasonally by changes to the environment.

Appendix B. Significance Determination Tables

Table B-1: Summary of significance determination for predicted residual adverse effects from Rook I Project

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
Fish and Fish Habitat							
Habitat availability	Negligible to low: due to the potential for limited changes to the food base for fish resulting from exposure to elevated copper concentrations in the far future projection	Local: restricted to Patterson Lake North Arm – West Basin where peak copper concentrations are predicted to occur	Permanent	Periodic: fluctuating with climate	Irreversible: not reversible before end of modeling timeframe	N/A	**Not Significant** Effects on fish VC habitat availability was determined to be local in geographic extent and the predicted effects would be within the resilience and adaptability limits for the four fish VCs.
Survival and reproduction	Negligible to low: due the potential for direct toxicological effects (lake whitefish) and/or due to predicted changes in habitat availability (i.e., food base; all VCs)	Local: exposure of fish VCs to peak copper concentrations and changes in habitat availability would be restricted to Patterson Lake North Arm – West Basin. However, as fish VCs can move around, the geographic extent of effects on survival and	Permanent	Periodic: fluctuating with climate	Irreversible: not reversible before end of modelling timeframe	N/A	**Not Significant** Effects on fish VC survival and reproduction was determined to be local in geographic extent and the predicted effects would be within the resilience and adaptability

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
		reproduction was assessed as local					limits for the four fish VCs..
Terrestrial Biota							
Woodland caribou habitat alteration and/or habitat loss	Moderate The habitat area lost to the project does not meet the minimum 65% undisturbed habitat threshold necessary to support a self-sustaining population of this species. Alteration of terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect woodland caribou habitat availability and distribution, and survival and reproduction.	Moderate Local to regional study areas, and beyond regional study area, including SK2 West Administration Unit	Long term Effect predicted to occur during construction, operation, and the closure/decommissioning phases.	Continual Effect predicted to occur continuously during all phases of the Project.	Reversible Effect predicted to be reversible (reclaimed habitat) once project activities cease.	N/A	**Not significant** Woodland Caribou are a federal and provincial species at risk that is present and uses habitat within the RSA. Potential habitat disturbance is expected to be appropriately addressed through mitigation, offsetting, and/or other measures necessary to meet the Government of Canada's Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
							Population, in Canada. An EA Condition (see table 12.1 EA2) to meet the federal recovery strategy is proposed accordingly.
Woodland caribou sensory disturbance	Moderate Sensory disturbance resulting from the presence of people, lights, dust, smells, and noise can alter woodland caribou movement and behaviour, and adversely affect caribou habitat availability and caribou abundance and distribution.	Moderate Local to regional study areas, and beyond regional study area, including SK2 West Administration Unit	Long term Effect predicted to occur during construction, operation, and the closure/decommissioning phases.	Continual Effect predicted to occur continuously during all phases of the Project.	Reversible Effect predicted to be reversible (reclaimed habitat) once project activities cease.	N/A	**Not significant** Woodland Caribou are a federal and provincial species at risk that is present and uses habitat within the RSA. Potential sensory disturbance is expected to be appropriately addressed through mitigation, offsetting, and/or other measures necessary to meet the Government of Canada's Amended Recovery Strategy for

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
							Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. An EA Condition (see table 12.1 EA2) to meet the federal recovery strategy is proposed accordingly.
Sensory disturbance for migratory birds	Low Noise, light and human disturbance is predicted to have little effect on migratory birds or unique migratory bird habitats.	Moderate Effect predicted to extend into the local study area.	Moderate Effect predicted to occur during construction, and operation phases and the early part of decommissioning phase.	Intermittent Effect predicted to occur at intermittent intervals during, construction, operation phases, and the early part of the decommissioning phase.	Reversible Effect predicted to be fully reversible once project activities cease.	Moderate Timing of sensory disturbance may affect breeding activities of migratory birds, despite proposed timing of activities to avoid sensitive breeding seasons.	**Not significant** Migratory birds predicted to inhabit or frequent parts of the local and regional study areas, where sensory disturbance would be similar to the baseline.
Loss of wetlands	Low Removal of wetlands in the project study area and reduction in	Moderate Effect predicted to occur within the local study area.	Long – term Effect predicted to extend into	Continuous Effect predicted to occur continuously	Partially Reversible Effect predicted to be partially reversible as	N/A	**Not significant** Wetland habitats are available within the local

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
	function of wetlands in the local study area.		closure/decommissioning phases.	during all phases of the Project.	pre-project conditions would not be fully achieved.		and regional study areas. Site rehabilitation in accordance with the decommissioning plan would partially restore wetlands in the project and local study areas in the long term.
Indigenous Land and Resource Use for Traditional Purposes							
Changes to access of and/or quality and quantity of hunting, fishing, trapping, and ceremonial gathering activities in the Site Study Area (SSA) as a result of the project.	Moderate A loss of access to the Project SSA is expecting for the surface lease area. The effect results in a change to locations or resources, experience, or use of locations or resources for traditional purposes, and preferred locations or means to practice the activity and use by an Indigenous group may be modified or limited. However, Indigenous Nations and communities are	Moderate Local Effect predicted to be in the Project SSA but may extend into the LSA as construction takes place in the short term due to increase in traffic etc. so some land users may choose to stay away from LSA.	High Medium-term Access to the SSA is expected to be restricted at the NexGen gate to the project site and is expected to last between 4 to 43 years (i.e., effect expected during construction through to the end of post-decommissioning) when the lands are expected to return to province through Institutional Control Program (ICP)	High Continuous Effect predicted to occur to start during construction (1-4 years) and continuously during operations, and decommissioning.	Moderate Partially Reversible Effect predicted to be reversible as the access to the SSA would be permitted for hunting, fishing and trapping post-decommissioning for traditional activities once it enters provincial Institutional Control Program (ICP)	Moderate Timing of project activities may affect some traditional activities in the SSA including moose harvesting, fishing and berry picking but mitigation measures will reduce these activities during the cultural harvesting seasons where possible.	**Not Significant** The Project may change the availability and distribution of resources for hunting, fishing and gathering for the Project Area and to a lesser extent as there will be restricted access. However, there is limited ILRU in the Site Study Area and the changes in the availability of resources are not

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
	able to continue to utilize both the LSA and RSA for traditional activities.						expected to affect the ability of Indigenous Nations and communities to hunt, fish or gather plants in the LSA or RSA.
Changes to access of and/or quality and quantity of hunting, fishing, trapping, and ceremonial gathering activities in the Local Study Area and Regional Study Area (LSA/RSA) as a result of the project.	Low A loss of access to the LSA/RSA is not expected and Indigenous Nations and communities should continue to have full access to the LSA and RSA to hunt, fish, and trap and carry out ceremonial and traditional gathering and activities in the same or similar manner.	Moderate Local Effects are predicted to extend into the LSA along the 955 road only and will not extend into the RSA.	Moderate Medium-term Access to LSA/RSA is not expected to be restricted but the Project is expected to last between 4 to 43 years (i.e., effect expected during construction through to the end of post-decommissioning when the lands are expected so may potentially impact use of LSA due to mine.	High Continuous Effect predicted to occur to start during construction (1-4 years) and continuously during operations, and decommissioning	Low Reversible Effect predicted to be reversible as the access to the LSA and RSA would be permitted for hunting, fishing and trapping for traditional activities.	Low Inconsequential Timing of project activities that take place are not expected to affect hunting, fishing and harvesting activities in the LSA or RSA.	**Not Significant** It is expected that changes to access of and/or quality and quantity of hunting, fishing, trapping, and ceremonial gathering activities in the LSA/RSA as a result of the project will be Not Significant
Changes in access to cultural and heritage resources including any of those of historical,	Low The effect results in a change to locations or experience, or use of locations or for	Low Site-Specific The change could be direct but will only	High Long-term Any change to a historical,	Moderate Intermittent While the possibility for a change exists	High Irreversible Any destruction or heritage resources that	Low Inconsequential The timing of predicted project	**Not significant** The Project may change the availability of a historical,

Residual Effect	**Magnitude**	**Geographical Extent**	**Duration**	**Frequency**	**Reversibility**	**Timing**	**Significance of Residual Effect**
archaeological, paleontological or architectural significance	traditional purposes, but the activity and use by an Indigenous group could be practiced in the same or similar manner as before**.**	likely take place in the SSA as no other areas outside the lease areas should be disturbed during construction, operations and decommissioning activities.	archaeological, paleontological or architectural significance likely be permanent.	throughout all Project phases, the actual change events are expected to occur sporadically and primarily take place during the construction phase of the project (1-4 years) during ground disturbance activities and are therefore deemed intermittent.	take place would likely be permanent and therefore deemed not reversible.	activities is not expected to affect sensitive activities to changes to a historical, archaeological, paleontological or architectural significance.	archaeological, paleontological or architectural significance sites in the Project Area**.** However, there are limited Heritage resources known to exist in the SSA and the identified Heritage mitigation and follow-up monitoring program measures were deemed adequate.
Fear and Avoidance and/or Perceived contamination of animals, water and plants (traditional foods) near Patteron area causing avoidance behaviour due to low trust in quality of harvested resources.	Moderate The effect may result in a modification or change to a harvesting location(s) and/or experience, or use of preferred locations or resources for traditional purposes, by Indigenous Nations and communities due	Low to Moderate Local Fear and avoidance behaviour is generally expected to be limited to around the Project site but some land users perceived risks may extend into the LSA.	Moderate to High Medium-term to Long-term Perceived risk and fear and avoidance behavior is generally expected to last the life of construction, operations and through decommissioning although some land users may feel	High Continual Effect predicted to occur continuously during all phases of the Project.	Moderate Partially Reversible Some land users will be open to learning more from monitoring programs and testing results and be confident with harvesting game, fish and plants again while others may avoid the	Low Inconsequential NexGen has committed to engaging with Indigenous Nations and communities on Project Follow-up Monitoring Programs in order to help address	**Not significant** NexGen has committed to engaging with Indigenous in their Project Follow-up Monitoring Programs in order to help address concerns raised regarding fear and

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
	to perceived risks of contamination.		comfortable continuing to hunt, fish and trapping in the LSA while the project in ongoing.		area and find new areas to hunt, fish, trap etc.	concerns raised regarding fear and avoidance behaviours.	avoidance behaviours and has also committed to supporting independent Indigenous environmental monitors
(Sensory) Noise, traffic, and dust from construction and operation activities degrades the sensory experience of being on the land, causing avoidance of the area for traditional land use and ceremonial activities	Moderate The effect may result in a modification or change to a harvesting location(s) and/or experience, or use of preferred locations or resources for traditional purposes, by Indigenous Nations and communities due to sensory disturbance	Low to Moderate Local The primary sensory disturbances are expected to take place at the SSA although may extend into the LSA due to increased boundary traffic and access to site primarily during construction activity.	Moderate Medium-term Sensory disturbances are expected to be primarily during the construction phase (years 1-4) yet may extend into the operations phase due to increased traffic to and from the site.	High Continuous Effect predicted to occur continuously during all phases of the Project although initial construction will likely have a greater impact due to increase in human activity to the site	Low Reversible Effect predicted to be reversible after the project is decommissioned.	Moderate Timing of project activities may affect some sensory experiences including traditional activities in the SSA including moose harvesting and berry picking but mitigation measures will help to reduce these sensory experiences during the cultural harvesting seasons where possible.	**Not significant** NexGen has committed to a number of mitigation measures regarding noise, traffic and sensory disturbances to ensure monitoring is taking place and has committed to work with Indigenous Nations and communities to understand when cultural important periods relative to harvest times culture camps are

Residual Effect	Magnitude	Geographical Extent	Duration	Frequency	Reversibility	Timing	Significance of Residual Effect
							taking place to reduce potential sensory impacts.
			Human Environment				
Cancer risk for Arsenic: consumption of traditional foods including fish and game harvested	Low Predicted ILCR was calculated to be 4 in in 100, 000, as compared to a background level of approximately 50, 000 in 100,000.	Moderate Effects are mostly local and limited to the project footprint.	Long-term Effect predicted to occur during the lifespan of the project.	Continual Effects predicted to occur continuously during the lifespan of the project.	Reversible Effects predicted to be fully reversible once the project activities cease.	N/A	**Not significant** Effects were determined to be local in geographic extent and categorized as negligeable to low.
Exposure to air and water radiological contaminants by inhalation and ingestion	Low No residual adverse effects anticipated after application of mitigation and follow-up monitoring measures.	N/A	N/A	N/A	N/A	N/A	**Not significant** No residual adverse effects carried into significance assessment.

Appendix E. List of acronyms

AAQO	Ambient Air Quality Objectives
ACFN	Athabasca Chipewyan First Nation
ALARA	As low as reasonably achievable
BATEA	Best available technology economically achievable
BC MOE	British Columbia Ministry of Environment
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
Ca	Calcium
CAAQS	Canadian Ambient Air Quality Standards
$CaCO_3$	Calcium carbonate
CCME	Canadian Council of Ministers of the Environment
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CEC	Cation Exchange Capacity
CEPA	Canadian Environmental Protection Agency
CIAR	Canadian Impact Assessment Registry
Cl-	Chloride
CMD	Commission member document
CMOP	Caribou Mitigation and Offsetting Plan
CNSC	Canadian Nuclear Safety Commission
CNWA	*Canadian Navigable Waters Act*
Co	Cobolt
CO_{2e}	Carbon Dioxide equivalent
COPC	Contaminant of potential concern
CPT	Cemented paste tailings
CRDN	Clearwater River Dene Nation
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSA	Canadian Standards Association

CSM	Conceptual Site Model
Cu	Copper
dBA	A-weighted decibels
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EAA	Environmental Assessment Act
EC	Electrical Conductivity
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
EIS	Environmental impact statement
ELC	Ecological land classification
EMP	Environmental Monitoring Program
EPP	Environmental Protection Program
ERA	Environmental Risk Assessment
FA	Federal Authorities
Fe	Iron
FIRT	Federal Indigenous Review Team
GCM	Global climate models
GHG	Greenhouse gas
GHGRP	Greenhouse gas reporting program
HC	Health Canada
HCB	Heritage Conservation Brance
HCO3-	Bicarbonate
HCT	Humidity cell test
HHRA	Human health risk assessment
HQ	Hazard quotient
HRIA	Heritage Resource Impact Assessment
HIS	Habitat Suitability Index

IAA	*Impact Assessment Act*
ICP	Institutional control program
IDF	Intensity duration frequency
IK	Indigenous Knowledge
ILCR	Incremental lifetime cancer risk
ILRU	Indigenous land and resource use
IMS	Integrated Management System
INT	Intermediate orthogneiss
IR	Information request
IRKS	Indigenous Rights and Knowledge Survey
ISQG	Interim Sediment Quality Guideline
LCH	License condition handbook
LEL	Lower Effect Level
LLRW	Low level radioactive waste
LNG	Liquefied natural gas
LSA	Local study area
JWG	Joint working group
masl	Metres above sea level
MCFN	Mikisew Cree First Nation
MDA	Mine development area
MDMER	Metal and Diamond Mine Effluent Regulations
Mg	Magnesium
MK	Métis Knowledge
Mkg	Million kilograms
Mn	Manganese
MN-S	Métis Nation of Saskatchewan
Mo	Molybdenum
mSv	Millisievert

Na+	Sodium
NEW	Nuclear energy worker
NexGen	NexGen Energy Ltd.
NFWQM	Near-Field Water Quality Model
NO_2	Nitrogen Dioxide
NORM	Naturally occurring radioactive materials
NP	Neutralization potential
NPAG	Non-potentially acid generating
NRCan	Natural Resources Canada
NSCA	*Nuclear Safety and Control Act*
NSEQC	Northern Saskatchewan Environmental Quality Committee
PAG	Potentially acid generating
Pb-210	Lead-210
PC	Parks Canada
PD	Project description
PEL	Probably Effect Level
PFP	Participant Funding Program
PM	Particulate matter
PMP	Probable maximum precipitation
RA	Responsible authority Ra-226 Radium-226
RCP	Representative concentration pathways
Registry	The Canadian Impact Assessment Registry
RFD	Reasonably foreseeable development
RIA	Rights Impact Assessment
RSA	Regional study area
RSWQM	Regional Surface Water Quality Model
SACC	Strategic Assessment of Climate Change
SAR	Sodium adsorption ratio

SARA	Species at Risk Act
SEL	Severe Effect Level
SKEAB	Saskatchewan Environmental Assessment Brance
SO_2	Sulfur Dioxide
SPGN	Semi-pelitic gneiss
Sr	Strontium
SSA	Site study area
SWSA	Saskatchewan Water Security Agency
TC	Transport Canada
TDS	Total dissolved solids
Th-230	Thorium-230
TLU	Traditional land use
TOR	Terms of reference
TRV	Toxicity reference value
TSP	Total suspended particals
U	Uranium
U_3O_8	Triuranium Oxide
UGTMF	Underground tailings management facility
VC	Valued component
WHO	World Health Organization
WLMN	Willow Lake Métis Nation
WRSA	Waste rock storage area
WSE	Water surface elevations
YNLR	Ya' thi Néné Land and Resource Office