CMD 25-H12.1-Ref4

Date: 2025-10-15

Reference from NexGen Energy Ltd.

Référence de NexGen Energy Ltd.

In the matter of

À l'égard de

NexGen Energy Ltd.

NexGen Energy Ltd.

Licence application to prepare a site for and construct its Rook 1 uranium mine and mill project

Demande de permis concernant la préparation de l'emplacement et la construction de son projet de mine et d'usine de concentration d'uranium Rook I

Commission Public Hearing
Part 1

Audience publique de la Commission
Partie 1

November 19, 2025

Le 19 novembre 2025

Document ID: DAMZHJW66V33-166150894-8321

Volume 2: Rook I Project Environmental Impact Statement

Rook I Project

Environmental Impact Statement

Section 3 Indigenous and Local Knowledge

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Abbreviations and Units of Measure

Abbreviation	Definition
ACFN	Athabasca Chipewyan First Nation
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CEA Agency	Canadian Environmental Assessment Agency
CEAA 2012	*Canadian Environmental Assessment Act*, *2012*
CNSC	Canadian Nuclear Safety Commission
CRDN	Clearwater River Dene Nation
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERFN	English River First Nation
JWG	Joint Working Group
KP	key person
LPA	local priority area
MN-S	Métis Nation – Saskatchewan
NexGen	NexGen Energy Ltd.
NR2	Northern Region 2
IKTLU	Indigenous Knowledge and Traditional Land Use
Project	Rook I Project
RCMP	Royal Canadian Mounted Police
VC	valued component
YNLR	Ya'thi Néné Lands and Resources

Unit	Definition
%	percent
km	kilometre

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3 INDIGENOUS AND LOCAL KNOWLEDGE

3.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located 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 (Figure 3.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland, and be adjacent to Treaty 10 territory. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 3.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

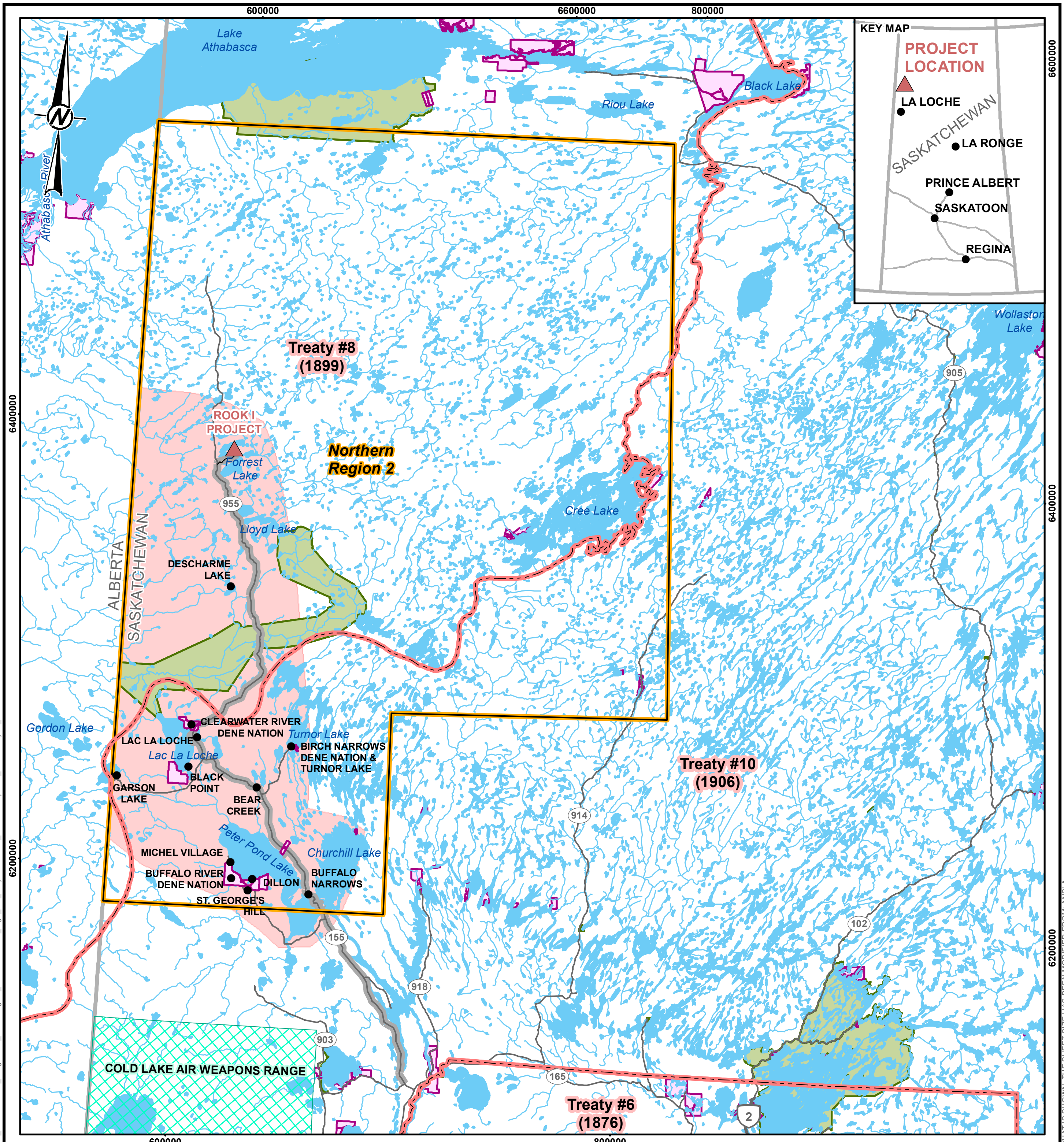
Section 3, Indigenous and Local Knowledge, of the Environmental Impact Statement (EIS) provides a detailed account regarding the collection and incorporation of Indigenous and Local Knowledge[1] into the Project Environmental Assessment (EA). NexGen is committed to the meaningful inclusion and consideration of Indigenous and Local Knowledge in the EA process, which contributes to a holistic and robust EIS for the Project. NexGen has been meeting with potentially affected or interested First Nation and Métis Groups (collectively referred to as Indigenous Groups) and local communities on the Project since 2013 (i.e., prior to exploration drilling), and is committed to fostering relationships that facilitate collaboration and respect diverse perspectives. NexGen will continue to work with Indigenous Groups to provide meaningful opportunities for Indigenous and Local Knowledge to be shared and incorporated into the EA.

This section of the EIS discusses the inclusion of Indigenous and Local Knowledge within the EA as follows:

- **Section 3.2** introduces the Indigenous Groups and local priority area (LPA)[2] communities from which Indigenous and Local Knowledge was collected.
- **Section 3.3** outlines the key factors considered within the Indigenous and Local Knowledge collection framework.
- **Section 3.4** provides definitions of Indigenous Knowledge and Local Knowledge for the purposes of the EA.
- **Section 3.5** describes the sources of Indigenous and Local Knowledge.
- **Section 3.6** outlines the approach to incorporation of Indigenous and Local Knowledge into the EA.
- **Section 3.7** discusses how Indigenous and Local Knowledge influenced Project planning and design.
- **Section 3.8** describes how Indigenous and Local Knowledge was incorporated into the EA.
- **Section 3.9** summarizes NexGen's commitment to continued incorporation of Indigenous and Local Knowledge throughout the Project lifespan.

[1] Indigenous Knowledge can generally be understood as the unique and collective knowledge of a group of Indigenous People that is built up through generations of living in close contact with the land and natural environment. Local Knowledge is a more general term and, for the purposes of the Environmental Assessment, represents information from a citizen or community representative, but without Indigenous Group/Elder sanction. Further details on the definition and use of these terms are provided in Section 3.4, Defining Indigenous and Local Knowledge.

[2] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.



LEGEND

- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARK
- WATERBODY
- PROJECT LOCATION
- LOCAL PRIORITY AREA COMMUNITIES
- ROUTE TO ROOK I PROJECT
- FIRST NATION TREATY BOUNDARIES
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2
- COLD LAKE AIR WEAPONS RANGE
- LOCAL PRIORITY AREA

0 60 120
1:2,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA (AANDC) AND MEADOW LAKE TRIBAL COUNCIL, BIRCH NARROWS DENE NATION.
4. COLD LAKE AIR WEAPONS RANGE OBTAINED FROM SASKATCHEWAN MINISTRY OF ENVIRONMENT

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

ROOK I PROJECT LOCATION AND LOCAL PRIORITY AREA

CONSULTANT

WSP

PROJECT		20144150	PHASE	3314 - 6
DESIGN	CM	2023-02-06	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-06	FIGURE 3.1-1	
CHECK	KG	2023-02-06		
REVIEW	SJ	2023-02-06		

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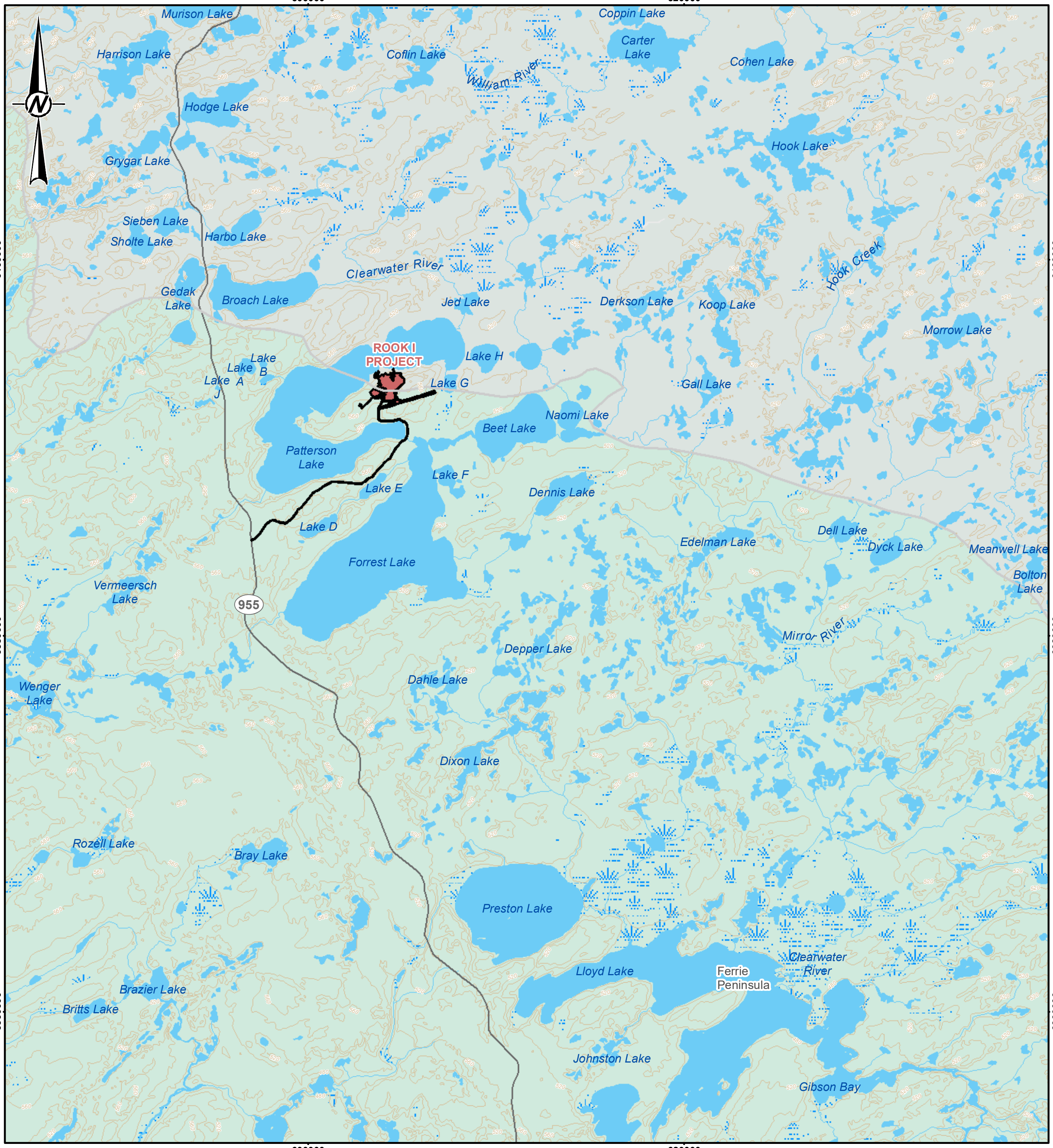

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10
1:300,000 KILOMETRES

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT 20144150 SCALE AS SHOWN REV. 0

FIGURE 3.1-2

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

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3.1.1 Inclusion of Indigenous and Local Knowledge in the Environmental Assessment – General Context

The proposed Project is subject to federal approval under the *Canadian Environmental Assessment Act*, *2012* (CEAA 2012) and provincial approval under *The Environmental Assessment Act* (Section 1.3, Regulatory Framework). The inclusion of Indigenous and Local Knowledge in the EA process may be considered under CEAA 2012; however, NexGen has committed to actively explore avenues for inclusion of Indigenous and Local Knowledge beyond the EA process. Provincial regulatory requirements for the inclusion of Indigenous and Local Knowledge are similar to the Canadian Nuclear Safety Commission (CNSC) regulatory requirements, and outline guidelines for engaging and consulting with potentially affected Indigenous Groups, including the consideration of Indigenous Knowledge in the EA. Specific to incorporation of Indigenous and Local Knowledge in the EA, NexGen has chosen to pursue an approach based on regulatory guidance, available literature, international best practices, and Project team experience. Consideration was also given to guidance for incorporating Indigenous and Local Knowledge under the new federal *Impact Assessment Act* (2019).

The inclusion of Indigenous and Local Knowledge in the EA aligns with the Government of Canada's commitment to advancing reconciliation through a renewed relationship based on the recognition of rights, respect, cooperation, and partnership (IAAC 2020a). Indigenous Knowledge is playing an increasingly important role in regulatory processes and the assessment of the effects of major projects in Canada, with the understanding that different types of knowledge and diverse perspectives are needed to obtain a full understanding of the existing conditions in which a project is proposed, the potential effects of a project, and the significance of those effects, especially to Indigenous Peoples (BC EAO 2020). In recognition of this, NexGen, local Indigenous Groups, and local communities have worked together to identify opportunities to best incorporate Indigenous and Local Knowledge into the proposed Project and the EA.

Indigenous Knowledge is valuable to the EA process and to decision makers, and can contribute in the following ways (CEA Agency 2015; IAAC 2020b; MVEIRB 2005; BC EAO 2020):

- Identify key issues and interests of Indigenous Groups early in the process and incorporate these in improved project design.
- Influence the selection of valued components (VCs) that are reflective of traditional and cultural values important to Indigenous Peoples.
- Inform study design and the selection of field study sites or receptor sites for modelling based on Indigenous Knowledge of the environment, key resources, and important traditional use areas or cultural sites.
- Focus and refine baseline data collection and methods, and establish study areas.
- Characterize past and existing environmental or social conditions, including trends over time, based on experiences and long-term observations over multiple generations, and improve the understanding of the extent of potential cumulative effects on Indigenous Peoples, their rights, and their other interests.
- Identify links between components of the environment, such as water, vegetation, and wildlife, and provide a more holistic understanding of the environment and relationships between different components, including their spiritual and cultural contexts.
- Enhance the understanding of potential effects on VCs, particularly those important to Indigenous Peoples.
- Increase the accuracy of predicted effects and contribute to the significance determinations of effects.
- Strengthen mitigation measures, including avoiding or minimizing the effects on culturally sensitive sites and traditional resources.

- Contribute to more effective long-term monitoring programs by identifying monitoring priorities, appropriate indicators, and the involvement of Indigenous Knowledge holders to help observe and collect monitoring data.

3.2 Indigenous Groups and Local Priority Area Communities

A goal for the development of the EIS was to incorporate Indigenous and Local Knowledge into the EA for the proposed Project. An important early step was to identify the specific Indigenous Groups and local communities who should be engaged. Section 3.2.1, Indigenous Groups, describes the Indigenous Groups engaged for the Project (including the process to identify the appropriate Indigenous Groups) and Section 3.2.2, Local Priority Area Communities, describes the communities in the LPA.

Further information on the Indigenous Groups and LPA communities is included in Section 2, Indigenous, Regulatory, and Public Engagement. Details regarding the definitions of Indigenous and Local Knowledge are included in Section 3.4, Defining Indigenous and Local Knowledge, and information regarding how Indigenous and Local Knowledge was incorporated within the EA is included in Section 3.6, Incorporation of Indigenous and Local Knowledge.

3.2.1 Indigenous Groups

NexGen has worked closely with the communities local to the Project since 2013 to help develop meaningful relationships based on trust and respect. Prior to commencement of the EA process in 2019 through the submission of the *Project Description for the Rook I Project* (NexGen 2019), NexGen regularly engaged with local Indigenous Groups on proposed exploration activities and early Project development aspects. In addition, NexGen and the local Indigenous Groups and communities collaborated to develop programs focused on youth, with an emphasis on education, health and wellness, and building economic capacity. Among other things, these activities provided NexGen an opportunity to identify the local Indigenous Groups, including gaining an understanding of their level of interest towards the proposed Project. Information on engagement activities conducted by NexGen prior to the formal commencement of the EA process for the proposed Project can be found in Section 2.

After submission of the Project Description, one of the formative means by which Indigenous Groups were initially identified for inclusion in the EA process was through letters of notification issued by the CNSC and the Saskatchewan Ministry of Environment inviting Indigenous Groups to participate. These letters provided key context to help determine which groups should be considered the primary groups for engagement (i.e., invited to participate) based on likely Project effects and those who should be considered as other groups for engagement (i.e., informed). NexGen's approach for achieving a deeper level of engagement with primary Indigenous Groups was established during early EA engagement activities through the signing of Study Agreements in 2019 (Section 3.3.2, Study Agreements). The identification of Indigenous Groups for engagement on the Project is described in more detail in Section 2.4.1, Identification of Indigenous Groups for Engagement.

NexGen has been engaging with the following primary Indigenous Groups on the Project:

- Clearwater River Dene Nation (CRDN);
- Métis Nation – Saskatchewan (MN-S) Northern Region 2 (NR2) through the MN-S;
- Birch Narrows Dene Nation (BNDN); and
- Buffalo River Dene Nation (BRDN).

NexGen has actively consulted the primary Indigenous Groups and will continue to explore opportunities to involve and collaborate with these Indigenous Groups as the proposed Project develops. An overview of each of the primary Indigenous Groups is provided in Section 3.2.1.1, Clearwater River Dene Nation, to Section 3.2.1.4, Buffalo River Dene Nation. A more detailed overview of these Indigenous Groups is provided in Annex X, Socio-economic Baseline Report, Section 5.1.2.2, History and Settlement Patterns.

In addition to engagement activities with the primary Indigenous Groups, NexGen has been engaging with the following other Indigenous Groups on the Project, consistent with CNSC and Saskatchewan Ministry of Environment letters indicating these groups would be informed of the Project:

- Black Lake Denesųłiné First Nation, as represented by the Ya'thi Néné Lands and Resources (YNLR);
- Fond du Lac Denesųłiné First Nation, as represented by the YNLR;
- Athabasca Chipewyan First Nation (ACFN); and
- English River First Nation (ERFN).

An overview of each of the other Indigenous Groups is provided in Section 3.2.1.5, Ya'thi Néné Lands and Resources, Section 3.2.1.6, Athabasca Chipewyan First Nation, and Section 3.2.1.7, English River First Nation.

NexGen has informed the YNLR, ACFN, and ERFN of the Project and will continue to inform these Indigenous Groups as the Project advances.

3.2.1.1 Clearwater River Dene Nation

The CRDN is a Denesųłiné Nation, formerly known as the Portage La Loche Band. The CRDN traditional territory in Alberta and Saskatchewan encompasses the upper reaches of Churchill River and west and north of the eastern shores of Lake Athabasca (TSD V.1: CRDN).

The administrative office of the CRDN is in the village of Clearwater River, Saskatchewan, on the eastern shore of Lac La Loche. The CRDN's current reserve lands and settlements are Clearwater River Dene 222, Clearwater River Dene Band 221, Clearwater River Dene Band 223, and La Loche Indian Settlement (CIRNAC 2021a; Figure 3.2-1). There are also CRDN members living off reserve, including some in the Northern Village of La Loche. The CRDN holds Treaty Rights under Treaty 8.

3.2.1.2 Métis Nation – Saskatchewan Northern Region 2

The MN-S is the governing body that represents the political, socio-economic, cultural, and educational interests of the approximately 80,000 Métis citizens in Saskatchewan through a representative system of 12 regions and approximately 130 locals (TSD IV: MN-S). The MN-S NR2 includes Métis citizens in northwest Saskatchewan and 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 (MN-S 2021; Figure 3.2-1). The MN-S NR2 represents the following Métis locals within the LPA for the Project:

- Local 39, La Loche;
- Local 40, Turnor Lake;
- Local 62, Buffalo Narrows;
- Local 65, Michel Village;
- Local 70, St. George's Hill;
- Local 156, Bear Creek; and
- Local 162, Black Point.

The MN-S asserts Aboriginal Rights and title within the Métis Homeland.

3.2.1.3 Birch Narrows Dene Nation

The BNDN, also referred to as the Birch Narrows First Nation, is a Denesųłiné Nation in the Upper Churchill River Basin, with an administrative centre in Turnor Lake, Saskatchewan (TSD II: BNDN). In northern Saskatchewan, the Dene people have occupied territory that extended as far west as Lake Athabasca, and east to Wollaston Lake (Heber 2005 in TSD II: BNDN). The BNDN's current reserve lands are Churchill Lake 193A, Turnor Lake 193B, and Turnor Lake 194 (CIRNAC 2021b; Figure 3.2-1). The BNDN holds Treaty Rights under Treaty 10.

3.2.1.4 Buffalo River Dene Nation

The BRDN is a Denesųłiné First Nation, 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 (BRDN 2017). The BRDN is located on the western shore of Peter Pond Lake, or Buffalo Lake, at the mouth of the Dillon River, or Buffalo River, and the administrative centre is in Dillon, Saskatchewan (MLTC 2020a). The BRDN's current reserve land is Buffalo River Dene Nation 193 (CIRNAC 2021c; Figure 3.2-1). The BRDN holds Treaty Rights under Treaty 10.

3.2.1.5 Ya'thi Néné Lands and Resources

The YNLR is a non-profit organization established in 2016 and owned by Hatchet Lake Denesułiné First Nation, Black Lake Denesułiné First Nation, Fond du Lac Denesułiné First Nation, and the municipalities of Stony Rapids, Uranium City, Wollaston Lake, and Camsell Portage (YNLR n.d.). The administrative centre for the YNLR is located in Saskatoon, Saskatchewan. For the purposes of the EA, the YNLR represents the Athabasca Denesųłiné of Black Lake First Nation and Fond du Lac First Nation. The Black Lake First Nation's current reserve lands are Chicken 225, Chicken 226, and Chicken 224 (CIRNAC 2021d; Figure 3.2-1), and the Fond du

Lac First Nation's current reserve lands are Fond du Lac 227, Fond du Lac 228, Fond du Lac 229, Fond du Lac 231, Fond du Lac 232, and Fond du Lac 233 (CIRNAC 2021e; Figure 3.2-1).

The Black Lake and Fond du Lac Denesų̨łiné First Nations, along with the Hatchet Lake First Nation, are collectively termed the Athabasca Denesų̨łiné. Their traditional territory is Nuhenéné. Athabasca Denesų̨łiné culture, history, and way of life are interwoven with the movements and health of the caribou herds. Where there have been barren-ground caribou, there are Athabasca Denesų̨łiné. This has been true for at least 2,600 years. Current land use activities are well documented in the vicinity of the proposed Project and archeological records of the Denesų̨łiné and their closest ancestors, the Taltheilei, correspond very closely to the caribou range which fluctuates due to natural cycles, and impacts such as climate changes, forest fires, and development. The Athabasca Denesų̨łiné are signatories to Treaty 8 and Treaty 10 (TSD VI: YNLR, Figure 2, Figure 3, Figure 4, and Figure 5).

3.2.1.6 Athabasca Chipewyan First Nation

The ACFN is an Athabascan-speaking Denesų̨łiné nation (ACFN n.d.a), with an administrative centre located in Fort Chipewyan, Alberta. The ACFN have described their core territory as extending "north, east, west and south from the Peace Athabasca Delta in Alberta, including the Lower Athabasca River and lands to the south of Lake Athabasca, and the lands south of Fort McMurray" (ACFN n.d.a). The ACFN's homelands are mapped along the boundary of the Firebag River south of Lake Athabasca and west of the Project (ACFN n.d.b).

The ACFN's reserve lands are on the south shore of Lake Athabasca, on the Athabasca Delta, and on the Athabasca River, and include Chipewyan 201, Chipewyan 201A, Chipewyan 201B, Chipewyan 201C, Chipewyan 201D, Chipewyan 201E, Chipewyan 201F, and Chipewyan 201G (CIRNAC 2021f).

3.2.1.7 English River First Nation

The ERFN is based in Patuanak and composed of both Dene and Cree people (ERFN 2022). The ERFN have 19 reserves, settlements, and villages, including but not limited to La Plonge 192, Wapachewunak 192D, Ile A La Crosse 192E, Elak Base 192A, Knee Lake 192B, Dipper Rapids 192C, Cree Lake 192G, and Primeau Lake 192F (CIRNAC 2021g; MLTC 2020b).

3.2.2 Local Priority Area Communities

Local Knowledge included in the EA has primarily been obtained from LPA communities. The LPA comprises the communities north of the junction between Highway 155 and Highway 923, and extends south of Peter Pond Lake, north of the Firebag River, east of Highway 155 and Highway 955, and west to the Saskatchewan border (Figure 3.1-1). These communities include the northern villages of La Loche and Buffalo Narrows and surrounding northern hamlets and settlements, and the communities around the CRDN, BNDN, and BRDN. All LPA communities are within the MN-S NR2 (Figure 3.2-1).

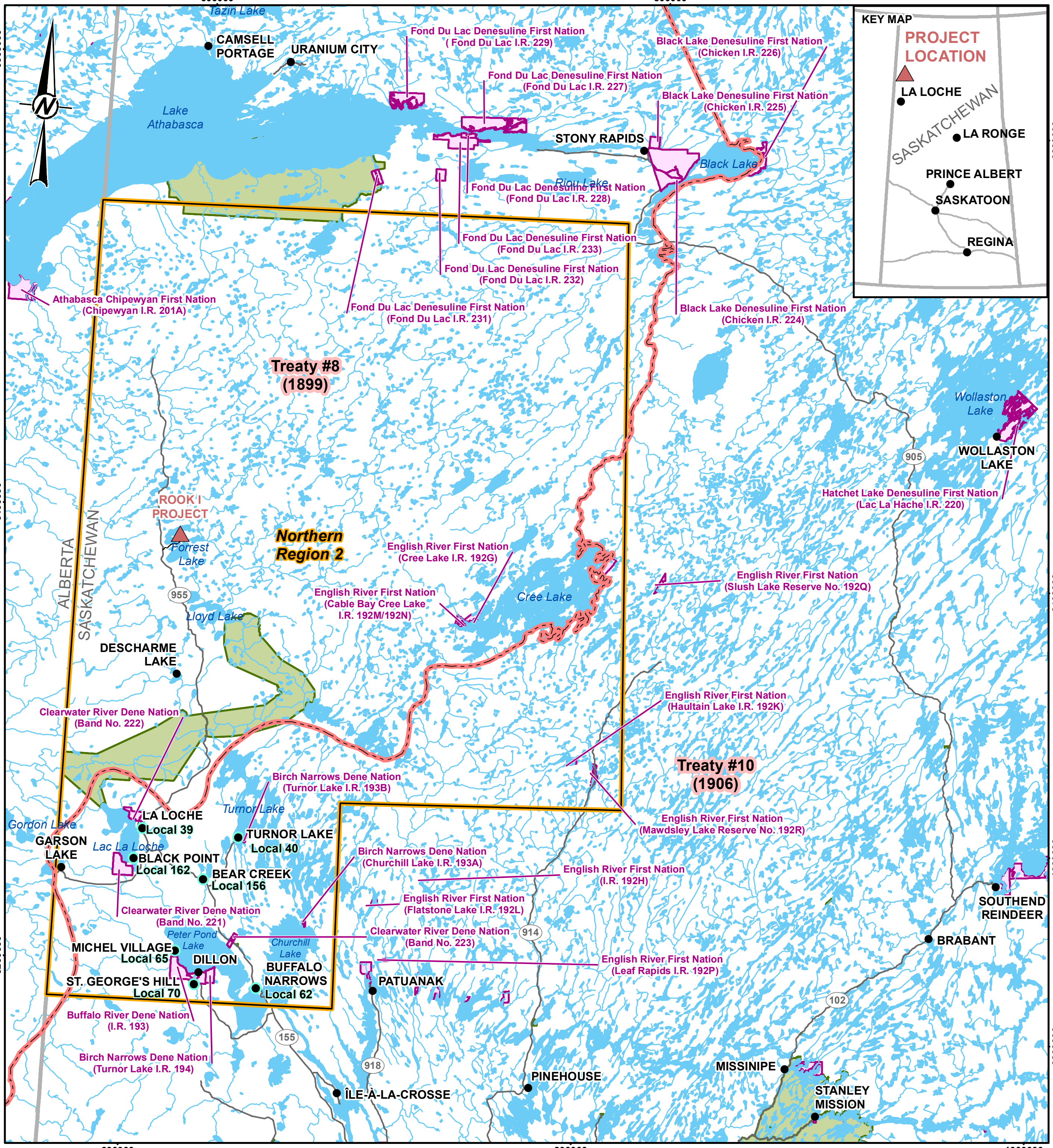
Communities within the LPA are generally composed of Métis citizens, off-reserve Dene Nation citizens, those who have identified as other Indigenous persons, and those who have identified as non-Indigenous (Statistics Canada 2016). Overall, approximately 96% of the LPA community members have identified as being Indigenous. Table 3.2-1 outlines the LPA communities arranged by proximity (closest to farthest) to the proposed Project. Populations are included based on the 2016 Census data to note the size of each community in proportion to the total LPA population.

Table 3.2-1: Population of Local Priority Area Communities by Increasing Distance to the Rook I Project

Local Priority Area Communities	Population (2016 Census)
Northern settlement of Descharme Lake	5
Northern village of La Loche	2,372
Northern hamlet of Black Point	43
Northern hamlet of Bear Creek	33
Northern settlement of Garson Lake	10
Northern hamlet of Turnor Lake	149
Northern village of Buffalo Narrows	1,110
Northern hamlet of St. George's Hill	131
Northern hamlet of Michel Village	57
Total	**3,910**

Source: Statistics Canada 2016.

Obtaining Local Knowledge for the EA from the LPA communities has been and will continue to be important as members of these communities are known to use the area around the proposed Project and are most likely to be affected by the Project, both positively and negatively. Members of the LPA communities are also the people that NexGen is prioritizing for employment, business, education, and training opportunities from the Project.



LEGEND

- POPULATED PLACE
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARK
- WATERBODY
- PROJECT LOCATION
- LOCAL PRIORITY AREA COMMUNITIES
- FIRST NATION TREATY BOUNDARIES
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 60 120
1:2,500,000 KILOMETRES

NOTE(S)

MÉTIS LOCALS HAVE ELECTED LEADERSHIP AND OPERATE AT THE COMMUNITY LEVEL WITHIN EACH MÉTIS NATION - SASKATCHEWAN REGION.

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
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3. ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA (AANDC) AND MEADOW LAKE TRIBAL COUNCIL, BIRCH NARROWS DENE NATION.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

INDIGENOUS GROUPS AND LOCAL PRIORITY AREA COMMUNITIES IN THE VICINITY OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	JO	2023-02-06	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-06	FIGURE 3.2-1	
CHECK	KG	2023-02-06		
REVIEW	SJ	2023-02-06		

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3.3 Indigenous and Local Knowledge Framework

The following subsections describe the key framework components considered for the collection and incorporation of Indigenous and Local Knowledge into the EA. This includes discussions on NexGen's philosophy, Project-specific engagement agreements with Indigenous Groups, the context for applying Indigenous Knowledge, and regulatory context.

3.3.1 NexGen Philosophy

Key aspects of NexGen's philosophy to working with people (Section 1.1.6, Working with People) have informed the overall approach to engagement and the incorporation of Indigenous and Local Knowledge into the EA. As a foundational principle, NexGen acknowledges and values the interests and aspirations of potentially affected Indigenous Groups and LPA communities. NexGen is committed to fostering trusting relationships that facilitate collaboration and maximize the benefits of the Project to Indigenous Groups and LPA communities. Aligned with this philosophy, NexGen is committed to the following:

- respecting the diverse cultures and perspectives of those with whom the Project interacts;
- proactively engaging with communities;
- enhancing workers' awareness of the history, traditions, and rights of Indigenous Peoples;
- supporting the economic participation of affected communities in training, education, employment, and business opportunities from the Project;
- seeking to provide opportunities resulting in sustainable, lasting benefits to local communities beyond the Project lifespan; and
- providing clear and timely information to those who have direct interest in the Project.

NexGen's values of honesty, respect, resilience, and accountability serve as the roadmap to creating as much positivity for as many people as possible. These values, which are applicable across the design and implementation of the engagement program, include:

- **Honesty:** Transparent and clear with self and others; open to giving and receiving feedback.
- **Respect:** Treat others in the way we want to be treated and without judgement.
- **Resilience:** Agile and entrepreneurial, nimble with the structure to pivot.
- **Accountability:** Clear in our expectations; curious and open, we have ownership of our work and execute with excellence.

NexGen is committed to strong ethical standards, and the company's reputation is built through the conduct and interactions of all members of the NexGen team, including directors and officers, employees, consultants, and contractors. NexGen's Code of Ethics is built on its core values and beliefs. The following Code of Ethics aspects form a basis for all NexGen activities, including NexGen's engagement program approach:

- Act in a way that upholds and reflects NexGen's values.
- Act with integrity and honesty.
- Act ethically and with courtesy and respect to others.
- Treat communities and the environment in which NexGen operates with respect.

- Never use one's power or status in an effort to gain undue benefit or advantage over others.
- Maintain confidentiality, where required, to protect corporate, personal, and third-party information.
- Take responsible steps to avoid any conflicts of interest, either real or perceived.
- Always comply with the law and relevant rules and regulations.

3.3.2 Study Agreements

NexGen entered into a Study Agreement with each of the primary Indigenous Groups (i.e., CRDN, MN-S, BNDN, and BRDN) for, among other things, the sharing of Indigenous Knowledge (Section 3.5, Indigenous and Local Knowledge Sources). Study Agreements are agreements signed by NexGen and each primary Indigenous Group that outline the engagement approach, as well as resources and funds provided by NexGen to support Indigenous Group participation in the Project EA process. These agreements were signed in September and October of 2019.

While the content of each Study Agreement is confidential, the focus of the Study Agreements with each primary Indigenous Group is as follows:

- Develop a Joint Working Group (JWG) structure for each Indigenous Group to support the inclusion of Indigenous Knowledge into the EA process and to facilitate regular, ongoing engagement.
- Assist in the identification of VCs for the EA.
- Explore special interest topics for each Indigenous Group.
- Support Indigenous Knowledge and Traditional Land Use (IKTLU) Studies[3] in various forms particular to each Indigenous Group.
- Establish a Community Coordinator position in each Indigenous Group to act as the primary contact between NexGen and the Indigenous Group.

Each Study Agreement formalized an engagement process between NexGen and individual Indigenous Groups to, among other things, identify and characterize potential effects on Indigenous (i.e., First Nation and Métis) Rights and socio-economic interests resulting from the Project, and to collaboratively identify potential avoidance, mitigation, and accommodation measures related to all identified effects on those Rights. The Study Agreements also acknowledged that, notwithstanding the activities contemplated under the Study Agreement, the responsibility for fulfilling the Duty of Consult remains with the Crown (Section 1.3).

In addition to the above, each of the Study Agreements:

- commits NexGen to providing capacity funding for the JWG engagement, the retention of technical support by the Indigenous Group, and the completion of a self-directed IKTLU Study (Section 3.5.2, Indigenous Knowledge and Traditional Land Use Studies); and
- commits NexGen and each individual Indigenous Group to negotiate in good faith to formalize a Benefit Agreement, and for NexGen to provide funding to assist in negotiating such an agreement.

A Study Funding Agreement was also signed in 2020 with the YNLR on behalf of the Black Lake Denesųłiné First Nation and Fond du Lac Denesųłiné First Nation as the YNLR identified an interest in sharing Indigenous

[3] Indigenous Knowledge and Traditional Land Use Studies include all land use studies developed by the potentially affected Indigenous Groups for the Project, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, Indigenous Rights and Knowledge studies (henceforth referred to as collectively as IKTLU Studies).

Knowledge through an IKTLU Study. This Study Funding Agreement between NexGen and the YNLR was strictly for funding an IKTLU Study.

Through the Study Agreements and the Study Funding Agreement, the CRDN, MN-S, BNDN, BRDN, and YNLR formally shared Indigenous Knowledge to inform the EA for the Project.

3.3.3 Application of Indigenous Knowledge in the Environmental Assessment

Indigenous Peoples in Canada have been calling for greater collaboration and participation in EAs for decades, including the incorporation of their knowledge, values, and perspectives into the regulatory process and decisions. While recent EA processes in Canada have attempted to incorporate Indigenous Knowledge, Indigenous Peoples have criticized the ability of EAs to meaningfully engage with and incorporate Indigenous Knowledge (Eckert et al. 2020). For example, a comment was made by a JWG member on the Cluff Lake Mine process that the community was forgotten about after that project was approved (MN-S-JWG 2019). Other comments were made about Indigenous Groups feeling apprehension to share their Indigenous Knowledge with proponents because of the perception that their knowledge would be used for the purpose of permitting other projects, without respect of the community's ownership and control of their knowledge, and with no benefit to the community (MN-S-JWG 2019; BNDN-JWG 2019a).

Feedback from Indigenous Groups during engagement for the Project has informed the approach to the incorporation of Indigenous Knowledge in the EA (Section 3.6). The JWGs were established to support the inclusion of Indigenous Knowledge, include a broader group of voices and perspectives from the communities, and facilitate two-way dialogue. Comments made by Indigenous Groups related to the value of incorporating Indigenous Knowledge into all stages of the EA process included the following topics:

- The inclusion of both Indigenous Knowledge and Western science in the EA is important (BRDN-JWG 2020).
- Indigenous Groups have acquired in-depth knowledge of the land and "how it works", which is rooted in living off the land for generations (BRDN-JWG 2019; MN-S-JWG 2019).
- Indigenous Groups have a unique local knowledge of particular places based on generations of use (TSD V.2: CRDN; MN-S-JWG 2019).
- It is important to listen to and incorporate the knowledge of Elders (BNDN-JWG 2021b; BRDN-JWG 2019; CRDN-JWG 2021).
- Indigenous Knowledge plays an important role in helping proponents mitigate potential project effects, including avoiding areas where there are sacred sites, traditional plants, or harvesting sites (MN-S-JWG 2019).
- Sustainability is critically important; the environment and land and resources must be protected for future generations (MN-S-JWG 2019; BNDN-JWG 2021e).
- Indigenous Knowledge can provide information about the cumulative effects of past and existing activities on both culture and the environment (TSD IV: MN-S; TSD V.2: CRDN).
- Incorporating community-led, long-term environmental testing and monitoring during construction and operation of the Project is important (TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021e).

- The inclusion of cultural awareness training for all employees working on the Project site is essential, given that Indigenous Peoples have a long history that is not always well understood (BNDN-JWG 2021d; BNDN-JWG 2021c; BRDN-JWG 2019; BRDN-JWG 2021c; MN-S JWG 2021).

Through the JWGs, IKTLU Studies, and other engagement activities, Indigenous Groups have shared invaluable Indigenous and Local Knowledge, including what Indigenous Knowledge means to them (Section 3.4.1, Defining Indigenous Knowledge) and comments on why it is important to incorporate Indigenous Knowledge into the EA.

3.3.4 Regulatory Context

On 20 February 2020, the CNSC issued a Record of Decision (DEC 19-H112; CNSC 2020a) on the scope of the EA for the proposed Project. In this document, the CNSC stated "pursuant to section 19 of the CEAA 2012, [the Commission] determines the scope of the factors for the Environmental Assessment of the Rook I Project proposed by NexGen Energy Ltd. to include the factors mandated in paragraphs 19(1)(a) to (h) of the *Canadian Environmental Assessment Act, 2012*, with no additional factors" and "the Commission accepts CNSC staff's submission that, in accordance with subsection 19(3) of CEAA 2012, Indigenous traditional knowledge and community knowledge shall inform the EA for the Rook I Project" [4].

The incorporation of Indigenous and Local Knowledge into the EA considered regulatory guidance provided by both the federal and provincial governments, which are described in Section 3.3.4.1, Federal Regulatory Context, and Section 3.3.4.2, Provincial Regulatory Context.

3.3.4.1 Federal Regulatory Context

From a federal perspective, the incorporation of Indigenous and Local Knowledge into the EA was guided by the following regulatory documents from the CNSC and the Canadian Environmental Assessment Agency (CEA Agency; now the Impact Assessment Agency of Canada):

- *Considering Aboriginal Traditional Knowledge in Environmental Assessments Conducted Under the Canadian Environmental Assessment Act, 2012* (CEA Agency 2015).
- *Generic Guidelines for the Preparation of an Environmental Impact Statement - Pursuant to the Canadian Environmental Assessment Act, 2012, Version 2* (CNSC 2021a).
- Public and Indigenous Engagement, *Indigenous Engagement: REGDOC-3.2.2, Version 1.2* (CNSC 2022).
- E-DOC #6470679: *Guidance on Indigenous Engagement for Proposed Projects undergoing Environmental Assessments under CEAA 2012* (CNSC 2021b).
- E-DOC #6474990 *Version 2: CNSC Guidance Key Documents Expected of Proponent by CNSC to fulfill Indigenous Engagement Requirements for Designated CEAA 2012 projects in the key regulatory guidance section* (CNSC n.d.).
- E-DOC #6515310 *Version 1: Additional information on the role of Indigenous groups who will be participating in the technical review of the EIS and preparation of the CNSC EA Report under CEAA 2012* (CNSC 2020b).

[4] For the purposes of the EIS, the term "Indigenous traditional knowledge" and "Aboriginal traditional knowledge" are represented by "Indigenous Knowledge" and the term "community knowledge" is represented by "Local Knowledge". When referring to both simultaneously, the term "Indigenous and Local Knowledge" is used.

Subsection 19(3) of CEAA 2012 states that “the Environmental Assessment of a designated project may take into account community knowledge and Aboriginal traditional knowledge”. The CEA Agency (2015) provides guidelines on how Indigenous Knowledge can be considered throughout the EA process and the general principles that should be followed when working with communities and their knowledge:

- Work with the community.
- Seek prior informed consent.
- Access Indigenous Knowledge with the support of the community.
- Respect intellectual property rights.
- Collect Indigenous Knowledge in collaboration with the community.
- Bring Indigenous Knowledge and Western knowledge together.

The CNSC Generic Guidelines for the Preparation of an EIS Pursuant to CEAA 2012 (CNSC 2021a) provide guidance on Indigenous Engagement in accordance with the CNSC REGDOC-3.2.2 (CNSC 2022), while Part 1, Section 3.3.2 of CNSC (2021a) outlines the requirements for considering and documenting Indigenous and Local Knowledge in the EIS, including that “[a]greement should be obtained from Indigenous groups regarding the use, management, and protection of their existing traditional knowledge during and after the EA”. Section 3.3.2 also outlines that the EIS should document the Indigenous Knowledge gathered and how it was gathered, the sources of Indigenous Knowledge, and how the proponent considered Indigenous Knowledge in the assessment (CNSC 2021a).

Ongoing engagement to distribute Project information and provide opportunities for Indigenous and community participation are important aspects of the EA process. Regulatory Document 3.2.2, Indigenous Engagement (CNSC 2022) provides guidelines for early engagement and the sharing of Indigenous Knowledge:

> Early engagement provides the opportunity to start or further develop relationships with Indigenous communities and can help build trust and respect. For example, it may provide Indigenous groups the necessary time to gather and share information on local and Indigenous knowledge (IK). IK may help to identify potential impacts from the activity described in the licence application on traditional land use, treaty rights, Indigenous rights, and culturally important sites, including archeological sites. Gathering of IK must be approached respectfully, in collaboration with the Indigenous group, and with the understanding that the IK may be sensitive or proprietary. IK must be understood in the context of the Indigenous group’s world view.

The E-DOCS #6470679 (CNSC 2021b) and #6474990 v2 (CNSC n.d.) provide guidance on the CNSC’s requirements for the key steps of the EA process and guidance for fulfilling Indigenous engagement requirements as part of an EA for a designated project under CEAA 2012. The E-DOC #6470679 (CNSC 2021b) states that an EIS should contain a balanced presentation of issues and conclusions drawn from scientific, engineering, technical, traditional, and local knowledge, and should document how scientific, engineering, traditional, and local knowledge were collected and used to reach conclusions. It also provides guidelines on Indigenous engagement methods, which can include sources of Indigenous Knowledge, and to ensure that Indigenous Knowledge shared during Indigenous engagement is incorporated into an EIS. The E-DOC #6474990 v2 (CNSC n.d.) provides a description of the key documents proponents are expected to produce to fulfill Indigenous engagement requirements as part of an EA for a designated project under CEAA 2012 at the key stages of the process.

The E-DOC #6515310 (CNSC 2020b) outlines the roles and responsibilities of Indigenous Groups participating in the technical review of an EIS and the preparation of an EA report. It states that the participation of Indigenous Groups in the technical review process provides an opportunity for them to provide specific Indigenous Knowledge and expertise with respect to their community as it relates to an EIS.

The approach taken by NexGen to engage and work collaboratively with Indigenous Groups through the terms and conditions of the Study Agreements (Section 3.3.2), including the establishment of the JWGs (Section 3.5.1, Joint Working Groups) and the funding to conduct independent IKTLU Studies (Section 3.5.2) to facilitate the incorporation of Indigenous and Local Knowledge in the EA process, aligned with guidelines from the CEA Agency (2015) and the CNSC (2021a, 2022). NexGen's approach was also developed in consideration of current best practices from the Impact Assessment Agency of Canada (IAAC 2020a, 2020c). NexGen has been and remains committed to facilitating meaningful opportunities for Indigenous Groups to share their knowledge according to their protocols and in their preferred format, and to respect the knowledge provided.

Further information specific to the regulatory context for public and Indigenous consultation and engagement is presented in Section 2.3.2, Regulatory Context.

3.3.4.2 Provincial Regulatory Context

From a provincial perspective, the incorporation of Indigenous and Local Knowledge into the EA was guided by the following regulatory documents from the Government of Saskatchewan:

- *First Nation and Métis Consultation Policy Framework* (Government of Saskatchewan 2010).
- *Proponents Guide – Consultation with First Nations and Métis in Saskatchewan Environmental Impact Assessment* (Government of Saskatchewan 2014).
- *Proponent Handbook – Voluntary Engagement with First Nations and Métis Communities to Inform Government's Duty to Consult Process* (Government of Saskatchewan 2013).

The provincial regulatory requirements are similar to the CNSC regulatory requirements discussed in Section 3.3.4.1, and outline guidelines for engaging and consulting with potentially affected Indigenous Groups, including the consideration of Indigenous Knowledge in the EA.

The *First Nation and Métis Consultation Policy Framework* (Government of Saskatchewan 2010) states that consultation with First Nations and Métis communities is to be undertaken in a spirit of mutual respect and trust, including the consideration of Indigenous Knowledge. The framework describes the Duty to Consult Policy, including its application and interest-based engagement of First Nations and Métis communities.

The *Proponents Guide – Consultation with First Nations and Métis in Saskatchewan Environmental Impact Assessment* (Government of Saskatchewan 2014) encourages proponents to work with First Nations and Métis communities to gather and present Indigenous Knowledge through methods such as project-specific Traditional Knowledge and/or use studies, and to incorporate relevant Indigenous Knowledge in the EIS. The guide outlines the Crown's duty to consult, the role of the proponent, and how consultation activities are assessed by the Crown.

The *Proponent Handbook – Voluntary Engagement with First Nations and Métis Communities to Inform Government's Duty to Consult Process* (Government of Saskatchewan 2013) states that proponents should consider "learning about, recognizing and respecting First Nations and Métis cultural activities, traditional practices and knowledge and uses of lands and resources" to facilitate effective engagement and build strong relationships. The handbook also describes how proponents could engage and how engagement should be documented to inform the Crown's duty to consult, among other topics.

Through the engagement and collaborative approach described in Section 3.3.4.1, NexGen is also compliant with regulatory requirements in Saskatchewan (Government of Saskatchewan 2010, 2013, 2014).

3.4 Defining Indigenous and Local Knowledge

To facilitate proper use of Indigenous and Local Knowledge in the EA, deriving appropriate definitions for both of these terms was important. The process for establishing these definitions included consideration of regulatory guidance, input from Indigenous Groups, and relevant literature.

3.4.1 Defining Indigenous Knowledge

The concept and application of Indigenous Knowledge has been evolving in the CEAA process since 2012. The new federal *Impact Assessment Act* identifies Indigenous Knowledge as a holistic system embedded in the unique cultures, languages, values, and worldviews of Indigenous Peoples (IAAC 2020c, 2020b). For the purposes of the EA, Indigenous Knowledge is specifically defined as information sanctioned (i.e., authoritative permission or approval given) by an Indigenous Group as an official statement, document, or position. Further information on how the Indigenous Groups internally defined Indigenous Knowledge for sanctioned use in the EA is provided in this subsection.

During early JWG meetings between NexGen and Indigenous Groups in October 2019 (Section 2.6.1, Indigenous Engagement), Indigenous Groups were asked to define Indigenous Knowledge based on their own perspectives and explain what it means to their community. In addition, Indigenous Knowledge was described in the IKTLU Studies. In general, Indigenous Groups described Indigenous Knowledge as being tied to history, places, spirituality, and Indigenous Peoples' intimate relationship with the land and resources (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR).

Indigenous Knowledge was described by Indigenous Groups in terms of being rooted in living off the land for generations and the intimate relationship with the land and resources that is developed from the long-term practice of traditional activities. For the CRDN, harvesting activities and cultural practices are integral to the distinctive identity of Denesųłiné Peoples, and the maintenance and strengthening of Denesųłiné identity and heritage includes the transmission of Indigenous Knowledge (TSD V.1: CRDN).

> Throughout time immemorial, Indigenous societies such as CRDN have relied on the oral transmission of stories, lore, histories, teachings, and other knowledges to sustain unique ways of life and identity as a people. (TSD V.2: CRDN)

Similarly, a member of the MN-S described Indigenous Knowledge as being part of the community's fabric and being "who we are" that is gained from "living in the bush" and surviving off the land, and spending a lifetime hunting, trapping, and gathering medicines (MN-S-JWG 2019). A member of the BRDN described Indigenous Knowledge as the community's way of life, and how knowledge is accumulated from living and surviving off the land, as well as from the teachings of Elders (BRDN-JWG 2019). The YNLR described the importance of the land to the Athabasca Denesųłiné culture and way of life, which has been passed down through the generations (TSD VI: YNLR).

Members of the BNDN and BRDN highlighted the critical role of experiential learning, where specialized knowledge and skills required to hunt, trap, fish, or gather plants is taught to younger generations by learning and doing while out on the land with family members and Elders (TSD II: BNDN; TSD III: BRDN). The CRDN also described the importance of learning on the land, and how “the land is simultaneously the teacher and the school room”, as noted below:

> Within Dene societies, children learn the values, traditions, and customary practices by listening, observing, and emulating Elders and adults within extended families. This learning takes place directly on the land and includes the acquisition of intimate knowledge of particular places, of the plants and animals living in those places, and their unique habits and seasonal cycles. It also includes the ancestral stories associated with such spaces. (TSD V.2: CRDN)

The critical importance of passing down knowledge to younger generations for the preservation of knowledge and maintenance of culture was emphasized by Indigenous Groups (MN-S-JWG 2019; TSD IV: MN-S; TSD III: BRDN; TSD II: BNDN; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).

> Their ancestral Métis Knowledge, accumulated over generations, is integral to the legacy of Métis understanding and interaction with the natural world, and the transfer of natural and cultural environmental Métis Knowledge to younger generations is vital for the maintenance of Métis culture. (TSD IV: MN-S)

> We’re teaching that young generation how to live off the land. And in order for them to do that, this is something that has to be out [on the land]. (TSD V.2: CRDN)

> I teach, we teach lots. Our kids and our grandkids, until today. We teach them all the traditional ways . . . . Like everything, hunting, trapping, fishing, everything. Yeah. Everything! (TSD V.2: CRDN)

The vital role of the extended family in sharing and preserving knowledge was highlighted by a member of the BNDN (BNDN-JWG 2019b). The CRDN also described the essential role and responsibilities of parents, grandparents, and great grandparents within extended family networks to pass down Denesųłiné customs, traditions, and knowledge to younger generations:

> Like our parents, our ancestors, like they were raised off the land, and that’s how I was raised. And that’s how he [husband] was raised. So this is what we’re doing right now for our children and our grandchildren, you know. We took our children to those kind of camps, we teach them to hunt, to trap and everything. And now - their parents are working and our grandchildren we are teaching because their parents won’t be there for them, to teach them, because they are working. You know, like we take them out and we show them how to do things. (TSD V.2: CRDN)

The ability to transfer knowledge to younger generations requires access to the land and availability of high-quality, abundant resources (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN). For the CRDN, the maintenance and strengthening of Denesųłiné identity and heritage includes the transmission of Indigenous Knowledge, which is tied to “a healthy productive land base which draws on the knowledge and experience of the ancestors, Elders, and current harvesters” (TSD V.1: CRDN).

Indigenous Knowledge was also described by a member of the MN-S as having a vast understanding of the land and how it works, including its resources, the interrelationships between different environmental components, and the importance of sustainably managing resources for future use (MN-S-JWG 2019). Showing respect for the environment and resources that are depended upon was emphasized by the MN-S, a teaching that has been passed down from Elders and then transferred on to children and grandchildren (MN-S-JWG 2019). Similarly, the CRDN described how "CRDN families (past and present) have fostered deeply respectful relationships with the land and have acquired an intimate knowledge of the features and living and non-living beings sharing this same space" (TSD V.2: CRDN).

The long-term observations, including observed environmental trends, have been expressed by Indigenous Groups as important components of Indigenous Knowledge. Observations included, for example, changes in migration patterns of wildlife and in predator-prey dynamics, decreasing wildlife populations and increasing prevalence of unhealthy animals, and the delayed onset of spring and changes in ice and water (MN-S-JWG 2019). The MN-S noted that Indigenous Knowledge can also provide information about the cumulative effects of past and existing activities on both culture and the environment (TSD IV: MN-S).

Indigenous Knowledge was described by members of the CRDN, MN-S, BNDN, and BRDN as being place based and building on historical connections with specific places used in the past (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN). For the BNDN, the transmission of knowledge plays a vital role in identity by connecting people with their ancestors, particularly through stories from the past (TSD II: BNDN). The CRDN described how learning on the land includes the acquisition of intimate knowledge of particular places, which includes the ancestral stories associated with such spaces (TSD V.2: CRDN). For example, specific locations where medicines and berries have been gathered or moose have been harvested for generations are also associated with particular stories and teachings.

Members of the CRDN, MN-S, and BNDN discussed how Indigenous Knowledge is being lost, including from the loss of language and ceremonies, and how culture and identity that comes from being on the land is slowly being eroded (TSD V.2: CRDN; MN-S-JWG 2019; BNDN-JWG 2019a,b). The importance of preserving Indigenous Knowledge for future generations and the maintenance of culture was emphasized, including through revitalization of language and ceremonies, teaching Indigenous Knowledge in schools, time spent with Elders and at cultural camps, and land-based education (MN-S-JWG 2019). Many CRDN members who lost touch with Denesųłiné traditional ways for some time have now returned to the land and traditional ways because they want their children to know and fully embrace their Denesųłiné heritage and identity (TSD V.2: CRDN). The CRDN highlighted the essential role that Elders play in teaching Denesųłiné knowledge, teachings, and traditions to younger generations though school- and land-based education.

In summary, Indigenous Knowledge can generally be understood as the unique and collective knowledge of a group of Indigenous People that is built up through generations of living in close contact with the land and natural environment. The body of knowledge builds upon the historical experiences of a people and adapts to social, economic, environmental, spiritual, and political change; therefore, it is cumulative and dynamic (CEA Agency 2015; IAAC 2020c). Indigenous Knowledge is place based, unique to each Indigenous community and culture, and specific to community context, the biophysical environment, the knowledge holder(s), and often to the language of the Indigenous Group. It is passed down within a community to the next generation orally through language, stories, ceremonies, teachings, and observations (ICT 2018; IAAC 2020c).

Indigenous Knowledge is often associated with the exercise and protection of Aboriginal and Treaty Rights, which are supported by the continued accumulation of Indigenous Knowledge through use of lands and resources for traditional purposes (IAAC 2020c).

3.4.2 Defining Local Knowledge

Local Knowledge is a more general term than Indigenous Knowledge and, for the purposes of the EA, represents information from an LPA citizen or representative, but without Indigenous Group/Elder sanction (i.e., it is not an official position, statement, or document); therefore, this information is not considered to be Indigenous Knowledge. However, the information has still been captured in the EA. Local Knowledge is sometimes used when describing the knowledge of local people who may or may not be Indigenous and who hold knowledge that is based on personal and collective experiences of their local environments over time, without necessarily having generational connections to a place (Hill et al. 2006 in Williams et al. 2020). Local Knowledge is created within particular social and political contexts (Turnbull 1997; Bowker 2010 in Johnson et al. 2016). For example, Local Knowledge holders can include commercial fishers, hunters, recreationists, and others who have a stake in, and interact with, the local environment (Johnson et al. 2016).

Given that approximately 96% of the population in the Project's LPA communities identify as Indigenous, the inclusion of the term "Local" in "Indigenous and Local Knowledge" is used to recognize the necessity to capture the information provided by locals in the EA, but not as the official Indigenous Knowledge sources provided by Indigenous Groups. In this regard, Local Knowledge captures both information provided by various community members in the LPA and information collected through formal engagement processes as agreed to with Indigenous Groups. As examples, Local Knowledge was shared during community information sessions, site tours, and other formal and informal meetings, as well as through research conducted as part of environmental and socio-economic baseline data collection. Collection and consideration of Local Knowledge from Indigenous and non-Indigenous people is described further in Section 2.

3.5 Indigenous and Local Knowledge Sources

Indigenous Groups and members of communities within the LPA have shared Indigenous and Local Knowledge with NexGen through a variety of engagement activities and sources of information. In general, sources of Indigenous Knowledge were identified through methods associated with the signed individual Study Agreements (e.g., JWGs, IKTLU Studies) with each primary Indigenous Group (i.e., the CRDN, MN-S, BNDN, and BRDN) and through the Study Funding Agreement with the YNLR (Section 3.3.2). Indigenous and Local Knowledge was also shared by the Indigenous Groups in forms such as individual presentations describing important historical information, cultural practices, and knowledge. The majority of Local Knowledge was shared through EA baseline activities or other formal or informal individual and community events, including the community information sessions held in 2019.

Section 3.5.1, Section 3.5.2, and Section 3.5.3, Sources of Local Knowledge, provide more details regarding the processes associated with the collection of Indigenous and Local Knowledge.

3.5.1 Joint Working Groups

Joint Working Groups were established in late 2019 with each of the four primary Indigenous Groups as a means of early engagement and collaboration between representatives of NexGen and each Indigenous Group to facilitate regular, ongoing engagement during the EA process. These JWGs are composed of NexGen and Indigenous Group representatives, the latter of which were chosen by the leadership of each Indigenous Group. A goal of the JWGs is to meet every four to eight weeks, with the meeting cadence being set by each Indigenous Group; NexGen has been and will continue to be committed to meeting as often as requested. Detailed transcripts[5] from each JWG meeting are prepared by an independent consultant and distributed to each JWG member for review, editing, and feedback, including the identification of information considered sensitive or confidential that should not be included in public reporting. A Community Coordinator for each Indigenous Group acts as a liaison between the community and NexGen and helps coordinate the planning of JWG meetings. For each Indigenous Group, the Community Coordinator position is funded by NexGen as part of the individual Study Agreement.

The JWGs were established to include a broader group of voices and perspectives from the community during the EA process. The JWGs facilitate the exchange of information and sharing of Indigenous and Local Knowledge, including understanding each Indigenous Group's protocols on consent, ownership, access, control, and possession of their knowledge. The JWGs support the incorporation of Indigenous Knowledge into the EA, including the identification of VCs, characterization of certain baseline conditions, discussion of potential effects of the Project, and identification of potential mitigation measures to avoid or minimize those effects. The JWGs were also planned to facilitate the review of and afford an opportunity to provide feedback on the EIS. A summary of JWG activities, including topics discussed, is presented in Section 2.6.1.1, Summary of Indigenous Engagement Activities.

While JWG meetings were generally held regularly between NexGen and the Indigenous Groups during development of the EIS (i.e., between 2019 and 2021), there were times where the usual cadence was not possible. When the COVID-19 pandemic first impacted Canada, JWGs were paused between April 2020 and July 2020, re-initiating in August 2020. Late in 2019, the CRDN proposed a specific agenda for three JWG meetings, two of which were held in 2020. The third meeting, scheduled to occur after completion of CRDN: TSD V.2, has not yet occurred at the date of writing this report. In addition to these three meetings scheduled as part of the CRDN agenda, one additional JWG meeting was held in March 2021. The MN-S paused their participation in the JWGs in December 2020 and reengaged in May 2021 with a restructured JWG membership that included new members and some members from the original JWG. As part of this restructuring process, the MN-S communicated in early May 2021 that a two-month meeting cadence would be their preference, and provided a list of topics of interest for discussion. However, the MN-S subsequently were unable to maintain this schedule. Regular meetings occurred with both the BNDN and BRDN at their preferred cadence. More information on the JWG meetings, including topics discussed, is included in Section 2.6.1.1.1, Summary of Joint Working Group Activities.

[5] Joint Working Group transcripts are detailed records of the conversations dictated from a recording of the meeting. Participants have agreed to the meetings being recorded, with sensitive components like prayers not recorded as requested by Indigenous Groups.

3.5.2 Indigenous Knowledge and Traditional Land Use Studies

As part of the Study Agreements, each Indigenous Group was responsible for undertaking a self-directed, community-led IKTLU Study related to the Project for consideration in the EA. The purpose of the IKTLU Studies was for each Indigenous Group to share information on their traditional uses of the area around the proposed Project and their importance to the community, the key resources used and their value to the community, cultural resources, Indigenous Knowledge, and how the Project could potentially affect traditional use. Each of the Indigenous Groups selected their own third-party consultant to work with to undertake the IKTLU Study in a way deemed appropriate for their community by the Indigenous Group. To date, the CRDN, MN-S, BNDN, BRDN, and YNLR have all completed IKTLU Studies, which have been shared with NexGen for incorporation into the EA:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area;
- TSD V.3 (CRDN), Socio-economic and Harvest Study; Clearwater River Dene Nation; NexGen Rook 1 Project; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

In some instances, the IKTLU Studies were delivered in a staged approach where Indigenous Groups provided draft reports to NexGen to allow for incorporation of Indigenous Knowledge into the EA, with final IKTLU Studies issued at a later date. In these instances, final IKTLU Studies were reviewed for consistency and to determine if any new information should be incorporated into the EA.

Indigenous Knowledge was also shared by the CRDN through a community-led household harvest survey (TSD V.3: CRDN) that was completed in conjunction with their IKTLU Study to identify and quantify the use of valued cultural resources in the vicinity of the Project. In conjunction with their IKTLU Study, the MN-S also conducted a community-led Traditional Foods study to support the inclusion of community-specific information in the EA.

3.5.3 Sources of Local Knowledge

Local Knowledge was provided to NexGen through a variety of public and Indigenous engagement activities, which are provided in greater detail in Section 2.5, Engagement Approach. In general, these activities fell into one of two different categories: Project engagement activities and EA environmental and socio-economic baseline programs.

Project engagement included a broad range of activities, with Local Knowledge primarily provided to NexGen through in-person interactions. These activities included meetings with LPA community members, organizations, and municipalities; JWG breakout sessions; site tours; and community events.

Local Knowledge obtained through the EA environmental and socio-economic baseline programs was primarily derived through key person (KP) interviews, as well as workshops with youth (i.e., local high school students) and trappers active in the area of the proposed Project. Key person interviews covered a broad range of topics such as current and historical Indigenous land and resource use, participation in traditional and wage economies, business operations and opportunities, perception of community well-being, education, and local services, among other topics. Individuals who participated in the KP interviews were specifically selected for their knowledge and subject matter expertise.

NexGen has also employed locally based field staff during baseline field studies and monitoring, including individuals from the local Indigenous Groups and communities. In addition, in 2016, NexGen initiated a summer student program that hires students from the LPA communities for various jobs at the Project site or within the LPA. In both instances, these individuals provided local insights, knowledge, and perspectives; however, as they were not in a position to speak on behalf of the Indigenous Group, these insights and knowledge were included in the EA as Local Knowledge. In 2021, NexGen also opened an office in La Loche, staffed with a well-respected, knowledgeable former community leader. The La Loche office provides a community-based access point where people can learn about the Project, submit inquiries, and provide Local Knowledge.

In addition to the in-person activities, some Local Knowledge was obtained through more passive engagement methods such as individual conversations and electronic communications. NexGen maintains a telephone number and email address for community members and stakeholders to contact the company regarding the Project, and has a Project website, which provides information on both NexGen and the Project.

3.6 Incorporation of Indigenous and Local Knowledge

The process for incorporation of Indigenous and Local Knowledge into the EA was defined through two main themes: guiding principles (Section 3.6.1) and approach and methods (Section 3.6.2).

3.6.1 Guiding Principles

NexGen is committed to taking a comprehensive approach to the EA by considering all types of knowledge to produce a full understanding of the potential effects of the Project and identify ways to avoid and mitigate potential negative effects and enhance positive effects. The consideration of different types of knowledge contributes to an enhanced understanding in the EA and can serve as a starting point for further knowledge generation, as well as a way to identify the need for additional collaborative monitoring or management programs to address any discrepancies between the types of knowledge (BC EAO 2020).

The following principles have guided the identification of Indigenous Knowledge and the way it would be utilized throughout the Project lifespan (BC EAO 2020; IAAC 2020a,b,c; GNWT n.d.):

- **Establish and maintain collaborative relationships:** A collaborative approach is required to support the involvement of Indigenous Groups throughout all phases of the Project. Early engagement with Indigenous Groups promotes meaningful and ongoing dialogue and a better understanding of the context of any Indigenous Knowledge that is provided. Only Indigenous Groups and Indigenous Knowledge holders (e.g., Elders) are positioned to share their Indigenous Knowledge.

- **Adhere to community-based protocols:** Indigenous Groups will establish acceptable ground rules for engagement regarding the gathering, use, and management of Indigenous Knowledge. Community protocols and procedures should be understood, respected, and followed.
- **Understand and respect the value of Indigenous Knowledge:** Indigenous Knowledge and Western science are equally valued as distinct ways of knowing that can both inform the EA. Indigenous Knowledge should be viewed as complementary and influential information alongside Western science and considered throughout all phases of the EA. It should be examined in the same way as other evidence, including by looking at its relevance and keeping it in full context, and be given full and fair consideration of the information provided.
- **Confirm informed consent:** Indigenous Knowledge is to be used with appropriate permission and according to the governance, laws, policies, and practices of each Indigenous Group. The collection and use of Indigenous Knowledge requires informed consent from Indigenous Groups and individuals sharing their knowledge and their ongoing, active participation. Formal agreements are put in place to prevent the unauthorized disclosure of Indigenous Knowledge and to confirm consent is explicit and not assumed.
- **Respect local ownership and control:** The Indigenous Groups' principles of ownership, control, access, and possession as they relate to Indigenous Knowledge are to be respected. Indigenous Groups retain inherent rights to their Indigenous Knowledge, cultural practices, and traditions, even when this information is being shared. Indigenous Knowledge is under the authority and control of each Indigenous Group, and each community makes decisions on who can use it and how it can be used.
- **Protect sensitive Indigenous Knowledge:** Indigenous Groups will determine whether to share their Indigenous Knowledge and what aspects of that knowledge they wish to share in confidence. Privileged and/or confidential information is to be protected, and there must be a clear understanding and agreement on its storage, use, and release.

Reasonable best efforts were made to adhere to the above principles. The establishment of the Study Agreements between NexGen and each Indigenous Group (Section 3.3.2), which define the approach to the IKTLU Studies and the JWGs, is aligned with these guiding principles. The processes of understanding and respecting the value of Indigenous Knowledge and how Indigenous Knowledge was incorporated into the EA are described in Section 3.6.2, Approach and Methods, and have been documented in each EA discipline section.

The IKTLU Studies that were shared with NexGen were prepared by each Indigenous Group, and each Indigenous Group determined how the information was gathered and from whom (e.g., knowledge holders, Elders) and what information they wished to share, with the understanding that the information would be used for the purposes of the Project and be incorporated in the EA process. NexGen worked collaboratively with each Indigenous Group to understand their knowledge protocols and procedures, including their preferred approach and methods for incorporating their knowledge in the EA, and to discuss how their knowledge is used, managed, and protected. NexGen suggested three options for consideration by each of the primary Indigenous Groups and the YNLR: inclusion of the full IKTLU Study, partial redactions of key details of the IKTLU Study to protect confidential information, or references only to a fully confidential IKTLU Study (i.e., not included for public review). Each Indigenous Group was asked to provide their preferred option. NexGen also advised any Indigenous Group who provided an IKTLU Study that if no preferred option was provided, the default was to designate the IKTLU Study as fully confidential to protect Indigenous Knowledge.

NexGen has made efforts to interpret and present Indigenous Knowledge in the appropriate context by staying true to the information presented by Indigenous Groups in the IKTLU Studies and striving not to take information out of context. Wherever possible and applicable, direct quotes and carefully paraphrased information have been used in the EIS. Where applicable, NexGen sought guidance from Indigenous Groups regarding their preferences for presentation of information from the IKTLU Studies in the EIS.

3.6.2 Approach and Methods

Section 3.6.2.1, Gathering Indigenous and Local Knowledge, Section 3.6.2.2, Incorporating Indigenous and Local Knowledge, and Section 3.6.2.3, Documenting Use of Indigenous and Local Knowledge, describe the process of gathering, incorporating, and documenting Indigenous and Local Knowledge in the EA.

The engagement program for the Project, including the gathering of Indigenous and Local Knowledge, was faced with challenges, particularly associated with the global COVID-19 pandemic. In-person engagement events were largely not possible throughout most of 2020 and 2021, requiring NexGen and the Indigenous Groups to be flexible in their approach and hold the majority of engagement events and meetings online to allow for ongoing communications to be conducted in a safe manner. Transitioning to online engagement activities posed some difficulties associated with being able to successfully present technically complex information and have meaningful discussions, while also understanding limitations with respect to internet connectivity, access to technology, and the ability of Indigenous Groups to participate effectively. NexGen and the Indigenous Groups regularly evaluated the online approaches in an effort to seek improvements that could be implemented in subsequent engagement activities. While all parties recognized a preference for in-person meetings such as those conducted during pre-pandemic conditions, overall engagement processes were informative and beneficial, and allowed collaboration between NexGen, Indigenous Groups, and community members. Through the COVID-19 pandemic, opportunities were still sought to meet in person where possible and safe to conduct. Some in-person sessions were held later in 2021 and into 2022.

3.6.2.1 Gathering Indigenous and Local Knowledge

Prior to the establishment of the JWGs and as part of NexGen's early engagement activities, community information sessions were held in four communities in June 2019 (Section 2.6.3.1.2, Summary of Community Information Sessions). The purpose of these sessions was to update the communities of the proposed Project, answer questions, provide information regarding the EA process, and solicit initial feedback on the Project, including on the selection of VCs (Section 2, Appendix 2E, Summary of Community Information Sessions). Key interests and concerns related to the potential identification of VCs and intermediate components were recorded, and specific surveys for soliciting feedback on VCs were available for participants to complete. The comments received are detailed in Appendix 2E.

During JWG meetings with Indigenous Groups held between late 2019 and mid-2021, specific EA topics were presented and discussed to facilitate a two-way exchange by providing information about the Project and EA process, as well as to solicit input and feedback from Indigenous Groups on the EA. The JWG topics that were discussed are summarized below and presented in Section 2, Table 2.6-3.

- In late 2019 and early 2020, the scoping of the EA was discussed at JWG meetings (Section 2.6.1.1.1), including the selection of preliminary VCs. NexGen presented the list of preliminary VCs for fish and fish habitat, vegetation, wildlife and wildlife habitat (i.e., biophysical VCs) and social, cultural, and economic VCs (i.e., socio-economic VCs), which were informed in part by input received during community information sessions. Feedback from Indigenous Groups was then used to refine the list of VCs. During these initial JWG meetings (i.e., October 2019 to February 2020), NexGen presented on the human health risk assessment, and requested feedback from Indigenous Groups on proposed receptor groups and locations, items comprising the Traditional Foods diet, and recommended species (e.g., wildlife, fish, plants) to be used as receptors.

- Between January 2020 and March 2020, NexGen presented information and requested feedback and input from Indigenous Groups on socio-economics and community well-being, the baseline and existing environment results for the terrestrial and aquatic components, and the potential pathways identified and assessment methods.
- In August 2020, NexGen provided an update on the Project and regulatory process, reviewed the JWG meetings to date, and presented a summary of the youth workshop that was held in La Loche on 12 March 2020. In December 2020, the CNSC gave a presentation on various topics related to uranium mining, the environmental review process, and radiation protection.
- Between January 2021 and March 2021, NexGen presented information and requested feedback from Indigenous Groups on modelling and the EA process, Project alternatives that were assessed, results of the women's interviews, terrestrial and aquatic baseline studies, environmental interactions (i.e., pathways), and cumulative effects.
- Between April 2021 and June 2021, NexGen presented information and requested feedback and input from Indigenous Groups on the topics of traffic accidents and malfunctions, EA methods (i.e., pathway analysis, residual effects classification, determination of significance, prediction confidence and uncertainty, and monitoring and follow-up programs), and the Caribou Mitigation and Offsetting Plan. The pathways for community well-being and Indigenous land and resource use were also presented and discussed, as well as the measurement indicators for the community well-being assessment.

In addition to feedback from JWG meetings, early engagement (i.e., late 2019 and early 2020) and the IKTLU Studies were used to identify the initial list of VCs for socio-economic and biophysical components as well as intermediate components such as air quality, noise, hydrology, and water quality. These intermediate components support the assessment of biophysical VCs, including the VCs assessed for the fish and fish habitat, vegetation, and wildlife and wildlife habitat disciplines. Air quality, noise, water quality, human health, and specific social and economic topics were also identified as key interests and concerns expressed by attendees at the community information sessions held in 2019 (Appendix 2E).

The IKTLU Studies were generally completed and shared with NexGen between December 2019 and December 2020, with one IKTLU Study being provided in November 2021. These IKTLU Studies were reviewed for applicable Indigenous Knowledge and to identify and confirm effects pathways for biophysical and socio-economic intermediate components and VCs. In some instances, the IKTLU Studies were delivered in a staged approach where Indigenous Groups provided draft reports to NexGen to allow for incorporation of Indigenous Knowledge into the EA; final IKTLU Studies were issued at a later date and reviewed for consistency and any new information that should be incorporated into the EA.

In parallel to JWGs and the completion of IKTLU Studies by the Indigenous Groups, KP interviews and workshops were held with LPA community members. Key person interviews were conducted with key information holders within organizations and the KP interview process was approached collaboratively with communities through the Community Coordinators hired for each of the JWGs. A total of 78 KP interviews were conducted with community members, primarily through telephone unless another method was requested. Interviews were completed with business owners, principals and staff of schools, housing clerks, health care directors, band councillors, and the RCMP. Workshops included a youth workshop held in La Loche in 2020, which included 75 students and 9 members of staff from high schools in BRDN, Buffalo Narrows, BNDN, CRDN, and La Loche, and a Fur Block N-19 trapper's workshop held in 2021. A workshop with women planned for March and April 2020 was postponed due to COVID-19. The workshop was reorganized into a series of individual interviews with women identified by each Indigenous Group who had direct or indirect experience with mining employment. Further information on KP interviews and workshops is included in Annex X.

Local Knowledge was also obtained during site tours, which occurred at various times between 2013 and 2021.

Feedback provided by Indigenous Groups and community members on the information presented during community information sessions and at JWG meetings, and information received through IKTLU Studies, KP interviews, and workshops, was incorporated into the EA.

3.6.2.2 Incorporating Indigenous and Local Knowledge

Available sources of Indigenous and Local Knowledge described in Section 3.6.2.1 were shared with the EA discipline leads (i.e., specialists leading the assessments for social and environmental disciplines such as hydrology, water quality, wildlife and wildlife habitat, Indigenous land and resource use, community well-being, and others) for their review and incorporation into their respective assessments. Specifically, the discipline leads were responsible for reviewing the IKTLU Studies and JWG meeting transcripts for applicable Indigenous and Local Knowledge to include in their assessments. In addition, a guidance document was distributed to the discipline leads that outlined the definitions of Indigenous and Local Knowledge, the sources of available Indigenous and Local Knowledge, how to appropriately include Indigenous and Local Knowledge, and how to document the Indigenous and Local Knowledge included in their assessments.

The guidance document included instructions to discipline leads to include Indigenous and Local Knowledge alongside scientific information in the relevant assessment subsections by incorporating and viewing Indigenous and Local Knowledge as equally valuable, complementary, and influential information alongside Western science. Discipline leads were also instructed to limit any analysis or interpretations of the Indigenous and Local Knowledge shared, to present it as closely as possible to the original source, and to quote directly where appropriate. To guide discipline leads in considering how Indigenous and Local Knowledge influenced their respective assessments, they were asked if Indigenous and Local Knowledge:

- confirmed or verified currently known information;
- improved or enhanced known information;
- contradicted current information, and if so, whether there were any perspectives shared that were critical to the Project assessment; and
- informed methods, mitigation, analysis, or the monitoring approach/design.

The incorporation of Indigenous and Local Knowledge into each discipline assessment was reviewed by an EA coordinator with experience incorporating Indigenous and Local Knowledge into EAs for accuracy and consistency, and to determine if there was any additional information to be considered by cross-referencing the Indigenous and Local Knowledge that was used in the assessments with what was available in the sources provided. This step served as an additional check that available and applicable Indigenous and Local Knowledge was captured in the appropriate way and was not misinterpreted or taken out of context.

General concerns (e.g., Project effects on water) and specific issues (e.g., Project effects on the water quality of Patterson Lake) expressed by Indigenous Groups and LPA communities through the collection of Indigenous and Local Knowledge that were relevant to intermediate components and VCs were considered and used to inform the scoping of Project interactions and identify potential Project effects (i.e., how they were considered in the pathways analysis). Further information on issues and concerns raised by Indigenous Groups and LPA communities is provided in Section 2.

3.6.2.3 Documenting Use of Indigenous and Local Knowledge

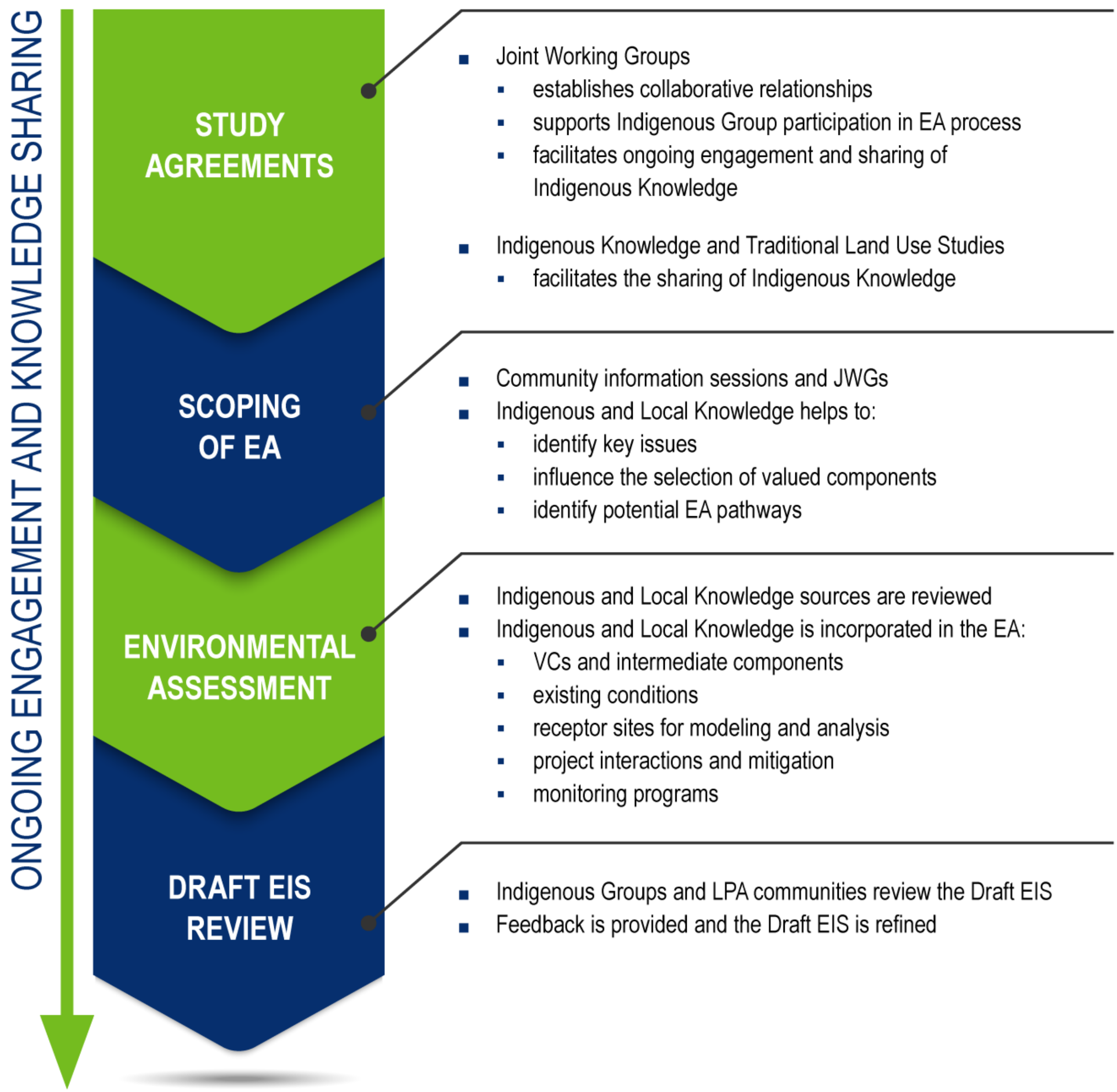
To support the documentation of the incorporation of Indigenous and Local Knowledge in the EA, discipline leads were asked to identify the specific information used from Indigenous Groups and LPA communities to clearly document where Indigenous and Local Knowledge was incorporated in the following aspects of the EA:

- Project design;
- engagement processes (e.g., site visits, additional effort to engage);
- baseline study design and methods;
- defining spatial and temporal boundaries;
- VCs and intermediate components;
- existing conditions;
- assessment methods and modelling;
- scoping and pathways analysis;
- mitigation measures;
- residual effects analysis and classification;
- monitoring, follow-up, and adaptive management; and
- cumulative effects considerations.

The general process of Indigenous and Local Knowledge incorporation into the EA is included in the component methods subsection of each discipline assessment. This subsection in each discipline assessment also describes the sources used and the specific assessment subsection where Indigenous and Local Knowledge was incorporated (e.g., selection of VCs, existing conditions, Project interactions and mitigation measures, residual effects analysis, monitoring programs). Section 3.8, Influence on the Environmental Assessment, presents a compiled summary of where Indigenous and Local Knowledge was incorporated in each discipline assessment.

Information on how Indigenous and Local Knowledge was considered in Project planning and design, and how it would be considered through the life of mine, is summarized in Section 3.7, Influence on Project Planning and Design, and Section 3.9, Use of Indigenous and Local Knowledge through the Rook I Project Lifespan, respectively. Figure 3.6-1 graphically summarizes how ongoing engagement and Indigenous and Local Knowledge has informed the development of the EIS through the EA process. NexGen views ongoing engagement and knowledge sharing as a critical success factor for the Project, and this relationship will continue throughout the EIS review phase and into all other future Project phases (Section 3.9).

Figure 3.6-1: Indigenous and Local Knowledge throughout the Environmental Assessment Process



EA = Environmental Assessment; JWG = Joint Working Group; VC = valued component; LPA = local priority area; EIS = Environmental Impact Statement.

3.7 Influence on Project Planning and Design

NexGen's goal is to leave lasting benefits to the communities well beyond the Project's Decommissioning and Reclamation (i.e., Closure) Phase. Advancing design for the Project has incorporated this goal through a life cycle planning approach in consideration of current and future generations, and in recognition of the role that Indigenous and Local Knowledge has in guiding aspects of decision making throughout the Project lifespan. Knowledge of community values, commitment to high standards, and understanding of lessons learned from other mining operations complement NexGen's commitment to life cycle engagement for the Project that is early, often, and lasting.

The knowledge of community values, commitment to high standards, and understanding of lessons learned from other mining operations led to key early design decisions being incorporated into the Project. As NexGen has proceeded through the regulatory process and advanced development of the Project, engagement activities have evolved as necessary to provide Indigenous Groups and local communities opportunities for effective information exchange and dialogue specific to each stage of the Project. Indigenous and Local Knowledge and feedback received during these engagement activities was considered during relevant Project planning and design phases. This approach has resulted in consideration of Indigenous and Local Knowledge both early (i.e., prior to submission of the Project Description in 2019) and during the ongoing EA activities to date (i.e., through the development of the EIS). More information on results of engagement with local Indigenous Groups and communities can be found in Section 2.6.1.

3.7.1 Early Project Decisions

NexGen's commitment to certain design decisions was made during early definition of the Project and was influenced by feedback received by local Indigenous Groups and communities. Key examples include the decisions to permanently store all tailings from the Project underground and eliminating ammonia from the metallurgical process.

- The decision to store all tailings underground was consistent with the expressed preference heard through engagement with local Indigenous Groups and communities, and would result in a smaller Project footprint, reduced access restrictions for local land users, and reduced potential effects on Patterson Lake and, more broadly, water, vegetation, and wildlife.
- The decision to utilize a metallurgical process to eliminate ammonia (i.e., strong acid stripping) would reduce potential effects on air quality and water quality, and was reflective of feedback heard through Indigenous and Local Knowledge on the importance of reducing potential effects to Patterson Lake, and, more broadly, water, vegetation, and wildlife.

These decisions were validated through formal engagement activities completed during the EA process.

3.7.2 Project Planning and Design Process

Consistent with NexGen's life cycle approach to engagement, ongoing planning and design continued to consider Indigenous and Local Knowledge and feedback received through Project advancement phases following early design decisions. This process included incorporation of feedback from both the public review of the Project Description and engagement with local Indigenous Groups and communities, including Indigenous and Local Knowledge (e.g., information from JWGs, community information sessions, IKTLU Studies, workshops, KP interviews). Key themes NexGen has heard through engagement to date include:

- recognizing, accepting, and respecting the local communities' Indigenous rights and cultural links to, and reliance on, the land and its resources to support current and future generations;
- protecting the quality of the water, air, land, and wildlife through all phases of the Project;
- minimizing, to the extent possible, disturbances to the water, air, land, and wildlife through all phases of the Project;
- continued, effective, and respectful engagement with the local communities through all phases of the Project; and
- maximizing potential business and employment opportunities for local people through all phases of the Project to support current and future generations.

Specific to Project design, the following key concerns and feedback were identified through the engagement process:

- The protection of Patterson Lake, and subsequently downstream waterbodies and watercourses, from potential negative effects during all phases of the Project, is paramount, including during upset conditions (i.e., unanticipated discharges).
- The continued ability to pursue traditional activities is important for the preservation of culture, and the ability to safely use the land after closure is important.
- There is a preference for designs that reduce the size of the Project footprint, and subsequently the potential effects on vegetation, wildlife, and local land users.
- There is a preference for the placement of process tailings underground as opposed to the long-term storage of tailings on surface.
- Protecting the safety and health of workers, Indigenous and other land users, and local community members, is vital.

Information provided by local Indigenous Groups and communities was considered, where applicable, in the completion of the feasibility study (NexGen 2021), the assessment alternatives for the Project (Section 4, Project Alternatives), and the current design of the Project that forms the basis of the EA (Section 5, Project Description).

Key design changes and their relation to feedback received from Indigenous Groups and local communities included:

- **Relocation of the underground tailings management facility:** This relocation resulted in a reduction of potentially acid generating material, and a subsequent reduction of on-surface, permanent disposal required. This change was consistent with feedback heard through Indigenous and Local Knowledge on the importance of reducing potential effects on Patterson Lake, and, more broadly, water, vegetation, and wildlife.
- **Reduction of the Project footprint:** This reduction was achieved through decisions to relocate the worker accommodations from the southern part of the proposed Project footprint to a location more central to the mining and processing access, and consolidating various ancillary infrastructure (e.g., laydowns, water intakes, sewage treatment facilities). Relocation of Project infrastructure facilitated the optimization of the site road routing (i.e., avoiding a wetland); reduced the total length of all on-site roads; and removed the

requirement for a second set of water intake infrastructure from Patterson Lake. This surface footprint optimization was reflective of feedback heard through engagement with Indigenous Groups and local communities, and would result in reduced access restrictions for local land users and reduced potential effects to Patterson Lake and, more broadly, water, vegetation, and wildlife.

- **Reduction in Project infrastructure:** This reduction facilitated further optimization of water management, including replacing a bermed runoff collection area with a more centralized pond system that would allow greater control of contact water, and centralizing the location of the proposed treated effluent and treated sewage discharge locations within Patterson Lake. This design approach was reflective of feedback heard through engagement with Indigenous Groups and local communities, and would result in a smaller Project footprint, reduced restriction of access for local land users, and reduced potential effects on Patterson Lake and, more broadly, water, vegetation, and wildlife.

To provide an illustrative demonstration of how the Project design has evolved, Figure 3.7-1 provides snapshots of Project layout (i.e., design) iterations from the Project Description (NexGen 2019) through to that considered for the EA, including an interim layout developed during the Feasibility Study phase.

Specific examples of how Indigenous and Local Knowledge has influenced Project planning were the subject of engagement with JWGs in 2020 and 2021 (BNDN-JWG 2021a; BRDN-JWG 2021a; MN-S-JWG 2021; CRDN-JWG 2020a). Feedback from members of the JWGs during these meetings indicated that members had greater understanding of the Project design:

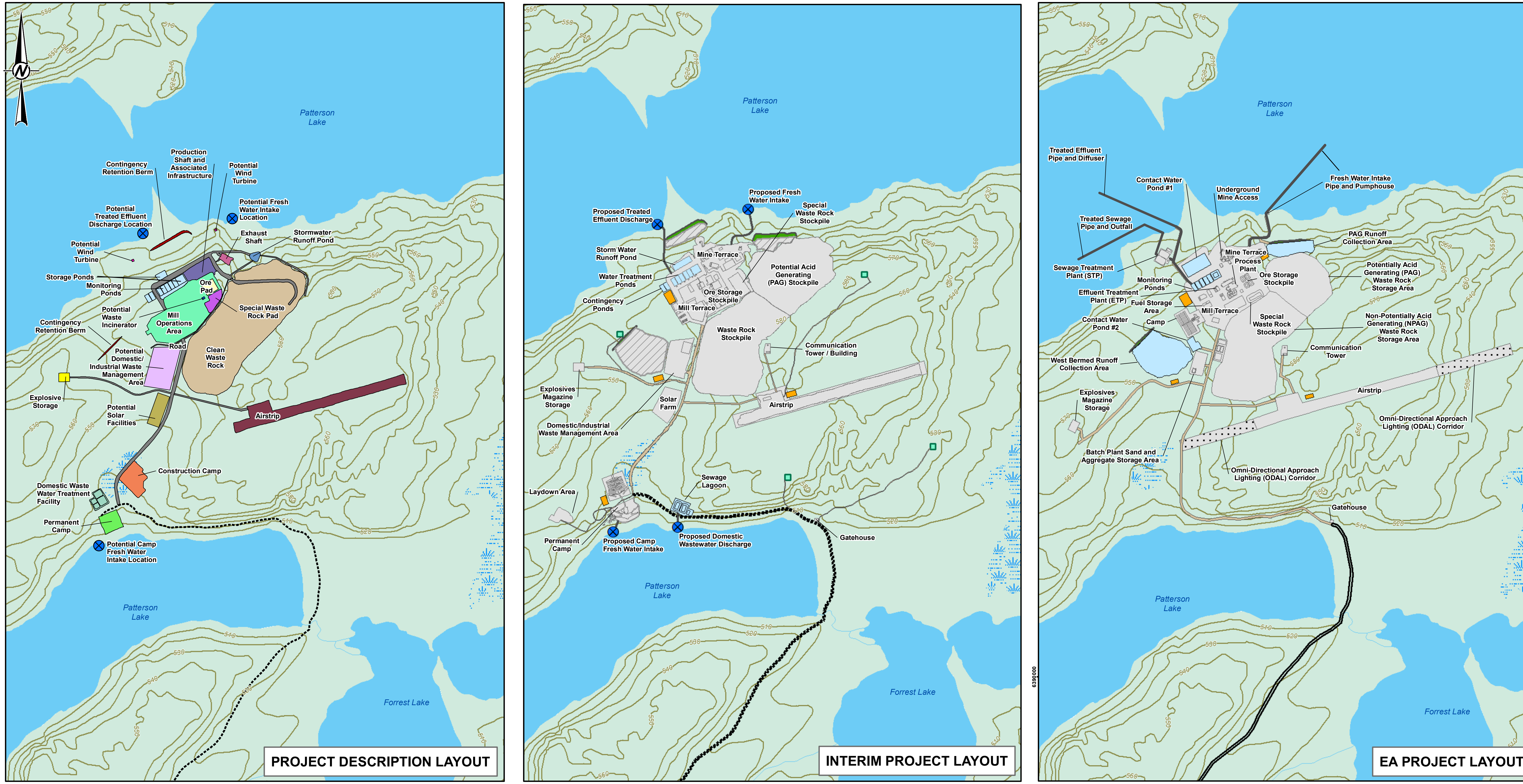
> In general, I think the underground facility is a good approach from a preliminary standpoint. There is that trade-off . . . [NexGen] mentioned some will go into the shaft and other places. Any opportunity, even during operations, to store waste rock in mined-out areas should be maximized. (BNDN-JWG 2021a)

> When we initially started talking about waste rock and tailings, I couldn’t comprehend what that all meant. I was thinking of waste rock as still being radioactive. Now I have a clear understanding of what this means. At the time I couldn’t understand how you can still have safe drinking water when we’re storing all this stuff on surface. Now it makes sense for me. (BNDN-JWG 2021a)

> You’re on the right track in terms of the UGTMF [underground tailings management facility]. It reduces the pathways for contaminants to enter the environment and the food chain. I was a little skeptical when I first read the Project description, but it makes a lot of sense. It’s a good approach . . . . It’s positive the see the site changing in this way; reducing the surface disturbance as you’ve done is certainly a way to reduce the impact. You’re on the right track. (BNDN-JWG 2021a)

> You have addressed my concerns [regarding tailings and waste rock interdependency]… When you showed what they were doing before, and what we’re doing now, it makes sense, but we need visuals . . . I’m trying to envision how it will look on surface at the end of the Project. I took a tour of Cluff Lake after it shut down and saw the waste rock pile – they planted trees on it and it looks not too bad. But for this one we’re putting stuff back underground so there will be less visual disturbance, it will look aesthetically pleasing. (BRDN-JWG 2021a)

These decisions were validated through formal engagement activities completed during the EA process.



LEGEND

ELEVATION CONTOUR (10 m INTERVAL)
WATERCOURSE
WATERBODY
WETLAND
WOODED AREA
POTENTIAL INTAKE AND DISCHARGE LOCATIONS
EXISTING ACCESS ROAD
INTAKE OR DISCHARGE PIPE

PROJECT DESCRIPTION LAYOUT

AIRSTRIP
CLEAN WASTE ROCK
CONSTRUCTION CAMP
CONTINGENCY RETENTION BERM
EXHAUST SHAFT
EXPLOSIVE STORAGE
DOMESTIC WASTE WATER TREATMENT FACILITY
MILL OPERATIONS AREA
ORE PAD
PERMANENT CAMP
POTENTIAL DOMESTIC/INDUSTRIAL WASTE MANAGEMENT AREA
POTENTIAL SOLAR FACILITIES
POTENTIAL WASTE INCINERATOR
POTENTIAL WIND TURBINE
PRODUCTION SHAFT AND ASSOCIATED INFRASTRUCTURE
ROAD
SPECIAL WASTE ROCK PAD
STORAGE/MONITORING POND
STORMWATER RUNOFF POND

INTERIM PROJECT LAYOUT

PROJECT INFRASTRUCTURE
SITE ACCESS ROAD
SITE ROAD
SITE WATER CONTACT CONTAINMENT BERM
SITE WATER CONTACT CONTAINMENT AREA
TOPSOIL AND UNSUITABLE MATERIAL STOCKPILE
WIND TURBINE

EA PROJECT LAYOUT

ACCESS ROAD
CONTACT WATER CONTAINMENT BERM
OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
PROJECT INFRASTRUCTURE
SITE ROAD
TOPSOIL STORAGE AREA
WATER MANAGEMENT POND

0 1 2
1:35,000 KILOMETRES

REFERENCE(S)

1. EA PROJECT LAYOUT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021.
2. INTERIM PROJECT LAYOUT FEATURES OBTAINED FROM NEXGEN, OCTOBER 28, 2019 AND MARCH 4, 2020.
3. PROJECT DESCRIPTION LAYOUT FEATURES OBTAINED FROM NEXGEN, NOVEMBER 2018.
4. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
EVOLUTION OF ROOK I PROJECT DESIGN

CONSULTANT
wsp

PROJECT		20144150	PHASE 3305 - 1
DESIGN	DW	2020-03-13	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-06	
CHECK	KG	2023-02-06	**FIGURE 3.7-1**
REVIEW	SJ	2023-02-06	

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

3.7.3 Summary of Influence on Project Design

An understanding of community values resulted in early Project design decisions that have been further informed and refined through receipt of Indigenous and Local Knowledge through the EA process. Key Project design changes to date are included in Table 3.7-1.

Table 3.7-1: Indigenous and Local Knowledge Key Influence on Rook I Project Design

Theme	Key Considerations	Key Project Design Considerations
Environment	▪ Minimizing disturbances to and protecting the quality of the air, water, land, and wildlife ▪ Protecting Patterson Lake, and preferring alternatives with smaller footprints and thus lesser potential effects on vegetation, and wildlife throughout all phases of the Project, as well as post-closure	▪ Underground storage of all tailings ▪ Eliminating ammonia from metallurgical process ▪ Relocation of the underground tailings management facility to reduce generation of potentially acid generating material ▪ Redesign of site road and construction camp to avoid a wetland ▪ Optimization of water management approach ▪ Optimization of Project surface footprint (e.g., removal of bermed runoff collection area, reduction of site roads)
Health and safety	▪ Negative perception of the surface storage of uranium tailings ▪ Operating in a manner that is protective of workers, Indigenous and other land users, and local communities	▪ Underground storage of all tailings ▪ Optimization of water management approach ▪ Optimization of Project surface footprint
Traditional land and resource use	▪ Recognizing, accepting, and respecting the local communities' cultural links to, and reliance on, the land and its resources as a critical part of the well-being, identity, and culture ▪ Minimizing (to the extent possible) restrictions on the ability of Indigenous land users to access area land and resources throughout all phases of the Project, as well as post-closure	▪ Underground storage of all tailings ▪ Optimization of Project surface footprint ▪ Removal of second fresh water intake location in Patterson Lake
Community well-being	▪ Considering both the positive and negative social effects of the Project on the local communities, and providing the necessary support to mitigate negative effects	▪ Inclusion of a dedicated space for Elders on site to be available to support Indigenous employees

NexGen is committed to incorporating Indigenous and Local Knowledge throughout the Project lifespan. This approach has been consistent through early engagement activities, has continued during the EA process, and will continue as more opportunities to share knowledge become available through engagement activities with Indigenous Groups and LPA communities (Section 3.9). As part of the EA, information received through Indigenous and Local Knowledge was also used to inform discipline-specific assessments conducted for the Project (Section 3.8; EIS Section 7, Air Quality, Noise, and Climate Change, to EIS Section 19, Community Well-Being).

3.8 Influence on the Environmental Assessment

To support the documentation of the incorporation of Indigenous and Local Knowledge in the EA, discipline leads were asked to identify the specific information used from Indigenous Groups and LPA communities to clearly document where Indigenous and Local Knowledge was incorporated in the various EA Sections, including but not limited to VCs and intermediate components; component methods; existing conditions; scoping and pathways analysis; mitigation measures; and monitoring, follow-up, and adaptive management. The approach is described in more detail in Section 3.6.2.2.

An accounting of how Indigenous and Local Knowledge was incorporated into the EA is provided in Table 3.8-1. The information is presented according to each discipline and detailed for each relevant aspect of the assessment.

NexGen has committed to the development of detailed monitoring plans and follow-up activities (Section 23, Summary of Mitigation, Monitoring, and Follow-Up Programs). Monitoring programs are in various stages of development, and all disciplines would incorporate Indigenous and Local Knowledge through the following means:

- Considering feedback provided by Indigenous Groups during engagement, including recommendations, in the development of monitoring and follow-up activities.
- Considering ongoing feedback from Indigenous Groups on the effectiveness of mitigations when updating monitoring and management plans.
- Independent Indigenous Monitors chosen by each primary Indigenous Group having opportunities to participate in environmental monitoring programs for the Project.

Table 3.8-1: Incorporation of Indigenous and Local Knowledge in the Environmental Assessment

Discipline	EA Component	How Indigenous and Local Knowledge was Incorporated into the EA
Air quality	Component Methods - Valued Components and Intermediate Components (Section 7.2.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the air quality intermediate component and reflects: ▪ the importance of having access to "clean fresh air" while practising traditional activities and contributing to community well-being ▪ the interrelationships between different environmental components and the critical role air quality plays in aquatic and terrestrial environmental health
	Existing Conditions (Section 7.2.3)	Indigenous and Local Knowledge was shared about: ▪ the air quality being "clean" in the communities where Indigenous Groups live ▪ observations of the cumulative effects of air emissions from regional industrial developments on aquatic and terrestrial environmental health and human health ▪ observations related to the effects of reduced air quality on vegetation, wildlife populations, and health
	Project Interactions and Mitigations (Section 7.2.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures, including: ▪ observations and experiences of land users related to the cumulative effects of air emissions from industry, including from dust and machinery exhaust, on aquatic and terrestrial environmental health and factors affecting the safety of wild foods and risks to human health
Noise	Component Methods - Valued Components and Intermediate Components (Section 7.3.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the noise intermediate component and reflects: ▪ the importance of the land use experience and enjoyment (e.g., peacefulness, solitude, sense of place) found while practising Indigenous and other land and resource use activities
	Component Methods - Existing Conditions (Section 7.3.2.6)	Indigenous and Local Knowledge informed the identification of receptors in the LSA and RSA for the noise analysis through the identification of active or historical cabins, campsites, hunting sites, fishing sites, and areas of recreational, cultural, or spiritual importance by Indigenous Groups.
	Existing Conditions (Section 7.3.3)	Indigenous and Local Knowledge was shared about: ▪ existing noise conditions in the LSA and RSA and larger region including the experiences of Indigenous land users with noise disturbances in the area of the Project ▪ observations of the cumulative effects of noise from industrial activities and increased traffic on traditional use and wildlife abundance and distribution in the region
	Project Interactions and Mitigations (Section 7.3.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures including: ▪ observations and experiences of land users related to the cumulative effects of noise from industry and increased traffic on wildlife abundance and distribution, and subsequent effects on traditional hunting and trapping ▪ the effects of sensory disturbance on the experience and enjoyment of Indigenous and other land and resource use
Climate change	Component Methods - Valued Components (Section 7.4.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the climate change VC and reflects: ▪ its ecological and socio-economic / cultural value to Indigenous Groups ▪ observations and experiences of shifts in weather, increasing frequency and magnitude of forest fires and declines in wildlife populations
	Project Interactions and Mitigations (Section 7.4.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions, pathway analysis, and consideration of mitigation measures, including: ▪ observations related to the cumulative effects of reduced air quality and climate related effects in the region from industry, including mining activities
Hydrogeology	Component Methods - Valued Components and Intermediate Components (Section 8.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the hydrogeology intermediate component and reflects: ▪ the importance of both above-ground and underground water for supporting traditional land use activities and contributing to community well-being and health ▪ the interconnectedness of above-ground and underground water systems, and to other aquatic and terrestrial environmental components, including the value of Patterson Lake and the Clearwater River as an interconnected system and fresh water resource
	Project Interactions and Mitigations (Section 8.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions, pathway analysis, and consideration of mitigation measures, including: ▪ observations and experiences of land users related to the cumulative effects from industry, including mining activities, on hydrogeology measurement indicators / effect pathways
Hydrology	Component Methods - Valued Components and Intermediate Components (Section 9.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the hydrology intermediate component and reflects: ▪ the importance of water for supporting traditional land use activities including habitation, harvesting, and transportation, and to community well-being and health ▪ physical features on the landscape, including water (e.g., lakes and river valleys), contribute to a sense of place and are often used for travel to access traditional use areas and as navigational landmarks ▪ the interconnectedness of rivers and lakes and to other environmental components
	Component Methods - Spatial Boundaries (Section 9.2.3)	The approach used to select spatial boundaries, which includes a portion of the Clearwater River system and connecting waterbodies, was supported by Indigenous and Local Knowledge about the interconnectedness of the region's waterways and the Clearwater River as a holistic river system.
	Existing Conditions - Hydrographic Setting (Section 9.3.2) and Surface Water Uses (Section 9.3.3)	Indigenous and Local Knowledge was shared about: ▪ the interconnectedness of the Clearwater River, Patterson Lake, and other large waterbodies in the LSA ▪ the importance of the waterways in the LSA for fishing and other harvesting activities, recreation, and travel

Table 3.8-1: Incorporation of Indigenous and Local Knowledge in the Environmental Assessment

Discipline	EA Component	How Indigenous and Local Knowledge was Incorporated into the EA
Surface water quality and sediment quality	Component Methods - Valued Components and Intermediate Components (Section 10.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the surface water quality and sediment quality intermediate components and reflects: ▪ the importance of fresh water for supporting harvesting activities and contributing to community well-being and health ▪ the interconnectedness of rivers, lakes, and other waterways, and the relationship of water to aquatic and terrestrial environmental health ▪ the value of Patterson Lake and the Clearwater River as an interconnected system and fresh water resource
	Component Methods - Spatial Boundaries (Section 10.2.3)	The approach used to select spatial boundaries, which includes a portion of the Clearwater River system and connecting waterbodies, was supported by Indigenous and Local Knowledge about the interconnectedness of the region's waterways, and the Clearwater River as a holistic river system.
	Component Methods - Existing Conditions (Section 10.2.6)	The waterbodies sampled (e.g., Patterson Lake) to represent existing conditions generally align with Indigenous and Local Knowledge provided regarding culturally important areas for harvesting activities, fresh water, occupancy, and travel.
	Component Methods - Residual Effects Analysis (Section 10.2.8)	Constituents of potential concern that were identified through Indigenous and Local Knowledge were included in the residual effects analysis.
	Existing Conditions - Water Quality (Section 10.3.1)	Indigenous and Local Knowledge was shared about: ▪ the quality of the surface water in the Clearwater River, Patterson Lake, and other large waterbodies in the LSA ▪ changes in water quality, fish, vegetation, and wildlife health observed over time
	Project Interactions and Mitigations (Section 10.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures, including: ▪ observations and experiences of land users related to the cumulative effects of changes in water quality (e.g., air emissions, dust) and effects from industry, including mining activities, on water quality and aquatic and terrestrial environmental health
Fish and fish habitat	Component Methods - Valued Components (Section 11.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the fish VCs and reflects: ▪ species identified that are important for traditional purposes ▪ the value of traditional fishing for cultural purposes, as an important component of traditional diets and health, and in playing a key role in the intergenerational transmission of knowledge
	Component Methods - Spatial Boundaries (Section 11.2.3)	The approach used to select spatial boundaries, which includes a portion of the Clearwater River system and connecting waterbodies, was supported by Indigenous and Local Knowledge about the interconnectedness of the region's waterways and the Clearwater River as a holistic river system.
	Component Methods - Sampling Locations and Activities (Section 11.2.6.1)	The waterbodies that were sampled (e.g., Patterson Lake) to represent existing conditions generally align with Indigenous and Local Knowledge provided regarding culturally important areas used for traditional fishing.
	Existing Conditions - Fish Communities (Section 11.3.4)	Indigenous and Local Knowledge was shared about: ▪ fish species observed or fished in the waterbodies and Clearwater River in the baseline study area ▪ observations of trends in fish populations
	Project Interactions and Mitigations (Section 11.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions, pathway analysis, and consideration of mitigation measures, including: ▪ observations and experiences of land users related to the cumulative effects of industry, including mining activities, on water quality, fish populations, and aquatic health
Terrain and soils	Component Methods - Valued Components and Intermediate Components (Section 12.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the terrain and soils intermediate component and reflects: ▪ the broader importance of "land", in which terrain and soils are key components, the inter-relationships between different components of the biophysical environment, and the importance of having access to a healthy and productive land base for harvesting activities ▪ the physical features of the landscape (e.g., ridges, river valleys, frozen lakes) contribute to a sense of place and are often used for travel to access traditional use areas and as navigational landmarks
	Project Interactions and Mitigations (Section 12.2.7)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures, including: ▪ observations and experiences of land users related to the cumulative adverse effects from industry, including mining activities, on air and water quality, and subsequent effects on terrestrial environmental health ▪ observations related to the successfulness of reclamation activities
Vegetation	Component Methods - Valued Components (Section 13.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the traditional use plant species VC and reflects: ▪ the importance of traditional use plants and plant gathering as a cultural activity that contributes to community well-being ▪ the value of traditional plant gathering for spiritual and ceremonial purposes, as an important component of traditional diets and health, and in playing a key role in the transmission of knowledge and maintenance of culture ▪ the selection of traditional use plants used in the assessment are species identified that are used for food, medicinal, spiritual, and ceremonial purposes
	Component Methods - Existing Conditions - Traditional Use Plant Species (Section 13.2.6.2)	Indigenous and Local Knowledge informed the list of traditional use plant species (e.g., medicinal plants, berries) used in the description of baseline conditions for traditional use plants.
	Existing Conditions (Section 13.3)	Indigenous and Local Knowledge was shared about: ▪ information regarding traditional use plant species (e.g., medicinal plants, berries) considered important to Indigenous Groups was used to inform the baseline conditions for availability and distribution of traditional use plants ▪ traditional use plant gathering areas ▪ existing conditions related to increasing wildfires in northern Saskatchewan in recent years ▪ observations of the cumulative effects of air emissions (e.g., dust) on vegetation from existing or previous industrial developments, including oilsands and mining activities
	Project Interactions and Mitigations (Section 13.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures, including: ▪ observations and experiences of land users related to the cumulative effects from industry, including mining activities, and subsequent effects to terrestrial environmental health, including traditional use plants

Table 3.8-1: Incorporation of Indigenous and Local Knowledge in the Environmental Assessment

Discipline	EA Component	How Indigenous and Local Knowledge was Incorporated into the EA
Wildlife and wildlife habitat	Component Methods - Valued Components (Section 14.2.2.1)	Indigenous and Local Knowledge helped to inform the selection of wildlife VCs and reflects: ▪ species that were identified as important for cultural and economic purposes ▪ the value of wildlife resources as an important component of traditional diets and health, to food security, and as a source of fur and other resources ▪ the value of hunting and trapping activities for subsistence and livelihood; as a foundation of culture and way of life; in contributing to community well-being; and in playing a key role in the transmission of knowledge and maintenance of culture
	Existing Conditions (Sections 14.3.1, Woodland Caribou, 14.3.2, Moose, 14.3.3, Grey Wolf, 14.3.4, Black Bear, 14.3.5, Beaver, 14.3.9, Common Goldeneye, and Section 14.3.10, Mallard)	Indigenous and Local Knowledge was shared about: ▪ wildlife population trends and wildlife habitat and distribution in the RSA, including hunting and trapping locations in the RSA ▪ the movement of caribou, moose, and black bear across Patterson Lake North Arm at the narrows ▪ observations of some of the factors contributing to changes in wildlife abundance and distribution (e.g., forest fires, industrial disturbance)
	Project Interactions and Mitigations (Section 14.4) and Residual Effects Analysis Sections 14.5.1, Woodland Caribou, 14.5.2, Moose, 14.5.3, Grey Wolf, 14.5.4, Black Bear, 14.5.5, Beaver, 14.5.9, Common Goldeneye, and Section 14.5.10, Mallard	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures, including: ▪ observations and experiences of Indigenous Groups and community members related to the cumulative effects of natural and anthropogenic disturbances (e.g., forest fires, mining and exploration activities, noise, linear disturbances) on wildlife habitat, abundance, and distribution ▪ the cumulative effects to air, water, and vegetation from previous or existing industrial activities on wildlife health and the safety of wild foods
Human health	Component Methods - Valued Components and Receptors (Section 15.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the human health VC and reflects: ▪ the importance of traditional hunting, trapping, fishing, and gathering to subsistence, survival, and livelihood, and as a key aspect of community well-being and culture ▪ Traditional Foods (i.e., wildlife, plant, and fish species) and water as key parts of diets and the promotion of health ▪ the importance of having access to a healthy land base, clean air and water, and high-quality resources for human health
	Component Methods - Spatial Boundaries (Section 15.2.3)	The approach used to select spatial boundaries, which includes a portion of the Clearwater River system and connecting waterbodies, was supported by Indigenous and Local Knowledge about the interconnectedness of the region's waterways, and the Clearwater River as a holistic river system.
	Component Methods - Existing Conditions (Section 15.2.6).	Indigenous and Local Knowledge informed the assumptions on the Traditional Foods diet, including: ▪ the proportions of different Traditional Food categories consumed (e.g., prevalence of berries, representative plants, fish, game, and birds), and ingestion rates to be included in the Traditional Foods exposure assessment
	Component Methods - Risk Assessment (Section 15.2.8)	Indigenous and Local Knowledge informed the selection of human health receptor groups and receptor locations based on where people reside and locations where fresh water is collected and Traditional Foods are hunted, trapped, fished, and gathered.
	Existing Conditions (TSD XXI, Environmental Risk Assessment, Section 5.1.3.2.1, Total Food Diet General Assumptions, and Section 5.1.1.2, Subsistence Harvester)	Indigenous and Local Knowledge helped develop an understanding of the Traditional Foods diet, including: ▪ the specific fish, mammal, bird, berry, and plant species that are traditionally used for food, medicine, and other purposes, which informed the Traditional Foods categories
	Project Interactions and Mitigations (Section 15.2.7)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures including: ▪ observations and experiences of Indigenous Groups related to the cumulative effects of industrial disturbances (e.g., mining, exploration activities) to air and water quality and aquatic and terrestrial ecosystems, and associated effects to the safety of wild foods and human health
Cultural and heritage resources and Indigenous land and resource use	Component Methods - Valued Components, Measurement Indicators, and Assessment Endpoints (Section 16.2.2)	Indigenous and Local Knowledge was considered in the selection of the Indigenous land and resources use VC and reflects: ▪ the importance of traditional hunting, trapping, fishing, and gathering for subsistence and cultural purposes ▪ the importance of habitation sites (e.g., cabins, camp sites), travel routes, culturally important sites (e.g., ceremonial, spiritual sites) and the cultural landscape to Indigenous land and resource use ▪ the value of quality of resources and quality of the land use experience to Indigenous land users
	Component Methods - Spatial Boundaries (Section 16.2.3)	The spatial boundaries selected reflects shared Indigenous and Local Knowledge regarding the locations of travel routes used to access traditional use areas, including travel routes from Highway 955, along the existing access road, and east to destinations on the Clearwater and Mirror rivers.
	Existing Conditions (Section 16.3)	Indigenous and Local Knowledge informed the characterization of existing conditions through: ▪ the identification of occupancy and travel routes, and fishing, gathering, hunting, trapping, and culturally important sites in the LSA and RSA ▪ the level of use and species targeted for harvesting ▪ trends in the populations of moose and fish ▪ how mining and exploration activities in the Patterson Lake area have affected access and harvesting activities
	Project Interactions and Mitigations (Section 16.4)	Indigenous and Local Knowledge informed the scoping of Project interactions, pathway analyses, and consideration of mitigation measures, including: ▪ observations and experiences of Indigenous land users related to the existing and cumulative effects of mining and exploration activities on access to and area available for land and resource use, changes to quality and availability of wildlife and fish, and changes to the quality of the resource use experience
	Residual Effects Analysis (Section 16.5)	Indigenous and Local Knowledge, including long-term observations and experiences of Indigenous land users in the Patterson Lake area, was used to inform the residual effects analysis related to changes in access and availability of land and resource use areas, and the quality of the Indigenous land use experience.

Table 3.8-1: Incorporation of Indigenous and Local Knowledge in the Environmental Assessment

Discipline	EA Component	How Indigenous and Local Knowledge was Incorporated into the EA
Other land and resource use	Component Methods - Valued Components (Section 17.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the other land and resource use VC and reflects: ▪ the importance of commercial fishing and trapping to both Indigenous and non-Indigenous land users for income and supporting livelihoods and community well-being ▪ the value of cabins, travel routes, quality of resources, and quality of the land use experience to both Indigenous and non-Indigenous land users
	Component Methods - Spatial Boundaries (Section 17.2.3)	The spatial boundary selected for the LSA reflects shared Indigenous and Local Knowledge regarding the specific locations of travel routes used to access trapping and other harvesting areas, including travel routes from Highway 955, along the existing access road and east to destinations on the Clearwater and Mirror rivers.
	Existing Conditions (Section 17.3)	Indigenous and Local Knowledge informed the characterization of existing conditions through: ▪ the identification of cabin locations and travel routes ▪ the level of use and species targeted for commercial trapping and fishing ▪ trends in the populations of moose, furbearers, and fish ▪ the effects of wildfires on resource use ▪ how mining and exploration activities in the Patterson Lake area have affected other land and resource use
	Project Interactions and Mitigations (Section 17.4)	Indigenous and Local Knowledge informed the scoping of Project interactions, pathway analyses, and consideration of mitigation measures, including: ▪ observations and experiences of land users related to the existing and cumulative effects of mining and exploration activities on access to and area available for land and resource use, quality of the resource use experience, changes to air or water quality, and availability of wildlife and fish
	Residual Effects Analysis (Section 17.5)	Indigenous and Local Knowledge, including long-term observations and experiences of Indigenous and non-Indigenous land users in the Patterson Lake area, was used to inform the residual effects analysis related to changes in access and availability of land and resource use areas and the quality of the resource use experience.
Economy	Component Methods - Valued Components (Section 18.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the economy VC and reflects: ▪ the importance of the traditional economy to Indigenous Groups and LPA communities by contributing to the economic and community well-being of people and communities
	Existing Conditions - Economy (Section 18.3)	Indigenous and Local Knowledge informed the description of the existing economic conditions, including: ▪ changes to primary industry over time ▪ the prevalence of temporary jobs (i.e., short-term work) versus the number of careers (i.e., long-term work) ▪ types of industries and different employment opportunities by gender ▪ the types of traditional economic activities that are undertaken ▪ factors that influence how and when people participate in the traditional economy ▪ the understanding of participation trends in the traditional and wage economies, and how government transfers can affect participation in both ▪ how people in the local communities interact with and move between the wage economy and the traditional economy ▪ how community members view money and savings
	Project Interactions, Mitigations, and Benefit Enhancements (Section 18.4)	Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures. This included the following pathways considered in the assessment: ▪ employment, income and training opportunities ▪ business and contracting opportunities ▪ participation and employment in the traditional economy ▪ population migration
Community well-being	Component Method - Valued Components (Section 19.2.2.1)	Indigenous and Local Knowledge was considered in the selection of the community well-being VC and reflects the importance of physical and mental health, social cohesion, cultural continuity, spirituality, and educational and employment opportunities to Indigenous Groups and LPA community members.
	Component Methods - Existing Conditions- (Section 19.2.6)	Characterization of existing conditions was informed by Indigenous and Local Knowledge and community perspectives provided by Indigenous Groups and LPA community members through the KP interview program conducted in all communities, and through other engagement activities including community information sessions, JWG meetings, and workshops with trappers, youth, and women.
	Existing Conditions (Section 19.3)	Indigenous and Local Knowledge and community perspectives were shared by Indigenous Groups and LPA community members to characterize existing conditions related to: ▪ community context and cultural continuity, including the maintenance of traditional ways of life and the intergenerational transmission of knowledge ▪ safety and security ▪ governance, including the maintenance of cultural identity and ways of life ▪ health, including mental health, addictions, and traditional diets ▪ the physical environment ▪ education and employment
	Project Interactions and Mitigations (Section 19.4)	Indigenous and Local Knowledge informed the scoping of Project interactions, pathway analyses, and consideration of mitigation measures. This included the following pathways considered in the assessment: ▪ increased educational and training opportunities ▪ opportunities for resource harvesting ▪ increased disposable income potentially leading to increased community issues ▪ population changes ▪ contracting and employment opportunities ▪ access restrictions ▪ local quality of life, cohesion, and family stability

EIS = Environmental Impact Statement; EA = Environmental Assessment; JWG = Joint Working Group; VC = valued component; LSA = local study area; RSA = regional study area; LPA = local priority area.

3.9 Use of Indigenous and Local Knowledge through the Rook I Project Lifespan

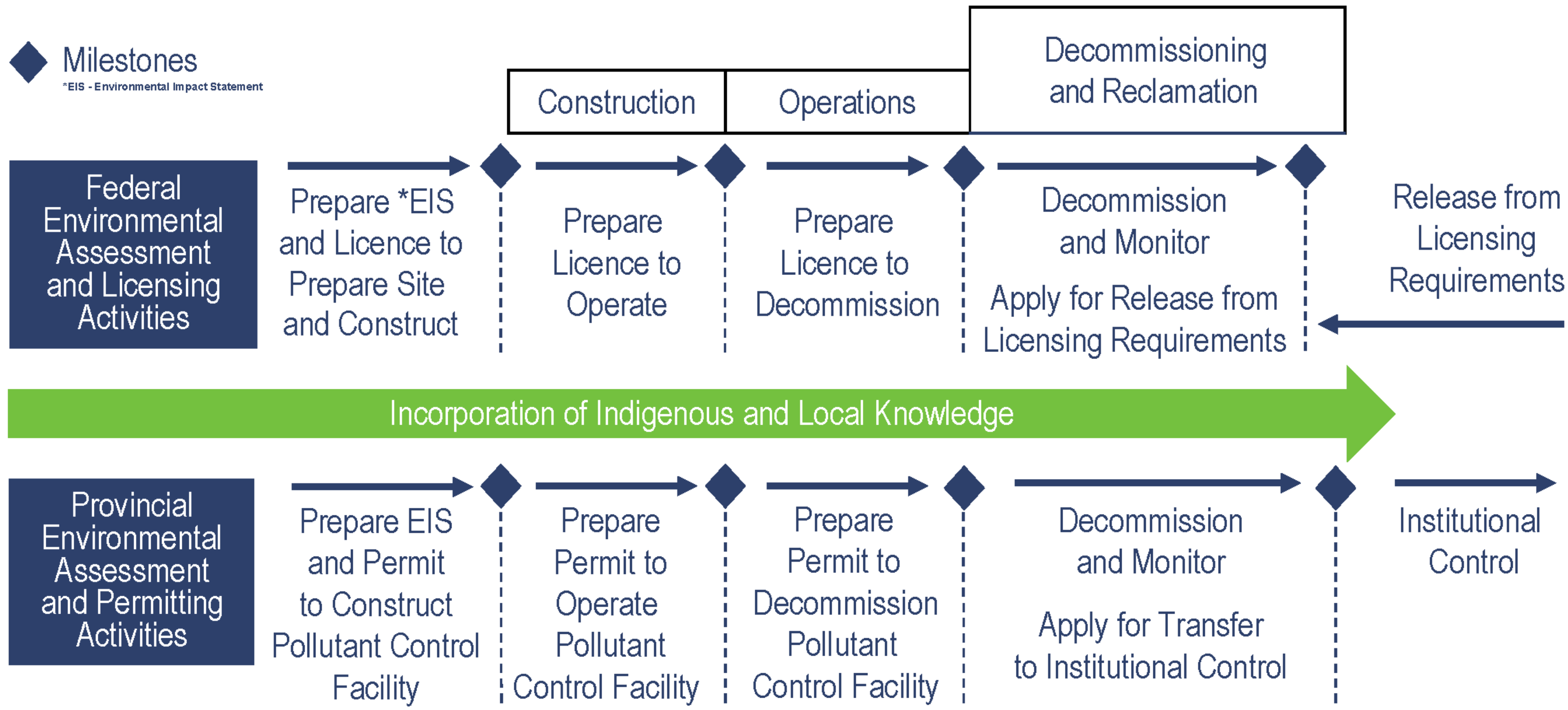
NexGen is committed to incorporating Indigenous and Local Knowledge throughout the Project lifespan. This approach has been consistent through early engagement activities (starting in 2013) and during the EA process, and will continue as more opportunities to share knowledge become available through engagement activities with Indigenous Groups and LPA communities (Figure 3.9-1). This includes consideration of additional Indigenous and Local Knowledge that may be brought forward during the Construction, Operations, and Decommissioning and Reclamation (i.e., Closure) phases of the Project as part of ongoing planning and development.

Evaluation of the environmental, technical, social, and economic performance of the Project design is an ongoing process that would be reviewed and optimized as the Project evolves through the EA process, permitting, and ultimately, through Construction, Operations, and Closure. As NexGen proceeds through the regulatory process and advances development of the Project, engagement activities would evolve as necessary to include Indigenous Groups and local communities in a manner that provides the opportunity for effective information exchange and dialogue specific to each stage of the Project. NexGen would continue to take an adaptive and respectful approach to engagement to allow adequate opportunity to respond to the needs of local communities as new information becomes available, while also respecting specific government policy and/or legislation.

As part of the evaluation of Project performance, monitoring and adaptive management are expected to represent key aspects of Project development, and would provide opportunities for inclusion of Indigenous and Local Knowledge. NexGen has proposed the formation of an Environmental Committee with each of the four primary Indigenous Groups. Each Environmental Committee would be composed of representatives from the Indigenous Group and representatives from NexGen and act as an oversight committee to monitor the environmental performance of the Project and to verify the parties (i.e., NexGen and the Indigenous Group) are implementing the regulatory and environmental commitments made in respect of the Project. The Environmental Committee would be fully funded by NexGen for the entire life of the Project. In addition to the Environmental Committee, NexGen has proposed funding a full-time, independent Indigenous Monitor chosen by each of the primary Indigenous Groups (i.e., one monitor per group). The intent of these positions is to provide unrestricted environmental monitoring opportunities, including independent environmental sampling, for the life of the Project (i.e., through Construction, Operations, and Closure). The Indigenous Monitors would also participate in annual community meetings to report openly and without restriction on the environmental performance of the Project to community members.

Opportunities for the inclusion of Indigenous and Local Knowledge in the Preliminary Decommissioning and Reclamation Plan, including end land use planning, are also anticipated. Evolution of the Decommissioning and Reclamation Plan is planned to occur throughout the lifespan of the Project. Initial conversations regarding the Decommissioning and Reclamation Plan were held during JWG meetings in February 2020 and March 2021 (BRDN-JWG 2021b, BNDN-JWG 2021b, CRDN-JWG 2020b,c). At that time, NexGen shared the intent to work with the local communities on end land use and reclamation planning throughout all phases of the Project, including Construction, Operations, and Closure.

Figure 3.9-1: Engagement and Incorporation of Indigenous and Local Knowledge throughout the Rook I Project Lifespan



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Rook I Project

Environmental Impact Statement

Section 4 Project Alternatives

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Abbreviations and Units of Measure

Abbreviation	Definition
CNSC	Canadian Nuclear Safety Commission
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COPC	constituent of potential concern
CPT	cemented paste tailings
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
ETP	effluent treatment plant
GHG	greenhouse gas
GISTM	Global Industry Standard on Tailings Management
JWG	Joint Working Group
LLRW	low-level radioactive waste
LNG	liquified natural gas
MAA	multiple accounts analysis
MBR	membrane bioreactor
NexGen	NexGen Energy Ltd.
NF	nanofiltration
NPAG	non-potentially acid generating
ODAL	omni-directional approach lighting
PAG	potentially acid generating
pH	potential of hydrogen
Project	Rook I Project
RO	reverse osmosis
SERM	Saskatchewan Environment and Resource Management
TSD	Technical Support Document
UGTMF	underground tailings management facility
$UO_2.nH_2O$	uranium peroxide
U_3O_8	triuranium octoxide
WRSA	waste rock storage area

Unit	Definition
%	percent
°	degree
°C	degrees Celsius
CO_2e/kWh	carbon dioxide equivalent per kilowatt hour
g	gram
Gt	gigatonne
ha	hectare
km	kilometre
kWh	kilowatt hour
M/km	million per kilometre
m^3	cubic metre
m^3/d	cubic metres per day
m^3/h	cubic metres per hour
mg/L	milligrams per litre
MW	megawatt
Mt	million tonne

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4 PROJECT ALTERNATIVES

This section outlines the alternatives assessments completed for the proposed Rook I Project (Project), and includes the purpose of, alternatives to, and the analysis conducted to evaluate alternative means of carrying out the Project.

The purpose of a project is the rationale or reasons for which the project would be carried out from the proponent's perspective and conveys what the proponent intends to achieve by carrying out the designated project (CEAA 2012). Alternatives to a project are functionally different ways to achieve the purpose of the project, while alternative means are the various technically and economically feasible ways considered by the proponent that would allow a designated project to be carried out (CEA Agency 2015).

This section satisfies the requirements of an Environmental Assessment (EA) of a designated project under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and requirements under *The Environmental Assessment Act* of Saskatchewan. This section also meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment and Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables).

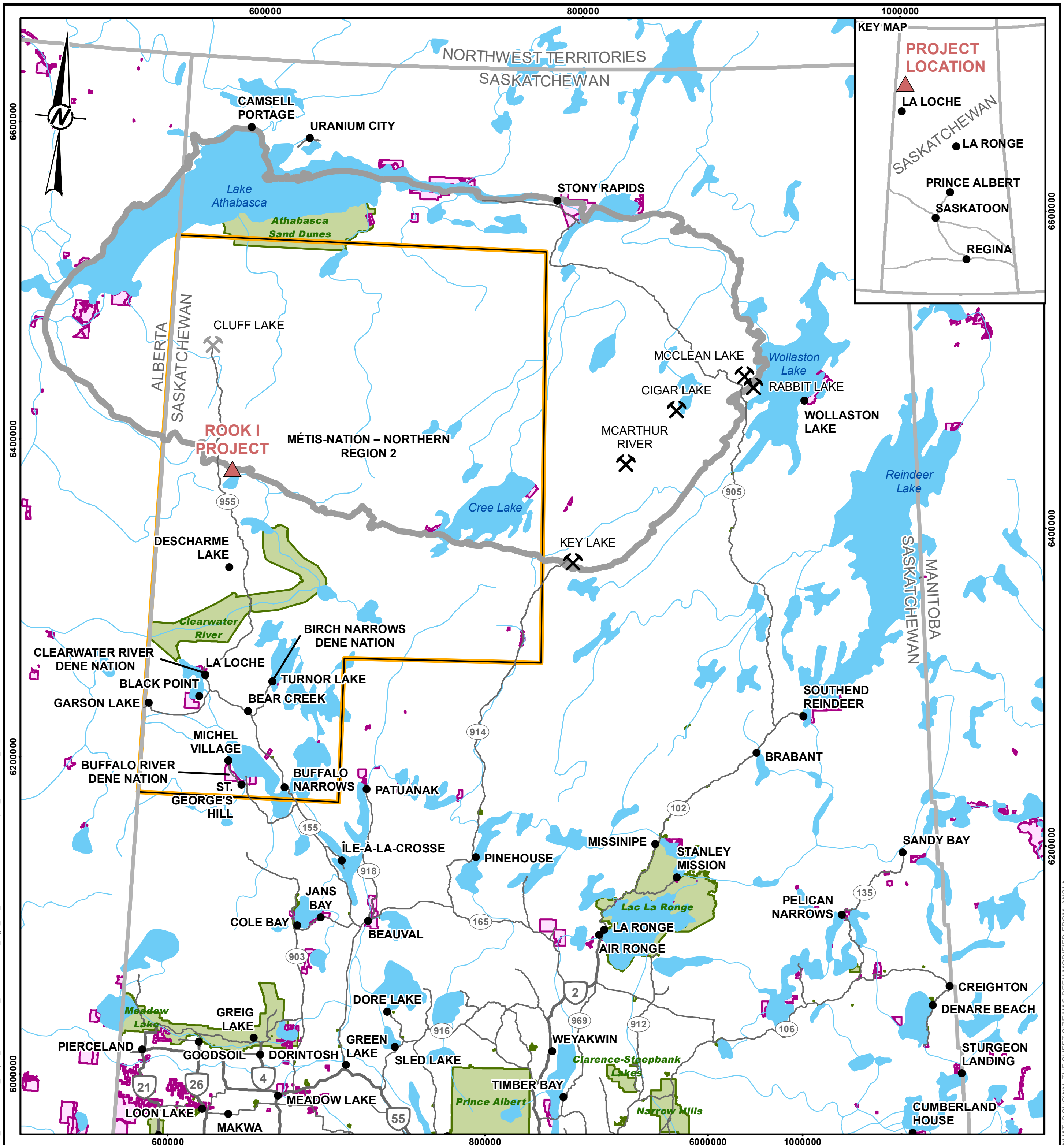
4.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan. The Project would be located 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 (Figure 4.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. The Project would include facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement hosted, high-grade uranium deposit.

The assessment of alternative means was used to select alternatives that were considered in the EA for the proposed Project, recognizing that the Project would continue to evolve as it advances through the EA process, licensing, and permitting and, ultimately, if approved, through Construction, Operations, and Decommissioning and Reclamation (i.e., Closure). The assessment of alternatives has been informed by NexGen's vision and values (Section 1.1.2, NexGen Vision, Values, and Approach) and input received from potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) (including Indigenous Knowledge), local communities, and regulatory authorities through engagement activities (Section 2, Indigenous, Regulatory, and Public Engagement, and Section 3, Indigenous and Local Knowledge). NexGen would develop and operate all Project infrastructure, facilities, and systems in accordance with applicable provincial and federal acts and the associated regulations (e.g., *The Environmental Management and Protection Act*, *The Saskatchewan Employment Act*, *The Nuclear Safety and Control Act*); guidance documents and standards (e.g., CNSC regulatory documents, Canadian Standards Association Group Standards, National Building Code of Canada, National Fire Code of Canada); and design standards developed specifically for the Project in consideration of best available practices as developed by applicable industry and trade associations. Through planning for consistent and reliable operation of equipment and processes, design standards would promote the protection of the public, workers, and the environment in all phases of the Project. The approach to carrying out the Project would be routinely reviewed and optimized as updates are issued by legislative and guiding bodies, additional data are collected, feedback from Indigenous Groups and the public are received, experience is gained based on site-specific operations, new technologies are introduced, and research is advanced.

Review and optimization of alternative means would be undertaken throughout the Project lifespan with the objective of identifying opportunities to further improve the environmental, technical, economic, and social performance of the Project.

The approach outlined in this section for the identification and evaluation of alternative means remains consistent with the precautionary approach and conservatively captures the potential effects associated with these selected alternatives. It is recognized that alternatives optimization would be pursued through Project design and planning and into the Project lifespan with the intent that any potential design iterations would be improvements on, and within the current considerations of, the assumptions carried within the EA (i.e., within the scope of the Project as defined for assessment).



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 4.1-1

4.2 Purpose of the Project

The proposed Project represents a substantial and consistent potential source of uranium for meeting the expected growing global demand for electricity. The Project could contribute to the Government of Canada's ability to meet its environmental obligations and commitments with respect to climate change by displacing high greenhouse gas (GHG) intensity, fossil fuel (i.e., coal and natural gas) electrical generation in favour of low-GHG emitting, renewable energy options. Providing a potential source of uranium would also support Saskatchewan's objective of developing lower carbon emission electricity generation over the next decade (Government of Saskatchewan 2020).

Market demand for uranium is driven primarily by the level of current or planned nuclear reactors operating globally, while market supply is driven by the global supply of uranium. In the long term, a significant increase in the uranium resource will be required, nationally and internationally, to support the use and growth of nuclear capacity as the transition to low-carbon electricity generation continues (Nuclear Energy Agency and the International Atomic Energy Agency 2020). Strategic uranium development is required so these resources are ready for use in nuclear fuel production, adhering to nuclear cooperation agreement guidelines and in accordance with Canada's commitment that exports be properly protected, safely handled, and resourced for peaceful purposes.

The International Energy Agency forecasts that the global demand for electricity could increase by up to 90% between 2018 and 2040. This forecasted growth in turn could result in increased GHG emissions from electricity generation, particularly through the burning of fossil fuels (IEA 2018). Under the 2015 Paris Agreement (UNFCC 2015), Canada has committed to reduce its GHG emissions by 40% to 45% below 2005 levels by 2030 (Prime Minister of Canada 2021). To meet these commitments, the Government of Canada targets carbon dioxide (CO_2) emission reduction by 219 million tonnes (Mt) by 2030 (Canadian Nuclear Society n.d.).

Reducing carbon emissions in Saskatchewan's electricity production by 2030 is a stated objective of the Government of Saskatchewan's *Growth Plan*, with a target of a 40% reduction in carbon emissions from 2005 levels by 2030 (Government of Saskatchewan 2020). Even if achieving this target reduction through increasing the amount of renewable electricity, 50% or more of the Saskatchewan's power would continue to come from fossil fuels, requiring additional strategies as part of the energy mix. Incorporating nuclear power into Saskatchewan's energy mix could provide up to 80% of the province's electricity through zero-emission sources, and the province is pursuing small modular reactor operation in the early to mid 2030s (Government of Saskatchewan 2020).

Given the forecasted increase in global demand for electricity and in consideration of the international Paris Agreement targets, there would have to be an 80% increase in global nuclear power production by 2040 compared to current production levels, along with investments in renewable energy sources (IEA 2019). In Canada, 80% of national electricity generation is currently from non-GHG emitting sources and Canada aims to increase that amount to 90% by 2030. To meet growing electricity demands and the GHG emission reduction targets, significant new nuclear and other low-carbon emitting electrical capacity would have to be established in Canada in addition to decarbonization efforts (Canadian Nuclear Association 2017).

Canada is a major producer of uranium, having contributed between 8% and 22% of the global supply annually from 2011 to 2020 (World Nuclear Association 2021). It has been estimated that the use of Canadian mined and milled uranium in nuclear power plants avoids approximately 300 Mt to 500 Mt of CO_2 emissions worldwide per year (International Atomic Energy Agency Ministerial Conference 2017). Currently, all uranium that is supplied globally from Canada is mined in Saskatchewan (Canada Energy Regulator 2021).

The purpose of the proposed Project is to provide a potential source of uranium as part of meeting global demand for electricity through low-GHG emitting energy options. The development of the Project can support the establishment of renewable energy options, help meet the growing global electricity demands, and support both national and international efforts to reduce GHG emissions. While uranium is not the only option to support these local and global endeavours, the demand for uranium is increasing, and this energy source can be an important part of the solution as the world moves towards more sustainable measures to protect the environment and help reduce effects on climate change. In addition to supporting national environmental objectives and commitments, the proposed Project would generate socio-economic benefits and opportunities for local Indigenous Groups, communities, the province of Saskatchewan, and Canada, including tax and royalty revenue, increased direct local and national employment, as well as associated indirect economic benefits and employment at local to national scales.

4.3 Alternatives to the Project

Alternatives to the Project are functionally (i.e., technically and economically feasible) different ways to achieve the purpose of the Project (CEA Agency 2015). This subsection outlines alternatives to the Project by energy type and by location (i.e., go/no-go decision). The majority of uranium is used as the primary input in the production of nuclear fuel, which is required globally in the nuclear power generation industry, an important component of the global electricity mix (Section 4.2, Purpose of the Project).

To achieve decarbonization at the lowest possible cost in Canadian provinces, a diverse set of low carbon technologies, including nuclear, will need to be implemented (Canadian Nuclear Association 2017). In Canada, various climate scenarios for low-GHG economy modelling analyses indicate the importance of nuclear energy installation before mid-century to meet the Paris Agreement targets. Studies indicate that provinces such as Saskatchewan, Alberta, Ontario, and New Brunswick would have to identify how nuclear energy can support their GHG emission reduction targets along with meeting higher electricity demand at lower costs (Canadian Nuclear Association 2017).

Alternatives to uranium for the generation of electricity include fossil fuels and renewable energy (e.g., hydroelectric, tidal, solar, wind, and biofuel).

4.3.1 Alternatives to the Project – Energy Type

Carbon intensity can be used to evaluate alternatives to the Project by energy type. Carbon intensity is a measure of the amount of CO_2 produced per unit of electrical energy generated. Carbon intensity of electricity depends on the fuel used in generation of electricity along with efficiency of power generation and transportation (Carbon Tracer n.d.). The current world average carbon intensity of the power sector is approximately 500 g CO_2 equivalent (CO_2e) per kilowatt-hour (kWh) (Buongiorno et al. 2019). Based on the climate change stabilization scenarios developed by the International Energy Agency in 2017, the power sector's carbon intensity must be reduced by 95% to 98% (i.e., to 10 to 25 g CO_2e/kWh) by 2050, and by more than 99.6% (i.e., to less than 2 g CO_2e/kWh) by 2060 to limit the global mean temperature warming to 2.0°C (Buongiorno et al. 2019).

Nuclear power, along with hydroelectric and wind power, emits the lowest quantity of GHGs per unit of electricity. A study for Organisation for Economic Co-operation and Development countries estimates that nuclear power has one of the lowest carbon intensities, generating approximately 25 g CO_2e/kWh as compared to fossil fuel chains, which have carbon intensities of 450 to 1,250 g CO_2e/kWh (i.e., 18 to 50 times greater than nuclear power), and the introduction of nuclear power has accounted for lowering the carbon intensity of energy economies in Organisation for Economic Co-operation and Development countries in the last 25 years (Nuclear Energy Agency n.d.).

4.3.1.1 Fossil Fuels

In Canada, nuclear energy displaces approximately 50 Mt of CO_2 emissions per year compared to the same amount of electricity produced from natural gas (Canadian Nuclear Society n.d.). In 2005, the Canadian nuclear industry produced 85 terawatt hours of electricity, which was approximately 11% of Canada's total energy use. The estimated total annual emissions from Canada's nuclear sector in 2006 (23 reactors) was between 468,000 and 594,000 tonnes of CO_2, or approximately 0.07% of Canada's total CO_2 emissions for the same year. For comparison, a single 500 megawatt (MW) coal-fired power plant, representing approximately 0.4% of Canada's total installed electricity capacity, would produce the equivalent of 0.4% of Canada's total 2006 CO_2 emissions (Ilnyckyj 2009). In Ontario, between 2005 and 2015, nuclear energy helped the province phase out coal by providing a clean energy option that is affordable and reliable, and avoided approximately 60 Mt of GHG emissions, the equivalent of taking about 12 million combustion engine vehicles off the road over the same period (Canadian Nuclear Association 2017). Without nuclear power, GHG emissions in Canada from electricity generation would have been 50% higher during the 1971 to 2018 period (IEA 2019).

While fossil fuels have been used consistently and continuously over the past few generations, the increasing global energy requirements, along with the higher CO_2 emissions associated with fossil fuels, makes nuclear energy a more sustainable fuel alternative, and one consistent with both Saskatchewan's and Canada's commitment to GHG emission reduction.

4.3.1.2 Renewable Energy

Renewable and nuclear energy are both important resources for a low carbon economy; however, the New Nuclear Watch Institute study on *The Failings of Levelised Cost and the Importance of System-Level Analysis* has identified that, on a per-megawatt of installed capacity basis, nuclear power is associated with 34% greater reduction in carbon intensity of a power system compared to that of other renewable energy sources (NNWI 2020).

In many advanced economies, nuclear has been the largest source of low carbon energy (IEA 2019). Globally, 55 gigatonnes (Gt) of CO_2 emissions have been avoided over the last 50 years due to the use of nuclear power, which is equal to 2 years of global energy related CO_2 emissions (IEA 2019). In Canada, nuclear power is the second largest source of low carbon economy, behind hydroelectricity (Canadian Nuclear Association 2021). Even though hydroelectric power is a low carbon economy option in Canada, there are a limited number of locations across the country for damming. For installing hydroelectricity, the geography of a location needs to be appropriate, and Canada is already near 90% of its hydroelectric capacity (Canadian Nuclear Association 2021). Nuclear power is readily expandable in Canada as there is abundant supply of uranium, and nuclear power requires a fraction of the land footprint when compared to hydroelectric, solar, and wind (Canadian Nuclear Association 2021). Nuclear power plants, in comparison to renewable energy, can also help stabilize the electrical grids as they can limit the impacts from temporal (e.g., daily, seasonal) fluctuations in the renewable energy sources (NNWI 2020).

Considering the increasing global energy requirements and commitments to GHG emission reduction, a combination of low GHG emission energy resources will be required as part of the global energy mix (Canadian Nuclear Association 2017). As noted above, hydroelectricity has historically been the primary low GHG emission energy resource developed in Canada; however, limited hydroelectric power development opportunities remain in this country (Canadian Nuclear Association 2021). Other renewable resources, such as solar, wind, and tidal, can help to meet demand, particularly in remote locations; however, these energy sources only make up approximately 2% of Canada's total power generation, and their growth is limited by their intermittent nature and need for comparatively large footprint areas (Canadian Nuclear Association 2021; NNWI 2020). With nuclear power currently representing the second largest Canadian source of low carbon economy options, there is an opportunity for the extraction and processing of uranium ore for nuclear power generation to be a significant contributor to meeting the expected growing global demand for electricity while limiting GHG emissions associated with the generation process.

4.3.2 Alternatives to the Project – Location

Alternatives to the Project itself include not proceeding (i.e., no project). If the proposed Project is not advanced, uranium could potentially be mined and milled at other locations to meet the increasing demand of uranium at the national and international scale.

While other uranium projects could be developed by either other operators or by NexGen in the future (i.e., future NexGen projects), the proposed Project could play a key role in meeting the global demands for uranium. Considering Saskatchewan is a major source of the world's uranium (International Atomic Energy Agency Ministerial Conference 2017), and considering the high-grade nature of the Arrow deposit, the proposed Project could be developed into a uranium concentrate producer of global importance. The Arrow deposit is located within the Athabasca Basin, which is a well-explored and well-developed uranium mining region. The proposed Project can be developed such that strong health, safety, and environmental performance would be achieved and economic benefits realized by local Indigenous Groups, local communities, Saskatchewan, and Canada. The Project would be designed to meet applicable regulatory requirements and industry best management practices, and to be safe for the public and workers. The Project would also operate in well-regulated provincial and federal jurisdictions, which include strong commitments to the safe export and peaceful use of nuclear fuel. Given these potential advantages and benefits, NexGen considers advancing the Project to be preferred over the no-project alternative.

4.4 Alternatives Assessment Approach

Alternative means are the various technically and economically feasible ways considered by a proponent that would allow a designated project to be carried out (CEA Agency 2015). The assessment of alternative means for the Project, called alternatives assessments, involved the systematic evaluation and comparison of the relative advantages and disadvantages of a range of feasible alternatives. Assessment was used to facilitate the selection of an alternative that, on balance, best meets a combined set of decision criteria that considers environmental, technical, economic, and social aspects, and the assessment of potential effects for the purposes of an EA. This multiple criteria decision analyses approach to alternatives assessment was achieved either through a screening-level assessment or through a multiple accounts analysis (MAA).

Alternatives assessments were considered during scoping, prefeasibility, and feasibility studies for the Project to understand how alternatives or options compared to each other. Assessments were completed by an integrated group of subject matter experts including members of the project development, environmental, and socio-economic teams for the Project. Following applicable guidance (CEA Agency 2015; Government of Saskatchewan 2021), the alternatives assessments for the Project consisted of the following:

- identifying technically and economically feasible alternative options (Section 4.4.1, Alternative Identification);
- selecting alternative-specific assessment criteria for the alternatives assessments (Section 4.4.2, Assessment Criteria);
- identifying the appropriate assessment level as either a screening-level assessment or an MAA (Section 4.4.3, Level of Assessments);
- developing a general, logical order to assess the different alternatives assessments (Section 4.4.4, Order of Assessments);
- analyzing potential effects of technically and economically feasible alternative options, which includes relative ranking of alternatives (Section 4.5, Alternatives Assessments for the Project):
  - for MAAs, including a sensitivity analysis where appropriate; and
- identifying selected alternatives to be carried forward for the Project (Section 4.6, Selected Alternatives Summary).

For all alternatives assessments, whether screening-level assessments or MAAs, alternative options were identified, assessment criteria were applied quantitatively (where possible) or qualitatively (where required), and relative preferences assigned. The preferences reflected the relative degree to which an alternative addressed a particular criterion compared to other options. Based on the overall evaluation of alternatives in consideration of the applicable assessment criteria, the more preferred alternatives were identified in summary tables. Colour coding is used in table summaries to reflect these relative preferences, with dark blue representing more preferred alternatives, light blue representing alternatives that are neutral, and white representing less preferred alternatives.

In some instances, the identified preferred alternative from an assessment was not selected for the Project for the purposes of the EA. This condition occurred when the complexity of an alternatives assessment could not be fully captured based on the availability of information at the time of the assessment. In these instances, additional discussion is provided to outline the unique circumstances of the particular selected alternative. To inform the evaluation of alternative means for the EA, a precautionary approach was taken in selecting alternatives to conservatively capture the potential effects associated with the selected alternatives. For selected alternatives that were carried forward into the EA Project design (Section 4.6), an assessment of the potential effects associated with those alternatives is presented as part of the Environmental Impact Statement (EIS). As described in Section 4.1, Introduction, review and optimization of the selected alternatives would continue throughout the Project lifespan with the objective of identifying opportunities to further improve the environmental, technical, economic, and social performance of the Project as assessed within the EA.

4.4.1 Alternative Identification

The identification of technically and economically feasible alternative options was carried out using the following criteria:

- **Technical feasibility:** Although the technical feasibility for various alternatives may have been previously demonstrated at other projects, this criterion relates to the viability or applicability of a technology in the context of the Project, which considers:
  - climatic conditions and geographic setting of the Project;
  - size of the operation;
  - ability to meet Project design criteria and operational complexity;
  - proven technology;
  - constructability; and
  - Project schedule considerations.
- **Economic feasibility:** Economic feasibility relates to a comparison of costs against forecasted revenues. An alternative option was considered uneconomic if its use or implementation poses a significant risk to return on investment; that is, its use would be cost prohibitive considering technical application of the option (e.g., climatic and geographical context of the Project site, Project design criteria and operational complexity, constructability). Where an alternative was deemed to be prohibitive in terms of capital expenditure, it was not advanced as an alternative option.

Table 4.4-1 lists the alternatives assessments that were evaluated for the Project. Details of the alternatives assessments are provided in Section 4.5. The order of alternatives assessments was established recognizing that each alternative can limit and influence other assessments. The order of assessments, along with Project aspect categories, presented in Table 4.4-1 is generally reflective of the order in which alternatives assessments were completed for the Project. Further details on alternatives assessment order are presented in Section 4.4.4.

Table 4.4-1: List of Rook I Project Alternatives Assessments

Project Aspect Categories	Project Alternatives Assessments
Mining	▪ Primary mining method ▪ Underground mining method
Processing	▪ Process plant location ▪ Process stripping method ▪ Final product type
Mine waste	▪ Mine waste storage – tailings ▪ Mine waste storage – gypsum ▪ Mine waste storage – waste rock
Supporting infrastructure	▪ Power supply type ▪ Fuel delivery method ▪ Camp location ▪ Airstrip location ▪ Site road alignment
Water	▪ Effluent treatment technology ▪ Treated effluent discharge location ▪ Fresh water supply – source ▪ Fresh water supply – location ▪ Sewage treatment technology

Table 4.4-1: List of Rook I Project Alternatives Assessments

Project Aspect Categories	Project Alternatives Assessments
Conventional waste	▪ Domestic waste ▪ Industrial waste ▪ Hazardous waste ▪ LLRW
Decommissioning demolition waste	▪ Clean waste ▪ LLRW ▪ Hazardous waste

LLRW = low-level radioactive waste.

4.4.2 Assessment Criteria

Once potential alternative options were identified based on technical and economic feasibility, each alternative option was assessed against four key assessment categories: environmental considerations, technical feasibility, economic feasibility, and social considerations (Table 4.4-2). Within key assessment categories, standardized sub-categories were considered. From this point, alternative-specific criteria for the selected sub-categories were defined with the intent of describing the material differences (i.e., differentiating aspects) between the options of each alternatives assessment. This evaluation process, including the identification of key assessment categories, sub-categories, and alternative-specific criteria, followed the applicable guidelines from the Canadian Environmental Assessment Agency and Government of Saskatchewan (CEA Agency 2015; Government of Saskatchewan 2021). The key assessment categories and associated sub-categories are shown in Table 4.4-2; alternative-specific criteria are outlined within each alternatives assessment (Section 4.5).

Categories and sub-categories were not exhaustive in terms of relevance to design, and while each sub-category was considered, those included in the individual alternatives assessments were selected based on their ability to identify differentiating factors between alternative options being considered. For example, if a specific environmental or social consideration would have been rated equally across all alternative options, this particular consideration was not assessed; only differentiating criteria were carried forward for evaluation as part of each alternatives assessment. Alternative-specific criteria were intentionally analyzed separately and individually to reduce the potential for cumulative bias through cross-consideration of criteria (i.e., to preserve judgmental independence). This approach is standard practice in conducting options analyses and promotes the objective assessment of all considerations independently so that no one set of criteria can overweight or over-influence other criteria. Additional consideration was given to selecting sub-categories and indicator criteria that were effect driven, value relevant and non-redundant, consistent with options analysis best practice.

In addition to evaluating environmental, technical, economic, and social aspects of potential alternative options, alternatives assessment is to include consideration of Treaty and Aboriginal Rights and traditional uses (Government of Saskatchewan 2021). To reduce potential for redundancy during assessment, consideration of traditional use was incorporated into the development and evaluation of sub-categories and indicator criteria. The comparison between alternative options was presented in relative terms and is not intended as a definitive statement of Treaty or Aboriginal Rights as they pertain to the proposed Project. Such an evaluation is the responsibility of the Crown in consultation with the potentially affected Indigenous Groups. Further details on how Indigenous and local considerations were used in the assessment of alternatives is provided in Section 4.4.2.1, Input from Indigenous Groups and the Public.

Categories, sub-categories, and alternative-specific criteria were used to assess the identified viable (i.e., technically and economically feasible) alternatives. Assessment categories and sub-categories

(Table 4.4-2) were standardized, and an appropriate level of assessment was determined (Section 4.4.3) to establish alternatives for assessment that reflect input from Indigenous groups and the public (Section 4.4.2.1) and result in a conservative assessment of potential effects consistent with best practice and regulatory guidance.

Table 4.4-2: Categories and Key Considerations for Evaluating Alternatives Assessments

Assessment Categories	Key Considerations	Assessment Sub-categories[(a)]
Environmental considerations	▪ How do the likely effects on the aquatic, terrestrial, or atmospheric environments compare? ▪ Can the alternative be constructed, operated, and decommissioned in a manner that provides long-term protection of ecological health?	▪ Ecological integrity ▪ Hydrologic regime ▪ Air quality
Technical feasibility	▪ Does the alternative meet the Project design principles? ▪ Is the alternative an approach or technology that has been successfully implemented elsewhere? ▪ Does the alternative require any tools, equipment, or technologies that cannot be easily adapted to the current application (e.g., climate, location)? ▪ Is the alternative an example of best available technology? ▪ Does the design incorporate sufficient design robustness to protect the environment, communities, and workers? ▪ What is the complexity of design or monitoring?	▪ Design and reliability ▪ Construction risk and complexity ▪ Operational risk and complexity ▪ Closure risk and complexity ▪ Flexibility
Economic feasibility	▪ How does the total cost of each alternative over the Project lifespan compare to the other(s)? ▪ Are the costs of the alternative supportable within the current funding framework? ▪ Are the costs of the alternative well defined and sustainable through the Project lifespan?	▪ Capital cost ▪ Operating cost ▪ Closure cost
Social considerations	▪ How do the likely effects on land and resource use (e.g., access), heritage resources, and socio-economics (e.g., employment opportunities) compare? ▪ How are the alternatives perceived by Indigenous Peoples and the public, and is one alternative preferred over another? ▪ Can the alternative be constructed and operated in a manner that provides protection of public and worker health and safety, and how does the protection of health and safety compare?	▪ Community effect ▪ Change in end land use ▪ Population at risk

a) Sub-categories were not used in an assessment if considered non-differentiating for the alternatives being evaluated.

4.4.2.1 Input from Indigenous Groups and the Public

NexGen values and respects the culture, interests, and aspirations of the communities where it operates and firmly believes in the establishment and maintenance of trusting relationships that facilitate open discussion and meaningful collaboration. The design elements of the proposed Project were evaluated in consideration of helping local individuals and businesses to advance economic benefits and opportunities, drive economic capacity building, and support entrepreneurs across the province—with a focus on Saskatchewan's North.

Engagement with Indigenous Groups and local communities, residents, businesses, organizations, land users, and the various regulatory authorities is foundational to NexGen, and an integral part of the responsible development of the Project. As discussed in Section 1.1.6, Working with People, NexGen recognizes the importance of community input and continually strives to acknowledge and incorporate key feedback in the design and development of the Project. A variety of engagement methods have and will continue to be implemented in support of Project engagement that is early, often, and long lasting (Section 2.5, Engagement Approach).

Engagement for the Project resulted in the collection of important feedback for consideration within the EA, including Indigenous and Local Knowledge. Indigenous Knowledge is understood as a body of knowledge built up by a community of Indigenous people through generations of living in close association with the land. For the purposes of the EA, Indigenous Knowledge represents knowledge that meets this definition and has been formally sanctioned by an Indigenous Group. NexGen values Indigenous Knowledge based on a foundation of respect for the world view of the Indigenous communities and knowledge holders. Local Knowledge represents other information collected through engagement activities with local Indigenous Groups and communities that does not meet the specific criteria for Indigenous Knowledge, including Indigenous Group sanction. Further context regarding the definitions of Indigenous Knowledge and Local Knowledge is provided in Section 3.4, Defining Indigenous and Local Knowledge.

Engagement activities have provided a mechanism for local Indigenous and non-Indigenous community members to share knowledge of their communities, the land, and the environment. Indigenous and Local Knowledge has been collected through community information sessions (Section 2.6, Engagement Summary), site tours with community members, other formal and informal meetings, and research conducted as part of environmental and socio-economic baseline data collection programs. As an example of the formal meeting mechanism, Indigenous and Local Knowledge was shared through Joint Working Groups (JWGs) established with the Clearwater River Dene Nation, Métis Nation – Saskatchewan, Birch Narrows Dene Nation, and Buffalo River Dene Nation. The JWGs represent an agreed upon primary engagement mechanism as outlined in the Study Agreements signed by each Indigenous Group and NexGen. More details regarding the JWGs can be found in Section 3. Specific discussion on potential Project alternatives and the alternatives assessment process was a part of the JWG topics. Information derived from the JWGs, gained through individual and collective lived experience, was considered alongside other Indigenous and Local Knowledge in the alternatives assessments for the Project.

Key themes NexGen heard and considered in the alternatives assessments included:

- **Environment:** minimizing disturbances to and protecting the quality of the air, water, land, and wildlife; protection of Patterson Lake; and preference for alternatives with smaller footprints and thus lesser potential effects on vegetation and wildlife throughout all phases of the Project, including post-closure;
- **Health and safety:** understanding the health and safety aspects of the uranium industry, including negative perception of yellowcake, which is a type of uranium product generated through mining and processing; negative perception of the surface storage of uranium tailings; and operating in a manner that is protective of workers, Indigenous and other land users, and local communities;
- **Traditional land and resource use:** recognizing, accepting, and respecting the local communities' cultural links to, and reliance on, the land and its resources as a critical part of the well-being, identity, and culture; minimizing (to the extent possible) restrictions on the ability of Indigenous land users to access area land and resources throughout all phases of the Project, including post-closure;
- **Community well-being:** considering both the positive and negative social effects of the Project on the local communities, and providing the necessary support to mitigate negative effects; and
- **Socio-economics:** maximizing potential business and employment opportunities for local people through educational and training opportunities, and development of local contractors to be competitive in Project procurement opportunities.

More information on results of engagement and Indigenous and Local Knowledge considerations included in Project planning and design can be found in Section 2 and in Section 3.7, Influence on Project Planning and Design.

4.4.3 Level of Assessments

Multiple criteria decision analyses include multiple different types of detailed assessment, and assessment type can vary depending upon the nature and complexity of the alternatives assessment being evaluated. For the proposed Project, two levels of assessment were considered for the alternatives assessments (Table 4.4-1): screening-level assessment and MAA assessment.

Complex alternatives with high interdependencies and/or potential significance to achieving Project success used an MAA assessment (ECCC 2016). The MAA assessment approach was used for mine waste (i.e., tailings, gypsum, and waste rock), effluent treatment plant (ETP) technology, and conventional and demolition waste disposal alternatives assessments.

For all other alternatives assessments that were considered less complex, a screening-level assessment was employed. These screening-level assessments were associated with Project aspects such as mining, processing, and water source and treated effluent discharge locations, as well as supporting infrastructure (e.g., road alignments, camp locations power sources).

The level of assessment used to evaluate each set of alternatives is provided in Table 4.4-3. All alternatives assessments considered the systematic comparison of alternative options to identify preferred alternatives that best met the combined set of criteria used in the assessment (Section 4.4.2).

4.4.4 Order of Assessments

The overall Project design, and the order of alternatives assessments, reflects how key components and infrastructure “fit together” to achieve Project objectives. There are often constraints related to the natural environment, which can limit and influence the basis of Project design and approach for development. Examples of constraints of the natural environment include the location of ore bodies and waterbodies, existing geotechnical conditions, and local climate considerations (Section 5.3, Project Design Considerations).

The collective mine components must also fit together in terms of the physical space required, and selected processes must match the characteristics of materials being handled (e.g., chemical characteristics, volumes). In addition, some alternatives assessments (e.g., mining method, processing methods, mine waste management approach) have a larger influence on Project design and inform the overall development approach of the Project. Alternatives assessments that could limit or influence additional alternatives assessments were considered before other alternatives assessments were completed (i.e., a systematic order was taken for conducting the assessments).

The bullets below outline the general order in which the alternatives assessments for key mine components and infrastructure were prioritized in recognition of influence on Project design and other alternatives assessments.

- The **primary mining method** was dependent on characteristics of the ore body; in particular, the depth to ore, the shape and orientation of the ore, and the existing ground conditions:
    - The selected primary mining method influenced the **underground mining method**, which was also dependent on ore body characteristics but at a smaller and more local scale.
    - The selected primary mining method also influenced the amount of surface or underground disturbance, including the volume of **mine waste** storage (e.g., waste rock) available underground, and the siting of the **process plant location**.

- Processing methods (i.e., **process stripping method** and **final product type**) had a large influence on the amount and type of **mine waste** (e.g., tailings) that needs to be managed and disposed of on site.
- **Mine waste** management and storage included multiple waste streams (i.e., tailings, gypsum, waste rock) and was dependent on the above alternatives assessments. Selection of preferred mine waste storage alternatives, including locations and sizes, had a large effect on overall Project design and disturbance areas. The selected mine waste storage alternatives for particular waste streams (e.g., waste rock) was in turn dependent upon the preferred storage alternative selected for other waste streams (e.g., tailings, gypsum).
- The choice of **power supply type** was dependent on the feasibility and cost of various alternatives. For fuel-dependent power systems, the selected **fuel delivery method** influenced decisions related to Project access routes requirements for personnel and/or delivery of supplies (i.e., **airstrip location** and **site road alignment**).
- The **camp location** was dependent on workforce availability, travel logistics, and availability of community housing or remote camp options. The type and location of camp also influenced worker transportation and access route requirements (i.e., **airstrip location** and **on-site road alignment**).
- The alternatives assessments for **airstrip location**, **on-site road alignment**, and **camp location** were dependent on existing geographic and topographic constraints as well as the alternatives assessments associated with main mine components such as the **primary mining method**, **process plant location**, **mine waste storage**, and **power supply type**.
- The **effluent treatment technology** and **sewage treatment technology** were dependent on expected inputs and inflows from the associated process plant, mine workings, and camp. The **treated effluent discharge location** was dependent on predicted discharge water quality and receiving water characteristics.
- Selection of **fresh water supply source** and **fresh water supply location** were dependent on water availability and reliability, and were influenced by the **treated effluent discharge location**.
- **Conventional waste disposal** (i.e., domestic, industrial, hazardous [non-LLRW], low-level radioactive waste [LLRW]) and **decommissioning demolition waste disposal** (i.e., clean, LLRW, hazardous) were dependent on the waste characteristics, including the levels of radioactivity, potential for release of contaminants, and the degree of long-term management required.

The alternative options for the Project alternatives assessments are listed in Table 4.4-3 and discussed in Section 4.5. A summary of selected alternatives is presented in Section 4.6.

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Table 4.4-3: Alternative Options Evaluated for the Rook I Project

Project Alternatives[a]	Level of Assessment[b]	Alternative Options					
		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Primary mining method	Screening	Open pit	Underground				
Underground mining method	Screening	Caving	Long hole	Cut and fill			
Process plant location	Screening	On-site process plant	Off-site process plant				
Process stripping method	Screening	Ammonia stripping	Strong acid stripping				
Final product type	Screening	$UO_2.nH_2O$	U_3O_8				
Mine waste storage – tailings	MAA	Underground with paste at location U-4	In-pit with slurry at location P-3	Surface with paste at location S-1	Surface with paste at location S-3		
Mine waste storage – gypsum	MAA	Underground with tailings in UGTMF	Surface with waste rock in WRSA				
Mine waste storage – waste rock	MAA	Unsegregated, base case, unlined	Unsegregated, base case, lined	Unsegregated, engineered source control, unlined	Unsegregated, engineered source control, lined	Segregated, NPAG unlined, PAG lined	Segregated, NPAG unlined, PAG engineered source control and lined
Power supply type	Screening	Grid power	On-site diesel power plant	On-site LNG power plant	On-site hybrid system of power plant and renewable energy supply		
Fuel delivery method	Screening	Truck	Pipeline	Air			
Camp location	Screening	South location	West location	East location			
Airstrip location	Screening	Central west–east	Eastern south–north	Central south–north	Western south–north		
On-site road alignment	Screening	Southwest alignment	Northeast alignment				
Effluent treatment technology	MAA	Two-stage chemical precipitation using lime	Two-stage chemical precipitation using caustic	One-stage chemical precipitation followed by RO	One-stage chemical precipitation followed by ion exchange or adsorption		
Treated effluent discharge location	Screening	North Arm – East Basin, near shore	North Arm – basin divide, near shore	North Arm – West Basin, near shore	North Arm – West Basin, near shore, close to effluent pond	North Arm – West Basin, optimal depth	North Arm – West Basin, maximum depth
Fresh water supply – source	Screening	Surface water	Groundwater	Trucked supply			
Fresh water supply – location	Screening	North Arm – East Basin ~700 m from shore	North Arm – East Basin ~300 m from shore	North Arm – West Basin ~100 m from shore			
Sewage treatment technology	Screening	Sewage lagoon	MBR	MBR with NF or RO			
Conventional waste disposal – domestic	MAA	On-site repurpose/recycle	On-site incineration	On-site landfilling	Off-site disposal	Off-site repurpose/recycle	
Conventional waste disposal – industrial	MAA	On-site repurpose/recycle	On-site incineration	On-site landfilling	Off-site disposal	Off-site repurpose/recycle	Underground disposal
Conventional waste disposal – hazardous	MAA	On-site incineration	On-site landfilling	Off-site disposal	Off-site repurpose/recycle		
Conventional waste disposal – LLRW	MAA	On-site incineration	On-site landfilling	Off-site disposal	Underground disposal		
Decommissioning demolition waste disposal – clean	MAA	On-site landfill	Off-site disposal	On-site processing / off-site recycling	Underground disposal		
Decommissioning demolition waste disposal – LLRW	MAA	On-site landfill	Off-site disposal	On-site processing / off-site recycling	Underground disposal		
Decommissioning demolition waste disposal – hazardous	MAA	On-site landfill	Off-site disposal				

Legend: Not applicable

a) Section 4.4.4, Order of Assessments for information on order of assessments.
b) Section 4.4.3, Level of Assessments for information on level of assessments.
LLRW = low-level radioactive waste; LNG = liquified natural gas; UGTMF = underground tailings management facility; WRSA = waste rock storage area; NPAG = non-potentially acid generating; PAG = potentially acid generating; $UO_2.nH_2O$ = uranium peroxide; U_3O_8 = triuranium octoxide; MBR = membrane bioreactor; RO = reverse osmosis; NF = nanofiltration; MAA = multiple accounts analysis.

4.5 Alternatives Assessments for the Project

Details of the assessments completed for each of the alternatives listed in Table 4.4-3 are provided in the subsections below. The assessments of alternative means for the Project, called alternatives assessments, are presented in the same order as described in Section 4.4.4, and have considered the interaction with, and influence from, one decision or selection to the next.

4.5.1 Primary Mining Method

The primary mining (i.e., extraction) method chosen for a project is based largely on the characteristics of the ore body and host rock. For example, ore bodies close to surface are often developed using open pit mining methods, while underground mining methods are typically used for ore bodies at greater depths. The ore body thickness, orientation, and ore grade also dictate the most appropriate extraction method.

The Project would target development of the Arrow deposit, which is a near-vertical, high-grade uranium deposit adjacent to Patterson Lake. The deposit is overlain by approximately 100 m of glacial overburden (Figure 4.5-1) and extends approximately 900 m in depth within the basement rock. The mineral reserve (i.e., target ore body for mining) is hosted within the basement rock and extends from approximately 350 m below surface to 650 m below surface (Figure 4.5-2).

Figure 4.5-1: Arrow Deposit Setting within the Athabasca Basin

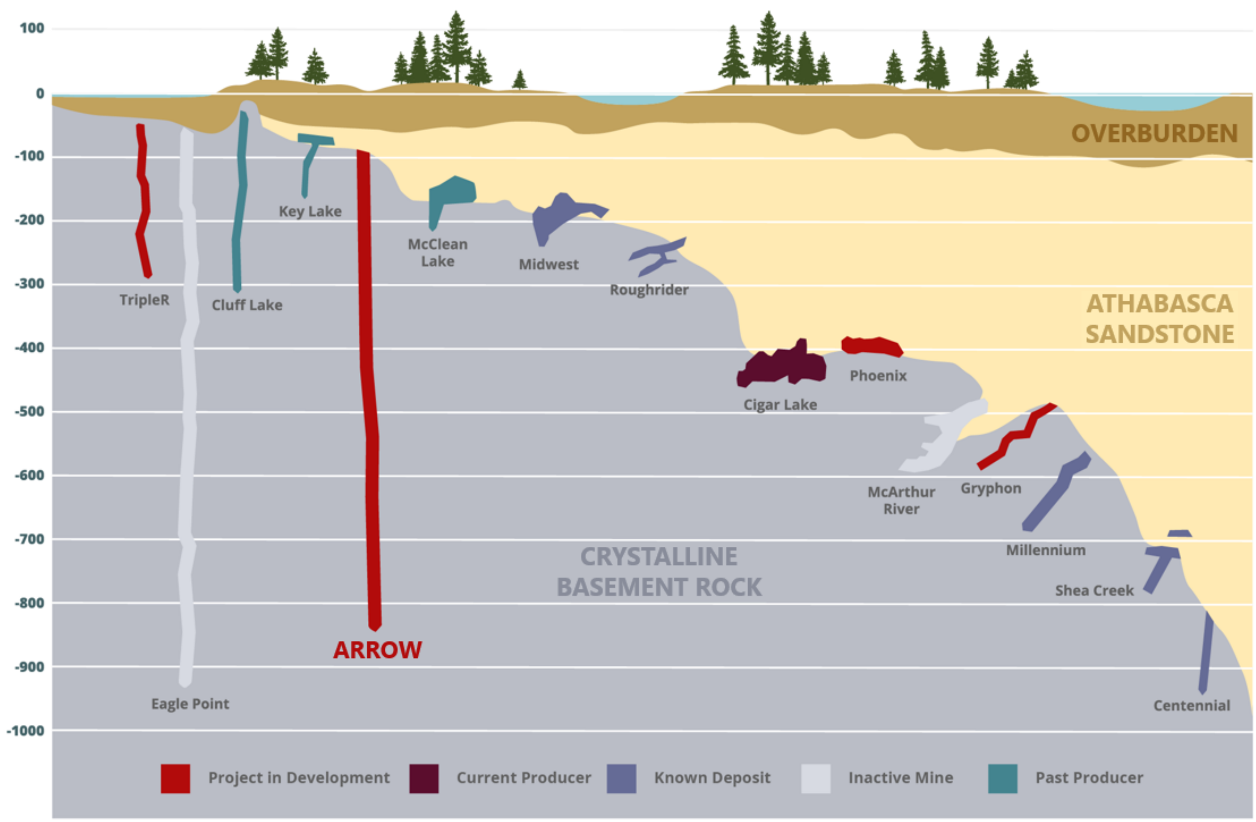
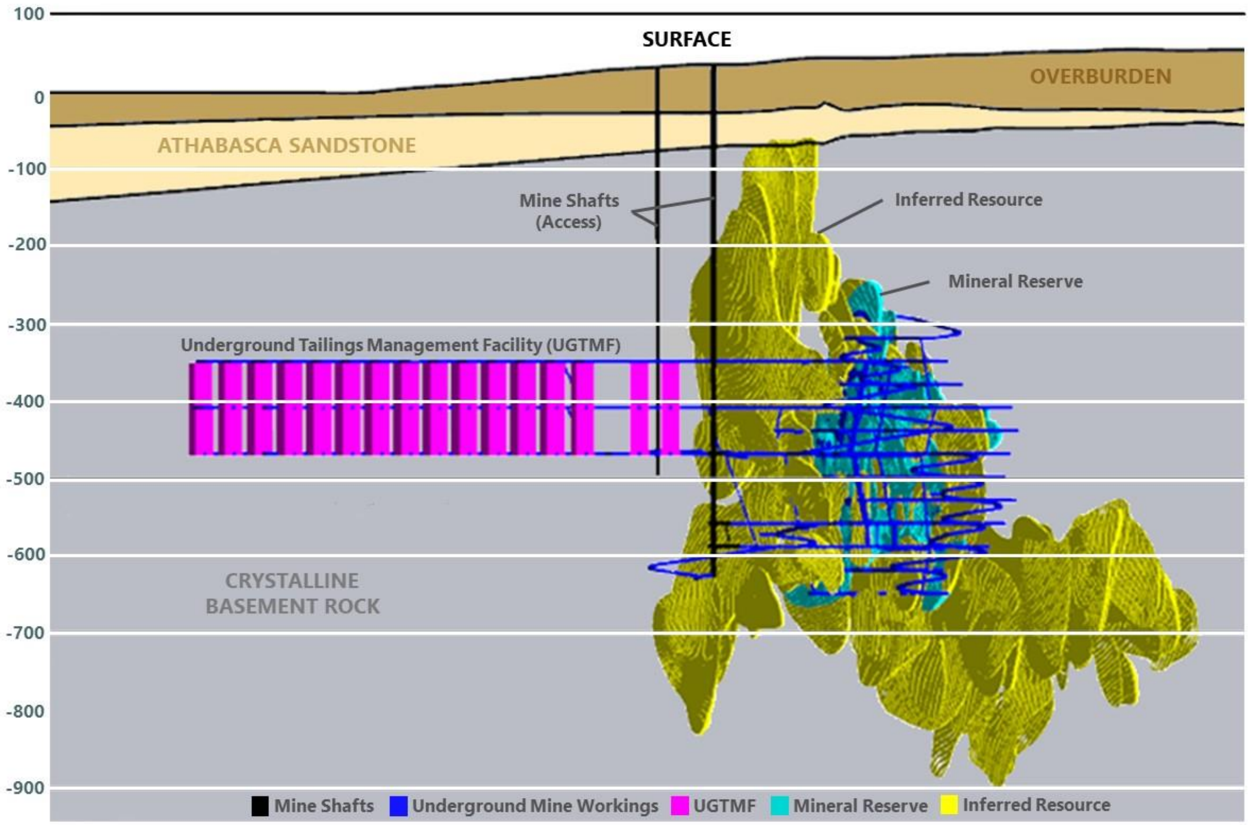


Figure 4.5-2: Location of Target Ore Relative to Surface



The primary mining methods considered for the Project were:

- open pit; and
- underground.

Open pit mining of the Arrow deposit could be used to access a portion of the target ore body; however, proximity to, and encroachment on, Patterson Lake would limit the maximum size of the pit at surface and thus the amount of ore that could be extracted at depth. If an open pit were developed, the pit rim could extend approximately 1 km in diameter without interacting with the lake (i.e., no large dikes into lake that would require dewatering), and at this size, could reach a depth of approximately 500 m if reasonable pit slope angles were assumed. At this pit size, only approximately 150 m of ore at depth could be exposed, and a large portion of ore below this elevation would not be accessible via the pit. Therefore, using an exclusively open pit mining method would sterilize (i.e., make no longer accessible) a significant portion of the target ore body, or would require a combination of open pit and underground mining to recover the full extent of the target ore. While the upper portions of the target ore would be recoverable using open pit mining, the stripping ratio (i.e., volume of non-ore bearing material [i.e., waste rock] vs. volume of ore) would likely be uneconomic. Open pit mining would require removal of significant volumes of the 100 m thick overburden layer and of the 250 m thick layer of waste rock and low-grade ore. The open pit design would also be complicated by poor and unconsolidated ground conditions and the presence of aquifers or high water tables in the uppermost 30 m of ground, as well as potential water seepage from Patterson Lake into the pit. To accommodate increased waste rock volumes, larger waste rock storage areas (WRSAs) would be required, as well as design of a surface tailings disposal site. Development of an open pit would also require that the Project infrastructure (e.g., process plant, stockpiles, camp, airstrip) be located sufficiently set back (i.e., distanced) from the pit; this setback requirement has the potential to increase the overall Project footprint and associated environmental effects.

Underground mining of the Arrow deposit would enable more focused mining of the target ore body (i.e., 350 m to 650 m in depth). With this mining method, Project surface disturbance would be reduced compared to an open pit method and include lower volumes of waste rock for handling and storage. The in situ material above the ore body would remain in place, and tailings could be stored in dedicated underground chambers (i.e., cells), created as an extension of underground mining operations.

A **screening-level assessment** for the primary mining method was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-1. Based on the screening-level assessment, the more preferred alternative was underground mining.

Table 4.5-1: Alternatives Assessment for Primary Mining Method

Assessment Category	Sub-category or Criteria	Alternative Options	
		Open Pit	Underground
Environmental	Surface area disturbance Potential effect on plant, fish, and other wildlife populations and habitat	▪ Larger surface disturbance associated with open pit development and additional waste rock and surface tailings storage ▪ Physical effect on lake habitat if pit extends into the lake	▪ Smaller surface disturbance ▪ Potential effects on biological receptors limited to mine infrastructure, and smaller WRSA ▪ Provides opportunity for tailings storage underground
	Potential effect on Patterson Lake	▪ Potential interaction with Patterson Lake in terms of pit extents near or extending into the lake	▪ Patterson Lake is buffered from underground development by larger extent of competent host rock
	Potential effect on surface water or groundwater	▪ Additional waste rock storage and tailings storage on surface could affect surface and groundwater quality	▪ Less waste rock storage on surface that could affect surface and groundwater; tailings storage underground would be confined in competent host rock
Technical	Design and reliability	▪ Open pit size and depth are regularly mined at other locations ▪ Potential challenges of interaction with lake if full depth of ore body is to be accessed; would require large dike, flow cut-off wall, or similar water management infrastructure to keep the open pit dry for mining	▪ Ore body depths are regularly mined at other underground operations ▪ No interaction with lake ▪ Conventional underground mine designs apply
	Construction risk and complexity	▪ Geomechanical issues with slope stability in upper 30 m due to unconsolidated ground ▪ Groundwater near surface would require dewatering wells ▪ Lower target ore body would require underground development to recover unless pit extends farther into the lake	▪ Limited interaction with poor ground and aquifers near surface ▪ Requires development of underground excavations for access and connections

Table 4.5-1: Alternatives Assessment for Primary Mining Method

Assessment Category	Sub-category or Criteria	Alternative Options	
		Open Pit	**Underground**
Technical	Operational risk and complexity	▪ Operation of large water management infrastructure required to keep lake water out, if large pit developed to access full depth of ore body ▪ Pit dewatering, and risk of infrastructure failure	▪ No interaction with lake ▪ Underground dewatering required, but lower volumes than pit dewatering
	Flexibility to develop new areas	▪ Limited ability to access adjacent mineralized areas without having to push back pit slopes (i.e., increase pit size) or to include underground mining for adjacent material	▪ Easier access to adjacent mineralized areas, laterally or with depth, that may be targeted in future
Economic	Operating cost	▪ Open pit development typically lower cost than underground; however, increased waste rock volumes from higher strip ratio would result in increased material handling costs ▪ Access to partial target ore body only, unless pit extends into the lake; underground development would be required to access full target ore body ▪ Reduced processing costs (i.e., more tonnes to process)	▪ Underground development involves low strip ratios, thus requiring substantially less handling of waste materials compared to open pit development ▪ Ability to access full target ore body
	Closure cost	▪ Larger Project footprint at surface to reclaim, including above-ground tailings storage and backfilled pit (or management of flooded pit)	▪ Majority of reclamation costs associated with closure of shafts ▪ Underground operations would be flooded, with management likely limited to water quality of seeps or discharge locations
Social	Change in land use	▪ At closure, the open pit would likely be flooded, or partially backfilled; the area would unlikely be returned to original land use	▪ At closure, underground access would be capped; the area would more likely be returned to original land use
	Worker safety and human health	▪ Open pit mines typically have less health and safety risks than underground operations; risks include poor weather and working around large heavy equipment. If a dike is constructed for water management, risks may also include working downgradient of a constructed embankment ▪ Potential radon exposure in the open pit is limited due to dispersion to the atmosphere	▪ Underground operations involve work in constrained spaces, with additional health and safety risks compared to open pit operations; additional risks can include poor ventilation, lighting, and limited egress points ▪ Potential radon exposure is managed through ventilation
Overall		**Less Preferred**	**More Preferred**

Legend: more preferred | less preferred

WRSA = waste rock storage area.

4.5.1.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for primary mining method for the Project was **underground** mining. Key considerations included:

- technical and economic feasibility of accessing the full extent of the target ore;
- ability to minimize surface disturbance and the overall Project footprint;
- significantly reduced water management quantity and complexity for surface and groundwater flows;
- avoiding the permanent storage of tailings on surface; and
- minimizing direct and indirect effects on Patterson Lake.

As discussed in Section 4.4.2.1, Indigenous Groups and local communities value minimal effects on the surface and on Patterson Lake, and through the JWGs have indicated a preference for underground mining for these reasons (CRDN-JWG 2020).

Underground mining would allow effective targeting of the ore body, which would reduce the amount of waste rock generated compared to an open pit operation. Underground mining also provides the opportunity to store mine waste underground as an extension to underground development (Section 4.5.6, Mine Waste Storage), further reducing the Project footprint at surface. Importantly, the underground mining option does not encroach on the Patterson Lake shoreline and does not require an extension (e.g., large dike) into the lake to access the target ore. While a combined open pit and underground operation is conceivable, the open pit portion alone would still be constrained by the challenges described above and would be considered uneconomic. As such, a combined open pit and underground operation was not considered as a separate feasible alternative.

4.5.2 Underground Mining Method

Similar to selection of the primary mining method (Section 4.5.1, Primary Mining Method), specific underground mining methods are typically chosen based on the shape and size of the ore body and how the ore is hosted in the deposit. These characteristics affect how targeted or selective mining can be, what combination and sequence of activities are involved, and how waste materials and voids (i.e., spaces created during mining) are managed.

As described in the Section 4.5.1, the Arrow deposit is near vertical and the target ore body is located between approximately 350 m and 650 m below ground surface. The deposit is relatively narrow, with the highest grade mineralization contained within the middle of the targeted range.

The potential underground mining methods range from bulk mining (i.e., unselective; low cost) to very targeted mining (i.e., highly selective mining; high cost). The choice of mining method is dictated by the deposit geometry and by considering the balance of ore dilution (i.e., how much waste rock is mixed in with ore) and ore recovery with the costs of a particular mining method. Three alternatives for underground mining method were considered:

- caving;
- long hole; and
- cut and fill.

Caving is an underground bulk mining method that is typically used to mine deep low-grade deposits where the target ore body is massive or disseminated (i.e., spread out) in all three dimensions. Caving is non-selective in nature (i.e., less control on how much waste rock is extracted with ore) and is associated with high dilution but has the potential to provide high and continuous production rates at relatively low cost. Caving relies on the fracturing of rock due to in situ stress changes, and on gravity to draw the fractured rock to collection points below. There are variations of caving methods, two of which are discussed here: block caving and sub-level caving. In block caving, the deposit is developed from the bottom up, with rock fracturing continually propagating upward as material is extracted from below. Drilling and blasting are either not required or minimally required. The result is a large void where the fractured rock was originally located; an area of subsidence can often develop at surface as material falls in on itself due to gravity and the void created below. Sub-level caving is another type of cave mining and is often used to mine ore bodies that are smaller in size or where more competent rock prevents the continuous caving that is required for the block caving method. With sub-level caving, mining typically progresses from higher elevations downward. This method requires blasting of the ore mass rather than using gravity alone to fracture the rock, and tends to be more selective than block caving.

The Arrow deposit is narrow and tall (i.e., not wide or massive) and is characterized by lenses of high-grade uranium mineralization. Development by block caving would result in high dilution and an inconsistent feed to the process plant due to the large amounts of non-target ore material that would have to be fractured to develop the caving. To facilitate continued mining activities with the caving method, backfilling of the mine workings would not be conducted during Operations. As such, additional storage volume is required for tailings that could otherwise be used as paste backfill with the alternative underground mining methods described below.

Long hole mining is a more selective but still highly productive mining method; it is considered the mid-range of mining methods in terms of dilution and recovery. As suggested by the name, the method involves the drilling of long holes (i.e., up to about 40 m) into the target ore body. An upper and a lower excavation are paired and advanced in parallel, such that when the holes drilled from the upper excavation are blasted, the fractured ore falls to the lower excavation, from where the material is removed. Long hole stoping provides flexibility to develop multiple sets of excavations simultaneously but also requires development of multiple access points along the width of the deposit and at different elevations.

The vertical orientation and consistent rock characteristics of the Arrow deposit lend themselves to long hole stoping. The mine would be developed vertically from bottom up and make use of paste backfill to support the walls of surrounding voids created by drilling and blasting of the ore body. This approach results in a relatively high amount (i.e., 80% to 85%) of the target ore not requiring engineering support (e.g., shotcrete, bolts), which reduces the cost per tonne compared to other approaches that require additional engineered support. Long hole mining activities involve a wide range of equipment that can be used for removal of fractured ore, and the configuration is such that worker exposure at the active mining face is limited.

Cut and fill mining is a highly selective underground mining method that is best suited for flatter or irregular deposits since the ore is mined in horizontal or slightly inclined slices. This method is often used for deposits that are shallower than approximately 50° (from the horizontal), where long hole stoping becomes less preferable or feasible. While cut and fill is more selective and typically less productive in terms of tonnes per shift, its advantage is reduced dilution and improved recovery. Cut and fill uses short holes to mine target areas and requires a large amount of underground development to provide access to the target areas. Each tonne of ore that is extracted requires engineered support (e.g., bolts and screen, shotcrete, concrete floors to reduce radiation exposure), after which mined areas are progressively backfilled. There are fewer opportunities for equipment automation and thus more frequent worker exposure to active mining areas.

The high cost per tonne and lower productivity of cut and fill mining relative to other methods considered makes it a less preferable method for the Arrow deposit. Due to the vertical geometry and consistent rock mass characteristics of the target mining areas, a bulk mining method would be more suitable.

A **screening-level assessment** for the underground mining method was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-2. Based on the screening-level assessment, the more preferred alternative was long hole stoping.

Table 4.5-2: Alternatives Assessment for Underground Mining Method

Assessment Category	Sub-category or Criteria	Alternative Options		
		Caving	Long Hole	Cut and Fill
Environmental	Surface area disturbance	▪ Potential for additional surface disturbance (subsidence, increased tailings storage volume due to no backfill during Operations)	▪ Lowest potential (i.e., underground voids are backfilled with tailings paste)	▪ Lower potential (i.e., underground voids are backfilled with tailings paste but would create more waste rock compared to long hole)
	Potential effect on surface water or groundwater	▪ Low use of explosives ▪ Increased underground surface area for potential exposure to groundwater	▪ Moderate use of explosives ▪ Lower underground surface area for potential exposure to groundwater	▪ Higher use of explosives ▪ Lower underground surface area for potential exposure to groundwater
Technical	Design and reliability	▪ Non-selective / high dilution ▪ Deposit has two relatively narrow veins (for caving purposes) separated by waste, not ideally suited to caving	▪ Selective/moderate dilution ▪ Vertical deposit geometry suitable for long hole stoping	▪ Most selective/low dilution (i.e., high recovery) ▪ Vertical deposit geometry less suitable for cut and fill mining
	Flexibility	▪ Caving is a bulk mining approach that targets a large area and does not provide flexibility to access adjacent areas without more overall development	▪ Long hole stoping provides flexibility to mine new areas from existing developments, if new resource areas are identified and targeted	▪ Cut and fill is very flexible; as a highly selective mining method, it can be used to access new areas of ore and is better suited to variability in the ore body over a short interval
Economic	Capital cost	▪ Additional costs associated with tailings storage facility (i.e., on surface or additional UGTMF chambers) ▪ Additional capital cost and time to develop draw points ahead of production	▪ Moderate cost	▪ Higher cost due to increased lateral development requirements and more equipment, increased ventilation controls
	Operating cost	▪ Typically very low operating cost ▪ High cost to recover uranium concentrate, as a lot of waste would be generated due to the geometry of the deposit	▪ Medium cost for recovered ore	▪ High cost for recovered ore due to more labour, more controls and ventilation, more underground support, and more equipment

Table 4.5-2: Alternatives Assessment for Underground Mining Method

Assessment Category	Sub-category or Criteria	Alternative Options		
		Caving	Long Hole	Cut and Fill
Social	Employment opportunities	▪ Low labour requirements in terms of workforce size	▪ Moderate labour requirements	▪ Higher labour requirements
	Worker safety and human health	▪ Worker exposure to active mining area is very limited; can be further reduced by use of automated equipment	▪ Worker exposure to active mining area is limited; can be further reduced by use of automated equipment	▪ Workers are exposed to active mining areas; the ability to use automated equipment is limited
Overall		**Less Preferred**	**More Preferred**	**Neutral**

Legend: more preferred | neutral | less preferred

WRSA = waste rock storage area.

4.5.2.1 *Selected Alternative*

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for underground mining method for the Project was **long hole** stoping. Key considerations included:

- suitability of long hole mining for the geometry of the target ore body (i.e., increased recovery); and
- flexibility to adapt to changes in the ore body targeting and mining new target areas.

As discussed in Section 4.4.2.1, Indigenous Groups and local communities value minimal effects on the surface and operating in a manner that is protective of workers. The long hole stoping option minimizes the potential for surface subsidence above the mined area that can result from caving, and allows tailings produced during processing of ore to be used as backfill during mining, partially offsetting the amount of tailings that would need to be stored elsewhere, including possibly on surface. In addition, the mining method tends to be safer than cut and fill as workers do not have to access the active mining area and thus have a lower risk exposure.

4.5.3 Process Plant Location

After the ore is extracted from the underground mine, it is processed in the process plant to become a marketable product (i.e., uranium concentrate). Two alternatives for process plant location were considered:

- on-site process plant; and
- off-site process plant.

An **on-site process plant** would involve the design, construction, and operation of a process plant at the Project site. It would be owned by NexGen and purpose-built to receive ore from the Arrow deposit at throughput rates that align with the proposed underground mining method. Tailings generated in the milling process would be stored at the Project based on the selected mine waste management alternative (Section 4.5.6), and the uranium concentrate would be packaged and transported from site in sealed drums. The relative advantages of ownership, certainty of processing capacity, and underground tailings storage potential would be offset by high capital and operating costs.

With the **off-site process plant** option, NexGen would utilize an existing process facility within the Athabasca Basin and rely on toll milling (i.e., paying a fee for using another company's process plant). Most of the existing uranium mining development is on the eastern side of Athabasca Basin, with the closest existing plant located near MacLean Lake, approximately 720 km from the Project by road. While an off-site process plant would be a viable option for projects on the east side of the basin, this option is less feasible for projects on the west side of the basin given the long distance that ore would need to be transported (i.e., trucked). For the Project, 1,300 tonnes per day of ore would need to be transported over this 720 km distance, requiring approximately 60 truck loads per day. In addition, appropriate storage for tailings would need to be identified off site or transported back to the Project site for disposal.

A **screening-level assessment** for the process plant location was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-3. Based on the screening-level assessment, the more preferred alternative was an on-site process plant.

Table 4.5-3: Alternatives Assessment for Process Plant Location

Assessment Category	Sub-category or Criteria	Alternative Options	
		On-Site Process Plant	Off-Site Process Plant
Environmental	Surface area disturbance	▪ Disturbance associated with process plant	▪ Pre-processing area may be required for Project site ▪ Potential incremental surface area for tailings management at off-site process plant
	Potential effect on surface water or groundwater	▪ Tailings stored on site under NexGen control, potential for underground storage ▪ Discharge of plant effluent could affect surrounding water quality	▪ Tailings stored at off-site location, likely on surface ▪ Potential effects as a result of accidents from increased traffic ▪ Potential to affect water quality at location of off-site process plant
	Interactions with wildlife	▪ Potential interactions managed alongside other Project infrastructure	▪ Increased potential for vehicle-wildlife interactions (injury, mortality) due to increased traffic
	Effects on air quality and GHG emissions	▪ Emissions from new on-site plant	▪ Emissions from off-site plant (i.e., possibly older technology) ▪ Higher GHG emissions and potential dust concerns related to increased trucking
Technical	Design and reliability	▪ NexGen ownership provides control over decisions, priorities, and timelines ▪ New process plant design required	▪ NexGen relies on toll milling contracts to provide certainty and reliability ▪ Existing plant, no facility design needed but production may be less
	Construction risk and complexity	▪ Construction required	▪ No or limited construction required at Project site ▪ Potential incremental processing and or tailings management construction at off-site process plant
	Closure risk and complexity	▪ Process plant buildings would need to be decommissioned	▪ No process plant buildings to be decommissioned at Project site ▪ Potential for incremental tailings management risk and complexity with additional processed waste streams
	Flexibility	▪ Plant design tailored to the Project ore feed ▪ Processed uranium concentrate can be stored on site for a few weeks if access or transport is disrupted	▪ Plant requirements are conceptually similar; potential reduction in recovery ▪ Some pre-processing of ore at Project site may be required; extended storage is not possible if access or transport are disrupted

Table 4.5-3: Alternatives Assessment for Process Plant Location

Assessment Category	Sub-category or Criteria	Alternative Options	
		On-Site Process Plant	Off-Site Process Plant
Economic	Capital cost	▪ High costs for construction of plant	▪ No capital costs for plant construction ▪ Road upgrades may be required
	Operating cost	▪ Costs for processing ▪ No ore transport costs and less risk of transport interruptions	▪ Costs for toll processing (including tailings management) ▪ High ore transport costs, assuming contract trucking, and risks of transport interruptions ▪ No control of uranium product quality (i.e., impurity penalties may be incurred)
Social	Visual/audio disturbance	▪ Processed material leaves site by truck (i.e., ~2 trucks per day)	▪ Increased truck traffic, with ore leaving site (i.e., ~60 trucks per day)
	Employment opportunities	▪ Direct employment by NexGen at on-site plant	▪ Employment through contract trucking ▪ Potential for incremental employment at off-site process plant
	Worker safety and human health	▪ No added risks associated with increased traffic for ore transport ▪ Risk of radiation exposure related to process plant buildings at site	▪ Safety risks for public due to increased traffic for ore transport to off-site process plant ▪ Safety risks for drivers transporting ore to off-site process plant ▪ Reduced risk of radiation exposure at site since no process plant buildings on site
Overall		**More Preferred**	**Less Preferred**

Legend: more preferred | neutral | less preferred

GHG = greenhouse gas.

4.5.3.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for the Project was an **on-site process plant**. In particular, this alternative selection was influenced by the ability to control the design process and store tailings underground, and by the removal of the requirement for high-volume, long-distance ore transport, which would result in increased carbon emissions.

4.5.4 Process Stripping Method

In the process plant, uranium ore undergoes a series of processes to transform it into a marketable product, uranium concentrate. Uranium ore processing typically involves a physical process where the ore is crushed and ground into smaller pieces and then a leaching solution is used to dissolve uranium from the host rock. The leached solution undergoes chemical processes to separate the uranium from the other dissolved minerals. One of these chemical processes is stripping, which involves using weak alkaline or strong acidic solutions followed by precipitation to separate uranium from the stripping solution in the solvent extraction circuit. The two alternatives considered for stripping method were:

- ammonia stripping, followed by ammonium diuranate precipitation; and
- strong acid stripping, followed by uranium peroxide precipitation.

Ammonia stripping involves adding ammonia as a stripping reagent in the process plant solvent extraction circuit. As a result of the ammonia addition, ammonium ultimately leaves the system through the process plant calciner stack (i.e., vertical exhaust pipe) as a gas in the form of nitrogen oxides. Un-ionized ammonia is listed as a deleterious substance under the Metal and Diamond Mining Effluent Regulations (SOR/2002-222 under the *Fisheries Act*), and achieving discharge limits for un-ionized ammonia in effluent would be required. Achieving these limits would require use of a crystallizer (driven by steam) in the process plant to recover ammonium sulphate as a solid by-product, which could then be marketed as a fertilizer for farming. The remaining ammonium in the liquid condensate (i.e., liquid by-product remaining once solid ammonium sulphate is recovered) from the crystallization circuit would report to the ETP. In terms of the ammonium that reports to the calciner stack, a scrubber would be installed, which would reduce, but not eliminate, the associated nitrogen oxides air emissions.

Ammonia gas is typically used as the ammonia source for ammonia stripping and requires special handling during transport and in the process plant due to its gaseous state, potential fire hazard, and potential toxicity as nitrogen oxides and sulphur dioxide gas.

The product from ammonia stripping is soluble in an acidic condition (i.e., low pH), but the calcined processing product downstream from ammonia stripping has low solubility in human lung fluid, so if inhaled, it can build up in human systems. Additional mitigations and controls would be required to minimize airborne dust exposure to the calcined product.

The use of ammonia in the precipitation circuit (at a pH level of 7 to 8 after the stripping process) can also affect product purity, with increased presence of undesirable constituents such as molybdenum in the finished uranium product, which could warrant the addition of a specialized removal circuit. Sulphur entrainment as sulphate in solution must be controlled by adequate precipitate washing prior to calcination.

Strong acid stripping, as suggested by the name, uses a strong acid (i.e., has a pH range of 0 to 1) as the stripping agent in the process plant solvent extraction circuit. With this approach, there are no ammonia considerations and fewer sulphur considerations related to effluent quality air emissions and handling safety. Another advantage of strong acid stripping, followed by use of uranium peroxide precipitation at pH 3 to 4, is that it avoids co-precipitation of impurities such as molybdenum. However, the strong acid strip solution requires neutralization using lime prior to uranium peroxide precipitation, which produces large volumes of gypsum (i.e., calcium sulphate) as a by-product that requires management. The lime itself is transported and handled in solid form and presents a low risk to the health and safety of the workers and the public. Gypsum storage would require consideration as part of the mine waste storage alternatives assessment (Section 4.5.6.3, Gypsum).

The low temperature dried product from strong acid stripping is uranium peroxide precipitate, which is more soluble in lung fluid and is processed by the human body relatively quickly as compared to high temperature calcined product.

The strong acid stripping followed by uranium peroxide precipitation method produces a high-quality final product that does not require additional treatment for removal of impurities.

A **screening-level assessment** for the stripping method was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-4. Based on the screening-level assessment, the more preferred alternative was strong acid stripping.

Table 4.5-4: Alternatives Assessment for Process Stripping Method

Assessment Category	Sub-category or Criteria	Alternative Options	
		Ammonia Stripping	Strong Acid Stripping
Environmental	Potential to affect Patterson Lake, surface water, or groundwater	▪ Ammonia or ammonium hydroxide is added to the process and ultimately some of the ammonia reports to the effluent	▪ No ammonia in effluent from the precipitation process

Table 4.5-4: Alternatives Assessment for Process Stripping Method

Assessment Category	Sub-category or Criteria	Alternative Options	
		Ammonia Stripping	**Strong Acid Stripping**
	Effects on air quality	▪ Ammonia reports to the calciner stack and produces nitrogen oxides and sulphur dioxide air emissions; partially mitigated by a scrubber	▪ The strong acid does not contribute to nitrogen oxides emissions
Technical	Design and reliability	▪ Successfully used in plants operating in the Athabasca Basin (e.g., Key Lake, McLean Lake)	▪ Successfully used in plants operating in the Athabasca Basin (e.g., Rabbit Lake)
	Operating risk and complexity	▪ Relatively more complex to operate solvent extraction, including crystallizer	▪ Operation is relatively simple, including neutralization via pH management
Economic	Capital cost	▪ Requires an additional circuit involving a crystallization plant to remove ammonium sulphate	▪ Gypsum is produced as a by-product but does not require additional equipment to manage ▪ Purer final product does not require additional treatment ▪ Increase tailings management cost for underground storage
	Operating cost – general	▪ Low cost for operation. ▪ High cost of steam (i.e., crystallization plant)	▪ Strong acid strip has higher operating costs
	Operating cost – waste management	▪ Costs to ship ammonium sulphate (i.e., low value by-product) to market, assuming revenue does not offset associated cost ▪ Potential for ammonium sulphate as a marketable by-product	▪ Neutralizing step using lime; produces large volumes of gypsum that need to be managed and disposed of ▪ Potential for gypsum as a marketable by-product
Social	Worker safety and human health	▪ Ammonia requires special handling during transport and in the process plant ▪ Higher potential for worker exposure to sulphur dioxide within the process plant	▪ Less radiological and sulphur dioxide risks for workers
Overall		**Less Preferred**	**More Preferred**

Legend: more preferred | neutral | less preferred

4.5.4.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for stripping method for the Project was **strong acid stripping**. This alternative selection was influenced by expected effluent quality (i.e., no ammonia in effluent), easier management of waste and by-products, and handling requirements for reagents. Overall, it was determined that strong acid stripping would provide better environmental performance for the process plant and reduce health and safety concerns for the Project.

4.5.5 Final Product Type

The product from processing is a uranium compound (referred to as uranium concentrate) that can be marketed and sold, including sales to companies that then refine and enrich the product further for use as nuclear fuel. The characteristics of the final product depend on the degree to which it has been purified, refined, or enriched. Two of the more common products that were considered as alterative options for the Project were:

- $UO_2.nH_2O$ (uranium peroxide); and

- U_3O_8 (triuranium octoxide).

Uranium peroxide is a coarse yellow powder that is often referred to as "yellowcake", and is produced by drying at temperatures between 200°C and 250°C. It is considered an intermediary product and is typically and ultimately transformed into U_3O_8 in a further refinement step. While further refinement is required, there is only one refinery in Canada (i.e., in Port Hope, Ontario) that can receive $UO_2.nH_2O$ as an input. Uranium peroxide is water soluble, which complicates handling and spill management; however, this water solubility is an advantage from a human health standpoint as it flushes from the human system more easily.

Triuranium octoxide is dark green to black in colour and is sometimes referred to as "gunpowder". The term "yellowcake" is also used interchangeably with this product despite the colour differences between U_3O_8 and $UO_2.nH_2O$. This product, U_3O_8, is saleable on international scales. Production requires a calcining step at 800°C, and results in a stable product that is insoluble in water. Its stability and insolubility are advantageous in terms of handling, and those characteristics make environmental management easier while reducing logistics complexity and costs.

A **screening-level assessment** related to the type of final product produced at the processing plant was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-5. Based on the screening-level assessment, the more preferred alternative was U_3O_8.

Table 4.5-5: Alternatives Assessment for Final Product Type

Assessment Category	Sub-category or Criteria	Alternative Options	
		$UO_2.nH_2O$	U_3O_8
Environmental	Potential to affect Patterson Lake, surface water, or groundwater	▪ $UO_2.nH_2O$ is water soluble and thus has a higher potential to affect waterbodies as a result of spills or on-site management	▪ U_3O_8 is not water soluble and thus more stable; materials management and spill mitigation and clean-up are easier, and potential to affect waterbodies is lower
	Increased GHG emissions	▪ Product has lower uranium content, which results in higher volumes leaving site and additional transportation costs	▪ Product has higher uranium content, which results in smaller volumes and lower off-site transportation needs
Technical	Design and reliability; capital, operational, closure risk and complexity	▪ Similar equipment and process ▪ Low temperature drying	▪ Similar equipment and process ▪ High temperature calcining
	Flexibility	▪ $UO_2.nH_2O$ is typically further transformed to U_3O_8 prior to refinement ▪ There is only one existing refinery in Canada that can receive $UO_2.nH_2O$ directly	▪ U_3O_8 is a common product on the international market ▪ There are multiple existing refineries in Canada that can receive U_3O_8
Economic	Capital and operating costs	▪ Lower costs for drying at lower operating temperatures	▪ Slightly higher costs associated with calciner and higher operating temperatures that require more fuel
Social	Public perception	▪ Local Indigenous communities have expressed a negative impression of $UO_2.nH_2O$ from experience related to the decommissioned Cluff Lake Mine and spill management/response	▪ U_3O_8 is not soluble in water, and would allow more effective spill management (i.e., confinement and recovery) relative to $UO_2.nH_2O$
	Worker safety and human health	▪ $UO_2.nH_2O$ is water soluble and thus passes through a person's system easier than U_3O_8 if there is an exposure	▪ U_3O_8 is not soluble in water and thus the risk of exposure is generally reduced; however, if exposed, U_3O_8 does not pass through a person's system as easily as $UO_2.nH_2O$
Overall		**Less Preferred**	**More Preferred**

Legend:	more preferred	neutral	less preferred

$UO_2.nH_2O$ = uranium peroxide; U_3O_8 = triuranium octoxide; GHG = greenhouse gas.

4.5.5.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for final product type for the Project was **U_3O_8**. This selection was influenced by higher quality effluent (i.e., no ammonia in effluent), the easier management of waste and by-products, and simpler handling requirements for reagents, and the concerns expressed by the community regarding possible environmental and health effects from potential spills of yellowcake ($UO_2.nH_2O$) during transport.

4.5.6 Mine Waste Storage

Mine waste generated by the proposed Project would include tailings, gypsum, and waste rock. Each mine waste type was evaluated separately and in combination (i.e., tailings with waste rock [co-disposal], gypsum with tailings, gypsum with waste rock) to determine the preferred storage alternative (i.e., location and technology). Mine waste storage alternatives were evaluated in the order of priority for location, with tailings having first priority followed by gypsum and then waste rock. This prioritization was informed by recognizing that tailings typically represent the greatest potential risk for long-term management and have the greatest potential for constraining integrated management approaches when considering other mine and process waste products (i.e., gypsum and waste rock). Gypsum was selected as the second priority recognizing the selected alternative for this mine waste could potentially influence the total volume of waste rock that required management.

An **MAA assessment** was conducted for each mine waste type by completing the steps listed in Table 4.5-6. Typically, only the last step (i.e., an MAA) would be completed as part of an alternatives assessment; however, a more robust process was undertaken for the Project in recognition of the importance of an integrated assessment for mine waste alternatives. The process was as follows:

- pre-screening for general location (i.e., tailings, gypsum, waste rock);
- screening for specific locations (i.e., tailings, gypsum) and MAA for specific locations (i.e., waste rock);
- screening for technologies (i.e., tailings); and
- MAA of alternative options remaining after screening, where each alternative includes a location and technology.

Table 4.5-6: Overview of Mine Waste Storage Alternatives Assessment Steps

Stage	Tailings	Gypsum	Waste Rock
Pre-screening for general location	▪ Descriptive comparison ▪ Relative evaluation for advantages/disadvantages		
Screening for specific locations	▪ Descriptive comparison ▪ Relative evaluation for advantages/disadvantages		▪ MAA
Screening for technology	▪ Descriptive comparison ▪ Relative evaluation for advantages/disadvantages	▪ n/a	▪ n/a
Alternatives assessment	▪ MAA		

MAA = multiple accounts analysis; n/a = not applicable.

Pre-screening for general location was performed to evaluate each mine waste type for storage at five general locations: underground; in-pit; surface off-site; surface on-site; and in-lake. The in-pit location would require excavation of a new dedicated pit since the open pit mining method was screened out for the Project (Section 4.5.1). Relative advantages and disadvantages for each general location were evaluated by pre-screening against the following criteria (termed “indicators” in Technical Support Document [TSD] VII, Mine Waste Alternatives Assessment Report):

- *No mine waste in lakes:* NexGen’s criterion that no mine waste should be placed in lakes was adopted. As discussed in Section 4.4.2.1, this recognizes feedback NexGen received during local public and Indigenous community engagement. NexGen’s approach is also supported by regulatory policies that discourage in-lake disposal (Metal and Diamond Mining Effluent Regulations; CNSC 2018).
- *Area of effect:* A location with the smallest area of effect was preferred.
- *Has required storage capacity:* A location with capacity to store the full quantity of mine waste was required to pass pre-screening.
- *Quantity of waste rock generated:* A location with the smallest quantity of waste rock generated was preferred.

Screening for specific locations (i.e., tailings, gypsum) was performed for alternatives remaining after the pre-screening process to evaluate storage locations unique to both mine waste types. An **MAA for specific locations (i.e., waste rock)** was performed to incorporate additional quantitative considerations into the waste rock storage location evaluation.

Screening for technology (i.e., tailings) was performed for alternatives remaining after the location screening process to evaluate technologies unique to tailings. Gypsum was not screened for technology and was considered as a solid form for storage on surface, and as part of the cemented paste tailings (CPT) for storage underground. Waste rock was not screened for technology as waste rock technologies were incorporated into the MAA of waste rock alternatives carried forward from screening.

For screening for locations and technology, relative advantages and disadvantages for each location were evaluated using criteria within the environmental, technical, economic, and social categories (termed ‘accounts’ in TSD VII).

4.5.6.1 Alternatives Assessment by Multiple Accounts Analysis Overview

Multiple accounts analysis for mine waste storage (i.e., tailings, gypsum, waste rock) were performed to quantitatively evaluate alternatives carried forward from screening. Assessment included a location and technology for the storage of each mine waste type using criteria within the environmental, technical, economic, and social categories. Individual criteria were assigned a value between 1 and 6, with the lowest value of 1 indicating the least favourable criteria and the highest value of 6 indicating the most favourable criteria. Weighting of categories, sub-categories (termed “sub-accounts” in TSD VII), and criteria was applied to purposefully reflect the relative importance of each category and criterion, including the importance of feedback from Indigenous Groups, the local public, and other stakeholders, as well as existing regulatory guidance. Scoring and weighting of alternatives followed Environment and Climate Change Canada (ECCC) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (ECCC 2016). Alternatives were then ranked with the highest overall weighted score ranked 1, the next highest score ranked 2, and so on. A sensitivity analysis was completed by varying category weighting to evaluate the effect of potential bias introduced by weighting. Category weighting cases used in the sensitivity analysis are summarized in Table 4.5-7.

Table 4.5-7: Category Weighting Cases Used in Mine Waste Storage Sensitivity Analysis

Category	Category Weighting Cases							
	Base Case		NexGen		Equal		Economic = 0	
	Value	Percent	Value	Percent	Value	Percent	Value	Percent
Environmental	6	44.4%	4.1	30%	3.4	25%	6	50%
Technical	3	22.2%	2.0	15%	3.4	25%	3	25%
Economic	1.5	11.1%	3.4	25%	3.4	25%	0	0%
Social	3	22.2%	4.1	30%	3.4	25%	3	25%
Total	**13.5**	**100%**	**13.5**	**100%**	**13.5**	**100%**	**12**	**100%**

Note: Values may not sum due to rounding.

The following subsections summarize the alternatives assessments that were conducted for tailings, gypsum, and waste rock storage. Results from the pre-screening and screening steps are discussed, including the combination of alternatives carried forward for evaluation in the MAAs. Final rankings from the MAAs, for the four different category sensitivity weighting cases, are also provided. Additional information on the mine waste storage alternatives assessment can be found in TSD VII.

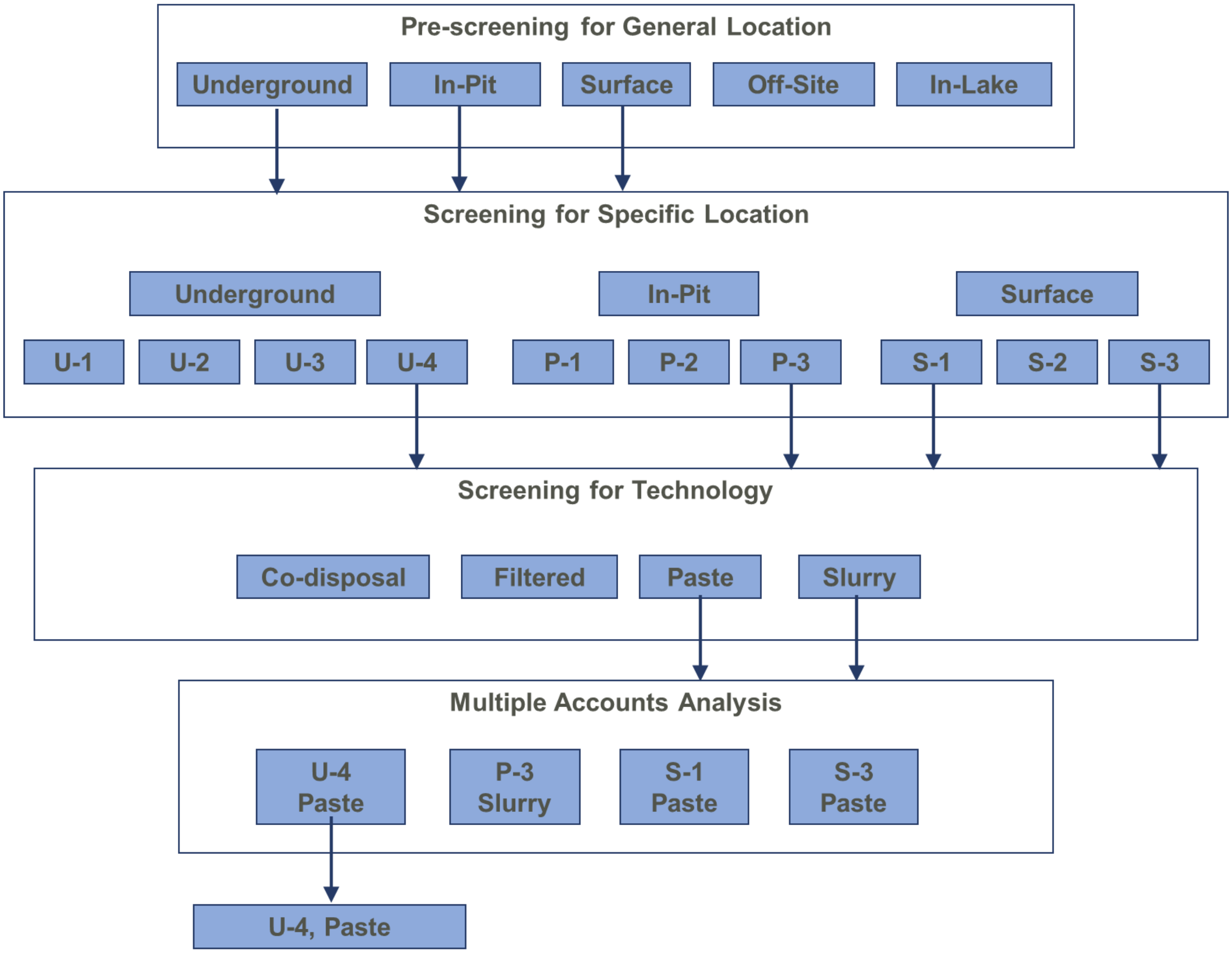
4.5.6.2 Tailings

Tailings would be generated by the processing of uranium ore for the proposed Project, and would be a combination of neutralized leach residue, ETP residuals (Section 4.5.12, Effluent Treatment Technology), and gypsum.

The tailings **MAA assessment** (Figure 4.5-3) included the following:

- pre-screening for five general locations (i.e., underground, in-pit, surface, off-site, in-lake);
- screening for 10 specific locations (i.e., four underground, three in-pit, three surface);
- screening for four technologies at four specific locations (i.e., 16 combinations); and
- MAA of remaining options following pre-screening, considering location and technology, and including completion of a sensitivity analysis to evaluate the potential effect of bias.

Figure 4.5-3: Overview of Tailings Mine Waste Storage Alternatives Assessment Methods and Outcomes

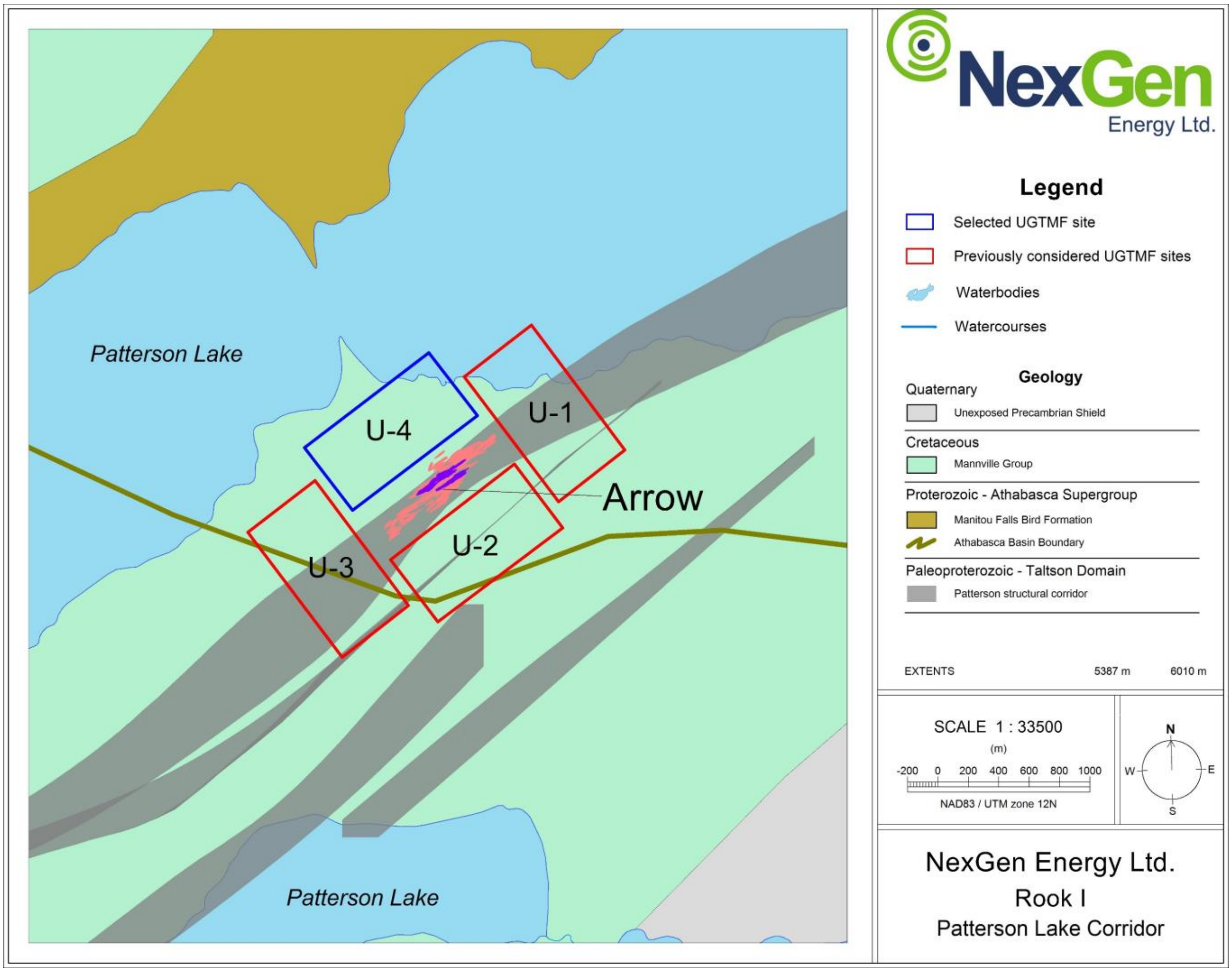


Pre-screening for general location was conducted for five general locations: underground, in-pit, surface (on-site), off-site, and in-lake. Two general locations were eliminated during pre-screening: in-lake and off-site. The storage of tailings in-lake was eliminated based on the criterion to not place waste in lakes. The storage of tailings at an off-site general location was eliminated due to the increase in overall surface disturbance outside of the proposed maximum disturbance area and potential for additional health, safety and environmental effects and financial liability associated with an off-site location that is not owned and operated by NexGen.

Three locations were carried forward to screening for specific location: underground, in-pit, and surface (on-site).

Screening for specific location was conducted for four underground locations (Figure 4.5-4), three in-pit locations (Figure 4.5-5), and three surface (on-site) locations (Figure 4.5-6). Relative advantages and disadvantages for each of the ten locations were evaluated by screening against criteria within the environmental, technical, economic, and social categories.

Figure 4.5-4: Locations for Underground Storage of Tailings Considered during Screening for Specific Location

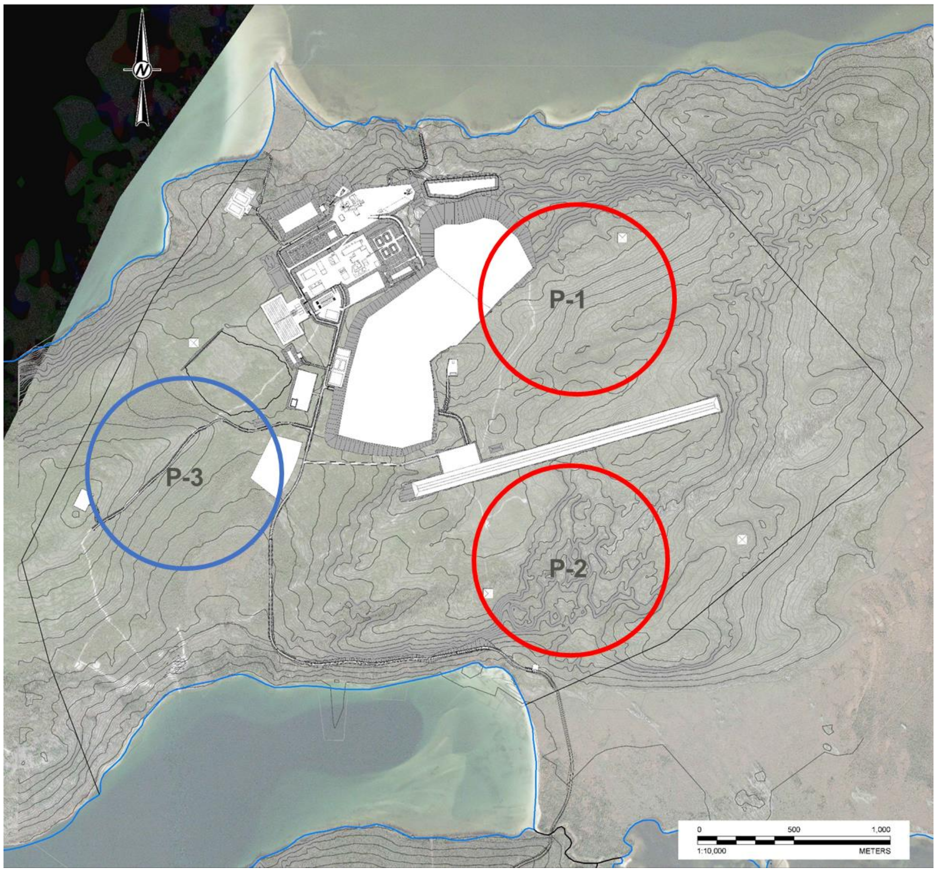


UGTMF = underground tailings management facility.

Underground locations. Of the four considered locations (i.e., U-1 through U-4), three specific locations for underground storage of tailings (i.e., U-1, U-2, and U-3) did not pass screening based on relative disadvantages for sub-categories within the technical category. Underground locations U-1, U-2, and U-3 are in areas of potential uranium mineralization (i.e., areas that would generate mine rock that is mineralized but not economic and require additional management considerations), and U-1 and U-3 are located within the Patterson Lake structural corridor characterized by fault and shear zones (i.e., areas with less favourable geotechnical and groundwater conditions).

One specific underground location, U-4, was carried forward to screening for technology; U-4 is located outside of known major geologic structures and potential areas of mineralization.

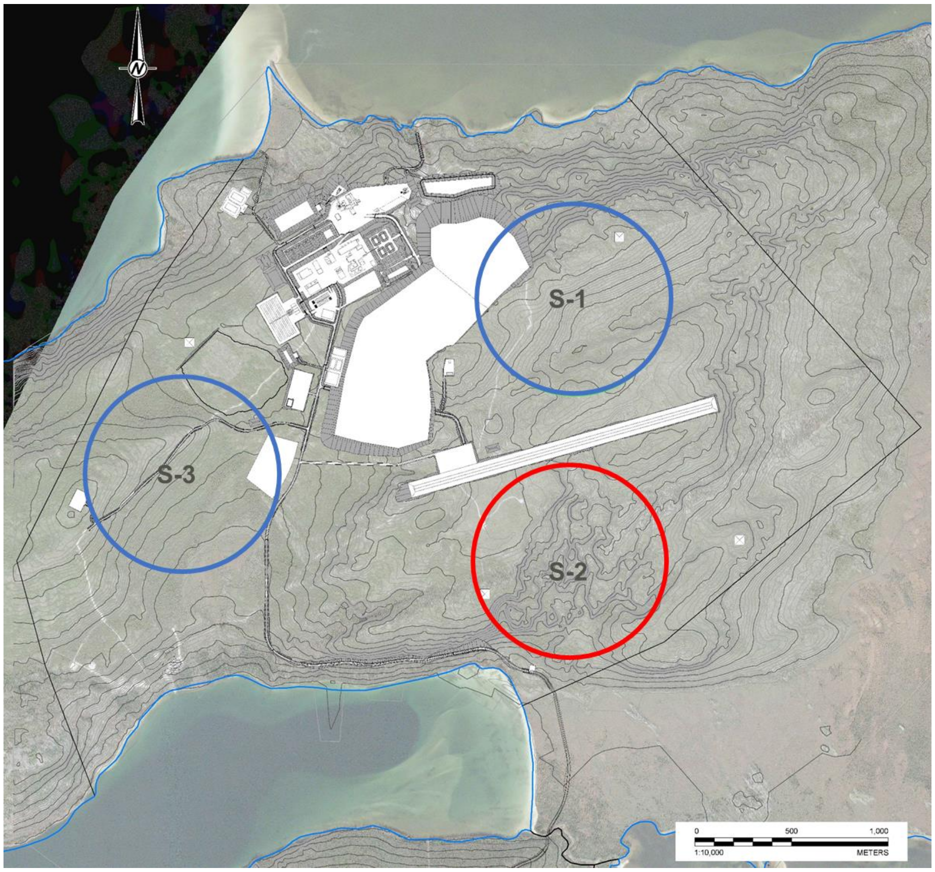
Figure 4.5-5: Locations for In-Pit Storage of Tailings Considered during Screening for Specific Location



In-pit location. Of the three specific open pit locations considered for in-pit storage of tailings (P-1 through P-3), two locations (i.e., P-1 and P-2) did not pass screening based on relative disadvantages for sub-categories within the environmental, technical, economic, and social categories. In-pit location P-1 is within a valley where surface water controls would be required to manage runoff from the surrounding area and additional excavation into the surrounding area would be required for pit development and future expansion, which would generate higher material quantities for handling and management. In-pit location P-2 is within the Patterson Lake structural corridor characterized by fault and shear zones that may host uranium, is nearest to Patterson Lake, and is the most visible location due to a natural topographic plateau. Location P-2 also would have the greatest area of effect and cost, and higher risk to worker safety and human health due to the longest haul and tailings transport distance from the mine terrace.

One specific in-pit location, P-3, was carried forward to screening for technology. Location P-3 is situated within a relatively flat topographic area that does not restrict storage capacity or potential facility expansion. This location has a median haul and transport distance from the mine terrace.

Figure 4.5-6: Locations for Surface Storage of Tailings Considered during Screening for Specific Location



Surface location. Of the three surface specific locations for tailings storage (i.e., S-1, S-2, and S-3), one location (i.e., S-2) did not pass screening based on relative disadvantages for sub-categories within the environmental, technical, economic, and social categories. Surface location S-2 is within the Patterson Lake structural corridor, is nearest to Patterson Lake, is the most visible location, and has the least natural containment due to a topographic plateau. Location S-2 also has the greatest area of potential environmental effect, greatest cost, and higher risk to worker safety and human health due to the longest haul and tailings transport distance from the mine terrace.

Two specific surface locations were carried forward to screening for technology: S-1 and S-3. The surface location S-1 is located within a topographic valley with the greatest potential for natural containment, and potential cost and operating efficiency due to the use of planned access and infrastructure with the shortest haul and transport from the mine terrace. Location S-3 is situated within a relatively flat topographic area that does not restrict storage capacity and has some potential for cost and operating efficiency due to the use of planned access and infrastructure, though S-3 is located farther from the process plant than S-1.

Screening for technology was conducted for four tailings technologies at the specific locations that passed screening: underground location U-4, in-pit location P-3, and surface locations S-1 and S-3. The four tailings technologies considered were co-disposal (i.e., tailings and waste rock), filtered (required to support a "dry stack" construction method), paste, and slurry. The considered technologies would generate different tailings solids contents with filtered being the highest (i.e., greater than 70% solids), followed by paste (i.e., 50% to 70% solids) and slurry (30% to 50% solids). Filtered tailings would require hauling and compaction for placement, while paste and slurry would be flowable, pumpable products. In this assessment, co-disposal of tailings with waste rock considered paste tailings technology (i.e., pumpable product at 50% to 70% solids).

Underground technology. Three technologies for underground tailings storage at specific location U-4 (i.e., co-disposal, filtered, and slurry) did not pass screening based on relative disadvantages for sub-categories within the environmental, technical, economic, and social categories. Co-disposal technology was determined to be not feasible due to volume incompatibility, where the excavation of underground chambers to store tailings and waste rock would generate more excavated rock to be stored underground. Filtered technology was determined to be not feasible due to potential worker exposure to gamma radiation through contact with the tailings and potential dust ingestion during tailings transport and placement. Additionally, unconsolidated filtered tailings have a higher hydraulic conductivity and can swell once saturated, potentially affecting geochemical stability. Slurry technology did not pass screening as slurry tailings consolidation and consistency are uncontrolled and there is a higher potential for ecological effects due to the permeability of tailings and open voids that may form during construction. Additionally, there is limited precedent application for placement of slurry tailings underground.

One technology, paste, at underground location U-4 was carried forward to the overall MAA. There is a proven precedent for the application of paste technology in underground tailings deposition and cementing the tailings in underground chambers reduces the potential for effects on the environment.

In-pit technology. Three technologies for in-pit tailings storage at specific location P-3 (i.e., co-disposal, filtered, and paste) did not pass screening based on relative disadvantages for sub-categories within the environmental, technical, economic, and social categories. Co-disposal technology was not considered feasible due to volume incompatibility, where the excavation of a pit to store tailings and waste rock would generate more excavated rock to be stored in-pit. Filtered technology was not considered feasible due to potential worker exposure to gamma radiation through contact with the tailings and dust ingestion during tailings transport, placement, and compaction. Paste technology did not pass screening as there is a higher potential for fugitive dust emission and worker exposure to gamma radiation through contact with the tailings and absence of a supernatant pond (i.e., in developing paste tailings, water would be separated from the tailings, and a pond would not form overtop of the tailings resulting in higher potential dust generation from the exposed paste tailings). Additionally, paste tailings has the highest cost due to construction, operation, and decommissioning of a paste plant, and facility closure may be complicated by the presence of ice lenses that could form during tailings deposition.

One technology, slurry, at in-pit location P-3 was carried forward to the overall MAA. There is a proven precedent for the application of tailings as slurry for storage in-pit at other uranium mines. This option would include the development of a supernatant water pond that would form as the slurry tailings consolidate (i.e., separate into solids and water); the presence of a supernatant pond reduces the potential for fugitive dust emission and worker exposure to gamma radiation and mitigates the formation of ice lenses within the tailings.

Surface technology. Three technologies for surface tailings storage at specific locations S-1 and S-3 (i.e., co-disposal, filtered, and slurry) did not pass screening based on relative disadvantages for sub-categories within the environmental, technical, economic, and social categories. Co-disposal and filtered technologies were determined to be not feasible due to potential worker exposure to gamma radiation through contact with the tailings and dust ingestion during tailings transport, placement, and compaction (filtered only). Slurry technology did not pass screening as it has the highest water content and potential for seepage, resulting in a higher cost for water management. Additionally, the supernatant pond would not meet the Global Industry

Standard on Tailings Management (GISTM) requirement to minimize the volume of tailings and water placed in external tailings facilities (GTR 2020).

One technology, paste, at surface locations S-1 and S-3 was carried forward to the overall MAA. Paste has a lower potential for seepage, lower water management cost, and meets the requirement for new tailings facilities to minimize the volume of tailings and water placed in external tailings facilities under the GISTM (GTR 2020).

Based on the pre-screening for location and technology, an **MAA** was conducted for four alternatives (Figure 4.5-3):

- underground with paste at location U-4;
- in-pit with slurry at location P-3;
- surface with paste at location S-1; and
- surface with paste at location S-3.

These four alternatives were assessed using the categories, sub-categories, and set of criteria indicated in Table 4.5-8 and as described in Section 4.5.6.1, Alternatives Assessment by Multiple Accounts Analysis Overview, with additional information provided in TSD VII. The selection of sub-categories and criteria, and descriptions of potential effects, focus on the main aspects that differentiate the alternative options and are not intended to be exhaustive. Similar to the other alternatives assessments, the MAA included environmental, technical, economic, and social categories.

Underground location U-4 with paste technology. Would require excavating underground chambers, hauling excavated rock to the surface, and construction of a paste plant and tailings transport system. Tailings would be thickened, and cement added prior to placing in underground chambers. Chambers would be progressively decommissioned during Operations.

In-pit location P-3 with slurry technology. Would require excavating a pit, hauling excavated overburden and rock to the surface, and construction of tailings transport and surface water management systems. Tailings slurry would be thickened prior to deposition in-pit to reduce the water content of the tailings. The supernatant pond would be drained during Closure.

Surface location S-1 with paste technology. Would require earthwork for construction of a single containment structure utilizing some topographic containment, progressive raises during facility operation, and construction of a paste plant and tailings transport system. Tailings paste would be placed in the containment structure.

Surface location S-3 with paste technology. Would require a greater amount of earthworks for cellular containment structures as no natural topographic containment would be available, progressive raises during facility operation, and construction of a paste plant and tailings transport system. Tailings paste would be placed in the cellular containment structures.

Table 4.5-8: Tailings Assessment Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Environmental	Ecological integrity	6	Surface area of disturbance	1
			Potential effect on plant, fish, and other wildlife population and habitat during construction, operation, and closure	1
	Hydrologic regime	1	Surface water – potential for contact water management	3
			Surface water – potential for non-contact water management	1
			Groundwater – potential for effect	1
	Air quality	1	Potential for excessive emissions of fugitive dust (e.g., particulates, heavy metals) and other non-GHG emissions during construction and operation	1
Technical	Design and reliability	6	Facility design effort	1
	Construction risk and complexity	2	Geotechnical stability[(a)] considering foundation conditions and waste placement	1
	Operational risk and complexity	3	Operation and maintenance for transport and disposal system	3
			Water balance and management during seasonal changes	1
			Potential for progressive facility closure during operation	1
			Potential for radon mitigation	1
			GISTM requirement of new tailings facilities to minimize the volume of tailings and water placed in external tailings facilities	6
	Closure risk and complexity	1	Ease of decommissioning	1
			Resistance to extreme natural events (flood, earthquake) and climate change	1
	Flexibility	2	Effort required for expansion, optimization, and design changes	1
Economic	Capital cost	4	Facility construction and centralization	1
			Water treatment plant for surface runoff	1
			Paste plant	1
	Operating cost	2	Transport and placement of tailings, including energy, diesel, labour	1
			Requirement for tailings binder, flocculant, or other additives	1
			Water treatment	1
	Closure cost	1	Facility closure	1
			Water treatment	3
Social	Community effect	1	Visual disturbance for an observer	1
			Change in local employment opportunities	1
	Change in land use	1	Potential for loss of access and current land use	1
	Population at risk	1	Physical risk to people downstream	1
			Worker safety and human health during construction, operation, and closure	1

a) Geotechnical stability includes geotechnical stability of the excavated caverns under the underground alternative, the excavated pit walls under the in-pit alternative, and the containment structure under each of the surface alternatives considered in the assessment.
GISTM = Global Industry Standard on Tailings Management (GTR 2020).

Results of the assessment for tailings storage are summarized in Table 4.5-9. The placement of tailings as CPT in the underground was the highest scoring and is considered the more preferred alternative for tailings management.

Table 4.5-9: Alternatives Assessment for Mine Waste Storage of Tailings

Assessment Category	Sub-category or Criteria	Alternative Options			
		Underground with Paste at Location U-4	In-Pit with slurry at Location P-3	Surface with Paste at Location S-1	Surface with Paste at Location S-3
Environmental	Ecological integrity	▪ Least surface disturbance area but located closest to Patterson Lake[1]	▪ Smaller surface disturbance area and intermediate potential to affect the environment	▪ Greatest surface disturbance area but located farthest from Patterson Lake	▪ Intermediate surface disturbance area and potential to affect the environment
	Hydrologic regime	▪ Least potential to require surface water management ▪ Least potential for groundwater effect with CPT	▪ Intermediate potential to require surface water management ▪ Intermediate potential for groundwater effect with slurry	▪ Greater potential to require surface water management ▪ Greatest potential for groundwater effect with paste stored on surface	▪ Greatest potential to require surface water management ▪ Greatest potential for groundwater effect with paste stored on surface
	Air quality	▪ Greater potential to generate fugitive dust during facility construction due to haulage and on-surface placement of excavated waste rock ▪ Greater potential to generate fugitive dust during operation due to water separation from tailings to form paste and absence of supernatant pond overtop of the tailings	▪ Greatest potential to generate fugitive dust during facility construction due to haulage and on-surface placement of excavated waste rock ▪ Least potential to generate fugitive dust during operation due to presence of supernatant pond formed overtop of the tailings	▪ Least potential to generate fugitive dust during facility construction due to construction of a single containment structure ▪ Greater potential to generate fugitive dust during operation due to water separation from tailings to form paste and absence of supernatant pond overtop of the tailings	▪ Intermediate potential to generate dust during facility construction due to construction of a cellular containment structure rather than a single containment structure ▪ Greater potential to generate fugitive dust during operation due to water separation from tailings to form paste and absence of supernatant pond overtop of the tailings

[1] As noted in TSD VII, Mine Waste Alternatives Assessment Report, the distance to Patterson Lake was adopted as an intuitive and easily quantifiable indicator for the ecological integrity sub-account. However, if a more complex indicator was used that also considered gradients and hydraulic conductivities, it is expected that the underground option would score higher in the ecological integrity sub-category compared to alternatives that store the tailings on surface.

Table 4.5-9: Alternatives Assessment for Mine Waste Storage of Tailings

Assessment Category	Sub-category or Criteria	Alternative Options			
		Underground with Paste at Location U-4	In-Pit with slurry at Location P-3	Surface with Paste at Location S-1	Surface with Paste at Location S-3
Technical	Design and reliability	▪ Intermediate design complexity due to blasting, excavating, and hauling rock to surface	▪ Greatest design complexity due to blasting, pit wall stability, tailings transport, and water management	▪ Least design complexity	▪ Least design complexity
	Construction risk and complexity	▪ Greater construction complexity than surface storage alternatives due to quantity of earthwork	▪ Greatest construction complexity due to quantity of earthwork	▪ Least construction complexity for a single containment structure	▪ Greater construction complexity for a cellular containment structure than a single containment structure
	Operational risk and complexity	▪ Least operational complexity due to shortest tailings transport distance and least surface disturbance area ▪ Greatest potential for progressive facility closure ▪ Intermediate potential for radon mitigation	▪ Intermediate operational complexity due to greatest tailings transport distance and intermediate surface disturbance area ▪ Least potential for progressive facility closure ▪ Greatest potential for radon mitigation due to water cover	▪ Greater operational complexity due to greater tailings transport distance and greatest surface disturbance area ▪ Intermediate potential for progressive facility closure ▪ Least potential for radon mitigation with no water cover	▪ Greatest operational complexity due to greater tailings transport distance and surface disturbance area ▪ Intermediate potential for progressive facility closure ▪ Least potential for radon mitigation with no water cover
	Closure risk and complexity	▪ Least closure complexity due to ease of decommissioning ▪ Greatest resistance to post-closure extreme events such as flood or earthquake	▪ Intermediate closure complexity due to pond dewatering, tailings consolidation, and cover placement ▪ Intermediate resistance to post-closure extreme events such as flood or earthquake	▪ Greatest closure complexity due to potential formation of ice lenses, tailings consolidation, and cover placement ▪ Least resistance to post-closure extreme events such as flood or earthquake	▪ Greatest closure complexity due to potential formation of ice lenses, tailings consolidation, and cover placement ▪ Least resistance to post-closure extreme events such as flood or earthquake
	Flexibility	▪ Greatest flexibility due to modular design where expansion is by additional chamber excavation	▪ Least flexibility due to containment where expansion is by excavation	▪ Intermediate flexibility due to single containment structure where expansion is by structure raise	▪ Greater flexibility due to cellular containment structure where expansion is by additional cell or structure raise

Table 4.5-9: Alternatives Assessment for Mine Waste Storage of Tailings

Assessment Category	Sub-category or Criteria	Alternative Options			
		Underground with Paste at Location U-4	In-Pit with slurry at Location P-3	Surface with Paste at Location S-1	Surface with Paste at Location S-3
Economic	Capital cost	▪ Higher capital cost than surface storage alternatives due to the greater earthwork quantity for facility construction ▪ No surface water treatment requirement	▪ Highest capital cost due to greatest earthwork quantity for facility construction ▪ No paste plant requirement	▪ Lowest capital cost due to least earthwork quantity for a single containment structure facility construction	▪ Higher capital cost due to greater earthwork quantity for a cellular containment structure than a single containment structure
	Operating cost	▪ Lowest operating cost due to shortest tailings transport distance ▪ No surface water treatment required ▪ Cement and flocculant required	▪ Intermediate operating cost due to longest tailings transport distance and water treatment ▪ No cement or flocculant requirement	▪ Intermediate operating cost due to long tailings transport distance and water treatment ▪ Flocculant required	▪ Highest operating cost due to longer tailings transport distance and water treatment ▪ Flocculant required
	Closure cost	▪ Lowest closure cost for decommissioning and water treatment	▪ Intermediate closure cost for pond dewatering, cover placement, and water treatment	▪ Highest closure cost for potential thawing of ice lenses, cover placement, and water treatment	▪ Highest closure cost for potential thawing of ice lenses, cover placement, and water treatment
Social	Community effect	▪ Least visual surface disturbance area	▪ Less visual surface disturbance area than surface storage alternatives	▪ Greatest visual surface disturbance area	▪ Greater visual surface disturbance area
	Change in land use	▪ Least potential for loss of access to current land use	▪ Greatest potential for loss of access to current land use	▪ Intermediate potential for loss of access to current land use	▪ Intermediate potential for loss of access to current land use
	Population at risk	▪ Least physical risk to people downstream ▪ Greater risk to worker safety and human health due to quantity of earthwork	▪ Lower physical risk to people downstream ▪ Greatest risk to worker safety and human health due to quantity of earthwork	▪ Greatest physical risk to people downstream ▪ Least risk to worker safety and human health due to least quantity of earthwork	▪ Greater physical risk to people downstream ▪ Greater risk to worker safety and human health due to greater earthwork quantity for a cellular containment structure than a single containment structure
Overall		**More Preferred**	**Less Preferred**	**Less Preferred**	**Neutral**

Legend: more preferred | neutral | less preferred

CPT = cemented paste tailings.

A sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weightings; this approach aligns with ECCC's guidelines for mine waste MAAs (ECCC 2016). Results of the sensitivity analysis are presented in Table 4.5-10 using the sensitivity weighting cases shown in Table 4.5-7. Account merit ratings shown are the quantitative rankings of alternative options; additional details can be found in TSD VII.

The first-place ranking (i.e., tailings placed as CPT in underground location U-4) remained the same for all sensitivity cases, which indicates that changing weighting categories (i.e., introduction of bias) does not change the outcome.

Table 4.5-10: Tailings Assessment Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	Tailings Alternative Rank			
		Underground Location U-4, Paste Technology	In-Pit Location P-3, Slurry Technology	Surface Location S-1, Paste Technology	Surface Location S-3, Paste Technology
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	1 [4.1]	4 [3.3]	3 [3.5]	2 [3.7]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	1 [4.1]	4 [3.1]	3 [3.3]	2 [3.5]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	1 [4.1]	4 [2.9]	3 [3.5]	2 [3.6]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	1 [4.1]	4 [3.4]	3 [3.5]	2 [3.8]

Legend: more preferred | less preferred

[ ] = account merit rating.

4.5.6.2.1 Selected Alternative

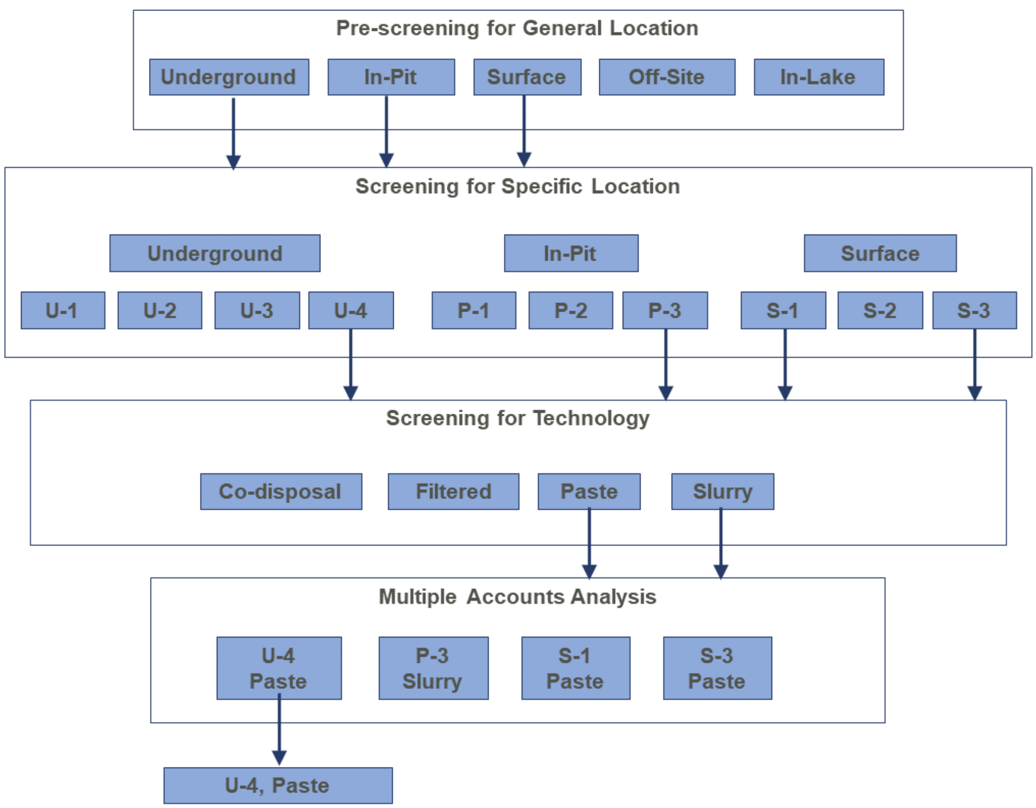
Aligned with the tailings assessment summary (Table 4.5-9) and the sensitivity analysis (Table 4.5-10), the selected alternative for mine waste storage of tailings for the Project was **underground with paste at location U-4**. As discussed in Section 4.4.2.1, Indigenous Groups and local communities generally have a negative perception of the surface storage of uranium tailings and value backfilling tailings underground where possible as a means of minimizing potential effects on the surface and Patterson Lake. This option, which is outside of known geologic structures and mineralized deposits, avoids the need for a surface storage facility. In addition, placement underground has precedent for the controlled deposition of CPT and meets the best practice for new tailings facilities to minimize the volume of tailings and water placed in external tailings facilities under the GISTM (GTR 2020).

4.5.6.3 Gypsum

Gypsum would be generated by the processing of uranium ore for the proposed Project. The gypsum **MAA assessment** (Figure 4.5-7) included the following:

- pre-screening for five general locations;
- screening for four specific locations (two underground, two surface); and
- MAA of remaining options following pre-screening, considering location and paired technology, and including completion of a sensitivity analysis to evaluate the potential effect of bias.

Figure 4.5-7: Overview of Gypsum Mine Waste Storage Alternatives Assessment Methods and Outcomes



Pre-screening for general location was conducted for five general locations: underground, in-pit, surface (on-site), off-site, and in-lake. The in-pit, off-site, and in-lake general locations were eliminated during pre-screening. In-pit storage of gypsum was eliminated based on the increase in surface disturbance due to the quantity of overburden and waste rock excavated for the pit that would need to be stored on the surface. The storage of gypsum at an off-site general location was eliminated due to the increase in overall surface disturbance outside of the proposed maximum disturbance area and potential for environmental contamination and liability associated with an off-site location that is not owned and operated by NexGen. In-lake storage of gypsum was eliminated based on NexGen's criterion to not place waste in lakes. Two locations were carried forward to screening for specific locations: underground and surface (on-site).

Screening for specific location was conducted for two specific underground locations, with the tailings in the underground tailings management facility (UGTMF) or in a purpose-built facility, and for two specific surface locations, with the waste rock in a WRSA or in a purpose-built facility.

A purpose-built facility for both the underground and surface storage of gypsum did not pass screening. The storage of gypsum only in a separate, purpose-built facility has a greater potential for environmental effects, greater surface disturbance due to haulage and placement of excavated rock at surface, increased complexity associated with the design and operation of additional facilities, and increased cost relative to storage of gypsum in combination with the tailings or waste rock.

Based on the pre-screening for location, with associated paired technology, an **MAA** was conducted for two alternatives**:**

- placement of gypsum with the tailings in the UGTMF; and
- placement of gypsum with the waste rock in a WRSA.

These two alternatives were assessed using the set of criteria, sub-categories, and categories indicated in Table 4.5-11 and as described in Section 4.5.6.1, with additional information provided in TSD VII. The selection of sub-categories and criteria, and descriptions of potential effects, focus on the main aspects that differentiate the alternative options and are not intended to be exhaustive. Similar to the other alternatives assessments, the MAA included environmental, technical, economic, and social categories.

Underground with tailings in UGTMF. Would require incrementally excavating underground chambers, hauling excavated rock to the surface, and construction of the planned UGTMF, access, and associated water management systems. Gypsum would be included with the tailings stream and would have a potential advantage of reducing the cement binder requirement for CPT. Chambers would be progressively decommissioned during Operations.

Surface with waste rock in WRSA. Would require a single containment structure with incremental increases in size of the planned WRSA, access, and associated water management systems. Gypsum would be cleaned prior to hauling and placing at the WRSA.

Table 4.5-11: Gypsum Assessment Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Environmental	Ecological integrity	6	Potential effect on plant, fish, and other wildlife population and habitat during construction, operation, and closure	1
	Hydrologic regime	1	Surface water – potential for contact water management	1
	Air quality	1	Potential for excessive emissions of fugitive dust (e.g., particulates, heavy metals) and other non-GHG emissions during construction and operation	1
Technical	Design and reliability	3	Facility design effort	1
			Proven precedent for technology and configuration	6
	Construction risk and complexity	1	Geotechnical stability considering foundation conditions and waste placement	1
	Flexibility	1	Effort required for expansion, optimization, and design changes	1
Economic	Capital cost	2	Facility construction and centralization	1
	Operating cost	1	Transport and placement of gypsum, including energy, diesel, labour	1
			Requirement for tailings binder, flocculant, or other additives	1
Social	Population at risk	1	Worker safety and human health during construction, operation, and closure	1

GHG = greenhouse gas.

Results of the assessment for gypsum storage are summarized in Table 4.5-12. The placement of gypsum underground with CPT in the UGTMF was the highest scoring and was considered the more preferred alternative for gypsum management.

Table 4.5-12: Alternatives Assessment for Mine Waste Storage of Gypsum

Assessment Category	Sub-category or Criteria	Alternative Options	
		Underground with Tailings in UGTMF	Surface with Waste Rock in WRSA
Environmental	Ecological integrity	▪ Lower potential for gypsum to affect Patterson Lake with underground placement	▪ Greater potential for gypsum to affect Patterson Lake with surface haulage and placement
	Hydrologic regime	▪ Lower potential to require surface water management with incremental increase in excavated material hauled to surface	▪ Greater potential to require surface water management
	Air quality	▪ Greater potential to generate fugitive dust from waste rock due to haulage and on-surface placement of waste rock excavated to accommodate gypsum storage	▪ Lower potential to generate fugitive dust from waste rock due to no additional waste rock quantity hauled to surface (i.e., no additional waste rock from underground to create space to store gypsum)
Technical	Design and reliability	▪ Lower design complexity due to incremental increase in UGTMF chambers and use of UGTMF transport system	▪ Greater design complexity due to gypsum removal from tailings stream, haulage from plant to WRSA, and placement to avoid segregation
	Construction risk and complexity	▪ Lower construction complexity with a proven precedent for placement of gypsum with tailings	▪ Greater construction complexity due to management of placement to avoid segregation ▪ Not a common storage alternative
	Flexibility	▪ Lower flexibility and more effort for expansion	▪ Greater flexibility and less effort for expansion

Table 4.5-12: Alternatives Assessment for Mine Waste Storage of Gypsum

Assessment Category	Sub-category or Criteria	Alternative Options	
		Underground with Tailings in UGTMF	Surface with Waste Rock in WRSA
Economic	Capital cost	▪ Higher capital cost due to greater additional waste rock quantity hauled to surface to accommodate gypsum storage	▪ Lower capital cost due to no additional waste rock quantity hauled to surface
	Operating cost	▪ Lower operating cost due to potential use of planned tailings transport system for gypsum transport ▪ Gypsum may be used to reduce the binder requirement in CPT	▪ Higher operating cost due to the requirement to separate gypsum from tailings, clean gypsum, load, haul, and place
Social	Population at risk	▪ Greater risk to worker safety and human health due to haulage and placement of waste rock on surface, excavated to accommodate gypsum storage	▪ Lower risk to worker safety and human health due to no additional waste rock quantity hauled to surface (i.e., no additional waste rock from underground to create space to store gypsum)
Overall		**More Preferred**	**Less Preferred**

Legend: more preferred | less preferred

UGTMF = underground tailings management facility; WRSA = waste rock storage area; CPT = cemented paste tailings.

A sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. Results of the sensitivity analysis are presented in Table 4.5-13 using the sensitivity weighting cases shown in Table 4.5-7. Account merit ratings shown are the quantitative rankings of alternative options; additional details can be found in TSD VII.

The first-place ranking (i.e., gypsum placed with tailings in the UGTMF) remained the same for all sensitivity scenarios except when considering the NexGen weighting case, where the economic and social categories have a higher weighting, indicating that category weighting (i.e., introduction of bias) does change the outcome. The change in rank was investigated and found to be due, in part, to the limited number of differentiating indicators in the social category such that the use of 1 and 6 for indicator scoring changes the overall score.

Table 4.5-13: Gypsum Assessment Sensitivity Analysis Summary

Category Weighting Case	Category Weight	Gypsum Alternative Rank	
		With Tailings in UGTMF	With Waste Rock in WRSA
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	1 [4.0]	2 [3.0]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	2 [3.3]	1 [3.7]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	1 [3.51[a]]	2 [3.49[a]]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	1 [4.2]	2 [2.8]

Legend: more preferred | less preferred

a) Account merit rating shown to additional significant figure so values are not presented as equivalent due to rounding.
[ ] = Account merit rating; UGTMF = underground tailings management facility; WRSA = waste rock storage area.

4.5.6.3.1 Selected Alternative

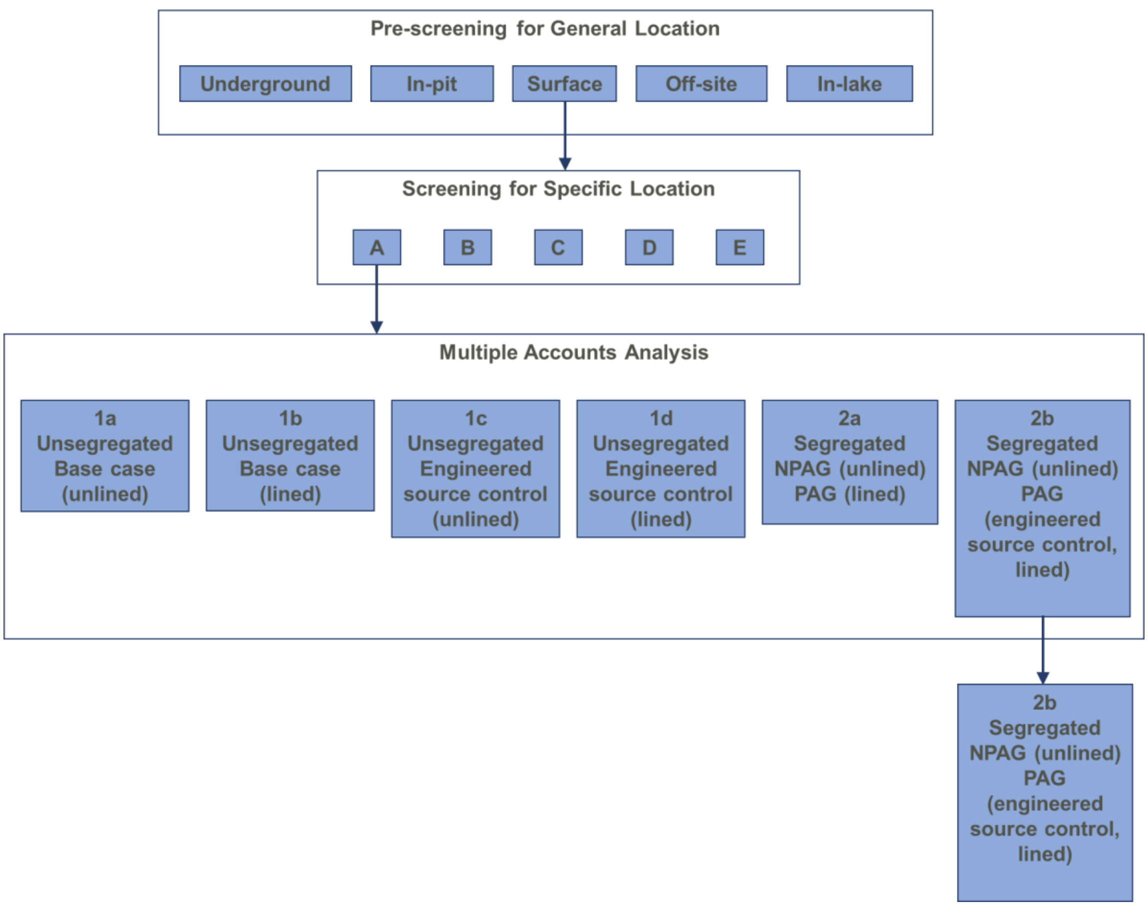
Aligned with the gypsum assessment summary (Table 4.5-12) and with the majority of cases in the sensitivity analysis (Table 4.5-13), the selected alternative for mine waste storage of gypsum for the Project was **underground with tailings in UGTMF**. This option has the advantages of lower operational complexity and the potential for gypsum to reduce the binder requirement in the CPT. Storage of gypsum with waste rock in the WRSA would require separation and cleaning of the gypsum, and engineered placement in the WRSA to avoid potential instability related to dissolution of gypsum. The storage of gypsum with the tailings stream has precedent at other uranium mines in Saskatchewan and is considered standard practice.

4.5.6.4 Waste Rock

Waste rock would be generated by excavating underground mine areas, UGTMF chambers, and underground access development. The waste rock **MAA assessment** (Figure 4.5-8) included the following:

- pre-screening for five general locations;
- screening for five specific locations (five surface) by MAA; and
- MAA of remaining options following pre-screening, considering location and technology, and including completion of a sensitivity analysis to evaluate the potential effect of bias.

Figure 4.5-8: Overview of Waste Rock Mine Waste Storage Alternatives Assessment Methods and Outcomes

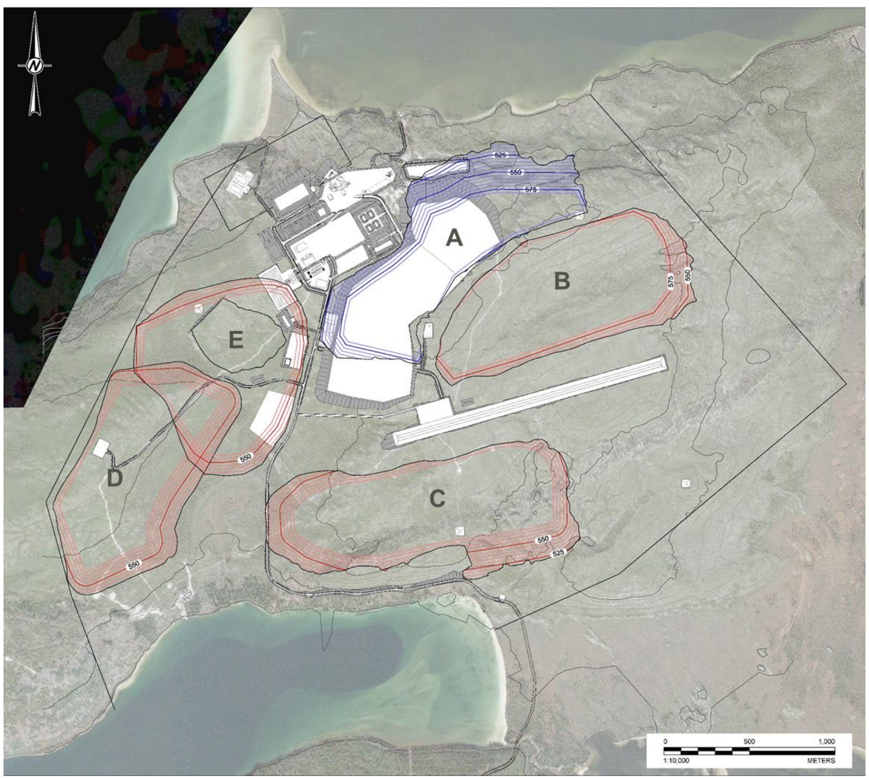


PAG = potentially acid generating; NPAG = non-potentially acid generating.

Pre-screening for general location was conducted for five general locations: underground, in-pit, surface (on-site), off-site, and in-lake. Underground, in-pit, off-site, and in-lake general locations were eliminated during pre-screening. The storage of waste rock underground and in pit were not considered feasible due to volume incompatibility, where excavating an underground facility or pit to store waste rock would generate more rock than could be backfilled due to material bulking and there would be no additional capacity to store additional waste in the underground facility or pit. The storage of waste rock at an off-site general location was eliminated due to the increase in overall surface disturbance outside of the proposed maximum disturbance area and potential for environmental contamination and liability associated with an off-site location that is not owned by NexGen. The storage of waste rock in lake was eliminated based on NexGen's criterion to not place waste in lakes. One general location was carried forward to screening for specific locations: surface (on-site).

Screening for specific location by MAA was conducted to incorporate additional quantitative considerations for five surface locations (Figure 4.5-9): A, B, C, D, and E.

Figure 4.5-9: Specific Locations for Surface Storage of Waste Rock Considered for Screening



The five specific on-site storage locations were assessed using the categories, sub-categories, and set of criteria indicated in Table 4.5-14 and as described in Section 4.5.6.1, with additional information provided in TSD VII. The selection of sub-categories and criteria, and descriptions of potential effects, focused on the main aspects that differentiate the alternative options and was not intended to be exhaustive. Similar to the other alternatives assessments, the MAA included environmental, technical, economic, and social categories.

Location A. Would require hauling waste rock from the mine terrace and placement at a location southeast and adjacent to the mine and mill terraces.

Location B. Would require hauling waste rock from the mine terrace and placement at a location southeast of the mine and mill terraces, north of and adjacent to the airstrip.

Location C. Would require hauling waste rock from the mine terrace and placement at a location south of the airstrip.

Location D. Would require hauling waste rock from the mine terrace and placement at a location southwest of the mine and mill terraces.

Location E. Would require hauling waste rock from the mine terrace and placement at a location southwest of and adjacent to the mine and mill terraces.

Table 4.5-14: Waste Rock Location Screening Assessment Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Environmental	Ecological integrity	6	Surface area of effect	1
			Potential for effect on plant, fish, and other wildlife population and habitat during construction, operation, and closure	1
	Hydrologic regime	1	Surface water – potential for contact water management	3
		1	Groundwater – potential for contact water management	1
	Air quality	1	Potential for excessive emissions of fugitive dust (e.g., particulates, heavy metals) and other non-GHG emissions during construction and operation	1
Technical	Operational risk and complexity	1	Operation and maintenance for transport and disposal system	1
			Water balance and management during seasonal changes	1
Economic	Operating cost	2	Transport and placement	1
			Energy use for transport – diesel (haul)	1
			Water use	1
	Closure cost	1	Facility closure	1
Social	Population at risk	1	Worker safety and human health during construction, operation, and closure	1

GHG = greenhouse gas.

Results of the waste rock location screening assessment by MAA are summarized in Table 4.5-15. The placement of waste rock at location A was the highest scoring and is considered the more preferred location. Location A was carried forward to the alternatives assessment as this location had the greatest ability to manage contact water and the shortest distance from the mine terrace with the least potential for dust emissions and worker exposure due to transport during construction, access, and waste rock haulage. The relative advantages of location A being closer to the Project main facilities, keeping the overall Project footprint smaller, and not needing to build a road to access a storage area located farther away, was also identified by the Buffalo River Dene Nation during the JWGs (BRDN-JWG 2021).

The remaining four specific locations for surface storage of waste rock were either neutral (i.e., B and E) or less preferred (i.e., C and D) options based on relative disadvantages for sub-categories within the environmental, technical, economic, and social categories. Surface locations B and E had intermediate haul distances and associated costs for transport and operational maintenance. Surface locations C and D had longer haul distances and increased associated costs for transport and operational maintenance, and greater risk to worker safety and human health resulting from the longer transport distance between the mine terrace and WRSA. Location C was also less preferred due to its relative proximity to Patterson Lake and the airstrip.

Table 4.5-15: Screening Assessment for Waste Rock Location

Assessment Category	Sub-category or Criteria	Location Options A	B	C	D	E
Environmental	Ecological integrity	▪ Intermediate potential to affect the environment, with lower surface disturbance area and intermediate distance to Patterson Lake	▪ Least potential to affect the environment, with intermediate surface disturbance area and longest distance to Patterson Lake	▪ Greatest potential to affect the environment, with greatest surface disturbance area and shortest distance to Patterson Lake	▪ Greater potential to affect the environment, with intermediate surface disturbance area and distance to Patterson Lake	▪ Lower potential to affect the environment, with least surface disturbance area and intermediate distance to Patterson Lake
	Hydrologic regime	▪ Least potential to affect the hydrologic regime, with greatest setback from infrastructure, wetland areas, and Patterson Lake ▪ Shallow gradient beyond facility toe	▪ Intermediate potential to affect the hydrologic regime, with intermediate setback from infrastructure, wetland areas, and Patterson Lake ▪ Intermediate gradient beyond facility toe	▪ Greatest potential to affect the hydrologic regime, with least setback from infrastructure, wetland areas, and Patterson Lake ▪ Steep gradient beyond facility toe	▪ Greatest potential to affect the hydrologic regime, with least setback from infrastructure, wetland areas, and Patterson Lake ▪ Steep gradient beyond facility toe	▪ Greatest potential to affect the hydrologic regime, with least setback from infrastructure, wetland areas, and Patterson Lake ▪ Steep gradient beyond facility toe
	Air quality	▪ Least potential for emissions of fugitive dust and other non-GHG emissions with shortest haul distance	▪ Intermediate potential for emissions of fugitive dust and other non-GHG emissions with intermediate haul distance	▪ Greater potential for emissions of fugitive dust and other non-GHG emissions with longer haul distance	▪ Greatest potential for emissions of fugitive dust and other non-GHG emissions with longest haul distance	▪ Lesser potential for emissions of fugitive dust and other non-GHG emissions with shorter haul distance
Technical	Operational risk and complexity	▪ Lower operational complexity due to shortest haul distance	▪ Least operational complexity due to intermediate haul distance and longest distance to Patterson Lake	▪ Greatest operational complexity due to longer haul distance and shortest distance to Patterson Lake	▪ Greater operational complexity due to longest haul distance and intermediate distance to Patterson Lake	▪ Intermediate operational complexity due to shorter haul distance and intermediate distance to Patterson Lake
Economic	Operating cost	▪ Lower operating cost due to shortest haul distance	▪ Intermediate operating cost due to intermediate haul distance	▪ Higher operating cost due to longer haul distance and intermediate elevation change	▪ Highest operating cost due to longest haul distance	▪ Lowest operating cost due to shorter haul distance and least elevation change
	Closure cost	▪ Lower closure cost for cover placement	▪ Intermediate closure cost for cover placement	▪ Highest closure cost for cover placement	▪ Higher closure cost for cover placement	▪ Lowest closure cost for cover placement
Social	Population at risk	▪ Least potential risk to worker safety and human health due to shortest haul distance	▪ Intermediate potential risk to worker safety and human health due to intermediate haul distance	▪ Greater potential risk to worker safety and human health due to greater haul distance	▪ Greatest potential risk to worker safety and human health due to greatest haul distance	▪ Lesser potential risk to worker safety and human health due to shorter haul distance
Overall		**More Preferred**	**Neutral**	**Less Preferred**	**Less Preferred**	**Neutral**

Legend: more preferred | neutral | less preferred

GHG = greenhouse gas.

It is noted that the specific location A that was carried forward to the alternatives assessment (shown in blue in Figure 4.5-9) does not exactly align with the proposed Project layout associated with the EIS (shown in white in Figure 4.5-9). This variation, including the reduced footprint area and increased setback from Patterson Lake, was driven by the iterative nature of the design as engineering for the Project progressed, and does not alter the results of the specific location screening presented herein.

A sensitivity analysis was not completed for the screening-level assessment by MAA for waste rock location.

An **MAA** was conducted for six alternative technologies at surface location A, using the set of criteria, sub-categories, and categories indicated in Table 4.5-16 and as described in Section 4.5.6.1. The selection of sub-categories and criteria, and descriptions of potential effects, focused on the main aspects that differentiate the alternative options and was not intended to be exhaustive. Similar to the other alternatives assessments, the MAA included environmental, technical, economic, and social categories.

Alternative options were defined based on the foundation lining, use of engineered source control layers, and material segregation. Foundation lining considered both lined and unlined. The presence and absence of engineered source control layers were also considered. Source control layers are layers of lower permeability material to control air and water flow through a waste rock pile and reduce potential for material acidification. Material segregation was considered as both segregated and unsegregated, with segregation being based on waste rock being either potentially acid generating (PAG; material with less than 0.03% U_3O_8 and greater than or equal to 0.1% sulphur), or non-potentially acid generating (NPAG; clean material with less than 0.03% U_3O_8 and less than 0.1% sulphur). The alternative options considered were:

Unsegregated, base case, unlined (Option 1a). Would require incremental hauling and placing of waste rock in a single, unsegregated facility during construction, operation, and closure of the facility.

Unsegregated, base case, lined (Option 1b). Would require installing a liner and incremental hauling and placing of waste rock in a single, unsegregated facility during construction, operation, and closure of the facility.

Unsegregated, engineered source control, unlined (Option 1c). Would require incremental hauling and placing of waste rock in lifts at a single, unsegregated facility with alternating lifts of engineered source control material during construction, operation, and closure of the facility.

Unsegregated, engineered source control, lined (Option 1d). Would require installing a liner and incremental hauling and placing of waste rock in lifts as a single, unsegregated facility with alternating lifts of engineered source control material during construction, operation, and closure of the facility.

Segregated, NPAG (unlined), and PAG (lined) (Option 2a). Would require installing a liner and incremental segregating, hauling, and placing of PAG waste rock in a segregated facility during construction and operation; incremental segregating, hauling, and placing of NPAG waste rock in a separate facility during construction and operation; and closure of both the PAG and NPAG facilities.

Segregated, NPAG (unlined), and PAG (engineered source control, lined) (Option 2b). Would require installing a liner and incremental segregating, hauling, and placing of PAG waste rock in a segregated facility with alternating lifts of engineered source control material during construction and operation; incremental segregating, hauling, and placing of NPAG waste rock in a separate facility during construction and operation; and closure of both the PAG and NPAG facilities.

Table 4.5-16: Waste Rock Assessment Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Environmental	Ecological integrity	6	Surface area of disturbance, borrow for engineered layers	1
			Potential effect on Patterson Lake during Operations	2
			Potential effect on Patterson Lake during Closure	6
	Air quality	1	Potential for excessive emissions of fugitive dust (e.g., particulates, heavy metals) and other non-GHG emissions during construction and operation	1
Technical	Design and reliability	6	Facility design effort	1
			Proven precedent for technology and configuration	6
			Compliance with SERM's *Draft Guidelines for Pollution Control Facilities at Uranium Mining and Milling Operations*	4
			Difference in mass (engineered layers)	1
	Construction risk and complexity	2	Liner area	1
			Water management infrastructure (number of systems to be constructed)	1
	Operational risk and complexity	3	Operation and maintenance for transport and disposal system	1
			Water balance and management during seasonal changes	1
			Potential for progressive facility closure during operation	1
	Closure risk and complexity	1	Ease of decommissioning; number of facilities	1
	Flexibility	2	Effort required for expansion, optimization, and design changes	1
Economic	Capital cost	4	Liner procurement and installation	1
	Operating cost	2	Water treatment (capture by lined alternatives)	1
			Engineered layers	2
	Closure cost	1	Facility closure	1
			Water treatment	1
Social	Community effect	1	Change in local employment opportunities	1
	Change in land use	1	Local resource consumption as borrow source(s) for construction	1
	Population at risk	1	Health risk to people downstream	1
			Worker safety and human health during construction, operation, and closure	1

GHG = greenhouse gas; SERM = Saskatchewan Environment and Resource Management.

Results of the assessment for waste rock storage are summarized in Table 4.5-17. The segregated, unlined NPAG facility and lined PAG with engineered source control facility (Option 2b) was the highest scoring and is the more preferred alternative for waste rock management.

Table 4.5-17: Alternatives Assessment for Mine Waste Storage of Waste Rock

Assessment Category	Sub-category or Criteria	Alternative Options					
		Unsegregated, Base Case, Unlined (1a)	Unsegregated, Base Case, Lined (1b)	Unsegregated, Engineered Source Control, Unlined (1c)	Unsegregated, Engineered Source Control, Lined (1d)	Segregated, NPAG (Unlined), PAG (Lined; 2a)	Segregated, NPAG (Unlined), PAG (Engineered Source Control, Lined; 2b)
Environmental	Ecological integrity	▪ No borrow source required for engineered source control ▪ Greatest potential to affect Patterson Lake during Operations and Closure	▪ No borrow source required for engineered source control ▪ Least potential to affect Patterson Lake during Operations ▪ Greatest potential to affect Patterson Lake during Closure	▪ Borrow source required for engineered source control ▪ Greatest potential to affect Patterson Lake during Operations ▪ Least potential to affect Patterson Lake during Closure	▪ Borrow source required for engineered source control ▪ Least potential to affect Patterson Lake during Operations and Closure	▪ No borrow source required for engineered source control ▪ Least potential to affect Patterson Lake during Operations ▪ Greatest potential to affect Patterson Lake during Closure	▪ Borrow source required for engineered source control ▪ Least potential to affect Patterson Lake during Operations and Closure
	Air quality	▪ Greatest potential to generate fugitive dust due to construction of a single facility by end-dumping	▪ Greatest potential to generate fugitive dust due to construction of a single facility by end-dump	▪ Least potential to generate fugitive dust due to construction of a single facility from bottom up	▪ Least potential to generate fugitive dust due to construction of a single facility from bottom up	▪ Greatest potential to generate fugitive dust due to construction of two facilities by end-dumping	▪ Intermediate potential to generate fugitive dust due to construction of a one facility from bottom-up and one facility by end-dumping

Table 4.5-17: Alternatives Assessment for Mine Waste Storage of Waste Rock

Assessment Category	Sub-category or Criteria	Alternative Options					
		Unsegregated, Base Case, Unlined (1a)	Unsegregated, Base Case, Lined (1b)	Unsegregated, Engineered Source Control, Unlined (1c)	Unsegregated, Engineered Source Control, Lined (1d)	Segregated, NPAG (Unlined), PAG (Lined; 2a)	Segregated, NPAG (Unlined), PAG (Engineered Source Control, Lined; 2b)
Technical	Design and reliability	▪ Least design complexity due to single, unlined facility and no engineered source control ▪ Proven not to work for source control ▪ Does not comply with SERM guidelines for liner placement	▪ Less design complexity due to single, lined facility and no engineered source control ▪ Proven precedent for liner as source control ▪ Complies with SERM guidelines for liner placement	▪ Intermediate design complexity due to single, unlined facility with engineered source control ▪ No proven precedent ▪ Potential benefit for engineered source control ▪ Does not comply with SERM guidelines for liner placement	▪ Intermediate design complexity due to single, lined facility with engineered source control ▪ Proven precedent for liner as source control ▪ Potential benefit for engineered source control ▪ Complies with SERM guidelines for liner placement	▪ Greater design complexity due to segregated NPAG (unlined) and PAG (lined) facilities ▪ Proven precedent for liner as source control ▪ Complies with SERM guidelines for liner placement	▪ Greatest design complexity due to segregated NPAG (unlined) and PAG (lined with engineered source control) facilities ▪ Proven precedent for liner as source control ▪ Potential benefit for engineered source control ▪ Complies with SERM guidelines for liner placement
	Construction risk and complexity	▪ Least construction complexity due to single facility and no liner placement	▪ Intermediate construction complexity due to single facility and liner placement	▪ Least construction complexity due to single facility and no liner placement ▪ Engineered source control placement	▪ Intermediate construction complexity due to single facility and liner placement ▪ Engineered source control placement	▪ Greatest construction complexity due to two segregated facilities, one with liner placement	▪ Greatest construction complexity due to two segregated facilities, one with liner placement ▪ One facility with engineered source control placement
Technical	Operational risk and complexity	▪ Least operational complexity due to single, unlined facility and no engineered source control ▪ Water management for a single facility ▪ Least potential for progressive facility closure	▪ Less operational complexity due single, lined facility with placement atop liner and no engineered source control ▪ Water management for a single facility ▪ Least potential for progressive facility closure	▪ Intermediate operational complexity due to single, unlined facility placement of engineered source control ▪ Water management for a single facility ▪ Intermediate potential for progressive facility closure	▪ Intermediate operational complexity due to single, lined facility with placement atop liner and placement of engineered source control ▪ Water management for a single facility ▪ Intermediate potential for progressive facility closure	▪ Greater operational complexity due to segregated NPAG (unlined) and PAG (lined) facility with placement atop liner ▪ Water management for two facilities ▪ Greater potential for progressive facility closure	▪ Greatest operational complexity due to segregated NPAG (unlined) and PAG (lined) facility with placement atop liner and placement of engineered source control ▪ Water management for two facilities ▪ Greatest potential for progressive facility closure

Table 4.5-17: Alternatives Assessment for Mine Waste Storage of Waste Rock

Assessment Category	Sub-category or Criteria	Alternative Options					
		Unsegregated, Base Case, Unlined (1a)	Unsegregated, Base Case, Lined (1b)	Unsegregated, Engineered Source Control, Unlined (1c)	Unsegregated, Engineered Source Control, Lined (1d)	Segregated, NPAG (Unlined), PAG (Lined; 2a)	Segregated, NPAG (Unlined), PAG (Engineered Source Control, Lined; 2b)
	Closure risk and complexity	▪ Least closure complexity due to single facility	▪ Least closure complexity due to single facility	▪ Least closure complexity due to single facility	▪ Least closure complexity due to single facility	▪ Greatest closure complexity due to two facilities	▪ Greatest closure complexity due to two facilities
	Flexibility	▪ Greatest flexibility to expand with no liner or engineered source control	▪ Intermediate flexibility to expand with liner	▪ Greater flexibility to expand with no liner	▪ Less flexibility to expand with liner and engineered source control	▪ Intermediate flexibility to expand with liner	▪ Least flexibility to expand with liner and engineered source control
Economic	Capital cost	▪ Lowest capital cost due to no liner	▪ Highest capital cost due to liner for one larger facility	▪ Lowest capital cost due to no liner	▪ Highest capital cost due to liner for one larger facility	▪ Intermediate capital cost due to liner for one smaller facility	▪ Intermediate capital cost due to liner for one smaller facility
	Operating cost	▪ Lowest operating cost due to no liner and no engineered source control for one larger facility	▪ Lower operating cost due to treatment of water captured on liner for one smaller facility ▪ No engineered source control	▪ Greater operating cost due to engineered source control for one larger facility ▪ No liner	▪ Greatest operating cost due to treatment of water captured on liner and engineered source control for one larger facility	▪ Intermediate operating cost due to treatment of water captured on liner for one smaller facility ▪ No engineered source control	▪ Intermediate operating cost due to treatment of water captured on liner and engineered source control for one smaller facility
	Closure cost	▪ Intermediate closure cost for one larger facility and water treatment without engineered source control	▪ Intermediate closure cost for one larger facility and water treatment without engineered source control	▪ Lowest closure cost for one larger facility and water treatment with engineered source control	▪ Lowest closure cost for one larger facility and water treatment with engineered source control	▪ Greatest closure cost for two facilities and water treatment without engineered source control	▪ Intermediate closure cost for two facilities and water treatment with engineered source control
Social	Community effect	▪ Least potential for local employment opportunities	▪ Intermediate potential for local employment opportunities due to specialized labour required for liner installation	▪ Greater potential for local employment opportunities due to specialized labour required for placement of engineered source control	▪ Greatest potential for local employment opportunities due to specialized labour required for liner installation and placement of engineered source control	▪ Intermediate potential for local employment opportunities due to specialized labour required for liner installation	▪ Greater potential for local employment opportunities due to specialized labour required for liner installation and placement of engineered source control

Table 4.5-17: Alternatives Assessment for Mine Waste Storage of Waste Rock

Assessment Category	Sub-category or Criteria	Alternative Options					
		Unsegregated, Base Case, Unlined (1a)	Unsegregated, Base Case, Lined (1b)	Unsegregated, Engineered Source Control, Unlined (1c)	Unsegregated, Engineered Source Control, Lined (1d)	Segregated, NPAG (Unlined), PAG (Lined; 2a)	Segregated, NPAG (Unlined), PAG (Engineered Source Control, Lined; 2b)
	Change in land use	▪ Least potential, with no additional resource consumption	▪ Least potential, with no additional resource consumption	▪ Greatest potential, with additional resource consumption for engineered source control borrow	▪ Greatest potential, with additional resource consumption for engineered source control borrow	▪ Least potential, with no additional resource consumption	▪ Intermediate potential, with additional resource consumption for engineered source control borrow for one smaller facility
Social	Population at risk	▪ Greatest health risk to people downstream due to unlined facility with no engineered source control ▪ Greatest risk to worker safety and human health by noise, dust, and equipment exposure	▪ Less health risk to people downstream due to lined facility with no engineered source control ▪ Greatest risk to worker safety and human health by noise, dust, and equipment exposure	▪ Intermediate health risk to people downstream due to engineered source control with no liner ▪ Least risk to worker safety and human health by noise, dust, and equipment exposure	▪ Least health risk to people downstream due to lined facility with engineered source control ▪ Least risk to worker safety and human health by noise, dust, and equipment exposure	▪ Intermediate health risk to people downstream due to lined facility with no engineered source control ▪ Greatest risk to worker safety and human health by noise, dust, and equipment exposure	▪ Less health risk to people downstream due to once, smaller lined facility with engineered source control ▪ Intermediate risk to worker safety and human health by noise, dust, and equipment exposure
Overall		**Less Preferred**	**Less Preferred**	**Less Preferred**	**Neutral**	**Less Preferred**	**More Preferred**

Legend:	more preferred	neutral	less preferred

SERM = Saskatchewan Environment and Resource Management; PAG = potentially acid generating; NPAG = non-potentially acid generating.

A sensitivity analysis was completed to evaluate the effect of bias introduced by category weighting; this approach aligns with ECCC's guidelines for mine waste MAAs (ECCC 2016). Results of the sensitivity analysis are presented in Table 4.5-18 using the sensitivity weighting cases shown in Table 4.5-7. Account merit ratings shown are the quantitative rankings of alternative options; additional details can be found in TSD VII.

The first-place ranking for segregated, NPAG unlined, PAG engineered source control and lined (i.e., Option 2b) remained the same for all sensitivity scenarios except when the economic category was removed from consideration (i.e., economic considerations = 0); then unsegregated, engineered source control, lined (i.e., Option 1d) was ranked first. This finding indicates that category weighting (i.e., introduction of bias) does change the outcome. The change in rank is due to a reduction in complexity for constructing and operating an unsegregated waste rock facility (1d), though the cost for engineered source control layers is greater for an unsegregated, larger facility.

Table 4.5-18: Waste Rock Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	Waste Rock Alternative Rank					
		1a	1b	1c	1d	2a	2b
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	6 [2.7]	4 [3.3]	3 [4.1]	2 [4.5]	5 [3.1]	1 [4.6]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	6 [3.2]	4 [3.3]	2 [4.2]	3 [4.0]	5 [3.3]	1 [4.4]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	5 [3.4]	4 [3.4]	2 [4.2]	3 [3.9]	6 [3.3]	1 [4.3]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	6 [2.4]	4 [3.3]	3 [4.0]	1 [4.9]	5 [3.0]	2 [4.7]

Legend: more preferred | less preferred

[ ] = Account merit rating.

4.5.6.4.1 Selected Alternative

Aligned with the waste rock assessment summary (Table 4.5-17) and with the majority of cases in the sensitivity analysis (Table 4.5-18), the selected alternative for mine waste storage of waste rock for the Project was **segregated, NPAG unlined, PAG engineered source control and lined** (Option 2b).

As discussed in Section 4.4.2.1, Indigenous Groups and communities value protection of Patterson Lake. Option 2b with a segregated lined PAG facility with engineered source control is predicted to have a reduced potential to affect Patterson Lake water quality. In addition, this option, which exceeds Saskatchewan Environment and Resource Management (SERM) draft guidelines for best practice waste rock management, would have lower costs for lining compared to fully lined, unsegregated alternatives; would have the potential to be progressively closed during Operations; and would have reduced potential for long-term water treatment to be required.

4.5.7 Power Supply Type

An estimated 24.1 MW of power would be required to meet the electricity demand for the proposed Project. Feedback from Indigenous Groups has identified that how power is supplied to the Project is important in the assessment of potential Project effects on the environment and culture, and requires consideration in the assessment of alternatives (CRDN 2019). The following alternatives were considered:

- grid power;
- on-site diesel power plant;
- on-site liquified natural gas (LNG) power plant; and
- on-site hybrid system (LNG power plant and renewable energy supply).

Grid power would involve connecting the Project to an existing power generation and transmission system that has sufficient capacity to meet Project needs. However, the region in which the Project would be located is not serviced by any high voltage power lines, and the nearest substations with adequate capacity are far removed. This alternative would require a new interconnection and transmission line running approximately 240 km to Key Lake, or 175 km to Fort McMurray; it would also involve the clearing of a linear corridor along the transmission line route to facilitate construction, and then regular maintenance to manage vegetation through Operations. Permitting and construction of such a long transmission line extension would be complex and costly (i.e., approximately one million dollars per kilometre of transmission line) and would likely require agreements with third parties in terms of responsibilities, ownership, and operation. Given these complexities, the timelines to advance grid power would also delay the development of the Project.

An **on-site diesel power plant** or **on-site LNG power plant** could provide power for the Project, with direct supply to the process plant, camp, and other infrastructure. On-site power generation is typically employed when connecting to grid power is not economically feasible, and both diesel and LNG power plants are proven technology. Historically, diesel generators are reliable and inexpensive, while LNG generators are more expensive but quieter and with better environmental performance (i.e., lower emissions). The differences in costs and performance have reduced in recent years with advancements in LNG generator technologies and design. The advantages or disadvantages of either system depend on the specific site and application, with trade-offs associated with, for example, operational efficiency over different load ranges, capital costs, fuel handling and costs, emissions, and noise and vibration. For the proposed Project, reliability was considered an important consideration, along with environmental performance from an emissions and GHG standpoint.

An **on-site hybrid system** could also be used, incorporating a power plant combined with renewable energy alternatives (e.g., solar arrays, wind turbines) and batteries. Renewable energy alone would be insufficient and not reliable enough to meet the Project power requirements; however, it could be used to supplement the energy supply. Because the renewable sources considered are lower in terms of reliability, batteries would be required to store energy for future use and to serve as a limited backup energy supply.

A feasibility study was conducted to assess the economic viability of alternative energy options (Stantec 2019). In that study, economically viable combinations of numbers and sizes of generators, wind turbines, solar cells, and batteries were identified and assessed in terms of net present cost. Results of the study indicated that a hybrid system would be more economically attractive than connecting to the existing power grid. Results also indicated that the combination of generator (assumed to be LNG) and wind turbines would be the most attractive type of hybrid system. Further study is ongoing to confirm the potential of integrating a hybrid power system at the Project.

The above results formed the basis of the **screening-level assessment** for power supply using the sub-categories (Table 4.4-2) and criteria included in Table 4.5-19. Based on the screening-level assessment, the more preferred alternative was on-site LNG power plant.

Table 4.5-19: Alternatives Assessment for Power Supply Type

Assessment Category	Sub-category or Criteria	Alternative Options			
		Grid Power	On-Site Diesel Power Plant	On-Site LNG Power Plant	On-Site Hybrid System[a]
Environmental	Footprint of facilities	▪ Very large footprint off site between substation and site ▪ Approximately 400 ha based on 20 m right of way and ~200 km transmission line	▪ Approximately 1.7 ha on site, including support infrastructure	▪ Approximately 1.7 ha on site, including support infrastructure	▪ Larger than a diesel or LNG plant; extra area required to accommodate the renewable energy components
	Air and GHG emissions	▪ Incremental emissions from the existing power supply as a result of the Project (combination of emissions from various sources including fossil fuels, hydroelectric, wind/biomass/geothermal)	▪ Higher emissions ▪ Emissions associated with fuel delivery if transported by truck	▪ 25% less emissions than diesel plant ▪ Emissions associated with fuel delivery if transported by truck	▪ Less emissions (assuming LNG plant would be able to operate at a lower capacity and as part of the hybrid system)
Technical	Design effort	▪ Proven technology	▪ Proven technology	▪ Proven technology	▪ Mix of proven and newer (i.e., less established) technology ▪ May require development of new systems or designs to accommodate cold weather
	Reliability of power supply	▪ Permanent connection; however, potential for interruptions from poor weather and downed transmission lines ▪ Lower control over timing of maintenance and planned outages	▪ Power supply is managed on site ▪ Greater control over timing of maintenance and planned outages	▪ Power supply is managed on site ▪ Greater control over timing of maintenance and planned outages	▪ Wind and/or solar power supply systems would not provide sufficient power ▪ Uncertainty in the ability for the hybrid system to consistently meet power demands unless batteries and supplemental power supply is available ▪ Greater control over timing of maintenance and planned outages
	Construction risk and complexity	▪ Higher uncertainty of achieving required in-service date due to complexity of planning, approvals, required agreements, and construction timelines	▪ Greater control over, and certainty of, achieving required in-service date	▪ Greater control over, and certainty of, achieving required in-service date	▪ Greater control over, and certainty of, achieving required in-service date ▪ Added complexity with construction of the renewable energy components of the hybrid system

Table 4.5-19: Alternatives Assessment for Power Supply Type

Assessment Category	Sub-category or Criteria	Alternative Options			
		Grid Power	On-Site Diesel Power Plant	On-Site LNG Power Plant	On-Site Hybrid System[a]
Technical (continued)	Operational risk and complexity – fuel management	▪ Operational risk and complexity are managed by SaskPower or third party	▪ Potential for interruption of fuel supply is mitigated by temporary fuel storage on site	▪ Potential for interruption of fuel supply is mitigated by temporary fuel storage on site	▪ Potential for interruption of fuel supply is mitigated by temporary fuel storage on site ▪ Increased complexity (e.g., variable capacity) of operating a hybrid system with multiple power generation sources
Economic	Capital cost	▪ High capital cost; portion paid by NexGen could be reduced or negotiated if agreement in place with SaskPower or third party	▪ Capital costs for on-site power (diesel vs LNG) are comparable	▪ Capital costs for on-site power (LNG vs diesel) are comparable	▪ Capital costs for hybrid system would be higher than a single diesel or LNG plant, as a secondary and separate power system would be required
	Operational cost	▪ Low cost associated with annual supply contract with SaskPower	▪ Cost of diesel, and thus operating cost, is much higher than LNG for comparable power output	▪ Cost of LNG, and thus operating cost, is much less than diesel for comparable power output	▪ Operating costs would likely be slightly less than a single LNG plant
Social	Potential health or community concerns	▪ Potential for health concerns with proximity of lines to community areas	▪ Power generation infrastructure and activities would be managed within Project footprint	▪ Power generation infrastructure and activities would be managed within Project footprint	▪ Power generation infrastructure and activities would be managed within Project footprint ▪ Potential for incremental noise or health concerns from wind turbines
Overall		**Less Preferred**	**Neutral**	**More Preferred**	**Neutral**

Legend: more preferred | neutral | less preferred

a) Assuming LNG power plant in combination with turbines, solar arrays, and battery storage system.
LNG = liquified natural gas; GHG = greenhouse gas.

4.5.7.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for power supply for the Project was an **on-site LNG power plant**. Connecting to grid power was considered a less preferred option due to the large capital costs and complexity and timelines involved, in particular due to the higher uncertainty of having power to site in a timeline that would support Project needs. In addition, NexGen prefers to have a higher degree of control in terms of reliability of power supply, including scheduled maintenance and outages. Of the two main on-site power plant options, LNG was selected over diesel as a fuel source based on the relatively better air quality and considerably lower GHG emissions associated with LNG, as well as the cost of LNG being considerably lower than diesel (i.e., lower operating costs). Compared to the on-site hybrid system option, carrying an on-site LNG power plant through the EA was considered a more conservative approach (i.e., higher potential GHG emissions) while further evaluation on potential integration of a hybrid power system incorporating renewable energy is completed.

4.5.8 Fuel Delivery Method

Operation of the selected power supply type alternative of an LNG power plant (Section 4.5.7, Power Supply Type) would require a reliable natural gas supply and a delivery method that is economical, considers environmental effects, and is safe. The alternatives considered for fuel delivery were:

- truck;
- pipeline; and
- air.

Fuel delivery by **truck** would involve transporting natural gas in the form of LNG from a fuelling depot to the proposed Project site. Based on site power requirements, truck capacity, and fuel depot locations, an estimated 12 to 15 trucks per day of LNG would be required during Operations, with a similar or smaller number of deliveries during Construction and Closure. While transportation by road is more susceptible to disruptions due to weather and natural events compared to pipeline transport, this consideration would be offset by providing on-site LNG storage sufficient to run the power plant at full capacity for approximately four days in the event of a short-term interruption in fuel delivery.

Fuel delivery by **pipeline** would involve connecting to an existing natural gas pipeline or constructing and operating an extension from an existing pipeline. Similar to the grid access challenge noted in the power supply alternatives assessment (Section 4.5.7), the Project is located in a region of Saskatchewan that is not serviced by an existing natural gas pipeline, with the nearest pipeline being hundreds of kilometres away. This option would require constructing a long pipeline extension with considerable surface disturbance and large capital costs. Some of those costs could potentially be reduced if support from, or partnership with, the Government of Saskatchewan or a private supplier were possible. For pipeline operations, operating costs (e.g., gas delivery) and GHG emissions would be lower than with the trucking option.

Fuel delivery by **air** would involve the transport of LNG on planes from a supply airport to the Project site. Suitable containers would be required that could be efficiently filled, loaded on to aircraft, and then offloaded and emptied into on-site storage. This approach, while technically possible for small quantities, would require many flights per day and/or designs for larger aircraft and potentially larger airstrip, complex logistics and handling, and additional safety measures.

A **screening-level assessment** related to the method of LNG fuel delivery was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-20. Based on the screening-level assessment, the more preferred alternative was fuel delivery by truck.

Table 4.5-20: Alternatives Assessment for Fuel Delivery Method

Assessment Category	Sub-category or Criteria	Alternative Options		
		Truck	Pipeline	Air
Environmental	Surface area disturbance	▪ Minor additional disturbance at site to accommodate fuel storage	▪ Disturbance along a 150 to 200 km pipeline right-of-way	▪ Additional surface disturbance associated with expanded runway at site, assuming larger planes required for transport
	Air quality and emissions	▪ Emissions associated with trucking and increased traffic	▪ Minimal emissions	▪ Large emissions associated with aircraft transport
Technical	Design and construction risk and complexity	▪ Low design effort required ▪ Use of existing provincial road network, with potential minor upgrades; site roads designed to accommodate trucks	▪ High level of design effort for pipeline routing and details ▪ Long construction timeline to achieve in service date for a 150 km to 200 km pipeline compared to other options	▪ Low design effort, but more than for the truck delivery option ▪ Use of existing airports; however, additional supply, loading, and receiving infrastructure required ▪ Additional permits likely required
	Operational risk and complexity	▪ Known ability to accommodate the number of trucks per day required to transport the required fuel volumes	▪ Low complexity in terms of day-to-day operations	▪ Uncertain ability to accommodate the high number of planes and flights per day that may be required to transport the required fuel volumes
	Reliability	▪ On-site storage is required to address potential for weather or road-related disruptions to delivery	▪ Less on-site storage is required, as delivery reliability is unlikely to be affected by weather	▪ Increased on-site storage is required to address potential weather-related disruptions to air service delivery
	Flexibility	▪ Ability to add additional trucks for increased supply; greater operational flexibility than pipeline which would have maximum on-demand delivery capability based on infrastructure and pipeline demand	▪ Ability to increase supply, assuming the system (e.g., pipe size and tanks on site) would have extra built-in capacity	▪ Lesser ability to increase fuel supplies, as is dependent on additional aircraft and/or frequency or sizes of delivery
Economic	Capital cost	▪ Minimal, assuming contract trucking	▪ High cost to construct 150 to 200 km of new pipeline	▪ Minimal, assuming contract air transport ▪ Some costs associated with additional infrastructure
	Operating cost	▪ Moderate costs associated with trucking contracts, including LNG costs, truck maintenance, and fleet management	▪ Pipeline operations costs, including natural gas supply, would be lower than costs associated with truck or air delivery	▪ Very high costs associated with aircraft operation and contracts, including fuel costs for transport

Table 4.5-20: Alternatives Assessment for Fuel Delivery Method

Assessment Category	Sub-category or Criteria	Alternative Options		
		Truck	Pipeline	Air
Social	Workforce from community – Construction	▪ Negligible for Construction	▪ High labour requirement for Construction	▪ Negligible for Construction
	Workforce from community – Operations	▪ Moderate for Operations	▪ Low for Operations	▪ Low for Operations
	Worker safety and human health	▪ Safety risks associated with road travel, and number of trucks required for delivery	▪ Minimal health and safety risks	▪ Minimal health and safety risks associated with air travel. Safety risks associated with road travel, and number of trucks required for delivery from airstrip to site
Overall		**More Preferred**	**Neutral**	**Less Preferred**

Legend:	more preferred	neutral	less preferred

LNG = liquified natural gas.

4.5.8.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for fuel delivery method for the Project was fuel delivery by **truck**. This selection is based on the prohibitive costs and timeline associated with pipeline construction, as well as large surface area disturbance that would be associated with a new pipeline right-of-way. Air transport was not considered feasible due to costs, logistics, and additional emissions associated with transporting large volumes of LNG by air.

4.5.9 Camp Location

The proposed Project would require a workforce of about 350 people during Construction and 300 people during Operations. La Loche is the closest population centre, located approximately 2.5 hours away by road, while the larger cities of Prince Albert and Saskatoon are approximately 1 and 2 hours away by air, respectively. With the planned 12-hour work shifts, daily commute to site is impractical due to the travel times at both ends of the shift and the large number of bus trips or flights that would be required.

Options were preliminarily assessed to consider off-site vs. on-site camp accommodations. There is an existing camp near Grygar Lake, about a half-hour drive north of the proposed Project site, which could accommodate about half the workforce; however, additional housing would be required to accommodate the full staffing requirement for the Project. Given the need for additional housing, construction of a new on-site camp was determined to be most appropriate as this choice would provide sufficient accommodation for the entire workforce in one location and daily off-site transport would not be required.

Based on the above, the Project has been developed as an on-site camp-based operation, similar to other developments in the region, with the workforce typically working 12-hour shifts (i.e., 24-hour coverage by two shifts) on a rotational basis. From this determination, the following on-site camp locations, as shown in Figure 4.5-10, were considered:

- south location;
- west location; and
- east location.

For the **south location**, a camp at the south end of the site was considered, roughly in the same area that the existing exploration camp is located. This option would allow camp accommodations to be located in an area that was already partly disturbed along the lakeshore, and away from active mining and processing areas. Additional infrastructure would be required to support a larger camp at this location, including an intake for fresh water supply (or an extension of supply from the mine terrace), power, lighting, and communications. Workers would have to be bussed the approximate 1.5 km distance from the camp to their work locations at the mine terrace.

For the **west location**, a camp would be located west of, and adjacent to, mine buildings for the Project, and would be integrated into the general mine and mill terrace areas. This option would result in a reduced overall Project footprint compared to the other alternatives (i.e., integration within the main mine development area and less additional on-site road development required to connect the camp and main working areas) and would allow direct access for arrivals from and departures along the on-site road. In addition, some workers could walk from camp to the administration building (i.e., no bussing required) and possibly to other areas such as the process plant and supporting infrastructure. Bussing would still be required for workers to access areas such as the underground mine and mine dry complex.

Figure 4.5-10: Camp Location Alternatives

For the **east location**, the land to east of the mine terrace and WRSAs would be used for the camp location. This option would require a site road to this location, which would possibly be routed through the mine and mill terraces. While this option is relatively close to the main site, services would need to be extended to that location and bussing of the workers to their work locations would be required.

A **screening-level assessment** for the camp location was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-21. Based on the screening-level assessment, the more preferred alternative for the camp was the west location.

Table 4.5-21: Alternatives Assessment for Camp Location

Assessment Category	Sub-category or Criteria	Alternative Options		
		South Location	West Location	East Location
Environmental	Surface area disturbance	▪ Camp could take advantage of existing disturbance associated with the exploration camp; overall would still likely result in more disturbance than the west location option	▪ Camp adjacent to mine terrace; surface area disturbance is limited	▪ New surface disturbance
	Potential effect on Patterson Lake	▪ Could require an additional water lake intake and/or discharge ▪ Larger development on the shore could affect riparian zone; runoff would need to be managed	▪ Camp would be integrated into the main mining area; no additional effect on Patterson Lake as water supply, discharge, and surface runoff would be managed as part of overall site plans	▪ Camp would be located away from the main mining area, and also away from shore of Patterson Lake; surface runoff would be managed locally or routed to the main development area. A dedicated system would have to be designed to direct sewage to the treatment plant
	Potential effect on plants and wildlife habitat	▪ Some new surface disturbance has the potential to affect plants and wildlife habitat ▪ Additional traffic along the on-site road could affect wildlife	▪ Camp would be integrated into the main mining area; no camp-specific effects on plants or wildlife habitat	▪ New surface disturbance has the potential to affect plants and wildlife habitat
	Air quality and emissions	▪ Greatest additional emissions associated with bussing of workforce from camp to mine terrace	▪ Minor additional emissions from limited on-site transportation needed to move workers from camp to work locations	▪ Additional emissions associated with bussing of workforce from camp to mine terrace
Technical	Design and reliability	▪ Requires extension of infrastructure from mine terrace to camp location (approximately 1.5 km)	▪ Camp adjacent to mine terrace; no extension of infrastructure required	▪ Requires extension of infrastructure from mine terrace to camp location (less than 1 km), need to add additional road to access the camp location.
	Operational risk and complexity	▪ Access to camp direct from on-site road ▪ Requires regular bussing to transport workforce from camp to mine terrace	▪ Access to camp direct from on-site road ▪ Portion of the workforce can walk from camp to work areas; minimal bus transport distances to other locations	▪ Access to camp may have to be routed through mine terrace ▪ Requires regular bussing (short distance) to transport workforce from camp buildings to work locations
	Flexibility	▪ Adjacent land provides flexibility for future expansion and/or alternative use of lakeshore camp buildings in future	▪ Area is more constrained between mine components and mine terrace infrastructure; less flexible for a significant expansion of camp	▪ Adjacent land provides flexibility for future expansion

Table 4.5-21: Alternatives Assessment for Camp Location

Assessment Category	Sub-category or Criteria	Alternative Options		
		South Location	West Location	East Location
Economic	Capital cost	▪ Higher due to extension of infrastructure to southern location	▪ Lowest cost	▪ Additional costs associated with short extension of infrastructure
	Operating cost	▪ Greatest costs for transporting workers from camp to mine terrace; potential for additional costs for services as farther from mine terrace (e.g., water and treating sewage)	▪ Lowest cost	▪ Increased costs for transporting workers from camp to mine terrace; potential for additional costs for services as farther from mine terrace
Social	Worker safety and human health	▪ Located farther away from main noise and air quality emission sources	▪ Subject to noise and air quality emissions associated with adjacent mine buildings and activities	▪ Subject to noise and air quality emissions associated with rock storage area and airstrip
Overall		**Less Preferred**	**More Preferred**	**Neutral**

Legend: more preferred | neutral | less preferred

4.5.9.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for camp location for the Project was the **west location**. As discussed in Section 4.4.2.1, consolidating the site footprint to reduce the overall Project disturbance area (e.g., integrating the camp within the main mine development area and less additional on-site road development) was a key consideration in the selection of this alternative. While the west location is situated relatively closer to mining activities, the camp would be designed to minimize worker exposure to potential noise and air quality emissions.

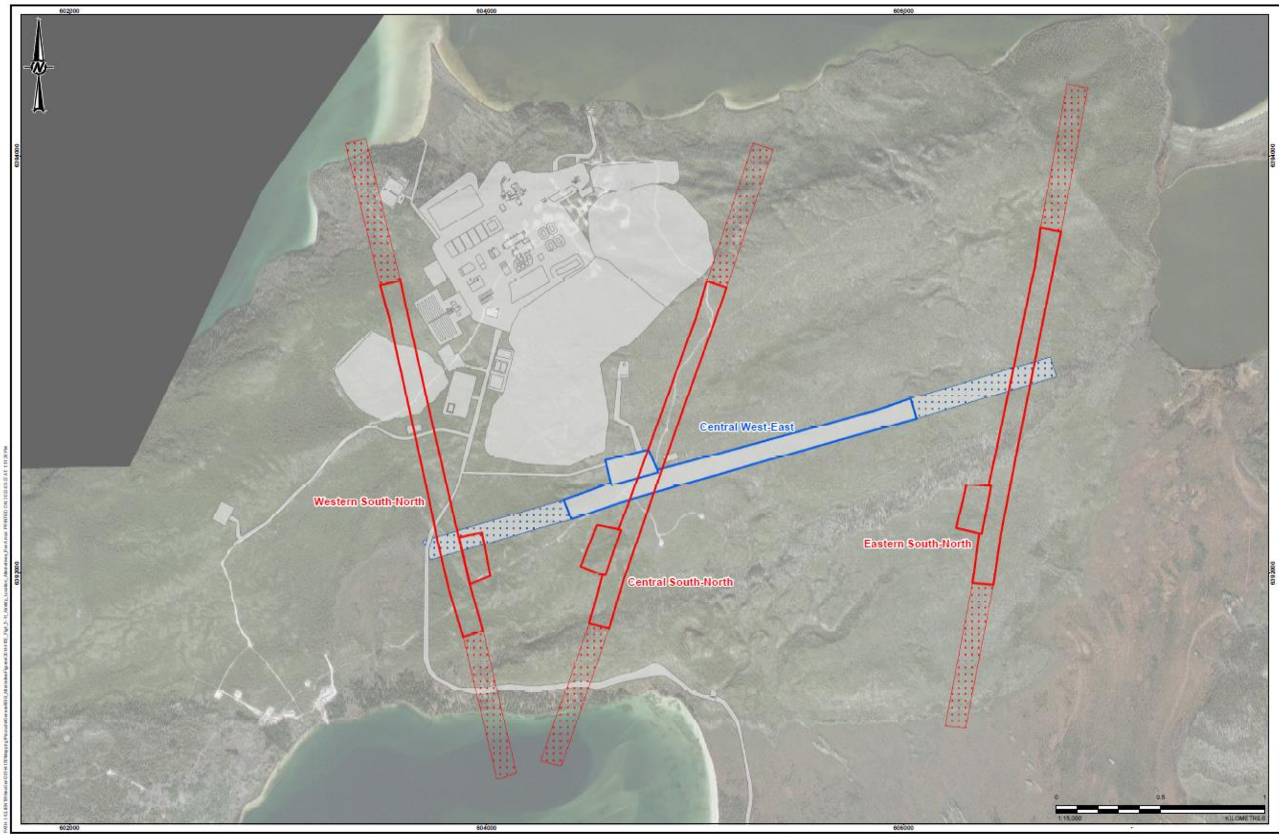
4.5.10 Airstrip Location

Given the number of Project workers required, NexGen's aspiration employment targets maximizing local hiring, the distance of population centres from the Project site, and the selected alternative to house workers in an on-site camp (Section 4.5.9, Camp Location), worker transportation to the Project would be primarily by air. To support air transportation, an on-site airstrip would be required as part of the overall Project design. Airstrips are typically designed and located based on design aircraft size, wind direction, location topography, and aerodrome obstacle limitation requirements (i.e., constraints on how close and high surrounding infrastructure can be in relation to an active airstrip). For the proposed Project, the design aircraft size was planned to accommodate up to 48 passengers, and the airstrip design length was 1,600 m plus additional allowance for the omni-directional approach lighting (ODAL) corridor at each end of the airstrip. The ODAL is a ground-based lighting system that illuminates the airstrip centreline and approach pathway for aircraft. The airstrip would have an operating width of 30 m and total (i.e., runway safety area) width of 80 m.

Options for siting of the airstrip considered the characteristics mentioned above, locations proximal to the proposed Project, and potential interactions with other Project components and site infrastructure. In general, alternative options followed the natural topography and were situated along higher ridges (vs. lower valleys) to provide adequate ground clearance for aircraft and to reduce materials requirements for cut and fill construction. Four alignment options for the on-site airstrip were considered, as shown in Figure 4.5-11 and described below:

- central west–east;
- eastern south–north;
- central south–north; and
- western south–north.

Figure 4.5-11: Airstrip Location Alternatives



The **central west–east** alignment would be located south and southeast of the mine and mill terraces, along an area of higher elevation (i.e., approximately 564 m) that stretches in a generally west to east direction. Beyond the ends of the airstrip, the topography falls away in the east, west, and south directions. This airstrip alignment and design would allow a balanced cut and fill airstrip construction (i.e., material excavated in higher areas would approximately equal material quantities required in lower areas) and provide the necessary clearances to the WRSAs to the north.

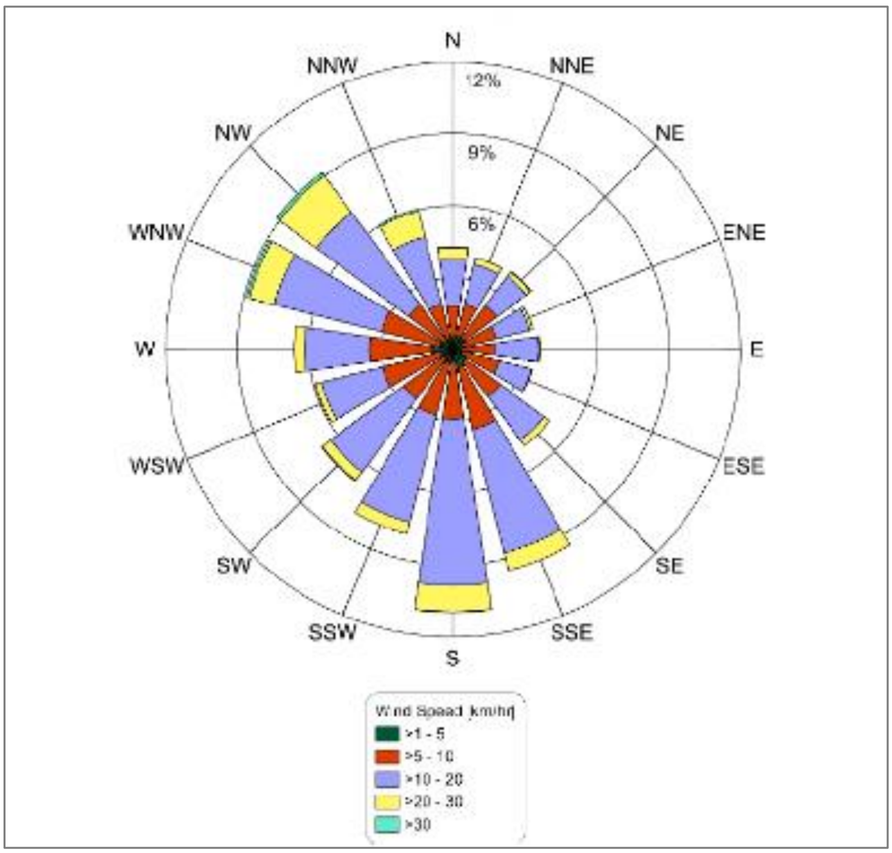
The **eastern south–north** alignment would be located approximately 2 km east of the mine and mill terraces, between two higher ridges, and at an approximate elevation of 520 m. This airstrip alignment may interact with an adjacent watershed currently unaffected by the Project and would require a new and longer on-site road to transport workers between the airstrip and all other Project infrastructure. The volume of cut and fill material would be almost double of the central west–east alignment.

The **central south–north** alignment would be located south and east of the mine and mill terraces, at an approximately elevation of 564 m (i.e., similar to central west–east alternative). The southern end of this airstrip alignment would require high fill volumes for construction due to the topography falling away steeply towards Patterson Lake; on the northern end of the alignment, high cut volume would be required to accommodate the full airstrip length. There may not be sufficient area, or area at a suitable height, to accommodate the full allowances of the ODAL corridor.

The **western south–north** alignment would be situated at an elevation of approximately 540 m, with cut and fill volumes of similar magnitude to the eastern south–north and central south–north options. This airstrip location is constrained on both the southern and northern ends as elevation drops away towards Patterson Lake and may not provide sufficient clearance extensions for the ODAL corridor. An airstrip at this location would conflict with the selected alternative for the camp location (Section 4.5.9).

A **screening-level assessment** related to the airstrip location was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-22. Wind direction was considered during the alternatives assessment; however, winds at the Project site tend to originate from a wide range of directions (i.e., from south, to west, to northwest; Figure 4.5-12), and therefore wind direction was not a major differentiating factor relative to the constraints associated with the natural landscape. Based on the screening-level assessment, the more preferred alternative was the central west–east alignment.

Figure 4.5-12: Wind Direction at the Rook I Project



N = north; NNE = north–northeast; NE = northeast; ENE = east–northeast; E = east; ESE = east–southeast; SE = southeast; SSE = south–southeast; S = south; SSW = south–southwest; SW = southwest; WSW = west–southwest; W = west; WNW = west–northwest; NW = northwest; NNW = north–northwest.

Table 4.5-22: Alternatives Assessment for Airstrip Location

Assessment Category	Sub-category or Criteria	Alternative Options			
		Central West–East	Eastern South–North	Central South–North	Western South–North
Environmental	Potential to affect another watershed	▪ Development is contained within current Project watershed	▪ Development would extend into a neighbouring watershed	▪ Development is contained within current Project watershed	▪ Development is contained within current Project watershed
	Air and GHG emissions	▪ Similar between the central and western alignments	▪ Minor amount of additional dust and GHG emissions associated with road and transport between airstrip and site	▪ Similar between the central and western alignments	▪ Similar between the central and western alignments
Technical	Design	▪ Adequate aerodrome clearances ▪ Provides adequate clearance for ODAL corridor ▪ Acceptable in terms of typical and dominant winds	▪ Adequate aerodrome clearances ▪ Extension for ODAL corridor available; however, land drops away in elevation ▪ Acceptable in terms of typical and dominant winds	▪ May need to adjust location or design of WRSAs to provide adequate aerodrome clearances ▪ Extension for ODAL corridor could be constrained, and land drops away in elevation ▪ Acceptable in terms of typical and dominant winds	▪ Inadequate aerodrome clearances based on selected camp location and proximity to process plant and power plant ▪ Extension for ODAL corridor is constrained, and land drops away in elevation ▪ Slightly preferred in terms of typical and dominant winds
	Flexibility	▪ Flexible for future expansions, including of WRSAs, if required	▪ Flexible for future expansions, including of WRSAs, if required	▪ Close to WRSAs ▪ Low amount of flexibility	▪ Flexible for future expansions, including of WRSAs, if required; however, future camp expansions may be limited
	Construction risk and complexity	▪ Involves a balance of ~75,000 m^3 of cut and fill ▪ Construction expected to be completed in one season	▪ Double the amount of cut and fill compared to central west–east option ▪ Could require additional construction season to avoid placement of frozen materials	▪ Double the amount of cut and fill compared to central west–east option ▪ Could require additional construction season to avoid placement of frozen materials	▪ Double the amount of cut and fill compared to central west–east option ▪ Could require additional construction season to avoid placement of frozen materials
	Operational risk and complexity	▪ Comparable length of road for central and western options	▪ Requires maintenance of longer length of road to airstrip	▪ Comparable length of road for central and western options	▪ Comparable length of road for central and western options
Economic	Capital cost	▪ Lowest cut and fill balance	▪ Relatively higher cut and fill balance	▪ Relatively higher cut and fill balance	▪ Relatively higher cut and fill balance
Social	Worker health and safety	▪ Potential noise effects moderated by buffer between airstrip and camp	▪ Least potential noise effects on workers at camp as airstrip is located 2 km away	▪ Potential noise effects moderated by buffer between airstrip and camp; however, potentially more than the central west–east orientation due to proximity to site at north end of airstrip	▪ Highest potential noise effects on workers at camp
Overall		**More Preferred**	**Neutral**	**Less Preferred**	**Less Preferred**

Legend:	more preferred	neutral	less preferred

GHG = greenhouse gas; WRSA = waste rock storage area; ODAL = omni-directional approach lighting.

4.5.10.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for airstrip location for the Project was the **central west–east** alignment. Key considerations in this alternatives assessment were minimizing cut and fill construction requirements, limiting effects on additional watersheds, and locating the airstrip as close as possible to other infrastructure without limiting potential future expansion of these components (e.g., WRSAs, camp). The selected alternative takes advantage of the natural higher topographic ridge in the area, includes balanced cut and fill material requirements, and provides the required clearances for the airstrip and the ODAL relative to other Project infrastructure. The other options required considerably more cut and fill material volumes and were constrained in terms of length as well as proximity to other Project infrastructure.

4.5.11 On-Site Road Alignment

All-season on-site roads would be required within the proposed Project footprint to connect Project facilities and infrastructure. These on-site roads would connect to the all-season access road leading off site, which connects to Highway 955 and would support the transportation of equipment, materials, and supplies to (e.g., fuel) and from (e.g., uranium concentrate) the proposed Project. In general, shorter road lengths mean less construction and operating costs; however, shorter lengths need to be balanced with the complexities of the topography and required cut and fill quantities. In addition, utilizing existing roads and trails wherever possible provides advantages in terms of minimizing costs and limiting additional surface disturbance. Two options were considered for the on-site road alignment within the Project footprint, as shown in Figure 4.5-13 and described below:

- southwest alignment; and
- northeast alignment.

Figure 4.5-13: On-Site Road Alignment Alternatives

The **southwest alignment** option leads west from the proposed gatehouse, parallel to Patterson Lake shoreline, and would involve the upgrade of an existing road that has been used for exploration activities. This alignment turns north and passes to the east of a marshy area before rejoining an existing trail and reaching the mine terrace. The total length of this alignment would be approximately 2.7 km, with roughly 75% of this length overlapping existing roads and trails.

The **northeast alignment** option leads north from the proposed gatehouse up a steep embankment, then west and north around the western end of the selected airstrip location (Section 4.5.10, Airstrip Location). This alignment would range in length from 2.4 km to 2.6 km depending on the exact routing up the embankment, including required switchbacks, and around the height of land at the top of the embankment (i.e., north or south of the rise). The alignment would be located primarily on undisturbed land, with some routing approaches that could overlap approximately 20% of the total length with an existing trail. This option would run closer to and parallel to the airstrip for longer lengths, and would cross through the ODAL corridor at the west end of the airstrip.

A **screening-level assessment** for the on-site road alignment was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-23. Based on the screening-level assessment, the more preferred alternative was the southwest alignment.

Table 4.5-23: Alternatives Assessment for On-Site Road Alignment

Assessment Category	Sub-category or Criteria	Alternative Options	
		Southwest Alignment	Northeast Alignment
Environmental	Surface area disturbance	▪ Follows mostly existing exploration road and trails	▪ New disturbance area for entire length of road; limited potential to use existing trail
Technical	Design and reliability; capital, operational, closure risk and complexity	▪ Follows existing road for majority of length ▪ New section of road is relatively flat and follows a direct route ▪ Minor cut and fill may be required along upgraded section of existing road	▪ A new alignment that requires road design up a steep embankment ▪ Design is technically challenging given the embankment is characterized by existing slope failures ▪ Some sections of steep grades and switchbacks
	Flexibility	▪ Distance from airstrip allows flexibility around the airstrip for future development	▪ Route runs closer to and around the west end of the airstrip
Economic	Capital and operating costs	▪ Costs of slightly longer route are more than offset by lower design and construction costs compared to the northeast route due to lower cut and fill volumes, gentler slopes, and no switchbacks	▪ Higher costs associated with new route, including larger cut and fill volumes, and more maintenance
Social	Worker safety and human health	▪ Direct route, with low grades and good visibility	▪ Higher potential for accidents due to steep grades and/or switchbacks ▪ Potential concerns related to interaction with ODAL corridor associated with the airstrip
Overall		**More Preferred**	**Less Preferred**

Legend: more preferred | less preferred

ODAL = omni-directional approach lighting.

4.5.11.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for on-site road alignment for the Project was the **southwest alignment**. This selection was based primarily on the higher percentage of existing roads and trails that could be utilized (i.e., less additional disturbance and costs), as well as avoidance of technical challenges with the northeast alignment that would require road construction and maintenance over steeper grades and/or multiple switchbacks. The southwest alignment is also farther removed from the selected airstrip location (Section 4.5.10), which reduces the potential for interactions with and distractions to drivers, and maintains flexibility around the airstrip should expansions or other development in that area be required in future.

4.5.12 Effluent Treatment Technology

An ETP would treat waste water from the process plant, as well as water from the underground mine and contact water from the proposed Project. An **MAA assessment** was carried out to evaluate effluent treatment technology options for the proposed Project, and included the following:

- identification of alternative options;
- pre-screening alternatives against Project-specific evaluation criteria; and
- MAA of remaining options following pre-screening, including completion of a sensitivity analysis to evaluate the potential effect of bias.

It is noted that during the preparation of the Draft EIS (NexGen 2022), and while undertaking this MAA, the CNSC released a draft version of REGDOC-2.9.2 *Controlling Releases to the Environment* (CNSC 2021). Ongoing engagement with the CNSC indicates that additional considerations, which have not yet been factored into this assessment, may affect the ultimate selection of effluent treatment technology. Therefore, this MAA assessment is considered preliminary and will be refined as part of Project licensing in accordance with REGDOC-2.9.2.

Identification of alternative options was performed to generate an initial list of water treatment technologies for consideration; these options were based on professional judgment of subject matter experts in consideration of Project-specific water quality requirements, and the location and environmental setting of the Project. The list was developed based on the anticipated influent (i.e., pre-treatment) water quality, expected treatment requirements, and effluent water quality targets. The 10 treatment technology options considered were:

- two-stage chemical precipitation with lime;
- two-stage chemical precipitation with caustic;
- one-stage chemical precipitation as pre-treatment followed by using reverse osmosis (RO);
- one-stage chemical precipitation followed by using ion exchange or adsorption;
- non-biological passive treatment;
- biological passive treatment;
- biologic reduction with sulphide generation;
- electrocoagulation;
- electrodialysis reversal; and
- secondary polishing treatment using ultraviolet advanced oxidation process with hydrogen peroxide.

Pre-screening against Project-specific evaluation criteria was completed for all alternative options to identify credible technologies that have demonstrated success in treating the anticipated influent constituents of potential concern (COPCs). Pre-screening criteria were developed to provide a minimum specification for the Project and were used to carry out a “fatal flaws analysis” of each of the options. Options that did not pass the pre-screening criteria were eliminated from further evaluation, and options that passed all the pre-screening criteria were carried forward to the MAA. The pre-screening criteria identified for effluent treatment technology and rationale for inclusion are shown in Table 4.5-24.

Table 4.5-24: Pre-screening Criteria for Effluent Treatment Technology

Rationale for Inclusion	Pre-screening Criteria
Technology that is currently successful in use (North America to globally)	Proven technologies
	Appropriate for mining and the Project
	Technologies that meet treatment goals
	Appropriate for northern Saskatchewan climatic conditions
	Provide for adaptive management considerations for future technology applications
Environmental protection	Meet receiving environment water quality criteria

Of the 10 alternative options, 6 options did not meet all the pre-screening criteria, and therefore were not carried forward to the MAA. The main reasons why these treatment technologies did not meet the pre-screening criteria are summarized below:

- *Non-biological passive treatment.* This method is not expected to meet treatment goals because the treated water quality would not be of sufficient quality for discharge on a consistent basis. Additionally, this method would not be mining- or Project-appropriate due to the large flows volumes that would require treatment.
- *Biological passive treatment.* This method is not expected to meet treatment goals because the treated water quality would not be of sufficient quality for discharge on a consistent basis (i.e., potential for reduced dissolved oxygen and high levels of sulphide).
- *Biologic reduction with sulphide generation***.** This method was eliminated due to a low confidence in meeting receiving environment water quality criteria as hydrogen sulphide is toxic to aquatic life.
- *Electrocoagulation.* This method is not expected to meet treatment goals because the treated water quality would not be of sufficient quality for discharge on a consistent basis. Additionally, this method would not be mining- or Project-appropriate due to the large flows volumes that would require treatment.
- *Electrodialysis reversal.* This is not a proven technology, particularly with respect to mine water treatment.
- *Secondary polishing treatment using ultraviolet advanced oxidation process with hydrogen peroxide.* This treatment technology is used for polishing (i.e., further refining) treated effluent and is not appropriate as a stand-alone treatment process to meet the required treatment goals of the Project.

An **MAA** was conducted for effluent treatment technology options remaining after pre-screening. The four alternative options carried forward in the MAA were:

- *Two-stage chemical precipitation using lime.* This technology uses two pH adjustments with lime, ferric sulphate, and sulphuric acid to reduce metals in the effluent. This option includes design possibilities involving sand filters, microfilters, and settling ponds.
- *Two-stage chemical precipitation using caustic.* This technology is similar to the two-stage chemical precipitation using lime option except sodium hydroxide is used instead of lime.
- *One-stage chemical precipitation followed by RO.* This technology uses one stage of pH adjustment to precipitate select metals as a pre-treatment step prior to using RO to physically remove remaining COPCs with a semi-permeable membrane and application of pressure.
- *One-stage chemical precipitation followed by ion exchange or adsorption.* This technology uses one stage of pH adjustment to precipitate select metals as a pre-treatment step prior to using ion exchange or adsorption to physio-chemically remove remaining COPCs through the addition of a treatment resin.

For the purposes of the MAA, it was assumed that the site would be powered by LNG (Section 4.5.7, Power Supply Type), and each of the treatment technology alternatives would be similar and include a building that would house equipment and outdoor clarifiers. It was also assumed that on-site storage (i.e., ponds) would be used to manage peak contact water runoff reporting from the site to the treatment process, and non-contact water runoff would be diverted to prevent its potential contamination. Treatment residuals (i.e., sludges or brines) from each of the alternatives were assumed to be disposed with the tailings process stream in the UGTMF (Section 4.5.6.2, Tailings).

Similar to the other alternatives assessments, these alternative options were assessed using criteria within the environmental, technical, economic, and social categories. Sub-categories were defined within each of the categories and individual criteria were assigned within each sub-category. The selection of sub-categories and criteria, and descriptions of potential effects, focus on the main aspects that differentiate the alternative options and are not intended to be exhaustive. A summary of the categories, sub-categories, and criteria used in the effluent treatment technology MAA is provided in Table 4.5-25.

Table 4.5-25: Effluent Treatment Technology Assessment Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Environmental	Ecological integrity	5	Residuals after closure / metal leaching	4
			Water consumption and use of fresh water / ability to recycle water	5
	Climate	2	Effect on performance from severe weather	3
	Air quality	4	Potential for GHG emissions during Construction, Operations, and Closure (related to power)	4
Technical	Design and reliability	6	Facility design effort (including schedule effect on pilot tests)	3
			Proven technology in mining application	6
			Technology maturity (more reliable)	1
	Construction risk and complexity	2	Location of equipment suppliers for initial purchase and part replacement	2
			Technical support for troubleshooting and repair	4
	Operational risk and complexity	6	Operational complexity	5
			Operational robustness (ability to respond changing conditions)	5
			Water balance and management during seasonal changes	4
			Recovery from upset conditions, or redundancy in system to mitigate upset conditions	5
			Residuals volume	6
			Specific handling requirements for residuals	1
	Flexibility	3	Effort required for expansion and design changes	6
			Adaptability to different design conditions (one stream vs. two streams of influent)	4
			Adaptability to future technology development and improvement	1
Economic	Capital cost	6	Major equipment costs	6
			Facility construction	6
	Operating cost	6	Power	4
			Chemicals	5
			Water use	2
	Closure cost	5	Post-closure monitoring and maintenance	5
Social	Community effect	2	Public support	3
	Change in land use	2	Footprint	3
	Population at risk	3	Worker safety and human health during construction and operation (primarily exposure to chemicals/reagents)	6
			Specialized workforce required to operate (either additional training for local workforce or need to import expertise from outside the community)	3

GHG = greenhouse gas.

Following guidance provided in ECCC's *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (ECCC 2016), scoring of the four effluent treatment technology alternatives against the criteria for each category and sub-category was performed qualitatively, based on engineering judgment, Project knowledge, and experience with similar applications. Alternatives were then ranked with the highest overall weighted score ranked 1, the next highest score ranked 2, and so on to identify a more preferred alternative.

The base case category weight scheme adopted for the effluent treatment technology MAA weighted the technical and cost accounts highest due to the technical nature of water treatment, and the corresponding costs that could be incurred over the life of the Project. The environmental and social categories were weighted moderately high as all the treatment alternatives are able to meet environmental protection requirements in terms of water quality and discharges to the receiving environment. A sensitivity analysis was completed by varying category weightings to evaluate the effect of potential bias introduced by weighting. Category weighting cases used in the sensitivity analysis are summarized in Table 4.5-26.

Table 4.5-26: Category Weighting Cases Used in Effluent Treatment Technology Sensitivity Analysis

Category	Category Weighting Cases							
	Base Case		NexGen		Equal		Economic = 0	
	Value	Percent	Value	Percent	Value	Percent	Value	Percent
Environmental	4	20.0%	6	30.0%	1	25.0%	4	28.6%
Technical	6	30.0%	3	15.0%	1	25.0%	6	42.9%
Economic	6	30.0%	5	25.0%	1	25.0%	0	0.0%
Social	4	20.0%	6	30.0%	1	25.0%	4	28.6%
Total	**20**	**100%**	**20**	**100%**	**4**	**100%**	**14**	**100%**

Note: Values may not sum due to rounding.

A summary of the assessment for effluent treatment technology is shown in Table 4.5-27. Two-stage chemical precipitation using lime was the highest scoring alternative and is the more preferred alternative.

Table 4.5-27: Alternatives Assessment for Effluent Treatment Technology

Assessment Category	Sub-category or Criteria	Alternative Options			
		Two-Stage Precipitation with Lime	Two-Stage Precipitation with Caustic	One-Stage Precipitation + RO	One-Stage Precipitation + Ion Exchange or Adsorption
Environmental	Residuals after closure / metal leaching	▪ Disposed sludges have low likelihood of contaminant migration after closure	▪ Disposed sludges have low likelihood of contaminant migration after closure	▪ Disposed concentrate brine has higher potential to leach metals	▪ Disposed regeneration brine has highest potential to leach metals
	Water use / ability to recycle water	▪ Effluent meets discharge quality requirements but may require additional treatment for reuse in process plant and mining operations	▪ Effluent meets discharge quality requirements but may require additional treatment for reuse in process plant and mining operations	▪ Treated effluent suitable for reuse in process plant and mining operations	▪ Treated effluent suitable for reuse in process plant and mining operations but to lesser degree than for RO
	Severe weather performance effects	▪ More susceptible to disruption as result of chemicals freezing during extreme cold weather	▪ More susceptible to disruption as result of chemicals freezing during extreme cold weather	▪ Least susceptible to disruption as result of severe winter weather	▪ Lower susceptibility to disruption as result of severe winter weather
	Potential GHG emissions	▪ Lower operational power requirements but higher trucking requirements for supply of treatment chemicals	▪ Lower operational power requirements but higher trucking requirements for supply of treatment chemicals	▪ Lower trucking requirements for supply of treatment chemicals but highest operational power requirements	▪ Lower trucking requirements for supply of treatment chemicals and lowest operational power requirements
Technical	Facility design effort	▪ Least complex design	▪ Lower design complexity	▪ Higher design complexity	▪ Highest design complexity
	Proven in mining applications	▪ Greatest number of full-scale mining applications, including in uranium mining	▪ Higher number of full-scale mining applications	▪ Lower number of full-scale mining applications	▪ Lowest number of full-scale mining applications
	Technology maturity	▪ Technology is well-known and has been used in full-scale installations outside of mining	▪ Technology is well-known and has been used in full-scale installations outside of mining	▪ Technology is well known and has been used in full-scale installations outside of mining	▪ Technology is least well known and has been used in the fewest full-scale installations outside of mining
	Location of equipment suppliers	▪ Equipment suppliers located in the region of the mine	▪ Equipment suppliers located in the region of the mine	▪ Equipment suppliers located farther from the mine region	▪ Equipment suppliers located farthest from the mine region
	Technical support	▪ Greatest likelihood of technical support located within the region of the mine	▪ High likelihood of technical support located within the region of the mine	▪ Lower likelihood of technical support located within the region of the mine	▪ Least likelihood of technical support located within the region of the mine
	Operational complexity	▪ Lower operational complexity	▪ Least complex operationally	▪ Higher operational complexity	▪ Most complex operationally

Table 4.5-27: Alternatives Assessment for Effluent Treatment Technology

Assessment Category	Sub-category or Criteria	Alternative Options			
		Two-Stage Precipitation with Lime	Two-Stage Precipitation with Caustic	One-Stage Precipitation + RO	One-Stage Precipitation + Ion Exchange or Adsorption
Technical (continued)	Operational robustness	▪ Greatest ability to handle variations in influent water quality	▪ Able to handle variations in influent water quality	▪ Able to handle variations in influent water quality	▪ Limited ability to respond to variations in influent water quality (dependent upon treatment resin)
	Water balance / management seasonality	▪ Largest permissible range for influent flow rate to treatment	▪ Larger permissible range for influent flow rate to treatment	▪ Smaller permissible range for influent flow rate to treatment	▪ Smaller permissible range for influent flow rate to treatment
	Recovery from upset conditions	▪ Less effort and time required to recover treatment process following upset conditions	▪ Less effort and time required to recover treatment process following upset conditions	▪ Some effort and time required to recover treatment process following upset conditions	▪ Most effort and time required to recover treatment process following upset conditions
	Residuals volume	▪ Lower volume of residuals (sludge) produced	▪ Least volume of residuals (sludge) produced	▪ Higher volume of residuals (concentrate brine) produced	▪ Highest volume of residuals (regeneration brine) produced
	Residuals handling requirements	▪ Sludge residuals considered operationally more difficult to handle and transport for disposal	▪ Sludge residuals considered operationally more difficult to handle and transport for disposal	▪ Slurry residuals considered operationally easier to handle and transport for disposal	▪ Slurry residuals considered operationally easier to handle and transport for disposal ▪ Residuals volume larger than for RO
	Effort for expansion / design changes	▪ Similar to caustic, but more than the one-stage precipitation alternatives	▪ Similar to lime, but more than the one-stage precipitation alternatives	▪ Least amount of effort required to expand hydraulic treatment capacity or implement additional pre- or post-treatment processes	▪ Slightly more effort than for RO
	Design adaptability	▪ Most adaptable to treating additional COPCs or separate influent streams	▪ Adaptable to treating additional COPCs or separate influent streams	▪ Lower adaptability to treating additional COPCs or separate influent streams	▪ Least adaptable to treating additional COPCs or separate influent streams
	Adaptability to future technology	▪ Mature technology that is less likely to experience significant technological advances in the future	▪ Mature technology that is less likely to experience significant technological advances in the future	▪ Greater potential for significant technological advances in the future	▪ Some potential for significant technological advances in the future

Table 4.5-27: Alternatives Assessment for Effluent Treatment Technology

Assessment Category	Sub-category or Criteria	Alternative Options			
		Two-Stage Precipitation with Lime	Two-Stage Precipitation with Caustic	One-Stage Precipitation + RO	One-Stage Precipitation + Ion Exchange or Adsorption
Economic	Major equipment costs	▪ Lower equipment capital cost	▪ Lowest equipment capital cost	▪ Higher equipment capital cost	▪ Highest equipment capital costs
	Facility construction	▪ Lower construction cost	▪ Lowest construction cost	▪ Higher construction cost	▪ Highest construction cost
	Power	▪ Relatively low treatment power demand	▪ Relatively low treatment power demand	▪ Highest treatment power demand	▪ Higher treatment power demand
	Chemicals	▪ Lowest chemical costs	▪ Higher chemical costs	▪ Lower chemical costs	▪ Highest chemical costs (includes treatment resin)
	Water use	▪ Requires the most amount of fresh water	▪ Requires a higher amount of fresh water	▪ Requires the least amount of fresh water	▪ Requires a lower amount of fresh water
	Post-closure monitoring / maintenance	▪ Lowest post-closure and monitoring requirements anticipated for disposed sludges	▪ Low post-closure and monitoring requirements anticipated for disposed sludges	▪ More post-closure and monitoring may be required for disposed concentrate brine	▪ More post-closure and monitoring may be required for disposed regeneration brine
Social	Public support	▪ Higher support inferred based on similar projects and familiarity with the process	▪ Lower support inferred based on similar projects and familiarity with the process	▪ Greatest support inferred based on similar projects and familiarity with the process	▪ Lower support inferred based on similar projects and familiarity with the process
	Footprint	▪ Largest footprint	▪ Larger footprint	▪ Smaller footprint	▪ Smaller footprint
	Worker safety and human health	▪ Workers likely more familiar with the technology, including chemicals/reagents	▪ Risks associated with potential exposures to caustic	▪ Less potential exposure to chemicals/reagents but workers likely less familiar with the technology	▪ Less potential exposure to chemicals/reagents but workers likely less familiar with the technology
	Specialized workforce requirements	▪ Common treatment process; anticipate being able to hire from local community with on-site training	▪ Common treatment process; anticipate being able to hire from local community with some additional training provided	▪ Specialized workforce required to operate; significant training required to maximize local employment opportunities	▪ Specialized workforce required to operate; significant training required to maximize local employment opportunities
Overall		**More Preferred**	**Neutral**	**Less Preferred**	**Less Preferred**

Legend: more preferred | neutral | less preferred

COPC = constituent of potential concern; RO = reverse osmosis; GHG = greenhouse gas.

Results of the sensitivity analysis are presented in Table 4.5-28 using the sensitivity weighting cases shown in Table 4.5-26. Account merit ratings shown are the quantitative rankings of the alternative options. The first-place ranking (i.e., two-stage chemical precipitation with lime) remained the same for all sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) does not change the outcome. The second-place, third-place, and fourth-places rankings also remained the same across all sensitivity cases in the following order: two-stage precipitation with caustic, one-stage precipitation plus RO, and one-stage precipitation plus ion exchange or adsorption.

Table 4.5-28: **Effluent Treatment Technology Assessment Sensitivity Analysis Summary**

Category Weighting Cases	Category Weight	Effluent Treatment Alternatives Ranking			
		Two-Stage Precipitation with Lime	Two-Stage Precipitation with Caustic	One-Stage Precipitation + RO	One-Stage Precipitation + Ion Exchange or Adsorption
Base Case	Environmental = 4 Technical = 6 Economic = 6 Social = 4	1 [4.9]	2 [4.3]	3 [3.4]	4 [2.9]
NexGen	Environmental = 6 Technical = 3 Economic = 5 Social = 6	1 [4.6]	2 [4.0]	3 [3.6]	4 [3.4]
Equal	Environmental = 1 Technical = 1 Economic = 1 Social = 1	1 [4.6]	2 [4.1]	3 [3.8]	4 [3.4]
Economic = 0	Environmental = 4 Technical = 6 Economic = 0 Social = 4	1 [4.7]	2 [3.9]	3 [3.8]	4 [3.4]

Legend: more preferred | less preferred
[ ] = Account merit rating; RO = reverse osmosis.

4.5.12.1 Selected Alternative

Aligned with the effluent treatment technology assessment summary (Table 4.5-27) and the sensitivity analysis (Table 4.5-28), the selected alternative for the Project was **two-stage precipitation using lime**. As discussed in Section 4.4.2.1, Indigenous Groups and local communities have identified the protection of Patterson Lake as a high priority, and during JWGs a question was asked as to whether effluent releases to Patterson Lake would meet provincial and federal guidelines (BNDN-JWG 2021). All treatment alternatives considered in this assessment could meet environmental protection requirements in terms of water quality and discharges to the receiving environment (i.e., Patterson Lake). As such, the overall rankings between the alternatives were driven by relative differences in capital cost, and long-term operational, management, and surveillance costs, as well as factors associated with operational risk/complexity. The primary factors in selecting two-stage precipitation using lime technology were the simple and reliable design, and its robustness and flexibility/adaptability to changing conditions. The one-stage with RO or ion exchange alternatives can reduce the amount of water supply from, and discharged to, Patterson Lake through process plant and mining reuse of treated effluent; however, these systems are more complex in design, construction, and operation, and are less flexible in accommodating potential upset conditions or changes in the influent water quality. Two-stage precipitation with caustic was not selected owing to the greater risk of potential worker exposure to harmful chemicals/reagents (i.e., caustic).

As noted above, while the assessment resulted in an appropriate technology selection to support a conservative approach for the EA, this analysis will continue to be refined in accordance with REGDOC-2.9.2 and in consultation with the CNSC, other regulators, and stakeholders as the Project advances through subsequent stages of engineering and licensing.

4.5.13 Treated Effluent Discharge Location

As described in Section 4.5.12, the ETP would treat waste water from the process plant, as well as water from the underground mine and contact water from the proposed Project. The effluent from the ETP would be treated so that discharge water quality is acceptable, and then pumped and batch discharged via a pipeline and diffuser to Patterson Lake.

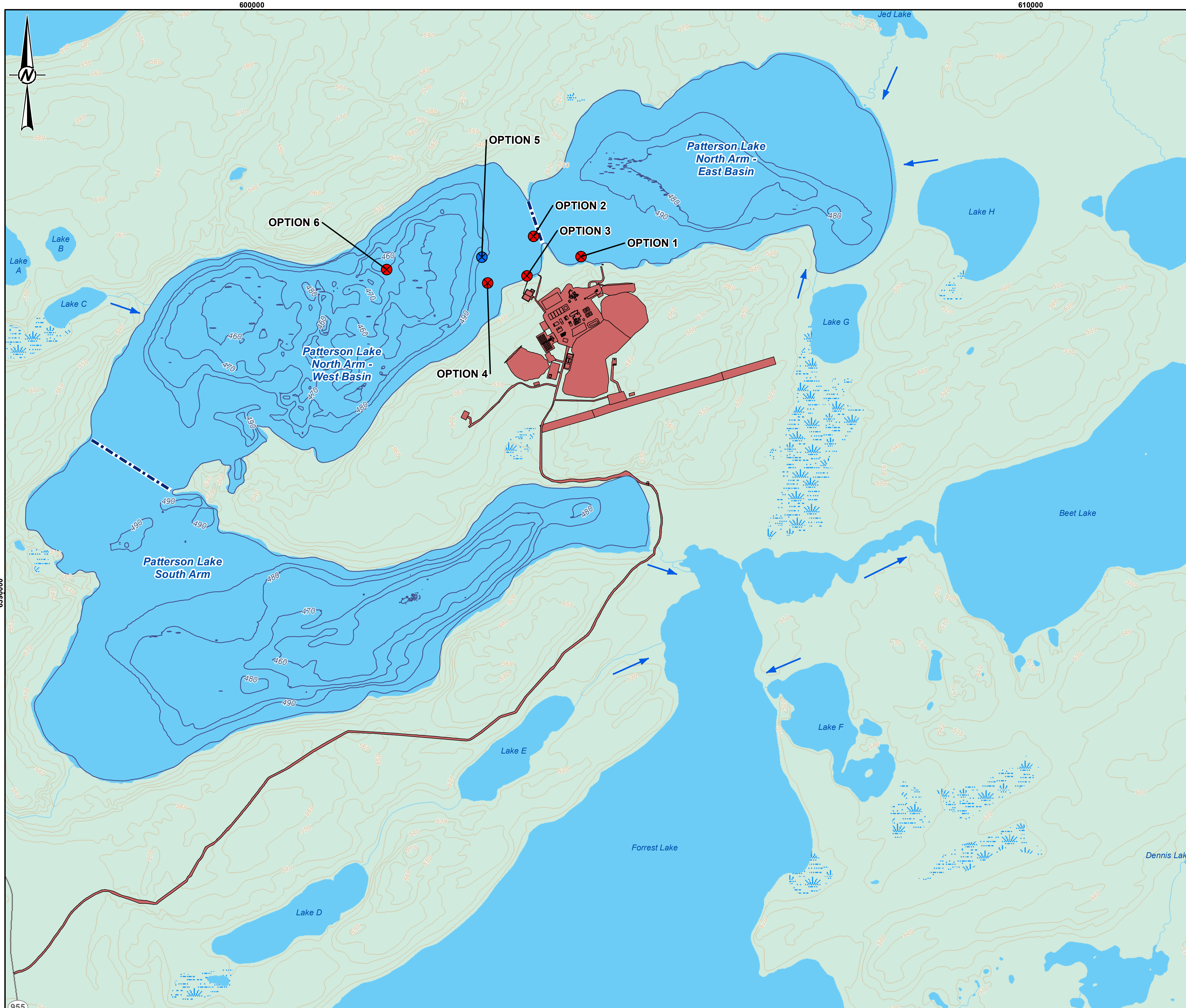
Six alternative options for treated effluent discharge location were evaluated based on Patterson Lake bathymetry and proposed treatment plant design including its location, operational mode, and range of treated effluent discharges (i.e., quality and flows). Options were also evaluated in consideration of a high-level mixing analysis, which focused on characterizing dilution performance once effluent was discharged to Patterson Lake. The six alternative options are listed in Table 4.5-29 and shown in Figure 4.5-14.

Table 4.5-29: Alternatives Assessment for Treated Effluent Discharge Location

Option	Alternative Options	Distance from Effluent Pond (m)	Water Depth (m)
1	North Arm – East Basin, near shore	893	1.05
2	North Arm – basin divide, near shore	959	0.79
3	North Arm – West Basin, near shore	566	0.85
4	North Arm – West Basin, near shore, close to effluent pond	790	2.39
5	North Arm – West Basin, optimal depth	1,300	10.0
6	North Arm – West Basin, maximum depth	2,220	46.4

All alternative options are located in the North Arm of Patterson Lake near the proposed ETP location and associated water management ponds. The options included near-shore locations in the North Arm – West Basin and North Arm – East Basin, as well as two off-shore options in the North Arm – West Basin: an optimal depth option and a maximum depth (i.e., deep water) option.

A **screening-level assessment** for the six alternative options for treated effluent discharge location was conducted using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-30. Based on the screening-level assessment, the more preferred alternative was the North Arm – West Basin, optimal depth (Option 5).



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- LAKE BASIN DIVISION
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT
- BATHYMETRY CONTOUR ELEVATION (METRES)
- FLOW DIRECTION

EFFLUENT TREATMENT PLAN DISCHARGE LOCATION ALTERNATIVE

- LESS PREFERRED EFFLUENT TREATMENT PLANT DISCHARGE LOCATION
- SELECTED EFFLUENT TREATMENT PLANT DISCHARGE LOCATION

0 1.5 3

1:50,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. BATHYMETRY CONTOURS DERIVED FROM DATA COLLECTED BY NEXGEN, 2016.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

ALTERNATIVES FOR EFFLUENT TREATMENT PLANT DISCHARGE LOCATION

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 4.5-14

Table 4.5-30: Alternatives Assessment for Effluent Treatment Discharge Location

Assessment Category	Sub-category or Criteria	Alternative Options					
		North Arm – East Basin, Near Shore (Option 1)	North Arm – Basin Divide, Near Shore (Option 2)	North Arm – West Basin, Near Shore (Option 3)	North Arm – West Basin, Near Shore, Close to Effluent Pond (Option 4)	North Arm – West Basin, Optimal Depth (Option 5)	North Arm – North West Basin, Maximum Depth (Option 6)
Environmental	Ecological integrity	▪ Larger mixing zone due to limited currents and water volumes ▪ Interaction with littoral zone that is moderately suitable for spawning walleye and lake whitefish, and marginal for white sucker and longnose sucker	▪ Larger mixing zone due to limited currents and water volumes ▪ Interaction with littoral zone that is low suitability with marginal spawning habitat for walleye and lake whitefish, and not suitable for other large-bodied fish	▪ Larger mixing zone due to limited currents and water volumes ▪ Interaction with littoral zone that is moderately suitable for spawning walleye and lake whitefish, and marginal for white sucker and longnose sucker	▪ Larger mixing zone due to limited currents and water volumes ▪ Interaction with littoral zone that has relatively high value as fish habitat and suitability for spawning	▪ Smaller mixing zone due to favourable currents and depths ▪ Pipeline intersects littoral zone with marginal habitat for yellow perch, and not suitable for other large-bodied fish	▪ Smaller mixing zone due to favourable currents and depths ▪ Pipeline intersects littoral zone that has relatively high value as fish habitat and suitability for spawning
Technical	Design and reliability	▪ Too shallow ▪ Insufficient current for adequate mixing	▪ Too shallow ▪ Unlikely to be adequate for mixing	▪ Too shallow ▪ Insufficient current for adequate mixing	▪ Too shallow ▪ Unlikely to be adequate for mixing	▪ Optimal depth ▪ Ambient currents would promote mixing	▪ Acceptable depth ▪ Ambient currents would promote mixing
	Construction risk and complexity	▪ Shallow with easy access	▪ Shallow with easy access	▪ Shallow with easy access	▪ Shallow with easy access	▪ Moderate depth; acceptable access	▪ Greater depth; difficult access
Economic	Capital cost	▪ Low cost due to short length and shallow depth	▪ Low cost due to short length and shallow depth	▪ Low cost due to short length and shallow depth	▪ Low cost due to short length and shallow depth	▪ Moderate cost due to length and depth	▪ High cost due to long length and deeper water
Social	Community effect / change in land use	▪ Potential for reduction in ice cover or thickness due to temperature effects in shallow water	▪ Potential for reduction in ice cover or thickness due to temperature effects in shallow water	▪ Potential for reduction in ice cover or thickness due to temperature effects in shallow water	▪ Potential for reduction in ice cover or thickness due to temperature effects in shallow water	▪ Potential to effect ice cover based on modelled plume velocity	▪ Unlikely to affect ice cover or thickness as discharge is at maximum depth
Overall		**Less Preferred**	**Neutral**	**Less Preferred**	**Less Preferred**	**More Preferred**	**Neutral**

Legend: more preferred | neutral | less preferred

4.5.13.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for treated effluent discharge location for the Project was **North Arm – West Basin, optimal depth** (Option 5). This option is best aligned with feedback received from Indigenous Groups and local communities regarding avoiding key of fish habitat and installations around shorelines of Patterson Lake (Section 4.4.2.1). The discharge location is situated at an optimal depth of around 10 m and is estimated to have favourable ambient currents to promote mixing in the receiving environment. In addition, the pipeline alignment for this option would intersect a section of shoreline that is not suitable fish spawning habitat except for yellow perch where the spawning habitat is only marginally suitable (Annex V.1, Aquatic Environment Baseline Report).

Options 1, 2, 3, and 4 are similar distances from the proposed ETP, and all four of these locations are sited in shallow water (i.e., less than 2.5 m deep). These shallow water areas would make construction relatively easy; however, shallow water is not favourable in terms of effluent mixing in the receiving environment. In addition, infrastructure and mixing zones for Options 1, 3, and 4 would interact with littoral fish habitat that is suitable for spawning by several large-bodied fish (Annex V.1). While Option 6 provides the greatest depth for mixing, the pipeline would affect habitat for large-bodied fish (Annex V.1); it would also require the longest pipeline, and the combined characteristics would make this option more difficult to construct, inspect, and maintain, as well as more costly than the other alternatives.

4.5.14 Fresh Water Supply – Source

Fresh water would be required by the Project for use as potable water (i.e., safe to drink), as well as process makeup water in the process plant. Fresh water would also be used for underground activities (e.g., line flushing and equipment uses), dust suppression, and to supply the fire suppression system. The fresh water demand for the proposed Project would be approximately 185 m^3/h. Three options for the source of fresh water supply were considered:

- surface water;
- groundwater; and
- trucked supply.

The **surface water** option for fresh water supply assumes that water would be withdrawn from Patterson Lake. This option would involve an intake structure at the lake connected to a treatment, storage, and distribution system. The intake structure would be designed to supply water year round, considering constraints around lake ice cover and operational conditions in winter.

The **groundwater** option would involve a well, or series of wells, from which groundwater would be pumped to surface and into a similar treatment, storage, and distribution system as noted for the surface water option.

With the **trucked supply** option, potable water would be brought to site by truck to meet the fresh water demands. This water, which would be pumped into large holding tanks for onward distribution to areas of the site, would not need to be treated prior to use but would involve additional logistics and increased traffic along regional roads.

Based on a **screening-level assessment**, and the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-31, surface water was identified as the preferred alternatives for fresh water supply.

Table 4.5-31: Alternatives Assessment for Fresh Water Supply Source

Assessment Category	Sub-category or Criteria	Alternative Options		
		Surface Water	Groundwater	Trucked Supply
Environmental	Potential effect on Patterson Lake	▪ Infrastructure located within and water withdrawn from Patterson Lake	▪ Low potential effect on Patterson Lake, assuming groundwater drawdown around wells has negligible effect on lake water levels	▪ Not applicable for Patterson Lake; may have adverse effects at alternate water source
	Potential effect on surface or groundwater	▪ Water is withdrawn from lake and treated effluent is discharged back to Patterson Lake; minimal effect on lake water volumes and levels	▪ Water is withdrawn from groundwater, and treated effluent is discharged to Patterson Lake (groundwater is not recharged directly)	▪ Would result in net increase to Patterson Lake watershed from addition of off-site (i.e., trucked) water ▪ Not applicable for local groundwater ▪ May have adverse effects at alternate water source
	Air quality and emissions	▪ Comparable to groundwater for pumping requirements	▪ Comparable to surface water for pumping requirements	▪ Increased emissions and GHGs associated with increased trucking
Technical	Design	▪ Design of lake intake system required	▪ Design of well infrastructure and withdrawal network required	▪ Minimal design required related to storage tanks
	Reliability	▪ Large volumes of water available immediately adjacent to site ▪ Most reliable water source	▪ Groundwater volumes could be limited from deep competent rock; shallower groundwater could be connected to lake system and have unintended interactions with lake water (e.g., could affect lake levels)	▪ Sufficient water volume available from off-site source; could be subject to transportation disruptions due to weather (potentially mitigated by on-site storage)
	Construction risk and complexity	▪ In-water construction required	▪ Drilling from land surface required	▪ Limited construction required, water tanks required on site
	Operational risk and complexity	▪ Maintenance of pumps and in-water at intake required	▪ Maintenance of pumps and groundwater well installations required	▪ Logistics of water delivery need to be managed ▪ High number of trucks per day required to supply the necessary volumes
Economic	Capital cost	▪ Higher capital costs	▪ Lower capital costs	▪ Lowest capital costs, assuming contract water delivery
	Operating cost	▪ Operating costs associated with pumps and energy required	▪ Operating costs associated with pumps and energy required	▪ High costs, based on on-going contract for water delivery that involves trucking
Social	Worker safety and human health	▪ Comparable to groundwater	▪ Comparable to surface water	▪ Risks associated with driving and increased traffic
Overall		**More Preferred**	**Neutral**	**Less Preferred**

Legend:	more preferred	neutral	less preferred

GHG = greenhouse gas.

4.5.14.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for fresh water supply source for the Project was **surface water** withdrawn from Patterson Lake. Despite the relative complexity in design and construction, fresh water supply from the adjacent Patterson Lake was preferred over the trucking option due to the lower reliability and increase in traffic, GHG emissions, and operating costs that trucking would involve to meet the fresh water needs. Fresh water supply from groundwater was also considered a feasible option; however, this option is less preferred than surface water as there is uncertainty in long-term availability and reliability from deep groundwater (i.e., competent rock is relatively dry) and drawing water from shallower depths could result in interactions with lake water.

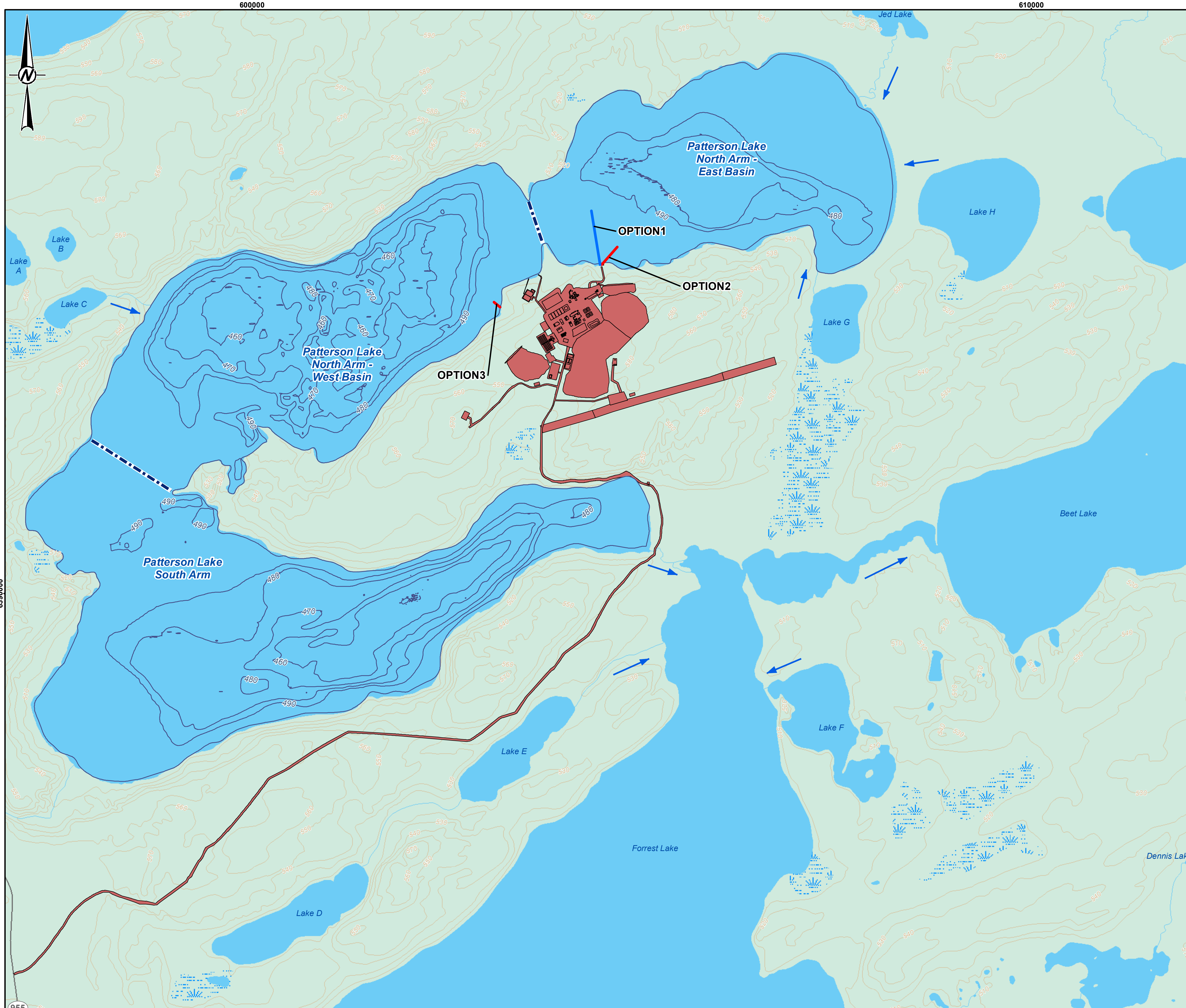
4.5.15 Fresh Water Supply – Location

Surface water from Patterson Lake was selected as the source for fresh water supply for the proposed Project (Section 4.5.14, Fresh Water Supply – Source). The fresh water system would involve an intake structure, intake pipe, and pump station to transfer lake water to the Project site for treatment and use. Potential intake locations were considered based on several characteristics including required depth of intake structure, resulting length of intake pipe, dominant lake currents, aquatic habitat (lake bed substrate), lake ice thickness and duration, and location of other site infrastructure (e.g., treated effluent discharge location [Section 4.5.13, Treated Effluent Discharge Location]). Three options for the fresh water supply location in Patterson Lake were considered, as shown in Figure 4.5-15, and are described below:

- North Arm – East Basin ~700 m from shore;
- North Arm – East Basin ~300 m from shore; and
- North Arm – West Basin ~100 m from shore.

The three options are similar in that they involve an intake structure located within Patterson Lake at comparable depths where winter ice formation is not anticipated to pose operational risks. Because the North Arm – East Basin of Patterson Lake is considerably shallower around its shoreline edge than the West Basin, the intake would have to be located farther out into the lake and would require longer intake pipes. However, the East Basin options provide an advantage over the West Basin option in that they minimize the potential for interactions with treated effluent discharges. As discussed in Section 4.5.13, the selected alternative for treated effluent discharge location is in the West Basin; from this location, dominant lake currents from east to west would tend to push treated effluent away from a fresh water intake location in the East Basin.

A **screening-level assessment** was completed for the fresh water supply location using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-32. Based on the screening-level assessment, the more preferred alternative was North Arm – East Basin at ~700 m from shore.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- LAKE BASIN DIVISION
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED
- PROPOSED PROJECT FOOTPRINT
- BATHYMETRY CONTOUR ELEVATION (METRES)
- FLOW DIRECTION

FRESH WATER INTAKE LOCATION ALTERNATIVE

- LESS PREFERRED FRESH WATER INTAKE LOCATION
- SELECTED FRESH WATER INTAKE LOCATION

0 1.5 3

1:50,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. BATHYMETRY CONTOURS DERIVED FROM DATA COLLECTED BY NEXGEN, 2016.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

FRESH WATER INTAKE LOCATION ALTERNATIVE

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 4.5-15

NexGen Energy Ltd.

Table 4.5-32: Alternatives Assessment for Fresh Water Supply Location

Assessment Category	Sub-category or Criteria	Alternative Options		
		North Arm – East Basin, ~700 m from Shore	North Arm – East Basin, ~300 m from Shore	North Arm – West Basin, ~100 m from Shore
Environmental	Potential effect on fish and fish habitat	▪ Gravel/cobble/boulder substate along shoreline ▪ Higher potential for medium to high quality spawning habitat for lake whitefish and northern pike	▪ Gravel/cobble/boulder substate along shoreline ▪ Higher potential for medium to high quality spawning habitat for lake whitefish and northern pike	▪ Sand/gravel substrate along shoreline near sandbar ▪ Potential for medium to high quality spawning habitat for lake whitefish and northern pike
Technical	Design and reliability	▪ Intake and pipe can be placed at adequate depth so that the intake screen is not affected by annual freezing	▪ Intake would be at adequate depth, but pipe may be more susceptible to freezing over shorter distance and shallow depths (effect on reliability)	▪ Deeper basin allows for intake screen and pipe to be placed at sufficient depths to avoid annual freezing (i.e., higher reliability)
	Construction risk	▪ Longer pipe makes installation more complicated	▪ Shorter pipe involves simpler installation	▪ Shorter pipe is easier to handle; installation at higher lake bed gradient could add some complexity
	Construction complexity	▪ Construction activities separate from other site activities (e.g., concurrent construction in the West Basin for the ETP and discharge pipes)	▪ Construction activities separate from other site activities (e.g., concurrent construction in the West Basin for the ETP and discharge pipes)	▪ Construction activities would overlap with other site activities (e.g., concurrent construction in the West Basin for the ETP and discharge pipes)
	Operational risk	▪ Minimizes potential to mix with site discharge (treated effluent), which is planned for the deeper waters of the West Basin)	▪ Minimizes potential to mix with site discharge (treated effluent), which is planned for the deeper waters of the West Basin) ▪ Higher potential for pipe freezing	▪ Some potential to mix with site discharge (treated effluent); would be mitigated by having the intake and discharges located at different elevations and locations
	Operational complexity	▪ Maintenance requires boat access and work at longer distances from shore	▪ Maintenance requires boat access and work at shorter distances from shore	▪ Maintenance involves more direct access (nearer to shore) but could require work at greater depths and gradients along pipe alignment
	Flexibility	▪ Could increase pipe size or add a second pipe ▪ Alternate routes available	▪ Difficult to increase pipe size due to shallow water ▪ Limited route options due to near-shore location and consistent depths	▪ Could increase pipe size or add a second pipe ▪ Potential alternate routing limited by location of treated effluent discharge
Economic	Capital cost	▪ Highest cost due to length of pipeline	▪ Lower cost due to shorter pipeline	▪ Lowest cost due to shortest pipeline
Social	Worker safety and human health	▪ Potential safety issues with maintenance activities at distances farther away from shore	▪ Fewer safety issues with maintenance work being done closer to shore and in shallower depths along pipe alignment	▪ Potential safety issues with work maintenance being done at greater depths and gradients along pipe alignment
Overall		**More Preferred**	**Neutral**	**Less Preferred**

Legend:	more preferred	neutral	less preferred

ETP = effluent treatment plant.

4.5.15.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for fresh water supply location for the Project was **North Arm – East Basin, ~700 m from shore**. The primary factors for selecting this option relate to the lower risk of potential influence from the treated effluent discharge compared to the West Basin option, and higher anticipated operational reliability compared to the other East Basin option (i.e., greater depth and protection against ice damage and freezing).

4.5.16 Sewage Treatment Technology

Sewage generated at the proposed Project would be collected at each building in individual sewage holding tanks and then hauled to the sewage treatment plant receiving station for treatment. For the camp, the sewage collection system would drain by gravity directly to the sewage treatment plant. The design of the sewage collection and treatment system would allow for redundancy and capacity to accommodate a peak population of approximately 350 people. It is estimated that approximately 165 m^3/d of sewage would be generated.

Three options for sewage treatment technology were considered:

- sewage lagoon;
- membrane bioreactor (MBR); and
- MBR with nanofiltration (NF) or RO.

The **sewage lagoon** option is a common method of sewage treatment and the simplest operation of the three options. Cells are typically lined with local clay material if suitable; otherwise, cells are lined with imported clay or synthetic liners (e.g., high-density polyethylene). In a lagoon, sewage is treated through a combination of aerated cells, chemical addition (e.g., alum), and ultraviolet disinfection. The aerated cells would aerate the incoming sewage to reduce biological oxygen demand, total suspended solids, and pathogen concentrations to levels that can be further reduced by alum addition and ultraviolet disinfection. Alum addition would also be required to achieve appropriate phosphorus limits for discharge. The treated sewage effluent is typically discharged twice seasonally, so a larger footprint is required for storage. Treated sewage effluent water quality is generally acceptable for surface water discharge. From a biosolids (treatment residuals) disposal perspective, this option may require disposal or land application every 8 to 10 years.

The **MBR** option is based on an advanced activated sludge process that utilizes membranes in tanks for solids separation instead of secondary clarifiers (e.g., alum). The membranes used in the process are either submerged in, or external to, the bioreactor tanks. Submerged MBR systems that utilize either hollow fibre ultrafiltration or flat sheet membranes are more common in municipal applications. Use of membranes for solids separation allows the treatment process to operate at high mixed liquor suspended solids concentrations (i.e., 8,000 mg/L to 12,000 mg/L) irrespective of sludge settling characteristics and provides a high quality of treated sewage effluent. Operation at high mixed liquor suspended solids also reduces the required bioreactor volume and the use of membrane replaces the need for clarifiers, which reduces the overall footprint of the treatment system. For purposes of the assessment, it was assumed that the treated sewage effluent from this option could be reused for process plant operations (i.e., dust control, process plant tower cooling, toilets).

The **MBR with NF or RO** option is similar to the MBR option with an additional membrane step. This added step removes dissolved impurities and generates the highest treated sewage effluent quality of the three options. The MBR with NF or RO option utilizes pressure across semipermeable membranes to primarily target the removal of dissolved contaminants such as organics, dissolved solids, and heavy metals. Additional post-treatment would be required to reduce corrosivity and adjust pH levels before any potential reuse in process plant operations. This option would also produce a high volume (i.e., 20% to 25%) of treatment residuals as membrane reject that requires a separate handling strategy. For the purposes of the assessment, it was assumed that the treated sewage effluent from this option could be reused for process plant operations (i.e., dust control, process plant tower cooling, toilets).

A **screening-level assessment** for the sewage treatment technology using the set of sub-categories (Table 4.4-2) and criteria indicated in Table 4.5-33. Based on the screening-level assessment, the more preferred alternative was a sewage lagoon.

Table 4.5-33: Alternatives Assessment for Sewage Treatment Technology

Assessment Category	Sub-category or Criteria	Alternative Options		
		Sewage Lagoon	**MBR**	**MBR with NF or RO**
Environmental	Potential to affect Patterson Lake, surface water, or groundwater	▪ Larger footprint required ▪ Treated effluent quality acceptable for environmental discharge	▪ Better treated effluent quality ▪ Smaller footprint ▪ Potential reduction in water supply and discharge volumes due to reuse of treated sewage effluent in process plant	▪ Best treated effluent quality ▪ Smaller footprint ▪ Potential reduction in water supply and discharge volumes due to reuse of treated sewage effluent in process plant
Technical	Design and reliability	▪ Standard level of design and reliability ▪ Minimal complexity	▪ Increased level of design and complexity	▪ Highest level of design and complexity
	Construction risk	▪ Minimal risk due to simple design	▪ Increased risk due to a more complicated design	▪ Highest risk due to a more complicated design
	Construction complexity	▪ Simple design allows for easy construction and installation	▪ Increased complexity for construction over sewage lagoon	▪ Highest complexity for construction
	Operational risk	▪ Minimal risk due to small amount of mechanical equipment (small pumps and piping that is easy to replace if required)	▪ Increased operational risk due to more equipment and higher level of maintenance requirements	▪ Highest operation risk due to the most equipment and highest level of maintenance requirements
	Operational complexity	▪ With minimal equipment, operation has low complexity ▪ Produces smaller volume of treatment residuals	▪ With increased equipment, operation has increased complexity ▪ Produces larger volume of treatment residuals that would require disposal	▪ With the highest amount of equipment, operation has the highest level of complexity ▪ Produces largest volume of treatment residuals that would require disposal
	Flexibility	▪ Additional lagoon can be added with required equipment without disruption to the existing facility	▪ Some flexibility available with potential disruption	▪ Limited flexibility with probable disruption
Economic	Capital and Operating costs	▪ Lowest cost option for capital and operating costs	▪ Higher cost option for capital and operating costs	▪ Highest cost option for capital and operating costs
Social	Worker safety and human health	▪ Requires less worker presence to operate; therefore, less potential exposure ▪ Less risk of exposure to raw sewage (no screening step) ▪ Less equipment and maintenance requirements ▪ Lower risk associated with hydrogen sulphide gas generation ▪ Less frequent treatment residuals removal ▪ Maintenance may require working on water	▪ Greater worker presence required to operate ▪ Greater risk of exposure to raw sewage (screening step) ▪ Greater exposure to mechanical equipment and confined spaces ▪ Hydrogen sulphide gas generation risk in enclosed spaces ▪ More frequent treatment residuals removal	▪ Similar to MBR with potentially more frequent treatment residuals removal required
Overall		**More Preferred**	**Neutral**	**Less Preferred**

Legend: more preferred | neutral | less preferred

MBR = membrane bioreactor; NF = nanofiltration; RO = reverse osmosis.

4.5.16.1 Selected Alternative

After evaluation of the relative advantages and disadvantages of the range of feasible alternatives, the selected alternative for sewage treatment technology for the Project was sewage lagoon. The primary factors in this selection were the simple and reliable design, both during construction and operation; ease of expansion if necessary; and relatively lower health and safety risks to workers. The other two options could have smaller footprints and generate higher water quality and reduce the amount of water supply drawn from, and discharged to, Patterson Lake through process plant reuse of treated sewage effluent; however, these systems are more complex in design, construction, and operation, pose relatively higher health and safety risks to workers, and are less flexible in accommodating potential upset conditions.

While a sewage lagoon would generate treated effluent that is acceptable for discharge, carrying this option through the EA was considered more conservative in terms of the assessment the potential effects of effluent discharges (quantity and quality) to Patterson Lake.

4.5.17 Conventional Waste Disposal

This alternatives assessment considered disposal for conventional waste generated during Construction and Operations of the proposed Project. Conventional waste in this assessment was categorized into four waste types:

- **Domestic waste:** all non-industrial waste, non-hazardous waste, and non-LLRW generated from the camp and office areas, including living quarters and coffee rooms, as well as kitchen, food preparation, and eating areas.
- **Industrial waste:** all non-domestic waste, non-hazardous waste, and non-LLRW generated from construction, commissioning, operation, and maintenance activities for the mine and process plant.
- **Hazardous waste:** all non-domestic, non-industrial, non-LLRW waste that is defined as a waste dangerous good in The Hazardous Substances and Waste Dangerous Goods Regulations.
- **Low-level radioactive waste (LLRW):** waste with radionuclide content above established unconditional clearance levels and exemption quantities but generally has limited amounts of long-lived radionuclides. This waste type includes radiologically contaminated materials from mining and processing activities but does not include ore, special waste, tailings (Section 4.5.6.2), gypsum (Section 4.5.6.3), or waste rock (Section 4.5.6.4, Waste Rock).

As discussed in Section 4.4.2.1, Indigenous Groups and local communities value minimizing potential disturbances to, and protecting the quality of, air, water, land, and wildlife. In review of the *Project Description for the Rook I Project* (NexGen 2019), NexGen was encouraged to recycle and reuse as many materials as possible during all phases of the proposed Project so as to decrease the amount of materials sent to a landfill and decrease the overall environmental footprint of the Project (YLNRO 2019).

Effective conventional waste management requires a multi-faceted approach to waste disposal. As such, it is acknowledged that many alternative options are not mutually exclusive, and that different alternative options could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project and protect the environment. Given that multiple alternative options could be utilized and that some options may be not available during the timelines of Project activities, the selected alternative for each waste type was determined based on the certainty of achievability and in consideration of a precautionary (i.e., conservative) approach for determining potential effects of the Project on the environment. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified (e.g., recycling and reuse), these alternatives or additional alternative options would be reconsidered, as necessary. By applying the precautionary approach, the Project design can be refined within established conservatism of the effects assessments in the EIS. Regardless, the recycling and reuse of materials that would otherwise require disposal would be an important component of the conventional waste management approach implemented for the Project.

4.5.17.1 Conventional Waste Alternatives Approach

An **MAA assessment** was conducted for each conventional waste type by completing the following steps:

- identification of alternative options (termed “candidate alternatives” in Golder [2022a]);
- pre-screening of alternatives against Project-specific evaluation criteria; and
- multiple accounts analysis of remaining options following pre-screening, including completion of a sensitivity analysis to evaluate the potential effect of bias.

Identification of alternative options was performed to generate an initial list of conventional waste disposal alternative options by waste type that could be implemented for the proposed Project during Construction and Operations. A summary of alternative options is provided in Table 4.5-34.

Table 4.5-34: Conventional Waste Disposal Alternative Options Summary

Alternative	Conceptual Description[a]	Applicable Waste Types
On-site repurpose/recycle	Material is processed or managed on site in a manner that extends the useful life of the item	Domestic waste Industrial waste
On-site incineration	Material is incinerated on site	Domestic waste Industrial waste Hazardous waste LLRW
On-site landfilling	Construction of dedicated on-site landfill to dispose of wastes that are generated	Domestic waste Industrial waste Hazardous waste LLRW
Co-mingled disposal with mine waste	Wastes are co-disposed on site in the same footprint as the NPAG WRSA	Domestic waste Industrial waste Hazardous waste LLRW
Off-site disposal	Disposal of waste at an existing, off-site facility that is permitted to accept waste materials	Domestic waste Industrial waste Hazardous waste LLRW
Off-site repurpose/recycle	Waste is processed at an existing, off-site facility for reuse/recycling by a third party	Domestic waste Industrial waste Hazardous waste
Underground disposal[b]	Disposal of waste in underground mine workings	Domestic waste Industrial waste Hazardous waste LLRW

a) It is recognized that all conventional waste may not be suitable to be handled by a single alternative. The conceptual description presented is reflective of the portion of the conventional waste appropriate to be managed under each alternative.
b) To maintain compliance with The Mines Regulations, 2018 and prevent the creation of potential fire hazards in the underground mine workings, the assessment assumed that waste disposed underground would be either non-combustible or would be processed or contained in a manner that would make it non-combustible.
NPAG WRSA = non-potentially acid generating waste rock storage area; LLRW = low-level radioactive waste.

Pre-screening against Project-specific evaluation criteria was completed for all identified alternative options. The pre-screening criteria were developed to provide a minimum specification for the Project. Options that did not pass the pre-screening criteria were eliminated from further evaluation, and options that passed each of the pre-screening criteria were carried forward to the MAA. The pre-screening criteria identified for conventional waste disposal and rationale for inclusion are shown in Table 4.5-35.

Table 4.5-35: Pre-screening Criteria for Conventional Waste Disposal

Pre-screening Criteria	Rationale for Inclusion
NexGen policy	Alternative options meet NexGen's overall objectives and policy commitments (i.e., if an alternative is not aligned with NexGen's policies and objectives, it is considered fatally flawed)
Regulatory compliance	Alternative options can meet regulatory requirements
Schedule	Alternative options can meet achievable, practical, and cost acceptable (as much as possible) implementation timelines during Construction and Operations of the Project

The following alternative options did not pass the pre-screening criteria and were not carried forward to the MAA:

- *Underground disposal for domestic and hazardous wastes.* This option was not considered a viable alternative for domestic and hazardous wastes due to the difficulty in preventing the generation of combustible gases during decomposition of these waste types, which is not compliant with the requirements of The Mines Regulations, 2018.
- *Co-mingled disposal with mine waste for all conventional waste types.* This option was not considered a viable alternative for conventional waste as detailed accounting and documentation of the volumes and locations of various waste types disposed within the WRSAs would not be feasible.

Multiple accounts analyses for the four remaining conventional waste types were performed for the options shown in Table 4.5-36.

Table 4.5-36: Summary of Alternative Options for Conventional Waste Multiple Accounts Analyses

Type of Waste	Alternative Options						
	On-Site Repurpose/ Recycle	On-Site Incineration	On-Site Landfilling	Co-mingled Disposal with Mine Waste	Off-Site Disposal	Off-Site Repurpose/ Recycle	Underground Disposal
Domestic waste	Yes	Yes	Yes	No	Yes	Yes	No
Industrial waste	Yes	Yes	Yes	No	Yes	Yes	Yes
Hazardous waste	n/a	Yes	Yes	No	Yes	Yes	No
LLRW	n/a	Yes	Yes	No	Yes	n/a	Yes

Yes = passed pre-screening and carried forward to MAA; No = did not pass pre-screening, not included to MAA; LLRW = low-level radioactive waste; MAA = multiple accounts analysis; n/a = not applicable: alternative not considered for waste type (Table 4.5-34).

Similar to the other alternatives assessments, the alternative options carried forward in the four MAAs were assessed using criteria within the environmental, technical, economic, and social categories to determine the preferred options. Sub-categories were defined within each of the categories, and individual criteria were assigned within each sub-category; these categories and sub-categories are termed "accounts" and "sub-accounts" in Golder (2022a). The selection of sub-categories and criteria, and descriptions of potential effects, focus on the main aspects that differentiate the alternative options and are not intended to be exhaustive. A summary of the weightings for the criteria, sub-categories, and categories is shown in Table 4.5-37 and is described in Section 4.5.6.1, with additional information in Golder (2022a).

Table 4.5-37: Conventional Waste Disposal Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Environmental	Ecological integrity	6	Surface area of disturbance	1
			Distance to critical habitat or habitat of interest	1
			Potential effect on Patterson Lake	6
			Potential for effect on plant, fish, and other wildlife population and habitat during Closure	1
	Hydrologic regime	1	Surface water – potential for effect	1
			Groundwater – potential for effect	1
	Air quality	1	Potential for excessive emissions of fugitive dust (e.g., particulates, heavy metals) and other non-GHG emissions during construction and operation	1
Technical	Design and reliability	6	Facility design effort	1
			Proven precedent for technology and configuration	6
			Available storage capacity	5
	Construction risk and complexity	2	Geotechnical stability considering foundation conditions and waste placement	1
			Liner area	1
	Operational risk and complexity	3	Operation and maintenance for transport and disposal system	1
			Ability for progressive facility closure during Operations	1
	Closure risk and complexity	1	Ease of decommissioning	1
	Flexibility	2	Effort required for expansion, optimization, and design changes	1
Economic	Capital cost	4	Procurement and facility construction	3
	Operating cost	2	Transport	1
			Operations and maintenance	1
			Water use	1
			Waste disposal (permitting and tipping fees)	1
	Closure cost	1	Facility closure	1
			Post-closure monitoring and maintenance	1

Table 4.5-37: Conventional Waste Disposal Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Social	Community effect	1	Measured distance to the nearest community	1
			Visual disturbance for an observer	1
			Perceived disruption to traditional land uses during Construction, Operations, and Closure	1
			Change in local employment opportunities	1
			Potential for disruption to archaeological site, cultural, or heritage asset	1
	Change in land use	1	Energy consumption for closure and potential restriction of public use	1
			Local resource consumption as borrow source(s) for construction	1
	Population at risk	1	Change to plant, fish, and other wildlife used by people	1
			Physical risk to people downstream	1
			Health risk to people downstream	1
			Worker safety and human health during closure	1
	Regulatory precedent	1	Alternative has precedent in application within Canadian mining industry	1

GHG = greenhouse gas.

Scoring and weighting of alternatives followed ECCC's *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (ECCC 2016). Alternatives were then ranked with the highest overall weighted score ranked 1, the next highest score ranked 2, and so on.

The MAAs for conventional waste disposal assessed which options would be preferred if all alternative options were equally feasible; however, the availability of off-site facilities to accept certain waste types or volumes could not be confirmed at the time of the assessment. Other considerations that factored into the MAA for conventional waste included:

- Lack of proximity of disposal facilities to the Project site: The proposed Project is in northern Saskatchewan, which would require long travel distances if materials were disposed off site.
- The alternatives assessment focuses on "disposal" of waste streams. An evaluation of alternatives for "managing" waste streams (e.g., sorting, segregation) is not considered part of the assessment.

For each of the conventional waste types, a sensitivity analysis was completed by varying category weighting to evaluate the effect of potential bias introduced by weighting. Category weighting cases used for each waste type are included in the subsections below and align with the sensitivity weighting cases shown in Table 4.5-7. Account merit ratings shown are the quantitative rankings of alternative options; additional details can be found in Golder (2022a).

4.5.17.2 Domestic Waste

Five waste disposal alternatives for domestic waste passed pre-screening and were carried forward in the **MAA**:

- on-site repurpose/recycle;
- on-site incineration;
- on-site landfilling;
- off-site disposal; and
- off-site repurpose/recycle.

A summary of the alternatives assessment for domestic waste is shown in Table 4.5-38, and category weighting cases used in the sensitivity analysis are summarized in Table 4.5-39.

After evaluating the relative environmental, technical, economic, and social aspects of the options, the following four alternatives were considered preferrable (as outlined in Table 4.5-38), and could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project:

- on-site repurpose/recycle;
- on-site incineration;
- off-site disposal; and
- off-site repurpose/recycle.

Table 4.5-38: **Alternatives Assessment for Domestic Waste**

Assessment Category	Sub-category or Criteria	Alternative Options				
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle
Environmental	Ecological integrity	▪ Some surface disturbance required for construction and operation	▪ Some surface disturbance required for construction and operation	▪ Large surface area disturbance	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility
	Hydrologic regime	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Greatest potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Low potential for hydrological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Low potential for hydrological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility
	Air quality	▪ Low potential for generation of dusts or other emissions	▪ Potential for emissions during incineration; however, facility can be designed to meet air quality requirements	▪ Potential for generation of gases due to decomposition of waste within facility	▪ Potential for higher GHG emissions due to long-distance travel to off-site facilities	▪ Potential for higher GHG emissions due to long-distance travel to off-site facilities

Table 4.5-38: Alternatives Assessment for Domestic Waste

Assessment Category	Sub-category or Criteria	Alternative Options				
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle
Technical	Design and reliability	▪ Straightforward design; however, relies on a need for repurposing materials	▪ Proven design concept and technology	▪ Proven design concept; however, higher design effort than other alternatives	▪ Straightforward, proven design	▪ Straightforward, proven design
	Construction risk and complexity	▪ Straightforward construction approach (low complexity)	▪ Proven technology with straightforward construction approach	▪ Proven concept; however, larger construction effort than other alternatives	▪ Low risk, as on-site construction activities not required	▪ Low risk, as on-site construction activities not required
	Operational risk and complexity	▪ Straightforward operational approach (low complexity)	▪ Established technology and operational approaches available	▪ Operational and maintenance activities (e.g., monitoring) required	▪ Risk associated with unknown disposal capacity at receiving facilities	▪ Risk associated with market need for recycled products
	Closure risk and complexity	▪ Straightforward closure approach (low complexity)	▪ Facility would require demolition/decommissioning upon closure	▪ Long-term monitoring requirements	▪ Closure risk and uncertainty managed by off-site facility	▪ Closure risk and uncertainty managed by off-site facility
	Flexibility	▪ Facility can be designed to accommodate portion of estimated volume of waste[a]	▪ Facility can be designed to accommodate portion of estimated volume of waste[a]	▪ Facility can be designed to accommodate estimated volume of waste	▪ Capacity and availability of off-site facilities is unknown	▪ Market need for recycled products is unknown
Economic	Capital cost	▪ Lowest capital costs for on-site disposal alternatives	▪ Capital costs expected to be lower than on-site landfilling	▪ High capital costs required for facility design and construction	▪ Limited capital costs required for temporary storage facility construction	▪ Limited capital costs required for temporary storage facility construction
	Operating cost	▪ Lowest operational costs for on-site disposal alternatives	▪ Operational costs primarily associated with power for the facility	▪ Ongoing maintenance and monitoring costs	▪ Uncertainty associated with landfill tipping fees	▪ Uncertainty associated with market need for recycled products
	Closure cost	▪ Small footprint/disturbance with low closure costs	▪ Costs associated with decommissioning infrastructure; post-closure monitoring not expected	▪ Long-term maintenance and monitoring of facility	▪ No post-closure monitoring required (managed by off-site facility)	▪ No post-closure monitoring required (managed by off-site facility)

Table 4.5-38: Alternatives Assessment for Domestic Waste

Assessment Category	Sub-category or Criteria	Alternative Options				
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle
Social	Community effect	▪ Lower visual impacts for public ▪ Potential for employment opportunities during Operations	▪ Lower visual impacts for public ▪ Potential for employment opportunities during Operations	▪ Higher visual impacts for public ▪ Limited potential for additional employment opportunities during Operations	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation
	Change in land use	▪ Potential disturbance/restrictions to land surface during Operations	▪ Potential disturbance/restrictions to land surface during Operations	▪ Potential for long-term disturbance to traditional land use during Closure ▪ Potential restriction to public access during Closure	▪ No change in land use or local resource consumption expected for existing facility	▪ No change in land use or local resource consumption expected for existing facility
	Population at risk	▪ Low potential physical and/or health risks to people downstream	▪ Low potential physical and/or health risks to people downstream	▪ Potential physical effects on wildlife and/or humans	▪ Potential physical and health risks to people downstream during off-site transport	▪ Potential physical and health risks to people downstream during off-site transport
Social	Regulatory precedent	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry, but anticipated to be less preferred compared to other alternatives	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry
Overall		**Neutral**	**Neutral**	**Less Preferred**	**Neutral**	**More Preferred**

Legend: more preferred | neutral | less preferred

a) Remaining materials managed using a parallel preferred waste disposal alternative.
GHG = greenhouse gas.

Following the ranking of alternatives, a sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. The first-place ranking (i.e., off-site repurpose/recycle) and second-place ranking (i.e., off-site disposal) remained the same for all sensitivity cases, and the third- and fourth-place rankings exchanged places between sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) had a limited effect on the alternative preference outcome. On-site landfilling remained the lowest ranked option under all sensitivity cases.

Table 4.5-39: Domestic Waste Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	Domestic Waste Alternatives Ranking				
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	4 [4.2]	3 [5.5]	5 [3.1]	2 [5.8]	1 [6.2]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	3 [4.2]	4 [4.0]	5 [2.3]	2 [4.6]	1 [5.0]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	3 [4.3]	4 [4.1]	5 [2.5]	2 [4.6]	1 [5.0]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	4 [4.2]	3 [4.4]	5 [2.4]	2 [4.4]	1 [4.8]

Legend: more preferred | less preferred

[ ] = account merit rating (Golder 2022a).

4.5.17.2.1 Selected Alternative

At this stage of the Project, **on-site incineration** was selected as the primary domestic waste disposal method. While assessed as a neutral alternative in the MAA due to the relative requirement for on-site infrastructure (i.e., surface disturbance) and emissions potential, this option was selected as the availability of off-site facilities to accept certain waste types or volumes could not be confirmed at the time of the assessment. As noted in the introduction to Section 4.5.17, Conventional Waste Disposal, effective conventional waste management requires a multi-faceted approach to waste disposal, and different alternative options, including maximizing recycling and reuse of suitable materials, could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project and protect the environment. Based on the information available for the assessment, on-site incineration provides greater certainty and flexibility for managing this waste stream and was deemed most conservative for the purposes of the EA with the consideration of direct effects of incinerator emissions included as part of the assessment basis for the EIS. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified (e.g., recycling and reuse), the options for domestic waste disposal would be reconsidered, as necessary.

4.5.17.3 Industrial Waste

Six waste disposal alternatives for industrial waste passed pre-screening and were carried forward in the **MAA**:

- on-site repurpose/recycle;
- on-site incineration;
- on-site landfilling;
- off-site disposal;
- off-site repurpose/recycle; and
- underground disposal.

A summary of the alternatives assessment for industrial waste is shown in Table 4.5-40, and category weighting cases used in the sensitivity analysis are summarized in Table 4.5-41.

After evaluating the relative environmental, technical, economic, and social aspects of the options, the following five alternatives were considered preferable (as outlined in Table 4.5-40), and could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project:

- on-site repurpose/recycle;
- on-site incineration;
- off-site disposal;
- off-site repurpose/recycle; and
- underground disposal.

Table 4.5-40: Alternatives Assessment for Industrial Waste

Assessment Category	Sub-category or Criteria	Alternative Options					
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle	Underground Disposal
Environmental	Ecological integrity	▪ Some surface disturbance required for construction and operation	▪ Some surface disturbance required for construction and operation	▪ Large surface area disturbance	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility	▪ Low potential for ecological effects given smaller surface disturbance as waste is securely disposed of underground
	Hydrologic regime	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Greatest potential for surface runoff contamination and/or groundwater infiltration of on-site surface facilities; however, facility design can include runoff and seepage collection systems, if necessary	▪ Low potential for hydrological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Low potential for hydrological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Potential for groundwater infiltration
	Air quality	▪ Low potential for generation of dusts or other emissions	▪ Potential for emissions during incineration; however, facility can be designed to meet air quality requirements	▪ Potential for dust generation	▪ Relatively high GHG emissions due to requirement for long-distance travel to off-site facilities	▪ Relatively high GHG emissions due to requirement for long-distance travel to off-site facilities	▪ Low potential for generation of dusts or other emissions

Table 4.5-40: Alternatives Assessment for Industrial Waste

Assessment Category	Sub-category or Criteria	Alternative Options					
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle	Underground Disposal
Technical	Design and reliability	▪ Straightforward design; however, relies on a need for repurposing materials	▪ Proven design concept and technology	▪ Proven design concept; however, higher design effort than other alternatives	▪ Straightforward, proven design	▪ Straightforward, proven design	▪ Sequencing, timing, and movement of waste to final disposal location underground during Operations may be unreliable
	Construction risk and complexity	▪ Straightforward construction approach (low complexity)	▪ Proven technology with straightforward construction approach	▪ Proven concept, but larger construction effort than other alternatives	▪ Low risk, as on-site construction activities not required	▪ Low risk, as on-site construction activities not required	▪ Straightforward construction approach for surface storage area; underground infrastructure developed as part of mine operations
	Operational risk and complexity	▪ Straightforward operational approach (low complexity)	▪ Established technology and operational approaches available	▪ Operations and maintenance activities (e.g., monitoring) required	▪ Risk associated with unknown disposal capacity at receiving facilities	▪ Risk associated with market need for recycled products	▪ Higher complexity due to sequencing and material handling from source to final disposal location
	Closure risk and complexity	▪ Straightforward closure approach (low complexity)	▪ Facility would require demolition/decommissioning upon closure	▪ Long-term monitoring requirements	▪ Closure risk and uncertainty managed by off-site facility	▪ Closure risk and uncertainty managed by off-site facility	▪ Straightforward closure approach (low complexity) for surface storage areas
	Flexibility	▪ Facility can be designed to accommodate portion of estimated volume of waste[(a)]	▪ Facility can be designed to accommodate portion of estimated volume of waste[(a)]	▪ Facility can be designed to accommodate estimated volume of waste	▪ Capacity and availability of off-site facilities are unknown	▪ Market need for recycled products is unknown	▪ Requires detailed handling/sequencing for final disposal

Table 4.5-40: Alternatives Assessment for Industrial Waste

Assessment Category	Sub-category or Criteria	Alternative Options					
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle	Underground Disposal
Economic	Capital cost	▪ Lowest capital costs for on-site disposal alternatives	▪ Capital costs expected to be lower than on-site landfilling	▪ High capital costs required for facility design and construction	▪ Limited capital costs required for temporary storage facility construction	▪ Limited capital costs required for temporary storage facility construction	▪ Low capital costs required for infrastructure upgrades and/or surface storage area prior to final disposal
	Operating cost	▪ Lowest operational costs for on-site disposal alternatives	▪ Operational costs primarily associated with power for the facility	▪ Ongoing maintenance and monitoring costs	▪ Uncertainty associated with landfill tipping fees	▪ Uncertainty associated with market need for recycled products	▪ High costs associated with handling and sequencing of wastes
	Closure cost	▪ Small footprint/disturbance with low closure costs	▪ Costs associated with decommissioning infrastructure; post-closure monitoring not expected	▪ Long-term maintenance and monitoring of facility	▪ No post-closure monitoring required (managed by off-site facility)	▪ No post-closure monitoring required (managed by off-site facility)	▪ Long-term monitoring required following closure
Social	Community effect	▪ Lower visual impacts for public ▪ Potential for employment opportunities during Operations	▪ Lower visual impacts for public ▪ Potential for employment opportunities during Operations	▪ Higher visual impacts for public ▪ Limited potential for additional employment opportunities during Operations	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation	▪ No visual impacts ▪ Lower potential for community effects ▪ Limited potential for additional employment opportunities during Operations

Table 4.5-40: Alternatives Assessment for Industrial Waste

Assessment Category	Sub-category or Criteria	Alternative Options					
		On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle	Underground Disposal
Social	Change in land use	▪ Potential disturbance / restrictions to land surface during Operations	▪ Potential disturbance/restrictions to land surface during Operations	▪ Potential for long-term disturbance to traditional land use during Closure ▪ Potential restriction to public access during Closure	▪ No change in land use or local resource consumption expected for existing facility	▪ No change in land use or local resource consumption expected for existing facility	▪ No incremental change in land use, beyond mine disturbances
	Population at risk	▪ Low potential physical and/or health risks to people downstream	▪ Low potential physical and/or health risks to people downstream	▪ Potential physical effects on wildlife and/or humans	▪ Potential physical and health risks to people downstream during off-site transport	▪ Potential physical and health risks to people downstream during off-site transport	▪ Low potential physical and/or health risks to people downstream
	Regulatory precedent	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry, but anticipated to be less preferred compared to other alternatives	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry
Overall		**Neutral**	**Neutral**	**Less Preferred**	**Neutral**	**More Preferred**	**Neutral**

Legend:	more preferred	neutral	less preferred

a) Remaining materials managed using a parallel preferred waste disposal alternative.
GHG = greenhouse gas.

Following the ranking of alternatives, a sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. The first-place ranking (i.e., off-site repurpose/recycle) and second-place ranking (i.e., off-site disposal) remained the same for all sensitivity cases, and the third-, fourth- and fifth-place rankings exchanged places between sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) had a limited effect on the alternative preference outcome. On-site landfilling remained the lowest ranked option under all sensitivity cases.

Table 4.5-41: Industrial Waste Assessment Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	Industrial Waste Alternatives Ranking					
		On-Site Repurpose /Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/ Recycle	Underground Disposal
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	5 [4.2]	4 [5.4]	6 [2.9]	2 [6.3]	1 [6.4]	3 [5.8]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	4 [4.3]	5 [4.0]	6 [2.3]	2 [4.9]	1 [5.0]	3 [4.6]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	4 [4.3]	5 [4.1]	6 [2.4]	2 [4.9]	1 [5.0]	3 [4.4]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	5 [3.0]	3 [3.3]	6 [1.7]	2 [3.8]	1 [3.8]	4 [3.2]

Legend: more preferred | less preferred

[ ] = account merit rating (Golder 2022a).

4.5.17.3.1 Selected Alternative

At this stage of the Project, **on-site incineration** was selected as the primary industrial waste disposal method. While assessed as a neutral alternative in the MAA due to the relative requirement for on-site infrastructure (i.e., surface disturbance) and emissions potential, this option was selected as the availability of off-site facilities to accept certain waste types or volumes could not be confirmed at the time of the assessment. As noted above, effective conventional waste management requires a multi-faceted approach to waste disposal, and different alternative options, including maximizing recycling and reuse of suitable materials, could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project and protect the environment. Based on the information available for the assessment, on-site incineration provides greater certainty and flexibility for managing this waste stream and was deemed most conservative for the purposes of the EA with the consideration of direct effects of incinerator emissions included as part of the assessment basis for the EIS. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified (e.g., recycling and reuse), the options for industrial waste disposal would be reconsidered, as necessary.

4.5.17.4 Hazardous Waste

Four waste disposal alternatives for hazardous waste passed pre-screening and were carried forward in the **MAA**:

- on-site incineration;
- on-site landfilling;
- off-site disposal; and
- off-site repurpose/recycle.

A summary of the alternatives assessment for hazardous waste is shown in Table 4.5-42, and category weighting cases used in the sensitivity analysis are summarized in Table 4.5-43.

After evaluating the relative environmental, technical, economic, and social aspects of the options, the following three alternatives were considered preferable (as outlined in Table 4.5-42), and could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project:

- on-site incineration;
- off-site disposal; and
- off-site repurpose/recycle.

Table 4.5-42: Alternatives Assessment for Hazardous Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle
Environmental	Ecological integrity	▪ Some surface disturbance required for construction and operation	▪ Large surface area disturbance	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility
	Hydrologic regime	▪ Potential for surface runoff, contamination, and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Greatest potential for surface runoff contamination and/or groundwater infiltration of on-site surface facilities; however, facility design can include runoff and seepage collection systems, if necessary	▪ Low potential for hydrological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Low potential for hydrological effects in area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility
	Air quality	▪ Potential for emissions during incineration; however, facility can be designed to meet air quality requirements	▪ Potential for generation of gases due to decomposition of waste within facility	▪ Relatively high GHG emissions due to requirement for long-distance travel to off-site facilities	▪ Relatively high GHG emissions due to requirement for long-distance travel to off-site facilities
Technical	Design and reliability	▪ Design concept considered applicable for certain types of hazardous waste[(a)]	▪ Proven design concept; however, higher design effort than other alternatives	▪ Straightforward, proven design	▪ Straightforward, proven design
	Construction risk and complexity	▪ Proven technology with straightforward construction approach	▪ Proven concept; however, larger construction effort than other alternatives	▪ Low risk, as on-site construction activities not required	▪ Low risk, as on-site construction activities not required
	Operational risk and complexity	▪ Established technology and operational approaches available	▪ Operations and maintenance activities (e.g., monitoring) required	▪ Disposal facilities are well established, but capacity and availability in the longer-term is unknown	▪ Disposal facilities are well established, but market need for recycled products in the longer term is unknown
	Closure risk and complexity	▪ Facility would require demolition/decommissioning upon closure	▪ Long-term monitoring requirements	▪ Closure risk and uncertainty managed by off-site facility	▪ Closure risk and uncertainty managed by off-site facility
	Flexibility	▪ Facility can be designed to accommodate portion of estimated volume of waste[(a)]	▪ Facility can be designed to accommodate portion of estimated volume of waste[(a)]	▪ Capacity and availability of off-site facilities in the longer-term is unknown	▪ Market need for recycled products in the longer term is unknown

Table 4.5-42: Alternatives Assessment for Hazardous Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle
Economic	Capital cost	▪ Capital costs expected to be lower than on-site landfilling	▪ High capital costs required for facility design and construction	▪ Limited capital costs required for temporary storage facility construction	▪ Limited capital costs required for temporary storage facility construction
	Operating cost	▪ Operational costs primarily associated with power for the facility	▪ Ongoing maintenance and monitoring costs	▪ Uncertainty associated with landfill tipping fees	▪ Uncertainty associated with market need for recycled products
	Closure cost	▪ Costs associated with decommissioning infrastructure; post-closure monitoring not expected	▪ Long-term maintenance and monitoring of facility	▪ No post-closure monitoring required (managed by off-site facility)	▪ No post-closure monitoring required (managed by off-site facility)
Social	Community effect	▪ Lower visual effects for public ▪ Potential for employment opportunities during Operations	▪ Higher visual effects for public ▪ Limited potential for additional employment opportunities during Operations	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation
	Change in land use	▪ Potential disturbance/restrictions to land surface during Operations	▪ Potential for long-term disturbance to traditional land use during Closure ▪ Potential restriction to public access during Closure	▪ No change in land use or local resource consumption expected for existing facility	▪ No change in land use or local resource consumption expected for existing facility
	Population at risk	▪ Low potential physical and/or health risks to people downstream	▪ Potential physical effects on wildlife and/or humans	▪ Potential physical and health risks to people downstream during off-site transport	▪ Potential physical and health risks to people downstream during off-site transport
	Regulatory precedent	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry, but anticipated to be less preferred compared to other alternatives	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry
Overall		**Neutral**	**Less Preferred**	**Neutral**	**More Preferred**

Legend:	more preferred	neutral	less preferred

a) Remaining materials managed using a parallel preferred waste disposal alternative.
GHG = greenhouse gas.

Following the ranking of alternatives, a sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. All rankings remained the same for all sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) had no effect on the outcome of preferred alternatives.

Table 4.5-43: Hazardous Waste Assessment Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	Hazardous Waste Alternatives Ranking			
		On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	3 [4.2]	4 [2.4]	2 [4.7]	1 [4.8]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	3 [4.1]	4 [2.4]	2 [4.7]	1 [5.0]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	3 [4.1]	4 [2.5]	2 [4.6]	1 [4.9]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	3 [4.3]	4 [2.8]	2 [5.3]	1 [5.4]

Legend: more preferred | less preferred

[ ] = account merit rating (Golder 2022a).

4.5.17.4.1 Selected Alternative

At this stage of the Project, **off-site repurpose/recycle** was selected as the primary hazardous waste disposal method. As noted in the introduction to Section 4.5.17, feedback received from the local community encouraged NexGen to recycle and reuse as many materials as possible during all phases of the proposed Project so as to decrease the amount of materials requiring disposal in a landfill (YLNRO 2019). Based on the information available for the assessment, the off-site options for repurposing/recycling hazardous waste were considered well-established and adequately equipped to safely manage this waste stream in particular. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified, the options for hazardous waste disposal would be reconsidered, as necessary.

4.5.17.5 Low-Level Radioactive Waste

Four waste disposal alternatives for LLRW waste passed pre-screening and were carried forward in the **MAA**:

- on-site incineration;
- on-site landfilling;
- off-site disposal; and
- underground disposal.

A summary of the alternatives assessment for LLRW is shown in Table 4.5-44, and category weighting cases used in the sensitivity analysis are summarized in Table 4.5-45.

After evaluating the relative environmental, technical, economic, and social aspects of the options, the following three alternatives were considered preferable (as outlined in Table 4.5-44), and could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project:

- on-site incineration;
- off-site disposal; and
- underground disposal.

Table 4.5-44: Alternatives Assessment for Low-Level Radioactive Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Underground Disposal
Environmental	Ecological integrity	▪ Some surface disturbance required for construction and operation	▪ Large surface area disturbance	▪ Low potential for ecological effects in area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility	▪ Low potential for ecological effects given smaller surface disturbance for temporary storage of wastes prior to secure, underground disposal
	Hydrologic regime	▪ Potential for surface runoff, contamination, and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Greatest potential for surface runoff contamination and/or groundwater infiltration of on-site surface facilities; however, facility design can include runoff and seepage collection systems, if necessary	▪ Low potential for hydrological effects in area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Potential for groundwater infiltration
	Air quality	▪ Potential for emissions during incineration; however, facility can be designed to meet air quality requirements	▪ Potential for dust generation	▪ Relatively high GHG emissions due to requirement for long-distance travel to off-site facilities	▪ Low potential for generation of dusts or other emissions
Technical	Design and reliability	▪ Proven design concept and technology	▪ Proven design concept; however, higher design effort than other alternatives	▪ Straightforward, proven design	▪ Sequencing, timing, and movement of waste to final disposal location underground, during Operations may be unreliable
	Construction risk and complexity	▪ Proven technology with straightforward construction approach	▪ Proven concept; however, larger construction effort than other alternatives	▪ Low risk, as on-site construction activities not required	▪ Straightforward construction approach for surface storage area; underground infrastructure developed as part of mining activities
	Operational risk and complexity	▪ Established technology and operational approaches available	▪ Operations and maintenance activities (e.g., monitoring) required	▪ Risk associated with unknown disposal capacity at receiving facilities	▪ Higher complexity due to sequencing and material handling from source to final disposal location
	Closure risk and complexity	▪ Facility would require demolition/decommissioning upon closure	▪ Long-term monitoring requirements	▪ Closure risk and uncertainty managed by off-site facility	▪ Straightforward closure approach (low complexity) for surface storage areas
	Flexibility	▪ Facility can be designed to accommodate a portion of the estimated volume of waste[(a)]	▪ Facility can be designed to accommodate estimated volume of waste	▪ Capacity and availability of off-site facilities is unknown	▪ Requires detailed handling/sequencing for final disposal

Table 4.5-44: Alternatives Assessment for Low-Level Radioactive Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Underground Disposal
Economic	Capital cost	▪ Capital costs expected to be lower than on-site landfilling	▪ High capital costs required for facility design and construction	▪ Limited capital costs required for temporary storage facility construction	▪ Low capital costs required for infrastructure upgrades and/or temporary surface storage area prior to final disposal
	Operating cost	▪ Operational costs primarily associated with power for the facility	▪ Ongoing maintenance and monitoring costs	▪ Uncertainty associated with landfill tipping fees	▪ High costs associated with handling and sequencing of wastes
	Closure Cost	▪ Costs associated with decommissioning infrastructure; post-closure monitoring not expected	▪ Long-term maintenance and monitoring of facility	▪ No post-closure monitoring required (managed by off-site facility)	▪ Long-term monitoring required following Closure
Social	Community effect	▪ Lower visual impacts for public ▪ Potential for employment opportunities during Operations	▪ Higher visual impacts for public ▪ Limited potential for additional employment opportunities during Operations	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation	▪ No visual impacts ▪ Lower potential for community effects ▪ Limited potential for additional employment opportunities during Operations
	Change in land use	▪ Potential disturbance/restrictions to land surface during Operations	▪ Potential for long-term disturbance to traditional land use during Closure ▪ Potential restriction to public access during Closure	▪ No change in land use in area of the Project or local resource consumption expected for existing facility	▪ No incremental change in land use beyond mine disturbances
	Population at risk	▪ Low potential physical and/or health risks to people downstream	▪ Potential physical effects on wildlife and/or humans	▪ Increased potential physical and health risks to people downstream during off-site transport	▪ Low potential physical and/or health risks to people downstream
	Regulatory precedent	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry, but anticipated to be less preferred compared to other alternatives	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry
Overall		**More Preferred**	**Less Preferred**	**Neutral**	**Neutral**

Legend:	more preferred	neutral	less preferred

a) Remaining materials managed using a parallel preferred waste disposal alternative.
GHG = greenhouse gas.

Following the ranking of alternatives, a sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. All rankings remained the same for all sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) had no effect on the alternative preference outcome.

Table 4.5-45: Low-Level Radioactive Waste Assessment Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	LLRW Alternatives Ranking			
		On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Underground Disposal
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	1 [4.7]	4 [2.4]	2 [4.6]	3 [3.8]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	1 [4.6]	4 [2.3]	2 [4.6]	3 [3.9]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	1 [4.7]	4 [2.5]	2 [4.6]	3 [3.7]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	1 [4.6]	4 [2.4]	2 [4.6]	3 [3.9]

Legend: more preferred | less preferred

[ ] = account merit rating (Golder 2022a); LLRW = low-level radioactive waste.

4.5.17.5.1 Selected Alternative

At this stage of the Project, **on-site incineration** was selected as the primary LLRW disposal method. As noted above, effective conventional waste management requires a multi-faceted approach to waste disposal, and different alternative options, including maximizing recycling and reuse of suitable materials, could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project and protect the environment. On-site incineration was considered conservative for the purposes of the EA with the direct effects of incinerator emissions included as part of the assessment basis for the EIS. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified (e.g., recycling and reuse), the options for LLRW waste disposal would be reconsidered, as necessary.

4.5.18 Decommissioning Demolition Waste Disposal

This alternatives assessment considered options for disposing of decommissioning demolition waste generated during Closure. At the conclusion of Operations, Project infrastructure would be transitioned to a safe and secure inactive state and demolished as part of decommissioning and reclamation activities. This infrastructure would consist of underground facilities and services required to support underground operations (e.g., maintenance facilities, fuel and lubricant storage); mining surface facilities (e.g., shaft headframe, hoist house); process plant facilities (e.g., buildings, storage tanks); water management and treatment infrastructure; and surface ancillary and support facilities (e.g., administration building, camp, maintenance and warehouse buildings, utilities, airstrip).

It is recognized that local communities may have interest in repurposing on-site infrastructure (e.g., camp buildings) prior to demolition. Leaving infrastructure in place is not anticipated as part of Closure activities;

however, it may be a subject of discussion between NexGen and local communities during the development of the Detailed Decommissioning and Reclamation Plan, which would be subject to approval by the CNSC and Government of Saskatchewan.

For the purposes of this assessment, demolition waste generated as result of decommissioning activities was categorized into three waste types:

- **Clean waste:** any waste generated from the decommissioning and demolition of the built infrastructure on the site that is not LLRW or hazardous waste. This is expected to be primarily steel and concrete but would also include smaller amounts of wood, plastic, and interior building contents in various forms.
- **Low-level radioactive waste (LLRW):** waste with radionuclide content above established unconditional clearance levels and exemption quantities but generally has limited amounts of long-lived radionuclides. This waste type includes radiologically contaminated facilities and equipment from mining and processing activities, but does not include ore, special waste, waste rock, gypsum, tailings, or hazardous, potentially LLRW.
- **Hazardous waste:** all non-clean decommissioning demolition waste that is defined as a waste dangerous good in The Hazardous Substances and Waste Dangerous Goods Regulations. For the purpose of this assessment, it has been assumed that hazardous, potentially LLRW decommissioning demolition waste is included in this waste type. However, the volume of hazardous, potentially LLRW is expected to be relatively small.

Decommissioning demolition waste does not include domestic or industrial wastes generated as a result of performing decommissioning activities as these are assumed to be managed in accordance with the selected options described in Section 4.5.17. The decommissioning demolition waste assessment also does not include tailings (Section 4.5.6.2), gypsum (Section 4.5.6.3), or waste rock (Section 4.5.6.4).

This assessment was conceptual in nature and considered appropriate for the EA and Closure planning at this stage of the proposed Project. The selected alternatives form the basis for the decommissioning methods that would be reflected in the Preliminary Decommissioning and Reclamation Plan and Cost Estimate. The options outlined herein may be subject to further evaluation and would be confirmed prior to development of the Detailed Decommissioning and Reclamation Plan.

As discussed in Section 4.4.2.1, Indigenous Groups and local communities value minimizing potential disturbances to, and protecting the quality of, air, water, land, and wildlife. In review of the *Project Description for the Rook I Project* (NexGen 2019), NexGen was encouraged to recycle and reuse as many materials as possible during all phases of the proposed Project so as to decrease the amount of materials sent to a landfill and decrease the overall environmental footprint of the Project (YLNRO 2019).

Similar to conventional waste disposal (Section 4.5.17), effective decommissioning demolition waste management requires a multi-faceted approach to waste disposal. As such, it is acknowledged that many alternative options are not mutually exclusive, and that different alternative options could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project and protect the environment. The selected alternative for each waste type was determined based on the certainty of achievability and in consideration of a precautionary (i.e., conservative) approach for determining potential effects of the Project on the environment. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified (e.g., recycling and reuse), these alternatives or additional alternative options would be reconsidered, as necessary. By applying the precautionary approach, the Project design can be refined within established conservatism of the effects assessments in the EIS. Regardless, the recycle and reuse of materials that would otherwise require disposal would be an important component of the decommissioning demolition waste management approach implemented for the Project.

4.5.18.1 Decommissioning Demolition Waste Alternatives Approach

An **MAA assessment** was conducted for each decommissioning demolition waste type by completing the following steps:

- identification of alternative options (termed “candidate alternatives” in Golder 2022b);
- pre-screening of alternatives against Project-specific evaluation criteria; and
- multiple accounts analysis of remaining options following pre-screening, including completion of a sensitivity analysis to evaluate the potential effect of bias.

Identification of alternative options was performed to generate an initial list of decommissioning demolition waste disposal alternative options by waste type that could be implemented for the Project during Closure. A summary of alternative options is provided in Table 4.5-46.

Table 4.5-46: Decommissioning Demolition Waste Disposal Alternative Options Summary

Alternative	Conceptual Description	Applicable Waste Types
Repurposing	Material is decontaminated (if necessary) and repurposed for another use on site	Clean waste LLRW
On-site landfilling	Construction of a dedicated on-site landfill to dispose of wastes that are generated during decommissioning	Clean waste LLRW Hazardous waste
Off-site disposal	Disposal of waste at an existing, off-site facility that is permitted to accept waste materials	Clean waste LLRW Hazardous waste
On-site processing and off-site recycling	Waste is processed on site and recycled off-site for use by a third party	Clean waste LLRW
Underground disposal[a]	Disposal of waste in underground mine workings	Clean waste LLRW Hazardous waste

a) To maintain compliance with The Mines Regulations, 2018 and prevent the creation of potential fire hazards in the underground workings, the assessment assumes that waste disposed underground would be either non-combustible or would be processed or contained in a manner that would make it non-combustible.
LLRW = low-level radioactive waste.

Pre-screening against Project-specific evaluation criteria was completed for all alternative options. The pre-screening criteria were developed to provide a minimum specification for the Project. Options that did not pass the pre-screening criteria were eliminated from further evaluation, and options that passed each of the pre-screening criteria were carried forward to the MAA. The pre-screening criteria identified for decommissioning demolition waste disposal and rationale for inclusion are shown in Table 4.5-47.

Table 4.5-47: Pre-screening Criteria for Decommissioning Demolition Waste Disposal

Pre-screening Criteria	Rationale for Inclusion
NexGen policy	Alternative options meet NexGen's overall objectives and policy commitments (i.e., if an alternative is not aligned with NexGen's policies and objectives, it is considered fatally flawed)
Regulatory compliance	Alternative options can meet regulatory requirements
Schedule	Alternative options can meet achievable, practical, and cost acceptable (as much as possible) implementation timelines during Closure phase of the Project

The following alternative options did not pass the pre-screening criteria and were not carried forward to the MAA:

- *Repurposing for clean waste and LLRW.* This option was not considered a viable alternative for all decommissioning demolition clean and LLRW waste as maintaining materials suitable for repurposing through demolition activities would not be feasible from a cost and schedule perspective. The feasibility of this option may be revisited during the development of the Detailed Decommissioning and Reclamation Plan.
- *Underground disposal for hazardous waste.* This option was not considered a viable alternative for hazardous waste as hazardous waste presents a potential for combustion, which is not compliant with the requirements of The Mine Regulations, 2018.

Multiple accounts analyses for the three decommissioning demolition waste types were performed for the options shown in Table 4.5-48.

Table 4.5-48: Summary of Alternative Options for Decommissioning Demolition Waste Multiple Accounts Analyses

Type of Waste	Alternative Options				
	Repurposing	On-Site Landfilling	Off-Site Disposal	On-Site Processing + Off-Site Recycling	Underground Disposal
Clean waste	No	Yes	Yes	Yes	Yes
LLRW	No	Yes	Yes	Yes	Yes
Hazardous waste	n/a	Yes	Yes	n/a	No

LLRW = low-level radioactive waste; MAA = multiple accounts analysis; Yes = passed pre-screening and carried forward in the MAA; No = did not pass pre-screening, not included in the MAA; n/a = not applicable: alternative not considered for waste type (Table 4.5-46).

Similar to the other alternatives assessments, the alternative options carried forward in the three MAAs were assessed using criteria within the environmental, technical, economic, and social categories to determine the preferred options. Sub-categories were defined within each of the categories and individual criteria were assigned within each sub-category; these categories and sub-categories are termed "accounts" and "sub-accounts" in Golder (2022b). The selection of sub-categories and criteria, and descriptions of potential effects, focus on the main aspects that differentiate the alternative options and are not intended to be exhaustive. A summary of the weightings for the criteria, sub-categories, and categories is shown in Table 4.5-49, and is described in Section 4.5.6.1, with additional information in Golder (2022b).

Table 4.5-49: Decommissioning Demolition Waste Assessment Category, Sub-category, and Criteria Summary

Assessment Category	Sub-category	Sub-category Weight	Criteria	Criteria Weight
Environmental	Ecological integrity	6	Surface area of disturbance	1
			Distance to critical habitat or habitat of interest	6
			Potential effect on Patterson Lake during Closure	6
			Potential effect on plant, fish, and other wildlife populations and habitat during Closure	6
	Hydrologic regime	1	Surface water – potential for effect	1
			Groundwater – potential for effect	1
			Groundwater – post-closure infiltration	1
Technical	Design and reliability	3	Facility design effort	1
			Proven precedent for technology and configuration	6
			Available storage capacity	5
	Closure risk and complexity	1	Number of geohazards identified and potential influence	1
			Liner area[(a)]	1
			Geotechnical stability considering foundation conditions	1
			Operation and maintenance for transport and disposal system	1
			Ability for progressive facility closure	1
	Flexibility	1	Effort required for expansion, optimization, and design changes	1
Economic	Capital cost	4	Procurement and facility construction	4
	Operating cost	2	Transport and disposal of waste	1
			Energy use for transport – diesel (haul)	1
			Water use[(a)]	1
			Waste disposal (permitting and tipping fees)	1
	Closure cost	1	Facility closure	1
			Post-closure monitoring and maintenance	1
Social	Community effect	1	Measured distance to the nearest community	1
			Visual disturbance for an observer	1
			Perceived disruption to traditional land uses during Construction, Operations, and Closure	1
			Change in local employment opportunities	1
			Potential for disruption to archaeological site or cultural or heritage asset	1
	Change in land use	1	Energy consumption for closure and potential restriction of public use	1
			Local resource consumption as borrow source(s) for construction	1
	Population at risk	1	Change to plants, fish, and other wildlife used by people	1
			Physical risk to people downstream	1
			Health risk to people downstream	1
			Worker safety and human health during closure	1
	Regulatory precedent	1	Alternative has precedent in application within Canadian mining industry	1

a) Criteria included for LLRW and clean waste categories, but not hazardous waste category.
LLRW = low-level radioactive waste.

Scoring and weighting of alternatives followed ECCC's *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (ECCC 2016). Alternatives were then ranked with the highest overall weighted score ranked 1, the next highest score ranked 2, and so on.

The MAAs for decommissioning demolition waste disposal assessed which options would be preferred if all alternative options were equally feasible; however, the availability of off-site facilities to accept certain waste types or volumes could not be confirmed at the time of the assessment. Other considerations that factored into the MAA for decommissioning demolition waste included:

- Lack of proximity of disposal facilities to the Project site: the proposed Project is in northern Saskatchewan, which would require long travel distances if materials were disposed off-site; and
- Decommissioning approaches planned at other uranium mining operations in Saskatchewan, including underground disposal of decommissioning wastes.

For each of the decommissioning demolition waste types, a sensitivity analysis was completed by varying category weighting to evaluate the effect of potential bias introduced by weighting. Category weighting cases used for each waste type are included in the subsections below and align with sensitivity weighting cases shown in Table 4.5-7. Account merit ratings shown are the quantitative rankings of alternative options; additional details can be found in Golder (2022b).

4.5.18.2 Clean Waste

Four waste disposal alternatives for clean waste passed pre-screening and were carried forward in the **MAA**:

- on-site landfilling;
- off-site disposal;
- on-site processing / off-site recycling; and
- underground disposal.

A summary of the alternatives assessment for clean waste is shown in Table 4.5-50 and category weighting cases used in the sensitivity analysis are summarized in Table 4.5-51.

After evaluating the relative environmental, technical, economic, and social aspects of the options, the following three alternatives were considered preferrable (as outlined in Table 4.5-50), and could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project:

- off-site disposal;
- on-site processing / off-site recycling; and
- underground disposal.

Table 4.5-50: Alternatives Assessment for Clean Decommissioning Demolition Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Landfilling	Off-Site Disposal	On-Site Processing / Off-Site Recycling	Underground Disposal
Environmental	Ecological integrity	▪ Large surface area disturbance	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility	▪ Some processing areas required on site, but material would be physically removed from site	▪ Low potential for ecological effects given no incremental surface impact as waste is securely disposed of underground
	Hydrologic regime	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Low potential for hydrological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, processing areas can include runoff and seepage collection systems, if necessary	▪ Potential for groundwater infiltration during Closure; high level of complexity to manage/control potential infiltration
Technical	Design and reliability	▪ Proven design concept; however, higher design effort than other alternatives	▪ Straightforward, proven design	▪ Straightforward design; however, relies on market need for recycled products	▪ Straightforward design process; storage capacity is available
	Closure risk and complexity	▪ Potential for leachate generation and/or leakage	▪ Closure risk and uncertainty managed by off-site facility	▪ Low complexity and risk	▪ Higher complexity due to sequencing and material handling from source to final disposal location
	Flexibility	▪ Facility can be designed to accommodate estimated volume of waste	▪ Capacity and availability of off-site facilities are unknown	▪ Market need for recycled products is unknown	▪ Limited flexibility for changes to design
Economic	Capital cost	▪ High capital costs required for facility design and construction	▪ No capital costs required for facility construction	▪ No capital costs required for facility construction	▪ Low capital costs required for infrastructure upgrades and/or modifications to underground infrastructure prior to final disposal
	Operating cost	▪ Lowest operational costs during Closure	▪ Uncertainty associated with landfill tipping fees	▪ Uncertainty associated with market need for recycled products (increased operating costs if waste is disposed at a landfill)	▪ Costs associated with handling and sequencing of wastes
	Closure cost	▪ Long-term monitoring required following closure	▪ No post-closure monitoring required (managed by off-site facility)	▪ No post-closure monitoring required (managed by off-site facility)	▪ Long-term monitoring required following closure

Table 4.5-50: Alternatives Assessment for Clean Decommissioning Demolition Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Landfilling	Off-Site Disposal	On-Site Processing / Off-Site Recycling	Underground Disposal
Social	Community effect	▪ Higher visual impacts for public ▪ Limited potential for additional employment opportunities	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation	▪ Lower visual impacts ▪ Potential effects on communities through which waste would be transported ▪ Potential for on-site opportunities for processing and third-party employment opportunities for off-site transportation	▪ No visual impacts ▪ Low potential for community effects ▪ Limited potential for additional employment opportunities
	Change in land use	▪ Potential for long-term disturbance to traditional land use during Closure ▪ Potential restriction to public access during Closure	▪ No change in land use or local resource consumption expected for existing facility	▪ No incremental change in land use beyond mine disturbances	▪ No incremental change in land use beyond mine disturbances
	Population at risk	▪ Potential physical effects on wildlife and/or humans	▪ Potential physical and health risks to people downstream during off-site transport	▪ Potential physical and health risks to people downstream during off-site transport	▪ Additional worker safety considerations during closure of underground
	Regulatory precedent	▪ Demonstrated precedence in Canadian mining industry, but anticipated to be less preferred compared to other alternatives	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry
Overall		**Less Preferred**	**More Preferred**	**Neutral**	**Neutral**

Legend: more preferred | neutral | less preferred

Following the ranking of alternatives, a sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. The first-place ranking (i.e., off-site disposal) remained the same for all sensitivity cases, and the second- and third-place rankings exchanged places between sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) had a limited effect on the alternative preference outcome. On-site landfilling remained the lowest ranked options under all sensitivity cases.

Table 4.5-51: Clean Decommissioning Demolition Waste Assessment Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	Clean Waste Alternatives Ranking			
		On-Site Landfilling	Off-Site Disposal	On-Site Processing + Off-Site Recycling	Underground Disposal
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	4 [3.6]	1 [5.3]	2 [4.6]	3 [4.5]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	4 [3.3]	1 [5.2]	3 [4.6]	2 [4.7]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	4 [3.4]	1 [5.2]	2 [4.6]	3 [4.5]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	4 [3.8]	1 [5.3]	2 [4.7]	3 [4.6]

Legend: more preferred | less preferred
[ ] = account merit rating (Golder 2022b).

4.5.18.2.1 Selected Alternative

At this stage of the Project, **underground disposal** was selected as the primary method for clean decommissioning demolition waste disposal. While assessed as a neutral alternative in the MAA, this option was selected for the purposes of the EA as the future availability of off-site disposal and/or recycling cannot be confirmed at this time, and in consideration of Indigenous Group and community feedback valuing backfilling of material underground as a means of minimizing effects on the surface (Section 4.4.2.1). As noted above, effective decommissioning waste management requires a multi-faceted approach to waste disposal, and different alternative options, including maximizing recycling and reuse of suitable materials, could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project and protect the environment. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified (e.g., recycling and reuse), the options for clean decommissioning demolition waste disposal would be reconsidered, as necessary.

4.5.18.3 Low-Level Radioactive Waste

Four waste disposal alternatives for LLRW passed pre-screening and were carried forward in the **MAA**:

- on-site landfilling;
- off-site disposal;
- on-site processing / off-site recycling; and
- underground disposal.

A summary of the alternatives assessment for LLRW is shown in Table 4.5-52, and category weighting cases used in the sensitivity analysis are summarized in Table 4.5-53.

After evaluating the relative environmental, technical, economic, and social aspects of the options, the following three alternatives were considered preferrable (as outlined in Table 4.5-52), and could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project:

- off-site disposal;
- on-site processing / off-site recycling; and
- underground disposal.

Table 4.5-52: Alternatives Assessment for Low-Level Radioactive Decommissioning Demolition Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Landfilling	Off-Site Disposal	On-Site Processing/Off-Site Recycling	Underground Disposal
Environmental	Ecological integrity	▪ Large surface area disturbance	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility	▪ Some processing areas required on-site; however, material would be physically removed from site	▪ Low potential for ecological effects given no incremental surface effect as waste is securely disposed of underground
	Hydrologic regime	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Low potential for hydrological effects in area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility	▪ Potential for surface runoff contamination and/or groundwater infiltration; however, processing areas can include runoff and seepage collection systems, if necessary	▪ Potential for groundwater infiltration during Closure; high level of complexity to manage/control potential infiltration
Technical	Design and reliability	▪ Proven design concept; however, higher design effort than other alternatives	▪ Straightforward, proven design	▪ Straightforward design; however, relies on market need for recycled products	▪ Straightforward design process; storage capacity is available
	Closure risk and complexity	▪ Potential for leachate generation and/or leakage	▪ Closure risk and uncertainty managed by off-site facility	▪ Low complexity and risk	▪ Higher complexity due to sequencing and material handling from source to final disposal location
	Flexibility	▪ Facility can be designed to accommodate estimated volume of waste	▪ Capacity and availability of off-site facilities is unknown	▪ Market need for recycled products is unknown	▪ Limited flexibility for changes to design
Economic	Capital cost	▪ High capital costs required for facility design and construction	▪ No capital costs required for facility construction	▪ No capital costs required for facility construction	▪ Low capital costs required for infrastructure upgrades prior to final disposal
	Operating cost	▪ Lowest operational costs during Closure	▪ Uncertainty associated with landfill tipping fees	▪ Uncertainty associated with market need for recycled products (increased operating costs if waste is disposed at a landfill)	▪ Costs associated with handling and sequencing of wastes
	Closure cost	▪ Long-term monitoring required following closure	▪ No post-closure monitoring required (managed by off-site facility)	▪ No post-closure monitoring required (managed by off-site facility)	▪ Long-term monitoring required following closure

Table 4.5-52: Alternatives Assessment for Low-Level Radioactive Decommissioning Demolition Waste

Assessment Category	Sub-category or Criteria	Alternative Options			
		On-Site Landfilling	Off-Site Disposal	On-Site Processing/Off-Site Recycling	Underground Disposal
Social	Community effect	▪ Higher visual impacts for public ▪ Limited potential for additional employment opportunities	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation	▪ Lower visual impacts ▪ Potential effects on communities through which waste would be transported ▪ Potential for on-site opportunities for processing and third-party employment opportunities for off-site transportation	▪ No visual impacts ▪ Low potential for community effects ▪ Limited potential for additional employment opportunities
	Change in land use	▪ Potential for long-term disturbance to traditional land use during Closure ▪ Restriction to public access during Closure	▪ No change in land use or local resource consumption expected for existing facility	▪ No incremental change in land use beyond mine disturbances	▪ No incremental change in land use beyond mine disturbances
	Population at risk	▪ Potential physical effects on wildlife and/or humans	▪ Potential physical and health risks to people downstream during off-site transport	▪ Potential physical and health risks to people downstream during off-site transport	▪ Additional worker safety considerations during closure of underground
	Regulatory precedent	▪ Demonstrated precedence in Canadian mining industry, but anticipated to be less preferred compared to other alternatives	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry	▪ Demonstrated precedence in Canadian mining industry
Overall		**Less Preferred**	**More Preferred**	**Neutral**	**Neutral**

Legend: more preferred | neutral | less preferred

Following the ranking of alternatives, a sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. All rankings remained the same for all sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) had no effect on the preferred alternative outcome.

Table 4.5-53: Low-Level Radioactive Decommissioning Demolition Waste Assessment Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	LLRW Alternatives Ranking			
		On-Site Landfilling	Off-Site Disposal	On-Site Processing + Off-Site Recycling	Underground Disposal
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	4 [3.6]	1 [5.3]	3 [4.4]	2 [4.8]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	4 [3.2]	1 [5.2]	3 [4.4]	2 [4.9]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	4 [3.4]	1 [5.2]	3 [4.4]	2 [4.7]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	4 [3.7]	1 [5.3]	3 [4.5]	2 [4.8]

Legend: more preferred | less preferred

[ ] = account merit rating (Golder 2022b); LLRW = low-level radioactive waste.

4.5.18.3.1 Selected Alternative

At this stage of the Project, **underground disposal** was selected as the primary method for low-level radioactive decommissioning demolition waste disposal. While assessed as a neutral alternative in the MAA, this option was selected for the purposes of the EA as the future availability of off-site disposal and/or recycling cannot be confirmed at this time, and in consideration of community and Indigenous Groups feedback valuing backfilling of material underground as a means of minimizing effects on the surface (Section 4.4.2.1). As noted above, effective decommissioning waste management requires a multi-faceted approach to waste disposal, and different alternative options, including maximizing recycling and reuse of suitable materials, could be employed in parallel, in series, or in conjunction to meet the long-term needs of the Project and protect the environment. As the Project advances, additional information becomes available, and opportunities to optimize waste disposal practices are identified (e.g., recycling and reuse), the options for low-level radioactive decommissioning demolition waste disposal would be reconsidered, as necessary.

4.5.18.4 Hazardous Waste

Two waste disposal alternatives for hazardous waste passed pre-screening and were carried forward in the **MAA**:

- on-site landfilling; and
- off-site disposal.

A summary of the alternatives assessment for hazardous waste is shown in Table 4.5-54, and category weighting cases used in the sensitivity analysis are summarized in Table 4.5-55.

After evaluating the relative environmental, technical, economic, and social aspects of the options, off-site disposal is considered preferrable to meet the long-term needs of the Project, as outlined in Table 4.5-54.

Table 4.5-54: Alternatives Assessment for Hazardous Decommissioning Demolition Waste

Assessment Category	Sub-category or Criteria	Alternative Options	
		On-Site Landfilling	Off-Site Disposal
Environmental	Ecological integrity	▪ Large surface area disturbance	▪ Low potential for ecological effects in the area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential disturbance in existing off-site facility
	Hydrologic regime	▪ Higher potential for surface runoff contamination and/or groundwater infiltration; however, facility design can include runoff and seepage collection systems, if necessary	▪ Low potential for hydrological effects in area of the Project because waste would be physically removed from site; assumed relatively lower incremental potential effects in existing off-site facility
Technical	Design and reliability	▪ Proven design concept; however, higher design effort than other alternatives	▪ Straightforward, proven design
	Closure risk and complexity	▪ Potential for leachate generation and/or leakage	▪ Closure risk and uncertainty managed by off-site facility
	Flexibility	▪ Facility can be designed to accommodate estimated volume of waste	▪ Capacity and availability of off-site facilities is unknown
Economic	Capital cost	▪ High capital costs required for facility design and construction	▪ No capital costs required for facility construction
	Operating cost	▪ Lowest operational costs during Closure	▪ Uncertainty associated with landfill tipping fees
	Closure cost	▪ Long-term maintenance of facility	▪ No post-closure monitoring required (managed by off-site facility)
Social	Community effect	▪ Visual impacts for public ▪ Limited potential for additional employment opportunities	▪ Potential effects on communities through which waste would be transported ▪ Potential for third-party employment opportunities for off-site transportation
	Change in land use	▪ Potential for long-term disturbance to traditional land use during Closure ▪ Potential restriction to public access during Closure	▪ No change in land use or local resource consumption expected for existing facility
	Population at risk	▪ Potential physical effects on wildlife and/or humans	▪ Potential physical and health risks to people downstream during off-site transport
	Regulatory precedent	▪ Demonstrated precedence in Canadian mining industry, but anticipated to be less preferred compared to other alternatives	▪ Demonstrated precedence in Canadian mining industry
Overall		**Less Preferred**	**More Preferred**

Legend: more preferred | less preferred

Following the ranking of alternatives, a sensitivity analysis was completed to evaluate the potential effect of bias introduced by category weighting. All rankings remained the same for all sensitivity cases, which indicated that changing weighting categories (i.e., introduction of bias) had no effect on the alternative preference outcome.

Table 4.5-55: Hazardous Decommissioning Demolition Waste Assessment Sensitivity Analysis Summary

Category Weighting Cases	Category Weight	Hazardous Waste Alternatives Ranking	
		On-Site Landfilling	Off-Site Disposal
Base Case	Environmental = 6 Technical = 3 Economic = 1.5 Social = 3	2 [3.3]	1 [5.7]
NexGen	Environmental = 4.1 Technical = 2 Economic = 3.4 Social = 4.1	2 [3.2]	1 [5.5]
Equal	Environmental = 3.4 Technical = 3.4 Economic = 3.4 Social = 3.4	2 [3.4]	1 [5.5]
Economic = 0	Environmental = 6 Technical = 3 Economic = 0 Social = 3	2 [3.3]	1 [5.8]

Legend: more preferred | less preferred

[ ] = account merit rating (Golder 2022b).

4.5.18.4.1 Selected Alternative

At this stage of the Project, **off-site disposal** was selected as the primary method for hazardous decommissioning demolition waste disposal. As the Project advances, and additional information becomes available, opportunities to minimize the amount of decommissioning demolition waste materials sent for off-site disposal would also be evaluated.

4.6 Selected Alternatives Summary

Through the screening-level and MAA assessments of alternatives, selected alternatives were identified for key Project components and processes. The selected alternatives are indicated in Table 4.6-1 and are described in more detail in Section 5, Project Description. As described in Section 4.1, the assessment of alternatives was carried out to identify the selected alternatives to carry forward for the Project through the EA process.

It is acknowledged many alternative options are not mutually exclusive, and that different alternative options could be employed in parallel, in series, or in conjunction to meet the long-term needs of the proposed Project. Given that multiple alternative options could be utilized, the selected alternative for each waste type for the Project was determined based on the certainty of achievability and in consideration of the precautionary (i.e., conservative) approach for determining potential effects of the Project on the environment.

Evaluation of the environmental, technical, social, and economic performance of the Project will be an ongoing process, and the alternatives assessment would be reviewed and optimized as the Project evolves through the EA process, permitting, and ultimately, through Construction, Operations, and Closure.

Table 4.6-1: Selected Alternatives for the Rook I Project

Project Alternatives	Alternative Options					
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Primary mining method	Open pit	**Underground**				
Underground mining method	Caving	**Long hole**	Cut and fill			
Process plant location	**On-site process plant**	Off-site process plant				
Process stripping method	Ammonia stripping	**Strong acid stripping**				
Final product type	$UO_2.nH_2O$	**U_3O_8**				
Mine waste storage – tailings	**Underground with paste at location U-4**	In-pit with slurry at location P-3	Surface with paste at location S-1	Surface with paste location S-3		
Mine waste storage – gypsum	**Underground with tailings in UGTMF**	Surface with waste rock in WRSA				
Mine waste storage – waste rock	Unsegregated, base case, unlined	Unsegregated, base case, lined	Unsegregated, engineered source control, unlined	Unsegregated, engineered source control, lined	Segregated, NPAG unlined, PAG lined	**Segregated, NPAG unlined, PAG engineered source control, and lined**
Power supply type	Grid power	On-site diesel power plant	**On-site LNG power plant**	On-site hybrid system of power plant and renewable energy supply		
Fuel delivery method	**Truck**	Pipeline	Air			
Camp location	South location	**West location**	East location			
Airstrip location	**Central west–east**	Eastern south–north	Central south–north	Western south–north		
On-site road alignment	**Southwest alignment**	Northeast alignment				
Effluent treatment technology	**Two-stage chemical precipitation using lime**	Two-stage chemical precipitation using caustic	One-stage chemical precipitation followed by RO	One-stage chemical precipitation followed by ion exchange or adsorption		
Treated effluent discharge location	North Arm – East Basin, near shore	North Arm – basin divide, near shore	North Arm – West Basin, near shore	North Arm – West Basin, near shore, close to effluent pond	**North Arm – West Basin, optimal depth**	North Arm – West Basin, maximum depth
Fresh water supply – source	**Surface water**	Groundwater	Trucked supply			
Fresh water supply – location	**North Arm – East Basin, ~700 m from shore**	North Arm – East Basin, ~300 m from shore	North Arm – West Basin, ~100 m from shore			
Sewage treatment technology	**Sewage lagoon**	MBR	MBR with NF or RO			
Conventional waste disposal – domestic	On-site repurpose/recycle	**On-site incineration**	On-site landfilling	Off-site disposal	Off-site repurpose/recycle	
Conventional waste disposal – industrial	On-site repurpose/recycle	**On-site incineration**	On-site landfilling	Off-site disposal	Off-site repurpose/recycle	Underground disposal
Conventional waste disposal – hazardous	On-site incineration	On-site landfilling	Off-site disposal	**Off-site repurpose/recycle**		
Conventional waste disposal – LLRW	**On-site incineration**	On-site landfilling	Off-site disposal	Underground disposal		
Decommissioning demolition waste disposal – clean	On-site landfill	Off-site disposal	On-site processing / off-site recycling	**Underground disposal**		
Decommissioning demolition waste disposal – LLRW	On-site landfill	Off-site disposal	On-site processing / off-site recycling	**Underground disposal**		
Decommissioning demolition waste disposal – hazardous	On-site landfill	**Off-site disposal**				

Legend: selected | not selected | not applicable

LLRW = low-level radioactive waste; LNG = liquified natural gas; UGTMF = underground tailings management facility; WRSA = waste rock storage area; NPAG = non-potentially acid generating; PAG = potentially acid generating; $UO_2.nH_2O$ = uranium peroxide; U_3O_8 = triuranium octoxide; MBR = membrane bioreactor; RO = reverse osmosis; NF = nanofiltration.

4.7 References

Acts and Regulations

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Rook I Project

Environmental Impact Statement

Section 5 Project Description

Submitted to:

Canadian Nuclear Safety Commission

Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Abbreviations and Units of Measure

Abbreviation	Definition
3-D	three-dimensional
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CNSC	Canadian Nuclear Safety Commission
CPB	cemented paste backfill
CPT	cemented paste tailings
EA	Environmental Assessment
ENV	Saskatchewan Ministry of Environment
ETP	effluent treatment plant
H:V	horizontal to vertical
HDPE	high-density polyethylene
IMS	Integrated Management System
ISO	International Organization for Standardization
IT	information technology
LHD	load-haul-dump
LLRW	low-level radioactive waste
LPA	local priority area
LNG	liquified natural gas
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
OPC	ordinary Portland cement
PAG	potentially acid generating
pH	potential of hydrogen
PMP	probable maximum precipitation
Project	Rook I Project
RMR	rock mass rating
STP	sewage treatment plant
TSD	Technical Support Document
U_3O_8	triuranium octoxide
UGTMF	underground tailings management facility
WRSA	waste rock storage area

Unit	Definition
%	percent
°C	degrees Celsius
<	less than
cfu/100 mL	colony forming units per 100 millilitres
cm/s	centimetres per second
Bq/g	becquerels per gram
d/yr	days per year
ha	hectare
h/d	hours per day
kg	kilogram
kg/yr	kilograms per year
km	kilometre

Unit	Definition
km/h	kilometres per hour
km^2	square kilometre
kt	kilotonne
kV	kilovolt
L	litre
L/min	litres per minute
m	metre
m/s	metres per second
m^3	cubic metre
m^3/d	cubic metres per day
m^3/h	cubic metres per hour
m^3/s	cubic metre per second
masl	metres above sea level
mg/L	milligrams per litre
Mlb	million pound
Mlb/yr	million pounds per year
mm	millimetre
Mm^3	million cubic metre
MPa	megapascal
Mt	million tonne
MW	megawatt
t	tonne
t/yr	tonnes per year

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5 PROJECT DESCRIPTION

Section 5, Project Description, of the Environmental Impact Statement provides a description of the proposed Rook I Project (Project), including information on the setting, design, components, and activities. Section 5 also includes information on the Project's human resource requirements, management system framework, and ongoing review and optimization process during the Project lifespan. As outlined in this Project description, the proposed Project has been informed by the completion of a Feasibility Study (NexGen 2021), which has primarily formed the basis for the Environmental Assessment (EA).

This section meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment (ENV) and Canadian Nuclear Safety Commission (CNSC; Section 1, Introduction; Terms of Reference from ENV and the CNSC *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* [Appendix 1A, Concordance Tables]).

5.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop the Project, a new uranium mining and milling operation in northwestern Saskatchewan. The Project would be located 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 (Figure 5.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 5.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

The Project, which is 100% owned by NexGen, would include facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement hosted, high-grade uranium deposit. The anticipated lifespan of the Project would be 43 years and include Construction, Operations, and Decommissioning and Reclamation (i.e., Closure) phases.

The proposed Project is subject to both provincial and federal EA processes, would be licensed as a nuclear facility by the CNSC, and would be subject to various provincial and federal permits and approvals (Section 1.3, Regulatory Framework). The EA for the Project is being advanced under a co-operative federal and provincial review, subject to CEAA 2012 and Saskatchewan's *The Environmental Assessment Act*, respectively. NexGen is implementing an integrated approach to the EA and licensing processes for the Project whereby information to support the licence application is submitted to the CNSC in a staged manner so there is alignment between the EA and licensing documentation.

The Project would be designed, constructed, operated, decommissioned, and closed in accordance with applicable regulatory requirements and industry best management practices, which would provide for the safety of the public and workers and the long-term protection of the environment. NexGen would develop and operate all Project infrastructure, facilities, and systems in accordance with design standards developed for the Project. Informed by a robust understanding of environmental considerations (e.g., climate; geotechnical, hydrological, and geochemical conditions), NexGen is committed to advancing the proposed Project with innovative approaches to mine design, management, and operations to deliver enhanced environmental, social, and economic performance.

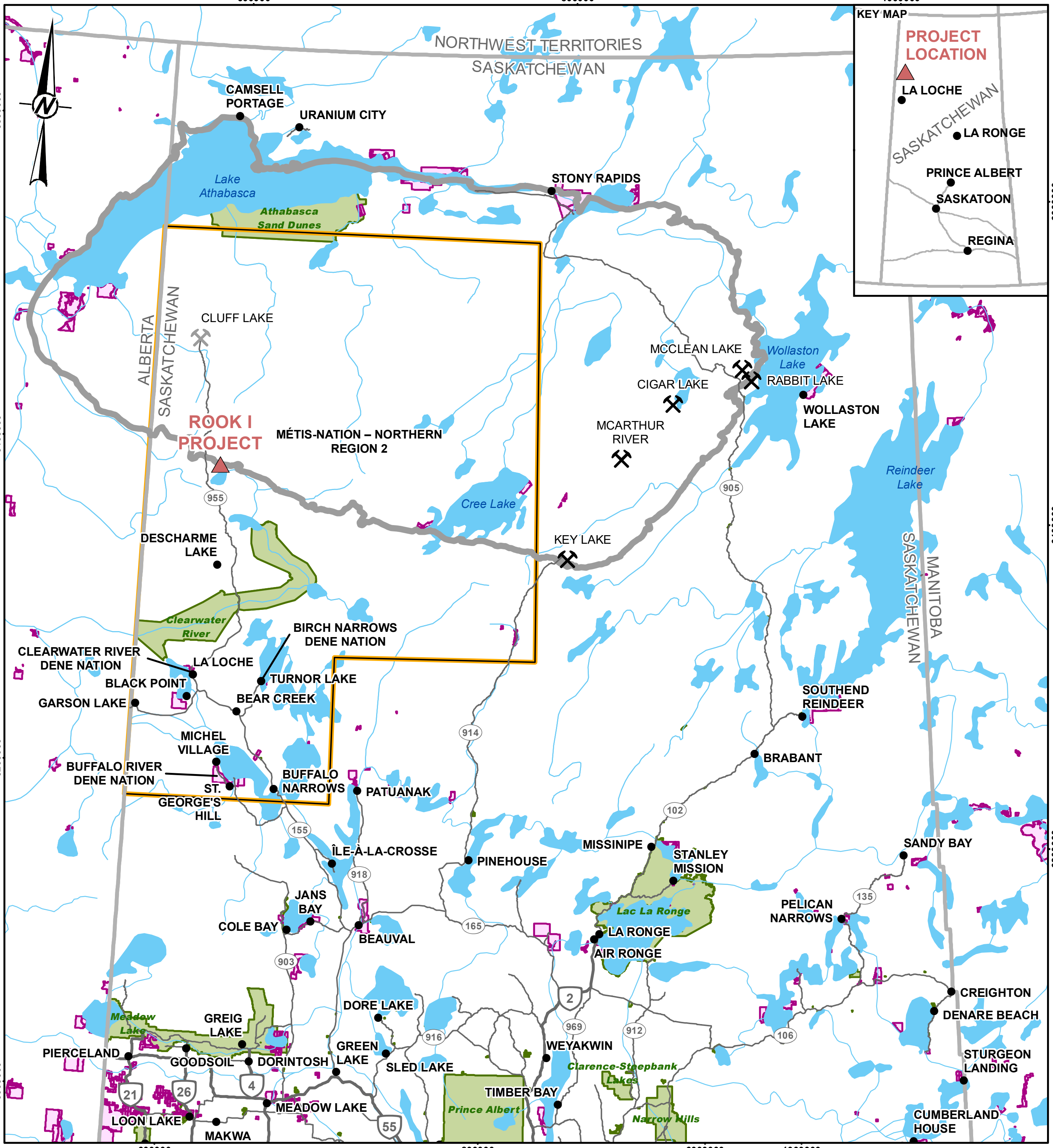
The proposed Project represents a substantial and consistent potential source of uranium for meeting the expected growing global demand for electricity. The Project could meaningfully contribute to the Government of Canada's ability to meet its environmental obligations and commitments with respect to climate change (Prime Minister of Canada 2021) by displacing high-greenhouse gas intensity fossil fuel (e.g., coal, natural gas) electricity generation in favour of low-greenhouse gas emitting, green energy. Providing a potential source of uranium would also support Saskatchewan's objective of developing lower carbon emission electricity generation over the next decade (Government of Saskatchewan 2019). The need for and purpose of the Project are further described in Section 4, Project Alternatives.

The facility designs, construction methods, and operating practices described in this section are based on feasibility engineering studies and design (NexGen 2021); have been informed by feedback from Indigenous, regulatory, and public engagement (Section 2); and have been influenced by Indigenous and Local Knowledge (Section 3). An assessment of alternative means was conducted to select the Project components and activities that formed the basis of the EA for the Project (Section 4, Project Alternatives).

The purpose of this Project description is to provide the Project details necessary to support the assessment of potential effects on components and attributes of the biophysical, cultural, and socio-economic environments, including ecological health and human health. It is recognized that review and optimization of Project components and activities described herein would be undertaken throughout the Project lifespan, with the objective of identifying opportunities to further enhance environmental, technical, economic, and social performance. This review and optimization would be pursued with the intent that any potential design iterations would be improvements on, and within the current considerations of, the assumptions carried within the EA (i.e., within the scope of the Project as defined for assessment). Final designs, construction methods, and operating practices will be developed during detailed engineering.

This section details the Project description used as the basis for the EA as follows:

- **Section 5.1, Introduction,** provides an overview of NexGen and the Project, including the key facilities, key Indigenous and community feedback, and the Project phases.
- **Section 5.2, Project Setting,** describes the Project setting, including mineral tenure and surface rights, current activities, regulatory context, local First Nations and Métis (collectively referred to in the Environmental Impact Statement as Indigenous) Groups, local communities, geology, and mineral resources.
- **Section 5.3, Project Design Considerations,** discusses key Project design considerations, including design standards, Project-specific environmental considerations (i.e., constraints), and design objectives.
- **Section 5.4, Project Components,** details the key Project components, organized by area (e.g., mining, processing, waste management, water management, supporting and off-site infrastructure).
- **Section 5.5, Project Activities,** summarizes key activities through the phases of the Project lifespan.
- **Section 5.6, Human Resources,** provides an overview of Project employment, training, and business and contracting opportunities.
- **Section 5.7, Integrated Management System,** discusses the management system framework that is foundational to conducting Project activities.
- **Section 5.8, Project Description Development, Review, and Optimization**, provides context for the proactive review and optimization of the Project description throughout the Project lifespan following the precautionary principle and within the scope of the Project as defined for the EA.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200
1:3,500,000 KILOMETRES

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

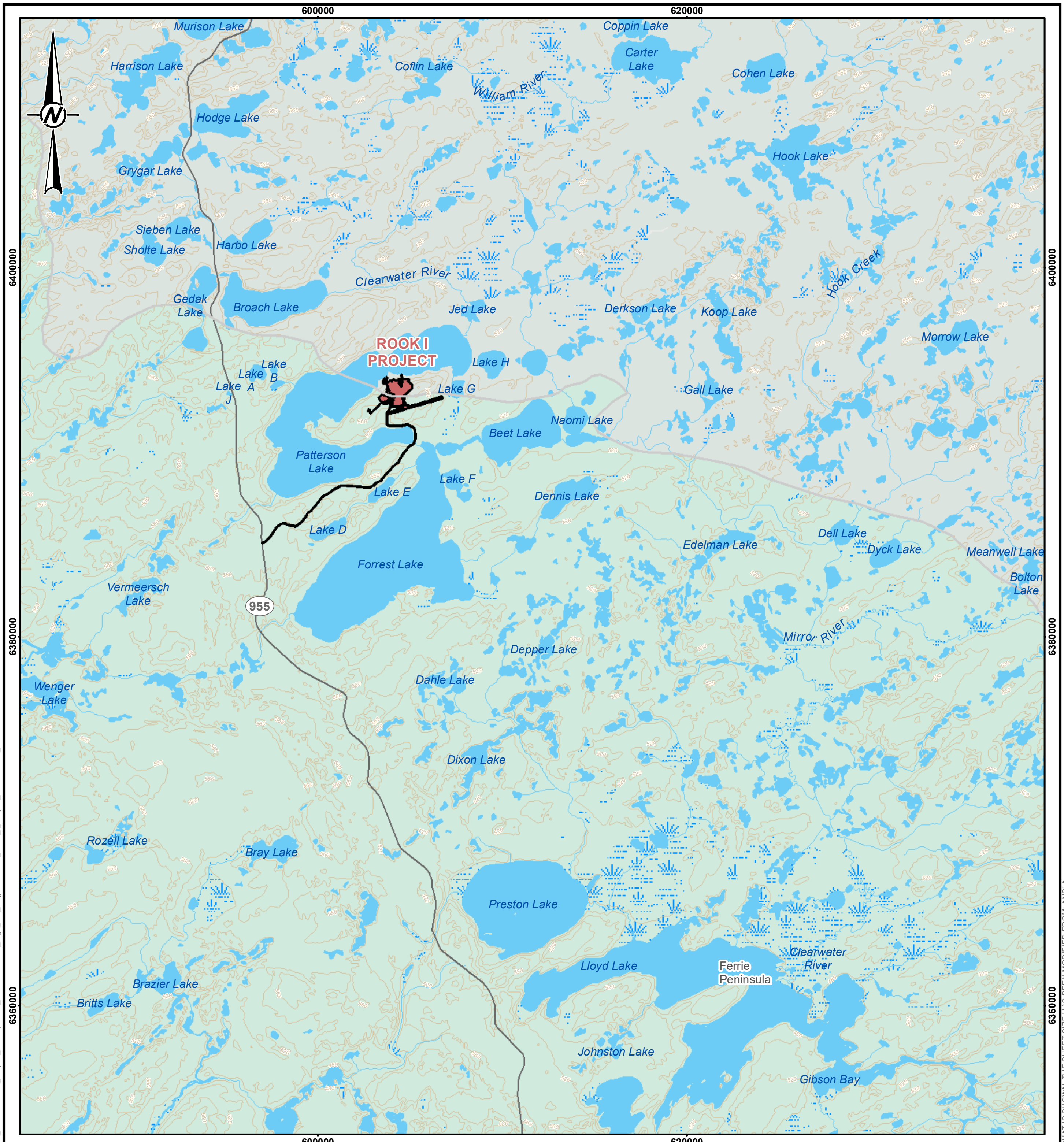
PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
LOCATION OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 5.1-1



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 5.1-2

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\05_Project_Description\8_5x11\20144150_Fig5_1-2_Regional-Area_Rook_I_Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-07 AT: 9:38:43 AM

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5.1.1 Project Overview

The proposed Project would include an underground mine and surface facilities to support the extraction of uranium ore from the Arrow deposit and the production of uranium concentrate.

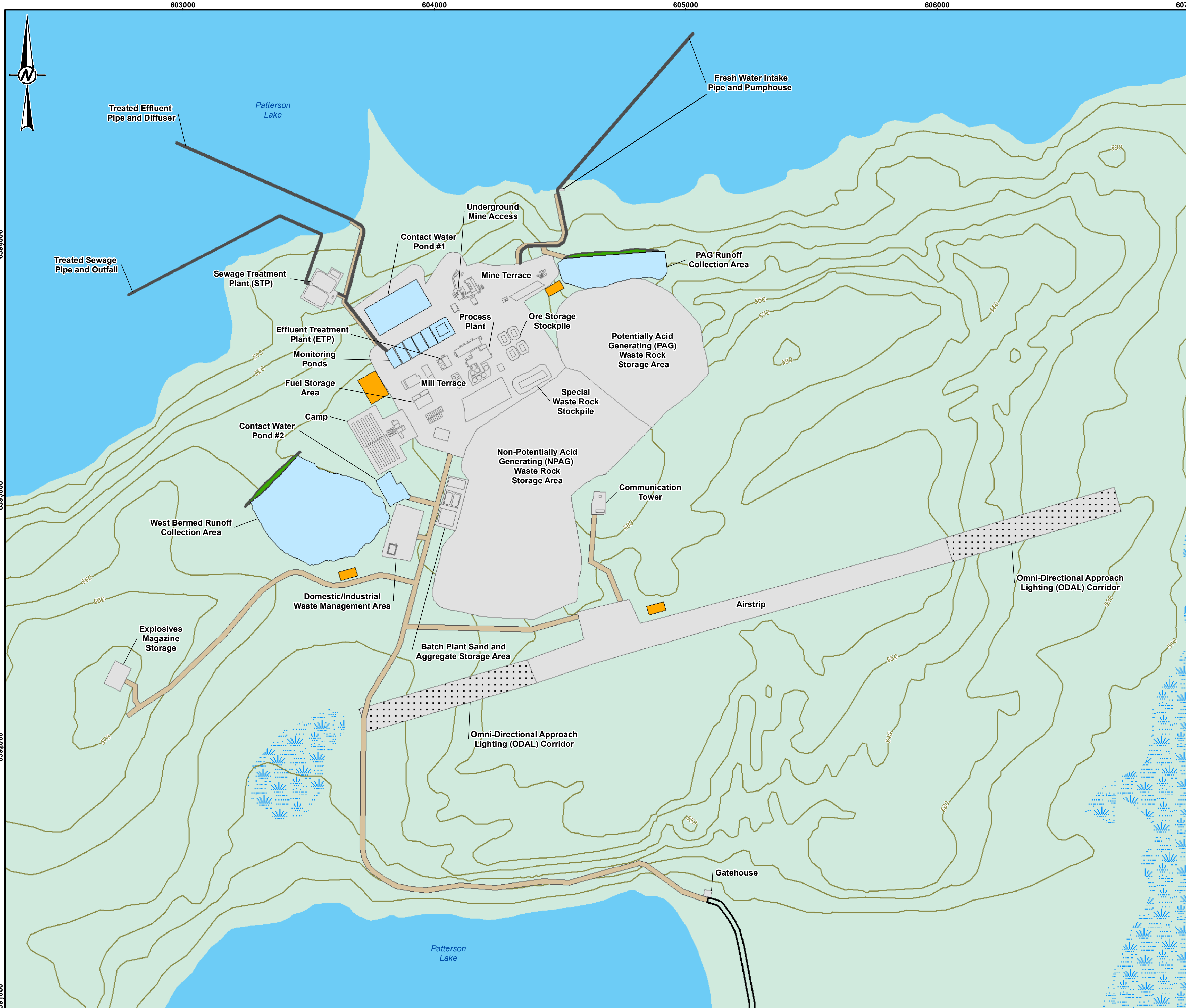
The Project would span a 43-year period from the beginning of Construction, through Operations, to the end of Closure. Construction is expected to take place over approximately four years and include activities such as site preparation and infrastructure development. Operations is expected to last for 24 years and include mining and processing and the associated tailings, waste, and water management. Closure would follow, with an expected duration of 15 years. Further detail on Project phases is provided in Section 5.1.4, and activities during Project phases are summarized in Section 5.5.

The anticipated physical footprint of the mine site and access road is approximately 228 ha, and would include the following key facilities (Figure 5.1-3):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility (UGTMF);
- potentially acid generating (PAG) waste rock storage area (WRSA);
- non-potentially acid generating (NPAG) WRSA;
- special waste rock[1] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant (ETP), and sewage treatment plant (STP);
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to the Project and site roads.

For illustrative purposes, a general schematic of primary Project infrastructure is shown in Figure 5.1-4. Detailed information regarding the mine and related infrastructure and facilities is included in subsequent subsections.

[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

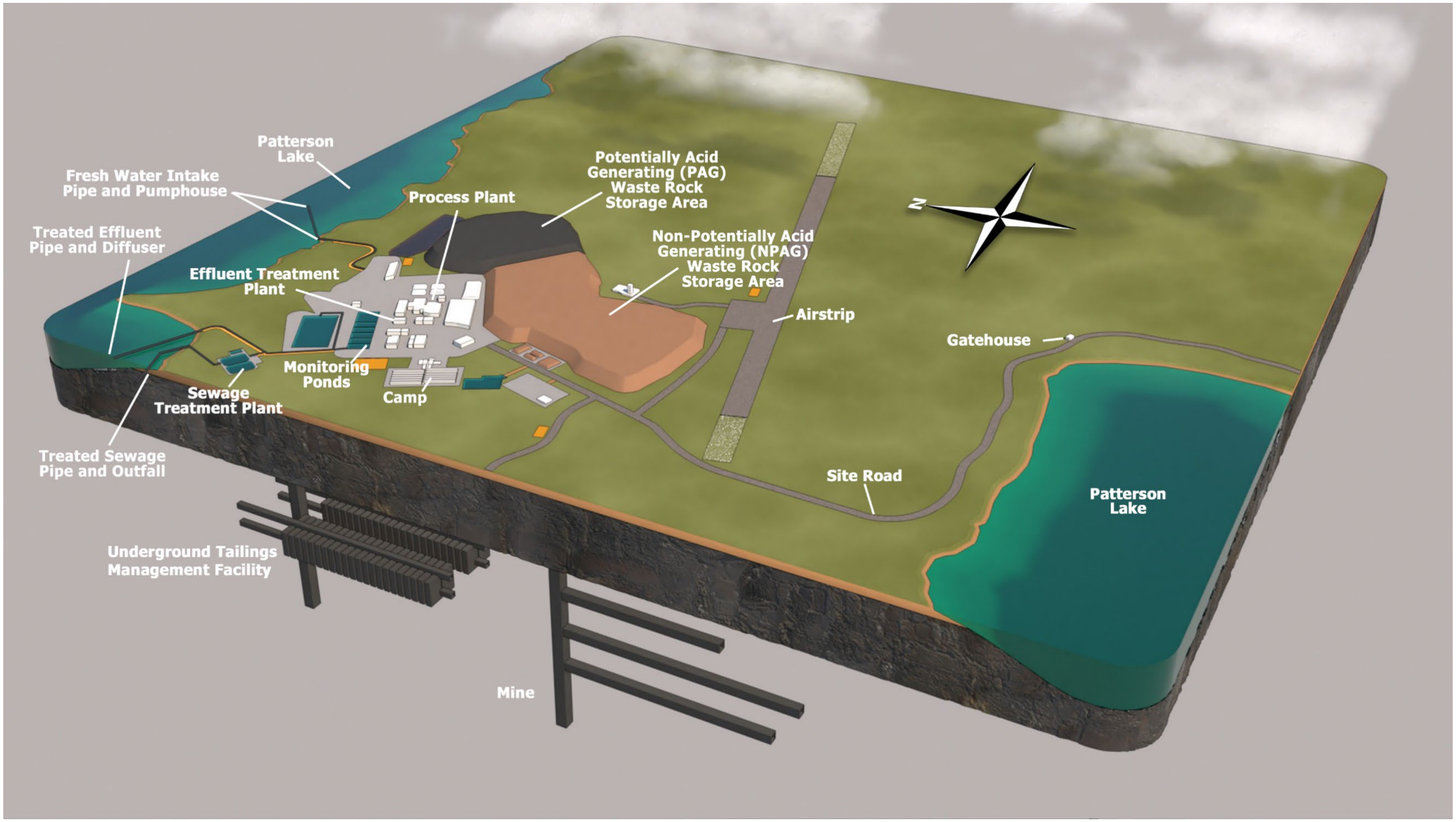
CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 5.1-3

Figure 5.1-4: General Schematic of Primary Rook I Project Infrastructure



5.1.2 Proponent Information

NexGen is a well-funded Canadian corporation focused on the acquisition, exploration, and development of Canadian uranium projects. Founded on the belief that natural resource development can be successfully attained in a sustainable and responsible manner resulting in prosperity and opportunity for multiple generations, NexGen's is leveraging its proven experience to deliver long-term economic, social, and environmental benefits for Saskatchewan, Canada, and the world.

NexGen was founded in 2011 after an extensive evaluation process of global uranium assets, which led to the acquisition of the southwest Athabasca Basin project portfolio that includes the Rook I property. Led by a team of experienced uranium and mining industry professionals with expertise across the entire mining life-cycle (e.g., exploration, mine development, operations, closure), NexGen's vision is to become a world leader in delivering clean energy solutions for current and future generations.

Sustainability is embedded in all of NexGen's business and operational decisions. With the Project, NexGen is committed to maximizing value to all stakeholders in a way that makes a lasting positive impact. Further information on NexGen can be found in Section 1.1, Proponent Overview.

5.1.3 Indigenous and Community Feedback

NexGen is committed to incorporating feedback from engagement and Indigenous and Local Knowledge[2] throughout the Project lifespan, consistent with the approach taken through early engagement activities and the EA process to date.

NexGen's goal is to leave lasting benefits to local communities. Advancing design for the Project has incorporated this goal through a life-cycle planning approach in consideration of current and future generations, and in recognition of the role that Indigenous and Local Knowledge has in guiding aspects of decision making throughout the Project lifespan.

Since 2013, NexGen has worked closely with the local communities and those expressing interest in the Project to help develop meaningful relationships based on trust and respect. Prior to commencement of the EA process in 2019 through the submission of the *Project Description for the Rook I Project* (NexGen 2019), NexGen regularly engaged with local Indigenous Groups and communities on proposed exploration activities and early Project development aspects. Specific to Project design, the following feedback was received through engagement activities:

- The protection of Patterson Lake, and subsequently downstream waterbodies and watercourses, from potential negative effects during all phases of the Project is paramount, including during upset conditions (i.e., unanticipated discharges).
- There is a preference for designs that reduce the size of the Project footprint, and therefore the potential effects on vegetation, wildlife, and local land users.
- There is a preference for the placement of process tailings underground, as opposed to the long-term storage of tailings on surface.

[2] Indigenous Knowledge can generally be understood as the unique and collective knowledge of a group of Indigenous People that is built up through generations of living in close contact with the land and natural environment. Local Knowledge is a more general term and, for the purposes of the EA, represents information from a citizen or community representative, but without Indigenous Group/Elder sanction.

- Protecting the safety and health of workers, Indigenous and other land users, and local community members is vital.

Information provided by local Indigenous Groups and communities was considered, where applicable, in the completion of the Feasibility Study (NexGen 2021) and the assessment alternatives for the Project (Section 4), and is reflected in the current design of the Project presented herein as the basis of the EA. For example, NexGen's commitment to permanently store all tailings from the Project underground is consistent with feedback received by local Indigenous Groups and communities. Key design changes that were influenced by the feedback received included modifications to the Project to reduce the overall surface expression (i.e., reduce Project footprint) through the removal, centralization, and consolidation of Project infrastructure, which in turn facilitated the further optimization of water management (e.g., centralizing water management infrastructure and reducing the total number of in-water infrastructure installations).

Further detail on feedback received through NexGen's engagement with local Indigenous Groups and communities can be found in Section 2 and additional information on the influence of Indigenous and Local Knowledge on Project planning and design is included in Section 3. Information on the alternatives assessment completed for the Project is provided in Section 4.

5.1.4 Project Phases

The lifespan of the proposed Project would be 43 years and include Construction, Operations, and Closure (Table 5.1-1). The transition between Construction and Operations would be defined by the start of processing, and the transition between Operations and Closure would be defined by the end of processing. At this time, the duration of each of the Project phases is an estimate based on feasibility design detail and the current global resource estimate. Further details on Project activities in each phase are provided in Section 5.5.

Table 5.1-1: Rook I Project Phases

Phase	Description	Duration (Years)
Construction	▪ Includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences	4
Operations	▪ Includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences	24
Decommissioning and Reclamation (i.e., Closure)	▪ Includes two stages: Active Closure Stage and Transitional Monitoring Stage: o Active Closure Stage: includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating 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. The duration of the Active Closure Stage is expected to be five years o Transitional Monitoring Stage: includes monitoring and reporting activities that occur post-Active Closure Stage 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. Once that is achieved, and upon Provincial approval, the land would be transferred under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria	15

CNSC = Canadian Nuclear Safety Commission.

5.2 Project Setting

A robust understanding of the setting of a project is foundational to the project design process. Key Project setting considerations include the Project environs, existing mineral tenure and surface rights in the area of the Project, the regulatory context for the Project, an understanding of local Indigenous Groups and communities and traditional land use, potential presence of heritage resources in the area of the project, and the local geology and mineral resources.

5.2.1 Project Environs

At a regional scale, the proposed Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system (Figure 5.1-1). The Clearwater River watershed drains to the Mackenzie River watershed.

Climatic conditions at the Project site are considered sub-arctic, with mean ambient temperatures ranging from -18°C in February to a high of 17°C in July. Winters are characterized as long and cold, with mean monthly temperatures below freezing from October to April. Drumlins, lakes, wetlands, rivers, streams, and muskegs are common in the Project vicinity. Elevations in the region range from 583 metres above sea level (masl) at the crest of major drumlins to 480 masl for some of the lowland lakes. The Project site is covered by 30 m to 100 m thick glacial drift over Cretaceous mudstone, which is composed of fine-grained clay particles that have been compressed by overlying material over a long period of time. The glacial drift is composed primarily of sand with gravels, cobbles, and boulders. The Project site is dominated by sandstone (i.e., sand-sized grains of rock material) with some bedrock outcroppings (i.e., rock that rises above the surface).

The broader regional area of the proposed Project intersects the Boreal Shield and Boreal Plain ecozones. At a smaller, more local scale, the Project site is located within the Boreal Plain Ecozone of the Mid-Boreal Uplands Ecoregion. The area surrounding the Project site consists of recent burns with residual stands of jack pine (*Pinus banksiana*) and some black spruce (*Picea mariana*), with shrub and lichen as ground cover. Over the last 40 years, much of the region has been burned in historical fires.

The wildlife species present within the regional area of the proposed Project are typical of the Boreal Shield and Boreal Plains ecozones. The proposed Project is located within the SK2 West administration unit for woodland caribou (*Rangifer tarandus caribou*) and adjacent to the boundary of the SK1 caribou conservation unit. Moose (*Alces alces*), black bear (*Ursus americanus*), and beaver (*Castor canadensis*) are commonly harvested species.

Large-bodied fish species captured or previously documented in waterbodies and watercourses surveyed in the area of the proposed Project are typical of northern temperate waterbodies and watercourses in Saskatchewan and include Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), cisco (*Coregonus artedi*), lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), longnose sucker (*Catostomus catostomus*), northern pike (*Esox lucius*), walleye (*Sander vitreus*), white sucker (*Catostomus commersonii*), and yellow perch (*Perca flavescens*). These fish species are commonly targeted by recreational and subsistence fishers.

Two Saskatchewan provincial parks are located within 150 km of the proposed Project: Clearwater River Provincial Park (41 km south), and Athabasca Sand Dunes Provincial Park (141 km north). Preston Lake Wildlife Refuge is located on a small island on Preston Lake to protect a pelican colony during its nesting and rearing period (29 km south; Figure 5.1-2). The two closest Alberta provincial parks to the proposed Project are Marguerite River Wildland Provincial Park (38 km west) and Richardson River Dunes Wildland Provincial Park

(51 km northwest). The portion of the Clearwater River in Saskatchewan is recognized for its cultural heritage and has been designated as part of the Canadian Heritage River Systems.

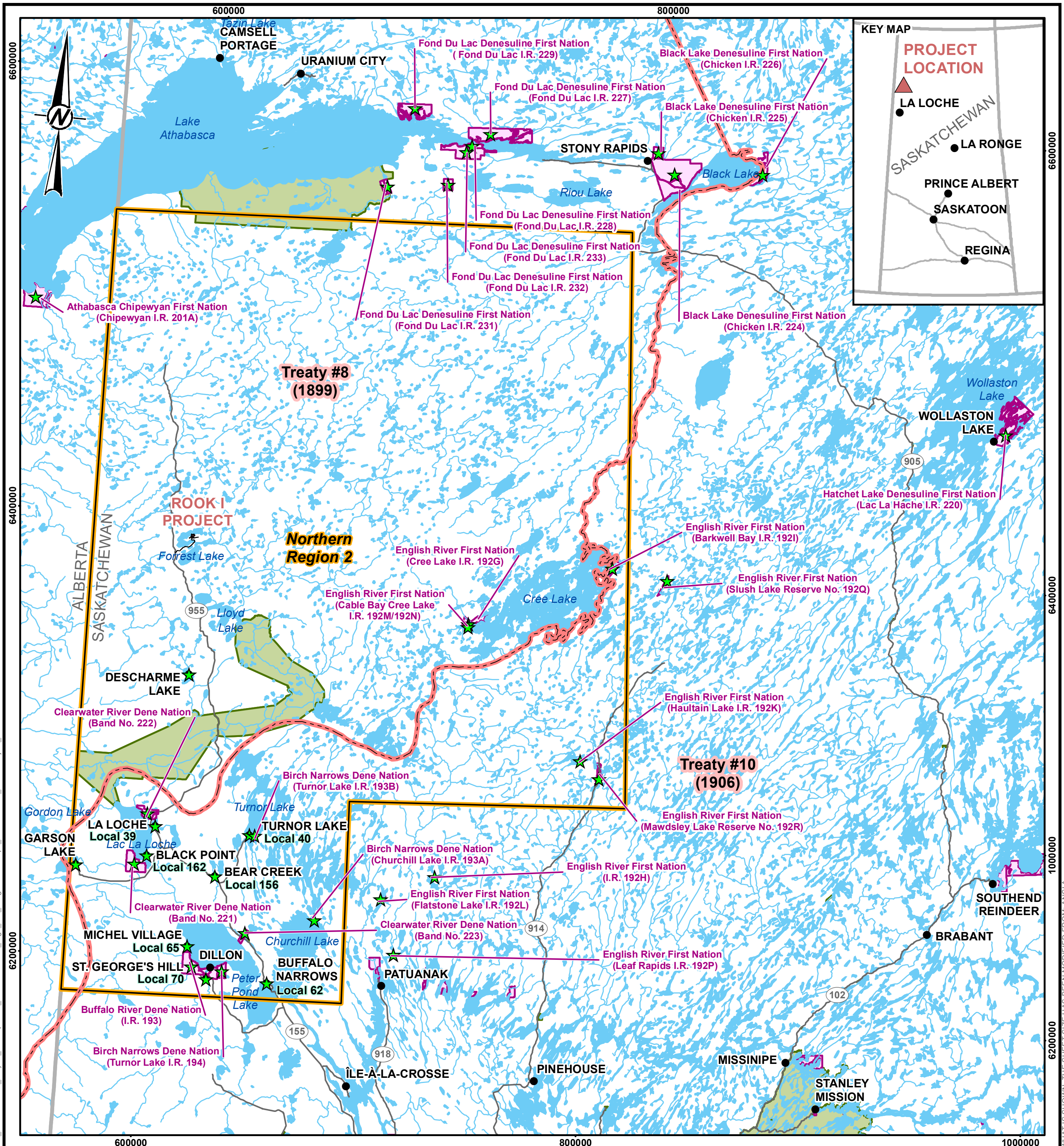
The proposed Project is located entirely on Provincial Crown Land within Treaty 8 territory and the Métis Homeland, and adjacent to Treaty 10 territory. The closest federal lands to the Project site consist of Indigenous reserves, including Clearwater River Dene Band 222 (approximately 120 km south), 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 5.2-1).

Local communities in the vicinity of the proposed Project are captured within the Project's local priority area (LPA). The LPA consists of the communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize training, employment, and business opportunities for the Project. These communities include the villages of La Loche and Buffalo Narrows and surrounding northern hamlets and settlements, and the communities around the Clearwater River Dene Nation, Birch Narrows Dene Nation, and Buffalo River Dene Nation. Métis communities nearest the Project site include La Loche (Local 39; approximately 130 km south), Turnor Lake (Local 40; approximately 135 km southeast), and Black Point (Local 162; approximately 145 km south). All LPA communities are within the Métis Nation – Saskatchewan Northern Region 2 (Figure 5.2-1).

Communities within the LPA are generally composed of Métis citizens, off-reserve Dene Nation citizens, those who have identified as other Indigenous persons, and those who have identified as non-Indigenous (Statistics Canada 2016). Overall, approximately 96% of the LPA residents in 2016 have identified as being Indigenous.

The broader regional area surrounding the Project is largely undisturbed by human activities and infrastructure; approximately 0.5% of the regional area (i.e., 1,000 km^2) encompassing the Patterson Lake watershed has been influenced by human developments. Most human-related disturbances in this regional area include linear features such as Highway 955, cutlines, seismic lines, and trails with some cleared areas. The Project is north of the commercial forest zone; commercial forestry activity is not conducted in vicinity of the Project. There are no active mines near the Project. The now closed Cluff Lake Mine was operated by AREVA Resources Canada Inc. (now Orano) and is located 80 km north of the Project site. The mine closed in 2002 and is in a long-term monitoring and maintenance phase.

Approximately 92 active mineral dispositions, issued to twelve companies, exist within the general area of the proposed Project (Figure 5.2-2). Although mineral dispositions are in the area, they do not necessarily lead to the development of resources due to many factors (e.g., resource geology, environment, technical and economic feasibility, markets). The proposed Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019) and is also located on Patterson Lake, approximately 5 km from the proposed Project, recently commenced the EA process per the requirements of *The Environmental Assessment Act* (Fission 2021).



LEGEND

- COMMUNITY ENGAGED
- POPULATED PLACE
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- FIRST NATION TREATY BOUNDARIES
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 60 120

1:2,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA (AANDC) AND MEADOW LAKE TRIBAL COUNCIL, BIRCH NARROWS DENE NATION.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

INDIGENOUS GROUPS AND COMMUNITIES IN THE REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT		20144150	PHASE 3314 - 6
DESIGN	DW	2021-10-26	SCALE AS SHOWN / REV. 0
GIS	NO	2023-02-07	**FIGURE 5.2-1**
CHECK	DW	2023-02-07	
REVIEW	MM	2023-02-07	

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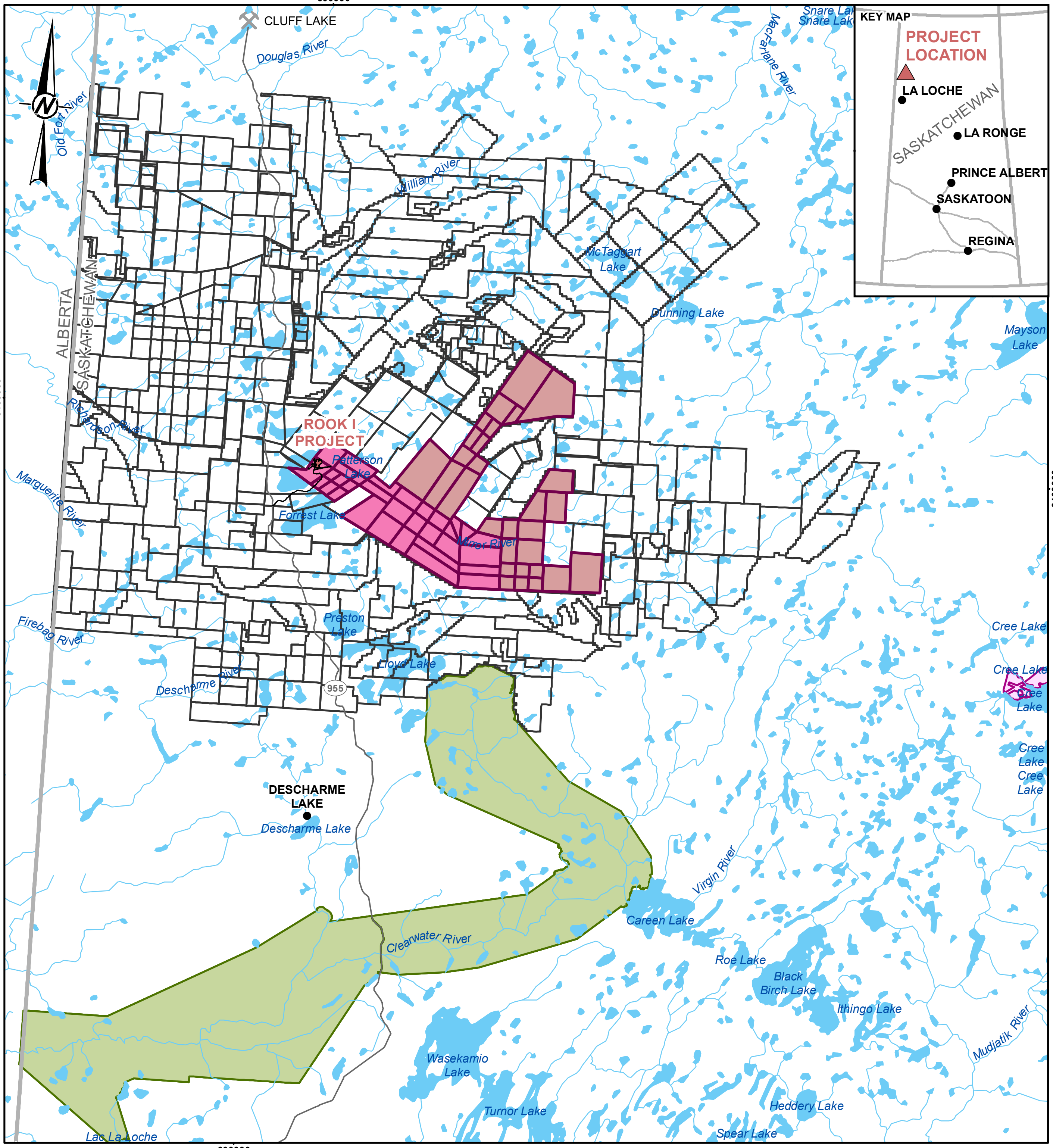

LEGEND

- ● POPULATED PLACE
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- NEXGEN ROOK I PROPERTY MINERAL DISPOSITIONS
- OTHER NEXGEN MINERAL DISPOSITIONS
- MINERAL DISPOSITIONS

0 30 60

1:1,000,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021.
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PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

ACTIVE MINERAL DISPOSITIONS IN THE AREA OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	GE	2024-01-08	SCALE AS SHOWN	REV. 1
GIS	NO	2024-01-08		
CHECK	DW	2024-01-08	**FIGURE 5.2-2**	
REVIEW	MM	2024-01-08		

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5.2.2 Mineral Tenure, Surface Rights, and Current Activities

The Rook I property consists of 32 contiguous mineral claims with a total area of 35,065 ha (351 km^2; Figure 5.2-3) as of 31 December 2023. All claims are 100% owned by NexGen and registered in the name of NexGen Energy Ltd. All 32 claims are in good standing (i.e., payments have been made to the Government of Saskatchewan) until at least 2040. The claim that hosts the Arrow deposit is in good standing until 2043.

Surface rights are distinct from subsurface or mineral rights. The property is located on provincial Crown Land; as the land owner, the Province of Saskatchewan can grant surface rights under the authority of *The Forest Resources Management Act* and *The Provincial Lands Act*. Granting surface rights for the purpose of accessing the land to extract minerals is completed by issuing a mineral surface lease subject to the Crown Resource Land Regulations. NexGen does not currently hold surface rights for the proposed Project site.

Current activities on the Rook I property support regional exploration programs, environmental baseline and monitoring programs for the proposed Project, and field investigation programs to support Project design. The Rook I property is the location of the existing all-season temporary exploration camp and ancillary infrastructure required to conduct and support current activities. Access to the existing exploration camp is via a 13 km long all-season access road from Highway 955. In the event of emergency, the exploration camp can be accessed by boat or float-plane during ice-free periods or by helicopter year-round.

The existing exploration camp includes hard-walled accommodation and insulated tent accommodations equipped with diesel-electric stoves and can accommodate up to 200 persons. Ancillary infrastructure includes a modular kitchen with seating, an office building, a recreation centre, full-amenity washrooms, and two changing facilities (i.e., dries). Camp services include a maintenance shop, laundry facility, first aid tent, an STP, and a water treatment plant. The exploration camp is powered by diesel generators.

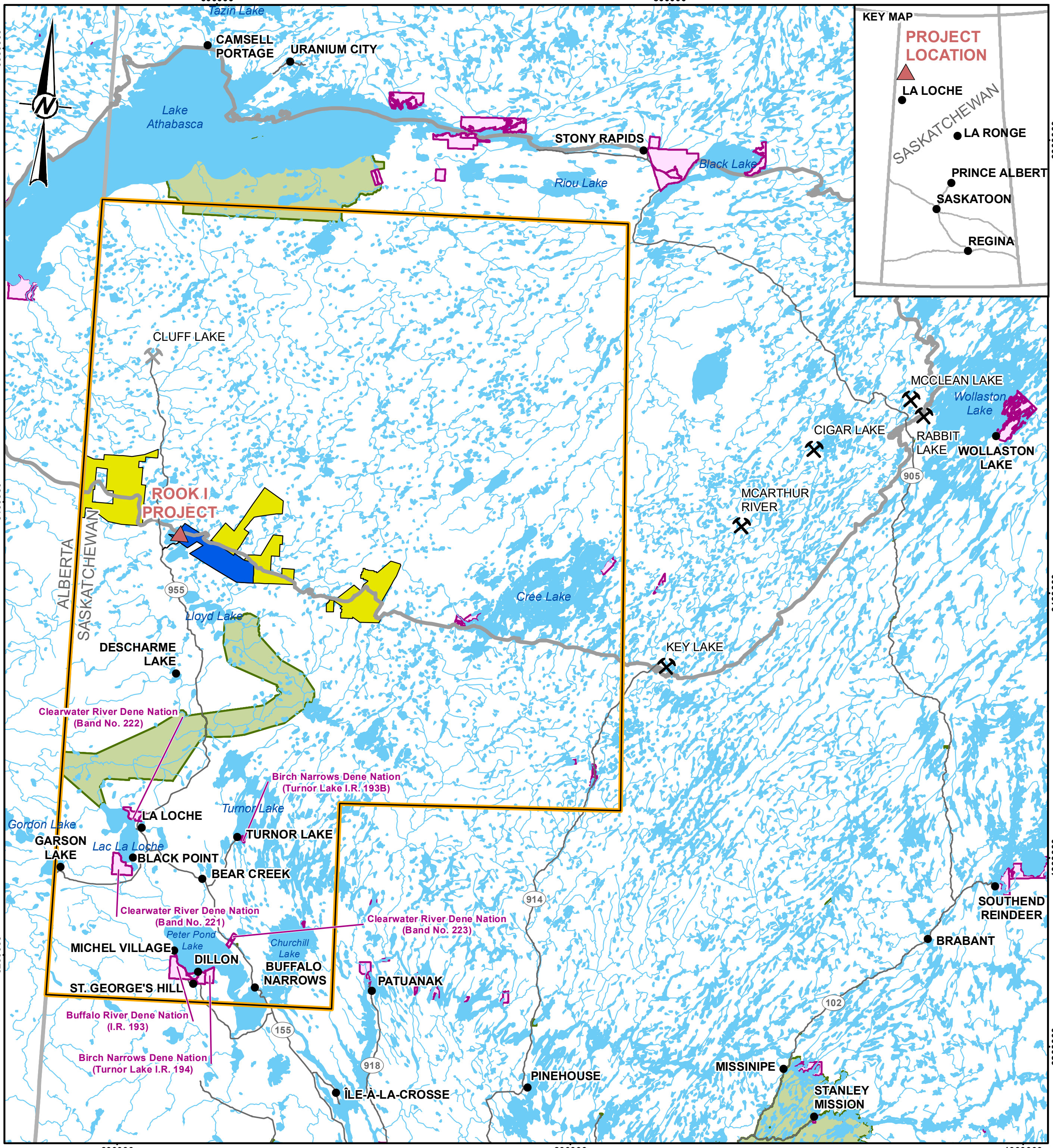
A core processing facility is adjacent to the existing exploration camp and includes two logging tents, a wash car, a modular changing dry, a core splitting area, and a geotechnical building. The core processing facilities are heated by propane and powered by diesel generators. The core processing facility also includes a fenced-in core storage area that contains all core drilled by NexGen to date.

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 along the Arrow access trail and a temporary storage tent at the laydown area.

A total fuel (i.e., gasoline, diesel, and jet fuel) capacity of 118,260 L is available on the Rook I property. Fuel is stored in certified double-wall tanks in accordance with The Hazardous Substances and Waste Dangerous Goods Regulations. Fuel is used to support all infrastructure at the exploration camp and core processing facility, in addition to requirements of field activities.

Silt fencing is installed as necessary to prevent erosion, and locally sourced gravel is used for road maintenance. All wildlife sightings and interactions are recorded at the exploration site office and caribou sightings are reported to the Saskatchewan Conservation Data Centre (i.e., online portal) and ENV (i.e., program closure reports). A fire suppression sprinkler system is established during the fire season in the existing exploration camp, the core processing facilities, and core storage area. NexGen has a comprehensive fire prevention plan and submits a Wildfire Prevention and Preparedness Plan to the Saskatchewan Public Safety Agency annually. Reclamation trials along historical linear disturbances are ongoing at sites where further activity is no longer expected.

Authorizations from applicable regulatory bodies are maintained to support continued regional exploration, environmental baseline and monitoring programs, and field investigation activities (e.g., Crown Land Work authorizations).



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARK
- WATERBODY
- PROJECT LOCATION
- NEXGEN ROOK I PROJECT MINERAL DISPOSITIONS OUTLINE
- OTHER NEXGEN MINERAL DISPOSITIONS OUTLINE
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 60 120
1:2,500,000 KILOMETRES

REFERENCE(S)
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2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. OBTAINED FROM GEOLOGICAL ATLAS OF SASKATCHEWAN VIEWER © 2021, GOVERNMENT OF SASKATCHEWAN
4. ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA (AANDC) AND MEADOW LAKE TRIBAL COUNCIL, BIRCH NARROWS DENE NATION.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
NEXGEN MINERAL DISPOSITIONS

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 1

FIGURE 5.2-3

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5.2.3 Regulatory Context

Uranium and nuclear projects in Saskatchewan are subject to both federal and provincial EA processes, and require federal and provincial licences, approvals, and permits. The EA for the Project is subject to CEAA 2012 and *The Environmental Assessment Act* of Saskatchewan. Uranium mines and mills in Canada must be licensed under the *Nuclear Safety and Control Act* and applicable regulations administrated by the CNSC.

Designated projects are defined under the Regulations Designating Physical Activities for CEAA 2012, which identify the CNSC as the responsible authority for projects that are regulated under the *Nuclear Safety and Control Act*. As the sole federal responsible authority for uranium and nuclear projects under CEAA 2012, the CNSC acts as the lead agency overseeing the federal EA process and is responsible for coordinating activities in cooperation with other federal agencies and the provincial government. Other federal agencies or departments that may be involved in the EA process include Environment and Climate Change Canada, Health Canada, Natural Resources Canada, Parks Canada, and Transport Canada.

In Saskatchewan, provincial EAs require that a proponent receive a positive Ministerial Decision issued pursuant to *The Environmental Assessment Act* before proceeding with a development as defined under *The Environmental Assessment Act*. Other provincial ministries, agencies, and authorities (referred to as the Saskatchewan EA Review Panel, which is composed of subject matter experts from various governmental bodies) may be involved in the provincial EA review process, including, but not necessarily limited to the following: the Ministries of Environment, Agriculture, Education, Energy and Resources, Government Relations, Highways, and Labour Relations and Workplace Safety; the Water Security Agency; and the Saskatchewan Health Authority.

The Crown has a duty to consult and, where appropriate, accommodate Indigenous Peoples prior to making decisions that may adversely impact established or claimed Aboriginal or Treaty Rights protected by Section 35 of the *Constitution Act, 1982*. With regards to the Project, the Crown's duty to consult and accommodate is required to be satisfied by 1) the CNSC in making decisions under CEAA 2012, and 2) the Government of Saskatchewan in making decisions under *The Environmental Assessment Act*.

Prior to commencing Construction, NexGen would be required to obtain the necessary Project permits, licences, and authorizations from the appropriate federal and provincial regulatory agencies under their specific legislation or mandate. The CNSC would require NexGen to apply for and meet the requirements of licences under the *Nuclear Safety and Control Act*. NexGen is implementing an integrated approach to the federal (i.e., CNSC) EA and licensing processes for the Project whereby information to support the licence application is submitted to the CNSC in a staged manner so there is alignment between the EA and licensing documentation. At the provincial level, uranium mines and mills require approvals, including those under *The Environmental Management and Protection Act, 2010* and the associated regulations. Applications for the required provincial regulatory approvals would be made prior to the commencement of Project-related activities.

Further details on the provincial and federal approvals, including potentially applicable federal and provincial permitting requirements for the Project, are outlined in Section 1.3.

5.2.4 Local Indigenous Groups and Communities

As NexGen has advanced development of the Project, review has been undertaken to confirm those Indigenous communities who may be affected by or have an interest in the Project. Identification of potentially affected or interested Indigenous Groups and communities has been informed through direct correspondence and discussion with Indigenous leaders, community members, and other organizations in the region; review of publicly available information; and guidance provided by provincial and federal regulatory agencies. Further information on the process for the identification of local Indigenous Groups and communities can be found in Section 2.4, Indigenous Group and Stakeholder Identification.

The primary Indigenous Groups identified for full engagement are:

- Clearwater River Dene Nation;
- Métis Nation – Saskatchewan Northern Region 2 through the Métis Nation – Saskatchewan;
- Birch Narrows Dene Nation; and
- Buffalo River Dene Nation.

The other Indigenous Groups identified for information sharing are:

- English River First Nation;
- Athabasca Chipewyan First Nation;
- Black Lake Denesųłiné First Nation, as represented by the Ya’thi Néné Lands and Resources; and
- Fond du Lac Denesųłiné First Nation, as represented by the Ya’thi Néné Lands and Resources.

NexGen supported the completion of Indigenous Knowledge and Traditional Land Use Studies by each of the primary Indigenous Groups as part of the Study Agreements signed in 2019. A Study Funding Agreement was also signed in 2020 with the Ya’thi Néné Lands and Resources as the Ya’thi Néné Lands and Resources identified an interest in sharing Indigenous Knowledge through an Indigenous Knowledge and Traditional Land Use Study.

Based on information from Indigenous Knowledge and Traditional Land Use Studies completed for the Project, the Patterson Lake area is used by Indigenous Groups for resource use activities such as hunting, fishing, trapping, and gathering (Section 16, Cultural and Heritage Resources and Indigenous Land and Resource Use). Public and Indigenous use of the land also occurs in the broader area surrounding the proposed Project. Activities include traditional harvest and use by Indigenous Peoples as well as recreational and commercial fishing, hunting, trapping, gathering, outfitting and guiding, canoeing, and mineral exploration.

5.2.5 Heritage Resources

A Heritage Resources Impact Assessment was completed for the Project, including a heritage resource survey conducted in 2018. The purpose of the heritage resource survey was to determine the presence of any culturally or archaeologically significant sites or artifacts within the vicinity of the Project. No heritage resources were identified.

In 2018, the Heritage Conservation Branch (Saskatchewan Ministry of Parks, Culture and Sport) confirmed that the Heritage Resources Impact Assessment met the requirements of Section 63 of *The Heritage Property Act* and no further assessment was required (Annex IX, Heritage Resources Impact Assessment and Cover Letter).

Follow-up communications with the Saskatchewan Heritage Confirmation Branch were completed in 2021 outlining changes to the Project footprint that served as the basis of the heritage resource survey in 2018. The Saskatchewan Heritage Confirmation Branch determined that no additional requirements were necessary, and that the Project remained in full compliance with Saskatchewan Heritage Confirmation Branch requirements.

5.2.6 Geology and Mineral Resources

The Rook I property is located along the southwestern rim of the Athabasca Basin, a large Paleoproterozoic-aged, flat-lying, intracontinental, fluvial, redbed sedimentary basin that covers much of northern Saskatchewan and part of northern Alberta (Bosman and Ramaekers 2015).

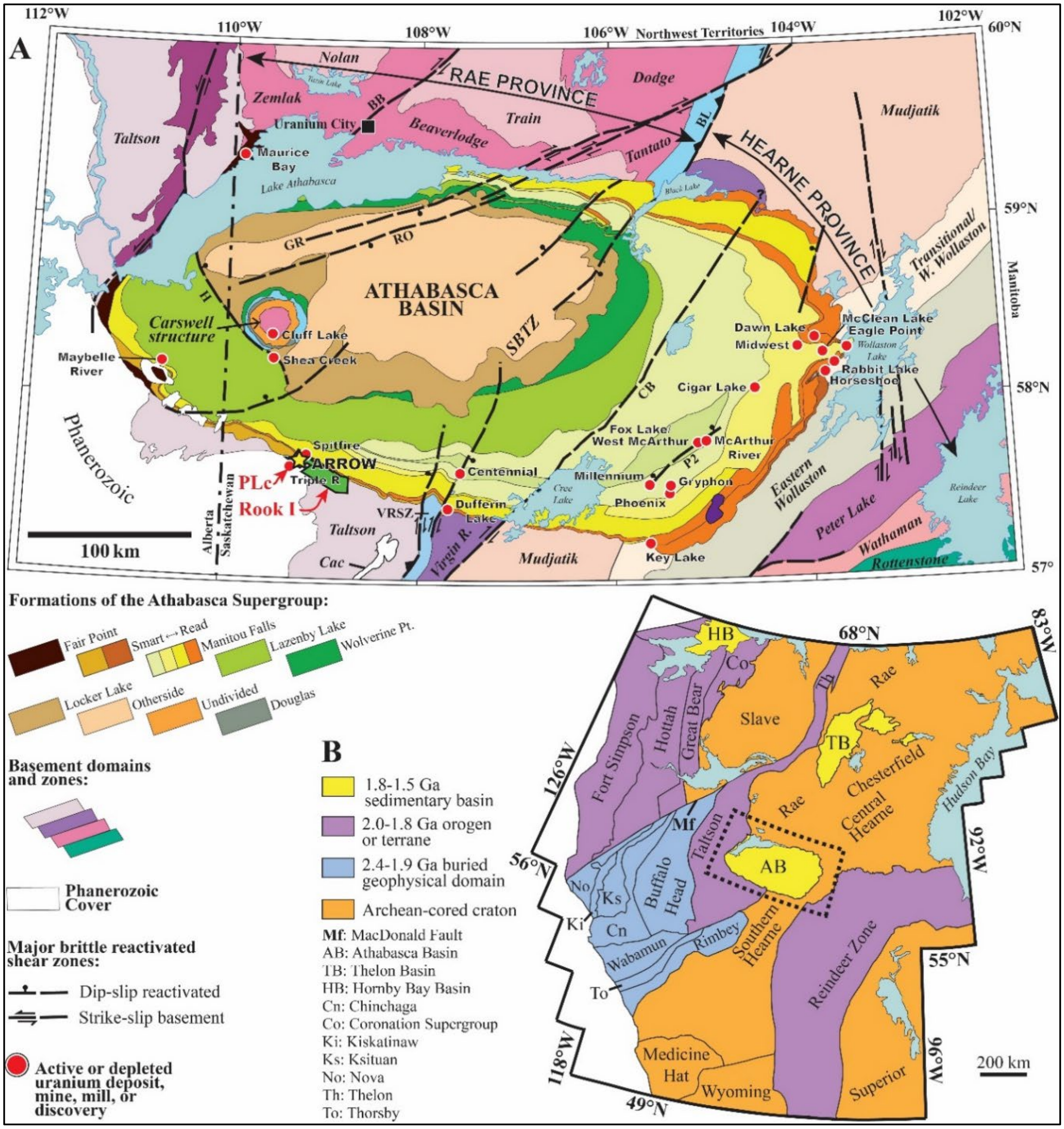
The Athabasca Basin is oval-shaped at surface, with approximate dimensions of 450 km by 200 km, reaching a maximum thickness of approximately 1,500 m near its centre (Figure 5.2-4) (Tschirhart et al. 2021). The basin consists primarily of cross-bedded and ripple laminated quartz arenite with local conglomerate beds collectively referred to as the Athabasca Supergroup (Bosman and Ramaekers 2015).

The base of the Athabasca Supergroup is marked by an unconformity with the underlying crystalline basement rocks of the Archean to Paleoproterozoic-aged Hearne and Rae provinces to the east and west. The Hearne and Rae provinces are separated near the centre of the Athabasca Basin by the northeast trending Snowbird Tectonic Zone. The Rae Province consists predominantly of metasedimentary supracrustal sequences and granitoid rocks. In contrast, the Hearne Province consists primarily of granitoid gneisses that contain supracrustal rocks (Card et al. 2007).

The Athabasca Supergroup basal unconformity is spatially related to all significant uranium occurrences in the region. The basement immediately below the unconformity typically has a paleoweathered profile; this weathering horizon ranges in thickness from a few centimetres to up to 220 m, where fluid migration was aided by fault zones (MacDonald 1980). The paleoweathered profiles consist of a thin bleached zone at the unconformity, which grades into a hematite altered zone, and then a chlorite altered zone before alteration features dissipate.

The southwestern portion of the Athabasca Supergroup is overlain by flat-lying Phanerozoic rocks from the Western Canada Sedimentary Basin (i.e., mudstones, siltstones, and sandstones).

Figure 5.2-4: (A) Lithostructural Domains of Northern Saskatchewan and Alberta Illustrating the Major Components of the Churchill Structural Province of the Precambrian Shield and Overlying Phanerozoic Cover; (B) Cratonic Map of Western Laurentia showing (A) (dashed box) in Context of Continent-Scale Tectonics



Source: Hillacre et al. 2021 (as modified from Jefferson et al. 2007 and Card et al. 2014).

Note: (A) The location of the Rook I Project and Clearwater anorthosite complex (Cac) within the Taltson Domain, and with respect to the Snowbird Tectonic Zone (SBTZ), the Virgin River Shear Zone (VRSZ), the Grease River Shear Zone (GR), and the Cable Bay Shear Zone (CB). Athabasca Basin unconformity-related uranium deposits are shown, with the Arrow deposit (yellow star) along the Patterson Lake corridor (PLc) in the southwest Basin. Major uranium deposits, mines, and prospects are highlighted, as well as major brittle-reactivated shear zones: BB = Black Bay, BL = Black Lake, CB = Cable Bay, GR = Grease River, H = Harrison, RO = Robillard, VRSZ = Virgin River shear zone.

Local and Property Geology

The Rook I property straddles the Athabasca Supergroup basal unconformity. Directly below the unconformity is variably weathered basement rock, where the weathering depth and profile varies and penetrates deeper into the basement along conduits for water (i.e., shears, faults, and other persistent geologic structures).

The oldest rocks in the area of the Rook I property are in the Taltson magmatic zone of the Rae Province (Figure 5.2-5). Within the property, the Taltson magmatic zone consists mostly of granitic, granodioritic, tonalitic, dioritic, and locally gabbroic orthogneisses (Card 2021).

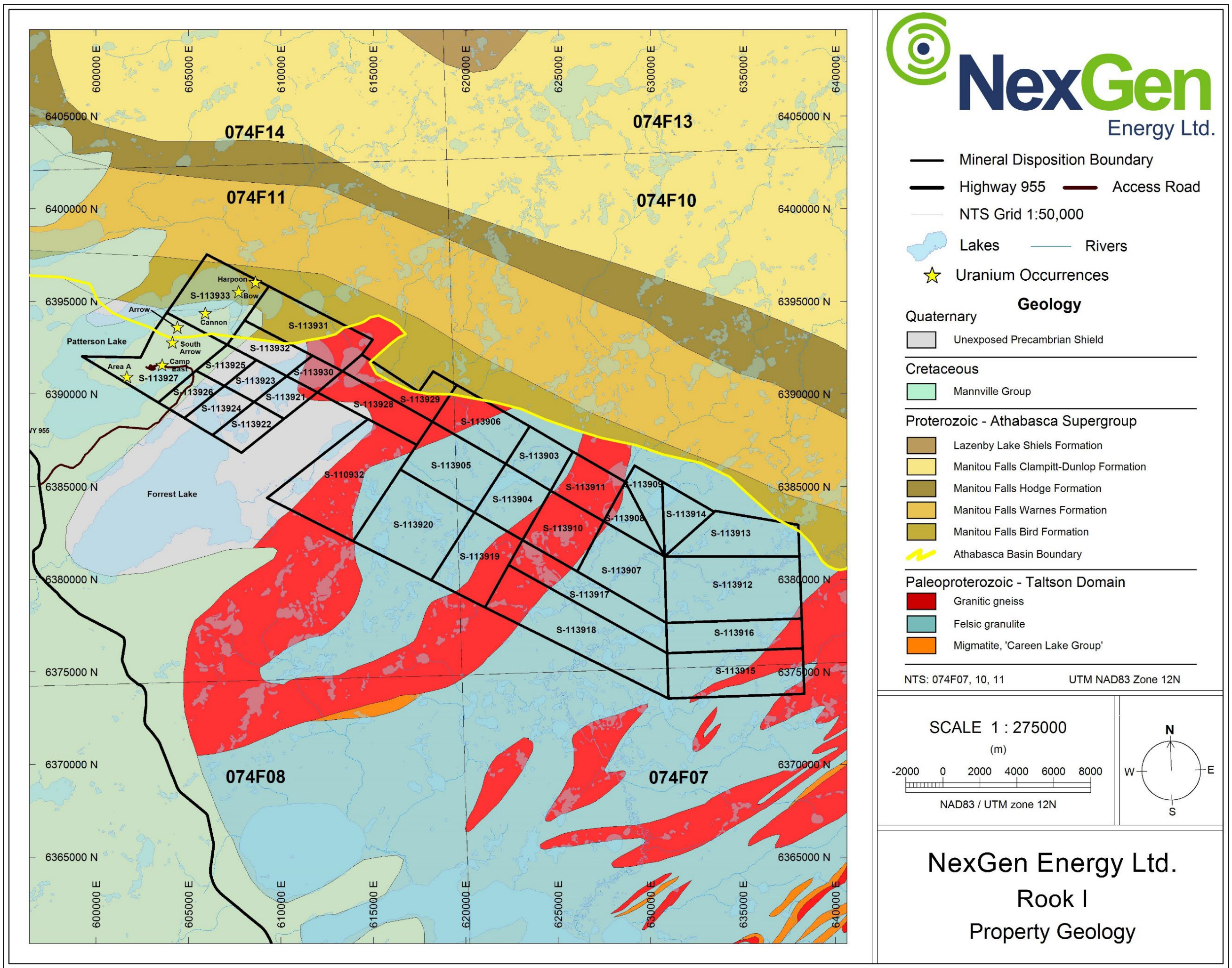
The quartz-feldspar-garnet-biotite (±graphite) gneisses are the predominant host rock of uranium mineralization in basement settings in the area, including the Arrow deposit. All lithologies present in the Taltson magmatic zone have been metamorphosed at upper amphibolite to granulite facies conditions (Card 2021).

Overlying the basement rocks in the area of the Rook I property are the flat-lying sandstones of the Athabasca Supergroup of variable thickness, rarely exceeding 50 m. The local Athabasca Supergroup rocks are likely part of the Smart Formation and Manitou Falls formations. These formations are characterized by both uniform quartz arenite beds and rare pebble conglomerate beds.

Phanerozoic rocks of the Cretaceous Mannville Group and Devonian La Loche Formation overlie the Athabasca Supergroup and basement rocks in portions of the western side of the property, including above the Arrow deposit. The Mannville Group is characterized by both non-marine and marine shales and sandstones. A coal bed marker horizon at the bottom of the Mannville Group is often observed in drill core. The La Loche Formation consists of arenitic to arkosic sandstones and conglomerates (Hillacre et al. 2021).

The Rook I property and surrounding area are covered by Pleistocene glacial deposits composed of sand, Athabasca Supergroup sandstone boulders, and rare basement and Mannville Group boulders. Glacial geomorphological topographic features are common; these features include northeast to east-northeast trending drumlins, outwashes, hummocky terrain, and kettle lakes. The glacial deposits are typically at least 30 m thick and may be up to 100 m thick. The glacial overburden over the Arrow deposit is approximately 60 m thick. The cumulative thickness of the units overlying the basement rock at the Arrow deposit is between 90 m and 120 m.

Figure 5.2-5: Local Geology of Rook I Property

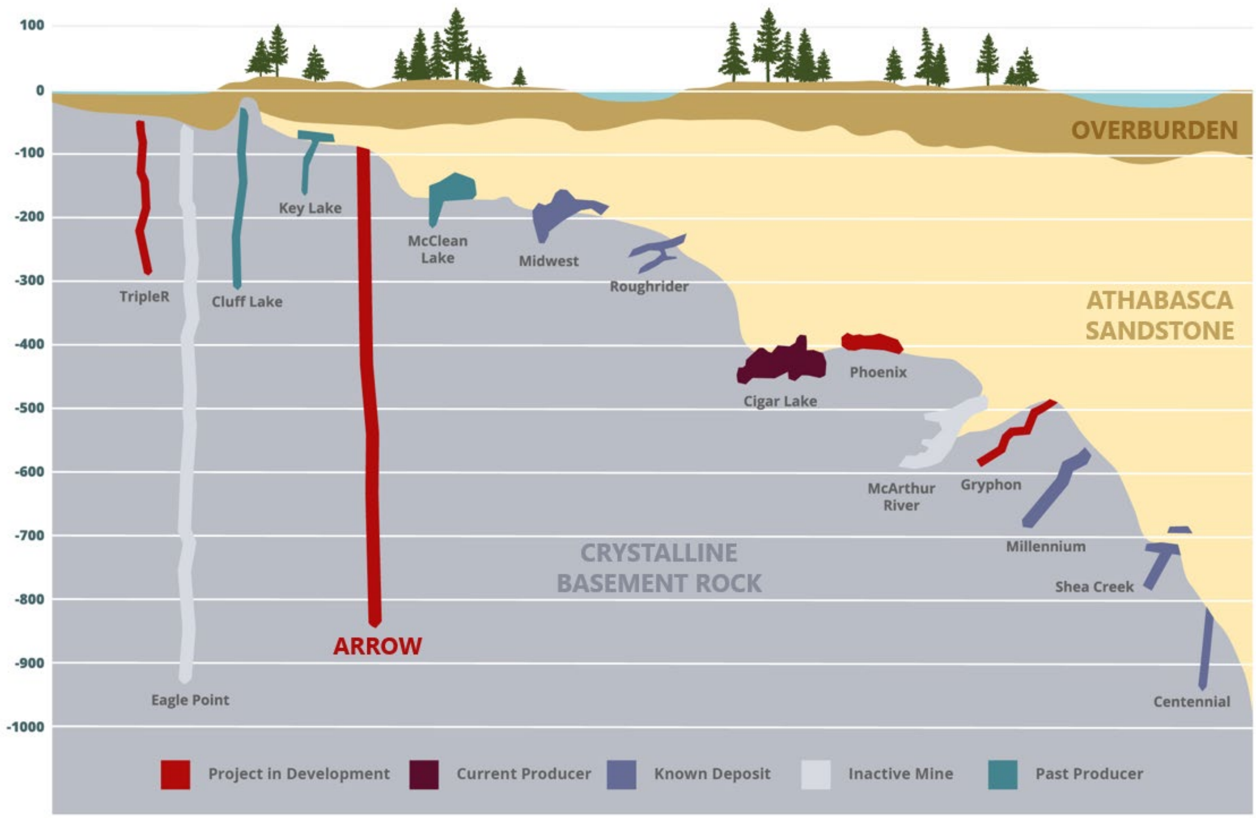


Mineralization

Mineralization occurs at seven locations on the Rook I property (i.e., Arrow deposit, South Arrow discovery, Harpoon occurrence, Bow occurrence, Cannon occurrence, Camp East occurrence, Area A occurrence). Mineralization is exclusively hosted in basement lithologies below the unconformity that is overlain by the Athabasca Supergroup. Of the seven mineralized locations, the Arrow deposit has undergone the most investigation.

The Arrow deposit is an example of a basement-hosted, vein type uranium deposit. Two end members of unconformity-associated mineralization have been identified in the Athabasca Basin: egress type deposits and ingress type deposits. Egress type deposits occur at or above the unconformity and are hosted by sandstone (e.g., Cigar Lake). The Arrow deposit is an ingress type deposit, which occurs in basement rocks below an unconformity located between the crystalline basement lithologies and overlying sedimentary units (Figure 5.2-6).

Figure 5.2-6: Arrow Deposit Setting within the Athabasca Basin



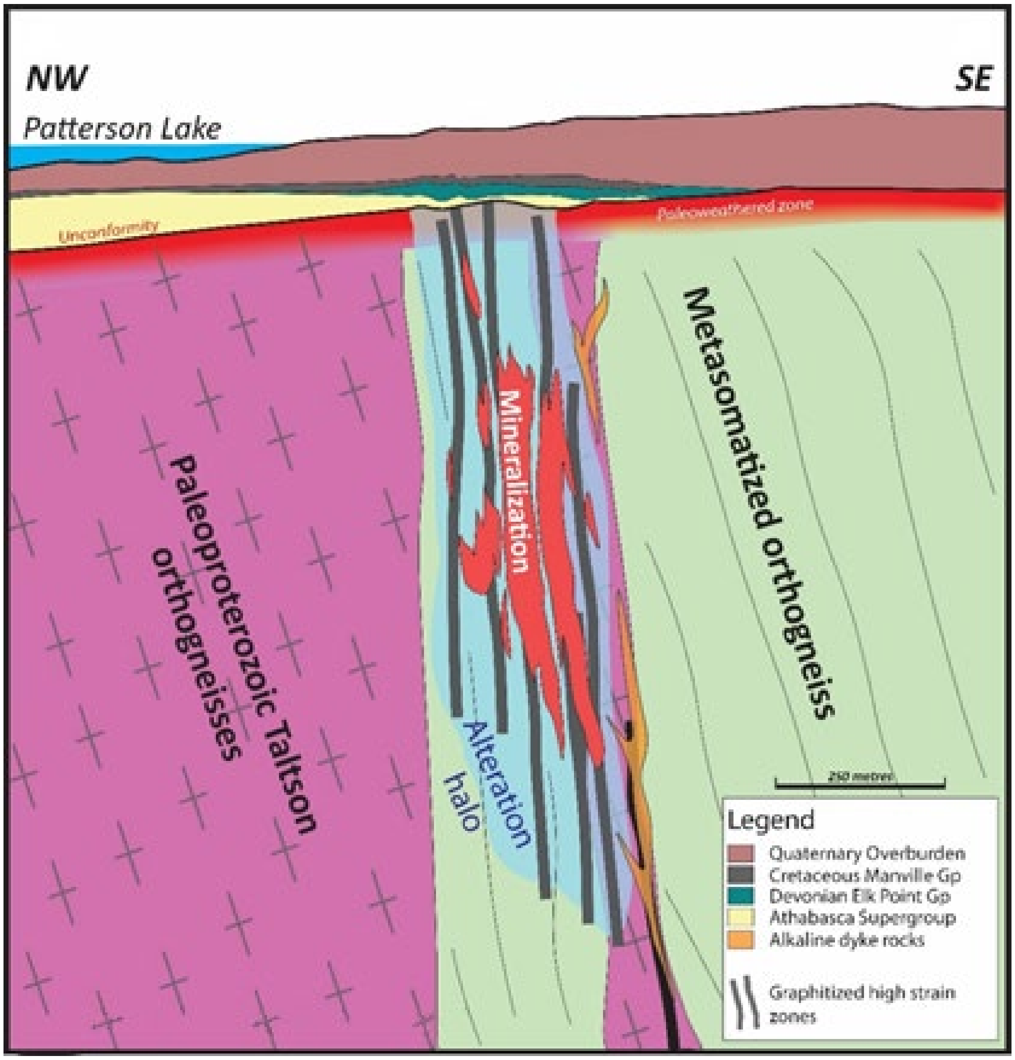
Source: Roy 2008.

The Arrow deposit is within the crystalline basement rocks of the Taltson Domain (Figure 5.2-7). The dominant host rock is porphyroblastic, weakly to moderately gneissic and/or augen textured, pervasively quartz-flooded quartz-feldspar-garnet-biotite (± graphite) gneiss. The main fabrics and contacts of crystalline basement rocks in the Arrow deposit area are all steeply dipping, with a northeast–southwest strike.

The deposit consists of several high-grade, near-vertical, high-grade uranium veins within at least six reactivated high strain zones, known as the A0 through A5 shears. The heterogeneous high strain zones hosting the Arrow deposit evolved through episodic reactivation events creating various small-scale brittle fault linkages oblique to, and connecting, the main fault zones. The mineralized shear zones defining the Arrow deposit comprise part of the Patterson Lake structural corridor.

The main uranium-bearing mineral present at the Arrow deposit is uraninite, whereas secondary uranium minerals such as coffinite or uranophane may partially or wholly replace uraninite. The mineralized area is 315 m wide with an overall strike of 980 m. Mineralization occurs 100 m below surface and extends to a depth of 950 m. The individual shear zones vary in thickness from 2 m to 60 m. The Arrow deposit is open in most directions and at depth.

Figure 5.2-7: Arrow Deposit Lithology Schematic Cross-Section



SE = southeast; NW = northwest.

The Arrow deposit has undergone considerable advancement since discovery in February 2014, with mineral resources completed in 2016, 2017, 2018, and 2021, each supported by successive systematic drill programs. Currently, the Arrow deposit has Measured Mineral Resources[3] of 209.6 million pounds (Mlb) of triuranium octoxide (U_3O_8) contained in 2,183 kilotonnes (kt) grading 4.35% U_3O_8, Indicated Mineral Resources of 47.1 Mlb of U_3O_8 contained in 1,572 kt grading 1.36% U_3O_8, and Inferred Mineral Resources of 80.7 Mlb of U_3O_8 contained in 4,399 kt grading 0.83% U_3O_8.

[3] "Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource" (CIM 2014; p.4)

5.3 Project Design Considerations

NexGen's overall philosophy is to design, construct, commission, operate, decommission, reclaim, and close the Project with fit-for-purpose approaches to mine design, management, and operations to deliver enhanced environmental, social, and economic performance. NexGen will continue to advance the Project in accordance with applicable regulatory requirements and industry best management practices, which provide for the safety of the public and workers and the long-term protection of the environment.

Design of the proposed Project considered the following key principles:

- The Project will be designed and operated to ensure the safety of workers, Indigenous and local communities, and the public.
- The Project will provide site-specific, industry-leading environmental, social, and economic performance.
- The Project will provide meaningful opportunities for local Indigenous Groups and communities.

Project design to date has incorporated applicable regulatory guidance, design standards, and the local environment; been influenced by Indigenous and Local Knowledge; and been informed by completion of alternatives assessments. Application of design standards, objectives, and guiding principles are further detailed in the following subsections, and an overview of environmental considerations in design is provided.

5.3.1 Design Standards

NexGen would develop and operate all Project infrastructure, facilities, and systems in accordance with design standards relevant to the Project, which are based on regulatory guidance (e.g., CNSC regulatory documents, ENV guidelines), applicable building code requirements (e.g., National Building Code of Canada, National Fire Code of Canada; Canadian Commission on Building and Fire Codes), and best management practices as developed by applicable industry and trade associations (e.g., Mining Association of Canada) and standards organizations (e.g., International Organization for Standardization [ISO], Canadian Standards Association Group [CSA Group]). These design standards help promote the protection of the public, workers, and the environment. The design standards implemented for the proposed Project would be routinely reviewed and revised as updates are issued by the guiding bodies; based on site-specific operating experience, updates to legislation, and regulatory guidance; and with the introduction of new technologies and in consideration of advances in research.

All Project phases from Construction through Closure would satisfy licence and permitting requirements from the CNSC and ENV, and would follow NexGen management systems. NexGen has also considered design principles that would support the safety of workers and the public from radiological and non-radiological constituents of potential concern, as discussed in the subsection below.

Worker Health and Safety

Potential radiological, chemical, physical, and biological hazards associated with Project activities that pose risks to the health and safety of workers would be systematically assessed to determine the nature, likelihood, and consequence of the potential risk; to identify and implement measures to mitigate associated effects; and to keep radiological exposures to workers as low as reasonably achievable.

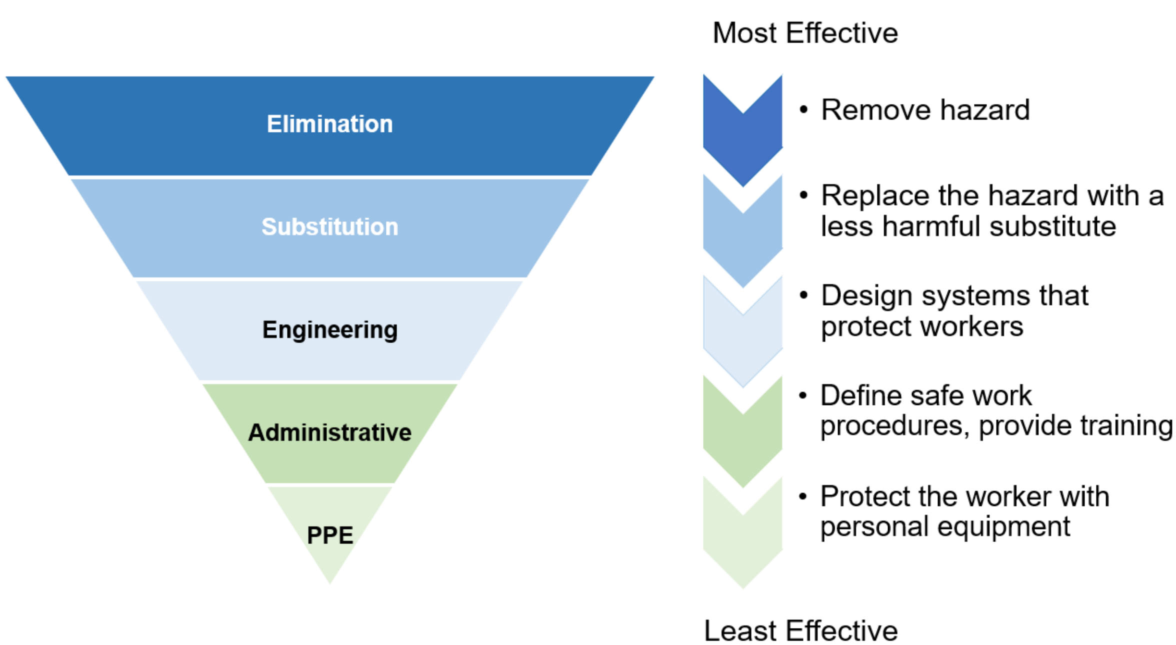
Risk assessments performed for the Project specific to worker health and safety are documented in a variety of reports and studies that were used to confirm the design basis for the proposed Project. These assessments will be submitted to the CNSC and other regulatory agencies in support of the Project licence application and other regulatory approvals. The type of assessments performed are appropriate for the topic, apparent level of risk, and complexity of the activity. Examples of studies completed to date include:

- radiological exposure assessment for the underground mine, process plant, and paste processing and delivery systems;
- diesel exhaust and crystalline silica exposure assessments for the underground mine, process plant, and paste processing and delivery systems;
- hazard and operability studies; and
- human factors assessment.

The controls identified during risk assessments are used to eliminate, prevent, or reduce the potential risk of injury, illness, or disease to workers, and would be implemented with consideration for the hierarchy of controls (Figure 5.3-1). The same hierarchy of controls was applied throughout the EA when selecting mitigation and environmental design features to protect people and the environment. The controls applied for the Project would be specific to the nature of the risk and would be documented, tracked, and periodically evaluated for effectiveness. Examples of controls would include:

- facility, equipment, and process design;
- safe work practices and training; and
- personal protective equipment.

Figure 5.3-1: Hierarchy of Controls



PPE = personal protective equipment.

In addition to these foundational reports and studies, risks to worker health and safety would be managed throughout the lifespan of the Project in accordance with the processes that would be outlined in the Integrated Management System (IMS) Manual and its supporting programs (Section 5.7); specifically, the Health and Safety Program and the Radiation Protection Program. These management system documents would also describe the processes required to monitor and characterize workplace hazards, monitor and characterize the effectiveness of mitigations, and continually improve the protection of worker health and safety throughout all Project phases. Where uncertainty associated with the potential worker health and safety hazards exists, adaptive management measures may also be proposed. The process for determining when, how, and where to use adaptive management will be described within the IMS Manual in support of licensing and approval steps.

In addition to NexGen's commitment to continually assess and improve its internal processes to maintain protection of worker health and safety, the effectiveness of IMS Manual and its supporting programs would be subject to ongoing oversight from the CNSC and provincial regulatory agencies (e.g., Labour Relations and Workplace Safety) throughout Construction, Operations, and Closure.

Radiation Protection

Radiation hazards associated with Project activities are in the form of ionizing radiation, which is energy that can damage cells and tissues by detaching electrons from atoms. There are three forms of ionizing radiation that would be present at the Project site (i.e., alpha, beta, and gamma), and each poses different hazards to human health. Alpha and beta radiation take the form of small, charged particles that are potentially hazardous if ingested, inhaled, or introduced via an open wound. Gamma radiation is in the form of an energy wave and can penetrate through skin and protective clothing. Sources of ionizing radiation at the proposed Project and potential exposure pathways are listed in Table 5.3-1. The exposure potential is based on multiple factors, including duration of exposure, form of hazard, and distance from the source.

Table 5.3-1: Rook I Project Ionizing Radiation Sources

Type of Radiation	Exposure Pathway	Sources[a]
Gamma	External exposure	Mineralization, nuclear density gauges, aged uranium ore concentrate
Alpha/beta - radon progeny[b]	Inhalation	Mine or process water, mineralization
Alpha - radon gas	Inhalation	Mine or process water
Alpha/beta - long-lived radioactive dust	Inhalation, ingestion, wound contamination	Mineralization, uranium ore concentrate

a) Listed sources of radiation are typical of uranium mining and milling facilities and not meant to be a comprehensive representation of any particular phase of the proposed Project.
b) Radon progeny are decay products produced from radon gas.

For underground mining and paste tailings placement, measures for protection from radiation sources would include, but not be limited to:

- **Gamma radiation:** using engineered protection (e.g., shielding), distance (e.g., possible use of remote mining methods), and managing time spent on the various mining activities. For workers in cabs of heavy equipment, there would be an intrinsic protection (i.e., shielding) provided by the steel of the vehicle itself. Shotcrete would be applied on the ceiling and walls during mine development, as needed, and either crushed waste rock or concrete would be used to cover the floor. Both waste rock and concrete would have very low uranium content and provide shielding, with the protection factor increasing with increasing thickness.

- **Radon progeny and radon gas:** managing ventilation, managing time spent on the various mining activities, and using remote-control mining equipment, as appropriate. The Project would include a push-pull ventilation system for ventilating mining stopes, where fresh air would be pulled into a working stope from a main travel way and a portion of that fresh air would be pushed toward the working face (i.e., the rock surface where the mining work is advancing). Contaminated air would then be pulled from the working stope and exhausted past any active work area.
- **Long-lived radioactive dust:** managing ventilation and applying dust suppression measures (e.g., wet drilling).

For the process plant and paste tailings preparation at surface, measures for protection from sources of radiation would include, but not be limited to:

- **Gamma radiation:** using engineered protection (e.g., shielding of process vessels) and distance (e.g., situating process vessels apart from routine work areas), and managing time spent on the various process plant and paste processing and delivery activities.
- **Radon progeny and radon gas:** general area ventilation and source control (e.g., covered process vessels directly vented to the atmosphere).
- **Long-lived radioactive dust:** managing ventilation and source control (e.g., capture dust and vent to the atmosphere).

Assessments predicting the effective dose (i.e., combined dose from external gamma radiation, inhalation of radon gas, radon progeny, and long-lived radioactive dust) received by workers in the underground mine, process plant, and paste processing and delivery facilities will be completed to confirm the Project design basis and inform the controls required to protect workers from radiological hazards and keep radiological exposures as low as reasonably achievable. Dose assessments will be submitted to the CNSC and other regulatory agencies in support of the licence application and other regulatory approvals.

5.3.2 Design Objectives and Guiding Principles

In addition to developing and operating the Project in accordance with relevant design standards, NexGen's goal is to leave lasting benefits to local communities, and the company has approached advancement of the proposed Project with consideration of current and future generations. NexGen is focused on the responsible and optimal development of the Project, incorporating environmental stewardship, social advancement, and sustainable long-term economic benefits for local Indigenous Groups, communities, and other stakeholders.

To achieve the goal of lasting benefits to local communities, NexGen has always and will continue to focus on community confidence through rigorous environmental standards and engagement, and employee assurance through effective health and safety measures. NexGen's Project planning has utilized national and international best practices and lessons learned from other mining operations.

Environmental Stewardship

NexGen is dedicated to minimizing potential effects on the environment throughout all phases of the Project; incorporating proven best practices and designs around mine planning, tailings and mine rock management; and reducing the operational footprint. NexGen delivers innovative solutions to complement proven technologies while recognizing and valuing the importance of protecting and preserving the environment throughout the Project lifespan and beyond. NexGen's approach to responsible development includes:

- early and continuous Indigenous and public engagement on environmental protection;
- exercising responsible stewardship of air, land, and water resources;
- applying economically viable best available technology and techniques;
- avoiding or minimizing Project effects;
- designing and operating for responsible closure and long-term land use;
- minimizing the generation of waste;
- responsibly managing tailings and waste facilities;
- respecting the principles of pollution prevention;
- responsibly managing energy use and greenhouse gas emissions;
- maximizing the application of the reduce, reuse, and recycle principles;
- monitoring and adaptively managing the Project based on rigorous scientific practice and in consideration of Indigenous and Local Knowledge; and
- working with local Indigenous Groups to implement independent environmental monitoring.

Worker Health, Safety, and Well-Being

NexGen is committed to fully supporting and engaging all workers in the implementation and improvement of an IMS (Section 5.7) as a means of systematically and reliably achieving desired Project outcomes and excellence in worker safety, radiation safety, and environmental protection. This unified framework includes processes for implementing compliance measures, enables continual improvement, and fosters a culture where protecting the health and safety of workers and preserving the environment are principal considerations guiding overall decisions and daily actions. NexGen has established an IMS Policy that reflects NexGen's vision and values, and provides the foundation for NexGen's IMS approach.

The IMS Policy defines management system principles and expectations for protecting the health, safety, and well-being of workers; preserving the environment; engaging with Indigenous communities and members of the public; complying with legal and other requirements; and continually improving management system processes and performance.

NexGen is committed to continual improvement through an ongoing process to improve the suitability, adequacy, and effectiveness of the IMS.

Decommissioning, Reclamation, and End Land Use

Decommissioning and reclamation objectives are used to outline the targets towards which mine closure efforts are directed. Defining end land use to support Project closure is a critical component of closure planning because end land uses inform all other aspects of closure planning, including reclamation plans and prescriptions.

The Project's decommissioning and reclamation objectives are intended to establish a closure landscape that would be:

- geotechnically, geochemically, and radiologically stable and remain stable under a natural disturbance regime typical for the Project location;
- able to support the sustainable management of surface water and groundwater quantity and quality on and off site such that it safely sustains fish and wildlife populations and is safe for human use;

- capable of supporting a functioning, self-sustaining ecosystem with diverse fish and wildlife habitats that retains the landscape and its function as designed over time and that requires no or minimal maintenance post-closure;
- accessible for unrestricted traditional use by Indigenous Groups and local communities; and
- integrated with the adjacent natural landforms and drainage systems in the Patterson Lake watershed and have a natural appearance.

Key documents in planning for the effective closure of the Project would include decommissioning and reclamation plans. A conceptual decommissioning and reclamation plan for the proposed Project is provided in Appendix 5A, Conceptual Preliminary Decommissioning and Reclamation Plan, and includes:

- decommissioning objectives and timeframes for all components;
- potential for consultation with Indigenous communities regarding decommissioning;
- preferred methods for decommissioning;
- progressive decommissioning and reclamation activities;
- alternate procedures for decommissioning site facilities;
- environmental impacts of mitigation and reclamation measures;
- identification of acceptable post-operational land use options for the site;
- long-term institutional control measures proposed for the site;
- identification of monitoring required to manage potential short term, long term, and permanent effects following decommissioning and reclamation; and
- proposed contingency measures.

As part of the formal Preliminary Decommissioning and Reclamation Plan submitted in support of future Project approvals, an end land use plan would be included that focuses on creating ecosystems following Closure that are similar to those that existed prior to Construction. The end land use plan would incorporate measures required to mitigate the potential environmental effects associated with the proposed Project and reclaim disturbed areas to the targeted end land uses. The end land use planning process will include engaging and collaborating with local communities to understand the possible uses of the Project landscape following Closure, identifying preferred end land uses, and establishing strategies to achieve these preferred uses in consideration of local ecosystems and habitat types. This approach acknowledges that a variety of end land uses can occur simultaneously on the landscape and over different ranges of time.

The Preliminary Decommissioning and Reclamation Plan would be periodically re-evaluated throughout the Project lifespan to incorporate best available information and feedback from ongoing engagement with Indigenous Groups and the public. When the Project is nearing the end of its operational life, a Detailed Decommissioning and Reclamation Plan would be prepared as part of the application to the ENV and CNSC for decommissioning approval. This detailed plan would provide similar information as the Preliminary Decommissioning and Reclamation Plan along with greater operational detail.

Disciplined Planning

Knowledge of community values, commitment to high standards, and understanding of lessons learned from other mining operations complement NexGen's life-cycle engagement for the Project that is early, often, lasting, and transparent.

The proposed Project has been designed to promote high levels of environmental performance and incorporate best practices of minimalistic surface expression, progressive reclamation, and advanced closure management design. The characteristics of the Arrow deposit at the Project site (Section 5.2.6, Geology and Mineral Resources) are conducive to proven mining methods and underground tailings storage. The natural geological setting of the deposit (e.g., basement-hosted, monometallic) reduces the requirement for complex, costly, and technically challenging engineering designs. These characteristics, combined with NexGen's commitment to environmental performance, enable the opportunity for the development of a unique project to support the promising nuclear power industry and the global demand for base load clean air energy.

Identification, presentation, and due consideration of local Indigenous Groups' input through the early and ongoing engagement processes (Section 2) has validated, informed, and influenced aspects of Project design (Section 3). These aspects include the deposition of all tailings underground, minimization of the total site disturbance footprint, optimization of water management strategies and infrastructure, and commitment to fund and support independent Indigenous Monitors chosen by each primary Indigenous Group for opportunities to participate in environmental monitoring programs for the Project through all phases.

5.3.3 Environmental Considerations

Environmental considerations for the Project include the following physical characteristics of the existing local natural environment that informed the development and design of the Project:

- climate;
- geotechnical conditions;
- hydrological conditions;
- hydrogeological conditions;
- geochemical conditions; and
- climate change.

These environmental considerations are summarized in Section 5.3.3.1 to Section 5.3.3.6 and, along with the information presented in Section 5.2, provided the foundation for proposed Project design and were taken into account as part of development of the EA. Potential extreme weather and seismic events were evaluated and are described in detail in Section 22, Assessment of Effects of the Environment on the Project.

5.3.3.1 Climate

The regional climate of the proposed Project was an important design consideration, as well as a critical component of the EA. Understanding variables such as temperature, precipitation, and wind speed and direction are necessary for Project engineering, as well as for defining modelling inputs in the EA. A regional meteorological and hydrological characterization in the area of the Project was completed as part of the hydrology program to establish baseline conditions (Annex IV, Hydrology Baseline Road Map). The climate characterization was also required to support an analysis of climate change and climate adaptation (Section 5.3.3.6, Climate Change).

The overall climatic conditions in the area of the Project are considered sub-arctic, with mean ambient temperatures ranging from -18°C in February to a high of 17°C in July. Winters are characterized as long and cold, with mean monthly and daily temperatures below freezing from October to April. Precipitation typically falls as rain between May and October, and as snow from October to April, with the greatest snowfall amounts occurring between November and January. Average total annual precipitation in the region is on the order of 440 mm. Maximum wind speeds in the region can vary between 30 km/h and 48 km/h, and can occur from every direction but are most commonly from the northwest.

Additional information on climate in the area of the Project can be found in Annex IV.1, Regional Meteorological and Hydrological Characterization Report.

5.3.3.2 Geotechnical Conditions

Geotechnical conditions in the area of the Project are generally characterized by up to 75 m of dense to very dense sedimentary layers underlain by very competent basement rock extending to below the Arrow deposit. Overlying materials generally have a higher level of hydraulic conductivity, allowing water to flow, while basement rock has very low hydraulic conductivity, with the exception of well-understood shear or fault zones, which can be conduits for water movement.

The following subsections provide details on the surface and underground geotechnical conditions and design considerations for the Project.

Surface Geotechnical

An understanding of surface geotechnical conditions allows the proper modelling and design of proposed Project infrastructure. The Project site is situated on a peninsula adjacent to Patterson Lake. The highest local point near the middle of the peninsula is approximately 583 masl. From this local high point, topography slopes down towards the shoreline of Patterson Lake to the north, west, and south to a shoreline elevation of approximately 500 masl (Figure 5.3-2).

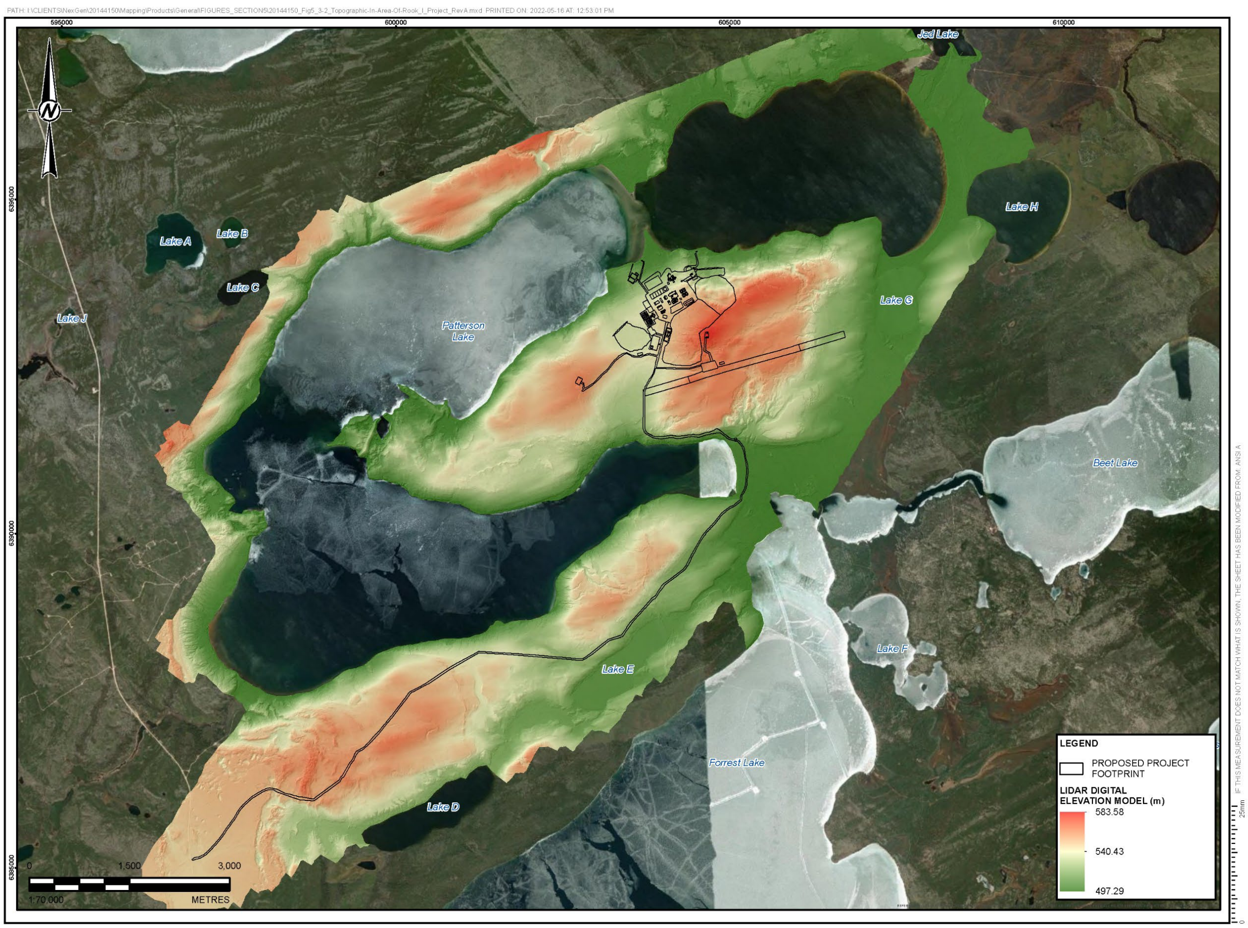
The landscape in the area of the Project has been formed through historical glacier influences. The existing topography is variable, with drumlins and lakes/wetlands dominating the northwest and southeast parts of the regional area of the Project, respectively, and lowland lakes, rivers, and muskeg dominating the central part of the area. Surficial soils in the region are scattered with rocks, boulders, sands, and fines.

Surficial materials in the immediate vicinity of the Project site include coarse sands and gravels with varying quantities of cobbles, boulders, and larger blocks (BGC Engineering Inc. 2020). The shallow subsurface materials are characterized by two types of glacial till (i.e., basal till and ablation till), as well as other sedimentary materials. Basal till in the area of the Project is composed of dense (i.e., very compacted) to very dense sands and silts with some interbedded clays; this material thickness ranges from less than 5 m to 75 m. The ablation till is composed of dense sands with layers ranging in thickness from less than 5 m to 25 m, with widespread cobbles and boulders. Other sedimentary materials in the area of the Project that have been deposited by glaciers include interbedded sedimentary rocks of mudstone and sandstone with varying thicknesses of 2 m to 15 m, as well as less compacted sediments of sands and silts up to 35 m in thickness. Table 5.3-2 outlines the eight geological units that define the shallow subsurface conditions in the area of the Project. Based on the soil types encountered, the overburden soil types have been grouped into a single geotechnical unit: ablation till.

The depth of frost penetration in the area of the Project is estimated to be approximately 2.5 m to 3 m with a vegetative cover in place and approximately 3.2 m to 3.5 m below buildings (BGC Engineering Inc. 2020). Based on the varying silt content of the soils within the frost penetration depth, the frost susceptibility of the soil material is expected to be variable.

Additional geological details associated with the area of the Project can be found in Section 5.2.6.

Figure 5.3-2: Topography in the Area of the Rook I Project



LiDAR = light detection and ranging.

Table 5.3-2: Subsurface Geologic Units in the Area of the Rook I Project

Geologic Unit Name	Geologic Unit Description
Basal till (TILL 3)	Fine sand to sandy silt, some clay interbedded, dense to very dense. Deposited over an ablation till facies. Generally, only present on the northeast corner of the Project footprint.
Ablation till	Poorly graded sand, compact to dense, with widespread distribution of cobbles and boulders. Over-thickening and the coarse texture of the ablation till facies are the result of repeated pushing/reworking by glacial thrusting and meltwater. Unit thickness varies from <5 m to 25 m.
Basal till (TILL 2)	Fine sand to sandy silt, some clay interbedded, dense to very dense. Till deposited during initial glacial thrusting advances. Laminations and other depositional structures are present. Covered by varying thickness of ablation till. Unit thickness varies from 5 m to 30 m.
Basal till (TILL 1)	Sand and silt horizons, dense to very dense. Covered by varying thicknesses of ablation till in uplands to the south of the main mine development area. Unit thickness varies from <5 m to 75 m.
Glaciolacustrine sediments	Complex interbedding of sands, silts, and clays interpreted to have been deposited by proglacial lakes. The beds change quickly both horizontally and vertically, and often contain drop stones. This unit is buried by TILL 2 in some areas of the Project, and elsewhere (particularly the east side of the Project footprint) has been completely removed by glacial thrusting. Unit thickness varies from <5 m to 35 m.
Cretaceous Mannville Formation	Interbedded sedimentary bedrock sequence of mudstone and sandstone, with some coal seams. Unit thickness varies from 2 m to 15 m. The mudstone has been identified as the critical unit for the evaluation of slope stability factors of safety for infrastructure at the Project site.
Devonian La Loche Formation	Sedimentary bedrock with mainly marine quartzose mudstone and weakly cemented sandstone; silty and clayey.
Athabasca Supergroup	Weakly cemented sedimentary bedrock, poorly graded, fine to medium, quartz rich sandstone and conglomerate with lesser dolomite and shale. This unit is absent on the south-southeast side of the Arrow deposit but increases in thickness to the north-northwest.

Note: Glacial geologic unit names from BGC Engineering Inc. (2020).
<= less than.

Underground Geotechnical

An understanding of basement rock mass conditions is required to reliably predict rock mass responses and conditions in the Arrow deposit, which allows the appropriate design of underground development and infrastructure, and ultimately, performance of mining activities. Generally, the basement rock in which proposed Project underground infrastructure would be developed is competent ground suitable for mine development and long-term tailings storage.

Rock mass classification systems have been used to classify rock mass quality in basement rock and assess the range in anticipated rock quality in the primary areas of interest associated with the Project (e.g., mining, shafts, and UGTMF zones). In addition to rock quality, other geotechnical parameters associated with the material types were spatially interpreted to develop geotechnical domain (i.e., units representing different material types) models to relate the geotechnical conditions to the mine plan.

As described in Section 5.2.6, several interpreted basement shears and faults align with, and are close to, mineralization (i.e., the uranium ore body). Shear zones are closely related to the strength of the overall rock mass. Lab-measured unconfined compressive strengths at the Arrow deposit range from 10 megapascals (MPa) to nearly 250 MPa. The basement geotechnical domains are presented in Table 5.3-3.

Table 5.3-3: Basement Geotechnical Domains in the Area of the Arrow Deposit

Domain	Sub-domain	Description	Intact Rock Strength (MPa)	Rock Mass Rating (RMR) Range[(a)]
Weathered basement domain	Primary lithology	Paleoweathered basement below unconformity, extending deeper in the metasomatized orthogneiss	<50	40 to 60
Basement domain	Primary lithology	Unaltered basement rock, dominated by metamorphosed intrusives. Good to very good rock quality	100 to 250+	60+
Altered basement domain	ABMT-1	Slightly altered basement. Fair rock quality. The outer halo of alteration. Primarily in metasomatized orthogneiss. Encompasses all stoping areas	50 to 100	50 to 60
	ABMT-2	Moderately altered to strongly altered basement. Predominantly fair to poor rock quality. The inner halo of alteration. Primarily metasomatized orthogneiss	25 to 50	40 to 50

a) Rock mass quality range: very good (RMR 100–81), good (RMR 80–61), fair (RMR 60–41), poor (RMR 40–21), and very poor (RMR <20).
<= less than; MPa = megapascal; ABMT = altered basement.

5.3.3.3 Hydrological Conditions

A hydrological characterization study of the Project and regional areas was completed to understand the variability of water levels and flows for local and regional lakes and streams (Annex IV.1). This understanding is necessary to support the proposed Project design and EA, including hydrological modelling used to predict potential effects of proposed Project water withdrawals, diversions, and discharges on local and regional waterbodies.

The proposed Project would be located adjacent to Patterson Lake within the Clearwater River watershed. Patterson Lake is located near the headwaters of the Clearwater River watershed at Broach Lake (CHRS 2021). The headwaters of the Clearwater River are traditionally known to be situated north of Patterson Lake (CRDN 2019). The Clearwater River flows from Broach Lake through a series of lakes including Patterson, Forrest, Beet, and Naomi lakes, in order from upstream to downstream (Figure 5.1-2).

The upper Clearwater River from Broach Lake to Naomi Lake is dominated by glaciolacustrine terrain (Annex IV.3, Geomorphology Characterization Report), and the mainstem of this river is made up mainly of waterbodies separated by short channel sections, except for the relatively long, steeper reach downstream of Broach Lake. From Naomi Lake, the Clearwater River flows another 20 km southeast before reaching the Mirror River confluence. Below the Mirror River confluence, the Clearwater River deepens with the higher flow volumes from the Mirror River, and the channel form changes to meandering within a well-defined river valley.

Farther downstream, the Clearwater River flows through Lloyd Lake, which is upstream of Clearwater River Provincial Park; the downstream end of the park is at the Saskatchewan-Alberta border. The Clearwater River flows into the Athabasca River at Fort McMurray, Alberta, which flows north into the west end of Lake Athabasca through the Peace-Athabasca delta. Water from the Clearwater River ultimately flows to the Arctic Ocean through the Mackenzie River.

The hydrological characterization study (Annex IV.1) was complemented by a currents study of Patterson Lake (Annex IV.4, Patterson Lake Currents Assessment Report) and a mixing study of Forrest Lake (Annex IV.5, Forrest Lake Mixing Study Report). The currents study informed the analyses of potential effects of the Project on Patterson Lake; specifically, understanding potential effects on surface water quantity and quality to inform the design and locations of proposed water intakes and outfalls associated with the Project. The Forrest Lake mixing study informed the understanding potential effects of the Project on water quality downstream of Patterson Lake (i.e., Forrest Lake).

Additional information on hydrology in the area of the Project can be found in Section 9, Hydrology.

5.3.3.4 Hydrogeological Conditions

Characterizing the regional hydrogeological conditions (i.e., the way groundwater moves through soil and rock) is important for understanding the quantity and quality of groundwater that would require management during underground mining operations and at surface. Characterizing hydrogeological conditions is also important for understanding potential changes to groundwater chemistry that may result from the Project, and the effect of those changes on surface waters.

Groundwater Flow

For the purposes of characterizing groundwater flow directions in the vicinity of the Project, the local geology was divided into hydrostratigraphic units (i.e., distinct hydrologic units with consistent behaviour in groundwater flow). This information was used to inform underground mine design and proposed mitigation measures. The three hydrostratigraphic units for the Project are summarized in Table 5.3-4.

Table 5.3-4: Hydrostratigraphic Units in the Area of the Rook I Project

Hydrostratigraphic Unit Name	Geologic Unit Description
Glacial drift	Ranging from approximately 25 m to 100 m below surface in the vicinity of the Arrow deposit and consisting of glacial drift overburden deposits, with the upper overburden characterized by higher sand and boulder content generally located above the groundwater table, and lower overburden with higher fines content and generally located below the water table.
Shallow bedrock	Spanning the Cretaceous Mannville Group, Devonian La Loche Formation, and Athabasca Sandstone located between the glacial drift above and the paleoweathered zone of the crystalline basement rock below. The depth to the bottom of the shallow bedrock hydrostratigraphic unit ranges from 100 m to 150 m below surface in the vicinity of the Arrow deposit.
Deep bedrock	Extending below approximately 100 m to 150 m below surface in the vicinity of the Arrow deposit, and consisting of the crystalline basement rock, including paleoweathered zone at the contact with the overlying Athabasca Supergroup sandstones.

Both the shallow and deep bedrock materials are considered low permeability (i.e., the ability of water to move through a rock), where water movement is slower and smaller in total volume, while the near surface materials (i.e., glacial drift) have higher permeability. Hydraulic head measurements recorded within the basement rock indicate that static groundwater elevations range from between approximately 498 masl and 513 masl.

Groundwater flow directions in the glacial drift are predominantly toward local surface water and drainage features. In the area of the underground mine, the groundwater flow direction in the glacial drift is towards Patterson Lake. Project infrastructure would be situated on a peninsula surrounded by Patterson Lake, and a groundwater flow divide in the glacial drift exists to the south of the Project site. Groundwater flow to the north of the divide flows to the north and groundwater flow to the south of the divide flows towards the south, ultimately discharging to Patterson Lake in both directions.

The lateral groundwater flow direction in the shallow bedrock in the area of the Project is predominantly from west to east, with a component of the flow towards major water features (e.g., Patterson Lake, Forrest Lake) in localized areas. In the northern portion of the area, flow is towards the south, generally following the topographic setting of the Clearwater River catchment. Local to the proposed Project infrastructure, the groundwater flow in the shallow bedrock is similar to the glacial drift. A groundwater flow divide is interpreted to the south of the proposed underground infrastructure, with flow directed to the northern and southern portions of Patterson Lake on the respective sides of the divide.

Groundwater flow direction in the deep bedrock is predominantly from west to east, with the highest hydraulic gradient occurring west of Patterson Lake. Local to the proposed underground infrastructure, the lateral groundwater flow direction is to Patterson Lake to the north. The groundwater flow divide noted for the shallow bedrock is also anticipated in the deep bedrock, though less pronounced.

The vertical groundwater flow direction is downwards in the area of the topographic high in the Project footprint (Section 5.3.3.2, Geotechnical Conditions), transitioning to upwards in the area of the underground mine and UGTMF. The influence of the structures in the basement rock (i.e., fault zones and shear zones) is evident in the simulated groundwater elevations, as indicated by localized reduction in groundwater pressures near these geologic features. The structures are considered more conductive than the adjacent basement rock and represent the primary groundwater flow path between the proposed underground mine workings and groundwater discharge locations in Patterson Lake.

During Construction and roughly the first half of Operations (i.e., Year -4 to Year 10), groundwater inflows to the underground development are predicted to range from a total of approximately 1,200 m^3/d to 2,000 m^3/d, with the greatest portion of inflow occurring at the underground openings that are not associated with the UGTMF or stope excavations. At Year 10, the total groundwater inflows are predicted to increase to approximately 3,900 m^3/d, corresponding to the opening of additional stopes. After Year 16, the groundwater inflows are predicted to be relatively stable at approximately 3,500 m^3/d total inflow.

Additional information on hydrogeology in the area of the Project can be found in Section 8, Hydrogeology; Annex III, Hydrogeology Baseline Report; and TSD XIV, Groundwater Flow and Solute Transport Modelling Report.

Groundwater Chemistry

Groundwater chemistry provides an understanding of the quality of groundwater that may be encountered and require management over the Project lifespan. Groundwater quality sampling at the Project site has been conducted since 2017 using standpipe piezometers and Westbay wells installed within the near surface materials (i.e., glacial drift) and basement rock, respectively.

In low-permeability rock (i.e., within the basement rocks), groundwater chemistry tends to be rock-dominated because of a low water-to-rock ratio (i.e., water has a longer residence time due to the low permeability of the material), which causes the groundwater to be more saline. Conversely, in permeable formations (i.e., the glacial drift), groundwater chemistry tends to be less saline because of a higher water to rock ratio. In addition to changes in overall salinity, the aging of groundwater tends to be associated with cation exchange, whereby calcium is replaced with sodium as the dominant cation. In other words, the younger waters tend to be calcium bicarbonate-dominated, whereas the aged waters tend to be sodium/potassium bicarbonate-dominated.

Additional details on groundwater geochemistry can be found in Annex III.

5.3.3.5 Geochemical Conditions

The development of the underground mine would require management of various materials, which include mine rock (i.e., waste rock, special waste, and ore; Section 5.4.4, Mine Rock Management) and tailings (Section 5.4.3, Tailings Management).

The geochemical characteristics of these materials are an important consideration to management of mine rock and water (Section 5.4.5.2, Surface Water Management) at the Project. Multiple drill core samples have been collected in the area of the Project for geochemical analysis and uranium assay. Results from the geochemical analysis and characterization program were used in the following Project components:

- consideration of management alternatives for waste rock, ore, and process wastes;
- design of the ore storage stockpile, special waste stockpile, and WRSAs at surface, as well as process waste disposal and tailings management facilities;
- development of geochemical source terms for the evaluation of potential runoff and leachate water quality reporting from waste rock, underground wall rock, and tailings areas at the proposed Project; and
- use of geochemical source terms for water quality modelling of site waters and receiving waters.

An overview of the geochemical characterization of waste rock and tailings generated through Project activities is provided in this subsection.

Waste Rock

Mining of the Arrow deposit would produce a component of pyrite-bearing PAG mine rock. Mineralogical testing indicates pyrite is the main sulphide mineral at the Arrow deposit. Under natural conditions, the pyrite is chemically stable in bedrock where it is isolated from atmospheric oxygen. However, following blasting of the bedrock, pyrite in the waste rock would be exposed to atmospheric water and oxygen prior to, and after, being placed in WRSAs. Pyrite within the waste rock is expected to oxidize in the presence of oxygen and water to produce sulphate, iron, and acidity. The iron liberated from the sulphide could subsequently oxidize to ferric iron in neutral pH water to produce additional acidity.

In waste materials, the onset of acidic conditions would be dependent on the balance of acid generated and neutralization potential available. Acidic conditions would not occur until carbonate minerals are consumed, as these minerals create a natural buffering capacity within the waste rock, which neutralizes the generated acidity. Based on static geochemical testing, the overall sulphur concentration associated with pyrite in waste rock is generally low (i.e., less than 0.2%). However, the dominant waste rock units are deficient in carbonate minerals and therefore contain limited buffering capacity.

Release mechanisms for metals, ions, and acidity are governed by two main processes: oxidation (i.e., reactions with oxygen) and dissolution (i.e., dissolving into a solution [e.g., water]). Oxidation of sulphide is assumed to be the dominant mechanism of constituent release for parameters associated with sulphides (e.g., sulphate, copper, cobalt, arsenic). Conversely, dissolution is assumed to be the dominant mechanism of constituent release from oxide, sulphate, and carbonate minerals. As uranium occurs as the oxide species uraninite at the Arrow deposit, uranium and radionuclide release (e.g., radium-226) is expected to result primarily from dissolution. Release from these minerals can also be influenced by pH and chemical (i.e., redox reactions) conditions.

Based on results from ongoing kinetic (i.e., longer-term tests over many weeks) testing on representative waste rock samples, material with greater than 0.1% sulphur content has been defined as PAG, and material with less than 0.1% sulphur content has been defined as NPAG. Further, a delay to onset of acidic conditions is expected in PAG material with low sulphide content (i.e., below approximately 1% sulphide). Geochemical depletion calculations indicate that acidic conditions are not expected to develop for decades in PAG material with low sulphide content; the low-sulphide PAG material is expected to have near neutral pH during Operations, with acidic conditions forming after Closure.

Once the predicted acidic conditions form, the mobility of cation species (e.g., copper, cobalt), which are sensitive to pH conditions, would increase, potentially resulting in higher concentrations and loadings to the groundwater system and ultimately to Patterson Lake. The design of the PAG WRSA (Section 5.4.4.3, Waste Rock Storage Areas) would limit ingress of oxygen available for sulphide oxidation. By limiting oxygen ingress, the reduction in waste rock mass exposed to oxic conditions would reduce loadings of parameters released from sulphide oxidation.

The management of waste rock at the Project is further described in Section 5.4.4. Surface runoff and infiltration reporting to the toe of the WRSAs would be managed through the contact water management system as described in Section 5.4.5.2. Further information on potential solute mass loading from waste rock is evaluated in Section 8 and Section 10, Surface Water Quality and Sediment Quality. Results from the geochemical analysis and characterization program for ore and special waste were considered in the water quality modelling completed for the proposed Project (TSD XVIII, Site-Wide Water Balance and Water Quality Modelling Report).

Tailings

A geochemical characterization program of tailings, process wastes (i.e., leached residue, gypsum, ETP precipitates), binder, and cemented composite materials from pilot-scale metallurgical testing of Arrow deposit ore was conducted with the following objectives:

- Determine the geotechnical, geochemical, and radiological properties of individual and composite tailings materials, process wastes and binders.
- Evaluate the geochemical and radiological leaching behaviour of these materials over time.

Results from the geochemical analysis and characterization program were considered in the development of the tailings handling and storage plans and as inputs to groundwater modelling (TSD XIV) and water quality modelling for the proposed Project (TSD XVIII). A summary of key geotechnical, geochemical, and radiological properties of representative cemented paste backfill (CPB) and cemented paste tailings (CPT) materials is provided below, and is detailed in TSD XVI, Tailings Geochemical Characterization Report:

- The hydraulic conductivity of CPB and CPT materials is influenced by the amount of binder in the material and range from the order of 10^{-8} m/s to 10^{-10} m/s.
- All CPB samples are classified as NPAG. The high binder CPT materials contain a high neutralization potential and are classified as NPAG. The low binder CPT materials contain a neutralization potential at least an order of magnitude lower than the representative high binder materials and have an uncertain or PAG classification.
- The CPB and CPT materials contain enriched solid-phase concentrations of arsenic, bismuth, copper (CPT only), lead, molybdenum, selenium, silver (CPB only), sulphur, and uranium.
- Constituents with a high leachability potential for representative CPB materials identified from short-term leach testing include aluminum, antimony, chloride, cadmium, iron, molybdenum, selenium, sulphate, lead-210, and radium-226. For representative CPT materials, the constituents include aluminum, arsenic, chromium, lead, molybdenum, selenium, silver, strontium, sulphate, and thallium.

- The lower binder variant of the CPB materials contained the highest average radioactivity (i.e., gross alpha activity 4,825 becquerels per gram [Bq/g] and gross beta activity 1,500 Bq/g) compared to the higher binder variant (i.e., gross alpha activity 2,900 Bq/g and gross beta activity 1,020 Bq/g). For CPT, the lower binder variant also contained the highest average radioactivity (i.e., gross alpha activity 3,075 Bq/g and gross beta activity 1,075 Bq/g) compared to the higher binder variant (i.e., gross alpha activity 1,725 Bq/g and gross beta activity 548 Bq/g).
- Elemental liberation rates from CPB materials under advective mass transfer conditions indicate that the initial pore water quality is alkaline (i.e., pH 9.4 to 11) and remains alkaline after ten pore volume replacements. For CPT materials the initial pore water quality is circumneutral to alkaline (i.e., pH 7.4 to 11) and remains slightly alkaline after 30 pore volume replacements.
- Diffusive mass flux values for representative CPB and CPT materials are greatest during the initial leaching period and most constituents follow ordered rate kinetics (i.e., flushing).

The release of solutes from CPB and CPT is expected to be limited since the paste composition is designed to not release water after deposition. Additionally, groundwater reporting to the underground mine would be pumped to the surface during Operations. As such, the underground mine would be under hydraulic containment, and release of mining-affected groundwater from underground sources to the surrounding environment would not occur.

Upon completion of mining and backfilling, the underground would be re-flooded and groundwater pressures would return to natural hydrostatic conditions. The backfilled CPB and CPT would be inundated, and two mass transfer mechanisms would be established that would determine the mass loading rates from these materials to the surrounding groundwater:

- leaching of solutes from CPB and CPT as groundwater moves through the material under regional groundwater flow gradients (i.e., advective mass transfer); and
- leaching of solutes from CPB and CPT due to concentration differences between the material surface, the material pore water, and the surrounding groundwater (i.e., diffusive mass transfer).

The amount and rate at which constituents are released from CPB and CPT under advective and diffusive mass transfer mechanisms would be governed by the physical properties of the CPB and CPT, surrounding host rock, and the interaction with percolating groundwater. Transport time for solutes to reach Patterson Lake after Closure are predicted to be many thousands of years.

Progeny formed by the radioactive decay of uranium-238, including thorium-230, radium-226, lead-210, and polonium-210, would be present in the CPB and CPT. These radionuclides are subject to both advective and diffusive mass transfer mechanisms, and ongoing radioactive decay (i.e., ingrowth) is expected to occur during transport through the CPB and CPT. Half-life periods for these decay series range from tens of thousands of years in the case of uranium-238 and thorium-230 to relatively short periods such as 138 days in the case of polonium-210.

The management of tailings for the proposed Project is further described in Section 5.4.3. The potential solute mass loading from underground tailings disposal is evaluated in Section 8; Section 10; TSD XIV; TSD XV, Tailings Source Term Derivation Report; and TSD XVI. Results from the geochemical analysis and characterization program tailings were considered in the water quality modelling for the proposed Project (TSD XVIII).

5.3.3.6 Climate Change

Climate change has the potential to change future precipitation and temperature regimes, which would modify how weather-related hazards could affect the proposed Project. Therefore, understanding the current climate and the future climate trends is important when evaluating Project design parameters. To support this understanding, a climate change dataset for the Project was developed (Appendix 22A, Climate Change Dataset Summary Report). This appendix summarizes the existing available local and regional climate data related to the current climate and projected future climate.

In general, the climate in the region of the Project is predicted to become warmer and wetter over the next 80 years. The degree of warming varies by Intergovernmental Panel on Climate Change model scenario (downscaled to the region), with temperature increases ranging from 0.5°C to 5°C by the 2050s and from 0.5°C to 9°C by the 2080s. Similarly, the predicted increase in precipitation varies from a slight decrease to a 20% increase by the 2050s and a slight decrease to a 30% increase by the 2080s.

Climate change has been considered in the Project design. Potential effects of climate change on the Project are discussed in Section 22. Briefly, climate change was considered in the following ways:

- Climate change predictions from Intergovernmental Panel on Climate Change model scenarios were downscaled to regional predictions to support Project design (Appendix 22A) and for consideration with regards to effects of the environment on the Project (Section 22).
- Potential modifying effects of climate change were considered in model scenarios for environmental disciplines that may influence Project design considerations; specifically, hydrology (Section 9) and water quality (Section 10).
- A Climate Adaptation Framework was developed for the Project to respond and adapt to climate change over the lifespan of the Project (TSD XXII: Climate Adaptation Framework).
- A Net-Zero Framework was developed to provide a preliminary assessment of potential alternative technologies and practices that could be used to reduce GHG emissions during the lifespan of the proposed Project (TSD XII: Net-Zero Framework).

A full description of how climate change was considered in the EA is provided Appendix 6A, Climate Change Road Map.

5.4 Project Components

As described in Section 5.1.1, Project Overview, the proposed Project would include components to support the extraction of uranium ore from the Arrow deposit and the production of uranium concentrate.

Mine development proposes to use conventional mining methods conducted within the crystalline basement rock that hosts the Arrow deposit. The proposed milling facilities designed to process the ore on site would be located on surface directly above the underground mine. Tailings from the processed ore would be returned below ground as a cemented backfill material, with permanent storage in either previously mined areas or the dedicated UGTMF. The UGTMF is a key environmental design feature that would safely store tailings underground, reduce the Project footprint at surface, and substantially minimize the associated risks to the environment throughout and beyond the Project lifespan.

The Project components are summarized within this subsection by key area:

- mining;
- processing;
- tailings management;
- mine rock management;
- site water management;
- conventional waste management;
- supporting infrastructure; and
- off-site infrastructure.

This subsection generally describes components in their steady state (i.e., operational) condition. Information on Project activities, including the phasing of the construction and commissioning of the components, is described in Section 5.5.

5.4.1 Mining

The underground mine includes all the components required to access, extract, and support mining and UGTMF storage. The key components of the mining area include:

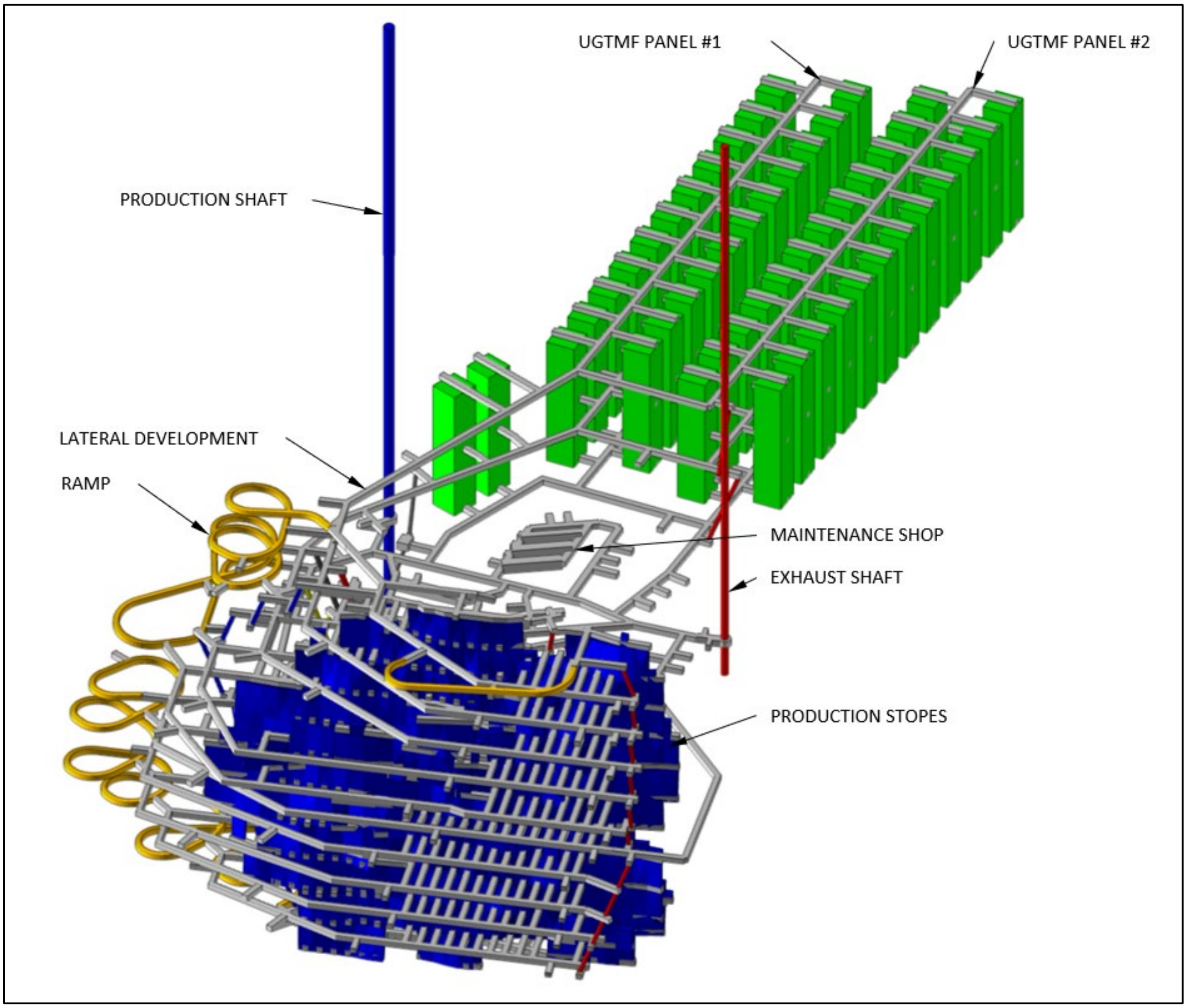
- production and exhaust shafts;
- lateral development;
- vertical development;
- explosives and detonator storage facility;
- underground mine infrastructure;
- mining production stopes;
- UGTMF chambers;
- mine ventilation; and
- mining surface infrastructure.

Access underground would be via the production shaft, with stations on the 500 Level and 590 Level. The exhaust shaft would provide a secondary means of egress. The Arrow deposit would be accessed from the shafts through a series of levels, spaced at 30 m vertical intervals, and connecting ramps, which would be used to transport people and equipment. Additional underground development would be required for ventilation, ore, and waste passes, and supporting infrastructure and services.

The tailings produced by the process plant would be returned underground as a cemented paste product. Tailings disposal would include CPB for the production stopes (i.e., areas developed during mining activities) and CPT deposited into the UGTMF chambers (i.e., areas developed specifically for tailings storage).

Figure 5.4-1 provides a general overview of the underground layout and infrastructure for illustrative purposes.

Figure 5.4-1: Rook I Project Underground Mine and Infrastructure Overview



UGTMF = underground tailings management facility.

5.4.1.1 Mining Method

The conceptual mine design would utilize conventional long hole stoping as the primary mining method for both the production and development of UGTMF chambers.

Production Mining

The mining method selected for the Arrow deposit is long hole stoping, which is a variation of bulk mining. The long hole mining method was chosen to optimize safety performance, reduce worker exposure to physical hazards and radiation, maximize mineral resource extraction, and increase operational flexibility and productivity by achieving simultaneous production from multiple mining fronts. Long hole stoping is the process of extracting ore by drilling, blasting, and excavating material from underground, leaving behind an open space, known as a stope, which is subsequently backfilled to support further development in the surrounding workings. This mining method is generally associated with steeply dipping ore bodies and is a proven technique that has been successfully applied at other mining operations worldwide and within the Athabasca Basin. The Project may also apply other bulk tonnage mining methods or raise boring (i.e., underground mining method to obtain ore without use of explosives, in which a circular hole is excavated between two levels of a mine).

Long hole stoping requires dividing the mineral resource targeted for production into individual stopes and establishing mining levels to access the stopes and orientate development to facilitate drilling, blasting, and extraction of the material. Personnel would be prohibited from entering the open portion of a stope; instead, material from within the stope would be mucked (i.e., removed) remotely using load-haul-dump (LHD) units, which would reduce worker exposure to potential ground hazards and radiation. Once extraction of material within a stope is completed, the stope would be filled with CPB.

For the Project, a 30 m spacing between mining levels would be used to maximize productivity via bulk mining while maintaining selectivity with typical long hole mining equipment. Greater mining equipment selectivity allows for less dilution of ore by waste rock.

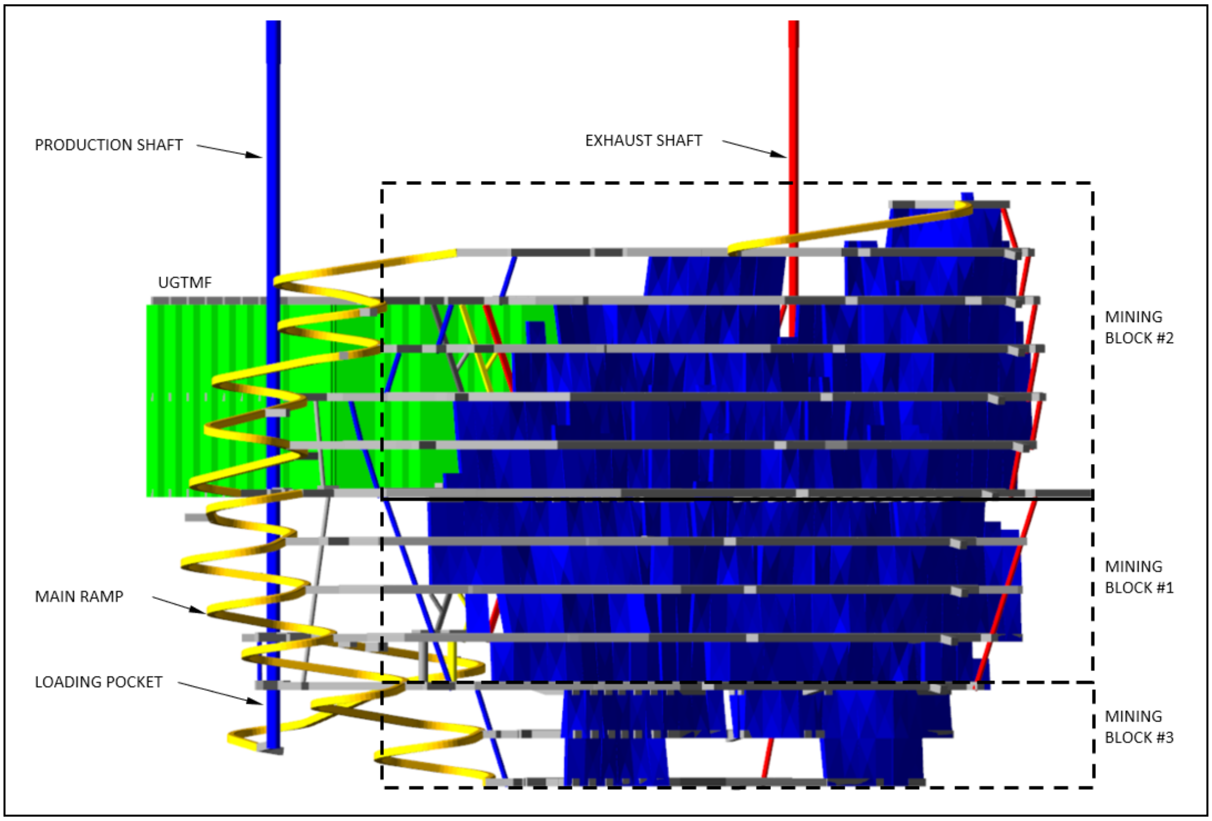
Multiple mining blocks would be developed concurrently. A mining block is a group of underground stopes that can be mined independent of the other mining blocks. Concurrent development of multiple mining blocks provides the ability to better control grades and flexibility if production from one mining block is limited. Each mining block would be developed using a bottom-up approach. There would be two main vertical mining blocks (blocks 1 and 2) and a third smaller tonnage mining block (block 3).

Figure 5.4-2 indicates the mining blocks within the general overview of the underground layout and infrastructure.

Underground Tailings Management Facility Mining

The UGTMF chambers would also be mined using long hole stoping with horizontal access levels developed above (i.e., overcuts) and below (i.e., undercuts) the underground area to be excavated. Overcuts would used as access to drill down into the chambers, while undercuts would provide access for the mobile LHD units to collect (i.e., muck out) the blasted material. Once a chamber is fully mined out, it would be backfilled up to the overcut elevation, and the overcut would become the undercut for the next chamber above. The level spacing for the UGTMF chambers would increase to 60 m to maximize the storage efficiency of the chambers and reduce the number of sub-levels and associated development required.

Figure 5.4-2: Arrow Deposit Underground Mining Blocks Profile – Looking North



UGTMF = underground tailings management facility.

5.4.1.2 Production Shaft and Exhaust Shaft

Mine access refers to means of ingress and egress to underground areas for personnel and materials. The production shaft, an 8 m diameter shaft that is approximately 650 m in depth, would serve as the access point to the Arrow deposit, and the exhaust shaft, a 5.5 m diameter shaft that is approximately 533 m in depth, would provide a means of secondary egress should the production shaft become inaccessible.

Personnel and material would access the underground mine via the production shaft, which would have two skips (i.e., conveyance systems), a large cage, an auxiliary cage, and mine services (i.e., process water pipeline, dewatering pipeline, compressed air pipeline, and power and communication lines). All ore and waste rock produced during underground operations would be hoisted up (i.e., removed via) the production shaft. The production shaft infrastructure would include a hoist building, headframe and collar house, ventilation infrastructure (i.e., dedicated ventilation pathway between the intake fans and shaft), two shaft stations (i.e., connecting excavations between the shaft and underground mine workings), and a loading pocket shaft station. The production shaft would also provide the fresh air intake for the underground operations. Access to the production shaft would be from the 500 Level and 590 Level, as well as from the 620 Level. A dedicated ramp would be excavated to the bottom of the production shaft to recover any spillage of mine rock from the hoisting process.

Exhaust air would be returned to the surface via the exhaust shaft. A trailer-mounted, diesel-powered winch would be located above the exhaust shaft on surface for use in lowering an escape pod if secondary egress is required.

Shaft stations would be required to provide access to the underground mine workings, to route services, and to distribute ventilation underground.

In the production shaft, shaft stations would be located on the 500 Level and 590 Level, along with the 620 Level loading pocket. All intake air would be distributed out of the 500 and 590 Levels. The exhaust shaft would have one station on the 500 Level.

The production and exhaust shaft stations would be sized to keep ventilation velocities at safe operating levels; access to the exhaust shaft station would be restricted to prevent exposure of workers to exhaust air from the mine workings. Mine ventilation is further described in Section 5.4.1.7, Mine Ventilation.

The underground mine development must maintain safe operating conditions and abide by legislative and licensing requirements. The following considerations were taken into account during the design process for the production and exhaust shafts:

- The shaft locations and sizes were designed for the production, geotechnical, worker egress, and ventilation requirements of the underground mine.
- The production shaft was designed with a hoisting capacity of 5,290 t/d, which includes 10% design factor allowance plus 5% moisture content. This capacity would be aligned with the peak hoisting requirements of 4,600 t/d of combined ore, special waste, and waste rock, which is estimated to occur in Year 1 through Year 4 of Operations.
- Both shafts would be constructed using ground freezing in conjunction with a concrete hydrostatic liner for the upper portion of the shafts. Freezing of the ground is planned based on the shaft excavation proceeding through water-bearing formations and weak to poor ground. Shaft freezing, sinking, and lining is further described in Section 5.5.1.2, Mining.
- Geotechnical information was used to determine the required depth of the freeze at each shaft location.

5.4.1.3 Lateral Development

Lateral development consists of ramps, access drifts, sill cuts, and purpose-built excavations such as sumps, electrical substation, and maintenance facilities. Lateral development would be used to provide access and connection throughout the underground mine workings, providing locations for storage (e.g., consumables, uranium ore, waste rock) and locations for maintenance and services.

All lateral excavations would be developed using drill and blast methods and mobile equipment. Many lateral development excavations would be required for the life of the mine (i.e., Construction, Operations and Active Closure Stage) to maintain access to key infrastructure and mining areas. For purpose-built excavations, the excavation method would also consist of the development drilling, blasting, mucking, and ground support installation. Most purpose-built excavations would be required for the life of the mine.

A 5 m by 5 m ramp would be constructed to provide access between the various underground levels. The ramp would be angled with a maximum gradient of 15%, with flattened areas at 5% grade (i.e., slope) at the level accesses.

The level developments would be at an approximate 2% gradient to direct water from mining activities and groundwater inflow to the level sumps for collection. The footwall and hanging wall drifts would be driven parallel to the ore body and would provide access from the ramp to different stopes and to the level infrastructure. These drifts would be developed with an additional 0.5 m of height to provide sufficient room for the ventilation ducting required to direct the air from the stopes directly to the exhaust raises (Section 5.4.1.7).

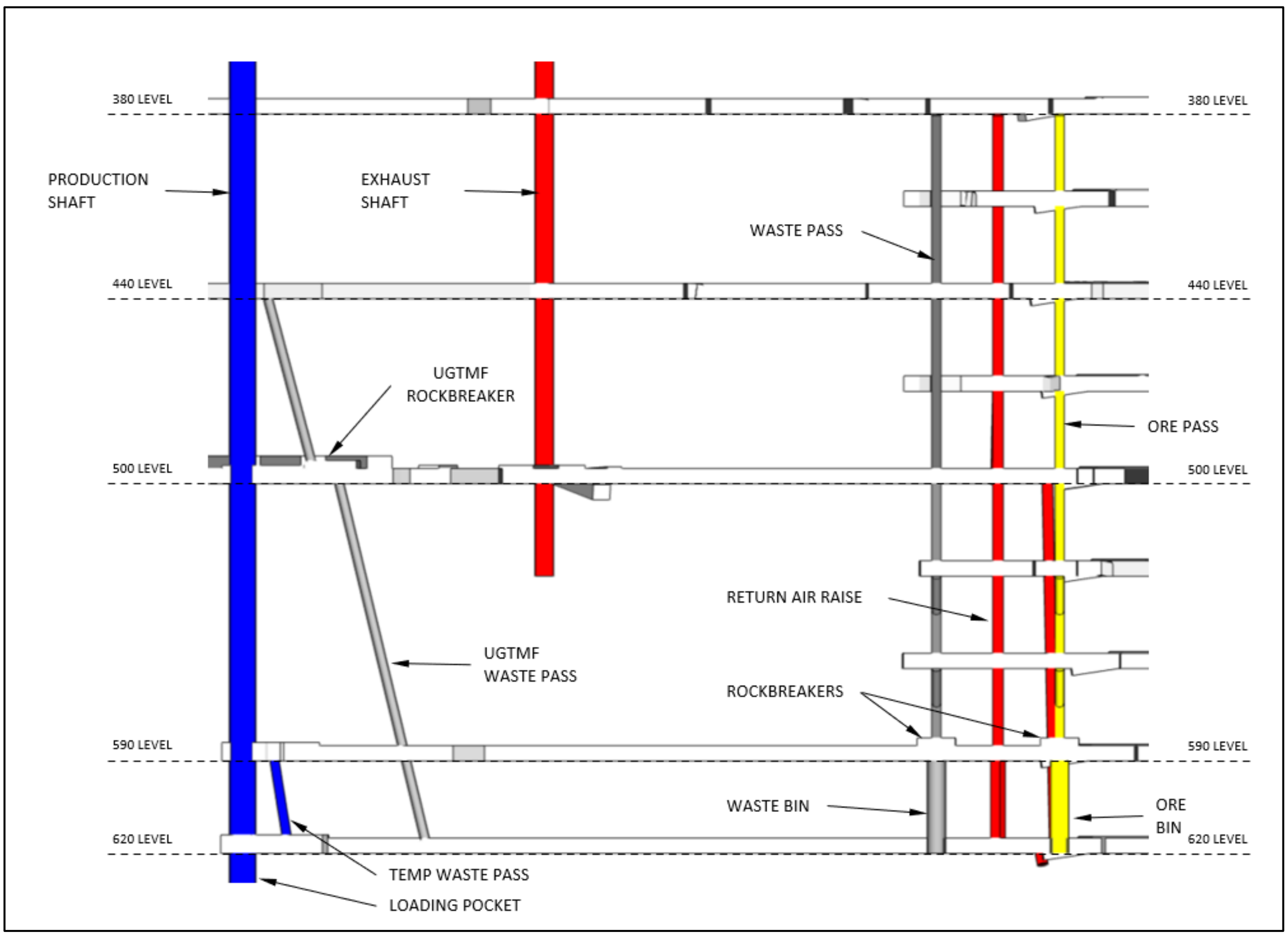
5.4.1.4 Vertical Development

Vertical development would consist of ventilation raises, ore and waste passes (i.e., development to transfer material between levels), and ore and waste bins (Figure 5.4-3). The raises would be used to provide ventilation to the levels. The ore and waste passes would pass the material from the level to the rock breaker below. Ore and waste bins, with a nominal live (i.e., available) capacity of approximately 500 m^3 (1,000 t), would be located below the rock breaker and would provide storage capacity for the sized material until the material is directed onto a conveyor belt on the 620 Level.

Internal ventilation raises would be used to connect each production level for ventilation (Section 5.4.1.7). These raises would be predominantly raise-bored by drilling a pilot borehole from the top level to the bottom level then utilizing a boring machine to excavate the raise to its final dimensions from the bottom up. All internal ventilation raises would be 3.5 m in diameter. The underground internal ventilation raise accesses would include a station for raise bore setup and associated equipment storage. Selected internal ventilation raises would be equipped with an escapeway for secondary egress.

The ore and waste passes would be excavated to allow installation of ground support during the excavation. The passes would be excavated in sections, ultimately connecting the rock breaker stations to the active mining levels. The passes would be sized to accept the blasted ore and waste rock.

Figure 5.4-3: Rook I Project Vertical Development Profile – Looking East



UGTMF = underground tailings management facility.

5.4.1.5 Explosive and Detonator Storage Facilities

Underground storage magazines for explosives, detonators, and blasting accessories would be located on the 500 Level and 590 Level, set a safe distance from the underground infrastructure and work areas. The explosives, including ammonium nitrate and fuel oil, emulsion (i.e., water-resistant explosives), detonators, and packaged explosives, would be stored in separate magazines, and regulatory safety requirements for the handling and storage of explosive products would be followed.

All explosives would be stored, stacked, and labelled to facilitate a first-in/first-out inventory control system. Each underground magazine would be designed with a locking gate. In accordance with The Mine Regulations, 2018, the location of the explosive or detonator facility would be a minimum of 60 m from any work area, fire hazard, or other vulnerable area, and would not be located on any main travel way (e.g., access ramp).

Explosive and detonator materials would be transported from the surface via the main service cage in the production shaft to the underground magazines. Specialized trucks operated by trained and authorized individuals would be used to transport explosive materials from the underground magazines to the workplace. The magazines would each be designed to store a maximum of one week's worth of explosives during operations.

5.4.1.6 Additional Underground Mine Infrastructure

The following additional underground infrastructure would be used to support the daily operations:

- maintenance facilities, including a main workshop;
- satellite workshop;
- fuel and lubricant facilities;
- mine dewatering station;
- backfill receiving station;
- explosive handling and distribution infrastructure;
- personnel and material movement infrastructure;
- electrical infrastructure;
- shotcrete and concrete receiving and handling infrastructure; and
- communications and automation infrastructure.

These facilities would be required to perform many tasks, including but not limited to:

- sizing the ore and waste rock to fit into the skips to be hoisted to surface;
- allowing the mobile equipment to operate by providing maintenance, fuel, and lubricant facilities;
- dewatering underground workings;
- providing refuge in case of an emergency situation;
- providing clean locations for breaks and sanitation;
- power and communication; and
- storage of consumables.

Infrastructure required for mine dewatering and tailings management is further described in Section 5.4.5.3, Mine Dewatering, and Section 5.4.3, respectively.

5.4.1.7 Mine Ventilation

Mechanical ventilation is required for underground mines to provide fresh air to the active working areas and recirculate older air. The underground mine ventilation system has been designed to be a push-pull system (i.e., both surface intake fans and surface exhaust fans) with the exhaust fans being the main driving fans. The main driving fans would be installed on the surface at the exhaust shaft, and the fresh air intake fans would be located at the production shaft.

Smaller fans installed in conjunction with ventilation ducting would be situated underground to direct air to all underground areas, including mine development areas and UGTMF areas.

The intake fans would pull air into a liquified natural gas (LNG) heater and through the surface ventilation infrastructure. Some of the air would be upcasted (i.e., directed upwards) into the headframe to heat the associated equipment, and the rest of the air would be downcast (i.e., directed downwards) through the production shaft.

The intake ventilation fans would have a maximum design capacity of 460 m^3/s, and exhaust fans would have a maximum design capacity of 440 m^3/s. This ventilation capacity is based on the requirement to provide adequate airflow for radiation control, diesel particulate matter dilution, dust control, and to maintain adequate air changes through all active areas.

Single pass ventilation would be employed throughout the mine in ore headings, stopes, and where contact with ore would be encountered, including dewatering sumps (i.e., air would not be reused in areas with the potential for radiation exposure). Air would be reused in non-production areas, such as waste development headings. Ventilation on demand would be used to monitor and control the ventilation system to verify that adequate air quality is maintained on all working levels.

Ventilation for the development of the production and UGTMF headings would use an exhaust-overlap ventilation system to exhaust radon from the headings directly to the exhaust raise.

Air velocities would be maintained at approximately 6 m/s in airways with personnel and mobile equipment travel to mitigate the generation of dust; this lower velocity would be maintained by using the fresh air raises to transfer air.

Dust would be controlled at underground ore and waste handling facilities (e.g., at the rock breakers, passes, and conveyors) by maintaining adequate air velocities in these areas. A dedicated exhaust raise would also be developed for the ore and waste handling locations, and fans would exhaust from any operating passes to prevent dust spreading throughout the underground mine. At the passes, plugs or covers would be used so that air does not short circuit through (i.e., bypass) the passes.

Ventilation on demand would be implemented for the proposed Project to maintain adequate air quality underground and to maximize energy efficiency of the system. The ventilation-on-demand system would use a series of sensors distributed throughout the underground mine to send real-time information regarding the air quality, the location of the equipment, and the location of the personnel to a central computer with specialized software that would be located in the central control room on surface. The software, with input from personnel managing the ventilation system, would determine the ventilation requirements for each mining level or production heading.

In the unlikely event of communications or ventilation control software malfunction, manual overrides would be included in the ventilation system control so that regular operation of the fans could be maintained. This technology system, combined with variable-speed main fans, would create a highly adaptable ventilation system that would maintain air quality and would be capable of substantial energy savings.

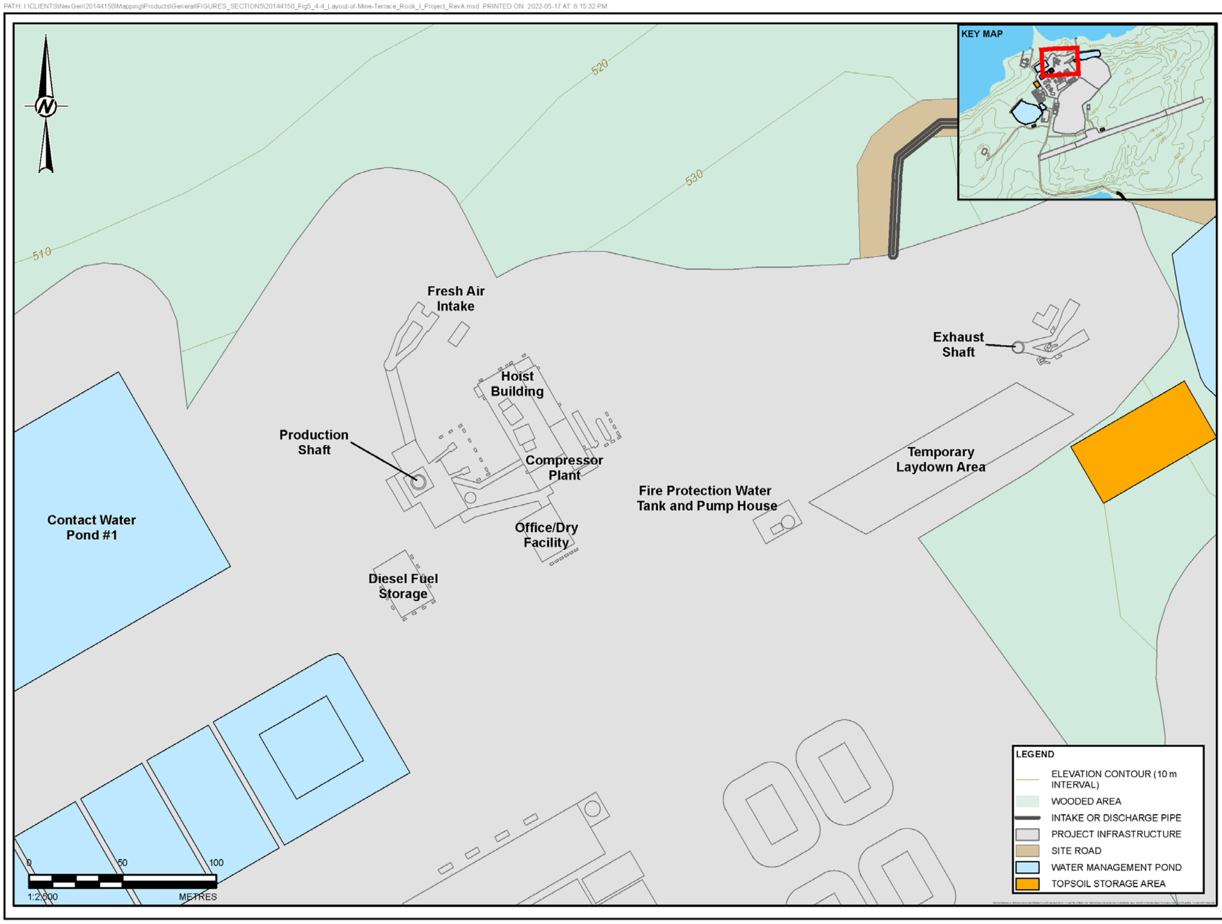
5.4.1.8 Mining Surface Infrastructure

Much of the mine infrastructure required to support underground mining would be located on the mine terrace at surface. The mine terrace would be a graded pad area surrounding the production shaft, exhaust shaft, and connecting areas in between (Figure 5.4-4), and would include the following key infrastructure:

- compressor plant;
- headframes and collar buildings;
- hoist buildings;
- freeze plant;
- batch plant;
- fresh air intake fans and heaters to the underground mine;
- ventilation exhaust fans from the underground mine;
- office/dry facility;
- diesel fuel storage; and
- fire protection water tank and pump house.

In addition, laydown areas would be developed for shaft sinking operations. A surface explosives magazine would also be required to support development of the underground workings. Additional details on the surface explosives magazine are provided in Section 5.4.1.9, Surface Explosives Magazine.

Figure 5.4-4: Rook I Project Mine Terrace Layout



All graded surfaces on the mine terrace and the pad for the fresh air intake fan would be developed with a granular surfacing suitable for permanent all-season traffic, except for the temporary laydown area where this surfacing would not be required.

The area surrounding the production shaft would be constructed with a single high-density polyethylene (HDPE) liner under the gravel pad surface. The remaining portion of the mine terrace, east of the exhaust headframe area, would not be lined.

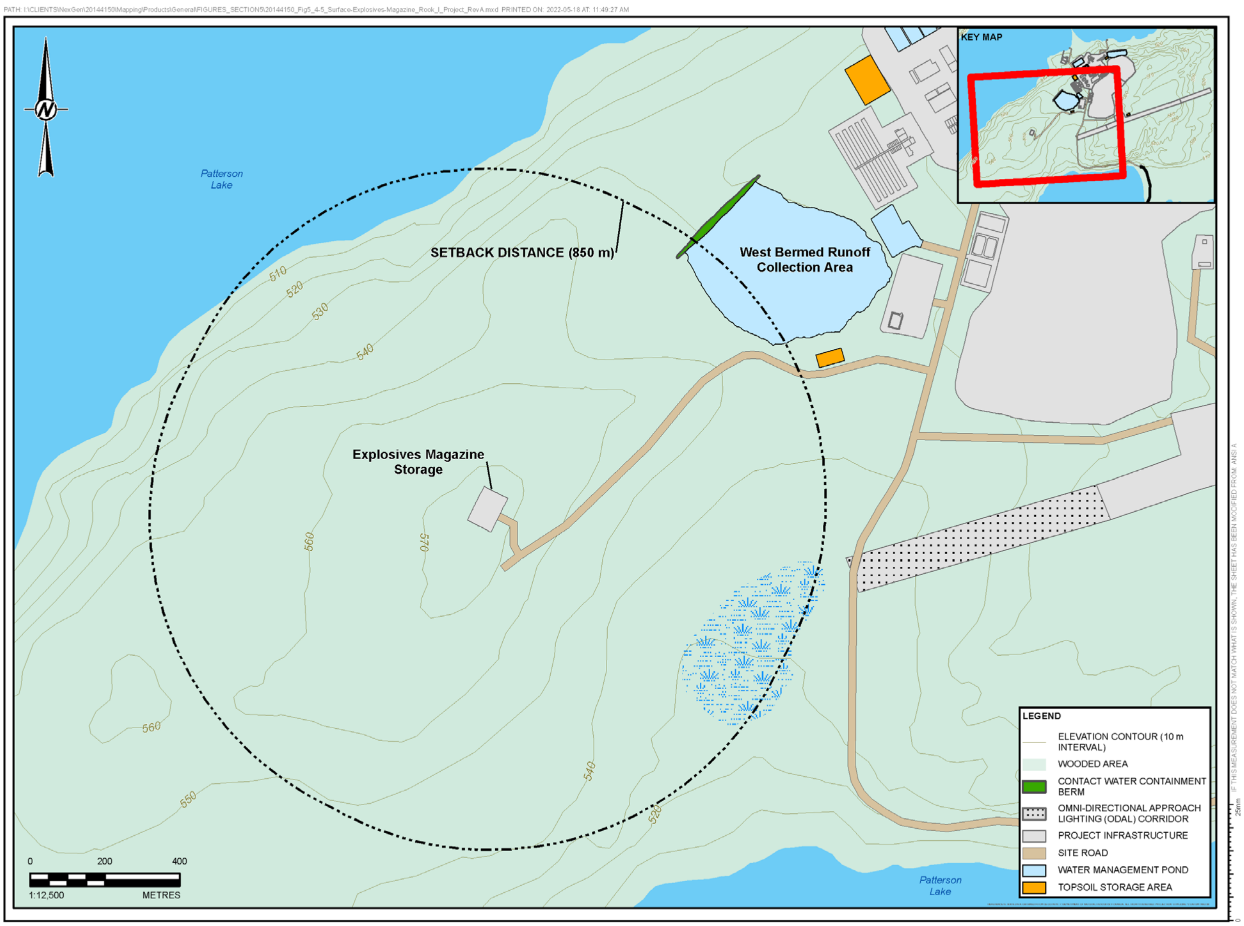
Access to the various WRSAs and special waste rock and ore storage stockpiles would be via the haul road to the south of the mine terrace; additional details on site roads are provided in Section 5.4.7.8, Site Roads.

Surface runoff from precipitation events, including snow melt, on the mine terrace and the fresh air intake pad would be directed to the west and northwest, respectively, to contact water pond #1 by means of surface grade slopes, swales, and ditching (Section 5.4.5.2).

5.4.1.9 Surface Explosives Magazine

The surface explosives magazine would be located in the southwestern portion of the Project footprint (Figure 5.4-5) and set back a minimum of 850 m from infrastructure to meet appropriate explosives management and storage regulations (NRCan 2018). The magazine would be a secured, prefabricated shipping-container-style modular building capable of storing up to 60,000 kg of explosives (i.e., approximately two weeks of storage), and access to the magazine would be controlled.

Figure 5.4-5: Rook I Project Surface Explosives Magazine Location



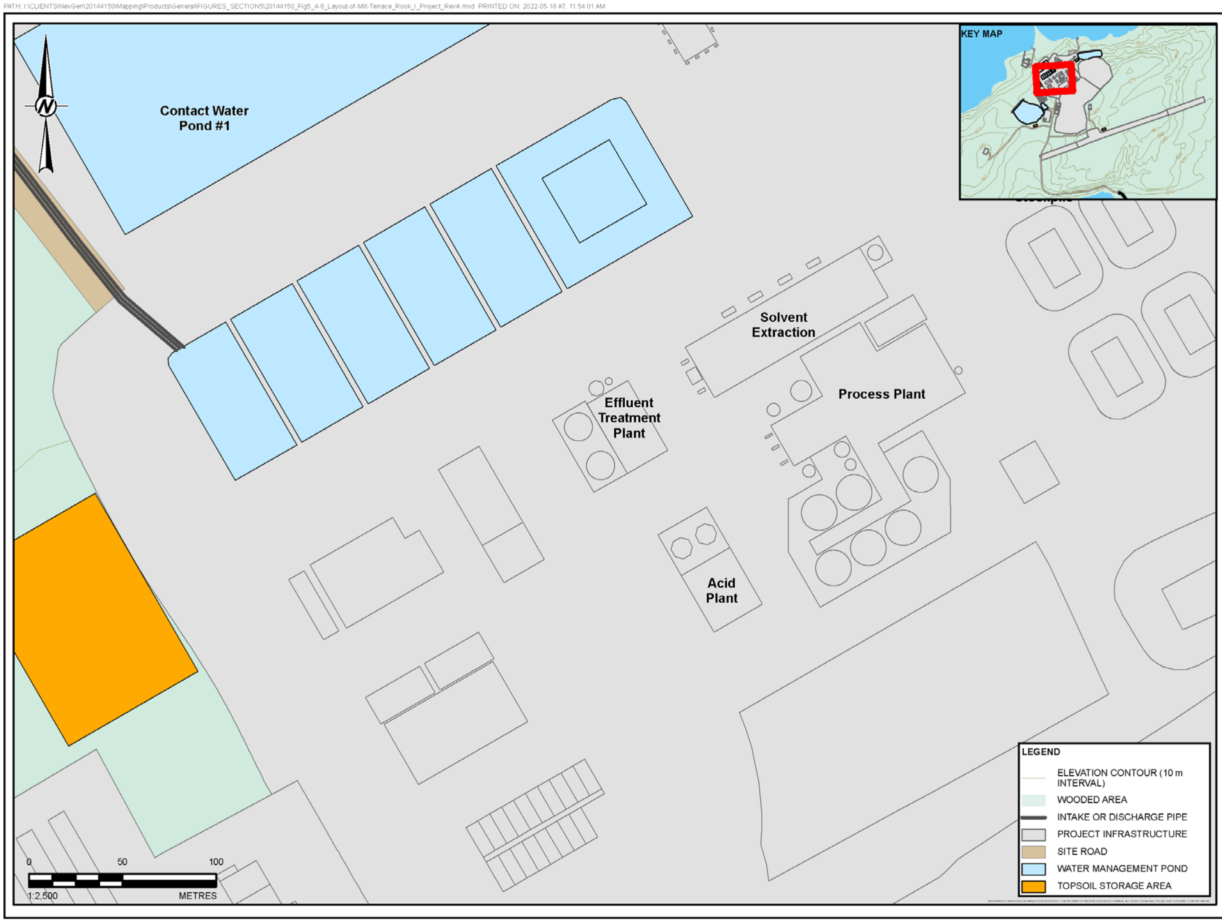
5.4.2 Processing

Processing refers to the activities occurring after uranium ore is received at the ore storage stockpile, and up to the point of the uranium concentrate being packaged. The process plant would process a maximum of 1,300 t/d of uranium ore with an annual production capacity of up to 30 million pounds per year (Mlb/yr) of uranium concentrate.

The majority of Project process facilities and other ancillary support facilities for the operation of the process plant would be located on a graded pad area referred to as the mill terrace (Figure 5.4-6). All proposed buildings on the mill terrace were designed to be fit for purpose and in accordance with relevant provincial and federal regulations, laws, and codes.

Surface runoff from precipitation events (e.g., rain, snow melt) on the mill terrace would be directed to the northwest and northeast, to contact water pond #1 by means of surface grade slopes, swales, and ditches.

Figure 5.4-6: Rook I Project Mill Terrace Layout



5.4.2.1 Metallurgy and Process Flowsheet

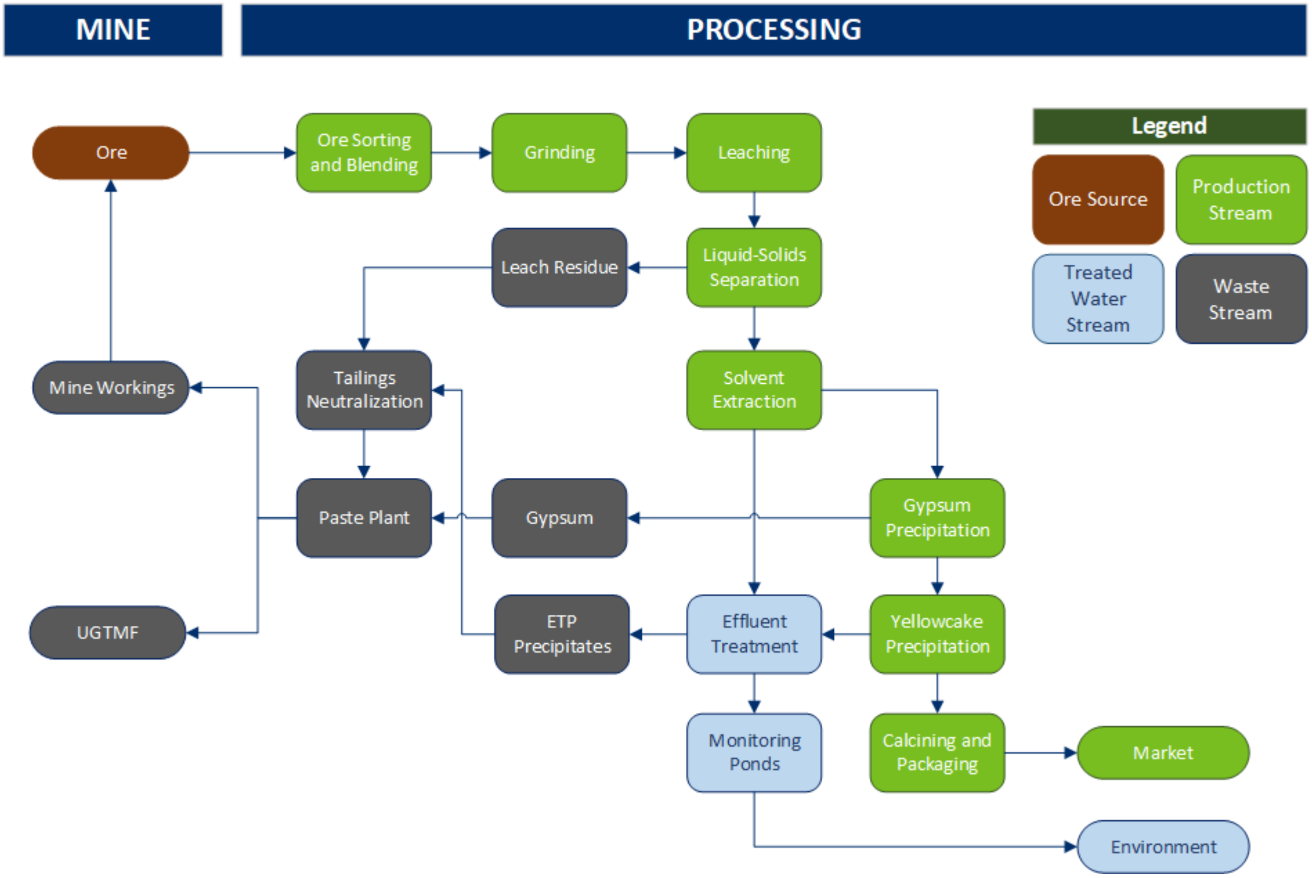
Uranium ore processing for the Project would include acid leaching, solvent extraction, uranium precipitation, and calcining to extract a marketable uranium concentrate product. The acid leaching method, assisted by hydrogen peroxide, would extract uranium from the ore received from the underground mine. This uranium would be purified by a solvent extraction method using a strong acid stripping technique and solidified by hydrogen peroxide. The uranium would be dried and calcined (i.e., reduced, oxidized, or desiccated) at high temperature to create a marketable product of uranium concentrate. The acid used in processing and effluent treatment is produced in an acid plant using sulphur.

The process plant would include ten key process circuits, as outlined below:

- ore sorting and blending;
- grinding;
- leaching;
- liquids and solids separation;
- solvent extraction;
- gypsum precipitation;
- yellowcake precipitation;
- drying, calcination, and packaging;
- tailings neutralization and paste plant; and
- effluent treatment.

The milling process design was informed by metallurgical test program results, knowledge from literature, and experience with existing successful process methods. The basic milling process is illustrated in Figure 5.4-7, and additional details on key process circuits are provided in Table 5.4-1.

Figure 5.4-7: Rook I Project Process Flow Diagram



UGTMF = underground tailings management facility, ETP = effluent treatment plant.

Table 5.4-1: Rook I Project Process Plant Circuits

Process Circuit	Description
Ore sorting and blending	All material identified as ore in the underground would be brought to surface and loaded into haul trucks that would drive through gamma radiation scanners to determine the uranium grade of each truck load. Based on the scanner results, this material would be unloaded at the ore storage stockpile in the appropriate grade pile (e.g., high, low), or at the special waste stockpile. A loader would deliver ore from the ore storage stockpile to the ore feed hopper (i.e., container with a bottom discharge). A grizzly (i.e., screen) over the hopper would control the size of ore entering and any oversize material would be broken up mechanically before being fed into the hopper. The ore would be weighed on a feeder belt and scanned to confirm the uranium content and then would be delivered into a semi-autogenous grinding mill that would reduce the particle size of the ore.
Grinding	The grinding circuit would further reduce the particle size of the ore and introduce water to produce ground particles that are suitably sized and in slurry form at the appropriate thickness to allow efficient leaching of uranium in the leaching circuit. The grinding circuit would produce a relatively homogeneous slurry that would be pumped into an agitated leach feed tank that would further blend the ore.
Leaching	The leaching circuit would oxidize and dissolve the uranium and other leachable non-uranium minerals that are present in ore solids through the control of feed ore slurry flowrates and the addition of steam, sulphuric acid, hydrogen peroxide, and ferric sulphate, as required. These processes would achieve target uranium feed rates, leach retention time, temperature, acid concentration, and oxidation potentials in six in-line stirred tanks and associated leaching equipment. A target of 99.3% of uranium in ore would dissolve in the leaching circuit. Achievement of this target would be validated using assays upstream and downstream of the leaching process.

Table 5.4-1: Rook I Project Process Plant Circuits

Process Circuit	Description
Liquid and solids separation	The liquid/solids separation circuit would separate uranium-bearing solution from the leached residue using six thickener tanks that would be set up in a counter-current decantation configuration.
Solvent extraction	The organic (i.e., mixture of petroleum reagents) solution would selectively separate uranium from other elements. The organic solution would bind with the uranyl sulphate and produce a high uranium content solution. A strong acidic solution would be used to strip uranium from the loaded organic (i.e., uranium in organic) solution.
Gypsum precipitation	Precipitation processes would be used to separate gypsum and uranium concentrate from loaded strip (i.e., uranium in solution) solutions for further processing. Gypsum would be precipitated and washed from the loaded strip solution, followed by uranium concentrate precipitation.
Yellowcake precipitation	The yellowcake precipitation and washing circuit precipitates the uranium from the loaded strip solution. The uranium concentrate solids would be washed to confirm minimal contamination when the uranium concentrate is dried in the next circuit.
Product drying, calcining, and packaging	In the product drying and packaging circuit, the moist uranium concentrate would be dried and calcined to produce the final mill product. The uranium concentrate would then be packaged and placed in secure storage prior to off-site shipment.
Tailings neutralization	The tailings neutralization circuit would neutralize the leached residue, thicken it to a paste, and mix in binder to produce a paste suitable for underground mine backfilling needs, as well as disposal in the UGTMF. For additional details on tailings management and storage, refer to Section 5.4.3 and Section 5.5.2.3, Tailings Management.
Effluent treatment	The ETP would chemically treat the mine water, site contact water, and waste water generated in the process plant.

ETP = effluent treatment plant; UGTMF = underground tailings management facility.

5.4.2.2 Process Plant Ventilation

Process plant ventilation includes the equipment to be used to heat, cool, and ventilate the process plant areas to minimize exposure to potential radiological and industrial hygiene hazards. Process plant ventilation would consist of three systems: primary ventilation system, secondary ventilation system, and make-up air system. Primary ventilation would include the main systems used to supply, circulate, and exhaust air in the milling process area, while secondary ventilation would include air flows taken from particular areas (e.g., tanks, sumps) and exhausted directly or indirectly to atmosphere. Make-up air systems would replace the air exhausted by the primary and secondary ventilation systems, as well as air lost through building exfiltration (e.g., air losses through doors when opened).

5.4.2.3 Additional Processing Surface Infrastructure

In addition to the process plant, other infrastructure is required to support processing activities, including the mill dry facility, site laboratory facility, and control room. These additional components would be located adjacent to the process plant building on the same pad.

Mill Dry Facility

The mill dry would be a modular building located at the northeast corner of the plant. The building would consist of change rooms, lockers, showers, and laundry for process plant staff. The mill dry would also include both men’s and women’s dry areas as well as a separate visitor area.

Site Laboratory Facility

The on-site laboratories would provide analyses of mine, process plant, and environmental samples. The laboratory facility would be a modular building located between the solvent extraction plant and the process plant. The site laboratory facility would include the following areas:

- analytical laboratory;
- metallurgical laboratory;
- sample storage;
- laboratory office; and
- industrial hygiene safety radiation office.

The laboratories would typically consist of a sample preparation room, X-ray room, direct coupled plasma and photometer room, indirect coupled plasma room, environmental room, weigh room, and metallurgical test room. Samples that would be processed on site include the following:

- all assays required to support ETP operations and release of treated effluent into the environment;
- ore assays to support exploration, underground development, and process plant feed;
- process plant operational control assays;
- calcine product assays;
- instrumentation calibration check assays;
- monitoring pond and other environmental monitoring assays;
- health check / compliance assays (e.g., urine analysis for uranium); and
- analysis of non-routine metallurgical test samples.

5.4.3 Tailings Management

Tailings management infrastructure refers to the structures, systems, and components that would process, deliver, and safely deposit engineered paste tailings in mined-out underground production stopes and the purpose-built UGTMF. The underground tailings disposal method facilitates progressive reclamation and ongoing decommissioning and long-term disposal of waste from the process plant during the Operations Phase of the Project.

Tailings are a by-product of ore processing that is considered uneconomic. Tailings from the proposed Project would consist of the following materials:

- neutralized leached residue;
- gypsum; and
- ETP precipitate.

The tailings management system would include the following:

- paste plant;
- paste delivery system;
- production stope backfilling; and

- UGTMF.

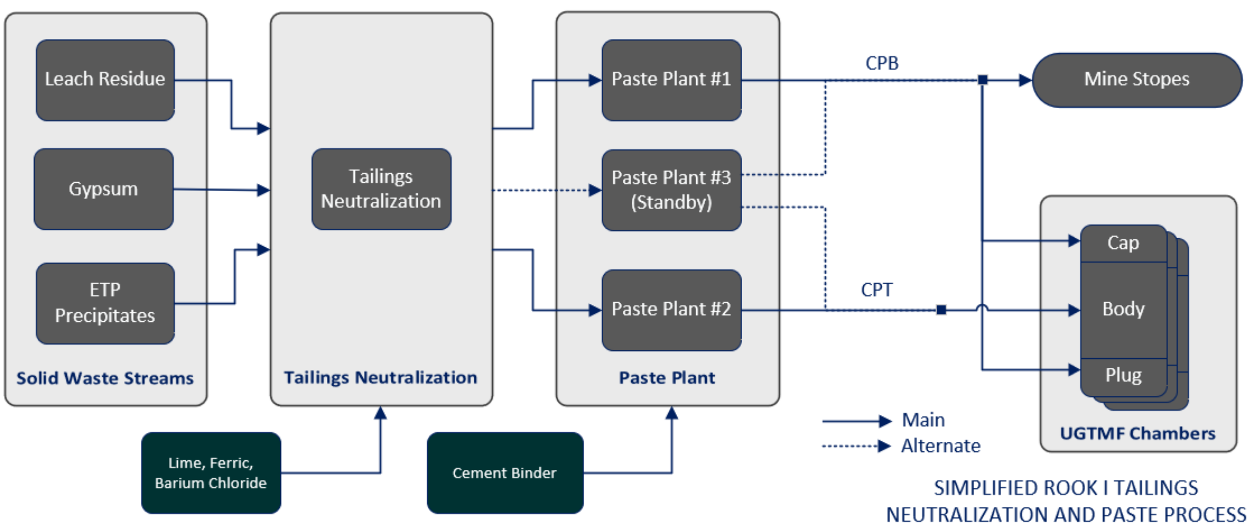
A total of approximately 13.7 Mm^3 (million cubic metres; 17.7 million tonnes [Mt]) of tailings would be generated during the proposed Project lifespan. All tailings would be permanently deposited underground, either as CPB for production stope backfill (approximately 6.9 Mm^3), or as CPT in UGTMF chambers (approximately 6.7 Mm^3).

5.4.3.1 Paste Plant

The paste plant would be situated on the west end of the mill building and would be used to manage solid waste streams generated through processing (i.e., leach residue, gypsum, and ETP precipitates) through the production of engineered paste products (i.e., CPB and CPT). The tailings management system would consist of two main processes: tailings neutralization and paste preparation (Figure 5.4-8).

The CPB product would consist of neutralized leached residue, water, and binder mixed in various ratios to meet appropriate geotechnical strength requirements for disposal in the primary and secondary underground mine stopes. The CPB product would also be used in the UGTMF to develop chamber plugs (i.e., the obstruction at the bottom of the UGTMF chamber to contain the paste tailings within the UGTMF chamber) and caps (i.e., the trafficable surface at the top of the UGTMF chambers). The CPT would consist of a mixture of neutralized leached residue, gypsum, ETP precipitate, and binder for disposal in the UGTMF.

Figure 5.4-8: Rook I Project Tailings Management Process Diagram



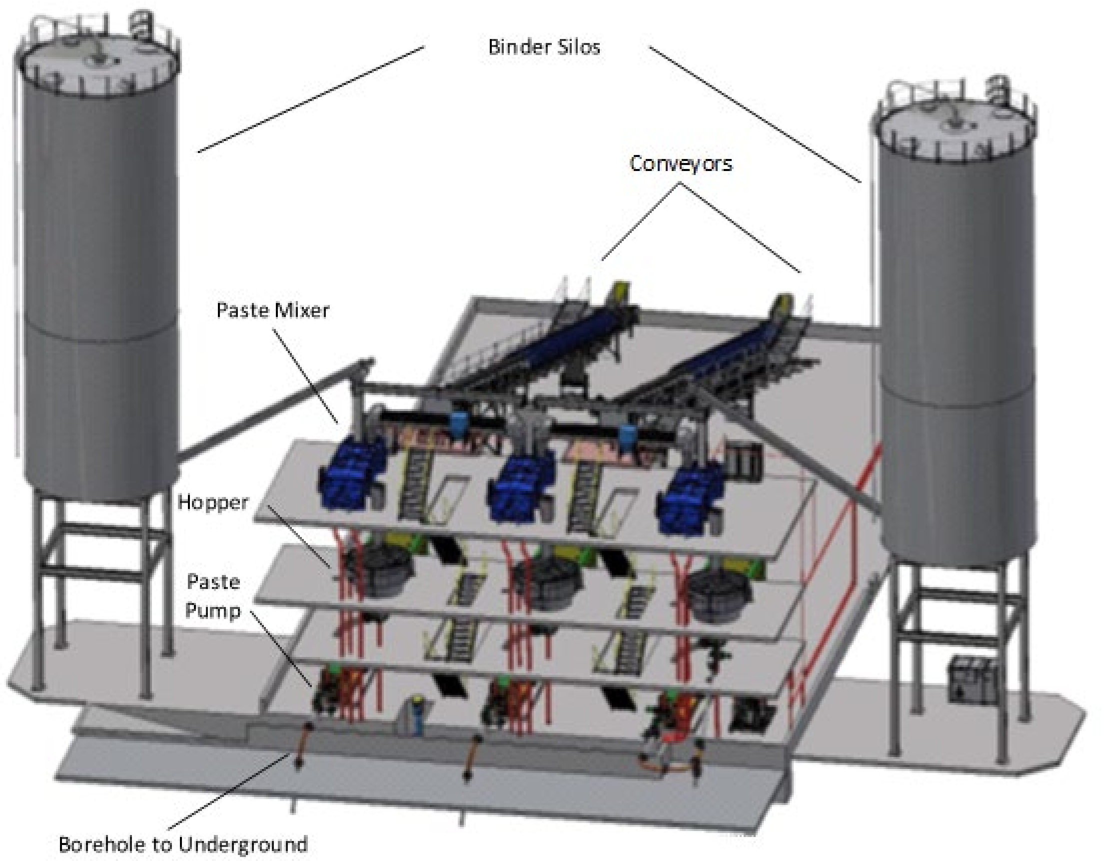
ETP = effluent treatment plant; CPB = cemented paste backfill; CPT = cemented paste tailings; UGTMF = underground tailings management facility.

Paste plant tailings processing would include a system of conveyors, belts, silos, and pumps to mix the solid waste streams and generate CPB and CPT products. Figure 5.4-9 shows a 3-D image of the paste plant.

The paste plant would consist of three identical modules, and two of these modules would operate in parallel. Each module would consist of a paste mixer (also referred to as twin shaft horizontal continuous mixer), paste hopper, and a hydraulic piston paste pump, and all modules would be fed by a series of conveyor belts.

The first module would produce only CPB, and the second module would produce only CPT; the third module would be capable of producing CPT and CPB, and would be available for standby purposes (e.g., when maintenance would be required on the first or second module).

Figure 5.4-9: Rook I Project Paste Plant 3-D Rendering



5.4.3.2 Paste Tailings Delivery System

The paste delivery system would include a pipeline system to pump CPB and CPT from the paste plant to the underground. This pipeline system would enter the underground through boreholes (Figure 5.4-9) drilled during the Construction Phase of the Project. Once underground, the paste products would be distributed to the various working areas via manual switchovers from the main paste pipelines to the pipelines on individual levels (e.g., 500 Level), and eventually to pipelines within each stope and UGTMF chamber (Section 5.4.3.3, Underground Tailings Storage).

The paste delivery system would consist of three paste pumps; three dedicated, lined paste delivery boreholes from surface; and an underground paste distribution system with one pipeline system to service all areas of the underground stopes and two side-by-side pipeline systems to service the UGTMF. One borehole would be fully dedicated to the UGTMF, while flow from the other two boreholes would be able to switch deposition between the production stopes and the UGTMF. The two side-by-side pipeline systems would allow flexibility in paste placement in the UGTMF and manage potential operational complexities during the pumping process.

The paste delivery system would be designed to operate 24 h/d. In the event of upset conditions, the system would be equipped with an emergency flush pump that could flush the underground paste pipelines with water to prevent the delivery boreholes from plugging.

5.4.3.3 Underground Tailings Storage

Tailings would be deposited underground either as CPB for production stope backfill and the plug and cap of UGTMF chambers, or as CPT in the UGTMF. Primarily, CPB would be pumped to exhausted underground production stopes and CPT would be pumped to UGTMF chambers. When production stope backfilling is not required, CPB would be diverted to the UGTMF and for use as a high-strength plug and cap of each UGTMF chamber.

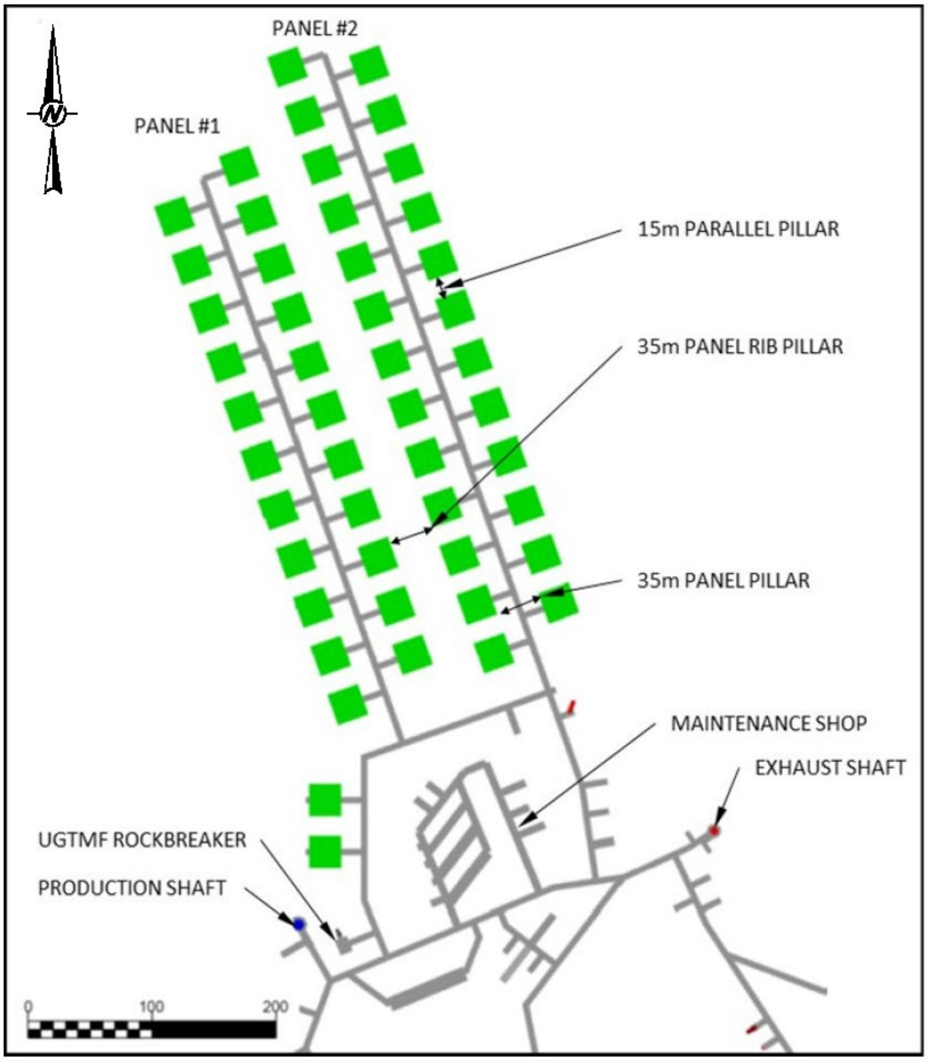
Underground Tailings Management Facility

The UGTMF would be a purpose-built underground facility with chambers dedicated to the permanent disposal of tailings. The UGTMF would be located on the north side of the Arrow deposit (Figure 5.4-1), and the UGTMF chamber size requirements and development schedule would be derived from, and adapted to, the ore processing schedule to provide sufficient storage for tailings.

A general layout for the UGTMF is provided in Figure 5.4-10. Three empty chambers would be required when the process plant begins to produce tailings; from this point, chambers would be progressively mined and backfilled. During steady-state operations, approximately 10 to 11 additional UGTMF chambers would be developed each year to meet process plant production rates. Additional chambers could be safely added should expansion of the UGTMF be required to accommodate additional tailings disposal.

The UGTMF chambers would be developed using long hole stoping mining methods (Section 5.4.1.1, Mining Method). Geomechanical modelling has confirmed that chambers with approximately 25 m by 25 m openings and 15 m wide rock pillars between chambers would create stable excavations that would remain open until they are backfilled with the CPT.

Figure 5.4-10: Rook I Project Underground Tailings Management Facility General Layout



UGTMF = underground tailings management facility.

5.4.4 Mine Rock Management

Mine rock is defined as any naturally occurring material that would be removed from underground areas. Mine rock is divided into four classifications for the Project: ore, special waste rock, PAG, and NPAG. Mine rock management refers to the structures, systems, and components required to transport and store the different classifications of mine rock generated from underground activities. Additional details on the classifications of mine rock are included in Table 5.4-2.

The mine rock on surface would be managed and controlled throughout the Project lifespan. Mine rock not used, processed, or returned to underground workings would be safely placed and stored on surface before or during Closure.

Table 5.4-2: Rook I Project Mine Rock Classifications

Mine Rock Term	Details
Ore	Ore is mine rock sourced from underground with 0.26% U_3O_8 or greater. Ore would be temporarily stored in the ore storage stockpile. Ore would be processed throughout Operations and material remaining after processing disposed in the UGTMF for permanent storage.
Special waste rock	Special waste is mine rock with insufficient grade to be considered ore (i.e., greater than 0.03%, but less than 0.26%, U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile. Special waste would be processed throughout Operations and material remaining after processing disposed in the UGTMF for permanent disposal.
PAG waste rock	PAG waste rock is mine rock with less than 0.03% U_3O_8 and greater than or equal to 0.1% sulphur. All PAG waste rock would be stored in the PAG WRSA.
NPAG waste rock	NPAG waste rock is mine rock with less than 0.03% U_3O_8 and less than 0.1% sulphur. All NPAG mine rock would either be stockpiled for use as construction material at site or become NPAG waste rock that is stored in the NPAG WRSA.

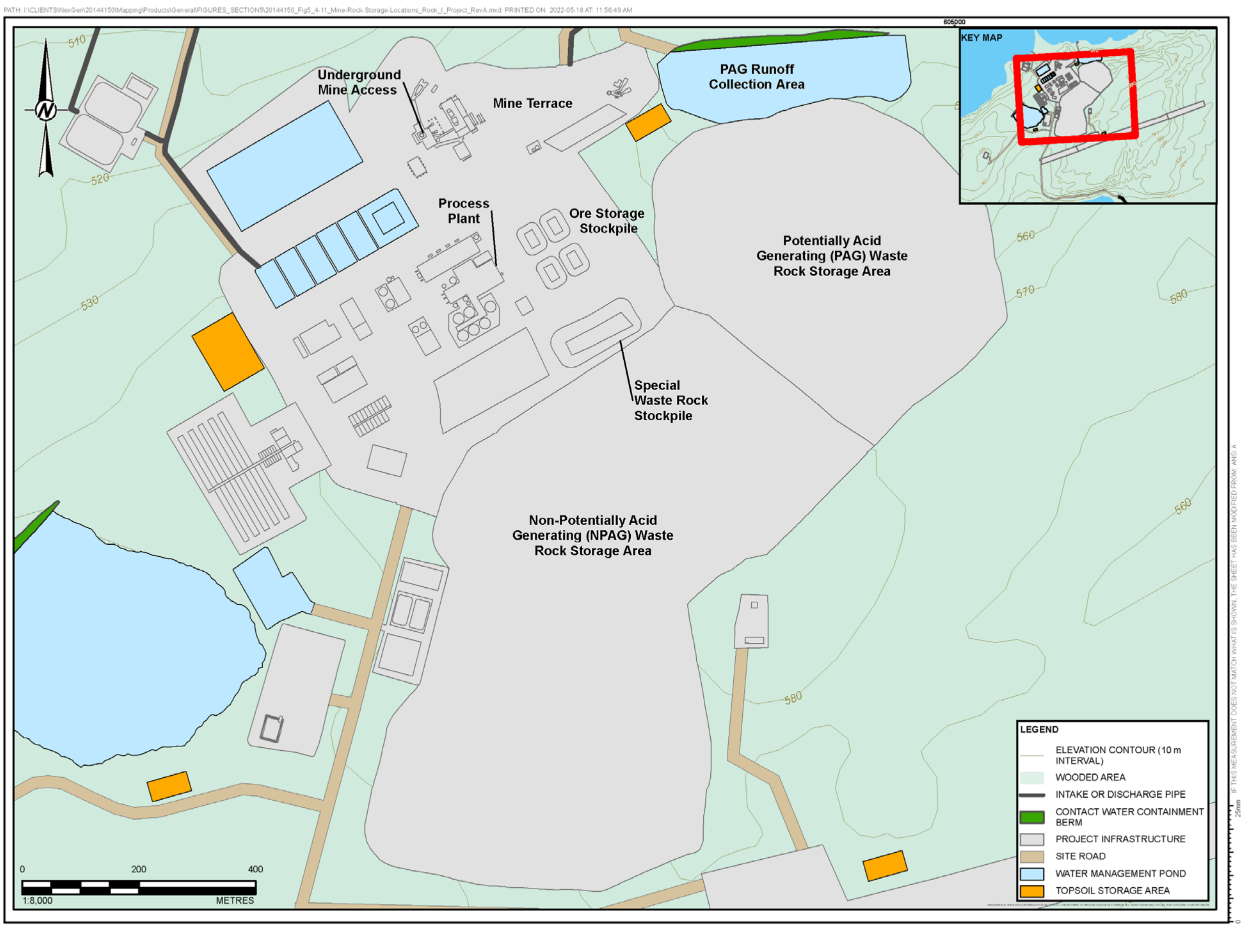
NPAG = non-potentially acid generating; WRSA = waste rock storage area; PAG = potentially acid generating; UGTMF = underground tailings management facility; U_3O_8 = triuranium octoxide.

Mine rock management facilities would be sized with sufficient storage capacities and associated water management systems to accommodate the planned mine rock volume over the life of the mine. Four separate facilities would be used to store the different classifications of mine rock at surface (Figure 5.4-11).

- ore storage stockpile;
- special waste rock stockpile;
- PAG WRSA; and
- NPAG WRSA.

The following subsections summarize the ore, special waste, and PAG and NPAG waste rock facilities. Additional details on water management and site roads associated with mine rock stockpiles and storage areas can be found in Section 5.4.5.2 and Section 5.4.7.8, respectively.

Figure 5.4-11: Rook I Project Mine Rock Storage Locations



5.4.4.1 Ore Storage Stockpile

The ore storage stockpile would be used to temporarily store mined ore during Operations. The ore storage stockpile would be located east of the process plant (Figure 5.4-11) and would consist of separate piles of different ore grades, with a total approximate stockpile capacity of 26,000 m^3.

The ore storage stockpile would be lined and surrounded by a perimeter berm that would provide sufficient storage capacity to contain and accommodate a probable maximum precipitation (PMP) 24-hour precipitation event plus 1 m of freeboard. The ore storage stockpile area would be dual HDPE lined and would include primary and secondary leak detection and monitoring wells. The liner system would capture seepage through the stockpile, and the perimeter berms would contain runoff and keep it separate from non-contact water.

5.4.4.2 Special Waste Rock Stockpile

The special waste rock stockpile would be used to temporarily store special waste during Operations. The special waste rock stockpile would be located adjacent to the ore storage stockpile (Figure 5.4-11) and would have a capacity of 60,000 m^3.

The special waste rock stockpile would consist of both the stockpile and a runoff collection area. The stockpile would be self-contained and capable of accommodating a PMP 24-hour precipitation event plus 1 m of freeboard. The special waste rock stockpile area would be dual HDPE lined and would include primary and secondary leak detection and monitoring wells. The liner system would capture seepage through the stockpile, and the runoff collection area would contain runoff contact water for management.

5.4.4.3 Waste Rock Storage Areas

The PAG and NPAG waste rock would be permanently stored in separate WRSAs: the PAG WRSA and the NPAG WRSA. Approximately 13.8 Mm^3 (25.4 Mt) of waste rock would be generated over the lifespan of the Project. Of this total volume, an estimated 5.8 Mm^3 (i.e., 42%) would be PAG and 8.0 Mm^3 (i.e., 58%) would be NPAG.

The PAG WRSA would be located east of the ore storage stockpile (Figure 5.4-11) and would include the placement of a single HDPE liner and a self-contained water collection system. The perimeter of the PAG WRSA and runoff collection area would be a combination of berm, collection ditching, and diversion ditching, dependent on location. The PAG runoff collection area would capture and contain runoff for a PMP 24-hour precipitation event and seepage from the PAG WRSA.

The NPAG WRSA would be located south of the ore storage stockpile (Figure 5.4-11). Since it would be storing clean (i.e., NPAG) waste rock, the NPAG WRSA would not require a liner. Similar to the PAG WRSA, the perimeter of the NPAG WRSA would include combination of berm, collection ditching, and diversion ditching, dependent on location. The NPAG WRSA would capture all precipitation for a 1:100 year 24-hour precipitation event within the perimeter bermed or collection ditch area.

The top of the finished PAG and NPAG WRSAs would be tied into the hill to the south of the mill terrace, and the overall height would not exceed the highest nearby topography. At Closure, an engineered cover system (e.g., growth medium) would overlay the final PAG WRSA and NPAG WRSA landforms.

5.4.5 Site Water Management

Site water would be classified and managed as defined in Table 5.4-3.

Table 5.4-3: Rook I Project Water Management Classifications

Site Water Term	Description	General Management Approach
Fresh water	Surface water sourced from Patterson Lake for use at the Project site for domestic consumption (i.e., including treatment) and to support various demands on site (e.g., process plant).	Reduce fresh water consumption to minimize fresh surface water usage and withdrawals.
Non-contact water	Water that has not been physically, chemically, or radiologically altered by Project activities (e.g., construction, mining, milling).	Divert non-contact water to the extent practicable and allow for discharge directly to the receiving environment. Manage non-contact water that cannot be diverted away as contact water.
Contact water	Water that may have been physically, chemically, or radiologically altered by Project activities (e.g., construction, mining, milling).	Collect, capture, and contain contact water. Reuse contact water where possible. Treat and manage water quality relative to environmental release targets as required before release to the environment. This includes mine water, as well as all runoff on surfaces disturbed by the Project and non-diverted non-contact water.
Mine water	Water that flows into the underground workings.	Pump water from underground to surface and manage as contact water.
Release water	Project-influenced water that is suitable for release to the environment. Release water includes contact water, treated or untreated, that has been confirmed as acceptable for release relative to discharge criteria.	Discharge treated water that meets water quality criteria appropriate for release.
Waste water	Water that has been treated in the STP and is ready for release to the environment, after meeting discharge criteria.	Discharge treated water that meets water quality criteria appropriate for release.

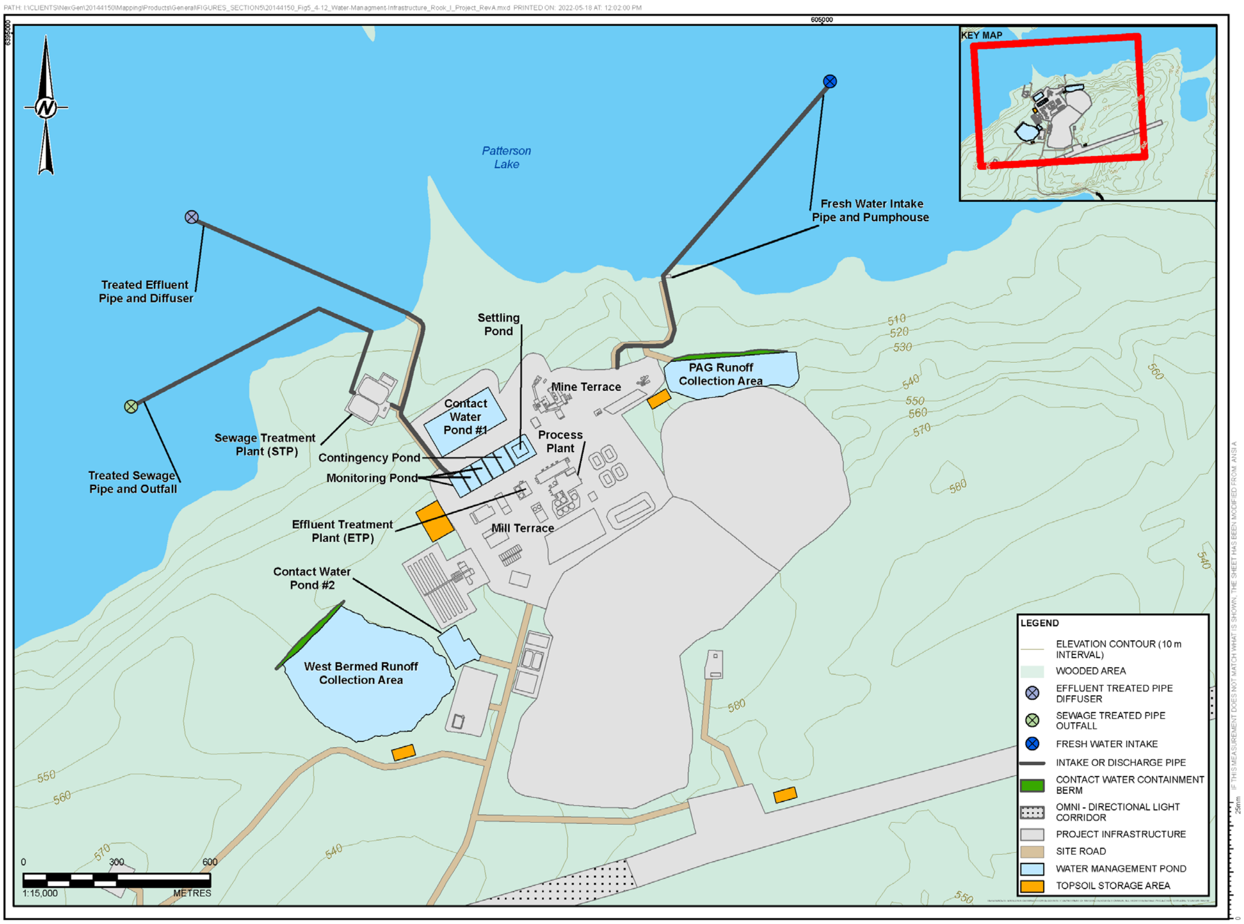
STP = sewage treatment plant.

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.

This infrastructure would include a system of intakes, pumps, pipelines, storage tanks, diversion and conveyance structures, ponds, treatment plants, and discharge structures (Figure 5.4-12).

Figure 5.4-12: Rook I Project Water Management Infrastructure



5.4.5.1 Water Supply

The site water system would draw fresh water from a single location in Patterson Lake (Figure 5.4-12). Once drawn from the lake, the fresh water would be screened and distributed to the fresh water system. The withdrawal system would include a screen at the fresh water intake that would filter for sediment and organic materials.

The fresh water intake and distribution system would be composed of:

- a fresh water intake structure and pipe;
- a fresh water pump station and pumping gallery;
- fresh water storage tanks;
- two break tanks (i.e., non-pressurized, closed water tank with an air gap to stop water backflowing);
- a fresh water supply main to the potable water treatment plants; and
- piping to process plant buildings and utility facility buildings.

Fresh water would be distributed throughout the Project site to be used for:

- fire hydrants and fire suppression systems;
- dust suppression;
- mine and mine terrace processes;
- process plant and mill terrace processes; and
- potable (i.e., safe to drink) domestic usage.

Each water usage would require equipment for pumping, storage and conveyance, and recirculation. Water would be reused where possible (e.g., process plant), dependent on quality and quantity requirements, regulatory requirements, and feasibility to do so.

Fresh Water Intake

The fresh water intake structure would consist of a stainless-steel passive intake and fish screen that is elevated above a fixed, sealed concrete pad at the bottom of Patterson Lake. The fish screen would be designed in accordance with DFO's *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO 1995). Due to Patterson Lake's relatively shallow depth, the intake would be located approximately 740 m from shore in Patterson Lake North Arm – East Basin (Figure 5.4-12).

The structure would have an air backwash to continually clean the intake screen (i.e., remove sediment and organic materials), which would be designed to maintain the intake velocity below 0.15 m/s to allow juvenile fish to swim away. The fresh water intake would be designed for a maximum flow rate of approximately 16,500 L/min.

The assumed low water level for Patterson Lake is at an approximate elevation of 498.1 masl, based on a normal water level of approximately 498.8 masl. The top of the intake structure would be lower than 496.1 masl to account for an estimated ice thickness of 1.5 m and 0.5 m of clearance.

Fresh Water Intake Pipeline

The fresh water intake pipe is designed to be a 750 mm diameter HDPE pipe, approximately 820 m long from the intake structure to the fresh water pump station. This pipeline would provide the maximum flow rate of 16,500 L/min.

Similar to the fresh water intake, the associated pipeline would also be situated lower than 496.1 masl (i.e., approximately 2 m below the estimated low water level elevation of 498.1 masl in Patterson Lake) and the top of the intake pipe on land would be buried approximately 4 m deep to avoid potential frost effects. Concrete ballast would be added to the submerged portion of the pipeline to keep the pipeline anchored and counter buoyancy effects.

Fresh Water Distribution and Storage

The fresh water pump station would distribute fresh water throughout the Project site and would be an enclosed building located near the shore of Patterson Lake. The station would include a fresh water storage tank, which would be sized to provide adequate storage for potable, process, dust suppression, and fire suppression purposes, and four vertical turbine pumps that would pump water from the fresh water pump station to two break tanks at the mine area via the fresh water supply main. This supply main would be approximately 686 m in length and buried approximately 4 m below the surface to avoid potential frost effects.

The two break tanks would be above ground and provide fresh water storage to meet mine and mill operations and fire protection requirements. The additional fresh water distribution pipes would vary in diameter (e.g., 50 mm to 750 mm) and would be buried approximately 4 m below the surface to avoid potential frost effects.

The two break tanks would be sized to contain fresh water for 30 minutes of the maximum system demand and would have a refill mechanism. The combined fresh water storage requirement for system demand and fire protection is 520 m^3. Each break tank would have a storage volume of 360 m^3 (i.e., 720 m^3 total active volume) and would sufficiently meet the minimum available storage to satisfy fire protection requirements (i.e., 250 m^3).

Potable Water Supply

Fresh water from the fresh water pump station would be pumped at an average flow rate of 142.5 L/min to water treatment plants located on the Project footprint for treatment to potable water standards. The potable water treatment plants would be located proximal to mine and mill dry areas, the wash bay, and the camp for use as potable water.

Fire Protection Water System

The fire protection water system would be composed of an above-ground water storage tank and a pump station; this system would meet the fire protection water demand for fire-fighting purposes for a duration of two hours. The pump station would house both fresh water and fire protection pumps, which would direct water to the mine terrace and mill terrace fire protection hydrants located around the Project site. These pumps would also direct water to various buildings that would have internal fire protection systems. All piping for fire protection water would be buried at a minimum frost cover depth of approximately 4 m.

The fire protection water for the mine area would be sourced from the break tanks to avoid duplication of tanks; this design would reduce the total volume of water requiring storage, circulation, and heating to keep the water supply free of frost or ice.

5.4.5.2 Surface Water Management

Surface water management for the proposed Project would include multiple water management structures (i.e., ponds and collection areas) as described in Table 5.4-4 and outlined in Figure 5.4-13. The subsections below provide additional information on these structures.

Table 5.4-4: Rook I Project Water Management Structure Summary

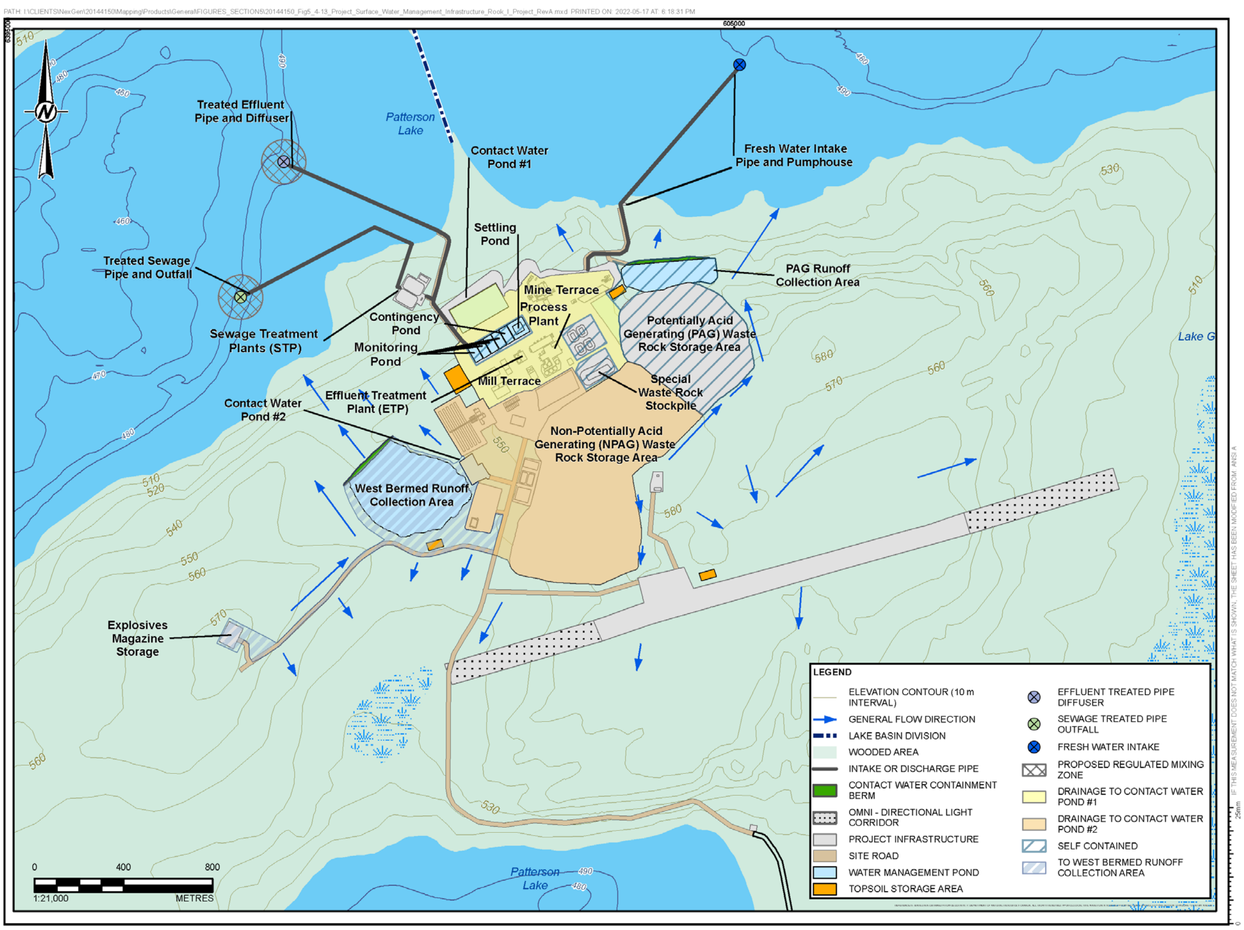
Water Management Structure	Description
Contact water ponds (i.e., site runoff ponds)	Includes two lined water management ponds that would collect runoff from across the Project site: contact water pond #1 (i.e., site runoff pond #1) and contact water pond #2 (i.e., site runoff pond #2). Water from contact water pond #1 would be pumped to the settling pond. Water from contact water pond #2 would be pumped to the west bermed runoff collection area if discharge criteria are met, or to the settling pond if water treatment in the ETP is required.
PAG runoff collection area	The PAG runoff collection area would be located in the northeast corner of the Project site and would receive runoff from the PAG WRSA. This area would be fully lined with a single layer of HDPE, and collected water would be pumped to the settling pond for further treatment, if necessary.
Settling pond	This lined pond, with a capacity of 16,000 m^3, would be used for general collection of contact water from across the Project site that may require treatment. Water from this pond would be treated in the ETP, then pumped to the monitoring ponds.
Contingency pond	This lined pond would have a capacity of 5,000 m^3 and would be used as an additional settling pond to handle additional volume if required.

Table 5.4-4: Rook I Project Water Management Structure Summary

Water Management Structure	Description
Monitoring ponds	These four lined ponds, each with a capacity of 5,000 m^3, would be located north of the mill terrace and would receive water after treatment in the ETP. Water would be tested and discharged if appropriate criteria are met; if criteria are not met, the water would be pumped to the settling pond for additional treatment.
West bermed runoff collection area	The west bermed runoff collection area would be located on the west side of the Project site. This collection area would receive runoff from the local contributing area as well as discharges from contact water pond #2 (i.e., a final point of control), provided Project discharge criteria are met. This bermed area would prevent suspended solids entrained in runoff water from entering Patterson Lake by natural filtration through an unlined berm.

PAG = potentially acid generating; HDPE = high-density polyethylene; ETP = effluent treatment plant; WRSA = waste rock storage area.

Figure 5.4-13: Rook I Project Surface Water Management Structures



Contact Water Ponds and Collection Areas

Site water infrastructure would be designed to maximize the diversion of non-contact surface runoff water away from Project infrastructure. Precipitation and snow melt runoff that contacts disturbed infrastructure areas or potential contact zones would be collected and directed to respective site contact water ponds and collection areas. Figure 5.4-13 provides a layout of ponds and water collection areas.

All ponds and collection areas that would contain contact water that may be mineralized or radiologically contaminated would be designed to accommodate a PMP 24-hour event of 489.2 mm. These ponds and collection areas include contact water pond #1 and the PAG runoff collection area. The ponds and collection areas would be self-contained (i.e., direct precipitation to the structure would be contained within the structure itself). No precipitation from other sources would be able to enter these structures, and the direct precipitation would not exit elsewhere until pumped out. The contained water would be tested before release to the environment based on regulatory requirements; water that does not meet the release specifications would report to the ETP for treatment.

Contact water that would not interact with mineralized or radiologically contaminated materials (i.e., runoff from the NPAG WRSA) would be captured in contact water pond #2, which would be designed to retain a 1:100 year, 24-hour precipitation event (i.e., 89.4 mm). The contained water would be tested before release to the environment. Water not requiring treatment (i.e., water meeting release specifications) would be released via the west bermed runoff collection area. The west bermed runoff collection area would be designed to retain a PMP 24-hour precipitation event; water reporting to the area would be released to Patterson Lake via natural filtration through an unlined berm. Water that does not meet the release specifications would report to the ETP for treatment.

Settling and Monitoring Ponds

Settling and monitoring ponds used in the effluent treatment process would be located north of the mill terrace (Figure 5.4-13) and would include:

- one settling pond with 16,000 m^3 capacity;
- one contingency pond with 5,000 m^3 capacity; and
- four monitoring ponds with 20,000 m^3 combined capacity (i.e., 5,000 m^3 each).

Each pond would have a maximum operating depth of approximately 5 m plus 1 m of freeboard, and the ponds would be interconnected with weirs in the event of upset conditions so contained water could flow from one pond to another without overtopping the overall containment structure.

The ponds would be self-contained with respect to precipitation events; the ponds would only collect precipitation that falls within the pond footprints and precipitation diverted from the trafficable area south of the ponds. Collectively, the ponds would retain a PMP 24-hour precipitation event, in addition to the anticipated water volumes generated under routine and non-operating conditions.

All ponds would be double-lined with HDPE liner for primary and secondary containment. The containment system would also include perforated leak detection piping for both the primary and secondary liners, along with interconnecting buried HDPE piping connected to leak detection monitoring wells. The trafficable area would be single-lined with HDPE and designed so that runoff is diverted into the ponds and no water is retained on the trafficable area surface. The pipeline corridors connecting the settling pond, contingency pond, and monitoring ponds to the ETP on the mill terrace would also be lined with a single layer of HDPE. The HDPE liner, which would have a permeability rating equal to or lower than 1×10^{-7} cm/s (Saskatchewan Environment and Resource Management 2000), would represent secondary containment around the interconnecting pipelines (i.e., the primary containment).

Surface Drainage Structures

Surface drainage refers to systems that collect or convey precipitation runoff. Where practicable, non-contact or natural site surface runoff from undisturbed catchments would be diverted from or around any Project infrastructure to limit the total volume of contact water to be managed by the Project. Site precipitation events (e.g., rain, snow melt) that may contact contaminated areas or potential contact zones (i.e., potential contaminants) would be captured, collected, and directed to respective site contact water ponds and collection areas.

Collection ditches and culverts would convey water to one of the two site contact water ponds. Collection ditches would be sized to accommodate a full PMP 24-hour event. Diversion ditches and perimeter berms would be designed to divert clean non-contact water away from any disturbed areas, facilities, or workings where water may become contaminated. Diversion ditches would be sized to accommodate 1:100 year, 24-hour precipitation events.

Where required, both diversion ditches and collection ditches would be designed with erosion control measures, including consideration of ditch slopes and flows rates, to maintain structure integrity. Swales, which control the release of water into the landscape, would be constructed on surface-graded pads where ditches are not possible, and where the initial anticipated contributing precipitation would not warrant a ditch.

5.4.5.3 Mine Dewatering

As noted in Section 5.3.3.4, Hydrogeological Conditions, naturally occurring groundwater would require management during underground mining operations and development of the UGTMF. The underground dewatering facilities would be designed to remove water from three sources: groundwater seepage, water used to flush/clean paste backfill lines, and water used for underground operations (e.g., drilling, bolting, shotcreting). Table 5.4-5 provides the estimated peak and average volumes of water to be dewatered and managed from the underground mine. The water volume generated from underground workings and UGTMF development would vary over the life of the mine, independently of each other, and would not occur at the same time.

Table 5.4-5: Rook I Project Estimated Dewatering Flows by Underground Area

Area	Source	Peak (m^3/h)	Average (m^3/h)
Underground development	Groundwater	63	60
	Operational use water	35	33
	Paste backfill flush water	1	1
UGTMF development	Groundwater	42	40
	Operational use water	2	2
	Paste backfill flush water	10	8
Total	**Combined**	**153**	**144**

UGTMF = underground tailings management facility.

The dewatering system would be a cascading design (i.e., water would overflow from one collection facility to another via gravity) that would include borehole sumps, sumps on different levels for both the footwall and hanging wall excavations, and a main sump station located on the 500 Level. Generally, water would be gathered using gravity at different underground mining levels and then collected at the main dewatering station before being pumped to surface for treatment.

5.4.5.4 Effluent Treatment

The ETP would be designed to treat contact water collected at the proposed Project with the treatment process based on industry accepted methods to remove constituents of potential concern, which would be expected to be elevated compared to discharge criteria. The current ETP design is summarized below, noting that the design is subject to additional refinement to meet requirements of REGDOC-2.9.2, Controlling Releases to the Environment (CNSC 2021), which is a draft document at the time of writing.

The ETP would include all equipment and infrastructure used to produce water that is suitable for either reuse in the process plant or underground activities, or for release to the environment (i.e., release water).

The effluent treatment circuit would treat process plant effluents, water pumped from the underground mine (e.g., backfill areas, shafts, underground workings), and site contact water from the following areas:

- mill terrace;
- mine terrace;
- ore storage stockpile;
- special waste rock stockpile; and
- PAG WRSA.

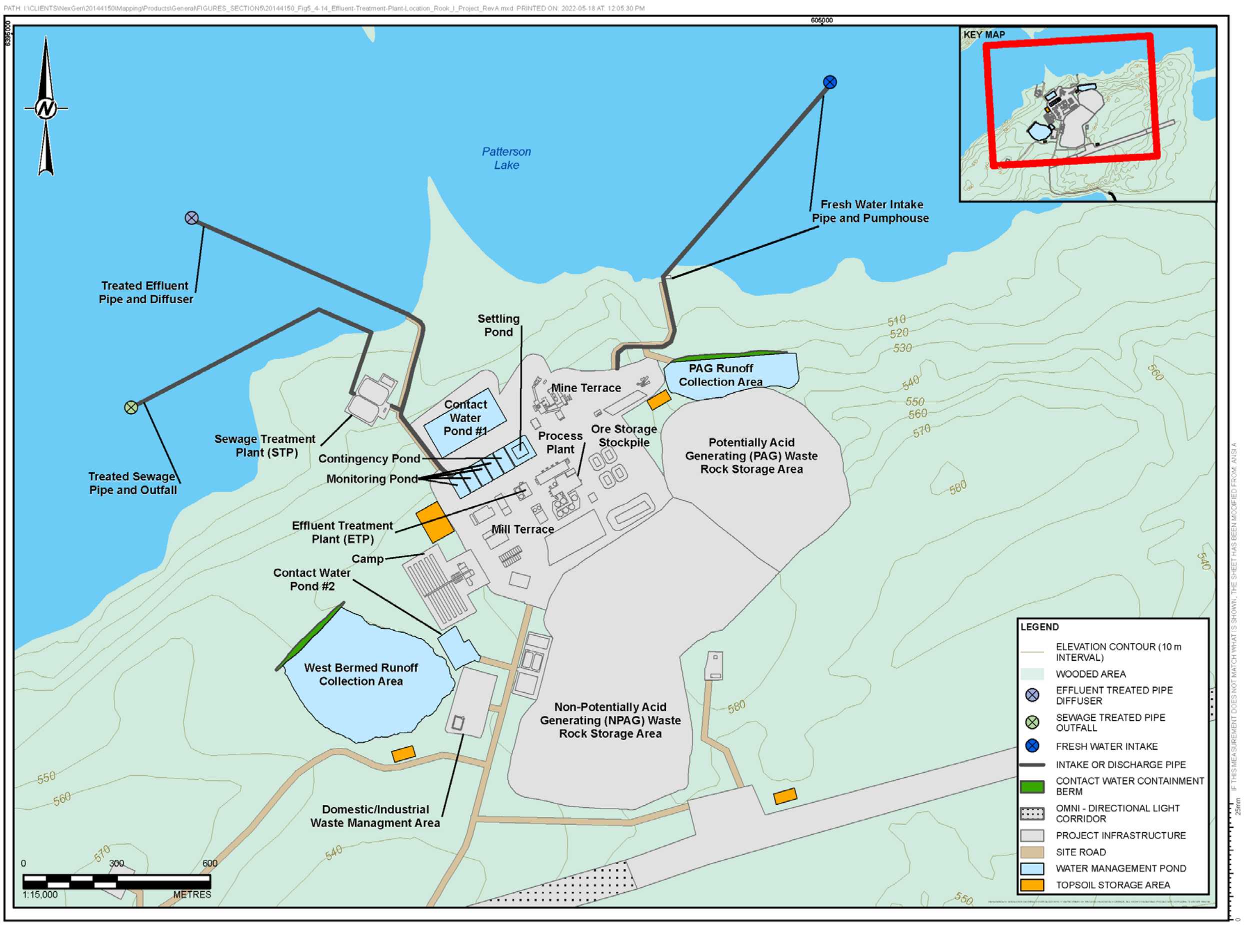
Contact water captured from the NPAG WRSA, camp area, and domestic/industrial waste management area would be pumped to the settling pond for treatment in the ETP if it did not meet water quality discharge criteria (Section 5.4.5.2).

The ETP would consist of a system of tanks and clarifiers and would be located south of the settling and monitoring ponds (Figure 5.4-14). The ETP would involve a two-stage chemical treatment process, primarily designed to remove metals from the effluent stream, as well as neutralize the effluent, before it is pumped to the treated effluent tank. Precipitates from the treatment process would be sent to the paste plant for disposal underground as CPB or CPT (Section 5.4.3).

From the treated effluent tank, treated effluent would be either recycled for the Project or pumped to monitoring ponds to be tested and released. Treated effluent to be recycled would be distributed by pump for underground, process plant, and paste plant use. The water management approach would use recycled treated water as much as feasible to reduce both the amount of fresh water that would be needed by the Project and the total amount of treated effluent discharged to the environment.

The treated effluent discharge system would consist of an approximately 750 m offshore pipeline and diffuser to convey treated effluent approved for discharge (i.e., release water) from the monitoring ponds to the treated effluent diffuser location in Patterson Lake North Arm – West Basin (Figure 5.4-14). The treated effluent diffuser would be elevated above the lake bed in a location where the water column is approximately 10 m deep. At nominal fill rates, each monitoring pond has been designed to hold approximately 18 hours of treated effluent; the diffuser would be designed to operate on a batch release schedule and would promote rapid mixing of release water with the ambient water in the receiving environment of Patterson Lake.

Figure 5.4-14: Rook I Project Effluent Treatment Plant Location



5.4.5.5 *Sanitary Sewage Collection and Treatment*

Sewage treatment refers to the processes and facilities that would be used for the effective management of human waste waters and grey water (e.g., water from facilities such as sinks, showers, and dishwashers) produced by the proposed Project.

The STP would be located in the northwestern corner of the Project footprint (Figure 5.4-14). The sewage collection system for the mine and process plant areas would be composed of piped, buried collection systems from each building that would discharge to individual sewage holding tanks (i.e., septic tanks). Septic tanks would be strategically located within the Project footprint, including one in each of the mine and mill terraces. All septic tanks would be fibreglass-reinforced plastic. Septic tank contents would be collected and hauled to the STP, except for the septic tank in the camp area, which would drain by gravity directly to the STP.

The STP would be designed for a total of 350 people on site, representative of the anticipated peak workforce during Construction. Design would include additional redundancy and capacity in the sewage collection and treatment system to accommodate this total peak population. The proposed Project is predicted to generate an estimated 6.9 m^3/h of waste water.

Waste water from the STP would be discharged to Patterson Lake once discharge criteria are met. Table 5.4-6 presents the discharge criteria for the STP design, based on proposed treated sewage discharge objectives for continuous discharge to Patterson Lake.

Table 5.4-6: Rook I Project Anticipated Treated Sewage Discharge Targets

Parameter	Target
Five-day carbonaceous (nitrification inhibited) biochemical oxygen demand	25 mg/L
Total suspended solids	25 mg/L
Total ammonia (N)	362 mg/L
Un-ionized ammonia (N)	1.24 mg/L
Total nitrate	700 mg/L
Total phosphorus	1.21 mg/L
Total coliforms	20,000 cfu/100 mL

N = nitrogen; cfu/100 mL = colony-forming units per 100 millilitres.

5.4.6 Conventional Waste Management

Conventional waste management refers to the infrastructure and processes used for the effective collection, storage, handling, processing, and disposal of conventional waste streams. The management of conventional waste represents a key design feature for the proposed Project. A suitable conventional waste management approach requires consideration of alternatives available for the Project and the goal to minimize potential effects to people and the environment. The conventional waste streams that would be managed at the Project site include domestic waste, industrial waste, hazardous waste, and low-level radioactive waste (LLRW). The Project is expected to implement a multi-faceted (i.e., multi-method) approach to conventional waste management that includes on-site material reuse and recycling, incineration, underground disposal, and off-site diversion (i.e., reuse and recycle) and disposal. To the extent practicable, these waste streams would be minimized and segregated at the source of generation to optimize this multi-faceted approach.

Conventional waste would be primarily managed in the domestic/industrial waste management area (i.e., conventional waste management area), a lined, compacted gravel pad approximately 100 m by 200 m located southwest of the mill terrace (Figure 5.1-3). This area would be surrounded by wildlife fencing and would house the non-LLRW and LLRW waste incinerators, which are currently planned to be in separate, dedicated buildings; this area, including the incineration buildings, would provide sufficient room for staging and processing (e.g., shredding, compacting) of conventional waste.

Outdoor collection bins would be located around the Project site and, once full, would be hauled to the domestic/industrial waste management area. These collection bins would provide primary containment for the waste collected, and the domestic/industrial waste management area would be lined with a single layer of HDPE to provide secondary containment. Contact water captured from the domestic/industrial waste management area that meets water quality discharge criteria would be pumped to the west bermed runoff collection area, or otherwise would be sent to the settling pond for treatment in the ETP (Section 5.4.5.2).

Information on conventional waste produced during Construction and Operations by waste type is summarized in the subsections below, including the estimated mass of industrial waste and LLRW to be produced during Construction and Operations. The industrial waste and LLRW mass estimates provided for Construction and Operations are based on published information from other uranium mining and milling operations. These estimates are conservative as the overall waste values are likely overestimated; the total waste to be produced by the Project is expected to be less than from other uranium mining and milling operations due to the Project's design (e.g., underground tailings storage), smaller footprint, and newer infrastructure and technologies.

The conventional waste management approach for Closure is provided in Appendix 5A.

5.4.6.1 Domestic and Industrial Waste

Domestic waste for the proposed Project would include all non-industrial waste, non-hazardous waste, and non-LLRW generated from the camp and office areas, including living quarters; coffee rooms; and kitchen, food preparation, and eating areas. Domestic waste would be composed of recyclable and non-recyclable materials, including food scraps; plastic, glass, paper, cardboard, and metal food containers; and electronics. The total quantities of domestic waste generated per year for the proposed Project are estimated to range between 220,000 kg/yr and 360,000 kg/yr during Construction, and between 188,000 kg/yr and 310,000 kg/yr during Operations.

Industrial waste for the proposed Project would include all non-domestic waste, non-hazardous waste, and non-LLRW generated from construction, commissioning, operation, and maintenance activities associated with the underground mine and process plant. Industrial waste would be composed of recyclable and non-recyclable materials, including cardboard (e.g., packaging), wood (e.g., pallets), metal (e.g., metal drums and containers), used tires, and plastics (e.g., piping). The total quantities of industrial waste generated per year for the proposed Project are estimated to range between 400,000 kg/yr and 625,000 kg/yr during Construction, and between 1,400,000 kg/yr and 2,400,000 kg/yr during Operations.

Indoor receptacles and outdoor collection bins designed to limit wildlife attraction would be located around the Project site in appropriate areas to collect both recyclable and non-recyclable domestic and industrial waste. To the extent possible, receptacles and collection bins would be designated for specific domestic and industrial waste types to segregate materials at the source of generation, minimize cross-contamination, and optimize domestic waste handling, processing, and disposal. Once full, collection bins would be hauled to the domestic/industrial waste management area to be fed to the non-LLRW incinerator, temporarily staged for on-site processing (e.g., shredding, compacting), or prepared for off-site disposal and/or recycling.

The non-LLRW waste incinerator would be designed with a nominal processing capacity of approximately 5 t/d based on the estimated non-LLRW waste quantities and diversion rates (i.e., waste volumes that would be managed by methods other than incineration [e.g., recycling, off-site disposal]). The waste incinerator would be designed for processing one batch per day, and the primary and secondary chambers would be fired using primarily LNG or diesel fuel to maintain the required temperatures; used oil would also be considered as a supplemental fuel. Emissions of heavy metals would be avoided through on-site waste diversion practices that would prevent hazardous materials from entering the non-LLRW incinerator.

The solid residual ash from incineration, which would be approximately 95% less than original volume of waste, would be collected before each new batch. The non-LLRW ash would be sealed in drums at surface and temporarily stored on pallets within the non-LLRW incinerator building before being transported underground via skips (Section 5.4.1.2) for safe, permanent disposal in the underground mine. The non-LLRW incinerator building would accommodate the storage of up to eight drums (i.e., two pallets) of ash at a time; this volume would equate to approximately one week of storage capacity. As a contingency, sealed drums of ash could also be temporarily stored on the domestic/industrial waste management area pad.

5.4.6.2 Hazardous Waste

Hazardous waste for the proposed Project would include all non-domestic, non-industrial, and non-LLRW waste that is defined as a waste dangerous good in the Hazardous Substances and Waste Dangerous Goods Regulations. Hazardous waste would be expected to include waste oils, batteries, cleaners, degreasers, fuels, chemicals, paints, and hydrocarbon-contaminated soil.

The total quantities of hazardous waste generated per year for the proposed Project are estimated to range between 430,000 kg/yr and 1,100,000 kg/yr during Construction, and between 380,000 kg/yr and 1,060,000 kg/yr during Operations. Receptacles and facilities dedicated for specific classes of hazardous waste, and designed with sufficient storage capacity and adequate containment, would be located around the Project site in appropriate areas to temporarily store hazardous waste.

5.4.6.3 Low-Level Radioactive Waste

Low-level radioactive waste for the proposed Project would include waste with radionuclide content above established unconditional clearance levels and exemption quantities but that generally has limited amounts of long-lived radionuclides. This waste type would include radiologically contaminated materials from mining and processing activities but would not include ore, special waste, waste rock, or tailings. Low-level radioactive waste would be expected to include materials such as wood, metal, tires, and miscellaneous waste (e.g., personal protective equipment).

The total quantities of LLRW generated per year for the proposed Project are estimated to range between 67,000 kg/yr and 102,000 kg/yr during Construction, and between 8,700,000 kg/yr and 14,600,000 kg/yr during Operations. Collection bins would be located within the underground mine and on surface in appropriate areas to collect LLRW. These bins would be colour-coded and labelled to clearly differentiate LLRW from other waste streams to minimize potential cross-contamination and optimize LLRW handling, processing, and disposal. Once full, collection bins would be hauled to the domestic/industrial waste management area to either be fed to the LLRW incinerator or prepared for underground disposal.

The LLRW incinerator would be batch fed and have a nominal processing capacity of approximately 10 t/d based on the estimated LLRW waste quantities and diversion rates. The LLRW incinerator would be designed for processing one batch per day, and the primary and secondary chambers would be fired using LNG or diesel fuel to maintain the required temperatures; used oil is also under consideration as a supplemental fuel.

The LLRW incinerator would include a third-stage air pollution control system designed to remove radiologically contaminated particulates, as well as a continuous emission monitoring system that would allow real-time monitoring of system performance.

The solid residual LLRW ash from incineration, which would be approximately 95% less than original volume of waste, would be collected before each new batch and handled in a manner that would keep potential radiological exposures as low as reasonably achievable. The LLRW ash would be sealed in drums at surface and temporarily stored on pallets within the LLRW incinerator building before being transported underground via skips for safe, permanent disposal in the underground mine. The LLRW incinerator building would accommodate the storage of up to eight drums (i.e., two pallets) of ash at a time; this volume would equate to approximately one week of storage capacity. As a contingency, sealed drums of ash could also be temporarily stored on the domestic/industrial waste management area pad.

5.4.6.4 Environmental Assessment Assumptions for the Multi-faceted Approach to Conventional Waste Management

For the purposes of the EA, a conservative approach was undertaken in consideration of the conventional waste management alternatives known to be available at the time of EA development. This approach included taking a conservative (i.e., precautionary) approach for assessment of potential adverse effects. Consistent with this approach, the EA assumes that all conventional waste would be incinerated. The selection of on-site incineration provided greater certainty and flexibility for managing the domestic and industrial waste streams and, in consideration of the increased surface footprint requirements and direct effects of incinerator emissions, was deemed most conservative.

Should the conventional waste management approach be modified during the Project lifespan (e.g., increased off-site reuse or recycling), environmental effects are expected to be less than predicted in the EA. As the Project advances and opportunities to optimize waste disposal practices are identified (e.g., recycling, reuse, regional partnerships), NexGen would re-evaluate the Project's approach to conventional waste management. Appendix 5B, Conventional Waste Management Approach and Contingency Options Report, provides a background of the alternatives assessment conducted for the Project conventional waste management approach and the contingency options available should incineration of industrial waste and LLRW not occur during Construction and Operations.

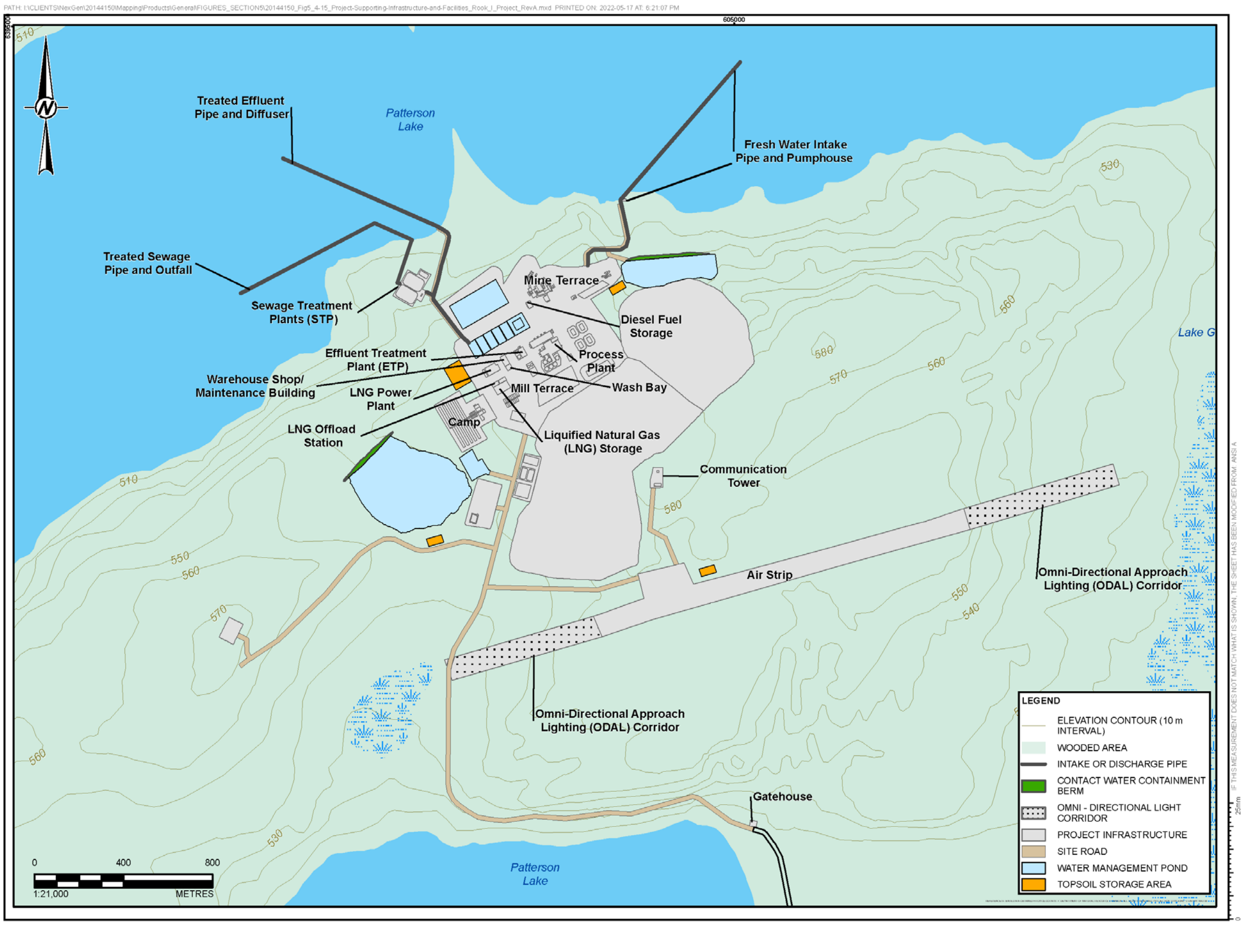
5.4.7 Supporting Infrastructure

Additional on-site surface infrastructure (Figure 5.4-15) would be required to support mining and milling at the Project site, with key components including:

- worker accommodations (i.e., camp) and associated facilities and utilities;
- maintenance shop and warehouse building;
- wash bays;
- airstrip and associated infrastructure;
- power supply and distribution;
- fuel storage;
- information technology (IT) and communications;
- site roads; and
- gatehouse.

Additional support facilities would also include office and administration buildings, additional warehousing, and cold storage.

Figure 5.4-15: Rook I Project Supporting Infrastructure



5.4.7.1 *Camp Facilities and Utilities*

The camp for the proposed Project would be a modular, single-story facility that would provide accommodation for all workers (e.g., employees, consultants, contractors) and other personnel staying at the Project site. The camp would be located on the west side of the Project footprint (Figure 5.4-15).

The camp would be designed for a maximum capacity of 350 individuals to accommodate workers during Construction. As the construction workforce completes commissioning activities and permanent workers begin shift rotations, the on-site population would reduce to approximately 260 individuals during Operations. Residential wings of the camp would be added or removed as the total worker requirements change through the Project lifespan.

The camp would provide semi-private spaces, such as individual rooms for workers that would be shared on a rotating basis, as well as amenity spaces for different activities including dining and recreation. The camp would include the following key facilities, connected by arctic corridors to move between areas while remaining indoors:

- dining hall, which would be used as a large meeting space when required;
- full kitchen and buffet-style service area, including washing facilities and dry and cold storage;

- medical and emergency services area, including first aid and observation rooms, offices, and a fire truck and ambulance garage;
- two recreation rooms, including exercise and meeting facilities and dedicated space for Elders;
- multiple bedrooms;
- multiple washrooms and shower rooms;
- concession area, boot room, and registration area;
- general loading and storage areas;
- laundry, janitorial, and mechanical/electrical rooms; and
- main IT room.

On-site systems would provide utilities for the camp, including potable water; electricity; heating, ventilation, and air conditioning; and sanitary. Potable water would be provided to the camp from the fresh water supply through a network of buried pipes (Section 5.4.5.1, Water Supply). Electricity would be provided by the on-site LNG power plant (Section 5.4.7.5, Power Supply and Distribution) to the camp by an overhead power line. Heating, ventilation, and air conditioning systems, including domestic hot water systems, would include both electrical and natural gas systems. The sanitary system (Section 5.4.5.5, Sanitary Sewage Collection and Treatment) would serve the washrooms, showers, housekeeping, kitchen, and laundry facilities. Kitchen waste would pass through a grease interceptor prior to entering the sanitary system. Floor drains would be located in mechanical rooms, showers, and other areas, where required. The camp sanitary system would flow by gravity to the STP via a buried pipeline for treatment.

5.4.7.2 Maintenance Shop and Warehouse Building

The maintenance shop and warehouse building would be located west of the ETP on the mill terrace (Figure 5.4-15). This maintenance shop would be an approximately 30 m by 55 m rigid frame, clear-span fabric shell building. The maintenance shop would occupy the northern half of the structure and would provide space for rebuilding and repairing process equipment and for fabricating items to support site operations. The warehouse storage area would occupy the southern half of the structure and would primarily store semi-trailers and large process equipment.

5.4.7.3 Wash Bays

The wash bay building would be located south of the maintenance and warehouse building on the mill terrace (Figure 5.4-15) for cleaning vehicles before maintenance. The wash bay building would be an approximately 30 m by 15 m, rigid frame, clear-span fabric shell building and would include a high-pressure washer, hot water heater, and soap system. Water from the fresh water pump station (Section 5.4.5.1) would be pumped to the wash bay building for use, and the two drive-through wash bays would include sloped concrete floors in each bay to promote gravity flow of wash water to oil interceptor sumps to collect water. Collected water would be diverted to the settling pond prior to treatment.

5.4.7.4 Airstrip and Airstrip Infrastructure

The gravel airstrip to support the proposed Project would be located approximately 1 km south of the mill terrace (Figure 5.4-15). This private airstrip would consist of a 1,600 m by 30 m runway, and an approximately 110 m by 200 m apron pad for loading and offloading purposes. The airstrip, which would include a total runway safety area of 80 m and clearing extensions of 100 m, would have a grade of 0.1% that would also be applied to the additional clearance extensions.

The airstrip would be designed to support Bombardier Dash 8 Q300 and ATR 42-320 aircraft, and would be laid out in accordance with Canadian *Aerodromes Standards and Recommended Practices – TP312*, 5th Edition (Transport Canada 2015). The airstrip would be intended for daytime use under normal operation, and would include appropriate instrumentation, approach requirements, and edge lighting for low visibility and/or nighttime operation. The airstrip would be equipped with an omni-directional approach light corridor that would include sequential strobing flashing light patterns off both ends of the airstrip to be used by pilots to identify the centreline and ends of the airstrip. A communication tower and building would be located near to the airstrip with an incoming buried fibre optic connection from the Northern Village of La Loche.

The airstrip would be positioned along a local high point where the topography falls away to the east, west, and south; selection of this location considered wind direction, location topography, orientation, and aerodrome obstacle limitation surfaces.

5.4.7.5 Power Supply and Distribution

Power generation and distribution refers to the methods, facilities, and equipment used to generate and distribute electricity to meet the proposed Project’s needs. Due to the remote location of the Project, there would be no access to the provincial power grid. Electricity for both surface and underground operations would be supplied by an on-site LNG power plant with associated fuel storage (Section 5.4.7.6, Fuel Storage) and power distribution infrastructure.

The 13.8 kV LNG power plant would be located in the northwest corner of the mill terrace (Figure 5.4-15) and would consist of nine LNG-fired reciprocating engines (i.e., generators), each rated for 3.329 megawatts (MW) of electrical output. Eight of the generators would produce the site nominal demand of 24.1 MW, and one additional unit would be on standby. The generators would be housed in individual modules, and each module would back onto a common service building that would contain the Project electrical house and control room.

The master control system and switchgear (i.e., the devices used to control, protect, and isolate electrical equipment) would be housed in the common service building, with each generator module being accessible through double doors. The modules and common service building would be fitted with access platforms, stairs, and handrails to allow for easy access to all areas of the generator modules. Each generator module would be fitted with a 13 m flue stack to vent exhaust from generators to the outside air. The common service building would also be used to house emergency diesel generators, which would be designed in accordance with clause 3(a)(ix) of the Uranium Mines and Mills Regulations.

Prior to the initial portion of the LNG power plant being commissioned, six diesel generators would be brought to the Project site to specifically power the batch plant, freeze plants, camp, office facility, and gatehouse and to support power plant construction. The gatehouse would be powered by a diesel generator for the Project lifespan.

Power would be distributed throughout the site by overhead and buried routing. Two overhead lines would provide power to the mine terrace, and a third overhead line would provide power along the main site road to the airstrip. Buried cables would be routed along the mill terrace to provide power to the process plant and ETP.

5.4.7.6 Fuel Storage

The Project would require various fuel sources to power the LNG power plant and the stationary and mobile equipment fleet. The following subsections outline the Project components for storage of LNG and diesel at the site. Other fuel sources would also be stored on site, including propane and gasoline.

Liquified Natural Gas Fuel Storage

Fuel delivered to site to support the operation of the on-site LNG power plant would be stored in the tank farm located south of the power plant (Figure 5.4-15). A fuel offloading station would be located adjacent to the tank farm, and fuel would be piped from the storage tanks to the 14 regasifiers (i.e., infrastructure used to convert liquified LNG back to natural gas at atmospheric temperature). The regasifiers would be located adjacent to the power plant and be used to vaporize the LNG to a gaseous form for use.

A total of twenty-eight 64 m^3 cryogenic LNG storage tanks would be required; this volume equates to four days worth of fuel storage if the power plant were to run at 100% capacity, 24 h/d, plus additional capacity to provide 784 m^3/h of gas flow for underground mine heating in the winter months.

Diesel Fuel Storage

Diesel fuel storage for the Project would be located on the west side of the mine terrace (Figure 5.4-15) and would consist of two tanks and two dispensers located adjacent to the administration offices on the southwest corner of the mill terrace. The diesel fuel storage tank area would be surrounded by bollards (i.e., barricade posts) to protect the tanks and dispensers from vehicular traffic. The storage tank area would have a concrete dispensing pad on the front for dispensing, and a concrete pad on the rear for refuelling storage tanks to allow for spill control in the event of a fuel spill.

Diesel fuel would be delivered to the two diesel tanks in certified tanker trucks. Each tank would have a capacity of 102,000 L and would store three weeks worth of fuel, based on the estimated fleet usage.

Fuel for underground use would be transported in bladders or pails to the main fuel and lubricant stations on the 500 Level, which would have two tanks, each with a capacity of 4,500 L. A secondary, smaller fuel station would be located on the 590 Level. Underground fuel stations would include instrumentation and controls, fire detection and suppression equipment, and safety items such as fire extinguishers, spare safety gloves, and spill absorbent.

5.4.7.7 Information Technology and Communications

The IT and communication systems would be installed throughout the Project footprint to provide constant and consistent connectivity for voice, video, and data transmission. A communication tower and building would be located near to the airstrip (Figure 5.4-15), with incoming buried fibre optic connection from the Northern Village of La Loche. The new fibre optic cable would be buried from existing SaskTel infrastructure to its termination at the communication building.

The IT and communications system infrastructure would be designed with the capacity of the following:

- monitoring all systems and facilities from the main control room, office and administration building, and off-site locations such as NexGen offices in Saskatoon and Vancouver;
- tele-remote operation from the main control room for underground equipment (e.g., rock breaker stations and mobile equipment); and
- monitoring and controlling systems related to the process plant, paste plant, and tailings delivery system from the process plant control room.

At surface, armoured fibre cables would run along overhead pole lines and buried trenches to connect all Project site facilities. Underground communication would be available via three systems: 1) standard analog telephone at shaft stations and refuge stations; 2) voice over internet protocol via the underground fibre backbone at all electrical rooms, refuge stations, and maintenance facility offices; and 3) radio systems installed in the production shaft, shaft stations, drifts, ramps, and escapeways. The radio systems would be installed to provide communication as close as possible to all development and production faces. The underground fibre backbone would include a wireless network complete with wireless access points located at required locations. This wireless system would support telemetry communication for mobile equipment, handheld devices, and devices for personnel and equipment tracking.

5.4.7.8 Site Roads

All Project site infrastructure would be accessible by new site roads, upgraded site roads, or existing roads (Figure 5.4-15). Project site roads would include the following types:

- **Haul roads** would be limited to haul truck traffic between the production shaft headframe and the various mine rock stockpiles and WRSAs (Section 5.4.4). Haul roads would have a road surface width of 12 m for two-way traffic. A portion of the haul roads would include a subsurface HDPE liner to maximize capture and containment of contact water on selected road portions where mineralized material is transported.
- **Primary roads**, including the main site road leading from the gatehouse, would connect key site facilities on the mine and mill terraces, as well as the camp and the airstrip. Site primary roads would have a surface width of up to 10 m to support two-way traffic and would be able to accommodate both light-duty vehicles and unloaded haul vehicles.
- **Service roads** would accommodate travel to and from Project secondary facilities and would be intended for intermittent and light-duty vehicle requirements. Service roads would have a road surface width of 6 m for two-way traffic, or have a road surface width of 5 m wide for one-way traffic with passing/pull-out lanes for selected roads with infrequent traffic flow.

The mine and mill terraces would have no defined road width; instead, granular material for these pads would permit traffic flow throughout these defined trafficable areas.

5.4.7.9 Gatehouse

The gatehouse would be located at the southern end of the Project footprint (Figure 5.4-15) and connect site roads to the existing access road that would be upgraded for Project use. The gatehouse would be the single point of access to the Project site by ground to control incoming/outgoing traffic, and would be powered by diesel generator for the Project lifespan. A small communications tower would also be permanently located at the gatehouse to eliminate the requirement for running fibre optic cables to the southern end of the Project footprint.

5.4.8 Off-Site Infrastructure

The only off-site infrastructure associated with the proposed Project would be the existing access road that extends from the Highway 955 turnoff to the gatehouse at the southern end of the Project footprint (Figure 5.1-2) and a fibre optic line running from the Northern Village of La Loche.

5.4.8.1 Off-Site Roads

Access to the Project site is currently by an existing access road from the turnoff to Highway 955 extending to the existing exploration camp. This existing access road is a 13 km long single-lane road with an all-season gravel driving surface approximately 5 m wide with rocky overburden along the edges. The existing access road alignment, which includes one bridge crossing at the Clearwater River, varies both vertically and horizontally to best fit the existing land topography by minimizing steeper side slopes and embankment cuts and fills.

Year-round vehicle and heavy equipment access to the Project would involve upgrading this 13 km road from the Highway 955 turnoff to the Project gatehouse. The upgraded road would be used to transport equipment, materials, personnel, and supplies to and from the Project site, as well as the hauling of the uranium concentrate off site. The access road would be accessible and operational 365 d/yr, 24 h/d, accommodating all highway-legal vehicles.

5.4.8.2 Fibre Line

The communication system for the Project would include a fibre optic line from the Northern Village of La Loche that would be constructed as armoured fibre cables that would either run along overhead pole lines or buried within trenches along a right-of-way adjacent to the existing access road.

5.5 Project Activities

Project activities would be conducted in phases to support the safe and efficient construction, commissioning, operation, decommissioning, and reclamation of the components required to support the extraction of uranium ore and the production of uranium concentrate (Section 5.4).

The proposed Project would span a 43-year period including Construction, Operations, and Closure. Construction is expected to take place over approximately four years and would include activities such as site preparation and infrastructure development. Operations is expected to last for 24 years and would include the mining and processing of ore, as well as the associated tailings, waste, and water management. Closure would follow, and include an Active Closure Stage of 5 years, followed by a Transitional Monitoring Stage of 10 years.

This subsection provides an overview of the key activities by Project phase, and summarizes predicted traffic volumes associated with Construction and Operations.

5.5.1 Construction

The focus of Construction would be to construct and commission all planned Project components required to support the commencement of production of uranium concentrate (Section 5.4).

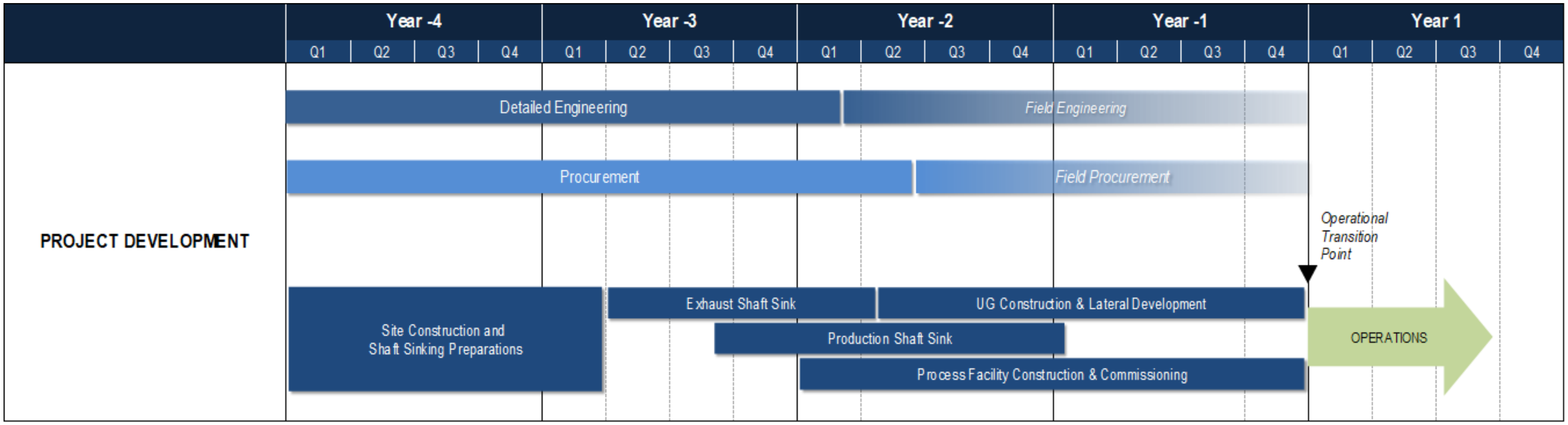
The construction and commissioning of the proposed Project would be completed over a four-year period utilizing up to approximately 350 on-site workers (e.g., employees, consultants, contractors).

The overall construction sequence would generally follow the order of activities listed below, with overlap occurring between some activities:

- Establish the gatehouse to manage access to the Project footprint.
- Upgrade the existing access road and develop selected site roads within the Project footprint to allow for the safe, efficient transportation of materials and equipment.
- Install the camp, including the potable water treatment plant, STP, and fresh water intake; establish fuel storage, power, and basic utilities; and begin staging equipment, fuel, and materials to support construction activities.
- 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 (e.g., ponds, preliminary stage ETP, domestic/industrial waste management area).
- Develop surface infrastructure to support underground activities (e.g., production shaft headframe, freeze plants).
- Establish the exhaust shaft and production shaft and begin underground development.
- Begin construction and commissioning of the process plant (e.g., mill building, batch plant, paste plant).
- Develop and commission other infrastructure and services in preparation for Operations.

Figure 5.5-1 provides an overview of the approximate duration and sequencing of the construction activities for illustrative purposes.

Figure 5.5-1: Rook I Project Construction Schedule



UG = underground.

The following subsections provide an overview of proposed activities during Construction, including a summary of site civil activities (i.e., site preparation) and a description of infrastructure development by Project component.

5.5.1.1 Site Civil Activities

Civil earthworks for the proposed Project would be a key aspect of site preparation, and would include:

- clearing and grubbing the mine and mill terrace and the airstrip areas, including removal of all existing surface vegetation, brush, shrubs, and trees;
- stripping topsoil layers, material, and organic materials and stockpiling for future reclamation; and
- cutting and filling to create mine and mill terrace and airstrip areas.

The location of site civil activities would be limited to the Project footprint, which would include the area where physical infrastructure would be located, as well as the access road for the Project that connects to Highway 955 (Figure 5.1-3).

The proposed Project site would be located on a peninsula of land in Patterson Lake, with the area grade rising from the shoreline elevation of approximately 500 masl to a high point near the middle of the peninsula of approximately 582 masl. Project site development would primarily occur on the northern half of the peninsula. Due to the natural topography of the Project site, and to minimize cuts and fills during Construction, the central portions of the Project would be tiered on three levels (Figure 5.5-2).

The lower tier, with an elevation of approximately 530 masl to 536 masl, generally correlates with the planned mine terrace facilities, as well as the monitoring and settling ponds. The middle tier, with an elevation of approximately 543 to 546 masl, generally correlates with the planned mill terrace facilities, as well as fuel storage, the ETP, and the camp. The upper tier, with an elevation of approximately 546 masl to 549 masl, would include the special waste rock and ore storage stockpiles, as well as the construction laydown and warehousing.

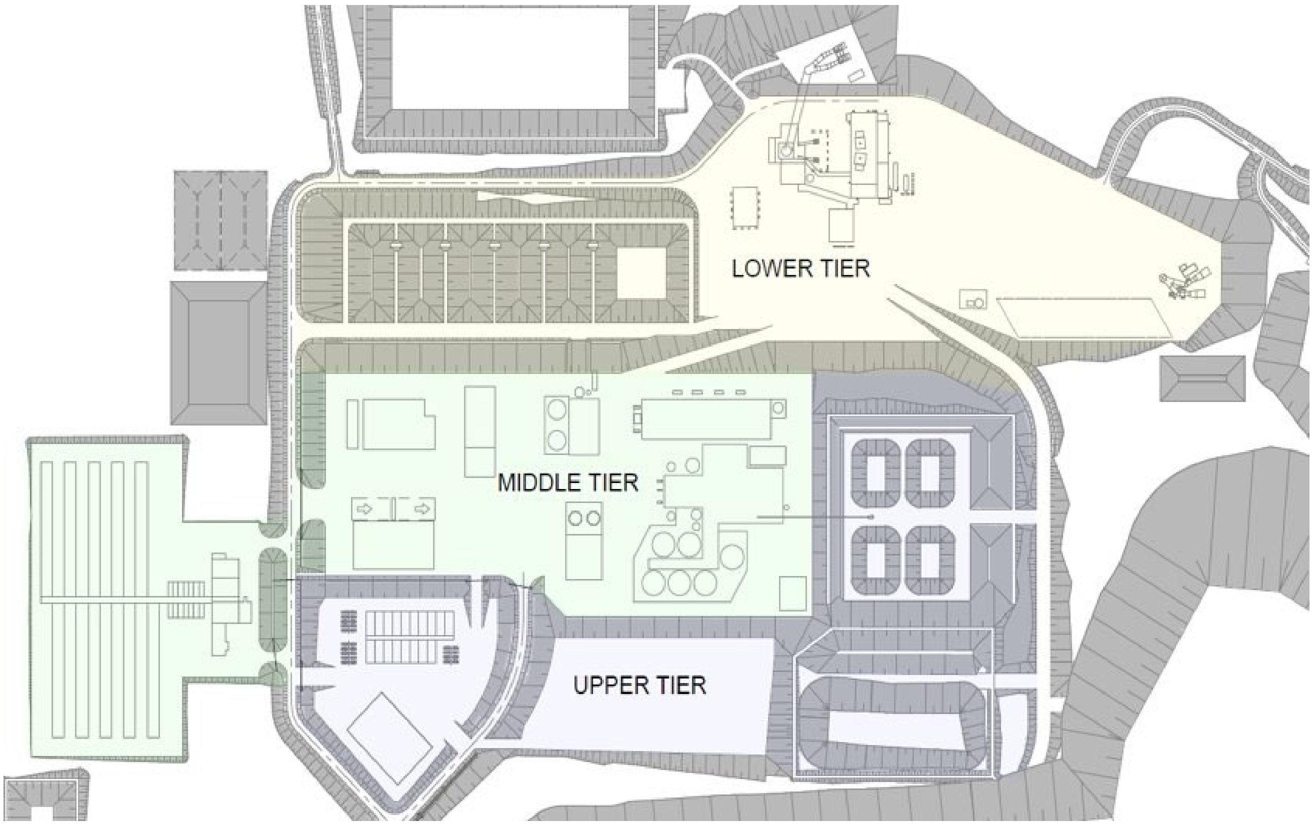
The site civil design is intended to be a balanced cut-and-fill design, as well as generating adequate excess material anticipated for initial crushing operations for granular surfacing material needs. The organic topsoil layer at surface is thin and may not be stripped in some areas. Decisions about stripping the topsoil layer in given areas would be made in the field during Construction. At present, it has been assumed that stripped topsoil, and materials geotechnically unsuitable for construction uses, would occur over all disturbed areas intended for development, with these materials stockpiled in appropriate locations around the Project footprint.

Borrow sources would be developed to provide required backfill material in selected areas where general earthworks cut-and-fill balances are not achievable. Effort would be made to design the civil earthworks to minimize the borrow material needs while ensuring fill material meets the required engineering specifications.

Surficial rock encountered from cut-and-fill activities and borrow development would be stockpiled for on-site crushing operations to meet granular surfacing material needs (e.g., supplemental aggregate). The NPAG waste rock excavated from shaft sinking and underground development may be used as fill for surface pads (e.g., crushed or directly placed as general fill).

Only NPAG material would be used as fill material for construction; any PAG material encountered during construction activities would be stockpiled in the PAG WRSA.

Figure 5.5-2: Rook I Project Construction Earthworks Tiers



5.5.1.2 Mining

The key construction activities relating to the mining area include surface infrastructure development, shaft freezing and lining, shaft sinking, underground development, and mine services and infrastructure construction.

Mining Surface Infrastructure

Mining surface infrastructure would be constructed prior to the subsurface activities of shaft (i.e., production and exhaust) freezing and lining and shaft sinking. Mining surface infrastructure would include Project components required to support these subsurface activities, such as construction of the shaft headframes and collar buildings, hoist buildings, freeze plants, batch plant, and other ancillary infrastructure (Section 5.4.1.8, Mining Surface Infrastructure).

The construction of the headframes, collar buildings, and hoist buildings would be required to transport blasted material from the shafts to surface, where it would be trucked to the ore and special waste rock stockpiles and the PAG and NPAG WRSAs.

The construction of the freeze plants and batch plant would be required to support the temporary ground freezing and shaft lining activities. Installation of ancillary infrastructure that would support key Project activities would include ventilation infrastructure, administration and dry facilities, fuel storage, and fire protection.

Shaft Freezing and Lining

Both shafts would be constructed using temporary ground freezing in conjunction with a concrete hydrostatic liner (i.e., a barrier that can resist high water pressure at depth). The design for the construction of the shafts would entail freezing to the competent ground located approximately 175 m below surface for the production shaft and approximately 220 m below surface for the exhaust shaft. Ground freezing would stabilize both shafts during excavation as the shafts progress through a variety of stable and unstable strata including water-saturated overburden, Devonian Sandstone, Cretaceous Shale, and Athabasca Sandstone (Section 5.2.6; Section 5.3.3.2). The existing ground around the shaft excavations would be temporarily frozen to create a freeze wall and provide a stable zone for development prior to the completion of the full hydrostatic liner.

Due to the distance between the two shafts, there would be a dedicated temporary modular freeze plant for each shaft. Each freeze plant would have a capacity of approximately 500 t of refrigerant at a temperature of -30°C. The freeze plants would be modular so the units could be temporarily set up for shaft construction and would be removed after the hydrostatic liner is installed down to the unweathered basement rock where the freeze plant would no longer be required. Each shaft would have four monitoring holes, which would include in-ground monitoring and temperature detectors for brine temperature monitoring to verify the shafts remain frozen during construction. A freeze ring would be constructed approximately 12 m below grade for each shaft to allow freeze walls to form.

The concrete hydrostatic liner would restrict water migration into the shaft once the freezing is removed. Although expected to be minimal, any water that migrates through the liner would report to a sump at the shaft bottom and would be pumped to the main dewatering facility underground for eventual pumping to surface for management.

Shaft Sinking

The production shaft headframe and hoist building would be used for production shaft sinking operations. Temporary winches would be installed near the headframe to facilitate shaft sinking, and a temporary sheave (i.e., pulley wheel for hoist ropes) floor would be installed in the headframe to mount the sinking stage head sheaves.

A hoist building and double-drum sinking hoist would be installed to sink the exhaust shaft, as well as a headframe for sinking operations. The temporary sinking equipment would be removed once exhaust shaft sinking is complete.

The exhaust shaft sinking would commence prior to the production shaft sinking as the permanent headframe and hoist building for the production shaft would take longer to construct than the temporary infrastructure at the exhaust shaft. Until the production shaft is complete, the exhaust shaft would be used for early underground development to establish the 500 Level infrastructure and production areas.

Temporary ventilation would be established at the exhaust shaft while the underground mine development is ongoing and the production shaft is being equipped.

Underground Development

Underground development completed during Construction would include a shaft station on the 500 Level, a temporary loading pocket and associated remucks (i.e., temporary underground storage areas), and a ramp that would be used to access the various underground levels to facilitate mining operations. In addition, underground development would include lateral and ramp development in mine rock, development in ore to establish the 500 Level production stopes, access development to the UGTMF area, and development of UGTMF chambers.

A temporary loading pocket would be installed in the exhaust shaft on the 500 Level and would be large enough to sling and assemble development equipment. The temporary loading pocket would allow mine rock to be hoisted from underground via the exhaust shaft, and would provide an area to receive equipment, gear, and consumables required for the early underground development work. The temporary loading pocket would consist of two steel bins, gates, and a chute arrangement for loading the shaft sinking buckets and would be used until the permanent material handling system in the production shaft is commissioned.

Since different types of material would be hoisted up the exhaust shaft, multiple remucks would be established near the loading pocket. A gamma radiation scanner would be installed to scan and direct material to the correct remuck for temporary storage before being hoisted to surface via the exhaust shaft. A small LHD unit would haul the material from a remuck and place it onto an inclined grizzly (i.e., heavy duty screen) to load the bins in the temporary loading pocket. Oversized material would be hauled to the nearest empty remuck for secondary blasting. Dedicated ventilation ducting would exhaust the air from the ore remucks directly into the exhaust shaft ventilation ducting (Section 5.4.1.7).

Mine Services and Infrastructure

Mine services and infrastructure would be constructed progressively to support the advancement of underground development. The mine services and infrastructure would include ventilation; electrical and communications infrastructure; compressed air, fuel, and lubrication facilities; maintenance facilities; personnel and material movement infrastructure; and shotcrete and concrete handling infrastructure.

Prior to permanent mine services being commissioned, temporary services may be utilized to support underground development.

5.5.1.3 Processing

The processing infrastructure would be composed of various process equipment and infrastructure, enclosed within a building constructed on site. The mill building would be founded on a concrete slab with structural steel, a sloped roof, and exterior cladding.

Processing equipment would be fabricated and transported to site for installation and commissioning. Integrated systems such as piping, electrical, ventilation, and air conditioning would be installed on site once the outer structures are erected.

5.5.1.4 Tailings Management

The UGTMF chambers would be developed from the bottom up over the lifespan of the proposed Project. These chambers would start on the 500 Level of the mine, with an access from above on the 440 Level that would create a vertical spacing of 60 m between levels (Figure 5.4-1). All production stopes on the 500 Level would be excavated and filled with tailings before the corresponding upper UGTMF chambers are developed on the 440 Level. At this point, the above access would be from the 380 Level. Access to the UGTMF chambers on each level would be via 5 m by 5 m development headings.

During Construction, initial UGTMF access would be developed along with several UGTMF chambers in various stages of readiness (i.e., drilled, drilled and blasted, drilled and blasted and mucked) to allow the curing of the UGTMF backfill plug and support commissioning of the process plant and ramp up to steady-state production.

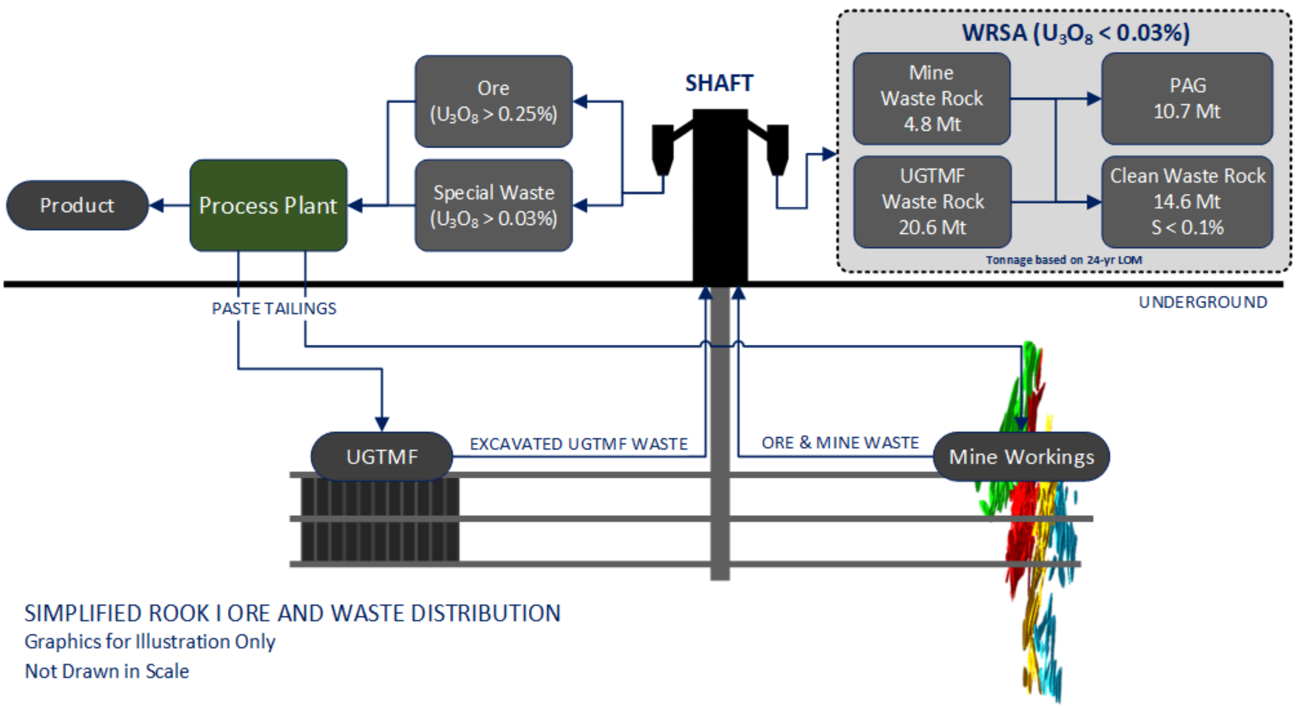
5.5.1.5 Mine Rock Management

The special waste rock stockpile and PAG WRSA footprint area would be graded prior to placement of a liner and mine waste material. The footprint of the NPAG WRSA would be built on existing grade slopes after the necessary ground preparations are complete. Perimeter berms and collection or diversion ditching would be developed prior to mine waste material placement.

The majority of mine rock identification and sorting during Construction would occur in the underground once material is blasted. All mine rock would be analyzed by gamma radiometric scanners, which would measure the radioactivity of the material, and depending on the scan results, the material would be defined as ore, special waste, or waste rock (Table 5.4-2).

For defining PAG and NPAG waste rock, in situ characterization has identified where each material type would likely be encountered; this characterization would be confirmed by sampling and assaying waste rock material. Material would be transferred to the appropriate storage bin underground (i.e., ore, special waste, PAG waste rock, NPAG waste rock) and hoisted to surface for transportation and storage (Figure 5.5-3). At surface, these materials would be directed into the appropriate ore bin or waste bin and loaded into trucks. Each truck load would be scanned by gamma radiation scanners to confirm grade, and then delivered to the appropriate WRSA or stockpile on the mine terrace.

Figure 5.5-3: Rook I Project Mine Rock Sorting Diagram



Note: Clean waste rock is NPAG.
U_3O_8 = triuranium octoxide; UGTMF = underground tailings management facility; WRSA = waste rock storage area; PAG = potentially acid generating; NPAG = non-potentially acid generating; >= greater than; <= less than; Mt = million tonne; S = sulphur.

5.5.1.6 Site Water Management

Site water management infrastructure would be constructed early in Construction so contact water related to construction activities would be appropriately contained and treated, as required, to an acceptable quality prior to release to the environment. This infrastructure would include a system of intakes, pumps, pipelines, storage tanks, diversion and conveyance structures, ponds, treatment plants, and discharge structures (Section 5.4.5, Site Water Management).

In some cases, temporary water management infrastructure may be developed to support construction activities or to support the development of water management infrastructure used during Operations. In addition, the ETP and STP would be installed to support the discharge requirements over the Project lifespan.

The infrastructure and processes required to effectively manage site water during routine and non-routine (e.g., extreme precipitation events) operating conditions during the Construction Phase would be described in documented and controlled site water management processes as part of the IMS (Section 5.7). These processes would be periodically reviewed and revised, as required, to ensure they remain appropriate to maintain compliance with applicable regulatory requirements and protective of human health and the environment.

5.5.1.7 On-Site Infrastructure

Other on-site infrastructure would be constructed to support both Construction and Operations such that duplicative temporary infrastructure would be limited to the maximum extent possible.

The airstrip design, and the chosen airstrip alignment and location, would allow a balance of cut and fill to reduce the potential for excess borrow material. The surface composition and structure of the gravel airstrip would be constructed in accordance with geotechnical recommendations developed during Project design.

All site road development would apply site-wide common construction techniques for the subgrade cut/fills and suitable foundation preparation before applying granular road surfacing materials. Suitable NPAG material would be used for road construction, and all ditching adjacent to roads, whether for diversion or collection, would be developed to meet the overall site surface water management requirements (Section 5.4.5.2).

The potable water treatment plants would be designed and constructed to support both the Construction and Operations stage requirements. Construction of the potable water treatment plants would include a network of pipes to connect the plants to the various infrastructure components.

Prior to the initial portion of the LNG power plant being commissioned, six diesel generators would be utilized to provide temporary power for early construction activities, including operation of the batch plant, freeze plants, camp, and office facility. The LNG power plant would be constructed using a series of modular generators and associated fuel storage and filling facilities.

The gatehouse would be powered by diesel generator for the lifespan of the Project, while other generators would remain in use for back-up or emergency power requirements as otherwise required to meet Project requirements.

5.5.1.8 Off-Site Infrastructure

Off-site infrastructure would include the 13 km access road from Highway 955 to the Project site (Section 5.4.7.8) and the proposed IT and communication system fibre optic line from La Loche to site (Section 5.4.8.2, Fibre Line).

The proposed access road upgrades would be completed during Construction to enable the safe and efficient transport of heavy materials, equipment, and fuel. Further development of the existing access road from Highway 955 to the Project site gatehouse would include:

- widening the existing access road surface width;
- clearing all vegetation, bushes, and trees from each side within 15 m of the road centreline to improve visibility, as well to limit potential obstructions to road usage should fallen trees land in close proximity to the road; and
- extending existing culverts, where required, to maintain existing drainage patterns, or installing new culverts to accommodate the wider road width.

The existing access road would be upgraded utilizing local cut material and borrow sources for fill material. The existing road alignment minimizes the number of water features crossed and is set back from waterbodies and watercourses. Setback distances from Patterson Lake would typically range from 300 m to more than 1 km. There are limited sections with a narrower setback distance; however, the minimum distance would remain more than 30 m from the lake shoreline.

During Construction, workers would be transported by bus to the Project site from La Loche until the airstrip on site is completed. During Operations and Closure, workers would be transported to and from site primarily by aircraft. To improve safety, traffic control measures would be implemented during the Project lifespan such as setting the speed limits for the access road and bridge to 40 km/h and 10 km/h, respectively, as well as spill and emergency response planning.

The proposed IT and communication system fibre optic line would be constructed either as armoured fibre cables that would run along overhead pole lines or buried within trenches along a right-of-way adjacent to the existing access road and highway. The system would be installed in two phases in Construction and Operations. During Construction, a very small aperture terminal system would be installed at the office and administration building and would provide for off-site communication (e.g., voice, data), and a small communication tower would be installed until the main communication tower is erected at the start of Operations. One of the smaller towers would be permanently located at the gatehouse to eliminate the requirement for running fibre optic cables to the south end of the Project site.

5.5.1.9 Temporary Infrastructure

Construction activities would utilize the proposed permanent Project infrastructure and footprint to the greatest extent practicable to minimize land disturbance and improve the overall efficiency of construction activities. Where possible, permanent support infrastructure would be built at the onset of construction activities and would be used during both Construction and Operations.

Where required, temporary infrastructure would be constructed or positioned at locations only for the duration of Construction and would be removed prior to Operations. Temporary infrastructure for the Project may include temporary water management infrastructure (including a temporary ETP), aggregate processing equipment, staging areas, laydowns and stockpiles, diesel generators, temporary ventilation, shaft sinking and hoisting infrastructure, freeze plant, and material handling equipment.

5.5.2 Operations

The focus of Operations would be the safe, economic recovery of uranium ore and delivery of uranium concentrate to the market. Section 5.4 provides a description of the proposed Project components, and the following subsections provide an overview of proposed activities during Operations, including a description of infrastructure development by Project component.

5.5.2.1 Mining

The primary activities associated with the proposed Project mining operations include mine development, production mining, and UGTMF development.

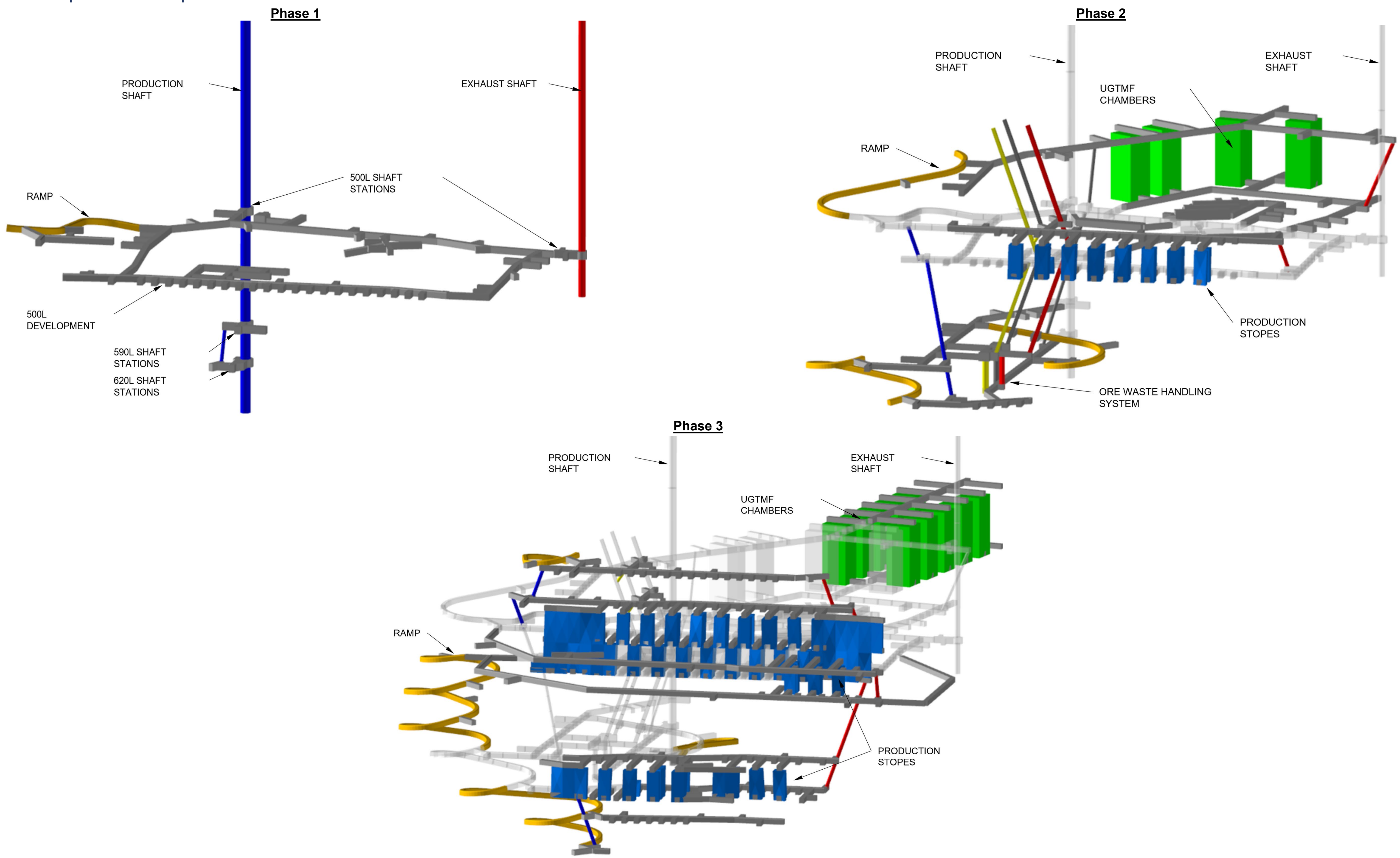
Mine Development

Mine development would be divided into the following three main phases of activity (Figure 5.5-4):

- **Phase 1 – 500 Level exhaust shaft development:** The first phase of development would include the initial development from the 500 Level exhaust shaft station. During this period, the primary development focus would be to connect to the 500 Level production shaft station. This connection would allow flow-through ventilation, and the connection is necessary prior to adding additional development equipment and capacity on the 500 Level and above.
- **Phase 2 – 590 Level and 620 Level production shaft development:** The second phase of development would consist of development from the 590 Level and 620 Level production shaft stations. The primary focus during this period would be to develop to the ore body on the 590 Level and the 620 Level to establish the ore and waste pass systems, as well as a connection between the two levels.

  Along with development on the 590 Level and the 620 Level, development would continue on the 500 Level. The primary focus would be to establish the return air (i.e., exhaust air) system, initial infrastructure, and ore development. Concurrently, development would begin above the 500 Level, with a ramp being developed to the 440 Level. Development on the 440 Level would be required as part of initial UGTMF development.
- **Phase 3 – Ongoing development:** The final phase of development would consist of ongoing development from the upper mine (i.e., above the 500 Level) and lower mine (i.e., below the 500 Level) concurrently. During this period, full production would be achieved and a connection between the lower mine and upper mine would be established.

Figure 5.5-4: Arrow Deposit Mine Development Phases

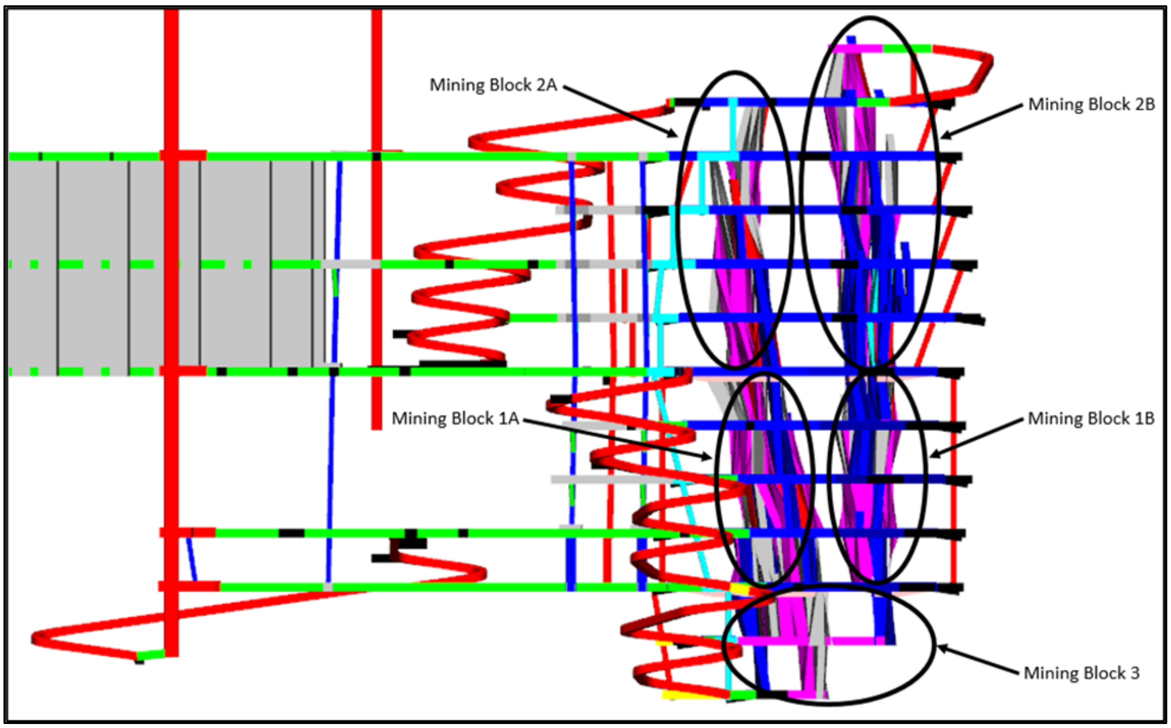


L = level; UGTMF = underground tailings management facility.

Production Mining

Initially, mining activities would commence from two main vertical mining blocks (blocks 1A and 2A) along the A2 vein of the Arrow deposit. This approach would provide two separate production areas for early production (Figure 5.5-5). As the operation progresses, an additional three mining blocks (blocks 1B and 2B along the A3 vein, as well as block 3) would be developed to provide five separate production areas. Having multiple production areas would provide operational flexibility for mine scheduling and sequencing. The daily ore production rate would range from 1,000 t/d to 1,300 t/d, with an average of 1,207 t/d over the life of the mine.

Figure 5.5-5: Arrow Deposit Mining Blocks Profile – Looking East

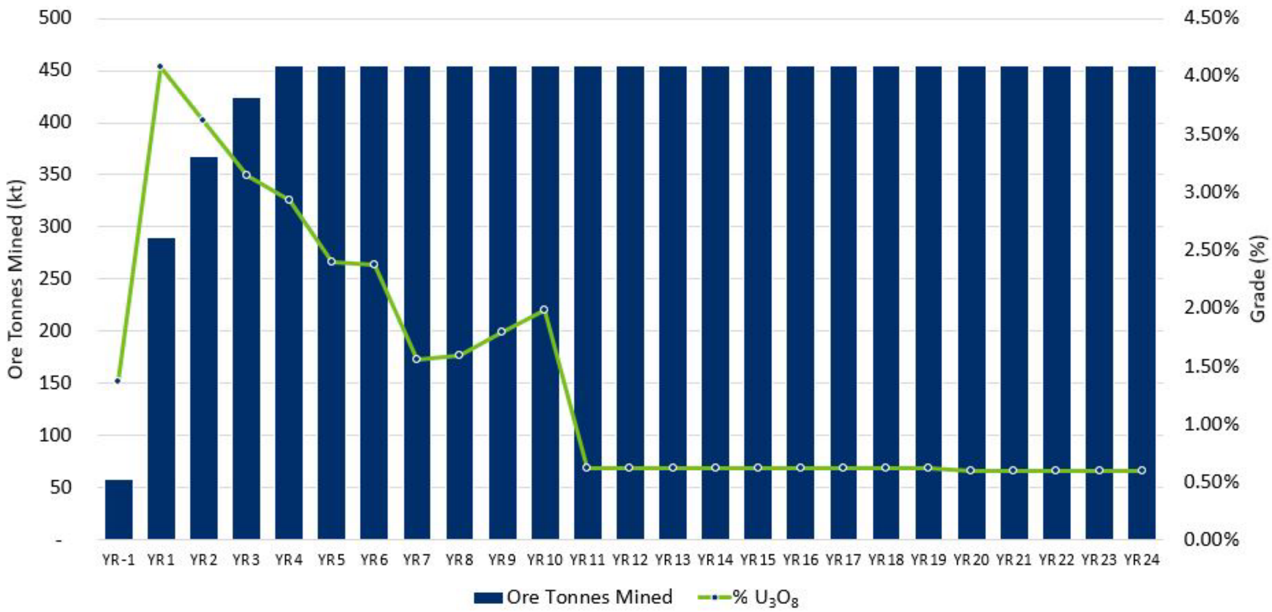


In the underground areas of transverse stopes, a primary and secondary stope system would be used to maximize ore recovery. The primary stopes would be recovered first, leaving adjacent secondary stopes in place as supporting pillars for the production area. Once the primary stopes are backfilled, the secondary stopes next to the primary stopes would be recovered.

The production plan would focus on optimizing underground ramp-up and maximizing productivity. In Year -1, development ore would be mined and stockpiled to access the first mining stopes. In Year 1, production of uranium concentrate would begin, progressing to full production in Year 2 and onward.

Figure 5.5-6 provides a summary of the planned mining production profile by year. Full production of 30 Mlb/yr would be achieved for approximately four years (i.e., Year 2 through Year 5), after which the uranium production profile would reduce, even though the overall mine tonnage would remain constant (i.e., at or near design capacity). The anticipated reduction in uranium concentrate pounds is correlated to the reduced average ore grade.

Figure 5.5-6: Rook I Project Mining Production Profile



kt = kilotonne; U_3O_8 = triuranium octoxide.

Underground Tailings Management Facility Development

The UGTMF chambers would be required for disposal of tailings as ore processing commences. The UGTMF capacity requirements and development schedule were derived directly from the process plant milling schedule to confirm there is sufficient storage for tailings. During Operations, UGTMF chambers would be progressively developed to provide sufficient capacity to store tailings underground. Solid un-blasted rock pillars, approximately 15 m wide, would be maintained between all UGTMF chambers.

For each tonne of ore processed, approximately 0.8 m^3 of tailings would be produced, along with approximately 0.3 m^3 of combined precipitates. A portion of the tailings produced would be deposited as paste fill into mined-out production stopes, and the remainder of the material would be deposited as backfill into the UGTMF chambers. To meet this schedule, 10 to 11 UGTMF chambers would require excavation per year.

Prior to filling the UGTMF chamber, a higher strength UGTMF backfill plug would be poured. The UGTMF backfill plug would require sufficient curing to support the remainder of the backfill material; therefore, a 28-day cure (i.e., drying and hardening) time is included in the schedule.

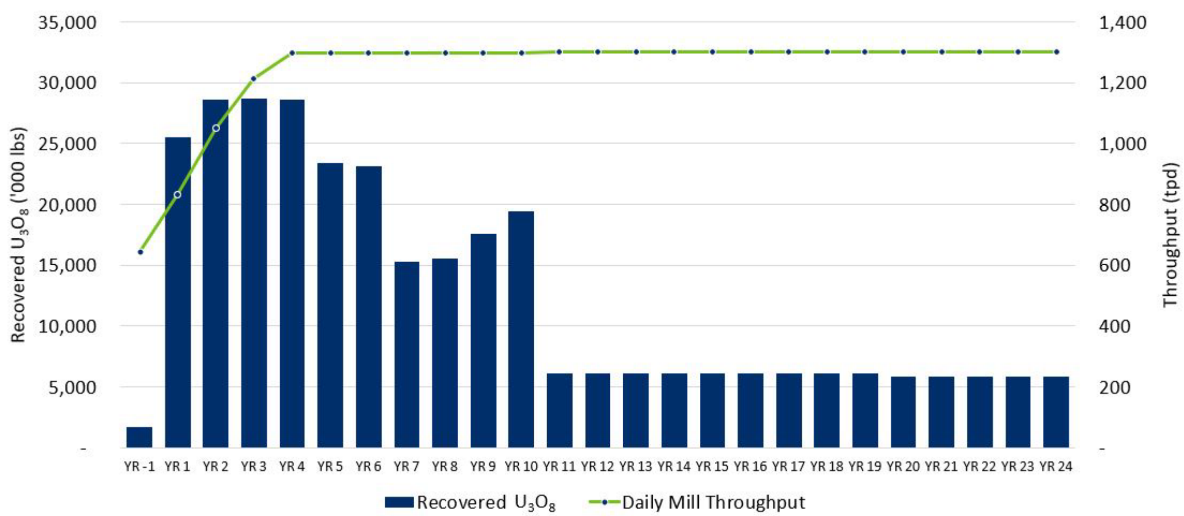
5.5.2.2 Processing

The maximum production capacity of the proposed Project is 30 Mlb of packaged uranium concentrate per year. Key design parameters for the process plant include:

- a maximum of ore feed rate of 455,000 t/yr;
- a maximum ore feed grade of 5% U_3O_8; and
- a process recovery of approximately 97.6%.

Figure 5.5-7 provides an overview of the planned annual output of uranium ore for the proposed Project.

Figure 5.5-7: Rook I Project Planned Uranium Recovery Profile



U_3O_8 = triuranium octoxide; tpd = tonnes per day; YR = year; lbs = pounds.

The Project would utilize a combination of fresh water, treated water, and recycled process water for the various process circuits. Total fresh water requirements for the process are estimated to be approximately 123 m^3/h.

The process for the Project would also used a number of bulk reagents to achieve the recovery of uranium concentrate, including:

- sulphur;
- sulphuric acid (94%);
- unslaked lime;
- hydrogen peroxide;
- flocculant;
- kerosene;
- tertiary amine;
- isodecanol;
- sodium carbonate;
- magnesia;
- barium chloride; and
- ferric sulphate.

All the reagents would be prepared in contained areas within the process plant, close to the points of application; the reagent storage (e.g., tanks, silos, pallets) would be placed in close proximity to the reagent preparation areas. The reagent storage tanks would be equipped with level indicators and instrumentation to confirm that spills do not occur during operation. Appropriate ventilation and fire and safety protection would be provided at the process plant.

5.5.2.3 Tailings Management

Leached residue and gypsum from the process plant and precipitates from the ETP would be collected and chemically treated with lime, ferric sulphate, and barium chloride to produce geochemically stable (i.e., neutralized) tailings that would be pumped to the paste plant for use in the production of CPB and CPT (Section 5.4.3.1, Paste Plant).

The CPB and CPT preparation rates would be directly proportional to the amount of ore processed through the process plant. In the paste plant, CPB and CPT products would be combined with cement binders in preparation for storage underground. Binder is the general term used for self-cementing materials such as ordinary Portland cement (OPC) or a blend of OPC and supplementary cementitious materials (e.g., ground-granulated blast-furnace slag [slag]). Binder would be added to the CPB and CPT to allow the paste materials to gain structural strength through the cementitious reactions. The binder mixture to create the CPB would consist of a 1:1 ratio of OPC and slag, whereas the binder mixture to create the CPT would consist entirely of OPC.

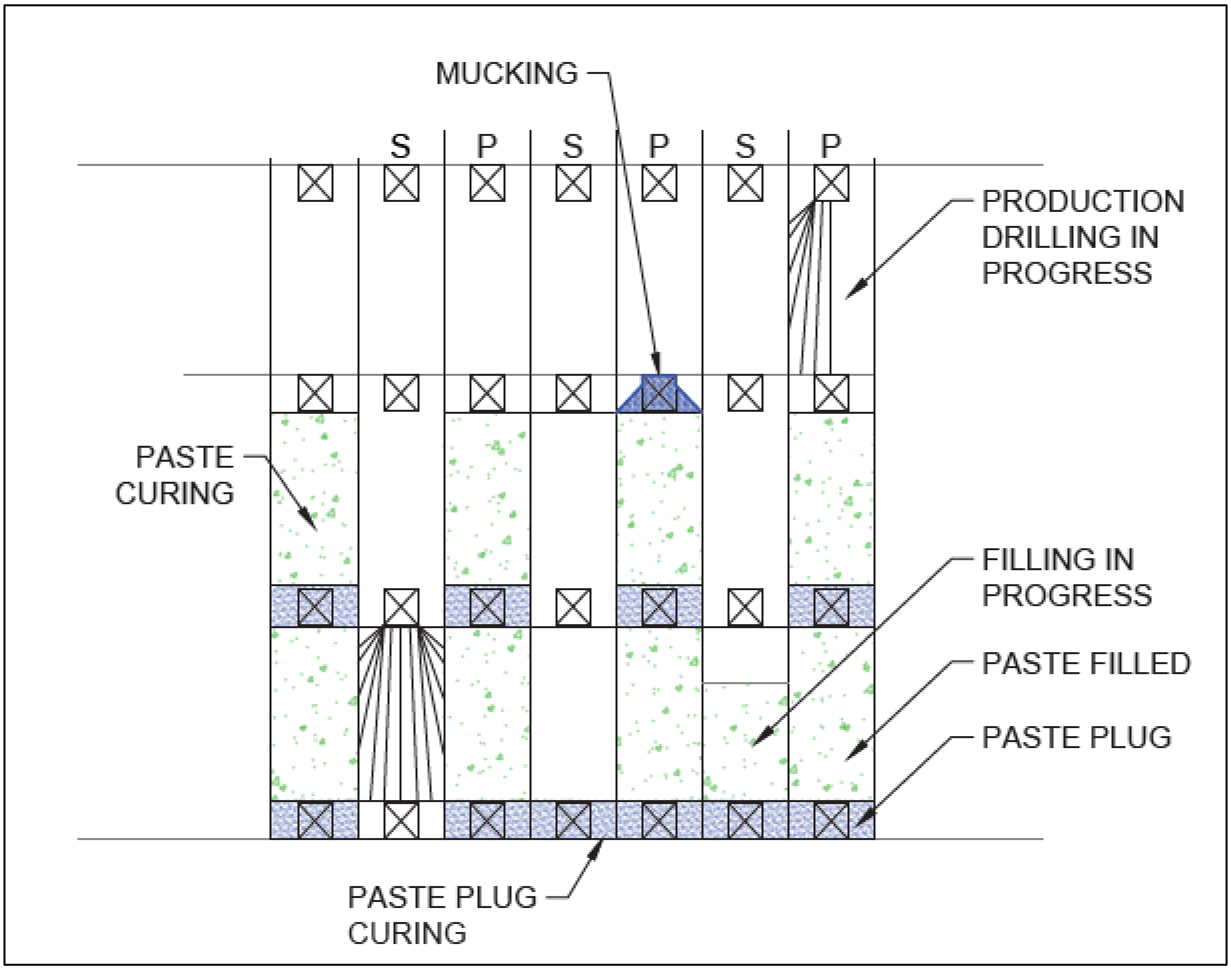
The CPB and CPT would be delivered from the paste plant located on surface adjacent to the process plant through boreholes to the UGTMF (Figure 5.4-9; Section 5.4.3.2, Paste Tailings Delivery System). The boreholes would be cased with ceramic-in-epoxy lined steel pipe for enhanced wear protection.

Production Stope and Underground Tailings Management Facility Backfilling

Long hole stoping would be used to mine the Arrow deposit (Section 5.4.1.1). Production stope backfill is the placement of CPB into exhausted production stopes that would enable progressive decommissioning of the underground and the permanent, long-term disposal of ore processing waste (i.e., tailings). Once extraction of ore within a stope is complete, a backfill plug using CPB would be poured at the bottom (i.e., stope draw point) and allowed to cure, and then the stope would be filled with CPB. The paste backfill plug would be designed to withstand hydrostatic pressures once backfilling of the stope is complete.

Figure 5.5-8 provides an illustrative overview of the production stope backfilling sequence, including the primary and secondary stopes.

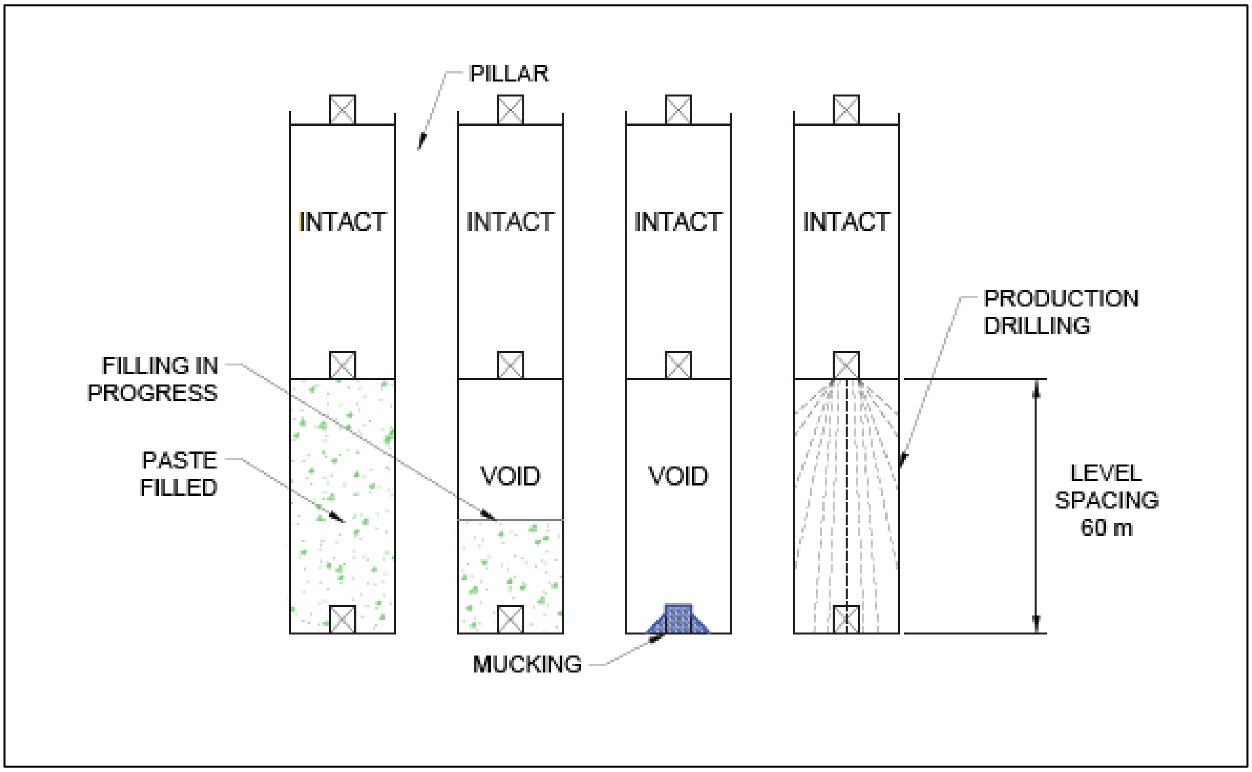
Figure 5.5-8: Rook I Project Production Stope Backfilling Diagram



P = primary; S = secondary.

The UGTMF would be backfilled with CPB and CPT similar to production stopes; however, based on the 15 m pillars between UGTMF chambers, backfilling would not require the sequencing of primary and secondary stopes. Figure 5.5-9 provides an illustrative overview of the UGTMF chamber backfilling sequence, including the pillar of waste between chambers.

Figure 5.5-9: Rook I Project Underground Tailings Management Facility Backfilling Diagram



5.5.2.4 *Mine Rock Management*

The identification and sorting of waste rock during Operations would follow the same process outlined for Construction (Section 5.5.1.5, Mine Rock Management).

The PAG WRSA would be constructed with side slopes of 4H:1V with maximum heights limited to the highest natural point in the immediate surrounding area. During development of the PAG WRSA, PAG waste rock would be placed in alternating lifts of waste rock and borrow material to provide engineered source control (i.e., material with lower flow properties) to reduce the advective air flux through the placed material.

The NPAG WRSA would be developed with anticipated side slopes of 2H:1V and reshaped to a final side slope of 4H:1V for reclamation at Closure. The planned 4H:1V side slope of the WRSAs aligns with a typical closure grading to allow for progressive reclamation.

The ore storage and special waste stockpiles would be placed at the angle of repose based on the temporary nature of the stockpiles.

The WRSAs and stockpiles would be accessed from the production headframe on the mine terrace by a dedicated haul road designed for heavy haul truck traffic with spurs connecting the respective stockpile or WRSA.

5.5.2.5 *Site Water Management*

The collection, management, and treatment of site contact water would continue throughout Operations. Any final treated effluent released to the environment would comply with discharge criteria before release. Treated water from the ETP would be pumped to and held in the monitoring ponds. A water sample would be collected during the filling of each monitoring pond. Once a monitoring pond is full, the composite sample that represents the full pond would be taken to the on-site laboratory and assayed. If all pond assays (i.e., assays taken during pond filling and the full pond composite assay) are within acceptable ranges and discharge criteria are met, approval would be given for the pond to be discharged to Patterson Lake via the diffuser. If pond assays are outside the ranges and discharge criteria, all pond contents would be pumped back to the settling pond for reprocessing in the ETP.

As a quality control measure, while the pond is discharging to the environment, a final composite sample would be taken and assayed. During release, in-stream measurement (e.g., pH and turbidity) would be available. If these measurements are outside of the acceptable ranges, discharging from the pond would cease, and all remaining pond contents would be pumped back to the settling pond.

Sewage would be treated in the STP through a combined use of settling, aeration, chemical addition (alum), and ultraviolet disinfection. Settling would reduce the concentration of total suspended solids. The aerated cells would aerate the incoming sewage to reduce biological oxygen demand and pathogen concentrations to levels that could be further reduced by alum addition and ultraviolet disinfection. Waste water from the STP would be released to Patterson Lake once discharge criteria are met.

The infrastructure and processes required to effectively manage and monitor discharges to Patterson Lake would be described in a documented and controlled Effluent Monitoring Plan as part of the IMS (Section 5.7). The Effluent Monitoring Plan would be periodically reviewed and revised, as required, to ensure it remains appropriate to maintain compliance with applicable regulatory requirements and protection of human health and the environment.

5.5.2.6 Waste Management

To the extent practicable, domestic, industrial, hazardous, and LLRW streams would be minimized and segregated at the source of generation to optimize recycling and reuse, handling, processing, and disposal.

Domestic and industrial waste not suitable for recycling or reuse would be fed to the non-LLRW incinerator, and the residual ash produced during incineration would be disposed in the underground mine (Section 0). Recyclable materials would be temporarily stored and transported to an off-site recycling facility. Hydrocarbon-contaminated soils would be hauled off site for remediation at a licensed facility. Hazardous materials would be segregated at the source of generation to maintain separation of non-compatible materials in accordance with regulatory requirements, and inventory levels would be periodically monitored until the materials are recycled or disposed off site at a licensed hazardous waste disposal facility. Low-level radioactive waste would either be incinerated in the LLRW incinerator or prepared for disposal in the underground mine (Section 5.4.6.3).

5.5.2.7 Mobile Fleet

The proposed Project would use diesel-powered mobile equipment for both underground (i.e., underground mining fleet) and above ground (i.e., surface fleet) as described in the following subsections.

5.5.2.7.1 Underground Mining Fleet

The underground mining fleet would include development, production, and auxiliary equipment commonly used in the mining industry. The overall fleet size would be determined based on the underground development, production, construction, maintenance, and services activities and productivities that would be required to achieve the development and production schedule. Table 5.5-1 identifies the anticipated underground mobile equipment fleet for the Project, including the equipment use classification and the maximum and average number of each piece of equipment that would be used during the Project lifespan.

Table 5.5-1: Rook I Project Underground Mobile Equipment Fleet

Underground Equipment Fleet	Classification	Maximum	Average
Two boom jumbo	Development	4	2
Rock bolter	Development	5	3
LHDs – development/production	Development/production	8	6
Scissor lift	Auxiliary	4	2
Production drill	Production	4	4
Block holer	Production	1	1
Cable bolt jumbos	Auxiliary	2	2
Ammonium nitrate and fuel oil trucks	Development/production	2	2
LHDs – utility	Auxiliary	1	1
Fuel delivery truck	Auxiliary	1	1
Boom truck	Auxiliary	1	1
Transmixer	Auxiliary	3	3
Shotcrete sprayer	Auxiliary	2	2
Personnel transport vehicles	Auxiliary	1	1
Scissor lift – construction	Auxiliary	1	1
Supervisor/engineer trucks	Auxiliary	5	5
Underground grader	Auxiliary	1	1
Leaders basket truck with backhoe	Auxiliary	3	2
Mechanics truck	Auxiliary	2	2
Underground forklifts	Auxiliary	2	2
Underground haulage trucks	Development/production	2	2
Total		**55**	**46**

LHD = load-haul-dump.

Underground mobile equipment including LHDs, drill rigs for working face development (i.e., jumbos), and long hole drills would have varying levels of remote operation and automation through various stages of Operations. These remote operation and automation modules would be used to reduce risk and increase productivity by moving workers farther away from potential hazards.

Development Fleet

The development fleet for the Project was determined based on the number of available drift faces (i.e., headings), the ability to share equipment between development crews, and the productivity of the primary development equipment. For the initial development from the shaft stations on the 500, 590, and 620 levels, the development crews would work on a limited number of faces and would not be able to share equipment. Each crew would be assigned a typical fleet of development equipment, including a jumbo, a bolter, a scissor lift, and LHD. A two-boom jumbo would be used to drill development rounds in the drift face so that they can be loaded with explosives and blasted. Once a round is blasted, a LHD would be used to clear broken rock from the face. Following the clearing of the mining face, a rock bolter would be used to install rock bolts and screen in the exposed rock so that that the ground is adequately supported for safe access by equipment and personnel. Finally, a scissor lift would be used for the installation of mine services (e.g., water pipelines, electrical cables, ventilation ducting) to support the operation. The fleet would expand as development advances on the 500 Level and additional faces become available.

Production Fleet

For the production fleet, underground production was divided into three separate areas: upper (i.e., 500 Level and up), lower (i.e., 620 Level and up), and UGTMF. The production fleet for each area was assigned based on the scheduled stope tonnes, stope cycle productivities, and estimated equipment performance.

The production fleet would include production drills and LHDs. The production drills would be used for drilling long holes in the production stopes and UGTMF chambers. These drills would also be used for the slot raises and miscellaneous boreholes. The LHDs would be used for mucking (i.e., removing material) from the stope and hauling to the nearest remuck bay, and re-handling ore from the remuck bay to the ore pass or rock breaker.

Auxiliary Equipment Fleet

The size and quantity of the auxiliary equipment fleet required for construction, services, maintenance, and personnel movement was estimated based on the level of development, construction, and production activities. A list of the auxiliary equipment and associated uses is provided in Table 5.5-2.

Table 5.5-2: Rook I Project Auxiliary Equipment Fleet

Auxiliary Equipment Fleet	Usage
Cable bolt jumbos	Mobile equipment used to install ground support
LHDs – utility	Multipurpose (e.g., cleanup of spills, mucking of sumps)
Fuel delivery truck	Delivery of fuel to remote fuel bay on 590 Level and directly to slow moving vehicles
Boom truck	Delivery of supplies throughout the mine
Transmixer	Pick-up of shotcrete/concrete at receiving station and delivery to workplace
Shotcrete sprayer	Connects to transmixer, applies shotcrete at workplace for support, used for shielding or construction activity
Personnel transport vehicles	Required to transport personnel to more distant locations from shaft station
Scissor lift – construction	A mobile elevated platform
Supervisor/engineers trucks	Personnel and tools transport
Underground grader	Ramp maintenance
Leaders basket truck with backhoe	All-purpose vehicle – many different accessories can be attached
Mechanics truck	Simple equipment repairs at the face for slower moving equipment
Underground forklifts	Offloading material from the cage, miscellaneous construction support

LHD = load-haul-dump; UGTMF = underground tailings management facility.

5.5.2.7.2 Surface Fleet

The surface mobile equipment fleet would be used to support the underground mine, process plant, and other site activities at the Project site. The proposed surface mobile equipment fleet, including maximum equipment quantity and associated uses, is provided in Table 5.5-3.

Table 5.5-3: Rook I Project Surface Mobile Equipment – Peak Requirement

Surface Mobile Equipment	Quantity (Peak)	Usage
Articulated truck	3	Surface haulage from headframe to stockpiles
Loader	2	Loading of trucks, loading of crusher
Grader	2	Road maintenance
Excavator	1	Yard maintenance / construction
Forklift	4	Material movements
Pickup truck	21	Movement of personnel around site
Boom truck	1	Material movement
Ambulance	1	Emergency response (medical aid)
Fire truck	1	Emergency response (firefighting)
Manlift	1	Support working at heights
Telehandler	2	Material movement
Bus	2	Transport to/from airstrip and mine
Truck with flatbed	1	Material movement
Water truck	1	Dust suppression
Sanitation tank truck	1	Haulage to sewage lagoon
Dump trucks equipped with snow plow and sander	2	Road maintenance
Concrete haulage trucks	2	Haulage of concrete and shotcrete to construction site
Rough terrain crane	1	Construction projects
Dozer	2	Construction and stockpile maintenance
De-icing unit	1	De-icing planes
Mobile rock breaker	1	Breakdown of large boulders or oversize rock at surface crusher

5.5.3 Decommissioning and Reclamation (Closure)

The final Project phase is Closure, which is expected to occur over 15 years and would include two stages: Active Closure and Transitional Monitoring (Table 5.1-1).

NexGen's preliminary objective for Closure is to design the landscape to allow for unrestricted traditional use by Indigenous Groups and local communities, and for functional self-sustaining, locally common ecosystems on the reclaimed landscape as soon as practical (Section 5.3.2). Monitoring would be performed during Closure to confirm that closure objectives have been met, the Project site is safe and stable, and ecological conditions are appropriate to transfer the land to the Province of Saskatchewan.

Progressive reclamation is a recognized industry best practice where infrastructure and lands that are no longer required for the operation of the mine or process plant are decommissioned and reclaimed while the site remains operational. Progressive decommissioning and reclamation would enhance environmental protection by minimizing the duration the Project facilities would be exposed to natural elements (e.g., wind and water) and would advance the timeline of achieving closure objectives. NexGen has incorporated key elements of progressive reclamation into the underground mine design (e.g., progressive closure of production stopes and UGTMF chambers with CPB and CPT) and the design of the PAG and NPAG WRSA stockpiles (e.g., construction of stockpiles to final closure side slopes). Additionally, any other areas of the Project that are no longer required would be decommissioned and reclaimed as soon as feasible.

Conceptual information associated with decommissioning and progressive reclamation activities is provided in Appendix 5A, and additional information on these activities is summarized below.

5.5.3.1 Active Closure Stage

The Active Closure Stage would include active decommissioning, water treatment, and reclamation activities, and would commence upon approval by the ENV and CNSC. These activities would be based upon a Detailed Decommissioning and Reclamation Plan that would include engineered designs, where required; detailed requirements for decommissioning, remediation, and reclamation; and monitoring of certain post-decommissioning aspects (e.g., water quality and air emissions, including radon concentrations). The plan would also include a detailed cost estimate that could be used to budget for execution of decommissioning and reclamation works at the proposed Project.

The purpose of decommissioning would be to transition the Project into a safe inactive state and would be preceded by the orderly ramp down and stoppage of site activities. Active underground mining areas would be backfilled and secured, and process plant circuits would be systematically shut down, flushed, and cleaned. Surface facilities, infrastructure, and equipment would be cleaned as necessary, scanned, and prepared for demolition in a staged and controlled manner.

The shafts from the underground would be decommissioned sequentially following completion of backfilling in the lateral portions of the mine. The lower portion of the shafts (i.e., from the bottom of the shaft to bottom of the hydrostatic liner) would be backfilled with scrap decommissioning demolition waste and NPAG (i.e., clean) waste rock. A concrete plug would then be installed in each shaft to seal it off below the bottom of the hydrostatic liner. The remaining upper portion of the shafts, from the concrete plug to shaft collar, would be filled with clean fill material removed from berms, roadways, or other surface earthworks. Each shaft would then be sealed with a shallow, reinforced concrete plug at surface. All other openings to surface would be filled with a low-conductivity, impermeable material and sealed at surface.

Decommissioning demolition waste would be segregated as required, backfilled, and secured in the underground workings. Backfilled material would be placed utilizing available space until all designated decommissioning demolition waste has been removed from surface. During this stage, the underground mine workings would continue to be dewatered, ventilated, and the required infrastructure maintained. Decommissioning demolition waste not suitable for underground storage would be sent off site to authorized facilities.

Once placement of decommissioning demolition waste underground is complete, dewatering activities would cease, allowing groundwater levels to return to a natural equilibrium; and surface openings would be sealed when underground access is no longer required.

At Closure, the WRSAs would be graded to blend into the surrounding topography and an engineered cover system (e.g., growth medium) would overlay the final WRSA landforms.

The ETP and associated water management infrastructure would remain operable until operational control monitoring results determine that the collection and treatment of contact water is no longer required to meet established decommissioning criteria and protect the environment.

Wherever practicable, surface and underground infrastructure, equipment, and materials that are not required during the Active Closure Stage and that meet radiological criteria for off-site removal would be salvaged, sold, or transferred off site for recycling or disposal. No structures or equipment would remain on the surface of the site post-decommissioning unless required for monitoring or maintenance activities.

The Active Closure Stage is expected to last approximately five years; the success of decommissioning activities would be determined through monitoring and assessment against the relevant closure objectives and criteria.

5.5.3.2 Transitional Monitoring Stage

The Transitional Monitoring Stage is the stage between the completion of the Active Closure Stage and when the Project site enters into Institutional Control, which is when control of the site is transferred to the Province of Saskatchewan for management. The Transitional Monitoring Stage would commence after all mine, process plant, and supporting infrastructure has been removed from the surface and the underground workings have been closed. This stage has two key purposes: monitoring and reporting against performance criteria, and the application of additional mitigation and maintenance to meet performance criteria, where required.

The Transitional Monitoring Stage is expected to last approximately 10 years, pending achievement of success criteria based upon periodic measurement and assessment of the effectiveness of decommissioning and reclamation. The focus of monitoring during the Transitional Monitoring Stage would be determined during the development of the Detailed Decommissioning and Reclamation Plan and is expected to include monitoring of post-decommissioning contaminant loadings, residual effects on the local surface and groundwater systems, geotechnical stability, and overall reclamation success. Post-reclamation gamma surveys would be completed after decommissioning and reclamation as required by the ENV and the CNSC. Financial assurances sufficient to cover the cost of transitional monitoring, as well as a contingency for unexpected occurrences, would be maintained.

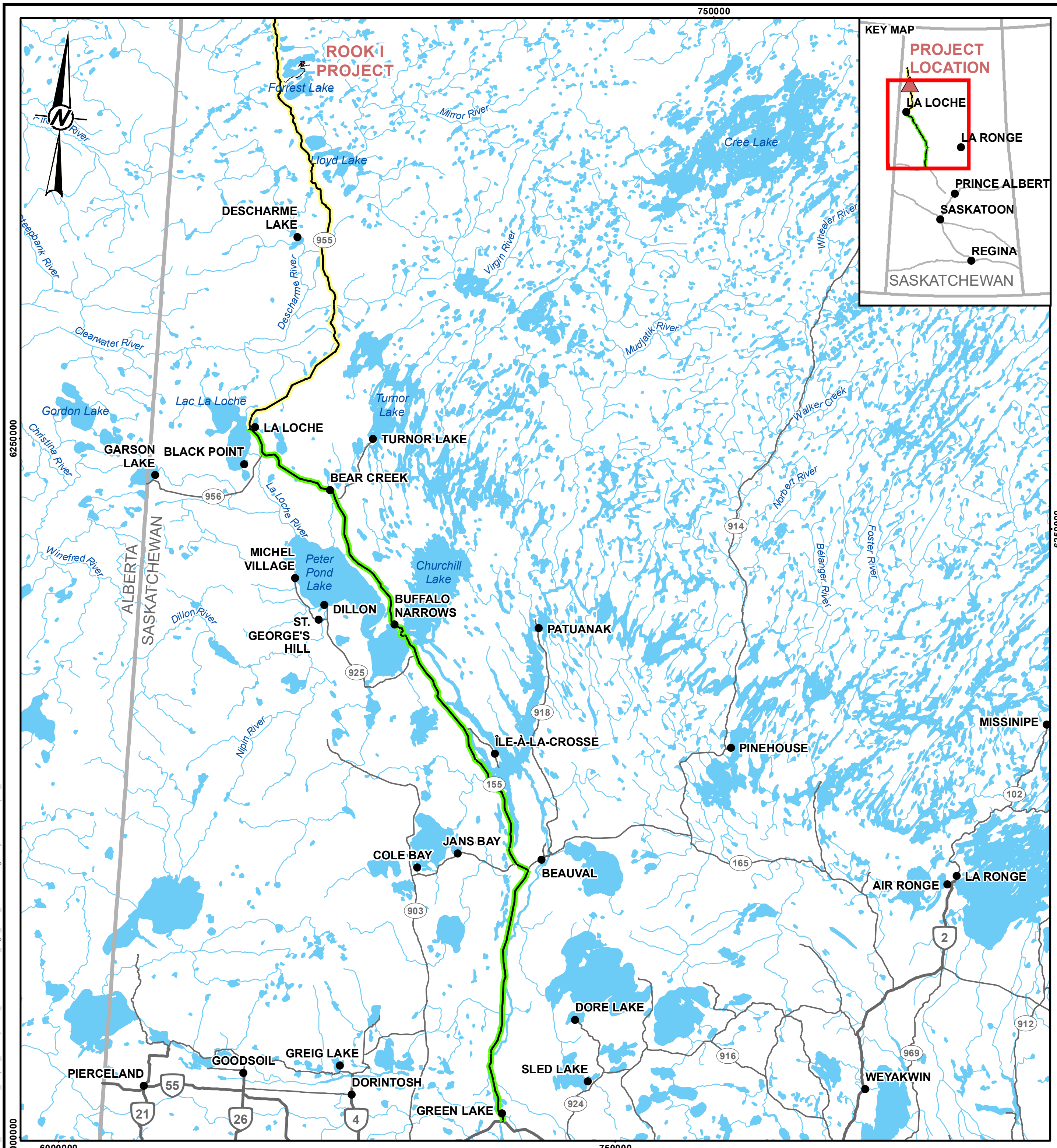
During the Transitional Monitoring Stage, periodic inspections would be conducted by regulators to confirm compliance with permit conditions. Reporting on monitoring and maintenance methods and results would be provided as required. Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval. Once release from the CNSC license is granted, and upon Provincial approval, the process for transfer to Institutional Control would be initiated.

5.5.4 Traffic

In Saskatchewan, the provincially managed highways and gravel highways leading to the Project include Provincial Highways 155 and 955 (Figure 5.5-10).

Highway 155 extends north/northwest for approximately 300 km from the intersection with Highway 55 and terminates near La Loche where Highway 955 begins. Highway 955 extends for approximately 270 km north of La Loche and ends near Carswell Lake and the former Cluff Lake Mine, which is north of the proposed Project. The Project site is located north of La Loche, approximately 160 km along Highway 955, followed by approximately 13 km along the access road for the Project (Section 5.4.8.1).

During Construction and Operations, an increase in traffic volumes is expected along Highway 155 and 955 associated with the proposed Project. Details associated with predicted traffic volumes during Construction and Operations are provided in Table 5.5-4 and Table 5.5-5, respectively.



LEGEND

- POPULATED PLACE
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- HIGHWAY 955
- HIGHWAY 155

0 50 100

1:2,000,000 KILOMETRES

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

PROVINCIAL HIGHWAYS IN RELATION TO THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT		20144150	PHASE 3314 - 6
DESIGN	JMC	2023-02-07	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-07	
CHECK	JMC	2023-02-07	**FIGURE 5.5-10**
REVIEW	MM	2023-02-07	

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

Table 5.5-4: Rook I Project Predicted Traffic Volumes during Construction

Transportation Category	Trips/Day	Trips/Week	One-Time Trips (One-Way)
Construction, Equipment, and Materials			
Cranes	n/a	n/a	110 (support vehicles included)
Mobile equipment (e.g., forklifts, loaders, fuel truck)	n/a	n/a	6
Temporary offices: Mostly trailers (6-8), one load per trailer	n/a	n/a	8
Administration building	n/a	n/a	60 (support vehicles included)
Batch plant / shotcrete plant (e.g., large building with tanks, feed chutes, conveyors)	n/a	n/a	100 (support vehicles included)
Mine dry trailers	n/a	n/a	6
Construction camp dormitories	n/a	n/a	200
Maintenance shop / warehouse building	n/a	n/a	120 (support vehicles included)
Power plant	n/a	n/a	50 (support vehicles included)
Fuel storage	n/a	n/a	45
Headframe, winch house, and hoist building steel	n/a	n/a	150 (support vehicles included)
Hoist, large cylinders and wheels	n/a	n/a	50 (support vehicles included)
Compressors	n/a	n/a	3
Temporary freeze plant	n/a	n/a	2
Fresh air fans	n/a	n/a	25 (support vehicles included)
Transformers	n/a	n/a	2
Pumps	n/a	n/a	4
Piping	n/a	n/a	30
Electrical equipment	n/a	n/a	25
Cable	n/a	n/a	30
ETP (pre-engineered building)	n/a	n/a	240 (support vehicles included)
Process plant	n/a	n/a	500 (support vehicles included)
Hoist drives and controls	n/a	n/a	12
Raise bore machine	n/a	n/a	5 (support vehicles included)
Underground mobile equipment	n/a	n/a	44
Civil materials	n/a	n/a	44
Site services materials	n/a	n/a	19
Structural materials	n/a	n/a	17
Mechanical materials	n/a	n/a	23
Electrical materials	n/a	n/a	15
Building cladding and roofing	n/a	n/a	5
Camp builder contractor	n/a	n/a	14
Heating, ventilation, and air conditioning equipment	n/a	n/a	4
Expendables			
Steel: 70 shipments at roughly a shipment per week	n/a	1	1
Explosives	n/a	1	1
Diesel fuel (underground equipment)	3	n/a	n/a
Diesel fuel (surface equipment)	12	n/a	n/a
Gasoline (surface equipment)	n/a	5	n/a
LNG	8	n/a	n/a
Cement	1	n/a	n/a
Lubricants	n/a	2	n/a
Additional shipment per week added for contingency	n/a	1	n/a
Food delivery	n/a	1	n/a
Ground support	n/a	1	n/a

Table 5.5-4: Rook I Project Predicted Traffic Volumes during Construction

Transportation Category	Trips/Day	Trips/Week	One-Time Trips (One-Way)
Labour Force			
Drive-in/drive-out staff; assumes airstrip is operational	n/a	50	n/a
Totals	**24**	**62**	**1,970**
Assumptions:			
▪ 25% of one-time trips occur in single day and all weekly trips occur on same day	578.5		
▪ Additional 25% for contingency	723		
▪ 9% of all daily trips are leaving site during evening peak hour	65		
▪ 3% of all daily trips are entering site during evening peak hour	22		

ETP = effluent treatment plant; LNG = liquified natural gas; n/a = not applicable.

Table 5.5-5: Rook I Project Predicted Traffic Volumes during Operations

Transportation Category	Trips/Day	Trips/Week	One-Time Trips (One Way)
Exports			
Uranium concentrate	2	n/a	n/a
One-Time Equipment Deliveries			
Camp	n/a	n/a	150
Vehicles: one-time trip for all	n/a	n/a	32
Expendables			
Sulphur	n/a	1	n/a
Unslaked lime	n/a	1	n/a
Hydrogen peroxide	n/a	1	n/a
Flocculant	n/a	1	n/a
Tertiary amine	n/a	1	n/a
Isodecanol	n/a	1	n/a
Sodium carbonate	n/a	1	n/a
Magnesia	n/a	1	n/a
Ferric sulphate	n/a	1	n/a
Mill grinding media	n/a	1	n/a
Mill liners	n/a	1	n/a
Gasoline (surface equipment)	1	n/a	n/a
LNG	15	n/a	n/a
Cement	10	n/a	n/a
Food delivery	n/a	2	n/a
Ground support	n/a	2	n/a
Bits and steel	n/a	1	n/a
Explosives	n/a	1	n/a
Lubricants	n/a	1	n/a
Labour Force			
Drive-in/drive-out staff; assumes airstrip is operational	10	n/a	n/a
Totals	**38**	**18**	**182**
Assumptions:			
▪ 25% of one-time trips occur in single day and all weekly trips occur on same day	101.5		
▪ Additional 25% for contingency	127		
▪ 9% of all daily trips are leaving site during evening peak hour	11		
▪ 3% of all daily trips are entering site during evening peak hour	4		

LNG = liquified natural gas; n/a/ = not applicable.

5.6 Human Resources

NexGen will continue to prioritize training, employment, and business opportunities for the local communities closest to the Project. During Construction, Operations, and the Active Closure Stage, the Project would create employment, training, and business opportunities, particularly locally but also more broadly. While the transition from the Active Closure Stage to the Transitional Monitoring Stage would result in decreases to employment, training, and business opportunities related to the Project, the work experience and training gained during previous Project phases would result in a more experienced and qualified local labour force.

Anticipated employment, training, and business opportunities that would result from the proposed Project are summarized in the subsections below, and additional details are provided in Section 18, Economy.

5.6.1 Employment

On-site labour requirements would vary by year throughout all Project phases depending on the specific work requirements. During Construction, the on-site labour is expected to peak at approximately 350 individuals on site, including labour associated with surface and underground construction, supervision, staff, maintenance, general and administration positions, the integrated execution team, and consultants and contractors. During Operations, peak employment is expected to comprise a total of approximately 490 positions on payroll (i.e., direct employment), of which approximately 260 individuals are expected to be on site at any one time. The transition from Operations to Closure would result in decreases to employment and training opportunities at the Project relative to Operations; however, some of the Operations workforce may be transitioned to other activities during the Active Closure Stage, such as backfilling underground mine workings, removal of physical infrastructure, and recontouring and revegetating disturbed areas.

Most personnel would work a two-week-in/two-week-out rotation on a fly-in/fly-out basis. Some staff would work a rotation of four days on site and three days off site, without a cross shift. The underground mine and process plant would operate on two 12-hour shifts, seven days per week. Crews would alternate day shifts and night shifts based on every second rotation worked at site.

NexGen is currently considering using the Buffalo Narrows Airport as a pick-up point There may also be an additional pick-up point within the LPA (e.g., La Loche) and there would also be pick-up points outside of the LPA in communities where there is a skilled workforce (e.g., Saskatoon); these locations are to be confirmed.

NexGen would provide a competitive compensation package. Compensation would be based on measured skill levels and competitive market practices in the mining industry for all positions. The compensation structure would include base salary, benefits, bonuses, and incentives. Base salaries would be competitive with other Saskatchewan employers, particularly those in the uranium industry. Benefits would be designed for flexibility to attract and retain talent.

Recruitment for key positions would begin early in Project execution, and all personnel would be hired prior to commencement of Operations. NexGen would regulate the search, selection, and hiring of operators, technicians, and professionals. Each candidate's suitability for a position would be determined based on education level, quality of experience, potential for development, and other specifications established in the position profile.

For Construction, NexGen would make best efforts to recruit residents from local communities; however, due to the specialized nature of some of the construction work and the associated technical employment qualification requirements, a greater portion of the Construction workforce is anticipated to be sourced from outside the area of the Project.

Most of the positions during Operations would require some form of training such as on-the-job training, a university or college diploma or certificate, trades training, or a university degree. A summary of the anticipated education and training requirements for peak employment during Operations is provided in Table 5.6-1. The education requirements shown in Table 5.6-1 would be the highest level of training anticipated to be necessary for each position; however, lower educational levels or a combination of training and experience may be accepted for certain positions.

Table 5.6-1: Rook I Project Anticipated Education and Training Requirements during Operations

Labour Category	Total Positions at Peak (Year 2)
High school, on-the-job training, university or college certificate or diploma	295
Trades	146
University degree	45
Total	**486**

NexGen is committed to the following measures to enhance employment opportunities at the proposed Project:

- implementing a tailored local workforce recruitment strategy to confirm that local residents are fully aware of and understand how to access Project employment opportunities;
- working with local communities to develop culturally sensitive employment policies, including addressing recruitment and retention barriers;
- using best efforts to provide qualified local residents with a first preference for employment and training opportunities to achieve a long-term aspirational target of 75% of the Project's workforce being composed of local residents;
- establishing a mentoring program to support long-term participation of local residents in the Project workforce;
- prioritizing advancement opportunities for qualified local residents into increasingly senior positions; and
- providing dedicated space for Elders to be available to support Indigenous employees and assist with employee retention.

A workforce transition plan would also be developed as part of overall closure planning to help workers transition to other employment and mitigate the decreases in employment, income, and training opportunities during Closure.

In addition to direct employment requirements, the Project would also result in indirect (i.e., employed in sectors supplying goods and services to the Project) and induced (i.e., employed as a result of consumer expenditures generated by direct and indirect employment) employment opportunities (Statistics Canada 2021). Total Canada-wide direct, indirect, and induced employment related to the Project, is estimated to range between approximately 8,200 and 10,500 full-time equivalent positions annually over the four years of Construction, and between 950 and 1,200 full-time equivalent positions during a typical year in Operations (Section 18.4, Project Interactions, Mitigations and Benefit Enhancements).

5.6.2 Training

NexGen would continue to provide workforce training opportunities throughout the Project lifespan. This training would allow employees to advance to more senior and higher-income employment at the proposed Project and improve their ability to obtain other employment in the future. These training opportunities would also assist in the development of a highly skilled local workforce.

In addition, the Project would enter into a Mineral Surface Lease Agreement with the Province of Saskatchewan that provides "the foundation for the development of support relationships between northern communities, mining operations, and the Government of Saskatchewan" (Government of Saskatchewan 2021). Each lease requires the operator to have a Human Resource Development Agreement that focuses on the priorities for northern training, employment, and job advancement. A Human Resource Development Plan would be created for the Project to achieve the agreement's objectives and would define responsibilities for Project roles and required training and development.

NexGen is committed to the following measures to enhance training opportunities at the Project:

- working with relevant training institutions to facilitate delivery of certified and accredited training and recruitment programs for construction and mining-related skills targeted at employment opportunities for LPA residents;
- continuing to provide scholarship funding for post-secondary education;
- continuing to provide summer student opportunities; and
- preparing detailed operator training that includes classroom training, field training, and on-the-job training to help prepare the Operations workforce.

Experience and training gained during Construction would improve the ability of local residents to obtain employment during Operations.

5.6.3 Business and Contracting Opportunities

The Project would provide increased business and contracting opportunities related to the provision of goods (e.g., equipment, fuel, supplies) and services (e.g., construction, transportation, hospitality) throughout Construction, Operations, and Closure. If the Project were to proceed, NexGen would continually evaluate its supply chain for opportunities to procure goods and services from existing sources in the area of the Project as well as opportunities to develop and expand local capacity. NexGen has an aspirational long-term target of greater than 30% of the Project's external spending being awarded to local businesses.

NexGen is committed to the following measures to enhance business and contracting opportunities relating to the proposed Project:

- developing and maintaining a business opportunities workplan that would describe the steps that NexGen and each primary Indigenous Group would follow to qualify for business opportunities with the Project;
- working with local communities to establish and maintain a local business registry;
- providing advance notice of business opportunities; and
- developing and implementing a single source process and a preferred competitive bid process to facilitate the success of capable and suitably qualified Indigenous businesses.

The transition from Operations to Closure would result in reductions in Project spending on supplies and services over time, and in a decrease in local business and contracting opportunities. NexGen is committed to ongoing communication with local Indigenous Groups and communities, contractors, and suppliers to provide information on decommissioning and reclamation plans to help businesses plan for closure of the Project.

5.7 Integrated Management System

NexGen is responsible for and committed to providing for the health and safety of workers and the public, and the protection of the environment. To fulfill these commitments, NexGen is developing an IMS for the Project that will provide a common, transparent, risk-informed process framework for both Project activities and achieving excellence in employee safety, radiation safety, and environmental protection by:

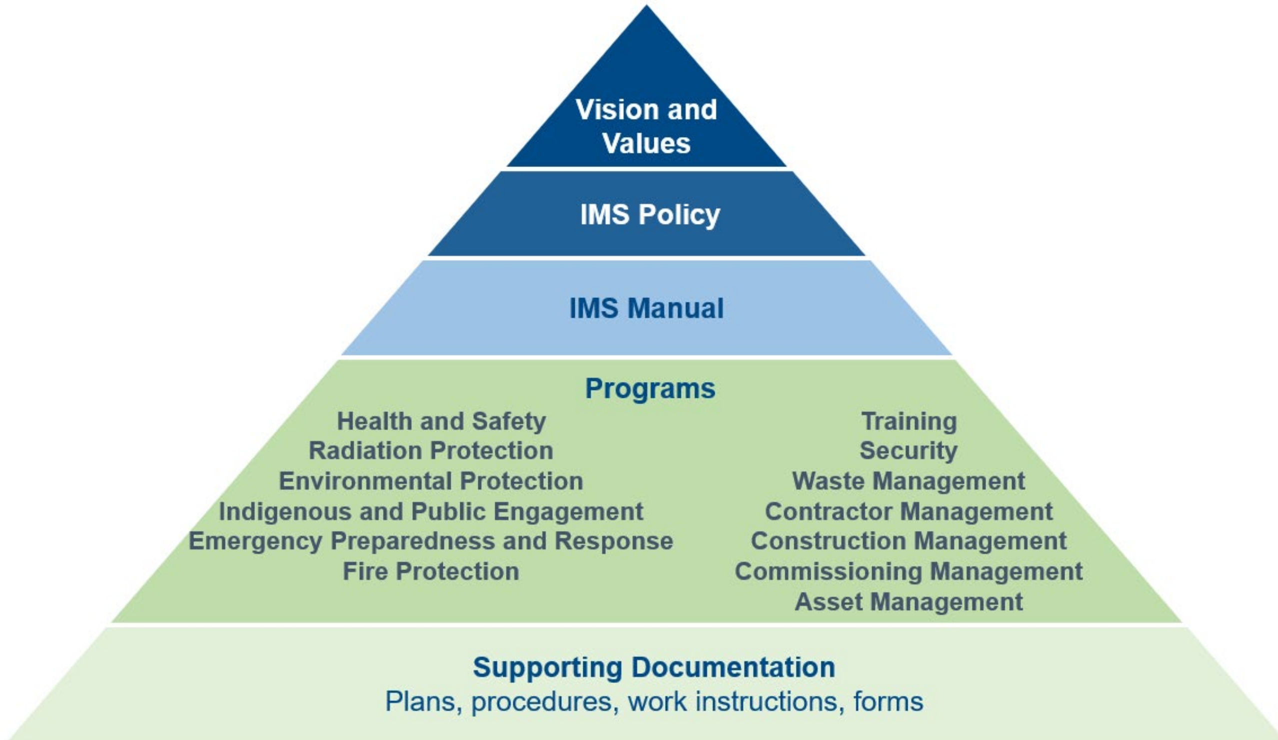
- defining the organization and its context;
- complying with all applicable requirements;
- setting meaningful objectives and targets;
- effectively managing resources, information, communication, work, and change;
- identifying and resolving problems to prevent reoccurrence;
- monitoring results and performing assessments;
- seeking, sharing, and using experience; and
- continually improving the management system.

The IMS would apply to all on-site Project-related licensed activities during Construction, Operations, and Closure and to all Project workers (including contractors) and visitors.

The IMS and its associated processes would be part of a management system hierarchy, which would incorporate NexGen's vision and values, a governing IMS Policy, an IMS Manual, programs, and supporting documentation (e.g., plans, procedures, work instructions) as shown in Figure 5.7-1. The IMS processes would enable a common integrated approach across program topics that would minimize redundant or duplicated work and maximize the use of shared processes to complete work in a consistent, safe, and reliable manner.

The IMS would be developed with reference to the applicable provincial, CNSC, and CSA Group requirements, as well as appropriate guidance documents (e.g., ISO 9001 Quality Management, ISO 14001 Environmental Management, ISO 45001 Occupational Health and Safety).

Figure 5.7-1: Rook I Project Integrated Management System Framework



IMS = Integrated Management System.

Integrated Management System Policy

The IMS Policy would document NexGen's commitment to the management system and articulate the principles and expectations for protecting the health, safety, and well-being of workers; preserving the environment; engaging with Indigenous communities and members of the public; complying with legal and other requirements; and continually improving management system processes and performance.

Integrated Management System Manual

The IMS Manual would outline NexGen's management system processes that provide a common framework for licensed activities supporting the Project. This unified framework includes processes for implementing compliance measures, enabling continual improvement, and fostering a culture where protecting the health and safety of workers and preserving the environment are principal considerations guiding overall decisions and daily actions.

NexGen's management system approach follows a Plan-Do-Check-Act continual improvement cycle. The "Plan" component of the IMS consists of processes that support a systematic, graduated approach to planning licensed activities. These processes are applicable to the supporting programs and management plans and include:

- identifying work processes for licensed activities;
- assessing and managing risks;
- setting and tracking management system objectives and targets;

- providing the resources necessary to implement and maintain management system functions;
- confirming that all workers are competent and properly trained to perform assigned work;
- managing documents and records;
- effectively communicating with internal and external parties; and
- managing changes to process, key personnel, facilities, and equipment.

The “Do” component of the IMS includes controls to mitigate risk, carry out work safely, and efficiently verify that processes and outcomes of design, construction, installation, commissioning, and turnover of facilities and equipment conform to requirements. The “Do” component also confirms that supply chains for procurement of equipment, materials, and services meet internal, legal, and other requirements along with technical specifications. Nonconformant and incident identification and reporting are equally important elements of this component of the IMS.

The “Check” component of the IMS includes monitoring to confirm that controls are in place, are implemented, and are effective at protecting people and the environment. Monitoring involves audits and inspections, along with management review to verify compliance and the suitability, adequacy, and effectiveness of the IMS at established intervals. Management also evaluates the sustainability of the management system with a focus on future challenges and opportunities. The management review considers the entirety of the IMS, which includes items such as status of corrective actions, trends in nonconformities, changes in external and internal issues, performance and effectiveness of the management programs, audit findings, adequacy of resources, and effectiveness of actions taken to address risk and opportunities for improvement. These management reviews of the IMS process are conducted annually at a minimum, and the outcomes from these reviews are documented and used to inform the development of strategic plans, objectives and targets, any required changes to the IMS, resource needs, and additional actions.

The “Act” component of the IMS verifies that events or situations identified from nonconformance, or incident reports, audits, inspections, or management reviews are subject to an appropriate level of investigation, causal analysis, and the development of corrective actions to prevent potential reoccurrence. Corrective actions are planned, implemented, verified, and reviewed for effectiveness.

NexGen is committed to continual improvement through an ongoing process to increase the suitability, adequacy, and effectiveness of the IMS. Management and workers continually seek out improvement opportunities for the IMS and Project processes through monitoring, auditing, management review, and maintaining awareness of changes in the business environment.

Integrated Management System Programs

The IMS consists of program-level documents that are organized into categories consistent with the CNSC safety and control areas and other matters of regulatory interest as shown in Table 5.7-1. The topics presented reflect the programs that would be in place during Project Construction. Additional programs may be added as the Project advances to Operations (e.g., Mine Operations Program) and Closure. Each program would be supported by lower-level management system-controlled documents (e.g., plan, procedures, work instructions) that describe topic-specific processes in greater detail. The programs and certain lower-level documents (e.g., codes of practice) would be referenced in provincial approvals and the CNSC licence condition handbook for the Project and would be subject to ongoing regulatory oversight and public reporting to maintain effectiveness and compliance.

Table 5.7-1: Rook I Integrated Management System Program-Level Documents

Program	Description	Key Supporting Documents
Health and Safety	Framework for fostering a health and safety culture, identifying, managing, and controlling occupational health and safety hazards (includes industrial hygiene).	Procedures, work instructions
Radiation Protection	Framework to address radiation protection and hazard control. Includes, but is not limited to, worker qualifications and competency, controls to maintain exposures to levels considered as low as reasonably achievable, dosimetry and contamination monitoring, and performance tracking and reporting.	Radiation Code of Practice Procedures, work instructions
Environmental Protection	Framework for the protection and preservation of the environment. Includes, but is not limited to, description of environmental aspects, risk assessment, release mechanisms (routine and non-routine) to all environmental media, pollution prevention and environmental protection measures, response mechanisms to unplanned environmental releases, monitoring of effluents and environmental media, inspection and evaluation of critical structures and systems, and performance tracking and reporting.	Effluent and Emissions Plan Environmental Monitoring Plan Environmental Code of Practice Procedures, work instructions
Indigenous and Public Engagement	Framework for providing Indigenous Groups, communities, and members of the public with timely, regular information regarding activities. Includes, but is not limited to, identification of target audiences, communication modes and methods, mechanisms for receiving feedback, and performance tracking and reporting.	Procedures, work instructions
Emergency Preparedness and Response	Framework for the measures to prepare, respond to, and mitigate the effect of emergencies. Includes, but is not limited to, identification of potential emergency situations, planning for emergencies, resources for responses, communication protocols, organization, training, and testing response plans.	Emergency Response Plan Ground Transportation Emergency Response Plan Crisis Management Plan Procedures, work instructions
Fire Protection	Framework for effective fire prevention, control, and mitigation. Includes fire hazard assessment, pre-incident planning, fire safety controls, and facility condition inspections.	Procedures, work instructions
Training	Framework for ensuring the ongoing qualification of employees and contracted workers through a systematic approach to training. Includes, but is not limited to, training program development, delivery, qualification tracking, and performance monitoring.	Procedures, work instructions
Security	Framework for maintaining security measures to prevent loss of nuclear substances and prevent deliberately destructive acts. Includes, but is not limited to, risk assessment, control measures, access management, and performance monitoring.	Procedures, work instructions
Waste Management	Framework for the safe and environmentally responsible management of all waste streams. Includes, but is not limited to, waste minimization, identification, classification, segregation, handling, and disposal.	Mine Waste Management Plan Conventional Waste Management Plan Site Water Management Plan Procedures, work instructions
Contractor Management	Framework for verifying that contractors working at the Project site comply with all internal requirements related to health, safety, environment, and security. Includes, but is not limited to, contractor risk evaluation, contractor roles and responsibilities, contractor training, oversight, and performance standards.	Procedures, work instructions
Construction Management	Describes the construction processes including Project design, mobilization, execution.	Procedures, work instructions
Commissioning Management	Describes the commissioning processes (i.e., component and system testing and confirmation of capability to operate within design basis).	Procedures, work instructions
Asset Management	Describes the processes for selecting, acquiring, maintaining, and dispositioning assets (e.g., equipment, materials).	Procedures, work instructions

5.8 Project Description Development, Review, and Optimization

The purpose of this Project description is to provide the Project details necessary to support the assessment of potential effects on components and attributes of the biophysical, cultural, and socio-economic environments, including ecological health and human health. The proposed Project components, activities, and systems described herein have been developed following NexGen's design objectives, guiding principles, and commitment to protecting the environment and the safety of workers and the public as described in Section 5.3.2. Some key aspects of the Project description that reflect this approach include:

- deposition of tailings underground (as opposed to on or near surface), to eliminate surface tailings storage infrastructure and the associated risks and the potential long-term effects on the lands and waters, including water quality and fish habitat;
- permanent underground tailings storage with engineered barriers to minimize seepage into groundwater and potential effects on aquatic organisms in Patterson Lake and the people who may use these resources;
- intentional consolidation and limiting of the total Project footprint (e.g., clustering buildings, optimizing the use of cleared areas, using existing road infrastructure) as much as practical to:
    - minimize the loss of land use by Indigenous Peoples and others;
    - minimize loss of wildlife habitat;
    - increase the ease and rate of reclamation; and
    - focus on end land use;
- separate management and storage strategies for PAG and NPAG materials;
- installation of an engineered cover on PAG material to minimize the long-term risks from seepage of constituents of potential concern into the ground and surface waters, and subsequent uptake by vegetation and transfer up the food chain;
- a focus on holistic water management that maximizes non-contact water diversion and provides for controlled and flexible release of contact water meeting discharge criteria;
- design and placement of the treated effluent diffuser to reduce potential effects on the water and fish habitat of Patterson Lake; and
- use of primarily LNG for power generation to reduce Project greenhouse gas emissions.

The general approach to an EA entails a systematic consideration of how project components, activities and systems may interact with, and affect, the biophysical, cultural, and socio-economic environments. It is recognized that review and optimization of Project components and activities described herein would be undertaken throughout the Project lifespan with the objective of identifying opportunities to further enhance the environmental, technical, economic, and social performance of the Project. Where potential adverse effects are identified, either during design, Construction, Operations, or Closure, feasible environmental design features and/or mitigation practices would be implemented to avoid and minimize the potential adverse effects.

Project review and optimization would be proactively pursued following the precautionary principle, and with the intent that any potential design iterations and mitigations would be improvements on, and within the current considerations of, the assumptions carried within the EA (i.e., within the scope of the Project as defined for assessment). The precautionary principle states that “where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation” (IAAC 2020). Thus, the conservative application of the precautionary principle in the development of the proposed Project, and the EA presented in the following sections, allows continued Project optimization while providing confidence that any likely refinement would be conservatively captured as part of the EA. Additional details on the precautionary approach can be found in Section 6, Environmental Assessment Approach and Methods.

5.9 References

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Appendix 5A Conceptual Preliminary Decommissioning and Reclamation Plan

Executive Summary

This conceptual Preliminary Decommissioning and Reclamation Plan (Plan) has been developed in support of the Environmental Impact Statement prepared for the NexGen Energy Ltd. (NexGen) Rook I Project (Project), a proposed uranium mining and milling operation located adjacent to Patterson Lake in northern Saskatchewan. The anticipated lifespan of the Project is 43 years and includes Construction, Operations, and Decommissioning and Reclamation (i.e., Closure) phases. The Plan provides a conceptual overview of the proposed decommissioning and reclamation objectives, criteria, methods, and monitoring requirements for the Project.

The proposed Project is subject to both provincial and federal environmental assessment processes, would be licensed as a nuclear facility by the Canadian Nuclear Safety Commission (CNSC), and would be subject to various provincial and federal permits and approvals. Consistent with the provincial requirements for an environmental assessment as described under Section 9 of *The Environmental Assessment Act,* this Plan describes how the area affected by the Project would be decommissioned and reclaimed (Government of Saskatchewan 2021a). Federally, the development of a preliminary decommissioning plan is required by the CNSC during the siting phase of a Class I nuclear facility and uranium mine and mill (CNSC 2021).

The Plan reflects NexGen's commitment to progressive reclamation and to designing, constructing, and operating for responsible closure by considering industry best practices and incorporating feedback received from local Indigenous Groups and communities. Decommissioning and reclamation of the Project addresses requirements associated with the provincial and federal legislation and fulfills Saskatchewan's long-term Institutional Control Program requirements with no, or minimal, maintenance post-closure (Government of Saskatchewan 2021b).

The Plan aligns with and meets applicable requirements included in:

- *The Environmental Assessment Act*;
- The Mineral Industry Environmental Protection Regulations, 1996;
- Northern Mine Decommissioning and Reclamation Guidelines, EPB 381 (Government of Saskatchewan 2008);
- The Mines Regulations, 2018;
- Metal and Diamond Mining Effluent Regulations;
- Environmental Code of Practice for Metal Mines (Environment Canada 2009);
- Uranium Mines and Mills Regulations;
- REGDOC-2.11.2 Decommissioning (CNSC 2021); and
- Canadian Standards Association (CSA) N294:19. Decommissioning of facilities containing nuclear substances (CSA 2019).

The decommissioning and reclamation objectives for the Project are to establish a closure landscape that is:

- geotechnically, geochemically, and radiologically stable and remains stable under a natural disturbance regime typical for the Project location;
- capable of supporting a functioning, self-sustaining ecosystem with diverse fish and wildlife habitats that is safe for human use; retains the landscape and its function as designed over time; and requires no, or minimal, maintenance post-closure;
- accessible for unrestricted traditional use by local Indigenous Groups and communities; and

- integrated with the adjacent natural landforms and drainage systems in the Patterson Lake watershed (i.e., has a natural appearance).

Criteria would be developed for each objective prior to reclamation implementation. Reclamation criteria may:

- be site-specific;
- be adopted from provincial or federal standards or through engagement activities;
- be narrative statements;
- be numerical values;
- contain a temporal aspect; and
- include one or more indicators or attributes.

Reclamation criteria would be selected to be meaningful, measurable, and achievable. Reclamation criteria may be adjusted over time as new information is acquired. The Detailed Decommissioning and Reclamation Plan developed for the Project would include final criteria to establish how decommissioning and reclamation is determined to be successful.

NexGen is currently estimating that the Active Closure Stage would last for 5 years following cessation of site activities followed by an approximately 10-year Transitional Monitoring Stage. Monitoring would confirm the success of the decommissioning and reclamation activities and demonstrate the Project site is in a stable or improving condition. Once this is demonstrated, NexGen would return the land to the Government of Saskatchewan under the Institutional Control Program with no long-term control measures anticipated.

Sufficient detail is included herein to confirm the Plan reflects a technically and financially feasible approach that protects health, safety, security, and the environment. Following submission and acceptance as part of provincial permitting and federal licensing processes, formal versions of the Preliminary Decommissioning and Reclamation Plan would be periodically updated to reflect the most up-to-date Project information; at a minimum, this would occur every five years throughout the life of the Project.

This Plan provides the structural outline for both future, formal submissions of the Preliminary Decommissioning and Reclamation Plan and the Detailed Decommissioning and Reclamation Plan that would be developed prior to cessation of the Operations Phase and transition to the Active Closure Stage. Future formally submitted versions of the Preliminary Decommissioning and Reclamation Plan would be used as the basis of the financial guarantee that is centered on a “decommission tomorrow by a third-party scenario” (Government of Saskatchewan 2008). The financial guarantee is required to cover costs associated with the Active Closure and Transitional Monitoring stages and Institutional Control, which would be further described in the Preliminary Decommissioning and Reclamation Cost Estimate.

Abbreviations and Units of Measure

Acronym	Term
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standard Association
EIS	Environmental Impact Statement
ENV	Saskatchewan Ministry of Environment
HDPE	high-density polyethylene
IMS	Integrated Management System
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
PAG	potentially acid generating
PE	planning envelope
Plan	conceptual Preliminary Decommissioning and Reclamation Plan
Project	Rook I Project
REGDOC	Regulatory Document
TSD	Technical Support Document
U_3O_8	triuranium octoxide
UGTMF	underground tailings management facility
WRSA	waste rock storage area

Unit	Definition
%	percent
°C	degrees Celsius
μSv/h	microsieverts per hour
Bq/g	becquerels per gram
cm	centimetre
H:V	horizontal to vertical
ha	hectare
km	kilometre
km^2	square kilometre
m	metre
m^2	square metre
m^3	cubic metre
mm	millimetre

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5A1 INTRODUCTION

The NexGen Energy Ltd. (NexGen) Rook I Project (Project) is a proposed uranium mining and milling operation located in northwestern Saskatchewan within the southern Athabasca Basin adjacent to Patterson Lake, and along the upper Clearwater River system (Figure 5A-1). The proposed Project resides within Treaty 8 territory and the Métis Homeland. Access to the Project site is from an existing 13 km road off Highway 955.

This conceptual Preliminary Decommissioning and Reclamation Plan (Plan) has been developed in support of the Environmental Impact Statement (EIS) prepared for the Project. The Project, which is 100% owned by NexGen, includes facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement hosted, high-grade uranium deposit.

The anticipated lifespan of the Project is 43 years and includes Construction, Operations, and Decommissioning and Reclamation (i.e., Closure) phases. The Closure Phase would consist of an Active Closure Stage followed by a Transitional Monitoring Stage. NexGen is currently estimating that the Active Closure Stage would last for five years following cessation of site activities and be followed by an approximately 10-year Transitional Monitoring Stage.

The Plan provides a conceptual overview of the proposed decommissioning and reclamation objectives, criteria, methods, and monitoring requirements for the Project. The Plan reflects NexGen's commitment to progressive reclamation and to designing, constructing, and operating for responsible closure by considering industry best practices and incorporating feedback received from local Indigenous Groups and communities.

NexGen's intent is to leave areas disturbed by Project activities in a state that is free from access restrictions, safe for traditional land use, and in an ecological condition that is functional and integrates with the surrounding physical and biological environment. Decommissioning and reclamation of the Project addresses requirements associated with the provincial and federal legislation described in Section 5A1.1, Purpose, and fulfills Saskatchewan's long-term Institutional Control Program requirements with no, or minimal, maintenance post-closure (Government of Saskatchewan 2021b).

The Plan document structure is as follows:

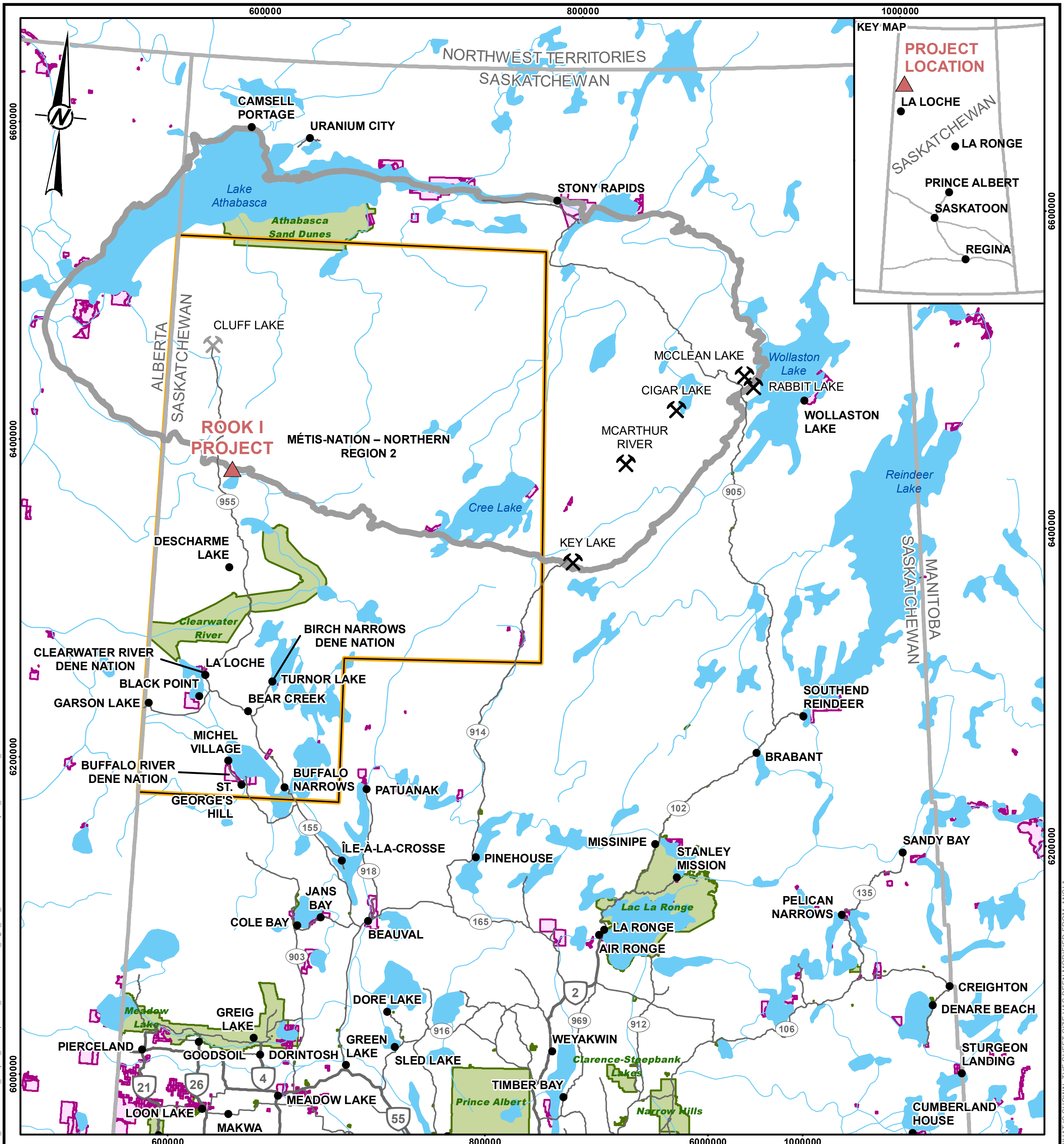
- **Section 5A2, Decommissioning and Reclamation Planning,** describes NexGen's approach to developing the Plan, including end land use, decommissioning and reclamation objectives and targets, and Indigenous and public engagement.
- **Section 5A3, Overview of Current Project Site Conditions,** provides an overview of the environmental and human activities occurring at and near the Project.
- **Section 5A4, Rook I Project Overview,** describes the Project and provides an overview of key activities.
- **Section 5A5, Decommissioning Plan,** describes decommissioning activities by planning envelope.
- **Section 5A6, Land Reclamation,** describes the approach for reclamation activities, including information on landform design, material handling, and revegetation. Progressive reclamation is also discussed.
- **Section 5A7, Uncertainty and Contingency Planning,** describes the processes for managing uncertainty and outlines contingencies developed for the currently proposed decommissioning and reclamation activities.
- **Section 5A8, Monitoring and Control,** outlines NexGen's processes to protect workers, the public, and the environment from associated risks during Closure, including the potential impacts of decommissioning and reclamation activities.

- **Section 5A9, Preliminary Decommissioning and Reclamation Schedule,** describes and provides an overview of the sequencing and timing of Project decommissioning and reclamation activities.
- **Section 5A10, Transfer to Institutional Control Program,** describes the process of entering the Project into the provincial Institutional Control Registry.
- **Section 5A11, Document and Record Management,** describes the process for controlling information related to decommissioning and reclamation activities.
- **Section 5A12, Regulatory Approvals,** outlines the regulatory context, including required future decommissioning and reclamation planning updates.

The proposed Project is subject to both provincial and federal environmental assessment processes, would be licensed as a nuclear facility by the Canadian Nuclear Safety Commission (CNSC), and would be subject to various provincial and federal permits and approvals.

Sufficient detail is included herein to confirm the Plan reflects a technically and financially feasible approach that protects health, safety, security, and the environment. Consistent with the provincial requirements for an environmental assessment as described under Section 9 of *The Environmental Assessment Act*, the Plan describes how the area affected by the Project would be decommissioned and reclaimed (Government of Saskatchewan 2021b). Following submission and acceptance as part of provincial permitting and federal licensing processes, formal versions of the Preliminary Decommissioning and Reclamation Plan would be periodically updated to reflect the most up-to-date Project information; at a minimum, this would occur every five years throughout the life of the Project. Future formally submitted versions of the Preliminary Decommissioning and Reclamation Plan will be used as the basis of the financial guarantee that is centered on a “decommission tomorrow by a third-party scenario” (Government of Saskatchewan 2008). The financial guarantee is required to cover costs associated with the Active Closure Stage, Transitional Monitoring Stage, and participation in the Institutional Control Program, which would be further described in the Preliminary Decommissioning and Reclamation Cost Estimate.

The Plan provides the structural outline for both future, formal submissions of the Preliminary Decommissioning and Reclamation Plan and the Detailed Decommissioning and Reclamation Plan that would be developed prior to cessation of the Operations Phase and transition to the Decommissioning and Reclamation (i.e., Closure) Phase.



LEGEND

- ● POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200
1:3,500,000 KILOMETRES

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 5A-1

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

5A1.1 Purpose

The purpose of the Plan is to provide a conceptual overview of the strategy for decommissioning and reclaiming the Project, including:

- a roadmap for progressive decommissioning and reclamation throughout the Project lifespan;
- anticipated post-operational conditions;
- radiological and environmental monitoring and survey commitments; and
- the basis for the cost estimate and value of the financial guarantee required to be outlined in the Preliminary Decommissioning and Reclamation Cost Estimate.

This Plan has also been developed to support the Project EIS, with the following information included:

- decommissioning objectives (Section 5A2.1) and timeframes for all components (Section 5A9);
- potential for consultation with Indigenous communities regarding decommissioning (Section 5A2.2);
- preferred methods for decommissioning (Section 5A5);
- progressive decommissioning and reclamation activities (Section 5A6.6);
- alternate procedures for decommissioning site facilities (Section 5A7.2);
- environmental impacts of mitigation and reclamation measures (Section 5A8.1);
- identification of acceptable post-operational land use options for the site (Section 5A2.1);
- long-term institutional control measures proposed for the site (Section 5A8.3.2; Section 5A10);
- identification of monitoring required to manage potential short-term, long-term, and permanent effects following decommissioning and reclamation (Section 5A8.2; Section 5A8.3); and
- proposed contingency measures (Section 5A7.2).

The decommissioning and reclamation methods outlined in the Plan reflect NexGen's commitment to protect and promote the health, safety, and well-being of people and the environment, and feedback received from local Indigenous Groups and communities. The Plan also incorporates the measures required to assess and, if required, mitigate the environmental effects identified in the EIS and reclaim disturbed areas to the targeted end land uses.

The Plan aligns with and meets applicable provincial and federal regulatory requirements, including:

- *The Environmental Assessment Act*;
- The Mineral Industry Environmental Protection Regulations, 1996;
- Northern Mine Decommissioning and Reclamation Guidelines, EPB 381 (Government of Saskatchewan 2008);
- The Mines Regulations, 2018;
- Metal and Diamond Mining Effluent Regulations;
- Environmental Code of Practice for Metal Mines (Environment Canada 2009);
- Uranium Mines and Mills Regulations;
- REGDOC-2.11.2 Decommissioning (CNSC 2021); and

- Canadian Standards Association (CSA) N294:19. Decommissioning of facilities containing nuclear substances (CSA 2019).

Future, formal versions of the Preliminary Decommissioning and Reclamation Plan will be periodically re-evaluated throughout the Project lifespan to incorporate best available information and feedback from ongoing engagement with local Indigenous Groups, communities, and the public. Planning for decommissioning and reclamation throughout the life of the Project assists in:

- Planning a decommissioning strategy for the Project that is technically feasible and protects health, safety, security, and the environment.
- Identifying potentially difficult or challenging technical issues early so that solutions can be pursued in a proactive manner.
- Designing and operating the Project in a manner that facilitates decommissioning.
- Allowing for continual improvement and/or adaptative management to adjust decommissioning and reclamation processes to incorporate new learnings, requirements, and practices.
- Estimating the quantities, types, and classes of waste that would be generated during decommissioning so appropriate management plans and cost estimates can be developed as part of the Preliminary Decommissioning and Reclamation Cost Estimate.

5A1.2 Scope

This Plan documents the conceptual decommissioning and reclamation strategy for the Project. Topics covered in this Plan include:

- descriptions of the Project and the current Project site conditions;
- shut-down, demolition, and removal of site facilities and infrastructure;
- landform design, reclamation material management, and revegetation;
- ongoing monitoring activities in the local and regional environment; and
- ongoing development, management, and implementation of decommissioning and reclamation plans developed for the Project.

Existing exploration disturbance, which includes a camp, office facilities, core shacks, meteorological stations, and various small roads, is outside of the scope of the Plan.

5A1.3 Terminology

Specific terminology used in the Plan and the associated definitions include:

- **Active closure stage** – includes active decommissioning and reclamation activities that occur post-Operations such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal or 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.
- **Closure** – to decommission, remediate, and reclaim a mine and plant site, with the ultimate goal of returning the land to the Crown.

- **Closure Phase** – refers to the Decommissioning and Reclamation Phase for the Project, which includes the Active Closure Stage and Transitional Monitoring Stage.
- **Construction** – includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences.
- **Decommissioning** – to remove or retire permanently from service or take any action to remove or retire all or part of a mining site.
- **Indigenous Knowledge** – the unique and collective knowledge of Indigenous Peoples that has been built up over time and passed on through generations of living in close contact with the land and natural environment.
- **Institutional Control Program** – in Saskatchewan, the Institutional Control Program implements the process for the long-term management of decommissioned mine and mill sites on Crown land after an owner/operator has ended activities, completed decommissioning and reclamation, and submits an application to transfer the remediated site into provincial custody (Government of Saskatchewan 2021b).
- **Integrated Management System (IMS)** – a common framework of programs, plans, procedures, work instructions, and other supporting documentation describing management system processes for achieving Project objectives and completing work safety, reliably, and consistently while conforming to internal requirements and complying with legal requirements.
- **Local knowledge** – the knowledge of local people who may or may not be Indigenous and who hold knowledge that is based on personal and collective experiences of their local environments over time, without necessarily having generational connections to a place. Represents information from a local citizen or representative, but without local Indigenous Group/Elder sanction, and is therefore not considered Indigenous Knowledge.
- **Non-potentially acid generating (NPAG)** – mine rock with less than 0.03% triuranium octoxide (U_3O_8) and less than 0.1% sulphur.
- **Operations** – refers to all Project activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of workers and materials to and from the Project up until Closure commences.
- **Planning envelope (PE)** – a definable part or area of a facility that is sufficiently removed from, or otherwise independent of, other parts or areas so that the strategic approach to decommissioning that part or area may be planned in a relatively independent manner.
- **Potentially acid generating (PAG)** – mine rock with less than 0.03% U_3O_8 and greater than or equal to 0.1% sulphur.
- **Project site** – term used to describe all property within the physical NexGen Rook I Project boundary.
- **Reclaim** – to rehabilitate all or part of the land, water, or watercourses used or disturbed by the construction or operation of a pollutant control facility, mine, or mill.
- **Transitional Monitoring Stage** – a monitoring and reporting stage that would continue until Project 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. Once that

is achieved, and upon Provincial approval, the land would be transferred back under Provincial management through the Institutional Control Program.

5A1.4 Plan Framework

The Plan is part of a hierarchy of interrelated documents that support applications for provincial authorizations and a CNSC licence for the Project (Figure 5A-2), which includes the EIS, Integrated Management System (IMS), and the Mining and Milling Facility Description Manual.

Figure 5A-2: Overarching Rook I Project Provincial Authorization and Licence Application Document Hierarchy

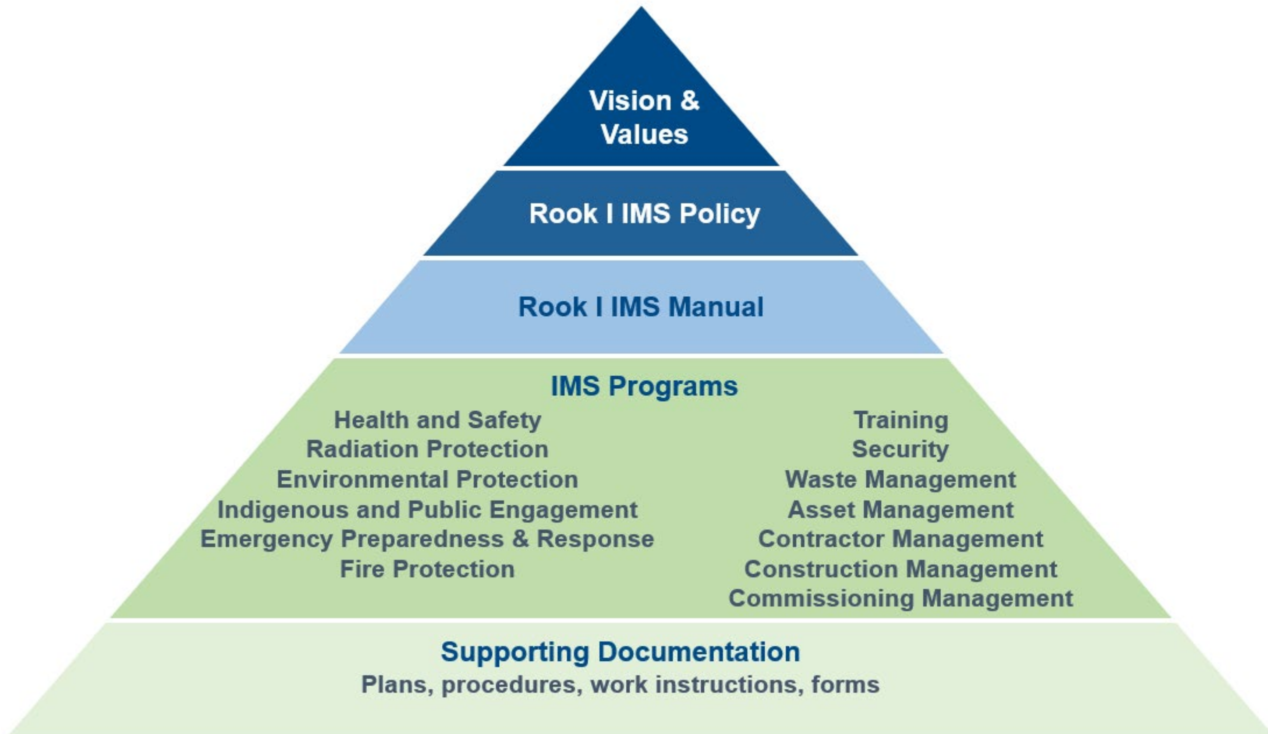
The EIS documents the potential adverse effects and benefits of the proposed Project in the context of the existing biophysical and socio-economic conditions. The EIS considers several components and factors, including baseline studies used to characterize the existing environment, Indigenous and Local Knowledge, effects predictions, residual effects classification and determination of significance to valued components, and recommendations for monitoring and follow-up programs to verify predicted effects or address uncertainties. The Plan incorporates the measures required to both mitigate the potential environmental effects identified in the EIS and reclaim disturbed areas to target end land uses.

The IMS would outline the management system policy, programs, and processes that provide a common framework for performing Project activities, including processes for implementing compliance measures, enabling continual improvement, and fostering a culture in which protecting the health and safety of workers and protecting the environment are principal considerations guiding decisions and actions. The use of management system processes during decommissioning and reclamation activities are described further in Section 5A8, Monitoring and Control and Section 5A11, Document and Record Management.

The IMS consists of the program-level documents and supporting documentation that are organized into categories that reflect the CNSC safety and control areas and other matters of regulatory interest as shown in Figure 5A-3. The program-level documents shown in Figure 5A-3 are closely integrated into the decommissioning and reclamation planning process as referenced throughout the Plan. Programs and supporting processes would be modified, as appropriate, and continue to be applied during the Active Closure

Stage and Transitional Monitoring Stage to maintain protection of human health and safety and the environment as described in Section 5A8.

Figure 5A-3: Plan Context with the Integrated Management System



IMS = Integrated Management System.

The Mining and Milling Facility Description Manual would describe the facilities, systems, components, and processes used to carry out the licensed activities for the Project. The Mining and Milling Facility Description Manual documents design bases and provides an overview of the expected operating performance and mitigation and control measures important to protect worker health and safety and the environment.

5A2 DECOMMISSIONING AND RECLAMATION PLANNING

NexGen recognizes the importance of safe, secure, and environmentally responsible mine closure to protect people and the environment. By embracing the application of technology and best practices and through engagement with local Indigenous Groups and local communities, employees, and other stakeholders, NexGen is focussed on achieving excellence in all aspects of the Project, including decommissioning and reclamation. These themes have been incorporated into development of this Plan and Project decommissioning and reclamation planning more broadly.

Specific end land use objectives and criteria would be established following a systematic approach that accounts for site-specific characteristics and conditions and feedback from engagement with local Indigenous Groups and communities. Final end land use objectives and criteria would be documented in the Detailed Decommissioning and Reclamation Plan prior to initiation of the Active Closure Stage.

By planning for responsible mine closure early in the Project lifespan and maintaining a life-cycle decommissioning and reclamation approach, decommissioning and reclamation considerations are integrated into Project design, and decommissioning and reclamation planning facilitates the protection and preservation of the environment throughout the Project lifespan and for future generations.

5A2.1 End Land Use and Decommissioning and Reclamation Objectives and Criteria

Establishing and updating end land use plans and decommissioning and reclamation objectives and criteria based on information gathered through Project activities and feedback from Indigenous, regulatory, and public engagement is fundamental to optimizing post-closure outcomes for all parties.

End Land Use

End land use planning represents the identification of preferred end land uses and establishment of strategies to achieve preferred end land uses with consideration for local ecosystems and habitat types based on landforms, substrates, and moisture regimes. The end land use planning process includes engaging and collaborating with local Indigenous Groups and communities to identify the various possible uses of the Project landscape after it has been decommissioned and reclaimed.

NexGen's intent is to leave areas disturbed by Project activities in a state that is free from access restrictions, safe for traditional land use, and in an ecological condition that is functional and integrates with the surrounding physical and biological environment (Government of Saskatchewan 2008), with no, or minimal, maintenance post-closure and no long-term control measures.

It is understood that end land uses envelop a multitude of values beyond ecological conditions and that a single piece of land may be used for multiple uses at any point in time (e.g., traditional land use, recreation, wildlife habitat). Land uses also change over time as reclaimed ecosystems mature and undergo a natural disturbance regime (e.g., fires, insect outbreaks, droughts, floods, windstorms). These factors will be considered when determining and refining end land use objectives.

Additional information on end land using planning for the Project would be outlined in an end land use plan that would be provided during future, formal regulatory submissions.

Decommissioning and Reclamation Objectives and Criteria

Decommissioning and reclamation objectives are used to outline the targets towards which mine closure efforts are directed. The decommissioning and reclamation objectives for the Project are to establish a closure landscape that is:

- geotechnically, geochemically, and radiologically stable, and remains stable under a natural disturbance regime typical for the Project location;
- capable of supporting a functioning, self-sustaining ecosystem with diverse fish and wildlife habitats that is safe for human use; retains the landscape and its function as designed over time; and requires no, or minimal, maintenance post-closure;
- accessible for unrestricted traditional use by local Indigenous Groups and communities; and
- integrated with the adjacent natural landforms and drainage systems in the Patterson Lake watershed (i.e., has a natural appearance).

Reclamation criteria are used to evaluate whether objectives have been met and if reclamation can be deemed successful. Criteria would be developed for each objective prior to reclamation implementation. Reclamation criteria may:

- be site-specific;
- be adopted from provincial or federal standards or through engagement activities;
- be narrative statements;
- be numerical values;
- contain a temporal aspect; and
- include one or more indicators or attributes.

Reclamation criteria would be selected to be meaningful, measurable, and achievable. Reclamation criteria may be adjusted over time as new information is acquired. Criteria would take into consideration the components of the Environmental Protection Program (a program-level document developed as part of the IMS), such as activities that would be completed under the Environmental Monitoring Plan and Environmental Excellence Plan, to make use of available programs and monitoring results. The Detailed Decommissioning and Reclamation Plan would include final criteria to determine how decommissioning and reclamation is determined to be successful.

5A2.2 Indigenous and Public Engagement

NexGen's goal is to leave lasting benefits to local Indigenous Groups and communities well beyond the Project's Decommissioning and Reclamation (i.e., Closure) Phase. NexGen recognizes the unique relationship that local Indigenous Groups and communities have with the environment and the importance of fostering trusting relationships that facilitate collaboration and maximize benefits of the Project beyond its lifespan. Advancing design for the Project incorporates a life-cycle planning approach in consideration of current and future generations, and in recognition of the role that Indigenous and Local Knowledge has in guiding aspects of decision making throughout the Project lifespan.

The proposed Project has been designed to promote high levels of environmental performance and incorporate best practices of minimalistic surface expression, progressive reclamation, and advanced closure management design. Knowledge of community values, commitment to high standards, and understanding of lessons learned from other mining operations led to key early design decisions being incorporated into the Project. Identification, presentation, and due consideration of local Indigenous Groups' input through the early and ongoing engagement processes has validated, informed, and influenced aspects of Project design. These aspects include the deposition of all tailings underground, minimization of the total site disturbance footprint, optimization of water management strategies and infrastructure, and commitment to fund and support independent Indigenous Monitors for opportunities to participate in Project environmental monitoring programs through all phases. Section 3.7 (Influence and Project Planning and Design) of the EIS provides further detail on the influence of Indigenous and Local Knowledge on the Project design.

As NexGen has proceeded through the regulatory process and advanced development of the Project, engagement activities have evolved as necessary to provide local Indigenous Groups and communities opportunities for effective information exchange and dialogue specific to each stage of the Project. End land use planning has represented a specific topic of meetings with local Indigenous Groups and the importance of traditional land use to local Indigenous Groups and communities has been communicated to NexGen during these and broader Project engagement activities. Local Indigenous Groups have indicated that the continued ability to pursue traditional activities is important for the preservation of culture, as is the ability to safely use the land after Closure.

Indigenous and Local Knowledge has been and will continue to be integrated into Project design and reclamation planning, including returning a reclaimed landscape that allows for the exercise of Treaty Rights and traditional land use. Further opportunities will be offered to local Indigenous Groups to provide input, feedback, and Indigenous and Local Knowledge regarding end land use planning and development of the Preliminary Decommissioning and Reclamation Plan. NexGen's commitment and approach to effectively sharing information and receiving feedback from local Indigenous Groups, local communities, and the public on Project-related topics such as decommissioning and reclamation, is outlined in the Indigenous and Public Engagement Program (a program-level document developed as part of the IMS).

Incorporating feedback into decommissioning and reclamation planning has been and will continue to be documented, tracked, and used to inform updates to decommissioning and reclamation planning documents throughout the Project lifespan.

5A2.3 Life-Cycle Decommissioning and Reclamation Planning

Life-cycle decommissioning and reclamation planning is founded on the understanding that considerations and practices for safe and reliable closure begin at Project planning and are regularly reviewed and updated until the Project has been fully decommissioned and reclaimed and the Project site transferred back to the Government of Saskatchewan. Life-cycle decommissioning and reclamation planning is an effective approach to:

- limit risks;
- control costs;
- maintain integrity;
- engage with local land users; and
- continually improve decommissioning and reclamation practices.

By planning for responsible mine closure early in the Project lifespan, resources are protected (e.g., soil salvage), progressive reclamation is completed (where feasible), research and monitoring are conducted to allow for improved processes, and engagement is undertaken to help build collaborative relationships and maximize benefits of the Project to all parties. This approach results in the integration of decommissioning and reclamation considerations into Project design and decommissioning and reclamation planning that facilitates the protection and preservation of the environment throughout the Project lifespan and for future generations.

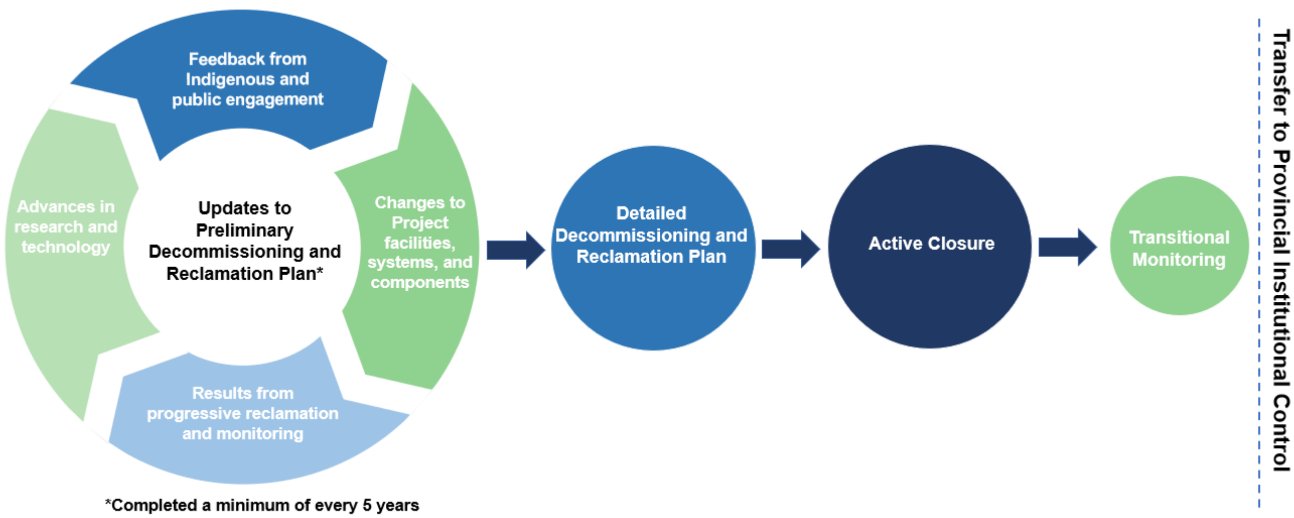
The Plan has been developed using best available information regarding the Project setting; planned Project facilities, systems, and components; and fit-for-purpose decommissioning and reclamation practices and technologies. Formal versions of the Preliminary Decommissioning and Reclamation Plan and, ultimately, the Preliminary Decommissioning and Reclamation Cost Estimate, will be submitted in support of provincial permitting and federal licensing for the Project. In addition, the formal versions of both the Preliminary Decommissioning and Reclamation Plan and associated cost estimates would be reviewed, updated, and submitted for regulatory approval throughout the Project lifespan to reflect the measures and costs necessary to safely decommission the Project. These updates would occur at a minimum of every five years, and sooner if there are material changes to the Project.

When the Project is nearing the end of its operational life, a Detailed Decommissioning and Reclamation Plan would be prepared as part of the application to the Saskatchewan Ministry of Environment (ENV) and CNSC for decommissioning approval. The detailed plan would provide similar information as this Plan, but in greater detail and incorporating information gathered through the Project Construction and Operations phases.

The Project Closure Phase would include an Active Closure Stage followed by a Transitional Monitoring Stage. Once the Active Closure Stage is complete, environmental monitoring would continue to be completed during the Transitional Monitoring Stage to confirm that closure objectives have been met, the Project site is safe and stable, and that ecological conditions are appropriate to return the land to the Government of Saskatchewan under the Institutional Control Program.

The decommissioning and reclamation planning management life-cycle framework is illustrated in Figure 5A-4.

Figure 5A-4: Life-Cycle Decommissioning and Reclamation Planning



5A3 OVERVIEW OF CURRENT PROJECT SITE CONDITIONS

Section 5A3.1 Environmental Setting and Section 5A3.2, Anthropogenic Activity provide an overview of the environmental setting and human development activities occurring at and near the proposed Project.

5A3.1 Environmental Setting

Section 5A3.1.1, Climate through Section 5A3.1.6, Radioactivity provide brief summaries of the pre-development environmental setting in and around the Project.

5A3.1.1 Climate

Climatic factors represent a key consideration when determining the best time of the year to conduct decommissioning and reclamation activities and selecting suitable vegetation species for revegetation of disturbed areas.

Climatic conditions in the area of the Project are considered sub-arctic, with temperatures ranging from warmer than 30°C in the summer to colder than -40°C during the winter. Winters are characterized as long and cold, with mean monthly temperatures below freezing between October and April. Precipitation typically falls as rain between May and October, and as snow from October to April, with the greatest snowfall amounts occurring between November and January. Average total annual precipitation in the region is on the order of 440 mm. Maximum wind speeds in the region can vary between 30 km/h and 48 km/h and can occur from every direction but are most commonly from the northwest.

Additional detail on climate can be found in Annex I, Atmospheric Baseline Report and Annex IV.1, Regional Meteorological and Hydrological Characterization Report.

5A3.1.2 Soils

Parameters such as soil texture, coarse fragment content, ease of salvage, and depth of soil horizons are used to determine the suitability of soils for use as reclamation material.

The landscape in the area of the Project has been formed through historical glacier influences. The existing topography is variable, with drumlins and lakes/wetlands dominating the northwest and southeast parts of the regional area of the Project, respectively, and lowland lakes, rivers, and muskeg dominating the central part of the area. Surficial soils in the region are scattered with rocks, boulders, sands, and fines. Surficial materials in the immediate vicinity of the Project site include coarse sands and gravels with varying quantities of cobbles, boulders, and larger blocks.

Based on baseline field programs and mapping, the mineral soil map units at the Project site are considered to have a poor reclamation suitability in the upper lift and lower lift (Annex VI, Terrain and Soils Baseline Report). The poor reclamation suitability rankings are due to low pH and low cation exchange capacity, which suggests low nutrient content, and coarse underlying subsoil. These conditions are consistent with reference sites in the surrounding area and are not considered inappropriate for reclamation; however, these characteristics are not conducive to rapid vegetation establishment on reclaimed sites due to the low nutrient content and lack of water holding capacity of the naturally occurring soils.

Additional detail on soils can be found in Annex VI.

5A3.1.3 Vegetation

Observations of plant species present prior to disturbance help guide the selection of revegetation species suitable for the reclaimed landscape that support the desired end land uses. Understanding local vegetation is also an important aspect of determining traditional land use objectives for the reclaimed landscape.

The broader regional area of the Project intersects the Boreal Shield and Boreal Plain ecozones. At a smaller, more local scale, the Project site is located within the Boreal Plain Ecozone of the Mid-Boreal Uplands Ecoregion. The area surrounding the Project site consists of recent burns with residual stands of jack pine (*Pinus banksiana)* and some black spruce (*Picea mariana*), with shrub and lichen as ground cover. Over the last 40 years, much of the region has been burned in historical fires.

Climax communities at and around the Project site consist of closed-crown mixed wood and coniferous species, including:

- trembling aspen (*Populus tremuloides*);
- balsam poplar (*Populus balsamifera*);

- paper birch (*Betula papyrifera*);
- white spruce (*Picea glauca*);
- black spruce;
- tamarack (*Larix laricina*); and
- jack pine.

The most frequently observed traditional use plant species during baseline studies included jack pine, bog cranberry (*Vaccinium vitis-idaea*), common Labrador tea (*Rhododendron groenlandicum*), and blueberry (*Vaccinium myrtilloides)*. Traditional use species that were observed at least once included knotted rush (*Juncus nodosus* var. *nodosus*), wild black currant (*Ribes americanum*), low bush-cranberry (*Viburnum edule*), and American wild strawberry (*Fragaria veseca* ssp*. americana*).

Gathering plants for food, medicinal, spiritual, and ceremonial purposes is an important traditional activity for local Indigenous Groups and an important aspect of culture and community well-being (Technical Support Document [TSD] II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). The Clearwater River Dene Nation and Métis Nation – Saskatchewan have described the importance of berries, medicinal and other traditional plants for the promotion of health and community well-being (TSD IV: MN-S; TSD V.2 CRDN).

Additional detail on vegetation can be found in Annex VII.2, Vegetation Baseline Report 2 (Inventory, Rare Plants, and Wetlands), and Annex VII.3, Vegetation Chemistry Characterization Report.

5A3.1.4 Wildlife

Knowledge of wildlife presence in the area of the Project factors into final landscape design decisions and the selection of revegetation species to facilitate successful reclamation of local wildlife habitats. Understanding local wildlife is also an important aspect of determining traditional land use objectives for the reclaimed landscape.

The wildlife species present within the regional area of the Project are typical of the Boreal Shield and Boreal Plains ecozones. The proposed Project is located within the SK2 West administration unit for woodland caribou (*Rangifer tarandus caribou*) and adjacent to the boundary of the SK1 caribou conservation unit.

Wildlife species known to occur in the region include moose (*Alces alces*), woodland caribou, deer (*Odocoileus* spp.), black bear (*Ursus americanus*), wolf (*Canis lupus*), and other mammal species commonly found in boreal forest ecosystems. Semi-aquatic mammals common to the area include beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), and river otter (*Lontra canadensis*).

Local Indigenous Groups have shared their knowledge with NexGen through a variety of engagement activities and sources of information. Traditional land use studies have indicated that trapping and hunting of a variety of mammals is conducted around Patterson Lake. For example, members of the local Dene Nations use the area:

- to harvest Spruce grouse (*Falcipennis canadensis*) and rabbits (*Leporidae* spp.);
- for temporary resting and camping locations during moose hunts;
- for moose processing locations; and
- as water routes and terrestrial trails for accessing hunting and trapping locations for American marten (*Martes americana*), beaver, red fox (*Vulpes vulpes*), mink (*Neovison vison*), and Canada lynx (*Lynx canadensis*).

The Clearwater River Dene Nation and Birch Narrows Dene Nation members use the area for travel routes for hunting and trapping; teaching areas for trapping; trapping sites for lynx, marten, beaver, fisher (*Pekania pennanti*), muskrat, squirrel (*Sciurus* spp.), weasel (*Mustela* spp.), and otter; and hunting for moose, caribou, deer, rabbits, and bear. The Metis Nation – Saskatchewan Northern Region 2 live off the land hunting moose and other wildlife and trapping rabbit.

Additional detail on wildlife can be found in Annex VIII.1, Wildlife Baseline Report 1 (Mammals, Waterfowl, and Raptors), Annex VIII.2, Wildlife Baseline Report 2 (Amphibians, Birds, and Bats), and Annex VIII.3, Wildlife Baseline Report 3 (Bird Migration and Bats).

5A3.1.5 Surface Water

Knowledge of water features local to the Project site factors into final landscape design decisions to support final drainage patterns that would integrate with the surrounding areas. The location of water features is also required to plan for soil conservation and reclamation material management.

At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. The Clearwater River watershed drains to the Mackenzie River watershed.

The Project site is located adjacent to Patterson Lake near the headwaters of the Clearwater River system at Broach Lake (Figure 5A-1). The Clearwater River watershed near the Project site has an abundance of waterbodies from small wetlands to larger lakes. The waterbodies along the mainstem of the Clearwater River include Broach, Patterson, Forrest, Beet, and Naomi lakes, and there are numerous other small named and unnamed lakes.

North of the Clearwater River watershed are the headwaters of the Williams and Douglas rivers that both eventually flow into Lake Athabasca in Saskatchewan. West of the Clearwater River drainage divide near Broach Lake is the Davidson River watershed, which is a tributary of the Richardson River that flows into the Athabasca River in Alberta, upstream of Lake Athabasca.

Waterbodies including Broach, Patterson, Forrest, Beet, and Naomi lakes, as well as the Clearwater River are culturally important to local Indigenous Groups and used for harvesting activities (e.g., fishing), drinking water, occupancy, and travel (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN). Clearwater River was identified as an ancestral water route that is still used presently to access traditional use areas (TSD IV: MN-S; TSD V.2: CRDN). The Clearwater River Dene Nation reported that the Patterson Lake, Forrest Lake, Beet Lake, and other lakes farther downstream are intrinsically connected and integral to the Clearwater River (TSD V.2: CRDN), and the Métis Nation – Saskatchewan highlighted Patterson Lake as being central to the river system for the entire area because it feeds the lakes to the south (TSD IV: MN-S).

Additional detail on surface water can be found in Annex IV.1 and Annex IV.2, Hydrometric Monitoring Characterization Report.

5A3.1.6 Radioactivity

Radioactivity is the spontaneous emission of radiation in the form of particles or high energy photons. Soil covers are used during reclamation to provide a barrier between possible residual low level gamma radiation and the reclaimed ecosystems. Soil covers can act to isolate radionuclides, thereby limiting infiltration into groundwater and leaching into surface water, and consequently, limiting radionuclide uptake by plants. Information collected from baseline gamma radiation surveys would be used to help determine how thick of a soil cover may be required during reclamation for areas with elevated gamma radiation.

Radionuclide analysis of soil samples taken at the 2019 exposure sites (i.e., areas anticipated to be affected by Project activities) and reference sites (i.e., areas not anticipated to be affected by Project activities) identified no detectable levels of lead-210, thorium-228, thorium-230, or thorium-232 (Annex VI). Polonium-210 levels ranged between 0.01 becquerels per gram (Bq/g) and 0.02 Bq/g, and radium-226 levels ranged between 0.02 Bq/g and 0.03 Bq/g. Concentrations of polonium-210 and radium-226 were slightly elevated at reference sites as compared to the exposure sites. When compared to the *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials* (Canadian NORM Working Group 2013), none of the radionuclides analyzed in 2019 from the Project site exceeded the derived release limits.

A gamma radiation baseline program was conducted in 2022 to gather baseline data across the Project site and along two sections of Highway 955 to characterize the natural variability in baseline gamma radiation levels (CanNorth 2022). Overall, the baseline gamma radiation levels across the Project site and the surveyed portions of Highway 955 were low, with the highest hectare average recorded being 0.26 micro sieverts per hour (µSv/h). Average baseline gamma radiation levels across the Project site, access road, and Highway 955 sections were 0.021 µSv/h, 0.014 µSv/h, and 0.025 µSv/h, respectively. These baseline gamma levels are generally in line with background levels determined for use at other uranium mines in northern Saskatchewan that are in the process of being decommissioned or reclaimed.

5A3.2 Anthropogenic Activity

The broader regional area surrounding the Project site is largely undisturbed by human activities and infrastructure; approximately 0.5% of the regional area (i.e., 1,000 km^2) encompassing the Patterson Lake watershed has been influenced by human developments. Most human-related disturbances in this regional area include linear features such as Highway 955, cutlines, seismic lines, and trails, with some cleared areas. The Project site is north of the commercial forest zone; commercial forestry activity is not conducted in vicinity of the proposed Project. There are no active mines near the Project site. The now closed Cluff Lake Mine was operated by AREVA Resources Canada Inc. (now Orano) and is located 80 km north of the Project site.

Mineral exploration has been recorded in and around the Project site by multiple companies since 1968. Exploration activities, delineation drilling, and geotechnical and other investigations continue at the Project site and surrounding area.

Additional detail on anthropogenic activity can be found in EIS Section 1.2.2 (Project Location and Setting) and EIS Section 5.2.2 (Mineral Tenure, Surface Rights, and Current Activities).

5A4 ROOK I PROJECT OVERVIEW

The Project would include an underground mine and surface facilities to support the extraction of uranium ore from the Arrow deposit and the production of uranium concentrate.

The anticipated physical footprint of the mine site and access road is approximately 228 ha, and would include the following key facilities:

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;

- underground tailings management facility (UGTMF);
- potentially acid generating (PAG) waste rock storage area (WRSA);
- non-potentially acid generating (NPAG) WRSA;
- special waste rock[1] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant, and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to the Project and site roads.

The anticipated lifespan of the Project is 43 years and includes Construction, Operations, and Decommissioning and Reclamation (i.e., Closure) phases. An overview of the Project phases and the anticipated phase durations is provided in Table 5A-1.

For illustrative purposes, a general schematic of primary Project infrastructure at the end of the Operations Phase is shown in Figure 5A-5. Project facilities and dimensions are further described in Section 5A5, Decommissioning Plan. A more detailed description of the underground and surface facilities would be included in the Mining and Milling Facility Description Manual.

Table 5A-1: Rook I Project Phases

Phase/Stage		Description	Estimated Duration (years)
Construction Phase		Includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project site; and all activities associated with commissioning the Project up until the Operations Phase commences.	4
Operations Phase		Includes all activities associated with mining and processing ore; tailings management; management of mine rock, domestic waste, and hazardous materials; water management; release of treated effluent; surface storage of clean material; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project site.	24
Decommissioning and Reclamation (i.e., Closure) Phase	Active Closure Stage	Includes maintaining the Project site in a safe inactive state while regulatory approvals are secured and performing active decommissioning and reclamation activities that occur post-Operations such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal or 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.	5

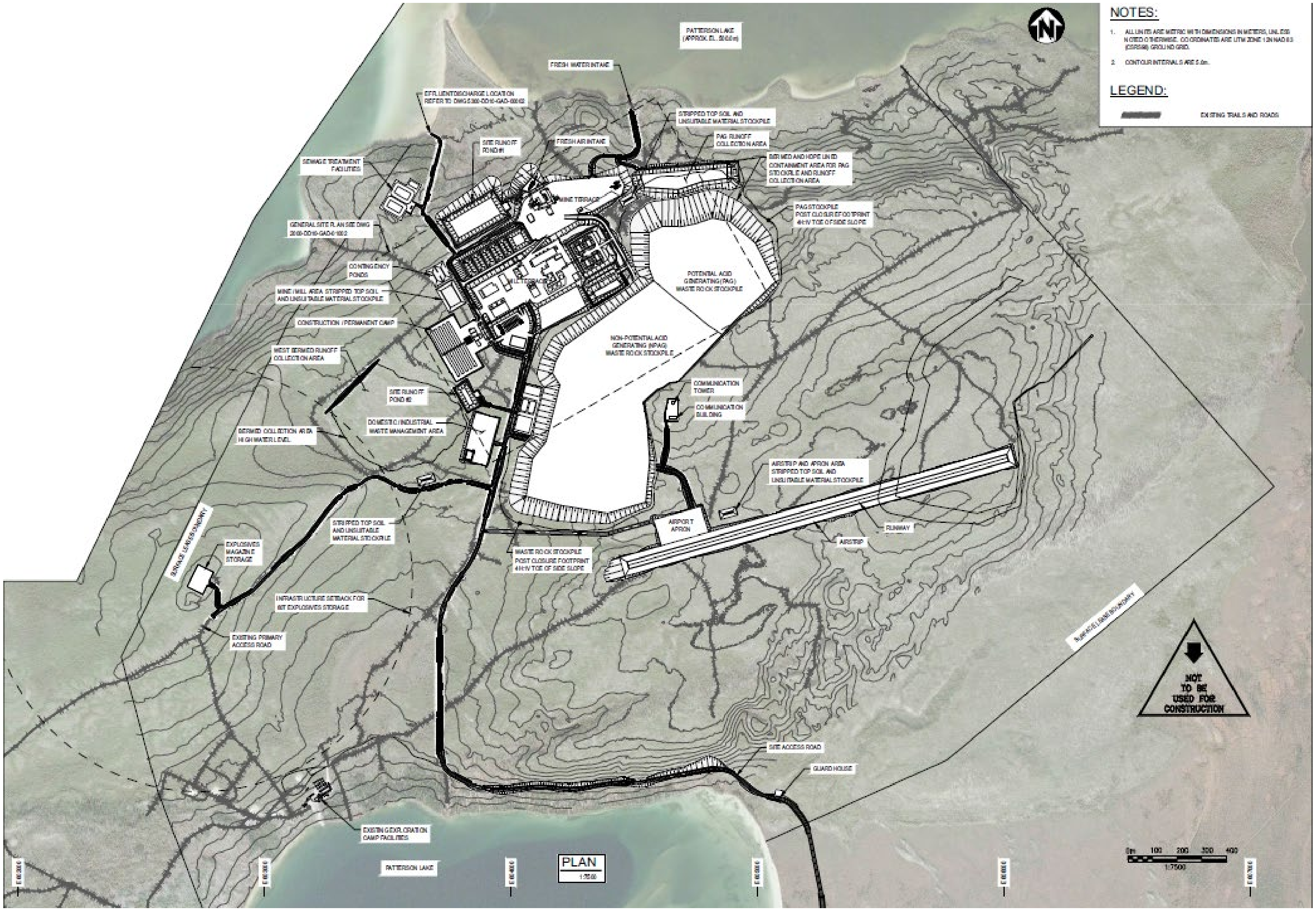
[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.

Table 5A-1: Rook I Project Phases

Phase/Stage		Description	Estimated Duration (years)
	Transitional Monitoring Stage	Includes site inspections, environmental monitoring, and reporting until results verify that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the Saskatchewan Ministry of Environment approval and Canadian Nuclear Safety Commission licence would be submitted, and upon approval, the land would be transferred back to the Government of Saskatchewan under the provincial management through the Institutional Control Program.	10[(a)]

a) Actual duration depends on achieving performance criteria.

Figure 5A-5: Illustration of Rook I Project Primary Infrastructure



The underground mine would be developed using long hole stope mining methods and accessed through two shafts: the production shaft and the exhaust shaft. Once constructed, the production shaft would be used to transport personnel and materials, to deliver ore and waste rock from the underground workings, and to deliver fresh air from surface into the underground mine. The exhaust shaft would be used to return exhaust air from the underground to surface and would provide secondary emergency egress.

Mine rock would be segregated and stored on surface either in permanent storage areas or temporary stockpiles. Special waste rock, which includes mine rock with insufficient grade to be considered ore, would be temporarily stored in the special waste rock stockpile. Prior to the Active Closure Stage, special waste rock would be transferred to the process plant for processing. Non-potentially acid generating (i.e., clean) waste rock would be used, where possible, as a source of aggregate material for activities such as construction and road maintenance. Any NPAG waste rock not used for these purposes would be stored on surface on a pad, regraded, and reclaimed with a cover system and growth media to support revegetation during the Active Closure Stage. Potentially acid generating waste rock would be segregated and stored on surface on a lined pad. Alternating lifts of PAG waste rock and engineered source control layers would be placed at the PAG WRSA at 4H:1V final design slopes to facilitate progressive reclamation of lower slopes (Section 5A6.6, Progressive Decommissioning and Reclamation).

The milling facilities designed to process the ore on site would be located on surface directly above the underground mine. During the Operations Phase, tailings from the processed ore would be progressively decommissioned through permanent storage underground, either as cemented paste backfill in mined out stopes or cemented paste tailings within a purpose-built UGTMF. The UGTMF represents a key Project environmental design feature that avoids the requirement for permanent surface tailings storage facility and the associated potential risks to the environment.

Fresh water for site activities (e.g., process plant, domestic consumption, fire protection water) would be drawn from Patterson Lake. To the extent practical, contact water generated by the Project or as a result of mining activities would be recycled to minimize the amount of fresh water drawn from Patterson Lake and the total volume of water requiring active management.

The effluent treatment plant would receive and treat contact water to meet established discharge criteria and would be constructed with sufficient capacity to meet operational requirements and manage non-routine inflows from underground and surface runoff from extreme precipitation events. Treated effluent would be batch released to Patterson Lake.

The access road from Highway 955 would be used to transport equipment and supplies to and from the Project. Personnel would be flown to and from site. Electricity for both surface and underground workings would be provided by on-site diesel generators during the Construction Phase and liquified natural gas during the Operations Phase.

5A5 DECOMMISSIONING PLAN

To ‘decommission’ means to remove or retire permanently from service or to take any action to remove or retire all or part of a mining site. The Plan includes decommissioning of facilities for the Project. Decommissioning would be preceded by the orderly cessation of site activities and transition of the Project site into a safe, inactive state. Underground mining areas would be decommissioned and secured. Surface facilities, infrastructure, and equipment would be cleaned (as necessary), scanned, and prepared for demolition in a staged and controlled manner.

Wherever practicable, surface and underground infrastructure, equipment, and materials not required during the Active Closure Stage, and which meet radiological criteria for off-site removal, would be salvaged, sold, or transferred off site by a licensed contractor for recycling or disposal at an authorized facility. No structures or equipment would remain on the surface of the Project site post-decommissioning unless required for monitoring or maintenance activities. Decommissioning demolition waste would be segregated to separate hazardous and non-hazardous materials (as required). Hazardous materials would be sent off site to authorized facilities, and non-hazardous decommissioning demolition wastes would either be recycled off site (e.g., clean steel) or disposed of in the underground shafts. Clean concrete would be segregated and disposed of in both the underground shafts and the NPAG WRSA.

For the non-hazardous decommissioning demolition wastes to be to be disposed underground, waste would be deposited with a series of engineered concrete plugs installed during the disposal process. All other openings to surface would be filled with a low conductivity, impermeable material and sealed at surface. Following closure of the underground mine openings, groundwater elevations would re-establish to natural equilibrium and the Project site would be reclaimed as outlined in Section 5A6.

The effluent treatment plant and the associated water management infrastructure would remain operable until operational control monitoring results determine that the collection and treatment of contact water is no longer required to meet established decommissioning criteria and protect the environment.

The decommissioning methods described in Section 5A5.1, Planning Envelopes are considered adequate and appropriate to protect people and the environment, meet decommissioning criteria, and satisfy applicable external requirements during the Construction Phase, Operations Phase, and Closure Phase of the Project, pending approval.

The success of decommissioning activities would be determined through assessment against the relevant objectives and criteria, as outlined in Section 5A2.1, End Land Use and Decommissioning and Reclamation Objectives and Criteria.

5A5.1 Planning Envelopes

As per CNSC REGDOC-2.11.2 Decommissioning, planning envelopes (PEs) are “a definable part or area of a facility that is sufficiently removed from, or otherwise independent of, other parts of areas so that the strategic approach to decommissioning that part or area may be planned in a relatively independent manner” (CNSC 2021). The PEs for the Project are described in Table 5A-2 and a summary of specific decommissioning activities for each is provided in the following subsections. Monitoring and reporting during decommissioning, reclamation, and post-closure is described in Section 5A8 and Section 5A11.

The design bases, locations, and function of the infrastructure associated with each PE would be further outlined in the Mining and Milling Facility Description Manual.

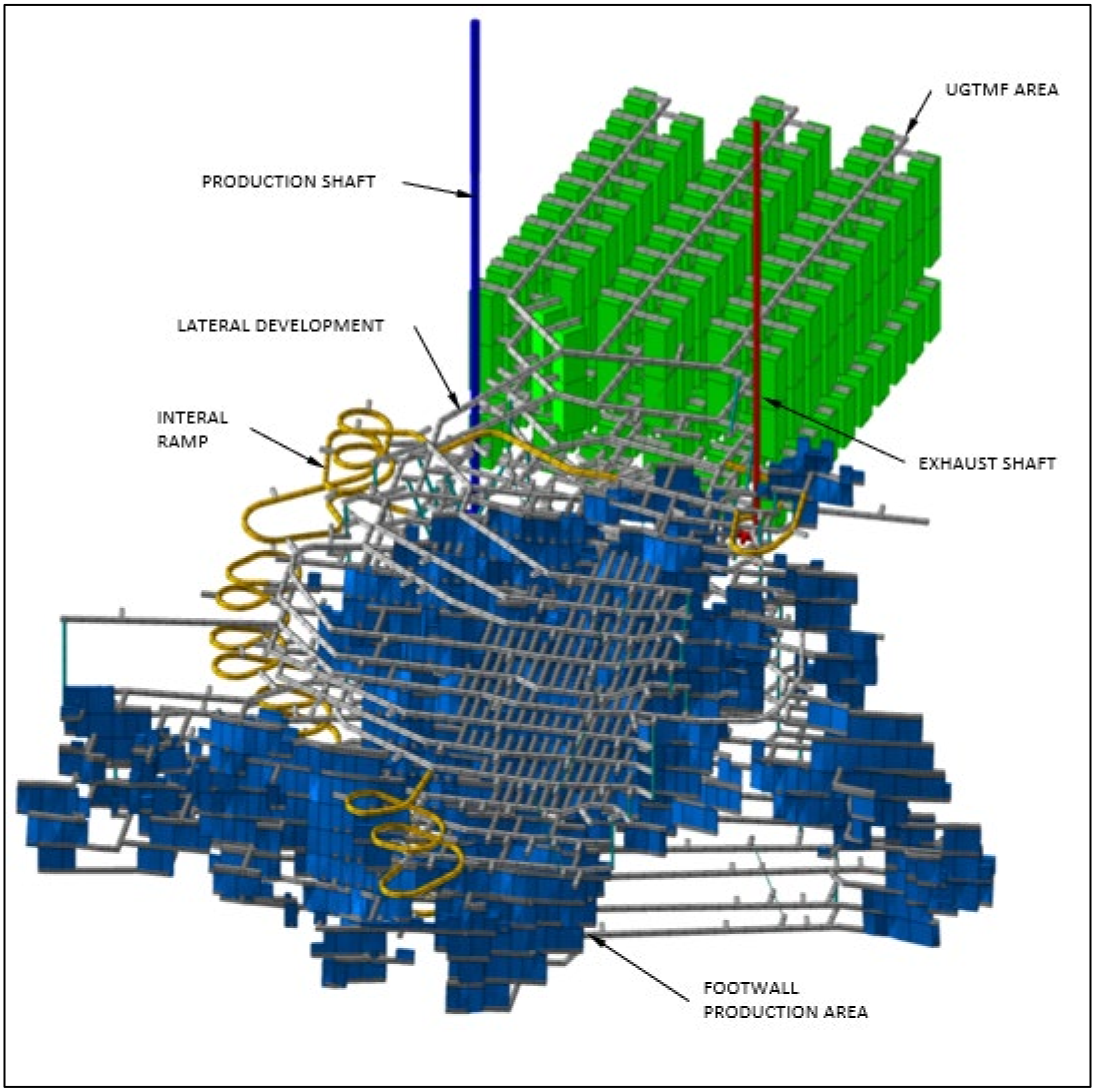
Table 5A-2: Rook I Project Planning Envelopes

Planning Envelope	Sub-envelope	Rationale
Planning Envelope 1.0 Underground Facilities	Planning Envelope 1.1 Underground Infrastructure and Services	Decommissioned in a similar way, distinct from surface facilities.
	Planning Envelope 1.2 Underground Tailings Management Facility	Decommissioned in place. May require unique strategies for monitoring during closure.
	Planning Envelope 1.3 Surface Openings	Decommissioned in a similar way, distinct from surface facilities.
Planning Envelope 2.0 Surface Buildings, Facilities, and Services	Planning Envelope 2.1 Mining Surface Facilities	Decommissioned and reclaimed in a similar way.
	Planning Envelope 2.2 Process Plant	
	Planning Envelope 2.3 Site Water Management	
	Planning Envelope 2.4 Utilities and Essential Services	
	Planning Envelope 2.5 Waste Management Facilities	
	Planning Envelope 2.6 Surface Ancillary and Support Facilities	
Planning Envelope 3.0 Waste Disposal	Planning Envelope 3.1 On-Site Disposal	Similar waste management processes (e.g., sorting, staging).
	Planning Envelope 3.2 Off-Site Disposal	
Planning Envelope 4.0 Mine Rock Stockpiles and Storage Areas	Not applicable	Decommissioned and reclaimed in a similar way.
Planning Envelope 5.0 Site Roads and Disturbed Areas	Not applicable	Decommissioned and reclaimed in a similar way.

5A5.1.1 Planning Envelope 1.0 Underground Facilities

Access underground would be via two shafts: an 8.0 m diameter production shaft for primary access and intake air, and a 5.5 m diameter exhaust shaft for secondary egress and exhaust air. Access to the workings would be from the production shaft, with stations on the 500 Level and 560 Level (Figure 5A-6).

Figure 5A-6: Overview of Underground Mine and Infrastructure



UGTMF = underground tailings management facility.

The volume available to store decommissioning demolition waste in the underground workings and the shafts at the end of the Operations Phase is provided in Section 5A5.1.3, Planning Envelope 3.0 Waste Disposal. Section 5A5.1.3 also provides information on the approximate volumes of decommissioning demolition waste at the end of the Operations Phase, and how the waste would be managed.

Critical services (e.g., underground mine dewatering, heating, ventilation) and required equipment would remain in place until it is determined that sufficient storage space is available to dispose decommissioning demolition waste in the shafts. Once dewatering ceases, groundwater levels elevations would re-establish to natural equilibrium.

Planning Envelope 1.1 Underground Infrastructure and Services

Underground infrastructure and services required to support underground activities during the Active Closure Stage include:

- underground mobile equipment;
- surface equipment;
- shotcrete and concrete receiving station;
- refuge stations and sanitary systems;
- maintenance facilities;
- fuel and lubricant storage and service;
- personnel and materials movement;
- electrical infrastructure; and
- communications and automation services.

At decommissioning, underground infrastructure that is suitable for reuse would be cleaned and removed from the underground. The remaining infrastructure would be abandoned underground. Prior to abandonment, fuel, oil, transmission fluid, hydraulic fluid, coolant, and other hazardous materials would be removed and transported to the surface along with residual explosives and other chemicals to be sent off site for recycling or disposal at an authorized facility.

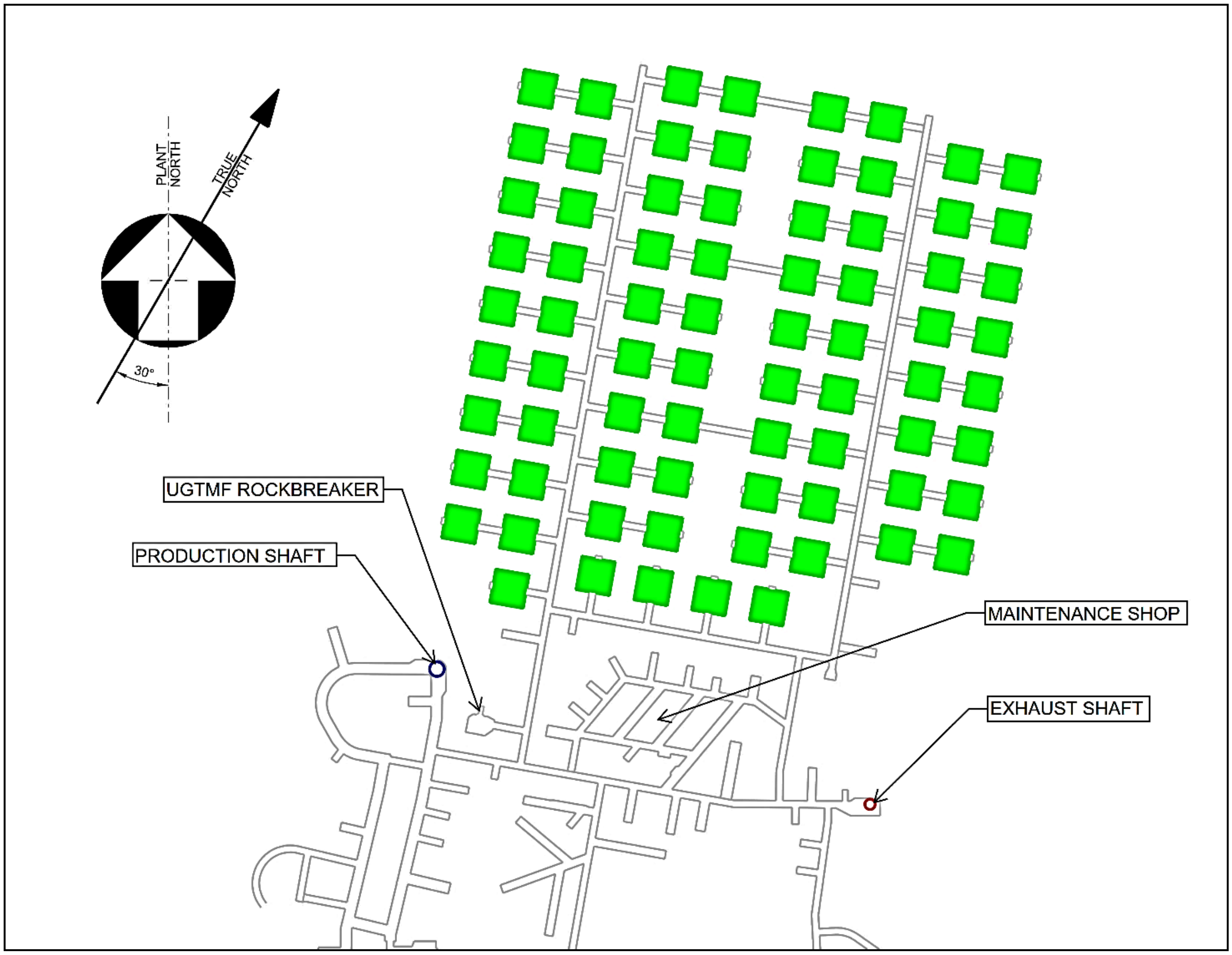
Planning Envelope 1.2 Underground Tailings Management Facility

The UGTMF would be an underground facility with chambers dedicated to the storage and progressive decommissioning of tailings and other waste streams generated through mining and ore processing. These chambers are required in addition to the production stopes to facilitate the underground storage of all tailings produced by the Project.

Appropriate measures would be in place to protect workers during the handling of radiologically contaminated materials from locations that convey, store, or process tailings. Decommissioning activities for UGTMF chambers would be limited to removal of underground infrastructure and services (Planning Envelope 1.1 Underground Infrastructure and Services), as the materials deposited in the UGTMF during Operations (i.e., cemented paste tailings and cemented paste backfill) are in their final decommissioned form (i.e., UGTMF chambers are progressively reclaimed during the Operations Phase).

Figure 5A-7 shows the general layout of the UGTMF.

Figure 5A-7: Underground Tailings Management Facility General Layout



UGTMF = underground tailings management facility.

Planning Envelope 1.3 Surface Openings

The production shaft would serve as the primary access point to the underground workings and the exhaust shaft would provide a means of secondary egress should the production shaft become incapacitated. At the exhaust shaft, an airlock would be required for the cage pod entering the shaft.

To stabilize the ground and manage water during excavation, the ground around the shaft excavations would be temporarily frozen using a freeze plant. The freezing would extend to the competent ground estimated at 175 m below surface for the production shaft, and 220 m below surface for the exhaust shaft.

Once the ground is excavated, a 600 mm thick concrete hydrostatic liner would be installed in each shaft to prevent water inflows once active freezing is stopped and the ground thaws. A summary of the underground mine surface openings included in this sub-planning envelope is provided in Table 5A-3.

Table 5A-3: Underground Mine Surface Openings

Facility Name	Quantity	Surface Dimensions (m)	Subsurface Dimensions (m)[a]	Height (m)	Footprint (m^2)	Volume (m^3)
Production shaft	1	⌀9.2	⌀8	568	66	133[b]
Exhaust shaft	1	⌀7	⌀5.5	533	35	71[b]
Paste delivery borehole	6	⌀0.11	⌀0.10	500	0.5	24[c]
Production freeze borehole	27	⌀0.11	⌀0.10	175	0.5	37[c]
Production pressure well	1	⌀0.11	⌀0.10	80	0.5	1[c]
Production monitoring well	4	⌀0.11	⌀0.10	175	0.5	5
Exhaust freeze borehole	24	⌀0.11	⌀0.10	220	0.5	41[c]
Exhaust pressure well	1	⌀0.11	⌀0.10	80	0.5	1[c]
Exhaust monitoring well	4	⌀0.11	⌀0.10	220	0.5	7[c]

a) Finished internal diameter.
b) Volume consists of concrete required for two 1-m thick engineered concrete plugs per shaft.
c) Volume consists of concrete required for one 1 m-thick concrete plug per hole.
⌀ = outside diameter.

Following the disposal of non-hazardous decommissioning demolition wastes into the shafts, an engineered concrete plug would be placed to seal the shafts as described in Section 5A5.1.3 (Planning Envelope 3.0 Waste Disposal). Any surficial monuments or stickups for remaining surface openings (e.g., paste delivery boreholes, freeze holes) would be cut below grade and disposed of with other demolition waste as described in Section 5A5.1.3. Holes would be decommissioned using hydrated bentonite in accordance with regulatory requirements for decommissioning groundwater wells.

5A5.1.2 Planning Envelope 2.0 Surface Buildings, Facilities, and Services

This PE includes surface buildings and facilities used to support ore extraction, processing, water management, waste management, site management, and maintenance, as well as the utilities required to service them (e.g., power, potable water).

All surface buildings, facilities, and services remaining at the end of Operations would be demolished in an orderly sequence prioritizing infrastructure that is not required to support Active Closure activities. The approximate timeline for the Active Closure Stage is five years. All surface buildings, facilities, and services would be demolished in accordance with the following sequence:

- Locate utilities and hoarding (i.e., temporarily fence) work areas, and identify hazards.
- Isolate all utilities and services to achieve a zero-energy state.
- Manage access to specific work areas and re-route site traffic, as necessary.
- Remove fixtures (e.g., furniture) and hazardous materials.
- Demolish structures from the top-down and from the exterior to interior using equipment appropriate for the building, facility, or service (e.g., excavator with specialty tools).

- Break up and remove structural reinforced slabs and foundations to below grade to allow for backfilling and grading.
- Remove utilities, as required (e.g., non-hazardous materials that are safely drained and capped or cut off at least 1 m below the ground surface, may remain in place).
- Segregate, process (e.g., cut, shred, pulverize), and transport decommissioning demolition waste streams to the appropriate disposal location (Section 5A5.1.3).

A detailed site-wide gamma radiation survey would be performed prior to commencement of decommissioning activities once the Operations Phase is complete (Section 5A5.2, Site-Wide Gamma Survey). Facilities that are radiologically contaminated would be demolished in a manner that minimizes the generation of dust and spread of potential contamination. Appropriate measures would be in place to protect workers during decommissioning activities that include the handling of radiologically contaminated materials from locations that conveyed, stored, or processed ore, uranium concentrate, or tailings. Radiologically contaminated materials would be prioritized for on-site disposal in the shafts, or in the underground workings if additional space is determined to be required (Section 5A5.1.3).

NexGen would work with local Indigenous Groups and communities to determine if there is an ongoing use case to keep the power plant building and associated power lines in place. Once buildings, facilities, and services are demolished and demolition waste is removed, the remaining disturbance would be remediated as required (e.g., fuel tanks, potentially contaminated sites), decompacted if necessary, and recontoured to a self-draining condition that is suitable for reclamation as described in Section 5A6, Land Reclamation.

Planning Envelope 2.1 Mining Surface Facilities

The facilities included in this sub-planning envelope include surface infrastructure required to support underground operations as summarized in Table 5A-4. A general schematic of primary Project infrastructure is shown in Figure 5A-5.

Table 5A-4: Mining Surface Facilities

Facility Name	Quantity	Surface Dimensions			Footprint (m^2)
		Length (m)	Width (m)	Height (m)	
Production headframe	1	Irregular		68	1,100
Exhaust headframe	1	Irregular		54	541
Production shaft hoist house	1	34	66	17.5	2,244
Exhaust shaft hoist house	1	26	33	14	858
Core sheds	70	12	8	2.5	96
Surface intake fan	1	Irregular		10	980
Surface exhaust fan	1	Irregular		15	1,028
Surface explosive magazine pad	1	70	100	n/a	7,000

Planning Envelope 2.2 Process Plant

Processing refers to the activities occurring after ore is received at the ore storage stockpile, to the point of the uranium concentrate (i.e., processed U_3O_8) being packaged. Process plant buildings would be located on the mill terrace, as shown in Figure 5A-8. Facilities included in this sub-planning envelope are summarized in Table 5A-5.

Figure 5A-8: Process Plant Layout on Mill Terrace

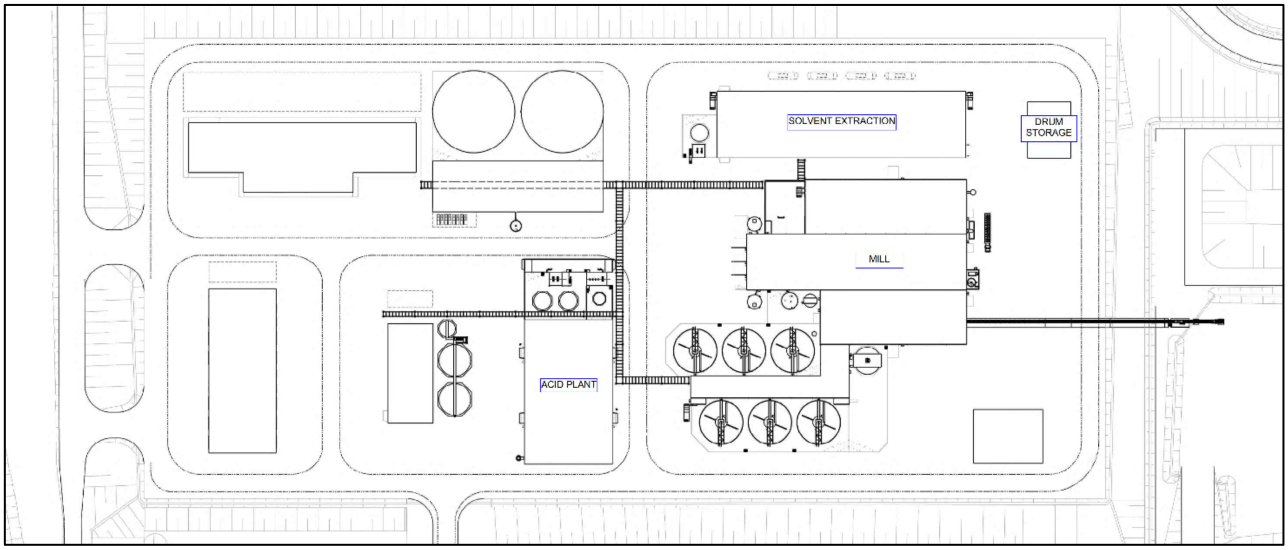


Table 5A-5: Process Plant Facilities

Facility Name	Quantity	Surface Dimensions			Footprint (m²)
		Length (m)	Width (m)	Height (m)	
Mill building	1	Irregular		35	7,120
Solvent extraction	1	114	30	14	3,420
Acid plant – process	1	40	66	22	2,640
Acid plant – exterior containment	1	28	40	1	1,120
CCD thickeners – exterior containment	1	Irregular		1	3,681
CCD thickeners – tanks	6	⌀20		12	314
Pin bed clarifier	1	⌀6		15	28
Raffinate tank	1	⌀8		10	50
Emergency organic dump tank	1	⌀3.2		13	167
Lime silo and bag house	1	⌀3.8		18	238

CCD = counter current decantation; ⌀ = outside diameter.

Buildings associated with the process plant would be decommissioned as described in Planning Envelope 2.0 Surface Buildings, Facilities, and Services (Section 5A5.1.2). Hazardous materials would be removed and sent off site for recycling or disposal as described in Section 5A5.1.3.

Planning Envelope 2.3 Site Water Management

Site contact water is any water that interacts with the Project, including water from precipitation events that is intercepted by the Project and mine water generated as a result of mine development and Project-related activity. Site water management is the control of precipitation, runoff, and mine water from underground workings, through collection, reuse, storage, treatment, and batch release to protect the receiving environment of the Project.

Site water management facilities included in this sub-planning envelope are summarized in Table 5A-6.

Water management infrastructure would remain operable until operational control monitoring results determine that the collection and treatment of contact water is no longer required to meet established decommissioning criteria and protect the environment. Once water management infrastructure is no longer required, ponds would be drained in accordance with the applicable site water management plan and authorizations. Sediments that settled in the ponds and pond liners would be excavated and disposed of in the shafts. Pipes, pumps, culverts, and other equipment that can be reused or recycled would be transported off site and the remaining material would be disposed of in the shafts.

No water management infrastructure would be retained during the Transitional Monitoring Stage; once the water management infrastructure is removed, areas would be graded and recontoured as described in Planning Envelope 5.0 Site Roads and Disturbed Areas (Section 5A5.1.5).

Table 5A-6: Site Water Management Facilities

Facility Name	Quantity	Surface Dimensions			Footprint (m^2)
		Length (m)	Width (m)	Height (m)	
Fresh water intake pumphouse building	1	8	7	8	58
PAG runoff collection area	1	Irregular, perimeter = 1,140 m			58,600
Settling pond	1	78	76	n/a	5,928
Contingency pond	1	44	76	n/a	3,344
West bermed runoff containment area	1	Irregular, perimeter = 1,440 m			128,950
Site runoff pond #1 (contact water pond #1)	1	Irregular		n/a	36,420
Site runoff pond #2 (contact water pond #2)	1	110		n/a	5,940
Effluent treatment plant	1	80	20	16	1,600
Effluent water treatment tanks (clarifier)	2	⌀ 38		7	1,444
Diffuser (treated effluent discharge)	1	5	10	3	50
Monitoring ponds	4	44	76	n/a	3,344

PAG = potentially acid generating; ⌀ = outside diameter; n/a = not applicable.

Planning Envelope 2.4 Utilities and Essential Services

Utilities and essential services include infrastructure to provide the electricity, heat, water, and communication resources required to support the continued safe operation of site infrastructure and processes. Facilities included in this sub-planning envelope are summarized in Table 5A-7.

Table 5A-7: Utilities and Essential Services Facilities

Facility Name	Quantity	Surface Dimensions			Footprint (m^2)
		Length (m)	Width (m)	Height (m)	
Liquefied natural gas power plant	1	60	40	7	2,400
Liquefied natural gas storage area	1	84	40	5	3,360
Regasifier area	1	20	6	8	120
Above ground power lines and poles	1	5,813	6	16	34,878
Buried piping fire water	1	10,900	n/a	n/a	n/a
Buried piping sanitary	1	2,310	n/a	n/a	n/a
Drum storage	1	20	26	6	520
Diesel generator	6	3	2	2	36
Reagents storage	1	32	25	6.0	800
Fuel station and storage	1	45	40	n/a	1,800

n/a = not applicable.

Buildings associated with utilities and essential services would be decommissioned as described in Planning Envelope 2.0 Surface Buildings, Facilities, and Services (Section 5A5.1.2). Hazardous materials would be removed and sent off site for recycling or disposal as described in Planning Envelope 3.0 Waste Disposal (Section 5A5.1.3). Tanks and liners would be safely cleaned, compressed, and disposed of in the shafts if they cannot be recycled or reused. Buried piping would be drained, capped, and abandoned in place.

Planning Envelope 2.5 Waste Management Facilities

Waste management is the effective collection, processing, transport, and disposal of waste generated during decommissioning and reclamation. The waste management infrastructure included in this sub-planning envelope is summarized in Table 5A-8. The buildings associated with waste management would be decommissioned as described in Section 5A5.1.2.

Table 5A-8: Waste Management and Hazardous Materials Facilities

Facility Name	Quantity	Surface Dimensions			Footprint (m^2)
		Length (m)	Width (m)	Height (m)	
LLRW – incinerator building	1	24	22	8.5	528
Non-LLRW incinerator building	1	33	32	14	1,056

LLRW = low-level radioactive waste.

Planning Envelope 2.6 Surface Ancillary and Support Facilities

This subsection provides an overview of support services, buildings, and infrastructure. Surface ancillary and support facilities included in this sub-planning envelope are summarized in Table 5A-9.

Buildings associated with surface ancillary and support facilities would be decommissioned as described in Section 5A5.1.2.

Table 5A-9: Surface Ancillary and Support Facilities

Facility Name	Quantity	Length (m)	Width (m)	Height (m)	Footprint (m^2)
Communication building area pad	1	50	85	1	4,250
Warehouse / maintenance shop	1	58	31	13	1,798
Wash building	1	19	31	13	589
Concrete / shotcrete delivery building	1	21	13	8	273
Accommodation complex / camp	1	Irregular		7	12,858
Emergency response building	1	25	23	7	575
Mill dry facility	1	30	23	7	690
Mine and process plant dry facilities	1	58	20	7	1,160
Fresh water and fire water building	1	24	20	10	480
Process plant control room and laboratory building	1	19	25	14	475
Sewage treatment facilities – pad	1	28	22	n/a	616
Administration permanent office and building	1	51	32	7	1,632
Communication tower[(a)]	1	4	4	20	16
Treated water tanks	2	⌀14.5		18	165
Airstrip	1	80	1,900	n/a	152,000
Potable water treatment building	1	20	20	10	400
Fences	1	986	n/a	n/a	n/a

a) NexGen assumes the communications tower and building would be retained and maintained by SaskTel following decommissioning and reclamation of the Project.
⌀ = outside diameter; n/a = not applicable.

5A5.1.3 Planning Envelope 3.0 Waste Disposal

Decommissioning demolition waste would be segregated as required, and non-hazardous decommissioning demolition wastes would be collected and disposed of in the production shaft and exhaust shaft for permanent storage (as described in Planning Envelope 3.1 On-Site Disposal). Clean concrete would be segregated and disposed of in both the underground shafts and the NPAG WRSA. Hazardous materials would be disposed of off site at an authorized facility as described in Planning Envelope 3.2 Off-Site Disposal.

Approximate decommissioning waste quantities and their expected disposal destinations are provided in Table 5A-10.

Table 5A-10: Decommissioning Waste Streams and Disposal Destinations

Waste Streams (m^3)			Destinations (m^3)		
			Shaft	NPAG WRSA	Off-Site Recycling
Surface Buildings, Services, and Facilities	Steel	6,962	1,392	n/a	5,569
	Concrete	65,632	22,849	42,784	n/a
	Mixed	7,250	7,250	n/a	n/a
Lined areas (mixed waste)		3,827	3,827	n/a	n/a
Linear infrastructure (mixed waste)		1,774	1,774	n/a	n/a
Subtotal – Steel		6,962	1,392	n/a	5,569
Subtotal – Concrete		65,632	22,849	42,784	n/a
Subtotal – Mixed		12,851	12,851	n/a	n/a
Total		**85,445**	**37,092**	**42,784**	**5,569**

NPAG = non-potentially acid generating; WRSA = waste rock storage area; n/a = not applicable.

Approximate volumes available for disposing decommissioning demolition waste into the shafts at the end of the Operations Phase are shown in Table 5A-11. Volumes provided do not account for the engineered concrete plugs. It is anticipated that approximately 90% of the shaft volumes would be available for waste disposal at the end of the Operations Phase. A range of utilization percentages is provided to help estimate the amount of residual material that may require management if 90% utilization is not met.

Table 5A-11: Available Underground Volume in Mine Shafts at the end of the Operations Phase

Shaft Volumes						
Facility	Inner Diameter (m)	Depth (m)	Volume Utilization (m^3)			
			100%	90%	80%	70%
Production Shaft	8	568	28,551	25,696	22,841	19,986
Exhaust Shaft	5.5	533	12,663	11,397	10,131	8,864
Total Shaft Volume			**41,214**	**37,093**	**32,971**	**28,850**

Waste requiring underground disposal prior to commencement of decommissioning would be stored in the underground mine workings. Underground workings could also be utilized to store decommissioning demolition waste should the volume of decommissioning demolition waste exceed space available in the shafts. Approximate volumes available for disposing waste into the open lateral development within the mine workings at the end of the Operations Phase are shown in Table 5A-12.

Table 5A-12: Available Underground Volume in Mine Workings at the end of the Operations Phase

Mine Workings Volumes				
Facility	Drift Size		Available Length (m)	Available Volume[a] (m^3)
	Width (m)	Height (m)		
UGTMF access lateral development	5	5	7,000	175,000
Other development areas	5	5	30,000 +	500,000 +
Total Mine Workings Volume			**37,000 +**	**675,000 +**

a) Volume represented as total void space. Volume utilization is predicted to range between 30% (end dumping) to 70% (mechanical stacking).
UGTMF = underground tailings management facility.

Planning Envelope 3.1 On-Site Disposal

Underground disposal of decommissioning demolition waste was selected through a detailed multiple accounts exercise as a preferred method of disposal because it would create no additional visual impacts, have low potential for community effects, and have a low potential for physical and/or health risks to people downstream. No additional surface disturbance is required for underground disposal and ecological effects are limited to the existing surface disturbance and interactions of the waste with groundwater. Critical services (e.g., mine dewatering, heating, ventilation) and required equipment would remain in place until decommissioning demolition waste quantities are confirmed.

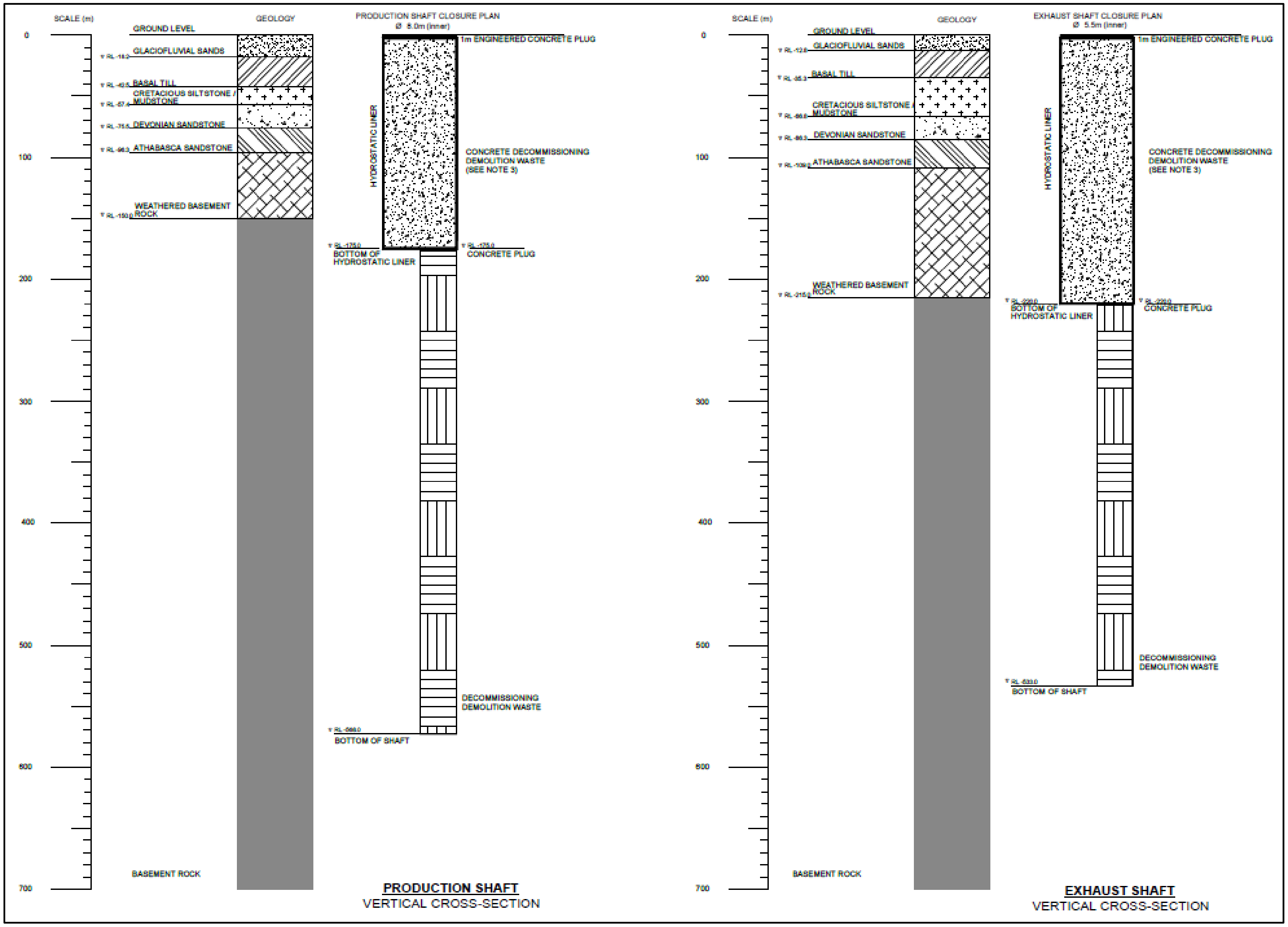
Non-hazardous decommissioning demolition waste that is not slated for recycling or disposal off site would be primarily deposited into the shafts. To prevent inadvertent plugging of the shafts during disposal, the internal shaft infrastructure (e.g., shaft steel) would be removed. To facilitate disposal activities, waste materials would be sheered to appropriate sizes. Disposal activities would be conducted using a systematic, orderly approach.

As shown in Figure 5A-9, non-hazardous decommissioning demolition wastes would be deposited into the shafts starting at the shaft bottom. Disposal would be temporarily halted once waste reaches the bottom of the hydrostatic liner near the top of the bedrock to install concrete plugs (Figure 5A-9) for each shaft. Once the concrete plugs are set, waste disposal would resume. Broken concrete from the decommissioning demolition process would be deposited into the two shafts above the concrete plug using a stacker. Waste would be deposited systematically, filling the shafts until the waste is near the surface. If required, NPAG waste rock may be used as supplemental material to fill void spacing above the concrete plugs. A second, shallow reinforced engineered concrete plug would be placed at surface to seal each shaft. Clean concrete would be segregated and disposed of in both the underground shafts and the NPAG WRSA.

As described in Planning Envelope 3.0 Waste Disposal, if decommissioning demolition waste volumes exceed the space available in the shafts, prior to backfilling the shafts, available volume in the underground mine workings would be utilized for disposal of waste. Decommissioning demolition waste requiring disposal in underground workings would be staged on surface prior to being loaded by surface equipment into the production shaft underground conveyance system (i.e., skips). Following conveyance underground via the production shaft, waste would be unloaded by underground equipment into a near-shaft staging area. Underground loading and hauling equipment would then transfer the materials from the staging area to the appropriate disposal areas for end-dumping or mechanical stacking.

Appropriate measures would be in place to protect workers during disposal activities that include the handling of radiologically contaminated materials from locations that conveyed, stored, or processed ore, uranium concentrate, or tailings. Radiologically contaminated materials would be prioritized for on-site disposal in the shafts, or in the underground workings if additional space is determined to be required.

Figure 5A-9: Exhaust Shaft and Production Shaft Closure Plan Geology and Decommissioning Plan



Planning Envelope 3.2 Off-Site Disposal

Wherever practicable, surface and underground infrastructure, equipment, and materials not required during the Active Closure Stage, and which meet radiological criteria for off-site removal, would be salvaged, sold, or transferred off site for recycling or disposal at an authorized facility. Oversize steel components identified for potential future reuse, such as mill components, would be systematically dismantled and transported off site via flat deck trailer. Other metal wastes would be segregated during demolition, sheared to appropriate size, and loaded into large tractor trailers with open-top bin style containment for transportation to an authorized facility. All waste sent off site would be packaged in a manner to minimize accidental release and transported in a manner that complies with applicable requirements.

Hazardous materials not required for decommissioning would be removed and sent off site by a licensed contractor for recycling or disposal at an authorized facility. Dangerous goods would be managed in accordance with The Hazardous Substance and Waste Dangerous Goods Regulations and transported in accordance with the Transportation of Dangerous Goods Regulations. Hazardous materials that may be on site at the end of the Operations Phase include:

- acetylene gas;
- ammonia;
- diesel fuel;
- ferric chloride;
- organosulphide;
- liquified natural gas;
- sodium hydroxide;
- sulphuric acid;
- unleaded gasoline; and
- waste oil.

Hazardous materials required to facilitate the Active Closure Stage activities (e.g., diesel fuel) would be consumed on site. Inventories would be monitored and resupplied as necessary to maintain sufficient quantities. Stock reordering would be tapered such that a minimal amount of materials would remain on site at the end of the Active Closure Stage. Any remaining hazardous materials would be removed and their associated storage and dispensing systems would be purged. The tanks and any vaporizer components and piping would be dismantled and disposed of as described above.

No structures or equipment would remain on the surface of the site post-decommissioning unless required for monitoring or maintenance activities. Hazardous decommissioning demolition waste not suitable or not safe for underground storage would be sent off site to authorized facilities.

5A5.1.4 Planning Envelope 4.0 Mine Rock Stockpiles and Storage Areas

Mine rock is the material removed from the underground workings and includes ore, special waste rock, PAG waste rock, and NPAG waste rock. Mine rock is generated in the Construction and Operations phases during shaft sinking, underground mine development, excavation of the UGTMF storage chambers, and ore mining. Mine rock would be segregated according to the definitions in Table 5A-13, and transported to the appropriate storage location (Figure 5A-10). The mine rock storage location capacities and footprints at the end of the Operations Phase and end of the Project lifespan are provided in Table 5A-13.

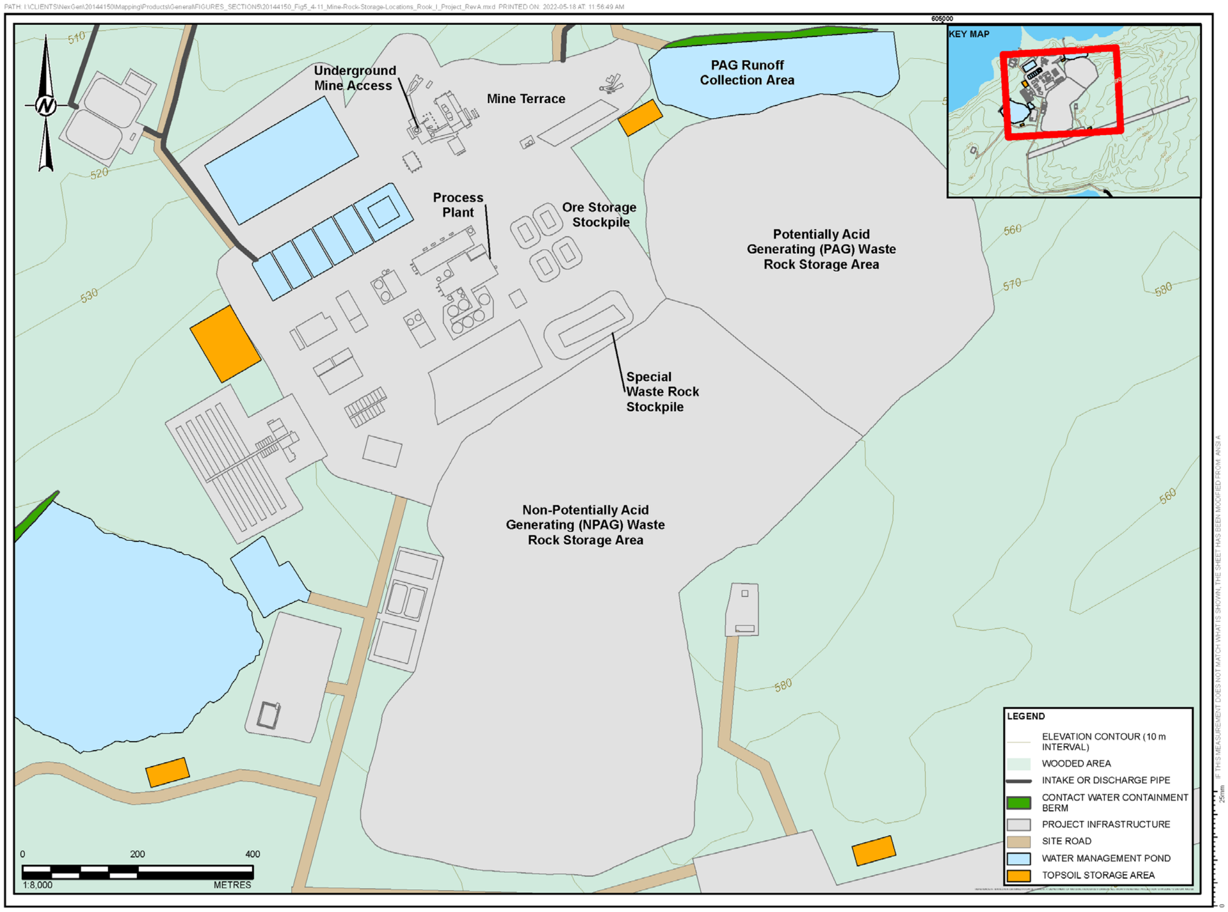
Waste rock storage areas would be created to store PAG and NPAG waste rock removed from the underground workings and are designed for responsible closure in a manner that protects and preserves the environment throughout the Project lifespan and minimizes the reliance on active institutional controls following decommissioning and reclamation.

Table 5A-13: Waste Rock Storage Areas Terminology, Footprints, and Capacity

Waste Rock Term	Details	Volume Capacity (m^3) at the End of Operations	Volume Capacity (m^3) at the End of Lifespan	Footprint (m^2) at the End of Operations	Footprint (m^2) at the End of Lifespan
Ore	Ore is mine rock with greater than or equal to 0.26% U_3O_8 and less than 0.3% U_3O_8 that must be extracted to access ore mining areas. Ore would be temporarily stored in the ore storage stockpile.	0[(a)]	0	9,520	0
Special waste rock	Special waste rock includes mine rock with greater than 0.03% U_3O_8 and less than 0.26% U_3O_8. All special waste rock would be temporarily stored in the special waste rock stockpile.	0[(a)]	0	9,057	0
Potentially acid generating (PAG) waste rock	Potentially acid generating waste rock is mine rock with less than 0.03% U_3O_8 and greater than or equal to 0.1% sulphur. All PAG mine rock would be stored in the PAG WRSA.	5,800,000	5,800,000	241,600	241,600
Non-potentially acid generating (NPAG) waste rock	Non-potentially acid generating waste rock is clean mine rock with less than 0.03% U_3O_8 and less than 0.1% sulphur. Non-potentially acid generating waste rock would either be stockpiled for use as construction material at site or stored in the NPAG WRSA.	8,000,000	8,000,000[(b)(c)]	489,000	489,000

a) Rock would be processed prior to the cessation of the Operations Phase and footprints would be reclaimed during Active Closure Stage.
b) If required, NPAG waste rock may be used as supplemental material to fill void spacing above the concrete plugs in the production and exhaust shafts.
c) The NPAG WRSA would receive a portion of clean concrete prior to final reshaping and revegetation.
NPAG = non-potentially acid generating; PAG = potentially acid generating; WRSA = waste rock storage area; U_3O_8 = triuranium octoxide.

Figure 5A-10: Mine Rock Storage Locations



The ore storage stockpile is where ore would be stored before transfer to the process plant for processing during the Operations Phase. A dual high-density polyethylene (HDPE) liner system would contain runoff and prevent external fresh or contact water from entering the ore storage stockpile area. The primary and secondary liner system would include perforated leak detection piping routed to leak detection monitoring wells. Prior to the Active Closure Stage, any remaining ore would be transferred to the process plant for processing and the liner would be excavated and backfilled underground (i.e., in one of the shafts or in available underground workings).

The special waste rock stockpile would temporarily store special waste rock. The special waste rock stockpile area would be graded in preparation for liner placement, and the area would be dual HDPE-lined, with primary and secondary leak detection and monitoring wells. Prior to the Active Closure Stage, any remaining special waste rock would be transferred to the process plant for processing and the liner would be excavated and disposed of in one of the shafts.

The PAG WRSA would be placed on an HDPE liner and used for long-term storage of PAG waste rock. Consistent with NexGen's commitment to designing, constructing, and operating for responsible closure, alternating lifts of PAG waste rock and engineered source control layers would be placed at the PAG WRSA during the Construction and Operations phases. This engineered source control design represents a progressive reclamation concept that includes the use of prescribed waste rock and control layer placement to reduce oxygen ingress to the waste rock, which minimizes the development of acid rock drainage and metal leaching and eliminates the need for an engineered cover system on the PAG WRSA during decommissioning. The PAG WRSA would also be constructed at the final design slopes of 4H:1V during Construction and Operations to facilitate progressive reclamation (i.e., revegetation) of the lower slopes (Section 5A6.6) and minimize recontouring required during decommissioning.

The PAG WRSA would remain in place following Closure. Final decommissioning and reclamation would occur during the Active Closure Stage; key aspects of the PAG WRSA closure would include:

- Final reshaping of the land surface to be geotechnically stable and integrated into the landscape (i.e., developing a landform that is similar to those in the adjacent, undisturbed landscape). Reshaping would include re-establishing drainage pathways into the surface of the final PAG WRSA landform using a geomorphic design approach (i.e., designing drainage to be able to accommodate climatic variability/changes and to minimize erosion). Final reshaping may include the application of small amounts of NPAG material (i.e., nominally 1.0 m depth of less, subject to further refinement during engineering design) on the top surfaces of the PAG WRSA to achieve design objectives.
- Application of a topsoil cover (nominally 0.15 m in thickness, subject to further refinement during engineering design) to facilitate revegetation. As part of the topsoil cover placement, site preparation techniques (e.g., mounding) would be incorporated, as required, to support revegetation activities and increase biodiversity and vegetation survival.
- Revegetation utilizing planting prescriptions considering plant species, application rate, and timing of soil amendment application (e.g., fertilizers, if required) appropriate for the substrate type, ecosite, landform, and landscape position. Target plant species for the PAG WRSA would include jack pine, paper birch, blueberry, and river alder, with final prescriptions to be refined based on feedback from Indigenous Groups and regulatory agencies as well as information gathered during monitoring of progressive reclamation completed during the Construction and Operations phases of the Project.

Further information on decommissioning and reclamation of the PAG WRSA is described in Section 5A6.1 and Section 5A6.4 (recontouring of the surface to facilitate drainage and minimize erosion, respectively), Section 5A6.3 (placement of a topsoil cover to facilitate revegetation), and Section 5A6.5 (planting to support revegetation). Following the Active Closure Stage, the PAG WRSA would be monitored for geotechnical stability, erosion, and revegetation success, as further described in Section 5A8.3.2.

The NPAG WRSA would be unlined and used for short- and long-term storage of NPAG waste rock; NPAG waste rock not used as a construction material would remain in place.

Final decommissioning and reclamation of the NPAG WRSA would be similar to the PAG WRSA. Decommissioning and reclamation of the NPAG WRSA would occur during the Active Closure Stage and include placing a portion of clean concrete in the WRSA (Section 5A5.1.3); recontouring of the surface to final design slopes of 4H:1V for long-term geotechnical stability, to facilitate drainage (Section 5A6.1), and to minimize erosion (Section 5A6.4); placing a 0.15 m thick topsoil cover to facilitate revegetation (Section 5A6.3); and planting appropriate species (e.g., jack pine, paper birch, blueberry, river alder) according to feedback from Indigenous Groups and regulatory agencies (Section 5A6.5). Following the Active Closure Stage, the NPAG WRSA would be monitored for geotechnical stability, erosion, and revegetation success (Section 5A8.3.2).

5A5.1.5 Planning Envelope 5.0 Site Roads and Disturbed Areas

Site roads are trafficable areas that would provide access to Project site infrastructure. All site infrastructure would be accessible either by new site roads or by upgraded site trails or roads where minimal access via a site trail or road already exists. A summary of the approximate areas of roads, culverts, and disturbed areas that would be developed to support the proposed Project is included in Table 5A-14. Figure 5A-11 shows a layout of Project site roads.

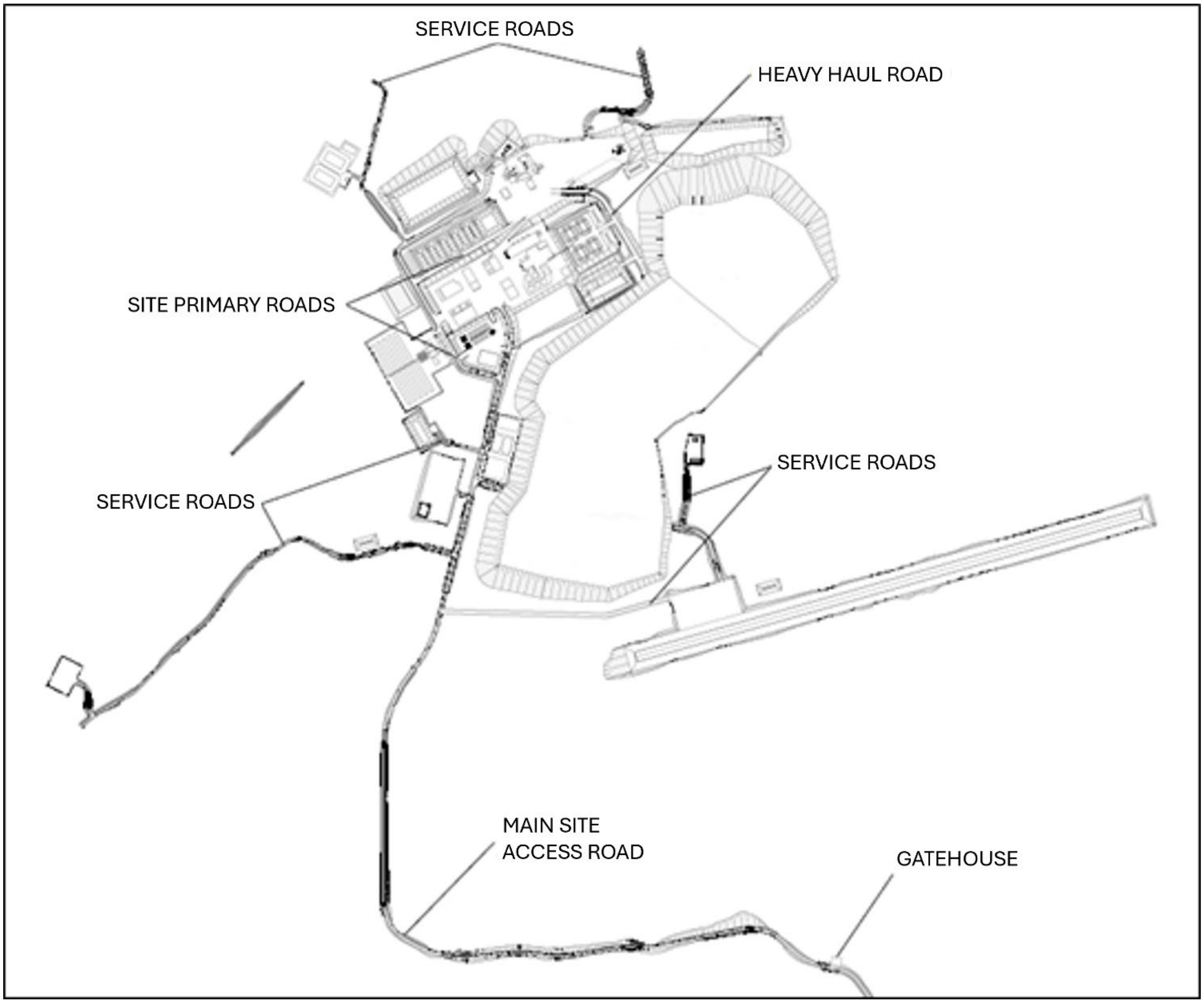
Disturbed surface areas (i.e., supporting infrastructure areas that were disturbed to support Project construction), would be reclaimed as described in Section 5A6. As roads are no longer required to support operational and long-term monitoring activities, roads would be decommissioned by removing culverts, levelling berms, and decompacting surfaces, where required, to establish conditions that would be suitable for reclamation as described in Section 5A6.

Table 5A-14: Roads and Disturbed Areas

Category		Length (m)	Width (m)	Height (m)	Footprint (m^2)
Site roads	Primary	3,256	8	n/a	26,048
	Secondary	3,695	6	n/a	22,170
	Off-site	11,676	Variable	n/a	240,000
	Mine haul road	1,014	12	n/a	12,168
	Mine haul road (temporary)	1,369	12	n/a	16,428
Disturbed areas	Gatehouse	8	8	5	64
	Culverts	1,113	0.15 to 0.6	n/a	n/a
	Apron	200	110	n/a	22,000
	Contractor laydown	450	500	n/a	225,000
	Owner's office laydown	200	100	n/a	20,000
	Area of mine surface	Irregular		n/a	n/a
	Area of mill surface	220	440	n/a	96,800

n/a = not applicable.

Figure 5A-11: Site Road Layouts



5A5.2 Site-Wide Gamma Survey

Once the Operations Phase is complete, a detailed site-wide gamma radiation survey would be performed prior to the commencement of decommissioning activities. Results of the baseline site-wide gamma survey completed in 2022 (CanNorth 2022) and the detailed site-wide gamma survey would inform the Detailed Decommissioning and Reclamation Plan. Results would help to characterize the radiological conditions, establish detailed radiological endpoints, and identify targeted decommissioning and reclamation activities. Results would be compared to criteria identified in the *Saskatchewan Guidelines for Northern Mine Decommissioning and Reclamation* (ENV 2008) for gamma radiation.

During the Closure Phase, a post-closure site-wide gamma survey on 10 m by 10 m grids would be performed and a record of the results maintained. The surveys would include, but may not necessarily be limited to, all disturbed areas within the Project site and the 13 km long all-season access road from the site to Highway 955.

If material within the survey area is identified to exceed the established radiological criteria, it would be collected and deposited into the shafts or underground workings during the Active Closure Stage.

5A6 LAND RECLAMATION

Land reclamation is a mitigation measure that returns the land to a useful and productive state (e.g., covering and revegetating a surface facility). Section 5A6 describes the approach to reclaiming the disturbed land in a way that would facilitate achieving the final decommissioning and reclamation objectives described in Section 5A2.1. Reclamation of the Project site would consist of:

- landform design;
- site preparation including decompaction, as required;
- reclamation material handling;
- erosion control;
- revegetation; and
- progressive decommissioning and reclamation.

Conceptual renderings of the Project site prior to and following the Active Closure Stage are shown in Figure 5A-12 and Figure 5A-13, respectively.

Figure 5A-12: Conceptual Rendering of the Rook I Project before Closure

Figure 5A-13: Conceptual Rendering of the Rook I Project Post-Closure

5A6.1 Landform Design

Landform design is the process of establishing criteria for landforms such as stable slopes and cover system concepts. For the Project site, landform design involves reshaping the land surface to be stable and integrated into the landscape, resulting in landforms that are similar to those in the adjacent undisturbed landscape. Implementation of the desired landform designs for the Project is expected to involve three primary stages:

- **Non-potentially acid generating WRSA construction/stabilization** – The NPAG WRSA would be contoured and reclaimed during the Active Closure Stage to create a long-term structurally stable form.
- **Potentially acid generating WRSA construction/stabilization** – During the Construction and Operations phases, the PAG WRSA would be constructed in alternating lifts of PAG waste rock and engineered source control layers at 4H:1V final design slopes to facilitate progressive reclamation (i.e., revegetation) of lower slopes. The PAG WRSA would be fully decommissioned, revegetated, and closed during the Active Closure Stage.
- **Recontouring the Project site** – The Project site would be contoured to result in a gently rolling terrain that is similar to pre-development topography and would encourage topographic diversity. The disturbed area of the Project developed during the Construction and Operations phases would be recontoured to mimic a more natural topography; this would occur both as part of progressive reclamation (i.e., during the Construction and Operations phases) and during the Active Closure Stage.

5A6.1.1 Drainage Design

Drainage design is the process of designing landform features to encourage the flow of surface water in desired directions. Drainage would be re-established on the Project site using a geomorphic design approach. This approach aims to provide sustainable, dynamic systems capable of accommodating changes without accelerated erosion or unacceptable environmental risks. The geomorphic approach is based on the recognition that natural drainage systems ebb and flow seasonally and exhibit sediment equilibrium, and that natural channels change over time.

At the Project site, to the extent possible, drainage patterns would be reintegrated with the surrounding landscape with the objective of channelling overland flows to limit erosion and unintentional ponding on, or adjacent to, the Project. To the extent practical, water drainage would be restored to flow to the same watersheds as prior to Project development.

5A6.2 Site Preparation

Site preparation techniques as a part of decommissioning and reclamation activities are the methods used to prepare a site to integrate with the surrounding landscape by adding surface variability, providing a more effective growth medium (e.g., enhancing soil moisture) to support revegetation, and increasing biodiversity and vegetation survival.

Site preparation would be completed using a combination of the following techniques, depending on the facility and site-specific conditions:

- **Recontouring** – Landform features would be reshaped to be safe, stable, accessible, functional, and appear natural. One of the most important aspects of recontouring is to restore effective drainage. This technique would be applied throughout the Project site.
- **Ripping** – This technique would be used to break up any heavily compacted surfaces and is commonly used on building pads, roads, and laydowns. Ripping is typically completed with a ripper tooth or a plow to a depth of at least approximately 50 cm. Alternatively, disking can also be used to decompact the surface (from approximately 10 cm to 15 cm depth) of less compacted areas. Most of the substrates within the Project site are sandy and are typically not prone to compaction; however, the requirement to 'rip' areas would be determined on a location-by-location basis.
- **Rough mounding** – Mounds and hollows would be created using Project equipment such as excavators. The bucket/rake attachment for excavators is specifically designed to flip the soil in a manner that creates more suitable planting sites. Excavated material is generally placed adjacent to, or overlapping, the edge of a depression to create mounds and hollows in a checkerboard pattern. Mounding is effective for erosion-prone slopes and low-lying organic areas.

5A6.3 Reclamation Material Handling

5A6.3.1 Soil Salvage and Stockpiling

Soils in the area of the Project are in the upper 0.05 m to 0.10 m of the upper glacial till unit. The soils support vegetation growth and are an important resource for progressive reclamation during the Operations Phase and reclamation during the Active Closure Stage. Surface soil (i.e., topsoil) consists of organic litter layers, low-lying vegetation mats, and the underlying upper mineral horizon. Surface soil may also include stumps and root wads.

This material would be salvaged to a depth of approximately 15 cm, and not deeper than approximately 30 cm, except where the removal of root wads brings up deeper materials.

Industry best management practices for soil savage include:

- monitoring of soil salvage activities by a qualified professional who identifies materials to be stripped, material types, appropriate stripping depths, and appropriate stockpile locations;
- using low ground-bearing pressure machinery to prevent compaction;
- suspending placement operations if the ground becomes too wet such that equipment causes severe rutting or compaction; and
- separating surface soils from the underlying subsoil to the extent practicable.

A preliminary estimate of the amount of soil available for salvage during the Construction and Operations phases and placement during reclamation is approximately 410,000 m^3. This value is based on soil depths and properties recorded during baseline soil surveys, is a calculation of in situ volumes, and does not account for bulk density changes during salvage and stockpiling or material loss through handling. It is expected that the actual volume of soil would vary based on site-specific conditions and soil-handling equipment limitations.

Industry best management practices for stockpiling soils include:

- locating soil stockpiles in areas that minimize handling requirements during site preparation and mine operations;
- locating soil stockpiles away from waterbodies, watercourses, and wetlands (e.g., farther than 10 m away);
- creating rough surfaces on the stockpiles to reduce the potential for erosion and provide a seed bed for revegetation;
- seeding soil stockpiles with a rapidly establishing, erosion-control native grass seed mix suited to the area; and
- installing drainage ditches, berms, sediment fencing, straw bales, or erosion control cloths to protect the surrounding area from siltation, where required.

Soil stockpiles would be monitored for erosion, weed growth, and native vegetation establishment. Where required, weeds would be removed, and erosion paths repaired.

Replacing soil as part of progressive reclamation during the Construction and Operations phases and as part of reclamation during the Active Closure Stage would help rebuild a functioning ecosystem by providing water-holding capacity, maintaining nutrient cycling, and contributing organic matter. Properly salvaged, stockpiled, and replaced soil can reduce the time and cost to meet reclamation objectives.

The management of soils and overburden at the proposed Project site would be further described in the Waste Management Program (a program-level document developed as part of the IMS).

5A6.3.2 Woody Debris Management

Coarse woody debris is defined as dead, downed, or standing wood in all stages of decomposition such as logs, uprooted stumps, large branches, and coarse roots. Coarse woody debris is recognized as a valuable reclamation resource as its application increases microtopographic variability and creates favourable microsites for seedling establishment, along with localized changes in soil moisture, improved erosion control, reduced herbivore browsing, habitat for small animals and soil fauna, and additional organic matter and nutrients associated with vegetation decomposition.

Where safe and effective, non-merchantable timber would be salvaged and stockpiled for use as reclamation material.

5A6.3.3 Reclamation Material Placement

Reclamation material placement is the process of placing salvaged soil and/or woody debris back on the landscape. Reclamation material prescriptions are intended to facilitate the effective management of reclamation materials for the purpose of developing a growth medium that would facilitate achieving overall reclamation objectives. Soil cover systems would be created for the Project to encourage biodiversity at Closure through the development of variable soil moisture and nutrient regimes designed to facilitate various target ecosystems and planting prescriptions. Woody debris would be spread over replaced soil, where possible.

Industry best management practices for reclamation material placement include the following:

- monitoring of placement activities by a qualified professional using a handheld probe to confirm minimum depths are achieved and soil suitability is maintained during application activities;
- minimizing the number of equipment passes over newly placed soil;
- preferentially using wheeled or tracked equipment with low ground-bearing pressure front ends (i.e., loaders and/or bulldozers); and
- suspending placement operations if the ground becomes too wet, such that equipment causes severe rutting or compaction.

NexGen continues to investigate soil amendments and other methods to improve probability of reclamation success and quality of on-site reclamation materials.

5A6.4 Erosion Control

Erosion control includes techniques, activities, or practices that are designed to protect exposed soil surfaces and conserve soil to prevent or reduce sediment transport, promote revegetation, and help safeguard the geotechnical stability of structures. Generally, the primary erosion control measure is to seed and plant disturbed areas at the earliest opportunity; however, additional short-term erosion control measures may be required where there may be insufficient time for vegetation establishment. Short-term erosion control measures may include the use of erosion control blankets, live staking, clean straw bales, straw wattles, filter socks, or sediment fencing. Erosion control measures would be determined on a site-by-site basis. Re-sloping may also be conducted to direct surface flow away from slope faces to minimize surface water erosion, where possible.

Proper contouring of a reclamation area would limit the overall erosion potential by creating irregular surfaces that slow overland flows, channels that capture and direct flows, and rapid revegetation to further slow surface water and increase infiltration.

5A6.5 Revegetation

Revegetation is the process of revegetating areas that have been previously disturbed. Successful reclamation requires the re-establishment of ecosystem functions based on natural successional processes, which is a process whereby changes in the species structure of an ecological community occur naturally over time.

Accordingly, planting prescriptions are planned with the intention of achieving ecosite-specific goals for a given area of land.

Industry best management practices for revegetation include the following:

- monitoring of planting activities by a qualified professional;
- establishing a diversity of plant species richness and structural diversity;
- minimizing bare ground and subsequent weed invasion;
- promoting the use of local seed sources to maintain the genetic integrity of revegetation plant material; and
- promoting early recolonization of reclaimed land by wildlife with a focus on species of primary interest for traditional land use.

Planting prescriptions would vary according to the substrate type, target ecosite, landform, and landscape position. Planting prescriptions would provide instructions detailing the plant species, application rate, and timing of fertilizer applications, if required. Planting prescriptions would provide a roadmap for revegetation to achieve target end land uses and overarching reclamation goals. Revegetation would be augmented by natural ingress of locally common species, many of which have been identified as traditional use species, and natural succession, thereby providing a framework for these revegetated areas to evolve into ecosystems similar to those naturally present in the region.

Revegetation activities would proceed as areas become available for reclamation. Target ecosites would be selected using the Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010) by matching predicted edaphic (i.e., influenced by soil) conditions of areas to be reclaimed to their respective ecosite.

The preliminary planting prescriptions for the Project (Table 5A-15) consider the species composition needed for different ecosites and gives preference to species identified for traditional use as described in the EIS. Final planting prescriptions included in the Detailed Decommissioning and Reclamation Plan would consider feedback from Indigenous Groups and regulatory agencies, and would be subject to approval by the ENV. The density and distribution of species would be determined on a site-by-site basis depending on material availability, end land use objectives, substrate type, and results from monitoring of reclaimed sites at other mines.

Table 5A-15: Preliminary Planting Prescriptions Linking Ecosites to Vegetation, Reclamation, and Capping Material

Site Type	Cover System	Landscape Position	Suitable Vegetation Species
Dry Forest Jack Pine / Lichen	Topsoil mixed with sandy substrate	Level areas, mid and upper slopes	Jack pine
			Paper birch
			Blueberry
Shrubland, Riparian	Topsoil mixed with sandy substrate	Lower slopes, adjacent to watercourses, waterbodies, and wetlands	River alder
			Paper birch

Note: Planting densities would target densities similar to ecosystems in the surrounding undisturbed landscape.

Additional species may be added to planting prescriptions on a site-by-site basis. These changes may include introduction of understorey species, locally collected traditional use species, locally common grasses for erosion control, specific habitat elements for target species (e.g., berry bushes for bears), or experimental introduction of mosses and lichens (e.g., transplant mats, clippings).

5A6.6 Progressive Decommissioning and Reclamation

Progressive reclamation is any interim or concurrent reclamation of land undertaken during, following, or in connection with construction/development or ongoing operations associated with an active mine site. Progressive reclamation reduces the amount of land that must be reclaimed at the end of a mining operation.

The pace of progressive reclamation is governed by the availability of areas that are no longer required for mine operations. NexGen's goal is to complete reclamation activities as soon as practicable after development areas are no longer required as part of ongoing operations.

The benefits of progressive reclamation include:

- reducing the cumulative effects of the Project (e.g., area of direct habitat loss, erosion potential, dust production, invasive species establishment);
- optimizing the quality and availability of reclamation materials (e.g., direct placement and/or short-term stockpiling of soil, creating seed sources for future reclamation);
- creating opportunities to use woody debris and other habitat enhancements that may be more difficult to store in the long term;
- returning end land uses more quickly;
- spreading the costs of reclamation over the mine life;
- reclaiming landforms while equipment, operators, and staff are already present on site to monitor reclaimed sites, reducing the need for additional mobilizations; and
- creating opportunities to test reclamation approaches, with outcomes influencing future reclamation plans and prescriptions.

Key considerations to determine if a piece of land is appropriate for progressive reclamation include:

- confirmation that the land would not be required again during Project activities and would be accessible for reclamation activities and monitoring;
- confirmation that the landform would be built in its closure configuration or can be recontoured without negatively affecting the adjacent areas;
- planning for how water that flows onto and off reclaimed sites would be managed, both during progressive reclamation and after areas are integrated into site-wide reclamation;
- planning for how the reclaimed land would be used (e.g., would the reclaimed site attract wildlife and would that result in damage to the landform or potential human-wildlife interactions; would the public be allowed on the land and what type of land use would be permitted); and
- planning for access management by wildlife and/or humans, if required.

Progressively reclaimed sites can be closely monitored and maintained by on-site personnel and can provide mitigations for environmental effects as well as learnings that would allow for improved reclamation success over time.

NexGen has incorporated key elements of progressive reclamation into the underground mine design (e.g., progressive closure of underground areas and UGTMF chambers) and the design of the PAG WRSA (e.g., construction incorporating engineered source control layers and stockpile configuration to final closure side slopes). Additionally, any other areas that may be disturbed during the Construction or Operations phases, but that are not required for the continued operation of the Project, would be identified as candidates for progressive reclamation.

5A7 UNCERTAINTY AND CONTINGENCY PLANNING

The proposed decommissioning and reclamation objectives, methods, and measures described within this Plan are based on best available conservative information and predictions (CNSC 2021) and are sufficiently detailed to confirm that the approach is technically feasible and adequate to:

- achieve the decommissioning and reclamation objectives;
- protect worker and public health and safety;
- protect the environment;
- maintain security; and
- accurately estimate costs.

This section includes information on NexGen's approach to managing uncertainty as it pertains to decommissioning and reclamation planning for the Project and identification of contingencies to currently planned Project decommissioning and reclamation activities.

5A7.1 Project Decommissioning and Reclamation Uncertainty

At this phase of Project development, uncertainties related to Project decommissioning and reclamation include:

- developing and meeting a set of reclamation criteria for successful revegetation, particularly on the WRSAs, when challenged with nutrient-poor soils that exhibit poor water-holding capacity; and
- establishing vegetation communities required to support local wildlife populations on reclaimed landscapes.

Uncertainties are mitigated through the application of adaptive management, which is a rigorous and systematic approach to learning from experience to address uncertainties, gain knowledge, adapt planning, and improve confidence in reclamation success.

Adaptive management consists of the following steps:

- **Assess**: Formulate the problem.
- **Design**: Develop a solution to address the problem.
- **Implement**: Put the solution(s) into practice.
- **Monitor**: Collect information to understand outcomes and effects.
- **Evaluate**: Compare monitoring results against established criteria.
- **Adjust**: Modify decisions with consideration for results.

Adaptive management is supplemental and complementary to the continual improvement processes that would be outlined in the IMS Manual (a program-level document developed as part of the IMS). Additionally, the IMS Manual would further describe the process for determining when, how, and where adaptive management would be used.

5A7.2 Contingencies

The Project is not expected to pose any substantial concerns related to decommissioning or reclamation because of the:

- modern protection measures integrated into the design of the Project (e.g., storage of all tailings underground);
- use of proven technology (e.g., design and management of WRSAs);
- small Project footprint;
- application of best management practices; and
- application of lessons learned from other decommissioned properties.

Nonetheless, contingencies have been developed as viable alternate options that may be used for decommissioning and reclamation based on changes to mine plans, technology updates, logistics, timelines, costs, and efficiency. The currently proposed decommissioning and reclamation approach and contingency plan for each PE is provided in Table 5A-16.

Table 5A-16: Contingencies for Decommissioning and Reclamation by Planning Envelope

Planning Envelope	Current Plan	Contingency Plan
Planning Envelope 1.0 Underground Facilities	▪ **Clean and remove infrastructure suitable for reuse from the underground** ▪ Underground tailings management facility chambers would be decommissioned during Operations ▪ Fill production and exhaust shafts with non-hazardous decommissioning demolition waste up to the unconformity and place a concrete plug at the unconformity ▪ Fill production and exhaust shafts from the unconformity to the surface with non-hazardous decommissioning demolition waste and place an engineered concrete plug at surface to seal the shafts ▪ Decommission other surface openings with hydrated bentonite	▪ **Leave all underground infrastructure in place** ▪ Underground tailings management facility chambers would be decommissioned during Operations ▪ Fill production and exhaust shafts with non-hazardous decommissioning demolition waste up to the unconformity and place a concrete plug at the unconformity ▪ Fill production and exhaust shafts from the unconformity to the surface with non-hazardous decommissioning demolition waste and place an engineered concrete plug at surface to seal the shafts ▪ Decommission other surface openings with hydrated bentonite
Planning Envelope 2.0 Surface Buildings, Facilities, and Services	▪ **Demolish all buildings, facilities, and services (e.g., fuel storage)** ▪ Once buildings, facilities, and services are demolished and demolition waste removed, remaining disturbances would be remediated as required, decompacted, and recontoured as outlined in Section 5A6, Land Reclamation	▪ **Deconstruct some buildings, facilities, and services to maintain for reuse off site** ▪ **Demolish remaining buildings, facilities, and services (e.g., fuel storage)** ▪ Once buildings, facilities, and services are **deconstructed and/or** demolished and demolition waste removed, remaining disturbances would be remediated as required, decompacted, and recontoured as outlined in Section 5A6, Land Reclamation
Planning Envelope 3.0 Waste Disposal	▪ **Dispose of non-hazardous and non-recyclable decommissioning demolition wastes in the shafts** ▪ **Send material off site for recycling (e.g., clean steel)** ▪ Remove hazardous materials, such as oil and transmission fluid, and transport to authorized facility for recycling or disposal	▪ **Dispose and recycle all non-hazardous decommissioning and demolition wastes off site – or – backfill all non-hazardous decommissioning demolition waste underground** ▪ Remove hazardous materials, such as oil and transmission fluid, and transport to authorized facility for recycling or disposal
Planning Envelope 4.0 Mine Rock Stockpiles and Storage Areas	▪ Construct the PAG WRSA using alternating lifts of PAG waste rock and engineered source control layers at 4H:1V final design slopes to facilitate progressive reclamation	▪ Construct the PAG WRSA using alternating lifts of PAG waste rock and engineered source control layers at 4H:1V final design slopes to facilitate progressive reclamation

Table 5A-16: Contingencies for Decommissioning and Reclamation by Planning Envelope

Planning Envelope	Current Plan	Contingency Plan
	▪ **Use NPAG waste rock as supplemental material to fill void spacing in the shafts (as required)** ▪ **Decommission and reclaim the NPAG waste rock in situ during the Active Closure Stage**	▪ **Transfer maximum possible portions of PAG and NPAG waste rock underground according to available storage volume**
Planning Envelope 5.0 Site Roads and Disturbed Areas	▪ **Remove roads and culverts, level berms, and decompact surfaces once roads are no longer required to support operational and long-term monitoring activities. Reclaim as described in Section 5A6**	▪ **Leave site roads in place** ▪ **Allow the area to naturally regenerate**

Note: **Bolded** values represent differences between the current plan and contingency plan for each planning envelope.
PAG = potentially acid generating; NPAG = non-potentially acid generating; WRSA = waste rock storage area; H:V = horizontal to vertical.

5A8 MONITORING AND CONTROL

Monitoring would confirm the success of the decommissioning and reclamation activities and demonstrate the Project site is in a stable or improving condition. Once this is demonstrated, NexGen would return the land to the Government of Saskatchewan under the Institutional Control Program with no long-term control measures anticipated.

The IMS would provide the management system processes and administrative control required to protect workers, the public, and the environment from associated risks during the Closure Phase.

5A8.1 Risk Management

The IMS consists of the program-level documents and supporting documentation that are organized into categories that reflect the CNSC safety and control areas and other matters of regulatory interest as shown in Figure 5A-3. Programs and supporting processes (e.g., plans, procedures) would be reviewed and revised prior to commencing the Active Closure Stage to align with the work being completed at site (e.g., the cessation of mining and the beginning of building and infrastructure demolition) and to effectively mitigate effects of radiological and non-radiological hazards on people and the environment.

Potential hazards associated with proposed Project activities are systematically assessed to determine potential risks to human health and safety and the environment and to identify and implement measures to mitigate those risks. The type of assessment performed would be topic appropriate and include the apparent level of risk, safety significance, and complexity of activity. The general risk management framework, process, and requirements would be described in the IMS Manual. Other risk assessment methods (e.g., job hazard analyses) would be further described in the supporting programs, plans, and procedures, as applicable.

A preliminary summary of hazards to workers, the public, and the environment that are anticipated to be encountered during the Active Closure Stage for each PE is provided in Table 5A-17. A more detailed overview, including an overview of applicable controls to mitigate potential risks, would be developed as part of the Detailed Decommissioning and Reclamation Plan.

Table 5A-17: Summary of Decommissioning and Reclamation Risks to Workers, the Public, and the Environment

Planning Envelope	Workers	Public	Environment
Planning Envelope 1.0 Underground Facilities	▪ working around moving and active equipment ▪ exposure to spills or unauthorized releases ▪ radiation exposure and cross-contamination ▪ handling explosives ▪ confined spaces ▪ handling demolition materials ▪ dust	▪ none, public access to the site would be restricted during the Active Closure Stage	▪ spills or unauthorized releases
Planning Envelope 2.0 Surface Buildings, Facilities, and Services	▪ moving and active equipment ▪ locating utilities ▪ exposure to spills or unauthorized releases ▪ radiation exposure and cross-contamination ▪ dust ▪ handling demolition materials ▪ confined spaces ▪ exposure to acid fumes and liquid acid ▪ working alongside hazardous substances ▪ working around excavations	▪ none, public access to the site would be restricted during the Active Closure Stage	▪ spills or unauthorized releases ▪ effects on surface water due to erosion and sedimentation ▪ injury or mortality to wildlife caused by Active Closure Stage activities (e.g., moving equipment, excavations)
Planning Envelope 3.0 Waste Disposal	▪ working around moving and active equipment ▪ working around shaft openings/holes ▪ exposure to spills or unauthorized releases	▪ vehicle traffic on public roads used to send waste for off-site disposal	▪ spills or unauthorized releases ▪ injury or mortality to wildlife caused by the Active Closure Stage activities (e.g., moving equipment, excavations)
Planning Envelope 4.0 Mine Rock Stockpiles and Storage Areas	▪ working around moving and active equipment ▪ exposure to spills or unauthorized releases	▪ none, public access to the site would be restricted during the Active Closure Stage	▪ spills or unauthorized releases ▪ injury or mortality to wildlife caused by Active Closure Stage activities (e.g., moving equipment, excavations)
Planning Envelope 5.0 Site Roads and Disturbed Areas	▪ working around moving and active equipment ▪ exposure to spills or unauthorized releases ▪ working around excavations ▪ handling demolition materials ▪ dust	▪ none, public access to the site would be restricted during the Active Closure Stage ▪ hazards (e.g., such as motor vehicle incidents) exist for the public who do not follow posted and communicated access restrictions	▪ spills or unauthorized releases ▪ effects on surface water due to erosion and sedimentation ▪ injury or mortality to wildlife caused by Active Closure Stage activities (e.g., moving equipment, excavations)

5A8.2 Worker Monitoring

To keep exposures to ionizing radiation hazards as low as reasonably achievable during the Project lifespan, including Closure, exposures to gamma radiation, long-lived radioactive dust, radon progeny, and radon gas would be routinely monitored for workers designated as nuclear energy workers. Personal dosimetry equipment would be provided for all workers as required, and dose records would be maintained for each nuclear energy worker at the Project site. Effective (i.e., whole-body) and equivalent (i.e., organ-specific) doses would be measured and recorded, as applicable. Doses would be routinely tracked and compared to internal and external limits. The processes for classifying nuclear energy workers and for managing worker dosimetry would be described in the Radiation Protection Program (a program-level document developed as part of the IMS).

Chemical, physical, or biological health and safety hazards encountered during all Project phases would be monitored in accordance with established sample collection and analysis methods to quantify exposure risk to workers and confirm the effectiveness of applicable controls. Results from personal occupational exposure and workplace monitoring would be collected, maintained, stored, communicated, and used to identify improvement opportunities as required. The process for identifying health and safety hazards and monitoring occupational exposures would be described in the Health and Safety Program (a program-level document developed as part of the IMS).

5A8.3 Environmental Monitoring

Environmental monitoring performed during Closure would include the parameters, locations, and frequencies required to maintain sufficient information regarding environmental quality and closure outcomes and to keep risks to human health and the environment as low as reasonably achievable.

The documents developed as part of the Environmental Protection Program, which is a program-level document developed as part of the IMS, would provide the basis for effluent, emission, and receiving environment monitoring requirements during decommissioning and reclamation activities.

For the purpose of the Plan, it is assumed that environmental monitoring would occur in two distinct stages: the Active Closure Stage and the Transitional Monitoring Stage. The Detailed Decommissioning and Reclamation Plan would include final effluent, emission, and receiving environment monitoring requirements.

5A8.3.1 Active Closure Stage

Monitoring would continue during the Active Closure Stage at approximately the same level as during the Construction and Operations phases and would include monitoring of effluents (i.e., waterborne releases) and emissions (i.e., airborne releases), as well as the receiving environment.

Monitoring effluents and emissions from facilities, activities, and processes during the Active Closure Stage would be performed to:

- demonstrate adherence to internal release criteria;
- evaluate the effectiveness of effluent and emission control;
- identify unusual or unforeseen conditions that might require corrective measures or adaptive management;
- provide data to verify the most recent regulatory-approved environmental risk assessment predictions, refine models, and reduce uncertainty;
- demonstrate due diligence; and
- demonstrate compliance with legal and other requirements.

Effluent and emissions monitoring may include the following sources, but would not be limited to:

- point source releases of treated contact water from the monitoring ponds to Patterson Lake;
- point source releases of treated sewage from the sewage treatment plant to Patterson Lake;
- point source emissions to the atmosphere from stationary equipment (e.g., liquified natural gas power plant); and

- fugitive emissions to the atmosphere from mobile equipment, space heaters, fuel storage and handling areas; dust emissions from material handling; vehicle-generated road dust; and wind erosion from WRSAs.

As decommissioning and reclamation advances, effluent and emission monitoring requirements are expected to be modified to accurately reflect the site conditions and activities (e.g., effluent monitoring would stop once effluent releases and emissions have ceased).

Monitoring in the receiving environment would be performed to:

- provide data required to assess the level of risk to human health and the environment;
- characterize potential changes in the environment;
- identify unusual or unforeseen conditions that might require corrective measures or adaptive management;
- provide data to verify predictions made in the most recent regulatory-approved environmental risk assessment, refine models used in the environmental risk assessment, or reduce uncertainty identified in conducting the environmental risk assessment;
- verify, independently of effluent or emissions monitoring, the effectiveness of containment and effluent control, and provide public assurance of the effectiveness of containment and effluent control;
- demonstrate due diligence; and
- demonstrate compliance with legal and other requirements.

Receiving environment monitoring would include, but would not be limited to, sampling and analyzing air, groundwater, surface water, sediment, aquatic biota, soil, and vegetation for a variety of constituents of potential concern (e.g., major ions, nutrients, total metals, radionuclides) as well as monitoring and analyzing physical parameters (e.g., temperature, wind speed).

Monitoring locations, frequency, analytes, and methods would be informed by the most recent regulatory-approved environmental risk assessment and confirmed during the development of the Detailed Decommissioning and Reclamation Plan.

Within three years of notifying the ENV of the intention to close the Project, a supplemental biological monitoring study would be completed as required under the *Fisheries Act* and as further described in the Metal and Diamond Mining Effluent Regulations.

Once the Active Closure Stage environmental monitoring is complete, Transitional Monitoring Stage monitoring would commence.

5A8.3.2 Transitional Monitoring Stage

The Transitional Monitoring Stage represents the period of time between the completion of the Active Closure Stage and when the site is entered into the Institutional Control Program. The Transitional Monitoring Stage is expected to last about 10 years, pending achievement of success criteria (Section 5A4), and would provide periodic measurement and assessment of the effectiveness of decommissioning and reclamation activities.

It is anticipated that effluent and emissions monitoring would cease at the end of the Active Closure Stage and would not occur during the Transitional Monitoring Stage.

The focus of monitoring during the Transitional Monitoring Stage would be similar to the receiving environment monitoring performed during the Active Closure Stage and is expected to focus on monitoring of post-decommissioning constituents of potential concern loadings in the air, groundwater, surface water, and soil; residual changes to the local drainage system and groundwater; landform erosion and geotechnical stability; and revegetation success.

Post-reclamation gamma surveys would be completed after Closure as required by the ENV and CNSC. Financial assurances sufficient to cover the cost of the Transitional Monitoring Stage, as well as a contingency for unexpected occurrences, would be maintained.

During the Transitional Monitoring Stage, periodic inspections would be conducted by regulators to confirm compliance with legal and other requirements and demonstrate the Project site is in a stable or improving condition. Reporting on monitoring and maintenance methods and results would be conducted, as required. Once the Project meets applicable success criteria, the process for transfer to the Institutional Control Program (Section 5A10, Transfer to Institutional Control Program) would be initiated, once the Province has accepted the Project into Institutional Program, NexGen would return the land to the Government of Saskatchewan with no long-term control measures anticipated.

5A9 PRELIMINARY DECOMMISSIONING AND RECLAMATION SCHEDULE

Project decommissioning and reclamation activities would follow a logical sequence so that adequate facilities and services would be available for workers involved in decommissioning activities and with consideration for external factors (e.g., weather). Progressive decommissioning and reclamation of any areas of the Project that are no longer required (e.g., areas developed and used for construction activities only) would be completed during the Construction and Operations phase when possible.

The preliminary schedule (Table 5A-18) was developed based on critical path activities and would be used to support the development of the Preliminary Decommissioning and Reclamation Cost Estimate. Activities required for decommissioning and reclamation of each PE were determined and organized chronologically to better define the work scope and overall schedule.

Considerations and assumptions that were factored into the development of the preliminary schedule include:

- The Active Closure Stage includes a period of care and maintenance, which involves maintaining the site in a safe, inactive state while regulatory approvals for decommissioning and closure are secured.
- Decommissioning activities can occur across PEs concurrently.
- Task durations are determined by the critical path equipment hours and whether tasks are day shift limited or could be completed on either day and night shift; both shifts are 12-hours in length.
- Order of operations is based on activities required to generate waste for underground and off-site disposal.
- Following completion of demolition of surface buildings and infrastructure, lined areas and linear infrastructure can be removed/demolished for disposal in the shafts, except for the headframes and fans that are required for underground disposal activities. Following demolition of remaining buildings, pads, and laydowns, site preparation can commence with concrete crushing and spreading taking place.
- Following capping of the shafts, landform contouring, and reclamation of all disturbed areas can begin.

The schedule would be periodically updated along with the Preliminary Decommissioning and Reclamation Cost Estimate to reflect the most up-to-date information, and at minimum, every five years throughout the Project lifespan. A detailed schedule of decommissioning activities would be included in the Detailed Decommissioning and Reclamation Plan that would be developed prior to cessation of the Operations Phase and transition to the Closure Phase.

The preliminary decommissioning and reclamation schedule for the proposed Project is provided in Table 5A-18. Year 0 indicates the commencement of the Active Closure Stage regardless of the calendar year.

Table 5A-18: Preliminary Decommissioning and Reclamation Schedule for the Rook I Project

TASK	Y0				Y1				Y2				Y3				Y4				Y5-Y14			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Approvals Management																								
Detailed Decommissioning Plan[(a)]	■	■	■	■																				
Decommissioning Regulatory Approvals			■	■																				
CNSC Cost Recovery Fee	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Decommissioning Management																								
Site Management - Care and Maintenance	■	■	■	■																				
Decommissioning Management - Active Decommissioning					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Site Operations	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
PE 1.0: Underground Facilities																								
PE 1.1: Underground Infrastructure and Services				■	■	■	■																	
PE 1.2: Underground Tailings Management Facility																								
PE 1.3: Surface Openings																■	■							
PE 2.0: Surface Buildings, Facilities, and Services																								
PE 2.1: Mining Surface Facilities							■	■	■															
PE 2.2: Process Plant										■	■	■												
PE 2.3: Site Water Management												■	■											
PE 2.4: Utilities and Essential Services												■	■	■										
PE 2.5: Waste Management Facilities														■	■	■								
PE 2.6: Surface Ancillary and Support Facilities														■	■	■								
PE 3.0: Waste Disposal																								
PE 3.1: On-site Disposal														■	■	■	■							
PE 3.2: Off-site Disposal										■	■	■	■	■	■	■	■	■						
PE 4.0: Mine Rock Stockpiles and Storage Areas																								
NPAG - Waste Rock Reslope and Cover														■	■	■								
PAG - Waste Rock Reslope and Cover														■	■	■								
Ore and Special Waste Stockpiles																■	■							
PE 5.0: Site Roads and Disturbed Areas																								
Site Roads and Disturbed Areas																■	■	■						
Gatehouse																		■						
Environmental Monitoring[(b)]																								
Monitoring and Reporting (Active Closure Stage)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Monitoring and Reporting (Transitional Monitoring Stage)																					■	■	■	■

a) Includes pre-closure gamma survey.
b) Includes post-closure gamma survey.
Y = year; Q = quarter; PE = planning envelope; CNSC = Canadian Nuclear Safety Commission; NPAG = non-potentially acid generating; PAG = potentially acid generating.

5A10 TRANSFER TO INSTITUTIONAL CONTROL PROGRAM

In Saskatchewan, the Institutional Control Registry maintains a formal record of closed mining and milling sites, manages the funding for ongoing monitoring and maintenance (if required), and performs required monitoring and maintenance work.

The process of entering the Project into the Institutional Control Registry may be initiated once the success criteria of the Project site has been established and confirmed during the Transitional Monitoring Stage. To enter the Project into the Institutional Control Registry, an application for the revocation of the CNSC licence under the *Nuclear Safety and Control Act* and an application for a release from decommissioning and reclamation would be prepared to obtain a release from further monitoring and maintenance responsibilities, and from the obligation to maintain financial assurance. Engagement with local Indigenous Groups and communities, including local land users, would continue during this period.

Decommissioning and reclamation of the Project would address requirements associated with the provincial and federal legislation; NexGen plans to transfer the Project land back to the Government of Saskatchewan through the Institutional Control Program with no, or minimal, maintenance post-closure and no long-term control measures.

5A11 DOCUMENT AND RECORD MANAGEMENT

Documents and records generated for, or resulting from, decommissioning and reclamation activities are controlled to verify the information is accurate, available when needed, and protected from uncontrolled alteration. Documents and records allow for the long-term retention of knowledge and can help identify post-closure land use restrictions that may exist.

Documents may include, but are not limited to, procedures and work instructions that outline safe and environmentally responsible decommissioning and reclamation practices.

Records specific to decommissioning and reclamation may include, but are not limited to:

- training received by workers performing decommissioning and reclamation activities;
- drawings and plans showing surface infrastructure, underground mine workings, and waste disposal facilities;
- quantities of decommissioning demolition waste disposed on site and off site;
- worker dosimetry records; and
- effluent and environmental monitoring results.

The processes for managing documents and records would be outlined within the IMS Manual.

5A12 REGULATORY APPROVALS

The proposed Project is subject to both provincial and federal environmental assessment processes, would be licensed as a nuclear facility by the CNSC, and would be subject to various provincial and federal permits and approvals.

The decommissioning methods that have been described in this Plan are considered adequate and appropriate to protect people and the environment, meet decommissioning criteria, and satisfy applicable external requirements during the Construction Phase, Operations Phase, and Closure Phase of the Project, pending approval.

Following submission and acceptance as part of provincial permitting and federal licensing processes, formal versions of the Preliminary Decommissioning and Reclamation Plan would be periodically updated to reflect the most up-to-date Project information; at a minimum, this would occur every five years throughout the life of the Project.

Before entering the Active Closure Stage, a Detailed Decommissioning and Reclamation Plan would be developed in accordance with provincial and federal requirements and an application to decommission the Project would be made to the ENV and the CNSC.

As required by The Mines Regulations, 2018, prior to initiating final decommissioning and reclamation activities, the Saskatchewan Ministry of Labour Relations and Workplace Safety would be notified and provided with copies of current mine plans.

The costs associated with securing the necessary provincial and federal regulatory approvals, including the costs associated with engaging with local Indigenous Groups and communities, would be outlined in the Preliminary Decommissioning and Reclamation Cost Estimate.

5A13 REFERENCES

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Attachment 5A-A: Drawings

NOTES:

1. ALL UNITS ARE METRIC WITH DIMENSIONS IN METERS, UNLESS NOTED OTHERWISE. COORDINATES ARE UTM ZONE 12N NAD 83 (CSRS98) GROUND GRID.
2. CONTOUR INTERVALS ARE 5.0m.

LEGEND:

EXISTING TRAILS AND ROADS

PLAN

1:7500

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN BY	DES BY	DWG CHK	DES CHK	ENG MGR	PM
G	01MAR21	ISSUED FOR DESIGN	CJE	BEP	BEP		ABB	PO
F	16DEC20	ISSUED FOR DESIGN	CJE	BEP	BEP	CLC	ABB	PO
E	27NOV20	ISSUED FOR APPROVAL	JTH	BEP	BEP	CLC	ABB	PO
D	30OCT19	ISSUED FOR DESIGN	CJE	BEP	BEP	CLC	ABB	PO
C	22OCT19	ISSUED FOR APPROVAL	CJE	BEP	BEP	CLC	ABB	PO
B	16SEP19	ISSUED FOR REVIEW	CJE	BEP	BEP	ABB	ABB	PO
A	09SEP19	ISSUED FOR REVIEW	CJE	BEP	BEP	ABB	ABB	PO

ISO A1-594x841

REF	NUMBER	TITLE
02	5300-DD10-GAD-00002	GENERAL SITE PIPING LAYOUT
01	2000-DD10-GAD-01002	GENERAL SITE PLAN EA SCENERIO

REFERENCES

STAMP/SEAL

ASSOCIATION OF PROFESSIONAL ENGINEERS & GEOSCIENTISTS OF SASKATCHEWAN
CERTIFICATE OF AUTHORIZATION
Wood Canada Limited
NUMBER C0577
PERMISSION TO CONSULT HELD BY:
DISCIPLINE Sk. Reg. No. SIGNATURE

APPROVED FOR FEASIBILITY STUDY

R. WEYMARK 08DEC20	B.E. POZNIAK	P. O'HARA
CLIENT PROJECT MGR	DEPARTMENT MGR	PROJECT MGR

PROJECT PHASE: ROOK I FEASIBILITY STUDY

PROJECT NO.: 246061

SCALE: 1:7500

	BY	DDMMMYY
DES	B.E. POZNIAK	27AUG19
DRN	C. ENGEL	27AUG19
CHK	C.L. CHIN	17DEC20
APP	A.B. BOEHM	17DEC20

NexGen Energy Ltd.

SUBJECT: CIVIL
SURFACE INFRASTRUCTURE
OVERALL AREA PLAN
EA SCENARIO

CONSULTANT LOGO

wood.

AREA: 2000

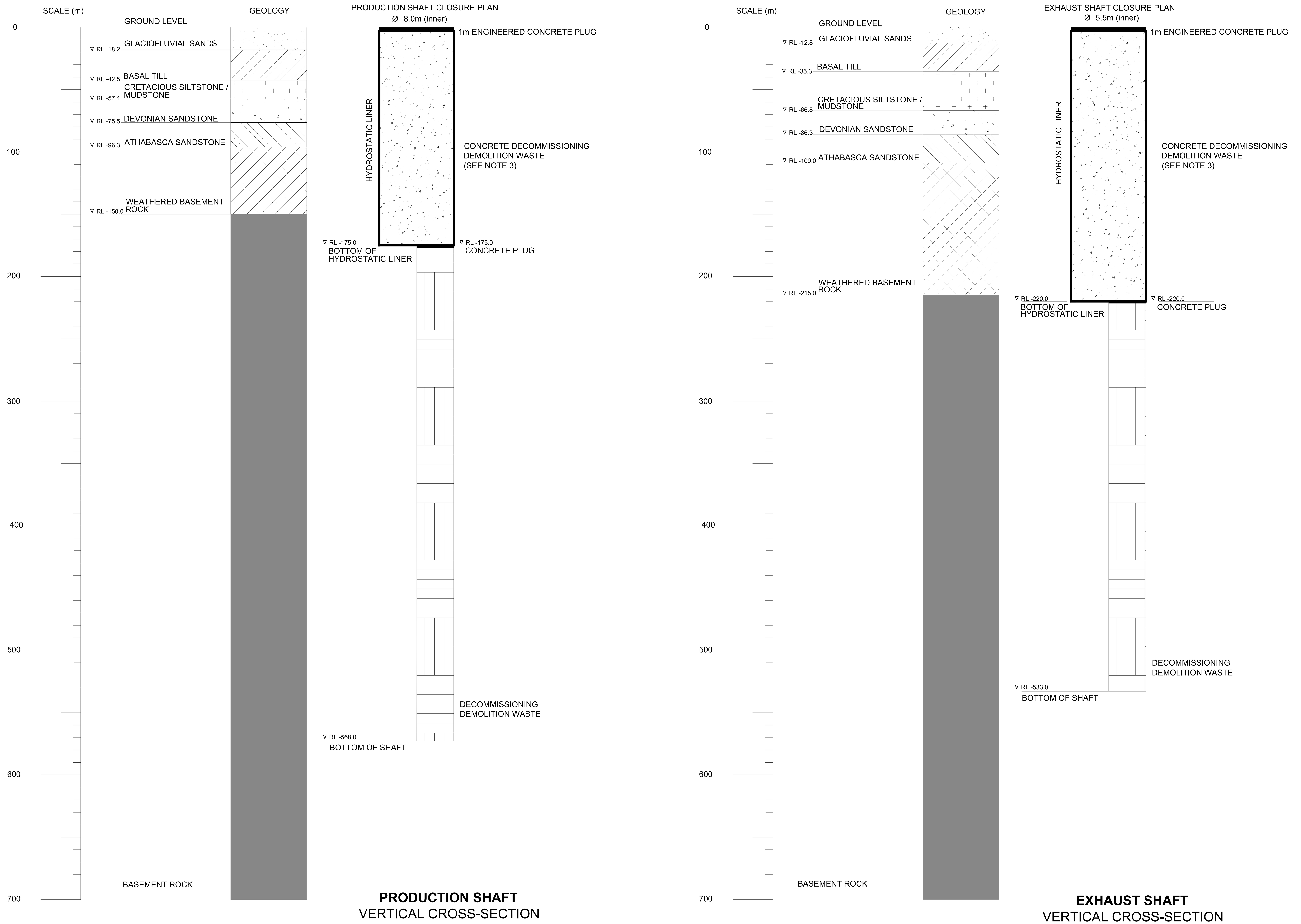
AREA DESCRIPTION: SITE DEVELOPMENT

DRAWING NO.: 2000-DD10-GAD-01001

REV: G

CAD FILE: P:\CAD\CIV\2000-DD10-GAD-01001.DWG

SAVED: 01-Mar-21 1:19 PM PLOTTED: 01-Mar-21 2:14 PM USER: POZNIAK, BRIAN E.



NOTES:
1. DO NOT SCALE TO THIS DRAWING
2. ALL LEVELS SHOWN ON THIS DRAWING ARE IN METERS (m)
3. NON-POTENTIALLY ACID GENERATING WASTE ROCK WILL ONLY BE USED IF SUPPLEMENTAL MATERIAL IS REQUIRED TO FILL VOID SPACE.
4. R.L. FOR REDUCED LEVEL.

REFERENCE DRAWINGS

NO.	DWG NO.	TITLE

DRAWING REVISION

NO.	DESCRIPTION	DATE
1	ISSUED FOR USE	01.05.2023

	NAME	DATE
DRAWN BY:	J.J	14 NOV 2022
DESIGNED BY:	A.S	14 NOV 2022
CHECKED BY:		
APPROVED BY:		

NexGen

JDS Energy & Mining Inc.

NEXGEN ENERGY LTD
ROOK I PROJECT

PRODUCTION & EXHAUST SHAFT POST-CLOSURE CONCEPT

DWG NO. ROOK-DEC-SEC-00001
REV. 1

C:\Users\leighs\OneDrive - JDSEM\NEXR0001C - EPCM\Drawings\Layout Optimization 21.03.2023.dwg May 01, 2023 - 3:51pm

Attachment 5A-B: Discharge Inventory

Table 5A.B-1 Rook I Project Discharge Inventory

Date	Material	Volume	Detailed Circumstances	Cause	Mitigating Procedures

No discharges have occurred on the Project site. This table will be updated once information is available.

Attachment 5A-C: Hazardous and Radioactive Substance Inventory

Table 5A.C-1 Rook I Project Hazardous Substances and Waste Dangerous Goods Storage Facilities

Tank Number/Storage Facility	Location	Contents	Capacity

Placeholder – will be updated once an inventory of hazardous and radioactive substances is available.

Appendix 5B Conventional Waste Management Approach and Contingency Options Report

Abbreviations and Units of Measure

Abbreviation	Definition
EA	Environmental Assessment
EIS	Environmental Impact Statement
LLRW	low-level radioactive waste
MAA	multiple accounts analysis
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
PPE	personal protective equipment
Project	Rook I Project
UGTMF	underground tailings management facility
WRSA	waste rock storage area

Unit	Definition
%	percent
kg	kilogram
kg/m^3	kilograms per cubic metre
km	kilometre
m	metre
m^3	cubic metres

Table of Contents

List of Tables

5B1 INTRODUCTION

The management of conventional waste represents a key design feature for the proposed Rook I Project (Project). A suitable conventional waste management approach requires consideration of alternatives available for the Project and the goal to minimize potential effects to people and the environment.

The Project is expected to implement a multi-faceted (i.e., multi-method) approach to conventional waste management that includes on-site material reuse and recycling, incineration, underground disposal, and off-site diversion (i.e., reuse and recycle) and disposal. However, for the Environmental Assessment (EA) conducted for the Project, a conservative approach was undertaken that considered both conventional waste management alternatives known to be available at the time of EA development and the need to take a conservative (i.e., precautionary) approach for assessment of potential adverse effects. For these reasons, the EA assumes that all conventional waste would be incinerated.

While incineration was chosen as the basis for conventional waste management in the EA, Project permitting and licensing would follow the EA process and would require demonstrating that incineration of industrial waste and low-level radioactive waste (LLRW) could meet provincial and federal regulatory requirements. The purpose of this report is to demonstrate that, should it not be possible to permit or license the incineration of industrial waste and LLRW, alternative options exist that would meet the Project's disposal demands for waste generated through the Construction and Operations phases.

The remainder of this report provides a background of the alternatives assessment conducted for the Project conventional waste management approach and the contingency options available should incineration of industrial waste and LLRW not occur during Construction and Operations. The discussion on contingency planning includes preliminary waste balance calculations that are based on conservative (i.e., precautionary) assumptions regarding waste volume generation, compaction ability, storage space available, reuse and recycling opportunities, and off-site disposal options.

The conventional waste management approach for the Project Decommissioning and Reclamation (i.e., Closure) Phase is documented in the conceptual Preliminary Decommissioning and Reclamation Plan included as EIS Appendix 5A.

5B2 ASSESSMENT OF ALTERNATIVES FOR THE ROOK I PROJECT CONVENTIONAL WASTE MANAGEMENT APPROACH

The proposed Project would produce conventional waste throughout the Construction, Operations, and Decommissioning and Reclamation (i.e., Closure) phases. Conventional waste would need to be managed appropriately in consideration of options available for the Project as well as the goal of minimizing potential adverse effects to the environment. Overall, effective conventional waste management requires a multi-faceted approach to waste management and disposal.

The Project would produce the following types of conventional waste:

- **Domestic waste:** all non-industrial waste, non-hazardous waste, and non-LLRW generated from the camp and office areas, including living quarters and coffee rooms, as well as kitchen, food preparation, and eating areas.

- **Industrial waste:** all non-domestic waste, non-hazardous waste, and non-LLRW generated from construction, commissioning, operation, and maintenance activities for the mine and process plant.
- **Hazardous waste:** all non-domestic, non-industrial, and non-LLRW waste that is defined as a waste dangerous good in The Hazardous Substances and Waste Dangerous Goods Regulations.
- **Low-level radioactive waste:** waste with radionuclide content above established unconditional clearance levels and exemption quantities but generally has limited amounts of long-lived radionuclides. This waste type includes radiologically contaminated materials from mining and processing activities but does not include ore, special waste, tailings, gypsum, or waste rock.

To determine the best approach for Project conventional waste management, a multiple accounts analysis (MAA) assessment was conducted for each conventional waste type. Identification of alternative options to be considered within the MAA was performed to generate an initial list of conventional waste disposal alternative options by waste type that could be implemented for the Project during Construction and Operations. More information regarding the MAA conducted for conventional waste management is provided in EIS Section 4.5.17, Conventional Waste Disposal. A summary of alternative options considered for the Project is provided in Table 5B2-1.

Table 5B2-1: Conventional Waste Disposal Alternative Options Summary

Alternative	Conceptual Description[(a)]	Applicable Waste Types
On-site repurpose/recycle	Material is processed or managed on site in a manner that extends the useful life of the item	Domestic waste Industrial waste
On-site incineration	Material is incinerated on site	Domestic waste Industrial waste Hazardous waste LLRW
On-site landfilling	Construction of dedicated on-site landfill to dispose of wastes that are generated	Domestic waste Industrial waste Hazardous waste LLRW
Co-mingled disposal with mine waste	Wastes are co-disposed on site in the same footprint as the NPAG WRSA	Domestic waste Industrial waste Hazardous waste LLRW
Off-site disposal	Disposal of waste at an existing, off-site facility that is permitted to accept waste materials	Domestic waste Industrial waste Hazardous waste LLRW
Off-site repurpose/recycle	Waste is processed at an existing, off-site facility for reuse/recycling by a third party	Domestic waste Industrial waste Hazardous waste
Underground disposal[(b)]	Disposal of waste in underground mine workings	Domestic waste Industrial waste Hazardous waste LLRW

a) It is recognized that all conventional waste may not be suitable to be handled by a single alternative. The conceptual description presented is reflective of the portion of the conventional waste appropriate to be managed under each alternative.
b) To maintain compliance with The Mines Regulations, 2018 and prevent the creation of potential fire hazards in the underground mine workings, the assessment assumed that waste disposed underground would be either non-combustible or would be processed or contained in a manner that would make it non-combustible.
NPAG WRSA = non-potentially acid generating waste rock storage area; LLRW = low-level radioactive waste.

Prior to conducting the MAA, pre-screening was completed to identify and eliminate any candidate conventional waste management options that would not meet NexGen-policy, regulatory-compliance, or schedule criteria. The screening exercise eliminated underground disposal of domestic and hazardous waste as well as the surface co-mingled disposal of all waste types with mine waste.

During development of the MAA for conventional waste, NexGen actively surveyed potential off-site waste diversion and disposal facility options capable of receiving domestic and industrial waste that would be generated by the Project. Through this process, NexGen was unable to confirm a single facility or combination of facilities that would be a viable option for receiving all domestic waste and industrial waste stream volumes through the Project lifespan.

In addition to known, existing facilities, NexGen also actively sought out and engaged with Government of Saskatchewan representatives responsible for leading, in collaboration with local communities, the northwestern Saskatchewan regional municipal landfill initiatives. Discussions with the Government of Saskatchewan during EIS development confirmed that these landfill facilities were still in the planning phases. No timelines were available for when such regional facilities could receive Project waste nor confirmation of facilities' abilities to accept Project waste. Follow up conducted by NexGen since that time (as recently as April 2023) has confirmed that the Government of Saskatchewan representative has made the regional landfill group aware of NexGen's interest in being considered in planning of these facilities; however, this individual noted that the facilities are primarily envisioned to serve municipal waste requirements, and the ability to receive industrial waste has yet to be determined. Through these recent discussions, it was reconfirmed that the timing of availability of these facilities is uncertain, and confirmed that LLRW was not being considered as part of the accepted waste streams.

The results from the MAA showed that off-site repurpose/recycle was the preferred alternative for domestic waste, industrial waste, and hazardous waste, and on-site incineration was the preferred alternative for LLRW. For all waste types, off-site disposal was the second preferred alternative. Where identified as a viable alternative, underground disposal represented the third preferred alternative and, for waste types other than LLRW, on-site incineration was either the third or fourth preferred alternative (Table 5B2-2).

Table 5B2-2: Conventional Waste Alternatives Rankings by Conventional Waste Type

Category Weight	Conventional Waste Alternatives Ranking					
	On-Site Repurpose/Recycle	On-Site Incineration	On-Site Landfilling	Off-Site Disposal	Off-Site Repurpose/Recycle	Underground Disposal
Domestic	4	3	5	2	1	N/A
Industrial	5	4	6	2	1	3
Hazardous	N/A	3	4	2	1	N/A
LLRW	N/A	1	4	2	N/A	3

Legend: more preferred | neutral | less preferred

N/A = not applicable (i.e., did not pass pre-screening and not included in MAA); MAA = multiple accounts analysis; LLRW = low-level radioactive waste.

Based on the information available for the MAA, the selected alternative for domestic, industrial, and LLRW waste was on-site incineration, which represents the more-preferred alternative for LLRW and neutral alternatives for domestic and industrial wastes. With respect to domestic and industrial wastes, on-site incineration was selected as the primary waste management approach due to the uncertainty of off-site facilities being able to accept certain waste types or volumes for repurpose and recycle or disposal (Table 5B2-2). Therefore, the selection of on-site incineration provided greater certainty and flexibility for managing the domestic and industrial waste streams and, in consideration of the increased surface footprint requirements and direct effects of incinerator emissions, was deemed most conservative (i.e., following a precautionary approach) for the purposes of the EA. Should the conventional waste management approach be modified during the Project lifespan (e.g., increased off-site reuse or recycling), environmental effects are expected to be less than predicted in the EA.

The selected alternative for hazardous waste was off-site repurpose/recycle, which was also the preferred alternative (Table 5B2-2). Unlike the circumstances for other waste types, the off-site options for repurposing/recycling hazardous waste are well established and adequately equipped to safely manage this waste stream in its entirety throughout the Project lifespan.

NexGen acknowledges that the ultimate goals for the Project conventional waste management approach are to meet the long-term Project needs and protect people and the environment. In addition to incineration, maximizing reuse/repurposing and recycling of suitable materials, off-site disposal, and/or on-site underground disposal would all represent important components of the Project's conventional waste management approach. As the Project advances and opportunities to optimize waste disposal practices are identified (e.g., recycling, reuse, regional partnerships), NexGen would re-evaluate the Project's approach to conventional waste management.

5B3 ROOK I PROJECT CONVENTIONAL WASTE MANAGEMENT CONTINGENCY PLANS

While the Project would include a multi-faceted approach to conventional waste management with on-site incineration planned to be a key component of this approach, NexGen acknowledges that the provincial permitting and federal licensing processes are not yet concluded, and that the provincial permit and federal licensing applications will need to demonstrate that incinerator emissions could meet appropriate provincial and federal regulatory requirements. For this reason, the following information has been provided to demonstrate that mechanisms exist that would allow for the disposal of all Project-generated industrial waste and LLRW during Construction and Operations should incineration only be conducted for domestic waste.

5B3.1 Industrial Waste and Low-Level Radioactive Waste Volumes

The estimated mass of industrial waste and LLRW to be produced during Construction and Operations phases are presented in Table 5B3.1-1. Industrial waste and LLRW mass estimates are based on published information from other uranium mining and milling operations. These estimates are conservative as the overall waste values are likely overestimated; the total waste to be produced by the Project is expected to be less than from other uranium mining and milling operations due to the Project's design (e.g., underground tailings storage), smaller footprint, and newer infrastructure and technologies.

Within Table 5B3.1-1, the initial volume column reflects bulk (i.e., pre-processed) waste volumes by type. The low- and high-volume ranges are based on the low- and high-mass ranges contained within the published information from other uranium mining and milling operations, while the low- and high-compaction ranges are based on information sourced from an independent third-party subject matter expert.

A total of four waste volume scenarios were considered:

- **Scenario 1: low total mass estimate and high compaction ability** – this represents the least conservative scenario and assumes the low range of waste produced and high compaction ability.
- **Scenario 2: low total mass estimate and low compaction ability** – this represents the second least conservative scenario and assumes the low range of waste produced and low compaction ability.
- **Scenario 3: high total mass estimate and high compaction ability** – this represents the second most conservative scenario and assumes the high range of waste produced and high compaction ability.
- **Scenario 4: high total mass estimate and low compaction ability** – this represents the most conservative scenario and assumes the high range of waste produced and low compaction ability.

Note that the 'level of conservatism' described in comparing the four scenarios is relative and comparative, and the underlying conservative assumption for total mass estimate ranges is common to all scenarios (i.e., mass estimate ranges based on published data from other uranium mining and milling operations may not be directly comparable to conventional waste produced by the Project).

Table 5B3.1-1: Estimated Industrial and Low-Level Radiation Waste Volumes

Operations Phase

Waste Category	Waste Type	Total Mass (kg)		Density	Volume (m^3)		Compaction % (Lowest Effectiveness)[(a)]	Compaction % (Highest Effectiveness)[(a)]	Volume Post-Compaction (Lowest Effectiveness; m^3)		Volume Post-Compaction (Highest Effectiveness; m^3)	
		Low	High	kg/m^3	Low	High			Low	High	Low	High
Industrial	Plastic (rigid)	53,156	88,593	29	1,833	3,055	78%	95%	397	662	99	164
	Plastic Film	5,906	9,844	29	204	339	76%	97%	48	80	7	11
	Paper	374	623	120	3	5	67%	79%	1	2	1	1
	Cardboard	294,264	490,440	209	1,408	2,347	30%	92%	983	1,639	116	194
	Metal (Ferrous materials, buckets and drums)	763,768	1,272,947	652	1,171	1,952	50%	75%	586	976	293	488
	Clean Wood	198,535	330,892	239	831	1,384	44%	44%	465	775	465	775
	Painted or Treated Wood	56,550	94,250	239	237	394	44%	44%	133	221	133	221
	Tires	48,437	80,728	Variable	484	807	60%	60%	193	322	193	322
	Miscellaneous (Rubber products, rags, etc.)	15,779	26,161	74	213	354	60%	60%	85	141	85	141
	Industrial Total	**1,436,769**	**2,394,478**		**6,384**	**10,638**			**2,891**	**4,818**	**1,391**	**2,317**
LLRW	Plastic	639,883	1,066,471	29	22,065	36,775	78%	95%	4,781	7,968	1,187	1,978
	Paper	55,652	92,753	120	464	773	67%	79%	153	256	96	159
	Cardboard	238,025	396,709	209	1,139	1,898	30%	92%	795	1,326	94	157
	Metals	2,452,444	4,063,109	652	3,761	6,232	50%	75%	1,881	3,116	940	1,558
	Wood	2,818,767	4,697,946	239	11,794	19,657	44%	44%	6,605	11,008	6,605	11,008
	Bagged Materials	216,033	358,186	74	2,919	4,840	60%	60%	1,164	1,930	1,164	1,930
	Miscellaneous plastic, garbage and PPE	2,350,264	3,896,770	74	31,760	52,659	60%	60%	12,665	20,999	12,665	20,999
	LLRW Total	**8,771,069**	**14,571,945**		**73,903**	**122,834**			**28,044**	**46,602**	**22,751**	**37,789**
TOTAL Industrial + LLRW (Operations [per year])					**80,287**	**133,472**			**30,935**	**51,420**	**24,142**	**40,107**
TOTAL Industrial + LLRW (Operations [full phase])					**1,926,881**	**3,203,328**			**742,450**	**1,234,080**	**579,404**	**962,561**

Construction Phase

Waste Category	Waste Type	Total Mass (kg)		Density	Volume (m^3)		Compaction % (Lowest Effectiveness)[(a)]	Compaction % (Highest Effectiveness)[(a)]	Volume Post-Compaction (Lowest Effectiveness; m^3)		Volume Post-Compaction (Highest Effectiveness; m^3)	
		Low	High	kg/m^3	Low	High			Low	High	Low	High
Industrial	Plastic (rigid)	14,799	23,124	29	510	797	78%	95%	111	173	27	43
	Plastic Film	1,644	2,569	29	57	89	76%	97%	13	21	2	3
	Paper	104	163	120	1	1	67%	79%	0	0	0	0
	Cardboard	81,924	128,013	209	392	613	30%	92%	274	428	32	51
	Metal (Ferrous materials, buckets and drums)	212,635	332,261	652	326	510	50%	75%	163	255	82	127
	Clean Wood	55,273	86,369	239	231	361	44%	44%	130	202	130	202
	Painted or Treated Wood	15,744	24,601	239	66	103	44%	44%	37	58	37	58
	Tires	13,485	21,071	Variable	135	211	60%	60%	54	84	54	84
	Miscellaneous (Rubber products, rags, etc.)	4,393	6,829	74	59	92	60%	60%	24	37	24	37
	Industrial Total	**400,000**	**625,000**		**1,777**	**2,777**			**805**	**1,258**	**387**	**605**
LLRW	Plastic	4,888	7,465	29	169	257	78%	95%	37	56	9	14
	Paper	425	649	120	4	5	67%	79%	1	2	1	1
	Cardboard	1,818	2,777	209	9	13	30%	92%	6	9	1	1
	Metals	18,734	28,441	652	29	44	50%	75%	14	22	7	11
	Wood	21,532	32,884	239	90	138	44%	44%	50	77	50	77
	Bagged Materials	1,650	2,507	74	22	34	60%	60%	9	14	9	14
	Miscellaneous plastic, garbage and PPE	17,953	27,276	74	243	369	60%	60%	97	147	97	147
	LLRW Total	**67,000**	**102,000**		**565**	**860**			**214**	**326**	**174**	**265**
TOTAL Industrial + LLRW (Construction [per year])					**2,342**	**3,637**			**1,019**	**1,584**	**561**	**869**
TOTAL Industrial + LLRW (Construction [full phase])					**9,367**	**14,546**			**4,077**	**6,335**	**2,244**	**3,478**
TOTAL Industrial + LLRW (Construction and Operations)					**1,936,248**	**3,217,874**			**746,526**	**1,240,415**	**581,648**	**966,038**
TOTAL Industrial (Construction and Operations)					**160,326**	**266,424**			**72,607**	**120,658**	**34,930**	**58,037**
TOTAL LLRW (Construction and Operations)					**1,775,923**	**2,951,450**			**673,919**	**1,119,756**	**546,719**	**908,002**

Note: for compaction %, the mean of the effectiveness range was used for the compaction type (i.e., compacting, baling, or shredding) that was categorized as low or high based on compaction effectiveness.
a) Shredding only considered for wood waste as shredding of other products typically used for incinerator preparation.
LLRW = low-level radioactive waste; PPE = personal protective equipment.

Table 5B3.1-1 shows that during Construction and Operations, the anticipated total industrial waste and LLRW volumes (post-compaction) range from approximately 582,000 m^3 to 1,240,000 m^3, with the anticipated LLRW volume (post-compaction) ranging from approximately 547,000 m^3 to 1,120,000 m^3; these industrial waste and LLRW volumes include both recyclable and non-recyclable materials.

For the purposes of the preliminary conventional waste balance exercise, NexGen assumed that disposal would be required for all industrial waste and LLRW produced during the Construction and Operations phases (e.g., recyclables); this approach includes another layer of conservatism to the waste management balance exercise conducted for underground storage capacity.

5B3.2 Underground Storage Capacity

During Construction and Operations, underground void space would be available for the storage of conventional waste. Void spaces available for waste storage include underground tailings management facility lateral developments and other underground mine lateral developments. Mine stopes were not assumed to be available for conventional waste storage as these areas are anticipated to be backfilled with cemented paste backfill. Mine shafts were also not assumed to be available for conventional waste storage as space available within the mine shafts is reserved for waste generated during the Closure Phase (EIS Appendix 5A, Conceptual Preliminary Decommissioning and Reclamation Plan). Available storage space at the end of Construction, Operations (Year 5), and Operations (end of mine life [i.e., Year 24]) is presented in Table 5B3.2-1.

Table 5B3.2-1: Underground Waste Storage Capacities

Project Phase (Time)	Void Space Type	Lateral Development Available for Fill	Volume Available	Volume Utilization[(a)]	Total Storage Volume Available
Construction (End of Phase)	Lateral developments	8,000 m	210,000 m^3	70%	147,000 m^3
	Total (Construction)	**8,000 m**	**210,000 m^3**		**147,000 m^3**
Operations (Year 5)	UGTMF lateral developments	3,800 m	90,000 m^3		63,000 m^3
	Other lateral developments	25,000 m	600,000 m^3		420,000 m^3
	Total (Operations Year 5)	**28,800 m**	**690,000 m^3**		**483,000 m^3**
Operations (Year 24)	UGTMF lateral developments	10,000 m	230,000 m^3		161,000 m^3
	Other lateral developments	50,000 m	1,150,000 m^3		805,000 m^3
	Total (end of mine life)	**60,000 m**	**1,380,000 m^3**		**966,000 m^3**

Note: lateral development and volume available numbers are based on 2023 mine plan estimates. These estimates are conservative, and do not account for any lateral development required for primary transportation within the mine workings that would be incrementally available as the mine is decommissioned during the Closure Phase.
a) To allow for a conservative assessment of available void space, it was assumed that 70% of the total underground void space available would be utilized for conventional waste storage.
UGTMF = underground tailings management facility.

In consideration of the waste scenarios discussed in Section 5B3.1, the total storage volume available at the end of Operations (i.e., 966,000 m^3) represents sufficient volume to store 100% of the combined waste (i.e., industrial waste and LLRW waste) for Scenario 1, Scenario 2, and Scenario 3, and 78% of the combined waste for Scenario 4 (86% for LLRW only). For Scenario 4, additional storage capacity of approximately 274,000 m^3 would be required for combined waste and 154,000 m^3 would be required for LLRW only. The total storage volume available at the end of Operations does not consider additional lateral development (and corresponding volume available for waste storage) that would be available as the underground mine workings transition into Closure; during the Closure Phase, additional lateral development (e.g., that used for primary access within the mine workings) would be incrementally available for waste storage as the mine is decommissioned.

While these preliminary calculations show that there is one scenario (i.e., Scenario 4) where the total volume of Project Construction and Operations industrial waste and LLRW may exceed the available underground volumes, NexGen believes that this exceedance being realized during the Project lifespan is unlikely. A high level of conservatism has been incorporated into these waste volume outputs, including mass conservatism (i.e., estimates based on public data from other mine and mills, which are anticipated to overestimate values; high mass range for Scenario 4), compaction conservatism (i.e., low compaction range for Scenario 4), available storage area conservatism (e.g., utilization of only 70% of available void volume, not considering lateral development that would be available during the Closure Phase as mine workings are decommissioned), and waste management approach conservatism (i.e., underground disposal would be required for all industrial waste and LLRW, which is inconsistent with NexGen's goal to maximize reuse/repurposing and recycling of suitable materials), along with the assumption that incineration would not be part of the industrial waste and LLRW management approach.

With respect to LLRW, the total available void space would accommodate 100% of the LLRW for all scenarios except for Scenario 4. While NexGen notes that the outcomes of Scenario 4 are unlikely for the reasons stated above, it is expected that, should an exceedance of LLRW occur, opportunities would exist to remediate (i.e., clean) sufficient LLRW volumes to allow for off-site disposal along with any excess industrial waste.

Management and tracking of waste generation and disposal during Construction and Operations phases would provide ample opportunity to determine what, if any, additional waste management approaches would be required, in the unlikely event an excess of industrial waste and LLRW were to occur.

5B3.3 Industrial Waste Off-Site Disposal

As noted in Section 5B2, currently there are no regional landfills available to accept all industrial waste volumes produced by the Project, and potential, future regional municipal landfills are only in the planning phase. Also, it is unclear whether future regional landfills, should they be created, would accept industrial waste or LLRW. While NexGen will continue to work with local communities and provincial governments during regional landfill planning processes, there are other non-local, provincial diversion and disposal facilities that may be able to accept Project waste, should additional Project waste disposal capacity be required. These diversion and disposal facilities are presented in Table 5B3.3-1. It is noted that, in the event that future regional municipal landfills are developed, some of the facilities listed in Table 5B3.3-1 may be decommissioned.

Table 5B3.3-1: Information for Off-site Diversion and Disposal Facilities

Facility	Materials Handled	Distance to Site	Contact Information
Northwest Regional Landfill (Meadow Lake)	Domestic and industrial waste (e.g., tires, appliances, clean cement, wood)	488 km	Administrator 1 (780) 826-0497
La Ronge Regional Landfill	Domestic waste (e.g., metals, clean wood)	548 km	1 (306) 420-5492
Material Recovery Facility Landfill and Organics	Domestic recyclables (e.g., paper, cardboard, household plastic)	800 km	Loraas Disposal North 1 (306) 242-2300 customerservice@loraas.ca
SARCAN Recycling	Domestic recyclables (e.g., deposit beverage containers, electronics)	Multiple locations	Multiple locations
City of Prince Albert Landfill	Domestic and industrial waste (e.g., metal, yard waste)	661 km	1 (306) 953-4900
Call2Recycle	Consumer batteries	See website	1 (888) 224-9764 https://www.call2recycle.ca/saskatchewan/
Hazardous Waste Facilities	Hazardous wastes	800 km	GFL Saskatoon 1 (306) 244-9500
Product Care Association of Canada	Hazardous wastes (e.g., paint, flammable, corrosive, toxic, environmentally hazardous)	See website	info@recyclesaskatchewan.ca https://www.productcare.org/products/paint/saskatchewan/

km = kilometre.

Recycling

As noted in Section 5B3.1, the industrial waste and LLRW volumes included in Table 5B3.1-1 include both recyclable and non-recyclable materials. Industrial waste types that could be recycled by utilizing existing established facilities (Table 5B3.3-1), by returning to suppliers, or through Saskatchewan-based stewardship programs include: plastic, paper, cardboard, metal, wood, and tires.

These recyclable material types represent approximately 33,000 m^3 to 115,000 m^3 of the post-compaction industrial waste volumes presented in Table 5B3.1-1. Conservatively assuming that 50% of these materials would be suitably clean for off-site recycling, this volume would represent up to approximately 60,000 m^3 of industrial waste not requiring on-site management (e.g., incineration, underground disposal) for Scenario 4. These volumes account for recycling of industrial waste only, and do not consider any LLRW streams that could be cleaned and recycled in a similar manner, if required to meet conventional waste management objectives.

Non-recyclable Industrial Waste

In the event that incineration of industrial waste and LLRW does not form part of Project design, utilization of existing facilities for off-site recycling has been maximized, and the available underground storage space does not accommodate the total industrial waste and LLRW produced by the Project, NexGen could also arrange to have non-recyclable industrial waste shipped off-site to other non-local, provincial diversion and disposal facilities. If required, LLRW streams could be cleaned and disposed of in a similar manner, if required to meet conventional waste management objectives.

5B4 ROOK I PROJECT CONVENTIONAL WASTE MANAGEMENT SUMMARY

Effective conventional waste management requires a multi-faceted approach to waste disposal. As such, it is acknowledged that many alternative options available for the proposed Project are not mutually exclusive, and that different alternative options are expected to be employed in parallel, in series, or in conjunction with one another to meet the long-term needs of the Project and protect people and the environment. Given that multiple alternative options could be utilized and that some options may be not available during certain Project activity timelines, the selected alternative for each waste type was determined based on the certainty of achievability and in consideration of a precautionary (i.e., conservative) approach for determining potential effects of the Project on the environment within the EA.

While incineration currently represents a key component of the Project conventional waste management approach, contingency plans exist should it not be possible to demonstrate that incineration of industrial waste and LLRW could meet provincial and federal regulatory requirements. Underground void spaces from production and UGTMF lateral developments are anticipated to be able to store most or all industrial waste and LLRW generated during Construction and Operations. Where conservative assumptions were used (e.g., high waste volumes, low waste compaction wastes, no on-site reusing or recycling of materials) and potential excess of industrial waste and LLRW is shown to potentially occur, it is expected that off-site diversion and disposal, including reusing and recycling, could be utilized to appropriately and safely manage these excesses.

As the Project advances, additional information becomes available, and opportunities to optimize conventional waste disposal practices are identified (e.g., recycling, reuse), employment of currently known alternatives or additional new alternative options would be reconsidered within the conventional waste management approach, as necessary. As the EA used a precautionary approach, it is expected that effects associated with any potential adjustments in the conventional waste management approach would already be sufficiently and appropriately captured within the established conservatism of the effects assessments in the EIS. Overall, several measures are anticipated to be part of the Project conventional waste management strategy including incineration, reusing and recycling materials, underground storage, and off-site diversion and disposal.

5B5 REFERENCES

The Mines Regulations, 2018. RRS c S-15.1 Reg 8. Effective 6 April 2019. Available at https://www.canlii.org/en/sk/laws/regu/rrs-c-s-15.1-reg-8/latest/rrs-c-s-15.1-reg-8.html.

Rook I Project

Environmental Impact Statement

Section 6 Environmental Assessment Approach and Methods

Submitted to:

Canadian Nuclear Safety Commission

Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Abbreviations

Abbreviation	Definition
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CNSC	Canadian Nuclear Safety Commission
COPC	constituent of potential concern
CRDN	Clearwater River Dene Nation
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERA	environmental risk assessment
IKTLU	Indigenous Knowledge and Traditional Land Use
JWG	Joint Working Group
LSA	local study area
LPA	local priority area
MN-S	Métis Nation – Saskatchewan
NexGen	NexGen Energy Ltd.
pH	potential of hydrogen; measure of the acidity or alkalinity of a solution on a scale of 0 to 14
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
VC	valued component

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6 ENVIRONMENTAL ASSESSMENT APPROACH AND METHODS

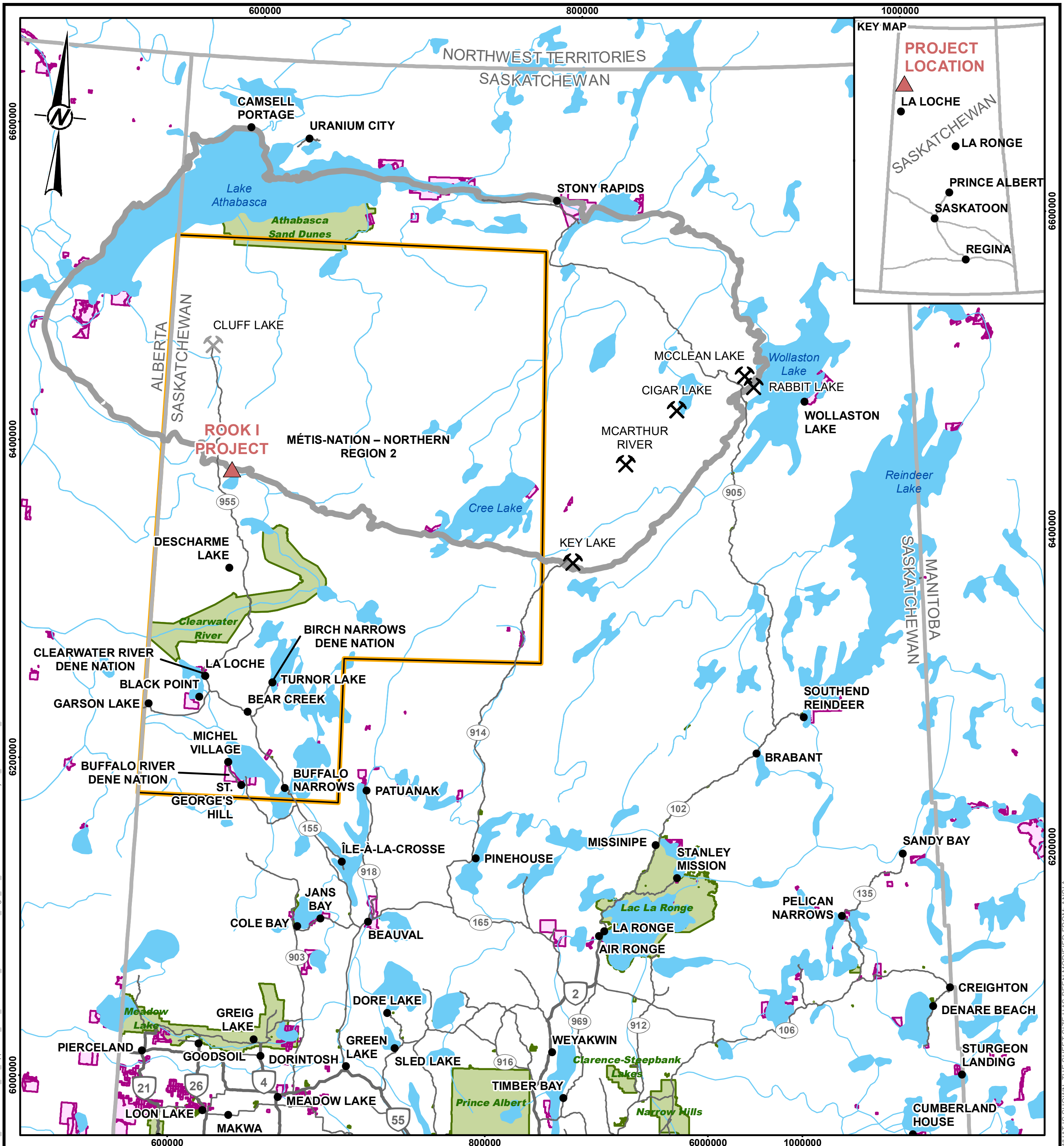
6.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located 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 (Figure 6.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 6.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 6.1-3):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility;
- potentially acid generating waste rock storage area;
- non-potentially acid generating waste rock storage area;
- special waste rock [1] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant, and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT

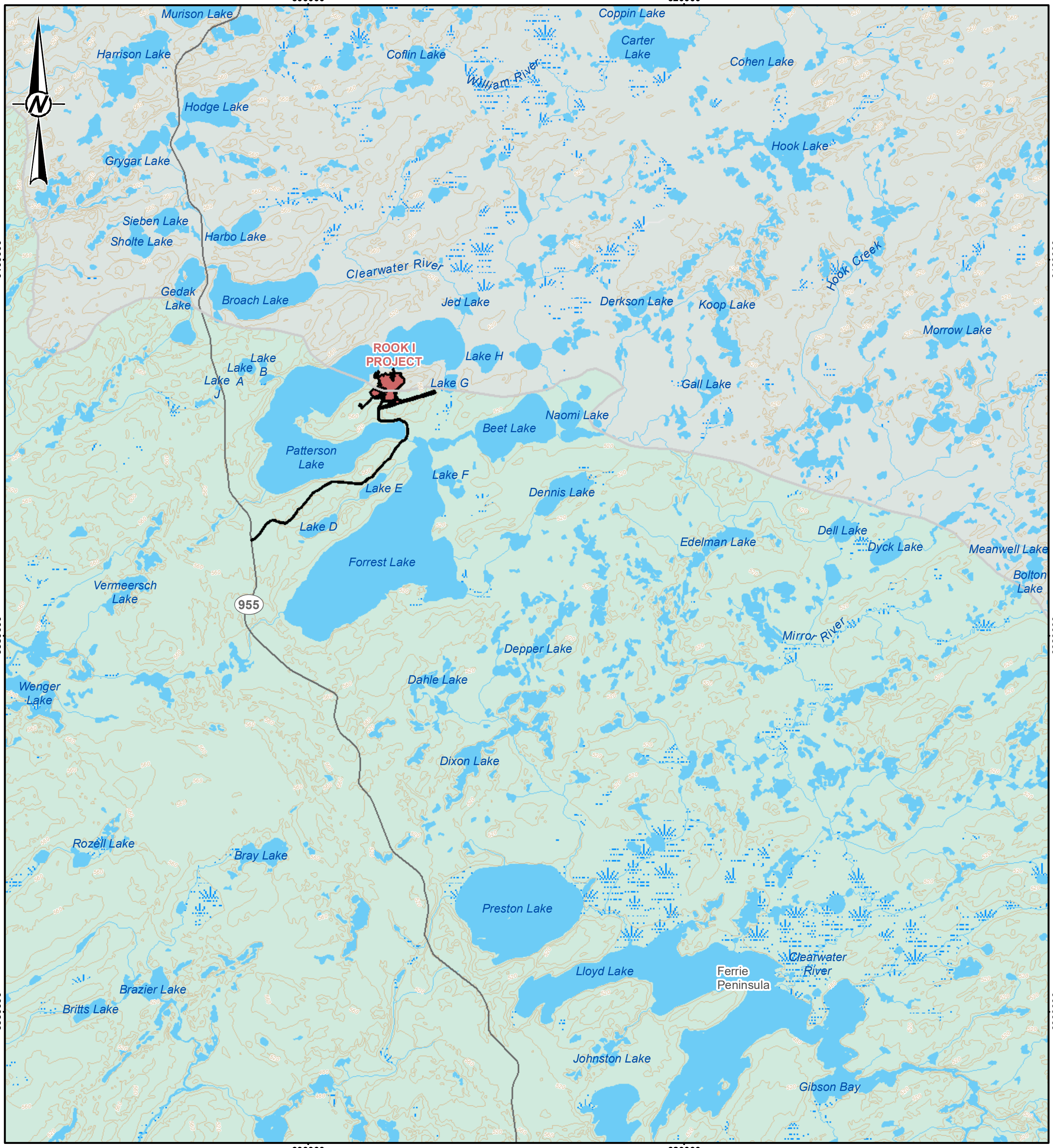
CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV.	0

FIGURE 6.1-1

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 6.1-2

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\06_EA_Approach_and_Methods\8_5x11\20144150_Fig6_1-2_Regional-Area_Rook_I_Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-07 AT: 11:10:37 AM

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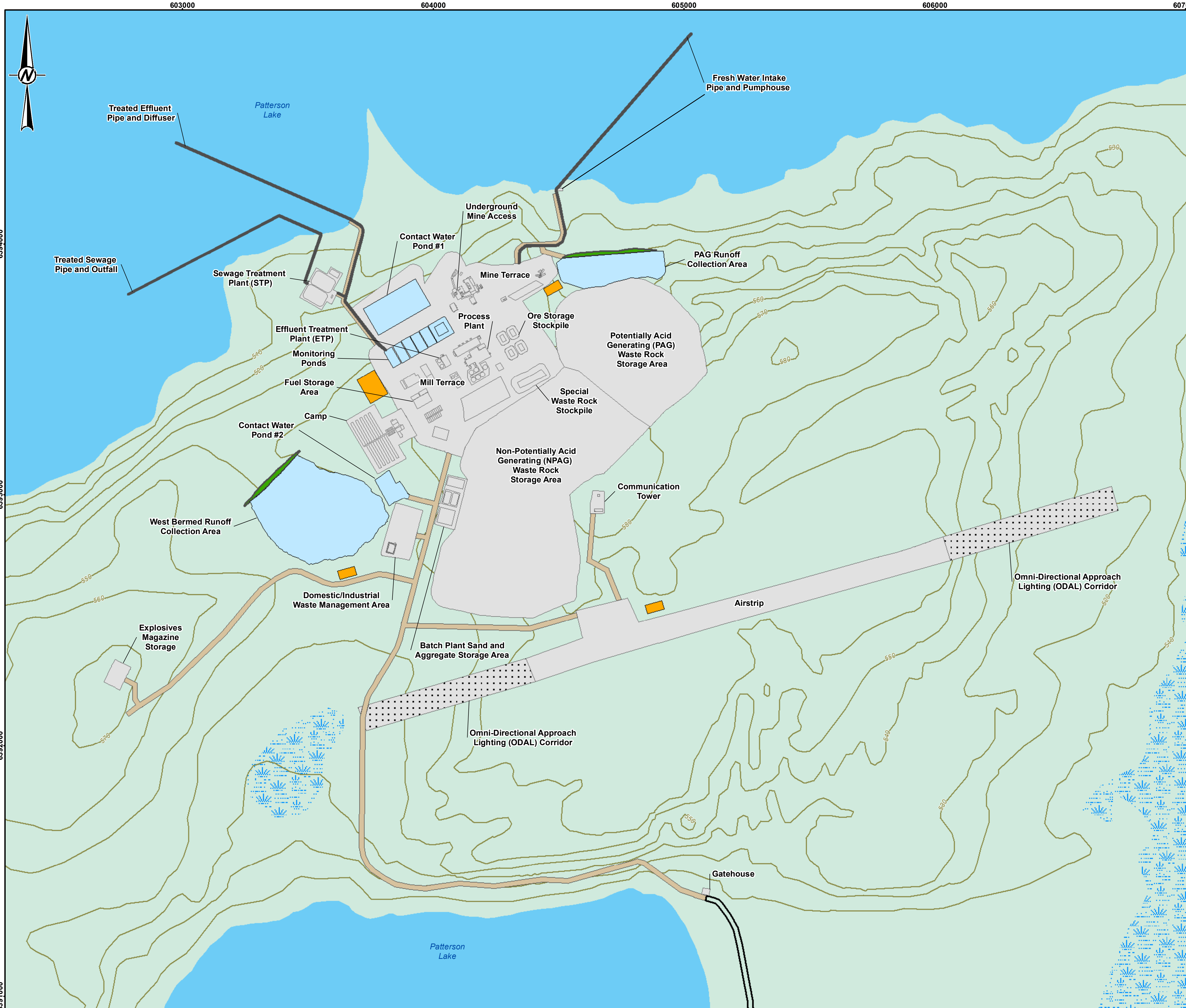
25mm 0



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT	PROJECT	20144150	SCALE AS SHOWN	REV. 0
wsp	**FIGURE 6.1-3**			

6.1.1 Purpose and Scope

The Environmental Assessment (EA) process is a tool for proponents to integrate environmental and social factors into project planning and decision making. The following are additional goals of the EA process:

- Engage Indigenous communities, government agencies, and the public.
- Assess whether a project is likely to have significant adverse effects after mitigation measures are implemented.
- Promote the sustainable development of natural resources.

The purpose of Section 6, Environmental Assessment Approach and Methods, is to describe the scope and general approach and methods applied for the Project EA. The scope and general approach and methods have been designed to meet both the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment and the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables).

The scope of the EA is to identify and evaluate the potential adverse effects and benefits associated with the Project. The Project would span a 43-year period from the beginning of Construction, through Operations, to the end of Decommissioning and Reclamation (i.e., Closure). For the purposes of the EA, the effects from all Project phases, as well as the longer-term effects that extend beyond Closure, were considered. Project details are provided in Section 5, which considered the evaluation of Project alternatives (Section 4) and engineering design as well as feedback from engagement (Section 2, Indigenous, Regulatory, and Public Engagement).

The general approach to an EA entails a systematic consideration of how project components and activities may interact with the environment and result in effects on the biophysical, cultural, and socio-economic environments. Section 5 of the *Canadian Environmental Assessment Act, 2012* describes the environmental effects that must be considered in an EA, including changes to the environment and the associated effects of these changes on the environment. Where potential adverse effects are identified, either from normal operating activities or from potential accidents and malfunctions, feasible environmental design features and/or mitigation practices are implemented to avoid or minimize these potential adverse effects. Applying mitigation follows the precautionary principle, which states that "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (IAAC 2020a). To align with the precautionary principle, a conservative approach is applied in EAs when information is limited so that effects are typically overestimated.

The existing or current conditions of the biophysical, cultural, and socio-economic environments are described in the Environmental Impact Statement (EIS) as a basis to identify, assess, and determine the significance of potential adverse effects of the Project. Baseline studies were conducted to support the characterization of the environment before disturbance from the Project. Baseline studies involved the collection of data from field programs and socio-economic studies. The understanding of the existing conditions also informed Project design features and potential mitigation measures that may be required.

Environmental design features and mitigation measures can include project engineering design elements, environmental best practices, management policies, programs, plans, and procedures, and social programs. Management measures can also include contingency plans and emergency response plans to prevent effects that could result from accidents and malfunctions. Social programs may also enhance beneficial aspects of a project.

In addition to assessing the effects from a project, the assessment must include an analysis of the cumulative effects that are likely to result from a project in combination with other developments (CEA Agency 2018a). Consideration is also given to the potential effects of the environment on a project.

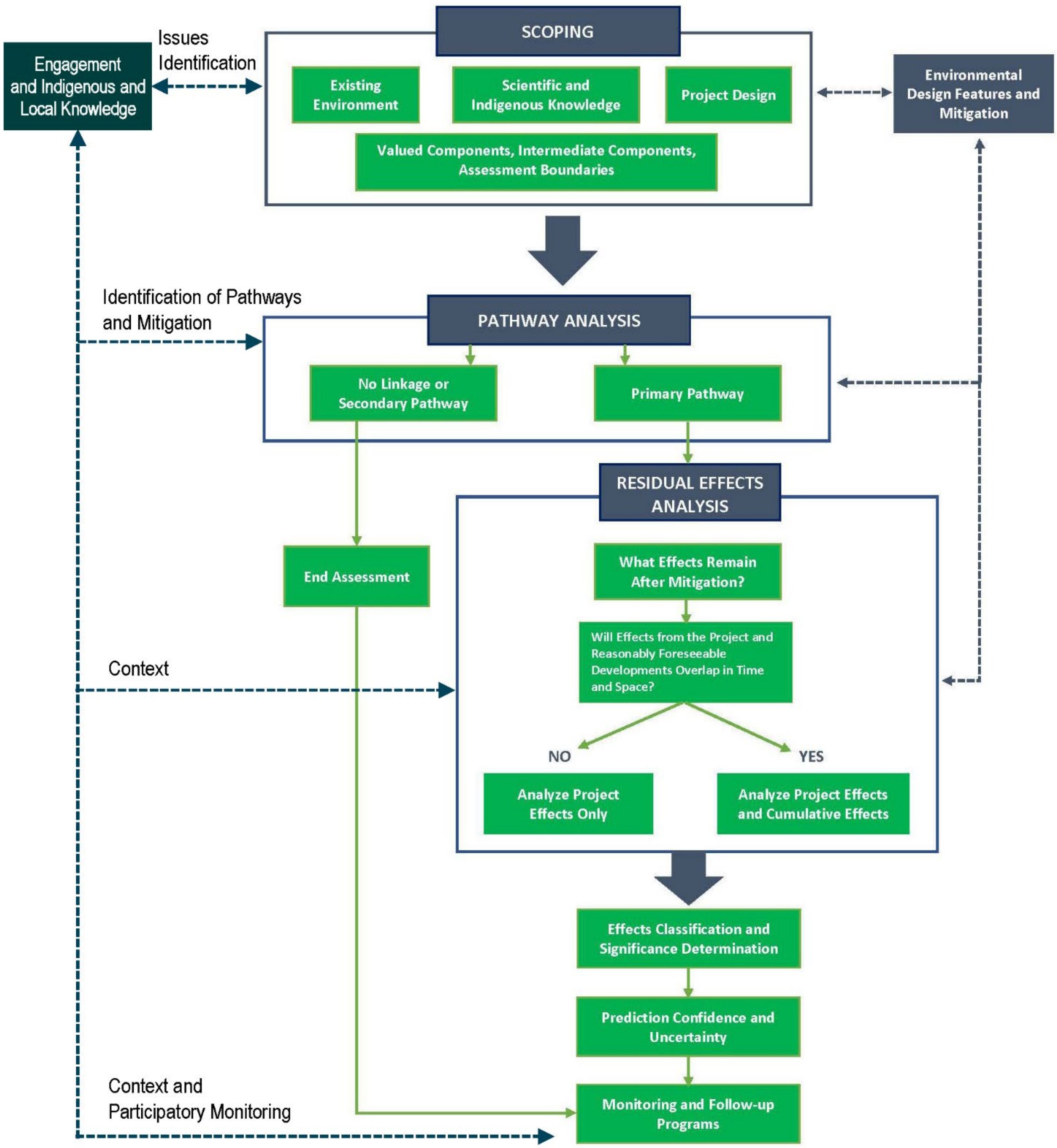
6.1.2 Approach

The EA approach was applied to individual disciplines (e.g., air quality, hydrology, Indigenous land and resource use), as described in Sections 7 to 19 of the EIS, and included the following steps, where applicable (Figure 6.1-4):

- Describe how Indigenous Knowledge was collected and incorporated into the EIS (Section 6.2).
- Define the valued components (VCs) and intermediate components, as well as the associated assessment endpoints and measurement indicators, for the biophysical, social, heritage, cultural, and economic aspects of the environment that could be potentially affected by the Project (Section 6.3, Assessment Scoping).
- Define the spatial and temporal boundaries of the EA (Section 6.4, Assessment Boundaries).
- Describe the assessment cases, which consider existing conditions, the Project, and other reasonably foreseeable developments (RFDs; Section 6.5, Assessment Cases).
- Describe the existing conditions, which include the combined effects of previous, existing, and approved projects, to provide context for evaluating potential incremental effects (i.e., Project-specific) and cumulative effects from existing conditions, the Project, and RFDs (Section 6.6, Existing Conditions Characterization).
- Provide the definitions of pathways and general approach and methods for evaluating relevant effects pathways (i.e., interactions) between the Project and biophysical, cultural, socio-economic, and human health VCs and intermediate components (Section 6.7, Pathways Analysis). This step included consideration of environmental design features and mitigation.
- Complete an assessment for associated primary pathways to predict Project-specific residual effects for each VC and intermediate component as well as residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs, if applicable (Section 6.8, Residual Effects Analysis).
- Classify and tabulate residual effects using the following criteria: direction, magnitude, geographic extent, duration, frequency, reversibility, and probability of occurrence to provide structure and comparability across VCs and intermediate components. Once residual effects were defined, a significance determination for VCs was completed (Section 6.9, Residual Effects Classification and Determination of Significance).
- Identify key uncertainties in the EA and describe how these uncertainties were addressed to achieve a precautionary assessment. Discuss the implications of the approaches used to address uncertainties and the level of confidence in the residual effects analysis (Section 6.10, Prediction Confidence and Uncertainty).
- Propose monitoring and follow-up activities to verify the predicted residual effects; evaluate the effectiveness of planned mitigation designs, policies, and practices; and address key sources of uncertainty (Section 6.11, Monitoring, Follow-Up, and Adaptive Management).

All biophysical, cultural, socio-economic, and human health disciplines followed the general framework presented in this section. The approach and methods were tailored for each discipline to assess effects of the Project on that discipline and to account for the selected VCs and intermediate components. Discipline-specific assessment methods are presented in each discipline section of the EIS.

Figure 6.1-4: Assessment Approach



6.2 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge was integrated into the development of the Project, including the EA process. Indigenous and Local Knowledge was incorporated into the EIS by integrating the results from Indigenous Knowledge and Traditional Land Use (IKTLU) Studies and from engagement with local priority area (LPA)[2] community members. The IKTLU Studies include all land use studies developed by the Project's affected First Nations and Métis Groups (collectively referred to as Indigenous Groups), including Traditional Land Use and Occupancy studies, Traditional Knowledge and use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as IKTLU Studies. In addition to IKTLU Studies, Joint Working Groups (JWGs) were established with the Project's primary Indigenous Groups as a mechanism to discuss details of the Project and further enable opportunities to capture and include Indigenous and Local Knowledge into the Project. The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake. The four primary Indigenous Groups are:

- Clearwater River Dene Nation (CRDN);
- Métis Nation – Saskatchewan (MN-S), representing MN-S Northern Region 2 (NR2);
- Birch Narrows Dene Nation (BNDN); and
- Buffalo River Dene Nation (BRDN).

Available sources of Indigenous and Local Knowledge were shared with the EA discipline leads (i.e., specialists leading the assessments for social and environmental disciplines such as hydrology, water quality, wildlife and wildlife habitat, Indigenous land and resource use, community well-being, and others) for their review and incorporation into their respective assessments. Specifically, the discipline leads were responsible for reviewing the IKTLU Studies and JWG meeting transcripts for applicable Indigenous and Local Knowledge to include in their assessments. In addition, a guidance document was distributed to the discipline leads that outlined the definitions of Indigenous and Local Knowledge, the sources of available Indigenous and Local Knowledge, how to appropriately include Indigenous and Local Knowledge, and how to document the Indigenous and Local Knowledge included in their assessments.

The incorporation of Indigenous and Local Knowledge into each discipline assessment was reviewed for accuracy and consistency by an EA coordinator with experience incorporating Indigenous and Local Knowledge into EAs, and to determine if there was any additional information to be considered by cross-referencing the Indigenous and Local Knowledge that was used in the assessments with what was available in the sources provided. This step served as an additional check that available and applicable Indigenous and Local Knowledge was captured in the appropriate way and was not misinterpreted or taken out of context.

General concerns (e.g., Project effects on water) and specific issues (e.g., Project effects on the water quality of Patterson Lake) expressed by Indigenous Groups and LPA communities through the collection of Indigenous and Local Knowledge that were relevant to VCs and intermediate components were considered and used to inform the scoping of Project interactions and identify potential Project effects (i.e., how they were considered in the pathways analysis). Further information on issues and concerns raised by Indigenous Groups and LPA communities is provided in Section 2.

[2] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.

6.3 Assessment Scoping

Assessment scoping was the initial step in the development of the EA and involved selecting VCs to focus the assessment on attributes of the biophysical, cultural, and socio-economic environments that are most important to people. Intermediate components were also selected because they are necessary to support the assessment of VCs.

6.3.1 Valued Components

Valued components are aspects of the biophysical, cultural, and socio-economic environments that are considered to have scientific, social, cultural, economic, historical, archaeological, or aesthetic importance (Beanlands and Duinker 1983; CNSC 2021). Valued components are identified to be of concern by the proponent, scientists, government agencies, Indigenous Peoples, or the public (CEA Agency 2018b). The selection of appropriate VCs allows an EA to be focused on those aspects of the biophysical, cultural, and socio-economic environments that are of greatest importance to both society and species conservation. Focusing an EA on VCs facilitates decision making by regulatory agencies with respect to a project.

The BNDN and BRDN define VCs as tangible biophysical resources (e.g., particular places and species) and less tangible (i.e., intangible, not physical) social, economic, cultural, health, and knowledge-based values (e.g., social cohesion, place names, Indigenous language; TSD II: BNDN; TSD III: BRDN). Additionally, the Canadian Environmental Assessment Agency[3] (CEA Agency 2015) was cited in an IKTLU study (TSD IV: MN-S), which stated:

> Physical and cultural heritage refers to the “important aspects of human history and culture [that] encompass various social, economic, political, environmental, scientific, natural and cultural dimensions . . . . Spiritual and cultural practices of Aboriginal Groups” are often integrally linked to specific locations and surrounding landscape features, as well as objects of social significance.

Valued components were selected using the results from baseline studies and IKTLU Studies and feedback from engagement with regulators, Indigenous Groups, and the public. The following factors were considered when developing the list of VCs for the Project:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;
- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occur;
- species conservation status or concern (e.g., rarity, sensitivity, uniqueness);
- Indigenous and Local Knowledge obtained from feedback during community engagement sessions for the Project in La Loche, Turnor Lake, Buffalo River, and Buffalo Narrows (Sections 2 and 3); information provided by IKTLU Studies (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD VI: YNLR) and obtained through discussions with the JWGs;
- ecological and socio-economic/cultural value to communities, government agencies, and the public;
- inclusion in Appendix C of REGDOC 2.9.1 (CNSC 2020);
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and

[3] Now the Impact Assessment Agency of Canada.

- avoidance of redundancy with other VCs; if two potential VCs represent the same issues, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

The VCs selected focused on particular species or receptors within a discipline (e.g., moose [*Alces americanus*] is a VC within wildlife and wildlife habitat, traditional use plants are a VC within vegetation, camp worker is a receptor within the human health VC) or were synonymous with the discipline (e.g., cultural and heritage resources is a VC). The rationale for the specific VCs selected is provided in each applicable discipline section of the EIS (Section 7 to Section 19).

6.3.2 Assessment Endpoints and Measurement Indicators

Each VC assessment used assessment endpoints and measurement indicators to structure the analyses and facilitate assessment conclusions and determination of significance. Assessment endpoints are qualitative expressions that represent the key properties of VCs that should be protected. These endpoints provide additional definition to VCs to support the residual effects assessment and significance determination. Measurement indicators represent physical and biological/human attributes of the biophysical, cultural, and socio-economic environments that can be measured to help inform the assessment of VCs.

Assessment endpoints incorporate the concept of sustainability. In this context, sustainability means “the ability to protect the environment, contribute to the social and economic well-being of the people of Canada, and preserve their health in a manner that benefits present and future generations” (IAAC 2020a). At a high level, sustainability means meeting this generation’s needs without compromising the ability of future generations to meet their own needs.

Environmental sustainability considers the maintenance of ecological integrity, and social sustainability considers economic stability and healthy communities. For example, the assessment endpoint for certain biophysical VCs (e.g., VCs within the fish and wildlife disciplines) considered the maintenance of self-sustaining and ecologically effective populations, whereas the assessment endpoint for the socio-economic VC of community well-being considered the ability to maintain the current way of life or community well-being. Sustainability concepts, scientific principles, and the outcomes from engagement (Section 2) and IKTLU Studies were used to help define the assessment endpoints for biophysical, cultural, and socio-economic VCs.

Because assessment endpoints are typically not quantifiable, one or more measurement indicators are linked to each assessment endpoint to inform conclusions on the ability to maintain or achieve assessment endpoints and thereby characterize effects on VCs. Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, can be key variables for study in potential follow-up and monitoring programs. The rationale and description of measurement indicators for VCs are provided in each applicable discipline section (Section 7 to Section 19).

The significance of effects from the Project on a VC was evaluated by linking changes in measurement indicators to effects on the VC in the context of the associated influences on assessment endpoint(s) (Section 6.9.2, Significance Determination). Determining whether an assessment endpoint is maintained or achieved requires the compilation and interpretation of the results from several measurement indicators and the predicted effects on VCs; these lines of evidence collectively provide a meaningful evaluation of expected changes in the assessment endpoint for the VC, as described in Section 6.8 and Section 6.9.

The primary rationales for VCs and the associated assessment endpoints and measurement indicators used in the EIS are presented in Table 6.3-1.

Table 6.3-1: Valued Components and Associated Assessment Endpoints and Measurement Indicators

Discipline	VCs	Rationale for Selection	Measurement Indicators	Assessment Endpoints
Climate change	▪ Climate change	▪ Greenhouse gases (GHG) contribute to climate change ▪ Socio-economic/cultural importance ▪ Federal and provincial plans associated with greenhouse gas emissions reductions and climate change	▪ Project GHG emissions of CO_2 ▪ Project GHG emissions of CH_4 ▪ Project GHG emissions of N_2O	▪ Contribution of Project's GHG emissions to the provincial and federal totals ▪ Continued ability for Canada to reach climate change commitments in the form of emission reduction targets
Fish and fish habitat	▪ Lake trout (*Salvelinus namaycush*) ▪ Lake whitefish (*Coregonus clupeaformis*)[(a)] ▪ Walleye (*Sander vitreus*) ▪ Northern pike (*Esox lucius*)[(a)]	▪ Traditional and/or current food source ▪ Socio-economic/cultural importance ▪ Ecological importance ▪ Relatively abundant in nearby lakes and/or the Clearwater River	▪ Habitat availability (i.e., habitat quantity and quality) ▪ Habitat distribution (i.e., habitat arrangement and connectivity) ▪ Survival and reproduction	▪ Self-sustaining and ecologically effective fish populations
Vegetation	▪ Upland ecosystems ▪ Wetland ecosystems ▪ Riparian ecosystems	▪ Ecosystems contain plants that represent both traditional and current food sources ▪ Socio-economic/cultural importance ▪ Critical attribute of biodiversity ▪ Provide wildlife habitat ▪ Wetlands provide important hydrologic and biochemical functions ▪ Sensitive to disturbance ▪ Federal and/or provincial species at risk protected by legislation	▪ Ecosystem availability (i.e., amount) ▪ Ecosystem distribution (i.e., arrangement and connectivity) ▪ Ecosystem condition (i.e., integrity)	▪ Self-sustaining and ecologically effective ecosystems
	▪ Traditional use plants[(b)]	▪ Plant species identified during IKTLU Studies and JWG meetings ▪ Social/cultural importance	▪ Habitat availability (i.e., amount of habitat occupied by traditional use plant species) ▪ Habitat distribution (i.e., arrangement and connectivity of habitat occupied by traditional use plant species)	▪ Self-sustaining and ecologically effective traditional use plant populations
Wildlife and wildlife habitat	▪ Woodland caribou (*Rangifer tarandus caribou*)[(a)] ▪ Moose[(a)] ▪ Wolf (*Canis lupus*)[(a)] ▪ Black bear (*Ursus americanus*)[(a)] ▪ Beaver (*Castor canadensis*)[(a)] ▪ Little brown myotis (*Myotis lucifugus*)[(a)] ▪ Olive-sided flycatcher (*Contopus cooperi*) ▪ Mallard (*Anas platyrhynchos*)[(a)] ▪ Goldeneye (*Bucephala clangula*) ▪ Rusty blackbird (*Euphagus carolinus*)[(a)] ▪ Canadian toad (*Anaxyrus hemiophrys*)	▪ Traditional and/or current food source ▪ Federal and/or provincial species at risk protected by legislation ▪ Socio-economic/cultural importance ▪ Ecological importance ▪ Potential to be exposed to chemical changes in air, soil, surface water, dietary items, or sediment quality resulting from the Project	▪ Habitat availability (i.e., quantity and quality) ▪ Habitat distribution (i.e., arrangement and connectivity) ▪ Animal survival and reproduction	▪ Self-sustaining and ecologically effective wildlife populations
Human health	▪ Human health o Camp worker[(c)] o Subsistence harvester[(c)] o Seasonal resident / lodge operator[(c)] o Future permanent resident of the Patterson Lake North Arm area[(c)]	▪ Protection of human health is a core value of NexGen and a key interest identified by communities and regulators ▪ People may be exposed to changes in air quality, soil, surface water, plants, fish, and wildlife resulting from Project activities ▪ Traditional and/or current food source security ▪ Socio-economic/cultural importance	▪ Hazard quotient ▪ Lifetime cancer risk ▪ Radiation dose	▪ Protection of human health
Cultural and heritage resources	▪ Cultural and heritage resources	▪ Heritage and archaeological resources have spiritual and/or cultural importance to Indigenous Peoples and communities and the public ▪ Archaeological sites are protected under *The Heritage Property Act*	▪ Number, quality, and significance of archaeology and heritage sites in the heritage study area	▪ Protection of archaeological and heritage resources
Indigenous land and resource use	▪ Indigenous land and resource use	▪ Patterson Lake is a traditional land use area for the CRDN, MN-S, BNDN, and BRDN ▪ Plant, fish, and wildlife harvesting have cultural, social, and economic value to Indigenous Peoples ▪ Access to traditional resource and land use areas would be affected by Project activities ▪ The expression of rights and interests through land and resource use contributes to cultural expression and the intergenerational transmission of knowledge	▪ Changes to access to and area available for Indigenous land and resource use ▪ Changes to the availability and quality of fish, plants, and wildlife for harvesting ▪ Changes to the quality of the Indigenous land use experience	▪ Continued ability to participate in Indigenous land and resource use activities
Other land and resource use	▪ Other land and resource use	▪ Recreation, tourism, and guiding occurs in the area ▪ Fish, and wildlife harvesting has social and economic value to land and resource users ▪ Access to land and resource use may be affected by Project activities	▪ Access to and area available for land and resource use ▪ Availability of fish and wildlife for harvesting ▪ Quality of resource use experience and quality of the resources	▪ Continued level of opportunities for other land and resource use

Table 6.3-1: Valued Components and Associated Assessment Endpoints and Measurement Indicators

Discipline	VCs	Rationale for Selection	Measurement Indicators	Assessment Endpoints
Economy	▪ Economy	▪ Changes in employment, business, and income opportunities may affect population in-migration and out-migration ▪ Project workforce hiring and contract opportunities may affect employment, income, training opportunities, and opportunities to participate in the traditional economy ▪ Project expenditures for supplies and services may affect opportunities for existing and new businesses ▪ Project-related payments to government may affect government revenues	▪ Local population levels ▪ Project-related employment ▪ Indigenous community participation and employment in the traditional economy ▪ Income (including both wage income and traditional economy income) ▪ Training, and educational opportunities ▪ Project-related contracting opportunities for businesses in local communities ▪ Project-related procurement expenditures ▪ Business counts ▪ Federal and provincial government revenues	▪ Enhancing the participation of local Indigenous and non-Indigenous individuals in employment, income, education, and training opportunities ▪ Enhancing Indigenous and locally owned businesses opportunities ▪ Enhancing government revenue ▪ Maintaining opportunities to participate in the traditional economy
Community well-being	▪ Community well-being	▪ Job creation, economic influences, and changes to land use resulting from the Project can change the current balance and structure of communities, families, and cultural values, affecting both individual and community well-being	▪ Changes in societal and cultural well-being ▪ Changes in health well-being ▪ Changes in neighbourhood and physical environment well-being ▪ Changes in educational well-being ▪ Changes in economic well-being	▪ Maintenance of local community well-being

a) Receptor in the ecological and human health risk assessments.
b) Labrador tea (*Rhododendron groenlandicum*) and blueberry (*Vaccinium myrtilloides*) are receptors in the ecological and human health risk assessments.
c) Receptor for human health VC.
GHG = greenhouse gas; JWG = Joint Working Group; CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; BRDN = Buffalo River Dene Nation; CH_4 = methane; CO_2 = carbon dioxide; N_2O = nitrous oxide; VC = valued component; IKTLU = Indigenous Knowledge and Traditional Land Use.

6.3.3 Intermediate Components

Intermediate components of the biophysical environment were also assessed to support VC assessments. Intermediate components include physical attributes of the biophysical environment or media upon which VCs rely, such as air quality and hydrology (Table 6.3-2).

Intermediate components are identified using the same process described for VCs (Section 6.3.1, Valued Components). Similarly, VCs and intermediate components are assessed using the same steps. However, unlike VCs, intermediate components do not have assessment endpoints or significance criteria. The significance of changes in intermediate components can only be evaluated in the context of related influences to VCs, which are the ultimate receptors. As an example, changes to surface water quality cannot be evaluated without the context of what these changes would mean to fish, vegetation, wildlife, and human health VCs. The determination of significance requires a defined assessment endpoint or threshold, and thresholds for water quality are related to guidelines, which are explicitly linked to the health of aquatic organisms and people. Therefore, the consequences and significance of changes in surface water quality were evaluated in the context of those VCs.

Ultimately, changes to intermediate components could influence VC assessment endpoints. Accordingly, the assessment of intermediate components, and the measurement indicators used to characterize changes to intermediate components, are fundamental to understanding the total effects of the Project on the biophysical, cultural, and socio-economic environments. Figure 6.3-1 illustrates potential interactions between intermediate components and VCs, using hydrology as an example.

Table 6.3-2: Intermediate Components and Associated Measurement Indicators

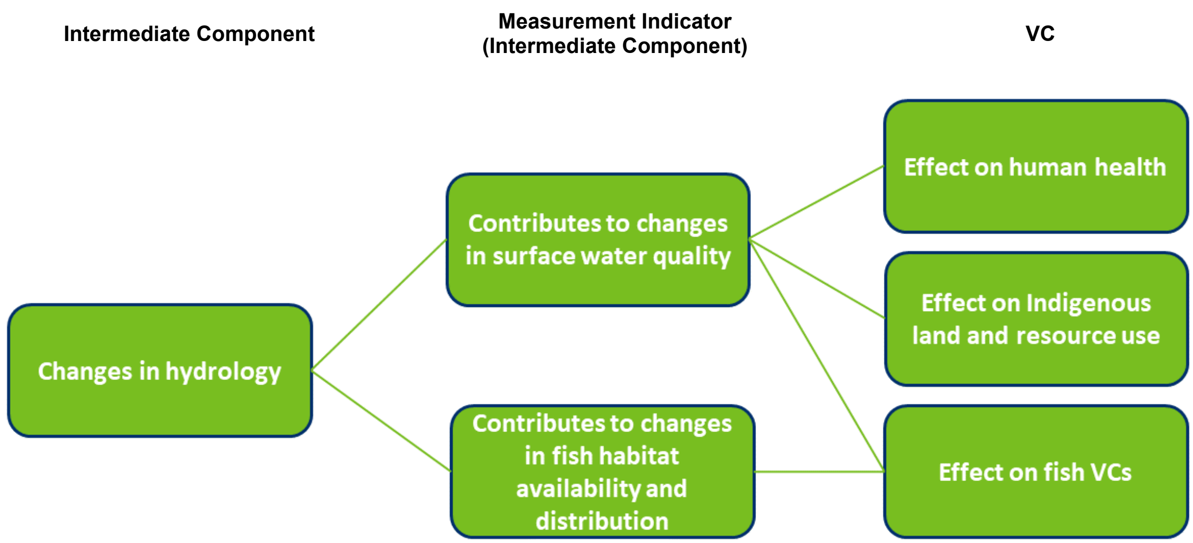
Intermediate Components	Rationale for Selection	Measurement Indicators
Air quality	▪ Sensitivity of the environment (e.g., soils, plants, animals) to air quality ▪ Link to human health	▪ Ambient air concentrations of CACs that have applicable provincial or federal ambient air quality criteria and would be emitted directly from the Project: o nitrogen oxides reported as nitrogen dioxide o sulphur dioxide o sulphuric acid o carbon monoxide o $PM_{2.5}$ o PM_{10} o total suspended particulates
Noise	▪ Influence on Indigenous and other land and resource use ▪ Sensitivity of some wildlife species to noise ▪ Presence of cabins/camp sites historically/currently in the area	▪ Energy equivalent sound levels for the daytime period (Leq,day) and the nighttime period (Leq,night), expressed in dBA and dBC ▪ Combined day-night sound levels (Ldn), expressed in dBA ▪ Maximum sound levels (Lmax), expressed in dBA
Hydrogeology (groundwater quality and quantity)	▪ Important component in the hydrologic cycle, linked to surface water quantity through exchange with overlying surface water features, important to fish and fish habitat ▪ Linked to surface water quality through overlying surface water features, which is important for fish and fish habitat, human use (i.e., drinking water or other consumption), and overall ecological integrity	▪ Groundwater levels and flow rates ▪ Spatial and temporal distribution of groundwater ▪ Concentrations of physical analytes (e.g., pH and conductivity) ▪ Concentrations of major ions and nutrients ▪ Concentrations of dissolved metals and radionuclides

Table 6.3-2: Intermediate Components and Associated Measurement Indicators

Intermediate Components	Rationale for Selection	Measurement Indicators
Hydrology	▪ Important to human use ▪ Indigenous and other land users may use local waterbodies and watercourses for navigation and recreational or cultural practices ▪ Key attribute of healthy and functioning aquatic and terrestrial ecosystems ▪ Link to fish and fish habitat	▪ Waterbody water surface elevation ▪ Watercourse flow rates ▪ Stream channel parameters (e.g., wetted area) ▪ Fluvial sediment transport
Surface water quality	▪ Key attribute of healthy and functioning aquatic and terrestrial ecosystems ▪ Important to human use and health ▪ Indigenous and other land users may use local waterbodies and watercourses for recreational or cultural practices	▪ Water quality constituent concentrations ▪ Drinking water quality constituent concentrations ▪ Productivity status constituent concentrations
Sediment quality	▪ Key attribute of healthy and functioning aquatic ecosystems ▪ Important to human use and health ▪ Indigenous and other land users may use local waterbodies and watercourses for recreational or cultural practices	▪ Sediment quality constituent concentrations (i.e., risk to aquatic life)
Terrain and soils	▪ Provide physical structure and foundation for aquatic and terrestrial ecosystems	▪ Quantity and distribution of terrain units, which includes surficial materials, topography, and slope stability parameters ▪ Quantity and distribution of soil map units ▪ Soil quality (i.e., productivity)

$L_{eq,day}$ = energy equivalent sound level for the daytime period; $L_{eq,night}$ = energy equivalent sound level for the nighttime period; L_{dn} = combined day-night sound level; dBA = A-weighted decibel; dBC = C-weighted decibel; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; PM_{10} = particulate matter with a diameter of 10 microns or less; CAC = criteria air contaminant.

Figure 6.3-1: Example Interactions between Valued Components and Intermediate Components



VC = valued component.

Like VCs, intermediate components were analyzed to determine the Project-specific and cumulative changes, if applicable, in the associated measurement indicators using a science-based approach. The changes in measurement indicators were used as lines of evidence to predict overall effects on VCs and intermediate components. The classification of effects criteria and determination of significance that were completed for each VC considered relevant inputs from intermediate components. The rationale and description of measurement indicators for intermediate components are provided in each discipline section of the EIS.

6.3.4 Environmental Risk Assessment Receptors

An environmental risk assessment (ERA) was completed for the Project that included a human health risk assessment and an ecological risk assessment. The ERA examined both aquatic and terrestrial ecosystems (TSD XXI, Environmental Risk Assessment). Healthy lakes, rivers, plants, fish, and wildlife are important to Indigenous land and resource use in the area of the Project. People from the local communities and Indigenous Groups expressed concerns about potential contaminants entering the environment and making it unsafe for people to drink the water and eat the plants and animals (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD VI: YNLR; CRDN-JWG 2020a; CRDN-JWG 2020b; MN-S-JWG 2019).

The ERA is a holistic assessment of the overall ecosystem and human environment that considers multiple pathways from potential sources of chemical and radiological exposure through environmental media to biological receptors. Receptors represent people and aquatic and terrestrial plants and animals that might be exposed to air pollutants, metals, and other harmful substances related to Project activities. These harmful substances are called constituents of potential concern (COPCs).

The receptor selection process for the ERA considered some of the same criteria as for VCs (Section 6.3.1), such as the presence and abundance of the species in the area of the Project, value or importance to Indigenous communities and other land and resource users in the area, and species conservation status or concern. In addition, the selection of ecological receptors considered the identification of potential exposure pathways to COPCs and availability of chemical analyses for radiological and non-radiological parameters for the species.

Receptors in the ecological risk assessment were selected as a representative subset of organisms from each major plant or animal group to represent different possible pathways of exposure to COPCs. These receptors include a subset of VCs identified for the EA so that the results from the ERA could be used in the effects assessments for fish and fish habitat, vegetation, wildlife and wildlife habitat, human health, Indigenous land and resource use, and other land and resource use. As examples, moose, black bear, and northern pike receptors in the ERA represent fish and wildlife VCs (i.e., designated by superscript “(a)” in Table 6.3-1). Labrador tea and blueberry represent ecological receptors and species of the traditional use plants VC for vegetation.

Receptors for the human health risk assessment were selected to be appropriate for assessment of effects on human health from COPCs. For the human health VC, a camp worker, subsistence harvester, seasonal resident / lodge operator, and future permanent resident were selected as receptors (Table 6.3-1).

The ERA provides lines of evidence that support the overall determination of significance for given VCs. Results from the ecological health risk assessment were incorporated into the measurement indicators of applicable biophysical VCs (e.g., survival and reproduction of fish, plants, and wildlife; Table 6.3-1). Similarly, results from the human health risk assessment were used as measurement indicators for VCs such as Indigenous and other land and resource use (i.e., risks to human health from exposure to COPCs; Table 6.3-1).

Further details on the selection and assessment of human and ecological health receptors and are provided in the ERA (TSD XXI). The human health assessment is provided in Section 15, Human Health, and results from the ecological health risk assessment are provided in relevant sections such as Fish and Fish Habitat (Section 11), Vegetation (Section 13), and Wildlife and Wildlife Habitat (Section 14).

6.3.5 Biodiversity

The biophysical VCs and assessment endpoints in Table 6.3-1 were selected in a manner that allowed potential effects on biodiversity to be evaluated. Biodiversity can be defined as the abundance and variety of living organisms and ecosystems on Earth, and it includes life at all levels of biological and ecological organization such as species, communities, habitats, ecosystems, and their interactions as well as the ecosystem services they provide (SCBD 2000). Sustainability concepts (Section 6.3.2, Assessment Endpoints and Measurement Indicators) are also important for the assessment and maintenance of biodiversity.

Biodiversity conservation often considers both a coarse-filter and fine-filter approach. The coarse-filter approach involves maintaining a diversity of structures within forest stands and a diversity of ecosystems across the landscape to meet most of the habitat requirements for the majority of the native species. The fine-filter approach is directed toward particular habitats or species that may be threatened or endangered and might fail to be identified through a coarse filter.

The vegetation ecosystems assessment applied mostly a coarse-filter approach to evaluating potential Project effects on many biodiversity attributes together, such as wildlife guilds and plant communities dependent on mature forests with live and dead standing trees, regenerating forests, wetland ecosystems, and riparian areas (Table 6.3-1). The assessment of vegetation ecosystems also applied a fine-filter approach in the determination of potential effects on federally and provincially listed species and traditional use plants.

The assessments of fish and fish habitat and wildlife and wildlife habitat applied a fine-filter approach to understand potential effects from the Project at the species and habitat levels. These assessments considered the potential effects of the Project on the habitats and populations of the individual fish and wildlife VCs selected for the EA (Table 6.3-1).

The coarse- and fine-filter assessments complemented and interacted with one another and together enabled determinations of effects on biodiversity. Implementation of Project design features and mitigation to avoid and minimize effects on vegetation, fish, and wildlife VCs are part of NexGen's overall strategy for the management and sustainability of biodiversity and the associated ecological services that are important to Indigenous and other land and resource users.

Project-specific and cumulative effects on biodiversity were evaluated for the biophysical VCs in the fish and fish habitat, vegetation, and wildlife and wildlife habitat disciplines in Section 11, Section 13, and Section 14 of the EIS, respectively. The effects assessment for biodiversity was completed through the assessment of changes in measurement indicators for fish and fish habitat, vegetation ecosystems and traditional use plants, and wildlife and wildlife habitat. Combined, these discipline sections provide a holistic coarse- and fine-filter assessment of the potential effects of the Project on biodiversity.

6.4 Assessment Boundaries

Assessment boundaries define the geographic and temporal extents of the assessment for each technical discipline.

6.4.1 Spatial Boundaries

To focus an EA on different processes and endpoints with varying geographical distributions, spatial boundaries are set for each VC or for related sets of VCs. Biological populations and communities function within the environment at different spatial and temporal scales (Wiens 1989), and the response of physical, chemical, and biological processes to changes in the environment can occur across several spatial scales at the same time (Holling 1973; Levin 1992). Similar cross-scale patterns exist in socio-economic systems (Folke 2006). In consideration of these factors, multiple spatial scales are considered in EAs depending on the assessment requirements of the VCs and intermediate components. Because the responses of physical, biological, cultural, social, and economic properties to natural and human-induced disturbance would be unique and occur across different scales, the approach for describing existing conditions and predicting effects from a project on VCs involves more than one spatial scale.

Accordingly, defining spatial boundaries within which the discipline assessments were constrained was a key element of the assessment scoping process. Spatial boundaries were selected for VCs and intermediate components of the biophysical, cultural, and socio-economic environments using the following criteria:

- physical extent of the Project footprint, which is also referred to as the site study area;
- spatial extent of expected Project-related effects, including those that extend beyond the Project footprint;
- physical extent of key ecological and socio-economic systems (e.g., watershed boundaries of potentially affected lakes and streams or jurisdictional boundaries of affected Indigenous communities); and
- geographic distribution, movement, and spatial interaction of VCs and intermediate components.

Although additional spatial scales are possible for individual VCs and intermediate components, spatial scales typically include a minimum of a site study area, a local study area (LSA), and a regional study area (RSA; CNSC 2021).

The LSAs used within discipline assessments were defined at a scale that contains most or all of the expected effects of the Project on a VC and supporting intermediate components; as such, more detailed data were collected in the LSA to describe existing conditions. Effects from the Project on the biophysical environment are typically of higher intensity at the local scale. For example, effects on terrain and soils and vegetation would mostly be captured by local changes to the environment from Project activities and associated infrastructure.

The RSAs used within discipline assessments included larger areas designed to provide broader context for the assessment of Project effects on VCs and intermediate components and the appropriate scale to assess cumulative effects from the Project combined with existing conditions and other RFDs (Section 6.5.3, Reasonably Foreseeable Development Case). For VCs with extensive distributions, such as fish that can move within a watershed and wildlife species that move within large seasonal ranges, effects from the Project have a higher likelihood of combining with effects from other human developments and activities at a larger geographical scale. Regional study area boundaries were defined to capture such potential interactions for each VC.

The spatial boundaries considered for VCs and intermediate components and the rationale for the selection of these boundaries are identified in each discipline section of the EIS.

6.4.2 Temporal Boundaries

The temporal scope of the EA focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure). The temporal scope of the EA is intended to evaluate the shorter- and longer-term changes from the Project and the associated Project-specific and cumulative effects on the biophysical, cultural, and socio-economic environments. While the temporal scope varies by VC, the minimum temporal boundary for the EA is defined by the following Project phases:

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations)**: includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure)**: includes two stages expected to occur over 15 years:
    - **Active Closure Stage:** includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating 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. The duration of the Active Closure Stage is expected to be five years.
    - **Transitional Monitoring Stage**: 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. Once that is achieved, and upon Provincial approval, the land would be transferred back under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

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. This far-future scenario is not a Project phase; it encompasses the long-term period during extremely slow migration of COPCs from the underground tailings management facility and waste rock storage areas to the environment are anticipated (i.e., more than 5,000 years). The far-future scenario is applicable for groundwater and surface water quality intermediate components and to the human health VC, including ecological receptors, which are assessed through the ERA. While it is not possible to accurately predict any process thousands of years into the future, the far-future scenario is a reasonable representation of the long-term return to steady-state conditions.

The temporal boundaries used in the EA were specific to the VCs and intermediate components and considered the identified Project phases. For some VCs and intermediate components, residual effects were assessed for all phases of the Project. For other VCs and intermediate components, residual effects were only relevant to specific Project phases. For example, Project effects on wildlife would begin during Construction with the removal and alteration of habitat and continue through Operations and for a period after Closure until effects are reversed or determined to be irreversible (i.e., permanent). In consideration of these factors, effects on wildlife were analyzed and predicted from Construction through Closure and typically beyond, which generated the maximum potential spatial and temporal extent of effects and provided confident and ecologically relevant effects predictions.

Alternatively, for other VCs and intermediate components, the assessment was completed for those phases or periods (i.e., temporal snapshots) of the Project when adverse effects were predicted to be most pronounced (e.g., most hydrology and surface water quality effects would occur during Operations). Where required, these snapshots were taken at several points within a Project phase or phases so that effects were not underestimated (i.e., a precautionary approach was applied). An example is evaluating surface water quality predictions at specific times that represent key milestones throughout the lifespan of the Project. For all VCs and intermediate components, the phase(s) or period(s) of the largest adverse effect were carried forward to the residual effects analysis (Section 6.8).

6.5 Assessment Cases

Assessment cases are development scenarios that distinguish between existing, proposed, and future projects so that the results of each scenario can be compared to each other. The concept of assessment cases was applied to the assessment boundaries of the associated VCs and intermediate components to estimate the incremental and cumulative effects from the Project and other developments (Table 6.5-1). The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. The assessment cases comprised a Base Case, Application Case, and RFD Case. The amount and level of analysis in assessment cases varied among VCs and intermediate components depending on the number, size, and type of existing and known or hypothetical projected human activities and developments within the spatial boundary of the assessment.

To provide context for evaluating potential changes from the Project, each discipline assessment includes a description of the existing conditions (Section 6.6).

Table 6.5-1: Contents of Each Assessment Case

Base Case	Application Case	RFD Case
Existing conditions including previous, existing, and approved projects/activities	Base Case plus the Project	Application Case plus RFDs

RFD = reasonably foreseeable development.

6.5.1 Base Case

In the context of assessment cases, the Base Case is generally represented by existing conditions. The Base Case represents the cumulative effects of historical and current environmental pressures that have influenced the observed condition/patterns of a VC or intermediate component (CEA Agency 2018b).

The Base Case describes the existing environment in the LSA and RSA before the inclusion of the Project to provide an understanding of the current physical, biological, economic, social, and cultural conditions that may be influenced by the Project. The temporal boundary of the Base Case includes the combined effects from previous, existing, and approved (but not necessarily constructed) projects and activities within the spatial assessment boundaries of VCs and intermediate components. The Base Case reflects the effects of existing human disturbances and natural factors (e.g., fire, disease, insects, drought, floods).

6.5.2 Application Case

The Application Case represents predictions of the combined effects of the Base Case plus the effects from the Project. This case also assessed incremental, Project-specific changes that are predicted to occur to VCs and intermediate components.

6.5.3 Reasonably Foreseeable Development Case

The RFD Case includes the Base Case, Application Case, and RFDs that have not yet been approved. This case was used to identify and assess potential cumulative effects on VCs and intermediate components (i.e., relative to existing conditions) derived from the addition of the proposed Project and RFDs. For the purposes of the EA, RFDs are defined as projects and activities that fit any of the first three and both of the last two criteria from the list below:

- are currently under regulatory review or have officially entered a formal regulatory application process;
- have been publicly disclosed by other proponents;
- may be induced by the Project;
- have the potential to change the Project or the effects predictions; and
- occur in the spatial assessment boundary defined by the VCs and intermediate components.

A key criterion for selecting other projects to include in the EA for a discipline is that those projects must cause similar effects on the same VCs or intermediate components influenced by the Project (Hegmann et al. 1999). Accordingly, an RFD Case was not required for all VCs and intermediate components as it depended on whether or not effects from the RFDs would have the potential to overlap with the selected VCs and intermediate components within the spatial and temporal assessment boundaries defined for the Project (Section 6.4).

The RFD Case assessed the residual effects from the Project plus the effects from other previous, existing, approved, and future projects and activities. The rationale for completing or not completing an RFD Case is provided in each discipline section. In slight contrast to the effects analyses for the Base and Application cases, which are largely quantitative, the analysis for the RFD Case was quantitative where possible and qualitative where necessary, based on the information available. As a scenario within the RFD Case (where applicable), potential effects from climate change were considered within the EA (Appendix 6A, Climate Change Road Map).

Indigenous Knowledge indicated concerns about cumulative effects from human development and policies and climate change (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN). The CRDN (CRDN 2019; TSD V.1: CRDN), specifically mentioned the risk of cumulative effects from the Project and the nearby proposed Fission Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021).

The Fission Patterson Lake South Property was designated as an RFD in the EA and applied to the RFD Case for VCs and intermediate components. Exceptions were climate change, hydrogeology, and terrain and soils, which did not assess an RFD Case and the rationale is provided in these discipline sections. Additional RFDs were identified and included in the assessment of cumulative effects for applicable VCs (e.g., woodland caribou).

The lifespan of the Fission Patterson Lake South Property was estimated based on available information and assumptions where necessary and as applicable to given disciplines. Public information describes a projected three-year construction period and a seven-year operating period (production and processing) (Fission 2019, 2021). The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the EA, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years). Thus, the minimum temporal overlap of potential cumulative effects from the Project and the Fission Patterson Lake Property was assumed to be 15 years. Depending on the amount of time for effects to be reversed, the duration of cumulative effects from the two projects would vary among VCs and intermediate components (Section 6.4.2, Temporal Boundaries).

6.6 Existing Conditions Characterization

Each discipline section of the EIS (Section 7 to Section 19) includes a subsection that describes and characterizes the existing conditions for the relevant VCs or intermediate components. As described in Section 6.5.1, Base Case, the existing conditions generally formed the Base Case for the EA, against which the effects of the Project and RFDs were assessed.

The existing conditions also represent the outcome of historical and current environmental and socio-economic pressures that have shaped the observed condition of each VC and intermediate component. Environmental and socio-economic pressures or factors were either natural (e.g., weather, wildfire, predation, disease) or human related (e.g., industrial development, forestry, changing business models, fishing, hunting).

Baseline studies identify temporal variation (e.g., annual or seasonal changes in water flow or habitat use, trends over time in populations and employment) and other conditions relevant to the assessment of a project (CNSC 2021). Baseline studies were conducted to support the characterization of the existing conditions; these included the collection of both environmental field data (e.g., surface water quality, fish and fish habitat, vegetation, wildlife) and socio-economic data. The baseline studies were conducted within the anticipated Project footprint, LSA, and RSA. Information used to support the description of existing conditions also included available Indigenous and Local Knowledge from engagement and IKTLU Studies, published and unpublished materials, and other available data and information obtained from government and industry. Combined, this information was used to establish and describe existing conditions for the physical, biological, economic, social, and cultural VCs and intermediate components that may be influenced by the Project.

Data collected in the anticipated physical footprint and in the immediate vicinity of the Project (i.e., within the LSA) were used to provide measures of environmental conditions prior to construction of the Project and to predict the direct and indirect changes from the Project on VCs and intermediate components (e.g., changes to terrestrial and aquatic habitat from the physical footprint, dust, and air emissions). Data collected at larger scales (i.e., within the RSA) were used to measure broader-scale environmental conditions and provide regional context for the effects of the Project.

6.7 Pathways Analysis

Pathways analysis is a process that is used to develop an understanding of how a project may affect VCs and intermediate components. Potential Project effect pathways are identified, and mitigation that can be incorporated into the Project to minimize adverse effects is reviewed to assess if, after incorporation of mitigation, there is still potential for a project to cause residual effects. This process helps to focus further, more detailed, assessments on key interactions between a project and the environment. This section describes how the potential pathways were identified and screened.

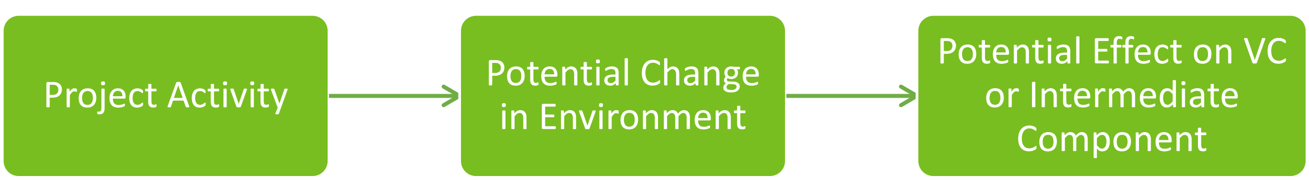
6.7.1 Identification of Project Interactions

The first step in a pathways analysis is to identify all pathways by which a project facility or activity could affect the environment. This was conducted by constructing a Project-environment interactions matrix that identified potential interactions among key Project facilities/activities and VCs and intermediate components of the biophysical, cultural, and socio-economic environments for each Project phase (Appendix 6B, Project-Environment Interactions Matrix). A comprehensive list of effect pathways was then developed using the following information:

- review of the Project description (Section 5) and potential effects scoping by the project development, environmental, and socio-economic teams for the Project;
- input from Indigenous, regulatory, and public engagement (Section 2) and Indigenous and Local Knowledge (Section 3);
- results of baseline studies;
- scientific knowledge;
- previous experience with mining projects; and
- consideration of potential effects identified from the Terms of Reference (Appendix 1A).

For an effect to occur, there must be a source (i.e., a Project component, works, or activity that interacts with the biophysical, cultural, or socio-economic environments) that results in a measurable change to the environment and at least one measurement indicator of the VC or intermediate component (Figure 6.7-1).

Figure 6.7-1: Project-Environment Interaction



VC = valued component.

Table 6.7-1 provides examples of effects pathways related to certain Project activities for air quality, an intermediate component, and for wildlife, fish, and Indigenous land and resource use VCs. The examples show the linkages from Project activities to changes in the environment and associated measurement indicators (Table 6.3-1 and Table 6.3-2) for the intermediate components and VCs.

Table 6.7-1: Examples of Effects Pathways

VC or Intermediate Component	Project Activities	Measurement Indicators	Pathway Description
Air quality	Project components/activities that contribute to CAC emissions during Construction and Operation (e.g., land clearing, site preparation, construction of facilities and infrastructure, transportation of personnel, equipment, and materials)	Ambient air concentrations of CACs (e.g., carbon monoxide and $PM_{2.5}$)	The CAC emissions can affect air quality.
Wildlife and wildlife habitat	Project components/activities that contribute to the Project footprint (e.g., land clearing, site preparation, construction of facilities and infrastructure)	Habitat availability	Direct removal/alteration of soil and vegetation can cause loss of wildlife habitat and affect wildlife VCs.
Fish and fish habitat	Project components/activities that may increase soil erosion (e.g., land clearing, in-water construction)	Habitat availability	Release of sediment from ground disturbance may alter fish habitat quality in local waterbodies and watercourses and affect fish VCs.
Indigenous land and resource use	Project components/activities that contribute to the Project footprint (e.g., land clearing, site preparation, construction of facilities and infrastructure)	Access to plants, fish, and wildlife for harvesting	Restricted access to land and resources for the duration of Project activities.

VC = valued component; CAC = criteria air contaminant; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less.

6.7.2 Identification of Mitigation

Following pathway identification, the next step of pathway analysis includes the development of environmental design features and mitigation that could be incorporated into a project to remove a pathway or limit the effects on VCs and intermediate components. This step includes the application of the precautionary principle (Section 6.1.1, Purpose and Scope).

Mitigation involves measures to eliminate, reduce, control, or offset the adverse effects of a project, and it includes restitution for any damage caused by those effects through replacement, restoration, compensation, or other means (IAAC 2020b). Under the *Canadian Environmental Assessment Act, 2012*, these measures must also be technically and economically feasible. The Saskatchewan Ministry of Environment (ENV 2018) describes mitigation as a stepwise progression of actions to avoid, minimize, and offset adverse effects. Other reference documents (IFC 2012; BBOP 2021) include reclamation as a mitigation and define the following hierarchies of mitigation with the most preferable actions/measures listed first:

Avoid: Proponents should avoid, to the extent practicable, effects on the environment by modifying the design of a proposed project. Avoidance and minimization are widely recognized as the most important strategies for biodiversity conservation (BBOP 2021). Avoidance of sensitive areas, such as wetlands, is a key mitigation action.

Minimize: When avoidance is not possible, proponents should limit effects that cannot be avoided through the best available technology economically achievable and best management practices (e.g., sediment and erosion control).

Reclamation: Proponents should reclaim and rehabilitate affected areas to set them on a possible trajectory towards restoration of previous conditions, end land use, or land capability. Reclamation returns the land to a useful and productive state (e.g., covering and revegetating a surface facility). Rehabilitation aims to restore basic ecological functions and/or ecosystem services (e.g., providing erosion protection), while restoration tries to return an area to the original ecosystem that occurred before the effects from a project. Reclamation, rehabilitation, and restoration include actions taken to improve ecosystems following exposure to effects that cannot be completely avoided or minimized. Most reclamation, rehabilitation, and restoration actions typically take place towards the end of a project's lifespan, and there is usually uncertainty in the timelines for the effects to be reversed, which requires monitoring to verify performance measures are trending towards targets and objectives.

Offset: Proponents should offset effects that cannot be fully mitigated through avoidance, minimization, and reclamation measures or when temporal losses to the environment would compromise the viability or function of aspects of the environment. Offsetting measures typically counterbalance this loss through positive contributions to the ecosystem. Offsets may include compensation or community enhancement. Offsetting requirements are determined through regulatory processes and engagement, and monitoring is needed to determine effectiveness.

Given the uncertainty and time lag inherent in reclamation and offsetting, a precautionary approach was applied to the assessment, and reclamation and offsetting were not used to remove pathways.

Following these principles and hierarchies of mitigation, the Project would incorporate technically and economically feasible environmental design features, as well as mitigation practices and procedures, to avoid, minimize, reclaim, or offset adverse effects. Specific design features include the following:

- limiting the area of the Project footprint;
- designing the Project to avoid or minimize effects (e.g., placing facilities away from sensitive features, designing and using the underground tailings management facility);
- implementing procedures, practices, and management policies to limit an effect (e.g., using dust suppression on roads);
- incorporating progressive reclamation of available disturbed areas and a Detailed Decommissioning and Reclamation Plan at the end of mining operations; and
- implementing compensation, where required, to offset effects remaining after avoidance, minimization, and reclamation.

Environmental design features and mitigation were developed through an iterative process between the Project's design engineers and environmental scientists to avoid and minimize effects. The environmental scientists worked closely with the Project design engineers to incorporate appropriate mitigation into the Project design and implementation plans so that residual effects would be acceptable. In cases where an initial analysis of effects indicated unacceptable results, the Project team collaborated further to identify additional Project design elements to reduce effects. The results of this iterative process are reflected in the design of the proposed Project described in Section 5, Project Description, and form the basis for the prediction and assessment of effects of the Project. Project designs and mitigation also considered direct and indirect input from Indigenous communities and regulatory engagement.

Examples of design and mitigation include minimizing the Project footprint, proposed re-alignment of an on-site road to avoid physical disturbance to a wetland, and a commitment to provide breaks in snow berms along the access road to facilitate movement of wildlife. Proposed environmental design features include Project design elements (e.g., centralized infrastructure), environmental best practices, management policies, programs, plans, and procedures, which include spill response and emergency response, and social programs. Input from communities regarding concerns with mine waste contributed to the decision to include the underground tailings management facility in the Project design.

Following development of environmental design features and mitigation, knowledge of the environmental design features and mitigation was then applied to each pathway to understand the expected degree and extent of Project-related changes to the environment and the associated residual effects (Section 6.8) on VCs and intermediate components.

6.7.3 Pathway Screening

To focus the residual effects analysis on the most important and meaningful changes from a project, pathways are screened for each VC and intermediate component. For the Project, each potential effect pathway was evaluated using proposed mitigation to predict whether the pathway had the potential to cause residual adverse effects. The effectiveness of mitigation proposed for each pathway analysis was assessed to determine whether the mitigation would address the potential Project effect such that the pathway was eliminated or would result in a negligible adverse effect on a VC or intermediate component.

This screening step was largely a qualitative assessment that was intended to focus the effects analysis on pathways that required a more quantitative or comprehensive assessment of effects on VCs and intermediate components (Figure 6.1-4). Using scientific knowledge, feedback from community engagement, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that the proposed mitigation would work), each pathway was categorized as one of the following:

- **No pathway:** The pathway could be removed (i.e., effect would be avoided) by avoidance measures and/or additional mitigation so that the Project would result in no measurable environmental change relative to existing conditions or guideline values (e.g., air, soil, or water quality guidelines), and therefore would have no residual effect on a VC or intermediate component.
- **Secondary pathway:** With the application of mitigation, the pathway could result in a measurable but minor environmental change relative to existing conditions or guideline values, but the change is sufficiently small that it would have a negligible residual effect on a VC or intermediate component (e.g., an increase in an air quality parameter that is negligible compared to the range of existing values and is well within the air quality guideline for that parameter). Therefore, the pathway would not be expected to contribute to effects of RFDs to cause a significant effect.
- **Primary pathway:** Even with the application of mitigation, the pathway was likely to result in an environmental change relative to existing conditions or guideline values that could cause a greater-than-negligible effect on a VC or intermediate component.

Pathways with no linkage to a VC or intermediate component, either because there was no linkage initially or because environmental design features or mitigation would avoid the pathway, were described but not advanced for further assessment. Pathways that were assessed to be secondary and demonstrated to have a negligible residual effect on a VC or intermediate component through simple qualitative or semi-quantitative evaluation were also described but not advanced for further assessment. Positive interactions or outcomes (e.g., economic benefits of the Project) were identified and discussed in applicable discipline sections but were not classified into these categories and were not assessed for significance (Section 6.9.2). Pathways that would result in changes to the environment and have the potential to cause a greater-than-negligible effect on a VC or intermediate component were carried forward to the residual effects analysis (Section 6.8) and residual effects classification (Section 6.9.1).

Within each discipline section, the results of the pathway analysis were tabulated and described. This information included Project facilities/activities and associated mitigation to be implemented during Project phases as well as the potential effects pathways from each Project interaction and the associated categorization.

6.8 Residual Effects Analysis

Residual effects are those effects that remain after mitigation has been applied with known or expected success. A residual effects analysis is a method to determine the residual effects for a given VC or intermediate component. As part of the residual effects analysis, the predicted environmental changes for primary pathways were evaluated using methods appropriate for each discipline. The methods used to make predictions varied by VC and intermediate component and are described in the applicable discipline section (Section 7 to Section 19). Where possible and appropriate, each analysis was quantitative and included data from field studies, modelling results, scientific literature, government publications, monitoring reports, and personal communications.

Environmental changes were predicted for the Application Case and RFD Case for VCs and intermediate components within the defined spatial and temporal assessment boundaries. The concept of assessment cases (Section 6.5) was applied to estimate the incremental and cumulative adverse residual effects from the Project as well as those from previous, existing, and approved projects/activities, and RFDs. Valued components and intermediate components that required a cumulative effects assessment under the RFD Case considered the extent of the adverse effects from the Project and their potential to overlap or interact spatially and temporally with effects from other RFDs.

6.8.1 Project Effects (Application Case)

In the Application Case, the residual effects analysis considered all pathways that were verified to be primary in the pathway analysis (Section 6.7; Figure 6.1-4) relative to the Base Case. Therefore, the Application Case included the combined natural and human-related effects described in the Base Case plus the residual effects from the Project (Section 6.5).

For some VCs and intermediate components, the predicted residual effects were the result of more than one primary pathway that linked the Project activity to an interaction with the environment and a subsequent effect on a VC and associated endpoint or intermediate component. For example, the pathways for effects on the ability of fish populations to remain self-sustaining and ecologically effective included consideration of alteration of both water quantity and water quality. Similarly, effects from the Project on the ability of wildlife populations to remain self-sustaining and ecologically effective included consideration of predicted changes in habitat quantity and quality and survival and reproduction. The residual effects assessment therefore considered the combined effect of multiple pathways, where applicable.

Effects on social, economic, and cultural VCs include a description of the positive and negative changes to socio-economic measurement indicators including, but not limited to, employment, training and education; personal/family income; Indigenous land use; health; and societal and cultural well-being. Where possible, these measurement indicators were analyzed quantitatively (e.g., number of jobs created and estimated income levels) and expressed qualitatively as necessary. Other measurement indicators, such as community cohesion and IKTLU, were more difficult to quantify; therefore, qualitative data from engagement, IKTLU Studies, literature, examples from similar projects under similar conditions, and experienced opinion were relied upon to complete the analysis. The effects analysis considered the interactions among the unique and common attributes, challenges, and opportunities related to social, cultural, and economic measurement indicators. A key aspect of the effects analysis was to predict the positive and negative influence from the Project on the development and sustainability of socio-economic conditions in the study areas.

Existing provincial and/or federal management actions and policies (e.g., provincial hunting regulations, federal recovery strategies for listed species) applicable to biophysical, cultural, and socio-economic VCs and intermediate components were considered in the evaluation of Project effects. Environmental context, which forms part of existing conditions, was also used in the analysis of effects. Context for biophysical VCs included current status and trends, ecological thresholds, resilience and adaptive capacity, and applicable legislation and best management practices. Similarly, context for socio-economic VCs included existing social pressures, tolerance limits and vulnerability, political trends, applicable legislation, standards, plans and policies, and traditional way of life for Indigenous Peoples.

The methods and results of the residual effects analysis for VCs and intermediate components are provided in each discipline section (Section 7 to Section 19) with appendices to provide comprehensive details associated with data, analysis, and modelling, where appropriate. The methods followed the principles outlined in this section, with details varying appropriately for each discipline. Results from the residual effects analysis were then used to inform residual effects classification for VCs and intermediate components and to help determine the significance of Project effects on VCs.

6.8.2 Cumulative Effects from Reasonably Foreseeable Developments Case

By definition, cumulative effects represent the sum of all natural and human-induced influences on the biophysical, cultural, and socio-economic environments through time and across space. Some changes may be human-related, such as increasing industrial and mineral development. Other changes may be associated with natural phenomena, such as extreme rainfall events, intensity and frequency of forest fires, insect outbreaks, floods, and periodic harsh and mild winters, which may also be related to climate change. The cumulative effects assessment, through the RFD Case assessments, predicts or projects the contribution of effects from the Project and RFDs on VCs and intermediate components in the context of natural and climate-related changes in the system.

In the RFD Case, cumulative effects from the Project; previous, existing, and approved projects; and RFDs are identified, analyzed, and assessed in the discipline sections, where applicable. For the purposes of this cumulative effects assessment, it was assumed that only adverse Project-related changes in measurement indicators and intermediate components linked to VCs have the potential to cause significant cumulative effects. Positive changes in measurement indicators of VCs and intermediate components from the Project were identified but were not assessed for cumulative effects. This approach is the same as the approach used for the residual effects analysis of the Project described in the Application Case (Section 6.8.1, Project Effects [Application Case]).

An RFD Case assessment was not required for every VC or intermediate component. A key step was to determine if the effects from the Project and one or more additional existing or approved projects and activities or RFDs overlapped or interacted within the temporal or spatial distribution of the VC or intermediate component (Section 6.5.3, Reasonably Foreseeable Development Case; Figure 6.1-4). If no such overlap or interaction was considered plausible, an RFD Case assessment was not completed. Conversely, for VCs and intermediate components that are distributed or travel over large areas and can be influenced by a number of developments (e.g., surface water quality, fish, caribou), the analysis of cumulative effects through the completion of the RFD Case was warranted. Socio-economic components also required consideration of the potential cumulative effects of the Project with other developments and human activities.

Environmental design features and mitigations measures implemented by the Project are expected to avoid or limit the Project's contribution to cumulative effects. The assessments of the RFD Case also considered mitigation for future projects/activities (if known) designed to reduce adverse cumulative effects. Any assumptions or uncertainties regarding the implementation of anticipated mitigation for other projects/activities are described in the discipline sections.

6.9 Residual Effects Classification and Determination of Significance

The residual effects analysis generated the information required for the classification of effects and determination of significance. For VCs, the outcomes of the residual effects analysis were described considering the influence on assessment endpoints. The specific effects criteria terms were subsequently defined and used in the residual effects classification subsection to formally classify the residual effects.

6.9.1 Residual Effects Classification

The purpose of the residual effects classification is to describe the residual incremental and cumulative adverse effects from previous and existing developments and the Project (Application Case) and potential future developments (i.e., RFD Case), if applicable. Residual effects on VCs and intermediate components are described using a set of common words or effects criteria. The use of effects criteria to facilitate classification of adverse residual effects is an accepted practice in EAs (CEA Agency 2018b; CNSC 2021).

The residual effects classification uses direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence as criteria. It is not possible to define meaningful effects criteria and significance that are universally applicable to all VCs and intermediate components. Consequently, definitions for each effect criterion are presented in each discipline section.

Where possible, expected changes were expressed quantitatively for each primary pathway influencing a VC or intermediate component within the study areas (Section 6.4.1, Spatial Boundaries) and temporal boundaries (Section 6.4.2) of the assessment. Each analysis was supported by calculations, Geographic Information System mapping and analysis, and modelling, as appropriate. For some residual effects analyses, the expected changes were described qualitatively (e.g., how loss of potential habitat and increased sensory disturbance could result in changes in movement for a wildlife VC). Where possible, qualitative methods included support from literature, scientific and Indigenous Knowledge, and monitoring data from other developments.

General classification schemes applied to each effect criterion used in the EA are as follows:

Direction: classified as negative (i.e., net loss or adverse effect), neutral (i.e., no change), or positive (i.e., net gain or beneficial effect). Direction may change over time; the Project could have adverse effects during some time periods and positive effects during other time periods.

Magnitude: a measure of the intensity or the degree of change (i.e., effect size) caused by the Project and other developments, if applicable, relative to existing conditions. Established guidelines, thresholds, or screening values were considered where available. Magnitude is presented as a quantitative or qualitative expression of effect size for VCs and intermediate components relating to the respective measurement indicators. When categorical definitions were used, magnitude was classified as negligible, low, moderate, or high and supported by a reasoned narrative.

Geographic extent: refers to the area, distance covered, or zone of influence of the effect on VCs and intermediate components. The geographic extent of effects can occur at several different scales within the spatial boundary of the assessment and is specific to the VC or intermediate component. Categorical classifications included effects that were confined to the Project footprint, effects that may extend beyond the Project footprint but are confined to the LSA, effects that may extend beyond the LSA but are confined to the RSA, and effects that may extend beyond the RSA (e.g., air emissions that contribute to atmospheric accumulation, climate change effects).

Duration: presented as numerical values for most disciplines (e.g., days, months, years, decades). Duration has three aspects: the amount of time between the start and end of a Project activity or stressor and is related to Project phases, the time required for the effect on the VC or intermediate component to be reversed, and the timing of the effect. When duration was classified categorically, it was typically expressed in the discipline sections as short term, medium term, or long term relative to Project activity periods or phases.

Some residual effects may be reversible soon after the stressor has ceased (e.g., change in distribution of some wildlife species following the decrease in noise and activity levels after Closure), while other residual effects may take longer to be reversed (e.g., change in abundance of some species on mine-altered habitat after reclamation). By definition, residual effects that are short term, medium term, or long term in duration are reversible. In other cases, the duration of a residual effect may not be known, except that it is expected to last beyond the temporal boundary of the Project (e.g., many decades after Closure is completed). In such cases, where science and logic indicated that the likelihood of reversibility is very low or uncertain, the residual effect was considered permanent (i.e., a precautionary approach was applied).

The timing of individual events during which the residual effect may occur was also considered. Some effects may exhibit temporal variation over the life of the Project (e.g., during breeding or spawning season).

Reversibility: after removal of the Project activity or stressor, reversibility describes whether the Project would no longer influence a VC or intermediate component at a future predicted time. This criterion usually has one of two alternatives: reversible or irreversible. The duration was provided for reversibility if a residual effect is expected to be reversible. Permanent residual effects were considered irreversible.

Frequency: refers to how often a residual effect would occur during the temporal boundary of the assessment. Occasional residual effects occur once (e.g., once during the installation of a culvert) or a few times (e.g., predicted maximum precipitation events during lifespan of the Project). Continuous effects occur constantly over a specified duration. Periodic effects occur at regular intervals or in association with temporal events (e.g., during breeding or spawning season, spring freshet, low flows, growing season, and plant harvest season).

Probability of occurrence: defined categorically as unlikely, possible, probable, or certain.

The classification for the Application Case was conservatively completed for the phase or period (i.e., temporal snapshot) when adverse effects from the Project were predicted to be largest. For the RFD Case, the classification was also conservatively completed under the assumption of capturing the maximum combined overlapping temporal and spatial effects of existing developments, the Project, and RFDs.

A summary or classification of the residual effects analysis is provided in tabular form for VCs and intermediate components in each discipline section. The tables present the residual effects classification for both the Application Case and RFD Case, if applicable. The classification of residual effects criteria in tabular form is intended to provide structure and comparability across all VCs and intermediate components assessed for the Project. The residual effects classification was then used to support significance determinations for VCs (Section 6.9.2).

6.9.2 Significance Determination

The predicted changes in measurement indicators and associated residual effects classification of primary pathways provided the foundation for determining the significance of adverse effects from the proposed Project and other previous, existing, and approved projects, RFDs, and natural factors on VCs.

6.9.2.1 Project and Cumulative Effects

Following the classification of residual adverse effects, a determination of significance was completed for VCs, as VCs have assessment endpoints or qualitatively defined significance thresholds (Section 6.3.1). Significance determination was binary, such that adverse effects were either deemed significant or not significant for each VC. Although the positive residual effects associated with the Project are reported in the EIS, these residual effects were not assessed for significance.

The Canadian Environmental Assessment Agency (CEA Agency 2015, 2018a) recommends that significance be determined for both the residual effects of the Project alone and the cumulative effects of the Project combined with other developments (CEA Agency 2015, 2018a). Generally, a determination of significance cannot be accomplished without a cumulative effects assessment because the effects of a single project seldom cause an environmentally significant effect on their own (McCold and Saulsbury 1996), and many environmental effects of primary concern are cumulative (Canter and Ross 2010). Significance was determined for the Application Case and RFD Case, as applicable.

6.9.2.2 Factors Considered

Key factors that were considered in the determination of significance for VCs are summarized as follows.

Magnitude, geographic extent, and duration were the primary criteria used to determine significance, while other criteria such as frequency and probability of occurrence were used as modifiers. For example, determining the significance of an effect from changes in habitat availability and connectivity on a fish or wildlife VC depended on the magnitude (e.g., amount of habitat lost), spatial extent (e.g., zone of influence or proportion of the population affected), and duration of the changes in habitat (e.g., how long the population would be adversely affected). Effects were predicted to be less harmful if the probability of occurrence of the effect was unlikely as supported by the assessment results and scientific studies.

Ecological context is often relevant when describing the significance of residual effects on biophysical VCs. Ecological context relates to the potential for environmental effects to cause disruption of ecological functions and processes in the receiving environment, which may be fragile with little resilience to further imposed stresses or may be already adversely affected by human activities and natural factors (Holling 1973). As such, the ability of biophysical VCs to accommodate disturbance was evaluated using the concepts of ecological resilience and adaptability. Resilience is a concept that is distinct from, yet closely related to, adaptability. Adaptability influences the duration and magnitude of an effect, whereas resilience defines the ability of a species or ecosystem to recover from disturbance.

Resilience is largely a function of life history traits such as size and number of litters, number of eggs, lifespan, age at reproduction, and survival rate. Highly resilient wildlife species have the potential to recover quickly from disturbance (e.g., after reclamation is achieved or a mortality source is removed), whereas species with low resilience will recover more slowly or may not recover at all (Weaver et al. 1996). For example, while the magnitude of an effect on a fish or wildlife VC may be influenced by the current level of disturbance, population status, and trend (i.e., as reflected in the species at risk listing), it may also be affected by the resilience of the VC to further changes in habitat availability and connectivity. Biological populations will often continue to function after disturbance up to the point where the disturbance becomes severe and long enough that the population undergoes a fundamental change. Residual effects on VCs with high resilience (i.e., ability to recover from disturbance) would be expected to be shorter relative to VCs with lower resilience to disturbance.

Adaptable plant, fish, and wildlife species are those that can change their behaviour, physiology, or population characteristics (e.g., reproduction rate) in response to a disturbance such that the integrity of the population remains more or less unchanged. For example, certain wildlife populations can accommodate loss of some individuals without a change in overall population status or trajectory (i.e., compensatory mortality; Connell et al. 1984). Fish species, such as lake trout, have been shown to actively seek out alternate spawning sites when their traditional habitat is lost (McAughey and Gunn 1995; Gunn and Sein 2000). Other wildlife species that avoid human features in relatively undisturbed landscapes can change their behaviour to accommodate disturbance where it is more prevalent (Martin et al. 2010; Knopff et al. 2014). Adaptable species can accommodate substantial disturbance and sometimes thrive in highly modified environments, whereas species with low adaptability can accommodate little or no disturbance.

Socio-economic context is also relevant when assessing cultural and socio-economic VCs. Consistent with the concept of ecosystem resilience, a resilient human community is one that has the capacity to cope with change and disturbance without shifting into a qualitatively different state. Resilience or tolerance to change can be accelerated through mitigation. In contrast, a less resilient community may have limited capacity to adapt to further human and natural disturbances.

6.9.2.3 Overall Approach

The determination of significance considered the primary pathways and affected measurement indicators that influence a particular VC assessment endpoint. Significance was not explicitly assigned to each pathway or measurement indicator; rather, the relative contribution of each pathway or measurement indicator was used to determine the significance of potential adverse effects of the Project and other developments on a VC in context of the associated assessment endpoint(s). The approach was based on a “weight of evidence” or an evaluation of the persuasiveness of the collective evidence considering the concepts described above, including the magnitude, geographic extent, and duration of the effect, as well as resilience and adaptive capacity. The relative effect from each pathway on a VC and the assessment endpoint is discussed; however, pathways that were predicted to have the largest influence on the assessment endpoint were assumed to contribute the most to the determination of significance for the VC. The weight-of-evidence approach included the process of assembling, weighing, and evaluating information to come to a scientifically defensible conclusion.

As indicated in Section 6.9.2.2, Factors Considered, the primary factors affecting the determination of significance were magnitude, geographic extent, and duration. An effect was deemed significant if a cumulative adverse effect of the Project and other developments had a sufficiently high magnitude, affected a sufficiently large area, and lasted for a sufficient duration to cause a significance threshold defined by the assessment endpoint for a VC to be exceeded. Furthermore, the determination of significance considered the key sources of uncertainty in the effects analysis, the management of uncertainties, and the corresponding level of confidence in effects predictions. Where uncertainty was determined to be high and the effect was predicted to be either significant or not significant, the assessment used a precautionary approach and identified the effect as significant. Additional follow-up actions were then proposed to reduce the uncertainty.

In summary, significance determination of adverse residual effects was completed by evaluating the following against assessment endpoints defined for each VC:

- magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence of the residual adverse effect for each applicable measurement indicator and related intermediate component(s);
- applicable ecological or socio-economic context; and
- uncertainty in effects predictions.

Details on the approach and methods for determining significance on specific VCs are provided in the discipline sections.

6.10 Prediction Confidence and Uncertainty

A major element of the EA is the prediction of future conditions of the biophysical, cultural, and socio-economic environments as a result of the Project, previous, existing, and approved projects, and RFDs. Given that biophysical, cultural, and socio-economic environments change naturally and continually through time and across space, assessments of effects and predictions about future conditions embody some degree of uncertainty (CEA Agency 2018a).

The purpose of the Prediction Confidence and Uncertainty sections of the EIS is to identify the key sources of uncertainty and qualitatively describe how uncertainty was addressed to increase the level of confidence that effects would not be larger than predicted. Additionally, this information can be used to inform the monitoring and follow-up programs (Section 6.11) that can reduce uncertainty over time.

Confidence in effects analyses can be related to many elements, including the following:

- adequacy of the baseline data for providing an understanding of the existing conditions;
- the direction, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socio-economic variables, independent of effects from the Project and other developments (e.g., climate change, fire, flood);
- assumptions, conditions, and constraints of model inputs;

- understanding of Project-related effects on complex social-ecological systems that contain interactions across different scales of time and space (e.g., how and why the Project would influence wildlife and Indigenous land and resource use);
- knowledge and experience with the type of effect in the system;
- knowledge of the effectiveness of proposed Project environmental design features or mitigation for avoiding or minimizing effects; and
- uncertainties associated with the exact location, physical footprint, activity level, and the timing and rate of future developments.

Uncertainty in these elements can decrease confidence in the residual effects analysis and determination of significance. The assessment applied a precautionary approach to address uncertainty by using the largest magnitude, duration, and geographic extent of potential adverse effects when a range of possible outcomes could be possible. Similarly, a conservative approach was implemented when information was limited so that effects were typically overestimated (e.g., defining the key input variables in a model to produce a conservatively high effect prediction). Consequently, uncertainty is addressed in a manner that increases the level of confidence that residual effects would not be larger than predicted, especially because layers of uncertainty can accumulate throughout the assessment of any given VC.

Uncertainty in the effectiveness of mitigations was also incorporated into the assessment. If uncertainty was high, the analysis applied a precautionary approach and mitigation was not considered sufficient to remove a pathway. For example, if a mitigation was considered new or unproven technology or challenging to implement under certain conditions, then a pathway was conservatively considered to be primary.

Each discipline section includes a discussion of how uncertainty was addressed and provides a qualitative evaluation of the resulting level of confidence. The implications of uncertainty are also included in the residual effects analysis and classification (i.e., probability of occurrence criterion) and the determination of significance. Where necessary, residual uncertainty is addressed by proposing additional mitigation, compliance monitoring programs, and/or follow-up monitoring programs.

6.11 Monitoring, Follow-Up, and Adaptive Management

Once a project is approved, environmental monitoring is used to verify the predicted effects and to measure compliance with future permit conditions. Monitoring is also used to identify any unanticipated effects and provide input into adaptive management to limit these effects. Typically, monitoring includes one or more of the following categories, which may be applied during the development of the Project:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, conditions of approval, and NexGen commitments (e.g., inspecting the installation of a silt fence and monitoring the quality of water discharged from the Project). Compliance monitoring is also completed to confirm that project activities are undertaken in ways that maintain environmental conditions within or below protective thresholds.
- **Follow-up monitoring:** programs designed to test 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). Results from these programs can also be used to increase the certainty of effects predictions in future EAs.

Monitoring programs are proposed in each discipline section of the EIS (Section 7 to Section 19) to address the uncertainties associated with the effects predictions and to evaluate the performance of the Project, including the applied mitigation measures. Where relevant, conceptual monitoring programs have been proposed to address the uncertainties associated with the effect predictions and mitigation. Upon Project approval, these programs would be included in NexGen's Integrated Management System.

In addition to environmental monitoring programs typically implemented for projects (i.e., as noted above), NexGen is working with local Indigenous Groups to implement independent environmental monitoring. In combination with standard Project monitoring processes, independent Indigenous monitoring would be used to verify Project performance and to determine if mitigations and controls are effective in protecting the receiving environment.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. Adaptive management is a planned and systematic process for continual improvement of environmental management policies and practices by assessing the effectiveness of these practices and the associated outcomes (CEA Agency 2009; CNSC 2021). Adaptive management provides a structured approach to decision making that emphasizes accountability and explicitness, but also allows for flexibility to identify and implement new mitigation measures or to modify existing ones during the lifespan of a project. Adaptive management requires careful implementation, monitoring, evaluation of results, and adjustment of objectives and practices. Where uncertainties associated with effects predictions and mitigations exist, adaptive management would be used to improve knowledge over time through an iterative process that provides the information required to increase confidence to make decisions that reduce uncertainty and improve risk management outcomes. Actions stemming from adaptive management may include more intensive or focused monitoring, specific studies focused on better understanding of a particular change in measurement indicator and associated environmental effect, improved or modified design features, or additional mitigation measures. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

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Appendix 6A Climate Change Road Map

Abbreviations

Abbreviation	Definition
EA	Environmental Assessment
EIS	Environmental Impact Statement
GHG	greenhouse gas
Project	Rook I Project
RFD	reasonably foreseeable development
TSD	technical support document
VC	valued component

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6A1 INTRODUCTION

The Climate Change Road Map appendix has been developed to support Section 6, Environmental Assessment Approach and Methods, of the Environmental Impact Statement (EIS) for the NexGen Energy Ltd. (NexGen) Rook I Project (Project). This road map outlines where and how climate change was incorporated throughout the EIS and identifies the key linkages between the EIS sections and technical support documents (TSDs) where climate change was considered.

Climate change is a dynamic process that can affect how projects interact with the environment over the long term. Climate change can modify the potential environment effects of a project by altering thermal and hydrologic regimes. Projects can affect the climate by emitting greenhouse gases (GHGs), and in turn, the climate can affect the resiliency of projects over the long term by changing the frequency and magnitude of extreme weather events. Therefore, climate change has been incorporated throughout the EIS in the following three ways:

- consideration of climate change by discipline;
- identifying potential effects of the Project on climate change; and
- identifying potential effects of climate change on the Project.

Table 6A-1 provides the climate change road map for the EIS. For each of the sections where climate change was incorporated into the EIS, the table summarizes how climate change was considered. The table outlines whether the methods were quantitative or qualitative, the overall approach, and key assumptions.

The first subsection of the table (Consideration of Climate Change by Discipline) identifies the sections of the EIS where effects of climate change were considered as part of the effects assessment for each valued component (VC) or intermediate component. Climate change projections developed for the proposed Project were applied to the individual discipline sections (Section 7 to Section 19), where applicable, to identify the effects of climate change on the VC or intermediate component. The approach for incorporation of climate change differed within the individual discipline sections, and was based on the potential for climate change to influence the VC or intermediate component.

The second subsection of the table (Identifying Potential Effects of the Project on Climate Change) identifies the sections of the EIS that evaluated the effects of the Project on climate change. The Project has the potential to emit GHGs, which contribute to climate change. The Project GHG emissions were estimated in the EIS, along with planned mitigation measures. A series of TSDs were developed to identify how the Project GHG emissions could be reduced to meet NexGen's commitment of managing energy use and reducing GHG emissions (TSD XIII, Upstream Greenhouse Gas Emissions and Carbon Intensity Discussion), and how the Project would help supply clean energy and displace emissions (TSD XXII, Climate Adaptation Framework). In evaluating alternatives to the Project (Section 4, Project Alternatives), emissions intensity of other energy types such as fossil fuels and renewable energy were considered as alternatives to nuclear energy.

The third subsection of the table (Potential Effects of Climate Change on the Project) identifies the sections of the EIS that considered the effects of the environment on the Project. Climate change has the potential to change the future temperature and precipitation regimes that could affect Project infrastructure and activities. Therefore, a detailed climate change dataset was developed for the Project to compare the climate projections with design parameters to evaluate the resiliency of the Project. To align with NexGen's vision and values and to support the continual improvement process for climate change adaptation, the Climate Adaptation Framework (TSD XXII) was prepared to monitor and manage risks as an ongoing process.

Table 6A-1: Climate Change Road Map

EIS Section	Quantitative or Qualitative Methods	Approach Summary	Key Assumptions
Consideration of Climate Change by Discipline			
Section 9: Hydrology and Appendix 9A, Hydrological Modelling Summary Report	**Quantitative** **Base Case:** ▪ A climate change scenario was developed for the Base Case to determine effects of projected climate change on hydrology independent from effects of the Project and other developments. ▪ Potential effects of climate change were assessed by adjusting the current climate conditions to reflect the mean projected climate change for the 2050s, based on the information in Appendix 22A, Climate Change Dataset Summary Report. ▪ Four sensitivity scenarios were also modelled (Appendix 9A) ▪ No Project activities were considered when evaluating the effects of climate change in the Base Case. **RFD Case:** ▪ A climate change scenario was included in the RFD Case to evaluate the combined effects of the Project and the Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019), with projected climate change (i.e., increased precipitation and evaporation during the lifespan of the Project relative to current climate conditions). ▪ Changes in hydrology from the Project and Fission Patterson Lake South Property under current climate conditions were examined without projected climate change to assess development-only effects. ▪ The contribution of effects from projected climate change without developments is also provided.	▪ Site-specific future climate projections that were developed for the Project and summarized in Appendix 22A were used for assessment. ▪ Climate change scenarios were incorporated into the regional hydrological model to evaluate the effect of climate change on the hydrology in Appendix 9A. ▪ In the classification of residual effects for the RFD Case, the effects are classified in the table (Table 9.7-1) for cumulative developments only (i.e., the Project and the Fission Patterson Lake South Property), the climate change scenario only, and developments plus climate change. This allows for greater understanding of sources of hydrological effects predictions in the RFD Case (i.e., separate contributions of effects from developments and climate change).	▪ The mean of climate change projections for 2041 to 2070 (i.e., change relative to the period of 1981 to 2010) was adopted as the most probable of the climate change scenarios. ▪ The period from 2041 to 2070 presents a conversative estimate in terms of climate change during the Project lifespan.

Table 6A-1: Climate Change Road Map

EIS Section	Quantitative or Qualitative Methods	Approach Summary	Key Assumptions
Section 10: Surface Water Quality and Sediment Quality	**Quantitative** ▪ A climate change sensitivity scenario was included in the RFD Case to evaluate the combined effects of the Project and the Fission Patterson Lake South Property with projected climate change (i.e., increased precipitation and evaporation during the lifespan of the Project relative to current climate conditions).	▪ Site-specific future climate projections that were developed for the Project and summarized in Appendix 22A were used to support this assessment for surface water quality. ▪ The climate change scenario developed in Appendix 9A was included in the regional surface water quality model (Appendix 10A, Surface Water Quality Modelling Report). ▪ In the classification of residual effects for the RFD Case, effects for the climate change scenario are consistent with effects for the current (historical) climate scenario. ▪ The residual effects classification table (Table 10.5-7) does not differentiate between effects from climate change and combined effects of developments (Project plus Fission Patterson Lake South Property), as the results under the historical climate and projected climate change scenarios are similar.	▪ The mean changes of projections for 2041 to 2070 relative to the period from 1981 to 2010 were applied to the historical climate record compiled for the Project. ▪ The period from 2041 to 2070 presents a conversative estimate in terms of climate change during the Project lifespan.
Section 11: Fish and Fish Habitat	**Qualitative:** ▪ The effects of projected climate change on fish and fish habitat were considered in the RFD Case through the inclusion of a climate change scenario in the hydrological data inputs to the regional surface water quality model. ▪ These inputs were considered in the ecological risk assessment, the aquatic health assessment, and ultimately in the residual effects analysis for fish VCs.	▪ Site-specific climate projections from Appendix 22A were used for the assessment. ▪ In Section 10, the sensitivity scenario developed was considered in the RFD Case for the regional surface water quality model for Fish and Fish Habitat, which evaluated the effects of projected climate change based on hydrological processes. ▪ Results from the RFD plus climate change sensitivity scenario were reviewed to determine if the minor changes in hydrologic conditions would result in changes to constituent of potential concern concentrations that would ultimately change the predicted effects for fish VCs. ▪ The residual effects classification table (Table 11.5-1) does not differentiate between effects from climate change and combined effects of developments (Project plus Fission Patterson Lake South Property), as the results under the historical climate and projected climate change scenarios are similar.	
Section 12: Terrain and Soils	**Qualitative:** ▪ Projected climate change effects on terrain and soils were assessed qualitatively for different climate variables (i.e., increased temperature and precipitation) and scientific literature. ▪ Effects from climate change were separated from Project effects.	▪ Site-specific climate projections from Appendix 22A were used for the assessment. ▪ The influence of climate change projections on terrain and soils was assessed qualitatively and independently of Project effects. ▪ Climate change was projected to not change the conclusions of the assessment and was not included in the residual effects classification.	▪ Not applicable.

Table 6A-1: Climate Change Road Map

EIS Section	Quantitative or Qualitative Methods	Approach Summary	Key Assumptions
Section 13: Vegetation	**Qualitative:** ▪ Projected climate change effects on vegetation ecosystems and traditional use plants were assessed qualitatively for different climate variables (i.e., increased temperature, precipitation, and evapotranspiration rates), and scientific literature. ▪ Effects from climate change were separated from effects due to the Project and the Fission Patterson Lake South Property but included in the overall determination of significance.	▪ Site-specific climate projections from Appendix 22A, were used for the assessment. ▪ Climate change scenarios were incorporated into the regional hydrological model to evaluate the effect of climate change on the hydrology (e.g., surface water elevation). Changes to the annual mean temperature and evapotranspiration rates considered in Section 9 could affect hydrology and drainage patterns, which was considered for assessment of vegetation. ▪ The influence of climate change projections on vegetation ecosystems and traditional use plants was assessed qualitatively and independently of effects from the Project and other developments. ▪ Effects from climate change would likely interact with changes in vegetation measurement indicators from the Project and other developments and were included in the residual effects classification tables for the RFD Case.	▪ Not applicable.
Section 14: Wildlife and Wildlife Habitat	**Qualitative:** ▪ Projected climate change effects on wildlife and wildlife habitat were assessed qualitatively using information from Section 22, Assessment of Effects of the Environment on the Project (i.e., increased temperature and precipitation), Section 9 (i.e., increased temperature and evapotranspiration rate), and scientific literature. ▪ Effects from climate change were separated from effects due to the Project and the Fission Patterson Lake South Property but included in the overall determination of significance.	▪ Site-specific climate projections from Appendix 22A, were used for the assessment. ▪ Climate change scenarios were incorporated into the regional hydrological model to evaluate the effect of climate change on the hydrology (e.g., surface water elevation). ▪ The influence of climate change projections on wildlife and wildlife habitat was assessed qualitatively and independently of effects from the Project and other developments. ▪ Effects from climate change would likely interact with changes in wildlife and wildlife habitat measurement indicators from the Project and other developments and were included in the residual effects classification tables for the RFD Case.	▪ Not applicable.
Section 15: Human Health	**Qualitative:** ▪ Potential climate change influences on surface water quality in the RFD Case were considered as a sensitivity scenario for the surface water quality model (Section 10). ▪ A quantitative assessment for the human health risk assessment for this sensitivity scenario of the RFD Case was not performed, but the results are discussed qualitatively.	▪ Potential effects of climate change are discussed with reference to changes in constituents of potential concern as identified in the surface water quality model (Section 10).	▪ Not applicable.

Table 6A-1: Climate Change Road Map

EIS Section	Quantitative or Qualitative Methods	Approach Summary	Key Assumptions
Section 16: Cultural and Heritage Resources and Indigenous Land and Resource Use	**Qualitative:** ▪ The RFD Case qualitatively considers potential effects due to projected climate change on resource use based on the qualitative assessment completed for fish and fish habitat, vegetation, and wildlife and wildlife habitat.	▪ Influences of climate change on resource users are described qualitatively using the qualitative assessments of projected climate change effects on fish and fish habitat (Section 11), vegetation (Section 13), and wildlife and wildlife habitat (Section 14). ▪ Climate change is included in the residual effects classification table for the RFD Case (Table 16.6-1).	▪ Not applicable.
Section 17: Other Land and Resource Use	**Qualitative:** ▪ The RFD Case qualitatively considers potential effects due to projected climate change on resource use based on the qualitative assessment completed for fish and fish habitat, vegetation, and wildlife and wildlife habitat.	▪ Influences of climate change on resource users are described qualitatively using the qualitative assessments of projected climate change effects on fish and fish habitat (Section 11), vegetation (Section 13), and wildlife and wildlife habitat (Section 14). ▪ Climate change is considered in the residual effects classification and determination of significance to the other land and resource use VC in Section 17.6.2, Significance Determination.	▪ Not applicable.
Section 18: Economy	▪ Climate change is not anticipated to materially interact with the economy measurement indicators for the Project.	▪ Not applicable.	▪ Not applicable.
Section 19: Community Well-Being	▪ Climate change is not anticipated to materially interact with the community well-being measurement indicators for the Project.	▪ Not applicable.	▪ Not applicable.
Identifying Potential Effects of the Project on Climate Change			
Section 1: Introduction	**Qualitative:** ▪ A qualitative description of NexGen's vision and values has been provided, which identified NexGen's role in reducing its effect on the environment by: o contributing to delivery of clean energy; and o implementing environmental stewardship commitments to responsibly manage energy use and reduce GHG emissions.	▪ Highlights the commitments by NexGen from their latest Sustainability Report on environmental, social, and corporate governance. ▪ Based on NexGen's vision and values, a range of studies have been completed as TSDs to meet the environmental and sustainability goals: o The Upstream GHG and Carbon Intensity Discussion TSD (TSD XIII) provides a qualitative discussion of how uranium concentrate produced from the Project would help contribute to the nuclear energy sector to help reduce carbon intensity of electric grids. o The Net-Zero Framework TSD (TSD XII) provides a preliminary assessment of potential alternative technologies and practices that could be used to manage Project energy use and reduce Project GHG emissions during its lifetime.	▪ Not applicable.

Table 6A-1: Climate Change Road Map

EIS Section	Quantitative or Qualitative Methods	Approach Summary	Key Assumptions
Section 4: Project Alternatives	**Qualitative:** ▪ The GHG emissions associated with alternative energy types including fossil fuels and renewable energy were compared in the consideration of Project alternatives.	▪ Based on the available literature review, carbon intensity of nuclear power is qualitatively compared to the carbon intensity of fossil fuels and renewable energy, to identify the effect of alternatives (e.g., fossil fuels and renewable energy) on GHG emissions compared to nuclear energy. ▪ The Upstream GHG and Carbon Intensity Discussion TSD (TSD XIII) was used to support the discussion on carbon intensity of alternative energy type.	▪ Not applicable.
Section 7: Air Quality, Noise, and Climate Change	**Quantitative:** ▪ The climate change assessment conducted a quantitative assessment of Project GHG emissions to identify the effects of the Project on climate change during Construction, Operations, and Decommissioning and Reclamation (i.e., Closure).	▪ Based on the quantitative assessment of GHG emissions, it was determined whether the Project would have an effect on the provincial and federal GHG levels and the ability of Canada to achieve its commitments of reducing GHGs. ▪ Project's emission intensity was calculated based on GHG emitted per pounds uranium concentrate produced on an annual basis. In the classification of residual effects, the RFD case includes the Application, which provides necessary information for the federal government to consider the Project relative to future development. It is assumed that provincial and federal governments will regulate and manage GHGs within their jurisdictions including RFDs, which is why there is no RFD for climate change. ▪ Upstream GHG emissions were not calculated for the Project. However, the Upstream GHG and Carbon Intensity Discussion TSD (TSD XIII) was used to support the discussion on importance of uranium supply for nuclear energy, to deliver clean energy and displace emissions internationally.	▪ Uncertainty associated with GHG emissions was addressed by making assumptions that overestimated rather than underestimated potential effects. A worst-case scenario was assumed while calculating GHG emissions based on maximum expected value in a given year.
Section 20: Summary of Residual Project and Cumulative Effects	▪ Provides a summary of residual effects classification and significance determination for VCs, including the climate change VC.	▪ Not applicable.	▪ Not applicable.
Section 23: Summary of Mitigation, Monitoring, and Follow-Up Programs	▪ Provides a summary of monitoring and follow-up measures for climate change, including for GHG emissions.	▪ Provides an overview of monitoring and follow-up measures that could be implemented to reduce Project GHG emissions. Detailed monitoring and follow-up measures for GHG emissions are provided in Section 7.	▪ Not applicable.
Section 24: Conclusions	▪ Provides a qualitative summary of significance of effects for all disciplines, including climate change.	▪ Not applicable.	▪ Not applicable.

Table 6A-1: Climate Change Road Map

EIS Section	Quantitative or Qualitative Methods	Approach Summary	Key Assumptions
Potential Effects of Climate Change on the Project			
Section 1: Introduction	**Qualitative:** ▪ A qualitative description of NexGen's vision and values has been provided, which identified NexGen's role reducing the effect of environment on the Project through the Integrated Management System that follows a Plan-Do-Check-Act cycle to protect the health, safety, and well-being of workers; preserving the environment; for engaging with Indigenous communities and members of the public; complying with legal and other requirements; and continually improving management system processes and performance.	▪ Based on NexGen's vision and values to minimize risks on the Project, a Climate Adaptation Framework TSD (TSD XXII) has been prepared to reduce the effect of climate change by supporting a decision-making process to build climate resilience based on NexGen's Integrated Management System and Plan-Do-Check-Act cycle.	▪ Not applicable.
Section 5: Project Description	**Qualitative:** ▪ Current and projected climate conditions for a range of climate variables such as temperature, precipitation, wind speed, and wind direction were considered for the Project design.	▪ The current climate change conditions were used to support the Project design, while the future climate projections were used to evaluate the Project design parameters. ▪ Appendix 22B, Climate-Infrastructure Interactions, has been prepared to identify how current and projected climate might affect the Project infrastructure (climate-infrastructure interactions) and Project activities (climate interactions by Project activity) during different stages of the Project lifespan. ▪ The climate-infrastructure interactions from Appendix 22B, (see below) were used to evaluate the Project design parameters based on future climate projections.	▪ Not applicable.
Section 21: Accidents and Malfunctions	▪ The effects of climate change are not considered in this section.	▪ The effects of climate change on the Project, including an overview of accidents and malfunctions because of climate change, is qualitatively discussed in Section 22.	▪ Not applicable.

Table 6A-1: Climate Change Road Map

EIS Section	Quantitative or Qualitative Methods	Approach Summary	Key Assumptions
Section 22: Assessment of Effects of the Environment on the Project	**<u>Qualitative and Quantitative:</u>** ▪ A detailed climate change dataset has been developed for the Project and summarized in Appendix 22A. The dataset includes a review of the current climate and future climate projections for the Project region, and a discussion of the climate baseline and future projections for temperature, precipitation, and extreme indices. ▪ Based on a detailed climate change dataset, Appendix 22B has been developed. A summary of potential interactions of climate events with Project's infrastructure and design has been provided. The appendix also provides a summary of climate vulnerabilities for Project activities based on Construction, Operations, and Closure. ▪ Section 22 provides a description of climate change vulnerabilities for the Project.	▪ For Appendix 22A, detailed, site-specific future climate projections were developed for the Project through analysis of available projections from a multi-model ensemble. The multi-model ensemble consists of available regional scale projections from several climate models representing different future climate scenarios (e.g., level of GHG emissions). ▪ For Appendix 22B, the assessment of climate-infrastructure interactions and climate vulnerabilities is based on a qualitative, high-level risk approach of identifying of how current and projected climate might affect the Project. The detailed, site-specific climate projections developed in Appendix 22A are used for identifying interactions and vulnerabilities. ▪ Section 22 includes qualitative identification of whether the Project might be sensitive to the projected changes in the climate conditions.	▪ The mean changes of projections for 2041 to 2070 relative to the period from 1981 to 2010 were applied to the historical climate record compiled for the Project. ▪ The period from 2041 to 2070 presents a conversative estimate in terms of climate change during the Project lifespan. ▪ Assumes representative concentrations pathway 8.5 provides a conservative basis for assessment and planning.

GHG = greenhouse gas; VC = valued component; RFD = reasonably foreseeable development; TSD = technical support document.

REFERENCES

Literature Cited

Fission (Fission Uranium Corp.). 2019. Technical Report on the Pre-Feasibility Study of the Patterson Lake South Property using Underground Mining Methods, Northern Saskatchewan, Canada. NI 43-101 Report. Prepared by Roscoe Postle Associates Inc. for Fission Uranium Corp. November 2019.

Fission. 2021. Fission Project Description. Prepared by Clifton Engineering Group Inc. and Canada North Environmental Services Limited Partnership for Fission Energy Corp. 22 November 2021.

Appendix 6B Project-Environment Interactions Matrix

Table 6B-1: Rook I Project Interactions with Valued Components and Intermediate Components

Project Phase or Far-Future Scenario	Key Project Component/Activity[a]	Atmospheric Environment			Aquatic Environment				Terrestrial Environment			Human Health	Social Environment				
		Air Quality	Climate	Noise	Hydrogeology	Hydrology	Surface Water Quality	Fish VCs	Terrain and Soils	Vegetation VCs	Wildlife VCs	Human Health VCs	Cultural and Heritage Resources	Indigenous Land and Resource Use	Other Land and Resource Use	Economy	Community Well-Being
Construction	Land clearing, site preparation, and construction of facilities and infrastructure, underground shaft/mine development	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Site traffic, transportation of personnel and materials to and from the site	X	X	X	n/i	n/i	X	X	X	X	X	X	n/i	X	X	X	X
Operations	Site traffic, transportation of personnel and materials to and from the site	X	X	X	n/i	n/i	X	X	X	X	X	X	n/i	X	X	X	X
	Process plant and underground operations, underground tailings management facility	X	X	X	X	X	X	X	X	X	X	X	n/i	X	X	X	X
	Handling and storage of waste rock, special waste rock, and ore	X	X	X	X	X	X	X	X	X	X	X	n/i	X	X	X	X
	Effluent treatment plant and treated effluent discharge	n/i	n/i	n/i	n/i	X	X	X	n/i	X	X	X	n/i	X	X	X	X
	Water intake for fresh water and process water	n/i	n/i	n/i	n/i	X	n/i	X	n/i	n/i	n/i	n/i	n/i	X	X	X	X
	Power generation	X	X	X	n/i	n/i	X	X	X	X	X	X	n/i	X	X	X	X
	Non-hazardous waste incineration	X	X	n/i	n/i	n/i	X	X	X	X	X	X	n/i	X	X	X	X
	Additional infrastructure (e.g., roads, airstrip, and camp, maintenance shop and offices), water storage, and effluent monitoring ponds	X	X	X	n/i	X	X	X	X	X	X	X	X	X	X	X	X
Decommissioning and Reclamation (i.e., Closure)	Site traffic, transportation of personnel and materials to and from the site	X	X	X	n/i	n/i	X	X	X	X	X	X	n/i	X	X	X	X
	Removal of infrastructure, restoration and revegetation of facilities and infrastructure	X	X	X	n/i	X	X	X	X	X	X	X	X	X	X	X	X
Far-Future scenario[b]	▪ Potential for long-term migration of constituents of potential concern from underground facility and waste rock storage areas ▪ Not a Project phase	n/i	n/i	n/i	X	n/i	X	X	n/i	X	X	X	n/i	n/i	n/i	n/i	n/i

a) Project components or activities may combine to interact with VCs or intermediate components; as such, pathways identified in Section 7, Air Quality, Noise, and Climate Change, to Section 19, Community Well-Being, of the Environmental Impact Statement may include more than one of the key Project components/activities listed.

b) An environmental risk assessment is completed on ecological and human receptors. Some of the fish, vegetation, and wildlife VCs are also ecological receptors (Section 6.3.4, Environmental Risk Assessment Receptors).

VC = valued component; X = interaction is anticipated (i.e., primary or secondary pathway, or positive interaction); n/i = no interaction is anticipated, or interaction is avoided by Project design or mitigation (i.e., no pathway).