Rook I Project

Environmental Impact Statement

TSD XXII: Climate Adaptation Framework

CLIMATE ADAPTATION FRAMEWORK TECHNICAL SUPPORT DOCUMENT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

WSP Canada Inc.

March 2024

Abbreviations and Units of Measure

Abbreviation	Definition
EIS	Environmental Impact Statement
IMS	Integrated Management System
MAC	Mining Association of Canada
MAA	multiple accounts analysis
NexGen	NexGen Energy Ltd.
Project	Rook I Project

Unit	Definition
%	percent

Table of Contents

TABLES

FIGURES

1.0 INTRODUCTION

Climate change has the potential to change future precipitation and temperature regimes and has been identified for consideration in assessment and planning of Construction, Operation, and Decommissioning and Reclamation (i.e., Closure) of the NexGen Energy Ltd. (NexGen) Rook I Project (Project). As part of the Environmental Impact Statement (EIS), a detailed climate dataset has been developed to support the analysis of potential climate-infrastructure interactions and to support the assessment of climate-related effects over the lifespan of the Project. In addition to supporting the EIS, this framework supports the decision-making process to build climate resilience (i.e., the ability to continue activities during all Project phases in the face of projected climate change).

A climate adaptation strategy forms the basis of a plan developed to document ongoing monitoring and continual improvement related to climate change, as well as to outline the decision-making process for when action needs to be taken to increase climate resilience. A climate adaptation framework is the approach used to develop the climate adaptation strategy. This technical support document provides a proposed framework that could be used to develop a climate adaptation strategy for the Project outside of the Environmental Assessment (EA) process. This report also provides guidance on how existing systems and processes for the Project, along with work completed as part of the EIS, could be mapped to support the proposed framework. This mapping could be used as a basis for developing a climate adaptation strategy for the Project to support future climate risk assessments or to provide operational and financial decision-making support. The climate adaptation framework could be used by NexGen to develop a climate adaptation strategy to document a climate-focused continual improvement process, including outcomes of future climate risk assessments, identification and implementation of adaptive measures (i.e., actions taken to improve climate resilience), and performance of implemented adaptation measures through monitoring and surveillance programs.

This technical support document is organized to first provide an understanding of existing processes and systems developed for the Project and relevant climate-related EIS work (Section 2.0, Supporting Project Information). Following this supporting information, the report summarizes a climate adaptation framework (Section 3.0, Proposed Climate Adaptation Framework) based on recent guidance from the Mining Association of Canada (MAC 2021). The supporting information is then mapped to the proposed framework to show how existing information from the Project could be used to develop a climate adaptation strategy (Section 4.0, Mapping to the Proposed Climate Adaptation Framework). Potential next steps to develop a climate adaptation strategy are discussed (Section 5.0, Developing a Climate Adaptation Strategy), further demonstrating how the framework could be applied to the Project. Finally, a glossary of terms used throughout the report is provided (Section 6.0, Glossary).

2.0 SUPPORTING PROJECT INFORMATION

The proposed climate adaptation framework relies on an understanding of the current and future climate and potential climate interactions, as well as an understanding of risk management systems and continual improvement processes. The work completed under the EIS relevant to a climate adaptation framework is summarized first, followed by summaries of the Integrated Management System (IMS), which governs both continual improvement processes and risk management systems.

2.1 Relevant Environmental Impact Statement Sections

Environmental Impact Statement (EIS) Appendix 22A, Climate Change Dataset Summary Report, describes the current climate conditions and future projected climate for the general region of the Project. The dataset provides a description of the current climate conditions using the most representative local observation data and a description of the future climatic conditions using publicly available climate projections in terms of percentiles of results generated by a model ensemble. The dataset focuses on mean temperature and precipitation, along with information on extreme weather events. Understanding the current climate and the future climate trends is important when evaluating the Project design parameters and potential climate-infrastructure interactions.

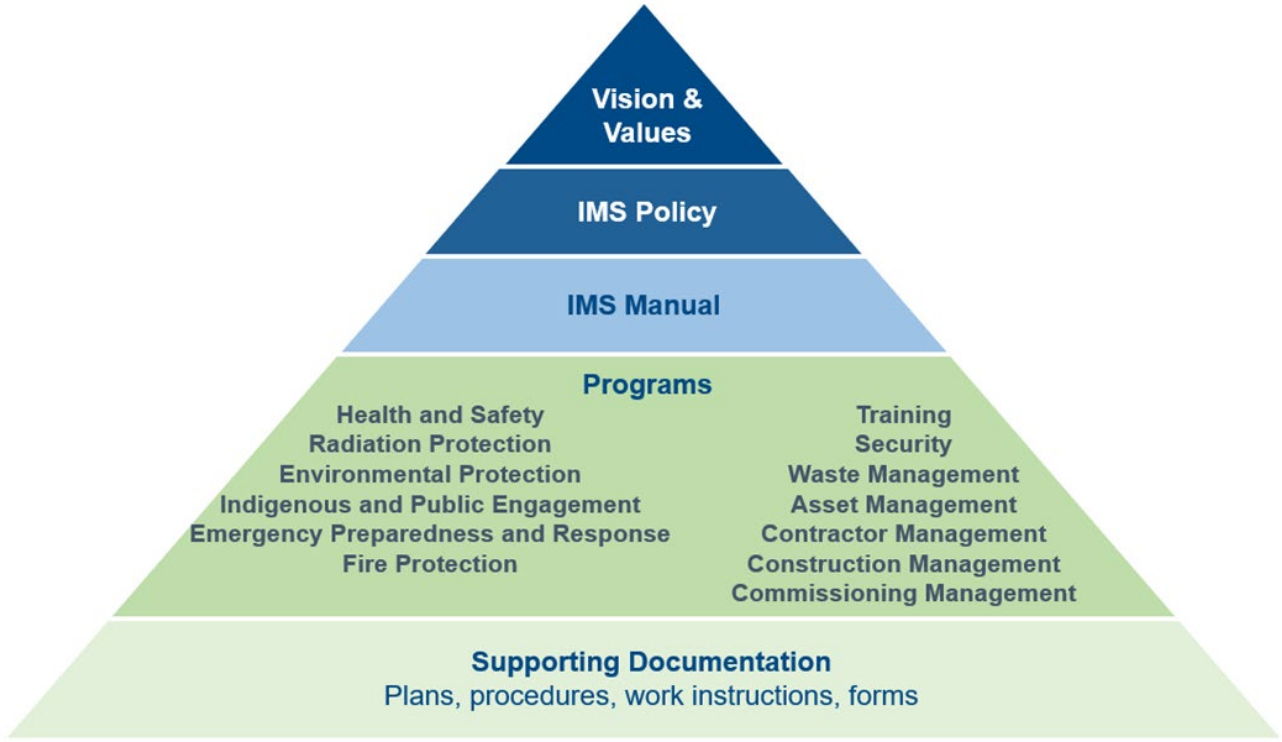
Environmental Impact Statement (EIS) Appendix 22B, Climate–Infrastructure Interactions, identifies the climate-infrastructure interactions, the resilience and mitigation actions, and the required monitoring and surveillance commitments to support the resilience actions. The climate-infrastructure interactions have been identified for the surface and underground infrastructure for temperature, precipitation, and extreme events, which is the first step in a risk assessment. The interactions provide a high-level summary on areas of risk. To address the uncertainty of the identified interactions, a detailed climate risk assessment could be conducted for high priority areas. Appendix 22B summarizes a range of mitigation measures that have been identified in the feasibility study (NexGen 2021) for the Project. Although the mitigation measures have the potential to reduce climate risks, the measures need to be monitored for their performance through an ongoing monitoring and surveillance process. Additional mitigation measures identified through the EA process would also have to be added to EIS Appendix 22B for monitoring and evaluation of their performance to reduce climate change effects. Appendix 22B could be used as a supporting document for implementation of this climate adaptation framework.

Environmental Impact Statement (EIS) Section 22, Assessment of Effects of the Environment on the Project, included a high-level risk assessment of present and future environmental risks such as extreme temperatures, extreme precipitation, and related natural hazards on the Project. The analyses were qualitative, considering likelihood and consequence of each hazard to estimate a level of risk. Climate-related risks considered the future projections in Appendix 22A and infrastructure interactions in Appendix 22B as outlined above.

2.2 Integrated Management System

NexGen has established the IMS which is subject to the IMS Policy and the IMS Manual. The policy and the manual provide the foundation for NexGen's approach to risk management and continual improvement. The IMS is summarized in Figure 2-1.

Figure 2-1: Rook I Project Integrated Management System Framework



IMS = Integrated Management System.

NexGen is developing an IMS Policy to support the health, safety, well-being, environment, and Indigenous and community processes of the organization. NexGen is committed to health, safety, and well-being of the employees through a serios of actions such as identifying, managing, and eliminating hazards, managing hazards to confirm exposure is low as achievable, and establishing a strong safety culture which is periodically assessed and continually improved. NexGen, through the IMS Policy is committed to recognizing and valuing the importance of protecting and preserving the environment through the lifecycle of the Project and future generations by a series of actions including:

- exercising responsible stewardship of air, land, and water resources;
- keeping all releases and adverse impacts low and respecting the principle of pollution prevention;
- designing and operating for closure and responsibly managing tailings and waste facilities;
- minimizing waste generation;
- managing energy use and reducing greenhouse gas emissions; and
- monitoring and assessing against indicators and targets based on sound science.

NexGen is also committed to acknowledging and valuing community interests and aspirations of those impacted by the Project through fostering trusting relationships that facilitate collaborations.

As a part of the IMS Policy, NexGen is developing the IMS Manual, which will set continual improvement as a general process for the Project. NexGen's continual improvement will be an ongoing process to improve the suitability, adequacy, and effectiveness of the IMS and its underlying programs and plans. Management and workers will be expected to continually seek out improvement opportunities for the IMS and Project processes; this effort typically would involve program monitoring, auditing, management review, and maintaining awareness of changes in the business environment, and may also include benchmarking the Project performance against other similar projects and facilities. Continual improvement opportunities would be identified, documented, and evaluated and this process will be described in the IMS procedure Continual Improvement. The IMS Manual will identify that the Project would follow a Plan-Do-Check-Act cycle to identify, control, monitor, and continually improve the Project processes. The continual improvement process at the Project is described in Table 2-1.

Table 2-1: Plan-Do-Check-Act Cycle for the Project

Step	Description
Plan	As a part of the continual improvement process, identify and document hazards, and assess the risks using a risk matrix appropriate for the assessment based on the likelihood and severity of the occurrence. Document risks in the risk registers and implement controls where required.
Do	Apply controls to address the identified hazards and risks to lower the risks to an acceptable level. Document, track, and periodically review controls for their effectiveness
Check	Conduct ongoing performance monitoring and periodical analysis.
Act	Perform corrective actions as appropriate and continually improve the management system.

2.3 Risk Management Process

NexGen describes a risk management process as part of its IMS Manual to identify hazards to people, environment, systems, facilities, and equipment. NexGen's risk management process starts with hazard identification to consider what, how, and why things could go wrong. This step is followed by a risk assessment using a risk matrix appropriate for the type of assessment and rated based on likelihood and consequence. Hazards with higher risk rankings would require additional mitigation measures to reduce the risk to an acceptable level. The IMS risk assessment would be documented in the Project risk register, which would be updated periodically and used for decision making and the identification of improvement opportunities.

Based on the ongoing identification of risks through the IMS risk assessment process, controls would be implemented as appropriate to reduce the risks. NexGen has developed a hierarchical system to identify the control that should be implemented to reduce a risk. Controls would be documented, tracked, and periodically monitored for their performance. To support the IMS risk management process, NexGen has systems to implement work control, design control, and supply chain control. NexGen also has systems for monitoring and measuring controls, as well as auditing and inspecting the implemented controls. Any events deemed sufficiently serious in nature would go through the corrective action process. Corrective actions would be planned, implemented, verified, and reviewed for their effectiveness based on the level of risk.

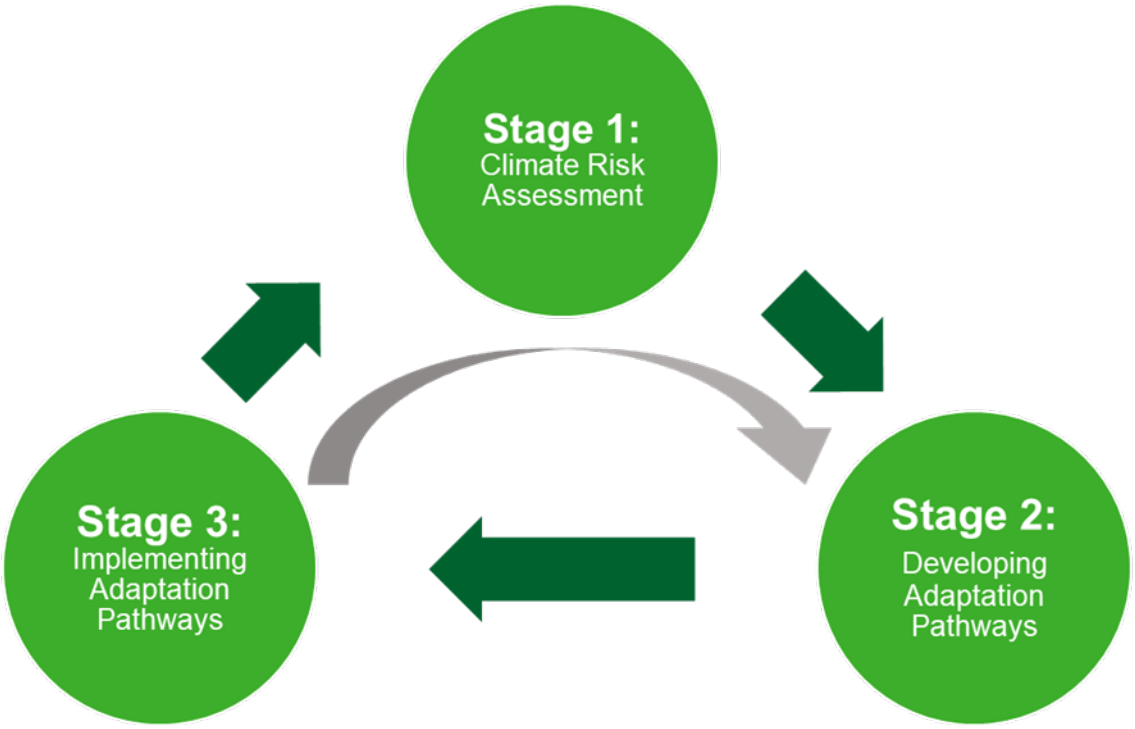
3.0 PROPOSED CLIMATE ADAPTATION FRAMEWORK

This subsection summarizes the *Guide on Climate Change Adaptation for the Mining Sector* (MAC 2021) that could be used to integrate climate risks and opportunities in its operations. The MAC guidance provides a stepwise approach that NexGen could apply to consider and incorporate climate change adaptation considerations into decision making to increase the resiliency of the Project. The document could help identify an approach to reduce potential climate change effects, take advantage of climate change opportunities, and reduce the need to implement costly adaptation measures (i.e., actions taken to manage risks or opportunities associated with climate change) later in the project's lifecycle.

The MAC guidance provides a three-stage framework that involves the following: climate risk assessment; developing adaptation pathways; and implementing adaptation pathways to incorporate climate change in decision making. The MAC (2021) defines adaptation pathways as the different options to implement identified adaptation measures (i.e., actions taken to manage risks or opportunities associated with climate change) to address climate risks or opportunities. As there are multiple ways adaptation measures could be implemented; multiple pathways could be developed to address the same risk or opportunity. This three-stage process could be used to understand current and future climate trends in areas of operations, identify key site and organizational (i.e., corporate) level aspects that could be vulnerable to a changing climate, assess risks, identify adaptation measures, and implement adaptation pathways. The outcomes of this climate risk assessment process could be integrated into a site- or company-wide risk management program or organizational governance policy or strategy.

Section 3.1, Climate Risk Assessment (Stage 1), Section 3.2, Developing Adaptation Pathways (Stage 2), and Section 3.3, Implementing Adaptation Pathways (Stage 3) provide a summary of how projects could incorporate climate change into decision making through an iterative process. In an iterative process, the vulnerabilities (i.e., the extent to which infrastructure or activities are susceptible to, or unable to cope with, climate change) are reconsidered, risks are re-assessed, and adaptation measures are re-evaluated based on performance (Figure 3-1).

Figure 3-1: Three Stages of Climate Resiliency



This three-step climate risk assessment is an iterative process, where each stage of the cycle requires successive re-evaluation. Re-evaluation is based on the findings derived from the monitoring and surveillance of the adaptation pathways and on whether prescribed triggers/thresholds are met. For example, the need for re-assessment will arise if there are updates to future climate projections and/or changes to the infrastructure or operations of project components. The risk assessment is not static and needs to be updated to address the uncertainties of a changing climate or changes to:

- climate science;
- engineering codes and standards or legal requirements that may alter vulnerabilities or risks;
- project operations, including infrastructure;
- policies, plans, and business strategies;
- project assets;
- life cycle phases of a project;
- future plans of a project (e.g., closure planning); and
- the environment surrounding the project (i.e., outside of the project boundary).

In addition to the MAC guidance, additional resources considering the climate resilience of buildings and infrastructure (Cannon et al. 2020), the application of future rainfall intensity-duration-frequency information (CSA Group 2019), and assessing climate change resilience (Government of Canada 2022) would be considered, where appropriate, as part of the proposed adaptation framework.

3.1 Climate Risk Assessment (Stage 1)

Climate risk assessment involves identifying and incorporating current and future climate trends and developing and implementing a vulnerability identification into a risk evaluation framework.

3.1.1 Developing Climate Change Datasets

A thorough understanding of historical and current climate conditions is essential to all aspects of climate risk assessments and adaptation planning (i.e., process of adjustment to reduce the impacts of climate change, or to take advantage of the opportunities arising out of climate change), including inputs from future climate change projections. This stage of the process may include but is not limited to:

- compiling and analyzing datasets provided for observed climate conditions for the site;
- establishing baseline climate conditions based on the observed climate data;
- developing projected future climate conditions for the site using accepted modelling tools and approaches; and
- identifying and characterizing inherent uncertainties in historical and future climate conditions.

Considering that dataset development is an iterative process, one area of continual improvement is recognizing and fulfilling the need to update the climate data that support the risk assessment. Updated climate change projections should be incorporated in the process at regular intervals as triggers for adaptation planning.

3.1.2 Developing a Climate Change Risk Assessment Framework

Climate change risk assessment is a systematic process used to identify, assess, and prioritize climate change risks. The assessment provides a foundation to support the development, selection, and implementation of adaptation pathways that would then be carried forward for further assessment in the climate change risk assessment process (e.g., development of triggers and thresholds where required). A systematic process is required to address all project operations and must be based on accurate and up-to-date climate data relevant to a project's infrastructure and operations. The risk assessment outcomes are derived in such a way that they could be used to facilitate the development, implementation, and re-evaluation of adaptation pathways. The risk assessment process should be iterative, considering the uncertainties associated with climate change, and should be reviewed regularly (e.g., annually, when there are changes to operations or business, when model updates are released) to validate that the assessment is up to date. The results of the review could help identify a required update to the risk assessment.

Risk assessments require input from a multi-disciplinary team, including representatives from project operations, environment, community and government relations, water management, tailings management, procurement, and mine and mill management. These representatives could be internal or external to an organization, depending on the expertise available. The climate change risk assessment involves the steps outlined in Table 3-1.

Table 3-1: Climate Change Risk Assessment Steps

Step	Actions Involved
Risk assessment scope	Identify: ▪ objectives; ▪ knowns and unknowns; ▪ boundaries for assessment; ▪ existing risk management programs; ▪ required human and financial resources; ▪ stakeholders; and ▪ how the risk assessment could be integrated into overall decision-making process.
Information gathering	Identify existing information such as: ▪ current climate data and future projections for the area; ▪ existing risk assessment practices; ▪ Indigenous and Local Knowledge; ▪ climate adaptation measures taken by third parties (e.g., stakeholders, insurers); ▪ list of project equipment and operations; ▪ current infrastructure design and closure plans; and ▪ operational data for equipment and infrastructure.
Identifying vulnerabilities and opportunities	Identify: ▪ Direct and indirect effects of climate change on project operations. ▪ Associated vulnerabilities for on-site and off-site components. ▪ Relationships between direct and indirect effects of climate change on mining operations. ▪ Opportunities due to climate change (e.g., longer growing season could potentially enhance reclamation activities).
Defining risk ranking system	▪ Identify timeframes for likelihood and consequences. ▪ Describe a risk-ranking system. ▪ Provide a risk matrix to display risk ratings for each vulnerability.
Assessing risks	▪ Assign a consequence and likelihood score to each vulnerability using the risk-ranking system for current and projected future climate conditions. ▪ Rank and prioritize risks based on analysis.

The outcomes of the risk assessment process would be documented and reported and would be communicated with internal and external stakeholders. Community of Interest groups would include local communities and First Nations and Métis Groups (collectively referred to as Indigenous Groups). Reporting should be completed in a common and simple language to support communication with senior management, regulators, and stakeholders.

3.2 Developing Adaptation Pathways (Stage 2)

Developing adaptation pathways involves identifying and documenting possible actions to reduce climate-related risk. The key components include identifying adaptation options, identifying triggers and thresholds, and developing adaptation pathways.

3.2.1 Identifying Adaptation Measures

Adaptation measures refer to any implemented actions that reduce the risk of critical project infrastructure to climate change. Adaptation measures usually include, but are not limited to, physical actions (e.g., the construction of a piece of infrastructure), though adaptation measures could also include strategic action (e.g., changes to business practices) and operational action (e.g., design considerations, location, and operation

of a project infrastructure component). The objective of this stage is not to select which adaptation measures need to be implemented, but instead to develop a list of potential measures that could be implemented. Determining the most suitable adaptation measures is dependant on the outcomes of the risk assessment from Stage 1 (i.e., the climate risk assessment). The adaptation measures selected to minimize any identified climate-related risks should take advantage of identified opportunities posed by climate change and optimize future performance by reducing future risks.

The adaptation options (i.e., available adaptation measures) should be selected by a multi-disciplinary team that includes personnel involved in the risk assessment (Stage 1) and personnel responsible for different aspects of Project and organizational (i.e., corporate) operations. Due to the iterative nature of the climate resilience process, every time a climate risk assessment (Stage 1) is updated, the identified adaptation measures need to be re-evaluated based on the outcomes of the updated risk assessment.

3.2.2 Identifying Triggers and Thresholds

Developing pre-defined triggers and thresholds is key for developing adaptation pathways that facilitate effective decision making to determine when to implement the pathways. Thresholds or tipping points describe the climate conditions for a specific climate variable (e.g., mean annual precipitation) beyond which further changes in climate would result in the existing risk management or adaptation measures no longer being able to meet performance objectives and potentially failing (e.g., the maximum capacity of a spillway) (Buurman and Babovic 2017). A trigger describes a point before the threshold is reached at which a climate hazard/event deviates from current climatic conditions and creates an early warning sign that a threshold is approaching.

As a trigger could be used as an early warning of crossing a threshold, it is important to establish a trigger for each pathway. The identified early warnings should provide sufficient time to allow implementation of the selected adaptation measures and manage the identified risks before thresholds are reached. Specific adaptation measures to be implemented could prevent the threshold being reached. For example, consider a water crossing that is designed for a flood event of a specific magnitude with a return period of 1:1,000 years. If a flood event of the same magnitude has a shorter return period under future conditions, then the risk could be re-evaluated. If the risk is unacceptable, an adaptation measure is necessary. A reassessment of intensity is necessary on a regular basis to monitor the change in risk.

3.2.3 Developing Adaptation Pathways

Adaptation pathway processes could be used to evaluate, develop, and potentially implement adaptation actions, and should be used to evaluate which actions need to be taken in the short term, and which actions are best deferred to the longer term. The MAC (2021) guide defines adaptation pathways as the different options to implement identified adaptation measures to address risks or opportunities. Since there are multiple ways adaptation measures could be implemented, multiple pathways could be developed to address the same risk or opportunity. The development of adaptation pathways should consider the projected future climate conditions, outcomes of climate risk assessment (Stage 1), identified opportunities, status of existing implemented adaptation measures, and identified potential adaptation measures to be integrated into decision-making processes. The adaptation pathways approach is a “planning approach addressing the uncertainty and challenges of climate change decision-making. It enables consideration of multiple possible futures and allows analysis/exploration of the robustness and flexibility of various options across those multiple futures” (MAC 2021).

Adaptation pathways also consider what additional adaptation may be required at some point in the future if trigger levels are met.

Identified adaptation pathways could include:

- "no action required" pathway (where climate risk could be considered acceptable under current and future climatic conditions);
- "wait" pathway (where additional information is gathered before making a decision);
- "defer with pre-defined triggers for action" pathway (where risk is acceptable in short-term, but will require action in future); or
- "implementing action" pathway (where adaptation measure needs to be implemented in short-term).

A decision-making process could be implemented to identify the adaptation pathway. There are a range of decision analysis tools that could be used to rank and prioritize the adaptation pathways for implementation. The use of decision-making processes involves assumptions and biases, and to test the sensitivity of outcomes of the decision-analysis, a sensitivity analyses could be conducted using tools such as multiple accounts analysis (MAA).

No matter which adaptation pathway is selected, monitoring and surveillance should be integrated into the maintenance program as part of a continual improvement process. Furthermore, adaptation pathways should be developed by qualified professionals who have sufficient practical experience in internal risk assessment processes, along with input from multi-disciplinary stakeholders (e.g., climate scientists, Engineer of Record, design engineer). The approach to develop adaptation pathways is outlined in Table 3-2.

Table 3-2: Adaptation Pathways Approach Steps

Step	Actions involved
Objective and scope	▪ Identify the objective and scope. ▪ Identify the acceptable level of risk. ▪ Identify team and team member responsibilities to develop adaptation pathways. ▪ Define measurable performance objectives for the adaptation pathways.
Adaptation measures	▪ Identify physical/strategic/operational adaptation measures. ▪ Describe the identified adaptation measures. ▪ Identify how the adaptation measures would be implemented.
Potential adaptation measures classification and screening	▪ Classify adaptation measures into no/low regrets adaptation, flexible adaptation, win-win adaptation, or critical adaptation[(a)]. ▪ Pre-screen the identified adaptation measures based on the performance objectives to eliminate measures that do not meet the objectives or are not feasible.
Adaptation pathways	▪ Identify adaptation pathways for identified adaptation measures, which could include no action required, wait, defer with pre-defined triggers for action, and/or implement action. ▪ Schedule the implementation of identified adaptation measures. ▪ Identify actions that need to be taken in short-term and those that could be deferred to long-term. ▪ Document the identified potential adaptation pathways for effective communication.
Climate thresholds and triggers	▪ Establish the threshold when the climate risk is unacceptable. ▪ Establish triggers based on design parameters with the intent that the there is adequate time to take action (i.e., implement adaptation measures) to modify design/construction before a threshold is reached. ▪ Where a number of different triggers are defined prior to reaching the threshold, identify multiple levels of triggers that could be used.

Table 3-2: Adaptation Pathways Approach Steps

Step	Actions involved
Decision analysis and Sensitivity analysis	▪ Apply decision-making processes such as MAA. ▪ Conduct a sensitivity analysis to test outcomes of decision-analysis against the biases and assumptions involved.
Preferred adaptation pathway selection	▪ Select the preferred adaptation pathway for implementation; use decision-making tool if required. ▪ Document timelines for implementing preferred adaptation pathways. ▪ Identify issues that may affect implementation of a selected adaptation pathway.

a) Classifications are defined in Section 6.0, Glossary.
MAA = multiple accounts analysis.

The outcomes of this process, including the adaptation pathway selected, should be documented and reported. The results should be communicated to the appropriate internal and external stakeholders using common and simple terms.

3.3 Implementing Adaptation Pathways (Stage 3)

This stage includes designing the adaptation pathways that were selected in Stage 2, implementing monitoring and surveillance systems, and developing adaptation management plans. All three steps are needed to implement the adaptation pathways. This stage of the process supports the iterative and continual improvement approach to incorporating climate change adaptation into decision making.

3.3.1 Designing the Adaptation Pathways

Once adaptation pathways have been selected (Stage 2), the adaptation pathway and the associated adaptation measures should be designed to effectively manage risks and opportunities. This step includes defining and documenting any modification actions for infrastructure, documenting any new short-term and long-term construction, defining and documenting maintenance and surveillance practices, and/or revising closure plans.

3.3.2 Implementing Surveillance Systems

Surveillance is a key step of the design and implementation of adaptation pathways. Surveillance is used to confirm that new climate data and performance of implemented adaptation measures are reviewed and integrated into new plans as part of an iterative process. Surveillance involves monitoring and collecting qualitative and quantitative observations and data of activities and infrastructure. Surveillance includes the documentation, analysis, and communication of monitoring results that will help to inform decision making and verify whether performance objectives and risk management objectives are being met (adapted from MAC 2019a).

Implementation of surveillance systems involves assessment of current climate conditions in comparison to future projections, effectiveness of existing risk management practices and implemented adaptation measures, performance against defined thresholds and triggers. It also includes surveillance of vulnerabilities where risk was identified to be acceptable, regardless of the pathway selected. Given that it is an iterative process, results from monitoring and surveillance should be used to inform any updates to the risk assessment, adaptation pathways framework/decision analysis, or adaptation management plans, to support the continual improvement process.

3.3.3 Implementing Climate Adaptation Management Plans

A climate adaptation management plan is key to implementing adaptation pathways, as it could improve the effectiveness of the adaptation pathways approach by providing a governance and decision-making framework. In this case, adaptive management will be a process that involves planning, implementation, and modification of strategies to address the uncertainties of climate change. Adaptive management is an iterative process that could inform updates to adaptation measures in response to observations of effects and changes to the system and other variables through monitoring and surveillance (ISO 2019). As a part of the continual improvement process, existing project conditions, future plans, current and evolving climate conditions, and findings from monitoring and surveillance activities should be re-evaluated annually. This re-evaluation will help identify deficiencies, establish completeness and confirm objectives have been met. Adaptive management plans support record keeping, presenting users a tool with which they could review preceding versions to track the development of identified adaptation pathways (e.g., where thresholds were reached, and pathways were assigned and/or modified).

Table 3-3 provides an overview of the Plan-Do-Check-Act process as defined by MAC (2021). The Plan-Doc-Check-Act process defined by MAC (2021) is consistent with the process defined by NexGen under the IMS Manual. Table 3-4 provides steps for implementing adaptation pathways.

Table 3-3: Plan-Do-Check-Act Adaptive Management Process

Step	Description
Plan	Establish objectives for adaptive management, synthesize existing knowledge, and develop processes and plans to implement adaptation pathways. This step relies on the results of vulnerability and risk assessment and selection of adaptation pathways.
Do	Implement adaptation pathways involving adaptation measures, along with implementation of monitoring and surveillance, which were developed as a part of adaptive management process.
Check	Monitor and evaluate the outcomes of the implementation to assess the performance of adaptation measures. Step involves periodic review to identify any changes that have occurred that could affect the implemented adaptation measures (e.g., changes to project operations, climatic conditions).
Act	Adjust the plan based on the results of the Check step. Step involves an iterative approach to review implemented pathways and making updates to improve the efficiency of measures.

Source: MAC 2021.

Table 3-4: Implementation of Adaptation Pathways Steps

Step	Actions Involved
Design and implementation of adaptation pathways	Depending on type of adaptation pathway selected, actions could include: ▪ preparing and documenting detailed designs for modifications to existing infrastructure; ▪ preparing and documenting detailed designs for construction of new infrastructure; ▪ defining, documenting, and implementing changes to existing/new operating, maintenance, and surveillance practices; and ▪ revising closure plans.
Establish a monitoring and surveillance program	Confirm there is ongoing assessment of: ▪ current climate conditions; ▪ effectiveness of existing risk management practices and adaptation measures; ▪ performance against defined thresholds and triggers; and ▪ surveillance of vulnerabilities regardless of pathway selected.

Table 3-4: Implementation of Adaptation Pathways Steps

Step	Actions Involved
Develop and implement adaptation management process	▪ Develop and implement a climate adaptation management process through the Plan-Do-Check-Act process (Table 3-3). ▪ Outline a review schedule to confirm ongoing collection of data for continual improvement.

Continued engagement is required throughout the implementation process for the adaptation measures as well as during the monitoring and surveillance of the adaptation measures once they are implemented. The schedule and outcomes of the monitoring and surveillance program should be shared with stakeholders and regulatory agencies.

4.0 MAPPING TO THE PROPOSED CLIMATE ADAPTATION FRAMEWORK

Using the proposed climate adaptation framework as a guide, the Project information provided in Section 2.0, Supporting Project Information, is mapped out in this subsection to help identify what portions of the process are complete at the time of writing and which portions will need to be further developed. The mapping applies the three-stage process described in Section 3.0 using Project-specific information.

As the Project progresses past the time of writing, this information would need to be revisited to implement a climate adaptation framework. This mapping to the climate adaptation framework could be used as a guide to demonstrate how climate change considerations could be applied to the operations and management of the Project.

4.1 Climate Risk Assessment

As summarized in Section 2.1, Relevant Environmental Impact Statement Sections, to support the ongoing climate strategy development and the ongoing risk assessments, a climate change dataset has been developed for current and future climate conditions (EIS Appendix 22A). Based on the available climate dataset, the climate-infrastructure interactions have been identified in EIS Appendix 22B. The interactions provide a high-level overview of the vulnerabilities associated with different climate variables. The Project has considered climate change by identifying the Project's vulnerabilities over the Project lifespan, including Construction, Operations, and Closure, and by identifying mitigation measures to reduce the effects of weather events on the Project activities. These mitigation measures would be incorporated in the final Project design and activities, increasing the resiliency of the Project to climatic hazards.

During Operations, to identify ongoing potential climate effects, the initial assessment could be refined to conduct an in-depth qualitative or quantitative climate change risk assessment. This process could be conducted by using NexGen's risk ranking system (Section 2.3, Risk Management Process). Based on likelihood and consequence, risk could be categorized under the current and projected future climatic conditions. As a part of the continual improvement process, NexGen could inform the ongoing development of the Project by the updates to the climate projections to represent the most current synthesis of information on climate change. By using this approach, NexGen could identify how the risk may change over time based on climate projections (e.g., greater likelihood or greater consequence) and document whether Project infrastructure is resilient, particularly during Closure.

Considering all critical infrastructure and a range of climate variables, a risk analysis could be conducted for the current and future conditions. A series of workshops with the subject matter experts from NexGen could be conducted to identify areas of high risk. Results from the risk analysis could be documented in NexGen's risk registers and updated periodically based on updates to climate science, Project infrastructure, and design updates. The documented climate risks from the risk register could be ranked and prioritized to inform NexGen's decision making and determine whether additional action is required, in alignment with NexGen's continual improvement process.

4.2 Developing Adaptation Pathways

Following the identification of risks and opportunities, the potential adaptation measures for the short-, medium-, and long-term would need to be identified and documented, along with documentation of the potential pathways between them to increase climate resiliency. NexGen could identify a range of triggers and thresholds for different infrastructure. Defining triggers and thresholds could help in development of adaptation pathways, in which implementation of adaptation measures could be deferred (Section 3.2.2, Identifying Triggers and Thresholds). NexGen could define thresholds using the climate change dataset described in EIS Appendix 22A. Defining the thresholds and triggers using site-specific climate data could help NexGen meet performance objectives for infrastructure and allow adequate time to implement any identified adaptation measures.

NexGen could monitor changing climate trends to identify whether the adaptation measures would have to be altered to reduce future risks. By identifying additional climate risks and adaptation measures, a decision-making process could be established to prioritize the potential adaptation measures that would have to be implemented for areas of high risks.

NexGen could use an MAA approach to rank and prioritize multiple adaptation options. As noted in EIS Section 4, Project Alternatives, NexGen has applied MAA for various Project alternatives. Prioritization is based on qualitative analysis that includes identifying the feasibility, co-benefits, resources required, ease of implementation, and the cost-effectiveness (MAC 2021). For example, costs associated with vulnerabilities of dealing with a major rainfall event, or localized flooding in low- and high-risk areas, could be qualitatively identified. The costs and benefits associated with implementation of adaptation measures (e.g., infrastructure required for managing high-intensity rainfall events) could be identified.

4.3 Implementing Adaptation Pathways

To effectively implement the developed adaptation pathways, there would need to be decision-making support and monitoring and surveillance plans in place, which could be implemented by NexGen over the course of the Project as part of the continual improvement process. To set up a decision-making process, NexGen would have to set up internal accountability, roles, and responsibilities for implementation of adaptation pathways and for making decisions related to climate change adaptation. This process would document the relevant person who would identify how to obtain the necessary information to update the implementation of adaptation pathways. NexGen could develop a training plan that would verify personnel are aware of their roles and responsibilities related to climate change and understand the changes that need to be implemented with adaptation measures.

For the decision-making process, a list of performance indicators would have to be identified and developed. These indicators could help measure and assess the performance for specific adaptation measures. The adaptation pathways could then be integrated into existing policies, procedures, and schedules for the Project. The monitoring and surveillance for climate change would be based on identifying the performance of the

implemented adaptation pathways, opportunities for continual improvement, and changes to the observed and projected climate conditions. The monitoring and surveillance plans for climate change could include monitoring for compliance with the adaptation measures, monitoring for risk management and contingencies, and monitoring the extent to which the projected climate change effects have occurred. The developed and implemented adaptation measures could be monitored by NexGen, along with the planned review cycle to incorporate the gathered information.

NexGen could implement its existing Plan-Do-Check-Act cycle from the IMS, which is consistent with the approach used in the MAC guidance (MAC 2021) for conducting monitoring and surveillance. Projected climate events that are deemed sufficiently serious in nature could be managed through the corrective action process. Corrective actions could be planned, implemented, verified, and reviewed for their effectiveness based on the level of risk. These steps align with NexGen's continual improvement process.

5.0 DEVELOPING A CLIMATE ADAPTATION STRATEGY

The proposed climate adaptation framework is meant to be used as a guide to incorporate climate change into the continual improvement process for the Project. At this planning stage, the Project has considered climate change by identifying the vulnerabilities over the Project lifespan, including during Construction, Operations, and Closure, and by identifying the mitigation measures to reduce the effects of weather events on Project activities and infrastructure. These mitigation measures would be considered in the detailed design for the Project.

The climate adaptation framework could be used by NexGen to develop a climate adaptation strategy as part of a continual improvement process according to the following steps.

- An in-depth quantitative climate change risk assessment could be conducted by using a risk ranking system for the Project's lifecycle.
- A range of triggers and thresholds for critical and high-risk infrastructure could be developed that could help in identification of adaptation pathways and the timing of implementing the adaptation pathways.
- A decision-making process could be established to prioritize the potential adaptation measures that would have to be implemented for areas of high risks.
- Internal accountability, roles, and responsibilities for implementation of adaptation pathways and for making decisions related to climate change adaptation could be documented.
- A list of performance indicators that could help measure and assess the performance for specific adaptation measures could be documented.
- Monitoring and surveillance plans including monitoring for risk management and contingencies could be developed and implemented.

6.0 GLOSSARY

Term	Definition
Acceptable risk	The level of risk deemed acceptable to an owner, considering legal requirements, internal policy, business factors, and societal acceptance.
Adaptive management	The iterative process of planning, implementing, monitoring, and modifying strategies that address the uncertainty of a changing climate. The process adjusts approaches in response to changes in the system that occur from feedback effects and other variables (ISO 2019).
Adaptation measures	Actions taken to manage risks or opportunities associated with climate change. Adaptation measures may include actions to either prevent or reduce the likelihood of the occurrence of an adverse effect due to climate change, or to reduce or mitigate the consequences of an adverse effect due to climate change. These measures may be implemented on a site-specific basis or at the corporate level.
Adaptation pathways	The different options to implement identified adaptation measures to address risks or opportunities. As there are multiple ways adaptation measures that can be implemented, multiple pathways can be developed to address the same risk or opportunity (MAC 2021).
Adaptation planning	A process of adjustment to reduce the impacts of climate change, or to take advantage of the opportunities arising from climate change.
Climate change	A change in the mean and/or variability of climate that persists for an extended period, typically for decades or longer (IPCC 2013).
Climate change adaptation	The process of adjusting to the current and projected climate and its effects (ISO 2019).
Climate data	Measurements of weather/climate variables (i.e., minimum and maximum temperature, total precipitation) collected at varying durations (i.e., hourly, daily, annually) used to help identify trends in climate (Roy et al. 2017).
Critical adaptation	Adaptation measures that need to be implemented irrespective of the associated costs (e.g., there could be potential loss of life if these actions are not implemented; MAC 2021).
Consequence	The outcome of an event or through cascading and cumulative effects, affecting the owner's objectives (ISO 2018). It can have a positive or negative, direct or indirect, effect on objectives and can be expressed qualitatively or quantitatively. Consequence is commonly described as the severity of the event and is used to calculate/define risk: Risk = Consequence × Likelihood.
Flexible adaptation	Adaptation measures that provide an iterative approach to manage uncertainty. For example, building a dyke with broader foundation base so that a higher dyke can be built on existing one in future if required (MAC 2021).
Likelihood	The chance of something happening, commonly described as the probably or frequency of occurrence.

Term	Definition
Low regrets adaptation	Adaptation measures have relatively lower costs and the measures will increase the adaptive capacity to cope with the future climate risks (MAC 2021).
MAA	It is a tool used to support decision-making and has a two-step process. First step includes developing a list of accounts and sub-accounts that describe the alternatives and its potential impacts. Second step includes ranking, scaling, and weighing the indicator values in the sub-accounts (MAC 2019a).
No regrets adaptation	Adaptation measures are justified under current climate conditions and would provide benefits irrespective of how climate changes (MAC 2021).
Risk	Risk represents the inability of infrastructure/facility/communities/environment to withstand negative effects or benefit from any positive effects of changes in climate. Risk is a function of the magnitude of the changes in the climate, the sensitivity of an entity to those changes, and the adaptive capacity. The potential severity or consequence of the effect and its probability or likelihood of occurrence are both considered when evaluating risk (MAC 2021). Risk = Consequence × Likelihood.
Risk criteria	The factors used to categorize risk. Risk criteria include consequence and likelihood and may include confidence and other risk modifiers.
Surveillance	Includes the inspection and monitoring (i.e., collection of qualitative and quantitative observations and data) of activities and infrastructure. Surveillance also includes the timely documentation, analysis, and communication of surveillance results to inform decision making and verify whether performance objectives and risk management objectives, including critical controls, are being met (adapted from MAC 2019b).
Threshold	Thresholds or tipping points describe the climate conditions for a specific climate variable (e.g., mean annual precipitation) beyond which further changes in climate would result in the existing risk management or adaptation measures no longer being able to meet performance objectives and potentially failing (e.g., the maximum capacity of a spillway; Buurman and Babovic 2017).
Trigger	Describes a smaller deviation from current conditions for the climate variable associated with a threshold. Triggers are established to provide the owner an early warning of the approach of a threshold, with adequate time to implement adaptation measures and manage risk before the threshold is reached. This approach enables implementation to be proactive and strategic, rather than reactive and ad hoc (Buurman and Babovic 2017).
Vulnerability	The extent to which infrastructure or activities are susceptible to, or unable to cope with climate change.
Win-win adaptation	Adaptation measures not only help to reduce climate risks but also have other associated benefits (MAC 2021).

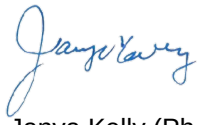
MAA = multiple accounts analysis.

CLOSING

WSP is pleased to submit this report to NexGen in support of the environmental assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

WSP Canada Inc.

Surabhi Sheth
Climate Change Specialist



Janya Kelly (Ph.D)
Senior Climate Change Specialist

Sean Capstick (Ph.D)
Principal

SS/JK/SC

STUDY LIMITATIONS

This report has been prepared by WSP Canada Inc. (WSP) for NexGen Energy Ltd. (Client) and for the express purpose of supporting the Environmental Assessment (EA) of the proposed Rook I Project. This report is provided for the exclusive use by the Client. WSP authorizes use of this report by other parties involved in, and for the specific and identified purpose of, the EA review process. Any other use of this report by others is prohibited and is without responsibility to WSP.

The report, all plans, data, drawings and other documents as well as all electronic media prepared by WSP are considered its professional work product and are not to be modified, amended, excerpted or revised. The report, all plans, data, drawings and other documents as well as all electronic media prepared by WSP shall remain the copyright property of WSP, who authorizes the Client to make copies of the report or any portion thereof, but only in such quantities as are reasonably necessary for the specific purpose set out herein. The Client may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express prior written permission of WSP.

WSP has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty expressed or implied is made. The findings and conclusions documented in this report have been prepared for the specific site, design objective, development and purpose described to WSP by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of or variation in the site conditions, purpose or development plans, or if the project is not initiated within a reasonable time frame after the date of this report, may alter the validity of the report.

The scope and the period of WSP's services are as described in WSP's proposal, and are subject to restrictions and limitations. WSP did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the report. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by WSP in regard to it. Any assessments, designs and advice made in this report are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this report. Where data supplied by the Client or other external sources (including without limitation, other consultants, laboratories, public databases), including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by WSP for incomplete or inaccurate data supplied by others.

The nature of the work undertaken is stochastic, with substantial inherent uncertainly around any given data points. The reader acknowledges that the uncertainty associated with any projections or forecasts is increased with the duration of the projected period and is subject to future developments or intervening acts, which may manifest in the interim period. The information in this report was prepared using published data and information, technical journals, and articles, as well as professional judgment and experience. No sampling or fieldwork was conducted in the course of this work.

The passage of time affects the information and assessment provided in this report. WSP's opinions are based upon information that existed at the time of the production of the report. The Services provided allowed WSP to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be to the foregoing and to the entirety of the report. WSP cannot be responsible for use of portions of the report without reference to the entire report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client and were prepared for the specific purpose set out herein. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

REFERENCES

Buurman J, Babovic V. 2017. Adaptation pathways and real options analysis: An approach to deep uncertainty in climate change adaptation policies. Policy and Society 35:2, 137-150. Available at https://www.tandfonline.com/doi/full/10.1016/j.polsoc.2016.05.002.

Buurman J, Babovic V. 2017. Adaptation pathways and real options analysis: An approach to deep uncertainty in climate change adaptation policies. Policy and Society 35:2, 137-150. Available at https://www.tandfonline.com/doi/full/10.1016/j.polsoc.2016.05.002.

Cannon, A. J., Jeong, D. I., Zhang, X., & Zwiers, F. W. 2020. Climate-resilient buildings and core public infrastructure 2020: assessment of the impact of climate change on climatic design data in Canada. Gatineau: Environment and Climate Change Canada.

CSA Group (Canadian Standards Association Group). 2019. Technical guide: Development, interpretation, and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners. CSA PLUS 4013:19.

Government of Canada. 2022. Draft technical guide related to the Strategic Assessment of Climate Change: Assessing climate change resilience. Gatineau: Environment and Climate Change Canada.

IPCC (Intergovernmental Panel on Climate Change). 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Available at http://www.ipcc.ch/report/ar5/wg1/.

ISO (International Organization for Standardization). 2018. Risk management – Guidelines. ISO 31000:2018.

ISO. 2019. Adaptation to Climate Change – Principles, Requirements, and Guidelines. ISO 14090:2019.

MAC (Mining Association of Canada). 2019a. A Guide to the Management of Tailings Facilities Version 3.1. Available at https://mining.ca/our-focus/tailings-management/tailings-guide/.

MAC. 2019b. Developing an Operation, Maintenance, and Surveillance Manual for Tailings and Water Management Facilities Second Edition. Available at https://mining.ca/our-focus/tailings-management/oms-guide/.

MAC. 2021. Guide on Climate Change Adaptation in Mining Sector. Prepared by Golder Associates Ltd. January 2021. Available at https://mining.ca/resources/guides-manuals/guide-on-climate-change-adaptation-for-the-mining-sector/.

NexGen (NexGen Energy Ltd.). 2021. Technical Report on the Feasibility Study of the Arrow Deposit, Rook I Project. Saskatchewan. NI 43-101 Report. Prepared by Stantec, Wood, RPA, and Golder for NexGen Energy Ltd. 22 February 2021.

Roy P, Fournier E, Huard D. 2017. Standardization Guidance for Weather Data, Climate Information and Climate Change Projections. Montreal, Ouranos. 52 pp. + Appendixes. Available at https://www.scc.ca/sites/default/files/file_attach/SCCReport_Standardization_guidance_for_Weather_data_Climate_Change_Infor_Final_English.pdf.