NexGen Energy Ltd.

Rook I Project

Environmental Impact Statement

Annex I: Atmospheric Baseline Report

GOLDER
MEMBER OF WSP

ATMOSPHERIC BASELINE REPORT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

Golder Associates Ltd.

March 2022

Executive Summary

Potential changes to air quality resulting from mining and milling operations can create adverse effects on both the social and biophysical environments in the anticipated area of the Rook I Project (Project). The atmospheric baseline program was undertaken to provide context from which the potential atmospheric effects from the Project can be assessed in the Rook I Environmental Impact Statement.

The objective of the atmospheric baseline study was to gather information on the existing atmospheric environment of the anticipated area of the Project. Specifically, the atmospheric baseline study was conducted to characterize the measured climate and meteorology and to describe the historical and existing air quality environment. Doing so entailed a desktop review and a field monitoring program.

The air quality environment was evaluated based on a comparison of available ambient air quality measurements against relevant air quality criteria and guidelines (e.g., Saskatchewan Ambient Air Quality Standards [SAAQS], Alberta Environment and Parks [AEP] dustfall guidelines) and the background concentrations of the anticipated area of the Project. The Saskatchewan air quality monitoring guidelines, which outline requirements for air quality monitoring in Saskatchewan, were followed for the design and execution of the field monitoring program. The Saskatchewan air quality modelling guideline provided guidance on deriving the background concentration from monitoring data and provided the prescribed background concentrations for the anticipated area of the Project. The Environment and Climate Change Canada (ECCC), Canadian Council of Ministers of the Environment (CCME), and World Meteorological Organization (WMO) guidance was followed when processing the meteorological and air quality data.

Meteorological information on temperature, precipitation, wind speed and wind direction, relative humidity, and solar radiation was compiled from observations made within the anticipated area of the Project during the baseline monitoring program. Long-term measurements of temperature, precipitation, wind speed and wind direction, and relative humidity were collected from one or both of two long-term Climate Normal monitoring stations: the Cluff Lake Station and the Fort McMurray A Station. The observed meteorological conditions in the anticipated area of the Project were similar to the long-term measurements.

Local air quality was monitored through a baseline program started in September 2018. All data available at the end of 2020 were incorporated into the baseline study. Continuous particulate monitoring was conducted for total suspended particulate (TSP) and particulate matter less than 2.5 µm ($PM_{2.5}$). Passive sampling of nitrogen dioxide, sulphur dioxide, dustfall, and radon was conducted on a monthly basis. Radon passive sampling was performed at nine discrete locations in the planned area of the Project. Dustfall and rainfall samples collected in the anticipated area of the Project were analyzed to determine the concentration of metals in dust and rainfall, respectively. Regional air quality monitoring data from other programs at four remote locations were used to supplement data collected in the anticipated area of the Project and characterize baseline air quality conditions. No SAAQS exceedances were observed from the local and regional air quality monitoring data, except for 24-hour $PM_{2.5}$ and particulate matter less than 10 µm (PM_{10}). The derived background concentrations from monitoring data were close to or lower than the prescribed background concentrations.

The baseline study achieved the objective of characterizing the existing atmospheric environment in the planned area of the Project. Specifically, climate, meteorology, and air quality characterized in the baseline program provided a representative baseline against which potential air quality effects from the Project could be assessed.

If referencing this report, please use for the following citation:

Golder (Golder Associates Ltd.). 2022. Atmospheric Baseline Report for the Rook I Project. Prepared for NexGen Energy Ltd.

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TABLES

FIGURES

APPENDICES

Abbreviations and Units of Measure

Acronym	Definition Air Baseline
AEP	Alberta Environment and Parks
AOSR	Athabasca Oil Sands Region
AQSA	air quality study area
CAAQS	Canadian Ambient Air Quality Standards
CALA	Canadian Association for Laboratory Accreditation Inc.
CCME	Canadian Council of Ministers of the Environment
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
NexGen	NexGen Energy Ltd.
PM_{10}	particulate matter with a mean aerodynamic diameter less than 10 µm
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter less than 2.5 µm
Project	Rook I Project
RDL	reportable detection limit
SAAQS	Saskatchewan Ambient Air Quality Standards
SAQMG	Saskatchewan Air Quality Modelling Guideline
TSP	total suspended particulate
WBEA	Wood Buffalo Environmental Association

Units	Definition Air Baseline
%	percent
°	degrees
°C	degrees Celsius
$µg/m^3$	micrograms per cubic metre
µm	micron
Bq/m^3	becquerels per cubic metre
cm	centimetre
km	kilometre
km/h	kilometres per hour
m	metre
m/s	metres per second
$mg/100\ cm^2/30\ d$	milligrams per 100 square centimetres per 30 days
mg/L	milligrams per litre
mm	millimetre
pH	potential of hydrogen
W	watt
W/m^2	watts per square metre

1.0 INTRODUCTION

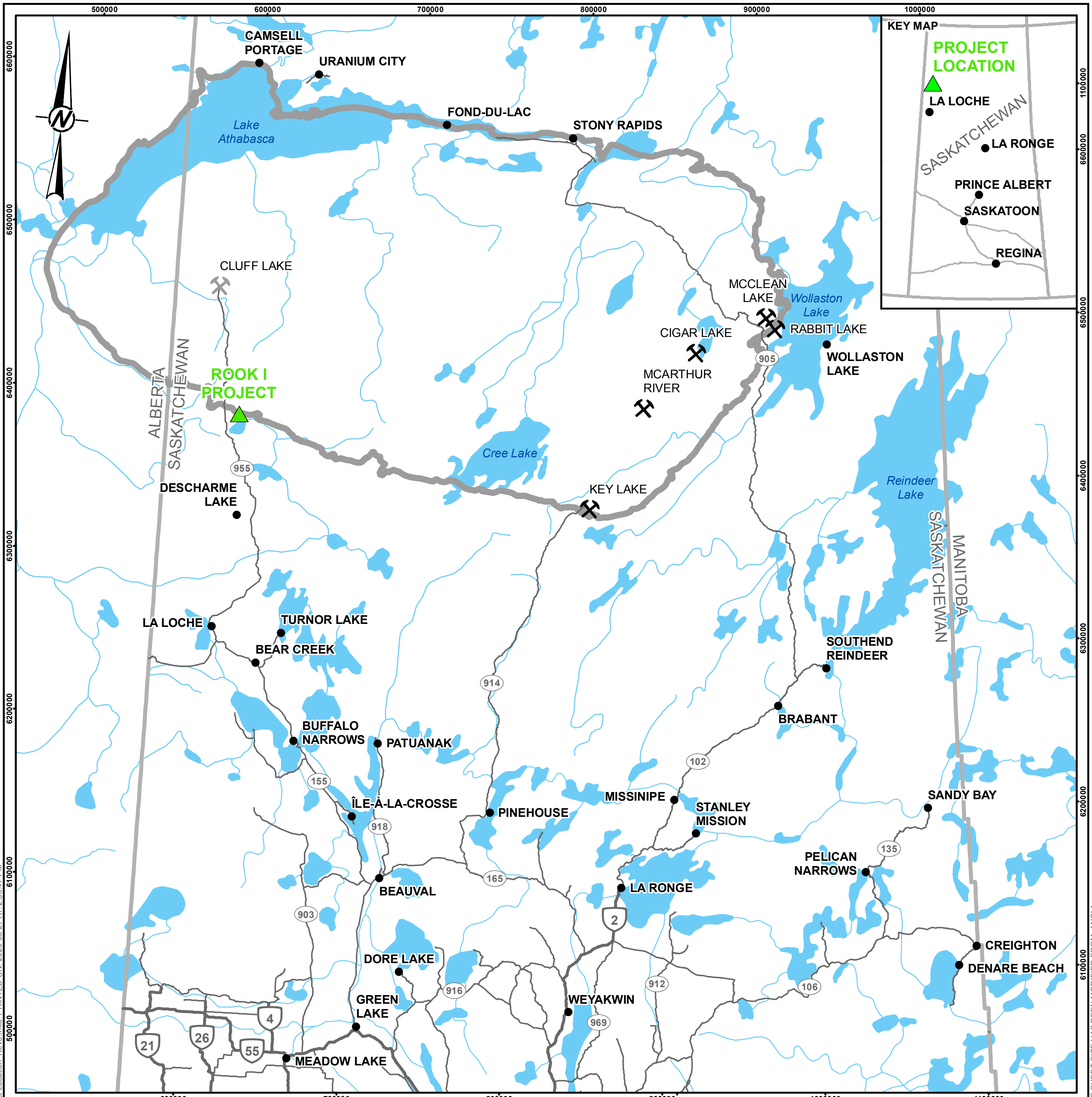
The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project would be located in northwestern Saskatchewan, approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1). The Project would reside within Treaty 8 territory and within the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake and along the upper Clearwater River system (Figure 2). Access to the Project would be from an existing road off Highway 955. The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit.

The atmospheric baseline report represents a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. Potential changes to air quality resulting from mining and milling operations can create adverse effects on both the social and biophysical environments in the anticipated area of the Project. The atmospheric baseline program was undertaken to provide context from which Project environmental atmospheric effects could be assessed in the Environmental Impact Statement (EIS).

Since exploration at the Project commenced in 2013, NexGen has engaged regularly and established relationships with local First Nation and Métis Groups (collectively referred to as Indigenous Groups) and northern communities, specifically those closest and with greatest access to the proposed Project. NexGen respects the rights of Indigenous Peoples and the unique relationship Indigenous Peoples have with the environment and recognizes the importance of full and open discussion with interested or potentially affected Indigenous communities regarding the development, operation, and decommissioning of the proposed Project. Engagement activities to date, as well as future planned engagement activities, reflect the value NexGen places on meaningful engagement with Indigenous Peoples and northern communities who could be potentially affected by the proposed Project. Engagement mechanisms have included, but are not limited to: meetings with leadership, workshops and community information sessions, Project site tours, establishing Joint Working Groups to support the gathering and incorporation of Indigenous and Local Knowledge throughout the Environmental Assessment (EA) process, and providing funding for Traditional Land Use (TLU) Studies[1] to understand how the proposed Project may interact with the Indigenous communities traditional use of the anticipated area of the Project.

Feedback received during engagement activities was documented for contribution to the EIS for the Project; examples of feedback received include discussion of concerns, interests, potential adverse effects, mitigation, and design alternatives. Many baseline studies were initiated in advance of formal engagement on the EA for the Project; however, engagement during the execution of baseline studies has helped inform the understanding of baseline conditions and confirmed components of the natural and socio-economic environments that required study. A summary of feedback related to the atmospheric baseline program is presented in Appendix A.

[1] Traditional Land Use Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as TLU studies



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- ATHABASCA BASIN BOUNDARY
- PROJECT LOCATION

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT, SASKATCHEWAN

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	SS
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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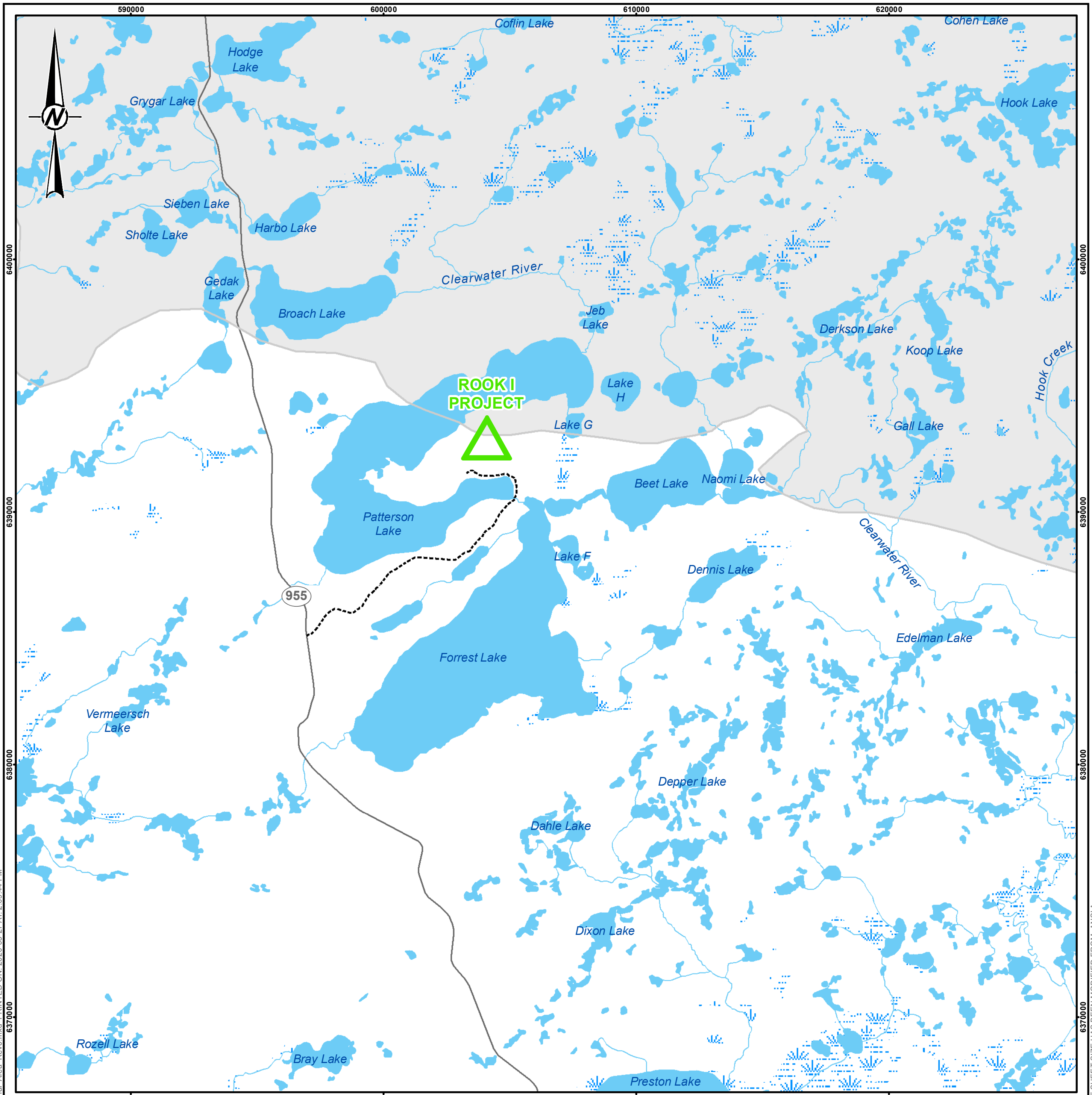

LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- ATHABASCA BASIN
- PROJECT LOCATION
- EXISTING ACCESS ROAD

0 5,000 10,000

1:225,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	JMC
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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2.0 STUDY OBJECTIVE

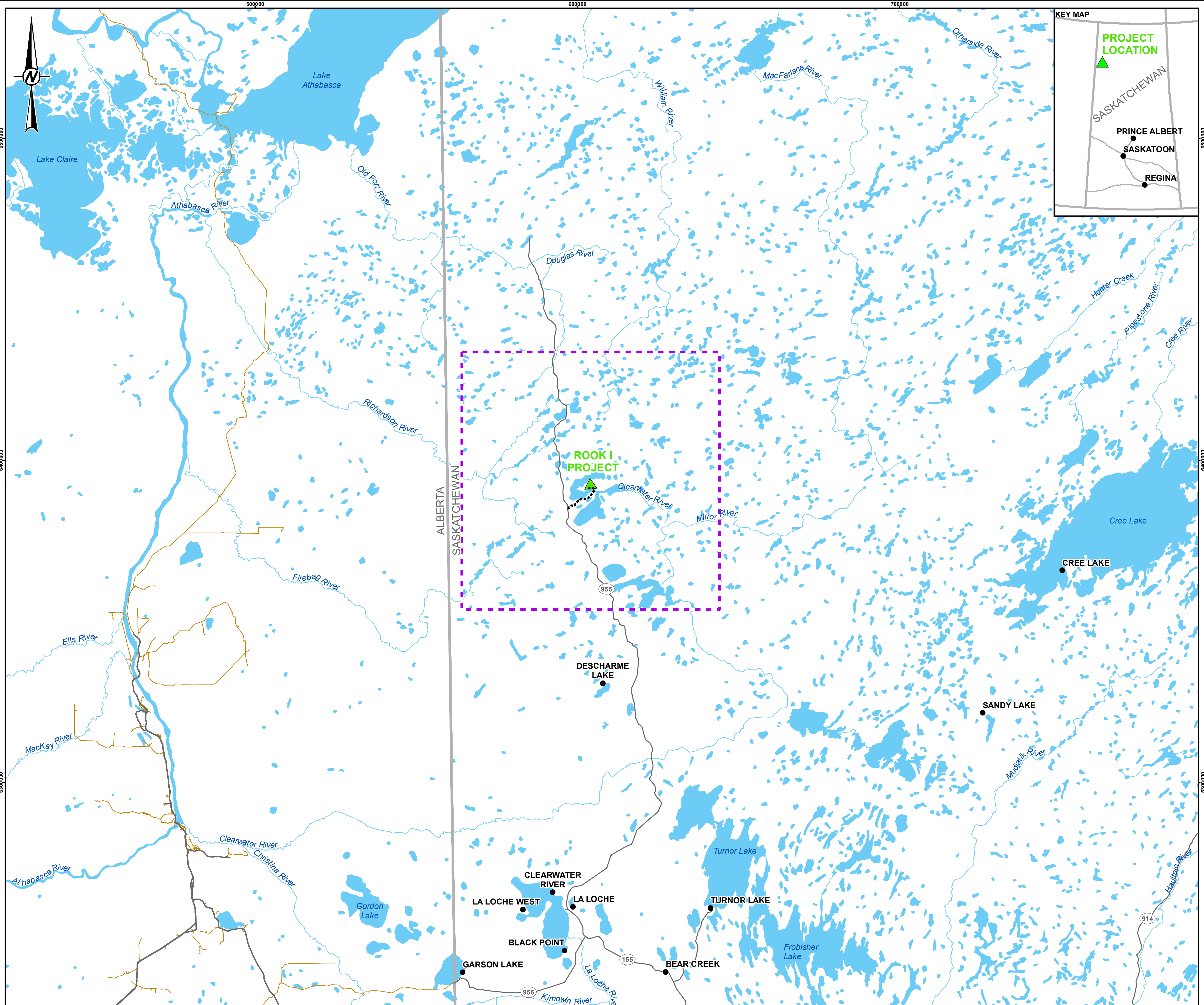
An atmospheric baseline study was completed to describe the existing atmospheric conditions in the local and regional area prior to potential development of the Project. This study describes the existing climate, weather, and air quality. Climate considers the occurrence and trends of weather conditions over a long period of time. Weather is the conditions of the atmosphere over a short period of time in terms of meteorological parameters (e.g., temperature, humidity, precipitation, and wind). Air quality includes measurement parameters such as radon, particulate matter (i.e., a mixture of solid particles and liquid droplets in the air), carbon monoxide, nitrogen dioxide, and sulphur dioxide.

The objectives of the atmospheric baseline study were to:

- characterize the natural variability of climate in the region and the anticipated area of the Project;
- characterize meteorological parameters in the area that influence existing air quality, including temperature, precipitation, and wind;
- identify compounds expected to be emitted from the Project and describe the historical and existing air quality environment for these compounds;
- acquire baseline information that supports the Project EA, and that can inform Project design and potential mitigation measures that may be required; and
- provide supporting information for other components of the EA, such as human health, ecological risk assessment, aquatics (e.g., surface water quality and quantity, and fish and fish habitat), and terrestrial (e.g., soils, vegetation, and wildlife and wildlife habitat).

3.0 STUDY AREA

The baseline study area was selected to characterize the existing climate, meteorological, and air quality conditions for the region in support of the EA. Therefore, the baseline study area is equivalent to the air quality study area (AQSA) that will be used to assess potential effects of the Project on the atmospheric environment. The AQSA is defined as the region adequate to address potential direct air quality effects anticipated to result from the Project. Since the atmospheric baseline study and the air quality assessment provide information to other components of the EA, the AQSA also encompasses the areas being assessed for human health, ecological risk, aquatic (i.e., surface water quality and quantity, and fish and fish habitat), and terrestrial (i.e., soils, vegetation, and wildlife and wildlife habitat) components. The AQSA is defined by an area of 80 km by 80 km centred on the proposed Project site (Figure 3).



LEGEND

- POPULATED PLACE
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- EXISTING ACCESS ROAD
- AIR QUALITY STUDY AREA
- PROJECT LOCATION

0 40,000 80,000

1:1,200,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NEXGEN

PROJECT
ROOK 1 ATMOSPHERIC BASELINE

TITLE
ATMOSPHERIC BASELINE STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2022-02-08
DESIGNED	MC
PREPARED	NO/AK
REVIEWED	ZY
APPROVED	CM

PROJECT NO.	PHASE	REV.	FIGURE
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4.0 METHODS

The baseline study for atmospheric conditions included the following two components:

- desktop review of the publicly available regional monitoring data in the AQSA; and
- baseline field monitoring program to collect local meteorology and air quality data in the anticipated area of the Project.

The air monitoring program was conducted according to the general guidance outlined in the Air Monitoring Guideline for Saskatchewan (ENV 2012a). The guideline lists the monitoring requirements for an air monitoring station including site selection, sampling system design, station operations, data validation, and reporting. The guideline also provides technical information and instructions for passive sampling.

Feedback related to the atmospheric baseline program received during engagement activities was considered during the desktop review and the field monitoring program. The feedback helped inform the understanding of the baseline conditions and improve the baseline field monitoring program. For example, feedback received during Joint Working Group (JWG) meetings included the following comments (MN-S-JWG 2020):

> “We live in a very clean environment, other than Fort McMurray - we can sometimes smell the oil. The air is very clean; we can drink the water and eat the berries wherever they are. As you come south, those things change. We live in a very clean land; in our culture we call it the “land of the white eagle” because of the snow, and that represents clean”.

> “When we see the damage Fort McMurray is doing to our area – it’s 100+ miles from us, but it’s still affecting us. So much sulphur is put into the air and it comes down as acid rain. That changes our lake structures and the pH balance. It gets rid of the aquatic life. That oil industry is vastly affecting our area. Our lakes are turning to blue-green algae from the lower pH from acid rain. They have no concern for me if my fishing industry dies, as long as they get the last gallon of oil. They should be a lot more aware. Our government doesn't care about it as long as they get their percentage. It’s about money with everything”.

A summary of feedback that was provided through JWG meetings that is related to the atmospheric baseline program is presented in Appendix A.

4.1 Climate

The climate of a region is often characterized by 30 continuous years of meteorological observations (IPCC 2013), and the Climate Normals are used to summarize or describe the average climatic conditions of a given location. Environment and Climate Change Canada (ECCC) provides Climate Normals for stations with at least 15 years of data for the periods between 1961 and 1990, 1971 and 2000, and 1981 and 2010. The Cluff Lake Station, 82 km north-northwest of the Project, is the closest station to the Project with a long enough record to provide Climate Normals data (Figure 4); data are available for the period from 1971 to 2000. The Cluff Lake Station Climate Normals parameters include temperature, precipitation, and wind speed and direction. The Fort McMurray A Station, the next nearest ECCC Climate Normals station, is located at the Fort McMurray airport, approximately 164 km southwest of the Project (Figure 4). Climate Normals data at the Fort McMurray A Station are available for the period from 1981 to 2010; parameters include temperature, precipitation, wind speed and direction, bright sunshine, humidex, wind chill, humidity, pressure, visibility, cloud amount, and frost. Both stations are used to characterize the regional climate though the Fort McMurray A Station offers measurements for more climate parameters and provides a more recent record than the Cluff

Lake Station. On the other hand, Fort McMurray is located in a river valley that affects wind speed and direction, so Cluff Lake provides a more representative dataset for regional wind patterns.

4.2 Weather

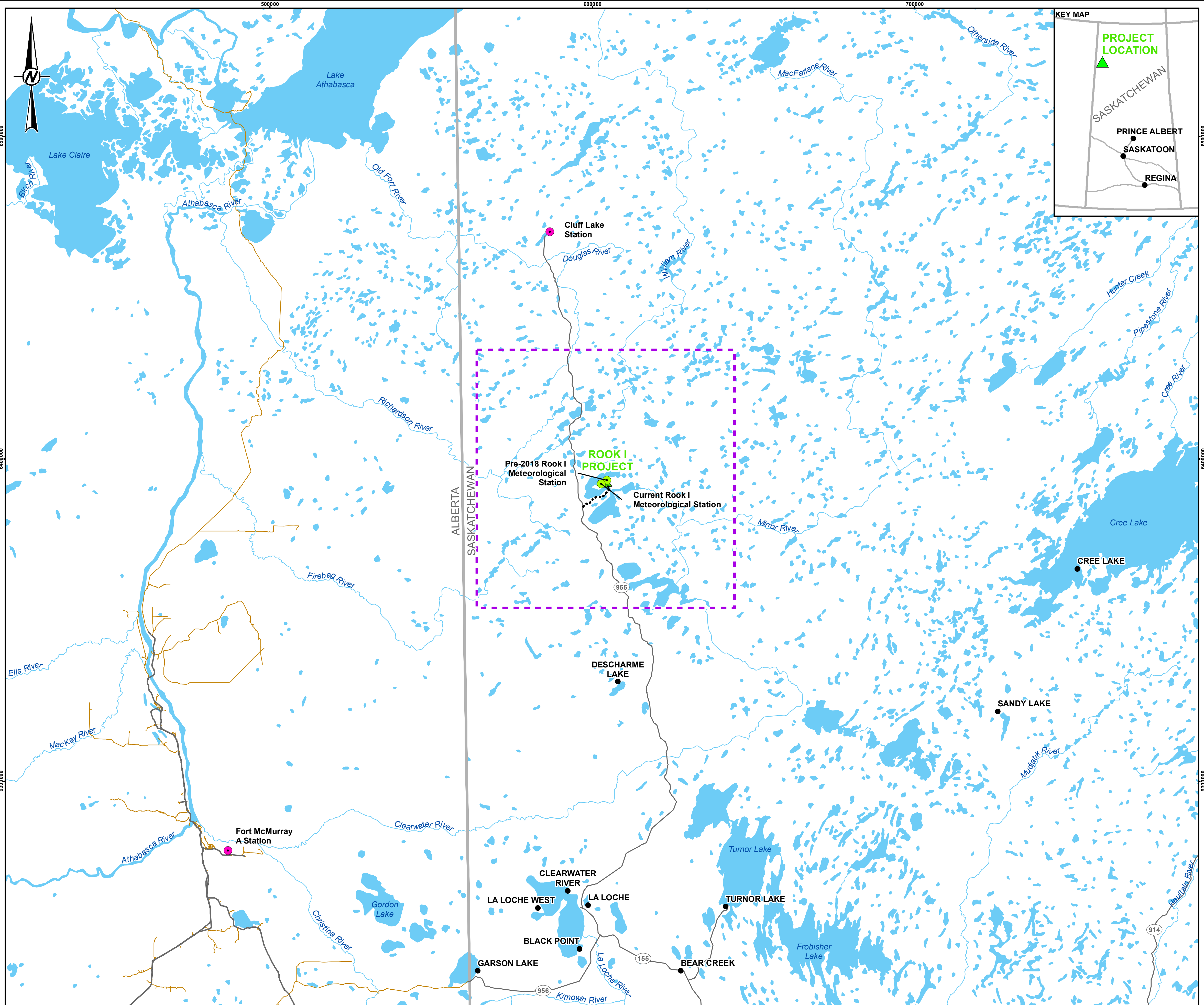
To monitor meteorological parameters (e.g., temperature, rainfall, wind speed, wind direction, relative humidity, and solar radiation) in the anticipated area of the Project, the Rook I Meteorological Station, operated by NexGen, was installed and has been collecting data since November 2015. The original station location (i.e., from November 2015 to September 2018) was based on topography, local interferences (i.e., trees), and site accessibility (Figure 4). Once the location of the Project infrastructure was better known, the meteorological station was relocated in September 2018 to its current location so that the future project construction and operation activities would not affect the data collecting program (Figure 4). As a part of the relocation, the instruments were re-calibrated and additional instrumentation (e.g., total precipitation sensor) was installed. Hourly measurements of wind speed, wind direction, solar radiation, temperature, relative humidity, rainfall, and total precipitation were collected from instruments mounted on or adjacent to a 10 m tower (Figure 5). Table 1 provides a description of the parameters measured and the instrumentation used for the measurements.

Local meteorology baseline data were measured and reported from November 2015 to December 2020. Statistics similar to the Climate Normals were generated. The calculation methods and the data completeness requirements followed the guidance provided by ECCC (ECCC 2020) and the World Meteorology Organization (WMO 2017).

Large uncertainties could be introduced into the meteorological statistics if the data completeness requirements are not met. The data completeness requirements adopted from ECCC and the WMO for this study include:

- **temperature:** 3 and 5 rule (i.e., no more than 3 consecutive missing data points and no more than 5 missing data points in total);
- **rainfall and precipitation:** 100% completeness;
- **wind speed and direction:** 90% completeness;
- **relative humidity:** 90% completeness; and
- **solar radiation:** 11 and 5 rule (i.e., no more than 11 missing data points and no more than 5 consecutive missing data points).

These completeness requirements were followed when calculating daily, monthly, and annual statistics. For example, the 3 and 5 rule needs to be followed when calculating daily maximum temperature from hourly temperature; the 100% completeness requirement needs to be met when calculating monthly total precipitation from daily precipitation.



LEGEND

- POPULATED PLACE
- CLIMATE NORMAL METEOROLOGICAL STATION
- LOCAL METEOROLOGICAL STATION
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- EXISTING ACCESS ROAD
- AIR QUALITY STUDY AREA
- PROJECT LOCATION

0 40,000 80,000

1:1,200,000 METRES

REFERENCE(S)

1.BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NEXGEN

PROJECT
ROOK 1 ATMOSPHERIC BASELINE

TITLE
CLIMATE AND METEOROLOGY STATIONS USED FOR BASELINE STUDY

CONSULTANT
GOLDER

YYYY-MM-DD	2022-02-08
DESIGNED	MC
PREPARED	NO/AK
REVIEWED	ZY
APPROVED	CM

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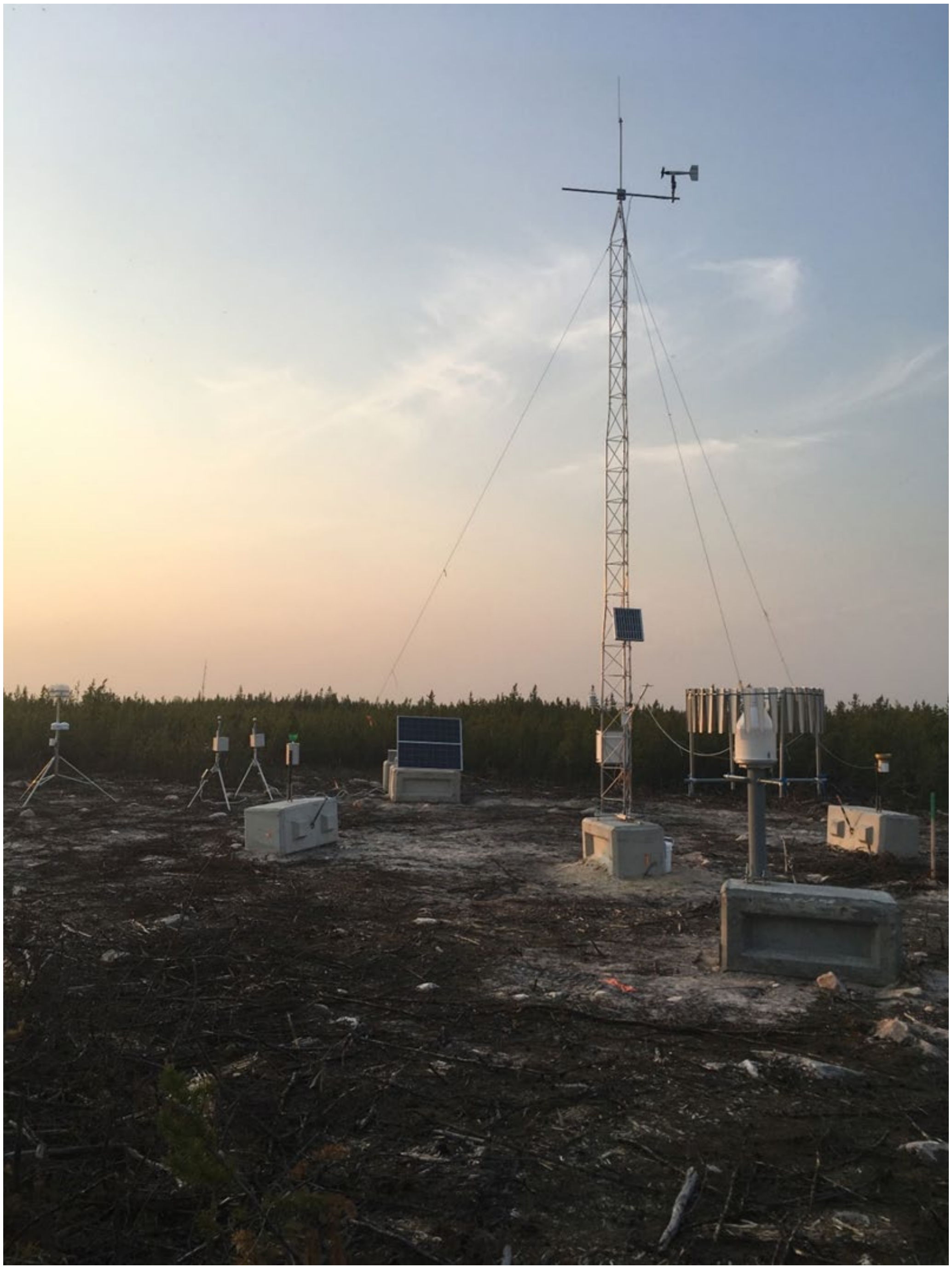
Figure 5: Current Rook I Meteorological Station



Note: The tower and instruments are level/plumb; any apparent off-vertical angles of the instrumentation are an artifact of the camera image.

Table 1: Rook I Meteorological Station Components

Parameter	Instrumentation
Temperature and Relative Humidity	Temperature and relative humidity (RH) sensors are housed in a radiation shield that is mounted on the tower at approximately 2 m above ground
Air temperature (-50°C to +50°C)	Rotronic HC2-S3 temperature and RH gauge
Relative humidity (%)	
Wind	Anemometer is mounted to the tower cross-arm 10 m above ground
Wind speed (km/h)	RM Young 05103 anemometer
Wind direction (˚)	
Solar Radiation	Device mounted on the tower approximately 2 m above ground level
Incoming solar radiation (W/m^2)	Kipp and Zonen SPLITE2 pyranometer
Precipitation	
Total rainfall (mm)	Texas Electronics TE525M tipping bucket rain gauge; located on the northeast anchor block of the station at approximately 1.5 m above ground
Rainfall (mm)	Palmex Rain Sampler 1B non-evaporative rainfall collector; located on the northwest anchor block of the station at approximately 1.5 m above ground
Total precipitation (mm)	Geonor T-200B total precipitation sensor with alter wind shield; located on the south anchor block at approximately 2.5 m above ground
Rainfall deposition of metals, pH, sulphates, and nitrates [a)]	Palmex Rain Sampler 1B non-evaporative rainfall collector; located on the northwest anchor block of the station at approximately 1.5 m above ground
Data Storage and Retrieval	
Datalogger	Campbell Scientific CR1000 data logger
Power supply	20 W solar cell and 26 Ah backup battery
Retrieval device	SC115 USB stick

a) Rainfall metals deposition monitoring discussed further in Section 4.3.1, Local Air Quality.
Ah = ampere hour; RH = relative humidity.

4.3 Air Quality

4.3.1 Local Air Quality

Air quality monitoring stations were installed in the planned area of the Project in September 2018. The air quality monitoring network includes the Rook I Particulate Monitoring Station, the Rook I Tripod Station, and multiple radon monitoring locations. Table 2 and Figure 6 provide the descriptions and locations of the monitoring stations, respectively. The data collected from the air quality monitoring are described below.

- **Particulate monitoring:** Two Met One E-Samplers were installed at the Rook I Particulate Monitoring Station. Sampling was conducted for total suspended particulate (TSP) and fine particulate matter with a mean aerodynamic diameter less than 2.5 microns (µm; $PM_{2.5}$). The E-Samplers provide continuous, hourly particulate matter concentrations and had a sample filter installed during the spring redeployment in 2019 and during the site visit in 2020 to allow for calibration.

  A limitation of most nephelometer instruments (e.g., E-samplers) is that the accuracy of the mass output can be negatively affected by variation in size, color, shape, and index of refraction of the sampled particles. A gravimetric K-Factor was generated for the E-sampler to compensate for local particulate characteristics. To do this, a filter disc was weighed on a microbalance scale under laboratory conditions, then placed into the E-sampler filter holder and run for a predetermined period of time (e.g., June 11, 2019 to July 10, 2019 and

May 17, 2020 to June 16, 2020). The filter was then reweighed in the lab, and the resulting total mass of the particles on the filter was correlated with the volume of air sampled to calculate the concentrations. The concentrations were then compared with the concentrations that the E-sampler recorded over the same time period to calculate a correction factor (i.e., K-Factor). The K-Factors derived from the 2019 calibration were applied to the data collected before 2020; the K-Factor constants derived from the 2020 calibration were applied to the 2020 data.

The E-Samplers were demobilized for the winter season at the end of October and reinstalled in the spring when conditions allowed. The Rook I Particulate Monitoring Station location was reviewed in May 2019, as the initial deployment location was close to anticipated activities (i.e., lower core facility) that could influence ambient particulate measurements and overestimate the background levels. The review identified that a semi-permanent location would be more appropriate for background particulate monitoring than the initial location, as it is farther from fugitive dust sources. As a result, the station was relocated in May 2019 to a nearby temporary location while preparing the semi-permanent location. The station was moved to the semi-permanent location adjacent to the Rook I Meteorological Station (Figure 4) in June 2019. A solar power supply was also installed at this time.

- **Passive gas monitoring:** Monthly passive gas sampling for nitrogen dioxide and sulphur dioxide was performed at the Rook I Tripod Station. Passive samples were deployed each month, usually at the beginning of the month, and retrieved after approximately 30 days, at which time they were sent to an accredited laboratory for analysis. Duplicate samples were taken each month. Where concentrations of the compounds were below the reportable detection limit (RDL), the results were presented as one-half of the RDL. The RDL is the smallest concentration (or amount) of analyte (e.g., nitrogen dioxide and sulphur dioxide), that can be reported by a laboratory.
- **Dustfall monitoring:** Dustfall is the settleable fraction of the total particulate matter in air.

  Dustfall is collected in an open-topped jar with an opening of a known size that contains a liquid collecting medium such as diluted copper sulphate solution. Three litres of a 10 mg/L copper sulphate solution were used to collect samples for total and fixed dustfall analysis at the station, and 3 L of de-ionized water were used to collect samples for deposited metals. A sample jar of the solution was mounted at 3 m height above ground on a tripod at the station and exposed to the air for approximately 30 days on a monthly cycle during the non-winter months (i.e., June to October).

  Total dustfall is defined as the amount of dried material from the sample while total fixed dustfall is the inorganic portion of the total dustfall that remains after the total sample is combusted in the laboratory. Both the total dustfall and fixed dustfall were sampled at the Rook I Tripod Station. Dustfall samples were also collected for deposited metal analysis.

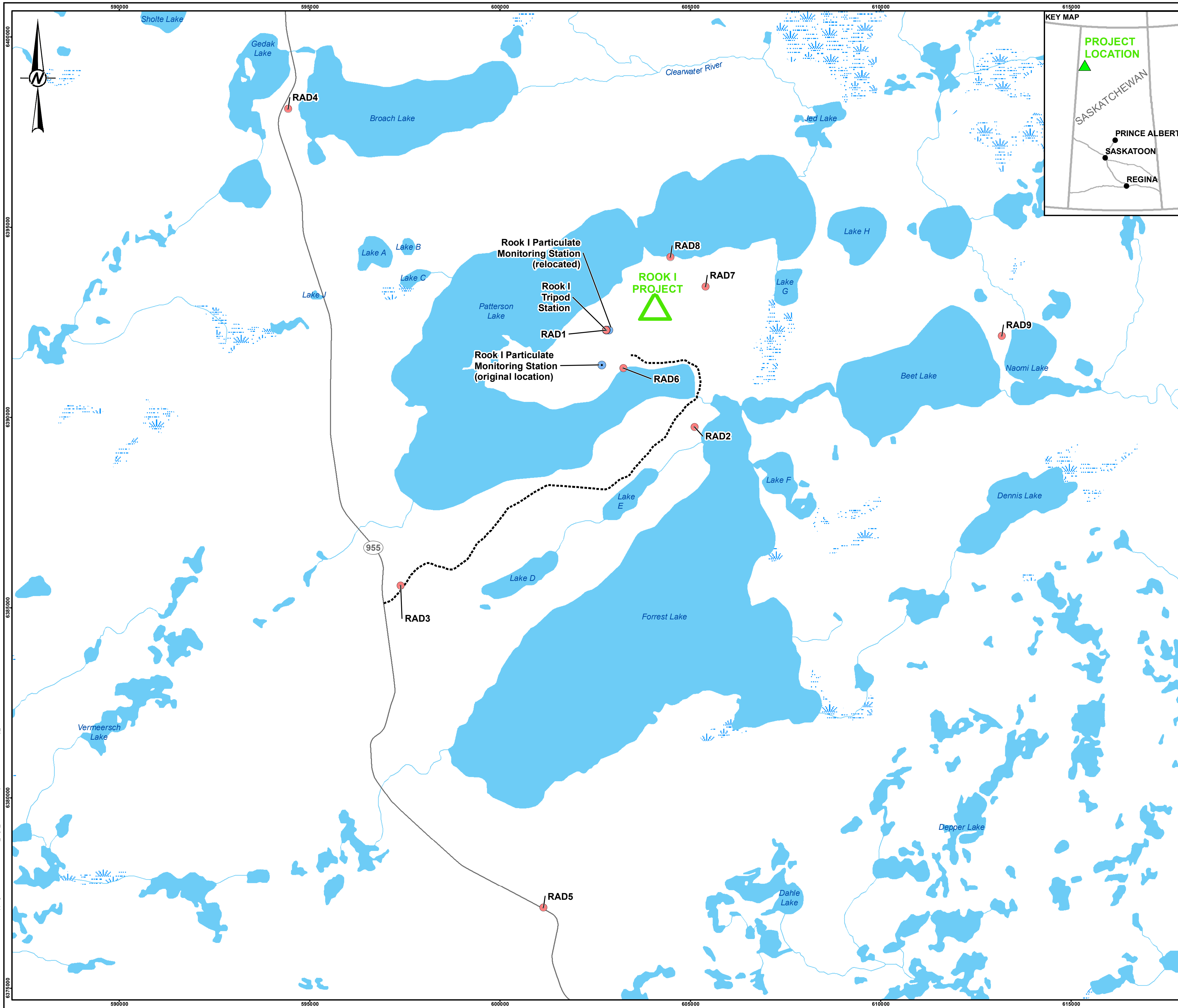
  Duplicate samples were taken for the dustfall and metals samples. One sample was deployed for the winter seasons, from 16 November 2018 through 10 May 2019 and from 26 October 2019 through 29 May 2020. The samples were retrieved from the field and sent to an accredited laboratory for analysis.
- **Metals, sulphates, and nitrates in rainfall monitoring**: Rainfall was collected approximately monthly in the non-evaporative rainfall collector located at the Rook I Meteorological Station and retrieved for analysis at an accredited laboratory for concentrations of selected metals as listed in Table 21, sulphates, nitrates, and pH.

- **Radon monitoring:** Rapidos alpha track detectors were deployed at nine locations (Figure 6), chosen to represent near-field (i.e., where Project effects are anticipated to be measurable) and far-field (i.e., where Project effects are anticipated to have declined to background levels). These detectors sample for radon entering the detectors by diffusion. Radon samplers were retrieved for analysis at an ISO/IEC 17025 - accredited laboratory (e.g., Radonova Laboratories AB). Duplicate radon samples were also taken at the Rook I Tripod Station. A transit control kit was used during retrieval and was submitted with the samples to the laboratory.

Table 2: Rook I Air Quality Monitoring Locations

Air Quality Monitoring	Station ID	Monitoring Type	Coordinates (m)[a]	
			Easting	Northing
Particulate	Rook I Particulate Monitoring Station	Continuous sampling	602673[b], 602792[c]	6391382[b], 6392297[c]
Passive gas	Rook I Tripod Station	Passive sampling	602788	6392298
Dustfall		Dustfall jar sampling		
Metals, sulphates, and nitrates in rainfall	Rook I Meteorological Station	Rainfall deposition sampling	602795	6392291
Radon	RAD1	Radon passive sampling	602788	6392298
	RAD2		605114	6389753
	RAD3		597386	6385583
	RAD4		594435	6398118
	RAD5		601139	6377127
	RAD6		603240	6391302
	RAD7		605399	6393444
	RAD8		604473	6394224
	RAD9		613181	6392145

a) Coordinates presented are in UTM NAD 83 Zone 12.
b) Initial particulate monitoring station location chosen during September 2018 install due to reliance online power.
c) Relocated particulate monitoring station in June of 2019 away from activities that could influence particulate monitoring.
UTM = Universal Transverse Mercator; NAD = North American Datum; $PM_{2.5}$ = fine particulate matter with a mean aerodynamic diameter less than 2.5 µm; TSP = total suspended particulate.



LEGEND

- CONTINUOUS AIR QUALITY MONITORING STATION
- PASSIVE AIR QUALITY MONITORING STATION
- WATERCOURSE
- WETLAND
- WATERBODY
- EXISTING ACCESS ROAD
- PROJECT LOCATION

0 4,000 8,000

1:100,000 METRES

REFERENCE(S)

1.BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NEXGEN

PROJECT
ROOK 1

TITLE
LOCAL AIR QUALITY STATIONS USED FOR BASELINE STUDY

CONSULTANT

GOLDER

YYYY-MM-DD	2022-02-08
DESIGNED	MC
PREPARED	NO/AK
REVIEWED	ZY
APPROVED	CM

PROJECT NO.	PHASE	REV.	FIGURE
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4.3.2 Regional Air Quality

Two types of monitoring approaches were used in the region for ambient air quality monitoring: continuous monitoring and passive monitoring. Continuous monitoring refers to the rapid sampling of the air (e.g., one measurement per second) using an electronic instrument that analyzes the air for compounds of interest (e.g., nitrogen dioxide, sulphur dioxide, and $PM_{2.5}$) and stores averages of the samples (e.g., each hour) over a longer period of time (e.g., days, months, or years). Passive monitoring consists of exposing a contaminant-sensitive sample medium (e.g., tape treated with triethanolamine) to the atmosphere for a fixed period of time so that the contaminant can accumulate on the medium. The ambient concentrations can then be determined by laboratory analysis of the exposed media given the known time of exposure.

Ambient air quality monitoring in the AQSA is limited due to the low level of development and remoteness of the region. Two continuous monitoring stations were identified in the search of publicly available ambient air quality monitoring data. Stations were chosen based on available monitoring data and their representativeness of air quality conditions in the AQSA. Stations likely to be influenced by human activities, such as those at industrial operations or in urban settings, were not included. Table 3 provides summary station information. The baseline study presents the most recent five years (i.e., 2016 to 2020) of available monitoring data.

The closest regional station monitoring compounds of interest is the Wood Buffalo Environmental Association (WBEA) Fort Chipewyan Station located approximately 160 km northwest of the Project, adjacent to the community of Fort Chipewyan in northeastern Alberta (Figure 7). The WBEA operates meteorological and air quality continuous monitoring stations located in communities or near major industrial developments in the Athabasca Oil Sands Region (AOSR) encompassing the northeast region of Alberta bordering Saskatchewan. Community stations, such as the one located at Fort Chipewyan, are permanent monitoring stations strategically located to measure the air quality in the communities and to track trends or changes to air quality over time. Data collected continuously through WBEA's network of monitoring stations are quality controlled and available online through direct download of the historical database (WBEA 2020a).

The Fort Chipewyan Station monitors continuously for compounds of interest. The station also monitors meteorological parameters and additional air quality contaminants including nitric oxide, total oxides of nitrogen, and ozone. The station is located near the small community of Fort Chipewyan and may be influenced by community-related emissions (e.g., local traffic and building heating) more than might be reasonably expected under baseline conditions in the anticipated area of the Project. However, the Fort Chipewyan Station was considered a reasonable surrogate for existing atmospheric conditions within the AQSA due to its position typically upwind from the AQSA and major oil sands developments in the AOSR (Davidson C. and D. Spink 2018).

Additional WBEA monitoring locations, such as the Firebag Station located approximately 110 km west-southwest of the Project, and others in the AOSR are not presented in the atmospheric baseline study. These stations are located at or near industrial oil sands sites and would be influenced by activities that do not represent baseline conditions within the AQSA.

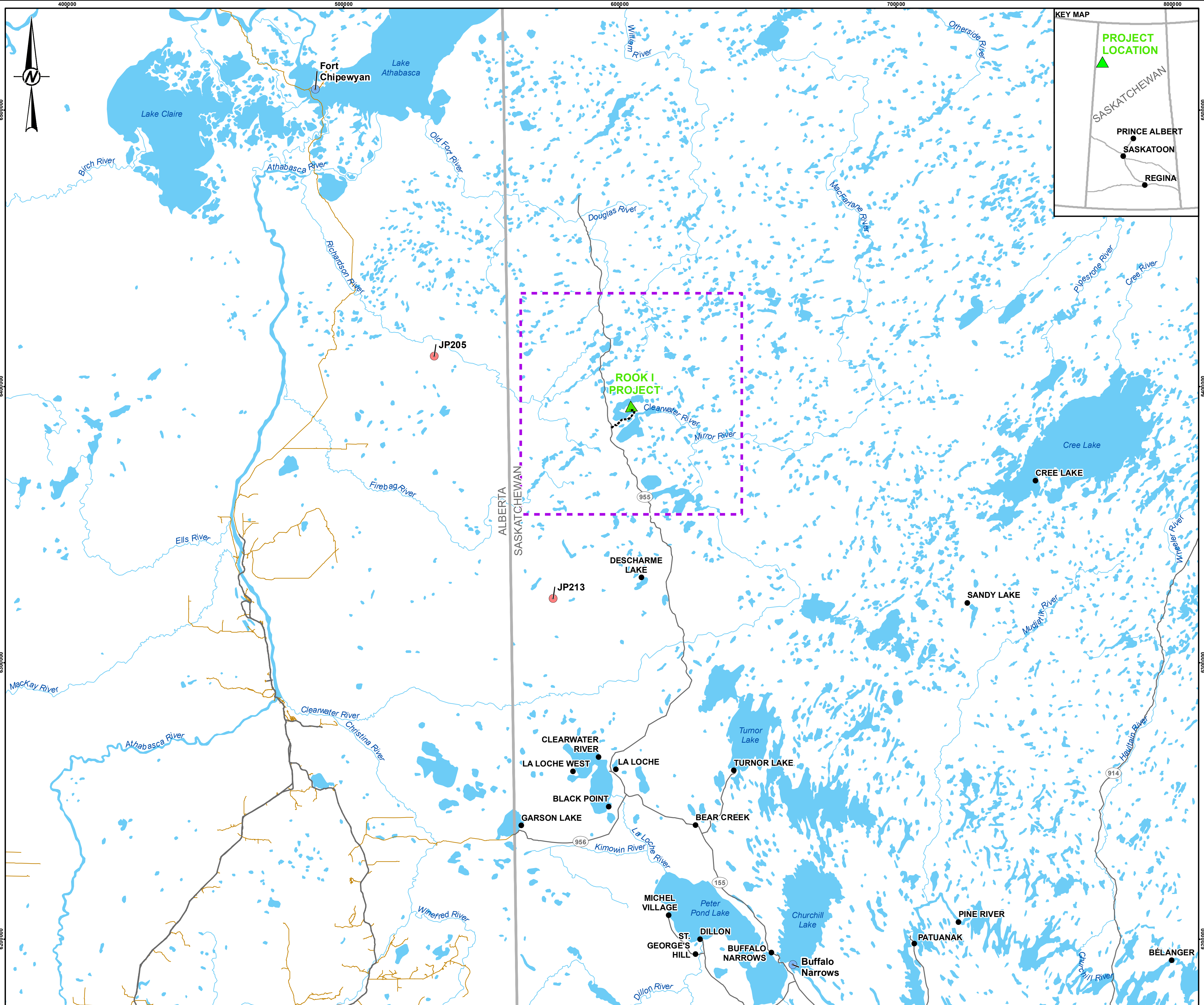
A second regional air quality motoring station is located near the small, remote community of Buffalo Narrows, approximately 210 km south-southeast of the Project (Figure 7). This station is part of the ECCC National Air Pollution Surveillance program that collects air quality data across Canada. The Buffalo Narrows Station continuously monitors compounds of interest including nitrogen dioxide, sulphur dioxide, $PM_{2.5}$, and particulate matter with a mean aerodynamic diameter less than 10 µm (PM_{10}). The station also monitors meteorological parameters and additional air quality contaminants including nitric oxide, oxides of nitrogen, and ozone. The data are available publicly for download through the Government of Saskatchewan historical air quality database (Government of Saskatchewan 2020). Similar to Fort Chipewyan station, the station is located at the airport of the small community of Buffalo Narrows and therefore may be influenced by community-related emissions (e.g., local traffic, building heating, and airstrip) more than might be reasonably expected in the anticipated area of the Project. It was considered a reasonable surrogate for atmospheric conditions within the AQSA due to its displacement from major industrial developments and its rural, northern Saskatchewan location.

The WBEA operates a network of passive monitoring stations in the AOSR. Typically, within the WBEA network, the samples are exposed for a one-month period. Two passive-only stations, JP205 Station and JP213 Station located approximately 73 km west-northwest and 75 km southwest of the Project, respectively, are considered in the baseline study (Figure 7). These stations were chosen based on data availability and the location of passive monitors that are often upwind of the AQSA and remote from major oil sands developments in the AOSR to reflect the expected conditions within the AQSA.

Table 3: Regional Air Quality Monitoring Locations used in the Baseline Study

Station Name	Station Type	Station Operator	Coordinates (m)[a]		Approximate Distance and Direction from Project (km, direction)	Compounds Monitored[b]	Monitoring Period
			Easting	Northing			
Fort Chipewyan Station	Continuous sampling	WBEA	489861	6507689	160 km NW	nitrogen dioxide, sulphur dioxide, $PM_{2.5}$	July 1998 - Present
Buffalo Narrows Station	Continuous sampling	ECCC NAPS	662619	6190717	210 km SSE	nitrogen dioxide, sulphur dioxide, $PM_{2.5}$	March 2012 - Present
JP205 Station	Passive sampling	WBEA	532866	6411054	73 km WNW	nitrogen dioxide, sulphur dioxide	2007 - Present
JP213 Station	Passive sampling	WBEA	575855	6323351	75 km SW	nitrogen dioxide, sulphur dioxide	2007- Present

a) Coordinates presented are UTM NAD 83 Zone 12.
b) Compounds presented are those of interest for the Project, additional compounds and parameters are monitored that are not presented here.
NAPS = National Air Pollution Surveillance; NW = northwest; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter less than 2.5 µm; SSE = south-southeast; SW = southwest; WBEA = Wood Buffalo Environmental Association; WNW = west-northwest; UTM = Universal Transvers Mercator; NAD = North American Datum.



LEGEND

- POPULATED PLACE
- CONTINUOUS AIR QUALITY MONITORING STATION
- PASSIVE AIR QUALITY MONITORING STATION
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- EXISTING ACCESS ROAD
- AIR QUALITY STUDY AREA
- PROJECT LOCATION

0 50,000 100,000

1:1,400,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT
NEXGEN

PROJECT
ROOK 1 ATMOSPHERIC BASELINE

TITLE
REGIONAL AIR QUALITY STATIONS USED FOR BASELINE STUDY

CONSULTANT

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Historical radon data from August 2017 to August 2018 are available for the Cluff Lake region located in the Athabasca Basin. A mining and milling facility, the Cluff Lake Mine, was previously operated by Orano Canadian Inc. in the region from 1981 until 2002. An Independent Environmental Monitoring Program was conducted by the Canadian Nuclear Safety Commission (CNSC) from 2017 to 2018 to observe and monitor any lasting environmental effects after the closure of the facility in the surrounding area. Ambient air sampling was conducted to measure radon concentrations in the region (CNSC 2018).

4.3.3 Ambient Air Quality Criteria

The air quality environment is evaluated based on a comparison of available ambient air quality measurements against relevant air quality criteria and guidelines. Measured data were compared to the Saskatchewan Ambient Air Quality Standards (SAAQS; Government of Saskatchewan 2015) for relevant compounds, as listed in Table 4. The guidelines refer to averaging periods ranging from one hour to one year. Other compounds either not predicted to be directly emitted by the Project (e.g., ozone) or not expected to affect local air quality (e.g., carbon monoxide) are excluded from this analysis.

Table 4: Relevant Saskatchewan Ambient Air Quality Standards

Compound	Ambient Air Quality Standard (µg/m³)		
	1-Hour	24-Hour	Annual
$PM_{2.5}$	n/a	28[(a)]	10
PM_{10}	n/a	50	n/a
TSP	n/a	100	60[(b)]
Nitrogen dioxide	300	200	45[(c)]
Sulphur dioxide	450	125	20[(c)]

Source: Government of Saskatchewan 2015.
a) average of the annual 98th percentile of the daily 24-hour average concentrations for three consecutive years.
b) Geometric mean.
c) Arithmetic mean.
n/a = not applicable; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter less than 2.5 µm; PM_{10} = particulate matter with a mean aerodynamic diameter less than 10 µm; TSP = total suspended particulate.

In 2012, the Canadian Council of Ministers of the Environment (CCME) and the Canadian provinces and territories, excluding Quebec, agreed to implement a national Air Quality Management System (CCME 2012). The framework resulted in the development of the Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$, ozone, nitrogen dioxide, and sulphur dioxide. The CAAQS are human health-based air quality objectives for compound concentrations in ambient air (Table 5). The CAAQS were implemented in a two-phased approach for achievement, namely 2015 and 2020 for $PM_{2.5}$ and ozone (CCME 2012), respectively, and 2020 and 2025 for nitrogen dioxide and sulphur dioxide (Government of Canada 2017a, 2017b), respectively.

The SAAQS for $PM_{2.5}$ are equivalent to the CAAQS derived for 2015 achievement. The CCME has developed guidance documents on achievement determination of CAAQS for $PM_{2.5}$, nitrogen dioxide, and sulphur dioxide (CCME 2020). Before determining the achievement of CAAQS, transboundary flows and exceptional events need to be identified, and the weight of evidence approach needs to be used to demonstrate the influence of transboundary flows and exceptional events. Without accounting for the transboundary flows and exceptional events, it is not appropriate to make direct comparisons to the CAAQS. Therefore, the remaining CAAQS are presented here for information only.

Table 5: Canadian Ambient Air Quality Standards

Compound	Ambient Air Quality Standard (µg/m³)								
	2015			2020			2025		
	1-Hour	24-Hour	Annual	1-Hour	24-Hour	Annual	1-Hour	24-Hour	Annual
$PM_{2.5}$	n/a	28[(a)]	10[(b)]	n/a	27[(a)]	8.8[(b)]	n/a	n/a	n/a
Nitrogen dioxide	n/a	n/a	n/a	113 (60 ppb)[(c)]	n/a	32 (17.0 ppb)	79 (42 ppb)[(c)]	n/a	22.6 (12.0 ppb)
Sulphur dioxide	n/a	n/a	n/a	183 (70 ppb)[(d)]	n/a	13 (5.0 ppb)	170 (65 ppb)[(d)]	n/a	10.5 (4.0 ppb)

Source: CCME 2012, 2016, 2017.
a) Average of the annual 98th percentile of the daily 24-hour average concentrations for three consecutive years.
b) Average of the annual average of 1-hour concentrations for three consecutive years.
c) Average of the annual 98th percentile of the daily maximum 1-hour average concentrations for three consecutive years.
d) Average of the annual 99th percentile of the daily maximum 1-hour average concentrations for three consecutive years.
n/a = not applicable; $PM_{2.5}$ = fine particulate matter with a mean aerodynamic diameter less than 2.5 µm; ppb = parts per billion.

In the absence of dustfall standards for Saskatchewan, the Alberta Ambient Air Quality Guideline for dustfall was used to assess baseline dustfall measurements (Alberta Environment and Parks [AEP] 2019). The AEP guidelines apply to the mass of dustfall per unit area over a 30-day period for both residential and recreational areas or for commercial and industrial areas (Table 6).

Table 6: Relevant Dustfall Standards

Compound	Alberta Ambient Air Quality Guideline (mg/100 cm²/30 d)	
	Residential and Recreation Areas	Commercial and Industrial Areas
Dustfall	53	158

Source: AEP 2019.
mg/100 cm²/30 d = milligrams per 100 square centimetres per 30 days.

There are no ambient air quality standards in place for the other air quality parameters measured in the planned area of the Project (e.g., ambient radon exposure and metals deposition). The baseline study of these air quality parameters will help characterize the existing conditions, put the air quality modelling results into context, and provide a basis for comparison against operational values if the project proceeds.

4.3.4 Background Air Quality Concentrations

In accordance with the Saskatchewan Air Quality Modelling Guideline (SAQMG; ENV 2012b), the inclusion of a background air contaminant concentration is to be added to air dispersion modelling predictions to obtain the total concentration to use in comparisons with ambient air quality criteria. The background concentrations were chosen from the SAQMG to represent the portion of ambient concentrations that occur naturally or due to sources not evaluated in the model. Regional background concentration values, derived from air quality monitoring data, are required to be added to dispersion modelling predictions to account for natural, distant, or minor sources. The background concentrations from the representative “background monitors” are prescribed in the SAQMG (ENV 2012b). As the expected area of the Project is in the northern air dispersion modelling zone defined in the SAQMG, the appropriate background concentrations will be added to the modelled predictions for the EA as presented in the SAQMG.

The SAQMG also lists the methods used to determine a site-specific background concentration, including:

- at least one year of monitoring data are required;
- all monitoring data are subjected to validation and quality control;
- the 90th percentile value from the monitoring data is selected to represent the 1-hour and 24-hour background concentrations; and
- the 50th percentile value from the monitoring data is selected to represent the annual background concentration.

Where applicable, the local and regional air quality monitoring data were processed and used to create site-specific background concentrations following the SAQMG methods. The site-specific background concentrations were compared against the regional background concentrations listed in Table 7.

Table 7:Northern Air Dispersion Modelling Zone Regional Background Air Compound Concentrations

Compound	Background Concentration for Air Dispersion Modelling (µg/m^3)[(a)(b)]			
	1-Hour	8-Hour	24-Hour	Annual
$PM_{2.5}$	n/a	n/a	6.5	3.1
PM_{10}	n/a	n/a	23.1	n/a
Carbon monoxide	527.5 (500 ppb)	527.5 (500 ppb)	n/a	n/a
Nitrogen dioxide	11.3 (6 ppb)	n/a	9.4 (5 ppb)	3.8 (2 ppb)
Sulphur dioxide	0	n/a	0	0.000

Source: SMOE 2012.
a) 90th percentile value of monitoring data is added to the 1-hour and 24-hour predictions and 50th percentile value of the monitoring data is added to the annual predictions per the SAQMG guidance.
b) TSP background concentration is not available in the Northern air dispersion modelling zone.
n/a = not applicable; ppb = parts per billion; $PM_{2.5}$ = fine particulate matter with a mean aerodynamic diameter less than 2.5 µm; PM_{10} = particulate matter with a mean aerodynamic diameter less than 10 µm; SAQMG = Saskatchewan Air Quality Modelling Guideline.

4.4 Quality Assurance and Quality Control

Quality assurance and quality control (QC) practices determine data integrity and are relevant to all aspects of a study, from sample collection to data analysis and reporting. Quality assurance encompasses management and technical practices designed to confirm that the data generated are of consistent high quality. Quality control is an aspect of quality assurance and includes the procedures used to measure and evaluate data quality and the corrective actions to be taken when data quality objectives are not met.

4.4.1 Quality Assurance

Quality assurance applicable to this study covers field and laboratory management. Meteorological and air quality monitoring instruments are subject to maintenance and calibration per their specifications. Thorough checkups were performed to identify gaps and abnormal data points from the data collected. For the field sampling program, one field crew member managed the sample shipping process for the field program to confirm that samples were properly labelled, documentation was completed, and samples were delivered to the laboratory. The other member of the field crew was designated as the laboratory liaison. The laboratory selected for the analysis of samples is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Under CALA's accreditation program, performance evaluation assessments are conducted annually for laboratory procedures, methods, and internal quality control.

4.4.2 Quality Control

The QC program consisted of the collection and analysis of field replicate samples and laboratory QC analysis. Laboratory QC analysis included a variety of techniques, such as the analysis of reference materials, control samples/field blank, and spike recovery measurements to verify the validity of the analytical results. A sample QC report is shown in Appendix B. If QC issues were identified, the samples were re-analyzed or other corrective action was undertaken to demonstrate that the analytical results are within the expected measurement uncertainty.

5.0 RESULTS

5.1 Climate

5.1.1 Cluff Lake Station

Climate Normals from 1971 to 2000 from the Cluff Lake Station are used to characterize the climate of the region for several observed meteorological parameters (Table 8). Wind was measured at the Cluff Lake Station during this period as hourly maximum wind speed and wind direction; average wind speeds were not available from this station.

Table 8: Cluff Lake Station Climate Normals, 1971 to 2000

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature													
Daily average (°C)	-20.4	-16.4	-9.5	0.5	8.8	14.6	16.9	15.6	9	1.1	-11	-17.6	-0.7
Average daily maximum (°C)	-15.4	-11	-3.3	6.1	14.9	20.8	22.7	21.3	13.6	4.6	-7.3	-13.3	4.5
Average daily minimum (°C)	-25.5	-21.8	-15.6	-5.1	2.7	8.4	11.1	9.9	4.3	-2.4	-14.6	-21.9	-5.9
Extreme maximum (°C)	9	11.5	14.5	24	34.5	33	34.5	36	29.5	26.5	9	6.5	n/a
Extreme minimum (°C)	-49	-46	-44	-36	-14	-4.5	0.5	-0.5	-7.5	-25	-39	-45	n/a
Precipitation													
Rainfall (mm)	0.1	0.5	1.8	6.6	24	58.6	88.2	71.7	50.7	15.8	0.8	0.6	319.3
Snowfall (cm)	24.3	21.9	21.4	9.7	2	0	0	0	1.2	19.4	36.4	26.5	162.8
Total precipitation (mm)	18.9	18.1	19.8	15.8	26	58.6	88.2	71.7	51.9	33.6	27.9	20.6	451
Extreme daily total precipitation (mm)	9.4	9	20.6	17	37.4	34	62.2	40.9	49.6	18.7	20	12.2	n/a
Days with precipitation >0.2 mm	12.9	11	9.4	6.7	10	13.5	15.2	15.5	13.9	14.7	15.1	12.3	150.2
Wind													
Maximum hourly speed (km/h)	35	39	42	42	35	43	48	43	43	40	35	40	48
Direction of maximum hourly speed	NW	SW	NW	NW	N	NW	NW	SW	W	NW	SE	NW	NW

Source: ECCC 2019.
> = greater than; N = north; NW = northwest; SE = southeast; SW = southwest; W = west; n/a = not applicable.

5.1.1.1 Temperature

Observations at the Cluff Lake Station show that the mean air temperature has a large seasonal dependence (Table 8). In the winter (January), a daily mean of -20.4°C was recorded, while in the summer (July) the recorded daily mean was 16.9°C (ECCC 2019). By November, mean temperatures were generally below freezing at -11°C and remained below freezing until April. The annual daily mean obtained from the data recorded at the Cluff Lake Station from 1981 to 2010 was -0.7°C.

5.1.1.2 Precipitation

Mean annual total rainfall at the Cluff Lake Station was 319.3 mm, with approximately 98% occurring from May to October (ECCC 2019). Most snow falls between October and April with the greatest amount of snowfall occurring in November (Table 8). The average total annual precipitation was 451 mm; therefore, approximately 71% of the precipitation was in the form of rainfall.

5.1.1.3 Wind Speed and Direction

Maximum hourly wind speed and direction of the hourly maximum wind speed are recorded at the Cluff Lake Station. The maximum hourly wind speed varied between 30 km/h and 48 km/h. Maximum wind speeds were recorded from every quadrant but are most commonly from the northwest (Table 8).

5.1.2 Fort McMurray A Station

Climate Normals for 1981 to 2010 from the Fort McMurray A Station were used to characterize the climate of the region for several observed meteorological parameters (Table 9). The Fort McMurray A Station provides additional climate parameters not monitored at the Cluff Lake Station including average wind speed and direction, and relative humidity.

Table 9: Fort McMurray A Station Climate Normals, 1981 to 2010

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature													
Daily average (°C)	-17.4	-13.3	-6.2	3.3	9.9	14.6	17.1	15.4	9.5	2.3	-8.6	-15.1	1.0
Average daily maximum (°C)	-12.2	-7.1	0.6	10.0	16.9	21.5	23.7	22.2	15.8	7.4	-4.3	-10.1	7.0
Average daily minimum (°C)	-22.5	-19.5	-12.9	-3.5	2.8	7.7	10.5	8.6	3.2	-2.8	-12.9	-20	-5.1
Extreme maximum (°C)	15.1	15.0	20.1	30.2	34.8	36.8	35.6	37.0	32.4	28.6	18.9	10.7	n/a
Extreme minimum (°C)	-50.0	-50.6	-44.4	-34.4	-17.3	-4.4	-3.3	-3.1	-15.6	-24.5	-37.8	-47.2	n/a
Precipitation													
Rainfall (mm)	0.4	0.7	2.1	11.0	33.5	73.3	80.7	57.1	38.8	15.6	2.6	0.7	316.3
Snowfall (cm)	23.8	18.4	19.1	11.9	3.5	0.0	0.0	0.0	0.9	12.2	22.9	21.3	133.8
Total precipitation (mm)	17.7	13.2	16.7	21.4	36.5	73.3	80.7	57.1	39.7	26.2	19.9	16.4	418.6
Extreme daily total precipitation (mm)	16.0	13.2	29.7	26.8	39.4	50.0	57.5	94.5	60.5	29.4	15.7	22.6	n/a
Days with precipitation >0.2 mm	12.3	10.4	9.6	8.5	11.3	14.2	15.8	13.2	12.5	10.9	12.0	11.8	142.5
Wind													
Average speed (km/h)	8.6	9.2	10.3	11.3	11.0	9.9	9.2	8.9	9.8	10.2	9.0	8.6	9.7
Most frequent direction	E	E	E	E	E	E	W	W	W	E	E	E	E
Maximum hourly speed (km/h)	89	94	74	79	80	97	113	80	96	97	97	85	113
Direction of maximum hourly speed	W	NW	W	W	W	N	W	N	W	W	W	W	W
Relative Humidity													
Average relative humidity - 06:00 LST (%)	73.2	73.6	73.7	71.7	71.3	76.8	82.8	87.5	86.5	82.1	80.4	75.3	77.9
Average relative humidity - 15:00 LST (%)	68.7	60.7	49.4	40.1	39.5	46.3	51.0	50.6	52.2	58.4	71.7	72.4	55.1

Source: ECCC 2019.
> = greater than; LST = local standard time; N = north; NW = northwest; W = west; E = east; n/a = not applicable.

5.1.2.1 Temperature

Observations at the Fort McMurray A Station, similarly to those observed at the Cluff Lake Station, show that the mean air temperature has a large seasonal dependence (Table 9). The Fort McMurray A Station daily mean of -17.4°C was recorded in the winter (January), while in the summer (July) the recorded daily mean was 17.1°C (ECCC 2019), both slightly warmer than the average climate observed at the Cluff Lake Station. At the Fort McMurray A Station, mean temperatures were generally below freezing at -8.6°C starting in November and remained below freezing until March, slightly earlier than that observed at the Cluff Lake Station (April). The annual daily mean (1.0°C) recorded at the Fort McMurray A Station from 1981 to 2010 was also slightly higher than that observed at the Cluff Lake Station (-0.7°C).

5.1.2.2 Precipitation

Mean annual total rainfall at the Fort McMurray A Station was 316.3 mm with the majority occurring from April to October (ECCC 2019). Snowfall occurred primarily between October and April with the greatest amount of snowfall occurring in January (Table 9). The average total annual precipitation was 418.6 mm, slightly less than that observed at the Cluff Lake Station due to lower recorded snowfall at the Fort McMurray A Station.

5.1.2.3 Wind Speed and Direction

Fort McMurray's geographic location in a river valley heavily influences the wind data (i.e., wind speed and direction) that are measured at the Fort McMurray A Station. Due to this local topographic influence, the Fort McMurray A Station is not a suitable surrogate for wind patterns in the AQSA.

5.1.2.4 Relative Humidity

Climate Normals for average relative humidity (RH) were available for the morning (06:00) and afternoon (15:00) at the Fort McMurray A Station (Table 9). Relative humidity tended to be higher in the mornings than the afternoons throughout every season. The lowest RH occurred in the spring (i.e., April and May) for both the morning and afternoon. The highest morning RH has historically been observed in August, while the highest afternoon RH occurred during the late fall and early winter months (i.e., November to January).

5.2 Weather

Weather describes atmospheric conditions at a specific time and over a shorter duration relative to the long-term averages used to describe climate. The following subsections describe weather in the anticipated area of the Project and within the AQSA. Weather is described rather than climate because the record of measurement is relatively short compared to the long-term records at Cluff Lake and Fort McMurray.

5.2.1 Temperature

The coldest month observed in the anticipated area of the Project was January, with a daily mean of -18.1°C, while the warmest month was July with a recorded daily mean of 17.1°C (Table 10). Mean temperatures below freezing begin in October and continue until May. The annual average temperature observed in the anticipated area of the Project was -0.6°C. Over the monitoring period, the temperature extremes ranged from -39.2°C to 32.4°C.

Table 10: Observed Temperatures at Rook I Meteorological Station, November 2015 to December 2020

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily average (°C)	-18.1	-17.9	-9.3	-1.2	9.6	14.6	17.1	14.9	9.2	-0.7	-9.6	-15.3	-0.6
Daily maximum (°C)	-14.2	-13.0	-4.0	4.0	15.2	19.5	22.1	19.5	13.4	2.2	-6.9	-11.8	3.8
Daily minimum (°C)	-21.7	-22.3	-14.3	-6.5	3.7	9.9	12.4	10.8	5.7	-3.2	-12.4	-18.8	-4.7
Extreme maximum (°C)	4.7	11.0	14.0	22.5	31.3	32.4	32.2	30.0	29.5	17.9	11.3	6.8	n/d
Extreme minimum (°C)	-36.7	-38.0	-34.2	-27.9	-14.8	0.4	4.8	2.7	-7.7	-12.8	-23.7	-39.2	n/d

n/d = no data or data completeness requirements not met.

The average temperatures observed from November 2015 to December 2020 are shown in Figure 8 and Figure 9 and compared to the Cluff Lake Station and Fort McMurray Station Climate Normals, respectively. The observed temperatures at the Rook I Meteorological Station aligned closely with the long-term average temperatures observed at the Cluff Lake Station. Slightly milder winter temperatures observed within the most recent five years could be related to the location of the Rook I Meteorological Station, which is approximately 75 km south of Cluff Lake Station. The Rook I Meteorological Station recorded temperatures were also similar to the long-term average temperatures observed at the Fort McMurray A Station.

Figure 8: Rook I Meteorological Station Observed Temperatures Compared to the Cluff Lake Station Climate Normals

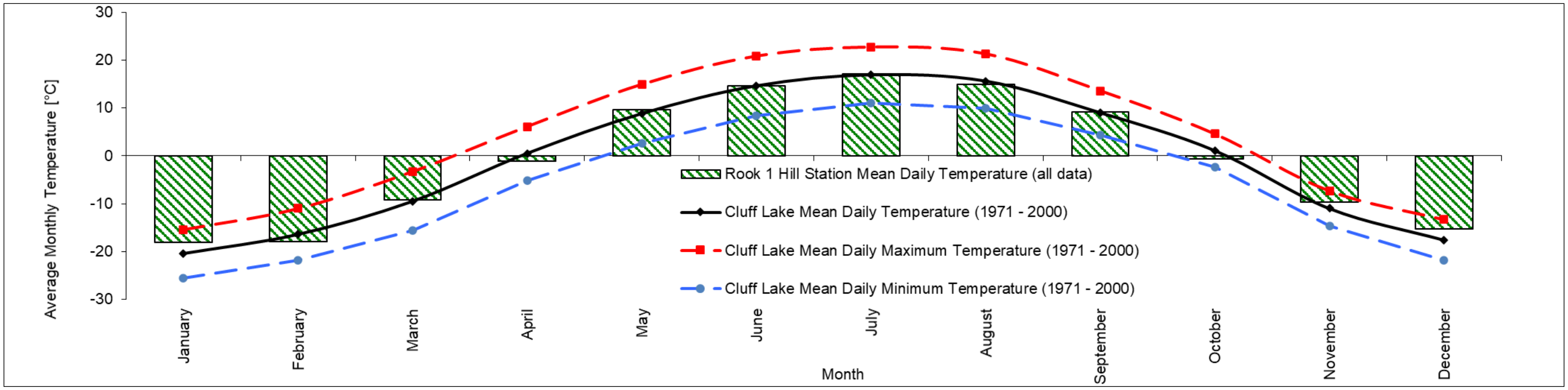
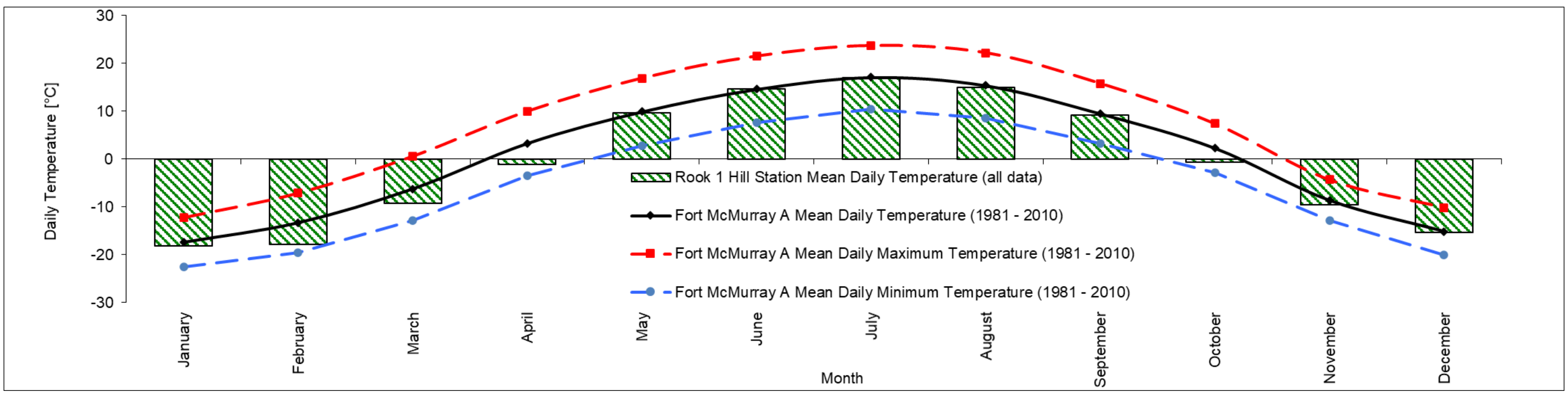


Figure 9: Rook I Meteorological Station Observed Temperatures Compared to the Fort McMurray A Station Climate Normals



5.2.2 Precipitation

At the original Rook I Meteorological Station (i.e., from November 2015 to September 2018), precipitation monitoring was only carried out for rainfall (i.e., tipping bucket). During the station relocation in September 2018, a second analyzer for total precipitation (i.e., rainfall and snowfall) was added. Several data gaps resulted from equipment downtime for rainfall in 2015 and 2016 and for precipitation data in 2018. By the end of 2020, there were four years (i.e., 2017 to 2020) of rainfall data and two years (i.e., 2019 to 2020) of precipitation data with 100% completeness (Table 11). Snowmelt events, characterized by afternoon temperatures above freezing coincident with high solar radiation and low relative humidity (i.e., a sunny winter or spring day), are often recorded by tipping buckets as rainfall events due to the melting of accumulated snow in the bucket. Rainfall values recorded in these days were replaced with zero in the rainfall dataset.

Four full calendar years of rainfall data, 2017 to 2020, were collected at the Rook I Meteorological Station. Total annual rainfall in 2017 (220.1 mm) and 2018 (267.2 mm) was less than the Climate Normals recorded at the Cluff Lake Station (319 mm) and the Fort McMurray A Station (316 mm). Total rainfall in 2019 and 2020 was observed to be higher than Climate Normals rainfall. 2020 was an exceptionally wet year with 506.3 mm of total rainfall. However, the average annual rainfall from 2017 to 2020 was 331.9 mm, which was close to the Climate Normals annual rainfall at both Cluff Lake Station and Fort McMurray A Station.

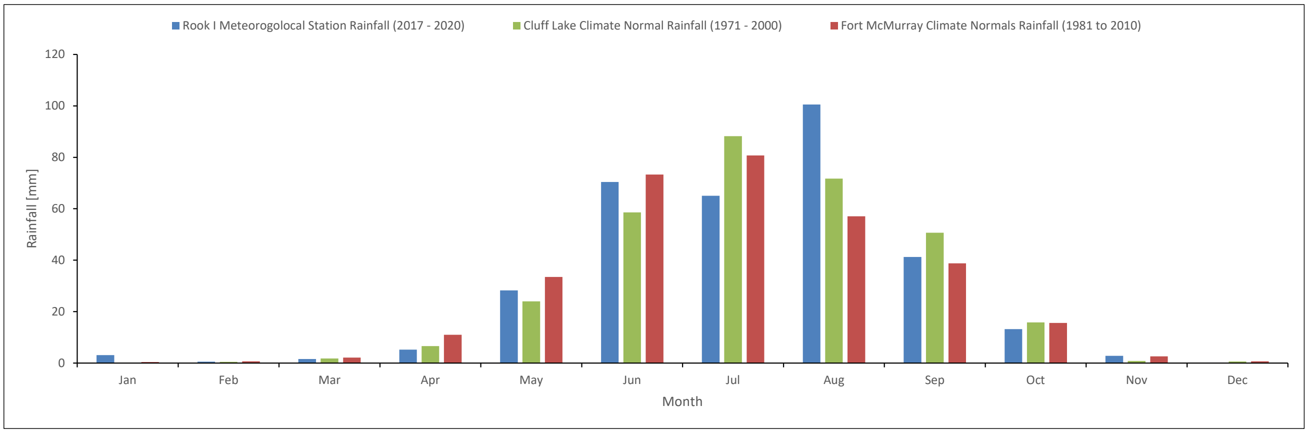
The average monthly rainfalls observed at Rook I Meteorological Station were compared to the Climate Normals at the Cluff Lake Station and the Fort McMurray A station as shown in Figure 10. The observed monthly rainfalls from 2017 to 2020 were similar to the long-term Climate Normals. The observed rainfall in August was higher than the Climate Normals.

Table 11: Observed Rainfall at Rook I Meteorological Station, November 2015 to December 2020

Parameter	Rainfall (mm)[a]												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2015	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	0.2	n/d
2016	n/d	n/d	3.9	10.1	20.0	105.1	n/d	n/d	n/d	10.3	1.4	0.0	n/d
2017	12.4	0.3	1.1	1.6	21.4	52.6	31.3	32.5	41.2	23.9	0.0	0.0	218.3
2018	0.0	0.0	0.6	7.1	26.7	71.7	61.0	56.0	34.7	1.9	0.0	0.0	259.7
2019	0.0	0.0	4.6	9.1	6.5	38.4	51.4	181.6	38.1	6.2	7.3	0.0	343.2
2020	0.0	1.8	0.0	3.2	58.3	118.8	116.4	132.1	50.9	20.8	3.9	0.1	506.3
Average	3.1	0.5	1.6	5.3	28.2	70.4	65.0	100.6	41.2	13.2	2.8	0.0	331.9

a) Winter snowmelt events characterized by afternoon temperatures above freezing coincident with high solar radiation and low relative humidity (i.e., a sunny winter day) were replaced with zero.
n/d = no data or data completeness less than 100%.

Figure 10: Rook I Meteorological Station Observed Rainfall Compared to the Climate Normals



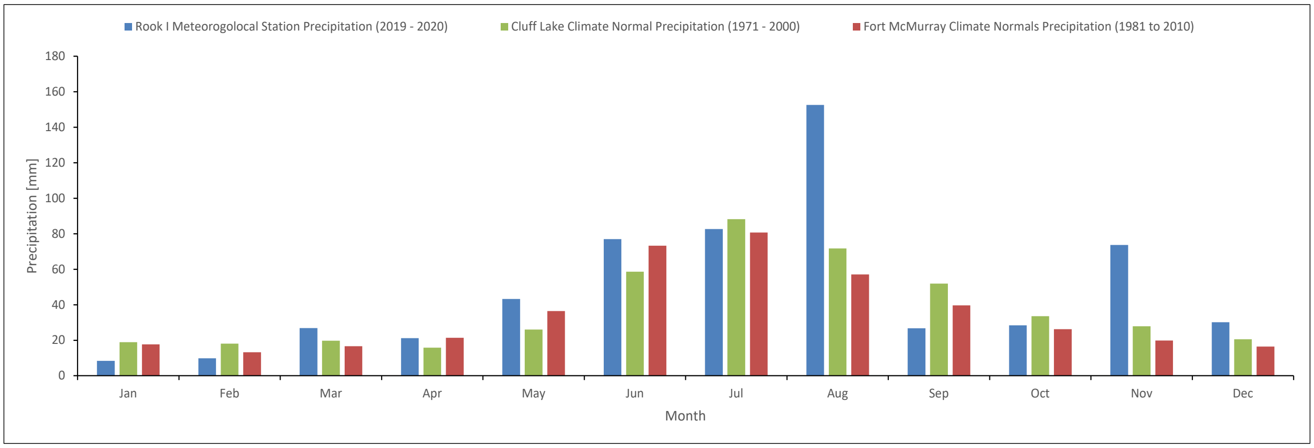
Two complete calendar years (2019 and 2020) of total precipitation data were recorded at the Rook I Meteorological Station (Table 12). In both years, the total precipitation recorded at the Rook I Meteorological Station were higher than the Cluff Lake Station (451 mm) and Fort McMurray A Station (418.6 mm) Climate Normal total precipitation. Figure 11 shows the comparison of average monthly precipitation at the Rook I Meteorological Station to the Climate Normals. Higher than Climate Normal precipitations were recorded in August and November in 2018 and 2019.

Table 12: Observed Total Precipitation at Rook I Meteorological Station, September 2018 to December 2020

Parameter	Total Precipitation (mm)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	19.1	26.9	28.1	n/d
2019	9.0	6.7	38.6	32.2	29.6	44.6	55.7	206.4	44.8	32.3	38.9	31.4	570.1
2020	7.7	13.1	15.2	10.3	57.0	109.3	109.7	98.8	8.8	33.8	155.4	31.1	650.0
Average	8.4	9.9	26.9	21.2	43.3	76.9	82.7	152.6	26.8	28.4	73.7	30.2	610.1

n/d = no data or data completeness less than 100%.

Figure 11: Rook I Meteorological Station Observed Precipitation Compared to the Climate Normals



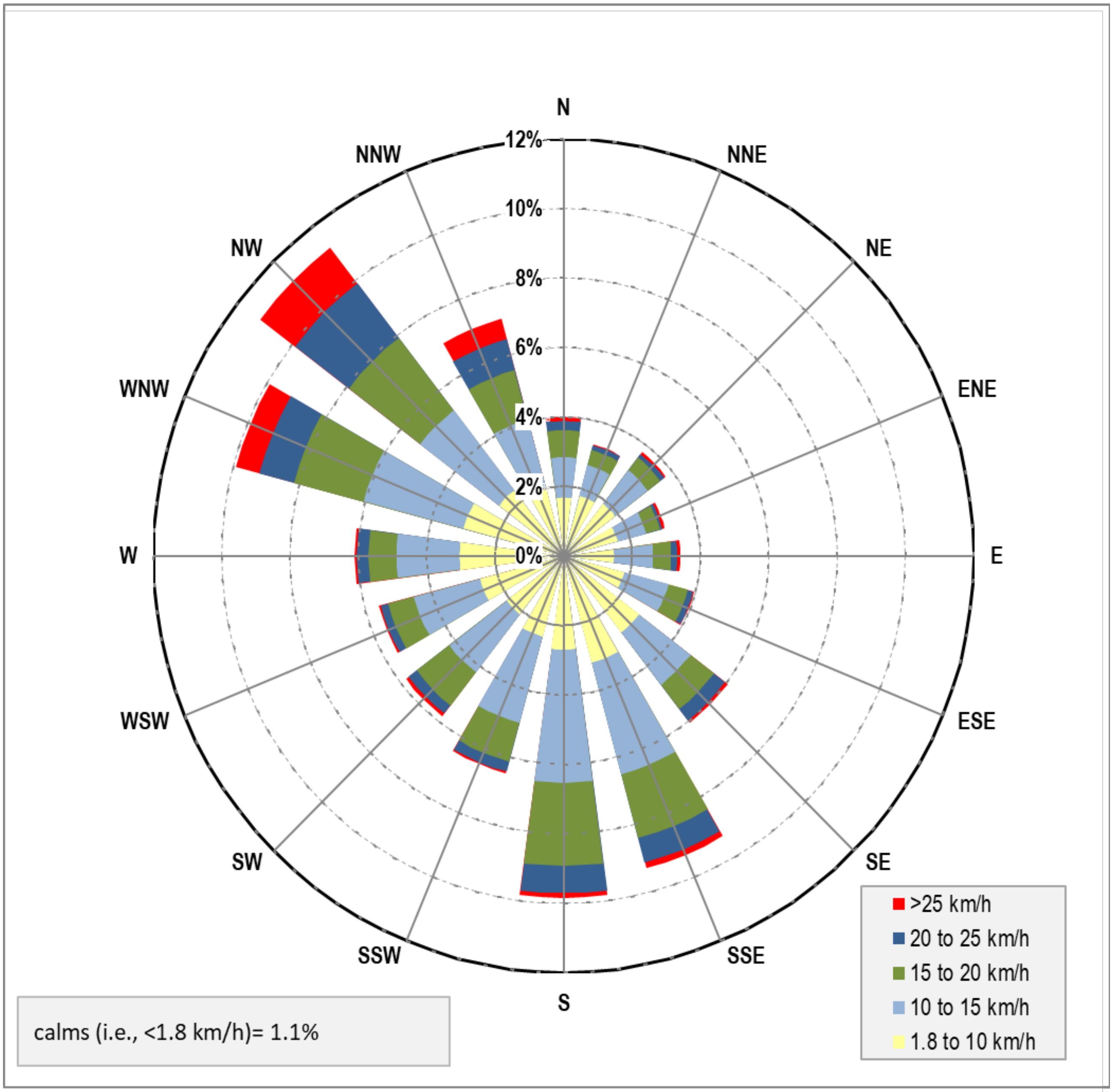
5.2.3 Wind Speed and Direction

A wind rose is often used to illustrate the frequency of wind direction and the magnitude of wind speed. The length of the bars on the wind rose indicate the frequency of the wind from the specified direction. The colour of the bars indicates the wind speed ranges. The direction from which the wind blows is illustrated by the orientation of the bar in 1 of 16 directions.

The dominant wind directions observed were from the northwest throughout the years, with a large portion of higher windspeeds observed from this direction (Figure 12). A considerable portion of the winds (greater than 9%) were also observed from the south, west-northwest, and south-southeast.

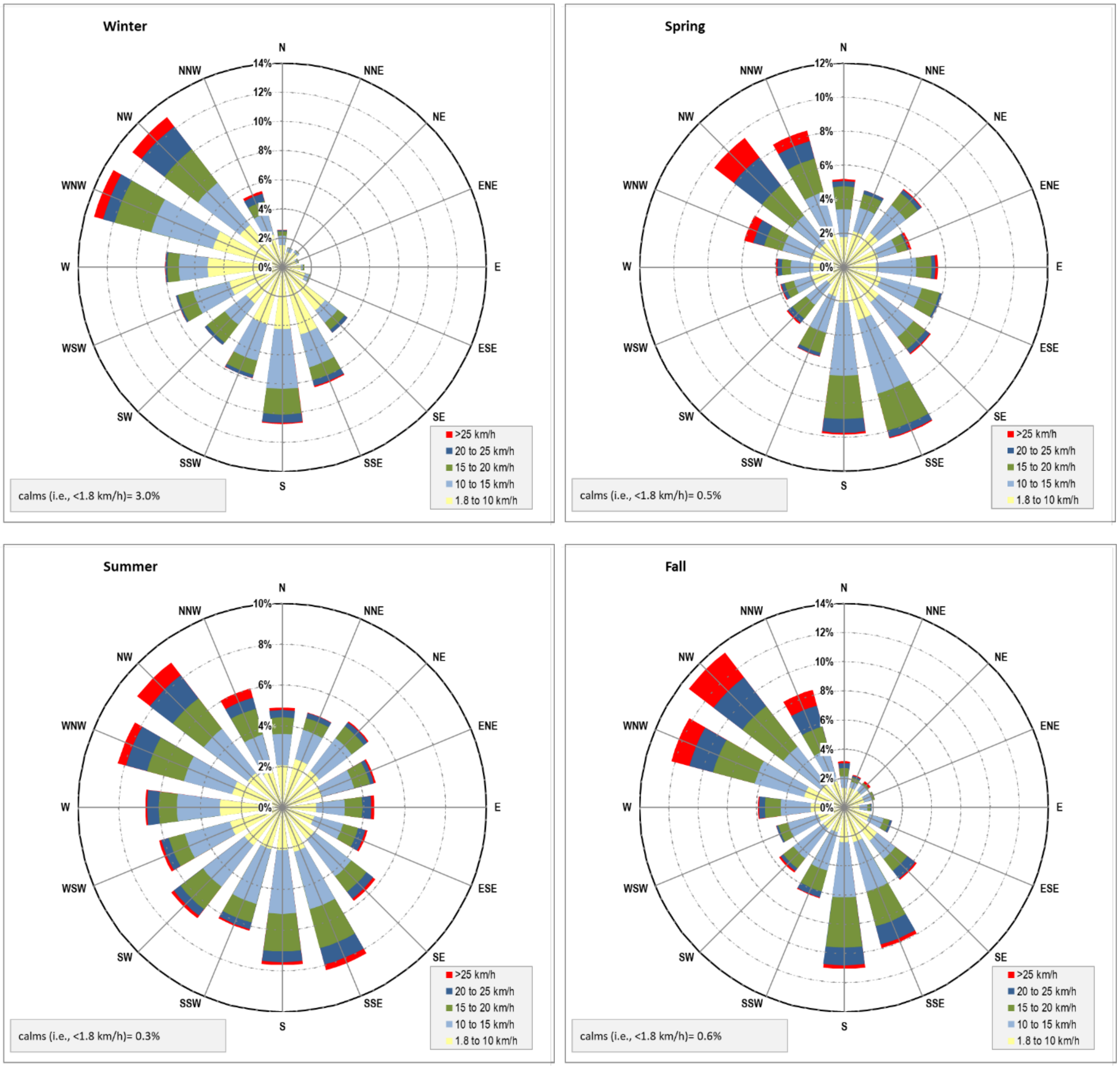
Over the monitoring period, calm wind conditions (i.e., winds less than 0.5 m/s) were observed approximately 1.1% of the time. Low wind conditions (i.e., winds less than 10 km/h), which tend to result in elevated ground-level concentrations of air pollutants, were observed 37.6% of the time. Low winds were observed most frequently from the south-southeast direction 3.3% of the time. High wind conditions (i.e., winds greater than 19.3 km/h when wind erosion of stockpile surfaces starts to occur) were observed for approximately 13.5% of the time. The greatest wind speeds tend to occur in the fall and are typically from the northwest.

Figure 12: Rook I Meteorological Station Wind Rose, November 2015 to December 2020



Wind roses for each season are presented in Figure 13. The dominant wind directions were from the northwest and south throughout all seasons. In the fall and winter, winds tended to be from the northwest and were rarely observed from the northeast. In the spring and summer, southerly winds were more common than northwest winds and a greater distribution of winds were observed from the east. Though the dominant northwest and south winds were observed, winds in the summer tended to be more evenly distributed from all directions more than in other seasons.

Figure 13: Rook I Meteorological Station Seasonal Wind Roses, November 2015 to December 2020



5.2.4 Relative Humidity

Relative humidity is the ratio of the amount of water vapour present in the air to the amount of vapour necessary for saturation at the same temperature and pressure. Relative humidity was generally higher during the winter (i.e., October through February) and lower in spring and summer (Table 13). The lowest relative humidity observations were recorded in May in the anticipated area of the Project.

Table 13: Observed Relative Humidity at Rook I Meteorological Station, November 2015 to December 2020

Parameter	Relative Humidity (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2015	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	86.9	n/d
2016	86.2	n/d	74.2	60.3	55.4	62.5	n/d	n/d	n/d	n/d	85.2	82.8	n/d
2017	84.7	77.5	68.5	56.7	53.2	60.4	61.2	57.4	70.4	86.3	83.6	83.9	70.3
2018	82.1	77.0	68.4	59.1	49.6	64.6	64.0	65.0	n/d	79.0	89.5	86.9	71.5
2019	80.7	75.8	65.6	65.0	54.0	67.4	62.8	82.6	81.1	85.3	90.2	86.5	74.7
2020	84.7	81.0	73.8	67.6	61.4	66.1	73.7	78.7	80.9	86.6	87.4	82.4	77.0
Average	83.7	77.8	70.1	61.7	54.7	64.2	65.4	70.9	77.5	84.3	87.2	84.9	73.4

n/d = no data or data completeness requirements not met.

5.2.5 Solar Radiation

Solar radiation levels measured at the surface are a function of hours of sunlight and sun azimuth angle, as well as local weather conditions. Changes in weather parameters may cause the annual peak in solar radiation to fluctuate from year to year.

Average daily solar radiation at the Rook I Meteorological Station varied seasonally (Table 14). The highest solar radiation was recorded during the spring, summer, and early fall months (i.e., April to September) after which the observations drop off substantially during the darker winter days. The peak solar radiation was observed in May in the expected area of the Project, though both June and July were nearly as high. As expected, solar radiation was weakest in December and January.

Table 14: Observed Daily Solar Radiation at Rook I Meteorological Station, November 2015 to December 2020

Parameter	Daily Solar Radiation (MJ/m^2)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2015	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	2.3	0.6	n/d
2016	1.4	n/d	9.7	16.5	19.8	20.7	n/d	n/d	n/d	n/d	2.0	0.4	n/d
2017	1.4	4.1	10.6	17.0	21.6	19.6	19.6	17.1	10.7	3.8	2.3	1.2	10.8
2018	0.5	3.4	12.0	18.5	21.4	18.6	18.6	15.0	10.4	5.4	1.3	0.8	10.5
2019	1.5	3.3	11.5	15.8	23.2	18.6	20.1	12.5	10.3	4.6	2.2	0.5	10.4
2020	0.6	4.9	10.9	16.2	19.5	19.2	17.8	13.5	9.3	4.1	2.0	1.0	10.0
Average	1.1	3.9	10.9	16.8	21.1	19.4	19.0	14.5	10.2	4.5	2.0	0.7	10.4

MJ/m^2 = Megajoule per square metre; n/d = no data or data completeness requirement not met.

5.3 Air Quality

5.3.1 Local Air Quality

5.3.1.1 Particulates

5.3.1.1.1 Total Suspended Particulate

TSP in remote and rural areas is often a result of windblown dust from erosion and re-entrainment, wildfire smoke, long-range transport of dust, and vehicle travel on gravel roads. No exceedances of the 24-hour SAAQS for TSP (i.e., 100 µg/m^3) were recorded over the baseline study period. The highest 24-hour TSP concentration was recorded on 24 July 2019 (Table 15) and was characterized by an 11-hour period of elevated 1-hour TSP measurements, which indicates a short-term event in the area above typical ambient levels.

The TSP concentrations remained below the 24-hour SAAQS. The 90th percentile values for each month were observed to be below one-third of the SAAQS, with the highest TSP observed in the drier summer months in 2019 (i.e., May through July). The 90th percentile 24-hour concentrations for each month were usually well below and occasionally slightly above the SAQMG prescribed background for the northern air modelling zone of 23.1 µg/m^3; the PM_{10} background value was applied in the absence of a TSP background concentration. The average of the 90th percentile 24-hour concentrations of all data collected by the end of 2020 was 9.7 µg/m^3, which was lower than the background concentration. The average of all 24-hour TSP concentrations from all data was 3.4 µg/m^3, which is well below the annual SAAQS of 60 µg/m^3 and the prescribed background concentration of 11.6 µg/m^3.

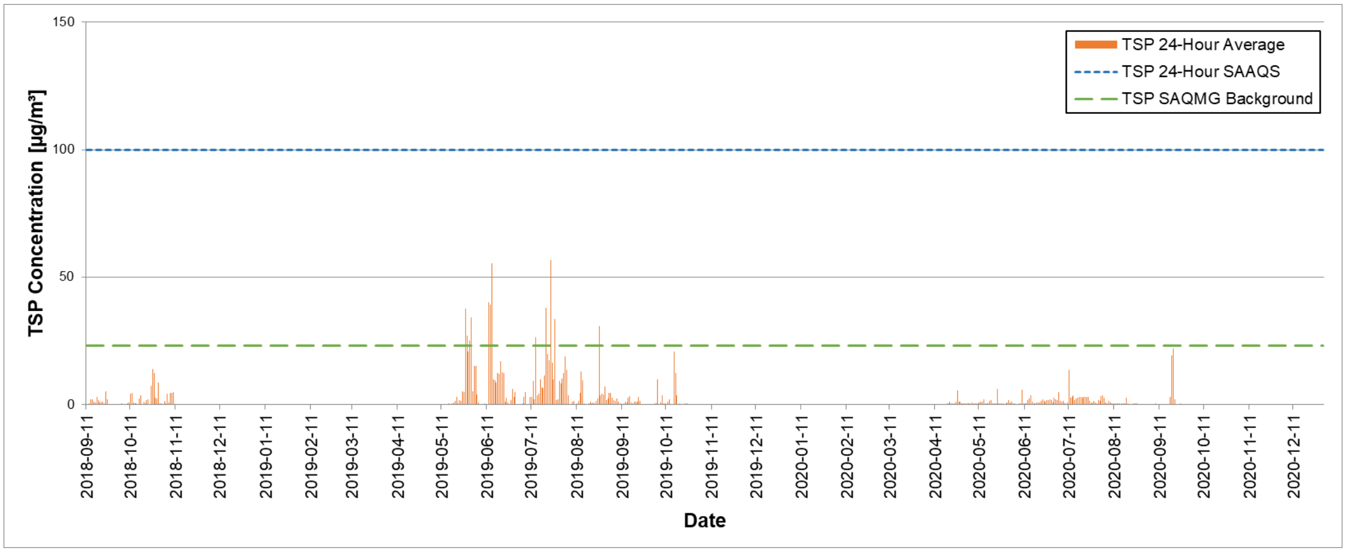
Table 15: Rook I Particulate Monitoring Station 24-Hour Total Suspended Particulate Monitoring Results

Month and Year	Total Suspended Particulate Concentration (µg/m^3)			
	Maximum 24-Hour	90th Percentile[(a)] 24-Hour	50th Percentile[(b)] 24-Hour	Number of Days >100 µg/m^3
Sep-18	5.1	2.6	1.0	0
Oct-18	13.7	7.8	0.8	0
Nov-18	4.7	4.6	1.3	0
May-19	37.6	**28.4**	1.3	0
Jun-19	55.4	**23.7**	5.5	0
Jul-19	56.5	**26.4**	4.7	0
Aug-19	30.7	12.9	1.4	0
Sep-19	4.5	3.0	0.9	0
Oct-19	20.8	7.3	0.1	0
Apr-20	5.5	1.2	0.4	0
May-20	6.0	1.7	0.3	0
Jun-20	5.6	2.1	0.8	0
Jul-20	13.6	3.0	1.9	0
Aug-20	3.7	2.7	0.1	0
Sep-20	21.9	1.9	0.0	0
All Data	56.5	9.7	0.7	0

Bolded values are above the Saskatchewan Air Quality Modelling Guideline prescribed background for the northern air modelling zone of 23.1 µg/m^3.
a) The 90th percentile value from the monitoring data is selected to represent 24-hour background concentrations.
b) The 50th percentile value from the monitoring data is selected to represent the annual background concentration.
> = greater than.

A visual representation of the TSP monitoring data at the Rook I Particulate Monitoring Station is presented in Figure 14. The figure shows that, for the majority of the monitoring period, the 24-hour average concentrations are shown to be below the background concentration prescribed for modelling in the SAQMG, indicating that concentrations of TSP at the anticipated area of the Project are low.

Figure 14: Total Suspended Particulate 24-Hour Average Concentrations at the Rook I Particulate Monitoring Station



TSP = total suspended particulate; SAAQS = Saskatchewan Ambient Air Quality Standards; SAQMG = Saskatchewan Air Quality Modelling Guideline.

5.3.1.1.2 Fine Particulate Matter

$PM_{2.5}$ is either emitted directly (primary $PM_{2.5}$) or formed in the atmosphere from precursor emissions (secondary $PM_{2.5}$). Primary $PM_{2.5}$ is formed predominantly by combustion processes such as fossil fuel burning and forest fires. Key precursors of secondary $PM_{2.5}$ are oxides of nitrogen, sulphur dioxide, ammonia, and volatile organic compounds. The chemical composition of the particulate matter can vary depending on the processes involved in its formation.

The highest 24-hour $PM_{2.5}$ concentration of 28.5 µg/m^3 (Table 16) was recorded on 24 July 2019 and was likely due to smoke from regional wildfires given that the measured $PM_{2.5}$ and TSP concentrations were nearly identical during the event. Although this concentration appears to be above the 24-hour SAAQS of 28 µg/m^3, it does not indicate an exceedance of the standard as compliance is based on the metric of 98th percentile of 24-hour average concentration over a year, averaged over three consecutive years. The highest $PM_{2.5}$ concentrations were observed in the drier summer months in 2019 (i.e., May through July), which is consistent with the trend observed in the TSP data.

The $PM_{2.5}$ concentrations were low compared to the SAAQS (Table 16). The 90th percentile 24-hour concentrations for each month are in the range of the SAQMG prescribed background for the northern air modelling zone of 6.5 µg/m^3. The 90th percentile of all 24-hour $PM_{2.5}$ concentrations collected by 2020 was 4.1 µg/m^3, which is lower than the prescribed background value. The 90th percentile of all 24-hour $PM_{2.5}$ concentrations collected by 2020 was 4.1 µg/m^3, which is lower than the prescribed background value.

The average of all 24-hour $PM_{2.5}$ concentrations was 1.6 µg/m^3, which is lower than the prescribed annual background of 3.1 µg/m^3.

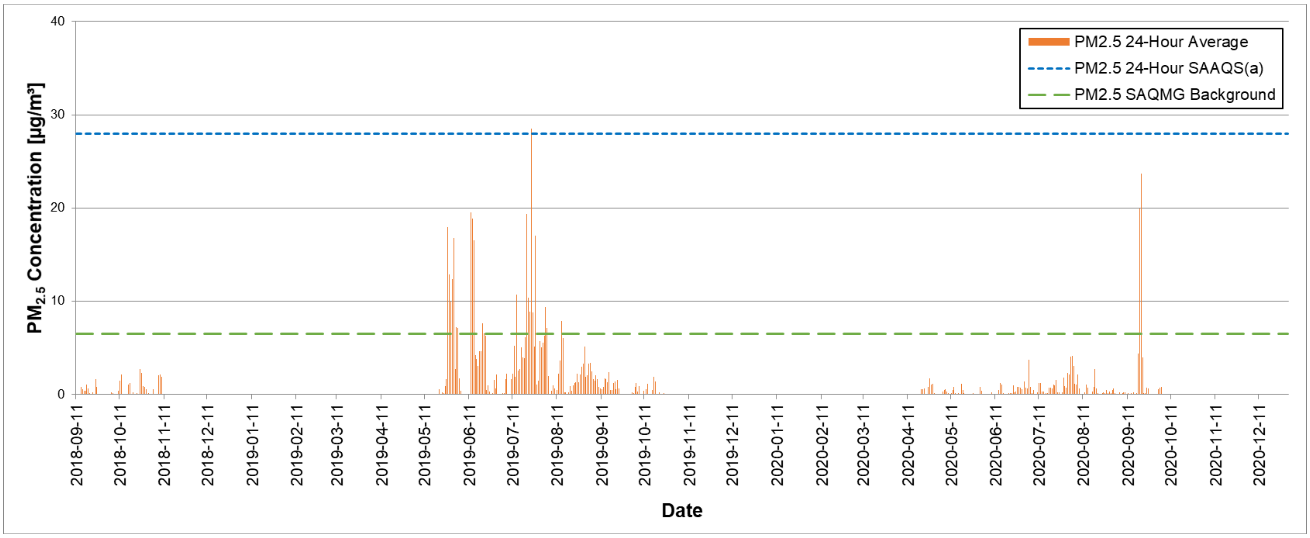
In August and September 2020, the monitored maximum 24-hour $PM_{2.5}$ concentrations were slightly higher than the maximum 24-hour TSP concentrations. Due to the lower sensitivity of TSP samplers to fine particulate matter than the $PM_{2.5}$ sampler, this could happen when the ambient suspended particulate matter is all in the size range of particles less than 2.5 µm.

Table 16: Rook I Particulate Monitoring Station 24-Hour Fine Particulate Matter Monitoring Results

Month and Year	Fine Particulate Matter Concentration (µg/m^3)		
	Maximum 24-Hour	90th Percentile 24-Hour	50th Percentile 24-Hour
Sep-18	1.6	0.9	0.3
Oct-18	2.7	1.6	0.1
Nov-18	2.1	2.0	0.0
May-19	17.9	13.6	0.1
Jun-19	19.5	10.3	2.4
Jul-19	28.5	10.7	2.7
Aug-19	9.3	6.3	1.3
Sep-19	3.4	2.4	1.0
Oct-19	1.9	1.2	0.1
Apr-20	1.7	1.1	0.5
May-20	1.1	0.5	0.0
Jun-20	1.2	0.8	0.0
Jul-20	3.7	1.5	0.6
Aug-20	4.1	2.7	0.3
Sep-20	23.7	4.0	0.1
All Data	28.5	4.1	0.3

A visual representation of the $PM_{2.5}$ baseline monitoring data at the Rook I Particulate Monitoring Station is presented in Figure 15. Although the 24-hour SAAQS of 28 µg/m^3 is presented alongside the data, the data shown above the SAAQS line on this graph does not indicate an exceedance of the standard due to the metric of the $PM_{2.5}$ SAAAQS. For a large portion of the monitoring period, the 24-hour average concentrations were below the background concentration prescribed for modelling in the SAQMG (i.e., 6.5 µg/m^3), indicating that concentrations of $PM_{2.5}$ in the anticipated area of the Project site are low.

Figure 15: Fine Particulate Matter 24-Hour Average Concentrations at the Rook I Particulate Monitoring Station



a) 24-hour SAAQS of 28 µg/m³ is presented alongside the data; data shown above the SAAQS line does not indicate an exceedance of the standard, as the standard metric is the comparison against the 98th percentile of a full year of monitoring data.
$PM_{2.5}$ = particulate matter with a mean aerodynamic diameter less than 2.5 µm; SAAQS = Saskatchewan Ambient Air Quality Standards; SAQMG = Saskatchewan Air Quality Modelling Guideline.

5.3.1.2 Nitrogen Dioxide and Sulphur Dioxide

Nitrogen dioxide can be directly released to the air, but more often it is produced by the conversion of nitric oxide released from combustion processes. Together, nitrogen dioxide and nitric oxide are typically referred as oxides of nitrogen. The primary anthropogenic sources of oxides of nitrogen emissions in the expected area of the Project are related to fossil fuel combustion. Nitrogen dioxide can cause short-term health effects in humans and is a component of smog, acid rain, and secondary particulate formation.

Sulphur dioxide is a colourless gas with a weak odour. Exposure to higher levels of sulphur dioxide can cause both short-term and long-term health effects in humans and can affect vegetation. Ambient sulphur dioxide is also a contributor to the formation of acid rain and secondary particulate matter. Sulphur dioxide can be released by burning of fossil fuels, industrial process, and natural sources such as volcanoes.

The monthly passive monitoring results for the anticipated area of the Project are presented in Table 17. There are no SAAQS for monthly nitrogen dioxide or sulphur dioxide for comparison to the monthly measurements. The annual average measured concentrations for nitrogen dioxide and sulphur dioxide can be conservatively compared to the annual SAAQS of 45 µg/m³ and 20 µg/m³, respectively. The passive monitoring indicates that concentrations of nitrogen dioxide remained below the annual SAAQS of 45 µg/m³ over the monitoring period with an annual average concentration of 0.39 µg/m³. Similarly, the annual average sulphur dioxide concentration was measured to be 0.83 µg/m³, lower than the annual SAAQS of 20 µg/m³.

Measured nitrogen dioxide concentrations were below the SAQMG annual background concentration of 3.8 µg/m³. The SAQMG annual background concentration for sulphur dioxide for the northern air modelling zone is 0 µg/m³; therefore, measured concentrations at the anticipated area of the Project were above the prescribed background concentration. This indicates that local activities in the area (e.g., traffic and fuel combustion) may be contributing to ambient sulphur dioxide levels, though levels remained low.

Table 17: Rook I Tripod Station Passive Monitoring Results

Month and Year	Concentration (µg/m^3)[(a)]	
	Nitrogen Dioxide	Sulphur Dioxide
Sep-18	0.38	0.52
Oct-18	0.47	0.65
Nov-18	1.69	2.49
Dec-18	0.85	0.79
Jan-19	1.41	1.83
Feb-19	0.09	1.05
Mar-19	0.09	0.65
Apr-19	0.14	0.13
May-19	0.09	0.39
Jun-19	0.09	0.13
Jul-19	0.09	0.26
Aug-19	0.09	0.26
Sep-19	0.38	0.52
Nov-19	0.42	1.05
Dec-19	0.19	0.92
Jan-20	0.14	1.83
Feb-20	0.14	0.79
Apr-20	0.09	0.65
May-20	0.12	0.39
Jun-20	0.09	0.52
Jul-20	0.38	0.52
Aug-20	0.19	0.79
Oct-20	0.47	0.92
Nov-20	1.13	1.83
Annual[(b)]	0.39	0.83

a) Duplicate samples were taken at this station. The average value is presented.
b) Laboratory concentrations were measured in ppb and converted to µg/m^3. Values below the reportable detection limit of 0.1 ppb were treated as one-half of the detection limit (0.05 ppb).
ppb = parts per billion.

5.3.1.3 *Dustfall*

The dustfall monitoring program measured the quantities of dust deposited in the anticipated area of the Project. The maximum monthly fixed dustfall deposition measured at the Rook I Tripod Station was 37.2 milligrams per 100 square centimetres per 30 days (mg/100 cm^2/30 d) in June 2019, which is below both the Alberta residential and industrial dustfall guidelines (Table 18). As expected, the overwinter samples produced much lower dustfall due to the frozen conditions and presence of snow cover. The summer months tended to produce the highest dustfall measurements due to the warmer, drier conditions and greater likelihood of dust emissions from high wind and on-site activities.

Table 18: Rook I Tripod Station Monthly Total and Fixed Dustfall Monitoring Results

Month and Year	Dustfall (mg/100 cm^2/30 d)[(a)(b)]	
	Total	**Fixed**
Sep-18	24.0	18.0
Oct-18	25.0	23.5
Overwinter (18-19)[(c)]	5.0	7.5
May-19	14.9	7.5
Jun-19	66.8	37.2
Jul-19	30.5	11.3
Aug-19	32.5	29.5
Sep-19	24.9	18.9
Overwinter (19-20)[(c)]	7.1	7.5
Jun-20	16.4	7.5
Jul-20	23.5	17.0
Aug-20	32.0	23.0
Sep-20	31.0	23.0
Oct-20	26.0	21.5
All data	*16.7*	13.2
Alberta residential dustfall guideline	**53**	
Alberta industrial dustfall guideline	**158**	

a) Duplicate samples were taken at this station. The geometric mean value is presented.
b) Calculated on a 30-day basis.
c) Overwinter sampled from 16 November 2018 through 10 May 2019 and from 26 October 2019 through 29 May 2020.
d) Values below the reportable detection limit were assumed to be one-half of the detection limit for annual averages.
mg/100 cm^2/30 d = milligrams per 100 square centimetres per 30 days; n/d = no data or invalid data.

Dustfall samples were also analyzed for metals (Table 19). Averages for the year are presented for values above the RDL. Most of the metals analyzed were not observed above the RDL during the monitoring (e.g., arsenic, beryllium, bismuth, boron). Antimony and lead were measured above RDL for only one month of the monitoring period. A few metals were detected above the RDL in several of the monthly samples: aluminium, barium, calcium, copper, magnesium, manganese, and strontium. Of the metals that were measured above the RDL, the highest metals depositions were observed in either May or June.

Table 19: Rook I Tripod Station Monthly Metals in Dustfall Monitoring Results

Metals (Dustfall)	Metals (Dustfall)														
	$mg/dm^2/day$														
	Sep-18	Oct-18	Winter 18-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Winter 19-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Average[(a)]
Aluminum (Al), total	< 7.50E-03	< 2.40E-03	9.90E-05	8.70E-04	< 5.80E-04	< 9.60E-04	< 1.40E-03	< 8.70E-04	3.15E-04	5.95E-04	< 1.80E-04	5.90E-04	3.70E-04	7.10E-04	5.07E-04
Antimony (Sb), total	< 2.50E-04	< 8.00E-05	< 1.30E-06	2.25E-05	< 1.90E-05	< 3.20E-05	< 4.80E-05	< 2.90E-05	< 6.20E-06	< 5.70E-06	< 6.10E-06	< 8.10E-06	< 8.10E-06	< 1.10E-05	2.25E-05
Arsenic (As), total	< 2.50E-04	< 8.00E-05	< 1.30E-06	< 1.50E-05	< 1.90E-05	< 3.20E-05	< 4.80E-05	< 2.90E-05	< 6.20E-06	< 5.70E-06	< 6.10E-06	< 8.10E-06	< 8.10E-06	< 1.10E-05	-
Barium (Ba), total	< 1.20E-04	< 4.00E-05	7.08E-06	5.64E-05	4.09E-05	< 1.60E-05	< 2.40E-05	1.55E-05	3.09E-05	4.25E-05	2.01E-05	1.05E-04	2.78E-05	2.81E-05	3.75E-05
Beryllium (Be), total	< 1.20E-03	< 4.00E-04	< 6.70E-06	< 7.30E-05	< 9.70E-05	< 1.60E-04	< 2.40E-04	< 1.40E-04	< 3.10E-05	< 2.80E-05	< 3.00E-05	< 4.10E-05	< 4.00E-05	< 5.30E-05	-
Bismuth (Bi), total	< 1.20E-03	< 4.00E-04	< 6.70E-06	< 7.30E-05	< 9.70E-05	< 1.60E-04	< 2.40E-04	< 1.40E-04	< 3.10E-05	< 2.80E-05	< 3.00E-05	< 4.10E-05	< 4.00E-05	< 5.30E-05	-
Boron (B), total	< 2.50E-02	< 8.00E-03	< 1.30E-04	< 1.50E-03	< 1.90E-03	< 3.20E-03	< 4.80E-03	< 2.90E-03	< 6.20E-04	< 5.70E-04	< 6.10E-04	< 8.10E-04	< 8.10E-04	< 1.10E-03	-
Cadmium (Cd), total	< 1.20E-04	< 4.00E-05	< 6.70E-07	< 7.30E-06	< 9.70E-06	< 1.60E-05	< 2.40E-05	< 1.40E-05	< 3.10E-06	< 2.80E-06	< 3.00E-06	< 4.10E-06	< 4.00E-06	< 5.30E-06	-
Calcium (Ca), total	< 5.00E-02	< 1.60E-02	1.11E-03	1.13E-02	1.25E-02	< 6.40E-03	< 9.60E-03	< 5.80E-03	6.50E-03	9.55E-03	4.85E-03	1.57E-02	3.70E-03	6.55E-03	7.96E-03
Chromium (Cr), total	< 1.20E-03	< 4.00E-04	< 6.70E-06	< 7.30E-05	< 9.70E-05	< 1.60E-04	< 2.40E-04	< 1.40E-04	< 3.10E-05	< 2.80E-05	< 3.00E-05	< 4.10E-05	< 4.00E-05	< 5.30E-05	-
Cobalt (Co), total	< 2.50E-04	< 8.00E-05	< 1.30E-06	< 1.50E-05	< 1.90E-05	< 3.20E-05	< 4.80E-05	< 2.90E-05	< 6.20E-06	< 5.70E-06	< 6.10E-06	< 8.10E-06	< 8.10E-06	< 1.10E-05	-
Copper (Cu), total	< 2.50E-04	< 8.00E-05	8.05E-05	1.03E-04	3.90E-04	1.80E-04	1.88E-04	1.45E-04	3.62E-04	3.75E-04	1.88E-04	3.03E-04	1.43E-04	5.70E-05	2.09E-04
Iron (Fe), total	< 7.50E-02	< 2.40E-02	< 4.00E-04	< 4.40E-03	< 5.80E-03	< 9.60E-03	< 1.40E-02	< 8.70E-03	< 1.90E-03	< 1.70E-03	< 1.80E-03	< 2.40E-03	< 2.40E-03	< 3.20E-03	-
Lead (Pb), total	< 1.20E-04	< 4.00E-05	< 6.70E-07	1.02E-05	< 9.70E-06	< 1.60E-05	< 2.40E-05	< 1.40E-05	1.58E-05	3.03E-06	< 3.00E-06	6.58E-06	5.05E-06	< 5.30E-06	8.12E-06
Lithium (Li), total	< 1.20E-02	< 4.00E-03	< 6.70E-05	< 7.30E-04	< 9.70E-04	< 1.60E-03	< 2.40E-03	< 1.40E-03	< 3.10E-04	< 2.80E-04	< 3.00E-04	< 4.10E-04	< 4.00E-04	< 5.30E-04	-
Magnesium (Mg), total	< 1.20E-02	< 4.00E-03	2.71E-04	2.44E-03	6.25E-03	3.45E-03	< 2.40E-03	< 1.40E-03	8.90E-04	1.86E-03	1.07E-03	3.59E-03	7.85E-04	9.45E-04	2.15E-03
Manganese (Mn), total	< 1.20E-04	< 4.00E-05	1.10E-05	1.35E-04	1.53E-04	7.50E-05	9.15E-05	2.60E-05	4.12E-05	1.43E-04	2.52E-05	8.07E-05	4.84E-05	5.77E-05	7.39E-05
Molybdenum (Mo), total	< 1.20E-04	< 4.00E-05	< 6.70E-07	< 7.30E-06	< 9.70E-06	< 1.60E-05	< 2.40E-05	< 1.40E-05	< 3.10E-06	< 2.80E-06	< 3.00E-06	1.09E-05	< 4.00E-06	7.73E-06	9.31E-06
Nickel (Ni), total	< 1.20E-03	< 4.00E-04	< 6.70E-06	< 7.30E-05	< 9.70E-05	< 1.60E-04	< 2.40E-04	< 1.40E-04	< 3.10E-05	< 2.80E-05	< 3.00E-05	< 4.10E-05	< 4.00E-05	< 5.30E-05	-
Phosphorus (P), total	< 7.50E-01	< 2.40E-01	< 4.00E-03	< 4.40E-02	< 5.80E-02	< 9.60E-02	< 1.40E-01	< 8.70E-02	< 1.90E-02	< 1.70E-02	< 1.80E-02	< 2.40E-02	< 2.40E-02	< 3.20E-02	-
Potassium (K), total	< 1.20E-01	< 4.00E-02	< 6.70E-04	< 7.30E-03	< 9.70E-03	< 1.60E-02	< 2.40E-02	< 1.40E-02	< 3.10E-03	3.75E-03	< 3.00E-03	< 4.10E-03	< 4.00E-03	< 5.30E-03	3.75E-03
Selenium (Se), total	< 2.50E-03	< 8.00E-04	< 1.30E-05	< 1.50E-04	< 1.90E-04	< 3.20E-04	< 4.80E-04	< 2.90E-04	< 6.20E-05	< 5.70E-05	< 6.10E-05	< 8.10E-05	< 8.10E-05	< 1.10E-04	-
Silicon (Si), total	< 1.20E-01	< 4.00E-02	< 6.70E-04	< 7.30E-03	< 9.70E-03	< 1.60E-02	< 2.40E-02	< 1.40E-02	< 3.10E-03	< 2.80E-03	< 3.00E-03	< 4.10E-03	< 4.00E-03	< 5.30E-03	-
Silver (Ag), total	< 2.50E-05	< 8.00E-06	< 1.30E-07	< 1.50E-06	< 1.90E-06	< 3.20E-06	< 4.80E-06	< 2.90E-06	< 6.20E-07	< 5.70E-07	< 6.10E-07	< 8.10E-07	< 8.10E-07	< 1.10E-06	-
Sodium (Na), total	< 1.20E-01	< 4.00E-02	< 6.70E-04	< 7.30E-03	< 9.70E-03	< 1.60E-02	< 2.40E-02	< 1.40E-02	< 3.10E-03	< 2.80E-03	< 3.00E-03	1.45E-02	< 4.00E-03	< 5.30E-03	1.45E-02
Strontium (Sr), total	< 2.50E-04	< 8.00E-05	5.25E-06	5.60E-05	8.35E-05	< 3.20E-05	5.40E-05	< 2.90E-05	2.78E-05	3.45E-05	3.38E-05	1.19E-04	1.15E-05	2.55E-05	4.51E-05
Thallium (Tl), total	< 2.50E-04	< 8.00E-05	< 1.30E-06	< 1.50E-05	< 1.90E-05	< 3.20E-05	< 4.80E-05	< 2.90E-05	< 6.20E-06	< 5.70E-06	< 6.10E-06	< 8.10E-06	< 8.10E-06	< 1.10E-05	-
Tin (Sn), total	< 2.50E-04	< 8.00E-05	< 1.30E-06	< 1.50E-05	< 1.90E-05	< 3.20E-05	< 4.80E-05	< 2.90E-05	< 6.20E-06	< 5.70E-06	< 6.10E-06	1.74E-05	< 8.10E-06	< 1.10E-05	1.74E-05

Table 19: Rook I Tripod Station Monthly Metals in Dustfall Monitoring Results

Metals (Dustfall)	Metals (Dustfall) mg/dm²/day														
	Sep-18	Oct-18	Winter 18-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Winter 19-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Average[(a)]
Titanium (Ti), total	< 2.50E-02	< 8.00E-03	< 1.30E-04	< 1.50E-03	< 1.90E-03	< 3.20E-03	< 4.80E-03	< 2.90E-03	< 6.20E-04	< 5.70E-04	< 6.10E-04	< 8.10E-04	< 8.10E-04	< 1.10E-03	-
Uranium (U), total	< 2.50E-05	< 8.00E-06	< 1.30E-07	< 1.50E-06	< 1.90E-06	< 3.20E-06	< 4.80E-06	< 2.90E-06	1.78E-06	< 5.70E-07	< 6.10E-07	< 8.10E-07	< 8.10E-07	< 1.10E-06	1.78E-06
Vanadium (V), total	< 2.50E-03	< 8.00E-04	< 1.30E-05	< 1.50E-04	< 1.90E-04	< 3.20E-04	< 4.80E-04	< 2.90E-04	< 6.20E-05	< 5.70E-05	< 6.10E-05	< 8.10E-05	< 8.10E-05	< 1.10E-04	-
Zinc (Zn), total	< 7.50E-03	< 2.40E-03	< 4.00E-05	< 4.40E-04	< 5.80E-04	< 9.60E-04	< 1.40E-03	< 8.70E-04	< 1.90E-04	< 1.70E-04	< 1.80E-04	6.05E-04	< 2.40E-04	< 3.20E-04	6.05E-04

a) Average represents average of values above the RDL.
$mg/dm^2/d$ = milligrams per square decimetre per day; "-" = not applicable

5.3.1.4 pH, Anions, and Nutrients in Rainfall

Rainfall water was collected and analysed for the following parameters: pH, ammonia, nitrate, nitrite, and sulphate. The anions and nutrients were consistently above RDL for the entire duration of the sampling period. The results are shown in Table 20. No air quality or other standards are currently in place for these parameters in rainfall.

Table 20: Rook I Meteorological Station Monthly pH, Anions, and Nutrient concentrations in Rainfall Monitoring Results

pH, Anions, and Nutrients (Water)	Rainfall (Water)[b] mg/L													
	Sep-18	Overwinter[a] 2018-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Overwinter[c] 2019-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Average
pH[d]	6.22	7.13	6.42	6.52	6.21	5.95	6.26	6.34	5.86	6.55	6.47	6.53	6.27	6.36
Ammonia (as N)	0.146	<0.005	0.191	<0.005	<0.005	0.0085	0.0214	0.142	0.0493	<0.005	0.0053	0.0106	0.0961	0.07
Nitrate (as N)	0.165	0.376	0.218	0.0076	0.0854	0.036	0.0396	0.163	0.12	<0.005	0.0157	0.0388	0.111	0.11
Nitrite (as N)	0.0039	0.002	0.0045	<0.001	<0.001	<0.001	<0.001	0.0024	0.0029	<0.001	<0.001	0.0012	<0.001	0.00
Sulphate (SO_4)	2.24	3.04	0.873	0.342	0.334	0.656	1.22	0.959	0.383	0.684	0.531	1.01	0.714	1.00

a) Overwinter sampled from 20 October 2018 through 10 May 2019.
b) Average represents average of values above RDL.
c) Overwinter sampled from 26 October 2019 through 29 May 2020.
d) pH data expressed in units of pH.
"-" = not applicable

5.3.1.5 Metals in Rainfall

Selected metals concentrations were obtained from the non-evaporative rainfall collector at the Rook I Meteorological Station. There are no air quality standards in place for concentrations of metals in rainfall. Of the analysed metals, some were consistently detected above the RDL in all the samples including barium, cadmium, calcium, chromium, copper, lead, manganese, magnesium, nickel, and zinc (Table 21). Beryllium, bismuth, boron, lithium, tellurium, thorium, and vanadium were not observed above the RDL during the monitoring. The remaining metals (i.e., antimony, barium, cesium, cobalt, iron, mercury, molybdenum, phosphorus, potassium, rubidium, selenium, silicon, silver, sodium, strontium, sulphur, thallium, tin, titanium, tungsten, uranium, and zirconium) measured above RDL for at least one month of the monitoring period.

Table 21: Rook I Meteorological Station Monthly Metals Concentration in Rainfall Monitoring Results

Metals	Rainfall (Metals in Water)[b]													
	mg/L													
	Sep-18	Overwinter[a] 2018-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Overwinter[c] 2019-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Average
Aluminum (Al), total	2.83E-02	4.26E-02	3.60E-02	2.33E-02	4.80E-03	3.10E-03	4.90E-02	9.60E-03	4.10E-03	7.40E-03	4.00E-03	<3.00E-03	1.10E-02	1.86E-02
Antimony (Sb), total	1.50E-04	3.80E-04	<5.00E-04	1.30E-04	<1.00E-04	<1.00E-04	<5.00E-04	2.00E-04	2.40E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	2.20E-04
Arsenic (As), total	<1.00E-04	1.90E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	1.90E-04
Barium (Ba), total	1.01E-01	1.85E-02	1.06E-02	4.65E-03	1.85E-03	1.31E-03	3.56E-03	1.49E-03	1.15E-03	8.20E-04	7.30E-04	8.50E-04	1.71E-03	1.14E-02
Beryllium (Be), total	<1.00E-04	<1.00E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	-
Bismuth (Bi), total	<5.00E-05	<5.00E-05	<2.50E-04	<5.00E-05	<5.00E-05	<5.00E-05	<2.50E-04	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	-
Boron (B), total	<1.00E-02	<1.00E-02	<5.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<5.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	-
Cadmium (Cd), total	1.68E-04	4.90E-04	1.74E-04	1.06E-04	6.82E-05	1.16E-04	2.52E-04	8.13E-05	7.27E-05	9.19E-05	6.04E-05	9.67E-05	9.44E-05	1.44E-04
Calcium (Ca), total	1.73E+00	1.91E+00	9.00E-01	4.61E-01	1.89E-01	3.08E-01	6.00E-01	4.05E-01	4.25E-01	6.17E-01	5.83E-01	8.31E-01	6.01E-01	7.35E-01
Cesium (Cs), total	<1.00E-05	1.50E-05	<5.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<5.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	1.50E-05
Chromium (Cr), total	7.32E-03	7.85E-03	1.76E-03	1.94E-03	1.20E-04	1.50E-04	1.00E-02	2.33E-03	1.20E-04	2.50E-04	2.20E-04	1.30E-04	2.20E-04	2.49E-03
Cobalt (Co), total	2.70E-04	5.30E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	4.00E-04
Copper (Cu), total	6.53E-03	2.67E-02	4.80E-03	2.07E-03	9.90E-04	1.20E-03	7.80E-03	3.05E-03	1.20E-03	1.76E-03	6.50E-04	1.04E-03	2.40E-03	4.63E-03
Iron (Fe), total	6.50E-02	1.12E-01	5.60E-02	3.60E-02	<1.00E-02	<1.00E-02	1.23E-01	2.30E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	1.50E-02	6.14E-02
Lead (Pb), total	2.14E-03	4.46E-03	4.83E-03	3.24E-03	1.28E-03	9.16E-04	5.14E-03	1.40E-03	5.33E-04	1.01E-03	2.69E-04	4.77E-04	1.03E-03	2.06E-03
Lithium (Li), total	<1.00E-03	<1.00E-03	<5.00E-03	<1.00E-03	<1.00E-03	<1.00E-03	<5.00E-03	<1.00E-03	<1.00E-03	<1.00E-03	<1.00E-03	<1.00E-03	<1.00E-03	-
Magnesium (Mg), total	5.66E-02	2.09E-01	1.04E-01	6.39E-02	1.71E-02	2.66E-02	5.20E-02	3.64E-02	4.04E-02	1.91E-02	2.19E-02	3.21E-02	3.86E-02	5.52E-02
Manganese (Mn), total	9.03E-03	1.25E-02	1.14E-02	4.81E-03	1.47E-03	1.74E-03	5.97E-03	2.66E-03	3.28E-03	9.80E-04	1.27E-03	1.69E-03	3.20E-03	4.62E-03
Mercury (Hg), total	<5.00E-06	<5.00E-06	<5.00E-06	<5.00E-06	<5.00E-06	<5.00E-06	1.28E-05	2.23E-05	<5.00E-06	<5.00E-06	<5.00E-06	8.60E-06	<5.00E-06	1.46E-05
Molybdenum (Mo), total	4.89E-04	4.72E-04	<2.50E-04	1.35E-04	<5.00E-05	<5.00E-05	2.70E-04	1.15E-04	<5.00E-05	<5.00E-05	5.10E-05	<5.00E-05	<5.00E-05	2.55E-04
Nickel (Ni), total	3.12E-02	1.38E-01	1.04E-01	1.88E-01	1.31E-01	2.58E-01	2.57E-01	1.24E-01	1.30E-01	1.61E-01	1.15E-01	1.52E-01	1.11E-01	1.46E-01
Phosphorus (P), total	2.75E-01	2.04E-01	<2.50E-01	7.40E-02	<5.00E-02	<5.00E-02	<2.50E-01	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	1.84E-01
Potassium (K), total	2.23E-01	5.61E-01	<2.50E-01	3.15E-01	<5.00E-02	<5.00E-02	<2.50E-01	5.10E-02	6.40E-02	<5.00E-02	<5.00E-02	<5.00E-02	2.88E-01	2.50E-01
Rubidium (Rb), total	2.40E-04	4.70E-04	<1.00E-03	9.70E-04	<2.00E-04	<2.00E-04	<1.00E-03	<2.00E-04	2.10E-04	<2.00E-04	<2.00E-04	<2.00E-04	3.00E-04	4.38E-04
Selenium (Se), total	<5.00E-05	1.58E-04	<2.50E-04	<5.00E-05	<5.00E-05	<5.00E-05	<2.50E-04	1.21E-04	5.10E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	1.10E-04

Table 21: Rook I Meteorological Station Monthly Metals Concentration in Rainfall Monitoring Results

Metals	Rainfall (Metals in Water)[b] mg/L													
	Sep-18	Overwinter[a] 2018-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Overwinter[c] 2019-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Average
Silicon (Si), total	2.80E-01	2.06E-01	<2.50E-01	6.80E-02	<5.00E-02	<5.00E-02	<2.50E-01	7.90E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<1.00E-01	1.58E-01
Silver (Ag), total	<1.00E-05	1.50E-05	<5.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<5.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	1.50E-05
Sodium (Na), total	1.27E+00	7.95E-01	<2.50E-01	1.44E-01	6.00E-02	1.15E-01	3.80E-01	1.07E-01	7.60E-02	9.64E-01	2.95E-01	1.68E-01	5.42E-01	4.10E-01
Strontium (Sr), total	2.64E-03	4.05E-03	2.20E-03	7.40E-04	4.50E-04	3.60E-04	<1.00E-03	6.80E-04	6.40E-04	5.30E-04	4.40E-04	6.70E-04	6.80E-04	1.17E-03
Sulphur (S), total	9.60E-01	1.23E+00	<2.50E+00	<5.00E-01	<5.00E-01	<5.00E-01	<2.50E+00	8.70E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	1.02E+00
Tellurium (Te), total	<2.00E-04	<2.00E-04	<1.00E-03	<2.00E-04	<2.00E-04	<2.00E-04	<1.00E-03	<2.00E-04	<2.00E-04	<2.00E-04	<2.00E-04	<2.00E-04	<2.00E-04	-
Thallium (Tl), total	1.90E-05	2.15E-04	<5.00E-05	4.20E-05	1.90E-05	6.40E-05	9.30E-05	1.90E-05	4.00E-05	3.50E-05	2.70E-05	3.30E-05	5.00E-05	5.47E-05
Thorium (Th), total	<1.00E-04	<1.00E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	-
Tin (Sn), total	1.80E-04	2.50E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<5.00E-04	1.10E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	1.80E-04
Titanium (Ti), total	5.70E-04	9.30E-04	<1.50E-03	5.80E-04	<3.00E-04	<3.00E-04	<1.50E-03	<3.00E-04	<3.00E-04	<3.00E-04	<3.00E-04	<3.00E-04	<3.00E-04	6.93E-04
Tungsten (W), total	1.40E-04	1.50E-04	<5.00E-04	1.30E-04	<1.00E-04	<1.00E-04	<5.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	1.40E-04
Uranium (U), total	<1.00E-05	2.74E-04	<5.00E-05	<1.00E-05	<1.00E-05	<1.00E-05	<5.00E-05	1.20E-05	<1.00E-05	1.20E-05	<1.00E-05	<1.00E-05	<1.00E-05	9.93E-05
Vanadium (V), total	<5.00E-04	<5.00E-04	<2.50E-03	<5.00E-04	<5.00E-04	<5.00E-04	<2.50E-03	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	-
Zinc (Zn), total	2.41E-01	6.34E-01	6.88E-01	3.07E-01	1.51E-01	2.60E-01	3.27E-01	2.54E-01	1.84E-01	1.72E-01	1.70E-01	2.58E-01	3.06E-01	3.04E-01
Zirconium (Zr), total	<6.00E-05	8.10E-05	<3.00E-04	1.19E-03	<6.00E-05	<2.00E-04	<1.00E-03	<2.00E-04	<2.00E-04	<2.00E-04	<2.00E-04	<2.00E-04	<2.00E-04	6.36E-04

a) Overwinter sampled from 20 October 2018 through 10 May 2019.
b) Average represents average of values above RDL.
c) Overwinter sampled from 26 October 2019 through 29 May 2020.
“-“ = not applicable

5.3.1.6 Radon

Radon is a colourless, odourless, and tasteless gas. It is radioactive and naturally occurs in the environment and is released to the environment during the breakdown of uranium found in all soil and rock. Radon is linked to adverse health effects such as lung cancer, and there is no threshold below which radon exposure is considered without risk (World Health Organization [WHO] 2016).

The average outdoor radon level varies from 5 to 15 becquerels per cubic metre (Bq/m^3; WHO 2016). Depending on rock type in the area, outdoor radon levels can vary from place to place; one study found outdoor summer radon measurements in communities in Saskatchewan to average 61 Bq/m^3 (Gratsy 1994). Typically, in outdoor spaces, radon gas disperses to a low concentration, but in confined areas the gas can build up (WorkSafe Saskatchewan 2019). There are standards in place for radon levels in residential homes and occupational exposure standards but no ambient radon exposure or concentration standards. For reference, Health Canada's permissible radon concentration level is 200 Bq/m^3 in any area of residential homes (Health Canada 2013). Occupational exposure limits for workers in Saskatchewan are given in units of annual effective dose (millisieverts [mSv]). The Saskatchewan occupational exposure limit for nuclear energy workers is 50 mSv, or 100 mSv over five years, while the occupational exposure limit for a non-nuclear energy worker is 1 mSv (Carex Canada 2019). Thirty Bq/m^3 is associated with an exposure of 1 mSv per year.

Monitoring results for radon concentrations obtained from the anticipated area of the Project are provided in Table 22. No detectable radon was measured at all locations during the sampling periods from September 2018 to December 2018, from March 2019 to June 2019, and from September 2019 to December 2019. Detectable radon was observed in the anticipated area of the Project during the winter period in 2019 (i.e., December to March) at all monitoring sites except for RAD5, though radon was detected there in the summer period (i.e., June to September). During the winter period of 2019 to 2020, only detectable radon was measured at RAD2 and RAD9. Radon was also detected at RAD3 in the summer monitoring period. The concentrations measured were on the lower end of the range of background radon concentrations (i.e., 5 to 15 Bq/m^3; WHO 2016) and markedly lower than summer outdoor radon measurements of 61 Bq/m^3 (Gratsy 1994) except for measurements in RAD9 for one sampling period (i.e., December 2019 to May 2020), which were 79 Bq/m^3.

Table 22: Rook I Radon Concentration Monitoring Results

Sampling Period	Exposure Days	RDL (Bq/m^3)	Radon Concentration (Bq/m^3)								
			RAD1[(a)]	RAD2	RAD3	RAD4	RAD5	RAD6	RAD7	RAD8	RAD9
Sep-18 to Dec-18	85-88	5.0, 4.0[(b)]	**< 5.0**	**< 5.0**	**< 4.0**	**< 5.0**	**< 5.0**	**< 5.0**	**< 5.0**	**< 5.0**	**n/d**
Dec-18 to Mar-19	94-95	4.0	**4.5**	**6.0**	**6.0**	**6.0**	**< 4.0**	**4.0**	**7.0**	**6.0**	**n/d**
Mar-19 to Jun-19	89-90	4.0	**< 4.0**	**< 4.0**	**< 4.0**	**< 4.0**	**< 4.0**	**< 4.0**	**< 4.0**	**< 4.0**	**n/d**
Jun-19 to Sep-19	94	4.0, 6.0[(b)]	**< 4.0**	**< 4.0**	**6.0**	**< 4.0**	**4.0**	**< 4.0**	**< 4.0**	**< 4.0**	**< 6.0**
Sep-19 to Dec-19	87	9.0, 10.0[(b)]	**< 9.0**	**< 10.0**	**< 10.0**	**< 10.0**	**< 10.0**	**< 10.0**	**< 10.0**	**< 10.0**	**n/d**
Dec-19 to May-20	170, 171, 259	3.0	**< 3.0**	**11**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**79**
May-20 to Aug-20	94-95	3.0	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**	**< 3.0**
Average[(c)]	n/d		4.5	8.5	6.0	6.0	4.0	4.0	7.0	6.0	79

a) Duplicate samples were taken at this station. The geometric mean value is presented.
b) Reportable detection limits for Rapidos alpha trackers vary based on the sample medium in the detector.
c) Average represents average of values above RDL.Bq/m^3 = becquerel per cubic metre; RDL = reportable detection limit; n/d = no data or invalid data.

5.3.2 Regional Air Quality

Regional surrogate monitoring stations were used to support the local data from the Rook I monitoring stations to characterize baseline air quality parameters (i.e., $PM_{2.5}$, PM_{10}, nitrogen dioxide, and sulphur dioxide) in the AQSA. Regional data included continuous monitoring at Fort Chipewyan and Buffalo Narrows and passive sampling at JP13 and JP205 (Figure 7).

There are SAAQS for 24-hour and annual $PM_{2.5}$; 24-hour PM_{10}; and 1-hour, 24-hour, and annual nitrogen dioxide and sulphur dioxide. Each criterion uses a different metric to evaluate the data (e.g., 98th percentile, maximum value, and average value). The monitoring data are compared to the applicable criteria using the appropriate method.

The most recent five years (i.e., 2016 to 2020) of monitoring data are presented in this report. An annual data completeness requirement of 75% adopted from the Alberta air quality modelling guideline (AEP 2019) was applied. The years where more than 25% of the hourly ambient data are missing were not used in the study. For 24-hour $PM_{2.5}$, the metric for the SAAQS is an average of the 98th percentiles from three consecutive years. Thus, for the years 2016 and 2017, the monitoring data from previous years need to be used. At the Buffalo Narrows station, the 2015 monitoring has a large amount of missing data, resulting in data completeness of less than 75%. Therefore, no SAAQS comparison can be made for these two years.

5.3.2.1 PM_{10}

Continuous PM_{10} monitoring was conducted at the Buffalo Narrows Station. Table 23 presents the monitoring results for the most recent five-year period (i.e., 2016 to 2020). The first three years (i.e., from 2016 to 2018) of monitoring data contain many missing values resulting in data completeness of less than 75%. Therefore, only the data from 2019 and 2020 are presented. The following summarizes the PM_{10} data over the monitoring period.

- Exceedances of the 24-hour SAAQS were recorded at the Buffalo Narrows Station for three days in 2019. There was no exceedance of SAAQS in 2020. Wildfire activity or local events were likely the primary contributor to the high recorded concentrations of PM_{10} in 2020.
- The highest recorded concentrations occurred at the end of May, indicating that seasonal factors such as drier conditions (e.g., increased windblown and road dust particulate) and episodic events such as forest fire smoke play key roles in ambient levels of PM_{10}.
- The 90th percentile concentrations of 24-hour PM_{10} were 14.4 µg/m^3, which was well below the prescribed PM_{10} background concentration (i.e., 23.1 µg/m^3).

Table 23: Continuous Monitoring PM_{10} Concentrations

Averaging Period	Parameter	SAAQS	PM_{10} Concentration (µg/m^3)					
			2016	2017	2018	2019	2020	2016-2020 Average[(a)]
Buffalo Narrows Station								
24-Hour	Maximum (µg/m^3)	50	n/d	n/d	n/d	**72.7**	47.4	60.0
	days ≥ 50 µg/m^3	n/a	n/d	n/d	n/d	3	0	n/a
	90th percentile (µg/m^3)	n/a	n/d	n/d	n/d	14.4	14.4	14.4

Note: **Bold values** indicate exceedance of the applicable Saskatchewan Ambient Air Quality Standards (SAAQS).
a) The apparent average or mean may differ from the reported average or mean due to rounding.
PM_{10}= particulate matter with a mean aerodynamic diameter less than 10 µm; SAAQS = Saskatchewan Ambient Air Quality Standard; ≥= greater than or equal to; n/a = not applicable; n/d = no data available or data completeness less than 75%.$PM_{2.5}$

The continuous $PM_{2.5}$ monitoring results from the surrogate air quality stations for the most recent five-year period (i.e., 2016 to 2020) are presented in Table 24. The following summarizes the $PM_{2.5}$ data over the monitoring period.

- Exceedances of the 24-hour SAAQS were recorded at the Fort Chipewyan Station in 2016 and 2017, after which ambient concentrations decreased. Wildfire activity was likely the primary contributor to the high recorded concentrations of $PM_{2.5}$ during these periods.
- The high $PM_{2.5}$ values at the Fort Chipewyan Station indicate that the events resulting in increased ambient particulate matter are widespread and likely not related to industry. The maximum 24-hour $PM_{2.5}$ concentrations in 2017 was 22.7 µg/m^3; however, the three-year average of 98th percentiles was 40.79 µg/m^3, resulting from the high 98th percentile concentrations observed in 2015 and 2016. Large, widespread forest fires in 2015 and 2016 resulted in substantially higher ambient $PM_{2.5}$ concentrations than typically recorded at WBEA air monitoring stations (WBEA 2020b).
- A comparison of the Buffalo Narrows Station data to the 24-hour SAAQS was not possible in 2016 and 2017 due to incomplete datasets in 2015. In 2018, the 24-hour SAAQS was exceeded, and the concentrations were decreased in the latter two years.
- The highest recorded concentrations occur during the summer months at both of the stations, indicating that seasonal factors such as drier conditions (e.g., increased windblown and road dust particulate) and episodic events such as forest fire smoke play key roles in ambient levels of $PM_{2.5}$.
- No exceedances of the annual SAAQS for $PM_{2.5}$ were recorded at either of the continuous monitoring stations.
- The 90th percentile values from the 24-hour $PM_{2.5}$ monitoring data in some years were higher than the prescribed background concentration of 6.5 µg/m^3 (i.e., 9.2 µg/m^3 in 2019 at Fort Chipewyan Station and 9.6 µg/m^3 in 2018 at Buffalo Narrows Station); however, in the most recent year (i.e., 2020), the 90th percentile values are lower than the background concentration.
- The 50th percentile values used to represent background concentrations from all years at both stations were close to the prescribed background concentration of 3.1 µg/m^3.
- The Fort Chipewyan Station is in an often-upwind direction from the anticipated area of the Project; therefore, it is a more representative surrogate of air quality in the AQSA.

Table 24: Continuous Monitoring $PM_{2.5}$ Concentrations

Averaging Period	Parameter	SAAQS	$PM_{2.5}$ Concentration (µg/m³)					
			2016	2017	2018	2019	2020	2016-2020 Average[(a)]
Fort Chipewyan Station								
24-Hour	Maximum (µg/m³)	n/a	106.2	22.7	70.9	73.2	19.9	58.6
	3-year average of the annual 98th percentile (µg/m³)	28	**49.2**	**40.8**	22.8	22.2	20.9	n/a
	Exceedance of the SAAQS (Y/N)[(b)]	n/a	**Y**	**Y**	N	N	N	n/a
	90th percentile (µg/m³)	n/a	6.5	7.0	8.9	9.2	6.0	7.5
Annual	Average (µg/m³)	10	4.6	3.6	4.9	5.2	3.7	4.4
	Exceedance of the SAAQS (Y/N)[(b)]	n/a	N	N	N	N	N	n/a
	50th percentile (µg/m³)[(c)]	n/a	2.7	2.3	2.8	3.3	3.3	2.8
Buffalo Narrows Station								
24-Hour	Maximum (µg/m³)	n/a	171.7	79.5	230.5	70.1	38.7	118.1
	3-year average of the annual 98th percentile (µg/m³)	28	n/d	n/d	**32.9**	24.2	22.7	n/a
	Exceedance of the SAAQS (Y/N)[(b)]	n/a	n/d	n/d	Y	N	N	n/a
	90th percentile (µg/m³)	n/a	6.3	7.1	9.6	7.6	6.4	7.4
Annual	Average (µg/m³)	10	4.6	4.5	5.5	4.2	3.9	4.5
	Exceedance of the SAAQS (Y/N)[(b)]	n/a	N	N	N	N	N	n/a
	50th percentile (µg/m³)[(c)]	n/a	2.2	3.0	2.7	3.1	3.3	2.9

Note: **Bold values** indicate exceedance of the applicable Saskatchewan Ambient Air Quality Standards (SAAQS).

a) The apparent average or mean may differ from the reported average or mean due to rounding.

b) Exceedances of the 24-hour and Annual SAAQS are presented as a binary result as the method of comparison produces a single value to compare to the criteria and is thus binary (i.e., exceeds or does not exceed the criteria).

c) The 50th percentile value from hourly monitoring data.

N = no; $PM_{2.5}$= fine particulate matter with a mean aerodynamic diameter less than 2.5 µm; SAAQS = Saskatchewan Ambient Air Quality Standard; Y = yes; n/a = not applicable; n/d = no data available or data completeness less than 75%.

5.3.2.2 Nitrogen Dioxide

The continuous nitrogen dioxide monitoring results from the surrogate air quality monitoring stations for the most recent five-year period (i.e., 2016 to 2020) are presented in Table 25. The following summarizes the available nitrogen dioxide continuous data.

- No exceedances of the 1-hour, 24-hour, or annual SAAQS were recorded at the Fort Chipewyan Station between 2016 and 2020. The highest hourly measurement occurred in 2016 at 57.0 µg/m^3, below 20% of the 1-hour standard.
- No exceedances of the 1-hour, 24-hour, or annual SAAQS were recorded at the Buffalo Narrows Station between 2016 and 2020. The highest hourly measurement occurred in 2020 at 43.1 µg/m^3, below 15% of the 1-hour standard. The highest 24-hour average measurement occurred in 2020 at 15.4 µg/m^3, below 8% of the 24-hour standard, and the highest annual average measurement occurred in 2018 at 1.6 µg/m^3, approximately 3% of the annual standard.
- The 90th percentile of 1-hour nitrogen dioxide concentrations for all years at both stations were lower than the prescribed 1-hour nitrogen dioxide background concentrations of 11.3 µg/m^3.
- The 90th percentile of 24-hour nitrogen dioxide concentrations for all years at both stations were lower than the prescribed 24-hour nitrogen dioxide background concentration of 9.4 µg/m^3.
- The 50th percentile of 1-hour nitrogen dioxide concentrations for all years at both stations were lower than the prescribed annual nitrogen dioxide background concentration of 3.8 µg/m^3.

Table 25: Continuous Monitoring Nitrogen Dioxide Concentrations

Averaging Period	Parameter	SAAQS	Nitrogen Dioxide Concentration (µg/m^3)					
			2016	2017	2018	2019	2020	2016-2020 Average[(a)]
Fort Chipewyan Station								
1-Hour	Maximum (µg/m^3)	300	57.0	51.4	49.1	42.1	43.3	48.6
	Hours ≥300 µg/m^3	n/a	0	0	0	0	0	n/a
	90th percentile (µg/m^3)	n/a	4.5	3.0	4.9	7.9	7.1	5.5
24-Hour	Maximum (µg/m^3)	200	23.3	23.0	23.3	21.4	23.7	22.9
	Days ≥200 µg/m^3	n/a	0	0	0	0	0	n/a
	90th percentile (µg/m^3)	n/a	4.7	3.1	4.6	8.3	6.9	5.5
Annual	Average (µg/m^3)	45	2.0	1.5	2.8	3.8	4.0	2.8
	Exceedance of the SAAQS (Y/N)[(b)]	n/a	N	N	N	N	N	n/a
	50th percentile (µg/m^3)[(c)]	n/a	0.8	0.6	1.9	2.4	3.2	1.8
Buffalo Narrows Station								
1-Hour	Maximum (µg/m^3)	300	27.1	14.1	16.6	19.6	43.1	24.1
	Hours ≥300 µg/m^3	n/a	0	0	**0**	0	0	n/a
	90th percentile (µg/m^3)	n/a	2.4	2.8	3.4	2.8	3.0	2.9
24-Hour	Maximum (µg/m^3)	200	8.5	7.0	6.6	6.1	15.4	8.7
	Days ≥ 200 µg/m^3	n/a	0	0	0	0	0	n/a
	90th percentile (µg/m^3)	n/a	2.7	2.6	2.9	2.6	3.1	2.8

Table 25: Continuous Monitoring Nitrogen Dioxide Concentrations

Averaging Period	Parameter	SAAQS	Nitrogen Dioxide Concentration (µg/m³)					
			2016	2017	2018	2019	2020	2016-2020 Average(a)
Annual	Average (µg/m³)	45	2.0	1.5	2.8	3.8	4.0	2.8
	Exceedance of the SAAQS (Y/N)(b)	n/a	N	N	N	N	N	n/a
	50th percentile (µg/m³)(c)	n/a	0.6	0.9	1.1	0.8	0.8	0.8

a) The apparent average or mean may differ from the reported average or mean due to rounding.
b) Exceedances of the annual SAAQS are presented as a binary result as the method of comparison produces a single value to compare to the criteria and is thus binary (i.e., exceeds or does not exceed the criteria).
c) The 50th percentile value from hourly monitoring data.
N= no; SAAQS = Saskatchewan Ambient Air Quality Standard; ≥= greater than or equal to; n/a = not applicable.

Table 26 presents the results of the passive regional nitrogen dioxide monitoring. Annual average nitrogen dioxide concentrations monitored passively between 2016 and 2020 remained low compared to the annual SAAQS of 45 µg/m³. The measured concentrations ranged from 0.6 µg/m³ at JP213 Station from 2017 to 2020 to 1.3 µg/m³ at the JP205 Station in 2016.

Table 26: Passive Monitoring Nitrogen Dioxide Concentrations

Monitoring Station	Annual Average Nitrogen Dioxide Concentration (µg/m³)					
	2016	2017	2018	2019	2020	2016-2020 Average(a)
JP205 Station	1.3	1.1	1.1	0.9	1.1	1.1
JP213 Station	0.8	0.6	0.6	0.6	0.6	0.6
Annual nitrogen dioxide SAAQS	45					

a) The apparent average or mean may differ from the reported average or mean due to rounding.
SAAQS = Saskatchewan Ambient Air Quality Standard

5.3.2.3 Sulphur Dioxide

Table 27 presents the continuous sulphur dioxide monitoring results from the surrogate air quality monitoring stations for the most recent five-year period (i.e., 2015 to 2019). The following summarizes the available sulphur dioxide continuous monitoring data.

- There were no exceedances of 1-hour, 24-hour, or annual SAAQS between 2016 and 2020 at either of the continuous monitoring stations.
- The 90th percentiles of the 1-hour and 24-hour data, the and the long-term (i.e., annual) averages were similar at both stations. Because the Fort Chipewyan Station is located upwind of the anticipated area of the Project; it is a more representative surrogate of air quality in the AQSA.
- The derived 1-hour, 24-hour, and annual sulphur dioxide background concentrations from monitoring data at both stations were slightly above the prescribed background sulphur dioxide concentrations of zero. Since the background concentrations listed in SAQMG are shown in the units of parts per million, the slight differences between derived and prescribed background concentrations might have been influenced by rounding with loss of precision. For example, the 90th percentile concentration in 2020 at Fort Chipewyan Station was 1.1 µg/m³, which can be converted to 0.00042 parts per million.

Table 27: Continuous Monitoring Sulphur Dioxide Concentrations

Averaging Period	Parameter	SAAQS	Sulphur Dioxide Concentration (µg/m^3)					
			2016	2017	2018	2019	2020	2015-2019 Average[(a)]
Fort Chipewyan Station								
1-Hour	Maximum (µg/m^3)	450	27.6	53.8	47.8	94.1	29.4	50.5
	Hours ≥450 µg/m^3	n/a	0	0	0	0	0	n/a
	90th percentile (µg/m^3)	n/a	1.0	0.9	0.8	1.5	1.1	1.1
24-Hour	Maximum (µg/m^3)	125	4.0	15.4	13.8	28.4	6.2	13.8
	Days ≥125 µg/m^3	n/a	0	0	0	0	0	n/a
	90th percentile (µg/m^3)	n/a	1.3	1.8	1.4	1.4	1.7	1.5
Annual	Average (µg/m^3)	20	0.4	0.6	0.5	0.6	0.5	0.6
	Exceedance of the SAAQS (Y/N)[(b)]	n/a	N	N	N	N	N	n/a
	50th percentile (µg/m^3)[(c)]	n/a	0.1	0.1	0.1	0.2	0.2	0.1
Buffalo Narrows Station								
1-Hour	Maximum (µg/m^3)	450	n/d	11.5	12.8	14.1	13.4	13.0
	Hours ≥450 µg/m^3	n/a	n/d	0	0	0	0	n/a
	90th percentile (µg/m^3)	n/a	n/d	0.8	1.3	1.0	1.0	1.0
24-Hour	Maximum (µg/m^3)	125	n/d	2.2	3.7	4.2	2.2	3.1
	Days ≥125 µg/m^3	n/a	n/d	0	0	0	0	n/a
	90th percentile (µg/m^3)	n/a	n/d	0.9	1.3	1.1	1.0	1.1
Annual	Average (µg/m^3)	20	n/d	0.3	0.7	0.7	0.3	0.5
	Exceedance of the SAAQS (Y/N)[(b)]	n/a	n/d	N	N	N	N	n/a
	50th percentile (µg/m^3)[(c)]	n/a	n/d	0.0	0.5	0.5	0.0	0.3

a) The apparent average or mean may differ from the reported average or mean due to rounding.
b) Exceedances of the annual SAAQS are presented as a binary result as the method of comparison produces a single value to compare to the criteria and is thus binary (i.e., exceeds or does not exceed the criteria).
c) The 50th percentile value from hourly monitoring data.
N = no; SAAQS = Saskatchewan Ambient Air Quality Standard; ≥ = greater than or equal to; n/a = not applicable; n/d = no data available or data completeness less than 75%.

The results of the regional passive sulphur dioxide monitoring are presented in Table 28. Annual average sulphur dioxide concentrations monitored passively between 2016 and 2020 remained low compared to the annual SAAQS of 20 µg/m^3. The measured concentrations ranged from 1.0 µg/m^3 at the JP213 Station in 2020 to 2.1 µg/m^3 for two consecutive years at the JP205 Station in 2017 and 2018.

Table 28: Passive Monitoring Sulphur Dioxide Concentrations

Monitoring Station	Annual Average Sulphur Dioxide Concentration (µg/m^3)					
	2016	2017	2018	2019	2020	2016-2020 Average[(a)]
JP205 Station	1.3	2.1	2.1	1.8	1.8	1.8
JP213 Station	1.1	1.3	1.6	1.3	1.0	1.3
Annual sulphur dioxide SAAQS	20					

a) The apparent average or mean may differ from the reported average or mean due to rounding.
SAAQS = Saskatchewan Ambient Air Quality Standard.

5.3.2.4 Radon

A summary of the ambient air quality radon results is shown in Table 29. The results from the program demonstrate that the radon content present in ambient air at Cluff Lake is within natural background concentrations.

Table 29: Independent Environmental Monitoring Program: Ambient Air Radon Concentrations

Station Name	Coordinates (m)[(a)]		Sampling Period	Radon Concentration (Bq/m³)
	Easting	Northing		
Cluff Lake Reference Station	588849	6449269	August 2017 - February 2018	<3
			August 2017 - February 2018	<3
			August 2017 - February 2018	<3
			February 2018 - August 2018	<3
Cluff Lake Exposure Station #1	588849	6449270	August 2017 – February 2018	<3
			August 2017 – February 2018	<3
			August 2017 – February 2018	<3
			February 2018 – August 2018	<4
			February 2018 – August 2018	4
			February 2018 – August 2018	<4
Cluff Lake Exposure Station #2	583107	6467775	August 2017 - February 2018	<3
			August 2017 - February 2018	<3
			August 2017 - February 2018	<3
			February 2018 - August 2018	7
			February 2018 - August 2018	5
			February 2018 - August 2018	5
			August 2017 - February 2018	<3

a) Coordinates presented are in UTM NAD 83 Zone 12.

5.3.3 Background Air Quality Concentrations

To support the derivation of background air quality concentrations, the following conclusions can be drawn from Section 5.3.1, Local Air Quality, and Section 5.3.2, Regional Air Quality:

- For all averaging periods, the derived background concentrations of TSP, $PM_{2.5}$, nitrogen dioxide, and sulphur dioxide from local and regional air quality monitoring data were either close to or much lower than the prescribed background concentrations.
- The derived PM_{10} background concentration from Buffalo Narrows Station in 2019 and 2020 was 14.4 µg/m³, which is lower than the prescribed background concentration of 23.1 µg/m³.

Given these conclusions, the prescribed background concentrations for $PM_{2.5}$, nitrogen dioxide, and sulphur dioxide were adopted for the air quality assessment. On the other hand, the prescribed PM_{10} background concentration is likely an overestimate of the true rural background of the anticipated area of the Project as it is 60% higher than the derived background concentration . The prescribed PM_{10} background data were collected from an area with considerably more particulate-generating activity (i.e., La Loche) than a truly rural setting like at of the anticipated area of the Project. The data collected at Buffalo Narrows station are more consistent with

the Rook I on-site observations. After consultation with and agreement from ENV, the 90th percentile of the PM_{10} data from 2019 measured at the Buffalo Narrows Station (i.e., 14.4 µg/m³) is considered a more reasonable background value to use in the air quality assessment. The PM_{10} 24-hour background value was applied for
24-hour TSP background in the absence of a prescribed value for 24-hour TSP background. The 50th percentile of the PM_{10} monitoring data in 2019 (i.e., 6.2 µg/m³) is applied for annual TSP background in the absence of a prescribed value for annual TSP background. Table 30 summarizes the background concentrations used in the air quality assessment.

Table 30: Background Air Compound Concentrations

Compound	Background Concentration for Air Dispersion Modelling (µg/m³)[(a)]			
	1-Hour	8-Hour	24-Hour	Annual
$PM_{2.5}$	n/a	n/a	6.5	3.1
PM_{10}	n/a	n/a	14.4	n/a
TSP	n/a	n/a	14.4	6.2
Carbon monoxide	527.5 (500 ppb)	527.5 (500 ppb)	n/a	n/a
Nitrogen dioxide	11.3 (6 ppb)	n/a	9.4 (5 ppb)	3.8 (2 ppb)
Sulphur dioxide	0	n/a	0	0

a) 90th percentile value of monitoring data is added to the 1-hour and 24-hour predictions and 50th percentile value of the monitoring data is added to the annual predictions per the SAQMG guidance.
n/a = not applicable; ppb = parts per billion; $PM_{2.5}$ = fine particulate matter with a mean aerodynamic diameter less than 2.5 µm; PM_{10} = particulate matter with a mean aerodynamic diameter less than 10 µm; TSP = total suspended particulate.

6.0 SUMMARY

6.1 Climate and Weather

Meteorological information on temperature, precipitation, wind speed and wind direction, relative humidity, and solar radiation was available from observations made within the anticipated area of the Project during the baseline monitoring program. Long-term measurements of temperature, precipitation, wind speed and wind direction, and relative humidity were available from one or both of two long-term Climate Normal monitoring stations: the Cluff Lake Station and the Fort McMurray A Station. Both Climate Normal monitoring stations are considered representative of the existing conditions within the AQSA and are operated by ECCC. The following is a summary of the climate and meteorology data from the baseline study:

- **Temperature:** Mean ambient temperatures in the expected area of the Project ranged from a daily average low of -18.1°C in February to 17.1°C in July. Temperatures at the Rook I Meteorological Station were similar to temperatures recorded at the Fort McMurray A Station. Winters in the anticipated area of the Project were marginally milder than those recorded at the Cluff Lake Station, while summer temperatures were similar.
- **Precipitation:** The observed monthly rainfall from 2017 to 2020, on average, was similar to the long-term climate averages. The observed rainfall in August was higher than the Climate Normals. Two complete calendar years (i.e., 2019 and 2020) of total precipitation data were recorded at the Rook I Meteorological Station. In both years, the total precipitation recorded at the Rook I Meteorological Station was higher than the Cluff Lake Station and Fort McMurray A Station Climate Normals total precipitation record.
- **Wind Speed and Direction:** Prevailing winds and the strongest winds in the expected area of the Project were from the northwest. This is consistent with the dominant wind direction for maximum wind speeds at the Cluff Lake Station. The same wind pattern was not observed at the Fort McMurray A Station due to the influence of local topography.
- **Relative Humidity:** There is substantial seasonal variation in the relative humidity recorded at the Rook I Meteorological Station, with the lowest measurements occurring in the spring and higher relative humidity recorded during the winter months. This trend was consistent with the Climate Normals relative humidity trends observed at the Fort McMurray A Station.
- **Solar Radiation:** Average daily solar radiation at the Rook I Meteorological Station varied seasonally with the highest solar radiation recorded between April and September and peak solar radiation in May. Solar radiation was the weakest in the anticipated area of the Project in January and December.

6.2 Air Quality

Local air quality was monitored through a baseline program started in September 2018. All data available at the end of 2020 were incorporated into the baseline study. The baseline program monitored selected compounds of interest either continuously or passively at several discrete locations including the Rook I Particulate Monitoring Station, the Rook I Tripod Station, and a number of radon sampling locations. Continuous particulate monitoring was conducted for TSP and $PM_{2.5}$. Passive sampling of nitrogen dioxide, sulphur dioxide, dustfall, and radon was conducted monthly. Radon was passively sampled at nine discrete locations in the expected area of the Project.

Dustfall samples and rainfall collected in the anticipated area of the Project were analyzed to determine concentration of metals in dust and rainfall, respectively. The local air quality observations collected in the anticipated area of the Project were considered in relation to applicable air quality standards and guidelines (i.e., SAAQS and Alberta Ambient Air Quality Guideline).

Regional air quality monitoring data collected under other programs not specifically linked to the Rook I Project from four remote locations were used to supplement data collected in the anticipated area of the Project and characterize baseline air quality conditions in the AQSA. Two remote northern communities and two additional remote sites were chosen for the baseline study.

The following summarizes the available local and regional air quality in the baseline study:

- **Continuous TSP monitoring:** No exceedances of the 24-hour SAAQS for TSP were recorded over the monitoring period between September 2018 and December 2020; the monitoring was demobilized over the winter seasons. The 24-hour TSP concentrations remained below the 24-hour SAAQS with the highest 24-hour TSP concentration in July 2020, which was primarily due to several hours of high concentrations, with the days preceding and following measured at typical background levels. Annual TSP concentrations are not presented as the baseline program did not capture a full calendar year of data for comparison to the annual SAAQS of 60 µg/m^3. The 90th percentile 24-hour concentrations of all valid data collected by end of 2020 was 9.7 µg/m^3, which was lower than the prescribed background concentration. The average of all 24-hour TSP concentrations from all data was 3.4 µg/m^3, which is well below the prescribed background concentration of 11.6 µg/m^3.

- **Continuous PM_{10} monitoring:** Exceedances of the 24-hour SAAQS were recorded at the Buffalo Narrows Station in 2019. There was no exceedance of SAAQS in 2020. The 90th percentile concentrations of 24-hour PM_{10} are 14.4 µg/m^3, which is below the prescribed PM_{10} background concentration (i.e., 23.1 µg/m^3).

- **Continuous $PM_{2.5}$ monitoring:** Calculations of SAAQS, equivalent to the $PM_{2.5}$ CAAQS, for 24-hour $PM_{2.5}$ were based on three years of continuous monitoring data (i.e., three-year average of the 98th percentile of 24-hour average concentrations) and the annual $PM_{2.5}$ SAAQS was based on an average of one calendar year. Baseline continuous $PM_{2.5}$ monitoring was supplemented by the regional continuous $PM_{2.5}$ data available from the Fort Chipewyan Station and Buffalo Narrows Station. Measured $PM_{2.5}$ was generally below the 24-hour and annual air quality standards in the most recent five years of monitoring, except for the Fort Chipewyan Station between 2016 and 2017 and for the Buffalo Narrows Station in 2018, which both had measurements exceeding the 24-hour SAAQS. Intense and extensive wildfire activity was likely the primary contributor to the high recorded concentrations of $PM_{2.5}$ during these periods. The derived background concentrations from local and regional monitoring data were similar to the prescribed background concentrations.

- **Nitrogen dioxide and sulphur dioxide passive monitoring:** The passive sampling data collected in the expected area of the Project for nitrogen dioxide and sulphur dioxide indicated that concentrations remained below the annual SAAQS for each compound. Measured nitrogen dioxide concentrations were observed to be below the SAQMG annual background concentration of 3.8 µg/m^3. The measured sulphur dioxide indicated that local activities in the area (e.g., traffic and fuel combustion) may be contributing to ambient sulphur dioxide levels above the SAQMG annual background concentration for sulphur dioxide, though levels remain low. Baseline passive nitrogen dioxide and sulphur dioxide monitoring was supplemented by the regional passive nitrogen dioxide and sulphur dioxide data available from the

JP205 Station and the JP213 Station. The regional surrogate passive monitoring indicated that ambient nitrogen dioxide and sulphur dioxide concentrations in AQSA are below ambient air quality criteria.

- **Nitrogen dioxide and sulphur dioxide continuous monitoring:** Baseline passive nitrogen dioxide and sulphur dioxide monitoring was supplemented by the regional continuous nitrogen dioxide and sulphur dioxide data available from Fort Chipewyan Station and Buffalo Narrows Station. Generally, nitrogen dioxide and sulphur dioxide concentrations at the regional surrogate stations suggest that the air quality in the AQSA would remain below the SAAQS. This prediction is supported by the results from the Rook I passive nitrogen dioxide and sulphur dioxide monitoring stations. No exceedance of the 1-hour, 24-hour, and annual nitrogen dioxide SAAQS was recorded at either station. The derived background concentrations were similar to the prescribed background concentrations.
- **Dustfall monitoring:** Monthly dustfall deposition measured in the anticipated area of the Project remained below the residential and industrial dustfall guidelines in place in Alberta (AEP 2019), which were used as surrogate criteria in the absence of a Saskatchewan dustfall standard. Of the metals that were measured above the RDL, the highest metals depositions were observed in either May or June.
- **Metals in rainfall monitoring:** Selected metals concentrations were obtained from the non-evaporative rainfall collector at the Rook I Meteorological Station. Of the analyzed metals, some were consistently above the RDL in all of the samples including aluminum, barium, cadmium, calcium, cobalt, iron, lithium, manganese, molybdenum, and potassium. Other metals, such as antimony, arsenic, chromium, copper, lead, and nickel were measured above the RDL for at least one month of the monitoring period. Beryllium, bismuth, boron, magnesium, and vanadium were not observed above the RDL during monitoring. There are no standards for metals concentrations in rainfall.
- **Radon monitoring:** Radon exposure and concentrations in the anticipated area of the Project were generally below the RDL of the sampling media. The concentrations measured were within the range of background radon concentrations in Canada and low compared to measured values from a previous radon study (Gratsy 1994) for outdoor, summer radon concentrations in Saskatchewan communities.

CLOSING

Golder 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.

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APPENDIX A

Joint Working Group Feedback Applicable to Atmospheric Baseline

Table A-1 presents the comments and feedbacks NexGen has received from members of local Indigenous communities through established Joint Working Group meetings. NexGen continues to engage with communities, and the feedback presented in Table A-1 reflects comments and feedback received through March 2020 that were related to atmospheric baseline or the comprehensive baseline program generally.

Table A-1: Joint Working Group Feedback Related to Atmospheric Baseline

Community	Comment
Birch Narrows Dene Nation (BNDN)	What is the environmental effect of the west winds from the Tar Sands in Fort MacMurray?
	Important topics for the JWG moving forward are Indigenous knowledge, traditional land use, the species discussion, water quality, environmental monitoring, employment and business opportunities
	Are you aware of any huge adverse environmental impacts in any of the current mine sites?
	Could we ask that you take samples here? That way we can see changes into the future. Even if it isn't affected by the mine. Respectfully, I request that samples are taken here.
	What about climate change?
Buffalo River Dene Nation (BRDN)	Have you gone to communities to show what you are doing? If so, what was the feedback?
	It's important to explain the Project to elders in a way that they can then explain it to other elders in the communities.
	Will you be taking air quality samples in Dillon?
	In 2001 in Dillon, the water was shallow. Since then it never went down; still going up. This lake is still full here. In Dillon the water is just about full now. But a lot of things are going to change; there are signs of acid rain from Alberta – changes to trees. Half of the trees are different colours. Every time it rains, the trees look a little but different.
	Another comparison you could probably do is the impact from Fort McMurray.
	Some are straightforward words; the more difficult ones are "valued component". We have no word for air – we could maybe say "white wind". We could ask.
Clearwater River Dene Nation (CRDN)	Remember we're trying to implement a plain speak document because of visual concepts of understanding. That is what the chief is talking about.
	In terms of baseline studies, are there any opportunities for community involvement with any of your residual baseline work, from fish, terrestrial, etc.?
	So Golder is the environmental part of this. What happened to CanNorth?
	And we will eventually throw in our environmental monitors. I don't know if you knew that. We want to train our own people because of lack of trust of government and industry.
	The interim CRDN Rights and Knowledge study will come out of the CRDN-defined initial list of VCs that we want to talk to you about. As we go through there may be additional ones. We know there's a certain window, but we'll try to be as comprehensive as possible. It may not be as linear as moose; it might be having undisturbed places on waterbodies. They might be more complex.
	There are things that haven't happened in our area, but eventually they will, like earthquakes. We didn't have tornados in Canada before and now we're having them.
	Golder does the same thing – hires three or four band members to do the interviews, then takes the notes and puts the document together. When you find the stuff it's not always based on the relationship to the stuff. It's based on what the government's qualifications are on the environmental assessment's impacts, and not the actual concerns of it. I'm trying to reach what [CRDN Member] is saying between traditional and modern ways.
	When we started looking at the strategy process, there's that interpretation of cumulative effects. Then we define and introduce an interpretation for that. It's not just one side, western science, we're doing the traditional side as well. That's what the Chief's referring to.
	Both traditional and western science are very important.
	All the studies I've ever seen done is more or less where you hunt and trap, and you can come back in 10 or 20 years when we've finished here. I would like to see it based on how much land has been lost already over the last 5-6 mines compared to the fears on fishing etc. – really saying this is what the impacts are, not the traditional knowledge like where they hunted, fished or gathered or what's sacred to them. In certain areas, communities can't even practice their traditional activities or do their ceremonies on the land within 1 km of a gas well. Nobody takes that into account. So what if you smell gas, so what if you hear a noise – there's actually impacts. When you're talking about total loss, and continually being squeezed in, this is just another step. That's what I would like to see in indigenous knowledge. Fear of eating that moose or fish or drinking the water.
	Will we see the results of those studies?
	How many other projects are in that square box (referring to map)?
	Do other companies have mineral holdings in that box on the map – like for oil and gas?
	I think it's really important to compare Cluff Lake to what's happening in the baseline studies. It's a good question.
	With global warming, each year we won't have the same amount of snowfall, so you will see the water drop.
	The wind's not going the same way every day.
	What's the purpose of trying to gather all this information?
Métis Nation–Saskatchewan (MN-S)	We have to understand all living and non-living things.
	Are any community members involved in the establishment of the baseline for environmental monitoring, so can they verify their accuracy?
	Would the results be released and reviewed by the community?
	From a trust point of view, our people will want to know that those numbers are accurate now, not later. Just a comment to think about.
	How would this group know – is there a way for the people involved in the studies to inform the group of what they saw and if they are confident they are accurate? Once the stuff hits the EIS, how do we know that it's good? If community folks that were involved in that process and they can validate the results, that brings comfort to community members.
	How often are you monitoring?
	It's that validation we're looking for. When I had to involve community members in monitoring, I would get them to write a report if they couldn't speak to the broader community in general. If they didn't feel like writing it, they could talk so someone who would transcribe it. That report could give a summary of how things went, what they saw, were the readings accurate; that could come back to this group, if they couldn't present themselves. The point [MN-S Member]'s trying to make is, we need some connection to that community resource that's out there doing the monitoring and seeing this stuff. We know who they are, and we're confident in the results. That builds trust.
	Do you have instruments or people taking samples? What does an instrument look like?
	What's your method of collecting dust?
	We've already lost it around Cluff Lake. Do you pick and eat blueberries right there, or just leave them because they're scary? If there's dust on that berry, am I eating raw uranium? The worst way to be involved with uranium is to ingest. If you get it on your hands you can wash it off, but once it's inside you've got a serious problem.
	The studies we did a few years back, these guys don't want to use them. That's what I heard.

Table A-1: Joint Working Group Feedback Related to Atmospheric Baseline

Community	Comment
Métis Nation-Saskatchewan (MN-S)	I had feedback on community engagement, and I'm trying to figure out how we can move forward in a responsible way where people have their input without being offended. We're working towards a bigger goal than what is currently perceived. We need a discussion on how we can approach it. I can offer some high-level thinking to help bring my community around.
	I learned a lot from this first meeting. More youth would be good for this because in future it would be something we would have to carry on. Climate change is a huge thing right now; it's kind of terrifying because would this add on to climate change?
	We should have more of these meetings with other companies like this. I'd like to get a Métis community member to work side by side with you guys and report the environmental side to the community instead of you guys doing it, so we know where we are and how much damage is being done to the land.
	This is general – the same information will come back to all the JWGs?
	We live in a very clean environment, other than Fort McMurray - we can sometimes smell the oil. The air is very clean; we can drink the water and eat the berries wherever they are. As you come south, those things change. We live in a very clean land; in our culture we call it the "land of the white eagle" because of the snow, and that represents clean.
	About 15 years ago at a workshop in Saskatoon, we knew why there were dying trees along the road – acid rain on the lakes. I said at least where I live, that nice clean water. I was introduced to a political scientist. She said the water looks clean but it's not. But I still drink water out of the lake when I camp, but it's getting there.
	When we see the damage Fort McMurray is doing to our area – it's 100+ miles from us, but it's still affecting us. So much sulphur is put into the air and it comes down as acid rain. That changes our lake structures and the pH balance. It gets rid of the aquatic life. That oil industry is vastly affecting our area. Our lakes are turning to blue-green algae from the lower pH from acid rain. They have no concern for me if my fishing industry dies, as long as they get the last gallon of oil. They should be a lot more aware. Our government doesn't care about it as long as they get their percentage. It's about money with everything.
	It gets you one way or another. The height of land changes at Wasagamio; everything flows from the Clearwater to Fort Chipewyan. We're lucky on the Churchill River that we don't get that flow coming our way. Yet we get the westerly winds coming over us
	There's so much humidity in the air from that steam that Syncrude creates its own clouds. It rains just about every day. It's always drizzling or wet there.

APPENDIX B

Quality Control Report

[redacted]

Quality Control Report

Client: NexGen Energy Ltd.
Suite 200 - 475 2nd Avenue S
Saskatoon SK S7K 1P4

Contact: Keith Shannon

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
DUSTFALL-TOT-ED	**Air**							
Batch R5286278								
WG3442130-2 LCS								
Total Dustfall (mg/100cm2/30days)			99.7		%		80-120	16-NOV-20
WG3442130-1 MB								
Total Dustfall (mg/100cm2/30days)			<10		mg		10	16-NOV-20
DUSTFALL-TOTFIX-ED	**Air**							
Batch R5286278								
WG3442130-2 LCS								
Total Fixed Dustfall (mg/100cm2/30days)			98.4		%		80-120	16-NOV-20
WG3442130-1 MB								
Total Fixed Dustfall (mg/100cm2/30days)			<15		mg		15	16-NOV-20
MET-DUST-DM2-CCMS-ED	**Dustfall**							
Batch R5292038								
WG3448776-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	20-NOV-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	20-NOV-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	20-NOV-20
Barium (Ba)-Total			<0.000050		mg/L		0.00005	20-NOV-20
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	20-NOV-20
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	20-NOV-20
Boron (B)-Total			<0.010		mg/L		0.01	20-NOV-20
Cadmium (Cd)-Total			<0.000050		mg/L		0.00005	20-NOV-20
Calcium (Ca)-Total			<0.020		mg/L		0.02	20-NOV-20
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	20-NOV-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	20-NOV-20
Iron (Fe)-Total			<0.030		mg/L		0.03	20-NOV-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	20-NOV-20
Lithium (Li)-Total			<0.0050		mg/L		0.005	20-NOV-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	20-NOV-20
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	20-NOV-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	20-NOV-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	20-NOV-20
Phosphorus (P)-Total			<0.30		mg/L		0.3	20-NOV-20
Potassium (K)-Total			<0.050		mg/L		0.05	20-NOV-20
Selenium (Se)-Total			<0.0010		mg/L		0.001	20-NOV-20
Silicon (Si)-Total			<0.050		mg/L		0.05	20-NOV-20
Silver (Ag)-Total			<0.000010		mg/L		0.00001	20-NOV-20

[redacted]

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DUST-DM2-CCMS-ED	**Dustfall**							
Batch R5292038								
WG3448776-1 MB								
Sodium (Na)-Total			<0.050		mg/L		0.05	20-NOV-20
Strontium (Sr)-Total			<0.00010		mg/L		0.0001	20-NOV-20
Thallium (Tl)-Total			<0.00010		mg/L		0.0001	20-NOV-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	20-NOV-20
Titanium (Ti)-Total			<0.010		mg/L		0.01	20-NOV-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	20-NOV-20
Vanadium (V)-Total			<0.0010		mg/L		0.001	20-NOV-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	20-NOV-20

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.