Rook I Project

Environmental Impact Statement

TSD XI: Light Effects Analysis Report

GOLDER
MEMBER OF WSP

LIGHT EFFECTS ANALYSIS TECHNICAL SUPPORT DOCUMENT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

Golder Associates Ltd.

March 2022

Executive Summary

A light analysis was undertaken for the Rook I Project (Project). The analysis evaluated potential effects resulting from artificial lighting anticipated for the Project, and included artificial lighting anticipated for the Patterson Lake South Property, planned by Fission Uranium Corp. (Fission 2019, 2021), which is located approximately 5.2 km west of the proposed Project footprint.

Light was analyzed using two measurement indicators:

- light trespass, which is light or illuminance that strays from its intended purpose onto nearby areas where lighting may be undesirable; and
- sky glow, which is stray light that is scattered in the atmosphere, brightening the natural sky and reducing star visibility.

Light trespass levels were predicted using a commercial computer program called AGi32. Sky glow levels were predicted using a purpose-built computer program developed based on a model from the light assessment literature.

Light trespass and sky glow levels were predicted at 16 sensitive receptors located within the light study area. Sensitive receptors were identified through NexGen Energy Ltd. (NexGen) engagement with local First Nations and Métis Groups (collectively referred to as Indigenous Groups) and northern communities.

There are no federal or provincial regulations or guidelines for the analysis of potential light effects. Therefore, light trespass effects were analyzed using thresholds from the International Commission on Illumination (CIE), and sky glow effects were analyzed using thresholds from the Institution of Lighting Professionals (ILP).

The light analysis concluded:

- Light trespass from the Project and from the Fission Patterson Lake South Property are predicted to be less than applicable light trespass thresholds.
- Light trespass levels at the 16 receptors are predicted to be unchanged as a result of the Project and the proposed Fission Patterson Lake South Property.
- For some receptors and environmental conditions, sky glow from the Project is predicted to be brighter than the threshold applicable to environmental lighting zone E1 – “relatively uninhabited rural area”.
- For all receptors, cumulative sky glow from the Project in combination with the Fission Patterson Lake South Property is predicted to be brighter than the E1 threshold.
- Cumulative sky glow from the Project in combination with the Fission Patterson Lake South Property is predicted to be less bright than the threshold applicable to environmental lighting zone E2 – “sparsely inhabited rural area”.

The significance of potential light effects is assessed in the following sections of the Environmental Impact Statement (EIS):

- fish and fish habitat (EIS Section 11);
- wildlife and wildlife habitat (EIS Section 14);
- cultural and heritage resources and Indigenous land and resource use (EIS Section 16); and
- other land and resource use (EIS Section 17).

The light effects analysis achieved the objective of characterizing potential light effects from the Project and the Fission Patterson Lake South Property. Specifically, light trespass and sky glow levels were predicted using computer models and analyzed in the context of thresholds from the CIE and the ILP.

Abbreviations and Units of Measure

Abbreviation	Definition
CIE	International Commission on Illumination
EIS	Environmental Impact Statement
ILP	Institution of Lighting Professionals
NexGen	NexGen Energy Ltd.
Project	Rook I Project
RFD	reasonably foreseeable development
SSALR	simplified short approach lighting with runway alignment indicator lights
TSD	technical support document

Unit	Definition
%	percent
km	kilometre
lux	1 lumen per square metre
m	metre
mag/arcsec^2	magnitude per square second of arc
mlux	millilux; 0.001 lumens per square metre

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1 INTRODUCTION

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Access to the Project would be from an existing road off Highway 955 (Figure 1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 1-3):

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

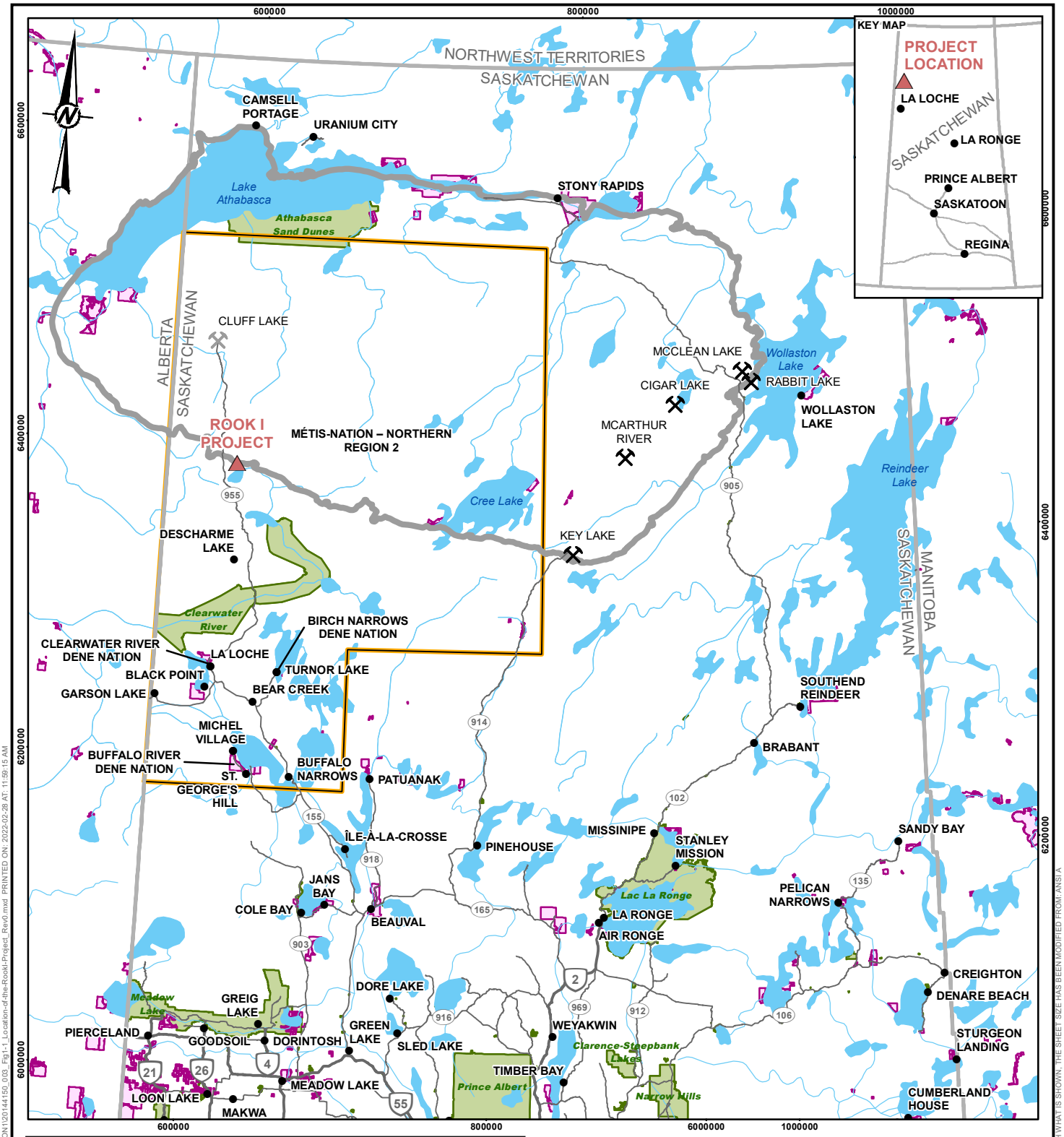
This technical support document (TSD) to the Environmental Impact Statement (EIS) analyzes potential light effects from the proposed Project. Artificial light sources (luminaires) would be installed outdoors to illuminate work areas and roadways, to alert aircraft to the presence of elevated infrastructure, and to guide aircraft using the on-site airstrip. These outdoor luminaires could create adverse effects on the social and biophysical environment. Outdoor luminaires would be required during both Construction and Operations of the Project. Accordingly, this TSD to the EIS analyzes potential light effects during Construction and Operations of the Project. Light from Project luminaires could influence aquatic and terrestrial ecosystems, as well as the people that use natural resources or ecosystem services (e.g., surface water, fish, plants, and wildlife). The light

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

analysis provides information that is used to support the assessments of biophysical, cultural, and socio-economic valued components.

Light specifically supports the effects assessments for the following components:

- fish and fish habitat (EIS Section 11);
- wildlife and wildlife habitat (EIS Section 14);
- cultural and heritage resources and Indigenous land and resource use (EIS Section 16); and
- other land and resource use (EIS Section 17).



LEGEND

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

0 100 200
1:3,500,000 KILOMETRES

REFERENCE(S)

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

PROJECT: NexGen Energy Ltd. — ROOK I PROJECT

TITLE: LOCATION OF THE ROOK I PROJECT

CONSULTANT: GOLDER, MEMBER OF WSP

PROJECT	20144150		PHASE	3314 - 6
DESIGN	JMC	2022-02-28	SCALE AS SHOWN	REV. 0
GIS	NO	2022-02-28		
CHECK	JMC	2022-02-28		
REVIEW	MM	2022-02-28		

FIGURE 1-1

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

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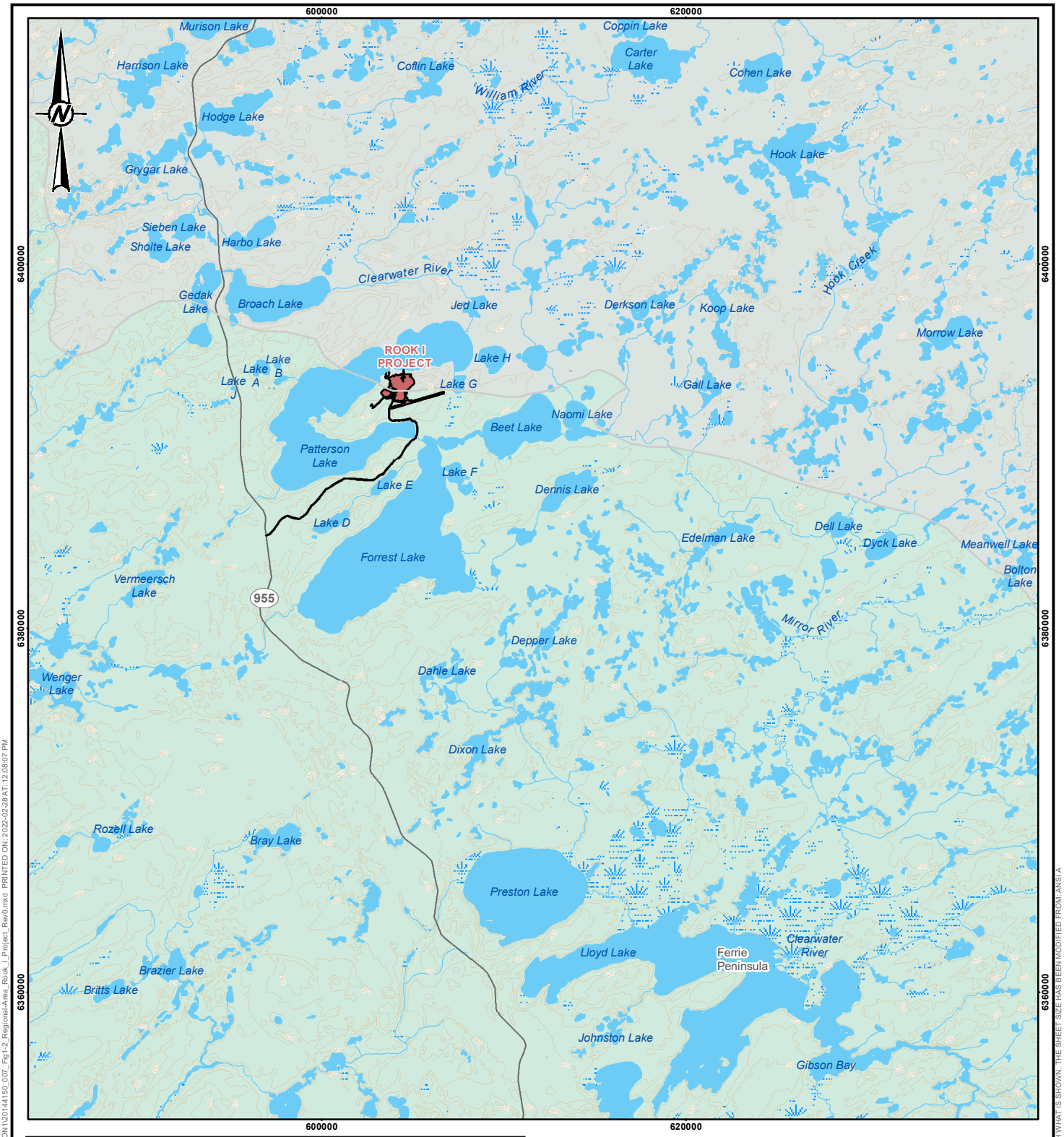

LEGEND

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

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)

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

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

GOLDER
MEMBER OF WSP

PROJECT		20144150	PHASE	3314 - 6
DESIGN	JMC	2022-02-28	SCALE AS SHOWN	REV. 0
GIS	NO	2022-02-28		
CHECK	JMC	2022-02-28		
REVIEW	MM	2022-02-28		

FIGURE 1-2

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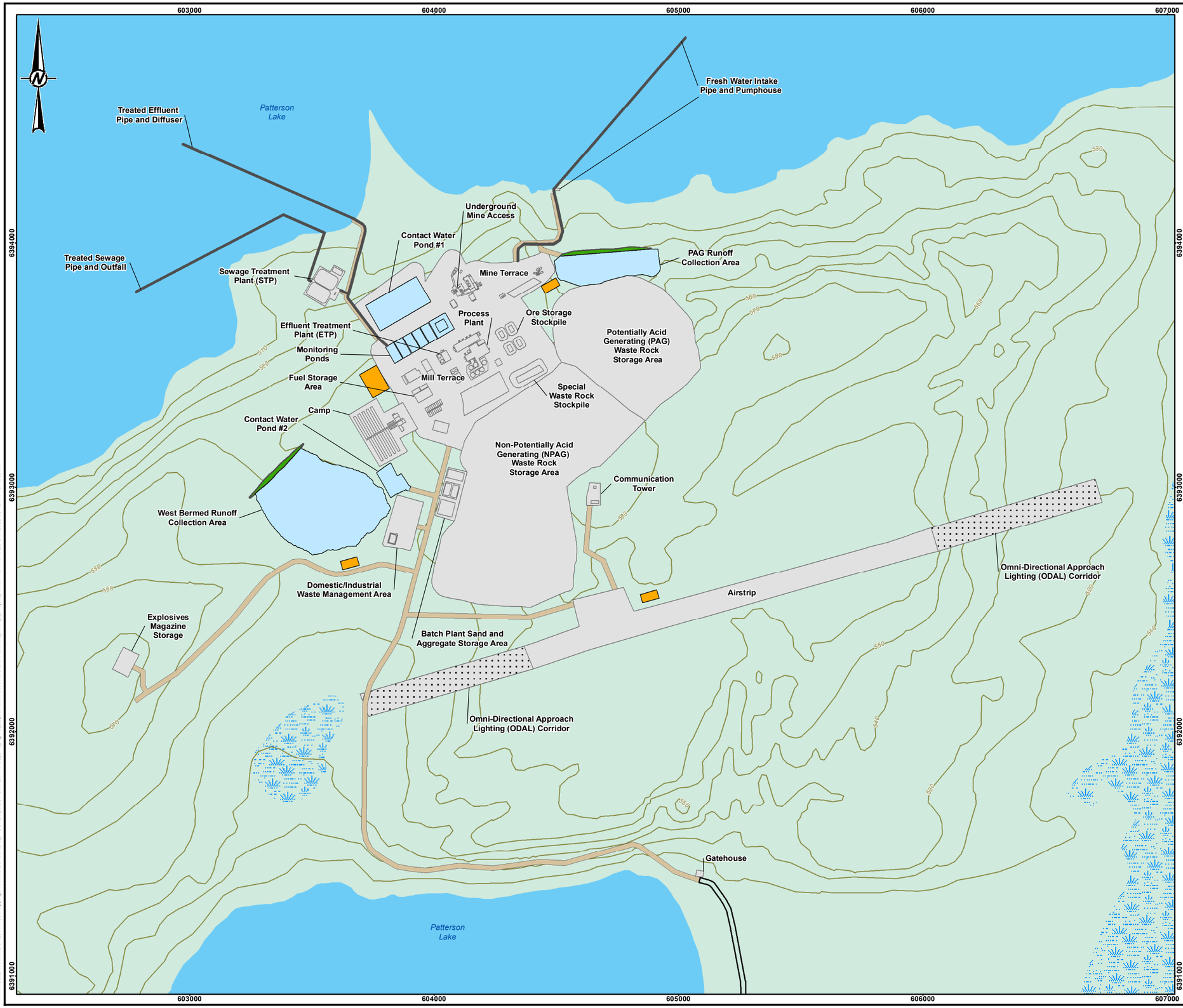

LEGEND

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

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

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

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT

GOLDER MEMBER OF WSP

PROJECT		20144150	PHASE	3314 - 6
DESIGN	JV	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2022-03-18		
CHECK	JMC	2022-03-18		
REVIEW	MM	2022-03-18		

FIGURE 1-3

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PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\General\EIS_FIGURES_SECTION1\20144150_011_Fig1-3_Layout-of-Infrastructure-and-Facilities_Rook_I_Project_Rev0.mxd PRINTED ON: 2022-03-19 AT: 10:46:38 AM

2 METHODS

This section of the TSD describes the methods used to analyze potential effects from Project lighting. It describes the measurement indicators used to characterize light levels, the analysis thresholds used to analyze light effects, the study area and receptors used in the analysis, and the methods used to predict light levels from the Project.

2.1 Measurement Indicators

Potential light effects are analyzed using two measurement indicators:

- Light trespass is light or illuminance that strays from its intended purpose onto nearby areas where lighting may be undesirable. Light trespass is measured in units of lux (1 lumen per square metre) or millilux (mlux; 0.001 lumen per square metre).
- Sky glow is stray light that is scattered in the atmosphere, brightening the natural sky and reducing star visibility. Sky glow is measured in units of magnitude per square second of arc (mag/arcsec^2); these units reflect “sky quality” relative to a theoretical condition in which there is zero sky glow. Larger values represent better “sky quality” and less sky glow.

Representative illumination values for several common situations and environments are provided in Table 2-1; this information can be used to provide context to the light trespass predictions that appear elsewhere in the TSD. Representative sky glow values for several common situations and environments are provided in Table 2-2; this information can be used to provide context to the sky glow predictions that appear elsewhere in the TSD.

Table 2-1: Illumination for Common Situations and Environments

Sample Situation/Environment	Illumination Level (lux)
Moonless overcast night[(a)]	0.0001
Moonless clear night[(a)]	0.002
Full moon on a clear night[(a)]	0.27
Family living room[(b)]	50
Hallway[(c)]	80
Overcast day[(a)]	1,000
Full daylight (not direct sun) [(a)]	10,000 to 25,000

a) Schlyter 2021.
b) AGO 1998.
c) AGO 2005.
lux = 1 lumen per square metre.

Table 2-2: Sky Glow for Common Situations and Environments

Sample Situation/Environment	Sky Glow (mag/arcsec^2)
Standard natural background (zero sky glow)	21.6
Limit for astronomical site of international standing	21.5
Limit for dark sky site for most astronomers	21.2
Full moon night sky	18
Night sky in densely populated area	17
Clear sky 30 minutes after sunset	15
Heavily overcast daytime sky	8
Clear daytime sky	3

Source: Narisada and Schreuder 2004.
mag/arcsec^2 = magnitude per square second of arc.

2.1.1 Analysis Thresholds

There are no federal or provincial regulatory thresholds for the analysis of potential light effects from the Project. In the absence of federal or provincial regulatory guidance, light effects from the Project were analyzed using thresholds from:

- International Commission on Illumination (CIE) *Technical Report: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Installations* (CIE 2017); and
- Institution of Lighting Professionals (ILP) *Guidance Note for the Reduction of Obtrusive Light* (ILP 2020).

The CIE is a technical, scientific, and cultural non-profit organization whose objectives are:

- To provide an international forum for the discussion of all matters relating to the science, technology, and art in the fields of light and lighting and for the interchange of information in these fields between countries.
- To develop basic standards and procedures of metrology in the fields of light and lighting.
- To prepare and publish standards, reports and other publications concerned with all matters relating to science, technology, and art in the fields of light and lighting.
- To maintain liaison and technical interaction with other international organizations concerned with matters related to the science, technology, standardization, and art in the fields of light and lighting (CIE 2021).

The ILP is professional body based in the United Kingdom (UK) that establishes standards for good practice in the development of interior and exterior lighting (ILP 2021). The ILP is consulted by the UK government on a wide range of issues, including legislation and regulations that affect the built environment (ILP 2021).

The CIE has established five environmental lighting zones (CIE 2017) in recognition that some areas are more sensitive to light effects than others. For example, the CIE acknowledges that lighting considered acceptable and appropriate in a busy urban centre may not be acceptable in a remote national park. The CIE environmental lighting zones are described in Table 2-3.

The CIE guidance recommends light trespass thresholds for each environmental lighting zone (CIE 2017). Corresponding sky glow thresholds are provided in the ILP guidance (ILP 2020). Light trespass and sky glow

thresholds for each environmental lighting zone are presented in Table 2-3. The light trespass thresholds are generally applicable to all environmental conditions, while the sky glow thresholds are only applicable under summertime conditions when the sky is clear.

Because there are no federal or provincial regulatory thresholds for the analysis of potential light effects, Project compliance with the CIE and ILP thresholds is not mandatory. Instead, the CIE and ILP thresholds provide a helpful framework for analyzing potential light effects. Exceedance of the light trespass and/or sky glow thresholds from Table 2-3 may annoy or disturb human and wildlife receptors, but exceedance of these thresholds is not a risk to health or safety.

Table 2-3: Environmental Lighting Zones and Analysis Thresholds

Zone[a]	Lighting Environment[a]	Examples[a]	Light Trespass Threshold[b] (lux)	Sky Glow Threshold[c] (mag/arcsec^2)
E0	Intrinsically dark	UNESCO Starlight Reserves, IDA Dark Sky Parks, major optical observatories	0	20.5
E1	Dark	Relatively uninhabited rural areas	0.1	20
E2	Low district brightness	Sparsely inhabited rural area	1	15
E3	Medium district brightness	Well inhabited rural and urban settlements	2	n/a[d]
E4	High district brightness	Town and city centres and other commercial areas	5	n/a[d]

a) CIE 2017.

b) Light trespass thresholds taken from CIE 2017.

c) Sky glow thresholds taken from ILP 2020. These thresholds are applicable under summertime conditions with clear skies.

d) There is no sky glow threshold applicable to this environmental lighting zone (ILP 2020).

UNESCO = United Nations Educational, Scientific, and Cultural Organization; IDA = International Dark-Sky Association; lux = 1 lumen per square metre; mag/arcsec^2 = magnitude per square second of arc; n/a = not applicable.

2.2 Study Area

A maximum disturbance area of 981 ha was used for the assessment of terrain and soils, vegetation, and wildlife and wildlife habitat to address uncertainty in the final design of the Project. The maximum disturbance area represents the smallest scale of assessment and an area where the potential direct effects of the anticipated Project on soils, vegetation, and wildlife can be assessed accurately and precisely. The spatial boundary of the maximum disturbance area was delineated by applying buffers to the outer edges of the anticipated Project infrastructure. The spatial boundary was also constrained to the shoreline of Patterson Lake (Figure 2-1).

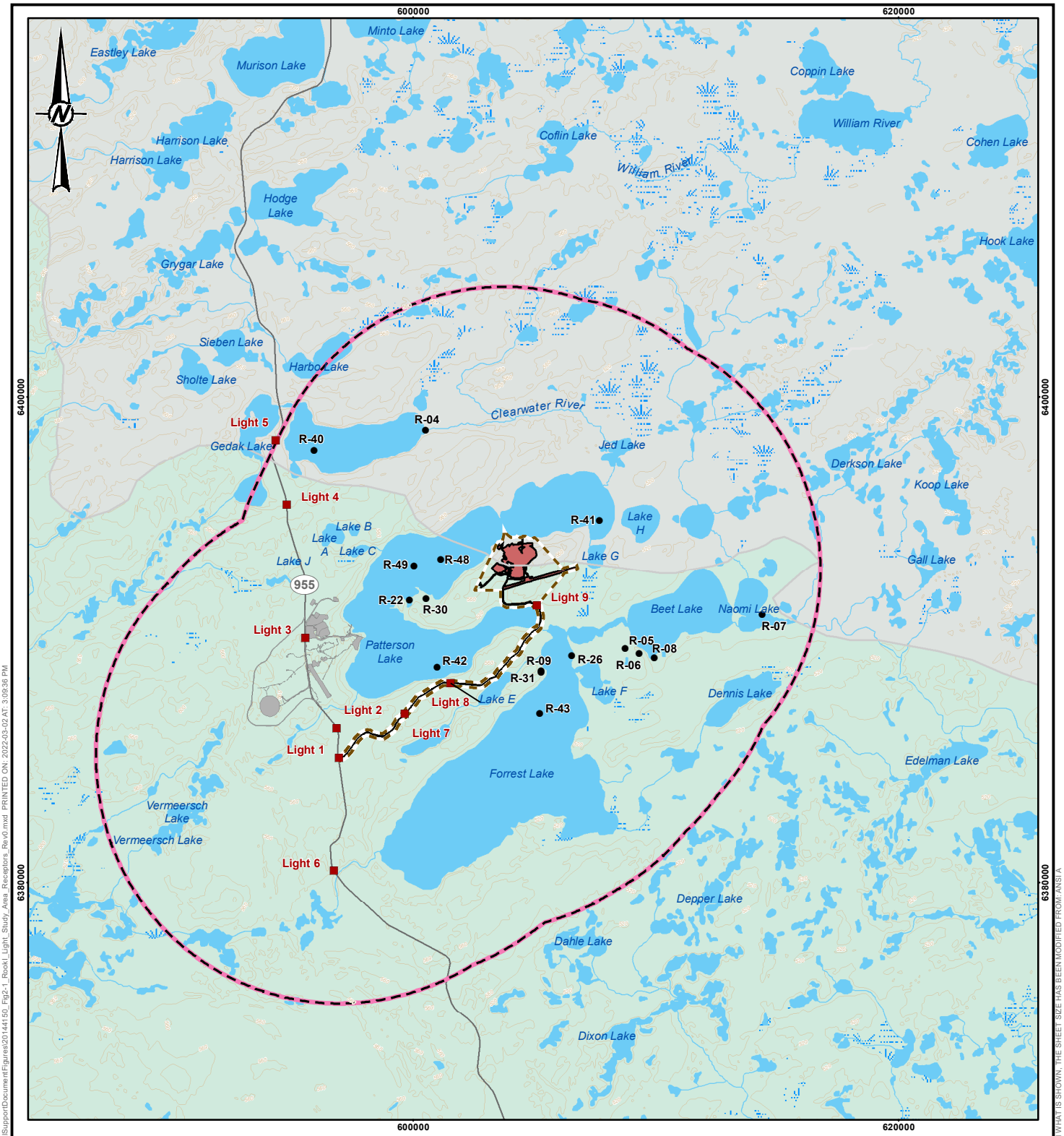
The study area for the light analysis was defined as a 10 km buffer surrounding the maximum disturbance area for the Project (Figure 2-1). This study area is large enough to characterize any vibration effects from the Project, as well as any potential cumulative effects from the Patterson Lake South Property, which is a reasonably foreseeable development (RFD) proposed by Fission Uranium Corp. (Fission 2019, 2021).

Receptors within the light study area were primarily identified through NexGen's engagement with Indigenous Groups and local communities. A review was completed of the comments provided on the Rook I Project Description by the Clearwater River Dene Nation (CRDN 2019), Métis Nation – Saskatchewan (MN-S 2019), and Ya'thi Néné Land and Resources (YNLRO 2019). Indigenous Knowledge and Traditional Land Use Studies completed by the Clearwater River Dene Nation (TSD V.1: CRDN), Métis Nation – Saskatchewan (TSD IV: MN-S), Birch Narrows Dene Nation (TSD II: BNDN), Buffalo River Dene Nation (TSD III: BRDN), and Ya'thi Néné

Land and Resources (TSD VI: YNLRO) were also reviewed. Receptors identified through this process are shown in Figure 2-1, along with light measurement stations used in the noise and light baseline study for the Project (Annex II, Noise and Light Baseline Report). These receptors correspond to the closest known human presence within the light study area. These same receptors were used in the assessment of potential noise effects (EIS Section 7.3, Noise) and in the analysis of potential vibration effects (TSD X, Vibration Effects Analysis Report).

Table 2-4 presents a list of receptors considered in the light analysis and identifies the environmental lighting zone and analysis thresholds that are applicable at each receptor. The light study area is relatively uninhabited under existing conditions and is not located within designated parks or reserves; therefore, all receptors are classified as environmental lighting zone E1. If development of the Project proceeds, the light study area would become sparsely inhabited with mine workers and support staff, in which case environmental lighting zone E2 may become a more appropriate classification.

Table 2-4 also identifies the baseline measurement station that is most representative of existing conditions at each receptor. During the baseline field program, light trespass and sky glow levels were measured at nine stations (Light 1 through Light 9) under summertime cloudy skies, summertime clear skies, wintertime cloudy skies, and wintertime clear skies. Existing light trespass and sky glow levels observed at the nine baseline measurement stations were assigned to the 16 receptors considered in the light analysis based on physical proximity. For example, measurements collected at Light 5 were assigned to receptor R-04 because Light 5 is the closest measurement station to R-04. Similarly, measurements collected at Light 9 were assigned to receptor R-05 because Light 9 is the closest measurement station to R-05. Given the general lack of human activity and artificial light sources throughout the light study area, it was not necessary to measure existing conditions at each receptor; using representative data from the closest measurement station accurately characterizes existing conditions at the receptors.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- MAXIMUM DISTURBANCE AREA
- PROPOSED PROJECT FOOTPRINT
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- LIGHT MEASUREMENT STATIONS
- LIGHT RECEPTORS
- LIGHT STUDY AREA

0 5 10
1:225,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT: NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LIGHT STUDY AREA AND RECEPTORS

CONSULTANT: GOLDER MEMBER OF WSP

PROJECT		20144150	PHASE	3102 - 3
DESIGN	VY	2022-03-02	SCALE AS SHOWN	REV. 0
GIS	NO	2022-03-02		
CHECK	VY	2022-03-02		
REVIEW	AF	2022-03-02		

FIGURE 2-1

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

25mm

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PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\NoiseLight\AssessmentTechnicalSupportDocument\Figures\20144150_Fig2-1_RookI_Light_Study_Area_Receptors_Rev0.mxd PRINTED ON: 2022-03-02 AT: 3:09:36 PM

Table 2-4: Light Receptors and Relevant Thresholds

Receptor Identification Code[a]	Universal Transverse Mercator Coordinates (Zone 12)		Receptor Description[b]	Representative Baseline Measurement Station	Environmental Lighting Zone[c]	Analysis Threshold	
	Easting (m)	Northing (m)				Light Trespass (lux)	Sky Glow[d] (mag/arcsec^2)
R-04	600523	6398606	Cabin	Light 5	E1	0.1	20
R-05	608757	6389632	Lodge	Light 9	E1	0.1	20
R-06	609329	6389420	Cabin (old cabin)	Light 9	E1	0.1	20
R-07	614387	6391050	Cabin	Light 9	E1	0.1	20
R-08	609942	6389235	Camp (tourist camp)	Light 9	E1	0.1	20
R-09	605286	6388706	Camp (tourist camp)	Light 9	E1	0.1	20
R-22	599851	6391630	Fishing (nets)	Light 8	E1	0.1	20
R-26	606543	6389350	Plane crash	Light 9	E1	0.1	20
R-30	600546	6391678	Historical camp	Light 8	E1	0.1	20
R-31	605282	6388662	Camp (rough camp)	Light 9	E1	0.1	20
R-40	595924	6397789	Fishing	Light 5	E1	0.1	20
R-41	607681	6394910	Fishing	Light 9	E1	0.1	20
R-42	600992	6388870	Fishing	Light 8	E1	0.1	20
R-43	605233	6386971	Fishing	Light 8	E1	0.1	20
R-48	601140	6393297	Fishing	Light 9	E1	0.1	20
R-49	600042	6393020	Fishing	Light 8	E1	0.1	20

a) This table lists all receptors within the light study area that were identified during community engagement activities. Receptor numbering is non-continuous because some of the locations identified during community engagement activities are beyond the light study area (i.e., some of the locations identified during community engagement activities are more than 10 km from the maximum disturbance area for the Project). Because light trespass and sky glow levels would attenuate with distance, potential light effects would be greater at receptors within the study area than at receptors beyond the study area.

b) Receptor description provided during community engagement activities.

c) Environmental lighting zone E1 reflects the present status of the light study area. If development of the Project proceeds, the light study area would become sparsely inhabited with mine workers and support staff, in which case environmental lighting zone E2 may become a more appropriate classification.

d) Sky glow thresholds are applicable under summertime conditions with clear skies.

lux = 1 lumen per square metre; mag/arcsec^2 = magnitude per square second of arc.

2.3 Temporal Boundaries

The temporal scope of the light analysis focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases (EIS Section 6.5.2, Temporal Boundaries):

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.

- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
  - **Active Closure Stage:** active decommissioning and reclamation activities occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, and any other activities deemed necessary to achieve decommissioning objectives and return the site to a safe and stable condition prior to post-Closure activities. The duration of the Active Closure Stage is expected to be five years.
  - **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the Canadian Nuclear Safety Commission licence would be submitted to the Canadian Nuclear Safety Commission for approval. Once that is achieved, and upon Provincial approval, the land would be transferred under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

The presence of luminaires is anticipated during Construction and Operations , and during the Active Closure Stage of Closure. Because lighting during the Active Closure Stage is expected to be less intense than during either Construction or Operations, quantitative light modelling focused on Construction and Operations to capture maximum predicted light trespass and sky glow from Project-related activities. This represents a conservative analysis of potential light effects from the Project (i.e., an approach that tends to overestimate potential effects).

The temporal boundaries applied to cumulative effects include the period during which the presence of luminaires at the Fission Patterson Lake South Property may overlap the presence of Project luminaires. Information presented in the Fission Patterson Lake South Property prefeasibility study was not sufficient to characterize separately potential light effects from construction and operation of that project (Fission 2019). Therefore, the light analysis characterized potential effects once the Fission Patterson Lake South Property becomes fully operational as surrogate information for the construction and decommissioning phases. To be clear, the light analysis of potential cumulative effects considered one snapshot in which Project Construction temporally overlaps the fully operational Fission Patterson Lake South Property and another snapshot in which Project Operations temporally overlaps the fully operational Fission Patterson Lake South Property. Lighting required for operations is anticipated to be greater than for the other project phases, and so this approach to analyzing the Fission Patterson Lake South Property is considered conservative.

2.4 Baseline Measurement Methods

A baseline study was conducted to characterize existing light trespass and sky glow levels in the light study area (Annex II, Noise and Light Baseline Report). The light baseline study was conducted overnight on:

- 13 September 2018 and 14 September 2018;
- 14 September 2018 and 15 September 2018;
- 18 March 2020 and 19 March 2020;
- 22 March 2020 and 23 March 2020; and
- 23 March 2020 and 24 March 2020.

Measurements were collected at nine stations (Light 1 through Light 9; Figure 2-1). All measurement data were collected during periods when the night sky was dark (i.e., both sun and moon below the horizon). Measurement data were collected over multiple nighttime periods to capture a variety of environmental conditions: summertime cloudy skies, summertime clear skies, wintertime cloudy skies, and wintertime clear skies.

Measurement data were collected in general accordance with guidance from the Illuminating Engineering Society of North America (IESNA 2000) and the CIE (CIE 1997, 2017). Existing light trespass levels were measured using a Solar Light PMA2010 photometer, outfitted with a PMA2131 scotopic detector. Existing sky glow levels were measured using a Unihedron sky quality meter.

2.5 Prediction Methods

Light trespass from the Project and from the Fission Patterson Lake South Property was predicted using a commercial computer program called AGi32, developed by Lighting Analysts Inc. Inputs to the AGi32 computer models included location, orientation, and emissions from luminaires, location and dimensions of buildings and other objects, and location of light receptors (Table 2-4).

In the absence of commercial sky glow models, sky glow from the Project and from the Fission Patterson Lake South Property was predicted using a computer program developed by Golder based on a model from Garstang (1986) that predicts sky brightness caused by a city or large industrial facility at receptor locations outside the city/facility. The Garstang sky glow model accounts for molecular scattering, aerosol scattering, reflectivity of the ground, facility-receptor distance, and luminous intensity of the city/facility. Inputs to the Garstang sky glow model include location and emissions from luminaires, ground reflectivity (i.e., the amount of light reflected by the ground), and location of light receptors (Table 2-4).

2.5.1 Inputs and Assumptions

Project illumination requirements for outdoor work areas are presented in Table 2-5 (Poole 2019a).

Table 2-5: Illumination Requirements for Outdoor Work Areas

Outdoor Work Area	Illumination Requirement (lux)
Parking lots	30
Roads around buildings	30
General (e.g., areas adjacent to buildings and outdoor equipment)	10

Source: Poole (2019a).
lux = 1 lumen per square metre.

Roadway lighting for the Project would consist of 15 m vertical poles with 2.4 m upsweeps (Poole 2019b). These lights would be spaced at 80 m horizontal intervals along the segment of the access road between the gatehouse and the Project site, and along other roads within the Project footprint (Poole 2019b). There would be no artificial lighting along the segment of the access road between the Project gatehouse and Highway 955.

Lighting for the Project airstrip would be designed based on the "simplified short approach lighting with runway alignment indicator lights" (SSALR) system from *TP 312 – Aerodrome Standards and Recommend Practices* (Transport Canada 2015; Halliday 2021). The SSALR system consists of a series of flashing lights that guide pilots along the approach path to the airstrip and mark the landing threshold and runway apron. Elevated Project structures (i.e., headframe and communication tower) would be marked with aircraft warning lights, in accordance with *Standard 621 – Obstruction Marking and Lighting* (Transport Canada 2019; Poole 2019a).

Because information about lighting at the Fission Patterson Lake South Property was not publicly available at the time this lighting analysis was completed, it was assumed the Fission Patterson Lake South Property would have the same general illumination requirements as the Project (Table 2-5), and would make use of the same roadway lighting design and the same SSALR system at the on-site airstrip. This approach was taken because the Fission Patterson Lake South Property is a similar type of development to the proposed Project and is anticipated to have similar lighting requirements. Publicly available information suggests there are no headframes associated with the Fission Patterson Lake South Property; instead, ore would be hauled to the surface using trucks (Fission 2019). As such, aircraft warning lights were not modelled at the Fission Patterson Lake South Property.

Specific vendors and luminaires for the Project are yet to be confirmed. Therefore, the light analysis identified representative luminaires from the database provided within the AGi32 computer program. The AGi32 luminaire database is updated regularly and contains detailed information about thousands of luminaires from dozens of manufacturers. Representative luminaires considered in the light analysis are summarized in Table 2-6. These luminaires are from large, well-established manufacturers and are likely similar to those that would ultimately be installed on site. In any case, the light trespass and sky glow modelling is not sensitive to the particular make/model of luminaires; the relevant quantity for the light analysis is the light emissions (lumens) of the luminaires.

Table 2-6: Representative Luminaires Considered in the Light Analysis

Luminaire Identification Code	Make/Model	Description	Light Emissions (lumens)
Site Bright	GE Lighting Solutions / EASC Z5NX30	400-watt LED; pole-mounted; used to light general work areas	54,200
Site Medium	GE Lighting Solutions / EALP01 KAAA730	274-watt LED; pole-mounted; used to light general work areas	32,700
Parking Area	GE Lighting Solutions / ECBB C5F530	110-watt LED; pole-mounted; used to light parking areas	13,410
Wall Mount	GE Lighting Solutions / EWNB F3730	125-watt LED; wall-mounted; used to light areas outside of buildings	13,900
Streetlight	GE Lighting Solutions / ERHM01 30E1730	253-watt LED; pole-mounted; used to light roadways	28,800
Airstrip Bright	ATX Appleton Group / 95003	150-watt quartz halogen; various mounting configurations; used for airstrip lighting and SSALR system	1,593
Airstrip Medium	Simes / S1050.14	50-watt quartz halogen; various mounting configurations; used for airstrip lighting and SSALR system	211
Aircraft Warning	Performance in Lighting / Quasar 10 4WB	4-watt LED; aircraft warning light mounted on elevated structures	402

LED = light emitting diode; SSALR = simplified short approach lighting with runway alignment indicator lights.

Within the AGi32 light trespass model and the Garstang sky glow model, luminaires from Table 2-6 were allocated to Project buildings and work areas until light levels were predicted to reach the illumination requirements from Table 2-5. Luminaires were allocated to roadways based on the Project design specifications (Poole 2009b). Luminaires were allocated to the Project airstrip in accordance with the Transport Canada SSALR requirements (Transport Canada 2015), and aircraft warning lights were allocated to the Project headframe and communication tower in accordance with the applicable Transport Canada standard (Transport Canada 2019). Luminaires were allocated to the Fission Patterson Lake South Property in a similar manner.

The luminaire allocation used to model light trespass and sky glow from Construction and Operations is presented in Table 2-7. The luminaire allocation used to model light trespass and sky glow from the Fission Patterson Lake South Property is also presented in Table 2-7.

Table 2-7: Luminaire Allocation

Luminaire Identification Code	Quantity of Luminaires		
	Project Construction	Project Operations	Fission Patterson Lake South Property
Site Bright	120	120	669
Site Medium	96	96	0[(a)]
Parking Area	93	93	0[(a)]
Wall Mount	170	241	0[(a)]
Streetlight	121	121	166
Airstrip Bright	236	236	236
Airstrip Medium	18	18	18
Aircraft Warning	18	18	0[(b)]

a) In the absence of a detailed footprint or building information for the Fission Patterson Lake South Property, illumination requirements for general work areas were achieved using the Site Bright luminaires. Site Medium, Parking Area, and Wall Mount luminaires were not considered in the light models developed for the Fission Patterson Lake South Property because illumination requirements were achieved using the Site Bright luminaires.

b) There are no headframes associated with the Fission Patterson Lake South Property; as such, aircraft warning lights were not modelled at the Fission Patterson Lake South Property.

Because light trespass results from light shining directly on a receptor, predictions from the AGi32 light trespass model are not sensitive to ground cover (i.e., light reflected from the ground is not accounted for in the AGi32 algorithm). In contrast, light reflecting from the ground is a key component of sky glow modelling using the Garstang (1986) model. To characterize potential differences in sky glow during the summertime and wintertime periods, the Project and Patterson Lake South were modelled based on bare ground (i.e., summertime conditions) and snow-covered ground (i.e., wintertime conditions). Bare ground was assumed to reflect 25% of incident light and snow-covered ground was assumed to reflect 85% of incident light (Engineering Toolbox 2021). Because of the greater reflectivity from snow-covered ground, sky glow levels tend to be elevated during the wintertime period.

2.6 Analysis Cases

Analysis cases were applied to the light study area to estimate the incremental and cumulative effects from the proposed Project and the Fission Patterson Lake South Property. The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. Analysis cases included a Base Case, Application Case, and RFD Case.

Base Case is represented by existing conditions. The Base Case describes the existing environment in the light study area before application of the proposed Project to provide an understanding of the current conditions that may be influenced by the Project.

Application Case represents predictions of the combined effects of the previous and existing projects/activities and natural factors in the Base Case plus the potential effects from the proposed Project. This case was also used to identify and assess incremental, Project-specific changes that are predicted to occur.

Reasonably Foreseeable Development (RFD) Case includes the Base Case, Application Case, and the Fission Patterson Lake South Property.

3 RESULTS

This section summarizes existing conditions in the light study area (Base Case), then presents results from the light trespass and sky glow modelling for the Project (Application Case). Project-specific light trespass and sky glow predictions are presented for Construction and Operations. Cumulative light trespass and sky glow levels, which include the contribution from the proposed Fission Patterson Lake South Property (RFD Case), are subsequently presented. Predicted light trespass and sky glow levels are analyzed using thresholds taken from guidance documents published by the CIE (2017) and the ILP (2020).

3.1 Base Case

Existing light trespass and sky glow levels in the light study area were established by means of a baseline field program (Annex II). Table 3-1 presents existing light trespass levels at each of the 16 receptors considered in the light analysis and compares existing levels to the light trespass threshold applicable to environmental lighting zone E1 (CIE 2017). The results presented in Table 3-1 indicate that existing light trespass levels at all receptors are below the applicable light trespass threshold.

Table 3-1: Existing Light Trespass Levels

Receptor Identification Code	Representative Baseline Measurement Station	Existing Light Trespass Level[a] (mlux)				Light Trespass Threshold[b] (mlux)	Comment
		Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies		
R-04	Light 5	6	3	1	3	100	Existing conditions are below threshold
R-05	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-06	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-07	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-08	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-09	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-22	Light 8	0	0	1	3	100	Existing conditions are below threshold
R-26	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-30	Light 8	0	0	1	3	100	Existing conditions are below threshold
R-31	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-40	Light 5	6	3	1	3	100	Existing conditions are below threshold
R-41	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-42	Light 8	0	0	1	3	100	Existing conditions are below threshold
R-43	Light 8	0	0	1	3	100	Existing conditions are below threshold
R-48	Light 9	3	4	22	4	100	Existing conditions are below threshold
R-49	Light 8	0	0	1	3	100	Existing conditions are below threshold

a) Existing light trespass levels were measured during a baseline field program (Annex II).

b) Light trespass threshold applicable to environmental lighting zone E1 (CIE 2017).

mlux = millilux (0.001 lumen per square metre).

Table 3-2 presents existing sky glow levels at each of the 16 receptors considered in the light analysis and compares existing levels under summertime clear skies to the sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). As discussed in Section 2.1.1, Analysis Thresholds, the ILP sky glow threshold only applies to summertime clear skies; there are no sky glow thresholds applicable to other environmental conditions.

The units used to quantify sky glow (mag/arcsec^2) reflect “sky quality” relative to a theoretical condition in which there is zero sky glow. Larger values represent better “sky quality” and less sky glow; in particular, an existing sky glow value greater than 20 mag/arsec^2 indicates existing conditions are darker than the 20 mag/arcsec^2 threshold, and an existing sky glow value less than 20 mag/arcsec^2 indicates conditions are brighter than the 20 mag/arcsec^2 threshold.

The results presented in Table 3-2 indicate that existing conditions in the light study area are generally darker than the applicable sky glow threshold. However, existing conditions at receptors R-22, R-30, R-42, R-43, and R-49 (5 of the 16 receptors) are brighter than the applicable E1 sky glow threshold. As discussed in the in the noise and light baseline study (Annex II), elevated sky glow levels in the light study area likely result from the combined influence of aurora activity during the field study and the presence of Fort McMurray approximately 180 km southwest of the light study area.

At the five receptors (R-22, R-30, R-42, R-43, and R-49) with elevated sky glow, the difference between the measured sky glow and the E1 threshold is 0.1 mag/arcsec^2 (i.e., 19.9 mag/arcsec^2 measurement vs. 20 mag/arcsec^2 threshold). This is less than the magnitude of the difference in sky glow observed under different environmental conditions at these same receptors. For example, the difference between the brightest and darkest skies at R-22/Light 8 was observed to be 1.7 mag/arcsec^2 (i.e., 19.9 mag/arcsec^2 for summertime clear vs. 21.6 mag/arcsec^2 for wintertime cloudy). This suggests the magnitude of elevated sky glow at receptors R-22, R-30, R-42, R-43, and R-49 can be considered small within the context of variability in the existing environment.

Table 3-2: Existing Sky Glow Levels

Receptor Identification Code	Representative Baseline Measurement Station	Summertime Clear Skies			Existing Sky Glow[a] (mag/arcsec^2)		
		Existing Sky Glow[a] (mag/arcsec^2)	Sky Glow Threshold[b] (mag/arcsec^2)	Comment	Summertime Cloudy Skies	Wintertime Cloudy Skies	Wintertime Clear Skies
R-04	Light 5	20.5	20	Existing conditions are darker than threshold	19.8	20.8	20.1
R-05	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-06	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-07	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-08	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-09	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-22	Light 8	19.9	20	Existing conditions are brighter than threshold	20.6	21.6	20.3
R-26	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-30	Light 8	19.9	20	Existing conditions are brighter than threshold	20.6	21.6	20.3
R-31	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-40	Light 5	20.5	20	Existing conditions are darker than threshold	19.8	20.8	20.1
R-41	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-42	Light 8	19.9	20	Existing conditions are brighter than threshold	20.6	21.6	20.3
R-43	Light 8	19.9	20	Existing conditions are brighter than threshold	20.6	21.6	20.3
R-48	Light 9	20.1	20	Existing conditions are darker than threshold	20.7	20.8	20.7
R-49	Light 8	19.9	20	Existing conditions are brighter than threshold	20.6	21.6	20.3

a) Existing light trespass levels were measured during a baseline field program (Annex II).

b) Sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). These thresholds are applicable under summertime conditions with clear skies; there are no sky glow thresholds applicable to other environmental conditions.

mag/arcsec^2 = magnitude per square second of arc.

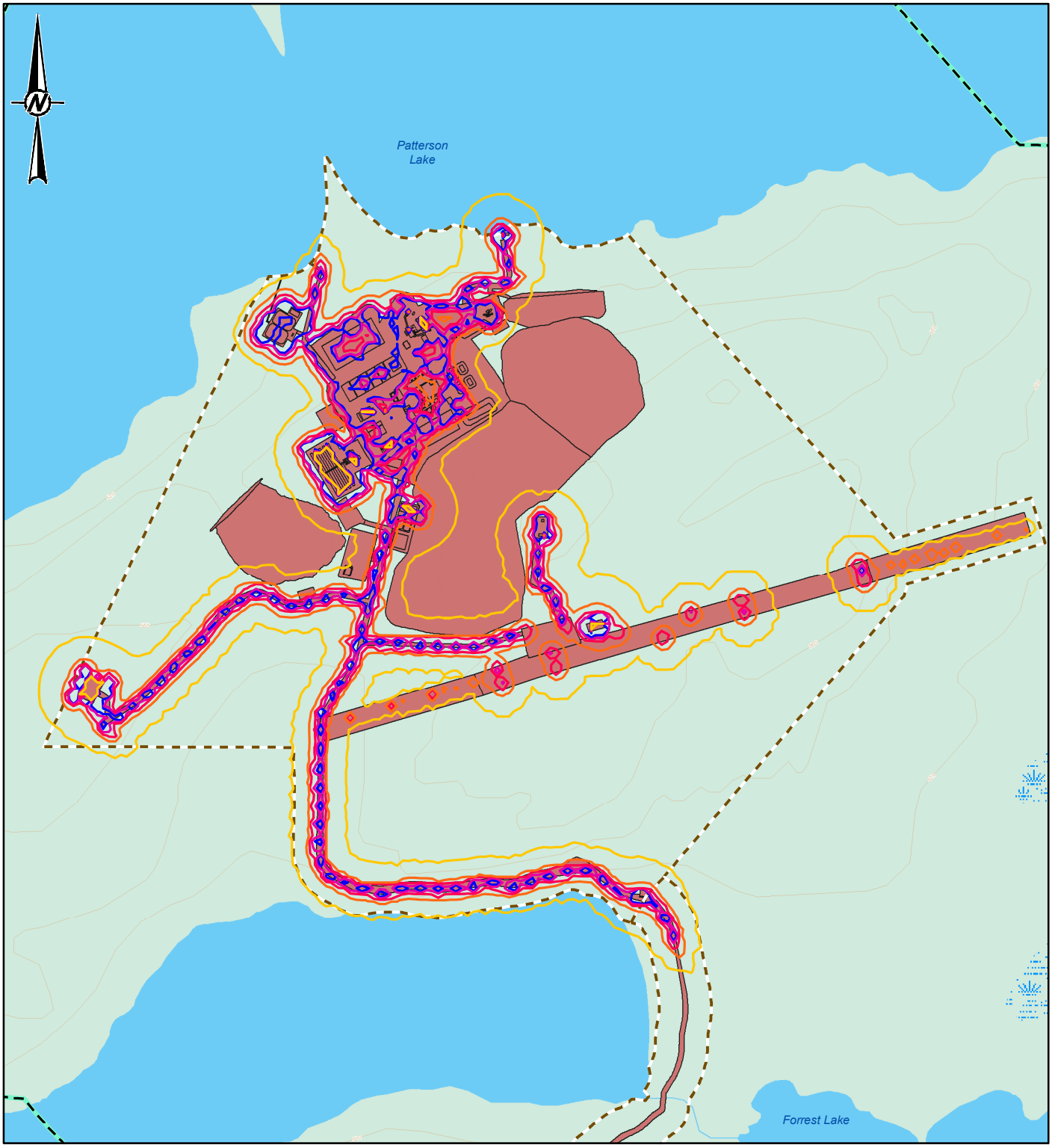
3.2 Application Case

3.2.1 Construction

Figure 3-1 presents a light trespass contour map showing predicted light trespass levels for the Project during Construction. As shown in Figure 3-1 light trespass from Construction is predicted to be primarily confined to the maximum disturbance area. However, there are several places where light trespass is predicted to extend beyond the maximum to the area by up to 200 m (e.g., adjacent the surface explosives magazine, intake water facility, and gatehouse).

For each of the 16 receptors considered in the light analysis, Table 3-3 presents predicted Application Case cumulative light trespass levels during Construction. Application Case cumulative light trespass levels were calculated by summing predictions from the AGi32 light trespass model of Construction with existing light trespass levels (Table 3-2).

Table 3-3 also compares Application Case cumulative light trespass levels during Construction to the light trespass threshold applicable to environmental light zone E1 (CIE 2017). Table 3-3 shows that Application Case cumulative light trespass levels during Project Construction are predicted to comply with the applicable light trespass threshold. Moreover, Table 3-3 shows that Application Case cumulative light trespass levels during Construction would be effectively identical to existing light trespass levels; in other words, Construction would result in no change to existing light trespass levels at receptors in the light study area. This result does not mean that artificial light associated with Construction would not be visible in the light study area. Project lights would be visible from any location where there is direct line of sight. However, artificial light associated with Construction would not result in increased illumination at receptors in the light study area.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- MAXIMUM DISTURBANCE AREA
- PROPOSED PROJECT FOOTPRINT
- LIGHT LOCAL STUDY AREA

PREDICTED LIGHT TRESPASS LEVEL [LUX]

- 0.001 LUX
- 0.1 LUX
- 1 LUX
- 5 LUX
- 10 LUX

0 0.6 1.2
1:24,000 KILOMETRES

PROJECT
NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LIGHT TRESPASS - PROJECT CONSTRUCTION

CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT		20144150	PHASE	3102 - 3
DESIGN	VY	2022-03-02	SCALE AS SHOWN	REV. 0
GIS	NO	2022-03-02		
CHECK	VY	2022-03-02		
REVIEW	AF	2022-03-02		

FIGURE 3-1

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

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\NoiseLight\AssessmentTechnicalSupportDocumentFigures\20144150_Fig3-1_RookI_Light_Trespass_Project_Construction_Phase_Rev0.mxd PRINTED ON: 2022-03-02 AT: 3:13:26 PM

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

0 25mm

Table 3-3: Application Case Cumulative Light Trespass Levels during Construction

Receptor Identification Code	Existing Light Trespass Level (mlux)				Predicted Light Trespass from Project Construction (mlux)	Cumulative Light Trespass Level (mlux)				Light Trespass Threshold[(a)] (mlux)
	Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies		Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies	
R-04	6	3	1	3	0	6	3	1	3	100
R-05	3	4	22	4	0	3	4	22	4	100
R-06	3	4	22	4	0	3	4	22	4	100
R-07	3	4	22	4	0	3	4	22	4	100
R-08	3	4	22	4	0	3	4	22	4	100
R-09	3	4	22	4	0	3	4	22	4	100
R-22	0	0	1	3	0	0	0	1	3	100
R-26	3	4	22	4	0	3	4	22	4	100
R-30	0	0	1	3	0	0	0	1	3	100
R-31	3	4	22	4	0	3	4	22	4	100
R-40	6	3	1	3	0	6	3	1	3	100
R-41	3	4	22	4	0	3	4	22	4	100
R-42	0	0	1	3	0	0	0	1	3	100
R-43	0	0	1	3	0	0	0	1	3	100
R-48	3	4	22	4	0	3	4	22	4	100
R-49	0	0	1	3	0	0	0	1	3	100

a) Light trespass threshold applicable to environmental lighting zone E1 (CIE 2017).
mlux = millilux (0.001 lumen per square metre).

For each of the 16 receptors considered in the light analysis, Table 3-4 presents predicted Application Case cumulative sky glow levels during Construction. Application Case cumulative sky glow levels were calculated by summing predictions from the Garstang (1986) sky glow model of Construction with existing sky glow levels (Table 3-2). Note that sky glow levels are expressed in units (mag/arcsec^2) that do not sum in the conventional manner. For example, 20.5 mag/arcsec^2 + 20.6 mag/arcsec^2 = 19.8 mag/arcsec^2 (not 41.1 mag/arcsec^2).

As discussed in Section 2.5.1, Inputs and Assumptions, sky glow levels were predicted for summertime clear skies and wintertime clear skies. The Garstang model cannot predict sky glow during cloudy periods, so these conditions were not considered in the analysis. As discussed in Section 2.1.1, the ILP sky glow threshold only applies to summertime clear skies, so the inability to predict sky glow under cloudy skies does not limit the validity of the light analysis.

For the summertime clear skies modelling scenario, Table 3-4 compares Application Case cumulative sky glow levels during Construction to the sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). Results presented in Table 3-4 suggest Application Case cumulative sky glow levels during Construction would result in skies brighter than the E1 threshold for 15 of the 16 receptors considered in the light analysis. For context, note that existing sky glow levels at five receptors (R-22, R-30, R-42, R-43, and R-49) already exceed the E1 threshold (Table 3-2). Also, note that the maximum difference between the predicted sky glow level in Table 3-4 and the E1 threshold is 1.4 mag/arcsec^2 (receptor R-48), which is less than the 1.7 mag/arcsec^2 difference between existing sky glow levels under summertime clear skies and wintertime cloudy skies (Table 3-2). This suggests the magnitude of the elevated sky glow predicted for the Application Case can be considered small within the context of variability in the existing environment. Moreover, none of the Application Case cumulative sky glow predicted for Construction is brighter than the 15 mag/arcsec^2 threshold that applies to environmental lighting zone E2. In other words, the ILP would consider sky glow associated with Construction to be reasonable and acceptable for a sparsely inhabited rural area (ILP 2020).

Table 3-4: Application Case Cumulative Sky Glow Levels during Construction

Receptor Identification Code	Summertime Clear Skies					Wintertime Clear Skies		
	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from the Construction (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)	Sky Glow Threshold[(a)] (mag/arcsec^2)	Comment	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from Construction (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)
R-04	20.5	20.6	19.8	20	Brighter than threshold	20.1	19.4	18.9
R-05	20.1	20.4	19.5	20	Brighter than threshold	20.7	19.3	19.0
R-06	20.1	20.6	19.6	20	Brighter than threshold	20.7	19.5	19.2
R-07	20.1	21.9	19.9	20	Brighter than threshold	20.7	20.8	20.0
R-08	20.1	20.8	19.6	20	Brighter than threshold	20.7	19.7	19.3
R-09	20.1	19.9	19.2	20	Brighter than threshold	20.7	18.7	18.5
R-22	19.9	19.8	19.1	20	Brighter than threshold	20.3	18.6	18.4
R-26	20.1	19.9	19.2	20	Brighter than threshold	20.7	18.7	18.5
R-30	19.9	19.5	18.9	20	Brighter than threshold	20.3	18.3	18.1
R-31	20.1	19.9	19.2	20	Brighter than threshold	20.7	18.7	18.5
R-40	20.5	21.5	20.1	20	Darker than threshold	20.1	20.4	19.5
R-41	20.1	19.6	19.1	20	Brighter than threshold	20.7	18.4	18.3
R-42	19.9	20.1	19.2	20	Brighter than threshold	20.3	19.0	18.7
R-43	19.9	20.6	19.4	20	Brighter than threshold	20.3	19.4	19.0
R-48	20.1	18.9	18.6	20	Brighter than threshold	20.7	17.7	17.6
R-49	19.9	19.6	19.0	20	Brighter than threshold	20.3	18.4	18.2

a) Sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). These thresholds are applicable under summertime conditions with clear skies.

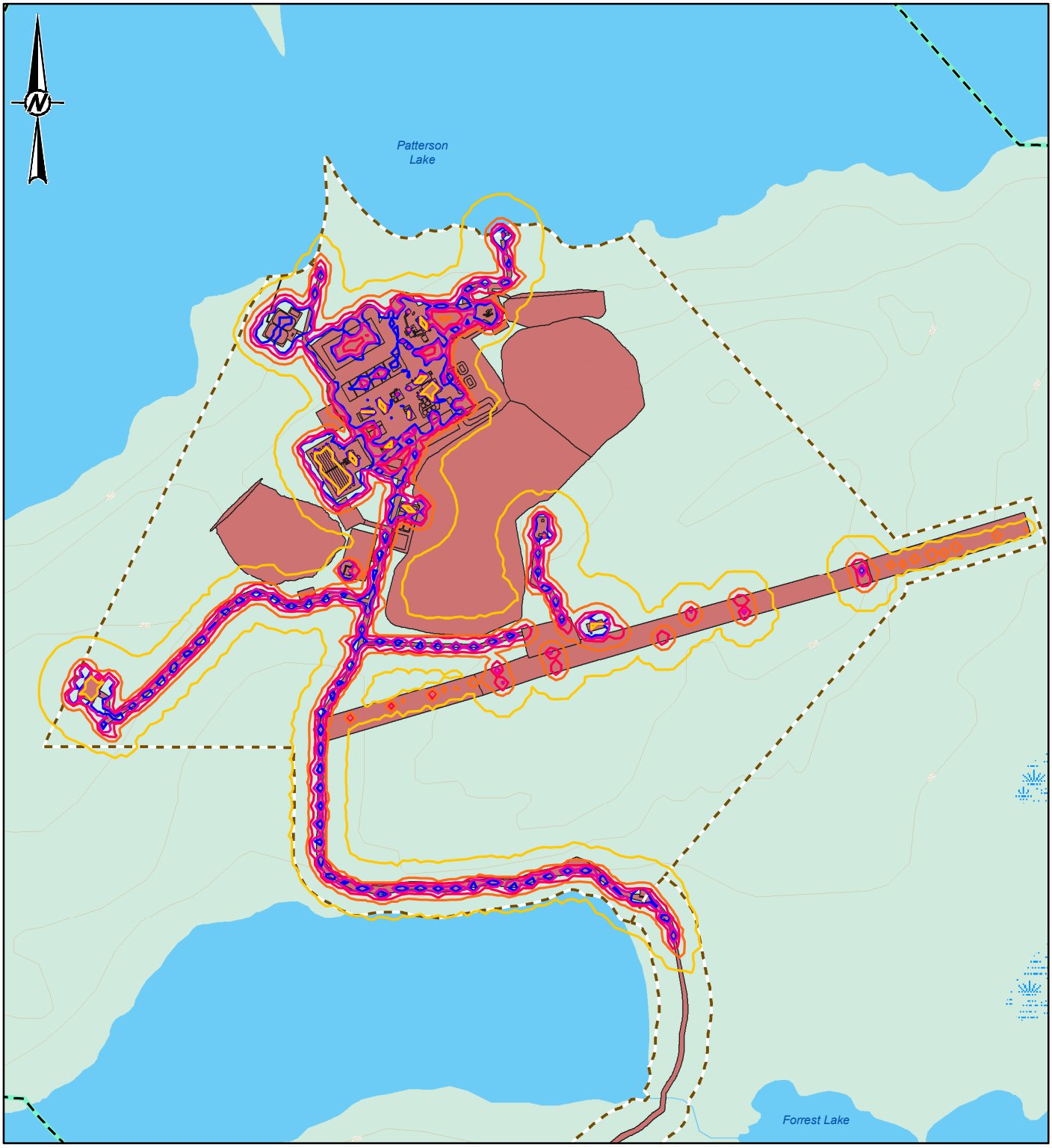
mag/arcsec^2 = magnitude per square second of arc.

3.2.2 Operations

Figure 3-2 presents a light trespass contour map showing predicted light trespass levels for the Project during Operations. As shown in Figure 3-2, light trespass from Operations is predicted to be primarily confined to the maximum disturbance area. However, there are several places where light trespass is predicted to extend beyond the maximum disturbance area by up to 200 m (e.g., adjacent the surface explosives magazine, intake water facility, and gatehouse).

For each of the 16 receptors considered in the light analysis, Table 3-5 presents predicted Application Case cumulative light trespass levels during Operations. Application Case cumulative light trespass levels were calculated by summing predictions from the AGi32 light trespass model of Operations with existing light trespass levels (Table 3-2).

Table 3-5 also compares Application Case cumulative light trespass levels during Operations to the light trespass threshold applicable to environmental light zone E1 (CIE 2017). Table 3-5 shows that Application Case cumulative light trespass levels during Operations are predicted to comply with the applicable light trespass threshold. Moreover, Table 3-5 shows that Application Case cumulative light trespass levels during Operations would be effectively identical to existing light trespass levels; in other words, Operations would result in no change to existing light trespass levels at receptors in the light study area. This result does not mean that artificial light associated with Operations would not be visible in the light study area. Project lights would be visible from any location where there is direct line of sight. However, artificial light associated with Operations would not result in increased illumination at receptors in the light study area.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- MAXIMUM DISTURBANCE AREA
- PROPOSED PROJECT FOOTPRINT
- LIGHT LOCAL STUDY AREA

PREDICTED LIGHT TRESPASS LEVEL [LUX]

- 0.001 LUX
- 0.1 LUX
- 1 LUX
- 5 LUX
- 10 LUX

0 0.6 1.2
1:24,000 KILOMETRES

PROJECT
NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LIGHT TRESPASS - OPERATIONS

CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT		20144150	PHASE	3102 - 3
DESIGN	VY	2022-03-02	SCALE AS SHOWN	REV. 0
GIS	NO	2022-03-02		
CHECK	VY	2022-03-02		
REVIEW	AF	2022-03-02		

FIGURE 3-2

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

Table 3-5: Application Case Cumulative Light Trespass Levels during Operations

Receptor Identification Code	Existing Light Trespass Level (mlux)				Predicted Light Trespass from Operations (mlux)	Cumulative Light Trespass Level (mlux)				Light Trespass Threshold[a] (mlux)
	Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies		Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies	
R-04	6	3	1	3	0	6	3	1	3	100
R-05	3	4	22	4	0	3	4	22	4	100
R-06	3	4	22	4	0	3	4	22	4	100
R-07	3	4	22	4	0	3	4	22	4	100
R-08	3	4	22	4	0	3	4	22	4	100
R-09	3	4	22	4	0	3	4	22	4	100
R-22	0	0	1	3	0	0	0	1	3	100
R-26	3	4	22	4	0	3	4	22	4	100
R-30	0	0	1	3	0	0	0	1	3	100
R-31	3	4	22	4	0	3	4	22	4	100
R-40	6	3	1	3	0	6	3	1	3	100
R-41	3	4	22	4	0	3	4	22	4	100
R-42	0	0	1	3	0	0	0	1	3	100
R-43	0	0	1	3	0	0	0	1	3	100
R-48	3	4	22	4	0	3	4	22	4	100
R-49	0	0	1	3	0	0	0	1	3	100

a) Light trespass threshold applicable to environmental lighting zone E1 (CIE 2017).
mlux = millilux (0.001 lumen per square metre).

For each of the 16 receptors considered in the light analysis, Table 3-6 presents predicted Application Case cumulative sky glow levels during Operations. Application Case cumulative sky glow levels were calculated by summing predictions from the Garstang (1986) sky glow model of Operations with existing sky glow levels (Table 3-2). Note that sky glow levels are expressed in units (mag/arcsec^2) that do not sum in the conventional manner. For example, 20.5 mag/arcsec^2 + 20.5 mag/arcsec^2 = 19.7 mag/arcsec^2 (not 41.0 mag/arcsec^2).

As discussed in Section 2.5.1, sky glow levels were predicted for summertime clear skies and wintertime clear skies. The Garstang model cannot predict sky glow during cloudy periods, so these conditions were not considered in the analysis. As discussed in Section 2.1.1, the ILP sky glow threshold only applies to summertime clear skies, so the inability to predict sky glow under cloudy skies does not limit the validity of the light analysis.

For the summertime clear skies modelling scenario, Table 3-6 compares Application Case cumulative sky glow levels during Operations to the sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). Results presented in Table 3-6 suggest Application Case cumulative sky glow levels during Operations would result in skies brighter than the E1 threshold for 15 of the 16 receptors considered in the light analysis. For context, note that existing sky glow levels at five receptors (R-22, R-30, R-42, R-43, and R-49) already exceed the E1 threshold (Table 3-2). Also, note that the maximum difference between the predicted sky glow level in Table 3-6 and the E1 threshold is 1.4 mag/arcsec^2 (receptor R-48), which is less than the 1.7 mag/arcsec^2 difference between existing sky glow levels under summertime clear skies and wintertime cloudy skies (Table 3-2). This suggests the magnitude of the elevated sky glow predicted for the Application Case can be considered small within the context of variability in the existing environment. Moreover, none of the Application Case cumulative sky glow predicted for Operations is brighter than the 15 mag/arcsec^2 threshold that applies to environmental lighting zone E2. In other words, the ILP would consider sky glow associated with Operations to be reasonable and acceptable for a sparsely inhabited rural area (ILP 2020).

Table 3-6: Application Case Cumulative Sky Glow Levels during Operations

Receptor Identification Code	Summertime Clear Skies					Wintertime Clear Skies		
	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from Operations (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)	Sky Glow Threshold[a] (mag/arcsec^2)	Comment	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from Operations (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)
R-04	20.5	20.5	19.7	20	Brighter than threshold	20.1	19.4	18.9
R-05	20.1	20.4	19.5	20	Brighter than threshold	20.7	19.2	19.0
R-06	20.1	20.6	19.6	20	Brighter than threshold	20.7	19.4	19.1
R-07	20.1	21.8	19.9	20	Brighter than threshold	20.7	20.7	19.9
R-08	20.1	20.8	19.6	20	Brighter than threshold	20.7	19.6	19.3
R-09	20.1	19.8	19.2	20	Brighter than threshold	20.7	18.7	18.5
R-22	19.9	19.7	19.0	20	Brighter than threshold	20.3	18.6	18.4
R-26	20.1	19.8	19.2	20	Brighter than threshold	20.7	18.6	18.5
R-30	19.9	19.4	18.9	20	Brighter than threshold	20.3	18.2	18.1
R-31	20.1	19.9	19.2	20	Brighter than threshold	20.7	18.7	18.5
R-40	20.5	21.5	20.1	20	Darker than threshold	20.1	20.3	19.4
R-41	20.1	19.5	19.0	20	Brighter than threshold	20.7	18.3	18.2
R-42	19.9	20.1	19.2	20	Brighter than threshold	20.3	18.9	18.6
R-43	19.9	20.5	19.4	20	Brighter than threshold	20.3	19.4	19.0
R-48	20.1	18.9	18.6	20	Brighter than threshold	20.7	17.7	17.6
R-49	19.9	19.5	18.9	20	Brighter than threshold	20.3	18.3	18.1

a) Sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). These thresholds are applicable under summertime conditions with clear skies.
mag/arcsec^2 = magnitude per square second of arc.

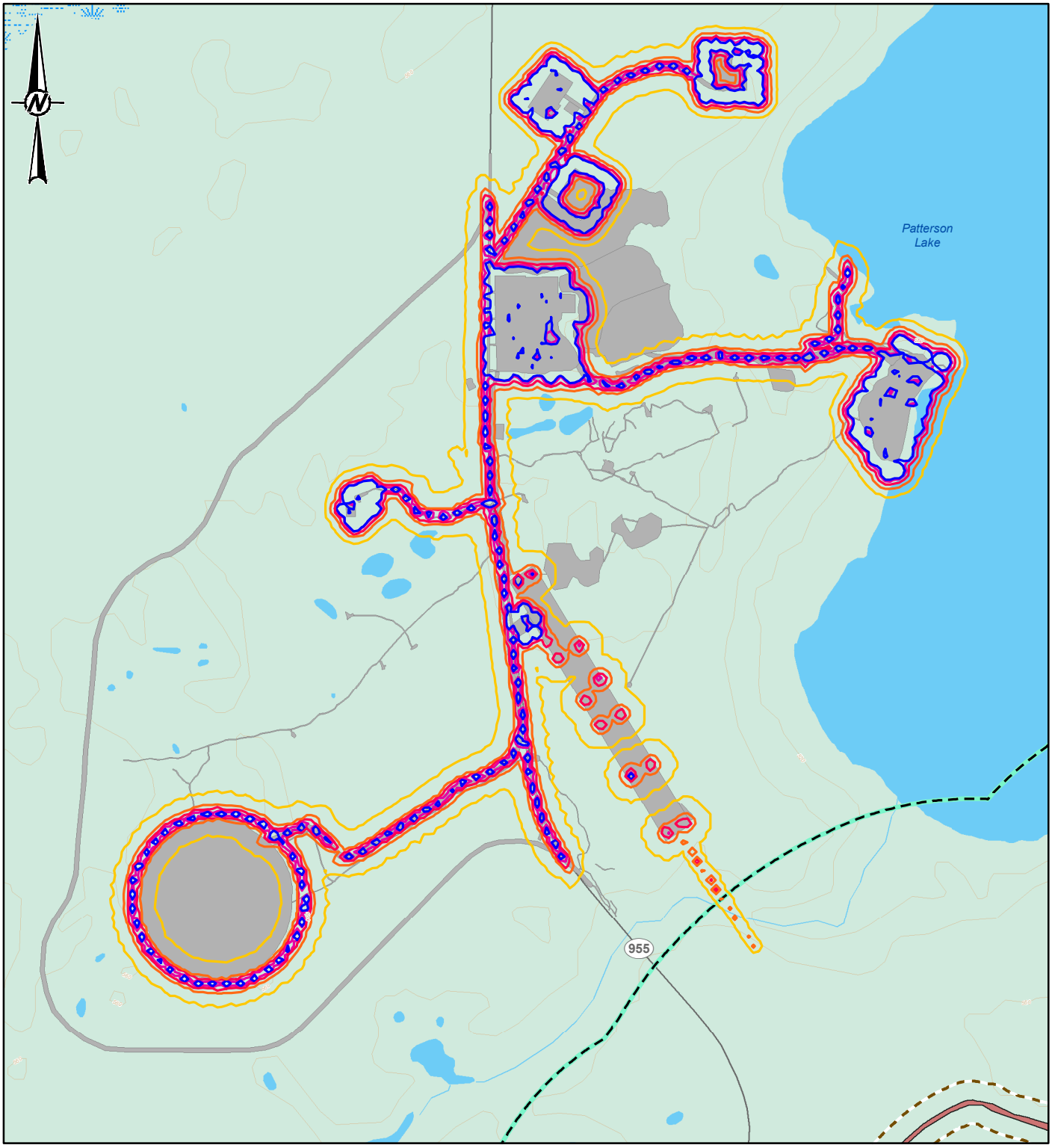
3.3 Reasonably Foreseeable Development Case

Figure 3-3 presents a light trespass contour map showing predicted light trespass levels associated with the Fission Patterson Lake South Property. As shown in Figure 3-3, light trespass from the Fission Patterson Lake South Property is predicted to be confined to an area with approximately 200 m of the Fission Patterson Lake South Property footprint.

For each of the 16 receptors considered in the light analysis, Table 3-7 presents predicted RFD Case cumulative light trespass levels during Construction. These RFD Case cumulative light trespass levels were calculated by summing predictions from the AGi32 light trespass models of Construction and the Fission Patterson Lake South Property with existing light trespass levels (Table 3-2).

For each of the 16 receptors considered in the light analysis, Table 3-7 presents predicted RFD Case cumulative light trespass levels during Operations. These RFD Case cumulative light trespass levels were calculated by summing predictions from the AGi32 light trespass models of Operations and the Fission Patterson Lake South Property with existing light trespass levels (Table 3-2).

Table 3-7 and Table 3-8 also compare RFD Case cumulative light trespass levels to the light trespass threshold applicable to environmental light zone E1 (CIE 2017). Table 3-7 and Table 3-8 show that RFD Case cumulative light trespass levels are predicted to comply with the applicable light trespass threshold. Moreover, Table 3-7 and Table 3-8 show that RFD Case cumulative light trespass levels are effectively identical to existing light trespass levels; in other words, the Project and the Fission Patterson Lake South Property would result in no change to existing light trespass levels at receptors in the light study area. This result does not mean that artificial light associated with the Project or Fission Patterson Lake South Property would not be visible in the light study area. Artificial lights would be visible from any location where there is direct line of sight. However, artificial light associated with the Project and the Fission Patterson Lake South Property would not result in increased illumination at receptors in the light study area.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- MAXIMUM DISTURBANCE AREA
- PROPOSED PROJECT FOOTPRINT
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- LIGHT LOCAL STUDY AREA

PREDICTED LIGHT TRESPASS LEVEL [LUX]

- 0.001 LUX
- 0.1 LUX
- 1 LUX
- 5 LUX
- 10 LUX

0 0.8 1.6
1:30,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LIGHT TRESPASS - FISSION PATTERSON LAKE SOUTH PROPERTY

CONSULTANT

GOLDER MEMBER OF WSP

PROJECT		20144150	PHASE	3102 - 3
DESIGN	VY	2022-03-02	SCALE AS SHOWN	REV. 0
GIS	NO	2022-03-02		
CHECK	VY	2022-03-02		
REVIEW	AF	2022-03-02		

FIGURE 3-3

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

25mm

0

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\Noise\Light\AssessmentTechnicalSupportDocumentFigures\20144150_Fig3-3_Rook_Light_Trespass_Project_Patterson Lake South Property_Rev0.mxd PRINTED ON: 2022-03-02 AT: 3:11:41 PM

Table 3-7: Reasonably Foreseeable Development Case Cumulative Light Trespass Levels during Construction

Receptor Identification Code	Existing Light Trespass Level (mlux)				Predicted Light Trespass from Construction (mlux)	Predicted Light Trespass from Fission Patterson Lake South Property (mlux)	Cumulative Light Trespass Level (mlux)				Light Trespass Threshold[a] (mlux)
	Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies			Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies	
R-04	6	3	1	3	0	0	6	3	1	3	100
R-05	3	4	22	4	0	0	3	4	22	4	100
R-06	3	4	22	4	0	0	3	4	22	4	100
R-07	3	4	22	4	0	0	3	4	22	4	100
R-08	3	4	22	4	0	0	3	4	22	4	100
R-09	3	4	22	4	0	0	3	4	22	4	100
R-22	0	0	1	3	0	0	0	0	1	3	100
R-26	3	4	22	4	0	0	3	4	22	4	100
R-30	0	0	1	3	0	0	0	0	1	3	100
R-31	3	4	22	4	0	0	3	4	22	4	100
R-40	6	3	1	3	0	0	6	3	1	3	100
R-41	3	4	22	4	0	0	3	4	22	4	100
R-42	0	0	1	3	0	0	0	0	1	3	100
R-43	0	0	1	3	0	0	0	0	1	3	100
R-48	3	4	22	4	0	0	3	4	22	4	100
R-49	0	0	1	3	0	0	0	0	1	3	100

a) Light trespass threshold applicable to environmental lighting zone E1 (CIE 2017).
mlux = millilux (0.001 lumen per square metre).

Table 3-8: Reasonably Foreseeable Development Case Cumulative Light Trespass Levels during Operations

Receptor Identification Code	Existing Light Trespass Level (mlux)				Predicted Light Trespass from Operations (mlux)	Predicted Light Trespass from Fission Patterson Lake South Property (mlux)	Cumulative Light Trespass Level (mlux)				Light Trespass Threshold[a] (mlux)
	Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies			Summertime Cloudy Skies	Summertime Clear Skies	Wintertime Cloudy Skies	Wintertime Clear Skies	
R-04	6	3	1	3	0	0	6	3	1	3	100
R-05	3	4	22	4	0	0	3	4	22	4	100
R-06	3	4	22	4	0	0	3	4	22	4	100
R-07	3	4	22	4	0	0	3	4	22	4	100
R-08	3	4	22	4	0	0	3	4	22	4	100
R-09	3	4	22	4	0	0	3	4	22	4	100
R-22	0	0	1	3	0	0	0	0	1	3	100
R-26	3	4	22	4	0	0	3	4	22	4	100
R-30	0	0	1	3	0	0	0	0	1	3	100
R-31	3	4	22	4	0	0	3	4	22	4	100
R-40	6	3	1	3	0	0	6	3	1	3	100
R-41	3	4	22	4	0	0	3	4	22	4	100
R-42	0	0	1	3	0	0	0	0	1	3	100
R-43	0	0	1	3	0	0	0	0	1	3	100
R-48	3	4	22	4	0	0	3	4	22	4	100
R-49	0	0	1	3	0	0	0	0	1	3	100

a) Light trespass threshold applicable to environmental lighting zone E1 (CIE 2017).
mlux = millilux (0.001 lumen per square metre).

For each of the 16 receptors considered in the light analysis, Table 3-9 presents predicted RFD Case cumulative sky glow levels during Construction. These RFD Case cumulative sky glow levels were calculated by summing predictions from the Garstang (1986) sky glow models of Construction and the Fission Patterson Lake South Property with existing sky glow levels (Table 3-2).

For each of the 16 receptors considered in the light analysis, Table 3-10 presents predicted RFD Case cumulative sky glow levels during Operations. These RFD Case cumulative sky glow levels were calculated by summing predictions from the Garstang (1986) sky glow models of Operations and the Fission Patterson Lake South Property with existing sky glow levels (Table 3-2).

As discussed in Section 2.5.1, sky glow levels were predicted for summertime clear skies and wintertime clear skies. The Garstang model cannot predict sky glow during cloudy periods, so these conditions were not considered in the analysis. As discussed in Section 2.1.1, the ILP sky glow threshold only applies to summertime clear skies, so the inability to predict sky glow under cloudy skies does not limit the validity of the light analysis.

For the summertime clear skies modelling scenario, Table 3-9 and Table 3-10 compare RFD Case cumulative sky glow levels to the sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). Results presented in Table 3-9 and Table 3-10 suggest RFD Case cumulative sky glow levels would result in skies brighter than the E1 threshold for all 16 receptors considered in the light analysis. For context, note that existing sky glow levels at five receptors (R-22, R-30, R-42, R-43, and R-49) already exceed the E1 threshold (Table 3-2). Also, note that the maximum difference between the predicted sky glow level in Table 3-9 or Table 3-10 and the E1 threshold is 1.9 mag/arcsec^2 (receptor R-22), which is very close to the 1.7 mag/arcsec^2 difference between existing sky glow levels under summertime clear skies and wintertime cloudy skies (Table 3-2). This suggests the magnitude of the elevated sky glow predicted for the RFD Case can be considered small within the context of variability in the existing environment. Moreover, none of the RFD Case cumulative sky glow is predicted to be brighter than the 15 mag/arcsec^2 threshold that applies to environmental lighting zone E2. In other words, the ILP would consider cumulative sky glow associated with the Project and the Fission Patterson Lake South Property to be reasonable and acceptable for a sparsely inhabited rural area (ILP 2020).

Table 3-9: Reasonably Foreseeable Development Case Cumulative Sky Glow Levels during Construction

Receptor Identification Code	Summertime Clear Skies						Wintertime Clear Skies			
	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from Construction (mag/arcsec^2)	Predicted Sky Glow from the Fission Patterson Lake South Property (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)	Sky Glow Threshold[(a)] (mag/arcsec^2)	Comment	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from Construction (mag/arcsec^2)	Predicted Sky Glow from the Fission Patterson Lake South Property (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)
R-04	20.5	20.6	20.7	19.4	20	Brighter than threshold	20.1	19.4	19.5	18.4
R-05	20.1	20.4	21.6	19.3	20	Brighter than threshold	20.7	19.3	20.4	18.8
R-06	20.1	20.6	21.7	19.4	20	Brighter than threshold	20.7	19.5	20.5	18.9
R-07	20.1	21.9	22.9	19.8	20	Brighter than threshold	20.7	20.8	21.7	19.8
R-08	20.1	20.8	21.9	19.5	20	Brighter than threshold	20.7	19.7	20.7	19.1
R-09	20.1	19.9	20.7	19.0	20	Brighter than threshold	20.7	18.7	19.4	18.1
R-22	19.9	19.8	18.7	18.1	20	Brighter than threshold	20.3	18.6	17.4	17.0
R-26	20.1	19.9	21.0	19.0	20	Brighter than threshold	20.7	18.7	19.8	18.2
R-30	19.9	19.5	19.0	18.2	20	Brighter than threshold	20.3	18.3	17.7	17.1
R-31	20.1	19.9	20.7	19.0	20	Brighter than threshold	20.7	18.7	19.5	18.2
R-40	20.5	21.5	20.1	19.4	20	Brighter than threshold	20.1	20.4	18.9	18.4
R-41	20.1	19.6	21.5	19.0	20	Brighter than threshold	20.7	18.4	20.3	18.1
R-42	19.9	20.1	19.2	18.5	20	Brighter than threshold	20.3	19.0	17.9	17.5
R-43	19.9	20.6	20.8	19.2	20	Brighter than threshold	20.3	19.4	19.6	18.5
R-48	20.1	18.9	19.5	18.2	20	Brighter than threshold	20.7	17.7	18.3	17.2
R-49	19.9	19.6	19.0	18.2	20	Brighter than threshold	20.3	18.4	17.8	17.2

a) Sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). These thresholds are applicable under summertime conditions with clear skies.
mag/arcsec^2 = magnitude per square second of arc.

Table 3-10: Reasonably Foreseeable Development Case Cumulative Sky Glow Levels during Operations

Receptor Identification Code	Summertime Clear Skies						Wintertime Clear Skies			
	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from Operations (mag/arcsec^2)	Predicted Sky Glow from the Fission Patterson Lake South Property (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)	Sky Glow Threshold[(a)] (mag/arcsec^2)	Comment	Existing Sky Glow (mag/arcsec^2)	Predicted Sky Glow from Operations (mag/arcsec^2)	Predicted Sky Glow from the Fission Patterson Lake South Property (mag/arcsec^2)	Cumulative Sky Glow (mag/arcsec^2)
R-04	20.5	20.5	20.7	19.4	20	Brighter than threshold	20.1	19.4	19.5	18.4
R-05	20.1	20.4	21.6	19.3	20	Brighter than threshold	20.7	19.2	20.4	18.7
R-06	20.1	20.6	21.7	19.4	20	Brighter than threshold	20.7	19.4	20.5	18.8
R-07	20.1	21.8	22.9	19.8	20	Brighter than threshold	20.7	20.7	21.7	19.8
R-08	20.1	20.8	21.9	19.5	20	Brighter than threshold	20.7	19.6	20.7	19.0
R-09	20.1	19.8	20.7	18.9	20	Brighter than threshold	20.7	18.7	19.4	18.1
R-22	19.9	19.7	18.7	18.1	20	Brighter than threshold	20.3	18.6	17.4	17.0
R-26	20.1	19.8	21.0	19.0	20	Brighter than threshold	20.7	18.6	19.8	18.2
R-30	19.9	19.4	19.0	18.2	20	Brighter than threshold	20.3	18.2	17.7	17.1
R-31	20.1	19.9	20.7	19.0	20	Brighter than threshold	20.7	18.7	19.5	18.2
R-40	20.5	21.5	20.1	19.4	20	Brighter than threshold	20.1	20.3	18.9	18.4
R-41	20.1	19.5	21.5	18.9	20	Brighter than threshold	20.7	18.3	20.3	18.0
R-42	19.9	20.1	19.2	18.5	20	Brighter than threshold	20.3	18.9	17.9	17.5
R-43	19.9	20.5	20.8	19.1	20	Brighter than threshold	20.3	19.4	19.6	18.5
R-48	20.1	18.9	19.5	18.2	20	Brighter than threshold	20.7	17.7	18.3	17.2
R-49	19.9	19.5	19.0	18.2	20	Brighter than threshold	20.3	18.3	17.8	17.2

a) Sky glow threshold applicable to environmental lighting zone E1 (ILP 2020). These thresholds are applicable under summertime conditions with clear skies.
mag/arcsec^2 = magnitude per square second of arc.

4 KEY FINDINGS

Results from the analyses predict that light trespass from the Project and from the Fission Patterson Lake South Property would be less than light trespass thresholds from the CIE guidance document (CIE 2017). Moreover, light trespass levels at the 16 receptors are predicted to be unchanged as a result of the Project and the proposed Fission Patterson Lake South Property. In other words, cumulative light trespass levels would be equal to existing light trespass levels for all 16 receptors. This result does not mean that artificial light associated with the Project or Fission Patterson Lake South Property would not be visible in the light study area. Artificial lights would be visible from any location where there is direct line of sight. However, artificial light associated with the Project and the Fission Patterson Lake South Property would not result in increased illumination at receptors in the light study area.

Results from the analyses predict that, for some receptors and environmental conditions, sky glow from the Project would be brighter than the ILP threshold applicable to environmental lighting zone E1 – “relatively uninhabited rural area” (ILP 2020). For all receptors, cumulative sky glow from the Project in combination with the Fission Patterson Lake South Property is predicted to be brighter than the E1 threshold.

For context, note that existing sky glow levels at five receptors already exceed the E1 threshold. Also, note that the difference between the predicted sky glow levels and the E1 threshold can be considered small within the context of variability in the existing environment. Moreover, cumulative sky glow from the Project in combination with the Fission Patterson Lake South Property is predicted to be less bright than the ILP threshold applicable to environmental lighting zone E2 – “sparsely inhabited rural area” (ILP 2020). In other words, the ILP would consider cumulative sky glow associated with the Project and the proposed Fission Patterson Lake South Property to be reasonable and acceptable for a sparsely inhabited rural area (ILP 2020).

The significance of potential light effects on VCs is assessed in the following sections of the EIS:

- fish and fish habitat (EIS Section 11);
- wildlife and wildlife habitat (EIS Section 14);
- cultural and heritage resources and Indigenous land and resource use (EIS Section 16); and
- other land and resource use (EIS Section 17).

The light effects analysis achieved the objective of characterizing potential light effects from the Project and the Fission Patterson Lake South Property. Specifically, light trespass and sky glow levels were predicted using computer models and analyzed in the context of thresholds from CIE (2017) and ILP (2020).

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.

Golder Associates Ltd.

Victor Young (M.Sc)
Acoustic Scientist

Andrew Faszer (B.Sc., INCE)
Senior Consultant

VY/AF/MM

STUDY LIMITATIONS

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly

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