Appendix C.2

Light Assessment

Crawford Nickel Project
Technical Data Report – Light Assessment

September 30, 2024

Prepared for:

Canada Nickel Company

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Limitations and Sign-off

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Executive Summary

Canada Nickel Company Incorporated (Canada Nickel) proposes to develop, construct, operate, and progressively reclaim a new open pit nickel mine, collectively known as the Crawford Nickel Project, approximately 42 kilometres (km) north of Timmins, Ontario. The Project includes the development of an Open Pit, Stockpiles, two ore Processing Plants, and other mine related infrastructure, as well as a new rail spur line and the relocation of Highway 655 and an existing 500 kilovolt (kV) transmission line. The Project has an expected Project life of 41 years.

The following Technical Data Report (TDR) consolidates the results of the assessment of the effects of each of the Project components and physical activities, in all phases of the Project, based upon a comparison of baseline environmental, health, social and economic conditions and the predicted future conditions with and without the Project for Lighting. The TDR will inform the completion of the associated Valued Component (VC) chapter and will be appended to the Impact Statement.

This TDR has been prepared pursuant to the *Impact Assessment Act,* 2019 and in consideration of the Tailored Impact Statement Guidelines (TIS Guidelines) for the Project (Appendix A.1 of the Impact Statement).

Lighting for the Project has the potential to affect ambient levels. The assessment characterized baseline ambient light levels in the area around the Project, assessed the potential for light trespass illuminance and glare at the nearest light sensitive receptors and provides recommendations for next steps during the Project lighting design to mitigate against degradation of the ambient light environment.

Baseline lighting conditions were assessed and deemed to be similar to an environmental zone classification of E1 (natural) or E2 (rural) region as defined by the CIE 150:2017, or a rural area with few residences. The existing levels of light pollution are therefore assumed to be very low for trespass, glare, and sky glow. There are few light sensitive receptors in the Local Study Area (LSA), and they are all well removed from the Project with intervening forested areas that will obstruct Project lighting. Thus, no significant adverse impacts from Project light trespass are expected at the receptors.

Design of exterior of lighting systems for the Project will be guided by a strategy based on widely accepted standards and guidelines, including direction of light to limit light trespass, to avoid glare and limit any contribution to skyglow.

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Acronyms and Abbreviations

cd	Candela, SI unit of luminance or luminous intensity
CIE	Commission Internationale de L'Éclairage or International Commission on Illumination
CIE 150:2017	CIE 150:2017 Technical Report: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations, 2nd Edition. Outdoor lighting guideline document.
IAA	*Impact Assessment Act*, 2019
IK	Indigenous knowledge
IPT	In Process Tailings
mag/arcsec^2	Sky Glow in magnitudes per square arcsecond
masl	metres above sea level
MMB	Modelled Mine Boundary
TIS Guidelines	Tailored Impact Statement Guidelines
VC	Valued Component
PA	Project Area
LSA	Local Study Area
Lux	Lux (lx), SI unit of illuminance, 1 lux= 1 lumen/m^2
RSA	Regional Study Area
SAR	Species At Risk
SI	International System of Units
SQM-L	SQM-L Sky Quality Meter with Lens
Stantec	Stantec Consulting Ltd.
TDR	Technical Data Report

UTM	Universal Transverse Mercator

1 Introduction

Canada Nickel proposes to develop, construct, operate, and progressively reclaim a new Open Pit nickel mine and Processing Plant, collectively known as the Crawford Nickel Project, approximately 42 kilometres (km) north of Timmins, Ontario. The Project is being assessed in accordance with the *Impact Assessment Act*, 2019.

Stantec Consulting Ltd. (Stantec) has been retained by Canada Nickel to conduct an assessment of Project lighting. This report provides a lighting assessment based on the proposed Project design and corresponding activities proposed during construction, operations, and decommissioning of the Project.

This Light Assessment Technical Data Report (TDR) has been completed to inform the Impact Statement. It has been prepared pursuant to the *Impact Assessment Act,* 2019 and in consideration of the Tailored Impact Statement Guidelines: Crawford Nickel Project (Appendix A.1 of the Impact Statement [TIS Guidelines]).

1.1 Study Objectives

The Light Assessment will inform the Impact Statement for the Project. Outdoor lighting is essential at industrial developments to provide safe work conditions during nighttime hours and to provide security for the workers and the Project. Light in itself is not a pollutant; however, inappropriately designed lighting or excessive lighting can cause effects that can range from a minor nuisance to a disruptive environmental effect.

The three attributes that are used to describe lighting (and which can cause lighting to become obtrusive if criteria for each of these attributes are not met), are generally referred to as light trespass, glare, and sky glow. These are defined below.

Light Trespass – also known as light spill, refers to the transmission of light from fixtures within a facility to the environment and receptors outside the facility. The International System of Units (SI) unit of measure for light incidence either in or outside the facility is lux (lx). A lux is equal to 1 lumen per square metre (lumen/m^2) where a lumen is a measure of total quantity of visible light emitted by a source, weighted according to the human eye. As an example, the light output in lumens of a 100-watt incandescent (non-halogen) light bulb is 1,600 lumens. The incident light reaches problematic levels, for example, when lights located on the outside of an industrial facility shine in through the windows of nearby residential homes at levels that could disrupt sleep or distract from normal activities. In the middle of the night, light trespass at residential properties should not exceed the recommended maximum level for the environmental zone classification (E0, E1, E2, E3 and E4) of their location, the levels of which range from 0-5 lux (CIE 150:2017).

Glare – is a potential environmental effect where intense, harsh or contrasting lighting conditions reduce humans, birds, and other organisms' ability to see. The most common example of glare is oncoming high-beam headlights that provide ample light but paradoxically result in poor visibility, potentially reaching hazardous conditions. Excessively bright and improperly aimed floodlighting can have similar adverse effects on the perimeter of a project. The units of measure for brightness from sources that can become glare are units of luminance, which are lumens per steradian which equal a candela (cd).

Sky Glow – refers to the illumination of the sky and/or clouds by light sources on the surface of the earth such as street lighting, and haze in the atmosphere that replaces the natural nighttime sky with a translucent to opaque lighted dome. The sky appears to be washed out or brownish-purple and may be devoid of visible stars in the extreme. Sky glow is the cumulative effect of all lights at the surface either emitting upward or being reflected upward by the surface plus the emission from photochemical activity in the atmosphere. The unit of measure for the brightness of the sky, including sky glow, is magnitudes per square arcsecond (mag/arcsec^2). Values for sky glow range from approximately 22 mag/arcsec^2 in a rural environment where stars are abundant, to approximately 18 mag/arcsec^2 in an urban environment where stars are barely visible. The unit is derived from astronomical convention, and magnitudes are inversely directed; that is, a large number is very dim, and a very low number is very bright.

The activities and light fixtures associated with construction and operations of the Project have the potential to alter the nighttime lighting environment. The scope of the Lighting Assessment therefore includes the following:

- characterizing baseline nighttime light levels in the area around the Project under different weather conditions and seasons, before any construction begins
- identify light sensitive receptors in the lighting Local Study Area (LSA)
- assessing the potential impact of light trespass illuminance at the nearby light sensitive receptors due to the Project
- provide recommendations for next steps during the Project lighting design to mitigate against degradation of the ambient light environment and inform the development of a light management plan

1.2 Project Overview

Canada Nickel proposes to develop, construct, operate, and progressively reclaim a new Open Pit nickel mine, collectively known as the Crawford Nickel Project, approximately 42 kilometres (km) north of Timmins, Ontario. The Project includes the development of an Open Pit, Stockpiles, Processing Plant(s), and other mine related infrastructure, as well as a new rail spur line and the relocation of Highway 655 and an existing 500 kilovolt (kV) transmission line. Ore will be extracted from an Open Pit that will be divided into an East Zone and Main Zone. The Project is expected to have a Project life of 41 years.

The Crawford Project site is located approximately 42 km north of the City of Timmins, Ontario, in the geographic townships of Crawford, Carnegie, Kidd, Lucas, Beck, Nesbitt, Wark and Prosser. A small portion of the Project extent within the geographic townships of Kidd and Wark also lies within the municipal boundary of the City of Timmins.

Based on the current Project design, the maximum rate of ore extraction will be up to 240,000 tonnes per day (tpd) during year 5 of operations and an average rate of 160,000 tpd over the life of mine. The two ore processing plants and associated service facilities will process run of mine ore delivered to primary crushers to produce nickel concentrate, iron concentrate, and tailings at a rate of approximately 60,000 tpd at the start of mine life, ramping up to a maximum of 120,000 tpd. In addition to nickel and iron, other metals such as cobalt, chromium, palladium and platinum are expected to be recovered from concentrate streams.

Based on the proposed processing rate and current information regarding the ore body, the current life of the proposed Project is expected to be approximately 41 years. Mining would be completed at a faster pace than milling, thus mining of ore would occur for about 30 years, then milling alone for the last 11 years.

Concentrate from the processing plants will be loaded onto rail cars and shipped via the rail spur line for refinement offsite.

1.3 Key Project Activities

The temporal boundary of the assessment includes all Project phases from the start of construction through to the end of closure. Based on the current Project schedule, the Project phases include:

- Construction (Year -3 to Year -1)
- Operations
  - Operations phase 1 (Year 1 to Year 5); 60 kilotonnes per day (kt/d) milling capacity with ore extraction
  - Operations phase 2 (Year 5 to Year 30); 120 kt/d milling capacity with ore extraction
  - Operations phase 3 (Year 30 to Year 41); 60 kt/d milling capacity with no ore extraction
- Decommissioning and closure
  - Active closure (Year 41 to Year 46)
  - Passive closure (Year 46+)

1.3.1 Construction Phase

The construction phase will include the preparation of the site up to the point at which the first process plant has been commissioned and is ready to commence operations. This phase will include site preparation, physical construction, pre-production, and commissioning activities. Construction is anticipated to begin in the Main Zone and East Zone, and rock extracted at this time may be crushed into aggregate using a mobile aggregate crusher for use during the construction of roads and other infrastructure, as necessary.

It is noted that additional construction will occur through the operations phases of the Project, and that this phase is defined by the start of ore processing.

1.3.2 Operations Phase

The operations phase is focused on the active processing of ore and generation of concentrate for delivery to market, specifically operation of the process plant(s). Due to the sequential nature of the mine operations, the operations phase of the Project has been divided into 3 sub-phases based on the Open Pit extraction schedule and sequential operation of the two Process Plants.

The three sub-phases of the operations phase include:

- Operations phase 1 – This phase includes the operation of the first of two process plants that will be operating at an ore processing capacity of approximately 60 kt/day (or 21.9 Mt/a). In Process Tailings (IPT) carbonation within the process plant may also commence if a CO_2 source is available. Mining operations during this phase will produce more ore than the Process Plant can process, with surplus material to be stockpiled in the East Stockpile location for future processing. Construction will continue during the phase to expand and construct the second Process Plant and other supporting mine infrastructure, including the Highway 655 realignment. Material will begin to be stored within the West Stockpile at the end of this phase.
- Operations phase 2 – This phase includes the operation of both process plants that will be operating at an ore processing capacity of approximately 120 kt/d (or 43.8 Mt/a), including IPT carbonation. Mining operations during this phase will produce up to 240 kt/day, which is more ore than the process plants can process. Low grade ore will continue to be stockpiled in the East and/or the West Ore Stockpiles.
- Operations phase 3 – This phase includes continuation of the operation of both process plants at an ore processing capacity of approximately 120 kt/d (or 43.8 Mt/a) following completion of mining operations (e.g., no further extraction of ore from the Open Pit). The Process Plants, including IPT carbonation, will continue to operate by processing the ore stockpiled during operations phase 1 and 2. As mine operations cease, there will be an opportunity for progressive reclamation of the pits, haul routes, and other infrastructures no longer used areas of the Project site.

1.3.3 Decommissioning and Closure Phase

Following the completion of ore processing, all Project operations will cease, and active closure will commence. Active closure includes the removal of buildings, structures, and other infrastructure, as well as reclamation and site stabilization activities. Once complete, the Project will then enter a passive closure phase as the pit lake fills. During this time, closure monitoring and adaptive mitigation will occur. Following pit lake filling, the Project site will be permanently closed.

Activities completed during the decommissioning and closure phase of the Project are focused on reclaiming the environments, establishing physical, chemical, and biological stability at the site, and to meet desired end land functions and uses. The Mine Development Closure Plan (refer to Appendix F of the Impact Statement for the Conceptual Closure Plan) will be updated throughout the life of the Project as necessary to reflect the environmental requirements in place at the time of closure. The Closure Plan will be prepared, refined, and implemented in accordance with the Ontario *Mining Act* and Ontario Regulation 35/24.

Progressive reclamation throughout the course of the mine life will occur, but the majority of the closure activities will commence at the cessation of mining activities and will be completed during the five year period after ore processing ceases. Ongoing closure monitoring and maintenance activities will be carried out throughout active and passive closure phases until the closure objectives have been satisfied and the Project has been moved to a closed out and abandoned status.

2 Study Area

The Project comprises approximately 11,785 hectares (ha) (118 square kilometres [km^2]) along Highway 655 approximately 42 km north of the City of Timmins, Ontario. The Project is located within geographic townships of Crawford, Carnegie, Kidd, Lucas, Beck, Nesbitt, Wark and Prosser. The proposed Highway 655 realignment and rail spur line extend into the geographic Townships of Kidd and Wark (which are considered to be part of the City of Timmins).

2.1 Project Area

The **Project Area (PA)** encompasses the project footprint and is the anticipated area of physical disturbance associated with the construction, operation, and decommissioning/closure of the Project. Further, the PA is the footprint of the sites where permanent lighting, construction lighting, or regular heavy vehicles, with lights, are routinely operated. The PA is shown on Figure A.1 of this report.

2.2 Local Study Area

The **Local Study Area (LSA)** for lighting is defined as the area where there is potential for lighting effects on the environment from the Project. The LSA for lighting was selected to extend beyond the reasonably expected propagation limits of Project lighting sources. This extent considered structures, topography, and foliage that could affect light propagation. The LSA for lighting is defined as 5 km from the boundary of the PA and is shown in Figure A.1 of this report. The LSA contains the PA.

2.3 Regional Study Area

The **Regional Study Area (RSA)** for lighting is defined as the areas within which the Project will be developed, and the surrounding areas which have the potential to experience environmental effects from construction and operation of the Project. The RSA contains the LSA and, in turn, the PA. Since light intensity decreases rapidly with distance, the RSA for the purpose of the lighting study can be considered the same as the LSA.

2.4 Light Sensitive Receptors

A listing of current light sensitive receptors is provided in Table 2-1. Also indicated in this table is the distance from each receptor to the processing plants, which will have outdoor lighting, and the Impoundment Facility. Their locations are shown in Figure A.2 of this report.

It is noted that Canada Nickel will impose the following restrictions within the Modelled Mine Boundary (Figure A.2) and at receptors R1 and R5:

- Agreements with property owners within the restricted area to remove buildings (through acquisition of the property or other arrangements)
- Agreements with other individual landowners to prevent construction of any seasonal or permanent housing through acquisition or specific agreements to defer any construction until after mine operations are completed
- Crown Leases to be obtained on Crown lands, to restrict access
- In addition to the receptor specific mitigations listed above, the following general mitigation are proposed:
  - Install signage and/or gates on trails to restrict access into the Modelled Mine Boundary (MMB) (agreement with landowners if needed to place the signs)
  - Prohibit overnight stays in warming huts except in cases of emergency along the snowmobile trail (signage for warming huts to be installed)

Receptors R2 to R4 are within the MMB that will demark an area around the PA in which Canada Nickel will limit access, including no overnight stays. These receptors will therefore not be light-sensitive locations during construction or operations of the mine.

The nearest light sensitive receptor will be a Sensitive Receptor - Indigenous (R8) about 5.7 km to the west of the Process Plant Area and at least 7.3 km from the Impoundment Facility. The nearest receptor with continuous occupancy will be the campground at Big Water Lake (R6), which is about 24.5 km from the Process Plant Area and 28 km from the Impoundment Facility and is outside the LSA.

Wildlife and birds, including Blanding's turtle, several bat species, as well as several bird species at risk have been confirmed in the area, while others have potential to be present.

Table 2.1 Light Sensitive Receptors in the Vicinity of the PA

Rec #	Receptor Description	UTM E (m)	UTM N (m)	Elevation (m)	Distance to Processing Plants / Impoundment Facility (km)	Description
R1	House South of Site, at Lake 300m East of Highway 655	473500.1	5398566	280	9 / 12.5	Outside MMB with intervening forested areas.
R2	Camp/Cottage on Davis Lake	471449.9	5403929	275	3.5 / 7	Within MMB
R3	Camp on the West Buskegau River	477544.4	5408361	270	6.5 / 4.8	Within MMB
R4	Camp/Cottage East of Site	477052.3	5403390	281	7 / 8.8	Within MMB
R5	Camp/Cottage Near Highway 655 South of Site	475946.3	5387777	291	20 / 23.5	Outside MMB with intervening forested areas.
R6	Campground at Big Water Lake	479442	5384066	284	24.5 / 28	Outside LSA with intervening forested areas.
R7	Representative Receptor - Indigenous			264	9.5 / 11.5	Outside LSA with intervening forested areas.
R8	Sensitive Receptor – Indigenous			269	5.7 / 7.3	Outside MMB with intervening forested areas.
R9	Sensitive Receptor – Indigenous			281	9.4 / 12.5	Outside MMB with intervening forested areas.
R10	Sensitive Receptor – Indigenous			288	24.5 / 27.8	Outside LSA with intervening forested areas.
R11	Sensitive Receptor – Indigenous			291	25.3 / 28.4	Outside LSA with intervening forested areas.
R12	Camp/Cottage North of Existing Rail Corridor	484849.9	5384101	281	27.4 / 30	Outside MMB with intervening forested areas.
R13	Camp/Cottage North of Existing Rail Corridor	485094.5	5383767	281	27.6 / 30.2	Outside MMB with intervening forested areas.

Notes:
MMB – Modelled Mine Boundary
LSA – Local Study Area

The effects of light on aesthetics and safety are most relevant to humans, but excessive or poorly designed lighting can have serious effects on other living organisms. The research on the dose-response relationships is ongoing, but sufficient evidence exists to indicate that control of lighting impacts will be of benefit to the natural environment.

The effects of artificial lighting on terrestrial mammals depend on whether the mammal is nocturnal or diurnal. In isolated laboratory studies, artificial lighting has been shown to have an effect on nocturnal terrestrial mammals by reducing open areas use, restricting foraging activity, and generally reducing activity (Beier, 2005).

It is well known that artificial light with and without reflective man-made structures can result in disorientation of birds, interfering with their navigation systems potentially with fatal results (Rich and Longcore, 2006). Artificial lighting can induce behavioural change in nocturnal avifauna foraging at night to avoid diurnal predators (Rich and Longcore, 2006).

The potential lighting impacts for humans were assessed at the receptor locations described above, as these are reasonable representative of locations where interactions with the Project may occur.

The potential effects of artificial lighting on the biophysical environment (e.g., mammals, birds) are assessed in the respective biophysical sections of the Impact Statement.

3 Regulatory Setting

Most lighting guidelines and regulations have been directed toward the provision of suitable lighting for the safe and efficient activities of humans. For example, street lighting, indoor lighting and lighting around industrial plants are all subjects of various guidelines to facilitate a safe work environment. These are typically written to prescribe minimum acceptable levels. Recently, guidelines have been developed to prevent obtrusive and/or excess lighting; that is, to prescribe maximum acceptable levels.

The Commission Internationale de L'Éclairage (CIE), also known as the International Commission on Illumination, has developed sets of maximum values for light trespass and glare that should not be exceeded. These guidelines have also been adopted as best management practice for other industrial projects in Canada. There are no legal requirements (e.g., general guidelines, regulations, or policies), either federal or provincial, that regulate the amount of obtrusive light emitted from projects. Use of the Commission on Illumination guidelines is an accepted practice.

The values represented in the guidelines are based on environmental zones and time of day. The CIE has established five environmental zones as a basis for outdoor lighting guidance in their document Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations (CIE 2017) which are shown in Table 3.1.

Table 3.1 CIE 150:2017 Environmental Zones

Zone	Surrounding	Lighting Environment
E0	Protected	Intrinsically Dark
E1	Natural	Dark
E2	Rural	Low District Brightness
E3	Suburban	Medium District Brightness
E4	Urban	High District Brightness

The CIE has also established guidelines for light trespass for each environmental zone (Table 3.2).

Table 3.2: CIE 150:2017 Maximum Values for Light Trespass

Time of Day	CIE 150:2017 Maximum Values of Light Trespass on Properties by Environmental Zone (in lux) [1]				
	E0	E1	E2	E3	E4
Pre-Curfew (19:00 – 23:00)	N/A	2	5	10	25
Post-Curfew (23:00 – 6:00)	N/A	<0.1 [2]	1	2	5

Notes:
1. Terminology, environmental zones, and values defined by CIE 150:2017
2. If the installation is for public (road) lighting, this value may have a max of 1 lux

For glare, the maximum values recommended by CIE (intensity of luminaires) in designated directions vary with environmental zone and time of day. The recommended values for glare depend not only on the brightness of the luminaire, but also the distance from the observer to the luminaire (*d)* and the size of the luminaire (Ap). For the rural E2 zone, this can range from 0.29·d to 10 d (CIE 2017).

Sky glow levels have been established for zones of various levels of urban development (Berry 1976) (Table 3.3). Sky glow is the result of illumination that is directed upward, typically as a result of the use of lighting that has significant upward directivity, or is omnidirectional, such as “bare bulbs”. Reference values are arranged so that decreasing values are associated with more night sky lighting sourced from anthropogenic sources.

Table 3.3 Reference Levels for Sky Glow

Sky Glow (mag/arcsec^2)	Corresponding Appearance of the Sky
21.7 (Rural)	The sky is crowded with stars that appear large and close. In the absence of haze, the milky way can be seen to the horizon. The clouds appear as black silhouettes against the sky.
21.6	The above with a glow in the direction of one or more cities is seen on the horizon. Clouds are bright near the city glow.
21.1	The milky way is brilliant overhead but cannot be seen near the horizon. Clouds have a greyish glow at the zenith and appear bright in the direction of one or more prominent city glows.
20.4	The contrast of the milky way is reduced and the detail is lost. Clouds are bright against the zenith sky. Stars no longer appear large and near.
19.5	Milky way is marginally visible, only near the zenith. Sky is bright and discoloured near the horizon in the direction of cities. The sky looks dull grey.
18.5 (Urban)	Stars are weak and washed out and reduced to a few hundred. The sky is bright and discoloured everywhere.
Source: Berry 1976	

4 Baseline Lighting Levels

This section describes the baseline (current) lighting levels in the vicinity of the PA. A nighttime light level assessment was conducted by WSP to quantify existing, baseline light conditions in the vicinity of the Project (Appendix B.3 of the Impact Statement). The monitoring program was conducted from June 2022 to June 2023 and used two methods to quantify ambient light for both observed light trespass and light in the night sky:

- a Sonel LXP-2 Illuminance meter to measure light trespass
- a Unihedron Sky Quality Meter (Model SQM-LU-DL-V) was used to measure sky brightness.

Measurements were collected at four locations in the vicinity of the Project in 10 months over the period from June 2022 to June 2023, allowing nighttime light levels to be quantified in all seasons. Locations with a mix of tree cover were selected, as some minor influence is expected from foliage related light absorption associated with deciduous trees and the seasonal variation caused by the increase and decrease of leaves. Details of the monitoring methodology and measurement data are available in the WSP report (Appendix B.3 of the Impact Statement).

Based on the 2022 - 2023 field readings, the ambient nighttime light levels were low (non-detect lux) with sky glow levels generally above (i.e., darker than) 20.6 mag/arc-sec^2 (see Appendix B.3 of the Impact Statement). The ambient light environment in the Project and surrounding area was, depending on season, characterized as “low district brightness” (E2) lighting environment for skyglow and a “dark” (E1) lighting environment for light trespass (Appendix B.3 of the Impact Statement).

Seasonal variations were measured, reflecting snow cover and light absorption related to foliage. Sky quality was measured at 21.2 mag/arcsec^2 in summer and was marginally brighter at 20.3 mag/arcsec^2 in winter. Further details are available in Appendix B.3 of the Impact Statement.

5 Project-Related Environmental Effects of Lighting

5.1 Construction

Portable lighting units may be used during Project construction in the PA during site preparation and grading, and during the construction of onsite infrastructure. Portable light units typically illuminate an area lateral to the unit and are typically bright powerful lights that unavoidably cause some glare and vertically directed illumination.

Mobile mining and construction equipment operating at night will have headlights, work lights and marker lights on while operational. Lights on mobile equipment constructing the temporary grade separation of Highway 655 and the rail spur, and equipment moving materials around the site to stockpiles via internal site roads may result in glare and light shining in the direction of some receptors. The duration of light pointed in the direction of those receptors is expected to be short and incremental as the equipment will be continually moving around.

5.2 Operations

During Project operations, lighting will be required for work areas in the Open Pit and Process Plant area during night shifts. In the pits this can be achieved through the use of portable lighting plants and lights on mobile equipment. Perimeter lighting (permanent outdoor light fixtures) may be required at the Process Plant, Fuel Farm, maintenance shops, Primary Crushers and water treatment plants. This lighting may be controlled by timers or photocells. Street lighting on haul roads is not anticipated as autonomous haul trucks will be utilized.

Mining fleet mobile equipment operating at night will have headlights, work lights and marker lights on while operational. Construction of the Highway 655 realignment, which will occur in the operations phase, will also require lighting for work areas in addition to the equipment lights. Lights on mobile equipment may result in glare and light shining in the direction of some receptors when the equipment is on the piles.

Lights on locomotives may also contribute to glare. The duration of light pointed in the direction of receptors is expected to be short and incremental as the locomotives travel along the rail spur.

5.3 Closure

Lighting during Project closure is expected to be similar or less in magnitude than that for construction, and short-term in duration.

5.4 Project Lighting Effects

The effects of the Project lighting on nearby receptors are assessed by comparing predicted light levels to the specified light criteria. As the exterior lighting plan for the Project has not been designed, light levels related to the Project cannot be quantified. Therefore, the light assessment method is qualitative. While the predictions are qualitative, they are based on the professional judgment of the study team and incorporate design mitigation to manage potential light effects to acceptable levels, as published in the CIE guidelines (CIE 2017).

The analysis of a change in ambient light focuses on the potential effects that the Project infrastructure and activities could have on light trespass, glare and sky glow. Lighting can become obtrusive if the light criteria (e.g., CIE guidelines) are exceeded. A residual adverse effect on ambient light is defined as an increase in Project related light emissions such that the CIE guidelines for light trespass and glare in a natural and rural environment are exceeded and sky glow levels would be altered toward those of a rural environment.

There are few light sensitive receptors in the LSA, and they are all well removed from the Project with intervening forested areas that will obstruct Project lighting.

The nearest light sensitive receptor to the Project outside the MMB is a Sensitive Receptor - Indigenous (R8) about 5.7 km to the west of the processing area and at least 7.3 km from the Impoundment Facility. Intervening forests (consisting primarily of coniferous trees that provide year-round line of sight obstruction) will block light emissions from the processing plant and ground level site traffic from reaching this receptor during construction, operation and closure/decommissioning. The difference in elevation between the top of the Impoundment Facility (at its maximum height) and this receptor will be 113 m. At 7.3 km from this receptor, with intervening forested areas, the top of the Impoundment Facility (at its maximum height during operation) will not be visible at this receptor, thus no adverse light trespass or glare effects are predicted at this receptor.

The nearest receptor with continuous occupancy will be the campground at Big Water Lake (R6), which is about 24.5 km from the processing areas and 28 km from the Impoundment Facility. It is outside the LSA and is thus too far away from the PA to be significantly affected by Project lighting during construction, operation and closure/decommissioning.

Construction lighting will be specified to use only as much lighting as is necessary for safe and efficient construction activities and is not expected to be visible at the light-sensitive receptors. Where nighttime construction work is conducted, lighting used will be in compliance with regulations and permit conditions issued for the Project. Portable light units typically illuminate an area lateral to the unit and are typically bright powerful lights that unavoidably cause some glare and vertically directed illumination. This type of effect can be avoided by using directional light fixtures to avoid the transmission of light outside of the PA. By implementing mitigation, the levels of light trespass and glare from mobile artificial lighting units are not expected to exceed CIE guidelines for natural or rural environments at the receptor locations noted above. Mitigation measures would also control light emissions that may contribute to sky glow, and so it is expected that sky glow levels would be similar to baseline conditions during Project construction.

Industrial facilities are typically characterized by a much lower presence of reflective surfaces, such as windows, and a lower level of “decorative” lighting. Site lighting that uses luminaires with full horizontal cutoff fixtures can greatly reduce or eliminate the single glaring light that can confuse migrating birds. By implementing mitigation, the levels of light trespass and glare are expected to be maintained below the CIE guidelines at the receptor locations noted above. Adherence to mitigation measures related to full cut-off fixtures and other design approaches are expected to limit sky glow contributions. It is therefore expected that sky glow levels will remain close to baseline levels during Project operations.

Therefore, no substantive adverse impacts associated with light trespass, glare or skyglow are anticipated at the receptors.

6 Mitigation, Management and Monitoring

The following measures will be incorporated into the design of the Project and/or proposed to avoid or reduce Project-related effects on ambient light:

- Canada Nickel will consider the following principles during the Project lighting design for construction, operations and closure/decommissioning:
  - Project lighting (locations, intensity) will be limited to that which is necessary for safe and efficient Project activities
  - Use lighting fixtures that limit or concentrate the lighting to targeted areas and avoid light spilling out of the spaces to be illuminated
  - Limit the projection of light toward the sky by using fixtures that meet actual lighting needs
  - Avoid the emission of light at more than 90 degrees, using luminaires with known cut-off specifications
  - Mobile and permanent lighting will be located such that unavoidable light spill off the working area is not directed toward receptors outside of the PA, to the extent practicable
- Canada Nickel will design the exterior lighting systems for Project operations to include directional lighting to limit light trespass and to avoid glare. Downward directed, full cutoff luminaires will be incorporated into the Project lighting plan (where practical) and portable lighting will be positioned to limit visibility outside the Project Area.
- Canada Nickel will leave tree cover in place to reduce the line-of-sight from onsite infrastructure to Highway 655.
- Canada Nickel will implement lighting at required locations along Highway 655 in accordance with applicable Ministry of Transportation standards.
- Lighting during closure will follow the same principles as for the Project construction phase.

7 Conclusions

Baseline lighting conditions were assessed and deemed to be similar to an E1 (natural) or E2 (rural) region as defined by the CIE 150:2017, or a rural area with few residences. The existing levels of light pollution are therefore assumed to be low for trespass, glare, and sky glow.

During construction and operations, with mitigation, the levels of light trespass and glare from Project lighting sources are not expected to exceed CIE guidelines at the receptor locations that have been identified. There are few light sensitive receptors in the LSA, and they are all well removed from the Project with intervening forested areas that will obstruct Project lighting. Thus, no substantive adverse impacts from Project light trespass are expected at the receptors. Following decommissioning and closure, ambient lighting is expected to return to baseline conditions once Project lighting sources are removed from the area.

Design of exterior lighting systems for the Project will be guided by a strategy based on widely accepted guidelines, including direction of light to limit light trespass, to avoid glare and to avoid impacts on the night sky. Consideration of the CIE 150:2017 guideline will inform the lighting plan.

With the implementation of mitigation measures, residual effects from the Project on change in light are anticipated to be low, and reversible.

8 References

Beier, P. 2005. Effects of Artificial Night Lighting on Terrestrial Mammals. Pages 34-62 in Rich, C., and T. Longcore (eds.), Ecological Consequences of Artificial Night Lighting, Island Press, Washington.

Berry, R.L. 1976. Light Pollution in Southern Ontario. J. Roy. Astronomical Soc. of Canada. Vol. 70, no. 3, June 1976.

Black, A. 2005. Light induced seabird mortality on vessels operating in the Southern Ocean: incidents and mitigation measures. Antarctic Science 17(1): 67-68.

Canada Nickel Company. 2022. Detailed Project Description, Crawford Nickel Project. Available at: https://iaac-aeic.gc.ca/050/documents/p83857/145854E.pdf

CIE (Commission Internationale de L'Éclairage) (CIE 150:2017). 2017. Technical Report. Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations, 2nd Edition.

Rich, C., and T. Longcore, 2006: Ecological Consequences of Artificial Night Lighting. Island Press.

Appendices

Appendix A Figures

Stantec

CANADA NICKEL COMPANY

Legend

- Project Area
- Local/Regional Study Area

Base Features

- Expressway / Highway
- Major Road
- Minor Road
- Railway
- Existing Transmission Line
- GAS - Natural Gas Pipeline
- Watercourse
- Municipal Boundary - Lower Tier
- Waterbody

0 2.5 5 km

1:200,000 (At original document size of 11x17)

Notes

1. Coordinate System:NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2023.

Project Location
Timmins, Ontario

160930456 REVA
Prepared by tcoghlan on 2024-09-25

Client/Project
Canada Nickel Company (CNC)
Crawford Nickel Project

Figure No.
A.1

Title
Light Assessment Project Area, Local Study Area, and Regional Study Area

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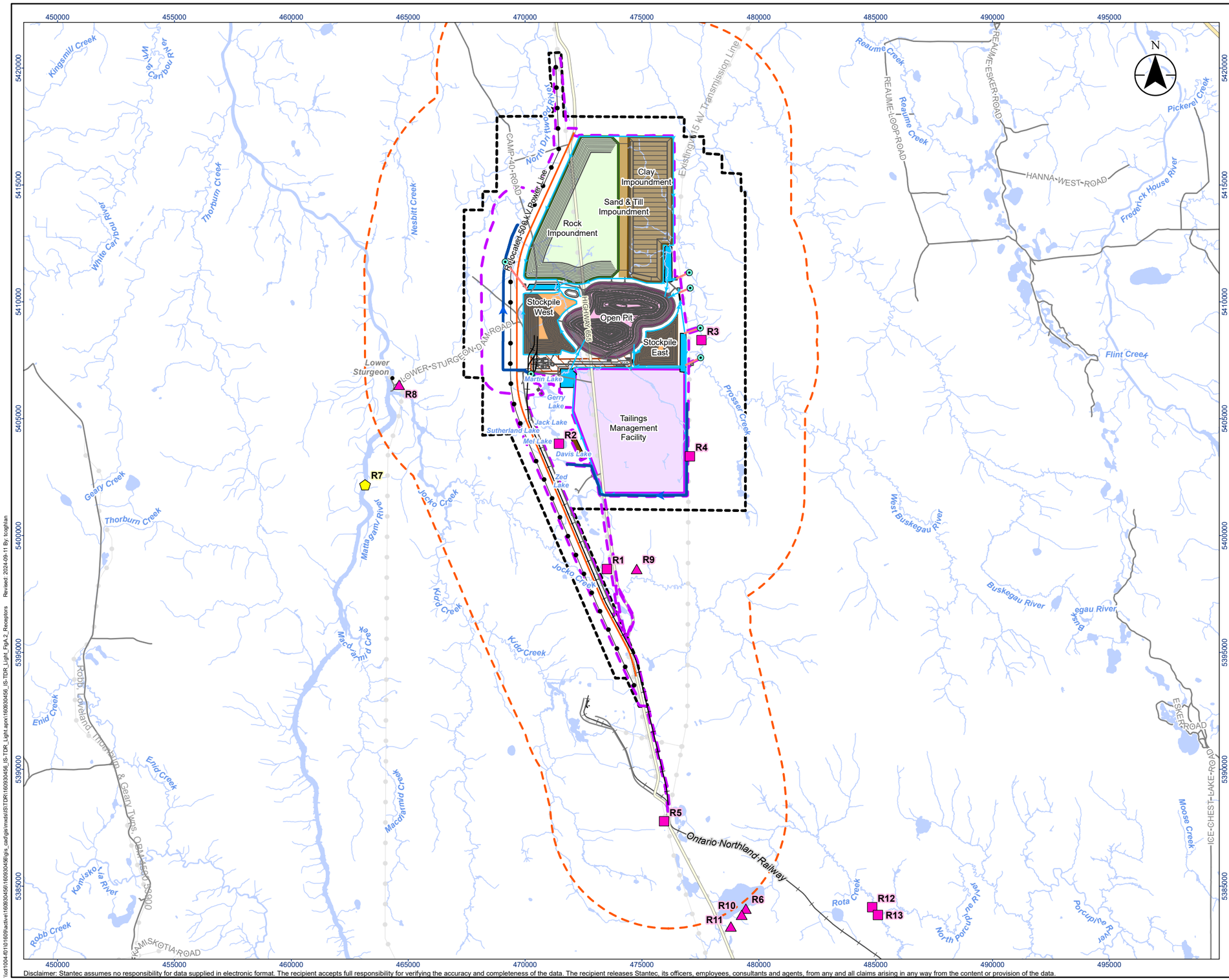

Stantec

CANADA NICKEL COMPANY

Legend

- Project Area
- Local/Regional Study Area
- Sensitive Receptor - Non-Indigenous
- Sensitive Receptor - Indigenous
- Representative Receptor - Indigenous
- Modelled Mine Boundary

Base Features

- Expressway / Highway
- Major Road
- Minor Road
- Railway
- Existing Transmission Line
- Unknown Pipeline
- Watercourse
- Waterbody

Ancilliary Infrastructure

- Relocated Hwy 655
- Rail Spur Line
- Transmission Line

Proposed Project Components

- Discharge Route
- Non-Contact Water Channel
- Contact Water Channel
- Site Road
- Discharge Location
- Ore Stockpile
- Open Pit
- Clay Impoundment
- Pond
- Tailings Management Facility
- Rock Impoundment
- Reclaim Stockpile
- Sand & Till Impoundment
- Process Plant Area

0 2.5 5 km

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Notes

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Project Location
Timmins, Ontario

160930456 REVA
Prepared by tcoghlan on 2024-09-11

Client/Project
Canada Nickel Company (CNC)
Crawford Nickel Project

Figure No.
A.2

Title
Locations of Potentially Light Sensitive Receptors

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