



Appendix J.3

Ambient Light Baseline and Predictive Assessment
Report - Fifteen Mile Stream Gold Project,
Wood Environment & Infrastructure Americas

Ambient Light Baseline and Predictive Assessment Report

Fifteen Mile Stream Gold Project
Trafalgar, Nova Scotia
Project # TV184005

Prepared for:

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August 2019

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Prepared by:

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a Division of Wood Canada Limited

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Executive Summary

Atlantic Mining NS Corp. is currently exploring the Fifteen Mile Stream (FMS) Gold Project located near Trafalgar in eastern Nova Scotia. The FMS Mine Site is located 100 kilometres (km) northeast of Halifax.

This document is a supporting document to one of a series of natural environment baseline reports prepared by Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited (Wood) to describe the current (baseline) environmental conditions and conduct a predictive assessment.

This report summarizes relevant data collected by Wood during the baseline light monitoring field programs conducted in 2018 at the FMS Mine Site. The baseline light monitoring programs were conducted under a variety of sky conditions to determine the best representation of baseline light levels. Where possible, monitoring times were selected to minimize the presence of ambient moonlight either on, or close to the night of a new moon.

Based on the 2018 field readings, the ambient light levels were low (non-detect lux) with sky glow levels generally above 21 mag/arc sec². The proposed project is in an area of very low industrial activity currently. Therefore, the ambient light environment in the project and surrounding area can be characterized as an intrinsically dark environment.

Site infrastructure and equipment will be lit by luminaires that are not anticipated to produce a significant area of illumination. Atlantic Mining NS Corp will also employ a lighting strategy that incorporates good lighting practices.

The predicted extent of light spill varies from 0 to a maximum of approximately 2 km from the property boundary and given that there are no receptors in the immediate vicinity (< 4 km), any off-site light spillage is not anticipated to have an effect on surrounding residences.

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1.0 Introduction

Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited (Wood) has prepared this Ambient Light Baseline and Predictive Assessment Report for the Fifteen Mile Stream (FMS) Gold Project (the Project). The Project is located in eastern Nova Scotia near Trafalgar and Seloam Lake, approximately 100 kilometres (km) northeast of Halifax (Appendix A, Figures A1 and A2). There are no residences within the FMS Mine Site. The proposed mine site is more than 4.9 km from the nearest residence (refer to Table 5-1 for a list of closest residences).

This study was prepared in support of a CEAA 2012 Environmental Impact Statement (EIS) for the development the Fifteen Mile Stream Gold Project, in Halifax County, Nova Scotia.

This report summarizes relevant data collected by Wood personnel during the baseline light monitoring field program conducted in late 2018 and provides a predictive assessment of potential light effects.

2.0 Scope of Assessment

An ambient light assessment was conducted for the proposed FMS Gold Project (the Project). The objectives of the assessment were (i) to identify and describe potential environmental light pollution effects of the Project, (ii) determine how ambient light pollution levels compare to existing scales of sky quality used by the astronomy community, (iii) indicate whether control measures are required to mitigate any adverse environmental light effects, and (iv) complete a predictive assessment to determine the change from the current intrinsically dark environment due to Project development.

2.1 Project Setting

Fifteen Mile Stream is situated in an area of low topographic relief, climbing gently to the east from around 110 masl (meters above sea level) to 150 masl with scattered drumlins reaching 170 masl. Commercial activities in the area include widespread logging, including clear cutting in the immediate area of the Project. There are no residences within the FMS Mine Site. The Project is more than 4.9 km from the nearest residence (refer to Table 5-1).

2.2 Environmental Light

A pre-development light assessment considers sky glow and a prediction of light spill.

Sky glow includes all stray light escaping above the horizontal plane into the atmosphere. The effect is readily seen approaching urban areas from the dark countryside at night as a brightening of the natural sky background level. It arises from light being projected above a horizontal plane and which is not illuminating a surface. Stray light travels long distances contributing to sky glow along its entire path.

Light Spill is the encroachment of unwanted light or illuminance on receptors outside the site boundaries that cause annoyance, loss of privacy, or nuisance effects.

As the FMS Mine Site is in a relatively remote and undisturbed area, the main sources of light in the night sky are expected to be from celestial bodies (e.g. moon, stars, planets, nebulae) and atmospheric effects such as:

- ▶ Airglow: Triggered when molecules, photoionized by ultraviolet radiation from the sun, undergo a chain of daytime atmospheric reactions which upon nightfall may undergo further reactions resulting in chemiluminescence, a uniform glowing effect observable globally (EB, 2015); and
- ▶ Aurora Borealis: Triggered when charged particles bombard the atmosphere, transfer energy to the atmospheric gases, and force the emission of light resulting in a structured (as a result of magnetic pole influence) effect of glowing light observable in a band near the geomagnetic poles (EB, 2015).

Minimal light from a drill rig at FMS3 and slight light on the southwest horizon at FMS2 were noted during data collection; these light sources are not expected to have significantly affected measurements.

2.3 Ambient Light Reference Levels

There are no regulatory criteria applicable for ambient light baseline assessments.

There is the potential for weather conditions, cloud cover and snow on the ground to increase the sky glow level which may obstruct the view of celestial objects. Therefore, existing sky glow levels were obtained from sky quality measurements taken under minimal cloud cover with no snow on the ground (during the new moon phase) in order to determine the darkest possible ambient light levels and hence the greatest possible change in sky glow attributable to the Project.

The unit of measure of sky glow is magnitudes per square arcsecond ($\text{mag}/\text{arcsec}^2$) and is essentially a measure of the brightness of the sky as perceived by the human eye. A difference of 1 magnitude is defined to be a factor of $100^{1/5}$ in received photons. Therefore, a sky brightness $5.0 \text{ mag}/\text{arcsec}^2$ fainter corresponds to a reduction in photon arrival rate of a factor of 100 (Unihedron, 2018).

Values for sky glow after dark range from approximately $22 \text{ mag}/\text{arcsec}^2$ in a rural undeveloped environment where stars are abundant to approximately $17 \text{ mag}/\text{arcsec}^2$ in an urban environment where only the brightest stars can be seen.

Two classification systems are included in this report for reference including:

- ▶ The Bortle Scale introduced in 2001 created 9 Classes of sky darkness linked to detailed descriptions of what celestial details were visible with the naked eye or with certain equipment; and
- ▶ The Commission Internationale de l'Éclairage (CIE) published in 2003 recommended maximum values (lux) of light for the control of obtrusive light to be applied near dwellings or potential dwellings pre and post-curfew. The maximum values are differentiated according to four environmental Zones (e.g. Zone E1 – Intrinsically Dark such as National Parks). An E0 Zone was added to this scale for areas with especially darks sky such as designated Dark Sky Preserves (e.g. Kejimikujik National Park and National Historic Site in southwest Nova Scotia).

provides reference levels of sky glow / measured ambient light levels to corresponding scales and appearance of the sky. These values are meant to be representative, not definitive, and the conversion between units/scales is approximate. In this table, SQM refers to Sky Quality Meter readings.

Table 2-1 Light Reference Levels

Bortle Class	CIE Class	Approx. SQM (mag/arcsec ²)	Illuminance in the Vertical Plane (lux)	Sky Description	Milky Way (MW)	Night Time Scene
1	E0	>21.7	0	Excellent, truly dark-skies, UNESCO Starlight Reserves	MW shows great detail and light from the Scorpio / Sagittarius region casts obvious shadows on the ground.	By convention, this is assumed to be the average brightness of a moonless night sky that is completely free of artificial light pollution, i.e., natural background. The Milky Way and abundant stars would be readily visible. The brightness of Jupiter and Venus is annoying to night vision. Ground objects are barely lit, and trees and hills are dark.
2	E1	21.5-21.7	0-1	Typical, truly dark skies	Summer MW shows great detail and has veined appearance.	Ground is mostly dark, but objects projecting into the sky are discernible.
3	E2	21.3-21.5	1-5	Rural sky	MW still appears complex, dark voids and bright patches and meandering outline are all visible.	Some light pollution evident along the horizon. Ground objects are vaguely apparent. Natural starlit night. Clear rural night sky with no moon.
4		20.4-21.3		Rural / suburban transition	Only well above the horizon does the MW reveal any structure. Fine details are lost.	Light pollution domes are obvious in several directions. Sky is noticeably brighter than the terrain. This is typical for a rural area with a medium-sized city not far away.
5	E3	19.1-20.4	2-10	Suburban sky	MW appears washed out overhead and is lost completely near the horizon.	Light pollution domes are obvious to casual observers. Ground objects are partly lit. This is typical for the outer suburbs of a major city.
6		18.0-19.1		Bright, suburban sky	MW only apparent overhead and appears broken as parts are lost to sky glow.	Sky from horizon to 35 degrees glows with grayish color. Ground is well lit. Typical for a suburb with widely spaced single-family homes; also characteristic of twilight where the sun has set but the brightest stars are visible.
7	Suburban / urban transition			MW is totally invisible or nearly so	Entire sky background appears washed out, with a grayish or yellow color. Bright suburb or dark urban neighborhood. Also representative of the sky glow directly overhead at a rural site when the Moon is full. The Milky Way is invisible, or nearly so.	
8	E4	<18.0	5-25	City sky	Not visible at all	Entire sky background has an orange glow and it is bright enough to read at night.
9				Inner city sky	Not visible at all	Entire sky background has a brought bright glow, even at the zenith. Typical near the centre of a major city such as Toronto or Montreal.

Note: Table adapted from multiple sources: (City of Toronto, 2017), (IDA, 2016), (Bortle, 2001), (CIE, 2003), (Ribas et al., 2017)



3.0 Ambient Light Monitoring Methodology

An ambient light baseline assessment program was established to determine existing, baseline light conditions near the FMS Mine Site. The monitoring program was conducted in September of 2018. There have been no prior light assessment programs and the baseline assessment is not dependent on any existing data.

3.1 Monitoring Equipment

Two devices were used to determine light levels at each station:

- ▶ The Digi-Sense data logging electronic photometer measures illuminance (i.e., the amount of visible light incident upon the surface of the instrument sensor) or natural ambient light in the environment in units of lux (lumens/m²) and has a resolution of 0.01 lux. The sensor is set on a surface or held in-hand pointing toward the zenith to take the measurement;
- ▶ The Unihedron Sky Quality Meter (model SQM-LU-DL-V) measures the amount of light striking the sensor and converts this into units of magnitudes per square arcsecond (mag/arcsec²). It measures sky brightness over a prescribed arc. The datalogging feature allows the sky brightness meter to combine vector data from a built-in altitude and azimuth sensor with sky brightness to generate a contour plot of sky brightness (as well as logging the individual readings that make up the plot). The sensor has a 40-degree cone of effective response.

A global positioning system (GPS) was utilized during data collection to measure location coordinates for mapping.

Sky Quality Meter (SQM) measurements were taken as a measure of sky brightness at each measurement site. As luminance varies on even a very dark night, a number of measurements were recorded to create a sky-plot centred on the zenith (the point directly above the observer in the sky). SQM measurements were taken around the zenith at angles ranging from approximately 0 degrees to 60 degrees from the zenith.

The Digi-Sense ambient light meter recorded ambient light levels at each location for each sampling event. The sensor was pointed nominally toward the zenith when taking measurements with small variations in direction to ensure any detectable light in a 30-degree zenith cap would be measured.

3.2 Monitoring Site Notes

The ambient light monitoring program for the Project used four representative receptor locations located in the vicinity of the FMS Mine Site for the baseline investigation (Appendix A, Figure A1). At each general location, an appropriate monitoring site was selected for baseline ambient light data collection. The sites were selected to minimize interference from existing artificial light sources and based on available clearings in the undeveloped area. Three locations

were selected within the FMS Mine Site to confirm the intrinsically dark nature of the site and one was selected as an off-site receptor. This will ensure a conservative baseline assessment as the program was carried out under new moon conditions with clear sky and no snow cover which represents the lowest ambient light or “worst-case” scenario for comparison to post-development conditions. Monitoring under different conditions or other seasons of the year would likely measure higher ambient light levels.

Light data (Appendix B) was collected on September, 9th, 2018 at the FMS Mine Site using a Digi-Sense Light Meter and Sky Quality Meter (SQM) at four locations. A map depicting the FMS Mine Site and four survey locations is provided in Appendix A, Figure A1. Table 3-1 provides the coordinates and descriptions of the survey locations.

Table 3-1 Fifteen Mile Stream Light Assessment Locations

ID	UTM Coordinates		Date	Time	Description	Conditions
	Northing	Easting				
FMS1	4998952	535910	10 September 2018	00:30	Near the western Site boundary on Seloam Lake Road. Seloam Lake Road is completely bordered by trees, light readings of the full sky-dome were not possible for this section of the Site.	<ul style="list-style-type: none"> • 4°C, clear sky, 0/10 cloud cover • Heavily treed area, no way to collect readings from the full dome • No sources of light interference but the full horizon was not visible due to the tree line • Ground clear
FMS2	4998399	539562	9 September 2018	23:52	Located near the eastern site boundary along an unnamed road, in a forested area. It is noted that the tree line was unavoidable.	<ul style="list-style-type: none"> • 4°C, clear sky, 0/10 cloud cover • Subtle light on the horizon to the SW of the assessment point possibly from Sheet Harbour • No other sources of light interference • Ground clear
FMS3	4999935	538085		22:25	Located at the northern boundary of the Site in a clearing at the branch of two unnamed roads. The forest borders all sides of the unnamed roads.	<ul style="list-style-type: none"> • 6°C, clear sky, 1/10 cloud cover • Bright stars observed • Light on drill rig to the S was likely too far to affect the assessment at this point • No other sources of light interference • Ground clear
FMS4	5001866	534814		23:14	Located approximately 3 km NW of the Site boundary along an unnamed road in an open grassy field. The full sky-dome was accessible in this area.	<ul style="list-style-type: none"> • 4°C, clear sky, 0/10 cloud cover, no wind • Subtle light visible on the horizon to the N, W, and NE, which may be from the nearest population centres (e.g. Upper Musquodoboit or New Glasgow) • Ground Clear



Both light measurement instruments were calibrated before the sampling events at FMS. The data collection timeframe was based on the review of the lunar cycle date and time, and the Clear Sky Chart for the nearest stations in proximity to the site. Data was collected during the new moon phase and the ideal time of night, taking into consideration astronomical and meteorological conditions. Measurements were taken during the new moon phase to avoid ambient light from moonlight. All measurements were taken after 22:30 hours during the optimal time of night based on the Clear Sky Chart, which considers parameters such as cloud cover, transparency, seeing, darkness, wind, humidity, and temperature. The closest weather station, the Malay Falls station, was used for assessing field conditions at Fifteen Mile Stream.

The four locations were monitored to determine the best representation of baseline light levels. Where possible, monitoring times were selected to minimize the presence of ambient moonlight either on, or close to the night of a new moon. Global positioning system (GPS) readings were recorded at each location.



4.0 Baseline Ambient Light Conditions

4.1 Data Analysis

Ambient light measurements were taken on the night of 9 September 2018 at four (4) locations around the FMS Mine Site. Sky conditions were clear and there was no snow on the ground (which can increase sky brightness).

Tree cover was mixed with weighting towards coniferous trees so minimal influence is expected from foliage related light absorption usually associated with deciduous trees and the seasonal variation caused by the increase and decrease of leaves (Flanders, 2008).

SQM readings ranged from 20.3 to 22.0 mag/arcsec². Measurements were averaged into bands by zenith angle as well as a 0-30 degree dome average to represent the average zenith sky brightness. The lower the band the more caution should be taken when using for comparative purposes as artificial sky glow brightening (i.e. light on the horizon) or darkening (i.e. tree shrouding) will be more pronounced near the horizon.

Illuminance measurements were below detection at all locations.

Table 4-1 summarizes the sky measurements at each location.

Table 4-1 Fifteen Mile Stream Zenith Measurements

ID	0-15° Dome Band (mag/arcsec ²)	16-30° Dome Band (mag/arcsec ²)	31°-45° Dome Band (mag/arcsec ²)	0-30° Zenith Average (mag/arcsec ²)	Zenith (lux)
FMS1	21.68	21.67	21.67	21.68	<0.01
FMS2	21.52	21.53	21.46	21.57	<0.01
FMS3	21.46	21.46	21.46	21.46	<0.01
FMS4	21.52	21.53	21.48	21.53	<0.01

Note: The SQM is only accurate to one decimal place however 2 decimals were included to show the band variation.

Sky brightness plots are provided in Figures 4-1 to 4-4.



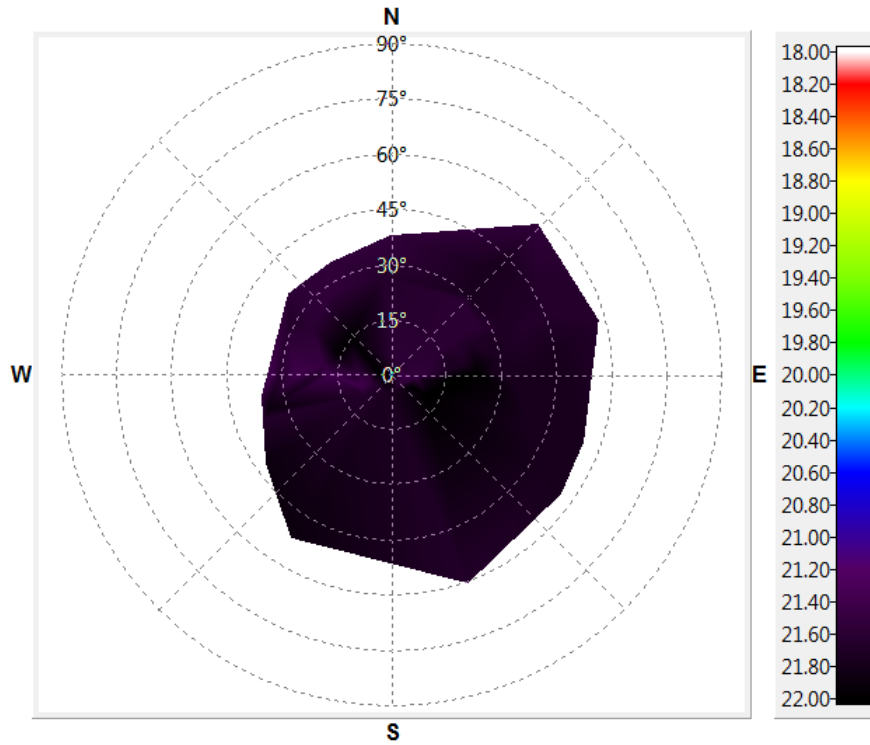


Figure 4-1: FMS1 Sky Brightness Plot (mag/arcsec²)

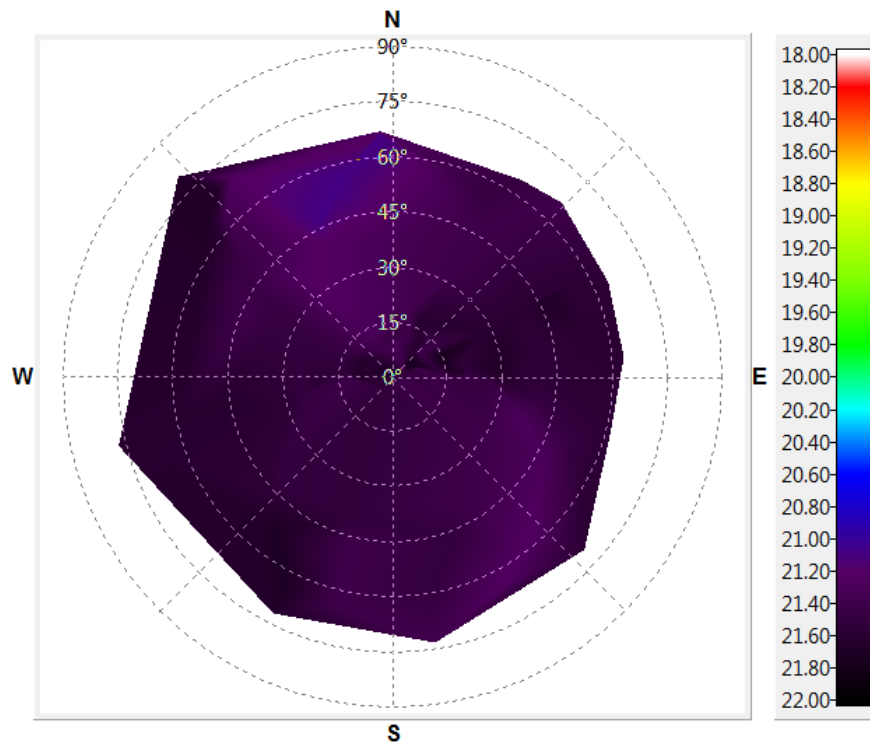


Figure 4-2: FMS2 Sky Brightness Plot (mag/arcsec²)

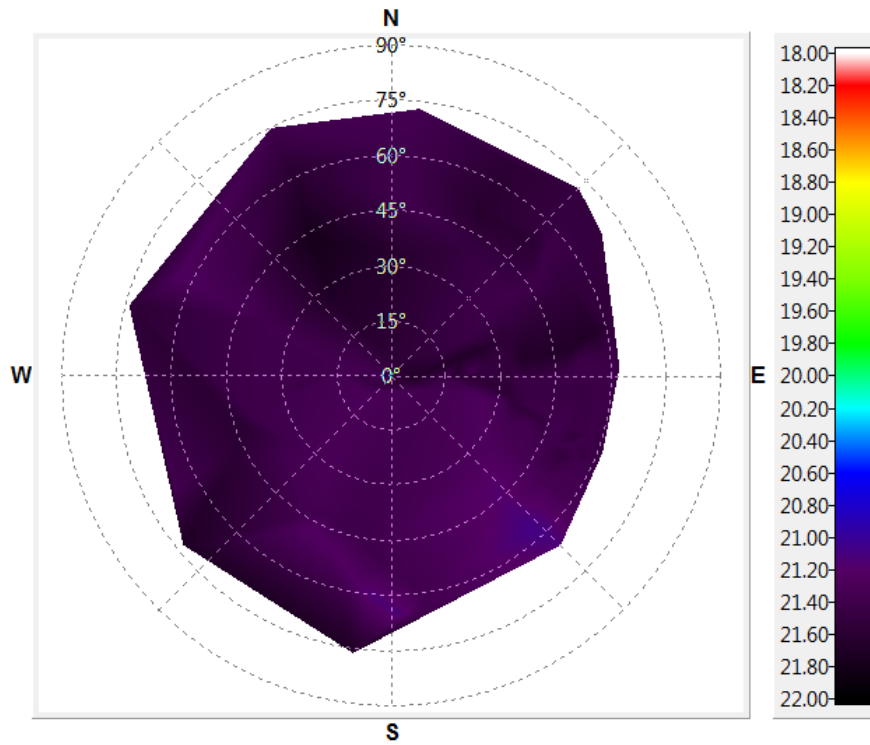


Figure 4-3: FMS3 Sky Brightness Plot (mag/arcsec²)

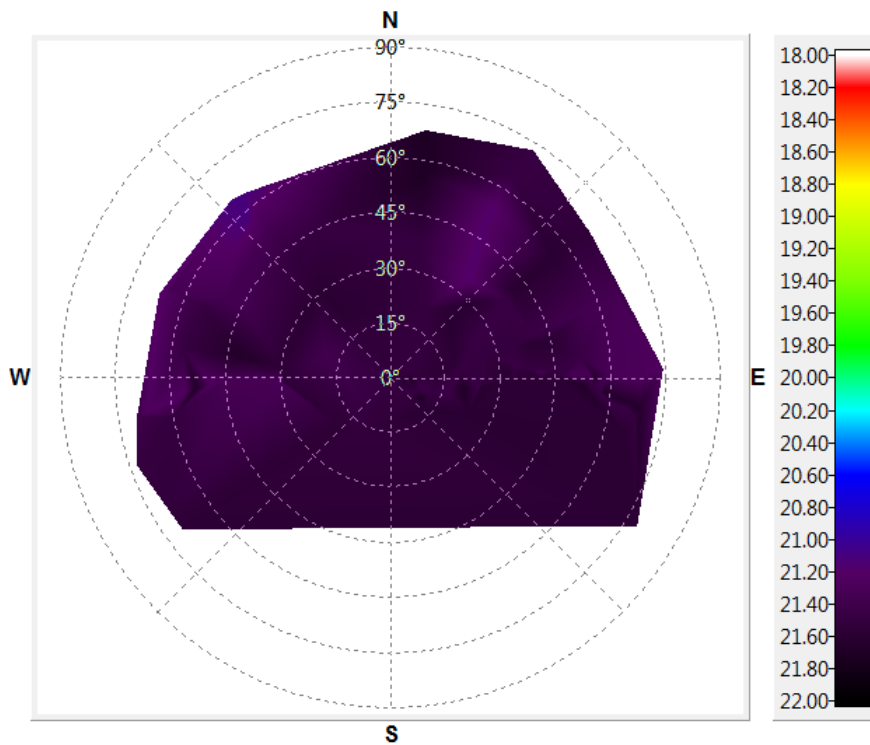


Figure 4-4: FMS4 Sky Brightness Plot (mag/arcsec²)

4.2 Summary of Baseline Conditions

Based on the 2018 field readings, the ambient light levels were low (<0.01 lux). Sky brightness on clear, dark sky nights was generally near 21.5 mag/arcsec² corresponding to an intrinsically dark environment with CIE Classification E1. The Project is in an area that currently has very low industrial activity and population density.

The small amounts of light on the horizon was compensated for in the calculation method.

Baseline sky brightness (dependent on meteorological and celestial conditions) for each location is presented in Table 4-2.

Table 4-2 Baseline Sky Brightness

ID	Brightness (mag/arcsec ²)	CIE Classification ¹
FMS1	21.7	E1 (Intrinsically Dark)
FMS2	21.6	E1 (Intrinsically Dark)
FMS3	21.5	E1 (Intrinsically Dark)
FMS4	21.5	E1 (Intrinsically Dark)

¹ Ref. CIE 2003 E1 Intrinsically Dark Classification is characteristic of wilderness or park sites.

5.0 Predictive Assessment

5.1 Receptors

Table 5-1 summarizes the location of the nearest residences. Figure A2, Appendix A shows the location of the nearest residence (4.9 km) relative to the FMS Mine Site.

Table 5-1 Receptors

No.	Distance to FMS Mine Site (km)	UTM Coordinates (20T)		Description
		Northing	Easting	
1	4.9	4992589	538964	Seasonal residence - access is gated (Lowe property)
2	7.9	4989308	538981	Seasonal residence - Liscomb Camp
3	8.7	4989094	539047	Seasonal residence, with possible conversion to permanent dwelling - Crowell Property, Hwy 374 at civic address 3411.
4	8.7	4989094	539047	Seasonal residence - Rutledge Property, Hwy 374 at civic address 3411, used mostly July – September

5.2 Direct and Indirect Effects

5.2.1 Sky Glow

Ambient night-time light conditions are typical of an undeveloped rural area. Site infrastructure and equipment will be from local light sources or haul vehicles that are not anticipated to produce a significant area of illumination. Therefore, skyglow effects are anticipated to be limited to the immediate vicinity of the mine site (within 2 km) and not likely noticeable at the closest residence (4.9 km).

5.2.2 Light Spill

The limits for light spill are differentiated by environmental zone. Two sets of limiting values are given dependent on the levels of lighting already in the area:

Pre-curfew - These higher values apply before a curfew hour set by the controlling authority. Pre-curfew limiting values are less restrictive and meant to give passive recipients of spill light relief from it being excessively obtrusive.

Post-curfew (e.g. 23:00 - 6:00) - These more restrictive values apply after the curfew hour and are designed such that the spill light at these times will not be obtrusive to the majority of recipients.

The light spill is determined by the illuminance of a vertical plane (e.g. window) in units of lux, as indicated in Table 5-2.

Table 5-2 Environmental Lighting Zone

CIE Zone	Surrounding Area	Illuminance in the Vertical Plane (lux)	
		Pre-Curfew	Post-Curfew
E1	Natural	2	0
E2	Rural	5	1
E3	Suburban	10	2
E4	Urban	25	5

Note: (CIE, 2003)

For this intrinsically dark area, light spill is determined by estimating light attenuation and by “line-of-sight” of project luminaires in the area by reviewing the topography of the surrounding terrain and taking the height of land as the limit of light impact.

Light emissions during the Project’s operation phase are considered to be representative of both the construction and operation phases. Light emissions during the construction phase are anticipated to vary according to construction equipment requirements and are expected to be lower than those during the operation phase (based on available information about anticipated construction equipment types and usage, and operational light sources).

Both the quantitative light attenuation and qualitative line-of-site methodologies resulted in the conclusion that any off-site light spillage is anticipated to have minimal effect at receptors.

5.2.2.1 Light Attenuation

To provide a quantitative estimate of illuminance at the receptors, the inverse-square law was employed (CIE, 2003). The inverse-square law states that the intensity of a physical quantity dilutes with distance as a geometric necessity and is described by the formula:

$$B_{\text{density of physical quantity at distance "d"}} = \frac{\phi_{\text{flux of the physical quantity}}}{d^2_{\text{distance between source and receptor}}}$$

In the context of light, ϕ is the output (lumens) of the light source and B is the illuminance (lux) at the receptor.

For each source at the Site, the total wattage of lighting was summed based on estimations or manufacturer specifications where available. The wattage of each source was converted to lumens utilizing the luminous efficacy from published sources (US DOE, 2017) for comparable



lighting types. Luminous efficacy considers the sensitivity of the human eye to the wavelength of light produced. All sources were conservatively treated as a single source at the point of infrastructure closest to the closest residence.

Sample Calculation for Light Vehicles Light Attenuation at Receptor 1:

Assumptions:

- 33 light vehicles have an equivalent of 2 x 65W halogen lights each; and
- The luminous efficacy of a halogen A19 bulb (20 lumens/watt) is similar to that of a light vehicle's headlights.

$$\begin{aligned} \text{Illuminance}_{\text{at receptor}} (\text{lux}) &= \frac{\text{Total Light Vehicles Light Output (lumens)}}{(d_{\text{distance between source and receptor}}(\text{metres}))^2} \\ &= \frac{33 (\text{vehicles}) * 130 \left(\frac{\text{watts}}{\text{vehicle}}\right) * 20 \left(\frac{\text{lumens}}{\text{watt}}\right)}{(5040 (\text{metres}))^2} \\ &= \frac{85800 (\text{lumens})}{(5040 (\text{metres}))^2} \\ &= 3.38e^{-3} (\text{lux}) \end{aligned}$$

With 3.38 e^{-3} lux for light vehicles added to the lux for all other light sources gives a resultant illuminance at Receptor 1 of 0.26 lux.

Cumulatively, this would be below the CIE pre-curfew and post-curfew (after rounding to the same significant figures as the criteria) criteria for an E1 area noting that this methodology is limited in that it cannot result in no illuminance unless there is no light output at the source. The method also does not take into account the following:

- As evident by roadside observations near the Site, a few dense rows of trees can fully obscure any direct light from ground level;
- The tallest light source is expected to be the pole-mounted lights at 10 metres compared to the average tree of 14 metres; and
- These estimates assume all lights are pointing at the receptor simultaneously and that there are no traffic-controls or berm-type mitigations.

Receptors 2, 3 and 4 are further from the sources and would have, therefore, notably lower illuminance. All residences identified are expected to have CIE-acceptable "E1" illuminance levels during construction and operation phases. Detailed results are available in Appendix C.

5.2.2.2 Line-of-Site Assessment

Considering just the density of trees, topography, receptor and source heights, and trigonometric ratios, a significant removal of trees or significant elevation change at the receptor or source would be needed for any light to be noticeable at the receptor.

The estimated extent of light spill is shown on Figure A2, Appendix A. The light spill limit ranges from within the site boundary to a maximum of 2 km away. It should be noted that the nearest sensitive light receptor is 4.9 km from FMS mine site and any off-site light spillage is anticipated to have minimal effect at receptors.

6.0 Light Mitigation and Monitoring

Modern industrial lighting practices and available technologies provide the means to prevent or minimize light effects through effective design.

The Illuminating Engineering Society of North America (IESNA) publishes guidance on the level of lighting that is necessary for efficient and safe work in a variety of work environments, including mine facilities. Lighting for the buildings on-site is guided by the Leadership in Energy and Environmental Design (LEED) criteria and the green building rating system of the Canada Green Building Council. Finally, the Commission Internationale de l'Eclairage has developed the *Technical Report: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations* (CIE 150:2003); this document, which forms the basis for some of the LEED criteria, includes information on classifying and assessing effects on the receiving environment.

The FMS lighting design will consider elements of these three guidance documents in order to prevent or minimize light emissions such that adverse off-site light effects at residences will not occur.

Examples of strategic lighting system elements that mitigate effects include:

- Lighting fixtures should be full cut-off design; that is, the luminaries will shed light downwards, with no light emitted above the horizontal. This will minimize light spill.
- Security lighting should be as required, with full cut-off, and motion sensor technology as appropriate.
- Lighting power should be the minimum level, and an energy efficient technology to meet the required working levels.
- Exterior light standards should be set back from the perimeter of the site, located so as to illuminate work or parking areas as needed, but no farther.
- Warm-coloured LED lighting of less than 3000 Kelvin should be used, where possible (Wakefield et. al, 2016).
- On-site vehicular lighting can be controlled by directing traffic flow and constructing vegetative or earthen berms.

The Project proponent will consider these measures in lighting design, where technically and economically feasible, in order to reduce the potential for light effects associated with the Project.

Monitoring to ensure effective light management is expected to include: compliant investigation, recordkeeping, and response, oversight of purchasing practices to ensure most appropriate light fixtures and replacement bulbs are installed, and requirements for temporary or new light fixtures, as examples.

7.0 References

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wood.

Appendix A
Figures



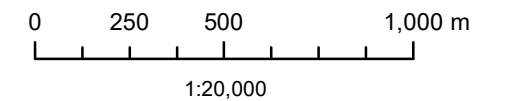
Legend

- FMS Mine Site
- Monitoring Location
- Preferred Infrastructure Layout

Location Map:



Coordinate System: NAD 1983 CSRS UTM Zone 20N
 Projection: Transverse Mercator
 Datum: North American 1983 CSRS
 Units: Meter



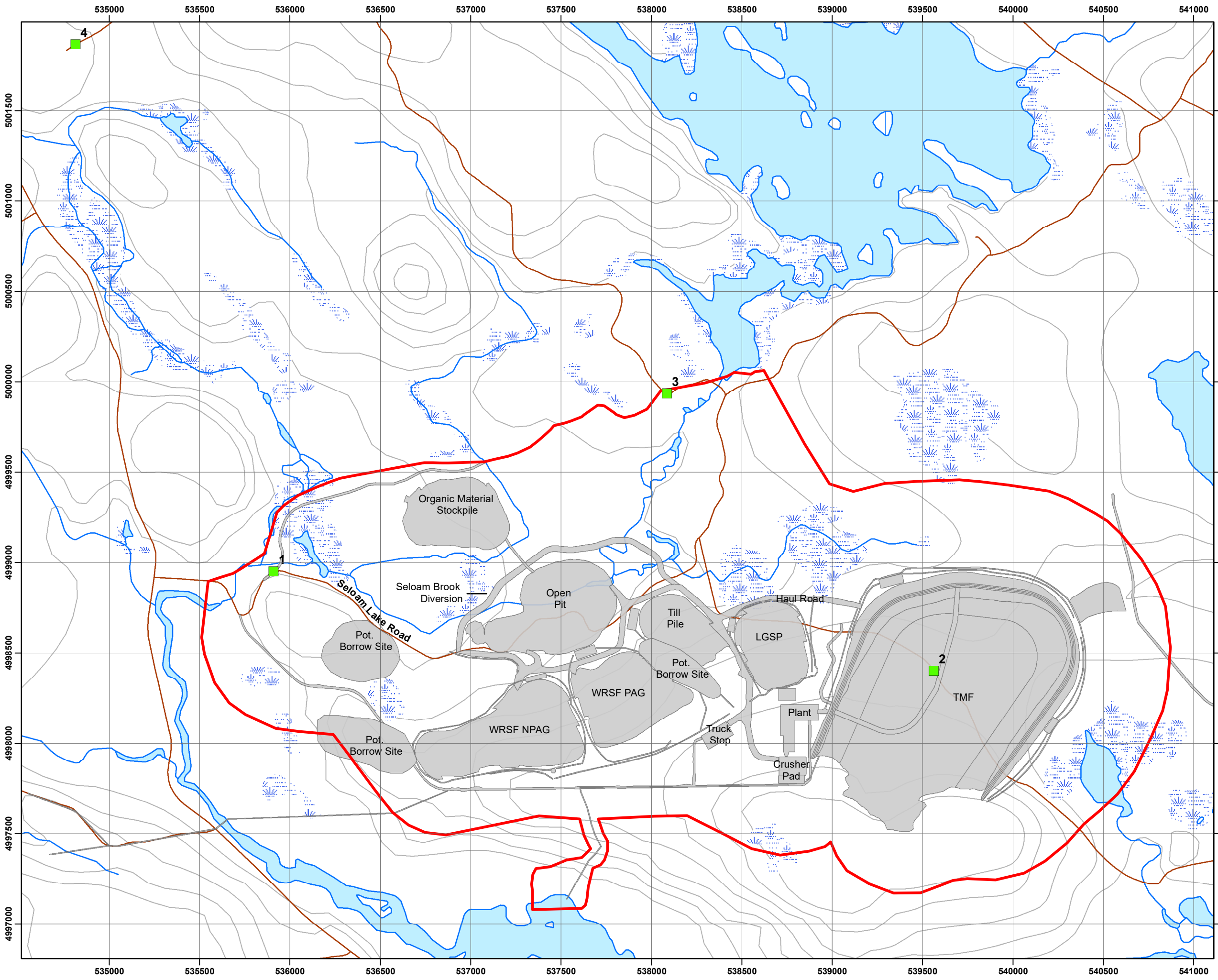
04/09/2019

Project: Fifteen Mile Stream
 Trafalgar, NS

Title: Light Assessment
 Monitoring Locations

Project No.
 TV184005

Figure No.
 A1



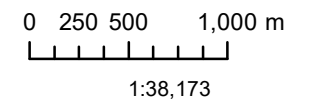
Legend

- FMS Mine Site
- Residence
- Preferred Infrastructure Layout
- Monitoring Location
- Light Spill Limit

Location Map:



Coordinate System: NAD 1983 CSRS UTM Zone 20N
 Projection: Transverse Mercator
 Datum: North American 1983 CSRS
 Units: Meter



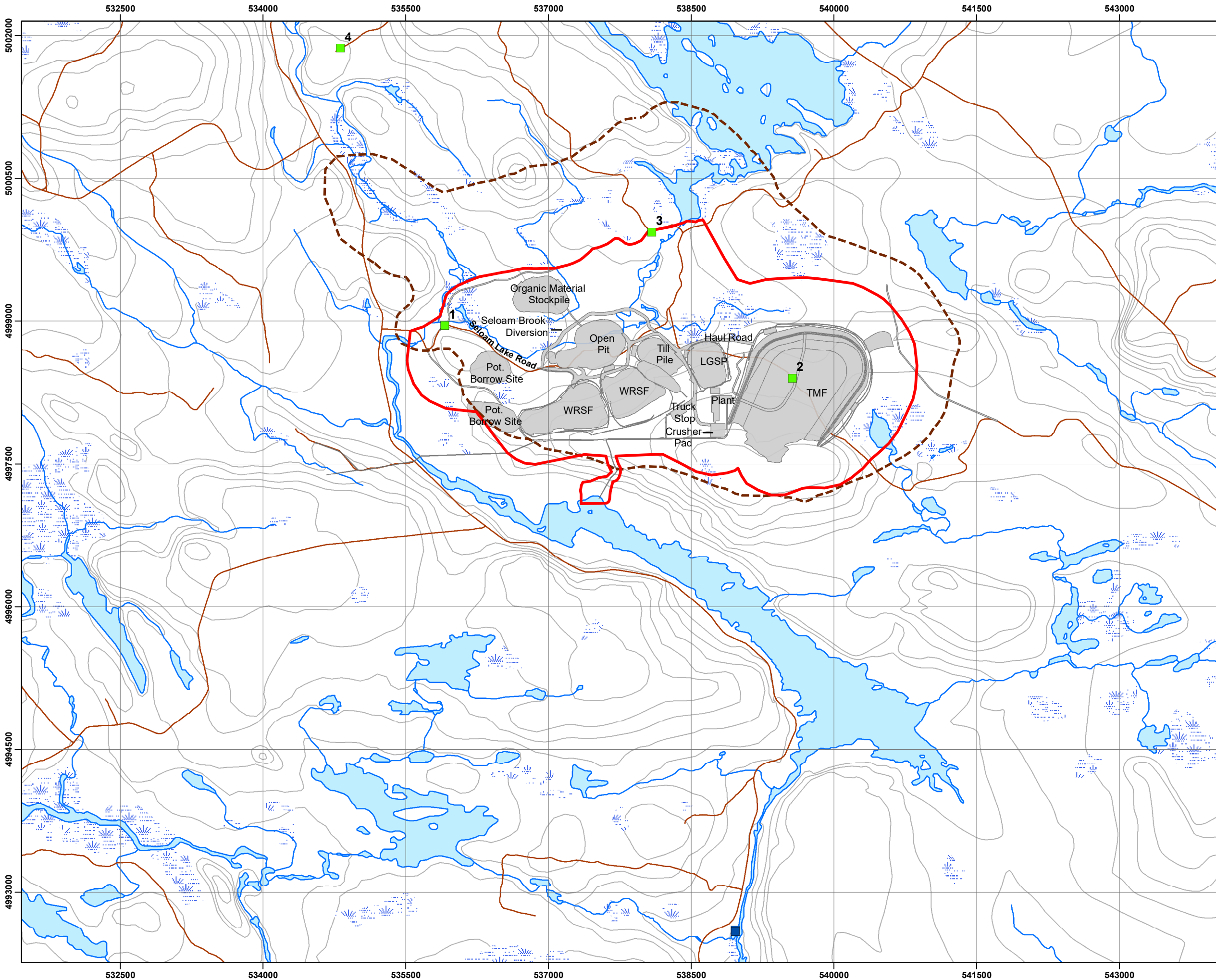
04/09/2019

Project: Fifteen Mile Stream
 Trafalgar, NS

Title: Light Assessment
 Light Spill Limit

Project No.
 TV184005

Figure No.
 A2





wood.

Appendix B
Field Data



ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS4	16.4	21.3	6023	100	16949	-871	2113	-599	21	69	90	165
FMS4	16.4	21.3	6030	43	16909	-871	2114	-602	22	69	90	333
FMS4	16.4	21.3	6181	-185	16984	-939	2094	-572	22	68	91	466
FMS4	16.4	21.32	8266	-36	15412	-1129	2050	-577	31	59	89	487
FMS4	16.4	21.32	9541	23	15018	-1299	2003	-534	36	54	89	348
FMS4	16.4	21.32	10649	103	14183	-1460	1969	-460	41	50	89	225
FMS4	16.4	21.32	12185	194	12182	-1576	1932	-387	49	41	88	270
FMS4	16.4	21.32	12249	26	12268	-1629	1925	-344	49	41	88	242
FMS4	16.4	21.47	13660	288	10359	-1806	1874	-160	57	33	89	393
FMS4	16.4	21.47	15724	383	5195	-2078	1799	528	76	14	100	477
FMS4	16.4	21.51	16147	525	2375	-2095	1779	849	86	5	132	354
FMS4	16.4	21.51	16075	561	1692	-2089	1770	983	87	3	176	477
FMS4	16.4	21.43	15887	-593	4508	-2104	1457	1198	79	11	108	243
FMS4	16.4	21.43	15603	-652	5776	-2120	1454	1055	74	16	103	203
FMS4	16.4	21.43	14860	-771	8016	-2141	1466	776	66	24	95	237
FMS4	16.4	21.57	13798	-892	10053	-2110	1485	533	58	32	90	192
FMS4	16.4	21.57	13238	-918	11017	-2080	1486	427	55	35	89	113
FMS4	16.4	21.57	12576	-938	11819	-2042	1498	317	51	39	89	346
FMS4	16.4	21.57	12096	-956	12523	-2005	1496	250	48	42	90	260
FMS4	16.4	21.57	11720	-927	12810	-1965	1505	186	46	44	90	458
FMS4	16.4	21.65	9932	-1135	14634	-1855	1510	49	38	53	92	334
FMS4	16.4	21.65	8677	-1102	15527	-1774	1546	-34	32	58	94	401
FMS4	16.4	21.65	7069	-1220	16476	-1679	1567	-90	25	65	96	447
FMS4	16.4	21.65	6083	-1304	16929	-1615	1582	-120	22	69	97	493
FMS4	16.1	21.48	6381	-1651	16797	-1916	1217	-23	23	67	99	269
FMS4	16.1	21.45	7219	-1691	16229	-1947	1217	19	26	64	97	195
FMS4	16.1	21.45	7511	-1729	15950	-1959	1221	29	28	62	97	382
FMS4	16.4	21.45	8869	-1663	15362	-2011	1225	100	33	57	94	251
FMS4	16.4	21.49	9295	-1731	14844	-2026	1212	139	35	55	93	352
FMS4	16.4	21.49	11174	-1495	13021	-2118	1215	284	44	46	89	472
FMS4	16.4	21.49	11833	-1525	12765	-2148	1219	398	47	43	87	365
FMS4	16.4	21.49	12798	-1547	11494	-2187	1223	554	52	38	86	288
FMS4	16.4	21.62	13695	-1439	10148	-2216	1206	703	58	32	88	370
FMS4	16.4	21.62	14673	-1362	8143	-2229	1211	1014	65	25	95	325
FMS4	16.1	21.69	15119	-1464	6995	-2219	1207	1118	70	21	99	279
FMS4	16.1	21.69	16167	-1133	1781	-2032	1248	1860	86	4	90	218
FMS4	16.1	21.54	16102	-1106	1608	-2020	1256	1885	86	4	85	389
FMS4	16.1	21.54	16130	-1118	1374	-2012	1248	1913	87	4	77	499
FMS4	16.1	21.5	16079	-1477	906	-1979	875	2157	85	5	70	374
FMS4	16.1	21.5	15879	-1480	2001	-2008	869	2091	85	5	99	337
FMS4	16.1	21.5	15888	-1560	3991	-2185	855	1735	79	11	115	252
FMS4	16.1	21.5	15351	-1623	6366	-2287	854	1434	72	18	108	401
FMS4	16.1	21.5	14693	-1764	8131	-2327	846	1173	65	25	94	393
FMS4	16.1	21.6	12703	-1855	11902	-2330	847	718	51	39	76	314
FMS4	16.1	21.6	11765	-2047	12807	-2309	829	529	46	44	77	485
FMS4	16.1	21.6	9297	-2245	14882	-2231	810	227	35	55	89	257
FMS4	16.1	21.59	6825	-2224	16437	-2162	764	56	25	66	103	248
FMS4	16.1	21.59	3506	-2311	17647	-2081	709	-94	12	78	121	235
FMS4	15.7	21.58	5243	-2812	15438	-2214	-99	-279	20	70	234	303
FMS4	15.7	21.53	5800	-2780	16726	-2246	-67	-178	21	69	238	356
FMS4	15.7	21.48	8943	-2683	15028	-2338	46	139	33	57	278	193
FMS4	15.7	21.48	9350	-2710	14768	-2342	65	192	35	55	291	281
FMS4	15.7	21.48	11136	-2568	13089	-2378	103	421	44	46	334	312
FMS4	15.7	21.48	12300	-2510	11898	-2391	127	632	50	41	355	165
FMS4	15.7	21.48	13232	-2538	10668	-2391	142	853	55	35	15	308
FMS4	15.7	21.6	13912	-2389	9425	-2357	146	1064	60	30	47	306
FMS4	15.7	21.6	14878	-2279	7530	-2300	164	1367	67	23	115	202
FMS4	15.7	21.6	15726	-2111	4481	-2129	136	1795	77	13	132	453
FMS4	15.7	21.6	15849	-2133	3840	-2102	130	1836	79	11	128	259
FMS4	15.7	21.69	15877	-2189	3449	-2063	125	1926	80	10	124	325
FMS4	15.7	21.69	16062	-1986	1229	-1853	60	2247	84	7	95	264
FMS4	15.7	21.54	15996	-2111	1373	-1771	-795	1907	83	7	116	383
FMS4	15.7	21.54	16018	-2207	1082	-1766	-787	1928	83	7	109	242
FMS4	15.7	21.54	16011	-2041	1063	-1748	-793	1947	83	7	109	220
FMS4	15.7	21.54	15989	-2171	796	-1733	-800	1975	83	7	103	200
FMS4	15.7	21.52	16020	-2038	571	-1703	-806	1997	83	7	98	347
FMS4	15.7	21.52	15975	-2062	287	-1662	-819	2054	83	8	93	221
FMS4	15.7	21.52	16028	-2188	2412	-1867	-744	1792	82	8	139	222
FMS4	15.7	21.52	15424	-2409	5863	-2131	-658	1318	72	18	212	108
FMS4	15.7	21.57	15230	-2410	6355	-2167	-644	1229	71	19	227	347
FMS4	15.7	21.57	14156	-2556	9114	-2287	-629	839	61	29	273	353
FMS4	15.7	21.57	13896	-2501	9377	-2291	-637	745	60	30	275	339
FMS4	15.4	21.67	12126	-2747	12072	-2317	-644	310	49	42	278	179
FMS4	15.4	21.67	9879	-2849	14428	-2240	-698	-123	37	53	267	225
FMS4	15.4	21.67	9486	-2870	14470	-2230	-700	-188	36	54	266	211
FMS4	15.4	21.5	8158	-2934	15578	-2170	-736	-361	30	60	260	276
FMS4	15.4	21.5	5030	-3059	17193	-2006	-828	-696	17	73	251	337
FMS4	15.4	21.42	5545	-2867	16899	-1363	-1224	-1360	20	71	261	232
FMS4	15.4	21.24	6402	-2716	16426	-1438	-1218	-1285	23	67	262	300

ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS4	15.4	21.24	8018	-2703	15640	-1611	-1205	-1091	30	61	264	345
FMS4	15.4	21.24	9167	-2545	14979	-1708	-1212	-942	34	56	266	227
FMS4	15.4	21.24	10565	-2467	13622	-1799	-1229	-747	41	49	268	366
FMS4	15.4	21.33	11498	-2486	12861	-1867	-1226	-592	45	45	269	320
FMS4	15.4	21.33	12448	-2309	11904	-1911	-1238	-448	50	40	270	359
FMS4	15.4	21.33	12929	-2197	11146	-1934	-1247	-341	53	37	270	494
FMS4	15.1	21.32	14029	-2247	9305	-1935	-1250	34	60	30	268	380
FMS4	15.1	21.55	14167	-2148	9163	-1925	-1294	62	61	29	268	486
FMS4	15.4	21.56	15991	-1124	-133	-1380	-1576	480	84	6	111	393
FMS4	15.4	21.51	15613	-221	-2655	-1316	-1527	-204	77	13	100	308
FMS4	15.4	21.46	15861	-246	-1842	-1354	-1494	-259	80	10	102	293
FMS4	15.1	21.46	16020	-451	3637	-1514	-1399	-682	82	8	285	239
FMS4	15.1	21.46	15920	-475	4174	-1516	-1384	-728	80	10	286	462
FMS4	15.1	21.37	15217	-540	6768	-1488	-1339	-962	71	19	290	387
FMS4	15.1	21.36	11473	-834	13239	-972	-1182	-1660	45	45	296	365
FMS4	14.8	21.36	10403	-897	14277	-845	-1167	-1736	40	50	295	236
FMS4	14.8	21.36	9965	-993	14441	-814	-1169	-1752	38	52	294	436
FMS4	14.8	21.34	8006	-1094	15901	-566	-1115	-1837	29	61	292	281
FMS4	14.8	21.34	7608	-1097	16224	-519	-1113	-1850	28	63	292	456
FMS4	15.1	21.34	7243	-1064	16256	-447	-1100	-1852	26	64	292	113
FMS4	15.1	21.18	6610	-1101	16817	-406	-1087	-1863	23	67	290	255
FMS4	14.8	21.11	7286	185	16441	196	-846	-2123	26	64	322	359
FMS4	14.8	21.11	6937	15	16382	143	-889	-2107	25	65	318	430
FMS4	14.8	21.11	7400	-34	16254	85	-886	-2106	27	63	318	436
FMS4	14.8	21.11	8447	-38	15804	-68	-899	-2109	31	59	318	320
FMS4	14.8	21.36	10079	57	14448	-300	-899	-2084	38	52	320	483
FMS4	14.8	21.36	10188	5	14492	-347	-898	-2065	39	52	319	345
FMS4	14.8	21.53	12387	317	12279	-660	-917	-1955	49	41	322	163
FMS4	14.8	21.53	12815	223	11559	-730	-914	-1928	52	38	322	231
FMS4	14.8	21.6	13847	381	10001	-945	-924	-1800	59	31	322	275
FMS4	14.8	21.6	14593	441	8461	-1130	-932	-1670	65	25	322	177
FMS4	14.8	21.6	14985	488	7419	-1191	-944	-1611	68	22	323	394
FMS4	14.8	21.54	15524	539	5883	-1283	-938	-1513	74	16	326	395
FMS4	14.8	21.54	16051	667	3346	-1413	-946	-1298	82	8	338	467
FMS4	14.5	21.41	16008	2173	434	-1625	255	-1447	82	8	103	126
FMS4	14.5	21.5	15544	2169	5187	-1259	169	-1813	74	16	40	262
FMS4	14.5	21.5	15107	1944	6886	-1092	141	-1941	69	21	27	374
FMS4	14.5	21.5	13235	1782	10841	-484	128	-2228	55	35	14	191
FMS4	14.1	21.5	12778	1726	11449	-347	119	-2284	52	38	13	382
FMS4	14.1	21.71	9332	1545	14928	432	147	-2393	35	55	9	278
FMS4	14.1	21.71	8969	1633	15308	552	159	-2396	33	57	9	332
FMS4	14.5	21.71	7612	1583	16021	831	172	-2382	28	62	9	229
FMS4	14.5	21.71	6193	1472	16945	1087	164	-2344	22	68	8	189
FMS4	14.5	21.47	4975	1772	17247	1313	937	-2242	17	73	32	328
FMS4	14.5	21.47	5918	1927	16833	1156	906	-2276	21	69	32	277
FMS4	14.1	21.47	7257	1898	16238	834	876	-2325	26	64	31	301
FMS4	14.1	21.17	9662	1915	14770	295	802	-2366	36	54	31	251
FMS4	14.1	21.17	10569	2010	13819	114	786	-2341	41	49	31	250
FMS4	14.5	21.17	12085	2072	12323	-282	754	-2273	48	42	34	467
FMS4	14.5	21.17	13400	2146	10519	-666	731	-2161	56	34	38	284
FMS4	14.5	21.61	14413	2267	8530	-985	723	-2020	63	27	44	176
FMS4	14.5	21.61	15241	2414	6404	-1264	727	-1852	70	20	53	217
FMS4	14.1	21.57	15817	2476	3964	-1783	1216	-1202	77	13	85	300
FMS4	14.1	21.57	15379	2425	5716	-1648	1226	-1375	72	18	75	186
FMS4	14.1	21.46	14795	2322	7595	-1350	1247	-1629	66	24	66	356
FMS4	14.1	21.46	14517	2203	8528	-1261	1242	-1681	63	27	63	287
FMS4	14.1	21.46	12870	2101	11522	-770	1301	-1932	52	38	56	381
FMS4	14.1	21.61	12310	2132	12026	-630	1319	-1989	49	41	54	279
FMS4	14.1	21.61	9529	1893	15003	-6	1453	-2070	35	55	53	298
FMS4	13.8	21.54	7558	1763	16100	435	1554	-2047	27	63	53	268
FMS4	13.8	21.54	6292	1752	16614	660	1609	-2009	23	67	54	336
FMS4	13.8	21.31	6690	1297	16584	-50	2057	-1534	24	66	73	160
FMS4	13.8	21.36	9041	1337	15072	-422	1951	-1577	34	56	71	358
FMS4	13.8	21.36	8617	1401	15964	-462	1941	-1567	31	59	74	481
FMS4	13.8	21.36	9334	1527	15173	-526	1925	-1566	35	56	73	465
FMS4	13.8	21.45	12365	1570	12067	-1086	1795	-1422	50	40	73	325
FMS4	13.8	21.51	13344	1640	10668	-1340	1744	-1286	55	35	76	472
FMS4	13.8	21.51	14367	1729	8732	-1574	1692	-1110	63	27	78	340
FMS4	13.8	21.48	15249	1736	6399	-1826	1666	-831	71	19	84	459
FMS4	13.5	21.48	16108	1974	2475	-2113	1623	-308	82	8	112	300
FMS4	13.8	21.44	15934	2131	-647	-2239	1598	137	80	10	247	387
FMS4	13.8	21.46	16004	1520	-78	-2207	1704	548	83	7	252	430
FMS4	13.8	21.46	16143	1436	2598	-2198	1707	242	83	7	123	141
FMS4	13.5	21.46	13430	987	10662	-1682	1868	-758	56	34	84	236
FMS4	13.5	21.45	9938	726	14524	-1151	2011	-1064	38	52	84	450
FMS4	13.5	21.25	4637	578	17384	-509	2175	-970	16	74	88	356
FMS3	16.4	21.38	6368	68	16654	-2594	-1103	-1144	23	67	242	499
FMS3	16.4	21.71	4082	-1974	17537	-2244	256	-1540	14	76	188	433
FMS3	16.4	21.71	4747	-244	17358	-2706	-949	-1409	17	73	231	426

ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS3	16.1	21.4	9209	618	15199	-1762	870	-1610	34	56	107	258
FMS3	16.1	21.4	9068	558	15380	-1819	825	-1530	34	57	114	371
FMS3	16.1	21.37	10347	629	14264	-1974	802	-1282	39	51	112	143
FMS3	16.1	21.37	11035	693	13569	-1992	824	-1249	43	47	106	247
FMS3	16.1	21.47	9996	991	14584	-1705	875	-1682	38	52	94	350
FMS3	16.1	21.45	8939	965	15379	-1428	860	-1964	33	57	85	401
FMS3	16.1	21.45	10086	655	14665	-1558	898	-1808	38	52	84	483
FMS3	16.1	21.45	11045	703	13700	-1748	896	-1574	43	47	89	318
FMS3	16.1	21.45	12478	1101	11930	-1972	901	-1171	50	40	92	390
FMS3	16.1	21.45	12788	890	11565	-2093	890	-956	52	38	97	423
FMS3	16.1	21.57	13690	972	10230	-2238	827	-574	58	32	99	254
FMS3	16.1	21.57	14744	1037	8046	-2279	812	-207	66	24	93	444
FMS3	16.1	21.57	14993	1089	7281	-2284	827	-70	69	22	91	438
FMS3	16.1	21.53	15518	1191	5755	-2273	835	162	74	16	89	225
FMS3	16.1	21.53	14920	922	7656	-2278	822	94	67	23	89	340
FMS3	16.1	21.53	13566	883	10436	-2265	794	-546	57	33	101	274
FMS3	16.1	21.53	12981	828	11579	-2229	803	-702	53	38	104	334
FMS3	16.4	21.51	12087	781	12590	-2157	819	-940	48	42	107	304
FMS3	16.4	21.51	10505	739	14680	-2037	820	-1197	39	51	115	397
FMS3	16.4	21.51	10035	689	14521	-1919	837	-1417	38	52	109	347
FMS3	16.4	21.51	9037	610	15517	-1836	853	-1544	33	57	113	291
FMS3	16.4	21.51	7849	479	15875	-1646	889	-1790	29	61	110	407
FMS3	16.4	21.41	8541	573	15596	-1776	857	-1608	32	59	113	419
FMS3	16.4	21.41	9995	582	14436	-1937	819	-1377	38	52	111	271
FMS3	16.4	21.41	10830	643	13777	-2042	791	-1185	42	48	112	135
FMS3	16.1	21.41	11499	613	13288	-2120	776	-1035	45	45	112	91
FMS3	16.1	21.36	12505	665	11936	-2222	745	-772	51	40	109	456
FMS3	16.1	21.36	13778	842	9993	-2345	703	-364	59	32	102	479
FMS3	16.4	21.45	15422	905	5821	-2363	700	207	74	16	88	354
FMS3	16.4	21.45	16211	1048	1872	-2218	714	849	85	5	243	456
FMS3	16.1	21.37	16113	1040	1220	-2144	724	1010	86	4	260	316
FMS3	16.1	21.37	15975	1146	-502	-2019	751	1219	83	7	284	330
FMS3	16.1	21.37	15945	839	4390	-2340	586	667	79	11	110	454
FMS3	16.4	21.36	14986	613	7662	-2439	550	159	68	22	87	387
FMS3	16.4	21.36	13393	505	10824	-2386	600	-380	56	35	112	240
FMS3	16.4	21.36	13099	489	11117	-2365	605	-435	54	36	114	165
FMS3	16.4	21.35	12303	404	12332	-2300	634	-674	49	41	120	359
FMS3	16.4	21.35	11650	374	12985	-2238	674	-863	46	44	121	476
FMS3	16.4	21.35	10222	251	14404	-2089	719	-1136	39	51	124	314
FMS3	16.1	21.34	7960	197	15835	-1812	798	-1489	29	61	125	488
FMS3	16.1	21.14	6964	-165	16437	-1762	762	-1482	25	65	135	273
FMS3	16.1	21.07	8942	-50	15312	-2011	647	-1203	33	57	137	187
FMS3	16.1	21.17	11342	22	13611	-2258	535	-787	44	46	138	361
FMS3	16.1	21.17	12004	99	12599	-2326	494	-663	48	42	137	207
FMS3	16.1	21.27	13686	161	10376	-2450	425	-223	57	33	126	213
FMS3	16.1	21.27	14172	259	9169	-2457	417	-182	62	28	119	493
FMS3	16.1	21.27	14556	272	8719	-2493	389	38	64	26	103	245
FMS3	16.1	21.3	16199	537	3530	-2443	335	784	82	8	235	255
FMS3	16.1	21.33	12698	-485	11715	-2406	124	-430	52	38	209	442
FMS3	16.1	21.33	13650	-390	10075	-2459	97	-302	58	32	225	454
FMS3	16.1	21.33	15463	-185	6460	-2589	-8	323	72	18	278	216
FMS3	16.1	21.39	14521	-333	8695	-2548	34	38	64	26	261	311
FMS3	16.1	21.39	13664	-363	10467	-2501	59	-170	57	33	236	263
FMS3	16.1	21.4	12335	-544	12246	-2385	138	-482	49	41	204	263
FMS3	16.1	21.4	11943	-524	12716	-2357	157	-555	47	43	198	289
FMS3	16.1	21.4	11122	-613	13427	-2264	204	-698	44	47	189	300
FMS3	16.1	21.4	10143	-619	14381	-2185	249	-810	39	51	182	333
FMS3	16.1	21.37	8218	-704	15900	-1990	356	-1019	30	60	171	295
FMS3	16.1	21.37	6949	-930	16304	-1860	369	-1086	25	65	173	486
FMS3	15.7	21.14	6889	-925	16533	-1846	304	-1057	25	65	178	251
FMS3	15.7	21.14	8172	-837	15807	-1966	229	-972	30	60	185	157
FMS3	16.1	21.23	9223	-866	15207	-2065	184	-898	34	56	191	264
FMS3	16.1	21.23	9507	-843	14842	-2107	171	-848	36	54	193	73
FMS3	16.1	21.23	10563	-760	14010	-2193	123	-762	41	49	201	487
FMS3	16.1	21.23	11158	-765	13470	-2259	85	-677	43	47	208	346
FMS3	16.1	21.37	11700	-711	12906	-2312	74	-591	46	44	212	234
FMS3	15.7	21.37	13061	-587	11041	-2442	1	-367	54	36	233	455
FMS3	15.7	21.37	14065	-545	9610	-2537	-56	-97	60	30	255	389
FMS3	16.1	21.45	14598	-545	8607	-2568	-61	8	64	26	263	311
FMS3	16.4	21.4	15273	-388	6751	-2599	-104	277	71	19	274	104
FMS3	16.4	21.4	15443	-370	6226	-2611	-113	339	73	17	275	358
FMS3	16.1	21.36	15904	-812	4694	-2676	-387	283	78	12	269	478
FMS3	16.1	21.36	15727	-911	5232	-2671	-390	249	76	14	270	314
FMS3	16.1	21.36	15576	-905	5798	-2653	-383	158	74	16	270	292
FMS3	15.7	21.42	15150	-986	6798	-2634	-379	84	71	20	270	477
FMS3	15.7	21.42	14629	-1077	8506	-2546	-369	-161	64	26	266	408
FMS3	15.7	21.42	14363	-1209	8954	-2525	-361	-196	63	27	265	491
FMS3	15.7	21.42	12481	-1182	11773	-2286	-320	-593	51	39	253	410
FMS3	15.7	21.59	12005	-1290	12513	-2225	-317	-641	48	42	250	347

ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS3	15.7	21.59	11501	-1349	13214	-2179	-306	-679	45	45	247	231
FMS3	15.7	21.59	10750	-1338	13869	-2089	-288	-772	41	49	242	223
FMS3	15.7	21.57	4626	-1431	17364	-359	-849	-1975	16	74	285	432
FMS3	15.4	21.26	7088	-1078	16375	-680	-765	-2250	26	64	295	424
FMS3	15.7	21.39	10475	-769	13855	-1393	-709	-2279	41	49	301	248
FMS3	15.7	21.39	11481	-639	13378	-1559	-748	-2213	45	46	301	291
FMS3	15.7	21.39	13343	-1041	11261	-2085	-783	-1959	54	36	293	480
FMS3	15.4	21.39	15357	-1263	6306	-2738	-654	-1393	72	18	288	422
FMS3	15.7	21.7	14525	-685	9069	-2209	-247	-2095	63	27	323	378
FMS3	15.4	21.79	12014	-987	12698	-1441	-186	-2565	47	43	330	409
FMS3	15.4	21.6	7751	-949	16187	-381	-209	-2843	28	62	334	276
FMS3	15.4	21.39	4259	-1018	17663	390	-227	-2828	15	75	334	357
FMS3	15.4	21.35	4921	-914	17502	361	470	-2964	17	73	6	381
FMS3	15.4	21.39	7677	-1090	16350	-290	491	-2950	28	63	5	218
FMS3	15.4	21.39	10941	-1067	13841	-1106	525	-2772	42	48	6	343
FMS3	15.4	21.62	13750	-663	10574	-1952	434	-2357	57	33	6	291
FMS3	15.1	21.57	16088	107	2389	-2966	127	-1234	86	4	20	458
FMS3	15.1	21.49	14815	496	8133	-2365	572	-2033	66	24	37	393
FMS3	15.1	21.49	12241	132	12313	-1621	682	-2581	49	41	31	436
FMS3	15.1	21.63	10466	-30	14344	-1098	757	-2806	40	50	29	467
FMS3	15.1	21.63	10081	-79	14518	-1014	744	-2844	38	52	28	387
FMS3	15.1	21.58	6698	241	16684	-203	741	-3017	24	66	29	253
FMS3	15.1	21.42	9065	70	15140	-968	1213	-2786	34	56	50	487
FMS3	14.8	21.42	11273	324	13493	-1634	1140	-2485	44	46	57	291
FMS3	15.1	21.4	12920	-43	11717	-1990	1141	-2226	52	38	56	460
FMS3	15.1	21.46	15208	151	7217	-2609	1156	-1521	69	21	65	476
FMS3	14.8	21.48	14636	396	8654	-2844	1280	-1080	64	26	86	360
FMS3	14.8	21.6	9905	327	14798	-811	887	-2008	37	53	47	435
FMS3	14.8	21.5	8673	247	15266	-627	894	-2089	33	57	46	334
FMS3	14.8	21.5	7325	184	16661	-451	895	-2156	26	64	48	407
FMS3	14.8	21.5	6687	165	16628	-308	882	-2198	24	66	45	256
FMS3	14.8	21.5	5157	142	17262	-64	889	-2242	18	72	45	335
FMS3	14.5	21.5	5858	338	16982	-356	981	-2216	21	69	56	425
FMS3	14.5	21.5	7557	366	16255	-639	984	-2125	27	63	58	373
FMS3	14.8	21.51	9502	704	15138	-955	983	-1947	35	55	62	365
FMS3	14.8	21.51	10009	660	14589	-1049	986	-1886	38	52	62	432
FMS3	14.8	21.56	12192	720	12418	-1450	1036	-1554	49	42	69	270
FMS3	14.8	21.56	13414	802	10770	-1604	1055	-1320	56	34	72	344
FMS3	14.8	21.56	13834	785	10161	-1625	1053	-1258	58	32	71	150
FMS3	14.8	21.67	14789	903	8245	-1710	1065	-1030	65	25	73	186
FMS3	14.8	21.67	15303	951	6743	-1740	1061	-865	71	19	75	259
FMS3	14.8	21.67	16061	1070	2996	-1742	1095	-513	83	7	89	209
FMS3	14.5	21.67	16042	1267	2240	-1736	1094	-454	84	6	99	383
FMS3	14.5	21.52	14527	1029	8443	-1827	1050	-742	64	26	83	353
FMS3	14.8	21.52	13775	1020	10009	-1786	1031	-954	58	32	83	348
FMS3	14.8	21.68	13070	911	11235	-1702	1016	-1143	54	36	82	193
FMS3	14.8	21.68	11969	863	12594	-1605	1007	-1351	48	43	82	89
FMS3	14.5	21.69	10567	804	14057	-1442	996	-1573	41	50	81	163
FMS3	14.5	21.69	9041	792	15213	-1210	979	-1818	34	56	78	199
FMS3	14.5	21.54	8038	673	15908	-1057	988	-1942	29	61	77	449
FMS3	14.5	21.42	7789	588	16084	-1203	1025	-1858	28	62	88	281
FMS3	14.5	21.42	9994	788	14553	-1532	1015	-1519	38	52	91	214
FMS3	14.5	21.45	11065	785	13450	-1665	1012	-1316	43	47	91	287
FMS3	14.5	21.45	12237	878	12446	-1794	1021	-1076	49	42	91	423
FMS3	14.5	21.45	13408	1055	10899	-1922	1027	-749	55	35	92	342
FMS3	14.5	21.59	15420	1098	6402	-2007	1060	-104	72	18	90	131
FMS3	14.5	21.49	15906	1448	-961	-1765	1247	786	81	9	270	179
FMS3	14.5	21.49	16015	1530	-1038	-1759	1254	786	81	10	270	382
FMS3	14.5	21.44	9432	606	15049	-1703	960	-1301	35	55	106	269
FMS3	14.5	21.44	10171	581	14405	-1780	938	-1185	39	51	106	314
FMS3	14.5	21.44	11870	661	12703	-1978	886	-824	47	43	104	314
FMS3	14.1	21.44	12993	800	11452	-2099	846	-482	53	37	102	155
FMS3	14.1	21.45	14810	850	8046	-2172	824	28	66	24	90	411
FMS3	14.1	21.45	15501	954	5763	-2162	821	403	74	16	91	445
FMS2	18.6	21.69	11046	-1312	13564	-937	917	-1145	43	47	63	250
FMS2	18.6	21.57	7226	-1437	16195	-353	1030	-1035	26	64	66	276
FMS2	18.6	21.57	7785	-1451	15741	-392	1015	-1050	29	61	63	367
FMS2	18.6	21.57	9119	-1329	14883	-574	987	-1111	35	55	62	404
FMS2	18.6	21.57	11474	-1322	13045	-994	924	-1133	45	45	62	278
FMS2	18.6	21.61	11870	-1270	12579	-1062	902	-1114	47	43	62	147
FMS2	18.6	21.61	13334	-1204	10868	-1384	843	-1025	55	35	65	444
FMS2	18.6	21.61	14329	-1080	9001	-1591	807	-924	62	28	63	373
FMS2	18.6	21.78	15676	-940	5150	-1982	747	-560	76	14	67	318
FMS2	18.6	21.78	16058	-774	3146	-2100	730	-385	83	7	64	392
FMS2	18.6	21.56	15969	-717	-888	-2316	722	217	83	8	272	202
FMS2	18.6	21.56	15674	-667	-2467	-2335	706	436	77	13	271	133
FMS2	18.6	21.55	15926	-1139	3070	-2198	881	-140	83	7	76	135
FMS2	18.6	21.55	15673	-1183	4517	-2157	881	-223	78	12	82	430
FMS2	18.6	21.55	15304	-1278	6702	-1926	898	-536	71	19	78	462


ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS2	18.3	21.55	12461	-1626	11900	-1314	948	-929	50	40	77	119
FMS2	18.3	21.61	9749	-1717	14217	-841	995	-968	38	52	76	407
FMS2	18.3	21.61	7447	-1766	16164	-628	1005	-883	27	63	85	370
FMS2	18.3	21.57	7983	-2060	15782	-904	887	-768	29	61	104	335
FMS2	18.3	21.57	10425	-1907	14108	-1152	919	-790	40	50	96	315
FMS2	18.3	21.56	10827	-1819	13614	-1202	918	-785	42	48	95	363
FMS2	18.3	21.56	12995	-1721	11091	-1482	940	-700	54	36	88	200
FMS2	18.3	21.56	12807	-1767	11469	-1494	954	-696	52	38	90	208
FMS2	18	21.69	14155	-1632	9280	-1701	947	-548	61	29	87	375
FMS2	18	21.69	14286	-1633	8921	-1738	942	-523	62	28	87	399
FMS2	18	21.69	15250	-1509	6720	-1933	949	-313	71	20	85	301
FMS2	18	21.69	15482	-1512	5571	-2026	949	-167	74	16	85	493
FMS2	18	21.66	15969	-1153	-1282	-2308	1009	752	81	9	298	215
FMS2	18	21.66	15871	-1246	-1041	-2301	1025	753	81	9	304	424
FMS2	18	21.42	15992	-1212	-780	-2266	970	959	82	8	333	445
FMS2	18	21.42	15923	-1403	3698	-2161	933	264	81	10	88	480
FMS2	18	21.49	14802	-1633	7750	-1904	909	-249	67	23	91	241
FMS2	18	21.49	14670	-1615	8447	-1866	906	-288	64	26	92	477
FMS2	17.7	21.49	12609	-1785	11746	-1544	868	-592	51	39	99	289
FMS2	17.7	21.49	12070	-1813	12090	-1455	849	-651	49	41	100	336
FMS2	17.7	21.49	10113	-1973	14231	-1224	817	-731	39	51	109	396
FMS2	17.4	21.6	6591	-2067	16534	-947	724	-744	24	66	127	233
FMS2	17.4	21.6	5699	-2069	17116	-903	707	-718	20	70	132	347
FMS2	17.4	21.39	4786	-1974	17348	-965	419	-885	17	73	171	129
FMS2	17.4	21.24	7134	-1904	16453	-1109	532	-830	26	64	152	300
FMS2	17.4	21.24	8582	-1795	15491	-1199	576	-804	32	58	141	475
FMS2	17.4	21.24	8713	-1836	15445	-1229	595	-787	32	58	139	345
FMS2	17.4	21.28	11185	-1640	13155	-1442	688	-662	44	46	117	495
FMS2	17.4	21.28	12489	-1634	11847	-1606	722	-529	51	40	110	432
FMS2	17.4	21.28	13032	-1502	11052	-1666	726	-455	54	36	107	190
FMS2	17.4	21.49	14908	-1378	7737	-1921	754	-76	67	23	94	123
FMS2	17.4	21.49	15361	-1368	6234	-2006	750	97	72	18	91	302
FMS2	17.4	21.49	15406	-1402	5570	-2040	753	205	74	16	90	466
FMS2	17.4	21.49	16013	-1217	2894	-2130	742	557	83	7	92	250
FMS2	17.4	21.48	16028	-1178	1125	-2161	732	836	86	4	76	196
FMS2	17.4	21.48	15804	-1064	-1778	-2048	683	1292	79	11	359	398
FMS2	17.4	21.42	15641	-562	-2644	-1952	248	1530	77	13	20	345
FMS2	17.4	21.42	15677	-523	-2181	-1959	249	1500	78	12	20	357
FMS2	17.4	21.42	16002	-555	-66	-2095	338	1154	85	5	37	380
FMS2	17.4	21.41	16176	-805	2352	-2170	387	777	86	5	105	234
FMS2	17.4	21.41	15713	-938	4962	-2170	432	444	77	13	86	370
FMS2	17.4	21.41	15182	-1057	6863	-2149	450	176	70	20	89	234
FMS2	17.4	21.41	14015	-1082	9683	-2040	461	-213	60	30	124	372
FMS2	17.4	21.41	12309	-1261	12327	-1839	453	-574	49	41	148	335
FMS2	17	21.51	11036	-1302	13556	-1693	427	-769	43	47	159	498
FMS2	17	21.51	9070	-1266	15273	-1476	390	-988	34	56	168	292
FMS2	17	21.51	8668	-1293	15461	-1428	391	-1020	32	58	169	413
FMS2	17	21.41	7198	-997	16429	-1327	198	-1288	26	64	195	177
FMS2	17	21.41	9538	-870	14900	-1593	200	-1034	36	54	195	218
FMS2	16.7	21.41	11050	-867	13625	-1760	207	-824	43	47	195	239
FMS2	16.7	21.53	12492	-811	11973	-1887	213	-584	50	40	197	185
FMS2	16.7	21.53	15374	-532	6431	-2089	126	226	72	18	281	177
FMS2	16.7	21.53	15702	-305	5244	-2079	96	423	76	14	278	406
FMS2	16.7	21.53	16198	-359	2477	-2015	30	734	86	4	217	308
FMS2	16.7	21.63	15979	-135	-1283	-1772	-98	1266	82	9	37	344
FMS2	16.7	21.63	15827	-128	-2303	-1694	-146	1367	78	12	37	326
FMS2	16.7	21.42	15678	487	-2689	-1453	-432	1062	77	13	50	242
FMS2	16.7	21.42	15858	506	-1571	-1554	-409	993	80	10	47	138
FMS2	16.7	21.42	16090	436	86	-1715	-350	847	86	4	31	240
FMS2	16.7	21.42	15829	129	4760	-1998	-230	373	78	12	269	496
FMS2	16.7	21.51	15486	184	6253	-2043	-165	181	73	17	270	188
FMS2	16.7	21.51	14656	-15	8364	-2084	-115	-121	65	25	260	284
FMS2	16.7	21.51	12601	-155	11967	-1976	-39	-684	51	39	232	129
FMS2	16.7	21.51	11887	-149	12662	-1945	-38	-775	47	43	227	257
FMS2	16.7	21.72	10004	-284	14590	-1731	5	-1139	38	52	217	267
FMS2	16.4	21.72	6876	-374	16672	-1413	33	-1501	25	65	207	350
FMS2	16.4	21.67	5164	82	17244	-1144	-7	-1772	18	72	207	284
FMS2	16.4	21.67	6240	129	16862	-1270	-20	-1694	22	68	210	156
FMS2	16.4	21.67	8622	171	15661	-1553	-53	-1430	32	58	218	330
FMS2	16.4	21.67	9805	375	14703	-1667	-66	-1293	37	53	221	314
FMS2	16.4	21.58	11234	373	13550	-1795	-66	-1082	43	47	227	162
FMS2	16.4	21.58	12915	323	11422	-1921	-112	-730	53	37	243	402
FMS2	16.4	21.58	14193	657	9277	-1943	-139	-480	61	29	255	203
FMS2	16.4	21.58	15070	575	7384	-1923	-180	-203	69	21	265	244
FMS2	16.4	21.7	15910	722	3807	-1770	-255	166	81	9	272	449
FMS2	16.1	21.7	15986	849	3176	-1716	-274	248	83	8	273	145
FMS2	16.1	21.7	16207	839	940	-1583	-306	403	87	4	334	475
FMS2	16.1	21.7	16129	1006	167	-1469	-339	438	85	5	41	313
FMS2	16.4	21.57	16063	1237	1507	-1469	-318	105	85	5	338	414

ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS2	16.4	21.57	16039	1177	3185	-1579	-326	12	82	8	284	491
FMS2	16.4	21.57	15533	1107	6088	-1711	-315	-231	73	17	276	377
FMS2	16.1	21.57	13570	933	10580	-1753	-301	-751	56	34	267	391
FMS2	16.1	21.63	11852	900	12834	-1668	-283	-1083	47	43	260	451
FMS2	16.1	21.63	10164	739	14475	-1491	-281	-1397	39	52	261	263
FMS2	16.1	21.63	8511	587	15720	-1293	-277	-1610	31	59	260	276
FMS2	16.1	21.63	5763	529	17109	-969	-260	-1843	20	70	253	250
FMS2	16.1	21.63	3925	467	17747	-682	-244	-1973	13	77	256	382
FMS2	16.1	21.69	2931	734	18133	-130	-257	-2074	10	80	313	307
FMS2	16.1	21.69	3856	645	17907	-268	-261	-2049	13	77	311	235
FMS2	16.1	21.69	5641	737	17106	-478	-256	-1971	20	70	317	271
FMS2	16.1	21.69	6848	819	16477	-718	-251	-1857	25	65	310	324
FMS2	16.1	21.45	9997	887	14555	-1130	-245	-1567	38	52	307	222
FMS2	16.1	21.45	10208	778	14383	-1173	-246	-1527	39	51	303	253
FMS2	16.1	21.45	11477	946	13128	-1318	-251	-1353	45	45	302	365
FMS2	16.1	21.45	12226	898	12379	-1400	-241	-1217	49	41	297	196
FMS2	16.1	21.48	13568	858	10454	-1505	-246	-1034	57	33	301	437
FMS2	15.7	21.48	14448	1107	8830	-1575	-235	-799	63	27	298	240
FMS2	15.7	21.48	15650	1193	5402	-1577	-201	-408	75	15	297	387
FMS2	15.7	21.56	16109	397	642	-1451	-17	-95	87	3	90	336
FMS2	15.7	21.5	16034	1381	3733	-1622	-111	-233	80	10	309	276
FMS2	15.7	21.5	15701	1255	5090	-1639	-139	-346	76	14	295	254
FMS2	15.7	21.5	14538	1121	8574	-1604	-204	-719	64	26	292	268
FMS2	15.7	21.5	12969	997	11403	-1484	-240	-1020	53	37	289	436
FMS2	15.7	21.39	11918	710	12651	-1354	-245	-1213	47	43	294	228
FMS2	15.7	21.39	7901	736	16002	-775	-208	-1671	29	61	313	337
FMS2	15.7	21.39	7497	804	16346	-735	-207	-1708	27	63	313	203
FMS2	15.7	21.24	5521	621	17136	-399	-187	-1846	20	71	321	333
FMS2	15.4	21.24	6452	392	16788	-356	107	-1766	23	67	357	203
FMS2	15.4	21.08	6633	372	16549	-353	105	-1763	24	66	357	233
FMS2	15.4	21.08	8857	351	15287	-712	29	-1655	33	57	346	449
FMS2	15.4	21.08	10051	524	14432	-938	5	-1534	38	52	342	109
FMS2	15.4	21.08	11054	565	13590	-1112	-25	-1444	43	47	335	289
FMS2	15.4	21.23	12144	589	12409	-1227	-29	-1336	49	42	335	398
FMS2	15.4	21.23	12146	555	12590	-1263	-32	-1301	48	42	329	180
FMS2	15.4	21.23	13193	493	10936	-1438	-47	-1123	55	35	319	470
FMS2	15.4	21.23	14331	761	9108	-1597	-41	-922	62	28	321	186
FMS2	15.4	21.31	15818	967	4598	-1805	8	-406	78	12	333	179
FMS2	15.4	21.31	16008	996	3721	-1812	14	-342	81	9	3	167
FMS2	15.4	21.36	16020	637	3290	-1972	184	-275	83	8	69	295
FMS2	15.4	21.36	15840	552	4759	-1931	174	-401	78	12	46	305
FMS2	15.4	21.36	15226	416	7127	-1756	176	-739	70	20	15	332
FMS2	15.1	21.38	13849	260	10168	-1511	213	-1052	58	32	15	309
FMS2	15.1	21.38	12181	1	12578	-1199	279	-1294	48	42	17	249
FMS2	15.1	21.38	10885	19	13917	-975	328	-1411	42	48	23	351
FMS2	15.1	21.49	9104	-227	15307	-690	413	-1499	34	56	26	448
FMS2	15.1	21.49	7098	-198	16479	-343	524	-1530	26	64	33	296
FMS2	14.8	21.4	6723	-779	16641	-199	727	-1281	24	66	44	279
FMS2	14.8	21.4	7168	-626	16397	-251	709	-1303	26	64	43	171
FMS2	14.8	21.41	9033	-666	15113	-518	626	-1345	34	56	37	372
FMS2	14.8	21.41	11041	-580	13261	-817	550	-1334	44	46	31	203
FMS2	15.1	21.41	12903	-389	11586	-1214	447	-1199	52	38	33	357
FMS2	15.1	21.41	13565	-370	10441	-1332	424	-1140	57	33	30	455
FMS2	14.8	21.63	15633	-196	5834	-1813	327	-725	74	16	26	491
FMS2	14.8	21.46	16191	92	298	-2148	253	-13	87	3	95	330
FMS1	21.2	21.89	10040	-423	14433	-1716	68	-384	38	52	212	166
FMS1	21.2	21.89	10082	-423	14310	-1720	71	-368	39	51	212	383
FMS1	21.2	21.89	11892	-420	12495	-1873	1	-213	48	42	235	372
FMS1	21.2	21.89	13107	-265	10872	-1972	-44	-37	55	35	255	383
FMS1	21.2	21.38	15212	-72	6803	-2113	-144	478	71	19	274	393
FMS1	21.5	21.38	15882	54	4006	-2105	-182	869	81	10	251	367
FMS1	21.5	21.58	15949	106	2906	-2080	-190	993	84	6	244	221
FMS1	21.5	21.58	15948	153	83	-1982	-190	1349	86	4	15	455
FMS1	21.5	21.58	15954	-67	-227	-2060	-330	1273	85	5	46	436
FMS1	21.2	21.65	16090	-152	42	-2099	-413	1147	86	4	58	371
FMS1	21.2	21.65	15056	-456	7099	-2132	-357	290	70	20	271	476
FMS1	21.2	21.65	13833	-585	9981	-2048	-326	46	59	31	268	214
FMS1	21.5	21.52	12935	-651	11167	-1946	-292	-131	54	36	261	494
FMS1	21.2	21.4	13364	-1186	10269	-1744	-575	-391	57	33	269	347
FMS1	21.2	21.4	13345	-1180	10662	-1792	-570	-350	56	34	267	348

ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS1	21.2	21.4	14461	-1137	8486	-1945	-586	-184	64	26	270	414
FMS1	21.2	21.4	15328	-946	6018	-2080	-582	59	73	17	270	415
FMS1	21.2	21.44	16116	-864	641	-2239	-609	711	87	3	98	388
FMS1	21.2	21.44	15933	-850	253	-2232	-598	810	86	4	90	382
FMS1	21.2	21.62	15759	-1183	3886	-2159	-669	25	80	10	267	457
FMS1	21.2	21.48	16001	-1218	3929	-2117	-658	-56	80	10	268	403
FMS1	21.2	21.48	15158	-1233	6657	-1814	-637	-578	71	19	278	294
FMS1	21.2	21.52	15854	-1205	3691	-2027	-646	-232	81	9	270	252
FMS1	21.2	21.52	16110	-1063	-354	-2216	-685	285	84	6	97	469
FMS1	21.2	21.52	15912	-1034	-778	-2245	-708	424	82	8	93	430
FMS1	21.2	21.57	15963	-1039	-470	-2004	-637	113	83	7	101	396
FMS1	21.2	21.57	16096	-992	468	-1991	-613	-3	86	4	122	441
FMS1	21.2	21.57	15969	-996	2814	-1911	-576	-302	84	6	270	210
FMS1	20.9	21.6	13794	-1494	9909	-1295	-516	-1055	59	31	291	300
FMS1	20.9	21.6	13101	-1259	10990	-1012	-358	-1315	54	36	308	159
FMS1	20.9	21.6	13467	-1333	10365	-1097	-382	-1294	57	33	306	274
FMS1	20.9	21.6	14518	-1151	8286	-1341	-393	-1116	65	25	301	369
FMS1	20.9	21.98	15526	-968	5754	-1585	-440	-844	74	16	292	145
FMS1	21.2	21.98	16032	-718	2729	-1641	-324	-656	85	6	287	463
FMS1	21.2	21.98	16020	-512	2689	-1585	-228	-688	85	5	296	198
FMS1	21.2	21.98	15476	-740	5668	-1430	-159	-978	75	15	312	213
FMS1	21.2	21.54	14267	-901	9087	-1186	-107	-1255	62	28	322	202
FMS1	20.9	21.54	13274	-919	10761	-947	-65	-1445	55	35	331	233
FMS1	20.9	21.54	12777	-512	11496	-859	257	-1585	52	38	359	443
FMS1	20.9	21.54	13074	-493	11048	-864	258	-1582	54	36	359	197
FMS1	20.9	21.65	14288	-405	8919	-1116	200	-1367	63	27	355	276
FMS1	20.6	21.55	9010	-294	15234	-479	897	-1760	34	56	43	451
FMS1	20.6	21.55	8967	-242	15336	-470	906	-1745	33	57	44	276
FMS1	20.6	21.55	9018	-223	15082	-491	905	-1746	34	56	44	257
FMS1	20.6	21.76	11847	-53	12644	-898	845	-1573	47	43	44	306
FMS1	20.6	21.76	12534	-80	11461	-948	837	-1537	52	38	40	389
FMS1	20.6	21.76	13963	72	9726	-1145	775	-1320	60	30	43	297
FMS1	20.6	21.6	14303	78	9050	-1200	763	-1248	62	28	44	285
FMS1	20.6	21.6	14670	416	8260	-1308	905	-1035	65	25	60	294
FMS1	20.6	21.6	15303	486	6539	-1342	890	-901	72	18	62	462
FMS1	20.6	21.6	15702	543	4995	-1346	872	-778	77	13	65	464
FMS1	20.3	21.6	14280	444	8916	-1302	926	-1075	63	27	62	265
FMS1	20.3	21.71	12271	271	12150	-1110	957	-1414	50	41	59	392
FMS1	20.3	21.71	12103	291	12429	-1091	970	-1438	48	42	59	350
FMS1	20.3	21.71	12102	259	12592	-1100	971	-1427	48	42	60	452
FMS1	20.6	21.71	12164	269	12290	-1103	962	-1421	49	41	59	279
FMS1	20.6	21.71	12006	364	12422	-1093	968	-1438	48	42	60	61
FMS1	20.6	21.66	11194	279	13402	-1003	981	-1522	44	46	60	369
FMS1	20.6	21.66	10504	220	14018	-943	989	-1574	41	50	61	422
FMS1	20.3	21.66	10058	253	14407	-909	1001	-1597	38	52	62	198
FMS1	20.3	21.66	8665	386	15529	-967	1107	-1688	32	58	75	401
FMS1	20.3	21.66	11265	328	13399	-1178	1094	-1459	44	46	70	326
FMS1	20.3	21.66	11771	413	12927	-1210	1088	-1416	46	44	69	329
FMS1	20.3	21.66	12577	402	11848	-1295	1076	-1284	51	39	69	429
FMS1	20.3	21.72	13309	415	10686	-1323	1069	-1195	56	34	67	213
FMS1	20.3	21.72	14294	462	9116	-1370	1054	-1025	62	28	68	266
FMS1	20.3	21.72	14772	575	7861	-1397	1031	-910	67	23	69	346
FMS1	20.3	21.72	15487	641	5829	-1391	1025	-708	74	16	72	261
FMS1	20.3	21.72	16086	796	667	-1222	970	-376	86	4	173	175
FMS1	20.3	21.74	16001	1103	738	-1174	1189	-86	85	5	195	322
FMS1	20.3	21.74	15994	1067	3292	-1324	1185	-204	82	8	96	157
FMS1	20.3	21.74	15487	923	5791	-1448	1152	-408	74	16	84	362
FMS1	20.3	21.74	15141	915	6827	-1489	1149	-506	70	20	82	246
FMS1	20.3	21.74	14139	759	9331	-1499	1147	-737	61	29	81	212
FMS1	19.9	21.77	11421	560	13204	-1365	1148	-1245	45	45	81	210
FMS1	19.9	21.77	10533	800	14016	-1537	1132	-1121	41	50	93	429
FMS1	19.9	21.77	11684	844	12810	-1634	1130	-940	46	44	92	267
FMS1	19.9	21.77	13083	864	11154	-1713	1140	-696	54	36	90	341
FMS1	19.9	21.77	14363	1026	8715	-1739	1172	-388	63	27	88	292
FMS1	19.9	22	15921	1186	2559	-1480	1270	239	84	6	122	282
FMS1	19.9	22	15859	1265	4116	-1735	1020	643	79	11	120	372
FMS1	19.9	22	14800	957	7879	-1767	802	237	67	24	88	317
FMS1	19.9	21.77	13673	942	10103	-1772	788	-49	58	32	93	163
FMS1	19.9	21.77	9452	473	15023	-1444	868	-818	35	55	109	273
FMS1	19.6	21.77	9195	155	15224	-1525	663	-607	34	56	125	365
FMS1	19.6	21.77	10736	377	13951	-1670	601	-399	41	49	122	185
FMS1	19.6	21.77	12524	430	11838	-1796	545	-127	51	39	109	359
FMS1	19.6	21.77	13256	431	10871	-1846	528	20	55	35	98	369
FMS1	19.6	22.03	15360	718	5897	-1865	484	629	74	16	94	474
FMS1	19.6	22.03	16177	849	709	-1673	381	1337	86	4	283	106
FMS1	19.6	22.03	16036	414	1142	-1825	58	1334	88	2	281	245
FMS1	19.6	21.67	15947	349	3709	-1945	56	1038	81	9	235	263
FMS1	19.6	21.67	15218	268	6748	-2010	65	667	71	19	276	198
FMS1	19.6	21.67	13910	244	9862	-1989	119	304	59	31	295	258

ID	Temperature	MSAS (mag/arcsec2)	Ax	Ay	Az	Mx	My	Mz	Altitude	Zenith	Azimuth	Vibration
FMS1	19.6	21.67	12941	101	11337	-1913	150	80	53	37	251	142
FMS1	19.6	21.67	8269	60	15829	-1513	356	-427	30	60	160	498

Appendix C
Light Attenuation Summary



**Table C1: Summary of Illuminance at Receptors
Fifteen Mile Stream - Atlantic Mining NS Corp.**

Source Type	Estimated Luminous Efficacy Equivalent	Assumed Equivalent No. of Lights (where applicable) ²	Total Source Lighting Power (watts)	Source Quantity	Total Source Type Lighting Power (watts)	Total Source Lighting Output (lumens)	Receptor #1		Receptor #2		Receptor #3/4		
							Distance from Source (m)	Resultant Illuminance at Receptor (lux)	Distance from Source (m)	Resultant Illuminance at Receptor (lux)	Distance from Source (m)	Resultant Illuminance at Receptor (lux)	
CAT 420F2 Backhoe	Halogen A19	3	195	1	195	3,900	5,040	1.54E-04	8,340	5.61E-05	8,550	5.33E-05	
Terex RT-335 Crane	Halogen A19	3	195	1	195	3,900	5,040	1.54E-04	8,340	5.61E-05	8,550	5.33E-05	
CAT CT681SG Dump Truck	Halogen A19	3	195	1	195	3,900	5,040	1.54E-04	8,340	5.61E-05	8,550	5.33E-05	
CAT D8T Dozer	Halogen A19	4	260	3	780	15,600	5,040	6.14E-04	8,340	2.24E-04	8,550	2.13E-04	
CAT 336F Excavator	Halogen A19	4	260	1	260	5,200	5,040	2.05E-04	8,340	7.48E-05	8,550	7.11E-05	
CAT 390F Excavator	Halogen A19	5	325	2	650	13,000	5,040	5.12E-04	8,340	1.87E-04	8,550	1.78E-04	
CAT 314E Excavator	Halogen A19	4	260	1	260	5,200	5,040	2.05E-04	8,340	7.48E-05	8,550	7.11E-05	
CAT 14M Grader	Halogen A19	4	260	1	260	5,200	5,040	2.05E-04	8,340	7.48E-05	8,550	7.11E-05	
CAT 775G-01 Haul Truck	Halogen A19	6	390	6	2,340	46,800	5,040	1.84E-03	8,340	6.73E-04	8,550	6.40E-04	
CAT 950M Loader	Halogen A19	3	195	3	585	11,700	5,040	4.61E-04	8,340	1.68E-04	8,550	1.60E-04	
CAT CS688 Roller	Halogen A19	3	195	1	195	3,900	5,040	1.54E-04	8,340	5.61E-05	8,550	5.33E-05	
CAT 745 Articulated Truck	Halogen A19	4	260	2	520	10,400	5,040	4.09E-04	8,340	1.50E-04	8,550	1.42E-04	
Bobcat S770 Skid Steer	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
CAT TH1255 Telehandler	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
Ford F550 Service Truck	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
IH 7400 Lube Truck	Halogen A19	3	195	1	195	3,900	5,040	1.54E-04	8,340	5.61E-05	8,550	5.33E-05	
Ford F550 Mill Service Truck	Halogen A19	3	195	1	195	3,900	5,040	1.54E-04	8,340	5.61E-05	8,550	5.33E-05	
GMC Sierra Light Truck	Halogen A19	2	130	4	520	10,400	5,040	4.09E-04	8,340	1.50E-04	8,550	1.42E-04	
Chevrolet Light Truck	Halogen A19	2	130	2	260	5,200	5,040	2.05E-04	8,340	7.48E-05	8,550	7.11E-05	
Ford Light Truck	Halogen A19	2	130	24	3,120	62,400	5,040	2.46E-03	8,340	8.97E-04	8,550	8.54E-04	
Ford SUV	Halogen A19	2	130	3	390	7,800	5,040	3.07E-04	8,340	1.12E-04	8,550	1.07E-04	
Kubota RTV-X1100CW	Halogen A19	2	130	6	780	15,600	5,040	6.14E-04	8,340	2.24E-04	8,550	2.13E-04	
Freightliner Medium ERV	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
International 5600i Water Truck	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
Kenworth T370 Vacuum Truck	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
Ford F550 Sample Truck	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
Chevrolet Passenger Bus	Halogen A19	2	130	1	130	2,600	5,040	1.02E-04	8,340	3.74E-05	8,550	3.56E-05	
Mobile Floodlights	MLT3060M Floodlight	—	4200	12	50,400	5,544,000	5,040	2.18E-01	8,340	7.97E-02	8,550	7.58E-02	
Polemount Lights	naturaLED SAL (75W)	—	75	84	6,300	724,500	5,040	2.85E-02	8,340	1.04E-02	8,550	9.91E-03	
Total Estimated Resultant Illuminance at the Receptor =									0.26		0.09		0.09

¹All sources were treated (conservatively) as a single source at the point of infrastructure closest to the closest receptor.

²Where specifications were unavailable, lighting was assumed to be based an estimated equivalent number of 65W Halogen lights. Worst-case assumed to be headlights facing the receptors.

Wattage: Light Energy Input

Lumens: Light output

Lux: Light output per square meter scaled based on the sensitivity of the human eye to various wavelengths

Assume process small plant mobile equipment (e.g. manlift, forklifts etc.) are insignificant compared the other equipment



**Table C2: Luminous Efficacy
Atlantic Mining NS Corp.**

Source Lighting Description	Luminous Efficacy* (lumen/watt)	Source
LED A19 Lamp (Dimmable, 2700 K)	100	U.S. Department of Energy (US DOE). 2017. Solid-State Lighting - 2017 Suggested Research Topics Supplement: Technology and Market Context (Tables 2.1 and 2.2)
LED PAR38 Lamp (3000 K)	88	
LED T8 Tube (4000 K)	149	
LED 6" Downlight (3000 K)	86	
LED Troffer 2' x 4' (3500 K)	129	
LED High/Low-Bay Fixture (4000 K)	136	
LED Street Light (5000 K)	118	
OLED Luminaire (3000 K)	—	
Incandescent A19	15	
Halogen A19	20	
CFL A19 Replacement	70	
CFL (Dimmable) A19 Replacement	70	
Linear Fluorescent System	108	
HID (High-Watt) System	115	
HID (Low-Watt) System	104	

*Luminous Efficacy - A measure of how well a light source produces visible light taking into account the sensitivity of the human eye to different wavelengths
Source: A.K.R. Choudhury. 2014. Principles of Colour and Appearance Measurement.

Source Lighting Description	Luminous Efficacy* (lumen/watt)	Source
MLT3060M Floodlight	110	Manufacturer's Specification
naturaLED SAL (75W)	115	Manufacturer's Specification

