



**Environmental and Social Impact  
Assessment for the Troilus Mine Project**

ATMOSPHERIC CONDITIONS



# Environmental and Social Impact Assessment for the Troilus Mine Project

## ATMOSPHERIC CONDITIONS

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## Acronyms and abbreviations

µg	microgramMicrogram
AAQC	Ambient Air Quality Criteria
AERMOD	Air Quality Dispersion Model
AP-42	US Environmental Protection Agency Compilation of Air Pollution Emission Estimation Factors Document
B(a)P	Benzo(a)pyrene
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminants
CARB	California Air Resources Board
CAS	Chemical Abstracts Service
CCME	Canadian Council of Ministers of the Environment
CCME	Canadian Council of Ministers of the Environment
CIE	Commission Internationale de L'Éclairage
CO	Carbon Monoxide
CoPC	Contaminants of Potential Concern
ECCC	Environment and Climate Change Canada
ESIA	Environmental and Social Impact Assessment
GLC	Ground Level Concentrations
GLCs	Ground Level Concentrations
HHERA	Human Health and Ecological Risk Assessment
IAAC	Impact Assessment Agency of Canada
LOM	Life of Mine
LSA	Local Study Area
m <sup>3</sup>	cubic metre
MECP	Ministry of the Environment, Conservation and Parks (Ontario)
MELCC	Ministère de l'Environnement, de la Lutte contre les changements climatiques
MELCCFP	Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (Ministry of Environment, the Fight Against Climate Change, Wildlife and Parks)
N/A	Not Applicable
ND	Not Detected
NO <sub>2</sub>	Nitrogen Dioxide
PAH	Polycyclic Aromatic Hydrocarbon
PAPDA	Project Development AreaProject Area
PM	Particulate Matter (also referred to as TSP)
PM <sub>10</sub>	Particulate Matter Smaller Than 10 Microns
PM <sub>2.5</sub>	Particulate Matter Smaller Than 2.5 Microns
RH	Relative Humidity
RSA	Regional Study Area
SO <sub>2</sub>	Sulphur Dioxide
t	Tonnes

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TIS	Tailored Impact Statement
tpd	Tonnes Per Day
TSF	Tailings Storage Facility
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VC	Valued Component
VOC	Volatile Organic Compounds

### 8. Atmospheric Conditions

#### 8.1 Scope of Assessment

As part of the Environmental and Social Impact Assessment (ESIA), an air quality assessment was conducted to determine the potential residual and cumulative changes in air quality due to the Project with the consideration of the Quebec Directive Specific to the Troilus Project (Quebec Directives) (MELCC, 2022) and the Federal Tailored Impact Statement Guidelines (TIS Guidelines) (IAAC, 2023).

The air quality assessment estimates the quantities of air contaminants that may be released to the atmosphere from the planned Project activities and uses an atmospheric dispersion model to predict the potential changes in ambient air quality associated with those Project emissions. The air quality assessment considers substances for which there are applicable air quality criteria and screening levels adopted by Ministry of Environment, the Fight Against Climate Change and Parks (MELCCFP), the Ontario Ministry of the Environment, Conservation and Parks (MECP), and the Canadian Ambient Air Quality Standards (CAAQS). The predicted effects are assessed relative to these criteria and screening levels, which are presented in Section 22.1.1.

The air quality assessment considers the following air contaminants referred to as Contaminants of Potential Concern (CoPCs):

- Particulate Matter - Suspended particulate matter (PM or TSP), particulate matter with particles less than 10 microns in diameter (PM<sub>10</sub>) and particulate matter with particles less than 2.5 microns in diameter (PM<sub>2.5</sub>) - PM is a measure of the particles in the atmosphere that are too small to settle out quickly but remain suspended for substantial periods of time. PM is produced by a variety of activities including wind erosion of agricultural or cleared fields and other open areas, abrasion of vehicle tires on paved and unpaved roads, and combustion processes (e.g., industrial boilers and heaters, power generation, vehicle emissions). Although total suspended particulate matter is an excellent measure of the loading of particulate matter in the air, it does not necessarily reflect the health risks of the particulate matter. The larger aerodynamic particles (PM<sub>10</sub>) are trapped by the upper airways, and do not enter the lungs. Smaller diameter particles (PM<sub>2.5</sub>) can make their way deep into the lungs;
- Other Criteria Air Contaminants (CAC) – substances with regulatory limits including sulphur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), and carbon monoxide (CO);
- Hazardous Air Pollutants - Substances that can cause environmental or health effects including Volatile Organic Compounds (VOCs), Polycyclic Aromatic Hydrocarbons (PAHs) and metals. PAHs and VOCs (including benzo(a)pyrene and benzene) from vehicle tailpipe emissions were included in the assessment. PAH derivatives such as nitrated PAHs (nitro-PAHs) and oxygenated PAHs (oxy-PAHs) occur at far lower concentrations than those of parent PAHs in off-road diesel engine exhaust (CARB, 2020) and were therefore not included in the assessment;
- Asbestiform minerals - The ore and waste rock types identified by Troilus contain amphibole minerals in the form of tremolite and actinolite. Troilus specified that no traces of asbestos-like amphibole are present due to unfavourable geological conditions. Amphiboles are generally of higher metamorphic grade and in the form of more coarse-grained hornblende-chermakite-gedrite. Tremolite and actinolite

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are included as CoPCs in the air quality assessment as non-asbestiform based on analysis by Troilus.

The predicted ambient concentrations of these CoPCs arising from the Project activities were also used for the Assessment of Potential Effects on Health (Chapter 22 of the ESIA).

The greenhouse gases (GHGs) associated with the Project are assessed in the Assessment of Potential Effects on Climate Change (Chapter 10 of the ESIA).

Detectable odours could result from emissions of odorous hydrocarbons, which would only be released to the atmosphere at negligible emission rates from mining equipment powered with fossil fuel. Odour emissions from chemicals used in the process plant were reviewed and considered negligible due to their low volatility. Other materials stored and used in the sewage and effluent treatment system are all enclosed with negligible emissions. Odour emissions are not expected to be a concern provided adequate consideration of odour management is incorporated in the Project operations and therefore were not considered further in this assessment.

Since the Project is located in a remote, forested area, potential Project-related effects associated with ambient light were qualitatively assessed by analyzing sight lines and distances from the Project to potential nearby receptors (i.e., residences, campgrounds, locations of non-Indigenous and Indigenous receptors), as well as luminaire design considerations to minimize directional upward lighting, to determine the potential for light trespass (brightening of adjacent areas), glare, and skyglow to affect the receptors.

### 8.1.1 Regulatory and Policy Setting

#### 8.1.1.1 Provincial Air Quality Criteria

In Quebec, air emissions from all sources, including mining operations, are regulated under the Clean Air Regulation (CAR). In regard to ambient air concentrations from industrial sources, these are regulated under article 197 of the CAR that presents (in Schedule K) applicable air quality standards.

In addition to regulatory standards of the CAR, additional air quality criteria (non-regulatory) are published by MELCCFP in the document entitled Quebec Air Quality Standards and Criteria, version 9, Quebec, Air Quality and Climate Branch (MELCCFP, 2025). These standards and criteria were used to assess air impacts in the Local Study Area. Criteria are applied at a point of impingement, most commonly at or beyond a mine boundary.

Ontario air quality criteria were also considered for CoPCs without Quebec Air Quality Standards and Criteria. The MECP publish criteria in the document “Air Contaminants Benchmarks (ACB) List – Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants” (MECP, 2023), which includes Benchmark 1 values (Standards and Guidelines) and Benchmark 2 values (Screening Levels). Modelled concentrations of chemicals that are below published screening levels are considered to be insignificant, while concentrations above a Benchmark 2 value require further assessment. In addition, Ontario has an Ambient Air Quality Criteria (AAQC), developed by

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the MECP which are used to assess general (ambient) air quality resulting from all sources of a contaminant in ambient air.

Summaries of the relevant provincial air quality criteria and screening levels are presented in table 8.1 for PM and metals / metallic compounds; table 8.2 for CACs; table 8.3 for VOCs; table 8.4 for PAHs and table 8.5 for other CoPCs.

**Table 8.1 Summary of Provincial Air Quality Criteria for PM, Metals and Metallic Compounds**

Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria ( $\mu\text{g}/\text{m}^3$ )	Ontario Air Quality Criteria and Screening Levels ( $\mu\text{g}/\text{m}^3$ )
PM	N/A	24 hour	120	N/A
PM <sub>10</sub>	N/A	24 hour	--	50 <sup>(1)</sup>
PM <sub>2.5</sub>	N/A	24 hour	30	N/A
Silver (Ag)	7440-22-4	annual	0.23	N/A
Aluminum (Al)	7429-90-5	-	-	N/A
Arsenic (As)	7440-38-2	annual	0.003	N/A
Gold (Au)	7440-57-5	24 hour	-	1.25 <sup>(3)</sup>
Boron (B)	7440-42-8	-	-	N/A
Barium (Ba)	7440-39-3	annual	0.05	N/A
Beryllium (Be)	7440-41-7	annual	0.0004	N/A
Bismuth (Bi)	7440-69-9	-	-	N/A
Carbon (C)	7440-44-0	1 hour	1	N/A
		annual	0.3	N/A
Calcium (Ca)	7440-70-2	-	-	N/A
Cadmium (Cd)	7440-43-9	annual	0.0036	N/A
Cerium (Ce) and Compounds (as Ce)	7440-45-1	1 hour	21	N/A
		annual	0.7	N/A
Cobalt (Co)	7440-48-4	annual	0.1	N/A
Chromium (Cr) and Compounds (as Cr)	7440-47-3	annual	0.1	N/A
Cesium (Cs) and Compounds (as Ce)	7440-46-2	1 hour	17	N/A
		annual	0.4	N/A
Copper (Cu)	7440-50-8	24 hour	2.5	N/A
Iron (Fe)	7439-89-6	-	-	N/A
Gallium (Ga)	7440-55-3	-	-	N/A
Hafnium (Hf) and Compounds (as Hf)	7440-58-6	1 hour	5	N/A
		annual	0.9	N/A
Mercury (Hg)	7439-97-6	annual	0.005	N/A
Indium (In)	7440-74-6	-	-	N/A
Potassium (K)	7440-09-7	-	-	N/A
Lanthanum (La)	7439-91-0	-	-	N/A

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Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria ( $\mu\text{g}/\text{m}^3$ )	Ontario Air Quality Criteria and Screening Levels ( $\mu\text{g}/\text{m}^3$ )
Lithium (Li)	7439-93-2	1 hour	2	N/A
Lutetium (Lu)	7439-94-3	-	-	N/A
Magnesium (Mg) and Compounds (as Mg)	7439-95-4	1 hour	24	N/A
Manganese (Mn) and Compounds (as Mn)	7439-96-5	annual	0.08 <sup>(4)</sup>	N/A
Molybdenum (Mo)	7439-98-7	24 hour	-	120 <sup>(2)</sup>
Sodium (Na)	7440-23-5	-	-	N/A
Niobium (Nb)	7440-03-1	-	-	N/A
Nickel (Ni)	7440-02-0	24 hour	0.07 <sup>(4)</sup>	N/A
		annual	0.02 <sup>(4)</sup>	N/A
Phosphorus (P)	7723-14-0	24 hour	-	0.5 <sup>(3)</sup>
Lead (Pb)	7439-92-1	annual	0.1	N/A
Rubidium (Rb) and Compounds (as Rb)	7440-17-7	24 hour	4	N/A
Sulphur (S)	7704-34-9	-	-	N/A
Antimony (Sb)	7440-36-0	annual	0.17	N/A
Scandium (Sc)	7440-20-2	-	-	N/A
Selenium (Se)	7782-49-2	1 hour	2	N/A
Tin (Sn)	7440-31-5	4 min	2	N/A
		annual	0.1	N/A
Strontium (Sr)	7440-24-6	-	-	N/A
Tantalum (Ta)	7440-25-7	24 hour	-	25 <sup>(3)</sup>
Terbium (Tb)	7440-27-9	-	-	N/A
Tellurium (Te)	13494-80-9	1 hour	1	N/A
Titanium (Ti) and Compounds (as Ti)	7440-32-6	24 hour	2.5 <sup>(4)</sup>	N/A
Thallium (Tl)	7440-28-0	annual	0.25	N/A
Uranium (U)	7440-61-1	24 hour	-	0.3 <sup>(2,6)</sup>
		annual	-	0.06 <sup>(2,6)</sup>
Vanadium (V)	7440-62-2	annual	1	N/A
Tungsten (W) and Compounds (as W)	7440-33-7	24 hour	5.4	N/A
Yttrium (Y) and Compounds (as Y)	7440-65-5	24 hour	13	N/A
		annual	2.8	N/A
Ytterbium (Yb)	7440-64-4	-	-	N/A
Zinc (Zn)	7440-66-6	24 hour	2.5	N/A
Zirconium (Zr)	7440-67-7	24 hour	2.5	N/A
Silicon Dioxide (SiO <sub>2</sub> )	7631-86-9	-	-	N/A
Aluminum Oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1	-	-	N/A
Iron Oxide (Fe <sub>2</sub> O <sub>3</sub> )	1309-37-1	-	-	N/A
Magnesium Oxide (MgO)	1309-48-4	-	-	N/A
Calcium Oxide (CaO)	1305-78-8	-	-	N/A

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Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria ( $\mu\text{g}/\text{m}^3$ )	Ontario Air Quality Criteria and Screening Levels ( $\mu\text{g}/\text{m}^3$ )
Sodium Oxide ( $\text{Na}_2\text{O}$ )	1313-59-3	-	-	N/A
Potassium Oxide ( $\text{K}_2\text{O}$ )	12136-45-7	-	-	N/A
Titanium dioxide ( $\text{TiO}_2$ )	13463-67-7	-	-	N/A
Phosphorus Pentoxide ( $\text{P}_2\text{O}_5$ )	1314-56-3	24 hour	-	1 <sup>(3)</sup>
Manganese Oxide ( $\text{MnO}$ )	1344-43-0	-	-	N/A
Chromium Oxide ( $\text{Cr}_2\text{O}_3$ )	1308-38-9	-	-	N/A
Vanadium Pentoxide ( $\text{V}_2\text{O}_5$ )	1314-62-1	24 hour	-	1 <sup>(3)</sup>
Chalcopyrite ( $\text{CuFeS}_2$ )	1308-56-1	-	-	N/A
Bornite ( $\text{Cu}_5\text{FeS}_4$ )	1308-82-3	-	-	N/A
Chalcocite ( $\text{Cu}_2\text{S}$ )/Covellite ( $\text{CuS}$ )	22205-45-4, 19138-68-2	-	-	N/A
Tetrahedrite ( $\text{Cu}_{12}\text{Sb}_4\text{S}_{13}$ )/Tennantite ( $\text{Cu}_{12}\text{As}_4\text{S}_{13}$ )	N/A, 12178-49-3	-	-	N/A
Cuprite ( $\text{Cu}_2\text{O}$ )	1317-39-1	-	-	N/A
Galena ( $\text{PbS}$ )	1314-87-0	-	-	N/A
Sphalerite ( $\text{ZnS}$ )	1314-98-3	24 hour	-	1 <sup>(3)</sup>
Pyrite ( $\text{Fe}_2\text{S}_2$ )	1309-36-0	24 hour	-	120 <sup>(3)</sup>
Pyrrhotite ( $\text{Fe}_7\text{S}_8$ )	12305-96-3	-	-	N/A
Arsenopyrite ( $\text{FeAsS}$ )	1303-18-0	-	-	N/A
Ilmenite ( $\text{Fe,Ti}_2\text{O}_3$ )	12168-52-4	-	-	N/A
Quartz	14808-60-7	1 hour	23 <sup>(4)</sup>	N/A
		annual	0.07 <sup>(5)</sup>	N/A
Plagioclase ( $\text{NaAlSi}_3\text{O}_8 - \text{CaAl}_2\text{Si}_2\text{O}_8$ )	N/A	-	-	N/A
K-Feldspars ( $\text{KAlSi}_3\text{O}_8$ )	N/A	-	-	N/A
Biotite ( $\text{K}(\text{Mg,Fe})_3\text{AlSi}_3\text{O}_{10}(\text{F,OH})_2$ )	N/A	-	-	N/A
Actinolite ( $\text{Ca}_2(\text{Mg}_{4.5}-2.5\text{Fe}^{2+}0.5-2.5)\text{Si}_8\text{O}_{22}(\text{OH})_2$ )	77536-66-4	24 hour	-	0.00008 <sup>(3)</sup>
Chlorite ( $\text{Fe,}(\text{Mg, Mn})_5\text{Al}(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_8$ )	14998-27-7	-	-	N/A
Muscovite ( $\text{KAl}_2(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_2$ )	1318-94-1	24 hour	-	1.5 <sup>(3)</sup>
Epidote ( $(\text{Ca}_2)(\text{Al}_2\text{Fe}^{3+})\text{O}[\text{Si}_2\text{O}_7][\text{SiO}_4](\text{OH})$ )	N/A	-	-	N/A
Augite ( $((\text{Ca,Na})(\text{Mg,Fe,Al,Ti})(\text{Si,Al})_2\text{O}_6)$ )	N/A	-	-	N/A
Andradite ( $\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3$ )	15078-96-3	-	-	N/A
Kaolinite ( $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ )	1318-74-7	-	-	N/A
Calcite ( $\text{CaCO}_3$ )	1317-65-3	-	-	N/A
Dolomite ( $\text{CaMg}(\text{CO}_3)_2$ )/Ankerite ( $\text{Ca}(\text{Fe,Mg,Mn})(\text{CO}_3)_2$ )	16389-88-1, N/A	-	-	N/A
Titanite ( $\text{CaTiSiO}_5$ )	N/A	-	-	N/A
Apatite ( $\text{Ca}_5(\text{PO}_4)_3$ )	1306-05-4	-	-	N/A
Mica	12001-26-2	1 hour	30	N/A
		annual	7	N/A
Tremolite ( $\text{Ca}_2(\text{Mg}_{5.0}-4.5\text{Fe}^{2+}0.0-0.5)\text{Si}_8\text{O}_{22}(\text{OH})_2$ )	77536-68-6	24 hour	-	0.00008 <sup>(3)</sup>

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Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria ( $\mu\text{g}/\text{m}^3$ )	Ontario Air Quality Criteria and Screening Levels ( $\mu\text{g}/\text{m}^3$ )
Bytownite (Ca,Na)(Si,Al) <sub>4</sub> O <sub>8</sub>	N/A	-	-	N/A
Labradorite (Na,Ca) <sub>1-2</sub> Si <sub>3-2</sub> O <sub>8</sub>	N/A	-	-	N/A
Andesine (Na,Ca)Al <sub>1-2</sub> Si <sub>3-2</sub> O <sub>8</sub>	96158-02-0	-	-	N/A
Oligoclase (Na,Ca)(Si,Al) <sub>4</sub> O <sub>8</sub>	N/A	-	-	N/A
Albite (NaAlSi <sub>3</sub> O <sub>8</sub> )	N/A	-	-	N/A
Phlogopite (KMg <sub>3</sub> AlSi <sub>3</sub> O <sub>10</sub> (F,OH) <sub>2</sub> )	N/A	-	-	N/A
Sillimanite (Al <sub>2</sub> SiO <sub>5</sub> )	12141-45-6	-	-	N/A

- Notes:
1. Ontario AAQC. AAQC for PM<sub>10</sub> is an interim AAQC provided as a guide for decision making.
  2. Ontario ACB B1 Criteria
  3. Ontario ACB B2 Screening Value
  4. Measured in PM<sub>10</sub>.
  5. Measured in PM<sub>4</sub>.
  6. Converted from measurement in PM<sub>10</sub> to PM
- “-“ indicates no data available  
N/A – not applicable

**Table 8.2 Summary of Provincial Air Quality Criteria for Criteria Air Contaminants (CACs)**

Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria ( $\mu\text{g}/\text{m}^3$ )	Ontario Air Quality Criteria and Screening Levels ( $\mu\text{g}/\text{m}^3$ )
Carbon Monoxide (CO)	630-08-0	1 hour	34000	N/A
		8 hour	12700	N/A
Sulphur Dioxide (SO <sub>2</sub> )	7446-09-5	4 min	1050	N/A
		24 hour	288	N/A
		annual	52	N/A
Nitrogen dioxide (NO <sub>2</sub> )	10102-44-0	1 hour	414	N/A
		24 hour	207	N/A
		annual	103	N/A

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**Table 8.3 Summary of Provincial Air Quality Criteria for VOCs**

Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria	Parameter
Hydrocarbons	N/A	-	-	N/A
1,3-Butadiene	106-99-0	4 min	352	N/A
		annual	0.5	N/A
Acetaldehyde	75-07-0	4 min	3	N/A
		annual	0.5	N/A
Acrolein	107-02-8	4 min	8.3	N/A
		annual	0.02	N/A
Benzene	71-43-2	24 hour	10	N/A
Formaldehyde	50-00-0	15 min	37	N/A

Notes: "-" indicates no data available  
N/A – not applicable

**Table 8.4 Summary of Provincial Air Quality Criteria for Selected PAHs**

Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria ( $\mu\text{g}/\text{m}^3$ )	Ontario Air Quality Criteria and Screening Levels ( $\mu\text{g}/\text{m}^3$ )
Acenaphthene	83-32-9	annual	- <sup>(1)</sup>	N/A
Acenaphthylene	208-96-8	annual	- <sup>(1)</sup>	N/A
Anthracene	120-12-7	annual	- <sup>(1)</sup>	N/A
Benzo(a)anthracene	56-55-3	annual	- <sup>(1)</sup>	N/A
Benzo(a)pyrene (B(a)P)	50-32-8	annual	- <sup>(1)</sup>	N/A
		annual	0.0009	N/A
Benzo(b+k) fluoranthene	205-99-2/ 207-08-9	annual	- <sup>(1)</sup>	N/A
Benzo(g,h,i)perylene	191-24-2	annual	- <sup>(1)</sup>	N/A
Chrysene	218-01-9	annual	- <sup>(1)</sup>	N/A
Fluoranthene	206-44-0	annual	- <sup>(1)</sup>	N/A
Fluorene	86-73-7	annual	- <sup>(1)</sup>	N/A
Phenanthrene	85-01-8	annual	- <sup>(1)</sup>	N/A
Pyrene	129-00-0	annual	- <sup>(1)</sup>	N/A
		annual	13	N/A
Total PAHs (as equivalent B(a)P)	N/A	annual	0.0024	N/A

Notes: 1. The concentration of carcinogenic polycyclic aromatic hydrocarbons (PAHs) compounds in ambient air was expressed as toxic equivalent (TEQ) of benzo(a)pyrene (BaPET). The total concentration of BaP toxic equivalent (BaPET) was calculated by adding the product of the concentration of each of the different PAHs by the corresponding toxicity equivalency factor (TEF).

"-" indicates no data available

N/A – not applicable

# Environmental and Social Impact Assessment for the Troilus Mine Project

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**Table 8.5 Summary of Provincial Air Quality Criteria for Other CoPCs**

Parameter	CAS #	Averaging Period	Quebec Air Quality Standards and Criteria (µg/m <sup>3</sup> )	Ontario Air Quality Criteria and Screening Levels (µg/m <sup>3</sup> )
Diesel particulate matter	N/A	-	-	N/A
Elemental carbon	7440-44-0	1 hour	1	N/A
		annual	0.3	N/A
Potassium Amyl Xanthate (PAX)	2720-73-2	-	-	N/A
Sodium sulphite	7757-83-7	24 hour	-	0.14 <sup>(1)</sup>
Zinc sulphate	7733-02-0	24 hour	-	1 <sup>(1)</sup>
Sodium trithiocarbonate	534-18-9	-	-	N/A
Magnafloc 10	N/A	-	-	N/A

Note 1: Ontario ACB B2 Screening Value

“-“ indicates no data available

N/A – not applicable

### 8.1.1.2 Federal Air Quality Criteria

The Federal air quality criteria are published in the Canadian Ambient Air Quality Standards referred to as the CAAQS. The CAAQS were developed through a collaborative process involving the federal, provincial, and territorial governments and stakeholders, as directed by the Canadian Council of Ministers of the Environment (CCME) (CCME 2012, 2020a, 2020b).

The applicable federal criteria are summarized in table 8.6 below.

**Table 8.6 Summary of Canadian Ambient Air Quality Standards**

Parameter	Averaging Time	CAAQS (µg/m <sup>3</sup> )
NO <sub>2</sub>	1 hour	83 <sup>(1)</sup>
	24 hour	-
	Annual	24 <sup>(1)</sup>
PM <sub>2.5</sub>	24 hour	27 <sup>(2)</sup>
	Annual	8.8 <sup>(2)</sup>
SO <sub>2</sub>	1 hour	179 <sup>(3)</sup>
	24 hour	-
	Annual	11 <sup>(3)</sup>

Notes:

- 1-hour and Annual CAAQS for NO<sub>2</sub>, effective by 2025 (CCME, 2020b). The 1-hour CAAQS is referenced to the 3-year average of the annual 98<sup>th</sup> percentile of the daily maximum 1-hour average concentrations. The annual CAAQS is the average over a single calendar year of all 1-hour average concentrations. The criteria were converted from ppb to µg/m<sup>3</sup> based on standard temperature of 10°C and pressure of 1 atm.

# Environmental and Social Impact Assessment for the Troilus Mine Project

## ATMOSPHERIC CONDITIONS

Parameter	Averaging Time	CAAQS ( $\mu\text{g}/\text{m}^3$ )
2.	24-hour and Annual CAAQS for Respirable Particulate Matter, effective by 2020 (CCME, 2012). The 24-hour CAAQS is referenced to the 98 <sup>th</sup> percentile daily average concentration averaged over 3 consecutive years. The annual CAAQS is referenced to the 3-year average of the annual average concentrations.	
3.	1-hour and Annual CAAQS for SO <sub>2</sub> , effective by 2025 (CCME, 2020a). The 1-hour CAAQS is the 3-year average of the annual 99 <sup>th</sup> percentile of the SO <sub>2</sub> daily maximum 1-hour average concentrations. The annual CAAQS is the average over a single calendar year of all 1-hour average concentrations. The criteria were converted from ppb to $\mu\text{g}/\text{m}^3$ based on standard temperature of 10 °C and pressure of 1 atm.	

### 8.1.1.3 Light

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 8.7.

**Table 8.7 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 8.8).

**Table 8.8 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) <sup>1</sup>				
	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 <sup>2</sup>	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

## Environmental and Social Impact Assessment for the Troilus Mine Project

### ATMOSPHERIC CONDITIONS

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 ( $A_p$ ). For the rural E2 zone, this can range from  $0.29 \cdot d$  to  $10 \cdot d$  (CIE, 2017).

Sky glow is the result of illumination that is directed upward, typically as a result of the use of lighting that has substantial upward directivity, or is omnidirectional, such as “bare bulbs”.

Sky glow levels have been established for zones of various levels of urban development (Berry, 1976). Reference values are arranged so that decreasing values are associated with more night sky lighting sourced from anthropogenic sources, and range from 18.5 Urban, where stars are weak and washed out, to 21.7 Rural, where the sky is crowded with stars and the Milky Way can be seen.

#### 8.1.2 Influence of Consultation and Engagement

Troilus has engaged with potentially affected Indigenous nations, regulators, the public, and stakeholders. table 8.9 provides a summary of the topics, key information including Indigenous knowledge, and concerns that Troilus identified as part of their engagement initiatives that relate to Atmospheric Conditions, as well as a summary of the influence that the outcomes of this engagement had on the assessment.

Feedback on Atmospheric Conditions received during the various consultation and engagement activities included concerns related to changes in air quality and light.

This information was considered when evaluating whether Troilus’s planned mitigation and enhancement measures will effectively manage the identified potential interactions, or whether additional or refined mitigation is warranted. Specific concerns regarding the Atmospheric Conditions raised during engagement for the Project and any additional and specific mitigation measures added to address one or more of the concerns, are described in table 8.9.

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**Table 8.9 Summary of Key Information, Indigenous Knowledge, and Concerns for the Project Related to Air Quality Conditions**

Topic	Key Information, Indigenous Knowledge, and Concerns	Influence on the Assessment	Where Information is Addressed in the ESIA
Air Quality	<p>Members of the public and other stakeholders expressed concern regarding:</p> <ul style="list-style-type: none"> <li>• past experiences (former operations) where dust generation was an issue. Particular attention should be paid to certain facilities (tailings pond, crusher, roads)</li> <li>• potential presence of silica and cyanide in the dust, and the dispersion radius</li> <li>• nuisance from traffic on the Route du Nord and for the camps near the access roads</li> </ul>	<ul style="list-style-type: none"> <li>• Contributed to an understanding of existing conditions for air quality regarding changes to air quality and the effects on human health.</li> <li>• Considered in the development of mitigation and management measures pertaining to changes in air quality.</li> </ul>	Appendix H1 of the Impact Statement, Section 4.2.7
Light	<p>Nibiischii Corporation, in charge of managing the wildlife reserves where the Project is located, expressed concerns about light pollution from the Project given the Assinica reserve has been in the process of becoming a Dark Sky Reserve.</p>	<ul style="list-style-type: none"> <li>• Contributed to an understanding of existing conditions for light.</li> <li>• Considered in the development of mitigation and management measures pertaining to changes in light.</li> </ul>	Section 8.4.3

# Environmental and Social Impact Assessment for the Troilus Mine Project

## ATMOSPHERIC CONDITIONS

Where made available by Indigenous nations through engagement, information gathering, and voluntary information sharing, Indigenous knowledge has been considered and incorporated into the Impact Statement, as applicable. Refer to the description of engagement with Indigenous Peoples (Chapter 4 of the ESIA) for detailed methods regarding the incorporation of Indigenous knowledge to the ESIA.

### 8.1.3 Potential Impacts, Pathways and Measurable Parameters

Project activities during construction and operations will result in the release of CoPCs to the atmosphere that will change ambient air quality. The air quality assessment was completed for both construction and operations and is documented in the Air Quality Assessment (Appendix H1). This chapter focuses on Project operation because the operations phase has the greatest potential for adverse effects to air quality (see Section 5.0 in the Air Quality Assessment [Appendix H1]). The estimated air emissions, including dust, associated with Project construction, decommissioning and closure are generally less than the emissions from the worst-case year of operation.

The potential effect addressed in the air quality assessment is the “change in ambient air quality” due to Project emissions. Measurable parameters facilitate qualitative or quantitative measurement of Project effects and provide a means to evaluate the change to a Valued Component (VC). The measurable parameters for the air quality assessment are provided in table 8.10.

Project activities during construction and operations will also generate light during night-time activities, such as temporary lighting during construction, vehicle lights, and more permanent lights during operations for visibility and safety. The potential effect addressed in the lighting assessment is the “change in nighttime ambient light levels” due to Project outdoor lighting fixtures and equipment. The measurable parameters for the air quality assessment are provided in table 8.10.

**Table 8.10 Potential impacts, impacts pathways and measurable parameters for atmospheric conditions**

Potential Impact	Impact Pathway	Measurable Parameters and Units of Measurement
Change in ambient air quality	The release of CoPCS to the atmosphere due to Project activities may adversely affect the quality of the ambient air, or adversely affect human or ecological health (e.g., wildlife or vegetation) through contact with contaminants, inhalation, and consumption of contaminated food.	<ul style="list-style-type: none"> <li>Changes in SO<sub>2</sub>, CO, NO<sub>2</sub>, particulate matter (PM or TSP), PM<sub>2.5</sub>, PM<sub>10</sub>, metals/metallic minerals, potential acid input (PAI) concentrations or loadings (including dust deposition).</li> <li>Changes in ambient PAH or VOCs concentrations.</li> <li>Changes in diesel PM concentrations.</li> </ul>
Change in ambient light	Light trespass and glare at nearby receptors and skyglow.	<ul style="list-style-type: none"> <li>Light emissions may disturb sleep by shining in windows, cause harsh and objectionable outdoor illumination, and potentially compromise security by emitting a light distribution that may negatively affect visibility. Facility lighting directed upward may affect the ability to see the stars.</li> </ul>

# Environmental and Social Impact Assessment for the Troilus Mine Project

## ATMOSPHERIC CONDITIONS

### 8.1.4 Boundaries

#### 8.1.4.1 Spatial Boundaries

The spatial boundaries of the study are defined by establishing relevant geographical areas to be assessed. These areas are based on the Project activities (where they are located) and the areas surrounding the Project where effects may be expected.

The **Project Development Area (PDA)** encompasses the Project footprint and is the anticipated area of physical disturbance associated with the construction, operations and decommissioning/closure of the Project. The PDA is approximately 2,600 hectares (ha) (26 square kilometres [km<sup>2</sup>]) and includes but is not limited to the open pits, ore processing components, tailings storage facility (TSF), water management facilities and drainage works, mining infrastructure, site access and internal roads, power supply and distribution, and storage areas. The extent of the PDA for the Project is shown in figure 8.1.

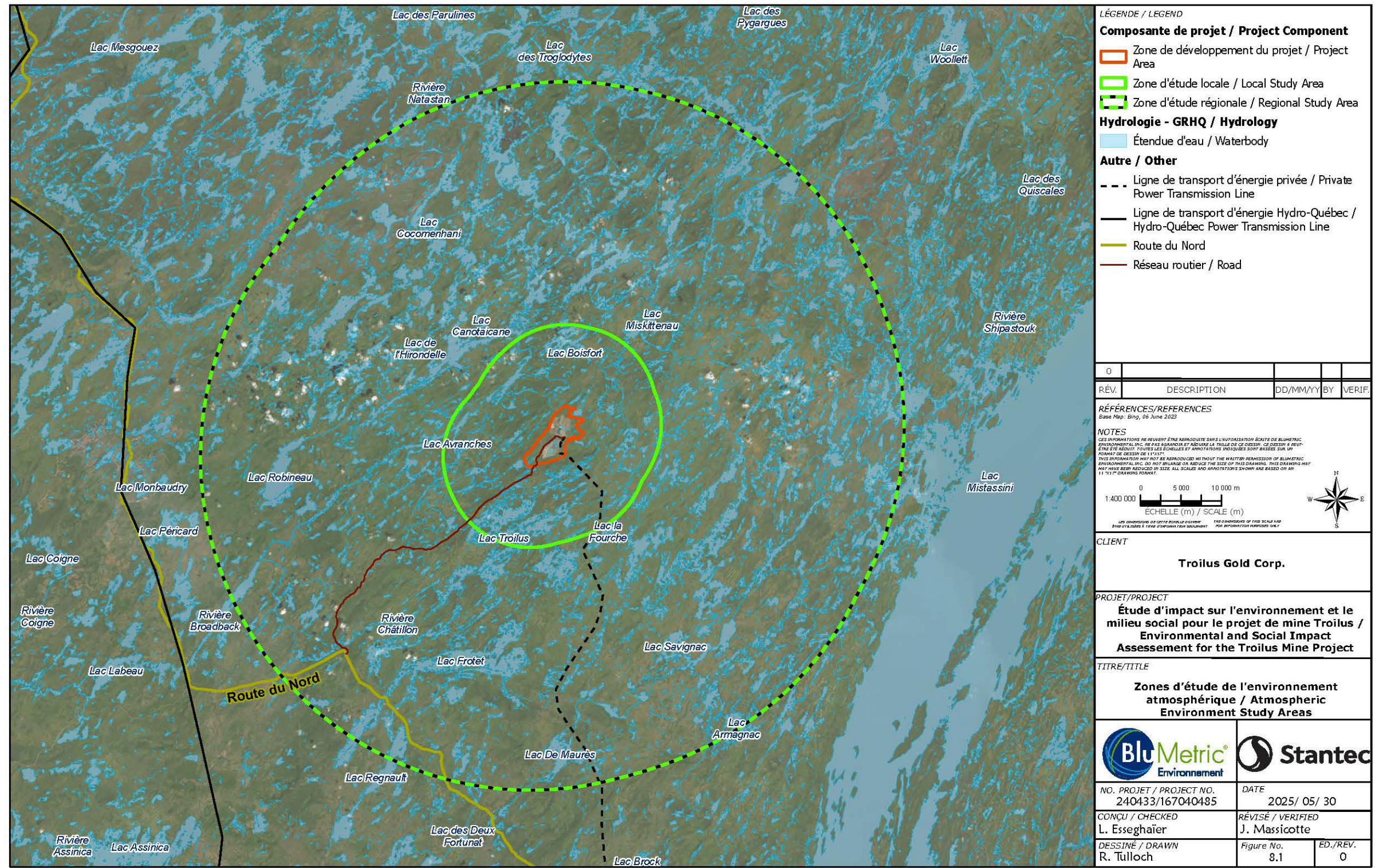
The **Local Study Area (LSA)** is the maximum area within which environmental effects from Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. It consists of the PDA and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information and professional judgment. The LSA for air quality is also depicted in figure 8.1. The LSA for air quality is considered to be an area extending about 10 km from the PDA.

The **Regional Study Area (RSA)** is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present and future (i.e., certain or reasonably foreseeable) physical activities. The RSA is based on the potential for interactions between the Project and other existing or future potential projects.

For air quality, the RSA is an area extending 40 km from the PDA and is depicted in figure 8.1. This distance defines the extent that other projects within this area may have a measurable effect on air quality in this study's LSA based on the types of emission sources anticipated for this Project.



Map 8.1 Atmospheric Conditions Study Areas



**LÉGENDE / LEGEND**

**Composante de projet / Project Component**

- Zone de développement du projet / Project Area
- Zone d'étude locale / Local Study Area
- Zone d'étude régionale / Regional Study Area

**Hydrologie - GRHQ / Hydrology**

- Étendue d'eau / Waterbody

**Autre / Other**

- Ligne de transport d'énergie privée / Private Power Transmission Line
- Ligne de transport d'énergie Hydro-Québec / Hydro-Québec Power Transmission Line
- Route du Nord
- Réseau routier / Road

0				
RÉV.	DESCRIPTION	DD/MM/YY	BY	VERIF.

**RÉFÉRENCES/REFERENCES**  
Base Map: Bing, 06 June 2025

**NOTES**  
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ECHELLE (m) / SCALE (m)

**CLIENT**  
**Troilus Gold Corp.**

**PROJET/PROJECT**  
**Étude d'impact sur l'environnement et le milieu social pour le projet de mine Troilus / Environmental and Social Impact Assessment for the Troilus Mine Project**

**TITRE/TITLE**  
**Zones d'étude de l'environnement atmosphérique / Atmospheric Environment Study Areas**

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DESSINÉ / DRAWN R. Tulloch	Figure No. 8.1
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1500 rue du Collège - Suite 200, Saint-Laurent (Québec) H4L 5G6, TEL: (514) 844-7199, FAX: (514) 841-9111, Courriel: montreal@blumetric.ca, Web: http://www.blumetric.ca



# Environmental and Social Impact Assessment for the Troilus Mine Project

## ATMOSPHERIC CONDITIONS

### 8.1.4.2 Temporal Boundaries

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 -2 to Year -1)
- Operations
  - Operations phase 1 (Year 1 to Year 21): milling with ore extraction
  - Operations phase 2 (Year 22): milling with no ore extraction
- Decommissioning and closure (Year 23+)

Refer to Chapter 3 of the Impact Statement (Project Description) for a detailed description of the activities anticipated to occur during each phase.

### 8.1.5 Residual Impacts Characterization

The characterizations used to assess residual effects on the atmospheric conditions are provided in table 8.11.

**Table 8.11 Characterization of Residual Impacts on Atmospheric Conditions**

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual impact	<b>Positive</b> – a residual impact that moves measurable parameters in a direction beneficial to VC relative to baseline <b>Adverse</b> – a residual impact that moves measurable parameters in a direction detrimental to VC relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	<b>No Measurable Change</b> – no measurable change in the impact can be noted <b>Low</b> – a measurable change but of comparable magnitude to baseline conditions <b>Moderate</b> – measurable change but less than but less than regulatory limits or standards <b>High</b> – measurable change that causes exceedance of objectives or standards beyond the Modelled Mine Boundary
Geographic Extent	The geographic area in which a residual impact occurs	<b>PDA</b> – residual effects are restricted to the PDA <b>LSA</b> – residual effects extend into the LSA <b>RSA</b> – residual Impacts extend into the RSA
Timing	Considers when the residual impact is expected to occur, where relevant to the VC	<b>No sensitivity</b> - timing does not affect the VC <b>Moderate sensitivity</b> - timing may affect VC during lower sensitivity period, but the effects are manageable with proper planning and mitigation measures

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## ATMOSPHERIC CONDITIONS

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		<b>High sensitivity</b> - residual effects occur during high sensitivity period
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual impact can no longer be measured or otherwise perceived	<b>Short-term</b> – the residual effect is restricted to construction (< 3 years) <b>Medium-term</b> –the residual impact extends through the operations phase (3 to 22 years) <b>Long-term</b> – the residual impact extends beyond the life of the project (>22 years)
Frequency	Identifies how often the residual impact occurs and how often during the project or in a specific phase	Single event <b>Multiple irregular event</b> – occurs at no set schedule <b>Multiple regular event</b> – occurs at regular intervals <b>Continuous</b> – occurs continuously
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	<b>Reversible</b> – the residual impact is likely to be reversed after activity completion and reclamation <b>Irreversible</b> – the residual impact is unlikely to be reversed

### 8.1.6 Significance Definition

Adverse impacts will be characterized using a negligible, low, moderate or high-ranking system, as described in IAAC’s *Guidance: Describing Effects and Characterizing Extent of Significance* (2023b).

- **Negligible or Low:** Effects are likely to be negligible or minor in scale if they are negligible or low in magnitude, of short duration, infrequent, small in spatial extent, reversible or readily avoided, and to generate few or minor impacts in social or ecological contexts. Mitigation measures will allow baseline conditions to remain largely unchanged.
- **Moderate:** Effects are likely to be medium in scale if they are moderate in magnitude, of moderate duration, occasionally frequent, possibly/partially reversible, and to generate a moderate level of impacts in social or ecological contexts. Mitigation measures may not fully eliminate, reduce, control or offset effects but should enable affected communities to maintain economic and social well-being, and should prevent the diminishment or loss of key components of the environment and its ecological functioning.
- **High:** Effects are likely to be severe in scale if they are high in magnitude, permanent/long term, frequent, irreversible, and over a large spatial extent or within an area of exclusive/preferred Indigenous use or of ecological/environmental sensitivity. High levels of impacts in social or ecological contexts are expected. There is a high degree of uncertainty of the effectiveness of mitigation measures, or mitigation measures are unable to fully address effects such that valued components are diminished or lost.

### 8.2 Existing Conditions

#### 8.2.1 Methods

Existing conditions for Atmospheric conditions refer to the conditions that exist today associated with climate and ambient air quality.

Long term climatological data in the vicinity of the PDA are available from the Chapais meteorological station. The climatology is based on 30-year (1991 – 2020) Canadian Climate Normal data obtained from Environment and Climate Change Canada (ECCC). Precipitation data from 1981 to 2010 was used since precipitation data were not available for the 1991- 2020 range. Chapais is the nearest climate normal station with a comprehensive set of measurements and with a similar setting to the Project area.

Due to the schedule for the Project Environmental Impact Assessment, baseline ambient monitoring for CoPCs was not feasible. In the absence of site-specific ambient monitoring data, background air quality data published by the MELCCFP in the following documents (referred to as initial concentrations in these documents) was used to characterize air quality in the LSA and to develop background concentration levels to be used in the assessment:

- Quebec Air Quality Standards and Criteria, version 9, Quebec, Air Quality and Climate Branch (MELCCFP, 2025);
- Instruction Guide for Preparation and Realization of Air Emission Dispersion Modelling – Mining Projects (MELCCFP, 2017).

Where background concentrations for CoPCs were not available, representative ambient monitoring data from another proposed mining project was used to estimate background CoPC concentrations. The Crawford Nickel Project is located approximately 42 km north of the City of Timmins, Ontario in a remote area similar to that of the Project, and therefore the background levels are expected to be representative of the Troilus Project background levels. The Crawford Nickel Project ambient monitoring results are presented in Impact Statement Chapter 12: Assessment of the Potential Effects on the Atmospheric Environment dated September 30, 2024 (Stantec, 2024). The MECP normally requires that the that 90<sup>th</sup> percentile ambient monitoring data be added to the dispersion model predictions to conservatively account for existing ambient concentrations. The background level used in the assessment were therefore the 90th percentile values for short-term averaging periods. For annual averages, an annual average value was used as the background level.

The nearest populated centre is approximately 90 km away and existing activities in the area (e.g. forestry) are limited to daytime hours, therefore, the CIE environmental light zone for the LSA was considered “dark” (E1).

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### ATMOSPHERIC CONDITIONS

#### 8.2.1.1 Climate

##### Temperature

A summary of the daily average, maximum and minimum temperatures on a monthly basis (1991 – 2020) is shown below in table 8.12. Temperatures in Chapais are characterized by warm summers and cold winters with the coldest temperatures occurring during the winter months of December to February and the warmest temperatures occurring in the summer months of June to August. The daily average temperature varies between -18.5 °C and 16.6 °C, with an annual average temperature of 0.4 °C.

**Table 8.12 Summary of Average Temperature Data**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-18.5	-16.6	-9.9	-1.0	8.1	14.4	16.6	15.1	10.4	3.4	-4.5	-13.0	0.4
Daily Maximum (°C)	-12.7	-10.2	-3.0	5.1	14.7	21.2	22.9	21.0	15.9	7.3	-1.1	-8.4	6.1
Daily Minimum (°C)	-24.1	-23.0	-16.7	-7.0	1.4	7.5	10.2	9.2	4.8	-0.5	-8.0	-17.6	-5.3

##### Precipitation

A summary of the monthly average rainfall, snowfall, total precipitation (as equivalent rainfall based on a conversion factor for snowfall to equivalent rainfall of 0.1) and average snow depth (1981 – 2010) is presented in table 8.13. The average annual precipitation for Chapais was 995.8 mm.

**Table 8.13 Monthly Mean Precipitation**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	3.2	2.4	8.8	28.7	75.5	100.1	124.3	100.2	128.6	70.9	36.7	5.0	684.5
Snowfall (cm)	58.8	37.0	41.6	29.5	6.9	0.0	0.0	0.0	1.2	23.0	56.5	58.5	312.9
Precipitation (mm)	61.9	39.4	50.3	56.6	82.4	100.1	124.3	100.2	129.7	93.9	93.2	63.5	995.8
Average Snow Depth (cm)	58	74	77	45	2	0	0	0	0	1	10	33	25

##### Relative Humidity

Relative humidity (RH) is the gravimetric ratio of water vapour in a unit volume to the water vapour that would prevail under saturated conditions at a given temperature. Average monthly RH levels at 6:00 AM and 3:00 PM local standard time (LST) from Chapais (1991 – 2020) are presented in table 8.14. Monthly average RH ranged from 78.7% - 93.5% at 6:00 AM and 45.4% - 83.8% at 3:00 PM.

## Environmental and Social Impact Assessment for the Troilus Mine Project

### ATMOSPHERIC CONDITIONS

**Table 8.14 Summary of Average Relative Humidity Data**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Relative Humidity – 0600 LST (%)	80.2	79.7	79.9	82.2	78.7	n/a	89.3	93.5	93.5	92.4	91.3	86.2	n/a
Average Relative Humidity – 1500 LST (%)	77.2	67.7	52.8	52.1	45.4	49.8	56.3	60.9	64.6	74.4	83.5	83.8	64.0

### Wind Speed and Direction

Wind speed and direction climate normal data for Chapais (1991 – 2020) are presented in table 8.15. The annual average windspeed is 6.3 km/h with the most frequent wind direction being westerly.

**Table 8.15 Monthly Average Wind Speed and Direction Data**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Speed (km/h)	6.1	6.4	6.9	7.1	6.7	6.0	5.7	5.5	6.1	6.4	6.7	5.9	6.3
Most Frequent Direction	W	W	W	W	W	W	W	W	S	W	W	W	W

#### 8.2.1.2 Ambient Air Quality

Background air quality was considered in dispersion modelling to represent the effect of other emissions sources in addition to the sources being included in the dispersion modelling. Sources of ambient air emissions in the LSA may include:

- Transportation (traffic on local roads);
- Naturally occurring (wind erosion of open surfaces, forests, fires);
- Long-range transport from other sources outside the LSA.

Background air quality levels due to these sources can be included in a dispersion modelling assessment in order to quantify the incremental change in local air quality with respect to the emissions source(s) being studied. Cumulative air quality levels due to the emissions sources being studied combined with background levels can then be compared to applicable air quality criteria to assess significance.

Table 8.16 summarizes the background air quality data sources.

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## ATMOSPHERIC CONDITIONS

**Table 8.16 Background Concentrations Used in the Dispersion Modeling Assessment**

Parameter	CAS #	Averaging Period	Background Concentration ( $\mu\text{g}/\text{m}^3$ )	
			Quebec Air Quality Standards and Criteria – Initial Concentrations	Representative Ambient Monitoring Data <sup>(1)</sup>
PM	N/A	24 hour	40	N/A
		annual	-	11.6
PM <sub>10</sub>	N/A	24 hour	-	13.1
		annual	-	8.3
PM <sub>2.5</sub>	N/A	24 hour	15	N/A
		annual	-	6.2
Silver (Ag)	7440-22-4	24 hour	-	0.00026
		annual	0.005	N/A
Aluminum (Al)	7429-90-5	24 hour	-	0.42
		annual	-	0.146
Arsenic (As)	7440-38-2	24 hour	-	0.00126
		annual	0.002	N/A
Gold (Au)	7440-57-5	-	-	-
Boron (B)	7440-42-8	24 hour	-	0.026
		annual	-	0.026
Barium (Ba)	7440-39-3	24 hour	-	0.0086
		annual	0.02	N/A
Beryllium (Be)	7440-41-7	annual	0	N/A
Bismuth (Bi)	7440-69-9	24 hour	-	0.0013
		annual	-	0.0013
Carbon (C)	7440-44-0	1 hour	0	-
		annual	0	-
Calcium (Ca)	7440-70-2	24 hour	-	0.68
		annual	-	0.3
Cadmium (Cd)	7440-43-9	24 hour	-	0.00026
		annual	0.0005	N/A
Cerium (Ce) and Compounds (as Ce)	7440-45-1	1 hour	0	N/A
		annual	0	N/A
Cobalt (Co)	7440-48-4	annual	0	N/A
Chromium (Cr) and Compounds (as Cr)	7440-47-3	24 hour	-	0.006
		annual	0.01	N/A
Cesium (Cs) and Compounds (as Ce)	7440-46-2	1 hour	0	N/A
		annual	0	N/A
Copper (Cu)	7440-50-8	24 hour	0.2	N/A
		annual	-	0.0032
Iron (Fe)	7439-89-6	24 hour	-	0.22

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Parameter	CAS #	Averaging Period	Background Concentration ( $\mu\text{g}/\text{m}^3$ )	
			Quebec Air Quality Standards and Criteria – Initial Concentrations	Representative Ambient Monitoring Data <sup>(1)</sup>
		annual	-	0.15
Gallium (Ga)	7440-55-3	-	-	-
Hafnium (Hf) and Compounds (as Hf)	7440-58-6	1 hour	0	-
		annual	0	-
Mercury (Hg)	7439-97-6	24 hour	-	0.000064
		annual	0.002	N/A
Indium (In)	7440-74-6	-	-	-
Potassium (K)	7440-09-7	24 hour	-	0.126
		annual	-	0.13
Lanthanum (La)	7439-91-0	-	-	-
Lithium (Li)	7439-93-2	1 hour	0	N/A
Lutetium (Lu)	7439-94-3	-	-	-
Magnesium (Mg) and Compounds (as Mg)	7439-95-4	1 hour	6	N/A
		24 hour	-	0.19
		annual	-	0.096
Manganese (Mn) and Compounds (as Mn)	7439-96-5	24 hour	-	0.0086
		annual	0.005 <sup>(2)</sup>	N/A
Molybdenum (Mo)	7439-98-7	24 hour	-	0.00076
		annual	-	0.00078
Sodium (Na)	7440-23-5	24 hour	-	0.52
		annual	-	0.32
Niobium (Nb)	7440-03-1	-	-	-
Nickel (Ni)	7440-02-0	24 hour	0.005 <sup>(2)</sup>	N/A
		annual	0.002 <sup>(2)</sup>	N/A
Phosphorus (P)	7723-14-0	-	-	-
Lead (Pb)	7439-92-1	24 hour	-	0.0034
		annual	0.004	N/A
Rubidium (Rb) and Compounds (as Rb)	7440-17-7	24 hour	0	-
Sulphur (S)	7704-34-9	-	-	-
Antimony (Sb)	7440-36-0	24 hour	-	0.00126
		annual	0.007	N/A
Scandium (Sc)	7440-20-2	-	-	-
Selenium (Se)	7782-49-2	1 hour	0.15	N/A
		24 hour	-	0.0026
		annual	-	0.0026
Tin (Sn)	7440-31-5	4 min	0	N/A
		annual	0	N/A
Strontium (Sr)	7440-24-6	24 hour	-	0.0015

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Parameter	CAS #	Averaging Period	Background Concentration ( $\mu\text{g}/\text{m}^3$ )	
			Quebec Air Quality Standards and Criteria – Initial Concentrations	Representative Ambient Monitoring Data <sup>(1)</sup>
		annual	-	0.00148
Tantalum (Ta)	7440-25-7	-	-	-
Terbium (Tb)	7440-27-9	-	-	-
Tellurium (Te)	13494-80-9	1 hour	0	N/A
Titanium (Ti) and Compounds (as Ti)	7440-32-6	24 hour	0 <sup>(2)</sup>	N/A
Thallium (Tl)	7440-28-0	24 hour	-	0.00026
		annual	0.005	N/A
Uranium (U)	7440-61-1	24 hour	-	0.00026
		annual	-	0.00026
Vanadium (v)	7440-62-2	24 hour	-	0.00076
		annual	0.01	N/A
Tungsten (W) and Compounds (as W)	7440-33-7	24 hour	0	N/A
Yttrium (Y) and Compounds (as Y)	7440-65-5	24 hour	0	N/A
		annual	0	N/A
Ytterbium (Yb)	7440-64-4	-	-	-
Zinc (Zn)	7440-66-6	24 hour	0.1	N/A
		annual	-	0.014
Zirconium (Zr)	7440-67-7	24 hour	0	N/A
Silicon Dioxide (SiO <sub>2</sub> )	7631-86-9	-	-	-
Aluminum Oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1	-	-	-
Iron Oxide (Fe <sub>2</sub> O <sub>3</sub> )	1309-37-1	-	-	-
Magnesium Oxide (MgO)	1309-48-4	-	-	-
Calcium Oxide (CaO)	1305-78-8	-	-	-
Sodium Oxide (Na <sub>2</sub> O)	1313-59-3	-	-	-
Potassium Oxide (K <sub>2</sub> O)	12136-45-7	-	-	-
Titanium dioxide (TiO <sub>2</sub> )	13463-67-7	-	-	-
Phosphorus Pentoxide (P <sub>2</sub> O <sub>5</sub> )	1314-56-3	-	-	-
Manganese Oxide (MnO)	1344-43-0	-	-	-
Chromium Oxide (Cr <sub>2</sub> O <sub>3</sub> )	1308-38-9	-	-	-
Vanadium Pentoxide (V <sub>2</sub> O <sub>5</sub> )	1314-62-1	-	-	-
Chalcopyrite (CuFeS <sub>2</sub> )	1308-56-1	-	-	-
Bornite (Cu <sub>5</sub> FeS <sub>4</sub> )	1308-82-3	-	-	-
Chalcocite (Cu <sub>2</sub> S)/Covellite (CuS)	22205-45-4, 19138-68-2	-	-	-
Tetrahedrite (Cu <sub>12</sub> Sb <sub>4</sub> S <sub>13</sub> )/Tennantite (Cu <sub>12</sub> As <sub>4</sub> S <sub>13</sub> )	N/A, 12178-49-3	-	-	-
Cuprite (Cu <sub>2</sub> O)	1317-39-1	-	-	-
Galena (PbS)	1314-87-0	-	-	-

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Parameter	CAS #	Averaging Period	Background Concentration ( $\mu\text{g}/\text{m}^3$ )	
			Quebec Air Quality Standards and Criteria – Initial Concentrations	Representative Ambient Monitoring Data <sup>(1)</sup>
Sphalerite (ZnS)	1314-98-3	-	-	-
Pyrite (Fe,S <sub>2</sub> )	1309-36-0	-	-	-
Pyrrhotite (Fe <sub>7</sub> S <sub>8</sub> )	12305-96-3	-	-	-
Arsenopyrite (FeAsS)	1303-18-0	-	-	-
Ilmenite (Fe,Ti) <sub>2</sub> O <sub>3</sub>	12168-52-4	-	-	-
Quartz	14808-60-7	1 hour	6 <sup>(2)</sup>	N/A
		24 hour	-	0.99
		annual	0.04 <sup>(3)</sup>	N/A
Plagioclase (NaAlSi <sub>3</sub> O <sub>8</sub> – CaAl <sub>2</sub> Si <sub>2</sub> O <sub>8</sub> )	N/A	-	-	-
K-Feldspars (KAlSi <sub>3</sub> O <sub>8</sub> )	N/A	-	-	-
Biotite(K(Mg,Fe) <sub>3</sub> AlSi <sub>3</sub> O <sub>10</sub> (F,OH) <sub>2</sub> )	N/A	-	-	-
Actinolite (Ca <sub>2</sub> (Mg <sub>4.5</sub> –2.5Fe <sup>2+</sup> 0.5–2.5)Si <sub>8</sub> O <sub>22</sub> (OH) <sub>2</sub> )	77536-66-4	-	-	-
Chlorite (Fe,(Mg,Mn) <sub>5</sub> ,Al)(Si <sub>3</sub> Al)O <sub>10</sub> (OH) <sub>8</sub>	14998-27-7	-	-	-
Muscovite (KAl <sub>2</sub> (Si <sub>3</sub> Al)O <sub>10</sub> (OH) <sub>2</sub> )	1318-94-1	-	-	-
Epidote (Ca <sub>2</sub> )(Al <sub>2</sub> Fe <sup>3+</sup> )O[Si <sub>2</sub> O <sub>7</sub> ][SiO <sub>4</sub> ](OH)	N/A	-	-	-
Augite ((Ca,Na)(Mg,Fe,Al,Ti)(Si,Al) <sub>2</sub> O <sub>6</sub> )	N/A	-	-	-
Andradite (Ca <sub>3</sub> Fe <sub>2</sub> (SiO <sub>4</sub> ) <sub>3</sub> )	15078-96-3	-	-	-
Kaolinite (Al <sub>2</sub> Si <sub>2</sub> O <sub>5</sub> (OH) <sub>4</sub> )	1318-74-7	-	-	-
Calcite (CaCO <sub>3</sub> )	1317-65-3	-	-	-
Dolomite (CaMg(CO <sub>3</sub> ) <sub>2</sub> )/Ankerite (Ca(Fe,Mg,Mn)(CO <sub>3</sub> ) <sub>2</sub> )	16389-88-1, N/A	-	-	-
Titanite (CaTiSiO <sub>5</sub> )	N/A	-	-	-
Apatite (Ca <sub>5</sub> (PO <sub>4</sub> ) <sub>3</sub> )	1306-05-4	-	-	-
Mica	12001-26-2	1 hour	0	N/A
		annual	0	N/A
Tremolite (Ca <sub>2</sub> (Mg <sub>5.0</sub> –4.5Fe <sup>2+</sup> 0.0–0.5)Si <sub>8</sub> O <sub>22</sub> (OH) <sub>2</sub> )	77536-68-6	-	-	-
Bytownite (Ca,Na)(Si,Al) <sub>4</sub> O <sub>8</sub>	N/A	-	-	-
Labradorite (Na,Ca) <sub>1-2</sub> Si <sub>3-2</sub> O <sub>8</sub>	N/A	-	-	-
Andesine (Na,Ca)Al <sub>1-2</sub> Si <sub>3-2</sub> O <sub>8</sub>	96158-02-0	-	-	N/A
Oligoclase (Na,Ca)(Si,Al) <sub>4</sub> O <sub>8</sub>	N/A	-	-	N/A
Albite (NaAlSi <sub>3</sub> O <sub>8</sub> )	N/A	-	-	N/A
Phlogopite (KMg <sub>3</sub> AlSi <sub>3</sub> O <sub>10</sub> (F,OH) <sub>2</sub> )	N/A	-	-	N/A
Sillimanite (Al <sub>2</sub> SiO <sub>5</sub> )	12141-45-6	-	-	N/A
Carbon Monoxide (CO)	630-08-0	1 hour	600	N/A
		8 hour	400	N/A
Sulphur Dioxide (SO <sub>2</sub> )	7446-09-5	4 min	150	N/A

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Parameter	CAS #	Averaging Period	Background Concentration ( $\mu\text{g}/\text{m}^3$ )	
			Quebec Air Quality Standards and Criteria – Initial Concentrations	Representative Ambient Monitoring Data <sup>(1)</sup>
Nitrogen dioxide (NO <sub>2</sub> )	10102-44-0	24 hour	50	N/A
		annual	20	N/A
		1 hour	150	N/A
		24 hour	100	N/A
		annual	30	N/A
Hydrocarbons	N/A	-	-	-
1,3-Butadiene	106-99-0	4 min	2	N/A
		24 hour	-	0.6
		annual	0.14	N/A
Acetaldehyde	75-07-0	-	-	-
Acrolein	107-02-8	-	-	-
Benzene	71-43-2	24 hour	3	N/A
		annual	-	0.4
Formaldehyde	50-00-0	15 min	3	N/A
Acenaphthene	83-32-9	24 hour	-	0.00441
		annual	-	0.000846
Acenaphthylene	208-96-8	24 hour	-	0.00815
		annual	-	0.00156
Anthracene	120-12-7	24 hour	-	0.000161
		annual	-	0.0000308
Benzo(a)anthracene	56-55-3	-	-	-
Benzo(a)pyrene (B(a)P)	50-32-8	24 hour	-	0.000053
		annual	0.0003	N/A
Benzo(b+k)fluoranthene	205-99-2/ 207-08-9	24 hour	-	0.000279
		annual	-	0.0000535
Benzo(g,h,i)perylene	191-24-2	-	-	-
Chrysene	218-01-9	24 hour	-	0.000338
		annual	-	0.0000649
Fluoranthene	206-44-0	24 hour	-	0.000815
		annual	-	0.000156
Fluorene	86-73-7	24 hour	-	0.00147
		annual	-	0.000282
Phenanthrene	85-01-8	24 hour	-	0.00221
		annual	-	0.000424
Pyrene	129-00-0	annual	0	N/A
Total PAHs (as equivalent B(a)P)	N/A	annual	0.0014	N/A
Diesel particulate matter	N/A	24 hour	-	0.094
		annual	-	0.0182

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Parameter	CAS #	Averaging Period	Background Concentration ( $\mu\text{g}/\text{m}^3$ )	
			Quebec Air Quality Standards and Criteria – Initial Concentrations	Representative Ambient Monitoring Data <sup>(1)</sup>
Elemental carbon	7440-44-0	1 hour	0	N/A
		annual	0	N/A
Potassium Amyl Xanthate (PAX)	2720-73-2	-	-	-
Sodium sulphite	7757-83-7	-	-	-
Zinc sulphate	7733-02-0	-	-	-
Sodium trithiocarbonate	534-18-9	-	-	-
Magnafloc 10	N/A	-	-	-
Dustfall (deposition)	N/A	monthly	-	1.5 $\text{g}/\text{m}^2$

Note: 1. Crawford Nickel Project ambient monitoring results from the Impact Statement Chapter 12: Assessment of the Potential Effects on the Atmospheric Environment dated September 30, 2024  
 2. Measured in  $\text{PM}_{10}$ .  
 3. Measured in  $\text{PM}_4$ .  
 “-” indicates no background data available  
 N/A – not applicable or not used if MELCCFP data were available

### 8.2.1.3 Lighting

The ambient light environment in the Project and surrounding area was characterized as “dark” (E1) lighting environment for skyglow and a “dark” (E1) lighting environment for light trespass and glare as described in table 8.7.

## 8.3 Project Interactions with Atmospheric Conditions

Table 8.17 identifies, for each potential impact, the physical activities that might interact with the Atmospheric Conditions and result in the identified impact. These interactions are indicated by a check mark or a dash and are discussed in detail in Section 22.4, in the context of impacts pathways, standard and project-specific mitigation/enhancement, and residual impacts.

Project activities for each phase are described in the Project Description (Chapter 3 of the Impact Statement). Project related emissions and discharges are described in the Air Quality Assessment (Appendix H1 of the Impact Statement).

The potential interactions between Project activities and the environment were considered for the construction, operations, and decommissioning and closure phases of the Project. The identification of Project activities and their potential interactions is based on engagement with stakeholders, the professional judgement of technical specialists and a review of existing conditions. The selection of interactions was also informed by the potential effects and effects pathways for each VC.

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**Table 8.17 Project Interactions with Atmospheric Conditions**

Physical Activities	Impacts	
	Change to Ambient Air Quality	Change to Ambient Light
<b>Construction</b>		
Labour, equipment and materials transport to the site.	√	√
Vehicles and equipment operation and maintenance within the PA.	√	√
Tree cutting, vegetation clearing, soil stripping and earthworks.	√	√
Handling and use of explosives, including blasting	√	–
Construction of temporary and permanent buildings, including wastewater treatment system and drinking water collection and distribution system.	√	√
Construction of mining infrastructures such as stockpiles, pits and the raising of tailings management facility.	√	√
Construction of roads and preparation of construction surfaces including the crushing of material used for construction. Relocation of a section of the access road and power line	√	√
Construction of water management systems including ditches, diversion channel, sedimentation ponds and the water treatment plant.	√	√
Dewatering of natural water bodies and pits, lowering water level in tailings management facility and management of contact water.	–	–
Diversion of Bibou Creek (CE2)	√	√
Management of waste materials, including hazardous waste.	√	√
Purchases of goods and services	–	–
Employment	–	–
<b>Operation</b>		
Labour, equipment, and materials transport to the site.	√	√
Vehicles and equipment operation and maintenance within the PA.	√	√
Handling and use of explosives, including blasting	√	–
Ore extraction from pits including drilling and hauling of waste rock.	√	√
Ore, waste rock and tailings storage.	√	√
Ore processing including conveyor, crushing, loading and hauling on site.	√	√
Transportation of concentrate to a smelter or a wharf.	√	√
Management and treatment of water on the mine site and to the environment, including drainage and contact water.	√	√
Progressive reclamation of disturbed areas.	√	√

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Physical Activities	Impacts	
	Change to Ambient Air Quality	Change to Ambient Light
Management of waste materials, including hazardous waste.	√	√
Purchases of goods and services	–	–
Employment	–	–
<b>Decommissioning and Closure</b>	√	√
Labour, equipment, and materials transport to the site.	√	√
Vehicles and equipment operation and maintenance within the PA.	√	√
Decommissioning, dismantling and disposal of buildings and equipment.	√	√
Pits flooding, surface, and groundwater management.	–	–
Reclamation of disturbed areas, including earthworks, placement of overburden and revegetation.	√	√
Management of waste materials, including hazardous waste.	√	√
Purchases of goods and services <sup>1</sup>	–	–
Employment <sup>1</sup>	–	–

Notes:

√ = Potential interaction

– = No interaction

## 8.4 Assessment of Residual Impact on Atmospheric Conditions

This section describes the techniques and methods used to assess air quality and lighting. Further details on the air modeling assessment are provided in Appendix H1 of the Impact Statement, the Air Quality Assessment.

### 8.4.1 Analytical Assessment Techniques

#### 8.4.1.1 Ambient Air Quality

The assessment of potential effects on air quality related to the construction and operations of the Project consisted of the following elements:

1. Compiling CoPC emissions inventories of point sources (e.g., stacks), mobile sources (e.g., heavy equipment) and stationary sources (e.g., large storage piles) for the Project construction and operations scenarios;
2. Establishing background ambient air quality conditions for CoPCs from existing published sources of air quality data;

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3. Conducting dispersion modelling to predict the downwind concentrations of air CoPCs from the Project and comparing these predictions to regulatory criteria and screening levels (Project Alone comparisons);
4. Adding background ambient air quality CoPC concentrations to the Project Alone dispersion model predictions and comparing these cumulative levels to air quality criteria and screening levels (cumulative comparisons).

The emissions inventory was based on published emission factors (i.e., U.S. Environmental Protection Agency (US EPA) AP-42) or emissions levels provided by manufacturers. Emission estimates are expected to be conservative and represent worst-case short-term emissions from the Project activities during maximum construction and operations. The results of the air emission inventory were used to prepare the Project dispersion modelling assessment for comparison against the applicable ambient air quality criteria and screening levels.

Background air quality levels can be included in a dispersion modelling assessment in order to quantify the incremental change in local air quality with respect to the emission sources being studied. Cumulative air quality levels due to the emission sources being studied combined with background levels can then be compared to applicable air quality criteria to assess significance.

The US EPA dispersion model, AERMOD (Version 24142) (US EPA 2024), was used to predict the maximum 1-hour, 24-hour, and annual average ground level concentrations (GLCs). AERMOD is an approved model by the MELCCFP for assessing contaminants against the Quebec Air Quality Standards and Criteria. Maximum ground level concentration estimates from Project emissions were determined over an approximate 29 km by 30 km domain with varying receptor grid points to capture the maximum concentrations.

Direct influences on the dispersion of pollutants include: source characteristics; wind speed and direction; atmospheric stability; and mixing layer depths. A five-year (2019 – 2023) site-specific meteorological dataset was used in the modelling assessment. Upper air data from ECCC's Maniwaki station (the nearest representative upper air station to the Project site) and surface data from ECCC's Chapais station were processed using AERMET version 24142. The meteorological data were processed to reflect the land uses surrounding the Project.

For modelling purposes, the years with the highest mass of material mined for each phase was selected. These years are expected to have the highest emissions. As a result, Year -1 represents the worst-case year for construction and Year 6 represents the worst-case year for operations (refer to Appendix H1 of the Impact Statement (Air Quality Assessment) for additional details.

Several dispersion modelling scenarios were assessed to represent different construction and operational aspects of the Project. A summary of the dispersion modelling scenarios assessed in this study is presented in table 8.18.

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**Table 8.18 Summary of Dispersion Modelling Scenarios Assessed**

Scenario	Air CoPCs	Sources Modelled	Receptors
Construction	All <sup>1</sup>	Construction Sources, Access Road Outside of the PA	Special Receptors
Construction	Selected CoPCs <sup>2</sup>	Construction Sources	Gridded Receptors <sup>3</sup>
Construction	All <sup>1</sup>	Construction Sources	Modelled Mine Boundary
Operation	All <sup>1</sup>	Operation Sources, Access Road Outside of the PA	Special Receptors
Operation	Selected CoPCs <sup>2</sup>	Operation Sources	Gridded Receptors <sup>3</sup>
Operation	All <sup>1</sup>	Operation Sources	Modelled Mine Boundary

Notes:

1. CoPCs from the Project include PM, PM<sub>10</sub>, PM<sub>2.5</sub>; other CACs including NO<sub>2</sub>, SO<sub>2</sub>, CO; and hazardous air pollutants including PAHs, VOCs and metals.
2. CoPCs requiring additional modelling analysis to determine magnitude, extent, frequency, severity and sensitivity.
3. Details on gridded receptors provided in Appendix H1 of the Impact Statement

The Modelled Mine Boundary includes a 300 m buffer around the PA as specified in Section 4.3 of the MELCCFP instruction guide Preparation and Realization of Air Emission Dispersion Modelling (MELCCFP, 2017). In accordance with the Instruction Guide, if the air quality standards and criteria are not met, for one or more contaminants, at a distance of 300 metres or more from the project facilities, the proponent must demonstrate that routine mitigation measures have been applied where technically and economically feasible. In addition, the proponent must demonstrate, using the results of the atmospheric dispersion modelling, that the standards and criteria are met at sensitive receptors located beyond 300 m of the facilities.

The following special and discrete receptors were identified and included in the air quality assessment:

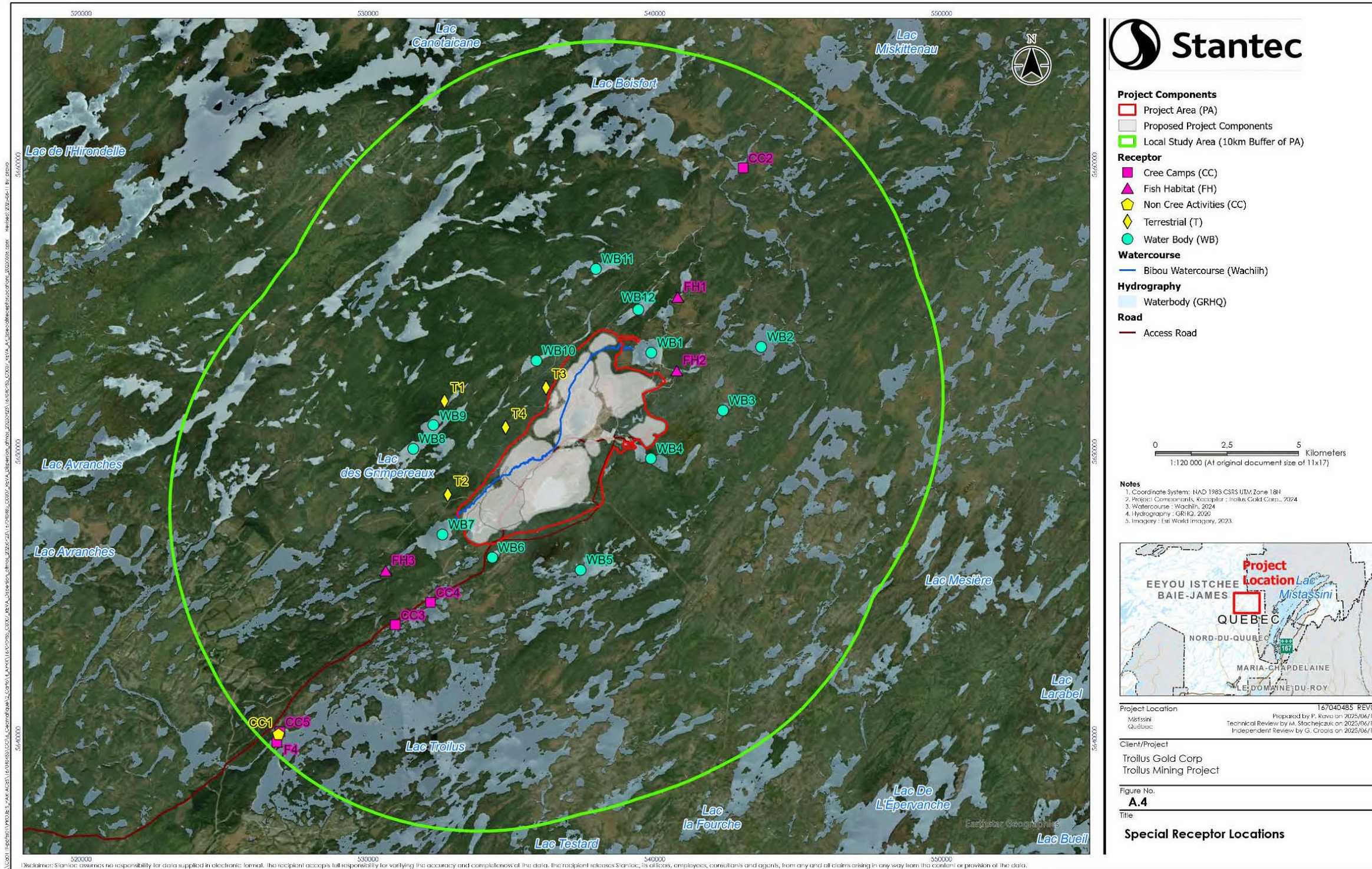
- Special Receptors: Locations where non-Indigenous or Indigenous overnight use has been confirmed or assumed;
- Surface Water Receptor (Discrete): Representative locations used for the surface water assessment;
- Fish Habitat Receptor (Discrete): Representative locations used for the fishery assessment;
- Terrestrial Receptor (Discrete): Representative locations used for the terrestrial environment assessment.

The sensitive and representative receptors identified for input into the Human Health and Ecological Risk Assessment (HHERA) in Appendix H8 of the Impact Statement include both non-Indigenous and Indigenous receptors. These special receptor locations are shown on Map 8.2 extracted from the Technical Data Report – Air Quality Assessment (Appendix H.1).

A total of 4,787 gridded, Modelled Mine Boundary and special receptors were utilized in the assessment covering the LSA. The extended receptor grid around the Modelled Mine Boundary is shown on Map 8.3, also extracted from the Technical Data Report – Air Quality Assessment (Appendix H.1).



Map 8.2 Special Receptor Locations

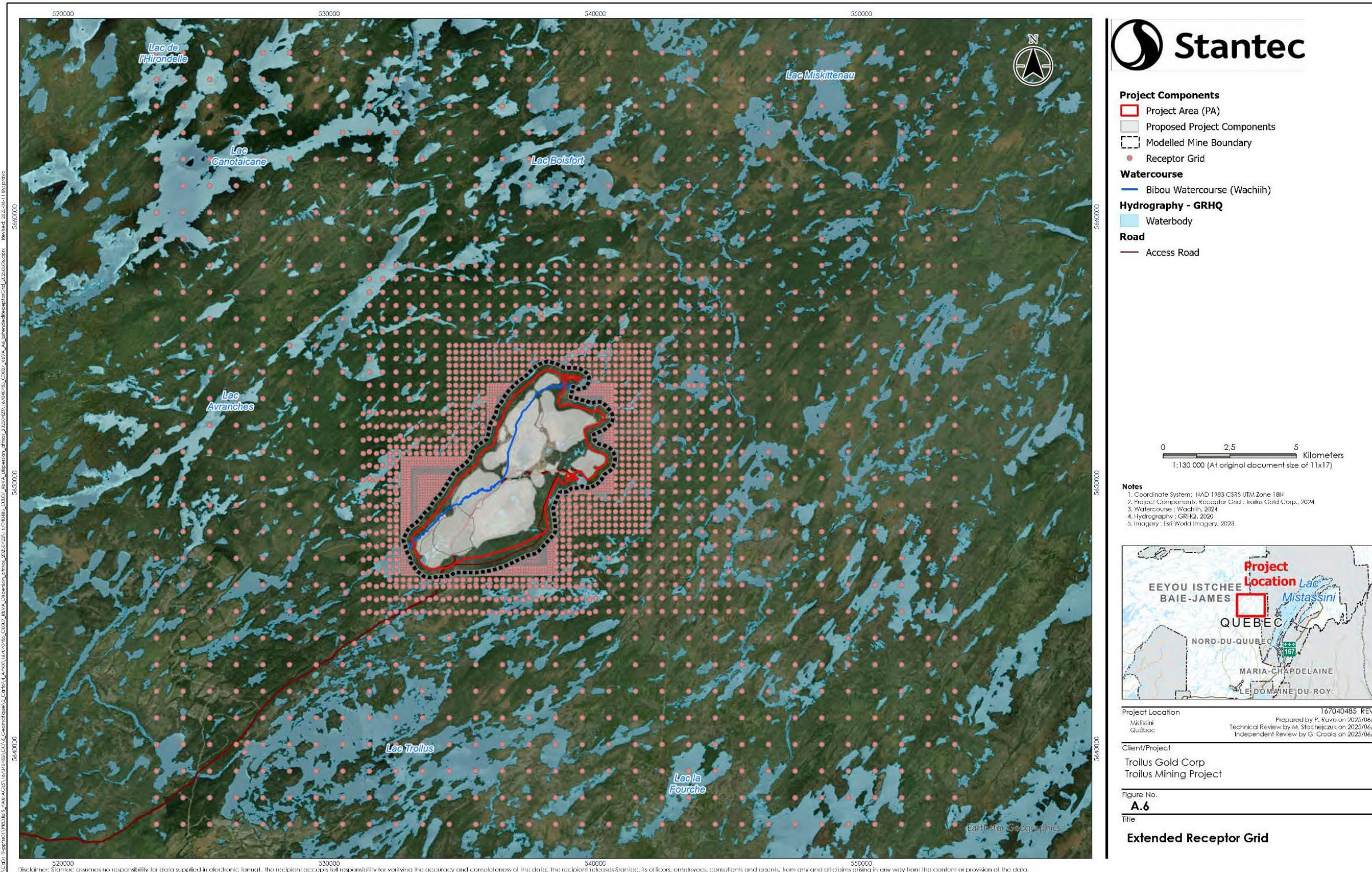




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Map 8.3 Extended Receptor Grid





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### 8.4.1.2 Ambient Light

The effects of the Project lighting on nearby receptors are typically 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 could not be quantified. Therefore, the lighting assessment method was 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.

Topography, vegetation cover, and distance from the PA were considered when determining the potential for ambient light to affect these receptors. Other land uses near the receptors were also considered when determining the potential effects of ambient light.

### 8.4.2 Change in Ambient Air Quality

#### 8.4.2.1 Project Pathways

Ore will be extracted from the pits and processed (crushed, ground, concentrated) at an on-site processing facility (Process Plant). Ore will be transported from the pit to the Process Plant via haul trucks and conveyors. A series of internal roads will be established to facilitate the movement of mine rock and other materials around the site. Final concentrates will be transported from the mine site for further processing.

#### Construction

During Project construction, emissions of air CoPCs may result from site preparation activities and the construction of Project infrastructure. This would increase the CoPC concentrations in the PA. These emissions would include particulate and combustion gases from construction equipment, and particulate (dust) emissions from operation of heavy earth-moving equipment (including haul trucks), blasting and wind erosion. Tailpipe emissions from the vehicles (i.e., combustion gas emissions such as NO<sub>2</sub>, CO, SO<sub>2</sub>, PM, PAHs, and VOCs) are also assessed. Many of the construction activities would not occur continuously (i.e., intermittent), nor would all activities occur concurrently at any given time.

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### Operations

For the operations phase of the Project, an emissions scenario corresponding to the year with “worst-case” or highest emissions was established for assessment. Year 6 operating data was conservatively used to represent the entire operations phase as it includes maximum mining and production levels.

During Project operation, emissions of air CoPCs (NO<sub>2</sub>, CO, SO<sub>2</sub>, PM, PM<sub>10</sub>, PM<sub>2.5</sub>, PAHs, and VOCs) will result from the combustion of diesel fuel in mining equipment, and other stationary equipment used during operation. The specific operational activity, each with its own duration and potential for the generation of airborne particulate, and the prevailing meteorological conditions, are considered.

Particulate (dust) emissions (including PM, PM<sub>10</sub>, PM<sub>2.5</sub>, metals, and metallic minerals contained in the mine rock and ore) would result from the following activities:

- Operation of the mining fleet and other equipment on on-site unpaved roads;
- Handling and transferring of extracted ore, mine rock and overburden;
- Stockpile/storage areas of ore, mine rock and overburden;
- Operations in the open pit (e.g., drilling, blasting, material handling, loading);
- Ore milling process (e.g., crushing, grinding, concentrating).

Further, winds blowing over storage piles would drive dust from the surface into the air, with quantities depending on wind speed. Other emissions would also be generated from the use of mill reagents for concentrate processing.

### Decommissioning and Closure

Project decommissioning would entail removal of infrastructure and revegetation of the PA.

Decommissioning emissions are expected to be less than construction emissions (as no pit extraction or TSF construction would be occurring) and, therefore, the construction assessment will implicitly address the decommissioning phase emissions as well. The closure phase is expected to generate negligible air emissions.

#### 8.4.2.2 Mitigation and Enhancement Measures

Troilus has proposed mitigation measures to avoid or reduce Project-related effects on air quality, which are summarized below. These mitigation measures were incorporated into the emissions estimates used in the air quality assessment. Details of assumptions associated with these mitigation measures, their contaminant emission reduction efficiencies and how they were applied in the emissions estimation are detailed in Section 4.7 of Appendix H1 of the Impact Statement (Air Quality Assessment).

The following mitigation measures have been incorporated into the design of the Project and/or are proposed to avoid or reduce Project-related effects on air quality:

- Troilus will develop a Dust Management Plan that:



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- Describes requirements for the routine management of sources of airborne dust during construction and operation.
- Tracks air quality performance and provides feedback to the Environment Manager, which may be used to refine the dust suppression program and other potentially significant air quality sources.
- Identify complaint response procedures and notification requirements.
- Troilus will develop an Air Quality Follow-up Monitoring Program Plan (AQFMP) to monitor selected CoPCs that may include dust (PM and/or PM<sub>2.5</sub>), metals in PM, quartz and NO<sub>2</sub> at selected offsite locations during construction and operation.
- Troilus will implement the following design mitigation measures:
  - Wet drilling in the pits
  - Optimized blasting practices (e.g., type, timing sequence and blast patterns)
  - Usage of dust suppressants during non-precipitation days in the summertime. Watering application rates and intervals will be adjusted to achieve the required mitigation efficiency, and additional operational measures that can control water evaporation rates will be implemented if needed
  - Limit speeds on onsite roads to 50 km
  - Maintenance of vehicles to increase fuel efficiency
  - Troilus will acquire mobile equipment that meets applicable Transport Canada off-road vehicle emission requirements (Tier 4 emissions standards), where feasible
  - Troilus will implement effective and timely vehicle maintenance to maintain equipment in good working condition
  - Implement an idling policy on site for mobile equipment and vehicles
  - Enclose and equip the following equipment with dust collectors:
    - Primary crusher
    - Secondary crusher
    - Secondary screener
    - HPGP
    - Solid reagent handling
    - Smelter
  - Maintain a high moisture content in the TSF surface material by controlling spigot discharge points
  - Crushed Ore Stockpile will be enclosed
  - Troilus will optimize the road network design and the mining schedule to reduce haulage distances

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### 8.4.2.3 Project Residual Impact

This air quality assessment was conducted following generally accepted methodologies to establish existing (baseline) conditions, estimate emissions and predict the maximum downwind ground level concentrations (GLCs) and long-term depositions for relevant air CoPCs due to Project construction and operations. As such, the findings of this study as described in this report are, for the most part, based on dispersion model predictions. The approach taken is conservative and represents reasonably accurate predictions for an air quality assessment.

This Section provides a summary of the predicted changes in air quality due to the Project including the mitigation measures presented in Section 22.4.2.2. More detailed information is presented in Appendix H1 of the Impact Statement (Air Quality Assessment).

Emissions from the short-term construction and closure activities are generally less than emissions during operating scenarios. Details of the construction phase air quality assessment are provided in Appendix H1 of the Impact Statement (Air Quality Assessment). Only emissions from Project operations are therefore presented in this section.

#### Project Residual (Project Alone) Air Quality Effects

Project Alone dispersion model predictions for the operations model scenario for receptors on or outside of the Modelled Mine Boundary were compared to the relevant air quality criteria and screening levels. The results are presented below.

The maximum predicted residual (Project Alone) GLCs at the Modelled Mine Boundary are above the applicable air quality criteria and screening levels for 6 of 132 CoPCs during the operation phase. In accordance with the Instruction Guide for Preparation and Realization of Air Emission Dispersion Modelling – Mining Projects (MELCCFP, 2017), Troilus is applying the mitigation measures listed in Section 22.4.2.2 to reduce Project air emissions.

The maximum predicted residual (Project Alone) concentrations for 126 of 132 CoPCs are below the applicable air quality criteria and screening levels for all six special receptors. The following CoPCs are predicted to have residual (Project Alone) concentrations above the applicable criteria at special receptors:

- 1-hour average elemental carbon exceedance at all six special receptors. The maximum predicted concentration of elemental carbon exceeds the Quebec criterion by 150%;
- 1-hour average quartz in PM<sub>10</sub> exceedance at two special receptors: Cree Camps CC3 and CC4, which are both adjacent to the main access road. The maximum predicted concentration of quartz exceeds the Quebec criterion by 15%;
- 1-hour average mica exceedance at two special receptors: Cree Camps CC3 and CC4. The maximum predicted concentration of mica exceeds the Quebec criterion by 17%;
- 24-hour average muscovite is above the Ontario Air Quality Screening Level. The Ontario screening levels are triggers for additional assessment to ensure that the predicted concentrations will not result in adverse effects, which is addressed in the Human Health and Ecological Risk Assessment;

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- 24-hour average actinolite and tremolite are above their Ontario Air Quality Screening Levels, which are based on health effects from asbestos. Tremolite and actinolite in the Project ore or waste rock are non-asbestiform and additional assessment of actinolite and tremolite is provided in the Human Health and Ecological Risk Assessment.

The maximum predicted 1-hour average NO<sub>2</sub> concentrations for operations are above the CAAQS at special and discrete receptors and over the gridded receptors. However, annual average NO<sub>2</sub> concentrations are well below the annual CAAQS. Maximum predicted PM<sub>2.5</sub> and SO<sub>2</sub> concentrations are below their relevant CAAQS at all locations on or outside the Modelled Mine Boundary. CAAQS were not developed as facility-level regulatory standards but rather are intended to be used in air zones as objectives for ambient air quality management – they are not legally binding or federally enforceable standards.

Residual (Project Alone) predicted maximum monthly particulate matter depositions at the special receptors are compared against the MECP (Ontario) monthly criterion for dustfall. The Ontario monthly deposition criterion is based on a nuisance (soiling) effect. Based on the maximum predicted deposition levels, it is expected that the potential for visible soiling of surfaces near the special receptors due to the Project is low.

#### Project Residual (Project Plus Existing Background) Air Quality Effects

The residual effects (Project + Existing Background) dispersion model predictions for the operations model scenario for receptors on or outside of the Modelled Mine Boundary were compared to the relevant air quality criteria and screening levels. The results are presented below.

The maximum predicted residual (Project + Existing Background) GLCs at the Modelled Mine Boundary are above the applicable air quality criteria and screening levels for 7 of 132 CoPCs during the operations phase. In accordance with the Instruction Guide for Preparation and Realization of Air Emission Dispersion Modelling – Mining Projects (MELCCFP, 2017), Troilus is applying mitigation measures listed in Section 22.4.2.2 to reduce Project air emissions.

The maximum predicted residual (Project + Existing Background) concentrations for 126 of 132 CoPCs are below the applicable air quality criteria and screening levels criteria for all six special receptors. The following CoPCs are predicted to have concentrations above the applicable criteria:

- Exceedances of the 1-hour average elemental carbon criterion are predicted at all six special receptors when considering the Project with existing background air quality. These results are consistent with the Project Alone scenario since the MELCCFP initial concentration for elemental carbon is zero. Existing background concentrations of elemental carbon from diesel exhaust are expected to be negligible since there are currently no significant industrial developments in the LSA. The maximum predicted 1-hour average concentration of elemental carbon exceeds the Quebec criterion by 150% with the exceedance predicted to occur infrequently - a maximum of 32 hours over a period of five years (0.073% of the time);
- Exceedances of the 1-hour average quartz in PM<sub>10</sub> criterion are predicted at two special receptors: Cree Camps CC3 and CC4, which are adjacent to the main access road. The maximum predicted 1-hour average cumulative concentration is predicted to exceed the Quebec criterion by 41%, however

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exceedances are predicted to occur infrequently - a maximum of 5 hours over a period of five years (0.011% of the time). The background quartz in PM<sub>10</sub> concentration used in the assessment is a MELCCFP initial concentration which is expected to provide a conservative estimate of background concentrations in the LSA;

- Exceedances of the annual average quartz in PM<sub>4</sub> criterion are predicted at the same two special receptors (CC3 and CC4) when considering the Project with existing background air quality. The maximum predicted annual average concentration is 20% above the Quebec criterion with the background concentration accounting for 48% of the total cumulative concentration. The background quartz in PM<sub>4</sub> concentration used in the assessment is a MELCCFP initial concentration which is expected to provide a conservative estimate of background concentrations in the LSA.
- Exceedances of the 1-hour mica criterion are predicted at Cree Camps CC3 and CC4. The cumulative results are consistent with the Project Alone scenario since the MELCCFP initial concentration is zero. The maximum predicted concentration exceeds the Quebec criterion by 17%. An exceedance is predicted to occur a maximum of 1 hour over a period of five years (0.002% of the time);
- The maximum predicted 24-hour average muscovite concentration is above the Ontario Air Quality Screening Level and is the same as the Project Alone scenario as no background muscovite concentration is available. The Ontario screening levels are triggers for additional assessment, which is addressed in the Human Health and Ecological Risk Assessment;
- The maximum predicted 24-hour average concentrations of actinolite and tremolite are above their Ontario Air Quality Screening Levels which are based on health effects from asbestos, while tremolite and actinolite in the Project ore or waste rock are non-asbestiform. Additional assessment of actinolite and tremolite is provided in the Human Health and Ecological Risk Assessment.

The maximum predicted 1-hour average NO<sub>2</sub> concentrations for operations are above the CAAQS at special and discrete receptors and over the gridded receptors. However, annual average NO<sub>2</sub> concentrations are well below the CAAQS. Maximum predicted PM<sub>2.5</sub> and SO<sub>2</sub> concentrations are below their relevant CAAQS at all locations on or outside the Modelled Mine Boundary. CAAQS were not developed as facility-level regulatory standards but rather are intended to be used in air zones as objectives for ambient air quality management – they are not legally binding or federally enforceable standards.

Residual (Project + Background) predicted maximum monthly particulate matter depositions at the special receptors are compared against the MECP (Ontario) monthly criterion for dustfall. The Ontario monthly deposition criterion is based on a nuisance (soiling) effect. Based on the maximum predicted deposition levels, it is expected that the potential for visible soiling of surfaces near the special receptors due to the Project is low.

### Summary

The residual effect for air quality is characterized as having adverse direction, high magnitude for three (3) CoPCs (elemental carbon, quartz and mica) that exceed provincial criteria and moderate magnitude

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for the remaining CoPCs, LSA in geographic extent, medium sensitivity, medium term duration, multiple irregular events, and reversible.

### 8.4.3 Change in Ambient Light

#### 8.4.3.1 Project Pathways

Lighting sources from the Project construction and operations phases will include stationary lighting sources associated with buildings/infrastructure and mobile sources from the mining equipment and traffic. Stray lighting can cause light pollution which can cause adverse effects for surrounding land users as well as migrating wildlife.

#### 8.4.3.2 Mitigation and Enhancement Measures

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:

- Troilus 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
- Troilus 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 PA.

#### 8.4.3.3 Project Residual Impact

There are few light sensitive receptors in the LSA outside the Modelled Mine Boundary, and they are all distant from the Project with intervening forested areas that will obstruct Project lighting. The nearest light sensitive receptor to the Project outside the Modelled Mine Boundary is a Cree Camp (CC4) approximately 8 km to the southwest of the process plant area and approximately 5 km from the TSF. Intervening forests (consisting primarily of coniferous trees that provide year-round line of sight obstruction) will block light emissions from the Process Plant and ground level site traffic from reaching this receptor. The difference in elevation between the top of the TSF (at its maximum height) and this receptor will be 60 m. At 5 km from receptor CC4, with intervening forested areas, the top of the TSF (at

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its maximum height) will not be visible at this receptor, thus no adverse light trespass effects are predicted at this receptor.

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 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.

With the mitigation measures described above, the potential effects of Project lighting on light trespass, glare and skyglow are expected to be low.

### Summary

The residual adverse effect for light is characterized as having adverse direction, low magnitude, LSA geographic extent, no sensitivity, medium term duration, regular event in frequency, and reversible.

#### 8.4.4 Summary of Project Residual Impacts

Table 8.19 summarizes project residual impacts on the atmospheric conditions.

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**Table 8.19 Project Residual Impacts on Atmospheric Conditions**

Residual Impact	Residual Impact Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Changes in Ambient Air Quality	C,O	A	H	LSA	MS	MT	IR	R
Change in Ambient Lighting	C,O	A	L	LSA	NS	MT	R	R

**KEY**

Project Phase  
 C: Construction  
 O: Operation  
 D: Decommissioning

Direction:  
 P: Positive  
 A: Adverse  
 Magnitude:  
 NMC: No Measurable Change  
 L: Low  
 M: Moderate  
 H: High

Geographic Extent:  
 PDA: Project Development Area  
 LSA: Local Study Area  
 RSA: Regional Study Area  
 Timing  
 NS: No sensitivity  
 MS: Moderate sensitivity  
 HS: High sensitivity  
 Duration:  
 ST: Short-term  
 MT: Medium-term  
 LT: Long-term

Frequency:  
 S: Single event  
 IR: Irregular event  
 R: Regular event  
 C: Continuous  
 Reversibility:  
 R: Reversible  
 I: Irreversible

N/A: Not applicable

## 8.5 Summary of Adverse Residual Impacts

### 8.5.1 Change in Ambient Air Quality

The residual effects of changes in ambient air quality parameters during Project operation are predicted to increase CoPCs above baseline conditions, but residual effects at special receptors would be within regulatory criteria for all but 3 CoPCs for which exceedances would be infrequent, are reversible, and restricted to the LSA.

Use of mitigation measures is proposed to reduce releases of CoPCs as much as practical. With the proposed mitigation and environmental protection measures incorporated into the assessment, the residual environmental effect of a change in ambient air quality is predicted to be negligible.

### 8.5.2 Lighting

The few light sensitive receptors in the LSA are all distant from the Project with intervening forested areas that will obstruct Project lighting. Therefore, no adverse light trespass impacts at the receptors are anticipated. With the proposed mitigation that will limit sky glow, the residual environmental effects of the Project on a change in lighting are rated as negligible.



#### 8.6 Prediction confidence

The effects of Project releases of air CoPC's are based on calculated emission rates and the AERMOD dispersion modelling results. Prediction confidence is high because emission rates used in the modelling were estimated based on a combination of emission factors, engineering estimates and maximum emission levels. Actual emissions vary from hour to hour and day to day. Emissions from the Project employed a conservative, worst-case hourly emission approach which is expected to over-estimate longer-term averaging periods. Because of the approach, there is a high degree of confidence that emissions are over-estimated. Air quality dispersion models such as AERMOD also employ assumptions to simplify the random behaviour of the atmosphere into short periods of average behaviour. These assumptions limit the capacity of the model to replicate every meteorological event. To compensate for these simplifications, five years of meteorological data are applied to evaluate a wide range of possible conditions. Regulatory models, such as AERMOD, are also designed to have a bias toward over estimation of contaminant concentrations.

As noted, the majority of the CoPCs were assessed not accounting for particulate deposition and depletion from the plume, which is conservative.

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