Marathon Palladium Project Environmental Impact Statement Addendum

VOLUME 2 OF 2

6.2.1 Atmospheric Environment

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Abbreviations

$\mu g/m^3$	Micrograms per cubic metre
µm	Micrometre
AAQC	Ambient Air Quality Criteria
ACB	Air Contaminants Benchmarks
AIRs	Additional information requests
CAAQS	Canadian Ambient Air Quality Standards
CAC	criteria air contaminant
CAS	Chemicals Abstracts Service
CEPA	*Canadian Environmental Protection Act*
CH_4	Methane
CIAR	Canadian Impact Assessment Registry
CMC	carboxymethyl cellulose
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	carbon dioxide equivalents
CoPC	constituent of potential concern
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
GenPGM	Generation PGM Inc.
GHG	Greenhouse Gas
GLC	Ground-level concentration

GWP	Global warming potential
HAP	Hazardous Air Pollutants
Hg	Mercury
HHRA	Human Health Risk Assessment
HPGR	high pressure grinding roll
IAA	*Impact Assessment Act*
IR	Information Request
JSL	Jurisdictional Screening Level
LSA	Local Study Area
MECP	Ministry of the Environment, Conservation and Parks
Mn	Manganese
MTO	Ministry of Transportation Ontario
MWh	megawatt hour
N_2O	Nitrous oxide
N/A	Not Applicable
NAAQO	National Ambient Air Quality Objective
NAPS	National Air Pollution Service
Ni	Nickel
NMHC	Non-methane hydrocarbon
NO_x	Nitrogen Oxides
NO_2	Nitrogen dioxide
NPRI	National Pollutant Release Inventory
O. Reg.	Ontario Regulation

PAHs	polycyclic aromatic hydrocarbons
PM	Particulate matter
PM_{10}	Particulate matter less than 10 microns
$PM_{2.5}$	Particulate matter less than 2.5 micrometres
POI	point of impingement
PSMF	Process Solids Management Facility
RSA	Regional Study Area
SIR	Supplemental Information Request
SLs	Screening Levels
SO_2	Sulphur Dioxide
SSA	Site Study Area
tCO_2e	tonnes of carbon dioxide equivalent
TLRU	Traditional Land and Resource Use
TOC	Total Organic Carbon
TSP	total suspended particulate
U	Uranium
UNFCCC	United Nations Framework Convention on Climate Change
URTs	Upper Risk Thresholds
USEPA	United States Environmental Protection Agency
VEC	valued ecosystem component
VOCs	volatile organic compounds

6.2.1 Atmospheric Environment

6.2.1.1 Summary of Original Atmospheric Environment Assessment

6.2.1.1.1 Assessment of Residual Effects in Original EIS

Section 6.2.1 of the original EIS (2012) and subsequent responses to information requests (IRs) from the Panel provided an assessment of the following effects to atmospheric conditions as result of the Project:

- change to air quality and dustfall
- change to greenhouse gases
- change to ambient light

Additional information on the assessment of effects on the atmospheric environment was provided in responses to the following IRs:

- Response to IR5.1 (CIAR # 441)
- Responses to IR10.1, 10.14, Atmospheric Environment (CIAR # 401)
- Responses to IR10.2, Atmospheric Environment (CIAR # 407)
- Response to IR10.3, 10.4, 10.8.1, 10.9 (CIAR # 423)
- Response to IR10.5, 10.7, 10.8.2, 10.10.2, 10.13, 10.15,10.16 (CIAR # 373)
- Response to IR10.6, 10.8.3, 10.11, 10.12, 10.18 (CIAR #443)
- Responses to IR10.10.1, 10.19, Atmospheric Environment (CIAR # 434)
- Responses to IR10.17, Atmospheric Environment (CIAR # 473)

During site preparation and construction, particulate matter and dustfall were predicted at the Project site through various processes such as, but not limited to, site clearing and construction activities, drilling and blasting, motor vehicle exhaust, and fugitive emissions such as wind erosion of overburden storage piles and movement of mobile equipment along unpaved roads. Products of combustion emissions were predicted to be generated during various activities, including:

- Nitrogen Oxides (NO_x) - produced from combustion sources such as vehicle traffic, construction equipment exhaust, blasting and diesel power generation
- Sulphur Dioxide (SO_2) emissions - produced through the combustion of sulphur-containing fuels in on-site vehicles, heavy equipment, and diesel power generation

- Carbon Monoxide (CO) - generated from the incomplete combustion of fuel from vehicles and heavy equipment, detonation of blasting compounds and diesel power generation
- Carbon Dioxide (CO_2) - emitted from combustion-related sources such as mobile equipment and passenger vehicles, as well as emissions from the continuous-duty diesel generator associated with the mobile crusher

During operations, particulate matter and dustfall were predicted at the Project site through various activities including, but not limited to, drilling, blasting, loading mine rock, mill processing, motor vehicle exhaust, diesel generator combustion, propane heating equipment combustion, and fugitive emissions (i.e. Total Suspended Particulate (TSP), Particulate Matter less than 10 microns (PM_{10}), Particulate Matter less than 2.5 microns ($PM_{2.5}$) and metals) such as wind erosion of storage piles and movement of mobile equipment along unpaved roads. Similar to the site preparation and construction phase, combustion sources such as vehicle traffic, mining equipment exhaust, blasting and diesel power generation were predicted to results in emissions of NO_x, SO_2, CO and CO_2.

With respect to air quality and dustfall, the original EIS (2012) predicted the following changes:

- Fugitive dust emissions were expected during site preparation, construction, and operation of the Project, mainly resulting from overburden and mine rock stockpiles, open pit mining activities, and road dust from vehicle use.
- During site preparation and construction activities, criteria air contaminant (CAC) concentrations were predicted to remain below federal and provincial reference standards at the Project boundary and sensitive receptor locations in the Local Study Area (LSA), with the exception of 1-hour NOx (during site preparation and construction) and 24-hour PM_{10} (during construction) at the modelled property boundary.
- During site preparation and construction, the maximum 1-hour NOx was predicted to exceed the Ambient Air Quality Criteria (AAQC) but not the federal maximum tolerable criterion of 1,000 $\mu g/m^3$ at the modelled property boundary.
- During site preparation, the maximum 24-hour PM_{10} of 35 $\mu g/m^3$ was expected to exceed the 24-hour National Ambient Air Quality Objective (NAAQO) of 25 $\mu g/m^3$, but not the provincial AAQC of 50 $\mu g/m^3$.
- During operation activities, predicted CAC concentrations were predicted to remain below AAQC criteria at the Project boundary and receptor locations in the LSA, with the exception of NOx at the modelled property boundary.
- Predicted air quality met all criteria at the nearest sensitive receptors on Hare Lake and Highway 17.
- During all years of operation, the maximum 1-hour NOx at the Project boundary was predicted to exceed the 1-hour AAQC of 400 $\mu g/m^3$, but not the federal maximum tolerable criterion of 1,000 $\mu g/m^3$.

- If concentrate is transported to an off-site processing facility via a rail load-out facility in Marathon, NOx emissions (1-hr averaging) associated with concentrate haul trucks were predicted to exceed provincial standards but would be below the Federal maximum tolerable criterion of 1,000 µg/m^3.

- During year 3 of operation, the predicted CO_2 concentration at the Project boundary of 162,596 µg/m^3 (0.5 hour average) and 55,000 µg/m^3 (24 hour average) was expected to exceed its Jurisdictional Screening Level (JSL) of 63,000 µg/m^3 (0.5 hour average) and 21,000 µg/m^3 (24 hour average).

Greenhouse Gas

With respect to greenhouse gases (GHGs), reported as carbon dioxide equivalents (CO_2e) calculated by multiplying the emission rate of each substance (CO_2, methane (CH_4) and nitrous oxide (N_2O)) by its global warming potential (GWP) relative to CO_2, the original EIS (2012) predicted the following changes:

- Total estimated GHG contribution from site preparation was 8,790 tonnes/yr CO_2e, which was considered negligible when compared to the provincial and federal CO_2e emission rates of 190 million tonnes/yr (0.0046%) and 734 million tonnes/yr (0.0012%), respectively.

- Total estimated GHG emissions during construction was 130,149 tonnes/yr, which was considered small in comparison to provincial and federal CO_2e emission rates (0.068% and 0.018%, respectively).

- Average annual GHG emissions from the operation of the mine was estimated at 206,026 tonnes/yr CO_2e, which was considered minor compared to provincial and federal annual CO_2e emission rates (0.1% and 0.03%, respectively).

- Average annual GHG emissions from the decommissioning phase were estimated at 23,430 tonnes/yr CO_2e, which were considered small compared to provincial and federal annual CO_2e emission rates (0.012% and 0.0032%, respectively).

Light

With respect to ambient light levels, in consideration that the Project is proposed in an undeveloped area north of Highway 17, the original EIS (2012) and response to IR10.3 (CIAR #423) predicted the following changes:

- ambient light levels would increase as a result of artificial lighting required to create a safe work environment during 24-hour operations, most notably during operations

- lights on the mine site would not be visible from the Town of Marathon as there is no direct line of sight

- lights from portions of the mine site (the west side of the process solids management facility (PSMF)) may be visible from Highway 17, but the geographic extent would be limited by the forest habitat surrounding the mine site combined with the changes in elevation (multiple ridges and valleys) across the site

- some sky glow was anticipated as a result of Project operations

Key mitigation measures originally proposed to avoid, reduce and/or offset potential effects of the Project on atmospheric conditions include:

- baghouse dust controls on the primary crusher, reclaim tunnel, rail loadout, assay lab, cupel furnace, and assay furnace
- scrubber dust controls on the secondary crusher, high pressure grinding roll (HPGR), precious metals furnace, and base metals furnace
- water or surfactant application on unpaved haul roads
- optimization of the lighting design to reduce the total amount of lighting needed
- directional lighting with shielded fixtures to reduce glare and light levels
- fixtures will be affixed on poles or buildings at the lowest possible height

6.2.1.1.2 Determination of Significance in Original EIS

For air quality, (including dustfall and greenhouse gas), the original EIS (2012) concluded that the residual effects on air quality would be not significant. Some air quality limits/guidelines were predicted to be exceeded but these were associated with motor vehicle emissions and were not mine-related. The residual effect was limited to the Site Study Area (SSA) and the immediate vicinity, was predicted to be short-term, and was considered reversible.

For light, the original EIS (2012) predicted that mitigation measures should be sufficient to reduce artificial light levels to the extent that no non-trivial residual effects were predicted.

6.2.1.2 Approach to Update the Assessment

The following subsections provide an update to the assessment of residual environmental effects of the Project, including a determination of their significance based on the following:

- Updated environmental conditions within the SSA, LSA and Regional Study Area (RSA), as appropriate
- Recognition of updated standards, criteria, guidelines, or other thresholds that inform the determination of significance
- Consideration and recognition of project refinements, including changes to the Project components and activities, that may affect potential Project interactions, mitigation measures and residual effects

Any changes to the results of the previous assessment have been highlighted and discussed below, as appropriate. Supplementary rationale and explanation for the conclusions of the assessment have been provided based on the previous responses to the information requests (IRs, supplemental information requests (SIRs), additional information requests (AIRs)) and additional input from the various technical discipline leads based on the current assessment.

6.2.1.3 Scope of the Assessment

6.2.1.3.1 Regulatory and Policy Setting

The Project may be regulated and/or influenced by a number of air quality policy mechanisms, including:

- air quality objectives and standards
- emissions limits for specific types of equipment (e.g., generators)
- emissions reporting through the National Pollutant Release Inventory (NPRI) and Ontario Regulation (O. Reg.) 452/09
- local municipal by-laws
- provincial and federal climate change policies

Ontario Air Quality Criteria

The following point of impingement (POI) criteria published by the Ministry of the Environment, Conservation and Parks (MECP) have been applied as part of this review:

- Ontario Regulation 419/05 standards and guidelines
- AAQC
- Screening Levels (SLs)
- Upper Risk Thresholds (URTs)

The Project will be considered a new facility under O. Reg. 419/05 and, as such, the Schedule 3 standards apply. Where no O. Reg. 419/05 Schedule 3 standards are available for a particular constituent of potential concern (CoPC), guidelines, Ontario AAQCs, SLs or URTs were considered. Ontario's AAQC criteria are desirable effects-based concentrations in air with variable averaging periods. The type of effect that a chemical may have varies, but may be based on health, odour, vegetation, soiling, visibility, or corrosion, amongst others.

These criteria are outlined in the MECP's "Air Contaminants Benchmarks (ACB) List – Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants" (MECP, 2018b), 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. URTs are maximum concentrations which are not to be exceeded anywhere off-property. Similar to SL values, URTs are compared to modelled concentrations at the claim boundary.

Criteria published in O. Reg. 419/05 are applied at a POI, most commonly a property boundary or, in the case of a mining property, the claim boundary. The exception is when a sensitive land use, such as a child-care facility, health care facility or educational facility, exists on site.

Summaries of the relevant provincial air quality objectives, guidelines, and standards are presented in Table 6.2.1-1 for TSP, metals and metallic compounds; Table 6.2.1-2 for CACs; Table 6.2.1-3 for volatile organic compounds (VOCs); Table 6.2.1-4 for polycyclic aromatic hydrocarbons (PAHs); and, Table 6.2.1-5 for other CoPCs. Changes in air quality criteria since the 2012 air quality assessment (TGCL, 2012a), as well as proposed future changes to criteria in O. Reg. 419/05 were also considered and included in the tables.

Table 6.2.1-1: Summary of Provincial Air Quality Criteria for TSP, Metals and Metallic Compounds

Parameter	Chemicals Abstracts Services Number (CAS #)	O. Reg. 419/05 - Schedule 3 Standards, Guidelines, SLs and URTs		Ontario AAQC	
		24 Hour (µg/m^3)	Other time period (µg/m^3)	24 Hour (µg/m^3)	Other time period (µg/m^3)
Total Particulate (TSP)	NA	120	-	-	-
Aluminum	7429-90-5	12	-	-	-
Antimony	7440-36-0	25	-	25	-
Arsenic	7440-38-2	0.3	-	.3	-
Barium	7440-39-3	10	-	10	-
Beryllium	7440-41-7	0.01	-	0.01	-
Bismuth	7440-69-9	2.5	-	-	-
Boron	7440-42-8	120	-	120	-
Cadmium	7440-43-9	0.025, 0.25(1)	-	0.025	0.005; annual
Calcium	7440-70-2	-	-	-	-
Chromium (total)	7440-47-3	0.5, 5(1)	-	0.5	-
Cobalt	7440-48-4	0.1	-	0.1	-
Copper	7440-50-8	50	-	50	-
Gallium	7440-55-3	-	-	-	-
Gold	7440-57-5	1.25			
Iron	15438-31-0	4 (2)	-	4	-
Iron Sulphide	1317-37-9	-	-	-	-
Lanthanum	7439-91-0	-	-	-	-
Lanthanum Chloride	10099-58-8	25	-	-	-

Table 6.2.1-1: Summary of Provincial Air Quality Criteria for TSP, Metals and Metallic Compounds

Parameter	Chemicals Abstracts Services Number (CAS #)	O. Reg. 419/05 - Schedule 3 Standards, Guidelines, SLs and URTs		Ontario AAQC	
		24 Hour ($\mu g/m^3$)	Other time period ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	Other time period ($\mu g/m^3$)
Lead	7439-92-1	0.5, 2(1)	0.2; 30+ day	0.5	0.2(+) 30day
Lithium	7439-93-2	20	-	20	-
Magnesium	7439-95-4	72	-	-	-
Manganese (Mn)	7439-96-5	0.4	-	0.1 (Mn in PM2.5), 0.2 (Mn in PM10), 0.4 (Mn in TSP)	-
Mercury (Hg)	7439-97-6	2	-	2 (Hg), 0.5 (Hg as alkyl compounds)	-
Molybdenum	7439-98-7	120	-	120	-
Nickel (Ni)	7440-02-0	2(1)	0.04	0.1 (Ni in PM10), 0.2 (Ni in TSP)	0.02 (Ni in PM10 - annual), 0.04 (Ni in TSP - annual)
Phosphorous	7723-14-0	-	-	-	-
Platinum	7440-06-4	0.2	-	0.2	-
Potassium	7440-09-7	1	-	-	-
Scandium	7440-20-2	-	-	-	-
Silicon	7440-21-3	27	-	-	-
Silver	7440-22-4	1	-	1	-
Sodium	7440-23-5	-	-	-	-
Strontium	7440-24-6	120	-	120	-
Thallium	7440-28-0	0.5	-	-	-
Tungsten	7440-33-7	5	-	-	-
Titanium	7440-32-6	120	-	120	-
Uranium (U)	7440-61-1	1.5(1)	0.03; annual	0.15 (U in PM10), 0.3 (U in TSP)	0.03 (U in PM10 - annual), 0.06 (U in TSP - annual)
Vanadium	7440-62-2	2	-	2	-
Zinc	7440-66-6	120	-	120	-

Notes:

1 – URT

2 – as metallic iron

Table 6.2.1-2: Summary of Provincial Air Quality Criteria for CACs

Parameter	CAS #	O. Reg. 419/05 – Schedule 3 Standards and AAQC		
		1-Hour (µg/m³)	24-Hour (µg/m³)	Other time Period (µg/m³)
Sulphur dioxide	7446-09-5	690, 100 [D]	275, N/A [D]	55 [A]; 10 [D] annual
Nitrogen oxides [B]	10102-44-0	400	200	-
Ozone	10028-15-6	165	-	-
$PM_{2.5}$	N/A	-	27 [A, C]	8.8 [A, C]
PM_{10}	N/A	-	50 [A, C]	-
Carbon monoxide	630-08-0	36,200 [A]	-	6,000; ½-hour [E] 15,700; 8-hour [A]

Notes:

A. Ontario Ambient Air Quality Criteria

B. The Schedule 3 standards for NO_X are based on health effects of Nitrogen dioxide (NO_2), as NO_2 has adverse health effects at much lower concentrations than NO. Therefore, the standard was compared to NO_2 in this report.

C. AAQC for $PM_{2.5}$ references CAAQS. AAQC for PM_{10} is an interim AAQC provided as a guide for decision making.

D. New Schedule 3 standards for SO_2 effective July 1, 2023.

E. Half-hour standard for carbon monoxide accounts for high background levels from automobiles (i.e., individual facilities are only allowed a small fraction of the total airshed).

Table 6.2.1-3: Summary of Air Quality Criteria for VOCs

Parameter	CAS #	O. Reg. 419/05 - Schedule 3 Standards, Guidelines, and SLs		Ontario AAQC	
		24 Hour (µg/m³)	Other (µg/m³)	24 Hour (µg/m³)	Other time period (µg/m³)
Acetaldehyde	75-07-0	500	500 (30 min)	-	-
Acrolein	107-02-8	0.4	4.5 (1 hour)	-	-
Aldehyde	75-07-0	-	-	-	-
1,3-Butadiene	106-99-0	10	2 (annual)	-	-
Benzene	71-43-2	-	0.45 (Annual)	-	-
Bromine	7726-95-6	20	-	-	-
Formaldehyde	50-00-0	65	-	-	-
Hydrochloric acid (hcl)	7647-01-0	20			
Hydrofluoric acid (hf)	7664-39-3	0.86	0.34 (30 day)		
TOC	-	-	-	-	-
TOC (Methane)	74-82-8	37330	-	-	-
Naphthalene	91-20-3	22.5	50 (10 min)	22.5	50 (10 min)

Table 6.2.1-3: Summary of Air Quality Criteria for VOCs

Parameter	CAS #	O. Reg. 419/05 - Schedule 3 Standards, Guidelines, and SLs		Ontario AAQC	
		24 Hour ($\mu g/m^3$)	Other ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	Other time period ($\mu g/m^3$)
Nitric Acid	7697-37-2	35	-	-	-
Propylene	115-07-1	4000	-	-	-
Sodium Carboxymethyl Cellulose	9004-32-4	120	-	-	-
Toluene	108-88-3	2,000	-	2,000	-
Xylenes	1330-20-7	730	3000 (10 min)		

Table 6.2.1-4: Summary of Applicable Provincial Air Quality Standards for Selected PAHs

CoPC	CAS #	O. Reg. 419/05 – Schedule 3 Standards and SLs		Ontario AAQC	
		24-Hour ($\mu g/m^3$)	Other time Period ($\mu g/m^3$)	24-Hour ($\mu g/m^3$)	Other time Period ($\mu g/m^3$)
Acenaphthene	83-32-9	-	-	-	-
Acenaphthylene	208-96-8	-	-	-	-
Anthracene	120-12-7	-	-	-	-
Benzo(a)anthracene	56-55-3	-	-	-	-
Chrysene	218-01-9	-	-	-	-
Fluoranthene	206-44-0	-	-	-	-
Fluorene	86-73-7	-	-	-	-
Phenanthrene	85-01-8	-	-	-	-
Pyrene	129-00-0	-	-	-	-
Benzo(a)pyrene	50-32-8	0.00005	0.00001	0.00005	0.00001
Benzo(b) fluoranthene	205-99-2	-	-	-	-
Benzo(k) fluoranthene	208-08-0	-	-	-	-
Benzo(g,h,i)perylene	191-24-2	-	-	-	-
Dibenz(a,h)perylene		-	-	-	-
Indeno(1,2,3-cd)pyrene		-	-	-	-

Table 6.2.1-5: Summary of Applicable Provincial Air Quality Standards for Other CoPCs

CoPC	Chemicals Abstracts Services Number (CAS No.)	O. Reg. 419/05 – Schedule 3 Standards and SLs		Ontario AAQC	
		24-Hour (µg/m^3)	Other time Period (µg/m^3)	24-Hour (µg/m^3)	Other time Period (µg/m^3)
Calcium Oxide	1305-78-8	10	-	-	-
Crystalline Silica	14808-60-7	5	-	-	-
Nitrous Oxide	10024-97-2	9000			

Federal Air Quality Criteria

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

New or updated CAAQS for sulphur dioxide (SO_2) and particulate matter with diameter less than 2.5 µm ($PM_{2.5}$) came into effect in 2020 and 2025 (for SO_2) (CCME 2016b, 2016a). CAAQS for nitrogen dioxide (NO_2) were released on November 3, 2017 and were/will be in effect in 2020 and 2025 (CCME 2017).

The federal criteria are summarized below.

Table 6.2.1-6: Summary of Federal Air Quality Standards

Parameter	Averaging Time	2020 CAAQS (µg/m^3)	2025 CAAQS (µg/m^3)
NO_2	1 hour	113 [a]	79 [b]
	24 hours	-	-
	Annual	32 [a]	23 [b]
$PM_{2.5}$	24 hours	27 [c]	-
	Annual	8.8 [c]	-
SO_2	1 hour	183 [d]	170 [e]
	24 hours	-	-
	Annual	13 [d]	10.5 [e]
O_3	8 hours	124	-

Notes:

A. 1 Hour and Annual CAAQS for NO_2, effective by 2020 (CCME 2020). The 1-hour CAAQS is referenced to the 3-year average of the annual 98th 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^3 based on standard temperature of 25 ^{o}C and pressure of 1 atm.

B. 1 Hour and Annual CAAQS for NO_2, effective by 2025 (CCME 2018). The 1-hour CAAQS is referenced to the 3-year average of the annual 98th 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^3 based on a standard temperature of 25 ^{o}C and pressure of 1atm.

Table 6.2.1-6: Summary of Federal Air Quality Standards

Parameter	Averaging Time	2020 CAAQS (µg/m³)	2025 CAAQS (µg/m³)

C. 24 Hour and Annual CAAQS for Respirable Particulate Matter, effective by 2020 (CCME, 2012). The 24-hour CAAQS is referenced to the 98th percentile daily average concentration averaged over 3 consecutive years. The annual CAAQS is referenced to the 3-year average of the annual average concentrations.

D. 1 Hour and Annual CAAQS for SO_2, effective by 2020 (CCME, 2018). The 1-hour CAAQS is the 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations. The annual CAAQS is referenced to the average over a single calendar year of all 1-hour average concentrations. The criteria were converted from ppb to µg/m³ based on a standard temperature of 25 °C and pressure of 1 atm.

E. 1 Hour and Annual CAAQS for SO_2, effective by 2025 (CCME, 2018). The 1 Hour CAAQS is the 3-year average of the annual 99th percentile of the SO_2 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/m³ based on a standard temperature of 25 °C and pressure of 1 atm.

Codes, Guidelines and Standards

Air CoPC emissions, emission controls, and equipment for specific sources from the Project may be influenced by the following guidelines:

- The MECP Guidance Document – Emission limits and operating conditions for emergency generator sets in non-emergency situations (MECP 2009c). This guidance document sets out the following emission requirements (listed in Table 6.2.1-7) for internal combustion engine generator sets used for non-emergency situations. At present, GenPGM is contemplating that the Project will be off-grid during construction when generators would be run on a continual basis to supply electricity for the site, so these criteria are unlikely to be applicable to the Project; however, they were included in this report for completeness.

Table 6.2.1-7: Summary of Emission Limits for Internal Combustion Engine Generator Sets for Non-Emergency Use

CoPC	Limits	Timeframe
Nitrogen oxides (NOx) (expressed as nitrogen dioxide equivalent)	1.0 kg/MWh 0.4 kg/MWh	2007 – 2010 2011 onward
Particulate Matter (PM)	0.2 kg/MWh 0.02 kg/MWh	2007 – 2010 2011 onward
Non-Methane Hydrocarbons (NMHC)	1.3 kg/MWh 0.19 kg/MWh	2007 – 2010 2011 onward
CO	3.5 kg/MWh	2007 onward
SO_2	Ultra-low sulphur diesel: 15 ppm	2007 onwards

SOURCE: MECP 2009c

Emissions Reporting

Project emissions would be required to be reported under Environment and Climate Change Canada's (ECCC) NPRI program and O. Reg. 452/09 Greenhouse Gas Reporting.

Municipal Planning Policies and Bylaws

No municipal policies or bylaws applicable to the Project for atmospheric environment were identified based on a search for the Town of Marathon by-laws (www.marathon.ca/en/town-hall/by-laws.aspx).

Federal and Provincial Greenhouse Gas and Climate Change Policy

ECCC's document *Strategic Assessment of Climate Change* (ECCC, 2020a) (Strategic Assessment) provides detailed guidance to project proponents required to assess climate change impacts within a federal impact assessment under the Impact Assessment Act, SC 2019, c 28, s 1 (IAA). The Strategic Assessment informs considerations under the IAA on the extent to which a designated project hinders or contributes to the Government of Canada's ability to meet its commitments with respect to climate change. This document replaces the Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment (2003) that previously provided guidance on incorporating climate change considerations in environmental assessment, including methods that can be used to obtain and evaluate information concerning a project's GHG emissions and the impacts of climate change on a project; key sources of information that practitioners can use to address climate change considerations in project EA; and methodology to encourage the consistent consideration of climate change in the EA process across federal, provincial and territorial jurisdictions and institutions of public government responsible for EA. The Strategic Assessment is now the primary source of guidance for the incorporation of GHG and Climate Change Impact considerations into an EA throughout Canada.

Policy initiatives have been implemented to address GHG emissions at the federal and international level. The Paris Agreement enacted by the United Nations Framework Convention on Climate Change (UNFCCC) is in place to strengthen the global response to climate change by limiting a global temperature rise to 1.5 to 2 degrees Celsius above pre-industrial levels (UNFCCC, 2016). The Government of Canada ratified the Paris Agreement in 2016 and it forms the basis for Canada's federal climate change policy and GHG reduction targets. The Pan-Canadian Framework on Clean Growth and Climate Change is the national plan – developed with the provinces and territories and in consultation with Indigenous peoples to, among other things, meet emissions reduction targets. The Pan-Canadian Framework has four main pillars: pricing carbon pollution; complementary measures to further reduce emissions across the economy; measures to adapt to the impacts of climate change and build resilience; and actions to accelerate innovation, support clean technology, and create jobs. In December of 2020, the Government of Canada introduced *A Healthy Environment and a Healthy Economy – Canada's strengthened climate plan to create jobs and support people, communities and the planet* (ECCC, 2020b). The plan builds on the efforts that are currently underway through the Pan-Canadian Framework and intends to exceed the 2030 Paris Agreement emissions reduction target with the goal of reaching net-zero emissions by 2050.

Under the federal Greenhouse Gas Reporting Program, facilities that emit greater than 10,000 tonnes of carbon dioxide equivalent (tCO_2e) must report their emissions to ECCC in accordance with the Canada Gazette Notice published on an annual basis (Government of Canada, 2021a). Furthermore, facilities that emit greater than 50,000 tCO_2e must comply with the requirements of the federal Output-Based Pricing System Regulations made under the *Greenhouse Gas Pollution Pricing Act,* which require such facilities to provide compensation for the GHG emissions that are over a prescribed amount or to obtain credit for GHG emissions that are under the prescribed amount (Government of Canada, 2021b). The *Greenhouse Gas Pollution Pricing Act* also sets out a schedule for carbon levies on fossil fuels for application across most jurisdictions in Canada.

GHG emissions for the Project will be reported as required to the Government of Canada's Greenhouse Gas Reporting Program (GHGRP), assuming emissions exceed 10 kilotonnes CO_2e annually. The information is collected under Section 46 of the Canadian Environmental Protection Act (CEPA).

O. Reg. 390/18 (Greenhouse Gas Emissions: Quantification, Reporting and Verification) made under the Environmental Protection Act requires that facilities subject to the regulation calculate and report GHG emissions annually if the minimum reporting threshold limit of 50,000 tCO_2e is exceeded. Furthermore, an Ontario provincial regulatory compliance program exists that is similar to the federal Output-Based Pricing System Regulations, as described in O. Reg. 241/19 (Greenhouse Gas Emissions Performance Standards). This regulation was put on hold until the federal government approved the basis and the requirements of the provincial regulation. On December 23, 2020, ECCC issued a Notice of Intent to stand down the federal Output-Based Pricing System Regulations in Ontario (Government of Canada, 2021b). The result of this Notice of Intent is that the federal Output-Based Pricing System Regulations will no longer apply in Ontario, to be replaced by Ontario Regulation 241/19; however, the date of the commencement of the Ontario Emissions Performance Standards program has yet to be determined and the federal Output-Based Pricing System Regulations are still in force.

No reporting to the province will be required under O. Reg. 390/18, under the Environmental Protection Act, as the regulation does not apply to the Project.

Lighting

The Occupational Health and Safety Act (Ontario) specifies that lighting of a workplace is to be appropriate to the task workers are undertaking. Specific lighting requirements will be determined during the detailed design phase of the Project so as to be consistent with the requirements of the Act and the regulations thereunder.

6.2.1.3.2 Influence of Consultation and Engagement on the Assessment

Consultation for the Project has been ongoing since 2004 and will continue throughout the life of the Project. Chapter 4 of the original EIS (2012) and Chapter 5 of this EIS Addendum (Vol 2) covers the consultation process and activities undertaken by GenPGM and formerly by Stillwater. Comments and feedback received throughout the consultation process pertaining to the atmospheric environment are summarized below:

- Information was requested on the selection of air quality monitoring locations.
- Traditional land and resource use (TLRU information was taken into consideration when selecting the locations for special receptors to air quality predictions; however, given the confidentiality associated with TLRU by various Indigenous Communities, special receptor locations were not explicitly located at locations identified by communities. Instead, this information was used to align TLRU receptors with other special receptors of importance (e.g., waterbodies like Pic River, traditional gathering locations) to include consideration of TLRU sites when assessing for potential Project interactions.
- Concerns relating to the potential effect that the Project may have on dust, including potential impacts to traffic and the nearby airport.
- Concern relating to the potential effect that the Project may have on climate change.

Feedback related to the atmospheric environment has been addressed through updates to the EIS Addendum and supporting materials, responses and meetings with communities and stakeholders, as appropriate. Traditional knowledge and TLRU information that contributes to the Atmospheric Environment was provided by Indigenous communities; however, given the confidentiality of this material, explicit details are not included nor are communities identified. Section 6.2.12 of this EIS Addendum (Vol 2) provides details on how TLRU and traditional knowledge have been incorporated into the assessment.

6.2.1.3.3 Potential Effects, Pathways and Measurable Parameters

Table 6.2.1-8 summarizes the potential environmental effects of the Project on the atmospheric environment, the effect pathway, and the measurable parameters. These potential environmental effects and measurable parameters were selected based on professional judgment, recent EAs for mining projects in Ontario, and comments provided during consultation.

Table 6.2.1-8: Potential Effects, Effects Pathways and Measurable Parameters for Atmospheric Environment

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in air quality (including dustfall)	• Emissions from the operation of vehicles and heavy equipment during site preparation, construction, operation, and decommissioning. • Emissions of particulate matter during earth works.	• Ambient concentration of suspended particulate matter (PM_{10}, $PM_{2.5}$, and TSP) and dustfall • Ambient concentrations of nitrogen oxides NO_x), sulphur dioxide (SO_2), carbon monoxide (CO), and carbon dioxide (CO_2) • Ambient concentrations of Hazardous Air Pollutants (HAPs) including Volatile Organic Compounds

Table 6.2.1-8: Potential Effects, Effects Pathways and Measurable Parameters for Atmospheric Environment

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
		(VOCs), Polycyclic Aromatic Hydrocarbons (PAHs) and metals. • Detectable odours
Change to Greenhouse Gases (climate change effects)	• Emission of GHGs due to vegetation removal, fuel combustion, electricity generation and blasting. • Creation of CO_2 sinks through site restoration	• Annual GHG emission rates measured in tonnes CO_2e per year
Change to ambient light	• Introduction of ambient light by site lighting and vehicles/equipment during site preparation/construction, operation, and decommissioning.	• Light trespass – light leaving the project site and brightening adjacent areas • Sky glow – light leaving the project site and brightening the night sky

6.2.1.3.4 Assessment Boundaries

In general, the spatial boundaries for the assessment of environmental effects are presented in Section 2.4 (EIS Addendum, Volume 1) (CIAR #727) while the LSA and RSA are defined based on the extent of potential effects specific to each valued ecosystem component (VEC).

- **Site Study Area**: The SSA is the direct footprint of the Project and is consistent across all VECs. The SSA has been revised from the original EIS (2012) to reflect changes and refinements to the Project design.
- **Local Study Area**: The Atmospheric LSAs represent the maximum area within which effects on air quality, dustfall, and light from Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. Separate LSAs have been created for air quality and light to best reflect the extent of VEC-specific effects. These LSAs consist of the SSA 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 has been updated relative to that defined in the original EIS (2012). The original EIS defined the LSA as 10 km from all GenPGM claim areas (surface and subsurface), which also encompassed the Town of Marathon and the Pic River First Nation. This assessment utilizes solely the surface claim area boundary, which defines the maximum surface extent of the mine site, as the basis for defining the 10-km zone around the site.

- An LSA for GHG emissions was not established; since GHG releases act cumulatively in the atmosphere globally, the environmental effect of GHG on the environment is a global concern. The spatial boundary is provincial and national in geographic extent.
- The light LSA is roughly defined by the area west of the SSA to Lake Superior to encompass the Town of Marathon and north to Hare Lake to include the cottages on the lake.

- **Regional Study Area**: The Atmospheric 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 with respect to air quality, dustfall, and light effects. These RSAs include the SSAs, LSAs and are defined as follows:
  - For air quality, the RSA is an area extending 50 km from the Site claim boundary. 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.
  - As stated above, GHG releases act cumulatively in the atmosphere globally and the environmental concern is global. The spatial boundary is provincial and national in geographic extent.
  - For light, the RSA is coincident with the LSA since effects are expected to be restricted to the LSA.

The Atmospheric LSA and RSA boundaries are included on Figure 6.2.1-1 and Figure 6.2.1-2 of this report.

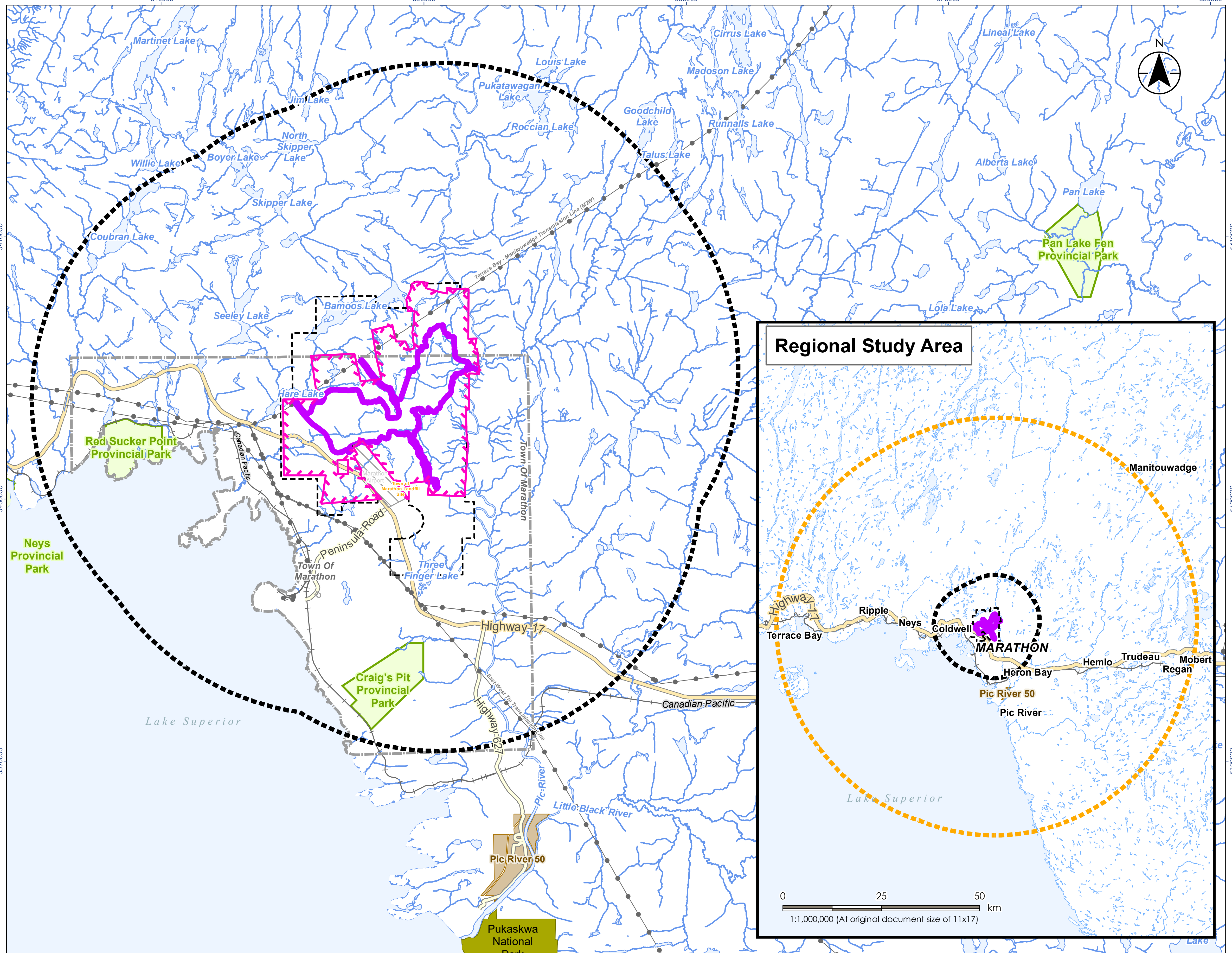
The temporal boundaries for the Project that have been considered in the determination of environmental effects are described in Section 2.5 of the EIS Addendum (Volume 1) (CIAR #727).

For the air quality, GHG, and light assessment, the following scenarios were evaluated:

- Phase I – Site Preparation and Construction: Emissions from Construction Year "-1" were assessed as this timeframe includes the most material movements and equipment operation, which will result in the largest CoPC emissions during this phase. Initial site preparation activities (clearing, grubbing, soil stripping, grading of the SSA, etc.) in this phase will be relatively brief with fewer numbers of equipment than subsequent construction activities. Emissions from site preparation activities in this phase were therefore not explicitly assessed as the construction assessment will implicitly address site preparation emissions.
- Phase II – Operations: Project material movements (mining and ore stockpile) and ore processing rates remain relatively constant through operating years 2 through 10, with lower rates in other years. CoPC emission rates would therefore be expected to be highest in years 2 to 10. Using year 2 operating data to represent the entire operations phase provides a conservative estimate of air

quality levels as the depth of the open pits will be less in year 2 versus later years, which will result in “worst-case” impacts.

- Phase III – Decommissioning and Closure: Closure emissions are expected to be less than construction emissions (as no pit extraction or PSMF construction would be occurring) and, therefore, the assessment of the construction scenario implicitly addresses the decommissioning and closure phase emissions as well.



Stantec

Legend

- Project Boundary (MLAS, MENDM Changed 2017)
- Site Study Area Boundary
- Limit of Surface Rights Controled by Generation Mining (Current or Pending)
- Local Study Area
- Regional Study Area
- Highway
- Major Road
- Hydro Line
- Railway
- Watercourse
- Airport
- Municipal Boundary, Lower Tier
- National Park
- Provincial Park
- Waterbody

0 2.5 5 km

1:150,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.

Project Location
Marathon

129673006 REVA
Prepared by SW on 2020-11-12
Technical Review by DH on 2020-09-17
Independent Review by ABC on yyyy-mm-dd

Client/Project
GENERATION PGM INC.
MARATHON PALLADIUM PROJECT

Figure No.
6.2.1-1

Title
Local and Regional Study Areas - Air Quality

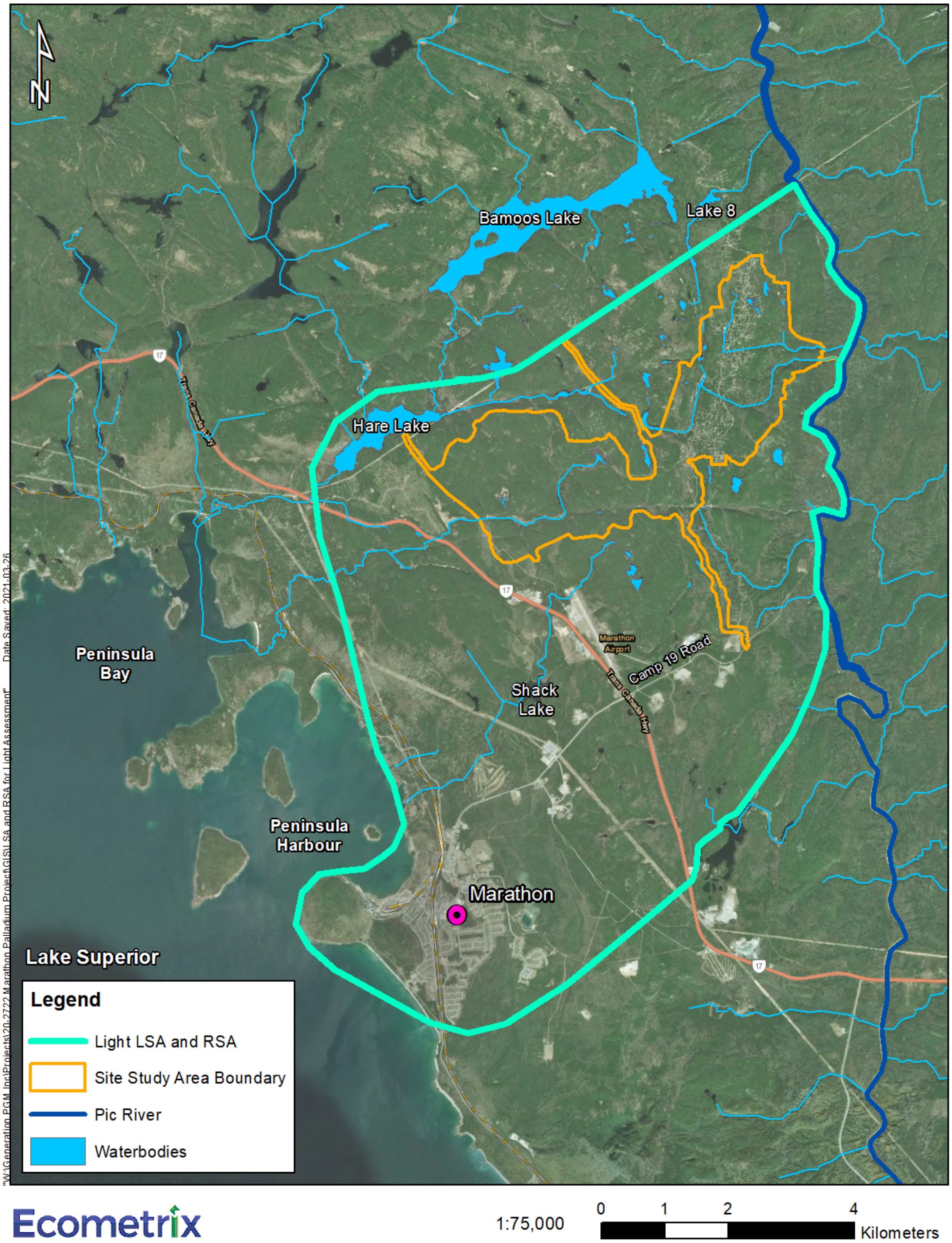


Figure 6.2.1-2: Local and Regional Study Areas - Light

6.2.1.3.5 Residual Effects Characterization

Table 6.2.1-9 summarizes how residual environmental effects are characterized in terms of direction, magnitude, geographic extent, timing, duration, frequency, reversibility, and ecological / societal value. The characterization of residual effects is consistent with the original EIS (2012), which were qualitative definitions, and have been further defined to include quantitative measures, where applicable, as part of this EIS Addendum.

Table 6.2.1-9: Characterization of Residual Effects on Atmospheric Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive** – Effect moves measurable parameters in a direction beneficial to air quality or light relative to baseline conditions. **Adverse** – Effect moves measurable parameters in a direction detrimental to air quality or light relative to baseline conditions.
Magnitude	The amount of change in measurable parameters of the VEC relative to existing conditions	**For Air Quality:** **Negligible –** model predicted air contaminant concentrations due to Project-related emissions are less than 10% of baseline conditions and do not result in exceedances of the ambient air quality criteria **Low –** a measurable change is expected but of comparable magnitude to baseline conditions **Medium –** a measurable change or effect but less than regulatory limits or standards **High –** a measurable change that causes exceedance of objectives or standards beyond the Project boundaries. **For Greenhouse Gas:** **Negligible –** no measurable change in GHG emissions **Low –** although a change is measurable, based on Agency guidance (CEAA 2003 and ECCC 2020a) and professional judgment, relatively small changes are expected in provincial and national GHG emissions **Medium –** based on Agency guidance (CEAA 2003 and ECCC 2020a) and professional judgment, notable changes are expected in provincial and national GHG emissions **High –** based on Agency guidance (CEAA 2003 and ECCC 2020a) and professional judgment, material changes are expected in provincial and national GHG emissions **For Lighting:** **Negligible –** no measurable change **Low –** effect is detectable but is limited through design mitigation **Medium –** facility lighting is effectively controlled, but navigation, security and other required lighting have a measurable effect

Table 6.2.1-9: Characterization of Residual Effects on Atmospheric Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		High – the design is uncontrolled by Project design criteria and has a pronounced effect
Geographic Extent	The geographic area in which a residual effect occurs	**Negligible (SSA) –** residual effects are limited to SSA **Low –** residual effects are restricted to within the modelled property boundary (for air quality) or immediate surroundings **Medium (LSA) –** residual effects extend into the LSA **High (RSA) –** residual effects extend into the RSA
Timing	Considers when the residual effect is expected to occur, where relevant to the VEC.	**For Air Quality and GHG** No sensitivity - Timing does not affect the VEC. **For Ambient Light** **Not Applicable** — during the day, light is not likely to have an effect. **Applicable** — during the night, light is likely to have an effect
Duration	The time required until the measurable parameter or the VEC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Negligible –** residual effect is limited to a single event **Low (short-term) –** the residual effect is limited to short term events (a few years or less) **Medium –** the residual effect is limited to the operational/decommissioning phases (years to decades) **High (Long-term) –** the residual effect extends beyond the life of the project (centuries)
Frequency	Considers whether the residual effect is expected to occur once, at regular or irregular intervals or continuously	**Negligible (single event) –** the residual environmental effect occurs only once **Low (Multiple irregular event) –** the residual environmental effect is limited to construction or active closure or for periods of less than 1 year during operation. **Medium (Multiple regular event) -** the residual environmental effect occurs on a regular basis and at regular intervals **High (Continuous) –** occurs continuously
Reversibility	Considers whether the residual effect is reversible or irreversible.	**Negligible –** effect ceases immediately once source or stressor is removed **Low –** effect ceases once source or stressor is removed **Medium –** effect persists for some time after source or stressor is removed **High (Irreversible) –** the residual effect is unlikely to be reversed

Table 6.2.1-9: Characterization of Residual Effects on Atmospheric Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Ecological/Societal Value	Considers the magnitude that the residual effect is expected to have on the ecological or societal community, as determined through consultation and engagement.	**Negligible –** the VEC has no value from a cultural or societal context **Low –** the VEC is common in the LSA and/or has little to no value from a cultural or societal context. For air quality the existing airshed is considered good for a rural area in northern Ontario. **Medium –** the VEC is abundant in the RSA, though may be less so in the LSA, and/or has moderate cultural or societal value. For air quality the existing airshed is typical of a rural area in northern Ontario. **High –** the VEC is rare and/or of high cultural or societal value. For air quality the existing airshed is considered compromised or stressed and is not typical of a rural area in northern Ontario.

Note: Timing was not included in the original EIS.

6.2.1.3.6 Significance Definition

Air Quality

A significant residual adverse effect for air quality is one where the Project predicted releases of air contaminants to the atmosphere degrade the quality of ambient air such that the model predicted concentrations (combined with background levels) are likely to exceed applicable objectives, guidelines or criteria for ambient air quality outside the modelled property boundary, and are of concern relative to the geographical extent of predicted exceedances, their frequency of occurrence, and the presence of potentially susceptible receptors.

This significance threshold considers the characterizations described in Table 6.2.1-9 when making a determination of significance. Direction is addressed in this significance threshold by the fact that, by definition, a degradation of ambient air quality as a result of the Project relates to an adverse condition. Magnitude is considered because the threshold considers whether air emissions released to the environment exceeds the applicable criteria. Geographic extent is considered in this significance threshold by predicting Project-related ground-level concentrations of CoPCs beyond the modelled property boundary and considering locations relevant to each CoPC's effect. Frequency and duration are considered by establishing threshold levels for ground-level concentrations for the CoPCs assessed over a specific time period (in this case, the maximum off-site 1-hour, 8-hour, 24-hour or annual average) and predicting whether or not air quality objectives will be exceeded on a continuous basis. Ecological and socio-economic context is addressed as the significance threshold considers local baseline conditions in the modelling to assess air quality emissions.

Timing is not directly addressed by this significance threshold, as this EIS Addendum is concerned primarily with environmental effects caused by the Project and not by natural variations in baseline conditions that may be associated with seasonality or other timing considerations. Where seasonal variations are expected to affect ambient air quality, they are mentioned in the environmental effects assessment (and characterized in Table 6.2.1-9) and accounted for in the air quality assessment with respect to their influence on direction and magnitude.

The remaining characterization and reversibility informs the determination of significance in terms of understanding whether or not ambient air quality will return to baseline conditions once the Project activity has ceased.

Greenhouse Gases

For GHGs, provincial and federal policies and regulations do not identify specific thresholds or standards that could be used to determine significance when assessing the residual effects of a single project's GHG emissions. The assessment considers the Strategic Assessment of Climate Change (ECCC 2020a) guidance by comparing estimated Project GHG emissions to the current provincial and federal GHG emission totals and targets. Within this context, a significant residual adverse effect for GHGs is one where the Project predicted releases of GHGs would contribute in a meaningful way to provincial and/or national GHG emissions.

Lighting

There are no legal requirements in place in Ontario that regulate the amount of ambient light being emitted from facilities. As such, a significant adverse residual effect for Light is defined as an increase in Project-related light emissions such that light levels would result in material light trespass for adjacent areas/receptors.

6.2.1.4 Existing Conditions for Atmospheric Environment

Existing conditions are described in Section 4 of the EIS Addendum (Vol 1) (CIAR #727). The Air Quality Baseline Update report (Stantec, 2020b) (CIAR #722) provides an overview of how baseline conditions have changed since the original EIS (2012) and/or how the understanding of the baseline conditions has evolved.

As outlined in the original EIS (2012), the SSA is located in an undeveloped area north of Highway 17 and existing levels of ambient light are assumed to be very low.

6.2.1.5 Determining Project Interactions with Atmospheric Environment

Table 6.2.1-10 identifies, for each potential effect, the project's physical activities that might interact with the VEC and result in the identified effect. This table is based on a similar table from the original EIS (2012) and has been updated to reflect changes to the Project.

Table 6.2.1-10: Project Interactions with Atmospheric Environment

Physical Activities	Effects			
	Change in Air Quality	Change in Dustfall	Change in Greenhouse Gases	Change to ambient light
Site Preparation/ Construction				
Clearing, grubbing and stripping of vegetation, topsoil and other organic material	✓	✓	✓	✓
Grading with topsoil	✓	✓	✓	✓
Drilling and blasting to develop the open pits and plant site area	✓	✓	✓	✓
Excavation and pre-stripping to remove mine rock and overburden	✓	✓	✓	✓
Preparation of construction surfaces and installation of temporary construction facilities	✓	✓	✓	✓
Site preparation for waste management	✓	✓	✓	✓
Construction of administration buildings, storage buildings, other ancillary structures and site services such as parking lots, area fencing, and security systems	✓	✓	✓	✓
Construction of explosives facilities	✓	✓	✓	✓
Construction of PSMF containment dams and MRSA	✓	✓	✓	✓
Management of surface water and groundwater on the site, including seepage and run-off	–	–	✓	
Maintenance and management of mine rock stockpiles, overburden, and PSMF	✓	✓	✓	✓
Construction of water management facilities and drainage works (including but not limited to pipelines, dewatering facilities, stormwater management, control ponds, and water management pond)	✓	✓	✓	✓
Dewatering of natural waterbodies in the project area	–	–	✓	–
Construction of new mine site access and haul roads, including any water crossings and water body shoreline works or undertaking	✓	✓	✓	✓
Upgrading of the existing mine access road(s) and entrance(s) to the project area including any water crossings and water body shoreline works or undertakings	✓	✓	✓	✓
Construction of a 115kV electrical transmission line within a new right-of-way from the M2W Transmission corridor	–	–	✓	✓
Aggregate sources and amounts	–	–	–	–
Management of waste	✓	✓	✓	✓
Any works or undertakings associated with upgrading a rail load-out facility for mine concentrate and off-site accommodations complex	✓	✓	✓	✓

Table 6.2.1-10: Project Interactions with Atmospheric Environment

Physical Activities	Effects			
	Change in Air Quality	Change in Dustfall	Change in Greenhouse Gases	Change to ambient light
Operating vehicles	✓	✓	✓	✓
Hiring and management of workforce	–	–	–	–
Taxes, contracts, and purchases	–	–	–	–
Operation				
Drilling, blasting, loading and hauling of mine rock from the pits to ROM stockpile pad, crusher or the MRSA	✓	✓	✓	✓
Operation of explosives facilities	–	–	–	✓
Handling, transportation, use and disposal of explosives	✓	✓	✓	✓
Transportation of crushed material to coarse ore stockpile	✓	✓	✓	✓
Transportation of mill feed (ore) to the Process Plant	✓	✓	✓	–
Process Plant operation	✓	✓	✓	✓
Transportation of filtered concentrate	✓	✓	✓	✓
Management and maintenance of the entire mine waste stream, including but not limited to process solids and mine rock	✓	✓	✓	✓
Decommissioning of the temporary process water pond (proposed during mine operations), including removal or breaching of dams	✓	✓	–	✓
Dewatering activities (e.g. open pit)	–	–	✓	✓
Management of surface water and groundwater on the site; including seepage, run-off, contact water, process water and storm water	–	–	–	✓
Management of surface water on site during dam removal or breaching	–	–	–	✓
Management of domestic waste from the mine site	–	–	–	–
Management of hazardous waste	–	–	–	–
Environmental safety procedures	–	–	–	✓
Operating vehicles	✓	✓	✓	✓
Hiring and management of workforce	–	–	–	–
Taxes, contracts, and purchases	–	–	–	–
Decommissioning and Closure/Post-Closure				
Installation of barriers around the pit perimeters	–	–	–	–
Management of inputs from groundwater and surface water run-off into pits	–	–	–	–
Decommissioning, dismantling and/or disposal of equipment	✓	✓	✓	✓

Table 6.2.1-10: Project Interactions with Atmospheric Environment

Physical Activities	Effects			
	Change in Air Quality	Change in Dustfall	Change in Greenhouse Gases	Change to ambient light
Demolition/removal of surface buildings and associated infrastructure and disposal of resulting rubble	✓	✓	✓	✓
Decommissioning/removal of explosives facilities	✓	✓	✓	✓
Removal of power lines and electrical equipment	✓	–	✓	✓
Decommissioning of the potable water and sewage treatment systems (e.g., water treatment plant and membrane bioreactor)	–	–	✓	✓
Maintenance and management of mine rock stockpiles and PSMF	✓	✓	–	–
Following removal of infrastructure, soil, groundwater, and surface water testing for residual contamination, and disposal of contaminated soils and treatment of groundwater and surface water, as required	–	–	–	–
Reclamation and restoration of landscape (including water bodies) to productive capacity including management and monitoring	–	–	✓	–
Management of flooded pits to protect groundwater and surface water quality during flooding and pit overflow	–	–	–	–
Operating vehicles	✓	✓	✓	✓
Hiring and management of workforce	–	–	–	–
Taxes, contracts and purchases	–	–	–	–

Notes:

✓ = Potential interaction

– = No interaction

* minor wording changes to the physical activities list have been made to better align with the updated Project description covered in Chapter 1 (EIS Addendum [Vol 1])

For air quality, emissions of CoPCs and dust occur from the operation of equipment on site combusting fuel and dust from equipment travel on unpaved haul routes. Emissions of CoPCs and dust also occur from material movement and processing. Relative to the original assessment, Project interactions have been updated to reflect dust emissions from vehicle traffic on roads and tailpipe CoPC emissions from vehicles used to transport explosives, run of mine materials, concentrate, etc.

For GHGs, emissions will occur as the result of the operation of vehicles and equipment on site, the combustion of fuels and blasting operations. Land clearing during construction will result in a loss of a carbon-sink and site restoration during closure will at least partially replenish the sink.

For Lighting, artificial lighting will be needed for all Project-related activities that occur outdoors during nighttime hours for safety purposes.

6.2.1.6 Assessment of Residual Effects on Atmospheric Environment

6.2.1.6.1 Change in Air Quality and Dustfall

This section describes the techniques and methodology used to assess air quality. Further detail on the modelling is provided in the Air Quality Updated Effects Assessment (Appendix D1 of this EIS Addendum [Vol 2]).

Analytical Assessment Techniques

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

- Compiling CoPC emissions inventories of point and mobile sources for the Project construction and operations scenarios.
- Establishing background ambient air quality conditions for CoPCs from existing published sources of air quality data and site-specific measurements.
- Conducting dispersion modelling to predict the downwind concentrations of air CoPCs from the Project and comparing these predictions to regulatory standards, objectives and guidelines (Project Alone comparisons).
- Adding background ambient air quality CoPC levels to the Project Alone dispersion model predictions and comparing these cumulative levels to air quality standards and guidelines (cumulative comparisons).

The emissions inventory was based on published emission factors (i.e., U.S. Environmental Protection Agency (USEPA) AP-42) or emissions levels provided by manufacturers. Emissions estimates are expected to be conservative and represent worst-case short-term emissions from the Project activities during maximum construction and operations. Sources of air CoPCs were identified and assessed following the procedures specified in MECP Guideline A-10, Procedure for Preparing an Emission

Summary and Dispersion Modelling Report (MECP 2018a). The results of the air emission inventory were used to prepare the dispersion modelling assessment of the Project for comparison against the applicable ambient air quality standards and objectives.

Background concentrations of CoPCs are used in dispersion modelling to represent the cumulative contribution of other emissions sources (e.g., both anthropogenic and biogenic) in addition to the sources being included in the dispersion modelling. The MECP normally requires that 90th percentile ambient monitoring data be added to the dispersion model predictions to conservatively account for existing ambient concentrations. The background levels used in this updated EIS were therefore the 90th percentile values for short-term averages. For long-term averages, an annual average value was used as the background level.

Background ambient concentrations established in this study are expected to be conservative and an over-estimation of actual ambient concentrations in the LSA. The Project will be located in a remote location of northern Ontario; air quality is primarily influenced by traffic on Highway 17. Background air concentrations established in this report are primarily based on National Air Pollution Service (NAPS) stations which are located in large urban residential, commercial, and industrial areas that are expected to have higher background concentrations relative to the LSA.

The US EPA’s AERMOD air dispersion model, which is an MECP-approved model, was used to estimate the maximum off-site 1-hour, 8-hour, 24-hour, 30-day and annual average ground-level concentrations (GLC) for the CoPCs assessed. Direct influences on the dispersion of pollutants include: source characteristics; wind speeds and direction; atmospheric stability; and, mixing layer depths. A five-year (2015 – 2019) meteorological dataset provided by the MECP based on upper air data from the U.S. National Weather Service’s Gaylord/Alpena station and surface data from Environment and Climate Change Canada’s Marathon airport station and processed using AERMET version 19191 was used in the modelling assessment. The meteorological data was processed by the MECP to reflect the land uses surrounding the proposed site.

Several dispersion modelling scenarios were developed to represent construction and operation phases of the Project. Emissions from Project traffic on public (off-site) roads were included in the assessment. Emissions from off-site roads (e.g., Peninsula Road) included emissions from both existing (public) traffic as well as Project traffic. The dispersion modelling of off-site road emissions assessed concentrations at the special receptors only, which follows guidance provided by the Ontario Ministry of Transportation (MTO) in the document “Ministry of Transportation Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects” (MTO, 2020).

A summary of the dispersion modelling scenarios assessed is presented in Table 6.2.1-11.

Table 6.2.1-11: Summary of Dispersion Modelling Scenarios Assessed

Scenario	Air CoPCs	Sources Modelled	Receptors
Construction	All [1]	Construction Sources (including off-site roads)	Special Receptors
Construction	Selected CoPCs	Construction Sources (excluding off-site roads)	Gridded Receptors
Construction	All [1]	Construction Sources (excluding off-site roads)	Modelled Property Boundary
Operation	All [1]	Project Sources (including off-site roads)	Special Receptors
Operation	Selected CoPCs	Project Sources (excluding off-site roads)	Gridded Receptors
Operation	All [1]	Project Sources (excluding off-site roads)	Modelled Property Boundary

Note:

1. CoPCs from the Project include TSP, PM_{10}, $PM_{2.5}$; other CACs including NO_X, SO_2, CO; and HAPs including PAHs, VOCs and metals.

The assessment area for air quality dispersion modelling was composed of a 27 km by 27 km domain, which is the same as the LSA. In the computational domain, outside modelled property boundary gridded receptors (i.e., locations where air quality levels were predicted) with variable spacing as well as receptors along the modelled property boundary were used in the assessment. A total of 11,421 receptors (6,860 gridded receptors, 4,464 modelled property boundary receptors and 97 special receptors) were utilized.

Special receptors were identified and included in the air quality assessment, including the following:

- The closest outside modelled property boundary residences surrounding the Project, and residences in Marathon.
- Hospitals, schools, daycare centres and nursing homes within the LSA. Data for these sources were compiled from various sources such as other EA studies, internet searches, maps, and official plans.
- Outside modelled property boundary watersheds and waterbodies.
- Outside modelled property boundary locations of known recreational use (e.g., parks, sports fields, etc.).
- Receptors identified for input into the human health risk assessment (HHRA) analyses.
- Indigenous TLRU areas: included in the assessment to represent potential areas of current use for traditional purposes by Indigenous communities. Approximate locations were assessed based on confidential TLRU information provided by communities. These areas may be used for traditional activities including fishing, hunting, trapping, and plant gathering.

The dispersion model predictions of the Project emissions were compared to the identified relevant air quality criteria (Project alone assessment). The dispersion model predictions were conservatively added to the background levels to determine the cumulative change in air quality (Project + background) and these levels were also compared to the relevant criteria.

For the air quality assessment, if there are multiple provincial or federal criteria for a given CoPC, the typical approach taken was to compare to the most conservative (i.e., lowest) of the available criteria. One exception to this approach was the use of the Ontario NO_2 criteria rather than the federal CAAQS. This approach was used as the NO_2 CAAQS came into effect in 2020 but have not been adopted by Ontario. At the time of this assessment, there was no indication that this approach would be adopted by the MECP.

Project Pathways

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 SSA. These emissions would include particulate and combustion gases from construction equipment, and particulate (dust) emissions caused by such things as the operation of heavy earth-moving equipment and wind erosion. Tailpipe emissions from the vehicles (i.e., combustion gas emissions such as NOx, CO, SO_2, TSP, PAHs and VOCs) are also expected. Many of the construction activities would not occur continuously (i.e., intermittent), nor would all activities occur concurrently at any given time.

Operation

For the operation phase of the Project, an emissions scenario corresponding to the year whose emissions will result in “worst-case” impacts was assessed. Year 2 operating data was conservatively used to represent the entire operations phase as it includes maximum mining and production levels in combination with shallower pit depths relative to subsequent years. As the depth of an open pit increases, particulate emissions decrease as a portion of the emissions remain trapped in the pit. Utilizing a shallow pit depth in the assessment therefore provides a conservative assessment of emissions in subsequent years as the pits get deeper.

During Project operation, emissions of air CoPCs (NOx, CO, SO_2, TSP, PM_{10}, $PM_{2.5}$, PAHs and VOCs) may result from the combustion of diesel fuel in mining equipment, and other stationary equipment used during operation. The specific operation, each with its own duration and potential for particulate generation, and the prevailing meteorological conditions are considered.

Particulate (dust) emissions (including TSP, PM_{10}, $PM_{2.5}$ and metal substances contained in the mine rock and ore) would result from:

- operation of 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
- operation in the open pit (e.g., drilling, blasting, material handling, loading)
- ore milling process (e.g., crushing, grinding, concentrating)

Other emissions would also be generated from the use of mill reagents for concentrate processing, such as calcium oxide, hydrochloric acid, etc.

Decommissioning and Closure

Project decommissioning would entail removal of infrastructure and re-vegetation of the area. Decommissioning emissions are expected to be less than construction emissions (as no pit extraction or PSMF 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.

Mitigation and Enhancement Measures

GenPGM has proposed mitigation measures to avoid or reduce Project-related effects on air quality, which are summarized below.

Site Preparation and Construction

Proposed mitigation measures for potential air emission concerns during the construction phase will include:

- use of dust suppressants (e.g., water) during situations that have an increased potential to generate airborne dust
- maintenance of vehicles to increase fuel efficiency

Operations

A number of mitigation measures would be implemented to control emissions to the atmosphere during Project operation. The following components of the ore milling process will be equipped with air pollution control devices:

- The primary crusher will be equipped with a dust collection system (baghouse or equivalent) to control fugitive emission during ore crushing.
- The mill feed crushed ore storage area will be enclosed and the crushed ore reclaim tunnel equipped with a baghouse.
- Baghouses will be used to control emissions from the concentrate loadout area, lime delivery area, lime slacking mill and carboxymethyl cellulose (CMC) Feed bin.

- Wet scrubbers will be used to control emissions from the precious metals and base metals furnaces.
- Baghouses will be used on the lead assay and cupel furnaces.
- Baghouses will be used to control emissions at the rail loadout.

CAC emissions from diesel-fired combustion equipment, including mobile non-road equipment and stationary equipment, are proposed to be controlled through the application of the following practices:

- Mobile equipment on site will meet applicable Transport Canada off-road vehicle emission requirements (Tier 4 emissions standards).
- Effective and timely equipment maintenance will be completed to maintain mining equipment in good working condition.

Fugitive dust emission controls for roadways, material handling and storage areas/stockpile may include, but not be limited to, application of water or surfactants. The site roads will be maintained in good condition, with regular inspections and maintenance to reduce the loose dust on the roads.

Decommissioning and Closure

Mitigation measures for potential air emission concerns during the decommissioning and closure phase will be similar to those for the construction phase.

Project Residual Effect

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

Due to the numerous updates to Project emissions estimates, dispersion model/methodologies and applicable regulatory criteria, the air quality residual effects in the original EIS (2012) and supporting assessment are not directly comparable to those presented in this report.

Predicted Air Quality for Project Alone Emissions

Project alone dispersion model predictions for both the construction and operations model scenarios were compared to the relevant air quality criteria. Downwind ambient concentrations of CoPCs emitted from Project construction are predicted to meet applicable AAQC outside of the modelled property boundary for 81 of the 83 CoPCs examined except for:

- Maximum benzo(a)pyrene concentrations were predicted to exceed the applicable 24-hour and annual criteria by no more than 4.6% and 65.8% at special receptors in the vicinity of the rail loadout that are in close proximity to Peninsula Road. The exceedances at these special receptors are due to emissions from vehicle traffic on Peninsula Road – the modelled emissions from this source (a public road) include traffic from both the Project and existing traffic (non-project related). Of the total B(a)P emissions from the road, only 3.8% is due to the Project. The Project is therefore a negligible contributor to the predicted B(a)P exceedances at these receptors.

- Maximum crystalline silica concentrations are predicted to exceed the 24-hour criterion over an area of 13 km2 outside the modelled property boundary and at 7 special receptors. At special receptor locations where people may be present for significant periods of time, the crystalline silica criterion is exceeded by no more than 78% and is exceeded infrequently (<1.6 % of the time). Therefore, crystalline silica exceedances are predicted to be limited in geographic extent (1.8% of the LSA) and infrequent at locations where human presence is expected.

Downwind ambient concentrations of CoPCs emitted from Project operations are predicted to meet applicable criteria outside the modelled property boundary for 79 of the 83 CoPCs examined other than:

- As with the construction scenario, maximum benzo(a)pyrene concentrations for operations were predicted to exceed the applicable 24-hour and annual criteria at special receptors in the vicinity of the rail loadout, with the exceedances due to emissions from vehicle traffic on Peninsula Road. Of the total B(a)P emissions from the road (public traffic and Project), only 3.2% are due to the Project. The Project is therefore a negligible contributor to the predicted B(a)P exceedances at these receptors.

- Maximum crystalline silica concentrations are predicted to exceed the 24-hour criterion in an area of 5.5 km2 outside the modelled property boundary and at 8 special receptors. At special receptor locations where people may be present for significant periods of time, the crystalline silica criterion is exceeded by no more than 64% and infrequently (<1% of the time). Therefore, crystalline silica exceedances are predicted to be limited in geographic extent (0.8% of the LSA) and infrequent at locations where human presence is expected.

- Exceedances of the 24-hour and annual average nickel criteria (41% and 185% respectively) are predicted on the modelled property boundary around the rail loadout. No exceedances are predicted at the special receptors. The extent of the predicted area of exceedance is small and extends no more than about 25 m from the property line and is therefore limited in geographic extent. The predicted exceedance is due to loading of concentrate to rail cars. This modelled exceedance will be addressed at the detailed design/permitting stage (once the actual location and final configuration of the rail loadout has been determined) through the inclusion of additional mitigation (e.g., full enclosure with dust collection) as required.

- An exceedance of the monthly dustfall criterion (25%) is predicted at the modelled property boundary, close to the entrance of the mine; however, predicted dustfall levels are below the criterion at the special receptors. The area in which cumulative dustfall levels are above the criterion is therefore expected to be limited in geographic extent to near the modelled property boundary.

The air quality modelling is expected to be conservative as it is based on a maximum emissions scenario and the dispersion model tends to be conservative under most conditions.

Predicted Air Quality for the Cumulative Scenario

The Project has the potential to interact with other existing industrial, residential, and natural sources of emissions, which were accounted for by adding background concentrations to the Project Alone predictions. The following results were noted for cumulative effects:

- The background levels of both benzene and benzo(a)pyrene are above applicable air quality criteria, with the Project only providing a small contribution to the cumulative concentration. With the Project added to the background levels, the cumulative concentrations also exceed applicable criteria for both Project construction and operations.

- No background concentration data was available for crystalline silica; therefore, cumulative effects could not be assessed for this CoPC.

- As for the operations Project alone scenario, for which predicted nickel concentrations are above the 24-hour and annual average nickel criteria, operations cumulative concentrations are also above the criteria. Predicted nickel exceedances will be addressed during the detailed design of the rail loadout facility.

- The maximum predicted cumulative monthly dustfall deposition levels on the modelled property boundary for both construction and operations exceeds the applicable criterion by 10% and 46%, respectively. However, cumulative dustfall levels are less than the criterion at all special receptors. The area in which cumulative dustfall levels are above the criterion is therefore expected to be near the modelled property boundary and limited in geographic extent.

- For the Project construction, the maximum cumulative concentration of hourly average nitrogen dioxide was predicted to exceed the criterion at the modelled property boundary by 15%. At all special receptors, the maximum predicted cumulative hourly concentrations are below the criteria. The area in which cumulative hourly NO_2 levels are above the criterion is predicted to be limited in geographic extent.

The background concentrations used on the assessment are expected to be conservative for the Marathon area and the cumulative effects assessment methodology is also conservative and is expected to overestimate the predicted effect of the Project on existing air quality levels.

Traditional Land and Resource Use (TLRU) Locations

The maximum predicted Project Alone concentrations of all CoPCs were below applicable criteria at the Pic River First Nation and in most potential areas for TLRU, or high use areas on Pic River and Hare Lake for both Project construction and operations. Maximum predicted Project Alone concentrations of crystalline silica ware predicted to be above the 24-hour criterion in the Bamoos Lake area; however, levels above the criterion are predicted to occur infrequently (less than 1.6% of the time) and are based on conservative modelling methodologies. The maximum predicted cumulative concentrations of all CoPCs were below applicable criteria for TLRU areas with the exception of benzene and benzo(a)pyrene. The background levels of both benzene and benzo(a)pyrene are above applicable air quality criteria, with the Project only providing a small contribution to the cumulative concentration.

Odour Detectability

There is only one CoPC with an odour-based criterion (10-minute average naphthalene) – the maximum predicted naphthalene concentration was well below this criterion. Sewage and effluent treatment plants are enclosed and expected to have negligible odour emissions.

Determination of Significance

Emissions of CoPCs will increase during Project construction, operations, and decommissioning/closure primarily due to the combustion of diesel fuel in equipment, particulate matter from vehicle and material movements and ore milling/concentrating. Dispersion modelling predicted the effect of Project construction and operations emissions on air quality with results compared to relevant air quality criteria. The residual effects of a change in ambient air quality parameters during Project construction and operations resulted in an increase in 77 of 83 CoPCs above baseline conditions but are predicted to remain below relevant air quality criteria, are reversible, and restricted to the LSA.

The residual effects of changes in ambient air quality of 6 CoPCs during Project construction and/or operation are predicted to increase concentrations above relevant air quality criteria as follows:

- Project alone and cumulative benzo(a)pyrene concentrations were predicted to be above the applicable 24-hour and annual criteria, but are due to existing traffic on local roads and background levels exceeding the criteria with the Project only contributing a small amount to the predicted exceedances. The Project contribution to the magnitude of the residual effect is therefore, small, of medium duration, restricted to the LSA, and reversible.
- Cumulative benzene concentrations were predicted to be above the applicable 24-hour and annual criteria, but are due to the background benzene levels exceeding the criteria with the Project only contributing a small amount to the predicted exceedances. The Project contribution to the magnitude of the residual effect is therefore, small, of medium duration, restricted to the LSA, and reversible.
- Project alone and cumulative nickel concentrations for operations are predicted to exceed applicable criteria in a small area around the rail loadout facility. With additional mitigation and

environmental protection measures applied, it is expected that ambient nickel levels will be reduced to below criteria, are restricted to the LSA, and reversible.

- Crystalline silica concentrations during construction and operations are predicted to exceed the 24-hour criterion. Off-property residual effects are limited to the LSA, infrequent at locations of potentially susceptible receptors, of medium duration, and reversible.
- Predicted dustfall levels during construction and operations are predicted to increase to above criteria at the modelled property boundary but be below criteria at locations of potentially susceptible receptors and will therefore be of low geographic extent, medium duration, and reversible.
- Cumulative NO_2 concentrations are predicted to increase above criteria at the modelled property boundary but be below criteria at locations of potentially susceptible receptors and, therefore, be of low geographic extent, low duration, infrequent and reversible.

Overall, with mitigation and environmental protection measures implemented, residual effects on air quality are predicted to be **not significant.** For the majority of CoPCs, the magnitude of the change in residual effects will be low to medium. For the few CoPCs whose magnitude would be rated as high, either the Project contribution is small, predicted residual effects are infrequent at potentially susceptible receptors, or the geographic extent is low for potentially susceptible receptors. In all cases, residual effects are reversible.

The significance assessment for air quality in this EIS Addendum is consistent with the conclusions of the original EIS (2012).

6.2.1.6.2 Change in Greenhouse Gas

Analytical Assessment Techniques

GHG emission estimates were calculated for Project activities in accordance with the Canada Greenhouse Gas Quantification Requirements (2019 Requirements) from the Greenhouse Gas Reporting Program. GHG emissions due to diesel and propane fuel combustion in vehicles and equipment over the Project life were estimated from annual diesel and propane fuel consumption data provided by GenPGM and emissions factors for:

- CO_2 emission factors from Tables 2-1 and 2-2 of the 2019 Requirements
- CH_4 and N_2O emission factors for diesel combustion for Tier 4 equipment from Table 2-6 of the 2019 Requirements
- methane and nitrous oxide emission factors for industrial propane combustion from Table 2-5 of the 2019 Requirements

The resulting annual CO_2, CH_4 and N_2O emissions were converted to CO_2e using the 100-year global warming potential for each parameter presented in the 2019 Requirements.

Annual GHG emissions from blasting were estimated using quantities of explosive and blasting schedules for construction and operations provide by GenPGM with a CO_2 emissions factor for blasting presented in the original EIS (2012).

Direct comparison to the emissions as presented in the original EIS (2012) is difficult due to the different methodologies employed, and also because the equipment list used to estimate the updated emissions is much more comprehensive than that used in the original EIS (2012).

Project Pathways

The primary source of Project-related GHG emissions will be derived from the combustion of fuels, such as what occurs in fuel combustion engines in vehicles and other equipment (e.g., haul trucks, generators, vehicles). Project phase-specific considerations are highlighted below.

Site preparation and construction activities will result in GHG emissions from the combustion of diesel fuel in heavy earth-moving equipment and equipment used in the construction of Project components. In addition, a loss of CO_2 storage due to tree/vegetation removal to accommodate the Project will also occur.

During operations, GHG emissions will result from the combustion of diesel in mining equipment and operation of other Project components, including the Process Plant and other vehicular equipment, as well as blasting. Emissions from mining equipment will occur throughout the operation phase.

The GHG emissions during the closure phase will be considerably less than during construction and operations, but emissions of GHGs will occur through fuel consumption and energy usage during site rehabilitation and infrastructure removal activities. It is noted that revegetation of areas will be undertaken during site closure and this revegetation will offset some of the loss of carbon storage due to initial tree removal to accommodate the Project.

Mitigation and Enhancement Measures

The following mitigation measures are proposed to avoid or reduce Project-related effects on GHG emissions:

- Optimized mine design - Reconfiguration of the mine site, more specifically by the centralization of infrastructure and improvements to haul truck routes to reduce travel distances.
- Energy efficiency – The use of energy efficient equipment in the Process Plant and other buildings, where practical.
- Vegetation clearing – To be carried out in such a manner to maximize the recovery of marketable wood products. Vegetative material will not be burned. Areas where vegetation has been removed will be revegetated quickly and to the greatest extent possible with plants native to the region through progressive rehabilitation activities.
- Reclamation activities – As indicated above, opportunities for the progressive rehabilitation of disturbed areas, including re-establishing vegetation, will be prioritized. Remaining disturbed areas

will be reclaimed at mine closure to ensure only the minimal level disturbance is maintained as necessary to support site monitoring and maintenance activities. As vegetation in reclaimed areas mature, carbon dioxide will be actively sequestered and, therefore, re-establishing vegetation in disturbed areas as quickly as possible is considered an important progressive closure planning principle.

- Management of fuel use – During operations, measures for reducing GHG emissions will focus on the reduction of fuel use. Passenger vehicles, off-road construction and mining equipment and diesel generators will be properly maintained to optimize performance. Vehicle idling times will be minimized and equipment will be turned off when not in use. Vehicle movements will be optimized to increase productivity and control fuel and other costs, thereby minimizing GHG emissions. Fuel use tracking will be done on a daily/weekly/monthly basis to identify anomalies in fuel use. Exploring the availability and potential use of biodiesel in all mine equipment may contribute to further reduction of GHGs. Exploring the potential to use Trolley Assist (electrical assistance for haul trucks) for key haulage segments may also be considered.

- CO_2 capture – exploring the possibility of employing CO_2 in construction concrete and processed solids stream.

Some of these mitigation measures (i.e., Trolley Assist and CO_2 capture) are being evaluated as part of the updated feasibility study and will be implemented based on the outcomes of those evaluations.

Project Residual Effect

Construction

As described above, Project construction will result in GHG emissions from the combustion of diesel fuel in heavy earth-moving equipment and equipment used for Project construction, as well as blasting. Detailed GHG emission estimates, including a breakdown of GHG emissions by individual gas and sample calculations, are provided in Table 6.2.1-12, Table 6.2.1-13, and Table 6.2.1-14. GHG emissions from construction were estimated using equipment power ratings and expected daily usage rates, assuming that the equipment had no GHG emissions reduction controls or mitigation applied.

Total CO_2e emissions have been predicted to range from 5.9 to 24.3 kt annually during construction (Table 6.2.1-12). The incremental contribution of Project construction to Ontario's and Canada's total annual GHG emissions (based on 2018 data), and assuming the higher annual Project emissions rate of 24.3 kt, would be 0.01% and 0.003%, respectively.

The loss of carbon storage due to tree removal to accommodate the Project has not been considered within the overall accounting of GHGs. In comparison to the carbon sink associated with forested areas in Ontario, the carbon sink loss as a result of the Project is considered negligible.

Operations

As described above, Project operations will result in GHG emissions from the combustion of diesel fuel in mining equipment (heavy haul trucks, dozers, graders, excavators) and other vehicles, the use of propane and blasting. Detailed GHG emission estimates, including a breakdown of GHG emissions by individual gas and sample calculations, are provided in the air quality modelling report (Table 6.2.1-12, Table 6.2.1-13, and Table 6.2.1-14).

Total CO_{2e} emissions during operations are predicted to average 61.6 kt/yr, ranging from 33.1 to 81.9 kt annually during operations (Table 6.2.1-12). The incremental contribution of Project operations to Ontario's and Canada's total annual GHG emissions (based on 2018 data), and assuming the higher annual Project emissions rate of 81.9 kt, would be 0.05% and 0.01%, respectively.

Table 6.2.1-12: GHG Emissions from Fuel Combustion

Emissions	Units	TOTAL	YEAR -2	YEAR -1	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17
Diesel Fuel																					
CO_2	kt	**903.04**	5.75	23.60	37.78	69.22	72.22	73.51	74.16	73.70	79.35	68.34	73.72	73.79	79.59	55.64	32.13	10.54	0.00	0.00	0.00
CH_4	kt	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_2O	kt	**0.08**	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Propane																					
CO_2	kt	**2.38**	0.00	0.07	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.08	0.00	0.00	0.00
CH_4	kt	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_2O	kt	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total CO2e	**kt**	**929.17**	**5.90**	**24.29**	**38.95**	**71.22**	**74.29**	**75.62**	**76.28**	**75.81**	**81.61**	**70.31**	**75.83**	**75.90**	**81.85**	**57.28**	**33.14**	**10.90**	**0.00**	**0.00**	**0.00**

Table 6.2.1-13: Production Data

Produce	Units	TOTAL	YEAR -2	YEAR -1	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17
MINE PRODUCTION																					
Total Tonnage	kt	**447,877**	3,027	10,354	24,000	40,000	40,000	40,000	39,982	40,289	39,199	40,000	40,230	35,248	29,318	18,744	7,485	0	0	0	0
Waste Rock	kt	**326,444**	2,475	7,752	17,392	26,534	26,841	29,574	30,402	30,974	28,965	31,722	30,869	29,956	2,2094	9,613	1,281	0	0	0	0
Overburden	kt	**3,732**	187	637	768	152	447	180	233	306	368	422	31	0	0	0	0	0	0	0	0
Ore	kt	**117,701**	365	1,965	5,840	13,313	12,712	10,246	9,347	9,010	9,866	7,855	9,330	5,292	7,224	9,131	6,204	0	0	0	0
ELECTRICITY																					
Electricity	MWhr	**6,490,760**	8,760	175,200	350,000	481,800	481,800	481,800	481,800	481,800	481,800	481,800	481,800	481,800	481,800	481,800	481,800	175,200	0	0	0
FUELS																					
Diesel Fuel	kL	**336,830**	2,144	8,803	14,092	25,820	26,939	27,419	27,660	27,491	29,599	25,491	27,496	27,523	29,685	20,754	11,983	3,930	0	0	0
Propane	kL	**1,568**	0	46	113	113	113	113	113	113	113	113	113	113	113	113	113	56	0	0	0

Table 6.2.1-14: GHG Emissions from Blasting

Parameter	Units	Construction	Operations
Kg of Explosive used	kg/blast	1,57,500	81,920
Number of Blasts per Day	per day	1	0.43
CO_2 Emission Factor	tonne CO2/tonne Explosive	0.189	0.189
CO_2 from Blasting	tonne/day	29.8	6.6
	kt/year	10.9	2.4

Closure

Closure activities will result in emissions of GHGs through fuel consumption and energy usage during site rehabilitation and infrastructure removal. No explicit predictions of GHG emissions during closure have been calculated, but it is expected that emissions over this initial period of site rehabilitation will be less than those associated with construction emissions or, at the very least, on the order of the lower range of those predicted for the site preparation and construction phase. Based on this assumption, the incremental contribution to provincial and federal GHG emissions totals would be less than 0.01% and 0.003%, respectively.

Determination of Significance

The GHG emissions from the Project are small in comparison to provincial or national emission rates; nevertheless, they represent an incremental increase in GHG emissions and, therefore, can be considered as a Project residual effect.

Overall, with mitigation and environmental protection measures to be implemented, residual effects on GHG emissions are predicted to be **not significant.** With respect to the criteria by which the significance of the Project residual effect is characterized, the following is noted: the direction is adverse - the Project will cause an increase in GHG emissions; the magnitude is low – the Project contribution is small in comparison to provincial and national emissions; the geographical extent is high – GHGs are a global phenomenon; the duration is medium – GHG emissions will occur in each Project phase; the frequency is medium – GHG emissions will occur intermittently depending on construction/active closure activities and schedule; the reversibility is high – GHG emissions will cease when the Project has been completed; and, ecological/societal value is high because of the overall importance upon which society places on GHGs and, by extension, climate change.

6.2.1.6.3 Change in Ambient Light Levels

Analytical Assessment Techniques

Potential Project-related effects associated with ambient light were qualitatively assessed by analyzing sight lines from the SSA to potential nearby receptors (i.e., the Town of Marathon, developments along Highway 17, and cottages on Hare Lake) in order to determine light trespass (brightening of adjacent areas). As described in Section 6.2.1.1.6 of the original EIS (2012) and in the response to IR10.3 (CIAR #423), topography, vegetation cover, and distance from the SSA were considered when determining potential for ambient light to affect these receptors. Other land uses near the receptors were also considered when determining the potential effect of ambient light.

Project Pathways

Light trespass or light spill is the light that is emitted by a facility and received at a property where it may disturb sleep by shining in windows, cause harsh and objectionable outdoor illumination, and potentially compromise security by imposing a light distribution that may negatively affect visibility. This type of effect is best avoided by using full cutoff fixtures that direct light toward work areas as required. The full cutoff fixture will avoid the transmission of light outside of the property.

Glare is a familiar problem that results from exposed and poorly directed lights such as the bright headlights in oncoming traffic. Paradoxically, glare, an excess of light, impairs vision in those affected, with consequent impairment of safety and security, in addition to the degradation of aesthetics. Glare may be reduced by the use of appropriate lighting fixtures, an efficient site lighting design, and operational measures that reduce excessive and energy-wasteful illumination.

Sky glow is the result of illumination that is directed upward, typically as a result of the use of lighting that has significant upward directivity, or is omnidirectional, such as “bare bulbs”. The sky glow reduces the aesthetic quality of the night sky, making it impossible under some situations to observe stars or features of the night sky. This upward lighting may also affect the navigational ability of birds. Sky glow is greatly reduced through the use of full horizontal cutoff fixtures, and other design and operational measures to minimize the use of excessive lighting.

During site preparation and construction, portable lighting units may be used during site preparation and construction to ensure a safe work site. Mobile construction and mining equipment operating at night will have headlights, marker lights and work lights. Light from this equipment has the potential to shine toward receptors or into the night sky. Construction and site preparations activities are planned to be conducted for two shifts a day (7 days a week).

During the operations phase, lighting will be required to ensure safe work areas at the open pits, haul routes and at the Process Plant. Similar to the site preparation and construction phase, portable lights will be employed, and mobile equipment will have appropriate lighting systems. Operations will proceed on a 24 hour per day basis. Perimeter lighting may also be required on mine buildings (e.g., the Process Plant, fuel farm, administration and services building).

Light pollution can adversely affect surrounding wildlife. Changes in ambient light levels in the SSA and adjacent LSA are expected to primarily affect wildlife behaviour and may consist of attracting specific species or repelling others, increasing the incidence of bird mortality through strikes, and changing photosensitive biorhythms (see Chapter 6.2.7 of this EIS Addendum).

During the active portion of the closure phase, Project-related light levels will be similar to those during site preparation and construction.

Mitigation and Enhancement Measures

The following mitigation measures are proposed to avoid or reduce Project-related effects on ambient light:

- Optimization of lighting design to reduce the total amount of lighting needed
- The use of directional lighting fixtures outfitted with shields to minimize sideways and upward light leakage

- Mounting of light fixtures as low as possible

Project Residual Effect

Given the Project location within an undeveloped area, the Project is expected to contribute to an increase in ambient light levels through sky glow (brightening of the sky). As stated in Section 6.2.1.1.6 of the original EIS (2012), ambient light from the SSA will not be visible from the Town of Marathon as there is no direct line of sight. As stated in response to IR10.3 (CIAR #423), there will be negligible effect from Project-related light to the cottages on Hare Lake and properties along Highway 17. Cottages on Hare Lake and the properties along Highway 17 will be screened from the SSA by existing vegetation and terrain changes. The properties along Highway 17 already experience some periodic elevated light levels associated with highway traffic, airport operations and lighting at businesses located along the highway. Mitigation measures will be employed to reduce the amount of light leakage sideways and upwards, further reducing potential for light trespass to affect these properties. A residual adverse effect for light is characterized as having low magnitude, low geographic extent, medium duration, medium frequency, negligible reversibility, and negligible ecological or societal value.

With mitigation, residual effects from light are generally not considered to be of concern to wildlife as lighting will be restricted to developed areas of the site where wildlife activity is likely to be low. Existing development immediately south of the Project along Highway 17 (e.g., hotels, gas stations, airport) and the Town of Marathon are much greater sources of light pollution.

Determination of Significance

As noted above, the significance threshold for light is defined as an increase in Project-related light emissions such that light levels would result in material light trespass for adjacent areas/receptors. Within this context and in consideration of proposed mitigation and environmental protection measures, residual Project effects associated with light are predicted to be **not significant**. This characterization is primarily in recognition of the low magnitude and geographic extent of the residual effect.

This conclusion is consistent with the original EIS (2012).

6.2.1.7 Prediction Confidence

For the air quality modelling, prediction confidence is high and the results are expected to be conservative. The effects of Project releases of air CoPCs are based on calculated emission rates and the AERMOD dispersion model. 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. Emissions were estimated based on maximum operating levels for each Project phase assessed. Emissions from the Project generally represent a conservative, worst-case short-term emissions approach (e.g., based on MECP guidelines) which is expected to over-estimate longer-term averaging periods.

Air quality dispersion models such as AERMOD also use assumptions to simplify the random behaviour of the atmosphere into short periods of average behaviour. These assumptions limit the capability of the model to replicate every individual 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 (e.g., to be conservative under most conditions).

For GHG emissions, prediction confidence is high and the results are expected to be conservative. GHG emissions were estimated using equipment power ratings and expected daily usage rates, assuming that the equipment had no GHG emissions reduction controls or mitigation applied, and followed the Canada Greenhouse Gas Quantification Requirements (2019 Requirements).

For lighting, prediction confidence is high. As described, though some light spill will occur, natural sight lines and screening by natural topography and forested areas will limit interaction with potential receptors.

6.2.1.8 Summary of Project Residual Effects

A summary of residual environmental effects on atmospheric environment that are likely to occur as a result of the Project is provided in Table 6.2.1-15.

Table 6.2.1-15: Project Residual Effects on Atmospheric Environment

Residual Effect	Residual Effects Characterization									
	Project Phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological/ Societal Value	Significance Determination
Change in Air Quality and Dustfall	C, O, D	A	M-H	M	NS	M	N-L	N	L	NS
Change in Greenhouse Gases	C, O, D	A	L	H	NS	M	M	H	H	NS
Change in Ambient Light	C, O, D	A	L	L	A	M	M	N	N	NS

KEY

See Section 2.5 of the EIS Addendum (Vol 1) and Table 6.2.1-2 for detailed definitions

Project Phase:
C: Site Preparation / Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse

Geographic Extent:
N: Negligible
L: Low
M: Medium
H: High

Timing:
A: Applicable
NA: Not applicable

Duration:
N: Negligible

Frequency:
N: Negligible
L: Low
M: Medium
H: High

Reversibility:
N: Negligible
L: Low
M: Medium
H: High

Table 6.2.1-15: Project Residual Effects on Atmospheric Environment

Residual Effect	Residual Effects Characterization									
	Project Phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological/ Societal Value	Significance Determination
Magnitude: N: Negligible L: Low M: Medium H: High N/A: Not applicable	L: Low M: Medium H: High **Significance Determination** S: Significant NS: Not Significant						**Ecological / Societal Value:** N: Negligible L: Low M: Medium H: High			
Note: Timing was not included in the original EIS.										

6.2.1.9 References

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