APPENDIX 7B

AIR EMISSION DETAILS

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DOMINION DIAMOND

Tables

Abbreviations

Abbreviation	Definition
ANFO	ammonium nitrate and fuel oil
CAC	Criteria Air Contaminants
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2E	carbon dioxide equivalent
CPK	coarse processed kimberlite
Diavik Mine	Diavik Diamond Mine
Dominion Diamond	Dominion Diamond Ekati Corporation
e.g.	for example
Ekati Mine	Ekati Diamond Mine
GHG	greenhouse gas
NO_x	nitrogen oxides
N_2O	nitrous oxide
NWT	Northwest Territories
PAH	polycyclic aromatic hydrocarbons
PK	processed kimberlite
PM	particulate matter
PM_{10}	particulate matter with a mean aerodynamic diameter of 10 microns or smaller
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 microns or smaller
Project	Jay Project
RSA	regional study area
SO_2	sulphur dioxide
TCWR	Tibbitt-to-Contwoyto Winter Road
TSP	total suspended particulate
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WRSA	waste rock storage area

Units of Measure

Unit	Definition
%	percent
<	less than
>	greater than
°	degrees
µm	microns
$cm^2/\mu m^2$	square centimetre per square micron
g/cm^3	grams per cubic centimetre
g/cm/s	grams per centimetre per second
g/m^2	grams per square metre
$g/m^2/y$	grams per square metres per year
kg/blast hole	kilograms per blast hole
kg/ha/y	kilograms per hectare per year
kg/hole	kilograms per hole
kg/hr	kilograms per hour
kg/VKT	kilograms per vehicle kilometre travelled
km	kilometre
km/hr	kilometres per hour
kt	kilotonnes
kW[e]	kilowatts electrical
lb/VMT	pounds per vehicle miles travelled
m	metre
m^2	square metres
m^3	cubic metres
m/s	metres per second
m/s^2	metres per square second
ppmw	parts per million by weight

7B1 INTRODUCTION

This appendix provides information on the Jay Project (Project) emissions and regional emissions considered in the air quality assessment. The objective of this appendix is to identify and document the basis for the air emissions information used in the assessment.

7B2 SUMMARY OF PROJECT AND REGIONAL EMISSIONS

The proposed Dominion Diamond Ekati Corporation (Dominion Diamond) Jay Project is located approximately 26 kilometres (km) southeast of the Ekati Diamond Mine (Ekati Mine). The only other development in the regional study area (RSA) is the Diavik Diamond Mine (Diavik Mine), which is located approximately 15 km southwest of the Project.

The air quality modelling assessment included the following emission scenarios:

- Base Case, which includes projected emissions from the Ekati Mine in 2015, the last year before Project construction activities begin, and the Diavik Mine emissions.
- Application Case, which includes the emissions from the Ekati Mine and Diavik Mine in combination with the maximum Project emissions during the operation phase of the Project. The mining of the Jay Pit will utilize the existing infrastructure at the Ekati Mine and will extend the life of the Ekati Mine by 10 or more years.
- Construction Case, which includes the emissions from the Ekati Mine and Diavik Mine in combination with the maximum Project emissions during the construction phase of the Project.

Criteria air contaminants (CAC) include sulphur dioxide gas (SO_2), nitrogen oxides (NO_X), carbon dioxide (CO), particulate matter (PM) with particle diameter less than 2.5 microns (µm; $PM_{2.5}$), particulate matter with particle diameter less than 10 µm (PM_{10}), and total suspended particulate (TSP). The emissions for SO_2, NO_X, CO, $PM_{2.5}$, PM_{10}, and TSP from the Project, Ekati Mine, and Diavik Mine in the three emission scenarios is summarized in Table 7B2-1. Volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), trace metals, and dioxin and furan (Non-CAC) emissions are presented in Table 7B2-2.

Table 7B2-1 Summary of Project and Regional Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Base Case						
2015 Ekati Mine	2.900	3,585.6	1,143.4	213.8	1,159.7	3,362.5
Diavik Mine	8.596	6,683.0	2,042.4	346.6	447.9	729.8
Total	**11.496**	**10,268.6**	**3,185.8**	**560.4**	**1607.6**	**4092.3**
Application Case						
Ekati Mine and Jay Project – Operation	4.246	4,707.2	1,823.0	326.2	1,510.0	4,159.3
Diavik Mine	8.596	6,683.0	2,042.4	346.6	447.9	729.8

Table 7B2-1 Summary of Project and Regional Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Total	**12.842**	**11,390.2**	**3,865.4**	**672.8**	**1,957.9**	**4,889.1**
Construction Case						
Ekati Mine and Jay Project – Construction	3.014	3,646.1	1,167.4	347.5	2,510.7	6,443.4
Diavik Mine	8.596	6,683.0	2,042.4	346.6	447.9	729.8
Total	**11.61**	**10,329.1**	**3,209.8**	**694.1**	**2,958.6**	**7,173.2**

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 microns or smaller; PM_{10} = particulate matter with a mean aerodynamic diameter of 10 microns or smaller; TSP = total suspended particulates.

Table 7B2-2 Summary of Project and Regional Non- Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)			
	VOC	PAH	Metals	Dioxins/Furans
Base Case				
2015 Ekati Mine(a)	135.1	0.314	262.8	2.31E-08
Diavik Mine	434.7	19.417	223.9	2.31E-08
Total	**569.8**	**19.731**	**486.7**	**4.62E-08**
Application Case				
Ekati Mine and Jay Project – Operation(a)	247.2	0.581	321.9	2.31E-08
Diavik Mine	434.7	19.417	223.9	2.31E-08
Total	**681.9**	**19.998**	**545.8**	**4.62E-08**
Construction Case				
Ekati Mine and Jay Project – Construction	138.9	0.337	323.9	2.31E-08
Diavik Mine	434.7	19.417	223.9	2.31E-08
Total	**573.6**	**19.754**	**547.8**	**4.62E-08**

a) Emissions include winter road emissions.
t/y = tonnes per year; VOC = volatile organic compound; PAH = polycyclic aromatic hydrocarbons.
— = no emissions.

The information in the following sections describes the detailed emission estimation approaches used for the Project, the Ekati Mine, and the Diavik Mine.

7B3 EKATI MINE AND PROJECT EMISSIONS

Air emissions at the Ekati Mine and the Project were estimated for the following five categories:

- emissions associated with mining activities such as blasting, loading/unloading, dozing, and operation of mining equipment;
- emissions associated with processing activities at the Ekati plant such as crushing;

- emissions associated with utility operation of the Ekati Mine and Project such as electricity generation by diesel generators, waste incineration, and space heating;
- emissions created by wind interacting with surface areas prone to erosion such as ore stockpiles, waste rock storage areas, and dry lake beds; and,
- emissions created by vehicle travel on the Tibbitt-to-Contwoyto Winter Road (TCWR).

The Ekati Mine emissions in the Base Case represent the emissions associated with the mining activities projected in 2015, the last year before the construction of the Jay Project is expected to begin. In 2015, there will be mining activities at the Misery Pit, the Pigeon Pit, the Lynx Pit, and the Koala Underground Mine.

In the Application Case, the mining emissions associated with these mining areas were replaced with the maximum mine emissions for the Jay Pit operation. The emissions associated with the Ekati plant and utility operation in the Application Case were assumed to remain unchanged from those in the Base Case.

For the purpose of this assessment, the Ekati Mine and Project emission sources were grouped into the following categories:

- Stack Emissions: includes power generators, diesel boilers, waste incinerators, fresh air raises, and heaters;
- Mine Fleet Exhaust Emissions: includes the mobile and portable diesel combustion equipment at the Ekati Mine;
- Fugitive Particulate Emissions: includes mining and material handling activities that result in fugitive dust emissions;
- Road Dust: emissions caused by vehicle travel on roads;
- Wind erosion: erosion, transportation, and deposition of particulate matter and metals by the wind;
- Exposed Lakebed: emissions created by wind on the exposed lakebed of Lac du Sauvage during the operational phase of the Project; and,
- Winter Access Road: emissions related to vehicle travel on the TCWR.

The following sections describe the supporting data used in the Ekati Mine, the Project construction phase, and Project operation phase emission calculations, and the methodologies for calculating emissions for each emission source.

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7B3.1 Supporting Data Used in Emission Calculations

7B3.1.1 Material Balance

Before the Ekati Mine and Project emissions were calculated, the quantity and distribution of the overburden, mine rock, kimberlite, and coarse processed kimberlite (PK) were reviewed to determine the most appropriate basis for each emission calculation. The production rates of overburden, kimberlite, coarse PK, and waste rock during the Base Case, Construction Case, and Application Case are outlined in Table 7B3.1-1.

Table 7B3.1-1 Material Production

Assessment Case	Overburden (t/y)	Kimberlite (t/y)	Waste Rock (t/y)	Coarse Processed Kimberlite (t/y)
Base Case	0	2,927,000	20,752,000	8,018,859
Construction Case	0	2,927,000	28,633,983	8,018,859
Application Case	0	4,544,997	28,476,537	2,893,559

t/y = tonnes per year.

7B3.1.2 Moisture Content

The estimated moisture and silt content for each type of material is summarized in Table 7B3.1-2. Coarse PK and kimberlite were assumed to have the same moisture content and silt content. The overburden, waste rock, and kimberlite moisture content values used in the emission calculations were 17.5 percent (%), 5%, and 10%, respectively.

Silt content is the fraction of silt, particles smaller than 75 µm in diameter, in a specific type of material. The silt content of the overburden was obtained from Table 13.2.4-1 in the United States Environmental Protection Agency (USEPA) Compilation of Air Pollutant Emission Factors: AP-42 (USEPA 2006a) due to a lack of site-specific silt data. Various types of material (e.g., coal, sand, clay) and their respective silt contents are listed in the USEPA AP-42's Table 13.2.4-1. The silt content for the kimberlite and coarse PK were assumed to be similar to the silt content of crushed limestone. Waste rock was estimated to have an average silt content of 7.5%. The haul roads will be surfaced with crushed waste rock; therefore, the silt content of the haul roads would be the same as the value selected for the waste rock.

Table 7B3.1-2 Moisture and Silt Content

	Overburden	Waste Rock	Kimberlite	Coarse PK
Moisture Content (%)	17.5	5	10	10
Silt Content (%)	7.5	7.5	1.6	1.6

PK = processed kimberlite; % = percent.

7B3.1.3 Metal Composition of Mine Rock and Kimberlite

The majority of the metal emissions from the Project originate from waste rock and kimberlite dust released during mining and transport operations. Metal emissions from the combustion sources are negligible in comparison to metal fractions in the fugitive particulate emissions. The waste rock and kimberlite metal compositions used in the emission calculations were based on geochemistry data for the Project. The average metal compositions for waste rock and kimberlite that were used in the air quality assessment are detailed in Table 7B3.1-3.

Table 7B3.1-3 Waste Rock and Kimberlite Composition

Composition in Weight Fraction	Waste Rock Weight Fraction	Kimberlite Weight Fraction
aluminum	0.06380	0.01804
antimony	0.00000	0.00000
arsenic	0.00001	0.00001
barium	0.00052	0.00129
beryllium	0.00000	0.00000
cadmium	0.00000	0.00000
cesium	—	—
cerium	—	—
chromium	0.00016	0.00095
cobalt	0.00001	0.00006
copper	0.00002	0.00004
iron	0.01512	0.04059
lead	0.00002	0.00001
lithium	—	—
manganese	0.00023	0.00084
mercury	0.00000	0.00001
molybdenum	0.00000	0.00000
nickel	0.00002	0.00116
rubidium	—	—
selenium	0.00000	0.00000
silver	0.00000	0.00000
strontium	0.00034	0.00069
tellurium	0.00000	0.00000
thallium	0.00000	0.00000
tin	—	—
titanium	0.00139	0.00132
tungsten	0.00000	0.00000
uranium	0.00001	0.00000
vanadium	0.00003	0.00007
zinc	0.00005	0.00005

— = Not applicable.

7B3.2 Base Case Ekati Mine Emissions

The emission profile for the Ekati Mine varies from year to year depending on the specific mining activities for a given year and the pit(s) being mined in a given year. The Ekati Mine emission profile selected for the Base Case was chosen to reflect the operations at the Ekati Mine in Year 2015, the year before the construction of the proposed Project is to start.

7B3.2.1 Stack Emissions

7B3.2.1.1 Power Generators

The Ekati plant uses seven 4,400 kilowatts electrical (kW[e]) prime-rated diesel-fired power generators to provide the electricity requirements. One of the seven generators is assumed to be offline for maintenance at any given time. The generator emissions were estimated based on the following assumptions and methods:

- SO_2 emission rates were calculated based on a maximum fuel input rate and a sulphur content of 15 parts per million by weight (ppmw) in diesel.
- NO_X, CO, particulate matter (PM) , VOC, PAH, and trace metal emission rates were calculated based on the maximum fuel input rates and emission factors from USEPA Compilation of Air Pollutant Emission Factors, or commonly referred as AP-42, Section 3.4 (USEPA 1996a).
- Greenhouse gas (GHG) emission rates were estimated based on the maximum fuel input rates and emission factors from the Environment Canada *National Inventory Report: 1990-2011, Greenhouse Gas Sources and Sinks in Canada* (Environment Canada 2013).

The CAC emissions from the power generators are summarized in Table 7B3.2-1. The VOC, PAH, and trace metal emissions from the generators are listed in Table 7B3.2-2. The stack parameters for the power generators are summarized in Table 7B3.2-3. The GHG emissions associated with generators are presented in Section 7B3.5.

Table 7B3.2-1 Base Case Power Generation Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Diesel generator 1	0.240	495.0	131.6	8.608	8.872	10.791
Diesel generator 2	0.240	495.0	131.6	8.608	8.872	10.791
Diesel generator 3	0.240	495.0	131.6	8.608	8.872	10.791
Diesel generator 4	0.240	495.0	131.6	8.608	8.872	10.791
Diesel generator 5	0.240	495.0	131.6	8.608	8.872	10.791
Diesel generator 6	0.240	495.0	131.6	8.608	8.872	10.791
Total	**1.442**	**2972.7**	**789.6**	**51.650**	**53.229**	**64.748**

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm ;PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulates.

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Table 7B3.2-2 Base Case Power Generation Non Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)		
	VOC	PAH	Metals
Diesel generator 1	12.680	0.033	0.035
Diesel generator 2	12.680	0.033	0.035
Diesel generator 3	12.680	0.033	0.035
Diesel generator 4	12.680	0.033	0.035
Diesel generator 5	12.680	0.033	0.035
Diesel generator 6	12.680	0.033	0.035
Total	**76.082**	**0.197**	**0.207**

t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

Table 7B3.2-3 Power Generation Stack Parameters

Source	Coordinates[a]		Elevation (m)	Stack height (m)	Diameter (m)	Velocity (m/s)	Temperature (K)
	Northing (m)	Easting (m)					
Diesel generator 1	518,087	7,176,555	466.80	36.15	0.86	28.672	657
Diesel generator 2	518,087	7,176,549	466.82	36.15	0.86	28.672	657
Diesel generator 3	518,087	7,176,543	466.78	36.15	0.86	28.672	657
Diesel generator 4	518,087	7,176,537	466.79	36.15	0.86	28.672	657
Diesel generator 5	518,087	7,176,532	466.74	36.15	0.86	28.672	657
Diesel generator 6	518,087	7,176,525	466.57	36.15	0.86	28.672	657

a) Universal Transverse Mercator North American Datum 83 Zone 12W.
m = metre, m/s = metres per second, K= degrees kelvin.

7B3.2.1.2 Boilers

Heating required by the Ekati Mine is provided primarily by diesel-fired boilers and heaters. The emissions from the boiler and heaters were estimated based on the following assumptions and methods:

- SO_2 emissions were calculated based on the maximum fuel input rate and a diesel sulphur content of 15 ppmw.
- NO_X, CO, PM, VOC, PAH, and trace metal emission rates were calculated based on the maximum fuel input rate and emission factors from USEPA AP-42, Section 1.3 (USEPA 2010).
- Greenhouse gas emission rates were estimated based on the maximum fuel input rate and emission factors from the Environment Canada *National Inventory Report: 1990-2011, Greenhouse Gas Sources and Sinks in Canada* (Environment Canada 2013).

The CAC emissions from the boilers and heaters are summarized in Table 7B3.2-4. The VOC, PAH, and trace metal emissions associated with the boiler are listed in Table 7B3.2-5. The stack parameters for the boilers are summarized in Table 7B3.2-6.

Table 7B3.2-4 Base Case Boiler Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Koala area FAR1	0.091	8.595	2.149	0.666	0.988	1.418
Koala area FAR2	0.091	8.595	2.149	0.666	0.988	1.418
Ekati area	0.043	4.040	1.010	0.313	0.465	0.667
Polar area	0.015	1.412	0.353	0.109	0.162	0.233
Misery area	0.021	1.975	0.494	0.153	0.227	0.326
Portable	0.002	0.209	0.052	0.016	0.024	0.034
Total	**0.264**	**24.826**	**6.206**	**1.924**	**2.855**	**4.096**

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulates.

Table 7B3.2-5 Base Case Boiler Non Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)			
	VOC	PAH	Dioxins/Furans	Metals
Koala area FAR1	0.086	5.117E-04	—	0.004
Koala area FAR2	0.086	5.117E-04	—	0.004
Ekati area	0.040	2.405E-04	—	0.002
Polar area	0.014	8.404E-05	—	0.001
Misery area	0.020	1.176E-04	—	0.001
Portable[(a)]	0.002	1.243E-05	—	0.000
Total	**0.248**	**1.478E-03**	**—**	**0.010**

a) For modelling, portable sources were included with the Ekati area emissions because they were very small sources and located in many different areas.

— = no emission factor for this source; t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

Table 7B3.2-6 Boiler Stack Parameters

Source	Coordinates[a]		Elevation (m)	Stack height (m)	Diameter (m)	Velocity (m/s)	Temperature (K)
	Northing (m)	Northing (m)					
Koala area FAR1	518,758	7,177,305	466.99	10	0.305	0.003	673.2
Koala area FAR2	518,904	7,177,277	456.79	10	0.305	0.003	673.2
Ekati area[b]	518,018	7,176,349	459.14	16.6	0.508	3.591	430
Polar area	516,359	7,176,435	469.94	16.6	0.508	1.974	430
Misery area	539,656	7,161,058	455.82	16.6	0.508	1.002	430
Portable[b]	—	—	—	—	—	—	—

a) Universal Transverse Mercator North American Datum 83 Zone 12W.

b) For Modelling, small portable emission sources such as light plants were included with the Ekati area emissions areas as their locations are indeterminate.

m = metre; m/s = metres per second, K= degrees kelvin.

7B3.2.1.3 Waste Incinerators

Solid waste other than mine waste that is collected at the Ekati Mine is segregated based on its suitability to be burned in an on-site waste incinerators. Certain types of waste, such as sewage sludge, will not be incinerated. The incinerator emissions were calculated based on the following assumptions and methods:

- Two incinerators on site operating at 12 hours a day, 365 days a year.
- SO_2, NO_X, CO, PM, and VOCs were calculated based on the average amount of waste incinerated at the Ekati Mine in 2013, and emission factors from USEPA AP-42, Tables 2.1-9 and 2.1 12 (USEPA 1996b).
- Dioxin and furan emission rates were calculated based on USEPA AP-42 Table 1.3-9 emission factors.
- Waste incinerator metal emissions were calculated using modular starved air combustion for a waste incinerator using USEPA AP42 Table 2.1-9.
- PAH emission rates were calculated based on stack test data, and the average amount of waste incinerated in 2013.

The incinerator CAC emissions are summarized in Table 7B3.2-7. The VOC, PAH, trace metal, dioxin and furan incinerator emissions are listed in Table 7B3.2-8. The stack parameters for the waste incinerators are summarized in Table 7B3.2-9.

Table 7B3.2-7 Incinerator Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
South incinerator	0.265	0.261	0.824	0.577	0.577	0.577
North incinerator	0.263	0.258	0.817	0.572	0.572	0.572
Total	**0.529**	**0.519**	**1.642**	**1.149**	**1.149**	**1.149**

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 microns or smaller; PM_{10} = particulate matter with a mean aerodynamic diameter of 10 microns or smaller.

Table 7B3.2-8 Incinerator Non Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)			
	VOC	PAH (stack data)	Metals	Dioxins/Furans
South incinerator	0.247	1.588E-04	1.442E-03	1.156E-08
North incinerator	0.245	8.742E-05	1.429E-03	1.156E-08
Total	**0.492**	**2.462E-04**	**2.871E-03**	**2.312E-08**

t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

Table 7B3.2-9 Incinerator Stack Parameters

Source	X (m)[(a)]	Y (m)[(a)]	Elevation (m)	Stack height (m)	Diameter (m)	Velocity (m/s)	Temperature (K)
South incinerator	515,567	7,177,303	467.07	8.839	0.2032	9.8	352.4
North incinerator	515,568	7,177,317	467.13	8.839	0.2032	10.6	346.9

a) Universal Transverse Mercator North American Datum 83 Zone 12W.

m = metre; m/s = metres per second, K = degrees kelvin.

7B3.2.2 Mine Fleet Exhaust Emissions

Emissions from the mine vehicle exhaust were calculated using the methodology from the NONROAD emission model (USEPA 2004a, 2005). The NONROAD emission model was created by the USEPA to assist state and local regulatory agencies in the development of accurate emission inventories for off-road diesel engines. The NONROAD model estimates emission rates for single off-road diesel engines based on the following equation:

Vehicle Emissions = Engine Horsepower × Zero-Hour, Steady-State Emission Factor × Gross Operating Hours × Load Factor × Transient Adjustment Factor × Deterioration Factor

The NONROAD model includes several key elements. First, an inventory of steady-state emission factors is developed for off-road diesel engines with various horsepower ranges. The emission factors represent the emissions from brand new engines under steady-state operation. These emission factors are also called zero-hour, steady-state emission factors. Second, the NONROAD model includes load factors accounting for the fact that the engines do not operate constantly at their maximum rated horsepower in real world applications. Lastly, the NONROAD model incorporates the emission profile for engines during transient operating conditions and takes into consideration the deterioration of engine performance over time.

The mine uses a large variety of equipment. A list of the key and large diesel-combustion mining equipment for the 2015 Ekati Mine is provided in Table 7B3.2-10. The majority of the existing mine equipment has pre-tier engines. Therefore, all engines were assumed to be pre-tier engines. The zero-hour, steady-state emission factors from the NONROAD model are summarized in Table 7B3.2-11. The transient adjustment factors and deterioration factors from the NONROAD model are presented in Table 7B3.2-12. The load factors from the NONROAD methods are listed in Table 7B3.2-13.

Table 7B3.2-10 2015 Ekati Mine Partial Mine Vehicle List

Vehicle	Horsepower
Dozer, Cat D10	646
Drill	1,180
Grader	275
Haul Truck, Cat 777D	1,000
Haul Truck, Cat 777F	1,016
Haul Truck, Cat Haul Max	787
Loader	555
Scooptram	353
Truck, Haul, UG, Cat/Elphinestone AD45	589
Truck, Pick-up, Ford F-350 Crewcab 4x4	400
Truck, Getman	220
Truck, Toyota	128

Table 7B3.2-11 Zero-Hour, Steady-State Emission Factors for Pre-Tier (Pre-1996) NONROAD Diesel Engines

Engine Size	Zero-Hour, Steady-State Emission Factors (g/bhp-h)		
	NO_X	CO	PM_{10}
16 to 25 bhp	8.5	5	0.9
25 to 50 bhp	6.9	5	0.8
50 to 75 bhp	8.3	3.49	0.722
75 to 100 bhp	8.3	3.49	0.722
100 to 175 bhp	8.38	2.7	0.402

Table 7B3.2-11 Zero-Hour, Steady-State Emission Factors for Pre-Tier (Pre-1996) NONROAD Diesel Engines

Engine Size	Zero-Hour, Steady-State Emission Factors (g/bhp-h)		
	NO_X	CO	PM_{10}
175 to 300 bhp	8.38	2.7	0.402
300 to 600 bhp	8.38	2.7	0.402
600 to 750 bhp	8.38	2.7	0.402
>750 bhp	8.38	2.7	0.402

Source: USEPA NONROAD Methods (USEPA 2004a, 2005).

NO_X = nitrogen oxides; CO = carbon dioxide; PM_{10} = particulate matter with particle diameter less than 10 μm; g/bhp-h = grams per brake horse power per hour; bhp = brake horse power; > = greater than.

Table 7B3.2-12 Transient Adjustment and Deterioration Factors for Pre-Tier NONROAD Diesel Engines

Category of Vehicle	Transient Adjustment Factors (g/hp-hr)		
	NO_X	CO	PM
Crawler Dozer	0.95	1.53	1.23
Rubber-tired Loader	0.95	1.53	1.23
Excavator	0.95	1.53	1.23
Backhoe Loader	1.10	2.57	1.97
Deterioration Factors[(a)]	0.024	0.185	0.473

Source: USEPA NONROAD Methods (USEPA 2004a, 2005).

a) Engines are assumed to be at the end of their median life to have conservative deterioration factors in calculations.

NO_X = nitrogen oxide; CO = carbon monoxide; PM = particulate matter.

Table 7B3.2-13 Load Factors for NONROAD Diesel Engines

Category of Vehicle	Load Factor
Crawler Dozer	0.58
Rubber-tired Loader	0.48
Excavator	0.53
Backhoe Loader	0.21
None	0.43

Source: USEPA NONROAD Methods (USEPA 2004a, 2005).

In addition to the NONROAD model methodology, the following assumptions were made in the emission calculations:

- Existing mining equipment were assumed to meet USEPA Pre-Tier emission standards for nonroad diesel engines (USEPA 1998a). These emission standards have been adopted by Canada.
- Sulphur content in diesel was assumed to be 15 ppmw.
- PAH emissions were calculated based on diesel consumption rates and emission factors from the *Technical Reference for the Meteorology, Emissions and Ambient Air Quality in the Athabasca Oil Sands Region* (Golder and Conor Pacific 1998).
- GHG emissions were estimated based on maximum fuel input rates and emission factors from the Environment Canada *National Inventory Report: 1990-2011, Greenhouse Gas Sources and Sinks in Canada* (Environment Canada 2013).

Maximum CAC emissions associated with the mine vehicle exhaust are summarized in Table 7B3.2-14. The VOC, PAH, and trace metal emission rates from the mine vehicle exhaust are provided in Table 7B3.2-15.

Table 7B3.2-14 Base Case Mine Equipment Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Mine equipment	0.661	586.7	345.5	44.5	45.4	42.9

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulates.

Table 7B3.2-15 Base Case Mine Equipment Non Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)		
	VOC	PAH	Metals
Mine equipment	58.2	0.116	0.225

t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

7B3.2.3 Fugitive Particulate Emissions

7B3.2.3.1 Drilling and Blasting Operations

Emissions from drilling were calculated using a TSP emission factor of 0.59 kilograms per hole (kg/hole) from AP-42, Table 11.9-4 (USEPA 1998b). The number of holes drilled per blast were calculated based on waste rock and kimberlite production rates and assumed one blast per day. The approximate number of holes drilled per blast at each pit is provided in Table 7B3.2-16.

Table 7B3.2-16 Base Case Drill Holes

Source	Number of holes drilled per blast
Misery Open Pit	42.46
Lynx Open Pit	0.26
Pigeon Open Pit	21.90
Koala Underground	3.69

Two types of emissions are typically generated from blasting. The detonation of the explosives and the associated chemical reactions will result in emissions of compounds such as SO_2, NO_X, and CO. The explosion will also generate fugitive particulate emissions.

The emission volumes generated by the detonation of the explosives were estimated based on the amount and the type of the explosives that will be used. Ammonia nitrate mixed with fuel oil (ANFO) and emulsion were used onsite for blasting.

The estimated amount of ANFO, based on 2013 explosive usage, that will be consumed per blast hole is 420.9 kilograms per blast hole (kg/blast hole) for open pits, and 340.35 kg/blast hole for underground detonation. The emission factors for the detonation of ANFO was from AP-42, Table 13.3 (USEPA 1980) were used in the emission calculations. The estimated quantity of emulsion that will be consumed per blast hole 152.07 kg/blast hole for open pits, and 316.69 kg/blast hole for underground detonations. The emission factors for the detonation of emulsion from Australia NPI (2012) were used in the emission calculations.

The fugitive particulate emissions resulting from blasting were calculated using the equations taken from AP-42, Table 11.9-2 (USEPA 1998a):

$$TSP\ EF = 0.00022(A)^{1.5}$$

$$PM_{10}\ EF = 0.52 \times TSP\ EF$$

$$PM_{2.5}\ EF = 0.03 \times TSP\ EF$$

Where:

EF = emission factor (kg/blast); and,

A = blasted mine area (square metre [m^2]).

The blasted mine area was calculated using the maximum total annual volume of kimberlite and waste rock mined (12,131,068 cubic metres [m^3]) divided by the depth of the blasted material (10 metres [m]), and the number of blasts per year. It was assumed that there will be approximately one blast per day for each pit during the operating years. The emissions associated with the drilling and blasting operations are summarized in Table 7B3.2-17 and 7B3.2-18.

Table 7B3.2-17 Base Case Drilling Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	**PM_{10}**	**TSP**	**Metals**
Misery Open Pit	0.056	0.355	0.543	0.044
Lynx Open Pit	0.000	0.002	0.003	0.000
Pigeon Open Pit	0.029	0.183	0.280	0.023
Koala Underground	0.005	0.032	0.069	0.006
Total	**0.091**	**0.573**	**0.895**	**0.073**

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

Table 7B3.2-18 Base Case Blasting Emissions

Source	Emission Rates (t/y)						
	SO_2	**NO_X**	**CO**	**$PM_{2.5}$**	**PM_{10}**	**TSP**	**Metals**
Misery Open Pit	0.002	0.012	0.054	0.020	0.323	0.449	0.037
Lynx Open Pit	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Pigeon Open Pit	0.001	0.006	0.028	0.007	0.120	0.166	0.014
Koala Underground	0.000	0.001	0.004	0.001	0.009	0.017	0.001
Total	**0.002**	**0.020**	**0.086**	**0.027**	**0.452**	**0.632**	**0.052**

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.2.3.2 Loading and Unloading Operations

Particulate emissions associated with loading and unloading the overburden, waste rock, kimberlite, and coarse PK were calculated based on the maximum annual production rates and emission estimation methodology described in AP 42, Section 13.2-4 (USEPA 2006b). The quantity of the particulate emissions per tonne of material being loaded or unloaded can be expressed by the following formula:

$$EF = k(0.0016)\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:

EF = emission factor (kilograms/tonne);

k = particle size-specific multiplier from AP-42, Section 13.2.4 (USEPA 2006b);

M = moisture content in percentage (%); and,

U = mean wind speed (metres per second [m/s]).

The mean wind speed used in the calculations was 4.21 m/s, which was calculated based on 2002 CALMET data. The moisture content used in the calculations are outlined in Table 7B3.1-2. The loading and unloading emissions are summarized in Table 7B3.2-19.

Table 7B3.2-19 Base Case Loading/Unloading Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Misery Pit	0.800	5.038	7.695	0.629
Misery WRSA	0.783	5.173	10.937	0.894
Ekati Stockpile	0.245	1.619	3.422	0.123
Ekati CPK Waste	0.123	0.809	1.711	0.062
Ekati WRSA	0.395	2.611	5.520	0.451
Pigeon Pit	0.406	2.559	3.909	0.319
Koala Underground	0.027	0.177	0.375	0.031
Lynx Pit	0.003	0.017	0.026	0.002
Total	**2.782**	**18.003**	**33.594**	**2.511**

WRSA = waste rock storage area; CPK = coarse processed kimberlite; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

7B3.2.3.3 Bulldozing Operations

The particulate emissions associated with bulldozing of overburden, waste rock, kimberlite, and coarse PK were estimated based on methodology described in AP-42, Section 11.9 (USEPA 1998b). The bulldozing emission factors are expressed as kilograms of particulate emissions per hour of dozer in operation based on the formulas provided in Table 7B3.2-20.

Table 7B3.2-20 Bulldozing Emission Factor Equations

Material	Emission Factor Equations
Coal (used for kimberlite, coarse processed kimberlite and waste rock)	$TSP\ EF = \frac{35.6\ (s)^{1.2}}{(M)^{1.3}}$ $PM_{15}\ EF = \frac{8.44\ (s)^{1.5}}{(M)^{1.4}}$ $PM_{10}\ EF = 0.75 \times PM_{15}\ EF$ $PM_{2.5}\ EF = 0.022 \times TSP\ EF$
Overburden	$TSP\ EF = \frac{2.6\ (s)^{1.2}}{(M)^{1.3}}$ $PM_{15}\ EF = \frac{0.45\ (s)^{1.5}}{(M)^{1.4}}$ $PM_{10}\ EF = 0.75 \times PM_{15}\ EF$ $PM_{2.5}\ EF = 0.105 \times TSP\ EF$

Where:

EF = emission factor (kilograms per hour [kg/hr]);
s = material silt content (%); and,
M = material moisture content (%).

The maximum annual operating hours for bulldozers is 10,084 hours. Material moisture and silt content were taken from Table 7B3.1-2. The bulldozing emission factors and emissions are summarized in Table 7B3.2-21.

Table 7B3.2-21 Base Case Bulldozing Emissions

Source	$PM_{2.5}$	PM_{10}	TSP	Metals
Overburden Emission Factor (kg/hr)	0.074	0.126	0.706	—
Kimberlite Emission Factor (kg/hr)	0.0696	0.510	3.136	—
Waste Rock Emission Factor (kg/hr)	1.08	13.66	49.30	—
All Bulldozers Emission Rates (t/y)	6.2	75.4	239.9	19.6

— = no emission factor for this source; kg/hr = kilograms per hour; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulates.

7B3.2.3.4 Grading Operations

Graders will be used to keep on-site haul roads in working condition. Particulate emissions from the haul road grading operations were estimated based on emission factors from Section 11.9 of AP-42 (USEPA 1998b). The emission factors are expressed by the following formulas:

$$TSP\ EF = 0.0034(S)^{2.5}$$

$$PM_{15}\ EF = 0.0056(S)^{2.0}$$

$$PM_{10}\ EF = 0.60 \times PM_{15}\ EF$$

$$PM_{2.5}\ EF = 0.031 \times TSP\ EF$$

Where:

EF = emission factor kilograms per vehicle kilometre travelled (kg/VKT); and,

S = mean vehicle speed (kilometres per hour [km/hr]).

The total distance the graders will travel was calculated based on grader 2013 gross operation hours of 11,899 hours, and an assumed grader mean speed of 11.4 km/hr from AP-42, Table 11.9-3 (USEPA 1998b). The grading emission factors and the grading emissions are presented in Table 7B3.2-22.

Table 7B3.2-22 Grading Emissions

Source	Emission Rates			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Emission Factor [kg/VKT]	0.046	0.437	1.492	—
All grader emissions (t/y)	5.9	9.9	20.2	1.7

— = no emission factor for this source; kg/VKT = kilograms per vehicle kilometre travelled; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulates.

7B3.2.3.5 Crushing, Screening, and Conveying Emissions

Crushing, screening, and conveying emissions were assumed to be unchanged from the *NWT Diamonds Project Environmental Impact Statement, Volume IV, Impacts and Mitigation* (BHP 1995). The $PM_{2.5}$ and PM_{10} emissions were scaled from TSP 2005 EIS Summary emissions using AP-42 Table 11.19.2-1 (USEPA 2004b) controlled emission factors. The crushing, screening, and conveying emissions are presented in Table 7B3.2-23.

Table 7B3.2-23 Base Case Crushing, Screening, and Conveying Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	**PM_{10}**	**TSP**	**Metals**
Primary Crusher	1.093	5.904	13.119	0.472
Reclaim Area	0.396	2.141	4.757	0.171
Processing Plant	3.648	19.697	43.772	1.574
Recovery plant	0.086	1.476	3.690	0.133
Total	**5.223**	**29.217**	**65.337**	**2.349**

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

7B3.2.4 Road Dust Emissions

Particulate emissions are expected to be generated when mining vehicles travel on the unpaved Project haul roads. The road dust emissions were estimated based on Section 13.2.2 of AP-42 (USEPA 2006c). The emission factor from AP-42 can be expressed by the following formula:

$$EF = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$

Where:

EF = emission factor in pounds (lb) per vehicle miles travelled (lb/VMT);

s = silt content of the unpaved road surface (percent [%]);

k, a, b = particulate matter size-specific constants from Section 13.2.2 of AP 42 (USEPA 2006c); and,

W = mean vehicle weight (ton).

The silt content of the haul road was assumed to be 7.5% in the calculations. The mean vehicle weights are shown in Table 7B3.2-24.

Table 7B3.2-24 Base Case Vehicle Weights

Vehicle Type	Mean Weight (tonnes)
CAT 730	38
CAT 777B	104
CAT 777C	114
CAT 777D	114
CAT 777F	117
CAT 777G	125
CAT 789C	229
CAT 3900	94
Crew Bus	15
F-550	9
F-350	6
Miscellaneous service truck	15
Snow Cat 2000	7
PACCAR heavy duty engine trucks	15
Ford L8000	23
Ford L9000	29
Ford E-350	4

During the summer months of June to September, road dust emissions can be mitigated by frequent watering of the haul roads. The quantity of road dust emitted into the atmosphere depends primarily on the amount of water applied to the roads, the frequency of application, and the water evaporation rate from the road surface. Data from field tests conducted in North Dakota, New Mexico, Ohio, and Missouri (USEPA 1987) indicated that frequent water applications every 1.8 to 4.5 hours can achieve dust control efficiencies between 59% and 88%. The Environment Canada guidance document for National Pollution Release Inventory (Environment Canada 2010) reporting recommends a 55% control efficiency when roads are watered twice a day, and a 70% control efficiency when roads are watered more than twice a day. The haul roads are watered during the summer and a chemical suppressant is used once per year; therefore a higher control efficiency of 80% was assumed.

Watering of the haul roads will not be possible in the winter due to freezing conditions. However, a large degree of natural mitigation of the road dust emissions can be expected from the freezing of the road material, and from snow and ice accumulation on the road surface. A study conducted at the De Beers Canada Inc. Snap Lake and Victor mines (Golder 2012) determined the natural mitigation on the road dust emissions brought about by the winter conditions. It was concluded that the natural winter mitigation efficiency on road dust emissions at these mines is approximately 95%. Road Dust Emissions are shown in Table 7B3.2-25.

Table 7B3.2-25 Base Case Road Dust Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
All Mine Vehicles	94.2	923.4	2,888.8	236.1

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.2.5 Wind Erosion Emissions

Fugitive dust emissions may be generated by wind erosion of outdoor stockpiles or exposed surfaces of loose materials at the Ekati stockpile, Koala/Panda waste rock storage area (WRSA), Ekati coarse processed kimberlite (CPK) storage area, and Misery WRSA. The fugitive dust emissions from these sources were estimated based on a methodology described in Section 13.2.5 of AP-42 (USEPA 2006b). The amount of fugitive dust emissions from these sources depends primarily on the following parameters:

- Magnitude of local wind gusts.
- Disturbance frequency of the erodible surface. Stockpile areas were separated into active areas and inactive areas based on disturbance frequency. A disturbance is when new material is added to or removed from a stockpile or an exposed surface.
- Erosion potential, which describes the finite availability of erodible material between disturbances.
- Threshold friction velocity, which is the minimum wind friction velocity to initiate wind erosion of a specific type of material.

The erosion potential can be determined by the following equation:

$$p = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*) \qquad (1)$$

$$P = 0 \; for \; u^* \leq u_t^*$$

Where:

P = erosion potential (grams per square metre [g/m²]);
u* = friction velocity (metres per second [m/s]); and,
ut = threshold friction velocity (m/s).

The erosion potential for a disturbance event would be zero if the friction velocity is lower than or equal to the threshold friction velocity. The wind erosion emission factors can finally be estimated based on the following equation:

$$EF = k\sum_{i=1}^{N} P_i \qquad (2)$$

Where:

EF = emission factor (grams per square metres per year [g/m²/y]);
k = particle size multiplier from AP-42, Section 13.2.4;
N = number of disturbance per year; and,
Pi = erosion potential corresponding to the fastest mile of wind for the ith period between disturbances (g/m²).

Overall, the wind erosion emission factors are determined based on the following steps:

1) Determine the threshold friction velocity for erodible material of interest.

2) Determine the friction velocity.

3) Calculate the erosion potential for each period between disturbances using Equation 1.

4) Calculate the emission factors by using Equation 2.

5) Multiply the emission factors by the area of the stockpile or exposed surface.

In Step 1, the threshold friction velocity for overburden, waste rock, kimberlite, processed kimberlite, and the Long Lake Containment Facility beach were taken from Table 13.2.5-2 of AP-42 (USEPA 2006b). A threshold friction velocity of 1.02 m/s was assumed for overburden. The threshold friction velocity for scoria (1.33 m/s) was assumed for waste rock and kimberlite, the threshold friction velocity for ground coal (0.55 m/s) was assumed for processed kimberlite, and the threshold friction velocity for fine coal dust on concrete pad (0.54 m/s) was assumed for the Long Lake Containment Facility beach.

At both the mine rock piles and the run of mine stockpile, only a portion of the total surface of the piles will be constantly disturbed by trucks unloading material onto the piles. Because the wind erosion emissions are dependent on the frequency of disturbances, the surface of the stockpiles can be separated into two categories: active area and inactive area.

The emissions for the active area of a surface were calculated assuming the area will be disturbed on an hourly basis. An erosion potential for every hour of the year was calculated and summed to provide an annual emission factor.

Conversely, the emissions for the inactive area of a surface were estimated assuming the area will be disturbed once a year. In this case, erosion potentials were calculated based on the friction velocity in a year.

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The active, inactive, and total area for the surfaces with wind erosion emissions are presented in Table 7B3.2-26.

Table 7B3.2-26 Base Case Surface Areas

Source	Active Area (m^2)	Inactive Area (m^2)	Total Area (m^2)
Ekati Stockpile	3,000	59,592	62,592
Ekati CPK Waste	18,000	360,601	378,601
Koala/Panda WRSA	18,000	2,272,005	2,290,005
Misery WRSA	18,000	1,470,525	1,488,525
Fox WRSA	0	995,132	995,132
Long Lake Containment Facility Area	0	1,691,444	1,691,444

CPK = coarse processed kimberlite; WRSA = waste rock storage area; m^2 = square metres.

In the air quality assessment, it was conservatively assumed that the conditions favourable for wind-blown emissions from the inactive areas of the exposed surfaces could only occur between May and September. Because these areas will be disturbed infrequently, the areas will be covered by snow during the rest of the year. Therefore, no wind-blown emissions from the inactive areas of the exposed surfaces are expected. The wind-erosion emission rates are summarized in Table 7B3.2-27.

Table 7B3.2-27 Base Case Wind Erosion Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Ekati Stockpile	0.000	0.000	0.001	0.000
Ekati CPK Waste	0.000	0.003	0.005	0.000
Koala/Panda WRSA	0.001	0.010	0.020	0.002
Misery WRSA	0.001	0.007	0.014	0.001
Fox WRSA	0.001	0.004	0.007	0.001
Long Lake Containment Facility Area	0.011	0.074	0.149	0.005
Total	**0.015**	**0.098**	**0.196**	**0.009**

CPK = coarse processed kimberlite; WRSA = waste rock storage area; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.2.6 Winter Road Emissions

The TCWR is the main artery used for transporting construction equipment, building materials, fuel, and food to the Lupin, Ekati, Diavik, Snap Lake, and Jericho mines.

The Project will be connected to the TCWR via an existing Winter Access Road that is already connected to the Ekati Mine. The maximum traffic volume on the Winter Access Road is expected to be 2,063 loads per year, and will occur exclusively during the winter road season. The operating period of the TCWR in 2012 was 60 days (Joint Venture 2014). Based on the most recent 10-year data, the winter road operating period can begin as early as January and end as late as April, but typically is in February and March. For all cases, it was assumed that the winter road was open for the same operating period as in 2012 (February 1 to March 31).

In the Application Case, the vehicle exhaust emissions from a 40-km stretch of the Winter Access Road starting 2 km southeast of the Diavik Mine and ending at the Ekati Mine were modelled. The Winter Access Road was modelled by a series of 30 m by 150 m area sources. Modelling the entire stretch of the road in the study area would require unmanageable number of area sources. To avoid modelling unmanageable large number of sources but still be able to capture the contributions of the Winter Access Road to traffic emissions, it was decided that only the emissions associated with a 40-km stretch of the road closest to the Project would be modelled in the assessment.

The exhaust emissions associated with the selected stretch of Winter Access Road were estimated based on emission factors derived from MOBILE6.2C, which is the Canadian version of the MOBILE6.2 software program that was developed by the USEPA to estimate on-road traffic emissions. Emission factors for Class 8b heavy-duty diesel vehicles with gross vehicle weight rating above 60,000 pounds (lb) were chosen to estimate truck exhaust emissions.

The truck emission factors and the truck exhaust emissions on the winter access road are summarized in Table 7B3.2-28. The Winter Access Road was only modelled as active emission sources in February and March to reflect the seasonal nature of winter road traffic.

Table 7B2.2-28 Winter Access Road Emissions

Compound	Emission Factor (g/VMT)	Emission Rates (t/d)
SO_2	0.0151	2.60×10-5
NO_X	8.270	1.42×10-2
CO	3.796	6.53×10-3
$PM_{2.5}$	0.167	2.88×10-4
PM_{10}	0.182	2.88×10-4
TSP	0.182[(a)]	3.13×10-4
VOC	3.796	1.33×10-3

a) MOBILE does not provide an emission factor for TSP. PM_{10} is a subset of TSP. Therefore, it was assumed that TSP emission rate equal the PM_{10} emission rate.

g/VMT = grams per vehicle kilometre,; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate; VOC = volatile organic compounds.

7B3.2.7 Escape Fraction of Particulate Emissions from Open Pits

Particulate emissions from the mine pits are limited by the phenomenon of pit wall retention. Particulates released within a mine pit have the potential to physically impact the mine pit walls. The impact causes deposition within the mine pit, effectively scrubbing particulates and reducing the amount emitted beyond the pits. The remaining portion that is emitted from the pits is referred to as the escape fraction. For this assessment, Misery, Lynx, and Pigeon pits are open pits, while the Koala pit is underground and an escape fraction will not apply to the Koala pit.

The escape fraction is calculated using the USEPA open-pit algorithm contained within the ISC3 model (Lakes Environmental 2014). The escape fraction is dependent upon the settling velocity of a particle which depends largely upon the effective diameter of the particle. The following equation demonstrates this dependency:

$$E_i = \frac{1}{\left(1 + \frac{v_g}{\alpha U_r}\right)}$$

Where:

E_i = escape fraction;
v_g = gravitational settling velocity (metres per second [m/s]);
a= proportionality constant; and,
U_r = wind speed at 10 m/s.

To obtain the value of vg, the following additional formula was used:

$$v_g = \frac{(\rho - \rho_{air}) g d_p^2 c_2 S_{cf}}{18\mu}$$

Where:

r = particle density (grams per cubic centimetre [g/cm^3]);
r_{air} = density of air (g/cm^3);
g = gravitational constant (metres per square second [m/s^2]);
d_p = particle diameter (µm);
c_2 = conversion constant (square centimetre per square micron [cm^2/µm^2]);
S_{cf} = the slip correction factor; and,
u = absolute viscosity of the air (grams per centimetre per second [g/cm/s]).

The escape fraction calculated for TSP, PM_{10}, and $PM_{2.5}$ is presented in Table 7B3.2-29.

Table 7B3.2-29 Escape Fractions for Particulates Emitted within the Mine Pits

Particulate Type	Mean Diameter (µm)	Escape Fraction
TSP	30	0.69
PM_{10}	10	0.95
$PM_{2.5}$	2.5	1.00

TSP = total suspended particulate; PM_{10} = particulate matter with particle diameter less than 10 µm; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; µm = micron.

7B3.2.8 Emission Summary

A summary of SO_2, NO_X, CO, and particulate emissions is provided in Table 7B3.2-30. The primary source of the SO_2, NO_X, and CO emissions are from the power generators, followed by mine fleet exhaust. Power generation accounts for 49.7% of all SO_2 emissions, while mine fleet exhaust accounts for 22.8% of all SO_2 emissions. Power generation accounts for 82.9% of all NO_X emissions, while mine fleet exhaust accounts for 16.4% of all NO_X emissions. Power generation accounts for 69.1% of all CO emissions, while mine fleet accounts for 30% of all CO emissions. The particulate emissions are primarily generated from road dust. Road dust accounts for 85.2% of all TSP emissions, followed by bulldozing which accounted for 7.1% of all TSP emissions. Road dust also accounts for 39.5% of all $PM_{2.5}$ emissions, while the mine fleets accounts for 29.0% of all $PM_{2.5}$ emissions.

A summary of VOC, PAH, metal, and dioxins and furan emissions is provided in Table 7B3.2-31. Almost all of the VOC and PAH emissions are generated by power generators and mine fleet exhaust. Power generation accounts for 56.3% of VOCs and 62.6% of PAH. Mine fleet exhaust VOC and PAH emissions account for 43.1% and 36.8% respectively. Road Dust generated 89.8% of all metal emissions with bulldozing generating 7.4% of all metal emissions. Waste incinerators are the only source of dioxins and furan emissions at the site.

Table 7B3.2-30 Base Case Ekati Mine Criteria Air Contaminants Emission Summary

Source Type	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Power Generators	1.442	2,972.7	789.6	51.6	53.2	64.7
Boilers/Heaters	0.264	24.8	6.2	1.9	2.9	4.1
Waste Incinerators	0.529	0.5	1.6	1.1	1.1	1.1
Mine Fleet Exhaust	0.661	586.7	345.5	44.5	45.4	42.9
Drilling and Blasting	0.002	0.0	0.1	0.1	1.0	1.5
Loading and Unloading	—	—	—	2.8	18.0	33.6
Bulldozing	—	—	—	6.2	75.4	239.9
Grading	—	—	—	5.9	9.9	20.2
Crushing, Screening, Conveying	—	—	—	5.2	29.2	65.3
Road Dust	—	—	—	94.2	923.4	2,888.8
Wind Erosion	—	—	—	0.0	0.1	0.2
Exposed Lakebed	—	—	—	—	—	—

Table 7B3.2-30 Base Case Ekati Mine Criteria Air Contaminants Emission Summary

Source Type	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Winter Roads	0.002	0.9	0.4	0.0	0.0	0.0
Total Plant Emissions	**2.900**	**3,585.6**	**1,143.4**	**213.8**	**1,159.7**	**3,362.5**

— = no emissions from this source; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

Table 7B3.2-31 Base Case Ekati Mine Non Criteria Air Contaminants Emission Summary

Source Type	Emission Rates (t/y)			
	VOC	PAH	Metals	Dioxins/Furans
Power Generators	76.1	0.197	0.2	—
Boilers/Heaters	0.2	0.001	0.0	—
Waste Incinerators	0.5	0.000	0.0	2.31E-08
Mine Fleet Exhaust	58.2	0.116	0.2	—
Drilling and Blasting	—	—	0.1	—
Loading and Unloading	—	—	2.5	—
Bulldozing	—	—	19.6	—
Grading	—	—	1.7	—
Crushing, Screening, Conveying	—	—	2.3	—
Road Dust	—	—	236.1	—
Wind Erosion	—	—	0.0	—
Exposed Lakebed	—	—	—	—
Winter Roads	0.1	—	0.0	—
Total Plant Emissions	**135.1**	**0.314**	**262.8**	**2.31E-08**

t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

7B3.3 Application Case Ekati Mine and Jay Project Emissions

7B3.3.1 Emission Summary

Typically, the Application Case represents Base Case plus new facilities or expansions to existing facilities. The Application Case for this assessment is for migrating mining operations from the existing and planned pits (e.g., Misery Pit and Lynx Pit) at the Ekati Mine to Jay Pit while utilizing the existing processing plant and other infrastructure.

Not all the emissions will be changing between the Application Case and the Base Case, as shown in Table 7B3.3-1. To estimate Application Case emissions, the total volume of ore and waste rock for the operating life of the Project was analyzed. The Application Case emissions were calculated based on the maximum annual volume of waste rock and kimberlite removed from the Project with the intent to evaluate the year with the maximum emissions from the Projects operation phase.

Table 7B3.3-1 Emissions Change Base Case and Application Case

Source Type	Change
Power Generators	—
Boilers/Heaters	√
Waste Incinerators	—
Mine Fleet Exhaust	√
Drilling and Blasting	√
Loading and Unloading	√
Bulldozing	√
Grading	—
Crushing, Screening, Conveying	—
Road Dust	√
Wind Erosion	√
Winter Roads	—
Total Plant Emissions	√

— = no change in emissions between Base Case and Application Case.
√ = Emissions change between Base Case and Application Case.

7B3.3.2 Stack Emissions

7B3.3.2.1 Boilers

Most of the boilers did not change emission rates, but since the only mine that will be operating is the Jay Pit, the Koala underground mine will no longer require heating and there will be no emissions from the fresh air raises or heaters from the Koala underground mine. Boiler emissions for the Application Case are summarized in Tables 7B3.3-2 and 7B3.3-3. Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.1.1.

Table 7B3.3-2 Application Case Boiler Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Koala area FAR1	—	—	—	—	—	—
Koala area FAR2	—	—	—	—	—	—
Ekati area	0.043	4.0	1.0	0.3	0.5	0.7
Polar area	0.015	1.4	0.4	0.1	0.2	0.2
Misery area	0.021	2.0	0.5	0.2	0.2	0.3
Portable	0.002	0.2	0.1	0.0	0.0	0.0
Total	**0.081**	**7.6**	**1.9**	**0.6**	**0.9**	**1.3**

— = no emissions from this source; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

Table 7B3.3-3 Application Case Boiler Non Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)			
	VOC	PAH	Dioxins/Furans	Metals
Koala area FAR1	—	—	—	—
Koala area FAR2	—	—	—	—
Ekati area	0.0	0.000	—	6.26E-10
Polar area	0.0	0.000	—	2.19E-10
Misery area	0.0	0.000	—	3.06E-10
Portable[(a)]	0.0	0.000	—	3.24E-11
Total	**0.1**	**0.000**	**—**	**1.18E-09**

a) For Modelling, portable sources were included with the Ekati area emissions because they were very small sources and were located in many different areas.

— = no emissions from this source; t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

7B3.3.3 Mine Fleet Exhaust Emissions

While most of the equipment in the mine fleet remained the same between the Base Case and the Application Case, the existing haul trucks will be replaced with vehicles indicated in Table 7B3.3-4. The Application Case mine vehicle exhaust emissions are summarized in Tables 7B3.3-5 and 7B3.3-6. Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.2.

Table 7B3.3-4 New Haul Truck Models for Jay Pit

Vehicle	Horsepower (hp)	Mean Weight (tonnes)
CAT 777F	1,016	117
CAT 789	2,100	229
240T Roadtrain	1,520	235

Table 7B3.3-5 Application Case Mine Equipment Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Mine equipment	2.189	1,725.5	1,029.3	131.3	132.8	118.4

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

Table 7B3.3-6 Application Case Mine Equipment Non Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)		
	VOC	PAH	Metals
Mine equipment	170.5	0.383	0.4

t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

7B3.3.4 Fugitive Particulate Emissions

7B3.3.4.1 Drilling and Blasting Operations

Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.3.1. The total amount of waste rock and kimberlite between the Base Case and Application Case is compared in Table 7B3.3-7.

The overall increase of material production will increase the number of holes drilled per blast to 86.7. The increase in the number of holes drilled per blast will result in an increase in explosives used, and will result in an increase in emissions. The emissions associated with the drilling and blasting operations are summarized in Table 7B3.3-8 and 7B3.3-9.

Table 7B3.3-7 Material Production Comparison

	Base Case	Application Case	Difference
Volume of material removed from mines (m^3)	12,131,068	15,428,261	+3,297,193

m^3 = cubic metres.

Table 7B3.3-8 Application Case Drilling Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Misery Open Pit	—	—	—	—
Lynx Open Pit	—	—	—	—
Pigeon Open Pit	—	—	—	—
Koala Underground	—	—	—	—
Jay Open Pit	0.115	0.726	1.108	0.091
Total	**0.115**	**0.726**	**1.108**	**0.091**

— = no emissions from this source; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

Table 7B3.3-9 Application Case Blasting Emissions

Source	Emission Rates (t/y)						
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP	Metals
Misery Open Pit	—	—	—	—	—	—	—
Lynx Open Pit	—	—	—	—	—	—	—
Pigeon Open Pit	—	—	—	—	—	—	—
Koala Underground	—	—	—	—	—	—	—
Jay Open Pit	0.003	0.025	0.110	0.057	0.943	1.310	0.107
Total	**0.003**	**0.025**	**0.110**	**0.057**	**0.943**	**1.310**	**0.107**

— = no emissions from this source; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.3.4.2 Loading and Unloading Operations

Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.3.2. The amount of waste rock and kimberlite will increase, as indicated in Table 7B3.3-7, which in turn will create more loading and unloading emissions. In addition, some locations at the Project will change between the Application Case and the Base Case. Emissions and locations used are indicated in Table 7B3.3-10.

Table 7B3.3-10 Application Case Loading/Unloading Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Misery Pit	—	—	—	—
Misery WRSA	—	—	—	—
Ekati Stockpile	0.2	1.2	2.6	0.1
Ekati CPK Waste	0.1	0.4	0.8	0.0
Ekati WRSA	—	—	—	—
Pigeon Pit	—	—	—	—
Lynx Pit	—	—	—	—
Jay Open Pit	1.6	10.4	15.8	1.3
Jay Transfer	0.2	1.2	2.6	0.1
Jay WRSA	1.6	10.3	21.7	1.8
Misery Stockpile	0.2	1.2	2.6	0.1
Total	**3.8**	**24.8**	**46.3**	**3.4**

WRSA = waste rock storage area; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate; — = no emissions from this source .

7B3.3.4.3 Bulldozing Operations

The same changes in material moved and operating areas to loading and unloading apply to bulldozing. Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.3.3. Bulldozing emissions in the Application Case are summarized in Table 7B3.3-11.

Table 7B3.3-11 Application Case Bulldozing Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
All Bulldozers	9.3	114.1	363.8	29.7

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

7B3.3.5 Road Dust Emissions

While some mine vehicle emissions will remain the same (grading and crew buses), the haul trucks will have to travel longer distances to transport waste rock and kimberlite. In addition, the amount of material requiring haulage will also increase as indicated in Table 7B3.3-7. Road dust emissions in the Application Case are summarized in Table 7B3.3-12. Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.4.

Table 7B3.3-12 Application Case Road Dust Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
All Mine Vehicles	117.0	1,142.0	3,475.3	284.0

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

7B3.3.6 Wind Erosion Emissions

Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.5. Active and inactive areas have changed from those in the Base Case, and new areas with wind erosion emissions were estimated for the Application Case. The active, inactive, and total area for the surfaces with wind erosion emissions are presented in Table 7B3.3-13. The wind-erosion emissions are summarized in Table 7B3.3-14.

Table 7B3.3-13 Application Case Surface Areas

Source	Active Area (m^2)	Inactive Area (m^2)	Total Area (m^2)
Ekati Stockpile	3,000	59,592	62,592
Ekati CPK Waste	18,000	360,601	378,601
Koala/Panda WRSA	0	2,290,005	2,290,005
Misery WRSA	0	1,488,525	1,488,525
Fox WRSA	0	995,132	995,132
Long Lake Containment Facility Area	0	1,691,444	1,691,444
Jay WRSA	18,000	1,777,461	1,795,461
Jay Transfer Pad	3,000	156,726	159,726
Misery Stockpile	3,000	277,077	280,077

CPK = coarse processed kimberlite; WRSA = waste rock storage area; m^2 = square metres.

Table 7B3.3-14 Application Case Wind Erosion Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Ekati Stockpile	6.67E-05	4.44E-04	8.89E-04	3.20E-05
Ekati CPK Waste	1.29E-03	8.59E-03	1.72E-02	6.18E-04
Koala/Panda WRSA	4.02E-04	2.68E-03	5.36E-03	4.38E-04
Misery WRSA	1.34E-04	8.91E-04	1.78E-03	1.46E-04
Fox WRSA	5.60E-04	3.73E-03	7.46E-03	6.10E-04
Long Lake Containment Facility Area	1.12E-02	7.43E-02	1.49E-01	5.35E-03
Jay WRSA	1.20E-03	7.99E-03	1.60E-02	1.31E-03
Jay Transfer Pad	1.21E-04	8.09E-04	1.62E-03	5.82E-05
Misery Stockpile	1.89E-04	1.26E-03	2.52E-03	9.06E-05
Total	**1.51E-02**	**1.01E-01**	**2.01E-01**	**8.64E-03**

CPK = coarse processed kimberlite; WRSA = waste rock storage area; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.3.7 Exposed Lakebed Emissions

The construction of the Jay Pit will require the partial draining of Lac du Sauvage and the exposure of part of the lakebed to the atmosphere. It is estimated that 2,574,981 m^3 of lakebed will be exposed and subject to wind erosion. Concern has been expressed that the sediment at the bottom of the lake would dry and contribute to windblown dust. However, it is expected that the sediment would solidify and that the lake bottom would form a hardpan crust to reduce the potential for wind erosion.

In the air quality assessment, it was conservatively assumed that the conditions favourable for wind-blown emissions from the dried lakebed can occur from June to September. It was assumed that the lakebed will be covered by snow during the rest of the year, and no wind-blown emissions can be expected during that time. The dust emissions from the lakebed were estimated based on the same methodology used for estimating the wind erosion emissions described in Section 7B3.2.5. The estimated wind-blown dust emissions from the exposed lakebed are presented in Table 7B3.3-15.

Table 7B3.3-15 Exposed Lakebed Wind Erosion Emissions

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Lac du Sauvage	0.014	0.094	0.189	0.015

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

7B3.3.8 Application Case Emissions Summary

The Project migrates the mining activities from the Ekati Mine to the Jay Pit. The Project mining activities will be located further from the Ekati Mine, and material production will be based on the year with the most material extracted from the Project. With the increased haul distances and materials extracted, the increased mine fleet activity increased all emissions with the exception of dioxins and furans. The Project did not affect the demand in power generation, waste incinerated, ore processed, or gross operating hours of graders. The Project decreased the amount of fuel oil used for boilers because the Koala underground mine will be closed and will no longer require heating.

The Application Case emission are summarized as follows:

- SO_2 emissions: The largest changes to SO_2 emissions were caused by the increased mine fleet activity. Total SO_2 emissions for the Ekati Mine and the Project increased 46.4%. Mine fleet exhaust replaced power generation as the primary source of SO_2 emissions, contributing 51.6% of the emissions.
- NO_X emissions: The largest changes to NO_X emissions were caused by the increased mine fleet activity. Total NO_X emissions for the Ekati Mine and the Project increased 32.3%. Power generation remained the primary source of NO_X emissions, contributing 63.2% of the emissions.

- CO emissions: The largest changes to CO emissions were caused by the increased mine fleet activity. Total CO emissions for the Ekati Mine and the Project increased 59.4%. Mine fleet exhaust replaced power generation as the primary source of CO emissions, contributing 56.5% of the emissions.
- $PM_{2.5}$ emissions: The largest changes to $PM_{2.5}$ emissions were caused by the increased mine fleet activity. Total $PM_{2.5}$ emissions for the Ekati Mine and the Project increased 52.6%. Mine fleet exhaust replaced road dust as the primary source of $PM_{2.5}$ emissions, contributing 40.3% of the emissions.
- PM_{10} emissions: The largest changes to PM_{10} emissions were caused by the increased mine fleet activity. Total PM_{10} emissions for the Ekati Mine and the Project increased 30.2%. Road dust remained the primary source of PM_{10} emissions, contributing 75.6% of the emissions.
- TSP emissions: The largest changes to TSP emissions were caused by the increased mine fleet activity. Total TSP emissions for the Ekati Mine and the Project increased 23.7%. Road dust remained the primary source of TSP emissions, contributing 83.6% of the total emissions.
- VOC emissions: The largest changes to VOC emissions were caused by the increased mine fleet activity. Total VOC emissions for the Ekati Mine and the Project increased 83.0%. Mine fleet exhaust replaced power generation as the primary source of VOC emissions, contributing 69.0% of the total emissions.
- PAH emissions: The largest changes to PAH emissions were caused by the increased mine fleet activity. Total PAH emissions for the Ekati Mine and the Project increased 84.7%. Mine fleet exhaust was the primary source of PAH emissions, contributing 66.0% of the total emissions.
- Metal emissions: The largest changes to metal emissions were caused by the increased mine fleet activity. Total metal emissions for the Ekati Mine and the Project increased 22.5%. Road dust was the primary source of metal emissions, contributing 88.2% of the total emissions.
- Dioxins and furan emissions: Waste incineration emissions did not change and was the only source of dioxins and furan emissions.

The total emissions for the Application Case are summarized in Tables 7B3.3-16 and 7B3.3-17. The emission differences from the Base Case and the Application Case are summarized in Tables 7B3.3-18 and 7B3.3-19.

Table 7B3.3-16 Application Case Ekati Plant and the Jay Project Criteria Air Contaminants Emissions Summary

Source Type	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Power Generators	1.442	2,972.7	789.6	51.6	53.2	64.7
Boilers/Heaters	0.081	7.6	1.9	0.6	0.9	1.3
Waste Incinerators	0.529	0.5	1.6	1.1	1.1	1.1
Mine Fleet Exhaust	2.189	1,725.5	1,029.3	131.3	132.8	118.4
Drilling and Blasting	0.003	0.0	0.1	0.2	1.7	2.4
Loading and Unloading	—	—	—	3.8	24.8	46.3

Table 7B3.3-16 Application Case Ekati Plant and the Jay Project Criteria Air Contaminants Emissions Summary

Source Type	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Bulldozing	—	—	—	9.3	114.1	363.8
Grading	—	—	—	5.9	9.9	20.2
Crushing, Screening, Conveying	—	—	—	5.2	29.2	65.3
Road Dust	—	—	—	117.0	1,142.0	3,475.3
Wind Erosion	—	—	—	0.0	0.2	0.4
Exposed Lakebed	—	—	—	0.0	0.1	0.2
Winter Roads	0.002	0.9	0.4	0.0	0.0	0.0
Total Plant Emissions	**4.246**	**4,707.2**	**1,823.0**	**326.2**	**1,510.0**	**4,159.3**

— no emissions from this source; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

Table 7B3.3-17 Application Case Ekati Plant and the Jay Project Non Criteria Air Contaminants Emissions Summary

Source Type	Emission Rates (t/y)			
	VOC	PAH	Metals	Dioxins/Furans
Power Generators	76.1	0.197	0.2	
Boilers/Heaters	0.1	0.000	0.0	
Waste Incinerators	0.5	0.000	0.0	2.31E-08
Mine Fleet Exhaust	170.5	0.383	0.4	—
Drilling and Blasting	—	—	0.2	—
Loading and Unloading	—	—	3.4	—
Bulldozing	—	—	29.7	—
Grading	—	—	1.7	—
Crushing, Screening, Conveying	—	—	2.3	—
Road Dust	—	—	284.0	—
Wind Erosion	—	—	0.0	—
Exposed Lakebed	—	—	0.0	—
Winter Roads	0.1	—	0.0	—
Total Plant Emissions	**247.2**	**0.581**	**321.9**	**2.31E-08**

— = no emissions from this source; t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

Table 7B3.3-18 Criteria Air Contaminants Emission Changes Due to the Jay Project

Source Type	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Power generators	—	—	—	—	—	—
Boilers	-0.183	-17.2	-4.3	-1.3	-2.0	-2.8
Waste Incinerators	—	—	—	—	—	—
Mine Fleet Exhaust	1.528	1,138.8	683.9	86.8	87.4	75.5
Drilling and Blasting	0.001	0.0	0.0	0.1	0.6	0.9
Loading and Unloading	—	—	—	1.0	6.8	12.7
Bulldozing	—	—	—	3.1	38.7	123.8
Grading	—	—	—	—	—	—
Crushing, Screening, Conveying	—	—	—	—	—	—
Road Dust	—	—	—	22.7	218.6	586.5
Wind Erosion	—	—	—	0.0	0.1	0.2
Exposed Lakebed	—	—	—	0.0	0.1	0.2
Winter Roads	—	—	—	—	—	—
Total Emission Change	**1.346**	**1,121.6**	**679.6**	**112.4**	**350.3**	**796.8**

— = no change from the Base Case emissions; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

Table 7B3.3-19 Non Criteria Air Contaminants Emission Changes Due to the Jay Project

Source Type	Emission Rates (t/y)			
	VOC	PAH	Metals	Dioxins/Furans
Power generators	—	—	—	—
Boilers	-0.2	-0.001	0.0	—
Waste Incinerators	—	—	—	—
Mine Fleet Exhaust	112.3	0.267	0.2	—
Drilling and Blasting	—	—	0.1	—
Loading and Unloading	—	—	0.9	—
Bulldozing	—	—	10.1	—
Grading	—	—	—	—
Crushing, Screening, Conveying	—	—	—	—
Road Dust	—	—	47.9	—
Wind Erosion	—	—	0.0	—
Exposed Lakebed	—	—	0.0	—
Winter Roads	—	—	—	—
Total	**112.1**	**0.266**	**59.2**	**—**

— = no change from the Base Case emissions; t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

7B3.4 Construction Case Emissions

The Construction Case emissions include all of the Base Case emissions with the additional emissions generated from the construction activities around the Jay Pit. The activities include construction of the dike and emissions form the temporary aggregate plant for waste rock to be used as construction material.

7B3.4.1 Construction Fleet Exhaust Emissions

The Construction Case will require new vehicles for construction activities. New vehicles that will be used during the Construction Case are listed in Table 7B3.4-1. Construction Case mine vehicle exhaust emissions excluding the Base Case emissions are summarized in Tables 7B3.4-2 and 7B3.4-3. Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.2.

Table 7B3.4-1 Construction Fleet Equipment List

Vehicles	Horsepower	Weight (Tonnes)
CAT 789 D	2,100	229
CAT 777 F	1,016	117
CAT 993D	1,039	134
CAT 385L	513	86
CAT 345C	345	47
CAT D10T	646	66
CAT D8T	359	38
Komatsu 1250	688	111
Liebherr LR 1160	362	167
Rockmaster 100 DTH	150	17
DP 1500i	385	22
Atlas Copco DM45	630	41
MDT 140B	162	15
CAT TL1055C	142	15
Dragflow DRH400E23	630	N/A
F-350 Pick-up	440	6
Crew Bus	250	15

Table 7B3.4-2 Construction Fleet Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Construction Fleet	0.114	60.5	24.0	3.6	3.7	3.7

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

Table 7B3.4-3 Construction Fleet Non Criteria Air Contaminants Emissions

Source	Emission Rates (t/y)		
	VOC	PAH	Metals
Construction Fleet	3.8	0.023	0.0

t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

7B3.4.2 Fugitive Particulate Emissions

7B3.4.2.1 Loading and Unloading Operations

Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.3.2. New loading and unloading activities will take place around the Jay Pit construction area, a stockpile for aggregate material, and an expansion to the Misery WRSA. New emissions and locations added for the Construction Case are summarized in Table 7B3.4-4.

Table 7B3.4-4 New Loading/Unloading Emissions for Construction Case

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Misery Aggregate	0.2	1.6	3.5	0.1
Misery WRSA	0.4	2.8	6.0	0.5
Jay Construction Area	13.9	175.4	6.0	0.5
Total	**14.6**	**179.9**	**15.5**	**1.1**

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

7B3.4.2.2 Bulldozing Operations

The same changes that apply to loading and unloading also apply to bulldozing. Emission calculation method remains the same as that for the Base Case, as outlined in Section 7B3.2.3.3. New bulldozing emissions are summarized in Table 7B3.4-5.

Table 7B3.4-5 New Bulldozing Emissions for Construction Case

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Bulldozing	13.9	175.4	632.9	51.7

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

7B3.4.2.3 Crushing, Screening, and Conveying Emissions

A temporary crushing plant is required for crushing waste rock to be used as construction material for the Jay Pit. The crushing, screening, and conveying emissions are presented in Table 7B3.4-6.

Table 7B3.4-6 New Crushing, Screening, and Conveying Emissions for Construction Case

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Misery Quarry	2.7	2.7	6.2	0.5

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.4.3 Road Dust Emissions

The new vehicles used for the Construction Case are outlined in Table 7B3.4-1. These vehicles will also be generating road dust around the Jay Pit construction area. New road dust emissions are summarized in Table 7B3.4-7. Emission calculation methods remain the same as the Base Case, as outlined in Section 7B3.2.4.

Table 7B3.4-7 New Road Dust Emissions for Construction Case

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Construction Fleet	98.9	989.4	2,422.6	7.8

t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.4.4 Wind Erosion Emissions

Emission calculation method remains the same as that for the Base Case, as outlined in Section 7B3.2.5. Active and inactive areas that will have wind erosion have been added for the Construction Case. The new active, inactive, and total area for the surfaces with wind erosion emissions are presented in Table 7B3.4-8.

Table 7B3.4-8 New Surface Areas for Construction Case

Source	Active Area (m^2)	Inactive Area (m^2)	Total Area (m^2)
Misery Aggregate Stockpile	18,000	262,077	**280,077**
Misery WRSA	18,000	504,211	**522,211**

WRSA = waste rock storage area; m^2 = square metres.

The new wind-erosion emission rates generated by the Construction Case are summarized in Table 7B3.4-9.

Table 7B3.4-9 New Wind Erosion Emissions for Construction Case

Source	Emission Rates (t/y)			
	$PM_{2.5}$	PM_{10}	TSP	Metals
Misery Stockpile	3.22E-04	2.15E-03	4.29E-03	1.54E-04
Misery WRSA	4.35E-04	2.90E-03	5.80E-03	4.74E-04
Total	**7.57E-04**	**5.05E-03**	**1.01E-02**	**6.29E-04**

WRSA = waste rock storage area; t/y = tonnes per year; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

7B3.4.5 Construction Case Emissions Summary

The Ekati Plant and the Jay Pit emissions in the Construction Case are summarized in Tables 7B3.4-10 and 7B3.4-11. A summary of the difference from the Construction Case and the Base Case is provided in Tables 7B3.4-12 and 7B3.4-13.

Overall SO_2 (3.9%), NO_X (1.7%), CO (2.1%), VOC,(2.8%), and dioxins and furan (0%) emissions increased marginally if at all compared to the Base Case. The $PM_{2.5}$ (56.1%), PM_{10} (116.5%), TSP (90.9%), PAH (7.2%), and metal (23.3%) emissions increased the most when compared to the Base Case. The increase in SO_2, NO_X, CO, VOC, and PAH emissions are generated by increased mine fleet exhaust. The increase in $PM_{2.5}$, PM_{10}, and TSP are primarily caused by increased road dust activity. Metal emissions are primarily increased as a result of PM emissions by bulldozing activities.

Table 7B3.4-10 Construction Case Ekati Plant and the Jay Project Construction Criteria Air Contaminants Emissions Summary

Source Type	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Power Generators	1.442	2,972.7	789.6	51.7	53.2	64.7
Boilers/Heaters	0.264	24.8	6.20	1.9	2.9	4.1
Waste Incinerators	0.529	0.5	1.642	1.1	1.1	1.1
Mine Fleet Exhaust	0.775	647.2	369.43	48.1	49.1	46.6
Drilling and Blasting	0.002	0.0	0.1	0.1	1.0	1.5
Loading and Unloading	—	—	—	17.4	197.9	49.1
Bulldozing	—	—	—	20.1	250.8	872.9
Grading	—	—	—	5.9	9.9	20.2
Crushing, Screening, Conveying	—	—	—	8.0	32.0	71.5
Road Dust	—	—	—	193.2	1,912.8	5,311.4
Wind Erosion	—	—	—	0.0	0.1	0.2
Winter Roads	0.002	0.9	0.4	0.0	0.0	0.0
Total Plant Emissions	3.014	3,646.1	1,167.4	347.5	2,510.7	6,443.4

— = no emissions from this source; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 µm; PM_{10} = particulate matter with particle diameter less than 10 µm; TSP = total suspended particulate.

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Table 7B3.4-11 Construction Case Ekati Plant and the Jay Project Construction Non Criteria Air Contaminants Emissions Summary

Source Type	Emission Rates (t/y)			
	VOC	PAH	Metals	Dioxins/Furans
Power Generators	76.1	0.197	0.2	—
Boilers/Heaters	0.2	0.001	0.0	—
Waste Incinerators	0.5	0.000	0.0	2.31E-08
Mine Fleet Exhaust	62.0	0.138	0.2	—
Drilling and Blasting	—	—	0.1	—
Loading and Unloading	—	—	3.6	—
Bulldozing	—	—	71.3	—
Grading	—	—	1.7	—
Crushing, Screening, Conveying	—	—	2.3	—
Road Dust	—	—	236.1	—
Wind Erosion	—	—	0.0	—
Winter Roads	0.1	—	0.0	—
Total Plant Emissions	**138.9**	**0.337**	**315.6**	**2.31E-08**

— = no emissions from this source; t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

Table 7B3.4-12 Criteria Air Contaminants Emission Changes Due to the Jay Project Construction

Source Type	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Power generators	—	—	—	—	—	—
Boilers	—	—	—	—	—	—
Waste Incinerators	—	—	—	—	—	—
Mine Fleet Exhaust	0.114	60.5	24.0	3.6	3.7	3.7
Drilling and Blasting	—	—	—	—	—	—
Loading and Unloading	—	—	—	14.6	179.9	15.5
Bulldozing	—	—	—	13.9	175.4	632.9
Grading	—	—	—	—	—	—
Crushing, Screening, Conveying	—	—	—	2.7	2.7	6.2
Road Dust	—	—	—	98.93	989.4	2,422.6
Wind Erosion	—	—	—	0.0	0.0	0.0
Winter Roads	—	—	—	—	—	—
Total Emission Change	**0.114**	**60.5**	**24.0**	**133.8**	**1,351.0**	**3,080.9**

— = no emissions from this source; t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

Table 7B3.4-13 Non Criteria Air Contaminants Emission Changes Due to the Jay Project Construction

Source Type	Emission Rates (t/y)			
	VOC	PAH	Metals	Dioxins/Furans
Power generators	—	—	—	—
Boilers	—	—	—	—
Waste Incinerators	—	—	—	—
Mine Fleet Exhaust	3.84	0.023	0.0	—
Drilling and Blasting	—	—	—	—
Loading and Unloading	—	—	1.1	—
Bulldozing	—	—	51.7	—
Grading	—	—	—	—
Crushing, Screening, Conveying	—	—	—	—
Road Dust	—	—	7.8	—
Wind Erosion	—	—	0.0	—
Winter Roads	—	—	—	—
Total	**3.84**	**0.023**	**61.1**	**—**

— = no emissions from this source; t/y = tonnes per year; VOC = volatile organic compounds; PAH = polycyclic aromatic hydrocarbons.

7B3.5 Greenhouse Gas Emissions

Greenhouse gases that will be emitted by the Project include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases are byproducts of combustion sources. Greenhouse gas emissions were calculated based on equipment rated capacity or fuel consumption rate, and emission factors from the Environment Canada National Inventory 1990-2011 (Environment Canada 2013). Estimates of maximum annual GHG emissions are expressed as kilotonnes of CO_2 equivalent (kt CO_2E), which were calculated based on the global warming potential for each greenhouse gas relative to the global warming potential of CO_2. The formula for expressing GHG emissions in CO_2E is as follows:

$CO_2 \text{ equivalent} = CO_2 + (25 \times CH_4) + (298 \times N_2O)$

Global warming potentials were obtained from the Intergovernmental Panel on Climate Change's *Fourth Assessment Report* (IPCC 2007). Before 2013, global warming potentials were obtained from the *Second Assessment Report* (IPCC 1995). Calculations in this report used global warming potentials from the *Fourth Assessment Report* unless otherwise specified.

Although the activity level for each year may vary, annual and total greenhouse gas emissions from the Project are based on the assumption that the Project will be operating at the maximum capacity throughout the life of the Project. Therefore, the presented greenhouse gas emissions are conservative and are expected to overestimate the actual emissions.

The maximum annual estimated GHG emissions from the Ekati Mine and the Project in the Base Case, Construction Case and Application Case are summarized in Table 7B3.5-1.

Table 7B3.5-1 Annual Greenhouse Gas Emissions

Case	Annual Greenhouse Gas Emissions (kt CO_2E)			
	CO_2	CH_4	N_2O	Total
Base Case (2015)	248.272	0.321	16.599	**265.192**
Construction Case (2017)	330.395	0.437	26.707	**357.539**
Application Case (2022)	364.195	0.487	32.364	**397.047**

kt CO_2E = kilotonne carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

A breakdown of greenhouse gas emissions by source for the Base Case, Construction Case, and Application Case is provided in Tables 7B3.5-2 to 7B3.5-4.

Table 7B3.5-2 Base Case Annual Greenhouse Gas Emissions

Source	Annual Greenhouse Gas Emissions (kt CO_2E) for Base Case			
	CO_2	CH_4	N_2O	Total
Generators	150.659	0.188	6.744	**157.591**
Boilers/heaters	27.586	0.034	1.235	**28.855**
Mine Fleet	70.028	0.099	8.620	**78.746**
Total	**248.272**	**0.321**	**16.599**	**265.192**

kt CO_2E = kilotonne carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

Table 7B3.5-3 Construction Case Annual Greenhouse Gas Emissions

Source	Annual Greenhouse Gas Emissions (kt CO_2E) for Construction Case			
	CO_2	CH_4	N_2O	Total
Generators	150.659	0.188	6.744	**157.591**
Boilers/heaters	27.586	0.034	1.235	**28.855**
Mine Fleet	70.028	0.099	8.620	**78.746**
Construction Equipment	82.122	0.116	10.109	**92.347**
Total	**330.395**	**0.437**	**26.707**	**357.539**

kt CO_2E = kilotonne carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

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Table 7B3.5-4 Application Case Annual Greenhouse Gas Emissions

Source	Annual Greenhouse Gas Emissions (kt CO_2E) for Application Case			
	CO_2	CH_4	N_2O	Total
Generators	150.659	0.188	6.744	**157.591**
Boilers/heaters	8.485	0.011	0.380	**8.875**
Mine Fleet	205.052	0.289	25.241	**230.581**
Total	**364.195**	**0.487**	**32.364**	**397.047**

kt CO_2E = kilotonne carbon dioxide equivalent; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

7B4 REGIONAL EMISSION SOURCES

7B4.1 Diavik Mine Emissions

The Diavik Diamond Mine (Diavik Mine) is located approximately 14 km southwest of the Project. It is operated by a joint venture of Dominion Diamond Corporation and Rio Tinto. The mine started production in 2003. The mine consists of both an open-pit mine and an underground mine.

Air emission information for the Diavik Mine was obtained from an air dispersion modelling assessment conducted for the mine in 2012 (Golder 2012). In the 2012 assessment, air emissions representing two different mine phases were modelled: Year 2011 and Year 2015. The emission profile for the Year 2015 was modelled in the assessment for the Project. The 2012 assessment quantified the emissions for SO_2, NO_X, $PM_{2.5}$, PM_{10}, and TSP.

For CO, VOC, PAH, metal, and dioxins/furans emission rates which were not quantified in the 2012 assessment, the emission rates were estimated based on scaling of the emission factors. The Diavik Mine CACs are summarized in Table 7B4.1-1, and the non-CACs are summarized in Table 7B4.1-2.

Table 7B4.1-1 Diavik Mine Criteria Air Contaminants Emissions Summary

Season	Emission Rates (t/y)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Frozen Season	5.86	4,466.7	1,364.4	229.1	285.6	474.6
Non-Frozen Season	2.74	2,216.3	678.0	117.4	162.3	255.3
Total	**8.60**	**6,683.0**	**2,042.4**	**346.6**	**447.9**	**729.8**

t/y = tonnes per year; SO_2 = sulphur oxide; NO_X = nitrogen oxides; CO = carbon dioxide; $PM_{2.5}$ = particulate matter with particle diameter less than 2.5 μm; PM_{10} = particulate matter with particle diameter less than 10 μm; TSP = total suspended particulate.

Table 7B4.1-2 Diavik Mine Non Criteria Air Contaminants Emissions Summary

Season	Emission Rates (t/y)			
	VOC	PAH	Metals	Dioxins/Furans
Frozen Season	290.0	14.29	152.5	1.541E-08
Non-Frozen Season	144.7	5.12	71.4	7.706E-09
Total	**434.7**	**19.42**	**223.9**	**2.312E-08**

t/y = tonnes per year; VOC = volatile organic compound; PAH = polycyclic aromatic hydrocarbon.

7B5 SCIENTIFIC UNCERTAINTY

This section discusses the uncertainties associated with the emission estimations in the assessment. Uncertainty in emission estimates generally depends on the assumptions and the quality of the project-related data used. Each source of uncertainty is discussed in turn below.

The Project emission profile modelled in this assessment was developed based on the maximum estimated volumes of material (e.g., overburden, mine rock, kimberlite, and coarse PK). In reality, the maximum production of these materials may be different than the estimates and may occur in a different year.

Power generation equipment was assumed to be operating at the maximum ratings for six of the power generators, with a seventh one not operating. It is more likely that the power generators will be operating continuously below the maximum capacities.

Other stationary combustion equipment (boilers and incinerators) were estimated from 2013 fuel consumption. Actual operations may change fuel consumption.

No vendor-specific data for the waste incinerator were available for the assessment. Vendor emission data are more accurate and indicative of the emissions from incinerators that have been designed specifically for waste disposal in northern region. Based on previous experience, the AP-42 emission factors are more conservative vendor data. The PAH, dioxin and furan data from 2013 stack test data were available and were used in the assessment. Actual emissions may vary year to year and depends on the amount and type of waste incinerated.

7B6 REFERENCES

Australia NPI. 2012. Australia NPI Emission estimation technique manual for explosives detonation and firing ranges Version 3.0 January 2012. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia.

BHP (Broken Hill Proprietary Company). 1995. NWT Diamonds Project Environmental Impact Statement, Volume IV, Impacts and Mitigation – Part 2. Available at: http://www.monitoringagency.net/ResourceCentre/EnvironmentalImpactStatement/tabid/111/Default.aspx. Accessed: September 2014.

Environment Canada. 2010. Unpaved Industrial Road Dust Calculator. Available at https://www.ec.gc.ca/inrp-npri/9C8F5570-19B6-4E37-97DB-290D4CE28153/UnpavedIndustrialRoadDustCalculator_e_18_Nov_2008.xls. Accessed: September 2014.

Environment Canada. 2013. National Inventory Report: 1990-2011, Greenhouse Gas Sources and Sinks in Canada, Part 2. Pollutant Inventories and Reporting Division, Environment Canada.

Golder (Golder Associates Ltd.). 2012. Determination of Natural Winter Mitigation of Road Dust Emissions from Mining Operations in Northern Canada. Submitted to De Beers Canada Inc. Available at http://www.reviewboard.ca/upload/project_document/EIR0607-001_Road_Dust_Emission_Study_-_De_Beers_Canada.PDF. Accessed: September 10, 2014.

Golder and Conor Pacific (Golder Associates Ltd. and Conor Pacific Environmental Technologies Inc.). 1998. Technical Reference for the Meteorology, Emissions and Ambient Air Quality in the Athabasca Oil Sands Region. Prepared for Suncor Energy Inc. May 1998.

IPCC (Intergovernmental Panel on Climate Change). 1995. Climate Change 1995: The Science of Climate Change. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change [Meira Filho, L.G., B.A. Callander, N. Harris, A. Kattenberg, K. Maskell and J.T. Houghton (eds.)]. University Press, Cambridge, United Kingdom, 588 pp.

IPCC. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

Joint Venture. 2014. Tibbitt-to-Contwoyto Winter Road Joint Venture Website. Available at Http://jvtcwinterroad.ca/. Accessed: September 2014.

Lakes Environmental. 2014. Gaussian Plume Air Model, Website. Available at http://www.weblakes.com/guides/iscst3/section6/6_2_4.html. Accessed: September 2014.

USEPA (United States Environmental Protection Agency). 1980. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Section 13.3 Explosives Detonation, Fifth Edition (AP 42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 1987. User's Guide: Emission Control Technologies and Emission Factors for Unpaved Road Fugitive Emissions. Office of Research and Development. Research Triangle Park, North Carolina, USA.

USEPA. 1996a. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Section 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 1996b. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Section 2.1 Refuse Combustion, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 1998a. Federal Register. Part II Environmental Protection Agency. Control of Emissions of Air Pollution from Nonroad Diesel Engines; Final Rule. Volume 63, Number 205.

USEPA. 1998b. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Section 11.9 Western Surface Coal Mining, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 2004a. Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression Ignition. Prepared by the Office of Transportation and Air Quality, Research Triangle Park, NC, USA. Report No. NR-009c.

USEPA. 2004b. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 2005. Technical Highlights – Frequently Asked Questions About NONROAD2005. Prepared by the Office of Transportation and Air Quality, Research Triangle Park, NC, USA. Report No. EPA420-F-05-058.

USEPA. 2006a. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Section 13.2.4 Aggregate Handling and Storage Piles, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 2006b. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Section 13.2.5 Industrial Wind Erosion, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 2006c. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Part 13.2.2 Unpaved Roads, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.

USEPA. 2010. Compilation of air pollutant emission factors: Volume I stationary point and area sources. Part 1.3 – Fuel Oil Combustion, Fifth Edition (AP 42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, USA.