APPENDIX 5C-4

PROJECT AIR EMISSION INVENTORY

APPENDIX 5C-4-1

EMISSION INVENTORY FOR THE MILNE PORT OPERATIONS

Emission Inventory for the Milne Port Operations

This appendix summarizes the information used to develop the emission inventory for Milne Port operations. The project base quantities, source parameters, emission factors and other assumptions used to develop the emission rate inputs for modelling are presented in Table 5C-4-1-1.

All references to AP-42 refer to the United States Environmental Protection Agency's (U.S. EPA) AP-42 emission factor documentation.

Table 5C-4-1-1: Combustion Emission Factors and Base Quantities Used to Develop the Milne Port Emission Inventory

Power Generation – Arctic Diesel Generators (Assumed Caterpillar CM43 or similar)	
Emission factors	• AP-42 Ch. 3.4 was used to calculate SO_2 emissions from the power generators at Milne Port • Manufacturer specification sheet was used to calculate NO_x, CO and $PM_{2.5}$ emissions • All particulate matter was assumed to be in the $PM_{2.5}$ size fraction
Base quantities	• Milne Port has 3 generators, each with a power rating of 7,200kW • Arctic Diesel with molecular mass of 226 g/mole with ultra-low sulphur fuel (i.e., 0.4 % fuel sulphur) was assumed similar to other sites
Source parameters	• Stack heights of 30 m was used similar to other sites • Stack diameters of 1.09 m were calculated based on an assumed exit velocity of 27.26 m/s and from flow-rates derived from engine specification sheet • Exhaust exit temperature is 320 ºC for the generators based on the manufacturer specification sheet
Emission controls	• No emission controls were assumed
Schedule of Operations	• 3 generators was assumed to operate 24 hours a day, 7 days a week
Incinerator	
Emission factors	• From "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer" Report, prepared by Eco Waste Solution, provided by Aker September 2007.
Base quantities	• Burns 1,000 kg/day
Source parameters	• Average flow rate of 1.13m³/s, velocity of 6.15m/s and exhaust temperature of 679°C were provided in "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer" Report, prepared by Eco Waste Solution, provided by Aker September 2007. • Stack diameter of 0.48m was calculated using the average flow rate and velocity.
Emission controls	• No emission controls were assumed
Schedule of Operations	• Assumed to operate 24 hours per day, 7 days a week.

Bulk Material Handling	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from bulk material handling operations were estimated using AP-42 13.2.4
Base quantities	• The following sources and corresponding parameters are included in the modelling:

ID	Process	Material Handled (Hourly) (Mg)	Material Handled (Daily) (Mg)	Material Handled (Annual) (Mg)	Site Specific Data (y/n)	Silt Content (%)	Moisture Content (%)
Milne Port							
3300-SK-001	Lump/Fine Stacker	2,400	57,600	17,280,000	y	9.5%	5.4%
3300-RC-010	Reclaimer 01	6,000	144,000	43,200,000	y	9.5%	5.4%
3300-RC-011	Reclaimer 02	6,000	144,000	43,200,000	y	9.5%	5.4%
3300-SL-001	Ship Loader 01	6,000	144,000	43,200,000	y	9.5%	5.4%
3300-SL-002	Ship Loader 02	6,000	144,000	43,200,000	y	9.5%	5.4%
3300-TR-001	Lump/Fine Tripper Chute	2,400	57,600	17,280,000	y	9.5%	5.4%
3300-CH-001	Lump/Fine Discharge Chute	2400	57,600	17280000	y	9.5%	5.4%
3300-CH-002	Reclaimer Discharge Chute 01	2400	57,600	17280000	y	9.5%	5.4%
3300-CH-003	Reclaimer Discharge Chute 02	2400	57,600	14400000	y	9.5%	5.4%
3300-CH-004	Ship Loader Discharge Chute 01	2400	57,600	14400000	y	9.5%	5.4%
3300-CH-005	Ship Loader Discharge Chute 02	2400	57,600	14400000	y	9.5%	5.4%
3300-TR-002	Ship Loader Tripper Discharge Chute	2400	57,600	14400000	y	9.5%	5.4%

Bulk Material Handling (Cont'd)	
Emission controls	• No emission controls were assumed
Schedule of Operations	• 24 hours a day, 90 days per year
Stockpiles	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from stockpiles were estimated using AP-42 13.2.5
Base quantities	• Four (4) lump stockpiles each having a capacity of 562,500 tonnes • Two fine stockpiles, each having a capacity of 375,000 tonnes
Source parameters	• Surface roughness length of 0.003 m was applied in the calculations • Threshold velocity for iron ore was estimated to be 6.94 m/s based on bulk sampling program conducted by RWDI • Emission rates calculated on an hourly basis to vary according to wind speeds
Emission controls	• No emission controls were assumed
Schedule of Operations	• 24-hours per day, 7 days per week

Truck Operation (From Mine Site Trucking Option Stock Piles to Milne Port Stockpiles)	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from stockpiles were estimated using AP-42 13.2.2 • NO_x, SO_2, and CO emissions are from the U.S. EPA Tier II/III Standards Document Entitled: Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines (http://www.epa.gov/otaq/cert/hd-cert/stds-eng.pdf).
Base quantities	• Twenty two (22) 120 ton trucks • Mean vehicle speed of 30 km/hour • Total distance travelled per pass is 100 km
Source parameters	• Modelled as a series of area sources • The maximum length to width ratio for the area sources was 10:1 with an effective height of 4 m and an initial vertical dimension (sigma z) of 2 m.
Emission controls	• A 50% emission controls were assumed due to the road maintenance using chemical suppression ($CaCl_2$)
Schedule of Operations	• Operates 24 hours a day and 300 days per year

Tables 5C-4-1-2, 5C-4-1-3 and 5C-4-1-4 provide a summary of the source parameters applied in the CALPUFF modelling of Milne Port operation for the point, area, and volume sources, respectively.

Table 5C-4-1-2: Milne Port Point Sources

Source Description	Generators			Incinerator
Source Name	**GEN01**	**GEN02**	**GEN03**	**MR_INCIN**
Power Rating	7200 kW (9MVA)	7200 kW (9MVA)	7200 kW (9MVA)	1000 kg/day
# of Units	1	1	1	1
Stack Height Above Grade (m)	30	30	30	17.3
Stack Height Above Roof (m)	18	18	18	
Stack Flow Rate (m^3/s)	25.44	14.13	14.13	1.127
Stack Diameter (m)	1.09	1.09	1.09	0.48
Exit Temperature (K)	593	593	593	952
Exit Velocity (m/s)	27.43	27.43	27.43	6.15
Source of Emissions	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	From "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer Report". Provided by Aker Sept 2007.
Emission Rates (g/s)				
NOx	57.37	57.37	57.37	2.97E-02
SO2	1.25	1.25	1.25	4.62E-04
SO3	0.049	0.049	0.049	1.82E-05
SO4	0.040	0.040	0.040	1.46E-05
CO	1.17	1.17	1.17	1.45E-03
PM	0.03	0.03	0.03	1.18E-02
HCl	N/A	N/A	N/A	1.77E-01
HF	N/A	N/A	N/A	3.38E-03
Mercury	N/A	N/A	N/A	3.31E-05
Antimony	N/A	N/A	N/A	8.10E-05
Arsenic	N/A	N/A	N/A	1.46E-06
Barium	N/A	N/A	N/A	3.27E-06
Beryllium	N/A	N/A	N/A	0.00E+00
Cadmium	N/A	N/A	N/A	1.35E-04
Chromium	N/A	N/A	N/A	5.98E-05
Cobalt	N/A	N/A	N/A	3.38E-07
Copper	N/A	N/A	N/A	2.41E-04
Lead	N/A	N/A	N/A	2.77E-04
Manganese	N/A	N/A	N/A	1.62E-05
Nickel	N/A	N/A	N/A	5.97E-06
Selenium	N/A	N/A	N/A	3.16E-06
Silver	N/A	N/A	N/A	4.17E-06
Thallium	N/A	N/A	N/A	0.00E+00
Zinc	N/A	N/A	N/A	1.58E-04
Dioxins and Furans	N/A	N/A	N/A	
2378-T4CDD	N/A	N/A	N/A	1.89E-12
12378-P5CDD	N/A	N/A	N/A	1.78E-12
123478-H6CDD	N/A	N/A	N/A	4.88E-13
123678-H6CDD	N/A	N/A	N/A	7.29E-13
123789-H6CDD	N/A	N/A	N/A	1.32E-12
1234678-H7CDD	N/A	N/A	N/A	7.51E-13
OCDD	N/A	N/A	N/A	1.50E-13
2378-T4CDF	N/A	N/A	N/A	4.36E-12
12378-P5CDF	N/A	N/A	N/A	5.86E-13
23478-P5CDF	N/A	N/A	N/A	1.21E-11
123478-H6CDF	N/A	N/A	N/A	7.08E-12
123678-H6CDF	N/A	N/A	N/A	2.96E-12
234678-H6CDF	N/A	N/A	N/A	6.47E-12
123789-H6CDF	N/A	N/A	N/A	5.48E-13
1234678-H7CDF	N/A	N/A	N/A	1.62E-12
1234789-H7CDF	N/A	N/A	N/A	6.76E-13
OCDF	N/A	N/A	N/A	3.12E-13
Total Dioxins and Furans	N/A	N/A	N/A	4.38E-11
Chlorobenzenes and Octachlorostyrene	N/A	N/A	N/A	
1,2,3,5-Tetrachlorobenzene	N/A	N/A	N/A	5.11E-09
1,2,4,5-Tetrachlorobenzene	N/A	N/A	N/A	1.62E-09
1,2,3,4-Tetrachlorobenzene	N/A	N/A	N/A	4.21E-09
Pentachlorobenzene	N/A	N/A	N/A	8.30E-09

Table 5C-4-1-2: Milne Port Point Sources

Source Description	Generators			Incinerator
Source Name	**GEN01**	**GEN02**	**GEN03**	**MR_INCIN**
Hexachlorobenzene	N/A	N/A	N/A	3.16E-09
Total Selected CBs	N/A	N/A	N/A	2.24E-08
Octachlorostyrene	N/A	N/A	N/A	0.00E+00
Polycyclic Aromatic Hydrocarbons (PAHs)	N/A	N/A	N/A	
Acenapthylene	N/A	N/A	N/A	6.01E-10
Acenpthene	N/A	N/A	N/A	0.00E+00
Fluorene	N/A	N/A	N/A	1.43E-09
2-Methyl-Fluorene	N/A	N/A	N/A	1.43E-09
Phenenthrene	N/A	N/A	N/A	1.25E-08
Anthracene	N/A	N/A	N/A	9.01E-10
Fluoranthene	N/A	N/A	N/A	3.61E-09
Pyrene	N/A	N/A	N/A	2.97E-09
Retene	N/A	N/A	N/A	4.36E-09
Benzo(a)Fluorene	N/A	N/A	N/A	1.50E-10
Benzo(b)Fluorene	N/A	N/A	N/A	0.00E+00
1-Methyl-Pyrene	N/A	N/A	N/A	1.13E-10
Benzo(g,h,i)Fluoranthene	N/A	N/A	N/A	1.13E-10
Benzo(a)Anthrecene	N/A	N/A	N/A	3.38E-10
Triphenylene	N/A	N/A	N/A	3.00E-10
Chrysene	N/A	N/A	N/A	8.26E-10
7-Methyl-Benzo(a)Anthracene	N/A	N/A	N/A	0.00E+00
Benzo(b)Fluoranthene	N/A	N/A	N/A	1.65E-09
Benzo(k)Fluoranthene	N/A	N/A	N/A	1.88E-10
Benzo(e)Pyrene	N/A	N/A	N/A	6.01E-10
Benzo(a)Pyrene	N/A	N/A	N/A	0.00E+00
Perylene	N/A	N/A	N/A	0.00E+00
3-Methyl-Cholanthrene	N/A	N/A	N/A	0.00E+00
Indeno(1,2,3-cd)Pyrene	N/A	N/A	N/A	4.88E-10
Dibenzo(a,h)Anthracene	N/A	N/A	N/A	0.00E+00
Benzo(b)Chrysene	N/A	N/A	N/A	0.00E+00
Benzo(g,h,i)Perylene	N/A	N/A	N/A	3.38E-10
Anthanthrene	N/A	N/A	N/A	0.00E+00
Total PAHs	N/A	N/A	N/A	3.31E-08
Selected Volatile Organic Compounds (VOCs)	N/A	N/A	N/A	
Chloromethane	N/A	N/A	N/A	2.14E-06
Vinyl Chloride	N/A	N/A	N/A	7.21E-07
1,3-Butadiene	N/A	N/A	N/A	2.06E-06
Dichloromethane	N/A	N/A	N/A	2.39E-06
Benzene	N/A	N/A	N/A	2.02E-05
Toluene	N/A	N/A	N/A	2.57E-03
Chlorobenzene	N/A	N/A	N/A	8.23E-07
Ethylbenzene	N/A	N/A	N/A	4.17E-06

Table 5C-4-1-3: Milne Port Area Sources

Source Description	**AREA1 - AREA23**
Source Name	
	Haul Truck -120 Tons (From Crusher to Trucking Stockpile)
Power Rating	1082 kW
# of Units	N/A
Area (m^2)	Hauling distance 100km with a width of 10m
Sigma z (m)	2.00
Release Height (m) [Fugitive]	4
Source of Emission Rates	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads
Emission Rates (g/s)	
NOx	3.97E+01
SO2	1.30E-01
SO3	5.14E-03
SO4	4.11E-03
CO	2.31E+01
PM2.5 (Combustion)	1.32E+00
TSP (Fugitive)	3.93E+02
PM10 (Fugitive)	1.02E+02
PM2.5 (Fugitive)	1.02E+01
Emission Rates (g/m2-s)	
NOx	3.97E-05
NO	N/A
NO2	N/A
NO3	N/A
SO2	1.30E-07
SO3	N/A
SO4	N/A
CO	2.31E-05
PM2.5 (Combustion)	1.32E-06
TSP (Fugitive)	3.93E-04
PM10 (Fugitive)	1.02E-04
PM2.5 (Fugitive)	1.02E-05

Table 5C-4-1-4: Milne Port Volume Sources

Source Description	Lump Stockpile	Lump Stockpile	Lump Stockpile	Lump Stockpile	Fine Stockpile	Fine Stockpile	Lump/Fine Stacker	Lump/Fine Reclaimer	Lump/Fine Reclaimer	Lump/Fine Ship Loader	Lump/Fine Ship Loader	Lump/Fine Tripper Discharge Chute	Ship Loader Tripper Discharge Chute	Fine/Lump Stacker Discharge Chute	Fine/Lump Reclaimer Discharge Chute	Fine/Lump Reclaimer Discharge Chute	Fine/Lump Ship Loader Discharge Chute	Fine/Lump Ship Loader Discharge Chute
Source Name	**MLUMP1**	**MLUMP2**	**MLUMP3**	**MLUMP4**	**MFINE1**	**MFINE2**	**3300-SK-01**	**3300-RC-01**	**3300-RC-02**	**3300-SL-01**	**3300-SL-02**	**3300-TR-01**	**3300-TR-02**	**3300-CH-01**	**3300-CH-02**	**3300-CH-03**	**3300-CH-04**	**3300-CH-05**
Location [X-coord] (km)	503.77	503.85	503.77	503.85	503.769	503.85	503.81	503.803	503.817	503.081	503.155	503.81	503.119	503.783	503.803	503.817	503.135	503.064
Location [Y-coord] (km)	7975.416	7975.416	7975.047	7975.048	7974.752	7974.752	7974.667	7975.548	7975.548	7976.532	7976.574	7974.642	7976.55	7974.667	7975.593	7975.573	7976.609	7976.569
Elevation (m ASL)	44	55	49	57	51	58	54	44	46	0	0	54	0	53	43	45	0	0
Power Rating	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
# of Units																		
Sigma y (m)	2	2	2	2	2	2	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Sigma z (m)	2.00	2.00	2.00	2.00	2.00	2.00	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Release Height (m)	5	5	5	5	5	5	6	6	6	6	6	1	1	1	1	1	1	1
Source of Emission Rates	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles
Emission Rates (g/s)																		
NOx	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PM2.5 (Combustion)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TSP (Fugitive) / PM10 (Fugitive) / PM2.5 (Fugitive)	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File

APPENDIX 5C-4-2

EMISSION INVENTORY FOR THE MINE SITE OPERATIONS

Emission Inventory for the Mine Site Operations

This appendix summarizes the information used to develop the emission inventory for Mine Site operations. The project base quantities, source parameters, emission factors and other assumptions used to develop the emission rate inputs for modelling are presented in Table 5C-4-2-1.

All references to AP-42 refer to the United States Environmental Protection Agency's (U.S. EPA) AP-42 emission factor documentation.

Table 5C-4-2-1: Combustion Emission Factors and Base Quantities Used to Develop the Mine Site Emission Inventory

Power Generation – Arctic Diesel Generators (Caterpillar CM32)	
Emission factors	• AP-42 Ch. 3.4 was used to calculate SO_2 emissions from the power generators at the Mine Site • Manufacturer specification sheet was used to calculate NO_x, CO and $PM_{2.5}$ emissions • All particulate matter was assumed to be in the $PM_{2.5}$ size fraction
Base quantities	• The Mine Site has 5 generators (3 operating, 1 standby and 1 backup), each with a power rating of 5,590kW • Arctic Diesel with molecular mass of 226 g/mole with ultra-low sulphur fuel (i.e., 0.4 % fuel sulphur) will be used
Source parameters	• Stack heights of 30 m confirmed by RWDI through preliminary stack height modelling • Stack diameters of 1.09 m were calculated based on an assumed exit velocity of 15.24 m/s and from flow-rates derived from engine specification sheet • Exhaust exit temperature is 320 ºC for the generators based on the manufacturer specification sheet
Emission controls	• No emission controls were assumed
Schedule of Operations	• 3 generators will operate 24 hours a day, 7 days a week
Power Generation – Back-up Emergency Boilers (Cleaver Brooks)	
Emission factors	• AP-42 Ch. 1.3 was used to calculate NO_x, SO_2, CO and $PM_{2.5}$ emissions from the power generators. • All particulate matter was assumed to be in the $PM_{2.5}$ size fraction
Base quantities	• The Mine Site has a total of two-4.8 million BTU/hr Cleaver Brooks emergency boilers.
Source parameters	• Stack heights of 30 m assumed in the assessment, based on preliminary stack height modelling • Stack diameters of 0.05 m were calculated based on an assumed exit velocity of 15.24 m/s and from calculated flow rates • Exhaust exit temperature is 175 ºC was assumed for the boilers
Emission controls	• No emission controls were assumed
Schedule of Operations	• Boilers used for back up heat generation only and were therefore not included in the air quality impact assessment as the operation of the generators results in higher emissions compared to the boilers.

Dust Collectors	
Emission factors	• Dust collectors are vented back into the building, therefore are considered insignificant
Base quantities	
Source parameters	
Emission controls	
Railway	
Emission factors	• US EPA Technical Highlights: Emission Factors for Locomotives document was used to generate NO_x, CO and PM emissions. Table 9 – Fleet Average Emission Factor for All Locomotives for Year 2016 were used. • SO_2 emissions were taken from a previous study conducted by RWDI in 1995.
Base quantities	• The trains will have 4400bhp engines, 2 locomotives and 110 wagons per train • Design speed of 75km/hour (60 km/hour scenario more plausible) • Transfer rate to load wagons: 6,000 tonnes per hour • Unloading rate: 1 minute per wagon
Source parameters	• Stack heights of 4.0 m above ground level were based on previous studies conducted by RWDI • Stack diameters of 0.5 m, exit velocity of 21.4 m/s, flow rate of 4.2m³/s and exhaust exit temperature of 149 ºC were based on previous studies conducted by RWDI
Emission controls	• No emission controls were assumed
Schedule of Operations	• 6 trains per day will travel the railway corridor (145 km) between the Mine Site and Steensby Port.
Aircraft	
Emission factors	• Based on the Federal Aviation Administration's (FAA) emission inventory for aircraft entitled Emissions and Dispersion Modeling System (EDMS) for inventory purposes only.
Base quantities	• During operations, Cessnas will be bringing in workers to the Mine Site. • 737 200C combination (freight + people) • Bell Ranger helicopters
Source parameters	• The aircraft sources were not quantified. Specific source parameters not required.
Emission controls	• No emission controls were assumed
Schedule of Operations	• 104 flights per year to the Mine Site (737s) • A few Cessna flights every two weeks to coincide with shift changes • Up to 4 helicopter flights per day. • Due to intermittent nature of flights, the air quality impacts were not quantified explicitly.
Incinerator	
Emission factors	• From "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer" Report, prepared by Eco Waste Solution, provided by Aker September 2007.
Base quantities	• Burns 1,000 kg/day

Source parameters	• Average flow rate of 1.13m³/s, velocity of 6.15m/s and exhaust temperature of 679°C were provided in "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer" Report, prepared by Eco Waste Solution, provided by Aker September 2007. • Stack diameter of 0.48m was calculated using the average flow rate and velocity.
Emission controls	• No emission controls were assumed
Schedule of Operations	• Assumed to operate 24 hours per day, 7 days a week.
Blasting, Grading and Dozing	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from blasting, grading and dozing operations were estimated using AP-42 11.9
Base quantities	Blasting: • Total area of blast is 4,000m^2, with a top area of 40m^2 and a face of 100m^2 • The blasting will occur approximately every day (94 blasts simultaneously covering a blast area of 100m x 40m). 283 blasts per year are required (283 * 94 = 26602 blasts per year). Grading: • 2 graders (CAT-16H) will be operating simultaneously Dozing: • 3 track dozers (CAT D9 and D10) and 2 wheel dozers (CAT834) will be operating simultaneously
Source parameters	Blasting: • Total area of blast is 4,000m^2, with a top area of 40m^2 and a face of 100m^2 The blasting will occur approximately every day (94 blasts simultaneously covering a blast area of 100m x 40m). 283 blasts per year are required. Grading: • The mean vehicle speed used for graders is 30 km/hour. Dozing: • Material silt content of 1.2% based on bulk sampling conducted by RWDI. • Moisture content of 0.1% based on bulk sampling. • Material flow of 70,000 tonnes per day (21,000,000 tonnes per year/300 days)
Emission controls	• No emission controls were assumed for blasting, grading and dozing.
Schedule of Operations	• One blast per day, assumed to occur at 4 pm (to coincide with shift change), 365 days per year. • Grading and dozing operations were assumed to occur 20 hours per day, 7 days per week.
Processing Operations – Drilling	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from drilling were estimated using AP-42 11.19.2.1 • Wet drilling emission factors are used since there are no dry drilling emission factors.
Base quantities	• Processing 21,000,000 tonnes per year
Source parameters	• Material handled from drilling was calculated using the volume of a cylinder • Blasting hole diameter is 9 inches (0.2286 m), assumed a drilling depth of 30m and a density provided by Aker Kvaerner (Process Design Criteria) of 2,620kg/m^3 (3.2 tonnes/hour).

Emission controls	• Drills are equipped with dust collectors
Schedule of Operations	• 20 hours a day, 7 days a week
Bulk Material Handling	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from bulk material handling operations were estimated using AP-42 13.2.4
Base quantities	• The following sources and corresponding parameters are included in the modelling:

ID [2]	Process	Material Handled (Hourly) (Mg)	Material Handled (Daily) (Mg)	Material Handled (Annual) (Mg)	Site Specific Data (y/n)	Silt Content (%)	Moisture Content (%)
MINE SITE							
2300-CH-001	Fines Yard Tripper Chute	1315	26,300	7,890,000	y	7.0%	4.8%
2300-CH-002	Lump Yard Tripper Chute	3200	64,000	19,200,000	y	9.5%	5.4%
2300-CH-012	Lump Yard Tripper Conveyor Feed Chute	3,200	64,000	19,200,000	y	9.5%	5.4%
2300-CH-014	Fine/Lump Reclaimer Discharge Chute	3,450	69,000	20,700,000	y	9.5%	5.4%
2300-CH-015	Product Reclaim Conveyor Feed Chute	3,450	69,000	20,700,000	y	9.5%	5.4%
2300-CH-024	Lump Tripper Chute	2834	56,680	17,004,000	y	9.5%	5.4%
2300-RC-006	Fine/Lump Reclaimer 1	3,450	69,000	20,700,000	y	9.5%	5.4%
2300-RC-007	Fine/Lump Reclaimer 2	3,450	69,000	20,700,000	y	9.5%	5.4%
2300-SK-002	Fines Mobile Stacker	1,315	26,300	7,890,000	y	7.0%	4.8%
2300-SK-004	Lump Mobile Stacker	3,200	64,000	19,200,000	y	9.5%	5.4%
2300-SK-005	Lump Mobile Stacker 2	3,200	64,000	19,200,000	y	9.5%	5.4%
TRSTCK1*	Lump/Fine Stacker 1	600	14,400	4,320,000	y	9.5%	5.4%
TRSTCK2*	Lump/Fine Stacker 2	600	14,400	4,320,000	y	9.5%	5.4%
TRRC1*	Lump/Fine Loader 1	1,000	24,000	7,200,000	y	9.5%	5.4%
TRSCHUT1*	Lump/Fine Stacker Discharge Chute 1	600	14,400	4,320,000	y	9.5%	5.4%
TRSCHUT2*	Lump/Fine Stacker Discharge Chute 2	600	14,400	4,320,000	y	9.5%	5.4%
TRRCHUT1*	Lump/Fine Loader Discharge Chute 1	600	14,400	4,320,000	y	9.5%	5.4%
TRCCHUT1*	Truck Discharge Chute 1	422	10,125	3,037,500	y	9.5%	5.4%

1. "*" These sources are added for trucking stockpile material handling in 2010 modelling scenario.

2. Green segment represents material handling emission sources included in both 2008 and 2010 modelling scenarios.

Bulk Material Handling (Cont'd)	
Emission controls	• No emission controls were assumed
Schedule of Operations	• 20 hours a day, 7 days a week.

Stockpiles (Mine Site for Rail Transport to Steensby Port)	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from stockpiles were estimated using AP-42 13.2.5
Base quantities	• Off spec fine stockpile is 100,000 tonnes • Fines stockpile is 300,000 tonnes • Off spec lump stockpile is 300,000 tonnes • Lump stockpile is 700,000 tonnes
Source parameters	• Surface roughness length of 0.003 m was applied in the calculations. • Threshold velocity for iron ore was estimated to be 6.94 m/s based on bulk sampling program conducted by RWDI. • Emission rates calculated on an hourly basis to vary according to wind speeds
Emission controls	• No emission controls were assumed
Schedule of Operations	• 24-hours per day, 7 days per week
Stockpiles (Trucking Option for Transport to Milne Port)	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from stockpiles were estimated using AP-42 13.2.5
Base quantities	• Two lump stockpiles, each having a capacity of 21,600 tonnes • Two fine stockpiles, each having a capacity of 21,600 tonnes
Source parameters	• Surface roughness length of 0.003 m was applied in the calculations. • Threshold velocity for iron ore was estimated to be 6.94 m/s based on bulk sampling program conducted by RWDI. • Emission rates calculated on an hourly basis to vary according to wind speeds
Emission controls	• No emission controls were assumed
Schedule of Operations	• 24-hours per day, 7 days per week
Truck Operation (From Crusher to Trucking Option Stockpiles)	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from stockpiles were estimated using AP-42 13.2.2 • NO_x, SO_2, and CO emissions are from the U.S. EPA Tier II/III Standards Document Entitled: Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines (http://www.epa.gov/otaq/cert/hd-cert/stds-eng.pdf).
Base quantities	• Eight (8) 55 ton trucks • Mean vehicle speed of 30 km/hour • Total distance travelled per pass is 1.12 km
Source parameters	• Modelled as a series of area sources • The maximum length to width ratio for the area sources was 10:1 with an effective height of 4 m and an initial sigma z of 2 m
Emission controls	• A 50% emission controls were assumed due to the road maintenance using chemical suppression ($CaCl_2$)
Schedule of Operations	• Operates 24 hours a day and 300 days per year

<table>
<tr><td colspan="2">Truck Operation (From Trucking Option Stock Piles to Milne Inlet Stock Piles)</td></tr>
<tr><td>Emission factors</td><td>• $PM_{2.5}$, PM_{10}, TSP emissions from stockpiles were estimated using AP-42 13.2.2
• NO_x, SO_2, and CO emissions are from the U.S. EPA Tier II/III Standards Document Entitled: Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines (http://www.epa.gov/otaq/cert/hd-cert/stds-eng.pdf).</td></tr>
<tr><td>Base quantities</td><td>• Twenty two (22) 120 ton trucks
• Mean vehicle speed of 30 km/hour
• Total distance travelled per pass is 100 km</td></tr>
<tr><td>Source parameters</td><td>• Modelled as a series of area sources
• The maximum length to width ratio for the area sources was 10:1 with an effective height of 4 m and an initial sigma z of 2 m</td></tr>
<tr><td>Emission controls</td><td>• A 50% emission controls were assumed due to the road maintenance using chemical suppression ($CaCl_2$)</td></tr>
<tr><td>Schedule of Operations</td><td>• Operates 24 hours a day and 300 days per year</td></tr>
<tr><td colspan="2">Mobile Engine Emissions</td></tr>
<tr><td>Emission factors</td><td>• The generation of SO_2, NO_x, CO and $PM_{2.5}$ from the combustion of diesel fuel in diesel engines was considered
• U.S. EPA Tier II/III Non-Road CI standards were used to calculate emission rates for the off-road fleet
• U.S. EPA Heavy-Duty Highway Engine standards were used to calculate emissions for on-road equipment (i.e. pick-up trucks)
• All engine PM emissions were assumed to be in the $PM_{2.5}$ size fraction</td></tr>
<tr><td>Base quantities</td><td>• The equipment fleet in the table below was provided by Aker
<table>
<tr><th>Equipment Fleet</th><th>Availability</th><th>Average Vehicle Weight (tons)</th><th>Power Rating (kW)</th></tr>
<tr><td>• Production Drills - Atlas Copco_V-271</td><td>3</td><td>75</td><td>555</td></tr>
<tr><td>• Drills - Atlas Copco D9-11</td><td>2</td><td>75*</td><td>555</td></tr>
<tr><td>• Hydraulic Shovel - O&K RH200</td><td>3</td><td>235*</td><td>1880</td></tr>
<tr><td>• Loader - CAT994</td><td>1</td><td>56</td><td>1176</td></tr>
<tr><td>• Truck - CAT793 220t</td><td>17</td><td>235</td><td>1801</td></tr>
<tr><td>• Trackdozer - CATD9 and D10</td><td>3</td><td>57.5</td><td>370</td></tr>
<tr><td>• Wheeldozer - CAT834</td><td>2</td><td>47</td><td>372</td></tr>
<tr><td>• Grader - CAT16H</td><td>2</td><td>25</td><td>198</td></tr>
<tr><td>• Watercart - 5000 Gallon Trucks</td><td>2</td><td>72.5</td><td>550*</td></tr>
<tr><td>• Backhoe - CAT385</td><td>1</td><td>85</td><td>382</td></tr>
<tr><td>• Service Truck</td><td>2</td><td>12*</td><td>200*</td></tr>
<tr><td>• Tire Handler - CAT996</td><td>1</td><td>10</td><td>195</td></tr>
<tr><td>• Pickup Truck - 4-5L engine</td><td>9</td><td>8*</td><td>190*</td></tr>
</table>
NOTES: * - values not provided therefore some assumptions were made
• Arctic Diesel with molecular mass of 226 g/mole with ultra-low sulphur fuel (i.e., 0.4 % fuel sulphur) will be used</td></tr>
<tr><td>Source parameters</td><td>• Power ratings and availability of vehicles</td></tr>
</table>

Emission controls	• No emission controls were assumed
Schedule of operations	• 20 hours a day, 7 days a week
Haul Road Emissions (CAT793)	
Emission factors	• Dust generation from vehicular activity on surface roads was considered • AP-42 13.2.2 was used to calculate $PM_{2.5}$, PM_{10} and TSP emissions
Base quantities	• Seventeen (17) 220 tonnes CAT793 (see Mobile Engine Emissions) • A silt content of 5.2% was applied based on bulk sampling.
Source parameters	• Unpaved industrial roads
Emission controls	• No emission controls were assumed
Schedule of Operations	• 24 hours a day, 7 days a week

Tables 5C-4-2-2, 5C-4-2-3 and 5C-4-2-4 provide a summary of the source parameters applied in the CALPUFF modelling for the point, area, and volume sources, respectively.

Table 5C-4-2-2: Mine Site Point Sources

Source Description	Generators					Incinerator
Source Name	**MR_GEN01**	**MR_GEN02**	**MR_GEN03**	**MR_GEN04**	**MR_GEN05**	**MR_INCIN**
Power Rating	5590 kW	5590 kW	5590 kW	5590 kW	5590 kW	1000 kg/day
# of Units	1	1	1	1	1	1
Stack Height Above Grade (m)	30	30	30	30	30	17.3
Stack Height Above Roof (m)	18	18	18	18	18	
Stack Flow Rate (m^3/s)	14.13	14.13	14.13	14.13	14.13	1.127
Stack Diameter (m)	1.09	1.09	1.09	1.09	1.09	0.48
Exit Temperature (K)	593	593	593	593	593	952
Exit Velocity (m/s)	15.24	15.24	15.24	15.24	15.24	6.15
Source of Emissions	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	From "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer Report". Provided by Aker Sept 2007.
Emission Rates (g/s)						
NOx	31.87	31.87	31.87	31.87	31.87	2.97E-02
SO2	0.97	0.97	0.97	0.97	0.97	4.62E-04
SO3	0.038	0.038	0.038	0.038	0.038	1.82E-05
SO4	0.031	0.031	0.031	0.031	0.031	1.46E-05
CO	0.65	0.65	0.65	0.65	0.65	1.45E-03
PM	0.02	0.02	0.02	0.02	0.02	1.18E-02
HCl	N/A	N/A	N/A	N/A	N/A	1.77E-01
HF	N/A	N/A	N/A	N/A	N/A	3.38E-03
Mercury	N/A	N/A	N/A	N/A	N/A	3.31E-05
Antimony	N/A	N/A	N/A	N/A	N/A	8.10E-05
Arsenic	N/A	N/A	N/A	N/A	N/A	1.46E-06
Barium	N/A	N/A	N/A	N/A	N/A	3.27E-06
Beryllium	N/A	N/A	N/A	N/A	N/A	0.00E+00
Cadmium	N/A	N/A	N/A	N/A	N/A	1.35E-04
Chromium	N/A	N/A	N/A	N/A	N/A	5.98E-05
Cobalt	N/A	N/A	N/A	N/A	N/A	3.38E-07
Copper	N/A	N/A	N/A	N/A	N/A	2.41E-04
Lead	N/A	N/A	N/A	N/A	N/A	2.77E-04
Manganese	N/A	N/A	N/A	N/A	N/A	1.62E-05
Nickel	N/A	N/A	N/A	N/A	N/A	5.97E-06
Selenium	N/A	N/A	N/A	N/A	N/A	3.16E-06
Silver	N/A	N/A	N/A	N/A	N/A	4.17E-06
Thallium	N/A	N/A	N/A	N/A	N/A	0.00E+00
Zinc	N/A	N/A	N/A	N/A	N/A	1.58E-04
Dioxins and Furans	N/A	N/A	N/A	N/A	N/A	
2378-T4CDD	N/A	N/A	N/A	N/A	N/A	1.89E-12
12378-P5CDD	N/A	N/A	N/A	N/A	N/A	1.78E-12
123478-H6CDD	N/A	N/A	N/A	N/A	N/A	4.88E-13
123678-H6CDD	N/A	N/A	N/A	N/A	N/A	7.29E-13
123789-H6CDD	N/A	N/A	N/A	N/A	N/A	1.32E-12
1234678-H7CDD	N/A	N/A	N/A	N/A	N/A	7.51E-13
OCDD	N/A	N/A	N/A	N/A	N/A	1.50E-13
2378-T4CDF	N/A	N/A	N/A	N/A	N/A	4.36E-12
12378-P5CDF	N/A	N/A	N/A	N/A	N/A	5.86E-13
23478-P5CDF	N/A	N/A	N/A	N/A	N/A	1.21E-11
123478-H6CDF	N/A	N/A	N/A	N/A	N/A	7.08E-12
123678-H6CDF	N/A	N/A	N/A	N/A	N/A	2.96E-12
234678-H6CDF	N/A	N/A	N/A	N/A	N/A	6.47E-12
123789-H6CDF	N/A	N/A	N/A	N/A	N/A	5.48E-13
1234678-H7CDF	N/A	N/A	N/A	N/A	N/A	1.62E-12
1234789-H7CDF	N/A	N/A	N/A	N/A	N/A	6.76E-13
OCDF	N/A	N/A	N/A	N/A	N/A	3.12E-13
Total Dioxins and Furans	N/A	N/A	N/A	N/A	N/A	4.38E-11
Chlorobenzenes and Octachlorostyrene	N/A	N/A	N/A	N/A	N/A	
1,2,3,5-Tetrachlorobenzene	N/A	N/A	N/A	N/A	N/A	5.11E-09
1,2,4,5-Tetrachlorobenzene	N/A	N/A	N/A	N/A	N/A	1.62E-09
1,2,3,4-Tetrachlorobenzene	N/A	N/A	N/A	N/A	N/A	4.21E-09
Pentachlorobenzene	N/A	N/A	N/A	N/A	N/A	8.30E-09
Hexachlorobenzene	N/A	N/A	N/A	N/A	N/A	3.16E-09
Total Selected CBs	N/A	N/A	N/A	N/A	N/A	2.24E-08
Octachlorostyrene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Polycyclic Aromatic Hydrocarbons (PAHs)	N/A	N/A	N/A	N/A	N/A	
Acenapthylene	N/A	N/A	N/A	N/A	N/A	6.01E-10
Acenpthene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Fluorene	N/A	N/A	N/A	N/A	N/A	1.43E-09
2-Methyl-Fluorene	N/A	N/A	N/A	N/A	N/A	1.43E-09

Table 5C-4-2-2: Mine Site Point Sources

Source Description	Generators					Incinerator
Source Name	**MR_GEN01**	**MR_GEN02**	**MR_GEN03**	**MR_GEN04**	**MR_GEN05**	**MR_INCIN**
Phenenthrene	N/A	N/A	N/A	N/A	N/A	1.25E-08
Anthracene	N/A	N/A	N/A	N/A	N/A	9.01E-10
Fluoranthene	N/A	N/A	N/A	N/A	N/A	3.61E-09
Pyrene	N/A	N/A	N/A	N/A	N/A	2.97E-09
Retene	N/A	N/A	N/A	N/A	N/A	4.36E-09
Benzo(a)Fluorene	N/A	N/A	N/A	N/A	N/A	1.50E-10
Benzo(b)Fluorene	N/A	N/A	N/A	N/A	N/A	0.00E+00
1-Methyl-Pyrene	N/A	N/A	N/A	N/A	N/A	1.13E-10
Benzo(g,h,i)Fluoranthene	N/A	N/A	N/A	N/A	N/A	1.13E-10
Benzo(a)Anthrecene	N/A	N/A	N/A	N/A	N/A	3.38E-10
Triphenylene	N/A	N/A	N/A	N/A	N/A	3.00E-10
Chrysene	N/A	N/A	N/A	N/A	N/A	8.26E-10
7-Methyl-Benzo(a)Anthracene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Benzo(b)Fluoranthene	N/A	N/A	N/A	N/A	N/A	1.65E-09
Benzo(k)Fluoranthene	N/A	N/A	N/A	N/A	N/A	1.88E-10
Benzo(e)Pyrene	N/A	N/A	N/A	N/A	N/A	6.01E-10
Benzo(a)Pyrene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Perylene	N/A	N/A	N/A	N/A	N/A	0.00E+00
3-Methyl-Cholanthrene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Indeno(1,2,3-cd)Pyrene	N/A	N/A	N/A	N/A	N/A	4.88E-10
Dibenzo(a,h)Anthracene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Benzo(b)Chrysene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Benzo(g,h,i)Perylene	N/A	N/A	N/A	N/A	N/A	3.38E-10
Anthanthrene	N/A	N/A	N/A	N/A	N/A	0.00E+00
Total PAHs	N/A	N/A	N/A	N/A	N/A	3.31E-08
Selected Volatile Organic Compounds (VOCs)	N/A	N/A	N/A	N/A	N/A	
Chloromethane	N/A	N/A	N/A	N/A	N/A	2.14E-06
Vinyl Chloride	N/A	N/A	N/A	N/A	N/A	7.21E-07
1,3-Butadiene	N/A	N/A	N/A	N/A	N/A	2.06E-06
Dichloromethane	N/A	N/A	N/A	N/A	N/A	2.39E-06
Benzene	N/A	N/A	N/A	N/A	N/A	2.02E-05
Toluene	N/A	N/A	N/A	N/A	N/A	2.57E-03
Chlorobenzene	N/A	N/A	N/A	N/A	N/A	8.23E-07
Ethylbenzene	N/A	N/A	N/A	N/A	N/A	4.17E-06

Notes:

1. Three (3) of the generators out of the five (5) listed here were modelled as they operate continuously; out of the remaining generators, one (1) is standby and another is backup

Total (ton/year)

Table 5C-4-2-3 Mine Site Area Sources

Source Description	AREA1	AREA2			AREA 3												AREA4 - AREA16	AREA17 - AREA86	AREA90 - AREA120
					Mobile												Material Transport through Tote Road		
Source Name	Blasting	Grading	Dozing	Drilling	Production Drills - Atlas Copco_V-271	Drills - Atlas Copco D9-11	Hydraulic Shovel - O&K RH200	Loader - CAT994	Trackdozer - CATD9 and D10	Wheeldozer - CAT834	Grader - CAT16H	Watercart - 5000 Gallon Trucks	Backhoe - CAT385	Service Truck	Tire Handler - CAT996	Pickup Truck - 4-5L engine	Haul Truck -55 Tons (From Crusher to Trucking Stockpile)	Haul Truck -120 Tons (From Crusher to Trucking Stockpile)	Truck - CAT793 220t
Sigma z (m)	10.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Release Height (m) [Fugitive]	0	1	1	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Source of Emission Rates	US EPA AP-42 Ch 11.9 Western Surface Coal Mining	US EPA AP-42 Ch 11.9 Western Surface Coal Mining	US EPA AP-42 Ch 11.9 Western Surface Coal Mining	US EPA AP-42 Ch 11.19.2.1	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads	Combustion from: US EPA AP-42 Ch 3.4 for SO2 and from US EPA TierII/III Standards Document. PM: US EPA AP-42 Ch 13.2.2 Unpaved Roads
Emission Rates (g/s)																			
NOx	N/A	N/A	N/A	N/A	1.67E+00	3.36E-01	9.40E+00	1.96E+00	1.11E+00	7.44E-01	3.96E-01	5.80E-01	3.82E-01	4.40E-01	1.95E-01	1.67E+00	4.42E+00	3.97E+01	5.10E+01
SO2	N/A	N/A	N/A	N/A	9.10E-03	1.84E-03	3.08E-02	6.43E-03	6.06E-03	4.07E-03	2.17E-03	3.17E-03	2.09E-03	2.41E-03	1.07E-03	9.10E-03	2.41E-02	1.30E-01	1.67E-01
SO3	N/A	N/A	N/A	N/A	3.59E-04	7.25E-05	1.22E-03	2.54E-04	2.39E-04	1.61E-04	8.55E-05	1.25E-04	8.24E-05	9.50E-05	4.21E-05	3.59E-04	9.53E-04	5.14E-03	6.61E-03
SO4	N/A	N/A	N/A	N/A	2.87E-04	5.80E-05	9.74E-04	2.03E-04	1.91E-04	1.28E-04	6.84E-05	1.00E-04	6.60E-05	7.60E-05	3.37E-05	2.87E-04	7.62E-04	4.11E-03	5.29E-03
CO	N/A	N/A	N/A	N/A	1.62E+00	3.27E-01	5.48E+00	1.14E+00	1.08E+00	7.23E-01	3.85E-01	5.64E-01	3.71E-01	4.28E-01	1.90E-01	1.62E+00	4.29E+00	2.31E+01	2.98E+01
PM2.5 (Combustion)	N/A	N/A	N/A	N/A	9.25E-02	1.87E-02	3.13E-01	6.53E-02	6.16E-02	4.13E-02	2.20E-02	3.22E-02	2.12E-02	2.44E-02	1.08E-02	9.25E-02	2.45E-01	1.32E+00	1.70E+00
TSP (Fugitive)	1.55E+01	1.40E+02	1.79E+01	2.26E-04	8.19E+01	2.77E+01	2.18E+02	2.39E+01	7.26E+01	4.42E+01	3.33E+01	5.37E+01	2.89E+01	9.39E+00	1.10E+01	3.52E+01	6.72E+00	3.93E+02	6.14E+01
PM10 (Fugitive)	8.04E+00	2.52E+01	3.10E+00	1.08E-04	2.12E+01	7.18E+00	5.64E+01	6.20E+00	1.88E+01	1.15E+01	8.62E+00	1.39E+01	7.48E+00	2.43E+00	2.85E+00	9.11E+00	1.74E+00	1.02E+02	1.59E+01
PM2.5 (Fugitive)	4.64E-01	4.33E+00	1.88E+00	1.61E-05	2.12E+00	7.18E-01	5.64E+00	6.20E-01	1.88E+00	1.15E+00	8.62E-01	1.39E+00	7.48E-01	2.43E-01	2.85E-01	9.11E-01	1.70E-01	1.02E+01	1.59E+00
Emission Rates (g/m2-s)																			
NOx	N/A	N/A	N/A	N/A	4.16E-04	8.40E-05	2.35E-03	4.90E-04	2.77E-04	1.86E-04	9.90E-05	1.45E-04	9.55E-05	1.10E-04	4.88E-05	4.16E-04	3.94E-04	3.97E-05	1.83E-03
NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NO2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NO3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO2	N/A	N/A	N/A	N/A	2.28E-06	4.59E-07	7.71E-06	1.61E-06	1.52E-06	1.02E-06	5.41E-07	7.93E-07	5.22E-07	6.01E-07	2.67E-07	2.28E-06	2.16E-06	1.30E-07	6.00E-06
SO3	N/A	N/A	N/A	N/A	8.98E-08	1.81E-08	3.04E-07	6.35E-08	5.98E-08	4.01E-08	2.14E-08	3.13E-08	2.06E-08	2.37E-08	1.05E-08	8.98E-08	N/A	N/A	N/A
SO4	N/A	N/A	N/A	N/A	7.19E-08	1.45E-08	2.43E-07	5.08E-08	4.78E-08	3.21E-08	1.71E-08	2.50E-08	1.65E-08	1.90E-08	8.42E-09	7.19E-08	N/A	N/A	N/A
CO	N/A	N/A	N/A	N/A	4.05E-04	8.17E-05	1.37E-03	2.86E-04	2.69E-04	1.81E-04	9.63E-05	1.41E-04	9.28E-05	1.07E-04	4.74E-05	4.05E-04	3.83E-04	2.31E-05	1.07E-03
PM2.5 (Combustion)	N/A	N/A	N/A	N/A	2.31E-05	4.67E-06	7.83E-05	1.63E-05	1.54E-05	1.03E-05	5.50E-06	8.06E-06	5.31E-06	6.11E-06	2.71E-06	2.31E-05	2.19E-05	1.32E-06	5.70E-05
TSP (Fugitive)	3.87E-03	3.49E-02	4.48E-03	5.65E-08	2.05E-02	6.93E-03	5.45E-02	5.98E-03	1.82E-02	1.11E-02	8.32E-03	1.34E-02	7.22E-03	2.35E-03	2.76E-03	8.80E-03	6.00E-04	3.93E-04	2.20E-03
PM10 (Fugitive)	2.01E-03	6.30E-03	7.75E-04	2.69E-08	5.30E-03	1.79E-03	1.41E-02	1.55E-03	4.70E-03	2.86E-03	2.16E-03	3.48E-03	1.87E-03	6.08E-04	7.13E-04	2.28E-03	1.55E-04	1.02E-04	5.70E-04
PM2.5 (Fugitive)	1.16E-04	1.08E-03	4.70E-04	4.03E-09	5.30E-04	1.79E-04	1.41E-03	1.55E-04	4.70E-04	2.86E-04	2.16E-04	3.48E-04	1.87E-04	6.08E-05	7.14E-05	2.28E-04	1.52E-05	1.02E-05	6.10E-05

Table 5C-4-2-4: Mine Site Volume Sources

Source Description	Railway	Off Spec Fine Stockpile	Fines Stockpile	Off Spec Lump Stockpile	Lump Stockpile	Lump Stockpile (Trucking Operation)	Lump Stockpile (Trucking Operation)	Fines Stockpile (Trucking Operation)	Fines Stockpile (Trucking Operation)
Source Name	**MR_RAIL**	**MRFine**	**MR1/4**	**MROffLump**	**MRLump**	**TRLUMP1**	**TRLUMP2**	**TRFINE1**	**TRFINE2**
Source Name	**VOL1**	**VOL2**	**VOL3**	**VOL4**	**VOL5**	**TRLUMP1**	**TRLUMP2**	**TRFINE1**	**TRFINE2**
Location [X-coord] (km)	562.394	562.386	562.285	562.456	562.29	561.712	561.725	561.778	561.845
Location [Y-coord] (km)	7912.098	7912.277	7912.276	7912.458	7912.53	7912.82	7912.754	7912.884	7912.878
Elevation (m ASL)	188	213	213	217	213	206	210	205	206
Power Rating	4400 hp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
# of Units	2 locos with 110 wagons								
Sigma y (m)	0.9	2	2	2	2	2	2	2	2
Sigma z (m)	1.40	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Release Height (m)	3	5	5	5	5	5	5	5	5
Source of Emission Rates	Previous RWDI studies	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion
Emission Rates (g/s)									
NOx	0.388	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO2	0.0325	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO3	0.0013	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO4	0.0010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO	0.167	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PM2.5 (Combustion)	0.021	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TSP (Fugitive)	N/A	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File
PM10 (Fugitive)	N/A								
PM2.5 (Fugitive)	N/A								

Table 5C-4-2-4: Mine Site Volume Sources

Source Description	Fines Mobile Stacker	Lump/Fine Stacker (Trucking Option)	Lump/Fine Stacker (Trucking Option)	Fine/Lump Reclaimer 1	Fine/Lump Reclaimer 2	Lump/Fine Loader (Trucking Option)	Lump/Fine Stacker Discharge Chute (Trucking Option)	Lump/Fine Stacker Discharge Chute (Trucking Option)	Lump/Fine Loader Discharge Chute (Trucking Option)	Truck Discharge Chute (Trucking Option)	Fine/Lump Reclaimer Discharge Chute	Product Reclaim Conveyor Feed Chute
Source Name	**2300-SK-002**	**TRSTCK1**	**TRSTCK2**	**2300-RC-006**	**2300-RC-007**	**TRL1**	**TRSCHUT1**	**TRSCHUT2**	**TRLCHUT1**	**TRCHUT1**	**2300-CH-014**	**2300-CH-015**
Source Name	**VOL6**	**TRSTCK1**	**TRSTCK2**	**VOL7**	**VOL8**	**TRL1**	**TRSCHUT1**	**TRSCHUT2**	**TRLCHUT1**	**TRCHUT1**	**VOL9**	**VOL10**
Location [X-coord] (km)	562.2339	561.735	561.809	562.331	562.45	561.856	561.709	561.785	561.782	562.025	562.403	562.519
Location [Y-coord] (km)	7912.268	7912.791	7912.866	7912.178	7912.307	7912.887	7912.817	7912.891	7912.905	7912.902	7912.111	7912.244
Northwest Corner [X-coord] (m)	562290.3768			562127.15	562390.3327	562390.3327					562419.8622	562097.8645
Northwest Corner [Y-coord] (m)	7912558.314			7912712.246	7912359.715	7912359.715					7912392.966	7912679.003
Southeast corner [X-coord] (m)	562293.4292			562132.8717	562396.0474	562396.0474					562425.577	562103.5792
Southeast corner [Y-coord] (m)	7912558.505			7912712.584	7912360.053	7912360.053					7912393.304	7912679.341
Southwest Corner [X-coord] (m)	562291.8598			562130.1834	562393.359	562393.359					562422.8886	562100.8908
Southwest Corner [Y-coord] (m)	7912556.881			7912709.558	7912357.027	7912357.027					7912390.278	7912676.314
Elevation (m ASL)	213	209	206	209	214	207	206	205	208	216	206	212
Power Rating	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
# of Units												
Sigma y (m)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Sigma z (m)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Release Height (m)	6	6	6	6	6	6	6	6	1	1	1	1
Source of Emission Rates	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles
Emission Rates (g/s)												
NOx	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PM2.5 (Combustion)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TSP (Fugitive) PM10 (Fugitive) PM2.5 (Fugitive)	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File

Table 5C-4-2-4: Mine Site Volume Sources

Source Description	Lump Mobile Stacker	Lump Mobile Stacker 2	Lump Yard Tripper Conveyor Feed Chute	Lump Yard Tripper Chute	Fines Yard Tripper Chute	Lump Tripper Chute	Lump Yard Tripper and Tripper Conveyor	Fines Yard Tripper and Tripper Conveyor
Source Name	**2300-SK-004**	**2300-SK-005**	**2300-CH-012**	**2300-CH-002**	**2300-CH-001**	**2300-CH-024**	**2300-CV-003 and 2300-TR-003**	**2300-CV-001 and 2300-TR-001**
Source Name	**VOL11**	**VOL12**	**VOL13**	**VOL14**	**VOL15**	**VOL16**	**VOL17**	**VOL18**
Location [X-coord] (km)	562.404	562.26	562.564	562.237	562.323	562.441	562.605	562.453
Location [Y-coord] (km)	7912.467	7912.602	7912.301	7912.577	7912.237	7912.484	7912.354	7912.268
Northwest Corner [X-coord] (m)	562479.4036	562134.544	562559.6621	562503.2844	562317.5281	562111.0186	562504.9965	562319.3722
Northwest Corner [Y-coord] (m)	7912391.768	7912598.408	7912368.101	7912418.194	7912588.654	791257.3993	7912416.731	7912586.877
Southeast corner [X-coord] (m)	562482.456	562137.5964	562588.2032	562505.7683	562320.0121	562113.5025	562560.4359	562563.3476
Southeast corner [Y-coord] (m)	7912391.959	7912598.599	7912344.809	7912418.1	7912588.56	7912571.305	7912369.663	7912372.281
Southwest Corner [X-coord] (m)	562480.8866	562136.0269	562587.1588	562504.6423	562318.8861	562112.3765	562559.3423	562562.2548
Southwest Corner [Y-coord] (m)	7912390.335	7912596.975	7912343.669	7912416.855	7912587.315	7912570.06	7912368.408	7912371.331
Elevation (m ASL)	214	213	215	213	212	216	219	208
Power Rating	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
# of Units								
Sigma y (m)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Sigma z (m)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Release Height (m)	6	6	1	1	1	1	1	1
Source of Emission Rates	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 11.19.2.1 Crushed Stone Processing and Pulverized Mineral Processing	US EPA AP-42 Ch 11.19.2.1 Crushed Stone Processing and Pulverized Mineral Processing
Emission Rates (g/s)								
NOx	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PM2.5 (Combustion)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TSP (Fugitive)	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File
PM10 (Fugitive)								
PM2.5 (Fugitive)								

APPENDIX 5C-4-3

EMISSION INVENTORY FOR THE STEENSBY PORT OPERATIONS

Emission Inventory for the Steensby Port Operations

Table 1 summarizes the information used to develop the emission inventory for Steensby Port operations. The project base quantities, source parameters, emission factors and other assumptions used to develop the emission rate inputs for modelling are presented in Table 5C-4-3-1.

All references to AP-42 refer to the United States Environmental Protection Agency's (U.S. EPA) AP-42 emission factor documentation.

Table 5C-4-3-1: Combustion Emission Factors and Base Quantities Used to Develop the Steensby Port Emission Inventory

Power Generation – Arctic Diesel Generators (Caterpillar CM32)	
Emission factors	• AP-42 Ch. 3.4 was used to calculate SO_2 emissions from the power generators • Manufacturer specification sheet was used to calculate NO_x, CO and $PM_{2.5}$ emissions • All particulate matter was assumed to be in the $PM_{2.5}$ size fraction
Base quantities	• Steensby Port has 6 generators (4 operating and 2 standby), each with a power rating of 5,590kW • Arctic Diesel with molecular mass of 226 g/mole with ultra-low sulphur fuel (i.e., 0.4 % fuel sulphur) will be used
Source parameters	• Stack heights of 30 m confirmed by RWDI through preliminary stack height modelling. • Stack diameters of 1.09 m were calculated based on an assumed exit velocity of 15.24 m/s and from flow-rates (14.13m^3/s) derived from engine specification sheet. • Exhaust exit temperature is 320 ºC for the generators based on the manufacturer specification sheet
Emission controls	• No emission controls were assumed
Schedule of Operations	• 4 generators will operate 24 hours a day, 7 days a week.
Power Generation – Back-up Emergency Boilers (Cleaver Brooks)	
Emission factors	• AP-42 Ch. 1.3 was used to calculate NO_x, SO_2, CO and $PM_{2.5}$ emissions from the power generators • All particulate matter was assumed to be in the $PM_{2.5}$ size fraction
Base quantities	• Steensby Port has a total of two-4.0 million BTU/hr Cleaver Brooks emergency boilers.
Source parameters	• Stack heights of to be confirmed by RWDI through preliminary stack height modelling • Stack diameters of 0.04 m were calculated based on an assumed exit velocity of 15.24 m/s and from calculated flow rates • Exhaust exit temperature is 175 ºC was assumed for the boilers
Emission controls	• No emission controls were assumed
Schedule of Operations	• Boilers to be used for back up heat generation only and were therefore not included in the air quality impact assessment as the operation of the generators results in higher emissions

Dust Collectors	
Emission factors	• Dust collectors are vented back into the building, therefore are considered insignificant.
Base quantities	
Source parameters	
Emission controls	
Incinerator	
Emission factors	• From "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer" Report, prepared by Eco Waste Solution, provided by Aker September 2007.
Base quantities	• Burns 500 kg/day
Source parameters	• Average flow rate of 1.13m³/s, velocity of 6.15m/s and exhaust temperature of 679°C were provided in "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer" Report, prepared by Eco Waste Solution, provided by Aker September 2007. • Stack diameter of 0.48m was calculated using the average flow rate and velocity.
Emission controls	• No emission controls were assumed
Schedule of Operations	• 24 hours a day, 7 days a week.
Ships	
Emission factors	• AP-42 Ch. 3.4 was used to calculate NO_x, SO_2, CO and $PM_{2.5}$ emissions from the "hotel power" generator located on the ship. • Emission factors under ship operation were taken from BC Ocean Going Vessels inventory.
Base quantities	• Average of 12 ore carriers per month on a year round basis with up to 17 vessels per month in summer open-water season • Ore will be loaded onto the ships at a rate of about 12,000 tonnes per hour • 10 Polar Class 4 cape-size vessels with a capacity of 135,000 dry weight tonne will transport 90-95% of annual ore production to market. • Ships will be 300m long and 46m wide. • Ships will be equipped with a 2MW "hotel power" generator
Source parameters	<u>2MW Generator</u> • 20 m stack height • Stack diameters of 0.8 m were calculated based on an assumed exit velocity of 15.24 m/s and from typical 2MW generator flow-rates (7.14m³/s) • Exhaust exit temperature is assumed to be 320 ºC <u>22 MW Generator</u> • 20 m stack height • Stack diameters of 0.8 m • 25 m/s exit velocity based on flow-rates (12.57 m³/s) • Exhaust exit temperature is assumed to be 320 ºC
Emission controls	• No emission controls were assumed

Schedule of Operations	• Ship assumed to operate under the 22 MW scenario 24 hours a day, 7 days a week. This is a conservative assumption, but accounts for other auxiliary equipment operating in the port which was not explicitly modelled (e.g., tugs)
Railway	
Emission factors	• US EPA Technical Highlights: Emission Factors for Locomotives document was used to generate NO_x, CO and PM emissions. Table 9 – Fleet Average Emission Factor for All Locomotives for Year 2016 were used. • SO_2 emissions were taken from a previous study conducted by RWDI in 1995 (RWDI Project No. 95-288T-6)
Base quantities	• The trains will have 4400 bhp engines, 2 locomotives and 110 wagons per train • 6 trains per day will travel the railway corridor (145 km) between the Mine Site and Steensby Port. • Design speed of 75km/hour (60 km/h speed more plausible) • Transfer rate to load wagons: 6,000 tonnes per hour • Unloading rate: 1 minute per wagon
Source parameters	• Stack heights of 4.0 m above ground level were assumed • Stack diameters of 0.5 m, exit velocity of 21.4 m/s, flow rate of 4.2m³/s and exhaust exit temperature of 149 ºC were assumed
Emission controls	• No emission controls were assumed
Schedule of Operations	• 24 hours a day 7 days a week
Aircraft	
Emission factors	• The airstrip at Steensby Port will be used extensively during construction, its use will be limited during mining operations. Therefore, it was not included in the emissions inventory and dispersion modelling. • Helicopter pad will be for emergency use only once the mining operations begin
Base quantities	
Source parameters	
Emission controls	
Stockpiles	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from stockpiles were estimated using AP-42 13.2.5
Base quantities	• One (1) Lump stockpile having a capacity of 700,000 tonnes • One (1) Lump stockpile having a capacity of 2,000,000 tonnes • One (1) Lump stockpile having a capacity of 1,000,000 tonnes • One (1) Lump stockpile having a capacity of 1,000,000 tonnes
Source parameters	• Surface roughness length of 0.003 m was assumed
Emission controls	• No emission controls were assumed
Schedule of Operations	• Erosion can potentially occur 24 hours a day 7 days a week. • Threshold velocity of iron ore is 6.94 m/s based on bulk sampling conducted by RWDI

Bulk Material Handling	
Emission factors	• $PM_{2.5}$, PM_{10}, TSP emissions from bulk material handling operations were estimated using AP-42 13.2.4
Base quantities	• The following sources and corresponding source parameters are included in the assessment:
Emission controls	• No emission controls were assumed
Schedule of Operations	• 20 hours a day 7 days a week

ID [1]	Process	Material Handled (Hourly) (Mg)	Material Handled (Daily) (Mg)	Material Handled (Annual) (Mg)	Site Specific Data (y/n)	Silt Content (%)	Moisture Content (%)
4100-CH-034	Fines Tripper Discharge Chute	6900	138,000	41,400,000	y	7.0%	4.8%
4100-CH-036	Lump Tripper Discharge Chute	13800	276,000	82,800,000	y	9.5%	5.4%
4100-CH-041	Lump/Fine Stacker Twin boom Discharge Chute	6900	138,000	41,400,000	y	9.5%	5.4%
4100-SK-001	Lump/Fines Stacker	6900	138,000	41,400,000	y	7.0%	4.8%
4100-SK-002	Lump/Fine Stacker (Twin boom)	6,900	138,000	41,400,000	y	9.5%	5.4%
4200-CH-001	Reclaimer Discharge Chute	8000	160,000	48,000,000	y	9.5%	5.4%
4200-CH-006	Tripper Discharge Chute	13800	276,000	82,800,000	y	9.5%	5.4%
4200-RC-001	Reclaimer (Fines/Lump Product)	8000	160,000	48,000,000	y	9.5%	5.4%
4200-RC-002*	Reclaimer (Fines/Lump Product)	8000	160,000	48,000,000	y	9.5%	5.4%
4200-CH-002*	Reclaimer Discharge Chute	8000	160,000	48,000,000	y	9.5%	5.4%
4200-SL-001*	Ship Loader	8,000	160,000	48,000,000	y	9.5%	5.4%
4200-CH-007*	Tripper Discharge Chute	8,000	160,000	48,000,000	y	9.5%	5.4%
4200-SL-002*	Ship Loader	8,000	160,000	48,000,000	y	9.5%	5.4%

Notes:

1. "*" These sources are added in 2010 modelling scenarios, based on the equipment list received on Sep 09, 2010.

2. Green segment represents material handling emission sources included in both 2008 and 2010 modelling scenarios.

Tables 5C-4-3-2 and 5C-4-3-3 provide a summary of the source parameters applied in the CALPUFF modelling for the point and volume sources, respectively. Table 5C-4-3-4 presents a qualitative assessment of fugitive dust emission from ore loaded trains.

Table 5C-4-3-2: Steensby Port Point Sources

Source Description	Generators								Incinerator
Source Name	**ST_GEN01**	**ST_GEN02**	**ST_GEN03**	**ST_GEN04**	**ST_GEN05**	**ST_GEN06**	**SHIP_2MW**	**SHIP_22MW**	**ST_INCIN**
Power Rating	5590 kW	5590 kW	5590 kW	5590 kW	5590 kW	5590 kW	2 MW	22MW	500 kg/day
# of Units	1	1	1	1	1	1	1	1	1
Stack Height Above Grade (m)	30	30	30	30	30	30	20	20	17.3
Stack Height Above Roof (m)	18	18	18	18	18	18	N/A	N/A	N/A
Stack Flow Rate (m^3/s)	14.13	14.13	14.13	14.13	14.13	14.13	7.84	12.57	1.127
Stack Diameter (m)	1.09	1.09	1.09	1.09	1.09	1.09	0.8	0.8	0.48
Exit Temperature (K)	593	593	593	593	593	593	555	555	952
Exit Velocity (m/s)	15.24	15.24	15.24	15.24	15.24	15.24	15.60	25.00	6.15
Source of Emissions	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	NOx, CO, PM from manufacturer spec sheet. SO2 from US EPA AP-42 Ch 3.4 Large Stationary Diesel and Stationary Dual Fuel Engines	Stack parameters from similar sized Caterpillar generator engine. Emissions from 2005-2006 BC Ocean-Going Vessel Emissions Inventory	Stack parameters from WB Marine Vessel Emission Project. Emissions from 2005-2006 BC Ocean-Going Vessel Emissions Inventory	From "Characterization of Emissions from the Eco Waste Solutions Thermal Oxidizer Report". Provided by Aker Sept 2007.
Emission Rates (g/s)									
NOx	31.87	31.87	31.87	31.87	31.87	31.87	1.70	2.40	2.97E-02
SO2	0.97	0.97	0.97	0.97	0.97	0.97	0.19	0.27	4.62E-04
SO3	0.038	0.038	0.038	0.038	0.038	0.038	0.01	0.01	1.82E-05
SO4	0.031	0.031	0.031	0.031	0.031	0.031	0.01	0.01	1.46E-05
CO	0.65	0.65	0.65	0.65	0.65	0.65	0.13	0.18	1.45E-03
PM	0.02	0.02	0.02	0.02	0.02	0.02	0.13	0.18	1.18E-02
HCl	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.77E-01
HF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.38E-03
Mercury	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.31E-05
Antimony	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.10E-05
Arsenic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.46E-06
Barium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.27E-06
Beryllium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Cadmium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.35E-04
Chromium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.98E-05
Cobalt	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.38E-07
Copper	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.41E-04
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.77E-04
Manganese	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.62E-05
Nickel	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.97E-06
Selenium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.16E-06
Silver	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.17E-06
Thallium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Zinc	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.58E-04
Dioxins and Furans	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
2378-T4CDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.89E-12
12378-P5CDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.78E-12
123478-H6CDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.88E-13
123678-H6CDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.29E-13
123789-H6CDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.32E-12
1234678-H7CDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.51E-13
OCDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.50E-13
2378-T4CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.36E-12
12378-P5CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.86E-13
23478-P5CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.21E-11
123478-H6CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.08E-12
123678-H6CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.96E-12
234678-H6CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.47E-12
123789-H6CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.48E-13
1234678-H7CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.62E-12
1234789-H7CDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.76E-13
OCDF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.12E-13
Total Dioxins and Furans	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.38E-11
Chlorobenzenes and Octachlorostyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
1,2,3,5-Tetrachlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.11E-09

Table 5C-4-3-2: Steensby Port Point Sources

Source Description	Generators								Incinerator
Source Name	ST_GEN01	ST_GEN02	ST_GEN03	ST_GEN04	ST_GEN05	ST_GEN06	SHIP_2MW	SHIP_22MW	ST_INCIN
1,2,4,5-Tetrachlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.62E-09
1,2,3,4-Tetrachlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.21E-09
Pentachlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.30E-09
Hexachlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.16E-09
Total Selected CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.24E-08
Octachlorostyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Polycyclic Aromatic Hydrocarbons (PAHs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Acenapthylene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.01E-10
Acenpthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Fluorene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.43E-09
2-Methyl-Fluorene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.43E-09
Phenenthrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.25E-08
Anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.01E-10
Fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.61E-09
Pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.97E-09
Retene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.36E-09
Benzo(a)Fluorene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.50E-10
Benzo(b)Fluorene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
1-Methyl-Pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.13E-10
Benzo(g,h,i)Fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.13E-10
Benzo(a)Anthrecene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.38E-10
Triphenylene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.00E-10
Chrysene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.26E-10
7-Methyl-Benzo(a)Anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Benzo(b)Fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.65E-09
Benzo(k)Fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.88E-10
Benzo(e)Pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.01E-10
Benzo(a)Pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Perylene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
3-Methyl-Cholanthrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Indeno(1,2,3-cd)Pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.88E-10
Dibenzo(a,h)Anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Benzo(b)Chrysene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Benzo(g,h,i)Perylene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.38E-10
Anthanthrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00E+00
Total PAHs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.31E-08
Selected Volatile Organic Compounds (VOCs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Chloromethane	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.14E-06
Vinyl Chloride	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.21E-07
1,3-Butadiene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.06E-06
Dichloromethane	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.39E-06
Benzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.02E-05
Toluene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.57E-03
Chlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.23E-07
Ethylbenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.17E-06

Note:
1. Four (4) generators out of six (6) listed here were considered for modelling as they operate continuously; the remaining two (2) are standby generators

Table 5C-4-3-3: Steensby Port Volume Sources

Source Description	Railway	Lump Stockpile	Lump Stockpile	Fines Stockpile	Fines Stockpile	Lump Stacker/Reclaimer	Lump Tripper Discharge Chute	Lump Stacker/Reclaimer Discharge Chute	Fines Tripper Discharge Chute	Fines Stacker Conveyor	Product Reclaimer (Fines or Lump Product)	Product Reclaimer (Fines or Lump Product)	Product Reclaimer (Fines or Lump Product)	Product Reclaimer (Fines or Lump Product)	Tripper Discharge Chute	Tripper Discharge Chute	Ship Loader	Ship Loader	Dust Collector	Dust Collector
Source Name	**ST_RAIL**	**SLump1**	**SLump2**	**SFine1**	**SFine2**	**4100-SK-002**	**4100-CH-036**	**4100-CH-041**	**4100-CH-034**	**4100-SK-001**	**4200-RC-001**	**4200-RC-002**	**4200-CH-001**	**4200-CH-002**	**4200-CH-006**	**4200-CH-007**	**4200-SL-001**	**4200-SL-002**	**4200-DC-001**	**4200-DC-002**
Location [X-coord] (km)	594.862	593.567	593.761	593.36	593.974	593.535	593.482	593.482	593.953	593.895	593.39	593.942	593.425	593.97	592.662	592.622	592.632	592.589	592.663	592.625
Location [Y-coord] (km)	7800.769	7799.558	7799.916	7799.43	7800.055	7799.522	7799.515	7799.515	7800.09	7800.079	7799.334	7800.017	7799.309	7799.99	7799.19	7799.099	7799.229	7799.14	7799.191	7799.102
Elevation (m ASL)	26.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power Rating	4400 hp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10,000 cfm	10,000 cfm
# of Units	2 locos with 110 wagons	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sigma y (m)	0.9	2	2	2	2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.58	0.58
Sigma z (m)	1.40	2.00	2.00	2.00	2.00	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	2.51	2.51
Release Height (m)	3	5	5	5	5	6	1	1	1	1	6	6	6	6	1	1	1	1	5.4	5.4
Source of Emission Rates	Previous RWDI studies	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.5 Industrial Wind Erosion	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	US EPA AP-42 Ch 13.2.4 Aggregate Handling and Storage Piles	Particulate Emissions from Dust Collectors (Spec Sheet) [0.023 grams/m³]	Particulate Emissions from Dust Collectors (Spec Sheet) [0.023 grams/m³]
Emission Rates (g/s)																				
NOx	0.388	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO2	0.0325	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO3	0.0013	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SO4	0.0010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CO	0.167	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PM2.5 (Combustion)	0.021	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TSP (Fugitive)	N/A																		N/A	N/A
PM10 (Fugitive)	N/A	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	Hourly Emission File	0.109	0.109
PM2.5 (Fugitive)	N/A																		N/A	N/A

Table 5C-4-3-4: Qualitative Assessment of Fugitive Dust Emission from Train Operation

(Ore Transportation from Mine Site to Steensby Port)

5C-4-3-4a. Measured Fugitive Emissions per 100 Miles

Emissions based on "Transportation of Iron Ore A Practical Experience in Environmental Control", The Annals of Occupational Hygiene, (1974)

	Sample 1 (cwt/100 miles)	Sample 2 (cwt/100 miles)	Sample 3 (cwt/100 miles)	Sample 4 (cwt/100 miles)	Sample 5 (cwt/100 miles)	Sample 6 (cwt/100 miles)	Sample 7 (cwt/100 miles)	Average (cwt/100 miles)	Average (kg/100 miles	Average (kg/km)
Kov'sky Untreated	7	7	6	8.5	4.5	7	6.25	6.61	336	2.10
Kov'sky Sprayed	0.25	0.25	-	-	-	-	-	0.25	12.7	0.08
Kov'sky Watered	1	-	-	-	-	-	-	1	50.8	0.32
Ol'sky Untreated	8	5.5	-	-	-	-	-	6.75	343	2.14
Cerro Boliver untreated	0.25	-	-	-	-	-	-	0.25	12.7	0.079

5C-4-3-4b. Fugitive Dust Emission from Trains

(Based on average estimated emission from Table 9.a)

	Kov'sky Untreated	Kov'sky Sprayed	Kov'sky Watered	Ol'sky Untreated	Cerro Boliver Untreated
Length of Track (km)	143	143	143	143	143
Total kg/railcar/trip	300.0	11.4	45.4	306.5	11.4
Total kg/Train/Km	302.1	11.4	45.7	308.6	11.4
Tonnes/Km/Day	0.60	0.02	0.09	0.62	0.02
Total Emissions @ 144 Ore Cars and 2 Loaded Trips / Day (Tonnes)	86	3	13	88	3

1 cwt = 50.8kg

Sample Calculations:

Total kg/train/km (Kov'sky Untreated):

$$\frac{\text{kg}}{\text{train} * \text{km}} = \frac{2.1\ \text{kg}}{\text{km} * \text{Railcar}} \times \frac{144\ \text{Railcars}}{\text{Train}} = \frac{302\ \text{kg}}{\text{train} * \text{km}}$$

5C-4-3-4c. Summary of Fugitive Emissions from Truck and Train Operation

Source	Truck Operation (Tote Road)[1]	Train Operation (Mine Site to Steensby Port)[2]
Kg/Km Travelled	2.0	11.4
Total Tonnes/Km/Day[3]	0.3	0.02
Total Emissions Full Trip/Day (Tonnes)	34.0	3.3

Notes:
[1] - Only Fugitive Dust Emissions based on AP-42 Emission Factor
[2] - Ore Blow off from Loaded Trains, 144 Ore Cars per trip. Assumes Emission Factors for Kovdorsky "Sprayed" Ore
[3] - Assumes 7 passes per hour on the Tote road and 2 loaded train trips per day