Stantec **Memo**

To:	Nettie Ore, Nicola Banton KGHM Ajax Kamloops, BC	From:	Peter Reid, Reid Person Stantec Consulting Ltd. Burnaby, BC, Kamloops, BC, Calgary, AB
File:	123510762	Date:	July 5, 2016

Reference: Stantec Response to Request for Information MOE 083

INTRODUCTION

A part of the Application review for the KGHM Ajax Mine (KAM) project the BC Ministry of Environment (BC MOE) submitted a Request for Information indexed as MOE 083 by the BC EAO. The content of MOE 083 is as follows:

> There are considerations for the detonation explosives emission rates:
>
> - no conversion to grams done for hourly and annually emission rates; please use the conversion and explain how the predicted concentrations of NO_X, SO_2 and CO change;
>
> - 24 hour denomination seems underestimating the annual emission factors (if as stated, there is one blast per day within an hour). Please clarify;
>
> - daily and annually explosive detonation emissions have the same value whereas it's stated that for average annual emission rates - a blast occurs once per day and for daily emission rates - 2 times/day. To compare, Table E-16 PM Emission rate (Year -1) indeed reflects the difference between daily and annual PM EFs. Clarification is required how daily rates were calculated.

This memorandum responds Request for Information MOE 083. As requested, it provides revised Project Alone case dispersion modelling results to show how predicted concentrations change. This memorandum also discusses recently discovered inconsistencies in emission rate calculations for explosives and haul trucks.

While reviewing this Request for Information response in DRAFT KAM noted in the EIS/Application that the stated ANFO usage rate of 52 tonne/day during peak operation did not agree with their current understanding that there will be 91 tonne/day ANFO and ANFO emulsion usage during peak operation. This discrepancy was traced to a misinterpretation of the emulsion content of the explosive mixture (39 tonne/day) over one year ago.

At this same time Stantec uncovered an inconsistency in the EIS/Application respecting haul truck engine horsepower ratings. Haul trucks were initially identified as having a 2,700 HP engine. This changed at some point to 3,500 HP. Unfortunately this change was not captured by Stantec prior to submission of the Application/EIS.

These inconsistencies and their resolution are discussed in this memorandum as "supplemental responses". The resulting changes are included in the revised Project Alone predicted concentrations presented at the end of this memorandum.

Reference: Stantec Response to Request for Information MOE 083

REQUEST FOR INFORMATION MOE_083

Preamble:

A key issue in MOE 083 pertains to the emission rate calculations for blasting. Notably, the MOE has identified a math error whereby a missed conversion from kilograms to grams resulted in an underestimate of gasses emitted by blasting. Stantec provides a detailed response to this issue, and presents revised Project Alone results that account for the blasting issue.

The MOE also has questions pertaining to how the daily and annual emissions were calculated. These will be explained in turn in this response.

Request:

The MOE makes three specific requests in the Request for Information above:

1. please use the conversion and explain how the predicted concentrations of NO_X, SO_2 and CO change
2. Please clarify the annual emission factor calculations
3. Clarification is required how daily rates were calculated.

RESPONSE TO REQUEST FOR INFORMATION MOE_083

RESPONSE TO REQUEST

The MOE has identified a math error whereby a missed conversion from kilograms to grams resulted in an underestimate of gasses emitted by blasting. Stantec provides a detailed recalculation of blasting emissions using the same assumptions and emission factors as assumed in the Application.

Blasting results in emissions of gases including NO_X, CO, SO_2 as well as particulate matter. An average of 136 holes will be drilled into the rock each day. The holes are then filled with ammonium nitrate/fuel oil (ANFO) explosive and detonated. Based upon an 8 x 17 hole pattern with approximately 10 m between drill holes, the average area of blasting per day is 13,600 m^2. A total of 52 tonne/day of ANFO is used for blasting. Blasting will normally occur in one hour per day.

Methodology

Revised Emission Rates of CO, NO_X and SO_2

Emission factors for U.S.EPA AP-42, Chapter 13.3, Table 13.3.1 are used along with the quantity of ANFO explosive to calculate emission rates. Emissions of CO, NO_X and SO_2 are calculated based upon the estimated ANFO usage rate of 52 tonne/day during peak operation. During the one-hour where blasting occurs, the emission rates are:

CO Emissions = 52 tonne/hour ANFO * 34 kg CO/tonne ANFO * 1000 g/kg * 1h / 3600 s = 492 g/s

NO_X Emissions = 52 tonne/hour ANFO * 8 kg NO_X/tonne ANFO * 1000 g/kg * 1h / 3600 s = 116 g/s

SO_2 Emissions = 52 tonne/hour ANFO * 1 kg SO_2/tonne ANFO * 1000 g/kg * 1h / 3600 s = 14.5 g/s

Revised Emission Rates of TSP, PM_{10} and $PM_{2.5}$

Emission factors from U.S.EPA AP-42, Chapter 11.9, Table 11.9-2 for Coal or Overburden are used along with the average area of blasting per day to calculate emission rates. During peak mine operation, it is estimated that blasting off an area equal to 13,600 m^2 will occur each day. There may be more than one blast; however, the area per day is constant and the number of blasts per day does not affect the emission calculation. The U.S.EPA emission factors assume that PM_{10} and $PM_{2.5}$ are 52% and 3% of TSP emissions respectively. During the one-hour where blasting occurs, the emission rates are:

TSP Emissions = 0.00022 * (13,600 $m^2)^{1.5}$ kg/h * 1000 g/kg * 1 h / 3600 s = 96.9 g/s

PM_{10} Emissions = 0.52 * 0.00022 * (13,600 $m^2)^{1.5}$ kg/h * 1000 g/kg * 1 h / 3600 s = 50.4 g/s

$PM_{2.5}$ Emissions = 0.03* 0.00022 * (13,600 $m^2)^{1.5}$ kg/h * 1000 g/kg * 1 h / 3600 s = 2.91 g/s

Due to gravitational settling, only a fraction of the particulate matter generated during blasting escapes the mine pit. The fraction of TSP, PM_{10} and $PM_{2.5}$ that escape the mine pit are 68.6, 92.0 and 99.1% respectively. After adjusting for effects of mine pit retention, the final emission rates are:

TSP Emissions = 96.9 g/s * 0.686 = 66.5 g/s

PM_{10} Emissions = 50.4 g/s * 0.92 = 46.4 g/s

$PM_{2.5}$ Emissions = 2.91 g/s * 0.991 = 2.88 g/s

Modelling Time Varying Blasting Emissions

The CALPUFF model allows for the use of time-varying emission rates. To realistically account for the episodic nature of blasting, the blast emission rate is assumed to be zero for 23 hours each day and assumed to be equal to the above recalculated emission rates for 1 hour of the day. Blast emissions are assumed to occur between 14:00 and 15:00 hours each day, 7 days per week, 52 weeks of the year.

As a result, the CALPUFF model will directly predict maximum 1-hour, 24-hour and annual concentration predictions for all contaminants. There are no time period adjustments to the emission rates and no time period adjustment scaling of the model output.

SUPPLEMENTAL RESPONSE RE: REVISED METHODOLOGY AFTER AUSTRALIA (2012)

In 2014 it was Stantec's understanding that the emulsion content was inert and did not contribute to emissions. The current understanding is that the emulsion is not inert. It is emulsified ANFO. The remaining explosive mixture is granular ammonium nitrate mixed with diesel oil. The water content of various explosive mixtures varies, but it is a relatively small proportion.

This improved understanding of ANFO product formulations used in this project allows us to contemplate the use of more realistic emission factors for explosives. The blasting emissions in the Application were calculated using U.S.EPA emission factors from Chapter 13.3 Explosives Detonation

(U.S.EPA 1980). The U.S.EPA ANFO emission factors originate from two U.S. Bureau of Mines Investigations in 1974 (Chaiken et al.) and in 1976 (Rogers et al.). The two U.S. Bureau of Mines studies were based upon the use of convention ANFO explosives using high sulphur heating oil.

Modern blasting techniques now favour the use of bulk emulsion explosives due to improved water resistance, increased reliability, and better energy distributions. In terms of emissions, ANFO emulsion formulations allow for stoichiometric oxygen balance closer to optimum which reduces NO_X and CO formation when compared to conventional ANFO (Budin 2009, Rowland et al. 2001, Sapko et al. 1999). Stantec has researched this issue and determined that recently-published guidance from the Australian Government (2012) provides new emission factors that are consistent with modern blasting techniques and bulk emulsion explosives.

The 2012 Australian Emission Estimation Technique Manual for Explosives Detonation and Firing Ranges provides emission factors for a more comprehensive range of explosives (including bulk ANFO emulsion explosives) and includes three decades worth of additional test data in development of the emission factors. The Manual includes emission factors for Branded bulk ANFO emulsion explosives and provides separate emission factors both for drill holes less than and greater than 6 inches in diameters.

Stantec has selected the emission factor that correspond to the drill hole diameter greater than 6 inches in diameter as the respective NO_X and CO emission factors are larger and the Project is expected to use 6 inch blasting drill holes. The Project will also use low sulphur diesel fuel in the bulk ANFO emulsion explosive. Because of this a new SO_2 emission factor was calculated. It is based upon the maximum quantity of diesel fuel in the bulk ANFO emulsion explosive (8%) and the maximum sulphur content in low-sulphur diesel fuel (15 ppm).

Stantec has included a supplement to this response where it details the emission calculations completed with the Australian NPI Manual and 91 tonne/day bulk ANFO explosive usage during peak production. It is worth noting that the AP-42 emission factors do not consider a wide range of ANFO emulsion explosives, and does not have the benefit of the preceding thee decades of research. This supplement in this response includes a comparison of emission rates using the (dated) USEPA AP-42 and the more recent Australian guidance.

The dispersion modelling has been revised, and the resulting changes to the Project Alone concentration predictions are presented at the end of this memorandum. These changes include i) revised ANFO usage, ii) the use of Australian NPI Manual emission factors, and iii) revised haul truck emissions.

Revised Emission Rates of CO, NO_X and SO_2

Emission factors have been revised based on the Australian NPI Manual emission factors for ANFO (Branded) for drill holes larger than 152 mm in diameter (2012 Australian Emission Estimation Technique Manual for Explosives Detonation and Firing Ranges, Appendix C, Table 7). The quantity of bulk ANFO emulsion explosive used to calculate emission rates for CO, NO_X and SO_2 are based upon the estimated explosive usage rate of 91 tonne/day during peak operation. A revised low-sulphur diesel adjusted emission factor of 0.0024 kg/tonne of explosive were also calculated based

Reference: Stantec Response to Request for Information MOE 083

upon the 8% diesel content of the explosive and the maximum sulphur content of 15 ppm in low-sulphur diesel.

During the one-hour where blasting occurs, the emission rates are:

CO Emissions = 91 tonne/hour ANFO * 21 kg CO/tonne ANFO * 1000 g/kg * 1h / 3600 s = 304 g/s

NO_X Emissions = 91 tonne/hour ANFO * 3.8 kg NO_X/tonne ANFO * 1000 g/kg * 1h / 3600 s = 55.0 g/s

SO_2 Emissions = 91 tonne/hour ANFO * 0.0024 kg SO_2/tonne ANFO * 1000 g/kg * 1h / 3600 s = 0.035 g/s

The TSP, PM_{10} and $PM_{2.5}$ emission rates are unchanged from those above as emission rates are dependent upon the area of blasting and not the quantity of explosive used. Revised Tables E-20 and E-23 from the Air Quality Technical Data Report are attached to this memo to provide updated Project Year 4/8 emission totals. The blasting emissions for CO and NO_X are based upon the more representative emissions factors in the Australian NPI Manual and the SO_2 emission rate is based upon use of low-sulphur diesel, to which the Proponent has committed.

Comparison of AP-42 and Australia (2012) Emission Estimates

The original blast calculations (after correcting the unit conversion error) consisted of the following. This was based upon the incorrect assumption of 52 t/d ANFO and the use of the (dated) USEPA AP-42 emission factors.

Note that the SO_2 emission rates from AP-42 are based on dated sulphur-in-fuel oil assumptions (circa 1980). Back calculating the assumed sulphur-in-fuel oil content from emission factors alone yields approximately 0.6% or 6,000 ppm elemental sulphur. These new emission factors represent a reduction of SO_2 on the order of 99.8%. The results are presented in Table 1.

Table 1: Explosive Emission rates based on 52 t/d ANFO Usage and AP-42 Emission Factors

Emission Factor kg/Mg (AP42 Table 13.3.1)			Daily Total Emissions (kg/blast)			Estimated Emission (g/s) assumed for 1 hour		
CO	NO_X	SO_X	CO	NO_X	SO_X	CO	NO_X	SO_X
34	8	1	1,771	417	52.1	492	116	14.5

The blast emission calculations were revised using the corrected 91 t/d bulk ANFO emulsion explosive usage rate and the Australian (2102) NPI Manual emission factors. Note that the SO_2 emission factor is calculated based upon the assumption that low-sulphur diesel fuel is used in the explosive mixture. The results are presented in Table 2.

Table 2: Explosive Emission rates based on 91 t/d ANFO Usage and Australian Emission Factors

Australian NPI Explosives Emission Factors (kg/tonne)			Daily Total Emissions (kg/blast)			Estimated Emission (g/s) assumed for 1 hour		
CO	NO_X	SO_X	CO	NO_X	SO_X	CO	NO_X	SO_X
21	3.8	0.0024	1,094	198	0.1	304	55.0	0.035

Despite the fact the rate of ANFO use has increased from 52 to 91 t/d, the calculated CO, NO_X and SO_X emission rates decrease 38%, 53% and 99.76% respectively.

SUPPLEMENTAL RESPONSE RE: HAUL TRUCK ENGINE HORSEPOWER.

In the evolution of the Mine Plan and General Arrangement the haul truck has been variously reported as a Komatsu 930E, 930SE, 930E – SE4, 930 SE4, and K930. The truck was initially identified as having a 2,700 HP engine. This changed at some point to a similarly named model (the Komatsu 930 SE4) which has a 3,500 HP engine. Unfortunately this change was not captured by Stantec. The emission inventory specifies a 2,700 HP rating, which under-estimates truck engine power output.

See also related Request for Information ECCC-090

Methodology

The methodology to calculate haul truck exhaust emissions is unchanged from that detailed in the technical data report. The only change is that the peak power rating for each haul truck has been increased from 2700 to 3500 hp. An example calculation is provided below which provides the revised emission estimate for NO_X from the Year 4/8 scenario mine fleet haul trucks.

The peak hourly and daily average emissions are calculated as:

Haul Truck NO_X Emissions = 28 trucks * 3500 hp * 0.746 kW/hp * 0.37 load factor * 1.004 deterioration factor * 6.2 g NOX / kWh * 1 h / 3600 s = 46.9 g/s NO_X

The annual average emission rate (37.1 g/s) incorporates an additional utilization rate factor of 79% which accounts for the average period of time each truck is expected to operate during the year.

Revised Tables E-20 and E-23 from the Air Quality Technical Data Report are attached to this memo to provide updated Project Year 4/8 emission totals.

REVISED PROJECT ALONE EMISSION TOTALS

The corrections to the blasting emission estimates and the revision to the mine haul truck maximum power rating increase Project emissions of NO_X, CO, SO_2 and particulate matter. The revised Project emission inventory totals are presented in Table E-20 and E-23.

Daily average Project emission rates of NO_X and diesel particulate matter are estimated to increase 26% and 19%, respectively. Daily average Project emission rates of CO and SO_2 are estimated to increase 56% and 10%, respectively. The increases in daily average emissions of TSP, PM_{10} and $PM_{2.5}$ are small, ranging from 4% to 9%.

The increases in NO_X and SO_2 emissions is influenced by both the mine fleet haul truck and blasting changes while the increase in diesel particulate emissions is attributable to only the mine fleet emission change. The increases in CO emissions are primarily attributable to the updated blasting emission rates.

REVISED PROJECT ALONE CASE RESULTS

Stantec has reprocessed the Project Alone case results for the year 2003 to provide revised predicted maximum concentrations to account for the following revisions:

Blasting	Rectified errors in gas and PM emission rate calculations, corrected explosive usage rate and adopted more representative emission factors
Haul Truck HP	Revised the haul truck engine HP from 2,700 to 3,500 (including associated fuel consumption)

Note: the corrected Annual TSF emissions have been included.

Table 1 provides the revised predicted maximum concentrations for the Project Alone Case (Operations), and a comparison to the values presented in Table 5-5 of the Air Quality Technical Data Report (Appendix 10.1-A of the EIS/Application).

Table 1 Revised Maximum Predicted CAC Concentrations Associated with the Project Case Operations

Substance	Averaging Interval	Maximum Predicted Concentrations			Applicable Regulatory Criteria [a]
		TDR	UPDATED	Change (%)	
DF ($mg/dm^2/d$)	30-day	0.3960	0.3980	1%	1.7
TSP ($\mu g/m^3$)	24-hour	406	420	3%	120
	Annual	13.5	14.0	4%	60
PM_{10} ($\mu g/m^3$)	24-hour	333	346	4%	50
$PM_{2.5}$ ($\mu g/m^3$)	24-hour [b]	31.4	34.2	9%	25
	24-hour [c]	19.2	n.a.	n.a.	28 (27) [e]
	Annual	2.1	2.4	11%	8
	Annual [d]	1.6	n.a.	n.a.	10 (8.8) [e]

Reference: Stantec Response to Request for Information MOE 083

SO_2 (µg/m³)	1-hour[f]	1.60	1.7	7%	200
	1-hour	1.83	2.0	10%	450
	24-hour	1.09	1.2	11%	150
	Annual	0.04	0.24	593%	30
NO_2 (µg/m³) [g]	1-hour [h]	142	165	16%	188
	1-hour	172	360	110%	400
	24-hour	117	139	18%	200
	Annual	9.5	11.2	18%	60
CO (µg/m³)	1-hour	927	7,424	701%	14,300
	8-hour	744	1,515	104%	5,500

NOTES:

Values in boldface identify results greater than the applicable regulatory criteria.

a Applicable AAQO and CAAQS from Table 3-1

b Based on the 98th percentile for one year

c Base on the annual 98th percentile of daily 24-hour average concentrations, averaged over three years

d Based on the 3-year mean of annual average concentrations

e The first CAAQS shown is the standard effective in 2015; the new standard proposed for 2020 is given in brackets (Environment Canada 2013).

f Based on 99th percentile of daily 1-hour maxima, averaged over one year.

g NO_2 based on the Ozone Limiting Method conversion of NO_X to NO_2.

h Based on the 98th percentile of daily 1-hour maxima, averaged over one year

n.a. These values are not available as they rely on the average of three consecutive years of predictions, and only year 2003 was reprocessed with the revised emissions.

Attachment 1 presents revised isopleth maps I-1 through I-11 consistent with those presented in Appendix I of the TDR (Appendix 10.1-A of the EIS/Application). These maps present the revised isopleths in red. The results are discussed by parameter below.

Dustfall

The updated maximum predicted rate of dustfall deposition as depicted in Table 1 does not change appreciably (+1%), nor does the spatial distribution of dustfall deposition (Figure I-1). Dustfall is not substantially affected by the changes in emission rates, nor are any of the conclusions based upon these predictions.

TSP

The updated maximum predicted concentrations of TSP (24-h and annual) as depicted in Table 1 does not change appreciably (+3% & +4% respectively), nor does the spatial distribution of TSP (24-h and annual; Figures I-2 and I-3). TSP concentrations are not substantially affected by the changes in emission rates, nor are any of the conclusions based upon these predictions.

PM_{10}

The updated maximum predicted concentrations of PM_{10} (24-h) as depicted in Table 1 do not change appreciably (+4%), nor does the spatial distribution of PM_{10} (24-h; Figure I-4). PM_{10} concentrations are not substantially affected by the changes in emission rates, nor are any of the conclusions based upon these predictions.

$PM_{2.5}$

The updated maximum predicted concentrations of $PM_{2.5}$ (24-h and annual) as depicted in Table 1 change by a small amount (+9% and +11% respectively). The spatial distribution of $PM_{2.5}$ (24-h and annual; Figures I-5 and I-6) does not change appreciably. The Air Quality disciplines conclusions respecting $PM_{2.5}$ concentrations are not substantially affected by the changes in emission rates. The HHERA discipline will comment separately on the significance of these changes on inhalation-based risks.

SO_2

The updated maximum predicted concentrations of SO_2 (1-h [99^{th} percentile and maximum], 24-h) as depicted in Table 1 change by a small amount (+7%, +10% and +11% respectively). The spatial distribution of SO_2 (1-h; Figure I-7) does not change appreciably. The annual average maximum predicted concentrations of SO_2 increases substantially (from 0.04 to 0.24 µg/m^3 or 593%) however the new maxima is less than 1% of the applicable AAQO (30 µg/m^3).

NO_2

The updated maximum predicted concentrations of NO_2 (1-h 999^{th} percentile], 24-h, annual) as depicted in Table 1 change by a small amount (+16%, +18% and +18% respectively). The spatial distribution of NO_2 (1-h [98^{th} percentile] and annual; Figure I-8 and I-9) do not change appreciably. The 1-h average maximum predicted concentrations of NO_2 does increase substantially (from 172 to 360 µg/m^3 or 110%) however the new maxima is less than the applicable AAQO (400 µg/m^3).

CO

The updated maximum predicted concentrations of CO (1-h, 8-h) as depicted in Table 1 change appreciably (+701% and 104% respectively). The spatial distribution of CO (1-h, 8-h; Figure I-10 and I-11) changes appreciably near the Plant Boundary. The patterns of exposure and maximum concentrations are altered; however there are no exceedances of the most stringent AAQO for CO.

Note:

The HHERA discipline will comment separately on the significance of the changes in SO_2, NO_2, and CO concentrations on inhalation-based risks in an attachment to the upcoming contextual memo entitled "0722_Integrated Summary - Air Quality Modelling".

Reference: Stantec Response to Request for Information MOE 083

DISCUSSION ON RESPONSE TO REQUEST FOR INFORMATION MOE_083

Revised Emission Rates

Stantec has documented changes to the emission rates to account for revised blasting and haul truck emissions. They have also provided amended Tables of emission quantities and comparisons to original emission rates. The effect of these revised emissions on predicted maximum concentrations has also been presented.

Revised Project Alone Case Results

Stantec has reprocessed the Project Alone case results for the year 2003 to provide revised predicted maximum concentrations to account for revisions to blasting and haul truck emissions. These revisions do not substantially change the predicted concentrations of Dustfall, TSP, and PM_{10}, $PM_{2.5}$ and SO_2. The changes to NO_2 are for the most part relatively small. The change to predicted concentrations of CO are substantial; however they remain well below the most stringent AAQO for CO.

The substances of greatest concern in this assessment are $PM_{2.5}$ and NO_2. From an Air Quality perspective the changes to these parameters are not meaningful. The maximum predicted concentrations are still below the most stringent AAQO.

The HHERA discipline will comment separately on the significance of these changes in predicted concentrations on inhalation-based risks.

CLOSURE

This concludes Stantec's response to the Request for Information MOE 083. Please direct any questions or concerns to the undersigned.

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Attachment 1: revised isopleth maps I-1 through I-11 (Attachment 1_Rev Figs I-1 to I-11.pdf)

REFERENCES

Australian Government. 2012. National Pollutant Inventory, Emission Estimation Technique Manual for Explosives detonation and firing ranges, Version 3.0, January 2012

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Sheridan J. Rogers, Analysis Of Noncoal Mine Atmospheres: Toxic Fumes From Explosives, Bureau Of Mines, U. S. Department Of Interior, Washington, DC, May 1976.

Reference: Stantec Response to Request for Information MOE 083

Table E-1 Diesel Source Emission Rate Summary for Year 4/8 (Revised)

Area	Hourly CAC Emission Rates (g/s)				Daily CAC Emission Rates (g/s)				Annual CAC Emission Rates (g/s)			
	NO_X	CO	Diesel PM	SO_2	NO_X	CO	Diesel PM	SO_2	NO_X	CO	Diesel PM	SO_2
Blast area	*5.50E+01*	*3.04E+02*	*0.00E+00*	*3.50E-02*	*2.29E+00*	*1.27E+01*	*0.00E+00*	*1.46E-03*	*2.29E+00*	*1.27E+01*	*0.00E+00*	*1.46E-03*
Pit	*2.64E+01*	*1.68E+01*	*1.12E+00*	*2.90E-02*	*2.64E+01*	*1.68E+01*	*1.12E+00*	*2.90E-02*	*2.06E+01*	*1.30E+01*	*8.66E-01*	*2.25E-02*
Ore Drop	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ore Storage Pile North	9.34E-01	8.04E-01	5.47E-02	1.71E-03	9.34E-01	8.04E-01	5.47E-02	1.71E-03	6.74E-01	5.95E-01	4.07E-02	1.27E-03
Ore Storage Pile South	9.34E-01	8.04E-01	5.47E-02	1.71E-03	9.34E-01	8.04E-01	5.47E-02	1.71E-03	6.74E-01	5.95E-01	4.07E-02	1.27E-03
Overburden/EMRSF	9.34E-01	8.04E-01	5.47E-02	1.71E-03	9.34E-01	8.04E-01	5.47E-02	1.71E-03	6.74E-01	5.95E-01	4.07E-02	1.27E-03
Reclamation	8.50E-03	9.74E-03	6.96E-04	1.78E-05	8.50E-03	9.74E-03	6.96E-04	1.78E-05	5.32E-03	6.09E-03	4.35E-04	1.11E-05
SMRSF	9.34E-01	8.04E-01	5.47E-02	1.71E-03	9.34E-01	8.04E-01	5.47E-02	1.71E-03	6.74E-01	5.95E-01	4.07E-02	1.27E-03
Tailings Beach	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TSFMRSF 1	9.34E-01	8.04E-01	5.47E-02	1.71E-03	9.34E-01	8.04E-01	5.47E-02	1.71E-03	6.74E-01	5.95E-01	4.07E-02	1.27E-03
TSFMRS 2	9.34E-01	8.04E-01	5.47E-02	1.71E-03	9.34E-01	8.04E-01	5.47E-02	1.71E-03	6.74E-01	5.95E-01	4.07E-02	1.27E-03
Haul Road 1	*6.36E+00*	*4.38E+00*	*2.89E-01*	*8.26E-03*	*6.13E+00*	*4.15E+00*	*2.75E-01*	*7.65E-03*	*4.86E+00*	*3.30E+00*	*2.18E-01*	*6.12E-03*
Haul Road 2	*1.99E+00*	*1.46E+00*	*9.84E-02*	*2.81E-03*	*1.99E+00*	*1.46E+00*	*9.84E-02*	*2.81E-03*	*1.54E+00*	*1.13E+00*	*7.64E-02*	*2.18E-03*
Haul Road 3	*7.86E+00*	*5.00E+00*	*3.31E-01*	*8.81E-03*	*7.86E+00*	*5.00E+00*	*3.31E-01*	*8.81E-03*	*6.19E+00*	*3.94E+00*	*2.60E-01*	*6.92E-03*
Haul Road 4	*1.10E+01*	*6.90E+00*	*4.55E-01*	*1.20E-02*	*1.10E+01*	*6.90E+00*	*4.55E-01*	*1.20E-02*	*8.68E+00*	*5.44E+00*	*3.59E-01*	*9.47E-03*
Haul Road C	*1.09E+00*	*9.19E-01*	*6.29E-02*	*1.89E-03*	*1.09E+00*	*9.19E-01*	*6.29E-02*	*1.89E-03*	*8.32E-01*	*7.05E-01*	*4.83E-02*	*1.45E-03*
Mill	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crusher	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Access Road	2.35E+00	2.39E+00	1.42E-01	5.26E-03	5.08E-01	5.40E-01	3.48E-02	1.25E-03	4.60E-01	4.89E-01	3.15E-02	1.15E-03
Original Total (Application) (g/s)	**5.20E+01**	**3.67E+01**	**2.40E+00**	**8.68E-02**	**4.98E+01**	**3.42E+01**	**2.28E+00**	**6.83E-02**	**3.88E+01**	**2.65E+01**	**1.77E+00**	**5.33E-02**
Revised Total (g/s)	**1.18E+02**	**3.47E+02**	**2.83E+00**	**1.13E-01**	**6.29E+01**	**5.33E+01**	**2.71E+00**	**7.51E-02**	**4.95E+01**	**4.42E+01**	**2.10E+00**	**5.89E-02**
Increase (g/s)	**6.57E+01**	**3.10E+02**	**4.27E-01**	**2.65E-02**	**1.31E+01**	**1.91E+01**	**4.26E-01**	**6.85E-03**	**1.07E+01**	**1.77E+01**	**3.34E-01**	**5.58E-03**

Note: The emission sources Blast Area, Pit, Haul Roads 1 to 4 and Haul Road C have been revised to correct an error in the blast emission calculations and an increase in haul truck engine power rating.

Reference: Stantec Response to Request for Information MOE 083

Table E-2 Daily Particulate Matter Emission Rate Summary for Year 4/8 (Revised)

Area	Daily Emission Rates (g/s)					
	Other TSP	Other PM_{10}	Other $PM_{2.5}$	Ore TSP	Ore PM_{10}	Ore $PM_{2.5}$
Blast area	*2.06E+00*	*1.44E+00*	*8.92E-02*	*7.13E-01*	*4.97E-01*	*3.09E-02*
Pit	1.15E+01	7.22E+00	8.52E-01	3.98E+00	2.50E+00	2.95E-01
Ore Drop	0.00E+00	0.00E+00	0.00E+00	5.27E-02	1.73E-02	4.89E-03
Ore Storage Pile North	0.00E+00	0.00E+00	0.00E+00	1.26E+00	8.04E-01	1.15E-01
Ore Storage Pile South	0.00E+00	0.00E+00	0.00E+00	1.23E+00	7.89E-01	1.13E-01
Overburden/EMRSF	1.04E-01	7.71E-02	1.08E-02	0.00E+00	0.00E+00	0.00E+00
Reclamation	1.02E-01	7.65E-02	1.07E-02	0.00E+00	0.00E+00	0.00E+00
SMRSF	9.83E-01	5.20E-01	7.68E-02	0.00E+00	0.00E+00	0.00E+00
Tailings Beach	2.46E+00	1.16E+00	1.76E-01	0.00E+00	0.00E+00	0.00E+00
TSFMRSF 1	4.66E-01	2.47E-01	3.63E-02	0.00E+00	0.00E+00	0.00E+00
TSFMRS 2	6.61E-01	3.39E-01	5.03E-02	0.00E+00	0.00E+00	0.00E+00
Haul Road 1	7.30E+00	1.88E+00	1.88E-01	0.00E+00	0.00E+00	0.00E+00
Haul Road 2	1.78E+00	4.58E-01	4.58E-02	0.00E+00	0.00E+00	0.00E+00
Haul Road 3	1.04E+01	2.68E+00	2.68E-01	0.00E+00	0.00E+00	0.00E+00
Haul Road 4	1.51E+01	3.87E+00	3.87E-01	0.00E+00	0.00E+00	0.00E+00
Haul Road C	4.59E-01	1.18E-01	1.18E-02	0.00E+00	0.00E+00	0.00E+00
Mill	2.57E-02	1.21E-02	3.70E-03	0.00E+00	0.00E+00	0.00E+00
Crusher	0.00E+00	0.00E+00	0.00E+00	1.88E+00	7.54E-01	1.35E-01
Access Road	1.65E+00	4.11E-01	4.11E-02	0.00E+00	0.00E+00	0.00E+00
Original Total (Application) (g/s)	**5.32E+01**	**1.92E+01**	**2.17E+00**	**8.47E+00**	**4.90E+00**	**6.65E-01**
Revised Total (g/s)	**5.51E+01**	**2.05E+01**	**2.25E+00**	**9.12E+00**	**5.36E+00**	**6.94E-01**
Increase (g/s)	**1.90E+00**	**1.30E+00**	**8.00E-02**	**6.50E-01**	**4.60E-01**	**2.90E-02**

Notes: Blast emissions have been revised to correct a calculation error. Peak hourly blast TSP, PM10 and PM2.5 emission rates are 66.5, 46.4 and 2.88 g/s, respectively. They are modelled using a time varying emission rate with one hour of emission at this rate and 23 hours at an emission rate of zero each day. The values summarized in this table for blasting are expressed on a daily average basis (i.e. divided by 24 hours) for presentation purposes.