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EMISSIONS SUMMARY REPORT OF FUGITIVE PARTICULATE MATTER SOURCES OF LEAD AND ZINC AT RED DOG MINE SITE

Prepared for:

Teck Cominco Alaska, Incorporated
Red Dog Operations
Anchorage, Alaska

Prepared by:

SENES Consultants Limited
Specialists in Energy, Nuclear and Environmental Sciences

SENES Consultants Limited
121 Granton Avenue
Unit 12
Richmond Hill, ON
L4B 3N4

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EXECUTIVE SUMMARY

SENES Consultants Limited (SENES) was retained by Teck Cominco Alaska, Incorporated (TCAK) to carry out an evaluation of fugitive particulate matter emissions from operations at their Red Dog Mine Site (Red Dog), which is located approximately 87 miles northeast of Kotzebue, Alaska and 46 miles inland of the Chukchi Sea. The purpose of the study is to address the Alaska Department of Environmental Conservation's (ADEC's) concerns on the relative contribution of the various fugitive sources at Red Dog to ambient particulate matter levels.

The study is iterative in nature with this report summarizing the results of the first and second steps of the study, including the completion of a mine/mill wide inventory of potential fugitive particulate matter sources and the use of a screening level air dispersion model (ISCST3) to facilitate a preliminary comparison of model predicted particulate matter levels and available particulate matter measurements at hi-volume samplers and TEOM sites at Red Dog.

A subsequent third step, which will depend upon the ADEC review of this report, will be to conduct a more sophisticated air dispersion modelling using the CALMET/CALPUFF modelling system which better accounts for terrain effects found at Red Dog. The results of the CALMET/CALPUFF air dispersion modelling compared to paired data from onsite hi-volume and TEOM measurements will then provide the basis for the final apportionment of particulate matter sources.

For this report the predicted air concentrations (obtained using the ISCST3 dispersion model) were compared (qualitatively) with the onsite sampling data as a means of benchmarking the estimated emission rates. As consistent data was available from the PAC Hi-Vol for the August through October 2005 time period for particulate matter, lead, and zinc, this data was used for the preliminary benchmarking. A comparison was made between the maximum values, 98^{th} percentile values, and average values.

The measured 24-hour particulate matter concentrations at the PAC Hi-Vol were compared to the model predicted particulate matter concentrations at the same location, and found to be within a factor of 2, with measured concentrations being higher than model predicted particulate matter concentrations. The model predicted lead concentrations were found to be approximately 1.5 times higher than the data from Aug-Oct 2005. The model predicted maximum zinc concentrations were found to be approximately 2 to 3 times higher than the maximum measured concentrations at the PAC Hi-Vol. The difference in model predicted and measured particulate matter, lead, and zinc concentrations was considered adequate at this stage of analysis.

A preliminary evaluation of the relative contributions from the various particulate matter emission units to measured concentrations was completed. The maximum predicted concentrations resulting from the majority of emission unit groups were found to be significantly higher at the PAC location than at the Overburden and T-Dam locations. While the pits and roads were identified to be the dominant emission units for all three sampler locations, the impact of individual emission unit groups is noticeably different at the three locations.

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1.0 INTRODUCTION

SENES Consultants Limited (SENES) was retained by Teck Cominco Alaska, Incorporated (TCAK) to carry out an evaluation of fugitive particulate matter emissions from operations at their Red Dog Mine Site (Red Dog), which is located approximately 87 miles northeast of Kotzebue, Alaska and 46 miles inland of the Chukchi Sea. The purpose of the study is to address the Alaska Department of Environmental Conservation's (ADEC's) and TCAK's concerns on the relative contribution of the various fugitive sources at Red Dog to ambient particulate matter levels.

The study is iterative in nature with the first step being a mine/mill wide inventory of potential fugitive particulate matter sources based on descriptions of the activities at the site, both current and past, information provided by Red Dog on the characteristics of the various emissions sources, and published emissions factors. The second step involves the use of a screening level air dispersion model (ISCST3) to facilitate a preliminary comparison of model predicted particulate matter levels and available particulate matter measurements at hi-volume samplers and TEOM sites at Red Dog. This allows for a preliminary evaluation of the relative contributions from the various particulate matter sources to measured concentrations. In turn, these data provide the basis for a re-evaluation of particulate matter emissions. A subsequent third step will be to conduct a more sophisticated air dispersion modelling using the CALMET/CALPUFF modelling system which better accounts for terrain effects found at Red Dog. The results of the CALMET/CALPUFF air dispersion modelling compared to paired data from onsite hi-volume and TEOM measurements will then provide the basis for the final apportionment of particulate matter sources.

This report describes the methods and information used to develop the current inventory of particulate matter emissions sources at Red Dog and, with the help of the ISCST3 air dispersion model, a preliminary allocation of the contribution of the various sources to levels measured at hi-volume and TEOM station locations. Once feedback on the current emissions summary is provided and discussed, the emissions will be updated and the final source apportionment carried out. The results of the source allocation will provide useful information to identifying potential future particulate matter control strategies and implementation plans.

1.1 FUGITIVE PARTICULATE MATTER STUDY

The first step in the fugitive particulate matter study is to carry out a detailed evaluation of particulate matter sources at the Red Dog Mine and Mill facility to assist in evaluation of the relative contributions from the various particulate matter sources and the evaluation of any potential future particulate matter control measures that may be proposed. This will be followed by an air dispersion model assessment to determine the relative concentrations of lead and zinc potentially attributable to mine sources. It is important to understand that the modeling is a special study intended for evaluation of potential impacts of the lead and zinc deposition on the surrounding tundra and is not intended to supplant or replace any analysis prepared in support of air permit or other regulatory initiatives. Finally, given the complex terrain and meteorological conditions at Red Dog, the CALMET/CALPUFF modeling system will be used as the basis of the final air dispersion component of the study.

Steps One and Two - Emissions Summary

This report summarizes the emission rate estimates that were iteratively developed by SENES and TCAK to reflect site operations as accurately as possible. This report presents preliminary modelling results, obtained using the ISCST3 dispersion model, site meteorological data and the emission estimates developed for the "Current Scenario" (see Section 2.0). While the ISCST3 dispersion model is not capable of fully handling the effects of complex local terrain on air dispersion, the model does provide an efficient method of comparing observations and preliminary modeling results. The predicted air concentrations (using the ISCST3 dispersion model) were compared with the onsite sampling data as a means of benchmarking the estimated emission rates. The first set of modelling results were analyzed, in particular looking backwards to the source contributions which then suggested appropriate adjustments for some of the emission estimates. An additional iteration with the ISCST3 model using updated emissions estimates was performed and the results of the modelling are presented in this report.

Step Three – Air Dispersion Model Assessment and Final Source Allocation

Following input from the ADEC on the emission estimates presented in the report, a refined dispersion modelling assessment will be performed using the CALMET/CALPUFF modeling system as noted above. The results from the air dispersion modelling will be compared to paired measurements for hi-volume and TEOM samplers at Red Dog to develop a final source allocation matrix.

1.2 FACILITY DESCRIPTION AND OUTLINE OF PROPOSED PROJECT

The Red Dog facility has been mining and milling lead/zinc ore since November 1989. The ore the mine processes contains lead (5-10%) and zinc (20-25%). Zinc concentrate from the mill contains approximately 56% zinc and 3% lead, while lead concentrate from the mill contains approximately 55% lead and 12% zinc. The waste rock also has relatively high lead (1-2%) and zinc (1-5%) contents. The handling of these materials has resulted in deposition of lead and zinc particulate material in the areas surrounding the mine and mill sites. In the early years of the operations, several sources of lead and zinc were not well controlled. Over the past 15 years, the mine and mill has made numerous modifications to ore storage, transportation and milling operations to reduce the release of lead and zinc, including:

Road Controls:

- 1992 - CaCl applications intensified for mill site roads and lay down areas; and
- July 1992 - addition of a water truck for roads.

Crushers:

- Summer/Spring 1993 - water sprays on jaw crusher drop box utilized then abandoned in the Fall due to freezing;
- Dec 1995 - existing 5000 cfm baghouse for jaw crusher with a new 7000 cfm baghouse;
- Mar 2002 - installed gyro crusher drop box particulate matter control stilling curtains; and
- Crusher feed stockpiles moved into pit.

Coarse Ore Stockpile:

- Coarse ore stockpile partially enclosed - 1990-1992 tarping installed, and periodically repaired to enclose stockpile;
- July 1992 - water spray bar on belts dumping into enclosed ore stockpile; and
- August 1992 - permanent hardsided coarse ore stockpile enclosure completed.

Concentrate Storage and Loadout:

- Oct 1992 - concentrate truck loading bay fully enclosed;
- July 2001 - summer concentrate truck wash system installed;
- Nov 2001 - stilling curtains installed in concentrate truck loadout bay; and
- July 2004 - installed fans to draw entrained particulate matter from concentrate loadout bay.

Tailings Basin:

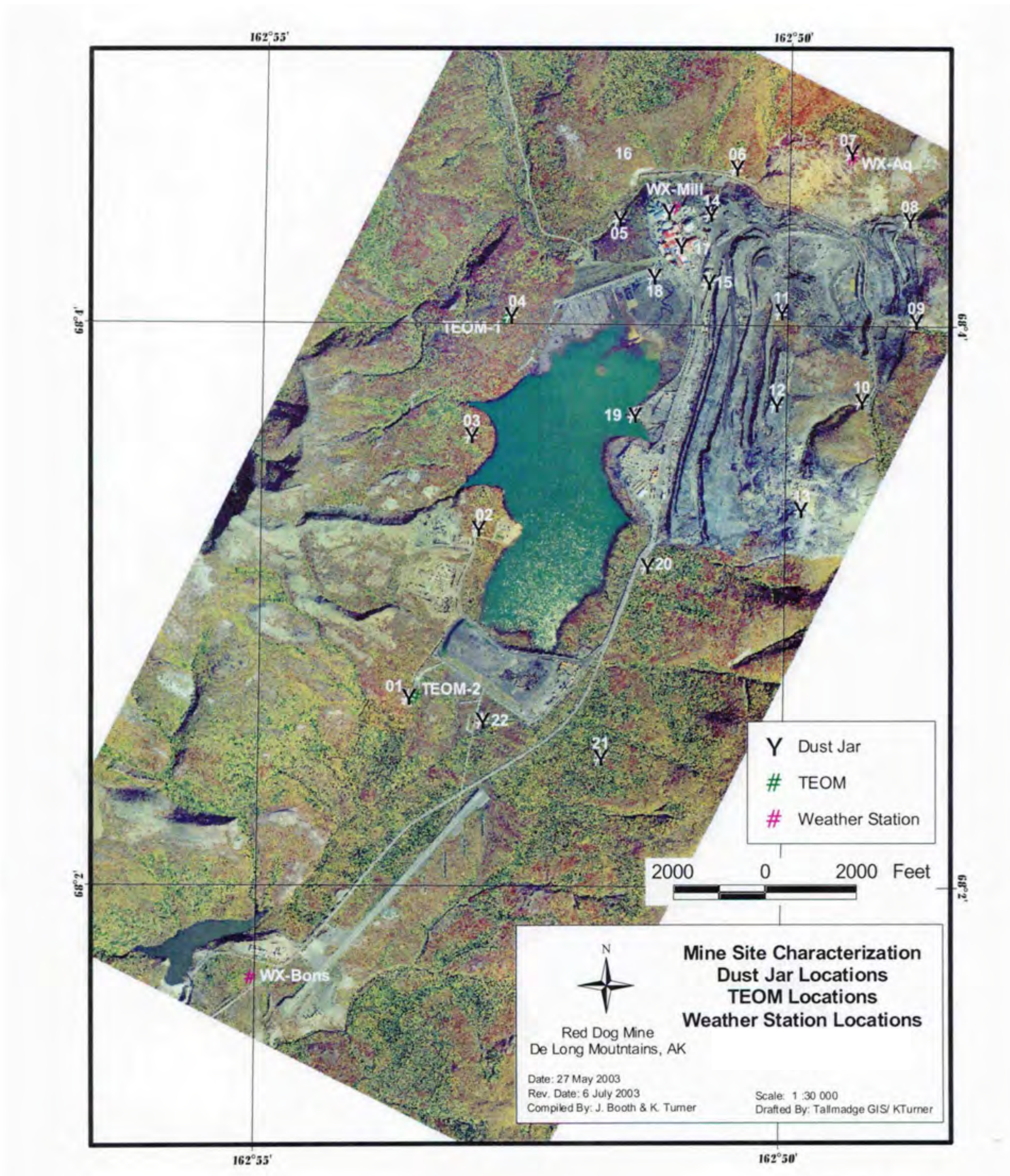
- Summer 2001 - installed eight "windrows" of waste rock (6' high 16' wide 150' long) to mitigate wind erosion; added Soil-Sement palliative to a portion of beach;
- Summer 2003 - flooded tailings beach; and
- 2005 – some exposed beach in 2005.

The TCAK Red Dog mine conducted soil and vegetation investigations in 2003 and 2004 to better understand the spatial extent of the lead and zinc deposition. These studies identified that some areas surrounding the mine and mill sites are potentially being affected by lead and zinc deposition.

To more fully understand the extent of the deposition since the beginning of operations, TCAK has undertaken to develop a historic emission inventory and air dispersion modeling exercise as described in this report. This will allow TCAK to determine how much of the lead and zinc deposition may have been due to historic activities versus current operations. Also, development of the emission inventory for existing operations will provide TCAK with a tool to assist in decisions for prioritizing sources for potential future application of particulate matter control. Together, these data are intended to provide ADEC with the information it needs concerning source contribution allocation and related fugitive particulate matter issues.

The overall approach of this study is to develop emission inventories for representative years (1992, 2000, 2003 and 2004) and to use an air dispersion model to calculate lead and zinc concentrations in air and deposition rates in the vicinity of the Red Dog Mine Site. TCAK has air quality monitoring data from several locations which will allow for validation of the results of the emission summary/dispersion modeling. TCAK also operates meteorological stations at the mill site and at the airport. (Figure 1.1).

Figure 1.1: Mine Site Characterization, Dust Jar Locations, TEOM Locations, Weather Station Locations



2.0 EMISSIONS INVENTORY METHODOLOGY

The potential sources of particulate matter containing lead and zinc from the Red Dog operations essentially track the process from the extraction of the ore and waste rock, to the transport of the concentrate away from the mill property. Tables 2.1 and 2.2 provide the emissions estimation method that was used to develop the emissions inventory. Due to the fact that activities have changed since the beginning of operations, several time periods have been evaluated. These were selected to reflect time frames when substantial changes were made that may have affected future particulate matter emissions. The emissions for each time frame have been used to develop a historic emissions inventory over the life of the mine. Figure 2.1 provides a general overview of the site and identifies its major features. Figure 2.2 provides identification of the sources contained within the Mill Area. Figure 2.3 provides a conceptual mining and milling process flow sheet which may be useful in considering the potential sources of fugitive particulate matter in Tables 2.1 and 2.2. Some of the factors that influence emissions for each time frame are:

Period 1 - 1992 (4,442 tons ore mined/day) to represent activities until 1992:

- start of mining operations (late 1989).

Period 2 - 2000 (8,985 tons ore mined/day) to represent activities from 1993 through 2001:

- 1992 - CaCl applications intensified for mill site roads and lay down areas;
- July 1992 - additional water truck for roads;
- Summer/Spring 1993 - water sprays on jaw crusher drop box abandoned;
- Dec 1995 - existing 5000 cfm baghouse for jaw crusher with a new 7000 cfm baghouse;
- Coarse ore stockpile partially enclosed - 1990-1992 tarping installed, repaired to enclose stockpile;
- July 1992 - water spray bar at enclosed ore stockpile;
- August 1992 - coarse ore stockpile enclosure completed;
- Oct 1992 - concentrate truck loading bay fully enclosed;
- July 2001 - summer concentrate truck wash system installed;
- Nov 2001 - stilling curtains installed in concentrate storage truck bay;
- Summer 2001 - installed eight "windrows" waste rock 6' high 16' wide 150' long; added Soil-Sement palliative to a portion of beach.

Period 3 - 2003 (9,359 tons ore mined/day) to represent activities from 2002 through 2003:

- March 2002 - installed gyro crusher drop box particulate matter control stilling curtains;
- Summer 2003 - flooded tailings beach.

Figure 2.1: Red Dog Mine – Mine Site Layout

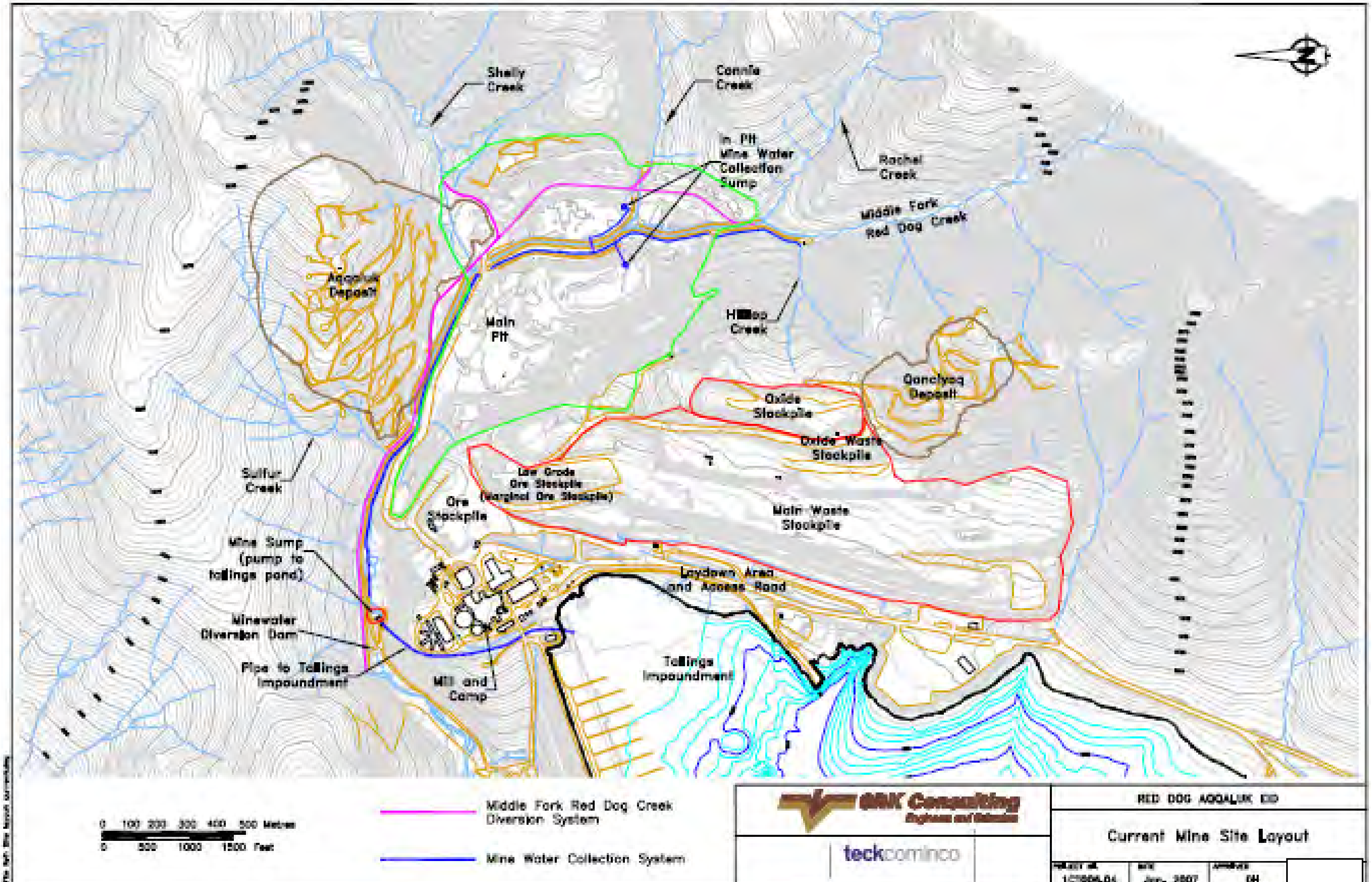


Figure 2.2: Red Dog Mine – Plan of Mill Area

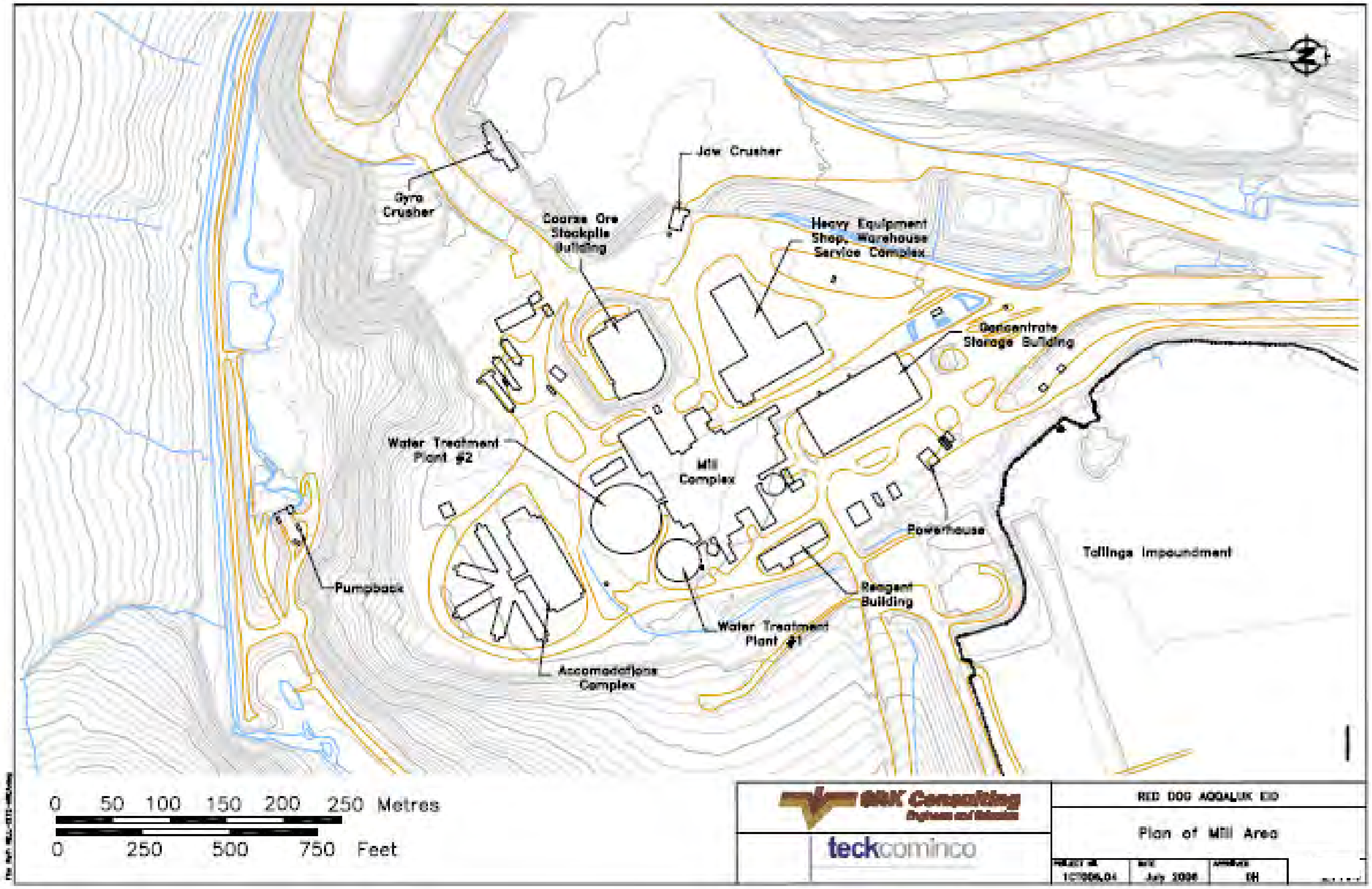
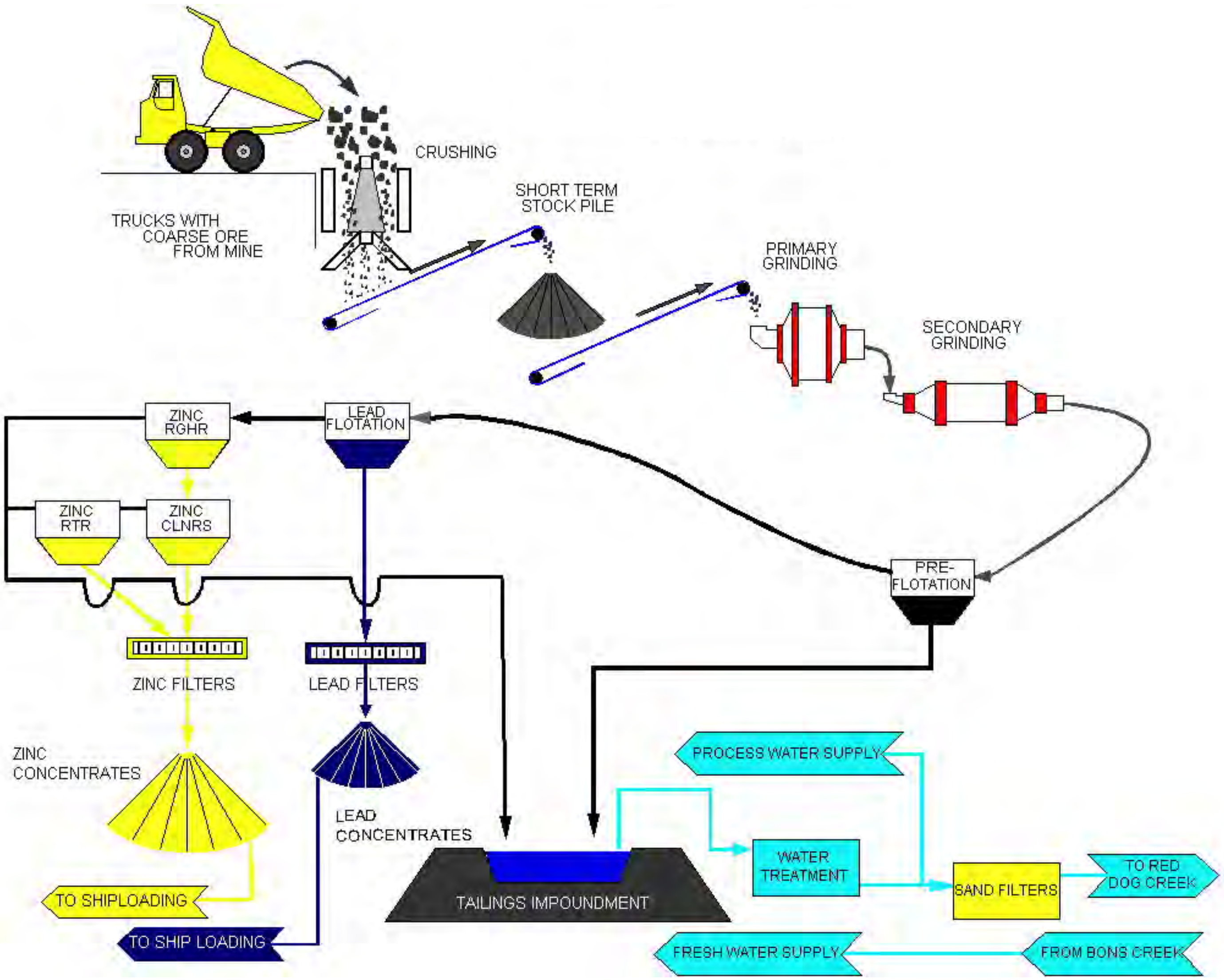


Figure 2.3: Red Dog Operations – Mill Process Flowsheet



Current - 2004 (8,597 tons ore mined/day) to represent activities from 2004 through 2005:

- July 2004 - Installed fans to draw entrained particulate matter from concentrate loadout;
- Late 2004 - crusher feed stockpiles moved into pit;
- Proposed baghouse particulate matter control for crusher(s).

The U.S. EPA AP-42 standard reference for emission factors [U.S. EPA 1995] has been used in conjunction with site specific data, to develop emissions of total particulate matter. Appropriate lead and zinc concentrations based on records of site operations have been applied to each source to determine the lead and zinc emissions from each source. Figure 2.4 shows the locations at which samples of road particulate matter have previously been collected. The main sources/activities identified to date and the appropriate U.S. EPA AP-42 sections are provided in Tables 2.1 and 2.2 for the mine and mill respectively.

Table 2.1: Mine Operations

Activity		Emission Estimation Method
Main Pit		
1	Drilling	AP-42 Drilling – Section 11.9
2	Blasting	AP-42 Blasting – Section 11.9
3	Dozer activity in blast area	AP-42 Dozer Equation – Section 11.9
4	Loading of haul trucks delivering ore and waste rock from blast area to storage	AP-42 Drop Equation – Section 13.2.4
5	Loader travel in blast area	AP-42 Travel on Unpaved Roads – Section 13.2.2
6	Haul truck travel in blast area	AP-42 Travel on Unpaved Roads – Section 13.2.2
Road from Main Pit to Ore Stockpile Area (Haul Road)		
7	Haul truck travel to ore storage area	AP-42 Travel on Unpaved Roads – Section 13.2.2
Ore Stockpile Area (East Pit or Crushing Area) (in Current period stockpiles were in the East Pit and during previous periods the stockpiles were located near the crushers)		
8	Haul truck unloading at ore storage area	AP-42 Drop Equation – Section 13.2.4
9	Haul truck travel in ore storage area	AP-42 Travel on Unpaved Roads – Section 13.2.2
10	Dozer activity in ore storage area	AP-42 Dozer Equation – Section 11.9
11	Loading of haul trucks in ore storage area	AP-42 Drop Equation – Section 13.2.4
12	Loader Travel in ore storage area	AP-42 Travel on Unpaved Roads – Section 13.2.2
13	Wind blown ore	Air Pollution Manual, Air & Waste Management Association
Road from Main Pit To Waste Rock Storage Area (Waste Road)		
14	Haul truck travel to waste rock storage area	AP-42 Travel on Unpaved Roads – Section 13.2.2
Waste Rock Storage Area		
15	Haul truck unloading at waste rock storage area	AP-42 Drop Equation – Section 13.2.4
16	Dozer activity in waste rock storage area	AP-42 Dozer Equation – Section 11.9
17	Wind blown waste rock	Air Pollution Manual, Air & Waste Management Association
Road from Ore Stockpile Area to Crushers (Crusher Road) (in past years ore was stored in crushing area, loader delivered material from the ore storage to crushers)		
18	Haul truck travel from ore storage to crushers	AP-42 Travel on Unpaved Roads – Section 13.2.2

Figure 2.4: Mine Site Characterization Road Sampling Locations

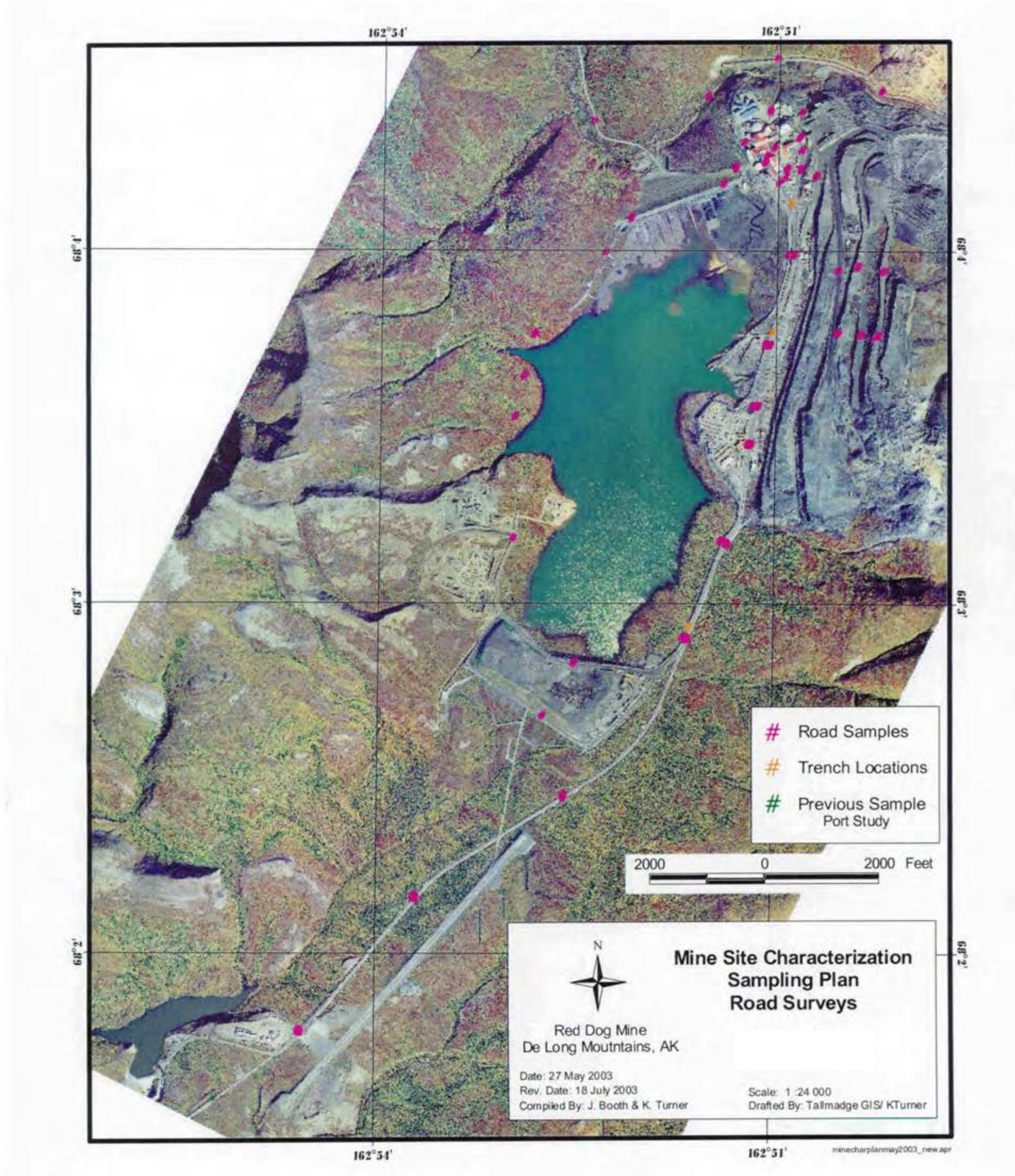


Table 2.2: Mill Operations

Activity		Emission Estimation Method
Crushers		
19	Unloading to each crusher dump pocket	AP-42 Drop Equation – Section 13.2.4 (currently controlled by sheds) Stilling curtains installed Baghouses to be installed in the future
20	Jaw Crusher Baghouse (conveyor transfer)	Source emission testing
21	Gyratory Crusher Baghouse (conveyor transfer)	Source emission testing
Coarse Ore Stockpile (fully enclosed by 2000)		
22	Fugitive releases from building – prior to full enclosure, dozer work on stockpile would have been a significant contributor.	1. Prior to full enclosure – AP-42 Drop Equation – Section 13.2.4 uncontrolled and AP-42 Dozer Equation – Section 11.9 2. Post enclosure – Estimate of air concentration within building (industrial hygiene measurements) and building ventilation and exhausts from release points.
Mill Concentrator Facility		
23	SAG Scrubber A	Source emission testing
24	SAG Scrubber B	Source emission testing
25	Fugitive releases from buildings	Estimate of air concentration within building (industrial hygiene measurements) and building ventilation and exhausts from release points.
26	Bucking Room Baghouse	Source emission testing
Concentrate Storage Building (CSB)		
27	Fugitive releases from building and loadout	Estimate of air concentration within building (industrial hygiene measurements) and building ventilation and exhausts from release points.
Road from CSB to Port (Port Road)		
28	Concentrate truck travel	AP-42 Travel on Unpaved Roads – Section 13.2.2
Tailings Beach		
29	Wind blown tailings – flooded in 2003, some exposed beach in 2005	Air Pollution Manual, Air & Waste Management Association

3.0 TOTAL SUSPENDED PARTICULATE EMISSIONS ESTIMATES

As noted in Section 2.0, emissions inventories were prepared for four time frames: Period 1, Period 2, Period 3, and Current. During each period, sources were grouped into the following categories and subcategories:

- mining;
- ore handling;
- waste rock handling;
- crushing;
- coarse ore stockpile storage;
- milling activities;
- concentrate storage activities; and
- tailings beach erosion.

Emissions of particulate matter (PM) were estimated using U.S EPA AP-42 factors, site source testing data, and mass balance calculations. Tables 3.1, 3.2, 3.3, and 3.4 present the emission sources, their associated emission estimate method, uncontrolled PM emission rate, control efficiency, and controlled PM emission rate for the four time frames. Figures 3.1, 3.2, 3.3, and 3.4 display the major emission sources for each time period assessed, as they were approximated for modelling purposes.

The following section presents the manner in which the PM emission rates were estimated for all scenarios, including reference to all assumptions made as well as emission factors and source data used. Detailed sample calculations have been included in Appendix A. Source data used and referenced in the following sections has been included in Appendix B.

It should be noted that all emission rates presented are 24-hour average emission rates and were prepared for use with the CALPUFF model, as this will be the model used to assess all four time periods. As discussed in Section 6.0, the Current scenario emission rates were adjusted, where necessary, to input into the ISCST3 model for this preliminary assessment.

Table 3.1: Summary of 24-Hour Average Emission Rates (g/s) – Period 1 (1989-1992)

Mining Activities (Ore and Waste)	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Summer Controlled Emission	Winter Controlled Emission
Mining: Drilling	AP-42 Drilling – Section 11.9	2.39E-01	2.39E-01	80%	80%	4.78E-02	4.78E-02
Mining: Blasting - Ore	AP-42 Blasting – Section 11.9	9.48E-05	9.48E-05			9.48E-05	9.48E-05
Mining: Blasting - Waste Rock		1.96E-04	1.96E-04			1.96E-04	1.96E-04
Mining: Dozer activity in Blast Area - Ore	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01
Mining: Dozer activity in Blast Area - Waste Rock		4.47E-01	4.57E-01			4.47E-01	4.57E-01
Mining: Loading of haul trucks in Blast Area - Ore	AP-42 Drop Equation – Section 13.2.4	7.46E-02	9.34E-02			7.46E-02	9.34E-02
Mining: Loading of haul trucks in Blast Area - Waste Rock		1.32E-01	1.65E-01			1.32E-01	1.65E-01
Mining: Loader travel in Blast Area	AP-42 Travel on Unpaved Roads - Section 13.2.2	1.98E+00		10.00%	10.00%	1.78E+00	1.78E+00
Mining: Haul truck travel in Blast Area		1.01E+01		10.00%	10.00%	9.05E+00	9.05E+00

Ore Handling	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Summer Controlled Emission	Winter Controlled Emission
Ore Handling: Dozer activity on Ore Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01
Ore Handling: Ore Storage Stockpile 1- Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	8.62E-02	1.23E-01			8.62E-02	1.23E-01
Ore Handling: Ore Storage Stockpile 2- Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01
Ore Handling: Haul truck Unloading at Ore Storage Area	AP-42 Drop Equation – Section 13.2.4	7.46E-02	9.34E-02			7.46E-02	9.34E-02
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul2	AP-42 Travel on Unpaved Roads - Section 13.2.2	5.23E-01	5.23E-01	10.00%	10.00%	4.71E-01	4.71E-01
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul3		6.46E-01	6.46E-01	10.00%	10.00%	5.81E-01	5.81E-01
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul4		6.99E-01	6.99E-01	10.00%	10.00%	6.29E-01	6.29E-01
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul5		5.98E-01	5.98E-01	10.00%	10.00%	5.38E-01	5.38E-01
Ore Handling: Haul truck travel in Ore Storage Area -Ore1		7.89E-01	7.89E-01	10.00%	10.00%	7.10E-01	7.10E-01
Ore Handling: Loader travel from Ore Storage Area to Jaw Crusher -Jaw1		5.15E-01	5.15E-01	10.00%	10.00%	4.63E-01	4.63E-01
Ore Handling: Haul Truck travel from Ore Storage Area to Jaw Crusher -Jaw1		5.23E-01	5.23E-01	10.00%	10.00%	4.70E-01	4.70E-01

Waste Rock Handling	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Summer Controlled Emission	Winter Controlled Emission
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul2	AP-42 Travel on Unpaved Roads - Section 13.2.2	8.96E-01	8.96E-01	10.00%	10.00%	8.06E-01	8.06E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul3		1.11E+00	1.11E+00	10.00%	10.00%	9.95E-01	9.95E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul4		1.20E+00	1.20E+00	10.00%	10.00%	1.08E+00	1.08E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul5		1.02E+00	1.02E+00	10.00%	10.00%	9.21E-01	9.21E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste1		9.46E-01	9.46E-01	10.00%	10.00%	8.51E-01	8.51E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste2		9.10E-01	9.10E-01	10.00%	10.00%	8.19E-01	8.19E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste3		1.38E+00	1.38E+00	10.00%	10.00%	1.25E+00	1.25E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste4		4.34E+00	4.34E+00	10.00%	10.00%	3.91E+00	3.91E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste5		5.48E+00	5.48E+00	10.00%	10.00%	4.93E+00	4.93E+00
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	AP-42 Dozer Equation – Section 11.9	5.36E-01	5.48E-01			5.36E-01	5.48E-01
Waste Rock: Haul Truck Unloading at Waste Rock Storage Area	AP-42 Drop Equation – Section 13.2.4	1.32E-01	1.65E-01			1.32E-01	1.65E-01
Waste Rock Handling: Waste Rock Storage Area1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.03E-01	1.47E-01			1.03E-01	1.47E-01
Waste Rock Handling: Waste Rock Storage Area2 - Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01

Crushers	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Jaw Crusher Baghouse	Source Test Emission Data					4.95E-03	4.95E-03
Ore Handling: Unloading Haul truck into Jaw Crusher	AP-42 Drop Equation – Section 13.2.4	6.41E-02	8.02E-02	50.00%	50.00%	3.21E-02	4.01E-02

Coarse Ore Stockpile	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Summer Controlled Emission	Winter Controlled Emission
Coarse Ore Stockpile: Drop from conveyor (from jaw crusher) to stockpile	AP-42 Drop Equation – Section 13.2.4	6.41E-02	8.02E-02	15.00%	15.00%	5.45E-02	6.82E-02
Coarse Ore Stockpile: Dozer	AP-42 Dozer Equation – Section 11.9	5.36E-01	5.48E-01			5.36E-01	5.48E-01
Coarse Ore Stockpile - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.07E-01	1.28E-01			1.07E-01	1.28E-01

Mill Concentrator Facility	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Mill Concentrator Facility Scrubber A	Source Test Emission Data					7.14E-03	7.14E-03
Mill Concentrator Facility Scrubber B						7.43E-03	7.43E-03
Mill Concentrator Facility: Fugitive Releases from buildings	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					3.94E-02	3.94E-02
Mill Concentrator Facility: Bucking Room Baghouse	Source Test Emission Data					2.52E-03	2.52E-03

Concentrate Storage Building (CSB)	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Summer Controlled Emission	Winter Controlled Emission
CSB: Fugitive Releases from building + loadout	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					7.87E-01	7.87E-01
CSB: Material Drop into Trucks	AP-42 Drop Equation – Section 13.2.4	2.02E-02	2.52E-02			2.02E-02	2.52E-02
CSB: Truck Travel around CSB	Road bed and snow samples AP-42 Travel on Unpaved Roads - Section 13.2.2	1.31E-01	1.31E-01	10.00%	10.00%	1.18E-01	1.18E-01
CSB: Concentrate truck travel - MAAB1		1.06E-01	1.06E-01	10.00%	10.00%	9.55E-02	9.55E-02
CSB: Concentrate truck travel - MAAB2		1.75E-01	1.75E-01	10.00%	10.00%	1.58E-01	1.58E-01
CSB: Concentrate truck travel - MAAB3		4.09E-01	4.09E-01	10.00%	10.00%	3.68E-01	3.68E-01
CSB: Concentrate truck travel - MAAB4		4.11E-01	4.11E-01	10.00%	10.00%	3.70E-01	3.70E-01
CSB: Concentrate truck travel - MAAB5		6.85E-01	6.85E-01	10.00%	10.00%	6.17E-01	6.17E-01
CSB: Concentrate truck travel - MAAB6		7.32E-01	7.32E-01	10.00%	10.00%	6.59E-01	6.59E-01
CSB: Concentrate truck travel - MAAB7		1.08E+00	1.08E+00	10.00%	10.00%	9.71E-01	9.71E-01
CSB: Concentrate truck travel - MAAB8		9.42E-01	9.42E-01	10.00%	10.00%	8.48E-01	8.48E-01

Tailings Beach	Emission Estimation Method	Summer Uncontrolled	Winter Uncontrolled	Summer Control	Winter Control	Summer Controlled Emission	Winter Controlled Emission
Tailings1	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.22E+00	1.74E+00			1.22E+00	1.74E+00

Figure 3.1: Period 1 (1989 – 1992) Source Identification

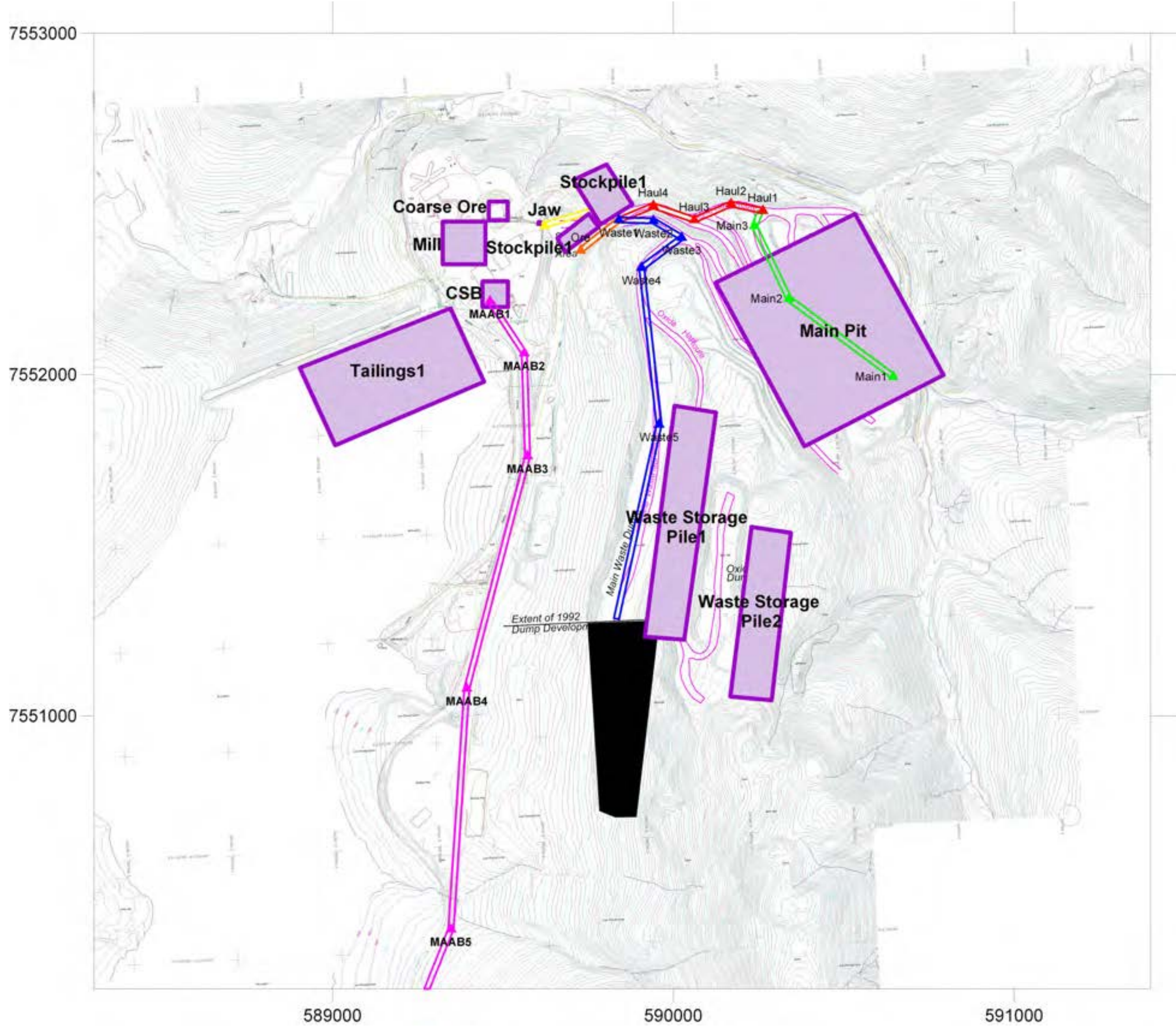


Table 3.2: Summary of 24-Hour Average Emission Rates (g/s) – Period 2 (1993-2000)

Mining Activities (Ore and Waste)	Emission Estimation Method	Uncontrolled Emission Rate (g/s) Summer	Uncontrolled Emission Rate (g/s) Winter	Control Summer	Control Winter	Controlled Emission Rate (g/s) Summer	Controlled Emission Rate (g/s) Winter
Mining: Drilling	AP-42 Drilling – Section 11.9	2.73E-01	2.73E-01	90.00%	90.00%	2.73E-02	2.73E-02
Mining: Blasting - Ore	AP-42 Blasting – Section 11.9	1.57E-04	1.57E-04	50.00%	50.00%	7.85E-05	7.85E-05
Mining: Blasting - Waste Rock		3.11E-04	3.11E-04	50.00%	50.00%	1.56E-04	1.56E-04
Mining: Dozer activity in Blast Area - Ore	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01	50.00%	50.00%	2.23E-01	2.28E-01
Mining: Dozer activity in Blast Area - Waste Rock		4.47E-01	4.57E-01	50.00%	50.00%	2.23E-01	2.28E-01
Mining: Loading of haul trucks in Blast Area - Ore	AP-42 Drop Equation – Section 13.2.4	1.51E-01	1.89E-01	50.00%	50.00%	7.55E-02	9.44E-02
Mining: Loading of haul trucks in Blast Area - Waste Rock		1.47E-01	1.85E-01	50.00%	50.00%	7.37E-02	9.23E-02
Mining: Loader travel in Blast Area	AP-42 Travel on Unpaved Roads - Section 13.2.2	3.84E+00		92.50%	82.50%	2.88E-01	6.73E-01
Mining: Haul truck travel in Blast Area		1.72E+01		92.50%	82.50%	1.29E+00	3.01E+00

Ore Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Ore Handling: Dozer activity on Ore Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	8.62E-02	1.23E-01			8.62E-02	1.23E-01
Ore Handling: Ore Storage Stockpile 2- Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01
Ore Handling: Haul truck unloading at Ore Storage Area	AP-42 Drop Equation – Section 13.2.4	1.51E-01	1.89E-01			1.51E-01	1.89E-01
Ore Handling: Loader travel in Ore Storage Area	AP-42 Travel on Unpaved Roads - Section 13.2.2	0.00E+00	0.00E+00	0.00%	0.00%	0.00E+00	0.00E+00
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul2		3.80E+00	3.80E+00	85.00%	65.00%	5.70E-01	1.33E+00
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul3		1.55E+00	1.55E+00	85.00%	65.00%	2.33E-01	5.43E-01
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul4		1.53E+00	1.53E+00	85.00%	65.00%	2.29E-01	5.34E-01
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area - Haul5		2.38E+00	2.38E+00	85.00%	65.00%	3.57E-01	8.33E-01
Ore Handling: Haul truck travel in Ore Storage Area - ORE		8.05E-01	8.05E-01	85.00%	65.00%	1.21E-01	2.82E-01
Ore Handling: Haul Truck travel from Ore Storage Area to Jaw Crusher - JAW1		1.22E+00	1.22E+00	85.00%	65.00%	1.83E-01	4.27E-01
Ore Handling: Haul Truck travel from Ore Storage Area to Gyro Crusher - GYRO1		4.15E-01	4.15E-01	85.00%	65.00%	6.22E-02	1.45E-01

Waste Rock Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul2	AP-42 Travel on Unpaved Roads - Section 13.2.2	3.71E+00	3.71E+00	85.00%	65.00%	5.57E-01	1.30E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul3		1.52E+00	1.52E+00	85.00%	65.00%	2.27E-01	5.30E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul4		1.49E+00	1.49E+00	85.00%	65.00%	2.24E-01	5.22E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul5		2.32E+00	2.32E+00	85.00%	65.00%	3.49E-01	8.14E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste1		5.98E+00	5.98E+00	85.00%	65.00%	8.97E-01	2.09E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste2		5.47E+00	5.47E+00	85.00%	65.00%	8.20E-01	1.91E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste3		4.35E+00	4.35E+00	85.00%	65.00%	6.52E-01	1.52E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste4		4.53E+00	4.53E+00	85.00%	65.00%	6.80E-01	1.59E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste5		1.47E+00	1.47E+00	85.00%	65.00%	2.20E-01	5.14E-01
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	AP-42 Dozer Equation – Section 11.9	5.36E-01	5.48E-01			5.36E-01	5.48E-01
Waste Rock: Haul truck unloading at Waste Rock Storage Area	AP-42 Drop Equation – Section 13.2.4	1.47E-01	1.85E-01			1.47E-01	1.85E-01
Waste Rock Handling: Waste Rock Storage Area1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.03E-01	1.47E-01			1.03E-01	1.47E-01
Waste Rock Handling: Waste Rock Storage Area2 - Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01

Crushers	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Jaw Crusher Baghouse	Source Test Emission Data					4.82E-03	4.82E-03
Gyro Crusher Baghouse	Source Test Emission Data					6.14E-03	6.14E-03
Ore Handling: Unloading Haul truck into Jaw Crusher	AP-42 Drop Equation – Section 13.2.4	1.20E-01	1.50E-01	65.00%	65.00%	4.21E-02	5.26E-02
Ore Handling: Unloading Haul truck into Gyro Crusher		4.01E-02	5.01E-02	65.00%	65.00%	1.40E-02	1.75E-02

Coarse Ore Stockpile	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Coarse Ore Stockpile: Emission from Building Exhaust	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and					1.28E-01	1.28E-01

Mill Concentrator Facility	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Mill Concentrator Facility Scrubber A	Source Test Emission Data					7.14E-03	7.14E-03
Mill Concentrator Facility Scrubber B						7.43E-03	7.43E-03
Mill Concentrator Facility: Fugitive Releases from buildings	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					3.94E-02	3.94E-02
Mill Concentrator Facility: Bucking Room Baghouse	Source Test Emission Data					2.52E-03	2.52E-03

Concentrate Storage Building (CSB)	Emission Estimation Method	Uncontrolled Emission Rate (g/s) Summer	Uncontrolled Emission Rate (g/s) Winter	Control Summer	Control Winter	Controlled Emission Rate (g/s) Summer	Controlled Emission Rate (g/s) Winter
CSB: Fugitive Releases from building + loadout	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					7.87E-01	7.87E-01
CSB: Concentrate truck travel - MAAB1	Road bed and snow samples AP-42 Travel on Unpaved Roads - Section 13.2.2	1.33E-01	1.33E-01	85.00%	65.00%	2.00E-02	4.66E-02
CSB: Concentrate truck travel - MAAB2		2.20E-01	2.20E-01	85.00%	65.00%	3.30E-02	7.69E-02
CSB: Concentrate truck travel - MAAB3		5.13E-01	5.13E-01	85.00%	65.00%	7.69E-02	1.80E-01
CSB: Concentrate truck travel - MAAB4		5.15E-01	5.15E-01	85.00%	65.00%	7.73E-02	1.80E-01
CSB: Concentrate truck travel - MAAB5		8.59E-01	8.59E-01	85.00%	65.00%	1.29E-01	3.01E-01
CSB: Concentrate truck travel - MAAB6		9.18E-01	9.18E-01	85.00%	65.00%	1.38E-01	3.21E-01
CSB: Concentrate truck travel - MAAB7		1.35E+00	1.35E+00	85.00%	65.00%	2.03E-01	4.73E-01
CSB: Concentrate truck travel - MAAB8		1.18E+00	1.18E+00	85.00%	65.00%	1.77E-01	4.14E-01

Tailings Beach	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Tailings1	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	9.86E-01	9.86E-01			9.86E-01	9.86E-01
Tailings2		2.94E-01	2.94E-01			2.94E-01	2.94E-01
Tailings3		9.86E-01	9.86E-01			9.86E-01	9.86E-01

Figure 3.2: Period 2 (1993-2000) Source Identification

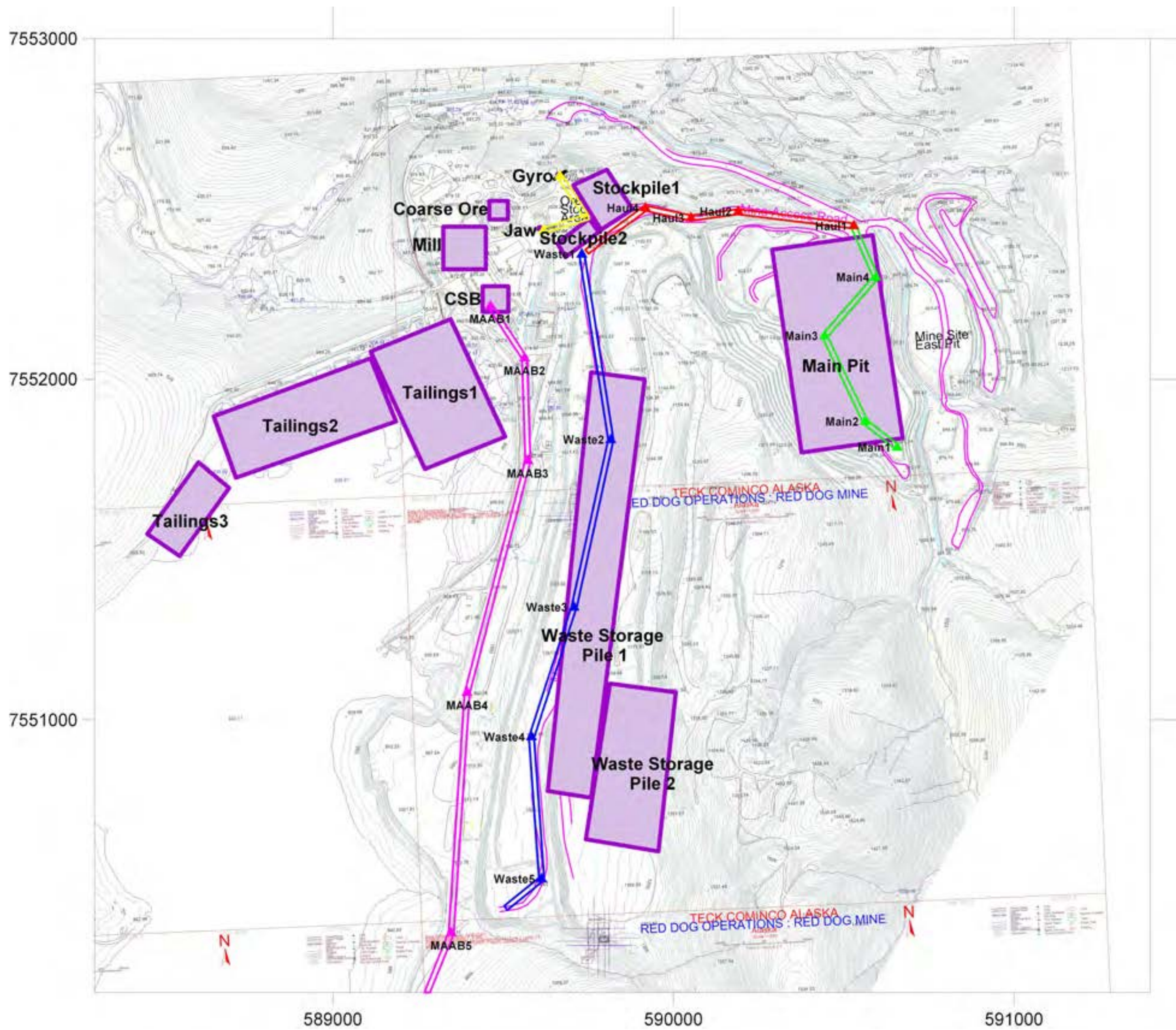


Table 3.3: Summary of 24-Hour Average Emission Rates (g/s) – Period 3 (2001-2003)

Mining Activities (Ore and Waste)	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Mining: Drilling	AP-42 Drilling – Section 11.9	3.28E-01	3.28E-01	90.00%	90.00%	3.28E-02	3.28E-02
Mining: Blasting - Ore	AP-42 Blasting – Section 11.9	1.57E-04	1.57E-04	50.00%	50.00%	7.85E-05	7.85E-05
Mining: Blasting - Waste Rock		3.40E-04	3.40E-04	50.00%	50.00%	1.70E-04	1.70E-04
Mining: Dozer activity in Blast Area - Ore	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01	50.00%	50.00%	2.23E-01	2.28E-01
Mining: Dozer activity in Blast Area - Waste Rock		4.47E-01	4.57E-01	50.00%	50.00%	2.23E-01	2.28E-01
Mining: Loading of haul trucks in Blast Area - Ore	AP-42 Drop Equation – Section 13.2.4	1.57E-01	1.97E-01	50.00%	50.00%	7.86E-02	9.84E-02
Mining: Loading of haul trucks in Blast Area - Waste Rock		1.40E-01	1.75E-01	50.00%	50.00%	6.98E-02	8.74E-02
Mining: Loader travel in Blast Area	AP-42 Travel on Unpaved Roads - Section 13.2.2	4.11E+00		92.50%	82.50%	3.08E-01	7.19E-01
Mining: Haul truck travel in Blast Area		2.16E+01		92.50%	82.50%	1.62E+00	3.79E+00

Ore Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Ore Handling: Dozer activity on Ore Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	8.62E-02	1.47E-01			8.62E-02	1.23E-01
Ore Handling: Ore Storage Stockpile 2- Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01
Ore Handling: Haul truck unloading at Ore Storage Area	AP-42 Drop Equation – Section 13.2.4	1.57E-01	1.97E-01			1.57E-01	1.97E-01
Ore Handling: Haul truck travel from Ore Storage Area to Crushers -Haul2	AP-42 Travel on Unpaved Roads - Section 13.2.2	2.94E+00	2.94E+00	85.00%	65.00%	4.41E-01	1.03E+00
Ore Handling: Haul truck travel from Ore Storage Area to Crushers-Haul3		3.90E+00	3.90E+00	85.00%	65.00%	5.85E-01	1.37E+00
Ore Handling: Haul truck travel from Ore Storage Area to Crushers -Haul4		7.10E-01	7.10E-01	85.00%	65.00%	1.07E-01	2.49E-01
Ore Handling: Haul truck travel from Ore Storage Area to Crushers -Haul5		3.13E+00	3.13E+00	85.00%	65.00%	4.69E-01	1.09E+00
Ore Handling: Haul truck travel within Ore Storage Area - Ore1		1.24E+00	1.24E+00	85.00%	65.00%	1.86E-01	4.34E-01
Ore Handling: Haul truck travel within Ore Storage Area - Ore2		2.15E+00	2.15E+00	85.00%	65.00%	3.23E-01	7.53E-01
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Gyro1		1.41E+00	1.41E+00	85.00%	65.00%	2.11E-01	4.92E-01
Ore Handling: Haul truck travel from Ore Storage Area to Jaw Crusher -Jaw1		1.72E-01	1.72E-01	85.00%	65.00%	2.59E-02	6.04E-02

Waste Rock Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul2	AP-42 Travel on Unpaved Roads - Section 13.2.2	2.61E+00	2.61E+00	85.00%	65.00%	3.92E-01	9.15E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul3		3.47E+00	3.47E+00	85.00%	65.00%	5.20E-01	1.21E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul4		6.31E-01	6.31E-01	85.00%	65.00%	9.46E-02	2.21E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul5		2.78E+00	2.78E+00	85.00%	65.00%	4.16E-01	9.71E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste1		1.22E+00	1.22E+00	85.00%	65.00%	1.82E-01	4.26E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste2		1.92E+00	1.92E+00	85.00%	65.00%	2.88E-01	6.72E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste3		3.54E+00	3.54E+00	85.00%	65.00%	5.31E-01	1.24E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste4		7.55E+00	7.55E+00	85.00%	65.00%	1.13E+00	2.64E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste5		2.05E+00	2.05E+00	85.00%	65.00%	3.07E-01	7.16E-01
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01
Waste Rock: Haul truck unloading at Waste Rock Storage Area	AP-42 Drop Equation – Section 13.2.4	1.40E-01	1.75E-01			1.40E-01	1.75E-01
Waste Rock Handling: Waste Rock Storage Area1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.03E-01	1.47E-01			1.03E-01	1.47E-01
Waste Rock Handling: Waste Rock Storage Area2 - Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01

Crushers	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Jaw Crusher Baghouse	Source Test Emission Data					3.57E-04	3.57E-04
Gyro Crusher Baghouse	Source Test Emission Data					1.09E-02	1.09E-02
Ore Handling: Unloading Haul truck into Jaw Crusher	AP-42 Drop Equation – Section 13.2.4	1.78E-02	2.23E-02	75.00%	75.00%	4.45E-03	5.57E-03
Ore Handling: Unloading Haul truck into Gyro Crusher		1.42E-01	1.78E-01	75.00%	75.00%	3.56E-02	4.45E-02

Coarse Ore Stockpile	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Coarse Ore Stockpile: Emission from Building Exhaust	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					1.28E-01	1.28E-01

Mill Concentrator Facility	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Mill Concentrator Facility Scrubber A	Source Test Emission Data					1.26E-01	1.26E-01
Mill Concentrator Facility Scrubber B						5.92E-02	5.92E-02
Mill Concentrator Facility: Fugitive Releases from buildings	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					3.94E-02	3.94E-02
Mill Concentrator Facility: Bucking Room Baghouse	Source Test Emission Data					2.52E-03	2.52E-03

Concentrate Storage Building (CSB)	Emission Estimation Method	Uncontrolled Emission Rate (g/s) Summer	Uncontrolled Emission Rate (g/s) Winter	Control Summer	Control Winter	Controlled Emission Rate (g/s) Summer	Controlled Emission Rate (g/s) Winter
CSB: Fugitive Releases from building + loadout	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					7.87E-01	7.87E-01
CSB: Concentrate truck travel - MAAB1	Road bed and snow samples AP-42 Travel on Unpaved Roads - Section 13.2.2	2.11E-01	2.11E-01	85.00%	65.00%	3.16E-02	7.38E-02
CSB: Concentrate truck travel - MAAB2		3.48E-01	3.48E-01	85.00%	65.00%	5.23E-02	1.22E-01
CSB: Concentrate truck travel - MAAB3		8.13E-01	8.13E-01	85.00%	65.00%	1.22E-01	2.84E-01
CSB: Concentrate truck travel - MAAB4		8.16E-01	8.16E-01	85.00%	65.00%	1.22E-01	2.86E-01
CSB: Concentrate truck travel - MAAB5		1.36E+00	1.36E+00	85.00%	65.00%	2.04E-01	4.77E-01
CSB: Concentrate truck travel - MAAB6		1.45E+00	1.45E+00	85.00%	65.00%	2.18E-01	5.09E-01
CSB: Concentrate truck travel - MAAB7		2.14E+00	2.14E+00	85.00%	65.00%	3.21E-01	7.50E-01
CSB: Concentrate truck travel - MAAB8		1.87E+00	1.87E+00	85.00%	65.00%	2.81E-01	6.55E-01

Tailings Beach	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Tailings	Air Pollution Engineering Manual, Air & Waste Management	1.55E+00	2.20E+00	72.50%	72.50%	4.26E-01	6.06E-01

Figure 3.3: Period 3 (2001-2003) Source Identification

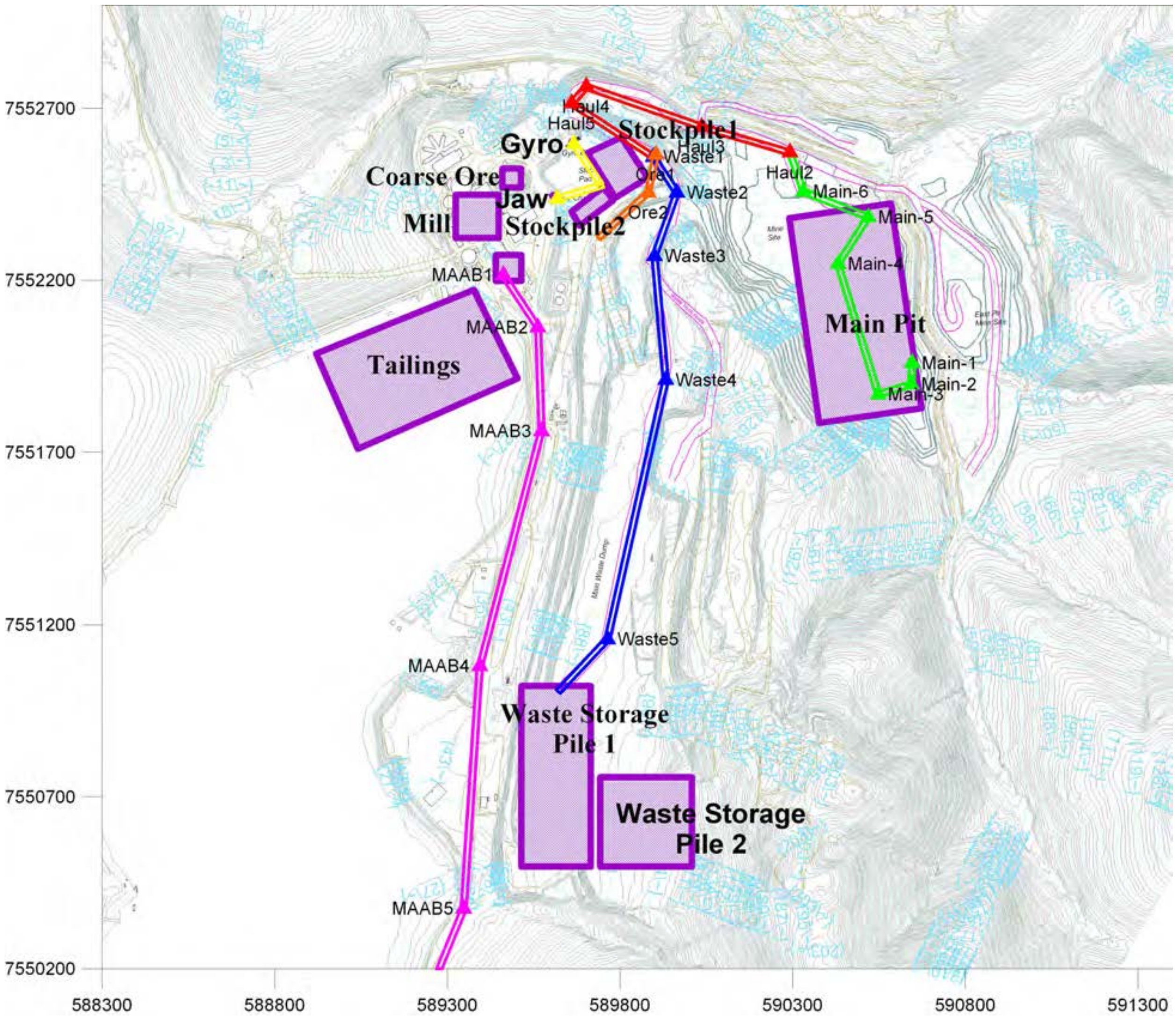


Table 3.4: Summary of 24-Hour Average Emission Rates (g/s) – Current

Mining Activities (Ore and Waste)	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Mining: Drilling	AP-42 Drilling – Section 11.9	3.41E-01	3.41E-01	90%	90%	3.41E-02	3.41E-02
Mining: Blasting - Ore	AP-42 Blasting – Section 11.9	1.57E-04	1.57E-04	50%	50%	7.85E-05	7.85E-05
Mining: Blasting - Waste Rock		3.40E-04	3.40E-04	50%	50%	1.70E-04	1.70E-04
Mining: Dozer activity in Blast Area - Ore	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01	50%	50%	2.23E-01	2.28E-01
Mining: Dozer activity in Blast Area - Waste Rock		4.47E-01	4.57E-01	50%	50%	2.23E-01	2.28E-01
Mining: Loading of haul trucks in Blast Area - Ore	AP-42 Drop Equation – Section 13.2.4	1.44E-01	1.81E-01	50%	50%	7.22E-02	9.04E-02
Mining: Loading of haul trucks in Blast Area - Waste Rock		1.71E-01	2.14E-01	50%	50%	8.53E-02	1.07E-01
Mining: Loader travel in Blast Area	AP-42 Travel on Unpaved Roads - Section 13.2.2	3.66E+00		93%	83%	2.74E-01	6.40E-01
Mining: Haul truck travel in Blast Area		2.30E+01		93%	83%	1.72E+00	4.02E+00

Ore Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Ore Handling: Dozer activity on Ore Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01	50%	50%	2.23E-01	2.28E-01
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.03E-01	1.47E-01	50%	50%	5.16E-02	7.35E-02
Ore Handling: Ore Storage Stockpile 2- Wind Erosion		7.28E-02	1.04E-01	50%	50%	3.64E-02	5.19E-02
Ore Handling: Haul truck unloading at Ore Storage Area	AP-42 Drop Equation – Section 13.2.4	1.44E-01	1.81E-01	50%	50%	7.22E-02	9.04E-02
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area Haul1	AP-42 Travel on Unpaved Roads - Section 13.2.2	3.61E+00	3.61E+00	85%	65%	5.41E-01	1.26E+00
Ore Handling: Haul truck travel in Ore Storage Area (in East Mine)		5.50E+00	5.50E+00	93%	83%	4.12E-01	9.62E-01
Ore Handling: Loader travel in Ore Storage Area (in East Mine)		0.00E+00	0.00E+00	93%	83%	0.00E+00	0.00E+00
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul1		3.61E+00	3.61E+00	85%	65%	5.41E-01	1.26E+00
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul2		2.70E+00	2.70E+00	85%	65%	4.06E-01	9.46E-01
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul3		3.59E+00	3.59E+00	85%	65%	5.38E-01	1.25E+00
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul4		6.52E-01	6.52E-01	85%	65%	9.78E-02	2.28E-01
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul5		2.87E+00	2.87E+00	85%	65%	4.31E-01	1.00E+00
Ore Handling: Haul truck travel from Ore Storage Area to Crushers -Ore1		6.96E-01	6.96E-01	85%	65%	1.04E-01	2.44E-01
Ore Handling: Haul truck travel from Ore Storage Area to Crushers -Ore2		1.33E+00	1.33E+00	85%	65%	1.99E-01	4.65E-01
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Gyro1		1.41E+00	1.41E+00	85%	65%	2.11E-01	4.92E-01
Ore Handling: Haul truck travel from Ore Storage Area to Jaw Crusher-Jaw1		1.72E-01	1.72E-01	85%	65%	2.59E-02	6.04E-02

Waste Rock Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul1	AP-42 Travel on Unpaved Roads - Section 13.2.2	2.97E+00	2.97E+00	85%	65%	4.45E-01	1.04E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul2		2.22E+00	2.22E+00	85%	65%	3.34E-01	7.78E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul3		2.95E+00	2.95E+00	85%	65%	4.42E-01	1.03E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul4		5.37E-01	5.37E-01	85%	65%	8.05E-02	1.88E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul5		2.36E+00	2.36E+00	85%	65%	3.54E-01	8.27E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste1		1.03E+00	1.03E+00	85%	65%	1.55E-01	3.62E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste2		1.63E+00	1.63E+00	85%	65%	2.45E-01	5.71E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste3		3.01E+00	3.01E+00	85%	65%	4.52E-01	1.05E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste4		6.43E+00	6.43E+00	85%	65%	9.64E-01	2.25E+00
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste5		1.74E+00	1.74E+00	85%	65%	2.61E-01	6.09E-01
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste6		4.69E+00	4.69E+00	85%	65%	7.03E-01	1.64E+00
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01
Waste Rock: Haul truck unloading at Waste Rock Storage Area	AP-42 Drop Equation – Section 13.2.4	1.71E-01	2.14E-01			1.71E-01	2.14E-01
Waste Rock Handling: Waste Rock Storage Area1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.03E-01	1.47E-01			1.03E-01	1.47E-01
Waste Rock Handling: Waste Rock Storage Area2- Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01
Waste Rock Handling: Waste Rock Storage Area 3- Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01

Crushers	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Jaw Crusher Baghouse	Source Test Emission Data					3.57E-04	3.57E-04
Gyro Crusher Baghouse	Source Test Emission Data					1.09E-02	1.09E-02
Ore Handling: Unloading Haul truck into Jaw Crusher	AP-42 Drop Equation – Section 13.2.4	1.78E-02	2.23E-02	75%	75%	4.45E-03	5.57E-03
Ore Handling: Unloading Haul truck into Gyro Crusher		1.42E-01	1.78E-01	75%	75%	3.56E-02	4.45E-02

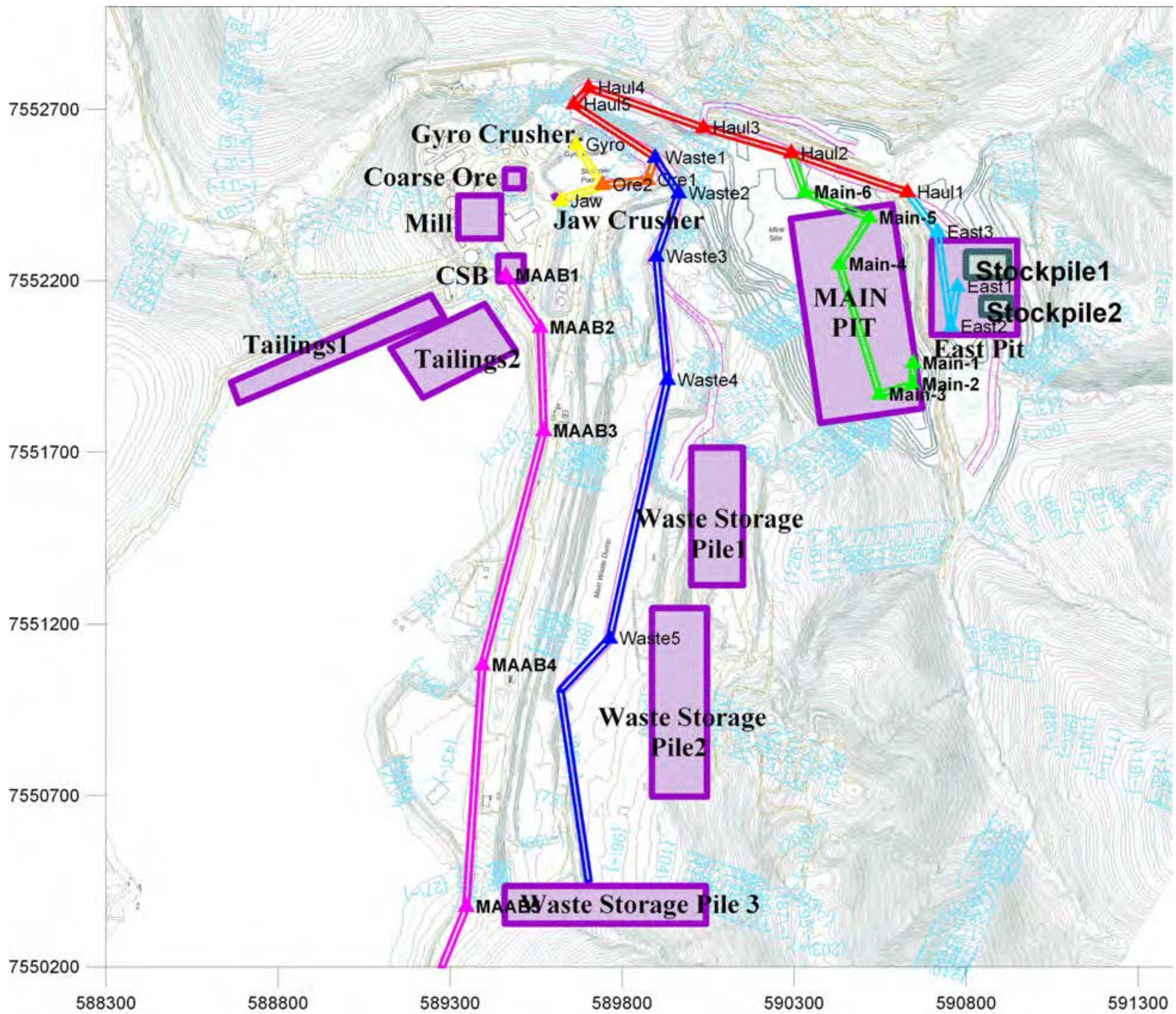
Coarse Ore Stockpile	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Coarse Ore Stockpile: Emission from Building Exhaust	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					1.28E-01	1.28E-01

Mill Concentrator Facility	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter
Mill Concentrator Facility Scrubber A	Source Test Emission Data					1.26E-01	1.26E-01
Mill Concentrator Facility Scrubber B						5.92E-02	5.92E-02
Mill Concentrator Facility: Fugitive Releases from buildings	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					3.94E-02	3.94E-02
Mill Concentrator Facility: Bucking Room Baghouse	Source Test Emission Data					2.52E-03	2.52E-03

Concentrate Storage Building (CSB)	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
CSB: Fugitive Releases from building + loadout	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					4.07E-01	4.07E-01
CSB: Concentrate truck travel - MAAB1	Road bed and snow samples AP-42 Travel on Unpaved Roads - Section 13.2.2	2.31E-01	2.31E-01	85%	65%	3.47E-02	8.10E-02
CSB: Concentrate truck travel - MAAB2		3.82E-01	3.82E-01	85%	65%	5.74E-02	1.34E-01
CSB: Concentrate truck travel - MAAB3		8.92E-01	8.92E-01	85%	65%	1.34E-01	3.12E-01
CSB: Concentrate truck travel - MAAB4		8.96E-01	8.96E-01	85%	65%	1.34E-01	3.14E-01
CSB: Concentrate truck travel - MAAB5		1.49E+00	1.49E+00	85%	65%	2.24E-01	5.23E-01
CSB: Concentrate truck travel - MAAB6		1.60E+00	1.60E+00	85%	65%	2.39E-01	5.59E-01
CSB: Concentrate truck travel - MAAB7		2.35E+00	2.35E+00	85%	65%	3.53E-01	8.23E-01
CSB: Concentrate truck travel - MAAB8		2.06E+00	2.06E+00	85%	65%	3.08E-01	7.19E-01

Tailings Beach	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter
Tailings1	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	4.86E-01	6.92E-01	95%	70%	2.43E-02	2.08E-01
Tailings2		5.38E-01	7.66E-01	95%	70%	2.69E-02	2.30E-01

Figure 3.4: Current Period Source Identification



3.1 MINING ACTIVITIES

Within the mine site, activities of drilling, blasting, dozing, loading of blasted material in haul trucks, and equipment travel are considered to be sources of PM emissions.

Due to the depth of the pit during Periods 2, 3, and Current, a portion of the emissions generated within the pit would not have had enough momentum to disperse beyond the pit, and thus be retained in the pit. The CALPUFF model does not incorporate this retention. As a starting point, the percentage of emissions retained within the pit was estimated to be 50% based upon general knowledge and previous studies investigating this matter [Winges & Cole 1986, Cole & Fabrick 1984]. The control applied as a result of the retention of emissions within the pit will be further investigated in a sensitivity analysis in the next phase of the assessment for all in-pit activities.

3.1.1 Drilling

Emissions of PM resulting from drilling activities were estimated using the drilling emission factors provided in *Section 11.9: Western Surface Coal Mining (Table 11.9-4)* of the U.S. EPA AP-42 document [U.S. EPA 1998]. Section 11.9 provides emission factors for drilling of overburden and coal. It was assumed that the drilled material at Red Dog was more appropriately described as overburden by a comparison of site specific silt and moisture values to those presented in AP-42 Section 11.9. The period specific parameters used to estimate the emissions from drilling are provided below in Table 3.5. It was assumed there would be no seasonal variations in uncontrolled emissions resulting from drilling operations. Control was applied to the drilling operations a result of the drilling occurring within a pit during Periods 2, 3, and Current. As noted previously, the implications of this will be investigated in a sensitivity analysis in the next phase of the assessment for all in-pit activities. An additional control of 80% was applied during all periods to account for the water spray applied directly on the drill bit. It should be noted that this control was applied for the summer and winter, as in the winter the site uses methanol as an anti-freezing agent, to allow the ability to spray year round.

Table 3.5: Drilling Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Holes Drilled (holes/day)	35	40	48	50
Pit Retention Control Applied to Emissions (%)	0	50	50	50
Water/Methanol Spray Control Applied to Emissions (%)	80%	80%	80%	80%

3.1.2 Blasting

Emissions of PM resulting from blasting activities were estimated using the blasting emission factors provided in *Section 11.9: Western Surface Coal Mining (Table 11.9-2)* of the U.S. EPA

AP-42 document [U.S. EPA 1998]. The period specific parameters used to estimate the emissions from blasting are provided below in Table 3.6. As with the drilling emissions, no seasonal variation was applied to the uncontrolled emissions and the control applied to the blasting operations as a result of the blasting occurring within a pit during Periods 2, 3, and Current.

Table 3.6: Blasting Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Ore Blasted (tons/day)	4,442	8,985	9,359	8,597
Waste Rock Blasted (tons/day)	7,859	8,778	8,312	10,159
Ore Blasted (million tons/yr)	1.6	3.3	3.4	3.1
Waste Rock Blasted (million tons/yr)	2.8	3.2	3.0	3.7
Pit Retention Control Applied to Emissions (%)	0	50	50	50

3.1.3 Bulldozing in Mining Area

Emissions of PM resulting from bulldozing activities of ore and waste rock were estimated using the bulldozing emission factors provided in *Section 11.9: Western Surface Coal Mining (Table 11.9-2)* of the U.S. EPA AP-42 document [U.S. EPA 1998].

The following assumptions were made:

- bulldozed material (both ore and waste rock) resembles overburden;
- pit retention control applied to all emissions during Periods 2, 3, and Current due to location within the pit; and
- silt content of ore and waste rock is 4.6%.

Further information regarding the use of emission factors for overburden and the control applied to the emissions is found in Section 3.1.1. The silt content while based upon the best information available is likely conservative as it is the same as the coal silt content provided in *Section 13.2.4: Iron & Steel Production* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The following site data was used:

- moisture content of ore and waste rock is 2.55% in summer and 2.51% in winter.

These values were obtained from analysis of daily material samples taken onsite between November 1993 and December 1994, (based on analysis of over 400 samples). The silt content of the ore and waste rock was estimated to be the average silt content of all samples taken onsite (sample data provided in Appendix B).

3.1.4 Material Loading into Haul Trucks

Emissions of PM resulting from the loading of ore and waste rock into haul trucks were estimated using the empirical expression provided in *Section 13.2.4: Aggregate Handling and Storage Piles (Equation 1)* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The following assumption was made:

- loading occurs 20 hrs/day x 50% activity = 10 hrs/day.

It was assumed that while the haul trucks would be loaded with material almost every hour during a given day, the loading would only occur on average 30 minutes out of every hour to allow for actual haul truck transportation cycle time.

The following site data was used for all periods:

- an average summer mean wind speed of 3.6 m/s;
- an average winter mean wind speed of 4.2 m/s;
- pit retention control applied to all emissions during Periods 2, 3, and Current due to location within the pit; and
- moisture content of ore and waste rock is 2.55% in summer and 2.51% in winter.

The summer and winter mean speeds were averages obtained from measurements made at the onsite Mill meteorological station during the 2003 and 2004 years. For this modeling exercise, winter was defined as November through April and summer was defined as May through October. It should be noted that as detailed in the *Protocol for Evaluation of Fugitive Dust Sources of Lead and Zinc at Red Dog Mine* [SENES 2005] one year of meteorology will used for modelling all periods. As detailed previously, the moisture contents of the ore and waste rock that were used were obtained from analysis of daily material samples taken onsite between November 1993 and December 1994.

The period specific parameters used to estimate the emissions from loading material into the mining haul trucks are provided below in Table 3.7. As with all mining activities, the control applied is due to the material loading occurring within a pit during Periods 2, 3, and Current.

Table 3.7: Mining Haul Truck Material Loading Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Ore Loaded (tons/day)	4,442	8,985	9,359	8,597
Waste Rock Loaded (tons/day)	7,859	8,778	8,312	10,159
Pit Retention Control Applied to Emissions (%)	0	50	50	50

3.1.5 Vehicular Movement within the Mining Area

Emissions of PM resulting from loader and haul truck travel were estimated using the empirical expression (*Equation 1a*) and parameters (*Table 13.2.2-2*) provided in *Section 13.2.2: Unpaved Roads* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The total haul truck distance travelled per day was estimated by:

(1) dividing the total tons of material loaded (ore and waste rock) per day, as noted in Table 3.7, by the capacity of the haul trucks to obtain the total number of trips per day; and
(2) multiplying the total number of trips travelled per day by the distance of each roundtrip.

The total loader distance travelled per day was estimated by multiplying the total loader distance travelled per hour (estimated by Red Dog personnel) by the loader daily operating hours. It should be noted that the loaders were assumed to be active only 50% of their operating hours, as there are downtimes when the trucks are in transit when the loaders are stationary.

The following assumptions were made:

- blast area (i.e., Muck Pile) has a surface silt content of 7.7%, which is the East Pit Road surface measured silt content;
- pit retention control applied to all emissions during Periods 2, 3, and Current due to location within the pit;
- loaders active 50% of the loader operating hours;
- conservative road control of 10% during Period 1;
- Summer road control of 85% due to increased watering and calcium chloride usage for Periods 2, 3, and Current; and
- Winter road control of 65% (as per discussion with Red Dog personnel) for Periods 2, 3, and Current.

The other parameters used in estimating the PM from the mining vehicular movement are detailed in Table 3.8 below.

Table 3.8: Mining Vehicular Movement Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Haul Truck Average Unloaded Weight (tons)	64.5	64.5	70.9	70.9
Haul Truck Average Loaded Weight (tons)	162	162	177.5	177.5
Haul Truck Capacity (tons)	97.5	97.5	106.6	106.6
Haul Truck Distance Per One-Way Trip (mi)	0.41	0.49	0.65	0.65
Haul Truck Daily Operation Hours (hrs/day)	20	20	20	20
Loader Average Unloaded Weight (tons)	97	97	101	101
Loader Average Loaded Weight (tons)	121	121	125	125
Loader Capacity (tons)	24	24	24	24
Loader Distance Travelled (mi/hr)	2.1	3.98	4.26	3.79
Loader Daily Operation Hours (hrs/day)	20	20	20	20
Percent of Operating Hours Loader Active (%)	50%	50%	50%	50%
Pit Retention Control Applied to Emissions (%)	0	50	50	50
Road Control – Summer (%)	10	85	85	85
Road Control – Winter (%)	10	65	65	65

3.2 ORE STOCKPILE HANDLING

At the ore storage area(s), activities of dozing, wind erosion of stockpiles, unloading of ore at stockpiles, loading of ore at stockpiles, unloading of ore at crushing equipment, and equipment travel are considered to be sources of PM emissions. Within the activity of ore handling, 'equipment travel' consists of haul truck travel from the blast area to the ore storage area, haul truck and loader travel within the ore storage area, and haul truck and/or loader travel from the ore storage area to the crushing equipment.

3.2.1 Ore Stockpile Bulldozing

Emissions of PM from bulldozing associated with ore handling were estimated in the same manner as the emissions from bulldozing in the mining area, using the bulldozing emission factors provided in *Section 11.9: Western Surface Coal Mining (Table 11.9-2)* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The following assumptions were made:

- bulldozed material (ore) resembles overburden ; and
- pit retention of 50% during the Current period, as the stockpile storage area is located in one of the mine pits. As indicated previously, the impact of the pit retention factor will be considered further in the next phase of the assessment.

The following site data was used for all periods:

- moisture content of ore and waste rock is 2.55% in summer and 2.51% in winter.

3.2.2 Wind Erosion – Ore Stockpile Handling

Emissions of PM from wind erosion of ore stockpiles were estimated using the empirical expression provided in the *Air Pollution Engineering Manual* (Air & Waste Management Association, 1992). As noted in the *Air Pollution Engineering Manual*, use of the empirical equation provided in Section 13.2.5 of the U.S. EPA AP-42 [U.S. EPA 2006] document to estimate wind erosion emissions requires stepwise calculations and detailed parameters, which is a time consuming exercise. The methodology outlined in the U.S. EPA AP-42 document will be incorporated during the third step of the study in which more comprehensive dispersion modelling will be performed. However, for this preliminary modelling, the simplified equation provided in the Air Pollution Engineering Manual was considered an adequate tool for estimating PM emissions arising from wind erosion.

The following assumptions were made:

- silt content of ore is 4.6% during all periods; and
- only a 100m by 100m surface area of the stockpile is exposed to wind erosion.

Only recently disturbed areas of stockpiles are susceptible to wind erosion as once the initial loose surface PM is blown away, if the pile remains undisturbed, this loose PM, which is the material susceptible to wind erosion, will not be replaced. Based upon the size of the stockpiles at Red Dog and the amount of material handled daily, it was conservatively estimated that a 100 meter by 100 meter area of the stockpile would be exposed to wind erosion. During normal mining operations two ore stockpiles are in use. While one of the stockpiles is built with a blend of different ore types, and the second completed stockpile is used for mill feed. Once the second stockpile is consumed the first stockpile is then fed to the mill and a new stockpile construction begins.

The other parameters used in estimating the PM emissions from wind erosion of the ore stockpiles are detailed in Table 3.9 below.

Table 3.9: Ore Stockpile Wind Erosion Emissions Parameters

<table>
<tr><th>Parameter</th><th>Period 1</th><th>Period 2</th><th>Period 3</th><th>Current</th></tr>
<tr><td>Stockpile 1 – Total Area (ft^2)</td><td colspan="3">214,684</td><td>145,872</td></tr>
<tr><td>Stockpile 1 - % Available for Erosion</td><td colspan="3">50</td><td>74</td></tr>
<tr><td>Stockpile 1 – Height (ft)</td><td colspan="3">25</td><td>33</td></tr>
<tr><td>Stockpile 1 – Pit Retention Control Applied to Emissions (%)</td><td colspan="3">0</td><td>50</td></tr>
<tr><td>Stockpile 2 – Total Area (ft^2)</td><td colspan="3">89,837</td><td>75,943</td></tr>
<tr><td>Stockpile 2 - % Available for Erosion</td><td colspan="3">100</td><td>100</td></tr>
<tr><td>Stockpile 2 – Height (ft)</td><td colspan="3">25</td><td>33</td></tr>
<tr><td>Stockpile 2 – Pit Retention Control Applied to Emissions (%)</td><td colspan="3">0</td><td>50</td></tr>
<tr><td>[1]Frequency Summer Wind Speed Exceeds 5.4 m/s (%)</td><td colspan="3">22.9</td><td>22.9</td></tr>
<tr><td>[1]Frequency Winter Wind Speed Exceeds 5.4 m/s (%)</td><td colspan="3">32.6</td><td>32.6</td></tr>
</table>

[1]Note that the frequency the wind speed exceeds 5.4 m/s is the same for all periods because the same year of meteorology will be used to model all four time periods [SENES 2005].

3.2.3 Material Unloading and Loading – Ore Stockpile Handling

Emissions of PM from the unloading of ore at the stockpiles, loading of ore from the stockpiles, and unloading of ore into the crushing equipment were estimated using the empirical expression provided in *Section 13.2.4: Aggregate Handling and Storage Piles (Equation 1)* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The following assumptions were made:

- All Periods - Haul trucks travel 20 hrs/day, feeding crushers only when crushers operate (see Table 3.10 for crusher operating hours)
  - Dozers operate 20 hrs/day x 40% activity = 8 hrs/day
- Period 1 - the material drop from the front-end loader and haul truck to the jaw crusher is enclosed on three sides and on top – providing 50% control of emissions;
- Period 2 - the material drop from the haul trucks into the jaw crusher dump pocket is controlled by enclosures (three sides and on top), providing a cumulative control of 65% on emissions (the increased control from Period 1 was due to the installation of a new, larger capacity baghouse);
  - control of 65 % applied to gyro crusher (gyro crusher was installed with an enclosure, however the enclosure did not have a stilling curtain and had an open door initially)

- Period 3 - the material drop from the haul trucks into the jaw crusher dump pocket is controlled by enclosures (three sides and on top and stilling curtains), providing a cumulative control of 75% on emissions;
  - control of 75 % applied to gyro crusher (March 2002 - installation of gyro crusher dump pocket particulate matter control stilling curtains. February 2003 - door installed on gyro crusher maintenance bay opening)
- Current - control of 75% applied to jaw and gryo crusher.

The following site data was used:

- a summer mean wind speed of 3.6 m/s during all periods;
- a winter mean wind speed of 4.2 m/s during all periods; and
- the moisture content of ore is 2.55% in summer and 2.51% in winter.

3.2.4 Vehicular Movement – Ore Stockpile

Emissions of PM resulting from loader and haul truck travel were estimated in the same manner as in the mining area, using the empirical expression *(Equation 1a)* and parameters *(Table 13.2.2-2)* provided in *Section 13.2.2: Unpaved Roads* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The total haul truck distance travelled per day was estimated in the same manner as for the mine area, by:

(1) dividing the total tons of ore crushed per day (from both the jaw and gyro crushers), as noted in Table 3.10, by the capacity of the haul trucks, to obtain the total number of trips per day; and
(2) multiplying the total number of trips travelled per day by the distance of each trip.

During Period 1 only, the ore was transported from the stockpile to the jaw crusher by both loaders and haul trucks, each making the same number of trips per day. The total loader distance travelled per day was estimated in the same manner as detailed above for the haul trucks.

The following assumptions were made:

- Haul Road (from the pit to the crushers) has a surface silt content of 7.74%, which is the average of three onsite road samples taken in 2005;
- road controls as detailed in Section 3.1.5.

The other parameters used in estimating the PM emissions from vehicular movement associated with ore stockpile handling are detailed in Table 3.10 below.

Table 3.10: Ore Stockpile Vehicular Movement Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Jaw Crusher (tons/day)	3816	7151	1059	1059
Gryo Crusher (tons/day)		2384	8476	8476
Jaw Crusher (hrs/day)	7.5	13.5	1	1
Gryo Crusher (hrs/day)	0	4.5	8	8
Control on Drop into Jaw Crusher (%)	50%	65%	75%	75%
Control on Drop into Gyro Crusher (%)	-	65%	75%	75%
Haul Truck Capacity (tons)	97.5	97.5	106.6	106.6
Haul Truck Distance Per One-Way Trip – Blast Area (Muck Pile) to Ore Storage Area (mi)	0.3	0.53	0.60	0.22
Haul Truck Daily Operation Hours (hrs/day)	20	20	20	20
Haul Truck Distance Per One-Way Trip – Ore Storage Area to Crushers (mi)	0.18	0.22	0.28	0.21
Road Control – Summer (%)	10%	85%	85%	85%
Road Control – Winter (%)	10%	65%	65%	65%

3.3 WASTE ROCK HANDLING

At the waste rock storage area, activities of equipment travel (haul trucks from the blast area to the waste storage area), dozing, and wind erosion of waste rock storage areas are considered to be sources of PM emissions.

3.3.1 Vehicular Movement – Waste Rock Handling

Emissions of PM from haul truck travel associated with waste rock haulage were estimated in the same manner as in the mining and ore handling areas, using the empirical expression *(Equation 1a)* and parameters *(Table 13.2.2-2)* provided in *Section 13.2.2: Unpaved Roads* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The total haul truck distance travelled per day was estimated in the same manner as for the mine area, by:

(1) dividing the total tons of waste rock loaded in the mine area, as noted in Table 3.7, by the capacity of the haul trucks, to obtain the total number of trips per day; and
(2) multiplying the total number of trips travelled per day by the distance of each trip.

The following assumptions were made:

- Haul Road (from the pit to the crushers) has a surface silt content of 7.74%, which is the average of three onsite road samples taken in 2005 (see Figure 2.3 for sample locations); and

- road controls as detailed in Section 3.1.5.

The other parameters used in estimating the PM emissions from haul truck travel from the mine site to the waste rock storage area are detailed in Table 3.11 below.

Table 3.11: Waste Rock Vehicular Movement Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Haul Truck Distance Per One-Way Trip – Muck Pile to Waste Rock Storage (mi)	1.1	1.8	1.6	2.2
Haul Truck Capacity (tons)	97.5	97.5	106.6	106.6
Haul Truck Daily Operation Hours (hrs/day)	20	20	20	20
Road Controls – Summer (%)	10	85	85	85
Road Controls – Winter (%)	10	65	65	65

3.3.2 Haul Truck Unloading - Waste Rock Storage Areas

Emissions of PM from haul trucks unloading waste rock were estimated using the empirical expression provided in *Section 13.2.4: Aggregate Handling and Storage Piles (Equation 1)* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The following site data was used for all periods:

- a summer mean wind speed of 3.6 m/s;
- a winter mean wind speed of 4.2 m/s; and
- moisture content of waste rock is 2.55% in summer and 2.51% in winter.

The other parameters used in estimating the PM emissions from haul trucks unloading waste rock are detailed in Table 3.12 below.

Table 3.12: Waste Rock Haul Truck Unloading Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Waste Rock Loaded (tons/day)	7,859	8,778	8,312	10,159
Haul Truck Unloading Daily Operations Hours (hrs/day)	20	20	20	20

3.3.3 Bulldozing – Waste Rock Handling

Emissions of PM from bulldozing in the waste rock storage area were estimated using the bulldozing emission factors found in *Section 11.9: Western Surface Coal Mining (Table 11.9-2)* of the U.S. EPA AP-42 document [U.S. EPA 1998].

The following assumptions were made:

- bulldozed material (ore) resembles overburden.

The following site data was used for all periods:

- moisture content of ore and waste rock is 2.55% in summer and 2.51% in winter.

3.3.4 Wind Erosion – Waste Rock Storage Areas

Similar to previous wind erosion emissions estimations (see Section 3.2.2), emissions of PM from waste rock storage areas were estimated using the empirical expression provided in the *Air Pollution Engineering Manual* (Air & Waste Management Association, 1992).

The following assumptions were made:

- silt content of waste rock is 4.6% during all periods; and
- only a 100m by 100m area of the storage pile is exposed to wind erosion.

The other parameters used in estimating the PM emissions from wind erosion of the waste rock storage pile are detailed in Table 3.13 below. Figures 3.1 through 3.4 identify the waste storage piles for the four time periods assessed.

Table 3.13: Waste Rock Storage Pile Wind Erosion Emissions Parameters

Parameter	Period 1	Period 2	Period 3	Current
Storage Pile 1 Total Area (ft^2)	982,889	1,933,225	1,249,141	764,929
Storage Pile 1 % Available for Erosion (%)	11	5.6	8.6	14.1
Storage Pile 2 Total Area (ft^2)	655,939	1,187,680	827,755	1,110,964
Storage Pile 2 % Available for Erosion (%)	16	9.1	13	9.8
Storage Pile 3 Total Area (ft^2)	-	-	-	843,150
Storage Pile 3 % Available for Erosion (%)	-	-	-	12.8
Storage Pile Height (ft)	25	25	25	33
Control on Storage Pile	0%	0%	0%	0%
[1]Frequency Summer Wind Speed Exceeds 5.4 m/s (%)	22.9	22.9	22.9	22.9
Frequency Winter Wind Speed Exceeds 5.4 m/s (%)	32.6	32.6	32.6	32.6

[1]Note that the frequency the wind speed exceeds 5.4 m/s is the same for all periods because the same year of meteorology will be used to model all four time periods [SENES 2005].

3.4 CRUSHER ACTIVITY

Emissions of PM from the jaw and gyratory baghouses (conveyor transfer point) were obtained from source testing conducted by TCAK, as presented in Table 3.14 below. The emissions from the transfer of material into the crushers for all scenarios have been estimated through use of U.S. EPA emission factors, as detailed in Section 3.2.3.

The gyratory crusher was installed in 2000, and once operational processed the majority of the ore. As the gyratory crusher only operated for a quarter of Period 2 (2000-2001) it was estimated to crush a quarter of the daily ore and operate a quarter of the total crusher hours during Period 2.

Table 3.14: Jaw and Gyratory Crusher Conveyor Transfer Baghouse Parameters

Parameters	Period 1	Period 2	Period 3	Current
Jaw Crusher Conveyor Transfer Baghouse PM Emission Rate (lb/hr)	0.127	0.068	0.068	0.068
Jaw Crusher Daily Operations Hours (hrs/day)	7.5	13.5	1	1
Gyro Crusher Conveyor Transfer Baghouse PM Emission Rate (lb/hr)	-	0.26	0.26	0.26
Gyro Crusher Daily Operations Hours (hrs/day)	0	4.5	8	8

3.5 COARSE ORE STOCKPILE

During Period 1 the coarse ore stockpile was not fully enclosed and activities of dozing, wind erosion of the stockpile, and conveyor stacking of the stockpile were sources of PM emissions. In August 1992 the coarse ore stockpile enclosure was completed, after which emissions consisted of fugitive releases from the building as detailed in Section 3.5.4.

3.5.1 Bulldozing – Coarse Ore Stockpile (Period 1 only)

Emissions of PM from bulldozing around the coarse ore stockpile were estimated using the bulldozing emission factors found in *Section 11.9: Western Surface Coal Mining (Table 11.9-2)* of the U.S. EPA AP-42 document [U.S. EPA 1998].

The following assumptions were made:

- bulldozed material (ore) resembles overburden.

The following site data was used for all periods:

- moisture content of ore and waste rock is 2.55% in summer and 2.51% in winter.

3.5.2 Conveyor Stacking – Coarse Ore Stockpile (Period 1 only)

Emissions of PM from conveyor stacking of the coarse ore stockpile were estimated using the empirical expression provided in *Section 13.2.4: Aggregate Handling and Storage Piles (Equation 1)* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The following assumption was made:

- 15% control applied for tarping on around the stockpile.

The following site data was used:

- 3,816 tons of ore a day transported via conveyor onto a cone shaped stockpile;
- a summer mean wind speed of 3.6 m/s during all periods;
- a winter mean wind speed of 4.2 m/s during all periods; and
- the moisture content of ore is 2.55% in summer and 2.51% in winter.

3.5.3 Wind Erosion – Coarse Ore Stockpile (Period 1 only)

Emissions of PM from the coarse ore stockpile were estimated using the empirical expression provided in the *Air Pollution Engineering Manual* (Air & Waste Management Association, 1992).

The following assumptions were made:

- silt content of ore is 4.6% during all periods; and
- only a 100m by 100m area of the stockpile is exposed to wind erosion.

The emissions of particulate arising from erosion of the stockpile are based upon the percentage of time the wind speed exceeds a threshold velocity. The threshold velocity used in association with the empirical expression provided in the *Air Pollution Engineering Manual* is 5.4 m/s and corresponds with an anemometer height of 10 metres. During Period 1, the coarse ore stockpile is elevated above ground on a platform, such that it stands approximately 22.6 meters (74 feet) above ground. At the height that the stockpile stands, the equivalent threshold velocity would be lower. The equivalent threshold wind velocity at 20 meters was estimated to be 4.4 m/s, as detailed in the sample calculations included in Appendix A.

The other parameters used in estimating the PM emissions from wind erosion of the coarse ore storage pile are detailed in Table 3.15 below.

Table 3.15: Coarse Ore Storage Pile Wind Erosion Emissions Parameters

Parameters	Period 1	Period 2	Period 3	Current
Stockpile Total Area (ft^2)	76,485	n/a		
Stockpile - % Available for Erosion (%)	100%			
Stockpile Height (ft)	55			
Control on Stockpile (%)	0%			
Frequency Summer Wind Speed Exceeds 4.4 m/s (%)	33.3			
Frequency Winter Wind Speed Exceeds 4.4 m/s (%)	39.9			

3.5.4 Coarse Ore Stockpile Enclosure (Periods 2, 3 and Current)

As noted previously, the coarse ore stockpile was enclosed during the second, third, and current periods. The emissions from the activities occurring at the coarse ore stockpile, contained within the building, were estimated through engineering calculations using a mass balance and air volume displacement calculations. These emissions were estimated by TCAK and have been included in Appendix A and B (sample calculations, including sampling data). The PM emission rate and operating hours of the coarse ore stockpile building exhaust are detailed in Table 3.16 below.

Table 3.16: Coarse Ore Storage Pile Building Exhaust Parameters

Parameters	Period 1	Period 2	Period 3	Current
Coarse Ore Stockpile Exhaust PM Emission Rate (g/s)	n/a	0.128	0.128	0.128
Coarse Ore Stockpile Exhaust Daily Operation Hours (hrs/day)		24	24	24

3.6 ORE PROCESSING AND CONCENTRATES

3.6.1 Mill Concentrator Facility

Within the Mill Concentrator Facility, emissions are expected from wet scrubbers, the baghouse and as fugitive releases from Mill structures. Emissions of PM were obtained from source testing conducted by TCAK of both wet scrubbers and the Bucking Room (laboratory prep) baghouse.

Fugitive emissions of PM from the Mill structures were calculated by TCAK through mass balance calculations, air volume displacement and fan ratings on dedicated exhausts. Sample calculations have been included in Appendix A. The Mill Concentrator Facility emission source parameters are included below in Table 3.17.

Table 3.17: Mill Concentrator Facility Emission Source Parameters

Parameters	Period 1	Period 2	Period 3	Current
Scrubber A PM Emission Rate (lb/hr)	0.057	0.057	1	1
Scrubber A Daily Operation Hours (hrs/day)	24	24	24	24
Scrubber B PM Emission Rate (lb/hr)	0.059	0.059	0.47	0.47
Scrubber B Daily Operation Hours (hrs/day)	24	24	24	24
Bucking Room Baghouse PM Emission Rate (lb/hr)	0.02	0.02	0.02	0.02
Bucking Room Baghouse Daily Operation Hours (hrs/day)	24	24	24	24
Fugitive Mill Structure PM Emission Rate (g/s)	0.04	0.04	0.04	0.04

3.6.2 Concentrate Storage Building (CSB) and Loadout

Fugitive emissions of PM from the CSB and loadout of concentrate into the trucks were calculated by TCAK through mass balance calculations and air volume displacement. The emissions were adjusted to account for improvements made over, as detailed below.

Period 1: no drivethrough;
Periods 2 & 3: drivethrough installed; and
Period 4: installation of fans to draw entrained particulate matter from the concentrate loadout bay.

During Period 1, as there was no drivethrough to contain the emissions from the material drop of concentrate into the trucks, emissions from the activity were accounted for in addition to the fugitive emissions from the CSB. Emissions of PM from the drop into the trucks were estimated using the empirical expression provided in *Section 13.2.4: Aggregate Handling and Storage Piles (Equation 1)* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The following site data was used:

- 1,201 tons of concentrate a day transported;
- a summer mean wind speed of 3.6 m/s during all periods;
- a winter mean wind speed of 4.2 m/s during all periods; and
- the moisture content of ore is 2.55% in summer and 2.51% in winter.

Sample calculations have been included in Appendix A. The CSB building and loadout emission source parameters are included below in Table 3.18.

Table 3.18: CSB Fugitive PM Emission Rate

Parameters	Period 1	Period 2	Period 3	Current
CSB Fugitive PM Emission Rate (g/s)	0.79	0.79	0.79	0.41
Truck Capacity (tons)	66	95	130	130

3.6.3 Concentrate Truck Travel

Emissions of PM were estimated for concentrate haul truck travel from the CSB to the mine ambient air boundary using the empirical expression *(Equation 1a)* and parameters *(Table 13.2.2-2)* provided in *Section 13.2.2: Unpaved Roads* of the U.S. EPA AP-42 document [U.S. EPA 2006].

The total concentrate haul truck distance travelled per day was estimated in the same manner as for the mine area, by:

(1) dividing the total tons of concentrate loaded (both zinc and lead) at the CSB, as noted in Table 3.19, by the capacity of the haul trucks, to obtain the total number of trips per day; and
(2) multiplying the total number of trips travelled per day by the distance of each roundtrip.

The following assumption was made:

- Port Haul Road (from the CSB to ambient air boundary) has a surface silt content of 1.63%, which is the average of the three haul road samples taken.

The other parameters used in estimating the PM emissions from concentrate haul truck travel from the CSB to the mine ambient air boundary are detailed in Table 3.19 below.

Table 3.19: Concentrate Truck Travel Source Parameters

Parameters	Period 1	Period 2	Period 3	Current
CSB Loadout – Lead (tons/day)	147.2	715.1	570.9	570.9
CSB Loadout – Zinc (tons day)	1053.9	3150.3	3074.9	3074.9
Truck Capacity (tons)	66	95	130	130
Concentrate Truck Travel Operating Hours (hrs/day)	24	24	24	24
Haul Truck Distance Per One-Way Trip – CSB to ambient air boundary (mi)	4.9	4.9	4.9	4.9

3.7 TAILINGS BEACH

Emissions of PM from the tailings beach were estimated using the empirical expression provided in the *Air Pollution Engineering Manual* (Air & Waste Management Association, 1992).

The following assumptions were made:

- surface silt content is 4.6% during all periods.

The other parameters used in estimating the PM emissions from wind erosion of the tailings beach are detailed in Table 3.20 below. The control applied during Period 3 is a result of the construction of eight "windrows", using waste rock, on the tailings beach perpendicular to the tailings dam and the application of a Soil-Sement® palliative to a portion of the tailings beach (providing a control of 50%). In addition, during approximately half of Period 3 and all of the Current period, the tailings beach was flooded maintaining the water level (providing a control of 95%) resulting in minimal potential for wind erosion. During the Current period, some freeze drying has been observed in the early winter prior to snow fall, resulting in a lower control (estimated to be 70%). Figures 3.1 through 3.4 depict the tailings areas for the various periods.

Table 3.20: Tailings Beach Wind Erosion Source Parameters

	Period 1	**Period 2**	**Period 3**	**Current**
Tailings 1 - Total Area (ft^2)	1,275,573	306,529	1,614,587	506,910
Tailings 1 - % Available for Erosion	100%	100%	100%	100%
Tailings 1 – Summer Control (%)	0%	0%	73%	95%
Tailings 1 – Winter Control (%)	0%	0%	73%	70
Tailings 2 – Total Area (ft^2)	-	1,027,627	-	561,269
Tailings 2 - % Available for Erosion	-	100%	-	100%
Tailings 2 – Summer Control (%)	-	0%	-	95%
Tailings 2 – Winter Control (%)	-	0%	-	70%
Tailings 3 – Total Area (ft^2)	-	1,039,127	-	-
Tailings 3 - % Available for Erosion	-	100%	-	-
Tailings 3 – Summer Control (%)	-	0%	-	-
Tailings 3 – Winter Control (%)	-	0%	-	-
[1]Frequency Wind Speed Exceeds 5.4 m/s (%)	22	22	22	22

[1]Note that the frequency the wind speed exceeds 5.4 m/s is the same for all periods because the same year of meteorology will be used to model all four time periods [SENES 2005].

4.0 ZINC AND LEAD EMISSION ESTIMATES

Percentages of zinc and lead in PM for material at various points throughout the process were obtained through metals analysis of onsite materials and road samples carried out by Red Dog personnel. These datum were applied to the estimated PM emission rates (detailed in Section 3) to obtain the emission rates of zinc and lead from the specified sources. Tables 4.1 through 4.4 present the emission sources along with their associated controlled PM emissions rates, lead and zinc emission rates as well as the material characteristics used to estimate the lead and zinc emission rates from the PM emission rates. A summary of the results of all onsite metals analyses performed has been included in Appendix B.

Table 4.1: Period 1 (1989-1992) Summary of Source Emissions

	Summer Controlled Emissions						Winter Controlled Emissions								
Sources	PM (g/s)		Zinc (g/s)		Lead (g/s)		PM (g/s)		Zinc (g/s)		Lead (g/s)		Material Characteristic	Zinc (%)	Lead (%)
Mining: Drilling	4.78E-02	0.12%	5.33E-03	0.19%	1.39E-03	0.19%	4.78E-02	0.12%	5.33E-03	0.19%	1.39E-03	0.19%	ore/waste (1/1.5)	11.16%	2.90%
Mining: Blasting - Ore	9.48E-05	0.00%	1.99E-05	0.00%	4.45E-06	0.00%	9.48E-05	0.00%	1.99E-05	0.00%	4.45E-06	0.00%	ore	21.00%	4.70%
Mining: Blasting - Waste Rock	1.96E-04	0.00%	9.03E-06	0.00%	3.34E-06	0.00%	1.96E-04	0.00%	9.03E-06	0.00%	3.34E-06	0.00%	waste	4.60%	1.70%
Mining: Dozer activity in Blast Area - Ore average	4.47E-01	1.12%	9.39E-02	3.40%	2.10E-02	2.95%	4.57E-01	1.12%	9.60E-02	3.39%	2.15E-02	2.93%	ore	21.00%	4.70%
Mining: Dozer activity in Blast Area - Waste Rock	4.47E-01	1.12%	2.06E-02	0.74%	7.60E-03	1.07%	4.57E-01	1.12%	2.10E-02	0.74%	7.77E-03	1.06%	waste	4.60%	1.70%
Mining: Loading of haul trucks in Blast Area - Ore	7.46E-02	0.19%	1.57E-02	0.57%	3.51E-03	0.49%	9.34E-02	0.23%	1.96E-02	0.69%	4.39E-03	0.60%	ore	21.00%	4.70%
Mining: Loading of haul trucks in Blast Area - Waste Rock	1.32E-01	0.33%	6.07E-03	0.22%	2.24E-03	0.31%	1.65E-01	0.40%	7.60E-03	0.27%	2.81E-03	0.38%	waste	4.60%	1.70%
Mining: Fleet Travel (in Blast Area)	1.08E+01	27.07%	7.57E-01	27.41%	2.48E-01	34.86%	1.08E+01	26.49%	7.57E-01	26.71%	2.48E-01	33.92%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Dozer activity on Ore Storage Area	4.47E-01	1.12%	9.39E-02	3.40%	2.10E-02	2.95%	4.57E-01	1.12%	9.60E-02	3.39%	2.15E-02	2.93%	ore	21.00%	4.70%
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	8.62E-02	0.22%	1.81E-02	0.66%	4.05E-03	0.57%	1.23E-01	0.30%	2.58E-02	0.91%	5.77E-03	0.79%	ore	21.00%	4.70%
Ore Handling: Ore Storage Stockpile2- Wind Erosion	1.03E-01	0.26%	2.17E-02	0.79%	4.85E-03	0.68%	1.47E-01	0.36%	3.09E-02	1.09%	6.91E-03	0.94%	ore	21.00%	4.70%
Ore Handling: Haul truck unloading at Ore Storage Area	7.46E-02	0.19%	1.57E-02	0.57%	3.51E-03	0.49%	9.34E-02	0.23%	1.96E-02	0.69%	4.39E-03	0.60%	ore	21.00%	4.70%
Jaw Crusher Baghouse	5.32E-03	0.01%	1.12E-03	0.04%	2.50E-04	0.04%	5.32E-03	0.01%	1.12E-03	0.04%	2.50E-04	0.03%	ore	21.00%	4.70%
Ore Handling: Unloading FEL into Jaw Crusher	3.21E-02	0.08%	6.73E-03	0.24%	1.51E-03	0.21%	4.01E-02	0.10%	8.42E-03	0.30%	1.88E-03	0.26%	ore	21.00%	4.70%
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	5.36E-01	1.34%	2.47E-02	0.89%	9.12E-03	1.28%	5.48E-01	1.34%	2.52E-02	0.89%	9.32E-03	1.27%	waste	4.60%	1.70%
Waste Rock: Haul truck unloading at Waste Rock Storage Area	1.32E-01	0.33%	6.07E-03	0.22%	2.24E-03	0.31%	1.65E-01	0.40%	7.60E-03	0.27%	2.81E-03	0.38%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 1 - Wind Erosion	1.03E-01	0.26%	4.75E-03	0.17%	1.76E-03	0.25%	1.47E-01	0.36%	6.76E-03	0.24%	2.50E-03	0.34%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 2 - Wind Erosion	1.03E-01	0.26%	4.75E-03	0.17%	1.76E-03	0.25%	1.47E-01	0.36%	6.76E-03	0.24%	2.50E-03	0.34%	waste	4.60%	1.70%
Coarse Ore Stockpile: Drop from conveyor (from jaw crusher) to stockpile	5.45E-02	0.14%	1.14E-02	0.41%	2.56E-03	0.36%	6.82E-02	0.17%	1.43E-02	0.51%	3.20E-03	0.44%	ore	21.00%	4.70%
Coarse Ore Stockpile: Dozer	5.36E-01	1.34%	1.13E-01	4.08%	2.52E-02	3.54%	5.48E-01	1.34%	1.15E-01	4.06%	2.58E-02	3.52%	ore	21.00%	4.70%
Coarse Ore Stockpile - Wind Erosion	1.07E-01	0.27%	2.24E-02	0.81%	5.01E-03	0.70%	1.28E-01	0.31%	2.68E-02	0.95%	6.00E-03	0.82%	ore	21.00%	4.70%
Mill Concentrator Facility Scrubber A	7.14E-03	0.02%	1.50E-03	0.05%	3.36E-04	0.05%	7.14E-03	0.02%	1.50E-03	0.05%	3.36E-04	0.05%	ore	21.00%	4.70%
Mill Concentrator Facility Scrubber B	7.43E-03	0.02%	1.56E-03	0.06%	3.49E-04	0.05%	7.43E-03	0.02%	1.56E-03	0.06%	3.49E-04	0.05%	ore	21.00%	4.70%
Mill Concentrator Facility: Fugitive Releases from buildings	3.94E-02	0.10%	8.28E-03	0.30%	1.85E-03	0.26%	3.94E-02	0.10%	8.28E-03	0.29%	1.85E-03	0.25%	ore	21.00%	4.70%
Mill Concentrator Facility: Bucking Room Baghouse	2.52E-03	0.01%	5.29E-04	0.02%	1.18E-04	0.02%	2.52E-03	0.01%	5.29E-04	0.02%	1.18E-04	0.02%	ore	21.00%	4.70%
CSB: Fugitive Releases from building	7.87E-01	1.97%	4.04E-01	14.64%	7.46E-02	10.46%	7.87E-01	1.92%	4.04E-01	14.26%	7.46E-02	10.19%	ratio of lead/zinc concentrate output	51.32%	9.48%
CSB: Material Drop into Trucks	2.02E-02	0.05%	1.04E-02	0.38%	1.91E-03	0.27%	2.52E-02	0.06%	1.30E-02	0.46%	2.39E-03	0.33%	ratio of lead/zinc concentrate output	51.32%	9.48%
CSB: Truck Travel around CSB	1.31E-01	0.33%	6.72E-02	2.43%	1.24E-02	1.74%	1.18E-01	0.29%	6.04E-02	2.13%	1.12E-02	1.52%	ratio of lead/zinc concentrate output	51.32%	9.48%
Tailings 1	1.22E+00	3.06%	6.73E-02	2.44%	1.96E-02	2.75%	1.74E+00	4.26%	9.58E-02	3.38%	2.79E-02	3.80%	tailings	5.50%	1.60%
Haul 2 Road	1.28E+00	3.19%	3.91E-02	1.42%	1.50E-02	2.11%	1.28E+00	3.12%	3.91E-02	1.38%	1.50E-02	2.05%	Pit @ U turn	3.06%	1.18%
Haul 3 Road	1.58E+00	3.94%	4.82E-02	1.75%	1.86E-02	2.60%	1.58E+00	3.85%	4.82E-02	1.70%	1.86E-02	2.53%	Pit @ U turn	3.06%	1.18%
Haul 4 Road	1.71E+00	4.26%	5.22E-02	1.89%	2.01E-02	2.82%	1.71E+00	4.17%	5.22E-02	1.84%	2.01E-02	2.74%	Pit @ U turn	3.06%	1.18%
Haul 5 Road	1.46E+00	3.65%	4.46E-02	1.62%	1.72E-02	2.41%	1.46E+00	3.57%	4.46E-02	1.58%	1.72E-02	2.35%	Pit @ U turn	3.06%	1.18%
Ore 1 Road	7.10E-01	1.77%	2.17E-02	0.79%	8.37E-03	1.17%	7.10E-01	1.74%	2.17E-02	0.77%	8.37E-03	1.14%	Pit @ U turn	3.06%	1.18%
Jaw1 Road	9.33E-01	2.33%	2.86E-02	1.03%	1.10E-02	1.54%	9.33E-01	2.28%	2.86E-02	1.01%	1.10E-02	1.50%	Pit @ U turn	3.06%	1.18%
Waste 1 Road	8.51E-01	2.13%	4.90E-02	1.77%	9.56E-03	1.34%	8.51E-01	2.08%	4.90E-02	1.73%	9.56E-03	1.30%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 2 Road	8.19E-01	2.05%	4.71E-02	1.71%	9.19E-03	1.29%	8.19E-01	2.00%	4.71E-02	1.66%	9.19E-03	1.26%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 3 Road	1.25E+00	3.11%	7.16E-02	2.59%	1.40E-02	1.96%	1.25E+00	3.04%	7.16E-02	2.53%	1.40E-02	1.91%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 4 Road	3.91E+00	9.76%	2.25E-01	8.14%	4.39E-02	6.15%	3.91E+00	9.55%	2.25E-01	7.93%	4.39E-02	5.99%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 5 Road	4.93E+00	12.32%	2.84E-01	10.27%	5.54E-02	7.76%	4.93E+00	12.05%	2.84E-01	10.01%	5.54E-02	7.56%	Main Waste at Landfill/Entrance	5.75%	1.12%
MAAB 1 Road	9.55E-02	0.24%	1.10E-03	0.04%	2.92E-04	0.04%	9.55E-02	0.23%	1.10E-03	0.04%	2.92E-04	0.04%	Road - CSB to Port	1.15%	0.31%
MAAB 2 Road	1.58E-01	0.39%	1.82E-03	0.07%	4.83E-04	0.07%	1.58E-01	0.39%	1.82E-03	0.06%	4.83E-04	0.07%	Road - CSB to Port	1.15%	0.31%
MAAB 3 Road	3.68E-01	0.92%	4.25E-03	0.15%	1.13E-03	0.16%	3.68E-01	0.90%	4.25E-03	0.15%	1.13E-03	0.15%	Road - CSB to Port	1.15%	0.31%
MAAB 4 Road	3.70E-01	0.92%	4.27E-03	0.15%	1.13E-03	0.16%	3.70E-01	0.90%	4.27E-03	0.15%	1.13E-03	0.15%	Road - CSB to Port	1.15%	0.31%
MAAB 5 Road	6.17E-01	1.54%	7.12E-03	0.26%	1.89E-03	0.26%	6.17E-01	1.51%	7.12E-03	0.25%	1.89E-03	0.26%	Road - CSB to Port	1.15%	0.31%
MAAB 6 Road	6.59E-01	1.65%	7.60E-03	0.28%	2.02E-03	0.28%	6.59E-01	1.61%	7.60E-03	0.27%	2.02E-03	0.28%	Road - CSB to Port	1.15%	0.31%
MAAB 7 Road	9.71E-01	2.42%	1.12E-02	0.41%	2.97E-03	0.42%	9.71E-01	2.37%	1.12E-02	0.40%	2.97E-03	0.41%	Road - CSB to Port	1.15%	0.31%
MAAB 8 Road	8.48E-01	2.12%	9.79E-03	0.35%	2.60E-03	0.36%	8.48E-01	2.07%	9.79E-03	0.35%	2.60E-03	0.35%	Road - CSB to Port	1.15%	0.31%

Table 4.2: Period 2 (1993-2000) Summary of Source Emissions

Sources	Summer Controlled Emissions						Winter Controlled Emissions						Material Characteristic	Zinc (%)	Lead (%)
	PM (g/s)		Zinc (g/s)		Lead (g/s)		PM (g/s)		Zinc (g/s)		Lead (g/s)				
Mining: Drilling	2.73E-02	0.19%	3.06E-03	0.25%	8.69E-04	0.26%	2.73E-02	0.10%	3.06E-03	0.17%	8.69E-04	0.18%	ore/waste (1/1.5)	11.20%	3.18%
Mining: Blasting - Ore	7.85E-05	0.00%	1.66E-05	0.00%	4.24E-06	0.00%	7.85E-05	0.00%	1.66E-05	0.00%	4.24E-06	0.00%	ore	21.10%	5.40%
Mining: Blasting - Waste Rock	1.56E-04	0.00%	7.15E-06	0.00%	2.64E-06	0.00%	1.56E-04	0.00%	7.15E-06	0.00%	2.64E-06	0.00%	waste	4.60%	1.70%
Mining: Dozer activity in Blast Area - Ore	2.23E-01	1.55%	4.72E-02	3.87%	1.21E-02	3.66%	2.28E-01	0.86%	4.82E-02	2.67%	1.23E-02	2.50%	ore	21.10%	5.40%
Mining: Dozer activity in Blast Area - Waste Rock	2.23E-01	1.55%	1.03E-02	0.84%	3.80E-03	1.15%	2.28E-01	0.86%	1.05E-02	0.58%	3.88E-03	0.79%	waste	4.60%	1.70%
Mining: Loading of haul trucks in Blast Area - Ore	7.55E-02	0.52%	1.59E-02	1.31%	4.08E-03	1.24%	9.44E-02	0.36%	1.99E-02	1.10%	5.10E-03	1.03%	ore	21.10%	5.40%
Mining: Loading of haul trucks in Blast Area - Waste Rock	7.37E-02	0.51%	3.39E-03	0.28%	1.25E-03	0.38%	9.23E-02	0.35%	4.24E-03	0.23%	1.57E-03	0.32%	waste	4.60%	1.70%
Mining: Fleet Travel	1.58E+00	10.94%	1.10E-01	9.03%	3.62E-02	10.96%	3.68E+00	13.90%	2.57E-01	14.23%	8.44E-02	17.13%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Dozer activity on Ore Storage Area	4.47E-01	3.10%	9.43E-02	7.73%	2.41E-02	7.31%	4.57E-01	1.72%	9.64E-02	5.34%	2.47E-02	5.00%	ore	21.10%	5.40%
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	8.62E-02	0.60%	1.82E-02	1.49%	4.65E-03	1.41%	1.23E-01	0.46%	2.59E-02	1.43%	6.62E-03	1.34%	ore	21.10%	5.40%
Ore Handling: Ore Storage Stockpile2 - Wind Erosion	1.03E-01	0.72%	2.18E-02	1.79%	5.58E-03	1.69%	1.47E-01	0.55%	3.10E-02	1.72%	7.94E-03	1.61%	ore	21.10%	5.40%
Ore Handling: Haul truck unloading at Ore Storage Area	1.51E-01	1.05%	3.19E-02	2.61%	8.15E-03	2.47%	1.89E-01	0.71%	3.99E-02	2.21%	1.02E-02	2.07%	ore	21.10%	5.40%
Ore Handling: Loader travel in Ore Storage Area	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Haul truck travel in Ore Storage Area - ORE	1.21E-01	0.84%	8.43E-03	0.69%	2.77E-03	0.84%	2.82E-01	1.06%	1.97E-02	1.09%	6.46E-03	1.31%	Pit West Pit Road	6.98%	2.29%
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	5.36E-01	3.72%	2.47E-02	2.02%	9.12E-03	2.76%	5.48E-01	2.07%	2.52E-02	1.40%	9.32E-03	1.89%	waste	4.60%	1.70%
Waste Rock: Haul truck unloading at Waste Rock Storage Area	1.47E-01	1.02%	6.78E-03	0.56%	2.51E-03	0.76%	1.85E-01	0.70%	8.49E-03	0.47%	3.14E-03	0.64%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 1 - Wind Erosion	1.03E-01	0.72%	4.75E-03	0.39%	1.76E-03	0.53%	1.47E-01	0.55%	6.76E-03	0.37%	2.50E-03	0.51%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 2 - Wind Erosion	1.03E-01	0.72%	4.75E-03	0.39%	1.76E-03	0.53%	1.47E-01	0.55%	6.76E-03	0.37%	2.50E-03	0.51%	waste	4.60%	1.70%
Jaw Crusher Baghouse	4.82E-03	0.03%	1.02E-03	0.08%	2.60E-04	0.08%	4.82E-03	0.02%	1.02E-03	0.06%	2.60E-04	0.05%	ore	21.10%	5.40%
Ore Handling: Unloading FEL into Jaw Crusher	4.21E-02	0.29%	8.87E-03	0.73%	2.27E-03	0.69%	5.26E-02	0.20%	1.11E-02	0.61%	2.84E-03	0.58%	ore	21.10%	5.40%
Gyro Crusher Baghouse	6.14E-03	0.04%	1.30E-03	0.11%	3.32E-04	0.10%	6.14E-03	0.02%	1.30E-03	0.07%	3.32E-04	0.07%	ore	21.10%	5.40%
Ore Handling: Unloading FEL into Gyro Crusher	1.40E-02	0.10%	2.96E-03	0.24%	7.57E-04	0.23%	1.75E-02	0.07%	3.70E-03	0.20%	9.47E-04	0.19%	ore	21.10%	5.40%
Coarse Ore Stockpile: Emissions from Building Exhaust	1.28E-01	0.89%	2.71E-02	2.22%	6.93E-03	2.10%	1.28E-01	0.48%	2.71E-02	1.50%	6.93E-03	1.41%	ore	21.10%	5.40%
Mill Concentrator FacilityScrubber A	7.14E-03	0.05%	1.51E-03	0.12%	3.86E-04	0.12%	7.14E-03	0.03%	1.51E-03	0.08%	3.86E-04	0.08%	ore	21.10%	5.40%
Mill Concentrator FacilityScrubber B	7.43E-03	0.05%	1.57E-03	0.13%	4.01E-04	0.12%	7.43E-03	0.03%	1.57E-03	0.09%	4.01E-04	0.08%	ore	21.10%	5.40%
Mill Concentrator Facility: Fugitive Releases from buildings	3.94E-02	0.27%	8.32E-03	0.68%	2.13E-03	0.65%	3.94E-02	0.15%	8.32E-03	0.46%	2.13E-03	0.43%	ore	21.10%	5.40%
Mill Concentrator Facility: Bucking Room Baghouse	2.52E-03	0.02%	5.32E-04	0.04%	1.36E-04	0.04%	2.52E-03	0.01%	5.32E-04	0.03%	1.36E-04	0.03%	ore	21.10%	5.40%
CSB: Fugitive Releases from building	7.87E-01	5.46%	3.90E-01	32.01%	8.01E-02	24.28%	7.87E-01	2.97%	3.90E-01	21.62%	8.01E-02	16.25%	ratio of lead/zinc concentrate output	49.59%	10.18%
Tailings1	9.86E-01	6.84%	3.55E-02	2.91%	1.87E-02	5.68%	9.86E-01	3.72%	3.55E-02	1.96%	1.87E-02	3.80%	tailings	3.60%	1.90%
Tailings2	2.94E-01	2.04%	1.06E-02	0.87%	5.59E-03	1.69%	2.94E-01	1.11%	1.06E-02	0.59%	5.59E-03	1.13%	tailings	3.60%	1.90%
Tailings3	9.86E-01	6.84%	3.55E-02	2.91%	1.87E-02	5.68%	9.86E-01	3.72%	3.55E-02	1.96%	1.87E-02	3.80%	tailings	3.60%	1.90%
Haul2 Road	1.13E+00	7.82%	3.45E-02	2.83%	1.33E-02	4.02%	2.63E+00	9.93%	8.04E-02	4.45%	3.10E-02	6.28%	Pit @ U turn	3.06%	1.18%
Haul3 Road	4.60E-01	3.19%	1.41E-02	1.15%	5.42E-03	1.64%	1.07E+00	4.05%	3.28E-02	1.82%	1.26E-02	2.56%	Pit @ U turn	3.06%	1.18%
Haul4 Road	4.52E-01	3.14%	1.38E-02	1.13%	5.33E-03	1.61%	1.06E+00	3.98%	3.23E-02	1.79%	1.24E-02	2.52%	Pit @ U turn	3.06%	1.18%
Haul5 Road	7.06E-01	4.89%	2.16E-02	1.77%	8.31E-03	2.52%	1.65E+00	6.21%	5.04E-02	2.79%	1.94E-02	3.93%	Pit @ U turn	3.06%	1.18%
Jaw1 Road	1.83E-01	1.27%	5.60E-03	0.46%	2.16E-03	0.65%	4.27E-01	1.61%	1.31E-02	0.72%	5.03E-03	1.02%	Pit @ U turn	3.06%	1.18%
Gyro1 Road	6.22E-02	0.43%	1.90E-03	0.16%	7.32E-04	0.22%	1.45E-01	0.55%	4.44E-03	0.25%	1.71E-03	0.35%	Pit @ U turn	3.06%	1.18%
Waste1 Road	8.97E-01	6.22%	5.16E-02	4.23%	1.01E-02	3.05%	2.09E+00	7.90%	1.20E-01	6.66%	2.35E-02	4.77%	Main Waste at Lanfill/Entrance	5.75%	1.12%
Waste2 Road	8.20E-01	5.69%	4.72E-02	3.87%	9.21E-03	2.79%	1.91E+00	7.22%	1.10E-01	6.09%	2.15E-02	4.36%	Main Waste at Lanfill/Entrance	5.75%	1.12%
Waste3 Road	6.52E-01	4.52%	3.75E-02	3.07%	7.32E-03	2.22%	1.52E+00	5.74%	8.75E-02	4.84%	1.71E-02	3.46%	Main Waste at Lanfill/Entrance	5.75%	1.12%
Waste4 Road	6.80E-01	4.72%	3.91E-02	3.20%	7.63E-03	2.31%	1.59E+00	5.99%	9.12E-02	5.05%	1.78E-02	3.61%	Main Waste at Lanfill/Entrance	5.75%	1.12%
Waste5 Road	2.20E-01	1.53%	1.27E-02	1.04%	2.47E-03	0.75%	5.14E-01	1.94%	2.95E-02	1.64%	5.77E-03	1.17%	Main Waste at Lanfill/Entrance	5.75%	1.12%
MAAB 1 Road	2.00E-02	0.14%	2.30E-04	0.02%	6.11E-05	0.02%	4.66E-02	0.18%	5.37E-04	0.03%	1.42E-04	0.03%	Road - CSB to Port	1.15%	0.31%
MAAB 2 Road	3.30E-02	0.23%	3.81E-04	0.03%	1.01E-04	0.03%	7.69E-02	0.29%	8.88E-04	0.05%	2.35E-04	0.05%	Road - CSB to Port	1.15%	0.31%
MAAB 3 Road	7.69E-02	0.53%	8.88E-04	0.07%	2.35E-04	0.07%	1.80E-01	0.68%	2.07E-03	0.11%	5.49E-04	0.11%	Road - CSB to Port	1.15%	0.31%
MAAB 4 Road	7.73E-02	0.54%	8.92E-04	0.07%	2.36E-04	0.07%	1.80E-01	0.68%	2.08E-03	0.12%	5.52E-04	0.11%	Road - CSB to Port	1.15%	0.31%
MAAB 5 Road	1.29E-01	0.89%	1.49E-03	0.12%	3.95E-04	0.12%	3.01E-01	1.14%	3.47E-03	0.19%	9.21E-04	0.19%	Road - CSB to Port	1.15%	0.31%
MAAB 6 Road	1.38E-01	0.96%	1.59E-03	0.13%	4.21E-04	0.13%	3.21E-01	1.21%	3.71E-03	0.21%	9.83E-04	0.20%	Road - CSB to Port	1.15%	0.31%
MAAB 7 Road	2.03E-01	1.41%	2.34E-03	0.19%	6.21E-04	0.19%	4.73E-01	1.79%	5.46E-03	0.30%	1.45E-03	0.29%	Road - CSB to Port	1.15%	0.31%
MAAB 8 Road	1.77E-01	1.23%	2.05E-03	0.17%	5.42E-04	0.16%	4.14E-01	1.56%	4.77E-03	0.26%	1.27E-03	0.26%	Road - CSB to Port	1.15%	0.31%

Table 4.3: Period 3 (2001-2003) Summary of Source Emissions

	Summer Controlled Emissions						Winter Controlled Emissions								
Sources	PM (g/s)		Zinc (g/s)		Lead (g/s)		PM (g/s)		Zinc (g/s)		Lead (g/s)		Material Characteristic	Zinc (%)	Lead (%)
Mining: Drilling	3.28E-02	0.25%	3.67E-03	0.32%	1.04E-03	0.33%	3.28E-02	0.12%	3.67E-03	0.21%	1.04E-03	0.21%	ore/waste (1/1.5)	11.20%	3.18%
Mining: Blasting - Ore	7.85E-05	0.00%	1.66E-05	0.00%	4.24E-06	0.00%	7.85E-05	0.00%	1.66E-05	0.00%	4.24E-06	0.00%	ore	21.10%	5.40%
Mining: Blasting - Waste Rock	1.70E-04	0.00%	7.81E-06	0.00%	2.89E-06	0.00%	1.70E-04	0.00%	7.81E-06	0.00%	2.89E-06	0.00%	waste	4.60%	1.70%
Mining: Dozer activity in Blast Area - Ore	2.23E-01	1.68%	4.72E-02	4.09%	1.21E-02	3.86%	2.28E-01	0.86%	4.82E-02	2.76%	1.23E-02	2.53%	ore	21.10%	5.40%
Mining: Dozer activity in Blast Area - Waste Rock	2.23E-01	1.68%	1.03E-02	0.89%	3.80E-03	1.22%	2.28E-01	0.86%	1.05E-02	0.60%	3.88E-03	0.80%	waste	4.60%	1.70%
Mining: Loading of haul trucks in Blast Area - Ore	7.86E-02	0.59%	1.66E-02	1.44%	4.25E-03	1.36%	9.84E-02	0.37%	2.08E-02	1.19%	5.31E-03	1.09%	ore	21.10%	5.40%
Mining: Loading of haul trucks in Blast Area - Waste Rock	6.98E-02	0.52%	3.21E-03	0.28%	1.19E-03	0.38%	8.74E-02	0.33%	4.02E-03	0.23%	1.49E-03	0.30%	waste	4.60%	1.70%
Mining: Fleet Travel	1.93E+00	14.49%	1.35E-01	11.69%	4.43E-02	14.17%	4.51E+00	17.01%	3.15E-01	18.05%	1.03E-01	21.19%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Dozer activity on Ore Storage Area	4.47E-01	3.35%	9.43E-02	8.17%	2.41E-02	7.72%	4.57E-01	1.72%	9.64E-02	5.53%	2.47E-02	5.06%	ore	21.10%	5.40%
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	8.62E-02	0.65%	1.82E-02	1.58%	4.65E-03	1.49%	1.23E-01	0.46%	2.59E-02	1.48%	6.62E-03	1.36%	ore	21.10%	5.40%
Ore Handling: Ore Storage Stockpile2 - Wind Erosion	1.03E-01	0.77%	2.18E-02	1.89%	5.58E-03	1.78%	1.47E-01	0.55%	3.10E-02	1.78%	7.94E-03	1.63%	ore	21.10%	5.40%
Ore Handling: Haul truck unloading at Ore Storage Area	1.57E-01	1.18%	3.32E-02	2.87%	8.49E-03	2.72%	1.97E-01	0.74%	4.15E-02	2.38%	1.06E-02	2.18%	ore	21.10%	5.40%
Ore Handling: Loader travel in Ore Storage Area	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	Pit West Pit Road	6.98%	2.29%
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	4.47E-01	3.35%	2.06E-02	1.78%	7.60E-03	2.43%	4.57E-01	1.72%	2.10E-02	1.20%	7.77E-03	1.59%	waste	4.60%	1.70%
Waste Rock: Haul truck unloading at Waste Rock Storage Area	1.40E-01	1.05%	6.42E-03	0.56%	2.37E-03	0.76%	1.75E-01	0.66%	8.04E-03	0.46%	2.97E-03	0.61%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 1 - Wind Erosion	1.03E-01	0.77%	4.75E-03	0.41%	1.76E-03	0.56%	1.47E-01	0.55%	6.76E-03	0.39%	2.50E-03	0.51%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 2 - Wind Erosion	1.03E-01	0.77%	4.75E-03	0.41%	1.76E-03	0.56%	1.47E-01	0.55%	6.76E-03	0.39%	2.50E-03	0.51%	waste	4.60%	1.70%
Jaw Crusher Baghouse	3.57E-04	0.00%	7.53E-05	0.01%	1.93E-05	0.01%	3.57E-04	0.00%	7.53E-05	0.00%	1.93E-05	0.00%	ore	21.10%	5.40%
Gyro Crusher Baghouse	1.09E-02	0.08%	2.30E-03	0.20%	5.90E-04	0.19%	1.09E-02	0.04%	2.30E-03	0.13%	5.90E-04	0.12%	ore	21.10%	5.40%
Ore Handling: Unloading FEL into Jaw Crusher	4.45E-03	0.03%	9.39E-04	0.08%	2.40E-04	0.08%	5.57E-03	0.02%	1.17E-03	0.07%	3.01E-04	0.06%	ore	21.10%	5.40%
Ore Handling: Unloading FEL into Gyro Crusher	3.56E-02	0.27%	7.51E-03	0.65%	1.92E-03	0.61%	4.45E-02	0.17%	9.40E-03	0.54%	2.41E-03	0.49%	ore	21.10%	5.40%
Coarse Ore Stockpile: Emissions from Building Exhaust	1.28E-01	0.96%	2.71E-02	2.34%	6.93E-03	2.22%	1.28E-01	0.48%	2.71E-02	1.55%	6.93E-03	1.42%	ore	21.10%	5.40%
Mill Concentrator Facility Scrubber A	1.26E-01	0.95%	2.66E-02	2.30%	6.80E-03	2.18%	1.26E-01	0.48%	2.66E-02	1.52%	6.80E-03	1.39%	ore	21.10%	5.40%
Mill Concentrator Facility Scrubber B	5.92E-02	0.44%	1.25E-02	1.08%	3.20E-03	1.02%	5.92E-02	0.22%	1.25E-02	0.72%	3.20E-03	0.66%	ore	21.10%	5.40%
Mill Concentrator Facility: Fugitive Releases from buildings	3.94E-02	0.30%	8.32E-03	0.72%	2.13E-03	0.68%	3.94E-02	0.15%	8.32E-03	0.48%	2.13E-03	0.44%	ore	21.10%	5.40%
Mill Concentrator Facility: Bucking Room Baghouse	2.52E-03	0.02%	5.32E-04	0.05%	1.36E-04	0.04%	2.52E-03	0.01%	5.32E-04	0.03%	1.36E-04	0.03%	ore	21.10%	5.40%
CSB: Fugitive Releases from building	7.87E-01	5.91%	3.62E-01	31.37%	8.37E-02	26.75%	7.87E-01	2.97%	3.62E-01	20.76%	8.37E-02	17.14%	ratio of lead/zinc concentrate output	45.99%	10.62%
Tailings	4.26E-01	3.19%	1.53E-02	1.33%	8.09E-03	2.59%	6.06E-01	2.29%	2.18E-02	1.25%	1.15E-02	2.36%	tailings	3.60%	1.90%
Haul 2 Road	8.34E-01	6.25%	2.55E-02	2.21%	9.82E-03	3.14%	1.94E+00	7.34%	5.95E-02	3.41%	2.29E-02	4.69%	Pit @ U turn	3.06%	1.18%
Haul 3 Road	1.11E+00	8.29%	3.38E-02	2.93%	1.30E-02	4.16%	2.58E+00	9.74%	7.89E-02	4.52%	3.04E-02	6.23%	Pit @ U turn	3.06%	1.18%
Haul 4 Road	2.01E-01	1.51%	6.15E-03	0.53%	2.37E-03	0.76%	4.69E-01	1.77%	1.44E-02	0.82%	5.53E-03	1.13%	Pit @ U turn	3.06%	1.18%
Haul 5 Road	8.85E-01	6.64%	2.71E-02	2.35%	1.04E-02	3.33%	2.07E+00	7.79%	6.32E-02	3.62%	2.43E-02	4.99%	Pit @ U turn	3.06%	1.18%
Ore 1 Road	1.86E-01	1.39%	5.69E-03	0.49%	2.19E-03	0.70%	4.34E-01	1.64%	1.33E-02	0.76%	5.11E-03	1.05%	Pit @ U turn	3.06%	1.18%
Ore 2 Road	3.23E-01	2.42%	9.87E-03	0.85%	3.80E-03	1.22%	7.53E-01	2.84%	2.30E-02	1.32%	8.87E-03	1.82%	Pit @ U turn	3.06%	1.18%
Gyro 1 Road	2.11E-01	1.58%	6.45E-03	0.56%	2.48E-03	0.79%	4.92E-01	1.86%	1.51E-02	0.86%	5.80E-03	1.19%	Pit @ U turn	3.06%	1.18%
Jaw 1 Road	2.59E-02	0.19%	7.91E-04	0.07%	3.05E-04	0.10%	6.04E-02	0.23%	1.85E-03	0.11%	7.11E-04	0.15%	Pit @ U turn	3.06%	1.18%
Waste 1 Road	1.82E-01	1.37%	1.05E-02	0.91%	2.05E-03	0.66%	4.26E-01	1.61%	2.45E-02	1.40%	4.78E-03	0.98%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 2 Road	2.88E-01	2.16%	1.66E-02	1.43%	3.23E-03	1.03%	6.72E-01	2.53%	3.86E-02	2.21%	7.54E-03	1.55%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 3 Road	5.31E-01	3.98%	3.05E-02	2.65%	5.96E-03	1.91%	1.24E+00	4.68%	7.13E-02	4.09%	1.39E-02	2.85%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 4 Road	1.13E+00	8.50%	6.52E-02	5.64%	1.27E-02	4.07%	2.64E+00	9.98%	1.52E-01	8.72%	2.97E-02	6.08%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 5 Road	3.07E-01	2.30%	1.76E-02	1.53%	3.44E-03	1.10%	7.16E-01	2.70%	4.12E-02	2.36%	8.04E-03	1.65%	Main Waste at Landfill/Entrance	5.75%	1.12%
CSB: Concentrate truck travel - MAAB1	3.16E-02	0.24%	3.65E-04	0.03%	9.68E-05	0.03%	7.38E-02	0.28%	8.52E-04	0.05%	2.26E-04	0.05%	Road - CSB to Port	1.15%	0.31%
CSB: Concentrate truck travel - MAAB2	5.23E-02	0.39%	6.03E-04	0.05%	1.60E-04	0.05%	1.22E-01	0.46%	1.41E-03	0.08%	3.73E-04	0.08%	Road - CSB to Port	1.15%	0.31%
CSB: Concentrate truck travel - MAAB3	1.22E-01	0.91%	1.41E-03	0.12%	3.73E-04	0.12%	2.84E-01	1.07%	3.28E-03	0.19%	8.71E-04	0.18%	Road - CSB to Port	1.15%	0.31%
CSB: Concentrate truck travel - MAAB4	1.22E-01	0.92%	1.41E-03	0.12%	3.75E-04	0.12%	2.86E-01	1.08%	3.30E-03	0.19%	8.74E-04	0.18%	Road - CSB to Port	1.15%	0.31%
CSB: Concentrate truck travel -MAAB5	2.04E-01	1.53%	2.36E-03	0.20%	6.25E-04	0.20%	4.77E-01	1.80%	5.50E-03	0.32%	1.46E-03	0.30%	Road - CSB to Port	1.15%	0.31%
CSB: Concentrate truck travel - MAAB6	2.18E-01	1.64%	2.52E-03	0.22%	6.68E-04	0.21%	5.09E-01	1.92%	5.88E-03	0.34%	1.56E-03	0.32%	Road - CSB to Port	1.15%	0.31%
CSB: Concentrate truck travel - MAAB7	3.21E-01	2.41%	3.71E-03	0.32%	9.84E-04	0.31%	7.50E-01	2.83%	8.66E-03	0.50%	2.30E-03	0.47%	Road - CSB to Port	1.15%	0.31%
CSB: Concentrate truck travel - MAAB8	2.81E-01	2.11%	3.24E-03	0.28%	8.60E-04	0.27%	6.55E-01	2.47%	7.56E-03	0.43%	2.01E-03	0.41%	Road - CSB to Port	1.15%	0.31%

Table 4.4: Current Period Summary of Source Emissions

	Summer Controlled Emissions						Winter Controlled Emissions						Material Characteristic	Zinc (%)	Lead (%)
Sources	PM (g/s)		Zinc (g/s)		Lead (g/s)		PM (g/s)		Zinc (g/s)		Lead (g/s)				
Mining: Drilling	3.41E-02	0.24%	3.82E-03	0.39%	1.09E-03	0.40%	3.41E-02	0.11%	3.82E-03	0.23%	1.09E-03	0.22%	ore/waste (1/1.5)	11.20%	3.18%
Mining: Blasting - Ore	7.85E-05	0.00%	1.66E-05	0.00%	4.24E-06	0.00%	7.85E-05	0.00%	1.66E-05	0.00%	4.24E-06	0.00%	ore	21.10%	5.40%
Mining: Blasting - Waste Rock	1.70E-04	0.00%	7.81E-06	0.00%	2.89E-06	0.00%	1.70E-04	0.00%	7.81E-06	0.00%	2.89E-06	0.00%	waste	4.60%	1.70%
Mining: Dozer activity in Blast Area - Ore	2.23E-01	1.57%	4.72E-02	4.81%	1.21E-02	4.40%	2.28E-01	0.76%	4.82E-02	2.86%	1.23E-02	2.53%	ore	21.10%	5.40%
Mining: Dozer activity in Blast Area - Waste Rock	2.23E-01	1.57%	1.03E-02	1.05%	3.80E-03	1.38%	2.28E-01	0.76%	1.05E-02	0.62%	3.88E-03	0.80%	waste	4.60%	1.70%
Mining: Loading of haul trucks in Blast Area - Ore	7.22E-02	0.51%	1.52E-02	1.55%	3.90E-03	1.42%	9.04E-02	0.30%	1.91E-02	1.13%	4.88E-03	1.00%	ore	21.10%	5.40%
Mining: Loading of haul trucks in Blast Area - Waste Rock	8.53E-02	0.60%	3.93E-03	0.40%	1.45E-03	0.53%	1.07E-01	0.35%	4.91E-03	0.29%	1.82E-03	0.37%	waste	4.60%	1.70%
Mining: Fleet Travel	2.00E+00	14.03%	1.39E-01	14.21%	4.58E-02	16.69%	4.66E+00	15.45%	3.25E-01	19.33%	1.07E-01	21.97%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Dozer activity on Ore Storage Area	2.23E-01	1.57%	4.72E-02	4.81%	1.21E-02	4.40%	2.28E-01	0.76%	4.82E-02	2.86%	1.23E-02	2.53%	ore	21.10%	5.40%
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	5.16E-02	0.36%	1.09E-02	1.11%	2.79E-03	1.02%	7.35E-02	0.24%	1.55E-02	0.92%	3.97E-03	0.82%	ore	21.10%	5.40%
Ore Handling: Ore Storage Stockpile 2- Wind Erosion	3.64E-02	0.26%	7.69E-03	0.78%	1.97E-03	0.72%	5.19E-02	0.17%	1.09E-02	0.65%	2.80E-03	0.58%	ore	21.10%	5.40%
Ore Handling: Haul truck unloading at Ore Storage Area	7.22E-02	0.51%	1.52E-02	1.55%	3.90E-03	1.42%	9.04E-02	0.30%	1.91E-02	1.13%	4.88E-03	1.00%	ore	21.10%	5.40%
Ore Handling: Haul truck travel in Ore Storage Area (in East Mine)	4.12E-01	2.90%	2.88E-02	2.93%	9.46E-03	3.45%	9.62E-01	3.19%	6.72E-02	3.99%	2.21E-02	4.54%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Loader travel in Ore Storage Area (in East Mine)	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	Pit West Pit Road	6.98%	2.29%
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	4.47E-01	3.14%	2.06E-02	2.10%	7.60E-03	2.77%	4.57E-01	1.51%	2.10E-02	1.25%	7.77E-03	1.60%	waste	4.60%	1.70%
Waste Rock: Haul truck unloading at Waste Rock Storage Area	1.71E-01	1.20%	7.85E-03	0.80%	2.90E-03	1.06%	2.14E-01	0.71%	9.82E-03	0.58%	3.63E-03	0.75%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 1 - Wind Erosion	1.03E-01	0.73%	4.75E-03	0.48%	1.76E-03	0.64%	1.47E-01	0.49%	6.76E-03	0.40%	2.50E-03	0.51%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 2 - Wind Erosion	1.03E-01	0.73%	4.75E-03	0.48%	1.76E-03	0.64%	1.47E-01	0.49%	6.76E-03	0.40%	2.50E-03	0.51%	waste	4.60%	1.70%
Waste Rock Handling: Waste Rock Storage Area 3 - Wind Erosion	1.03E-01	0.73%	4.75E-03	0.48%	1.76E-03	0.64%	1.47E-01	0.49%	6.76E-03	0.40%	2.50E-03	0.51%	waste	4.60%	1.70%
Jaw Crusher Baghouse	3.57E-04	0.00%	7.53E-05	0.01%	1.93E-05	0.01%	3.57E-04	0.00%	7.53E-05	0.00%	1.93E-05	0.00%	ore	21.10%	5.40%
Ore Handling: Unloading Haul truck into Jaw Crusher	4.45E-03	0.03%	9.39E-04	0.10%	2.40E-04	0.09%	5.57E-03	0.02%	1.17E-03	0.07%	3.01E-04	0.06%	ore	21.10%	5.40%
Gyro Crusher Baghouse	1.09E-02	0.08%	2.30E-03	0.23%	5.90E-04	0.21%	1.09E-02	0.04%	2.30E-03	0.14%	5.90E-04	0.12%	ore	21.10%	5.40%
Ore Handling: Unloading Haul truck into Gyro Crusher	3.56E-02	0.25%	7.51E-03	0.77%	1.92E-03	0.70%	4.45E-02	0.15%	9.40E-03	0.56%	2.41E-03	0.49%	ore	21.10%	5.40%
Coarse Ore Stockpile: Emissions from Building Exhaust	1.28E-01	0.90%	2.71E-02	2.76%	6.93E-03	2.52%	1.28E-01	0.43%	2.71E-02	1.61%	6.93E-03	1.42%	ore	21.10%	5.40%
Mill Concentrator Facility Scrubber A	1.26E-01	0.88%	2.66E-02	2.71%	6.80E-03	2.48%	1.26E-01	0.42%	2.66E-02	1.58%	6.80E-03	1.40%	ore	21.10%	5.40%
Mill Concentrator Facility Scrubber B	5.92E-02	0.42%	1.25E-02	1.27%	3.20E-03	1.16%	5.92E-02	0.20%	1.25E-02	0.74%	3.20E-03	0.66%	ore	21.10%	5.40%
Mill Concentrator Facility: Fugitive Releases from buildings	3.94E-02	0.28%	8.32E-03	0.85%	2.13E-03	0.78%	3.94E-02	0.13%	8.32E-03	0.49%	2.13E-03	0.44%	ore	21.10%	5.40%
Mill Concentrator Facility: Bucking Room Baghouse	2.52E-03	0.02%	5.32E-04	0.05%	1.36E-04	0.05%	2.52E-03	0.01%	5.32E-04	0.03%	1.36E-04	0.03%	ore	21.10%	5.40%
CSB: Fugitive Releases from building + loadout	4.07E-01	2.86%	1.98E-01	20.21%	4.58E-02	16.69%	4.07E-01	1.35%	1.98E-01	11.78%	4.58E-02	9.42%	ratio of lead/zinc concentrate output	48.77%	11.27%
Tailings1	2.43E-02	0.17%	1.19E-03	0.12%	4.73E-04	0.17%	2.08E-01	0.69%	1.02E-02	0.60%	4.04E-03	0.83%	Tailings Beach at Influent/Coffer Dam	4.90%	1.95%
Tailings2	2.69E-02	0.19%	1.32E-03	0.13%	5.24E-04	0.19%	2.30E-01	0.76%	1.13E-02	0.67%	4.47E-03	0.92%	Tailings Beach at Influent/Coffer Dam	4.90%	1.95%
Haul 1 Road	1.53E+00	10.72%	4.67E-02	4.76%	1.80E-02	6.55%	3.56E+00	11.81%	1.09E-01	6.47%	4.20E-02	8.62%	Pit @ U turn	3.06%	1.18%
Haul 2 Road	7.39E-01	5.19%	2.26E-02	2.30%	8.71E-03	3.17%	1.72E+00	5.72%	5.27E-02	3.13%	2.03E-02	4.17%	Pit @ U turn	3.06%	1.18%
Haul 3 Road	9.80E-01	6.88%	3.00E-02	3.06%	1.15E-02	4.21%	2.29E+00	7.58%	7.00E-02	4.15%	2.69E-02	5.54%	Pit @ U turn	3.06%	1.18%
Haul 4 Road	1.78E-01	1.25%	5.45E-03	0.56%	2.10E-03	0.77%	4.16E-01	1.38%	1.27E-02	0.76%	4.90E-03	1.01%	Pit @ U turn	3.06%	1.18%
Haul 5 Road	7.85E-01	5.51%	2.40E-02	2.45%	9.24E-03	3.37%	1.83E+00	6.07%	5.60E-02	3.33%	2.16E-02	4.43%	Pit @ U turn	3.06%	1.18%
Ore 1 Road	1.04E-01	0.73%	3.19E-03	0.33%	1.23E-03	0.45%	2.44E-01	0.81%	7.45E-03	0.44%	2.87E-03	0.59%	Pit @ U turn	3.06%	1.18%
Ore 2 Road	1.99E-01	1.40%	6.10E-03	0.62%	2.35E-03	0.86%	4.65E-01	1.54%	1.42E-02	0.85%	5.48E-03	1.13%	Pit @ U turn	3.06%	1.18%
Gyro 1 Road	2.11E-01	1.48%	6.45E-03	0.66%	2.48E-03	0.90%	4.92E-01	1.63%	1.51E-02	0.89%	5.80E-03	1.19%	Pit @ U turn	3.06%	1.18%
Jaw 1 Road	2.59E-02	0.18%	7.91E-04	0.08%	3.05E-04	0.11%	6.04E-02	0.20%	1.85E-03	0.11%	7.11E-04	0.15%	Pit @ U turn	3.06%	1.18%
Waste 1 Road	1.55E-01	1.09%	8.93E-03	0.91%	1.74E-03	0.63%	3.62E-01	1.20%	2.08E-02	1.24%	4.07E-03	0.84%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 2 Road	2.45E-01	1.72%	1.41E-02	1.44%	2.75E-03	1.00%	5.71E-01	1.89%	3.29E-02	1.95%	6.42E-03	1.32%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 3 Road	4.52E-01	3.17%	2.60E-02	2.65%	5.07E-03	1.85%	1.05E+00	3.50%	6.06E-02	3.60%	1.18E-02	2.43%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 4 Road	9.64E-01	6.77%	5.54E-02	5.65%	1.08E-02	3.94%	2.25E+00	7.46%	1.29E-01	7.68%	2.53E-02	5.19%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 5 Road	2.61E-01	1.83%	1.50E-02	1.53%	2.93E-03	1.07%	6.09E-01	2.02%	3.50E-02	2.08%	6.84E-03	1.41%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 6 Road	7.03E-01	4.94%	4.04E-02	4.12%	7.89E-03	2.87%	1.64E+00	5.44%	9.43E-02	5.60%	1.84E-02	3.78%	Main Waste at Landfill/Entrance	5.75%	1.12%
MAAB 1 Road	3.47E-02	0.24%	4.01E-04	0.04%	1.06E-04	0.04%	8.10E-02	0.27%	9.35E-04	0.06%	2.48E-04	0.05%	Road - CSB to Port	1.15%	0.31%
MAAB 2 Road	5.74E-02	0.40%	6.62E-04	0.07%	1.76E-04	0.06%	1.34E-01	0.44%	1.54E-03	0.09%	4.10E-04	0.08%	Road - CSB to Port	1.15%	0.31%
MAAB 3 Road	1.34E-01	0.94%	1.54E-03	0.16%	4.09E-04	0.15%	3.12E-01	1.04%	3.60E-03	0.21%	9.55E-04	0.20%	Road - CSB to Port	1.15%	0.31%
MAAB 4 Road	1.34E-01	0.94%	1.55E-03	0.16%	4.11E-04	0.15%	3.14E-01	1.04%	3.62E-03	0.21%	9.59E-04	0.20%	Road - CSB to Port	1.15%	0.31%
MAAB 5 Road	2.24E-01	1.57%	2.59E-03	0.26%	6.86E-04	0.25%	5.23E-01	1.73%	6.04E-03	0.36%	1.60E-03	0.33%	Road - CSB to Port	1.15%	0.31%
MAAB 6 Road	2.39E-01	1.68%	2.76E-03	0.28%	7.33E-04	0.27%	5.59E-01	1.85%	6.45E-03	0.38%	1.71E-03	0.35%	Road - CSB to Port	1.15%	0.31%
MAAB 7 Road	3.53E-01	2.48%	4.07E-03	0.41%	1.08E-03	0.39%	8.23E-01	2.73%	9.50E-03	0.56%	2.52E-03	0.52%	Road - CSB to Port	1.15%	0.31%
MAAB 8 Road	3.08E-01	2.16%	3.56E-03	0.36%	9.43E-04	0.34%	7.19E-01	2.38%	8.30E-03	0.49%	2.20E-03	0.45%	Road - CSB to Port	1.15%	0.31%

5.0 PRELIMINARY ANALYSIS OF EMISSION ESTIMATES

A review of emission estimates for each period was done to identify the major sources of emissions, and the key differences between the four time periods studied. Tables 5.1 through 5.4 summarize the PM, zinc, and lead emissions from source groups for all four time periods.

For all four time periods the major sources of emissions are the pits and the roads. The pit is a more significant source during Period 1 compared with the other 3 time periods because it was just being developed and hence the emissions did not benefit from any control from retention within the pit. Additionally, during Period 1, the facility had yet to implement adequate control to the onsite roads, as was done during later periods. These two factors resulted in the Period 1 PM, zinc and lead emissions estimated to be higher than Period 2, 3, and Current PM, zinc and lead emissions.

Total emissions decreased significantly from Period 1 to Period 2, despite a significant increase in production, due to the implementation of road controls and due to the pit becoming deep enough to retain a significant portion of the emissions generated within it. Total Period 3 emissions were slightly lower than Period 2 emissions, which is reflective of additional controls throughout the process.

The total Current period particulate emissions were estimated to be marginally higher than the Period 3 emissions, which was primarily a function of additional travel due to the fact that the ore storage piles were located within the East Pit during the Current period, as opposed to adjacent to the crushers. Also, waste rock stockpiles were located at a greater distance from the pit, and the waste rock production rate was slightly higher during the Current period, in comparison to Periods 2 and 3, resulting in extra travel to transport all of the waste rock to the waste rock storage pile. The Current period emissions increased despite the additional control applied to the tailings pond and the control on the ore stockpiles obtained through pit retention of emissions.

The pit and roads are the major sources of PM, lead and zinc emissions. However, due to the increasing concentration of lead and zinc in the product at later stages in the process, the processing area, in particular the concentrate storage building, is a significant emission unit of zinc and lead, but not PM.

Table 5.1: Period 1 Summary of Source Group Emissions

Source Group Contributions	Summer Controlled Emissions						Winter Controlled Emissions					
	PM		Zinc		Lead		PM		Zinc		Lead	
	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total
Main Pit	1.20E+01	29.94%	8.98E-01	32.54%	2.84E-01	39.87%	1.21E+01	29.47%	9.06E-01	31.98%	2.86E-01	39.09%
Mining Vehicle Travel	1.08E+01	27.07%	7.57E-01	27.41%	2.48E-01	34.86%	1.08E+01	26.49%	7.57E-01	26.71%	2.48E-01	33.92%
Mining Non-Vehicle Travel	1.15E+00	2.87%	1.42E-01	5.13%	3.58E-02	5.01%	1.22E+00	2.98%	1.50E-01	5.28%	3.78E-02	5.16%
Jaw Crusher	3.74E-02	0.09%	7.85E-03	0.28%	1.76E-03	0.25%	4.54E-02	0.11%	9.54E-03	0.34%	2.13E-03	0.29%
Processing Area	1.69E+00	4.23%	6.40E-01	23.19%	1.24E-01	17.44%	1.73E+00	4.23%	6.46E-01	22.79%	1.26E-01	17.17%
Coarse Ore Stockpile	6.98E-01	1.74%	1.46E-01	5.31%	3.28E-02	4.60%	7.44E-01	1.82%	1.56E-01	5.52%	3.50E-02	4.78%
Mill Concentrator Facility	5.65E-02	0.14%	1.19E-02	0.43%	2.66E-03	0.37%	5.65E-02	0.14%	1.19E-02	0.42%	2.66E-03	0.36%
Concentrate Storage Building	9.38E-01	2.34%	4.82E-01	17.45%	8.89E-02	12.47%	9.30E-01	2.27%	4.77E-01	16.85%	8.82E-02	12.04%
Ore Handling: Ore Storage Stockpiles - Wind Erosion	7.11E-01	1.78%	1.49E-01	5.41%	3.34E-02	4.69%	8.20E-01	2.00%	1.72E-01	6.08%	3.85E-02	5.26%
Waste Rock Handling	8.75E-01	2.19%	4.02E-02	1.46%	1.49E-02	2.09%	1.01E+00	2.46%	4.63E-02	1.64%	1.71E-02	2.34%
Tailings 1	1.22E+00	3.06%	6.73E-02	2.44%	1.96E-02	2.75%	1.74E+00	4.26%	9.58E-02	3.38%	2.79E-02	3.80%
Haul Road (from Pits to Processing Area)	6.02E+00	15.04%	1.84E-01	6.67%	7.09E-02	9.94%	6.02E+00	14.72%	1.84E-01	6.50%	7.09E-02	9.68%
Crusher/Ore Storage Road (from Haul Road to Crusher/Ore Storage)	1.64E+00	4.11%	5.03E-02	1.82%	1.94E-02	2.72%	1.64E+00	4.02%	5.03E-02	1.77%	1.94E-02	2.64%
Waste Road (from Processing Area to Waste Stockpile)	1.18E+01	29.36%	6.76E-01	24.48%	1.32E-01	18.51%	1.18E+01	28.73%	6.76E-01	23.85%	1.32E-01	18.01%
MAAB Road (from CSB to Mine Ambient Air Boundary)	4.09E+00	10.21%	4.71E-02	1.71%	1.25E-02	1.75%	4.09E+00	9.99%	4.71E-02	1.66%	1.25E-02	1.71%
Total	**4.00E+01**	**100.00%**	**2.76E+00**	**100.00%**	**7.13E-01**	**100.00%**	**4.09E+01**	**100.00%**	**2.83E+00**	**100.00%**	**7.32E-01**	**100.00%**

Table 5.2: Period 2 Summary of Source Group Emissions

Source Group Contributions	Summer Controlled Emissions						Winter Controlled Emissions					
	PM		Zinc		Lead		PM		Zinc		Lead	
	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total
Main Pit	2.20E+00	15.27%	1.90E-01	15.57%	5.83E-02	17.65%	4.35E+00	16.43%	3.43E-01	18.99%	1.08E-01	21.95%
Mining Vehicle Travel	1.58E+00	10.94%	1.10E-01	9.03%	3.62E-02	10.96%	3.68E+00	13.90%	2.57E-01	14.23%	8.44E-02	17.13%
Mining Non-Vehicle Travel	6.24E-01	4.33%	7.98E-02	6.54%	2.21E-02	6.69%	6.71E-01	2.53%	8.60E-02	4.76%	2.38E-02	4.82%
Crushers	6.70E-02	0.46%	1.41E-02	1.16%	3.62E-03	1.10%	8.11E-02	0.31%	1.71E-02	0.95%	4.38E-03	0.89%
Jaw Crusher	4.69E-02	0.33%	9.89E-03	0.81%	2.53E-03	0.77%	5.74E-02	0.22%	1.21E-02	0.67%	3.10E-03	0.63%
Gyro Crusher	2.02E-02	0.14%	4.25E-03	0.35%	1.09E-03	0.33%	2.37E-02	0.09%	5.00E-03	0.28%	1.28E-03	0.26%
Processing Area	9.72E-01	6.74%	4.29E-01	35.20%	9.01E-02	27.31%	9.72E-01	3.67%	4.29E-01	23.78%	9.01E-02	18.28%
Coarse Ore Stockpile	1.28E-01	0.89%	2.71E-02	2.22%	6.93E-03	2.10%	1.28E-01	0.48%	2.71E-02	1.50%	6.93E-03	1.41%
Mill Concentrator Facility	5.65E-02	0.39%	1.19E-02	0.98%	3.05E-03	0.92%	5.65E-02	0.21%	1.19E-02	0.66%	3.05E-03	0.62%
Concentrate Storage Building	7.87E-01	5.46%	3.90E-01	32.01%	8.01E-02	24.28%	7.87E-01	2.97%	3.90E-01	21.62%	8.01E-02	16.25%
Ore Handling: Ore Storage Stockpiles - Wind Erosion	9.08E-01	6.30%	1.75E-01	14.31%	4.53E-02	13.72%	1.20E+00	4.52%	2.13E-01	11.78%	5.59E-02	11.34%
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	4.46E-01	3.09%	8.55E-02	7.01%	2.22E-02	6.72%	5.86E-01	2.21%	1.04E-01	5.75%	2.73E-02	5.54%
Ore Handling: Ore Storage Stockpile2 - Wind Erosion	4.63E-01	3.21%	8.91E-02	7.30%	2.31E-02	7.00%	6.11E-01	2.31%	1.09E-01	6.03%	2.86E-02	5.80%
Waste Rock Handling	8.90E-01	6.18%	4.10E-02	3.36%	1.51E-02	4.59%	1.03E+00	3.88%	4.72E-02	2.61%	1.75E-02	3.54%
Tailings Total	2.27E+00	15.71%	8.16E-02	6.69%	4.30E-02	13.04%	2.27E+00	8.55%	8.16E-02	4.52%	4.30E-02	8.73%
Tailings 1	9.86E-01	6.84%	3.55E-02	2.91%	1.87E-02	5.68%	9.86E-01	3.72%	3.55E-02	1.96%	1.87E-02	3.80%
Tailings 2	2.94E-01	2.04%	1.06E-02	0.87%	5.59E-03	1.69%	2.94E-01	1.11%	1.06E-02	0.59%	5.59E-03	1.13%
Tailings 3	9.86E-01	6.84%	3.55E-02	2.91%	1.87E-02	5.68%	9.86E-01	3.72%	3.55E-02	1.96%	1.87E-02	3.80%
Haul Road (from Pits to Processing Area)	2.74E+00	19.04%	8.39E-02	6.88%	3.23E-02	9.80%	6.40E+00	24.17%	1.96E-01	10.84%	7.54E-02	15.30%
Crusher Road (from Haul Road to Crushers)	2.45E-01	1.70%	7.50E-03	0.61%	2.89E-03	0.88%	5.72E-01	2.16%	1.75E-02	0.97%	6.74E-03	1.37%
Waste Road (from Processing Area to Waste Stockpile)	3.27E+00	22.67%	1.88E-01	15.41%	3.67E-02	11.12%	7.63E+00	28.79%	4.39E-01	24.28%	8.56E-02	17.37%
MAAB Road (from CSB to Mine Ambient Air Boundary)	8.54E-01	5.92%	9.85E-03	0.81%	2.61E-03	0.79%	1.99E+00	7.52%	2.30E-02	1.27%	6.10E-03	1.24%
Total	**1.44E+01**	**100.00%**	**1.22E+00**	**100.00%**	**3.30E-01**	**100.00%**	**2.65E+01**	**100.00%**	**1.81E+00**	**100.00%**	**4.93E-01**	**100.00%**

Table 5.3: Period 3 (2001-2003) Summary of Source Group Emissions

Source Group Contributions	Summer Controlled Emissions						Winter Controlled Emissions					
	PM		Zinc		Lead		PM		Zinc		Lead	
	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total
Main Pit	2.56E+00	19.21%	2.16E-01	18.70%	6.67E-02	21.32%	5.18E+00	19.57%	4.02E-01	23.04%	1.27E-01	26.12%
Mining Vehicle	1.93E+00	14.49%	1.35E-01	11.69%	4.43E-02	14.17%	4.51E+00	17.01%	3.15E-01	18.05%	1.03E-01	21.19%
Mining Non-Vehicle	6.28E-01	4.71%	8.09E-02	7.01%	2.24E-02	7.15%	6.76E-01	2.55%	8.72E-02	5.00%	2.41E-02	4.93%
Crushers	5.13E-02	0.38%	1.08E-02	0.94%	2.77E-03	0.89%	6.14E-02	0.23%	1.30E-02	0.74%	3.31E-03	0.68%
Jaw Crusher	4.81E-03	0.04%	1.01E-03	0.09%	2.60E-04	0.08%	5.92E-03	0.02%	1.25E-03	0.07%	3.20E-04	0.07%
Gyro Crusher	4.65E-02	0.35%	9.82E-03	0.85%	2.51E-03	0.80%	5.55E-02	0.21%	1.17E-02	0.67%	2.99E-03	0.61%
Processing Area	1.14E+00	8.57%	4.37E-01	37.87%	1.03E-01	32.89%	1.14E+00	4.31%	4.37E-01	25.06%	1.03E-01	21.08%
Coarse Ore Stockpile	1.28E-01	0.96%	2.71E-02	2.34%	6.93E-03	2.22%	1.28E-01	0.48%	2.71E-02	1.55%	6.93E-03	1.42%
Mill Concentrator Facility	2.27E-01	1.70%	4.79E-02	4.15%	1.23E-02	3.92%	2.27E-01	0.86%	4.79E-02	2.75%	1.23E-02	2.51%
Concentrate Storage Building	7.87E-01	5.91%	3.62E-01	31.37%	8.37E-02	26.75%	7.87E-01	2.97%	3.62E-01	20.76%	8.37E-02	17.14%
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	3.88E-01	2.91%	8.19E-02	7.10%	2.10E-02	6.71%	4.49E-01	1.70%	9.48E-02	5.44%	2.43E-02	4.97%
Ore Handling: Ore Storage Stockpile2 - Wind Erosion	4.05E-01	3.04%	8.55E-02	7.41%	2.19E-02	7.00%	4.74E-01	1.79%	1.00E-01	5.73%	2.56E-02	5.24%
Waste Rock Handling	7.93E-01	5.95%	3.65E-02	3.16%	1.35E-02	4.31%	9.26E-01	3.49%	4.26E-02	2.44%	1.57E-02	3.22%
Tailings	4.26E-01	3.19%	1.53E-02	1.33%	8.09E-03	2.59%	6.06E-01	2.29%	2.18E-02	1.25%	1.15E-02	2.36%
Haul Road (from Pits to Processing Area)	3.03E+00	22.69%	9.25E-02	8.02%	3.56E-02	11.40%	7.06E+00	26.64%	2.16E-01	12.38%	8.31E-02	17.04%
Crusher Road (from Haul Road to Crushers)	7.45E-01	5.59%	2.28E-02	1.97%	8.78E-03	2.81%	1.74E+00	6.56%	5.32E-02	3.05%	2.05E-02	4.20%
Waste Road (from Processing Area to Waste Stockpile)	2.44E+00	18.31%	1.40E-01	12.16%	2.74E-02	8.77%	5.70E+00	21.50%	3.28E-01	18.78%	6.40E-02	13.11%
MAAB Road (from CSB to Mine Ambient Air Boundary)	1.35E+00	10.15%	1.56E-02	1.35%	4.14E-03	1.32%	3.16E+00	11.92%	3.64E-02	2.09%	9.66E-03	1.98%
Total	**1.33E+01**	**100.00%**	**1.15E+00**	**100.00%**	**3.13E-01**	**100.00%**	**2.65E+01**	**100.00%**	**1.74E+00**	**100.00%**	**4.88E-01**	**100.00%**

Table 5.4: Current Period Summary of Source Group Emissions

Source Group Contributions	Summer Controlled Emissions						Winter Controlled Emissions					
	PM		Zinc		Lead		PM		Zinc		Lead	
	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total	(g/s)	% of Total
Main Pit	2.64E+00	18.52%	2.20E-01	22.41%	6.81E-02	24.81%	5.35E+00	17.74%	4.12E-01	24.47%	1.31E-01	26.90%
East Mine Pit	7.96E-01	5.59%	1.10E-01	11.19%	3.02E-02	10.99%	1.41E+00	4.66%	1.61E-01	9.56%	4.61E-02	9.46%
Mining Vehicle Travel	2.41E+00	16.92%	1.68E-01	17.15%	5.53E-02	20.13%	5.62E+00	18.64%	3.93E-01	23.32%	1.29E-01	26.50%
Mining Non-Vehicle Travel	1.02E+00	7.18%	1.61E-01	16.45%	4.30E-02	15.67%	1.13E+00	3.75%	1.80E-01	10.71%	4.80E-02	9.86%
Crushers Total	5.13E-02	0.36%	1.08E-02	1.10%	2.77E-03	1.01%	6.14E-02	0.20%	1.30E-02	0.77%	3.31E-03	0.68%
Jaw Crusher	4.81E-03	0.03%	1.01E-03	0.10%	2.60E-04	0.09%	5.92E-03	0.02%	1.25E-03	0.07%	3.20E-04	0.07%
Gyro Crusher	4.65E-02	0.33%	9.82E-03	1.00%	2.51E-03	0.91%	5.55E-02	0.18%	1.17E-02	0.69%	2.99E-03	0.62%
Processing Area	7.62E-01	5.35%	3.16E-01	27.86%	8.08E-02	23.68%	1.87E+00	2.53%	3.24E-01	16.24%	8.39E-02	13.36%
Coarse Ore Stockpile	1.28E-01	0.90%	2.71E-02	2.76%	6.93E-03	2.52%	1.28E-01	0.43%	2.71E-02	1.61%	6.93E-03	1.42%
Mill Concentrator Facility	2.27E-01	1.60%	4.79E-02	4.88%	1.23E-02	4.47%	2.27E-01	0.75%	4.79E-02	2.85%	1.23E-02	2.52%
Concentrate Storage Building	4.07E-01	2.86%	1.98E-01	20.21%	4.58E-02	16.69%	4.07E-01	1.35%	1.98E-01	11.78%	4.58E-02	9.42%
Waste Rock Handling	9.27E-01	6.51%	4.27E-02	4.35%	1.58E-02	5.74%	1.11E+00	3.68%	5.11E-02	3.04%	1.89E-02	3.88%
Tailings	5.12E-02	0.36%	2.51E-03	0.26%	9.97E-04	0.36%	4.38E-01	1.45%	2.14E-02	1.27%	8.52E-03	1.75%
Haul Road (from Pits to Processing Area)	4.21E+00	29.56%	1.29E-01	13.12%	4.96E-02	18.06%	9.82E+00	32.56%	3.00E-01	17.84%	1.16E-01	23.77%
Crusher Road (from Haul Road to Crushers)	5.41E-01	3.80%	1.65E-02	1.69%	6.37E-03	2.32%	1.26E+00	4.18%	3.86E-02	2.29%	1.49E-02	3.05%
Waste Road (from Processing Area to Waste Stockpile)	2.78E+00	19.52%	1.60E-01	16.29%	3.12E-02	11.37%	6.49E+00	21.51%	3.73E-01	22.15%	7.28E-02	14.96%
MAAB Road (from CSB to Mine Ambient Air Boundary)	1.49E+00	10.43%	1.71E-02	1.75%	4.54E-03	1.66%	3.47E+00	11.49%	4.00E-02	2.37%	1.06E-02	2.18%
Total	**1.42E+01**	**100.0%**	**9.81E-01**	**100.0%**	**2.75E-01**	**100.0%**	**3.02E+01**	**100.0%**	**1.68E+00**	**100.0%**	**4.87E-01**	**100.0%**

6.0 PRELIMINARY ISCST3 MODELLING

As a preliminary "test" of the estimated emissions, all emission sources identified in Section 3 were modeled using the ISCST3 dispersion model and the model predicted PM, lead, and zinc concentrations were compared with onsite measured concentrations. This analysis was only done for the Current period, as this is the time period in which onsite measured data was available. As indicated earlier, the idea is to provide feedback to help refine the Current period emission estimates through comparison of the model predicted concentrations with the measured concentrations and apply similar refinements to the emission estimates from the other periods.

The ISCST3 dispersion model was used for a preliminary screening of the emission estimates due to the time involved in setting up, running, and post-processing CALPUFF files. The ISCST3 model was used rather than the AERMOD dispersion model for the preliminary assessment, as is has been shown that AERMOD tends to over predict the effect of releases from road sources, which represent a majority of the sources at the facility. While the ISCST3 dispersion model is not capable of fully handling the effects of local terrain on dispersion, the model has been widely used as a regulatory model at mine sites and provides an efficient method of comparing observations and preliminary modeling results. In addition, the input file developed for ISCST3 can be readily converted to a CALPUFF input file, thus facilitating the eventual running of CALPUFF with a refined source inventory. The 2003 full-year hourly meteorological data set from the two onsite meteorological stations, one located close to the airport and one located at the mill, and upper air data from Kotzebue were used to create a ISCST3 input file. Gridded terrain data for the modeling domain, available in 1 deg digital elevation models (DEMS) files (~90 resolution), and detailed site elevations were incorporated into the modeling.

The predicted air concentrations (obtained using the ISCST3 dispersion model) were compared (qualitatively) with the onsite sampling data as a means of benchmarking the estimated emission rates. As consistent data was available from the PAC Hi-Vol for the August through October 2005 time period for PM, lead, and zinc, this data was used for the preliminary benchmarking.

6.1 ISCST3 EMISSIONS VERSUS CALPUFF EMISSIONS

The emission estimates detailed in Section 3 were created for use with the CALPUFF dispersion model, as CALPUFF will be the primary dispersion model used for this study. Due to the differences between the ISCST3 and CALPUFF models there were a few adjustments that had to be made to the emissions estimates prior to using them as input into the ISCST3 model.

The CALPUFF dispersion model does not have a pit algorithm, and therefore the emission estimates developed applied a preliminary control factor of 50% (which will be refined) to sources located within pits to account for the TSP that would be retained within the pit. As noted earlier, the pit retention factor will be investigated in a sensitivity analysis when the CALPUFF modelling is performed. The ISCST3 dispersion model does have a pit algorithm, which applies the total pit emissions to the volume of air within the pit, and retains a fraction of the emissions within the pit, depending on the depth. As the retention is incorporated into the ISCST3 model, no separate factor for control of dust through pit retention was applied to the sources within the pit (i.e., "uncontrolled" emissions were used for modelling purposes).

In previous studies of this nature, SENES has often used the CAL3QHCR model to estimate concentrations due to fugitive particulate matter near roads, in addition to the ISCST3 model used for other (area or volume) sources in the modelling domain. This road-emissions model (CAL3QHCR) is an approved U.S. EPA model for fugitive particulate matter emissions. The use of the model for roadway emissions is considered appropriate because the model incorporates the increased dispersion of air contaminants due to turbulence generated by the moving vehicles. The ISCST3 model treats roads as elongated area sources and does not represent this feature, thereby predicting air concentrations near roadways that are much higher than air quality monitoring has shown. A drawback to using two separate models in an air quality study is that due to differences in models is that it greatly complicates the estimate of the total ground-level concentrations at individual locations and times.

Since these situations are common (i.e., multiple sources of different types), SENES has conducted a comprehensive study of the use of ISCST3 for modelling roadway emissions [Radonjic et. al. 2003]. The results of this work show that the ISCST3 model, representing roads as elongated area sources in 'RURAL' dispersion conditions, can reproduce CAL3QHCR estimates when modelled emission rates are reduced by a factor of 3.5. The net effect of applying the reduction factor accounts for the turbulent mixing that occurs surrounding the road(s). Therefore, for present screening purposes, roads within the modelling domain were modelled as elongated area sources in ISCST3 using the 3.5 reduction factor. However, this reduction factor was not applied to roadway emissions in the pits, since total emissions from the pit were classified as one "OPENPIT" source. No reduction factor was applied to the road emissions for the CALPUFF modelling, as CALPUFF has been shown to predict similar concentrations to CAL3QHCR.

6.2 TOTAL SUSPENDED PARTICULATE CONCENTRATIONS

Table 6.1 presents the emission sources, their associated emission estimate method, uncontrolled PM emission rate, control efficiency, and controlled PM emission rates that were used for modelling the Current time period using ISCST3. Many of the emission sources were grouped into one model emission unit for modelling purposes. The model emission unit that each emission source is associated with has been identified in Table 6.1. Tables 6.2 through 6.5 present the parameters of all emission units included in the ISCST3 modelling. Refer to Figure 3.4 for the location of each source included in the model with respect to the site layout.

Table 6.1: Summary of 24-Hour Average Emission Rates (g/s) – Current – ISCST3 Modelling

Mining Activities (Ore and Waste)	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter	Model Emission Unit ID
Mining: Drilling	AP-42 Drilling – Section 11.9	3.41E-01	3.41E-01	80%	80%	6.83E-02	6.83E-02	MAIN
Mining: Blasting - Ore	AP-42 Blasting – Section 11.9	1.57E-04	1.57E-04			1.57E-04	1.57E-04	MAIN
Mining: Blasting - Waste Rock		3.40E-04	3.40E-04			3.40E-04	3.40E-04	MAIN
Mining: Dozer activity in Blast Area - Ore	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01	MAIN
Mining: Dozer activity in Blast Area - Waste Rock		4.47E-01	4.57E-01			4.47E-01	4.57E-01	MAIN
Mining: Loading of haul trucks in Blast Area - Ore	AP-42 Drop Equation – Section 13.2.4	1.44E-01	1.81E-01			1.44E-01	1.81E-01	MAIN
Mining: Loading of haul trucks in Blast Area - Waste Rock		1.71E-01	2.14E-01			1.71E-01	2.14E-01	MAIN
Mining: Loader travel in Blast Area	AP-42 Travel on Unpaved Roads - Section 13.2.2	3.66E+00		85%	65%	5.48E-01	1.28E+00	MAIN
Mining: Haul truck travel in Blast Area		2.30E+01		85%	65%	3.45E+00	8.04E+00	MAIN

Ore Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter	Model Emission Unit ID
Ore Handling: Dozer activity on Ore Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01	EAST
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.03E-01	1.47E-01			1.03E-01	1.47E-01	EAST
Ore Handling: Ore Storage Stockpile 2- Wind Erosion		7.28E-02	1.04E-01			7.28E-02	1.04E-01	EAST
Ore Handling: Haul truck unloading at Ore Storage Area	AP-42 Drop Equation – Section 13.2.4	1.44E-01	1.81E-01			1.44E-01	1.81E-01	EAST
Ore Handling: Haul truck travel from Blast Area to Ore Storage Area Haul1	AP-42 Travel on Unpaved Roads - Section 13.2.2	1.03E+00	1.03E+00	85%	65%	1.55E-01	3.61E-01	Haul1
Ore Handling: Haul truck travel in Ore Storage Area (in East Mine)		5.50E+00	5.50E+00	85%	65%	8.25E-01	1.92E+00	EAST
Ore Handling: Loader travel in Ore Storage Area (in East Mine)		0.00E+00	0.00E+00	85%	65%	0.00E+00	0.00E+00	EAST
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul1		1.03E+00	1.03E+00	85%	65%	1.55E-01	3.61E-01	Haul1
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul2		7.72E-01	7.72E-01	85%	65%	1.16E-01	2.70E-01	Haul2
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul3		1.02E+00	1.02E+00	85%	65%	1.54E-01	3.59E-01	Haul3
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul4		1.86E-01	1.86E-01	85%	65%	2.80E-02	6.52E-02	Haul4
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Haul5		8.20E-01	8.20E-01	85%	65%	1.23E-01	2.87E-01	Haul5
Ore Handling: Haul truck travel from Ore Storage Area to Crushers -Ore1		1.99E-01	1.99E-01	85%	65%	2.98E-02	6.96E-02	Ore1
Ore Handling: Haul truck travel from Ore Storage Area to Crushers -Ore2		3.80E-01	3.80E-01	85%	65%	5.70E-02	1.33E-01	Ore2
Ore Handling: Haul truck travel from Ore Storage Area to Gyro Crusher -Gyro1		4.02E-01	4.02E-01	85%	65%	6.03E-02	1.41E-01	Gyro1
Ore Handling: Haul truck travel from Ore Storage Area to Jaw Crusher-Jaw1		3.83E-02	3.83E-02	85%	65%	5.75E-03	1.34E-02	Jaw1

Waste Rock Handling	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter	Model Emission Unit ID
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul1	AP-42 Travel on Unpaved Roads - Section 13.2.2	8.47E-01	8.47E-01	85%	65%	1.27E-01	2.97E-01	Haul1
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul2		6.35E-01	6.35E-01	85%	65%	9.53E-02	2.22E-01	Haul2
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul3		8.43E-01	8.43E-01	85%	65%	1.26E-01	2.95E-01	Haul3
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul4		1.53E-01	1.53E-01	85%	65%	2.30E-02	5.37E-02	Haul4
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Haul5		6.75E-01	6.75E-01	85%	65%	1.01E-01	2.36E-01	Haul5
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste1		2.96E-01	2.96E-01	85%	65%	4.43E-02	1.03E-01	Waste1
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste2		4.66E-01	4.66E-01	85%	65%	7.00E-02	1.63E-01	Waste2
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste3		8.61E-01	8.61E-01	85%	65%	1.29E-01	3.01E-01	Waste3
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste4		1.84E+00	1.84E+00	85%	65%	2.75E-01	6.43E-01	Waste4
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste5		4.97E-01	4.97E-01	85%	65%	7.46E-02	1.74E-01	Waste5
Waste Rock Handling: Haul truck travel from Blast Area to Waste Rock Storage Area - Waste6		1.34E+00	1.34E+00	85%	65%	2.01E-01	4.69E-01	Waste6
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	AP-42 Dozer Equation – Section 11.9	4.47E-01	4.57E-01			4.47E-01	4.57E-01	WSTOCK1/2/3
Waste Rock: Haul truck unloading at Waste Rock Storage Area	AP-42 Drop Equation – Section 13.2.4	1.71E-01	2.14E-01			1.71E-01	2.14E-01	WSTOCK1/2/3
Waste Rock Handling: Waste Rock Storage Area1 - Wind Erosion	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	1.03E-01	1.47E-01			1.03E-01	1.47E-01	WSTOCK1
Waste Rock Handling: Waste Rock Storage Area2 - Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01	WSTOCK2
Waste Rock Handling: Waste Rock Storage Area3 - Wind Erosion		1.03E-01	1.47E-01			1.03E-01	1.47E-01	WSTOCK3

Crushers	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter	Model Emission Unit ID
Jaw Crusher Baghouse	Source Test Emission Data					3.57E-04	3.57E-04	JAW
Gyro Crusher Baghouse	Source Test Emission Data					1.09E-02	1.09E-02	GYRO
Ore Handling: Unloading Haul truck into Jaw Crusher	AP-42 Drop Equation – Section 13.2.4	1.78E-02	2.23E-02	75%	75%	4.45E-03	5.57E-03	JAW
Ore Handling: Unloading Haul truck into Gyro Crusher		1.42E-01	1.78E-01	75%	75%	3.56E-02	4.45E-02	GYRO

Coarse Ore Stockpile	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter	Model Emission Unit ID
Coarse Ore Stockpile: Emission from Building Exhaust	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					0.00E+00	0.00E+00	ORE

Mill Concentrator Facility	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Rate Summer	Controlled Emission Rate Winter	Model Emission Unit ID
Mill Concentrator Facility Scrubber A	Source Test Emission Data					1.26E-01	1.26E-01	MILL
Mill Concentrator Facility Scrubber B						5.92E-02	5.92E-02	MILL
Mill Concentrator Facility: Fugitive Releases from buildings	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					6.93E-03	6.93E-03	MILL
Mill Concentrator Facility: Bucking Room Baghouse	Source Test Emission Data					2.52E-03	2.52E-03	MILL

Concentrate Storage Building (CSB)	Emission Estimation Method	Uncontrolled Emission Rate (g/s) Summer	Uncontrolled Emission Rate (g/s) Winter	Control Summer	Control Winter	Controlled Emission Rate (g/s) Summer	Controlled Emission Rate (g/s) Winter	Model Emission Unit ID
CSB: Fugitive Releases from building + loadout	Estimate of air concentration within building (industrial hygeine measurements) and building ventilation and exhausts from release points					1.02E-02	1.02E-02	CSB
CSB: Concentrate truck travel - MAAB1	Road bed and snow samples AP-42 Travel on Unpaved Roads - Section 13.2.2	6.61E-02	6.61E-02	85%	65%	9.92E-03	2.31E-02	MAAB1
CSB: Concentrate truck travel - MAAB2		1.09E-01	1.09E-01	85%	65%	1.64E-02	3.82E-02	MAAB2
CSB: Concentrate truck travel - MAAB3		2.55E-01	2.55E-01	85%	65%	3.82E-02	8.92E-02	MAAB3
CSB: Concentrate truck travel - MAAB4		2.56E-01	2.56E-01	85%	65%	3.84E-02	8.96E-02	MAAB4
CSB: Concentrate truck travel - MAAB5		4.27E-01	4.27E-01	85%	65%	6.41E-02	1.49E-01	MAAB5
CSB: Concentrate truck travel - MAAB6		4.56E-01	4.56E-01	85%	65%	6.84E-02	1.60E-01	MAAB6
CSB: Concentrate truck travel - MAAB7		6.72E-01	6.72E-01	85%	65%	1.01E-01	2.35E-01	MAAB7
CSB: Concentrate truck travel - MAAB8		5.87E-01	5.87E-01	85%	65%	8.81E-02	2.06E-01	MAAB8

Tailings Beach	Emission Estimation Method	Uncontrolled Summer	Uncontrolled Winter	Control Summer	Control Winter	Controlled Emission Summer	Controlled Emission Winter	Model Emission Unit ID
Tailings1	Air Pollution Engineering Manual, Air & Waste Management Association, 1992	4.86E-01	6.92E-01	95%	95%	2.43E-02	3.46E-02	TAIL1
Tailings2		5.38E-01	7.66E-01	95%	95%	2.69E-02	3.83E-02	TAIL2

Table 6.2: Pit Emission Unit Parameters – Current Scenario- ISCST3 Model

Source	Source ID	X	Y	Base Elevation	Release H	X Length	Y Length	Pit Depth	Pit Volume	Angle
		(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m3)	(o)
Main Pit	MAIN	590376	7551785	240	5	300.0	600.0	50.0	9,000,000	352
East Pit	EAST	590699	7552042	267	5	250.0	274.6	20.0	1,372,851	0

Table 6.3: Volume Emission Unit Parameters – Current Scenario- ISCST3 Model

Source	Source ID	X	Y	Base Elevation	Release H	Length of Side	Initial Lateral Dimension	Initial Vertical Dimension
		(m)	(m)	(m)	(m)	(m)	(m)	(m)
Jaw Crusher	JAW	589605	7552442	308.3	10	5	1.16	4.65
Gyro Crusher	GYRO	589660	7552598	303.5	10	5	1.16	4.65
Coarse Ore Stockpile	ORE	589487	7552476	301.4	15	55	12.79	6.98
Mill Concentrator Facility	SAG	589387	7552385	299.1	15	125	29.1	6.98
Concentrate Storage Building	CSB	589477	7552236	297.7	10	75	17.4	4.65

Table 6.4: Non-Road Area Emission Unit Parameters – Current Scenario- ISCST3 Model

Source	Source ID	X	Y	Base Elevation	Release H	X Length	Y Length	Angle
		(m)	(m)	(m)	(m)	(m)	(m)	(o)
Waste Rock Storage Area 1	WSTOCK1	590002	7551313	350.0	6.71	150	400	0
Waste Rock Storage Area 2	WSTOCK2	589887	7550696	350.0	6.71	160	550	0
Waste Rock Storage Area 3	WSTOCK3	589459	7550326	350.0	6.71	585	110	0
Tailings Beach 1	TAIL1	588686	7551839	295.8	1	653	72	-28.6
Tailings Beach 2	TAIL2	589230	7551858	295.8	1	293	178	-28.9

Table 6.5: Road Area Emission Unit Parameters – Current Scenario- ISCST3 Model

Source	Source ID	X	Y	Base Elevation	Release H	X Length	Y Length	Angle
		(m)	(m)	(m)	(m)	(m)	(m)	(o)
Haul 1 Road	Haul1	590628	7552455	272.5	2	15	355.7	-71.4
Haul 2 Road	Haul2	590291	7552569	269.4	2	15	266.7	-73.8
Haul 3 Road	Haul3	590035	7552643	274.4	2	15	353.7	-70.7
Haul 4 Road	Haul4	589658	7552716	282.7	2	15	64.3	40.9
Haul 5 Road	Haul5	589895	7552556	296.7	2	15	283.2	-56.7
Ore 1 Road	Ore1	589867	7552496	310.0	2	15	68.7	19.3
Ore 2 Road	Ore2	589743	7552487	314.6	2	15	131.1	83.8
Gyro 1 Road	Gyro1	589737	7552475	303.5	2	15	140.7	-33.5
Jaw 1 Road	Jaw1	589616	7552444	308.3	3	15	138.1	73.1
Waste 1 Road	Waste1	589962	7552453	312.9	2	15	124.1	-33.3
Waste 2 Road	Waste2	589897	7552271	330.7	2	15	195.8	19.3
Waste 3 Road	Waste3	589929	7551910	345.5	2	15	361.3	-5.1
Waste 4 Road	Waste4	589761	7551159	350.6	2	15	770.7	12.6
Waste 5 Road	Waste5	589619	7551008	348.2	2	15	208.7	43.1
Waste 6 Road	Waste6	589695	7550449	348.2	2	15	561.6	-8.4
MAAB 1 Road	Port1	589560	7552061	297.7	2	15	182.52	-33.4
MAAB 2 Road	Port2	589569	7551761	299.0	2	15	301.63	-1.8
MAAB 3 Road	Port3	589391	7551081	300.1	2	15	703.71	14.7
MAAB 4 Road	Port4	589340	7550376	299.6	2	15	706.7	3.8
MAAB 5 Road	Port5	588899	7549285	297.8	2	15	1179.2	22.0
MAAB 6 Road	Port6	587906	7548516	291.1	2	15	1259.5	52.2
MAAB 7 Road	Port7	586616	7547181	256.4	2	15	1855.4	44.0
MAAB 8 Road	Port8	586644	7545555	322.7	2	15	1621.4	-1.1

The emission rates detailed in Table 6.1 and the emission unit parameters presented in Tables 6.2 through 6.5 were used to model PM. The measured 24-hour PM concentrations at the PAC Hi-Vol were compared to the model predicted PM concentrations at the same location, and found to be within a factor of 2. Table 6.6 below details the comparison of model predicted concentrations to measured concentrations. A comparison was made between the maximum values, 98^{th} percentile values, and average values. For all three comparisons the measured concentrations were higher than the model predicted PM concentrations.

Considering the limitations of ISCST3 for complex terrain, the ratio of measured to modelled PM concentrations (i.e., less than a factor of 2) was considered to be reasonable for the purpose of screening the emission estimates. Nonetheless, it is noted that the PM emission estimates being used currently are possibly lower than those expected in reality.

Table 6.6: Model versus Measured 24-Hour PM Concentrations at the PAC Hi-Vol

Location	Model Predicted 24-hour PM Concentration (µg/m³)			[2]Measured 24-hour PM Concentration (µg/m³)			Ratio of Modeled to Measured PM Concentrations		
	Maximum	98th Percentile	Average[1]	Maximum	98th Percentile	Average	Maximum	98th Percentile	Average
PAC Hi-Vol	734.78	435.09	89.87	1037.99	826.99	122.22	0.71	0.53	0.74

[1]Average is actually the annual average from the model. It was considered a reasonable comparison to the measured data average.
[2]August 2005 through October 2005

6.3 LEAD CONCENTRATIONS

The lead emissions presented in Table 6.7 were input into the ISCST3 model and the resulting predicted concentrations at the PAC Hi-Vol were compared to the measured lead concentrations at the same location. The model predicted lead concentrations are approximately 1.5 times higher than the data from Aug-Oct 2005. Table 6.8 details the model predicted and measured 24-hour lead concentrations. The ratio of model predicted to measured lead concentrations is considered reasonable for this stage in the source evaluation process.

Table 6.7: Current Period Summary of Source Emissions– ISCST3 Modelling

Sources	Summer Controlled Emissions						Winter Controlled Emissions						Material Characteristic	Zinc (%)	Lead (%)
	PM (g/s)		Zinc (g/s)		Lead (g/s)		PM (g/s)		Zinc (g/s)		Lead (g/s)				
Total	**1.12E+01**	**100.00%**	**1.08E+00**	**100.00%**	**3.07E-01**	**100.00%**	**2.22E+01**	**100.00%**	**1.75E+00**	**100.00%**	**5.19E-01**	**100.00%**			
Mining: Drilling	6.83E-02	0.61%	7.65E-03	0.71%	2.17E-03	0.71%	3.41E-01	1.54%	3.82E-02	2.19%	1.09E-02	2.09%	ore/waste (1/1.5)	11%	3%
Mining: Blasting - Ore	1.57E-04	0.00%	3.31E-05	0.00%	8.48E-06	0.00%	1.57E-04	0.00%	3.31E-05	0.00%	8.48E-06	0.00%	ore	21%	5%
Mining: Blasting - Waste Rock	3.40E-04	0.00%	1.56E-05	0.00%	5.77E-06	0.00%	3.40E-04	0.00%	1.56E-05	0.00%	5.77E-06	0.00%	waste	5%	2%
Mining: Dozer activity in Blast Area - Ore	4.47E-01	3.98%	9.43E-02	8.73%	2.41E-02	7.85%	4.57E-01	2.06%	9.64E-02	5.51%	2.47E-02	4.75%	ore	21%	5%
Mining: Dozer activity in Blast Area - Waste Rock	4.47E-01	3.98%	2.06E-02	1.90%	7.60E-03	2.47%	4.57E-01	2.06%	2.10E-02	1.20%	7.77E-03	1.50%	waste	5%	2%
Mining: Loading of haul trucks in Blast Area - Ore	1.44E-01	1.29%	3.05E-02	2.82%	7.80E-03	2.54%	1.81E-01	0.82%	3.81E-02	2.18%	9.76E-03	1.88%	ore	21%	5%
Mining: Loading of haul trucks in Blast Area - Waste Rock	1.71E-01	1.52%	7.85E-03	0.73%	2.90E-03	0.94%	2.14E-01	0.96%	9.82E-03	0.56%	3.63E-03	0.70%	waste	5%	2%
Mining: Fleet Travel	4.00E+00	35.57%	2.79E-01	25.81%	9.16E-02	29.81%	9.32E+00	42.06%	6.51E-01	37.19%	2.14E-01	41.16%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Dozer activity on Ore Storage Area	4.47E-01	3.98%	9.43E-02	8.73%	2.41E-02	7.85%	4.57E-01	2.06%	9.64E-02	5.51%	2.47E-02	4.75%	ore	21%	5%
Ore Handling: Ore Storage Stockpile1 - Wind Erosion	1.03E-01	0.92%	2.18E-02	2.02%	5.58E-03	1.81%	1.47E-01	0.66%	3.10E-02	1.77%	7.94E-03	1.53%	ore	21.10%	5.40%
Ore Handling: Ore Storage Stockpile 2- Wind Erosion	7.28E-02	0.65%	1.54E-02	1.42%	3.93E-03	1.28%	1.04E-01	0.47%	2.19E-02	1.25%	5.60E-03	1.08%	ore	21.10%	5.40%
Ore Handling: Haul truck unloading at Ore Storage Area	1.44E-01	1.29%	3.05E-02	2.82%	7.80E-03	2.54%	1.81E-01	0.82%	3.81E-02	2.18%	9.76E-03	1.88%	ore	21.10%	5.40%
Ore Handling: Haul truck travel in Ore Storage Area (in East Mine)	8.25E-01	7.34%	5.76E-02	5.33%	1.89E-02	6.16%	1.92E+00	8.68%	1.34E-01	7.68%	4.41E-02	8.50%	Pit West Pit Road	6.98%	2.29%
Ore Handling: Loader travel in Ore Storage Area (in East Mine)	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	0.00E+00	0.00%	Pit West Pit Road	6.98%	2.29%
Waste Rock Handling: Dozer activity on Waste Rock Storage Area	4.47E-01	3.98%	2.06E-02	1.90%	7.60E-03	2.47%	4.57E-01	2.06%	2.10E-02	1.20%	7.77E-03	1.50%	waste	5%	2%
Waste Rock: Haul truck unloading at Waste Rock Storage Area	1.71E-01	1.52%	7.85E-03	0.73%	2.90E-03	0.94%	2.14E-01	0.96%	9.82E-03	0.56%	3.63E-03	0.70%	waste	5%	2%
Waste Rock Handling: Waste Rock Storage Area1 - Wind Erosion	1.03E-01	0.92%	4.75E-03	0.44%	1.76E-03	0.57%	1.47E-01	0.66%	6.76E-03	0.39%	2.50E-03	0.48%	waste	5%	2%
Waste Rock Handling: Waste Rock Storage Area2- Wind Erosion	1.03E-01	0.92%	4.75E-03	0.44%	1.76E-03	0.57%	1.47E-01	0.66%	6.76E-03	0.39%	2.50E-03	0.48%	waste	5%	2%
Waste Rock Handling: Waste Rock Storage Area3 - Wind Erosion	1.03E-01	0.92%	4.75E-03	0.44%	1.76E-03	0.57%	1.47E-01	0.66%	6.76E-03	0.39%	2.50E-03	0.48%	waste	5%	2%
Jaw Crusher Baghouse	3.57E-04	0.00%	7.53E-05	0.01%	1.93E-05	0.01%	3.57E-04	0.00%	7.53E-05	0.00%	1.93E-05	0.00%	ore	21%	5%
Ore Handling: Unloading Haul truck into Jaw Crusher	4.45E-03	0.04%	9.39E-04	0.09%	2.40E-04	0.08%	5.57E-03	0.03%	1.17E-03	0.07%	3.01E-04	0.06%	ore	21%	5%
Gyro Crusher Baghouse	1.09E-02	0.10%	2.30E-03	0.21%	5.90E-04	0.19%	1.09E-02	0.05%	2.30E-03	0.13%	5.90E-04	0.11%	ore	21%	5%
Ore Handling: Unloading Haul truck into Gyro Crusher	3.56E-02	0.32%	7.51E-03	0.69%	1.92E-03	0.63%	4.45E-02	0.20%	9.40E-03	0.54%	2.41E-03	0.46%	ore	21%	5%
Coarse Ore Stockpile: Emission from Building Exhaust	1.28E-01	1.14%	2.71E-02	2.50%	6.93E-03	2.25%	1.28E-01	0.58%	2.71E-02	1.55%	6.93E-03	1.33%	ore	21%	5%
Mill Concentrator Facility Scrubber A	1.26E-01	1.12%	2.66E-02	2.46%	6.80E-03	2.21%	1.26E-01	0.57%	2.66E-02	1.52%	6.80E-03	1.31%	ore	21%	5%
Mill Concentrator Facility Scrubber B	5.92E-02	0.53%	1.25E-02	1.16%	3.20E-03	1.04%	5.92E-02	0.27%	1.25E-02	0.71%	3.20E-03	0.62%	ore	21%	5%
Mill Concentrator Facility: Fugitive Releases from buildings	3.94E-02	0.35%	8.32E-03	0.77%	2.13E-03	0.69%	3.94E-02	0.18%	8.32E-03	0.48%	2.13E-03	0.41%	ore	21%	5%
Mill Concentrator Facility: Bucking Room Baghouse	2.52E-03	0.02%	5.32E-04	0.05%	1.36E-04	0.04%	2.52E-03	0.01%	5.32E-04	0.03%	1.36E-04	0.03%	ore	21%	5%
CSB: Fugitive Releases from building + loadout	4.07E-01	3.62%	1.98E-01	18.35%	4.58E-02	14.91%	4.07E-01	1.84%	1.98E-01	11.34%	4.58E-02	8.82%	ratio of lead/zinc concentrate output	49%	11%
Tailings1	2.43E-02	0.22%	1.19E-03	0.11%	4.73E-04	0.15%	2.08E-01	0.94%	1.02E-02	0.58%	4.04E-03	0.78%	Tailings Beach at Influent/Coffer Dam	4.90%	1.95%
Tailings2	2.69E-02	0.24%	1.32E-03	0.12%	5.24E-04	0.17%	2.30E-01	1.04%	1.13E-02	0.64%	4.47E-03	0.86%	Tailings Beach at Influent/Coffer Dam	4.90%	1.95%
Haul 1 Road	4.36E-01	3.88%	1.33E-02	1.23%	5.14E-03	1.67%	1.02E+00	4.59%	3.11E-02	1.78%	1.20E-02	2.31%	Pit @ U turn	3.06%	1.18%
Haul 2 Road	2.11E-01	1.88%	6.46E-03	0.60%	2.49E-03	0.81%	4.93E-01	2.22%	1.51E-02	0.86%	5.80E-03	1.12%	Pit @ U turn	3.06%	1.18%
Haul 3 Road	2.80E-01	2.49%	8.57E-03	0.79%	3.30E-03	1.07%	6.53E-01	2.95%	2.00E-02	1.14%	7.70E-03	1.48%	Pit @ U turn	3.06%	1.18%
Haul 4 Road	5.10E-02	0.45%	1.56E-03	0.14%	6.00E-04	0.20%	1.19E-01	0.54%	3.64E-03	0.21%	1.40E-03	0.27%	Pit @ U turn	3.06%	1.18%
Haul 5 Road	2.24E-01	2.00%	6.86E-03	0.63%	2.64E-03	0.86%	5.23E-01	2.36%	1.60E-02	0.91%	6.16E-03	1.19%	Pit @ U turn	3.06%	1.18%
Ore 1 Road	2.98E-02	0.27%	9.13E-04	0.08%	3.51E-04	0.11%	6.96E-02	0.31%	2.13E-03	0.12%	8.20E-04	0.16%	Pit @ U turn	3.06%	1.18%
Ore 2 Road	5.70E-02	0.51%	1.74E-03	0.16%	6.71E-04	0.22%	1.33E-01	0.60%	4.07E-03	0.23%	1.57E-03	0.30%	Pit @ U turn	3.06%	1.18%
Gyro 1 Road	6.03E-02	0.54%	1.84E-03	0.17%	7.10E-04	0.23%	1.41E-01	0.63%	4.30E-03	0.25%	1.66E-03	0.32%	Pit @ U turn	3.06%	1.18%
Jaw 1 Road	5.75E-03	0.05%	1.76E-04	0.02%	6.77E-05	0.02%	1.34E-02	0.06%	4.10E-04	0.02%	1.58E-04	0.03%	Pit @ U turn	3.06%	1.18%
Waste 1 Road	4.43E-02	0.39%	2.55E-03	0.24%	4.98E-04	0.16%	1.03E-01	0.47%	5.95E-03	0.34%	1.16E-03	0.22%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 2 Road	7.00E-02	0.62%	4.02E-03	0.37%	7.86E-04	0.26%	1.63E-01	0.74%	9.39E-03	0.54%	1.83E-03	0.35%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 3 Road	1.29E-01	1.15%	7.42E-03	0.69%	1.45E-03	0.47%	3.01E-01	1.36%	1.73E-02	0.99%	3.38E-03	0.65%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 4 Road	2.75E-01	2.45%	1.58E-02	1.47%	3.09E-03	1.01%	6.43E-01	2.90%	3.70E-02	2.11%	7.22E-03	1.39%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 5 Road	7.46E-02	0.66%	4.29E-03	0.40%	8.37E-04	0.27%	1.74E-01	0.79%	1.00E-02	0.57%	1.95E-03	0.38%	Main Waste at Landfill/Entrance	5.75%	1.12%
Waste 6 Road	2.01E-01	1.79%	1.15E-02	1.07%	2.25E-03	0.73%	4.69E-01	2.11%	2.69E-02	1.54%	5.26E-03	1.01%	Main Waste at Landfill/Entrance	5.75%	1.12%
MAAB 1 Road	9.92E-03	0.09%	1.14E-04	0.01%	3.03E-05	0.01%	2.31E-02	0.10%	2.67E-04	0.02%	7.08E-05	0.01%	Road - CSB to Port	1.15%	0.31%
MAAB 2 Road	1.64E-02	0.15%	1.89E-04	0.02%	5.01E-05	0.02%	3.82E-02	0.17%	4.41E-04	0.03%	1.17E-04	0.02%	Road - CSB to Port	1.15%	0.31%
MAAB 3 Road	3.82E-02	0.34%	4.41E-04	0.04%	1.17E-04	0.04%	8.92E-02	0.40%	1.03E-03	0.06%	2.73E-04	0.05%	Road - CSB to Port	1.15%	0.31%
MAAB 4 Road	3.84E-02	0.34%	4.43E-04	0.04%	1.17E-04	0.04%	8.96E-02	0.40%	1.03E-03	0.06%	2.74E-04	0.05%	Road - CSB to Port	1.15%	0.31%
MAAB 5 Road	6.41E-02	0.57%	7.39E-04	0.07%	1.96E-04	0.06%	1.49E-01	0.67%	1.73E-03	0.10%	4.57E-04	0.09%	Road - CSB to Port	1.15%	0.31%
MAAB 6 Road	6.84E-02	0.61%	7.90E-04	0.07%	2.09E-04	0.07%	1.60E-01	0.72%	1.84E-03	0.11%	4.89E-04	0.09%	Road - CSB to Port	1.15%	0.31%
MAAB 7 Road	1.01E-01	0.90%	1.16E-03	0.11%	3.08E-04	0.10%	2.35E-01	1.06%	2.71E-03	0.16%	7.20E-04	0.14%	Road - CSB to Port	1.15%	0.31%
MAAB 8 Road	8.81E-02	0.78%	1.02E-03	0.09%	2.70E-04	0.09%	2.06E-01	0.93%	2.37E-03	0.14%	6.29E-04	0.12%	Road - CSB to Port	1.15%	0.31%

Table 6.8: Model versus Measured 24-Hour Lead Concentrations at the PAC Hi-Vol

Location	Model Predicted 24-hour Lead Concentration (µg/m³)			Measured 24-hour Lead Concentration (µg/m³)[2]			Ratio of Modeled to Measured Lead Concentrations		
	Maximum	98th Percentile	Average[1]	Maximum	98th Percentile	Average	Maximum	98th Percentile	Average
PAC Hi-Vol	16.35	8.81	2.14	10.35	10.22	1.47	1.58	0.86	1.46

[1]Average is actually the annual average from the model. It was considered a reasonable comparison to the measured data average.
[2]August 2005 through October 2005

6.4 ZINC CONCENTRATIONS

The zinc emissions presented in Table 6.7 were input into the ISCST3 model and the resulting predicted concentrations at the PAC Hi-Vol were compared to the measured zinc concentrations at the same location. The model predicted maximum zinc concentrations were found to be approximately 2 to 3 times higher than the maximum measured concentrations at the PAC Hi-Vol, as detailed below in Table 6.9. The difference in model predicted and measured zinc concentrations was considered adequate at this stage of analysis.

Table 6.9: Model versus Measured 24-hour Zinc Concentrations at the PAC Hi-Vol

Location	Model Predicted 24-hour Zinc Concentration (µg/m³)			Measured 24-hour Zinc Concentration (µg/m³)[2]			Ratio of Modeled to Measured Zinc Concentrations		
	Maximum	98th Percentile	Average[1]	Maximum	98th Percentile	Average	Maximum	98th Percentile	Average
PAC Hi-Vol	55.12	33.10	7.87	18.18	16.57	3.27	3.03	2.00	2.40

[1]Average is actually the annual average from the model. It was considered a reasonable comparison to the measured data average.
[2]August 2005 through October 2005

7.0 PRELIMINARY SOURCE APPORTIONMENT - ISCST3 MODELLING

TCAK is interested in determining what fugitive emission units are the major contributors to ground level PM, lead, and zinc concentrations at various locations at the Red Dog site. The ISCST3 model was setup to output annual average concentrations resulting from individual emission units during the Current period. The source contributions were analyzed on an annual basis, as annual concentrations are more representative of long-term effects.

Table 7.1 below presents the predicted annual PM concentrations at the Overburden TEOM, T-Dam TEOM, and the Pac Hi-Vol/TEOM locations resulting from various emission unit groups during the Current period. The maximum predicted concentrations resulting from the majority of emission unit groups are significantly higher at the PAC location than the other two locations. While the pits and roads are the dominant emission units for all three locations, the impact of individual emission unit groups is noticeably different at the three locations (as indicated by the percentage of the total (all) concentration). Emission units and emission unit groups whose maximum concentrations are greater than 10% of the maximum concentration resulting from all emission units have been highlighted yellow in the following tables.

Table 7.1: Annual Average PM Emission Units & Emission Unit Group Concentrations – Current Period

Emission Unit	Overburden TEOM		T-Dam TEOM		PAC Hi-Vol/TEOM	
	(µg/m³)	% of All	(µg/m³)	% of All	(µg/m³)	% of All
Main Pit	6.603	42.73%	9.896	35.40%	16.891	18.80%
East Pit	1.501	9.71%	2.275	8.14%	4.083	4.54%
Jaw Crusher	0.003	0.02%	0.013	0.05%	0.031	0.03%
Gyro Crusher	0.032	0.21%	0.126	0.45%	1.145	1.27%
Coarse Ore Stockpile	0.070	0.45%	0.316	1.13%	3.711	4.13%
Mill Concentrator Facility	0.134	0.87%	0.685	2.45%	4.006	4.46%
Concentrate Storage Building	0.314	2.03%	1.586	5.68%	3.924	4.37%
Waste Rock Storage Area	0.630	4.08%	0.246	0.88%	0.165	0.18%
Tailings Area	0.337	2.18%	3.539	12.66%	1.269	1.41%
Haul Road	1.773	11.48%	4.702	16.82%	33.705	37.51%
Crusher Road	0.270	1.75%	0.920	3.29%	15.566	17.32%
Waste Road	1.983	12.83%	2.949	10.55%	4.806	5.35%
Port Road	1.802	11.66%	0.701	2.51%	0.567	0.63%
All Emission Units	**15.452**	**100.00%**	**27.953**	**100.00%**	**89.866**	**100.00%**
Emission Unit Group						
Main Pit + East Pit	8.104	52.45%	12.171	43.54%	20.974	23.34%
Processing Area (including Crushers, Coarse Ore Stockpile, Mill Concentrator Facility, Concentrate Storage Building)	0.554	3.57%	2.726	9.75%	12.817	14.26%
All Roads (including Haul, Crusher, Waste, and Port Road)	4.042	26.06%	6.883	24.62%	52.368	58.27%

Table 7.2 below presents the predicted annual average lead concentrations at the Overburden TEOM, T-Dam TEOM, and the Pac Hi-Vol/TEOM locations resulting from various emission untis and emission unit groups during the Current period. There are some similarities between the predicted PM and lead concentrations: the PAC Hi-Vol/TEOM location predicted concentrations are significantly higher than the other two locations, and the roads and pits are significant contributors at all three locations for both contaminants. However, the processing area sources, in particular the Concentrate Storage Building, have a much more significant impact on the lead concentrations than on the PM concentrations. This is not unexpected, as the concentration of lead in the product at the Concentrate Storage Building is significantly higher than at other locations.

Table 7.2: Annual Average Lead Emission Units & Emission Unit Group Concentrations – Current Period

Emission Unit	Overburden TEOM		T-Dam TEOM		PAC Hi-Vol/TEOM	
	(ug/m3)	% of All	(ug/m3)	% of All	(ug/m3)	% of All
Main Pit	0.164	49.43%	0.247	33.44%	0.420	19.62%
East Pit	0.051	15.26%	0.077	10.42%	0.137	6.39%
Jaw Crusher	0.000	0.05%	0.001	0.09%	0.002	0.08%
Gyro Crusher	0.002	0.52%	0.007	0.92%	0.062	2.88%
Coarse Ore Stockpile	0.004	1.14%	0.017	2.32%	0.201	9.37%
Mill Concentrator Facility	0.007	2.18%	0.037	5.02%	0.217	10.13%
Concentrate Storage Building	0.035	10.63%	0.179	24.18%	0.442	20.60%
Waste Rock Storage Areas	0.011	3.22%	0.004	0.57%	0.003	0.13%
Tailings Areas	0.007	1.96%	0.069	9.29%	0.025	1.15%
Haul Road	0.021	6.28%	0.055	7.51%	0.397	18.52%
Crusher Road	0.003	0.95%	0.011	1.46%	0.183	8.54%
Waste Road	0.022	6.70%	0.033	4.49%	0.054	2.52%
Port Road	0.006	1.66%	0.002	0.29%	0.002	0.08%
All Sources	**0.333**	**100.00%**	**0.738**	**100.00%**	**2.144**	**100.00%**
Emission Unit Group						
Main Pit + East Pit	0.215	64.69%	0.324	43.85%	0.557	26.01%
Processing Area (including Crushers, Coarse Ore Stockpile, Mill Concentrator Facility, Concentrate Storage Building)	0.048	14.53%	0.240	32.54%	0.923	43.06%
All Roads (including Haul, Crusher, Waste, and Port Road)	0.032	9.56%	0.075	10.11%	0.610	28.47%

Table 7.3 below presents the predicted annual average zinc concentrations at the Overburden TEOM, T-Dam TEOM, and the Pac Hi-Vol/TEOM locations resulting from various emission units and emission unit groups during the Current period. The emission unit group contributions to the predicted lead and zinc maximum concentrations are quite similar. However, the processing area emission units, in particular the Concentrate Storage Building, as well as the Tailings Area contribute even more significantly to the maximum zinc concentration. This is directly related to the fact that the percentage of zinc in the ore, final product, and tailings is greater than the corresponding percentage of lead.

Table 7.3: Annual Average Zinc Emission Units & Emission Unit Group Concentrations – Current Period

Emission Unit	Overburden TEOM		T-Dam TEOM		PAC Hi-Vol/TEOM	
	(ug/m3)	% of All	(ug/m 3)	% of All	(ug/m3)	% of All
Main Pit	0.519	42.56%	0.780	25.48%	1.327	16.86%
East Pit	0.179	14.70%	0.271	8.87%	0.483	6.13%
Jaw Crusher	0.001	0.06%	0.003	0.09%	0.007	0.08%
Gyro Crusher	0.007	0.56%	0.027	0.87%	0.242	3.07%
Coarse Ore Stockpile	0.015	1.22%	0.067	2.18%	0.786	9.99%
Mill Concentrator Facility	0.007	0.60%	0.037	1.21%	0.217	2.76%
Concentrate Storage Building	0.153	12.54%	0.772	25.22%	1.909	24.26%
Waste Rock Storage Area	0.029	2.38%	0.011	0.37%	0.008	0.10%
Tailings Area	0.091	7.49%	0.636	20.78%	0.477	6.06%
Haul Road	0.054	4.44%	0.144	4.69%	1.028	13.07%
Crusher Road	0.008	0.68%	0.028	0.92%	0.475	6.04%
Waste Road	0.114	9.36%	0.170	5.55%	0.277	3.52%
Port Road	0.021	1.70%	0.008	0.26%	0.007	0.08%
All Emission Unit	**1.219**	**100.00%**	**3.060**	**100.00%**	**7.869**	**100.00%**
Emission Unit Group						
Main Pit + East Pit	0.698	57.26%	1.051	34.35%	1.809	22.99%
Processing Area (including Crushers, Coarse Ore Stockpile, Mill Concentrator Facility, Concentrate Storage Building)	0.203	16.69%	1.012	33.08%	3.788	48.14%
All Roads (including Haul, Crusher, Waste, and Port Road)	0.094	7.75%	0.212	6.93%	1.656	21.04%

8.0 NEXT STEPS

The emission estimates presented in this report will be reviewed further by TCAK and the Alaska DEC. The emission estimates will be refined based upon the comments received from these reviews and any new data that may be provided.

The emission estimates will then be used as input into the more refined dispersion model CALPUFF. The CALPUFF dispersion model will be used with site meteorology processed through CALMET to assess the air concentrations and deposition rate of lead and zinc from the Red Dog site for current conditions. To evaluate the performance of the air dispersion model, predicted air concentrations will be compared to (paired with) results from sampling programs for a representative number of meteorological conditions and subject to a statistical analysis of model performance. Once it is determined that the model is performing well, emissions from the different historic time frames will also be modelled for air concentrations and deposition rates for a receptor grid which covers the site and proximate areas. The modelling results will then be used to develop an emission unit allocation matrix.

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APPENDIX A

SAMPLE CALCULATIONS

UNCONTROLLED PM EMISSION RATES

A sample calculation has been done for each U.S. EPA AP-42 emission factor or empirical equation used in estimating emission rates. The sample calculations have been done for **Period 1** mining activities on a 24-hour average basis. The same methodology was used to estimate emissions from the other activity categories (i.e., ore handling, waste rock handling, tailings, etc.) and the other three time periods. Note that the number of significant digits carried through could result in slight difference in numbers presented.

1.0 MINING ACTIVITIES: ORE AND WASTE

1.1 Drilling (AP-42 Drilling – Section 11.9):

$$EF_{PM} = 0.59\frac{kg}{hole}$$

$$ER_{PM} = 0.59\frac{kg}{hole} * 35\frac{holes}{day} * \frac{day}{24hours} * \frac{1hour}{3600s}\frac{1000g}{kg} = 2.39\times10^{-1}\frac{g}{s}$$

1.2 Blasting (AP-42 Blasting – Section 11.9):

$$EF_{PM} = 0.00022 * A^{1.5}\frac{kg}{blast}$$

where,
A = horizontal area when depth is less than 21m

<u>Waste Emission Rate</u>: (ore emission rate estimated in same manner)

$$ER_{PM} = 0.00022 * 18.12^{1.5}\frac{kg}{blast} * 1\frac{blasts}{day} * \frac{1000g}{1kg} * \frac{1day}{24hours} * \frac{1hour}{3600s} = 41.96\times10^{-4}\frac{g}{s}$$

1.3 Dozing (AP-42 Dozer Equation – Section 11.9):

$$EF_{PM\ (1\text{-hour average})} = \frac{K * s^{1.2}}{M^{a}}\frac{kg}{hr}$$

where,
K = 2.6 (material similar to overburden)
a = 1.3 (material similar to overburden)

s = silt content (%)
M = moisture content (%)

$EF_{PM\ (24\text{-hour average})}$ = $ER_{PM\ (1\text{-hour average})}$ * Operating Hours (hrs/day) * % of Operating Hours Dozer Operates

Summer Emission Rate: (winter emission rate estimated in same manner):

$$ER_{PM\ (1\text{-hour average})} = \frac{2.6 * 4.61^{1.2}}{2.55^{1.3}} \frac{kg}{hr} * \frac{1hr}{3600s} * \frac{1000g}{1kg} = 1.33\frac{g}{s}$$

$$ER_{PM\ (24\text{-hour average})} = 1.33\frac{g}{s} * 20\frac{hrs}{day} * 40\% = 0.446\frac{g}{s}$$

1.4 Material Loading (AP-42 Drop Equation – Section 13.2.4):

$$EF_{PM} = k * 0.0016 * \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \frac{kgTSP}{tonneloaded}$$

Ore Summer Emission Rate:

ER_{PM}=

$$0.74 * 0.0016 * \frac{\left(\frac{3.6}{2.2}\right)^{1.3}}{\left(\frac{2.55}{2}\right)^{1.4}} \frac{kgTSP}{tonneloaded} * 4030\frac{tonnesore}{day} * \frac{day}{24hours} * \frac{1hour}{3600s} * \frac{1000g}{1kg} = 7.46 \times 10^{-2}\frac{g}{s}$$

1.5 Fleet Travel in Blast Area (AP-42 Travel on Unpaved Roads - Section 13.2.2):

$$EF_{PM} = k * \left(\frac{s}{12}\right)^{a} * \left(\frac{W}{3}\right)^{b} \frac{lb}{VMT}$$

where,

k = 4.9 lb/VMT

a = 0.7
b = 0.45
s = surface material silt content (%)
W = mean vehicle weight (tons) of fleet
VMT = vehicle miles travelled

To calculate W, the loader and haul truck contributions to the total VMT must first be determined.

$$VMT_{loader} = 11000\frac{ft}{hr} * \frac{mi}{5280\,ft} * \frac{20hr}{day} * 50\% activity = 20.84\frac{mi}{day}$$

One-way distance from blast area to route is 664 m or 0.41mi (estimated from Surfer plot)

$$VMT_{haul\ truck} = 0.41mi * 2 * \frac{4442 tonsOreLoaded + 7859 tonsWasteLoaded}{day} * \frac{1truck}{97.5tonCapacity} = 103.5\frac{mi}{day}$$

$$VMT_{loader+haul\ truck} = 20.84\frac{mi}{day} + 103.5\frac{mi}{day} = 124.3\frac{mi}{day}$$

Average weight of loader = 109 tons
Average weight of haul truck = 113 tons

$$W = (109tons * \frac{20.8\frac{mi}{day}}{124.3\frac{mi}{day}}) + (113tons * \frac{103.5\frac{mi}{day}}{124.3\frac{mi}{day}}) = 112.3tons$$

$$ER_{PM} = 4.9 * \left(\frac{7.7}{12}\right)^{0.7} * \left(\frac{112.3}{3}\right)^{0.45} \frac{lb}{VMT} * 124.3\frac{VMT}{day} * \frac{453.593g}{lb} * \frac{day}{24hours} * \frac{1hour}{3600s} = 12.0\frac{g}{s}$$

1.6 Wind Erosion (Air Pollution Engineering Manual, Air & Waste Management Association, 1992):

$$EF_{PM} = 1.9 * \left(\frac{s}{1.5}\right) * \left(\frac{365 - p}{235}\right) * \left(\frac{f}{15}\right) \frac{kg}{ha * day}$$

where,

s = silt content (%)
f = percentage of time that the unobstructed wind speed exceeds 5.4 m/s at the mean pile height
p = number of days with >=0.25mm of ppt per year
Note: when p is not used, the resulting emission factor is more conservative

Surface area of ore prism was handled as a rectangular prism:

$$SA = (l * w) + (2 * l + 2 * w) * h$$

where l (length) and w (width) measurements were taken from Surfer

For Stockpile 1:
l = 106 m
w = 151 m
h = 7.6 m

SA = 19,945 m^2 = 1.99 ha

And the available area for erosion is assumed to be 100m by 100m for all piles.

$$ER_{PM} = 1.9 * \left(\frac{4.6}{1.5}\right) * \left(\frac{22.9}{15}\right) \frac{kg}{ha * day} * 1.99 ha * \frac{1000 g}{kg} * \frac{day}{24 hour} * \frac{1 hour}{3600 s} * \frac{100 m * 100 m}{19{,}945 m^2} = 1.03 \times 10^{-1} \frac{g}{s}$$

1.7 Coarse Ore Stockpile: Wind Erosion (Period 1)

During Period 1, the Course Ore Stockpile was not enclosed and thus susceptible to wind erosion. As noted above, the emissions of particulate arising from erosion of stockpiles are based upon the percentage of time the wind speed exceeds a threshold velocity. The threshold velocity used in association with the empirical expression provided in the *Air Pollution Engineering Manual* is 5.4 m/s and corresponds with an anemometer height of 10 meters. During Period 1, the coarse ore stockpile is elevated above ground on a platform, such that it stands approximately 22.6 meters (74 feet) above ground. At the height that the stockpile stands, the equivalent threshold velocity would be lower. The equivalent threshold wind velocity at 20 meters was estimated using the empirical expression below (Davenport, 1965).

$$\left(\frac{u_1}{u_2}\right) = \left(\frac{z_1}{z_2}\right)^{\alpha}$$

where: α = 0.28 for rural condition
u_1 = 5.4 m/s
z_1= 10 m
z_2 = 20 m

u_2, the equivalent threshold wind speed at 20m was determined to be 4.4 m/s:

$$u_2 = 5.4x\left(\frac{10}{20}\right)^{0.28} = 4.4m/s$$

The percentage of time that the unobstructed wind speed exceeds 4.4 m/s at the mean pile height (f) was determined and used solely for estimation of emissions from wind erosion of the coarse ore stockpile during Period 1.

1.8 Coarse Ore Stockpile: Emission from Building Exhaust (Periods 2, 3, and Current)

The emissions from the Coarse Ore Stockpile building exhaust were estimated as detailed below by Teck Cominco using available site information.

Mine Coarse Ore Stockpile Building door	2002-4901	25 ft by 22 ft
Tunnel Pressure	2012-2907	5000 cfm

Assumption
The building is structurally intact and not normally affected by wind
During normal operations the equipment door is shut.
Prior to the building being enclosed the TSP emissions were 100% of observed TSP concentrations within the current building. And can be determined using standard emission factors for stockpiles

Estimate of volume of air displacement in building

Budgeted 2005 Crushed Ore 3,225,000 tonnes

Average Density of Broken Ore 1.9 tonnes/cy

Annual Volume of Air displacement 1,697,368 cubic yards

Annual Volume of Air displacement 1,297,723 cubic meters

Correction Factor * 2.5
*To account for air that is pulled along with the ore transport and unaccounted for air inputs

Estimate of Air displacement from Ore 3,244,308 cubic meters

Annual Volume of Tunnel Pressure fan 2,628,000,000 cubic feet

Annual Volume of Tunnel Pressure fan 74,424,960 cubic meters

Annual Air exhaust from Mine CSB 77,669,268 cubic meters

Estimation of TSP Concentration.

During crushing the TSP inside the building exceeded the range of the DustScan (>100 mg/m3)

During the non-crushing periods the TSP decreases related to the length of time from the crushing activity.

To provide a conservative estimate of emission from the building a TSP factor of 100 mg/m3 is used during crushing activity. A TSP factor of 1/2 the active factor is used for non-crushing periods. The exhaust fan displacement is assumed to be related to non-active periods and the crushed ore displacement is assumed to be related to active periods.

Active TSP Concentrations 100 mg/m3
Inactive TSP Concentration 50 mg/m3

Mine Coarse Ore Stockpile Building Lead and Zinc Concentrations

2005 Budget Zinc in Ore 20.7% Percent
2005 Budget Lead in Ore 5.4% Percent

Annual TSP Emissions

	Exhaust Cubic Meters	Average TSP (mg/m3)	Percent Lead in TSP	Percent Zinc in TSP		TSP Emission (g/yr)	Lead Emission (g/yr)	Zinc Emission (g/yr)
Active period	3,244,308	100	5.4%	20.7%		324,431	17,519	67,157
Inactive period	74,424,960	50	5.4%	20.7%		3,721,248	200,947	770,298

1.9 Mill Concentrator Facility: Fugitive Releases from Buildings

Included below is an estimate of the air concentration within the building (from industrial hygiene measurements) and flow rates of building ventilation and exhausts. Detailed information on Mill building ventilations and concentration data has been included in Appendix B.

Mill Concentrator Facility Summary

Assumptions	[1]Percent Usage	[1]CFM		Cubic Feet per Month	Cubic Meters per month	[2]Average Mill TSP (µg/m^3)	[2]Percent Lead in TSP	[2]Percent Zinc in TSP		TSP Emission	Lead Emission	Zinc Emission
Winter	25%	151,775										
Spring/Fall	50%	303,550										
Summer	100%	607,100										
			Days							(g/month)	(g/month)	(g/month)
January	25%	151,775	31	6,775,236,000	191,874,684	253	26%	40%		48,542	12,541	19,445
February	25%	151,775	28	6,119,568,000	173,306,166	253	26%	40%		43,844	11,327	17,564
March	50%	303,550	31	13,550,472,000	383,749,367	253	26%	40%		97,083	25,081	38,891
April	50%	303,550	30	13,113,360,000	371,370,355	253	26%	40%		93,952	24,272	37,636
May	50%	303,550	31	13,550,472,000	383,749,367	253	26%	40%		97,083	25,081	38,891
June	100%	607,100	30	26,226,720,000	742,740,710	253	26%	40%		187,903	48,545	75,273
July	100%	607,100	31	27,100,944,000	767,498,734	253	26%	40%		194,167	50,163	77,782
August	100%	607,100	31	27,100,944,000	767,498,734	253	26%	40%		194,167	50,163	77,782
September	50%	303,550	30	13,113,360,000	371,370,355	253	26%	40%		93,952	24,272	37,636
October	50%	303,550	31	13,550,472,000	383,749,367	253	26%	40%		97,083	25,081	38,891
November	25%	151,775	30	6,556,680,000	185,685,178	253	26%	40%		46,976	12,136	18,818
December	25%	151,775	31	6,775,236,000	191,874,684	253	26%	40%		48,542	12,541	19,445
Totals									**Grams/year**	**1,243,293**	**321,205**	**498,055**
									Kilograms/year	**1,243**	**321**	**498**
									grams/second	**0.0394**	**0.0102**	**0.0158**

1. Percent Usage and CFM from "Mill Vents Summary"

2. Data from "Mill Concentrations"

1.10 CSB: Fugitive Releases from building + loadout

The fugitive releases from the Concentrate Storage Building (CSB) were estimated using site sampling results (dustscan and hi-vol) and an estimate of the potential mechanical and wind driven releases from the building. An overview of the estimation methodology is included below, and sampling data used has been included in Appendix B.

DustScan Results (October 2005)

				Zinc in TSP (ug/m3)	Lead in TSP (ug/m3)
Average TSP	471	ug/m3		229	54
Avg Max TSP	565	ug/m3		275	64

Mass Balance Metals in TSP Estimate

Zinc Conc Zinc	57%
Lead Con Lead	57%
Lead Con Zinc	15%

Percent Zinc in TSP	**49%**
Percent Lead in TSP	**11%**

Production Ratio

Zinc Conc	80%
Lead Conc	20%

Drivethruough Monitoring using Hi-Vol

	TSP (ug/m3)	Lead (ug/m3)	Zinc (ug/m3)		Percent Lead in TSP	Percent Zinc in TSP	
Pre-Modification	**1,463**	**94**	**437**		**6%**	**30%**	(January - March 2004)
Post Modification	756	48	211		6%	28%	(December 2004-February 2005)

Use TSP estimate from Drivethrough monitoring. The Dustscan results match periods of lower activity observed in the Drivethrough study. The post-modification results should more closely match the average conditions inside the CSB area.
Use Mass Balance estimate for the percentage of zinc and lead in the TSP. Provides a more conservative estimation.

TSP Estimation

Percent Zinc in TSP	**49%**
Percent Lead in TSP	**11%**
Pre-Modification	
Average TSP Concentration (ug/m3)	**1,463**
Average Zinc TSP (ug/m3)	**711**
Average Lead TSP (ug/m3)	**81**
Post Modification	
Average TSP Concentration (ug/m3)	**756**
Average Zinc TSP (ug/m3)	**367**
Average Lead TSP (ug/m3)	**86**

The main source of air exchange within the CSB is wind coming in through the open door and vents and exiting out leak points in the building.

Sources of Outflow
Leaks and vents in the building
Sufficient to not be limiting factor

MCC Exhaust Fan 1200 cfm

Sources of inflow

Wind Driven			Width	Length		Sq Feet	Sq Meters
Main Equipment Door			22	25	feet	413	38
Peak Vent South End			4	4	feet	16	1
					Total	**429**	**40**

Mechanical		Width	Length		Sq Feet	Sq Meters	Avg Flow (mps)	Volume (m3/s)
Conveyor Tunnel Pressure fans		3	6.7	feet	20.1	2	200	373

Mine CSB Summary - Post Drivethrough - Post Modification (installation of fans to draw entrained dust from concentrade loadout bay)

Month	[1]Avg Wind Speed (m/s)	[2,4]Wind Generated Inflow (m^3/s)	[3,4]Mechanical Generated Inflow (m^3/s)	Days	Total Inflow (m^3 per month)	[4]Average TSP ($\mu g/m^3$)	[4]Percent Lead in TSP	[4]Percent Zinc in TSP		TSP Emission (g/month)	Lead Emission (g/month)	Zinc Emission (g/month)
January	4.6	184	373	31	1,491,941,138	756	11%	49%		1,127,928	128,584	548,173
February	5.7	226	373	28	1,449,543,739	756	11%	49%		1,095,875	124,930	532,595
March	4.0	159	373	31	1,425,729,174	756	11%	49%		1,077,871	122,877	523,845
April	4.6	182	373	30	1,439,001,137	756	11%	49%		1,087,905	124,021	528,722
May	4.1	164	373	31	1,440,046,831	756	11%	49%		1,088,696	124,111	529,106
June	3.6	143	373	30	1,339,577,709	756	11%	49%		1,012,739	115,452	492,191
July	3.5	140	373	31	1,376,311,953	756	11%	49%		1,040,511	118,618	505,688
August	3.8	151	373	31	1,405,564,710	756	11%	49%		1,062,627	121,139	516,437
September	3.7	147	373	30	1,348,783,967	756	11%	49%		1,019,700	116,246	495,574
October	4.0	158	373	31	1,422,267,571	756	11%	49%		1,075,254	122,579	522,574
November	4.2	168	373	30	1,402,316,375	756	11%	49%		1,060,171	120,859	515,243
December	4.0	159	373	31	1,426,929,749	756	11%	49%		1,078,779	122,981	524,287
This estimate is for current condition with the drivethrough door closed and the equipment door open									**g/year**	**12,828,056**	**1,462,398**	**6,234,435**
									kg/year	**12,828**	**1,462**	**6,234**
									g/s	**0.4068**	**0.0464**	**0.1977**

1. Average of 2001 through 2003 data
2. Wind Generated Inflow (m^3/s) = Sources Wind Driven Inflow Area (40 m^2) x Avg Wind Speed (m^2)
3. Mechanical Generated Inflow = Conveyor Tunnel Pressure Fans Volume (m^3/s)
4. Data from "Mine Concentrate Storage Building - TSP Estimation" - TSP Concentration Post-Modifiction

Mine CSB Summary - Post Drivethrough - Pre Modification (installation of fans to draw entrained dust from concentrade loadout bay)

Month	[1]Avg Wind Speed (m/s)	[2,4]Wind Generated Inflow (m^3/s)	[3,4]Mechanical Generated Inflow (m^3/s)	Days	Total Inflow (m^3 per month)	[4]Average TSP ($\mu g/m^3$)	[4]Percent Lead in TSP	[4]Percent Zinc in TSP		TSP Emission (g/month)	Lead Emission (g/month)	Zinc Emission (g/month)
January	4.6	184	373	31	1,491,941,138	1,463	11%	49%		2,183,170	248,881	1,061,021
February	5.7	226	373	28	1,449,543,739	1,463	11%	49%		2,121,130	241,809	1,030,869
March	4.0	159	373	31	1,425,729,174	1,463	11%	49%		2,086,282	237,836	1,013,933
April	4.6	182	373	30	1,439,001,137	1,463	11%	49%		2,105,702	240,050	1,023,371
May	4.1	164	373	31	1,440,046,831	1,463	11%	49%		2,107,233	240,225	1,024,115
June	3.6	143	373	30	1,339,577,709	1,463	11%	49%		1,960,215	223,465	952,665
July	3.5	140	373	31	1,376,311,953	1,463	11%	49%		2,013,969	229,592	978,789
August	3.8	151	373	31	1,405,564,710	1,463	11%	49%		2,056,775	234,472	999,592
September	3.7	147	373	30	1,348,783,967	1,463	11%	49%		1,973,687	225,000	959,212
October	4.0	158	373	31	1,422,267,571	1,463	11%	49%		2,081,216	237,259	1,011,471
November	4.2	168	373	30	1,402,316,375	1,463	11%	49%		2,052,021	233,930	997,282
December	4.0	159	373	31	1,426,929,749	1,463	11%	49%		2,088,038	238,036	1,014,787
This estimate is for current condition with the drivethrough door closed and the equipment door open									**g/year**	**24,829,438**	**2,830,556**	**12,067,107**
									kg/year	**24,829**	**2,831**	**12,067**
									g/s	**0.7873**	**0.0898**	**0.3826**

1. Average of 2001 through 2003 data
2. Wind Generated Inflow (m^3/s) = Sources Wind Driven Inflow Area (40 m^2) x Avg Wind Speed (m^2)
3. Mechanical Generated Inflow = Conveyor Tunnel Pressure Fans Volume (m^3/s)
4. Data from "Mine Concentrate Storage Building - TSP Estimation"- TSP Concentration Pre-Modification

APPENDIX B

SITE INFORMATION

1.0 Mill Concentrator Facility – Building Vent Summary

Mill Vents Summary

EQ Tag	Description	In Service	CFM
2025-2907-01	PB Floatation Area	2/4/2001	13,000
2025-2906	PB Floatation Area	6/9/2001	13,000
2025-2909	Transformer Room Ventilation	6/9/2001	13,000
2020-2907	Exhaust Ceiling North	8/1/1998	24,100
2020-2907-02	Exhaust Ceiling South	8/1/1998	24,100
2007-2905	Exhaust Inline Hoffman Blower	5/21/2001	10,000
2020-2903-02	Exhaust Lime Reactor	10/1/1989	10,000
2020-2903-04	Exhaust Lime Reactor South	10/1/1989	10,000
2025-2901-02	PB Rougher Area	10/28/1998	8,800
2025-2901-01	PB Rougher Area	10/28/1998	8,800
2025-2901-03	PB Rougher Area	10/28/1998	8,800
2025-2901-04	PB Rougher Area	10/28/1998	8,800
2030-2904-01	Zn Rougher Area	7/9/2001	8,800
2030-2904-02	Exhaust ZN Thickener Tunnel	7/9/2001	8,800
2020-2903-01	2020 Area NW Wall	10/1/1989	1,200
2030-2904-06	Exhaust 2030 Utilidor Tower	7/9/2001	1,200
2030-2904-10	Exhaust 2030 Utilidor Tower	7/9/2001	1,200
2010-2915	Exhaust LCI Drive	5/16/2000	8,800
2025-2904	Intake PB Rougher Area	8/1/1998	1,800
2025-2901-05	Recerc PB Float	11/28/1998	7,000
2025-2901-06	Recerc PB Float	11/28/1998	7,000
2011-2905-01	Roof Exhaust Dewatering	8/1/1991	24,000
2011-2905-02	Roof Exhaust Dewatering	8/1/1991	24,000
2011-2905-03	Roof Exhaust Dewatering	8/1/1991	24,000
2011-2905-05	Roof Exhaust Dewatering	8/1/1991	24,000
2011-2905-07	Roof Exhaust Dewatering	8/1/1991	24,000
2011-2905-08	Roof Exhaust Dewatering	8/1/1991	24,000
2011-2905-06	Roof Exhaust Dewatering	8/1/1991	24,000
2011-2905-04	Roof Exhaust Dewatering	8/1/1991	24,000
2006-2915	Exhaust Cyclopac	7/2/2005	24,000
2008-2905	Supply	8/1/1998	25,000
2003-2905	Fan Wall Exhaust	8/1/1998	1,200
2007-2904-02	Fan Wall Exhaust	8/1/1998	1,200
2008-2902-01	Fan Wall Exhaust	8/1/1998	1,200
2008-2902-03	Fan Wall Exhaust	8/1/1998	1,200
2008-2902-02	Fan Wall Exhaust	8/1/1998	1,200
2007-2904-03	Fan Wall Exhaust	8/1/1998	1,200
2007-2904-01	Fan Wall Exhaust	8/1/1998	1,200
2010-2904-01	Fan Wall Exhaust	4/8/1998	1,200
2030-2904-08	Fan Wall Exhaust	11/8/2001	1,200
2030-2904-07	Fan Wall Exhaust	11/8/2001	1,200
2030-2904-06	Fan Wall Exhaust	11/8/2001	1,200
2030-2904-05	Fan Wall Exhaust	11/8/2001	1,200
2030-2904-04	Fan Wall Exhaust	7/9/2001	1,200
2030-2904-03	Fan Wall Exhaust	7/9/2001	1,200
2011-2904-03	Fan Wall Exhaust	8/1/1998	1,200
2011-2903	Fan Wall Exhaust	12/1/1989	1,200
2010-2911-02	Fan Wall Exhaust	4/8/1998	1,200
2010-2911-01	Fan Wall Exhaust	4/8/1998	1,200
2010-2904-02	Fan Wall Exhaust	4/8/1998	1,200
2010-2904-04	Fan Wall Exhaust	4/8/1998	1,200
2010-2904-03	Fan Wall Exhaust	4/8/1998	1,200
2009-2904	Wall Exhaust VIP	11/25/2001	1,200
2007-2902-01	Wall exhaust Joy Compressor F	6/23/2003	1,200
2021-2901	Wall exhaust North	8/1/1994	1,200
2021-2904	Wall Exhaust South	8/1/1994	1,200
2004-2911	Wall exhaust	8/1/1998	1,200
2011-2904-01	Wall exhaust	8/1/1991	24,500
2011-2904-02	Wall exhaust	8/1/1991	24,500
2021-2906	Wall MCC Cooling	6/17/1996	1,200
2008-2907-01	Wall Supply Dewatering	6/21/2004	20,000
2008-2907-02	Wall Supply Dewatering	6/21/2004	20,000
2008-2907-04	Wall Supply Dewatering	6/21/2004	20,000
2008-2907-03	Wall Supply Dewatering	6/21/2004	20,000
2010-2913	MCC Room Wall Vent	3/31/1999	6,500
Total			**607,100**

Assumptions	Percent Usage	CFM
Winter	25%	151,775
Spring/Fall	50%	303,550
Summer	100%	607,100
January	25%	151,775
February	25%	151,775
March	50%	303,550
April	50%	303,550
May	50%	303,550
June	100%	607,100
July	100%	607,100
August	100%	607,100
September	50%	303,550
October	50%	303,550
November	25%	151,775
December	25%	151,775

2.0 Mill Concentrator Facility Concentrations – Background Information

SAG Mill - NVL Lab Inc Sampling Data

Date	Location	Sample ID	Volume (l)	Volume (m3)	Cd (ug/filter)	Zn (ug/Filter)	Pb (ug/Filter)		Cd (ug/m3)	Zn (ug/m3)	Pb (ug/m3)
6/25/2005	Lead Stock Tank	062505-01	1138.5	1.14	1.4	132	270		1.2	116	237
6/25/2005	Lead Scavenger	062505-02	1138.5	1.14	1.4	170	73		1.2	149	64
6/25/2005	2011 Dewatering Belt 8	062505-05	1130.5	1.13	2.7	350	130		2.4	310	115
6/25/2005	2008 Lead Scavenger	062505-03	1138.5	1.14	2.1	200	93		1.8	176	82
6/25/2005	2008 Lead Thickener	062505-04	1135.2	1.14	1.5	180	80		1.3	159	70
9/20/2005	Lead Thickener Stairwell	092005-01	1155	1.16	1.4	210	180		1.2	182	156
9/20/2005	Lead Scavenger Cell 1	092005-05	1232	1.23	1.6	310	110		1.3	252	89
9/20/2005	Lead Stock Tank #2	092005-02	1269	1.27	1.6	220	290		1.3	173	229
9/20/2005	Lead Scavenger Cell 5	092005-04	1279	1.28	1.2	210	53		0.9	164	41
in the general location of the 2011.								**Average**	**1.4**	**186.7**	**120.4**

2011 TSP	466	ug/m3
Percent Lead in TSP		26%
Percent Zinc in TSP		40%

Dust Scan Results

Section	Average (ug/m3)	Max (ug/m3)
2003	121	128
2010	305	321
2005	150	159
2020	337	366
2030	211	236
2009	280	298
2007	154	159
2011	466	513
Mill Average	**253**	**272**

Table-1 Total Suspended Particulate Pre-Modification (CSB Drive through)

DATES	TOTAL LOADS	ZINC LOADS	LEAD LOADS	TOTAL TONS	ZINC TONS	LEAD TONS	ZINC Conc. Moisture (%)	LEAD Conc. Moisture (%)	PM (ug/m^3)	PM/Load Pre	PM/Ton Pre
1/19/2004	38	4	34	4499	480	4019	9.3	9.2	924.9	24.3	0.21
1/22/2004	40	40	0	4729	4729	0	10.0	8.2	1576.0	39.4	0.33
1/25/2004	36	34	2	4017	3785	232	9.2	8.6	1628.1	45.2	0.41
1/28/2004	36	36	0	3880	3880	0	9.5	9.0	1734.8	48.2	0.45
1/31/2004	39	19	23	4168	2062	2107	9.3	9.0	2359.1	60.5	0.57
2/3/2004	33	25	9	3579	1787	792	10.2	9.0	1392.9	42.2	0.39
2/9/2004	32	13	26	3690	1513	1177	9.4	9.0	1465.7	45.8	0.40
2/12/2004	32	32	0	3492	3492	0	9.0	9.1	799.2	25.0	0.23
2/15/2004	24	24	0	2844	2844	0	9.1	10.4	1586.3	66.1	0.56
2/18/2004	27	23	4	2970	2530	440	9.4	9.6	1769.7	65.5	0.60
2/21/2004	31	31	0	3557	3557	0	9.8	10.1	750.5	24.2	0.21
2/24/2004	23	0	23	2677	0	2677	9.3	8.4	255.8	11.1	0.10
2/27/2004	31	31	0	3551	3551	0	9.7	9.5	2668.5	86.1	0.75
3/1/2004	45	16	35	5228	1858	3370	9.7	8.7	1136.5	25.3	0.22
3/4/2004	38	23	17	4412	2656	1757	9.5	8.5	2129.8	56.0	0.48
3/7/2004	30	25	5	3300	2750	550	9.6	8.1	2213.7	73.8	0.67
3/10/2004	29	25	4	3346	2886	460	10.1	8.4	1634.4	56.4	0.49
3/13/2004	32	28	5	3749	3288	462	9.5	8.4	684.2	21.4	0.18
3/16/2004	29	24	5	3551	2944	608	9.0	8.9	876.3	30.2	0.25
3/19/2004	26	26	0	2913	2913	0	9.3	9.1	1679.7	64.6	0.58
Averages for the Sample Period	**32.6**	**24.0**	**9.6**	**3,708**	**2,675**	**933**	**9.5**	**9.0**	**1,463**	**45.6**	**0.40**

Table-2 Total Suspended Particulate Post-Modification (CSB Drive through)

DATES	TOTAL LOADS	ZINC LOADS	LEAD LOADS	TOTAL TONS	ZINC TONS	LEAD TONS	ZINC Conc. Moisture (%)	LEAD Conc. Moisture (%)	PM (ug/m^3)	PM/Load Post	PM/Ton Post
12/5/2004	45	45	0	5389	5389	0	9.9	8.3	704.3	15.7	0.13
12/8/2004	25	25	0	2985	2985	0	10.4	8.3	470.5	18.8	0.16
12/12/2004	42	17	25	4886	1895	2991	10.4	8.9	623.0	14.8	0.13
12/14/2004	45	45	0	5152	5152	0	10.4	9.3	473.3	10.5	0.09
12/17/2004	36	36	0	4319	4319	0	9.9	8.9	988.5	27.5	0.23
12/20/2004	40	24	16	4776	2795	1981	9.4	8.2	394.6	9.9	0.08
12/23/2004	29	29	0	3598	3598	0	9.1	8.4	1043.5	36.0	0.29
1/4/2005	11	11	0	1323	1323	0	8.9	8.1	243.7	22.2	0.18
1/7/2005	28	16	12	3505	1973	1532	10.1	8	625.3	22.3	0.18
1/10/2005	37	37	0	4536	4536	0	8.7	9.6	352.9	9.5	0.08
1/13/2005	24	24	0	2991	2991	0	9.9	8.7	1286.5	53.6	0.43
1/16/2005	36	24	12	4463	3017	1446	9.9	8.1	938.8	26.1	0.21
1/19/2005	37	37	0	4502	4502	0	10	8.2	878.2	23.7	0.20
1/22/2005	37	37	0	4626	4626	0	9.5	9.2	784.2	21.2	0.17
1/25/2005	34	27	7	3961	3156	805	10.4	8.5	940.9	27.7	0.24
1/28/2005	41	41	0	4891	4891	0	9.7	8.8	1257.5	30.7	0.26
1/31/2005	34	12	22	3886	1384	2502	10	11.2	808.5	23.8	0.21
2/3/2005	36	36	0	4211	4211	0	9.2	11.7	1256.3	34.9	0.30
2/6/2005	37	37	0	4408	4408	0	8.9	11.1	827.2	22.4	0.19
2/9/2005	26	26	0	3016	3016	0	9.3	9.9	488.9	18.8	0.16
2/18/2005	36	36	0	4174	4174	0	9.7	8	627.2	17.4	0.15
2/21/2005	41	41	0	4885	4885	0	10.2	9.1	618.6	15.1	0.13
Averages for the Sample Period	**34.4**	**30.1**	**4.3**	**4,113**	**3,601**	**512**	**9.7**	**9.0**	**756**	**22.8**	**0.19**
Percent Change	**6%**	**26%**	**-55%**	**11%**	**35%**	**-45%**	**2%**	**1%**	**-48%**	**-50%**	**-53%**

Table-3 Lead Concentrations Pre-Modification (CSB Drive through)

DATES	TOTAL LOADS	ZINC LOADS	LEAD LOADS	TOTAL TONS	ZINC TONS	LEAD TONS	ZINC Conc. Moisture (%)	LEAD Conc. Moisture (%)	Pb (ug/m^3)	Pb/Load Pre	Pb/Ton Pre
1/19/2004	38	4	34	4499	480	4019	9.3	9.2	150	4.0	0.03
1/22/2004	40	40	0	4729	4729	0	10.0	8.2	81	2.0	0.02
1/25/2004	36	34	2	4017	3785	232	9.2	8.6	180	5.0	0.04
1/28/2004	36	36	0	3880	3880	0	9.5	9.0	75	2.1	0.02
1/31/2004	39	19	23	4168	2062	2107	9.3	9.0	92	2.4	0.02
2/3/2004	33	25	9	3579	1787	792	10.2	9.0	101	3.1	0.03
2/9/2004	32	13	26	3690	1513	1177	9.4	9.0	107	3.3	0.03
2/12/2004	32	32	0	3492	3492	0	9.0	9.1	30	0.9	0.01
2/15/2004	24	24	0	2844	2844	0	9.1	10.4	99	4.1	0.03
2/18/2004	27	23	4	2970	2530	440	9.4	9.6	94	3.5	0.03
2/21/2004	31	31	0	3557	3557	0	9.8	10.1	29	0.9	0.01
2/24/2004	23	0	23	2677	0	2677	9.3	8.4	29	1.3	0.01
2/27/2004	31	31	0	3551	3551	0	9.7	9.5	86	2.8	0.02
3/1/2004	45	16	35	5228	1858	3370	9.7	8.7	152	3.4	0.03
3/4/2004	38	23	17	4412	2656	1757	9.5	8.5	126	3.3	0.03
3/7/2004	30	25	5	3300	2750	550	9.6	8.1	123	4.1	0.04
3/10/2004	29	25	4	3346	2886	460	10.1	8.4	127	4.4	0.04
3/13/2004	32	28	5	3749	3288	462	9.5	8.4	46	1.4	0.01
3/16/2004	29	24	5	3551	2944	608	9.0	8.9	62	2.1	0.02
3/19/2004	26	26	0	2913	2913	0	9.3	9.1	83	3.2	0.03
Averages for the Sample Period	**32.6**	**24.0**	**9.6**	**3,708**	**2,675**	**933**	**9.5**	**9.0**	**94**	**2.9**	**0.03**

Table-4 Lead Concentrations Post-Modification (CSB Drive through)

DATES	TOTAL LOADS	ZINC LOADS	LEAD LOADS	TOTAL TONS	ZINC TONS	LEAD TONS	ZINC Conc. Moisture (%)	LEAD Conc. Moisture (%)	Pb (ug/m^3)	Pb/Load Post	Pb/Ton Post
12/5/2004	45	45	0	5389	5389	0	9.9	8.3	69	1.5	0.01
12/8/2004	25	25	0	2985	2985	0	10.4	8.3	36	1.5	0.01
12/12/2004	42	17	25	4886	1895	2991	10.4	8.9	34	0.8	0.01
12/14/2004	45	45	0	5152	5152	0	10.4	9.3	26	0.6	0.01
12/17/2004	36	36	0	4319	4319	0	9.9	8.9	33	0.9	0.01
12/20/2004	40	24	16	4776	2795	1981	9.4	8.2	28	0.7	0.01
12/23/2004	29	29	0	3598	3598	0	9.1	8.4	52	1.8	0.01
1/4/2005	11	11	0	1323	1323	0	8.9	8.1	10	0.9	0.01
1/7/2005	28	16	12	3505	1973	1532	10.1	8	57	2.0	0.02
1/10/2005	37	37	0	4536	4536	0	8.7	9.6	18	0.5	0.00
1/13/2005	24	24	0	2991	2991	0	9.9	8.7	95	4.0	0.03
1/16/2005	36	24	12	4463	3017	1446	9.9	8.1	165	4.6	0.04
1/19/2005	37	37	0	4502	4502	0	10	8.2	37	1.0	0.01
1/22/2005	37	37	0	4626	4626	0	9.5	9.2	29	0.8	0.01
1/25/2005	34	27	7	3961	3156	805	10.4	8.5	68	2.0	0.02
1/28/2005	41	41	0	4891	4891	0	9.7	8.8	63	1.5	0.01
1/31/2005	34	12	22	3886	1384	2502	10	11.2	41	1.2	0.01
2/3/2005	36	36	0	4211	4211	0	9.2	11.7	74	2.1	0.02
2/6/2005	37	37	0	4408	4408	0	8.9	11.1	35	1.0	0.01
2/9/2005	26	26	0	3016	3016	0	9.3	9.9	19	0.7	0.01
2/18/2005	36	36	0	4174	4174	0	9.7	8	38	1.1	0.01
2/21/2005	41	41	0	4885	4885	0	10.2	9.1	22	0.5	0.00
Averages for the Sample Period	**34.4**	**30.1**	**4.3**	**4,113**	**3,601**	**512**	**9.7**	**9.0**	**48**	**1.4**	**0.01**
Percent Change	**6%**	**26%**	**-55%**	**11%**	**35%**	**-45%**	**2%**	**1%**	**-49%**	**-50%**	**-53%**

Table-5 Zinc Concentrations Pre-Modification (CSB Drive through)

DATES	TOTAL LOADS	ZINC LOADS	LEAD LOADS	TOTAL TONS	ZINC TONS	LEAD TONS	ZINC Conc. Moisture (%)	LEAD Conc. Moisture (%)	Zn (ug/m^3)	Zn/Load Pre	Zn/Ton Pre
1/19/2004	38	4	34	4499	480	4019	9.3	9.2	241	6.4	0.05
1/22/2004	40	40	0	4729	4729	0	10.0	8.2	470	11.7	0.10
1/25/2004	36	34	2	4017	3785	232	9.2	8.6	415	11.5	0.10
1/28/2004	36	36	0	3880	3880	0	9.5	9.0	490	13.6	0.13
1/31/2004	39	19	23	4168	2062	2107	9.3	9.0	653	16.7	0.16
2/3/2004	33	25	9	3579	1787	792	10.2	9.0	494	15.0	0.14
2/9/2004	32	13	26	3690	1513	1177	9.4	9.0	433	13.5	0.12
2/12/2004	32	32	0	3492	3492	0	9.0	9.1	294	9.2	0.08
2/15/2004	24	24	0	2844	2844	0	9.1	10.4	507	21.1	0.18
2/18/2004	27	23	4	2970	2530	440	9.4	9.6	566	21.0	0.19
2/21/2004	31	31	0	3557	3557	0	9.8	10.1	281	9.1	0.08
2/24/2004	23	0	23	2677	0	2677	9.3	8.4	78	3.4	0.03
2/27/2004	31	31	0	3551	3551	0	9.7	9.5	758	24.4	0.21
3/1/2004	45	16	35	5228	1858	3370	9.7	8.7	319	7.1	0.06
3/4/2004	38	23	17	4412	2656	1757	9.5	8.5	569	15.0	0.13
3/7/2004	30	25	5	3300	2750	550	9.6	8.1	620	20.7	0.19
3/10/2004	29	25	4	3346	2886	460	10.1	8.4	473	16.3	0.14
3/13/2004	32	28	5	3749	3288	462	9.5	8.4	251	7.9	0.07
3/16/2004	29	24	5	3551	2944	608	9.0	8.9	285	9.8	0.08
3/19/2004	26	26	0	2913	2913	0	9.3	9.1	537	20.7	0.18
Averages for the Sample Period	**32.6**	**24.0**	**9.6**	**3,708**	**2,675**	**933**	**9.5**	**9.0**	**437**	**13.7**	**0.12**

Table-6 Zinc Concentrations Post-Modification (CSB Drive through)

DATES	TOTAL LOADS	ZINC LOADS	LEAD LOADS	TOTAL TONS	ZINC TONS	LEAD TONS	ZINC Conc. Moisture (%)	LEAD Conc. Moisture (%)	Zn (ug/m^3)	Zn/Load Post	Zn/Ton Post
12/5/2004	45	45	0	5389	5389	0	9.9	8.3	202	4.5	0.04
12/8/2004	25	25	0	2985	2985	0	10.4	8.3	138	5.5	0.05
12/12/2004	42	17	25	4886	1895	2991	10.4	8.9	180	4.3	0.04
12/14/2004	45	45	0	5152	5152	0	10.4	9.3	107	2.4	0.02
12/17/2004	36	36	0	4319	4319	0	9.9	8.9	269	7.5	0.06
12/20/2004	40	24	16	4776	2795	1981	9.4	8.2	67	1.7	0.01
12/23/2004	29	29	0	3598	3598	0	9.1	8.4	337	11.6	0.09
1/4/2005	11	11	0	1323	1323	0	8.9	8.1	55	5.0	0.04
1/7/2005	28	16	12	3505	1973	1532	10.1	8	121	4.3	0.03
1/10/2005	37	37	0	4536	4536	0	8.7	9.6	106	2.9	0.02
1/13/2005	24	24	0	2991	2991	0	9.9	8.7	395	16.4	0.13
1/16/2005	36	24	12	4463	3017	1446	9.9	8.1	196	5.5	0.04
1/19/2005	37	37	0	4502	4502	0	10	8.2	277	7.5	0.06
1/22/2005	37	37	0	4626	4626	0	9.5	9.2	245	6.6	0.05
1/25/2005	34	27	7	3961	3156	805	10.4	8.5	264	7.8	0.07
1/28/2005	41	41	0	4891	4891	0	9.7	8.8	365	8.9	0.07
1/31/2005	34	12	22	3886	1384	2502	10	11.2	206	6.0	0.05
2/3/2005	36	36	0	4211	4211	0	9.2	11.7	369	10.3	0.09
2/6/2005	37	37	0	4408	4408	0	8.9	11.1	253	6.8	0.06
2/9/2005	26	26	0	3016	3016	0	9.3	9.9	145	5.6	0.05
2/18/2005	36	36	0	4174	4174	0	9.7	8	180	5.0	0.04
2/21/2005	41	41	0	4885	4885	0	10.2	9.1	164	4.0	0.03
Averages for the Sample Period	**34.4**	**30.1**	**4.3**	**4,113**	**3,601**	**512**	**9.7**	**9.0**	**211**	**6.4**	**0.05**
Percent Change	**6%**	**26%**	**-55%**	**11%**	**35%**	**-45%**	**2%**	**1%**	**-52%**	**-54%**	**-56%**

3.0 Material Characteristics 1 – Production Numbers

	Current (2005)			2003			2000			1990		
	zinc (%)	lead (%)	tonnes	zinc (%)	lead (%)	tonnes	zinc (%)	lead (%)	tonnes	zinc (%)	lead (%)	tonnes
ore	21.1	5.4	3,157,321	21.1	5.4	3,157,321	21	4.7	3,053,727	26.5	8.5	1,263,433
waste	4.6	1.7		4.6	1.7		4.6	1.7		1.04	2.3	
ore/waste (1/1.5)	11.2	3.18		11.2	3.18		11.16	2.9		11.2	4.8	
overburden	0.5	0.3		0.5	0.3		0.5	0.3		0.5	0.3	
oxide ore	4.6	1.7		4.6	1.7		4.6	1.7		8.84	5.84	
zinc concentrate	55.5	3.2	1,018,155	55.5	3.2	1,043,139	55.3	3	959,774	56.9	3.1	348,967
lead concentrate	12.5	54.7	189,053	12.5	54.7	236,802	10.3	59.6	139,376	11.4	55.1	48,767
Average	46.0	10.6		47.5	12.7		49.6	10.2		16.4	3.4	
Imperial Smelter Feed (1990)										31.7	22.9	45,000
Overall Average										48.3	12.0	
ore/concentrate/tailings Building ventilation by module												
tailings	3.6	1.9		3.6	1.9		5.5	1.6		5.5	1.6	501,700
contaminated onsite roads in mill area	0.865	0.25		0.865	0.25		0.865	0.25		1.04	2.26	
contaminated onsite roads to DMTS	0.31	0.12		0.31	0.12		0.31	0.12		0.31	0.12	
overburden/contamination	0.25	0.13		0.25	0.13		0.25	0.13		0.25	0.13	
low contamination DMTS	0.1	0.05		0.1	0.05		0.1	0.05		0.1	0.05	

4.0 Material Characteristics 2 – Lead & Zinc Concentrations

Averages of road sampling conducted by Teckcominco in 2005			Pb (%)				Zn (%)			
Notes			Sep-05 <75 um	Sep-05 <2000 um	Winter 05 <2000 um	Summer 05 <2000 um	Sep 05 <75 um	Sep 05 <2000 um	Winter 05 <2000 um	Summer 05 <2000 um
	1	Haul Road @ Y	0.17%	0.03%	0.02%	0.10%	0.57%	0.09%	0.20%	0.29%
	2	Haul Road @ Scale	0.18%	0.04%	0.41%	0.05%	0.67%	0.15%	3.67%	0.22%
Road - CSB to Port	3	Haul Road @ 4- way	0.37%	0.10%	0.14%	0.28%	1.45%	0.29%	0.99%	1.16%
	4	Main Waste @ Overlook	1.04%	0.28%			2.45%	0.67%		
	5	Main Waste @ Landfill	1.13%	0.69%			7.16%	3.75%		
Waste Road	6	Main Waste @ Entrance	1.11%	0.39%			4.34%	2.08%		
Road - CSB to Port	7	Mill Site @ CSB	0.50%	0.13%			1.93%	0.35%		
	8	Pit Ore Stockpile	12.26%	5.57%			61.35%	45.22%		
All Ore Handling Activities	9	Pit Ore Stockpile	15.80%	8.64%			83.96%	76.63%		
	10	Tails Beach @ Influent	1.18%	0.00%			181.50%	0.00%		
	11	Tails Beach Coffer Dam	1.95%	0.00%			4.90%	0.00%		
	12	Mill Site @ CSB exit	0.51%	0.06%	0.23%	0.93%	5.51%	0.39%	1.76%	2.56%
	13	Mill Site @ HE bullrail	0.67%	0.10%			2.04%	0.16%		
	14	Mill Site @ PAC	1.07%	0.15%			3.92%	0.43%		
Road - exiting Pit	15	Pit West Pit Road	2.29%	0.52%			6.98%	2.48%		
Road - towards East Pit	16	Pit East Pit Road	1.13%	0.21%			5.87%	1.31%		
Haul truck travel from Ore Storage Area to Crushers	17	Pit @ U turn	1.18%	0.40%			3.06%	0.88%		

Notes: Both Sample 10 and 11 are Tails samples which are 90% less than 80 microns these samples were dried and results are not true representations of Grain size and more a result of partical adhesion

Sample 12 - possible screen clogging

5.0 Road Sampling Data – Silt & Moisture Contents

Site of Sampling	**M(%)**	**S(%)**
Haul Road at Yield Sign	1.23	0.7
Haul Road at Scale	1.41	1.84
Haul Road at 4-way	2.16	2.34
Haul Road Average	**1.6**	**1.63**
Main Waste at Lookout	1.09	11.47
Main Waste at Old Landfill	2.06	2.88
Main Waste at Main Access	1.95	8.87
Waste Average	**1.7**	**7.74**
Mill Site at CSB	1.39	3.77
Pit East Pit Road	1.17	7.7
Pit at U-turn Inside Lane near Runway Ramp	0.7	8.9

4/11/1998		
Port Road - Tutak #2	8.1	2.69
Port Road - Tutak #1	11.3	3.09
Port Road - Little Creek	13.7	1.11
Port Road Average	**11.03**	**2.30**
Note: Roads are controlled with calcium chloride		
Average of All Samples		**4.61**

All samples were collected during September and October of 2005.