GOLDCORP CANADA LTD.
HOLLINGER MINE FEASIBILITY STUDY

CLIMATE AND AIR QUALITY STUDY

Submitted to:
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EXECUTIVE SUMMARY

Porcupine Gold Mines (PGM), a joint venture between Goldcorp Canada Ltd. (51%) and Goldcorp Inc. (49%) (Goldcorp), is conducting pre-feasibility level studies to determine the potential for re-developing the former Hollinger and McIntyre Mines area, in Timmins (Figure 1-1), as a new open pit mine and underground (UG) mining complex. For the purpose of this report, this undertaking is referred to as the Hollinger Project.

This document deals with Air Quality, and is one of a series of baseline and modelling reports prepared to describe existing environmental conditions, associated with the Hollinger site area, and to assess potential impacts of the future operation.

The project site is located in Timmins, Ontario, at a latitude of 48^{o} North. The climate of Timmins is generally characterized as Continental with cold, dry winters and relatively warm dry summers. The city is located inland, and is not significantly affected by the ocean or large bodies of water.

Air emissions from the Project are likely to include emissions from mining operations and ore and mine rock transport. No processing of ore will occur at the mine site. Ore is transported off-site for processing. The compounds that are expected to be released in measurable quantities include:

- Total Suspended Particulates (TSP) and Particulate Matter less than 10 microns (PM_{10}) particles less than 10 microns;
- Metals in the ore;
- Oxides of nitrogen (NO_x);
- Carbon monoxide (CO);
- Sulphur dioxide (SO_2) resulting from sulphur in the diesel fuel;
- Fine particulate matter $PM_{2.5}$ (particles with diameter of less than 2.5 microns); and,
- Carbon dioxide (CO_2), a Greenhouse Gas.

Particulate Matter less than 10 microns (PM_{10}), is expected to be generated from mining activities within the open pit (e.g., drilling, blasting and loading of haul trucks), and from haul truck traffic along the haul roads (road dust). The other compounds are expected to be emitted to a much lesser degree, as by-products of fuel combustion in the mining equipment and vehicles, and as by-products of explosive use in blasting.

The recent history of Timmins has been influenced by the gold mining activities that have taken place since 1910, with mining occurring at several sites including the Hollinger site, the Dome site, the McIntyre site, and others. Based upon this historical activity, a number of ambient monitoring stations have been operated to measure airborne concentrations of pollutants. Most recently, Goldcorp Canada PGM established a network of three monitoring stations to gather baseline data for the parameters total particulate, inhalable particulate (PM_{10}), dustfall, SO_2, NO_2, and metals. The ambient monitoring program was approved by the MOE. The purpose of the air monitoring program is to establish a robust baseline through the strategic location of monitoring stations, and with consideration of both nuisance parameters and those that may be associated with health-based impacts such as metals and fine particulate matter. The monitoring will continue throughout the life of the Hollinger Project as a means to monitor air quality effects and ensure mitigation efforts are effective.

Mitigation of dusts is imperative due to the close proximity of the Hollinger Project Site to residential and other sensitive land uses. Preliminary modelling with moderate control measures found that, without stringent dust control, the Project has the potential to significantly affect air quality across parts of Timmins and Schumacher.

Control strategies developed in this assessment will be incorporated into a Fugitive Dust Best Management Practices (BMP) Plan. The BMP will identify all potential sources of fugitive dusts, outline mitigative measures to control dust generation, and detail the inspection and recordkeeping required to demonstrate that fugitive dusts are being effectively managed. This BMP plan will be an integral part of site operating practices. The dust management plan includes opportunities for adaptive management, in which the intensity of the control measures may need to be increased if site inspections and monitoring indicate that current measures are insufficient to prevent off-site dust effects.

A specific focus of the BMP, will be a blast management component, which will be recognize the significance of the potential effects that uncontrolled blasting and the associated very high, short term dust emissions. It is expected that blasting will be carried out on a daily basis. Blasting will initially occur at grade during the beginning of the pit development at each of the 92 Pit, the Millerton Pit, and the Central Pit. As the pit develops, further blasting will occur below grade.

From the modelled prediction of potential effects, the highest TSP and PM_{10} effects were predicted to occur in the area where the Transport Corridor approaches the Hollinger Project Site. Due to the conservative nature of the modelling and other assumptions used to derive these maximum predictions, the actual maxima are expected to be lower than the modelled predictions.

The results of the TSP and PM_{10} dispersion modelling at four locations in the vicinity of the Hollinger Project Area with all proposed mitigation measures applied are summarized in Tables ES-1 and ES-2, respectively. The predicted effects of the Project and travel along the North Transport Corridor are presented in this table; the magnitude of the maximum predicted effects of using the North Transport Corridor was found to be slightly higher than the South Transport Corridor.

TABLE ES-1
TSP PROJECT EFFECTS SUMMARY

	UTM Location		Ontario Air Quality Criteria (g/m^3)	Maximum Predicted Effect	
	X (m)	Y (m)		Maximum Modelled Concentration (μg/m^3)	Frequency of Exceedance
Shania Twain Centre	476619	5368556	120	144	
Knox Avenue / Laidlaw Street (Timmins)	476017	5368664		71	n/a
Extendicare (Schumacher)	477567	5369127		85	n/a
Super 8 Motel (Highway 101)	476525	5369283		72	n/a

TABLE ES-2
PM_{10} PROJECT EFFECTS SUMMARY

	UTM Location		Ontario Air Quality Criteria (g/m^3)	Maximum Predicted Effect	
	X (m)	Y (m)		Maximum Modelled Concentration (μg/m^3)	Frequency of Exceedance
Shania Twain Centre	476619	5368556	50	60	
Knox Avenue / Laidlaw Street (Timmins)	476017	5368664		36	n/a
Extendicare (Schumacher)	477567	5369127		42	n/a
Super 8 Motel (Highway 101)	476525	5369283		31	n/a

The findings of the operations phase air quality study were as follow:

- It is expected that air emissions from mining activities will increase the airborne concentrations of particulate beyond the baseline levels.
- With intensive mitigation in place, TSP and PM_{10} criteria are expected to be met at receptors locations; one exception being the Shania Twain Centre location, where an exceedance of two days out of five years is predicted. Such exceedances are, however, not uncommon in populated areas, proximate to roadways, or in areas with a significant industrial or mining presence.

- Project-related greenhouse gas emissions (principally CO_2) will result from on-site fuel combustion in the large mining equipment and haul trucks. No other direct sources of GHG emissions will occur. Since on-site power is not required there are no direct or in-direct GHG emissions as a result of power use. Fuel use will be continuous throughout the operations phase of the mine, as there will be emissions to atmosphere throughout the life of the project. After closure, no further GHG emissions occur.

Provided that the Project is operated using current best management practices for fugitive dust control (including managing the blasting), and the other design and mitigation measures are implemented to minimize air emissions of the other key pollutants, the proposed Project is, with infrequent exceptions, not expected to exceed air quality criteria during operations. Air quality effects will cease upon mine closure.

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1.0 INTRODUCTION

Porcupine Gold Mines (PGM), a joint venture between Goldcorp Canada Ltd. (51%) and Goldcorp Inc. (49%) (Goldcorp), is conducting pre-feasibility level studies to determine the potential for re-developing the former Hollinger and McIntyre Mines area, in Timmins (Figure 1-1), as a new open pit mine and underground (UG) mining complex. For the purpose of this report, this undertaking is referred to as the Hollinger Project.

The former Hollinger Mine is located immediately adjacent to downtown Timmins and the urban area of Schumacher, on the south side of Highway 101. The former McIntyre Mine is located directly north and east of the former Hollinger Mine site. Ore from the proposed Hollinger Project would be processed at the existing Dome ore processing facility (Dome Mill), located approximately 5 km east of the former Hollinger Mine site. Considerable residual gold resources have been identified at the Hollinger Project Site, and development of the Site would have the added advantage of removing a number of known mine hazards (open stopes, mini-pits, and near surface underground workings) that are associated with past activities.

This document deals with Air Quality, and is one of a series of technical support documents prepared to describe existing environmental conditions, associated with the Hollinger site area, in part to assist with obtaining future environmental approvals to re-open the Hollinger Mine; assess potential air quality impacts of the proposed operation and to assist with project planning and to provide further information for Closure planning.

This introduction, or an abbreviated version of it in some instances, is included in each document, such that the reports can be read independent of one another. Baseline reports are being prepared to describe the following environmental aspects:

- Air Quality;
- Aquatic Environment;
- Cultural Heritage Environment;
- Noise;
- Hydrology;
- Hydrogeology;
- Socio-Economic Setting;
- Terrestrial Environment; and,
- Vibration.

The reports have been prepared by AMEC Earth & Environmental, a Division of AMEC Americas Limited (AMEC), with the exception of the baseline reports related to noise and vibration (Valcoustics Canada Ltd.), the cultural heritage environment (Woodland Heritage Services Limited), and the socio-economic setting (planning Alliance). The latter three entities worked under the direction of AMEC to ensure an appropriate level of study integration.

1.1 Site History

The Hollinger gold deposit was discovered in 1909, as one of the three original major Timmins properties, along with that of the Dome and McIntyre Mines. The main Hollinger Mine operated from 1910 to 1968 and further mining took place in the 1970's and 1980's. The Hollinger, McIntyre and Coniaurum underground mine workings are all interconnected, along with those of a number of other smaller mines in the area.

Because of their connection to the McIntyre Mine, the Hollinger underground workings were kept dry while McIntyre operations continued until 1988, when the McIntyre Mine was shut down. The pumps at Hollinger and McIntyre Mines were shut down in 1991, and the underground working allowed to flood. A surface pump was installed in the McIntyre No 11 Shaft in 2000 and currently the upper mine levels are dewatered to a level ranging between 24 to 34 m below ground surface (mbgs), to help manage near-surface groundwater levels in the area. Mine water from the Hollinger, McIntyre and Coniaurum Mines is managed through the McIntyre No. 11 Shaft, with discharge to Little Pearl Tailings Pond. The McIntyre Mine operated from 1911 to 1988.

1.2 Project Overview

Goldcorp, through PGM, is planning to develop the Hollinger Project by redeveloping the former Hollinger and McIntyre Mines area as a new open pit and UG mining complex. The open pit complex would involve the sequential development of an open pit, through a series of phased pushbacks that would be used to access shallow ore zones within 200 to 250 mbgs. The UG portion of the mine complex would involve the potential development of two new UG ramps and associated ventilation raises that would be used to access deeper ore zones.

Development of the new Hollinger Project would require comparatively limited new infrastructure, as ore from the Project Site would be hauled to and processed at the existing Dome Mill, with tailings from ore processing to be discharged to the existing Dome Mine tailings deposition area.

The UG operations would consist of the Millerton and Central Porphyry Zone (CPZ) UG operations. Ramps developed at the Millerton and CPZ locations would be developed to approximately 400 mbgs. Mining beyond that point would likely involve shaft hoisting. Opportunities to use existing infrastructure for the deeper mining could potentially involve using the existing Hollinger No. 26 Shaft to develop the Millerton UG, and the McIntyre No. 11 Shaft to develop the CPZ UG. Ramp development and associated UG exploration would be used to confirm UG ore resources, and the viability of UG mining.

Under the current open pit design, there would be a requirement for the disposal of approximately 37,000,000 m^3 of mine rock. The majority of the mine rock (estimated at 20,000,000 - 30,000,000 m^3) would be retained on the Hollinger Project Site and would be used to backfill and overfill the initially excavated phased mine pits. Rock will also be used to build the Environmental Control Berm and the Transportation Corridor with the remainder being stored at the Dome Mine site.

Infrastructure used and/or developed to support the Hollinger Project would include:

- At the Hollinger Project Site:
  - permanent mine rock and overburden stockpiles;
  - site water collection and drainage systems (if required);
  - potentially some small fuel and petroleum product storage facilities (if required);
  - electrical connections from nearby, currently in place, Hydro One infrastructure; and,
  - natural gas (if required) from nearby, currently in place, Union Gas infrastructure.

- Off the Hollinger Project Site:
  - the approximately 4.8 km long Transportation Corridor linking the Hollinger Project Site with the Dome Mill;
  - potentially additional mine rock stockpiles (at the Dome site) (if required); and,
  - mine dewatering system from McIntyre No. 11 Shaft to Little Pearl Tailings Pond.

In addition, the Project would include the construction of an Environmental Control Berm around the Hollinger Project Site. This is a key feature of the Project with the main purpose of the Environmental Control Berm being to manage noise and other effects on nearby receptors.

Throughout the operations phase, mine rock material would be used to progressively backfill the phased mined pits. At closure, the remaining pit will be allowed to flood, and the pit discharge will likely be routed by gravity flow south to either the Skynner Creek or Perch Lake systems, both of which drain to the Mountjoy River. All remaining Project infrastructure would be removed at closure, and the Project Site would be rehabilitated in accordance with established mine closure protocols. In addition, closure will be carried out such that existing safety hazards would be removed. Part of the Closure Plan would be to ensure, through stakeholder input and working collaboration with the City of Timmins' Planning Department, that the Project Site would be landscaped in an aesthetically pleasing manner.

1.3 General Setting

The Timmins area is characterized by a mix of urban and industrial development superimposed on a forested background. The City of Timmins consists of a major downtown urban area, as well as a number of other smaller urban centres scattered throughout the area, with Schumacher, South Porcupine, and Porcupine being the more prominent of these smaller centres. Various other smaller hamlets also occur throughout the area. All of these areas were amalgamated in 1973 to form the City of Timmins.

South Porcupine and other communities to the east are linked to Timmins by Highway 101, with a commercial strip occurring along this highway between downtown Timmins and Schumacher. Highway 655 extends north from Highway 101, with linkages to the Timmins airport via Airport and Laforest Roads, and linkages further north to Xstrata Copper's Kidd Mine site and Highway 11. Several major transmission, gas, water and sewer lines pass through the area, as well as local services.

Timmins was founded as a mining centre, with the three prominent original mines being the Hollinger Mine, the McIntyre Mine, and the Dome Mine. Of these, only the Dome Mine is still in operation. Numerous other smaller mines also operated in the local area (Section 1.4); many of which were or became linked to the three major mines at one time or another. None of these smaller historic mines are currently active. Above and below grade tailings, associated with these active and former mine sites, are widespread throughout the study area (Figure 1-1). Prominent waste rock piles are associated with the Dome Mine. There is little evidence of waste rock piles associated with the other mining operations, because all the mines, except for the Dome open pit operation, were underground mines. Waste rock produced by these underground mines was typically used as material for construction and backfill operations.

Topography in the Timmins area is dominated by its location at the transition of Precambrian Shield terrain to the south and southwest, and by flat-lying glaciolactrine silt and clay plains to the north and east. An extensive glaciolacustrine sand plain area lies to the south of Timmins, including dune formations, and extends into the lower, southwest portion of the study area (Figure 1-2). A prominent esker system extends immediately adjacent and parallel to the east side of Highway 655, north from Highway 101. The local topography reaches a maximum of about 365 m above mean sea level (amsl) in the area just southeast of the Hollinger site and north of Gold Mine Road. Further east towards South Porcupine, and within the glaciolacustrine silt and clay plains, the local topography decreases to as little as 280 m elevation.

The geology of the Timmins area is structurally complex, and includes several major fault zones, and anticline/syncline systems, many of which control surface topographic expressions.The Pearl Lake/Little Pearl Pond and the Gillies Lake area are controlled by these features, and as a result are the location of deeper sediment accumulations. Bedrock exposures are widespread and frequent throughout the major portion of the study area, but with much reduced expression in the areas dominated by glaciolacustrine silt, clay and sand plains.

Several small lakes and numerous ponds are scattered throughout the area, with larger numbers of ponds having formed along low gradient creek valleys as a result of beaver activity. Most of the area's drainage is captured by the Porcupine and South Porcupine Rivers, which flow east, converging just upstream of Porcupine Lake, northeast of the Dome Mine site. The Porcupine River is a low gradient system that has its headwaters in the area just north and east of the Hollinger site. The Porcupine River drains into Night Hawk Lake and the Frederick House River system. Areas south and west of the Hollinger site drain to either the Skynner Creek or Perch Lake systems, both of which drain to the Mountjoy River, which flows into the Mattagami

River. Areas north and west of the Hollinger site drain to Gillies Lake and the Town Creek system, which drains to the Mattagami River; or slightly further north there are a number of smaller drainages that drain directly west to the Mattagami River.

Virtually all drainages in the area have been affected by existing or past mining activities, which have affected water quality, and to a lesser extent drainage patterns themselves.

The majority of the landscape that has not been developed for urbanization or mining remains in forest cover, with the exception of principal agricultural areas to the north and south of Timmins, near to the Mattagami River, and a number of smaller parcels of land in and around the Porcupine Lake area. Forest communities in the area are virtually all second growth as a result of past logging activities, and fires. Throughout the generally lower-lying, eastern portion of the study area, forest communities are dominated by varying mixtures of Black Spruce and poplar (Trembling Aspen and Balsam Poplar), with White Spruce, Jack Pine, Balsam Fir, Larch and White Birch as common associates. Central portions of the study area, where rock outcroppings are common, show similar forest community types but with a somewhat stronger representation of Jack Pine. Sandy areas north of Gillies Lake bordering Highway 655, and south and west of the Kayorum (Hollinger) tailings stack, show a dominance of Jack Pine, or Jack Pine with poplar. The abundance of poplar in the area is indicative of the level of past disturbance, as poplar species are typically successional and not characteristic of mature forest communities. Virtually all major forest blocks are transected by roads, transmission lines, trails, or other such linear features.

1.4 Spatial and Temporal Boundaries

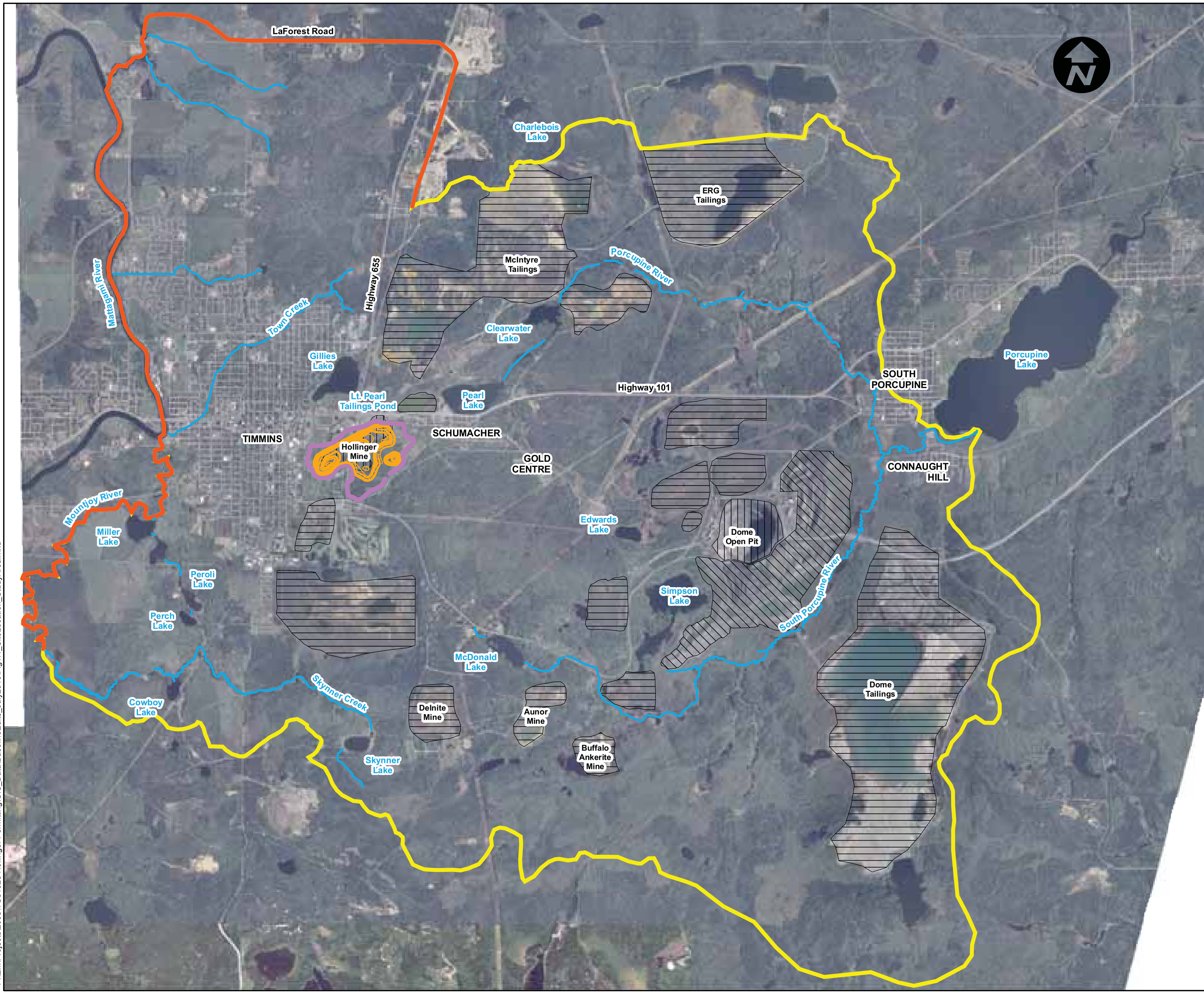
To encompass all potential development areas and immediate drainages there from, Local Study Area (LSA) boundaries for natural environment investigations were focused on watershed and riverine boundaries, with the exception of the northwest study area boundary, which was defined by Laforest Road and a narrow strip of land bordering the east side of Highway 655 (Figure 1-1). The narrow strip of land bordering the east side of Highway 655 was included because this area includes a small trailer park and a single residence north of the trailer park, which have the potential to be affected by possible Hollinger related developments. Biophysical environmental studies are limited to this larger area, but depending on the specific discipline, may focus only on the relevant portions of the LSA.

The socio-economic study area (SESA) is based on the City of Timmins limits, which encompass both urban and rural areas (Figure 1-3).

1.5 General Methodology

Baseline data were gathered using the standard approaches of literature review, sample collection, and data analysis.

Despite the generation of separate baseline reports, where appropriate an ecosystem perspective has been used to integrate the data into functional relationships. It is recognized that the entire physical, chemical, and biological system (i.e., the ecosystem) is interconnected. For example, surface water systems are connected to groundwater systems, which are in turn affected by climate, geology, soils and general aspects of the terrain. The expression of surface water systems in terms of water flow, water quality, and riverbed/creek bed materials, affects the presence and abundance of aquatic life and wildlife. In addition, the entire study team functioned as an integrated unit to ensure that all team members carried out their studies in a coordinated manner, so as to avoid inconsistencies and misinterpretations of the data.



Legend:

- Study Area (Watershed Boundary)
- Study Area (Riverine and Road Boundary)
- Mine Openings to Surface
- Exisiting Tailings Deposits
- Existing Waste Rock Deposits
- Proposed Open Pit
- Environmental Control Berm Outline
- River or Creek

0 1 2 3
Kilometers
1:52,500

amec

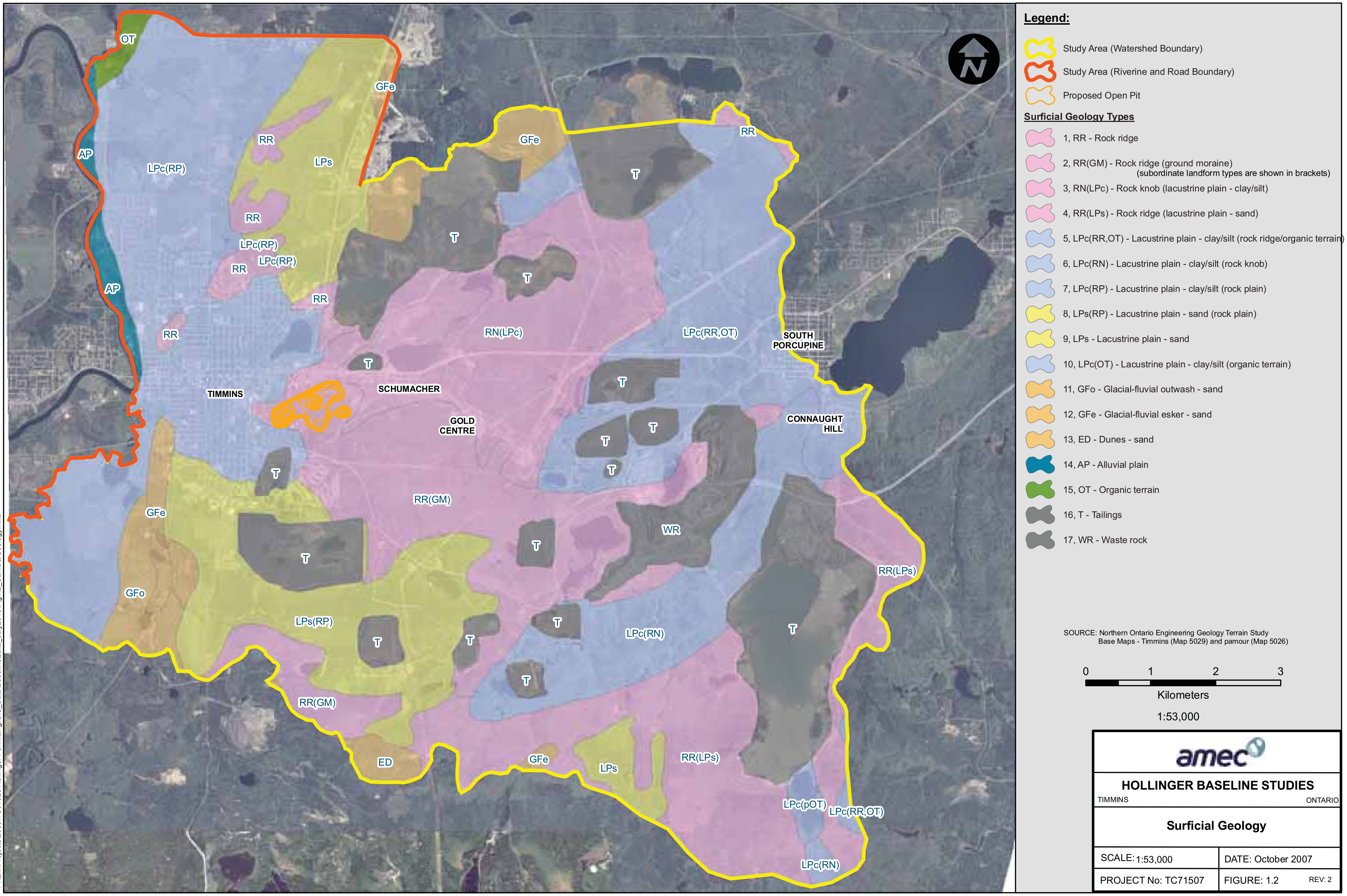
HOLLINGER BASELINE STUDIES

TIMMINS ONTARIO

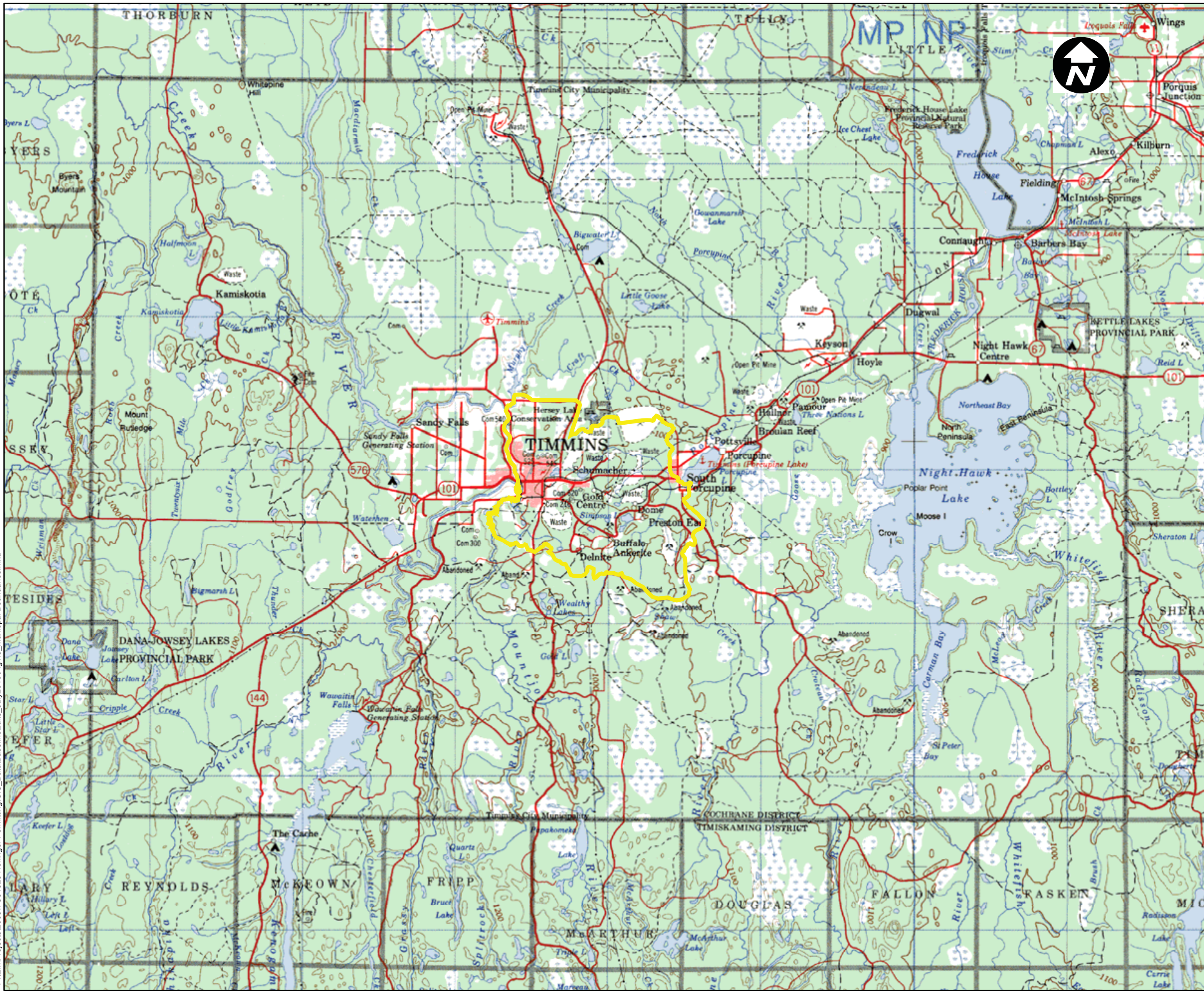
Site Location and Study Area

SCALE: 1:52,500	DATE: September 2007
PROJECT No: TC71507	FIGURE: 1.1 REV: 2

P:\EM\Projects\2008\TC81525 Hollinger Permitting\GIS_Data\BaselineEdits_July2010\Fig1.1_SiteLocation_StudyArea.mxd



P:\EM\Projects\2008\TC81525 Hollinger Permitting\GIS_Data\BaselineEdits_July2010\Fig1.2_SurficialGeology.mxd



Legend:

Study Area

NOTE: Base map supplied by Geomatics Canada, Department of Natural Resource

0 5 10 15

Kilometers

1:250,000

amec

HOLLINGER BASELINE STUDIES

TIMMINS ONTARIO

Study Area and City of Timmins Municipal Boundary

SCALE: 1:250,000	DATE: October 2007
PROJECT No: TC71507	FIGURE: 1.3 REV: 2

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2.0 CLIMATE

2.1 Background

The project site is located in Timmins, Ontario, at a latitude of 48° North. The climate of Timmins is generally characterized as Continental with cold, dry winters and warm dry summers. The city is located inland, and is not significantly affected by the ocean or large bodies of water.

Climate data, in the form of Environment Canada Climate Normals (1971 to 2000), is available for the Timmins Victor M. Power Airport which includes records of temperature, precipitation, wind speed, and wind direction. The airport is located approximately 11 km to the northwest of the proposed site, at co-ordinates 48°34'11"N and 81°22'36".

2.2 Mean Monthly Temperature, Precipitation and Evaporation

The average annual temperature for Timmins, as reported in the Climate Normals, is 1.3°C. The average July temperature is 17.4˚C, and the average December temperature is -17.5°C.

Precipitation is reported as rainfall (mm), snowfall (cm), and total precipitation (mm). The total monthly precipitation is highest in July at 91.5 mm, lowest in February at 36.6 mm, and the annual average precipitation is reported to be 831.3 mm.

The Timmins Victor M. Power Airport temperature and precipitation data are presented in Tables 2-1 and 2-2.

The historical meteorological data for Timmins does not include an evaporation record; therefore the lake evaporation has been estimated using the average pan evaporation data measured by Environment Canada at a station in Amos, Quebec. Amos is located approximately 200 km to the east, at approximately the same latitude, and therefore considered as a reasonable source for evaporation data for the Project site. The monthly mean evaporation data (lake evaporation) from the Amos, PQ station is provided in Table 2-3 for the 1968 to 1994 period of record that was available.

2.3 Wind Speed and Direction

Wind is a critical parameter in the dispersion of contaminants, as it affects the direction offsite effects, the extent of mixing and dispersion, and the generation and transport of fugitive dusts from open, exposed areas. The wind direction determines the primary direction of dispersion. At low wind speeds (or calm conditions), concentrations tend to be higher due to poor mixing and dispersion. Increasing wind speed has the effect of decreasing air concentrations of contaminants through enhanced dispersion and mixing, however for particulates, the enhanced dispersion may be offset by increased emissions of particulates (dust) due to wind shear and reduced settling.

Winds from the west and northwest are prevalent in winter and spring (January through May), and southerly winds are predominant during the June to December period. Historical wind records for the Timmins Victor M. Power Airport weather station are summarized in Table 2-4.

Meteorological data were available from the Ontario Ministry of the Environment (the 'MOE') for the Timmins airport for the 1996-2000; this data was used to generate the windrose presented in Figure 2-1 for the entire five-year data set. The predominant winds are from the south, southwest, and northwest. The average wind speed for this period was 3.2 m/s, and the wind speed exceeds 8.8 m/s less than 1% of the time. This data set was pre-processed by the MOE for use in dispersion modelling assessments; the pre-processing involved inserting a low wind speed as a replacement for calm hours.

TABLE 2-1
MEAN MONTHLY TEMPERATURE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (°C)	-17.5	-14.4	-7.7	1.2	9.6	14.7	17.4	15.7	10.3	4.2	-4.0	-13.2	1.3

(1971 to 2000 Climate Normals, Timmins Victor Power Airport 6078285)

TABLE 2-2
MEAN MONTHLY PRECIPITATION

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)	2.9	1.6	14.7	26.6	62.7	89.1	91.5	82.0	86.7	64.0	29.5	7.0	558.1
Snowfall (cm)	61.7	40.6	49.9	27.5	6.7	0.4	0	0	1.6	14.0	45.7	65.4	313.4

(1971 to 2000 Climate Normals, Timmins Victor Power Airport 6078285)

TABLE 2-3
MEAN LAKE EVAPORATION

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lake evaporation (mm)	-	-	-	15.7	97.8	120.8	127.0	100.1	58.9	17.3	0.0	-	537.5

(1968 to 1994 Amos, Quebec Station 7090120)

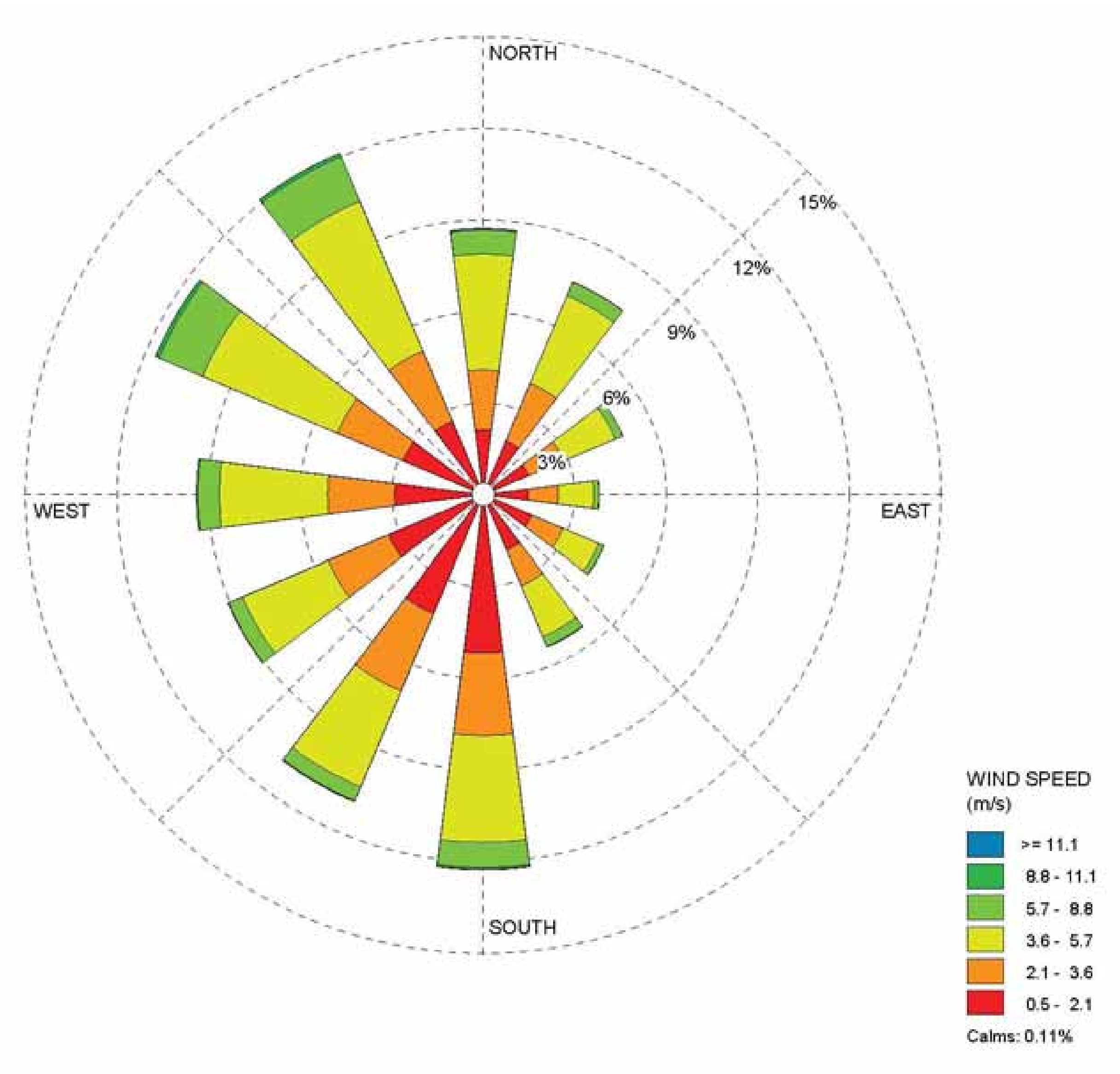
TABLE 2-4
WIND SPEED AND DIRECTION

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean speed (m/s)	3.4	3.4	3.7	3.8	3.4	3.2	2.9	2.7	3.1	3.4	3.5	3.3	3.3
Most frequent direction	W	NW	NW	NW	N	S	S	S	S	S	S	S	S
Maximum hourly speed (m/s)	15.8	16.4	16.1	15.6	17.8	15.6	13.3	20.0	15.6	15.6	16.9	15.6	-

(1971 to 2000 Climate Normals, Timmins Victor Power Airport 6078285)

FIGURE 2-1
WINDROSE

The windrose was generated using the five-year meteorological data set provided by the MOE; this data set was pre-processed for use in dispersion modelling assessments (a low wind speed was used as a replacement for calm hours).



3.0 AIR POLLUTANTS FROM MINING ACTIVITIES

The air emissions from the Project are likely to include emissions from mining operations and the combustion of fuel for power generation and equipment use. No crushing will occur at the mine site. No processing of ore will occur at the mine site. Ore is transported off-site for crushing and processing. The expected pollutants from the mining activities include:

- Total Suspended Particulates (TSP) and PM10 (particles less than 10 microns);
- Heavy metals found in the ore;
- Oxides of nitrogen (NOx);
- Carbon monoxide (CO);
- Sulphur dioxide (SO2) resulting from sulphur in the diesel fuel;
- Fine particulate matter PM2.5 (particles with diameter of less than 2.5 microns); and,
- Carbon dioxide (CO_2), a Greenhouse Gas.

3.1 Particulate Matter

Particulate matter, predominantly consisting of PM_{10} and coarser particulate matter, are the principal air quality contaminant emitted from the Hollinger Project. Particulate matter, mainly as fugitive dusts, are generated from mining activities within the open pit (drilling, blasting, and loading of haul trucks), and from haul truck traffic along the haul roads (road dust).

Airborne particles are categorized as primary (being emitted directly from the source into the atmosphere) and secondary (being formed in part by chemical and physical transformations). Particles can be chemically inert or active; even if inert, they may adsorb chemically active substances or they may combine to form chemically active species.

It has been generally accepted since the 1970's that there is an association between respiratory health and high levels of particulate pollution. What has not been clear until more recently is that adverse health effects also occur at ambient concentrations that are routinely experienced today in North America and Western Europe. Historically, the standards were developed for the full range of particle sizes that stay airborne (typically particles less than 44 μm). These standards were developed to be protective of visibility impairment. As the scientific data evolved, it was found that the correlation between health effects and particulate was stronger at smaller particle sizes. Standards were then developed for particles with diameters of less than 10 μm and, more recently, for particles sizes less than 2.5 μm.

Total suspended particulate (TSP) are generally considered to be in the particle size range of up to 44 micrometres (μm) in aerodynamic diameter, and includes the smaller particle size fractions PM10 and PM2.5. It is emphasized that that these particle size fractions are not separate compounds, nor are they additive. The smaller particle sizes are a subset of the large particulate matter size fractions. The respective standards and AAQCs for particulate matter are presented in Table 3-1. The standard and AAQC for total particulate matter is based upon potential effects on visibility; for PM_{10}, the criteria is an interim AAQC and is intended to be used as a guide for decision making.

The vast majority of dust from mining activities consists of coarse particles and particles larger than 10 microns (PM_{10}) generated from activities such mechanical disturbance of rock and soil materials, bulldozing, blasting, and vehicles on dirt roads. Dust may are also generated when wind blows over exposed ground or stockpiles of fine aggregate.

Respirable particle $PM_{2.5}$, with particles sizes less than 2.5 micron in diameter, are produced to a lesser extent from vehicle exhausts and mobile equipment.

Along with the potential effects of particulate exposure, contaminants found in the rock (i.e., heavy metals), can also have potential health impacts when carried off-site as part of the fugitive dust. The contaminants could include antimony, arsenic, cobalt, copper, lead, molybdenum, nickel, selenium, zinc, and mercury. MOE has specific health based standards for each of these contaminants.

3.2 Nitrogen Oxides

There are more than six forms of oxides of nitrogen; nitric oxide (NO) and nitrogen dioxide (NO_2) are the predominant forms found in air emissions and the most significant air pollutants. NO is a colourless gas and NO_2 is a red/brown gas and contributes to the formation of photochemical smog. Only NO, NO_2 and N_2O are found in significant amounts in the atmosphere. Collectively they are known as nitrogen oxides (NO_x) and are expressed as the equivalent mass concentration of NO_2.

Nitrogen dioxide (NO_2) acts as an acute irritant and in equal concentration is more injurious than NO. Increased airway resistance is experienced at a concentration of 1 ppm for 15 minutes. NO does not remain stable for long periods in the atmosphere, and oxidizes to NO_2 over time.

Nitrogen dioxide in the atmosphere is considered a harmful air pollutant and therefore Environment Canada and the Ontario Ministry of the Environment have set Ambient Air Quality Criteria (AAQC). There are no AAQC for NO or N_2O, though the latter is a greenhouse gas and ozone depleter. In the atmosphere, NO_2 is hydrolysed to form HNO_3 or nitric acid, a compound estimated to form 40% of acid rain.

Emissions of nitrogen oxides are of concern in locations where, in the presence of sunlight, they combine with man-made or natural volatile organic compounds (VOCs) to form photochemical smog, containing ozone. In locations where there are already significant existing emissions of NO_x and volatile organic compounds, particularly in warm summer months, smog conditions that last days or weeks can be detrimental to human health, crop and vegetation growth and health.

Nitrogen oxides (NO_x) include both nitrogen dioxide (NO_2) and nitric oxide (NO). Since NO_2 has adverse effects at much lower concentrations than NO, and NO converts to NO_2 in ambient air, the standard and AAQC for nitrogen oxides is based on the health effects of NO_2. In the assessment of ambient air quality, NO_2, not NO_x, is the reference contaminant; NO_x AAQCs and Schedule 3 standards with 1-hour and 24-hour averaging times should only be compared to monitored nitrogen dioxide (NO_2) data.

The Ambient Air Quality Criteria and Ontario Regulation 419/05 Schedule 3 standards for nitrogen dioxide are equivalent, at 400 µg/m^3 for a 1-hour averaging time, and 200 µg/m^3 for a 24-hour averaging times, as presented in Table 3-1. These standards are based upon potential health effects of exposure to NO_x.

3.3 Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless, tasteless gas, which is produced primarily through the combustion of fossil fuels as a result of incomplete combustion. Over 75% of the CO produced in Ontario is from the transportation sector and 25% is due to the combined effect of power generation, buildings, heating and industrial operations. Exposures at 100 ppm or greater can be dangerous to human health, and larger exposures can lead to significant toxicity of the central nervous system and heart.

The Ontario Regulation 419/05 CO standard is for the ½ hour averaging time; AAQC exist for the 1 hour and 8 hour averaging times. The standards and AAQC for CO are all based upon potential health effects, and are presented in Table 3-1. Carbon monoxide is generally not considered to be a key pollutant from above-ground mining operations; it is more significant for underground mines where worker exposure is of concern.

3.4 Sulphur Oxides

Sulphur oxides, or SO_x, comprise sulphur dioxide (SO_2), sulphur trioxide (SO_3) and solid sulphate forms. Sulphur dioxide is a non-flammable, non-explosive colourless gas. In connection with fuel burning, where the majority is in the form of SO_2, SO_x is normally expressed in terms of the equivalent mass concentration of SO_2 and sometimes as total sulphur. Sulphur oxide has an odour threshold limit of 0.47 to 3.0 ppm, and has pungent irritating odour above 3 ppm. SO_x compounds are significant contributors to acid rain and also precursors to the formation of secondary fine particulate matter.

SO_2 is irritating to the eyes and respiratory system above 5 ppm (exposure for 10 minutes), in the form of higher airway resistance. The effects of SO_2 on human health with respect to the short-term (acute) respiratory effects have been extensively studied. No clear evidence of long term or chronic effects is apparent.

Air quality standards for SO_2 have been set for the 1-hour and 24-hour averaging times, with equivalent AAQCs, as shown in Table 3-1. In addition, Ontario has an annual AAQC of 55 µg/m^3 for SO_2. The standards and AAQC are based upon potential health effects of SO_2, as well as potential effects on vegetation.

3.5 Carbon Dioxide and Greenhouse Gases

Greenhouse Gases (GHGs) are considered as a large-scale global environmental concern as opposed to a local airshed effect, there are no health based or site specific environmental impact based standards that could be used to assess the acceptability of the current emission estimates for the project. In lieu of this, the Project design will be according to industry standards and utilize best operating practises to minimize GHGs to the extent practicable. GHG emissions from combustion are currently best minimized through efficient combustion practices (i.e., minimizing fossil fuel use) and ensuring all engines are maintained to ensure optimal performance.

3.6 Air Quality Assessment Criteria

The MOE have established ambient air quality criteria (AAQC) and point-of-impingement air quality standards for various contaminants, including the target pollutants associated with mining projects. Point-of-impingement standards are set out in O.Reg. 419/05. The ambient air quality limit is the maximum concentration at off-site locations (receptors) for assessing impacts and compliance. It is the AAQC criteria that would be used to assess the significance of existing background air quality, and any incremental effects of emissions from the PGM Project.

The O.Reg. 419/05 and Ontario AAQC limits used for the assessment include limits for different averaging times, depending upon the pollutant. The provincial air quality standards and guidelines are summarized in Table 3-1.

Federal air quality criteria exist as well, established by the Canadian Council of Ministers of the Environment (CCME) and the federal government. The federal criteria are detailed in the Canadian Environmental Protection Act (CEPA), and the Canada Wide Standards (CWS) for particulate matter (respirable particulate matter, $PM_{2.5}$) were set by the CCME.

For the $PM_{2.5}$ size fraction, often referred to as respirable particulate, Ontario has established, based on the CCME standard, a level of 30 µg/m^3 for a 24-hour averaging time. However, the contribution of primary $PM_{2.5}$ from a single facility to ambient levels of $PM_{2.5}$ should be no more than 25 µg/m^3, in order to make the CWS ambient air target value of 30 µg/m^3 achievable at locations proximate to sources of respirable particulate matter.

TABLE 3-1
AMBIENT AIR QUALITY CRITERIA FOR TARGET POLLUTANTS

Contaminant	Averaging Time	Ontario Air Quality Criteria (μg/m^3)	
		O.Reg. 419/05 POI Standards	Ambient Air Quality Criteria
NO_2	1 hr	400	400
	24 hr	200	200
SO_2	1 hr	690	690
	24 hr	275	275
	Annual	-	55
CO	0.5 hr	6,000	-
	1 hr	-	36,200
	8 hr	-	15,700
PM (<44 µm)	24 hr	120	120
	Annual	-	60
PM_{10} (<10 µm)	24-hour	-	50 (Interim)
Metals			
Antimony	24-hour	25	25
Arsenic	24-hour	0.3	0.3
Cobalt	24-hour	0.1	0.1
Copper	24-hour	50	50
Lead	24-hour 30-day	0.5 0.2	0.5 0.2
Molybdenum	24-hour	120	120
Nickel	24-hour	2	2
Selenium	24-hour	10	10
Zinc	24-hour	120	120
Mercury	24-hour	2	2

Note: MOE points out these are not set AAQCs, but these are based on Canadian Council for Ministers of the Environment - Canada Wide Standards (CWS); MOE refers to the 30 µg/m^3 as the federal reference level

4.0 BACKGROUND AIR QUALITY

The recent history of Timmins has been influenced by the gold mining activities that have taken place since 1910, with mining occurring at several sites including the Hollinger site, the Dome site, the McIntyre site, and others.

There are both current and historical monitoring stations in the vicinity of the proposed mine site for the collection of ambient air quality data. The MOE operates air quality monitoring stations that provide regional air quality data; more localized data has been collected historically by previous mine operators, and a pre-project baseline monitoring program has been established by Goldcorp for the PGM project.

Based upon the activities proposed by PGM, and considering current activities and industries in the area, the key air pollutants that should be considered for the baseline scenario include total suspended particulate (TSP), metals in TSP, inhalable particulate matter (PM_{10}), dustfall, oxides of nitrogen (NO_x), and sulphur dioxide (SO_2).

Air emissions from mining activities (material handling and road dust) are predominantly larger particles, whereas $PM_{2.5}$ is mainly emitted as a by-product of fuel combustion. Although there will be combustion equipment in use, the $PM_{2.5}$ in the tailpipe emissions from trucks and mining equipment would be minor in comparison with the coarser particulate associated with material handling and road particulate emissions. It is also not a common practice to include $PM_{2.5}$ as part of an industrial monitoring program, as it is of interest in the context of smog, long range transport, and regional (macroscale) air quality.

Similar to $PM_{2.5}$, carbon monoxide is not considered to be a key pollutant from mining operations and ancillary equipment; therefore CO was not incorporated into the PGM ambient monitoring program.

4.1 Northern Ontario (Regional) Ambient Air Quality

Neither Environment Canada, nor the MOE, operate ambient air monitoring stations in the vicinity of Timmins. The nearest stations located in Northern Ontario include Sault Ste. Marie, North Bay, and Sudbury. These stations are considered to be too far to the south to be representative of ambient air quality in Timmins or South Porcupine. A 2003 Air Quality Study[1] was carried out by the MOE in Timmins at three locations which concluded that, during the July 9 to August 18, 2003 sampling period, the measured values of respirable particulate matter ($PM_{2.5}$), NOx, SO_2, and ozone, were all lower in Timmins than in the other MOE stations located further south (North Bay, Sudbury). . As such, these air monitoring stations may be useful only in presenting regional air quality information (macro-scale transboundary).

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1 Ontario Ministry of the Environment (2004) Timmins Air Quality Study 2003, Air Monitoring Section Environmental Monitoring and Reporting Branch Ontario Ministry of the Environment PIBS 4500e

The air quality data measured at Sudbury, North Bay, and Sault Ste. Marie are summarized in Table 4-1, with the 90th percentile value presented for each of the parameters.

TABLE 4-1
SUMMARY STATISTICS FOR MOE AIR MONITORING STATIONS IN NORTHERN ONTARIO (2008)

	2008 Air Quality Ontario Summary Data – 90th Percentile (µg/m³)			
	NO_2 (ppb)	NOx (ppb)	SO_2 (ppb)	CO (ppm)
Sudbury	NM	NM	3	NM
North Bay	18	26	NM	NM
Sault Ste. Marie	12	14	3	0.25
Average	15	20	3	NA

Notes: NM – not monitored, NA – not applicable

4.2 Historical PM10 Monitoring (2006)

Historical monitoring stations in the vicinity of the proposed mine site were operated for the collection of ambient air quality data during previous mining activities in the area, and after mine closure. Two stations were actively monitoring the PM_{10} concentration, one located in South Porcupine (Walter Lane), and one site proximate to the Minewater Storage Pond. A complete year of PM_{10} monitoring data (2006) is summarized in Table 4-2.

TABLE 4-2
LOCAL PM10 SUMMARY STATISTICS (2006)

	Concentration (µg/m³)	
	Walter Lane	Minewater Storage Pond
Average (arithmetic mean)	7.8	10.3
90th percentile	18.1	26.4

4.3 Pre-Project Baseline Ambient Monitoring

The pre-project air quality monitoring program operated by Goldcorp Canada PGM consists of three monitoring stations gathering baseline data for the parameters total particulate (TSP), inhalable particulate (PM_{10}), dustfall, SO_2, NO_2, and metals. The monitoring stations are sited at the Extendicare Facility, the Mattagami River Conservation Authority (MRCA) office, and on Shania Twain Road, as illustrated in Figure 4-1. These were established to bracket the proposed mining area. The ambient monitoring program was approved by the MOE.

The sampling equipment was installed and commissioned in mid-October 2009. Sampling for TSP and PM_{10} was initiated on October 22, 2009, whereas the first monthly dustfall, SO_2 and

NO_2 samples were collected in November. The monitoring equipment consists of hi-vol particulate samplers (TSP and PM_{10}), conventional dustfall collectors and passive sampling devices (SO_2 and NO_2).

The purpose of the air monitoring program is to establish a robust baseline through the strategic location of monitoring stations, and with consideration of both nuisance parameters and those that may be associated with health-based impacts such as metals and fine particulate matter. The data presented in this baseline study is based upon the limited number of samples collected and analysed since November 2009.

The total suspended particulate (TSP) and the inhalable particulate (PM_{10}) matter air concentrations were measured using hi-vol particulate samplers which operate on a six day sampling schedule (one 24-hour period every 6 days). The data summarized in Table 4-3 reflects a total of 81 samples (27 samples at each of three stations). As part of the ambient monitoring program, the TSP and PM_{10} samples collected on a sub-set of the filters are also analyzed for metal species which include arsenic, cadmium, cobalt, chromium, copper, iron (as ferric oxide), nickel, lead, sulphur, and selenium; the elemental (metal) concentrations in the TSP and PM_{10} were all well below the applicable standards and guidelines.

TABLE 4-3
SUMMARY STATISTICS FOR TSP AND PM_{10} (NOVEMBER 2009 TO JUNE 2010)

	Monitoring Results for PM / PM_{10} (µg/m^3)					
	Shania Twain		MRCA		Extendicare	
	TSP	PM_{10}	TSP	PM_{10}	TSP	PM_{10}
Average (arithmetic mean)	35.2	21.5	37.6	21.9	29.2	17.3
Max. concentration	121.4	60.4	104.2	59.3	109.8	49.4
Min. concentration	8.2	6.7	6.2	3.4	8.0	5.1
90^{th} percentile	54.2	36.1	75.4	40.6	51.3	27.9
AAQC (interim AAQC for PM_{10})	120	50	120	50	120	50
No. of valid samples	41	41	41	41	41	41

Although it is accepted practice to use the 90^{th} percentile of measured values as the baseline air quality, this air monitoring data set is still very limited and there are insufficient samples for proper statistical analyses. Therefore, the average of the TSP and PM_{10} concentrations measured at the three stations is considered a reasonable baseline for the current air quality in the vicinity of the Hollinger Project Site until a sufficient dataset is available. These concentrations are 34.0 µg/m^3 for TSP and 20.2 µg/m^3 for PM_{10}.

During the fourth quarter of 2009, there were no exceedances of the TSP standard and of the AAQC for PM_{10} at the Extendicare Facility sampling location. At the MRCA Office location, there was one exceedance of the TSP standard (December 27) and two exceedances of the PM_{10} AAQC (December 21 and 27). There were also two exceedances of the AAQC for PM_{10}, also on December 21 and 27, at the Shania Twain Road site. On December 21, the winds varied from 6 to 9 km/h and were from the northwest and north northwest for most of the day[2], and the temperatures varied from -15°C to -27°C. On December 27, the winds were blowing from the southwest and from the west at 6 to 15 km/h, and the temperature was significantly milder (-0.1°C to -4.2°C) with snowfall during part of the day. The wind conditions, together with the fact that there was no activity at the open pit mine site, suggest that unknown off-property particulate sources contributed to the elevated TSP and PM_{10} concentrations on these two days where higher particulate concentrations were measured.

Also of note, the fall and winter seasons of 2010 were atypical, with much lower than normal snow cover. There were numerous locations in Northern Ontario that broke records for lowest seasonal snowfalls. As a result, there were likely higher than normal fugitive dust levels from miscellaneous sources in the vicinity of the monitoring stations. Ambient concentrations of particulate matter and PM_{10} are generally much lower during these periods.

As is often the case during the initial months of ambient monitoring, some issues with the PM monitoring were encountered. Several pairs of TSP/PM_{10} results were found to be suspect since the PM_{10} values were higher than the corresponding TSP values. In response to these results, the methodology has been revised to reweigh any suspect TSP/PM_{10} filters prior to processing for metals analysis.

Conventional dustfall collectors were used to measure the insoluble, soluble, and total dustfall on a monthly basis, with the data summarized in Table 4-4. All samples were below the MOE limit for dustfall of 7.0 g/m^2/30 days, with the exception of one monthly measurement at the Shania Twain Road site.

Sulphur dioxide and nitrogen dioxide monitoring is conducted using passive sampling devices. The mean SO_2 concentrations at the three sites were in the order of 0.2 to 0.3 parts per billion (ppb). The mean NO_2 concentration ranged from 2.3 to 4.2 ppb, with a maximum measured concentration of 5.1 ppb at the Shania Twain Road site. The results of the SO_2 and NO_2 monitoring are summarized in Table 4-5; at present, there are no MOE standards, guidelines or AAQCs for SO_2 and NO_2 concentrations determined with passive samplers. The monitoring of SO_2 and NO_2 using passive samplers is being conducted as a screening study to establish a baseline, in order to determine whether continuous monitoring is warranted for these parameters during operations (i.e., if the passive monitors show a significant increase during operations).

[2] Measured at the Environment Canada weather station located at the Timmins airport.

TABLE 4-4
SUMMARY STATISTICS FOR DUSTFALL (NOVEMBER 2009 TO JUNE 2010)

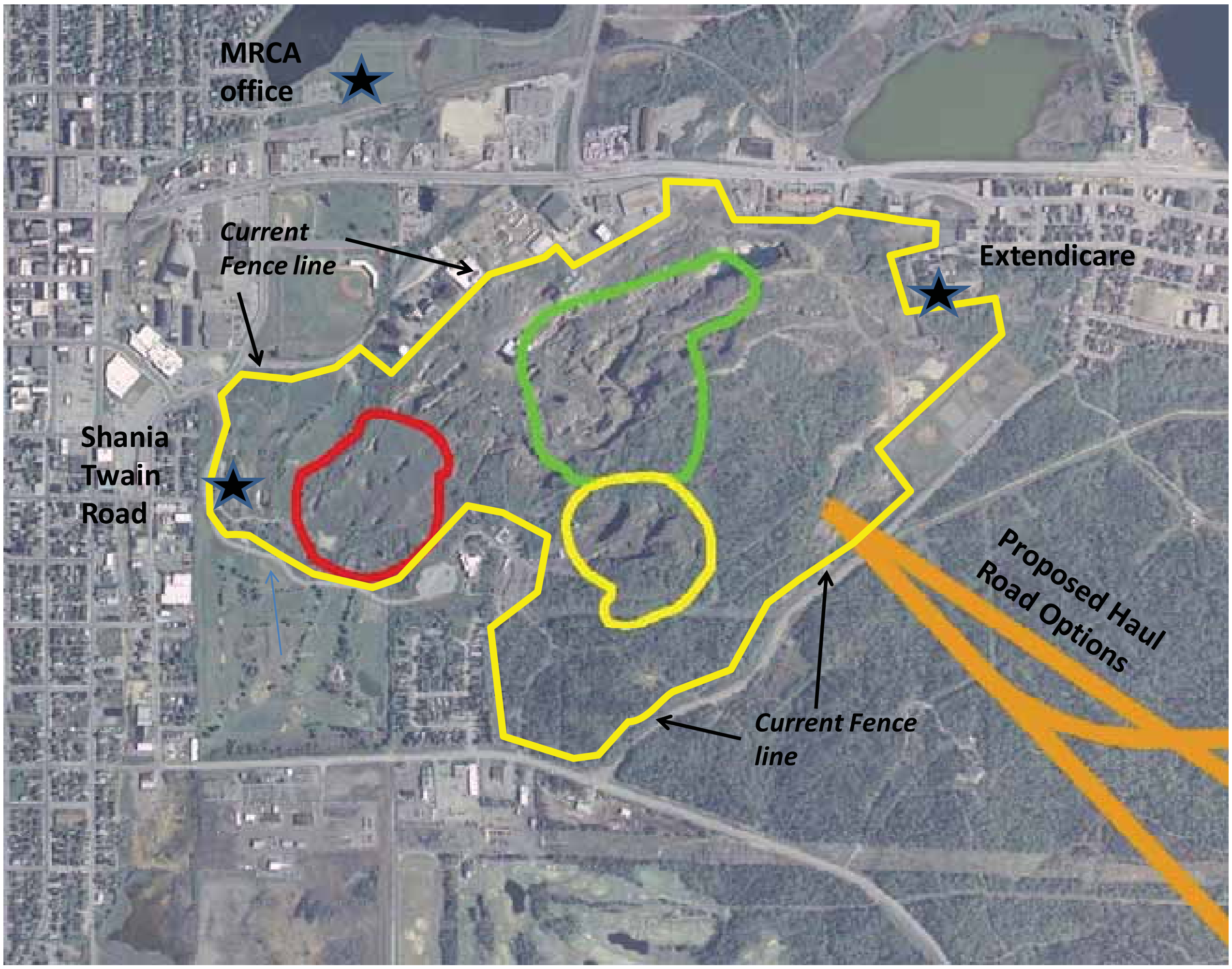
	Monitoring Results for Dustfall (g/m^2/30 days)								
	Shania Twain Road			MRCA Office			Extendicare Facility		
	Dustfall (Insoluble)	Dustfall (Insoluble)	Dustfall (Total)	Dustfall (Insoluble)	Dustfall (Insoluble)	Dustfall (Total)	Dustfall (Insoluble)	Dustfall (Insoluble)	Dustfall (Total)
Average (arithmetic mean)	1.77	1.28	3.05	1.50	0.89	2.40	0.77	0.62	1.29
Max. value	7.76	5.30	13.06	4.58	2.98	6.54	2.93	1.87	4.80
Min. value	0.02	0.11	0.21	0.02	0.07	0.10	0.02	0.17	0.20
MOE limit	n/a	n/a	7.0	n/a	n/a	7.0	n/a	n/a	7.0
No. > Sch. 3 value	n/a	n/a	0	n/a	n/a	0	n/a	n/a	0
No. of valid samples	8	8	8	7	7	7	7	8	8

TABLE 4-5
SUMMARY STATISTICS FOR SO_2 AND NO_2 (NOVEMBER 2009 TO JUNE 2010)

	Monitoring Results for Passive SO_2 and NO_2 (ppb)					
	Extendicare Home		MRCA Office		Shania Twain Road	
	SO_2	NO_2	SO_2	NO_2	SO_2	NO_2
Average (arithmetic mean)	0.2	2.0	0.2	3.6	0.2	3.5
Max. concentration	0.4	2.6	0.3	3.6	0.4	5.1
Min. concentration	0.1	1.2	0.1	3.3	0.1	2.1
No. of valid samples	8	5	8	8	7	7

The initial data collected by Goldcorp as part of the PGM monitoring program is comparable to the MOE data for the air quality stations in Sudbury, Sault Ste. Marie, and North Bay, and as expected for small northern city such as Timmins with no current nearby major emissions sources such as a large industrial facility or mining operation.

FIGURE 4-1
AIR MONITORING STATION SITES



5.0 EMISSIONS ESTIMATION AND DISPERSION MODELLING

5.1 Dispersion Model Selection

The off-site effects were predicted using the AERMOD atmospheric dispersion model. AERMOD is a sixth generation Gaussian dispersion model, which incorporates the latest algorithms to take into account the effects of building downwash, elevated terrain, and five years of local meteorological data. A modelling domain of 4.3 km by 8.5 km was used for the study, with a receptor grid consisting of more than 3,000 receptors at 10 m intervals.

The AERMOD model predicted the maximum ground-level air concentrations off-property of the mining claim boundary (the "fenceline").

5.2 Modelling Meteorology

The meteorological data used for the AERMOD modelling consisted of five years (1996 to 2000) of surface meteorological data provided by the Ontario Ministry of the Environment for the Timmins Victor M. Power Airport, located 11 km north-northwest of Timmins, and an upper air data set for White Lake, Michigan. This data set included a total of 43,584 hours.

5.3 Modelled Terrain

Although the immediate area surrounding the proposed facility does not have significant topographical features such as mountains, valleys, or canyons, the regional topography was included in the AERMOD modelling. A NAD-83 Digital Elevation Model DEM file was available for Timmins and the surrounding areas with USGS 7.5' 30-metre resolution. The berm planned to be constructed along the periphery of the mine site is not accounted for in this regional terrain data, and therefore the reducing effects of this berm on surface wind speeds and dust effects are not considered.

5.4 Modelled Air Emissions and Source Parameters

The emission estimates from the operations at PGM have been presented in the form of source and emission summary tables (Tables A-1 and A-2), which include data on all emission sources at the facility that may discharge one or more of the target pollutants.

The source summary table includes the following data for each source of significant contaminants. The following parameters are referenced:

- Contaminant;
- Source reference number and description;

- Source parameters as needed for the model (e.g., for stacks; flowrate, exhaust temperature, diameter, height);

- Source location (UTM Co-ordinates); and,

- Maximum emission rate, in grams per second.

A summary of the emission factors used and the associated calculations are included in Appendix A, specifically:

- Table A1: Source Summary - Emission Reference Data Summary;
- Table A2: Source Summary - Data Quality and Estimating Methods;
- Table A3: Source Summary - Percent by Source; and,
- Table A4: Source Summary - Emission Rates (g/s).

5.4.1 In-Pit Mining Activities

The major proposed Project components that will be carried out within the Hollinger Project Site include:

- Open pit mining;
- Aggregate handling and earth-moving via loaders, excavators, dozers, and graders;
- Stockpiles (ore and mine rock);
- Access roads; and,
- Potential fuel storage facilities.

The main sources of emissions at the open pit will be from the blasting and ore/mine rock transfer and haulage. The ore processing, including primary crushing, and gold refining will be carried out at the Dome Mill Site.

The rock will be drilled and blasted in the open pit. Up to four drill rigs will be used during the peak operating year. Blasting will occur daily. Broken rock will be identified as either ore or mine rock. Broken rock will be segregated and loaded into haul trucks using front end loaders.

Ore from the open pit will be loaded into haul trucks by a front end loader and transported to the Dome Mille Site. There will be no crushing at the Hollinger Project Site.

5.4.2 Transport Corridors

The assessment considered the effects of haul truck traffic on the proposed north and south routes, as the final road alignment has not yet been determined.

It is anticipated that these roads will be unpaved, and will be used frequently by haul trucks transporting ore to the mill for processing, and moving mine rock to the Dome Pit during future phases of pit development at the Hollinger Project site and less frequently by heavy load transportation and construction equipment.

Vehicular travel on unpaved roadways may be a very significant source of fugitive dust impacts, and the quantity of dust is affected by the number of vehicles traveling the roadway, vehicle weight, the vehicle speed, weather conditions, and the condition of the road surface.

6.0 MITIGATION MEASURES

The principal air quality contaminant emitted from the Hollinger Project will be dust associated with the following sources:

- Dust from mining activities within the open pit (drilling, blasting, and loading of haul trucks); and,
- Road dust associated with haul trucks transporting mine rock and ore from the pit.

Mitigation of dusts is imperative due to the close proximity of the Hollinger Project Site to residential and other sensitive land uses. Preliminary modelling with moderate control measures found that without control the Project has the potential to affect air quality across parts of Timmins to a distance of over 1.5 km from the open pit.

With significant mitigation, these impacts can be reduced to acceptable air quality levels. Specific mitigation measures used in this assessment will become part of a Fugitive Dust Best Management Practices (BMP) Plan for the site. The BMP will identify all potential sources of fugitive dusts, outline mitigative measures that will be employed to control dust generation, and detail the inspection and recordkeeping required to demonstrate that fugitive dusts are being effectively managed. The BMP will include a blasting mitigation plan. This BMP plan will become an integral part of site operating practices. The BMP will include opportunities for adaptive management, in which the intensity of the control measures may need to be increased if site inspections and monitoring indicate that current measures are insufficient to prevent off-site dust effects.

It should be noted that crushing activities will not be carried out at the Hollinger Project Site, and the materials handled and transported will consist of coarse aggregate. Therefore the increased fugitive dusts associated with the handling of fine aggregates and higher silt content materials will be avoided.

Dust mitigation and monitoring will be intensified during production phases when activities are carried out close to grade as the project progresses from the 92 Pit, to the Millerton Pit, and ultimately to the Central Pit. As the pit depth increases, the generation of dust will be below grade which will mitigate particulate emissions and particulate transport. Pit retention of particulate serves to significantly reduce TSP emissions from the site and to a lesser degree the PM_{10} emissions as well.

6.1 Mitigation Measures for Drilling, Material Handling, Transport

The Fugitive Dust BMP Plan will incorporate the following measures to minimize dust generation associated with the various mining activities. These control measures were assumed in the impact assessment. The dust control measures proposed are based on current international best management practices, are predictably effective, and are not prone to failure.

1. Development at the Hollinger Project Site will include the progressive construction of a berm. In addition to noise mitigation, the berm will reduce gusting of winds across the Project site, and will reduce the generation and transport of fugitive dusts. To increase the efficacy of the berm in dust abatement, it is recommended that it be vegetated with taller tree and shrubs along the top of the berm to further reduce wind speeds and act to suppress dust transport.

2. Water will be the primary means of dust mitigation. Dust emissions from roads and exposed areas will be controlled through the application of water sprays or water cannons that will be maintained by PGM for this purpose and will be complete with spray mechanism for roadways and for area wetting. Should site inspections note an increase in fugitive dusts, water sprays will be employed to control dust emissions from material handling within the pit, drilling, and material loading and unloading.

3. Chemical dust suppressants will be applied to roadways as practicable, and will supplement watering to control dust during dry periods. The use of chemical suppressants will be subject to MOE acceptability.

4. As soon as practicable, exposed area will be vegetated (soil stabilization) and progressive rehabilitation will be used wherever practicable to reduce open areas which may be subject to wind erosion. If the area is unlikely to sustain vegetation growth, the area may be finished with stones or geotextile to stabilize.

5. All site roadways will be maintained in good condition, with regular inspections and timely repairs completed to minimize the silt loading on the roads. Coarse aggregate will be available, and applied to areas of the roadway where significant dust generation is noted during inspection. The road maintenance procedures will be incorporated into the dust management plan.

6. Trackout onto public roadways will be avoided by maintaining haul roads separate from publicly accessible roadways, and constructing either an underpass or overpass where road crossings cannot be avoided.

7. A speed limit on site and haul roads will be established, communicated by training and signage, and enforced on all unpaved roads.

8. The location of outdoor storage piles shall be carefully selected (and approved) to optimally locate the storage piles close to natural vegetation or other site feature that would act as a wind break, taking the predominant wind direction and the direction of any sensitive areas into account.

9. During high winds or unfavourable conditions, grading, and ground disturbances are to be avoided where possible. Material handling and transfers will be limited during periods where prevailing conditions are unfavourable and the application of water is insufficient in controlling dust.

10. Training and accountability for all workers on site, including contractors, which emphasizes awareness of the importance of dust management.

11. A preventive maintenance program will be employed that encompasses all diesel-fired engines (vehicle, equipment, and power generating).

Management strategies will need to be reviewed regularly and updated based on the initial outcomes, site inspection reports, and the receipt of public complaints. The intensity of the control measures may need to be increased if frequent complaints are received or if the site inspection reports indicate that current measures may not suffice. This adaptive management approach allows for effective control of fugitive dust generation and transport.

6.2 Mitigation Measures for Blasting

A Blasting Management component of the BMP will be developed and implemented, cognizant of the significance of effects that uncontrolled blasting from the very high, short term dust emissions. It is expected that blasting will be carried out on a daily basis. Blasting will occur at grade during the initial pit development at each of the 92 Pit, the Millerton Pit, and the Central Pit.

The blasting has the potential to result in very high particulate concentrations in the air for short periods of time. Effects associated with these blast plumes are generally nuisance effects, including the potential for impaired visibility and dust deposition on nearby properties.

The nature and scale of blasting operations does not allow for active dust mitigation; therefore dust management will primarily be through blast planning and scheduling during favourable wind conditions.

Since there are a number of residences and sensitive land uses within close proximity to the pit, it is necessary to identify which wind directions are unfavourable and would likely result in the blast plume affecting the air quality at these locations. The unfavourable wind directions are expected to vary depending upon the location of the blasting within the pit. This plan will be based upon similar blasting mitigation plans developed are other sites near towns and residential areas (e.g., Super Pit in Kalgoorlie, Australia)

The Best Management Plan will provide assessment procedures and decision making aids to allow PGM to schedule and carry out blasting only during favourable wind conditions to prevent the blast plume from blowing directly over residential areas, health care facilities, seniors residences, or other identified sensitive receptors rather than over the pit or over non-sensitive areas. Weather conditions during which blasting restrictions are unnecessary, due to natural mitigation such as rainfall, and unfavourable conditions that would require postponing of a blast, will be clearly defined in the plan.

Adaptive management should also be applied to the Blast Management Plan, with review and revision of the plan based upon site specific experience once blasting commences, the depth of blasting as the pits develop, assessment of ambient monitoring concentrations; including deposition.

6.3 Reactive Management

An integral part of Dust Best Management Plan is the incorporation of public liaison measures and complaint management. PGM should be prepared to address neighbour concerns through discourse to understand the nature of the complaints, and remedial measures such as street sweeping, car washing, property cleanups or other means of mitigating the effects. Ongoing consultation with stakeholders will demonstrate to the community that significant efforts are going towards responsible management of emissions from the mining activities.

7.0 RESULTS AND CONCLUSIONS

7.1 Dispersion Modelling Results

For the operations phase of the mine air emissions from mining activities, ore and mine rock handling and transport were calculated and the potential off-site effects assessed by dispersion modelling (AERMOD). These activities occur during the entire operating day of the site. The effects of blasting were considered separately, as emissions from blasting are very short term.

The potential effect associated with air emissions is an increase in the airborne concentrations of the key pollutants in the vicinity of the project, with the potential to adversely affect air quality.

The results of the modelling assessment are depicted graphically in Figures 7-1 to 7-4, as concentration isopleths based on maximum concentration predicted at each receptor location as a result of emissions from PGM for TSP and PM_{10}, respectively. These figures illustrate the limited areas in which the highest predicted concentrations may, infrequently, exceed the ambient air quality criteria.

From the modelled assessment of potential impacts, the highest TSP and PM_{10} effects were predicted to occur in the area where the Transport Corridor approaches the Hollinger Project Site. Due to the conservative nature of the modelling and other assumptions used to derive these maximum predictions, the actual maxima are expected to be lower than the modelled predictions.

A discussion of the frequency of exceedances and cumulative effects that consider existing background concentrations are presented in the following section (Section 7.2).

7.2 Residual and Cumulative Effects – Mining Activities (Drilling, Material Handling and Transport)

The results of the TSP and PM_{10} dispersion modelling are summarized in Tables 7-1 and 7-2 respectively. The predicted effects of the Project and travel along the North Transport Corridor at four locations in the vicinity of the Hollinger Project Area are presented in this table; the magnitude of the maximum predicted effects of using the North Transport Corridor were found to be slightly higher than the South Transport Corridor.

TABLE 7-1
TSP PROJECT EFFECTS SUMMARY

	UTM Location		Ontario Air Quality Criteria (µg/m³)	Maximum Predicted Effect	
	X (m)	Y (m)		Maximum Modelled Concentration (µg/m³)	Frequency of Exceedance
Shania Twain Centre	476619	5368556	120	144	
Knox Avenue / Laidlaw Street (Timmins)	476017	5368664		71	n/a
Extendicare (Schumacher)	477567	5369127		85	n/a
Super 8 Motel (Hwy 101)	476525	5369283		72	n/a

TABLE 7-2
PM_{10} PROJECT EFFECTS SUMMARY

	UTM Location		Ontario Air Quality Criteria (µg/m³)	Maximum Predicted Effect	
	X (m)	Y (m)		Maximum Modelled Concentration (µg/m³)	Frequency of Exceedance
Shania Twain Centre	476619	5368556	50	60	
Knox Avenue / Laidlaw Street (Timmins)	476017	5368664		36	n/a
Extendicare (Schumacher)	477567	5369127		42	n/a
Super 8 Motel (Hwy 101)	476525	5369283		31	n/a

Fugitive dusts from mining activities are likely to contain trace concentrations of metals that are naturally present in the mine rock and the ore. As a conservative screening, the maximum off-site concentration of the metals was estimated by assuming that the composition of the particulate matter was that of the mine rock. Using this screening, it was determined that the ambient concentrations of all metals with health-based ambient air criteria were well below the respective standards. It was found that cobalt has the highest relative effect, which was less than 5% of the 0.1 µg/m³ standard.

In terms of residual effects, the predicted air quality effects will continue throughout the life of the project, and will cease upon mine closure. The effects are readily reversible.

Cumulative effects, as the combination of the effects of the project in conjunction with the current environmental baseline in the absence of the Project, are commonly assessed considering background ambient air quality concentrations as the baseline scenario. If measured proximate to the location of the proposed project, these background concentrations take into account other industrial activities in the area, other sources of air pollutants (traffic, residential, commercial), and transboundary effects. The cumulative effects are then assessed by adding the incremental air concentrations modelled in the vicinity of the project to the baseline, or background concentrations.

As the PGM ambient monitoring program was recently established, the use of the 90th percentile as a representative background for a discussion of cumulative impacts is not reasonable as it is based upon a very limited sample size. For this reason, the discussion of cumulative effects considered the arithmetic mean as the existing background levels (34.0 µg/m^3 for TSP, 20.2 µg/m^3 for PM_{10}). The addition of modelled concentrations to these background levels suggests that the cumulative ambient air TSP and PM_{10} concentrations may approach or exceed the respective ambient air quality criteria on occasion at the Shania Twain Centre, at the Extendicare Facility, and in other areas proximate to the Hollinger Project Site fenceline. The ambient monitors sited in the potentially affected areas will serve to monitor these off-site effects for increased community protection. Elevated background concentrations and infrequent exceedances of ambient air quality criteria are, however, not uncommon in populated areas, proximate to roadways, or in areas with a significant industrial or mining presence.

7.3 Cumulative and Residual Effects – Blasting

Blasting at the Hollinger Project Site has the potential to affect ambient air quality and create nuisance impacts if not adequately managed.

Due to the highly variable nature of blast emissions and the short duration of the emissions, affected by many factors including location, height relative to grade, charge size, hole depth, blast area, and the limitations of the dispersion models, it is difficult to quantify air quality effects from blasting with any reasonable accuracy.

The potential impacts of blasting are minimized through the implementation and enforcement of a Blast Management Plan, to monitor the effects both visually and through the ambient monitoring network, and to maintain an effective response program.

The objective of the Blast Management Plan is to minimize the effects of blasting events and to avoid blast plumes being carried in the direction of sensitive receptors such as residences. Through adaptive management, consideration of prevailing weather conditions and wind direction, and effective response, the nuisance effects of dust from blasting can be minimized or prevented.

In terms of residual effects, the predicted air quality effects from blasting will continue throughout the life of the project, and will cease upon mine closure. The effects are readily reversible.

7.4 Conclusions

The findings of the operations phase air quality study were as follows:

- With the implementation of the mitigation measures detailed in Section 6, the geographic extent of the potential effects are reduced, and generally limited to within a few hundred metres of the Project site.

- With the expected truck traffic levels, the highest predicted ambient TSP and PM10 concentrations adjacent to the haul roads decrease to levels below the relevant air quality criteria within 150 m of the roadway; the concentrations are below the relevant criteria at populated areas to the north and south of the haul roads such as Gold Centre to the north and the residential developments along Gold Mine Road to the south.

- Even with the mitigation described in Section 6 in place, during infrequent weather conditions, there were predicted off-site areas proximate to the Hollinger Project Site where the predicted TSP and PM10 concentrations are predicted to be at or above the respective criteria, although exceedances are expected to be very infrequent. Such exceedances are, however, not uncommon in populated areas, proximate to roadways, or in areas with a significant industrial or mining presence.

- The dust management plan will include special consideration of blasting, cognizant of the significance of effects that could occur from blasting and the very high, short term dust emissions. The Best Management Plan will provide assessment procedures and decision making aids to allow PGM to schedule and carry out blasting only during favourable wind conditions to prevent the blast plume from blowing directly over residential areas, health care facilities, seniors residences, or other identified sensitive receptors rather than over the pit or over non-sensitive areas.

- The effects on air quality only occur during operations, as the air emissions from the site will cease upon mine closure and rehabilitation.

- Project-related greenhouse gas emissions (principally CO_2) will result from on-site fuel combustion in the mining equipment and haul trucks. The effects will be continuous throughout the operations phase of the mine, as there will be emissions to atmosphere throughout the life of the project. After closure, no further GHG emissions occur

7.5 Follow-up Programs and Monitoring

A fugitive dust best management practices (BMP) plan must be developed and implemented by PGM to control dust emissions from the Hollinger Project (including blasting) and from the Transport Corridors connecting the Project Site to the Dome Mill. The BMP plan must be communicated to employees through training practices, and workers must be accountable to operating in accordance with the practices outlined in the BMP plan. The BMP plan must also include recordkeeping to demonstrate the mitigative measures that have been employed and the frequency and findings of site inspections and any corrective actions taken.

Environmental monitoring should continue to include an air quality aspect. It is recommended that once the operations phase begins, that the existing air monitoring stations be fitted with real-time particulate analyzers. The real-time monitoring would, include the availability of hourly particulate measurement concentrations to provide real-time feedback to the project manager and project site operators to modify pit activities and dust mitigation programs based on dust concentrations in the community, and a higher level of confidence in the ability of pit operators to take appropriate action to abate dust emissions based on activities in the pit, weather conditions and real-time dust measurements in the community.

FIGURE 7-1
TSP PREDICTED EFFECTS ISOPLETH

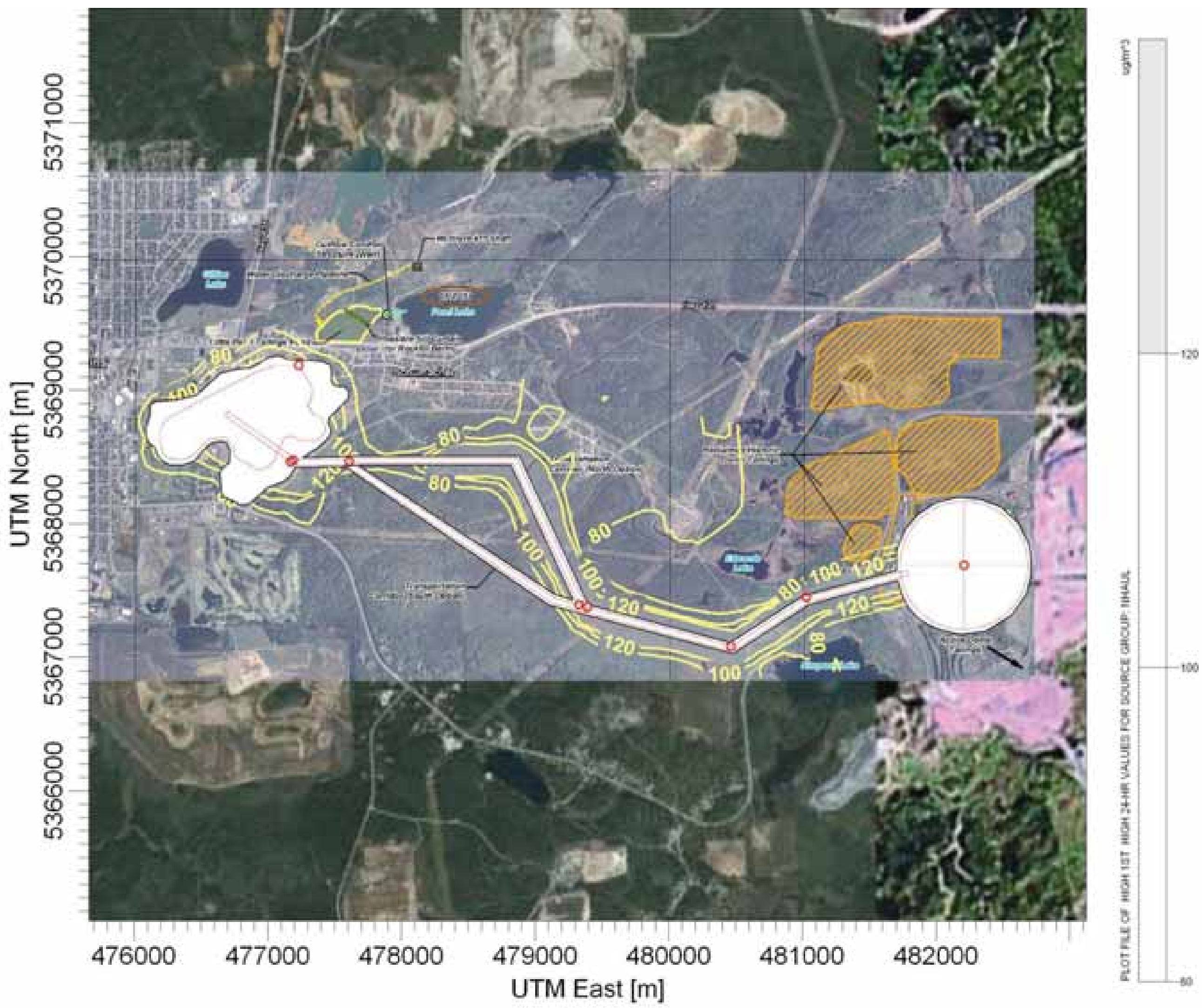


FIGURE 7-2
TSP PREDICTED EFFECTS ISOPLETH (INCLUDING THE VICINITY OF THE PIT)

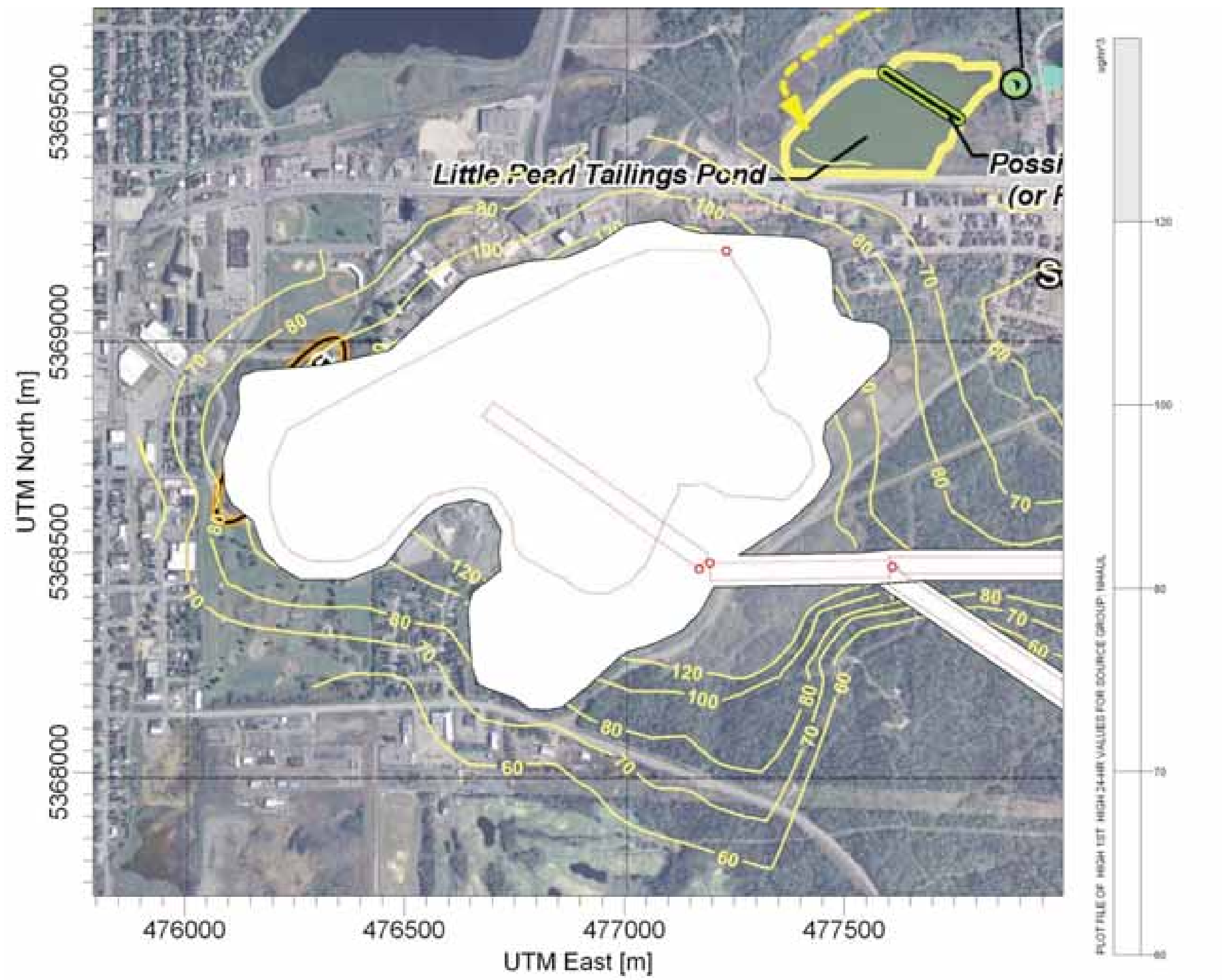


FIGURE 7-3
PM_{10} PREDICTED EFFECTS ISOPLETH

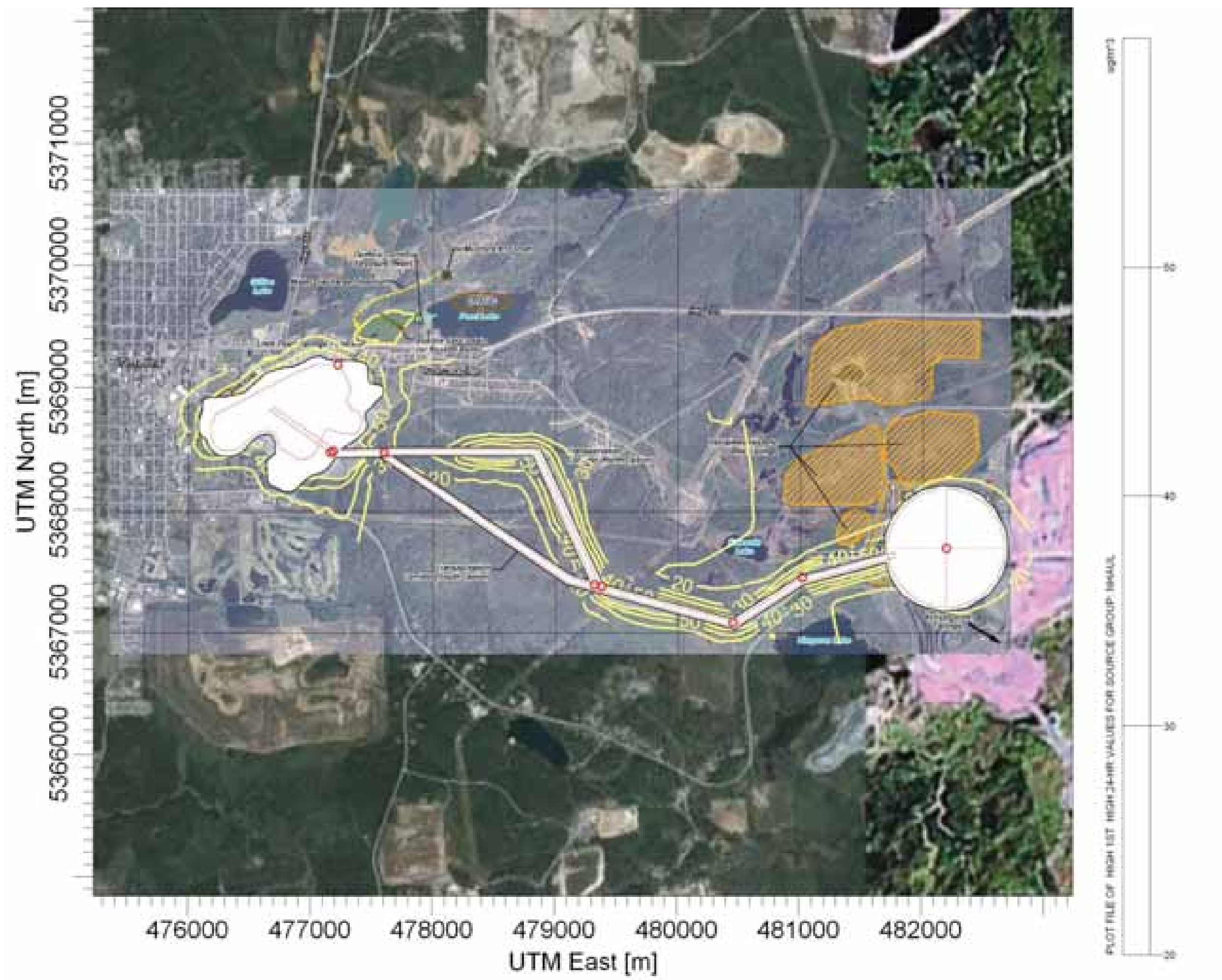
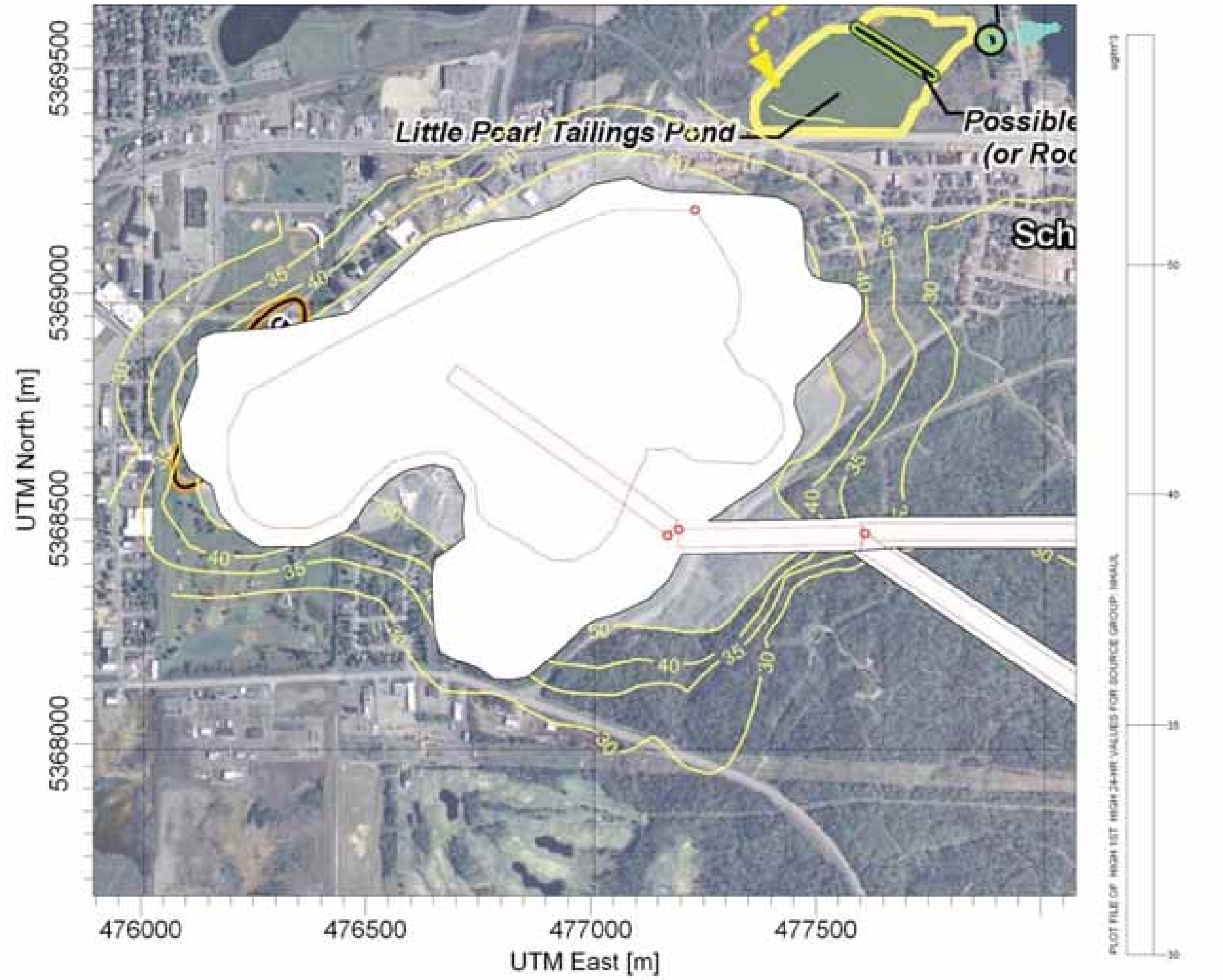


FIGURE 7-4
PM_{10} PREDICTED EFFECTS ISOPLETH (INCLUDING THE VICINITY OF THE PIT)



8.0 REFERENCES

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APPENDIX A

SOURCE SUMMARY TABLES AND CALCULATIONS

Table A1: Source Summary - Emission Reference Data Summary

				Particulate Material
Source No.	**Source**	**Description**	**Control**	**PM / PM10**
Pit-Drill	Open Pit Mining - Drilling	PM, PM10	dust curtain	Australian NPI / US EPA AP-42
Pit-Blast	Open Pit Mining - Blasting	PM, PM10	BMP plan	Australian NPI / US EPA AP-42
Pit-Load	Open Pit Mining - Load Haul Truck	PM, PM10 loader into trucks	watering	US EPA AP-42
Pit-Unload	Open Pit Mining - Mine Rock drop	PM, PM10 drop MR onto stockpile	watering	US EPA AP-42
Pit-Road	Open Pit Mining - Haul trucks	PM, PM10	road watering, chemical suppressants, road maintenance	US EPA AP-42
Pit -Dozer	Open Pit Mining - Dozer	PM, PM10	watering	Australian NPI / US EPA AP-42
Pit-Grader	Open Pit Mining - Grader	PM, PM10	watering	Australian NPI / US EPA AP-42
Pit-WE	Open Pit Wind Erosion	PM, PM10	watering, revegetation	Australian NPI / US EPA AP-42
Roads	Road Emissions	PM PM10 Fugitive Road Dust (Unpaved), Roads are 30 m wide for two way traffic	road watering, chemical suppressants, road maintenance	US EPA AP-42
MR-Unload	Mine Rock drop at Dome Mill pit	PM, PM10 drop MR onto stockpile	watering	US EPA AP-42
MR-WE	Dome Mill pit Wind Erosion	PM, PM10	watering, revegetation	Australian NPI / US EPA AP-42

Table A2: Source Summary - Data Quality and Estimating Methods

Source No.	Source	Description	Control	Estimating Method and Data Quality
				PM / PM10
Pit-Drill	Open Pit Mining - Drilling	PM, PM10	dust curtain	C
Pit-Blast	Open Pit Mining - Blasting	PM, PM10	BMP plan	C
Pit-Load	Open Pit Mining - Load Haul Truck	PM, PM10 loader into trucks	watering	C
Pit-Unload	Open Pit Mining - Mine Rock drop	PM, PM10 drop MR onto stockpile	watering	C
Pit-Road	Open Pit Mining - Haul trucks	PM, PM10	road watering, chemical suppressants, road maintenance	B
Pit -Dozer	Open Pit Mining - Dozer	PM, PM10	watering	B
Pit-Grader	Open Pit Mining - Grader	PM, PM10	watering	B
Pit-WE	Open Pit Wind Erosion	PM, PM10	watering, revegetation	U
Roads	Road Emissions	PM PM10 Fugitive Road Dust (Unpaved), Roads are 30 m wide for two way traffic	road watering, chemical suppressants, road maintenance	B
MR-Unload	Mine Rock drop at Dome Mill pit	PM, PM10 drop MR onto stockpile	watering	C
MR-WE	Dome Mill pit Wind Erosion	PM, PM10	watering, revegetation	U

Table A3: Source Summary - Percent by Source

Source No	Source	Description	Control	% of Emissions by Source and Contaminant	
				PM	PM10
Pit-Drill	Open Pit Mining - Drilling	PM, PM_{10}	dust curtain	0.9	1.4
Pit-Blast	Open Pit Mining - Blasting	PM, PM_{10}	BMP plan		
Pit-Load	Open Pit Mining - Load Haul Truck	PM, PM_{10} loader into trucks	watering	2.9	3.5
Pit-Unload	Open Pit Mining - Mine Rock drop	PM, PM_{10} drop MR onto stockpile	watering	2.4	2.9
Pit-Road	Open Pit Mining - Haul trucks	PM, PM_{10}	road watering, chemical suppressants, road maintenance	10.3	8.3
Pit -Dozer	Open Pit Mining - Dozer	PM, PM_{10}	watering	4.8	14.8
Pit-Grader	Open Pit Mining - Grader	PM, PM_{10}	watering	1.6	2.7
Pit-WE	Open Pit Wind Erosion	PM, PM_{10}	watering, revegetation	0.0	0.0
Roads	Road Emissions	PM PM_{10} Fugitive Road Dust (Unpaved), Roads are 30 m wide for two way traffic	road watering, chemical suppressants, road maintenance	70.0	56.4
MR-Unload	Mine Rock drop at Dome Mill pit	PM, PM_{10} drop MR onto stockpile	watering	2.4	2.9
MR-WE	Dome Mill pit Wind Erosion	PM, PM_{10}	watering, revegetation	4.7	7.1

Table A4: Source Summary - Emission Rates (g/s)

Source ID	Source	Description	Control	PM	PM_{10}
TOTAL				**12.773**	**4.194**
Pit-Drill	Open Pit Mining - Drilling	PM, PM_{10}	dust curtain	0.115	0.058
Pit-Blast	Open Pit Mining - Blasting	PM, PM_{10}	BMP plan		
Pit-Load	Open Pit Mining - Load Haul Truck	PM, PM_{10} loader into trucks	watering	0.365	0.146
Pit-Unload	Open Pit Mining - Mine Rock drop	PM, PM_{10} drop MR onto stockpile	watering	0.304	0.122
Pit-Road	Open Pit Mining - Haul trucks	PM, PM_{10}	road watering, chemical suppressants, road maintenance	1.318	0.349
Pit -Dozer	Open Pit Mining - Dozer	PM, PM_{10}	watering	0.619	0.619
Pit-Grader	Open Pit Mining - Grader	PM, PM_{10}	watering	0.211	0.113
Pit-WE	Open Pit Wind Erosion	PM, PM_{10}	watering, revegetation		
Roads	Road Emissions	PM PM_{10} Fugitive Road Dust (Unpaved), Roads are 30 m wide for two way traffic	road watering, chemical suppressants, road maintenance	8.940	2.366
MR-Unload	Mine Rock drop at Dome Mill pit	PM, PM_{10} drop MR onto stockpile	watering	0.304	0.122
MR-WE	Dome Mill pit Wind Erosion	PM, PM_{10}	watering, revegetation	0.599	0.299

Table A5: Model Source Descriptions and Details

Source ID	AERMOD Source ID	Source	Emission Description	Control	Model Source Description	Source Dimensions (m) Height AG	Width	Length	release height	sigma z	sigma y
Pit-Drill	PIT	Open Pit Mining - Drilling	PM, PM10	dust curtain	575,561 m^2 area source… assumed released height 5 m to allow for intial mixing..footprint is approximate pit - worst case during early pit development when pit depth not significantly below grade		1,250	790	5	2.33	
Pit-Blast	PIT	Open Pit Mining - Blasting	PM, PM10	BMP plan							
Pit-Load	PIT	Open Pit Mining - Load Haul Truck	PM, PM10 loader into trucks	watering							
Pit-Unload	PIT	Open Pit Mining - Mine Rock drop	PM, PM10 drop MR onto stockpile	watering							
Pit-Road	PIT	Open Pit Mining - Haul trucks	PM, PM10	road watering, chemical suppressants, road maintenance							
Pit -Dozer	PIT	Open Pit Mining - Dozer	PM, PM10	watering							
Pit-Grader	PIT	Open Pit Mining - Grader	PM, PM10	watering							
Pit-WE	PIT	Open Pit Wind Erosion	PM, PM10	watering, revegetation							
Roads	NR1,NR2,NR3,SR1,SR2,SR3,CR1,CR2	Road Emissions	PM PM10 Fugitive Road Dust (Unpaved), Roads are 30 m wide for two way traffic	road watering, chemical suppressants, road maintenance	Width is actual plus 9.75, release height is actual truck height, sigma z is 2 x truck height/4.3 (as per NSSGA guidance)	5.122	39.75	various	5.12	2.38	na
MR-Unload	Mine Rock drop at Dome Mill pit	Mine Rock drop at Dome Mill pit	PM, PM10 drop MR onto stockpile	watering	Area Source		940	990	5.00	2.33	
MR-WE	PIT	Dome Mill pit Wind Erosion	PM, PM10	watering, revegetation							

A6: Source Summary - Source Parameters

Source No.	Source	Description	Control	Source Type: Stack or Volume *	Location: X	Location: Y	Location: Z
Pit-Drill	Open Pit Mining - Drilling	PM, PM10	dust curtain	Area	477232	5369185	331.35
Pit-Blast	Open Pit Mining - Blasting	PM, PM10	BMP plan				
Pit-Load	Open Pit Mining - Load Haul Truck	PM, PM10 loader into trucks	watering				
Pit-Unload	Open Pit Mining - Mine Rock drop	PM, PM10 drop MR onto stockpile	watering				
Pit-Road	Open Pit Mining - Haul trucks	PM, PM10	road watering, chemical suppressants, road maintenance				
Pit -Dozer	Open Pit Mining - Dozer	PM, PM10	watering				
Pit-Grader	Open Pit Mining - Grader	PM, PM10	watering				
Pit-WE	Open Pit Wind Erosion	PM, PM10	watering, revegetation				
Roads	Road Emissions	PM PM10 Fugitive Road Dust (Unpaved), Roads are 30 m wide for two way traffic	road watering, chemical suppressants, road maintenance	Area (multiple)			
MR-Unload	Mine Rock drop at Dome Mill pit	PM, PM10 drop MR onto stockpile	watering	Area (Dome Mill)	482207	5367688	309.44
MR-WE	Dome Mill pit Wind Erosion	PM, PM10	watering, revegetation	Area (Dome Mill)			

A7: Drilling and Blasting

Drilling emissions

Reference: Australian NPI for Mining v 2.3, Table 1 (2001)

120 holes per shift (20 hours)

	Emission Factors (kg/hole)			
	TSP	*PM_{10}*		
uncontrolled	*0.59*	*0.30*	*AP-42, Table 11.9-4*	*C-rating*
controlled (control efficiency 86%)	*0.0826*	*0.042*		
emission rate (g/s)	*0.115*	*0.058*	*24-hour average*	

Control Measures:	TSP	PM10
Watering / Curtain	80%	80%
Windbreak (berm)	30%	30%

Mine Progression	
Year 1	*92 Pit*
Year 2	*92 Pit and Millterton Pit*
Year 3	*Millerton Pit and Central Pit*
Year 4	*Central Pit*
Year 5	*Central Pit*
Year 6	*Central Pit*

A8: Material Handling

Material Loading and Unloading

Reference: AP 42 - Section 11.24 (based on High Moisture (4%)

Activity Data:

Material Handling	417	tonnes/hour	Ore
	2,083	tonnes/hour	Mine Rock
	2,500	tonnes/hour	Ore + Mine Rock

Emission Factors:

		Uncontrolled			Control Efficiency	Controlled
	SCC	kg/Mg (kg/tonne)	Size Fractior	EPA Rating		kg/Mg
Material Transfer	3-03-024-04	0.005	TSP	C	89.5%	0.000525
		0.002	PM_{10}	C	89.5%	0.00021

Control Measures:	TSP	PM10
Watering	70%	70%
Pit Retention	50%	5%
Windbreak (berm)	30%	30%

The material transfer is used for all conveyor drops, stock pile drops, ore dumps and other locations where material is allowed to fall freely, as per AP42 - Section 11.24.

Ore/Mine Rock Loading to Haul Trucks in Open Pit			
Emission rate:	0.365	TSP	g/s
	0.146	PM_{10}	g/s
Mine Rock Drop (Hollinger Pit)			
Emission rate:	0.304	TSP	g/s
	0.122	PM_{10}	g/s
Mine Rock Drop (Dome Mill)			
Emission rate:	0.304	TSP	g/s
	0.122	PM_{10}	g/s

A9: Fugitive Road Dust

Table 1: Particulate Emission Coefficients for Truck Traffic on Unpaved Industrial Roads

Constant	Expressed Units	PM_{30} (TPM)[3]	PM_{10}	US EPA Data Quality
k	lb/VMT [(1)]	4.9	1.5	B
a	-	0.7	0.9	B
b	-	0.45	0.45	B
Conversion	lb/VMT to g/VKT	281.9	281.9	

Notes:
1. "lb/VMT" means pounds pre vehicle mile travelled.
2. "g/VKT" means grams per vehicle kilomtre
3. TPM means total particulate matter

from AP42 (Chapter 13.2 - Unpaved Roads; Nov 2006)

Table 2: Fixed Haul Road Segments

Road Segment	Route or Area Descript	Location (UTM,m)			Road Dimensions				Total VKT per hour per segment	Uncontrolled kg/hr		Uncontrolled (g/s)		Controlled (g/s)	
		X	Y	Z	Distance m	Length m	Width m	Area m^2		TPM Emission Rate	PM_{10} Emission Rate	TPM Emission per	PM_{10} Emission Rate	TPM Emission per segment	PM_{10} Emission Rate
	Out of pit														
1A					1.100	1,100	39.75	43,725	17.60	94.9	25.1	26.35	6.98	1.318	0.349
	Common Road														
CR					0.407	407	39.75	16,178	6.51	35.1	9.3	9.75	2.58	0.488	0.129
2	North Haul Road														
NR					2.415	2,415	39.75	95,996	38.64	208.3	55.1	57.85	15.31	2.893	0.766
3	South Haul Road														
SR					2.095	2,095	39.75	83,276	33.52	180.7	47.8	50.19	13.28	2.509	0.664
	Common Roads														
CR1					1.107	1,107	39.75	44,003	17.71	95.5	25.3	26.52	7.02	1.326	0.351
CR2					0.660	660	39.75	26,235	10.56	56.9	15.1	15.81	4.19	0.791	0.209
CR3					0.780	780	39.75	31,005	12.48	67.3	17.8	18.69	4.95	0.934	0.247
													Total	10.26	2.72
													Total (In-Pit)	1.32	0.35
													Total (Haul Roads)	8.94	2.37

Table 3: Truck Details	Tonnes per hour	Load per Truck (tonnes)	Trips per hour* (8 round trips)	Vehicle Weight Empty (tonnes)	Vehicle Weight Loaded (tonnes)	Mean Vehicle Weight (tonnes)	TPM Emission Factor lb/VKT	PM_{10} Emission Factor lb/VKT	TPM Emission Factor kg/VKT	PM_{10} Emission Factor kg/VKT
Haul Trucks (Cat 785C) - metric units	2,500	136	16	105.9	241.9	173.9			5.39	1.43
imperial units						191.6	19.1	5.1		

* increases to 18 trucks/hr if all mine rock transported to Dome Mill

Number of Tı 8

Road Emission Assumptions (needed for AP42)

Mean Silt Content	5.8	%	based on AP42 Chapter 13.2 for taconite mining
Assumed average speed of trucks	50	km/hour	31.1 miles/hour (not used in calculations)
Assumed Control	95	%	based on watering, vehicle speed, dust suppressant

A10: Emissions from Dozers and Graders

Bulldozers in Pit

Reference: Emission Estimation Technique Manual for Mining Version 2.3, Environment Australia, 2001, ISBN 0 642 54700 9.

Equation:

EF(kg/hour) = k*2.6*silt^1.2*moisture^-1.3, k = 1 for TSP, 0.75 PM_{10}

				Control Measures:	TSP	PM10
Silt	5.8	assumed		Watering	55%	55%
Moisture (%)	4	assumed		Pit Retention	50%	5%
Number of Dozers	4					
EF - uncontrolled (kg/hour)	3.54		EPA Rating	Windbreak (berm)	30%	30%

		Uncontrolled		Controlled		
TSP	ER (g/s)	3.93	B	0.619		
PM_{10}	ER (g/s)	2.95	D	~~0.882~~	0.619	(PM_{10}<=TSP)

Graders

Reference: Emission Estimation Technique Manual for Mining Version 2.3, Environment Australia, 2001, ISBN 0 642 54700 9.

Equation:

PM: EF(kg/hour) = 0.0034 x $S^{2.5}$

PM_{10}: EF(kg/hour) = 0.0034 x $S^{2.0}$

S - mean vehicle speed	20	mph	(max speed 33.5 mph, assume 23 mph 7th gear)
	12.4	km/hr	
Number of Graders	3		

	TSP	PM_{10}
EF - uncontrolled (kg/hour)	5.55	1.58
EF - controlled (kg/hr)	0.76	0.41
ER (g/s)	0.211	0.113

Control Measures:	TSP	PM10
Watering	61%	61%
Pit Retention	50%	5%
Windbreak (berm)	30%	30%

Control efficiency of watering assumed to be 61% (construction and demolition watering MRI 2001)*.

A11: Wind Erosion

Wind Erosion from Dome Mill Pit

Reference: Australian NPI for Mining v 2.3, Table 1 (2001)

		Dome Mill Pit	
	Area - m^2	673,539	
	- ha	67.4	
PM	Emission Factor - U (kg/ha/hr)	0.40	uncontrolled
	Emission Factor - C (kg/ha/hr)	0.03	controlled
	Emission Rate (g/s)	0.599	
PM_{10}	Emission Factor - U (kg/ha/hr)	0.20	uncontrolled
	Emission Factor - C (kg/ha/hr)	0.016	controlled
	Emission Rate (g/s)	0.299	

10,000 m^2/ha

Control Efficiencies

84% watering and dust suppressants to stabilize disturbed area

50% pit retention

A12: Metal Concentrations in Waste Rock

Since the majority of the material handled within the pit is mine rock, the metal content of the mine rock was used to screen to determine if the potential for effects from metals in the dust. A maximum PM concentration of 144 $\mu g/m^3$ was used for the screening excercise.

	Felspar Porphyries	Mafic Volcanics	Sedimentary Lithologies	Mean Concentration in Mine Rock (mg/kg or ppm)	Maximum Concentration (Screened) $\mu g/m^3$	Ambient Air Quality Criteria ($\mu g/m^3$)	% of Criteria
Antimony	0.66	0.28	1.07	0.7	9.67E-05	25	0.00%
Arsenic	15.3	11.3	41.3	22.6	3.27E-03	0.3	1.09%
Cobalt	13.5	38.7	39.2	30.5	4.40E-03	0.1	4.40%
Copper	10.4	80.6	234	108.3	1.56E-02	50	0.03%
Lead	16.6	2	11.3	10.0	1.44E-03	0.5	0.29%
Molybdenum	0.44	0.3	1.76	0.8	1.20E-04	120	0.00%
Nickel	26.4	60.1	72.3	52.9	7.64E-03	2	0.38%
Selenium	1	2	3	2.0	2.89E-04	10	0.00%
Zinc	192	112	978	427.3	6.17E-02	120	0.05%
Mercury	no data	no data	no data	no data	no data	2	

A13: AERMOD Dispersion Modelling Source Parameters

PM

Source ID	X Coord. [m]	Y Coord. [m]	Base Elevation [m]	Release Height [m]	Emission Rate [g/(s-m2)]	X Side Length [m]	Y Side Length [m]	Angle from North [deg]	Initial Vertical Dimension [m]	Description	Area m^2	Emission Rate (g/s)
CR2	480463	5367081.6	320	5.12	3.02E-05	39.75	660	56.91	2.38	Common Road 2	26235	0.7910
CR1	479391	5367375.7	331.3	5.12	3.01E-05	39.75	1107	104.67	2.38	Common Road 1	44003.3	1.3258
CR	477195	5368476.6	341.43	5.12	3.02E-05	39.75	407	88.85	2.38	Common Road	16178.3	0.4879
CR3	481029	5367451.2	311.97	5.12	3.01E-05	39.75	780	75.26	2.38	Common Road 3	31005	0.9339
PITRD	477170	5368463.6	341.97	5.12	5.53E-05	39.75	600	-55.49	2.38	Pit Road	23850	1.3180

Source ID	X Coord. [m]	Y Coord. [m]	Base Elevation [m]	Release Height [m]	Emission Rate [g/(s-m2)]	Initial Vertical Dimensio n [m]	No. Vertices (or sides)	Area m2	Emission Rate (g/s)	Description
DM	482207	5367687.5	309.44	5	1.25E-06	2.33	17	723,823	0.9033	Dome Pil Mine Rock Pile
SR	477610	5368467.9	357.07	5.12	2.87E-05	2.38	6	87382.1	2.5087	South Haul Road
NR	479327	5367393.3	331.94	5.12	3.07E-05	2.38	6	94335.2	2.8933	North Haul
OPENPIT	477232	5369185.4	331.35	5	2.87E-06	2.33	50	562,175	1.6118	Open Pit Mines

PM10

Source ID	X Coord. [m]	Y Coord. [m]	Base Elevation [m]	Release Height [m]	Emission Rate [g/(s-m2)]	X Side Length [m]	Y Side Length [m]	Angle from North [deg]	Initial Vertical Dimension [m]	Description	Area m^2	Emission Rate (g/s)
CR2	480463	5367081.6	320	5.12	7.97E-06	39.75	660	56.91	2.38	Common Road 2	26235	0.2090
CR1	479391	5367375.7	331.3	5.12	7.98E-06	39.75	1107	104.67	2.38	Common Road 1	44003.3	0.3510
CR	477195	5368476.6	341.43	5.12	7.97E-06	39.75	407	88.85	2.38	Common Road	16178.3	0.1290
CR3	481029	5367451.2	311.97	5.12	7.97E-06	39.75	780	75.26	2.38	Common Road 3	31005	0.2470
PITRD	477170	5368463.6	341.97	5.12	1.46E-05	39.75	600	-55.49	2.38	Pit Road	23850	0.3489

Source ID	X Coord. [m]	Y Coord. [m]	Base Elevation [m]	Release Height [m]	Emission Rate [g/(s-m2)]	Initial Vertical Dimensio n [m]	No. Vertices (or sides)	Area m2	Emission Rate (g/s)	Description
DM	482207	5367687.5	309.44	5	5.82E-07	2.33	17	723,823	0.4210	Dome Pil Mine Rock Pile
SR	477610	5368467.9	357.07	5.12	7.60E-06	2.38	6	87382.1	0.6640	South Haul Road
NR	479327	5367393.3	331.94	5.12	8.12E-06	2.38	6	94335.2	0.7660	North Haul
OPENPIT	477232	5369185.4	330.93	5	1.88E-06	2.33	50	562,175	1.6118	Open Pit Mines