7.2 Air Quality

This section provides a characterization of ambient air quality in the project area and assesses potential project effects on air quality conditions. Information on project related air emissions was provided by YZC, based on the project components and activities described in Section 2: Project Description. Information on climate conditions, provided in Section 7.1 Climate, is referenced and elaborated upon as required to describe the dispersion of air emissions and resulting effects on ambient air quality.

7.2.1 Scope of Assessment

Issues and Selection of Valued Ecosystem and Cultural Components

Air quality has been identified as a VECC because of its intrinsic importance to the health and well being of humans, wildlife, vegetation and other biota and because it is potentially sensitive to project effects. The atmospheric environment can be an important pathway for the transport of substances arising from various project activities to the freshwater, terrestrial, and human environments.

Project-related air emission sources include:

- operation of diesel burning generators
- waste burning incinerators
- fugitive dust and particulate matter from the ore stockpiling, conveyors and crushing and processing
- fugitive dust from access road and site construction activities and ongoing use of the gravel access road
- miscellaneous emissions from minor, intermittent sources (e.g., aircraft traffic, land clearing burning)

Continuous operation of the diesel generators for electricity is the main source of air emissions at the site. Air quality parameters were selected for detailed analysis based on project emissions of concern with respect to human and environmental health and which are subject to national standards and objectives. Selected parameters are listed in Table 7.2-1.

Based on the EA Report Guidelines and the Biophysical Workplan submitted to the Technical Committee, the following factors were chosen as potential air quality VECCs:

Table 7.2-1 Air Quality Parameters Analyzed, Selection Rationale and Data Sources

Parameter	Rationale for Selection	Linkage to EA Report Guidelines or Other Regulatory Drivers	Baseline Data for EA
Particulate matter, inhalable Particulate matter, respirable Particulate matter, SO_2, NOx and CO	• Indicators of potential project effects from diesel generators and fugitive dust emissions • Parameters of concern with respect to human and environmental health	• Requirement in EA Report Guidelines and Biophysical Workplan • Criteria Air Contaminants under National Ambient Air Quality Objectives	• Project-specific data for emission rates • Regional data for ambient air quality • Qualitative assessments and/or quantitative data
Greenhouse gases including CO_2, CH_4 and N_2O	• Project will emit greenhouse gases • Contribution to national emissions and potential effects on climate change	• Requirement in EA Report Guidelines and Biophysical Workplan • Kyoto Protocol	• Project-specific data for emission rates

Temporal Boundaries

The temporal boundaries for the assessment encompass the period of record for regional air quality data used to characterize baseline and all phases of the project when emissions may potentially affect ambient air quality, that is, construction (August 2006 - Oct 2007), operation (2007 - 2019), and decommissioning (12 months after end of production). At closure there will be no further project effects on ambient air quality.

Study Area

The LSA for the assessment of air quality is shown in Figure 7.2-1 and consists primarily of the zone of influence associated with the underground mine-industrial complex. The LSA is approximately 100 km^2 in size. It encompasses an area 1 km wide centered on the 27.7 km long haul road from the Robert Campbell Highway to the mine-industrial complex. It also encompasses a circular region 5 km in radius, centered on the industrial complex.

There are no substantial sources of criteria air contaminants (CACs) that are close enough to overlap with the effects of project emissions. Virtually all potential effects of project are contained within the LSA.

For sources of CACs less than 100 ty annum detectable concentrations of certain substances may reach as far as 25 km. For sources of CACs greater than 100 t per annum detectable concentrations of certain substances may reach as far as 100 km. Interactions with nearby sources of CACs greater than 5 km distant are therefore possible, and are thus considered. The next nearest substantial source of CACs proximate to the project is the Cantung minesite, scheduled to reopen in the fall of 2005, 110 km to the northeast (Figure 7.11-3). Accordingly, no RSA for cumulative effects assessment has been defined.

Respecting the issue of greenhouse gases (GHGs), the assessment boundaries include British Columbia (BC) and the Territories, plus Canada as a whole. As the climate change issue is global in scope, the project emissions will be placed in a national context to characterize project contributions to national greenhouse gas emissions.

Figure 7.2-1 Air Quality – Local Study Area (Vol. 2)

7.2.2 Baseline Conditions

Baseline ambient air quality conditions in the project area were characterized using available regional data and knowledge of activity levels in the project area. Climate conditions are discussed in Section 7.1: Climate.

The project area is remote, and as such is not substantially influenced by industrial emissions. The nearest source of anthropogenic emissions is vehicular traffic on the Robert Campbell Highway, 27.7 km distant. The existing air quality is expected to be relatively unaffected by substances released to atmosphere by human activities (anthropogenic emissions), save trace amounts of substances transported regionally and/or globally.

Substances released to the atmosphere through natural processes (biogenic emissions) may occasionally affect air quality. Examples of natural processes with the potential to negatively affect air quality include forest fires (smoke), wind storms (soil), volcanoes (particulate, oxides of sulphur), oceans (chloride aerosol, reduced sulphur), aerobic decomposition (reduced sulphur, methane), and chemical reactions typical of the lower and upper atmosphere (ozone and volatile organic compounds). Transport of these substances occurs on local, regional and global scales.

There are no site-specific air quality data available for the project area, nor are there data representative of the immediate region (within 50 km). The most representative regional data available was assembled to generate an approximation of baseline air quality in the LSA.

Two datasets were examined to generate these baseline data. The first is for Whitehorse, Yukon Territory, available through the National Air Pollution Surveillance Program (NAPS), a federally funded national air quality monitoring program. The second is from the British Columbia Ministry of Environment (BC MOE) for Fort Nelson, south of the BC – Yukon border, in northeast British Columbia. The BC data are available through the provincial Air Data Acquisition and Management System (ADAMS) and are collected from publicly and privately funded networks.

Both the Whitehorse and Fort Nelson monitoring stations are affected by anthropogenic sources of emissions to a much greater extent than is the project LSA. The Whitehorse stations are in an urban setting, and the Fort Nelson stations are in an area affected by forest products and natural gas industry emissions. To compensate for the relatively pristine conditions in the project area, values representative of the 50^{th} percentile of these regional data sets are discussed as representative of baseline conditions. Use of the 99^{th} percentile or the maximum values would result in an overly conservative baseline. For the purposes of this assessment, all of the available air quality monitoring results from the interval 2000 to 2005 (where available) have been extracted and analyzed. They are tabulated and discussed below by site in Table 7.2-2 and Table 7.2-3 for Whitehorse and Fort Nelson, respectively. Comparisons are made to appropriate air quality objectives. These are listed in Table 7.2-6.

Table 7.2-2 Summary of Hourly Air Quality Data from the Whitehorse, Yukon Monitoring Stations (μg/m^3)

Parameter	Metric	2000	2001	2002	2003	2004	2005
Co[a,b] (carbon monoxide)	Maximum	8,816	4,872	4,408	4,408	- -	- -
	99th percentile	3,712	1,276	1,160	1,044	- -	- -
	50th percentile	696	348	464	232	- -	- -
	30th percentile	580	348	348	116	- -	- -
	Minimum	232	116	0	0	- -	- -
O_3[c] (ozone)	Maximum	- -	90	120	106	- -	- -
	99th percentile	- -	80	102	100	- -	- -
	50th percentile	- -	46	61	40	- -	- -
	30th percentile	- -	36	49	20	- -	- -
	Minimum	- -	4	6	0	- -	- -
NO_2[b] (nitrogen dioxide)	Maximum	- -	6	19	24	- -	- -
	99th percentile	- -	4	8	4	- -	- -
	50th percentile	- -	0	2	0	- -	- -
	30th percentile	- -	0	0	0	- -	- -
	Minimum	- -	0	0	0	- -	- -
TSP (total suspended particulate)	Maximum	210	106	58	- -	- -	- -
	90th percentile	34	57	48	- -	- -	- -
	50th percentile	16	16	12	- -	- -	- -
	30th percentile	11	9	8	- -	- -	- -
	Minimum	4	2	3	- -	- -	- -
$PM_{2.5}$[b] (respirable particulate matter)	Maximum	- -	40	63	77	- -	- -
	99th percentile	- -	15	14	14	- -	- -
	50th percentile	- -	1	1	1	- -	- -
	30th percentile	- -	0	1	1	- -	- -
	Minimum	- -	0	0	0	- -	- -

Notes: All data obtained from the National Air Pollution Surveillance (NAPS) Network - Annual Data Summaries (Environment Canada 2000-2003)
Year 2004 and 2005 results are not yet published. Columns are included for consistency with other figures and for possible inclusion of these data at a later time
[a] Only 25% data availability in 2000 for CO
[b] Only 44% data availability in 2001 for CO, NO_2 and $PM_{2.5}$
[c] Only 42% data availability in 2003 for O_3
- - Indicates data not yet available or not monitored
CO, O_3, NO_2 and $PM_{2.5}$ data are 1-h values continuously monitored at 1091 1st Avenue
TSP data are 24-h values intermittently monitored at 2130 - 2nd Avenue

For Whitehorse, approximately 315 km to the west of the project area, the 50th percentile values of all measured parameters are well below the applicable Canada ambient air quality objective. The average of medians for the four available years of carbon monoxide data are 435 μg/m^3, or 3% of the Federal Objective (15,000 μg/m^3). For ozone, the three-year average of 49 μg/m^3 is 31% of the Federal Objective (160 μg/m^3). For nitrogen dioxide, the three-year average of 1 μg/m^3 is 0.2% of the Federal Objective (400 μg/m^3). For total suspended particulate, the three-year average of 15 μg/m^3 is 12% of the Federal Objective (120 μg/m^3). For respirable particulate matter ($PM_{2.5}$), the three-year average of 1 μg/m^3 is 31% of the Federal Objective (30 μg/m^3, expressed as the 98th percentile, averaged over three consecutive years).

Table 7.2-3 Summary of Hourly Air Quality Data from Selected Fort Nelson, British Columbia Monitoring Stations (μg/m^3)

Parameter	Metric	2000	2001	2002	2003	2004	2005
SO_2[a] (sulphur dioxide)	Maximum	72	37	29	24	61	64
	99th percentile	8	8	5	5	11	13
	50th percentile	0	0	0	0	0	0
	30th percentile	0	0	0	0	0	0
	Minimum	0	0	0	0	0	0
PM_{10}[b] (inhalable particulate matter)	Maximum	- -	- -	- -	780	640	256
	99th percentile	- -	- -	- -	247	135	84
	50th percentile	- -	- -	- -	10	10	10
	30th percentile	- -	- -	- -	6	7	6
	Minimum	- -	- -	- -	0	0	0
$PM_{2.5}$[b] (respirable particulate matter)	Maximum	- -	- -	- -	- -	- -	122
	99th percentile	- -	- -	- -	- -	- -	26
	50th percentile	- -	- -	- -	- -	- -	2
	30th percentile	- -	- -	- -	- -	- -	1
	Minimum	- -	- -	- -	- -	- -	0

__Notes:__ All data obtained from the British Columbia Ministry of Environment ADAMS System (BC WLAP 2005b)
Year 2005 results are incomplete (38%of year available)
All data are 1-h values, continuously monitored
[a] SO_2 data are from the Fort Nelson Townsite station
[b] PM data are from the Fort Nelson First Nation Chalo School station
- - Indicates data not yet available or not monitored

For Fort Nelson, 420 km to the east-southeast of the project area, the 50th percentile values of all measured parameters are well below the applicable Canada or British Columbia ambient air quality objectives. The average of medians for the six available years of sulphur dioxide data are less than 0.5 μg/m^3, or less than 0.1% of the Federal Objective (450 μg/m^3). For inhalable particulate (PM_{10}), the three-year average of 10 μg/m^3 is 20% of the interim British Columbia Objective (50 μg/m^3). For respirable particulate matter ($PM_{2.5}$), the one-year average of 2 μg/m^3 is 7% of the numeric value of the Canada Wide Standard (30 μg/m^3 expressed as the 98th percentile, averaged over three consecutive years).

The baseline climate conditions for the project are discussed in Section 7.1: Climate, however for purposes of assessing effects on air quality it is important to discuss the dispersion meteorology. Understanding the distributions of wind speed, the predominant wind directions and the patterns of atmospheric stability and mixed layer depth are crucial to predicting the behavior of gases and suspended particulate matter following release to the atmosphere.

As noted in Section 7.1.2.1, a weather station was installed in the vicinity of the airstrip which continuously measured wind speed, wind direction, air temperature, relative humidity, atmospheric pressure, solar irradiance and rainfall. The data were manually downloaded during monthly site visits and analyzed by Jacques Whitford for the purpose of this assessment. Approximately ten months of nearly continuous data were available at the time of writing, from October 15, 2004 to September 1, 2005. There are 27 days of missing data during that period, from July 30 to August 26, 2005. This is a reasonably complete data set, representing four seasons and a range of meteorological regimes experienced at that specific location.

From an air quality perspective, the data of primary interest are the speed and direction of the wind. Summary statistics for wind speed, temperature and relative humidity have been calculated and a cumulative frequency analysis of wind speed and direction performed. The summary statistics are presented below in Table 7.2-4 and the cumulative frequency analysis is presented in Table 7.2-5. The wind statistics are presented in a polar diagram (wind rose) and a wind class frequency histogram in Section 7.1: Climate, Figure 7.2-6 and Figure 7.2-7, respectively.

Table 7.2-4 Summary Statistics for Wind Speed, Temperature and Relative Humidity at Wolverine Project Airstrip HOBO Meteorological Monitoring Station: October 15, 2004 to September 1, 2005

Parameter	Metric						Units
	Min	10th	30th	50th	99th	Max	
Wind speed	0	0	0.37	0.74	3.34	5.38	metres / sec
Temperature	-33.7	-18.76	-8.91	-4.33	17.14	21.71	degrees C
Relative humidity	18.3	47.8	71.8	82.3	98.3	99.3	%

Notes: The metric "10th, 30th" etc. denotes percentiles.

Wind speeds measured at the project Airstrip station are very low. The temperature and humidity data collected at this station are somewhat consistent with expectations for this locale. A full discussion of these climate data are presented in Section 7.1: Climate. The wind speed and direction data are discussed in further detail below.

It is apparent upon reviewing the data presented in Table 7.2-5 and graphically depicted in Figures 7.1-6 and 7.1-7 that the weather station at the project airstrip is in a very sheltered location. The mean wind speed of 0.84 m/s or 3 kph is very low. The maximum speed (30 minute average) is 5.4 m/s or 19 kph. Speeds of less than 0.5 m/s (2 kph) are prevalent 38% of the time. Speeds of less than 2.1 m/s (8 kph) are prevalent 96% of the time.

Figure 7.1-6 illustrates two prominent features of the wind regime at this station. The direction of the prevailing wind is north-east (frequency: 11.2%). The next most prevalent direction, and the origin of the most frequent strong winds, is west (frequency: 6.4%). In describing the wind direction it is assumed that wind is prevailing *from* the cited direction.

Air in motion behaves much like a fluid. It tends to be channeled by terrain. The strongest and most frequent winds generally flow along the main valley axis, with weaker and less frequent winds occurring along the minor axes. Given the valley orientation in the project area winds would be expected to prevail north-northwest to south south-east.

Table 7.2-5 Summary Statistics for Wind Speed and Direction Frequency of Occurrence at Wolverine Project Airstrip HOBO Meteorological Monitoring Station: October 15 2004 to September 1 2005

Wind Direction Class Ranges (16)	Wind Speed Classes - Frequency of Occurrence						Sub-Total	Sub-Total
	0.5 - 2.1 (m/s)	2.1 - 3.6 (m/s)	3.6 - 5.7 (m/s)	5.7 - 8.8 (m/s)	8.8 - 11.1 (m/s)	≥ 11.1 (m/s)	(No.)	(%)
NORTH	514	4	0	0	0	0	518	3.7
NNE	840	23	0	0	0	0	863	6.1
NE	1497	65	15	0	0	0	1577	11.2
ENE	858	6	0	0	0	0	864	6.1
EAST	684	0	0	0	0	0	684	4.8
ESE	321	0	0	0	0	0	321	2.3
SE	306	29	4	0	0	0	339	2.4
SSE	280	22	17	0	0	0	319	2.3
SOUTH	297	27	0	0	0	0	324	2.3
SSW	245	16	0	0	0	0	261	1.8
SW	199	10	0	0	0	0	209	1.5
WSW	585	42	0	0	0	0	627	4.4
WEST	672	180	53	0	0	0	905	6.4
WNW	351	49	18	0	0	0	418	3.0
NW	198	15	5	0	0	0	218	1.5
NNW	223	2	0	0	0	0	225	1.6
Sub-total (No.)	8070	490	112	0	0	0	8672	
Sub-total (%)	57.1	3.5	0.8	0.0	0.0	0.0	61.4	

Frequency of calm winds (%):	38.6	Calm observations:	5449	38.6
		Missing observations:	0	0.0
Average wind speed (m/s):	0.84	Total observations:	14,121	100.0

The observed wind directions and the generally weak winds are consistent with the station location and sensor height (3 m). The prevailing weak north-east winds are a result of cooler (thus denser) air draining down Go Creek valley. These drainage or katabatic winds are prevalent at night and are most frequently observed in the colder months of the year.

The westerly winds reveal some influence of the main valley flow (NNE – SSW), albeit this effect is very muted. This is a result of the wind sensors location in a zone heavily influenced by the frictional influence of the local vegetation. It is expected that a sensor height of 10-20 m at this location would still register the influence of katabatic flow down Go Creek, however the NNE – SSW signature of the main valley flow would predominate.

These wind data collected at the airstrip stations are not considered representative of the mine-industrial complex area, nor should they be used in the conduct of atmospheric dispersion modeling. They would not faithfully portray the dispersion of airborne substances about the area. In the absence of more representative data, the effects of project emissions can be conservatively assess by assuming that worst-case conditions prevail, and that emissions will always be carried by the least favourable winds to the closest receptor at all times. If this scenario does not result in unacceptable ground-level concentrations, it is not necessary to proceed to more detailed analyses.

If dispersion modeling were deemed necessary, it would be appropriate to employ one of three options. The first would be to use the screening meteorological data set from the US Environmental Protection Agency (US EPA) SCREEN3 regulatory model. The second option would be to obtain a set of observations from a regionally-representative site and adjust it to suit local conditions. The third option would be to synthesize a meteorological time series from existing surface and upper air observations using the US EPA CALMET meteorological pre-processing software.

7.2.3 Effects Assessment Methodology

The assessment of project effects on ambient air quality focused on the following Criteria Air Contaminants and Greenhouse Gases, which reflect the project emissions of concern with respect to human and environmental health:

Criteria Air Contaminants:

- particulate matter, including total suspended particulate (TSP); inhalable particulate matter (PM_{10}) and respirable particulate matter ($PM_{2.5}$)
- sulphur dioxide (SO_2)
- nitrogen dioxide (NO_2)
- volatile organic carbon (VOC)
- carbon monoxide (CO)

Greenhouse Gases:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)

A description of these project related air contaminants and the ambient air quality objectives used to assess potential effects are provided in the following sections.

Total Suspended, Inhalable and Respirable Particulate Matter (TSP, PM_{10} and $PM_{2.5}$)

Particulate matter is classified by size of the particle. Particle size determines the velocity with which gravitational settling occurs, and the ease with which they penetrate the human respiratory tract. Generally, large particles settle out very close to the source, and very fine particles penetrate deep into the respiratory tract. Total suspended particulate matter encompasses all size ranges from approximately 100 micrometers (µm) to the sub-micrometer range. Inhalable (PM_{10}) and respirable ($PM_{2.5}$) particulate matter are comprised of very small particles that are less than 10 and 2.5 µm, respectively.

Particles smaller than 10 µm can make their way deep into the respiratory tract and become lodged there. Over the past few years, greater concern with regard to these fine particles has led to research resulting in new sampling methods and criteria. In June 2000, the Canadian Council of Ministers of the Environment (CCME) adopted in principle Canada-Wide Standard (CWS) for particulate matter. Although achievement of the CWS for $PM_{2.5}$ is proposed for 2010 it provides relevant guidance in the interim. For it to be enforceable it must be adopted by the Provincial or Territorial regulatory agency. The CWS provides for a proposed $PM_{2.5}$ standard of 30 $\mu g/m^3$ (micrograms per cubic metre) for the fine (<2.5 µm) particulate fraction as a 24-hour measurement. Achievement is to be based on the 98th percentile of the ambient measurement annually, averaged over three consecutive years.

Project-related sources of particulate matter (PM) include internal combustion and fired equipment such as the diesel generators, heaters, and the incinerator. The burning of land clearing debris also generates PM. Fugitive and process dust is also considered PM. Combustion-related PM is generally in the respirable range (<2.5 µm), while fugitive and process dust are generally above the inhalable range (>10 µm).

Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) is a colourless gas with a distinctive pungent sulphur odour. It is produced in combustion processes by the oxidation of sulphur in fuel. At high concentrations, SO_2 can have negative effects on leaf tissue, especially in sensitive species. At very high concentrations there may be effects on human and animal health, particularly with respect to the respiratory system. The SO_2 can also be further oxidized and may combine with water to form the sulphuric acid component of "acid rain."

Anthropogenic emissions comprise approximately 95% of global atmospheric SO_2. The largest anthropogenic contributor to atmospheric SO_2 is the industrial and utility use of heavy oils and coal. Oxidation of reduced sulphur compounds emitted by ocean surfaces account for nearly all biogenic emissions. Volcanic activity accounts for much of the remainder. Motor vehicles are relatively small contributors to the SO_2 content of the atmosphere (Wayne 1991).

The mass of sulphur dioxide emissions related to the project are expected to be very low. These emissions are largely confined to diesel generators, the waste incinerator and construction equipment. They will be released through combustion processes of fuels that contain sulphur (gasoline, diesel oil, and waste oil). Propane contains negligible amounts of sulphur. The diesel oil and gasoline utilized on site will be low-sulphur (<15 ppm). Waste oil will contain generally low amounts of sulphur.

Oxides of Nitrogen (NO, NO_2)

Nitrogen oxides are produced in most combustion processes, and almost entirely made up of nitric oxide (NO) and nitrogen dioxide (NO_2). Together, they are often referred to as NOx. The NO_2 is an orange to reddish gas that is corrosive and irritating. Most NO_2 in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure, such as internal combustion engines. Nitric oxide is a colourless gas with no apparent direct effects on animal health or vegetation at typical ambient levels. The concentration of NO_2 is the regulated form of NOx.

The levels of NO and NO_2, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight are the most important factors in the formation of ground-level ozone and other oxidants. Further oxidation and combination with water in the atmosphere forms nitric acid, another part of "acid rain". Anthropogenic emissions comprise approximately 93% of global atmospheric emissions of NOx (NO + NO_2). The largest anthropogenic contributor to atmospheric NO_X is combustion of fuels such as natural gas, oil and coal. Forest fires, lightning and anaerobic processes in soil account for nearly all biogenic emissions (Wayne 1991).

NOx will be released by all internal and external combustion equipment on site, but in relatively small quantities. External combustion processes, such as fired equipment (heaters and the waste incinerator), plus aircraft and land clearing burning are also sources of NOx.

Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless gas. It is a product of incomplete combustion of hydrocarbons such as fossil fuels and wood. Motor vehicles, industrial processes and natural sources (fires) are some common sources. Typical concentrations in the atmosphere are 120 $\mu g/m^3$, while minimum levels known to produce cardiovascular symptoms in smokers is approximately 35,000 $\mu g/m^3$. CO will be released by all internal and external combustion equipment on site, but in relatively small quantities.

Volatile Organic Carbon (VOC)

Volatile Organic Compounds (VOCs) are carbon-containing (organic) compounds that readily evaporate into the air under ambient conditions. Many VOCs are of natural origin including methane. For example, VOCs are largely responsible for the pleasant odour perceived in a forest. Others may be potentially harmful to the environment, either directly through inhalation or indirectly as a contributor to ground level ozone and smog formation.

Examples of VOC sources include: hydrocarbon fuels, paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions. While VOCs are naturally present in the atmosphere and emitted by automobiles and industrial processes, the concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. Some VOCs may have short and long-term adverse health effects.

VOC emissions during construction will be largely generated from heavy equipment operation at the site. During the operations phase, VOC emissions will be generated largely by internal combustion engines (mobile and stationery), heaters, the waste incinerator and fuel storage. Emissions of VOC at the project site will be relatively small.

Greenhouse Gases (GHG)

Greenhouse gases are emitted as a consequence of all internal and external combustion equipment on site, plus land clearing burning. The quantities of GHGs emitted are substantial given the need to generate all power on site through fossil-fuel combustion; however, they are comparatively small on a regional or national basis.

Greenhouse gasses generally include all emissions carbon dioxide (CO_2), nitrous oxide (N_2O) and methane(CH_4). The sum of all greenhouse gasses is generally expressed as a carbon dioxide equivalent (CO_{2e}). For the project, emissions of CH_4 are virtually absent as natural gas is not available as a fuel (natural gas is mostly methane). Diesel fuel and propane make up nearly all of the fuel used in the LSA. Nitrous oxide is emitted as a by-product of high-temperature combustion. These missions are insubstantial. As such, in this assessment it is assumed that GHGs are fully represented by emissions of CO_2 (e.g., $CO_{2e} = CO_2$).

There are currently no federal or provincial requirements or restrictions on the emission of greenhouse gases. However, aggressive targets for reduction have been agreed to at the federal level with the ratification of the Kyoto Protocol.

The quantities of GHG emissions resulting from the project will be estimated and considered in a larger context, consistent with the guidance provided by the Canadian Environmental Assessment Agency (CEAA 2003).

Federal Ambient Air Quality Criteria

The Canada (Federal) ambient air quality objectives are shown in Table 7.2-6. The objectives are denoted as Desirable, Acceptable and Tolerable as follows:

- ***The Maximum Desirable Level*** is the long-term goal for air quality and provides a basis for anti-degradation policy for unpolluted parts of the country, and for the continuing development of control technology.
- ***The Maximum Acceptable Level*** is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.
- ***The Maximum Tolerable Level*** denotes time-based concentrations of air contaminants beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.

Qualitative Assessment of Effects

In instances where emission rates of CACs are very low, professional judgment can be used to assess potential effects without application of quantitative tools such as atmospheric dispersion modeling. In this instance, emissions have been estimated and expressed in terms which allow comparison to other common sources. Baseline conditions have also been defined. As such, potential effects of the Wolverine Project have been assessed based on predicted and measured effects for like-sized sources in a similar context.

In keeping with the EA Report guidelines, project effects are characterized according to effects attributes in Table 7.2-7.

Table 7.2-6 Federal Ambient Air Quality Objectives

Pollutant and Units (alternative units in brackets)	Averaging Time Period	Canada			
		Canada-Wide Standards (pending)	Ambient Air Quality Objectives		
			Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Nitrogen dioxide (NO_2) µg/m^3 (ppb)	1 hour	-	-	400 (213)	1000 (532)
	24 hour	-	-	200 (106)	300 (160)
	Annual	-	60 (32)	100 (53)	-
Sulphur dioxide (SO_2) µg/m^3 (ppb)	1 hour	-	450 (172)	900 (344)	-
	24 hour	-	150 (57)	300 (115)	800 (306)
	Annual	-	30 (11)	60 (23)	-
Total suspended particulate matter (TSP) µg/m^3	24 hour	-	-	120	400
	Annual	-	60	70	-
PM_{10} µg/m^3	24 hour	50	-	-	-
$PM_{2.5}$ µg/m^3	24 hour	30	-	-	-
Carbon monoxide (CO) mg/m^3 (ppm)	1 hour	-	15 (13)	35 (31)	-
	8 hour	-	6 (5)	15 (13)	20 (17)
Ozone (O_3) µg/m^3 (ppb)	1 hour	-	100 (51)	160 (82)	300 (153)
	8 hour	128 (65)	-	-	-
	24 hour	-	30 (15)	50 (25)	-
	Annual	-	-	30 (15)	-

Sources:
[1] WLAP (2005), Air Quality Objectives and Standards
[2] Government of Canada (1999), National Ambient Air Quality Objectives
[3] Interim Level B PM_{10} Standard for the BC Ministry of Water, Land and Air Protection (WLAP)
[4] CCME (2000), Canada-Wide Standards for Respirable Particulate Matter and Ozone, effective by 2010. The Respirable Particulate Matter Objective is referenced to the 98th percentile over 3 consecutive years, and the Ozone Objective is referenced to the on 4th highest 8-hour average annual value, averaged over three consecutive years.

Determination of Effects Significance

Air Quality

The significance of any adverse residual project and cumulative effects on ambient air quality will be determined based on the defined effects attributes, as follows:

A residual effect will be considered significant if it is a high magnitude effect of any geographic extent or duration. Otherwise, effects will be rated as not significant.

A high magnitude effect on air quality is one that results in change in ambient air quality such that the maximum ground-level concentration of any identified substances of concern (CAC) results in an exceedance of the respective ambient air quality objective as defined by the Maximum Desirable Level.

Table 7.2-7 Effect Attributes for Air Quality

Attribute	Definition
Direction	
Positive	Condition of VECC is improving
Adverse	Condition of VECC is worsening or is not acceptable
Neutral	Condition of VECC is not changing in comparison to baseline conditions and trends
Magnitude	
Low	Within normal variability of baseline conditions
Moderate	Increase/decrease with regard to baseline but within limits and objectives
High	Singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives
Geographic Extent	
Site-specific	Effect on VECC confined to a single small area within the Local Study Area (LSA)
Local	Effect on VECC within Local Study Area (LSA)
Regional	Effect on VECC extends beyond the Local Study Area (LSA). Assessment of project effects on climate change are characterized in the context of contributions to Territorial/BC emissions and national emission only
Duration	
Short term	< 1 month
Medium term	> 1-24 months
Long term	> 24 months
Frequency (Short term duration effects that occur more than once)	
Low	Frequency within range of annual variability and does not pose a serious risk to the VECC or its economic or social/cultural values
Moderate	Frequency exceeds range of annual variability but is unlikely to pose a serious risk to the VECC or its economic or social/cultural values
High	Frequency exceeds range of annual variability and is likely to pose a serious risk to the VECC or its economic or social/cultural values
Reversibility	
Reversible	Effects on VECC will cease during or after the project is complete
Irreversible	Effects on VECC will persist during and/or after the project is complete
Likelihood of Occurrence	
Unknown	Effect on VECC is not well understood and based on potential risk to the VECC, effects will be monitored and adaptive management measures taken, as appropriate
High	Effect on VECC is well understood and there is a high likelihood of effect on the VECC as predicted

Climate Change

The science of climate change has not been advanced to the point where a clear cause-and-effect relationship can be established between specific or even provincial/territorial and national emissions and subtle changes in global climate. Climate change is a global issue.

The incremental increases in global emissions of greenhouse gases from anthropogenic sources are thought to be a substantial contributor to climate change. It is not possible to conclude with certainty that any given source of GHGs has a measurable cause-and-effect relationship on climate. As such, the incremental contribution of the project to national or global GHG emissions cannot be linked to specific changes in global climate.

The estimated GHG emissions from the project are described in context with total emissions from British Columbia and the Territories, and Canada. Estimates of the total GHG emissions have been obtained from federal regulatory agencies. In the absence of a measurable cause effect relationship between GHG emission levels and climate change, no determination of significance is made.

7.2.4 Project Effects

The assessment of effects of project-related emissions on ambient air quality is sub-divided into construction and operations phases. Emissions during decommissioning will be similar to those of construction, and project-related emissions will cease at closure. The sources of construction phase emissions are internal combustion engines employed in construction equipment, light and heavy-duty vehicles, mining equipment and diesel electrical generators. There are also emissions from mine heaters, transportation to and from the mine industrial complex (including aircraft) and land clearing burning. Operational phase emissions are mainly fugitive dust from crushers units on site, vehicular emissions from concentrate hauling, and emissions from operation of diesel generators and the waste incinerator. Minor operational emissions include other road transportation and aircraft emissions.

Emission rates for each phase were based on information on project equipment and transportation activity provided by YZC and literature documenting emission rates for various types of equipment and vehicles. Assumptions used estimates of project related emissions are described below.

Emission estimation for diesel engines in all phases is based on the US EPA Tier 2 standard for non-road diesel engines which is in effect from 2001-2006 (US EPA 2004). Tier 2 standard emission factors/limits vary according to engine power category; however, the highest emission factors among all engine ratings were employed to account for engine deteriorations and to provide a conservative estimate.

Equipment operation shifts were provided by YZC and were calculated over 365 days per year. Emissions from diesel generator are estimated for one generator during both construction and decommissioning and seven units during operation. YZC has specified the Cummins DQKC, a 1600 kW (2146 HP) diesel unit. The assumed operation time for the generator sets is 24 h/d and 365 d/y. One unit is assumed to be operating for the construction phase (and decommissioning) and six of seven units are assumed to be operating during the operations phase (with one as a backup).

There will be 13 round trips per day to transport concentrate, cement, fuel, reagents, local-based employees, mine supplies, and camp food. The new portion of the access road from the airstrip to the Robert Campbell Highway is 25.2 km long. The existing road from the airstrip to the mine-industrial complex is 2.5 km long, for a total road length of 27.7 km. Vehicular traffic emissions from the construction phase are expected to be similar to those during operations. There will be a once-weekly trip to the project airstrip via a DeHavilland Dash 7 aircraft for both construction and operations phases, for crew rotations, plus two flights per week via a Chieftain for emergency supplies and other employees/contractors not on a rotation schedule.

The estimation of CAC emissions assumes the application of best construction and operational practices and other mitigative actions, which have been confirmed by YZC. For example, emissions of sulphur dioxide are reduced dramatically through use of low sulphur diesel fuel (<15 ppm) for all internal and external combustion applications. Examples include light and heavy-duty motor vehicles, heavy construction equipment, electrical generators and the incinerator. Other mitigation measures for combustion-related equipment include maintenance as per the manufacturers recommended schedules and adherence to applicable criteria respecting emission quality.

Fugitive dust is reduced through the minimization of activities that generate large quantities of dust when windy and the application of dust suppressant to unconsolidated working surfaces during periods of heavy activity and/or dry periods. Land clearing burning will be conducted in accordance with best established practices.

7.2.4.1 Construction

Construction phase emissions are comprised of construction and mining equipment emissions, vehicular traffic emissions and emissions from the diesel generators. A summary of the estimated emissions in construction and commissioning phase are presented in Table 7.2-8.

Table 7.2-8 Estimated Air Emissions Associated with Wolverine Project - Construction Phase

Emission Source	Criteria Air Contaminant Emissions (t/y)[a]					Greenhouse Gas Emissions (t/y)
	$PM_{2.5}$	VOC	NOx	CO	SO_2	CO_2
Construction / mining equipment	3.85	6.11	70.75	57.35	0.08	8479
Vehicular traffic	0.16	0.25	3.86	1.67	0.77	361
Diesel generator sets[b]	1.88	6.40	133.57	18.80	0.10	9893
Total	**5.88**	**12.75**	**208.18**	**77.82**	**0.95**	**18,732**

Notes: [a] based on 365 d/y operation
[b] based on 24 h/d operation time at full load of 1 unit

Emissions of CACs in the construction phase are relatively small on a per annum basis. Estimated daily emission rates are as follows: $PM_{2.5}$ – 16 kg/d; VOC – 35 kg/d; NOx – 570 kg/d; CO – 213 kg/d; and SO_2 – 2.6 kg/d.

The total emission of GHGs in the construction phase is 18.7 KT/y. On a per-day basis GHG emissions are 51 t. Of this, 53% is for power generation and 45% for construction and mining equipment.

The largest stationery source of CACs in the construction phase is the single diesel generator. Next largest is the construction and mining equipment – largely mobile sources. It is expected that the number of vehicles and heavy equipment used during the construction phase will be operated intermittently over time and distributed spatially such that the atmosphere will effectively disperse the emissions and minimize the potential for effects on local air quality.

This analysis concluded that the largest stationery source of CACs, the single generator, has little discernable effect outside the LSA. Inside the LSA concentrations of NO_2 are expected to be very low, even at the most affected location. The 1-hour and 24-hour concentrations of NO_2 are expected to be less than the most stringent applicable objective (Maximum Acceptable Level in Table 7.2-6).

Respecting the mobile sources of CACs, it is expected that the heavy equipment and vehicles used during the construction phase will be operated for extended periods, but distributed spatially such that the atmosphere will effectively disperse the emissions. This will minimize the potential for effects on local air quality. Emissions for minor sources such as the three flights per week and the brief period of land clearing burning were not quantified.

The substances of concern respecting the combustion sources are $PM_{2.5}$, NOx and SO_2 from stationery and mobile sources. A qualitative analysis of these emissions indicates that the potential for any exceedances of the applicable objectives (Table 7.1-6) is insubstantial.

Based on quantitative estimates of CAC emissions and a qualitative assessment of potential effects during construction, project effects are rated as adverse, low magnitude, site-specific, medium term and reversible. The likelihood that effects will occur as predicted is high based on observations of similar facilities in similar baseline conditions.

7.2.4.2 Operations

Sources of operations phase emissions include mining equipment, mine heaters, vehicular traffic, diesel generators and the waste incinerator.

Crushing units are electric motors driven; therefore, emissions from those units are mainly fugitive dust. Fugitive dust estimates were provided by Hatch. Fugitive dust emissions from road traffic are not estimated in this assessment as they are insubstantial compared to those from mining operation. Fugitive dust emissions from road traffic are spread over 27.7 km distance and happen occasionally when there is traffic on the gravel road to the camp, while those from mining operation are localized and occur through the day.

A waste oil fuel-fired dual chamber incinerator is proposed waste disposal. Waste oil from routine equipment and vehicle maintenance will be used as a fuel source for the incinerator. Emissions from the incinerator are based on assumed 8 hr/week operation time. The incinerator manufacturer’s guaranteed emissions rates are presented below:

Particulate	0.805 lb/hr (0.08 g/dscf) Guarantee 0.1 g/dscf
Carbon Monoxide	0.218 lb/hr max (4 0ppm_v)
Hydrocarbons	0 lb/hr
Sulfur Oxides	1.9 lb/hr (0.24 g/s)
Hydrogen Chloride	0.6 lb/hr (0.08 g/s)

A summary of the estimated air and fugitive dust emissions in the operations phase is presented in Tables 7.2-9 and Table 7.2-10, respectively.

Table 7.2-9 Estimated Air Emissions Associated with the Wolverine Project - Operations Phase

Emission Source	Criteria Air Contaminant Emissions [a] (tonnes/year)					Greenhouse Gas Emissions (tonnes/year)
	$PM_{2.5}$	VOC	NOx	CO	SO_2	CO_2
Mine heating	0.05	0.02	0.50	0.68	0.00	35,950
Vehicular traffic	0.16	0.25	3.86	1.67	0.77	361
Diesel generator sets[b]	11.28	38.38	801.43	112.81	0.62	59,355
Incinerator[d]	0.15	0.00	0.01	0.04	0.36	164
Total	**11.64**	**38.64**	**805.81**	**115.20**	**1.75**	**95,831**

Notes: [a] based on 365 d/y operation
[b] based on 24hr/d operation time at full load of six units (not including 1 backup unit)
[c] assumed value
[d] based on 8 hr/week operation time

Table 7.2-10 Fugitive Dust Emissions Associated with On-Site Crushers for the Wolverine Project - Operations Phase

Emission Source	Fugitive Dust Emissions [a] (tonnes/year)
Primary crushing dust collector	1.570
Secondary crushing dust collector	1.570
Assay laboratory dust collector	0.445
Maintenance shop dust collector	0.525
Total	**4.110**

Notes: [a] as provided by Yukon Zinc

Emissions of CACs in the operations phase are relatively small on a per annum basis. Estimated daily emissions rates are as follows: $PM_{2.5}$ – 31 kg/day; VOC – 106 kg/day; NOx – 2206 kg/day; CO – 314 kg/day; and SO_2 - 4 kg/day. Fugitive dust emissions from the mine mill complex crushers are relatively small on a per annum basis. On a per-day basis they are 11 kg. Emissions of greenhouse gases, on a per-day basis, are 218 t.

The largest stationery source in the operational phase is the bank of six diesel generators (the single backup generator was not included in the calculations). Next largest is the vehicular traffic (mobile sources). Emissions for minor sources such as the aircraft were not quantified. The substances of concern respecting the combustion sources are $PM_{2.5}$, NOx and SO_2. Both qualitative and quantitative analysis of these emissions indicates that the potential for exceedances of the applicable objectives is insubstantial (Table 7.2-6).

This analysis reached the conclusion that the largest stationery source of CACs, the bank of six generators, has little discernable effect outside the LSA. Inside the LSA ground level concentrations of NO_2 are expected to be somewhat elevated at the most affected location under worst-case meteorological conditions. For the remainder of the time the ground level concentrations of NO_2 will be indistinct from baseline conditions (described in section 7.2.2). The 1-hour and 24-hour concentrations of NO_2 are expected to be less than the most stringent applicable objective (Maximum Acceptable Level in Table 7.2-6).

Respecting the mobile sources of CACs, it is expected that the limited number of vehicles used during the operational phase will be operated sporadically and distributed spatially such that the atmosphere will effectively disperse the emissions. This will minimize the potential for effects on local air quality.

Based on quantitative estimates of CAC emissions and a qualitative assessment of potential effects during operations, project effects are rated as adverse, low magnitude, site-specific, medium term and reversible. The likelihood that effects will occur as predicted is high based on observations of similar facilities in similar baseline conditions.

Total GHG emission in the operations phase are 95.8 KT/y. Of this, 68% is for power generation and 31% for mine heat. This emission was compared to GHG emissions estimates for Canada and British Columbia plus the Territories (Table 7.2-11).

Table 7.2-11 Greenhouse Gas Emissions for Canada and for British Columbia and the Territories Combined

Year	Estimated Total Greenhouse Gas Emissions	
	Canadian Total (KT CO_2-equivalent/y)	British Columbia + Territories Total (KT CO_2-equivalent/y)
2020	845,000	84,000
2015	813,000	78,000
2010	764,000	73,000
2005	728,000	68,000
2000	694,000	64,000
1995	653,000	63,000
1990	601,000	53,000

Source: NRCan 2005; NRCan 2005b

Note: Data for 2000 and beyond are projections
Data for British Columbia includes the Territories

Estimated project emissions of GHGs (CO_2) in the operational phase are approximately 0.2% of the total GHG emissions for British Columbia and the Territories (2010 estimate) and 0.015% of the projected 2010 emissions for Canada as a whole.

Energy uses (i.e., power generation, stationary fuel combustion, and transportation) account for approximately three-quarters of greenhouse gas emissions at both the national and provincial levels. Energy use for transportation accounts for just less than one half of the CO_{2e} emitted in British Columbia and the Territories. For Canada this category accounts for less than a quarter of the CO_{2e} emitted. This is likely due to the large distances between population and resource centers in this region. At both the national and provincial levels fossil fuel and other fuel combustion for industrial, energy industry and power generation purposes account for the much of the GHG emissions.

There is an increasing trend in greenhouse gas emissions, both nationally and provincially. Between 1990 and 2020, it is expected that British Columbia and the Territories will see GHG emissions rise by 58% (31 MT CO_{2e}). In that same interval, Canadian greenhouse gas emissions are expected to rise by 41% (244 MT CO_{2e}). This is due largely to an increase in consumer demand for goods and services, electricity and transportation fuels.

While climate may be influenced by increases in the concentrations of greenhouse gases in the atmosphere globally, the present state of climate science cannot demonstrate cause-and-effect relationship for emissions from individual projects. Adaptive management approaches will be employed for management of GHG emissions at the underground mine – industrial complex. For example, waste heat from the generators will be recovered to heat the industrial complex building. Other energy efficiency measures will be employed where economically viable.

It is anticipated that the project operations will not result in discernible changes to regional, national, or global climate patterns. Emissions of GHGs from the project are not expected to result in any significant adverse environmental effects. It is therefore not considered further in the assessment.

Under the authority of the Canadian Environmental Protection Act, 1999, the government of Canada has recently (Canada Gazette, March 13, 2004) announced mandatory reporting requirements for those facilities in Canada that emit 100 KT or more of CO_2 equivalent annually. The project will provide the annual report on GHG emissions after operations commence and prior to the regulatory report date.

7.2.4.3 Decommissioning

In the decommissioning phase of the project some effects on air quality are expected to occur. The magnitude of these effects is expected to be very low. The decommissioning of the underground mine – industrial complex, the removal of facilities, and site closure may result in emissions of CACs and fugitive dust.

The potential effects on air quality that may occur during decommissioning are similar to those predicted for construction. However, the magnitude, frequency, and duration of those effects are expected to be of a much smaller scale. The limited number of vehicles and equipment used during decommissioning will allow for sufficient dispersion of these emissions and will minimize potential effects on local air quality.

Mitigation will include the application of dust suppressants on unconsolidated working surfaces during periods of heavy activity and/or dry periods. The vehicles and heavy equipment will be properly maintained to minimize emissions. These measures will ensure that air quality will remain within the applicable ambient objectives.

As for the construction phase and based on quantitative estimates of CAC emissions and a qualitative assessment of potential effects during decommissioning, project effects are rated as adverse, low magnitude, site-specific, medium term and reversible. The likelihood that effects will occur as predicted is high based on observations of similar facilities in similar baseline conditions.

7.2.4.4 Closure

No further project-related air emissions are expected at closure, with the exception of possible intermittent road or air access for site monitoring, and a single generator to power the water treatment plant as required. These emissions are considered to be insubstantial and not significant.

7.2.4.5 Residual Project Effects and Significance

During project construction, operations and decommissioning, there will be emissions of CACs in particular $PM_{2.5}$, NO_X and SO_2. Effects on ambient air quality will be greatest during operations but projected emissions will not result in ground level concentrations in excess of the most stringent air quality objectives (Table 7.2-6). These 'Maximum Desirable' objectives represent the long-term goal for air quality. They provide a basis for antidegredation policy for unpolluted parts of the country. As such, they provide a large margin of safety respecting effects on soil, water, vegetation, materials, animals, visibility, and personal comfort and well-being. Note that for NO_2 the most stringent applicable 1-hour objective is the Canada Maximum Acceptable Level (there is no Maximum Desirable level for NO_2).

Emissions will cease within approximately five years of closure due to continued water treatment plant operations. After water quality objectives have been met, any effects attributable to them will be reversed. For example, subtle effects on the most sensitive receptors, native vegetation in close proximity to the emissions, are expected to be virtually undetectable in as little as one growing season. Based on the criteria in Section 7.2.3 residual project effects during all phases of the project are determined to be not significant.

These conclusions are based on a qualitative assessment of the emission quantities and preliminary quantitative analyses. Based on professional judgment a dispersion assessment of the largest emission source (the generators) was deemed unnecessary given the relatively small quantities of $PM_{2.5}$, NOx and SO_2 discharged. The likelihood of effects occurring as predicted is high.

7.2.5 Cumulative Effects

The project local study area is relatively remote. It is 110 km distant from the next-nearest substantial source of CACs. As such it is not substantially influenced by anthropogenic emissions, save trace amounts of substances transported regionally and/or globally. As well, it has been concluded that following application of mitigating measures the residual project effects on air quality are expected to be not significant.

Given the aforementioned, the potential for the residual project effects to have a significant effect in combination with effects of other activities in the area is negligible. This includes existing and ongoing activities, approved projects or activities, and projects or activities expected to occur in the reasonably foreseeable future.

7.2.6 Mitigation Measures

Table 7.2-12 is a summary of mitigation measures for potential project effects and potential cumulative effects.

Table 7.2-12 Mitigation Measures for Effects on Air Quality

Potential Project Effect	Mitigation Measures
Emissions of CACs, including respirable particulate matter, nitrogen dioxide and sulphur dioxide from vehicles, generators, mine heaters and the waste incinerator potentially affecting human health and the environment, including vegetation and wildlife	• Use low sulphur fuels including diesel fuel with a sulphur content <15 ppm and propane with negligible sulphur content • Meet applicable criteria respecting emission quality on all combustion-related equipment and provide maintenance according to manufacturers specifications
Emissions of fugitive dust from light and heavy duty motor vehicles, heavy construction equipment, construction activities and ore crushing activities potentially emit coarse particulate matter which is both a nuisance and can potentially affect human health and the environment, including vegetation and wildlife.	• Apply dust suppressant (such as water spray to unconsolidated working surfaces and development rock and ore stockpiles to minimize fugitive dust during periods of heavy activity and/or dry periods • Minimize activities that generate large quantities of fugitive dust when windy • Reseed disturbed areas and topsoil stockpiles to prevent fugitive dust from wind erosion
Emissions of CACs and GHGs from land clearing burning	• Apply best practices regarding land-burning clearing • Do not use prohibited materials (waste oil, tires) as accelerants
Emissions of GHGs from the diesel generators, mine heaters, construction equipment and vehicular traffic with potential contributions to climate change	• Recover waste heat from the generators to heat the process building, assay lab and camp
Potential Cumulative Effect	**Mitigation Measures**
N/A	• N/A

Notes: N/A = not applicable

7.2.7 Monitoring and Follow-up

Follow-up Studies

There are no proposed follow-up baseline studies identified to improve predictive confidence or improve the database for effects monitoring purposes.

Monitoring Programs

There are no monitoring programs identified for project effects or cumulative effects.

7.2.8 Summary of Effects

Table 7.2-13 is a summary of the effects assessment conclusions including the level of effect and the overall effects rating.

Table 7.2-13 Summary of Project Effects on Air Quality

Potential Effect	Level of Effect[1]						Effect Rating[2]	
	Direc-tion	Magni-tude	Extent	Duration/ Frequency	Reversi-bility	Like-lihood	Project Effect	Cumulative Effect
Construction and Decommissioning								
Fugitive dust emissions from ground disturbance, heavy construction equipment, and vehicles with potential effects on human health, vegetation and wildlife	Adverse	Moderate	Local	Medium Term	Reversible	High	Not significant	Not significant
Fugitive dust and emissions of CACs from diesel generators, mining equipment including mine heaters and waste incinerator	Adverse	Low to Moderate	Local	Medium term	Reversible	High	Not significant	Not significant
Particulates and VOC emissions from site clearing and burning of woody debris	Adverse	Low to Moderate	Local	Medium term	Reversible	High	Not significant	Not significant
GHG emissions from combustion engines, diesel generators, waste incinerators and land clearing burning	Adverse	Low to Moderate	Local	Medium term	Reversible	High	Not significant	Not significant
Operations								
Fugitive dust emissions from ore crushing and vehicle use with potential effects on human health, vegetation and wildlife	Adverse	Moderate	Local	Long term	Reversible	High	Not significant	Not significant
Fugitive dust and emission of CACs from diesel generators, mining equipment including mine heaters and waste incinerator	Adverse	Moderate	Local	Long term	Reversible	High	Not significant	Not significant
Closure								
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:
1 Based on criteria in Table 7.2-7
2 Based on criteria in Section 7.2.3
N/A = not applicable