MIRAMAR DORIS NORTH PROJECT

AIR QUALITY MANAGEMENT PLAN

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October 2006 **Golder Associates**

Suggested Citation: Golder Associates Ltd. 2006. Miramar Doris North Project Air Quality Management Plan. Prepared for Miramar Hope Bay Ltd., North Vancouver, BC by Golder Associates Ltd., Calgary, AB. Golder Report No. 06-1373-026AQ: 12 p.

1 INTRODUCTION

Miramar Hope Bay Ltd. (MHBL) has developed an air quality management program as part of the Doris North Mine permitting phase. The management plan includes the following:

- control measures that will be established to mitigate combustion and fugitive emissions from the Mine;

- a monitoring plan to collect on-site air quality and meteorological data to allow for an adaptive approach to air quality management at the Doris North Mine.

2 EMISSION ESTIMATES AND AIR QUALITY PREDICTIONS

2.1 AIR EMISSION SOURCES

There are two main types of air emissions from the Doris North Mine: combustion emissions and fugitive emissions. Combustion emissions at the Mine result from burning fuel to produce electricity, space or process heating and transportation. Compounds such as sulphur dioxide (SO_2), oxides of nitrogen (NO_X), total suspended particulates (TSP), particles with diameter less than 10 µm (PM_{10}), particles with diameter less than 2.5 µm ($PM_{2.5}$) and greenhouse gases are combustion by-products. Fugitive emissions are substances that are released to the atmosphere without passing through a stack or vent.

Table 2-1 has been reproduced from the EIS and provides a list of sources and emissions for the construction phase of the Mine. The majority of emissions during the construction phase are a result of mine fleet exhaust, space heating, incineration, road dust and construction activity, such as bulldozing and grading.

Table 2-1 Summary of Construction Emissions for the Doris North Mine

Source	Emission Rates [t/d]				
	SO_2	NO_X	TSP	PM_{10}	$PM_{2.5}$
space heating[(a)]	0.011	0.029	0.005	0.003	0.003
mine fleet exhaust	0.012	0.716	0.042	0.042	0.042
quarrying[(b)]	0.010	0.071	0.093	0.042	0.026
construction dust[(c)]	—	—	0.082	0.039	0.012
incinerator	0.000	0.000	0.001	0.001	0.001
airstrip activities[(d)]	0.000	0.019	0.001	0.001	0.001
Total	0.033	0.835	0.224	0.129	0.086

(a) Includes emissions from space heating and the waste oil burner.
(b) Includes emissions from drilling, blasting, crushing and truck loading.
(c) Includes emissions from road dust, bulldozing and grading.
(d) Includes emissions from air traffic and portable lighting plants.

Table 2-2 has also been reproduced from the EIS and includes the sources of combustion and fugitive emissions for the operations phase. Emission sources from the operations phase include underground mining activities, power generation, ore crushing and processing activities and the mine fleet.

Table 2-2 Summary of Operations Emissions for the Doris North Mine

Source	Emission Rates [t/d]				
	SO_2	NO_X	TSP	PM_{10}	$PM_{2.5}$
power generators	0.022	1.375	0.043	0.035	0.035
space heating[(a)]	0.011	0.030	0.006	0.004	0.004
underground activities[(b)]	0.006	0.282	0.021	0.020	0.019
mine fleet exhaust	0.007	0.343	0.022	0.022	0.022
road dust[(c)]	—	—	0.080	0.020	0.003
waste rock disposal[(d)]	—	—	0.007	0.004	0.001
ore stockpile[(d)]	—	—	0.011	0.005	0.002
ore processing[(e)]	—	—	0.018	0.007	0.003
refining[(f)]	0.012	0.000	0.003	0.002	0.002
incinerator	0.000	0.000	0.002	0.002	0.002
airstrip activities[(g)]	0.001	0.027	0.002	0.002	0.002
Total	0.060	2.056	0.214	0.124	0.096

(a) Includes emissions from space heating and the waste oil burner.
(b) Includes emissions from drilling, blasting, truck loading and air compressors.
(c) Includes emissions from road dust and grading.
(d) Includes emissions from unloading and wind erosion.
(e) Includes emissions from primary crushing and conveyors.
(f) Includes emissions from the sludge dryer and smelting.
(g) Includes emissions from air traffic and portable lighting plants.

Greenhouse gas emissions (i.e., carbon dioxide [CO_2], methane [CH_4], nitrous oxide [N_2O] and CO_2 equivalents [ECO_2]) associated with diesel fuel combustion from the Mine were quantified in the EIS, and are presented in Table 2-3.

Table 2-3 Greenhouse Gas Emission Associated With the Doris North Mine

Source Type	CO_2 [t/yr]	CH_4 [t/yr]	N_2O [t/yr]	Total ECO_2[(a)] [t/yr]
diesel consumption	7,396	0.4	1.1	7,745

(a) Total CO_2 equivalents calculated on global warming potentials of 21 and 310 for CH_4 and N_2O, respectively. In comparison, the global warming potential of CO_2 is considered to be 1.

Note: Calculations are based on the total amount of diesel fuel consumed over the life of the Mine.

2.2 AIR QUALITY PREDICTIONS

Table 2-3 presents the predicted concentrations of SO_2, NO_2, TSP, PM_{10}, $PM_{2.5}$ and dust deposition as presented in the EIS. All compounds were predicted to be below the applicable air quality criteria in the assessment area, except for the 24-hour PM_{10} predictions. The maximum 24-hour PM_{10} concentrations were predicted to exceed the 50 µg/m³ criterion within 200 m of the ore processing facility and only for two days per year.

Table 2-3 Summary of Predictions for Criteria Air Compounds

Parameter	Maximum Predictions	Criteria	Occurrences Above Criteria
1-hour SO_2 [µg/m³]	265.9	450	0
24-hour SO_2 [µg/m³]	49.6	150	0
annual SO_2 [µg/m³]	5.8	30	0
1-hour NO_2 [µg/m³]	306.7	400	0
24-hour NO_2 [µg/m³]	126.4	200	0
annual NO_2 [µg/m³]	47.7	60	0
24-hour TSP [µg/m³][(a)]	76.3	120	0
annual TSP [µg/m³][(a)]	14.5	60	0
24-hour PM_{10} [µg/m³][(a)]	61.9	50	2
annual PM_{10} [µg/m³][(a)]	8.0	50	0
98^{th} percentile 24-hour $PM_{2.5}$ [µg/m³][(a)(b)]	18.4	30	0
annual $PM_{2.5}$ [µg/m³][(a)]	4.5	15	0
dust deposition [mg/100 cm^2/ 30 days]	10.8	53	0

Note: Modelling results have been presented excluding the camp site and ore processing facilities.

(a) Includes both primary and secondary particulate matter.

(b) Compliance with the Canada-Wide Standard of 30 µg/m³ for $PM_{2.5}$ is based on the 98^{th} percentile 24-hour concentration, averaged over three years.

3 AIR QUALITY MANAGEMENT PLAN

The main objective of the Air Quality Management Plan (AQMP) is to comply with regulatory requirements set out in the Project Certificate issued by the Nunavut Impact Review Board.

The management plan includes control measures that will be established to mitigate combustion and fugitive emissions from the Mine. It also includes a monitoring plan which will collect on-site air quality and meteorological data to allow for an adaptive approach to air quality management at the Doris North Mine.

3.1 EMISSIONS MANAGEMENT

MHBL has committed to employ the following mitigation measures during the construction and operation phases of the Mine:

- Use of an aggressive fuel conservation effort;
- Use of dust suppression methods as outlined in the Nunavut Environmental Protection Act (EPA);
- Use of coarse rock in roads, airstrip, building pads and laydown areas to minimize dust during construction;
- Driving at designated speeds on site roads;
- Application of water to roadways to reduce dust from ore and waste rock haulage and grading to a minimum;
- Installation of dust covers, sonic sprays, etc. to suppress dust generation from equipment in the crushing facility;
- Installation of a dust scrubber on the smelting off-gas stream;
- Submerged release of tailings deposition to avoid tailings dust emissions;
- Installation of a waste oil burner unit equipped with a settling tank and filter system for particulate removal from the waste oil;
- Installation of an incinerator that complies with the Nunavut EPA standards, Canada-Wide Standards for Dioxins and Furans and Canada-Wide Standards for Mercury emissions. A waste segregation program will be implemented (i.e., materials that are unsuitable for incineration, e.g., chlorinated plastics, will be diverted to alternate waste disposal facilities) and personnel will be properly trained in incinerator

operations. Compliance with the Canada-Wide Standards will be determined by annual stack testing.

- Regular servicing of all mobile and stationary engines to maintain efficiency;
- Proper equipment maintenance; and
- Adherence to all permits, authorizations and approvals.

3.2 AIR QUALITY MONITORING PROGRAM

An air quality and meteorological monitoring program has been operating at the Doris North Mine site to measure pre-operational air quality conditions, and is the basis for the AQMP. The air quality monitoring program currently includes monitoring of total suspended particulates (TSP), dustfall, sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (O_3). Additional monitoring of PM_{10} and $PM_{2.5}$ will be initiated in summer 2007.

3.2.1 Total Suspended Particulate, PM_{10} and $PM_{2.5}$ Monitoring

Particulate emissions will be generated by wind erosion, movement of vehicles and large equipment, the airstrip, construction activities, and the combustion of diesel fuel and solid waste incineration.

3.2.1.1 Sample Locations

The particulate samplers will be sited based on protocols established by Alberta Environment (AENV Air Monitoring Directive, 1989) and through consultation with Environment Canada and Health Canada air quality officials. The Alberta Monitoring Directive has developed a site selection tool that incorporates parameters such as wind direction frequency, receptor sensitivity and site accessibility. The primary site selection tool is the geographic coverage factor (G), which is calculated as follows**:**

$$\mathbf{G = W \times D \times R \times A \times E}$$

where:

- W = Frequency of winds blowing from the emission source towards the site.
- D = Dispersion weighting computed from one of the following:

- Short-term concentration (i.e., 1-hour)
- long-term average concentration (i.e., annual)
- concentration occurring under the most frequent wind speed and stability class,
- probability of detecting concentrations above a specified concentration,
- probability that the measured concentration will be within a fixed fraction of its true value n times in N occurrences with specified percent confidence (method of Noll).

- R = Sensitivity of the receptor defined as low (1), medium (2), or high (3).
- A = Accessibility to the proposed location defined as poor (1), adequate (2), or good (3).
- E = Electric (AC) power availability for the proposed location defined as poor (1), good (2), or existing (3).

This siting method is a modified version of the one used in the Alberta Monitoring Directive in that it incorporates the accessibility to the proposed site (A) and the availability of electric power (E). The "A" parameter was included because pre-existing access may serve to minimize the environmental impact of implementing a monitoring program. Also, additional delays in program start up are possible if road work and associated permits are required to access the site. The "E" factor is considered in the site selection weighting to consider if there is electricity currently available or if installing an electrical power source will be relatively easy or difficult. The dispersion weighting factor has the greatest influence on the G value.

3.2.1.2 Sampling Methods

The particulate monitoring station will include equipment to monitor TSP, PM_{10}, and $PM_{2.5}$ at the Mine. Current monitoring practices recommend using a Hi-Vol sampler for measuring TSP and a Partisol sampler for measuring PM_{10} and $PM_{2.5}$.

Hi-Vol samplers operate on the principle that a stream of ambient air at a controlled flow rate is drawn through a size-selective inlet and then through a pre-weighed filter for a pre-determined time period. The exposed filter is shipped to a laboratory where it is re-weighed. The TSP concentrations can then be determined using the measured volume of air and the weight difference between the pre-weighed and exposed filter. Hi-Vol samplers can collect particulate with a nominal aerodynamic diameter of 30 µm or smaller.

Though the principle of operation is the same for the Partisol as it is for the Hi-Vol, the Partisol sampling system has a number of operational advantages when compared to other particle samplers. The Partisols require considerably less manual handling than Hi-Vol samplers as the Partisol uses an enclosed sample cartridge. The combination of enclosed sampling cartridges and the lower air volumes used in the Partisol system should enhance sample collection in the winter months. This type of monitoring is a United States Environmental Protection Agency reference method for quantifying ambient PM_{10} and $PM_{2.5}$ concentrations.

The monitoring of particulate matter (TSP, PM_{10}, and $PM_{2.5}$) concentrations will be carried out according to the National Air Pollution Surveillance (NAPS) schedule which follows a monitoring cycle where a single 24-hour sample is collected every six days. Sampling in accordance with the NAPS schedule provides consistency between the on-site stations and stations at other facilities across the country. In addition, by operating on a six day cycle, different days are sampled each week thus allowing for differing production intensity, or other cyclical production variations.

3.2.1.3 Data Analysis

The TSP and fine particulate matter data collected will be analysed and the results used to provide feedback to modify the dust management procedures incorporated at the site. Because the particulate sampling does not occur in "real time", there will be a delay between the events that lead to elevated concentrations and the receipt of results.

Once the results of the particulate monitoring are available, they will be analysed for compliance with available criteria and temporal trends. Since Nunavut does not have ambient air quality criteria, the monitored results will be compared to the NWT standards. The analysis of temporal trends will look for consistent, increasing trends in the measured dust concentrations with consideration to the time of year and meteorological conditions. For example, increasing particulate concentrations as the snow melts may not indicate a concern but reflect the natural trends as the snow melts. However, trends in monthly concentrations within a given season, or from one year to the next may indicate the need for a closer examination of the prescribed mitigation to manage dust levels.

3.2.2 Dustfall Monitoring

The main dust generation sources will be from wind erosion and movement of vehicles and large equipment on site. When the particles are large enough, they can settle from the air on vegetation. The dustfall monitoring program will measure the quantities of dust deposited near the Mine.

3.2.2.1 Sample Locations

The dustfall monitoring station will be co-located with the passive monitors and the location will be finalized through discussions with regulators.

3.2.2.2 Sampling Methods

Dustfall canisters will be used to collect ambient dustfall for analysis of deposition rates of dust. Dustfall collection is a passive program that provides a measure of particulates that would be directly deposited onto vegetation or soil in the vicinity of the Mine. Dustfall data are collected using open vessels containing a purified liquid matrix. Particles are deposited and retained in the vessel, which are sent to a laboratory where total and fixed dustfall are quantified.

Dustfall canisters are exposed in the field for a nominal period of 90 days. As dustfall sampling is done over a longer period to allow for a sufficient sample size for analysis, it provides an indication of longer-term air quality trends. Dustfall monitoring is proposed for the construction and operations phase of the Mine.

3.2.2.3 Data Analysis

Dustfall sampling does not occur in "real time". Therefore, there will be a delay between the events that lead to elevated dustfall readings and the receipt of results. The dustfall sampling containers are exposed 90 days and data analysis can take up to one month beyond the expiry of the sample period, leading to a delay of up to two months for results to be available.

The analysis of the dust fall sampling results will include the comparison of the results with Alberta guidelines since Nunavut does not have dustfall standards. Specifically, the on-site dustfall readings will be compared to the Alberta industrial objective of 158 mg/100 cm^2/30 days. These dustfall results collected off-site will be compared to the Alberta recreational objective of 53 mg/100 cm^2/30 days.

Analysis of temporal trends will include evaluation of mean monthly dustfall deposition rates from one year to the next. This information will also be monitored for increasing trends.

3.2.3 Passive SO_2, NO_2 and O_3 Monitoring

Emissions of SO_2 and NO_2 are expected as a result of fuel combustion associated with the Mine.

3.2.3.1 Sample Locations

The passive monitors will be co-located with the dustfall canisters. The location will be finalized through discussions with the regulators.

3.2.3.2 Sampling Methods

Passive SO_2, NO_2 and O_3 samplers are proposed for this monitoring program. The monitors are suitable for this type of program as they require no electricity, and can be left unattended for extended periods. The sample media are installed in the field and exposed in protective shelters that are mounted to a support pole or small tripod. The samples will be retrieved, replaced and sent to the laboratory for analysis every 30 days.

3.2.3.3 Data Analysis

The SO_2, NO_2 and O_3 sampling will provide a long-term average (i.e., 1 month) ground-level concentration for each compound. Because MHBL will be required to demonstrate that the Mine will not result in ground level concentrations above the standards, understanding pre-development ambient concentrations will provide the basis for assessing the contribution of the Mine to ambient concentrations of the measured compounds, relative to baseline conditions.

3.3 METEOROLOGICAL MONITORING PROGRAM

The current meteorological monitoring program will continue as part of the AQMP; however, the location and design of the station will be discussed with Environment Canada officials. The meteorological station was installed on the northern shore of Doris Lake in May 2003. The station is a self contained, solar/battery-powered system and includes instrumentation to measure hourly values of temperature, wind speed, wind direction, relative humidity, solar radiation and rainfall.

3.4 ADAPTIVE MANAGEMENT PROGRAM

The purpose of the AQMP is to determine the effects of the Mine on air quality and to demonstrate that air quality criteria are being met. The air quality monitoring data will be reviewed annually to determine if any trends are evident. Corrective actions based on the air quality monitoring results will be determined on a case-by-case basis; however, examples of responses are provided below:

- If particulate matter concentrations show an increasing trend, the issue will be investigated and additional control measures will be implemented where possible;
- If issues are raised by regulators or local communities, discussions will be initiated to resolve the issues.

It is possible that components of the AQMP may need to be revised over the life of the Mine based on regulatory changes and technological advances. The air quality monitoring data and input from the operators and the environmental manager will be used to modify the AQMP accordingly. Any modifications made to the AQMP will be communicated to regulatory authorities where applicable.

3.5 REPORTING

The results of the air quality monitoring program will be reported every six months to the Nunavut Impact Review Board through the Monitoring Officer.

4 CLOSURE

We trust the information contained in this report is sufficient for your present needs. Should you have any questions regarding the project, please do not hesitate to contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.

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