October 2012

FINAL REPORT

Canadian Zinc Prairie Creek Mine Air Quality and Emissions Monitoring and Management Plan

Submitted to:
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Report Number: 12-1331-0017

REPORT

Golder Associates

Executive Summary

The Prairie Creek Mine (the Mine) has developed this Air Quality and Emissions Monitoring and Management Plan (AQEMMP). The AQEMMP consists of two components: the Air Quality Monitoring (AQM) component and the Emissions Monitoring (EM) component. An integrated approach shows how the data from each program will be presented together each year in an annual report.

The AQM component will be used to coordinate monitoring of ambient air quality at the Mine during the construction, operations, and closure phases. This ambient air quality monitoring data will be compared to applicable air quality criteria and analyzed for trends each year in the annual report. In this fashion, the AQM will be able to provide an indication of the Mine's performance with respect to air quality.

The EM component presents the approach that will be used in the annual report to provide a summary of emissions from the Mine. The emission calculation methodology for each of the main Mine sources is discussed in detail in this document. The calculated emissions will be compared to those in the Developer's Assessment Report (CZN 2010) to evaluate emissions performance.

An important outcome of evaluating emissions performance is to identify potential areas for emissions mitigation. Recommendations for emissions mitigation will be made each year, if necessary, using a pro-active approach that considers the annual emissions and monitoring data against pre-determined action levels. The action levels for each compound are based on the Developer's Assessment Report (CZN 2010) predictions, the applicable ambient air quality criteria and a percent change (year to year) in measured concentrations. In this manner, potential issues can be resolved before the ambient air quality standards are reached, which is the primary benefit of this type of proactive management system.

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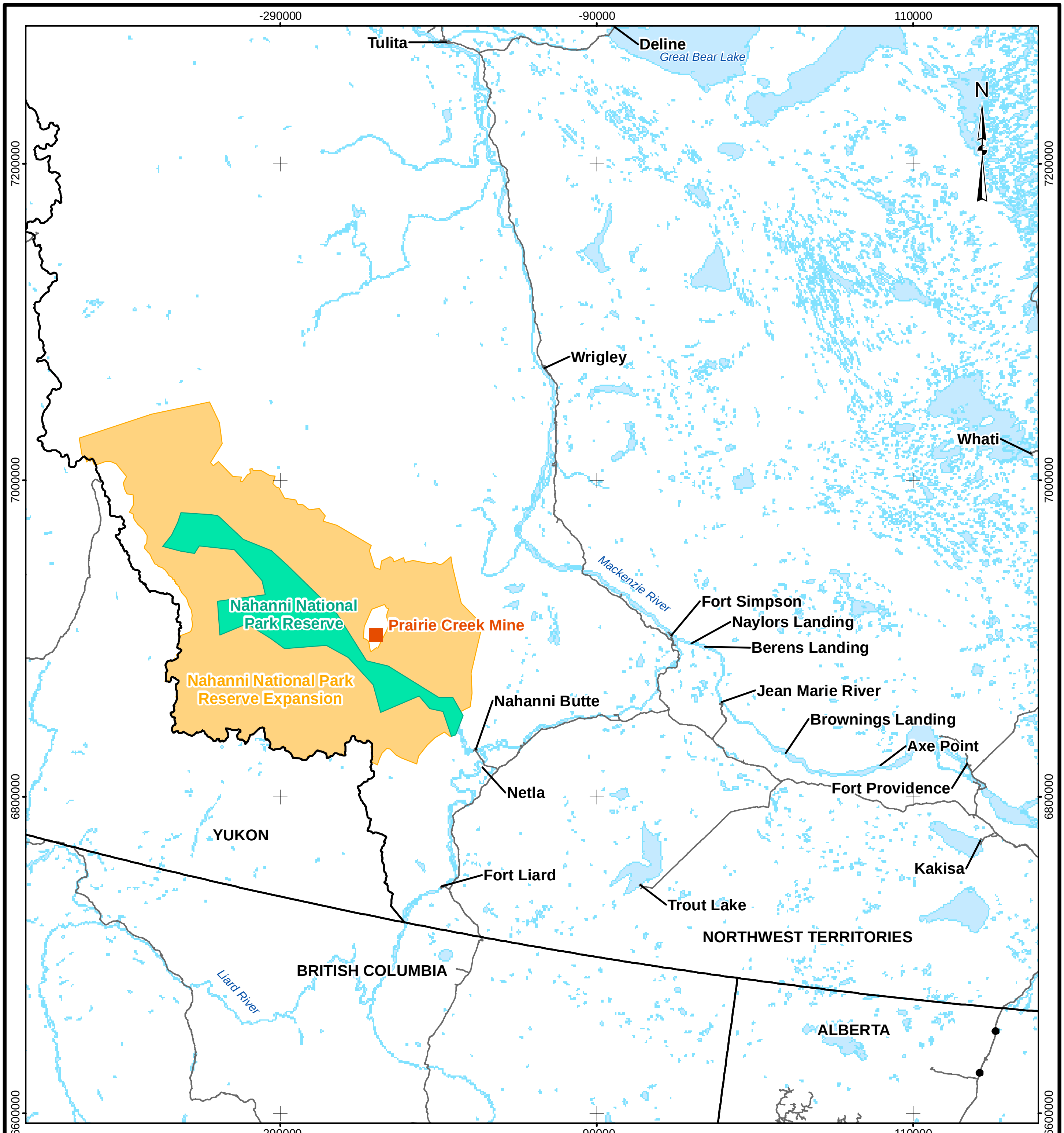
1.0 INTRODUCTION

Canadian Zinc Corporation (CZN) owns the Prairie Creek Mine (the Mine). The Mine site (Figure 1-1) is situated in the southern Mackenzie Mountains of the Northwest Territories, approximately 90 km northwest of Nahanni Butte. The Mine is 100% owned by CZN, and consists of significant mine infrastructure and facilities constructed in the early 1980s. The Mine received Land Use Permits in 1980 and an operating Water Licence in 1982 to allow production of concentrates of lead, zinc and a silver-bearing copper concentrate, and use of an access road from the Mine to the Liard Highway. The Mine was three months from production when it was placed into receivership due to market conditions.

CZN is currently acquiring new permits to operate the Mine. One of the requirements and commitments agreed to during environmental assessment EA0809-002 was to develop an adaptive management plan for air quality.

1.1 Legislation, Regulatory and Policy Requirements

CZN's Developer's Assessment Report for the Mine was submitted to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) in March 2010. The Board in turn completed a review, and concluded that *"In the Review Board's view, the Prairie Creek Mine is not likely to have significant adverse impacts on the human environment of the Dehcho Region or the Northwest Territories provided the developer's commitments are followed and enforced and the Socio-economic Agreement is implemented"* (MVEIRB 2011). Included in the subsequent phase of work required to bring the Mine to production is to develop a series of management plans, including this Air Quality and Emissions Management and Monitoring Plan (AQEMMP), designed to satisfy the commitments made during the environmental assessment process.



LEGEND

- PRAIRIE CREEK MINE
- ROAD
- WATERCOURSE
- PROVINCIAL / TERRITORIAL BOUNDARY
- NAHANNI NATIONAL PARK RESERVE EXPANSION
- WATERBODY

100 0 100

SCALE 1:3,500,000 KILOMETRES

REFERENCE

Populated Places and National Parks © [2011] DMTI Spatial Inc. Hydrography and Provincial Boundaries obtained from GeoGratis, © Department of Natural Resources Canada. All rights reserved. Roads obtained from GeoBase®.
DATUM: NAD83 PROJECTION: UTM ZONE 12

PROJECT

PRAIRIE CREEK MINE AIR QUALITY AND EMISSIONS MONITORING AND MANAGEMENT PLAN

TITLE

LOCATION OF PRAIRIE CREEK MINE

Golder Associates

PROJECT NO. 12-1331-0017			FILE No.	
DESIGN	CH	29 May 2011	SCALE AS SHOWN	REV. 1
GIS	HP	15 Aug. 2012	**FIGURE: 1-1**	
CHECK	CDM	01 Jun. 2012		
REVIEW	DP	15 Aug. 2012		

I:\2012\12-1331\12-1331-0017\Mapping\MXD\Fig1.1_Prairie_Creek_Mine_AirQuality.mxd

1.2 Scope

The AQEMMP has been prepared to address the two distinct monitoring activities designed to manage emissions from the mine. The Ambient Air Quality Monitoring (AQM) component is presented in Section 2 of this document and the Emissions Monitoring (EM) component is presented in Section 3.

The purpose of this document is to provide strategic direction of the activities involved in the AQM and the EM, to document specific triggers and the resulting necessary management actions required if the established trigger-levels are reached, and to provide a template for the annual monitoring reports. This report is a “living” document that may need to be adapted as the Mine evolves.

An important component of the AQEMMP is the comparison of annual monitoring data to emission estimates and dispersion modelling predictions presented in the Developer’s Assessment Report (CZN 2010).

1.3 Objectives

This document has been developed to address the following objectives:

- demonstrate compliance with applicable Federal and Territorial ambient air quality standards;
- track trends in ambient air quality and emissions;
- verify the accuracy of impact predictions made in the Developer’s Assessment Report;
- outline response plans for increasing trends, exceedances of air quality criteria or occurrences above emission estimates and dispersion modelling predictions presented in the Developers Assessment Report;
- provide data that could make a meaningful contribution to a regional cumulative effects monitoring data bank, should one be developed;
- identify strategies for emissions tracking and monitoring; and
- provide a mechanism to document fuel use as it relates to air quality management.

To achieve these objectives, Section 2 of the AQEMMP concentrates on the following three main components:

- on-site meteorological monitoring;
- ambient monitoring of fine particulate matter concentrations less than 2.5 micrometres (μm) ($PM_{2.5}$); and
- passive monitoring of sulphur dioxide (SO_2) and nitrogen dioxide (NO_2).

Section 3 focuses on the following three main components:

- emissions estimates;
- fuel use summary; and
- emissions mitigation strategies, which includes the fugitive dust abatement program.

1.4 Methodology and Approach

An initial, scoping ambient air quality monitoring program was conducted at the Mine in 2009. Data were collected on baseline air quality (TSP, PM_{10} and $PM_{2.5}$). The ongoing air monitoring program will focus on the monitoring of $PM_{2.5}$ because of its relationship to combustion and the demonstrated link to human health, and on SO_2 and NO_2 because they are common by-products of combustion.

CZN understands the need for adaptive management of the monitoring programs and acknowledges that the monitoring sites may change as the Mine evolves. However, an effort will be made to maintain consistency in the monitoring locations, as this is an important consideration in conducting trend analysis.

Monitoring activities are planned for “off-site” areas, that is, areas that are beyond the active mine area footprint. It is in these areas where ambient air quality standards are applicable and where CZN agrees that the ambient air quality ought to be protected.

The AQEMMP off-site monitoring focus is to more clearly demonstrate consistency with the applicable ambient air quality standards, which are based on off-site concentrations measured at or beyond the facility boundary. This off-site monitoring is important because it provides an indication of the ambient concentrations of air emissions to which the public, or other components of the receiving environment, may be exposed. The effectiveness of the AQEMMP is dependent, in part, on selecting appropriate criteria against which Mine emissions and the resulting ambient air concentrations should be compared. Since there is currently no provision for air quality to be included in permits for mines in the NWT, there is no requirement to monitor for compliance with permit limits. In lieu of air quality permit requirements, the Mine will be required to comply with the relevant NWT ambient air quality standards for TSP, $PM_{2.5}$ (24-hour and annual), NO_2 (1-hour, 24-hour and annual) and SO_2 (1-hour, 24-hour and annual) (GNWT 2011). Table 1-1 provides the relevant air quality criteria.

Table 1-1 Relevant Ambient Air Quality Criteria

Parameter	NWT Standards	Canada-Wide Standards[b]	National Air Quality Objectives[c]		Other Criteria
			Desirable	Acceptable	
SO_2 [µg/m³]					
1-Hour	450[a]	—	450	900	450[e]
24-Hour	150[a]	—	150	300	125[e]
Monthly	—	—	—	—	30[e]
Annual	30[a]	—	30	60	20[e]
NO_2 [µg/m³]					
1-Hour	400[a]	—	—	400	300[e]
24-Hour	200[a]	—	—	—	—
Annual	60[a]	—	60	100	45[e]
TSP [µg/m³]					
24-Hour	120[a]	—	—	120	100[e]
Annual[d]	60[a]	—	60	70	60[e]
PM_{10} [µg/m³]					
24-Hour	—	—	—	—	50[f]
Annual	—	—	—	—	—
$PM_{2.5}$ [µg/m³]					
24-Hour	30[a]	30	—	—	25[f]
Annual	—	—	—	—	8[f]

(a) Source: GNWT 2011.

(b) Source: CCME 2000a.

(c) Source: Environment Canada 2011.

(d) As a geometric mean.

(e) Source: Government of Alberta 2012.

(f) Source: Government of British Columbia 2009.

Notes: µg/m^3 = micrograms per cubic metres; SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; TSP = total suspended particulate; PM_{10} =particulate matter nominally less than or equal to 10 micrometres aerodynamic diameter; $PM_{2.5}$ = particulate matter nominally less than or equal to 2.5 micrometres aerodynamic diameter.

In addition to demonstrating that Mine emissions and ground-level concentrations are consistent with the applicable regulatory criteria, it is CZN's intent to manage emissions and ground-level concentrations in keeping with the principles of "Continuous Improvement" (CI) and "Keeping Clean Areas Clean" (KCAC), as described in the Canada-Wide Standards for Particulate Matter and Ozone (CCME 2000a). Therefore, the monitoring of trends in emissions and ambient air quality is an important component of the AQEMMP, as discussed in Sections 2 and 3.

CZN has incorporated a number of design features that demonstrate their commitment to KCAC and CI. These include, but are not limited to, the following:

- selection of highly-efficient combustion equipment;
- use of low-sulphur diesel;
- wet primary ore crushing;
- primarily conveyor-based, covered ore transport systems on surface;

- avoidance of particulate losses from tailings;
  - modern incineration facilities and waste segregation practices (details provided in the incineration management plan);
- worker education;
- on-site recycling programs; and
- development of management plans to guide actions and documentation needs for air quality.

Implementation of these policies and practices demonstrates CZN’s ongoing commitment to reducing emissions through the use of the best available, economically feasible technology and systems.

The AQEMMP covers the two main phases of the Mine; operations, and closure. However, the focus is on the operations phase. Results of operations phase monitoring will be presented and discussed in an annual Air Quality and Emissions Monitoring and Management Report (herein referred to as the ‘annual report’ and discussed in Section 5 of this document). The closure phase monitoring will occur many years into the future and the annual report will continue to evolve as management and monitoring needs change.

2.0 AIR QUALITY MONITORING

2.1 Introduction

The Air Quality and Emissions Monitoring and Management Plan (AQEMMP) will be used to coordinate monitoring of ambient air quality at the Mine during the operations and closure phases. This ambient air quality monitoring will be compared to applicable air quality criteria and the Developer's Assessment Report (CZN 2010) and analyzed for trends each year in the annual report as the data become abundant enough for trend analysis. Implementation of the AQEMMP will indicate the Mine's performance with respect to air quality.

The main components of the AQEMMP and the sections in which they are discussed are as follows:

- meteorological monitoring (Section 2.2);
- TSP and $PM_{2.5}$ monitoring (Section 2.3);
- dustfall (Section 2.4);
- passive SO_2 and NO_2 monitoring (Section 2.5); and
- quality assurance/quality control (QA/QC) (Section 2.6).

For each of the AQEMMP components, the details of the monitoring station locations, methods, parameters, frequency, and data analysis are presented in the following sections.

2.2 Meteorological Monitoring

Meteorological monitoring serves as part of the basis for interpretation of air quality data. Meteorological parameters are also used by other disciplines (e.g., hydrology) to aid in the analysis of monitoring data. Meteorological monitoring is a vital input for any subsequent emissions dispersion modelling assessment that may be required during the lifetime of the Mine. The data plays a crucial role in the characterization of general air quality trends and specific meteorological conditions at the Mine site.

2.2.1 Monitoring Station Location

A meteorological monitoring station was commissioned at the Mine in the late 1980s just southeast of the mill facilities. A review of this station will be completed to ensure that it will reliably collect the recommended meteorological parameters.

2.2.2 Monitoring Methods

Meteorological monitoring will be conducted at the site using Campbell Scientific meteorological monitoring equipment. Sensors will be mounted on a 10 metre (m) tower, consistent with current accepted practice in Canada.

2.2.3 Monitoring Frequency

Meteorological monitoring will be conducted year-round throughout the operations and closure phases of the Mine. Meteorological data will be measured continuously and recorded hourly. The data will be downloaded regularly by CZN's site staff.

2.2.4 Monitoring Parameters

The meteorological monitoring system will continuously measure the following meteorological parameters:

- wind speed at 10 m above the ground;
- wind direction at 10 m above the ground;
- temperature at 2 m above the ground;
- relative humidity at 2 m above the ground;
- solar radiation at 2 m above the ground; and
- rainfall at 2 m above the ground.

2.2.5 Data Analysis

Data will be analyzed regularly. A summary of the meteorological monitoring will be presented each year in the annual report. Discussion of extreme meteorological events and trends will be included as part of the annual report.

2.3 $PM_{2.5}$ Monitoring

Suspended particulate matter (particulate) emissions will be generated by wind erosion of local landscapes, movement of vehicles/equipment, airstrip activities, construction activities, the combustion of diesel fuel, and solid waste incineration.

Suspended particulate matter emissions are generally grouped into three size fractions, as follows:

- TSP – which includes particulate matter nominally less than 100 µm;
- PM_{10} – which includes particulate matter nominally less than 10 µm; and
- $PM_{2.5}$ – which includes particulate matter nominally less than 2.5 µm.

Current understanding is that those particles small enough to readily enter the lower respiratory tract (i.e., lungs and bronchi) are of the most concern. These particles are typically $PM_{2.5}$.

2.3.1 Monitoring Station Locations

Monitoring station locations are chosen to inform the operator and the public, through the annual report, of the ambient particulate concentrations, and are a representative estimate of particulate concentrations off-site. The monitoring station location will be chosen with consideration of the dispersion modelling conducted for the DAR: specifically, the pattern of dispersion observed in the modelling, wind direction, the sensitivity of the local receiving environment, accessibility and the availability of power.

A single particulate monitoring station, directly adjacent to the facility boundary near the existing meteorological monitoring station, is proposed. This location was identified as an area of potentially higher ambient particulate concentrations based on dispersion modelling predictions and the local topography.

This location is intended to be the permanent location and should not need to be moved in the future. Establishing permanent locations is an important part of producing consistent data suitable for comparison purposes.

2.3.2 Monitoring Methods

The particulate monitoring equipment proposed is the Sharp model 5014i continuous particulate sampling instrument. The 5014i uses beta-attenuation technology to measure hourly particulate concentrations. The concentration values will be recorded by the instrument and downloaded periodically. The data will be included in the annual report.

The 5014i proposed for the site will collect $PM_{2.5}$ data. The collection of $PM_{2.5}$ provides a good measure of airborne particulates and the 24-hour average concentrations are subject to the Northwest Territories' (NWT) ambient air quality standard of 30 micrograms per cubic metre ($\mu g/m^3$) (GNWT 2011).

This type of monitoring is a United States Environmental Protection Agency (US EPA) equivalent method for quantifying ambient and $PM_{2.5}$ concentrations.

2.3.3 Monitoring Frequency

Monitoring will be carried out continuously, year-round. When particulate sampling is conducted during extreme winter conditions, some data loss is to be expected as ambient conditions exceed the expected normal operating range for the equipment being used. However, CZN will enclose the 5014i in an appropriate climate controlled shelter to minimize this potential.

Monitoring of $PM_{2.5}$ is proposed to for the construction, operations and closure phases of the project.

2.3.4 Data Analysis

$PM_{2.5}$ data from the monitoring station will be analyzed for indications of air quality concerns (e.g., increasing trends or measured concentrations above the Developer's Assessment Report predictions or applicable ambient air standards). The results of this analysis will be presented in the annual report.

The analysis of temporal trends will look for consistent trends in the measured particulate concentrations on an annual basis. The response planning and action levels to deal with increasing trends are described in Section 4. Managing trends in ambient particulate concentrations on an annual basis is appropriate given the scale of the Mine and the long-term nature of the monitoring program.

In addition to the annual trend analysis, ongoing visual observation at the site is one mechanism for identifying high particulate events and triggering remedial actions The potential cause(s) of the condition and the mitigation action available will be evaluated and implemented as appropriate.

2.4 Dustfall Monitoring

The main dust generation processes at the Mine will be wind erosion of fugitive sources, rock crushing, ore stockpiling and movement of vehicles/equipment on site. When particles are large enough, they can settle from the air onto vegetation or waterbodies. The dustfall monitoring program measures the quantities of dust deposited near the Mine. Locations and details of the dustfall monitoring program will be coordinated with the Contaminant Loading Management Plan.

2.5 Passive Monitoring of SO_2 and NO_2

The main sources of SO_2 and NO_2 emissions from the Mine will be the power plant and the incinerator. CZN intends to incorporate the passive monitoring of SO_2 and NO_2 compounds into the AQEMMP to demonstrate compliance with the NWT standards (GNWT 2011).

2.5.1 Monitoring Station Locations

The proposed passive SO_2 and NO_2 monitoring stations will be co-located with the meteorological and particulate monitoring stations. Co-locating these stations serves two purposes. First, it allows for the efficient collection of samples. Second, it allows for the calculation of ambient secondary particulate (sulphates and nitrate) concentrations if this information is required at a later date.

2.5.2 Monitoring Methods

Passive SO_2 and NO_2 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 taken to the field and exposed to ambient air while housed in protective shelters that are mounted to a support pole or small tripod.

2.5.3 Monitoring Frequency

The passive samplers will be exposed for a nominal period of 30 days before they are retrieved, replaced and sent to the laboratory for analysis. As passive 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.

Passive SO_2 and NO_2 monitoring is proposed for the operations phase of the Mine. If SO_2 and NO_2 concentrations are consistently less than predicted in the Developer's Assessment Report, or static for the first few years of operation, the frequency of monitoring may be adjusted depending on the acceptability of this to regulatory agencies.

2.5.4 Data Analysis

The ambient SO_2 and NO_2 concentrations measured at the passive monitoring station will be analyzed for indications of air quality concerns (e.g., increasing trends or measured concentrations above the Developer's Assessment Report predictions or applicable ambient air standards) as well as spatial and temporal trends.

The analysis of the SO_2 and NO_2 sampling results will include comparison of results with NWT standards (GNWT 2011). However, since the passive sampling will be on a monthly basis and neither the NWT standards nor NAAQO have monthly criteria, the annual average of the monthly data will be compared to the annual NWT standard and Monthly Alberta Ambient Air Quality Guidelines (AAAQG) standard for SO_2, and the annual NAAQO for NO_2. The passive monitoring will be used to supplement the data generated through emissions calculations that are presented each year in the annual report.

The analysis of temporal trends will look for consistent, increasing trends in the measured SO_2 and NO_2 concentrations on an annual basis. The response planning and action levels for increasing trends are described in Section 4.

2.6 Quality Assurance/Quality Control Procedures

Quality Assurance (QA) refers to plans or programs that encompass a wide range of internal and external management and technical practices designed to ensure the collection of data of known quality that matches the intended use of the data. Quality Control (QC) is a specific aspect of QA that refers to the internal techniques used to measure and assess data quality (American Public Health Association et al. 1989). Because QC procedures implemented as part of the AQEMMP are variable and program-specific, the procedures have been summarized in this section on a program component basis.

2.6.1 Meteorological Monitoring

QA/QC procedures for the meteorological monitoring program include the following:

- Data are to be downloaded from the station frequently and reviewed for anomalous data that may indicate problems with sensors.
- Sensors will be calibrated on a schedule consistent with each sensor's requirements (generally every 24 months).
- The station will be inspected weekly to ensure that sensors are free of debris, frost or damage that may prevent accurate measurement of meteorological data. A checklist has been developed that allows an organized approach to determining the functionality of the station.
- Data will be downloaded consistent with the written operating instructions.

2.6.2 $PM_{2.5}$ Monitoring

QA/QC procedures for the particulate monitoring program include the following:

- The sampler will be calibrated and maintained in accordance with the manufacturers operating instructions;
- Suitably qualified personnel will interpret the data and report ambient particulate concentrations; and
- Data will be downloaded according to detailed written operating instructions.

2.6.3 Passive Monitoring

QA/QC procedures for the passive SO_2 and NO_2 monitoring program include the following:

- Travel blanks (laboratory prepared samples that travel with the samples but are not exposed to the atmosphere) will be used.
- Duplicate samples will be exposed.
- An accredited laboratory will be used for pre-sample preparation and analysis.
- Samples will be collected consistent with detailed written operating instructions.
- Suitably qualified personnel will calculate ambient SO_2 and NO_2 concentrations based on laboratory results.

3.0 EMISSIONS MONITORING

3.1 Introduction

The AQEMMP will be used to coordinate the monitoring of emissions during the operations and closure phases of the Mine. Emissions calculated for these phases will be compared to the Developer's Assessment Report (CZN 2010) emission estimates. This process will be done on an annual basis and will be summarized in an annual report. If the results of the AQEMMP suggest that further mitigation is necessary, this will be incorporated into the emissions mitigation strategies.

The three main components of the AQEMMP, and the sections in which they are discussed, are as follows:

- emissions estimates (Section 3.2);
- fuel use summary (Section 3.3); and
- emissions mitigation strategies, which include the dust abatement program (Section 3.4).

3.2 Emission Estimates

This section presents the approaches that will be used in an annual report to provide a summary of emissions at the Mine. This section identifies the various types of emissions from the Mine, as described in Section 3.2.1.1, and provides examples of approaches for calculating these emissions, as described in Section 3.3.2. The calculated emissions will be compared to those in the Developer's Assessment Report (CZN 2010).

The emissions estimate component of the AQEMMP has the following objectives:

- to demonstrate CZN's commitment to ongoing monitoring of emissions at the Mine site;
- to provide an overview of the appropriate methodology for calculating emissions from the Mine;
- to show that Mine emissions do not significantly exceed those modelled in the Developer's Assessment Report (CZN 2010); and
- to demonstrate CZN's commitment to minimizing emissions.

3.2.1 Types of Emissions

3.2.1.1 Combustion Emissions

Combustion is the process of burning fuels of various types and using the energy released to produce electricity, space or process heating, and to facilitate on-site transportation and incineration. There are five primary combustion sources at the Mine:

- power generators;
- mine air heaters;
- underground fleet;
- surface fleet; and
- incinerator.

Compounds such as SO_2, oxides of nitrogen (NO_X), particulates and greenhouse gases (GHGs) are common combustion by-products from the Mine sources. These by-products are the subject of regulatory guidance which limits the release amounts of the compounds to protect the receiving environment. CZN has committed to meeting the relevant Northwest Territories (NWT) standards, National Ambient Air Quality Objectives (NAAQO) and Canada-Wide standards that apply to these compounds. The applicable criteria are provided in Table 1-1.

In addition to the ambient air quality criteria for common combustion compounds (i.e., SO_2, NO_X, and suspended particulates), Canada-Wide Standards exist for other combustion by-products, such as dioxins, furans, and mercury that may be released during on-site waste incineration (CCME 2003). A summary of the Canada-Wide Standards for dioxins, furans and mercury is presented in Table 3-1, and these apply to waste incineration at new facilities such as the Mine. Meeting these Canada-Wide Standards requires that best available control techniques, such as a waste diversion program, be used.

By calculating and reporting annual combustion emissions, CZN can determine whether operational emissions are at or below the standards and emission estimates provided in the Developer's Assessment Report (CZN 2010).

Table 3-1 Canada-Wide Standards for Municipal Waste Incineration Emissions

Municipal Waste Incineration Compound	Emission Limit
Dioxins and Furans[(a)]	80 picograms of International Toxic Equivalents (I-TEQ) per cubic metre (m^{3})
Mercury[(b)]	20 µg/m^3

(a) Canadian Council of Ministers of the Environment (CCME) 2003.

(b) CCME 2000b.

3.2.1.2 Fugitive Emissions

Fugitive emissions are substances that are released to the atmosphere from various locations. These emissions represent unintentional losses of compounds to the atmosphere without passing through a stack, vent or functionally equivalent opening. Fugitive emissions are expected as a result of Mine construction and operation activities, and are expected to consist primarily of dust.

Fugitive dust emissions can result from Mine sources through either mechanical or natural processes. Examples of mechanical processes that can generate fugitive dust include crushing, materials handling, vehicle fleet operation, heavy equipment operation, vegetation removal, and the take-off and landing of aircraft from the airstrip. The main natural process that generates fugitive dust is wind erosion. There are two main potential fugitive emission sources at the Mine:

- the roads and airstrip; and
- the waste rock pile and stockpiles.

3.2.1.3 Methods

This section describes three methods that can be used to estimate Mine emissions (depending on the compounds). The methods are:

- using a mass balance approach;
- using an emission factor approach (published or calculated); or
- using available intermittent source stack testing data.

The mass balance approach is based on the law of conservation of mass in a system. Essentially, if there is no accumulation within the system, then all the materials that go into the system must come out. Fuel analysis data is a good example of the mass balance approach in predicting emissions. For example, if the sulphur content of a fuel is known, then the emissions of sulphur (in the form of SO_2) can be calculated by assuming that all of the sulphur in the gas is emitted from the system.

The second approach proposed for estimating emissions is the use of emission factors. Emission factors are available for many emission source categories and are based on the results of source tests performed at one or more facilities within an industry. An emission factor is the contaminant emission rate relative to the level of source activity. Generic emission factors are commonly used when site-specific source monitoring data are unavailable.

The use of source-specific stack testing data is appropriate for emission sources or compounds that may be difficult to characterize using either mass balance or emission factors. A stack test measures the amounts of specific compounds present in the stack exhaust gas.

The methods that can be used for estimating emissions are as follows:

- SO_2 – mass balance approach;
- NO_X – emission factor approach;
- particulates – emission factor approach;
- GHGs – emission factor approach; and
- dioxins, furans and mercury – stack testing approach, followed by mass balance approach.

The following sections provide examples of how emissions will be calculated using each of aforementioned approaches at the Mine. The recommended methods are consistent with those used in the Developer's Assessment Report.

3.2.1.4 SO_2 Emission Calculation Methods

3.2.1.4.1 SO_2 Combustion Emissions

The diesel fuel used at the Mine contains sulphur. When the fuel is burned, the sulphur oxidizes to form SO_2. To estimate SO_2 emissions from the Mine, the mass balance approach should be used. An example calculation of using this approach for a power plant is provided below. In the example calculation, a fuel sulphur content of 0.0015 percent (%) by weight (15 parts per million weight [ppmw]) is assumed. Supplier documentation will be used to confirm the fuel sulphur content for each reporting period.

Example: Assume the engines in a power plant consume 10,000 m^3 of fuel per year, and that the fuel has a density of 881 kilograms per cubic metre (kg/m^3) and a sulphur content of 0.0015% by weight.

$$M = \rho \times V_f \times f_S \times \frac{MW_{SO2}}{MW_S}$$

Where:

M = total emissions, (tonnes per year)

ρ = fuel density, (kg/m^3)

V_f = volume of fuel used, (m^3 per year)

f_S = fraction of sulphur in fuel, (unit-less)

MW_{SO_2} = molecular weight of sulphur dioxide (SO_2), (64.06 kilograms per kilomol [kg/kmol])

MW_S = molecular weight of sulphur (S), (32.07 kg/kmol)

Note: The above is a general equation designed to estimate SO_2 emissions from the combustion of fuel based on known fuel sulphur content.

Calculate the total weight of the compound released in kilograms per year (kg/year).

$$M = \frac{881kg}{m^3} \times \frac{10{,}000m^3}{year} \times 0.000015 \frac{64.06kg/kgmolSO_2}{32.07kg/kgmolS} = 263.97 \frac{kgSO_2}{year}$$

Convert the annual release to a daily value in tonnes.

$$263.97 \frac{kgSO_2}{year} \times \frac{1year}{365days} \times \frac{1tonnes}{1000kg} = 0.0007 \frac{tonnesSO_2}{day}$$

3.2.1.4.2 SO_2 Fugitive Emissions

No SO_2 fugitive emissions are expected from the Mine.

3.2.1.5 NO_X Emission Calculation Methods

3.2.1.5.1 NO_X Combustion Emissions

Fuel burned in combustion equipment at the Mine will produce NO_X emissions. An example calculation of power plant NO_X emissions using the emission factor approach is provided below.

Example: Assume the engines in a power plant consume 10,000 m^3 of fuel per year and the diesel specifications indicate that the heating value of diesel is 0.0449 gigajoules per kilogram (GJ/kg) of fuel consumed. Furthermore, the diesel has a density of 881 kg/m^3 and the emission factor for NO_X is 1,376 grams per gigajoules (g/GJ).

$$M = \rho \times V_f \times HV \times E$$

Where:

M = total emissions, (tonnes per year)

ρ = fuel density, (kg/m³)

V_f = volume of fuel used, (m³ per year)

HV = fuel heating value, (GJ/kg)

E = emission factor, (g/GJ)

Note: The above is a general equation for emissions estimation using emission factors.

Calculate the total weight of the compound released in grams per year (g/year).

$$M = \frac{881kg}{m^3} \times \frac{10{,}000m^3}{year} \times \frac{0.0449GJ}{kg} \times \frac{1{,}376g}{GJ} = 5.443x10^8 \frac{g}{year}$$

Convert the annual release to a daily value in tonnes.

$$5.443x10^8 \frac{g}{year} \times \frac{1tonne}{10^6 g} \times \frac{1year}{365day} = 1.491 \frac{tonnes}{day}$$

3.2.1.5.2 NO_X Fugitive Emissions

No NO_X fugitive emissions are expected from the Mine.

3.2.1.6 Particulate Emission Calculation Methods

3.2.1.6.1 Particulate Combustion Emissions

Fuel burned in combustion equipment at the Mine will produce particulate emissions. An example calculation of power plant particulate emissions using the emission factor approach is provided in the following paragraphs.

Example: Assume the engines in a power plant consume 10,000 m³ of fuel per year and the diesel specifications indicate that the heating value of diesel is 0.0449 GJ/kg of fuel consumed. Furthermore the diesel has a density of 881 kg/m³ and the emission factor for TSP is 42.99 g/GJ.

$$M = \rho \times V_f \times HV \times E$$

Where:

M = total emissions, (tonnes per year)

ρ = fuel density, (kg/m³)

V_f = volume of fuel used, (m³ per year)

HV = fuel heating value, (GJ/kg)

E = emission factor, (g/GJ)

Note: The above is a general equation for emissions estimation using emission factors.

Calculate the total weight of the compound released in g/year.

$$M = \frac{881kg}{m^3} \times \frac{10{,}000m^3}{year} \times \frac{0.0449GJ}{kg} \times \frac{42.99g}{GJ} = 1.701x10^7 \frac{g}{year}$$

Convert the annual release to a daily value in tonnes.

$$1.701x10^7 \frac{g}{year} \times \frac{1tonne}{10^6 g} \times \frac{1year}{365day} = 0.005 \frac{tonnes}{day}$$

The same type of calculation would be used to determine PM_{10} and $PM_{2.5}$ emissions with a modified emission factor based on published data (e.g., the United States Environmental Protection Agency's AP-42 compendium of emission factors for TSP, PM_{10} and $PM_{2.5}$). For example; to complete the calculation for PM_{10}, an emission factor of 35.34 g/GJ would be used instead of 42.99 g/GJ. This would result in a calculated total weight of PM_{10} emissions of 1.398×10^7 g/year or, when converted, 0.004 tonnes per day as shown in the following calculations.

$$M = \frac{881kg}{m^3} \times \frac{10{,}000m^3}{year} \times \frac{0.0449GJ}{kg} \times \frac{35.34g}{GJ} = 1.398x10^7 \frac{g}{year}$$

Convert the annual release to a daily value in tonnes.

$$3.35x10^7 \frac{g}{year} \times \frac{1tonne}{10^6 g} \times \frac{1year}{365day} = 0.004 \frac{tonnes}{day}$$

3.2.1.6.2 Particulate Fugitive Emissions

In addition to Mine combustion emissions, fugitive emissions should also be considered. Fugitive particulate emissions are expected from the Mine, particularly from vehicle traffic.

3.2.1.6.2.1 Vehicle Traffic Particulate Emissions

An example calculation of TSP emissions from vehicle traffic using the emission factor approach is provided below. The road dust emission calculation takes into consideration the following factors:

- the particle size;
- the silt content of the road surface;
- the mean vehicle weight;
- the surface material moisture content; and
- the number of days of precipitation per year.

The calculation is used to generate a site-specific emission factor, in this case kilograms (kg) of TSP released per vehicle kilometre travelled (VKT). The site-specific emission factor is then multiplied by the number of VKT on-site over the reporting period to obtain a mass emission rate.

$$E = FVKT \times k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b} \times \left(\frac{M}{1}\right)^{c} \times \left[\frac{365-(p+snow)}{365}\right]$$

Where:

E = emission factor, (kg per VKT)

k = particle size multiplier, (pound [lb] per vehicle miles travelled [VMT])

s = silt content of road surface material, (%)

W = mean vehicle weight, (tonnes)

M = surface material moisture content, (%)

p = number of days with at least 0.01 inches of precipitation per year, (dimensionless)

snow = number of days of snow cover per year, (dimensionless)

FVKT = conversion from (lb per VMT) to (kg per VKT)

a, b, c =constants

The above equation can be found in the Environment Canada Road Dust Guidance Document (Environment Canada 1998).

All of the above terms, except mean vehicle weight (W), which will be specific to the vehicle type, can be found in regulatory guidance documents (i.e., Environment Canada Road Dust Guidance Document [Environment Canada 1998] and US EPA AP-42 [US EPA 1995]).

$$E = 0.2819 \times 5.3 \times \left(\frac{8.3}{12}\right)^{0.8} \times \left(\frac{20}{3}\right)^{0.5} \times \left(\frac{0.7}{1}\right)^{-0.4} \times \left[\frac{365-(118+181)}{365}\right] = 0.599 kg/VKT$$

3.2.1.6.2.2 Wind Erosion Particulate Emissions

Fugitive particulate emissions generated by wind erosion of uncovered storage piles are also expected from the Mine. The wind-generated particulate emission calculation takes into consideration various factors, such as the particle size, the number of disturbances over the reporting period, amount of precipitation and the surface erosion potential.

3.2.1.7 Greenhouse Gas Emission Calculation Methods

Greenhouse gas emissions will be emitted from the combustion sources at the Mine.

Diesel combustion at the Mine will be the largest contributor to GHG emissions. The GHGs that are expected to be released as a result of the Mine include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). While the emissions of CH_4 and N_2O are expected to be much smaller than CO_2 in volume, their global warming potentials are much greater. To maintain a valid comparison of the relative contribution of each compound compared to the overall GHG emissions total, CH_4, and N_2O emissions are converted to CO_2 equivalent (CO_2E) units. Global warming potential factors are used to convert non-CO_2 greenhouse gases to CO_2E. The global warming potential factor for CH_4 and N_2O are 21 and 310, respectively (Environment Canada 2006). An example calculation is provided in the following paragraphs.

Example: Assume the engines in a power plant consume 10,000 m^3 of fuel per year. The GHG emission factors for CO_2, CH_4, and N_2O are 2,730, 0.133, and 0.4 kg/m³ respectively (Environment Canada 2006).

$$M = Vf \times E$$

Where:

M = total emissions, (tonnes per year)

V_f = volume of fuel used, (m³ per year)

E = emission factor, (kg/m^3)

Calculate the total CO_2 emissions in tonnes/year.

$$M_{CO_2} = \frac{10{,}000m^3}{year} \times \frac{2{,}730kg}{m^3} \times \frac{1tonne}{1{,}000kg} = 27{,}300 \frac{tonnesCO_2}{year}$$

Calculate the total CH_4 emissions in tonnes/year.

$$M_{CH4} = \frac{10{,}000m^3}{year} \times \frac{0.133kg}{m^3} \times \frac{1tonne}{1{,}000kg} = 1.33 \frac{tonnesCH_4}{year}$$

Calculate the total N_2O emissions in tonnes/year.

$$M_{N2O} = \frac{10{,}000m^3}{year} \times \frac{0.4kg}{m^3} \times \frac{1tonne}{1{,}000kg} = 4.000 \frac{tonnesN_2O}{year}$$

Calculate the total CO_2E emissions in tonnes/year using the global warming potential factors for CH_4 and N_2O.

$$27{,}300tonnesCO_2 + (1.33tonnesCH_4 \times 21) + (4.000tonnesN_2O \times 310) = 28{,}568 \frac{tonnesCO_2E}{year}$$

3.2.1.8 Dioxins, Furans, and Mercury Calculation Methods

Combustion of waste in the Mine incinerator has the potential to release dioxins, furans, and mercury to the atmosphere. The emissions of these compounds are regulated under the Canada-Wide Standards.

The emissions of dioxins, furans, and mercury in the Mine incinerator will be highly dependent on the quantities and types of waste that will be burned. For this reason, emission estimates based on mass balance or emission factors are difficult to calculate. The proposed approach for estimating emissions from the incinerator is to use intermittent stack sampling data for the incinerator and compare this data to the Canada-Wide Standards in the annual reports. No fugitive dioxin, furan or mercury emissions are expected from the Mine.

3.3 Fuel Use and Waste Summary

Fuel usage for the Mine combustion sources, identified in Section 3.2.1, will be documented monthly and presented in an annual report. Table 3-2 provides a summary table to track fuel usage per source on a monthly basis. This table also allows for year by year comparisons of the annual fuel usage so that trends can be identified in annual reports. In addition to fuel usage at the site, the amount of waste burned in the incinerator will be provided in an annual report. An example summary table for tracking waste tonnage and liquid fuel use in the incinerator is presented as Table 3-3.

Table 3-2 Summary Table for Tracking Monthly Fuel Usage from Major Combustion Sources (m^3)

Month	Power Generation	Mine Heaters	Mobile Fleet	Incineration	Total	Developer's Assessment Report	2012 Total	2013 Total
January								
February								
March								
April								
May								
June								
July								
August								
September								
October								
November								
December								
Total								

Table 3-3 Summary Table for Tracking Monthly Waste Tonnage Burned (tonnes) and Liquid Fuel Usage (m^3)

Month	Waste Tonnage Burned	Liquid Fuel Usage	Total	Developer's Assessment Report	2012 Total	2013 Total
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Total						

3.4 Emissions Mitigation Strategies

There are a number of mitigation measures that will be integrated into the operations phase of the Mine to minimize air emissions. These mitigation measures primarily focus on minimizing fugitive dust emissions. This is because fugitive dust can be effectively managed through operational strategies to a greater degree than the other air emission compounds released from the Mine. A fugitive dust abatement program has been incorporated as Section 3.4.1 of this document. As for the other compounds released from the Mine, particularly combustion compounds (i.e., SO_2, NO_X, particulate, dioxins, furans, and mercury), the following mitigation measures are used:

- fuel conservation measures to reduce SO_2, NO_X, and particulate emissions;
- CCME compliant equipment to reduce NO_X emissions;
- waste diversion methods to minimize dioxins, furans, and mercury emissions from the incinerator;
- operation of combustion equipment, particularly the incinerator, at optimal conditions (e.g., manufacturer recommended temperature, pressure etc); and
- regular maintenance of the vehicle fleet and limiting of engine idling.

3.4.1 Fugitive Dust Abatement Program

3.4.1.1 Objectives

The objective of the fugitive dust abatement program is to effectively manage dust generation from surface dust sources. The dominant fugitive dust sources are expected to be road traffic, wind erosion, and activities at the waste rock pile and stockpiles.

3.4.1.2 Methods

A discussion of mitigation measures to minimize dust from the drilling, blasting, ore handling, and primary crushing activities associated with the Mine and other fugitive dust abatement measures is provided in this section. These measures may be revisited pending results of the annual report.

3.4.1.3 Watering Surfaces

CZN will control dust through watering surfaces, as necessary. Water controls dust in two ways:

- The surface tension of the water present between dust particles will increase the cohesiveness of the surface material making it less susceptible to becoming suspended in the air.
- Water droplets in the form of a spray will also knock or wash out suspended particles from the air at a more defined source such as crushers and exposed conveyor transfer points.

Dust may be significant during the usually brief dry periods of the year during the months of June through September. The application of water to any dust-prone surfaces will be an effective approach to managing fugitive dust. This would apply to site roads and the airstrip, other dust production areas and exposed conveyor transfer points.

3.4.1.4 Wind Protection

Where practical, CZN will provide wind protection for surfaces that may erode or generate dust, as necessary. Actions could take various forms, including the application of coarse material on roadways, and a tarpaulin cover for exposed, filtered tailings.

4.0 RESPONSE PLANNING

One of the purposes of the Air Quality and Emissions Monitoring and Management Plan (AQEMMP) should be to identify trends in ambient air quality and to use this information to inform management decisions around emissions mitigation. This type of proactive management requires that a clear and well-documented system be established. This section provides details on how such a system would operate.

For the system to operate effectively, the following parameters must be clearly defined:

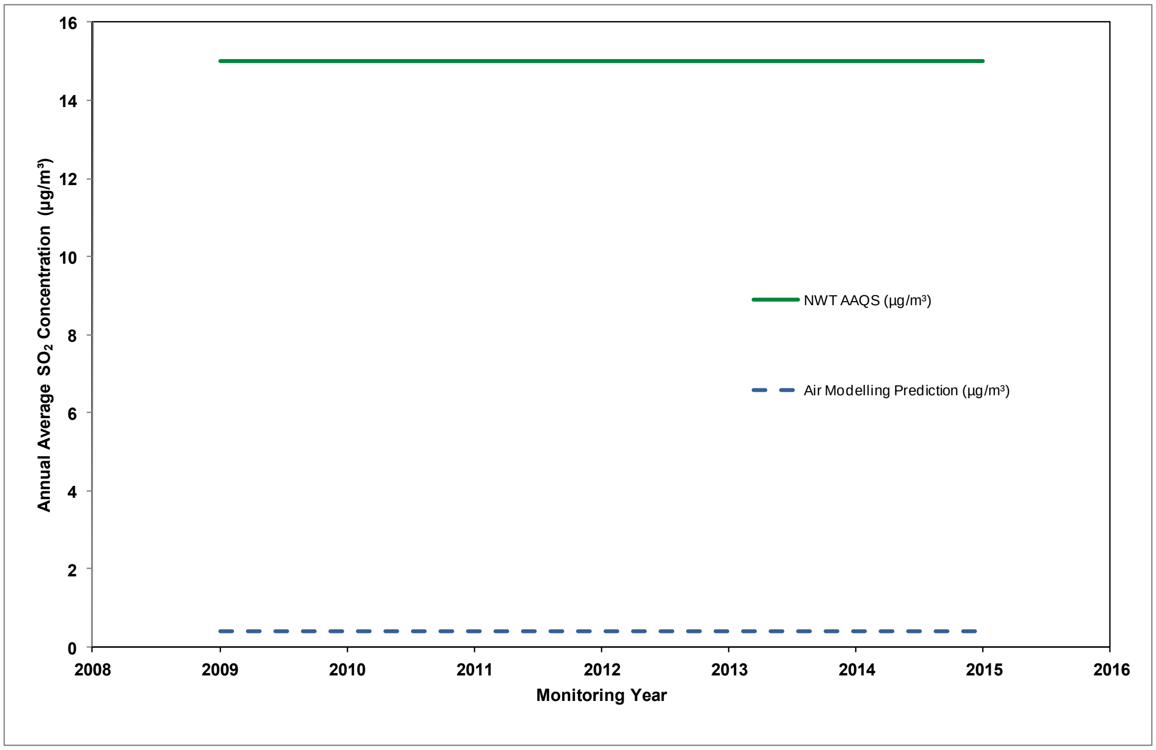
- the methodology for determining trends and identifying when emissions mitigation is necessary;
- the monitoring timeframe over which emissions mitigation decisions will be made; and
- the action levels at which emissions mitigation will be employed.

Each year the annual average concentrations for each of the monitored compounds will be summarized as part of an annual report. These concentrations will be plotted on a graph, similar to the example plot shown for SO_2 in Figure 4-1, so that the magnitude and trends in concentration over time can be easily observed. To evaluate the magnitude and trends in concentrations, a series of pre-determined action levels will also be presented in the figure. These action levels indicate a range or percent change (year to year) in concentrations at which emissions mitigation should be considered. A description of how the action levels should be applied to each of the compounds emitted by the Mine is provided below.

A systematic approach was taken to develop action levels for each compound based on the Developer's Assessment Report (CZN 2010) predictions, the applicable ambient air quality criteria and a percent change (year to year) in measured concentrations. For example, the action levels for SO_2 are as follows:

- Action Level I – annual concentrations below the maximum Developer's Assessment Report prediction or less than a 10% year to year increase.
- Action Level II – concentrations above the applicable short-term ambient air quality criteria; (e.g., 24-hour particulates) or above the maximum annual concentrations predicted in the Developer's Assessment Report but below 50% of the applicable ambient air quality criteria or from 10% to 20% year to year increase.
- Action Level III – annual concentrations above 50% of the applicable ambient air quality criteria or more than 20% year to year increase.

Figure 4-1 Action Levels for Annual Ambient SO_2 Concentrations



The above action levels are applicable to SO_2,, but are not applicable to NO_2 or $PM_{2.5}$. This is because the NO_2 and $PM_{2.5}$ concentrations predicted in the Developer's Assessment Report are high relative to the ambient air quality criteria and therefore require more proactive emissions management. This proactive management entails setting the action levels for NO_2 and $PM_{2.5}$ to respond to a smaller percentage change in concentrations as follows:

- Action Level I – concentrations below the maximum Developer's Assessment Report prediction or less than 5% year to year increase.
- Action Level II – concentrations above the maximum Developer's Assessment Report prediction but below 90% of the applicable ambient air quality standard or between 5% and 10% year to year increase.
- Action Level III – concentrations above 90% of the applicable ambient air quality standard or more than 10% year to year increase.

Table 4-1 shows each of the Action Levels and the criteria required to trigger the appropriate management action.

The management action that will be implemented for each of the action levels is as follows:

- Action Level I – continue monitoring, no mitigation necessary.
- Action Level II – internal review and consideration of further actions.

- Action Level III – external review and consideration of further actions.

Table 4-1 Action Level Triggering Criteria

Criteria	Action Level I	Action Level II	Action Level III
SO_2			
Concentration below the maximum Developer's Assessment Report prediction	✓		
Concentration above the maximum Developer's Assessment Report prediction but below 75% of the applicable air quality criteria		✓	
Concentration greater than 75% of applicable air quality criteria			✓
Concentration less than 10% year to year increase	✓		
Concentration between 10 and 20% year to year increase		✓	
Concentration greater than 20% year to year increase			✓
NO_2, $PM_{2.5}$			
Concentration below the maximum Developer's Assessment Report prediction	✓		
Concentration above the maximum Developer's Assessment Report prediction but below 90% of the applicable air quality criteria		✓	
Concentration greater than 90% of applicable air quality criteria			✓
Concentration less than 5% year to year increase	✓		
Concentration between 5 and 10% year to year increase		✓	
Concentration greater than 10% year to year increase			✓

Notes: SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; TSP = total suspended particulate; PM_{10} =particulate matter nominally less than or equal to 10 micrometres aerodynamic diameter; $PM_{2.5}$ = particulate matter nominally less than or equal to 2.5 micrometres aerodynamic diameter.

Table 4-2 indicates the criteria that will be used to determine "compliance" that will trigger actions as defined above.

Table 4-2 Criteria Used to Determine Compliance

Parameter	Air Quality Criteria [µg/m³]	Developer's Assessment Report prediction [(b)] [µg/m³]
Annual SO_2	30[(a)]	0.4
Annual NO_2	60[(a)]	40.1
24-Hour $PM_{2.5}$	30[(a)]	19.3

(a) Source: GNWT 2011.

(b) Maximum value at 200m from the lease boundary.

Notes: µg/m^3 = micrograms per cubic metres; SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter nominally less than or equal to 2.5 micrometres aerodynamic diameter.

This is a general approach that can be applied to any of the monitored compounds. If either an internal or external review is necessary, then this will likely include a review of ambient monitoring data and emissions to determine whether the elevated concentrations or trend is related to Mine equipment or operations. In this manner, the potential issues can be resolved before ambient air quality standards are exceeded, which is the primary benefit of this type of proactive management system.

5.0 ANNUAL REPORT

CZN will provide an annual report that summarizes the air quality monitoring and air emissions data collected during each year. The annual report will be submitted to appropriate regulatory authorities and the Technical Advisory Committee (TAC). In addition, CZN will report annual emission estimates to the National Pollutant Release Inventory (NPRI) and greenhouse gas (GHG) emissions to the appropriate federal program. To ensure that the Air Quality and Emissions Monitoring and Management Plan (AQEMMP) is effective, it will be reviewed every 5 years.

Examples of air emissions and ambient air monitoring tracking tables that could be used in the annual reports are provided as Tables 5-1 and 5-2 respectively.

Table 5-1 Example of Table for Tracking SO_2 Emissions (tonnes/year)

Sources	Developer's Assessment Report	2012	2013
Power generation			
Mine heaters			
Mobile fleet			
Incineration			

Table 5-2 Example of Table for Tracking Monitored $PM_{2.5}$

Monitoring Sites	Applicable Guideline	Developer's Assessment Report	2012	2013

Meteorological data will be summarized and presented by parameter, including seasonal and annual wind roses. Comparisons to applicable climate normals (30-year average) for Fort Simpson and past site monitoring will also be included.

Data summaries for each of the ambient monitoring parameters ($PM_{2.5}$, dustfall, SO_2, and NO_2) will also be provided in the annual report.

The annual report will include the following information:

- annual oxides of nitrogen (NO_X), SO_2, particulate, and GHG emissions;
- confirmation of use of low sulphur (0.0015% or less) diesel fuel through supplier specification sheets;

- an annual fuel use summary apportioned by the major sources using the same methods as the Developer's Assessment Report;
- an assessment of the effectiveness of emissions mitigation measures including fugitive dust abatement;
- comparisons of annual emission estimates to previous years and the estimates used in the Developer's Assessment Report;
- comparisons of ambient air quality and deposition monitoring results to previous years, the predictions of the Developer's Assessment Report dispersion modelling and all applicable federal and territorial criteria, standards, objectives, and guidelines;
- analysis of ambient air quality trends to determine if emissions mitigation might be necessary;
- responses (either initiated and/or planned) to air quality issues (e.g., equipment failure, data loss, increasing trends or exceedances of air quality critical/dispersion modelling predictions); and
- monitoring results made available to the GNWT for the data storage system.

6.0 REGIONAL AND CUMULATIVE EFFECTS MONITORING PROGRAMS

CZN will make available the results of the Air Quality Monitoring and emissions estimates to the recognized administering agency of the yet to be developed regional cumulative effects monitoring program.

Report Signature Page

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8.0 GLOSSARY

ambient	Existing or present in the surrounding air.
Hi-Vol sampling	An approved method for collecting total suspended particulate data in the NWT and other jurisdictions.
relative humidity	The ration of the amount of water vapour actually present in the air to the greatest amount possible at the same temperature.
respirable particles ($PM_{2.5}$)	Fine particulate matter that is able to reach the lungs, and go deeper into the respiratory tract and may have greater deleterious health impacts than the coarser inhalable particles (PM_{10}).

9.0 ACRONYMS & DEFINITIONS

Ambient	existing or present in the surrounding air
AQEMMP	Air Quality and Emissions Monitoring and Management Plan
AQM	Air Quality Monitoring
CCME	Canadian Council of Ministers of the Environment
CH_4	Methane
CI	continuous improvement
CO_2	carbon dioxide
CO_2E	carbon dioxide equivalent
CZN	Canadian Zinc Corporation
GHG	greenhouse gas
GNWT	Government of the Northwest Territories
Golder	Golder Associates Ltd.
KCAC	Keeping Clean Areas Clean
Mine	Prairie Creek Mine
MVEIRB	Mackenzie Valley Environmental Impact Review Board
N_2O	nitrous oxide
NAAQO	National Ambient Air Quality Objectives
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NPRI	National Pollutant Release Inventory
NWT	Northwest Territories
$PM_{2.5}$	particulate matter concentrations less than 2.5 micrometres
QA	quality assurance
QC	quality control
MVEIRB	Mackenzie Valley Environmental Impact Review Board
SO_2	sulphur dioxide
US EPA	United States Environmental Protection Agency

UTM	Universal Transverse Mercator

10.0 UNITS

%	Percent
°C	degrees Celsius
g/GJ	grams per gigajoule
g/year	grams per year
GJ/kg	gigajoules per kilogram
kg	Kilogram
kg/kmol	kilograms per kilomol
$kg/m^2/day$	kilograms per squared metre per day
kg/m^3	kilograms per cubic metre
kg/year	kilograms per year
km	kilometre(s)
kph	kilometres per hour
m	Metres
m^3	cubic metres
ppmw	parts per million weight
VKT	vehicle kilometres travelled
VMT	vehicle miles travelled
$\mu g/m^3$	micrograms per cubic metres
µm	Micrometers

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