Appendix 5.1.1.2A
Air Quality
2013 Baseline Report

Blackwater Gold Project

Air Quality
2013 Baseline Report

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ACRONYMS

Abbreviations and Units of Measure	Definition
%	Percent
µg/m^3	Microgram per cubic metre
µm	micrometre
AAQO	Ambient Air Quality Objectives
AMEC	AMEC Environment & Infrastructure
AQi	Air Quality Index
BC	British Columbia
BC AAQO	British Columbia Ambient Air Quality Objectives
BC EAO	British Columbia Environmental Assessment Office
BC MOE	British Columbia Ministry of Environment
BC MOH	British Columbia Ministry of Health
CAC	Criteria Air Contaminant
CAPMoN	Canadian Air and Precipitation Monitoring Network
CO	Carbon Monoxide
CWS	Canada-Wide Standards
EA	Environmental Assessment
EC	Environment Canada
EIA	Environmental Impact Assessment
ESD	Extreme Studentized Deviate
GHG	greenhouse gas
km	kilometre
km/hr	kilometre per hour
L/min	litres per minute
Lat	Latitude
Lon	Longitude
m	metre
m^3	cubic metres
MAML	Mobile Air Monitoring Laboratory
mm	millimetre
NAAQO	National Ambient Air Quality Objectives
NAPS	National Air Pollution Surveillance Program
NL	Newfoundland and Labrador
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPRI	National Pollutant Release Inventory
NT	Northwest Territories
O_3	Ozone
ON	Ontario

Abbreviations and Units of Measure	Definition
PM	particulate matter
PM_{10}	particulate matter no greater than 10 µm in aerodynamic diameter
$PM_{2.5}$	particulate matter no greater than 2.5 µm in aerodynamic diameter
ppb	parts per billion
ppm	parts per million
Project (the)	Proposed Blackwater Gold Project
QA/QC	Quality Assurance / Quality Control
SO_2	sulphur dioxide
SO_x	sulphur oxides
TPM	Total Particulate Matter
TSP	Total Suspended Particulate
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

An air quality assessment is a required component of the Application for an Environmental Assessment Certificate (Application) for submission to the British Columbia Environmental Assessment Office (BC EAO), with the objective to develop the proposed Blackwater Gold Project (the Project). A thorough understanding of baseline air quality is a prerequisite to the air quality environmental assessment (EA).

The baseline refers to the collective level of air contaminants contained in the larger airshed, rather than local measurements. These contaminants may arise from natural or anthropogenic (manufactured) sources. Understanding the appropriate background concentration of air pollutants is critical in assessing overall (cumulative) air quality, which incorporates background values and adds the predicted incremental increase from the Project emission sources.

AMEC Environment & Infrastructure (AMEC) identified and analyzed several databases using such references as the number of monitored criteria air contaminants (CACs), instrumentation, location, monitoring period, and relevance to the Project with respect to level of development. The final selection was narrowed to the following four data sources:

1. National Air Pollution Surveillance Program (NAPS);
2. British Columbia Ministry of Environment (BC MOE) Monitoring Network;
3. West Central Airshed Society (WCAS) Monitoring Stations; and
4. On-site Blackwater particulate monitoring.

Based on relevant data available at the above sources, values of the background concentrations accepted for the Project site for relevant contaminants are as follows:

Particulate matter 2.5 µm diameter ($PM_{2.5}$)	4 µg/m^3
Particulate matter 10 µm diameter (PM_{10})	9 µg/m^3
Nitrogen dioxide (NO_2)	8 µg/m^3
Sulphur dioxide (SO_2)	2 µg/m^3
Carbon monoxide (CO)	120 µg/m^3

The background concentrations are low, compared to ambient air quality objectives. This is expected, as the Project is located in a remote area with no nearby substantive anthropogenic emission sources.

1.0 INTRODUCTION

An air quality assessment is a required component of the Application for submission to the British Columbia Environmental Assessment Office (BC EAO), with the objective to develop the proposed Blackwater Gold Project (the Project).

In this study, air quality refers to the concentration, or other measure, of pollutants including gases, vapours, or solid particulate substances at concentrations above normal ambient levels that have the potential to produce a measurable and undesirable effect on humans, animals, and vegetation, or cause damage to property or the environment. Substances are natural or synthetic (anthropogenic) chemical elements or compounds capable of being airborne. Baseline air quality refers to the collective level of air contaminants contained generally in a larger airshed, rather than local measurements from specific natural or anthropogenic sources. Air masses can carry pollutants long distances from areas with heavy traffic, urban centres, and industrial conglomerates, where large amounts of contaminants are released. Local pollution sources, if present, will contribute to regional and inter-regional concentrations.

In stagnant weather conditions, when regional or inter-regional transport is not taking place, various local sources are responsible for air quality. The magnitude of the effect depends on emission intensity and a number of other factors such as source type (area, volume, or point sources), emission release height, meteorology, and topography. There are no significant local sources in the Project preconstruction phase.

The background concentration of air pollutants is needed in assessing overall (cumulative) air quality, which is given by:

Cumulative = Background + Predicted Increase from Modelled Project Emission

The information sources used to establish the background concentration level may include the following methods:

- A network of long-term ambient monitoring stations within the Project area;
- Long-term ambient monitoring at a different location that is adequately representative; and
- Modelled background.

A network of long-term ambient monitoring stations is neither justified nor feasible because the Project is located in a remote area with a relatively undisturbed environment (coniferous forest), limited accessibility, and no power supply. In addition, there is insufficient time for long-term monitoring as Project construction is scheduled to start in 2014. The only on-site station dedicated for particulate monitoring started operation in late September 2012, and a full year of data have been collected to date. A modelled background is impractical for use in this assessment because there are no permanent contributing sources in the area that

could be used to establish the cumulative background levels by dispersion modelling. Therefore, long-term ambient monitoring at a representative location is the only feasible option for estimating background concentrations of relevant criteria air contaminants.

2.0 METHODS

Determination of background concentrations of air pollutants using off-site monitoring data adhered to the Guidelines for Air Quality Dispersion Modelling in British Columbia, Section 10.1.5 (BC MOE, 2008). The Guidelines advise how to select a background level for three levels of air quality assessment using existing monitoring data. The methodology, which has been applied to justify the selection of the background, is required in the appropriate section of the air quality assessment report.

The air quality in the Project air quality study area is of very good quality, likely due to a sparse population, an absence of nearby highways, and a lack of industrial developments (**Figure 2-1**). Therefore, baseline air quality is expected to be similar to that monitored in other remote areas of northern BC. This approach was discussed with the air quality meteorologist of the British Columbia Ministry of Environment (BC MOE), Omineca–Peace Region in Prince George. From these discussions, it was agreed that long-term continuous monitoring of baseline air quality at the proposed location of the Project is not warranted and a desktop study is sufficient to estimate the most likely baseline concentrations. The exception is on-site monitoring of particulates ($PM_{2.5}$ and PM_{10}) because fugitive dust is a key air pollutant associated with pit mining for which exceedances of Ambient Air Quality Objectives (AAQO) are more likely. This approach is consistent with baseline air quality monitoring guidelines for mine proponents (BC MOE, 2012).

The value selected for background depends on the purposes of the modelling assessment. For the Project, where a conservative estimate of the effects from the source is desired (determining compliance with ambient objectives/guidelines for worst-case analysis), a conservative value should be used to establish background levels. Historically in BC, percentile background levels used in air quality assessments have been 98th percentile value of the monitored dataset or higher (BC MOE, 2008). In practice, background levels are selected for time averages that correspond to the modelled time averages (e.g., 24-hour average background level for 24-hour model predicted time-average concentration). If there is more than one representative monitoring site, an acceptable approach is to take the arithmetic average of the selected site background levels to determine the representative background concentration that corresponds to each averaging period (BC MOE, 2008, page 85). The averaging periods and corresponding ambient air quality objectives are shown in **Table 3-1**. Since the background concentrations are anticipated to be low, the median (i.e., 50th percentile) is proposed as the background concentration for all contaminants; this is a conservative approach, as project effects will show larger with lower background values. This approach was agreed to in the discussions with the Regional Meteorologist.

320000 360000 400000 440000

6000000 5960000 5920000 5880000

François Lake
Southbank
Cheslatta Carrier
Danskin
Skin Tyee
Uncha Mountains Red Hills Park
François Lake
Francois Lake Park
Uncha Lake
Takysie Creek
Binta Lake
Nithi River
Cheslatta River
Cheslatta Lake
Knapp Creek
Cheslatta
Bird Creek
Lucas Lake
Lucas Creek
Knewstubb Lake
Big Bend Creek
Natalkuz Lake (Nechako Reservoir)
Tetachuck River
Entiako River
Entiako Park
Entiako Lake
Tweedsmuir Park
Johnny Lake
Moose Lake
Laidman Lake
Fawnie Creek
Laidman Lake Ecolodge
Top Lake
Tsacha Lake
Kushya
Endako
Stellako
Fraser Lake
Nadleh Whuten
Fort Fraser
Engen
Nechako River
Proposed Transmission Line (Stellako Re-route)
Smith Creek
Tachick Lake
Stony
Saik'uz
Nulki
Nulki Lake
Tahultzu Lake
Hallett Lake
Clear Creek
Targe Creek
Corkscrew
Sinkut River
Vanderhoof
Weneez
Sinkut River
Stuart River Park
Stuart River
Mapes
Cluculz Lake
Cluculz Creek
Khai
Kluskus FSR
Proposed Transmission Line
Nechako Canyon Protected Area
Meridian Road (Vanderhoof) Ecological Reserve
Finger Lake
Tatuk Lake
Finger Tatuk Park
Chilako River Ecological Reserve
Chilako River
Proposed Transmission Line (Mills Ranch Re-route)
Chedakuz Creek
Taluk Creek
Batnuni Lake
Euchiniko River
Nataniko Creek
Euchiniko
Alexander Mackenzie Heritage Trail
Nazko
Kluskoil Lake Park
Euchiniko Lakes
Kuyakuz Lake
Blackwater-Spruce Ranch
Blackwater River
Kluskus
Baezaeko
Nazko
Proposed Airstrip Access Road
Proposed Airstrip
Tatelkuz Lake Reserve 28
Tatelkuz Lake Resort
Tatelkuz Lake
Proposed Mine Access Road
Kluskus-Ootsa FSR
Proposed Fresh Water Pipeline
Kluskus-Blue FSR
Exploration Road

Legend

- Populated Place
- Recreation Lodge
- Homestead
- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Railway
- Existing Transmission Line
- Stream
- Waterbody
- Parks & Protected Areas

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Proposed Transmission Reroute
- Proposed Fresh Water Pipeline
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site

Air Quality and Climate

- Local Study Area (LSA)
- Receptor Location

Note: Regional Study Area (RSA) is the same as the LSA

Scale: 1:500,000

0 5 10 20

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold™

PROJECT: Blackwater Gold Project

Air Quality and Climate Study Areas

DATE:	ANALYST:	**Figure** 2-1
September, 2014	WR	
JOB No: VE52420	QA/QC: GH	PDF FILE: 04-100-001_v5_Air_SA_Receptor.pdf
GIS FILE: 04-100-001_v5_Air_SA_Receptor.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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3.0 RESULTS/DISCUSSION

3.1 Criteria Air Contaminants

Expected air emissions resulting from the Project include particulate matter (PM), sulphur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), and volatile organic compounds (VOCs). These substances are categorized as criteria air contaminants (CACs).

Airborne PM is a mixture of microscopic solids and liquid droplets suspended in air. The composition includes acidifying substances (e.g., nitrates and sulphates), organic chemicals, metals, soil or dust particles, and allergens (e.g., fragments of pollen or mould spores). The chemical composition of particles depends on location, time of year, and weather. Particles are formed from gases released to the atmosphere by combustion sources such as vehicles and other engine powered equipment, grinding, material handling, and traffic. Particles 10 micrometres (µm) or less in diameter (PM_{10}) pose a health concern because they can be inhaled and thus accumulate in the respiratory system. They can also reduce visibility and contribute to acidification of soils. Fine particles, which are 2.5 µm or less in diameter ($PM_{2.5}$), are believed to pose the greatest health risks.

SO_2 is one of a group of highly reactive gases collectively known as oxides of sulphur. It is linked with a number of adverse effects on the respiratory system. The largest source of SO_2 emissions is fossil fuel combustion at power plants and other industrial and gas processing facilities. SO_x emissions from diesel-fuelled vehicles have decreased significantly due to the Canadian regulation that stipulates on-road and off-road permitted trucks must use ultra low sulphur diesel containing a maximum of 15 ppm sulphur. Natural levels of SO_2 are low due to oxidization to sulphate ion and wash out of the atmosphere during precipitation events. Small quantities of SO_2 will be present in diesel exhaust from mine equipment and vehicles.

NOx are primarily the sum of NO_2 and nitric oxide (NO). During high temperature combustion, as in the burning of natural gas, coal, oil, and gasoline, atmospheric nitrogen combines with molecular oxygen to form NO_x, primarily in the form of NO. Most NO in the ambient air will react with atmospheric ozone to form NO_2. NO_2 is a reddish-brown gas with a pungent odour and is partially responsible for the brown haze observed in and near large cities. Transportation (automobiles, locomotives, aircraft, and ships) is the major source of NO_x emissions in BC. In the Omineca–Peace Region, the oil and gas industry is the major source of NO_x emissions. Diesel powered equipment and trucks at the Project site will be the main contributors of NO_x emissions.

CO is a colorless and odourless gas emitted into the atmosphere primarily from incomplete combustion of carbon-based fuels such as gasoline, diesel, oil, and wood. The major source of CO in urban locations is motor vehicle exhaust emissions. Minor sources include

fireplaces, industry, aircraft, and natural gas combustion. Forest fires are a natural source of CO. Diesel engines at the Project site will be the main contributors of CO emissions.

VOCs are emitted from motor vehicle exhaust, and from many industrial processes, particularly the oil and gas industry. Coniferous trees emit VOCs and are a dominant natural source in the region. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. They participate in atmospheric photochemical reactions. VOCs are typically not acutely toxic, but have chronic effects. Health effects vary by type of VOC constituent. Some VOCs will be present in the exhaust discharged by Project equipment and vehicles.

3.2 Assessment Criteria

Both national and provincial ambient air quality objectives (AAQO) determine the maximum allowable concentrations of CACs. BC jurisdictions also have flexibility in defining ambient air quality guidelines that are more stringent than the national criteria. These requirements are defined in the Canadian Council of Ministers for the Environment (CCME, 2007) policy for keeping clean areas clean and maintaining a continuous improvement concept, and are intended as guidance for those areas that already comply with the Canada-Wide Standards (CWS) (CCME, 2000).

The primary goal of establishing AAQO is to protect the public from the effects of air pollution and to eliminate or minimize exposure to hazardous pollutants. The guidelines are set up to help the government assess projects against legally enforceable air quality standards, and to guide environmental health authorities and professionals responsible for the protection of the environment from the harmful effects of ambient air pollution.

BC has air time-based quality criteria for ambient air concentrations defined at three levels:

- Level A: Below this level, air quality is “good.” It represents the maximum desirable concentration.
- Level B: Below this level (but above Level A), air quality is “fair.” It represents the maximum acceptable concentration.
- Level C: Below this level (but above Level B), air quality is “poor.” Above this level, air quality is “very poor.” It represents the maximum tolerable concentration.

The Canadian National Ambient Air Quality Objectives (NAAQO) (HC, 2013) were developed as a three-tiered system. Each level represents a specific concentration for an individual air contaminant, with one or more averaging periods used. For each of the air contaminants, time-averaged concentrations shall not be greater than one of the following:

- The Maximum Desirable Level (Level A) defines the long-term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of the country and for the continuing development of control technology;

- The Maximum Acceptable Level (Level B) intends to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort, and well-being; and
- The Maximum Tolerable Level (Level C) denotes the concentration of an air contaminant that requires abatement without delay to avoid further deterioration to an air quality that would endanger the prevailing Canadian lifestyle or ultimately, to an air quality that would pose a substantial risk to public health.

The selection of the appropriate concentration level will depend upon the degree of protection to be afforded to affected receptors. Maximum Tolerable Levels are only for evaluation purposes to identify the severity of an anthropogenic or natural phenomenon in order to protect human health and institute appropriate corrective action. In general, Maximum Acceptable Levels are not to be exceeded in any urban centre including areas that are near industries with atmospheric emissions. Within rural areas, the goal is to maintain pollutant concentrations at or below Maximum Desirable Levels.

Table 3-1 presents the provincial and national guidelines and the CWS. The Project-specific compounds presented in the table include SO_2, NO_2, CO, total suspended particulate (TSP), PM up to 10 µm in diameter (PM_{10}), and PM up to 2.5 µm in diameter ($PM_{2.5}$). These guidelines and objectives apply to averaging periods ranging from one hour to one year.

The CWS are intended to be achievable standards based on sound science, which take into consideration social implications and technical feasibility. The CWS do not have any legal standing. Each jurisdiction that is a participant in the Harmonization Accord will implement the standards under existing provincial legislation, or draft new legislation.

Table 3-1: Provincial and National Ambient Air Quality Standards and Objectives[(a)] (µg/m³)

Contaminant/ Averaging Period	BC			National			Canada-Wide Standards
	Level A	Level B	Level C	Desirable	Acceptable	Tolerable	
SO_2							
1-hour	450	900	900-1,300	450	900	-	-
24-hour	160	260	360	150	300	800	-
Annual	25	50	80	30	60	-	-
NO_2							
1-hour	-	-	-	-	400	1,000	-
24-hour	-	-	-	-	200	300	-
Annual	-	-	-	60	100	-	-
CO							
1-hour	14,300	28,000	35,000	15,000	35,000	-	-
8-hour	5,500	11,000	14,300	6,000	15,000	20,000	-
TSP							

Contaminant/ Averaging Period	BC			National			Canada-Wide Standards
	Level A	Level B	Level C	Desirable	Acceptable	Tolerable	
24-hour	-	-	-	-	120	400	-
Annual[(b)]	-	-	-	60	70	-	-
PM_{10}							
24-hour[(c)]	-	-	50	-	-	-	-
$PM_{2.5}$							
24-hour	-	-	25	-	-	-	30
Annual	-	-	8	-	-	-	

Note: $\mu g/m^3$ = microgram per cubic metre
[(a)]At a temperature of 25°C and pressure of 101.3 kPa
[(b)]As a geometric mean
[(c)]NL, ON, and BC have an interim 24-hour guideline of 50 $\mu g/m^3$

3.3 Baseline Air Quality Data

Air quality data pertaining to the Project air quality local study area are based on the results of long-term ambient monitoring at different locations representing regional and inter-regional concentrations of CACs.

Several databases were identified and evaluated using such references as the number of monitored CACs, instrumentation, location, monitoring period, and relevance to the Project. The final selection has been narrowed to four data sources:

- National Air Pollution Surveillance (NAPS);
- BC MOE Monitoring Network;
- West Central Airshed Society (WCAS) Monitoring Stations; and
- Project on-site continuous monitoring of PM.

3.3.1 National Air Pollution Surveillance Program

The NAPS program, which has been in existence since 1969, is a cooperative partnership of federal, provincial, territorial, and some regional governments measuring air quality throughout Canada. The goal of the program is to provide accurate and long-term air quality data of uniform standard. NAPS data are included in the NAPS Network Annual Data Summary reports (NAPS, 2008). .

In 2005 and 2006, the NAPS Network and associated provincial/territorial/regional monitoring networks reporting data to the Canada-wide database, consisted of 319 stations in 216 communities including 83 in rural areas, equipped with approximately 850 continuous monitors measuring SO_2, CO, NO_2, O_3, and PM (TSP), and over 100 air samplers measuring components of PM ($PM_{2.5}$, PM_{10}), VOCs, and other toxics substances.

Various statistics derived from the measurements and comparisons with the National Air Quality Objectives prescribed under the *Canadian Environmental Protection Act, 1999* (Government of Canada, 1999) are published in the NAPS Annual Data Summary reports.

Depending on the specific reasons and purpose for monitoring, some or all of the air quality criteria pollutants may be monitored. Some stations are used by jurisdictions for Air Quality Index (AQi) reporting; other stations are used for CWS achievement determination or for trans-boundary transport monitoring or for special studies of local air pollution problems. The goal is to provide the best assessment of the air quality or of an air pollution problem, for the general population, with the most efficiency.

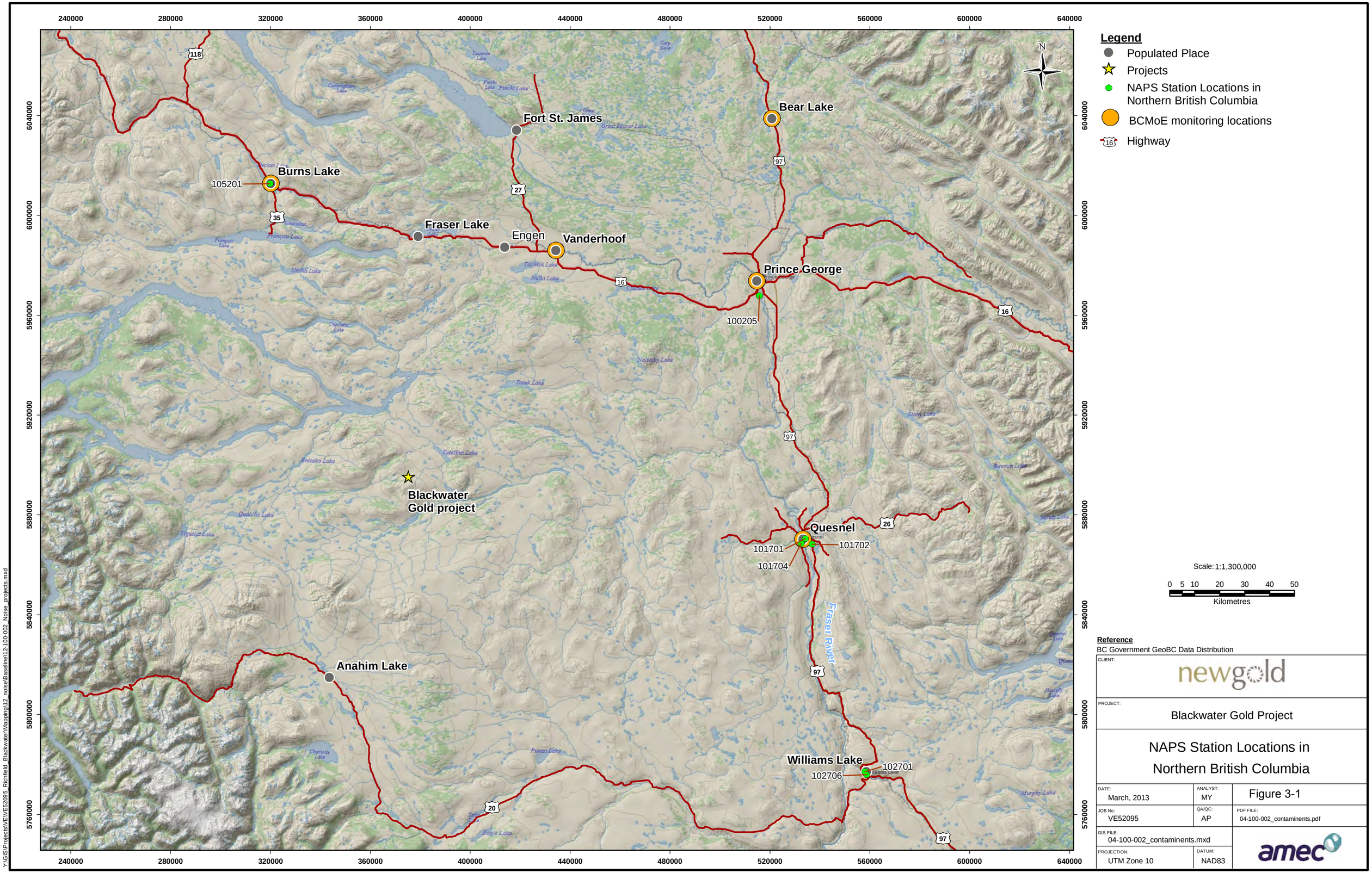
The selection of sites for the NAPS Network is done in consultation with network agencies to meet the network objective of producing air quality data representative of the geographic area of interest. The sites in the network are selected based on the requirements for distribution, location, separation, and spatial scale of representativeness. Air monitoring stations at these sites are meant to measure air quality trends over the long term and therefore are intended to have some degree of permanency. There are also stations established to characterize long-range transport and trans-boundary movement of air pollutants. The most recent NAPS full report published in 2008 (NAPS, 2008) includes monitoring data for 2005 and 2006. **Figure 3-1** shows the locations of the NAPS stations in northern BC (NAPS, 2008).

Additional information is shown in **Table 3-2**.

Table 3-2: Location and Monitored Pollutants by NAPS Stations in the Project Area

NAPS_ID	Location	Lat, ° N	Lon, ° W	SO_2	NO_2	PM
100202	Prince George, BC	53.9147	122.7419	X	X	X
100205	Prince George, BC	53.8583	122.7608	X	-	X
101701	Quesnel, BC	52.9822	122.4920	X	X	X
101702	Quesnel, BC	52.9631	122.4506	-	-	X
101704	Quesnel, BC	52.9664	122.5167	-	-	X
102701	Williams Lake, BC	52.1417	122.1528	-	X	X
102706	Williams Lake, BC	52.1308	122.1422	-	-	X
105201	Burns Lake, BC	54.2308	125.7640	-	-	X

A summary of median concentration (50th percentiles) of air contaminants measured at the locations shown in **Figure 3-1** are presented in **Table 3-3**. The table shows cumulative concentrations generated by natural and anthropogenic sources, which are most likely higher than concentrations at the Project area. However, when compared to ambient air quality objectives shown in **Table 3-1**, the discrepancies can be disregarded as the permissible concentrations are much higher than cumulative concentrations recorded at NAPS stations.



Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

NAPS Station Locations in Northern British Columbia

DATE: March, 2013	ANALYST: MY	Figure 3-1
JOB No: VE52095	QA/QC: AP	PDF FILE: 04-100-002_contaminents.pdf
GIS FILE: 04-100-002_contaminents.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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Table 3-3: Pollutants Concentration at Relevant NAPS Monitoring Stations, Northern BC

Year	Pollutant (Conc. Unit)	Period (hour)	100202	100205	101701	101702	101704	105201	102701	102706	Average
2005	PM_{10} (µg/m^3)	1	15	7	14	11	11	14	14	15	13
		24	16	9	16	13	10	15	16	18	14
	$PM_{2.5}$ (µg/m^3)	1	5	-	5	4	3	-	5	4	4
		24	6	-	6	5	4	-	5	5	5
	SO_2 (ppb)	1	1	0	-	-	-	-	-	-	1
		24	1	0	-	-	-	-	-	-	1
	SO_2 (µg/m^3)	1	3	0	-	-	-	-	-	-	3
		24	3	0	-	-	-	-	-	-	3
	NO_2 (ppb)	1	11	-	7	-	-	-	6	-	8
		24	12	-	8	-	-	-	7	-	9
	NO_2 (µg/m^3)	1	21	-	13	-	-	-	11	-	10
		24	23	-	15	-	-	-	13	-	17
2006	PM_{10} (µg/m^3)	1	14	11	15	11	9	12	15	15	13
		24	17	12	17	14	11	13	17	17	15
	$PM_{2.5}$ (µg/m^3)	1	5	-	6	4	4	4	5	4	5
		24	6	-	7	6	4	5	6	5	6
	SO_2 (ppb)	1	1	0	0	-	-	-	-	-	0
		24	1	1	0	-	-	-	-	-	1
	SO_2 (µg/m^3)	1	3	0	0	-	-	-	-	-	1
		24	3	3	0	-	-	-	-	-	2
	NO_2 (ppb)	1	12	-	8	-	-	-	7	-	9
		24	13	-	9	-	-	-	8	-	10
	NO_2 (µg/m^3)	1	23	-	15	-	-	-	13	-	17
		24	24	-	17	-	-	-	15	-	19

Year	Pollutant (Conc. Unit)	Period (hour)	100202	100205	101701	101702	101704	105201	102701	102706	Average
Annual All Stations Two-Year Period (2005–2006)											***Ave (µg/m^3)***
	PM_{10}	1	-	-	-	-	-	-	-	-	13
		24	-	-	-	-	-	-	-	-	15
	$PM_{2.5}$	1	-	-	-	-	-	-	-	-	5
		24	-	-	-	-	-	-	-	-	5
	SO_2	1	-	-	-	-	-	-	-	-	3
		24	-	-	-	-	-	-	-	-	3
	NO_2	1	-	-	-	-	-	-	-	-	13
		24	-	-	-	-	-	-	-	-	18

Note: µg/m^3 = microgram per cubic metre; ppb = parts per billion;
"- = no monitoring or monitoring time less than 90% of annual
0 = completed measurement with the concentration result below the detection limit

CO from the NAPS sources is not included in this table. CO is only measured in Prince George, the largest regional city, and therefore highly impacted by urban sources, such as motor vehicles, which are typically the dominant urban CO source. This is not representative of current conditions in the Project air quality local study area and thus is not used for baseline purposes.

3.3.2 BC Ministry of Environment Monitoring Network

Air quality monitoring in BC is conducted by BC MOE, Metro Vancouver, and industry (where required by permit) in cooperation with EC and regional districts. There are approximately 150 stations monitoring air quality throughout BC (BC MOE, 2013). These stations monitor for a variety of air contaminants, including CO, NO_2, O_3, PM ($PM_{2.5}$ and PM_{10}), SO_2, and H_2S. The data are reported as raw parameters and are used to calculate AQi.

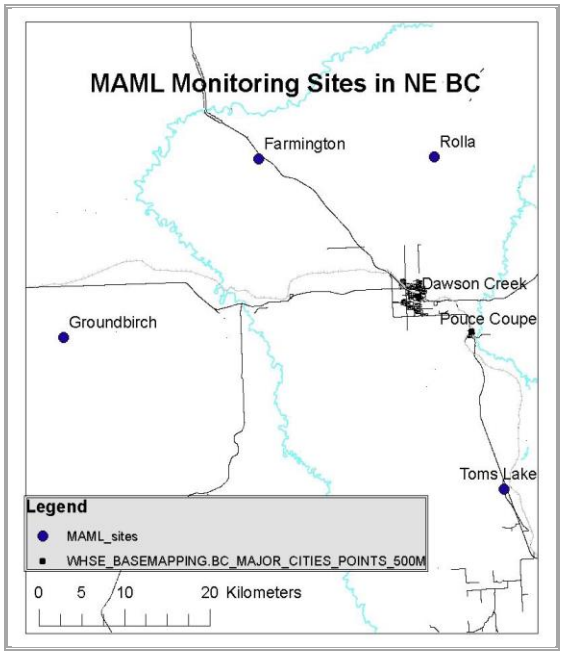
The provincial air monitoring network includes three categories of monitoring stations:

- *Continuous stations: Approximately 100 stations constantly monitor air quality by drawing air in through a tube and automatically transmitting the data (via telephone or cellular networks) to a central BC MOE database.*
- *Noncontinuous stations: Approximately 50 stations collect air pollutants on filters (or in canisters in the case of volatile organic compounds). The filters or canisters are collected by technicians in the field after a discrete period of time and sent to a certified laboratory for chemical and/or gravimetric (weight) analysis.*
- *Mobile monitors*: These consist of a number of instruments installed in a large vehicle or an airplane, and are used to assess ambient air quality over short periods of time in areas not covered by the permanent monitoring network or for special studies. BC MOE has been using the Mobile Air Monitoring Laboratory (MAML) to continuously measure common air pollutants, such as SO_x, NO_2, CO, ozone, and PM.

Current and historical air quality monitoring results are available at the BC Air Data Archive website (BC MOE, 2013), which provides historical data from the ambient air quality and meteorological stations throughout the province. BC MOE monitoring locations near the Project are shown on **Figure 3-2**.

Most of these monitoring stations operate at sites where local anthropogenic sources are significant (e.g., within municipalities). Therefore, determination of the exact magnitude of background concentrations based on routine ambient monitoring is problematic. In the absence of specific monitoring data from unpolluted sites, survey of published studies on background levels in the Omineca–Peace Region, where the Project will be located, revealed some monitoring sites in the northeastern part of the region that are relatively free of major industrial emission sources.

The MAML was deployed to monitor air quality in five communities free of major emission sources in northeastern BC during 2010 and 2011. The selected locations were Toms Lake, Ground Birch, Rolla, Farmington, and Kelly Lake. These locations, with the exception of Kelly Lake, which is located 55 kilometres (km) south of Dawson Creek, are shown on **Figure 3-2**. Although the monitoring periods were less than one year, the concentrations are good indicators of air pollution level at remote locations during summer.



Source: BC MOE, 2011

Figure 3-2: Location of MAML Sites Northeast of the Project

Summary results of the MAML surveys on a one-hour basis are shown in **Table 3-4**.

Table 3-4: Concentration of Air Pollutants at MAML Stations

Contaminant	Unit	Station					Average
		Rolla	Farmington	Ground Birch	Kelly Lake	Toms Lake	
$PM_{2.5}$	µg/m^3	4.6	6.7	2.3	4.6	4.4	4.5
PM_{10}	µg/m^3	7.8	9	4.9	5.6	8.9	7.2
SO_2	ppb	0.3	0.3	0.2	0.7	0.3	0.4
	µg/m^3	0.8	0.8	0.5	1.8	0.8	0.9
NO_2	ppb	3.6	2.3	0.5	2.6	1.8	2.2
	µg/m^3	6.8	4.3	0.9	4.9	3.4	4.1
CO	ppm	0.07	0.09	0.08	0.09	0.09	0.08
	µg/m^3	80	100	90	100	100	100
Start Date		7/20/2010	8/12/2010	6/22/2010	2/06/2011	5/23/2010	-
End Date		8/11/2010	9/10/2010	7/18/2010	4/18/2011	6/21/2010	-

Note: µg/m^3 = microgram per cubic metre; ppb = part per billion; mg/m^3 = milligram per cubic metre

The monitoring results are in general agreement with estimated average background concentrations of $PM_{2.5}$ and ozone in BC (McKendry, 2006), and are summarized as follows:

- The mean annual background concentration of $PM_{2.5}$ is approximately 2 µg/m^3 and varies seasonally with a summer peak and winter minimum. Lower values are likely in wet coastal areas while slightly higher values might be expected in drier regions. Local forest fires represent the major and most frequent source contributing to short-term peak background concentrations, which could result in the average measured concentration of 4.5 µg/m^3 shown in **Table 3-4**.
- The mean background concentration of ozone is estimated to be in the range 20 ppb to 35 ppb (39 µg/m^3 to 69 µg/m^3) and varies seasonally with a spring maximum. Stratospheric intrusions of ozone-rich air may contribute 20 ppb to 40 ppb to short-term peak concentrations (but generally in meteorological conditions not conducive to elevated concentrations associated with local anthropogenic activities).

3.3.3 West Central Airshed Society Monitoring Stations

The West Central Airshed Society (WCAS) promotes management of air quality within an airshed that spans from the western boundary of the Edmonton city limits to the BC border. The Society activities include, inter alia, monitoring of air quality in the region using 13 continuous on-line air quality-monitoring stations. The station relevant to the Project is Hightower Ridge located near the Alberta–BC border because it provides particulate monitoring at a remote location free of anthropogenic sources and the latitude, elevation and topography is similar to the Project area. The concentrations for the five-year period of PM_{10} and $PM_{2.5}$ are shown in **Table 3-5**; 2010 data are not included due to air polluting forest fires that occurred at that time (Fudge, personal comm. 2013).

Table 3-5: Annual Averages of Monthly Concentrations of PM_{10} and $PM_{2.5}$ at Hightower Station

Year	Concentration (µg/m^3)	
	$PM_{2.5}$	**PM_{10}**
2000	-	5.4
2001	-	5.8
2002	-	6.1
2003	2.8	6.8
2004	2.5	7.3
2008	2.0	-
2009	2.5	-
2011	1.6	-
Average	2.3	6.3

Note: " - " No monitoring or months with less than 50% data

3.3.4 Greenhouse Gases Measurements Laboratory

EC's Greenhouse Gases Measurements Laboratory (GGML) records accurate concentration measurements of greenhouse gases (GHG) from coastal, interior, and Arctic regions in Canada. The data are analyzed to detect seasonal and annual variations and to determine the magnitude of the Canadian and global GHG sources and sinks. Because CO measurements are included, the data can be accepted as an indicator of wide-range concentration of CO in western Canada where the Project is located. In BC, Estevan Point is the nearest monitoring site (Lat 49.5833 N, Lon 126.3667 W). Measurements of CO hourly concentrations over the 2009 to 2010 period (most recent data) shows the average (mean) value of 122.9 ppbv (141 µg/m^3) with the minimum of 66 ppbv and maximum 278 ppbv (NAtChem, 2013).

3.3.5 Monitoring of Particulate Matter

A dust-sampling program was devised and has been carried out since 22 September 2012 at the Project site. Currently, no anthropogenic dust emission sources are present and the results represent baseline concentrations.

3.3.5.1 Equipment

The Thermo Scientific Partisol 2025i-D Dichotomous Sequential Air Sampler was used for simultaneous concentration measurement of fine ($PM_{2.5}$) and coarse (PM_{10}) ambient PM. The sampler combines sequential filter exchange capabilities with dichotomous splitting technology to provide an automated split sample stream that offers long-term unattended operation. The device utilizes a virtual impactor operating at 16.7 L/min (1 m^3/h) to provide the initial D50 particle size cut-off at a 10-µm diameter. The virtual impactor is located after the inlet, and two separate flow controllers maintain the coarse particle stream at 1.7 L/min and the fine particle stream at 15 L/min. The Partisol is a US EPA $PM_{2.5}$, PM_{10}, and PM-Coarse Equivalent Sampler.

3.3.5.2 Methodology

The sampled air stream is collected concurrently on two 47-millimetre (mm) filters housed in FRM-style moulded filter cassettes. The sampling program consists of 24-hour sampling starting at 10:00 a.m. every third day in adherence to the BC MOE analytical method. Maxxam Analytical gravimetrically analyzes collected filters according to BBY5SOP-00005 laboratory method. The Quality Assurance / Quality Control (QA/QC) program for the sampling study consists of detailed chain of custody, as well as a collection of travel blanks for each batch of filters shipped to the laboratory for analysis. Maxxam Laboratory has carried out analytical QA/QC procedures.

3.3.6 Results

Figure 3-3 shows the current results of the baseline sampling program, from 22 September 2012 to 26 September 2013.

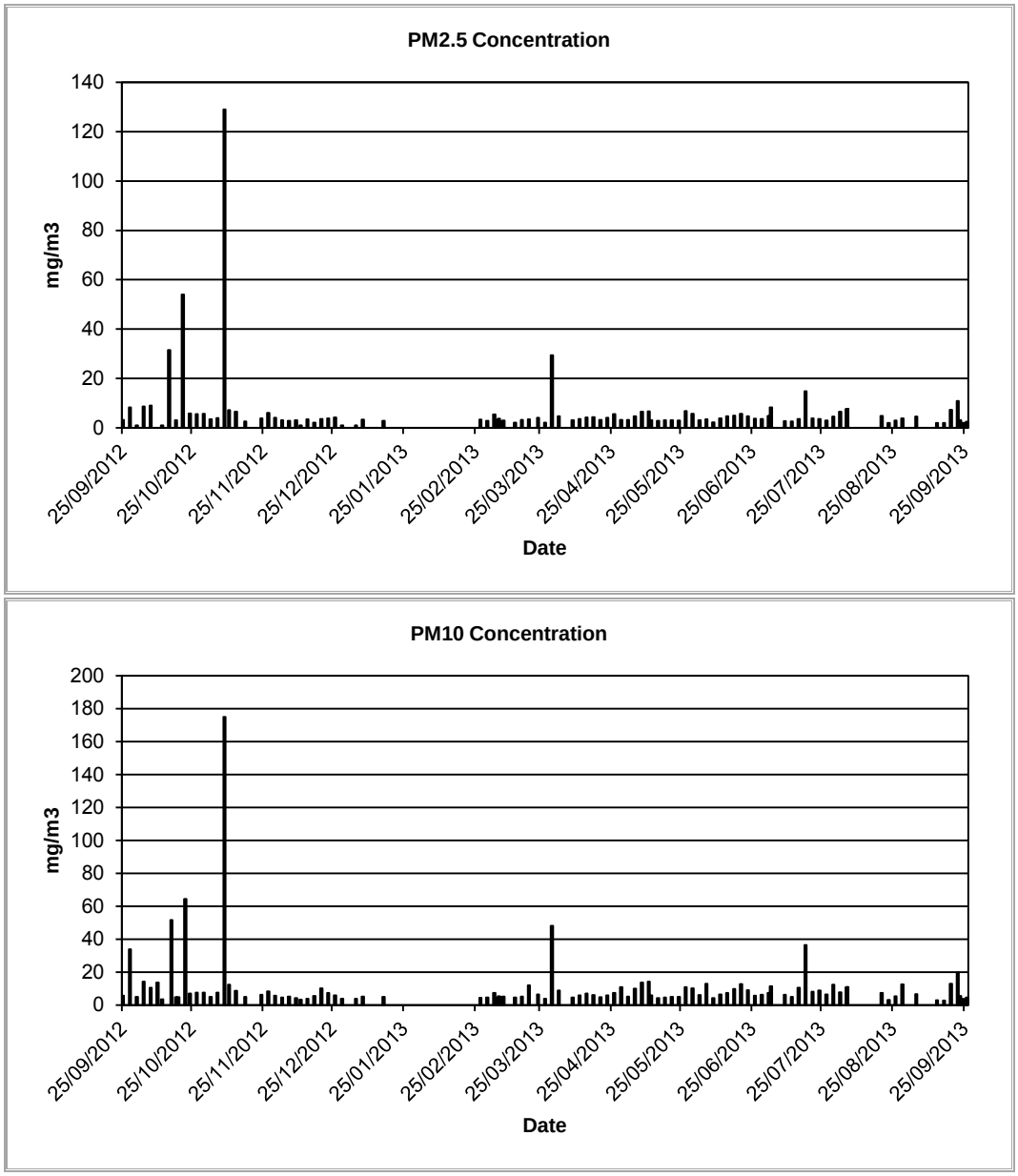


Figure 3-3: Concentration of $PM_{2.5}$ and PM_{10} at the Project Location

The on-site monitoring results are summarized in **Table 3-6**; the average concentrations are similar to those observed at the Hightower station.

Table 3-6: Project PM Statistical Data

Parameter	$PM_{2.5}$	PM_{10}
Average, µg/m^3	6.3	10.6
98th percentile, µg/m^3	31.4	51.4
Maximum, µg/m^3	129	175
Standard deviation	18.3724	24.4719

Note: µg/m^3 = Microgram per cubic metre

The results presented in **Table 3-6** are carried forward as baseline air quality data for $PM_{2.5}$ and PM_{10} for the Project site.

3.3.7 Total Particulate Matter / Dust Deposition

Total particulate matter (TPM), which is airborne particulate matter with an upper size limit of approximately 100 µm in aerodynamic equivalent diameter, has not been monitored at any of the above referenced locations. The Project dust sampling station does not monitor TPM. The BC MOE Prince George office advised at the early stage of the Project that monitoring of $PM_{2.5}$ and PM_{10} would be sufficient for air quality assessment. The reason is that the large particle size of the TPM poses a much lower respiratory risk than smaller particles.

A number of mathematical relationships have been developed to estimate TPM emissions from PM_{10} emission data (and vice versa), including that found in the National Pollutant Release Inventory (NPRI) Toolbox (EC, 2012). The relationship depends on the source of the PM; and the ratio of PM_{10} to TPM falls in the range of 25% to 45% for road dust and crushing, which are the primary PM-generating activities at the Project. A value of 40% has been selected because the largest PM-generating activity is road dust; therefore, the TPM background value has been estimated at 2.5 x PM_{10}. This value has not been included as it is not monitored, but will be incorporated into the assessment methodology.

No data exist for dust deposition at the reference locations because deposited dust contains only larger particles. The potential drift distance of particles is governed by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence. Dispersion models have computed theoretical drift distance, as a function of particle diameter and mean wind speed, for fugitive dust emissions. Results indicate that, for a wind speed of 16 km/h, particles larger than approximately 100 µm are likely to settle within 6 m to 9 m from the point of emission. Particles 30 µm to 100 µm in diameter are likely to undergo impeded settling. These particles, depending upon the extent of atmospheric turbulence, are likely to settle within 10s to 100s of metres from the point of release. Smaller particles have much slower gravitational settling velocities and are more likely to have their settling rate retarded by atmospheric turbulence (EPA, 1995). Therefore, it is expected that most dust would be deposited within the boundaries of the Project.

4.0 CONCLUSIONS

Baseline air quality is the concentration of contaminants due to emissions from both natural and human-caused sources. Choosing the appropriate background concentration is critical in assessing overall air quality. The information sources used to establish the background concentration levels include a network of long-term ambient monitoring stations pertaining to the Project and on-site monitoring of particulate matter.

Baseline concentrations of air pollutants for the Project are represented as the arithmetic averages on a one-hour basis, which are summarized in **Table 4-1**.

Table 4-1: Average Concentrations of Air Pollutants by Monitoring Network at Relevant Locations in British Columbia and Alberta

Data Source	$PM_{2.5}$	PM_{10}	NO_2	SO_2	CO
NAPS	5	13	13	3	-
BC MOE	4	7	4	1	100
WCAS	2	6	-	-	-
GGML	-	-	-	-	141
Project On-site Monitoring	6	11	-	-	-
Average	4	9	8	2	120

Note: "-" = Not monitored

Data analysis for each pollutant shows only a small variation in concentrations values recorded within monitoring networks and at the Project site for particulates. Higher concentrations of PM_{10}, NO_2, and CO at NAPS stations can be attributed to anthropogenic emission sources located near those monitoring sites.

A comparison of baseline concentrations shown in the above table with corresponding ambient air quality standards and objectives shown in **Table 3-1** demonstrate that only a small fraction of anticipated construction and operational ambient concentrations will be attributed to the Project preconstruction air pollutants.

As the Project is located in a remote area with no anthropogenic emission sources at present, the background concentrations are very low and the effect of averaging times is small. Therefore, in line with a conservative approach to impact assessment, the one-hour average concentrations can be accepted for all average times. This approach was discussed with and agreed to by the Regional Meteorologist of the BC MOE (2013).

Baseline concentrations shown in **Table 4-1** will be added to the maximum ground level concentrations of corresponding pollutants predicted by the dispersion model resulting in cumulative concentrations of criteria air contaminants.

REFERENCES

BC MOE. 2013. BC Air Quality. British Columbia Ministry of Environment. Available at http://www.bcairquality.ca/assessment/network-description.html; accessed June 2013.

BC MOE. 2012. Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. BC Ministry of Environment, October 2012.

BC MOE. 2011. Peace Region Air Quality Survey. Data Summary Report N.E. BC. Mobile Air Monitoring Laboratory (MAML). Ministry of Environment, June 17, 2011. Available at http://www.bcairquality.ca/reports/pdfs/maml_peace.pdf; accessed July 2013.

BC MOE. 2008. Guidelines for Air Quality Dispersion Modelling in British Columbia. British Columbia Ministry of Environment, Air Quality Section. Victoria, BC.

BC MOH. 2009. Guidance on Application of Provincial Air Quality Criteria for PM2.5. British Columbia Ministry of Healthy Living and Sport, Victoria, BC. June 2009. Available at http://www.bcairquality.ca/reports/pdfs/pm25-implement-guide.pdf; accessed July 2013.

CCME. 2000. Canada-Wide Standards for Particulate Matter (PM) and Ozone, June 2000, http://www.ccme.ca/assets/pdf/pmozone_standard_e.pdf.

CCME. 2007. Guidance Document on Continuous Improvement (CI) and Keeping Clean-Areas-Clean (KCAC), PN1389, 2007, http://www.ccme.ca/assets/pdf/1389_ci_kcac_e.pdf.

Environment Canada. 2012, NPRI Toolbox. Available at http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=65A75CDF-1; accessed July 2013.

EPA. 1995. AP-42 Compilation of Air Pollutant Emission Factors, Volume I – Stationary Point and Area Sources – 5th Edition. Office of Transportation and Air Quality, January.

EPA. 1992. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources. Revised. EPA Publication No. EPA-454/R-92-019. Office of Air Quality Planning and Standards. Research Triangle Park, NC. (NTIS No. PB 93-219095).

Fudge, Dennis. Air Pollution Meteorologist, BC MOE. Summary of West Central Airshed Society (WCAS) Annual Reports. Personal communication 10 September 2013.

Government of Canada. 1999. *Canadian Environmental Protection Act, 1999*. R.S. 1999, c. 33.

Health Canada. 2013, National Ambient Air Quality Objectives, Archived June 2013, http://www.hc-sc.gc.ca/ewh-semt/pubs/air/naaqo-onqaa/index-eng.php.

Lawrence, J.S. and S. Rastan. 2008. The Canadian Environmental Sustainability Indicators: On Population-Weighted Ground-Level Ozone. Environment Accounts and Statistics Division, Statistics Canada. Available at http://www.statcan.gc.ca/pub/16-002-x/2008002/article/10624-eng.htm; accessed July 2013.

McKendry, I. 2006, Background Concentrations of $PM_{2.5}$ and Ozone in British Columbia, Canada, prepared for BC MOE, March 2006, http://www.bcairquality.ca/reports/pdfs/background_pm25_ozone.pdf.

NAPS. 2008. National Air Pollution Surveillance (NAPS) Network, Annual Data Summary for 2005 and 2006. Report 7/AP/39. Environment Canada, October 2008 http://publications.gc.ca/collections/collection_2008/ec/En49-2-7-39.pdf.

NAtChem 2013. The Canadian National Atmospheric Chemistry (NAtChem) Database and Analysis System. Environment Canada Resources: Greenhouse Gases. Doug Worthy, Climate Research Division, Toronto, Ontario. Available at http://www.ec.gc.ca/natchem/default.asp?lang=En&n=6562770F-1; accessed September 2013.