TABLE OF CONTENTS

List of Tables

List of Figures

TABLE OF CONTENTS

List of Appendices

5.2.4 Air Quality

Air quality has intrinsic importance to the health and well-being of humans, wildlife, vegetation, and other biota. The assessment of the potential effect of the proposed Blackwater Gold Project (the Project)-related atmospheric emissions on air quality compares these effects against relevant provincial and federal criteria. In **Section 5.2.1** air quality is identified as a Valued Component (VC) under the Atmospheric and Acoustic Environment subject area.

5.2.4.1 Introduction

This subsection will describe the approach and applicable regulatory framework for the assessment of the Air Quality VC.

The assessment used a number of sources to determine which substances are relevant for air quality. The British Columbia Ministry of Environment (BC MOE), Health Canada, and Environment Canada (EC) have a number of ambient air quality guidelines that list various substances of concern. Project design staff and equipment vendors provided information on emissions and mitigation measures. The Guideline for the Selection of Valued Components and Assessment of Potential Effects (BC EAO, 2013) was the primary methodology followed to select VCs and assess potential effects of the Project on those VCs. Air quality was identified as a concern during consultation with potentially affected people and this was considered among other factors in the selection of VCs as presented in **Section 5.2.1**.

Parameters selected for assessment include those commonly found in mining assessments:

- Criteria air contaminants including Total Suspended Particulates (TSP), PM_{10}, $PM_{2.5}$, SO_2, NOx and carbon monoxide (CO) were compared to ambient air quality objectives (AAQO);
- Other parameters were evaluated, but only used in the human health risk assessment, these included Volatile Organic Compounds (VOCs), polyaromatic hydrocarbons (PAHs), metals, and cyanide;
- Nitrogen deposition was predicted and used in the vegetation impact assessment; and
- Visibility impairment was evaluated by modelling haze formation and used in the visual impact assessment.

Appended to this section is the Air Quality Modelling Report (**Appendix 5.2.4A**), which includes the full set of emission estimates and modelling results. This report is the primary basis of the air quality assessment.

5.2.4.2 Valued Component Baseline

Baseline information was used to characterize the pre-Project conditions for air quality. This is described in detail in **Section 5.1.1.2**. There was no pre-existing air quality data from the Project location; therefore, data from other sites representative of the Project location and PM monitoring performed at the Project site from August 2012 to December 2013 were used. This approach was discussed with and agreed to by the Regional Meteorologist of the BC MOE.

The data sources and methodology for calculating baseline concentrations is described in the Air Quality Baseline Report (**Appendix 5.1.1.2A**).

Baseline information was assembled from a number of sources, including:

- Published reports and studies relevant to air quality;
- Data available online from government websites; and
- Results of field studies undertaken for the Project.

These were narrowed down to four final data sources:

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

The choice was based on the data quality, substances monitored and surrounding land use and industrial activity. Certain data sources were excluded because they only provide a partial year's data (i.e., just seasonal data) or due to remoteness of the monitoring location from the site (i.e., Vancouver Island). The BC MOE Regional Meteorologist finalized the data list.

Data were extracted for each substance and averaging period of interest for which BC AAQOs exist. For substances where multiple data sources were used, the averaged values of the data sources were used. The hourly average value is referenced as the baseline value for all averaging periods. This was done as the baseline values are low and the effect of averaging period is small. This is a conservative approach for averaging periods linger than one hour as these values are lower than the one-hour average.

Table 5.2.4-1 provides background concentrations of substances assessed for air quality impacts.

Table 5.2.4-1: Background Concentrations

Species	Averaging Period	Baseline Value ($\mu g/m^3$)
SO_2	1-hour	1
	3-hour	
	24-hour	
	Annual	
NO_2	1-hour	8
	24-hour	
	Annual	
CO	1-hour	120
	8-hour	
TSP	24-hour	18
	Annual	
PM_{10}	24-hour	9
	Annual	
$PM_{2.5}$	24-hour	4
	Annual	

Local residents and Aboriginal groups and their members have expressed interest in the Project's potential effects on air quality. These groups' comments during the engagement and consultation process have provided insights into traditional, ecological, or community knowledge, which is defined as a body of knowledge built up by a group of people through generations of living in close contact with nature. This includes unique knowledge about the local environment, how it functions, and its characteristic ecological relationships.

Section 3.3 provides a summary of issues and information provided through consultation with Aboriginal groups. During a meeting with the Nazko First Nation (NFN), people emphasized that clean air, including being free of dust, is important to ensure medicinal plants and waters are clean to eat and drink. Lhoosk'uz Dene Nation (LDN) and Saikuz First Nation (SFN) elders also noted their concerns about the potential effects of the Project such as dust and emissions on air quality.

5.2.4.2.1 Assessment Boundaries

5.2.4.2.1.1 Spatial

The Local Study Area (LSA) and Regional Study Area (RSA) are described in **Section 4.3.1.1** and **Appendix 5.2.4A**. These boundaries were determined in the manner described in the Guidelines for Air Quality Dispersion Modelling in British Columbia (AQMG) (BC MOE, 2008) and discussed with the BC MOE Regional Meteorologist. The boundaries include all project air emission sources. Based on the potential for overlap of adjacent boundaries and to avoid unnecessary duplication, the EA boundaries differ slightly from those presented in the AIR (see **Section 4.3.1.1** for further discussion).

5.2.4.2.1.2 Administrative

There are no administrative boundaries for the air quality VC. The study areas were chosen based primarily on modelling methodology and not limited by geographic or political considerations.

5.2.4.2.1.3 Technical

The methodology for estimating emission and predicting ambient contaminant concentrations are well defined and widely used. The variability in project activities between phases and years reduces the accuracy of the estimate. The highest emission scenarios for any year and phase are used therefore the uncertainty is biased high (i.e., conservatively).

5.2.4.2.1.4 Temporal

The temporal boundaries for the assessment are aligned with the construction, operations, closure, and post-closure phases of the Project. For the air quality assessment the emission of each phase were estimated and it was determined that for all Project components the closure and post-closure phases had much lower emission than either the construction or operation phases. The amount of construction emissions was closer in magnitude to closure and post-closure; therefore, the construction phase is used as a conservative assessment of the closure and post-closure phases.

5.2.4.2.2 Past, Present and Future Projects and Activities

Section 4, Subsection 4.3.6.2, Table 4.3-11 shows the Summary Project Inclusion List developed for Cumulative Effects Assessment (CEA) (**Appendix 4C** contains the comprehensive Project Inclusion List). Almost all industrial activities have some air emission due to vehicle use and material handling. The activities that have the potential to impact the air quality include:

- Timber harvesting;
- Forestry – logging;
- Road construction, including bridges;
- Mineral exploration;
- Mining, including road and trail construction, drill lines, drill pads, and mining infrastructure and ancillary facilities; and
- Transmission line construction and maintenance.

5.2.4.3 Potential Effects of the Proposed Project and Proposed Mitigation

Key and moderate interactions of the Project on the VCs during the construction, operations, closure, and post-closure phases are presented in **Table 4.3-2** of **Section 4**. Key interactions are related to the mine site activities during the construction and operation phases that will generate most of the air quality emissions. Moderate interactions occur during the construction and operation phases and are mainly related to transportation and maintenance activities along the roads (mine access road, airstrip and Kluskus Forest Service Road (FSR)). Moderate interactions during the closure and post-closure stages will occur in various project components and are related to decommissioning, demolition, re-contouring, re-vegetation, and reclamation activities. However, air emissions during those two phases of the project will be significantly less.

Potential effects of the Project on air quality are assessed by predicting the changes in concentrations of the above-selected substances in the LSA. The air quality modelling report found in **Appendix 5.2.4A** described the various scenarios evaluated. These results are provided in Section 6 of the appendix and include:

1. Construction Phase.
2. Road operation.
3. Operation phase.

For the construction phase, emissions were estimated for mine construction, road construction, transmission line construction and pipeline construction. The road construction emission were noted to be larger than but similar to transmission line and pipeline construction; therefore, this modelling case was used as a conservative case for all linear disturbance activities (road, transmission line, pipeline). The mine construction case was modelled and presented as a separate construction case in the Air Quality Modelling Report in **Appendix 5.2.4A**.

The operation phase results in Section 6 of **Appendix 5.2.4A** include mine, road and airstrip operation. Operation emission for the transmission line and pipeline are negligible and not included.

The effects of past and present projects and activities that are present in the RSA, when measurable, are captured in the baseline characterization that is presented in **Section 5.1** and **Section 5.2.4.2**. If the residual effect of the Project on the VC is determined to be other than negligible and a potential temporal or spatial interaction with a project or activity is identified, then a cumulative effects assessment will be conducted taking into account past, present, certain and reasonably foreseeable future project or activities. The cumulative effects assessment is discussed in **Section 5.2.4.5**.

Emissions from mine site construction and operation are the key interactions with the air quality VC and these sources are all included in the air dispersion modelling assessment. Most of the air quality VC moderate interactions as listed in **Table 4.3-2** in **Section 4** are included in the air dispersion modelling assessment. The ones that are not included explicitly in the modelling assessment are assessed qualitatively as they are smaller than other sources that are included in the modelling assessment, hence the assessment is conservative.

Closure and post-closure moderate interactions are not modelled as they are smaller than construction activities which have been modelled. As described above the construction case is used as a conservative assessment of closure and post-closure phases and these phases are assessed qualitatively based on the construction phase results. The effects of closure and post-closure are assumed to be less significant than construction phase effects.

5.2.4.3.1 Emissions Inventory

An emissions inventory for the Project was established based on design data, construction plans, and operational scenarios. The activities considered for the emissions inventory include ore and waste rock transportation within the mine site, the transportation of materials and products outside the mine site by road, transportation of staff to and from the site (by air or road), materials handling, and incinerator point source emissions. Wherever possible, engineering data and manufacturers' specifications were used to estimate emission rates. Where necessary, this information was supplemented by emission factors from United States Environmental Protection Agency (US EPA) AP-42 (US EPA, 1995). Emissions from mobile sources during construction and operations are estimated using the US EPA models MOVES2010b and NONROAD.

Table 5.2.4-2 provides a summary of estimated Project emissions. Emissions from the mine fleet and material handling predominate, apart from SO_2 emissions, which are primarily generated by waste incineration.

For each substance listed in **Table 5.2.4-2**, dispersion modelling was used to predict ground-level concentrations in the LSA.

Table 5.2.4-2: Emissions Summary

Emission Type	SO_2 (t/d)	NOx (t/d)	CO (t/d)	PM (t/d)	PM_{10} (t/d)	$PM_{2.5}$ (t/d)
Unpaved Road Transportation	0	0	0	5.24	1.12	0.11
Paved Road Transportation	0	0	0	1.1	0.028	0.03
Material Handling	0.05	0.43	1.8	10.1	3.78	2.05
Processing Plant Operations	0	0	0	0.07	0.08	0.00
Dump/Storage Area	0	0	0	3.77	1.88	0.28
On-Road Vehicle Use	0.00	0.02	0.02	0.00	0.00	0.00
Mine Fleet Use	0.01	6.467	0.75	0.13	0.13	0.12
Aviation	0.00	0.02	0.05	0	0	0
Incinerator Operations	0.05	0.09	0.07	0.12	0.12	0.11
Refinery System Operations	0	0	0	0.00	0.00	0.00
Total	**0.12**	**7.02**	**2.74**	**20.5**	**7.32**	**2.71**

Note: t/d = tonnes per day

5.2.4.3.2 Dispersion Modelling

Dispersion modelling was performed with CALPUFF, a Lagrangian dispersion modelling system that simulates pollutant releases as a continuous series of puffs. The CALPUFF modelling system is preferred for regions with complex, non-steady-state meteorological conditions, such as those found in mountainous terrain like the proposed Project location. The model can predict both concentration and deposition patterns of air contaminants. This model was applied in the more refined CALMET model to incorporate mesoscale meteorological data (MM5). MM5 data were obtained for one year, and local meteorological data collected at the site were used to refine the meteorological modelling process.

The CALPUFF model contains certain inherent assumptions and limitations and various assumptions must be made when calculating emissions and in certain other input parameters. These are described in detail Section 8 of **Appendix 5.2.4A**. These assumptions and limitations are shown to be conservative in nature so they tend to overpredict results and provide for a conservative assessment.

5.2.4.3.3 Results

The model was used to predict ground level concentrations for PM and combustion gases, as well as dust deposition rates at the proposed mine site boundary and at sensitive receptors in the LSA (Figure 2.1-1 in **Appendix 5.2.4A** (Air Quality Modelling). The results were compared with Ambient Air Quality Objectives (AAQOs). **Table 5.2.4-3** through **Table 5.2.4-6** shows a comparison of the maximum predicted concentrations to the relevant AAQOs. The maximum predicted concentration is that predicted anywhere in the LSA. This occurred at various locations depending on the parameters, but for $PM_{2.5}$ where exceedances of the AAQO were predicted, this occurred on the fenceline at the edge of the project boundary. The fenceline is the boundary of the proposed mine site as shown in Figure 4.2-1 of the Air Quality Modelling Report found in **Appendix 5.2.4A**.

Table 5.2.4-3: Maximum Predicted Ground-Level Concentrations of SO_2

Species	Avg. Period	Max. Predicted Concentration (µg/m³)	Including Ambient Background (µg/m³)	BC Objective / Guideline (µg/m³)			Canada Objective (µg/m³)		
				Level A	Level B	Level C	Max. Desirable	Max. Acceptable	Max. Tolerable
SO_2	1-hour	40.5	41.5	450	900	900 to 1,300	450	900	-
	3-hour	26.4	27.4	375	665	-	-	-	-
	24-hour	6.49	7.49	160	260	360	150	300	800
	Annual	1.59	2.59	25	50	80	30	60	-

Note: Avg. = Averaging; µg/m³ = micrograms per cubic metre; Max. = Maximum

Table 5.2.4-4: Maximum Predicted Ground-Level Concentrations of NO_2

Species	Avg. Period	Max. Predicted Concentration (µg/m³)	Including Ambient Background (µg/m³)	BC Objective / Guideline (µg/m³)			Canada Objective (µg/m³)		
				Level A	Level B	Level C	Max. Desirable	Max. Acceptable	Max. Tolerable
NO_2	1-hour	285	293	-	-	-	-	400	1,000
	24-hour	87.8	95.8	-	-	-	-	200	300
	Annual	34.3	42.3	-	-	-	60	100	-

Note: Avg. = Averaging; µg/m³ = micrograms per cubic metre; Max. = Maximum

Table 5.2.4-5: Maximum Predicted Ground-Level Concentrations of CO

Species	Avg. Period	Max. Predicted Concentration (µg/m³)	Including Ambient Background (µg/m³)	BC Objective / Guideline (µg/m³)			Canada Objective (µg/m³)		
				Level A	Level B	Level C	Max. Desirable	Max. Acceptable	Max. Tolerable
CO	1-hour	761	881	14,300	28,000	35,000	15,000	35,000	-
	8-hour	257	377	5,500	11,000	14,300	6,000	15,000	20,000

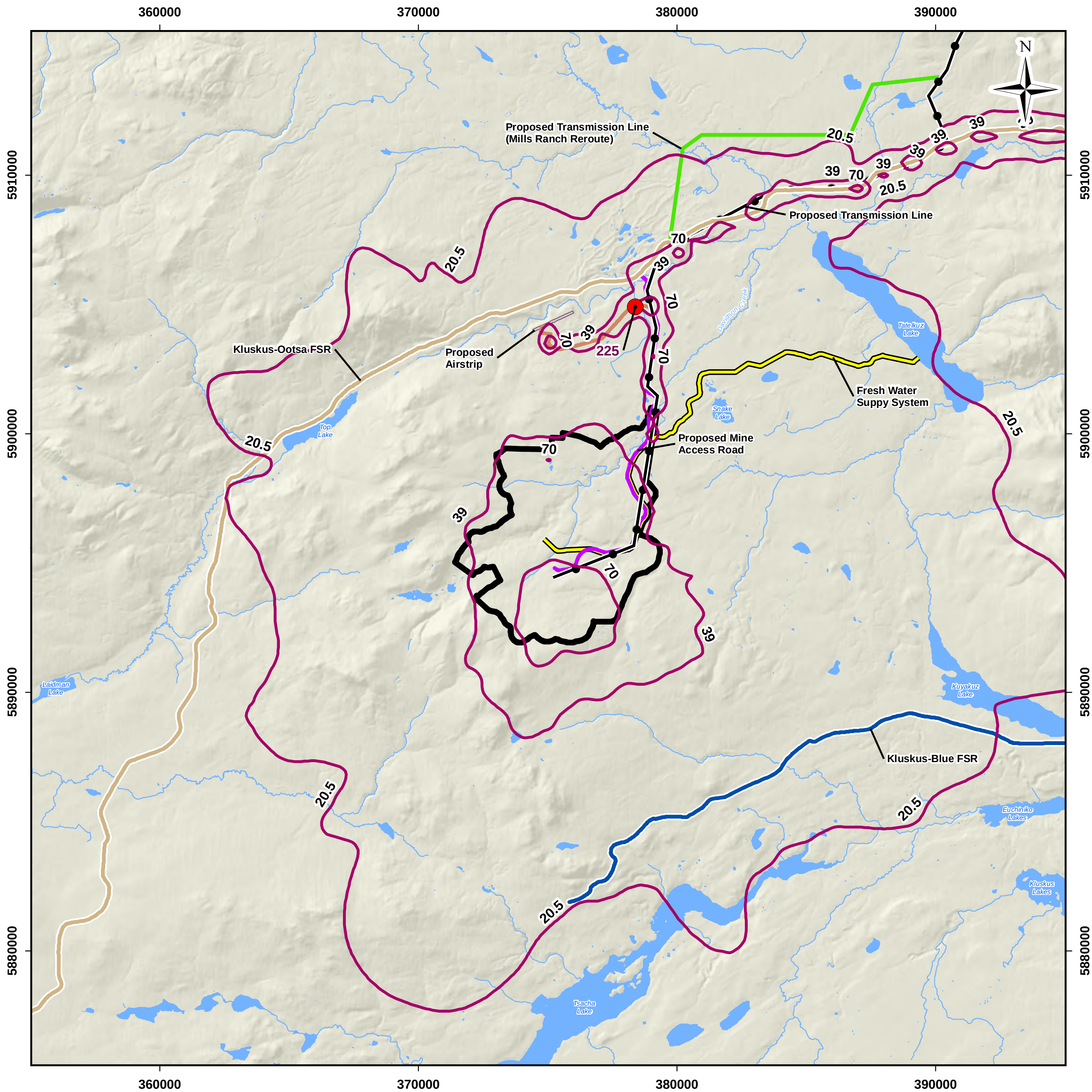
Note: Avg. = Averaging; µg/m³ = micrograms per cubic metre; Max. = Maximum

Table 5.2.4-6: Maximum Predicted Ground-Level Concentrations of PM

Species	Avg. Period	Max. Predicted Concentration (µg/m³)	Including Ambient Background (µg/m³)	BC Objective / Guideline (µg/m³)			Canada Objective (µg/m³)		
				Level A	Level B	Level C	Max. Desirable	Max. Acceptable	Max. Tolerable
TSP	24-hour	207	**225**	150	200	260	-	120	400
	Annual[b]	69.7	**87.7**	60	70	75	60	70	-
PM_{10}	24-hour	47.8	**56.8**	-	50	-	-	-	-
$PM_{2.5}$	24-hour	19.0	**23.0**	25			30		
	Annual	4.28	**8.28**	8			-		

Note: Avg. = Averaging; µg/m³ = micrograms per cubic metre; Max. = Maximum;
Bolded numbers exceed the relevant ambient objective

From the tables above it can be seen that AAQOs are not exceeded for SO_2, NO_2, CO, or PM_{10}. Both the 24-hour and annual average AAQOs for TSP and $PM_{2.5}$ are exceeded. **Appendix 5.2.4A** provides figures showing concentration isopleths for each pollutant and averaging period, as well as the location of the predicted maximum concentration. **Figure 5.2.4-1** and **Figure 5.2.4-2** show the 24 hours and annual average TSP concentration isopleths, **Figure 5.2.4-3** shows the PM_{10} 24 hour average concentration isopleths and **Figure 5.2.4-4** shows the $PM_{2.5}$ annual average concentration isopleths. These are the four cases listed in **Table 5.2.4-7** where exceedances of the AAQOs are predicted.



Legend

- Projected Maximum TSP Concentration
- Maximum Predicted 24-hour Average TSP Concentrations (µg/m^3) 24-hour AAQO: 120 ug/m^3
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Reroute)
- Proposed Mine Access Road
- Fresh Water Supply System
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site
- Stream
- Waterbody

Reference

BC Government GeoBC Data Distribution

Scale: 1:216,715

0 1 2 4

Kilometres

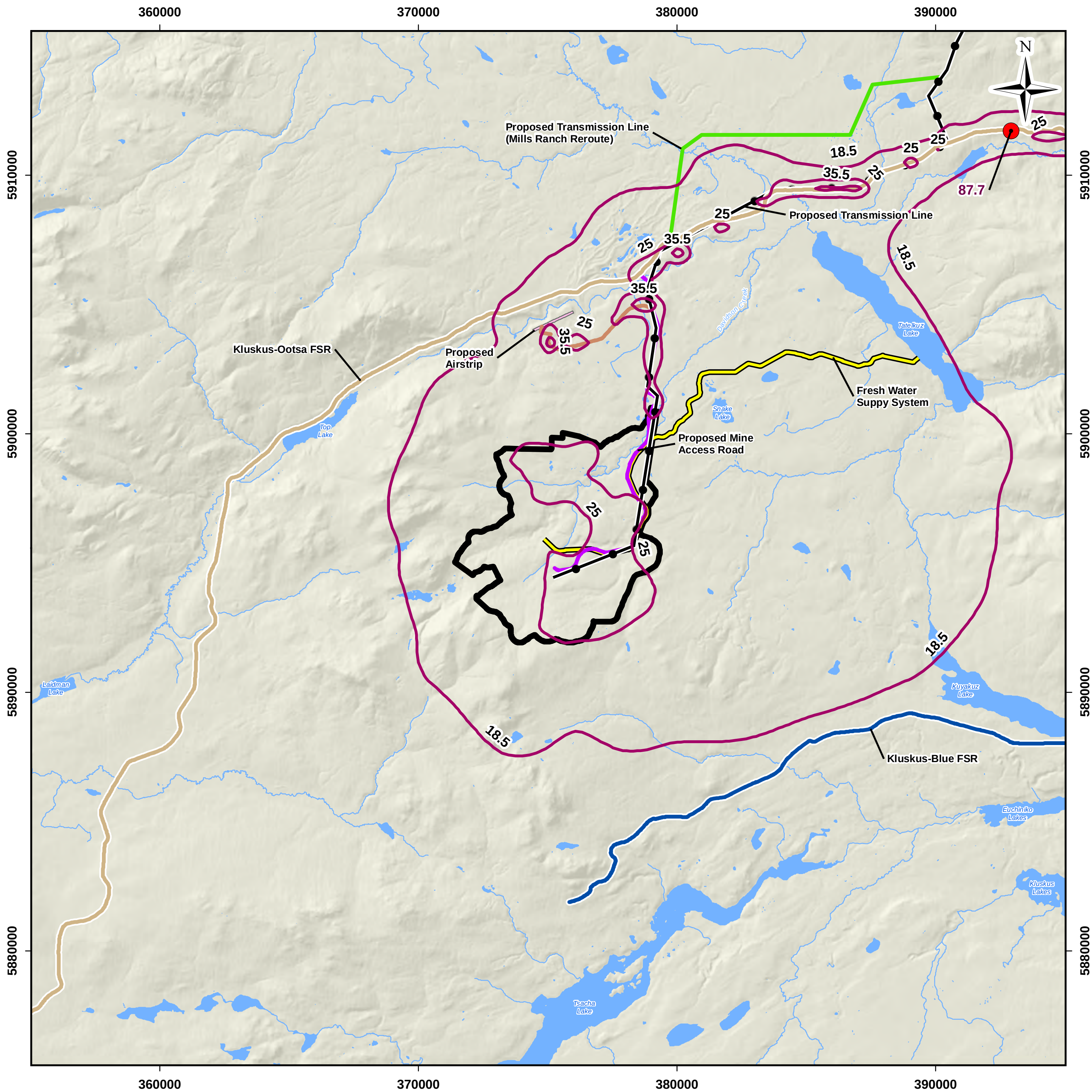
CLIENT:	newgold
PROJECT:	Blackwater Gold Project
	Maximum Predicted 24-hour Average Ground-level TSP Concentrations (ug/m^3) Associated with the Project with Background Concentration
DATE: October, 2013	ANALYST: PK
JOB No: VE52277	QA/QC: MY
GIS FILE: 04-100-018_Max_24hour_TSP_8.5x11_portrait.mxd	
PROJECTION: UTM Zone 10	DATUM: NAD83

Figure 5.2.4-1

PDF FILE: 04-100-018_Max_24hour_TSP_8.5x11_portrait.pdf

amec

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\04_air-quality\Baseline\04-100-018_Max_24hour_TSP_8.5x11_portrait.mxd



Legend

- Projected Maximum TSP Concentration
- Maximum Predicted Annual Average TSP Concentrations (µg/m^3) Annual AAQO: 60 ug/m^3
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Reroute)
- Proposed Mine Access Road
- Fresh Water Supply System
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site
- Stream
- Waterbody

Reference

BC Government GeoBC Data Distribution

Scale: 1:216,715

0 1 2 4
Kilometres

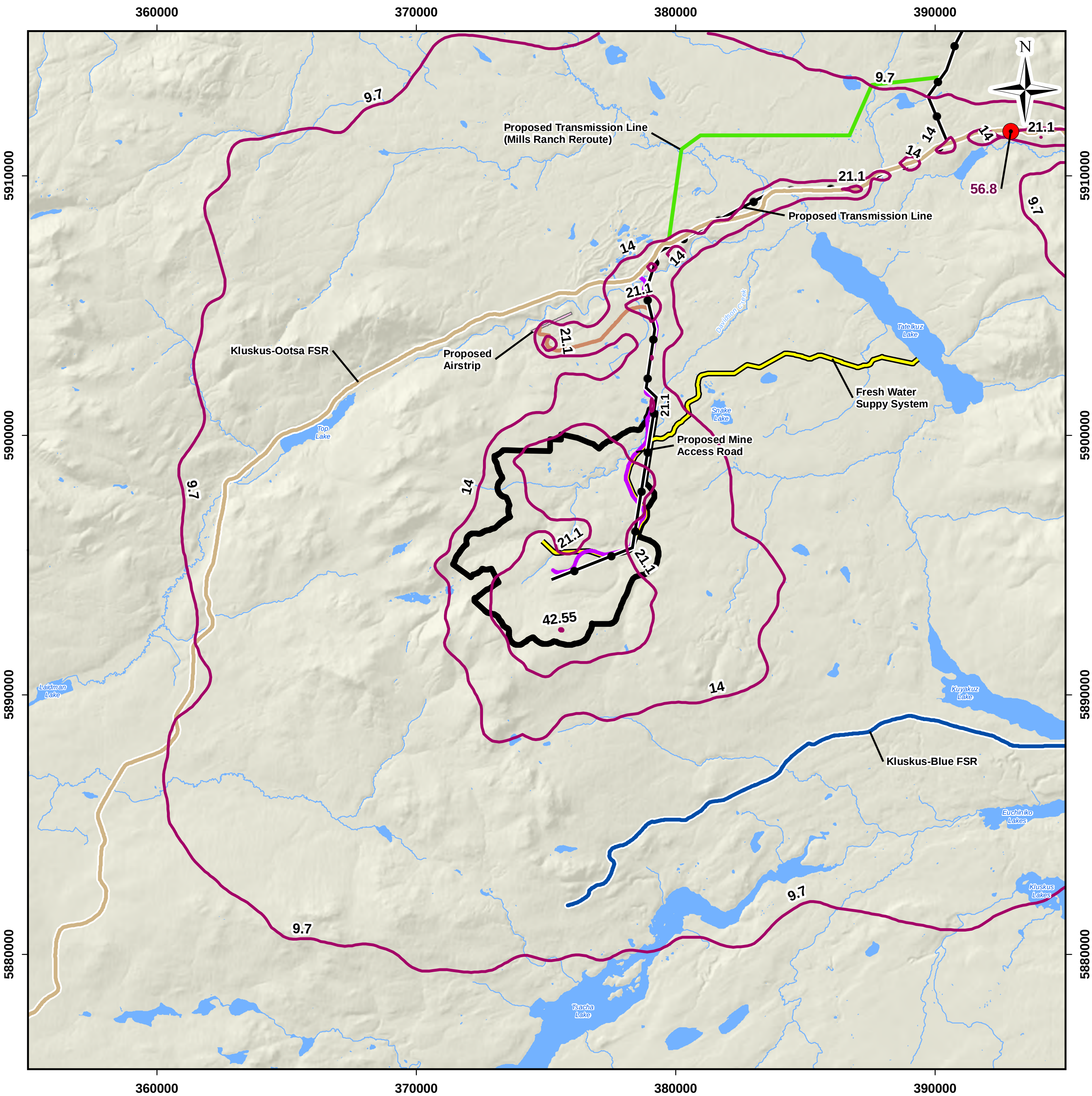
CLIENT:	newgold
PROJECT:	Blackwater Gold Project
	Maximum Predicted Annual Average Ground-level TSP Concentrations (ug/m^3) Associated with the Project with Background Concentration
DATE: October, 2013	ANALYST: PK
JOB No: VE52277	QA/QC: MY
GIS FILE: 04-100-014_Max_1_Year_TSP_8.5x11_portrait.mxd	
PROJECTION: UTM Zone 10	DATUM: NAD83

Figure 5.2.4-2

PDF FILE: 04-100-014_Max_1_Year_TSP_8.5x11_portrait.pdf

amec

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\04_air-quality\Baseline\04-100-014_Max_1_Year_TSP_8.5x11_portrait.mxd



Legend

- Projected Maximum PM_{10} Concentration
- Maximum Predicted 24-hour Average Ground-level PM_{10} Concentrations ($\mu g/m^3$) 24-hour AAQO: 50 ug/m^3
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Reroute)
- Proposed Mine Access Road
- Fresh Water Supply System
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site
- Stream
- Waterbody

Reference

BC Government GeoBC Data Distribution

Scale: 1:216,715

0 1 2 4

Kilometres

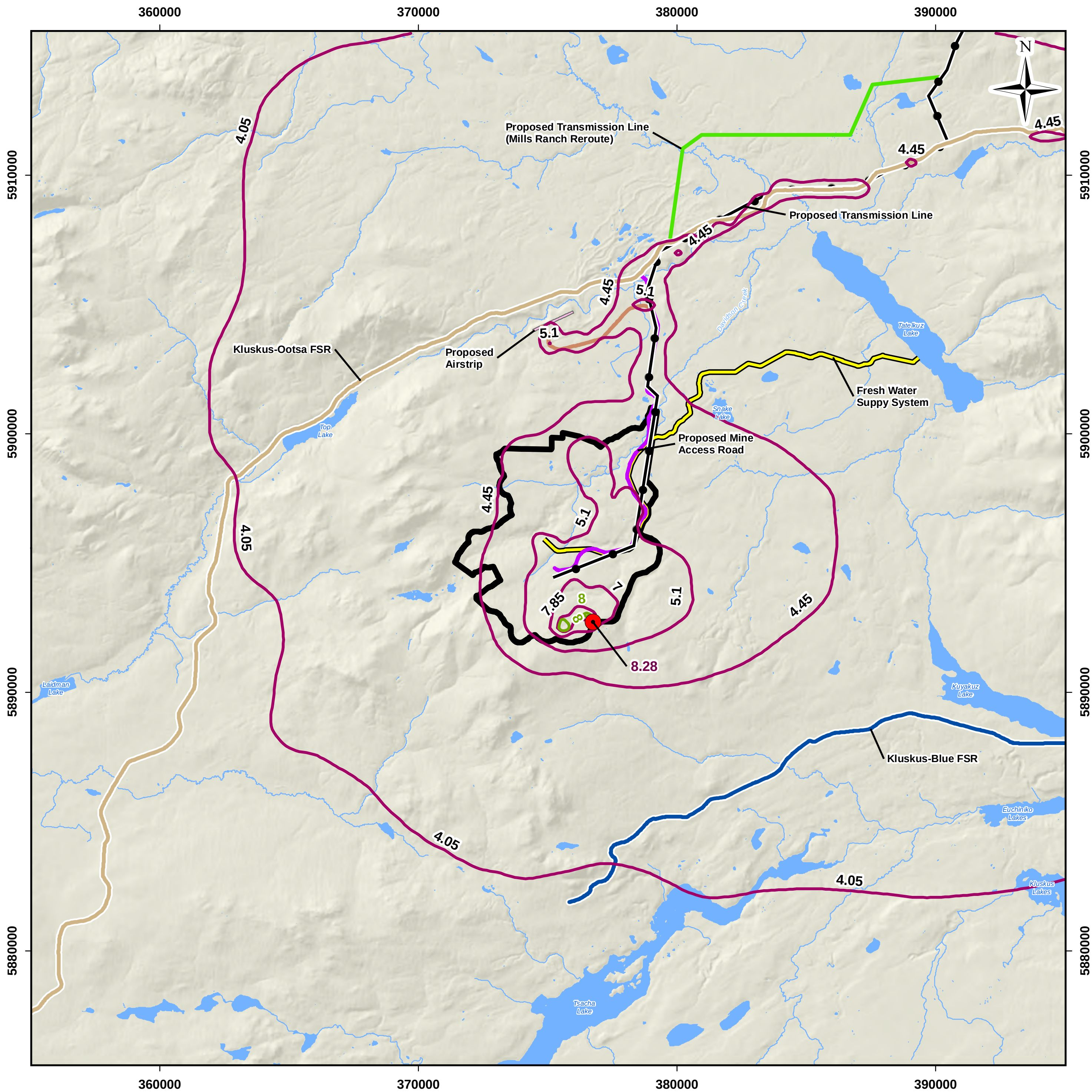
CLIENT: newgold

PROJECT: Blackwater Gold Project

Maximum Predicted 24-hour Average Ground-level PM_{10} Concentrations (ug/m^3) Associated with the Project with Background Concentration

DATE: October, 2013	ANALYST: PK	**Figure 5.2.4-3**
JOB No: VE52277	QA/QC: MY	PDF FILE: 04-100-019_PM10_24_Hour_8.5x11_portrait.pdf
GIS FILE: 04-100-019_PM10_24_Hour_8.5x11_portrait.mxd		amec
PROJECTION: UTM Zone 10	DATUM: NAD83	

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\04_air-quality\Baseline\04-100-019_PM10_24_Hour_8.5x11_portrait.mxd



Legend

- Projected Maximum $PM_{2.5}$ Concentration
- Maximum Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations ($\mu g/m^3$) Annual AAQO: 8 ug/m^3
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Reroute)
- Proposed Mine Access Road
- Fresh Water Supply System
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site
- Stream
- Waterbody

Reference
BC Government GeoBC Data Distribution

Scale: 1:216,715

0 1 2 4
Kilometres

CLIENT: newgold		
PROJECT: Blackwater Gold Project		
Maximum Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations (ug/m^3) Associated with the Project with Background Concentration		
DATE: October, 2013	ANALYST: PK	Figure 5.2.4-4
JOB No: VE52277	QA/QC: MY	PDF FILE: 04-100-022_PM25_Annual_8.5x11_portrait.pdf
GIS FILE: 04-100-022_PM25_Annual_8.5x11_portrait.mxd		amec
PROJECTION: UTM Zone 10	DATUM: NAD83	

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\04_air-quality\Baseline\04-100-022_PM25_Annual_8.5x11_portrait.mxd

Table 5.2.4-7 describes the area exceeding the AAQOs for PM and frequency concentrations above the AAQO. The maximum frequency exceedance reported below is for the peak receptor at the LSA. As all exceedances occur on the edge of the fenceline or road right-of-way, the area affected is zero as it's a line along the study area perimeter with zero width.

Table 5.2.4-7: Frequency of Exceedances of PM

Species	Avg. Period	Max. Predicted Concentration Including Ambient Background ($\mu g/m^3$)	Area of Exceedances (ha)	Max. Frequency Exceedances (d/y)
$PM_{2.5}$	Annual	**8.28**	0	Not applicable
PM_{10}	24-hour	**56.8**	0	42
TSP	24-hour	**225**	0	56
TSP	Annual	**87.7**	0	Not applicable

Note: Avg. = averaging; Max. = maximum; $\mu g/m^3$ = microgram per cubic metre.
Bolded numbers exceed the relevant ambient objective

5.2.4.3.4 Past, Present and Future Projects and Activities

Potential interactions and potential key interactions of the Project on the VCs during the construction, operations, closure, and post-closure phases are presented in **Table 4.3-2** of **Section 4**. Past, present and future projects and activities that potentially interact with the Project as a result of spatial or temporal overlap will be used in the assessment of potential cumulative effects (**Section 5.2.4.2.2**) if residual effects assessed for the Project are classified as significant. **Table 5.2.4-8** presents an overview of potential adverse effects associated with past, present and future projects and activities.

Table 5.2.4-8: Potential Adverse Effects Resulting from Past, Present and Future Projects and Activities

Past, Present and Future Projects and Activities	Potential Adverse Effect	General Mitigation
Timber harvesting	Increase in ambient contaminant concentration.	Use of low-emission equipment
Forestry – logging	Increase in ambient contaminant concentration.	
Road construction, including bridges	Increase in ambient contaminant concentration.	
Mineral exploration	Increase in ambient contaminant concentration.	Minimize material handling, apply water or other dust suppressant as needed,
Mining, including road and trail construction, drill lines, drill pads, and mining infrastructure and ancillary facilities	Increase in ambient contaminant concentration.	
Transmission line construction and maintenance	Increase in ambient contaminant concentration.	
Pipeline construction and maintenance	Increase in ambient contaminant concentration.	

Due to the absence of heavy industrial air emission sources within the local and regional study areas that could add to the Project, there are no overlaps in time and space with other projects or activities. The background air emissions generated by existing activities is already captured in the baseline conditions summarized in **Section 5.1.1.2**.

5.2.4.3.5 Mitigation Measures

Mitigation measures for SO_2, NO_2, and CO relate to engine emission controls, as those substances are entirely generated as combustion byproducts. Off-road vehicles (such as the mine fleet) will meet the most recent and stringent emission standards, commonly referred to as Tier 4.

EC adopted amendments to the *Off-Road Compression-Ignition Engine Emission Regulations* on 17 November 2011 (EC, 2011) that align Canadian emission standards with the US EPA Tier 4 standards for non-road engines, including the emission limits, testing methods, and effective dates. Most of these requirements are defined by reference to the pertinent sections of the US regulations. The Canadian Tier 4 standards referenced in this regulation apply to engines of the 2012 and later model years.

All off-road vehicles will use ultra-low sulphur diesel (15 parts per million [ppm] maximum), as required under the above-noted EC regulation.

Most PM emissions occur from vehicle travel on non-paved road (e.g., mine haul roads) and from materials handling (bulldozers, graders, truck dumping). This will be mitigated using a combination of administrative, design, and emission control strategies:

- Administrative: road dust emissions are directly related to vehicle speed, which will be controlled throughout the mine site;
- Design: road dust emissions are directly related to road silt content, and haul road surfaces will be constructed of coarse aggregate with very low silt content;
- Control: unpaved road surfaces will be wetted as needed to control dust emissions when conditions are not wet or frozen, and the wetting agent may include a chemical to extend and improve dust control over using water alone. The specific chemical has not yet been selected, and it is anticipated that a number of chemicals will be tried to ensure optimum performance. This is common practice at mine sites, and chemical selection will be informed by experiences at other mines in similar climate. Wetting with dust suppressant chemical addition is anticipated to reduce road dust emission by 90%. If required, the selection of a chemical suppressant will take into account protection of wildlife that could be attracted to roads; and
- Control: materials handling (dumping, bulldozing, grading) generates PM emissions, and wetting of the material before handling dramatically reduces PM emissions. Much of the material coming from the pit is saturated as it is excavated from below the water table and a 50% reduction in material handling PM emissions is anticipated due to material wetting prior to handling.

The Air Quality and Emissions Management Plan (AQEMP) will be developed and implemented that describes dust control measures plan including watering haul roads when required, maintaining TSF beaches in a wet condition, implementing progressive reclamation on waste rock dumps, and installing dust control systems for the crusher.

Table 5.2.4-9 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on air quality during mine site development.

Table 5.2.4-9: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Air Quality during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Air quality effects	Construction, Operations, Closure, Post-closure	Off-road vehicles (such as the mine fleet) will meet the most recent and stringent emission standards, commonly referred to as Tier 4	High
		All off-road vehicles will use ultra-low sulphur diesel (15 ppm maximum), as required under the EC regulation	High
		Vehicle speeds will be controlled throughout the mine site	High
		Unpaved road surfaces will be wetted as needed to control dust emissions when conditions are not wet or frozen, and the wetting agent may include a chemical to extend and improve dust control over using water alone	High
		Materials will be wetted before handling to dramatically reduce PM emissions	High
	Construction	Road surfaces will be constructed of coarse aggregate with very low silt content	High

Note: EC = Environment Canada; ppm = parts per million

In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective. The effectiveness of mitigation measures was rated to be high because the proposed mitigation measures are technologies that are widely used in mining and other industries and proven over a long period of time at reducing emissions.

5.2.4.4 Residual Effects and their Significance

Table 5.2.4-10 shows the projected residual effects from emissions of assessed pollutants. For this assessment, residual effects are the predicted increases in air contaminants after mitigation measures have been applied (e.g., emission control measures). The air quality changes described in **Table 5.2.4-10** include all substances, including PM. The impact ratings shown in **Table 5.2.4-10** are for the mine construction phase which has a key interaction with the air quality VC. Emissions from mine site construction and operations are the key interactions (**Table 4.3-2** in **Section 4**).

The impact ratings for all other Project components and phases are not larger than mine operations as mine operations has the largest emissions and mine operations is used as a conservative predictor of air quality effects due to the Project. Other project phases are assessed qualitatively as being not more significant than the mine operations phase.

Table 5.2.4-10: Determination of Significance of Residual Effects for Air Quality

Category	Rating	Comment
Context	Low	The VC has no existing sensitivities and is anticipated to be resilient to effects of the Project
Magnitude	High	Changes in predicted ground-level concentrations are >10% above background and/or exceed a listed AAQO in the LSA
Extent	Local	Predicted AQ effects are entirely within the LSA
Duration	Mid-term	Effects will end shortly after Project closure
Frequency	Continuous	Project emissions are assumed to be continuous
Reversibility	Reversible	Effects stop occurring shortly after Project closure
Likelihood	High	Similar effects are seen at many projects and the Project is not expected to be significantly different
Confidence for Likelihood	High	Similar effects are seen at many projects and the Project is not expected to be significantly different
Significance Determination	Not Significant (Minor)	Effects are local, reversible, and do not effect an already stressed environment
Confidence for Significance Determination	Moderate	Modelling tends to provide over-predictions of effects due to conservative assumptions in methodology

Note: AAQO = Ambient Air Quality Objectives; AQ = Air Quality; VC = Valued Component

5.2.4.5 Cumulative Effects

Based on the criteria described in **Section 4.3.5** (Assessment Methodology), a CEA for air quality is required if:

- The occurrence of a residual adverse Project effect has been determined, but this residual effect is not expected to be negligible; and
- The residual Project effects are demonstrated to interact with the effects of other past, present or future projects, or activities.

In that same section the following major projects were initially identified as possible candidates for inclusion in the assessment of cumulative effects:

- Nulki Hills Wind Project;
- Coastal Gas Link Pipeline; and
- Pacific Gas Looping Project.

Residual air quality effects are limited to the air quality LSA and the above listed projects all occur entirely outside the LSA. As these projects do not meet the second criteria above (Project effects interact with the effects of other projects) they are not considered to contribute to any cumulative effects.

Also listed in **Section 4** (Assessment Methodology) are the following general land uses that should be reviewed to determine the potential contribution to cumulative effects:

- Protected areas and parks;
- Recreation/tourism use (e.g., all-terrain vehicle use);
- Mining, exploration, and mineral tenures;
- Forestry and timber resource use;
- Hunting/trapping/guide outfitting;
- Fishing and aquaculture;
- Agriculture and grazing;
- Range use;
- Land ownership and tenures;
- Recreational and commercial use of waterways;
- Groundwater resource use; and
- Surface water resource use.

The activities determined to contribute to cumulative air quality effects are those with combustion emissions or vehicle traffic as these activities may generate air emissions such as TPM, PM_{10}, $PM_{2.5}$, CO and NO_x that interact with the Project. Of the above listed general land uses, mining exploration and forestry resource are the activities that may make the largest cumulative effects contribution to air quality. However, these other activities are not creating measurable changes in the air quality RSA as shown by the very low baseline contaminants concentrations.

In order to quantify cumulative air quality effects it is necessary to obtain spatially and temporally specific activity information so that emissions can be estimated and assigned to a specific geographic area. By their nature forestry resource use and mining exploration are activities that move continuously and have a relatively low level of activity in any specific location over a significant period of time. Therefore their interaction with Project air quality effects tends to be lower than an activity that remains in one location for a longer period of time.

Detailed activity information with any meaningful degree of confidence is not available for either activity so the only assessment possible is qualitative in nature. The level of forestry and mining exploration in the RSA is assumed to be small relative to the level of vehicle activity expected to be generated by the project. As these activities currently occur, their air quality impacts are already being included in the Project assessment by the addition of a background value. Therefore the cumulative effects are considered to be not significant at a minor level as presented in **Table 5.2.4-11**.

Table 5.2.4-11: Determination of Significance of Cumulative Effects for Air Quality

Category	Rating	Comment
Context	Low	The VC has no existing sensitivities and is anticipated to be resilient to effects of the Project and cumulative activities
Magnitude	Low	Changes in predicted ground-level concentrations between the project alone and cumulative scenarios is anticipated to be minimal as cumulative activities do not occur where maximum project effects are predicted (at Project boundary).
Extent	Regional	Predicted AQ cumulative effects are assessed in the AQRSA
Duration	Medium-term	Effects will end shortly after Project operations
Frequency	Continuous	Project and cumulative activity emissions are assumed to be continuous during the Project duration
Reversibility	Reversible	Project effects stop occurring shortly after Project closure, effects due to cumulative activities may continue after Project closure
Likelihood	High	Similar effects are seen at many projects and the Project and cumulative activities is not expected to be significantly different
Confidence for Likelihood	High	Similar effects are seen at many projects and the Project and cumulative activities is not expected to be significantly different
Significance Determination	Not Significant (Minor)	Cumulative effects are regional, reversible, and of low magnitude
Confidence for Significance Determination	Moderate	Modelling tends to provide over-predictions of effects due to conservative assumptions in methodology. Air quality related information with any meaningful degree of confidence on cumulative activities is not available and these can be assessed in a qualitative manner only

Note: AAQO = Ambient Air Quality Objectives; AQ = Air Quality; VC = Valued Component

5.2.4.6 Limitations

Dispersion modelling has inherent limitations due to simplifications required to reduce the data processing to a level that can be handled with current technology. These limitations are described in detail in Section 8 of the Air Quality Modelling Report found in **Appendix 5.2.4A**. The assumptions and limitations made in modelling tend towards conservatism and over-prediction of ambient values.

5.2.4.7 Conclusion

The results in **Section 5.2.4.3.3** predict potential exceedances of ambient objectives for $PM_{2.5}$, PM_{10} and TSP. These exceedances are infrequent, cover a small area in an area of relatively low accessibility. The inherent conservatism present in the assessment technique (dispersion modelling) suggests that these exceedances are potentially assessment artifacts and unlikely to occur during project activities. Therefore this effect is assessed as not significant.

To confirm the above assumptions, it is recommended that monitoring of $PM_{2.5}$ and PM_{10} be conducted during construction and operations to confirm the air quality predictions. TSP levels can be estimated based on PM_{10} monitoring as has been done previously for the Project. Emissions of other substances from the Project are not considered significant and monitoring and follow-up for those substances are not recommended.