RED MOUNTAIN UNDERGROUND GOLD PROJECT
VOLUME 3 | CHAPTER 7
AIR QUALITY EFFECTS ASSESSMENT

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7 AIR QUALITY EFFECT ASSESSMENT

7.1 Introduction

Air quality is an aspect of the environment that may be altered by the proposed Red Mountain Underground Gold Project (the Project), as proposed by IDM Mining Ltd. (IDM). Figure 7.1-1, Figure 7.1-2, and Figure 7.1-3 below illustrate the established disturbance limits for the entire Project footprint, for the Mine Site (location of Upper and Lower Portals), and for Bromley Humps (location of Process Plant and Tailings Management Facility (TMF)), respectively.

This chapter presents the effects assessment for the Air Quality intermediate component (IC) and highlights potential effects that could results in effects on the following identified valued components (VCs): Surface Water Quality (Volume 3, Chapter 13), Vegetation and Ecosystems (Volume 3, Chapter 15), Wildlife and Wildlife Habitat (Volume 3, Chapter 16), Aquatic Resources (Volume 3, Chapter 17), Fish and Fish Habitat (Volume 3, Chapter 18), Social (Volume 3, Chapter 20), and Human Health (Volume 3, Chapter 22).

This chapter provides the regulatory and policy context within which the Air Quality Effects Assessment occurs, the estimation and predictive modelling of Project-related air emissions to characterize existing air quality conditions, predict potential effects, identify applicable and effective mitigation measures, and characterize residual effects predicted to remain after the application of mitigation measures. The chapter concludes with an assessment of any potential cumulative effects associated with predicted changes in Air Quality.

The results of the Air Quality Effects Assessment show that there will be no effects to Air Quality outside of Canada.

Figure 7.1-1: Project Overview

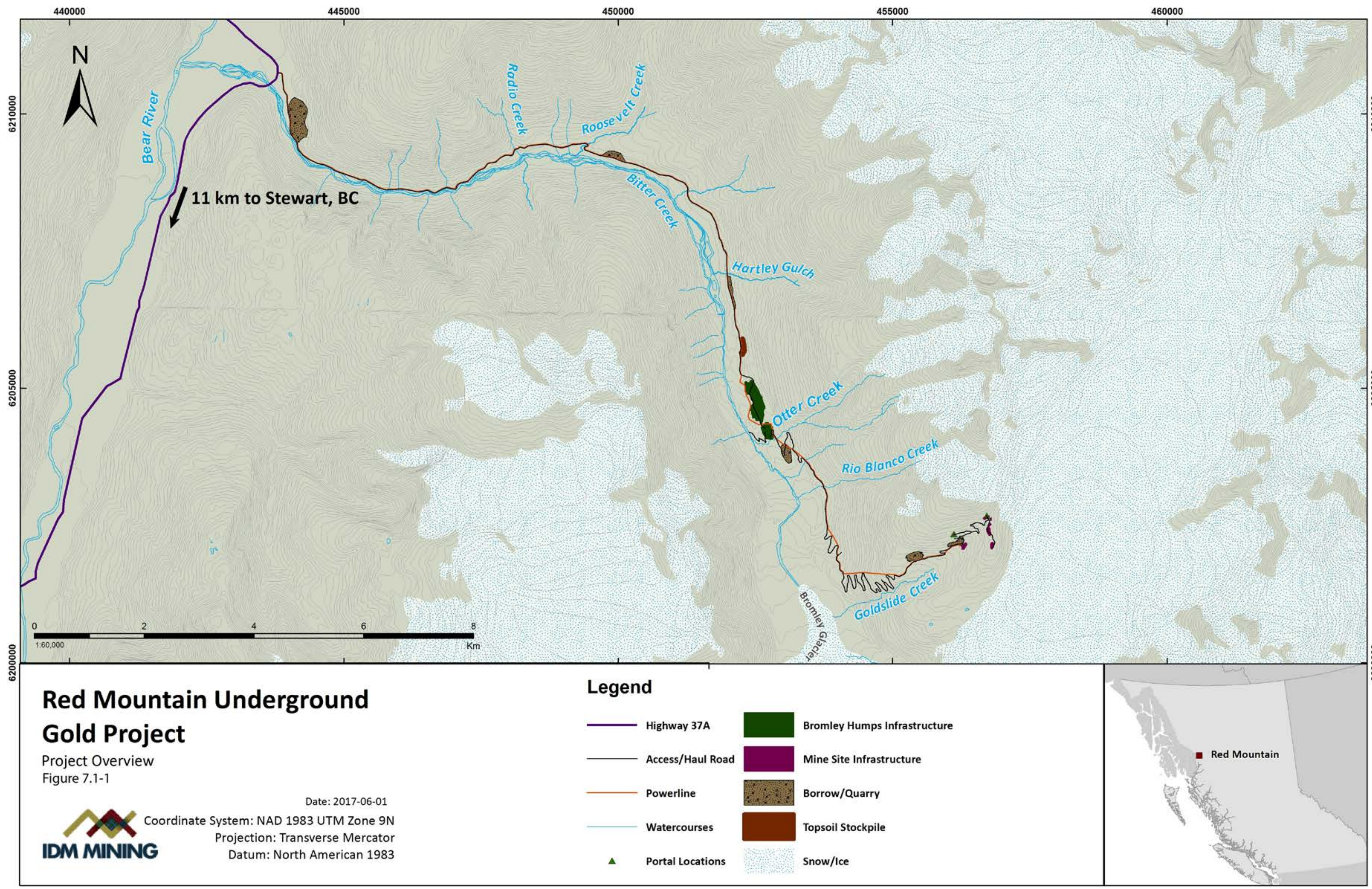


Figure 7.1-2: Project Footprint – Bromley Humps

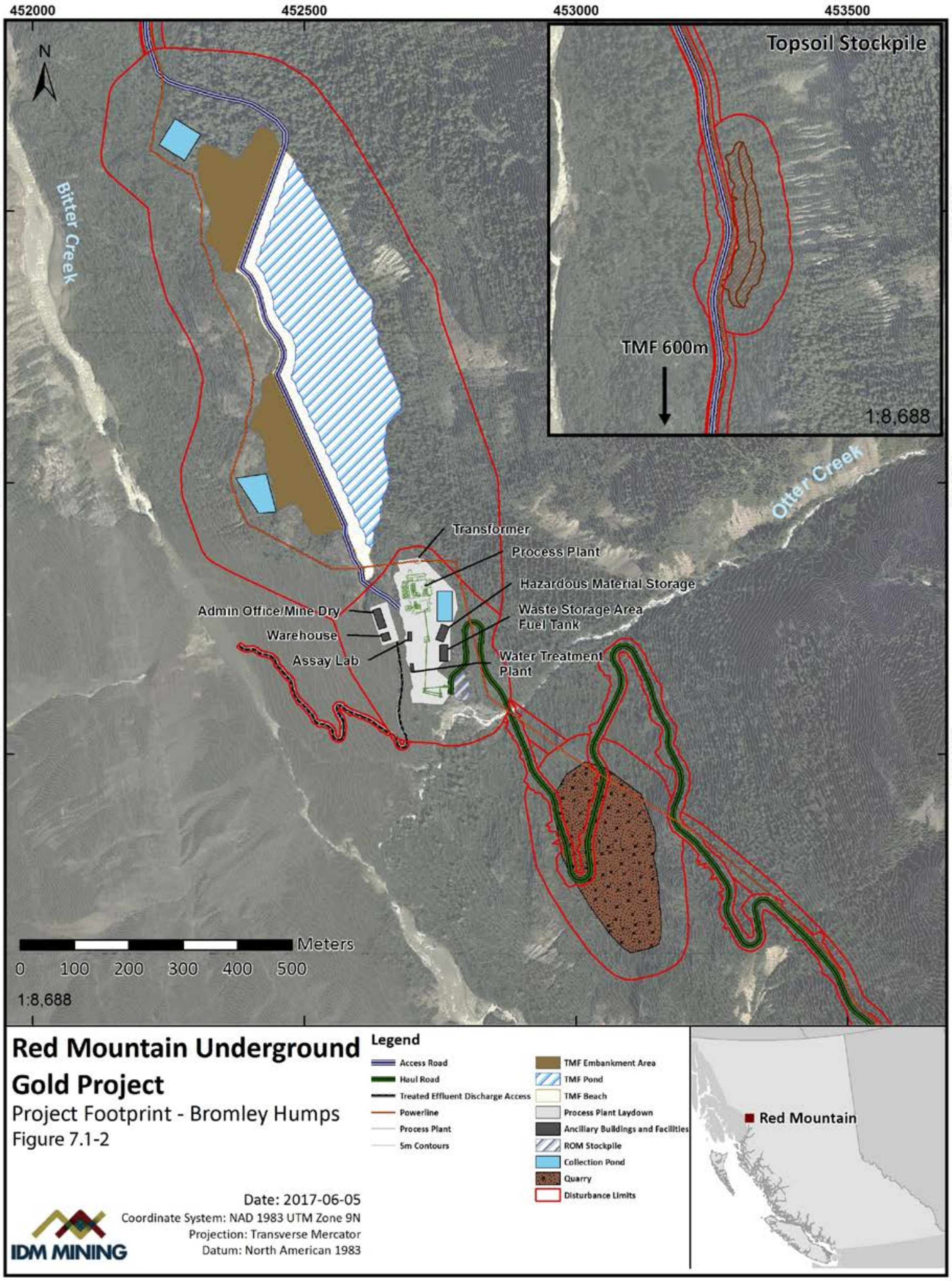
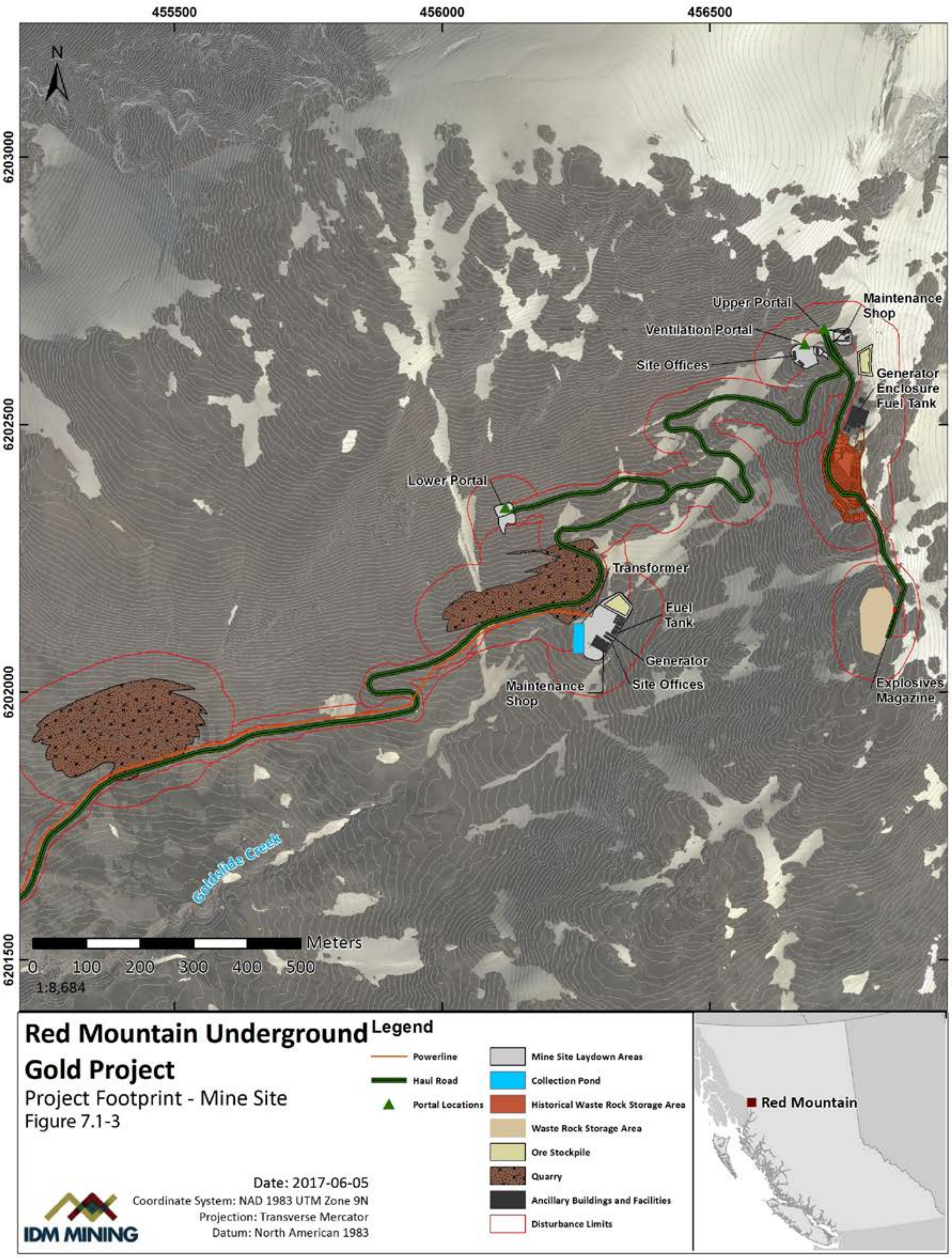


Figure 7.1-3: Project Footprint – Mine Site



7.2 Regulatory and Policy Setting

The Application Information Requirements (AIR) for the Project, approved by the British Columbia (BC) Environmental Assessment Office (EAO) in March 2017, outlines the requirements of the Air Quality Effects Assessment to meet both the provincial and federal environmental assessment (EA) requirements under the *BC Environmental Assessment Act* (2002) and *Canadian Environmental Assessment Act* (2012), respectively. To inform the regulatory and policy setting for the Project, the following references were reviewed:

- Canadian Environmental Protection Act (1999);
- Canadian Ambient Air Quality Standards (CAAQS);
- BC Ambient Air Quality Objectives (BC MOE 2016);
- Guidance on Application of Provincial Interim Air Quality Objectives for NO_2 and SO_2 (BC MOE 2014);
- The Pollution Control Objectives for the Mining, Smelting, and Related Industries of British Columbia (BC MOE 1979);
- Guideline for Air Quality Dispersion Modelling in BC (BC MOE 2015);
- Canadian Ambient Air Quality Standards (CAAQs) for Fine Particulate Matter (PM2.5) and Ozone (CCME 2013);
- Meteorological Data and Sensing Requirements in the B.C. Ministry of Environment (BC MOE 2013);
- Meteorological Sensors, Calibration and Routine Verification Ambient Air Program Standard Operating Procedures (SOP) (BC MOE 2016);
- Air Monitoring Site Selection and Exposure Criteria (BC MWLAP 2003);
- Air Monitoring Instrumentation - Guidance for Instrument Selection (BC MOE 2016); and
- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016).

The management of Air Quality in Canada is accomplished primarily through federal and provincial government collaboration. At the federal level, the Canadian Council of Ministers of the Environment (CCME) acts as a forum for provincial governments to jointly undertake initiatives to address major environmental issues. With regard to Air Quality, the CCME approved a new air quality management system (AQMS) in 2012. The AQMS is a comprehensive approach for improving air quality in Canada and is the product of collaboration by the federal, provincial, and territorial governments and stakeholders. As part of the AQMS, the CCME has issued and is developing new Canadian Ambient Air Quality Standards (CAAQS) for ambient air quality management across the country. The CCME has also established a new framework for air zone management within provinces that enables action tailored to specific sources of air emissions of concern for a given area.

As a result of these new Canadian initiatives, BC has adopted or updated several air quality objectives for a number of contaminants under the *Environmental Management Act* (2003). The BC Ministry of Environment (MOE) uses air quality objectives as limits on the acceptable presence of contaminants in the atmosphere to protect human health and the environment. Provincial air quality objectives are used to:

- Gauge current and historical air quality;
- Guide decisions on environmental effects assessments and authorization;
- Guide airshed planning efforts;
- Inform regulatory development; and
- Develop and apply episode management strategies, such as air quality advisories.

The most recent update to the BC Ambient Air Quality Objectives (BCAAQO; MOE 2016) has better aligned the provincial objectives with the new guidance provided by established CAAQS from the CCME (Table 7.2-1). Where both federal and provincial air quality objectives are available, this Air Quality Effects Assessment used the lower (i.e., more stringent) objective.

Table 7.2-1: Relevant British Columbia Ambient Air Quality Objectives

Contaminant	Averaging Period	Air Quality Objective ($\mu g/m^3$)	Source
Nitrogen Dioxide (NO_2)	1-hour	188	Interim Provincial Air Quality Objective (AQO)
	Annual	60	
Sulphur Dioxide (SO_2)	1-hour	196	Interim Provincial Air Quality Objective (AQO)
	1-hour	183	CAAQS
	Annual	13	CAAQS
Particulate Matter < 2.5 microns ($PM_{2.5}$)	24-hour	25	BC AAQO
	24-hour	28	CAAQS
	Annual	8	BC AAQO
	Annual	10	CAAQS
Particulate Matter < 10 microns ($PM_{2.5}$)	24-hour	50	BC AAQO
Total Suspended Particulate (TSP)	24-hour	120	National Ambient Air Quality Objective (NAAQO)
	Annual	60	NAAQO

Air quality objectives are designed to be protective of human health, including sensitive individuals such as the elderly, infants, or those with health conditions. Therefore, when evaluating air dispersion modelling predictions, it is typical to apply those standards at a "fenceline" or boundary that represents the area accessible to the general public. Air Quality effects within the fenceline are assumed to be applicable to and regulated by occupational health and safety codes that will apply to the Project.

Recommendations on approach and details for air dispersion modelling in BC are provided in the *Guidelines for Air Quality Dispersion Modelling in British Columbia* (MOE 2015). The Air Quality Effects Assessment used for this Project followed these recommendations and details of the modelling were confirmed in the Project's Air Dispersion Detailed Model Plan, developed in consultation with MOE, and incorporated into the Air Quality Modelling Report (Appendix 7-A). The modelling plan was submitted to MOE and comments were received on March 23, 2017. Comments provided were used to finalize the modelling study.

The Project is within the Nass Area and the Nass Wildlife Area, as set out in the Nisga'a Final Agreement (NFA). Pursuant to the NFA, Nisga'a Nation, as represented by Nisga'a Lisims Government (NLG) has Treaty rights to the management and harvesting of fish, wildlife, and migratory birds within the Nass Wildlife Area and the larger Nass Area. The Project is also within the asserted traditional territory of Tsetsaut Skii km Lax Ha (TSKLH) and is within an area where Métis Nation BC (MNBC) claims Aboriginal rights.

7.3 Scope of the Assessment

7.3.1 Information Sources

As a primary indicator of expectations from government and stakeholders, the scope of the Air Quality Effects Assessment was informed by historical EAs carried out for mining operations in the region. The scope included review of baseline reports and Application for an Environmental Assessment Certificate/Environmental Impact Statement (Application/EIS) submissions for the following projects near the Project: the Kemess Underground Project; Brucejack Gold Mine Project; KSM Project; Galore Creek Project; and the Kitsault Mine Project.

As discussed previously, the technical components of the Air Quality Effects Assessment were informed by the Guidelines for Air Quality Dispersion Modelling in British Columbia (MOE 2015) and discussions and consultation with MOE over the Project's Air Dispersion Model Plan.

7.3.2 Input from Consultation

IDM is committed to open and honest dialogue with regulators, Aboriginal Groups, community members, stakeholders, and the public.

IDM conducted consultation with regulators and Aboriginal Groups through the Working Group co-led by EAO and the Canadian Environmental Assessment Agency. Where more detailed and technical discussions were warranted, IDM and Working Group members, including sometimes Nisga'a Lisims Government (NLG) representatives, held topic-focused discussions, the results of which were brought back to EAO and the Working Group as a whole.

Further consultation with Aboriginal Groups, community members, stakeholders, and the public has been conducted as outlined by the Section 11 Order and Environmental Impact Statement Guidelines issued for the Project. The results of those consultation efforts relevant to the assessment of potential effects of the Project on Air Quality have been summarized in Table 7.3-1.

More information on IDM's consultation efforts with Aboriginal Groups, community members, stakeholders, and the public can be found in Chapter 3 (Information Distribution and Consultation Overview) Part C (Aboriginal Consultation), Part D (Public Consultation), and Appendices 27-A (Aboriginal Consultation Report) and 28-A (Public Consultation Report. A record of the Working Group's comments and IDM's responses can be found in the comment-tracking table maintained by EAO.

Consultation with regards to the Air Quality assessment consisted of email correspondence, teleconferences, and written submissions shared between IDM, MOE and NLG to define the scope of the Air Quality Effects Assessment. The correspondence considered the possibility of adopting an adaptive approach that would focus on implementing monitoring and trigger levels for mitigation for Project air quality management instead of a traditional air dispersion modelling assessment typical of EA submissions. However, through discussions and feedback, the parties agreed that an air dispersion modelling assessment was needed to inform potential Project effects.

Table 7.3-1: Summary of Consultation Feedback on Air Quality

Topic	Feedback by*				Consultation Feedback	Response
	NLG	G	P/S	O		
Air Quality		✓			Initial feedback from MOE indicated that, given the uncertainty associated with estimating fugitive dust emissions from mining operations, an adaptive approach to air quality management may be preferable to an air dispersion modelling assessment.	IDM provided a memo with an overview of a proposed adaptive approach to air quality management. Upon further discussion, it was agreed that a predictive air dispersion modelling assessment would be a better approach for the effects assessment in this chapter.
Air Quality	✓	✓			NLG and MOE requested an air dispersion modelling assessment to inform of potential Project effects.	IDM agreed to perform an air dispersion modelling assessment and submitted an air dispersion model to MOE for review.

*NLG = Nisga'a Lisims Government;
G = Government - Provincial or federal agencies;
P/S = Public/Stakeholder - Local government, interest groups, tenure and license holders, members of the public;
O = Other

7.3.3 Intermediate Components, Assessment Endpoints, and Measurement Indicators

Project activities will result in the generation and airborne transport of fugitive dust, exhaust emissions from mining equipment (both above and below ground), and emissions from the mine Process Plant. The primary measurement indicators for the Air Quality IC, as outlined in Table 7.3-2, are the concentrations of a subset of the criteria air contaminants that would be released by these Project activities that have the potential to interact with many VCs, but most importantly with Human Health. Potential greenhouse gas emissions are included in the air assessment emissions inventory as an indicator of potential Project contributions to provincial, national, and global greenhouse gas inventories. Dustfall has been included as a measurement indicator as it has the potential to interact with specific VCs (e.g., Vegetation and Ecosystems, and Surface Water Quality).

Ozone has not been included as a measurement indicator. Ozone forms when large volumes of nitrogen oxides (NOx) and volatile organic compounds (VOCs) are present during hot, sunny, stagnant air conditions. Although the Project is predicted to release emissions of ozone precursors (i.e., NOx and VOCs), the major components of the Project, including the Process Plant, TMF, Warehouse, Maintenance shops, and other ancillary buildings (see, Figure 7.1-1, Figure 7.1-2, and Figure 7.1-3) will be powered by electricity, minimizing the release of ozone precursors of NOx and VOCs. Hot, sunny, stagnant air conditions are also not prevalent meteorological conditions at the northern latitude location of the mine (Climate and Hydrology Report, Appendix 12-A).

Note that VOC emissions are quantified in the emissions inventory for the Project (Volume 8, Appendix 7-A, Section 3, Tables 3-2 and 3-3); however, the emissions are very low compared to most other contaminants. The only contributor of VOC emissions is from fuel combustion exhaust. No significant source of VOC is expected for the Project. Therefore, VOC emissions were not included as a baseline measurement or in the dispersion modelling discussed in the following sections.

Table 7.3-2: Measurement Indicators for Air Quality

Intermediate Component	Primary Measurement Indicators	Indicator Rationale
Air Quality	• Concentrations of criteria air contaminants in air (particulate matter, SO_2, and NO_2) • Dustfall Rate	The Project has the potential to change ambient air quality during Project Construction and Operation. Potential changes in Air Quality can affect Human Health, Vegetation and Ecosystems, and Surface Water Quality. Air Quality modelling will support the effects assessment of other VCs.

7.3.4 Assessment Boundaries

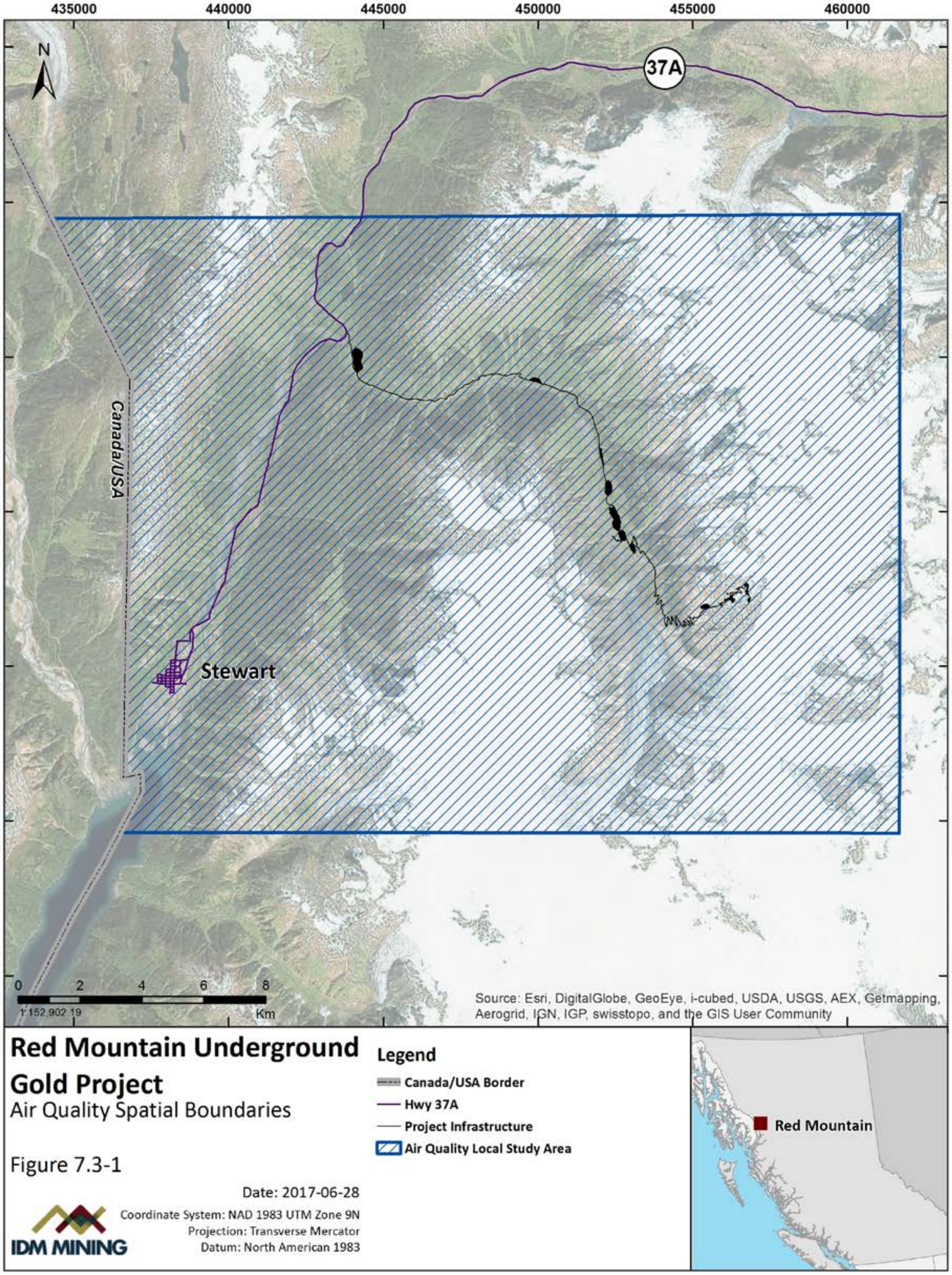
The following sections identify the spatial and temporal boundaries applicable to the Air Quality Effects Assessment. There are no administrative or technical boundaries applicable.

7.3.4.1 Spatial Boundaries

The Air Quality local study area (LSA) and dispersion modelling domain was selected to include the nearest community of Stewart and the topographical features expected to limit the dispersion of air emissions from the Project (Figure 7.3-1). Recommendations from the Guidelines for Air Quality Dispersion Modelling in British Columbia (MOE 2015) regarding the dispersion modelling domain were also considered. The domain was confirmed and agreed to in the Project's Dispersion Modelling Plan (as presented in Appendix 7-A).

A larger regional study area was not established as the LSA was sufficiently large to include all Project-related pollutant isopleths that represent 10% of the air quality objectives, as recommended in the Guidelines for Air Quality Dispersion Modelling in British Columbia.

Figure 7.3-1: Air Quality Spatial Boundaries



7.3.4.2 Temporal Boundaries

The Air Quality Effects Assessment considers the potential effects from the construction and operation of the Project.

For the Construction Phase, Project Year -1 was chosen because it reflects the highest level of construction activity and includes the site development and TMF construction.

For the Operation Phase, Project Year +3 was chosen because it will have the highest throughput levels and thus be the 'worst-case' scenario in terms of emissions.

Project interactions with Air Quality during the Closure and Reclamation Phase are anticipated to be minor compared to those during Construction and Operation therefore they have not been modelled but are considered in the Air Quality Effects Assessment.

Negligible interactions are anticipated during the Post-Closure Phase.

The dispersion modelling assessment considers one year of prognostic meteorological data as provided by the MOE provincial Weather Research and Forecasting (WRF) model dataset.

7.4 Existing Conditions

7.4.1 Overview of Existing Conditions

7.4.1.1 Climate and Meteorology

Meteorology and climate are related but are distinct in nature. Meteorology typically relates to the short-term meteorological conditions. Climate, as related to the assessment of Air Quality, is important on smaller, local scales, such as in boundary layer climatology. Climate is also the understanding of the weather conditions in an area in general or over a long period of time. Although these may be important drivers of existing conditions, long-term patterns, and global patterns in air quality, it is not anticipated that changes in climate would directly affect the assessment of air quality effects over the lifetime of the Project.

Both climate and meteorological patterns are summarized in the Climate and Hydrology Baseline Report (Appendix 12-A). This section provides an overview of the existing climate and meteorology in the LSA. However, within the Air Quality Effects Assessment, the meteorological conditions were determined by use of the three-dimensional gridded database of WRF model data available from the MOE as agreed to in the Project dispersion modelling plan (Appendix 7-A).

The Project lies within the transition zone between the wet Pacific and continental air masses. In this zone, the climate is primarily dominated by weather systems that develop over the Pacific Ocean and come from the west. When these weather systems affect the local mountainous topography, they influence the climate experienced in the LSA. Observed on-site data and regional re-analysis data (Appendix 12-A) show that the climatological temperature and precipitation trends at the Project site are most comparable to coastal stations within the region.

The Environment Canada Climate Trends and Variations Bulletin summarizes recent climate data and presents it in a historical context. In the most recent 2015/2016 Bulletin[1], the Pacific Coast region experienced its third-warmest winter since 1948 (2.3°C above average) with a strong upward trend. This is consistent with the re-analysis data presented in the baseline reports. Precipitation trends in the northern BC mountains are trending to lower amounts of winter precipitation and wetter summer months.

Wind speed and direction, as they pertain to the assessment of Air Quality, are important on a local scale within the Bitter Creek valley. The best available information on wind speed and direction at the site comes from the onsite meteorological data that was collected at the Project meteorological station starting on July 30, 2014 (Appendix 12-A). The predominant wind directions are from the southeast and northwest, which follows the valley alignment, and would be indicative of up-valley, down-valley flows, and terrain steering of winds on a local scale. The prognostic meteorological data used in the Air Quality Effects Assessment captured these local wind characteristics well and was therefore used in place of the onsite meteorological data collected.

The available meteorological data described above and in Appendix 12-A were sufficient for the description of the existing conditions as they relate to the Air Quality assessment. The air dispersion modelling assessment used a BC provincially-approved prognostic meteorological dataset to define the atmospheric and meteorological conditions for the prediction of ambient air pollutant concentrations, so the existing conditions data was only relevant to the general discussion provided above. The use of prognostic meteorological data for the dispersion modelling assessment means that existing or baseline meteorological data is not directly used in the Air Quality assessment. Therefore, further detailed information on existing meteorological conditions (i.e. relative humidity, solar radiation), while captured in the prognostic meteorological data used in the assessment, are not presented here as data that is relevant to the discussion of existing conditions.

7.4.1.2 Air Quality

MOE has recently compiled a series of air zone reports meant to inform regional air quality conditions or concerns. The Project sits along the border of the Coastal Air Zone and Central Interior Air Zone. The remote Project location is likely most represented by the Coastal Air Zone[2], which is relatively undeveloped outside of Prince Rupert, Terrace, and Kitimat. Air quality measurements and concerns identified in this air zone are focused on emissions from industrial sources and woodstoves within these communities, concerns that would not be applicable to the Project. Despite this, air zone management levels for $PM_{2.5}$ were classified as “green”, the classification given for air zones that are the lowest in comparison to ambient air quality objectives, based on monitoring conducted in the major population centres in the zone. It is reasonable to assume that the Project location, a remote area with few anthropogenic sources, would be less affected by air emissions than these communities.

[1] http://www.ec.gc.ca/sc-cs/default.asp?lang=En&n=439E7F88-1
[2] http://www2.gov.bc.ca/gov/content/environment/air-land-water/air/reports

7.4.2 Past and Current Projects and Activities

There are no past or current projects near the Project that are known to directly affect Air Quality in this remote location, in which the baseline air quality is more likely to be dictated by natural sources or long-range transport of pollution based on regional or continental air flow. Current recreational access and exploratory activities near the Project site are not likely to have a substantial effect on baseline air quality levels.

As the Project location is relatively remote and removed from industrial activities, there is a relatively low level of VOCs.

7.4.3 Project-Specific Baseline Studies

Project specific baseline studies related to Air Quality were limited to the collection of onsite meteorological data (Appendix 12-A) to support the Air Quality Modelling Report (Appendix 7-A) as well as other disciplines. The characterization of baseline air quality to support the Air Quality Effects Assessment relied on existing data and methods accepted for other mining project EAs in the region to define baseline conditions.

7.4.3.1 Data Sources

Many prior mining EAs in the region have been conducted by Rescan/ERM and rely on historical regional data to define an appropriate baseline for remote areas with few anthropogenic sources. Baseline data sources include information from the following regional mining EAs:

- Kemess Underground Project (ERM 2016);
- Brucejack Gold Mine Project (ERM 2014);
- KSM Project (Rescan 2012);
- Blackwater Project (New Gold 2016);
- Galore Creek Project (Rescan 2006; 2013); and
- Kitsault Mine Project (AMEC 2011).

Given the common characteristics of these regional Projects (see Section 7.4.4 below), the data collected at these locations was appropriate to characterize baseline air quality conditions for the Air Quality assessment. This approach to baseline data gathering was agreed upon with the BC Ministry of Environment, during the development of the model, by sharing the Dispersion Model Plan for the Project (Annex 1, Appendix 7-A).

As outlined in Chapter 6 (Effects Assessment Methodology), IDM has not conducted primary traditional use or traditional ecological knowledge (TEK) surveys in support of the Project due to the preferences of Nisga'a Nation, as represented by NLG, and EAO's and the Canadian Environmental Assessment Agency's direction for comparatively low levels of engagement with the other Aboriginal Groups potentially affected by the Project. IDM has committed to using TEK where that information is publicly available. As no TEK relevant to this effects assessment was publicly available at the time of writing, no TEK has been incorporated.

7.4.3.2 Primary Data Collection and Analysis Methods

The collection of onsite meteorological data is outlined in Appendix 12-A.

7.4.4 Baseline Characterization

The method that has been adopted to define the necessary baseline concentrations for the Air Quality Effects Assessment is a method that has been accepted for EAs conducted and approved for other mining projects in the region. Most of these assessments have relied on historical regional data collected to define an appropriate baseline for remote areas with few anthropogenic sources. This method to define baseline pollutant concentrations was confirmed with MOE in the Project Dispersion Modelling Plan.

The approach uses data from monitoring stations that are representative of remote project areas, typical of mining locations in northwest BC, including the Project location. The Project will be in an area that is similar to recent examples (Brucejack and Kemess; ERM 2014 and 2016) and historical projects (KSM; Rescan 2012) that have used this approach to baseline characterization. Common traits with these areas are:

- Remote, undeveloped locations;
- Located in complex terrain in steep valleys dominated by forest cover at lower elevations and rock, snow, and ice at higher elevations;
- No specific anthropogenic sources of emissions can be identified near the site beyond limited access for recreational or commercial activities along the Access Road from Highway 37A; and
- Located within the same biogeoclimatic zone in BC and subject to similar seasonal climatic regimes.

In order to perform air quality dispersion modelling as part of the EA, ambient background concentrations of air contaminants must be considered. The order of priority of information sources used to establish the background concentration levels is stated in the Guidelines for Air Quality Dispersion Modelling in British Columbia (MOE 2015):

- A network of long-term ambient monitoring stations near the source under study;
- Long-term ambient monitoring at a different location that is adequately representative; and
- Modelled background.

Recent and historical projects that utilized the approach outlined above to define baseline pollutant concentrations relied on a combination of ambient background concentrations from stations from various locations that are adequately representative of the background concentrations at the project site. A complete list of instrumentation and maintenance records from the monitoring conducted is not available, however the baseline reports indicate that the equipment consisted of:

- Dustfall monitors (dust deposition);
- Partisol (air particulate) monitors;
- DustTrak Aerosol Monitors; and
- Passive samplers (for SO_2 and NO_2 concentrations).

7.4.4.1 Criteria Air Contaminants

For representative SO_2 concentrations, other regional mining EAs have relied upon the available estimates of remote ambient background concentrations as published by the Canadian Air and Precipitation Monitoring Network (CAPMoN). CAPMoN is a non-urban air quality monitoring network with siting criteria designed to ensure that the measurement locations are regionally representative (i.e., not affected by local sources of air pollution). There are currently 28 measurement sites in Canada. The closest CAPMoN site to the Project is the Saturna station, off the southern tip of Vancouver Island in the middle of the Strait of Georgia. Although the station is almost 1,000 km southeast of the Project, it provides the best estimate of background concentration available for BC. Daily measurements of SO_2 concentrations are available from the Saturna monitoring station from 1996 to 2002 (1997 is not available). The average annual SO_2 concentration for that period was reported as 2.3 $\mu g/m^3$. Ambient NO_2 concentrations were not measured at the Saturna station.

Since CAPMoN does not provide background concentrations for all pollutants, ambient background concentrations were also determined from other representative locations. The ambient concentrations from these representative remote sites were adopted as the baseline conditions for the Project's Air Quality Effects assessment.

- The Diavik Diamond Mine (Diavik) is in the Northwest Territories, located about 300 kilometres (km) northeast of Yellowknife. In the Diavik Diamond Mine EA (Cirrus 1998), ambient background concentrations for NO_2, SO_2, and particulates were estimated based on surveys and assumptions. These ambient concentrations have been considered to be typical background concentrations for remote areas with few anthropogenic sources.

- The Galore Greek Mine Project (Galore) is located approximately 170 km northwest of the Project (Rescan 2006). The baseline monitoring conducted in 2005 included measurements of ambient PM10 and PM2.5 concentrations.

- The Kitsault Mine Project (Kitsault) is located on the northwest coast of BC, approximately 140 km north of Prince Rupert and 60 km south of the Project. Total suspended particulates (TSP), PM10, and PM2.5 were measured on site (AMEC 2011).

- The Brucejack Gold Mine Project (Brucejack) EA relied on the same baseline air quality representation as presented above and this mine is located approximately 65 km north-northwest of the Project.
- The Kemess Underground Project relied on the same baseline air quality representation as Brucejack and this project is located approximately 225 km northeast of the Project.

With the exception of the Kemess Underground Project, located approximately 225 km northeast of the Project, and the Diavik Diamond Mine located in the Northwest Territories, the locations of the relevant projects are presented in Volume 3, Chapter 6, Figure 6.12-1, titled Past, Present and Reasonably Future Projects with the Potential for Cumulative Effects.

Table 7.4-1: Regional Baseline Air Quality Concentrations Used to Determine Representative Baseline Concentrations for the Project Air Quality Assessment

Pollutant	Averaging Period	Concentration (µg/m^3)					
		Brucejack	Saturna	Diavik	Galore	Kitsault	Baseline Representing the Project
SO_2	1-hour	-	-	4.0	-	-	4.0
	24-hour	-	-	4.0	-	-	4.0
	30-day	0.13[a]	-	-	-	-	-
	Annual	-	2.3	2.0	-	-	2.0
NO_2	1-hour	-	-	21	-	-	21
	24-hour	-	-	21	-	-	21
	30-day	0.09 to 4.1	-	-	-	-	-
	Annual	-	-	5.0	-	-	5.0
CO	1-hour	-	-	100	-	-	100
	8-hour	-	-	100	-	-	100
TSP	24-hour	-	-	10	-	3.5	10
	Annual	-	-	10	-	-	10
PM_{10}	24-hour	-	-	10	3.4	2.5	3.4
$PM_{2.5}$	24-hour	-	-	-	1.3	2.3	1.3

Source: ERM 2014

1-hour and 24-hour SO_2 concentrations of 4.0 µg/m^3 are from the Diavik Diamond Mine EA. In the Brucejack EA, the passive collection of SO_2 concentrations revealed a 30-day SO_2 concentration of 0.13 µg/m^3. Comparing this to the annual concentrations of 2.3 and

2.0 μg/m^3 from Saturna and Diavik, ambient SO_2 concentrations at the Project area were deemed to be much lower. Therefore, the concentrations from Diavik are conservatively assumed to represent the LSA.

As with the Brucejack EA, the 30-day NO_2 concentration of 0.09 μg/m^3 was collected at the Project's proposed Mine Site and the concentration of 4.1 μg/m^3 was collected within 5 km of Highway 37A. Comparing with the background concentrations from Diavik, the NO_2 concentrations at the Project area are also much lower. The concentrations from Diavik are conservatively assumed to represent the LSA.

There are currently no CO ambient concentrations available other than from Diavik and therefore the background concentrations of 100 μg/m^3 from Diavik are assumed to represent the LSA.

For suspended particulates, a wider range of concentration variation was observed between Diavik and Kitsault. Thirty 24-hour samples were collected at Diavik; at Kitsault, the monitoring durations for TSP, PM_{10} and $PM_{2.5}$ were each approximately 7.5 hours. Data collected from Diavik were deemed to be a more accurate representation of the 24-hour averages and is used to represent the Project area. The Diavik study did not provide clear information on whether the PM_{10} concentration was assumed to be the same as TSP. Since the latter is more likely, PM_{10} concentration from Galore were assumed to be representative of the LSA. Concentration of $PM_{2.5}$ from Galore is also selected to represent the LSA. With the absence of available annual $PM_{2.5}$ concentrations, 24-hour $PM_{2.5}$ concentrations from Galore are conservatively assumed to represent $PM_{2.5}$ annual concentration.

Following the submission of the Application/EIS, as part of the management of Air Quality for the Project, baseline Air Quality conditions relevant to the Air Quality and Dust Management Plan (Volume 5, Chapter 29) will be characterized prior to construction. These baseline Air Quality conditions will be used to establish Air Quality management criteria or triggers for the construction and operation of the Project. This baseline monitoring, prior to construction, will also serve as a comparative check on the assumptions made in characterizing Air Quality existing conditions based on available information from other regional EAs and remote monitoring stations.

7.4.4.2 Dust

Dust deposition rates will be modelled to support other VC assessments. As with the Kemess Underground EA (Rescan 2013), dustfall monitoring was not conducted at the Project site; therefore, an average of background dustfall levels from other projects was used (Table 7.4-2). Baseline dustfall data have been collected at the KSM Project (approximately 75 km north of the Project) and at the Brucejack, Galore, Kitsault, and Schaft Creek projects (each located approximately 180 km northwest of the Project). Results indicate that:

- At KSM, dust deposition rates were monitored from June 2008 to October 2011 at five to ten locations, depending on the year. The deposition rates varied from below-detection limit to 2.75 milligrams per squared decametre per day (mg/dm^2/day). Sampling took place during the summer and early fall, which are typically the driest time of the year; therefore, dustfall values are estimated for the worst case (i.e., not mitigated by precipitation). The average dustfall rate for individual stations measured between 2008 and 2011 ranged from 0.12 to 1.22 $mg/dm^2/day$;

- At Brucejack, dustfall rates were monitored at six stations in 2012. The average dust deposition rates for each station ranged from 0.18 to 1.53 $mg/dm^2/day$. At Galore, dustfall was monitored in 2012. The average for each of the five sites ranged from 0.09 to 0.96 $mg/dm^2/day$;
- At Kitsault, the air quality baseline monitoring data showed that the highest dustfall rate was 0.46 $mg/dm^2/day$ in July 2009 and the average is 0.21 $mg/dm^2/day$; and
- At Schaft Creek, dustfall was monitored in 2007 (July, August, and September) and 2008 (June, July, August, and November) at eight stations. Dust deposition ranged from below-detection limit of 0.1 $mg/dm^2/day$ to 2.5 $mg/dm^2/day$, and the average for each station ranged from 0.18 to 0.93 $mg/dm^2/day$.

Table 7.4-2: Regional Baseline Dustfall Rates used to Determine Representative Baseline Dustfall Rates for the Project Air Quality Assessment

Pollutant	Dustfall Deposition Rate ($mg/dm^2/day$)					
	KSM	Brucejack	Galore	Kitsault	Schaft Creek	Baseline Representing the Project
Dustfall	0.12 - 1.22	0.18 - 1.53	0.09 - 0.96	0.21	0.13 - 0.93	0.56

7.5 Potential Effects

7.5.1 Methods

The assessment of Air Quality related effects from the Project uses predictive methods to quantify the pollutant concentrations at receptors situated within the Air Quality assessment study boundaries. To identify and quantify potential effects the following tasks were completed:

- A review of Project data and information (e.g., site plans, equipment specifications) to identify potential air emissions sources;
- Gathering and identification of potential sensitive receptors or receptors of interest from other Application/EIS disciplines;
- Dispersion modelling used to predict the potential air pollutant concentration levels from mining activities; and

- Comparison of predicted pollutant concentrations levels to applicable provincial ambient air quality objectives thresholds to identify the magnitude and spatial extent of potential effects.

7.5.1.1 Air Dispersion Modelling Methodology

An emissions inventory was prepared for the Project to quantify air contaminant emissions associated with the Project for two scenarios. As noted in Section 7.3.4.2, for the Construction Phase, Project Year -1 was chosen as it reflects the highest level of construction activity, including site development and TMF construction. For the Operation Phase, Project Year +3 was chosen as it will have the highest throughput levels and thus be the worst-case scenario in terms of emissions. The best available activity data from IDM and the most appropriate emission models and factors available to-date were used to compile the emissions inventory. Details on the emissions quantification methodology and activity data used to predict emissions from the Project are provided in the Air Quality Modelling Report (Appendix 7-A).

Air dispersion modelling of Project air emission sources was conducted based on the recommendations outlined in the Guidelines for Air Quality Dispersion Modelling in British Columbia (MOE 2015). The modelling approach for the assessment was submitted in the Project Dispersion Modelling Plan (Appendix 7-A) and reviewed by MOE. The CALPUFF model was selected for the Air Quality Effects Assessment. CALPUFF is a suite of numerical models (CALMET, CALPUFF, and CALPOST) that are used in series to determine the effect of emissions in the vicinity of a source or group of sources. Detailed three-dimensional meteorological fields are produced by the diagnostic computer model CALMET, based on inputs such as: surface, marine, and upper air meteorological data, digital land use data and terrain data, and prognostic meteorological data. The three-dimensional fields produced by CALMET are used by CALPUFF, a three-dimensional, multi-species, non-steady-state Gaussian puff dispersion model that can simulate the effects of time and space, varying meteorological conditions on pollutant transport. Finally, post-processing utilities CALSUM, POSTUTIL, and CALPOST were used to post-process and summarize the modelling output from CALPUFF.

CALMET Version 6.5.0 (Level 150223), an updated version of the United States Environmental Protection Agency approved CALMET Version 5.8.5 (Level 151214), was run to calculate meteorological fields for the modelled time period from January 1, 2015, through December 31, 2015. The CALMET modelling domain and grid resolution were chosen to encompass the main topographical features influencing the CALMET three-dimensional diagnostic meteorological fields.

Three-dimensional prognostic meteorological data from the Weather Research and Forecasting Nonhydrostatic Mesoscale Model (WRF-NMM) were used as the meteorological input into the CALMET model. WRF-NMM prognostic data used for this dispersion modelling analysis was from the provincial WRF dataset run by Exponent and provided as CALMET-ready for 2015 with 4 km grid resolution, encompassing the CALMET domain. Exponent ran WRF-NMM in “analysis mode”, using historical data snapshots from the National Centers for Environmental Prediction North American Mesoscale Model as initial and boundary conditions. This historical data includes all available observations, such as satellite, radar, balloon borne, surface, and tower observations.

Surface station meteorological data were not incorporated into CALMET as, despite regular inspection and maintenance, the surface meteorological data collected onsite contained significant data gaps related to instrument and datalogger errors and the harsh monitoring environment for meteorological parameters. In addition, given the complex terrain in the area, even if the surface station provided a more completed data record, the surface station influence would have to be limited by a small radius of influence of surface stations (R1) area in CALPUFF to restrict the influence of the station at inappropriate elevations. Thus, most of the mine footprint would likely fall outside the station influence and, therefore, CALMET was run using "NO-OBS" and using the provincial WRF dataset as input.

A 30 km x 20 km subset of the CALMET domain was used for the CALPUFF modelling to encompass the LSA and topographical features expected to limit the dispersion of air emissions from the Project. A nested receptor grid followed the spacing recommendations specified in the Guidelines for Air Quality Dispersion Modelling in British Columbia (MOE 2015):

- 20 metres (m) receptor spacing along the fenceline;
- 50 m spacing within 500 m of the fenceline;
- 250 m spacing within 2 km of the fenceline;
- 500 m spacing within 5 km of the fenceline; and
- 1000 m spacing beyond 5 km of the fenceline.

Although access to the Project will be limited to personnel, the Project will not be surrounded by a physical fence. For the purposes of Air Quality modelling, the "fenceline" was assumed to be a 500 m buffer around the Process Plant, TMF, and the portal areas. The buffer from the Access Road and Haul Road to the fenceline was assumed to be 50 m.

Emission source parameters were modelled in CALPUFF to predict the pollutant concentrations from the Project operations phase (Appendix 7-A). The predicted pollutant concentrations were added to the baseline (Section 7.4.4) and compared to the relevant ambient Air Quality objectives (Table 7.2-1) to assess the potential effect on Air Quality. Should the predicted pollutant concentrations exceed the ambient air quality objectives, an adaptive management and monitoring procedure, targeting those pollutants, will be developed, per the recommendations provided in the Air Quality and Dust Management Plan (Volume 5, Chapter 29).

7.5.2 Project Interactions

It is anticipated that the following proposed Project components or activities (Table 7.5-1) have the potential to affect Air Quality.

Table 7.5-1: Potential Air Quality Project Interactions

Project Component or Activity	Potential Interaction with Air Quality
Construction	
Construct Access/Haul Road from Hwy 37A to portal entrance	Dust and emissions generated by construction equipment and vehicles
Install powerline from substation tie-in to portal entrance	Dust and emissions generated by construction equipment and vehicles
Excavate and secure Lower Portal entrance and access tunnel	Dust and emissions generated by construction equipment and vehicles
Construct Mine Site water management infrastructure, including Talus Quarries and the Portal Collection Pond, dewatering systems, and water diversion, collection, and discharge ditches and swales	Dust and emissions generated by construction equipment and vehicles
Construct Explosives Magazine	Dust and emissions generated by construction equipment and vehicles
Construct other Mine Site ancillary buildings and facilities	Dust and emissions generated by construction equipment and vehicles
Initiate underground lateral development and cave gallery excavation	Dust and emissions generated by construction equipment and blasting
Temporarily stockpile ore at the Mine Site	Dust and emissions generated by construction equipment and vehicles and transfers to stockpiles
Transport to and deposit waste rock at the Waste Rock Storage Area (WRSA)	Dust and emissions generated by construction equipment and vehicles and transfers to stockpiles
Clear and prepare the TMF basin and Process Plant site pad	Dust and emissions generated by construction equipment and vehicles
Excavate rock and till from the TMF basin and local borrows/quarries for construction activities (e.g., dam construction for the TMF)	Dust and emissions generated by construction equipment and vehicles
Establish water management facilities including diversion ditches for the TMF and Process Plant	Dust and emissions generated by construction equipment and vehicles
Construct the TMF	Dust and emissions generated by construction equipment and vehicles
Construct the Process Plant and Run of Mine Stockpile	Dust and emissions generated by construction equipment and vehicles
Construct water treatment facilities and test facilities at Bromley Humps	Dust and emissions generated by construction equipment and vehicles
Construct Bromley Humps ancillary buildings and facilities	Dust and emissions generated by construction equipment and vehicles
Commence milling to ramp up to full production	Dust generated by material transfers, crushing and grinding

Project Component or Activity	Potential Interaction with Air Quality
Operation	
Use of Access Road for personnel transport, haulage, and delivery of goods	Dust and emissions generated by vehicles traveling on unpaved roads
Maintain Access Road and Haul Road, including grading and plowing as necessary	Dust and emissions generated by maintenance equipment and vehicles
Maintain Powerline right-of-way from substation tie-in to portal entrance, including brushing activities as necessary	Dust and emissions generated by maintenance equipment and vehicles
Continue underground lateral development, including dewatering	Dust and emissions generated by operations equipment and vehicles
Haul waste rock from the declines to the WRSA for disposal (waste rock transport and storage)	Dust and emissions generated by operation equipment, vehicles, and material transfers
Extract ore from the underground load-haul-dump and transport to Bromley Humps to the Run of Mine stockpile (ore transport and storage)	Dust and emissions generated by operation equipment, vehicles, and material transfers
Process ore to gold dore, including crushing and grinding circuit, stack emissions from the Process Plant, and operation of the TMF.	Dust and emissions from crushing/grinding circuit and process plant
Temporarily store hazardous substances, including fuel, explosives, and mine supplies	Dust and emissions generated by operation equipment and vehicles
Progressively reclaim disturbed areas no longer required for the Project	Dust and emissions generated by operation equipment and vehicles
Closure and Reclamation	
Use and maintain Access Road for personnel transport, haulage, and removal of decommissioned components until road is decommissioned and reclaimed	Dust and emissions generated by vehicles traveling on unpaved roads
Decommission underground infrastructure	Dust and emissions generated by equipment and vehicles
Decommission and reclaim Lower Portal area and powerline	Dust and emissions generated by vehicles traveling on unpaved roads
Decommission and Reclaim Haul Road	Dust and emissions generated by vehicles traveling on unpaved roads
Decommission and reclaim all remaining mine infrastructure (Mine Site and Bromley Humps, except TMF) in accordance with the Closure and Reclamation Chapter (Volume 2, Chapter 5)	Dust and emissions generated by vehicles traveling on unpaved roads
Construct the closure spillway	Dust and emissions generated by equipment and vehicles
Remove discharge water line and water treatment plant	Dust and emissions generated by vehicles traveling on unpaved roads

Project Component or Activity	Potential Interaction with Air Quality
Decommission and reclaim Access Road	Dust and emissions generated by vehicles traveling on unpaved roads

7.5.3 Discussion of Potential Effects

The two primary Project effects on the Air Quality IC are an increase in ambient criteria air contaminants and an increase in fugitive dust (i.e., dustfall). All air pollutant concentrations are predicted to remain below ambient air quality objectives (Table 7.5-2; Appendix 7-A). The maximum predicted pollutant concentrations detailed below were applied to the other VC pathways of effects, identified in Section 7.1, for consideration in those effects assessments. Similarly, maximum predicted pollutant concentrations at relevant receptors of interest to other VC pathways were also provided. In addition, the contour plots (Appendix 7-A, Section D) were provided to inform the spatial distribution of predicted pollutant concentrations for other VC pathways.

Table 7.5-2: Predicted Maximum Pollutant Concentrations and Dust Deposition Rates Compared with Ambient Air Quality Objectives

Pollutant	Averaging Period	Concentrations (µg/m³) and Dust Deposition Rate (mg/dm²/day)					
		Objective	Baseline	Maximum Predicted Concentration (Project)	% of Objective	Maximum Predicted Concentration (Project + Baseline)	% of Objective
NO_2	1-hour	188	21	166	88%	187	99%
	Annual	60	5.0	42	70%	47	79%
SO_2	1-hour	196	4.0	74	38%	78	40%
	Annual	13	2.0	4.5	34%	6.5	50%
CO	1-hour	14,300	100	505	3.5%	605	4.2%
	8-hour	5,500	100	371	6.7%	471	8.6%
$PM_{2.5}$	24-hour	25	1.3	17.3	69%	18.6	75%
	Annual	8	1.3	3.1	39%	4.4	55%
PM_{10}	24-hour	50	3.4	39.3	79%	42.7	85%
TSP	24-hour	120	10	81.3	68%	91.3	76%
	Annual	60	10	14.6	24%	24.6	41%
Total Dustfall	Annual	1.7	0.56	0.42	25%	0.98	34%
Wet Deposition	Annual	1.7	0.56	0.054	3.2%	0.61	33%
Dry Deposition	Annual	1.7	0.56	0.39	23%	0.95	34%

7.6 Mitigation Measures

7.6.1 Key Mitigation Approaches

Results from the review of best management practices, guidance documents, and mitigation measures conducted for similar projects, as well as professional judgment for the Project-specific effects and most suitable management measures, were considered in determining the mitigation measures. The approach to the identification of mitigation measures subscribed to the mitigation hierarchy, as described in the Environmental Mitigation Policy for British Columbia (http://www.env.gov.bc.ca/emop/).

Potential Project-related changes to Air Quality will be reduced through mitigation measures, management plans, and adaptive management. If mitigation measures were considered entirely effective, potential Project-related effects to the Air Quality IC were not identified as residual effects.

Specific mitigation measures were identified and compiled for each category of potential effect on Air Quality and presented in this section. For the purposes of this assessment, mitigation measures included any action or project design feature that will reduce or eliminate effects to Air Quality. Key approaches include:

- Design Mitigation;
- Best Available Technology (BAT); and
- Best Management Practices (BMPs).

Technical and economic feasibility constraints dictated the highest level on the hierarchy that could be achieved for each potential effect and the identification of mitigation measures for managing these effects.

Air Quality mitigation is targeted at reducing the direct release of emissions (from point or equipment sources) and the control of fugitive dust from mining and related activities. The majority of measures are relevant for the Construction, Operation, and Closure and Reclamation Phases of the Project and for all pollutants.

7.6.2 Environmental Management and Monitoring Plans

IDM will implement an Air Quality and Dust Management Plan (Volume 5, Chapter 29) to mitigate the potential Project-related effects on Air Quality.

7.6.3 Effectiveness of Mitigation Measures

The anticipated effectiveness of mitigation measures to minimize the potential for significant adverse effects is evaluated and classified as follows within this section:

- Low effectiveness: Proposed measure is experimental, or has not been applied in similar circumstances.

- Moderate effectiveness: Proposed measure has been successfully implemented, but perhaps not in a directly comparable situation.
- High effectiveness: Proposed measure has been successfully applied in similar situations.
- Unknown effectiveness: Proposed measure has unknown effectiveness because it has not been implemented elsewhere in a comparable project or environment.

The key measures proposed for mitigating potential effects on the Air Quality IC from increases in ambient criteria air contaminants and fugitive dust (i.e., dustfall), along with mitigation effectiveness and uncertainty are outlined in Table 7.6-1. This table also identifies the residual effects that will be carried forward for residual effects characterization and significance determination.

In general, mitigation measures have moderate (i.e., the effect is moderately changed) or high (i.e., the effect is practically eliminated) effectiveness ratings. The timing for the mitigation measures to become effective is immediate as these measures are part of the Project design, BAT or rely on avoidance or prevention of effect through BMPs or regulatory requirements.

The proposed mitigation measures include standard measures that are known to be effective (based on relevant/applicable experience with other mining projects), and therefore the uncertainty associated with their use is low. Any uncertainty associated with the effectiveness of the proposed mitigation measures will be addressed through the Air Quality and Dust Management Plan (Volume 5, Chapter 29). If dustfall monitoring indicates that effectiveness of mitigation measures is lower than predicted, further mitigation may be required as per adaptive management strategies outlined in the Air Quality and Dust Management Plan.

Table 7.6-1: Proposed Mitigation Measures and Their Effectiveness

VC/IC	Potential Effects	Mitigation Measures	Rationale	Applicable Phase(s)	Effectiveness[1]	Uncertainty[2]	Residual Effect
Air Quality	Increase in ambient criteria air contaminants	Road design and ore/waste transport plans have been optimized to minimize the distance travelled, which will reduce dust and emissions.	Reduces the direct release of ambient criteria air contaminants (from point or equipment sources).	Construction, Operation, Closure and Reclamation	High	Low	Yes
		Use of emission control measures on point source and crusher transfer point emissions (e.g., scrubbers, dust collectors)			Moderate	Low	
		Equipment will be properly maintained; mobile and stationary engines will have regular servicing to maintain efficiency.			Moderate	Low	
		Equipment will be turned off when not in use, where practical, to avoid unnecessary idling of motors (e.g., institute a no-idling policy for Project vehicles)			Moderate	Low	
		Use of vapour recovery units at fuel and chemical storage tanks will be implemented.			Moderate	Low	
		The ventilation systems for the underground mine will be designed to dilute and remove diesel emissions and blasting fumes, and will maintain compliance with BC mine regulations.			High	Low	
		Where practicable, select equipment with low emissions that meet latest applicable Canada emissions standards and guidelines			High	Low	
		The number of trips for ore and waste rock transport will be minimized, as much as possible, along the Haul Road.			High	Low	

VC/IC	Potential Effects	Mitigation Measures	Rationale	Applicable Phase(s)	Effectiveness[1]	Uncertainty[2]	Residual Effect
	Increase in fugitive dust	Road design and ore/waste transport plans have been optimized to minimize the distance travelled, which will reduce dust and emissions.	Reduces the release of fugitive dust.	Construction, Operation, Closure and Reclamation	High	Low	Yes
		Roads will be regularly maintained and kept in good repair.			Moderate	Low	
		Underground mining will result in significant reductions in Project emissions, such as from fuel burned during excavating, hauling waste rock, and blasting underground.			High	Low	
		The number of trips for ore and waste rock transport will be minimized along the Haul Road			High	Low	
		Vehicles will be driven at designated speeds on Project roads to limit dust generation			Moderate	Low	
		Stockpiles and storage areas will be designed and managed to minimize emission of dust.			Moderate	Low	
		Use of emission control measures on point source and crusher transfer point emissions (e.g., scrubbers, dust collectors)			Moderate	Low	

[1]Effectiveness: Low = measure unlikely to result in effect reduction; Moderate = measure has a proven track record of partially reducing effects; High = measure has documented success (e.g., industry standard; use in similar projects) in substantial effect reduction

[2]Uncertainty: Low = proposed measure has been successfully applied in similar; Moderate = proposed measure has been successfully implemented, but perhaps not in a directly comparable situation; High = situations proposed measure is experimental, or has not been applied in similar circumstances

7.7 Residual Effects Characterization

7.7.1 Summary of Residual Effects

The application of mitigation measures will reduce but not eliminate the Project-related effects on ambient criteria air contaminants and fugitive dust to below the modelled level (Table 7.5-2), levels that were already predicted to be below Air Quality objectives.

7.7.2 Methods

The characterization of the residual effect of increased air pollutant concentrations from the Project relies on the air dispersion modelling study and criteria summarized in this chapter. The complete air dispersion modelling assessment is provided in Appendix 7-A. The modelling study is used to inform the characterization of the residual effect on Air Quality in Table 7.7-2 below.

7.7.2.1 Residual Effects Criteria

Table 7.7-1: Characterization of Residual Effect an Increase in Air Pollutant Concentrations

Criteria	Characterization for Air Quality
Magnitude	In regards to Air Quality, the magnitude is determined by comparing predicted air pollutant concentrations to the established BC AAQOs. The magnitude of the effect is negligible, low, moderate, or high according to the following descriptions: • **Negligible (N)**: no detectable change from baseline conditions. • **Low (L)**: air pollutant concentrations are predicted to remain below the ambient air quality objectives. • **Moderate (M)**: air pollutant concentrations are predicted to be equal to or slightly above the ambient air quality objectives. • **High (H)**: air pollutant concentrations are significantly above the ambient air quality objectives.
Geographical Extent	• **Discrete (D):** effect is limited to the Project area within the modelled fenceline. • **Local (L):** effect is limited to the LSA, within the modelling domain, such that predicted air pollutant concentrations are at or near baseline conditions at the domain extents. • **Regional (R):** effect extends beyond the LSA and modelling domain, such that air pollutant concentrations from the Project emissions represent more than 10% of the ambient air quality objective at the domain extents. • **Beyond regional (BR):** effect extends well beyond the regional airshed.
Duration	• **Short term (ST):** effect lasts less than 18 months (during the Construction Phase of the Project). • **Long- term (LT):** effect lasts greater than 18 months and less than 22 years (encompassing Operation, Closure and Reclamation, and Post-Closure Phases). • **Permanent (P)**: effect lasts more than 22 years.

Criteria	Characterization for Air Quality
Frequency	• **One time (O)**: effect is confined to one discrete event. • **Sporadic (S)**: effect occurs rarely and at sporadic intervals. • **Regular (R)**: effect occurs on a regular basis. • **Continuous (C)**: effect occurs constantly.
Reversibility	• **Reversible (R)**: effect can be reversed. • **Partially reversible (PR)**: effect can be partially reversed. • **Irreversible (I)**: effect cannot be reversed, is of permanent duration.
Context	• **High (H)**: the receiving airshed, as measured by baseline air pollutant concentrations, are well below established BC AAQOs. • **Neutral (N)**: the receiving airshed, as measured by baseline air pollutant concentrations, are at or near the established BC AAQOs. • **Low (L)**: the receiving environment as measured by baseline air pollutant concentrations, is already above the established BC AAQOs.

7.7.2.2 Assessment of Likelihood

Likelihood refers to the probability of the predicted residual effect occurring and has been assessed based on the definitions and thresholds provided in Chapter 6.

7.7.3 Air Quality Residual Effects

The characterization of the residual effect of increased air pollutant concentrations from the Project relies on the air dispersion modelling study and criteria summarized in this chapter and in the detailed models (Appendix 7-A).

7.7.3.1 Characterization of Residual Effect

The residual effects to dust and criteria air contaminants can be characterized in the same manner (Table 7.7-2).

Table 7.7-2: Characterization of Residual Effect an Increase in Ambient Criteria Air Contaminants and Fugitive Dust

Criteria	Characterization for Air Quality
Magnitude	• **Low:** The effect on air pollutant concentrations will be low at receptors outside of the Mine Site and Access/Haul Road alignment. The predicted air pollutant concentrations remain below applicable objectives.
Geographical Extent	• **Local:** The effect on air pollutant concentrations will be restricted to the Mine Site and Access/Haul Road alignment, such that in much of the LSA the residual effect will be indistinguishable from baseline levels.

Criteria	Characterization for Air Quality
Duration	• **Long-Term:** Air emissions and dust will be produced at the Project site for the duration of the mining phases of construction, operations, and closure.
Frequency	• **Continuous:** Sources of air emissions and dust will operate on a regular basis.
Reversibility	• **Reversible:** Air pollutant concentrations would be anticipated to return to baseline levels following mine closure.
Context	• **High:** Baseline air quality is influenced by very few anthropogenic sources and air pollutant concentrations are well below ambient air quality objectives.

7.7.3.2 Likelihood

Residual effects on the Air Quality IC have a high likelihood of occurrence (i.e., the effects have an 80% chance of occurring).

7.7.3.3 Confidence and Risk

The dispersion modelling assessment was carried out in accordance with provincial recommendations and the Project Dispersion Modelling Plan. The estimation of emissions from Project sources use established protocols, but the confidence of these techniques, especially for fugitive dust emissions estimate, is not high. However, the regulatory modelling approach applies levels of conservatism in the simulation of predicted pollutant concentrations by establishing compliance with objectives based on maximum predicted concentrations. Proposed mitigation measures represent established best available technologies (BAT) and best management practices (BMPs) that have been proven effective in reducing air quality impacts. Given the approach applied in this assessment, there is High confidence in the conclusions of the assessment that pollutant concentrations outside the Mine Site and Access/Haul Road alignment will remain below ambient air quality objectives.

Table 7.7-3: Confidence Ratings and Definitions

Confidence Rating	Quantitative Threshold
High	There is a good understanding of the cause-effect relationship between the Project and a VC, and all necessary data are available to support the assessment. The effectiveness of the selected mitigation measures is moderate to high. There is a low degree of uncertainty associated with data inputs and/or modelling techniques, and variation from the predicted effect is expected to be low. Given the above, there is high confidence in the conclusions of the assessment.

Confidence Rating	Quantitative Threshold
Moderate	The cause-effect relationships between the Project and a VC are not fully understood (e.g., there are several unknown external variables or data for the Project area are incomplete). The effectiveness of mitigation measures may be moderate or high. Modelling predictions are relatively confident. Based on the above, there is a moderate confidence in the assessment conclusions
Low	Cause-effect relationships between the Project and a VC are poorly understood. There may be several unknown external variables and/or data for the Project area is incomplete. The effectiveness of the mitigation measures may not yet be proven. Modelling results may vary considerably given the data inputs. There is a high degree of uncertainty in the conclusions of the assessment.

7.7.4 Summary of Air Quality Residual Effects

Although the likelihood of residual effects on Air Quality is high, the remote location (coupled with the application of effective design standards, BATs and BMPs) will limit the magnitude and geographic extent of the residual effect (Table 7.7-4). In addition, predicted pollutant concentrations were all lower than the applicable ambient Air Quality objectives, and dustfall deposition rates were predicted to be lower than the historical provincial objectives.

Table 7.7-4: Summary of Air Quality Residual Effects

Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization Criteria *(Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Context)*	Likelihood *(High, Moderate, Low)*
Increased criteria air contaminants or fugitive dust	Construction Operation Closure and Reclamation	Design Mitigation, BAT, and Best Management Practices. See Table 7.6-1	The magnitude of the effect is predicted to be low (below objectives) and affect a local geographical extent within the LSA. The effect is anticipated to occur continuously throughout the Construction, Operation, and Closure and Reclamation Phases, and is reversible after mine closure, when it would be anticipated that levels would return to baseline levels for the remote location. Context is high.	High

7.8 Cumulative Effects

7.8.1 Review Residual Effects

The residual effect to Air Quality identified in the effects assessment is increased criteria air contaminants or fugitive dust.

7.8.2 Cumulative Effects Assessment Boundaries

7.8.2.1 Spatial Boundaries

Since Project predicted air pollutant concentrations generally disperse to baseline concentration levels at the extents of the Project modelling domain, the spatial boundaries of the Air Quality cumulative effects assessment have been set as the same spatial extents as the LSA and the Air Quality modelling domain.

7.8.2.2 Temporal Boundaries

The temporal boundaries for the Air Quality cumulative effects assessment include the Project Construction, Operation, and Closure and Reclamation Phases.

The threshold date for incorporating any new future developments in the cumulative effects assessment is 2029. This represents the final anticipated year of the mine life after the Closure and Reclamation Phase is complete.

7.8.3 Identifying Past, Present, or Reasonably Foreseeable Projects and/or Activities

Table 7.8-1 outlines the past, present, and reasonably foreseeable projects considered in the Air Quality cumulative effects assessment.

Table 7.8-1: List of Projects and Activities Included in the Air Quality Cumulative Effects Assessment

Project/Activity	Location	Proponent	Project Life
Stewart Bulk Terminals	Stewart	Stewart Bulk Terminals Ltd.	Currently Operating
Stewart World Port	Stewart	Stewart World Port	Currently Operating
Bitter Creek Hydro Project	Bitter Creek valley, 15 km northeast of Stewart	Bridge Power	Proposed

7.8.4 Potential Cumulative Effects and Mitigation Measures

7.8.4.1 Increased Criteria Air Contaminants or Fugitive Dust

The Stewart Bulk Terminals and Stewart World Port projects fall within the LSA and modelling domain used to assess the Project's effects on Air Quality. Although Stewart was included in the Project LSA, predicted air pollutant concentrations from Project sources will have no effect at or near the location of these two projects such that a cumulative effect would be anticipated to result in an increase in criteria air contaminants or fugitive dust. The physical barriers to airflow between the Bitter Creek valley and locations in Stewart means that the interaction with these projects will not result in cumulative effects to Air Quality. Additional mitigation measures are not required.

The Bitter Creek Hydro Project will be located in the same vicinity as the proposed Project. It is anticipated that the primary air emissions related to the Bitter Creek Hydro Project will be those resulting from construction activities, although there will be minor emissions associated with operations. A cumulative effect on Air Quality could occur if air contaminants or fugitive dust from both projects disperse in a manner to affect the same locations. During construction of the Bitter Creek Hydro Project, it is reasonable to assume that the emissions from construction will be mitigated using many of the same best management practices that will be used in the construction of the proposed Project. As such, the Bitter Creek Hydro Project is anticipated to produce air emissions that are minor, transient and temporary and it is not likely that Air Quality effects from the proposed Project and the Bitter Creek Hydro Project will result in cumulative effects to Air Quality. Additional mitigation measures are not required.

7.8.5 Cumulative Effects Interaction Matrix

Table 7.8-2 provides a cumulative effects interaction matrix that summarizes the potential cumulative interactions between the residual effect of the proposed Project on Air Quality and each past, current, and foreseeable future projects presented in Section 7.8.3.

Table 7.8-2: Interaction with Effects of other Past, Present, or Reasonably Foreseeable Future Projects and Activities

Air Quality Residual Effects	Current and Ongoing Projects and Activities		Future Projects and Activities
	Stewart Bulk Terminals	Stewart World Port	Bitter Creek Hydro Project
Increased criteria air contaminants or fugitive dust	N	N	Y

Notes:

Y = Yes, interaction exists between the residual effect of the Project and the other past, current, or future project/activity

N = No, interaction does not exist between the residual effect of the Project and the other past, current, or future project/activity

7.8.6 Cumulative Effects Characterization

7.8.6.1 Increased Criteria Air Contaminants or Fugitive Dust

No further dispersion modelling was conducted to evaluate the potential increase to air contaminants or fugitive dust as a result of the Project and the Bitter Creek Hydro Project. It is anticipated that the air emissions from the construction phase of the Bitter Creek Hydro Project will be minor, transient, temporary, and controlled using best management practices. As such, the cumulative effect from air emissions released from the construction phase of the Bitter Creek Hydro Project is not anticipated to materially increase the magnitude, geographic extent, duration, reversibility, or context of the predicted effect described for the Project. The frequency of the cumulative effect of both projects on a single receptor will be sporadic depending on the nature of the emissions from each Project and the dispersion of those emissions.

7.8.7 Summary of Cumulative Effects Assessment

Residual cumulative effects, characterization criteria, likelihood, and confidence evaluations are summarized in Table 7.8-3.

Table 7.8-3: Summary of Residual Cumulative Effects Assessment

Project Phase	IC	Residual Cumulative Effect	Characterization Criteria *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*
Construction Operation Closure and Reclamation	Air Quality	Increased criteria air contaminants or fugitive dust	The magnitude of the cumulative effect is predicted to be low (below objectives) and affect a local geographical extent within the LSA. The effect has the potential to occur throughout the duration of overlapping project schedules, but is reversible after the end of Project Closure and Reclamation when it would be anticipated that levels would return to baseline levels for the remote location. Context is high.	Moderate

7.9 Follow-up Program

The Air Quality and Dust Management Plan (Volume 5, Chapter 29) will include monitoring programs that will allow for real-time verification of the modelling results and the effectiveness of applied mitigation measures. These monitoring programs include:

- Passive air quality monitoring of NO_2, O_3, and SO_2;
- Dustfall monitoring of particulates, anions, cations, and total metals;
- Particulate monitoring of TSP and $PM_{2.5}$; and
- Meteorological monitoring.

7.10 Conclusion

The Project is anticipated to have low magnitude effects on Air Quality in the Bitter Creek valley. Although the likelihood of residual effects on Air Quality is high, the remote location (coupled with the application of effective design standards, BATs, and BMPs) will limit the magnitude and geographic extent of the residual effect. In addition, predicted pollutant concentrations are all lower than the applicable ambient Air Quality objectives, and dustfall deposition rates are predicted to be lower than the historical provincial objectives.

The Stewart Bulk Terminals, Stewart World Port, and proposed Bitter Creek Hydro Project have the potential to cumulatively interact with Air Quality in the identified LSA. The Project is not anticipated to affect Air Quality in Stewart therefore there will be no cumulative effects between the Project and Stewart Bulk Terminals or Stewart World Port. A cumulative effect on Air Quality could occur if air contaminants or fugitive dust from both the Project and the proposed Bitter Creek Hydro Project disperse in a manner to affect the same locations. However, both the Project and the Bitter Creek Hydro Project are anticipated to produce air emissions that are minor, transient, and temporary; therefore, it is not likely that Air Quality effects from the Project and the proposed Bitter Creek Hydro Project will result in cumulative effects to Air Quality.

As stated in the previous section, the Air Quality and Dust Management Plan (Volume 5, Chapter 29) will include monitoring programs that will allow for real-time verification of the modelling results and the effectiveness of applied mitigation measures.

This chapter is linked to the potential effects of the Project on other related ICs and VCs, including those identified and evaluated in the following chapters:

- Surface Water Quality (Volume 3, Chapter 13);
- Vegetation and Ecosystems (Volume 3, Chapter 15);
- Wildlife and Wildlife Habitat (Volume 3, Chapter 16);
- Aquatic Resources (Volume 3, Chapter 17);
- Fish and Fish Habitat (Volume 3, Chapter 18);
- Social (Volume 3, Chapter 20); and
- Human Health (Volume 3, Chapter 22).

7.11 References

AMEC, 2011. Kitsault Mine Project Environmental Assessment. Appendix 6.2-A Atmospheric Environmental Baseline Report.

MOE, 2015. Guidelines for Air Quality Dispersion Modelling in British Columbia. http://www.bcairquality.ca/pdf/bc-dispersion-modelling-guideline-2015.pdf.

Cirrus, 1998. Diavik Diamond Project – Environmental effects report, climate and air quality. Yellowknife, NT: Report prepared for Diavik Diamond Mines Inc. by Cirrus Consultants.

ERM, 2014. Brucejack Gold Mine Project: Application for Environmental Assessment Certificate. Prepared for Pretium Resources Inc. by ERM. Vancouver, BC. http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_document_395_37914.html

ERM. 2016. Kemess Underground Project: Application for Environmental Assessment Certificate. Prepared for Aurico Metals by ERM. Vancouver, BC.

Rescan, 2006. Galore Creek Project: Application for Environmental Assessment Certificate. Prepared for NovaGold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2012. KSM Project: Application for Environmental Assessment Certificate. Prepared for Seabridge Gold Inc. by Rescan Environmental Services Ltd.: Vancouver, BC http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_document_322_35961.html

Rescan, 2013. Galore Creek Project: 2012 Air Quality Baseline Report. Prepared for Galore Creek Mining Corporation by Rescan Environmental Services Ltd.: Vancouver, BC.