GOLDER
MEMBER OF WSP

REPORT

Air Quality Impact Assessment

Proposed Caledon Pit / Quarry

Submitted to:

CBM Aggregates (CBM), a Division of St Marys Cement Inc. (Canada)

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Submitted by:

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19129150

December 16, 2022

Distribution List

1 e-copy: CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

1 e-copy: Golder Associates Ltd.

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1.0 INTRODUCTION

CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) is applying to the Ministry of Natural Resources and Forestry (MNRF) for a Class A Licence (Pit and Quarry Below Water) and to the Town of Caledon for an Official Plan Amendment and Zoning By-law Amendment to permit a mineral aggregate operation. Golder Associated Ltd., a member of WSP (Golder), has been retained by CBM to complete an Air Quality Impact Assessment for the proposed CBM Caledon Pit / Quarry in accordance with the Terms of Reference developed in consultation with the Development Application Review Team (DART) found in Appendix A.

CBM owns / controls approximately 323 hectares of land located at the northwest, northeast and southwest intersection of Regional Road 24 (Charleston Sideroad) and Regional Road 136 (Main Street). Of these lands, approximately 262 hectares are proposed to be licenced under the Aggregate Resources Act and designated / zoned under the Planning Act to permit the proposed CBM Caledon Pit / Quarry. These lands are mapped as a Caledon High Potential Mineral Aggregate Resource Area (CHPMARA) in the Town of Caledon Official Plan and High Potential Mineral Aggregate Resource Area (HPMARA) in the Region of Peel Official Plan and are protected for their aggregate potential.

The remaining approximately 61 hectares of land owned / controlled by CBM are not subject to the application. These lands are referred to as “CBM Additional Lands” and these lands include approximately 36 hectares of land that is located adjacent to the minor urban centre of Cataract. As part of the application, CBM is proposing to create an upland forest and meadow grassland on these lands and is exploring the potential of conveying them permanently to a public authority for long term protection.

The lands proposed to be licenced under the Aggregate Resources Act are referred to as the “Subject Site” or “Site” and are legally described as Part of Lots 15-18, Concession 4 WSCR and Part of Lot 16, Concession 3 WSCR (former Geographic Township of Caledon). The Subject Site is approximately 262 hectares and extraction is proposed on approximately 204 hectares. These lands are referred to as the “Extraction Area”. The remaining approximate 58 hectares within the Subject Site and outside of the Extraction Area are referred to as the “Setback / Buffer Lands”. The Setback / Buffer Lands are used to provide setbacks to surrounding land uses and natural heritage features and the majority of these lands include a 5 metre visual / acoustic berm and visual plantings. For the purpose of this study, “Adjacent Lands” are defined as lands within 120 m of the Subject Site and the Study Area for this assessment includes lands within a 1,000 m of the Subject Site (section 6.1.2).

The proposed Extraction Area includes approximately 80 million tonnes of a high quality bedrock resource and approximately 5 million tonnes of a high quality sand and gravel resource. Testing has confirmed that the mineral aggregate resource found on-site is suitable for the production of a wide range of construction products, including the use for high performance concrete. The bedrock resource provides some of the strongest and most durable aggregate material in Southern Ontario. The primary market area for the proposed CBM Caledon Pit / Quarry is the Greater Toronto Area, including the Town of Caledon and the Region of Peel. This site represents a close to market source of a high quality mineral aggregate resource.

The proposed tonnage limit for the proposed CBM Caledon Pit / Quarry is 2.5 million tonnes per year and on average CBM anticipates shipping approximately 2.0 million tonnes per year. The proposed CBM Caledon Pit / Quarry is proposed to be operated in 7 phases. Phases 1, 2A, 3, 4, 5 are located to the northwest of the intersection of Regional Road 24 and 136. This area is referred to as the “Main Area”. Phase 2B is located to the northeast of the intersection of Regional Road 24 and 136. This area is referred to as the “North Area”. Phase 6 and 7 are located to the southwest of the intersection of Regional Road 24 and 136. This area is referred to as the “South Area”.

Operations would commence in the Main Area and Phase 1 would include the permanent processing area (crushing, screening and wash plant), aggregate recycling area and the entrance / exit for the proposed CBM Caledon Pit / Quarry. Until such time as sufficient space is opened up to establish the permanent processing area, a temporary mobile crushing and processing plant is proposed to be used in Phase 1. The entrance / exit for the CBM Caledon Pit / Quarry is proposed to be located onto Regional Road 24, approximately 775 m west of Regional Road 136. The entrance / exit is proposed to be controlled by a new traffic light and the installation of taper lanes and acceleration lanes on Regional Road 24 at CBM’s expense. The primary haul route for the proposed CBM Caledon Pit / Quarry is trucks will travel eastward on Regional Road 24 and then southward on Highway 10. The proposed haul route is an existing aggregate haul route and is designated as an aggregate haul route in the Town of Caledon Official Plan.

Access to the North Area for aggregate extraction is anticipated approximately 10 years after the start of the operations in the Main Area. There will be no processing in the North Area and aggregate extracted from the North Area is proposed to be transported to the Main Area through a proposed tunnel underneath Regional Road 136 or a truck crossing. Access to South Area is anticipated approximately 30 years after the start of the operations in the Main Area. In the South Area, CBM is proposing to permit a portable processing plant and the aggregate extracted and /or processed from the South Area is proposed to be moved to the Main Area through a proposed tunnel underneath Regional Road 24 or a truck crossing. Aside from the establishment of a 1 hectare stormwater settling pond on the easternmost portion of the North Area in the initial year of operation, the North and South areas will be maintained in their current state and agricultural uses until they are required for preparation for aggregate extraction.

The CBM Caledon Pit / Quarry is proposed to operate (extraction, processing and drilling) 7:00 am to 7:00 pm Monday to Saturday, excluding statutory holidays and shipping is proposed from 6:00 am to 7:00 pm Monday to Saturday consistent with other mineral aggregate operations in Caledon. CBM is also proposing to permit limited shipping in the nighttime (7:00 pm to 6:00 am) to support public authority contracts that require the delivery of aggregates during these hours to complete public infrastructure projects. These activities will be limited to only highway trucks and shipping loaders and no other operations will be permitted during nighttime hours. Site preparation and rehabilitation is proposed to be permitted 7:00 am to 7:00 pm Monday to Friday.

The proposed CBM Caledon Pit / Quarry involves stripping topsoil and overburden from the subject site to create perimeter berm and any excess soil will be temporarily stored in the northern portion of the Main Area or used for progressive rehabilitation of the site. The proposed Extraction Area includes extracting both sand and gravel below the water table and the site will be dewatered to allow operations in a dry state. The site will be extracted in sequence of the proposed phases (Phase 1 to 7) and following extraction of Phase 7 the permanent processing plant in Phase 1 will be removed and this will be the final area to be extracted and rehabilitated. The phasing of the proposed mineral aggregate operation has been designed to reach final extraction limits and depths within each phase so progressive rehabilitation of the side slopes can be completed.

The overall goal of the final rehabilitation plan is to create a landform that represents an ecological and visual enhancement and provides future opportunities for conservation, recreational, tourism and water management. Overall the progressive and final rehabilitation plan for the Subject Site includes the creation of lakes, vegetated shorelines, islands, wetlands, upland forested areas, riparian plantings adjacent to the existing watercourse, nodal shrub and tree planting on upland areas grassland meadows and specialized habitat features for bats and turtles.

The proposed rehabilitation has been designed to use of all of the on-site topsoil and overburden and does not require the importation of additional soils.

The Air Quality Impact Assessment assessed the proposed CBM Caledon Pit / Quarry and based on the implementation of the recommendations found in Section 10 of this report, this assessment concluded the following:

- The maximum off-site predicted cumulative air quality concentrations as a result of emissions from the Site are below the assessment criteria for all assessed contaminants;
- The results of this assessment are considered to be conservative as they consider maximum Site operations occurring at the same time as conditions that result in the 90th percentile of the existing air quality compounds. In reality there is a very low likelihood that these would occur simultaneously;
- The continued implementation of best management practices identified in the Site's Best Management Practices Plan (BMPP) can help to further control fugitive dust to reduce off-site effects.

The proposed Aggregate Resources Act Site Plans includes all of the technical recommendations from this report to ensure that the site operates in accordance with applicable provincial standards and the applicable policy requirements of the Provincial Policy Statement, Places To Grow Plan, Greenbelt Plan, Region of Peel Official Plan and Town of Caledon Official Plan.

1.1 Purpose

The preparation of a detailed air quality assessment is not typically required for a licence application; however, an air quality assessment is a requirement of the Provincial Policy Statement, 2020, under the Planning Act, Policy 2.5. Air quality is also anticipated to be a concern during the ARA application given that this is a greenfield application.

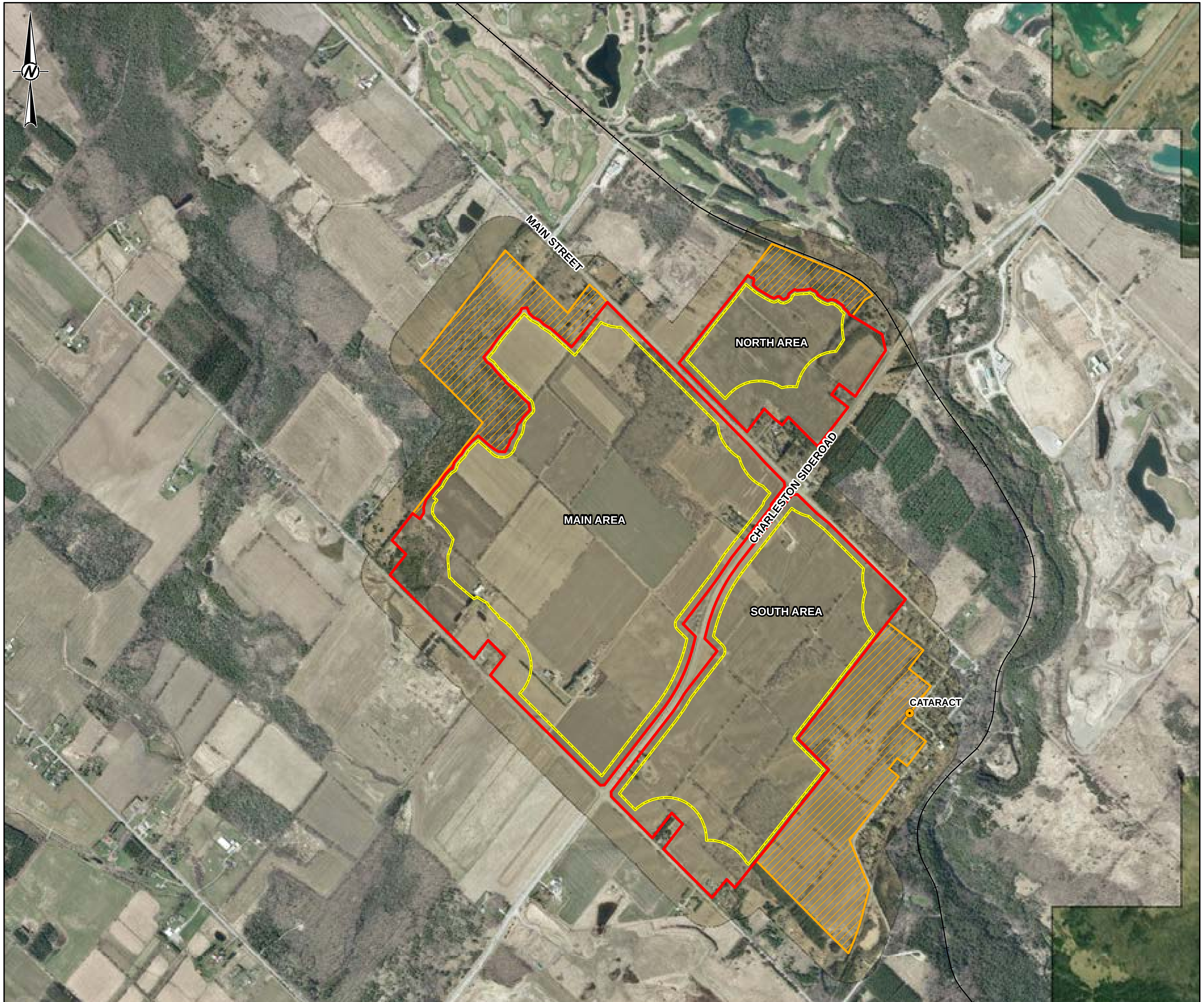
The air quality assessment has been completed to achieve the following:

- characterize the existing air quality in the surrounding area;
- estimate the emissions from future Site operations;
- predict the impact of the proposed Site on local air quality through dispersion modelling; and
- recommend best management practices to help mitigate the potential for fugitive dust generation.

For the purpose of this report, the following definitions are used:

Site (Figure 1 – Site Location Plan) - the total land area that will be licenced under the ARA. The site is approximately 262 hectares (ha) and is composed of three Site areas: Main Area, Northern Area and the Southern Area.

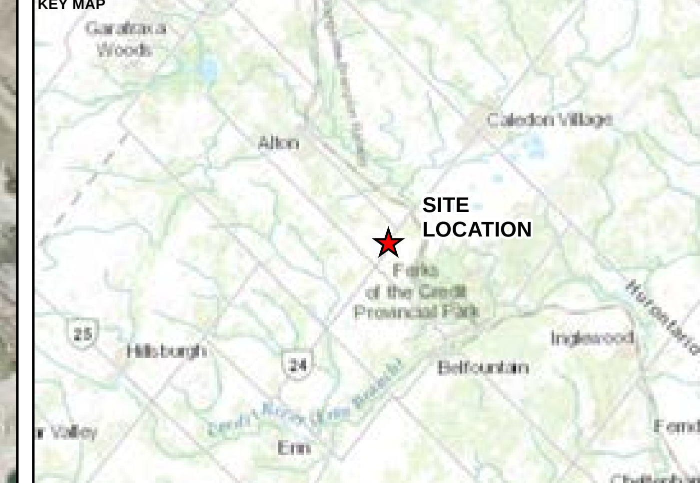
Extraction Area (Figure 1) – The total area within the site in which aggregate is proposed for extraction. The total combined area of the extraction area is approximately 204 ha.



LEGEND

- TOWN/VILLAGE
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY
- ADDITIONAL LANDS OWNED / CONTROLLED BY CBM

KEY MAP



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REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. SITE TOPOGRAPHIC DATA - SPRING 2021, FIRSTBASE SOLUTIONS, 2021
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

SITE LOCATION PLAN

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2022-12-12
DESIGNED	CGE
PREPARED	CGE
REVIEWED	SC
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
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2.0 DESCRIPTION OF PROPOSED DEVELOPMENT

The application is for a Class A Licence (Pit and Quarry Below Water) under the ARA. The intent is to extract, process and transport 2.5 million tonnes of aggregate annually from the site.

2.1 Extraction Plan

The proposed extraction at the Site will be undertaken in seven phases and involves the initial excavation in the Main Area and subsequently the advance of workings in a counter-clockwise direction. Works will progress to the Northern Area in the initial operation phases and the Southern Area towards the latter phases. Further detail of each operational phase is provided below. As part of the overburden removal, sand and gravel will also be extracted from the site.

- **Phase 1** – Operations will commence north of Charleston Sideroad and an entrance to the Main Area satisfying sightline and access spacing requirements will be installed. This entrance will be located on a designated haul route and may be signalised for additional safety.

  Topsoil and overburden will be stripped from the operational areas for access to the underlying aggregate resource.

  Controlled blasting will be undertaken to extract material from Site faces. Following each blast, it may also be necessary to break down the blast rock further using an excavator with a hydraulic rock breaking attachment. Rock form blast piles will then be transported to a temporary mobile crushing and processing plant. Processed materials will be stockpiled for off site transportation.

  A permanent processing facility will be installed north of Charleston Sideroad and adjacent to the entrance once workings have progressed to the final Site floor level in this area.

- **Phase 2A** – Extraction operations will continue in a counter-clockwise direction in the Main Area. Controlled blasting and hydraulic breaking of blast rock will be undertaken at each active face. Rock form blast piles will then be transported to the permanent processing facility north of Charleston Sideroad.
- **Phase 2B** – The Northern Area will be accessed with a tunnel under Main Street. Extraction activities will be the same as that carried out in the Main Area with the extracted materials being transported the permanent processing facility.
- **Phase 3, 4 and 5** – Extraction operations will continue in a counter-clockwise direction in the Main Area.
- **Phase 6** – The Southern Area will be accessed with a tunnel under Charleston Sideroad. Extraction operations will proceed southwards, and materials will be transported the permanent processing facility in the Main Area.
- **Phase 7** – Extraction operations will continue in a southward direction in the Southern Area and materials will be transported to the permanent processing facility in the Main Area.

In each phase, overburden and topsoil stripping, sand and gravel extraction activities will precede drilling, blasting and rock extraction activities.

2.2 Operating Schedule

Extraction and processing on site will be carried out between 07:00 and 19:00 hours. Off-site haulage (shipping) from the site will take place between 06:00 and 19:00 hours. Blasting will occur up to twice per week between the hours of 07:00 and 19:00 hours.

3.0 METHODOLOGY

3.1 Indicator Compounds

This air quality assessment focuses on predicting changes in the concentrations of Criteria Air Compounds (CACs). These compounds are generally indicative of air quality and are compounds for which relevant air quality criteria exist. The indicator compounds for Site activities fall into three categories:

- **particulate matter:** suspended particulate matter (SPM), particles nominally smaller than 10 µm in diameter (PM_{10}), and particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$);
- **crystalline silica:** as a fraction of PM_{10}; and
- **combustion gas:** nitrogen oxides [expressed as nitrogen dioxide (NO_2)].

In addition to the compounds listed above, ozone (O_3) was also quantified as it will be used to calculate NO_2 concentrations from the predicted nitrogen oxide (NO_X) concentrations. Ozone is not emitted directly into atmosphere but is associated with the reaction of NO_X (MECP 2021).

3.2 Applicable Guidelines

The relevant air quality criteria used for assessing the air quality effects of the Site include the Ontario criteria and federal standards and objectives where provincial guidelines are not available. The Ontario Ministry of the Environment, Conservation and Parks (MECP) has set guidelines related to ambient air concentrations which are summarized in the *Ambient Air Quality Criteria* (AAQC) document (MECP 2020). The Ontario AAQCs are characterized as desirable ambient air concentrations. They are not regulatory limits and are frequently exceeded at various locations across Ontario due to weather conditions and long-range transportation but represent an indicator of good air quality. The Ontario AAQCs are used for screening the air quality effects in environmental assessments, studies using ambient air monitoring data, and assessment of general air quality in a community or across the province (MECP 2020).

The Canadian Ambient Air Quality Standards (CAAQSs), formerly the National Ambient Air Quality Standards (NAAQS), have been developed under the *Canadian Environmental Protection Act* (CEPA) and include standards for $PM_{2.5}$ and ozone effective as of 2020, and standards for NO_2 to be implemented by 2025. Like the Ontario AAQCs, the CAAQSs are not regulatory limits and are used as national targets for $PM_{2.5}$, ozone and NO_2, excluding Quebec (CCME 2019). The CAAQSs are based on the long-term averages of measurement data not a short-term measurement value.

A summary of the applicable Ontario and federal standards as well as the final criteria that will be used for this assessment are listed in Table 1. Unless otherwise noted, for compounds that have both provincial and federal criteria, the lower of the two will be used for this assessment. For compounds with federal standards that are not currently in effect, the provincial criteria is also used when available.

Table 1: Ontario and Canadian Regulatory Air Quality Objectives and Criteria

Compound	Averaging Period	Ontario Ambient Air Quality Guidelines[a] (µg/m³)	Canadian Ambient Air Quality Standards[b] (µg/m³)	Assessment Criteria (µg/m³)
SPM[c]	24-Hour	120	—	120
	Annual	60[d]	—	60
PM_{10}	24-Hour	50[e]	—	50
$PM_{2.5}$	24-Hour	—	27[f][g]	27
	Annual	—	8.8[g]	8.8
Crystalline silica (<10 µm)	24-Hour	5	—	5
NO_2	1-Hour	400[h]	79 (42 ppb)[i]	400
	24-Hour	200[h]	—	200
	Annual	—	22.6 (12 ppb)[i]	22.6

Notes: µg/m³ = microgram per cubic metre

(a) MECP (2020)
(b) CAAQS published in the Canada Gazette Volume 147, No. 21 – May 25, 2013. Final standard phase in date of 2025 used, except where noted.
(c) SPM in Ontario is defined as Suspended Particulate Matter (<44 µm diameter)
(d) Geometric mean
(e) Interim AAQC and is provided as a guide for decision making (MECP 2020)
(f) 2020 target: Compliance is based on the annual 98th percentile of the daily monitored data averaged over three years of measurements.
(g) Phase in date for standard is 2020.
(h) Standard is for nitrogen oxides (NOx) but is based on the health effects of NO_2.
(i) Canadian ambient air quality standard for NO_2 is effective from 2025. Standards provided as parts per billion (ppb) were converted to µg/m³ using a reference temperature of 25°C and pressure of 1 atmosphere (atm). The 1-hour standard is based on the three-year average of the annual 98th percentile of the daily maximum 1-hour average concentration.

3.3 Assessment Scenarios

As described in Section 2.1, extraction will occur in several different phases and the location of material extraction will move over the lifetime of the Site. To identify the phases with the largest potential to impact air quality concentrations at neighbouring sensitive receptors, a screening assessment was completed. For the purposes of this assessment the above operational phases (Section 2.1) were set up as different air dispersion modelling scenarios based on the methodology described in the sections below. The three extraction phases with the highest predicted suspended particulate matter (SPM) concentrations were identified as having the largest potential to impact SPM concentrations and were therefore carried through into the assessment.

- Phase 3 Extraction;
- Phase 6 Extraction; and
- Phase 7 Extraction.

It was conservatively assumed that all material extracted is stone as this results in higher emission rates and additional blasting activities.

4.0 BACKGROUND AIR QUALITY

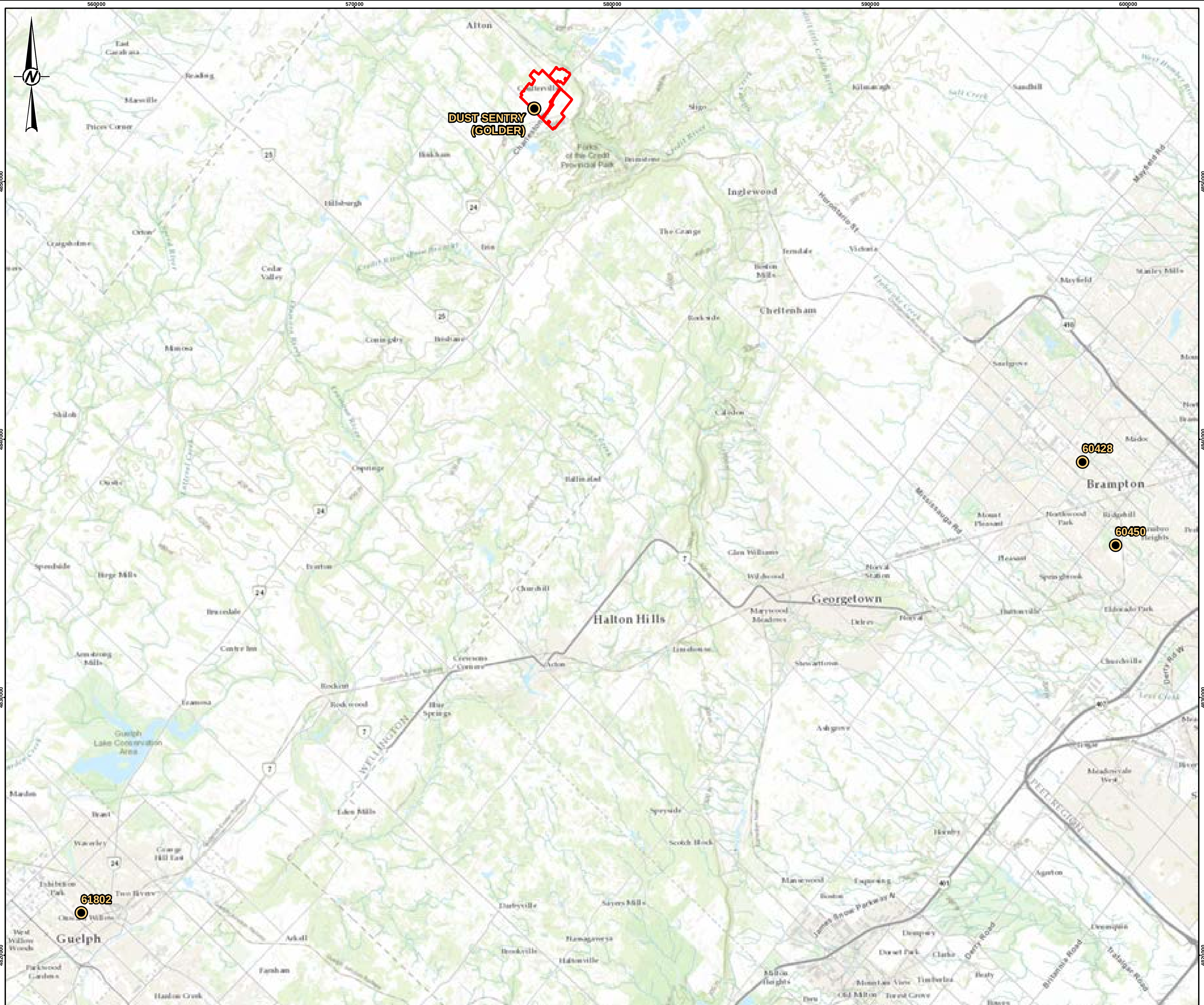
The background air quality in the area around the Site can be described by considering regional concentrations, based on publicly available monitoring data in the vicinity. The background air quality represents the existing conditions of air quality before the operation of the Site. Sources include industrial facilities, roadways, long range transboundary air pollution, small regional sources and large industrial sources. Background air quality can be described using concentrations based on local or regional monitoring stations and information on current activities and operations for neighbouring industrial sources.

4.1 Monitoring Data

4.1.1 Site-Specific Ambient Air Monitoring

An ambient air quality monitoring program was implemented at the Site beginning on October 7, 2021. Continuous monitoring of SPM, PM_{10} and $PM_{2.5}$ was carried out using an Aeroqual Dust Sentry Pro (Dust Sentry). The Dust Sentry is an instrument that delivers simultaneous measurements of the various particulate size fractions and reports real-time data in one-minute intervals.

The location for the Dust Sentry was selected with the aid of historical meteorological data from ECCC's Mono Centre station, which is the closest meteorological station to the Site with publicly available data. Predominant winds are westerly; therefore, the Dust Sentry was installed at the location illustrated on Figure 2, which is upwind of the Site. This location is set back from Mississauga Road and the farmhouse driveway, thus reducing the likelihood of the Dust Sentry capturing particulate matter generated by vehicle traffic. The selected location is also at least 50 m away from tall trees or farmhouse buildings, thus minimizing the influence of trees or building wakes on wind patterns around the Dust Sentry. As of the date of this report, one year's worth of SPM, PM_{10} and $PM_{2.5}$ data has been collected. A summary of the data collected to date is provided in Table 2, below.



LEGEND

AMBIENT AIR QUALITY MONITORING STATION

LICENCE BOUNDARY

Station	Address	NAPS Station ID	Latitude	Longitude
Brampton	525 Main St. N.	60428	43.698750	-79.780920
Brampton-2	109 McLaughlin Rd. S.	60450	43.669567	-79.765670
Exhibition Park Arena, Guelph	Exhibition Park & Clark St. W.	61802	43.545490	-80.264660
Dust Sentry (Golder)			43.824589	-80.042748

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REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
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4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

AMBIENT AIR QUALITY MONITORING STATIONS

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2022-12-07
DESIGNED	CGE
PREPARED	CGE
REVIEWED	SC
APPROVED	HM

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Table 2: Summary of On-Site Monitoring Data

Compound	Averaging Period	25th Percentile	50th Percentile	75th Percentile	90th Percentile	Maximum	Minimum
$PM_{2.5}$ (µg/m³)	1 hour	0.8	1.56	2.74	4.459	20.27	0.03
	24 hour	1.00	1.81	2.85	4.00	11.43	0.13
PM_{10} (µg/m³)	1 hour	1.29	2.4	4.09	6.12	45.49	0.05
	24 hour	1.65	2.76	4.00	5.58	13.73	0.21
SPM (µg/m³)	1 hour	1.47	2.74	4.66	7.11	55.64	0.05
	24 hour	1.94	3.16	4.56	6.26	14.36	0.23

4.1.2 Local Ambient Air Monitoring

Environment and Climate Change Canada (ECCC) operate the National Air Pollution Surveillance Network (NAPS) air quality monitoring stations (ECCC 2021) across the country. Monitoring stations are typically sited in locations where there are potential concerns about local air quality or in population centres, therefore there are no locations in the immediate vicinity of the Site and the closest stations to the Site are in Brampton and Guelph.

The relative locations of each of the air monitoring stations considered to describe the background air quality is summarized in Table 3 and presented on Figure 2 – Ambient Air Quality Monitoring Stations. Table 2 also includes the monitoring data that is available from each station for the 2014-2018 time period.

Table 3: Location of Air Monitoring Stations

Station	Address	NAPS Station ID	Latitude and Longitude	Distance to the Site (km)	Predominant Wind Direction	Monitoring Data Available
Brampton	525 Main St. N.	60428	43.69875, -79.78092	25	Westerly; generally downwind of the Site	$PM_{2.5}$, NO_2, NO, O_3
Brampton-2	109 McLaughlin Rd. S.	60450[(a)]	43.669567, -79.76567	28	Westerly; generally downwind of the Site	$PM_{2.5}$, NO_2, NO, O_3
Exhibition Park Arena, Guelph	Exhibition Park & Clark St. W.	61802	43.54549, -80.26466	36	Westerly, generally upwind	$PM_{2.5}$, NO_2, NO, O_3

(a) As of January 2017, station 60428 is inactive and replaced by Station 60450. The data from both stations was merged to form a complete dataset for the 2014-2018 period for this background air quality assessment.

The Brampton-2 station is a new station which began operating in 2017, replacing the Brampton station 60428. Data for 2014-2016 was obtained from 60428, while station 60450 was used for 2017-2018 data.

There are no monitoring data available for SPM and PM_{10}, however, an estimate of the SPM and PM_{10} concentrations can be calculated from the available $PM_{2.5}$ monitoring data. The mean levels of $PM_{2.5}$ in Canadian locations are found to be about 54% of the PM_{10} concentrations and about 30% of the SPM concentrations (Lall et. al. 2004). By applying this ratio, it was possible to estimate the SPM and PM_{10} concentrations for the monitoring stations.

The air flow into the Site is westerly. The closest air quality monitoring stations are the Brampton/Brampton-2 stations, which are generally downwind of the Site when winds are from the northwest, and crosswind to the Site when winds are from the west-southwest. As a result, the Brampton stations are expected to experience some similar wind patterns and impacts from transport of compounds into the city as the Project location.

All three stations are in suburban locations with more local sources of emissions than the Site including mixed residential, commercial and industrial land uses in the surrounding areas. As a result, they represent a conservative assessment of background air quality.

The 90th percentile of the 1-hour, 8-hour, and 24-hour measurements are typically used to represent the background air quality value when conducting an impact assessment as this value is exceeded only 10% of the time. The annual average concentration is used for annual background levels (Alberta Environment 2013) and based on the limited measurement data. 2014-2018 data collected for the three monitoring stations is provided in Table 4, below. Data for ozone is presented at 99th %ile only as these values are only used in the ozone limiting method calculations to estimate the amount of NOx as NO_2.

Table 4: Background Air Quality Values (90th Percentile, Average for Annual Only)

Indicator	Averaging Period	Brampton [µg/m³]	Guelph [µg/m³]
SPM	24-hour	46.94	45.42
	Annual	25.63	25.59
PM_{10}	24-hour	26.08	25.23
$PM_{2.5}$	24-hour	14.08	13.63
	Annual	7.69	7.68
NO_2	1-Hour	41.38	24.45
	24-Hour	35.10	22.31
	Annual	17.50	11.86
O_3 [a]	1-Hour	123.64	121.67
	24-Hour	97.96	91.79
	Annual	53.83	56.75

[a] O3 does not have an assessment criterion associated with it and the background O3 concentrations presented in the above table are only required for the Ozone Limiting Method (OLM) as described in section 6.4.1. The data presented for ozone represents the 99th Percentile, which was carried forward into the OLM calculations.

4.2 Industrial Emissions Sources

There are no industrial facilities that reported emissions of any indicator compounds to the National Pollutant Release Inventory (NPRI) in 2018 or 2019 located within a 5 km radius of the Site.

The following pits or quarries are located within a 1 km radius of the Site, based on a review of the MNRF Pits and Quarries Database. Distances are measured property line to property line:

- Town of Caledon Pit located approximately 500 m east of the North Area, behind the public works yard.
- Lafarge Caledon Pit located 750 m Northeast of the South Area.
- Lafarge Canada Limebeer Pit located approximately 930 m northeast of the North Pit.
- Lafarge Canada Lawford and Petch Pits located approximately 810 m northeast of the North Pit.

Of the four pits identified above, zero are located upwind of the Site and have not historically triggered emissions reporting to the NPRI. Typically, emissions from pits and quarries are considered low level fugitive sources with the maximum concentrations occurring close to the point of emission. The closest of these pits is the Town of Caledon Pit. This is a small operation located in the public works facility with no on-site processing of aggregate. The three Lafarge pits are much larger in extent; however, they are located further away from the Site with any processing equipment located over 1 km away from the Site boundary, based on a review of aerial imagery. In summary, given that all four pits are located downwind of the Site, and the surrounding receptors, with any processing activities over 1 km away, they were not considered further in the assessment am free.

4.3 Summary of Background Air Quality

Table 5 summarizes the background air quality in the area surrounding the Site, to be added to the dispersion modelling predictions as part of the air quality impacts assessment. The 90th percentile of the 1 hour, 8-hour, and 24-hour measurements are typically used to represent the background air quality value when conducting an impact assessment and the annual average concentration is used for annual background levels (Alberta Environment 2013) therefore Table 5 provides these values. Data for ozone is presented at 99th %ile only as these values are only used in the ozone limiting method calculations to estimate the amount of NOx as NO_2.

Based on a comparison of the on-site monitoring data and the local ECCC monitoring data, the ECCC data was carried forward into the assessment as it is based on a longer monitoring period (5 years) and provides a more conservative estimate of background air quality. The Brampton/Brampton-2 stations are the closest monitoring stations to the Site and are considered the most representative of the air quality surrounding the Site since they are generally downwind of the Site when winds are from the northwest, and crosswind to the Site when winds are from the west-southwest. Therefore, data from the Brampton/Brampton-2 stations has been used to represent the background for indicator compounds monitored by the stations. Existing crystalline silica concentrations were estimated as 6% of the background PM_{10} concentrations (US EPA 1996).

Table 5: Background Air Quality

Indicator	Averaging Period	Assessment Criteria (µg/m³)	Air Quality Concentration[(a)] (µg/m³)
SPM	24-hour	120	46.94
	Annual	60	25.63
PM_{10}	24-hour	50	26.08
$PM_{2.5}$[(b)]	24-hour	27	14.08
	Annual	8.8	7.69
Crystalline silica (<10 µm)[(c)]	24-Hour	5	2.82
NO_2	1-Hour	79/400	41.38
	24-Hour	200	35.10
	Annual	22.6	17.50
O_3[(d)]	1-Hour	—	123.64
	24-Hour	—	97.96
	Annual	—	53.83

(a) Background air quality concentrations from Brampton stations
(b) There are no monitoring data available for SPM and PM_{10}, however, an estimate of the SPM and PM_{10} concentrations can be calculated from the available $PM_{2.5}$ monitoring data. The mean levels of $PM_{2.5}$ in Canadian locations are found to be about 54% of the PM_{10} concentrations and about 30% of the SPM concentrations (Lall et al., 2004). By applying this ratio, it was possible to estimate the SPM and PM_{10} concentrations for the monitoring stations.
(c) Existing crystalline silica concentrations were estimated as 6% of the existing PM_{10} concentration (US EPA, 1996).
(d) Ozone data is presented at 99th percentile for 1-hour and 24-hour averaged concentrations.

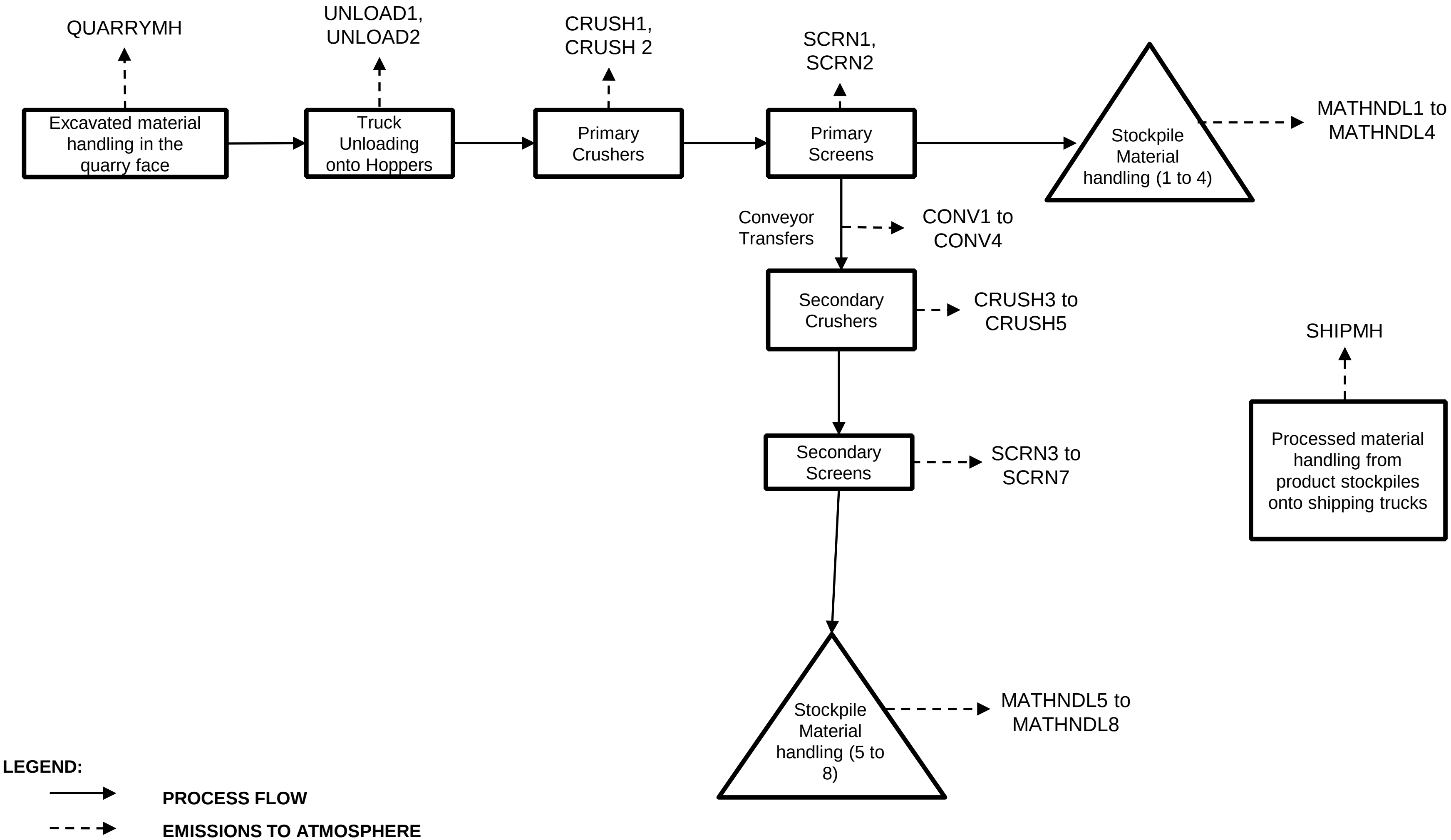
5.0 EMISSION RATE ESTIMATES

The Site will be used for the extraction of up to 2,500,000 tonnes of material per year. To extract the material, holes are drilled into the working area and filled with explosives. A maximum of two blasts will occur per week to extract material. A loader will transfer blasted aggregate from the working face into haul trucks, which will travel along the pit/quarry roads to the processing plant. Aggregate will be processed first through the crushing plant, with smaller sized material passing through to the wash plant. Finished materials will be stored in stockpiles before being hauled off-site for distribution.

Emission rate estimates will be calculated for each source using the methodologies provided below for each of the main emission sources at the Site. Detailed emission rate estimate calculations are provided in Appendix B. An example process flow diagram is provided in Figure 3.

Process Flow Diagram – Caledon Pit / Quarry Crushing Plant Layout

FIGURE 3



NOTES:

1. This schematic represents the major processes taking place at the Caledon Pit / Quarry Crushing plant for illustration purposes only. Simple processes such as maintenance, QA/QC procedures, backup operational procedures, have not been represented.

Date: December 2022

Project: 19129150

Golder Associates

Made By: SLC

Checked By: KSA

5.1 Drilling

Rock and stone are loosened by drilling and blasting the quarry face. Anywhere from 160 to 190 holes are drilled prior to each blast and a maximum of one blast occurs per day. It takes 47 working hours to drill the required number of holes (15 m depth per hole). Emissions are controlled by spraying water during drilling and a dust collection system on the drill rig. Drilling is expected to result in emissions of fugitive dust, consisting of SPM, PM_{10} and $PM_{2.5}$. Emission rates of particulate matter from drilling are based on emission factors obtained from the US EPA AP-42 Chapter 11.9 Western Surface Coal Mining (US EPA 1998).

In this methodology, drilling emission factors are only available for SPM. For the purpose of the assessment, an emission factor for PM_{10} was estimated from the SPM drilling factor based on the ratio between the SPM and PM_{10} emission factors for tertiary crushing (uncontrolled) from US EPA AP-42 Chapter 11.19.2 - Crushed Stone Processing and Pulverized Mineral Processing (US EPA 2004a). Similarly, an emission factor for $PM_{2.5}$ was estimated from SPM based on the ratio between the SPM and $PM_{2.5}$ emission factors for tertiary crushing (controlled) from US EPA (US EPA 2004a). Emissions of crystalline silica were estimated from PM_{10} using published data on the ratios of Crystalline Silica in PM_{10} (Richards et al, 2009). Emissions are controlled by dust controls equipped with a fabric filter, therefore a 99% control factor was applied to the calculations, as per the Australian Government National Pollutant Inventory Emission Estimation Technique Manual for Mining, Version 3.1, January 2012 (Australia NPI, 2012).

5.2 Blasting – Particulate

Rock and stone are loosened by blasting at the quarry using emulsion. Blasting activities will generate fugitive dust emissions, including SPM, PM_{10} and $PM_{2.5}$. An equation from US EPA AP-42 Chapter 11.9 Western Surface Coal Mining (US EPA 1998) was used to calculate the fugitive dust emissions associated with blasting activities.

As the blasting emission factor was only available for SPM; PM10 and PM2.5 emission factors were estimated using scaling factors ratios obtained from the US EPA Chapter 11.9 (US EPA 1998).

There will be at most one blast per day and the maximum horizontal area per blast will be 750 m2.

There are no emission control measures for blasting considered in the assessment. Emissions of crystalline silica were estimated from PM10 using published data on the ratio of Crystalline Silica less than 10 microns in diameter in PM10 (Richards et al, 2009), 14%.

5.3 Blasting – Combustion Gases

Blasting will result in emissions of combustion gases (NO_X) from the detonation of emulsion explosives-ammonium-nitrate and fuel oil (ANFO) blend explosives. 13,000 kg of explosives are used per blast with a ratio of 30% ANFO and 70% emulsion. Emission factors from the Australian Government National Pollutant Inventory document “Explosives Detonation and Firing Ranges 3.1, August 2016” (Australia NPI, 2016) were applied. The maximum diameter of the drilled holes at the Site will be no larger than 102 mm therefore, the emission factors for holes <150 mm were applied.

5.4 Material Handling

At the extraction face, loaders will be used to load blasted material into haul trucks, which will transport the aggregate to the crushing plant. Loaders will also be used to load processed aggregate from the stockpiles into shipping trucks. Similar drop operations will occur at the crushing plant where processed materials will drop from stacker conveyors onto stockpiles. Potential emissions from these drop operations include particulate matter because of the disturbance of material during handling.

Predictive emission factors for particulate emissions were developed using the drop operation equation from the US EPA AP 42 Section 13.2.4 Aggregate Handling and Storage Piles (US EPA 2006), which is dependent on wind speed.

A moisture content of 2.1% for various limestone products was obtained from Table 13.2.4.1 of the US EPA AP 42 (US EPA 2006) for material transfers of finished products. A moisture content of 4.8% was used for freshly extracted aggregate as this material is expected to have a high moisture content.

Since material handling emissions are based on wind speed, they were modelled using hourly emission rate files to account for both varying wind speed and time of day of operations. Therefore, an emission rate for every material handling source was calculated as presented above, for every hour between 7 am and 7 pm using the specific hourly wind speeds from the MECP pre-processed meteorological data. The emission rates of PM_{10}, $PM_{2.5}$, and crystalline silica were also estimated as presented above and for every hour in the meteorological data. Emissions of crystalline silica were estimated from PM_{10} using published data on the ratio of Crystalline Silica less than 10 microns in diameter in PM_{10} (Richards et al. 2009), 14%.

5.5 Processing Plant

Extracted material is hauled to the Processing Plant where it is crushed and passed through a screener to sort the various size fractions. Emission factors for SPM and PM_{10} were obtained from US EPA AP-42 Chapter 11.19.2 – Crushed Stone Processing, Table 11.19.2-1 (US EPA 2006). The equipment is fitted with spray bars, therefore controlled emission factors were used if available; if controlled emission factors are not available, a control efficiency was applied, where applicable.

Emissions of crystalline silica were estimated from PM_{10} using published data on the ratio of Crystalline Silica less than 10 microns in diameter in PM_{10} (Richards et al. 2009) for the relevant activity.

5.6 Diesel Combustion

Two generators (rated at 1650 kW each) meeting Tier 4 emission standards will be used to provide power to the portable crushing plant. In the absence of manufacturers specifications, crank case emission factors and load factors for non-road Engine Modelling (US EPA 2010) were used to calculate the exhaust emissions from these generators.

5.7 Stockpiles – Wind Erosion

Material will be stored in stockpiles after processing. The US EPA AP-42 emission factors from US EPA Control of Open Fugitive Dust Source (US EPA 1988) were used to calculate the fugitive dust emissions associated with the storage piles.

The emission rate calculated using this methodology is a function of wind speed, and assumes that there are no emissions generated when the wind speed is lower than 5.4 m/s (19.3 km/h). The percent of time the wind speed is greater than 5.4 m/s (22.33%) was obtained from the MECP pre-processed meteorological data (1996-2000) used for the dispersion modelling assessment.

A control efficiency of 70% was applied assuming that best practices for stockpiles will be adopted as part of the site's Fugitive Dust Best Management Practice Plan and based on a range of 50 % - 90% control efficiency as reported by different published literature. According to Western Regional Air Partnership Fugitive Dust Handbook, (WRAP, 2006), control efficiencies for control measures for materials handling application of water can lead to 90% control efficiency while the Australian Government National Pollutant Inventory Emission Estimation Technique Manual for Mining, Version 3.1, 2012 (Australian NPI, 2012) reported a control efficiency of 50% for water sprays on storage piles. Therefore, an average efficiency was taken (70%) and applied to the wind erosion emission calculations.

The emission rates of PM_{10} and $PM_{2.5}$ were calculated based on scaling factors provided in US EPA AP-42 Chapter 13.2.5 Industrial Wind Erosion Updated, 2006 (US EPA 2006).
Emissions of crystalline silica were estimated from PM_{10} using published data on the ratio of Crystalline Silica less than 10 microns in diameter in PM_{10} (Richards et al. 2009) for the relevant activity.

5.8 Vehicles – Unpaved Road Dust

Material will be transported between the working face and the processing plant by haul trucks and shipped offsite by shipping trucks. Roads within the Site will be unpaved. The predictive equation in US EPA AP 42 Chapter 13.2.2 – Unpaved Roads, 2006 (US EPA 2006) was used to calculate the fugitive dust emissions from unpaved roadways.

A 95% reduction of fugitive dust emissions (control efficiency) was used based on US EPA AP-42 Section 13.2.2, 2006 for implementation of a fugitive dust BMPP including intensive watering (ensuring the moisture ratio is 5 or greater where, the moisture ratio is defined as the surface moisture content of the watered road by the surface moisture content of the uncontrolled road). During freezing conditions, chemical dust suppressants will be applied instead of intensive watering.
Emissions of crystalline silica were estimated from PM_{10} using published data on the ratio of Crystalline Silica less than 10 microns in diameter in PM_{10} (Richards et al. 2009) for the relevant activity.

Table 6: Road Parameters by Scenario

Extraction Scenario	Source ID	Vehicle Type and Route	Distance Travelled (one-way) [km]	Number of trips per hour	Total distance travelled per hour for each vehicle type [VKT/hr]	Unloaded Vehicle Weight [tons]	Loaded Vehicle Weight [tons]	Mean Vehicle Weight [tons]
Phase 3	HAULTRK	Haul trucks travelling between pit/quarry and Processing Plant	0.8957	26	46	48	109	79
	QUARRYLD	Front end loaders at the pit/quarry face	0.1165	72	8	58	80	69
	SHIPLD	Shipping loaders	0.0779	52	4	87	117	102
	SHIPTRK	Shipping Trucks	0.3276	68	22	8	44	26
Phase 6	HAULTRK	Haul trucks at pit/quarry	0.3573	26	18	48	109	79
	QUARRYLD	Front end loaders at the pit/quarry face	0.0672	72	5	58	80	69
	SHIPLD	Shipping loaders	0.0779	52	4	87	117	102
	SHIPTRK	Shipping Trucks	0.3276	68	22	8	44	26
Phase 7	HAULTRK	Haul trucks at pit/quarry	0.7916	26	41	48	109	79
	QUARRYLD	Front end loaders at the pit/quarry face	0.0731	72	5	58	80	69
	SHIPLD	Shipping loaders	0.0779	52	4	87	117	102
	SHIPTRK	Shipping Trucks	0.3276	68	22	8	44	26

5.9 On Road Vehicles – Exhaust Emissions

Shipping trucks will operate at the Site to transport processed aggregate offsite to various customers. Emission rates for the vehicle exhaust from these shipping trucks were estimated using using the US EPA's MOVES model.

5.10 Non-Road Engines – Exhaust Emissions

Emission rates for heavy-duty off-road equipment were estimated using the US EPA NON-ROAD model. NON-ROAD uses the emission factors provided in documents published by US EPA (2010a, 2010b). Emission factors are not provided for PM_{10} and $PM_{2.5}$, therefore it was assumed that SPM emissions from vehicle exhaust consist of PM_{10} and that $PM_{2.5}$ emissions are 97% of PM10 emissions per US EPA 2010a.

The calculation method follows that of the US EPA NON-ROAD model for selecting the appropriate emission factor and load factors for heavy-duty equipment. Non-road vehicles and diesel engines at the Site will meet Tier 4 emission standards. Emission factors vary depending on the emission type, the equipment type, and the equipment make, model and year. The emission factors are found using the methods in Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression Ignition – Report No. NR 009d (US EPA 2010a). The load factor is determined by the type of equipment defined in Median Life, Annual Activity, and Load Factor Values for Non- Road Engine Emissions Modelling – Report No. NR-005d (US EPA 2010b).

5.11 Summary of Emissions

Table C1 in Appendix C summarizes the 1-hour and 24-hour averaged emission rates used in the Air Quality Assessment, in g/s, which were estimated for each activity as described above and in Appendix B.

6.0 DISPERSION MODELLING

The likely environmental effects for the air quality indicators were evaluated using the AERMOD air dispersion model developed by the United States Environmental Protection Agency (US EPA). AERMOD is recognized by federal and Ontario regulators as one of the regulatory dispersion models and is suitable to model pit and Site activities.

AERMOD consists of the model and two pre-processors; the AERMET meteorological pre-processor and the AERMAP terrain pre-processor. The following approved dispersion model and pre-processors were used in the assessment:

- AERMOD dispersion model (v. 19191); and
- AERMAP surface pre-processor (v. 18081).

AERMET was not used since pre-processed meteorological datasets were obtained from the MECP. Dispersion modelling was completed considering guidance from the MECP Guide "Air Dispersion Modelling Guideline for Ontario" (ADMGO) dated February 2017 (MECP 2017).

6.1 Model Inputs

To predict ambient air concentrations using AERMOD, a series of inputs are required that parameterize the sources of emissions as well as their transport. These inputs can be grouped into the categories listed below:

- Meteorological data;

- Terrain and receptors;
- Building downwash; and
- Emissions and model source configurations.

Each of these input categories are discussed separately in the following sections.

6.1.1 Meteorological Data

The MECP, as well as other agencies, recommends that five years of hourly data be used in the model to cover a wide range of potential meteorological conditions (MECP, 2017). In this assessment, the AERMOD model was run using a MECP pre-processed five-year dispersion meteorological dataset (i.e., surface and profile files), last updated in 2020, in accordance with paragraph 1 of s.13(1) of O.Reg.419/05. As the Site is located in the Central MECP Region – Halton-Peel, Toronto, York-Durham, the meteorological dataset for Central ("Toronto") Crops is used (MECP 2020). The data set covers the period of January 1996 to December 2000.

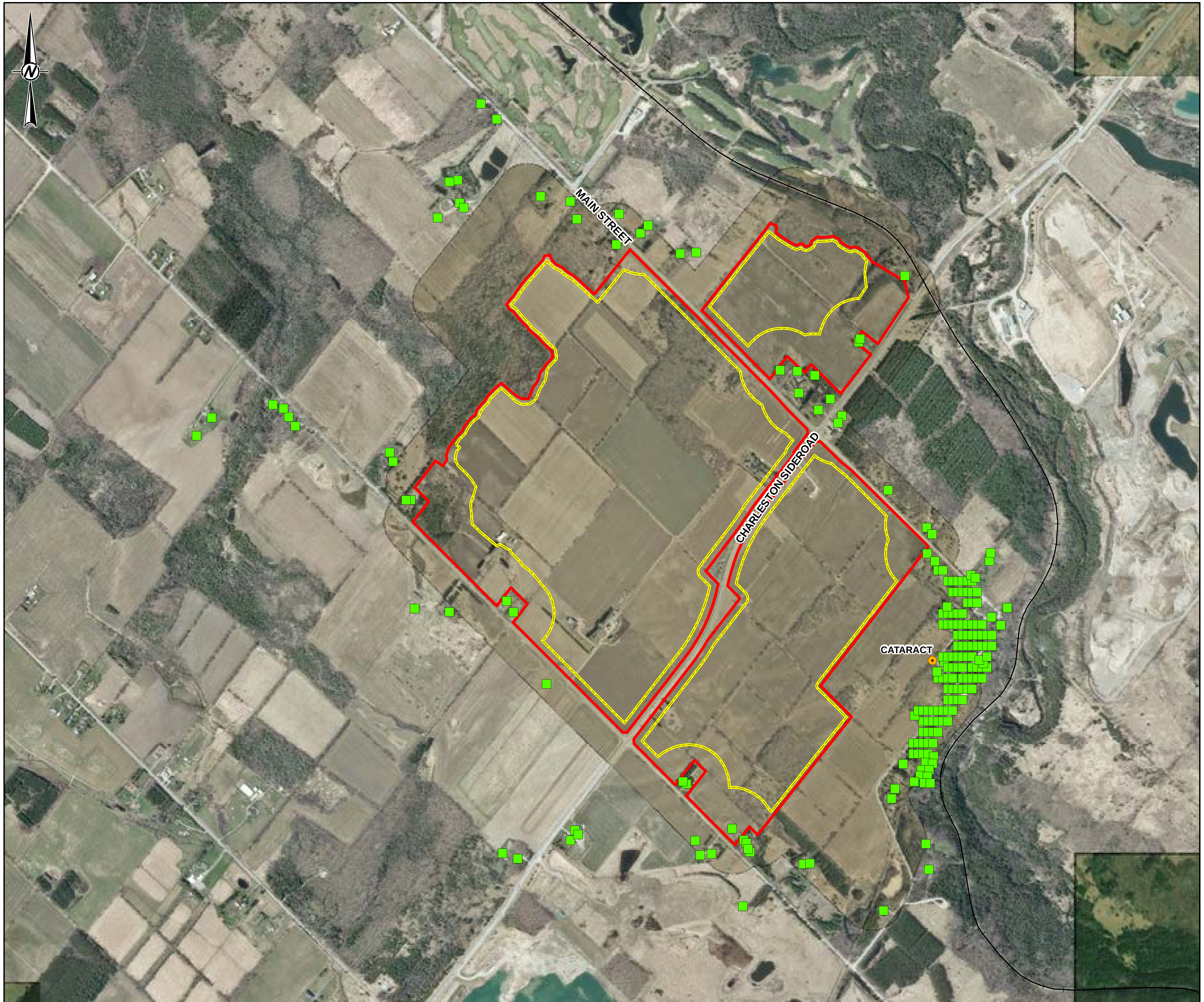
6.1.2 Terrain and Modelling Receptors

Terrain elevations have the potential to influence air quality concentrations at individual receptors, therefore surrounding terrain data is required when using regulatory dispersion models in both simple and complex terrain situations (US EPA 2004b). Digital terrain data is used in the AERMAP pre-processor to determine the base elevations of receptors, sources and buildings. AERMAP then searches the terrain height and location that has the greatest influence on dispersion for each receptor (US EPA 2004b). This is referred to as the hill height scale. The base elevation and hill height scale produced by AERMAP are directly inserted into the AERMOD input file.

Sensitive receptors were identified in the vicinity, within a 1000 m of the Site and a discrete receptor was placed directly at each nearest sensitive locations (residential private dwellings) at ground level. The area of modeling coverage and location of the sensitive receptors are illustrated in Figure 4 – Air Quality Dispersion Modelling Receptors.

6.1.2.1 Digital Terrain Data

Digital terrain data was obtained from the MECP (NED GeoTIFF format) (MECP 2020). The GeoTIFF files used in this assessment were cdem_dem_040P.tif. As many of the sources are to be located below grade, however, the elevation of these sources was corrected using information from the mining plan.



LEGEND

- TOWN/VILLAGE
- RECEPTOR LOCATION
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY

0 500 1,000

1:15,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. SITE TOPOGRAPHIC DATA - SPRING 2021, FIRSTBASE SOLUTIONS, 2021
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON PIT / QUARRY

TITLE
AIR QUALITY DISPERSION MODELLING RECEPTORS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-12-12
DESIGNED	CGE
PREPARED	CGE
REVIEWED	SC
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0037	0.0	4

6.1.3 Building Downwash

Building downwash was not considered in this assessment since sources are modelled as volume sources or area sources, to which building wake effects do not apply.

6.1.4 Emissions and Model Source Configurations

The emissions summarized in Table B1 were distributed into various model sources as described below and summarized in Table B2.

6.1.4.1 Volume Sources

Volume sources are used to model releases from a variety of industrial sources that cannot be classified as a being releases from a dedicated stack or from a large, fixed area, such as a pit or stockpile. The MECP has suggested that roads should be modelled as a series of individual volume sources creating a line that follows the road (MECP 2017). On-site roads were modelled using this volume source approach. The roads were divided into contiguous volume sources with release heights assumed to be half the plume height (plume height is calculated as 1.7 x vehicle height as per US EPA (2012)). Road widths varied depending on the route. The emission rate for the entire road segment was divided amongst the total volume sources for the entire segment.

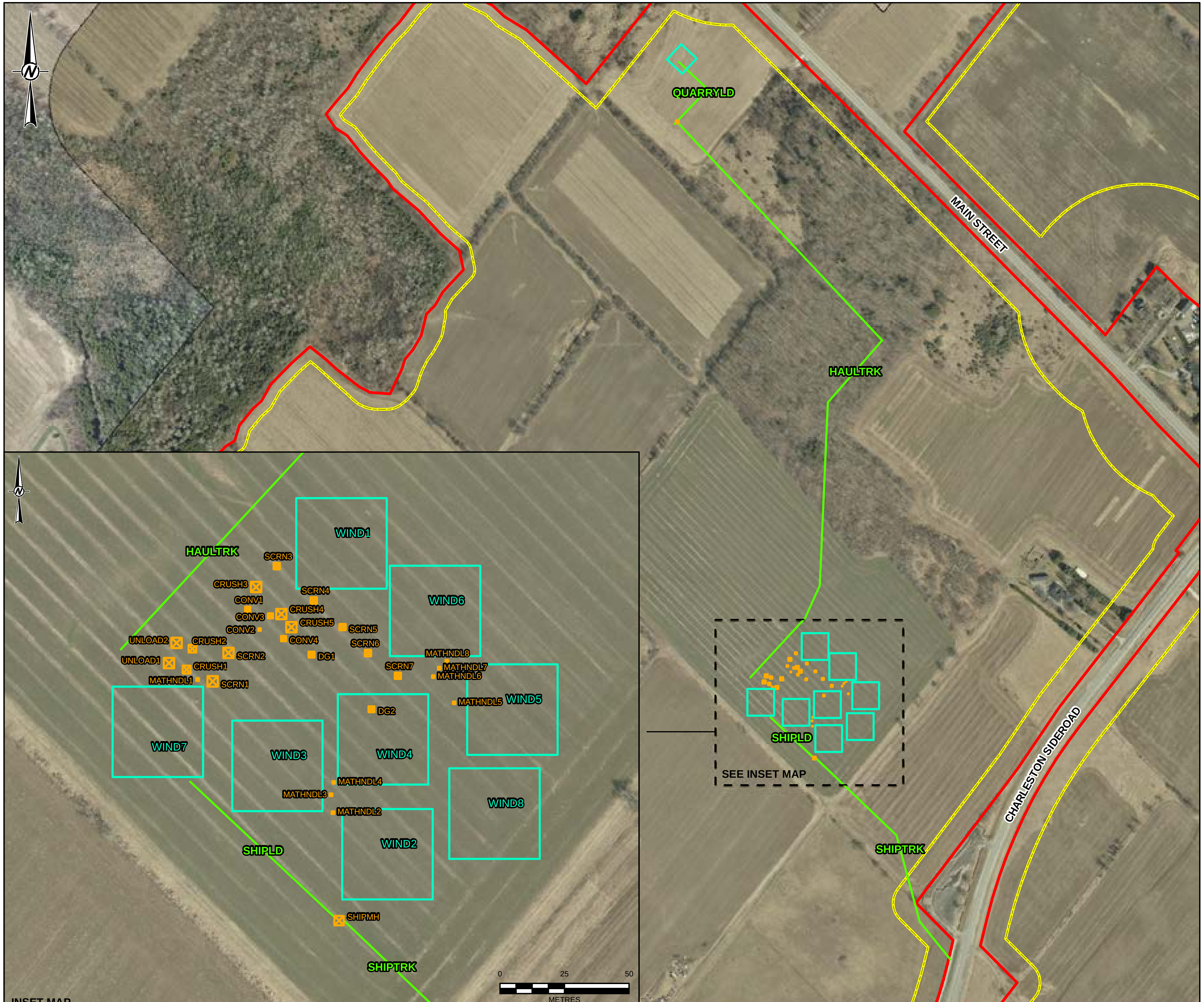
Line volume sources were also used to represent emissions from operations of loaders moving around the crushing plant, wash plant, and at the extraction face since these activities are not stationary. This approach accounts for the effects of turbulence from the loader movements on the loader exhaust and dust emissions. The volume source parameters for roads and moving loaders are summarized in Table C2 in Appendix C.

The emissions from the crushing plant, material handling activities and truck loading were modelled as volume sources. Separate volume sources were also used to model diesel combustion emissions from each of the diesel generators at the Site, since their exhaust stack information was not available. Emissions from blasting were also modelled as a volume source, with the release height representative of the centre of the blast. The source parameters for these individual volumes are also summarized in Table B2.

6.1.4.2 Area Sources

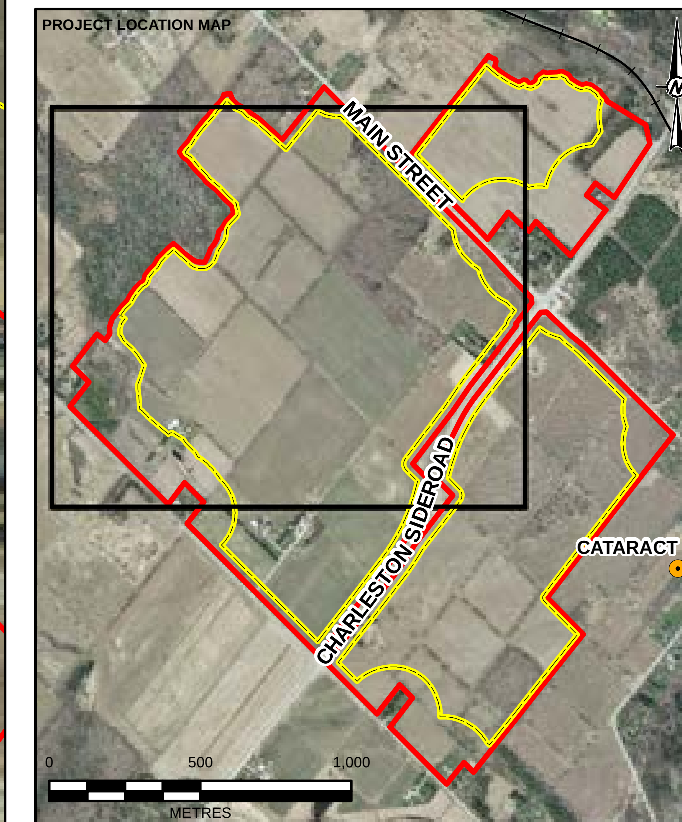
Area sources are used to model low level or ground releases of emissions to the atmosphere that are distributed over a fixed area. Emissions from wind erosion of stockpiles located in and around the crushing plant were modelled as rectangular area sources as per guidance from the National Stone, Sand & Gravel Association (NSSGA 2004).

Locations of the model sources are presented in Figure 5A to 5C – Dispersion Modelling Plans.



LEGEND

- TOWN/VILLAGE
- AIR SOURCES
- VOLUME SOURCES
- LINE VOLUME SOURCES
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY



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REFERENCE(S)

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3. SITE TOPOGRAPHIC DATA - SPRING 2021, FIRSTBASE SOLUTIONS, 2021
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

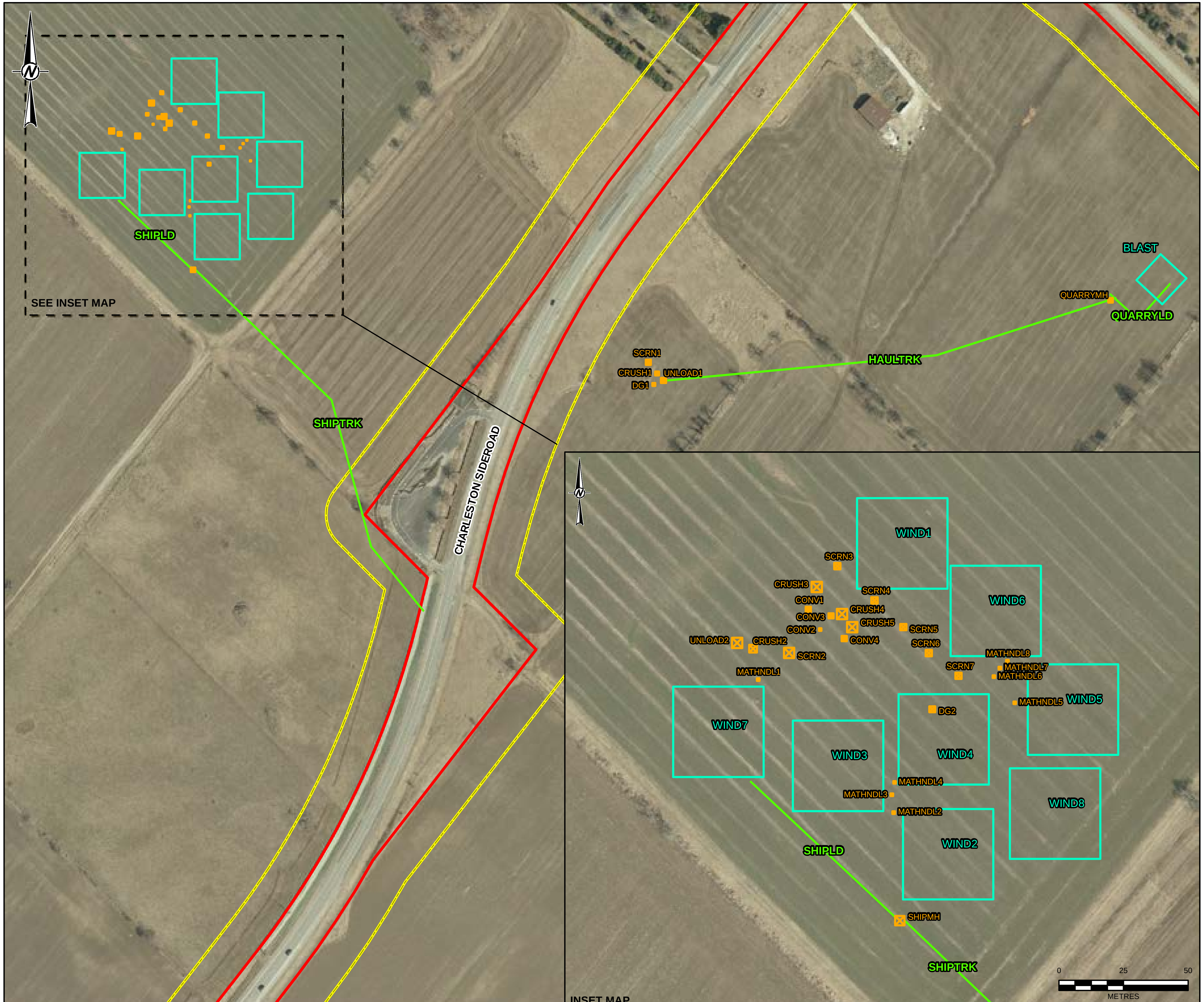
PROJECT
CALEDON PIT / QUARRY

TITLE
DISPERSION MODELLING PLAN (PHASE 3 EXTRACTION)

CONSULTANT
GOLDER
MEMBER OF WSP

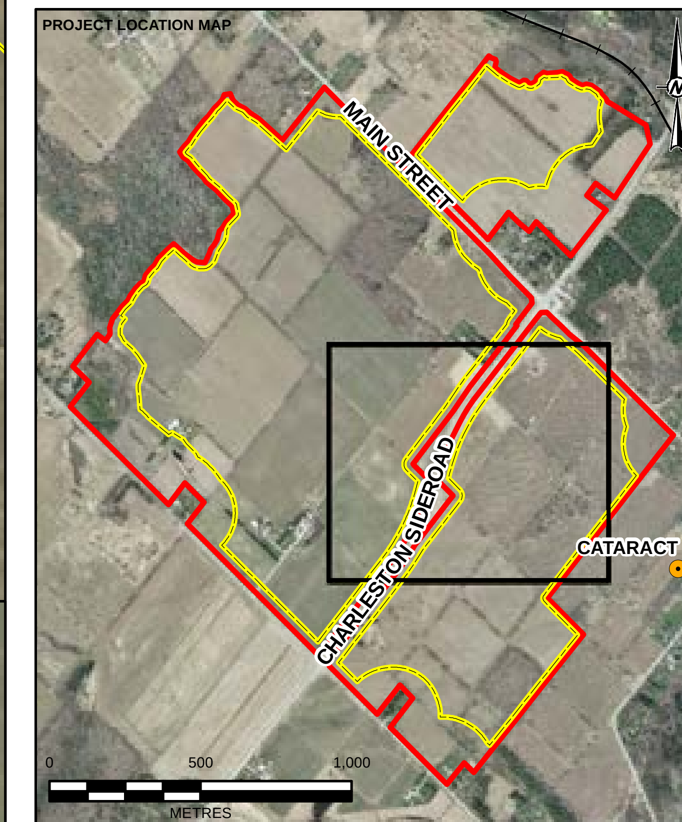
YYYY-MM-DD	2022-12-12
DESIGNED	CGE
PREPARED	CGE
REVIEWED	SC
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0037	0.0	5A



LEGEND

- TOWN/VILLAGE
- AIR SOURCES
- VOLUME SOURCES
- LINE VOLUME SOURCES
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY



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1:3,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. SITE TOPOGRAPHIC DATA - SPRING 2021, FIRSTBASE SOLUTIONS, 2021
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

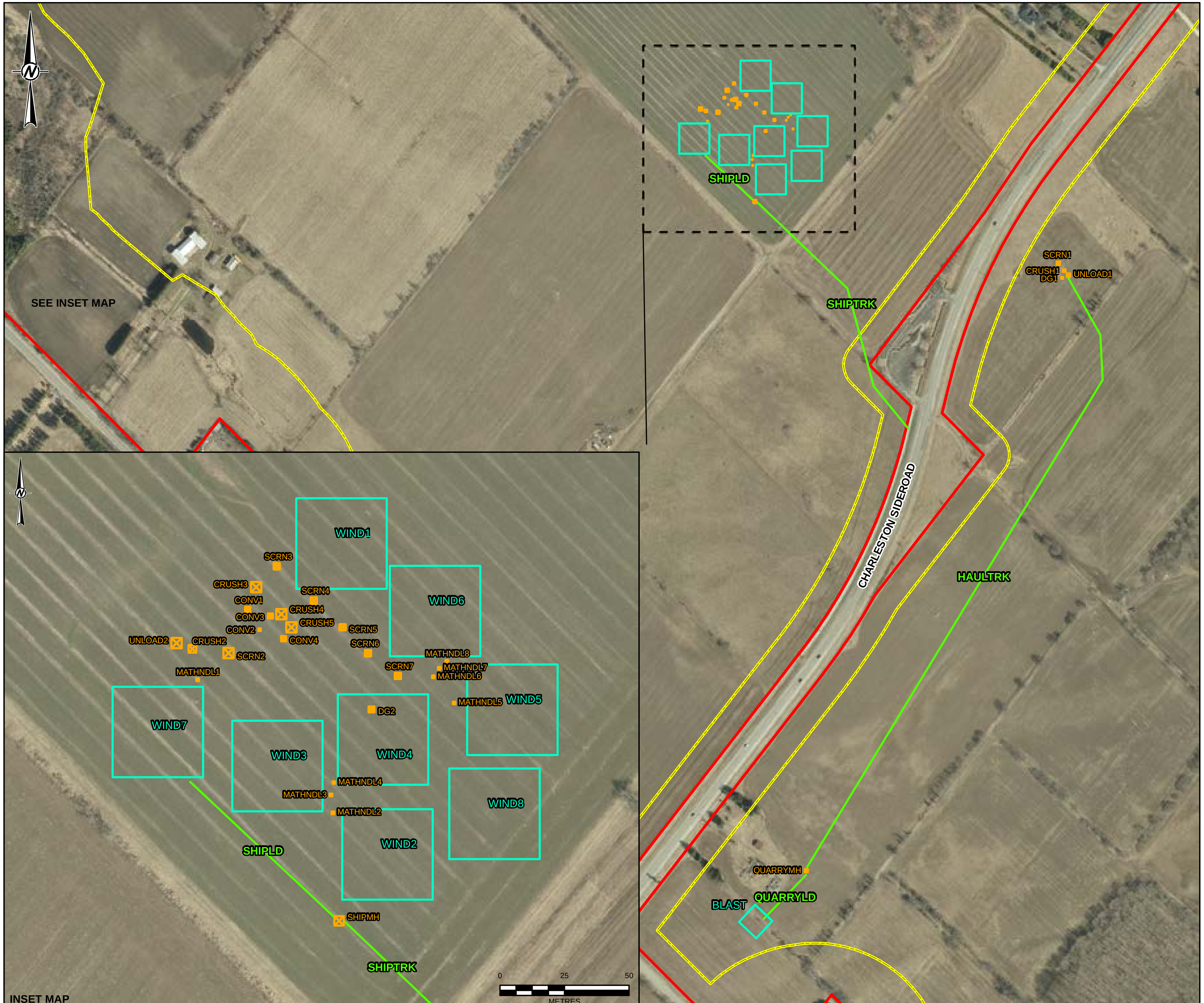
PROJECT
CALEDON PIT / QUARRY

TITLE
DISPERSION MODELLING PLAN (PHASE 6 EXTRACTION)

CONSULTANT
GOLDER
MEMBER OF WSP

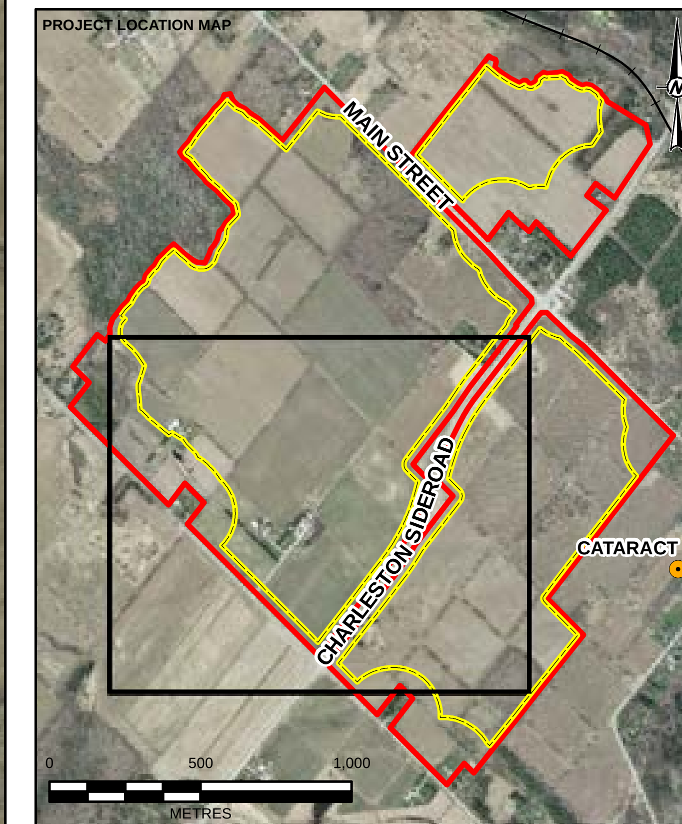
YYYY-MM-DD	2022-12-12
DESIGNED	CGE
PREPARED	CGE
REVIEWED	SC
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0037	0.0	5B



LEGEND

- TOWN/VILLAGE
- AIR SOURCES
- VOLUME SOURCES
- LINE VOLUME SOURCES
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY



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REFERENCE(S)
1. BASE DATA MNRF LIO OBTAINED 2020
2. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. SITE TOPOGRAPHIC DATA - SPRING 2021, FIRSTBASE SOLUTIONS, 2021
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON PIT / QUARRY

TITLE
DISPERSION MODELLING PLAN (PHASE 7 EXTRACTION)

CONSULTANT
GOLDER MEMBER OF WSP

YYYY-MM-DD	2022-12-12
DESIGNED	CGE
PREPARED	CGE
REVIEWED	SC
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0037	0.0	5C

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm

6.2 Summary of Model Options

The options used in the AERMOD model are summarized in Table 7.

Table 7: Options Used in the AERMOD Model

Modelling Parameter	Description	Used in Concentration Modelling?
DFAULT	Specifies that regulatory default options will be used.	Yes
CONC	Specifies that concentration values will be calculated.	Yes
OLM	Specifies that the non-default Ozone Limiting Method for NO_2 conversion will be used.	No - NO_2 is converted during post processing, as described in Section 6.4
DDEP (DRYDPLT)	Specifies that dry deposition will be calculated.	No - assessment is more conservative if this option is not selected
WDEP	Specifies that wet deposition will be calculated.	No - assessment is more conservative if this option is not selected
FLAT	Specifies that the non-default option of assuming flat terrain will be used.	No - the model will use elevated terrain as detailed in the AERMAP output.
NOSTD	Specifies that the non-default option of no stack-tip downwash will be used.	No
AVERTIME	Time averaging periods calculated.	1-hr, 24-hr, annual
URBANOPT	Allows the model to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions.	No
URBANROUGHNESS	Specifies the urban roughness length (m).	No
FLAGPOLE	Specifies that receptor heights above local ground level is allowed on the receptors.	No

6.3 Special Modelling Considerations

6.3.1 Variable Emissions Scenarios

Emissions from most of the activities at the Site will vary depending on the month and/or hour of day. These sources were modelled using the emission factor card for variable month, day of week and hour of day of operation as summarized in the Tables 8 to 10 below. To consider the full range of meteorological conditions, the Site activities were assumed to operate seven days per week.

Table 8: Variable emission rate scenario by hour-of-day

Hour-of-day	Factor	Sources
07:00 and 19:00	1	BLAST, DG1, DG2
19:00 and 07:00	0	

Table 9: Variable emission rate scenario by Month/Hour/Day (Production activities)

Month	Day	Hour-of-day	Factor	Sources
May to Aug	7 days a week	07:00 and 19:00	1	UNLOAD1-2, CRUSH1-4, MATHNDL1-8*, SCRN1-7, CONV1-4, HAULTRK, QUARRYLD*, QUARRYMH*, and WIND1-8 (Unloading, Crushing, Screening, Material handling, Onsite mobile equipment operating at the pit/quarry and crushing plant, and Wind erosion sources)
		19:00 and 07:00	0	
Sep to Nov Mar to Apr	7 days a week	07:00 and 19:00	0.7	
		19:00 and 07:00	0	
Dec to Feb	7 days a week	07:00 and 19:00	0.3	
		19:00 and 07:00	0	

*These sources were also varied based on the hourly wind speed; details provided in Section 6.3.2 below

Table 10: Variable emission rate scenario by Month/Hour/Day (Shipping activities)

Month	Day	Hour-of-day	Factor	Sources
May to Aug	7 days a week	06:00 and 19:00	1	SHIPTRK, SHIPLD, SHIPMH* (Shipping trucks and Shipping loaders sources)
		19:00 and 06:00	0	
Sep to Nov Mar to Apr	7 days a week	06:00 and 19:00	0.7	
		19:00 and 06:00	0	
Dec to Feb	7 days a week	06:00 and 19:00	0.3	
		19:00 and 06:00	0	

*This source was also varied based on the hourly wind speed; details provided in Section 6.3.2 below

6.3.2 Hourly Emission Rate Files

Emissions of SPM, PM_{10}, $PM_{2.5}$ and crystalline silica resulting from material handling activities were calculated using the drop operation equation obtained from the US EPA AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles, to consider varying wind speeds. As the material handling sources also vary by time of day and month of the year (sources MATHNDL1-8, QUARRYMH, SHIPMH), they were modelled using hourly emission rate files to account for all three variable parameters.

Emission rates for MATHNDL1-8 and QUARRYMH were calculated for every hour between 07:00 and 19:00 using the specific hourly wind speeds from the MECP's 5-year pre-processed meteorological data set for Toronto (crops). Emission rates were set to 0 for hours outside of 07:00 and 19:00in the meteorological dataset. Emission rates for SHPMH were calculated using the specific hourly wind speeds for every hour between 06:00 and 19:00 for all days and months of the year.

6.4 Post Processing

Most air quality concentration predictions are output directly from the model, however there are certain parameters, including conversion of NO_2 using existing regional ozone concentrations that require post processing. This post processing methods are described in the following sections.

6.4.1 Conversions of NO_x to NO_2

Emissions of oxides of nitrogen (NO_x) were used as inputs to the AERMOD model. Predictions of nitrogen dioxide (NO_2) can be calculated from modelled NO_x values using the Ozone Limiting Method (OLM). The OLM compares the maximum modelled NOx concentration to the background ozone concentration to assess the limiting factor to NO_2 (Cole et al. 1979). The following equations present the methodology:

If background $[O_3]$ >0.90 [NOx], total conversion: $[NO_2] = [NO_x]$

If background $[O_3]$ <0.90 [NOx], NO_2 is limited by O_3: $[NO_2] = [O_3] + 0.10\,[NO_x]$

Molecular weights (MW) used in the OLM:

- O_3 = 47.99 g/mol
- NO_X = 46.01 g/mol

For the air quality assessment, the background concentrations of O_3 used in the OLM are presented in Table 11.

Table 11: Ozone concentrations used in OLM

Averaging Period	Concentration of O_3 [µg/m3]
1-hour	123.64
24-hour	97.96
Annual	53.83

The NOx to NO_2 conversion calculation is described in detail in the table below with an example of conversion of the 1-hour modelled NOx to NO_2 for the Phase 3 Scenario:

Table 12: NOx to NO_2 Conversion Calculation

Modelled NOx POI (1-hour)		0.9NOx	0.1NOx	O_3 existing air concentration		O_3 > 0.9NOx?	NO_2 Estimated Concentration	
A	B = A × 24.45 × 0.001 ÷ MW of NOx	C = 0.9 × B	D = 0.1 × B	E = ECCC NAPs data	F = E × 24.45 × 0.001 ÷ MW of O3	F > C?	G = F + D	H = G × 0.0409 × MW of NO2 ÷ 0.001
µg/m3	ppm	ppm	ppm	µg/m3	ppm	ppm	ppm	µg/m3
256.39	0.14	0.12	0.01	123.64	0.06	No	0.08	144.14

6.5 Conservative Assumptions in Modelling Approach

Table 13 outlines the conservative assumptions in the modelling approach which results in an assessment that is not likely to under-predict the air quality associated with the Site.

Table 13: Conservative Assumptions in Modelling Approach

Area	Conservative Assumption
Operations were modelled to be occurring simultaneously	The modelling assessment considers all processes occurring simultaneously at the maximum rates of production **for each season**, rates that are reflective of the peak day **of each season** for the peak year in the life of the pit / quarry, and modelled those occurring every operating day over the 5 years. This is very unlikely to occur in practice.
Blasting Frequency	Although blasts will generally occur only twice per week, blasts were conservatively assumed to occur once per day in this assessment. This allows for the consideration of as many different meteorological conditions as possible for compounds with 1 hour averaging periods. This also results in conservative results for compounds with 24 hour and annual averaging periods.
Explosive usage	It was assumed that the same amount of explosive would be used in each blast. In reality, explosive usage varies and would likely be decreased as the extraction face approaches the Site property line and sensitive receptors. The termination point for the blasting operations will be governed by the results of the on-site blasting monitoring program.
Location of Working Area	For each phase assessed, the location of the working face was assumed to be located at the edge of the respective phase, at the location closest to sensitive receptors. In reality, extraction would only occur at this location for a limited window before moving to other locations within the respective phase.
Haul Truck Routes	For each phase assessed, the location of the haul routes was based on a working area located at the edge of the respective phase, at the location closest to sensitive receptors. This results in the longest distance between the working area and the processing plant, for each phase. In reality, extraction would only occur at this location for a limited window before moving to other locations within the respective phase, which would result in less distance travelled by the haul trucks, and consequently less emissions.
Particle deposition/removal processes	Dry deposition and Wet deposition (removal of particles from the atmosphere by precipitation) was not used in the assessment, which results in higher predicted concentrations.

It is assumed that the conservative emission rates, when combined with the conservative operating conditions and conservative dispersion modelling assumptions description herein, are not likely to under predict the modelled concentrations at each of the identified receptors.

7.0 IMPACT ASSESSMENT

To assess the overall local air quality effects of a given Site, the existing air quality must be combined with the maximum predicted concentrations from the proposed activities. The resulting air quality concentrations are referred to as the cumulative predicted concentration, which is compared to the relevant air quality assessment criteria.

The emissions from the Site were estimated for different extraction phases as described in Section 1. Cumulative concentrations were predicted for all three scenarios off-site and at sensitive receptors.

Table 14 to 16 summarizes the results of all three extraction phase scenarios. The maximum predicted concentrations as a result of emissions from the Site alone are below the relevant air quality assessment criteria at sensitive receptors. In addition, the maximum predicted cumulative concentrations as a result of emissions from the Site activities combined with the existing air quality are also below the relevant ambient air quality assessment criteria.

As discussed in Section 2.0 above, the existing air quality for this assessment was described using the 90^{th} percentile of monitoring data from stations located at considerable distances from the Site as there are no representative local monitoring stations close by. The predicted concentrations that result from the dispersion modelling assessment are also conservative because they take into consideration the worst-case meteorological conditions occurring at the same time as anticipated maximum Site operations. In reality, there is a very low likelihood that the worst-case meteorology, the maximum Site operations and the conditions that result in 90^{th} percentile of the existing air quality compounds occur simultaneously. As a result, the maximum predicted cumulative concentrations presented in this assessment are conservative.

Although some of the predicted concentrations are approaching the criteria, it is important to note that the provincial and federal assessment criteria that is used in this assessment are not regulatory limits and are frequently exceeded at various locations across Ontario due to weather conditions and long-range transportation. Instead of being used for a pass or fail compliance assessment, these criteria are to be used as benchmarks to facilitate air quality management on a regional scale and provide reference desirable levels for outdoor air quality.

Table 14: Phase 3 Extraction - Modelled and Cumulative Concentrations

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Existing Concentration % of Criteria	Sensitive Receptors			
					Maximum Predicted Concentration [µg/m³]	Predicted Concentration % of Criteria	Maximum Predicted Cumulative Concentration [µg/m³]	Predicted Cumulative Concentration % Criteria
SPM	24-Hour	120	46.94	39%	42.09	35%	89.04	74%
	Annual	60	25.63	43%	4.86	8%	30.50	51%
PM_{10}	24-Hour	50	26.08	52%	14.08	28%	40.16	80%
$PM_{2.5}$	24-Hour	27	14.08	52%	2.61	10%	16.69	62%
	Annual	8.8	7.69	87%	0.21	2%	7.90	90%
Crystalline Silica	24-hour	5	1.56	31%	1.88	38%	3.45	69%
NO_2	1-Hour	400	41.38	10%	144.14	36%	185.53	46%
	24-Hour	200	35.10	18%	28.73	14%	63.83	32%
	Annual	32	17.50	55%	2.22	7%	19.72	62%

Table 15: Phase 6 Extraction- Modelled and Cumulative Concentrations

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Existing Concentration % of Criteria	Sensitive Receptors			
					Maximum Predicted Concentration [µg/m³]	Predicted Concentration % of Criteria	Maximum Predicted Cumulative Concentration [µg/m³]	Predicted Cumulative Concentration % Criteria
SPM	24-Hour	120	46.94	39%	60.49	50%	107.43	90%
	Annual	60	25.63	43%	5.15	9%	30.78	51%
PM_{10}	24-Hour	50	26.08	52%	22.46	45%	48.54	97%
$PM_{2.5}$	24-Hour	27	14.08	52%	4.09	15%	18.18	67%
	Annual	8.8	7.69	87%	0.33	4%	8.02	91%
Crystalline Silica	24-hour	5	1.56	31%	2.75	55%	4.33	86%
NO_2	1-Hour	400	41.38	10%	190.71	48%	232.09	58%
	24-Hour	200	35.10	18%	105.55	53%	140.65	70%
	Annual	32	17.50	55%	4.70	15%	22.19	69%

Table 16: Phase 7 Extraction - Modelled and Cumulative Concentrations

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Existing Concentration % of Criteria	Sensitive Receptors			
					Maximum Predicted Concentration* [µg/m³]	Predicted Concentration % of Criteria	Maximum Predicted Cumulative Concentration [µg/m³]	Predicted Cumulative Concentration % Criteria
SPM	24-Hour	120	46.94	39%	62.09	54%	111.67	93%
	Annual	60	25.63	43%	5.97	10%	31.60	53%
PM_{10}	24-Hour	50	26.08	52%	21.32	44%	48.16	96%
$PM_{2.5}$	24-Hour	27	14.08	52%	2.79	10%	16.87	62%
	Annual	8.8	7.69	87%	0.22	3%	7.91	90%
Crystalline Silica	24-hour	5	1.56	31%	2.85	57%	4.42	88%
NO_2	1-Hour	400	41.38	10%	176.78	44%	218.16	55%
	24-Hour	200	35.10	18%	69.76	35%	104.86	52%
	Annual	32	17.50	55%	4.13	13%	21.63	68%

8.0 BEST MANAGEMENT PRACTICES PLAN (BMPP) FOR FUGITIVE DUST

The continued implementation of BMPP for the control of fugitive dust are recommended to assist with controlling emissions from the Site. As CBM is committed to minimizing the effects of fugitive dust off-site and at sensitive receptors, site specific BMPP has been developed for the Site submitted along with this Report. The BMPP outlines preventative and control measures to reduce the likelihood of high dust emissions from the Site. Inspections and monitoring procedures are also a part of the BMPP and will allow for continuous improvement of the fugitive dust practices. A copy of the fugitive dust BMPP is included in Appendix D.

9.0 CONCLUSIONS

The results of the conservative air quality impact assessment for the proposed Caledon Pit/Quarry conclude that:

- The maximum off-site predicted cumulative concentrations as a result of emissions from the Site are below the assessment criteria;
- With the implementation of the recommendations, concentrations of emissions from the Site are expected to be below the ambient air quality criteria at all surrounding sensitive land uses;
- The site has been designed to minimize and mitigate to acceptable levels any potential adverse effects from dust and other air pollutants in accordance with provincial guidelines, standards and procedures;
- Although some of the predicted concentrations are approaching the assessment criteria, it is important to note that the assessment criteria are not regulatory limits and are frequently exceeded at various locations across Ontario. Instead, they are to be used as screening criteria to represent an indicator of good air quality. In reality, there is a very low likelihood that the worst-case meteorology, the maximum Site operations and the conditions that result in the 90th percentile of the existing air quality compounds would occur simultaneously. As a result, the maximum predicted cumulative concentrations presented in this assessment are very conservative.
- The implementation of best management practices identified in the Site's BMPP will help to control fugitive dust to minimize impacts on surrounding sensitive land uses.

Copies of CVs for the authors of this document are provided in Appendix E.

10.0 TECHNICAL RECOMMENDATIONS

The results of the Air Quality Impact Assessment provide the basis for the following technical recommendations of guidelines and procedure to be followed during the extraction at the proposed Caledon Pit/Quarry:

- The Site shall operate in accordance with the Fugitive Dust Best Management Practices Plan (BMPP) dated December 2022. The BMPP shall be reviewed annually and updated if required based on current Site operations and new best management practices.

- Unpaved haul roads shall be watered using a water truck and/or dust suppressant. The application of water shall be dependent on weather conditions but should be designed to achieve a watering rate of at least 2 $L/m^2/hour$. Site personnel shall conduct daily visible inspections of visible dust from the onsite haul roads, which shall be used to inform additional watering activities if high opacity dust is reported. When temperatures fall below 4° C, a Ministry of Environment, Conservation and Parks chemical dust suppressant shall be used in place of water.
- Unpaved haul roads shall be re-graded annually (or as needed based on observations) using coarser material.
- A speed limit of 25 km/hour on all site roads shall be implemented.
- Stockpiles shall be placed below grade where possible with drop heights of less than 1 m maintained for fine material.
- The processing plant shall be equipped with a water spray system with the watering rate set to supress visible dust.
- The processing plant shall be located below grade as soon as feasible.
- Drills shall be equipped with dust suppression systems.
- If sustained winds exceed 40 km/hour, on-site processing activities, including drilling and blasting, shall cease and not resume until two consecutive hours of winds below 40 km/hour are recorded.
- A record of all visual inspections, dust mitigation activities and complaints shall be kept in the onsite filing system, as identified in the BMPP.

Signature Page

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https://golderassociates.sharepoint.com/sites/114392/project files/6 deliverables/ph 3200-air quality/final/air quality impact assessment-12.16.2022.docx

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APPENDIX A

Terms of Reference

GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE August 19, 2022 **Project No.** 19129150

TO David Hanratty, PGeo
CBM Aggregates

CC Jennifer Deleemans, Mike Lebreton

FROM Heather Melcher **EMAIL heather_melcher@golder.com**

PROPOSED CBM CALEDON QUARRY TERMS OF REFERENCE – AIR, NOISE AND BLASTING

Golder Associates Ltd. (Golder) has been retained by CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) to complete technical studies to accompany an application to the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) for a new Class A Quarry Below Water licence under the *Aggregate Resources Act* (ARA) (project). These studies will also be used for a Planning Act approval and application for Town of Caledon Official Plan and Zoning By-law amendment. Furthermore, these studies will provide an assessment of the application taking into consideration the applicable in-effect policies contained in the relevant Provincial Plans, Region of Peel Official Plan and Town of Caledon Official Plan. The properties to be licensed are located on Charleston Sideroad and Mississauga Road, Town of Caledon, Region of Peel, Ontario (site). The site is approximately 262.4 hectares (ha) in size (Figure 1).

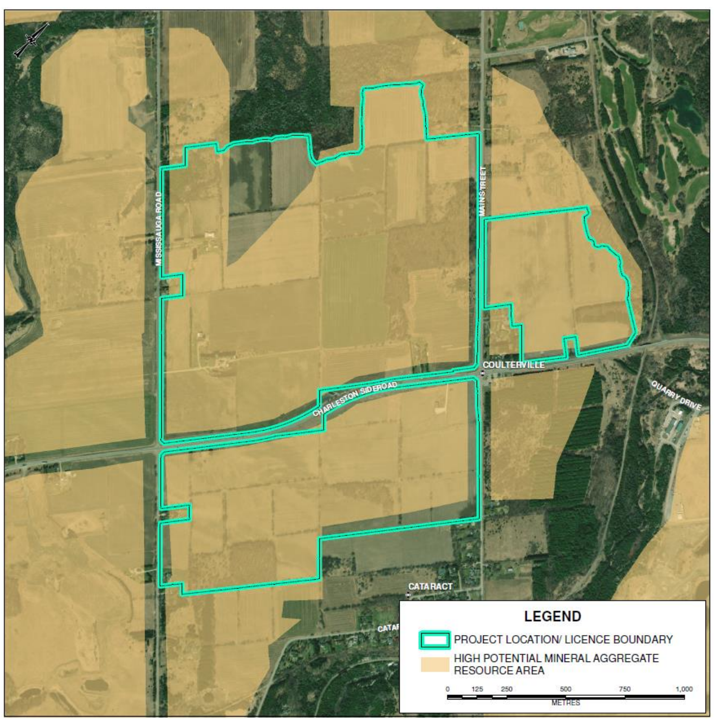

Figure 1: Proposed CBM Caledon Quarry Location

This Terms of Reference (TOR) includes a summary of the assessment and deliverables associated with the air quality, noise, and vibration/blasting components. Where relevant, this study shall be shared with other technical experts completing studies for the application to avoid internal inconsistencies.

1.0 AIR QUALITY

1.1 Air Quality Impact Assessment

As the ARA does not provide specific guidance and standards for air quality assessments, the preparation of a detailed air quality assessment is not typically required for a licence application. However, the preparation of an air quality assessment (including dust) is required per Sec 5.11.2.4.2 the Town of Caledon's Official Plan and will be required as part of the *Planning Act* application for the Project. The air quality assessment will include quantification of baseline air quality, specifically dust, in the vicinity of the site as well as numerical modelling of the proposed operations of the project to determine the change in air quality as well as comparison to provincial/federal standards, guidelines or regulations. This will be completed through four tasks, as described below.

1.1.1 Desktop Baseline Study

Golder will quantify the baseline or existing air quality in the vicinity of the site using publicly available ambient air monitoring data from Environment and Climate Change Canada (ECCC) National Air Pollution Surveillance (NAPS) system and/or information reported to the National Pollutant Release Inventory (NPRI) by facilities located close to the site. These data will be used to prepare a summary of existing local air quality. The locations of the closest NAPS monitoring stations that will be considered to describe background air quality data are located in Brampton (NAPS IDs 60428 and 60450), approximately 30 km southeast of the project and Guelph (NAPS ID 61802), approximately 35 km southwest of the project. Data will be collected for dust as well as products as combustion, including Nitrogen dioxide. These monitoring stations are the closest NAPS monitoring stations to the project but are located in more suburban environments. They are therefore expected to provide a conservative assessment of baseline air quality as they are surrounded by a greater density of residential and commercial emission sources.

1.1.2 Baseline Monitoring

Golder will organize and manage an ambient air quality monitoring program for dust (over a one-year period) to assess the baseline levels of particulate matter in the vicinity of the project prior to operations. There are no significant industrial sources of dust in the immediate area, therefore the station will be sited in a location that is predominantly upwind of the site to help understand the particulate concentrations that are being transported into the local area from long-range sources. Meteorological data taken from the closest Environment and Climate Change Canada meteorological station will be used to establish the prevailing wind direction and the location of closest sensitive receptors in the downwind direction will also reviewed to identify a potential siting area that was upwind of these locations. Consideration was also given to locating the station away from tall trees and buildings which may interfere with local wind flow, in accordance with MECP recommended protocol.

Golder will install one ambient dust continuous monitoring station at the site. Meteorological parameters will also be recorded. The dust monitoring program will include continuous monitoring of Total Suspended Particulate (TSP), Coarse Particulate Matter (PM_{10}), and Fine Particulate Matter ($PM_{2.5}$). The monitoring station will be equipped with an Aeroqual Dust Sentry Pro (Dust Sentry Pro) that measures dust and fine particulates (TSP, PM_{10}, and $PM_{2.5}$) continuously in real-time.

The Dust Sentry Pro is an instrument that delivers simultaneous measurements of dust particulates and reports real-time data in one-minute intervals. Meteorological conditions will also be monitored. The monitoring of meteorological conditions will be completed with a Vaisala WXT536 Weather Transmitter connected directly to the Dust Sentry Pro.

The baseline monitoring data will be used to supplement the data collected from publicly available sources, identified in Section 1.1.1. A comparison of data from all three stations will be provided.

1.1.3 Predictive Modelling

Predictive impacts on air quality from the proposed operations require an estimate of the emissions released into the atmosphere as well as representative local meteorology. Impacts are predicted using an approved regulatory atmospheric dispersion model to provide estimates of contaminant concentrations at various receptors around the project. These estimates will be combined with baseline data to provide a cumulative impact of the operations which can be compared to various regulatory standards, guidelines, and objectives. Generally, air quality modelling results are compared to provincial and/or federal Ambient Air Quality Criteria.

Golder will prepare emission estimates of indicator compounds during project operations. This includes consideration of the 1-hour, 24-hour, and annual operating scenarios that the project may be subject to. The relevant indicator compounds will include the following:

- Carbon monoxide (CO)
- Nitrogen oxides, expressed as nitrogen dioxide (NO_2)
- Suspended particulate matter[1] (SPM)
- PM_{10}
- $PM_{2.5}$
- Respirable Crystalline Silica.

The emission estimates for all indicator compounds will be used to complete atmospheric dispersion modelling for the following scenarios:

- Effects of the project operations only.
- Cumulative effects of the project in addition to baseline ambient air quality.

Modelling will be used to estimate predicted concentrations at sensitive receptor locations within 1 km of the proposed licence area. All dispersion modelling will be completed using the US EPA AERMOD dispersion model and carried out in accordance with the Ministry of the Environment, Conservation and Parks (MECP) "*Air*

[1] SPM can also be referred to as total suspended particulate or TSP

Dispersion Modelling Guideline for Ontario – Version 3.0" dated March 2017. Golder will use a 5-year hourly meteorological data set from the MECP.

1.1.4 Impact Assessment and Reporting

Time-averaged concentrations of all indicator compounds will be predicted at identified sensitive receptors with results compared to provincial and/or federal ambient air quality standards, guidelines and/or criteria. If necessary, Golder will identify proposed mitigation measures to reduce the potential for nuisance as a result of the project. The results of the air quality impact assessment will be documented in a report. The report will provide a detailed description of the methodology and results including the calculations and modelling.

1.2 Fugitive Dust Best Management Practices Plan and Follow Up Monitoring

Golder will use the results of the air quality impact assessment and recommended mitigation measures to prepare a comprehensive fugitive dust Best Management Practices plan (BMPP). The BMPP will document CBM's commitment to control the fugitive dust emissions from being carried beyond the limits of the site. The BMPP will give consideration to the following:

- Identification of the main sources of fugitive dust emissions.
- Identification of potential causes for high dust emissions and opacity from these sources.
- Description of preventative and control measures in place or under development to minimize the likelihood of high dust emissions and opacity from the sources of fugitive dust identified above.
- Implementation schedule for the BMPP.
- Inspection and maintenance procedures and monitoring initiatives to allow effective implementation of the preventative and control measures.

The need and frequency for monitoring recommendations will be reviewed as part of the air quality assessment.

2.0 NOISE

A noise impact assessment will be completed in accordance with applicable NDMNRF and MECP requirements to identify potential noise levels from the project onto sensitive Point(s) of Reception (POR(s)) in the vicinity of the site. Based on a review of available information, it is expected existing or potential (i.e., vacant lots) POR(s) exist within 500 metres (m), in all cardinal directions of the proposed licence area. For completeness noise contour modelling results will also be provided extending 1 km beyond the proposed licence area. The noise impact assessment will be completed through the tasks described below.

2.1 Site Reconnaissance and Establishment of Existing Conditions (Baseline Noise Monitoring Program)

Golder will complete a site reconnaissance field program to review the site surroundings and to complete a ground-based review of PORs. Golder will also gather noise data to document existing noise levels in the vicinity of PORs that could be impacted by the proposed project.

Based on an initial review of publicly available imagery of the site and surrounding environment, it is expected the POR(s) in the vicinity of the site are in an area defined by the MECP as either Class 2 or Class 3 (Rural). This will be confirmed by the site reconnaissance. Documented levels will be compared against any previous noise studies completed for other lands in the area, if available.

In establishing existing conditions Golder will complete a noise monitoring program where existing baseline noise levels will be documented through unattended noise monitoring at four locations, generally in four cardinal directions of the main proposed processing plant location, to establish representative noise levels at PORs located in the vicinity of the site. The monitoring will be completed over a period of approximately one week.

2.2 Predictive Modelling and Impact Assessment

Golder will complete noise prediction modelling based on proposed operational information provided by CBM. Golder will also use available information, including Golder's database of similar noise sources, manufacturer's sound level data (to be provided by CBM, if required) and data gathered from operations at an existing CBM site (i.e., CBM's Osprey Quarry) using similar equipment to predict the off-site noise levels at the identified sensitive POR(s) using the International Standard "*Acoustics – Attenuation of Sound During Propagation Outdoors"* (i.e., ISO 9613 part 2) as required by the NDMNRF and MECP.

Through a review of publicly readily available information, if it is determined that an identified POR could also be directly impacted (through noise) from other aggregate operations in the area, a semi-quantitative cumulative noise impact assessment will be completed. If detailed modelling results or modelling files are available for the other aggregate operations a detailed quantitative study will be completed. If detailed modelling results or modelling files are not available for the other aggregate operations, the assessment will be limited to a semi-quantitative assessment. In accordance with accepted practices and guidance provided by the MECP, the haul-route analysis will consider the potential noise impacts of the project through a review of noise levels along the haul-route with and without the project. This will be completed through a high-level quantitative haul-route analysis to assess haul-route project truck noise levels resulting from project-associated truck travel on local roadways.

Prediction results from project on-site operations will be compared to the MECP exclusionary noise limits at the identified sensitive POR(s). Based on modelling results, Golder will identify mitigation that will need to be incorporated into the design of the project in order to be in compliance with applicable noise limits.

2.3 Reporting

Once the noise modelling is complete and demonstrates that the project can operate in compliance with the applicable MECP noise limits, Golder will prepare a noise impact assessment report documenting the findings of the assessment.

3.0 VIBRATION

3.1 Background Data Compilation and Review

Background data review for this phase of the project will include a review of existing documents and a number of information sources. These sources include, but are not limited to:

- Existing provincial and federal guidelines for the assessment of environmental impacts from blasting.
- Proposed blasting parameters.
- Current vibration monitoring records from an existing nearby quarry operated by CBM (Osprey Quarry).
- Blast vibration attenuation models from Golder’s experience and from published literature.

3.2 Site Reconnaissance and Existing Conditions

The field investigation includes a site visit to identify the sensitive receptors and other features that may be potentially impacted.

3.3 Predictive Modelling

Predictive modelling to estimate the attenuation characteristics of ground and air vibration levels from blasting operations at sensitive receptors would typically involve monitoring a number of site blasts at specific locations. Since there are currently no blasting operations at the site, the investigation includes the compilation and analysis vibration monitoring information currently being collected at residential properties located nearby to a similar quarry operation (i.e., CBM’s Osprey Quarry). A site visit will also be arranged to visit a nearby CBM operated aggregate quarry (Osprey Quarry) where the blasting operations are similar to those proposed for the site. Predictive modelling of both ground and air vibrations from the proposed blasting operations will be carried out using the historic data from the existing CBM Osprey Quarry. The impact assessment will assume maximum explosive weights per delay period and minimum distances between the blast source and receptor.

3.4 Impact Assessment and Reporting

There is a requirement for a Blast Design Report, which is also commonly referred to as a Blast Impact Assessment. The data collected during the site reconnaissance will be analyzed with the data provided by CBM to assess the ground and air vibration decay characteristics. This will provide ground and air attenuation models. The impact assessment will address the following topics:

- An estimate of the potential ground and air vibration levels at potential points of impact.
- Evaluations of:
  - The potential impact on the nearby sensitive receptors.
  - The potential impact of the blasting operations on bedrock strata and adjacent water wells.
  - The long-term impact of the blasting operations on surrounding structures.
  - The impact of ground vibration effects at adjacent Canadian Fisheries waters if and where applicable.
  - The risk for flyrock.

- Recommendations for the continued control of ground and air vibration effects.
- General recommendations to prevent wild flyrock events (as required by Ontario Regulation 244/97).
- The assessment will not include specific recommendations related to fly rock since this is addressed during the operational phase of the quarry when detailed design is completed for each individual blast.

The study findings, impact assessment, and recommended mitigation strategies will be presented in a report.

The Blast Design Report will reference Ontario Regulation 244/97 and note that this requirement applies to the proposed quarry.

4.0 CARBON FOOTPRINT STUDY

Golder will complete a carbon footprint study which will include analyses of direct and purchased electricity related greenhouse gas (GHG) emissions associated with the following aspects of the project:

- Land clearing of the project site
- Project operations
- GHG removals as a result of rehabilitation of the project site

The analysis will be conducted in accordance with applicable guidance from the GHG Protocol Initiative document *"GHG Protocol Corporate Accounting and Reporting Standard"* and the recently released Environment and Climate Change Canada document entitled *"Technical Guide Related to the Strategic Assessment of Climate Change"* (SACC). In order to prepare the above analysis, current and post-rehabilitation land use information will be incorporated, along with fuel and electricity consumption projections for the project during operations. The assessment will also include a comparison if the material was imported further from market and a discussion of potential GHG impacts related to removal of rock.

A technical memorandum will be developed, which will include a description of the methodology and the results of the assessment. The magnitude of GHG estimates associated with the project will be put into context using metrics available in public literature (e.g., the project's contribution to local/regional GHG emissions).

5.0 CLOSURE

We trust that this technical memorandum meets your current needs. Please contact Golder and CBM with any questions or comments.

Golder Associates Ltd.

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https://golderassociates.sharepoint.com/sites/114392/project files/6 deliverables/terms of reference/atmospheric tor/19129150-tm-rev1-cbm caledon quarry atmospheric tor-19aug2022.docx

APPENDIX B

Emission Rate Calculations

Source ID **BLASTDRL** **Source Name** **Blast Hole Drilling**

Overview

Rock and stone are loosened by drilling and blasting the quarry face. Anywhere from 160 to 190 holes are drilled prior to each blast and only one blast occurs per day. It takes 47 hours to drill the required number of holes (15 m depth per hole). Emissions are controlled by spraying water during drilling and a dust collection system on the drill rig.

Methodology

Particulate matter (SPM) emissions due to blast hole drilling are estimated using the method described in the US EPA AP-42 Section 11.9 - Western Surface Coal Mining (7/98), specifically from Table 11.9-4 Uncontrolled Particulate Emission Factors for Open Dust Sources at Western Surface Coal Mines. The emission factor has a quality rating of Average.

The PM10 default emission factor provided for "drilling" activity in the Australian National Pollutant Inventory Emission Estimation Technique Manual for Mining (Version 3.1, January 2012) was applied to estimate PM10 emissions.

A 99% control was applied as per the Australian NPI for Mining (Version 3.1, January 2012) for use of a fabric filter dust collection system when drilling.

As noted on the Air Contaminants Benchmark List (dated April 2018) crystalline silica is defined as respirable < 10 µm in diameter. For blast hole drilling, silica content in PM10 was estimated based on the PM4 emission factors from Table 5 of the article by Richards, et. al. PM4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California (Journal of the Air & Waste Management Association, 59:11, 1287-1295, DOI: 10.3155/1047-3289.59.11.1287). The silica content estimated from PM4 for the conveyor transfer point was then conservatively applied to PM10.

Sample Calculations

Emission Rate [g/s] = Emission Factor [kg/hole] x Number of holes drilled x Hours required to drill x 1000 [g/kg] x Unit conversions x (1-Control Factor)

Dust control (%) 99% fabric filter dust collection system used while drilling

Source	Contaminant	CAS	Emission Factor (Uncontrolled) [kg/hole]	US EPA Quality Rating	MECP Quality Rating
Drilling, Overburden (uncontrolled)	SPM	N/A	5.90E-01	C	Average
	PM10[1]	N/A-1	3.10E-01	C	Average
	PM2.5[2]	N/A-2	4.92E-02	E	Marginal

1 - Emission factor for PM10 based on Australian NPI Emission Estimation Technique Manual for Mining (Version 3.1, January 2012).
2 - Emission factor for PM2.5 based on the ratio between TSP and PM2.5 emission factors for tertiary crushing (controlled).

$$\text{1-hr Emission Rate}_{SPM}\ [g/s] = \frac{0.59\ kg}{hole} \times \frac{190\ holes}{47\ hours} \times \frac{1000\ g}{kg} \times \frac{1\ hour}{3600\ seconds} \times (1 - 0.99)$$

1-hr Emission Rate $_{SPM}$ [g/s] = 6.66E-03 g/s

$$\text{Emission Factor}_{Crys\ sil} = \frac{0.000048 \text{ lb/t CrySi in } PM_4 \text{ for conveyor transfer point (AWMA article)}}{0.00035 \text{ lb/t } PM_4 \text{ EF for conveyor transfer point (AWMA article)}}$$

Emission Factor $_{Crys\ sil}$ = 14% conservatively assumed for silica content in PM_{10}

1-hr Emission Rate $_{Crys\ sil}$ = Emission Rate $_{PM10}$ x Max % of Crystalline Silica

$$\text{1-hr Emission Rate}_{Crys\ sil} = 3.50E\text{-}03 \frac{g}{s} \times 14\%$$

$$\text{1-hr Emission Rate}_{Crys\ sil} = 4.80E\text{-}04 \frac{g}{s}$$

$$\text{Annual Emission Rate}_{SPM} [g/s] = 0.59 \frac{kg}{hole} \times 190 \frac{holes}{blast} \times 156 \frac{blasts}{year} \times 1000 \frac{g}{kg} \times \frac{1\ year}{8760\ hours} \times \frac{1\ hr}{3600\ seconds} \times (1 - 0.99)$$

Annual Emission Rate $_{SPM}$ [g/s] = 5.55E-03 g/s

Emission Summary

Source ID	Source Description	Control Method	Contaminant	CAS	1-hr Emission Rate [g/s]	Annual Emission Rate [g/s]
BLASTDRL	Blast Hole Drilling	Water spray	SPM	N/A	6.66E-03	5.55E-03
			PM10	N/A-1	3.50E-03	—
			PM2.5	N/A-2	5.55E-04	4.62E-04
			Crystalline Silica	14808-60-7	4.80E-04	—

Source ID **EXPLOS** **Source Name** **Blasting Explosives**

Overview

Rock and stone are loosened by blasting the quarry face using emulsion explosives. A maximum of one blast can occur in a given day typically in the afternoon.

Maximum Operating Parameters

Maximum amount of explosive used per blast	13000	kg/blast
% explosive mixture ANFO	30%	
% explosive mixture emulsion	70%	
Number of Blasts in a given hour	1	blast/hour
Number of Blasts in a given day	1	blasts/day

Methodology

The compounds associated with blasting explosives include products of combustion (SO_2 and NO_X). The Nitrogen Oxides emission factor for blasting using 70% emulsion and 30% ANFO explosives (on site mixture) were obtained from the Australian NPI Emission Estimation Technique Manual for Explosive Detonation and Firing Ranges, Version 3.1, Table 7, dated August 2016. The data quality is rated "D" or "Marginal". The maximum diameter of the drilled holes at the quarry will be no larger than 102 mm, therefore the emulsion emission factors for holes <150 mm were applied.

Sample Calculations

Emission rate (g/s) = EF (kg/tonne pf explosives) × Hourly explosive usage rate (tonnes of explosives/hour)

Uncontrolled Emission Factor				
Type of Explosives	**Contaminant**	**CAS**	**Emission Factor [kg/tonne]**	**US EPA Quality Rating**
Emulsion	Nitrogen oxides	10102-44-0	0.20	Unknown
ANFO (on site mix)	Nitrogen oxides	10102-44-0	8	D

Nitrogen Oxides

For Emulsion 1-hour Emission Rate [g/s] =

0.2	kg	13000	kg explosives	1	tonne	1000	g	1	blast	1	hr	70%	emulsion
	tonne explosives		blast	1000	kg	1	kg	per	hour	3600	seconds		

For Emulsion 1-hour Emission Rate [g/s] = 5.06E-01 g/s

For ANFO 1-hour Emission Rate [g/s] =

8.0	kg	13000	kg explosives	1	tonne	1000	g	1	blast	1	hr	30%	ANFO
	tonne explosives		blast	1000	kg	1	kg	per	hour	3600	seconds		

For ANFO 1-hour Emission Rate [g/s] = 8.67E+00 g/s

Total BLAST Emissions = Emissions from Emulsion + Emissions from ANFO

= 9.17E+00 g/s

For emulsion 24-hour Emission Rate [g/s] =

0.2	kg	13000	kg explosives	1	tonne	1000	g	1	blast	1	day	70%	emulsion
	tonne explosives		hole	1000	kg	1	kg	per	day	86400	seconds		

For emulsion 24-hour Emission Rate [g/s] = 2.11E-02 g/s

Emission Summary

Total Emissions (Emulsion + ANFO)

Source ID	Source Description	Source Type	Control Method	Contaminant	CAS	1-hour ER [g/s]	24-hour ER [g/s]
EXPLOS	Blasting explosives (70/30 emuslsion and ANFO)	Explosive detonation	N/A	Nitrogen oxides	10102-44-0	9.17E+00	3.82E-01

Source ID BLASTFUG **Source Name** Blasting Fugitives

Overview

Rock and stone are loosened by drilling and blasting the quarry face. Blasting typically only occurs once per day in the afternoon.

Maximum Operating Parameters

Blast Duration	1	second
Maximum Horizontal Area per Blast	750	m^2
Maximum Number of Blasts	1	blast/day

Methodology

Blasting typically occurs a maximum of 2 times per week during peak production levels. Particulate emissions from blasting were estimated using emission factors from the US EPA AP-42 Section 11.9 Western Surface Coal Mining (10/98).

As noted on the Air Contaminants Benchmark List (dated April 2018) crystalline silica is defined as respirable < 10 μm in diameter. For blasting fugitives, silica content in PM10 was estimated based on the PM4 emission factors from Table 5 of the article by Richards, et. al. PM4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California (Journal of the Air & Waste Management Association, 59:11, 1287-1295, DOI: 10.3155/1047-3289.59.11.1287). The silica content estimated from PM4 for the conveyor transfer point was then conservatively applied to PM10.

Sample Calculations

SPM Emission factor based on EF [kg/blast] = 0.00022 $(A)^{1.5}$, where A = horizontal area (m^2)

Scaling Factors (from SPM) 0.52 PM10 0.03 PM2.5

Source	Contaminant	CAS	Emission Factor [kg/Blast]	US EPA Quality Rating	MECP Data Quality Rating
Blasting Fugitives	SPM	N/A	4.52	C	Average
	PM10	N/A-1	2.35	D	Marginal
	PM2.5	N/A-2	0.14	D	Marginal

$$\text{1-hr Emission Rate}_{SPM}\,[g/s] = \frac{4.52\ \text{kg}}{\text{blast}} \times \frac{1\ \text{blast}}{\text{day}} \times \frac{1000\ \text{g}}{\text{kg}} \times \frac{1\ \text{day}}{12\ \text{hr window blasting could occur}} \times \frac{1\ \text{hr}}{3600\ \text{s}}$$

1-hr Emission Rate $_{SPM}$ [g/s] = 1.05E-01 g/s

Emission Factor $_{Crys\ sil}$ = 0.000048 lb/t CrySi in PM_4 for conveyor transfer point (AWMA article) / 0.00035 lb/t PM_4 EF for conveyor transfer point (AWMA article)

Emission Factor $_{Crys\ sil}$ = 14% conservatively assumed for silica content in PM_{10}

1-hr Emission Rate $_{Crys\ sil}$ = Emission Rate $_{PM10}$ x Max % of Crystalline Silica

1-hr Emission Rate $_{Crys\ sil}$ = 5.44E-02 g/s | 14%

24-hr Emission Rate $_{Crys\ sil}$ = 7.46E-03 g/s

Emission Summary

Source ID	Contaminant	CAS	1-hour Emission Rate [g/s]	US EPA Quality Rating	MECP Data Quality Rating
BLASTFUG	SPM	N/A	1.05E-01	C	Average
	PM10	N/A-1	5.44E-02	D	Marginal
	PM2.5	N/A-2	3.14E-03	D	Marginal
	Crystalline Silica	14808-60-7	7.46E-03	C	Average

Source ID(s) Various Crushing plant sources listed below **Source Description** Crushing and Screening Activities

Overview

A crushing plant processes blasted material at the Site in the Main quarry area designated for the permanent below grade crushing plant location during Phase 3 Extraction Scenario.

Maximum Operating Parameters

See Emission Summary Table for maximum operating rates for each component of the crushing plant.

Production hours 7 am to 7 pm
12 hrs/day

Methodology

Emission factors from Table 11.19.2-1 in Chapter 11.19 *Crushed Stone Processing and Pulverized Mineral Processing* of the US EPA AP-42 (dated 8/04) were used to calculate suspended particulate matter (SPM) and PM_{10} emissions. The emission factor for tertiary crushing was used in the absence of the emission factor for primary crushing. Controlled emission factors for controlled screening was applied for screening due to the high moisture content in the material (2.1%).

As noted on the Air Contaminants Benchmark List (dated April 2018) crystalline silica is defined as respirable < 10 µm in diameter. For crushing, screening, and material transfers, the silica content in PM_{10} was estimated based on the PM_4 emission factors from Table 5 of the article by Richards, et. al. *PM_4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California* (Journal of the Air & Waste Management Association, 59:11, 1287-1295, DOI: 10.3155/1047-3289.59.11.1287). The silica content estimated from PM_4 for the conveyor transfer point was then conservatively applied to PM_{10}.

Sample Calculations

Emission rates for UNLOAD1

1-hr Emission Rate = Production Rate [tonnes/hr] x Emission Factor [kg/tonnes] x Conversion Factors

$$\text{1-hr Emission Rate}_{SPM} = \frac{709 \text{ tonnes}}{\text{hr}} \times \frac{8.00\text{E-}06 \text{ kg}}{\text{tonnes}} \times \frac{1000 \text{ g}}{\text{kg}} \times \frac{1 \text{ day}}{3600 \text{ s}}$$

$$\text{1-hr Emission Rate}_{SPM} = \frac{1.57\text{E-}03 \text{ g}}{\text{s}}$$

$$\text{Emission Factor}_{Crys\ sil} = \frac{0.000048 \text{ lb/t CrySi in } PM_4 \text{ for conveyor transfer point (AWMA article)}}{0.00035 \text{ lb/t } PM_4 \text{ EF conveyor transfer point (AWMA article)}}$$

$\text{Emission Factor}_{Crys\ sil}$ = 14% conservatively assumed for silica content in PM_{10}

$\text{1-hr Emission Rate}_{Crys\ sil}$ = $\text{Emission Rate}_{PM10}$ x Max % of Crystalline Silica

$$\text{1-hr Emission Rate}_{Crys\ sil} = \frac{1.57\text{E-}03 \text{ g}}{\text{s}} \times 14\%$$

$$\text{1-hr Emission Rate}_{Crys\ sil} = \frac{2.16\text{E-}04 \text{ g}}{\text{s}}$$

Crystalline Silica Emission Factors

Contaminant	Crusher	Screen	Conveyor
PM_4	0.00088	0.00044	0.00035
PM_4 Si	0.000097	0.000044	0.000048
Crystalline Silica EF	11%	10%	14%

Emission Summary

Source ID	Source Description	Maximum Rate [tonnes/hr]	Operating Hours per Day	Moisture Content [in %]	Contaminant	CAS #	Emission Factor	Emission Factor Units	Maximum 1-hr Emission Rate [g/s]	Emission Estimating Technique	Ministry Data Quality
UNLOAD1	Truck unloading	709	12	2.1	SPM	N/A	8.00E-06	kg/tonnes	1.57E-03	EF	Marginal
					PM_{10}	N/A-1	8.00E-06	kg/tonnes	1.57E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	8.00E-06	kg/tonnes	1.57E-03	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	2.16E-04	MB	Marginal
CRUSH1	Crushing	312	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	5.20E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	2.34E-02	EF	Average
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	4.33E-03	EF	Marginal
					Crystalline silica	14808-60-7	11%	% of PM_{10}	2.58E-03	MB	Average
UNLOAD2	Truck unloading	709	12	2.1	SPM	N/A	8.00E-06	kg/tonnes	1.57E-03	EF	Marginal
					PM_{10}	N/A-1	8.00E-06	kg/tonnes	1.57E-03	EF	Average
					$PM_{2.5}$	N/A-2	8.00E-06	kg/tonnes	1.57E-03	EF	Marginal
					Crystalline silica	14808-60-7	13.7%	% of PM_{10}	2.16E-04	MB	Average
CRUSH2	Crushing	312	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	5.20E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	2.34E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	4.33E-03	EF	Marginal
					Crystalline silica	14808-60-7	11%	% of PM_{10}	2.58E-03	MB	Marginal
SCRN1	Screening	312	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	9.53E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	3.20E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	2.16E-03	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	3.20E-03	MB	Marginal
SCRN2	Screening	312	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	9.53E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	3.20E-02	EF	Average
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	2.16E-03	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	3.20E-03	MB	Average
CONV1	Conveyor	282	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	5.48E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	1.80E-03	EF	Average
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	5.09E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	2.47E-04	MB	Average
CONV2	Conveyor	492	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	9.56E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	3.14E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	8.88E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	4.31E-04	MB	Marginal
CONV3	Conveyor	402	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	7.82E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	2.57E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	7.27E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	3.53E-04	MB	Marginal

Source ID	Source Description	Maximum Rate [tonnes/hr]	Operating Hours per Day	Moisture Content [in %]	Contaminant	CAS #	Emission Factor	Emission Factor Units	Maximum 1-hr Emission Rate [g/s]	Emission Estimating Technique	Ministry Data Quality
CONV4	Conveyor	402	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	7.82E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	2.57E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	7.27E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	3.53E-04	MB	Marginal
CRUSH3	Crushing	282	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	4.70E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	2.11E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	3.92E-03	EF	Marginal
					Crystalline	14808-60-7	11%	% of PM_{10}	2.33E-03	MB	Marginal
CRUSH4	Crushing	402	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	6.71E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	3.02E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	6.71E-02	EF	Marginal
					Crystalline	14808-60-7	11%	% of PM_{10}	3.33E-03	MB	Marginal
CRUSH5	Crushing	402	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	6.71E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	3.02E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	6.71E-02	EF	Marginal
					Crystalline	14808-60-7	11%	% of PM_{10}	3.33E-03	MB	Marginal
SCRN3	Screening	141	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	4.31E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	1.45E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	1.17E-02	EF	Marginal
					Crystalline	14808-60-7	10%	% of PM_{10}	1.45E-03	MB	Marginal
SCRN4	Screening	141	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	4.31E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	1.45E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	9.79E-04	EF	Marginal
					Crystalline	14808-60-7	10%	% of PM_{10}	1.45E-03	MB	Marginal
SCRN5	Screening	268	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	8.20E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	2.76E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	1.86E-03	EF	Marginal
					Crystalline	14808-60-7	10%	% of PM_{10}	2.76E-03	MB	Marginal
SCRN6	Screening	268	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	8.20E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	2.76E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	1.86E-03	EF	Marginal
					Crystalline	14808-60-7	10%	% of PM_{10}	2.76E-03	MB	Marginal
SCRN7	Screening	268	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	8.20E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	2.76E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	1.86E-03	EF	Marginal
					Crystalline	14808-60-7	10%	% of PM_{10}	2.76E-03	MB	Marginal

Source ID(s) Various Crushing plant sources listed below **Source Description** Crushing and Screening Activities

Overview

Part of the main crushing plant equipment (UNLOAD1, CRUSH1 and SCRN1) move to the south quarry area during Phase 6 and Phase 7 Extraction Scenarios. While the remaining equipment continues to operate at the Main quarry area.

Maximum Operating Parameters

See Emission Summary Table for maximum operating rates for each component of the crushing plant.

Production hours 7:00 to 19:00
12 hrs/day

Methodology

Emission factors from Table 11.19.2-1 in Chapter 11.19 *Crushed Stone Processing and Pulverized Mineral Processing* of the US EPA AP-42 (dated 8/04) were used to calculate suspended particulate matter (SPM) and PM_{10} emissions. The emission factor for tertiary crushing was used in the absence of the emission factor for primary crushing. Controlled emission factors for controlled screening was applied for screening due to the high moisture content in the material (2.1%).

As noted on the Air Contaminants Benchmark List (dated April 2018) crystalline silica is defined as respirable < 10 µm in diameter. For crushing, screening, and material transfers, the silica content in PM_{10} was estimated based on the PM_4 emission factors from Table 5 of the article by Richards, et. al. *PM_4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California* (Journal of the Air & Waste Management Association, 59:11, 1287-1295, DOI: 10.3155/1047-3289.59.11.1287). The silica content estimated from PM_4 for the conveyor transfer point was then conservatively applied to PM_{10}.

Sample Calculations

Emission rates for UNLOAD1

1-hr Emission Rate = Production Rate [tonnes/hr] x Emission Factor [kg/tonnes] x Conversion Factors

1-hr Emission Rate SPM = 1417 tonnes/hr | 8.00E-06 kg/tonnes | 1000 g/kg | 1 day/3600 s

1-hr Emission Rate SPM = 3.15E-03 g/s

Emission Factor $_{Crys\ sil}$ = 0.000048 lb/t CrySi in PM_4 for conveyor transfer point (AWMA article) / 0.00035 lb/t PM_4 EF conveyor transfer point (AWMA article)

Emission Factor $_{Crys\ sil}$ = 14% conservatively assumed for silica content in PM_{10}

1-hr Emission Rate Crys sil = Emission Rate $_{PM10}$ x Max % of Crystalline Silica

1-hr Emission Rate Crys sil = 3.15E-03 g/s | 14%

1-hr Emission Rate Crys sil = 4.32E-04 g/s

Crystalline Silica Emission Factors

Contaminant	Crusher	Screen	Conveyor
PM_4	0.00088	0.00044	0.00035
PM_4 Si	0.000097	0.000044	0.000048
Crystalline Silica EF	11%	10%	14%

Emission Summary

Source ID	Source Description	Maximum Rate [tonnes/hr]	Operating Hours per Day	Moisture Content [in %]	Contaminant	CAS #	Emission Factor	Emission Factor Units	Maximum 1-hr Emission Rate [g/s]	Emission Estimating Technique	Ministry Data Quality
UNLOAD1	Truck unloading	1417	12	2.1	SPM	N/A	8.00E-06	kg/tonnes	3.15E-03	EF	Marginal
					PM_{10}	N/A-1	8.00E-06	kg/tonnes	1.57E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	8.00E-06	kg/tonnes	1.57E-03	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	2.16E-04	MB	Marginal
CRUSH1	Crushing	312	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	5.20E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	2.34E-02	EF	Average
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	4.33E-03	EF	Marginal
					Crystalline silica	14808-60-7	11%	% of PM_{10}	2.58E-03	MB	Average
UNLOAD2	Conveyor	709	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	1.38E-02	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	4.53E-03	EF	Average
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	1.28E-03	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	6.21E-04	MB	Average
CRUSH2	Crushing	312	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	5.20E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	2.34E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	4.33E-03	EF	Marginal
					Crystalline silica	14808-60-7	11%	% of PM_{10}	2.58E-03	MB	Marginal
SCRN1	Screening	312	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	9.53E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	3.20E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	2.16E-03	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	3.20E-03	MB	Marginal
SCRN2	Screening	312	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	9.53E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	3.20E-02	EF	Average
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	2.16E-03	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	3.20E-03	MB	Average
CONV1	Conveyor	282	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	5.48E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	1.80E-03	EF	Average
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	5.09E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	2.47E-04	MB	Average
CONV2	Conveyor	492	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	9.56E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	3.14E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	8.88E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	4.31E-04	MB	Marginal
CONV3	Conveyor	402	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	7.82E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	2.57E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	7.27E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	3.53E-04	MB	Marginal
CONV4	Conveyor	402	12	2.1	SPM	N/A	7.00E-05	kg/tonnes	7.82E-03	EF	Marginal
					PM_{10}	N/A-1	2.30E-05	kg/tonnes	2.57E-03	EF	Marginal
					$PM_{2.5}$	N/A-2	6.50E-06	kg/tonnes	7.27E-04	EF	Marginal
					Crystalline silica	14808-60-7	14%	% of PM_{10}	3.53E-04	MB	Marginal
CRUSH3	Crushing	282	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	4.70E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	2.11E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	3.92E-03	EF	Marginal
					Crystalline silica	14808-60-7	11%	% of PM_{10}	2.33E-03	MB	Marginal

Source ID	Source Description	Maximum Rate [tonnes/hr]	Operating Hours per Day	Moisture Content [in %]	Contaminant	CAS #	Emission Factor	Emission Factor Units	Maximum 1-hr Emission Rate [g/s]	Emission Estimating Technique	Ministry Data Quality
CRUSH4	Crushing	402	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	6.71E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	3.02E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	5.59E-03	EF	Marginal
					Crystalline silica	14808-60-7	11%	% of PM_{10}	3.33E-03	MB	Marginal
CRUSH5	Crushing	402	12	2.1	SPM	N/A	6.00E-04	kg/tonnes	6.71E-02	EF	Marginal
					PM_{10}	N/A-1	2.70E-04	kg/tonnes	3.02E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	5.00E-05	kg/tonnes	5.59E-03	EF	Marginal
					Crystalline silica	14808-60-7	11%	% of PM_{10}	3.33E-03	MB	Marginal
SCRN3	Screening	141	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	4.31E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	1.45E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	9.79E-04	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	1.45E-03	MB	Marginal
SCRN4	Screening	141	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	4.31E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	1.45E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	9.79E-04	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	1.45E-03	MB	Marginal
SCRN5	Screening	268	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	8.20E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	2.76E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	1.86E-03	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	2.76E-03	MB	Marginal
SCRN6	Screening	268	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	8.20E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	2.76E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	1.86E-03	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	2.76E-03	MB	Marginal
SCRN7	Screening	268	12	2.1	SPM	N/A	1.10E-03	kg/tonnes	8.20E-02	EF	Marginal
					PM_{10}	N/A-1	3.70E-04	kg/tonnes	2.76E-02	EF	Marginal
					$PM_{2.5}$	N/A-2	2.50E-05	kg/tonnes	1.86E-03	EF	Marginal
					Crystalline silica	14808-60-7	10%	% of PM_{10}	2.76E-03	MB	Marginal

Source ID(s) **MATHNDL, QUARRYMH, SHIPMH** **Source Description** Crushing plant material handling

Overview

Crushed and screened material is dropped into various stockpiles from the crushing plant. Production occurs from 7 am to 7 pm and shipping can occur from 6 am to 7pm

Methodology

Particulate matter emissions were calculated using emission factor equations obtained from US EPA, AP-42 Chapter 13.2.4 Aggregate Material Handling and Storage Piles (11/06). The particle size multiplier (k) for PM<44 µm was calculated using the logarithmic regression of the aerodynamic particle size multipliers in the US EPA AP-42 Section 13.2.4. The maximum hourly wind speed was obtained from the MECP AERMET processed dataset for Toronto, Ontario ("Crops", 1996 - 2000).

The Ministry POI Limit for crystalline silica is based on particles that are <10µm in diameter, and therefore PM10 emissions have been estimated in the calculations below in order to obtain an estimate of crystalline silica emissions in the <10 µm particle size fraction. The fraction of silica present in particulate is specific to the activity that is generating emissions. Silica content in PM10 was estimated for material handling based on the PM4 emission factors from Table 5 of the article by Richards, et. al. "PM4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California" (Journal of the Air & Waste Management Association, 59:11, 1287-1295, DOI: 10.3155/1047-3289.59.11.1287). The silica content estimated from PM4 for the conveyor transfer point was then conservatively applied to PM10.

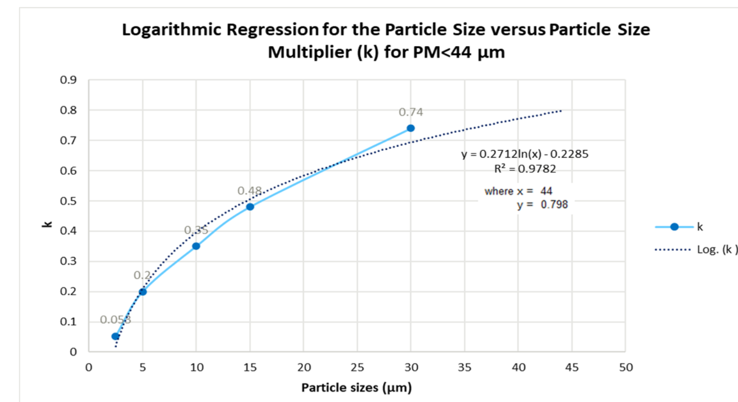
Emission Parameters

Particulate Matter Emission Factor Equation:

$$E = k(0.0016)\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Parameter	Description	Value	
k (PM)	constant	0.8	
k (PM_{10})	constant	0.35	
k ($PM_{2.5}$)	constant	0.053	
M1	Moisture Content of processed material [%]	2.1	Based on AP42 chapter 13.2.4 (Table 13.2.4-1)
M2	Moisture Content of freshly excavated material [%]	4.8	Material is extracted directly below grade and is fairly saturated with moisture, hence using 4.8% moisture content (maximum range allowed in the above equation), b
U	Wind Speed [m/s]	18.5	m/s (Maximum hourly wind speed from MECP AERMET Processed Met data for Toronto "Crops" (1996-2000))

k for PM<44 µm was extrapolated using the logarithmic regression for the particle size versus particle size multiplier (k).



Sample Calculations

$$\text{Emission Factor (Aggregate)} = 0.8 \times 0.0016 \times \frac{\left(\frac{18.5}{2.2}\right)^{1.3}}{\left(\frac{2.1}{2}\right)^{1.4}}$$

$$\text{Emission Factor (Aggregate)} = 1.90E\text{-}02 \ \frac{kg}{tonne}$$

Sample Calculation for Particulate Matter - MATHNDL2

Since the quarry operates 24 hours per day, the maximum hourly and daily emission rates are equivalent.

1-hr Emission rate $_{SPM}$ = Processing Rate [tonnes/day]x Emission Factor [kg/tonne] x conversion to [g/s]

$$\text{1-hr Emission rate}_{SPM} = 147 \ \frac{tonnes}{hour} \times 1.90E\text{-}02 \ \frac{kg}{tonne} \times 1000 \ \frac{g}{kg} \times \frac{1}{3600} \ \frac{hr}{s}$$

$$\text{1-hr Emission rate}_{SPM} = 7.78E\text{-}01 \ \frac{g}{s}$$

Sample Calculation for Crystalline Silica

CrySi EF = 0.000048 lb/t CrySi in PM_4 for conveyor transfer point (AWMA article) / 0.00035 lb/t PM_4 EF for conveyor transfer point (AWMA article)

CrySi EF = 14% conservatively assumed for silica content in PM_{10}

1-hr Emission Rate$_{Cry\ Sil}$ = Emission Rate$_{PM10}$ x Max % of Crystalline Silica

$$= 3.40E\text{-}01 \ \frac{g}{s} \times 14\%$$

$$\text{1-hr Emission Rate}_{Cry\ Sil} = 4.67E\text{-}02 \ \frac{g}{s}$$

Emission Summary

US EPA Data Quality	A
MECP Data Quality	Above Average

Source ID	Source Description	Amount of Material Loaded [tonnes/hr]	Contaminant	CAS	Emission Factor	Emission Factor unit	1-hr Emission Rate [g/s]
MATHNDL1	Stockpile 1	226	SPM	N/A	1.90E-02	[kg/tonne]	1.20E+00
			PM10	N/A-1	8.33E-03		5.23E-01
			PM2.5	N/A-2	1.26E-03		7.92E-02
			Crystalline Silica	14808-60-7	14%	% of PM10	7.17E-02
MATHNDL2	Stockpile 2	147	SPM	N/A	1.90E-02	[kg/tonne]	7.78E-01
			PM10	N/A-1	8.33E-03		3.40E-01
			PM2.5	N/A-2	1.26E-03		5.15E-02
			Crystalline Silica	14808-60-7	14%	% of PM10	4.67E-02
MATHNDL3	Stockpile 3	357	SPM	N/A	1.90E-02	[kg/tonne]	1.89E+00
			PM10	N/A-1	8.33E-03		8.26E-01
			PM2.5	N/A-2	1.26E-03		1.25E-01
			Crystalline Silica	14808-60-7	14%	% of PM10	1.13E-01
MATHNDL4	Stockpile 4	178	SPM	N/A	1.90E-02	[kg/tonne]	9.42E-01
			PM10	N/A-1	8.33E-03		4.12E-01
			PM2.5	N/A-2	1.26E-03		6.24E-02
			Crystalline Silica	14808-60-7	14%	% of PM10	5.65E-02
MATHNDL5	Stockpile 5	811	SPM	N/A	1.90E-02	[kg/tonne]	4.29E+00
			PM10	N/A-1	8.33E-03		1.88E+00
			PM2.5	N/A-2	1.26E-03		2.84E-01
			Crystalline Silica	14808-60-7	14%	% of PM10	2.57E-01
MATHNDL6	Stockpile 6	56	SPM	N/A	1.90E-02	[kg/tonne]	2.96E-01
			PM10	N/A-1	8.33E-03		1.30E-01
			PM2.5	N/A-2	1.26E-03		1.96E-02
			Crystalline Silica	14808-60-7	14%	% of PM10	1.78E-02
MATHNDL7	Stockpile 7	130	SPM	N/A	1.90E-02	[kg/tonne]	6.88E-01
			PM10	N/A-1	8.33E-03		3.01E-01
			PM2.5	N/A-2	1.26E-03		4.56E-02
			Crystalline Silica	14808-60-7	14%	% of PM10	4.13E-02
MATHNDL8	Stockpile 8	94	SPM	N/A	1.90E-02	[kg/tonne]	4.97E-01
			PM10	N/A-1	8.33E-03		2.18E-01
			PM2.5	N/A-2	1.26E-03		3.29E-02
			Crystalline Silica	14808-60-7	14%	% of PM10	2.98E-02
QUARRYMH	Excavated material handling in the quarry face	1417	SPM	N/A	5.99E-03	[kg/tonne]	2.36E+00
			PM10	N/A-1	2.62E-03		1.03E+00
			PM2.5	N/A-2	3.97E-04		1.56E-01
			Crystalline Silica	14808-60-7	14%	% of PM10	1.41E-01
SHIPMH	Processed material handling from product stockpiles onto shipping trucks	1417	SPM	N/A	1.90E-02	[kg/tonne]	7.50E+00
			PM10	N/A-1	8.33E-03		3.28E+00
			PM2.5	N/A-2	1.26E-03		4.97E-01
			Crystalline Silica	14808-60-7	14%	% of PM10	4.50E-01

Source ID(s) DG1, DG2 **Source Description** Crushing Plant Generators

Overview

Two 1650 kW diesel-fired generators will be used to provide primary power to the temporary excavation pit at grade crushing plant, that can operate simultaneously up to 24 hours per day at 100% load capacity.

Maximum Operating Parameters

Maximum generator rating [in kW]		Tier Rating
Generator 1	1,650	4
Generator 2	1,650	4
Operating load capacity	100%	

Methodology

Emissions of carbon monoxide, particulate matter and nitrogen oxides were calculated using the Exhaust Emission Standards for Nonroad Compression-Ignition (CI) engines, from the US EPA Transportation and Air Quality Emission Standards Reference Guide. Emission standards were not provided for PM10 and PM2.5; therefore, it was assumed that all PM emissions consist of PM10 and that PM2.5 emissions are 97% of PM10 emissions, per the US EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d (July 2010) (EPA Report NR-009d) document.

The generator is conservatively assumed to be operating at 100% load.

Sample Calculations

Sample Calculation Emission Rate = Emission Factor [g/kW-h] x Power Output [kW] x Load Capacity % x Conversion factors

$$\text{1-hr Emission Rate}_{NOx}\ [g/s] = 1,650\ kW \times \frac{3.5\ g}{kWh} \times 100\% \times \frac{1\ hr}{3,600\ s}$$

$$\text{1-hr Emission Rate}_{NOx}\ [g/s] = 1.60\ \frac{g}{s}$$

Emission Summary

Source ID	Contaminant	CAS Number	Emission Factor	Emission Factor Units	1-hour Emission Rate [g/s]	MECP Data Quality
DG1	Nitrogen oxides	10102-44-0	3.50	g/kWh	1.60	Above-Average
	SPM	N/A	1.00E-01	g/kWh	4.58E-02	Above-Average
	PM10	N/A-1	1.00E-01	g/kWh	4.58E-02	Above-Average
	PM2.5	N/A-2	9.70E-02	g/kWh	4.45E-02	Above-Average
DG2	Nitrogen oxides	10102-44-0	3.50	g/kWh	1.60	Above-Average
	SPM	N/A	1.00E-01	g/kWh	4.58E-02	Above-Average
	PM10	N/A-1	1.00E-01	g/kWh	4.58E-02	Above-Average
	PM2.5	N/A-2	9.70E-02	g/kWh	4.45E-02	Above-Average

Source ID	STOCKPILE	Source Description	Stockpiles - Wind Erosion

Overview

Crushed material from the crushing plant are stored in stockpiles near the crushing plant area.

Maximum Operating Parameters

Material	Silt content [%]
Aggregate	3

Control Efficiency = 70% Average control efficiency assuming dust best management practices for stockpiles

50% For water sprays based on Australian NPI EET, Table 4: Estimated control factors for various mining operations

90% Water the storage pile by hand or apply cover when wind events are declared, based on WRAP Fugitive Dust Handbook, Table 4-2. Control Efficiencies for Control Measures for Materials Handling

Methodology

Emission factors from US EPA Control of Open Fugitive Dust Sources (EPA-45/3-88-008), September 1988, Page 4-17 were used to calculate emissions from the storage piles. The silt content value for the crushed material was provided by CBM. A control efficiency of 70% was applied assuming that best practices for stockpiles will be adopted as part of the site's Fugitive Dust Best Management Practice Plan and based on a range of 50 - 90% control efficiency as reported by different published literature. According to WRAP Fugitive Dust Handbook, Table 4-2. Control Efficiencies for Control Measures for Materials Handling application of water can lead to 90% control efficiency while the National Pollutant Inventory Emission Estimation Technique Manual for Mining, Version 3.1, by Australian Government reported a control efficiency of 50% for water sprays on storage piles. Therefore, an average efficiency was taken (70%) and applied to the wind erosion emission calculations.

The Ministry POI Limit for crystalline silica is based on particles that are <10µm in diameter, and therefore PM10 emissions have been estimated in the calculations below in order to obtain an estimate of crystalline silica emissions in the <10 µm particle size fraction. The fraction of silica present in particulate is specific to the activity that is generating emissions. Silica content in PM10 was estimated for material transfers based on the PM4 emission factors from Table 5 of the article by Richards, et. al. "PM4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California" (Journal of the Air & Waste Management Association, 59:11, 1287-1295, DOI: 10.3155/1047-3289.59.11.1287). The silica content estimated from PM4 was then conservatively applied to PM10.

$$E = 1.9\left(\frac{s}{1.5}\right)\left(\frac{f}{15}\right)$$

Where:

E = Emission Factor [kg/ha/day]

s = silt content [%]

f = % Time Wind Speed > 5.4 m/s = 22.33 (Toronto "Crops" Meteorological Data)

	SPM	PM10	PM2.5
Scaling Factor:	1	0.5	0.075

Sample Calculation for SPM from the Aggregate Stockpile

$$\text{Emission Factor} = 1.9 \left(\frac{3}{1.5}\right)\left(\frac{22.33}{15}\right)$$

$$\text{Emission Factor} = 5.66 \ \frac{kg}{ha\text{-}day}$$

Emissions = Emission factor [kg/ha/day] x exposed area x 1 ha / 10,000 m² x 1000 g/kg x 1 day / 24 hrs x 1 hr / 3600 s x (100% - Control efficiency)

$$SPM = 5.66 \ \frac{kg}{ha/day} \times 1{,}232\ m^2 \times \frac{1\ ha}{10000\ m^2} \times \frac{1000\ g}{kg} \times \frac{1\ day}{24\ hrs} \times \frac{1\ hr}{3600\ s} \times (100\% - 70\%)$$

SPM = 2.42E-03 g/s

Sample Calculations

$$\text{CrySi EF} = \frac{0.000048 \text{ lb/t CrySi in } PM_4 \text{ from material transfer point (AWMA article)}}{0.00035 \text{ lb/t } (PM_4 \text{ EF for material transfer point, AWMA article})}$$

CrySi EF = 14% conservatively assumed for silica content in PM_{10}

$\text{Emission Rate}_{\text{Crystalline Silica}} = \text{Emission Rate}_{PM10} \times$ Max % of Crystalline Silica

$= 1.21E\text{-}03 \ \frac{g}{s} \times 14\%$

$\text{Emission Rate}_{\text{Crystalline Silica}} = 1.66E\text{-}04 \ \frac{g}{s}$

Stockpile Emissions

Stockpile Location	Storage Pile ID	Diameter [m]	Average Height [m]	Slant Height of the Conical stockpile [m] *(Sqrt √(Radius)² + (Height)²)*	Exposed Area [m^2] *(π × Radius × Slant height)*	Silt Content [%]	Emission Factor SPM [kg/ha/day]	Emission Factor PM10 [kg/ha/day]	Emission Factor PM2.5 [kg/ha/day]	Emission Estimating Technique	Emission Factor Quality
Crushing Plant	Stockpile1	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal
	Stockpile2	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal
	Stockpile3	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal
	Stockpile4	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal
	Stockpile5	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal
	Stockpile6	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal
	Stockpile7	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal
	Stockpile8	35.00	14.00	22.4	1,232	3	5.657	2.829	0.424	EF	Marginal

Emission Summary

Source ID	Source Description	Emission Rate [g/s] SPM	PM10	PM2.5	Crystalline Silica
Stockpile1	Crushing Plant Stockpiles Wind Erosion	2.42E-03	1.21E-03	1.82E-04	1.66E-04
Stockpile2		2.42E-03	1.21E-03	1.82E-04	1.66E-04
Stockpile3		2.42E-03	1.21E-03	1.82E-04	1.66E-04
Stockpile4		2.42E-03	1.21E-03	1.82E-04	1.66E-04
Stockpile5		2.42E-03	1.21E-03	1.82E-04	1.66E-04
Stockpile6		2.42E-03	1.21E-03	1.82E-04	1.66E-04
Stockpile7		2.42E-03	1.21E-03	1.82E-04	1.66E-04
Stockpile8		2.42E-03	1.21E-03	1.82E-04	1.66E-04

Source ID(s) HAULTRK, QUARRYLD, SHIPLD, SHIPTRK

Source Description Unpaved Roads - Fugitive Dust

Overview

All of the roads within the facility are unpaved. Haul trucks, loaders, shipping trucks and water trucks operate within the internal haul routes and enter the facility from the main site access.

Maximum Operating Parameters

Silt Content [%]	8.3	*from US EPA AP-42 Section 13.2.2, mean silt content for Stone quarrying and processing - Haul road to/from pit*
Dust Control Efficiency	95%	*based on US EPA AP-42 Section 13.2.2*

Methodology

The predictive equation in US EPA AP-42 Chapter 13.2.2 – Unpaved Roads (November 2006) was used to calculate the fugitive dust emissions from unpaved roadways. The equation accounts for control efficiency for the implementation of dust control measures. A control efficiency of 95% was obtained from US EPA AP-42 Section 13.2.2 for intensive watering ensuring the moisture ratio is 5 or greater, where the moisture ratio is defined as the surface moisture content of the watered road by the surface moisture content of the uncontrolled road.

As noted on the Air Contaminants Benchmark List (dated April 2018) crystalline silica is defined as respirable < 10 µm in diameter. For crushing and screening, silica content in PM10 was estimated based on the PM4 emission factors from Table 5 of the article by Richards, et. al. PM4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California (Journal of the Air & Waste Management Association, 59:11, 1287-1295, DOI: 10.3155/1047-3289.59.11.1287). The silica content estimated from PM4 was then conservatively applied to PM10.

Sample Calculations

Controlled Emission Factor

$$E = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b} \times 281.9$$

Where:

E = Size Specific Emission Factor (g/VKT)
k= particle size multiplier for particle size range and units of interest
s = silt content (%)
W = Mean Vehicle Weight (tons)

Constants for Unpaved Road Emission Calculation

	SPM	PM10	PM2.5
k (lb/VMT):	4.90	1.50	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45

For Haul Trucks ar Quarry (HAULTRK)

$$EF_{SPM} = 4.90 \left(\frac{8.3}{12}\right)^{0.7} \left(\frac{79}{3}\right)^{0.45} 281.9\ (100\% - 95\%)$$

$$= 231.89\ \frac{g}{VKT}$$

Phase 3 Extraction Scenario

Source ID	Vehicle Type and Route	Length [km] (based on modelling source parameters for each Scenario)	Number of trips per hour (based on vehicle capacity and crushing plant hourly tonnage)	Total distance travelled per hour for each vehicle type [VKT/hr]	Unloaded Vehicle Weight [tons][1]	Loaded Vehicle Weight [tons][1]	Prorated Mean Vehicle Weight[2] [tons]	Emission Factor (accounting for dust control efficiency)		
								SPM [g/VKT]	PM10 [g/VKT]	PM2.5 [g/VKT]
HAULTRK	Haul trucks at Quarry	0.8957	26	46	48	109	79	231.89	65.94	6.59
QUARRYLD	Front end loaders at the Quarry face	0.1165	72	8	58	80	69	218.77	62.21	6.22
SHIPLD	Shipping loaders	0.0779	52	4	87	117	102	260.50	74.08	7.41
SHIPTRK	Shipping Trucks	0.3276	68	22	8	44	26	141.19	40.15	4.01

Notes: "Loaded"/"Unloaded" refers to whether the vehicle is hauling a load of aggregate product or is travelling "empty" except for a driver.

"Unloaded" shipping truck weight is the inherent weight of the truck frame, cab, and all vehicle components, and includes the weight of the driver. "Loaded" shipping truck weight adds the aggregate payload to the unloaded truck weight.

1 - US tons to be consistent with requirements of formula obtained from US EP AP42.
2 - Vehicles are assumed to travel unloaded in one direction and loaded in the other direction.

1-hr SPM for Haul trucks at Quarry = $231.89 \frac{g}{VKT} \times 46 \frac{VKT}{hour} \times \frac{1\ hour}{3600\ s}$

1-hr SPM for Haul trucks at Quarry = 2.97E+00 $\frac{g}{s}$

Sample Calculation for Crystalline Silica - Haul Trucks at Quarry

CrySi EF = $\frac{0.000048 \text{ lb/t CrySi in } PM_4 \text{ from material transfer point (AWMA article)}}{0.00035 \text{ lb/t } (PM_4 \text{ EF for material transfer point, AWMA article)}}$

CrySi EF = 14% conservatively assumed for silica content in PM_{10}

$\text{Emission Rate}_{\text{Crystalline Silica}}$ = $\text{Emission Rate}_{PM10}$ x Max % of Crystalline Silica

= 8.45E-01 $\frac{g}{s}$ x 14%

$\text{Emission Rate}_{\text{Crystalline Silica}}$ = 1.16E-01 $\frac{g}{s}$

Emission Summary

Emission Factor Quality	Above Average

Source ID	Vehicle Type and Route	1-hour ER [g/s]			
		SPM	PM10	PM2.5	Crystalline Silica
HAULTRK	Haul trucks at Quarry	2.9728	8.45E-01	8.45E-02	1.16E-01
QUARRYLD	Front end loaders at the Quarry face	0.5129	1.46E-01	1.46E-02	2.00E-02
SHIPLD	Shipping loaders	0.29	8.35E-02	8.35E-03	1.14E-02
SHIPTRK	Shipping Trucks	0.87	2.48E-01	2.48E-02	3.41E-02

Phase 6 Extraction Scenario

Source ID	Vehicle Type and Route	Length [km] (based on modelling source parameters for each Scenario)	Number of trips per hour (based on vehicle capacity and crushing plant hourly tonnage)	Total distance travelled per hour for each vehicle type [VKT/hr]	Unloaded Vehicle Weight [tons][1]	Loaded Vehicle Weight [tons][1]	Prorated Mean Vehicle Weight[2] [tons]	Emission Factor (accounting for dust control efficiency)		
								SPM [g/VKT]	PM10 [g/VKT]	PM2.5 [g/VKT]
HAULTRK	Haul trucks at Quarry	0.3573	26	18	48	109	79	231.89	65.94	6.59
QUARRYLD	Front end loaders at the Quarry face	0.0672	72	5	58	80	69	218.77	62.21	6.22
SHIPLD	Shipping loaders	0.0779	52	4	87	117	102	260.50	74.08	7.41
SHIPTRK	Shipping Trucks	0.3276	68	22	8	44	26	141.19	40.15	4.01

Notes: "Loaded"/"Unloaded" refers to whether the vehicle is hauling a load of aggregate product or is travelling "empty" except for a driver.

"Unloaded" shipping truck weight is the inherent weight of the truck frame, cab, and all vehicle components, and includes the weight of the driver. "Loaded" shipping truck weight adds the aggregate payload to the unloaded truck weight.

1 - US tons to be consistent with requirements of formula obtained from US EP AP42.
2 - Vehicles are assumed to travel unloaded in one direction and loaded in the other direction.

$$\text{1-hr SPM for Haul trucks at Quarry} = 231.89\ \frac{g}{VKT} \times 18\ \frac{VKT}{hour} \times \frac{1\ hour}{3600\ s}$$

$$\text{1-hr SPM for Haul trucks at Quarry} = 1.19E+00\ \frac{g}{s}$$

Sample Calculation for Crystalline Silica - Haul Trucks at Quarry

$$\text{CrySi EF} = \frac{0.000048 \text{ lb/t CrySi in } PM_4 \text{ from material transfer point (AWMA article)}}{0.00035 \text{ lb/t } (PM_4 \text{ EF for material transfer point, AWMA article})}$$

CrySi EF = 14% conservatively assumed for silica content in PM_{10}

$$\text{Emission Rate}_{\text{Crystalline Silica}} = \text{Emission Rate}_{PM10} \times \text{Max \% of Crystalline Silica}$$

$$= 3.37E-01\ \frac{g}{s} \times 14\%$$

$$\text{Emission Rate}_{\text{Crystalline Silica}} = 4.62E-02\ \frac{g}{s}$$

Emission Summary

Emission Factor Quality	Above Average

Source ID	Vehicle Type and Route	1-hour ER [g/s]			
		SPM	PM10	PM2.5	Crystalline Silica
HAULTRK	Haul trucks at Quarry	1.19E+00	3.37E-01	3.37E-02	4.62E-02
QUARRYLD	Front end loaders at the Quarry face	2.96E-01	8.41E-02	8.41E-03	1.15E-02
SHIPLD	Shipping loaders	2.93E-01	8.35E-02	8.35E-03	1.14E-02
SHIPTRK	Shipping Trucks	8.74E-01	2.48E-01	2.48E-02	3.41E-02

Phase 7 Extraction Scenario

Source ID	Vehicle Type and Route	Length [km] (based on modelling source parameters for each Scenario)	Number of trips per hour (based on vehicle capacity and crushing plant hourly tonnage)	Total distance travelled per hour for each vehicle type [VKT/hr]	Unloaded Vehicle Weight [tons][1]	Loaded Vehicle Weight [tons][1]	Prorated Mean Vehicle Weight[2] [tons]	Emission Factor (accounting for dust control efficiency)		
								SPM [g/VKT]	PM10 [g/VKT]	PM2.5 [g/VKT]
HAULTRK	Haul trucks at Quarry	0.7916	26	41	48	109	79	231.89	65.94	6.59
QUARRYLD	Front end loaders at the Quarry face	0.0731	72	5	58	80	69	218.77	62.21	6.22
SHIPLD	Shipping loaders	0.0779	52	4	87	117	102	260.50	74.08	7.41
SHIPTRK	Shipping Trucks	0.3276	68	22	8	44	26	141.19	40.15	4.01

Notes: "Loaded"/"Unloaded" refers to whether the vehicle is hauling a load of aggregate product or is travelling "empty" except for a driver.

"Unloaded" shipping truck weight is the inherent weight of the truck frame, cab, and all vehicle components, and includes the weight of the driver. "Loaded" shipping truck weight adds the aggregate payload to the unloaded truck weight.

1 - US tons to be consistent with requirements of formula obtained from US EP AP42.
2 - Vehicles are assumed to travel unloaded in one direction and loaded in the other direction.

$$\text{1-hr SPM for Haul trucks at Quarry} = \frac{231.89 \text{ g}}{\text{VKT}} \times \frac{41 \text{ VKT}}{\text{hour}} \times \frac{1 \text{ hour}}{3600 \text{ s}}$$

$$\text{1-hr SPM for Haul trucks at Quarry} = 2.63\text{E}+00 \ \frac{\text{g}}{\text{s}}$$

Sample Calculation for Crystalline Silica - Haul Trucks at Quarry

$$\text{CrySi EF} = \frac{0.000048 \text{ lb/t CrySi in } PM_4 \text{ from material transfer point (AWMA article)}}{0.00035 \text{ lb/t } (PM_4 \text{ EF for material transfer point, AWMA article})}$$

CrySi EF = 14% conservatively assumed for silica content in PM_{10}

$$\text{Emission Rate}_{\text{Crystalline Silica}} = \text{Emission Rate}_{PM10} \times \text{Max \% of Crystalline Silica}$$

$$= 7.47\text{E-01} \ \frac{\text{g}}{\text{s}} \times 14\%$$

$$\text{Emission Rate}_{\text{Crystalline Silica}} = 1.02\text{E-01} \ \frac{\text{g}}{\text{s}}$$

Emission Summary

Emission Factor Quality	Above Average

Source ID	Vehicle Type and Route	1-hour ER [g/s]			
		SPM	PM10	PM2.5	Crystalline Silica
HAULTRK	Haul trucks at Quarry	2.6273	7.47E-01	7.47E-02	1.02E-01
QUARRYLD	Front end loaders at the Quarry face	0.3219	9.15E-02	9.15E-03	1.26E-02
SHIPLD	Shipping loaders	0.29	8.35E-02	8.35E-03	1.14E-02
SHIPTRK	Shipping Trucks	0.87	2.48E-01	2.48E-02	3.41E-02

Source ID **SHIPTRK_T**

Source Description Exhaust Emissions - On-Highway Engines (Shipping Trucks)

Overview

Processed aggregate material from the crushing plant is shipped offsite using highway (shipping) trucks which travel along the Site's access roads.

Maximum Operating Parameters

The US EPA's MOVES Model was used to estimate emissions from the shipping trucks. SPM emissions were assumed to be equal to PM10 emissions that were estimated by MOVES.

Sample Calculations

Emission Rate = Emission Factor (g/VKT)* Total VKT for all the tshipping trucks per hour*1 hr/3600s

MOVES Emission Factors Summary:

Source ID	Contaminant	Emission Factor [g/VKT]
SHIPTRK_T	Nitrogen Oxides	40.41
	Sulphur Dioxide	0.03
	PM10	0.55
	PM2.5	0.50

1-hour NOx Emission Rate for Shipping Trucks = $\frac{4.04E+01 \text{ g}}{\text{VKT}} \times \frac{22.33 \text{ Total VKT for all shipping trucks}}{\text{hour}} \times \frac{1 \text{ hr}}{3600 \text{ s}}$

1-hour NOx Emission Rate for Shipping Trucks = $\frac{2.51E-01 \text{ g}}{\text{s}}$

Emission Summary

Source ID	Maximum 1-hr Emission Rate [g/s]	
	Contaminant	1-hr Emission
SHIPTRK_T	Nitrogen Oxides	2.51E-01
	Sulphur Dioxide	1.67E-04
	SPM	3.39E-03
	PM10	3.39E-03
	PM2.5	3.12E-03

Source IDs **HAULTRK_T, QUARRYLD_T, SHIPLD_T, WATTRK_T** **Source Description** Exhaust Emissions - Nonroad Engines

Overview

Offroad vehicles operate within the quarry and along the haul route. Loaders move blasted material from the extraction face to haul trucks which further transport the material to the crushing plant. Loaders also operate at the crushing plant location to move the material from the crushed material stockpiles to the shipping trucks.

Maximum Operating Parameters

Nonroad CI Engine Emission Standards from Table A4 of the US EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d (July 2010) (EPA Report NR-009d) were used to calculate the exhaust emissions from on-site vehicles. All vehicles at the quarry meet Tier 4 emission standards. Emission standards were not provided for PM10 and PM2.5; therefore, it was assumed that all PM emissions consist of PM10 and that PM2.5 emissions are 97% of PM10 emissions, per the NR-009d document.

Sample Calculations

Front end Loader at the Quarry face

Basic SPM emission factor = Zero-hour emission factor (g/hp-hr) * Deterioration Factor * Transient Adjustment Factor - Sulphur Adjustment Factor

$$EF = 0.0092 \frac{g}{hp\text{-}hr} \times 1.473 \times 1.00 - 0.0000 \frac{g}{hp\text{-}hr}$$

$$EF = 1.36E\text{-}02 \frac{g}{hp\text{-}hr}$$

1-hour SPM = Emission Factor (g/hp-hr)* Horsepower * Load factor *1 hr/3600s * Number of units

$$\text{1-hour SPM} = 1.36E\text{-}02 \frac{g}{hp\text{-}hr} \times 528\ hp \times 0.59 \times \frac{1\ hr}{3600\ s} \times 3\ loader$$

$$\text{1-hour SPM} = 3.52E\text{-}03 \frac{g}{s}$$

Per the EPA Report NR-009d, emissions of SO2 are calculated based on brake-specific fuel consumption, sulphur content in the diesel fuel used, and the fraction of fuel sulphur which was converted to direct SPM, using the equation below:

Emissions

Emission Factor Quality	Marginal

Source ID	Vehicle/Equipment Type	# of units	hp[1]	Tier Rating	NONROAD model equipment type	Load Factor[2]	BSFCs [lb fuel/hp-hr]	BSFC TAF	Fraction of S Converted to PM	Default Fuel Sulphur Level in the US EPA NONROAD (SOXBAS) [ppmw]
HAULTRK_T	Haul Trucks - Tailpipe emissions	5	630	4	Crawler	0.59	0.367	1	0.02247	15
QUARRYLD_T	Front end Loaders at the Quarry face - Tailpipe emissions	3	528	4	RTLoader	0.59	0.367	1	0.02247	15
SHIPLD_T	Shipping Loaders - Tailpipe emissions	4	393	4	RTLoader	0.59	0.367	1	0.02247	15
WATTRK_T	Water Truck - Tailpipe emissions	2	332	4	Crawler	0.59	0.367	1	0.02247	15

Notes:

1 - Horsepower for the equipment was obtained from manufacturer's specifications documents available online based on the make and the model

2 - Load factors were obtained from the document titled Median Life, Annual Activity, and Load Factor Values for Nonroad engine Emissions Modeling – Report No. NR-005d (US EPA, July 2010), Table 9, Table 10, and Appendix A.

Calculations for 1-hour Particulate Matter

PM10 =	100%	of PM
PM2.5 =	97%	of PM10

Source ID	# of units	hp	Tier Rating	NONROAD model equipment type	PM Emission Factor [g/hp-hr]	Transient Factor [PM]	Deterioration Factor [PM]	Sulphur Adjustment Factor [g/hp-hr]	1-hour SPM Emissions [g/s]	1-hour PM10 emissions [g/s]	1-hour PM2.5 Emissions [g/s]
HAULTRK_T	5	630	4	Crawler	0.0092	1.00	1.473	0.00E+00	7.00E-03	7.00E-03	6.79E-03
QUARRYLD_T	3	528	4	RTLoader	0.0092	1.00	1.473	0.00E+00	3.52E-03	3.52E-03	3.41E-03
SHIPLD_T	4	393	4	RTLoader	0.0276	1.00	1.473	0.00E+00	1.05E-02	1.05E-02	1.02E-02
WATTRK_T	2	332	4	Crawler	0.0092	1.00	1.473	0.00E+00	1.47E-03	1.47E-03	1.43E-03

Calculations for 1-hour Nitrogen Oxides

Source ID	# of units	hp	Tier Rating	NONROAD model equipment type	NOx Emission Factor [g/hp-hr]	Transient Factor [NOx]	Deterioration Factor [NOx]	1-hour NOx Emissions [g/s]
HAULTRK_T	5	630	4	Crawler	0.276	1.00	1.008	1.44E-01
QUARRYLD_T	3	528	4	RTLoader	0.276	1.00	1.008	7.22E-02
SHIPLD_T	4	393	4	RTLoader	2.392	1.00	1.008	6.21E-01
WATTRK_T	2	332	4	Crawler	0.276	1.00	1.008	3.03E-02

Emission Summary

Source ID	Vehicle Type	1-hour Emissions by Vehicle ID [g/s]			
		SPM	PM10	PM2.5	Nitrogen Oxides
HAULTRK_T	Haul Trucks - Tailpipe emissions	7.00E-03	7.00E-03	6.79E-03	1.44E-01
QUARRYLD_T	Front end Loaders at the Quarry face - Tailpipe emissions	3.52E-03	3.52E-03	3.41E-03	7.22E-02
SHIPLD_T	Shipping Loaders - Tailpipe emissions	1.05E-02	1.05E-02	1.02E-02	6.21E-01
WATTRK_T	Water Truck - Tailpipe emissions	1.47E-03	1.47E-03	1.43E-03	3.03E-02

APPENDIX C

Source Summary Tables

Appendix C - Table C1
Source Summary Table

Source Identifier	Source Description	Emission Data						
		Contaminant	CAS No.	Averaging Period [hours]	1-hr Maximum Emission Rate [g/s]	24-hr Maximum Emission Rate [g/s]	Emission Estimating Technique	Emissions Data Quality
Sources and Emission Rates applicable to Extraction Phases 3, 6 and 7								
BLASTDRL	Blast Hole Drilling	SPM	N/A	24-hour, Annual	—	6.66E-03	EF	Average
		PM10	N/A-1	24-hour	—	3.50E-03	EF	Average
		PM2.5	N/A-2	24-hour, Annual	—	5.55E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	4.80E-04	MB	Average
EXPLOS	Blasting Explosives	Nitrogen oxides	10102-44-0	1-hour, 24-hour	9.17E+00	3.82E-01	EF	Unknown
BLASTFUG	Blasting Fugitives	SPM	N/A	24-hour, Annual	—	1.05E-01	EF	Average
		PM10	N/A-1	24-hour	—	5.44E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	3.14E-03	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	7.46E-03	MB	Average
UNLOAD2	Truck unloading	SPM	N/A	24-hour, Annual	—	1.57E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.57E-03	EF	Average
		PM2.5	N/A-2	24-hour, Annual	—	1.57E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.16E-04	MB	Average
CRUSH2	Crushing	SPM	N/A	24-hour, Annual	—	5.20E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	2.34E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	4.33E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.58E-03	MB	Marginal
SCRN2	Screening	SPM	N/A	24-hour, Annual	—	9.53E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	3.20E-02	EF	Average
		PM2.5	N/A-2	24-hour, Annual	—	2.16E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	3.20E-03	MB	Average
CONV1	Conveyor	SPM	N/A	24-hour, Annual	—	5.48E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.80E-03	EF	Average
		PM2.5	N/A-2	24-hour, Annual	—	5.09E-04	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.47E-04	MB	Average
CONV2	Conveyor	SPM	N/A	24-hour, Annual	—	9.56E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	3.14E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	8.88E-04	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	4.31E-04	MB	Marginal
CONV3	Conveyor	SPM	N/A	24-hour, Annual	—	7.82E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	2.57E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	7.27E-04	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	3.53E-04	MB	Marginal
CONV4	Conveyor	SPM	N/A	24-hour, Annual	—	7.82E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	2.57E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	7.27E-04	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	3.53E-04	MB	Marginal
CRUSH3	Crushing	SPM	N/A	24-hour, Annual	—	4.70E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	2.11E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	3.92E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.33E-03	MB	Marginal
CRUSH4	Crushing	SPM	N/A	24-hour, Annual	—	6.71E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	3.02E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	6.71E-02	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	3.33E-03	MB	Marginal
CRUSH5	Crushing	SPM	N/A	24-hour, Annual	—	6.71E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	3.02E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	6.71E-02	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	3.33E-03	MB	Marginal
SCRN3	Screening	SPM	N/A	24-hour, Annual	—	4.31E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	1.45E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.17E-02	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	1.45E-03	MB	Marginal
SCRN4	Screening	SPM	N/A	24-hour, Annual	—	4.31E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	1.45E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	9.79E-04	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	1.45E-03	MB	Marginal
SCRN5	Screening	SPM	N/A	24-hour, Annual	—	8.20E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	2.76E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.86E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.76E-03	MB	Marginal
SCRN6	Screening	SPM	N/A	24-hour, Annual	—	8.20E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	2.76E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.86E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.76E-03	MB	Marginal
SCRN7	Screening	SPM	N/A	24-hour, Annual	—	8.20E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	2.76E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.86E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.76E-03	MB	Marginal
MATHNDL1	Stockpile 1	SPM	N/A	24-hour, Annual	1.20E+00	—	EF	Average
		PM10	N/A-1	24-hour	5.23E-01	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	7.92E-02	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	7.17E-02	—	MB	Average
MATHNDL2	Stockpile 2	SPM	N/A	24-hour, Annual	7.78E-01	—	EF	Average
		PM10	N/A-1	24-hour	3.40E-01	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	5.15E-02	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	4.67E-02	—	MB	Average
MATHNDL3	Stockpile 3	SPM	N/A	24-hour, Annual	1.89E+00	—	EF	Average
		PM10	N/A-1	24-hour	8.26E-01	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	1.25E-01	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	1.13E-01	—	MB	Average
MATHNDL4	Stockpile 4	SPM	N/A	24-hour, Annual	9.42E-01	—	EF	Average
		PM10	N/A-1	24-hour	4.12E-01	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	6.24E-02	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	5.65E-02	—	MB	Average
MATHNDL5	Stockpile 5	SPM	N/A	24-hour, Annual	4.29E+00	—	EF	Average
		PM10	N/A-1	24-hour	1.88E+00	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	2.84E-01	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	2.57E-01	—	MB	Average
MATHNDL6	Stockpile 6	SPM	N/A	24-hour, Annual	2.96E-01	—	EF	Average
		PM10	N/A-1	24-hour	1.30E-01	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	1.96E-02	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	1.78E-02	—	MB	Average
MATHNDL7	Stockpile 7	SPM	N/A	24-hour, Annual	6.88E-01	—	EF	Average
		PM10	N/A-1	24-hour	3.01E-01	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	4.56E-02	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	4.13E-02	—	MB	Average
MATHNDL8	Stockpile 8	SPM	N/A	24-hour, Annual	4.97E-01	—	EF	Average
		PM10	N/A-1	24-hour	2.18E-01	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	3.29E-02	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	2.98E-02	—	MB	Average
QUARRYMH	Excavated material handling in the quarry face	SPM	N/A	24-hour, Annual	2.36E+00	—	EF	Average
		PM10	N/A-1	24-hour	1.03E+00	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	1.56E-01	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	1.41E-01	—	MB	Average
SHIPMH	Processed material handling from product stockpiles onto shipping trucks	SPM	N/A	24-hour, Annual	7.50E+00	—	EF	Average
		PM10	N/A-1	24-hour	3.28E+00	—	EF	Average
		PM2.5	N/A-2	24-hour, Annual	4.97E-01	—	EF	Average
		Crystalline Silica	14808-60-7	24-hour	4.50E-01	—	MB	Average

Source Identifier	Source Description	Emission Data						
		Contaminant	CAS No.	Averaging Period [hours]	1-hr Maximum Emission Rate [g/s]	24-hr Maximum Emission Rate [g/s]	Emission Estimating Technique	Emissions Data Quality
Stockpile1	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Stockpile2	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Stockpile3	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Stockpile4	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Stockpile5	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Stockpile6	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Stockpile7	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Stockpile8	Crushing Plant Stockpiles Wind Erosion	SPM	N/A	24-hour, Annual	—	2.42E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.21E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.82E-04	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	1.66E-04	EF	Marginal
Sources and Emission Rates applicable to Extraction Phase 3								
UNLOAD1	Truck unloading	SPM	N/A	24-hour, Annual	—	1.57E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.57E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.57E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.16E-04	MB	Marginal
CRUSH1	Crushing	SPM	N/A	24-hour, Annual	—	5.20E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	2.34E-02	EF	Average
		PM2.5	N/A-2	24-hour, Annual	—	4.33E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	2.58E-03	MB	Average
SCRN1	Screening	SPM	N/A	24-hour, Annual	—	9.53E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	3.20E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	2.16E-03	EF	Marginal
		Crystalline silica	14808-60-7	24-hour	—	3.20E-03	MB	Marginal
Sources and Emission Rates applicable to Extraction Phases 6 and 7								
UNLOAD1	Truck unloading	SPM	N/A	24-hour, Annual	—	3.15E-03	EF	Marginal
		PM10	N/A-1	24-hour	—	1.57E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	1.57E-03	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	2.16E-04	EF	Marginal
CRUSH1	Crushing	SPM	N/A	24-hour, Annual	—	5.20E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	2.34E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	4.33E-03	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	2.58E-03	EF	Marginal
SCRN1	Screening	SPM	N/A	24-hour, Annual	—	9.53E-02	EF	Marginal
		PM10	N/A-1	24-hour	—	3.20E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	—	2.16E-03	EF	Marginal
		Crystalline Silica	14808-60-7	24-hour	—	3.20E-03	EF	Marginal
DG1	Crushing Plant Generators	SPM	N/A	24-hour, Annual	4.58E-02	4.58E-02	EF	Above-Average
		PM10	N/A-1	24-hour	4.58E-02	4.58E-02	EF	Above-Average
		PM2.5	N/A-2	24-hour, Annual	4.45E-02	4.45E-02	EF	Above-Average
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	1.60E+00	1.60E+00	EF	Above-Average
Line Volume Sources								
Sources and Emission Rates applicable to Extraction Phase 3								
HAULTRK	Haul trucks at Quarry	SPM	N/A	24-hour, Annual	2.97E+00	2.97E+00	EF	Above Average
		PM10	N/A-1	24-hour	8.45E-01	8.45E-01	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	8.45E-02	8.45E-02	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	1.16E-01	1.16E-01	EF	Above Average
QUARRYLD	Front end loaders at the Quarry face	SPM	N/A	24-hour, Annual	5.13E-01	5.13E-01	EF	Above Average
		PM10	N/A-1	24-hour	1.46E-01	1.46E-01	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	1.46E-02	1.46E-02	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	2.00E-02	2.00E-02	EF	Above Average
SHIPLD	Shipping loaders	SPM	N/A	24-hour, Annual	2.93E-01	2.93E-01	EF	Above Average
		PM10	N/A-1	24-hour	8.35E-02	8.35E-02	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	8.35E-03	8.35E-03	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	1.14E-02	1.14E-02	EF	Above Average
SHIPTRK	Shipping Trucks	SPM	N/A	24-hour, Annual	8.74E-01	8.74E-01	EF	Above Average
		PM10	N/A-1	24-hour	2.48E-01	2.48E-01	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	2.48E-02	2.48E-02	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	3.41E-02	3.41E-02	EF	Above Average
HAULTRK_T	Haul Trucks - Tailpipe emissions	SPM	N/A	24-hour, Annual	7.00E-03	7.00E-03	EF	Marginal
		PM10	N/A-1	24-hour	7.00E-03	7.00E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	6.79E-03	6.79E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	1.44E-01	1.44E-01	EF	Marginal
QUARRYLD_T	Front end Loaders at the Quarry face - Tailpipe emissions	SPM	N/A	24-hour, Annual	3.52E-03	3.52E-03	EF	Marginal
		PM10	N/A-1	24-hour	3.52E-03	3.52E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	3.41E-03	3.41E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	7.22E-02	7.22E-02	EF	Marginal
SHIPLD_T	Shipping Loaders - Tailpipe emissions	SPM	N/A	24-hour, Annual	1.05E-02	1.05E-02	EF	Marginal
		PM10	N/A-1	24-hour	1.05E-02	1.05E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	1.02E-02	1.02E-02	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	6.21E-01	6.21E-01	EF	Marginal
WATTRK_T	Water Truck - Tailpipe emissions	SPM	N/A	24-hour, Annual	1.47E-03	1.47E-03	EF	Marginal
		PM10	N/A-1	24-hour	1.47E-03	1.47E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	1.43E-03	1.43E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	3.03E-02	3.03E-02	EF	Marginal
SHIPTRK_T	Exhaust Emissions - On-Highway Engines (Shipping Trucks)	SPM	N/A	24-hour, Annual	3.39E-03	3.39E-03	EF	Marginal
		PM10	N/A-1	24-hour	3.39E-03	3.39E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	3.12E-03	3.12E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	2.51E-01	2.51E-01	EF	Marginal
Sources and Emission Rates applicable to Extraction Phase 6								
HAULTRK	Haul trucks at Quarry	SPM	N/A	24-hour, Annual	1.19E+00	1.19E+00	EF	Above Average
		PM10	N/A-1	24-hour	3.37E-01	3.37E-01	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	3.37E-02	3.37E-02	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	4.62E-02	4.62E-02	EF	Above Average
QUARRYLD	Front end loaders at the Quarry face	SPM	N/A	24-hour, Annual	2.96E-01	2.96E-01	EF	Above Average
		PM10	N/A-1	24-hour	8.41E-02	8.41E-02	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	8.41E-03	8.41E-03	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	1.15E-02	1.15E-02	EF	Above Average
SHIPLD	Shipping loaders	SPM	N/A	24-hour, Annual	2.93E-01	2.93E-01	EF	Above Average
		PM10	N/A-1	24-hour	8.35E-02	8.35E-02	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	8.35E-03	8.35E-03	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	1.14E-02	1.14E-02	EF	Above Average

Source Identifier	Source Description	Emission Data						
		Contaminant	CAS No.	Averaging Period [hours]	1-hr Maximum Emission Rate [g/s]	24-hr Maximum Emission Rate [g/s]	Emission Estimating Technique	Emissions Data Quality
SHIPTRK	Shipping Trucks	SPM	N/A	24-hour, Annual	8.74E-01	8.74E-01	EF	Above Average
		PM10	N/A-1	24-hour	2.48E-01	2.48E-01	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	2.48E-02	2.48E-02	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	3.41E-02	3.41E-02	EF	Above Average
HAULTRK_T	Haul Trucks - Tailpipe emissions	SPM	N/A	24-hour, Annual	7.00E-03	7.00E-03	EF	Marginal
		PM10	N/A-1	24-hour	7.00E-03	7.00E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	6.79E-03	6.79E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	1.44E-01	1.44E-01	EF	Marginal
QUARRYLD_T	Front end Loaders at the Quarry face - Tailpipe emissions	SPM	N/A	24-hour, Annual	3.52E-03	3.52E-03	EF	Marginal
		PM10	N/A-1	24-hour	3.52E-03	3.52E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	3.41E-03	3.41E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	7.22E-02	7.22E-02	EF	Marginal
SHIPLD_T	Shipping Loaders - Tailpipe emissions	SPM	N/A	24-hour, Annual	1.05E-02	1.05E-02	EF	Marginal
		PM10	N/A-1	24-hour	1.05E-02	1.05E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	1.02E-02	1.02E-02	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	6.21E-01	6.21E-01	EF	Marginal
WATTRK_T	Water Truck - Tailpipe emissions	SPM	N/A	24-hour, Annual	1.47E-03	1.47E-03	EF	Marginal
		PM10	N/A-1	24-hour	1.47E-03	1.47E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	1.43E-03	1.43E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	3.03E-02	3.03E-02	EF	Marginal
SHIPTRK_T	Exhaust Emissions - On-Highway Engines (Shipping Trucks)	SPM	N/A	24-hour, Annual	3.39E-03	3.39E-03	EF	Marginal
		PM10	N/A-1	24-hour	3.39E-03	3.39E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	3.12E-03	3.12E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	2.51E-01	2.51E-01	EF	Marginal
Sources and Emission Rates applicable to Extraction Phase 7								
HAULTRK	Haul trucks at Quarry	SPM	N/A	24-hour, Annual	2.63E+00	2.63E+00	EF	Above Average
		PM10	N/A-1	24-hour	7.47E-01	7.47E-01	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	7.47E-02	7.47E-02	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	1.02E-01	1.02E-01	EF	Above Average
QUARRYLD	Front end loaders at the Quarry face	SPM	N/A	24-hour, Annual	3.22E-01	3.22E-01	EF	Above Average
		PM10	N/A-1	24-hour	9.15E-02	9.15E-02	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	9.15E-03	9.15E-03	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	1.26E-02	1.26E-02	EF	Above Average
SHIPLD	Shipping loaders	SPM	N/A	24-hour, Annual	2.93E-01	2.93E-01	EF	Above Average
		PM10	N/A-1	24-hour	8.35E-02	8.35E-02	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	8.35E-03	8.35E-03	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	1.14E-02	1.14E-02	EF	Above Average
SHIPTRK	Shipping Trucks	SPM	N/A	24-hour, Annual	8.74E-01	8.74E-01	EF	Above Average
		PM10	N/A-1	24-hour	2.48E-01	2.48E-01	EF	Above Average
		PM2.5	N/A-2	24-hour, Annual	2.48E-02	2.48E-02	EF	Above Average
		Crystalline Silica	14808-60-7	24-hour	3.41E-02	3.41E-02	EF	Above Average
HAULTRK_T	Haul Trucks - Tailpipe emissions	SPM	N/A	24-hour, Annual	7.00E-03	7.00E-03	EF	Marginal
		PM10	N/A-1	24-hour	7.00E-03	7.00E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	6.79E-03	6.79E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	1.44E-01	1.44E-01	EF	Marginal
QUARRYLD_T	Front end Loaders at the Quarry face - Tailpipe emissions	SPM	N/A	24-hour, Annual	3.52E-03	3.52E-03	EF	Marginal
		PM10	N/A-1	24-hour	3.52E-03	3.52E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	3.41E-03	3.41E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	7.22E-02	7.22E-02	EF	Marginal
SHIPLD_T	Shipping Loaders - Tailpipe emissions	SPM	N/A	24-hour, Annual	1.05E-02	1.05E-02	EF	Marginal
		PM10	N/A-1	24-hour	1.05E-02	1.05E-02	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	1.02E-02	1.02E-02	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	6.21E-01	6.21E-01	EF	Marginal
WATTRK_T	Water Truck - Tailpipe emissions	SPM	N/A	24-hour, Annual	1.47E-03	1.47E-03	EF	Marginal
		PM10	N/A-1	24-hour	1.47E-03	1.47E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	1.43E-03	1.43E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	3.03E-02	3.03E-02	EF	Marginal
SHIPTRK_T	Exhaust Emissions - On-Highway Engines (Shipping Trucks)	SPM	N/A	24-hour, Annual	3.39E-03	3.39E-03	EF	Marginal
		PM10	N/A-1	24-hour	3.39E-03	3.39E-03	EF	Marginal
		PM2.5	N/A-2	24-hour, Annual	3.12E-03	3.12E-03	EF	Marginal
		Nitrogen Oxides	10102-44-0	1-hour, 24-hour	2.51E-01	2.51E-01	EF	Marginal

Notes: "—" - No data or not applicable
"V-ST" - Validated Source Test, "ST" - Source Test, "EF" - Emission Factor, "MB" Mass Balance, "EC" - Engineering Calculation
Data Quality Categories: "Highest"; "Above-Average"; "Average"; and "Marginal"

Appendix C - Table C2
Dispersion Modelling Source Summary Table

Sources and Emission Rates applicable to Extraction Phases 3, 6 and 7

AREA SOURCES

Modelling ID	Source ID(s)	Source Description	Type of Source	Height Above Grade [m]	Area [m^2]	Initial vertical dimension [m]	Release Height [m]	Contaminant	CAS No.	Maximum 1-hr Emission Rate [g/s]	Maximum 24-hr Emission Rate [g/s]	Averaging Period [hours]
BLAST	BLASTDRL, EXPLOS, BLASTFUG	Blast Hole Drilling, Blasting Explosives, Blasting Fugitives	Area	8.00	6.37	1.86	4.00	SPM	N/A	—	1.11E-01	24-hour, Annual
								PM10	N/A-1	—	5.79E-02	24-hour
								PM2.5	N/A-2	—	3.69E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	7.94E-03	24-hour
								Nitrogen oxides	10102-44-0	9.17E+00	3.82E-01	1-hour, 24-hour
WIND1	Stockpile1	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour
WIND2	Stockpile2	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour
WIND3	Stockpile3	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour
WIND4	Stockpile4	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour
WIND5	Stockpile5	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour
WIND6	Stockpile6	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour
WIND7	Stockpile7	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour
WIND8	Stockpile8	Crushing Plant Stockpiles Wind Erosion	Volume	14.00	1225.00	3.26	7.00	SPM	N/A	—	2.42E-03	24-hour, Annual
								PM10	N/A-1	—	1.21E-03	24-hour
								PM2.5	N/A-2	—	1.82E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.66E-04	24-hour

Volume Sources

Modelling ID	Source ID(s)	Source Description	Type of Source	Height Above Grade [m]	Initial lateral dimension [m]	Initial vertical dimension [m]	Release Height [m]	Contaminant	CAS No.	Maximum 1-hr Emission Rate [g/s]	Maximum 24-hr Emission Rate [g/s]	Averaging Period [hours]
UNLOAD2	UNLOAD2	Truck unloading	Volume	6.00	0.93	1.40	3.00	SPM	N/A	—	1.57E-03	24-hour, Annual
								PM10	N/A-1	—	1.57E-03	24-hour
								PM2.5	N/A-2	—	1.57E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.16E-04	24-hour
CRUSH2	CRUSH2	Crushing	Volume	6.00	0.70	2.79	3.00	SPM	N/A	—	5.20E-02	24-hour, Annual
								PM10	N/A-1	—	2.34E-02	24-hour
								PM2.5	N/A-2	—	4.33E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.58E-03	24-hour
SCRN2	SCRN2	Screening	Volume	6.00	0.93	2.79	3.00	SPM	N/A	—	9.53E-02	24-hour, Annual
								PM10	N/A-1	—	3.20E-02	24-hour
								PM2.5	N/A-2	—	2.16E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	3.20E-03	24-hour
CONV1	CONV1	Conveyor	Volume	4.00	0.47	1.86	2.00	SPM	N/A	—	5.48E-03	24-hour, Annual
								PM10	N/A-1	—	1.80E-03	24-hour
								PM2.5	N/A-2	—	5.09E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.47E-04	24-hour
CONV2	CONV2	Conveyor	Volume	4.00	0.23	1.86	2.00	SPM	N/A	—	9.56E-03	24-hour, Annual
								PM10	N/A-1	—	3.14E-03	24-hour
								PM2.5	N/A-2	—	8.88E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	4.31E-04	24-hour
CONV3	CONV3	Conveyor	Volume	4.00	0.47	1.86	2.00	SPM	N/A	—	7.82E-03	24-hour, Annual
								PM10	N/A-1	—	2.57E-03	24-hour
								PM2.5	N/A-2	—	7.27E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	3.53E-04	24-hour
CONV4	CONV4	Conveyor	Volume	4.00	0.47	1.86	2.00	SPM	N/A	—	7.82E-03	24-hour, Annual
								PM10	N/A-1	—	2.57E-03	24-hour
								PM2.5	N/A-2	—	7.27E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	3.53E-04	24-hour

Modelling ID	Source ID(s)	Source Description	Type of Source	Height Above Grade [m]	Initial lateral dimension [m]	Initial vertical dimension [m]	Release Height [m]	Contaminant	CAS No.	Maximum 1-hr Emission Rate [g/s]	Maximum 24-hr Emission Rate [g/s]	Averaging Period [hours]
CRUSH3	CRUSH3	Crushing	Volume	7.00	0.93	3.26	3.50	SPM	N/A	—	4.70E-02	24-hour, Annual
								PM10	N/A-1	—	2.11E-02	24-hour
								PM2.5	N/A-2	—	3.92E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.33E-03	24-hour
CRUSH4	CRUSH4	Crushing	Volume	7.00	0.93	3.26	3.50	SPM	N/A	—	6.71E-02	24-hour, Annual
								PM10	N/A-1	—	3.02E-02	24-hour
								PM2.5	N/A-2	—	6.71E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	—	3.33E-03	24-hour
CRUSH5	CRUSH5	Crushing	Volume	7.00	0.93	3.26	3.50	SPM	N/A	—	6.71E-02	24-hour, Annual
								PM10	N/A-1	—	3.02E-02	24-hour
								PM2.5	N/A-2	—	6.71E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	—	3.33E-03	24-hour
SCRN3	SCRN3	Screening	Volume	6.00	0.57	2.79	3.00	SPM	N/A	—	4.31E-02	24-hour, Annual
								PM10	N/A-1	—	1.45E-02	24-hour
								PM2.5	N/A-2	—	1.17E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.45E-03	24-hour
SCRN4	SCRN4	Screening	Volume	6.00	0.57	2.79	3.00	SPM	N/A	—	4.31E-02	24-hour, Annual
								PM10	N/A-1	—	1.45E-02	24-hour
								PM2.5	N/A-2	—	9.79E-04	24-hour, Annual
								Crystalline Silica	14808-60-7	—	1.45E-03	24-hour
SCRN5	SCRN5	Screening	Volume	6.00	0.57	2.79	3.00	SPM	N/A	—	8.20E-02	24-hour, Annual
								PM10	N/A-1	—	2.76E-02	24-hour
								PM2.5	N/A-2	—	1.86E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.76E-03	24-hour
SCRN6	SCRN6	Screening	Volume	6.00	0.57	2.79	3.00	SPM	N/A	—	8.20E-02	24-hour, Annual
								PM10	N/A-1	—	2.76E-02	24-hour
								PM2.5	N/A-2	—	1.86E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.76E-03	24-hour
SCRN7	SCRN7	Screening	Volume	6.00	0.57	2.79	3.00	SPM	N/A	—	8.20E-02	24-hour, Annual
								PM10	N/A-1	—	2.76E-02	24-hour
								PM2.5	N/A-2	—	1.86E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.76E-03	24-hour
MATHNDL1	MATHNDL1	Stockpile 1	Volume	14.00	0.23	3.26	7.00	SPM	N/A	1.20E+00	—	24-hour, Annual
								PM10	N/A-1	5.23E-01	—	24-hour
								PM2.5	N/A-2	7.92E-02	—	24-hour, Annual
								Crystalline Silica	14808-60-7	7.17E-02	—	24-hour
MATHNDL2	MATHNDL2	Stockpile 2	Volume	14.00	0.23	3.26	7.00	SPM	N/A	7.78E-01	—	24-hour, Annual
								PM10	N/A-1	3.40E-01	—	24-hour
								PM2.5	N/A-2	5.15E-02	—	24-hour, Annual
								Crystalline Silica	14808-60-7	4.67E-02	—	24-hour
MATHNDL3	MATHNDL3	Stockpile 3	Volume	14.00	0.23	3.26	7.00	SPM	N/A	1.89E+00	—	24-hour, Annual
								PM10	N/A-1	8.26E-01	—	24-hour
								PM2.5	N/A-2	1.25E-01	—	24-hour, Annual
								Crystalline Silica	14808-60-7	1.13E-01	—	24-hour
MATHNDL4	MATHNDL4	Stockpile 4	Volume	14.00	0.23	3.26	7.00	SPM	N/A	9.42E-01	—	24-hour, Annual
								PM10	N/A-1	4.12E-01	—	24-hour
								PM2.5	N/A-2	6.24E-02	—	24-hour, Annual
								Crystalline Silica	14808-60-7	5.65E-02	—	24-hour
MATHNDL5	MATHNDL5	Stockpile 5	Volume	14.00	0.23	3.26	7.00	SPM	N/A	4.29E+00	—	24-hour, Annual
								PM10	N/A-1	1.88E+00	—	24-hour
								PM2.5	N/A-2	2.84E-01	—	24-hour, Annual
								Crystalline Silica	14808-60-7	2.57E-01	—	24-hour
MATHNDL6	MATHNDL6	Stockpile 6	Volume	14.00	0.23	3.26	7.00	SPM	N/A	2.96E-01	—	24-hour, Annual
								PM10	N/A-1	1.30E-01	—	24-hour
								PM2.5	N/A-2	1.96E-02	—	24-hour, Annual
								Crystalline Silica	14808-60-7	1.78E-02	—	24-hour
MATHNDL7	MATHNDL7	Stockpile 7	Volume	14.00	0.23	3.26	7.00	SPM	N/A	6.88E-01	—	24-hour, Annual
								PM10	N/A-1	3.01E-01	—	24-hour
								PM2.5	N/A-2	4.56E-02	—	24-hour, Annual
								Crystalline Silica	14808-60-7	4.13E-02	—	24-hour
MATHNDL8	MATHNDL8	Stockpile 8	Volume	14.00	0.23	3.26	7.00	SPM	N/A	4.97E-01	—	24-hour, Annual
								PM10	N/A-1	2.18E-01	—	24-hour
								PM2.5	N/A-2	3.29E-02	—	24-hour, Annual
								Crystalline Silica	14808-60-7	2.98E-02	—	24-hour
QUARRYMH	QUARRYMH	Excavated material handling in the quarry face	Volume	3.38	0.84	0.79	1.69	SPM	N/A	2.36E+00	—	24-hour, Annual
								PM10	N/A-1	1.03E+00	—	24-hour
								PM2.5	N/A-2	1.56E-01	—	24-hour, Annual
								Crystalline Silica	14808-60-7	1.41E-01	—	24-hour
SHIPMH	SHIPMH	Haul trucks at Quarry	Volume	3.38	0.84	0.79	1.69	SPM	N/A	7.50E+00	—	24-hour, Annual
								PM10	N/A-1	3.28E+00	—	24-hour
								PM2.5	N/A-2	4.97E-01	—	24-hour, Annual
								Crystalline Silica	14808-60-7	4.50E-01	—	24-hour

Modelling ID	Source ID(s)	Source Description	Type of Source	Height Above Grade [m]	Initial lateral dimension [m]	Initial vertical dimension [m]	Release Height [m]	Contaminant	CAS No.	Maximum 1-hr Emission Rate [g/s]	Maximum 24-hr Emission Rate [g/s]	Averaging Period [hours]
DG1	DG1	Crushing Plant Generators	Volume	2.54	0.53	0.59	2.54	SPM	N/A	4.58E-02	4.58E-02	24-hour, Annual
								PM10	N/A-1	4.58E-02	4.58E-02	24-hour
								PM2.5	N/A-2	4.45E-02	4.45E-02	24-hour, Annual
								Nitrogen Oxides	10102-44-0	1.60E+00	1.60E+00	1-hour, 24-hour
DG2	DG2	Crushing Plant Generators	Volume	2.54	0.53	0.59	2.54	SPM	N/A	4.58E-02	4.58E-02	24-hour, Annual
								PM10	N/A-1	4.58E-02	4.58E-02	24-hour
								PM2.5	N/A-2	4.45E-02	4.45E-02	24-hour, Annual
								Nitrogen Oxides	10102-44-0	1.60E+00	1.60E+00	1-hour, 24-hour
Sources and Emission Rates applicable to Extraction Phase 3												
UNLOAD1	UNLOAD1	Truck unloading	Volume	6.00	0.93	1.40	3.00	SPM	N/A	—	1.57E-03	24-hour, Annual
								PM10	N/A-1	—	1.57E-03	24-hour
								PM2.5	N/A-2	—	1.57E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.16E-04	24-hour
CRUSH1	CRUSH1	Crushing	Volume	6.00	0.70	2.79	3.00	SPM	N/A	—	5.20E-02	24-hour, Annual
								PM10	N/A-1	—	2.34E-02	24-hour
								PM2.5	N/A-2	—	4.33E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.58E-03	24-hour
SCRN1	SCRN1	Screening	Volume	6.00	0.93	2.79	3.00	SPM	N/A	—	9.53E-02	24-hour, Annual
								PM10	N/A-1	—	3.20E-02	24-hour
								PM2.5	N/A-2	—	2.16E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	3.20E-03	24-hour
Sources and Emission Rates applicable to Extraction Phases 6 and 7												
UNLOAD1	UNLOAD1	Truck unloading	Volume	6.00	0.93	1.40	3.00	SPM	N/A	—	3.15E-03	24-hour, Annual
								PM10	N/A-1	—	1.57E-03	24-hour
								PM2.5	N/A-2	—	1.57E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.16E-04	24-hour
CRUSH1	CRUSH1	Crushing	Volume	6.00	0.70	2.79	3.00	SPM	N/A	—	5.20E-02	24-hour, Annual
								PM10	N/A-1	—	2.34E-02	24-hour
								PM2.5	N/A-2	—	4.33E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	2.58E-03	24-hour
SCRN1	SCRN1	Screening	Volume	6.00	0.93	2.79	3.00	SPM	N/A	—	9.53E-02	24-hour, Annual
								PM10	N/A-1	—	3.20E-02	24-hour
								PM2.5	N/A-2	—	2.16E-03	24-hour, Annual
								Crystalline Silica	14808-60-7	—	3.20E-03	24-hour
DG1	DG1	Crushing Plant Generators	Volume	2.54	0.53	0.59	2.54	SPM	N/A	4.58E-02	4.58E-02	24-hour, Annual
								PM10	N/A-1	4.58E-02	4.58E-02	24-hour
								PM2.5	N/A-2	4.45E-02	4.45E-02	24-hour, Annual
								Nitrogen Oxides	10102-44-0	1.60E+00	1.60E+00	1-hour, 24-hour

Line Volume Sources

Modelling ID	Source ID(s)	Source Description	Type of Source	Height Above Grade [m]	Initial lateral dimension [m]	Initial vertical dimension [m]	Release Height [m]	Contaminant	CAS No.	Maximum 1-hr Emission Rate [g/s]	Maximum 24-hr Emission Rate [g/s]	Averaging Period [hours]
Sources and Emission Rates applicable to Extraction Phase 3												
HAULTRK	HAULTRK, HAULTRK_T, WATTRK_T	Haul trucks at Quarry, Haul Trucks - Tailpipe emissions, Water Truck - Tailpipe emissions	Line Volume	16.00	7.44	5.75	2.87	SPM	N/A	2.98E+00	2.98E+00	24-hour, Annual
								PM10	N/A-1	8.54E-01	8.54E-01	24-hour
								PM2.5	N/A-2	9.28E-02	9.28E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	1.16E-01	1.16E-01	24-hour
								Nitrogen Oxides	10102-44-0	1.74E-01	1.74E-01	1-hour, 24-hour
SHIPTRK	SHIPTRK, SHIPTRK_T	Shipping Trucks, Exhaust Emissions - On-Highway Engines (Shipping Trucks)	Line Volume	16.00	7.44	7.48	3.74	SPM	N/A	8.77E-01	8.77E-01	24-hour, Annual
								PM10	N/A-1	2.52E-01	2.52E-01	24-hour
								PM2.5	N/A-2	2.80E-02	2.80E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	3.41E-02	3.41E-02	24-hour
								Nitrogen Oxides	10102-44-0	2.51E-01	2.51E-01	1-hour, 24-hour
QUARRYLD	QUARRYLD, QUARRYLD_T	Front end loaders at the Quarry face, Front end Loaders at the Quarry face - Tailpipe emissions	Line Volume	9.60	4.47	6.39	3.20	SPM	N/A	5.16E-01	5.16E-01	24-hour, Annual
								PM10	N/A-1	1.49E-01	1.49E-01	24-hour
								PM2.5	N/A-2	1.80E-02	1.80E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	2.00E-02	2.00E-02	24-hour
								Nitrogen Oxides	10102-44-0	7.22E-02	7.22E-02	1-hour, 24-hour
SHIPLD	SHIPLD, SHIPLD_T	Shipping loaders, Shipping Loaders - Tailpipe emissions	Line Volume	9.60	4.47	6.39	3.20	SPM	N/A	3.04E-01	3.04E-01	24-hour, Annual
								PM10	N/A-1	9.39E-02	9.39E-02	24-hour
								PM2.5	N/A-2	1.85E-02	1.85E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	1.14E-02	1.14E-02	24-hour
								Nitrogen Oxides	10102-44-0	6.21E-01	6.21E-01	1-hour, 24-hour

Sources and Emission Rates applicable to Extraction Phase 6

Modelling ID	Source ID(s)	Source Description	Type of Source	Height Above Grade [m]	Initial lateral dimension [m]	Initial vertical dimension [m]	Release Height [m]	Contaminant	CAS No.	Maximum 1-hr Emission Rate [g/s]	Maximum 24-hr Emission Rate [g/s]	Averaging Period [hours]
HAULTRK	HAULTRK, HAULTRK_T, WATTRK_T	Haul trucks at Quarry, Haul Trucks - Tailpipe emissions, Water Truck - Tailpipe emissions	Line Volume	16.00	7.44	5.75	2.87	SPM	N/A	1.19E+00	1.19E+00	24-hour, Annual
								PM10	N/A-1	3.46E-01	3.46E-01	24-hour
								PM2.5	N/A-2	4.19E-02	4.19E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	4.62E-02	4.62E-02	24-hour
								Nitrogen Oxides	10102-44-0	1.74E-01	1.74E-01	1-hour, 24-hour
SHIPTRK	SHIPTRK, SHIPTRK_T	Shipping Trucks, Exhaust Emissions - On-Highway Engines (Shipping Trucks)	Line Volume	16.00	7.44	7.48	3.74	SPM	N/A	8.77E-01	8.77E-01	24-hour, Annual
								PM10	N/A-1	2.52E-01	2.52E-01	24-hour
								PM2.5	N/A-2	2.80E-02	2.80E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	3.41E-02	3.41E-02	24-hour
								Nitrogen Oxides	10102-44-0	2.51E-01	2.51E-01	1-hour, 24-hour
QUARRYLD	QUARRYLD, QUARRYLD_T	Front end loaders at the Quarry face, Front end Loaders at the Quarry face - Tailpipe emissions	Line Volume	9.60	4.47	6.39	3.20	SPM	N/A	2.99E-01	2.99E-01	24-hour, Annual
								PM10	N/A-1	8.77E-02	8.77E-02	24-hour
								PM2.5	N/A-2	1.18E-02	1.18E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	1.15E-02	1.15E-02	24-hour
								Nitrogen Oxides	10102-44-0	7.22E-02	7.22E-02	1-hour, 24-hour
SHIPLD	SHIPLD, SHIPLD_T	Shipping loaders, Shipping Loaders - Tailpipe emissions	Line Volume	9.60	4.47	6.39	3.20	SPM	N/A	3.04E-01	3.04E-01	24-hour, Annual
								PM10	N/A-1	9.39E-02	9.39E-02	24-hour
								PM2.5	N/A-2	1.85E-02	1.85E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	1.14E-02	1.14E-02	24-hour
								Nitrogen Oxides	10102-44-0	6.21E-01	6.21E-01	1-hour, 24-hour

Sources and Emission Rates applicable to Extraction Phase 7

Modelling ID	Source ID(s)	Source Description	Type of Source	Height Above Grade [m]	Initial lateral dimension [m]	Initial vertical dimension [m]	Release Height [m]	Contaminant	CAS No.	Maximum 1-hr Emission Rate [g/s]	Maximum 24-hr Emission Rate [g/s]	Averaging Period [hours]
HAULTRK	HAULTRK, HAULTRK_T, WATTRK_T	Haul trucks at Quarry, Haul Trucks - Tailpipe emissions, Water Truck - Tailpipe emissions	Line Volume	16.00	7.44	5.75	2.87	SPM	N/A	2.64E+00	2.64E+00	24-hour, Annual
								PM10	N/A-1	7.56E-01	7.56E-01	24-hour
								PM2.5	N/A-2	8.29E-02	8.29E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	1.02E-01	1.02E-01	24-hour
								Nitrogen Oxides	10102-44-0	1.74E-01	1.74E-01	1-hour, 24-hour
SHIPTRK	SHIPTRK, SHIPTRK_T	Shipping Trucks, Exhaust Emissions - On-Highway Engines (Shipping Trucks)	Line Volume	16.00	7.44	7.48	3.74	SPM	N/A	8.77E-01	8.77E-01	24-hour, Annual
								PM10	N/A-1	2.52E-01	2.52E-01	24-hour
								PM2.5	N/A-2	2.80E-02	2.80E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	3.41E-02	3.41E-02	24-hour
								Nitrogen Oxides	10102-44-0	2.51E-01	2.51E-01	1-hour, 24-hour
QUARRYLD	QUARRYLD, QUARRYLD_T	Front end loaders at the Quarry face, Front end Loaders at the Quarry face - Tailpipe emissions	Line Volume	9.60	4.47	6.39	3.20	SPM	N/A	3.25E-01	3.25E-01	24-hour, Annual
								PM10	N/A-1	9.50E-02	9.50E-02	24-hour
								PM2.5	N/A-2	1.26E-02	1.26E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	1.26E-02	1.26E-02	24-hour
								Nitrogen Oxides	10102-44-0	7.22E-02	7.22E-02	1-hour, 24-hour
SHIPLD	SHIPLD, SHIPLD_T	Shipping loaders, Shipping Loaders - Tailpipe emissions	Line Volume	9.60	4.47	6.39	3.20	SPM	N/A	3.04E-01	3.04E-01	24-hour, Annual
								PM10	N/A-1	9.39E-02	9.39E-02	24-hour
								PM2.5	N/A-2	1.85E-02	1.85E-02	24-hour, Annual
								Crystalline Silica	14808-60-7	1.14E-02	1.14E-02	24-hour
								Nitrogen Oxides	10102-44-0	6.21E-01	6.21E-01	1-hour, 24-hour

APPENDIX D

Fugitive Dust BMPP

REPORT

Best Management Practices Plan for the Control of Fugitive Dust

Proposed Caledon Pit / Quarry

Submitted to:

CBM Aggregates (CBM), a Division of St Marys Cement Inc. (Canada)

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Document Version Control

This Fugitive Dust Best Management Practices Plan (BMPP) has been prepared for CBM Aggregates (CBM), a Division of St Marys Cement Inc. (Canada) to manage fugitive dust associated with the proposed Caledon Pit / Quarry in Caledon, Ontario (the Pit / Quarry). The BMPP should be reviewed periodically and updated if required. Therefore, it is necessary to have appropriate version control. This version control will allow facility personnel and compliance auditors to track and monitor changes to the BMPP over time.

Version	Date	Revision Description	Prepared By	Reviewed By (Facility Contact)
1.0	December 2022	Original document to support Aggregate resources Act Application	Golder Associates Ltd.	D.H.

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1.0 INTRODUCTION

This Best Management Practices Plan for Fugitive Dust (the Plan) has been prepared to manage the fugitive dust associated with the proposed Caledon Pit / Quarry located in the vicinity of Charleston Sideroad and Main Street/Regional Road 136 in Caledon, Ontario (the Site).

This Plan follows the Plan, Do, Check, and Act cycle described in the "*Technical Bulletin: Management Approaches for Industrial Fugitive Dust Sources*" (updated April 26, 2019) guidance (Fugitive Dust Guidance Document) published by the Ministry of the Environment, Conservation and Parks (the Ministry). The "Plan" section includes a review of facility processes and operations, and identification and characterization of the anticipated fugitive dust sources at the Facility. The "Do" section includes the BMPs that are currently in place at the Facility, as well as those to be implemented, complaints protocols, and administrative controls such as training. The "Check" section includes a description of monitoring procedures, a record keeping system, and accountability. The "Act" section includes guidelines for periodic review of the BMPs to promote continuous improvement of this Plan.

In preparing this Plan, Golder has relied on information provided by CBM Aggregates (CBM), a Division of St Marys Cement Inc. (Canada), the Ministry and information on standard best practices for fugitive dust generating activities.

2.0 REQUIREMENTS OF A BMPP FOR FUGITIVE DUST

Table 1 lists the suggested content and requirements for a BMPP for Fugitive Dust as per the Fugitive Dust Guidance Document and the corresponding section of this Plan that addresses each requirement.

Table 1: Requirements of BMPP for Fugitive Dust

Requirement/Suggested Content	Section of This Plan
Identify and characterize the sources of fugitive dust emissions within the facility.	s.3.3, Table 3
Identify nearby potential receptors that may be impacted by dust emissions.	s.3.1, Figure 1
Develop a site map and/or figures to identify the locations of fugitive dust sources (such as storage piles and roadways) and potential receptors.	s.3.1, Figure 1
Characterize applicable fugitive dust monitoring parameters such as silt loading, silt content, moisture content, metal content, dust fall, etc.	s.3.4
Review the composition and particle size distribution of fugitive dust generated by each significant fugitive dust source where available.	s.3.4
Identify the contributing factors for each significant source that favour the generation of fugitive dust emissions (e.g. predominant wind direction, location of storage pile, frequency of activity, process operating parameters, control efficiency, etc.).	s.3.3, Table 3
Prioritize the use of resources based on the relative contributions of fugitive dust sources.	s.3.3, Table 5
Describe how fugitive dust will be controlled from each significant source (e.g. the application of dust suppressants such as water or chemical suppressants).	s.3.3, Table 4

Requirement/Suggested Content	Section of This Plan
Document how the control measures will be implemented with timelines (e.g. frequency of road cleaning or water application, etc.).	s.3.3, Table 4
Describe proper operating, monitoring, sampling, record-keeping and best practice procedures of control and monitoring equipment (e.g. how to minimize drop height, etc.).	s.3.3, Table 4, s.5.1, s.5.2
Include a program for site-wide training for facility personnel and contractors.	s.4.3
Implement a regular inspection, maintenance and calibration program (e.g. visual inspections of storage piles, maintenance of water sprays, etc.).	s.5.1
Describe methods of reviewing information collected from inspections, monitoring, sampling and record-keeping to verify, and document ongoing implementation of the plan and to determine when to take additional action, if needed.	s.5.1, s.5.2
Periodically review the effectiveness of control measures using available data from site inspections, silt loading and silt content analysis, dust fall jars, etc. on a regular basis to identify opportunities for continuous improvement.	s.6.0
Update the BMP plan as required.	s.6.0

3.0 PLAN

3.1 Facility Description

The Site will be located in Caledon, Ontario. The Site is approximately 262 hectares (ha) and is composed of three pit / quarry areas: Main Area, Northern Area and the Southern Area. The intent is to extract, process and transport 2.5 million tonnes of aggregate annually from the Site. The proposed extraction at the Site will be undertaken in seven phases and involves the initial excavation in the Main Area and subsequently the advance of workings in a counter-clockwise direction. Works will progress to the Northern Area in the initial operation phases and the Southern Area towards the latter phases. Further detail of each operational phase is provided below. As part of the overburden removal, sand and gravel will also be extracted from the site.

- **Phase 1** – Operations will commence north of Charleston Sideroad and an entrance to the Main Area satisfying sightline and access spacing requirements will be installed. This entrance will be located on a designated haul route and may be signalised for additional safety.

  Topsoil and overburden will be stripped from the operational areas for access to the underlying aggregate resource. All topsoil and overburden on site will be stripped and stockpiled separately in berms or stockpiles and replaced as quickly as possible in the progressive rehabilitation process. Berms will be constructed on the southern, eastern and northern boundaries of the Main Area to attenuate noise and provide visual screening. Surplus overburden materials will be stored in a designated storage area to the south of the Main Area which provides a short haul distance from the initial stripping in Phase 1.

  Controlled blasting will be undertaken in order to extract material from extraction faces. Following each blast it may also be necessary to break down the blast rock further using an excavator with an hydraulic rock breaking attachment. Rock form blast piles will then be transported to a temporary mobile crushing and processing plant. Processed materials will be stockpiled for off site transportation.

A permanent processing facility will be installed north of Charleston Sideroad and adjacent to the entrance once workings have progressed to the final quarry floor level in this area.

The permanent processing plant will include screening and crushing operations, capable of processing up to 2,000 tonnes of material per hour. A wash plant will also be used to clean and sort material.

- **Phase 2A** – Extraction operations will continue in a counter-clockwise direction in the Main Area. Controlled blasting and hydraulic breaking of blast rock will be undertaken at each active face. Rock form blast piles will then be transported to the permanent processing facility north of Charleston Sideroad. In-quarry backfilling will be carried out at appropriate quarried faces where extraction is complete.
- **Phase 2B** – The Northern Area will be accessed with a tunnel under Main Street. The area will be stripped and topsoil will be used for perimeter berms, while glacial in this area will be placed in the Main Area as in-quarry backfill. Extraction activities will be the same as that carried out in the Main Area with the extracted materials being transported the permanent processing facility. Once extraction in the Northern Area is complete overburden from the Main Area will be used to finish rehabilitation.
- **Phase 3, 4 and 5** – Extraction operations will continue in a counter-clockwise direction in the Main Area. In-quarry backfilling will be carried out at appropriate quarried faces where extraction is complete.
- **Phase 6** – The Southern Area will be accessed with a tunnel under Charleston Sideroad. The area will be stripped and topsoil will be used for perimeter berms, while glacial till will be placed in the Main Area as in-quarry backfill. Extraction operations will proceed southwards and materials will be transported the permanent processing facility in the Main Area.
- **Phase 7** – Extraction operations will continue in a southward direction in the Southern Area and materials will be transported the permanent processing facility in the Main Area. Once extraction has been completed overburden will be deposited to rehabilitate the quarried faces.

In each phase, overburden and topsoil stripping, sand and gravel extraction activities will precede drilling, blasting and rock extraction activities.

Figure 1 shows the Site location, nearby receptors and a wind rose from the Environment and Climate Change Canada Meteorological Station located in Mono, Ontario illustrating the predominant wind directions for the area. Table 2 presents general information about the Facility relevant to this Plan.

Table 2: Facility Description

Legal Name of Company and Site	CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) Caledon Pit / Quarry
Location	Caledon, Ontario
Address	Located in the vicinity of Charleston Sideroad and Main Street/Regional Road 136 in Caledon, Ontario

Legal Name of Company and Site	CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) Caledon Pit / Quarry
Main Activities	Drilling and blasting to extract material, material handling and haulage, crushing and screening of extracted material.
Hours of Operation	The CBM Caledon Pit / Quarry is proposed to operate (extraction, processing and drilling) 7:00 am to 7:00 pm Monday to Saturday, excluding statutory holidays and shipping is proposed from 6:00 am to 7:00 pm Monday to Saturday consistent with other mineral aggregate operations in Caledon. CBM is also proposing to permit limited shipping in the evening (7:00 pm to 6:00 am) to support public authority contracts that require the delivery of aggregates during these hours to complete public infrastructure projects. These activities will be limited to only highway trucks and shipping loaders and no other operations will be permitted during evening hours. Site preparation and rehabilitation is proposed to be permitted 7:00 am to 7:00 pm Monday to Friday.
Predominant wind direction	From the west southwest (Figure 1)
Nearest receptor	The individual residences closest to the Pit / Quarry in all directions are illustrated on Figure 1. The town of Cataract is also highlighted, which contains numerous residences.

3.2 Responsibilities

The following identifies the responsibilities held by each of the employment levels at the Facility as they pertain to this Plan.

3.2.1 Owner

The Owner is responsible for:

- reviewing the effectiveness of the current dust control measures at the Facility and assessing the need for improvements;
- ensuring the training of site personnel and contractors on the Plan and the best management practices to be implemented;
- ensuring the required resources are in place to execute the Plan;
- reviewing the dust control inspections to ensure adequate measures were taken to address issues;
- scheduling and coordinating the implementation of fugitive dust control measures;
- completing the Dust Control Inspection Form and Dust Control Activity Log (i.e. sweeping) as required;
- maintaining documentation of schedules and logs;
- ensuring dust control logs are transferred to the Facility’s on-site filing system; and
- receiving and handling complaints.

3.2.2 Site Personnel and Contractors

All Site Personnel and Contractors are responsible for:

- reviewing the effectiveness of the current dust control measures at the Facility and reporting issues to the Shift Supervisor; and
- following the dust control procedures that are currently in place.

3.3 Identification of Fugitive Dust Emission Sources and Factors Affecting Dust Emissions

Fugitive dust emissions are a result of mechanical disturbances of granular materials exposed to the air. Dust generated from these open sources is termed “fugitive” because it is not discharged to the atmosphere in a confined flow stream, such as emissions from an exhaust pipe or a stack (USEPA 1995).

The mechanical disturbance may result from equipment movement, the wind, or both. Therefore, some fugitive dust emissions occur and/or are intensified by equipment use, while others (i.e., wind erosion emissions) are independent of equipment use.

The main factors affecting the amount of fugitive dust emitted from a source include characteristics of the granular material being disturbed (i.e. particulate size distribution, density and moisture) and intensity and frequency of the mechanical disturbance (i.e. wind conditions and/or equipment use conditions). Precipitation and evaporation conditions can affect the moisture of the granular material being disturbed and, therefore, have an indirect effect on the amount of fugitive dust emitted.

Once dust is emitted, its travelling distance from the source is affected by climatic conditions, specifically wind speed, wind direction, precipitation, and particle size distribution. Higher wind speeds increase the distance travelled while precipitation can accelerate its deposition. Finer particulates can travel further before settling and, therefore, deserve greater attention.

Table 3 provides a list of the main sources of fugitive dust at the Facility.

Table 3: Sources of Fugitive Dust Emissions at the Facility

Source Category	Source Description	Source Location	Potential Causes for High Emissions and Opacity from Each Source (Parameter/Condition)
Unpaved Areas	Vehicles will travel between the working face and the processing plant and/or from the processing plant off-site	Pit floor	Number of vehicles/large Weight of vehicles/large Silt content/high Wind speed/high
Material Handling/Storage	Loading to haul trucks	Working Face	Moisture content/dry Silt content of the material/high Material size/fine Material transfer rate/high Material drop height/high Wind speed/high
	Loading/unloading at Processing plant	Processing Plant	
	Stockpiling	Stockpiles – various	

Source Category	Source Description	Source Location	Potential Causes for High Emissions and Opacity from Each Source (Parameter/Condition)
Extraction	Drilling and blasting	Working Face	Moisture content/dry Material size/fine Material transfer rate/high Wind speed/high Blast zone area/high
Processing	Crushing and screening of extracted material	Processing Plant	Moisture content/dry Material size/fine Material transfer rate/high Material drop height/high Wind speed/high

Control measures to reduce fugitive dust emissions should take into account the sources of the dust emission, the dispersion conditions and the location of sensitive areas. Control measures are in place to minimize one or more factors leading to the generation and/or dispersion of fugitive dust emissions. These control measures can be classified as follows:

- **Preventative Procedures**: Measures pertaining to the design and installation of structures and the operating procedures which are implemented on a regular basis in order to prevent the generation of dust and/or the dispersion of dust emitted reaching sensitive areas.
- **Reactive Control Measures**: Measures which are implemented in the event of unexpected circumstances which can lead to the generation of dust and/or the dispersion of dust emitted reaching sensitive areas.

Table 4 lists preventative procedures and reactive control measure for fugitive dust emissions that are associated with the Facility.

Table 4: Preventative Procedures and Control Measures for Fugitive Dust Emissions at the Facility

Emission Source	Preventative Procedures/ Control Measure	Description	Frequency
Unpaved Areas	Watering	Water shall be applied as a dust suppressant during non-freezing conditions.	At least 2 litres/m^2/hour
	Application of Chemical Dust Suppressants	Chemical dust suppressants shall be applied during freezing conditions (temperatures less than 4ºC)	As required, during winter season
	Speed Limits	Speed limits of less than 25 km/hour shall reduce speed and dust production.	Permanent control
	Re-grading	Applying coarser material to surface of roadways.	Annually in Spring and whenever necessary as determined through visual monitoring

Emission Source	Preventative Procedures/ Control Measure	Description	Frequency
Material Handling and Stockpiles	Stockpile Placement	Stockpiles shall be placed below grade where possible to minimize wind erosion.	Continual
	Maintain Minimum Drop Height	Material shall be dropped from the shortest possible distance If material is on the ground, it shall be pushed up with a loader to prevent the material from being dropped.	Continual
	Good Housekeeping	Minimize dust accumulation in material handling areas, reducing the probability of re-entrainment and generation of fugitive dust emissions.	Continual
	Cease Activity	Material handling activities shall be stopped in high wind conditions.	When sustained winds are greater than 40 km/hr
	Progressive Rehabilitation	Stockpiles shall be developed in stages and the pit / quarry progressively closed off (i.e., capped) to minimize the area susceptible to wind erosion.	Continual
Extraction	Location	Blasting shall be completed below grade reducing the susceptibility of emitting fugitive dust.	Continual
	Procedure	Drills equipped with dust suppression systems shall be used at all times.	Continual
	Cease Activity	Drilling and blasting activities shall be stopped in high wind conditions.	When sustained winds are greater than 40 km/hr
Material Processing	Equipment placement	Permanent equipment shall be located below grade as early as possible to reduce the susceptibility to wind erosion.	Continual
	Maintain Minimum Drop Height	Material shall be dropped from the shortest possible distance.	Continual
	Spray bars	Crushers and screens shall be equipped with spray bars to reduce fugitive dust generation	Continual
	Good Housekeeping	Dust accumulation on equipment and in material processing areas shall be minimized, reducing the probability of re-entrainment and generation of fugitive dust emissions.	Continual
	Cease Activity	Material processing activities shall be stopped in high wind conditions.	When sustained winds are greater than 40 km/hr

* 1 - ChemInfo, 2005

Each fugitive dust source at the Facility was assessed using the risk management tool described in the Centre for Excellence in Mining Innovation guidance document “Guide to the Preparation of a Best Management Practices Plan for the Control of Fugitive Dust for the Ontario Mining Section, Version 1.0” (CEMI 2010) to assess if the BMPs that are in place adequately manage the risk associated with each source. See Appendix A for the risk factors used in the ranking process. As the Working Face will move over the lifetime of the Site, the worst case has been assumed, where it is closest to residences. Table 5 identifies the fugitive dust sources with their respective relative risk score for the Facility.

Table 5: Fugitive Dust Sources and Associated Relative Risk Scores

Source Description	Relative Risk Score	Relative Risk Level
Unpaved Areas	45	Low
Material Handling – Working Face	25	Low
Material Handling – Processing Plant	11	Low
Stockpiles	22	Low
Extraction	27	Low
Processing	18	Low

There are no sources that are considered to be “high” risk after the implementation of the BMPs, therefore it is reasonable to assume that the BMPs in place adequately manage the risk associated with each fugitive dust source.

3.4 Fugitive Dust Characterization

Particle sizes can be divided into the following categories:

- Fine: < 30 µm in diameter;
- Medium: 30 to 100 µm in diameter; and
- Coarse: > 100 µm in diameter.

As the majority of fugitive dust from the Pit / Quarry results from mechanical disturbances from vehicles travelling on unpaved roads, the diameter of the dust particles can be categorized as medium (30 to 100 µm in diameter).

4.0 DO

4.1 BMPs for Sources of Fugitive Dust Emissions

The BMPs listed in Table 5 will be implemented at the Facility when activities commence, therefore no implementation schedule has been specified.

Dust generating work performed at the Facility, whether it is completed by CBM or under contractual agreements, must conform to the requirements of this Plan.

4.2 Procedures for Handling Complaints

The Facility has procedures in place to address complaints related to fugitive dust. All workers should be familiar with how to direct a complaint to the Owner who is responsible for receiving complaints (see section 3.2) should the need arise. The following steps should be taken by the Owner if a complaint is received:

- Complete copy of dust complaint form (Appendix C) and ask the complainant for the information required on the form (contact information, time of occurrence, etc.).
- Notify the Ministry of complaint (Spills Action Centre, 416-325-3000).
- Conduct a Facility and, if needed, off-site inspection to determine the source of the dust and whether the dust is still causing an issue.
- Carry out fugitive dust mitigation procedures, if needed, and summarize the measures that were taken in the complaint record.

4.3 Training

Site personnel and contractors will be informed about the requirements of this Plan. The Senior Management Representative will administer training prior to working on the property, so that staff have reviewed this document and activities on site are carried out in such a way to minimize dust. Training records specific to this Plan will be kept with all other training records. Appendix D contains information sheets that can be displayed around the site identifying the relevant controls associated with different activities.

5.0 CHECK

5.1 Maintenance Procedures and Inspections

As per section 3.2.2, all Site Personnel and/or Contractors should monitor the Facility for dust emissions/generation on a daily basis. Records of dust observations shall be noted on the Dust Control Inspection Form in Appendix B. If Site Personnel and/or Contractors observe high dust emissions/generation, the following steps will be taken:

- notify owner of high dust emissions/generation;
- owner to complete entry in Non-Conformance Log (Appendix B);
- owner to determine and implement the necessary corrective action.

In addition to the schedule in procedure above with respect to dust observations, a weekly inspection will be conducted by the Owner using the Dust Control Inspection Form in Appendix B. If the Owner observes a non-conformance, the following steps will be taken:

- owner to complete entry in Non-Conformance Log (Appendix B);
- owner to determine and implement the necessary corrective action.

5.2 Record Keeping Practices

The Facility retains copies of maintenance and inspection records in the onsite filing system. Examples of the dust control logs can be found in Appendix B.

The records should be stored in the Facility's on-site filing system.

6.0 ACT

The following will trigger reviews and updates, if needed, of this Plan:

- When there are significant changes in the Facility processes or equipment that introduce potential dust emission sources.
- When there are verified repetitive complaints associated with dust emissions from the Facility.
- When there are noticeable dust emissions occurring and/or an increased dust level (excluding seasonal conditions).

7.0 LIMITATIONS

In preparing this fugitive dust BMPP, Golder has relied on information provided by CBM regarding proposed Pit / Quarry procedures, as well as information on proposed Pit / Quarry operations and equipment.

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This fugitive dust BMPP was prepared for the exclusive use of CBM. The BMPP is based on discussions with CBM about Facility practices, fugitive dust sources and review of information provided by CBM. This BMPP cannot account for changes in Facility conditions and operational practices completed after it has been finalized.

The information, recommendations and opinions expressed in this report are for the sole benefit of CBM, subject to the limitations and purposes described herein. Use of or reliance on this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder. If CBM gives, lend, sell, or otherwise make available the report or any portion thereof to any other party, it does so at its own risk and liability. CBM acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore CBM cannot rely upon the electronic media versions of Golder's report or other work products.

When evaluating the Facility and developing this report, Golder has relied on information provided by CBM, the regulatory authorities, and others. Golder has acted in good faith and accepts no responsibility for any deficiencies, misstatements, or inaccuracies contained in this report resulting from omissions, misinterpretations or falsifications by those who provided Golder with information.

Physical sampling of atmospheric emission sources was not completed as part of the scope of work.

Signature Page

Golder Associates Ltd.

Sita Chinnadurai, MEnvSc
Air Quality Specialist

Katie Armstrong, BSC, MSc
Team Lead - Air Quality Modelling and permitting

SLC/KSA/mp

https://golderassociates.sharepoint.com/sites/114392/project files/6 deliverables/ph 3200-air quality/final/app d - dust bmpp/19129150-r-rev0-vcna caledon dust bmpp-13dec2022.docx

REFERENCES

Centre for Excellence in Mining Innovation (CEMI). 2010. Guide to the Preparation of a Best Management Practices Plan for the Control of Fugitive Dust for the Ontario Mining Section. Version 1.0, June 2010.

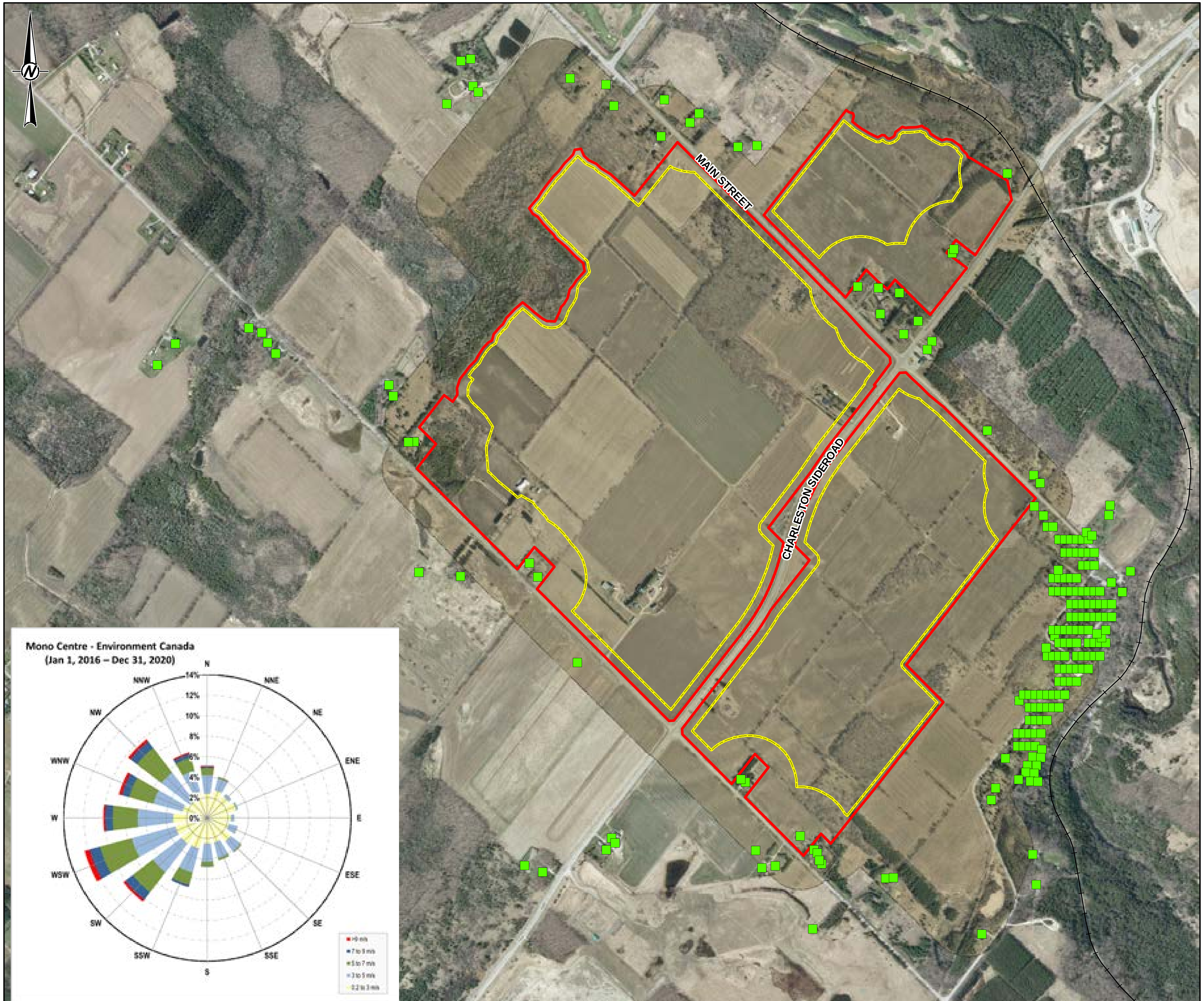
ChemInfo. 2005. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities. March 2005.

Golder Associates Ltd. 2020. Environmental Activity and Sector Registry Emission Summary and Dispersion Modelling Report, Version 1.0.

Ministry of Environment, Conservation and Parks. 2019. Technical Bulletin: Management Approaches for Industrial Fugitive Dust Sources (version updated April 26, 2019).

United States Environmental Protection Agency (USEPA). 1995. AP-42 – Compilation of Air Pollutant Emission Factors – Fifth Edition. January 1995.

FIGURES



LEGEND

- RECEPTOR LOCATION
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY

0 500 1,000

1:12,500 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. SITE TOPOGRAPHIC DATA - SPRING 2021, FIRSTBASE SOLUTIONS, 2021
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

SITE LOCATION PLAN AND WIND ROSE

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-12-07
DESIGNED	CGE
PREPARED	CGE
REVIEWED	KA
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0035	0.0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\99_PROJ\19129150\40_PROD\0035_Dust\19129150-0035-RN-0001.mxd PRINTED ON: 2022-12-07 AT: 11:57:44 AM

APPENDIX A

Fugitive Dust Risk Management Tool

		1	2	3	4	5	6	7	8	9	10	11	Risk
Description of the structure / equipment	Category	Frequency of process / activity that generates fugitive dust:	Position of the source related to sensitive areas (e.g.: communities, working areas):	Predominant wind direction is from the source to the closest sensible area?	Relative amount of visible dust generated in the process / activity:	Dust composition	Dust size range (higher mass percentage)	Is there some wind barrier (e.g.: trees, buldings, landscape) which can prevent the emissions from this source to reach the closest sensitive area?	Is there some measure applied on regular basis to prevent dust emission from this source (preventative)?	Is there some measure applied to this source to reduce dust emission once it occur (reactive)?	Is there some monitoring procedure applied to this source related to fugitive dust control?	Monitoring data / information trigger some control measure?	Total
Worst Case Scenario	Unpaved road / area	Continuous	Close	Yes	High	No metals	Fine	No	No	No	No	No	100
Unpaved Areas	Unpaved road / area	Continuous	Medium	Yes	Medium	No metals	Medium	Yes	Yes	Yes	Yes	Yes	45
Material Handling - Working Face	Material transfer (drop	Intermitent	Medium	Yes	Medium	No metals	Medium	Yes	Yes	No	Yes	Yes	25
Material Handling - Processing Plant	Material transfer (drop	Intermitent	Medium	No	Medium	No metals	Medium	Yes	Yes	No	Yes	Yes	11
Stockpiles	Material stockpile	Continuous	Medium	No	Medium	No metals	Medium	Yes	Yes	No	Yes	Yes	22
Extraction	Process	Sporadic	Close	No	High	No metals	Medium	No	No	No	Yes	Yes	27
Processing	Process	Intermitent	Medium	No	Medium	No metals	Fine	Yes	Yes	No	Yes	Yes	18

APPENDIX B

Sample Dust Control Logs

Dust Control Inspection Form

Date:

Inspector Name:

Weekly Inspection

Unpaved Roadways				
Inspection Items	**Response**	**Requirement**	**Conformance (Y or N)**	**Description of Non-Conformance**
Is visible dust observed from any section of roadway?		N		
Are appropriate load sizes maintained on haul vehicles?		Y		
Are roadways well maintained? (ie good housekeeping)		Y		
Has the watering log been maintained?		Y		
Has the non-conformance log been maintained?		Y		
Have previous non-conformances been rectified?		Y		

Material Handling / Storage				
Please list all areas that were inspected:				
Indicate which areas were not inspected, if any, and the reason why an inspection was not completed.				
Inspection Items	**Response**	**Requirement**	**Conformance (Y or N)**	**Description of Non-Conformance**
Is visible dust observed from any material handling location?		N		
Are low drop heights maintained?		Y		
Are material handling locations well maintained? (i.e. good housekeeping)		Y		
Has the activity log been maintained?		Y		
Has the non-conformance log been maintained?		Y		
Have previous non-conformances been rectified?		Y		

Dust Control Inspection Form

Date:

Inspector Name:

Weekly Inspection

Processing Plant				
Please list all areas that were inspected:				
Indicate which areas were not inspected, if any, and the reason why an inspection was not completed.				
Inspection Items	**Response**	**Requirement**	**Conformance (Y or N)**	**Description of Non-Conformance**
Is visible dust observed from the processing plant?		N		
Are the spray bars operational on the crushers and screens?		Y		
Is the processing equipment/area well maintained? (i.e. good housekeeping)		Y		
Has the activity log been maintained?		Y		
Has the non-conformance log been maintained?		Y		
Have previous non-conformances been rectified?		Y		

All non-conformances must be documented in the Non-Conformance Log

Inspector Sign Off: ______________________________

Material Handling and Storage
Dust Control Activity Log

Site Area	Date	Description of Activity	Start Time	End Time	Employee Name	Employee Signature

Unpaved Roads
Watering Log

Section of Roadway (Source ID)	Date	Description of Watering (Equipment used, amount of water applied)	Start Time	End Time	Operator Name & Company	Company Sign Off

Non - Conformance Log

Date	Time	Inspector Name	Potential or Actual Non-Conformance		Cause	Action	Recommendation	Corrective Action Sign Off
			Location / Source ID	Activity / Process / Condition				

APPENDIX C

Complaint Response Form

Dust Complaint Form

Date:

Time:

Complainant Information	
Name	
Address	
Contact Number	
Callback completed (if required)	

Complaint Details	
Date and time of dust event	
Description of dust event (describe where dust was detected, amount of dust, wind direction and any other items to help characterize the event)	
Summary of measures taken to address complaint:	

APPENDIX D

Information Sheets

DUST CONTROL MEASURES AND PREVENTATIVE PROCEDURES - UNPAVED AREAS

Preventative Procedures / Control Measure	Description	Frequency
Watering	Water shall be applied as a dust suppressant during non-freezing conditions.	At least 2 litres/m^2/hour
Application of Chemical Dust Suppressants	Chemical dust suppressants shall be applied during freezing conditions (temperatures less than 4ºC)	As required, during winter season
Speed Limits	Speed limits of less than 25 km/hour shall reduce speed and dust production.	Permanent control
Re-grading	Applying coarser material to surface of roadways.	Annually in Spring and whenever necessary as determined through visual monitoring

DUST CONTROL MEASURES AND PREVENTATIVE PROCEDURES - MATERIAL HANDLING AND STOCKPILES

Preventative Procedures / Control Measure	Description	Frequency
Stockpile Placement	Stockpiles shall be placed below grade where possible to minimize wind erosion.	Continual
Maintain Minimum Drop Height	Material shall be dropped from the shortest possible distance If material is on the ground, it shall be pushed up with a loader to prevent the material from being dropped.	Continual
Good Housekeeping	Minimize dust accumulation in material handling areas, reducing the probability of re-entrainment and generation of fugitive dust emissions.	Continual
Cease Activity	Material handling activities shall be stopped in high wind conditions.	When sustained winds are greater than 40 km/hr
Progressive Rehabilitation	Stockpiles shall be developed in stages and the pit / quarry progressively closed off (i.e., capped) to minimize the area susceptible to wind erosion.	Continual

DUST CONTROL MEASURES AND PREVENTATIVE PROCEDURES - EXTRACTION

Preventative Procedures / Control Measure	Description	Frequency
Location	Blasting shall be completed below grade reducing the susceptibility of emitting fugitive dust.	Continual
Procedure	Drills equipped with dust suppression systems shall be used at all times.	Continual
Cease Activity	Drilling and blasting activities shall be stopped in high wind conditions.	When sustained winds are greater than 40 km/hr

DUST CONTROL MEASURES AND PREVENTATIVE PROCEDURES - MATERIAL PROCESSING

Preventative Procedures / Control Measure	Description	Frequency
Equipment placement	Permanent equipment shall be located below grade as early as possible to reduce the susceptibility to wind erosion.	Continual
Maintain Minimum Drop Height	Material shall be dropped from the shortest possible distance.	Continual
Spray bars	Crushers and screens shall be equipped with spray bars to reduce fugitive dust generation	Continual
Good Housekeeping	Dust accumulation on equipment and in material processing areas shall be minimized, reducing the probability of re-entrainment and generation of fugitive dust emissions.	Continual
Cease Activity	Material processing activities shall be stopped in high wind conditions.	When sustained winds are greater than 40 km/hr

APPENDIX E

Curriculum Vitae

Education

MSc Weather, Climate and Modelling, University of Reading, UK, 2006

BSc Mathematics, Honours, University of Warwick, UK, 2005

Golder Associates Ltd. – Mississauga

Employment History

Golder Associates Ltd – Mississauga, Canada
Team Lead/ Senior Air Quality Specialist (2009 to Present)

Katie Armstrong works with the Atmospheric Services Group within Golder Associates Ltd. specialising in air quality. She is a senior air quality specialist with over 15 years experience and manages the day to day operations of the GTA air quality team.

Katie’s has extensive experience working within the Ontario Air Quality business, in particular with the preparation and review of Ontario Ministry of the Environment, Conservation and Parks (MECP) Environmental Compliance Approval (ECA) applications and Environmental Activity Sector Registry (EASR) submissions. Katie’s experience also includes the completion of air quality, dust and odour assessments to support Environmental Assessments, Land Use Planning initiatives and/or to assist clients with addressing nuisance complaints. Katie has also worked with many municipalities and assisted the City of Toronto with the development of their Regional Airshed model.

Katie's project experience includes a variety of industry sectors such as: mining, power generation, transportation, aggregate processing, chemical manufacturing, automotive manufacturing and assembly and waste. Additional experience includes air dispersion modelling using AERMOD, SCREEN3, CALPUFF, CAL3QHCR, MOVES, EDMS and GasSim2.

Golder Associates (UK) Ltd – Nottingham, UK
Environmental Scientist (2006 to 2009)

Katie gained experience in various areas of work carried out by Golder Associates. Such work included producing Air Quality Impact assessments and gas risk assessments for a variety of Landfill and Energy from Waste (EfW) sites using ADMS, AERMOD and GasSim modelling software; completing vehicle impact assessments for various road schemes in the UK using DMRB and ADMS-Roads software; completing nuisance impact assessments and management plans for dust, odour and bioaerosols at a Landfills, EfW sites nd mine sites across the UK and wider world; completing lateral migration risk assessments for landfill sites across the UK; and helping provide training and support for the users of GasSim landfill gas modelling software.

PROJECT EXPERIENCE – AIR QUALITY

Bell Canada – Various facilities
Ontario, Canada

Ms. Armstrong assisted Bell Canada with the completion of Environmental Screening under the Ontario Electricity Act (O.Reg. 116/01) for peak shaving activities at eight facilities in Ontario. As project manager for this work, Ms Armstrong co-ordinated all public and stakeholder communications for these projects, in addition to preparing the environmental screening reports and completing detailed air quality calculations and modelling for the supporting air quality studies. Following the successful completion of the Environmental Screening, Ms. Armstrong assisted Bell Canada with preparation and submission of applications under the ECA or EASR processes.

BGIS,
Cambridge, Ontario

Ms Armstrong completed air quality emission calculations and dispersion modelling using the AERMOD dispersion model to assess the emissions from existing diesel generators at a data centre. This assessment was completed in response to a proposed new development in close proximity to the data centre that would potentially introduce new sensitive receptors. The purpose of the assessment was to evaluate the impact of the new developments on the facility's ability to maintain compliance with air quality and noise standards

Canadian Nuclear Laboratories – PSNE Upgrades,
Port Hope, Ontario

Ms. Armstrong supported CNL with the development and implementation of a dust monitoring plan to assess dust from construction activities at the Pine Street North Extension access road. This scope of work involved installation of dust monitors, training of construction team on daily maintenance of the equipment and reporting of recorded concentrations to inform on-site mitigation activities.

Canadian Nuclear Laboratories – HDLF ECA,
Port Hope, Ontario

Ms. Armstrong supported CNL with the preparation of an air quality screening assessment for landfill reclamation activities at Highland Drive Landfill. This work involved estimating emissions from the excavation of waste and modelling the predicted impacts at nearby surrounding receptors to help inform the odour management plan and identify an optimum "working area" for input into the construction plan.

CBM Aggregates/ Votorantim
Various, Ontario

Ms. Armstrong has supported CBM Aggregates with air quality studies for numerous license applications across Ontario to support new and expanded pit and/or quarry operations. This work has also included preparation of detailed air quality assessments including dispersion modelling, preparation for fugitive dust best management plans, design and implementation of dust monitoring programs and participation at public open houses to discuss the air quality assessment with local residents and answer questions

CIMA+ Partnership
City of Vaughan, Ontario

Ms Armstrong prepared an Air Quality assessment in support of a Municipal Class Environmental Assessment for the proposed road widening and extension of Portage Parkway in the City of Vaughan, from Applewood Crescent to Jane Street. She completed a baseline air quality assessment using local air quality data and prepared an assessment of the impacts of the project on ambient air quality concentrations

City of Barrie - Barrie Landfill
Barrie, Ontario

Ms. Armstrong designed and managed a VOC sampling program to support a nuisance assessment concerning odour emissions from Barrie Landfill. In addition, Ms. Armstrong completed a landfill gas walkover survey of the capped and temporary capped areas of site to help identify any potential weaknesses in the cap or areas for remediation.

City of Hamilton
Hamilton, Ontario

Ms. Armstrong completed a peer review for City of Hamilton for a proposed air quality and odour study that was prepared on behalf of a developer to assess the potential impacts of introducing residential land use next to an existing industrial facility

City of Toronto – Various Precinct Planning
Toronto, Ontario

Ms. Armstrong prepared Odour and Air Quality feasibility studies to assist with precinct planning initiatives for The City of Toronto. This work included characterizing existing air quality in each precinct and using data from existing industry to identify areas that may be suitable for future residential development from an air quality or odour perspective without compromising the ability of existing industry to operate in compliance with relevant provincial legislation.

Further support has also been provided to the City to peer review multiple air quality and odour studies submitted by developers in support of zoning amendment applications to identify whether proposed new land uses can demonstrate land use compatibility with existing land uses.

City of Toronto - BBTCA
Toronto, Ontario

Ms. Armstrong prepared emission estimates for Billy Bishop Toronto City Airport using the EDMS dispersion model under a number of different proposed operating scenarios. She conducted air dispersion modelling using CALPUFF to assess the cumulative impacts in the city of Toronto to feed into a larger Health Impact Assessment.

City of Toronto – Airshed Study
Toronto, Ontario

Ms. Armstrong prepared emission rates for industrial, commercial, residential, agricultural, mobile (roads) and non-road mobile (e.g. trains, aircraft, marine) sources in South Western Ontario at a 12km resolution and for the City of Toronto on a finer 1km resolution. This data was used in conjunction with regional emissions data for the North Western US to compile a regional emissions database. Ms Armstrong then conducted air dispersion modelling using this regional emissions database and the CALPUFF model to create an airshed model for the City of Toronto.

City of Toronto – Highland Creek Wastewater Treatment Plant
Toronto, Ontario

Ms. Armstrong prepared a cumulative air quality assessment for Highland Creek Wastewater Treatment Plant. Four different on-site biosolid management options were assessed in addition to two different transportation options. Off-site transportation emissions were calculated using the US EPA Motor Vehicle Emissions Simulator (MOVES) model and modelled in CALPUFF. The emissions of over 40 different contaminants were calculated and modelled for each scenario using both gaseous and particulate deposition model options to provide additional information to a Human Health Impact Assessment

City of Hamilton
Toronto, Ontario

Ms. Armstrong completed a peer review for City of Hamilton for a proposed air quality and odour study that was prepared on behalf of a developer to assess the potential impacts of introducing residential land use next to an existing industrial facility

Covanta Energy Corporation
Clarington, Ontario

Ms. Armstrong completed an Environmental Compliance Approval application for air and odour emissions at a waste to energy facility in Clarington, Ontario, using the CALPUFF dispersion model. She continues to provide support with the update of this modelling to incorporate new source testing data.

County of Northumberland - Brighton Landfill
Brighton, Canada

Ms. Armstrong prepared emission estimates for Brighton Landfill using the GasSim2 dispersion model under a number of different proposed operating scenarios. She conducted air dispersion modelling using AERMOD and assisted in the preparation of the technical supporting documents for air quality as part of an Environmental Assessment.

Cliffs Natural Resources
Ontario, Canada

Ms. Armstrong conducted air dispersion modelling using CALPUFF in support of the Environmental Assessment for a proposed mine site. She worked closely with the design team to ensure the facility design complies with current standards from an air emission perspective.

Cyclone Manufacturing
Mississauga, Ontario

Ms. Armstrong prepared supporting documentation for an Environmental Compliance Approval application using the AERMOD atmospheric dispersion model for an aerospace part manufacturing facility.

Department of Food, Education and Rural Affairs
Various, UK

Ms Armstrong completed a review of the various techniques available for quantifying landfill methane emissions. The research involved visits to a variety of research organizations and landfill operators in Europe to discuss the different techniques in development or currently employed on landfill sites. The aim of the project was to review the suitability and practicality of using alternative techniques to fulfil requirements within the UK regulatory regime.

Enwave Energy Corporation
Toronto, Ontario

Ms. Armstrong prepared detailed dispersion modelling assessments for three steam generation facilities located in downtown Toronto using the AERMOD atmospheric dispersion model. She completed regular updates and maintenance of these models to assess the impacts of proposed new developments on compliance with Ontario Regulation 419/05 and provide comment on new developments from a land use compatibility perspective. Completed emission calculations and submissions for the National Pollutant Release Inventory, Ontario Regulation 127, ChemTRAC and both provincial and federal greenhouse gas reporting programs for all three facilities.

Epic Realty Partners Ltd.
Ontario, Canada

Ms. Armstrong completed National Pollutant Release Inventory and/or Ontario Regulation 127 emissions calculations and submissions for 10 commercial and retail properties in Ontario.

GM Blueplan Engineering Ltd Partnership
Niagara Falls, Canada

Ms. Armstrong completed an air quality and odour study for the proposed South Niagara Falls Wastewater Treatment Plant in Niagara Falls, Ontario. This scope of work included characterizing the existing environment, preparing emission estimates for the sources of air and odour emissions from the proposed WWTP, modelling the impact on the surrounding environment and providing input on the design of mitigation controls.

K+S Windsor Salt Windsor, Ontario	Ms. Armstrong completed an Environmental Compliance Approval application for air emissions from the salt manufacturing facility and new combined heat and power equipment at the K +S Windsor Salt Facility in Windsor, Ontario using the AERMOD dispersion model.
London District Energy London, Ontario	Ms. Armstrong assisted London District Energy with the design of a proposed new combined heat and power system for their district energy plant. This work involved the preparation of an air dispersion model to represent existing and proposed sources of emissions at the facility and the completion of iterative modelling to provide inputs to the design engineering team on stack height and location. Following the completion of this scope of work, Ms. Armstrong prepared the ECA amendment application for the facility.
Morguard Canada Oakville, Ontario	Ms. Armstrong completed an air quality study to assess the land use compatibility of proposed residential development at the Former Glenn Abbey Golf Course. This work included an assessment of existing air quality in the study area, identification of existing industries, application of the MECP D-6 guidelines and air quality modelling to assess whether the proposed development impacts the ability of the existing industry to comply with relevant Ontario regulation 419/05 air quality standards.
Prenix Niagara Falls, Ontario	Ms. Armstrong completed an air quality compatibility study for a residential developer to assess the impact of a proposed new residential development on the neighbouring industrial industries, from an air quality perspective. This task involved characterizing the existing air quality, preparing emission estimates for the surrounding local industries and completing air dispersion modelling to assess the predicted concentrations at proposed new sensitive receptors. The purpose of this study was to identify whether the proposed sensitive land use could be deemed compatible with the existing industrial land uses.
R. W. Tomlinson Ltd. Ottawa, Ontario	Ms. Armstrong completed over 20 Environmental Compliance Approvals for air emissions at numerous aggregate sites located throughout the Ottawa area including quarries, concrete ready-mix facilities, asphalt plants, construction and demolition recycling facilities and portable crushing equipment. This work has also included assessment of fugitive dust sources and control technologies.
The International Group Inc. Scarborough, Ontario	Ms. Armstrong completed an Environmental Compliance Approval application for air emissions from the wax manufacturing facility and new combined heat and power equipment at the IGI Wax Facility in Scarborough, Ontario using the AERMOD dispersion model. In addition, Ms Armstrong assisted IGI with the assessment of a proposed new development in the surrounding area to assess its impact on the facilities ability to maintain compliance with O.Reg. 419/05.
Thomas Cavanagh Construction Ottawa, Ontario	Ms. Armstrong completed an Environmental Compliance Approval application for air emissions at the Henderson Quarry in Ottawa, Ontario using the AERMOD dispersion model.
Tomlinson Environmental Services Inc. Ottawa, Ontario	Ms. Armstrong completed various Environmental Compliance Approvals for air emissions at numerous sites located throughout the Ottawa area including recycling facilities and waste transfer equipment. This included emission calculations and air dispersion modelling and detailed analysis of results to determine likelihood of impacts off-site.

Town of New Tecumseth
New Tecumseth, Ontario

Ms. Armstrong completed a peer review for the Town of New Tecumseth for a proposed air quality and odour study that was prepared on behalf of a developer to assess the potential impacts of introducing residential land use next to an existing industrial facility

Try Recycling
Oro-Medonte, Ontario

Ms. Armstrong completed Environmental Compliance Approvals for air emissions at a proposed material recovery facility located in the township of Oro-Medonte, Ontario.

Walterfedy Partnership
Waterloo, Ontario

Ms Armstrong prepared an Air Quality assessment in support of a Municipal Class Environmental Assessment for the proposed Erb Street Widening & Corridor Study, Fischer-Hallman Road to Wilmot Line in the Region of Waterloo. She completed a baseline air quality assessment using local air quality data and prepared an assessment of the impacts of the project on ambient air quality concentrations

Woodfibre LNG
Squamish, British Columbia

Ms. Armstrong prepared detailed emissions calculations for a proposed LNG facility as part of a larger Environmental Assessment. She prepared dispersion modelling protocol documents and provided review of CALPUFF modelling files

3500 Steeles Avenue LP,
Toronto, Ontario

Ms Armstrong completed air quality emission calculations and dispersion modelling using both the AERMOD and ASHRAE models to assess the emissions from proposed new diesel generators to be installed at a data centre. This information was used to prepare input to the design team on the stack height of the new generators, to allow the generators to operate in compliance with Ontario Regulation 419/05 air quality limits.

TRAINING

Calpuff (Advanced)
*E*ponent, 2012*

Calpuff (Introductory)
*E*ponent, 2012*

Health and Safety Training
Golder U, 2007

GasSim2
Golder U, 2007

Technical Writing
Golder U, 2007

Golder 101
Golder U, 2007

Landfill Gas Management
ESA/EA, 2007

Passport to Safety
STC, 2006

PUBLICATIONS

Conference Proceedings

Jammer, M., M. Rawlings and K. Armstrong. Limitations of the BPIP Building Selection Algorithm in Determining the Inputs to PRIME and a Practical Work Around. Air and Waste Management Association 2010 Conference Proceedings, Paper 2010-859-AWMA (2010).

Armstrong, K.S. and R.G. Gregory. Review of Optical and Other Techniques for Quantifying Landfill Methane Emissions. Waste 2008: Waste and Resource Management – A Shared Responsibility, 447-455.

Education

Master of Environmental Science, University of Toronto, Scarborough, 2017

Languages

English – Fluent

Golder Associates Ltd. – Mississauga

Sita Chinnadurai, M.Env.Sc., Air Quality Specialist

Sita Chinnadurai is an Air Quality Specialist based in Golder's Mississauga office with 5 years of cumulative air quality consulting and government experience with Golder and the Environment and Climate Change Canada.

At Golder, Ms. Chinnadurai has successfully co-ordinated and completed several Air quality impact assessment studies, Ontario Ministry of the Environment, Conservation and Parks (MECP) Environmental Compliance Approval (ECA) applications and Environmental Activity Sector Registry (EASR) submissions and regulatory reporting projects for a variety of sectors including but not limited to aggregate processing, steel and allied sectors, transportation, power generation, pharmaceuticals, automotive and general manufacturing.

Prior to Golder Ms. Chinnadurai was working at Environment and Climate Change Canada in Toronto as a Research Analyst in the Hazardous Air Pollutants Laboratory. She also has a diverse international experience in the air quality domain working for over five years in Delhi, India on a variety of projects related to vehicular air emissions, industrial air pollution and ambient air quality monitoring.

Employment History

WSP - Golder Associates Ltd. – Mississauga, Ontario

Air Quality Specialist (2019 to Present)

Environment and Climate Change Canada – Downsview, Ontario

Research Analyst (Chemist) (2018 to 2019)

The Energy and Resources Institute (TERI) – New Delhi, India

Research Associate (2011 to 2016)

PROJECT EXPERIENCE – AIR QUALITY ASSESSMENTS

Prenix Associates – Land Use Compatibility Study for Proposed Residential Development Thundering Waters, Niagara, Ontario	Completed an Air Quality Study to assess the feasibility of introducing a proposed residential development at the Thundering Waters Golf Course lands and identified any potential land use compatibility issues from an air quality perspective. Prepared a feasibility study report for air quality to support with the site plan approval process following the MECP's Guideline D-1 – Land Use Compatibility (Guideline D-1) and related Guideline D-6 that discusses the applicability of Guideline D-1 for industrial facilities.
Benny Stark Limited, Altus Group Land Use Compatibility Study (air and odour) Toronto, Ontario	Completed a Land Use Compatibility Study, from an air quality and odour perspective, and submitted to City of Toronto as part of a Zoning Bylaw Amendment application to allow for the redevelopment of sites in Toronto to residential and mixed land use.
Bell Canada Ltd., Air Compatibility Studies Various sites in Ontario	Completed detailed air quality studies including air dispersion modelling to assess the impact of residential developments around existing Bell facilities in several locations in Ontario.
Harmony Creek Realty Ltd., Oshawa, Ontario	Supported the planning of proposed residential developments in Oshawa by conducting air quality Land Use Compatibility Assessment in accordance with relevant MECP D-Series Guidelines and identifying potential impacts due to transportation corridors.
Build Toronto Inc., Toronto, Ontario	Completed an Air Quality Assessment study to support a zoning by-law amendment application for permitting residential development on lands previously zoned otherwise in Toronto, in accordance with relevant MECP D-Series Guidelines and identifying potential impacts due to transportation corridors.
Benny Stark Limited, Altus Group Land Use Compatibility Study (air and odour) Toronto, Ontario	Completed a Land Use Compatibility Study, from an air quality and odour perspective, and submitted to City of Toronto as part of a Zoning Bylaw Amendment application to allow for the redevelopment of sites in Toronto to residential and mixed land use.
Bell Canada Ltd., Air Compatibility Studies Various sites in Ontario	Completed detailed air quality studies including air dispersion modelling to assess the impact of residential developments around existing Bell facilities in several locations in Ontario.
Harmony Creek Realty Ltd., Oshawa, Ontario	Supported the planning of proposed residential developments in Oshawa by conducting air quality Land Use Compatibility Assessment in accordance with relevant MECP D-Series Guidelines and identifying potential impacts due to transportation corridors.
Bell Canada – Various facilities Ontario, Canada	Completed several environmental screening assessments under the Ontario Electricity Act (O.Reg. 116/01) for peak shaving activities at facilities in Ontario, including detailed air emissions calculations, and air dispersion modelling.

Metrolinx
Ontario

Part of the technical team to complete a Transit Project Assessment Process (TPAP) Addenda under Ontario Regulation (O. Reg.) 231/08, Transit Project and Metrolinx Undertakings, to fulfill their scope for Construction Air Quality Assessment for two construction sites in Ontario. Developed emission inventory by estimating potential emissions from the proposed construction activities, modelled the predicted concentrations using AERMOD to assess the impacts on the vicinity focusing on sensitive receptors and derived a detailed mitigation plan for Metrolinx.

Enwave Energy (various sites)
Toronto, Ontario

Performed air dispersion modelling to assess the impacts of proposed residential developments on future air quality compliance of Enwave steam plants in downtown Toronto. Prepared technical memorandum for the client summarizing the implications of the proposed developments and outlining recommended mitigation for the developer, to assist client with commenting on proposals at municipal hearings.

Rain Carbon Canada Inc.
Hamilton, Ontario

Assisted with Site Specific Standard compliance requirements, maintaining up-to-date emission estimations and Emission Summary and Dispersion Modelling Report, air dispersion modelling, preparing technical memorandums for the client and third-party consultants involved with the Facility.

Piramal Healthcare (Canada) Inc.
Aurora, Ontario

Assisted with on-going support for maintaining current Emission Summary and Dispersion Modelling Report, and preparing annual written summary reports, as per requirements of the facility's Environmental Compliance Approval.

DECAST Ltd.
Utopia, Ontario

Performed AERMOD modelling and emission estimations for different potential scenarios to assess stack design at the Facility. This work was completed in support of the facility's application for an Environmental Compliance Approval, which was subsequently granted by the MECP.

Tomlinson Group of Companies
Ottawa, Ontario

Project manager and coordinator for completing Emission Summary and Dispersion Modelling reports to support Environmental Compliance Approval applications for several different facilities across Ontario. The facilities and equipment assessed include mobile crushers, stationary and mobile ready-mix plants, hot mix asphalt plants and aggregate extraction pits.

Thomas Cavanagh Construction Limited
Ottawa, Ontario

Prepared Environmental Compliance Approval application package for ready-mix concrete plants, quarry and crushing plants operating in different parts of Ontario.

CBM Aggregates/ Votorantim
Sunderland, Ontario

Completed air quality impact study for a license application to support pit expansion. The scope of work included detailed air emission inventory development, air dispersion modelling, fugitive dust best management plans.

City of Barrie - Barrie Landfill
Barrie, Ontario

Supported the project team with a nuisance assessment concerning odour emissions from Barrie Landfill by completing analysis of a VOC sampling program including modelling the sampling results and providing periodic reports to City of Barrie.

Publications

Articles

Saini, A., Harner, T., **Chinnadurai, S.,** Schuster, J. K., Yates, A., Sweetman, A., Aristizabal-Zuluagad, B.H., Jimeneze, B., Manzano, C. A., Gaga, E. O., Stevenson, G., Falandysz, J., Ma, J., Miglioranza, K. S. B., Kannan, K., Tominaga, M., Jariyasopit, N., Rojas, N. Y., Amador-Munoz, O., Sinha, R., Alani, R., Suresh, R., Nishino, T., and Shoeib, T., (2020). GAPS-megacities: A new global platform for investigating persistent organic pollutants and chemicals of emerging concern in urban air. Environmental Pollution, 267.

Ravindranath, N.H., **Sita Lakshmi, C.**, Manuvie, R. and Balachandra, P., (2011) Biofuel Production and Implications for Land Use, Food Production and Environment in India, Energy Policy, 39 (10)

Book Chapters

Sita Lakshmi, C., and Sharma, S., (2016). Diesel Generator Sets, Ch.7. In: Sharma S., Kumar A. (Eds.), 2016, Air pollutant emissions scenario for India. The Energy and Resources Institute.

Mahtta, R., **Sita Lakshmi, C.**, Sharma, S., Kumar, A., and Das, S., (2016). Industries, Ch. 4. In: Sharma S., Kumar A. (Eds.), 2016, Air pollutant emissions scenario for India. The Energy and Resources Institute.

Ravindranath, N.H., Manuvie R. and **Sita Lakshmi, C.**, (2010). Biofuels and Climate Change: Implications for GHG Emissions, Biodiversity, Impacts, and Adaptation, Ch. 6. In: F. Rosillo-Calle and F.X. Johnson, Food versus Fuel. London: Zed Publishers. (Note: Sita Lakshmi, C

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