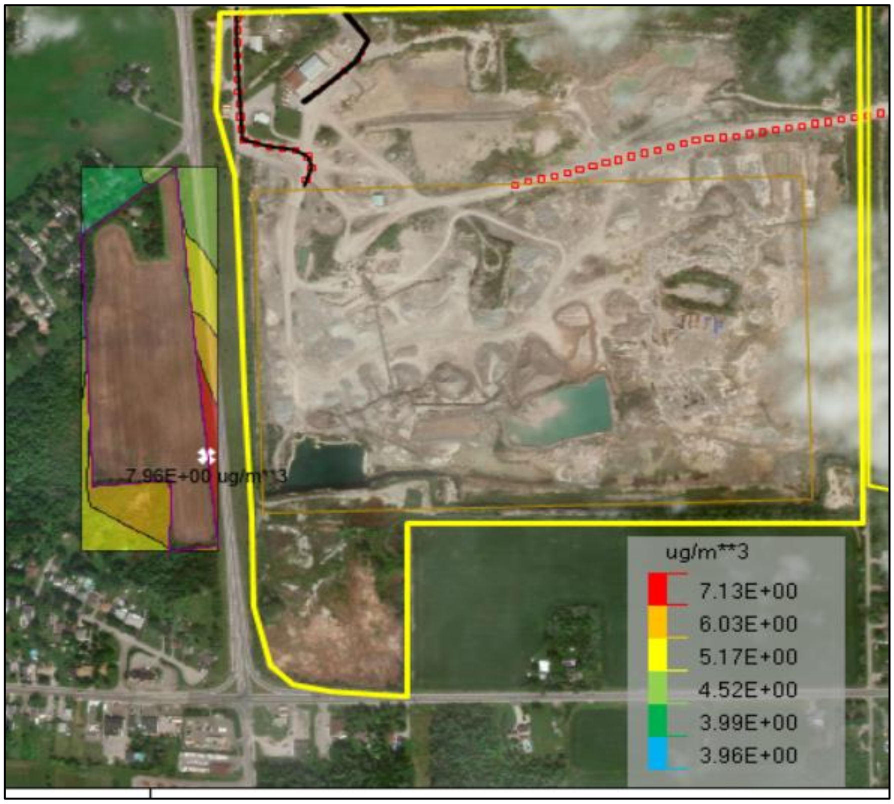
P21-1033

AIR QUALITY IMPACT ASSESSMENT
281 Chippawa Road
Port Colborne, Ontario
L3K 1T8



Prepared for:

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May 25, 2022

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EXECUTIVE SUMMARY

LAW Consultants Ltd. (LAW) was retained by Mr. Terry Graham on behalf of 2835935 Ontario Inc. (the "Client") to complete an Air Quality Impact Assessment (AIA) of the proposed development of a vacant (agricultural land) located at 281 Chippawa Road, Port Colborne, Ontario, hereinafter referred to as the 'Site'. This undertaking is carried out to support an application for zoning By-Law Amendment and plan of subdivision applications.

The air quality at the Site is likely impacted by the operation of the existing Port Colborne Quarries (PCQ) operation and some other industrial activities within a radius of 5 km. A series of emissions inventories and air dispersion modelling from the operation of the exercises were completed to P.Eng., QP conservatively assess the potential for air quality impacts from all significant onsite sources (both stationary and mobile sources) associated with the operation of PCQ.

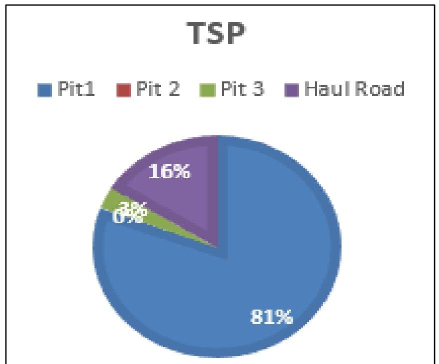

Fig A: TSP distribution

Information to complete this undertaking is taken from the AIA report completed by others on behalf of PCQ and included in PCQ website. The information was verified to some extent with a series of emails, phone calls and a brief site visit limited to Pit 1.

Contaminants of Potential Concern (CoPCs), including total particulate matter, PM10, PM2.5, respirable crystalline silica (RCS), combustion gases (nitrogen dioxide, sulphur dioxide, and carbon monoxide) were evaluated according to the Ontario Ministry of the Environment, Conservation and Parks (MECP) guidelines

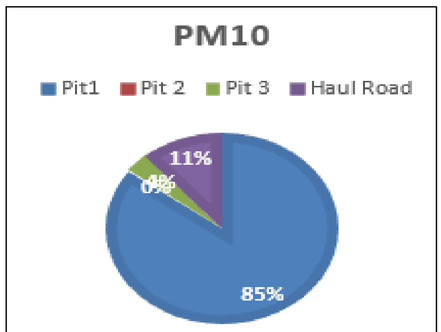

Fig B: PM10 distribution

Cumulative air quality impacts from PCQ operation were estimated by incorporating representative background concentrations and comparing the total concentrations to applicable ambient air quality criteria for CoPCs. The modelling results indicated the exceedances of particulate matter and RCS at the boundary receptors of the Site. As shown in Figures A and B, the sources of air emissions operating within Pit 1 impact the Site are quality the most.

Table 6-1: Maximum Predicted Concentrations for Existing Operations

Compound	Averaging Period	Criteria (µg/m³)	Existing Concentration (µg/m³)	Predicted Concentration (µg/m³)	Predicted Cumulative Concentration (µg/m³)	% Criteria
SPM	24-hr	120	42	332	374.0	**312**
	Annual	60	24	25.836	49.8	83
PM10	24 -hr	50	23.3	109.6	132.9	**266**
PM2.5	24-hr	27	12.6	12.8	25.4	94
	Annual	8.8	12.6	1.28	13.9	**158**
Crystalline Silica	24-hr	5	1.39	7.96	9.4	**187**
NO2	1-hr (AAQC)	400	25.51	99.3	124.8	31
	1-hr (CAAQS)	79	25.51	99.3	124.8	**158**
	24-hr	200	21.56	41.2	62.8	31
	Annual	22.6	12.23	2.5	14.8	65
SO2	1-hr (AAQC)	690	2.36	0.928	3.3	0.5
	1-hr (CAAQs)	170.3	2.36	0.928	3.3	2
	24-hr (AAQC)	275	2.31	0.928	3.2	1
	24-hr (CAAQS)	150	2.31	0.439	2.7	2
	Annual (AAQS)	55	1.05	0.032	1.1	2
	Annual (CAAQS)	10.5	1.05	0.032	1.1	10
CO	1-hr (AAQC)	36200	444.3	1521	1965.3	5
	1-hr (CAAQs)	15000	444.3	1521	1965.3	13
	8 hr	15700	426	1196	1622.0	10
	8-hr (NAAQO)	6000	426	1196	1622.0	27

Note:

* CAAQs for year 2025

** The predicted concentrations were not adjusted for meteorological anomalies.

*** The predicted annual concentrations were multiplied by 1.2.

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FIGURES (following text of report)

TABLES (within the report)

APPENDICES (following figures)

ACRONYMS, ABBREVIATIONS AND DEFINITIONS

Abbreviation	Definition
AAQO	Ambient Air Quality Objectives
AAQOS	Ambient Air Quality Objectives and Standards
ANFO	ammonium nitrate - fuel oil
AQ	air quality
AWMA	Air and Waste Management Association
ON	Ontario
MECP	Ministry of the Environment, Conservation and Parks
CACs	criteria air contaminants
CH4	Methane
CO	carbon monoxide
CO2	carbon dioxide
EC	Environment Canada
GHG	greenhouse gases
GLC	ground level concentrations
GWP	global warming potential
HC	Hydrocarbons
Hp	Horsepower
HV	high volume
IC	internal combustion
m.w.	molecular weight
MM5	5th generation mesoscale meteorological model
N2O	nitrous oxide
NO	nitric oxide
NO2	nitrogen dioxide
NOx	nitrogen oxide
NPRI	National Pollutant Release Inventory
O3	Ozone
Pb	Lead
SPM	Suspended particulate matter
PM10	particulate matter with an aerodynamic diameter no greater than 10 µm
PM2.5	particulate matter with an aerodynamic diameter no greater than 2.5 µm
SO2	sulphur dioxide
US EPA	United States Environmental Protection Agency

1.0 INTRODUCTION

LAW Consultants Ltd. (LAW) was retained by Mr Terry Graham on behalf of 2835935 Ontario Inc. (the "Client") to complete an Air Quality Impact Assessment (AIA) of the proposed development of a vacant (agricultural land) located at 281 Chippawa Road, Port Colborne, Ontario, hereinafter referred to as the 'Site'. This undertaking is carried out to support an application for zoning By-Law Amendment and plan of subdivision applications. The current plan is for a total of 169 units with 21 single lots, 40 semi-detached lots, 108 townhouse units. An illustration of the location of the proposed development property plan is presented in ***Figures 1 and 2.*** A copy of the Concept Plan prepared by Quartek is included following Figure 2.

This air quality assessment is required by the City of Port Colborne and focuses on the industrial operations (Port Colborne Quarries) to the east of Hwy 140, which borders the east side of the subject Site. Port Colborne Quarries (PCQ) operates an existing aggregate extraction and processing site of approximately 1,285 acres, Pit 1 through Pit 3. The location of the quarry is presented in **Figure 3**.

This air quality assessment reviews the compatibility of the housing development with the surrounding land uses. It considers the impacts of indicator contaminants, including suspended particulate matters, PM10, PM2.5, crystalline silica, carbon monoxide, sulphur dioxide, and oxides of nitrogen. The analysis in this report is based on predicted values, and is indicative of the input values used.

1.1 Subject Site Description

The Subject property is located on the southwest corner of Chippawa Road and Hwy 140. This property is located in an area designated Greenfield Lands and is designated RD (Residential Development) setting at the east end of the City of Port Colborne. Typical land use in the general area is residential and agricultural lands. There is a light industrial and mineral aggregate operation (Port Colborne Quarries) to the east of Hwy 140, which borders the east side of the Site. The Site is zoned for Residential Development and is also classified as a Greenfield Area under the City of Port Colborne Development Plan. A copy of the zoning plan is included in ***Figure 4***.

1.2 Port Colborne Site Description

The existing quarry (Pit 1, Pit 2 and Pit 3) is bounded by Second Concession Road to the north, Highway 140 to the west, Main Street East (Highway 3) to the south, and 200 metres west of Carl Road to the east. Based on the information provided by PCQ management via email and phone conversation, the current operations at the quarry include: extraction, processing and offsite transport. The extracted material is processed using a permanent processing plant located within Pit 1. The processing plant includes: crushers, screens, conveyors, and a wash plant. Drilling and blasting is carried out at the working face of the quarry (Pit 3) to extract material, which is then transported from the working face to the processing plant at Pit 1 using haul trucks. The processed material is stored in various stockpiles before being shipped off-site.

- Off-site shipping and related material handling activities occur year-round, generally from 7 am to 5 pm, Monday to Friday.

- Blasting occurs up to three times per week between the hours of 10 am to 4 pm, March through November. Blasting does not take place on weekends and no blasting activities occur during January or February. Extraction and processing occur from March through mid-December, generally from 7 am to 5 pm, Monday to Friday and on Saturdays from June through August.

1.3 Publicly Available Record Review

Golder Associates has completed an air quality impact assessment on behalf of PCQ in support of an application for licensing an expansion of the extraction face to the west of the current Pit 3. Most of the information provided in this report was taken from Golder report (Ref # 1771656), dated December 2020; hereinafter referred to as the Golder Report. The operating conditions, process equipment, On-road/Non-Road machinery equipment use were verified via email by PCQ management.

Most of the information provided in this report together with the information provided by PCQ are used to complete this undertaking.

2.0 AIR QUALITY REGULATIONS

This air quality assessment focuses on predicting changes in the concentrations of Potential Concern (CoPCs) including total particulate matter, PM10, PM2.5, respirable crystalline silica (RCS), combustion gases (nitrogen dioxide, sulphur dioxide, and carbon monoxide) The indicator compounds for quarry activities listed below.

2.1 Indicator Compounds

- Particulate matter: suspended particulate matter (SPM), particles nominally smaller than 10 µm in diameter (PM10);
- Particulate matter nominally smaller than 2.5 µm in diameter (PM2.5);
- crystalline silica: as a fraction of PM10; and
- combustion gases:
  - nitrogen dioxide (NO2),
  - sulphur dioxide (SO2), and
  - carbon monoxide (CO).

In addition to the compounds listed above, ozone (O3) was also quantified as it will be used to calculate NO2 concentrations from the predicted nitrogen oxide (NOX) concentrations. Ozone is not emitted directly into the atmosphere but is associated with the reaction of NOX (MECP 2015).

2.2 Applicable Guidelines

The relevant air quality criteria used for assessing the air quality effects of the Site development 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 Ontario (AAQC) document (MECP 2012). Regulated limits must already be met at the property line of the proposed development regardless of the current or future uses of the property.

Ontario Ambient Air Quality Standards

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, May 1, 2020).

Canadian Ambient Air Quality Standards

There are two sets of federal objectives and criteria: the National Ambient Air Quality Objectives (NAAQOs) and the Canadian Ambient Air Quality Standards (CAAQSs) (formerly National Ambient Air Quality Standards (NAAQS)). Similar to the Ontario AAQCs, the NAAQOs are benchmarks that can be used to facilitate air quality management on a regional scale, and provide goals for outdoor air quality that protect public health, the environment, or aesthetic properties of the environment (CCME 1999). The federal government has established the following levels of NAAQOs (Health Canada 1994):

National Ambient Air Quality Standards

- the maximum Desirable level defines the long-term goal for air quality and provides a basis for an anti degradation policy for unpolluted parts of the country and for the continuing development of control technology; and
- the maximum Acceptable level is intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort, and well-being

The CAAQSs have been developed under the Canadian Environmental Protection Act (CEPA) and include standards for PM2.5, Ozone, NO2 and SO2 to be implemented by 2025. Like the Ontario AAQCs, the CAAQSs are not regulatory limits and are used as national targets for PM2.5 and ozone, excluding Quebec (CCME 2014). 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 objectives and criteria as well as the criteria that will be used for this assessment are listed in Table 2.1. 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 are also used when available.

Table 2.1: Ontario and Canadian Regulatory Air Quality Objectives and Criteria

Compounds	Averaging Period	Ontario Ambient Air Quality Guidelines[(a)] (µg/m³)	Basis	Canadian Ambient Air Quality Standards[(b)] (µg/m³)	National Ambient Air Quality Standards and Objectives (µg/m³)		Assessment Criteria[)] (µg/m³)
					Desirable	Acceptable	
SPM[(d)]	24 h	120		-----	-----	120	120
	Annual	60		-----	60	70	60
PM_{10}	24 h	50	Health	-----	-	-	50
$PM_{2.5}$	24 h	27	Health	27 [2]	-	-	27
	Annual	8.8 [1]		8.8	-	-	8.8
NO_2	1 h	400	Health	79 (42 ppb)	-	400	79/400
	24 h	200	Health	‘-	-	-	200
	Annual	‘-		22.6 (12 ppb)	60	100	22.6
SO_2	1 h	106	Health	173 (65 ppb)	450	900	106/450
	24 h	_		-	150	300	150
	Annual	10.6	Vegetation	10.5 (4ppb)	30	60	10.5/30
CO	1 h	36,200	Health	-----	15,000	35,000	36,200/15000
	8 h	15,700	Health	-----	6,000	15,000	15,700/6,000
Crystalline silica, <10 µm	24 h	5	Health	-----	-----	-----	5

(a) MECP (2019)
(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) CCME (1999)
(d) SPM in Ontario is defined as Suspended Particulate Matter (<44 µm diameter)
(e) Geometric mean
(f) Interim AAQC and is provided as a guide for decision making (MECP 2018)

(g) Compliance is based on the 98th percentile of the annual monitored data averaged over three years of measurements. (h) Phase in date for standard is 2020.
(i) Standard is for nitrogen oxides (NOX) but is based on the health effects of NO2.
(j) Canadian ambient air quality standard for NO2 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.
(k) The 4 ppb standard for SO2 is effective from 2025, the current standard is 5 ppb. The new 1-hour standard is based on the three-year average of the annual 99th percentile of the daily maximum 1-hour average concentration;
(1) Year 2020 target;
(2) It reflects a three-year average of the annual 98th percentile of the 24-hr average concentrations
https://ccme.ca/en/air-quality-report#slide-7

3.0 EXISTING AIR QUALITY

The existing air quality in the area around the subject Site can be described by using publicly available monitoring data in the vicinity of the Site. The existing air quality includes the operation of PCQ, industrial facilities, roadways, long range transboundary air pollution, small regional sources and large industrial sources.

3.1 Monitoring Data

The existing air quality was characterized using observations from the Environment and Climate Change Canada (ECCC) National Air Pollution Surveillance Network (NAPS) air quality monitoring stations (ECCC 2019). 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. The stations located some distance away were used.

The relative locations of each of the air monitoring stations considered to describe the existing air quality is summarized in Table 3.1 and presented in ***Figure 5*** - Ambient Air Quality Monitoring Stations. Table 3.1 also includes the monitoring data that is available from each station for the 2015-2019 time period.

Table 3.1: Location of Air Monitoring Stations

Station	Address	NAPS Station ID	Latitude and Longitude	Distance to the Site (km)	Predominant Wind Direction	Monitoring Data Available
St. Catharines	62 Argyle Crescent	61302	43.16006, -79.23475	27	Northwest, generally downwind	PM2.5, NO2, NO, O3
Simcoe	Experimental Farm (Hwy 3& Bluebird Rd.)	62601	42.85685, -80.26964	85	West, generally upwind	PM2.5, NO2, NO, O3, SO2
Hamilton	Elgin & Kelly	60512	43.25778, -79.86167	65	Northwest, generally upwind	PM2.5, NO2, NO, SO2, CO, O3

There is no monitoring data available for SPM and PM10, however, an estimate of the SPM and PM10 concentrations are calculated from the available PM2.5 monitoring data. The mean levels of PM2.5 in Canadian locations are found to be about 54% of the PM10 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 across the Site is predominantly from the west and southwest (see Figure A) 50 % of the time. The closest air quality monitoring station is the St. Catharines station. This station is generally downwind of the Site and is likely the most representative station of the area due to proximity to the Site, however not all indicator compounds are monitored at this station. The Simcoe station has SO2 data and is generally upwind of the Site, however the station is located approximately 85 km away. Although the Hamilton station is closer to the Site than the Simcoe Station, the air quality monitoring data from the Simcoe station is likely more representative of air quality in the area of the Site given its surrounding land use which is a mix of rural, residential and few industrial facilities. CO is not monitored at the St. Catharines or the Simcoe station. Due to decreasing trends in CO levels in the province over the past ten years (MECP, 2018a), there are few stations that currently monitor CO. The closest station to the Site with monitoring data for CO is the Hamilton station.

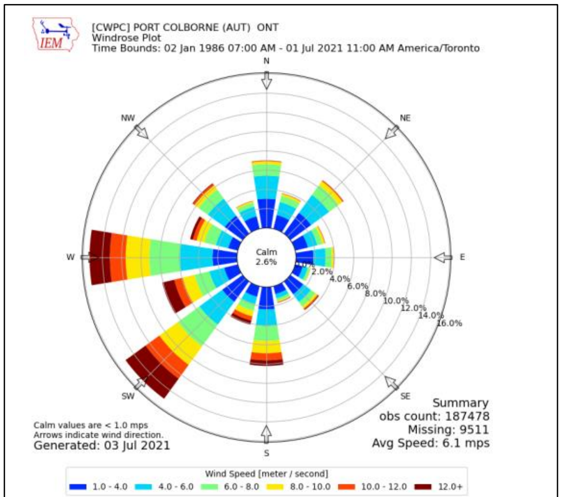

Fig A: Wind Rose for Port Colborne

Table 3.2 below summarizes monitoring data for the years 2015 through 2019 that were considered for this assessment. The 90th percentile of the 1 hour, 8-hour, and 24-hour measurements are typically used to represent the existing air quality value when conducting an impact assessment and the annual average concentration is used for annual background levels (Alberta Environment 2013). Monitored data is presented in Table 3.2

Table 3.2: Summary of Air Quality Station Data

Compounds	Averaging Period	Assessment Criteria) ($\mu g/m^3$)	Concentration ($\mu g/m^3$)		
			St. Catharines	Simcoe	Hamilton
SPM[d]	24 h	120	42.0		-
	Annual	60	24.0		
PM_{10}	24 h	50	23.30		
$PM_{2.5}$	24 h	27	12.6		
	Annual	8.8	7.2		
NO_2	1 h	79/400	25.51		
	24 h	200	21.56		
	Annual	22.6	12.23		
SO_2	1 h	170.3/690		2.36	
	24 h	275/150		2.31	
	Annual	10.5/55		1.05	
CO	1 h	36,200/15000			444.34

	8 h	15,700/6,000			426.01
O_3	1 h	165-	86.7		-

(a) Data measured in parts per billion (ppb) or parts per million (ppm), were converted to µg/m³ assuming standard temperature and pressure (25°C and one atmosphere of pressure).

3.2 Industrial Emissions Sources

There are eight industrial facilities that reported CACs to the National Pollutant Release Inventory (NPRI) within a 5 km radius of the Site in 2020 (ECCC 2021). Of those eight facilities, four reported contaminants in common with the Site. The 2020 reported data is the most recent data available. Reporting facilities and emission totals are summarized in Table 3.3. These emissions contribute to the local air quality and the consideration of cumulative effects. Overall, the data shows that there are not many industrial sources of air emissions located close to the Site in comparison to the locations of some of the monitoring stations referenced above. Therefore, the monitoring data described above is likely a conservative representation of the existing air quality in the area of the Site.

Table 3-3: Year 2020 Air Releases for Industry within 5 km of the Site

Company Name	Site Name	Distance to the Site (km)	Direction from the Site	Annual Releases to Air (tonnes)					
				NOx	SO2	CO	SPM	PM10	PM2.5
IMT Partnership	Forge Division	2.32	Southeast	-	-.	-	-	0.44	0.44
Vale Canada Limited	Port Colborne	2.5	South	-	-	-	-	0.79	0.17
ADM Agri-Industries Company	ADM Agri-Industries ADM Milling Co. - Port Colborne	3.4	Southwest	-	-	-	39.55	36.87	18.23
Jungbunzlauer Canada Inc	Jungbunzlauer Canada Inc.	1.85	northwest	243.91	-	58.93	27.29	28.89	27.84
Total (Facilities within 5 km)				243.91	-	58.93	66.84	66.99	46.68

https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/tools-resources-data/all-year-dashboard.html

3.3 Summary of Existing Air Quality

Table 3.4 summarizes the existing 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 existing air quality value when conducting an impact assessment and the annual average concentration is used for annual background levels (Alberta Environment 2013).

The St. Catharines station is the only air quality monitoring station located approximately 30 km downwind of the Site. Due to proximity and general air flow direction, data from the St. Catharines station is considered the most representative of the air quality surrounding the Site, and therefore is used for indicator compounds monitored at that station. Monitored SO2 data from the Simcoe station is used as it is more representative of air quality in the area of the Site given its similar elevation and has fewer industrial influences than the Hamilton station. The CO data from Hamilton is conservatively being used to represent existing air quality since the St Catharines and Simcoe stations do not have CO monitoring data. Existing crystalline silica concentrations were estimated as 6% of the existing PM10 concentration (US EPA, 1996).

Table 3.4: Existing Air Quality Concentrations

Indicator	Averaging Period	Assessment Criteria (µg/m³)	Air Quality Concentration (µg/m³)
SPM	24-hour	120	42
	Annual	60	24
PM10	24-hour	50	23.3
PM2.5	24-hour	27	12.6
	Annual	8.8	4.2
Crystalline silica (<10 µm)	24-Hour	5	1.39
NO2	1-Hour	79/400	25.51
	24-Hour	200	21.56
	Annual	22.6	12.23
SO2	1-Hour	1 170.3/690	2.36
	24-Hour	275/150	2.31
	Annual	10.5/55	1.05
CO	1-Hour	3 36200/15,000	444.34
	8-Hour	1 15,700/6,000	426.01
O3	1-Hour	1 165	86.7

4.0 EMISSION RATE ESTIMATES

Based on the information provided by PCQ, the Facility processes up to 4,500 MT of material per day. Reportedly, a total of one to three blasts are carried out per week and approximately (6.2-28) x1000 MT of aggregate per blast are generated. A loader transfers blasted aggregate from the working face of Pit 3 into haul trucks which travel to the processing plant located within Pit 1. The haul trucks travel along haul roads within the Facility property, crossing Snider and Babion Roads enroute to Pit 1.

Aggregate is processed first through the crushing plant, with smaller sized material passing through to the wash plant. Finished materials are stored in stockpiles before being hauled off-site. Supporting equipment include diesel dewatering pumps. Figure 6 illustrate the layout of the Site through the Pit 3 Extension phases.

Activities occur Monday to Friday, for approximately 10 hours per day, from 7:00 am to 5:00 pm. During the busy season (June, July and August), the Facility may operate on Saturdays, from 7:00 am to 3:00 pm. Blasting does not take place on weekends. Shipping can occur year-round, but there are no blasting or aggregate processing activities in the months of January and February.

The air quality assessment was carried out assuming the crushing plant and wash plant continue to operate in Pit 1; which results in the maximum distance between the extraction area and the processing area. This results in the longest haul road lengths for emission rate estimates and dispersion modelling, and thus represents a conservative worst-case scenario. Emission rate estimates are provided below for each of the main emission sources at the Facility.

4.1 Crushing Plant

The crushing plant can process up to 4,500 tonnes of material per day. For air emissions estimation from the crushing process, emission factors for SPM and PM10 were obtained from ***US EPA AP-42 Chapter 11.19.2 Crushed Stone Processing, Table 11.19.2-1 (U.S. EPA, 2006)***. Controlled emission factors were used if available; if controlled emission factors were not available, a control efficiency was applied, where applicable. The following equation was used to estimate the daily emission rates for particulates from trucks unloading.

$$ER \; = EF \; x \; M_h \; x \; (1 - \frac{CE}{100}) x \; conversion \; factor$$

Where;

ER = Emission rate, g/s

EF = Emission factor kg/Mg

M_h = Material handled, MT/day;

CE = Emission reduction efficiency

Daily emission rates were converted to hourly emission rates using the operating hours per day. The following is a sample calculation for the maximum hourly PM10 emission rate from haul trucks unloading at the grizzly feeder of the crush plant:

$$Hourly\ PM10\ Emission\ Rate = 8.0E - 06\ x\ \frac{kg}{Mg}\ x\ 4500\ x\ \frac{1000\ g}{kg}\ x\ \frac{1\ day}{10\ hr}\ x\ \frac{1\ hr}{3600\ s}$$

ER = 1.00E-03 g/s

4.2 Wash Plant

No emissions are expected as material processed in the wash plant is completely saturated with water.

4.3 Stockpiles

Material is stored in stockpiles after processing. The ***U.S. EPA AP 42 emission factors from U.S. EPA Control of Open Fugitive Dust Source (EPA 45/3 88 008), September 1988, Page 4-17*** were used to calculate the fugitive dust emissions associated with the storage piles. The following predictive emissions equation was used in determining the emission factors for material handling:

$$EF = 1.9\ x\ \frac{s}{1.5}\ x\ \frac{f}{15}\ x\ scaling\ factor\ x\ 1 - \frac{CE}{100}$$

EF : particulate emission factor (kg/ha/day);

S: silt loading (%);

f: % of time the wind speed is greater than 5.4 m/s;

Scaling factor: a particle size multiplier for particulate matter, and

CE: Control efficiency, reduction of fugitive dust emissions due to implementation of a BMP for fugitive dust.

The emission rate is a function of wind speed, and the equation 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 (16.52%) was obtained from the MECP pre-processed meteorological data (1996 2000) used for the dispersion modelling assessment.

The following is a sample calculation for the SPM emission factor for emissions that will occur from one of the stockpiles. The silt content for limestone products of 3.9% from Table ***13.2.4 1 of the U.S. EPA AP 42 Section 13.2.4*** was used.

$$EF = 1.9\ x\ \frac{3.9}{1.5}\ x\ \frac{16.52}{15}\ x\ 1$$

EF = 5.441 kg/ha-day

The following is a sample calculation for the SPM emission rate for one of the stockpiles. A control efficiency of 75% (obtained from the ***Western Regional Air Partnership Fugitive Dust Handbook, Table 9-4) (WRAP, 2006)*** was selected to represent the implementation of a fugitive dust best management practices plan (BMPP).

$$ER = EF\ x\ A\ x\ \frac{1\ ha}{10{,}000\ m^2}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ day}{24\ hr}\ x\ (1 - control\ efficiency)$$

Where:
EF = particulate emission factor (kg/ha/day);
A =exposed area (m2);
Control efficiency = reduction of fugitive dust emissions due to implementation of a BMP

$$ER = 5.441\ \frac{kg}{ha - day} x\ 347\ m^2\ x\ \frac{1\ ha}{10{,}000\ m^2}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ day}{24\ hr}\ x\ \frac{1\ hr}{3600\ s}\ x\ (1 - 0.75)$$

ER = 5.45 E-04 g/s

The emission rates of PM10 and PM2.5 were calculated as presented above based on scaling factors provided in ***AP-42 Chapter 13.2.5 Industrial Wind Erosion*** as summarized in Table 4.1.

Table 4.1: Particle Size Multipliers for Wind Erosion

Size Range	K
SPM	1
PM10	0.5
PM2.5	0.075

4.4 Vehicles Paved Road Dust

Vehicles (aggregate shipping trucks and passenger vehicles) enter and exit the site along a paved stretch of road that is approximately 92.7 m long. The ***U.S. EPA AP 42 emission factors from Chapter 13.2.1 Paved Roads (January 2011)*** were used to calculate the fugitive dust emissions from paved roadways. The following predictive emissions equation was used to estimate the fugitive dust emission factor for paved roads:

$$EF = (kx\ (sL)^{0.91}\ (W)^{1.02} x\ (1 - control\ efficiency)$$

Where:
EF = particulate emission factor (having units matching the units of k),
K = particle size multiplier for particle size range and units of interest (see Table 4.2),
sL = road surface silt loading (g/m2) assumed to be 8.2 (as ***per U.S. EPA AP 42 Section 13.2.1 3***, silt loading for Quarries),
W = average weight (tons) of the vehicles traveling the road, and
control efficiency = reduction of fugitive dust emissions due to implementation of a BMPP for fugitive dust.

Table 4.2: Particle Size Assumptions for Paved Road Dust

Size Range	k (g/VKT)
SPM	3.23
PM10	0.62
PM2.5	0.15

The following is a sample calculation for SPM for the predictive emission factor for vehicles that will travel along the main site access road. It was estimated that the mean vehicle weight on the main site access road is 18.22 tons. A control efficiency of 75% was selected to represent the implementation of a fugitive dust BMPP as per the ***Australian National Pollutant Inventory Emission Estimation Technique Manual for Mining (Version 3.1, January 2012).***

$$EF = 3.23\ x\ (8.2)^{0.91}\ x\ (18.22)^{1.02}\ )x\ (1 - 75\%)$$

EF = 105.81 g/VKT

The following is a sample calculation for the hourly SPM emission rate for vehicles travelling along the same paved road segment:

EF = $EF = \frac{105.81}{VKT}\ x\ \frac{3.5\ VKT}{day} x\ \frac{1\ day}{10\ hr} x\ \frac{1\ hr}{3600\ s}$

ER = 1.04E-02

The emission rates of PM10 and PM2.5 were calculated as presented above.

4.5 Vehicles Unpaved Road Dust

Roads within the quarry are unpaved. The predictive equation in ***U.S. 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 a control efficiency for the implementation of dust control measures. The equation is as follows:

$$EF = (kx\ (\frac{s}{12})^a\ x \left(\frac{W}{3}\right)^b\ x\ 281.9\Big)\ x\ (1 - control\ efficiency)$$

Where:

EF = particulate emission factor (g/VKT)

k = empirical constant for particle size range (pounds (lbs) per vehicle mile travelled (VMT)) (see Table 8)

s =road surface silt content (%) assumed to be 4.8% (as per U.S. **EPA AP 42 Section 13.2.2 for Sand and Gravel Processing Plant Roads)**

W = average weight (tons) of the vehicles traveling the road,

a = empirical constant for particle size range (dimensionless), Table 4.3;

b = empirical constant for particle size range (dimensionless), Table 4.3

281.9 = conversion from pounds per vehicle miles travelled to grams per vehicle kilometres travelled

control efficiency = reduction of fugitive dust emissions of 75% due to implementation of a fugitive dust BMPP (as per the ***Australian National Pollutant Inventory Emission Estimation Technique Manual for Mining, Version 3.1, January 2012***).

Table 4.3: Particle Size Assumptions for Unpaved Road Dust

Size Range	k (lb/VMT)	a	b
SP	4.9	0.7	0.45
PM	1.5	0.9	0.45
PM	0.15	0.9	0.45

The following is a sample calculation for SPM for the emission factor for vehicles that will travel along unpaved roads within the quarry. It was estimated that the loaders will have an average weight of 50.06 tons. A control efficiency of 75% was selected to represent the implementation of a BMPP which will include road watering and a speed limit.

$$EF = (4.9x\ (\frac{4.8}{12})^{0.7}\ x \left(\frac{50.06}{3})^{0.45}\ x\ 281.9\right) x\ (1 - 75\%)$$

EF = 645.26 g/VKT

The following is a sample calculation for the hourly SPM emission rate for loaders travelling along the same unpaved road segment:

$$ER = \frac{645.26\ g}{VKT}\ x\ \frac{3.0\ VKT}{hr}\ \ x\ \frac{1\ hr}{3600\ s}$$

ER = 0.54 g/s

The emission rates of PM10 and PM2.5 were calculated as presented above.

4.6 On Road Vehicles Exhaust Emissions

Shipping trucks operating at the Facility transport aggregate offsite to various customers. Emission rates for the vehicle exhaust from these shipping trucks were estimated using the ***U.S. EPA exhaust emission standards for Heavy-Duty Highway Compression-Ignition Engines and Urban Buses (U.S. EPA 2016)***. There are also some passenger vehicles (e.g., personal cars, company pick-up trucks, etc.) which will travel through the pits along haul vehicle emissions (U.S. EPA 2019).

Vehicles at the Facility meet Tier 3 emission standards at minimum. Emission standards are not provided for PM10 and PM2.5, therefore it was assumed that SPM emissions from vehicle exhaust consist of PM10 and that PM2.5 emissions are 97% of PM10 emissions per U.S. EPA 2010a.

The following predictive emissions equation was used to estimate the combustion emission rates for shipping trucks:

$$ER = EF\ x\ engine\ brake\ horse\ power\ rating\ x\ \frac{1\ hr}{3600\ s}$$

Where:

ER = emission rate (g/s)
EF = emission factor (g/bhp hr).

The following predictive emissions equation was used to estimate the combustion emission rates for passenger vehicles:

$$ER = \frac{2.0E - 01\ g}{bhp - hr}\ x\ 310.69\ bhp\ x\ \frac{1\ hr}{3600\ s}$$

Where:

ER = emission rate (g/s)
EF = emission factor (g/mile travelled).

The following is a sample calculation for the NOx emissions for a shipping truck:

$$ER = \frac{2.0E-01\ g}{bhp-hr}\ x\ 310.69\ bhp\ \ x\ \frac{1\ hr}{3600\ s}$$
$$ER = 1.73\ E-02\ g/s$$

The emission rates for SPM, PM10 and PM2.5, SO2, and CO were calculated using the same general equation.

4.7 Non-Road Engines Exhaust Emissions

Emission rates for heavy-duty off-road equipment were estimated using the ***U.S. EPA NON-ROAD model***. NON- ROAD uses the emission factors provided in documents published by U.S. EPA (2010a, 2010b). Emission factors are not provided for PM10 and PM2.5, therefore it was assumed that SPM emissions from vehicle exhaust consist of PM10 and that PM2.5 emissions are 97% of PM10 emissions per U.S. EPA 2010a. The following predictive emissions equation was used to estimate the combustion emission rates for onsite non- road vehicles:

$$ER = EF\ x\ engine\ brake\ horse\ power\ rating\ x\ number\ of\ equipment\ x\ \frac{1\ hr}{3600\ s}$$

Where:

ER = emission rate (g/s)

EF = emission factor (g/hp hr).

The calculation method follows that of the U.S. 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 Facility meet Tier 3 emission standards at minimum. The loader operating at the face of the extraction area meets Tier 4 emission standards. Emission factors vary depending on the sulphur content of the fuel, 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 (U.S. 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 (U.S. EPA 2010b).***

The following is a sample calculation for the SPM emissions for one of the loaders:

$$ER = \frac{1.36E-02\ g}{hp-hr}\ x\ 540\ hp\ x\ 0.59\ x\frac{1\ hr}{3600\ s}$$
$$ER = 1.2E-03\ g/s$$

The emission rates for PM10 and PM2.5, NOx, SO2, and CO were calculated using the same general equation.

4.8 Material Handling

At the extraction face, loaders are used to load blasted material into haul trucks, which transport the aggregate to the crushing plant. Loaders are also used to load processed aggregate from the Pit 1 stockpiles into shipping trucks. Similar drop operations occur at the crushing plant where processed materials drop from stacker conveyors onto stockpiles. Potential emissions from these drop operations include particulate matter because of the disturbance of material during handling. Extraction face loading and crushing plant operations typically occur Monday to Friday from March to December and on Saturdays from June to August. Loading at the Pit 1 stockpiles can take place year-round.

Predictive emission factors for particulate emissions were developed using the drop operation equation from the ***U.S. EPA AP 42 Section 13.2.4 Aggregate Handling and Storage Piles (November 2006)***, which is dependent on wind speed. The following predictive emissions equation was used in determining the emission factors for material handling:

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

Where:
EF = particulate emission factor (kg/Mg)
k = article size multiplier for particle size range (see Table 9);
U = mean wind speed (m/s)
M = moisture content of material (percent) (%).

Table 4.4: Particle Size Multiplier

Size Range	K
SPM	0.80
PM10	0.35
PM2.5	0.053

The following is a sample calculation for the SPM emission factor from the material handling of aggregate in Pit 1. A maximum wind speed of 19 m/s obtained from the MECP pre-processed meteorological data (1996 2000) was used for this sample calculation. A moisture content of 2.1% for various limestone products was obtained from ***Table 13.2.4.1 of the U.S. EPA AP 42***.

$$EF = 0.80x\ 0.0016\ x \frac{\left(\frac{19}{2.2}\right)^{1.3}}{\left(\frac{2.1}{2}\right)^{1.4}}$$

$$EF = 1.97\ E - 02 \frac{kg}{Mg}$$

The following is a sample calculation for the hourly SPM emission rate for a material handling rate of 756 tonnes/day and based on a wind speed of 19 m/s.

$$ER = \frac{1.97E-02\ kg}{Mg}\ x\ \frac{756\ Mg}{day}\ x\ \frac{1\ day}{10\ hr} x \frac{1000\ g}{1\ kg}\ x\ \frac{1\ hr}{3600\ s}$$

$$ER = 4.14E-01\frac{g}{s}$$

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 5 pm using the specific hourly wind speeds from the MECP pre-processed meteorological data. The emission rates of PM10 and PM2.5 were also estimated as presented above and for every hour in the meteorological data. Extraction rates are not anticipated to increase with the proposed pit expansion.

4.9 Drilling

Drilling is carried out to prepare the site for blasting. This is expected to result in emissions of fugitive dust, consisting of SPM, PM10 and PM2.5. Emission rates of particulate matter from drilling are based on emission factors obtained from ***the U.S. EPA AP-42 Chapter 11.9 Western Surface Coal Mining (U.S. EPA 1998***). The equation used to estimate the emission rates is as follows:

$$ER = Ef\ x\ Holes\ x\ \left(1-\frac{c}{100}\right) x\ \frac{1000\ g}{kg}\ x\ conversion\ to\ g/s$$

Where:
ER = emission rate of particulate matter (g/s);
EF = = emission factor (kg/hole)
Holes = number of holes drilled (holes/hour)
C = emission reduction factor of the control technology
The following is a sample calculation for the hourly SPM emission rate.

$$ER = \frac{0.59\ kg}{Hole}\ x\ \frac{10\ holes}{hr}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ hr}{3600\ s}$$

$$ER = 1.64E-02\frac{g}{s}$$

In this equation, drilling emission factors are only available for SPM. For the purpose of the assessment, an emission factor for PM10 was estimated from the SPM drilling factor based on the ratio between the SPM and PM10 emission factors for tertiary crushing (uncontrolled) from **U.S. EPA AP-42 Chapter 11.19.2 - Crushed Stone Processing and Pulverized Mineral Processing (U.S. EPA 2004**). Similarly, an emission factor for PM2.5 was estimated from SPM based on the ratio between the SPM and PM2.5 emission factors for tertiary crushing (controlled) from U.S. EPA (2004).

A maximum drilling rate of 10 holes/hour was used in estimating the emissions from drilling activities. Emissions are controlled by a vacuum bag dust collector equipped with a fabric filter, therefore a 99% control factor was applied to the calculations, as per the ***Australian National Pollutant Inventory Emission Estimation Technique Manual for Mining, Version 3.1, January 2012***.

4.10 Blasting Particulate

Blasting activities will generate fugitive dust emissions, including SPM, PM10 and PM2.5. An equation from ***U.S. EPA AP-42 Chapter 11.9 Western Surface Coal Mining (U.S. EPA 1998)*** was used to calculate the fugitive dust emissions associated with blasting activities. The equation is as follows:

$$E = 0.00022\ x\ A^{1.5}$$

Where:
E = emission factor (lb/blast);
A = reported blast horizontal area (9000 sf (847.5 m²)
The following is a sample calculation for the hourly SPM emission rate.

$$E = 0.00022\ x\ 847.5^{15} x\ \frac{1\ blast}{hr} x\ \frac{1\ hr}{3600\ s}\ x\ \frac{454\ g}{1\ lb}$$

E = 6.85 E-01 g/s

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)*** summarized in Table 4.5.

Table 4.5: Blasting Fugitive Emissions Scaling Factors for Particulate Matter

Parameter	SPM	PM10	PM2.5
Scaling Factor	1	0.52	0.03

There will be at most one blast per day. There are no emission control measures for blasting considered in the assessment.

4.11 Blasting Combustion Gases

Blasting will result in emissions of combustion gases (CO, NOX, SO2) from the detonation of emulsion-ammonium-nitrate and fuel oil (ANFO) blend explosives. Emission factors from the ***Australian National Pollutant blend is comprised predominantly of emulsion***, and 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. The equation is as follows:

$$ER = EF\ x\ Hourly\ Throughput\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ hr}{3600\ s}$$

Where:
ER = emission rate (g/s)

EF = emission factor (kg/tonne explosive)

The following is a sample calculation for the hourly NOx emission rate.

$$ER = \frac{0.2\ kg}{tonne\ explosive}\ x\ \frac{6160\ kg\ explosive}{blast}\ x\ \frac{1\ tonne\ explosive}{1000\ kg}\ \frac{1\ blast}{hr}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ hr}{3600\ s}$$

$$ER = 3.42E - 01\ \frac{g}{s}$$

The emission rates SO2 and CO were calculated using the same general equation.

4.12 Summary of Emissions

Tables A to N presents detailed calculation for particulate matter emissions from trucks loading, road dust from shipping trucks, loaders, dump trucks, and blasting operations. There was no sufficient information available to LAW Consultants to estimate combustion by products from the road/non-road equipment; therefore, emission rates for these contaminants were taken from the Golder Report.

The summary of calculations information used in the modelling are provided in Tables A1 and A2. Table A1 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.

5.0 DISPERSION MODELLING

The modelling was conducted using the United States Environmental Protection Agency (USEPA) Multi-Source Dispersion Model (AERMOD), as prescribed by Ontario Regulation 419/05 (O. Reg. 419/05). This section provides a description of how the dispersion modelling was conducted at the Site to calculate the maximum concentrations at POIs, as required by sub paragraphs 10 to 13 of s.26 (1) of O. Reg. 419/05. The dispersion modelling was conducted in accordance with the MECP publication "Air Dispersion Modelling Guideline for Ontario" (The ADMGO). AERMOD is an advanced steady-state plume model that has the ability to incorporate building cavity downwash, actual source parameters, emission rates, terrain data and historical meteorological information, to predict ground level concentrations (GLCs) at specified locations. The emission rates used in the dispersion modelling meet the requirements of Section 11 of O. Reg. 419/05. As required, the emission rate used in the dispersion model is at least as high as the maximum emission rate that the source of contaminant is reasonably capable of. These emission rates are further described in Appendix A - Source Emission Rate Calculations.

The other modelling requirements under Sections 13, 14, 15, 16 & 17 of O. Reg. 419/05 is described in Table 5.1 – Summary of Dispersion Modelling Input. The emissions from the Facility during the operating hours were considered to predict 24 - hour averages of contaminant concentrations at POI. The following approved dispersion model and pre-processors were used in the assessment:

AERMOD dispersion model (v. 19191); and
AERMAP surface pre-processor (v. 19191).
AERMET was not used since pre-processed meteorological datasets were obtained from the MECP. Dispersion Air Dispersion Modelling Guideline for Ontario

5.1 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.

5.2.1 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 years 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

Facility is located in the West Central MECP Region-Hamilton, Niagara, Guelph, the meteorological data set for West Central (London) crops is used is used (MECP 2020). The data set covers the period of January 1996 to December 2000.Niagara

5.2.2 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 (U.S. EPA 2004a). 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 (U.S. EPA 2004a). 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.

Digital Terrain Data

Digital terrain data was obtained from the MECP (NED GeoTIFF format) (MECP 2020). The GeoTIFF file used in this assessment was cdem_dem_030L.tif.

Model Receptors

For this air quality impact assessment, a modified version of the receptor placement recommended in Section 7.1 of the MECP ADMGO (MECP 2017) was chosen to reduce computing time. The subject Site property boundary at intervals of every 10 m.

5.2.3 Building Downwash

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

5.2.4 Emissions and Model Source Configurations

Air emissions from the quarry operation were grouped under three (3) open pit sources and line volume sources for paved and unpaved roads, as described herein.

Pit 3

The following sources were grouped under OPENPIT 3:

- Particulate matter from loading extracted material in haul trucks;
- Tail pipe and road dust from the loader operation;
- Combustion by-products from the operation of dewatering pump;
- Particulate matter from blast hole drilling;
- Particulate matter and gaseous emissions from blasting and use of explosive; and
- Tail pipe and road dust emissions from the haul truck travelling within pit 3

The estimated cumulative emission of particulate matter and combustion by-products is entered as a single area source in Pit 3. Please note that the emissions from the blasting operations are estimated but not used in the modelling, as blasting is not concurrent with other sources operated in pit 3.

Pit 2

The following sources were grouped under OPENPIT 2:

- Combustion by-products from the operation of dewatering pump;
- Tail pipe and road dust emissions from the haul truck travelling within pit 2

The estimated cumulative emission of particulate matter and combustion by-products was entered as a single area source in Pit 2.

Pit 1

The following sources were grouped under OPENPIT 1:

- Particulate matter from the stone crushing process;
- Particulate matter from the crushing plant drop operation;
- Particulate matter from the wash plant operation;
- Particulate matter from crusher stockpile wind erosion;
- Particulate matter from wash plant stockpile wind erosion;
- Particulate matter from west stockpile wind erosion;
- Tailpipe and road dust emissions from two (2) loaders handling crushed material;
- Tailpipe and road dust emissions from one (1) loader handling washed material;
- Tailpipe and road dust from the haul trucks travelling inside the Pit; and
- Particulate matter emissions from haul trucks loading process.

The estimated cumulative emission of particulate matter and combustion by-products is entered as a single area source in Pit 1.

Volume Sources

Volume sources were utilized to model road, fugitive process particulate, and tail pipe sources. The volume source parameters were calculated in accordance with the Ontario Ministry of the Environment, Conservation and Parks (MECP) Air Dispersion Modelling Guidelines for Ontario (A11). The initial vertical dimensions were calculated as source height divided by 2.15, and initial lateral dimensions were calculated as source width divided by 2.15. Source release heights were set at the center of the volume. A description of the various volume sources and modeling methodologies is described below.

Emissions due to haul road and general plant traffic on the unpaved/paved road network were modeled as adjacent volume sources. 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 used for haul trucks crossing the roads separating the pits, entering and exiting the pits. Air emissions from the passenger vehicles entering the parling lot were also modelled and a string of volume sources.

The volume source parameters for roads and pits are summarized in ***Table A2 in Appendix A.***

5.2.5 Summary of Model Options

The options used in the AERMOD model are summarized in Table 5.1.

Table 5.1: Options used in the AERMOD Model

Modelling Parameter	Description	Used in Concentration Modelling?
Regulatory Default	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 Method for N02 conversion will be used.	No - N02 is converted during post processing as defined in Section 5.8.2
Dry deposition	Specifies that dry deposition will be calculated	Yes - for particulates, silica
No Depletion	Specifies dry and wet depletion will be calculated	No - assessment is more conservative if this option is not selected
AVERTIME	Time averaging periods calculated	1-hr, 8-hr, 24-hr, annual
FLAGPOLE	Specifies that receptor heights above local ground level is allowed on the receptors.	No

5.2.6 Dry Deposition/Depletion

For modelling of SPM, PM10, crystalline silica and PM2.5 the dry deposition option was selected. Particle deposition is the naturally occurring process of removing suspended particles from the air, this process and through 'dry deposition' and 'wet deposition'. Dry deposition refers to the gravitational settling of particles and wet deposition refers to removal from the atmosphere by precipitation. Wet deposition was conservatively not accounted for since the meteorological datasets provided by the MECP did not contain precipitation data.

Use of the AERMOD dry depletion option requires an estimate of the mass fraction of each particle size for each emission source. This was determined using the emission rates of SPM, PM10 and PM2.5. The following is an example calculation for deposition parameters for modelling SPM from the Facility's main unpaved haul road (source ID HAULROAD), and the results are summarized in ***Table 5.2***.

$$mass\ fraction\ of\ PM_{2.5} = \frac{ER_{2.5}}{ER_{spm}} = \frac{4.10E-01\frac{g}{s}}{1.2E+01\frac{g}{s}} = 0.03$$

$$ass\ fraction\ of\ PM_{10} = \frac{ER_{PM10} - ER_{PM2.5}}{ER_{spm}} = \frac{3.15 - 4.10E-01\frac{g}{s}}{1.2E+01\frac{g}{s}} = 0.23$$

$mass\ fraction\ of\ SPM = 1 - mass\ fraction\ of\ PM_{10} - mass\ fraction\ of\ PM_{2.5} = 1 - 0.23 - 0.03$ =0.74

Table 5.2: Particle Size Parameters for Model Source HAULROAD

Compound	Emission Rate from Source HAULROAD (g/s)	Mass Fraction
PM	1.20E+01	0.74
PM10	3.15E+00	0.23
PM2.5	4.10E-01	0.03

A *particle density of 2.7 g/cm3*, which is the typical maximum density of soil, was assigned to each material handling source (i.e., crushing plant). A *particle density of 1.7 g/cm3*, which is the maximum density for loose sand or gravel from the US EPA (1985), was assigned to the road dust and vehicle tailpipe sources.

5.7 Special Modelling Considerations

5.7.1 Variable Emissions by Hour of Day

Sources operating within Pit 3 and pit 2 were modelled between the hours of 7 am and 5 pm seven days per week from March to November, then a factor of 0.5 was input for the month of December for hours between 7 am and 5 pm, to account for the 50% operating capacity. Emissions were set to 0 for January and February.

Product shipments off-site to customers can occur year-round, but only during daytime; therefore, sources associated with sources operating within Pit1, PR1, and PR2 were modelled using variable emissions to account for emissions occurring between 7 am and 5 pm seven days per week. Emissions from shipping activities were set to 0 during the evening and nighttime (i.e., between 5 pm and 7 am).

5.8 Post Processing

Most air quality concentration predictions are output directly from the model, however there are certain parameters, including averaging periods less than 1 hour and conversion of NO2 using existing regional ozone concentrations that require post processing. These post processing methods are described in the following sections.

5.8.1 Time Average Conversions

The smallest time scale that AERMOD predicts is a 1-hour average value. There are instances when criteria are based on different averaging times, and in these cases the following conversion factor, recommended by the MECP for conversion from a 1 hour averaging period to the applicable averaging period greater than 1 hour could be used (MECP 2017). An example is given below for converting from a 1 hour averaging period to a 1/2-hour averaging period:

$$F = (\frac{t_1}{t_0})^n$$
$$= (\frac{1}{24})^{0.28}$$
$$=0.411$$

Where:

F = the factor to convert from the averaging period t_1 output from the model (MECP assumes AERMOD predicts true 1 hr averages) to the desired averaging period t_0 (assumed to be 24 hr in the example above), and

N = the exponent variable; in this case the MECP value of n = 0.28 is used for conversion. For averaging periods greater than 1 hour, the AERMOD output was used directly.

5.8.2 Conversions of NOx to NO2

Emissions of oxides of nitrogen (NOx) were used as inputs to the AERMOD model. Predictions of nitrogen dioxide (NO2) can be calculated from modelled NOx 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 NO2 (Cole et al. 1979). The following equations present the methodology:

If background [O3] >0.90 [NOx], total conversion: [NO2] = [NOx]

If background [O3] <0.90 [NOx], NO2 is limited by O3: [NO2] = [O3] + 0.10 [NOx]

For the air quality assessment, the background concentrations of O3 used in the OLM are presented in Table 5.4. The 1-hour background concentration was converted to a 24-hour and annual concentration using the method detailed above in section 5.8.1.

Table 5.3: Ozone concentrations used in OLM

Averaging Period	Conversion Factor	Concentration of O3 (µg/m^3)
1 hr	1	86.7
24 hr	0.411	35.61
Annual	0.079	6.825

5.9 Conservative Assumptions in Modelling Approach

Table 5-4 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 Facility.

Table 5.4: Conservative Assumptions in Modelling Approach

Area	Conservative Assumption
Operations were modelled to be occurring simultaneously	The modelling assessment for the existing scenario and each expansion scenario includes all operations occurring simultaneously at maximum capacity for up to 10ours per day. This is unlikely to occur in practice.
Open Pit Source elevations	The pit depth was assumed 12 m to estimate pit volume. The pit depth was reported at least 16 m below grade, which reduces the amount of particulate matter and silica escaping off-site.
The longest haul road lengths were selected	The haul road emission rates were calculated using the maximum distance between the extraction area and crushing plant/wash plant. For the purposes of this assessment, it was assumed that the crushing plant and wash plant would remain in Pit 1 at all times.
Particle deposition/removal processes	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.

6.0 AIR QUALITY PREDICTIONS

The existing air quality is combined with the predicted concentrations from the facility operations. The resulting air quality concentrations are referred to as the cumulative predicted concentration, which is compared to the relevant air quality 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 desirable reference levels for outdoor air quality.

The maximum predicted cumulative concentrations for particulates, including crystalline silica, are above some of the assessment criteria at the subject Site boundary receptors. Emission sources operating in Pit 1 have the highest impact on air quality at the Site.

The maximum predicted cumulative concentrations of the combustion gases (NO2) at the subject Site boundary exceeds corresponding CAAQSs that will be coming into effect in 2025.

The MECP meteorological dataset used for this assessment shows that for the majority of the year, winds blow from westerly directions. It can be expected that if winds blow from the west, the highest concentrations are located immediately downwind to the east, far away from the subject Site.

Contour plots for compounds with maximum predicted cumulative concentrations above the Ontario AAQCs are provided in **Appendix B**. Emission of particulate matter from the onsite stockpiles wind erosion is bundled with other sources operating in Pit 1 and subjected to variable emission rate with the other sources. In reality, wind erosion is affected by the frequency of wind speed exceeding 5.4 m/s. Therefore, the predicted POI concentration of particulate matter is expected to be slightly higher than the modelling results.

The predicted cumulative concentrations of combustion gases are below the Ontario AAQCs at all receptors. However, the POI concentration of nitrogen dioxide exceeds the year 2025 CAAQs.

Table 6-1: Maximum Predicted Concentrations for Existing Operations

Compound	Averaging Period	Criteria (µg/m^3)	Existing Concentration (µg/m^3)	Predicted Concentration (µg/m^3)	Predicted Cumulative Concentration (µg/m^3)	% Criteria
SPM	24-hr	120	42	332	374.0	**312**
	Annual	60	24	25.836	49.8	83
PM10	24 -hr	50	23.3	109.6	132.9	**266**
PM2.5	24-hr	27	12.6	12.8	25.4	94
	Annual	8.8	12.6	1.28	13.9	**158**
Crystalline Silica	24-hr	5	1.39	7.96	9.4	**187**

NO2	1-hr (AAQC)	400	25.51	99.3	124.8	31
	1-hr (CAAQS)	79	25.51	99.3	124.8	**158**
	24-hr	200	21.56	41.2	62.8	31
	Annual	22.6	12.23	2.5	14.8	65
SO2	1-hr (AAQC)	690	2.36	0.928	3.3	0.5
	1-hr (CAAQs)	170.3	2.36	0.928	3.3	2
	24-hr (AAQC)	275	2.31	0.928	3.2	1
	24-hr (CAAQS)	150	2.31	0.439	2.7	2
	Annual (AAQS)	55	1.05	0.032	1.1	2
	Annual (CAAQS)	10.5	1.05	0.032	1.1	10
CO	1-hr (AAQC)	36200	444.3	1521	1965.3	5
	1-hr (CAAQs)	15000	444.3	1521	1965.3	13
	8 hr	15700	426	1196	1622.0	10
	8-hr (NAAQO)	6000	426	1196	1622.0	27

Note:

* CAAQs for year 2025

** The predicted concentrations were not adjusted for meteorological anomalies.

*** The predicted annual concentrations were multiplied by 1.2.

7.0 CONCLUSIONS

The results of the air quality impact assessment for the current operating conditions indicate that the predicted cumulative concentrations of several indicator compounds are above the assessment criteria at the subject Site boundary receptors.

Best management practice for fugitive dust control by PCQ and implementation of an air quality monitoring program would provide measured, off-site concentrations of the indicator compounds that could be used to evaluate the effectiveness of the BMPP and determine whether the modelling assessment requires further refinements to better represent emissions from the PCQ operations.

Yours truly,

LAW Consultants Ltd.

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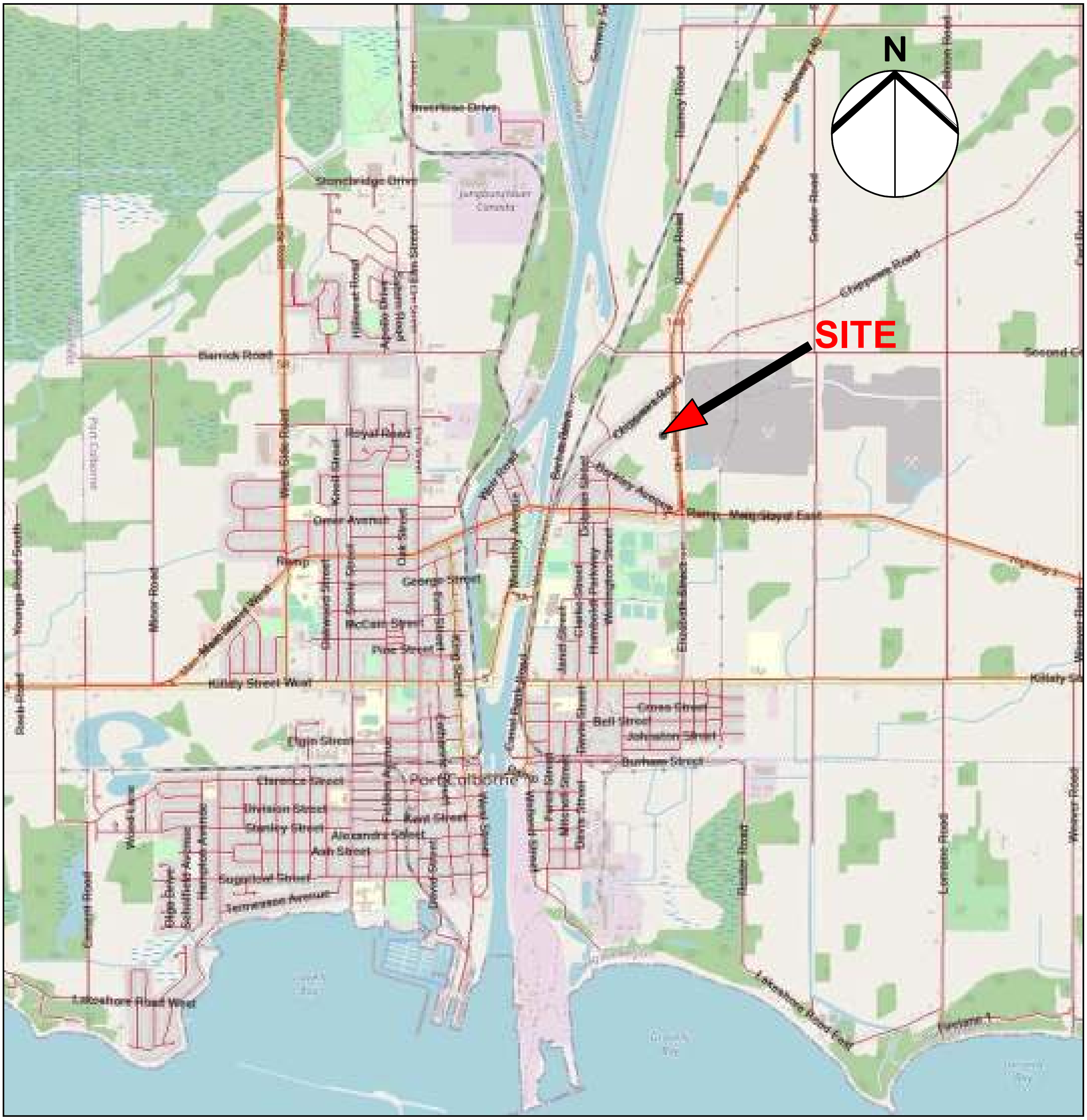
FIGURES



SITE LOCATION PLAN

281 CHIPPAWA ROAD, PORT COLBORNE ONTARIO

LAW Consultants Ltd. Concord Ontario

Drawn By	Reviewed By:	DWG NO	REV
JR	AN	FIGURE 1	

SCALE	NTS	July 5, 2021	SHEET

Approximate Location of Site Property Line

Approximate Location of Site Residential Area

SITE PLAN & SURROUNDING LAND USE

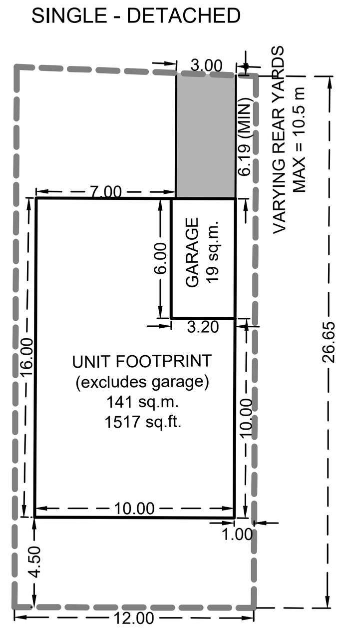
281 CHIPPAWA ROAD, PORT COLBORNE ONTARIO

LAW Consultants Ltd. Concord Ontario

Drawn By	Reviewed By:	DWG NO	REV
JR	AN	FIGURE 2	

SCALE	NTS	July 5, 2021	SHEET

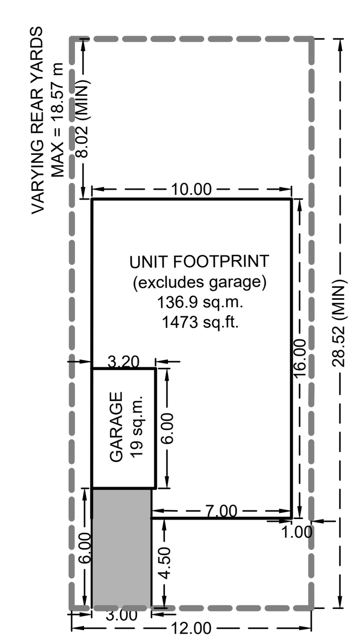
A1 - A8
SINGLE - DETACHED



MIN. LOT AREA: 327 sq. m.
MAX. LOT AREA: 357 sq. m.
TOTAL UNITS: 8 UNITS

	REQUIRED	PROVIDED
MIN LOT FRONTAGE	12 m	12 m
MIN LOT AREA	0.04 ha	***0.0327 ha***
MIN FRONT YARD	6.5 m	***4.5 m***
MIN SIDE YARD	1 m	1 m
MIN REAR YARD	6m	6 m
MAX LOT COVERAGE	50%	49%
MAX HEIGHT	11 m	Comply
MIN LANDSCAPED AREA	25%	45%

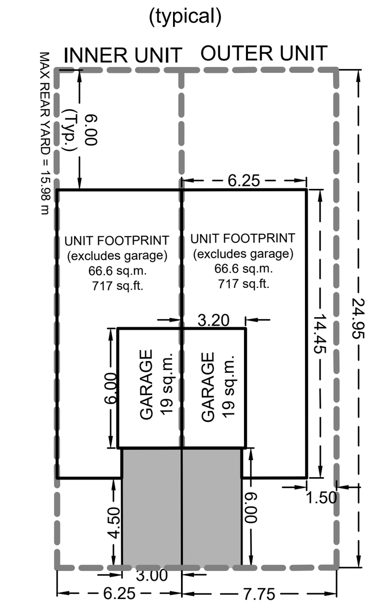
A9 - A21
SINGLE - DETACHED



MIN. LOT AREA: 400 sq. m.
MAX. LOT AREA: 570 sq. m.
TOTAL UNITS: 13 UNITS

	REQUIRED	PROVIDED
MIN LOT FRONTAGE	12 m	12 m
MIN LOT AREA	0.04 ha	0.04 ha
MIN FRONT YARD	6.5 m	***4.5 m***
MIN SIDE YARD	1 m	1 m
MIN REAR YARD	6m	8m
MAX LOT COVERAGE	50%	40%
MAX HEIGHT	11 m	Comply
MIN LANDSCAPED AREA	25%	49%

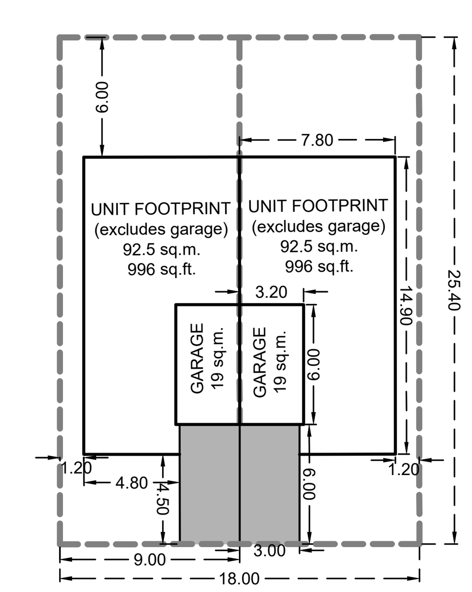
C1 - C108
TOWNHOUSES
(typical)



TYPICAL LOT AREA: 156 sq. m.
MIN. LOT AREA: 156 sq. m.
MAX LOT AREA: 272 sq. m.
TOTAL UNITS: 108 UNITS

	REQUIRED	PROVIDED
MIN LOT FRONTAGE	6 m	6.25m
MIN LOT AREA	0.02 ha	***0.0156 ha***
MIN FRONT YARD	7.5 m	***4.5 m***
MIN INT SIDE YARD	3 m	3 m
MIN EXT SIDE YARD	4.5 m	Comply
MIN REAR YARD	6 m	6 m
MAX HEIGHT	11 m	2 storeys
MIN LANDSCAPED AREA	25%	33%

B1 - B40
SEMI - DETACHED
(typical)



MIN. LOT AREA: 229 sq. m.
TOTAL UNITS: 40 UNITS

	REQUIRED	PROVIDED
MIN LOT FRONTAGE	18 m	18 m
MIN LOT AREA	0.05 ha	***0.045 ha***
MIN FRONT YARD	6.5 m	***4.5 m***
MIN INT SIDE YARD	1.2 m	1.2 m
MIN REAR YARD	6 m	6 m
MAX LOT COVERAGE	50%	48.6%
MAX HEIGHT	11 m	Comply
MIN LANDSCAPED AREA	25%	43%

TYPICAL UNIT DIMENSIONS

SITE STATISTICS	
TOTAL UNITS	169
SITE AREA	6.647 ha
DENSITY	25.4 UNITS/ha
PARKING	191 SPACES (1.13 PER UNIT)

17 Jan 2023
PRELIMINARY

issue	issued for	date	init.
H	REVIEW	14 DEC 2022	EP
G	REVIEW	09 DEC 2022	EP
F	REVIEW	04 AUG 2022	RM
E	REVIEW	22 JUL2022	RM
D	REVIEW	19 JUL2022	RM
C	REVIEW	11 MAY 2022	NS
B	REVIEW	18 JAN 2022	NS
A	REVIEW	25 OCT 2021	NS

approved by:

date:

CAD file: 21092-PLAN-REVISED-C-SHADES.dwg

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PORT COLBORNE, ON

drawing title: CONCEPT PLAN

drawn by	designed by
EP	EP
scale	date
1:750	14 DEC 2022
job number	issue
21092	H
drawing number	
21092-CP	

X:\Eric P\281 Chippawa Road\21092-PLAN-REVISED-C-SHADES.dwg drawing tab: 21092-CP

plotted by: epotts on Jan 17, 2023 - 10:11am

LEGEND

Property Boundary

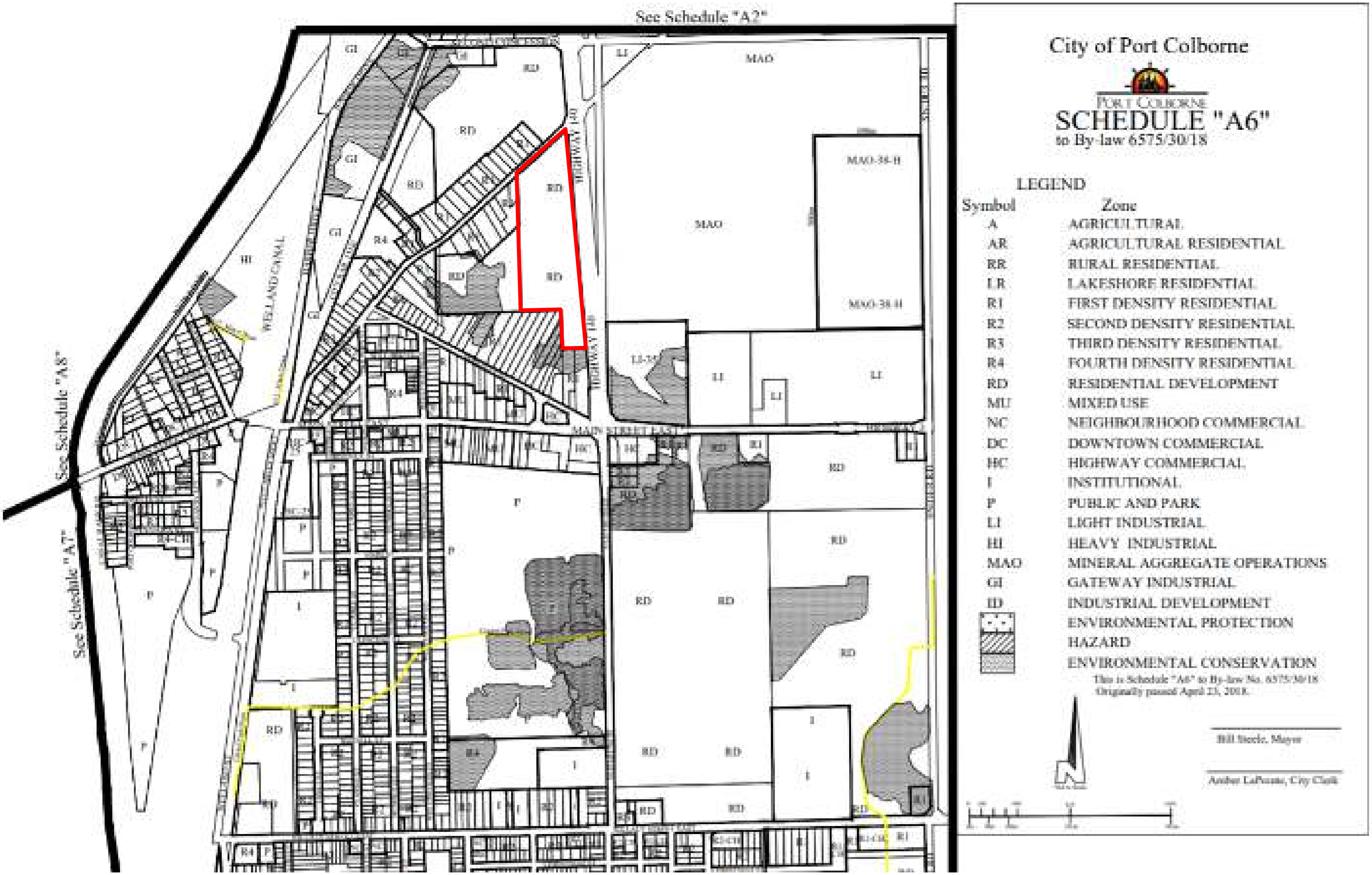
Proposed Quarry Extension

LAW Consultants Ltd.
Concord, Ontario

N

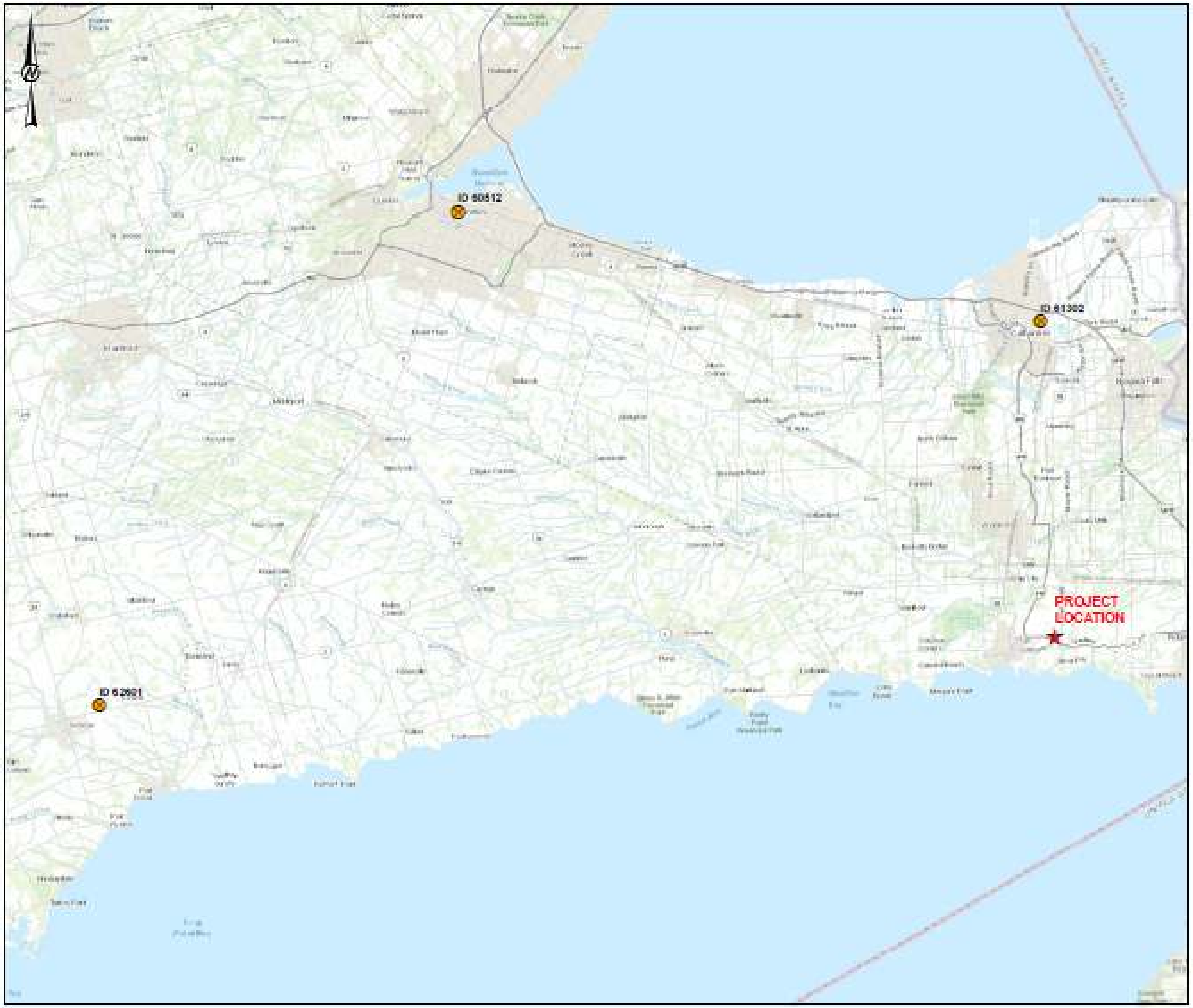
PORT COLBORNE QUARRY LOCATION

Drawn By	Reviewed By:	DWG NO	REV
JR	AN	FIGURE 3	
SCALE NTS	July 5, 2021	SHEET	



Site Boundary

	PORT COLBORNE PLANNING ZONES
	281 CHIPPAWA ROAD, PORT COLBORNE ONTARIO
LAW Consultants Ltd. Concord Ontario	Drawn By: JR · Reviewed By: AN · DWG NO: FIGURE 4 · REV
	SCALE: NTS · July 5, 2021 · SHEET



Project Location
Air Quality Monitoring Station

LAW Consultants Ltd. Concord Ontario	AMBIENT AIR QUALITY MONITORING STATIONS		
Drawn By: JR	Reviewed By: AN	DWG NO: FIGURE 5	REV
SCALE: NTS	July 5, 2021	SHEET	

APPENDIX A

Emission Summary Tables

Table A, (CRSHWIND), 4	
Emissions from Stockpiles Wind Erosion	
Emissions- Input	
Dust control efficieny, using BMP, (%)	75
Silt Loading%, S	3.90
% of time the wind speed>5.4 m/s;f	16.52
Area Source Characterization	
Length, m	88.5
Width,m	37.4
Source Height, (m)	4.50
Area, m2	3313.44
Initial Vertical Dimension, (m)	2.09
Particle Size Multiplier	
SPM, K-particle size multiplier	1.00
PM_{10}, k - particle size multiplier	0.50
$PM_{2.5}$, k - particle size multiplier	0.075
SPM:Emission Rate	
EF, Emission Factor (kg/ha-day)	5.441
24 hr, Emission rate, (g/s)	5.22E-03
PM10 Emissions	
24 hr, Emission rate, (g/s)	2.61E-03
PM 2.5 Emissions	
24 hr, Emission rate, (g/s)	3.91E-04
Crystalline Silica Emissions	
EF, Emission Factor (6% of PM10)	6.0%
24 hr, Emission rate, (g/s)	1.56E-04

$$EF = 1.9\ x\ \frac{s}{1.5}\ x\ \frac{f}{15}\ x\ scaling\ factor\ x\ (1 - control\ efficiency)$$

$$ER = EF\ x\ A\ x\ \frac{1\ ha}{10{,}000\ m^2}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ day}{24\ hr}\ x\ (1 - control\ efficiency)$$

https://nepis.epa.gov/Exe/ZyPDF.cgi/91010T54.PDF?Dockey=91010T54.PDF
https://www.epa.gov/sites/default/files/2020-10/documents/13.2.5_industrial_wind_erosion.pdf

Table B, (WASHWIND), 5	
Emissions from Stockpiles Wind Erosion	
Emissions- Input	
Dust control efficieny, using BMP, (%)	75
Silt Loading%, S	3.90
% of time the wind speed>5.4 m/s;f	16.52
Area Source Characterization	
Length, m	162.0
Width,m	93.9
Source Height, (m)	4.5
Area, m2	15220.2
Initial Vertical Dimension, (m)	2.1
Particle Size Multiplier	
SPM, K-particle size multiplier	1.00
PM_{10}, k - particle size multiplier	0.50
$PM_{2.5}$, k - particle size multiplier	0.075
SPM:Emission Rate	
EF, Emission Factor (kg/ha-day)	5.441
24 hr, Emission rate, (g/s)	2.40E-02
PM10 Emissions	
24 hr, Emission rate, (g/s)	1.20E-02
PM 2.5 Emissions	
24 hr, Emission rate, (g/s)	1.80E-03
Crystalline Silica Emissions	
EF, Emission Factor (6% of PM10)	6.0%
24 hr, Emission rate, (g/s)	7.19E-04

$$EF = 1.9\ x\ \frac{s}{1.5}\ x\ \frac{f}{15}\ x\ scaling\ factor\ x\ (1 - control\ efficiency)$$

$$ER = EF\ x\ A\ x\ \frac{1\ ha}{10{,}000\ m^2}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ day}{24\ hr}\ x\ (1 - control\ efficiency)$$

https://nepis.epa.gov/Exe/ZyPDF.cgi/91010T54.PDF?Dockey=91010T54.PDF
https://www.epa.gov/sites/default/files/2020-10/documents/13.2.5_industrial_wind_erosion.pdf

Table c, (WESTWIND), 6	
Emissions from Stockpiles Wind Erosion	
Emissions- Input	
Dust control efficieny, using BMP, (%)	75
Silt Loading%, S	3.90
% of time the wind speed>5.4 m/s;f	16.52
Area Source Characterization	
Length, m	184.8
Width,m	104.8
Source Height, (m)	4.5
Area, m2	19368.9
Initial Vertical Dimension, (m)	2.1
Particle Size Multiplier	
SPM, K-particle size multiplier	1.00
PM_{10}, k - particle size multiplier	0.50
$PM_{2.5}$, k - particle size multiplier	0.075
SPM:Emission Rate	
EF, Emission Factor (kg/ha-day)	5.441
24 hr, Emission rate, (g/s)	3.05E-02
PM10 Emissions	
24 hr, Emission rate, (g/s)	1.52E-02
PM 2.5 Emissions	
24 hr, Emission rate, (g/s)	2.29E-03
Crystalline Silica Emissions	
EF, Emission Factor (6% of PM10)	6.0%
24 hr, Emission rate, (g/s)	9.15E-04

$$EF = 1.9\ x\ \frac{s}{1.5}\ x\ \frac{f}{15}\ x\ scaling\ factor\ x\ (1 - control\ efficiency)$$

$$ER = EF\ x\ A\ x\ \frac{1\ ha}{10{,}000\ m^2}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ day}{24\ hr}\ x\ (1 - control\ efficiency)$$

https://nepis.epa.gov/Exe/ZyPDF.cgi/91010T54.PDF?Dockey=91010T54.PDF
https://www.epa.gov/sites/default/files/2020-10/documents/13.2.5_industrial_wind_erosion.pdf

Table D, (BLAST), 18	
Emissions from Quarry Blasting, Fugitives	
Emissions- Input	
Explosive Usage per blast, kg	6160
Area of the blast,ft2	9000
Area of the blast,m2	847.5
#of Blast/hr	1
Scaling Factor	
SPM	1
PM10	0.52
PM2.5	0.03
SPM:Emission Rate	
EF, Emission Factor (lb/blast)	**5.43E+00**
Emission rate, (g/s)	6.85E-01
PM10 Emissions	
PM10/SPM	**5.20E-01**
Emission rate, (g/s)	3.56E-01
PM 2.5 Emissions	
PM2.5/SPM	**3.00E-02**
Emission rate, (g/s)	2.05E-02
Crystalline Silica Emissions	
Crystalline Silica % of PM10	6.0%
Emission rate, (g/s)	2.14E-02

https://www3.epa.gov/ttnchie1/ap42/ch11/bgdocs/b11s09.pdf

TSP = $0.00022\,A^{1.5}$

$$E = 961\ x\ \frac{A^{0.8}}{D^{1.8}\,x\,M^{1.9}}$$

Table E, (BLAST), 1a	
Emissions from Quarry Blasting, Fugitives	
Emissions- Input	
Explosive Usage per blast, kg	6160
Area of the blast,ft2	9000
Area of the blast,m2	837
Avg depth of the hole, ft	10
Moisture content, %	2.5
#of Blast/hr	1
Emission Factor, Kfg/tonne explosive	
Nox	0.20
CO	17
SO2	0.54
NOx: Emissions Rate	
Emission rate, (g/s)	3.42E-01
SO2: Emission Rate	
Emission rate, (g/s)	9.24E-01
CO: Emission Rate	
Emission rate, (g/s)	2.91E+01

https://www3.epa.gov/ttnchie1/ap42/ch11/bgdocs/b11s09.pdf

$$ER = \frac{0.2\ kg}{tonne\ explosive}\ x\ \frac{6160\ kg\ explosive}{blast}\ x\ \frac{1\ tonne\ explosive}{1000\ kg}\ \frac{1\ blast}{hr}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ hr}{3600\ s}$$

$$ER = EF\ x\ Hourly\ Throughput\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ hr}{3600\ s}$$

Table F, (SHPTRCK),11	
Emissions from Ship Trucks Loading	
Emissions- Input	
Mean Wind Speed, m/s	19
Operating hrs	10
Moisture content of material,%	2.1
Quantity processed,tonnes/day	4500.00
Volume Source Characterization	
No. of volume sources	1.00
Initial lateral dimension (side length/4.3), (m)	0.47
Initial vertical dimension, m	0.4
Source Height, (m)	2.60
Side length, (m)	2.00
Particle Size Multiplier	
SPM, k	0.80
PM_{10}, k	0.35
$PM_{2.5}$, k	0.05
SPM:Emission Rate	
EF, Emission Factor (kg/Mg)	1.97E-02
Emission rate, (g/s)	2.46E+00
PM10 Emissions	
EF, Emission Factor (kg/Mg)	8.62E-03
Emission rate, (g/s)	1.08E+00
PM 2.5 Emissions	
EF, Emission Factor (kg/Mg)	**4.86E-04**
Emission rate, (g/s)	6.07E-02
Crystalline Silica Emissions	
Crystalline Silica % of PM10	6.0%
Emission rate, (g/s)	6.47E-02

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

$$ER = \frac{1.97E-02\ kg}{Mg}\ x\ \frac{756\ Mg}{day}\ x\ \frac{1\ day}{10\ hr}\ x\ \frac{1000\ g}{1\ kg}\ x\ \frac{1\ hr}{3600\ s}$$

Table G, (EXTLOAD), 16	
Extraction Face Material Handling	
Emissions- Input	
Mean Wind Speed, m/s	19
Operating hrs	10
Moisture content of material,%	2.1
Quantity processed,tonnes/day	4500.00
Volume Source Characterization	
No. of volume sources	1.00
Initial lateral dimension (side length/4.3), (m)	0.93
Initial vertical dimension, m	0.77
Source Height, (m)	3.33
Side length, (m)	4.00
Particle Size Multiplier	
SPM, k	0.80
PM_{10}, k	0.35
$PM_{2.5}$, k	0.05
SPM:Emission Rate	
EF, Emission Factor (kg/Mg)	**1.97E-02**
Emission rate, (g/s)	2.46E+00
PM10 Emissions	
EF, Emission Factor (kg/Mg)	**8.62E-03**
Emission rate, (g/s)	1.08E+00
PM 2.5 Emissions	
EF, Emission Factor (kg/Mg)	**1.31E-03**
Emission rate, (g/s)	1.63E-01
Crystalline Silica Emissions	
Crystalline Silica % of PM10	6.0%
Emission rate, (g/s)	6.47E-02

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

$$ER = \frac{1.97E-02\; kg}{Mg} \; x \; \frac{756\; Mg}{day} \; x \; \frac{1\; day}{10\; hr} \; x \; \frac{1000\; g}{1\; kg} \; x \; \frac{1\; hr}{3600\; s}$$

Table H, CRSHLOAD), 7	
Emissions from Loader Road Dust	
Emissions- Input	
Mean vehicle weight, (ton),W	37.5
*Road surface silt content, %	4.8
Dust control efficieny, (%)	75
Volume Source Characterization	
No. of line volume sources	7.00
Initial lateral dimension, (m)	12.09
Initial vertical dimension, (m)	2.82
Source Height, (m)	3.57
Side length, (m)	20.00
Particle Size Multiplier	
SPM, k - particle size multiplier, (lb/VMT)	4.90
PM_{10}, k - particle size multiplier, (lb/VMT)	1.5
$PM_{2.5}$, k - particle size multiplier, (lb/VMT)	0.15
Emprical constant for particle size range	
SPM, a	0.7
PM_{10},a	0.9
$PM_{2.5}$, a	0.9
SPM, b	0.45
PM_{10},b	0.45
$PM_{2.5}$, b	0.45
SPM: Emissions Rate	
Mean vehicle weight, (Ton),W	37.50
Distance Traveled, (VKT)/hr	3
Size specific EF, g/VKT	566.6
Controlled emission rate/truck, (g/s)	4.7E-01
PM10 Emissions	
Size specific EF, g/VKT	144.4
1 hr, Emission rate, (g/s)	1.20E-01
PM 2.5 Emissions	
Size specific EF, g/VKT	14.4
Emission rate, (g/s)	1.20E-02
Crystalline Silica Emissions	
Crystalline Silica% , 6%PM10	6.0%
24 hr, Emission rate, (g/s)	7.22E-03

$$EF = (kx\,(\frac{s}{12})^{a}\,x\,\left(\frac{W}{3}\right)^{b}\,x\,281.9\Big)\,x\,(1 - control\ efficiency)$$

*Road surface silt content, %(EPA-AP-42 section 13.2.2 silt loading for quarries

$$ER = \frac{645.26\ g}{VKT}\ x\ \frac{3.0\ VKT}{hr}\ \ x\ \frac{1\ hr}{3600\ s}$$

Table I, (WASHLOAD),9	
Emissions from Loader Road Dust	
Emissions- Input	
Mean vehicle weight, (ton),W	37.5
*Road surface silt content, %	4.8
Dust control efficieny, (%)	75
Volume Source Characterization	
No. of line volume sources	9.00
Initial lateral dimension, (m)	12.09
Initial vertical dimension, (m)	2.82
Source Height, (m)	3.57
Side length, (m)	20.00
Particle Size Multiplier	
SPM, k - particle size multiplier, (lb/VMT)	4.90
PM_{10}, k - particle size multiplier, (lb/VMT)	1.5
$PM_{2.5}$, k - particle size multiplier, (lb/VMT)	0.15
Emprical constant for particle size range	
SPM, a	0.7
PM_{10},a	0.9
$PM_{2.5}$, a	0.9
SPM, b	0.45
PM_{10},b	0.45
$PM_{2.5}$, b	0.45
SPM: Emissions Rate	
Mean vehicle weight, (Ton),W	37.50
Distance Traveled, (VKT)/hr	3
Size specific EF, g/VKT	566.6
Controlled emission rate/truck, (g/s)	4.7E-01
PM10 Emissions	
Size specific EF, g/VKT	144.4
1 hr, Emission rate, (g/s)	1.20E-01
PM 2.5 Emissions	
Size specific EF, g/VKT	14.4
Emission rate, (g/s)	1.20E-02
Crystalline Silica Emissions	
Crystalline Silica% , 6%PM10	6.0%
24 hr, Emission rate, (g/s)	7.22E-03

$$EF = (kx\,(\frac{s}{12})^{a}\,x\,\left(\frac{W}{3}\right)^{b}\,x\;281.9\Big)\,x\;(1 - control\ efficiency)$$

*Road surface silt content, %(EPA-AP-42 section 13.2.2 silt loading for quarries

$$ER = \frac{645.26\ g}{VKT}\ x\ \frac{3.0\ VKT}{hr}\ \ x\ \frac{1\ hr}{3600\ s}$$

Table S, Source V6 (HAULROAD), 19	
Emissions from Haul Road	
Emissions- Input	
Tare weight, MT	16.5
Payload weight, MT (45 x 1.10231)	49.6
Mean vehicle weight, (Ton),W	41.3
*Road surface silt content, %	4.8
Dust control efficieny, (%)	75
Unpaved Sretch of Haul Road, oneway, km	2.75
Travel per load, km	5.5
work shift, hr	10.0
No. of trucks haul aggregate to pit 1	3
Reported # of loads hauled from Pit 3 to Pit 1/workshift (10 hrs)	100
No. of Loads per truck	33.33
Distance travelled per truck, km	183
Distance travelled per truck, km/hr	18
Volume Source Characterization	
No. of line volume sources	
Initial lateral dimension, (m)	8.30
Initial vertical dimension, (m)	4.30
Source Height, (m)	4.44
Side length, (m)	
Particle Size Multiplier	
SPM, k - particle size multiplier, (lb/VMT)	4.90
PM_{10}, k - particle size multiplier, (lb/VMT)	1.5
$PM_{2.5}$, k - particle size multiplier, (lb/VMT)	0.15
Emprical constant for particle size range	
SPM, a	0.7
PM_{10},a	0.9
$PM_{2.5}$, a	0.9
SPM, b	0.45
PM_{10},b	0.45
$PM_{2.5}$, b	0.45
SPM: Emissions Rate	
Mean vehicle weight, (Ton),W	41.30
Distance Traveled, (VMT)/hr	18
Size specific EF, g/VKT	591.8
Controlled emission rate/truck, (g/s)	3.01E+00
Emission rate for three trucks: (g/s)	9.04E+00
PM10 Emissions	
Size specific EF, g/VKT	150.8
1 hr, Emission rate, (g/s)	7.68E-01
Emission rate for three trucks: (g/s)	2.30E+00
PM 2.5 Emissions	
Size specific EF, g/VKT	15.1
Emission rate, (g/s)	7.68E-02
Emission rate for three trucks: (g/s)	2.30E-01
Crystalline Silica Emissions	
Crystalline Silica% , 6%PM10	6.0%
24 hr, Emission rate, (g/s)	4.61E-02
Emission rate for three trucks: (g/s)	1.38E-01

$$EF = (kx\ (\frac{s}{12})^a\ x\ \left(\frac{W}{3}\right)^b\ x\ 281.9\Big)\ x\ (1 - control\ efficiency)$$

*Road surface silt content, %(EPA-AP-42 section 13.2.2 silt loading for quarries

Table K, (EXTFUG), 17	
Road Dust Emissions from Extraction Face	
Emissions- Input	
Mean vehicle weight, (ton),W	37.5
*Road surface silt content, %	4.8
Dust control efficieny, (%)	75
Volume Source Characterization	
No. of line volume sources	8.00
Initial lateral dimension, (m)	12.09
Initial vertical dimension, (m)	3.16
Source Height, (m)	4.00
Side length, (m)	20.00
Particle Size Multiplier	
SPM, k - particle size multiplier, (lb/VMT)	4.90
PM_{10}, k - particle size multiplier, (lb/VMT)	1.5
$PM_{2.5}$, k - particle size multiplier, (lb/VMT)	0.15
Emprical constant for particle size range	
SPM, a	0.7
PM_{10},a	0.9
$PM_{2.5}$, a	0.9
SPM, b	0.45
PM_{10},b	0.45
$PM_{2.5}$, b	0.45
SPM: Emissions Rate	
Mean vehicle weight, (Ton),W	37.48
Distance Traveled, (VKT)/hr	3
Size specific EF, g/VKT	566.5
Controlled emission rate/truck, (g/s)	4.7E-01
PM10 Emissions	
Size specific EF, g/VKT	144.4
1 hr, Emission rate, (g/s)	1.20E-01
PM 2.5 Emissions	
Size specific EF, g/VKT	14.4
Emission rate, (g/s)	1.20E-02
Crystalline Silica Emissions	
Crystalline Silica% , 6%PM10	6.0%
24 hr, Emission rate, (g/s)	7.22E-03

$$EF = (kx\,(\frac{s}{12})^a\,x\,\left(\frac{W}{3}\right)^b\,x\;281.9\Big)\,x\;(1 - control\;efficiency)$$

*Road surface silt content, %(EPA-AP-42 section 13.2.2 silt loading for quarries

$$ER = \frac{645.26\;g}{VKT}\;x\;\frac{3.0\;VKT}{hr}\quad x\;\frac{1\;hr}{3600\;s}$$

Table L, Drilling,17	
Emissions from Drilling Process	
Emissions- Input	
No. of holes drilled per hour	10
Emission Factor, kg/hole	0.59
Dust control efficieny, (%)	99
Emission Factor for uncontrolled Tertiary Crushing	
SPM, kg/Mg	0.0027
PM_{10}, kg/ Mg	0.0012
Emission Factor for controlled Tertiary Crushing	
SPM, kg/Mg	0.0006
$PM_{2.5}$, kg/Mg	0.00005
SPM: Emissions Rate	
Controlled emission rate, (g/s)	1.64E-02
PM10 Emissions	
PM10/SPM Ratio	0.44
Emission rate, (g/s)	7.28E-03
PM 2.5 Emissions	
PM2.5/SPM Ratio	8.33E-02
Emission rate, (g/s)	1.37E-03
Crystalline Silica Emissions	
Crystalline Silica% PM10	6.0%
Emission rate, (g/s)	4.37E-04

$$ER = Ef\ x\ Holes\ x\ \left(1 - \frac{c}{100}\right) x\ \frac{1000\ g}{kg}\ x\ conversion\ to\ g/s$$

https://www3.epa.gov/ttnchie1/ap42/ch11/final/c11s09.pdf

https://www3.epa.gov/ttnchie1/ap42/ch11/final/c11s1902.pdf

Table S, (SHIPROAD), 10	
Emissions from Ship Road	
Emissions- Input	
No. of trucks haul material offsite/day	300
Triaxial, Tare weight, MT	15
Payload weight, MT	23
Mean vehicle weight, (Ton),W	26.5
*Road surface silt content, %	4.8
Dust control efficieny, (%)	75
Traffic speed, km/hr	30
Unpaved Sretch of Haul Road, oneway, km	0.4
Travel per load, km	0.8
workshift, hrs	10
Distance Travelled, km	240
Distance Traveled, (VKT)/hr	24
Volume Source Characterization	
No. of line volume sources	
Initial lateral dimension, (m)	8.30
Initial vertical dimension, (m)	4.30
Source Height, (m)	4.44
Side length, (m)	
Particle Size Multiplier	
SPM, k - particle size multiplier, (lb/VKT)	4.90
PM_{10}, k - particle size multiplier, (lb/VKT)	1.5
$PM_{2.5}$, k - particle size multiplier, (lb/VKT)	0.15
Emprical constant for particle size range	
SPM, a	0.7
PM_{10},a	0.9
$PM_{2.5}$, a	0.9
SPM, b	0.45
PM_{10},b	0.45
$PM_{2.5}$, b	0.45
SPM: Emissions Rate	
Mean vehicle weight, (Ton),W	26.50
Distance Traveled, (VKT)/hr	24
Size specific EF, g/VKT	484.7
Controlled emission rate/truck, (g/s)	3.23E+00
PM10 Emissions	
Size specific EF, g/VKT	123.5
1 hr, Emission rate, (g/s)	8.23E-01
PM 2.5 Emissions	
Size specific EF, g/VKT	12.4
Emission rate, (g/s)	8.23E-02
Crystalline Silica Emissions	
Crystalline Silica% , 6%PM10	6.0%
Emission rate, (g/s)	4.94E-02

$$EF = \left(kx\left(\frac{s}{12}\right)^a x \left(\frac{W}{3}\right)^b x\ 281.9\right) x\ (1 - control\ efficiency)$$

*Road surface silt content, %(EPA-AP-42 section 13.2.2 silt loading for quarries

$$ER = \frac{645.26\ g}{VKT}\ x\ \frac{3.0\ VKT}{hr}\ \ x\ \frac{1\ hr}{3600\ s}$$

Table N, Source R2
Road Dust Emissions from Paved Road, Trucks Traffic

Emissions - Input		
Triaxial, Tare weight, MT	15	
Payload weight, MT	23	
Mean vehicle weight, (Ton),W	26.5	
Silt content, %	8.2	
Paved Sretch of Haul Road, oneway, km	0.24	
Travel per load, km	0.48	
Operating Time, hr	10	
Number of Shipments per day	300	
Distance travelled, km	144	
Distance travelled/hr	14.4	
Dust control efficieny, (%)	75	
Particle Size Multiplier		
PM_{30}, k - particle size multiplier, (g/VKT)	3.23	
PM_{10}, k - particle size multiplier, (g/VKT)	0.62	
PM_{10}, k - particle size multiplier, (g/VKT)	0.15	
SPM: Emissions Rate		
Mean vehicle weight, (MT),W	26.5	
Distance Traveled, (VKT)	14.4	
Size specific emission factor, (g/VKT) E= K x (Sl)^0.91 x W^1.02	620.1	
Uncontrolled emission rate, (g/s)	2.4805	18
Controlled emission rate, (g/s)	0.620	3.45E-02
PM10: Emission Rate		
Size specific emission factor, (g/VKT) E= K x (Sl)^0.91 x W^1.02	119	
Uncontrolled emission rate, (g/s)	0.4761	
Controlled emission rate, (g/s)	0.119	
PM2.5: Emission Rate		
Size specific emission factor, (g/VKT) E= K x (Sl)^0.91 x W^1.02	29	
Uncontrolled emission rate, (g/s)	0.1152	
Controlled emission rate, (g/s)	0.029	
Crystalline silica: Emission Rate		
Crystalline Silica % of PM10	6%	
Emission rate, (g/s)	0.01	

Table N, CRSHLOAD2),8

Emissions from Loader Road Dust

Emissions- Input	
Mean vehicle weight, (MT),W	37.5
*Road surface silt content, %	4.8
Dust control efficieny, (%)	75
Volume Source Characterization	
No. of line volume sources	7.00
Initial lateral dimension, (m)	12.09
Initial vertical dimension, (m)	2.82
Source Height, (m)	3.57
Side length, (m)	20.00
Particle Size Multiplier	
SPM, k - particle size multiplier, (lb/VMT)	4.90
PM_{10}, k - particle size multiplier, (lb/VMT)	1.5
$PM_{2.5}$, k - particle size multiplier, (lb/VMT)	0.15
Emprical constant for particle size range	
SPM, a	0.7
PM_{10},a	0.9
$PM_{2.5}$, a	0.9
SPM, b	0.45
PM_{10},b	0.45
$PM_{2.5}$, b	0.45
SPM: Emissions Rate	
Mean vehicle weight, (Ton),W	37.50
Distance Traveled, (VKT)/hr	3
Size specific EF, g/VKT	566.6
Controlled emission rate/truck, (g/s)	4.7E-01
PM10 Emissions	
Size specific EF, g/VKT	144.4
1 hr, Emission rate, (g/s)	1.20E-01
PM 2.5 Emissions	
Size specific EF, g/VKT	14.4
Emission rate, (g/s)	1.20E-02
Crystalline Silica Emissions	
Crystalline Silica% , 6%PM10	6.0%
24 hr, Emission rate, (g/s)	7.22E-03

$$EF = (kx\,(\frac{s}{12})^a\,x\left(\frac{W}{3}\right)^b\,x\,281.9\Big)\,x\,(1 - control\ efficiency)$$

*Road surface silt content, %(EPA-AP-42 section 13.2.2 silt loading for quarries

$$ER = \frac{645.26\ g}{VKT}\ x\ \frac{3.0\ VKT}{hr}\ \ x\ \frac{1\ hr}{3600\ s}$$

Table A1

Emission Summary Table by Source
Air Quality Impact Assessment

SOURCE INFORMATION				Emission Data			
Source ID	**Modelling ID**	**Source Description**	**Release Height, m**	**Contaminants**	**CAS Number**	**1-hr Emission Rate (g/s)**	**24-hr Emission Rate (g/s)**
				Pit 1			
1	**CRUSH**	**Crushing Plant, Volume Source**	**8.35**	SPM	N/A	5.84E-01	
				PM10	N/A	2.05E-01	--
				PM2.5	N/A	3.12E-02	--
				Crystalline Silica	14808-60-7	1.35E-02	--
2	**CRSHDRP**	**Crushing Plant Drop Operations, Volume Source**	**5.35**	SPM	N/A	2.75E+00	--
				PM10	N/A	1.20E+00	--
				PM2.5	N/A	1.82E-01	--
				Crystalline Silica	14808-60-7	7.91E-02	--
3	**WASHPL**	**Wash Plant, Volume Source**	**6.1**	SPM	N/A	2.75E-01	--
				PM10	N/A	1.16E-01	--
				PM2.5	N/A	7.72E-02	--
				Crystalline Silica	14808-60-7	7.64E-03	--
4	**CRSHWIND**	**Crusher Stockpiles Wind Erosion, Area Source**	**4.5**	SPM	N/A	—	5.22E-03
				PM10	N/A	—	2.61E-03
				PM2.5	N/A	—	3.91E-04
				Crystalline silica	14808-60-7	—	1.56E-04
5	**WASHWIND**	**Wash Plant Stockpiles Wind Erosion, Area Source**	**4.5**	SPM	N/A	—	2.40E-02
				PM10	N/A	—	1.20E-02
				PM2.5	N/A	—	1.80E-03
				Crystalline silica	14808-60-7	—	7.19E-04
6	**WESTWIND**	**West Stockpiles Wind Erosion, Area Source**	**4.5**	SPM	N/A	—	3.05E-02
				PM10	N/A	—	1.52E-02
				PM2.5	N/A	—	2.29E-03
				Crystalline silica	14808-60-7	—	9.15E-04
7	**CRSHLOAD1**	**Stockpile Area 1 Loader Dust, Line Volume, traffic**	**3.57**	SPM	N/A	4.72E-01	—
				PM10	N/A	1.20E-01	—
				PM2.5	N/A	1.20E-02	—
				Crystalline silica	14808-60-7	7.22E-03	—
8	**CRSHLOAD2**	**Stockpile Area 1 Loader Dust, Line Volume, traffic**	**3.57**	SPM	N/A	4.72E-01	—
				PM10	N/A	1.20E-01	7.20E-01
				PM2.5	N/A	1.20E-02	—
				Crystalline silica	14808-60-7	7.22E-03	—
9	**WASHLOAD**	**Stockpile Area 2 Loader Dust, Line Volume**	**3.57**	SPM	N/A	4.72E-01	—
				PM10	N/A	1.20E-01	—
				PM2.5	N/A	1.20E-02	—
				Crystalline silica	14808-60-7	7.22E-03	—
10	**SHIPROAD**	**Shipping Road Dust, Volume**	**3.47**	SPM	N/A	3.23E+00	—
				PM10	N/A	8.23E-01	—
				PM2.5	N/A	8.23E-02	—
				Crystalline silica	14808-60-7	4.94E-02	—

7a	**CRSHLOAD1**	**Stockpile Area 1 Loader Tailpipe, Line Volume**		CO	630-08-0	8.02E-02	—
				SO2	7446-09-5	2.66E-04	—
				SPM	N/A	1.47E-02	—
				PM10	N/A	1.47E-02	—
				PM2.5	N/A	1.43E-02	—
				Nox	10102-44-0	1.42E-01	—
8a	**CRSHLOAD2**	**Stockpile Area 1 Loader Tailpipe, Line Volume**		CO	630-08-0	8.02E-02	—
				SO2	7446-09-5	2.66E-04	—
				SPM	N/A	1.47E-02	—
				PM10	N/A	1.47E-02	—
				PM2.5	N/A	1.43E-02	—
				Nox	10102-44-0	1.42E-01	—
9a	**WASHLOAD**	**Stockpile Area 2 Loader Tailpipe, Line Volume**		CO	630-08-0	9.17E-02	—
				SO2	7446-09-5	3.04E-04	—
				SPM	N/A	1.68E-02	—
				PM10	N/A	1.68E-02	—
				PM2.5	N/A	1.63E-02	—
				Nox	10102-44-0	1.62E-01	—
10a	**SHIPROAD**	**Shipping Road Tailpipe, Volume**		CO	630-08-0	1.34E+00	—
				SO2	7446-09-5	7.14E-04	—
				SPM	N/A	8.63E-04	—
				PM10	N/A	8.63E-04	—
				PM2.5	N/A	8.37E-04	—
				Nox	10102-44-0	1.73E-02	—
11	**SHPTRCK**	**Stockpile Material Handling, Volume, Drop**	**2.6**	SPM	N/A	2.46E+00	—
				PM10	N/A	1.08E+00	—
				PM2.5	N/A	6.07E-02	—
				Crystalline silica	14808-60-7	6.47E-02	—
12	**HAULROAD**	**Haul Road Dust, Line Volume**	**4.44**	SPM	N/A	8.88E-01	—
				PM10	N/A	2.26E-01	—
				PM2.5	N/A	2.26E-02	—
				Crystalline silica	14808-60-7	1.36E-02	—
12a	**HAULROAD**	**Haul Road Non-Road Tail Pipe, Line Volume**	**4.44**	CO	630-08-0	8.74E-02	—
				SO2	7446-09-5	1.94E-04	—
				SPM	N/A	1.07E-02	—
				PM10	N/A	1.07E-02	—
				PM2.5	N/A	1.04E-02	—
				Nox	10102-44-0	1.03E-01	—
Pit2							
13	**HAULROAD**	**Haul Road Dust, Line Volume**	**4.44**	SPM	N/A	2.04E+00	—
				PM10	N/A	5.19E-01	—
				PM2.5	N/A	5.19E-02	—
				Crystalline silica	14808-60-7	3.12E-02	—
13a	**HAULROAD**	**Haul Road Non-Road Tail Pipe, Line Volume**	**4.44**	CO	630-08-0	2.01E-01	—
				SO2	7446-09-5	4.46E-04	—
				SPM	N/A	2.46E-02	—
				PM10	N/A	2.46E-02	—
				PM2.5	N/A	2.39E-02	—
				Nox	10102-44-0	2.37E-01	—
14	**PUMP2**	**Water Pump - Pit 2, Volume**	**0.75**	CO	630-08-0	1.43E-02	—
				SO2	7446-09-5	6.99E-05	—
				SPM	N/A	3.90E-03	—
				PM10	N/A	3.90E-03	—
				PM2.5	N/A	3.78E-03	—
				Nox	10102-44-0	3.61E-02	—

Pit 3							
15	**PUMP3**	**Water Pump - Pit 3, Volume**	**0.75**	CO	630-08-0	1.67E-02	—
				SO2	7446-09-5	8.15E-05	—
				SPM	N/A	4.55E-03	—
				PM10	N/A	4.55E-03	—
				PM2.5	N/A	4.41E-03	—
				Nox	10102-44-0	4.21E-02	—
16	**EXTLOAD**	**Extraction Face Material Handling, Volume, drop**	**3.7**	SPM	N/A	2.46E+00	—
				PM10	N/A	1.08E+00	—
				PM2.5	N/A	1.63E-01	—
				Crystalline silica	14808-60-7	6.47E-02	—
17	**EXTFUG**	**Extraction Face Loader Dust**	**3.7**	SPM	N/A	4.72E-01	—
				PM10	N/A	1.20E-01	—
				PM2.5	N/A	1.20E-02	—
				Crystalline silica	14808-60-7	7.22E-03	—
17a	**EXTFUG**	**Extraction Face Tailpipe, Line Volume**	**3.7**	CO	630-08-0	4.33E-02	—
				SO2	7446-09-5	6.07E-04	—
				SPM	N/A	7.26E-03	—
				PM10	N/A	7.26E-03	—
				PM2.5	N/A	7.04E-03	—
				Nox	10102-44-0	1.15E-01	—
17	**Blast Hole Drilling**	**Not Modelled, drilling,vol**	**3.7**	SPM	N/A	1.64E-02	—
				PM10	N/A	7.28E-03	—
				PM2.5	N/A	1.37E-03	—
				Crystalline silica	14808-60-7	4.37E-04	—
18	**BLAST**	**Quarry Blasting - Fugitives, Areapoly**		SPM	N/A	6.85E-01	—
				PM10	N/A	3.56E-01	—
				PM2.5	N/A	2.05E-02	—
				Crystalline silica	14808-60-7	2.14E-02	
18a	**BLAST**	**Quarry Blasting - Combustion, Areapoly**		CO	630-08-0	2.91E+01	—
				SO2	7446-09-5	9.24E-01	—
				Nox	10102-44-0	3.42E-01	—
19	**HAULROAD**	**Haul Road Dust, Line Volume**	**4.44**	SPM	N/A	2.73E+00	—
				PM10	N/A	6.95E-01	—
				PM2.5	N/A	6.95E-02	—
				Crystalline silica	14808-60-7	4.17E-02	—
19a	**HAULROAD**	**Haul Road Non-Road Tail Pipe, Line Volume**	**4.44**	CO	630-08-0	2.69E-01	—
				SO2	7446-09-5	5.98E-04	—
				SPM	N/A	3.29E-02	—
				PM10	N/A	3.29E-02	—
				PM2.5	N/A	3.20E-02	—
				Nox	10102-44-0	3.17E-01	—
Paved Road at Grade Level							
20	**PR1**	**Road to Parking Lot**		SPM	N/A	3.04E-03	—
				PM10	N/A	5.83E-04	—
				PM2.5	N/A	1.41E-04	—
				Crystalline silica	14808-60-7	3.83E-05	—
20a	**PR1**	**Road to Parking Lot, Tailpipe**		CO	630-08-0	2.80E-04	
				SO2	7446-09-5	2.77E-04	
				SPM	N/A	2.00E-07	
				PM10	N/A	2.00E-07	
				PM2.5	N/A	1.94E-07	
				Nox	10102-44-0	1.07E-05	
21	**PR2**	**Main Site Access, Volume Line**		SPM	N/A	1.04E-02	—
				PM10	N/A	1.99E-03	—
				PM2.5	N/A	4.81E-04	—
				Crystalline silica	14808-60-7	1.31E-04	—
21a	**PR2**	**Main Site Access, Tailpipe,Volume Line**		CO	630-08-0	1.34E+00	
				SO2	7446-09-5	7.14E-04	
				SPM	N/A	8.63E-04	
				PM10	N/A	8.63E-04	
				PM2.5	N/A	8.37E-04	
				Nox	10102-44-0	1.73E-02	

Unpaved Road at Grade Level						
22	HAULROAD HR_P3_P2	Haul Road Dust, Line Volume		SPM	N/A	1.48E+00
				PM10	N/A	3.77E-01
				PM2.5	N/A	3.77E-02
				Crystalline silica	14808-60-7	2.26E-02
22a	HAULROAD HR_P3_P2	Haul Road Non-Road Tail Pipe, Line Volume		CO	630-08-0	1.46E-01
				SO2	7446-09-5	3.24E-04
				SPM	N/A	1.78E-02
				PM10	N/A	1.78E-02
				PM2.5	N/A	1.73E-02
				Nox	10102-44-0	1.72E-01
23	HAULROAD HR_P2_P1	Haul Road Dust, Line Volume		SPM	N/A	1.91E+00
				PM10	N/A	4.86E-01
				PM2.5	N/A	4.86E-02
				Crystalline silica	14808-60-7	2.92E-02
23a	HAULROAD HR_P2_P1	Haul Road Non-Road Tail Pipe, Line Volume		CO	630-08-0	1.88E-01
				SO2	7446-09-5	4.18E-04
				SPM	N/A	2.30E-02
				PM10	N/A	2.30E-02
				PM2.5	N/A	2.24E-02
				Nox	10102-44-0	2.21E-01
Tailpipe emissions from the Haul Trucks Fleet						
A	HAULROAD, Tailpipe Emissions	Haul Road Non-Road Tail Pipe, Line Volume		CO	630-08-0	8.90E-01
				SO2	7446-09-5	1.98E-03
				SPM	N/A	1.09E-01
				PM10	N/A	1.09E-01
				PM2.5	N/A	1.06E-01
				Nox	10102-44-0	1.05E+00

Total Haul Road Length	2.75	km	Total Length of the Road	
Pit 1 Haul Road Length	0.27	km	Pit 3	0.83
Pit 1 Ratio	0.098		P3_P2	0.45
			P2	0.62
Pit 2 Haul Road Length	0.62	km	P2_P1	0.58
Pit 2 Ratio	0.225		P1	0.27
			Total Distance	2.75
Pit 3 Haul Road Length	0.83	km		
Ratio	0.302			

Segment of the road travelled from Pit2 to Pit1		0.58
Pit2_Pit1 Ratio	0.211	
Segment of the road travelled from Pit 3 to Pit2		0.45
Pit3_Pit2 Ratio	0.164	

Table A2-Dispersion Modelling Source Parameter Summary Table

Modelling ID	Sources Included	AERMOD Source Type	Modelling Source Data							
			UTM X	UTM Y	X Length (m)	Y Length (m)	Area m2	Volume m3	Emission Rate (g/s-m2)	Release Height (m)
Pit1	See Table A1	OPENPIT	644149.7	4751616	740.5	470.9	34184412	4184412	5.00E-09	3.5
Pit2	See Table A1	OPENPIT	645066.9	4752259	612.3	642	393096.6	4717152	1.09E-10	4.4
Pit3	See Table A1	OPENPIT	645823.2	4752050	640.7	515.7	330409	3964908	3.89E-09	3.5

Table A3-Dispersion Modelling Source Parameter Summary Table

Modelling ID	Sources Included	AERMOD Source Type				
			Width (m)	Initial Vertical Dimension	Initial Lateral Dimension	Release Height (m)
PR1	Parking Lot	Line Volume	12	1.516	5.72	1.63
PR2	Main Site Access	Line Volume	18	3.48	8.37	3.75
HRP2_P1	Haul Truck at grade level, Pit2to Pit1	Line Volume	18	4.13	8.37	4.44
HRP3_P2	Haul Truck at grade level, Pit3 to Pit1	Line Volume	18	4.13	8.37	4.44

APPENDIX B

Modelling Plot

LEGEND

LAW Consultants Ltd. Concord, Ontario	PORT COLBORNE QUARRY				
	Modelling Plot for TSP, 24 hr				
	Drawn By J	Reviewed By: AN		DWG NO FIGURE 7a	REV
	SCALE	NTS	Jan 26, 2022	SHEET	

LEGEND

LAW Consultants Ltd.
Concord, Ontario

N

PORT COLBORNE QUARRY

Modelling Plot for PM10, 24 hr

Drawn By	Reviewed By:	DWG NO	REV
J	AN	FIGURE 7b	

SCALE	NTS	Jan 26, 2022	SHEET

LEGEND

LAW Consultants Ltd. Concord, Ontario	PORT COLBORNE QUARRY			
	Modelling Plot for PM2.5, 24 hr			
	Drawn By J	Reviewed By: AN	DWG NO FIGURE 7c	REV
	SCALE NTS	Jan 26, 2022	SHEET	

LAW Consultants Ltd.
Concord, Ontario

N

PORT COLBORNE QUARRY

Modelling Plot for NO2, 1hr

Drawn By	Reviewed By:	DWG NO	REV
J	AN	FIGURE 7d	

SCALE	NTS	Jan 26, 2022	SHEET

APPENDIX C

Credentials

AHMED NADERI

Email: a.n@lawenvironmental.ca Cell: 647-854-0527

PROFILE

A demonstrated achiever with strong communication skills, detail-oriented team player with solid computer proficiency, excellent organizational skills, willingness to assume independent responsibilities, and fluency in three languages

EDUCATION

1995-1996 **Master of Engineering**, Chemical Engineering
University of Toronto, Canada
Thesis:
Cathodic protection of pipelines using sacrificial anodes

1986-1990 **Bachelor of Applied Science**, Chemical Engineering
University of Ottawa, Canada
Thesis:
Hollow-fibre membrane fabrication and its application in wastewater treatment

RELATED EXPERIENCE

Technical

- Completed environmental compliance approval and risk assessment for various industries, real estate, insurance companies, and government properties;
- Prepared toxic substances reduction plan for a number of industries in Ontario,
- Supervised installation of Ambient Air Quality Monitoring Stations;
- Process optimization and pollution prevention for various industries including oil and gas;
- Completed workplace air quality assessment: chemical agents, microbiological agents, physical agents, such as noise and vibration, ergonomics, and design of local exhaust ventilation system for commercial and industrial establishments;
- Completed emissions inventory and prepared applications for Environmental Compliance Approval for various operations and air dispersion modelling using AERMOD, CALPUFF, and Aloha for Air and Cadna for noise;
- Completed National Pollutant Release Inventory (NPRI), conducted odour investigation and abatement programs including pollution prevention for various industries;
- Completed regulatory compliance work for non-hazardous and hazardous waste, prepared WHMIS training and Emergency Response (ER) manuals, landfill gas monitoring;
- Completed asbestos survey and sampling for multi-unit commercial plazas, Industrial buildings, residential, and commercial units
- Completed various Phase (I, II, and III) Environmental Site Assessment for IC&I establishments, removal of underground storage tanks, and insitu remediation-soil vapour extraction System;

- Manufactured Poly (Propylene Oxide) membrane and tested the membrane for gas separation applications for British Petroleum Company, the study objective of this research project was removal of contaminants from natural gas;
- Optimized sampling methods for the examination of gas emissions from stationary sources. The work included EPS & EPA methodologies; and
- Designed wastewater and sewage treatment plants for hospitals & educational institutions, and water desalination units using spiral-wound, and hollow-fibre membranes.

Communication

Prepared detailed written reports and delivered presentations to clients and corporate management;

Liaised with clients and government agencies, consulting on projects and negotiating contracts.

WORK CHRONOLOGY

Feb 2014 to present	**Principal Engineer** LAW Consultants Ltd and Canadian Eco Systems
Dec 2013 Feb 2014	**Principal Engineer** Oakhill Environmental Inc.
Dec 2011 to Oct.2012	**Consulting Engineer** Khangiran Natural Gas Refinery
October 2008 to Oct 2009	**Principal, Air Quality Services** Mehrkanazsanat
Dec. 1998 to Aug 2008	**Senior Environmental Engineer** Land, Air & Water Environmental Consultants, Hamilton, Canada
Mar.1997- Oct. 1998	**Environmental Engineer** Golder Associates Ltd, Mississauga, Canada.
1995- 1996	**Environmental Engineer** Norton Environmental Services, Oakville, Canada
1994-1995	**Environmental Engineer** Chemical Emission Management System, Mississauga, Canada
1993-1994	**Environmental Engineer** Bluewing Environmental Services Ltd, Etobicoke, Canada.

1992-1993 **Research Assistant**
Membrane Institute Research, University of Ottawa, Canada

1991-1992 **Project Engineer**
Metito Arabia Industries, Riyadh, Saudi Arabia

Feb.1991 to Aug.1991 **Field Engineer**
Independent Measurement Technology Inc, Markham, Canada

TRAINING AND CERTFICATES

- Asbestos Management, New jersey, USA, 2007
- AERMOD and ISC Dispersion Modelling, Training with Lakes Environmental,
- Chicago, USA, 2003;
- Mold Remediation, ACGIH, Cincinnati, Ohio, USA, 2003
- QMI EMS Lead Auditor ISO 14001:2004 and ISO 1901:2002 Training, Mississauga, Canada, 2006
- Ecotech products and sales training, Cyprus, 2008
- Use and Maintenance of Synspec Products, Groningen, Netherland, 2009
- Use and Maintenance of Oldham fixed-gas detectors, Arras, France, 2009
- Licensed as a Professional Engineer with the Professional Engineers of Ontario
- Member, American Conference of Governmental Industrial Hygienists (ACGIH)

PROJECTS SUCCESSFULLY COMPLETED

Projects successfully completed through LAW Environmental Consultants and a number of other consulting firms:

i. National Pollutants Release Inventory (NPRI) including Criteria Air Contaminants (CAC) and Greenhouse Gases emissions inventory, Air Emissions Summary and Dispersion Modelling (AESDM) report, Industrial Hygiene project work including workplace air quality assessment for chemical and physical agents for various industries including
   - Chrysler, Windsor, Ontario
   - A&P (tier 1 parts supplier to Honda), Tottenham, Ontario
   - Home Hardware, home product and paint manufacturing,
   - Polywheels Manufacturing (tier 1 supplier to Ford), Oakville, ON
   - Forsythe, a Lubricant manufacturing company, Hamilton, ON
   - Hamilton Specialty Bar, a giant Steel Company, Hamilton, ON
   - John Deere, forestry equipment manufacturing, Ontario
   - McDonald Douglas (Boeing), Toronto, Ontario
   - Over 400 AESDM reports for various industries

ii. Over 500 projects completed on Environmental Site Assessment(ESA) for industrial, commercial, and agricultural land for residential development or transaction as required by the Canadian financial sectors;
iii. Over 50 projects completed on Environmental Risk Assessment on various site throughout Canada required by AIG
iv. Air and noise pollution control design and validation for various industrial sector
v. Compliance source testing for various sources
vi. Site remediation work on a number of petroleum contaminated site for gas stations including tank removal
vii. Preparation of MSDS for a number of products in collaboration with University of Toronto
viii. A number of projects on drinking water monitoring for French School Board, and surface and groundwater monitoring for various industries
ix. A number of industrial hygiene projects on monitoring and mitigation of chemical agents and acoustics.

REFERENCES

1) Dr. Mark Cotter, P.Eng, Cotter and Associates, Mississauga, ON, Tel. (416) 471-8774

2) Dr. Donald Kirk, Chemical Engineering, University of Toronto, Tel.:416-978-7406
Email: don.kirk@utoronto.ca

James (Jim) Robinson

Contract Project / Construction Manager

EXPERIENCE SUMMARY

Mr. Robinson has over 30+ years of experience that includes a wide variety of construction projects and Brownfield and environmental remediation projects since 1980. Jim has extensive experience in site investigation studies, quality control, and quality assurance on earth works projects ranging from small tailings dams to large irrigation canal and highway construction projects, throughout Western, and Northern Canada. In the latter part of his career, Jim has gained extensive and varied experience in cost estimating, project management, environmental compliance, and business and remediation services development. His experience varies from constructing and installing small treatment systems for groundwater treatment, excavations for Brownfield sites, managing in-situ remediation programs, and constructability studies for oil sands mine development, managing multi-disciplinary teams for the design and installation of water intake infrastructure and emergency spillway. Jim has been the site manager for several large Brownfield cleanups involving the handling and disposal of both nonhazardous and hazardous soils contaminated with PCB'S, lead, PAH, barium and petroleum hydrocarbons.

EXPERIENCE SUMMARY

2020/present	Environmental Coordinator LAW Environmental Ltd.
2018/2019	Environmental Coordinator Rubicon Environmental
2014/2018	Woodsmith
2011/2014	Self Employed Contract Project / Construction Manager
2010/2011	Tetra Tech, Contract Project / Construction Manager
2008/2010	Senior Project Manager Remediation Services, AIM Environmental
2006/2008	Project Manager, GAIA Contractors, Calgary, Mississauga
2003/2006	Contract Project Manager
1997/2003	Owner/President, CHL Technologies Ltd.
1995/1997	Contract Project/Operations Manager
1980/1995	Sr. Technologist, Golder Associates, Calgary, Mississauga

SELECTED PROJECT EXPERIENCE

- Successfully obtained and managed a cost plus contract to safely to remove and dispose of a granulated filter media from four TOX Adsorbers (mercury scrubbers). The filter media a mixture of activated granular carbon and an inert media designed for a service life of seven to ten years. However, the scrubbers were not operating correctly and clogging of the filter media was suspected. The media was designed to adsorb contaminates from the exhaust generated from burning sewage solids in fluidizing bed incinerators at a Regional Waste Water Treatment Facility (WWTF) in the GTA.

  Prior to working on the first vessel, it was necessary to determine the potential for off-gassing, particulate emissions and any chemical, physical or reactive properties existed. A bench scale-testing program designed to mimic the conditions generated during the proposed removal

Education:

Geotechnical Technologist Diploma; Sir Sanford Fleming College; Lindsay, Ontario

Years of Experience:

30+

Courses/Certificates:

40 Hour OHSA Training

First Aid Certificate CPR Level A

Fall Arrest

Confined Space Awareness

WHMIS

Waste Management

Time Management

Petroleum Helper Course

Petroleum Mechanic 2 & 3 Course

8 Hour OHSA Training Updates

Hazard Assessment & Control

Health & Safety Module 1 & 2

Project Management 24

Regenesis: Advanced Technologies for Site Remediation

Electrical Safety & Lockout

MOE Approvals Modernization 2013

Dealing with Air Emissions &GHGs 2013

Dealing with Water & Wastewater 2013

technologies. Samples of air discharge, particulates and the solid filter media where analyzed using the appropriate methodologies. The data generated lead to modification of the work procedures and finalizing the Health and Safety Plan including the proper PPE and respiratory protection for the task and associated activities.

In addition, project management included close communication and planning with the WWTF owner, operating authority, the facility construction entity and the original manufacturer.

After beginning to remove the media over 90% of the loose granular media was in a cemented state and requiring removal by hand tools and vacuum technology. The reacted material was classified as a corrosive waste with a mercury toxicity as secondary waste characteristic.

The filter media in the other three Adsorber vessels was also highly cemented. The cementation process of the filter media caused an expansion of the material resulting in pressure fractures of the filter cassette frames and covers of the individual beds. This necessitated expanding the work program to deconstruct the fiberglass filter bed structures to repair broken sections or replace sections with new components provided by the equipment manufacturer.

The filter beds in all four Adsorbers vessels were repaired to the owner's, the operating authority and manufacturer's satisfaction and the Adsorbers filled with a modified carbon based media.

The uniqueness of the filter media failure, working from scaffolding inside large confined spaces or working on some the vessels while the adjacent incinerators were operating through over the period of a year through hot humid summer days or freezing winter conditions created unique challenges. These challenges were safely and successfully mitigated by managing a team consisting of a skilled work force, specialized subcontractors, suppliers, full health safety personnel and using alternate methods to eliminate health and safety hazards or mechanical equipment to alleviate the extreme heat or cold work conditions.

- Successfully managed the remediation of petroleum hydrocarbon subsurface at a brownfield site in South Western Ontario the site subsequently sold to a major home improvement and appliance retailer. The entire project included the demolition of existing manufacturing facilities and associated above and below ground infrastructure. The major subsurface component included the excavation of PHC contaminated gravels to a depth of ±12 metres and managing the material through on-site stockpiling of marginal material to be tested and direct loading of known contaminated soil for disposal to a licensed landfill. The large excavation was backfilled using approved on-site stockpiled material and imported granular fill to rough grading of the site. All approved fill was placed and compacted to the contract specifications. Approximately 23,000 tonnes of soil managed on the site included approx. 4,300 tonnes sent to the landfill, the approved reuse of 7,700 tonnes of on-site material and importing of 11,000 tonnes of granular fill material.

- Prepared and won a bid on behalf of AIM Environmental for the Creek and Pond Restoration at a former Provincial Facility. Subsequently provided project management for the successful restoration which included excavation and removal of metal and PAH contaminated sediments from the south and north reaches of a creek. Removal of sediments from an inline pond, infill the pond and re-establish the creek channel through the pond and removal of a concrete flow control structure and earth dam to reconstruct creek channel to achieve a channel morphology that existed some 80 years ago. The restoration included removal of unwanted vegetation, shaping the creek banks, importing approved fill and topsoil to infill the former pond and bank restoration, planting of Carolina tree and plant species and placement of select gravel and stone fill for the creek bed.

Prior to construction a 100-year flood event management, an environmental, erosion control, dewatering and construction sequencing plans were developed and approved. We worked with three levels of project consultants to de-fish and dewater work sections and working with a Six Nations based Ecological Restoration Company to provide indigenous plant and tree species to re-vegetate the restored creek banks and 30-metre buffer zones.

- Construction Area Superintendent for a 250-man camp expansion project situated at Uranium mine in Northern Saskatchewan. The project included utility, sewer and road relocations to facilitate the 250-man camp and existing kitchen additions. Primary duties involved review of bid received and recommendations for successful contractor, project liaison (coordinator) between the contractor, mine personnel and project management for project objectives mobilization, performance , QA/QC, H&S. Ensure that contractor adhered to five point card safety system and the mine's safety protocols. In addition, to the main camp expansion supervised the successful contractors for the construction of two large sewage lagoon cells required to expand the capacity of the system to serve a peak population of 700 people. Liaised with mine personnel, regulatory personnel and the project design team to recommend and implement construction changes, QA/QC, project approvals etc.

  Project also included installation new membrane potable water treatment plant, and modification and expansion of Treated water storage tanks and distribution system.

- Project manager for vegetation clearing approximately 400 km of transect lines for geophysical survey for UXO at former military facilities in southern Ontario. Coordinate interviewing, hiring, and managing First Nation crew members involved in clearing crew. Management of two supervisors and 16 man cutting crew, preparation of bi-weekly invoices, negotiation extras and change in contract conditions

- Member of Technical Focus group to identify and prove alternate technologies for the treatment of contaminated filter cake produced from a soil washing pilot project. Sourced technology providers, set up non-disclosure agreements, set up bench scale testing of alternate technologies, worked with vendors to assess alternate uses of material to promote sustainability of the project.

- Project Manager for Remediation of 30 metre Strip at a former Grocer's Distribution Facility, Mississauga, ON. Successfully bid and managed the project for the excavation and disposal of 22,000 tonnes of soil contaminated with low-level BTEX concentrations exceeding MOE Table 1 criteria. Successfully obtained regulatory approval to discharge accumulated rainwater to the storm sewer system resulting in saving time and costs for the client. The project involved the temporary removal and re-instatement of a firewater service line and a sanitary sewer. The excavation was backfilled with imported sand fill from a licensed pit to ensure compliance with existing Table 1 criteria and the proposed Table 9 criteria.

- Project Manager for Storm Sewer and Pond Decommissioning, Former Auto Parts Manufacturing Facility, Thorold, ON. Successfully lead estimating team and managed project after award. The project involved the dewatering of two surface ponds and decommissioning of several catch basins and plugging of storm sewer piping. Contaminated sediment and soil was excavated and disposed off-site, backfilling and re-grading of the two ponds. Obtained local MOE approval to use a mobile water treatment plant and initially treat 2,000,000 liters of pond water. Due to heavy snow fall and a rapid thawing period, MOE approval was granted to direct discharge an additional 650,000 liters of water accumulated in the cleaned out ponds.

- Project Manager for Construction of Permeable Reactive Barrier, Manufacturing Facility. Installation of granular iron barrier to treat TCE contaminated groundwater. Successfully revised scope of work and installation methodology. Project completed under budget and on time.

- Project Manager for In-situ Chemical Oxidation Project and Temporary Water Treatment System, Brownfield Redevelopment Project. Injection of potassium permanganate solution to treat contaminated groundwater as part of multi-million dollar remediation. Installed temporary water treatment system to treat groundwater from a dewatering trench. Consultant successful in filing record of site condition.

- Project Manager for Lead Abatement Project, Former DND Indoor Rifle Range. Successfully bid a Lump Sum MERX opportunity and developed a work plan with subcontractors to meet project specifications. Project was completed on budget and on time.

- Project Manager for Temporary Water Supply and Design of Pond Spillway, Oil Sands Mining Client. Installation of a temporary water supply pump. Worked with the consultant's design team to design pipeline, wet well and instrumentation for a new outfall structure. Worked with suppliers and subcontractors to specify and procure equipment and materials.

- Project Manager for cleanup of MTO Facility, Cochrane, ON. Disposal of petroleum contaminated soil including reclassification of hazardous waste. Original project completed within original budget; additional contamination was discovered and led to increased total project value.

- Site Manager for Cleanup of former Transformer Manufacturing Facility, Hamilton, ON. Directed removal of heavy metal and PCB contaminated soil. Supervised and coordinated safety removal of approximately 240 tonnes of PCB waste. Reinstated facilities, sewer and water utilities and floor slabs resulting in successful sale of property.

- Site Manager for Cleanup of former foundry property, Cambridge, ON. Implemented and directed screening, excavation and disposal of PAH and Heavy Metal contaminated soils. Facilitated local approvals for wastewater and soil disposal. Site was successfully developed into a residential site.

- In-situ Cleanup of Operating Gas Station, Moncton, NB. Assumed project for major oil company. Designed, built and utilized small vacuum extraction unit and Fenton's Reagent resulting in the degradation of contaminates from 300,000 ppm to under 30,000 ppm in 6 weeks, within budget. Consultant was able to gain site compliance through risk assessment.

- Site manager for the construction of a tailings dam and polishing pond for a new gold mine, Ross River, Yukon. Assisted mine staff in layout and siting of containment facilities. Responsible for design changes, volume calculations and approval of payment certificates.

- Senior Site inspector for reconstruction of 28 kilometers of irrigation canal in Southern Alberta. Supervised six earthworks inspectors working two 12-hour shifts. Supervised onsite concrete testing facilities for concrete structures Prepared daily and weekly inspection reports for resident engineer.