REPORT

Air Quality Impact Assessment

Port Colborne Quarries Inc., Pit 3 Extension

Submitted to:

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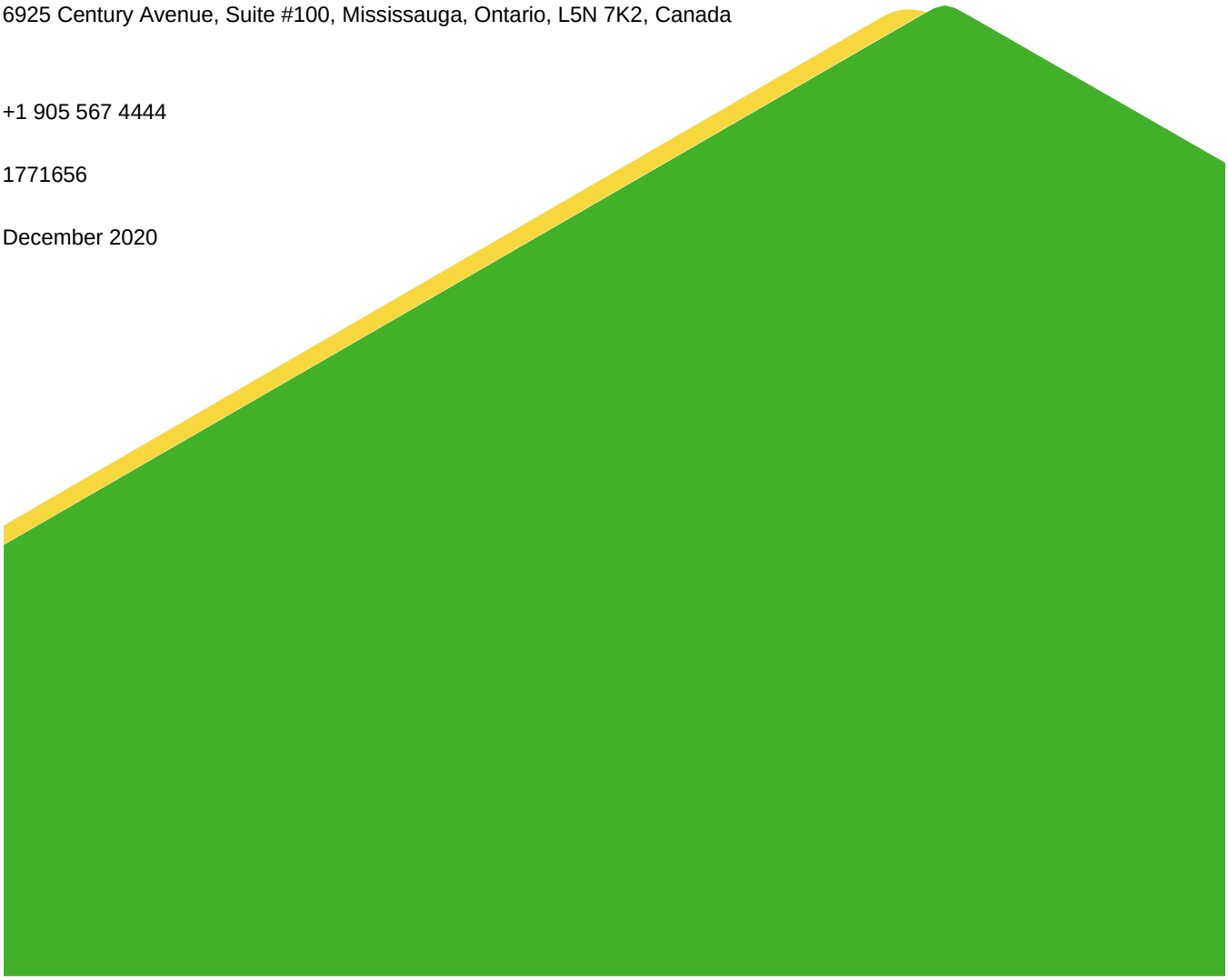

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Port Colborne Quarries Inc. (PCQ), a division of Rankin Construction Inc. (Rankin), to complete an air quality impact assessment of the proposed extension of the existing Port Colborne Quarry to support a Category 2, Class "A" Quarry Below Water license application under the Aggregate Resources Act (ARA).

The preparation of a detailed air quality assessment is not typically required for a licence application, however, an air quality assessment is a requirement of the following:

- Provincial Policy Statement, 2020, Under the *Planning Act*, Policy 2.5;
- Region of Niagara Official Plan policy 6.C.5; and
- City of Port Colborne Official Plan policy 10.2.

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

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

For the purpose of this report, the term "Facility" is used to describe the total area owned by PCQ which includes the existing quarry and the area that is proposed for licensing under the ARA (Figure 1 – Facility Location Plan).

1.1 Facility Description

The existing Port Colborne Quarry is located in the City of Port Colborne within the Regional Municipality of Niagara. 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 (Figure 1). 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 to extract material, which is then transported from the working face to the processing plant using haul trucks.

The proposed extension (Pit 3 Extension) is situated directly east of the existing quarry and remains between Second Concession Road to the north and Highway 3 to the south and extends approximately 410 - 790 metres east of Carl Road. The Pit 3 Extension is located in Part of Lots 17, 18 and 19 Concession 2 and Plan 59R-16702, Humberstone Township, Regional Municipality of Niagara and comprises 106.3 hectares (262.67 acres). The property is bordered by Second Concession Road to the north, Main Street East to the south, the existing Port Colborne quarry to the west and agricultural fields and Miller Road to the west.

Current operations at Facility include extraction, processing and offsite transport. Drilling and blasting are used to extract material. The extracted material is transported from the extraction face by haul truck to the crushing plant and wash plant located in Pit 1. Processed material is stored in various stockpiles before being shipped off-site.

1.1.1 Operating Schedule

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. Extraction and processing occurs from March through mid-December, generally from 7 am to 5 pm, Monday to Friday and on Saturdays from June through August.

1.2 Indicator Compounds

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

- **particulate matter**: suspended particulate matter (SPM), particles nominally smaller than 10 µm in diameter (PM10), and particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$);
- **crystalline silica**: as a fraction of PM_{10}; and
- **combustion gases**: nitrogen dioxide (NO_2), sulphur dioxide (SO2), and carbon monoxide (CO).

In addition to the compounds listed above, ozone (O_3) was also quantified as it will be used to calculate NO_2 concentrations from the predicted nitrogen oxide (NO_X) concentrations. Ozone is not emitted directly into atmosphere but is associated with the reaction of NO_X (MECP 2015).

1.3 Applicable Guidelines

The relevant air quality criteria used for assessing the air quality effects of the Pit 3 Extension 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's Ambient Air Quality Criteria* (AAQC) document (MECP 2012). 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 2017).

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):

- 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 $PM_{2.5}$, ozone, NO_2 and SO_2 to be implemented by 2025. Like the Ontario AAQCs, the CAAQSs are not regulatory limits and are used as national targets for $PM_{2.5}$ 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 1. Unless otherwise noted, for compounds that have both provincial and federal criteria, the lower of the two will be used for this assessment. For compounds with federal standards that are not currently in effect, the provincial criteria is also used when available.

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

Compound	Averaging Period	Ontario Ambient Air Quality Guidelines[a] (µg/m3)	Canadian Ambient Air Quality Standards[b] (µg/m3)	National Ambient Air Quality Standards and Objectives[c] (µg/m3)		Assessment Criteria (µg/m³)
				Desirable	Acceptable	
SPM[d]	24-Hour	120	—	—	120	120
	Annual	60[e]	—	60	70	60
PM_{10}	24-Hour	50[f]	—	—	—	50
$PM_{2.5}$	24-Hour	30[g]	27(g)[h]	—	—	27
	Annual	—	8.8[h]	—	—	8.8
Crystalline silica (<10 µm)	24-Hour	5	—	—	—	5
NO_2	1-Hour	400[i]	79 (42 ppb)[j]	—	400	79/400
	24-Hour	200[i]	—	—	200	200
	Annual	—	22.6 (12 ppb)[j]	60	100	22.6
SO_2	1-Hour	690	170.3 (65 ppb)[k]	450	900	170.3/690
	24-Hour	275	—	150	300	275/150
	Annual	55	10.5 (4 ppb)[k]	30	60	10.5/55
CO	1-Hour	36,200	—	15,000	35,000	36.200/15,000
	8-Hour	15,700	—	6,000	15,000	15,700/6,000

(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.

2.0 EXISTING AIR QUALITY

The existing air quality in the area around the Facility can be described by considering publicly available monitoring data in the vicinity. The existing air quality includes the operation of Pits 1, 2 and 3, before operation of the Pit 3 Extension. Other existing sources include industrial facilities, roadways, long range transboundary air pollution, small regional sources and large industrial sources.

2.1 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 2018). 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 Facility and 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 2 and presented on Figure 2 - Ambient Air Quality Monitoring Stations. Table 2 also includes the monitoring data that is available from each station for the 2014-2018 time period.

Table 2: Location of Air Monitoring Stations

Station	Address	NAPS Station ID	Latitude and Longitude	Distance to the Facility (km)	Predominant Wind Direction	Monitoring Data Available
St. Catharines	62 Argyle Crescent	61302	43.16006, -79.23475	27	Northwest, generally downwind	$PM_{2.5}$ (1), NO_2, NO, O_3
Simcoe	Experimental Farm	62601	42.85685, -80.26964	85	West, generally upwind	$PM_{2.5}$, NO_2, NO, SO_2, O_3
Hamilton	Elgin & Kelly	60512	43.25778, -79.86167	65	Northwest, generally upwind	PM2.5, NO_2, NO, SO_2, CO, O_3

(1) Data was not available for the 2014 year for the St. Catharines station; therefore, 2013 was included in the background air quality assessment.

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

The air flow into the Facility is predominantly from the southwest. The closest air quality monitoring station is located the St. Catharines station. This station is generally downwind of the Facility and is likely the most representative station of the area due to proximity to the Facility, however not all indicator compounds are monitored at this station. The Simcoe station has SO2 data and is generally upwind of the Facility, however the station is located approximately 85 km away. Although the Hamilton station is closer to the Facility 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 Facility 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 Facility with monitoring data for CO is the Hamilton station.

Table 3 summarizes monitoring data for the years 2014 through 2018 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) therefore Table 3 provides these values.

Table 3: Summary of Air Quality Station Data

Indicator	Averaging Period	Assessment Criteria (µg/m³)	Concentration (µg/m³)		
			St. Catharines	Simcoe	Hamilton
SPM	24-hour	120	41.89	44.69	—
	Annual	60	23.11	23.18	—
PM_{10}	24-hour	50	23.27	24.83	—
$PM_{2.5}$	24-hour	27	12.57 (b)	13.41	—
	Annual	8.8	6.93 (b)	6.96	—
NO_2 (a)	1-Hour	79/400	26.33	11.29	—
	24-Hour	200	22.36	10.97	—
	Annual	22.6	12.84	6.77	—
SO_2 (a)	1-Hour	170.3/690	—	2.62	—
	24-Hour	275/150	—	2.62	—
	Annual	10.5/55	—	1.17	—
CO (a)	1-Hour	36.200/15,000	—	—	435.19
	8-Hour	15,700/6,000	—	—	553.15
O_3 (a)	1-Hour	—	88.31	92.24	—

(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).

(b) No data was available at the St. Catharines station for 2014, hence the data for 2013, 2015-2018 was assessed instead.

2.2 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 Facility in 2018 (ECCC 2020). Of those eight facilities, four reported contaminants in common with the Facility. The 2018 reported data is the most recent data available as the 2019 reported data has not yet been finalized. Reporting facilities and emission totals are summarized in Table 4. 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 Facility 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 Facility.

Table 4: 2018 Air Releases for Industry within 5 km of the Facility

Company Name	Site Name	Distance to the Site (km)	Direction from the Site	Releases to Air (tonnes)					
				NO_X	SO_2	CO	SPM	PM_{10}	$PM_{2.5}$
IMT Partnership	Forge Division	2	South southeast	—	—	—	—	0.44	0.44
Vale Canada Limited	Port Colborne Refinery	2.5	South southwest	—	—	—	—	1.37	0.2
ADM Agri-Industries Company	ADM Agri-Industries ADM Milling Co. - Port Colborne.	3.6	South southwest	—	—	—	41.37	38.41	18.95
Jungbunzlauer Canada Inc.	Jungbunzlauer Canada Inc.	2.1	North northwest	225.08	—	55.04	27.29	25.76	25.14
Total (Facilities within 5 km)				225.08	—	55.04	68.66	30.98	44.73
Ontario Total				61,793	140,545	65,181	20,108	13,850	8,104
Emissions from Facilities within 5 km as a Percentage of Ontario Total				<1%	—	<1%	<1%	<1%	<1%

2.3 Summary of Existing Air Quality

Table 5 summarizes the existing air quality in the area surrounding the Facility, 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) therefore Table 5 provides these values. The St. Catharines station is the only air quality monitoring station located 30 km downwind of the Facility. 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 Facility, 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 Facility 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 SPM concentration (US EPA, 1996).

Table 5: Existing Air Quality Concentrations

Indicator	Averaging Period	Assessment Criteria (µg/m³)	Air Quality Concentration (µg/m³)
SPM	24-hour	120	41.89
	Annual	60	23.11
PM_{10}	24-hour	50	23.27
$PM_{2.5}$	24-hour	27	12.57
	Annual	8.8	6.93
Crystalline silica (<10 µm)	24-Hour	5	2.51
NO_2	1-Hour	79/400	26.33
	24-Hour	200	22.36
	Annual	22.6	12.84
SO_2	1-Hour	170.3/690	2.62
	24-Hour	275/150	2.62
	Annual	10.5/55	1.17
CO	1-Hour	36.200/15,000	435.19
	8-Hour	15,700/6,000	553.15
O_3	1-Hour	—	88.31

3.0 EMISSION RATE ESTIMATES

The Facility is an active quarry that can process up to 4,500 tonnes of material per day. One to three blasts per week produce approximately 6.2 to 28 thousand tonnes of aggregate per blast. 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 en-route 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 for distribution. Supporting equipment include diesel dewatering pumps. Figures 3a to 3e 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.

3.1 Extraction Phasing

During the Pit 3 Extension, the quarry expansion will begin from the existing Pit 3 and proceed from west to east during Phase 1 (refer to Figure 4 – Pit 3 Extension: Extraction Phasing). Upon reaching the extraction boundary at Miller Road, the expansion will return to the edge of the existing Pit 3 and then proceed again from west to east during Phase 2. Phase 3 will be extracted from south to north proceeding from the northern area of Phase 2.

PCQ is planning to relocate the crushing plant and wash plant to Pit 3. However, the air quality assessment of the expansion phases was carried out assuming the crushing plant and wash plant continue to operate in Pit 1 as that results in the maximum distance between the extraction area and the crushing plant and wash plant. 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.

3.2 Crushing Plant

The crushing plant can process up to 4,500 tonnes of material per day.

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:

$$\text{Daily Emission Rate } \left[\frac{\text{g}}{\text{s}}\right] = \text{Emission Factor } \left[\frac{\text{kg}}{\text{Mg}}\right] \times \text{Daily Throughput } \left[\frac{\text{tonne}}{\text{day}}\right] \times \text{ Conversion Factors}$$

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 SPM emission rate from haul trucks unloading at the grizzly feeder:

$$\text{Hourly SPM Emission Rate} = 0.000008 \frac{\text{kg}}{\text{Mg}} \times 4500 \frac{\text{tonnes}}{\text{day}} \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \frac{1\ \text{day}}{10\ \text{hr}} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}}$$

$$\text{ER} = 1.00\text{E} - 03\ \text{g/s}$$

3.3 Wash Plant

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

3.4 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:

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

Where:

EF = particulate emission factor (kg/ha/day),
s = silt loading (%),
f = percent of time the wind speed is greater than 5.4 m/s (%),
Scaling factor = a particle size multiplier for particulate matter, and
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.

$$\mathrm{EF} = 1.9 \times \left(\frac{3.9}{1.5}\right) \times \left(\frac{16.52}{15}\right) \times 1$$

$$\mathrm{EF} = 5.441\ \frac{kg}{\mathrm{ha} - \mathrm{day}}$$

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).

$$\mathrm{ER} = \mathrm{EF} \times \mathrm{A} \times \frac{1\ \mathrm{ha}}{10{,}000\ \mathrm{m}^2} \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}} \times \frac{1{,}000\ \mathrm{g}}{1\ \mathrm{kg}} \times \frac{1\ \mathrm{day}}{24\ \mathrm{hr}}\ \mathrm{x}\ (1 - \mathrm{control\ efficiency})$$

Where:

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

$$\mathrm{ER} = 5.441 \frac{\mathrm{kg}}{\mathrm{ha-day}} \text{ x } 347\ \mathrm{m^2} \times \frac{1\ \mathrm{ha}}{10{,}000\ \mathrm{m^2}} \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}} \times \frac{1{,}000\ \mathrm{g}}{1\ \mathrm{kg}} \times \frac{1\ \mathrm{day}}{24\ \mathrm{hr}} \times (1 - 75\%)$$

$$\mathrm{ER} = 5.45\mathrm{E}-04\ \mathrm{g/s}$$

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 6.

Table 6: Particle Size Multipliers for Wind Erosion

Size Range	k
SPM	1
PM10	0.5
PM2.5	0.075

3.5 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:

$$\mathrm{EF} = (\mathrm{k}(\mathrm{sL})^{0.91} \times (\mathrm{W})^{1.02})\ (1 - \text{control efficiency})$$

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 7),
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 7: 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).

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

$$\mathrm{EF} = 105.81\ \mathrm{g/VKT}$$

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

$$\mathrm{ER} = \frac{105.81\ \mathrm{g}}{\mathrm{VKT}} \times \frac{3.5\ \mathrm{VKT}}{\mathrm{day}} \times \frac{1\ \mathrm{day}}{10hr} \times \frac{1\ \mathrm{hr}}{3600\ \mathrm{s}}$$

$$\mathrm{ER} = 1.04\mathrm{E} - 02\ \mathrm{g/s}$$

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

3.6 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:

$$\mathrm{EF} = \left(\mathrm{k}\left(\frac{\mathrm{s}}{12}\right)^{\mathrm{a}} \times \left(\frac{\mathrm{W}}{3}\right)^{\mathrm{b}} \times 281.9\right)(1 - \text{control efficiency})$$

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) (see Table 8)
b = empirical constant for particle size range (dimensionless) (see Table 8)
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 8: Particle Size Assumptions for Unpaved Road Dust

Size Range	k (lb/VMT)	a	b
SPM	4.9	0.7	0.45
PM10	1.5	0.9	0.45
PM2.5	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.

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

$$\mathrm{EF} = 645.26\ \mathrm{g/VKT}$$

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

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

$$\mathrm{ER} = 0.54\ \mathrm{g/s}$$

The emission rates of PM_{10} and $PM_{2.5}$ were calculated as presented above.

3.7 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 roads. Emissions from passenger vehicles were estimated using the U.S. EPA's emission standards for light duty vehicle emissions (U.S. EPA 2019).

Vehicles at the Facility meet Tier 3 emission standards at minimum. Emission standards are not provided for PM_{10} and $PM_{2.5}$, therefore it was assumed that SPM emissions from vehicle exhaust consist of PM_{10} and that $PM_{2.5}$ emissions are 97% of PM_{10} emissions per U.S. EPA 2010a.

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

$$\mathrm{ER} = \mathrm{EF}\ \times \text{engine brake horsepower rating}\ \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}}$$

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:

$$\text{ER} = \text{EF} \times \text{distance travelled per hour} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}}$$

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:

$$\text{ER} = \frac{2.00\text{E}-01\ \text{g}}{\text{bhp}-\text{hr}} \times 310.69\ \text{bhp} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}}$$

$$\text{ER} = 1.73\text{E}-02\ \text{g/s}$$

The emission rates for SPM, PM_{10} and $PM_{2.5}$, SO_2, and CO were calculated using the same general equation.

3.8 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 PM_{10} and $PM_{2.5}$, therefore it was assumed that SPM emissions from vehicle exhaust consist of PM_{10} and that $PM_{2.5}$ emissions are 97% of PM10 emissions per U.S. EPA 2010a.

The following predictive emissions equation was used to estimate the combustion emission rates for on-site non-road vehicles:

$$\text{ER} = \text{EF} \times \text{engine horsepower rating} \times \text{load factor} \times \text{Number of equipment} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}}$$

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:

$$\text{ER} = \frac{1.36\text{E}-02\ \text{g}}{\text{hp}-\text{hr}} \times 540\ \text{hp} \times 0.59 \times \frac{1\ \text{hr}}{3{,}600\ \text{s}}$$

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

3.9 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:

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

Where:

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

Table 9: 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.

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

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

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.

$$\text{ER} = \frac{1.97\text{E}-02\ \text{kg}}{\text{Mg}} \times \frac{756\ \text{Mg}}{\text{day}} \times \frac{1\ \text{day}}{10\ \text{hr}} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}} \times \frac{1{,}000\ \text{g}}{1\ \text{kg}}$$

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

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 PM_{10} and $PM_{2.5}$ 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.

3.10 Drilling

There will be drilling in the Pit 3 expansion prior to blasting. This is expected to result in emissions of fugitive dust, consisting of SPM, PM_{10} and $PM_{2.5}$. Emission rates of particulate matter from drilling are based on emission factors obtained from the 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:

$$ER \quad = EF \times Holes \times \left(1 - \frac{C}{100}\right) \times \frac{1000\ g}{kg} \times Conversion\ to\ g/s$$

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.

$$\text{ER} = \frac{0.59\ \text{kg}}{\text{hole}} \times \frac{10\ \text{holes}}{\text{hour}} \times \frac{1\ \text{hr}}{3{,}600\ \text{s}} \times \frac{1{,}000\ \text{g}}{1\ \text{kg}} \times (1 - 0.99)$$

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

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 estimate 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.

3.11 Blasting – Particulate

Blasting activities will generate fugitive dust emissions, including SPM, PM_{10} and $PM_{2.5}$. 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:

$$E = 0.00022 \times \mathrm{A}^{1.5} \times \mathrm{SF}$$

Where:

E = emission factor (kg/blast)
A = horizontal area (m^2)
SF = scaling factor for PM_{10} and $PM_{2.5}$ only

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

$$\mathrm{ER} = \frac{3.65\ \mathrm{kg}}{\mathrm{blast}} \times \frac{1\ \mathrm{blast}}{\mathrm{day}} \times \frac{1\ \mathrm{day}}{6\ \mathrm{hrs}} \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}} \times \frac{1{,}000\ \mathrm{g}}{1\ \mathrm{kg}}$$

$$\mathrm{ER} = 1.69\mathrm{E}-01\ \frac{\mathrm{g}}{\mathrm{s}}$$

As the blasting emission factor was only available for SPM, PM_{10} and $PM_{2.5}$ emission factors were estimated using scaling factors ratios obtained from the US EPA Chapter 11.9 (US EPA 1998) summarized in Table 10.

Table 10: 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.

3.12 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 Inventory document “Explosives Detonation and Firing Ranges 3.1, August 2016” were applied. The explosives 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:

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

Where:

ER = emission rate (g/s)

EF = emission factor (kg/tonne explosive)

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

$$\mathrm{ER} = \frac{0.2\ \mathrm{kg}}{\mathrm{tonne\ explosive}} \times \frac{6160\ \mathrm{kg\ explosive}}{\mathrm{blast}} \times \frac{1\ \mathrm{tonnes\ explosive}}{1000\ \mathrm{kg}} \times \frac{1\ \mathrm{blast}}{\mathrm{hour}} \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}} \times \frac{1{,}000\ \mathrm{g}}{1\ \mathrm{kg}}$$

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

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

3.13 Summary of Emissions

Table A1 in Appendix A 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.

4.0 DISPERSION MODELLING

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

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

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

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

4.1 Model Development

The AERMOD dispersion modelling system was developed by the U.S. EPA as a replacement to the long standing Industrial Source Complex (ISC) model, as the model recommended by the U.S. EPA for regulatory applications in the United States. This model has also been adopted in Ontario as the regulatory model recommended for permitting and regulatory applications (MECP, 2017). The model is generally based on Gaussian plume dispersion theory (U.S. EPA 2004a), but also incorporates a series of specific algorithms to reflect current understanding of dispersion theory (U.S. EPA 2004a).

4.2 Model Calibration

Regulatory dispersion models do not readily lend themselves to modification to incorporate site specific characteristics in the equations themselves. However, the model does require site specific meteorological data to operate. Digital terrain data for the site and surrounding area are also required inputs to the AERMAP pre-processor and used to characterize how the local topography could affect the dispersion of air contaminants. If buildings are present at a site, building heights are required inputs to assess building downwash using the BPIP pre-processor.

4.3 Model Validation

Part of the rigorous process used by the U.S. EPA prior to adopting AERMOD as a regulatory model (U.S. EPA 2004a) was a significant peer review process to confirm that the model could accurately predict ground level concentrations when compared to monitoring data (U.S. EPA 2003, 2004a).

4.4 Model Uncertainty and Sensitivity

Dispersion models employ assumptions that simplify the random processes associated with atmospheric motions and turbulence. While this simplification limits the model's ability to replicate individual events, the strength of the model lies in the ability to predict overall values for a given set of meteorological conditions. The process undertaken by the U.S. EPA ensured that the model predictions can be relied on as reasonable estimates of the likely concentrations. AERMOD is based on known theory and has been proven to reliably produce repeatable results. To limit the uncertainty associated with emissions input to the model, conservative assumptions were made where practical (see Table 11 below). Finally, five years of publicly available meteorological data obtained from the MECP (MECP, 2020) are used as an input to the model so that a full range of possible meteorological conditions is evaluated.

Table 11: Reliability Summary for the AERMOD Dispersion Model

Model Name	Developer	Use in Assessment	Development	Calibration	Validation	Uncertainty and Sensitivity
AERMOD (Version 19191)	United States Environmental Protection Agency	Predict air quality concentrations and deposition	AERMOD was developed to replace the long-standing ISC model as the model recommended by the U.S. EPA. AERMOD is based on Gaussian plume dispersion theory (U.S. EPA 2004a) that has been used for more than 30 years. The application of specific algorithms has been updated to reflect current understanding of dispersion theory (U.S. EPA 2004a).	Site-specific meteorological data were used in the modelling (Section 4.5.1). Digital terrain data for the site and surrounding area input to the model (Section 4.5.2).	AERMOD has been adopted by the U.S EPA as it is preferred and recommended dispersion model (U.S. EPA 2005). Prior to adoption, the U.S. EPA completed a rigorous review of the model performance (U.S. EPA 2003, 2005).	AERMOD is based on known theory, and proven to reliably produce repeatable results. Uncertainty associated with emissions is managed by making conservative assumptions. Model predictions are sensitive to fluctuations in the meteorology, which can be managed by using a five-year data set. Five years of data should include the full range of possible meteorological conditions.

4.5 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.

4.5.1 Meteorological Data

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

4.5.2 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.

4.5.2.1 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.

4.5.2.2 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, specifically:

a) 20 m spacing, within an area of 200 m by 200 m;

b) 50 m spacing, within an area surrounding the area described in (a) with a boundary at 300 m by 300 m outside the boundary of the area described in (a);

c) 100 m spacing, within an area surrounding the area described in (b) with a boundary at 800 m by 800 m outside the boundary of the area described in (a);

d) 200 m spacing, within an area surrounding the area described in (c) with a boundary at 1,800 m by 1,800 m outside the boundary of the area described in (a);

e) Receptors at property line vertices; and

f) Receptors at sensitive receptors (private dwellings).

This modified receptor placement is expected to provide an accurate representation of the off-property concentrations as the highest concentrations are expected to be off-site, just beyond the property line. The area of modeling coverage is illustrated in Figure 5 – Air Quality Dispersion Modelling Grid Receptors and Figure 6 - Air Quality Dispersion Modelling Sensitive Receptors.

4.5.3 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.

4.5.4 Emissions and Model Source Configurations

4.5.4.1 Volume Sources

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

Line volume sources were also used to represent emissions from operations of loaders moving around the crushing plant, wash plant, and at the extraction face since these activities are not stationary. This approach accounts for the effects of turbulence from the loader movements on the loader exhaust and dust emissions. The volume source parameters for roads and moving loaders are summarized in Table A2 in Appendix A.

The emissions from the crushing plant, material handling activities and truck loading were modelled as single volume sources. Separate volume sources were also used to model diesel combustion emissions from each of two pit dewatering pumps at the Facility, since exhaust stack information for the pumps was not available. The source parameters for these individual volumes are also summarized in Table A2.

4.5.4.2 Area Sources

Area sources are used to model low level or ground releases of emissions to the atmosphere that are distributed over a fixed area. Emissions from wind erosion of stockpiles located in and around the crushing plant and wash plant, and stockpiles to the east of the crushing plant were modelled as three separate rectangular area sources (”CRUSHWIND”, ”WASHWIND” and ”WESTWIND”) as per guidance from the National Stone, Sand & Gravel Association (NSSGA, 2004). Emissions from blasting were modelled as a polygonal area source (”BLAST”). The effective height and initial vertical dimension used for each source are provided in Table A2 in Appendix A.

Locations of the model sources for each scenario are presented in Figure 3A through 3E.

4.6 Summary of Model Options

The options used in the AERMOD model are summarized in Table 12.

Table 12: Options Used in the AERMOD Model

Modelling Parameter	Description	Used in Concentration Modelling?
DFAULT	Specifies that regulatory default options will be used.	Yes
CONC	Specifies that concentration values will be calculated.	Yes
OLM	Specifies that the non-default Ozone Limiting Method for NO2 conversion will be used.	No - NO2 is converted during post processing, as described in Section 4.7.2
DDEP (DRYDPLT)	Specifies that dry deposition will be calculated.	Yes – for particulates, silica
WDEP	Specifies that wet deposition will be calculated.	No - assessment is more conservative if this option is not selected
FLAT	Specifies that the non-default option of assuming flat terrain will be used.	No - the model will use elevated terrain as detailed in the AERMAP output.
NOSTD	Specifies that the non-default option of no stack-tip downwash will be used.	No
AVERTIME	Time averaging periods calculated.	1-hr, 8-hr, 24-hr, annual
URBANOPT	Allows the model to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions.	No
URBANROUGHNESS	Specifies the urban roughness length (m).	No
FLAGPOLE	Specifies that receptor heights above local ground level are allowed on the receptors.	No

4.6.1 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 occurs 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 13.

$$mass\ fraction\ of\ PM_{2.5} = \frac{ER_{2.5}}{ER_{SPM}} = \frac{4.10E-01\ \frac{g}{s}}{1.20E+01\frac{g}{s}} = 0.03$$

$$mass\ fraction\ of\ PM_{10} = \frac{ER_{PM10} - ER_{PM2.5}}{ER_{SPM}} = \frac{3.15 - 4.10E-01\frac{g}{s}}{1.20E+01\frac{g}{s}} = 0.23$$

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

Table 13: 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.

4.7 Special Modelling Considerations

4.7.1 Variable Emissions by Hour of Day

Blasting, extraction and crushing sources were modelled using the emission factor card for variable month, day of week and hour of day of operation (EMISFACT MHRDOW7).

Blasting (model source BLAST) only occurs between 10 am and 4 pm, and the Facility does not blast during the months of December, January or February. Therefore, the EMISFACT MHRDOW7 card was applied so that blasting emissions were modelled between 10 am to 4 pm seven days per week, but only during the months of March through November. Blasting emissions were set to 0 from December through February.

Extraction and crushing operations occur between 7 am and 5 pm, but only from March through December. No extraction or crushing occurs during January or February. In addition, the crushing plant operates at 50% of its maximum capacity during December. Therefore, the EMISFACT MHRDOW7 card was also applied to the model sources associated with extraction and crushing (sources CRUSH, EXTFUG, HAULROAD, PUMP2 and PUMP3). Emissions from these sources 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 EMISFACT card 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 shipping (CRSHLOAD, PR1, PR2, PR3, PR4, SHIPROAD and WASHLOAD) were modelled using the EMISFACT HRDOW7 card, to account for emissions occurring between 7 am and 5 pm seven days per week. Emissions from shipping activities were set to 0 during evening and nighttime (i.e., between 5 pm and 7 am).

4.7.2 Hourly Emission Rate Files

Emissions of SPM and crystalline silica resulting from material handling activities were calculated using the drop operation equation obtained from the US EPA AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles, to consider varying wind speeds. As the material handling sources also vary by time of day and month of the year (sources CRSHDRP, SHPTRCK, and EXTLOAD), they were modelled using hourly emission rate files to account for all three variables.

Emission rates for CRSHDRP and EXTLOAD were calculated for every hour between 7 am and 5 pm using the specific hourly wind speeds from the MECP's 5-year pre-processed meteorological data set for London (crops). Emission rates were set to 0 for hours outside of 7 am and 5 pm in the meteorological dataset, and for the months of December, January and February.

Emission rates for SHPTRCK were calculated using the specific hourly wind speeds for every hour between 7 am and 5 pm for all days and months of the year (i.e., including wintertime).

4.8 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.

4.8.1 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 less 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:

$$F = \left(\frac{t_1}{t_0}\right)^n$$

$$= \left(\frac{60}{30}\right)^{0.28}$$

$$= 1.21$$

Where:

F = the factor to convert from the averaging period t1 output from the model (MECP assumes AERMOD predicts true 60 minute averages) to the desired averaging period t0 (assumed to be 30 minutes 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.

4.8.2 Conversions of NO_x to NO_2

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

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

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

For the air quality assessment, the background concentrations of O_3 used in the OLM are presented in Table 14. The 1-hour background concentration presented in Table 5 was converted to a 24-hour and annual concentration using the method detailed above in section 4.8.1.

Table 14: Ozone concentrations used in OLM

Averaging Period	Concentration of O3 [µg/m3]
1-hour	88.31
24-hour	36.27
Annual	6.95

4.9 Conservative Assumptions in Modelling Approach

Table 15 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 15: 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 10 hours per day. This is unlikely to occur in practice.
At grade source elevations	All sources were modelled at grade. In reality, the majority of operations occur at least 20 m below grade, which reduces the amount of particulate matter and silica escaping off-site.
Explosive usage	It was assumed that the same amount of explosive would be used in each blast. In reality, explosive usage varies and would likely be decreased as the extraction face approaches the Facility property line and sensitive receptors. The termination point for the blasting operations will be governed by the results of the on-site blasting monitoring program.
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.

5.0 AIR QUALITY PREDICTIONS

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

As discussed in Section 2.0 above, the existing air quality for this assessment was described using the 90th percentile of monitoring data from stations located at considerable distances from the Facility as there are no local monitoring stations close by. Additionally, the station data is collected in areas where there are more significant industrial sources of air emissions. As a result, the concentrations representing the existing air quality are conservative. In addition to this, the predicted concentrations that result from the dispersion modelling assessment are also conservative because they take into consideration the worst-case meteorological conditions occurring at the same time as maximum Facility operations. In reality, there is a very low likelihood that the worst-case meteorology, the maximum Facility operations and the conditions that result in 90th percentile of the existing air quality compounds occur simultaneously. As a result, the maximum predicted cumulative concentrations presented in this assessment are very conservative.

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

The emissions from the Facility were predicted for the current operations as well as for 4 different stages of the development of the Pit 3 extension. Cumulative concentrations were predicted for all five scenarios off-site and at sensitive receptors.

In all scenarios, maximum predicted cumulative concentrations for particulates, including crystalline silica, are above some of the assessment criteria at off-site locations and at sensitive receptors. The largest predicted concentrations are generally located at receptors immediately adjacent to sections of the property line by the Pit #1 crushing plant area and the active extraction face, which changes location in each scenario. The predicted concentrations decrease rapidly with distance, which is why sensitive receptors, located further from the property line, have much lower concentrations. The Facility activities with the highest contribution to the particulate concentrations are the material handling, haul truck traffic and traffic on unpaved areas at the extraction face. These activities generate fugitive dust emissions that can be significantly reduced with the implementation of mitigation measures presented Section 6.0.

When assessing the maximum predicted cumulative concentrations of the combustion gases (NO2, SO2 and CO) for the five scenarios, some of the maximum predicted cumulative concentrations at off-site locations and at sensitive receptors are above the CAAQS that will be coming into effect in 2025. However, when these concentrations are compared to the Ontario AAQCs, the majority are below the criteria. The Facility activity that is contributing most to the maximum predicted cumulative concentrations is blasting. Refinement and mitigation measures that can be implemented to reduce blasting emissions are discussed in Section 6.0.

The MECP meteorological dataset used for this assessment shows that for the majority of the year, winds blow from westerly directions. As the extraction phasing is proposed to move towards the east, it can be expected that if winds are blowing from the west, the highest concentrations are located immediately downwind to the east. This is reflected in extension scenarios 1 to 4, as the maximum predicted cumulative concentrations are located to the east of the various extraction and blasting locations.

Contour plots for compounds with maximum predicted cumulative concentrations above the Ontario AAQCs are provided in Appendix B. The following sections provide more detailed discussion about the predicted cumulative concentrations for each scenario.

5.1 Scenario 0 – Existing Operations

Scenario 0 represents the worst-case existing operations, where extraction and blasting are occurring at the southern extent of Pit 3 in the current licensed area, north of Main Street East (Highway #3). The crushing plant is located at its current location in Pit 1. A Dispersion Modelling Plan for this scenario is provided as Figure 3a.

As summarized in Table 16, maximum cumulative predicted concentrations of SPM, PM2.5 and crystalline silica at sensitive receptors are below the assessment criteria, however the maximum cumulative predicted concentration of PM10 is above the criterion at receptor 10. The maximum off-site predicted cumulative concentrations of SPM, PM10 and crystalline silica are above the assessment criteria (see Appendix B, figures B0a to B0c). These off-site concentrations occur just to the west of the Pit 1 crushing plant and to the west and south of the extraction area.

Maximum predicted cumulative concentrations of combustion gases are below the Ontario AAQCs at all receptors assessed for Scenario 0. However, these concentrations are above some of the CAAQS.

Table 16: Maximum Predicted Concentrations for Existing Operations

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Sensitive Receptors*			Off-site Receptors		
				Maximum Predicted Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria	Maximum Off-Site Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria
SPM	24-Hour	120	42	77	119	99%	153	195	162%
	Annual	60	25	4.8	30	50%	11	36	59%
PM_{10}	24-Hour	50	23	38	61	123%	60	83	166%
$PM_{2.5}$	24-Hour	27	13	6.4	19	70%	9.7	22	82%
	Annual	8.8	6.9	0.3	7.2	82%	0.7	7.6	87%
Crystalline Silica	24-hour	5	2.5	2.4	4.9	98%	3.8	6.3	126%
NO_2	1-Hour (AAQC)	400	26	104	131	33%	109	136	34%
	1-Hour (CAAQS)	79	26	104	131	165%	109	136	172%
	24-Hour	200	22	21	43	22%	39	62	31%
	Annual	22.6	13	1.2	14	62%	4.4	17	76%
SO_2	1-Hour (AAQC)	690	2.6	359	361	52%	175	178	26%
	1-Hour (CAAQS)	170.3	2.6	359	361	212%	175	178	104%
	24-Hour (AAQC)	275	2.6	23	25	9%	43	46	17%
	24-Hour (CAAQS)	150	2.6	23	25	17%	43	46	31%
	Annual (AAQC)	55	1.2	0.9	2.1	4%	2.9	4.1	7%
	Annual (CAAQS)	10.5	1.2	0.9	2.1	20%	2.9	4.1	39%
CO	1-Hour (AAQC)	36,200	435	11,321	11,756	32%	14,058	14,493	40%
	1-Hour (NAAQO)	15,000	435	11,321	11,756	78%	14,058	14,493	97%
	8-Hour	15,700	553	2,144	2,697	17%	9,863	10,417	66%
	8-Hour (NAAQO)	6000	553	2,144	2,697	45%	9,863	10,417	174%

* As per the MECP ADMGO (MECP 2017) meteorological anomalies were removed for modelling done over the entire modelling grid, and not at individual sensitive receptor locations.

5.2 Scenario 1 – Expansion Phase 1

Scenario 1 represents the worst-case expansion Phase 1 operations, where extraction and blasting are occurring at the southeastern extent of the Phase 1 area, south of the racetrack and north of Main Street East (Highway #3). The crushing plant is located at its current location in Pit 1. A Dispersion Modelling Plan for this scenario is provided as Figure 3b.

As summarized in Table 17, the maximum predicted cumulative concentration of PM2.5 is below the assessment criterion at sensitive receptors, however the maximum predicted cumulative concentrations of SPM, PM10 and crystalline silica are above the criteria at sensitive receptor 58. The maximum off-site predicted cumulative concentrations of SPM, PM10 and crystalline silica are above the assessment criteria (see Appendix B, figures B1a to B1c). These off-site concentrations occur just to the west of the crushing plant and to the south and east of the extraction area.

Maximum predicted cumulative concentrations of combustion gases are below the Ontario AAQCs at all receptors assessed for Scenario 1. However, these concentrations are above some of the CAAQS.

5.3 Scenario 2 – Expansion Phase 1

A second worst-case scenario was assessed for Expansion Phase 1, as the eastern extent of extraction area is situated between two sensitive receptors. These receptors are located directly north and south of the area to be extracted at the end of Phase 1. The crushing plant is located at its current location in Pit 1. A Dispersion Modelling Plan for this scenario is provided as Figure 3c.

As summarized in Table 18, the maximum predicted cumulative concentration of PM2.5 is below the assessment criterion at sensitive receptors, however the maximum predicted cumulative concentrations of SPM, PM10 and crystalline silica are above the criteria at sensitive receptor 44. The maximum off-site predicted cumulative concentrations of SPM, PM10, PM2.5 and crystalline silica are above the assessment criteria (see Appendix B, figures B2a to B2d). These off-site concentrations occur just to the west of the crushing plant and to the east of the extraction area.

Maximum predicted cumulative concentrations of combustion gases are below the Ontario AAQCs at all receptors assessed for Scenario 2. However, these concentrations are above some of the CAAQS.

5.4 Scenario 3 – Expansion Phase 2

Scenario 3 represents the worst-case expansion Phase 2 operations, where the eastern extent of extraction area reaches the east property line of the proposed expansion area. The crushing plant is located at its current location in Pit 1. A Dispersion Modelling Plan for this scenario is provided as Figure 3d.

As summarized in Table 19, maximum cumulative predicted concentrations of SPM, PM2.5 and crystalline silica at sensitive receptors are below the assessment criteria, however the maximum cumulative predicted concentration of PM10 is above the criterion at receptor 10. The maximum off-site predicted cumulative concentrations of SPM, PM10, PM2.5 and crystalline silica are above the assessment criteria (see Appendix B, figures B3a to B3d). These off-site concentrations occur just to the west of the crushing plant and to the east of the extraction area.

Maximum predicted cumulative concentrations of combustion gases are below the Ontario AAQCs at all receptors assessed for Scenario 3. However, these concentrations are above some of the CAAQS

Table 17: Maximum Predicted Concentrations for Expansion Phase 1 (Scenario 1)

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Sensitive Receptors*			Off-site Receptors		
				Maximum Predicted Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria	Maximum Off-Site Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria
SPM	24-Hour	120	42	98	140	117%	152	194	162%
	Annual	60	25	5.4	30	51%	16	41	68%
PM_{10}	24-Hour	50	23	41	64	128%	65	88	176%
$PM_{2.5}$	24-Hour	27	13	6.4	19	70%	10	23	84%
	Annual	8.8	6.9	0.3	7.2	82%	1.0	7.9	90%
Crystalline Silica	24-hour	5	2.5	2.6	5.1	102%	4.0	6.5	130%
NO_2	1-Hour (AAQC)	400	26	99	125	31%	110	136	34%
	1-Hour (CAAQS)	79	26	99	125	158%	110	136	172%
	24-Hour	200	22	21	43	22%	39	61	31%
	Annual	22.6	13	1.3	14	62%	4.4	17	76%
SO_2	1-Hour (AAQC)	690	2.6	244	247	36%	194	196	28%
	1-Hour (CAAQS)	170.3	2.6	244	247	145%	194	196	115%
	24-Hour (AAQC)	275	2.6	28	31	11%	39	41	15%
	24-Hour (CAAQS)	150	2.6	28	31	21%	39	41	27%
	Annual (AAQC)	55	1.2	1.2	2.3	4%	4.2	5.3	10%
	Annual (CAAQS)	10.5	1.2	1.2	2.3	22%	4.2	5.3	51%
CO	1-Hour (AAQC)	36,200	435	7,709	8,144	22%	13,445	13,880	38%
	1-Hour (NAAQO)	15,000	435	7,709	8,144	54%	13,445	13,880	93%
	8-Hour	15,700	553	2,685	3,238	21%	10,095	10,648	68%
	8-Hour (NAAQO)	6000	553	2,685	3,238	54%	10,095	10,648	177%

* As per the MECP ADMGO (MECP 2017) meteorological anomalies were removed for modelling done over the entire modelling grid, and not at individual sensitive receptor locations.

Table 18: Maximum Predicted Concentrations for Expansion Phase 1 (Scenario 2)

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Sensitive Receptors*			Off-site Receptors		
				Maximum Predicted Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria	Maximum Off-Site Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria
SPM	24-Hour	120	41.9	95.3	137.2	114%	236.1	278.0	232%
	Annual	60	25.1	7.1	32.1	54%	23.3	48.4	81%
PM_{10}	24-Hour	50	23.3	41.7	65.0	130%	92.0	115.2	230%
$PM_{2.5}$	24-Hour	27	12.6	6.6	19.1	71%	14.7	27.3	101%
	Annual	8.8	6.9	0.4	7.4	84%	1.4	8.4	95%
Crystalline Silica	24-hour	5	2.5	2.6	5.1	103%	5.8	8.3	167%
NO_2	1-Hour (AAQC)	400	26.3	115.7	142.1	36%	118.2	144.5	36%
	1-Hour (CAAQS)	79	26.3	115.7	142.1	180%	118.2	144.5	183%
	24-Hour	200	22.4	31.0	53.4	27%	42.8	65.2	33%
	Annual	22.6	12.8	2.3	15.1	67%	7.6	20.4	90%
SO_2	1-Hour (AAQC)	690	2.6	619.8	622.4	90%	540.3	542.9	79%
	1-Hour (CAAQS)	170.3	2.6	619.8	622.4	365%	540.3	542.9	319%
	24-Hour (AAQC)	275	2.6	48.6	51.2	19%	113.4	116.0	42%
	24-Hour (CAAQS)	150	2.6	48.6	51.2	34%	113.4	116.0	77%
	Annual (AAQC)	55	1.2	2.9	4.1	7%	13.5	14.7	27%
	Annual (CAAQS)	10.5	1.2	2.9	4.1	39%	13.5	14.7	140%
CO	1-Hour (AAQC)	36,200	435.2	19538.3	19973.5	55%	17037.6	17472.8	48%
	1-Hour (NAAQO)	15,000	435.2	19538.3	19973.5	133%	17037.6	17472.8	116%
	8-Hour	15,700	553.2	4602.0	5155.2	33%	12096.5	12649.7	81%
	8-Hour (NAAQO)	6000	553.2	4602.0	5155.2	86%	12096.5	12649.7	211%

* As per the MECP ADMGO (MECP 2017) meteorological anomalies were removed for modelling done over the entire modelling grid, and not at individual sensitive receptor locations

Table 19: Maximum Predicted Concentrations for Expansion Phase 2 (Scenario 3)

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Sensitive Receptors*			Off-site Receptors		
				Maximum Predicted Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria	Maximum Off-Site Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria
SPM	24-Hour	120	42	69	111	92%	243	285	238%
	Annual	60	25	4.4	30	49%	43	68	114%
PM_{10}	24-Hour	50	23	38	61	123%	93	117	233%
$PM_{2.5}$	24-Hour	27	13	6.4	19	70%	16	28	207%
	Annual	8.8	6.9	0.3	7.2	82%	2.5	9.4	107%
Crystalline Silica	24-hour	5	2.5	2.4	4.9	98%	5.9	8.4	168%
NO_2	1-Hour (AAQC)	400	26	95	121	30%	115	141	35%
	1-Hour (CAAQS)	79	26	95	121	154%	115	141	178%
	24-Hour	200	22	21	43	22%	42	64	32%
	Annual	22.6	13	0.7	14	60%	7.9	21	92%
SO_2	1-Hour (AAQC)	690	2.6	97	100	14%	365	368	53%
	1-Hour (CAAQS)	170.3	2.6	97	100	59%	365	368	216%
	24-Hour (AAQC)	275	2.6	6.1	8.7	3%	99	102	37%
	24-Hour (CAAQS)	150	2.6	6.1	8.7	6%	99	102	68%
	Annual (AAQC)	55	1.2	0.3	1.5	3%	17	18	32%
	Annual (CAAQS)	10.5	1.2	0.3	1.5	14%	17	18	170%
CO	1-Hour (AAQC)	36,200	435	3,837	4,272	12%	14,114	14,550	40%
	1-Hour (NAAQO)	15,000	435	3,837	4,272	28%	14,114	14,550	97%
	8-Hour	15,700	553	1,780	2,333	15%	9,836	10,389	66%
	8-Hour (NAAQO)	6000	553	1,780	2,333	39%	9,836	10,389	173%

* As per the MECP ADMGO (MECP 2017) meteorological anomalies were removed for modelling done over the entire modelling grid, and not at individual sensitive receptor locations

5.5 Scenario 4 – Expansion Phase 3

Scenario 4 represents the worst-case expansion Phase 3 operations, where the eastern extent of extraction area reaches the northeast corner of the proposed expansion area, south of Concession Road 2. The crushing plant is located at its current location in Pit 1. A Dispersion Modelling Plan for this scenario is provided as Figure 3e.

As summarized in Table 20, maximum cumulative predicted concentrations of SPM, $PM_{2.5}$ and crystalline silica at sensitive receptors are below the assessment criteria, however the maximum cumulative predicted concentration of PM_{10} is above the criterion at receptor 10. The maximum off-site predicted cumulative concentrations of SPM, PM_{10}, $PM_{2.5}$ and crystalline silica are above the assessment criteria (see Appendix B, figures B4a to B4d). These concentrations occur just off-site to the west of the crushing plant and to the east of the extraction area.

Maximum predicted cumulative concentrations of combustion gases are above some of the Ontario AAQCs in Scenario 4 (see Appendix B, figures B4e to B4f). These concentrations are also above the CAAQS.

Table 20: Maximum Predicted Concentrations for Expansion Phase 3 (Scenario 4)

Compound	Averaging Period	Criteria [µg/m³]	Existing Concentration [µg/m³]	Sensitive Receptors*			Off-site Receptors		
				Maximum Predicted Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria	Maximum Off-Site Concentration [µg/m³]	Maximum Predicted Cumulative Concentration [µg/m³]	% Criteria
SPM	24-Hour	120	42	73	115	95%	347	389	324%
	Annual	60	25	7.2	32	54%	60	85	141%
PM_{10}	24-Hour	50	23	37	61	121%	123	146	292%
$PM_{2.5}$	24-Hour	27	13	6.3	19	70%	20	32	120%
	Annual	8.8	6.9	0.5	7.4	84%	3.3	10	116%
Crystalline Silica	24-hour	5	2.5	2.3	4.9	97%	7.7	10	204%
NO_2	1-Hour (AAQC)	400	26	116	142	36%	135	162	40%
	1-Hour (CAAQS)	79	26	116	142	180%	135	162	205%
	24-Hour	200	22	23	45	23%	48	71	35%
	Annual	22.6	13	2.2	15	67%	8.7	21	95%
SO_2	1-Hour (AAQC)	690	2.6	325	328	48%	924	927	134%
	1-Hour (CAAQS)	170.3	2.6	325	328	192%	924	927	544%
	24-Hour (AAQC)	275	2.6	34	37	13%	193	196	71%
	24-Hour (CAAQS)	150	2.6	34	37	24%	193	196	130%
	Annual (AAQC)	55	1.2	2.5	3.7	7%	29	30	54%
	Annual (CAAQS)	10.5	1.2	2.5	3.7	35%	29	30	285%
CO	1-Hour (AAQC)	36,200	435	10,257	10,692	30%	29,125	29,560	82%
	1-Hour (NAAQO)	15,000	435	10,257	10,692	71%	29,125	29,560	197%
	8-Hour	15,700	553	3,211	3,764	24%	20,739	21,292	136%
	8-Hour (NAAQO)	6000	553	3,211	3,764	63%	20,739	21,292	355%

* As per the MECP ADMGO (MECP 2017) meteorological anomalies were removed for modelling done over the entire modelling grid, and not at individual sensitive receptor locations

6.0 RECOMMENDATIONS

6.1 Modelling Refinements

The results presented in Section 5 indicate that maximum cumulative predicted concentrations from the Facility are above some of the assessment criteria. However, the results also indicate that the concentrations are significantly lower at the sensitive receptors. To further reduce the maximum cumulative predicted concentrations, there are several aspects of this assessment that are conservative and have the potential for refinement, as listed below.

- Blasting - As discussed in Section 4.9, it was conservatively assumed that the same amount of explosive (6,160 kg) would be used in each scenario. However, it is also understood that the blasting parameters (e.g., amount of explosive, blast area) are subject to change depending on the results of the blast monitoring program, especially as the extraction face approaches the property line and sensitive receptors. More realistic blasting parameters could be used to refine the modelling assessment.
- Haul Truck Traffic - As discussed in Section 4.9, it was conservatively assumed that the crushing plant and wash plant would remain in Pit 1, resulting in longer haul routes. However, it is understood that the crushing plant and wash plant may be relocated to Pit 3 in the future, which would significantly decrease the haul distance. Decreasing the haul distance would likely reduce the off-site effects of fugitive dust from haul truck traffic. Road dust sampling could also be completed to provide site-specific particle size and silt content data to refine the modelling assessment.
- Material Handling – It was conservatively assumed that the material handling rate at the extraction face was 4,500 kg per day. If this amount were decreased when extraction approaches the property line and sensitive receptors, the off-site effects of fugitive dust from material handling would be reduced. Additional reductions would be possible if the material were watered before being loaded into the haul trucks.
- Wet Deposition – Wet deposition (removal of particles from the atmosphere by precipitation) was not used in the modelling assessment, which results in higher predicted concentrations. Including wet deposition and depletion calculations in the model options would reduce the off-site predicted concentrations of particulates (dust).

6.2 Best Management Practices Plan for the Control of Fugitive Dust

In addition, the continued implementation of a Best Management Practices Plan for the Control of Fugitive Dust (BMPP) is recommended to assist with controlling fugitive dust emissions. As PCQ is committed to minimizing the effects of fugitive dust off-site and at sensitive receptors, an updated BMPP has been developed for the Facility. The BMPP outlines preventative and control measures in place or under development to reduce the likelihood of high dust emissions from the Facility. Inspections and monitoring procedures are also a part of the BMPP and will allow for continuous improvement of the fugitive dust management practices.

6.3 Air Quality Monitoring

The implementation of an air quality monitoring program could be used to verify the predicted off-site concentrations of the indicator compounds as well as to guide the implementation and review of the fugitive dust best management practices. The monitoring program should be developed to follow the guidelines provided in the MECP *Operations Manual for Air Quality Monitoring in Ontario* (2018).

7.0 CONCLUSIONS

The results of the conservative air quality impact assessment for the proposed Port Colborne Quarry Pit 3 extension indicate that the maximum off-site predicted cumulative concentrations of several indicator compounds are above the assessment criteria. However, these concentrations become significantly lower at sensitive receptors. It is important to note that the assessment criteria are not regulatory limits and are frequently exceeded at various locations across Ontario. Instead, they are to be used as screening criteria to represent an indicator of good air quality. In reality, there is a very low likelihood that the worst-case meteorology, the maximum Facility operations and the conditions that result in the 90th percentile of the existing air quality compounds would occur simultaneously. As a result, the maximum predicted cumulative concentrations presented in this assessment are very conservative.

Refinements to the modelling assessment discussed in Section 6.0 will likely reduce the maximum predicted cumulative concentrations. The continued implementation of best management practices identified in the Facility's updated BMPP can help to control fugitive dust and reduce off-site effects. Off-site impacts from combustion gases, while not directly assessed under the Facility's blast monitoring program, will be influenced by the amount of explosive used and termination point for blasting operations. 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 Facility operations.

8.0 CURRICULA VITAE

Curricula vitae for the authors of the report are provided in Appendix C.

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Signature Page

Golder Associates Ltd.

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Associate, Senior Air Quality Specialist

EKL/BSF/NCJ/ly/ng

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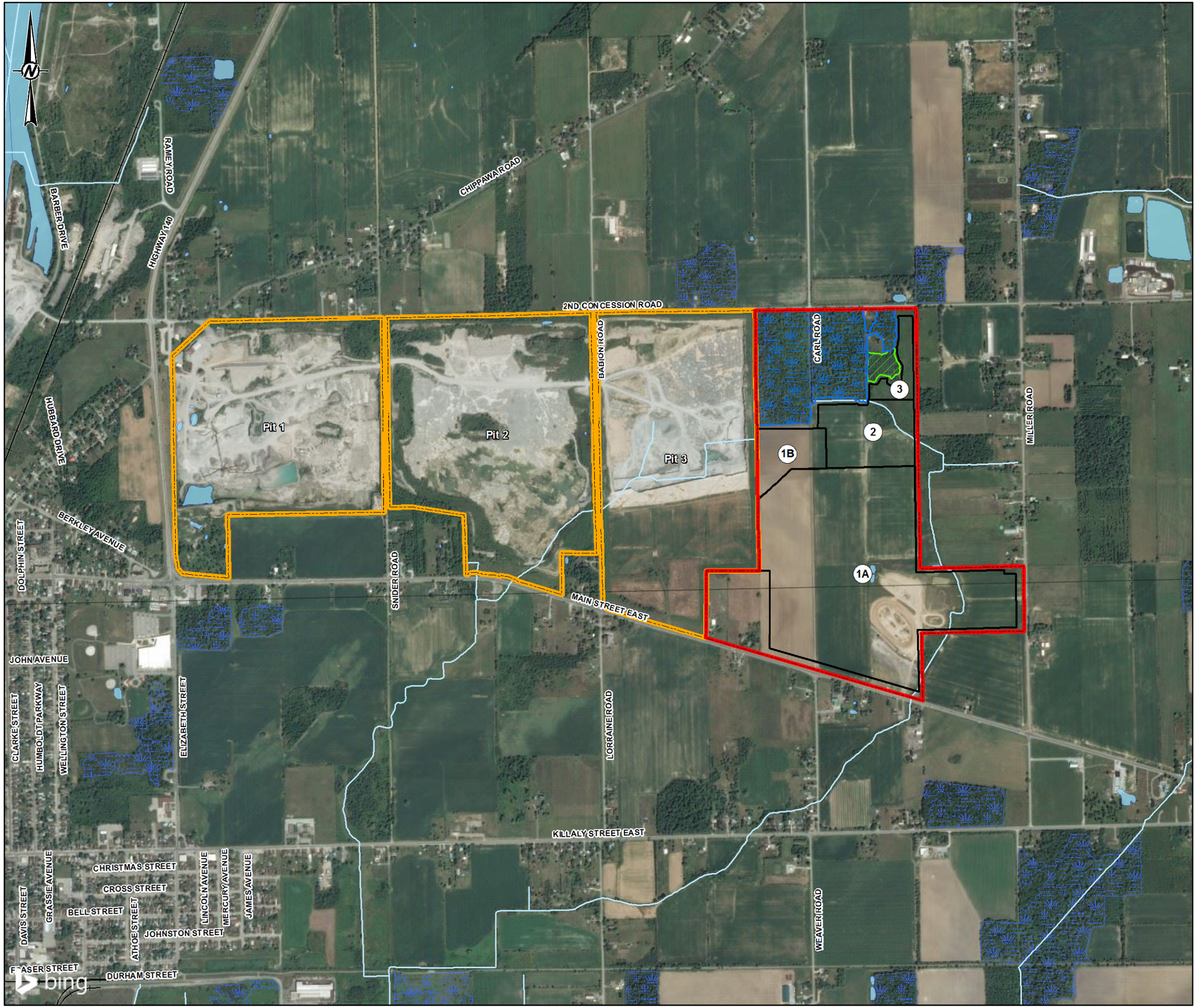
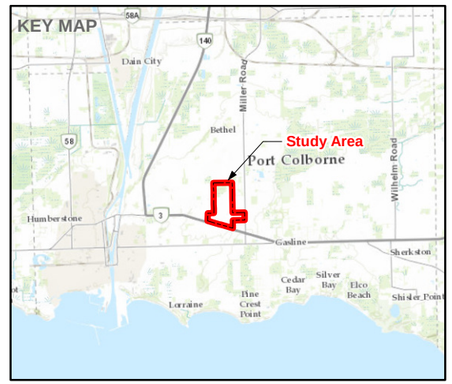
FIGURES



LEGEND

- (1) Excavation Phase
- Roads
- Railway
- Watercourse
- Waterbody
- Wetland
- Woodland
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary



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CLIENT
RANKIN CONSTRUCTION INC.

PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
FACILITY LOCATION PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
DESIGNED	PR
PREPARED	PR
REVIEWED	BC
APPROVED	NCJ

PROJECT NO.	CONTROL	REV.	FIGURE
1771656	0019		1

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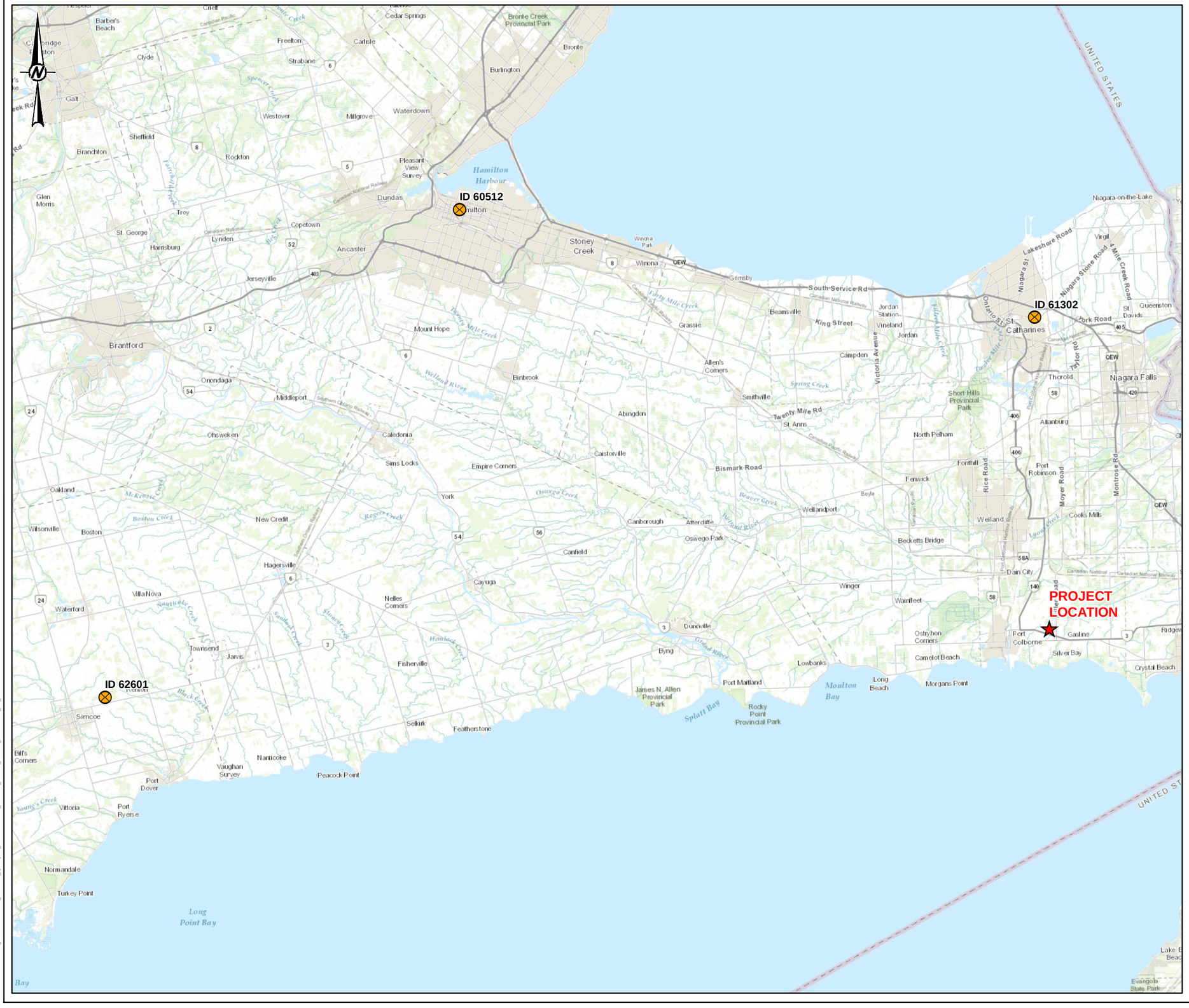

LEGEND

- Project Location
- Air Quality Monitoring Station

NOTE(S)

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CLIENT
RANKIN CONSTRUCTION INC.

PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
AMBIENT AIR QUALITY MONITORING STATIONS

CONSULTANT
GOLDER

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1771656	0019		2

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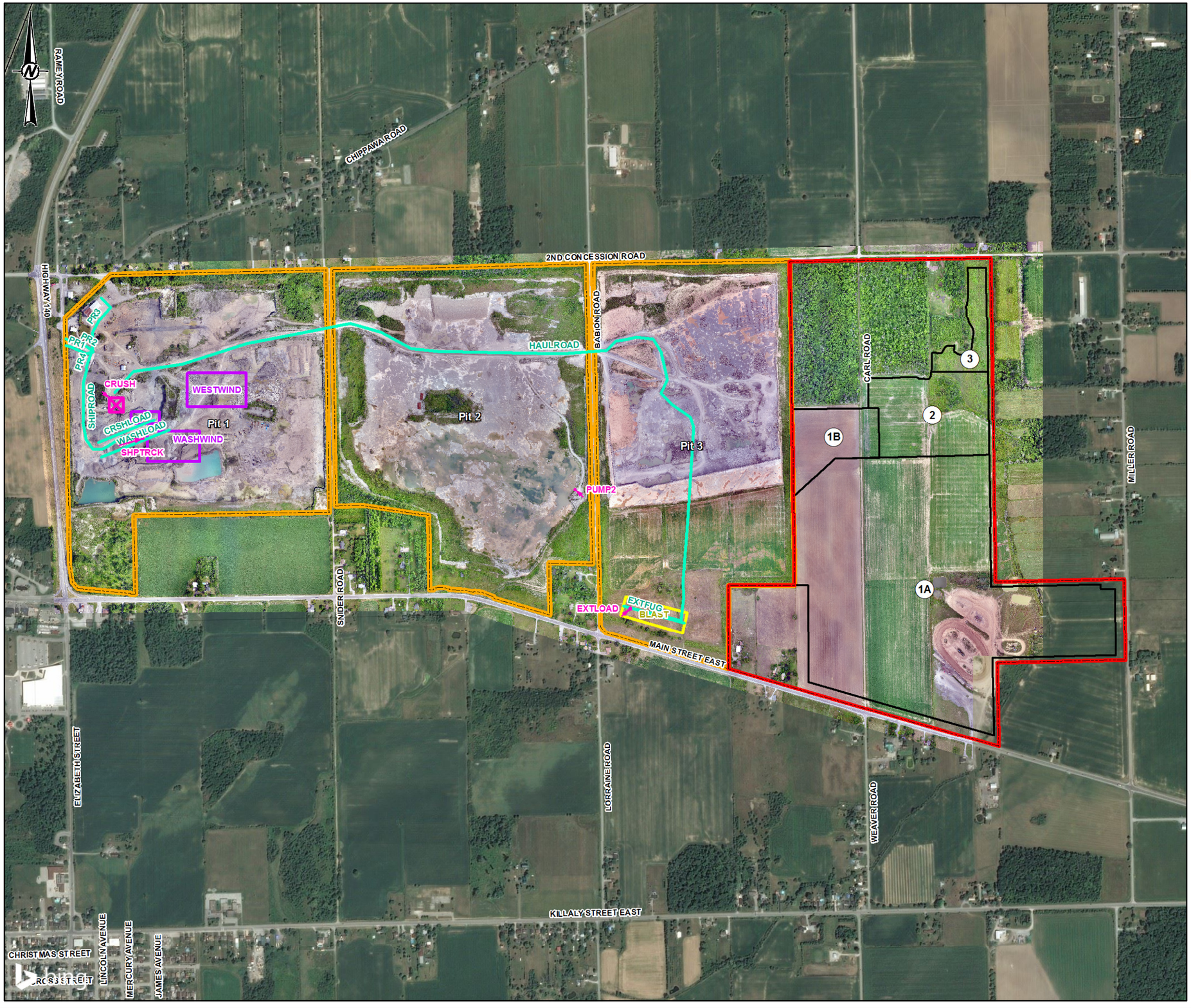

LEGEND

- (1) Excavation Phase
- Roads
- Railway
- Volume Sources
- Line Volume Sources
- Area Sources
- Polygonal Area Sources
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

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NOTE(S)

REFERENCE(S)

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CLIENT
RANKIN CONSTRUCTION INC.

PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
DISPERSION MODELLING PLAN – EXISTING OPERATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
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PROJECT NO.	CONTROL	REV.	FIGURE
1771656	0019		3A

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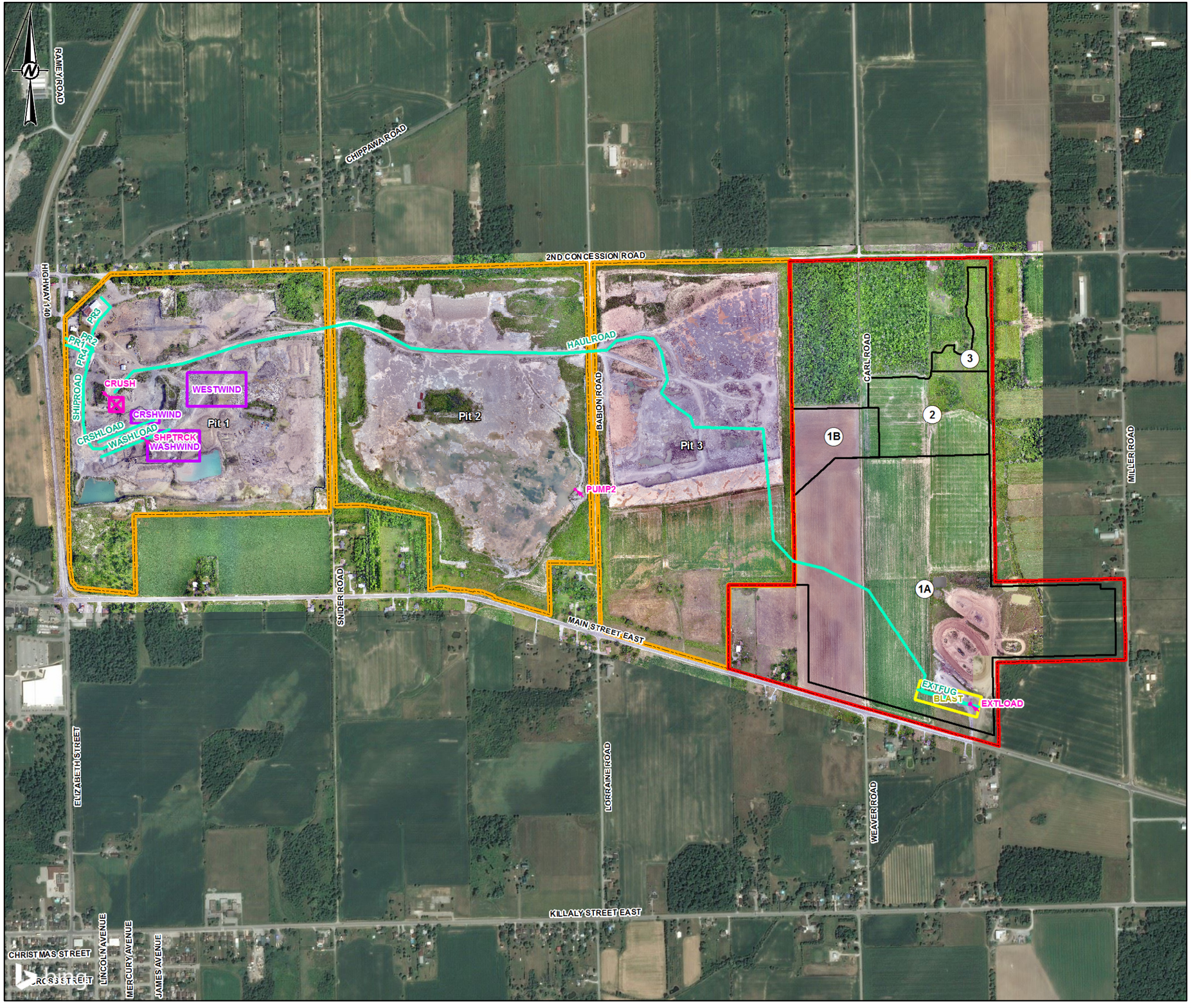

LEGEND

- (1) Excavation Phase
- Roads
- Railway
- Volume Sources
- Line Volume Sources
- Area Sources
- Polygonal Area Sources
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

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NOTE(S)

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PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
DISPERSION MODELLING PLAN – EXPANSION SCENARIO 1

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
DESIGNED	PR
PREPARED	PR
REVIEWED	BC
APPROVED	NCJ

PROJECT NO.	CONTROL	REV.	FIGURE
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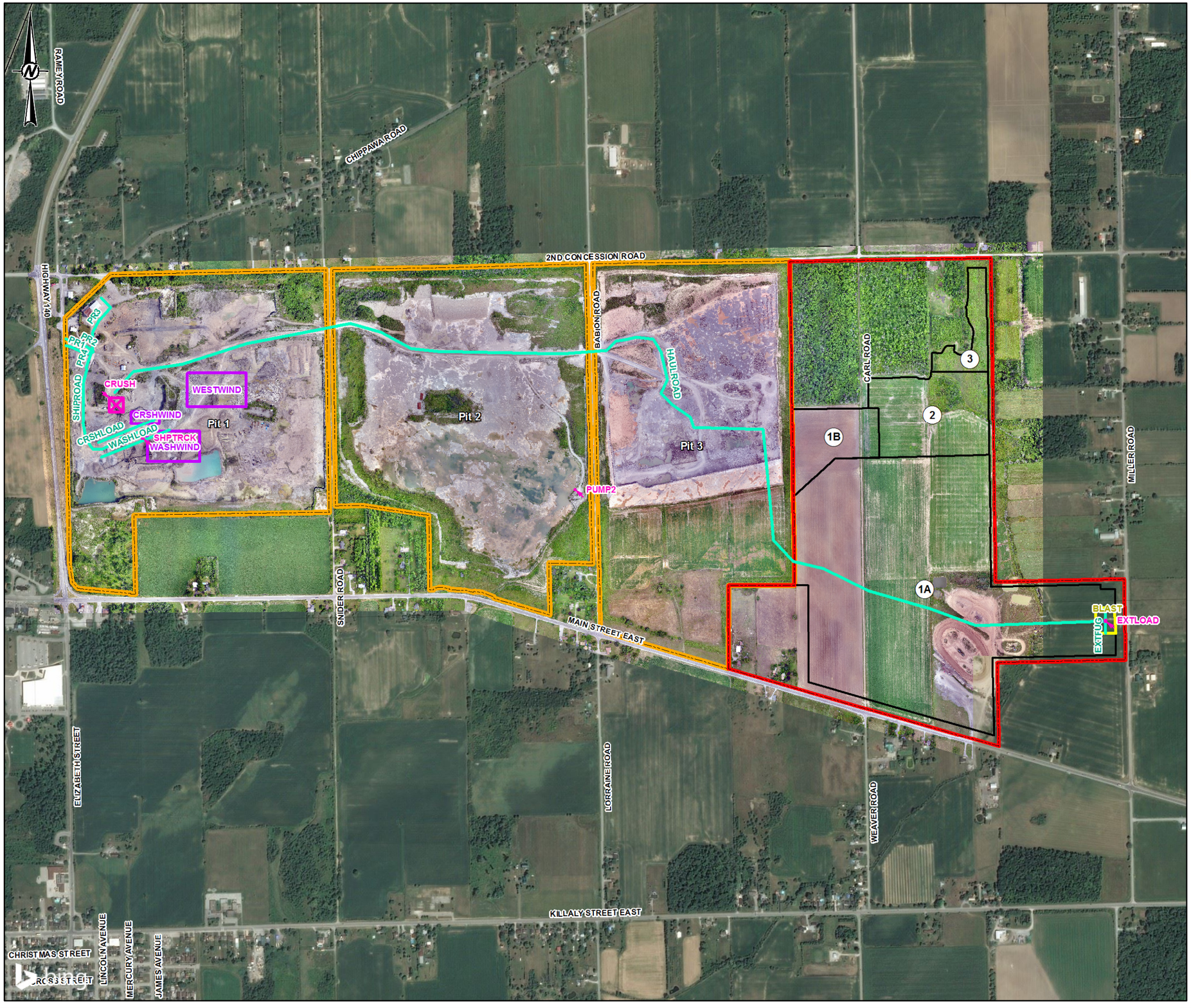

LEGEND

- (1) Excavation Phase
- Roads
- Railway
- Volume Sources
- Line Volume Sources
- Area Sources
- Polygonal Area Sources
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

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NOTE(S)

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PROJECT
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TITLE
DISPERSION MODELLING PLAN – EXPANSION SCENARIO 2

CONSULTANT
GOLDER

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PREPARED	PR
REVIEWED	BC
APPROVED	NCJ

PROJECT NO.	CONTROL	REV.	FIGURE
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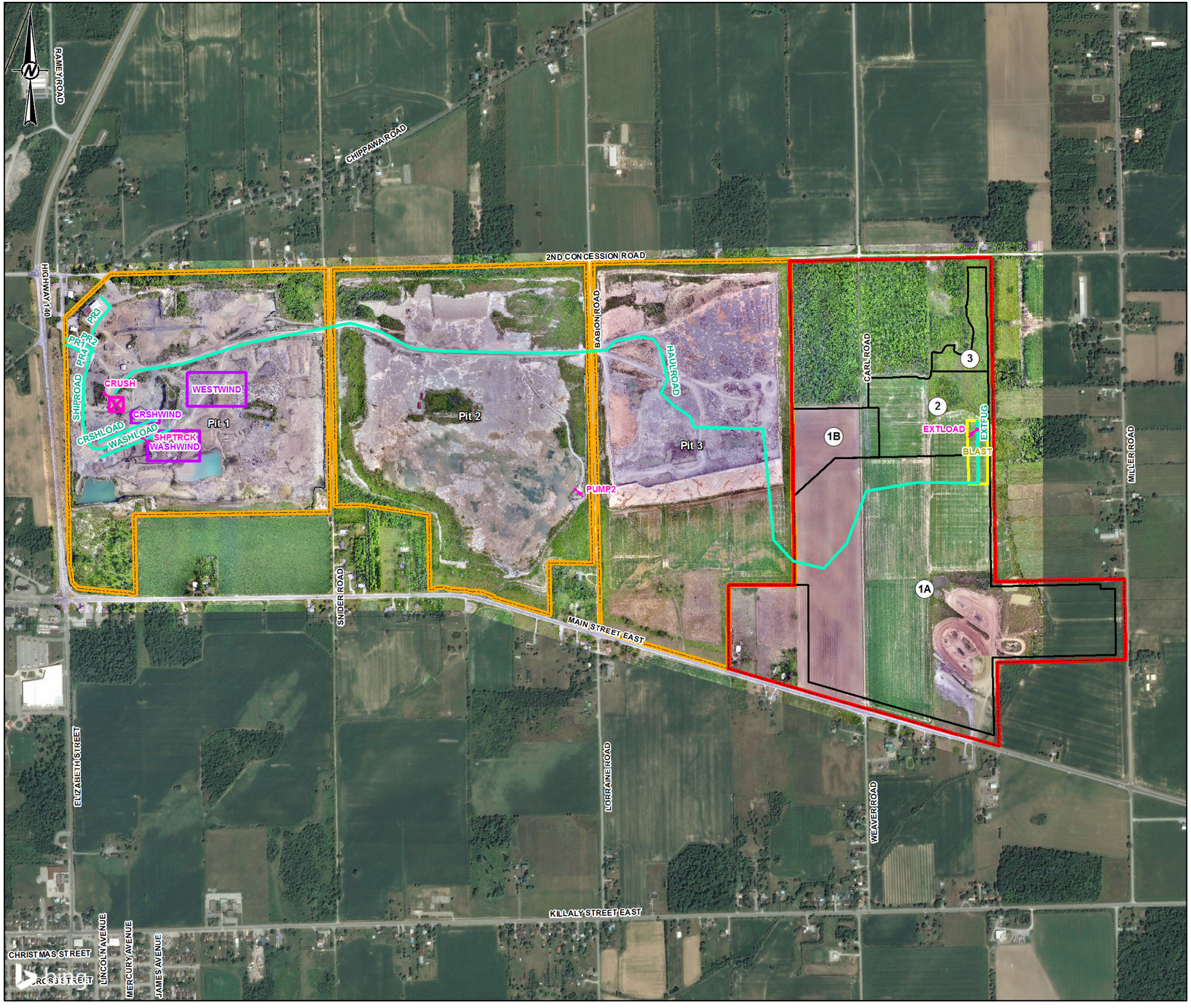

LEGEND

- (1) Excavation Phase
- Roads
- Railway
- Volume Sources
- Line Volume Sources
- Area Sources
- Polygonal Area Sources
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

0 500 1,000

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NOTE(S)

REFERENCE(S)

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RANKIN CONSTRUCTION INC.

PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
DISPERSION MODELLING PLAN – EXPANSION SCENARIO 3

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
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PREPARED	PR
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PROJECT NO.	CONTROL	REV.	FIGURE
1771656	0019		3D

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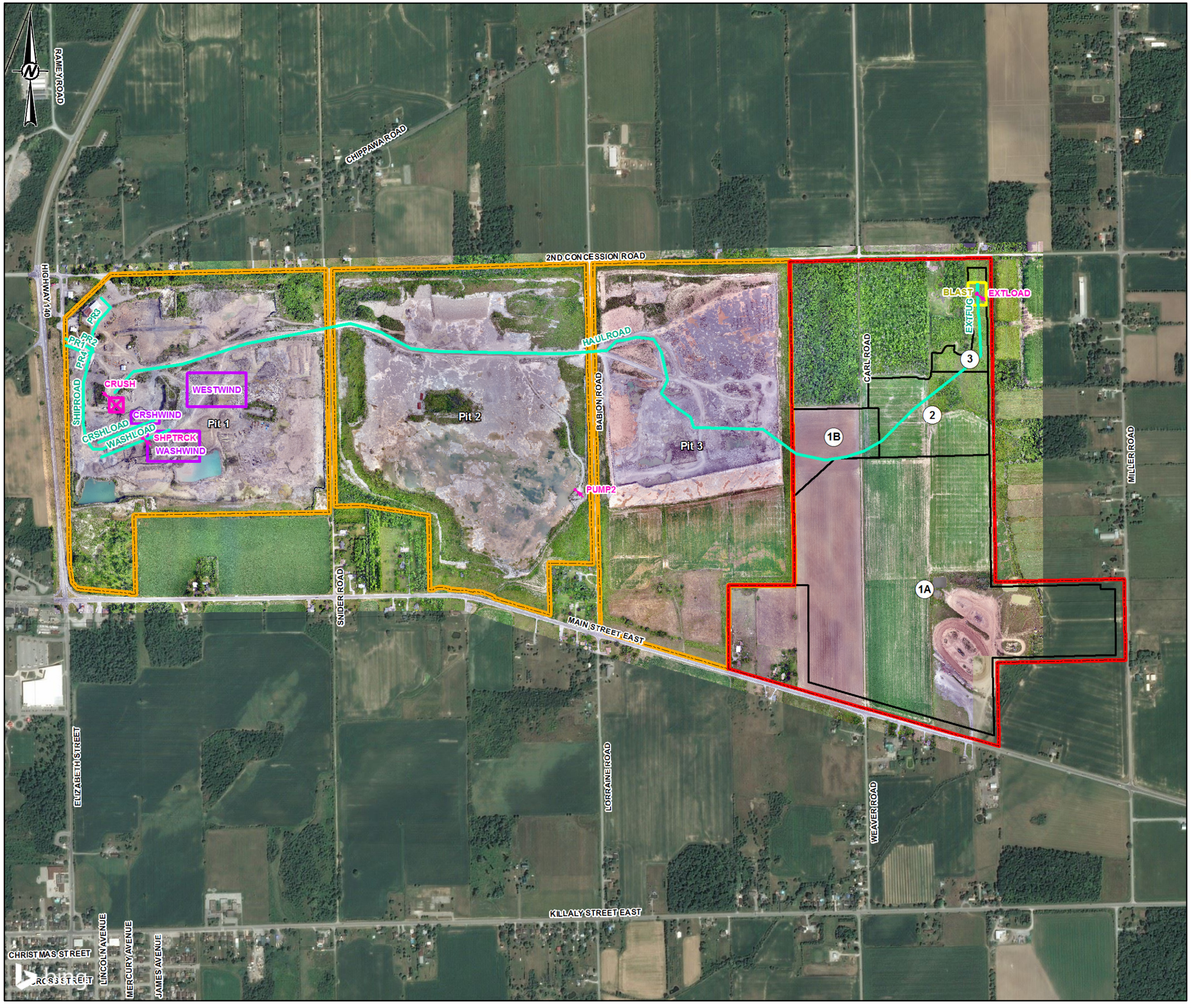

LEGEND

- (1) Excavation Phase
- Roads
- Railway
- Volume Sources
- Line Volume Sources
- Area Sources
- Polygonal Area Sources
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

0 500 1,000

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NOTE(S)

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PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
DISPERSION MODELLING PLAN – EXPANSION SCENARIO 4

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
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PREPARED	PR
REVIEWED	BC
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PROJECT NO. 1771656 | CONTROL 0019 | REV. | FIGURE **3E**

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LEGEND

- (1) Excavation Phase
- Roads
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

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NOTE(S)

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CLIENT
RANKIN CONSTRUCTION INC.

PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
PIT 3 EXTENSION: EXTRACTION PHASING

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
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PREPARED	PR
REVIEWED	BC
APPROVED	NCJ

PROJECT NO.	CONTROL	REV.	FIGURE
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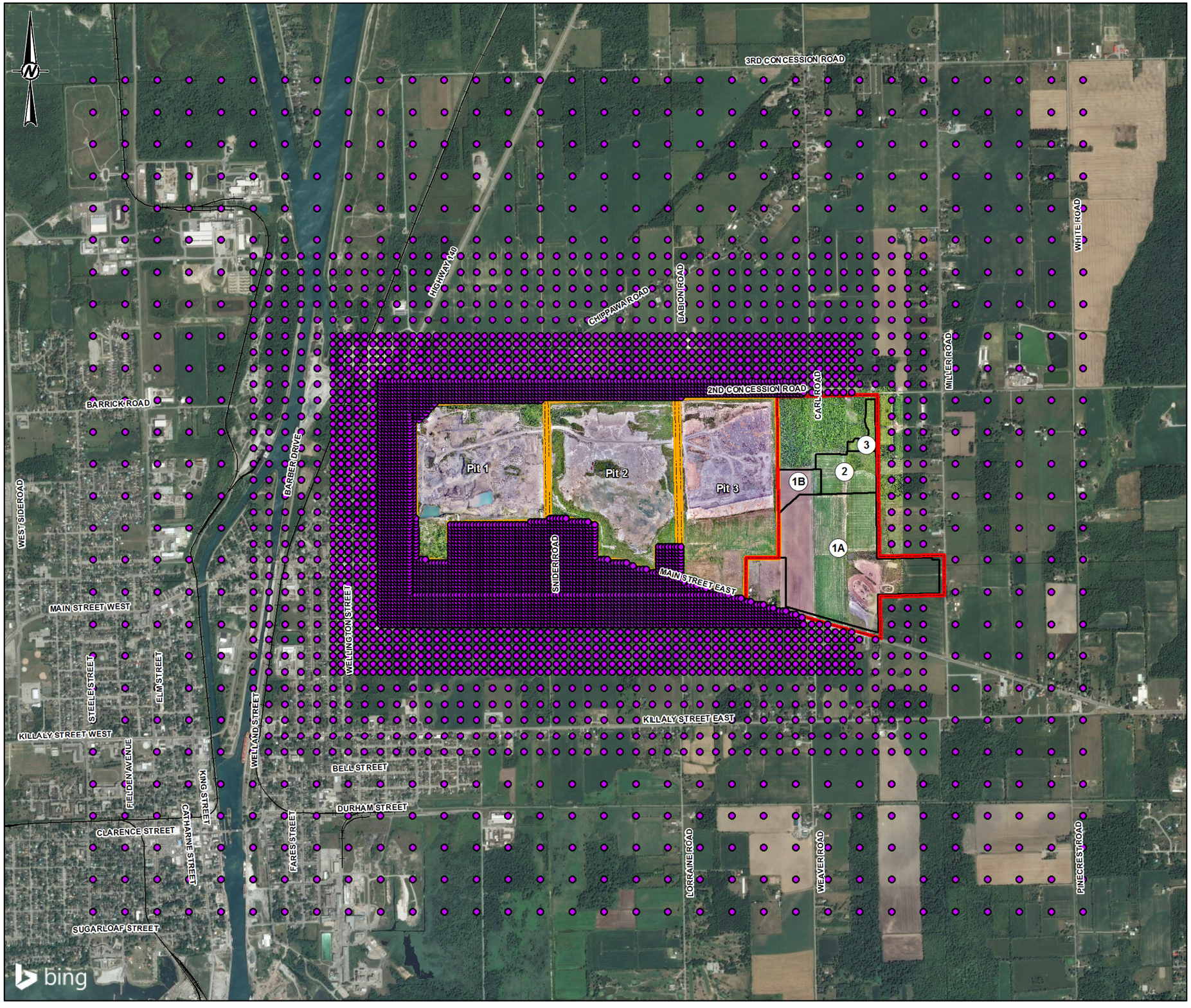

LEGEND

- Grid Receptors
- Excavation Phase
- Roads
- Railway
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

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1:24,000 Meters

NOTE(S)

REFERENCE(S)

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CLIENT
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PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
AIR QUALITY DISPERSION MODELLING GRID RECEPTORS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
DESIGNED	PR
PREPARED	PR
REVIEWED	BC
APPROVED	NCJ

PROJECT NO.	CONTROL	REV.	FIGURE
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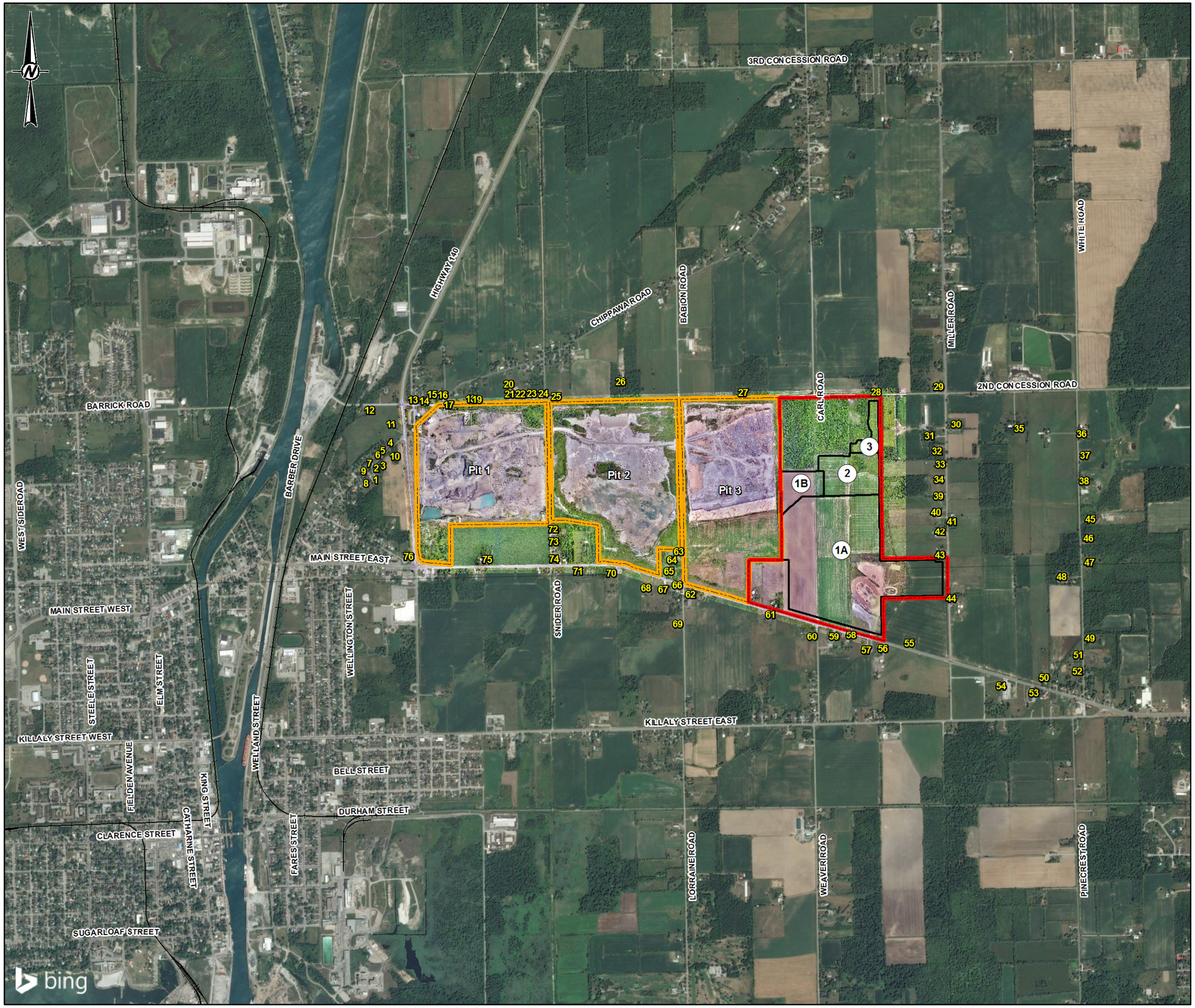

LEGEND

- Sensitive Receptors
- Excavation Phase
- Roads
- Railway
- Property Boundary
- Proposed Quarry Extension
- Approximate Excavation Phasing Boundary

0 500 1,000
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NOTE(S)

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CLIENT
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PROJECT
PROPOSED PORT COLBORNE QUARRY EXTENSION

TITLE
AIR QUALITY DISPERSION MODELLING SENSITIVE RECEPTORS

CONSULTANT
GOLDER

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PROJECT NO.	CONTROL	REV.	FIGURE
1771656	0019		6

APPENDIX A

Source Summary Tables

Table A1 - Emission Summary Table by Source

Source Identifier	Source Description	Emission Data			
		Contaminant	CAS No.	1-hour Emission Rate [g/s]	24-hour Emission Rate [g/s]
1a	Crushing Plant	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	—
1b	Crushing Plant Drop Operations	SPM[1]	N/A	2.75E+00	—
		PM10[1]	N/A	1.20E+00	—
		PM2.5[1]	N/A	1.82E-01	—
		Crystalline silica[1]	14808-60-7	7.91E-02	—
2	Wash Plant	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	—
3-1	Crusher Stockpiles Wind Erosion	SPM	N/A	—	1.10E-02
		PM10	N/A	—	5.50E-03
		PM2.5	N/A	—	8.24E-04
		Crystalline silica	14808-60-7	—	3.61E-04
3-2	Wash Plant Stockpiles Wind	SPM	N/A	—	4.52E-02
		PM10	N/A	—	2.26E-02
		PM2.5	N/A	—	3.39E-03
		Crystalline silica	14808-60-7	—	1.49E-03
3-3	West Stockpiles Wind Erosion	SPM	N/A	—	6.70E-02
		PM10	N/A	—	3.35E-02
		PM2.5	N/A	—	5.02E-03
		Crystalline silica	14808-60-7	—	2.20E-03
4-1	Main Site Access	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	—
4-2	Main Site Egress	SPM	N/A	1.08E-02	—
		PM10	N/A	2.07E-03	—
		PM2.5	N/A	5.00E-04	—
		Crystalline silica	14808-60-7	1.36E-04	—
4-3	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	—
4-4	Paved Entrance to Pit	SPM	N/A	1.09E-02	—
		PM10	N/A	2.09E-03	—
		PM2.5	N/A	5.05E-04	—
		Crystalline silica	14808-60-7	1.37E-04	—
5-1a	Stockpile Area 1 Loader Dust	SPM	N/A	4.53E-01	—
		PM10	N/A	1.15E-01	—
		PM2.5	N/A	1.15E-02	—
		Crystalline silica	14808-60-7	7.58E-03	—
5-1b	Stockpile Area 2 Loader Dust	SPM	N/A	4.47E-01	—
		PM10	N/A	1.14E-01	—
		PM2.5	N/A	1.14E-02	—
		Crystalline silica	14808-60-7	7.48E-03	—
5-2	Shipping Road Dust	SPM	N/A	3.41E-01	—
		PM10	N/A	8.68E-02	—
		PM2.5	N/A	8.68E-03	—
		Crystalline silica	14808-60-7	5.71E-03	—
5-4	Extraction Face Loader Road Dust	SPM	N/A	5.38E-01	—
		PM10	N/A	1.37E-01	—
		PM2.5	N/A	1.37E-02	—
		Crystalline silica	14808-60-7	9.01E-03	—
6a-1	Stockpile Area 1 Loader Tailpipe	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	—
6a-2	Stockpile Area 2 Loader Tailpipe	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	—
6a-3	Haul Road Non-Road Tail Pipe	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	—

Table A1 - Emission Summary Table by Source

Source Identifier	Source Description	Emission Data			
		Contaminant	CAS No.	1-hour Emission Rate [g/s]	24-hour Emission Rate [g/s]
6a-4	Extraction Face Tailpipe	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	—
6a-5	Water Pump - Pit 2	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	—
6a-6	Water Pump - Pit 3	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	—
6b-1	Shipping Road Tailpipe	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	—
6b-2	Main Site Access Road Tailpipe	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	—
6b-3	Main Site Egress Tailpipe	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	—
6b-4	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	—
6b-5	Paved Entrance to Pit Tailpipe	CO	630-08-0	1.34E+00	—
		SO2	7446-09-5	4.37E-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	—
7a	Stockpile Material Handling	SPM	N/A	4.14E-01	—
		PM10	N/A	1.81E-01	—
		PM2.5	N/A	2.74E-02	—
		Crystalline silica	14808-60-7	1.19E-02	—
7b	Extraction Face Material Handling	SPM	N/A	2.46E+00	—
		PM10	N/A	1.08E+00	—
		PM2.5	N/A	1.63E-01	—
		Crystalline silica	14808-60-7	7.09E-02	—
8	Blast Hole Drilling	SPM	N/A	1.64E-02	—
		PM10	N/A	7.28E-03	—
		PM2.5	N/A	1.37E-03	—
		Crystalline silica	14808-60-7	4.79E-04	—
9	Quarry Blasting - Fugitives	SPM	N/A	1.69E-01	—
		PM10	N/A	8.78E-02	—
		PM2.5	N/A	5.06E-03	—
		Crystalline silica	14808-60-7	5.77E-03	
10	Quarry Blasting - Combustion	CO	630-08-0	2.91E+01	—
		SO2	7446-09-5	9.24E-01	—
		Nox	10102-44-0	3.42E-01	—
Scenario 0 - Existing Operations					
5-3	Haul Road Dust	SPM	N/A	1.19E+01	—
		PM10	N/A	3.04E+00	—
		PM2.5	N/A	3.04E-01	—
		Crystalline silica	14808-60-7	2.00E-01	—
6b-6	Haul Road Passenger Tailpipe	CO	630-08-0	8.35E-04	—
		SO2	7446-09-5	2.77E-04	—
		SPM	N/A	5.97E-07	—
		PM10	N/A	5.97E-07	—
		PM2.5	N/A	5.79E-07	—
		Nox	10102-44-0	3.18E-05	—

Table A1 - Emission Summary Table by Source

Source Identifier	Source Description	Emission Data			
		Contaminant	CAS No.	1-hour Emission Rate [g/s]	24-hour Emission Rate [g/s]
Scenario 1 - Expansion Phase 1					
5-3	Haul Road Dust	SPM	N/A	1.47E+01	—
		PM10	N/A	3.75E+00	—
		PM2.5	N/A	3.75E-01	—
		Crystalline silica	14808-60-7	2.47E-01	—
6b-6	Haul Road Passenger Tailpipe	CO	630-08-0	1.032E-03	—
		SO2	7446-09-5	2.774E-04	—
		SPM	N/A	7.374E-07	—
		PM10	N/A	7.374E-07	—
		PM2.5	N/A	7.152E-07	—
		Nox	10102-44-0	3.933E-05	—
Scenario 2 - Expansion Phase 1					
5-3	Haul Road Dust	SPM	N/A	1.56E+01	—
		PM10	N/A	3.97E+00	—
		PM2.5	N/A	3.97E-01	—
		Crystalline silica	14808-60-7	2.61E-01	—
6b-6	Haul Road Passenger Tailpipe	CO	630-08-0	1.093E-03	—
		SO2	7446-09-5	2.774E-04	—
		SPM	N/A	7.806E-07	—
		PM10	N/A	7.806E-07	—
		PM2.5	N/A	7.571E-07	—
		Nox	10102-44-0	4.163E-05	—
Scenario 3 - Expansion Phase 2					
5-3	Haul Road Dust	SPM	N/A	1.52E+01	—
		PM10	N/A	3.87E+00	—
		PM2.5	N/A	3.87E-01	—
		Crystalline silica	14808-60-7	2.55E-01	—
6b-6	Haul Road Passenger Tailpipe	CO	630-08-0	1.065E-03	—
		SO2	7446-09-5	2.774E-04	—
		SPM	N/A	7.610E-07	—
		PM10	N/A	7.610E-07	—
		PM2.5	N/A	7.382E-07	—
		Nox	10102-44-0	4.059E-05	—
Scenario 4 - Expansion Phase 3					
5-3	Haul Road Dust	SPM	N/A	1.39E+01	—
		PM10	N/A	3.55E+00	—
		PM2.5	N/A	3.55E-01	—
		Crystalline silica	14808-60-7	2.33E-01	—
6b-6	Haul Road Passenger Tailpipe	CO	630-08-0	9.754E-04	—
		SO2	7446-09-5	2.774E-04	—
		SPM	N/A	6.967E-07	—
		PM10	N/A	6.967E-07	—
		PM2.5	N/A	6.758E-07	—
		Nox	10102-44-0	3.716E-05	—

Note: [1] Emission rates vary by hour of day and by wind speed. This table presents only the maximum possible emission rate, based on the maximum hourly wind speed of 19 m/s obtained from the "Crops" meteorological data set for West Central ("London").

Table A2 - Dispersion Modelling Source Parameter Summary Table

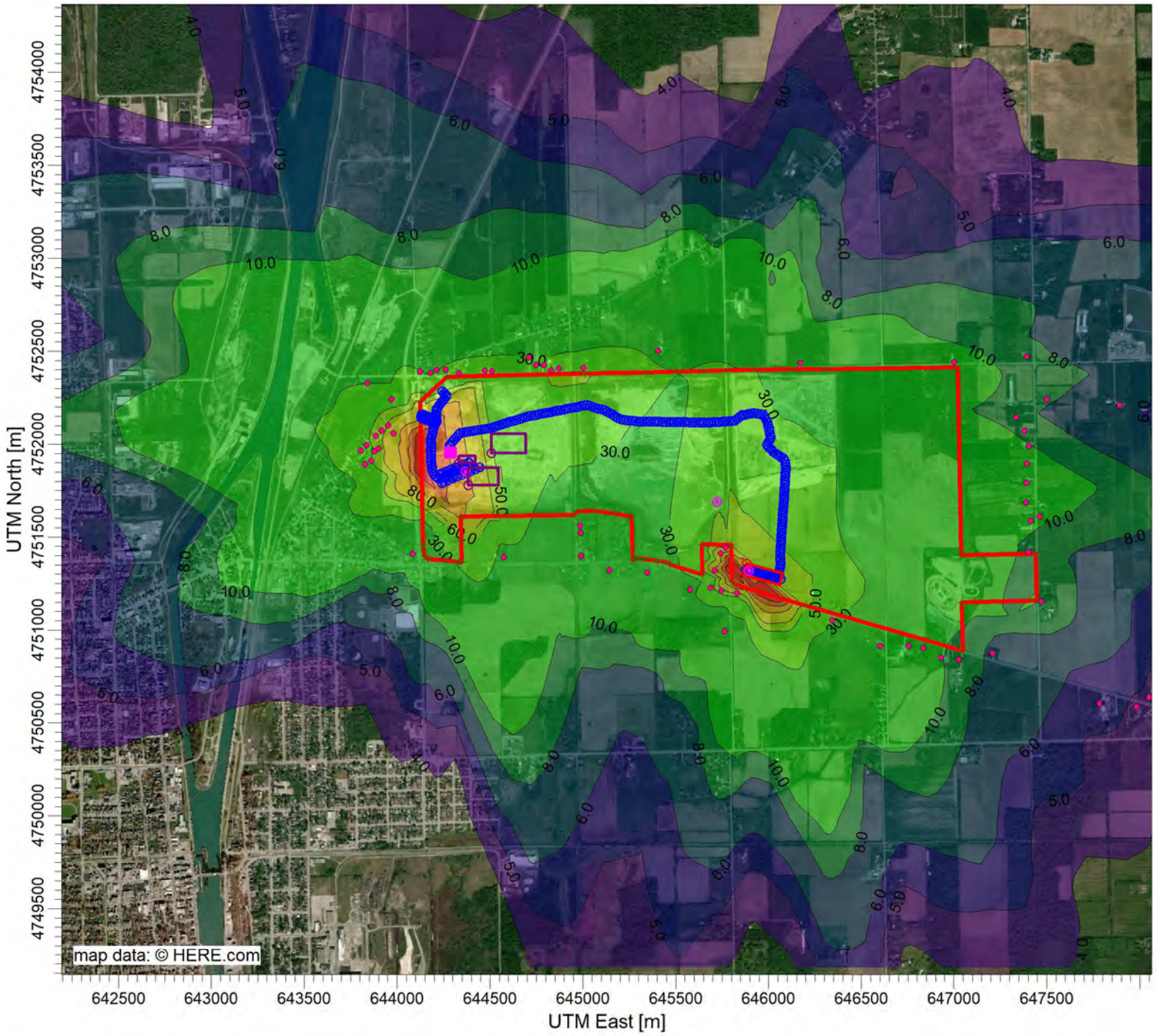
Modelling ID	Included Source(s)	AERMOD Source Type	Modelling Source Data				
			Length [m]	Width [m]	Initial Vertical Dimension	Area	Release Height [m]
CRSHWIND	Crusher Stockpiles Wind Erosion	Area	88.5	37.44	2.09	3313.44	4.50
WASHWIND	Wash Plant Stockpiles Wind Erosion	Area	162.02	93.94	2.09	15220.2	4.50
WESTWIND	West Stockpiles Wind Erosion	Area	184.8	104.81	2.09	19368.9	4.50
BLAST	Quarry Blasting - Fugitives, Quarry Blasting - Combustion Emissions	Areapoly	N/A	N/A	N/A	12509.1	1.00
Modelling ID	**Included Source(s)**	**Source Type**	**Number of Volume Sources**	**Initial Lateral Dimension**	**Initial Vertical Dimension**	**Length of Side [m]**	**Release Height [m]**
CRUSH	Crushing Plant	Volume	1	10.33	7.77	44.44	8.35
CRSHDRP	Crushing Plant Drop Operations	Volume	1	10.33	7.77	44.44	8.35
WASHPL	Wash Plant	Volume	1	5.20	5.67	22.34	6.10
SHPTRCK	Stockpile Material Handling	Volume	1	0.47	0.40	2.00	2.60
PR1	Main Site Access, Main Site Access Road Tailpipe	Volume Line	11	4.01	2.13	N/A	2.30
PR2	Main Site Egress, Main Site Egress Tailpipe	Volume	11	4.01	2.13	N/A	2.30
PR3	Road to Parking Lot, Road to Parking Lot Tailpipe	Volume	14	6.33	1.52	N/A	1.63
PR4	Paved Entrance to Pit, Paved Entrance to Pit Tailpipe	Volume	3	8.18	2.74	N/A	2.95
SHIPROAD	Shipping Road Dust,Shipping Road Tailpipe	Volume	26	8.18	2.74	N/A	3.47
PUMP2	Water Pump - Pit 2	Volume	1	0.23	0.70	1.00	0.75
PUMP3	Water Pump - Pit 3	Volume	1	0.23	0.70	1.00	0.75
CRSHLOAD	Stockpile Area 1 Loader Dust, Stockpile Area 1 Loader Tailpipe	Line Volume	7	12.09	2.82	20.00	3.57
WASHLOAD	Stockpile Area 2 Loader Dust, Stockpile Area 2 Loader Tailpipe	Line Volume	9	12.09	2.82	20.00	3.57
EXTLOAD	Extraction Face Material Handling	Volume	1	0.93	0.77	4.00	3.33

Modelling ID	Included Source(s)	Source Type	Number of Volume Sources	Initial Lateral Dimension	Initial Vertical Dimension	Length of Side [m]	Release Height [m]
Scenario 0 - Existing Operations							
HAULROAD	Haul Road Dust, Haul Road Non-Road Tail Pipe,Haul Road Passenger Tailpipe	Line Volume	177	7.57	3.51	N/A	4.44
EXTFUG	Extraction Face Loader Road Dust, Extraction Face Tailpipe, Blast Hole Drilling	Line Volume	8	12.09	3.16	20.00	4.00
Scenario 1 - Expansion Phase 1							
HAULROAD	Haul Road Dust, Haul Road Non-Road Tail Pipe,Haul Road Passenger Tailpipe	Line Volume	219	7.57	3.51	N/A	4.44
EXTFUG	Extraction Face Loader Road Dust, Extraction Face Tailpipe, Blast Hole Drilling	Line Volume	8	12.09	3.16	20.00	4.00
Scenario 2 - Expansion Phase 1							
HAULROAD	Haul Road Dust, Haul Road Non-Road Tail Pipe,Haul Road Passenger Tailpipe	Line Volume	231	7.57	3.51	N/A	4.44
EXTFUG	Extraction Face Loader Road Dust, Extraction Face Tailpipe, Blast Hole Drilling	Line Volume	3	12.09	3.16	20.00	4.00
Scenario 3 - Expansion Phase 2							
HAULROAD	Haul Road Dust, Haul Road Non-Road Tail Pipe,Haul Road Passenger Tailpipe	Line Volume	226	7.57	3.51	N/A	4.44
EXTFUG	Extraction Face Loader Road Dust, Extraction Face Tailpipe, Blast Hole Drilling	Line Volume	8	12.09	3.16	20.00	4.00
Scenario 4 - Expansion Phase 3							
HAULROAD	Haul Road Dust, Haul Road Non-Road Tail Pipe,Haul Road Passenger Tailpipe	Line Volume	207	7.57	3.51	N/A	4.44
EXTFUG	Extraction Face Loader Road Dust, Extraction Face Tailpipe, Blast Hole Drilling	Line Volume	2	12.09	3.16	20.00	4.00

APPENDIX B

Contour Plots

Figure B0a - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 0, 24-hr SPM
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 162.5 [ug/m^3] at (645795.48, 4751318.00)

4.0 5.0 6.0 8.0 10.0 30.0 50.0 60.0 80.0 100.0 120.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

SPM 24-hr AAQC = 120 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:30,000

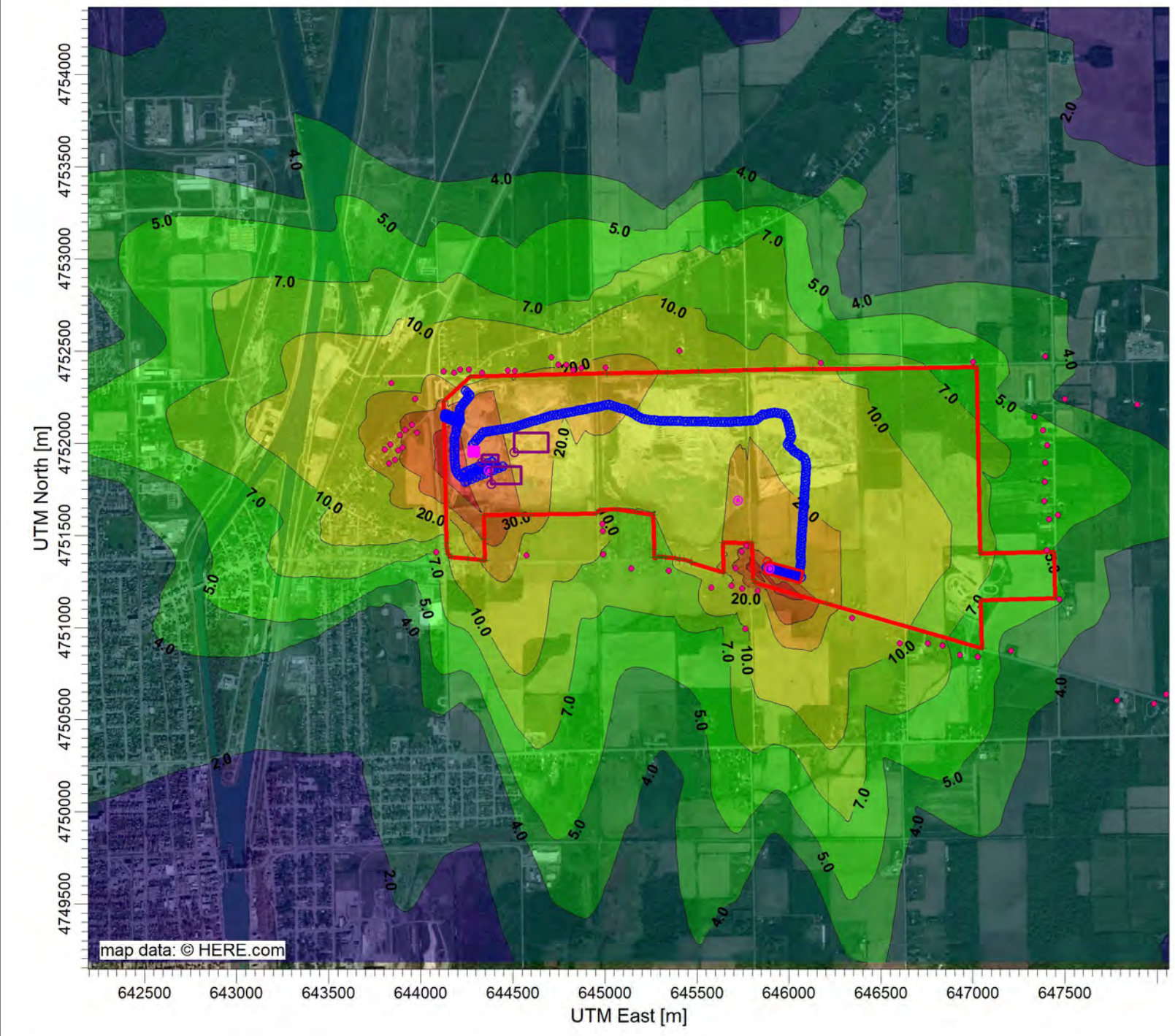
0 1 km

GOLDER

DATE:
2020-11-30

1771656

Figure B0b - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 0, 24-hr PM10
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 64.4 [ug/m^3] at (644115.48, 4751878.00)

1.0 1.0 2.0 4.0 5.0 7.0 10.0 20.0 30.0 50.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM10 24-hr AAQC = 50 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:30,000

0 1 km

GOLDER

DATE:
2020-11-30

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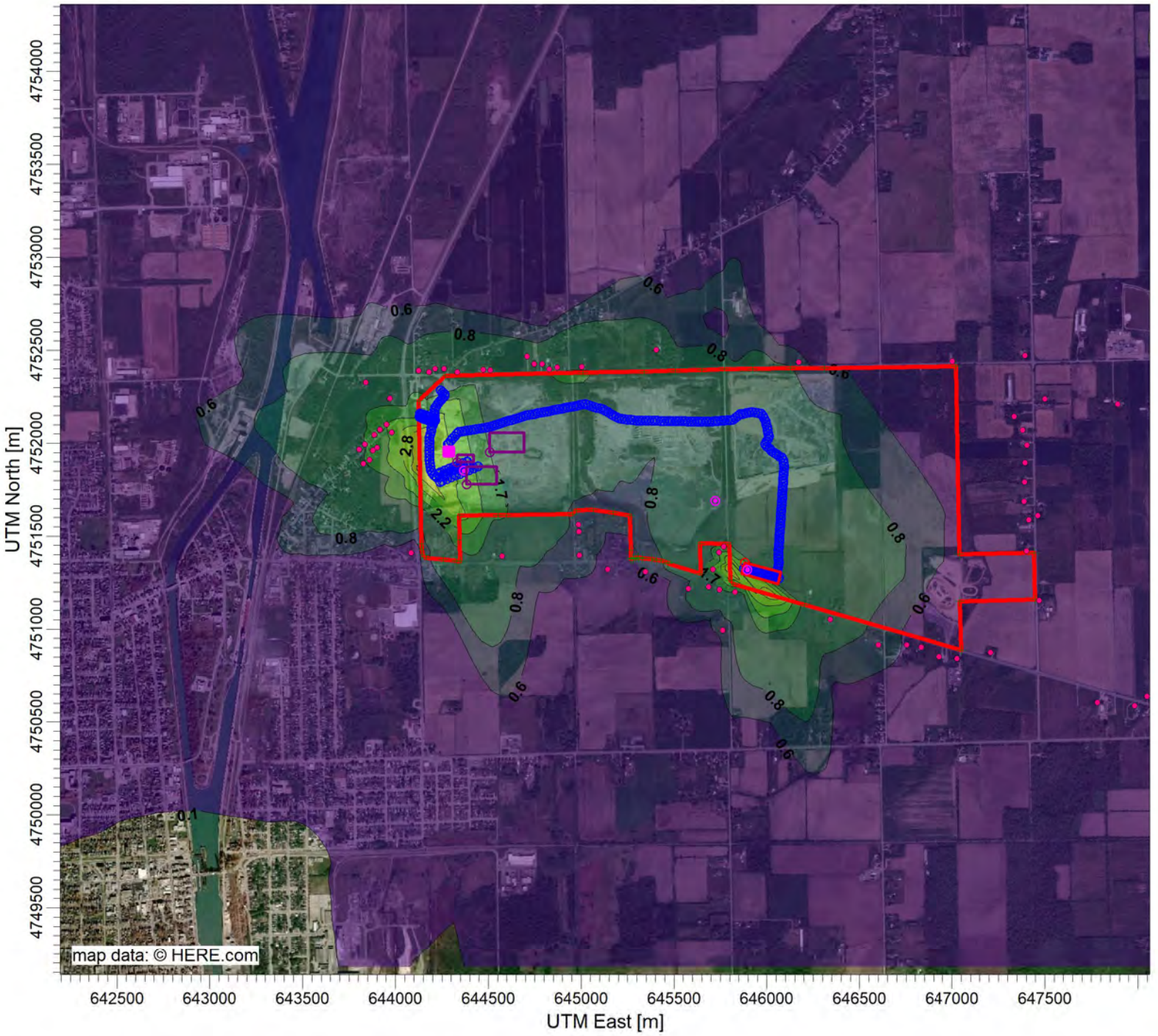
Figure B0c - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 0, 24-hr Crystallline Silica
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 4.0 [ug/m^3] at (645795.48, 4751318.00)

0.1 | 0.6 | 0.8 | 1.7 | 2.2 | 2.8 | 3.3 | 3.9 | 4.4 | 5.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

Crystalline Silica 24-hr AAQC = 5 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:30,000

0 1 km

GOLDER

DATE:

2020-11-30

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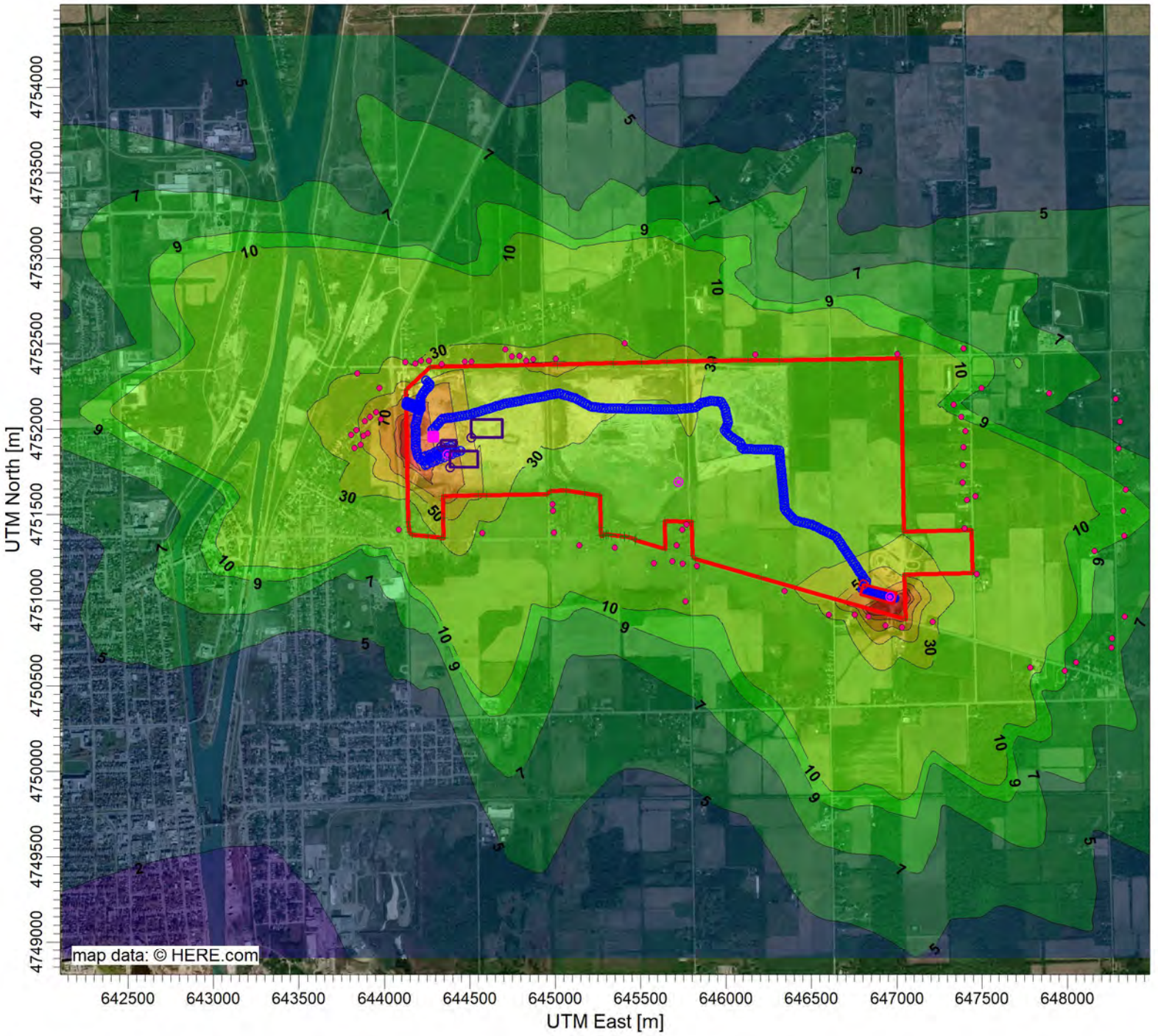
Figure B1a - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 1, 24-hr SPM
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 161 [ug/m^3] at (647055.48, 4751002.76)

0 1 2 5 7 9 10 30 50 70 100 120

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

SPM 24-hr AAQC = 120 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,600

0 1 km

GOLDER

DATE:
2020-11-30

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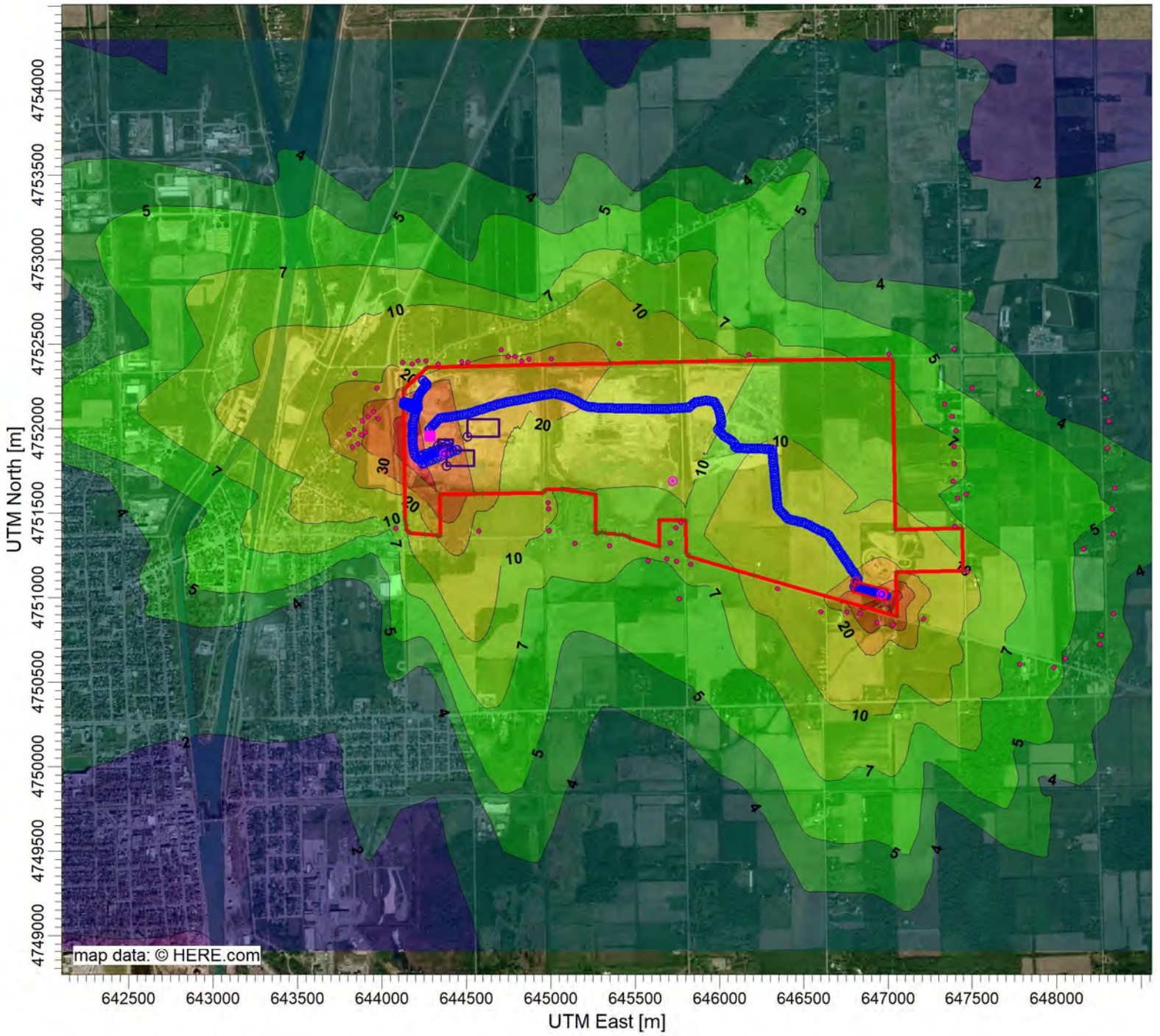
Figure B1b - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 1, 24-hr PM10
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 65 [ug/m^3] at (644115.48, 4751862.76)

0 1 2 4 5 7 10 20 30 50

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM10 24-hr AAQC = 50 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:33,000

0 1 km

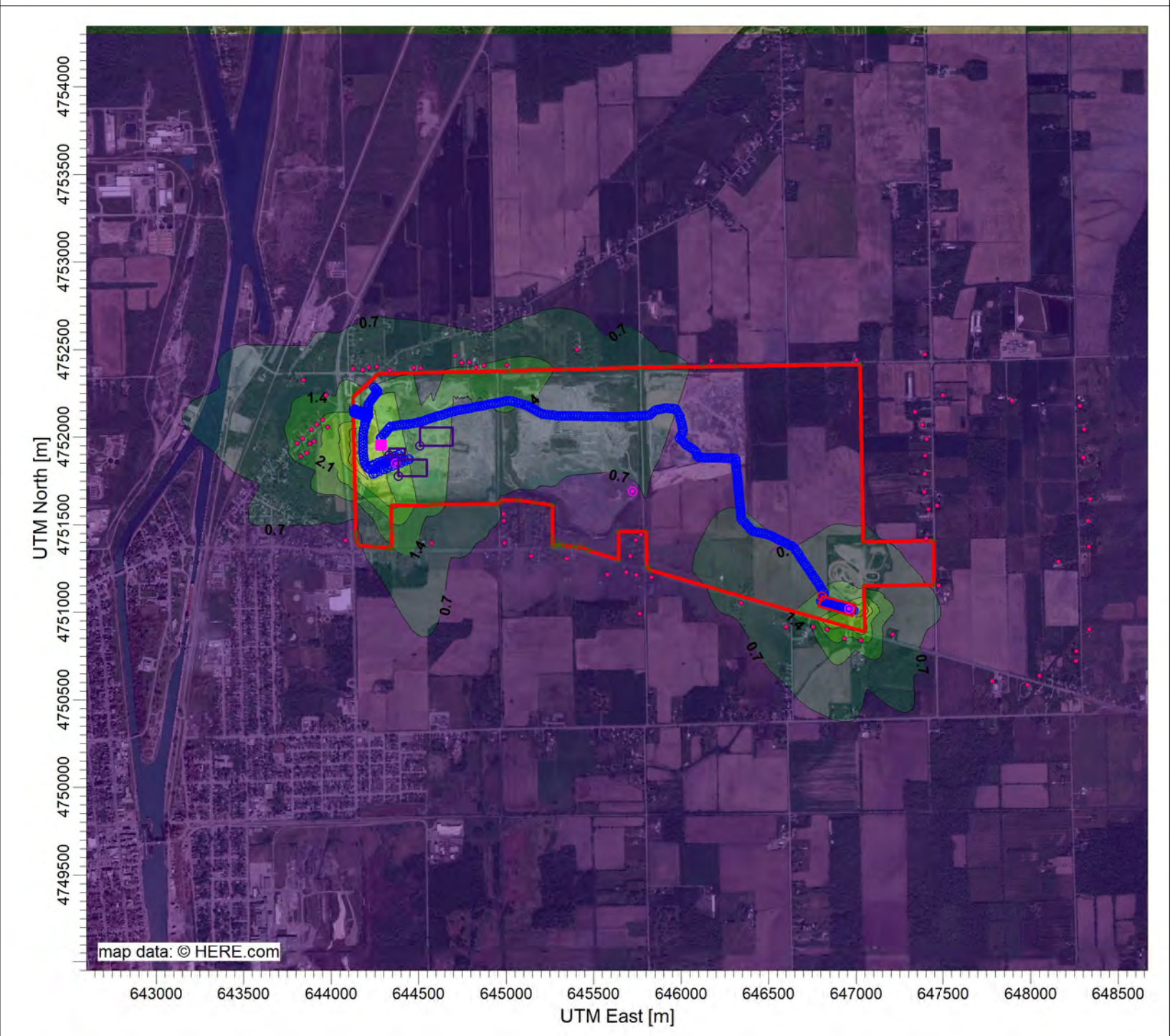
DATE:

2020-11-30

GOLDER

1771656

Figure B1c - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 1, 24-hr Crystalline Silica
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 4.1 [ug/m^3] at (647055.48, 4751002.76)

0.0 0.7 1.4 2.1 2.9 3.6 4.3 5.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

Crystalline Silica 24-hr AAQC = 5 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:31,000

0 1 km

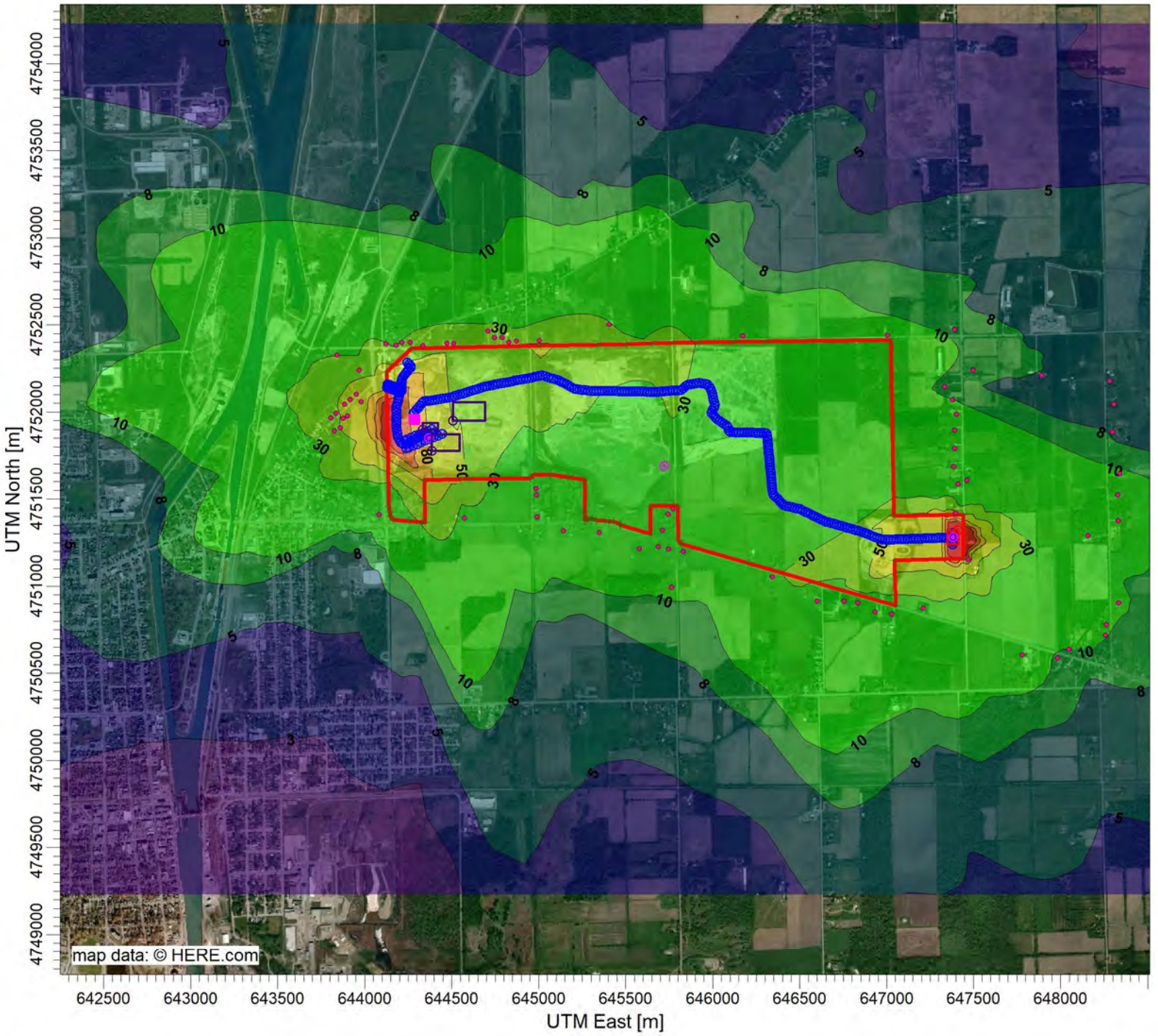
GOLDER

DATE:

2020-12-01

1771656

Figure B2a - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 2, 24-hr SPM
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 252 [ug/m^3] at (647455.48, 4751270.06)

2 3 5 8 10 30 50 80 100 120

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

SPM 24-hr AAQC = 120 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

0 1 km

GOLDER

DATE:
2020-11-30

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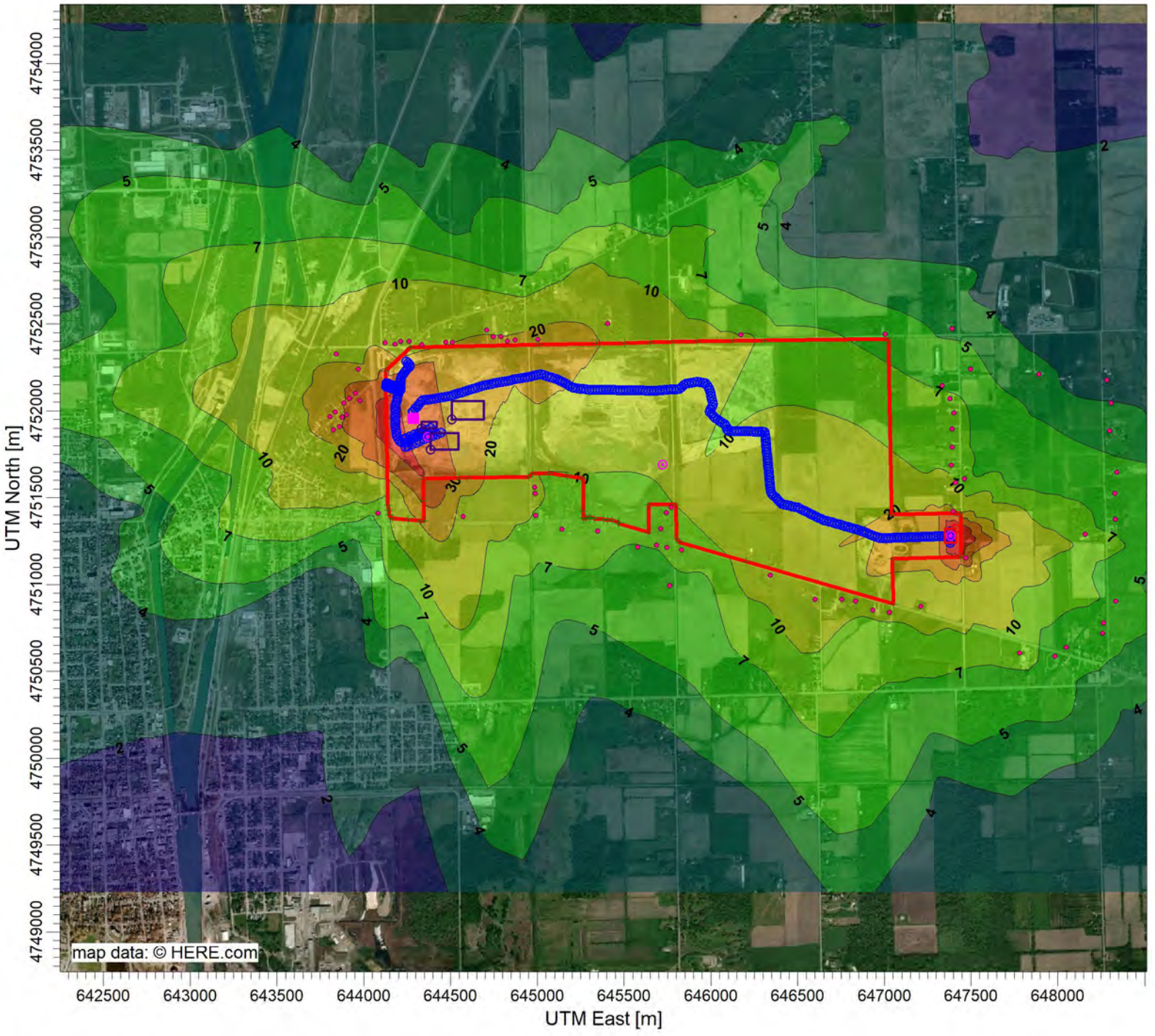
Figure B2b - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 2, 24-hr PM10
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 101 [ug/m^3] at (647455.48, 4751270.06)

0 1 2 4 5 7 10 20 30 50

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM10 24-hr AAQC = 50 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

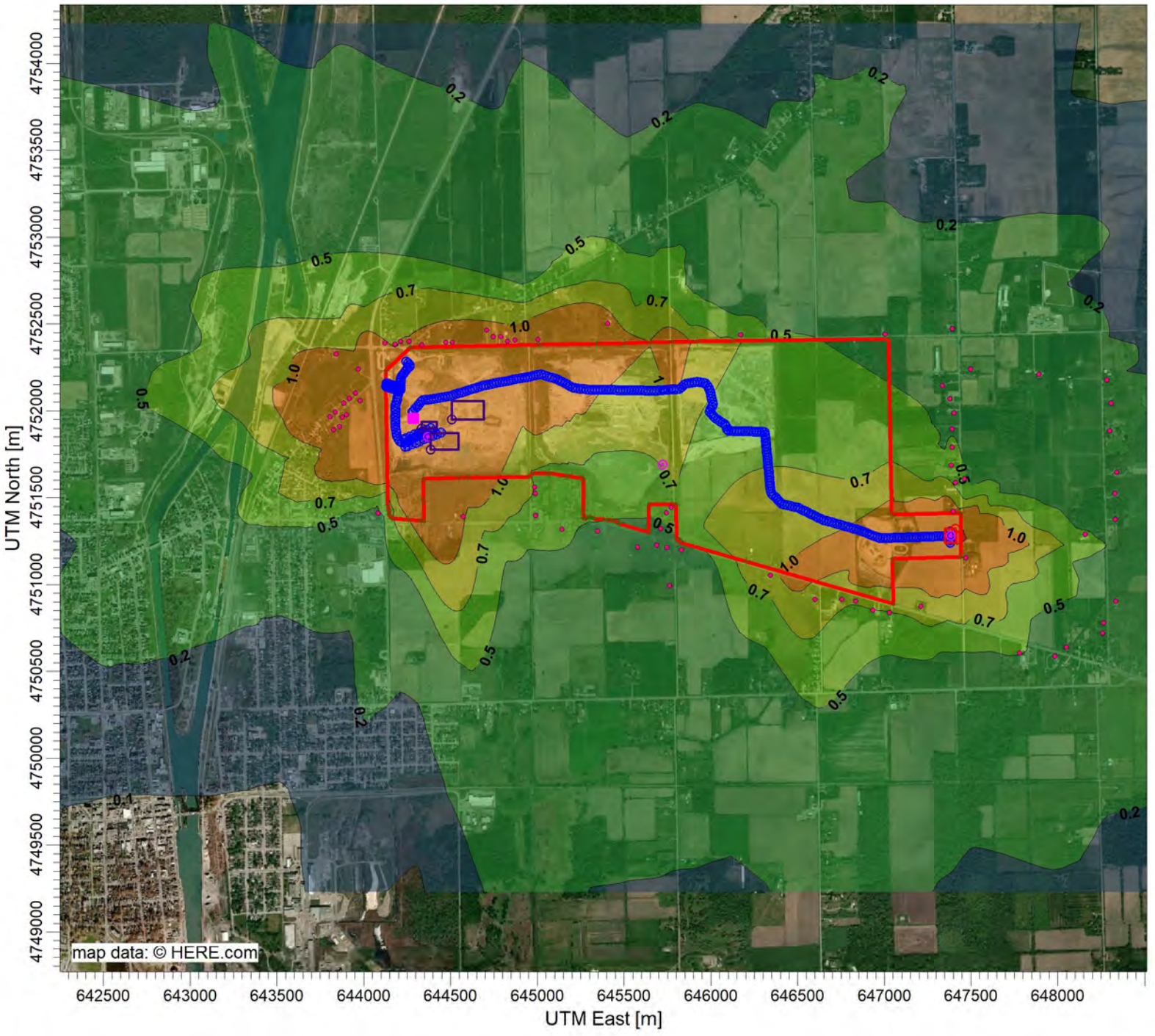
0 1 km

GOLDER

DATE:
2020-11-30

1771656

Figure B2c - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 2, 24-hr Crystalline Silica
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 6.3 [ug/m^3] at (647455.48, 4751270.06)

0.1 | 0.2 | 0.5 | 0.7 | 1.0 | 5.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

Crystalline Silica 24-hr AAQC = 5 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

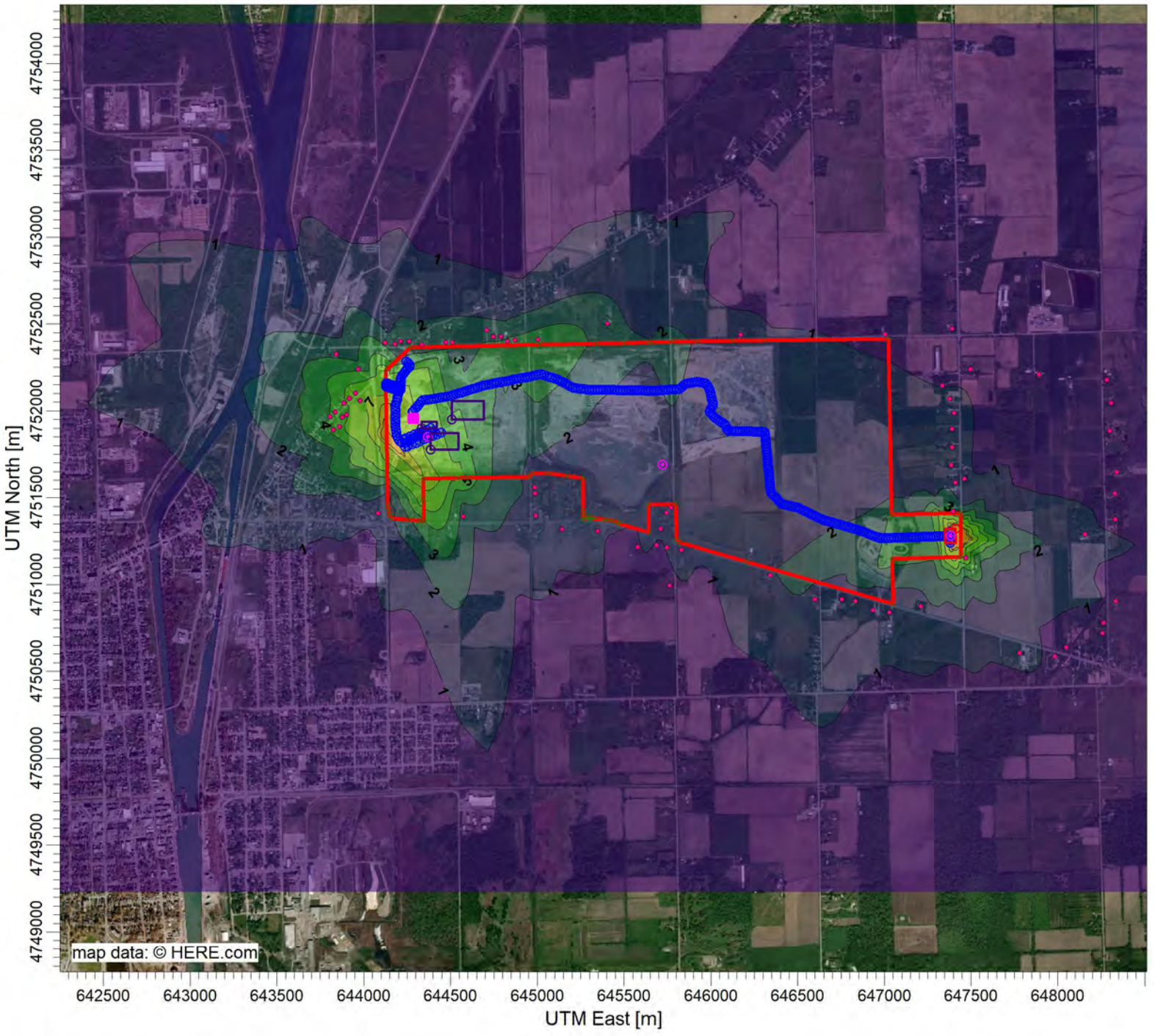
0 1 km

GOLDER

DATE:
2020-12-01

1771656

Figure B2d - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 2, 24-hr PM2.5
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 16 [ug/m^3] at (647455.48, 4751270.06)

0 1 2 3 4 5 7 9 10 20 27

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM2.5 24-hr AAQC = 27 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

0 1 km

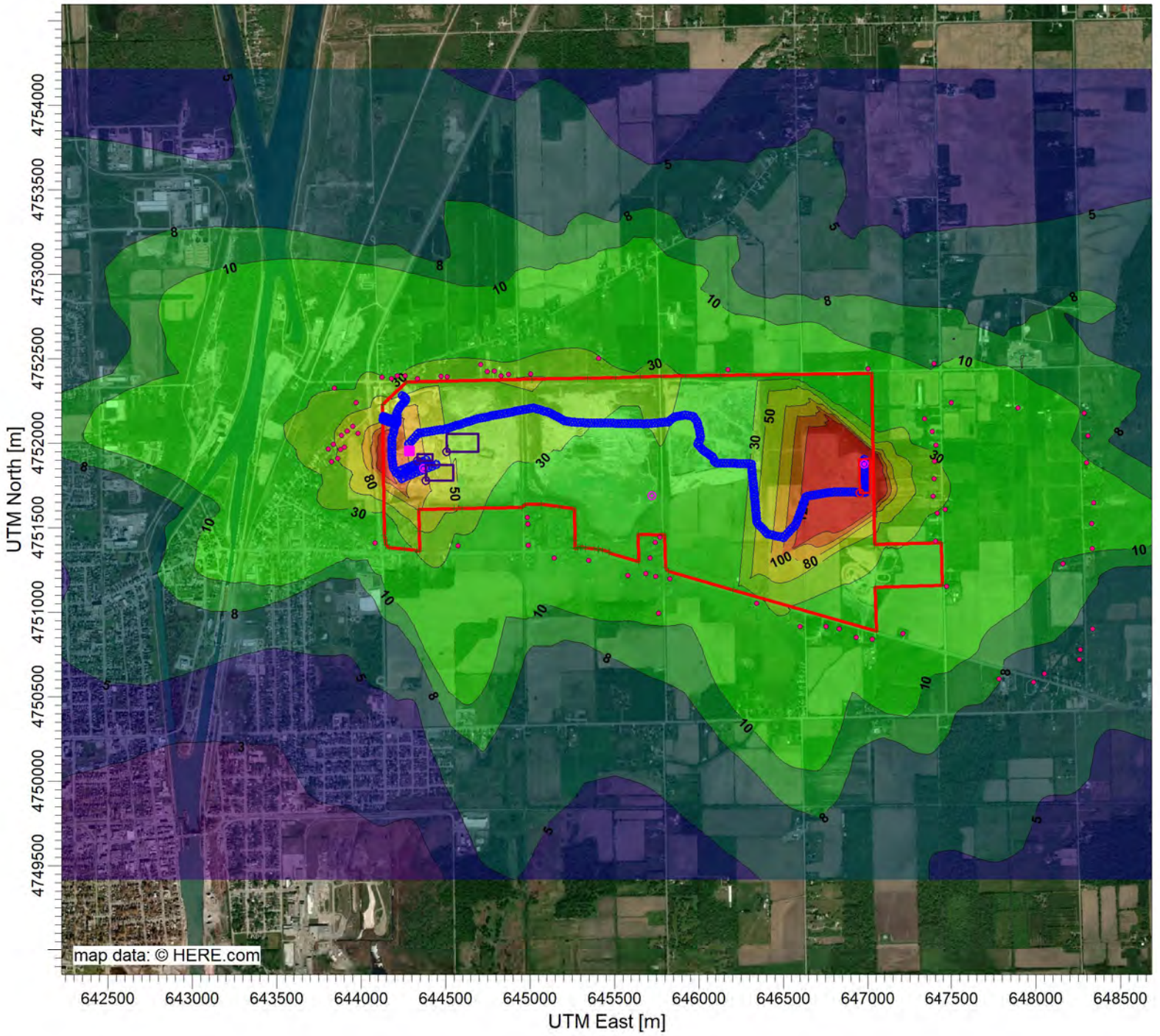
GOLDER

DATE:

2020-11-30

1771656

Figure B3a - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 3, 24-hr SPM
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 269 [ug/m^3] at (647035.48, 4751715.63)

2 3 5 8 10 30 50 80 100 120

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

SPM 24-hr AAQC = 120 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:33,000

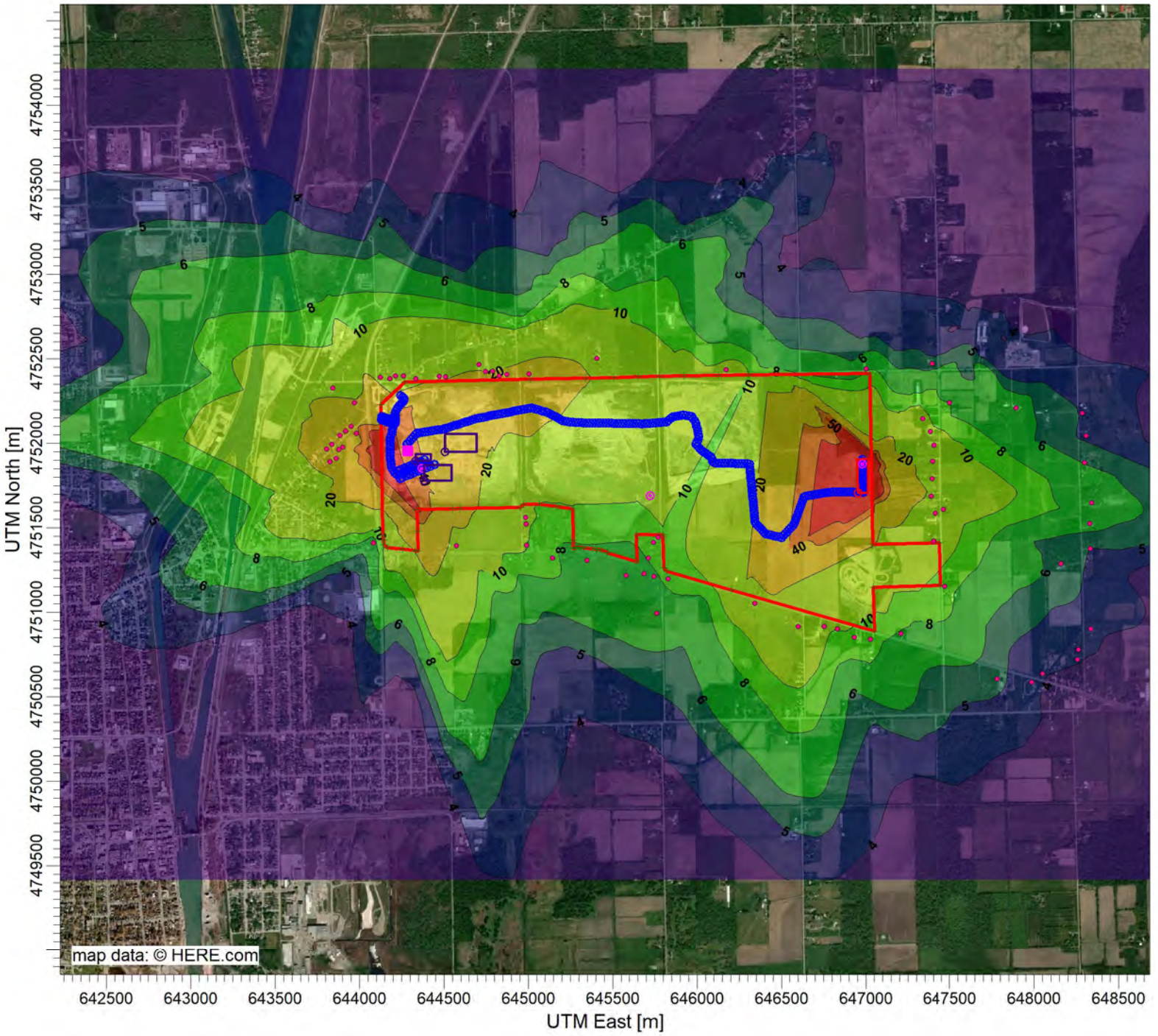
0 1 km

GOLDER

DATE:
2020-11-30

1771656

Figure B3b - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 3, 24-hr PM10
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 94 [ug/m^3] at (647035.48, 4751875.63)

1 4 5 6 8 10 20 40 50

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM10 24-hr AAQC = 50 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:33,000

0 1 km

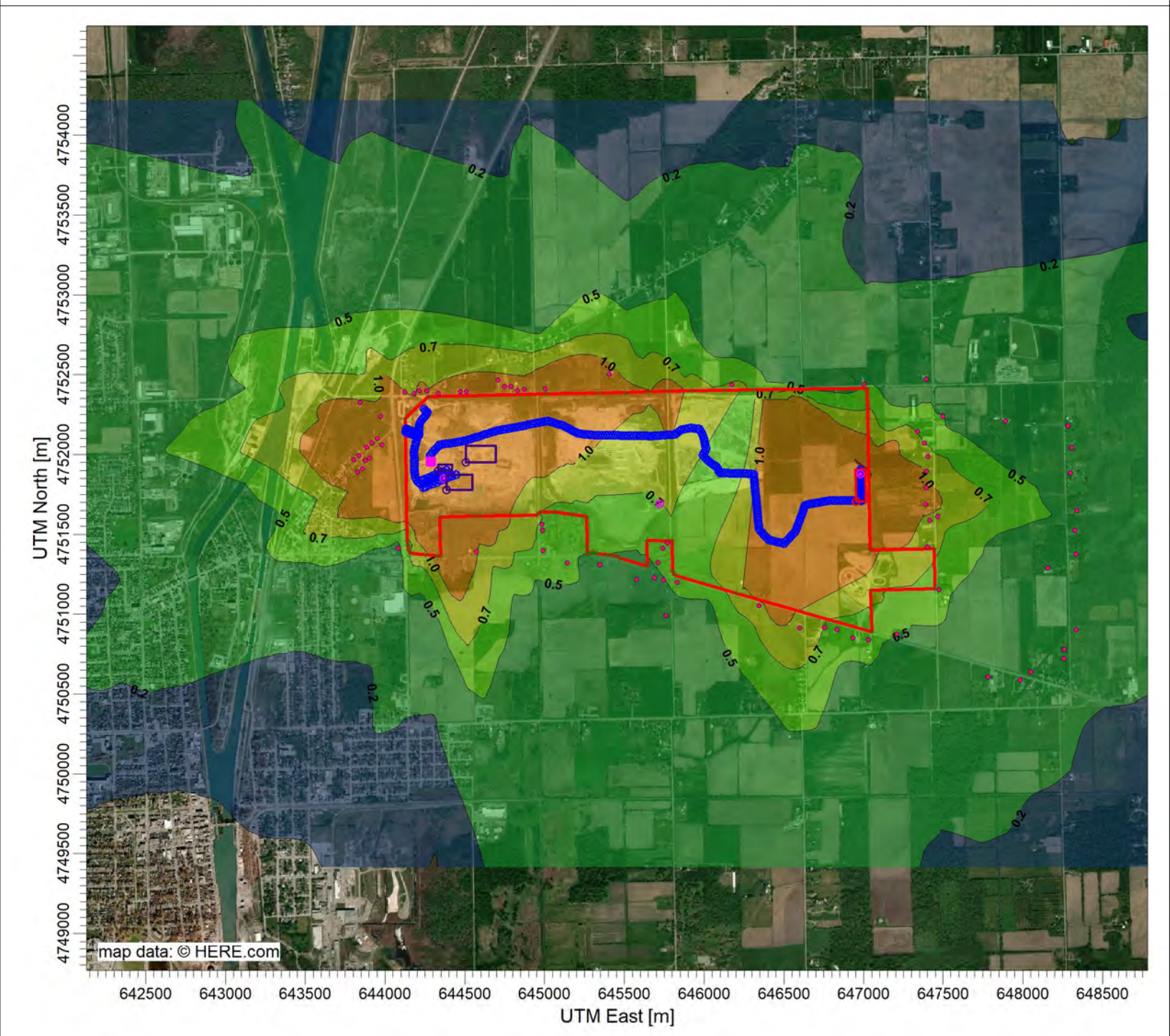
GOLDER

DATE:

2020-11-30

1771656

Figure B3c - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 3, 24-hr Crystalline Silica
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 6.0 [ug/m^3] at (647035.48, 4751875.63)

0.1 | 0.2 | 0.5 | 0.7 | 1.0 | 5.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

Crystalline Silica 24-hr AAQC = 5 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:34,000

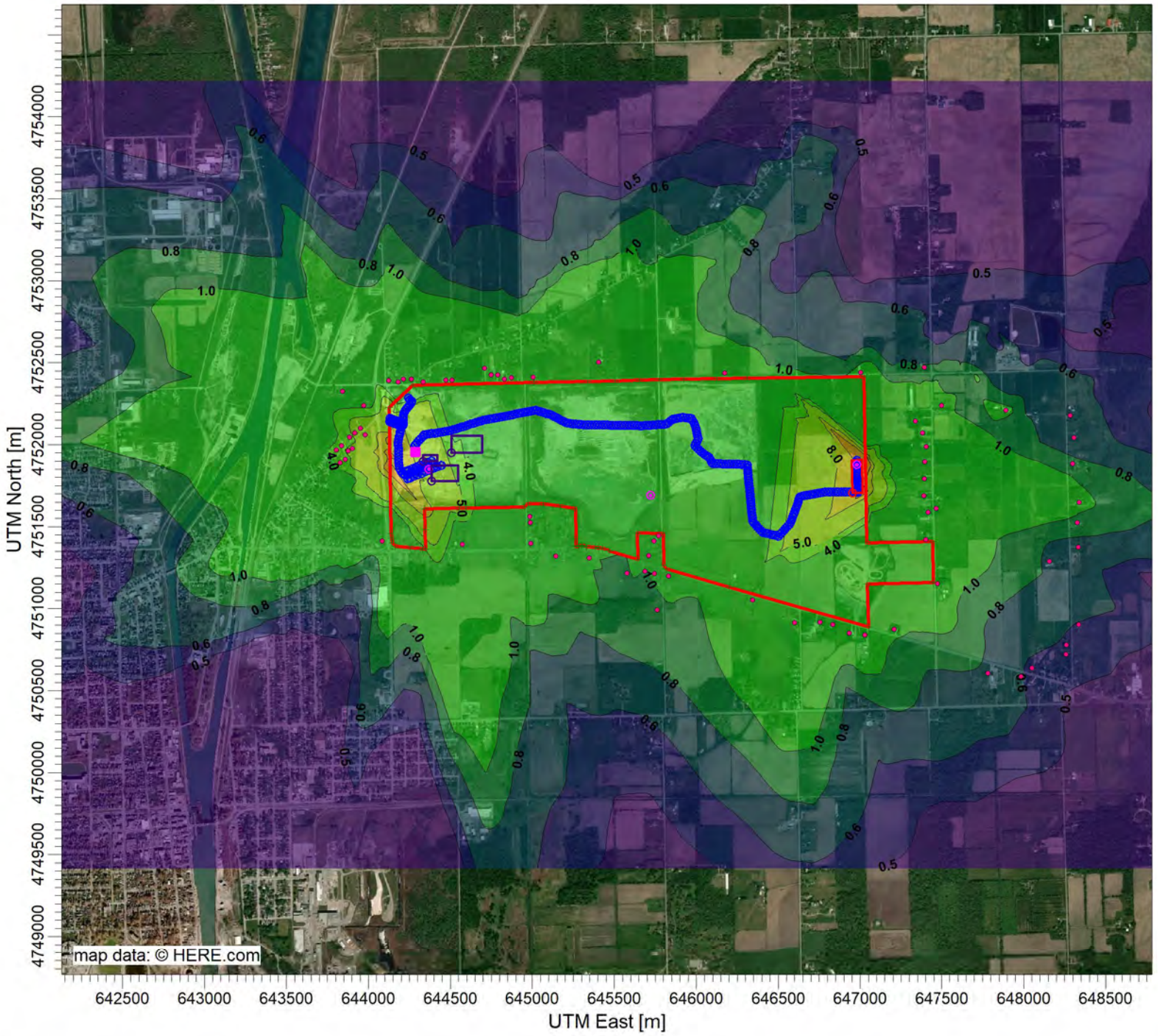
0 1 km

GOLDER

DATE:
2020-12-01

1771656

Figure B3d - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 3, 24-hr PM2.5
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 16.1 [ug/m^3] at (647035.48, 4751875.63)

0.2 | 0.5 | 0.6 | 0.8 | 1.0 | 4.0 | 5.0 | 8.0 | 10.0 | 20.0 | 27.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM2.5 24-hr AAQC = 27 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:34,000

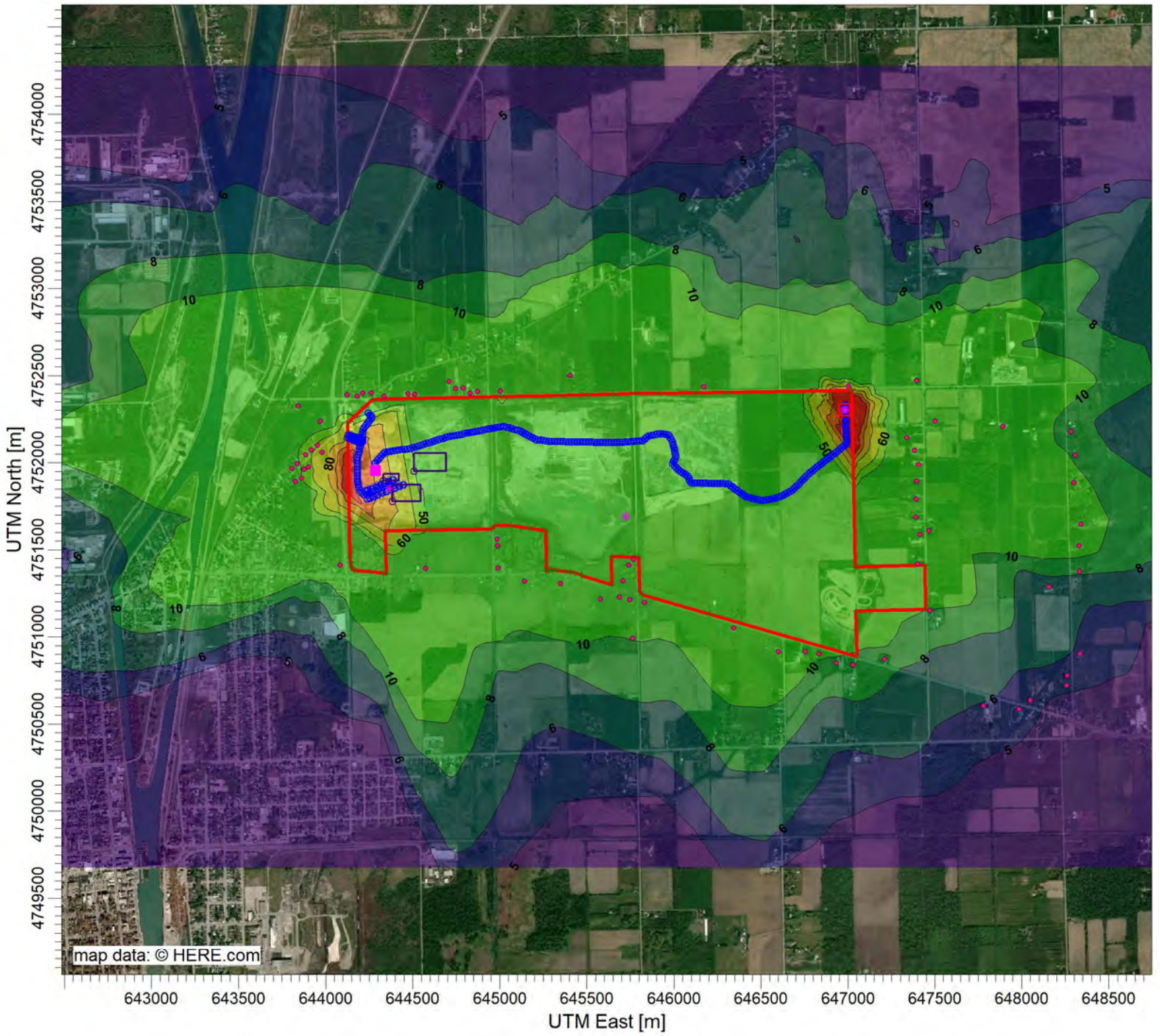
0 1 km

GOLDER

DATE:
2020-12-01

1771656

Figure B4a - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 4, 24-hr SPM
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 381 [ug/m^3] at (647035.48, 4752315.05)

2 5 6 8 10 50 60 80 100 120

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

SPM 24-hr AAQC = 120 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

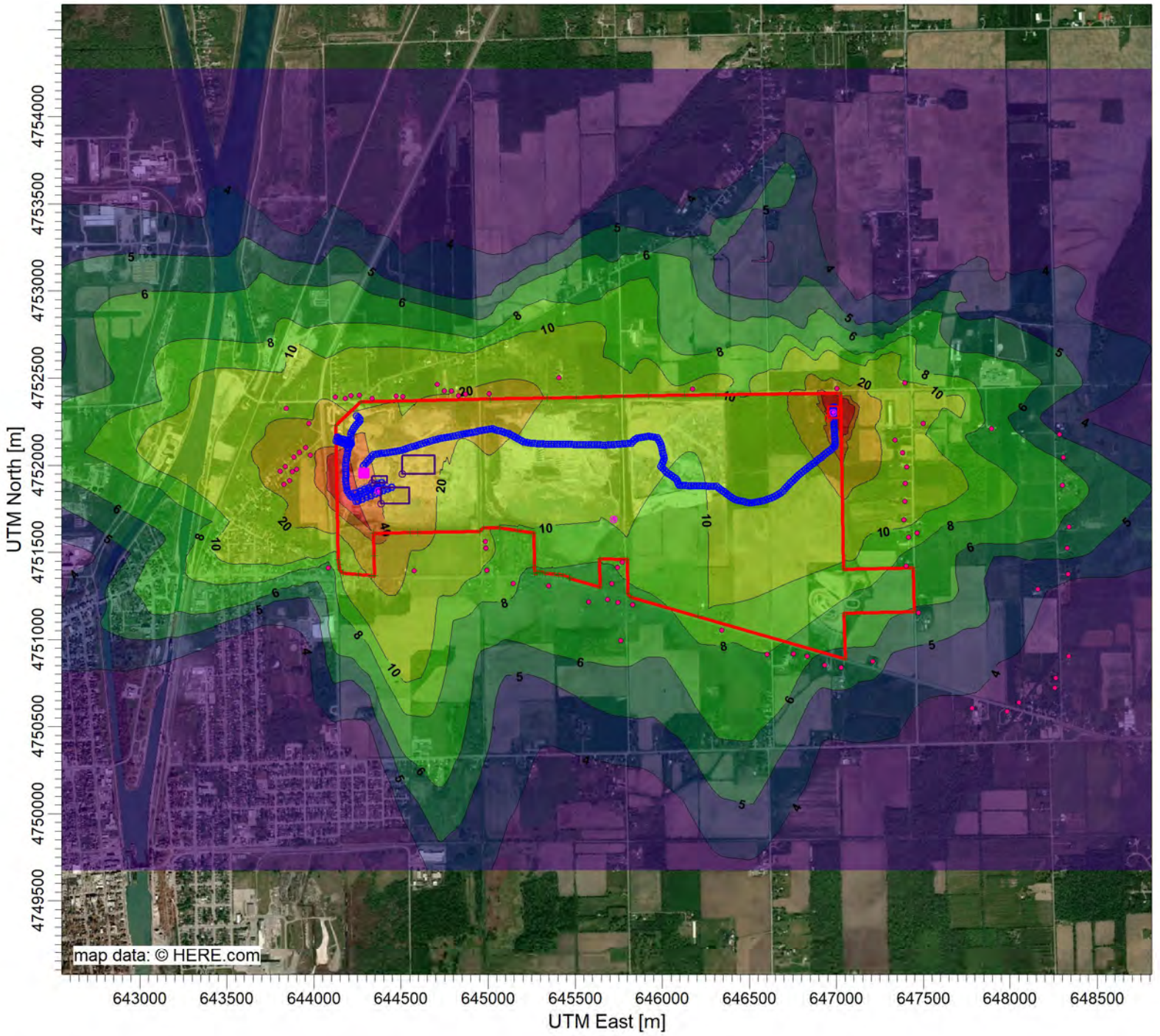
0 1 km

GOLDER

DATE:
2020-11-30

1771656

Figure B4b - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 4, 24-hr PM10
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 142 [ug/m^3] at (647035.48, 4752315.05)

1 4 5 6 8 10 20 40 50

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM10 24-hr AAQC = 50 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

0 1 km

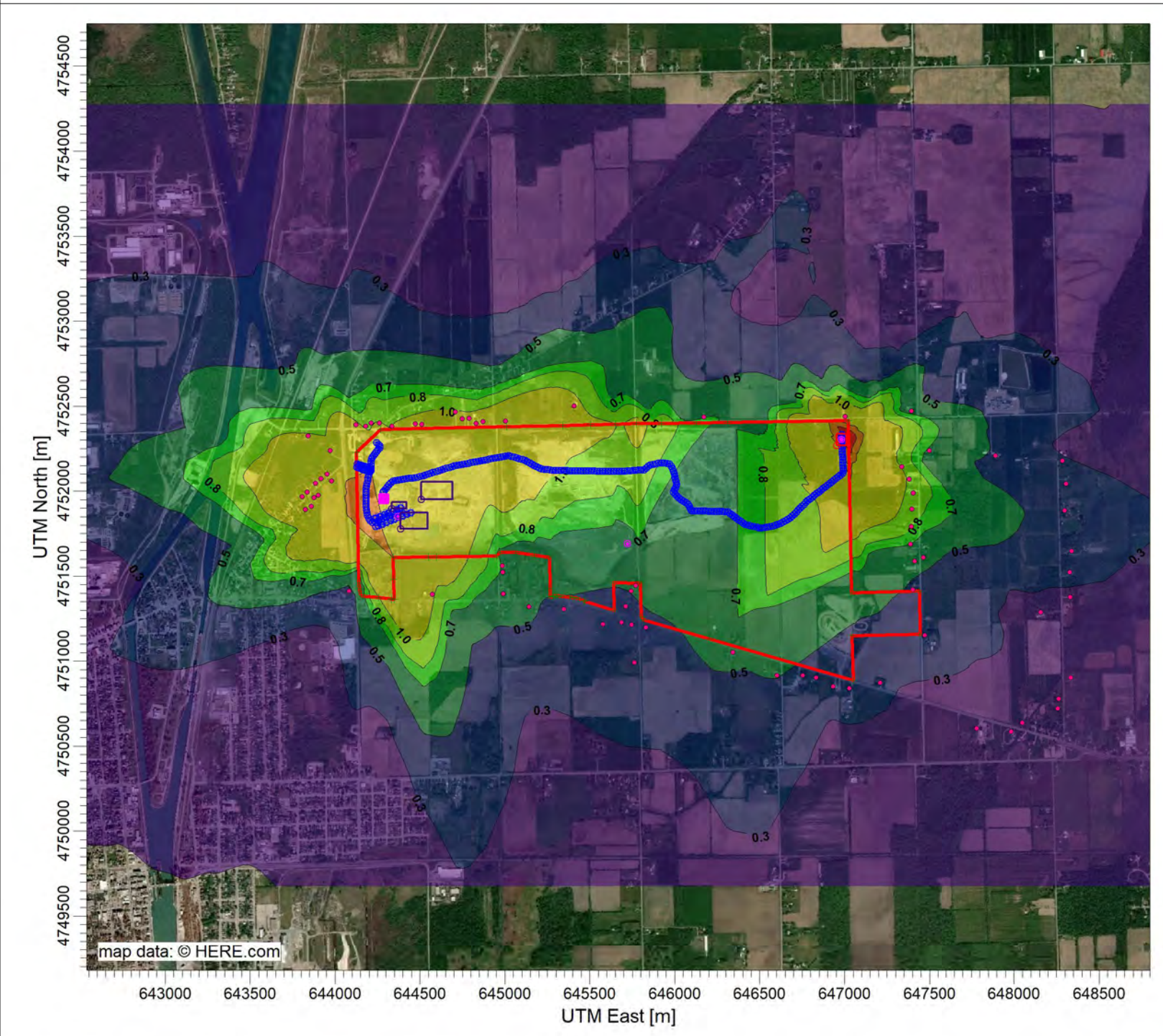
GOLDER

DATE:

2020-11-30

1771656

Figure B4c - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 4, 24-hr Crystalline Silica
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 8.9 [ug/m^3] at (647035.48, 4752315.05)

0.1 0.3 0.5 0.7 0.8 1.0 3.0 5.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

Crystalline Silica 24-hr AAQC = 5 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

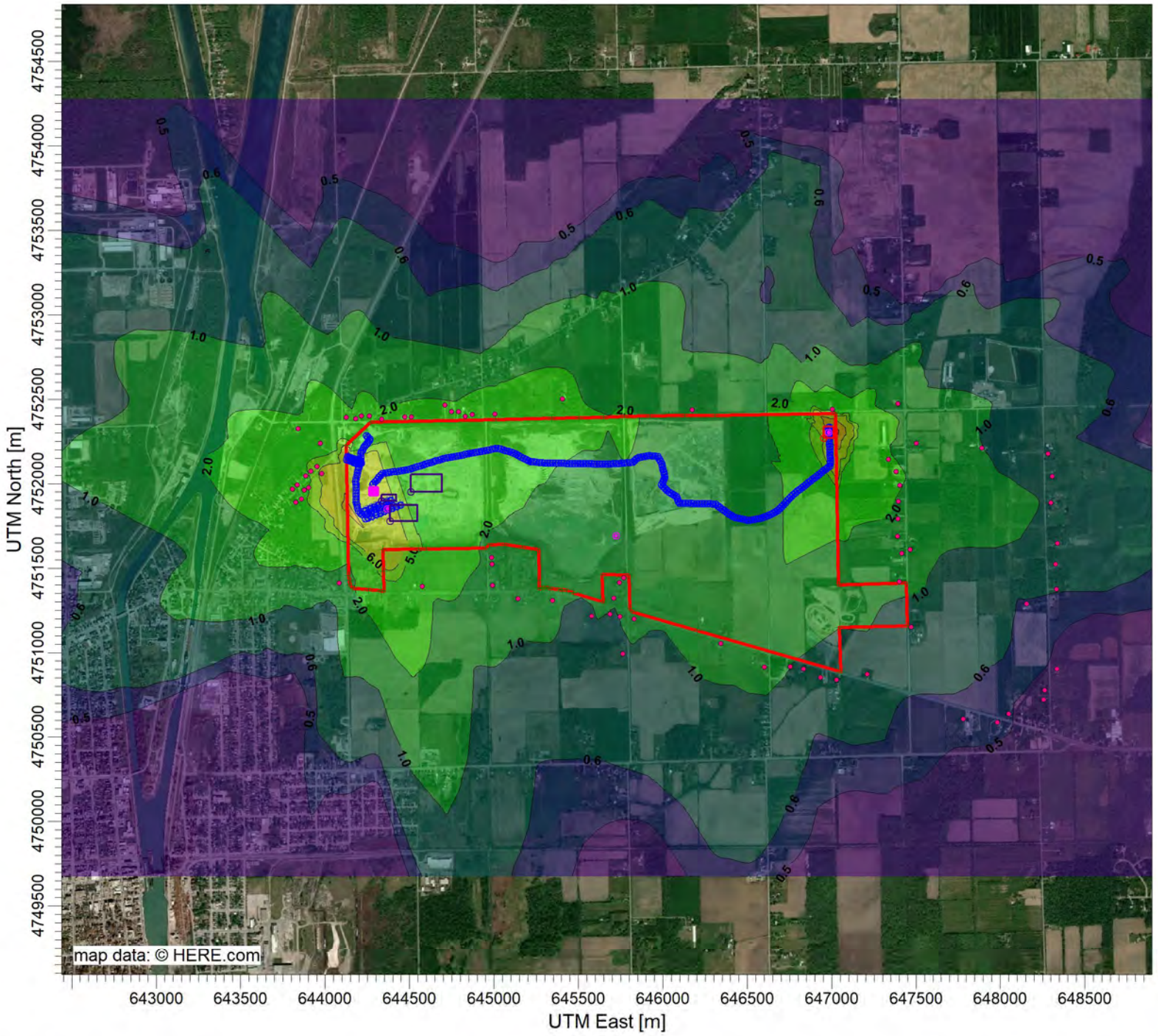
0 1 km

GOLDER

DATE:
2020-12-01

1771656

Figure B4d - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 4, 24-hr PM2.5
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 22.2 [ug/m^3] at (647035.48, 4752315.05)

0.2 | 0.5 | 0.6 | 1.0 | 2.0 | 5.0 | 6.0 | 10.0 | 20.0 | 27.0

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

PM2.5 24-hr AAQC = 27 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:33,000

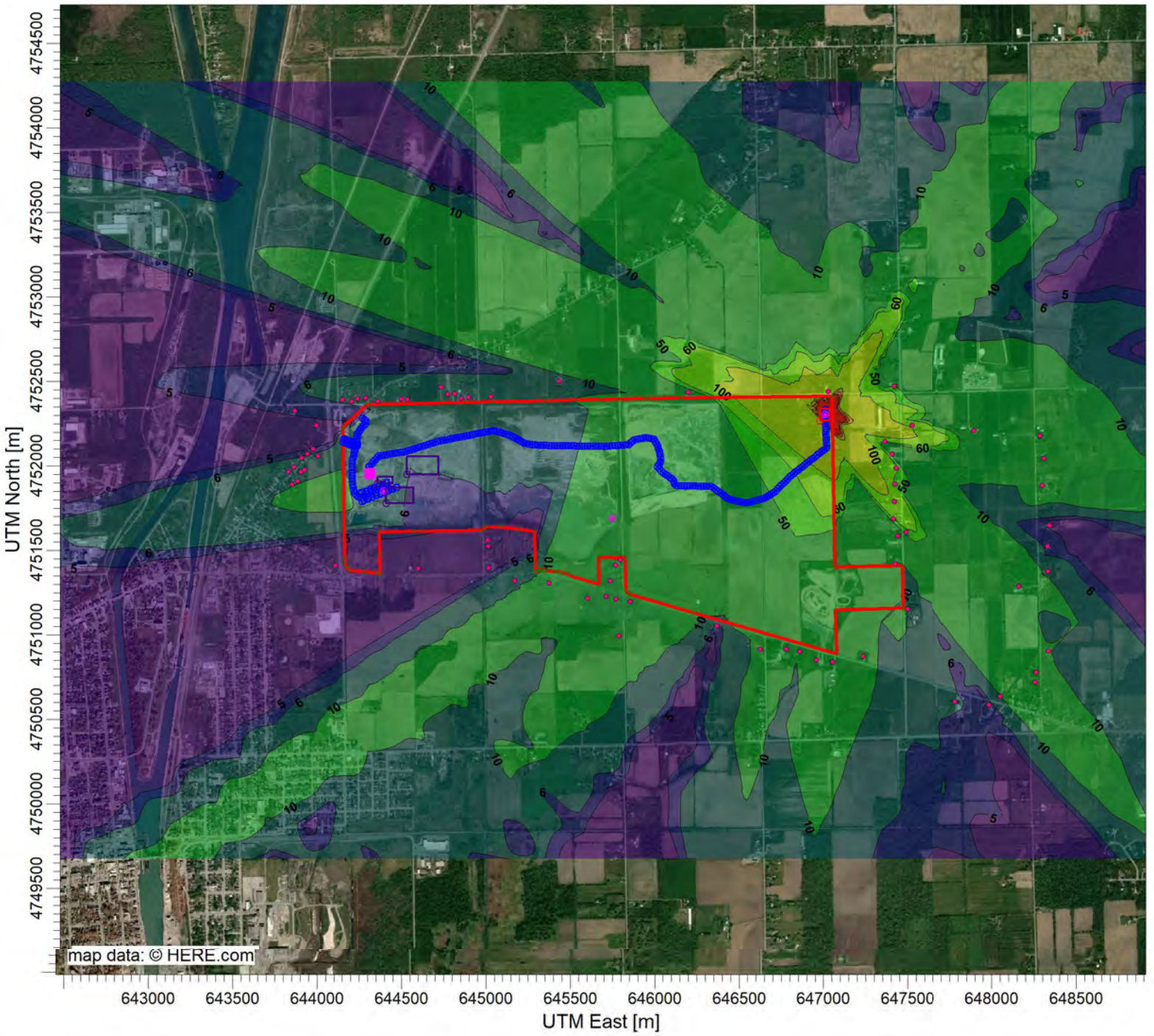
0 1 km

GOLDER

DATE:
2020-12-01

1771656

Figure B4e - Maximum Cumulative Predicted Concentration Contour Plot-Scenario 4, 1-hr SO2
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 1844 [ug/m^3] at (647035.48, 4752295.05)

2 5 6 10 50 60 100 500 600 690

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

SO2 Annual AAQC = 690 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:33,000

0 1 km

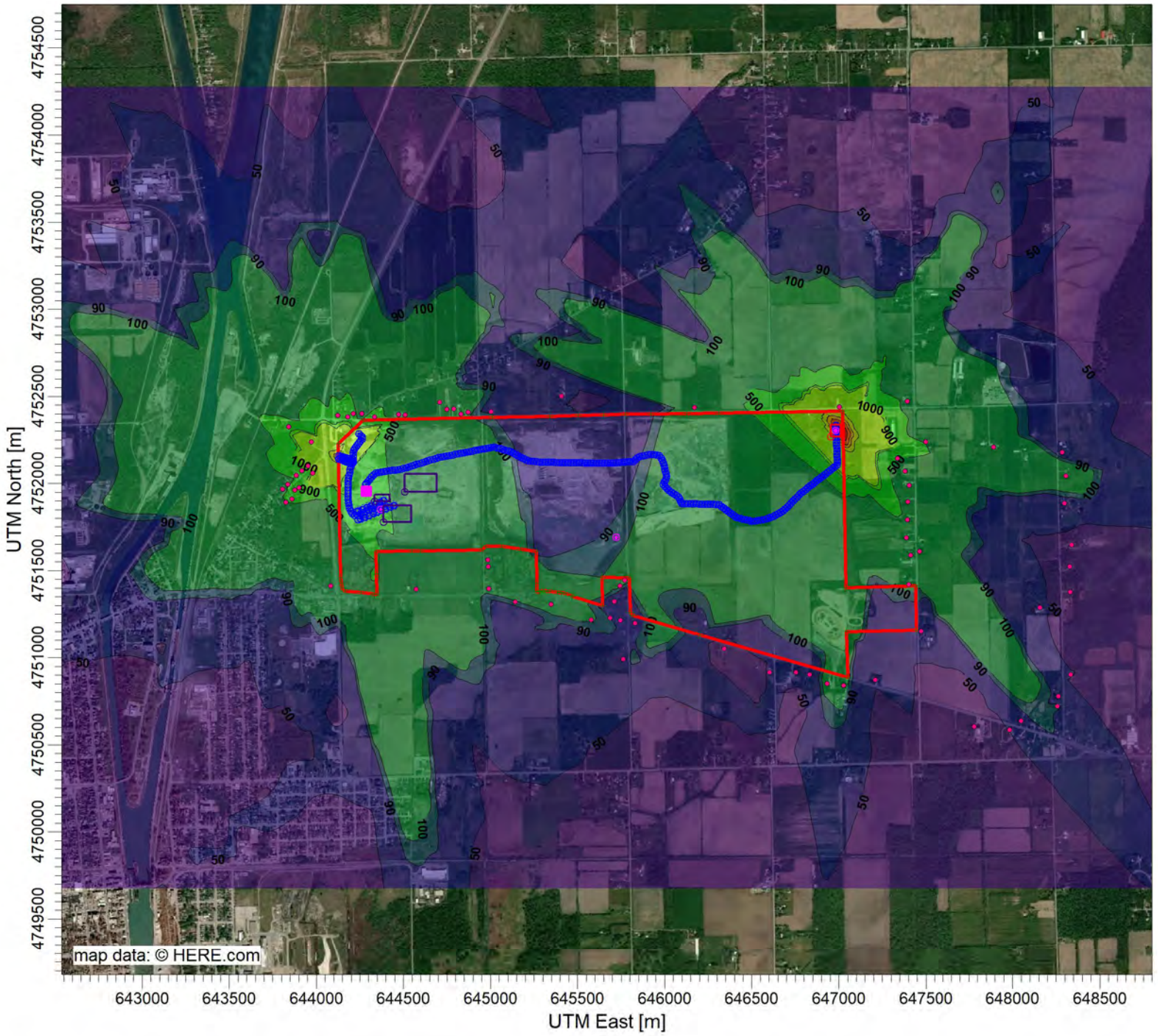
GOLDER

DATE:

2020-11-30

1771656

Figure B4f - Maximum Cumulative Predicted Concentration Contour Plot - Scenario 4, 8-hr CO
Port Colborne Quarries Inc., Pit 3 Extension



PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 20739 [ug/m^3] at (647035.48, 4752295.05)

14 50 90 100 500 900 1000 5000 7500 10000 15700

LEGEND

- Property boundary
- Discrete Sensitive Receptor
- Volume Source
- Area Source
- Line Volume Sources
- Polygon Area Source

CO 8-hr AAQC = 15,700 ug/m3

Made by: SC

Checked by: EKL

SCALE: 1:32,000

0 1 km

GOLDER

DATE:
2020-11-30

1771656

APPENDIX C

Curricula Vitae

Education

P.Eng. Chemical Engineering, Engineering Management, University of Ottawa, Ottawa, Ontario, 2003

Languages

English – Fluent

Golder Associates Ltd. – Sudbury

Associate/Senior Air Quality Specialist

Natalie is an Associate and Senior Air Quality Specialist with the Golder Sudbury office. Over the past fifteen years, Natalie has directed, managed and been involved in numerous air quality projects that include air emissions inventories, dispersion modelling, fugitive dust assessment and management plans, air monitoring programs, atmospheric components relating to both provincial and federal Environmental Assessments, National Pollutant Release Inventory and Greenhouse Gas reporting and Environmental Compliance Approval (ECA) applications, Environmental Activity and Sector Registry (EASR) registrations and ongoing compliance assessments, including Emission Summary and Dispersion Modelling (ESDM) Reports and Annual Written Summaries. Natalie was a part of team that created the Fugitive Dust Best Management Plan guidance documents for the Ontario Mining Association. Natalie was also on the industry working group that developed the Technical Standard under O.Reg.419/05 for the Mining industry in Ontario.

Employment History

Golder Associates Ltd. – Sudbury, Ontario
Senior Air Quality Specialist (2006 to Present)

Responsible for managing air quality projects in the Sudbury office. These projects involve air emissions inventories, acoustic audits, air monitoring programs, National Pollutant Release Inventory/ O.Reg.127/Greenhouse Gas reporting and Environmental Compliance Approval (Air and Noise) applications for various clients in Ontario. Responsibilities include proposal preparation and project initiation, project management, day-to-day client liaison, project work, and preparation of reports. Also involved in business development and marketing.

DST Consulting Engineers Inc. – Sudbury, Ontario
Environmental Field Technician/Project Manager (2004 to 2005)

Assisted in and managed projects, including conducting and supervising field work and reporting for Phase I and II Environmental Site Assessments (ESAs), landfill assessments and design projects, preparing supporting documentation for Ontario Ministry of the Environment and Climate Change (MOECC) Certificates of Approval (CofA) (Air and Noise) and conducting air emissions studies for land use planning. Also was involved in corporate advertising and marketing.

Natural Resources Canada – Ottawa, Ontario
Co-op Engineering Student (2003)

Created model of a flare/coil heat exchanger system using Hysys. The model was used to perform sensitivity analyses of various process inputs. Made recommendations and brainstormed with supervisors and peers regarding future developments.

Vale Canada Limited (formerly Inco Limited) – Sudbury, Ontario
Co-op Engineering Student (2002)

Part of Copper Cliff Copper Refinery Process Technology group involved in developing a process water balance for the tankhouse operations.

Natural Resources Canada – Ottawa, Ontario
Co-op Engineering Student (2002)

Part of the Mining and Material Sciences laboratory Underground Mine Environment group involved in testing that determined the efficiencies of equipment used in diesel engine emissions testing, as well as conducting the emissions tests in an ISO 9002 environment.

Natural Resources Canada – Ottawa, Ontario
Co-op Engineering Student (2001)

Part of the Material Technology Laboratories Advanced Materials group. Prepared metal alloy powders through mechanochemical milling and assisted in preparing and testing metal hydride batteries of varying compositions.

PROJECT EXPERIENCE – ENVIRONMENTAL ASSESSMENT

Argonaut Gold Inc. Reno, NV	A member of the Atmospheric component team for the Environmental Assessment (EA) of the Magino Gold Project in Northern Ontario. Work involved collection of baseline ambient air quality data, the development of emission inventory, dispersion modelling and EA technical support document writing.
Newmont Ghana Gold Ltd. Ghana	Directed the Air Quality component or the Environmental Impact Study (EIS) of the Ahafo North Project in Ghana. Work involved summarizing baseline ambient air quality data, the development of emission inventory, dispersion modelling and EIS technical support document writing.
Canada Fluorspar (NL) Inc. St. Lawrence, NL	Managed the creation of the emissions inventory in support of the Environmental Assessment for the St. Lawrence Fluorspar Project. The Project included construction, operation, rehabilitation and closure of a surface and underground mine, a mill, a Tailings Management Facility (TMF), and ancillary infrastructure.
BHP Billiton Chile	Carried out review and provided technical support for the air quality component of EIA regulatory review process for the Spence Expansion Project. This work included a thorough review of the air quality component as well as overview of the EIA process in Chile.
KGHM International Sudbury, Ontario	Managed the provincial Environmental Screening Assessment for the proposed diesel power plant for the Victoria Project in Sudbury, Ontario. The ESA involved potential impacts due to noise and air emissions. Was involved in the public consultation as well as summarizing baseline ambient air quality data, emissions inventory development and dispersion modelling.
Canadian Malarctic Toronto, Ontario	A member of the Atmospheric component team for the Environmental Assessment of the Hammond Reef Gold Mine Project in Northern Ontario. Work involved summarizing baseline ambient air quality data, the development of emission inventory, dispersion modelling and EA technical support document writing.
Cliffs Natural Resources Thunder Bay, Ontario	A member of the Atmospheric component team for the Environmental Assessment of the Cliffs Chromite Project in Northern Ontario. Work involved summarizing baseline ambient air quality data, the development of emission inventory, dispersion modelling and EA technical support document writing for the mining, processing and the transportation components of the Project.

PROJECT EXPERIENCE – APPROVALS AND COMPLIANCE

Ivaco Rolling Mills L'Orignal, Ontario	Project Director for managing ongoing ECA compliance, including air quality assessments and ESDM report updates for manufacturing facility in L'Orignal, Ontario
Roseburg Forest Products Canada Ltd. Pembroke, Ontario	Project director for the preparation an application for ECA (Air and Noise), including supporting documents, for the Pembroke MDF Facility as well as preparation of an Odour Abatement Plan.

EACOM Timber Corporation Elk Lake, Ontario	Project director for the preparation an application for ECA (Air and Noise), including supporting documents, for the Elk Lake Sawmill.
EIDCA Speciality Products Company (Dupont) Kingston, Ontario	Project Director for managing ongoing ECA compliance, including air quality assessments and ESDM report updates for chemical manufacturing facilities in Kingston, Ontario
Glencore Sudbury Integrated Nickel Operations Throughout Ontario	Directed the preparation of support documents for numerous applications for ECA (Air and Noise) for mining and milling facilities and directs ongoing compliance. Created Fugitive Dust Best Management Practices Plans for various operations.
Alamos Gold Inc. Throughout Ontario	Directed the preparation of support documents for applications for ECA (Air and Noise) for sites in Ontario and managed ongoing compliance.
Newmont Porcupine Gold Mines Timmins, Ontario	Directed the preparation of support documents for numerous applications for ECA (Air and Noise) for mining and milling facilities and directs ongoing compliance.
Vale Canada Limited Sudbury, Ontario	Directs ongoing ECA compliance for Vale mining operations in Levack, Ontario. Also managed the preparation of a Technology Benchmarking Report for Copper Cliff Smelter Facility.
KGHM International Sudbury, Ontario	Directed the preparation of support documents for numerous applications for ECA (Air and Noise) for mining facilities and directs ongoing compliance.
Kirkland Lake Gold Throughout Ontario	Directed the preparation of support documents for multiple applications for ECA (Air and Noise) for mining facilities and directs ongoing compliance.
Imerys Talc Timmins, Ontario	Directed the preparation of support documents for multiple applications for ECA (Air and Noise) for mining and milling facilities and managed ongoing ECA compliance.
LifeLabs LP Throughout Ontario	Project director for the ECA applications for air and noise (renewal of Limited Operational Flexibility or new), EASR Eligibility Assessments and EASR registrations we all as annual reporting requirements for multiple facilities located in Ontario since 2013. This work has involved the organization of large databases of facility information including product usage and facility configurations.
Health Sciences North Sudbury, Ontario	Managed and directed in the preparation of support documents for applications for approvals for multiple hospital locations.
Cushman & Wakefield Throughout Ontario	Project director for the completion of EASR Eligibility Assessments and EASR registrations for over 20 facilities in Ontario. To date, this work has resulted in the registration of four facilities under the EASR and submission of one electronic ECA application and work in progress for multiple other sites.
DECAST Ltd. Utopia, Ontario	Project Director for the preparation of support documents for an ECA (Air and Noise) for concrete products manufacturing facility and managed ongoing compliance.

Thomas Cavanagh Construction Limited Ottawa, Ontario	Project director for the preparation of support documents for an application for ECA (Air and Noise) for a proposed ready-mix concrete facility.
Tomlinson Ready Mix Ottawa, Ontario	Project director for the preparation of support documents for ECA (Air and Noise), including ESDM Report, for multiple ready-mix concrete facilities.
McCann Redi-Mix Inc. Throughout Ontario	Project director for the preparation of support documents for ECA (Air and Noise), including ESDM Reports, for numerous ready-mix concrete facilities in Ontario.
Pioneer Construction Inc. Throughout Ontario	Directed and assisted in the preparation of support documents for numerous applications for ECAs (Air and Noise) for a ready-mix concrete and asphalt facilities throughout Ontario and manages ongoing compliance.
Fisher Wavy Inc. Throughout Ontario	Directed the preparation of support documents for numerous applications for ECA (Air and Noise) for ready-mix concrete facilities and mobile plants and directs ongoing compliance.
William Day Construction Ltd. Sudbury, Ontario	Managed and directed the preparation of support documents for numerous applications for ECAs (Air and Noise) for mobile equipment, including crushing and screening equipment.

PROJECT EXPERIENCE – NATIONAL POLLUTANT RELEASE INVENTORY/GREENHOUSE GAS RREPORTING

Catalent Pharma Solutions Ontario	Directs preparation of National Pollutant Release Inventory (NPRI) and Greenhouse Gas (GHG) reports on an annual basis for pharmaceutical facilities in Strathroy and Windsor, Ontario.
Helmitin Inc. Toronto, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for adhesive manufacturing facility. Also involved in ongoing ECA compliance for this facility.
Cargill Cocoa & Chocolate Georgetown, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for food products facility. Also involved in ongoing ECA compliance for this facility.
Celestica International Inc. Mississauga, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for electronic manufacturing facility. Also involved in ongoing ECA compliance for this facility.
Honeywell Limited Mississauga, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for electronic manufacturing facility. Also involved in ongoing ECA compliance for this facility.
DECAST Ltd. Utopia, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for concrete products manufacturing facility.
Cam Tran Co. Ltd. Throughout Canada	Directs preparation of NPRI and GHG reports on an annual basis for facilities across Canada.
Ivaco Rolling Mills L'Orignal, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for the steel mill.

Coeur Silvertip Holdings Ltd. British Columbia	Directs the preparation of NPRI and GHG reports on an annual basis for Silvertip Mine. This work includes technical support with BC's CleanBC Industry Incentive Program.
Glencore Sudbury Integrated Nickel Operations Sudbury, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for Sudbury and Timmins area mines and mill.
KGHM International Inc. Sudbury, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for Sudbury area mines. Also prepared annual sustainability reporting under the Global Reporting Initiative (GRI) for KGHM International global operations.
Newmont Porcupine Gold Mines Timmins, Ontario	Directs preparation of NPRI and GHG reports on an annual basis for Timmins area mines and mill.

PROJECT EXPERIENCE – AIR MONITORING AND FIELD SAMPLING PROGRAMS

Glencore Sudbury Integrated Nickel Operations Sudbury, Ontario	Directed the Portable In-situ Wind Erosion Laboratory (PI-SWERL) sampling of tailings areas associated with Strathcona Mill.
Ivaco Rolling Mills L'Orignal, Ontario	Directed the annual road sampling program at the steel mill which involves sampling of numerous paved and unpaved road segments.
Glencore Sudbury Integrated Nickel Operations Sudbury, Ontario	Directed the annual road sampling program at the Levack area site which involves sampling of over 20 paved and unpaved road segments.
Glencore Sudbury Integrated Nickel Operations Sudbury, Ontario	Managed the ambient air sampling program for the collection of baseline data for the Norman West Project.

PROFESSIONAL AFFILIATIONS

Professional Engineers of Ontario

Air and Waste Management Association - Ontario Section Board of Directors

Women in Mining Association of Canada - Sudbury Chapter Board Member

Ontario Mining Association

Education

Bachelor of Applied Science Chemical Engineering, Environmental Option, University of Toronto, Toronto, 2004

Languages

English – Fluent

Golder Associates Ltd. – Mississauga

Emily Lau, B.A.Sc., P.Eng., Air Quality Engineer

Emily Lau is an Air Quality Engineer based in Golder's Mississauga office with more than 14 years of air quality consulting and government experience with the MECP. At Golder, Ms. Lau has successfully managed and completed numerous ECA applications and regulatory reporting projects for a variety of sectors including aggregate processing, municipal, mining, power generation, pharmaceuticals, automotive and general manufacturing.

Her other responsibilities include various client services such as: preparation of proposals, maintaining project budgets and schedules, client liaison, conducting site visits, preparation of reports and review of work prepared by junior staff.

As a Senior Air Engineer at the MECP, Ms. Lau was responsible for reviewing ECA applications to ensure their compliance with environmental legislation, regulations and established MECP standards and guidelines. She then made recommendations on the approval of the ECA applications.

Ms. Lau is also experienced in air dispersion modelling, emissions assessment and inventory development, preparation of ECA applications for air and emissions reporting for various industries. She has worked extensively with the air dispersion models approved by the MECP, such as the SCREEN 3 and AERMOD models. Ms. Lau has an in-depth knowledge of the MECP's air quality guidelines and policies, and frequently acts as liaison with the MECP on the applicability and interpretation of these to her various clients.

Employment History

Golder Associates Ltd. – Mississauga, Ontario
Air Quality Engineer (2017 to Present)

Ontario Ministry of the Environment, Conservation and Parks – Toronto, Ontario
Senior Air Engineer (2016 to 2017)

Golder Associates Ltd. – Mississauga, Ontario
Air Quality Engineer (2004 to 2015)

PROJECT EXPERIENCE – MINING AND AGGREGATE

Tomlinson Group of Companies Ottawa, Ontario	Project manager and air quality lead of numerous projects for the completion of Emission Summary and Dispersion Modelling reports to support Environmental Compliance Approval applications. The facilities and equipment assessed include mobile crushers, stationary and mobile ready-mix plants and aggregate extraction pits.
Thomas Cavanagh Construction Limited Ottawa, Ontario	Project manager and air quality lead for the completion of an Environmental Compliance Approval application for a ready-mix concrete plant. Follow up work on this project included responding to public comments regarding the assessment results and methodology.
Ecopave Asphalt Recycling Inc. Thunder Bay, Ontario	Project manager and air quality lead for the completion of an Environmental Compliance Approval application for a mobile asphalt plant with a tight deadline. The application was subsequently granted priority review status and an Environmental Compliance Approval was issued in less than 90 days.
Dufferin Construction Company Oakville, Ontario	Project manager and air quality lead for the completion of the Bronte Asphalt Plant Health Protection Air Quality By-law annual emissions report submitted to the Town of Oakville.
Lafarge Canada Inc. Various locations, Ontario	Preparing supporting documentation for CofA (Air and Noise) applications for six (6) aggregate and / or asphalt facilities across southern Ontario, including the Fonthill, Brechin, Woodstock, Stouffville, Kitchener and Stratford locations.
Barrick Gold Corporation Pascua-Lama, Chile	Prepared a site-wide emission inventory and assisted with report preparation as part of a study of the effect of mining activities on glaciers in the vicinity of the Pascua-Lama mine.

PROJECT EXPERIENCE – MANUFACTURING

Rain Carbon Canada Inc. Hamilton, Ontario	Project manager for ongoing work to assist with Site Specific Standard compliance. Project scope includes maintaining up-to-date Emission Summary and Dispersion Modelling Report, analyzing ambient monitoring data trends, support for Environmental Monitoring Team meetings.
Piramal Healthcare (Canada) Inc. Aurora, Ontario	Project manager and air quality lead providing on-going support for maintaining current Emission Summary and Dispersion Modelling Report, Acoustic Assessment Report and preparing annual written summary reports, as per requirements of the facility's Environmental Compliance Approval.
Sanofi Pasteur Toronto, Ontario	Air quality lead for completion of a Comprehensive Certificate of Approval (Air and Noise) application for the human vaccines manufacturing and research facility in Toronto, Ontario. Provided on-going support for maintaining current Emission Summary and Dispersion Modelling Report and for annual NPRI emissions reporting.
Cameco Corporation Port Hope, Ontario	Project manager and air quality lead for completing an Emission Summary and Dispersion Modelling Report for the uranium conversion facility located in Port Hope, Ontario. The scope of work also involved multiple site visits to locate and document hundreds of emission sources.

Western Waffles Corporation Brantford, Ontario	Project manager and air quality lead providing on-going support for maintaining current Emission Summary and Dispersion Modelling Report and preparing annual written summary reports, as per requirements of the facility's Environmental Compliance Approval.

PROJECT EXPERIENCE – REAL ESTATE AND COMMERCIAL

Oxford Properties Group Multiple Provinces, Canada	Project manager and air quality lead for completing National Pollutant Release Inventory and/or Ontario Regulation 127 emissions calculations and submissions for more than 80 of Oxford's commercial and retail facilities across Canada for seven years.
Primaris Real Estate Investment Trust Multiple Provinces, Canada	Project manager and air quality lead for completing National Pollutant Release Inventory and/or Ontario Regulation 127 emissions calculations and submissions for 26 of Primaris' commercial and retail facilities across Canada for three years.
Oxford Properties Group Multiple Locations, Ontario	Project manager and air quality lead for completing Certificate of Approval (Air) applications for 20 of Oxford's commercial and retail facilities across Ontario.

PROJECT EXPERIENCE – MUNICIPAL

New Oakville Hospital Oakville, Ontario	Project manager managing the completion of applications for both an Environmental Compliance Approval and a Town of Oakville Health Protection Air Quality By-Law Approval for the proposed New Oakville Hospital.
Disco Road Biogas Utilization Project Toronto, Ontario	Air quality lead for completion of a Renewable Energy Approval for a proposed 2.8 megawatt power generation facility located in Toronto, Ontario. The facility would be fuelled by biogas collected from an adjacent organics processing facility.
Durham Police Training Facility Whitby, Ontario	Project manager and air quality lead for the completion of an Certificate of Approval application for a police training facility.

PROJECT EXPERIENCE – POWER

Northland Power Kingston, Ontario	Project manager and air quality lead for the completion of an Environmental Compliance Approval application for natural gas fired co-generation facility.
purEnergy - Kawartha Biogas Havelock, Ontario	Project Manager and air quality lead for the completion of air, noise and surface water assessments in support of a Renewable Energy Approval application for the Kawartha Biogas facility.

Atikokan Generating Station Atikokan, Ontario	Project manager and air quality lead for assisting Ontario Power Generation in the acquisition of Certificates of Approval from the Ontario Ministry of the Environment (MOE) for the re-fuelling of the Atikokan Generating Station (GS) as a biomass fired generating station.

PROFESSIONAL AFFILIATIONS

Air and Waste Management Association

Professional Engineers Ontario

golder.com