FINAL REPORT

CAMBRIDGE AGGREGATES INC. EDWORTHY WEST

TOWNSHIP OF NORTH DUMFRIES, ONTARIO

AIR QUALITY ASSESSMENT

RWDI# 2102085

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SUBMITTED TO:

Kevin Hurley
Kevin.Hurley@LehighHanson.com
Area General Manager
Hanson Ready Mix & Aggregates

Caitlin Port
cport@mhbcplan.com
Planner
MHBC Planning, Urban Design
& Landscape Architecture

Chris Isley
chris@iugroup.ca
Cambridge Aggregate Services

SUBMITTED BY:

Monika Greenfield, M.Sc.
Sr Project Manager
Monika.Greenfield@rwdi.com

Brian G. Sulley, B.A.Sc., P. Eng.
Technical Director | Principal
Brian.Sulley@rwdi.com

Matthew Butts, B.Eng., EIT
Air Quality Scientist
Matthew.Butts@rwdi.com

RWDI AIR Inc.
600 Southgate Drive
Guelph, Ontario N1G 4P6
519-823-1311

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

REPORT SIGNATURES

Brian G. Sulley, B.A.Sc., P.Eng.

1 INTRODUCTION

RWDI was retained by Cambridge Aggregates to complete an air quality assessment in support of a new Aggregate Resource Act License Application with the Township of North Dumfries as well as an Aggregate Resources Act (ARA) Class A License application for the proposed Edworthy Pit operations ("the proposed pit"). This assessment quantifies and evaluates air quality impacts from the various air emission sources for the proposed pit operations. These sources include aggregate material handling equipment for the extraction of material at the proposed pit and the handling and processing equipment at the nearby Greenfield Road Pit operated by Al's Stone Service Inc. ("Greenfield Road Pit").

2 SITE DESCRIPTION & OPERATIONS

The proposed pit is located in between Alps Road (north of the pit) and Greenfield Road (south of the pit) in North Dumfries, Ontario. The site will operate from 7:00 AM – 5:00 PM Monday through Friday with an annual extraction and production rate of aggregate material of approximately 1,000,000 tonnes. The extraction and handling of aggregate material will be completed by bulldozers and an excavator. A fleet of trailer trucks will be used to ship the extracted material. No processing equipment will be present on site. All extracted material will be transported to an offsite processing facility, therefore the only product from the proposed pit is virgin aggregate.

Extraction at the site will normally occur from March through November, inclusive. Stripping operations would normally occur in November and December, when extraction operations have essentially ceased, or are at very low levels. Since moisture levels in the overburden material are normally higher during this period, and the volume of material handled is typically less, impacts during stripping operations were not directly assessed, and are best managed through appropriate management practices.

3 SENSITIVE RECEPTOR LOCATIONS

There are various rural homes located around the proposed pit extension. The nearest significant sensitive receptors are located north of the subject site along Shouldice Side Road and east along Spragues Road. These sensitive receptors were included as the basis for the assessment. Additional receptors were considered along Greenfield Road; however, these are much further away from the proposed pit extension site. Receptors considered in the model are shown in **Figure 1**.

4 CRITERIA

The Ontario Ministry of the Environment, Conservation and Parks (MECP) have outlined Ambient Air Quality Criteria (AAQC) which provide limits for desirable concentrations of contaminants in air based on protection against adverse effects on health or the environment. Environment Canada also has Canadian Ambient Air Quality Standards (CAAQS) for certain contaminants, which are used by provinces and territories to implement air quality improvements within their jurisdictions. The AAQCs and CAAQS are not enforceable standards. They are used as indicators for desirable air quality conditions.

5 CONTAMINANTS OF INTEREST

The primary contaminant of interest is airborne dust generated by operations at the site. The following key components of dust were modelled:

- Suspended particulate matter, which consists of particles with an aerodynamic diameter of 44 micrometres (µm) or less (known as TSP);
- Inhalable particulate matter, which consists of particles with an aerodynamic diameter of 10 micrometres (µm) or less (known as PM_{10});
- Crystalline silica within the PM_{10} portion of the dust; and,
- Respirable particulate matter, which consists of particles with an aerodynamic diameter of 2.5 micrometres (µm) or less (known as $PM_{2.5}$).

With regard to trace metals and other possible contaminants contained within dust generated at a gravel pit operation, concentrations of other metals are normally lower than the concentration of crystalline silica, but the corresponding benchmarks are less restrictive. Mathematically, it is therefore logical to screen these out. This is also consistent with the MECP guidance for assessing impacts from non-metallic mineral mining and quarrying operations under Ontario Regulation 419/05.[1] Based on this guidance, trace metals were not assessed explicitly.

On-site vehicles and heavy equipment also emit products of combustion. TSP, PM_{10}, $PM_{2.5}$, and nitrogen dioxide gas (NO_2) were modelled as the key representatives of combustion products. Other combustion by-products are emitted at lower levels relative to the associated benchmarks, and therefore do not need to be assessed explicitly, as was done for trace metals.

[1] Ministry of the Environment Conservation and Parks Guideline A10: Procedure for Preparing an Emission Summary and Dispersion Modelling Report, Version 4.1, March 2018.

6 EMISSION SOURCES

The potential sources of emissions in the proposed pit are as follows:

- Extraction of sand and gravel from the working face by two excavators and two loaders;
- Material handling operations (loading trailer trucks for material shipping);
- Movement of equipment over unpaved surfaces (front end loaders and trailer trucks); and,
- Tailpipe emissions from on-site vehicles and heavy equipment.

Cumulative impacts from the proposed pit and the nearby Greenfield Road Pit were also assessed in this study. The potential sources of emissions from Al's Stone are as follows:

- Extraction of sand and gravel from the working face by excavator;
- Material handling operations (loader moving material from the working face to the primary crusher, material conveyance, stackers, and loading triaxle trucks for material shipping);
- Movement of equipment over unpaved surfaces (front end loaders and trailer trucks); and,
- Tailpipe emissions from on-site vehicles and heavy equipment.

The working face will migrate across the site, as pit operations continue to extract material. In order to ensure compliance with air quality objectives, two worst-case operating scenarios were considered. **Figures 2** and **3** provide the locations of the proposed operations in these scenarios.

- Scenario 1 represents a reasonable worst-case location for the proposed operation at receptor R01.
- Scenario 2 represents the worst-case location for combined impacts from Al's Stone operations.

Compliance under these two operating scenarios will ensure compliance at all locations at the proposed pit.

7 EMISSION CALCULATIONS

Emissions were estimated in accordance with relevant guidance, using published emission factors. Detailed emission calculations are provided in the appendices to this report. The appendices contain details on assumptions, equipment types, sample calculations and other information that provide clarity as to RWDI's methodology. The emissions from sources that are wind-speed dependent (e.g., material handling) were calculated on an hour-by-hour basis, using the wind speed for each hour in the meteorological record. The emission values shown in the appendices for the wind-speed dependent emissions sources are example values, based on the average wind speed from the meteorological data. Tailpipe emissions from haul trucks were based on emission factors generated using the US EPA vehicle emissions model MOVES. Tailpipe emissions were based the year 2019 and for long haul trucks. All emission calculations are provided in Appendices A through D.

8 ATMOSPHERIC DISPERSION MODELLING

Air dispersion modelling was conducted to confirm that the proposed dust control recommendations will be sufficient to control off-site impacts at the sensitive impact locations. The modelling was conducted in accordance with MECP Guideline A11: Air Dispersion Modelling Guideline for Ontario, using the U.S. EPA AERMOD dispersion model, version 19191. AERMOD assesses multiple sources of emissions at discrete off-site receptors and is the current state-of-the-art regulatory model in Ontario.

Regional meteorological data obtained from the MECP website were used within the model, in accordance with the MECP's Guideline A11. Specifically, the data were those applicable to the Central Ontario Region, for open country (cropland). Terrain information for the site was also obtained from the MECP, in accordance with Guideline A11. Base elevations for sources within the site reflect the pit floor or appropriate elevations as provided by the proponent.

The model was run using the regulatory default options, without the addition of the dry depletion algorithms for particulate matter. The AERMOD model produced 1-hour, 24-hour, and annual average concentrations, as appropriate for each contaminant. As a conservative simplification, all sources were modelled as operating over the entire year, when in fact extraction operations only take place from March through November, inclusive. This ensures that the assessment is highly conservative.

9 BACKGROUND AIR QUALITY

Background ambient air monitoring data was used in conjunction with the emissions from the proposed operations. For the purposes of this assessment, 90th percentile background concentrations of particulate matter, nitrogen dioxide, and ozone were obtained from the nearest MECP monitoring station to the site (MECP Station 26060, located in Kitchener) and are presented in Table 1.

The use of historical data from a representative monitoring station operated by the MECP in the surrounding region is a widely accepted approach to estimating background air quality conditions. In the present case, the most representative station would be one situated in a rural location, with a number of aggregate operations nearby. However, there are no monitoring stations operating anywhere in Southern Ontario that fulfill those requirements. Therefore, the decision was made to use monitoring data from a station located in a suburban environment, which is expected to overestimate concentrations of $PM_{2.5}$ in a rural area and, thereby err on the safe side. Since the concentrations of TSP, PM_{10}, and silica are derived from the $PM_{2.5}$ measurements, this helps to ensure that the background values are reasonably conservative. The Kitchener monitoring station was chosen for this purpose. It is also the closest monitoring station to the site. Background concentrations of NO_2 are also expected to be similar or slightly lower at the proposed pit than the monitoring station in Kitchener, for similar reasons.

10 LOCAL EMISSION SOURCES

Environment Canada's National Pollutant Release Inventory (NPRI) is Canada's legislated, publicly accessible inventory of pollutant releases. Spatially allocated data for 2019 (the most recent available at the time of this report) was reviewed for locally significant emission sources that would have similar emission profiles to the Pit. There are six (6) facilities reporting emissions to NPRI within five (5) kilometres of the Pit. Of these, four (4) report particulate matter emissions. Three (3) of these sites are other aggregate operations and one (1) is a coated fabric and films manufacturer. The manufacturing company is required to comply with air quality criteria at the property line; there are several residences located in close proximity to this facility which suggests its zone of influence is limited. With a separation distance of three (3) kilometres between the manufacturing company and the proposed pit, combined impacts from/with the manufacturing facility are not anticipated.

With respect to other aggregate operations near the subject site, impacts from such operations are more localized, and, in RWDI's experience, are typically indistinguishable from regional background air quality levels at distances beyond one (1) kilometre. As a conservative measure, RWDI used two (2) kilometres for this review. The Ministry of Natural Resources and Forestry Pits and Quarries Online tool, as well as aerial photography for the area, was used to identify other aggregate operations. There are nine (9) licensed sites located within two (2) kilometres of the Pit. Of these, only one reported their emissions to the NPRI. The sites are listed below and are shown in **Figure 4**.

1. Greenfield Road Pit, licensed to Al's Stone Service Inc., located along Spragues Road. This site has an annual license limit of 350,000 tonnes. This site appears to be operating.
2. Lakeview Pit, licensed to Willson Aggregates Inc., located south of Spragues Road. This site has an annual license limit of 200,000 tonnes. This site appears to be operating.
3. Parkinson Pit No. 2, licensed to Willson Aggregates Inc., located south of Spragues Road. This site has an annual license limit of 200,000 tonnes. This site does not appear to be operating.
4. Alps Pit, licensed to Dufferin Aggregates, located North of Alps Road. This site has an annual license limit of 1,500,000 tonnes. This site does not appear to be operating but was recently licensed. In addition, the property immediately to the west is also the subject of a license application by Dufferin Aggregates and known as the Chudyk Pit. It is an extension of the Alps Pit and does not increase the overall tonnage extracted.
5. Brown/Cambridge Pit, licensed to The Warren Paving & Materials Group Limited, located north of Alps Road. This site has an annual license limit of 500,000 tonnes. This site appears to be operating;
6. Oliver Pit, licensed to David Oliver, located north of Alps Road. This site has an annual license limit of 600,000 tonnes. This site appears to be operating;
7. North Dumfries Pit, licensed to Cambridge Aggregates Inc., located north and south of Alps Road. This site has an annual license limit of 1,000,000 tonnes. This site is operating;
8. St. Mary's Cement Inc. Pit, licensed to St. Mary's Cement Inc., located north of Alps Road. This site has an annual license limit of 750,000 tonnes. This site appears to be operating; and,
9. Cedar Street Pit, licensed to St. Mary's Cement Inc., located north of Alps Road. This site has an annual license limit of 750,000 tonnes. This site appears to be operating.

Of these, only Greenfield Road Pit (Al's Stone Pit), and North Dumfries Pit are located within one (1) kilometre of the proposed pit and are currently in operation. However, current operations at the North Dumfries Pit are beyond 1 kilometre but are licensed to expand within 1 kilometre of site. Since impacts from these types of operations decrease rapidly with distance, RWDI believes that the adoption of a suitable background air quality level will provide a sufficient estimate of cumulative impacts. Due to the proximity of the Al's Stone Pit, RWDI considered emissions from Al's Stone Pit in the assessment. RWDI has assumed reasonable mitigation measures are in place at Al's Stone Pit, in accordance with the conditions for dust control on the Site Plans for Al's Stone Pit.[2]

The Township of North Dumfries Roads Department also operates a public works depot at 1168 Greenfield Road, immediately south of the site. While movement of heavy vehicles and handling of sand, aggregates and road salt can be expected at this facility, potential emissions are expected to be minor both in scale and duration. This site is not considered further in the assessment, as emissions of this scale would be included with other ubiquitous sources represented by the ambient background values.

11 RESULTS

The results of the two scenarios for the proposed pit are presented in Tables 2 and 3. The dispersion model results predicted maximum concentrations that were all less than the relevant criteria for all contaminants at the modelled receptors, based on the assumption that recommended dust control measures were in place for both modelling scenarios.

When the 90th percentile background concentration from the Kitchener ambient monitoring station was added to the predicted impacts from operations at the proposed pit extension, the cumulative concentrations continue to be below the relevant criteria for all contaminants at all nearby receptors.

Based on these modelling results, the proposed pit is not predicted to cause a significant air quality impact, with appropriate mitigation measures in place.

[2] Site Plan for Al's Stone Service Inc. Greenfield Road Pit. Page 2 of 7: Operations Plan, Oct 27, 2014 and Page 3 of 7: Technical Recommendations, October 15, 2014.

12 RECOMMENDATIONS FOR SITE PLAN

The proposed pit must operate in accordance with the operating standards pertaining to dust outlined in section 0.12 (2) Ontario Regulation 244/97, which include:

- The licensee or permittee shall apply water or another provincially approved dust suppressant to internal haul roads and processing areas, as necessary to mitigate dust, if the pit or quarry is located within 1,000 metres of a sensitive receptor.
- The licensee or permittee shall equip any processing equipment that creates dust with dust suppressing or collection devices if it is located within 300 metres of a sensitive receptor.
- The licensee or permittee shall obtain an environmental compliance approval under the Environmental Protection Act where required to carry out operations at the pit or quarry.

Furthermore, this assessment is based on the following recommendation, which is to be included in the Site Plans:

- The site will operate in accordance with a Best Management Practices Plan for fugitive dust (BMPP), which may be amended from time to time, considering actual impacts and operational considerations. The recommendations in the BMPP are based on the maximum daily production rates. At lower production rates, the control measures specified in the BMPP can be reduced accordingly, provided dust remains mitigated on site.

13 RECOMMENDED MANAGEMENT PRACTICES

RWDI recommends that the following mitigation measures form the basis of the BMPP:

- Extraction and Truck Loading
  - Extraction and loader transfers shall be visually monitored when the following criteria are met:
    - Extraction is occurring within 200 meters of a residence;
    - Winds are blowing from the operations towards those residences; and,
    - Dry weather is anticipated (operations can proceed at full production under rainy conditions);
  - If visible dust is observed blowing towards residences adjacent to the site, water should be applied as quickly as possible. Activities may need to be reduced or stopped completely if the dust cannot be mitigated.
- Unpaved Haul Roads
  - A water truck and sufficient water supply shall be available to provide water to all significant unpaved traffic areas.
  - The watering system shall be able to deliver the water evenly over the haul route surface and shall have the capacity to deploy water on all active haul routes at a rate of at least 1.5 $L/m^2/hour$.

- The actual watering rate shall vary, depending on surface moisture conditions and traffic conditions.
- At the start of each day, prior to trucks accessing the haul routes, the travel surfaces will be inspected, and water will be applied if dry conditions are observed.
- A speed limit of 25 km/h shall be posted near the site entrance. Haul truck and highway truck operators will be directed to observe the speed limit.
- To limit track-out onto the public roadway, the first 50 metres of the internal haul road from Spragues Road into the site shall be paved. A wet or vacuum sweeper shall be contracted to clean this surface should track out onto the public roadway occur.

- Wind Erosion
  - The amount of disturbed area will be kept to the minimum necessary for extraction to proceed in an efficient manner.
  - Progressive rehabilitation will be used to reduce erosion from previously extracted areas.
  - Where possible, existing tree screens shall be maintained and potentially augmented with additional plantings if existing trees die.

14 CONCLUSIONS

The modelling results in Tables 2 and 3 indicate that future operations at the extended pit will not cause a significant impact on nearby receptors, with appropriate mitigation measures in place.

TABLES

Year	TSP [2]		PM10 [2]		Silica	PM2.5		NO2 [4]						O3 [4]					
	90th Percentile 24-hour	Annual Average	90th Percentile 24-hour	Annual Average	90th Percentile 24-hour [3]	90th Percentile 24-hour	Annual Average	90th Percentile 1-Hour		90th Percentile 24-Hour		Annual Average		90th Percentile 1-Hour		90th Percentile 24-Hour		Annual Average	
	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)
2016	30	24	17	13	1.0	9	7.1	13	24	11	21	6.0	11	45	88	39	77	28	55
2017	25	23	14	13	0.8	7	6.8	12	32	11	20	5.8	14	43	84	38	74	27	54
2018	24	24	14	13	0.8	7	7.2	12	28	11	20	5.7	13	44	86	38	75	27	54
2019	24	24	14	13	0.8	7	7.1	13	25	11	21	6.2	12	43	84	38	74	27	53
2020	24	22	13	12	0.8	7	6.6	10	19	9	17	4.8	10	40	79	36	71	27	54
Average	25	23	14	13	0.8	8	7.0	12	26	10	20	6	12	43	84	38	74	27	54

Notes:

[1] All data from MECP Station 26060, in Kitchener.

[2] Estimated from PM2.5 measurements using published factors (Lall, et al., 2004)

[3] Estimated as 6% of PM10, from published data for cities in the northeast US (U.S. EPA, 1996)

[4] Conversion from ppb to µg/m³ based on 10°C.

Table 2: Scenario #1

RWDI Project# 2102085

Operations Located at the Western Property Boundary

Relevant Criteria

TSP	120	µg/m³ 24-Hour AAQC
	60	µg/m³ Annual AAQC
PM_{10}	50	µg/m³ Interim AAQC
$PM_{2.5}$	27	µg/m³ 24-Hour CAAQS
	8.8	µg/m³ Annual CAAQS
Silica	5	µg/m³ AAQC
NO_2	400	µg/m³ 1-Hour AAQC
	200	µg/m³ 24-Hour AAQC
	40	µg/m³ Annual

Background Concentrations

TSP	25	µg/m³ (24-hour)
	23	µg/m³ (Annual)
PM_{10}	14	µg/m³ (24-hour)
$PM_{2.5}$	8	µg/m³ (24-hour)
	7	µg/m³ (Annual)
Silica	0.8	µg/m³ (24-hour)
NO_2	26	µg/m³ (1-hour)
	20	µg/m³ (24-hour)
	12	µg/m³ (Annual)
O3	84	µg/m³ (1-hour)
	74	µg/m³ (24-hour)
	54	µg/m³ (Annual)

Notes:

[1] 1-hour and 24-hour background concentrations are based on the 90th percentile value

[2] Annual average background concentrations are based on the 1-hour average concentration

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R01	Residence	551,782	4,796,748	TSP	24	120	65	54%	90	75%
				PM10	24	50	11	22%	25	50%
					Annual	20	1	6%	14	71%
				PM2.5	24	27	6	21%	16	59%
					Annual	8.8	0.47	5%	7	80%
				Silica (<10µm)	24	5	2	38%	3	54%
				NO2	1	400	144	36%	170	42%
					24	200	37	18%	56	28%
					Annual	40	4	11%	16	41%
R02	Residence	551,922	4,796,147	TSP	24	120	18	15%	43	36%
				PM10	24	50	4	8%	18	36%
					Annual	20	0.16	1%	13	66%
				PM2.5	24	27	2	6%	8	30%
					Annual	9	0.04	1%	7	80%
				Silica (<10µm)	24	5	1	13%	1	29%
				NO2	1	400	117	29%	143	36%
					24	200	17	9%	37	19%
					Annual	40	1	2%	13	32%

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R03	Residence	552,259	4,796,239	TSP	24	120	19	16%	44	37%
				PM10	24	50	4	8%	18	36%
					Annual	20	0.24	1%	13	66%
				PM2.5	24	27	1	4%	8	30%
					Annual	8.8	0.06	1%	7	80%
				Silica (<10µm)	24	5	1	14%	2	30%
				NO2	1	400	120	30%	145	36%
					24	200	18	9%	37	19%
					Annual	40	1	2%	13	32%
R04	Residence	551,924	4,796,044	TSP	24	120	15	13%	40	33%
				PM10	24	50	3	6%	17	34%
					Annual	20	0.13	1%	13	66%
				PM2.5	24	27	2	6%	8	30%
					Annual	9	0.04	0%	7	80%
				Silica (<10µm)	24	5	1	11%	1	27%
				NO2	1	400	117	29%	143	36%
					24	200	16	8%	36	18%
					Annual	40	0	1%	12	31%
R05	Residence	552,142	4,796,041	TSP	24	120	12	10%	37	31%
				PM10	24	50	2	5%	16	33%
					Annual	20	0.14	1%	13	66%
				PM2.5	24	27	1	2%	8	30%
					Annual	8.8	0.04	0%	7	80%
				Silica (<10µm)	24	5	0.42	8%	1	24%
				NO2	1	400	116	29%	142	35%
					24	200	12	6%	32	16%
					Annual	40	1	1%	13	31%
R06	Residence	552,178	4,796,029	TSP	24	120	11	9%	36	30%
				PM10	24	50	2	4%	16	32%
					Annual	20	0.14	1%	13	66%
				PM2.5	24	27	1	3%	8	30%
					Annual	9	0.04	0%	7	80%
				Silica (<10µm)	24	5	0.38	8%	1	24%
				NO2	1	400	113	28%	138	35%
					24	200	11	6%	31	16%
					Annual	40	1	1%	13	31%

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R07	Residence	552,976	4,796,742	TSP	24	120	73	61%	98	81%
				PM10	24	50	19	37%	33	65%
					Annual	20	2	8%	15	73%
				PM2.5	24	27	6	20%	8	30%
					Annual	8.8	0.4	4%	7	80%
				Silica (<10µm)	24	5	3	63%	4	79%
				NO2	1	400	177	44%	202	51%
					24	200	40	20%	59	30%
					Annual	40	5	13%	17	43%
R08	Residence	552,747	4,797,063	TSP	24	120	31	26%	56	47%
				PM10	24	50	8	17%	22	45%
					Annual	20	0.4	2%	13	67%
				PM2.5	24	27	2	9%	8	30%
					Annual	9	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	28%	2	44%
				NO2	1	400	141	35%	167	42%
					24	200	24	12%	44	22%
					Annual	40	2	4%	14	34%
R09	Residence	553,055	4,797,308	TSP	24	120	15	12%	40	33%
				PM10	24	50	3	7%	17	35%
					Annual	20	0.2	1%	13	66%
				PM2.5	24	27	1	4%	8	30%
					Annual	8.8	0.0	1%	7	80%
				Silica (<10µm)	24	5	1	12%	1	28%
				NO2	1	400	115	29%	141	35%
					24	200	14	7%	34	17%
					Annual	40	1	2%	13	32%
R10	Residence	553,116	4,797,268	TSP	24	120	17	14%	42	35%
				PM10	24	50	4	7%	18	35%
					Annual	20	0.2	1%	13	66%
				PM2.5	24	27	1	4%	8	30%
					Annual	9	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	13%	1	29%
				NO2	1	400	124	31%	150	37%
					24	200	16	8%	36	18%
					Annual	40	1	2%	13	32%

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R11	Residence	553,334	4,796,498	TSP	24	120	42	35%	67	56%
				PM10	24	50	11	22%	25	50%
					Annual	20	0.5	2%	13	67%
				PM2.5	24	27	4	13%	8	30%
					Annual	8.8	0.1	1%	7	80%
				Silica (<10µm)	24	5	2	38%	3	54%
				NO2	1	400	142	36%	168	42%
					24	200	34	17%	54	27%
					Annual	40	2	5%	14	35%
R12	Residence	553,407	4,796,369	TSP	24	120	26	22%	51	43%
				PM10	24	50	6	13%	20	41%
					Annual	20	0.3	2%	13	67%
				PM2.5	24	27	2	6%	8	30%
					Annual	9	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	22%	2	38%
				NO2	1	400	132	33%	157	39%
					24	200	30	15%	50	25%
					Annual	40	2	4%	14	34%
R13	Residence	553,006	4,796,329	TSP	24	120	75	62%	100	83%
				PM10	24	50	20	40%	34	68%
					Annual	20	1	4%	14	69%
				PM2.5	24	27	6	22%	8	30%
					Annual	8.8	0.2	2%	7	80%
				Silica (<10µm)	24	5	3	69%	4	85%
				NO2	1	400	162	40%	188	47%
					24	200	42	21%	62	31%
					Annual	40	3	8%	15	38%
R14	Residence	552,678	4,796,248	TSP	24	120	31	25%	56	46%
				PM10	24	50	6	11%	20	39%
					Annual	20	0.3	2%	13	67%
				PM2.5	24	27	2	6%	8	30%
					Annual	9	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	19%	2	35%
				NO2	1	400	137	34%	162	41%
					24	200	22	11%	42	21%
					Annual	40	1	3%	13	33%

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (μg/m³)	Predicted Concentration (μg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (μg/m³)	Percentage of Revelant Criteria (%)
R15	Residence	552,574	4,796,155	TSP	24	120	32	27%	57	48%
				PM10	24	50	6	12%	20	40%
					Annual	20	0	1%	13	66%
				PM2.5	24	27	2	6%	8	30%
					Annual	8.8	0.1	1%	7	80%
				Silica (<10μm)	24	5	1	20%	2	36%
				NO2	1	400	132	33%	158	40%
					24	200	17	9%	37	18%
					Annual	40	1	2%	13	32%
R16	Residence	552,648	4,796,479	TSP	24	120	50	42%	75	63%
				PM10	24	50	12	23%	26	51%
					Annual	20	1	5%	14	70%
				PM2.5	24	27	3	13%	8	30%
					Annual	9	0.2	3%	7	80%
				Silica (<10μm)	24	5	2	39%	3	55%
				NO2	1	400	168	42%	193	48%
					24	200	35	18%	55	27%
					Annual	40	3	8%	15	38%
R17	Residence	552,455	4,796,337	TSP	24	120	31	26%	56	47%
				PM10	24	50	6	12%	20	40%
					Annual	20	0.39	2%	13	67%
				PM2.5	24	27	2	6%	8	30%
					Annual	8.8	0.09	1%	7	80%
				Silica (<10μm)	24	5	1.0	21%	2	37%
				NO2	1	400	133	33%	159	40%
					24	200	21	10%	40	20%
					Annual	40	1.4	3%	13	33%

Revision Date: 2021-09-24
Prepared by: MDKB
Checked by: AKG

Table 3: Scenario #2

RWDI Project# 2102085

Operations Located at the Eastern Property Boundary

Relevant Criteria

TSP	120	µg/m³ 24-Hour AAQC
	60	µg/m³ Annual AAQC
PM_{10}	50	µg/m³ Interim AAQC
$PM_{2.5}$	27	µg/m³ 24-Hour CAAQS
	8.8	µg/m³ Annual CAAQS
Silica	5	µg/m³ AAQC
NO_2	400	µg/m³ 1-Hour AAQC
	200	µg/m³ 24-Hour AAQC
	40	µg/m³ Annual

Background Concentrations

TSP	25	µg/m³ (24-hour)
	23	µg/m³ (Annual)
PM_{10}	14	µg/m³ (24-hour)
$PM_{2.5}$	8	µg/m³ (24-hour)
	7	µg/m³ (Annual)
Silica	0.8	µg/m³ (24-hour)
NO_2	26	µg/m³ (1-hour)
	20	µg/m³ (24-hour)
	12	µg/m³ (Annual)
O3	84	µg/m³ (1-hour)
	74	µg/m³ (24-hour)
	54	µg/m³ (Annual)

Notes:

[1] 1-hour and 24-hour background concentrations are based on the 90th percentile value

[2] Annual average background concentrations are based on the 1-hour average concentration

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R01	Residence	551,782	4,796,748	TSP	24	120	15	12%	40	33%
				PM10	24	50	4	8%	18	36%
					Annual	20	0	1%	13	66%
				PM2.5	24	27	1	4%	16	59%
					Annual	8.8	0.03	0%	7	80%
				Silica (<10µm)	24	5	1	13%	1	29%
				NO2	1	400	115	29%	141	35%
					24	200	21	11%	41	21%
					Annual	40	1	2%	13	32%
R02	Residence	551,922	4,796,147	TSP	24	120	10	8%	35	29%
				PM10	24	50	3	5%	17	33%
					Annual	20	0.07	0%	13	65%
				PM2.5	24	27	1	3%	8	30%
					Annual	9	0.02	0%	7	80%
				Silica (<10µm)	24	5	0	9%	1	25%
				NO2	1	400	117	29%	143	36%
					24	200	17	9%	37	19%
					Annual	40	0	1%	12	31%

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R03	Residence	552,259	4,796,239	TSP	24	120	14	11%	39	32%
				PM10	24	50	4	7%	18	35%
					Annual	20	0.11	1%	13	66%
				PM2.5	24	27	1	5%	8	30%
					Annual	8.8	0.03	0%	7	80%
				Silica (<10µm)	24	5	1	13%	1	29%
				NO2	1	400	120	30%	145	36%
					24	200	22	11%	42	21%
					Annual	40	1	2%	13	32%
R04	Residence	551,924	4,796,044	TSP	24	120	9	8%	34	28%
				PM10	24	50	2	5%	16	33%
					Annual	20	0.06	0%	13	65%
				PM2.5	24	27	1	3%	8	30%
					Annual	9	0.02	0%	7	80%
				Silica (<10µm)	24	5	0	8%	1	24%
				NO2	1	400	117	29%	143	36%
					24	200	16	8%	36	18%
					Annual	40	0	1%	12	31%
R05	Residence	552,142	4,796,041	TSP	24	120	8	7%	33	28%
				PM10	24	50	2	4%	16	32%
					Annual	20	0.07	0%	13	65%
				PM2.5	24	27	1	3%	8	30%
					Annual	8.8	0.02	0%	7	80%
				Silica (<10µm)	24	5	0.37	7%	1	23%
				NO2	1	400	116	29%	142	35%
					24	200	13	6%	32	16%
					Annual	40	0	1%	12	31%
R06	Residence	552,178	4,796,029	TSP	24	120	8	7%	33	27%
				PM10	24	50	2	4%	16	32%
					Annual	20	0.07	0%	13	65%
				PM2.5	24	27	1	2%	8	30%
					Annual	9	0.02	0%	7	80%
				Silica (<10µm)	24	5	0.34	7%	1	23%
				NO2	1	400	113	28%	138	35%
					24	200	12	6%	31	16%
					Annual	40	0	1%	12	31%

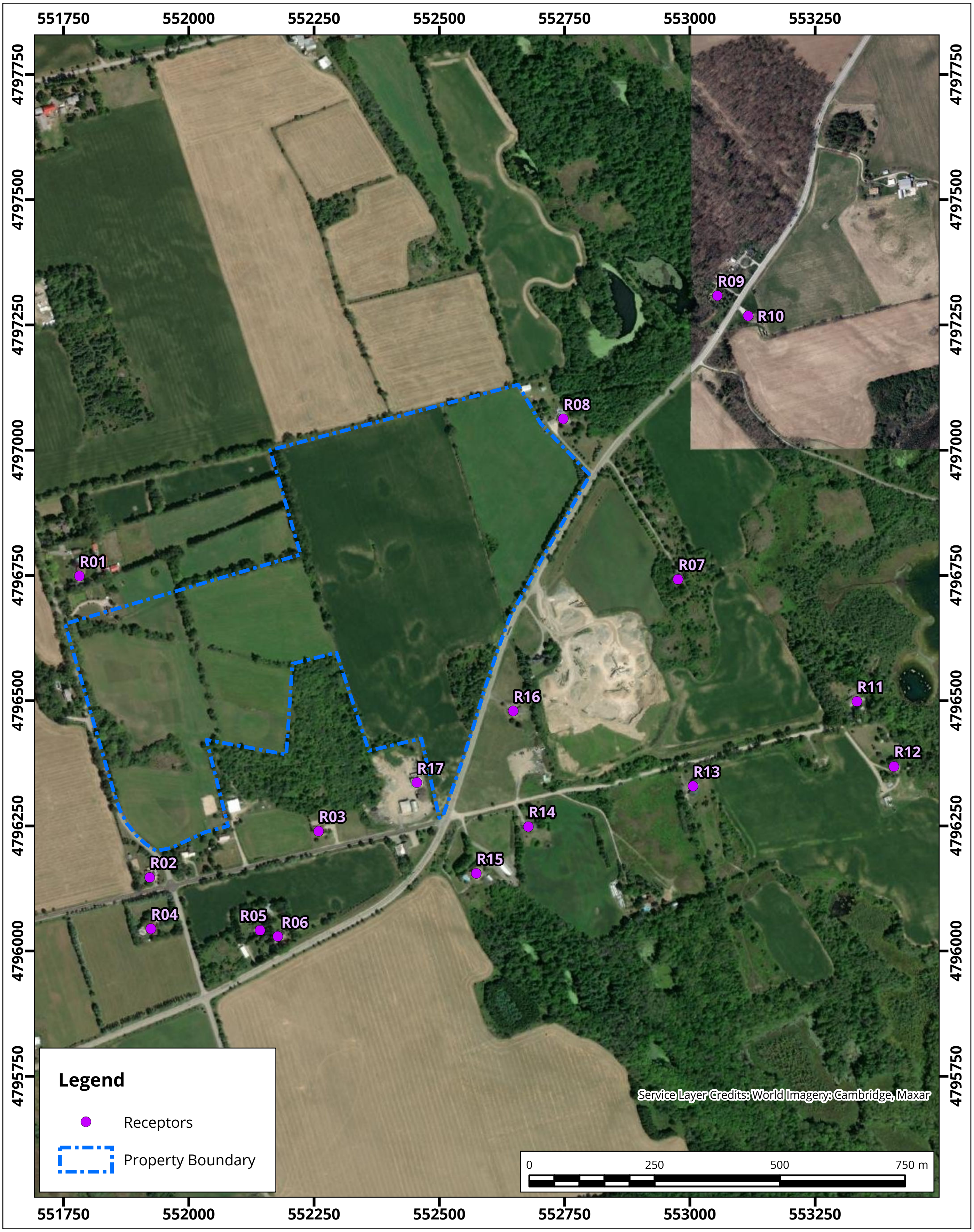
Receptor		UTM Coordinates		Contaminant	Averaging Period	Recommended Criteria for Cumulative Effects Analysis	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		(hours)	(µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R07	Residence	552,976	4,796,742	TSP	24	120	61	51%	86	72%
				PM10	24	50	18	37%	32	65%
					Annual	20	2	9%	15	74%
				PM2.5	24	27	6	21%	8	30%
					Annual	8.8	0.5	5%	7	80%
				Silica (<10µm)	24	5	3	63%	4	79%
				NO2	1	400	177	44%	202	51%
					24	200	40	20%	59	30%
					Annual	40	6	16%	18	46%
R08	Residence	552,747	4,797,063	TSP	24	120	69	58%	94	78%
				PM10	24	50	20	40%	34	68%
					Annual	20	1.2	6%	14	71%
				PM2.5	24	27	9	32%	8	30%
					Annual	9	0.5	6%	7	80%
				Silica (<10µm)	24	5	3	67%	4	83%
				NO2	1	400	179	45%	205	51%
					24	200	36	18%	56	28%
					Annual	40	4	10%	16	40%
R09	Residence	553,055	4,797,308	TSP	24	120	12	10%	37	31%
				PM10	24	50	4	7%	18	35%
					Annual	20	0.2	1%	13	66%
				PM2.5	24	27	2	6%	8	30%
					Annual	8.8	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	12%	1	28%
				NO2	1	400	121	30%	147	37%
					24	200	18	9%	38	19%
					Annual	40	1	3%	13	33%
R10	Residence	553,116	4,797,268	TSP	24	120	15	12%	40	33%
				PM10	24	50	4	8%	18	36%
					Annual	20	0.3	1%	13	66%
				PM2.5	24	27	1	5%	8	30%
					Annual	9	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	13%	1	29%
				NO2	1	400	124	31%	150	37%
					24	200	17	8%	37	18%
					Annual	40	1	3%	13	33%

Receptor		UTM Coordinates		Contaminant	Averaging Period	Recommended Criteria for Cumulative Effects Analysis	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		(hours)	(µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R11	Residence	553,334	4,796,498	TSP	24	120	28	23%	53	44%
				PM10	24	50	9	17%	23	45%
					Annual	20	0.5	2%	13	67%
				PM2.5	24	27	3	11%	8	30%
					Annual	8.8	0.1	2%	7	80%
				Silica (<10µm)	24	5	1	29%	2	45%
				NO2	1	400	137	34%	163	41%
					24	200	33	17%	53	26%
					Annual	40	2	6%	14	36%
R12	Residence	553,407	4,796,369	TSP	24	120	19	16%	44	37%
				PM10	24	50	5	10%	19	38%
					Annual	20	0.3	2%	13	67%
				PM2.5	24	27	2	6%	8	30%
					Annual	9	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	17%	2	33%
				NO2	1	400	131	33%	157	39%
					24	200	29	14%	49	24%
					Annual	40	2	4%	14	34%
R13	Residence	553,006	4,796,329	TSP	24	120	63	53%	88	74%
				PM10	24	50	19	38%	33	66%
					Annual	20	1	3%	14	68%
				PM2.5	24	27	6	23%	8	30%
					Annual	8.8	0.2	2%	7	80%
				Silica (<10µm)	24	5	3	64%	4	80%
				NO2	1	400	164	41%	189	47%
					24	200	42	21%	62	31%
					Annual	40	3	8%	15	38%
R14	Residence	552,678	4,796,248	TSP	24	120	17	14%	42	35%
				PM10	24	50	5	9%	19	37%
					Annual	20	0.2	1%	13	66%
				PM2.5	24	27	2	6%	8	30%
					Annual	9	0.1	1%	7	80%
				Silica (<10µm)	24	5	1	16%	2	32%
				NO2	1	400	137	34%	162	41%
					24	200	26	13%	46	23%
					Annual	40	1	3%	13	33%

Receptor		UTM Coordinates		Contaminant	Averaging	Recommended	Incremental		Cumulative	
ID	Type	X (m)	Y (m)		Period (hours)	Criteria for Cumulative Effects Analysis (µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R15	Residence	552,574	4,796,155	TSP	24	120	20	16%	45	37%
				PM10	24	50	5	11%	19	39%
					Annual	20	0	1%	13	66%
				PM2.5	24	27	2	6%	8	30%
					Annual	8.8	0.0	1%	7	80%
				Silica (<10µm)	24	5	1	18%	2	34%
				NO2	1	400	132	33%	158	40%
					24	200	19	9%	39	19%
					Annual	40	1	2%	13	32%
R16	Residence	552,648	4,796,479	TSP	24	120	43	36%	68	57%
				PM10	24	50	12	24%	26	52%
					Annual	20	1	4%	14	69%
				PM2.5	24	27	4	14%	8	30%
					Annual	9	0.2	2%	7	80%
				Silica (<10µm)	24	5	2	41%	3	57%
				NO2	1	400	168	42%	193	48%
					24	200	35	18%	55	27%
					Annual	40	3	7%	15	38%
R17	Residence	552,455	4,796,337	TSP	24	120	23	19%	48	40%
				PM10	24	50	6	11%	20	39%
					Annual	20	0.21	1%	13	66%
				PM2.5	24	27	2	6%	8	30%
					Annual	8.8	0.06	1%	7	80%
				Silica (<10µm)	24	5	1.0	19%	2	35%
				NO2	1	400	133	33%	159	40%
					24	200	21	10%	41	20%
					Annual	40	1.2	3%	13	33%

Revision Date: 2021-09-24
Prepared by: MDKB
Checked by: AKG

FIGURES



Site Plan Showing Nearby Receptors and Property Boundary

True North

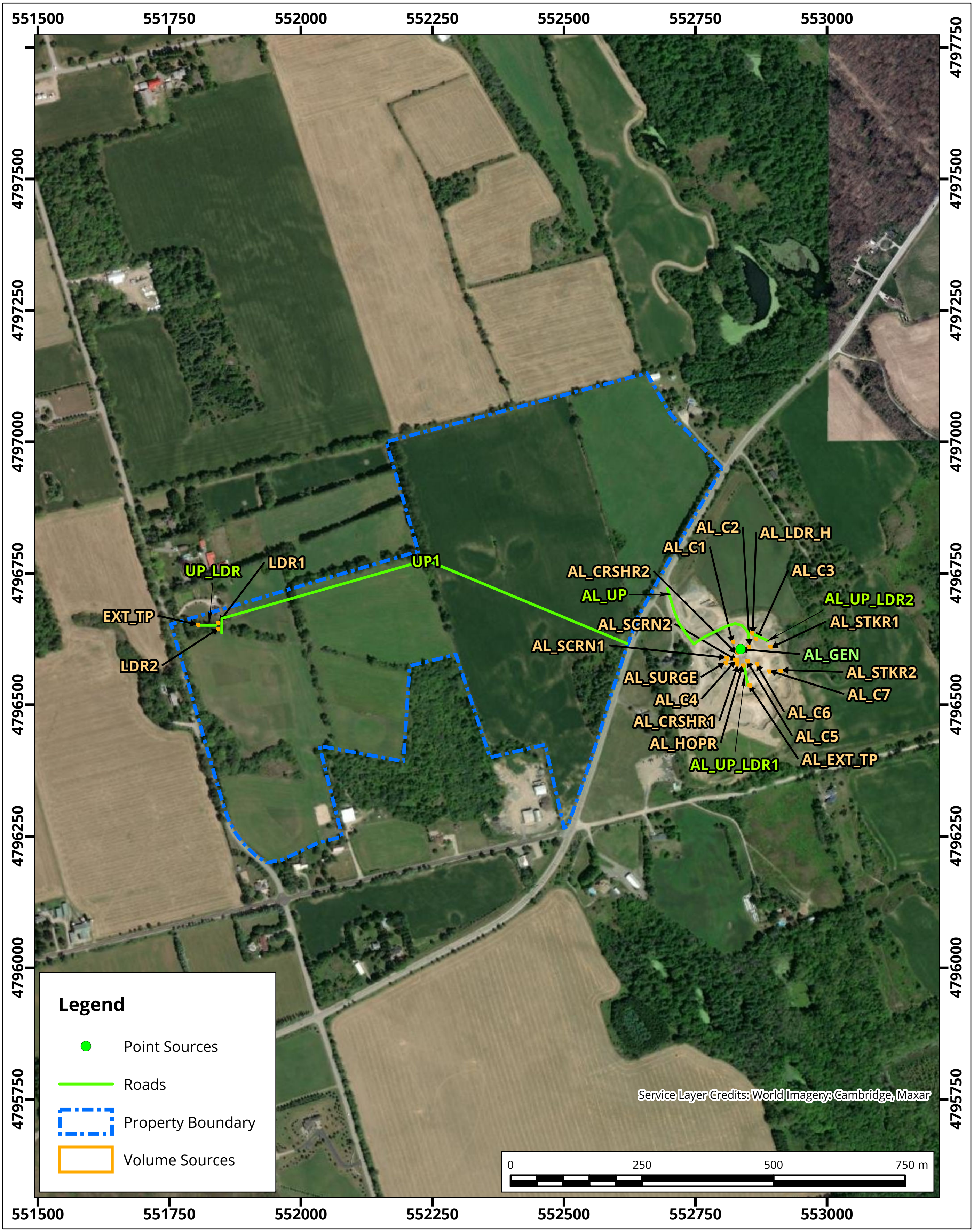
Map Projection: NAD 1983 UTM Zone 17N

Cambridge Aggregates - Edworthy West, Cambridge ON

Project #: 2102085

Drawn by: LJN	Figure: 1
Approx. Scale: 1:10,500	
Date Revised: Sep 24, 2021	

Map Document: C:\Users\LJN\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC\Desktop\GIS\Cambridge Aggregates\Cambridge Aggregates.aprx



Map Document: C:\Users\LJN\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC\Desktop\GIS\Cambridge Aggregates\Cambridge Aggregates.aprx

Site Plan Showing Significant Sources and Property Boundary - Scenario 1

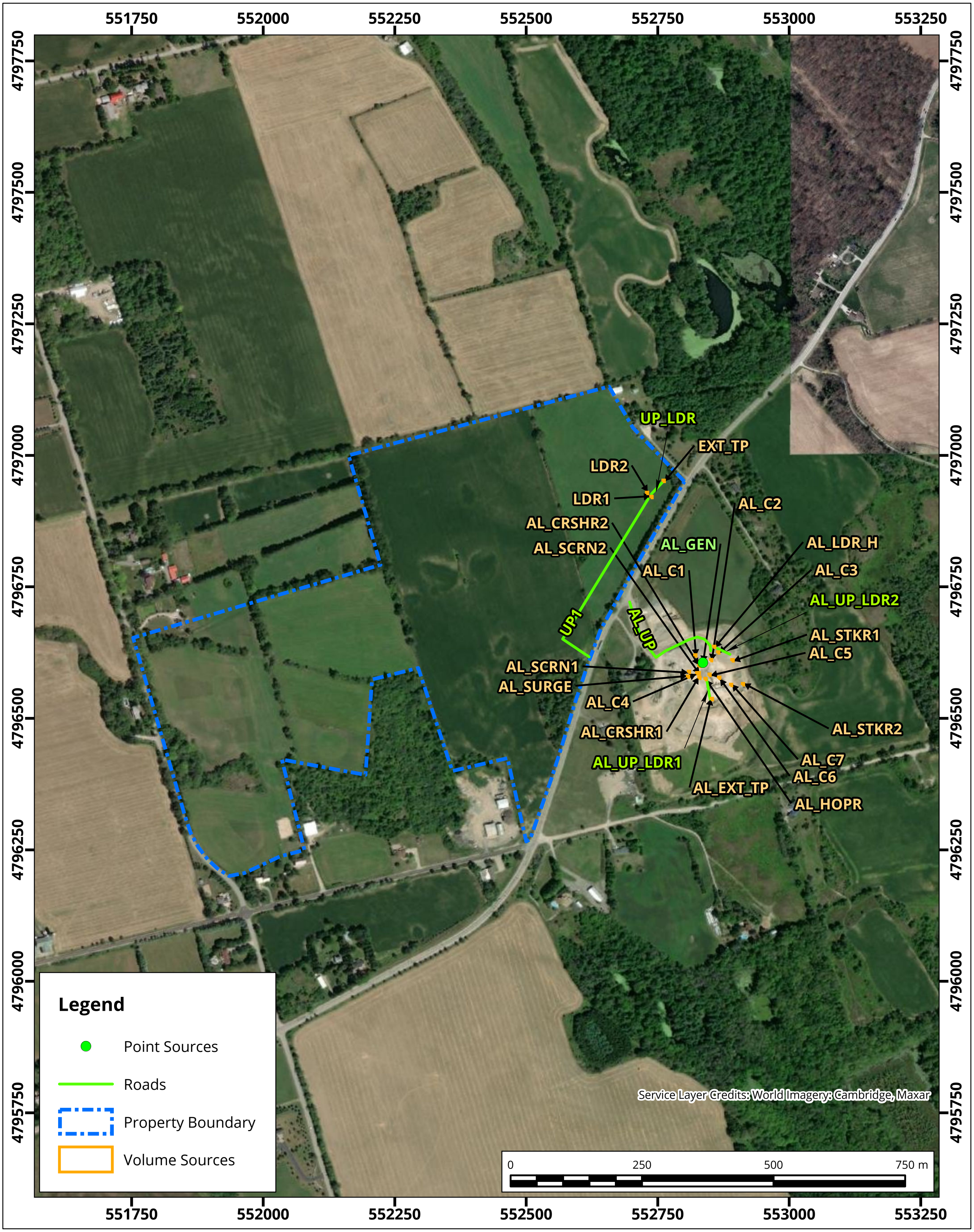
Map Projection: NAD 1983 UTM Zone 17N

Cambridge Aggregates - Edworthy West, Cambridge ON

True North

Project #: 2102085

Drawn by: LJN	Figure: 2
Approx. Scale:	1:10,000
Date Revised:	Sep 23, 2021



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Site Plan Showing Significant Sources and Property Boundary - Scenario 2

Map Projection: NAD 1983 UTM Zone 17N

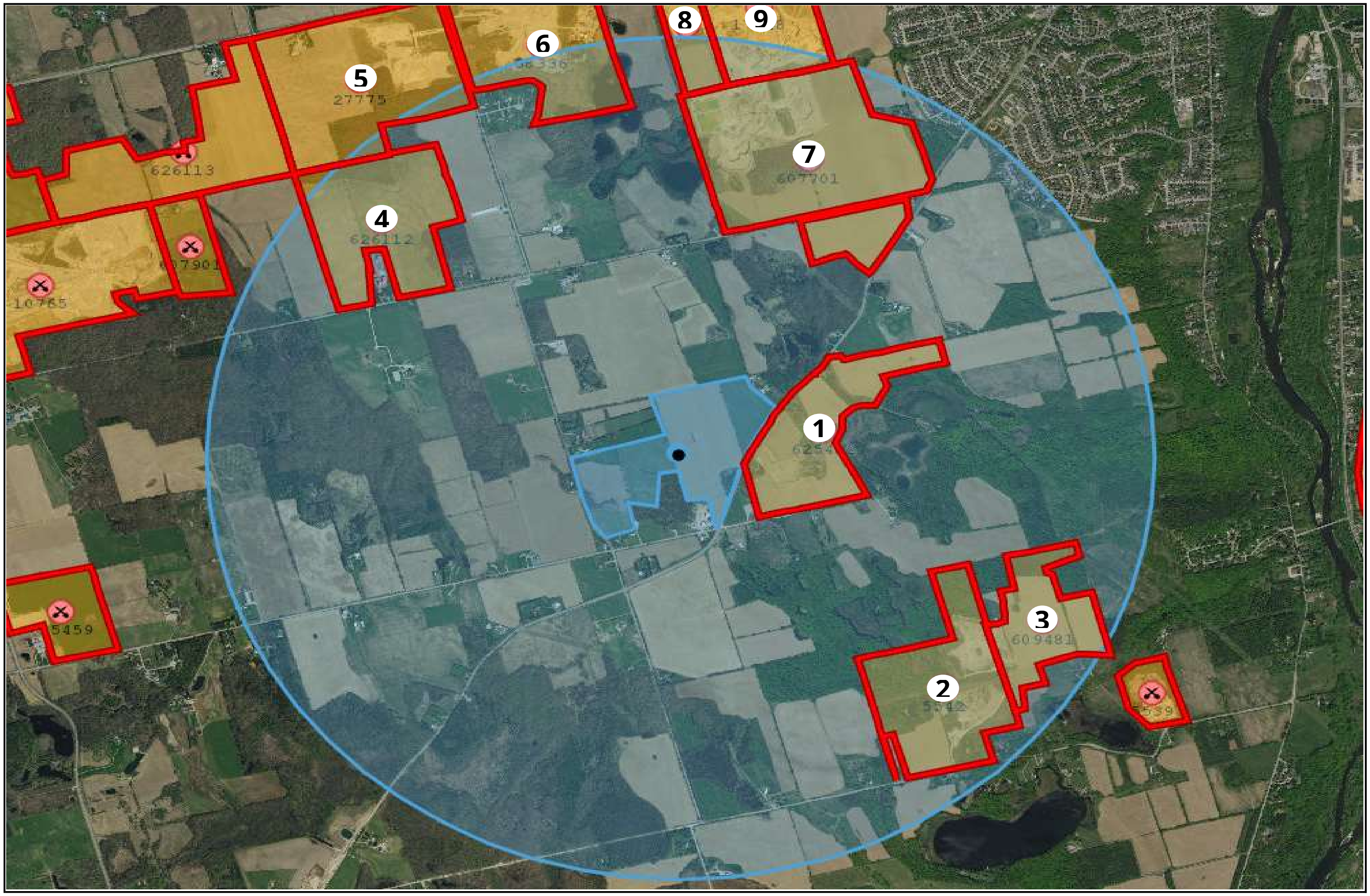
Cambridge Aggregates - Edworthy West, Cambridge ON

True North

Project #: 2102085

Drawn by: LJN	Figure: 3
Approx. Scale:	1:10,000
Date Revised:	Sep 23, 2021

RWDI



Aggregate Operations within 2 Kilometres of Edworthy Pit

Edworthy Pit - North Dumfires, Ontario

RWDI # 2102085

Drawn by: MDKB	Figure: 4
Approx. Scale: not to scale	
Date Revised:	September 30, 2021

APPENDICES

Appendix A: Bulk Material Handling Emissions Spreadsheet

Project #2102085

Cambridge Aggregates

AGGREGATE HANDLING AND STORAGE PILES - AP-42 Section 13.2.4

Average recorded hourly wind speed (m/s): 3.7
(used for sample calculations & factor validation)

Material handling emissions: $E = 0.0016\ k\ (U / 2.2)^{1.3} / (M / 2)^{1.4}$

- **E** emission factor
- **k** particle size multiplier (0.8, 0.74, 0.35 and 0.053 for TSP, PM_{30}, PM_{10} and $PM_{2.5}$, respectively) [3]
- **U** mean wind speed, meters per second (m/s)
- **M** material moisture content (%)

Source ID [1]	Description	Processing Rate: Hourly (Mg/h)	Processing Rate: Daily (Mg/d)	Site Data: Site Specific Data? (y/n)	Site Data: Silt Content (%)	Site Data: Moisture Content (%)	Site Data: Source Conditions Valid [2]	Base AP-42 Emission Factor: TSP (kg/Mg)	Base AP-42 Emission Factor: PM_{10} (kg/Mg)	Base AP-42 Emission Factor: $PM_{2.5}$ (kg/Mg)	Base AP-42 Emission Factor: Silica (kg/Mg)	Base Emission Rate: TSP (g/s)	Base Emission Rate: PM_{10} (g/s)	Base Emission Rate: $PM_{2.5}$ (g/s)	Base Emission Rate: Silica (g/s)	Additional Control Efficiency Applied (%)	Final Controlled Emission Rate at 3.7 m/s: TSP (g/s)	Data Quality Rating	PM_{10} (g/s)	Data Quality Rating	$PM_{2.5}$ (g/s)	Data Quality Rating	Silica (g/s)	Data Quality Rating
Cambridge Aggregates																								
LDR1	Loader #1 - loading trucks	313	3132	y	7.5%	4.8%	valid	7.4E-04	3.2E-04	4.9E-05	3.2E-05	6.4E-02	2.8E-02	4.3E-03	2.8E-03		6.4E-02	A	2.8E-02	A	4.3E-03	A	2.8E-03	A
LDR1	Loader #2 - loading trucks	313	3132	y	7.5%	4.8%	valid	7.4E-04	3.2E-04	4.9E-05	3.2E-05	6.4E-02	2.8E-02	4.3E-03	2.8E-03		6.4E-02	A	2.8E-02	A	4.3E-03	A	2.8E-03	A
Al's Stone Service Inc.																								
AL_HOPR	Loader loading the primary crusher hopper	220	2200	y	7.5%	4.8%	valid	7.4E-04	3.2E-04	4.9E-05	3.2E-05	4.5E-02	2.0E-02	3.0E-03	2.0E-03		4.5E-02	A	2.0E-02	A	3.0E-03	A	2.0E-03	A
AL_SURGE	Primary Crusher Surge Bin	220	2200	y	7.5%	4.8%	valid	7.4E-04	3.2E-04	4.9E-05	3.2E-05	4.5E-02	2.0E-02	3.0E-03	2.0E-03		4.5E-02	A	2.0E-02	A	3.0E-03	A	2.0E-03	A
AL_STKR1	Stacker #1	165	1650	y	7.5%	4.8%	valid	7.4E-04	3.2E-04	4.9E-05	3.2E-05	3.4E-02	1.5E-02	2.2E-03	1.5E-03		3.4E-02	A	1.5E-02	A	2.2E-03	A	1.5E-03	A
AL_STKR2	Stacker #2	55	550	y	7.5%	4.8%	valid	7.4E-04	3.2E-04	4.9E-05	3.2E-05	1.1E-02	4.9E-03	7.5E-04	4.9E-04		1.1E-02	A	4.9E-03	A	7.5E-04	A	4.9E-04	A
AL_LDR_H	Loader Loading Trixaxle Trucks	220	2200	y	7.5%	2.1%	valid	2.3E-03	1.0E-03	1.6E-04	1.0E-04	1.4E-01	6.3E-02	9.5E-03	6.3E-03		1.4E-01	A	6.3E-02	A	9.5E-03	A	6.3E-03	A

[1] ID corresponds to process flow diagram for facility and / or material
[2] Relates to AP-42 Section 13.2.4-4
[3] k-factor for TSP (PM44) scaled up logarithmically to 0.8 from published k-factor of 0.74 which refers to PM30.

Sample calculation for uncontrolled TSP emission factor for Source LDR1: LDR1, at a sample wind speed of 5 m/s

EF = 0.0016 x (0.8) x ((3.7 m/s) / 2.2)^1.3 / ((4.8%) / 2)^1.4 = 7.4E-04 kg TSP / Mg handled

Sample calculation for TSP emission rate for Source LDR1: LDR1, at a sample wind speed of 5 m/s

$$\frac{313\ Mg_{handled}}{1\ h} \times \frac{7.4E\text{-}04\ kg_{TSP}}{1\ Mg_{handled}} \times \frac{1\ h}{3600\ s} \times \frac{1000\ g_{TSP}}{1\ kg_{TSP}} \times \frac{100\%\ g_{TSP\ uncontrolled}}{1\ g_{TSP}} = 6.4E\text{-}02\ g_{TSP} / s$$

Comments
k-factor for TSP (PM44) scaled up logarithmically to 0.8 from published k-factor of 0.74 which refers to PM30.
Source condition validity used to determine the data quality rating, in accordance with AP-42.
Silica emissions based on "PM4 Crystalline Silica and PM10 Particulate Matter Emission Factors for Aggregate 'Producing Sources",
- 'Richards and Brozell, Air Control Techniques, July 31, 2007. Equivalent to 17% of PM10 emissions

Appendix B: Processing Emissions Spreadsheet

Project #2102085

Cambridge Aggregates

Soource ID	Source Description / Process Decription	AP-42 Process Description	AP-42 Chapter	Processing Rate Hourly (Mg/h)	Processing Rate Daily (Mg/d)	Base AP-42 Emission Factor TSP (kg/Mg)	Base AP-42 Emission Factor PM_{10} (kg/Mg)	Base AP-42 Emission Factor $PM_{2.5}$ (kg/Mg)	Base AP-42 Emission Factor Silica (kg/Mg)	Base Emission Rate TSP (g/s)	Base Emission Rate PM_{10} (g/s)	Base Emission Rate $PM_{2.5}$ (g/s)	Base Emission Rate Silica (g/s)	Additional Control Efficiency Applied (%)	Final Controlled Emission Rate TSP (g/s)	Data Quality Rating	PM_{10} (g/s)	Data Quality Rating	$PM_{2.5}$ (g/s)	Data Quality Rating	Silica (g/s)	Data Quality Rating
Al's Stone Service Inc.																						
AL_CRSHR1	Primary Crusher	Primary crushing (controlled)	11.19.2-1	220	2200	3.4E-04	2.70E-04	5.0E-05	4.6E-05	2.1E-02	1.7E-02	3.1E-03	2.8E-03		2.1E-02	E	1.7E-02	E	3.1E-03	E	2.8E-03	E
AL_CRSHR2	Secondary Crusher	Secondary crushing (controlled)	11.19.2-1	55	550	3.4E-04	2.70E-04	5.0E-05	4.6E-05	5.2E-03	4.1E-03	7.6E-04	7.0E-04		5.2E-03	E	4.1E-03	E	7.6E-04	E	7.0E-04	E
AL_SCRN1	Screener #1	Screening (controlled)	11.19.2-1	220	2200	5.6E-04	3.70E-04	2.5E-05	6.3E-05	3.4E-02	2.3E-02	1.5E-03	3.8E-03		3.4E-02	E	2.3E-02	C	1.5E-03	E	3.8E-03	C
AL_SCRN2	Screener #2	Screening (controlled)	11.19.2-1	165	1650	5.6E-04	3.70E-04	2.5E-05	6.3E-05	2.6E-02	1.7E-02	1.1E-03	2.9E-03		2.6E-02	E	1.7E-02	C	1.1E-03	E	2.9E-03	C
AL_C1	Conveyor transfer point #1	Conveyor transfer point (controlled)	11.19.2-1	110	1100	3.7E-05	2.30E-05	6.5E-06	3.9E-06	1.1E-03	7.0E-04	2.0E-04	1.2E-04		1.1E-03	E	7.0E-04	D	2.0E-04	E	1.2E-04	D
AL_C2	Conveyor transfer point #2	Conveyor transfer point (controlled)	11.19.2-1	165	1650	3.7E-05	2.30E-05	6.5E-06	3.9E-06	1.7E-03	1.1E-03	3.0E-04	1.8E-04		1.7E-03	E	1.1E-03	D	3.0E-04	E	1.8E-04	D
AL_C3	Conveyor transfer point #3	Conveyor transfer point (controlled)	11.19.2-1	165	1650	3.7E-05	2.30E-05	6.5E-06	3.9E-06	1.7E-03	1.1E-03	3.0E-04	1.8E-04		1.7E-03	E	1.1E-03	D	3.0E-04	E	1.8E-04	D
AL_C4	Conveyor transfer point #4	Conveyor transfer point (controlled)	11.19.2-1	55	550	3.7E-05	2.30E-05	6.5E-06	3.9E-06	5.7E-04	3.5E-04	9.9E-05	6.0E-05		5.7E-04	E	3.5E-04	D	9.9E-05	E	6.0E-05	D
AL_C5	Conveyor transfer point #5	Conveyor transfer point (controlled)	11.19.2-1	55	550	3.7E-05	2.30E-05	6.5E-06	3.9E-06	5.7E-04	3.5E-04	9.9E-05	6.0E-05		5.7E-04	E	3.5E-04	D	9.9E-05	E	6.0E-05	D
AL_C6	Conveyor transfer point #6	Conveyor transfer point (controlled)	11.19.2-1	55	550	3.7E-05	2.30E-05	6.5E-06	3.9E-06	5.7E-04	3.5E-04	9.9E-05	6.0E-05		5.7E-04	E	3.5E-04	D	9.9E-05	E	6.0E-05	D
AL_C7	Conveyor transfer point #7	Conveyor transfer point (controlled)	11.19.2-1	55	550	3.7E-05	2.30E-05	6.5E-06	3.9E-06	5.7E-04	3.5E-04	9.9E-05	6.0E-05		5.7E-04	E	3.5E-04	D	9.9E-05	E	6.0E-05	D

Sample calculation for TSP emissions from Source AL_CRSHR1: Primary Crusher

$$\frac{220\ Mg_{processed}}{1\ h} \times \frac{3.4E\text{-}04\ kg_{TSP}}{1\ Mg_{processed}} \times \frac{1\ h}{3600\ s} \times \frac{1000\ g_{TSP}}{1\ kg_{TSP}} \times \frac{100\%\ g_{TSP\ uncontrolled}}{1\ g_{TSP}} = 2.1E\text{-}02\ g_{TSP} / s$$

Comments

A silica content of: 17% was used in the assessment, based on <REFERENCE>.

AP-42 Emission Factor for TSP is based on PM100. The values have been corrected to reflect PM44.

Silica emissions based on "PM4 Crystalline Silica and PM10 Particulate Matter Emission Factors for Aggregate Producing Sources", Richards and Brozell, Air Control Techniques, July 31, 2007. Equivalent to 17% of PM10 emissions

Appendix C: On-Site Mobile Equipment Emissions Spreadsheet - Fugitive Dust

Project #2102085

Cambridge Aggregates

UNPAVED ROAD SECTIONS - AP-42 Section 13.2.2
PAVED ROAD SECTIONS - AP-42 Section 13.2.1

Paved Roads: $E = k\,(sL)^{0.91}\,(W)^{1.02}$
Unpaved Roads - Industrial: $E = 281.9\,k\,(s / 12)^{a}\,(W / 3)^{b}$
Unpaved Roads - Public: $E = 281.9\,k\,(s / 12)^{a}\,(S / 30)^{d} / (M / 0.5)^{c} - C$

E particulate emission factor (g/VKT)
k particle size multiplier (see below)
sL road surface silt loading (g/m²)
W average weight of the vehicles traveling the road (US short tons)
s surface material silt content (%)
C emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear
M surface material moisture content (%)
S mean vehicle speed (mph)
a,b,c,d constants (see below)

Route ID [1]	Route Description	Traffic Passes [2] Hourly (#/h)	Traffic Passes [2] Daily (#/d)	Segment Length [2] (m)	Road Surface [3]	Roadway Type [4]	Mean Vehicle Speed (km/h)	Mean Vehicle Speed (mph)	Average Vehicle Weight [5] (tons)	Surface Material Moisture Content [6] (%)	Surface Silt Content [7] (%)	Road Surface Silt Loading [8] (g/m²)	Base AP-42 Emission Factor TSP (g/VKT)	Base AP-42 Emission Factor PM_{10} (g/VKT)	Base AP-42 Emission Factor $PM_{2.5}$ (g/VKT)	Base AP-42 Emission Factor Silica (g/VKT)	Base Emission Rate TSP (g/s)	Base Emission Rate PM_{10} (g/s)	Base Emission Rate $PM_{2.5}$ (g/s)	Base Emission Rate Silica (g/s)	Additional Control Efficiency Applied (%)	Final Controlled Emission Rate TSP (g/s)	Data Quality Rating	PM_{10} (g/s)	Data Quality Rating	$PM_{2.5}$ (g/s)	Data Quality Rating	Silica (g/s)	Data Quality Rating
Cambridge Aggregates																													
UP1_S1	Unpaved haul route - scenario #1	34.8	348	912	Unpaved	Industrial	35	22	42		4.8%		3.9E+03	6.1E+02	6.1E+01	1.0E+02	3.4E+01	5.3E+00	5.3E-01	9.1E-01	95%	1.7E+00		2.7E-01		2.7E-02		4.5E-02	
UP1_S2	Unpaved haul route - scenario #2	34.8	348	608	Unpaved	Industrial	35	22	42		4.8%		3.9E+03	6.1E+02	6.1E+01	1.0E+02	2.3E+01	3.6E+00	3.6E-01	6.1E-01	95%	1.1E+00		1.8E-01		1.8E-02		3.0E-02	
UP_LDR	Loaders at working face	104.4	1044	25	Unpaved	Industrial	5	3	56		4.8%		4.5E+03	6.9E+02	6.9E+01	1.2E+02	3.2E+00	5.0E-01	5.0E-02	8.5E-02	95%	1.6E-01		2.5E-02		2.5E-03		4.3E-03	
Al's Stone Service Inc.																													
AL_UP	Triaxle trucks transporting material offsite	10	100	247	Unpaved	Industrial	35	22	19.6		4.8%		2.8E+03	4.3E+02	4.3E+01	7.3E+01	1.9E+00	3.0E-01	3.0E-02	5.0E-02	75%	4.8E-01		7.4E-02		7.4E-03		1.3E-02	
AL_UP_LDR1	Loader moving material to primary crusher	36.667	367	25	Unpaved	Industrial	5	3	26		4.8%		3.1E+03	4.9E+02	4.9E+01	8.3E+01	8.0E-01	1.2E-01	1.2E-02	2.1E-02	75%	2.0E-01		3.1E-02		3.1E-03		5.3E-03	
AL_UP_LDR2	Loader moving material to load trucks	36.667	367	25	Unpaved	Industrial	5	3	26		4.8%		3.1E+03	4.9E+02	4.9E+01	8.3E+01	8.0E-01	1.2E-01	1.2E-02	2.1E-02	75%	2.0E-01		3.1E-02		3.1E-03		5.3E-03	

Constants for Mobile Emission Equations

Roadway Type	Contaminant	k	a	b	c	d	Quality
Paved Roads:	**$PM_{2.5}$**	0.15	-	-	-	-	-
	PM_{10}	0.62	-	-	-	-	-
	PM_{30}	3.23	-	-	-	-	-
	TSP	4.79	-	-	-	-	-
Unpaved Roads - Industrial:	**$PM_{2.5}$**	0.15	0.9	0.45	-	-	C
	PM_{10}	1.5	0.9	0.45	-	-	B
	PM_{30}	4.9	0.7	0.45	-	-	B
	TSP	7.32	0.6	0.45	-	-	C
Unpaved Roads - Public:	**$PM_{2.5}$**	0.18	1	-	0.2	0.5	C
	PM_{10}	1.8	1	-	0.2	0.5	B
	PM_{30}	6	1	-	0.3	0.3	B
	TSP	8.96	1	-	0.49	0.2	C

[1] Route ID numbers provided on site plan.
[2] Length of a specific road segment. A separate segment should be used whenever one or more parameters change.
[3] Paved surfaces include asphalt, concrete, and recycled asphalt (if it forms a relatively consistent surface).
[4] Publicly accessible and dominated by light vehicles, or industrial, and dominated by heavy vehicles.
[5] The average vehicle weight reflects the average of the empty and loaded vehicle weight, for travel in both directions.
[6] Required only for publicly accessible unpaved roads.
[7] Required only for unpaved roads (public and industrial).
[8] Required only for industrial paved roads.

Sample calculation for uncontrolled TSP emission factor for Source UP1_S1: Unpaved haul route - scenario #1

EF = 281.9 x (4.9) x [(4.8% / 12)]^(0.7) x [(41.7 tons) / 3]^(0.45) = 3892 g TSP / vehicle kilometer travelled (vkt)

Sample calculation for TSP emission rate for Source UP1_S1: Unpaved haul route - scenario #1

$$\frac{35 \text{ vehicles}}{1 \text{ h}} \times 912 \text{ m} \times \frac{1 \text{ km}}{1000 \text{ m}} \times \frac{3892\ g_{TSP}}{1 \text{ vehicle km}} \times \frac{1 \text{ h}}{3600 \text{ s}} \times \frac{0.05\ g_{TSP\ uncontrolled}}{1\ g_{TSP}} = 1.7\text{E+00}\ g_{TSP} / \text{s}$$

Comments

A silica content of: 17% was used in the assessment, based on <REFERENCE>.
Constants for TSP (PM44) extrapolated from published factors for PM30, PM10 and PM2.5. Data quality downgraded by one step.

75% control applied to unpaved roads based on the watering as per the recommendations in the report (hourly watering under dry conditions)
Silt values for unpaved roads reflect mean values from AP-42
Silica emissions based on "PM4 Crystalline Silica and PM10 Particulate Matter Emission Factors for Aggregate Producing Sources", Richards and Brozell, Air Control Techniques, July 31, 2007. Equivalent to 17% of PM10 emissions

Appendix D: Summary of Combustion Exhaust Emissions (Mobile and Stationary Sources)

Project #2102085

Cambridge Aggregates

Source ID	Description	Gross Power Rating (kW)	Number Of Units	Traffic Passes [2] Hourly (#/h)	Traffic Passes [2] Daily (#/d)	Segment Length [3] (m)	Mean Vehicle Speed (km/h)	Load Factor [4] (%)	Tailpipe Emission Factor [5] TSP (g/vkt)	TSP (g/kW-h)	PM10 (g/vkt)	PM10 (g/kW-h)	PM2.5 (g/vkt)	PM2.5 (g/kW-h)	NOx (g/vkt)	NOx (g/kW-h)	Tailpipe Emission Rate TSP (g/s)	PM10 (g/s)	PM2.5 (g/s)	NOx (g/s)	Tailpipe + Fugitive Emission Rate [6] TSP (g/s)	PM10 (g/s)	PM2.5 (g/s)	Silica (g/s)	NOx (g/s)
Cambridge Aggregates																									
UP1_S1	Unpaved haul route - scenario #1	n/a	1	34.8	348	912	35		1.78		1.78		1.11		18.3		1.6E-02	1.6E-02	9.8E-03	1.6E-01	1.7E+00	2.8E-01	3.7E-02	4.5E-02	1.6E-01
UP1_S2	Unpaved haul route - scenario #2	n/a	1	34.8	348	608	35		1.78		1.78		1.11		18.3		1.0E-02	1.0E-02	6.5E-03	1.1E-01	1.2E+00	1.9E-01	2.4E-02	3.0E-02	1.1E-01
EXT_TP	Excavator at working face	316	1					53%		0.2		0.2		0.2		4	9.3E-03	9.3E-03	9.3E-03	1.9E-01	9.3E-03	9.3E-03	9.3E-03	0.0E+00	1.9E-01
UP_LDR	Two loaders moving material to trailer trucks	541	2				5	48%		0.3		0.3		0.3		4	4.3E-02	4.3E-02	4.3E-02	5.8E-01	2.0E-01	6.8E-02	4.6E-02	4.3E-03	5.8E-01
Al's Stone Service Inc.																									
AL_UP	Triaxle trucks transporting material offsite	n/a		10	100	247	35		1.78		1.78		1.11		18.3		1.2E-03	1.2E-03	7.6E-04	1.3E-02	4.8E-01	7.5E-02	8.2E-03	1.3E-02	1.3E-02
AL_UP_LDR1	Loader moving material to primary crusher	298	1			25	5	48%		0.2		0.2		0.2		4	7.9E-03	7.9E-03	7.9E-03	1.6E-01	2.1E-01	3.9E-02	1.1E-02	5.3E-03	1.6E-01
AL_UP_LDR2	Loader moving material to load trucks	298	1			25	5	48%		0.2		0.2		0.2		4	7.9E-03	7.9E-03	7.9E-03	1.6E-01	2.1E-01	3.9E-02	1.1E-02	5.3E-03	1.6E-01
AL_EXT_TP	Tailpipe emissions from the excavator	316	1				0	53%		0.2		0.2		0.2		4	9.3E-03	9.3E-03	9.3E-03	1.9E-01	9.3E-03	9.3E-03	9.3E-03	0.0E+00	1.9E-01
AL_CRSHR1	Primary Crusher	100	1				N/A	100%		0.3		0.3		0.3		4	8.3E-03	8.3E-03	8.3E-03	1.1E-01	2.9E-02	2.5E-02	1.1E-02	2.8E-03	1.1E-01
AL_CRSHR2	Secondary Crusher	100	1				N/A	100%		0.3		0.3		0.3		4	8.3E-03	8.3E-03	8.3E-03	1.1E-01	1.4E-02	1.2E-02	9.1E-03	7.0E-04	1.1E-01
AL_SCRN1	Screener #1	100	1				N/A	100%		0.3		0.3		0.3		4	8.3E-03	8.3E-03	8.3E-03	1.1E-01	4.3E-02	3.1E-02	9.9E-03	3.8E-03	1.1E-01
AL_SCRN2	Screener #2	100	1				N/A	100%		0.3		0.3		0.3		4	8.3E-03	8.3E-03	8.3E-03	1.1E-01	3.4E-02	2.5E-02	9.5E-03	2.9E-03	1.1E-01

[1] ID should reflect Source ID or Route ID, as appropripte.
[2] Where applicable, this value reflects travel in both directions (e.g., 1 round-trip = 2 passes)
[3] Length of a specific road segment. A separate segment should be used whenever one or more parameters change.
[4] Load Factors from "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", EPA-420-R-10-016, NR-005d, July 2010
[5] Emissions are input on either a vehicle distance or power rating basis. Load factor applies only to emissions based on power ratings.
[6] Applicable only for TSP, PM10 and PM2.5 emissions from mobile equipment. Emissions rates for Silica and NOx and stationary sources do not change.

Comments

Excavator assumed to be CAT 352.
Loaders assumed to be CAT 914.
Screnning plant engine assumed to be 100 kW (typical)
Excavator, loaders, and screen plant engine emissions based on Tier 3 emission limits.
Load Factors from "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", EPA-420-R-10-016, NR-005d, July 2010

Sample Calculations

Pit Loader Exhaust TSP Emissions:

$$\frac{0\ \text{kW}}{} \cdot \frac{0\ \text{g}}{1\ \text{kW h}} \cdot \frac{0\%\ \text{Load}}{} \cdot \frac{1\ \text{h}}{3600\ \text{s}} = 0.0E+00\ g_{TSP}\ /\ s$$

Highway Truck Exhaust TSP Emissions:
(10 Rd East)

$$\frac{34.8\ \text{Vehicles}}{1\ \text{h}} \cdot \frac{912\ \text{m}}{} \cdot \frac{1.78\ \text{g}}{1\ \text{Veh. Km}} \cdot \frac{1\ \text{km}}{1000\ \text{m}} \cdot \frac{1\ \text{h}}{3600\ \text{s}} = 1.6E-02\ g_{TSP}\ /\ s$$

Combustion Spreadsheet for Generator AL_GEN

RWDI Project #2102085

RWDI Project Name:	Cambridge Aggregates
RWDI Project Number:	2102085
RWDI Source ID:	AL_GEN
Manufacturer:	N/A
Engine Model:	N/A

Parameter	Units	Value
Engine Fuel		Diesel
Fuel Heating Value	(Btu/gal)	1370000
Stroke Cycle		4-Stroke
Engine Loading	(%)	n/a
Burn Style		n/a
NOx Controlled?		No

Manufacturer Emissions Data	Units	Factor
Oxides of Sulphur (SOx)	(lb/hp-hr)	
Oxides of Nitrogen (NO_x)	(lb/hp-hr)	
Carbon Monoxide (CO)	(lb/hp-hr)	
Particulate Matter (PM)	(lb/hp-hr)	
Source:		

Fuel Sulphur Information	Units	Value
Natural Gas Sulphur Content	(%)	
Fuel Oil Sulphur Content	(%)	0.0015

Rating (enter one set of units)	Units	Value
Engine Power (kW)	(kW)	800
Generator Transfer Efficiency	(%)	90
Engine Combustion Efficiency	(%)	35
Calculated Engine Output	(hp)	1072
Calculated Engine Input	(hp)	3065
Diesel Generator Size Range	(hp)	>600

Exhaust Temperature	Units	Value
Exhaust Temperature (°C)	(°C)	175
Calculated Exit Temperature	(K)	448
Exhaust Flow Rate	cfm	2125
	m^3/s	1.00

Pollutants	Emission Factor		Data	Source of Emission Factor
	Value	Units	Quality	
Oxides of Sulphur (SOx)	1.2E-05	(lb/hp-hr)	B	AP 42 (10/1996) Ch 3.3, Tables 3.3-1
Oxides of Nitrogen (NOx)	2.4E-02	(lb/hp-hr)	B	AP 42 (10/1996) Ch 3.3, Tables 3.3-1
Carbon Monoxide (CO)	5.5E-03	(lb/hp-hr)	C	AP 42 (10/1996) Ch 3.3, Tables 3.3-1
Total Particulate Matter (TSP)	7.0E-04	(lb/hp-hr)	B	AP 42 (10/1996) Ch 3.3, Tables 3.3-1

Pollutants	Emission Rate	
	Value	Units
Oxides of Sulphur (SOx)	1.6E-03	g/s
Oxides of Nitrogen (NOx)	3.2E+00	g/s
Carbon Monoxide (CO)	7.4E-01	g/s
Total Particulate Matter (TSP)	9.5E-02	g/s

MONIKA GREENFIELD, M.SC.

STRATEGIC DIRECTOR – MINING AND AGGREGATES

T: 519-823-1311 X 2117 | M: 705-280-7693 | Monika.Greenfield @rwdi.com

Monika brings over 40 years of diverse environmental consulting and industrial experience to her current role with RWDI. In addition to extensive technical capabilities, Monika is known for her productive engagement with industry working groups and her ability to build strong collaborative relationships with mining companies, regulatory agencies and local communities. Her current role focuses on driving RWDI's growth strategy in global mining markets, and providing leadership and support on our existing projects in the mining and industrial sectors. Before joining RWDI, Monika worked as an Environment Superintendent for Vale (formerly Inco) in Sudbury. Her 14-year tenure at Vale involved negotiating and maintaining air and noise permits for 10 discrete facilities, diverse noise and air quality monitoring initiatives, and community engagement. Her earlier consulting experience encompassed expert witness testimony, regulatory reporting, project management, and a range of monitoring, modelling and testing work for industrial sector clients.

Project Experience

- Environmental Assessments
- Project Management
- Fugitive Dust Modelling/Mitigation
- Air Dispersion Applications
- Noise and Odour Evaluations
- Air Quality Monitoring/Assessments
- Regulatory Compliance Reporting
- Meteorological and Climatological Studies
- Air Pollution Control Technology Applications
- Expert Testimony
- Community Liaison

Employment History

2018-Present
Strategic Director, Senior Project Manager, RWDI

2005-2018
Environment Superintendent, Vale Canada Limited

2000-2005
Senior Project Manager, Air Quality Specialist, RWDI

1999-2000
Senior Project Manager, O'Connor Associates Environmental Inc.

1981-1999
Senior Project Scientist, Ortech Corporation

1980-1981
Junior Project Scientist, Beak Consultants

Education

B.A. Geography McMaster University, Hamilton, ON, Canada 1978

M.Sc. Science (Climatology and Meteorology) McMaster University, Hamilton, ON, Canada 1980

B. Education, University of Toronto, Toronto, ON, Canada 1987

Affiliations

Member, Ontario Mining Association (OMA), Environment Committee

Member, Mining Association of Canada (MAC), Environment and Climate Change Committees

Canadian Institute of Mining, Metallurgy and Petroleum, Member

Member, Ontario Environment Industry Association (ONEIA), Climate Change Committee

BRIAN SULLEY, B.A.SC., P.ENG.

TECHNICAL DIRECTOR - AIR QUALITY | PRINCIPAL

T: 519.823.1311 X 2373 | Brian.Sulley@rwdi.com

Brian is a Technical Director and Principal whose air quality emissions and dispersion modelling work, as well as his chemical process quantitative risk analysis work, has benefitted our clients in almost every industrial and institutional sector served by RWDI. Brian's experience includes heavy industry such as mining, aggregate extraction, hot mix asphalt production, cement plants, pulp and paper mills, petrochemical facilities, and automotive production, through to institutional facilities such as hospitals and universities. Brian's experience in chemical process quantitative risk analysis spans his work with his previous employer in the chemical process industry and with RWDI. His work in chemical process engineering provides a strong foundation for both his air quality and risk assessment work.

Brian sits on the Board of the Ontario Section of the Air & Waste Management Association and is an active member with the Ontario Environmental Industry Association. Brian also sits on the Environment Committee of the Ontario Stone Sand and Gravel Association, providing guidance and training to members on fugitive dust management and control and regulatory compliance requirements.

In addition to working directly with clients to meet air quality objectives and comply with regulations, Brian acts as a technical lead for our Air Quality modelling group, coaching and mentoring scientists and engineers across Canada at work on a range of emissions inventory, monitoring and modelling projects.

Brian has also served as an expert witness before the Ontario Land Tribunal (formerly the Ontario Municipal Board and Local Planning Appeal Tribunal). He has been qualified as an expert on dust, odour, and chemical process quantitative risk analysis.

Employment History

2001 – Present
Technical Director – Air Quality, Principal, RWDI

2016 – Present
Instructor: Air and Water Quality Analysis, Environmental Building Science Program, Conestoga College

2003 – Present
Instructor: Introduction to Air Quality, Environmental Engineering Applications Program, Conestoga College

2011 – 2018
Instructor: Air Pollution Control, Environmental Control Program, Sheridan College

1999 – 2001
Process Engineering Associate, Huntsman Corporation Canada Inc.

Engineering Licenses

Licensed Professional Engineer (P.Eng.) with:

- **Professional Engineers of Ontario**
- **Association of Professional Engineers and Geoscientists of Saskatchewan**
- **Association of Professional Engineers of Nova Scotia**
- **Association of Professional Engineers and Geoscientists of Alberta**
- **Engineers and Geoscientists British Columbia**

Affiliations

A&WMA - Air & Waste Management Association

OSSGA – Ontario Stone Sand and Gravel Association

Ontario Air Practitioners Group

Education

Bachelor of Applied Science (Environmental [Chemical] Engineering), University of Waterloo, 2000

Courses Taught

Controlling Dust from Process Equipment. Ontario Agri Business Association

Evolution of the Ontario Approvals Process. Ontario Association of Physical Plant Administrators

Emission Sources, From Boilers to Bulldozers. A&WMA Ontario Section

Emission Estimation & Data Quality, Good Emissions Data Makes for Good Decisions. A&WMA Ontario Section

Controlling Fugitive Dust. OSSGA Bi-Annual Environmental Management Workshop

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Selected Project Experience

Hearings

- Albion Hills Automotive, Palgrave, ON, (OMB File PL070637)
- Crestwood Subdivision OMB Appeal, London, ON (OMB File PL080059)
- SASE Aggregates Ltd., Uxbridge, ON (OMB File PL160852)
- Blythe Holsteins Ltd., Municipality of Thames Centre, ON (LPAT File PL161154)
- Atlantic Power Corporation, Williams Lake, BC (EAB file 2016-EMA-G05)
- James Dick Construction Limited, Township of Guelph-Eramosa, ON (LPAT File PL170688)
- Colacem Canada Inc., Township of Champlain, ON (LPAT File PL170756)
- C. H. Demill Holdings Inc., Township of Tyendinaga (LPAT File MM180027)
- Halton Crushed Stone, Town of Erin, ON (LPAT File MM190008)
- Zircon Design and Development Inc., Toronto, ON Hearing of Necessity under the Expropriations Act.
- MJJJ Developments Inc., Town of Caledon, ON (LPAT File PL190106, PL190107)
- RioTrin Properties (Burnhamthorpe) Inc., Mississauga, ON (LPAT File PL190221, PL190222)
- REDECAN & REDECAN PHARM, Town of Pelham, ON (OLT File PL200426)

Federal Government

- Cliff Hill Central Heating Plant, Ottawa, ON
- Revision to NPRI Welding Emission Factors, Gatineau, PQ
- Tunney's Pasture Central Heating Plant, Ottawa, ON

Transportation / Roadway Air Quality

- Bluewater Bridge, Sarnia, ON
- CN MacMillan Yard, Vaughan, ON
- GO Milton Expansion, ON
- Highway 400 Improvements, Barrie, ON
- Highway 417 Widening, Ottawa, ON
- Highway 69 Widening North of Parry Sound, ON
- Jebel Ali Airport, Dubai, UAE
- Metrolinx Network Expansion, ON
- North Channel Seaway Bridge, Cornwall, ON
- QEW Widening, Oakville, ON

Building Design Reviews

- 81 Bay Street, Toronto, ON
- 141 Bay Street, Toronto, ON
- 280 King Street East, Toronto, ON
- 17 Prince Arthur Street, Toronto, ON

Land-Use Planning Air Quality Assessments

- Active Wellness Products, London, ON
- 225 Birmingham Street Redevelopment, Toronto, ON
- 6 Cuddy Boulevard, London, ON
- Dundas & Shorncliffe, Toronto, ON
- 5507-5509 Dundas Street Redevelopment, Toronto, ON
- 328-374 Dupont Street, Toronto, ON
- 176-178 Front Street Redevelopment, Toronto, ON
- 250 Front Street East Redevelopment, Toronto, ON
- 105 Garden Avenue Development, Brantford, ON
- Hansler Rd. Development, Thorold, ON
- iPoly, St. Catharines, ON
- 6 Lloyd Avenue, Toronto, ON
- Niagara Stone Rd. Development, Niagara-on-the-Lake, ON
- Nyon Energy Park Review, Port Colborne, ON
- Portage Rd. Development, Niagara Falls, ON
- Portuguese Cheese, Toronto, ON
- 933-935 Queensway Redevelopment, Toronto, ON
- Riverside Waste Transfer Facility, Centre, Wellington, ON
- 383 Sorauren Avenue Peer Review, Toronto, ON
- Thorold Park Redevelopment, Thorold, ON
- Xinyi Glass Canada, Guelph Eramosa Township, ON
- Xinyi Glass Canada, Stratford, ON
- 771 Yonge Street Redevelopment, Toronto, ON

Odour Assessments

- Active Wellness Products, London, ON
- Arnprior Sewage Treatment Plant, Arnprior, ON
- Colonial Sewage Pumping Station, Waterloo, ON
- Creemore Springs Brewery Peer Review, Creemore, ON
- Guelph Composting Facility, Guelph, ON
- Guelph Wet/Dry Facility, Guelph, ON
- Elora Wastewater Treatment Plant, Elora, ON
- IGPC Ethanol, Aylmer, ON
- Kawartha Ethanol, Kawartha Lakes, ON
- Keswick Wastewater Treatment Plant, Keswick, ON
- Lush Cosmetics, Toronto, ON
- Nitta Gelatin, Toronto, ON
- Parry Sound Sewage Treatment Plant, Parry Sound, ON
- Peel Composting Facility Management Plan, Caledon, ON
- Portuguese Cheese, Toronto, ON
- Ravensview Water Pollution Control Plant, Kingston, ON
- Royal Canin Pet Foods, Puslinch, ON
- S.C. Johnson, Brantford, ON
- Symplastics Engineering Plastics, Orangeville, ON
- Trail Road Landfill, Ottawa, ON
- Zircon Design and Development Inc., Toronto, ON
- Redecan Odour Assessment, Fenwick, ON

Institutional

- Bridgepoint Hospital, Toronto, ON
- Brock University, St Catharines, ON
- Carleton University, Ottawa, ON
- Centre for Addiction and Mental Health, Toronto, ON
- Centre Wellington Sportsplex, Fergus, ON
- Fanshaw College, London, ON
- Joseph Brant Hospital, Burlington, ON
- London Health Sciences Centre, London, ON
- Mackenzie Health Care, Multiple Sites, ON
- Milton District Hospital, Milton, ON
- North Bay Aquatic Centre, North Bay, ON
- North Bay Regional Health Centre, North Bay, ON
- St. Joseph's Health Centre, Hamilton, ON
- St. Michael's Hospital, Toronto, ON
- Stratford General Hospital, ON
- Trillium Health Care, Multiple Sites, ON
- Toronto Western Hospital, Toronto, ON
- University of Guelph, Guelph, ON
- University of Ottawa, Ottawa, ON
- Women's College Hospital, Toronto, ON
- Fanshaw College, London, ON

Industrial Facilities

- Anchor-Danly, Cambridge, ON
- Anchor-Danly, Windsor, ON
- Arcelor Mittal Hamilton East Works, Hamilton, ON
- Ar-Razi Methanol Plant, Jubail, Kingdom of Saudi Arabia
- Breeze Dried Flooring, Tilsonburg, ON
- Cooper Plating, Newmarket, ON
- Enbridge Gas Storage and Transfer Operations, ON
- Fiat Chrysler, Multiple Sites, ON
- Gateway Pet Memorial, Guelph, ON
- Gateway Pet Memorial, Ottawa, ON
- General Motors of Canada Limited, Multiple Sites, ON
- IMBC Blow Molding, Orangeville, ON
- Kuntz Electroplating, Kitchener, ON
- L.J. Barton, Hamilton, ON
- Mitten Vinyl, Paris, ON
- NOVA Chemicals, Corunna, Sarnia & St. Clair, ON
- Peel Plastics, Brampton, ON
- Pestell Pet Products, New Hamburg, ON
- Resolute Iroquois Falls Mill, Iroquois Falls, ON
- Resolute Thunder Bay Mill, Thunder Bay, ON
- Rochling Engineering Plastics, Orangeville, ON
- Sithe Energy, Mississauga and Brampton, ON
- Stelco, Hamilton & Nanticoke, ON
- TBay Tel Generators, Multiple Sites, ON
- Weston Bakeries, Multiple Sites, ON

Ready-Mix Concrete Facilities

- Dufferin Construction, Burlington, ON
- Dufferin Construction, Hamilton, ON
- Dufferin Construction, Bowmanville, ON
- Dufferin Construction, Toronto, ON
- Dufferin Construction, Scarborough, ON
- Ontario Redi-Mix, Pickering, ON
- Ontario Redi-Mix, Toronto, ON

Hot-Mix Asphalt Facilities

- AECON, Brampton, ON
- Walker Aggregates, Thorold, ON
- Ingram Asphalt, Toronto, ON
- Walker Aggregates, Vineland, ON
- Dufferin Aggregates, Mosport, ON
- Waterford Group, Port Colborne, ON
- Coco Paving, Windsor, ON

Mining

- Vale, Sudbury, ON
- Kirkland Lake Gold, Kirkland Lake, ON
- Rubicon Minerals Phoenix Gold Mine, Red Lake, ON
- Treasury Metals Goliath Gold, Wabigoon, ON

Air Quality Monitoring Studies

- SaskPower Boundary Dam Power Station, Estevan, SK

Environmental Protection Plans

- Pound-Maker Bioethanol, Lanigan, SK
- North West Bio-Energy Ltd, Unity, SK

Fugitive Dust Monitoring Studies

- Summit Aggregates, Ayr Pit, Ayr, ON
- CBM Sunderland Pit, Sunderland, ON
- CBM Codrington Pit, Codrington, ON
- CBM Westwood Pit, Peterborough, ON
- CBM Thamesford Pit, Thamesford, ON
- CBM St. Mary's Quarry, St. Mary's ON
- CBM Osprey Quarry, Duntoon, ON
- CBM Hillsburgh Pit, Hillsburgh, ON
- CBM David Pit, North Dumfries, ON
- CBM Buckhorn Quarry, Buckhorn, ON
- CBM Bowmanville Quarry, Bowmanville, ON
- CBM Aberfoyle South Pit, Puslinch, ON
- CBM Aberfoyle North Pit, Puslinch, ON
- Waterford Group Dunnville Rock Products, Dunnville, ON
- Waterford Group Law Crushed Stone, Port Colborne, ON
- Waterford Group Norfolk Aggregates, Norfolk, ON
- Waterford Group Vinemount Quarry, Vinemount, ON
- Waterford Group Waterford Pit, Waterford, ON

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Fugitive Dust Studies

- 5W Farms, Victoria Road Quarry, Victoria Road, ON
- AECON Ottawa Quarry, Ottawa, ON
- Blythe Dale Agg. Leitch Gover Pit, Thames Centre, ON
- Brampton Brick Hillsdale Plant, Hillsdale, ON
- Brampton Brick Norval Quarry Review, Brampton, ON
- Bruno's Contracting, Trout Lake Pit, Thunder Bay, ON
- Cambridge Aggregates Edworthy Pit, North Dumfries, ON
- Capital Paving, Aikensville Pit, Puslinch, ON
- Capital Paving, West Montrose Pit, West Montrose, ON
- Capital Paving, Shantz Station Pit, Maryhill, ON
- CBM Sunderland Pit Dust Control, Sunderland, ON
- C.H. Demill Melrose Quarry, Shannonville, ON
- City of Ottawa Trail Road Landfill, Ottawa, ON
- Cressy Quarry Review, Cressy, ON
- D&J Lockhart Martin Pit Expansion, Woolwich, ON
- Dufferin Aggregates Aberfoyle Pit, Puslinch, ON
- Dufferin Aggregates Acton Quarry, Acton, ON
- Dufferin Aggregates Alps Pit, North Dumfries, ON
- Dufferin Aggregates Butler Pit, North Dumfries, ON
- Dufferin Aggregates Carden Quarry, Carden, ON
- Dufferin Aggregates Cayuga Quarry, Cayuga, ON
- Dufferin Aggregates Cedar Creek Pit, North Dumfries, ON
- Dufferin Aggregates Chudyk Pit, North Dumfries, ON
- Dufferin Aggregates Flamboro Quarry, Dundas, ON
- Dufferin Aggregates Maple Yard, Maple, ON
- Dufferin Aggregates Mill Creek Pit, Puslinch, ON
- Dufferin Aggregates Milton Quarry, Milton, ON
- Dufferin Aggregates Mosport Pit, Mosport, ON
- Dufferin Aggregates Mill Creek Pit, Puslinch, ON
- Dufferin Agg. Richmond Hill Yard, Richmond Hill, ON
- Dufferin Aggregates Pickering Yard, Pickering, ON
- Duncor Portable Plant, Barrie, ON
- Duncor Emulsions, Shanty Bay, ON
- E.C. King Transfer Yard, Owen Sound, ON
- Essential Soils Solutions, Ramara, ON
- Farrish Crushing Portable Plant, Listowel, ON
- Federal Marine Terminals, Hamilton, ON
- Halton Crushed Stone, Town of Erin, ON
- Hanson Brick Burlington Review, Burlington, ON
- Highlands Group Melancthon Quarry, Melancthon, ON
- Hillway Equipment Limited, Orillia, ON
- James Dick Rockfort Quarry, Rockfort, ON
- James Dick Erin Pit Extension, Erin, ON
- James Dick Hidden Quarry, Guelph Eramosa, ON
- James Dick Reid Road Reservoir Quarry, Campbellville, ON
- Jennison Construction Clinton Pit, Clinton, ON
- Johnson Brothers McGuigan Pit, Cedar Springs, ON
- Johnson Brothers Erwin South Pit, Putnam, ON
- Kingfisher Aggregates Kingfisher Quarry, Ramara, ON
- Lafarge Cement, Bath, ON
- Lafarge Cement, Exshaw, AB
- Lafarge Goodwood Pit, Goodwood, ON
- Lippa Quarry, Skeleton Lake, ON
- Livingston Excavating & Trucking Inc., Simcoe, ON
- Lower Mattagami River Project, Mattagami, ON
- Lowndes Holdings, Mountsberg Quarry, Mountsberg, ON
- McCann Redi-Mix Durst Pit, Benmiller, ON
- NJ Excavating Martin Pit, Woolwich, ON
- SASE Aggregates, Uxbridge, ON
- Staples Himsworth Quarry, Himsworth, ON
- Thames Valley Agg., Banner Rd. Pit, Thamesford, ON
- Thames Valley Aggregates, Golding Pit, Putnam, ON
- The Murray Group, Cole Pit, Inverhaugh, ON
- The Murray Group, Devin Pit, Inverhaugh, ON
- Trent Valley Sand & Gravel Norfolk Quary, Norfolk, ON
- Try Aggregates Byron Pit Review, London, ON
- Preston Sand & Gravel Roszell Pit, Puslinch, ON
- Preston Sand & Gravel Henning Pit, North Dumfries, ON
- VicDom Sand and Gravel, Uxbridge, ON
- VicDom Sand and Gravel, Sunderland, ON
- VicDom Sand and Gravel, Utica, ON
- Walker Aggregates Walker Brothers Quarry, Thorold, ON
- Walker Aggregates Severn Pines Quarry, Orillia, ON
- Walker Aggregates Duntroon Quarry, Duntroon, ON
- Walker Aggregates Uppers Lane Quarry, Niagara Falls, ON
- Walker Aggregates Vineland Quarry, Vineland, ON
- Waterford Group Vinemount Quarry, Vinemount, ON
- Waterford Group Law Crushed Stone, Port Colborne, ON
- Wilson Quarry, Monck, ON

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Chemical Engineering Experience

- Process Design, Optimization and Control Relating to the Chemical Process Industry
- Two years in the process-engineering group of Huntsman Corporation Canada Inc.

Chemical Process Quantitative Risk Analysis

- Quantitative Hazard Assessment Sulphur Dioxide Storage and Transfer Systems, Huntsman Corporation Canada Inc., Guelph, ON
- Quantitative Hazard Assessment Hydrogen Chloride Storage and Transfer Systems, Huntsman Corporation Canada Inc., Guelph, ON
- Quantitative Hazard Assessment Ethylene Oxide Storage and Transfer Systems, Huntsman Corporation Canada Inc., Guelph, ON
- Peer Review of Cytec Canada Risk Assessment, Niagara Falls, ON
- Edmonton Air Quality Assessment, Edmonton, AB
- Madoc Co-Operative Association, Madoc, ON
- Screening Level Risk Assessment of a Propane Facility, St. George, ON
- RioTrin Grand Park Redevelopment Hazard Consequence Modelling, Mississauga, ON

Air Pollution Control Technologies

- Flue Gas Desulphurization Technology and Design Review, Moa Nickel, Cuba
- City of Guelph Waste Resource Innovation Centre Biofilter Replacement, Guelph, ON