REPORT

LAFARGE GOODWOOD PIT EXTENSION

GOODWOOD, ONTARIO

AIR QUALITY ASSESSMENT
RWDI # 1803861
April 20, 2023

SUBMITTED TO

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

1 INTRODUCTION

RWDI was retained by Lafarge to complete an air quality assessment in support of an Official Plan Amendment and Zoning By-Law Amendment with the Township of Uxbridge and Region of Durham as well as an Aggregate Resources Act (ARA) Class A License application for a proposed pit extension to the existing Lafarge Goodwood Pit. This assessment quantifies and evaluates air quality impacts from the various air emission sources for the proposed pit extension operations. These sources included aggregate material handling and processing and all associated equipment.

2 SITE DESCRIPTION & OPERATIONS

The current Lafarge Goodwood Pit is located at 4697 Concession 3 in Goodwood, Ontario between Wagg Road (north of the pit) and Durham Road 47 (south of the pit). The proposed pit extension will be located northeast of the current pit, at 4900 Concession 4, Goodwood, Ontario. The site will operate from 7:00 AM – 7:00 PM Monday through Saturday with an annual maximum extraction limit of approximately 1,177,000 tonnes. Shipping operations will begin at 6:00 AM. The proposed pit extension will ship aggregate material year-round but in general will only produce material during the summer months. The extraction and handling of aggregate material will be completed by front-end loader and an excavator. An aggregate processing plant powered by a generator will process the aggregate material. A fleet mix consisting of tri-axle and trailer trucks will be used to ship the processed material. The product mix consists of pit run, screened sand, granular B Type 1, granular A, and PEG B materials. **Figure 1** illustrates the location of the site, including the existing Goodwood Pit, and the proposed phasing of the proposed pit extension.

3 SENSITIVE RECEPTOR LOCATIONS

There are various rural homes located around the proposed Goodwood Pit extension. The nearest significant sensitive receptors are located east of the subject site along Concession Road 4 and north of the subject site along Wagg Road. These sensitive receptors were included as the basis for the assessment. Additional residences were considered along Durham Road 47 and Concession Road 3, however these are much further away from the proposed pit extension site, and therefore the impacts will be far lower than those included in the assessment.

4 CONTAMINANTS & SOURCES

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 $PM_{2.5}$).

In addition to dust, on-site vehicles and heavy equipment also emit products of combustion. Nitrogen dioxide gas (NO_2), TSP, PM_{10}, and $PM_{2.5}$ were modelled as the key representatives of combustion products.

The potential sources of emissions in the Pit are as follows:

- Overburden stripping and rehabilitation operations;
- Extraction of sand and gravel from the working face by excavator;
- Material handling operations (dumping material at the processing and wash plant, and loading highway trucks at the plant for shipping);
- Equipment travel over unpaved surfaces (front end loaders and highway trucks);
- Equipment travel over paved surfaces (highway trucks);
- Material crushing, screening and stockpiling; and,
- Tailpipe emissions from on-site vehicles, heavy equipment, and the crusher and screen deck engine.

Figure 2 presents modelled source locations for operations in representative locations.

5 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 details 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.

6 DISCUSSION OF MITIGATION MEASURES

The volume of truck and heavy equipment movement on unpaved surfaces within the proposed extension require above-average level of control, especially when operations are near sensitive receptors.

The 95% level of control used in the assessment for dust on the internal haul route is an outcome of the modelling, not an input assumption requiring justification. It represents the level of control found to be needed to achieve acceptable results at the nearest receptors. Published studies show that it is achievable. Rosbury (1985)[1] summarized results from various studies showing that levels of control as high as 98% were attained in some cases. Rosbury went on to prescribe a watering rate that would achieve near 100% control (approximately 1.7 L/m²/h). The U.S. EPA (AP-42, Chapter 13.2.2) showed that by maintaining a road surface moisture level of five times that of the ambient soil, a 95% level of control could be achieved. It is clear therefore that the 95% level of control prescribed by RWDI is attainable through sufficient watering. This finding of the studies is consistent with RWDI's experience in observing the effect of intensive watering programs.

The dispersion modelling analysis reflects the implementation of controls. The location of modelled sources also reflects the prohibition of processing within 160m of a residential receptor.

7 ATMOSPHERIC DISPERISON MODELLING

The 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 22112. 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, but 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 and processing operations do not occur for the entire year.

[1] Rosbury, Keith D. "Dust Control at Hazardous Waste Sites". Hazardous Waste Engineering Research Laboratory, Office of Research and Development, U.S. EPA. EPA/540/2-85/003,

Handling and processing sources were generally modelled using volume sources, in accordance with guidance from the National Stone Sand and Gravel Association (NSSGA)[2]. Haul routes and heavy equipment movement were modelled using adjacent volume sources, in accordance with from the MECP and NSSGA. Point sources were modelled using the appropriate source parameters.

The dispersion modelling files are available electronically upon request.

8 LOCAL EMISSION SOURCES

Environment Canada's National Pollutant Release Inventory (NPRI) is Canada's legislated, publicly accessible inventory of pollutant releases. Data for 2017 (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 no facilities reporting emissions to NPRI within five (5) kilometres of the Pit.

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) kilometer. 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 ten (10) licensed sites located within two (2) kilometres of the Pit, but none reported emissions to the NPRI. The sites are listed below.

- Nutter Pit, licensed to Lafarge Canada Inc., located west of Concession Road 3. This site has an annual license limit of 45,000 tonnes. The site is currently inactive;
- Weldon Aggregates, licensed to 2083293 Ontario Ltd., located west of Concession Road 3. This site has an annual license limit of 900,000 tonnes. The site is currently in operation;
- Harkow Pit, licensed to Wagg Road Development Ltd., located south of Wagg Road, west of Concession Road 3. This site has an annual license limit of 227,000 tonnes. The site does not currently appear to be in operation;
- Goodwood Pit, licensed to 614002 Ontario Limited, operating as Central Sand and Gravel, located north of Wagg Road, west of Concession Road 3. This site has an annual license limit of 454,000 tonnes. The site is currently in operation;
- Jefferson Pit, licensed to Lafarge Canada Inc., located north of Wagg Rd, east of Concession Road 2. This site has an annual license limit of 180,000 tonnes. The site is currently inactive;
- Central S&G North Pit, licensed to 1159644 Ontario Limited, operating as Central Sand and Gravel, located west of Wagg Road. This site has an annual license limit of 450,000 tonnes. The site is currently in operation;
- James Pit, licensed to Lafarge Canada Inc., located east of Concession Road 2. This site has an annual license limit of 600,000 tonnes. The site is currently inactive;

[2] National Stone Sand and Gravel Association, "Modeling Fugitive Dust Sources with AERMOD", January 2007.

- Boland Pit, licensed to Lafarge Canada Inc., located south of the James Pit, set back approximately 100 metres from Concession Road 2. This site has an annual license limit of 600,000 tonnes. The site does not currently appear to be in operation is currently inactive;
- Campbellville Pit, licensed to CRH Canada Group Inc., located on east of Concession Road 2. This site has an annual license limit of 350,000 tonnes. The site does not currently appear to be in operation;
- SASE Aggregates Pit, licensed to SASE Aggregates Ltd., consisting of two adjacent sites located south of Wagg Road, between Concession Road 5 and Old Highway 47. This site has an annual license limit of 350,000 tonnes. The site is currently in operation.

Of these, only the Boland Pit, Campbellville Pit and SASE Aggregates Pit are within one (1) kilometre, and the Boland Pit is not currently in operation. 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 SASE Aggregates Pit, RWDI has recommended additional mitigation measures to minimize the potential for combined, cumulative impacts from the two sites.

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 48006, located in Newmarket). This data is provided on **Table 1**. TSP and PM_{10} were estimated from station measured $PM_{2.5}$ data using factors derived from the analysis of extensive monitoring data from other sites, as presented by the 2004 report by Lall et. al.[3]. Silica was estimated using published data for cities in the northeast U.S.[4].

The use of historical data from a representative monitoring station operated by the MECP somewhere 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 that is in a rural location, with a number of aggregate operations nearby. There are no such monitoring stations operating anywhere in Southern Ontario. Therefore, the decision was made to use monitoring data from a station located in a suburban environment, which is expected to overestimate concentrations of fine particulate matter in a rural area and, thereby err on the safe side. The Newmarket monitoring station was chosen for this purpose. It is also the closest monitoring station to the site.

Although data for 2021 and 2022 are now available, there is concern that due to the effect of the COVID pandemic these values will artificially lower the estimated background concentrations. This effect can already be seen in the monitoring data from 2020, and therefore the 2021 and 2022 data was not included.

[3] Lall, R., M. Kendall, K. Ito and G. D. Thurston (2004). Estimation of Historical Annual $PM_{2.5}$ Exposures for Health Effects Assessments, Atmos. Env., 38, pp. 5217-5226.
[4] United States Environmental Protection Agency (1996). Ambient Levels and Noncancer Health effects of Inhaled Crystalline Silica and Amorphous Silica: Health Issue Assessment. EPA/600/R-95-115.

10 CHEMICAL REACTIONS AMONG CONTAMINANTS

The only chemical reaction among the emitted contaminants of relevance to local air quality impacts is the conversion of nitric oxide (NO) to nitrogen dioxide (NO_2). Oxides of nitrogen (NO_X) emitted in diesel exhaust are composed primarily of NO. However, once the exhaust is emitted to the atmosphere and begins to mix with outside air, some of the NO is oxidized in reactions with other contaminants, principally ground-level ozone (O_3), to produce NO_2. This is important to the cumulative effects assessment, as the criteria used in this assessment apply only to NO_2, which has a much greater toxicity than NO.

The Ozone Limiting Method (OLM) was used in the cumulative effects assessment to estimate the maximum short-term NO_2 concentrations resulting from emissions of NO_X. The OLM assumes that the conversion of NO to NO_2 is limited only by the amount of O_3 present in the outside air. If the concentration of available O_3 (ppb) is less than that of the NO contributed by the modelled roadway emissions, then the portion of NO that is converted to NO_2 equals the available O_3. If the concentration of available O_3 exceeds that of the NO contributed by the modelled roadway, then all NO is converted to NO_2.

This calculation is performed in the AERMOD dispersion model. A simplified version of the OLM was used to estimate the short-term concentration of NO_2 resulting from emissions of NOX. Concentrations of NO_X predicted by AERMOD are converted to NO_2 based on the background ozone concentration. To represent background ozone conditions, 99th percentile ozone concentrations by hour of day were derived from measurements recorded by the MECP at the Newmarket monitoring station. The portion of emitted total NO_X that is already in the form of NO_2 before exiting the tailpipe was estimated to be 10%.

11 RESULTS

The results of the assessment are presented in **Table 2**. Maximum predicted concentrations from the proposed pit extension are below the relevant criteria for all contaminants at the modelled receptors, with the recommended dust control measures in place. These receptor locations are shown on **Figure 1**. Receptors located further from the site will have lower predicted concentrations than those shown due to the physics of atmospheric transport.

When the 90th percentile background concentration from the Newmarket 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 nearby receptors. As 90th percentile 24-hour values for NO_2 are not available, the 90th percentile 1-hour values were used as background concentrations for the 24-hour modelling results, which is conservative.

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

12 RECOMMENDATIONS

The 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 on the Site Plans:

- The site will operate in accordance with Lafarge's Best Management Practices Plan for The Control of Fugitive Dust Emissions, 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 also recommends the following mitigation measures be incorporated into the BMPP.

- Excavation
    - Excavation and loading operations should be monitored hourly when all of the following criteria are met:
        - Dry weather is anticipated;
        - Excavation and loading activities are within 160 m of a residence; and,
        - Winds are anticipated to be blowing towards the residence.
    - If visible dust is observed under these conditions, these operations shall be reduced, or additional mitigation measures shall be undertaken, such that visible dust is prevented from leaving the site
    - The excavation rate shall not exceed 7,000 tonnes/day.
- Portable Plant
    - The portable plant may not operate within 160 metres of a residence.
    - The processing plant shall be equipped with a water spray system. Spray bars shall be located at the crushers and screen.
    - Watering rate will be set as needed to suppress visible dust.
    - For screenings and other high-fines materials, stackers will be kept as close to the tops of stockpiles as is feasible, to achieve a drop height of approximately 1m or less.
    - The processing rate shall not exceed 3,000 tonnes/day.

- 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/m2/hour.
    - The actual watering rate shall vary, depending on surface moisture conditions and traffic conditions, and shall be triggered by the Operational Watering Forecasting guidance provided in the BMPP.
    - 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 found.
    - A speed limit of 20 km/h shall be posted near the site entrance. Haul truck and highway truck operators will be directed to observe the speed limit.

14 CONCLUSIONS

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

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TABLES

Table 1: Ambient Air Quality Data

Project 180361

Year	TSP [2]		PM10 [2]	Silica	PM2.5		NO2 [4]						O3 [4]	
	90th Percentile 24-hour	Annual Average	90th Percentile 24-hour	90th Percentile 24-hour [3]	90th Percentile 24-hour	Annual Average	90th Percentile 1-Hour		90th Percentile 24-Hour		Annual Average		99th Percentile 1-Hour	
	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)	(ppb)	(µg/m³)
2016	43	20	24	1.4	13	6.0	15	32	13.1	32	6.5	14	64	99
2017	40	20	22	1.3	12	5.9	14	28	11.2	28	6.3	13	57	89
2018	43	21	24	1.4	13	6.4	13	27	11.8	23	6.1	12	65	134
2019	43	20	24	1.4	13	5.9	13	25	11.7	23	5.5	11	54	112
2020	40	20	22	1.3	12	5.9	10	20	9.3	18	4.5	9	59	122
Average	42	20	23	1.4	13	6.0	13	26	11.4	25	5.8	12	60	111

Notes:

[1] All data from MOECC Station 48006, in Newmarket, downloaded from http://www.airqualityontario.com/history/

[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 10ºC.

Revision Date: 2021-06-24

Prepared by: BGS

Table 2: Cumulative Effects Analysis with Mitigation

RWDI Project 1803861

Receptor		UTM Coordinates		Contaminant	Averaging Period	Recommended Criteria for Cumulative Effects Analysis	Without Background		With Background	
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 (%)
R01	Residence	646,098	4,879,291	TSP	24	120	20	16%	62	51%
					Annual	60	1.7	3%	22	36%
				PM10	24	50	5.1	10%	28	56%
				Silica (<10µm)	24	5	0.8	15%	2.2	43%
				PM2.5	24	27	4.0	15%	17	63%
					Annual	8.8	0.31	3%	6.3	72%
				NO2	1	400	22	5%	48	12%
					24	200	2.0	1%	27	13%
					Annual	40	0.16	0%	12	30%
R02	Residence	646,084	4,879,355	TSP	24	120	22	18%	64	53%
					Annual	60	2.0	3%	22	37%
				PM10	24	50	5.8	12%	29	58%
				Silica (<10µm)	24	5	0.89	18%	2.3	46%
				PM2.5	24	27	4.0	15%	17	63%
					Annual	9	0.38	4%	6.4	73%
				NO2	1	400	24	6%	50	12%
					24	200	2.6	1%	28	14%
					Annual	40	0.19	0%	12	30%
R03	Residence	645,944	4,879,489	TSP	24	120	47	39%	89	74%
					Annual	60	5.0	8%	25	42%
				PM10	24	50	13.4	27%	36	73%
				Silica (<10µm)	24	5	1.9	38%	3.3	66%
				PM2.5	24	27	9.5	35%	22	83%
					Annual	8.8	1.27	14%	7.3	83%
				NO2	1	400	46	11%	72	18%
					24	200	7.8	4%	33	16%
					Annual	40	0.68	2%	13	32%
R04	Residence	645,941	4,879,527	TSP	24	120	58	48%	100	83%
					Annual	60	5.3	9%	25	42%
				PM10	24	50	21.9	44%	45	90%
				Silica (<10µm)	24	5	2.99	60%	4.4	88%
				PM2.5	24	27	10.0	37%	23	85%
					Annual	9	1.40	16%	7.4	84%
				NO2	1	400	38	10%	64	16%
					24	200	11.9	6%	37	18%
					Annual	40	0.76	2%	13	32%

Receptor		UTM Coordinates		Contaminant	Averaging Period	Recommended Criteria for Cumulative Effects Analysis	Without Background		With Background	
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 (%)
R05	Residence	646,025	4,879,495	TSP	24	120	43	36%	85	71%
					Annual	60	3.2	5%	23	39%
				PM10	24	50	11.8	24%	35	70%
				Silica (<10µm)	24	5	1.7	33%	3.1	61%
				PM2.5	24	27	6.6	25%	20	73%
					Annual	8.8	0.75	9%	6.7	77%
				NO2	1	400	34	9%	60	15%
					24	200	5.6	3%	31	15%
					Annual	40	0.40	1%	12	31%
R06	Residence	646,012	4,879,549	TSP	24	120	40	34%	82	69%
					Annual	60	3.5	6%	24	39%
				PM10	24	50	14.3	29%	37	75%
				Silica (<10µm)	24	5	1.95	39%	3.3	67%
				PM2.5	24	27	6.8	25%	20	73%
					Annual	9	0.86	10%	6.9	78%
				NO2	1	400	30	8%	56	14%
					24	200	8.3	4%	33	17%
					Annual	40	0.47	1%	12	31%
R07	Residence	645,994	4,879,597	TSP	24	120	39	32%	81	67%
					Annual	60	3.7	6%	24	39%
				PM10	24	50	11.8	24%	35	70%
				Silica (<10µm)	24	5	1.7	35%	3.1	63%
				PM2.5	24	27	7.6	28%	21	76%
					Annual	8.8	0.89	10%	6.9	78%
				NO2	1	400	37	9%	63	16%
					24	200	8.1	4%	33	17%
					Annual	40	0.49	1%	12	31%
R08	Residence	645,978	4,879,639	TSP	24	120	38	31%	80	66%
					Annual	60	3.4	6%	23	39%
				PM10	24	50	11.7	23%	35	69%
				Silica (<10µm)	24	5	1.74	35%	3.1	63%
				PM2.5	24	27	8.2	30%	21	79%
					Annual	9	0.83	9%	6.8	78%
				NO2	1	400	47	12%	73	18%
					24	200	5.4	3%	30	15%
					Annual	40	0.46	1%	12	31%

Receptor		UTM Coordinates		Contaminant	Averaging Period	Recommended Criteria for Cumulative Effects Analysis	Without Background		With Background	
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 (%)
R09	Residence	645,932	4,879,925	TSP	24	120	29	24%	71	59%
					Annual	60	1.2	2%	21	35%
				PM10	24	50	6.6	13%	30	59%
				Silica (<10µm)	24	5	1.0	20%	2.4	48%
				PM2.5	24	27	3.9	14%	17	63%
					Annual	8.8	0.19	2%	6.2	70%
				NO2	1	400	47	12%	73	18%
					24	200	4.4	2%	29	15%
					Annual	40	0.14	0%	12	30%
R10	Residence	645,771	4,879,988	TSP	24	120	26	22%	68	57%
					Annual	60	1.0	2%	21	35%
				PM10	24	50	7.2	14%	30	60%
				Silica (<10µm)	24	5	0.97	19%	2.4	47%
				PM2.5	24	27	3.4	12%	16	61%
					Annual	9	0.15	2%	6.1	70%
				NO2	1	400	30	8%	56	14%
					24	200	4.3	2%	29	15%
					Annual	40	0.13	0%	12	30%
R11	Residence	645,693	4,879,857	TSP	24	120	21	17%	63	52%
					Annual	60	1.7	3%	22	36%
				PM10	24	50	6.3	13%	29	59%
				Silica (<10µm)	24	5	0.8	17%	2.2	45%
				PM2.5	24	27	3.6	13%	17	62%
					Annual	8.8	0.27	3%	6.3	71%
				NO2	1	400	37	9%	63	16%
					24	200	4.9	2%	30	15%
					Annual	40	0.24	1%	12	31%
R12	Residence	645,645	4,879,844	TSP	24	120	24	20%	66	55%
					Annual	60	1.8	3%	22	36%
				PM10	24	50	6.1	12%	29	58%
				Silica (<10µm)	24	5	0.84	17%	2.2	45%
				PM2.5	24	27	3.0	11%	16	59%
					Annual	9	0.30	3%	6.3	72%
				NO2	1	400	32	8%	58	15%
					24	200	4.3	2%	29	15%
					Annual	40	0.26	1%	12	31%

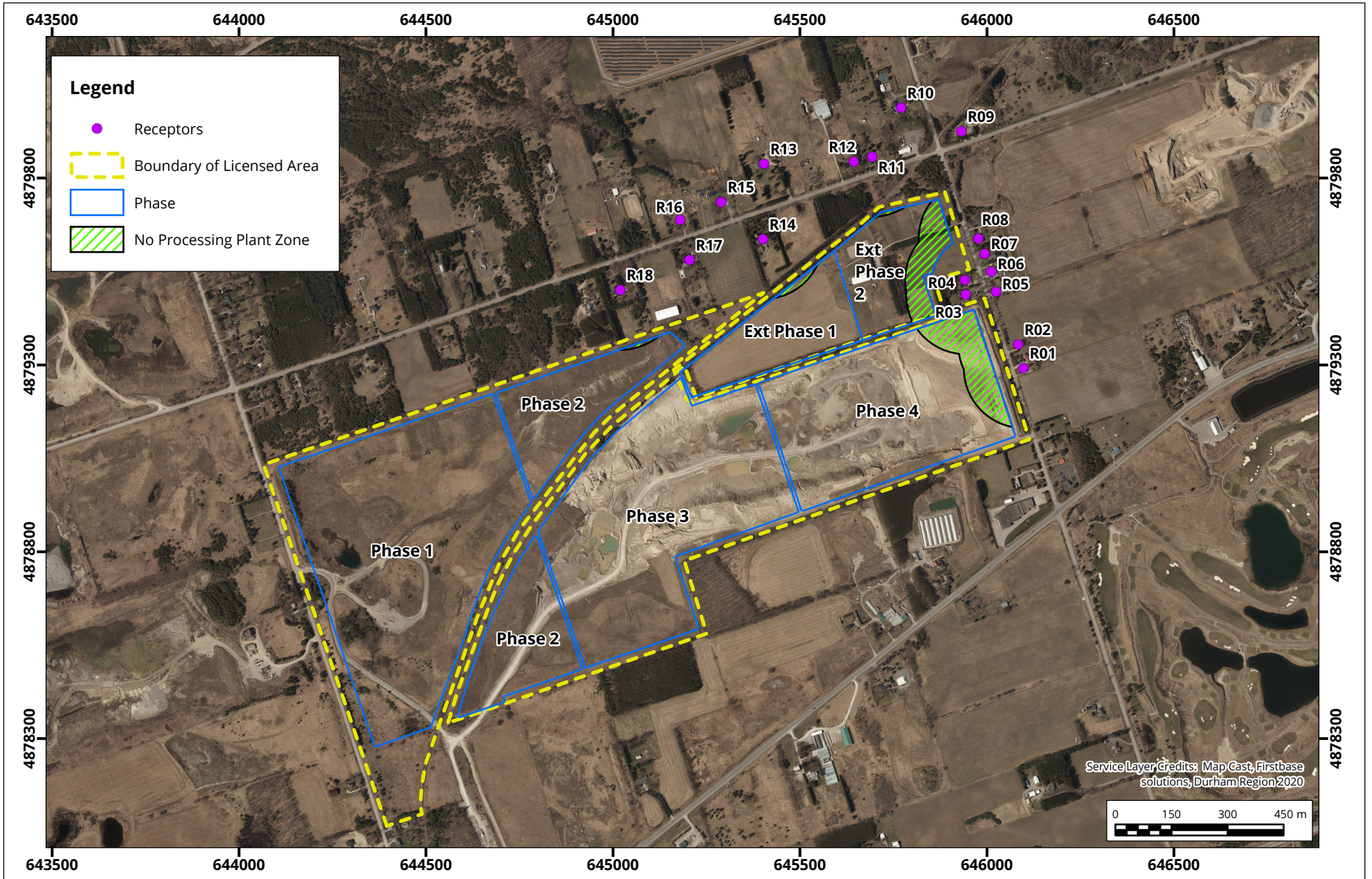
Receptor		UTM Coordinates		Contaminant	Averaging Period	Recommended Criteria for Cumulative Effects Analysis	Without Background		With Background	
ID	Type	X (m)	Y (m)		(hours)	(µg/m³)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)	Predicted Concentration (µg/m³)	Percentage of Revelant Criteria (%)
R13	Residence	645,404	4,879,839	TSP	24	120	26	22%	68	57%
					Annual	60	1.4	2%	21	36%
				PM10	24	50	6.3	13%	29	59%
				Silica (<10µm)	24	5	0.9	17%	2.3	45%
				PM2.5	24	27	3.0	11%	16	59%
					Annual	8.8	0.17	2%	6.2	70%
				NO2	1	400	27	7%	53	13%
					24	200	3.9	2%	29	14%
					Annual	40	0.14	0%	12	30%
R14	Residence	645,402	4,879,636	TSP	24	120	33	27%	75	62%
					Annual	60	2.3	4%	22	37%
				PM10	24	50	6.6	13%	30	59%
				Silica (<10µm)	24	5	0.98	20%	2.4	48%
				PM2.5	24	27	5.1	19%	18	67%
					Annual	9	0.23	3%	6.2	71%
				NO2	1	400	23	6%	49	12%
					24	200	2.7	1%	28	14%
					Annual	40	0.16	0%	12	30%
R15	Residence	645,290	4,879,736	TSP	24	120	29	24%	71	59%
					Annual	60	1.6	3%	22	36%
				PM10	24	50	4.0	8%	27	54%
				Silica (<10µm)	24	5	0.8	15%	2.2	43%
				PM2.5	24	27	3.1	12%	16	60%
					Annual	8.8	0.13	2%	6.1	70%
				NO2	1	400	23	6%	49	12%
					24	200	2.1	1%	27	14%
					Annual	40	0.10	0%	12	30%
R16	Residence	645,180	4,879,688	TSP	24	120	24	20%	66	55%
					Annual	60	1.6	3%	22	36%
				PM10	24	50	3.8	8%	27	54%
				Silica (<10µm)	24	5	0.62	12%	2.0	40%
				PM2.5	24	27	2.9	11%	16	59%
					Annual	9	0.11	1%	6.1	69%
				NO2	1	400	22	6%	48	12%
					24	200	1.6	1%	27	13%
					Annual	40	0.08	0%	12	30%

Receptor		UTM Coordinates		Contaminant	Averaging Period	Recommended Criteria for Cumulative Effects Analysis	Without Background		With Background	
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 (%)
R17	Residence	645,205	4,879,580	TSP	24	120	27	22%	69	57%
					Annual	60	2.0	3%	22	37%
				PM10	24	50	3.6	7%	27	53%
				Silica (<10µm)	24	5	0.7	14%	2.1	42%
				PM2.5	24	27	2.6	10%	16	58%
					Annual	8.8	0.13	1%	6.1	70%
				NO2	1	400	21	5%	47	12%
					24	200	1.6	1%	27	13%
					Annual	40	0.09	0%	12	30%
R18	Residence	645,020	4,879,501	TSP	24	120	23	19%	65	54%
					Annual	60	1.6	3%	22	36%
				PM10	24	50	2.9	6%	26	52%
				Silica (<10µm)	24	5	0.61	12%	2.0	40%
				PM2.5	24	27	2.0	7%	15	55%
					Annual	9	0.08	1%	6.1	69%
				NO2	1	400	13	3%	39	10%
					24	200	1.3	1%	26	13%
					Annual	40	0.05	0%	12	30%

Revision Date: 2023-04-20

Prepared by: BGS

FIGURES



Site Location and Phasing

True North

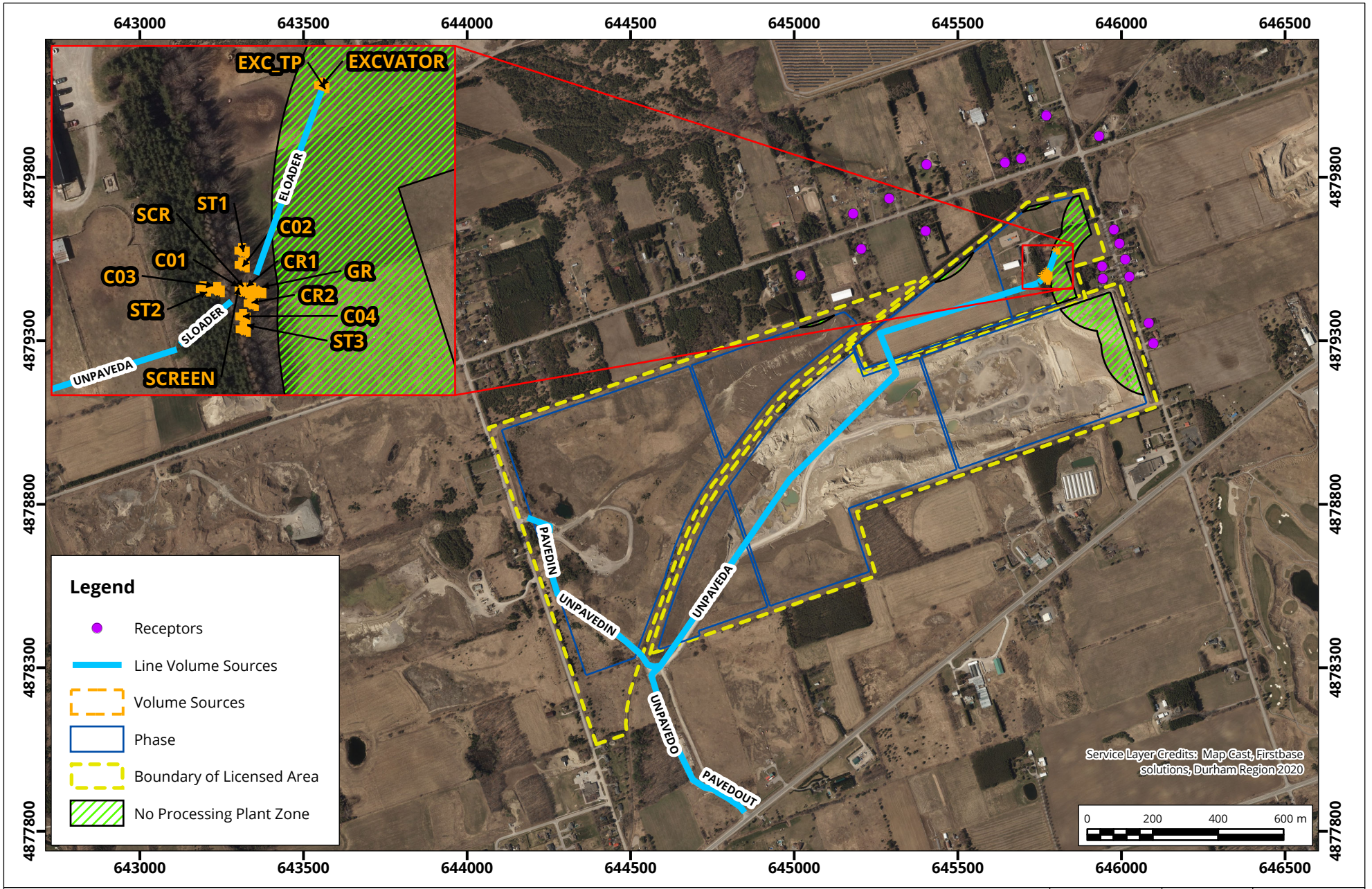
Map Projection: NAD 1983 UTM Zone 17N

LaFarge Goodwood Pit Extension - Goodwood, Ontario

Project #: 1803861

Drawn by: LJN	Figure: 1
Approx. Scale:	1:14,000
Date Revised: Dec 23, 2020	

Map Document: C:\Users\LJN\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC\Desktop\GIS\1803861_Goodwood Pit\1803861_GoodwoodPit.aprx



Site Plan Showing Significant Sources and Receptors

True North

Drawn by: LJN	Figure: 2
Approx. Scale:	1:16,000
Date Revised: Dec 23, 2020	

Map Projection: NAD 1983 UTM Zone 17N

LaFarge Goodwood Pit Extension - Goodwood, Ontario

Project #: 1803861

Map Document: C:\Users\LJN\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC\Desktop\GIS\1803861_Goodwood Pit\1803861_GoodwoodPit.aprx

APPENDIX A

Appendix A: Bulk Material Handling Emissions Spreadsheet

Project #1803861

LaFarge Goodwood Pit Extension

AGGREGATE HANDLING AND STORAGE PILES - AP-42 Section 13.2.4

Average recorded hourly wind speed (m/s): 3.96
(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, 0.35 and 0.053 for TSP, PM_{10} and $PM_{2.5}$) [3]
U mean wind speed, meters per second (m/s)
M material moisture content (%)

Source ID [1]	Description	Processing Rate		Site Data				Base AP-42 Emission Factor				Base Emission Rate				Additional	Final Controlled Emission Rate at 3.96 m/s							
		Hourly (Mg/h)	Daily (Mg/d)	Site Specific Data? (y/n)	Silt Content (%)	Moisture Content (%)	Source Conditions Valid [2]	TSP (kg/Mg)	PM_{10} (kg/Mg)	$PM_{2.5}$ (kg/Mg)	Silica (kg/Mg)	TSP (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)	Silica (g/s)	Control Efficiency Applied (%)	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
EXCVATOR	Excavator Loading Trucks	538	7000	n	7.5%	4.8%	valid	8.1E-04	3.5E-04	1.2E-04	6.0E-05	1.2E-01	5.3E-02	1.7E-02	9.0E-03		1.2E-01	B	5.3E-02	B	1.7E-02	B	9.0E-03	B
GR	Truck / Loader Drop to Grizzly	346	4500	n	7.5%	4.8%	valid	8.1E-04	3.5E-04	1.2E-04	6.0E-05	7.8E-02	3.4E-02	1.1E-02	5.8E-03		7.8E-02	B	3.4E-02	B	1.1E-02	B	5.8E-03	B
ST1	Stacker 1	115	1500	n	7.5%	2.1%	valid	2.6E-03	1.1E-03	3.7E-04	1.9E-04	8.2E-02	3.6E-02	1.2E-02	6.1E-03		8.2E-02	B	3.6E-02	B	1.2E-02	B	6.1E-03	B
ST1	Stacker 1	115	1500	n	7.5%	2.1%	valid	2.6E-03	1.1E-03	3.7E-04	1.9E-04	8.2E-02	3.6E-02	1.2E-02	6.1E-03		8.2E-02	B	3.6E-02	B	1.2E-02	B	6.1E-03	B
ST1	Stacker 1	115	1500	n	7.5%	2.1%	valid	2.6E-03	1.1E-03	3.7E-04	1.9E-04	8.2E-02	3.6E-02	1.2E-02	6.1E-03		8.2E-02	B	3.6E-02	B	1.2E-02	B	6.1E-03	B

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

EF = 0.0016 x (0.8) x ((3.96 m/s) / 2.2)^1.3 / ((4.8%) / 2)^1.4 = 8.1E-04 kg TSP / Mg handled

Sample calculation for TSP emission rate for Source EXCVATOR: Excavator Loading Trucks, at a sample wind speed of 5 m/s

538 $Mg_{handled}$	8.1E-04 kg_{TSP}	1 h	1000 g_{TSP}	1 $g_{TSP\ uncontrolled}$		
1 h	1 $Mg_{handled}$	3600 s	1 kg_{TSP}	1 g_{TSP}	=	1.2E-01 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.
Moisture and silt values reflect sampling conducted by RWDI at pits Southern Ontario
- Average moisture content from the stockpiles at sampled sites was 4.1%, silt was 6.4%
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
Hourly processing rate based on 13 hours of operation for shipping handling sources (0600h - 1900h)

APPENDIX B

Appendix B: Processing Emissions Spreadsheet

LaFarge Goodwood Pit Extension

Project #1803861

Soource ID [1]	Source Description / Process Decription	AP-42 Process Description [1]	Process Code	AP-42 Chapter	Processing Rate		Base AP-42 Emission Factor				Base Emission Rate				Additional Control Efficiency Applied (%)	Final Controlled Emission Rate							
					Hourly (Mg/h)	Daily (Mg/d)	TSP [3] (kg/Mg)	PM_{10} (kg/Mg)	$PM_{2.5}$ (kg/Mg)	Silica (kg/Mg)	TSP (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)	Silica (g/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
CR1	Primary Crusher	Primary crushing (controlled)	6	11.19.2-1	375	4500	3.4E-04	2.7E-04	5.0E-05	4.6E-05	3.5E-02	2.8E-02	5.2E-03	4.8E-03		3.5E-02	E	2.8E-02	E	5.2E-03	E	4.8E-03	E
C01	Conveyor	Conveyor transfer point (controlled)	14	11.19.2-1	375	4500	3.7E-05	2.3E-05	6.5E-06	3.9E-06	3.9E-03	2.4E-03	6.8E-04	4.1E-04		3.9E-03	E	2.4E-03	D	6.8E-04	E	4.1E-04	E
SCR	Triple Deck Screen	Screening (controlled)	2	11.19.2-1	375	4500	5.6E-04	3.7E-04	2.5E-05	6.3E-05	5.8E-02	3.9E-02	2.6E-03	6.6E-03		5.8E-02	E	3.9E-02	C	2.6E-03	E	6.6E-03	E
CR2	Secondary Crusher	Secondary crushing (controlled)	7	11.19.2-1	125	1500	3.4E-04	2.7E-04	5.0E-05	4.6E-05	1.2E-02	9.4E-03	1.7E-03	1.6E-03		1.2E-02	E	9.4E-03	E	1.7E-03	E	1.6E-03	E
C02	Conveyor from SCR to ST01	Conveyor transfer point (controlled)	14	11.19.2-1	125	1500	3.7E-05	2.3E-05	6.5E-06	3.9E-06	1.3E-03	8.0E-04	2.3E-04	1.4E-04		1.3E-03	E	8.0E-04	D	2.3E-04	E	1.4E-04	E
C03	Conveyor from SCR to ST02	Conveyor transfer point (controlled)	14	11.19.2-1	125	1500	3.7E-05	2.3E-05	6.5E-06	3.9E-06	1.3E-03	8.0E-04	2.3E-04	1.4E-04		1.3E-03	E	8.0E-04	D	2.3E-04	E	1.4E-04	E
C04	Conveyor from SCR to ST03	Conveyor transfer point (controlled)	14	11.19.2-1	125	1500	3.7E-05	2.3E-05	6.5E-06	3.9E-06	1.3E-03	8.0E-04	2.3E-04	1.4E-04		1.3E-03	E	8.0E-04	D	2.3E-04	E	1.4E-04	E

Sample calculation for TSP emissions from Source SCR: Triple Deck Screen

$$\frac{375\ Mg_{processed}}{1\ h} \left| \frac{5.6E\text{-}04\ kg_{TSP}}{1\ Mg_{processed}} \right| \frac{1\ h}{3600\ s} \left| \frac{1000\ g_{TSP}}{1\ kg_{TSP}} \right| \frac{1\ g_{TSP\ uncontrolled}}{1\ g_{TSP}} = 5.8E\text{-}02\ g_{TSP}/s$$

Comments
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
AP-42 process listed as "controlled" reflects between 70-90% control due to high moisture / water sprays (AP-42 11.19.2).
AP-42 Emission Factor is based on PM100. The values have been corrected to reflect PM44.
Hourly processing rate based on 12 hours of operation for processing sources (0700h - 1900h)

APPENDIX C

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

LaFarge Goodwood Pit Extension

Project #1803861

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/m^2)
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		Segment Length	Road Surface	Roadway Type	Mean Vehicle Speed		Average Vehicle Weight	Surface Material Moisture Content	Surface Silt Content	Road Surface Silt Loading	Base AP-42 Emission Factor				Base Emission Rate				Additional Control Efficiency Applied	Final Controlled Emission Rate							
		Hourly	Daily										TSP	PM_{10}	$PM_{2.5}$	Silica	TSP	PM_{10}	$PM_{2.5}$	Silica		TSP	Data Quality Rating	PM_{10}	Data Quality Rating	$PM_{2.5}$	Data Quality Rating	Silica	Data Quality Rating
		(#/h)	(#/d)	(m)			(km/h)	(mph)	(tons)	(%)	(%)	(g/m^2)	(g/VKT)	(g/VKT)	(g/VKT)	(g/VKT)	(g/s)	(g/s)	(g/s)	(g/s)	(%)	(g/s)		(g/s)		(g/s)		(g/s)	
ELOADER	Extraction Loader	23	300	75	Unpaved	Industrial	20	12	15.4		4.8%		2.5E+03	3.9E+02	3.9E+01	6.6E+01	1.2E+00	1.9E-01	1.9E-02	3.2E-02	95%	6.0E-02	C	9.3E-03	B	9.3E-04	C	1.6E-03	C
SLOADER	Shipping Loader	23	300	25	Unpaved	Industrial	20	12	14.7		4.8%		2.4E+03	3.8E+02	3.8E+01	6.4E+01	3.9E-01	6.1E-02	6.1E-03	1.0E-02	95%	1.9E-02	C	3.0E-03	B	3.0E-04	C	5.1E-04	C
PAVEDIN	Empty Trucks Entering Pit	12	150	595	Paved	Industrial	20	12	14.7			1.2	8.8E+01	1.1E+01	2.7E+00	1.9E+00	1.7E-01	2.3E-02	5.4E-03	3.8E-03		1.7E-01	C	2.3E-02	C	5.4E-03	C	3.8E-03	C
UNPAVEDI	Empty Trucks Entering Pit	12	150	1765	Unpaved	Industrial	20	12	14.7		4.8%		2.4E+03	3.8E+02	3.8E+01	6.4E+01	1.4E+01	2.2E+00	2.2E-01	3.8E-01	95%	7.2E-01	C	1.1E-01	B	1.1E-02	C	1.9E-02	C
UNPAVEDA	Unpaved Haul Route	23	300	1786	Unpaved	Industrial	20	12	29.0		4.8%		3.3E+03	5.1E+02	5.1E+01	8.7E+01	3.8E+01	5.9E+00	5.9E-01	1.0E+00	95%	1.9E+00	C	2.9E-01	B	2.9E-02	C	5.0E-02	C
UNPAVEDO	Loaded Trucks Leaving Pit	12	150	475	Unpaved	Industrial	20	12	43.2		4.8%		4.0E+03	6.2E+02	6.2E+01	1.0E+02	6.3E+00	9.7E-01	9.7E-02	1.7E-01	95%	3.1E-01	C	4.9E-02	B	4.9E-03	C	8.3E-03	C
PAVEDOUT	Loaded Trucks Leaving Pit	12	150	107	Paved	Industrial	20	12	43.2			1.2	2.6E+02	3.4E+01	8.2E+00	5.8E+00	9.4E-02	1.2E-02	2.9E-03	2.1E-03		9.4E-02	C	1.2E-02	C	2.9E-03	C	2.1E-03	C

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	0.1	B
	PM_{30}	6	1	-	0.3	0.3	B
	TSP	8.96	1	-	0.49	0.2	C

Comments

Hourly shipping traffic based on a peak of 150 trips per day, as per information provided by Lafarge (e-mail dated 180829)
- Traffic mix approximately 50% tri-axle, with 50% tri-axle plus trailer:
95% control applied to unpaved roads based on watering as per the recommendations in the report (hourly watering under dry conditions)
Silt values for unpaved roads reflect mean values from AP-42
Silt loading on the paved entrance road reflects a combination of flushing and sweeping as per the recommendations in the report.
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
Loader trips based on daily production rate and assumed bucket capacity of 15 tonnes
Hourly passes for shipping loader and trucks based on 13 hours of operation for shipping handling sources (0600h - 1900h)

Sample calculation for uncontrolled TSP emission factor for Source PAVEDIN: Empty Trucks Entering Pit

EF = 281.9 x (4.9) x [(0% / 12)]^(0.7) x [(14.7 tons) / 3]^(0.45) = 59 g TSP / vehicle kilometer travelled (vkt)

Sample calculation for TSP emission rate for Source PAVEDIN: Empty Trucks Entering Pit

$$\frac{12\ \text{vehicles}}{1\ \text{h}} \left| \frac{595\ \text{m}}{} \right| \frac{1\ \text{km}}{1000\ \text{m}} \left| \frac{59\ g_{TSP}}{1\ \text{vehicle km}} \right| \frac{1\ \text{h}}{3600\ \text{s}} \left| \frac{1\ g_{TSP\ uncontrolled}}{1\ g_{TSP}} \right. = 1.2\text{E-}01\ g_{TSP} / \text{s}$$

APPENDIX D

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

Project #1803861

LaFarge Goodwood Pit Extension

Source ID	Description	Gross Power Rating (kW)	Number Of Units	Traffic Passes Hourly (#/h)	Traffic Passes Daily (#/d)	Segment Length (m)	Mean Vehicle Speed (km/h)	Load Factor (%)	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)	NOx (g/s)
On-Site Mobile Equipment																								
EXC_TP	Excavator	400	1	n/a	n/a	n/a	n/a	53%	--	0.2	--	0.2	--	0.2	--	4	1.2E-02	1.2E-02	1.2E-02	2.4E-01	--	--	--	--
ELOADER	Extraction Loader	607	1	n/a	n/a	n/a	n/a	53%	--	0.2	--	0.2	--	0.2	--	6.4	1.8E-02	1.8E-02	1.8E-02	5.7E-01	7.7E-02	2.7E-02	1.9E-02	5.7E-01
SLOADER	Shipping Loader	607	1	n/a	n/a	n/a	n/a	53%	--	0.2	--	0.2	--	0.2	--	6.4	1.8E-02	1.8E-02	1.8E-02	5.7E-01	3.7E-02	2.1E-02	1.8E-02	5.7E-01
PAVEDIN	Empty Trucks Entering Pit	n/a	n/a	12	150	595	20	n/a	0.95	--	0.95	--	0.95	--	11.4	--	1.9E-03	1.9E-03	1.9E-03	2.3E-02	1.8E-01	2.4E-02	6.8E-03	2.3E-02
UNPAVEDI	Empty Trucks Entering Pit	n/a	n/a	12	150	1765	20	n/a	0.95	--	0.95	--	0.95	--	11.4	--	5.6E-03	5.6E-03	5.6E-03	6.7E-02	7.2E-01	1.2E-01	8.5E-03	6.7E-02
UNPAVEDA	Two-way Unpaved Haul Route	n/a	n/a	23	300	1786	20	n/a	0.95	--	0.95	--	0.95	--	11.4	--	1.1E-02	1.1E-02	1.1E-02	1.3E-01	1.9E+00	3.0E-01	1.1E-02	1.3E-01
UNPAVEDO	Loaded Trucks Leaving Pit	n/a	n/a	12	150	475	20	n/a	0.95	--	0.95	--	0.95	--	11.4	--	1.5E-03	1.5E-03	1.5E-03	1.8E-02	3.1E-01	5.0E-02	1.5E-03	1.8E-02
PAVEDOUT	Loaded Trucks Leaving Pit	n/a	n/a	12	150	107	20	n/a	0.95	--	0.95	--	0.95	--	11.4	--	3.4E-04	3.4E-04	3.4E-04	4.1E-03	9.4E-02	1.2E-02	3.4E-04	4.1E-03
Stationary Combustion Equipment																								
CRUSHER1	Primary Crusher Engine	100	1	n/a	n/a	n/a	n/a	100%	--	0.2	--	0.2	--	0.2	--	4	5.6E-03	5.6E-03	5.6E-03	1.1E-01	5.6E-03	5.6E-03	5.6E-03	1.1E-01
CRUSHER2	Secondary Crusher Engine	100	1	n/a	n/a	n/a	n/a	100%	--	0.2	--	0.2	--	0.2	--	4	5.6E-03	5.6E-03	5.6E-03	1.1E-01	5.6E-03	5.6E-03	5.6E-03	1.1E-01
SCREEN	Screening Plant Engine	100	1	n/a	n/a	n/a	n/a	100%	--	0.2	--	0.2	--	0.2	--	4	5.6E-03	5.6E-03	5.6E-03	1.1E-01	5.6E-03	5.6E-03	5.6E-03	1.1E-01

Sample Calculations

Excavator Exhaust TSP Emissions:

$$\frac{400\ \text{kW} \mid 0.2\ \text{g} \mid 53\%\ \text{Load} \mid 1\ \text{h}}{\mid 1\ \text{kW h} \mid \mid 3600\ \text{s}} = 1.2\text{E-}02\ g_{TSP}/\text{s}$$

Highway Truck Exhaust TSP Emissions:

$$\frac{12\ \text{Vehicles} \mid 595\ \text{m} \mid 0.95\ \text{g} \mid 1\ \text{km} \mid 1\ \text{h}}{1\ \text{h} \mid \mid 1\ \text{Veh. Km} \mid 1000\ \text{m} \mid 3600\ \text{s}} = 1.9\text{E-}03\ g_{TSP}/\text{s}$$

Comments

Excavator assumed to be CAT 324T or similar.
Loaders assumed to be CAT 992 or similar.
Screening plant engine assumed to be 100 kW (typical)
Excavator 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
Exhaust parameters for processing plant engines based on typical specs

Flow	745 cfm	=	0.35 m^3/s
Temp	1010 ºF	=	816 K
Diameter	0.1 m		
Velocity	45 m/s		