Technical Memorandum

2020 Mobile Air Monitoring Survey of St. Marys Cement (St. Marys, Ontario)

Ontario Ministry of the Environment, Conservation and Parks

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Report Completion Date:
October 2020

Ontario

Executive Summary

- The Ontario Ministry of the Environment, Conservation and Parks conducted real time air monitoring in the vicinity of St. Marys Cement located in St. Marys, Ontario over four days on July 14, 15, 16, and 17, 2020 using a mobile air monitoring vehicle. This survey was a continuation of previous mobile air monitoring completed near St. Marys Cement in 2017, 2018 and 2019.

- Concentrations of volatile organic compounds (VOCs), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and particulate matter 10 micrometres or less in diameter (PM_{10}) were measured, along with meteorological conditions, at several locations upwind and downwind of St. Marys Cement.

- The highest half-hour average concentrations observed during stationary measurements downwind of the facility were (concentrations in µg m^{-3}): benzene (0.9), toluene (2.4), styrene (2.5), xylenes (3.9), trimethylbenzenes (1.9), NO_2 (53.8), SO_2 (0.9) and PM_{10} (49). Downwind concentrations were close to background concentrations on all four survey days.

- Air pollutant measurements were compared to Ontario Regulation 419/05 – Local Air Quality (O. Reg. 419/05) air standards and Ambient Air Quality Criteria (AAQC) using converted half-hour assessment values where necessary. Concentrations of the measured pollutants did not exceed applicable O. Reg. 419/05 air quality standards, AAQC or converted assessment values during the Ministry's 2020 mobile air monitoring survey. Real time PM_{10} measurements were used for screening purposes only.

Survey Background

At the request of the London District Office, the Environmental Monitoring and Reporting Branch (EMRB) of the Ontario Ministry of the Environment, Conservation and Parks (MECP or Ministry) completed a mobile air monitoring survey near St. Marys Cement located in St. Marys, Ontario in 2020. The survey was requested in response to dust and odour complaints received from residents in the community. The purpose of the survey was to measure ambient concentrations of volatile organic compounds (VOCs), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and particulate matter (PM) and to compare the results to *Ontario Regulation 419/05 Air Pollution - Local Air Quality* (Ont. Reg. 419/05) air quality standards or guidelines and Ontario's Ambient Air Quality Criteria (AAQC) where applicable. Similar mobile air monitoring surveys were conducted using EMRB's Trace Atmospheric Gas Analyzer (TAGA) units in 2017, 2018 and 2019. The findings of the previous surveys were reported in the technical memoranda "2017 Mobile TAGA Survey in the vicinity of St. Marys Cement", "2018 Mobile TAGA Survey in the vicinity of St. Marys Cement", and "2019 Mobile Air Monitoring Survey of St. Marys Cement (St. Marys, Ontario)".

St. Marys Cement is located at 585 Water Street South, St. Marys, Ontario. It is a quarrying and cement processing facility (http://www.stmaryscement.com). The National Pollutant Release Inventory (NPRI) of Environment and Climate Change Canada (http://pollution-waste.canada.ca/national-release-inventory/archives/index.cfm) indicates that St. Marys Cement released 12 tonnes of benzene, 3.9 tonnes of toluene, 1.8 tonnes of styrene, 1.9 tonnes of xylenes, 1,478 tonnes of NO_2 , 528 tonnes of SO_2 and 80 tonnes of particulate matter smaller than 10 µm in diameter (PM_{10}) to the air in 2017.

St. Marys Cement is subject to O. Reg. 419/05 Schedule 3 standards or guidelines, which are based on annual or 24-hour averages. Ontario's AAQC are benchmarks used to assess general air quality resulting from all sources of a contaminant to air. They are based on effects on human health, vegetation, soil, visibility, odour detection and

approaches taken by other jurisdictions. In general, these standards and benchmarks are set at protective levels and based on effects that occur after long-term exposure and therefore direct comparison of shorter-term measurements is not always appropriate. To give context to the mobile air monitoring results, O. Reg. 419/05 standards/guidelines/jurisdictional screening levels (found on the Ministry's Air Contaminants Benchmarks List) and AAQC were converted to half-hour assessment values as described in Section 17 of the regulation (Appendix A). Since this conversion only considers meteorological variation and does not account for other factors, such as changes in facility operations, the calculated assessment values are for screening purposes only and cannot be used to determine non-compliance or whether an adverse health effect has occurred or will occur. Additional information on the use of the O. Reg. 419/05 air standards, guideline values, and other screening levels to interpret air monitoring results is provided in Appendix A.

Survey Methodology

Real-time air monitoring of VOCs was performed using a truck equipped with a mass spectrometer (Ionicon) featuring a Proton Transfer Reaction source (PTR-MS). The PTR-MS is calibrated for the quantification of aromatic hydrocarbons and chlorinated VOCs. Mobile monitoring was conducted while the truck was in motion to acquire measurement data in real time and to identify locations featuring the highest concentrations of pollutants in the vicinity of the facility. The mass spectrometer used here cannot separate the contributions of xylenes and ethylbenzene, and instead measures the sum of these species. For clarity xylenes/ethylbenzene are simply referred to as "xylenes" throughout. NO_2 concentrations were calculated as the difference between simultaneous NO_x and NO measurements made using Thermo Scientific 42C analyzers. SO_2 concentrations were measured using a Thermo Scientific 43i analyzer. PM_{10} concentrations were also recorded for screening level purposes using a TSI Dusttrak DRX Aerosol Monitor. All air pollutants were monitored at five second resolution. Site selection for stationary measurements was based on mobile monitoring results, meteorological conditions and odour observations by TAGA staff. Half-hour concentrations of VOCs, NO_2, SO_2 and

PM_{10} were measured upwind and downwind of St Marys Cement while the mobile unit was stationary.

Mobile Monitoring Results

Air monitoring near St. Marys Cement was conducted over four days on July 14, 15, 16 and 17, 2020. No odours were noted by the TAGA staff upwind of the facility however mild 'burning' odours were noted occasionally downwind of the facility. TAGA staff also observed visible dust downwind of the facility and resuspended dust caused by passing vehicles. An example of benzene mobile monitoring data collected while driving around the facility on July 17 from 09:22 to 09:34 is shown in Figure 1. Benzene concentrations were at background levels upwind of the facility on Water Street South (0.4 µg m^{-3}), but the facility plume was intercepted on James Street South, with downwind concentrations reaching 1.7 µg m^{-3}. Styrene concentrations for the same mobile monitoring period are shown in Figure 2, featuring a similar spatial pattern to that observed for benzene, but with concentrations reaching 4.1 µg m^{-3}. PM_{10} measurement data from the same monitoring period are shown in Figure 3. In contrast to the spatial pattern observed for benzene and styrene, several PM_{10} hotspots were observed while driving around the facility, with increases of up to 43.5 µg m^{-3} caused by dust resuspension from trucks entering/exiting the facility and from other passing vehicles. The PM_{10} concentrations reported here are considered as 'screening level' due to accuracy limitations of the Dusttrak instrument (Kingham et al., 2006; Yanosky et al., 2002).

Figure 1: Mobile monitoring of benzene in the vicinity of St. Marys Cement, St. Marys, Ontario, July 17, 2020 09:22-09:34. The arrow indicates the direction the wind was blowing during the measurement period.

Figure 2: Mobile monitoring of styrene in the vicinity of St. Marys Cement, St. Marys, Ontario, July 17, 2020 09:22-09:34. The arrow indicates the direction the wind was blowing during the measurement period.

Figure 3: Mobile monitoring of PM_{10} in the vicinity of St. Marys Cement, St. Marys, Ontario, July 17, 2020 09:22-09:34. The arrow indicates the direction the wind was blowing during the measurement period.

Stationary Monitoring Results

The locations used for stationary monitoring are shown in Figure 4. In total, 33 half-hour measurements of concentrations of the five VOCs (benzene, toluene, styrene, xylenes, trimethylbenzene), NO_2, SO_2 and PM_{10} were collected at various sites downwind of St. Marys Cement. Tables 1 (upwind) and 2 (downwind) summarize the data collected during the air monitoring survey including sampling times, monitoring sites, on-site meteorological data and half-hour average concentrations. Despite intermittent increases in levels of VOCs, NO_2, SO_2 and PM_{10}, the concentrations measured downwind of the facility remained similar to their respective upwind concentrations on all four survey days. Table 3 highlights the highest downwind half-hour concentrations observed, converted half-hour assessment values, and respective standards and guidelines for each measured air pollutant. Ambient concentrations of these pollutants did not exceed

applicable O. Reg. 419/05 air quality standards, guidelines, AAQC or converted assessment values at any time during the 2020 survey.

Figure 4: Stationary monitoring sites near St. Marys Cement, St. Marys, Ontario used during the July 2020 air monitoring survey.

Table 1: Ten-minute average stationary measurement concentrations of VOCs, NO_2, SO_2 and PM_{10} upwind of St. Marys Cement, St. Marys, Ontario during the mobile air monitoring survey, July 2020.

Date	Start Time (1)	Site (2)	Wind direction (from) (3)	Wind speed (km h^{-1}) (3)	Benzene (4)	Toluene (4)	Styrene (4)	Xylenes (4)	Trimethyl-benzenes (4)	NO_2 (4,5)	SO_2 (4,5)	PM_{10} (4,6)
July 14 2020	12:23	A	SW	4	0.5	1.5	0.8	2.4	1.6	13.1	<0.3	10
July 15 2020	9:39	C	SSE	12	0.6	1.8	0.9	2.9	1.7	4.3	<0.3	10
July 16 2020	9:56	A	ENE	4	0.7	2.3	1.0	3.5	2.0	9.1	<0.3	29
July 17 2020	9:36	C	SW	9	0.6	3.1	0.9	2.9	1.6	15.1	<0.3	24

Notes:
(1) Local starting time for each ten-minute sampling period.
(2) Monitoring sites upwind of the facility - see Figure 4.
(3) Weather conditions were recorded on-site by meteorological equipment on-board the mobile unit.
(4) Concentrations are in micrograms per cubic metre (µg m^{-3}).
(5) Concentrations converted from ppb to µg m^{-3} using T = 10 °C and P = 1 atm.
(6) Concentrations are for screening purposes only.

Table 2: Half-hour average stationary measurement concentrations of VOCs, NO_2, SO_2 and PM_{10} downwind of St. Marys Cement, St. Marys, Ontario during the mobile air monitoring survey, July 2020.

Date	Start Time [1]	Site [2]	Wind direction (from) [3]	Wind speed (km h^{-1}) [3]	Benzene [4]	Toluene [4]	Styrene [4]	Xylenes [4]	Trimethyl-benzenes [4]	NO_2 [4,5]	SO_2 [4,5]	PM_{10} [4,6]
July 14 2020	12:41	B	WSW	8	0.5	1.4	0.8	2.2	1.4	<0.2	<0.3	10
	13:11	B	SW	9	0.5	1.4	1.0	2.7	1.5	3.1	<0.3	10
	13:41	B	WSW	7	0.5	1.2	1.3	2.5	1.4	5.6	<0.3	10
	14:11	B	WNW	6	0.7	1.4	1.8	3.4	1.7	8.4	0.4	12
	14:41	B	W	8	0.7	1.4	1.5	3.2	1.6	7.4	0.9	13
	15:11	B	WNW	8	0.5	1.3	1.1	2.8	1.5	<0.2	<0.3	9
	15:41	B	NW	5	0.5	1.2	1.1	2.8	1.4	5.9	<0.3	9
	16:11	B	SSE	4	0.5	1.2	1.0	2.8	1.5	<0.2	<0.3	7
July 15 2020	9:56	D	SSW	6	0.6	1.5	1.2	2.8	1.5	9.3	<0.3	22
	10:26	D	SW	6	0.6	1.4	1.3	3.1	1.6	7.1	<0.3	19
	10:56	D	SSW	6	0.6	1.4	1.1	2.9	1.5	8.1	<0.3	21
	11:26	D	SW	6	0.7	1.3	1.6	3.4	1.6	11.1	<0.3	16
	11:56	D	SW	8	0.6	1.2	1.4	3.0	1.4	7.3	<0.3	18
	12:26	D	SW	6	0.6	1.3	1.1	3.0	1.4	7.3	<0.3	16
	13:04	E	SSW	4	0.8	1.3	1.8	3.6	1.6	21.5	<0.3	21
	13:34	E	S	4	0.9	1.3	2.4	3.8	1.6	24.7	<0.3	18
	14:04	E	SSW	3	0.9	1.4	2.5	3.9	1.6	30.0	0.3	24
	14:34	E	SSW	3	0.6	1.3	1.3	2.8	1.5	23.3	0.4	17
	15:04	E	S	4	0.6	1.3	1.3	2.9	1.5	21.8	<0.3	17
	15:34	E	S	3	0.6	1.3	1.2	2.8	1.5	24.1	<0.3	19
	16:04	E	SSW	2	0.6	1.3	1.1	2.9	1.5	27.4	<0.3	19
July 16 2020	10:26	F	ESE	7	0.7	2.1	1.1	3.4	1.8	41.2	<0.3	44
	10:56	F	ESE	7	0.7	2.0	1.1	3.4	1.8	52.4	<0.3	47
	11:26	F	ESE	6	0.8	2.0	1.6	3.6	1.9	53.8	<0.3	49
	12:35	D	SSW	5	0.6	1.5	1.2	2.8	1.5	12.3	<0.3	42
	13:05	D	S	5	0.6	1.4	1.2	2.9	1.6	14.1	<0.3	41
	13:35	D	SW	8	0.7	1.8	1.4	3.0	1.6	10.1	<0.3	44

	14:05	D	SSW	8	0.7	2.4	1.3	3.0	1.6	10.1	<0.3	46
	14:35	D	SW	6	0.6	1.4	1.2	3.1	1.6	11.4	<0.3	49
	15:05	D	WSW	3	0.6	1.4	1.2	3.1	1.6	9.4	<0.3	47
	15:35	D	WSW	2	0.6	1.3	1.2	3.0	1.6	9.9	<0.3	48
July 17 2020	9:58	A	W	4	0.7	2.4	1.1	3.1	1.5	16.1	<0.3	25
	10:28	A	W	5	0.7	1.9	1.0	3.0	1.6	14.3	<0.3	27

Notes:
(1) Local starting time for each half-hour sampling period.
(2) Monitoring sites downwind of the facility - see Figure 4.
(3) Weather conditions recorded on-site by meteorological equipment on-board the mobile unit.
(4) Concentrations are in micrograms per cubic metre (µg m^{-3}).
(5) Concentrations converted from ppb to µg m^{-3} using T = 10 °C and P = 1 atm.
(6) Concentrations are for screening purposes only.

Table 3: Summary of maximum half-hour concentrations of VOCs, NO_2, SO_2 and PM_{10} measured downwind of St. Marys Cement, St. Marys, Ontario during the mobile air monitoring survey, July 2020.

Pollutant	Survey highest half-hour concentration (1)	Converted half-hour Assessment Value (1,2)	O. Reg. 419/05 Standard/AAQC (1,3)
Benzene	0.9	6.8	0.45 (S, annual)
Toluene	2.4	5913	2000 (A, 24-hour)
Styrene	2.5	1183	400 (S, 24-hour)
Xylenes	3.9	2158	730 (S, 24-hour)
Trimethylbenzene	1.9	650	220 (S, 24-hour)
NO_2 (4)	53.8	591	200 (S, 24-hour)
SO_2 (4)	0.9	813	275 (S, 24-hour)
PM_{10} (5)	49	149	50 (A, 24-hour)

Notes:
(1) Concentrations are in micrograms per cubic metre (µg m^{-3}).
(2) Converted half-hour assessment values are provided for comparison purposes only.
(3) Benchmarks for which a converted assessment value was calculated with respective averaging periods: (S) O. Reg. 419/05 Schedule 3 Standard; (A) AAQC.
(4) Concentrations converted from ppb to µg m^{-3} using T = 10 °C and P = 1 atm.
(5) Concentrations are for screening purposes only.

Comparison of 2020 Results with Previous Mobile Monitoring Surveys

In addition to the 2020 survey, three previous mobile monitoring surveys were also performed in the vicinity of St. Marys Cement in 2017, 2018 and 2019. The same air pollutants were measured in all three surveys except for NO_2 which was measured only in 2019 and 2020 and SO_2 which was measured exclusively in 2020. The average concentrations of VOCs and PM_{10} measured downwind of St. Marys Cement during the four surveys are shown in Figure 5. It is important to note that differences in measured downwind concentrations between years do not necessarily represent changes in emission rates of these pollutants from St. Marys Cement. Downwind concentrations are also dependent on sampling location, meteorology and background air quality. Concentrations of the measured pollutants were similar during each survey and did not exceed their respective half-hour converted assessment values for applicable standards or AAQC at any time during any of the four surveys.

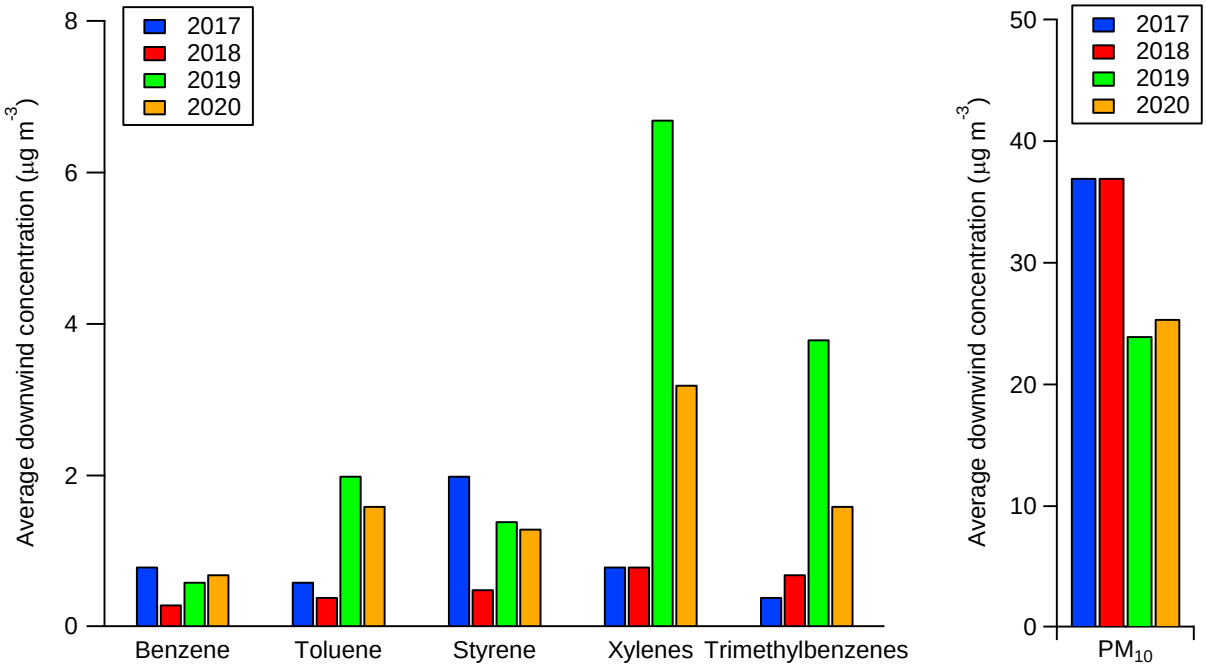

Figure 5: Average concentrations of VOCs and PM_{10} measured downwind of St. Marys Cement, St. Marys, Ontario during the 2017, 2018, 2019 and 2020 mobile air monitoring surveys.

Summary and Conclusions

The Ministry conducted real time air monitoring in the vicinity of St. Marys Cement located in St. Marys, Ontario in July 2020. Real-time mobile measurements of VOCs, NO_2, SO_2 and PM_{10} were combined with concurrent Global Positioning System and meteorological data to produce spatial air pollutant maps. The highest half-hour average concentrations observed during stationary measurements downwind of the facility were (concentrations in µg m^{-3}): benzene (0.9), toluene (2.4), styrene (2.5), xylenes (3.9), trimethylbenzenes (1.9), NO_2 (53.8), SO_2 (0.9) and PM_{10} (49). Measured air pollutant concentrations were compared with Ontario Regulation 419/05 standards and AAQC using converted half-hour assessment values where applicable. The concentrations of the measured pollutants did not exceed their respective half-hour converted assessment values for applicable standards or AAQC at any time during the survey period. The results of this survey are also consistent with similar surveys performed in 2017, 2018 and 2019.

References

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Yanosky, J. D., Williams, P. L., & MacIntosh, D. L. (2002). A comparison of two direct-reading aerosol monitors with the federal reference method for PM2.5 in indoor air. *Atmospheric Environment, 36*(1), 107-113.

Appendix A

Conversion of O. Reg 419/05 Standards/Guidelines/Jurisdictional Screening Levels and Ontario's Ambient Air Quality Criteria (AAQC) to Converted Assessment Values

To compare a short-term monitoring value to a benchmark with a longer averaging period a conversion factor was applied. Conversion factors were calculated using the method described in Section 17 of O. Reg. 419/05. This conversion only takes meteorological variation into account.

Calculation of a Conversion Factor for monitoring periods shorter than the averaging period specified by the standard/guideline/jurisdictional screening level or AAQC.

$(t_0 \div t_1)^n$

t_0 = the averaging period specified by the standard/guideline, expressed in hours
t_1 = the averaging period used for monitoring, expressed in hours
n = 0.28

The standard is multiplied by this calculated conversion factor to give a Converted Assessment Value

Use of the O. Reg. 419/05 air standards, guideline values, AAQC and other screening levels to interpret air monitoring results

Ontario regulates contaminants released to air by various sources, including local industrial and commercial facilities, to limit exposure to substances that can affect human health and the environment. The Ministry's *Ontario Regulation 419/05 – Local Air Quality* (O. Reg. 419/05) air standards, guideline values, and other screening levels are found on

the Air Contaminants Benchmarks List. These standards and guidelines are used under the general provisions of the *Environmental Protection Act*, including compliance purposes under O. Reg. 419/05. These values are, however, sometimes used to interpret air quality outside of the purposes of O. Reg. 419/05. Ontario's AAQC are benchmarks used to assess general air quality resulting from all sources of a contaminant to air. They are based on effects on human health, vegetation, soil, visibility, odour detection and approaches taken by other jurisdictions. They are set at concentrations that are protective against adverse effects.

Many of the applicable standards or guidelines are based on annual or 24-hour averages. In general, they are set at protective levels and based on effects that occur following long-term exposure. Therefore, direct comparison of short-term measurements is not always appropriate. To give context to the short-term monitored results (i.e., half-hour TAGA survey measurements), applicable O. Reg. 419/05 standards or guidelines are converted to half-hour assessment values, as described in Section 17 of O. Reg. 419/05. Since this conversion only considers meteorological variation and not factors such as changes in facility operations, these calculated assessment values are for screening purposes only, and cannot be used to determine non-compliance or whether an adverse health effect has occurred or will occur. However, these calculated assessment value comparisons can be used to provide context to monitoring results. Short-term monitoring results that are elevated with respect to the assessment values may be used to flag potential issues worthy of further investigation.

In these situations, monitoring results that are elevated with respect to the half-hour assessment values do not necessarily indicate that an adverse effect has occurred or will occur. Rather, an air quality analyst or risk assessor should consider, on a case-specific basis, whether there is potential for adverse effects when using the converted O. Reg. 419/05 standards or guidelines to interpret air monitoring data. This could include considerations of the nature of the contaminant, how the air limits were developed, supplementary monitoring or air dispersion modelling, or other elements typical of a

human health risk assessment (i.e., frequency, magnitude and duration of elevated values).

For additional details regarding the development of the Ministry's air standards, and the Ministry's framework for managing risk, please refer to the following document: *Guideline A-12: Guideline for the Implementation of Air Standards in Ontario* (GIASO). https://www.ontario.ca/page/guideline-12-guideline-implementation-air-standards-ontario