Technical Memorandum

2018 Mobile Air Monitoring Survey in the vicinity of St. Marys Cement (St. Marys, Ontario)

Ontario Ministry of the Environment, Conservation and Parks

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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 five days on May 23, June 7 to 8, June 11, and June 22, 2018 with a mobile air monitoring van. This was a follow up survey to the Ministry's mobile air monitoring survey completed near St. Marys Cement in 2017.
- Concentrations of volatile organic compounds (VOCs) and particulate matter 10 micrometers or less in diameter (PM_{10}) were measured, along with meteorological conditions, at several locations upwind and downwind of St. Marys Cement.
- Half-hour average concentrations of benzene, toluene, styrene, xylenes and trimethylbenzene up to 0.5, 0.8, 0.7, 1.4 and 1.5 µg m^{-3}, respectively, were observed during stationary measurements downwind of the facility. These concentrations were above background levels indicating that St. Marys Cement is a likely source of VOC emissions.
- VOC measurements were compared to Ontario Regulation 419/05 – Local Air Quality (O. Reg. 419/04) air standards and guidelines and Ambient Air Quality Criteria (AAQCs) using converted half-hour assessment values where necessary. Concentrations of the measured VOCs did not exceed applicable O. Reg. 419 air quality standards, guidelines or converted assessment values during the Ministry's 2018 mobile air monitoring survey. Real time PM_{10} measurements were used for screening purposes only.
- The concentrations of benzene, toluene, and styrene measured downwind of St. Marys Cement in 2018 were lower than those measured in 2017, and the average PM_{10} concentration was approximately the same in both years. Differences in downwind concentrations from one year to the next are highly dependant upon variation in sampling locations and meteorological conditions. No conclusions can be drawn about changes or improvement in facility emissions.

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 2018. 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) 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 Ambient Air Quality Criteria (AAQCs) where applicable. A similar mobile air monitoring survey was conducted using EMRB's Trace Atmospheric Gas Analyzer (TAGA) units in 2017. The 2017 findings were reported in the technical memorandum "2017 Mobile TAGA Survey in the vicinity of St. Marys Cement".

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, and 80 tonnes of 10 µm particulate matter (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. In general, these standards 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) 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 monitoring of VOCs in ambient air was performed using one of EMRB's mobile Trace Atmospheric Gas Analyzer (TAGA) units, a van outfitted with an AB Sciex mass spectrometer equipped with a Low Pressure Chemical Ionization (LPCI) source. The TAGA unit performed chemical fingerprinting to identify VOCs in ambient air. Plume tracking was conducted while TAGA was in motion to acquire VOC data in real time and to identify locations with the highest concentrations of VOCs downwind of the facility. Concurrently with TAGA measurements, PM_{10} concentrations were recorded for screening level purposes using a TSI Dusttrak DRX Aerosol Monitor on-board the TAGA van.

Site selection for half-hour concentration measurements was based on plume tracking results, meteorological conditions and odour observations by TAGA staff. One half-hour concentration of VOCs measured by the TAGA is the average of 360 five-second readings. Concentrations of target VOCs and PM_{10} were determined upwind and downwind of St Marys Cement while the mobile unit was stationary. The monitoring locations are shown in Figure 1.

Figure 1: Monitoring sites near St. Marys Cement Plant, St. Marys, Ontario. Mobile TAGA (EMRB, MECP) survey, May and June 2018.

Survey Results

Air monitoring near St. Marys Cement was conducted over five days on May 23, June 7 to 8, June 11, and June 22, 2018. No odours were noted by the TAGA staff upwind of the facility however odours were noted occasionally downwind of the facility. TAGA staff also observed visible dust downwind of the facility. Benzene, toluene, styrene, xylenes, trimethylbenzene and PM_{10} were detected downwind of the facility by the mobile TAGA unit. An example of plume tracking around the facility obtained on June 8 from 13:55 to 14:16 is shown in Figure 2 and suggests that St. Marys Cement is a source of benzene. This observation is consistent with the 2017 TAGA survey

data. PM_{10} concentrations reported here are considered screening level due to accuracy limitations of the Dusttrak instrument (Kingham et al., 2006; Yanosky et al., 2002),

In total, twenty half-hour measurements of concentrations of five VOCs (benzene, toluene, styrene, xylenes, trimethylbenzene) and particulate matter (PM_{10}) were collected at several sites downwind of St. Marys Cement. Table 1 (upwind) and Table 2 (downwind) summarize the data collected during the mobile air monitoring survey including sampling times, monitoring sites, on-site meteorological data and half-hour average concentrations. The average total concentration of the five VOCs and PM_{10} measured downwind were higher than upwind. Figure 3 shows the average total VOCs and PM_{10} concentrations measured upwind and downwind of St. Marys Cement. The average total concentration of the measured VOCs was approximately 1.7 times higher downwind than upwind. For PM_{10}, measured downwind concentrations were approximately 2.2 times higher downwind than upwind.

Mean concentrations of the five VOCs and PM_{10} measured in 2017 and 2018 downwind of St. Marys Cement are compared in Figure 4. The levels of benzene, toluene, and styrene measured downwind of the facility in 2018 were lower than those measured in 2017. Xylene and PM_{10} levels were similar in both years. Trimethylbenzene concentrations measured downwind of the facility in 2018 were higher than those measured in 2017. However, it is important to note that differences in downwind concentrations from one year to the next are in part dependent upon differences in meteorological conditions and the location of the selected downwind sampling sites. Table 3 highlights the highest half-hour concentrations of the five VOCs, their respective converted half-hour assessment values, and their respective standards and guidelines. Ambient concentrations of the measured VOCs did not exceed applicable O. Reg. 419 air quality standards, guidelines or converted assessment values during the 2018 survey.

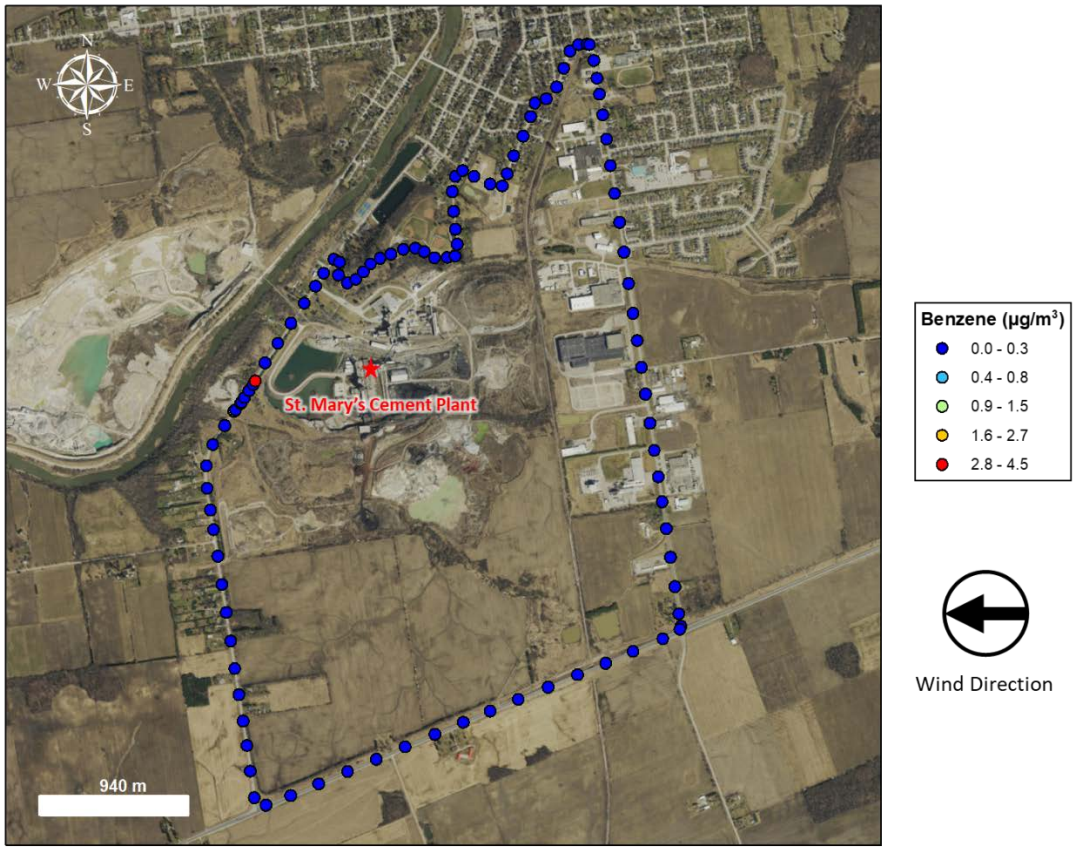

Figure 2: Plume tracking of benzene near St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, June 8, 2018. The wind was from the east during these measurements (13:55-14:16). The maximum instantaneous concentration of benzene observed was 4.5 µg m^{-3}.

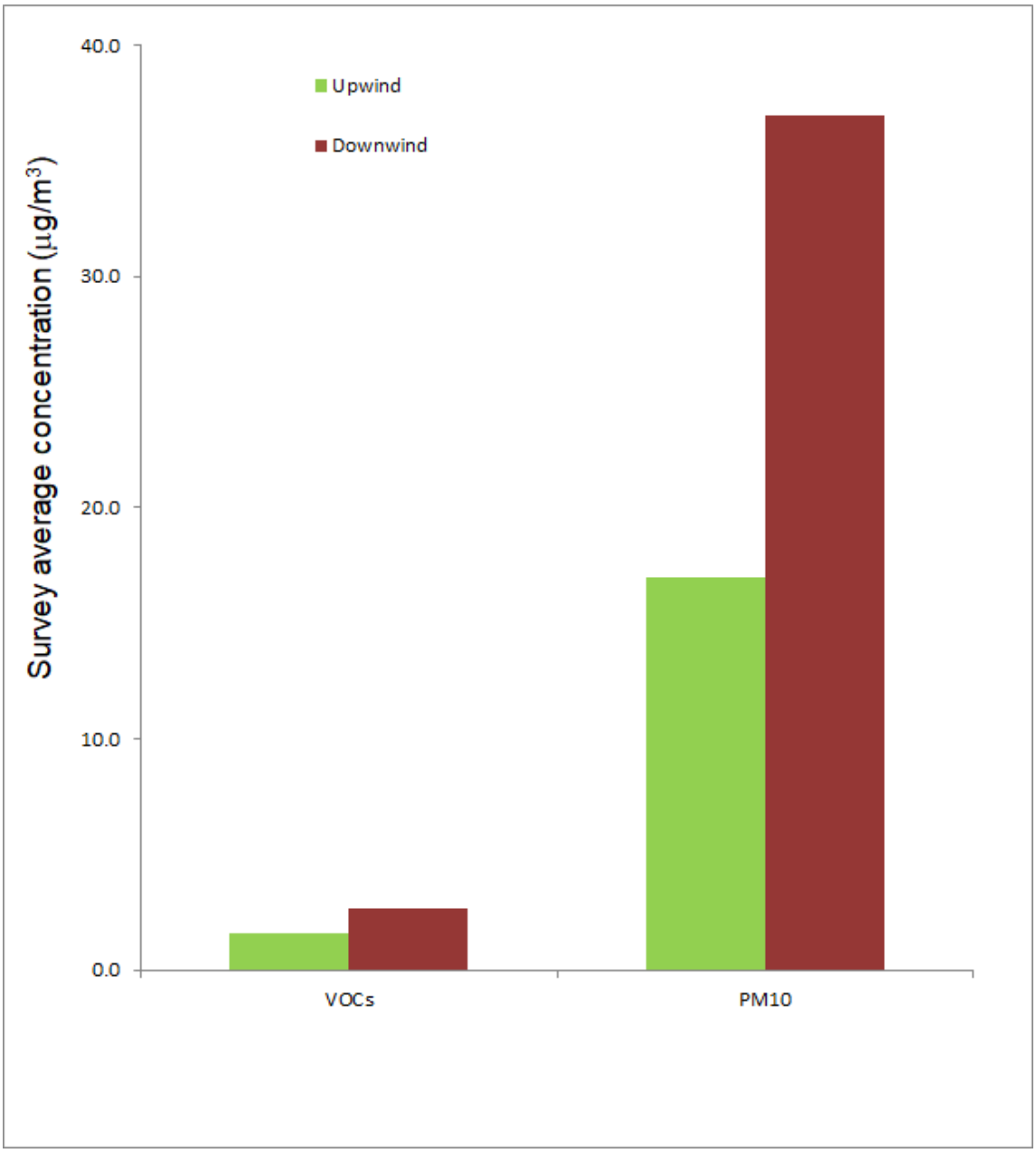

Figure 3: Survey average of stationary measurements of total VOCs and PM_{10} concentrations upwind and downwind of St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, May and June 2018.

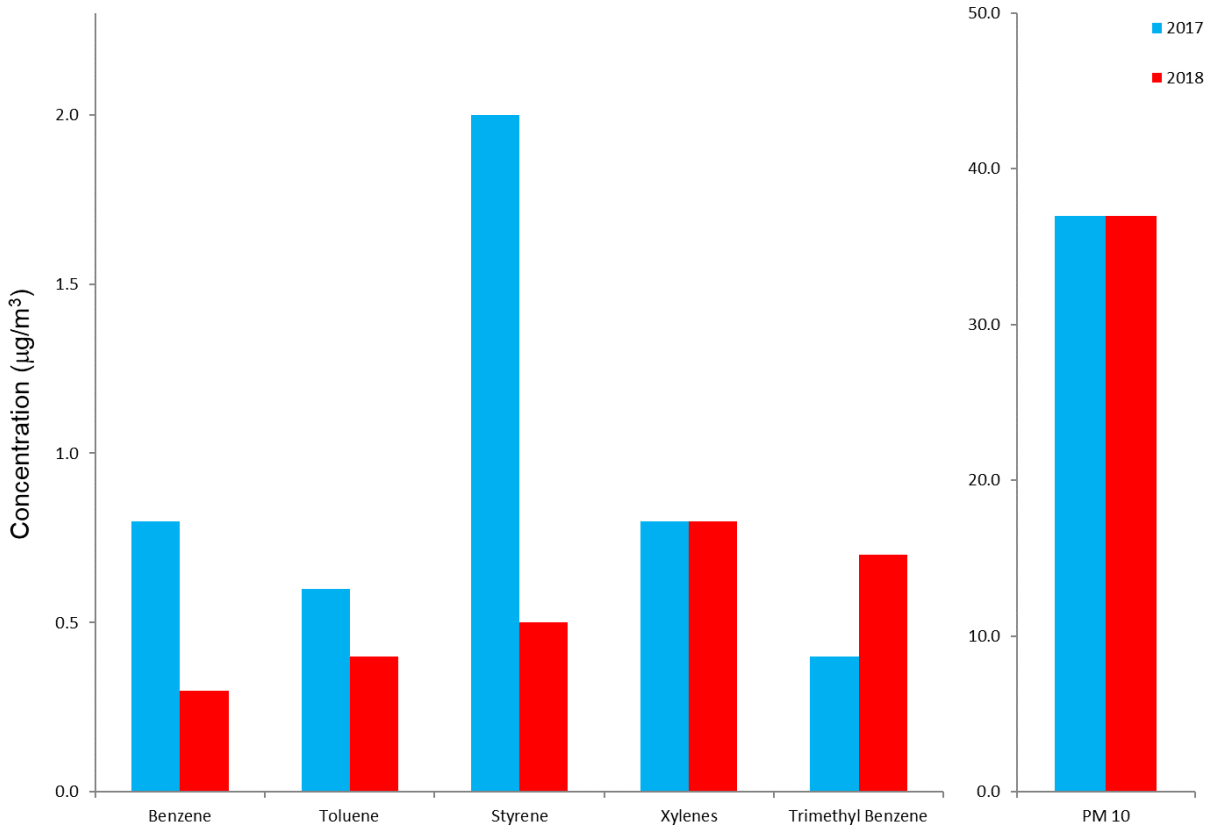

Figure 4: Survey average stationary measurements of VOCs and PM_{10} concentrations downwind of St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring surveys in 2017 and 2018.

Table 1: Ten-minute average stationary measurement concentrations of VOCs and PM_{10} by TAGA upwind of St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, May and June 2018.

			Met **(3)**			VOC (**4**)					PM (**5**)
Date	Starting Time **(1)**	Monitoring Site **(2)**	Wind Direction (from)	Wind Speed (km/hr)	Ambient Temp. (°C)	**Benzene**	**Toluene**	**Styrene**	**Xylenes**	**Trimethyl Benzene**	**PM_{10}**
May 23, 2018	11:40	UW1	WNW	15	20	< 0.3	< 0.3	< 0.4	< 0.3	< 0.3	25
June 7, 2018	11:23	UW2	SSW	14	20	< 0.3	< 0.3	< 0.4	0.3	0.3	27
June 8, 2018	11:25	UW3	ENE	12	23	0.3	< 0.3	< 0.4	0.3	0.4	11
June 11, 2018	11:47	UW3	ENE	16	21	0.3	0.3	0.4	0.3	0.3	15
June 22, 2018	11:05	UW3	E	17	19	< 0.3	0.3	< 0.4	0.4	0.3	9

Notes:

(1) Local starting time half-hour sample period.

(2) Monitoring sites upwind of the facility - see Figure 1.

(3) Weather conditions were recorded on-site by meteorological equipment on-board the mobile unit (average of 10 one-minute readings).

(4) Concentrations of measured VOCs are in micrograms per cubic meter ($\mu g\ m^{-3}$).

(5) Concentrations of measured PM_{10} are in micrograms per cubic meter ($\mu g\ m^{-3}$).

Table 2: Half-hour average concentrations of VOCs and PM_{10} from stationary measurements made by TAGA downwind of St. Marys Cement, St. Marys, Ontario during the TAGA air monitoring survey, May and June 2018.

				Met **(3)**			VOC (**4**)					PM (**5**)
Date	Sample	Starting Time **(1)**	Monitoring Site **(2)**	Wind Direction (from)	Wind Speed (km/hr)	Ambient Temp. (°C)	**Benzene**	**Toluene**	**Styrene**	**Xylenes**	**Trimethyl Benzene**	**PM_{10}**
May 23, 2018	S01	12:37	A	WNW	14	21	0.4	0.4	0.6	1.0	1.0	31
	S02	13:07	A	WNW	16	22	0.4	0.5	0.6	0.6	0.7	25
	S03	13:37	A	WNW	15	23	0.3	0.3	0.5	0.6	0.7	20
	S04	14:07	A	WNW	13	23	< 0.3	0.3	0.6	1.2	0.6	25
June 7, 2018	S05	12:14	B	SSW	13	20	0.4	0.6	0.6	1.0	0.4	30
	S06	12:45	B	SSW	12	20	0.3	0.8	0.5	0.8	0.4	28
	S07	13:15	B	SSW	11	21	< 0.3	0.3	0.5	0.7	0.3	29
	S08	13:45	B	SSW	10	22	< 0.3	0.6	0.5	0.8	0.6	64
June 8, 2018	S09	12:23	C	ENE	11	24	0.3	0.6	0.6	1.4	1.5	21
	S10	12:53	C	ENE	13	25	< 0.3	0.6	0.6	1.1	1.3	15
	S11	13:23	C	E	12	25	0.3	0.4	0.6	0.9	1.2	26
June 11, 2018	S12	12:39	D	ENE	15	22	0.4	0.5	0.7	1.2	1.0	42
	S13	13:09	D	ENE	17	23	0.5	0.5	0.7	1.0	0.8	34
	S14	13:39	D	ENE	18	23	< 0.3	0.3	0.5	1.0	0.7	27
June 22, 2018	S15	11:30	E	E	18	20	< 0.3	0.3	0.4	0.7	0.5	74
	S16	12:00	E	E	19	20	< 0.3	0.3	0.4	0.6	0.5	62
	S17	12:30	E	E	20	21	< 0.3	0.3	< 0.4	0.9	0.6	36
	S18	13:00	E	E	17	22	< 0.3	0.3	< 0.4	0.3	0.4	40
	S19	13:30	E	E	19	21	< 0.3	0.3	< 0.4	0.4	0.4	41
	S20	14:00	E	E	21	21	< 0.3	< 0.3	< 0.4	0.7	0.4	65
							Method Detection Limit (MDL)					
							0.3	0.3	0.4	0.3	0.3	1

Notes:

(1) Local starting time half-hour sample period.

(2) Monitoring sites downwind of the facility - see Figure 1.

(3) Weather conditions were recorded on-site by meteorological equipment on-board the mobile unit (average of 30 one-minute readings).

(4) Concentrations of measured VOCs are in micrograms per cubic meter ($\mu g\ m^{-3}$).

(5) Concentrations of measured PM_{10} are in micrograms per cubic meter ($\mu g\ m^{-3}$).

Table 3: Summary of half-hour concentrations of VOCs measured by TAGA downwind of St. Marys Cement, St. Marys, Ontario. Mobile TAGA (EMRB, MECP) air monitoring survey, May and June 2018.

Pollutant **(1)**	Survey average half-hour concentration **(2)**	Survey highest half-hour concentration **(3)**	Converted half-hour Assessment Value **(4)**	O. Reg. 419/05 Standard/Guideline **(5)**
Benzene	0.3	0.5	6.9	0.45 (S, annual)
Toluene	0.4	0.8	5913	2000 (G, 24-hour)
Styrene	0.5	0.7	1183	400 (S, 24-hour)
Xylenes	0.8	1.4	2158	730 (S, 24-hour)
Trimethylbenzene	0.7	1.5	650	220 (S, 24-hour)

Notes:

(1) Compound measured by TAGA.

(2) Average of all half-hour concentrations (µg m^{-3}) measured by TAGA.

(3) Survey highest half-hour concentrations (µg m^{-3}) measured by TAGA.

(4) Converted half-hour assessment values are provided for comparison purposes only.

(5) Benchmarks for which a converted assessment value was calculated with respective averaging periods- (S) O. Reg. 419/05 Schedule 3 Standard, (G) O. Reg. 419/05 Guideline when section 20 applies.

Summary

The Ministry conducted real time air monitoring in the vicinity of St. Marys Cement located in St. Marys, Ontario in May and June 2018. Real-time mobile measurements of VOCs were combined with concurrent Global Positioning System and meteorological data to produce plume-tracking maps. Half-hour average benzene, toluene, styrene, xylenes and trimethylbenzene concentrations up to 0.5, 0.8, 0.7, 1.4 and 1.5 µg m^{-3}, respectively, were observed during stationary measurements downwind of the facility. Measured VOC concentrations were compared with Ontario Regulation 419/05 standards and guidelines using converted half-hour assessment values where applicable. The concentrations of the measured VOCs did not exceed their respective half-hour converted assessment values nor the applicable standards or guidelines during the survey period in 2018.

References

Kingham, S., Durand, M., Aberkane, T., Harrison, J., Gaines Wilson, J., & Epton, M. (2006). Winter comparison of TEOM, MiniVol and DustTrak PM10 monitors in a woodsmoke environment. *Atmospheric Environment, 40*(2), 338-347.

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 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.

$(t_0 \div t_1)^n$

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 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.

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