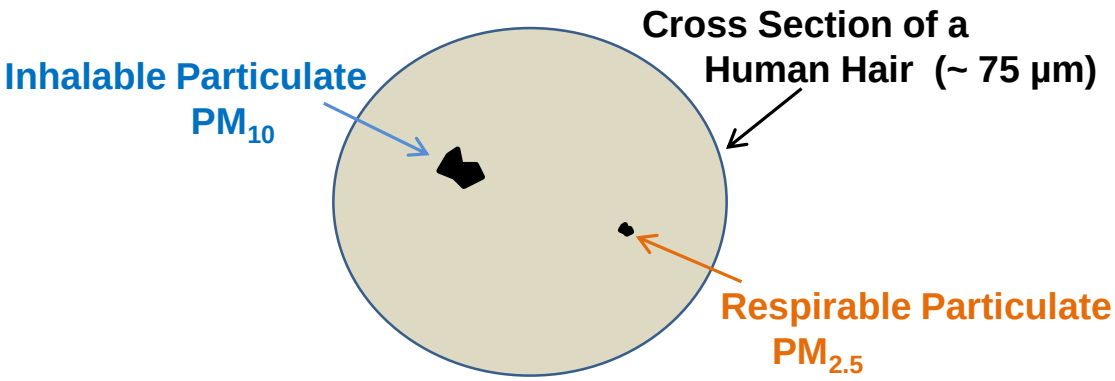
St. Marys - Bowmanville Cement Plant PM Monitoring Program

Rotek Environmental Inc.

What is Particulate Matter

- Particulate matter (PM) consists of airborne solid particles and liquid droplets suspended in air.
- Particulate matter includes aerosols, smoke, fumes, dust, fly ash and pollen.
- Particulate matter is classified according to its size, since different health effects are associated with particles of different diameters.
- The Ministry of the Environment, Conservation and Parks (MECP) identifies the following different sizes of PM:
  - Total Suspended Particulate (TSP) - airborne particulate matter with an upper size limit of approximately 44 micro metre (µm).
  - Particulate Matter < 10 microns (PM_{10}) - airborne particulate matter with a diameter less than 10 µm.
  - Particulate Matter < 2.5 microns ($PM_{2.5}$) - airborne particulate matter with a diameter less than 2.5 µm.

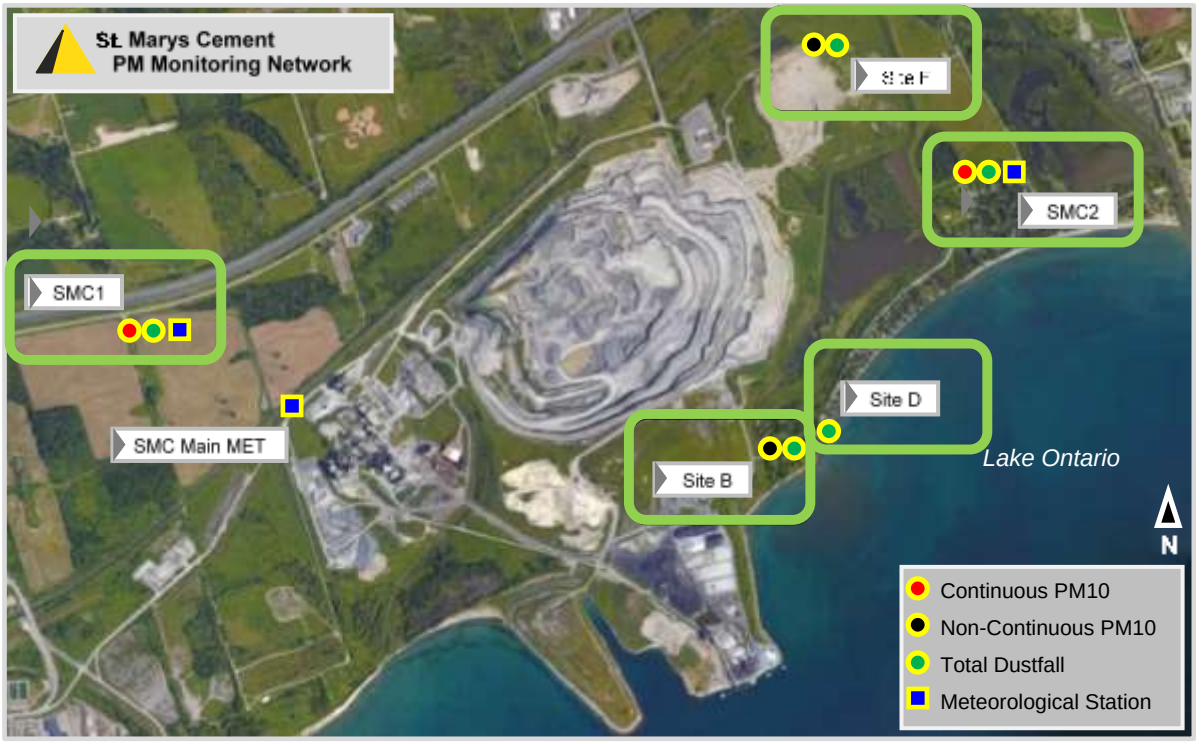
Particulate Matter Size



PM_{10} particles can stay suspended in the air for minutes or hours while $PM_{2.5}$ particles can stay suspended for days or weeks.

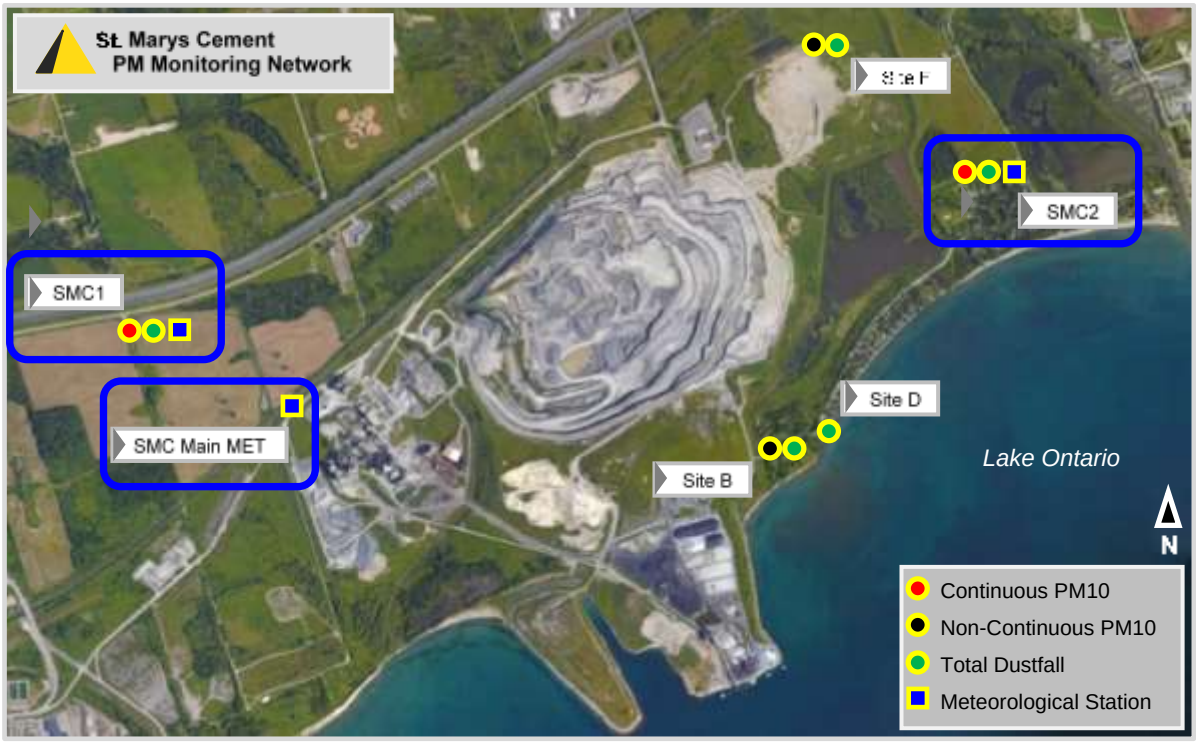
- **PM_{10} - Inhalable Particulate** - deposited in the upper respiratory tract.
- **$PM_{2.5}$ - Respirable Particulate** - capable of penetrating the alveolar region of the lung.

SMC PM Monitoring Network Overview



St. Marys Cement PM Monitoring Network		By : BB	**Figure 1**	ROTEK
	True North	Approx. Scale :	1:22000	
St. Marys Cement - Bowmanville Cement Plant		Date Revised :	26 Nov, 2018	

SMC PM Monitoring Network Overview



St. Marys Cement PM Monitoring Network	True North	By : BB	**Figure 1**
St. Marys Cement - Bowmanville Cement Plant		Approx. Scale :	1:22000
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ROTEK

SMC Continuous PM_{10} Monitoring Program

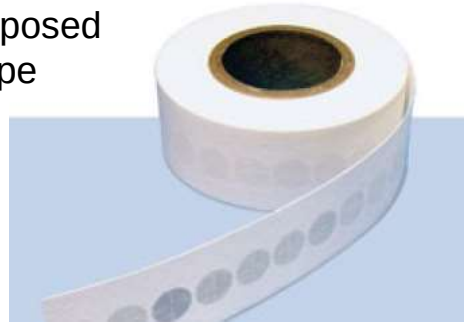
- SMC's air quality program monitors and reports accurate real-time continuous measurement of ambient PM_{10} at various sites located around the St. Marys Bowmanville Cement Plant facility. The data generated are used to measure compliance with provincial standards.
- PM_{10} is continuously monitored utilizing Met One BAM 1020 continuous particulate monitors.
- The BAM 1020 automatically measures and records airborne particulate concentration levels in micrograms per cubic meter using the industry-proven principle of beta ray attenuation.
- The Met One BAM 1020 has longstanding U.S. Environmental Protection Agency (EPA) designation as a Federal Equivalent Method (FEM) for continuous PM_{10} particulate monitoring.

Met One BAM 1020 Continuous PM_{10} Monitor

PM_{10} Size Selective Sample Inlet

Filter Tape Mechanism

Exposed Tape

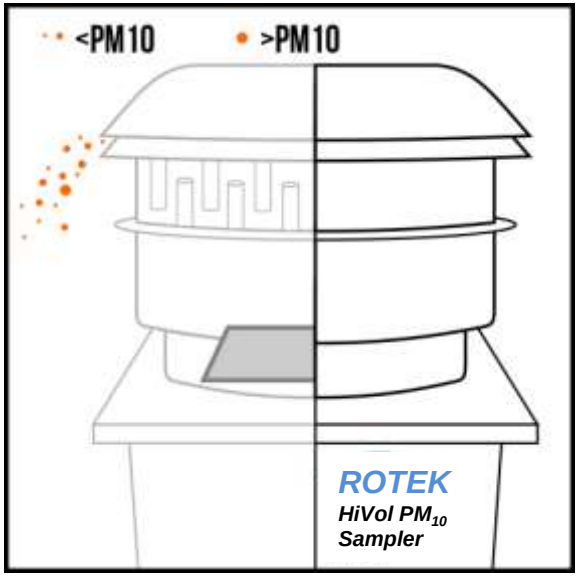


➥ The MECP AAQC is 50 µg/m^3 for a 24 Hr running average.

Non-Continuous PM_{10} High Volume Air Sampler

PM_{10} Size Selective Sample Inlet

An air sampler draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is separated by inertia into one or more size fractions within the PM_{10} size range.

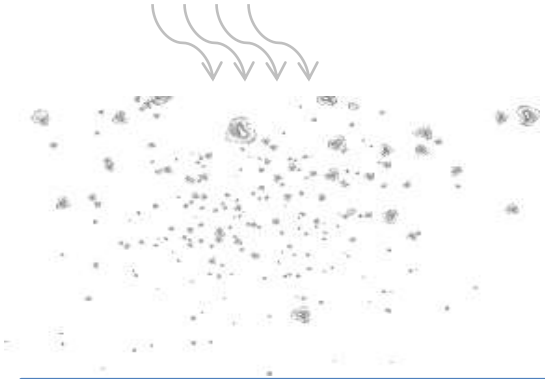


Runs on a '6 day' schedule (midnight to midnight)

➥ The MECP AAQC is 50 µg/m^3 for a 24 Hr clock average (midnight to midnight).

Non-Continuous Total Dustfall Sampler

Settleable Particulate



Dustfall collection is a passive sampling method that provides a measure of particulate deposition.

Containers (Dustfall Jars) of a standard size and shape are prepared and sealed in a laboratory and then opened and set up at appropriately chosen sites so that particulate matter can settle into them for periods of about 30 days.

The masses of the water-soluble and insoluble components of the material collected are determined. The result totals are reported as grams per square metre per 30 days (g/m2/30).

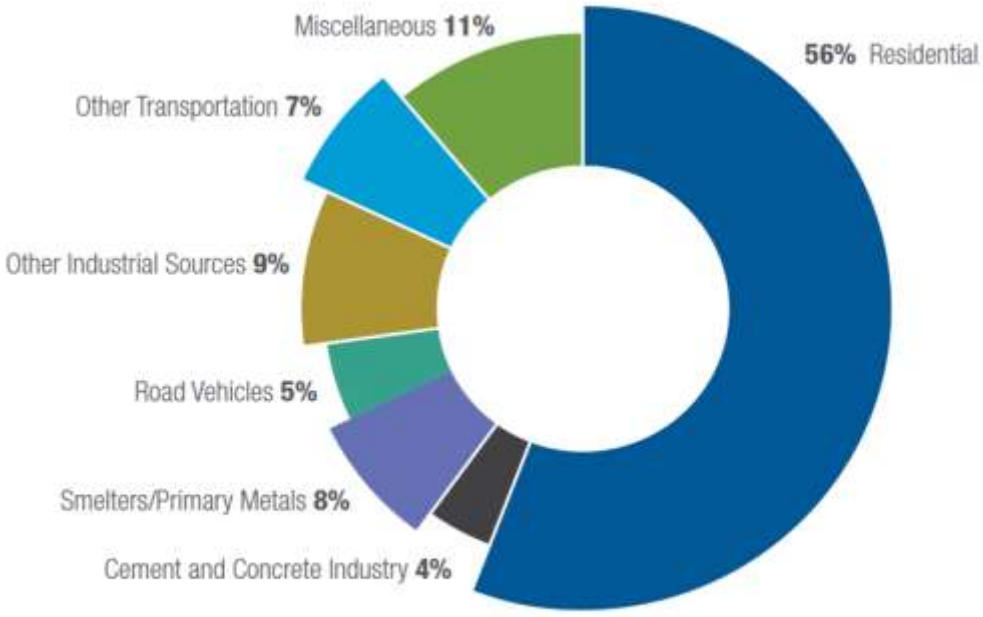
➥ The MECP AAQC is 7 g/cm^2/30 days.

Respirable Particulate - $PM_{2.5}$

- Fine particulate matter, a regional pollutant denoted as $PM_{2.5}$, is approximately 30 times smaller than the average diameter of a human hair.
- Fine particulate matter is one of the major components of smog.
- Fine particulate matter can have various negative health effects especially on the respiratory and cardiovascular systems.
- Major components of $PM_{2.5}$ in Ontario are typically nitrates, sulphates, organic matter and particulate bound water.
- Fine particulate matter may be emitted directly into the atmosphere as a by-product of fuel combustion or it may be formed indirectly in the atmosphere through a series of complex chemical reactions.

Respirable Particulate - $PM_{2.5}$

- The estimates for Ontario $PM_{2.5}$ emissions from point, area and transportation sources (excluding emissions from open and natural sources) indicate that residential fuel combustion accounted for 56% of $PM_{2.5}$ emissions.
- The Cement and concrete industry accounts for approximately 4% of Ontario $PM_{2.5}$ emissions.

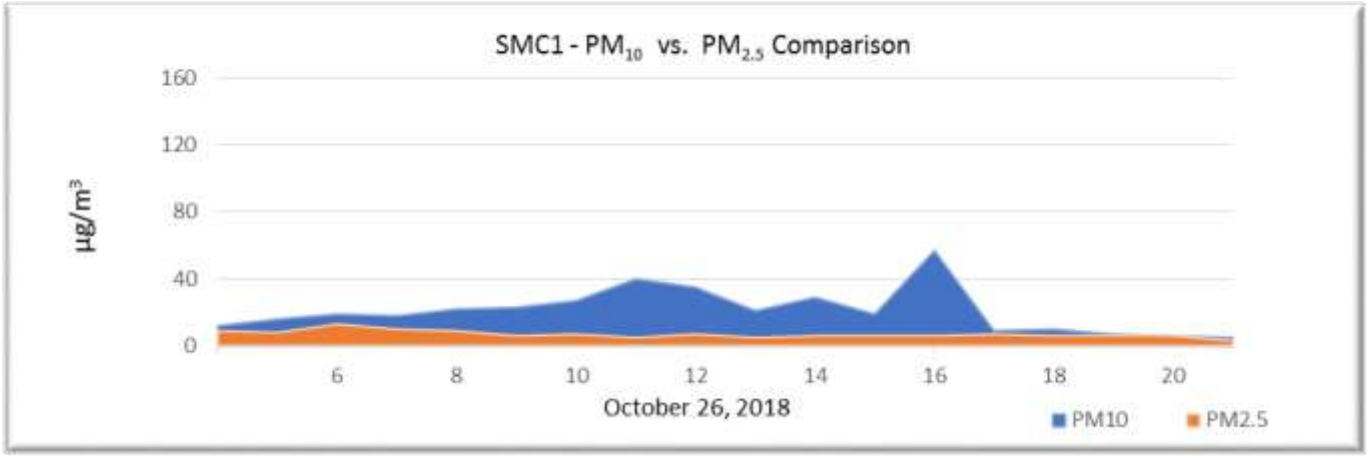


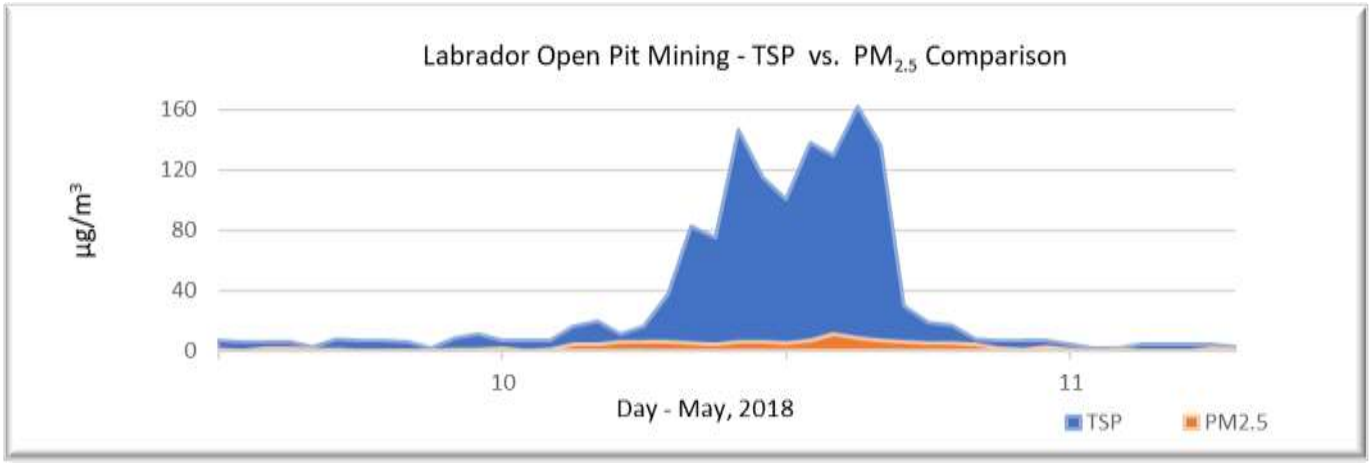
Note: Excludes emissions from open and natural sources.

Source: Ministry of the Environment, Conservation and Parks, Air Quality in Ontario, 2016 Report.

Point Source Contribution $PM_{2.5}$

Below are examples of $PM_{2.5}$ point source contributions from 2 industrial sources, one being St. Marys PM_{10} monitoring station SMC1 and the second an open pit mining operation in Labrador.



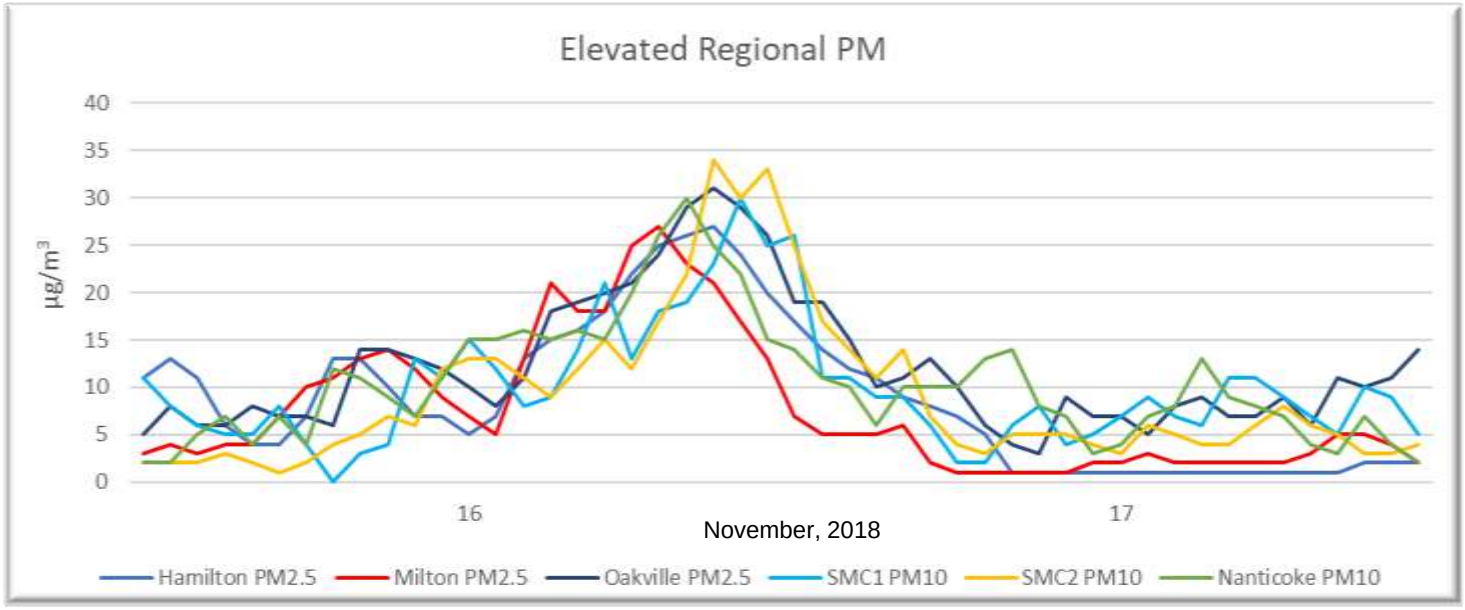


Regional $PM_{2.5}$ Events

$PM_{2.5}$ events are not typically primary or point source related but tend to be regional in nature as illustrated below.

Primary PM is emitted directly into the atmosphere from a source, such as a smokestack or exhaust pipe, or from wind-blown soils or vehicle traffic on a dirt road.

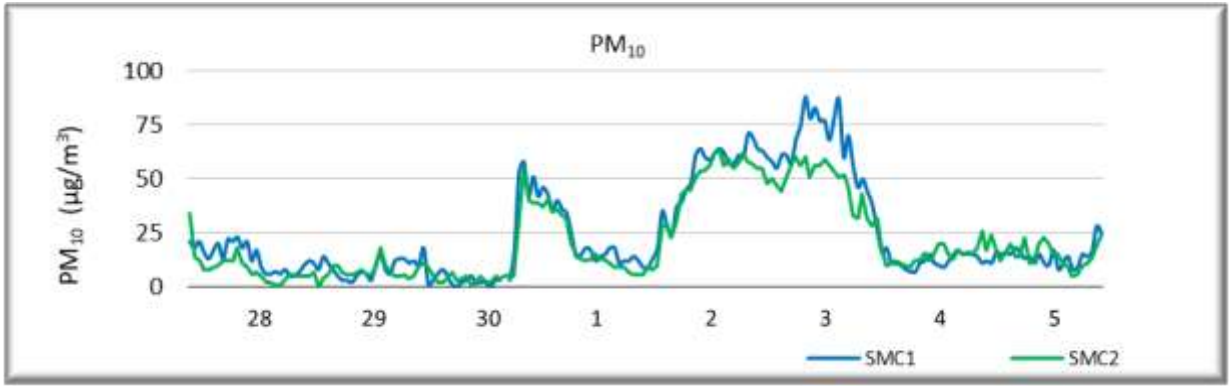
The secondary PM below is formed indirectly in the atmosphere through a series of complex chemical and physical reactions involving gases such as Sulphur oxides (SOx) and nitrogen oxides (NOx).



PM_{10} Exceedance Event June 30th - July 4th 2013

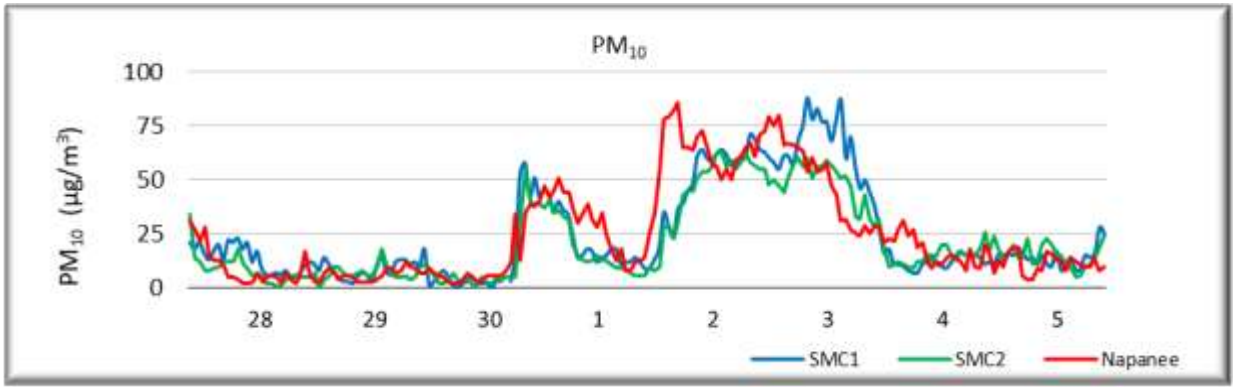
SMC1 and SMC2 records PM_{10} exceedances June / July, 2013.

Winds out of the NE, 'upwind' of SMC plant operations.

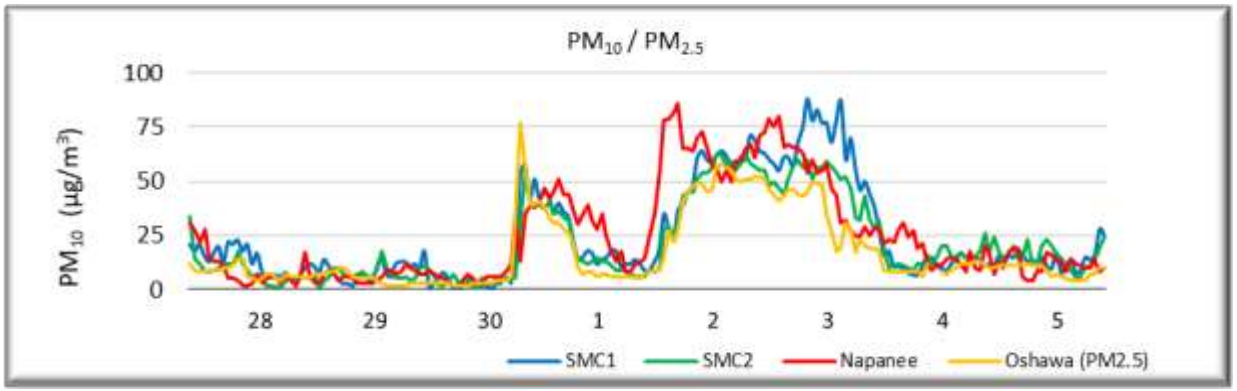


News reports of northern Quebec forest fires impacting Ontario air quality.

PM_{10} data from a Napanee monitor confirms Provincial wide impact on air quality



$PM_{2.5}$ data from the Oshawa AQHI station indicates a dominant size fraction in the $PM_{2.5}$ range.



MECP $PM_{2.5}$ Standards

A value of 28 µg/m^3 (24 Hr calendar day) is the Canadian Ambient Air Quality Standard (CAAQS) for $PM_{2.5}$, developed jointly by the Federal government and the Provinces, including Ontario, as a step towards the long-term goal of minimizing the risk that fine particles impose on human health and the environment.

Achievement of the $PM_{2.5}$ CAAQS in various airsheds is to be based on the 24 hour 98th percentile ambient measurement annually, averaged over three consecutive years.

The annual $PM_{2.5}$ AAQC is 10 µg/m^3 based on the 3 year average of the annual average concentrations. An annual standard helps protect human health from long term or chronic exposure to fine particulate.

Pollutant	Averaging Time	Standards		Metric
		2015	2020	
$PM_{2.5}$	24 Hr (Calendar Day)	28 µg/m^3	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.
$PM_{2.5}$	Annual (Calendar Year)	10.0 µg/m^3	8.8 µg/m^3	The 3-year average of the annual average concentrations.

Ministry Audit Program

- The MECP audits the St. Marys PM monitoring network quarterly.
- The audit program provides an indication of the effectiveness of quality control activities used by station operators and data management staff.
- Performance audits are independent evaluations of data quality produced by the PM monitors.
- Ministry staff document their findings in audit reports.
- Rotek has been involved in the service and maintenance of the SMC PM monitoring network since 2011 and have a 100% audit success rate.