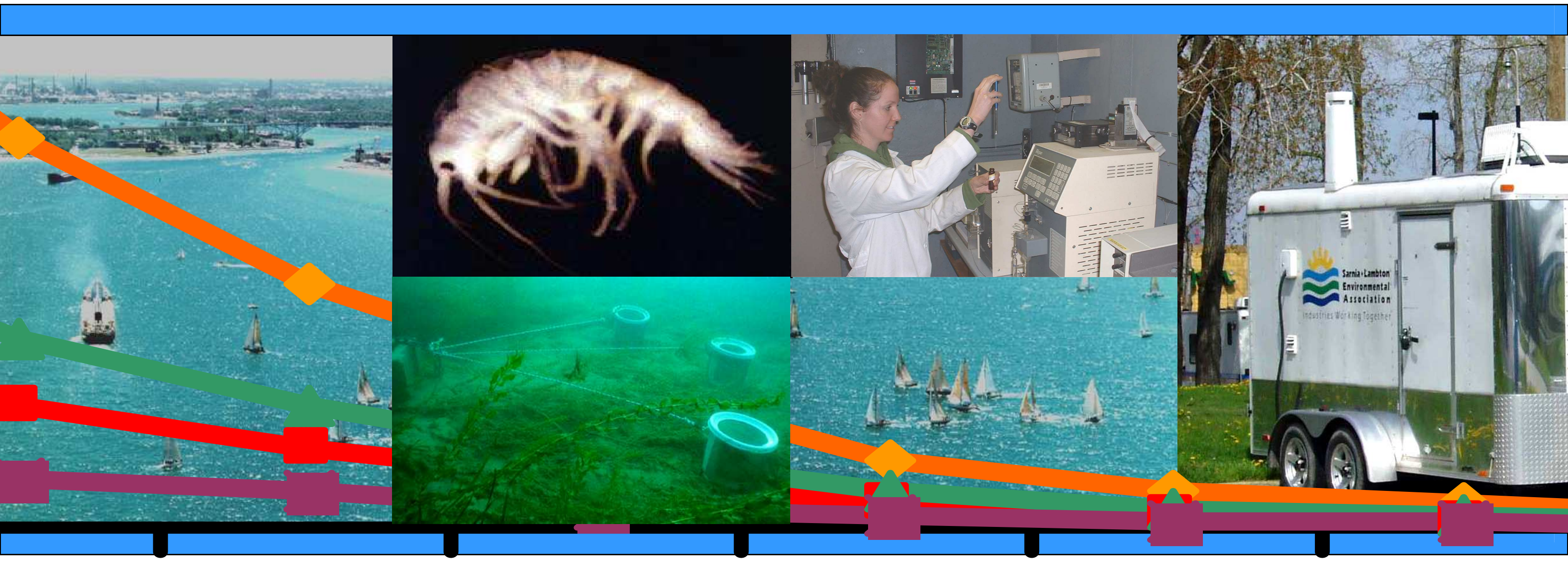
2006
Progress Review
Technical Summary



Sarnia♦Lambton
Environmental
Association
Industries Working Together

2006
Progress Review
Technical Summary

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Industries Working Together

Dean Edwardson, General Manager
Joan Green, Administrator

265 Front Street North, Suite 111
Sarnia, Ontario, Canada N7T 7X1
Tel: 519-332-2010
Fax: 519-332-2015
admin@sarniaenvironment.com
www.sarniaenvironment.com

Protecting the integrity of its technical research, reports and presentations is of the utmost importance to the Sarnia-Lambton Environmental Association (SLEA). The responsibility for managing the organization's environmental monitoring network and data associated with the annual technical program, as presented in this technical summary, rests in the capable hands of the following third-party consultants:

ORTECH is one of Canada's leading atmospheric science consulting firms providing technology based consulting services and expertise in environmental science and engineering to government, industrial and financial organizations. Local services are provided through the company's Sarnia office, which has been in operation for over 50 years.

A long-time SLEA consultant, ORTECH has been designing, implementing and operating ambient air monitoring networks for industry since the 1950s. In addition to the air program expertise, the company has had 20 years experience in the development and implementation of continuous water quality monitoring instrumentation.

Pollutech EnviroQuatics Limited has established a solid reputation for its biological laboratory research services, which have operated continuously in Sarnia/Point Edward since the early 1970s. The biological research laboratory has been performing routine compliance bioassays, as well as developing new and innovative bioassay and biomonitoring techniques for private- and public- sector clients locally and across Canada for over 20 years.

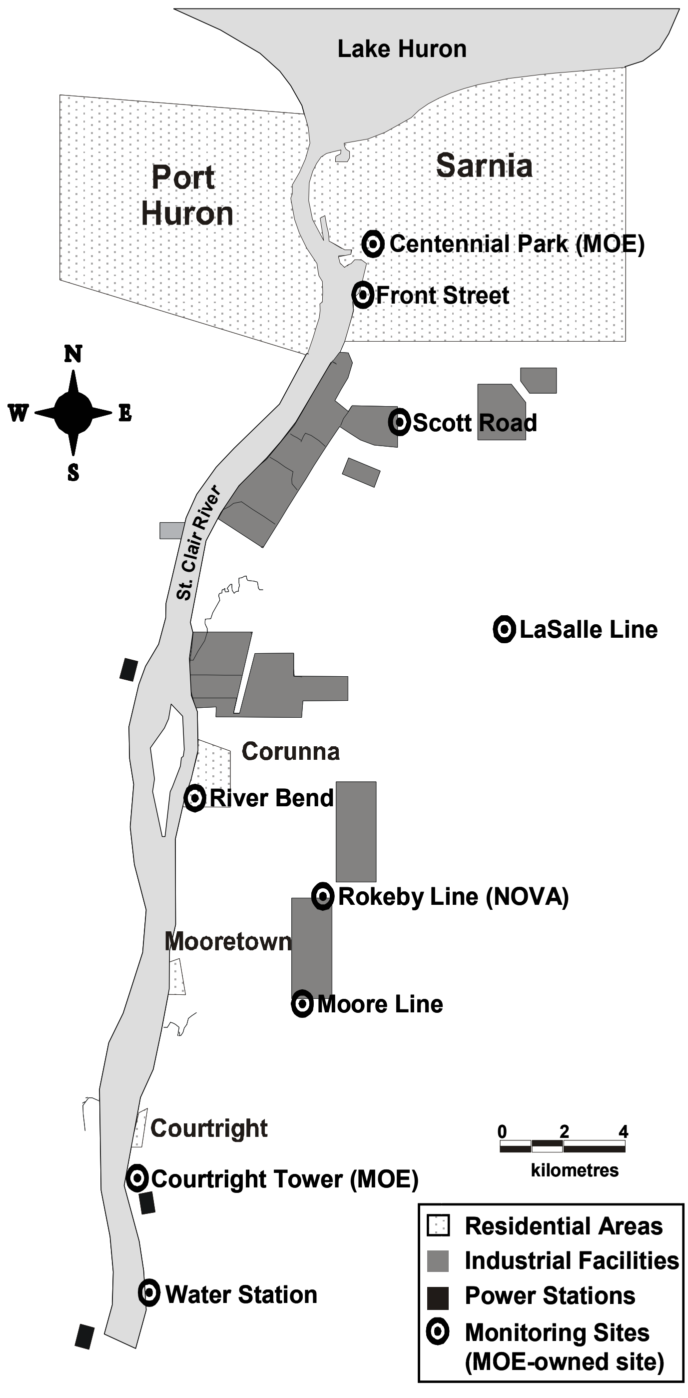
An environmental advisor to the SLEA on St. Clair River quality since the early 70s, Pollutech EnviroQuatics' corporate capabilities also include ambient effects monitoring, zebra mussel control, marine diving and general marine services, as well as geo-environmental engineering and assessment services.

OUR COVER: (clockwise from left) The St. Clair River for commerce; studying the amphipod Hyallella azteca of the river's benthic community; preparing river water sample for laboratory analysis; our mobile monitoring unit; the St. Clair River for recreation; in-stream toxicity testing of fathead minnows

Industries Working Together

Local industries learned long ago that improving our local environment takes teamwork.

As members of the Sarnia-Lambton Environmental Association (SLEA), both large and small companies share their knowledge and resources to understand the effects of their operations and to develop better ways to eliminate spills and cut emissions to air, water and land.



THE SLEA's Monitoring Network

The SLEA is a voluntary environmental co-operative of 20 industrial facilities in Lambton County. In its 55th year, the association works to keep its members and the public informed about local environmental conditions and trends, as well as related issues.

Through its network of seven air and water quality monitoring stations, plus two owned by the Ontario Ministry of the Environment, the SLEA uses third-party consultants to measure and assess long-term environmental changes along the St. Clair River, from the shore of Lake Huron downstream to Courtright. Since 2001, the association has also maintained a mobile monitoring unit. The self-contained trailer can be moved to the scene of an environmental incident, but is most often used by member companies to monitor air quality on their sites during large-scale maintenance and construction projects.

Using sound scientific information, the member companies encourage – and occasionally push – each other to reduce their environmental footprints, that is, the effects their plant operations have on our air, land and water resources.

As a result of their ongoing environmental improvements, positive and measured results are being realized.

Member company progress, priorities and programs may be viewed by visiting the SLEA's office and resource library at 265 Front Street North, Suite 111, in Sarnia, phone 519-332-2010, or contact admin@sarniaenvironment.com. See the latest environmental findings on the Internet at www.sarniaenvironment.com.

Our Mission

That the Association be recognized by its members, regulatory agencies and the community for excellence in promoting and fostering a healthy environment that is consistent with sustainable development.

Our Goals

- Members will have an exemplary awareness of environmental management and risk prevention regulations, technologies and procedures
- Members will fully understand the impacts of stressors on the local ecosystem
- The Association will be recognized for its competency and reliability such that regulatory agencies will seek information, expert advice and comment from the Association and its members when developing environmental legislation and regulatory programs
- The Association will strive to maintain a well-informed community that will actively contribute to sound resolutions of environmental issues

Our Member Companies

Basell Canada, Inc.

BP Canada Energy Company

Cabot Canada Ltd.

Canada Commercial Services L.P.

Clean Harbors Canada, Inc.

Dow Chemical Canada Inc.

Ethyl Canada Inc.

Fibrex Insulations Inc.

H.C. Starck

Imperial Oil Limited

LANXESS Inc.

NOVA Chemicals

Ontario Power Generation

PRAXAIR Canada Inc.

Royal Polymers Co.

Shell Canada Products

Suncor Energy Products Inc.

Terra International (Canada) Inc.

TransAlta Energy Corporation

Waste Management of Canada

Our Air Quality Monitoring Program

Long gone are the days when something invisible, like the air we breathe, could not be measured because it could not be seen. Today's sensitive air quality monitoring instruments can detect a contaminant present in the air at proportions less than one part per billion. That is like measuring a single step in a trip that extends 7.5 times around the world.

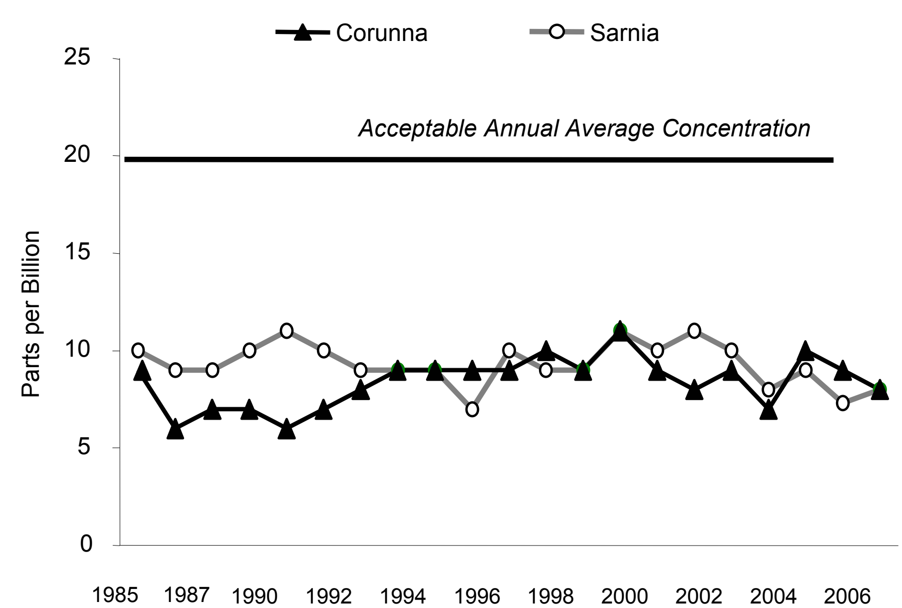
Equipped with a variety of control and monitoring devices, local industries identify and manage the quality of each emission source, whether from the stack of a large blast furnace or the pipe of a ventilation hood at a single laboratory technician's workstation. Large or small, industry's ongoing goal is to cut emissions and remain well below the allowable limits set by Ontario's clean air regulations, which protect public health and the environment.

To encourage continuous reductions in emissions from its member company sites, the SLEA has been monitoring real-time and long-term changes in local ambient air quality for 55 years. The SLEA's air quality monitoring network tests the local air for some 20 compounds typical of industrial emissions. As well, several of the stations measure ground-level ozone and particulate matter, the main ingredients in smog – the mixture of air contaminants that are the focus of the Ontario Ministry of the Environment's public smog alert program.

Sulphur Dioxide (SO_2)

For over 45 years, the SLEA has been tracking SO_2 from strategically located monitoring stations in the Sarnia-Lambton area (see map, Page 1). It is a colourless gas, but can often be readily identified by its rotten eggs-like odour. Sulphur dioxide can be oxidized to form sulphuric acid aerosols and also may form sulphates that contribute to fine particulate matter. It is an acid rain precursor, capable of contributing to the acidification of lakes, streams and soils, as well as the corrosion of buildings. Health effects include breathing problems and respiratory illness. People most sensitive to sulphur dioxide are asthmatics and those with chronic lung, or heart disease. So_2 is most prevalent near industrial areas, being released into the air by smelters, petroleum refineries, iron and steel mills and pulp and paper mills. However, other sources include residential and commercial heating and transportation. Although sources of SO_2 travel into Sarnia-Lambton from the U.S. Midwest on prevailing winds, petroleum refineries account for most of the local emissions.

Figure 1 - Sulphur Dioxide Annual Mean Levels



Levels of SO_2 have remained relatively constant over the past 20 years (see Figure 1). The Lambton Industry Meteorological Alert (LIMA) Regulation was established by the Ontario Government in the early 1980s with input from SLEA member companies to provide a response to help diminish the local effects of sulphur dioxide emissions. The regulation identifies the maximum average daily levels of SO_2 that may be reached at designated association monitoring stations, before participating area industries are advised to switch to lower-sulphur fuels, or reduce their production rates to lower emissions. Over the past 25 years, there have typically been six events per year, averaging approximately 16 hours in duration.

In 2006, there were seven LIMA events, averaging 11 hours in duration. The daily criterion of 100 parts per billion was maintained during all events that occurred on northerly winds. However, two hours above the acceptable hourly average of 250 parts per billion were recorded at the Corunna monitoring site, one in April and one in June. Conversely, the acceptable daily average was exceeded twice during two LIMA events that were reported at the Sarnia station on southerly winds, while all hourly levels remained below the hourly criterion. The exceedances were the result of weather conditions that prohibited normal emission dispersion.

Total Reduced Sulphur (TRS)

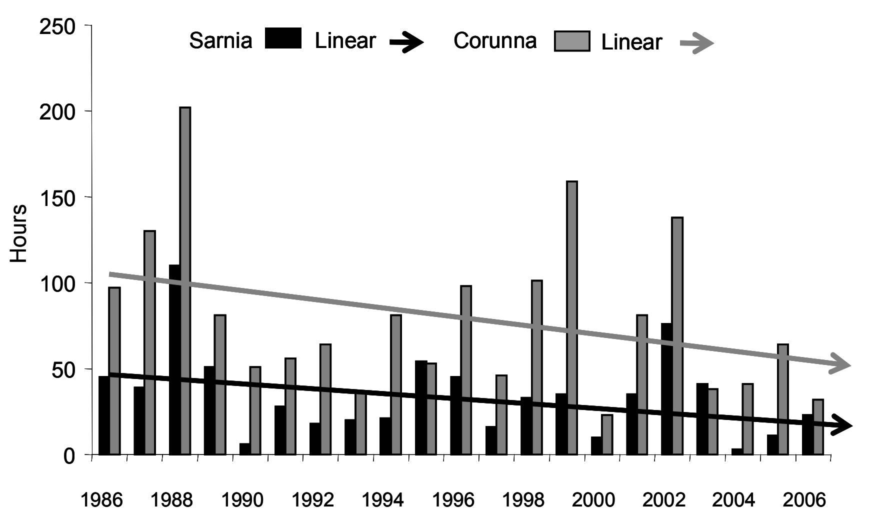
At low concentrations, TRS compounds are not normally considered a health hazard, although the rotten egg or cabbage-like odour they produce can be detected by most people. They are released by human sources, such as oil refineries, pulp and paper mills, steel mills and sewage treatment facilities, as well as by natural sources, including various types of wetlands. The Ontario one-hour acceptable level for TRS is 20 parts per billion. The challenge for industry is to manage related materials in contained environments to avoid the escape of errant odours, even for short durations.

During 2006, the Ontario one-hour acceptable level was not exceeded at either of the SLEA's Sarnia or Corunna monitoring locations. Annual levels of TRS have continued to decrease over the past 10 years to less than 0.3 parts per billion in 2006.

Ground Level Ozone (O_3)

The main component of smog, O_3 is formed when contaminants, such as nitrogen oxides (NO_x) and volatile organic compounds (VOCs), react together in the presence of sunlight. At ambient levels, O_3 is a colourless, odourless gas. Its formation and transport are dependent on weather factors, such as temperature, hours of bright sunshine and wind speed and direction.

Figure 2 – Annual Number of Ground Level Ozone Hours (above Ontario's Ambient Air Quality Criterion of 80 ppb)



Ozone occurs naturally in the stratosphere, providing the earth with a protective shield from harmful ultraviolet radiation. However, at ground level its presence stagnates the air, with human activities largely responsible for its increased presence in recent years. The primary contaminants contributing to the generation of O_3 are related to the coal, gas and oil in motor vehicles, industries, power plants and homes and from the evaporation of liquid fuels and solvents. Since the sun acts as a catalyst to its formation, O_3 concentrations at elevated levels are normally recorded in the afternoon on hot, sunny days during the months of May through September. Health effects of O_3 include irritation of the respiratory system and eyes. Children and people with respiratory disorders are most vulnerable. O_3 also adversely affects the growth rates and yields of sensitive farm crops, such as white beans, potatoes and tomatoes.

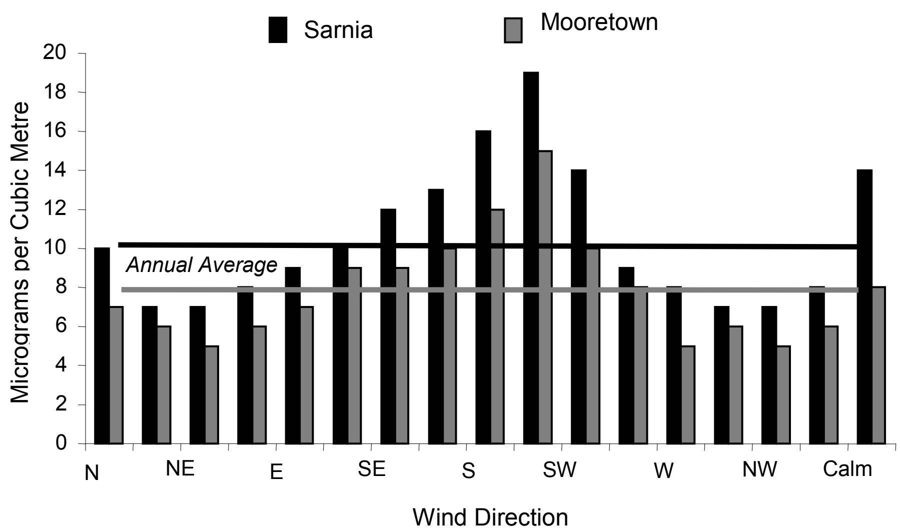
The SLEA monitors O_3 at two stations in Sarnia-Lambton. The site of the Front Street monitoring station near downtown Sarnia, north of the area's main industrial complex, reflects an urban location. The SLEA's river bend site is in a suburban location, at the edge of Corunna, south of Sarnia-Lambton's main industrial corridor. Concentrations are generally lower in urban areas, due to its reduction by reaction with nitric oxides, which are emitted by vehicles and local combustion sources. Readings at both SLEA monitoring sites are impacted by the long-range transport of O_3 and its primary compounds generated in the U.S. Midwest and transported into Southwestern Ontario on prevailing southerly winds.

In 2006, the highest hourly concentration was 103 parts per billion, measured at the SLEA's Front Street monitoring station on June 6 during southerly winds. O_3 concentrations exceeded Ontario's hourly ambient air quality criterion of 80 parts per billion at the Front Street station on 23 occasions and 32 times at the river bend station. Figure 2 illustrates the annual number of hours greater than the provincial criterion at both monitoring sites during the past 15 years. This graph shows a general downward trend, despite random fluctuations. Annual summer mean levels offer only a hint of an increase in O_3 concentrations over the past 20 years of records.

Particulate Matter ($PM_{2.5}$)

Particles of contaminants in atmosphere can come from a variety of sources, in nature and from human activities. Like ground level ozone, very fine particulate can remain in the atmosphere for weeks, drifing many miles, making it extremely difficult to accurately identify sources and control measure.

Figure 3 – Respirable Particulate Matter ($PM_{2.5}$)



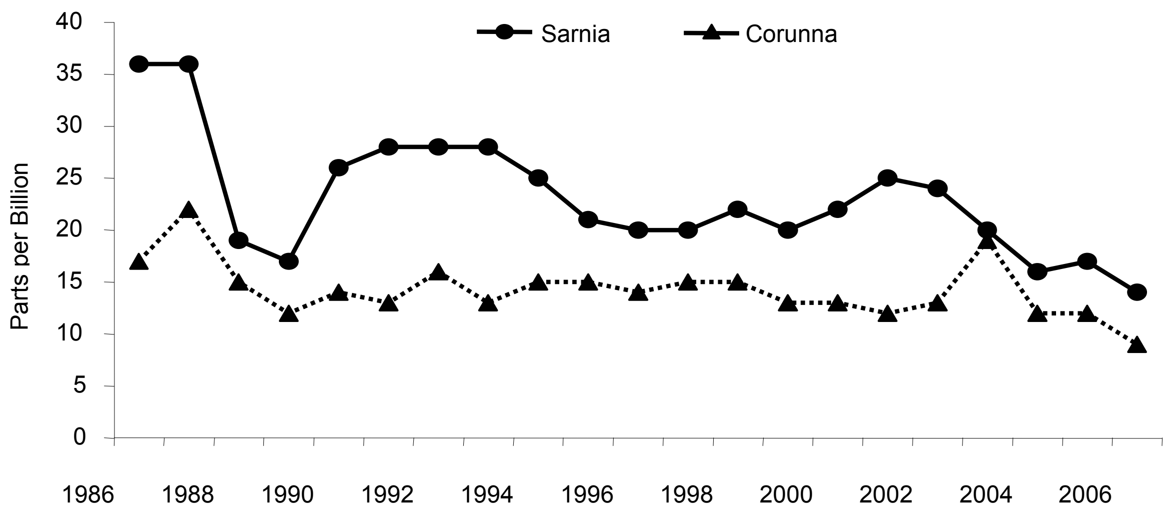
Airborne particulate matter is classified according to its aerodynamic size. In recent years, increased attention has been given to fine particulate, or respirable particulate matter ($PM_{2.5}$), which refers to particles that measure 2.5 microns or less in diameter and would be capable of penetrating deep into the respiratory system. The Canada-wide daily standard for $PM_{2.5}$ is 30 micrograms per cubic metre. The method for real-time continuous measurement of $PM_{2.5}$ is relatively new and has been developed and refined only over the past 12 years. The SLEA has measured $PM_{2.5}$ since 2000 at Moore Line, in St. Clair Township. At the beginning of 2006, the Ontario Ministry of the Environment commissioned a second monitoring site for the area at the SLEA's Front Street Site in Sarnia.

During 2006, the Canada-wide daily standard for $PM_{2.5}$ was exceeded on two days, at both the Sarnia and Moore Line monitoring stations. Both instances occurred on southerly winds. Further, the influence of distant sources was reflected through a rise of local $PM_{2.5}$ levels during strong southerly winds, as shown in Figure 3.

Nitrogen Oxides (NO_x)

NO_X are released into the atmosphere from sources that burn natural gas, coal, oil, or gasoline. Representing a combination of nitric oxide (NO) and nitrogen dioxide (NO_2), NO_X are commonly found at higher concentrations in urban locations, because of the increased volume of emission sources, the largest being motor vehicles, fossil fuel power generation plants and industrial processing facilities. The gases have a pungent and irritating odour that are often colourless, but range to a reddish-brown. NO_2 transforms in the air to form gaseous nitric acid and nitrates, which contribute to the formation of fine particulate matter.

Figure 4 – NOx Annual Mean Levels



For over 30 years, nitrogen oxides have been measured by the SLEA from its monitoring stations in Sarnia and Corunna. The annual levels at both stations are shown in Figure 4. Over the past 20 years, local NO_x levels have been in decline, although at a lesser rate over the past decade.

Volatile Organic Compounds (VOCs)

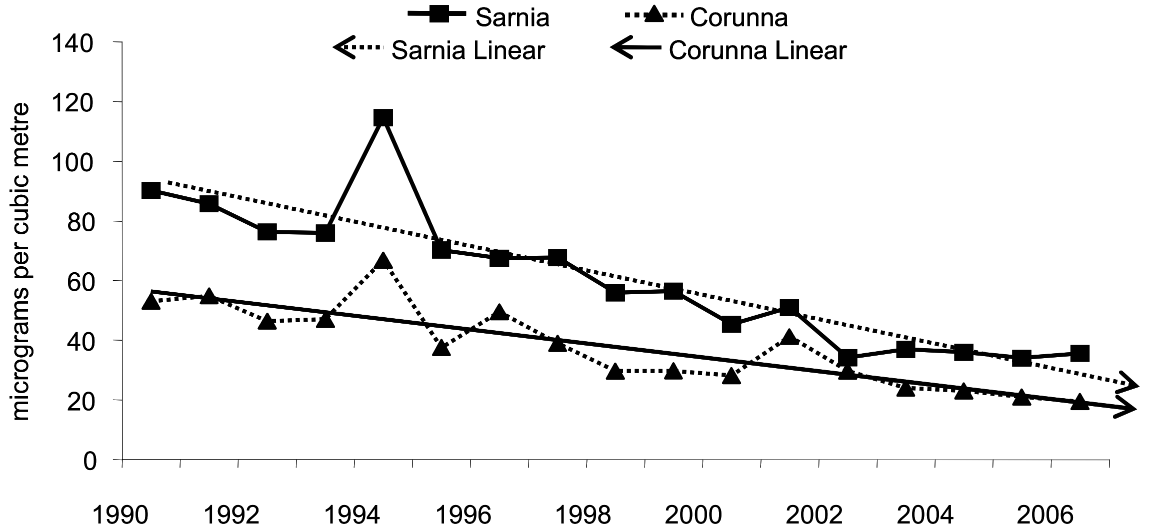
Many natural and man-made organic compounds, which are carbon-based molecules bonded to other elements, exist in the atmosphere. VOCs are chemicals that easily evaporate under normal pressures and temperatures. They are produced by a variety of natural and human sources, including emissions from automobiles, as well as petroleum, petrochemical and chemical industrial sites. Once emitted into the atmosphere, some VOCs can present hazardous effects on plants, animals and people. These compounds contribute to the formation of ground-level ozone and smog and are a possible health concern.

The SLEA's VOCs monitoring program is managed in three segments:
1. A group of 50 VOCs are collected over a 24-hour period once every 12 days from the Sarnia and Corunna monitoring sites to then undergo laboratory analysis. SLEA records date back to 1986.

2. A sub-group of 11 of the 50 VOCs are measured through hourly automated sampling at the Sarnia site. The unique program has been ongoing since 1994.

3. The VOC ethylene had been monitored on a continuous hourly basis at five sites since 1976. The compound is of particular interest, as it is a major commodity produced, widely used and stored locally.

Figure 5 – Measured Volatile Organic Compounds



During 2006, the annual sum averages of the group of 50 VOCs (excluding ethylene) continued the downward trend documented over the past 17 years (see Figure 5). Total levels have dropped 60 percent since 1990, while annual levels have changed little during the last four years. In 2006, all compounds were well below any associated Ontario ambient air quality criteria. The Ontario daily ambient air quality criterion for ethylene was exceeded on a total of 20 days at the various monitoring locations during the year.

Our Water Quality Monitoring Program

SLEA member companies remain committed to eliminating spills to the St. Clair River. The association's monitoring program represents a fact-based measure of their progress.

Since 1987, the SLEA's water quality monitoring instrumentation has maintained a continuous record – 24 hours per day, 365 days per year, at a riverside station just downstream of Courtright. The station's river water samples are analyzed for 20 volatile organic compounds that are representative of potential discharges from SLEA member companies. With 20 years of continuous operation to its credit, the automated system is recognized as being highly reliability and accuracy. SLEA consultants assess the more than 170,000 data measuring points generated by the station each year and interpret long-term trends related to St. Clair River water quality. The station also provides a supplementary service in detecting specific releases to the St. Clair River, so early warnings to downstream water users can be issued.

During 2006, a total of 173,740 results were reported, with all levels being well within the Ontario Government's water quality standards, which have been developed to protect human health and the most sensitive aquatic life. For the second time in four years, all analyses were below one part per billion (ppb; one ppb is comparable to one step of a journey travelling 7.5 times around the earth). In more than 99 percent of the analyses, the target compounds were not present, or less than method detection levels (< mdl; the mdl is the minimum concentration of a chemical that can be measured by a device and reported with a 99 percent confidence that the chemical concentration is greater than zero). During the year, only four of the 20 compounds measured by the SLEA program were detected (see Table 1).

Table 1 – Continuous Water Monitor Results for 2006

Compound	Detection Limit (mdl) (ppb)	Frequency of Detection (%)	Number of Analyses	Average (ppb)	Minimum (ppb)	Maximum (ppb)
Cyclohexane	0.04	0.2	20	< mdl	< mdl	0.18
Benzene	0.05	1.9	161	< mdl	< mdl	0.09
Toluene	0.08	13.9	1207	< mdl	< mdl	0.67
m+p-Xylene	0.16	0.2	19	< mdl	< mdl	0.21

Toluene continued to be seen most frequently. Of particular interest, monitoring results continued to show a well-established pattern, where levels increased during summer weekends to coincide with the greater number of recreational boats on the river.

While the current device has proven to be extremely reliable, it is slated to be replaced in 2007. The installation of a state-of-the-science device offers the SLEA the opportunity to consider an expansion of it river water quality monitoring program capabilities.

Summary of Historical Water Events Monitored

The greatest frequency of events detected at the one ppb or greater level occurred between 1988 and 1993 (see Table 2). During that time period, the maximum concentrations per event were typically higher as well. The shaded boxes indicate industrial sources, while the solid boxes represent non-industrial, or unknown sources. In 2003 and 2006, there was no episode with results at or above one ppb.

Table 2 – Maximum Concentrations of Target Compounds ≥ One Part Per Billion (ppb)																		
	MTBE	Hexane	Chloroform	Cyclohexane	Carbon Tet.	Benzene	1,2-DCE	TCE	1,2-DCP	Toluene	Perchloroethylene	Ethylbenzene	m+p-Xylene	o-Xylene/Styrene	1,3-DCB	1,3-DEB	1,2-DEB	Tetraethyl Lead
1988						**9**				**5**				**2**				
1989						**7**				**7**	**2**	**5**	**25**	**107**				
1990					**2**	**3**				**2**	**2**	**285**	**2**	**7**		**1**		
1991						**3**				**11**		**3**	**7**	**11**				
1992				**6**		**51**				**41**	**1**	**2**	**8**	**4**				
1993	**1**			**4**		**11**				**8**		**2**	**7**	**2**				
1994						**1**				**4**		**13**						
1995											**2**	**1**	**4**					
1996		**7**		**7**		**4**				**4**			**2**					
1997						**2**				**5**			**1**					
1998				**2**				**4**			**2**							
1999				**1**		**1**					**2**							
2000										**17**		**6**	**4**	**2**				
2001		**4**		**3**		**3**				**4**			**2**					
2002						**3**												
2003																		
2004						**2**				**4**	**2**	**1**	**4**	**3**				
2005		**2**								**31**	**1**	**9**	**14**	**4**				
2006																		

2 Industrial sources
2 Non-industrial or unknown sources

Overview of Historical Events
(Also see Figure 6 for historical trends)

1998 to 1995 all results (760) due to industrial events

1996 all results (45) due to a non-industrial event

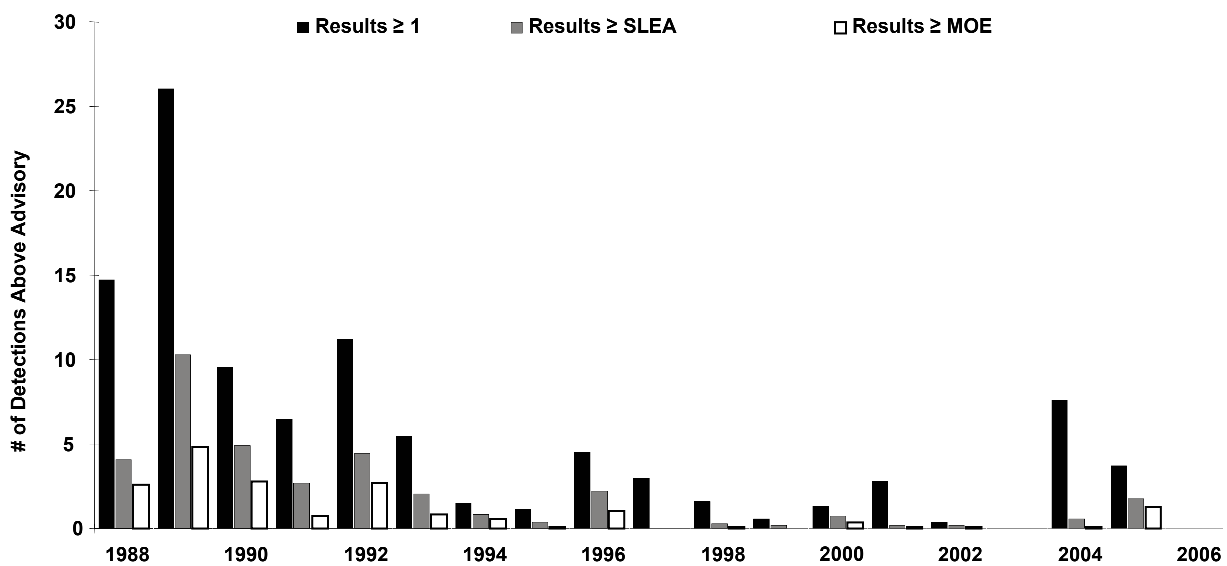
1997 all results (30) due to industrial events

1998 4 results due to industrial episode
12 results due to non-industrial event

1999 4 results due to non-industrial event
2 results due to industrial episode

2000	all results (13) due to a non-industrial event
2001	22 results due to heavy rainfall 6 results due to an industrial episode
2002	all results (4) due to non-industrial event
2003	none
2004	38 results due heavy rainfall 32 results due to a river sediment remediation program 6 results due to an industrial episode
2005	all results (37) due to heavy rainfall
2006	none

Figure 6 – Historical Review of Results ≥ 1 ppb and Advisory Levels



History of SLEA Continuous Monitoring Program Development

1988
- First full year of continuous monitoring at the Courtright station
- Packed column
- Monitoring for 6 compounds
- Valid Data recovery of 90%
- Analog signals from the GC were amplified by signal processors, and then fed into a remote terminal unit which used software modifications to serve as a "peak picker".
- Toluene had the lowest method detection limit (MDL) at 0.5 ppb (Benzene 1.0 ppb)

1989
- Target list of compounds increased to eight, and then 17
- Megabore capillary column
- Addition of integrator – data now sent via RS232 to the server
- Introduction of EARS – Early Automatic Response System

1990
- Addition of a mass flow controller to the GC to eliminate losses due to retention shifts

	•	Addition of pH, conductivity and river water temperature
1991	•	New Purge & Trap installed (previous instrument was a prototype)
	•	Installation of an automatic grab sampling device
	•	Improvement of MDLs (Benzene 0.3 ppb)
	•	Measurement of pH and conductivity suspended
	•	Installation of UPS to prevent data loss during power outages
	•	EARS refined to consist of three advisory levels
	•	Valid data recovery of 95%
1992	•	Integrator replaced
	•	Target list of compounds increased to 20
	•	QA/QC program improved with addition of internal standard check on each sample
	•	pH and conductivity program reactivated
	•	Valid data recovery of 98%
	•	Measurement of conductivity discontinued
1993	•	Second sample intake added
	•	Implementation of control limits and alarms for the internal standard check
1995	•	Determination of new MDLs (benzene 0.05 ppb)
	•	Special study undertaken to determine cause of summertime toluene
1999	•	Telemetry equipment replaced
2001	•	River transect study undertaken
2002	•	Software modifications to improve alarming capability for instrument problems
	•	Intake sample heads replaced with stainless steel to improve resistance to zebra mussels
2003	•	Automatic back flush system installed to improve sample integrity
2004	•	Backup generator installed
2005	•	Testing of alternative measurement technology
	•	One of the iron sample intakes replaced with a Teflon line

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