Preliminary Air Quality Assessment Related to Traffic Congestion at Windsor's Ambassador Bridge

2004

Ontario

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Ministry of the Environment

2004

Printed on recycled paper

PIBS 4624e

Ontario

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ACKNOWLEDGMENTS

This report has been prepared by staff of the Southwestern Region Technical Support Section, of the Ontario Ministry of the Environment. We wish to express our thanks to Scott Kennedy and Jackie Malott for the data collection, and Mike Ladouceur and Rob Bloxam for their assistance in the development of the air dispersion modelling**.**

EXECUTIVE SUMMARY

Heightened security at the Ambassador Bridge international border in Windsor has resulted in long delays especially for the large trucks that use this as a point of entry into the United States. In turn, these delays have caused long lines of idling trucks - sometimes several kilometres in length - on Huron Church Road, the main access road to the bridge. These lines can persist for hours at a time.

These long and persistent queues have raised concern among local residents about the impact of the truck emissions on local air quality. Diesel truck emissions are related to a variety of health effects, as well as impacts on the environment. New portable equipment has permitted the Ministry to measure some components of diesel emissions: particulate and volatile organic compounds (VOC). Problems associated with high levels of particulate matter include: damage to agricultural crops, vegetation, and homes; corrosion; reduced visibility and impacts on human health. VOC are known to contribute to smog and may have other health effects.

The Ministry has been monitoring air quality in the Windsor area for many years to determine the sources of emissions and levels of air contaminates. This report presents a preliminary assessment of the air quality impacts of the traffic emissions along the Huron Church corridor based upon a special short term air quality surveys conducted for this purpose. The study took place during selected days in the fall of 2002 and the spring and summer of 2003.

The key results of the study are highlighted below:

- During normal traffic movement (no delays), the average increase in particulate matter adjacent to the road was minimal.

- During events when truck traffic was backed up along the Huron Church corridor, the increase in particulate matter was sufficient to increase the Air Quality Index by one complete level for fine particulate matter ($PM_{2.5}$) in the monitored area.

- Increases in particulate matter above ambient conditions were measured at distances from a few metres to 300 metres from the roadway.

- The extent of the increased particulate matter was dependent upon traffic volume, length of delays and meteorological conditions (wind direction and speed).

- Larger particulate showed the greatest increase in the vicinity of the road and decreased with distance from the road.

- Smaller particulate often displayed the opposite trend, concentrations increasing with distance from the road.

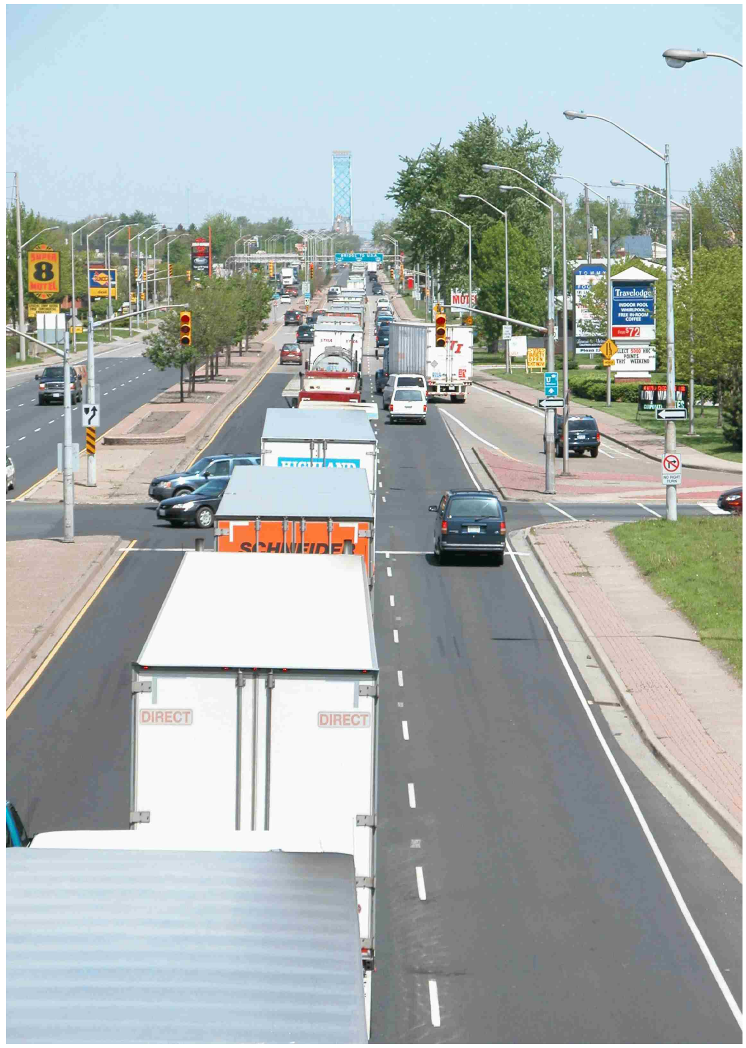
- Volatile Organic Compounds (VOC) sampling results adjacent to the road indicated no significant concentration increases from Huron Church traffic.

The Ministry has shared results of the study with the Medical Officer of Health to ensure that any potential health concerns are addressed.

PART 1: CONTEXT

Introduction

During the last several years, traffic across the Ambassador Bridge between Canada and the United States has increased significantly. The last two years have also seen a dramatic increase in security at the Canada-U.S. border. The combination of these factors has often resulted in long truck delays which can range from minutes up to several hours. This causes truck queues that may range several kilometres along Huron Church Road, the highway leading to the bridge. The trucks have also begun to spread into the side streets in the area near the bridge as drivers look for faster routes. Since these queues continue to move extremely slowly, the trucks sit idling their engines and occasionally moving a few feet and then returning to an idle. This creates a several- kilometre-long source of particulate and other pollutants running through a residential section of western Windsor. This, in turn, has caused concerns about air quality in these areas.



Typical truck delay to cross the Ambassador Bridge

Air Pollution

Air pollution, and in particular smog, are major problems in southwestern Ontario.

Ontario's large population - a third of Canada's total - and proximity to the United State’s most populated region subject it to increased smog, acid rain and persistent organic pollutants. Transboundary air pollutants from the United States account for up to 50 per cent of smog in Southwestern Ontario. In Windsor, this value may be as high as 90 per cent. In June 2000, the Ontario Medical Association estimated that:

> “Ontario is forecast to suffer in the order of 1,900 premature deaths, 9,800 hospital admissions, 13 thousand emergency-room visits and 46 million illnesses as a result of air pollution”. [i]

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[i] http://www.oma.org/phealth/smogexec.htm

The principal sources of air pollution are related to human activity. They include transportation, industrial activity such as fossil fuel-fired power generation, iron and steel production, cement and concrete manufacturing, petroleum refining, pulp and paper production, base-metal smelting and chemical processing. Residential wood stoves can also be a significant contributor to air pollution in parts of Ontario.

Some of the more common pollutants in Ontario's air include particulate matter (PM), nitrogen oxides (NO_X), sulphur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOC) such as benzene, toxic metals such as mercury, ground-level ozone (O_3), polycyclic aromatic hydrocarbons (PAH) and dioxins and furans.

Diesel Emissions

Most heavy duty trucks operating in North America rely on diesel engines. Diesel engines produce emissions that are lower in hydrocarbons, carbon monoxide, and carbon dioxide than emissions from gasoline engines. However, diesel engines also emit a complex mixture of gases and fine particulate that contains hundreds of chemical compounds, many known to be toxic. These include nitrogen oxides which are ozone precursors and components of urban smog, known or suspected carcinogenic substances such as benzene, polycyclic aromatic hydrocarbons, arsenic and formaldehyde. Much of this microscopic particulate is small enough to be inhaled deeply into the human lungs. Exposure to high levels of particulate of any sort is known to lead to increased incidence of respiratory illnesses.

These emissions can have a larger impact as vehicles release their exhaust at street level. Pedestrians and people living and working along the truck route are exposed to these emissions. As well, the "stop and go" traffic as in the case of lines of trucks waiting to cross the bridge are known to lead to the highest emission rates per vehicle. In particular the British Government Highways Authority notes that:

> The highest emissions tend to be associated with low average speeds. Low speed journeys are typified by frequent stops and starts, accelerations and decelerations in response to traffic congestion or other disruptions of a vehicle's progress. These operations are inefficient in fuel usage and the operation of emission control systems. [ii]

The California Air Resources Board has formally designated diesel particulate as a "Toxic Air Contaminant."[iii] Other health effects associated with diesel particulate include the following:

- Comprehensive review of potential health effects from ambient exposure to exhaust from diesel engines. (Health Assessment Document for Diesel Engine Exhaust, May 2002, U.S. Environmental Protection Agency)

- The proximity of schools to freeways and major truck routes is significantly associated with chronic respiratory symptoms in children (Speizer and Ferris, 1973. Environmental Research 74(2): 122-32).

[ii] http://www.highways.gov.uk/roads/projects/AIRQUAL/12.htm

[iii] http://www.dieselnet.com/news/9808carb2.html

- Children admitted to hospital with an asthma diagnosis are significantly more likely to live in an area with high truck traffic (Edwards, Walter, et. al., 1994, Archives of Environmental Health 49(4): 233-7).

- Children living near major diesel thoroughfares are more likely to suffer from reduced lung function (Brunekreef, et. al., 1997. Epidemiology, 8(3): 298-303).

- Particulate in diesel exhaust bind to pollen in the air, exacerbating allergies and asthma (Knox, et. al., 1997. Clinical and Experimental Allergy 27(3):246-51, 1997 Mar).

Study Background

The Ministry's London Office conducted this preliminary study to determine the impact of truck traffic on local air quality

- A series of short-term monitoring campaigns were undertaken to characterize levels of particulate and VOC (volatile organic compounds) in the neighbourhood of the bridge. Measurements were taken at various distances both upwind and downwind of Huron Church Road to permit the separation of background and traffic contributions to local pollutant concentrations.

- The monitoring was timed to attempt to examine the influence of long truck queues that form when wait times increase at the international border.

- The study was conducted near the Ontario Visitor Centre located on Huron Church Road near the entrance to the Canadian Customs at the Ambassador Bridge. This area was selected because of its proximity to residences, schools, nursing homes and businesses.

- Results of this part of the study were shared with the Medical Officer of Health to ensure that any potential health concerns are addressed as quickly as possible.

- A state-of-the-art air-dispersion model is being developed based upon the monitoring results. It is hoped that this model will permit the Ministry to predict the influence of the traffic for a far wider range of weather and traffic conditions than is possible with a limited number of monitors and samples. The model will also allow estimation of impacts in many more locations around Huron Church Road than would ever be practical with monitors.

- In the interim, a zone of influence map was created while Ministry scientists, university researchers and commercial developers are refining the air dispersion model that would assess the downwind particulate concentrations for different meteorological conditions.

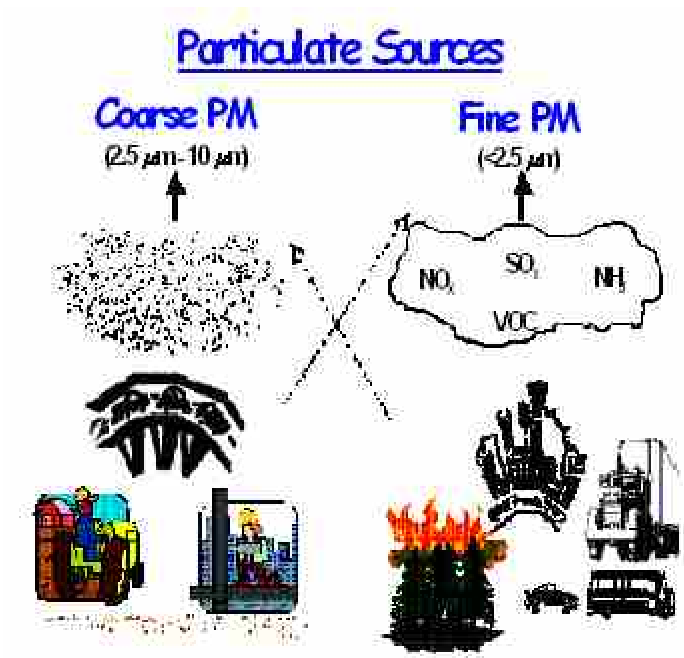
- Use of the model will allow the Ministry to determine if monitors were placed in the most appropriate locations available to them. Conversely, predicted levels could be compared to the monitoring data to ensure that it was a reasonable reflection of the actual conditions near the road.

PART 2: AIR MONITORING

Particulate Matter

The atmosphere contains a wide variety of very fine particles. These may be called particulate matter, dust, smoke, haze, aerosol, fumes, mist or other names, depending on the type of particle and who is describing it. These particles come both from man-made and natural sources, are composed of many different compounds and range considerably in size. Generally, the size (diameter) of individual particles ranges from 100 microns (1 micron = 1 µm = 1 millionth of a metre) down to one one-hundredth of a micron, or so. They may be liquid or solid and may be formed locally or come from long distances away. Larger particles tend to settle out of the atmosphere much more quickly and hence are more often associated with local sources. Fine particles, on the other hand, may travel a considerable distance. Particulate can be responsible for corrosion, soiling, damage to vegetation, reduction in visibility and may be injurious to health.

Total Suspended Particulate (TSP) is a generic term for all airborne particulate. Composition varies with place and season but normally includes soil particles, organic matter and nongaseous sulphur, metals and nitrogen compounds. The particles' diameters vary considerably from approximately 0.1 to 100 microns. [iv] Most particles greater than about 10 microns will be caught in the nose and throat, never reaching the lungs.



The term PM_{10} (inhalable particulate) has been given to those particles that have a diameter of ten microns or less. Particles of this size are more likely to bypass the body's natural defences and reach the upper respiratory tract. This size fraction of particles will be caught by cilia lining the walls of the bronchial tubes, which will move particles up and out. PM_{10} can result from industrial activity, vehicle exhaust, residential wood combustion and entrainment of road dust. Natural sources include soil erosion, forest fires, volcanic activity and ocean spray.

The term $PM_{2.5}$ (respirable particulate) refers to that part of PM_{10} whose particle diameter is 2.5 microns or less. $PM_{2.5}$ is able to penetrate deeper into the lungs, into regions where there are no cilia. Some removal mechanisms operate in the pulmonary region but because retention times are range from one to two years $PM_{2.5}$ most likely has a negative health effect. Ambient $PM_{2.5}$ is usually formed from chemical reactions in the atmosphere and combustion processes. However, mechanical and natural mechanisms may also lead to its formation. Particulate control equipment is usually less efficient at removing small particles.

[iv] Since mass is proportional to volume which varies as the cube of the diameter, the heaviest particles may be a billon times heavier than the smallest ones.

Particulate Monitoring

The Ministry used *GRIMM Dust Monitors* to conduct the traffic particulate surveys. They have been designed for continuous unattended operation and can determine levels of TSP, PM_{10}, $PM_{2.5}$ and PM_1 simultaneously. Two different models of this instrument were used during the study. The first, which was used for the earlier monitoring, could only measure three predetermined size ranges and so the measurements from November and December 2002 do not include TSP. The instrument operates by measuring the scattering of light from a small diode laser in a sealed chamber. It determines particle concentrations in each of the predetermined size categories. Other sensors in the instrument can measure temperature, pressure and humidity, while an attached wind sensor can give wind speed and direction information.

Portable Particulate Monitor

Volatile Organic Compounds (VOC)

Volatile Organic Compounds (VOC) are carbon-based chemicals that have a high vapour pressure, which means that they exist as a gas at normal temperatures and pressures. [v]

The term VOC is generally applied to organic solvents, certain paint additives, spray can propellants, fuels (such as gasoline and kerosene), petroleum distillates, dry cleaning products and many other industrial and consumer products ranging from office supplies to building materials. VOC are also naturally emitted by a number of plants and trees.

VOC are an important health and environmental concern for several reasons:

- Some VOC can be hazardous to human health when inhaled. For example, benzene is a probable human carcinogen and toxic. Formaldehyde is both an irritant and a sensitizer[vi] .
- VOC from out gassing[vii] of fabrics, building materials etc. are an important contributor to sick building syndrome.
- VOC such as hydrocarbon (gasoline, petroleum distillates) emissions from cars, chemical

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[v] From http://ilpi.com/msds/ref/voc.html

[vi] A chemical that may cause a significant proportion of people to develop allergic reactions after repeated exposure.

[vii] Many modern materials are made with the use of chemicals that slowly leach out of the article in gaseous form. This process is often referred to as "out gassing."

industries and trees are important contributors to photochemical smog.

A Photovac portable gas chromatograph is capable of detecting over 50 compounds. Benzene was of particular interest as it is readily detectable.

However the Photovac's detection limits do not permit the measurement of all pertinent compounds and subsequent sampling with VOC cartridges was also carried out. The cartridge results would include additional compounds not detected by the Photovac portable GC.

VOC Monitoring

The Ministry used two different types of VOC samplers during this study.

The first type is a portable gas chromatograph (GC). Gas chromatography is an analytical technique that can be used to separate gases including volatile organic compounds.

The Photovac portable GC was used during this study and is capable of detecting over 50 volatile organic compounds. It may be used to measure levels of VOC in the field in a variety of ways. It may sample directly from the atmosphere or analyse from a sample bag. A battery and weatherproof casing allow it to be used in the field under a wide variety of conditions. Data can be stored internally and viewed on a built in monitor or downloaded to a computer for later use.

The second type is a portable VOC cartridge sampler. This unit uses a flow controlled pump to draw air through a specialized charcoal carbon cartridge tube. After exposure the tube is sent to a laboratory for analysis on a more sensitive GC.

Portable GC

Portable VOC Cartridge Sampler

PART 3: PARTICULATE MONITORING RESULTS

Study Description

Particulate data were recorded on four days in late 2002. Samples were taken for $PM_{10,}$ $PM_{2.5}$ and PM_1. Further samples were taken in May and July 2003. These samples included the previous size fractions and TSP. Sampling locations varied from day to day and so are shown on a map included for each day.

The measurements were obtained from portable particulate monitors and one permanent particulate monitor that is part of the provincial Air Quality Index (AQI) network. Not all monitors were available for each set of measurements. For the 2002 measurements, results include data from the AQI particulate monitor which only measured $PM_{2.5}$. However for subsequent measurements, a GRIMM monitor was placed at the AQI site and results from it were used instead. This enabled all the size ranges to be monitored at a site remote from the traffic.

Results are presented in tables, graphs and charts in order to better illustrate the changes of particulate concentrations among the various sampling locations.

Since the portable particulate monitors were in different places on different sampling days they will be identified separately for each set of sampling results. A portable particulate monitor labelled as **DW1** indicates a monitor located near the road on the downwind side. **DW2** indicates a monitor placed further downwind and **DW3** was the monitor farthest downwind of the road. **UW1** was the designation for the local "upwind" station. It was placed in the neighbourhood of the road to ensure that there were no significant sources between it and the road but far enough away from the direct influence of the traffic. The **AQI** station was approximately 1 kilometre west of Huron Church Road and usually upwind.

Tables are included for every sampling period. The column labelled "Distance to Road" gives the distance from the road to sampler along a straight line perpendicular to the road. The "Distance to Source" gives the measurement from the sampler to the road along a straight line parallel to the wind direction. The "Source" measurement helps determine the area of influence of the vehicle emissions.

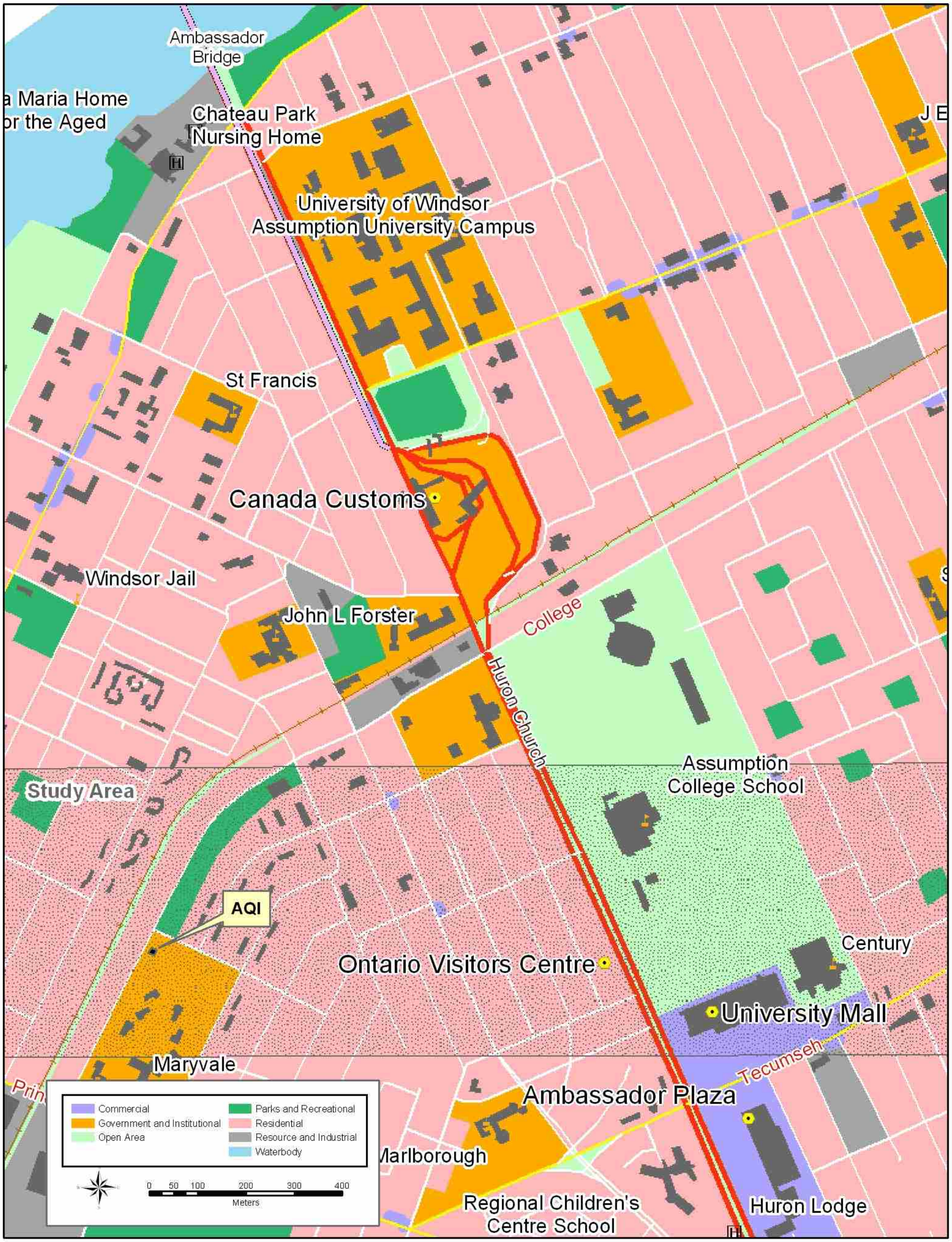
"Particulate Concentration" gives the average concentration in micro grams per cubic metre ($\mu g/m^3$) for each size range for the period when all the samplers were running. "Difference DW minus UW" is the downwind concentration minus the upwind concentration.

Co-ordinates were available for the monitoring sites, enabling daily maps to be created to better visualize the monitoring locations.

Bar Graphs are included for every sampling period. They indicate the average concentrations of various particulate sizes at all samplers. The upwind results are on the left side of the graphs and results to the right of this are progressively farther downwind from the road.

Appendix C includes all the graphs which display the real-time data for the various particulate sizes.

Windsor Area Overview Map

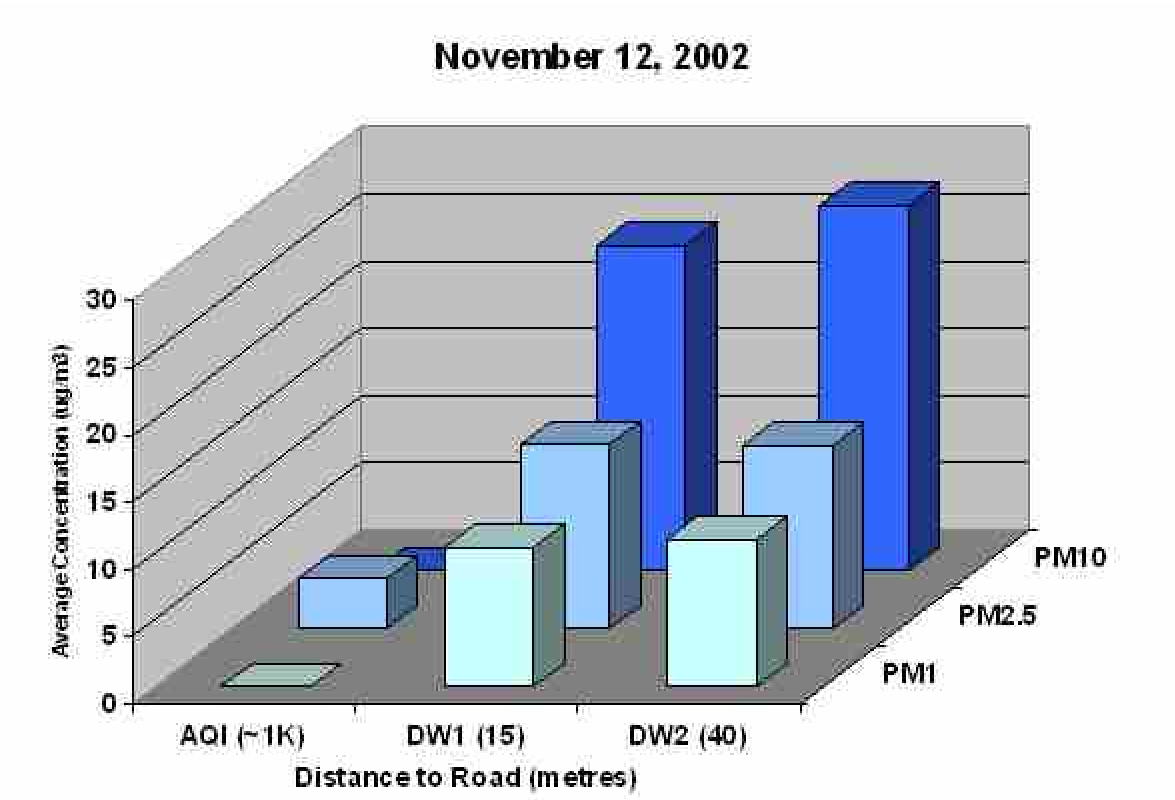


November 12, 2002

During the sampling period, winds were consistently from the west and were of moderate strength (averaging about 5.2 km/hr). Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Very Good" AQI category. (See Appendix B)

The data indicated that the average $PM_{2.5}$ concentration at both **DW1** and **DW2** was about 3 times as high as that at the upwind **AQI** station - a difference of about 10 µg/m^3. This was sufficient to change the AQI category from "Very Good" to "Good" near the road.

No readings were available from the AQI site for the particulate sizes PM_{10} and PM_1.



November 13, 2002

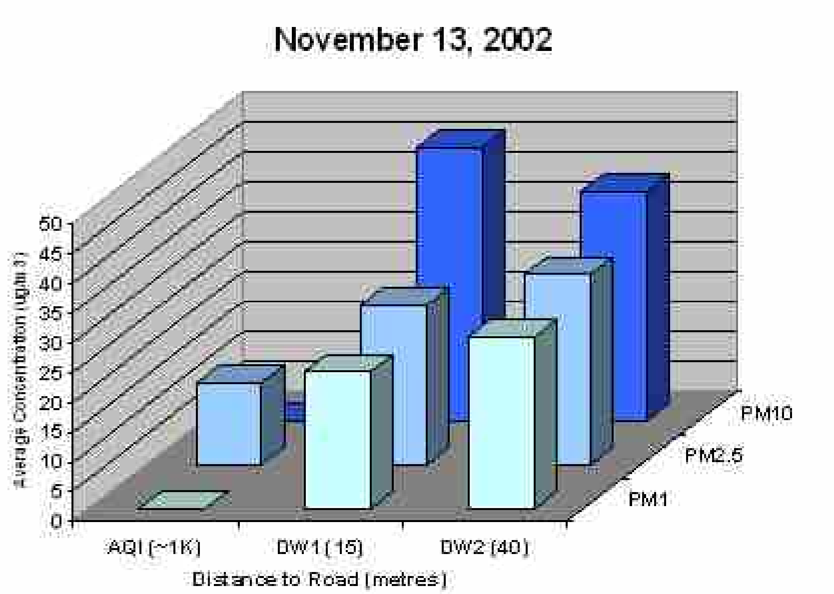
Winds were predominantly from the southwest and somewhat stronger than the previous day averaging about 9.1 km/hr. Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Good" AQI category. (See Appendix B)

$PM_{2.5}$ levels at both downwind stations were twice as high as the levels at the upwind **AQI** - approximately 15 µg/m^3 higher. This was sufficient to change the AQI category from "Good" to "Moderate".

The $PM_{2.5}$ levels at **DW1 & DW2** were both below the identified level of concern for $PM_{2.5}$ (Appendix A). $PM_{2.5}$ and PM_1 at **DW2** were distinguishably higher than **DW1** - that is their concentration increased with distance from the road. This may be related to the high exhaust pipes on the diesel trucks which emit particulate above the sampling level which will then diffuse to lower heights as it moves from the road.

PM_{10} however showed the opposite trend: the concentration decreased with increasing distance from the road. This suggests that larger particulate was settling out or dispersing. PM_{10} levels also approached their level of concern of 50 µg/m^3 (Appendix A) during the day at **DW1**.

No readings were available from the AQI site for the particulate sizes PM_{10} and PM_1.



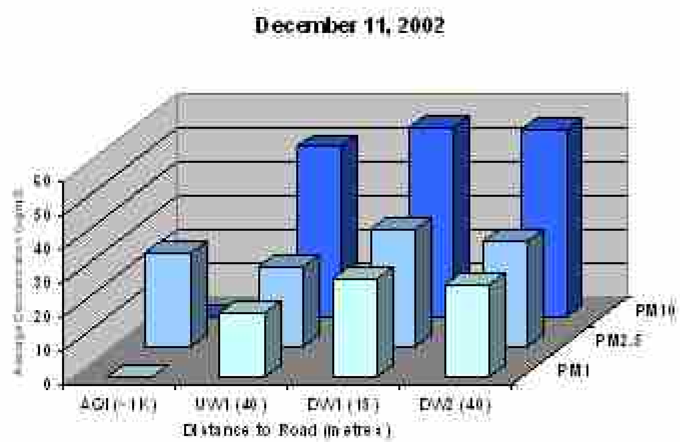
December 11, 2002

Winds during the sampling period were predominantly from the southwest, very light and highly variable (averaging about 2.3 km/hr). About a quarter of the winds fell into the "calm" category. When winds are this light, directional information is not reliable. As a result, it is harder to determine the source of the monitored particulate. Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Good" AQI category. (See Appendix B)

In December, a third portable monitor, **UW1**, was available and was located on the upwind side of the road at the Ontario Visitors Centre. This site was chosen to give an "upwind" reading that would sample the same air volume as the traffic monitors, avoiding the possibility that local sources near the AQI station would give anomalously higher "background" concentrations. No readings were available from the AQI site for the particulate sizes PM_{10} and PM_1.

The light winds seem to have resulted in higher $PM_{2.5}$ concentrations, both near the road and at the AQI site. This is a normal occurrence. Without strong winds to disperse pollutants, they tend to build up where they are emitted.

The downwind $PM_{2.5}$ levels remained relatively constant all day, **DW1** staying slightly above **DW2**, neither reaching the $PM_{2.5}$ level of concern. **UW1**, on the other side of the road, stayed consistently at about two-thirds of the **DW1** level This increase was sufficient to change the AQI category from "Good" to "Moderate."



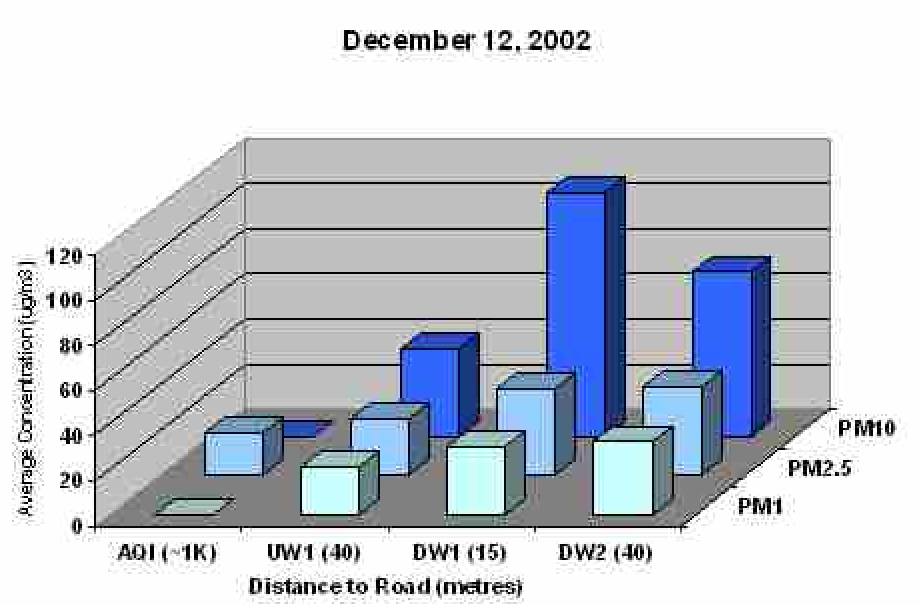
Similar characteristics can be seen in the PM_{10} results. There was little difference in the two "downwind" sites which both exceeded the 50 µg/m^3 level of concern for most of the day. This was only a marginal increase over the upwind concentration suggesting that both were impacted by traffic because of the light winds.

December 12, 2002

Winds blew consistently from the southwest during sampling (averaging about 6.0 km/hr). Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Good" AQI category. (See Appendix B)

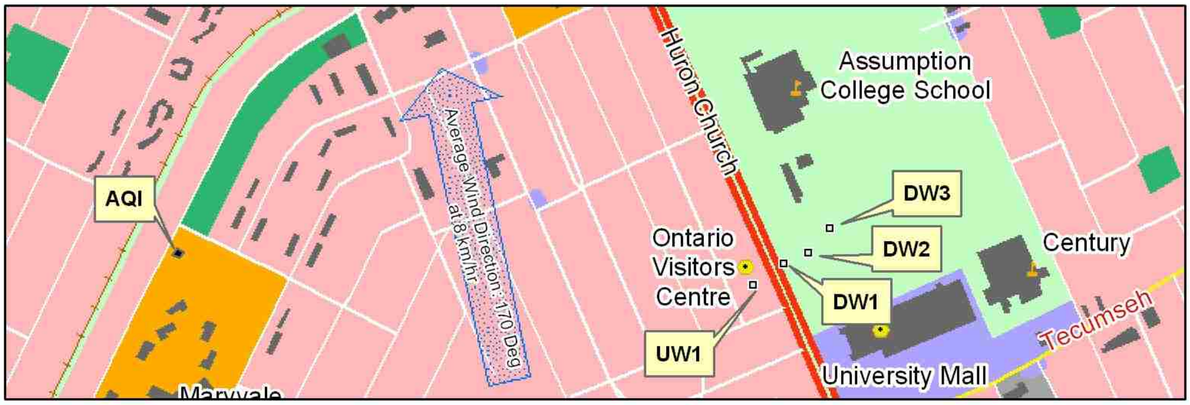
$PM_{2.5}$ levels at the two downwind sites stayed just below the 45 µg/m^3 level of concern, alternating as the higher concentration site. Both, however, stayed at levels that were more than double those seen at upwind **AQI** site. The site at the visitor centre, **UW1**, showed the influence of the traffic but $PM_{2.5}$ concentration was much lower than the downwind sites. The increased concentration at the downwind sites was sufficient to raise the AQI category from "Good" to "Moderate". Depending upon background concentrations, the AQI category could have increased two AQI categories. ("Good" to "Poor")

This difference was even more pronounced in the PM_{10} results. Particulate levels near the road averaged twice the 50 µg/m^3 level of concern. While both **DW1** and **DW2** showed a steady decline during the day, neither dropped below the level of concern during the sampling period. Both remained much higher than the upwind site though the effect was more pronounced near the road. This is consistent with a local source of the larger particles.



No readings were available from the AQI site for the PM_{10} and PM1 particulate size ranges.

May 20, 2003 Morning



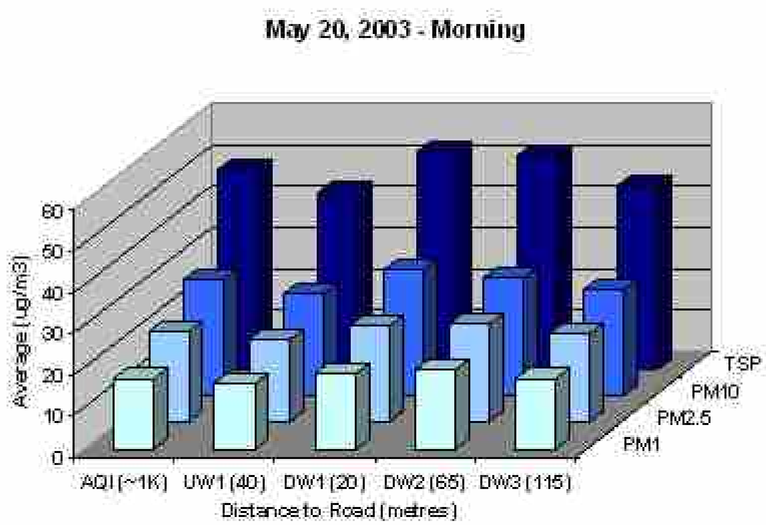
When sampling began on May 20, winds were blowing from the southwest but as the day progressed, they came around to the northwest and strengthened (averaging 7.6 km/hr). This change in wind direction prompted the relocation of the downwind samplers. The results have been broken down into two sessions to reflect the change in wind direction.

Five instruments were available for use, each of which had the ability to measure TSP in addition to the other size fractions. Three monitors were placed downwind of the road, one was placed upwind and the fifth was placed at the AQI station.

During the first session, traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Good" AQI category (See Appendix B).

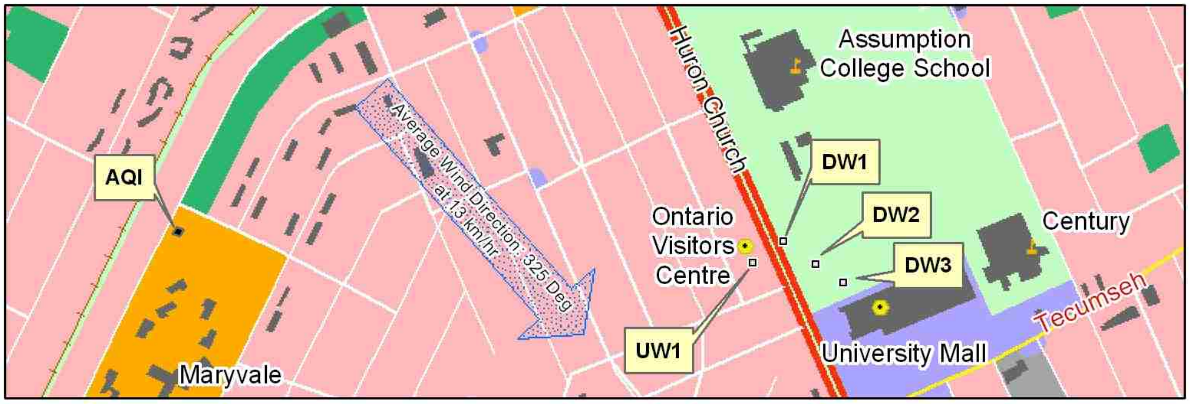
Smaller increases were seen between the upwind and downwind sites and depending upon background concentrations the AQI category could have increased one AQI category. This could have been related to the wind direction which was nearly parallel to the road.

A slight concentration increase in the finer particulate ($PM_{2.5}$ and PM_1) was seen when moving from **DW1** to **DW2**. However, levels at **DW3** were lower than the roadside values. This suggests the emissions travel further downwind but they continually become more dispersed, leading to lower concentrations.



TSP levels were highest on the downwind site nearest the road and dropped off steadily thereafter. Background particulate levels were reached by the time the air reached **DW3**.

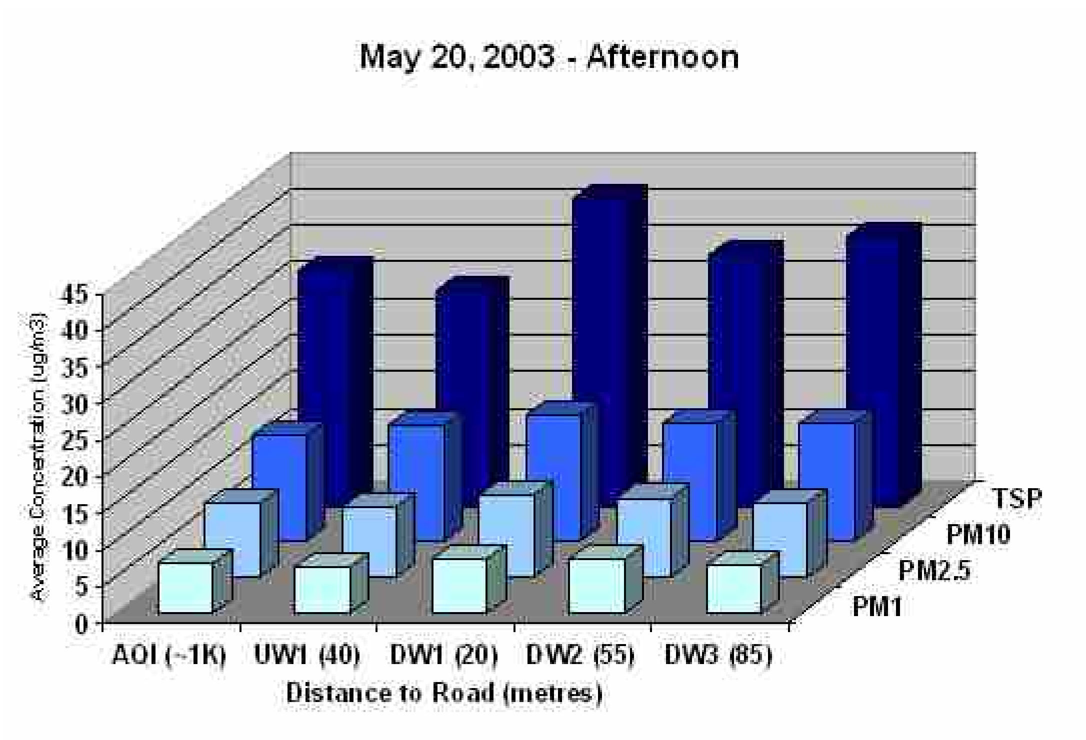
May 20, 2003 Afternoon



By the afternoon, the wind direction nearly reversed and the speed increased (averaging 12.8 kph). Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Very Good" AQI category (See Appendix B).

All levels showed a sharp drop in the early afternoon, which may have been due to periods of light rain as well as the dispersive nature of stronger winds. PM_{10}, $PM_{2.5}$ and PM_1 levels showed virtually no traffic impacts. TSP was nearly 13 µg/m^3 above background levels downwind of the road, dropping somewhat by **DW2** and then rising again slightly.

Smaller increases were seen between the upwind and downwind sites and increases in concentration at the downwind sites were not sufficient to raise the AQI category.



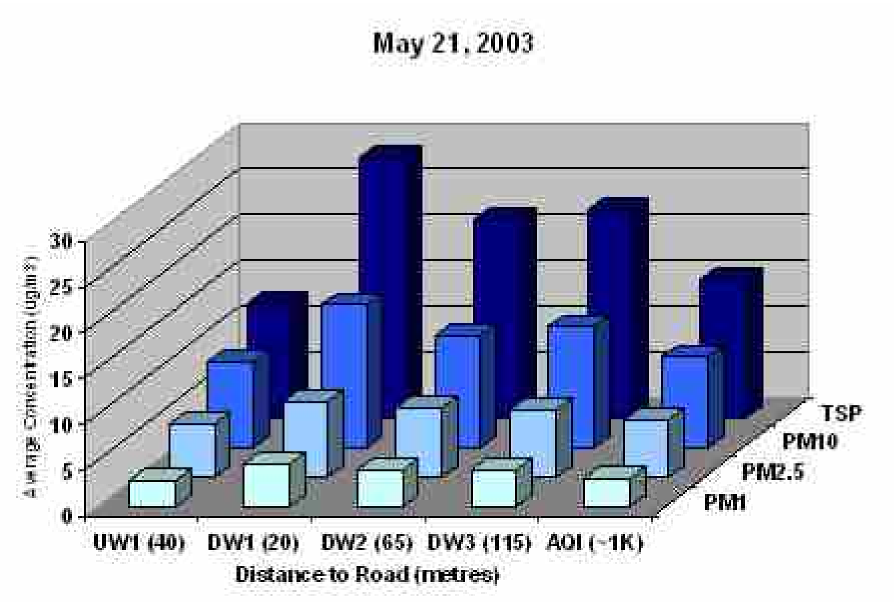
May 21, 2003

Winds on May 21 were consistently from the northeast. This resulted in the downwind samplers being placed on the west side of Huron Church Road. The average wind speed over the monitoring period was 13.7 km/hr. Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the “Very Good” AQI category (See Appendix B).

Measurements are available from five monitoring sites. An upwind monitor, **UW1** was placed in the open field on the east side of the road. A downwind site was placed at the Visitor Centre, **DW2** and two others, **DW1** and **DW3**, were placed on a residential side street (Melbourne). Note that the **AQI** site was a downwind station, though it is some distance from the traffic.

Since **DW1**, **DW2** and **DW3** were approximately the same distance from the road, it is reasonable to expect similar results at the three sites. Vegetation and buildings will change the way the particulate disperses and so different points at the same distance from the road may experience different contributions from the traffic, as seen in this case. **DW1** which was the closest of the three to the road showed the highest levels, over twice the upwind value. All particle sizes experienced increases downwind indicating that Huron Church Road was probably the source of the increased particulate.

Smaller increases were seen between the upwind and downwind sites and depending upon background concentrations the AQI category could have increased one AQI category.



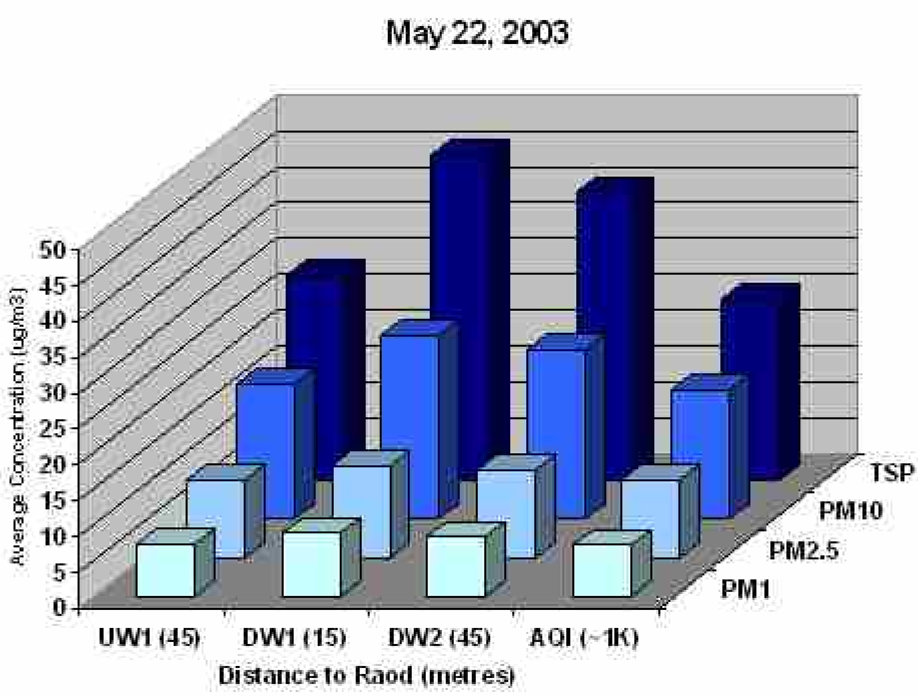
May 22, 2003

Winds on May 22 were generally from the northeast. This again resulted in the downwind samplers being placed on the west side of Huron Church Road, though only two were placed on this side allowing one to be used for other purposes. The average wind speed over the monitoring period was 10.0 km/hr, lighter than the previous day. Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Very Good" AQI category (See Appendix B).

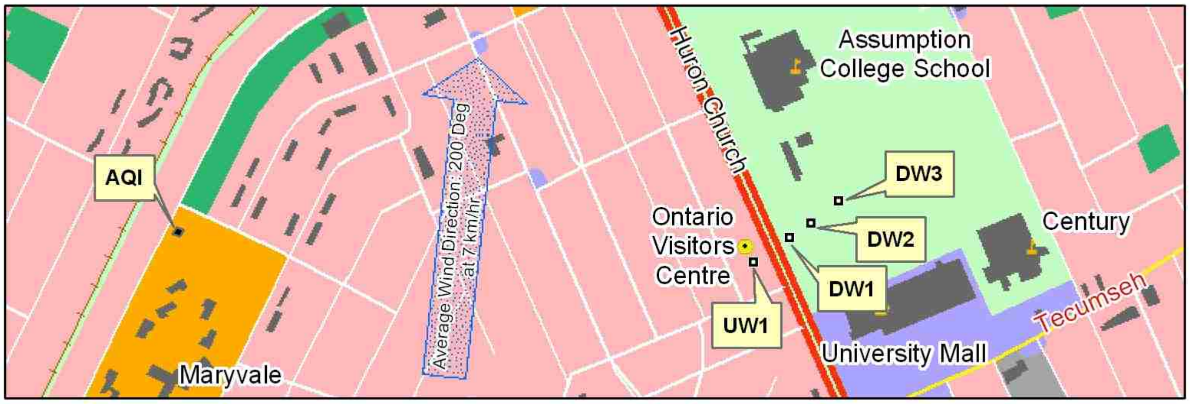
Particulate concentrations were high early in the morning but quickly dropped to more moderate levels. Traffic was heavy and this may explain the significantly higher levels of particulate on the downwind side of the road, even allowing for the higher background levels. Traffic impacts again appear to decrease as distance to Huron Church Road increased.

As in most cases, the influence of the traffic on local air quality is noticeable but not overwhelming. All levels decreased with distance and the larger, heavier particles again showed the most substantial increases downwind of the road.

Smaller increases were seen between the upwind and downwind sites and, depending upon background concentrations, the AQI category could have increased one AQI category.



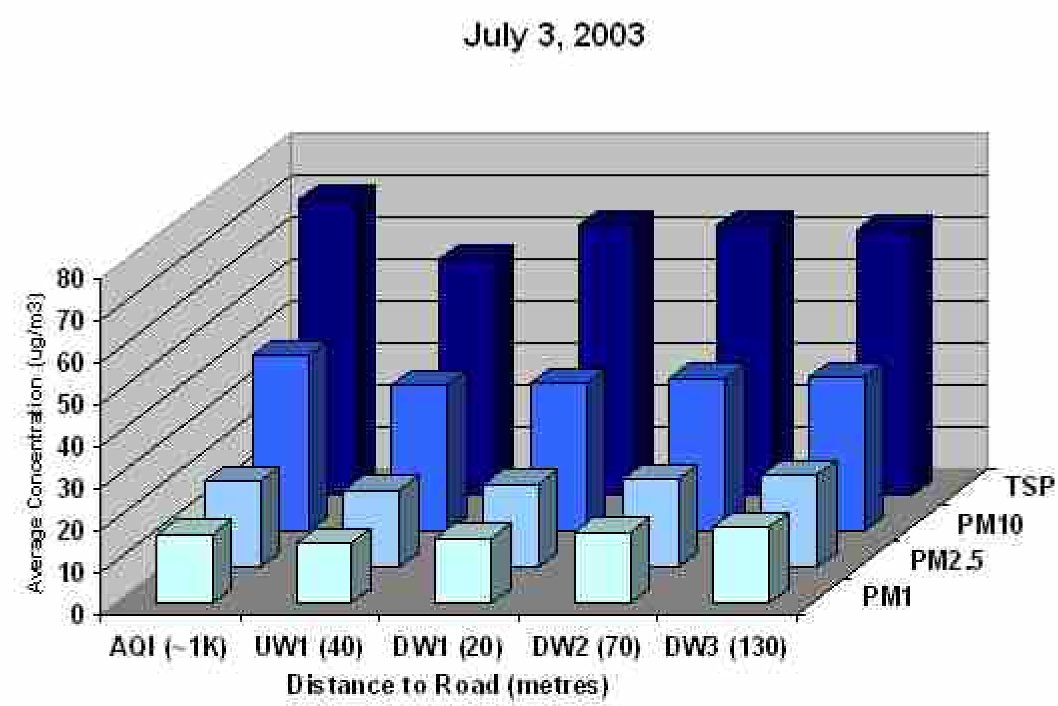
July 3, 2003



Winds on July 3 were from the south and gusty. The average wind speed over the monitoring period was 7.4 km/hr. Traffic delays were not a factor during the sampling period but an air quality alert had been issued for the area. Traffic was light in the morning, though it became moderately heavy by the end of the sampling period. No queue formed, however.

Most smog advisories in Windsor are called as a result of high ozone levels. Fine particulate levels are often elevated during these events. However, on this occasion, they did not reach unusually high concentrations. There was very little difference between upwind and downwind particulate levels, suggesting that undelayed traffic contributes only small increases to the local particulate concentrations. These small increases were not sufficient to raise the AQI category.

Particulate levels at the **AQI** station suggest that levels were being impacted by something other than Huron Church Road.

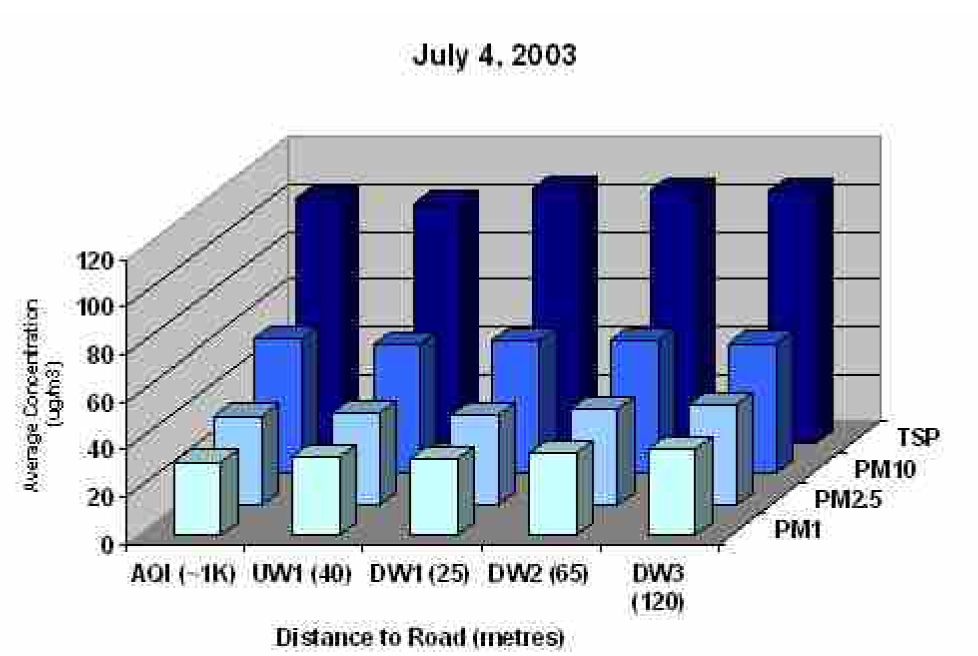


July 4, 2003

Winds on July 4 were from the south-southwest and somewhat variable. The average wind speed over the monitoring period was 6.3 km/hr. Traffic was light in the morning growing to medium by the end of the sampling period.

There was still a Smog Advisory in effect and unlike the previous day, all sampling locations measured relatively high concentrations of particulate. There were no border delays during the sampling period and so the results represent normal undelayed traffic volumes during a smog day.

Similar to the previous day, there was very little difference between upwind and downwind particulate levels, indicating that undelayed traffic does not significantly increase particulate concentrations. These small increases were not sufficient to raise the AQI category. As with the precious day, the greatest impacts are seen in the TSP levels.



Mobile Particulate Surveys

During the May monitoring period, Ministry staff conducted two additional brief surveys. A monitor was placed some distance downwind from the road (200 to 250 metres) and a measurement was made for 10 minutes. The monitor was then moved closer to the road and another 10-minute measurement. This process was repeated until the monitor was placed beside the road. Measurements were also taken in the middle of Huron Church Road on the traffic median and, lastly, one was made on the upwind side of the road.

Since the measurements at the different locations were not made simultaneously, changes in the background concentration could add a bias to some of the measurements. This could give a false sense of the traffic contribution to the particulate at different distances from the road. To compensate for this, all measurements reported here were corrected by subtracting the **UW1** concentrations for the same period. They are referred to below in the tables as "corrected concentrations".

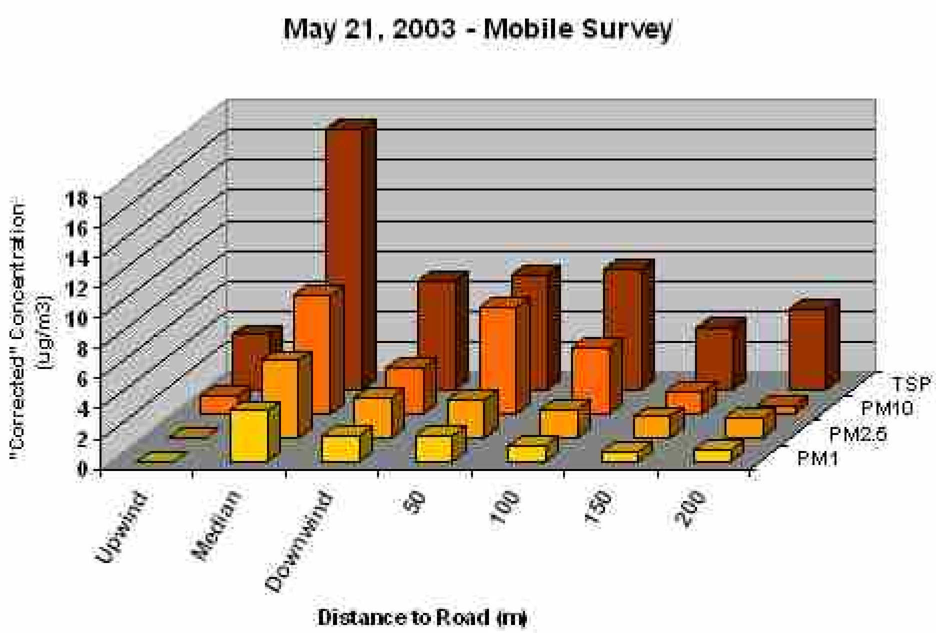
Two sets of measurements were made, one on May 21 and the other on May 22.

May 21, 2003 - Mobile Survey

The survey was performed between 10:30 and 14:00. Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Very Good" AQI category (See Appendix B). The measurements were started 200 metres downwind of Huron Church Road. The sampler was then moved 50 metres closer and another 10-minute sample taken. This pattern was repeated until the sampler was on the upwind side of the road. The "**X**"s on the above map indicate the locations of the sampler during this survey.

All of the downwind samples were higher than the upwind sample. Generally the levels decreased with distance from the road. The highest concentrations were recorded on the median in the centre of the road.

Smaller increases were seen between the upwind and downwind sites and depending upon background concentrations the AQI category could have increased one AQI category.

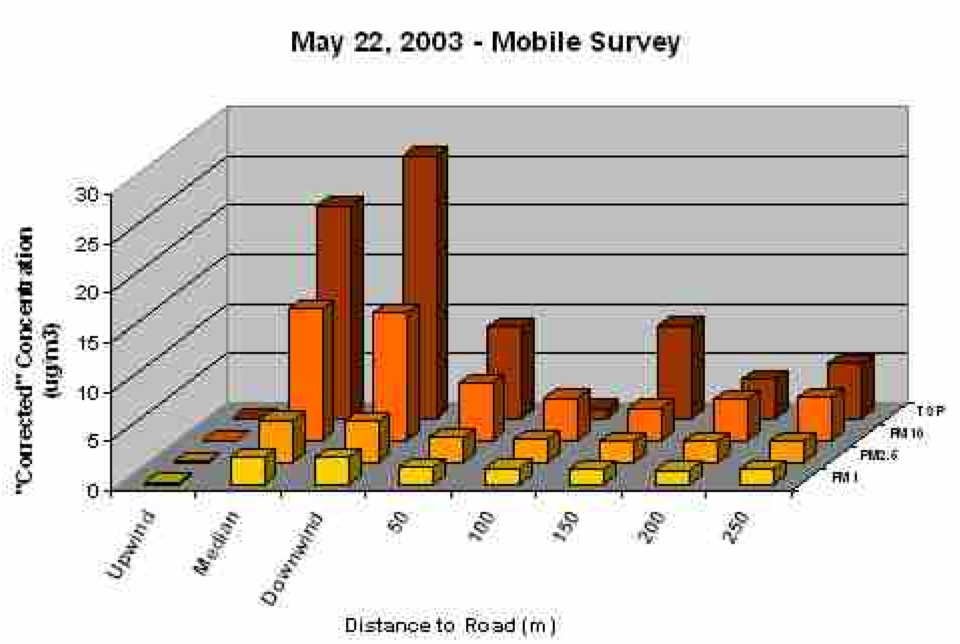


May 22, 2003 - Mobile Survey

On May 22 Ministry staff again conducted a mobile survey from 7:13 to11:45 EST. Traffic volumes were normal but truck traffic was delayed with queues extending past the samplers during the entire sampling period. Background levels for $PM_{2.5}$ were in the "Very Good" AQI category (See Appendix B). Measurements were taken 250 metres downwind of Huron Church Road for 10 minutes after which the sampler was moved 50 metres closer to the road and sampling conducted for another 10 minutes. This cycle was repeated until the sampler finished the survey by sampling on the upwind side of the road. The **"X"s** on the above map indicate the location of the sampler during this survey.

The downwind samples were uniformly higher than the upwind sample, the highest being the roadside sample. The largest size fraction was the most significant near the road but also dissipated most quickly with distance. The fine particulate results showed very little difference in their concentrations with distance from the road, on the downwind side.

Smaller increases were seen between the upwind and downwind sites and, depending upon background concentrations, the AQI category could have increased one AQI category.



PART 4: VOC MONITORING RESULTS

VOC Cartridge Results

VOC cartridges were used to sample the air both upwind and downwind of Huron Church Road on May 22, 2003 during particulate sampling. The cartridges were sent to the Ministry of the Environment laboratory in Rexdale for analysis.

The cartridge results showed very little difference between upwind and downwind samples and suggest that VOC levels were not significantly impacted by traffic on the Huron Church corridor.

A table showing the results for the various reported compounds is given in Appendix D

Portable Gas Chromatograph (GC) Results

Two portable GC samples were taken on May 22, 2003. Since the samples could not be taken simultaneously, they are not a true upwind-downwind pair. However, since the two samples were taken consecutively and since there was little VOC seen in either sample, we could not determine the exact contribution of traffic. The downwind sample was taken 50 metres from the road beginning at 07:50. The upwind sample was taken 30 metres from the road at 08:30.

The downwind sample only detected a small amount of benzene - 8 ppb (parts per billion). No other identifiable compounds were detected in any other samples, either upwind or downwind. Note that, as in most environment sampling, this does not mean that none were present. We conclude that none of the substances in the Photovac’s library were above the instrument’s detection limit.

Details of the sampling may be found in Appendix D.

PART 5: THE ZONE OF IMMEDIATE INFLUENCE

Survey results have been used to extrapolate particulate increases near Huron Church Road during truck traffic delays. The map "Zone of Immediate Influence" (page 25) depicts the average increase of particulate above ambient conditions based upon all survey results. Ministry scientists, university researchers and commercial developers are working to refine an air dispersion model that will more accurately assess the downwind particulate concentrations for different meteorological conditions.

The following map and tables shows:

- Three zones adjacent to the road for which we have data: Zone 1 is the closest to the road (0 to 25 metres). Zone 2 is the intermediate zone (25 to 100 metres) and Zone 3 is the zone farthest distance for the road (100 to 300 metres).

- Three particulate sizes: TSP, PM_{10} and $PM_{2.5}$.

- Average concentration increase over background levels for each particulate size and zone.

It is also important to remember the following:

- The map and table are based upon averaging of the surveys results. This, in turn, means that measurements reflect only a limited number of meteorological and traffic conditions.

- The measurements were mainly performed in an open field. Vegetation and buildings will change the way the particulate disperses and so different points at the same distance from the road may experience different contributions from the traffic.

- All points in a zone will not experience the same effect at the same time. Generally, one side of the road will be downwind and one upwind. The upwind side will receive little or no influence from the road.

- These zones disregard the influence from all other sources and background contributions.

The following table suggest that:

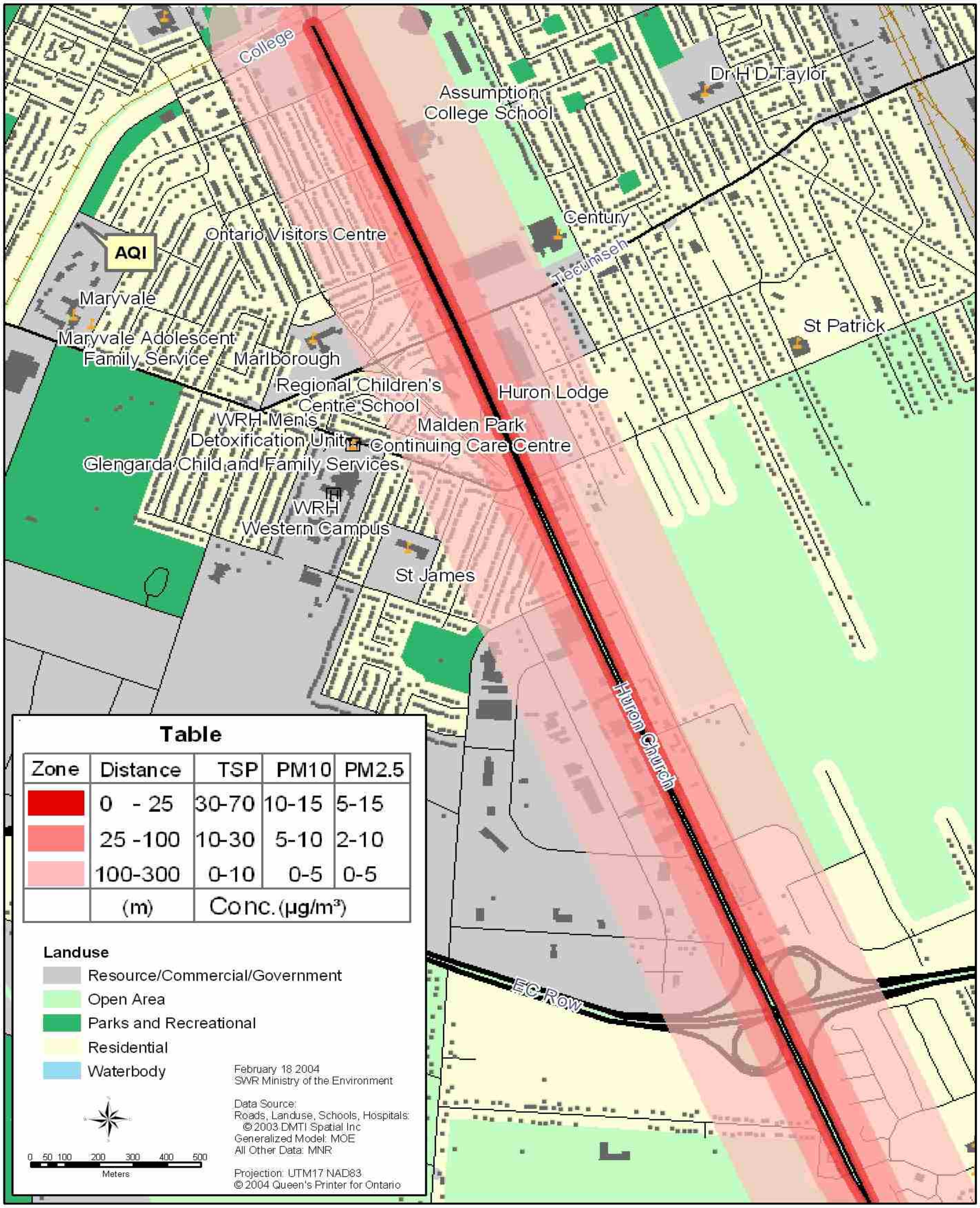
- The contribution of the traffic is most pronounced in the larger particle size ranges.

- This larger particle size contribution rapidly decreases with distance from the road.

- The traffic's contribution of smaller particles is not as pronounced, but its effect carries further from the road.

- Beyond the third zone, the contribution from the road was minimal and masked by other influences.

MAP: Zone of Immediate Influence



Zone	Distance	TSP	PM10	PM2.5
	0 - 25	30-70	10-15	5-15
	25 -100	10-30	5-10	2-10
	100-300	0-10	0-5	0-5
	(m)	Conc. (µg/m³)		

PART 6: SUMMARY AND CONCLUSIONS

- **General**

  - During late 2002 and the first half of 2003 the Ministry conducted preliminary sampling of selected air contaminants near Huron Church Road in Windsor. This report presented the results.

  - We were able to conduct this monitoring because of the acquisition of new, state-of-the-art monitors. This study would not have been feasible with older monitors.

  - Limited time and resources, and the scope of the problem have prevented the Ministry from conducting a full-scale study.

  - These results are being used to help develop a dispersion model which will permit the Ministry to expand the geographical range of the study. The Ministry will also be able to examine results for a wide variety of different weather and traffic patterns.

  - The Ministry is releasing the monitoring results before the modelling is finished as we feel they may be of use to the public and other agencies which are concerned with traffic on Huron Church Road.

  - The Ministry expects to conduct further monitoring. We will use these results to confirm and refine the modelling.

The Ministry's sampling results are summarized below. Results are based on real time data from the portable particulate monitors and VOC samplers. Statistical analysis was not carried out for these results**.** To accurately assess the data and determine relationship between different meteorological conditions, traffic volumes and background concentrations, data sets covering a longer period are required. This preliminary report is the first step in the Ministry assessment of traffic congestion impacts. The next step includes the refinement of an air dispersion model and then further monitoring to assess the accuracy of the model.

- **Total Suspended Particulate (TSP)**

  - During normal traffic, TSP levels were 6 to 8 $\mu g/m^3$ above background levels near the road and decreased with distance from the road.

  - When long border delays were experienced, the TSP levels showed larger increases of 10 to 25 $\mu g/m^3$ near the road and decreased sharply as distance from the road increased.

  - Increases in just TSP suggest that there are influences at work other than diesel exhaust, possibly road dust or tire wear.

- **Inhalable Particulate Matter (PM_{10})**

  - During normal traffic, PM_{10} levels increased by only 2 µg/m^3.

  - When long border delays were experienced, the PM_{10} levels varied from 2 µg/m^3 on average to levels as high as 69 µg/m^3. This large variance would suggest that meteorological conditions have some significant effect on the levels of PM_{10}.

  - Generally, PM_{10} levels dropped with increasing distance from the road.

- **Respirable Particulate Matter ($PM_{2.5}$) and Ultrafine Particulate (PM_1)**

  - During normal traffic, $PM_{2.5}$ levels showed very minor increases near the road and increased slightly further from the road. The distance to which those increases were felt was not determined in this study.

  - When long border delays were experienced, the $PM_{2.5}$ levels varied anywhere from 2 µg/m^3 to 14 µg/m^3 probably due meteorological conditions.

  - Generally, $PM_{2.5}$ levels increased with increasing distance from the road but by 250 metres from the road $PM_{2.5}$ levels had peaked and were approaching background levels.

  - During periods when traffic queues form along Huron Church Road, sometimes reaching several kilometres in length, the particulate concentrations were sufficient to increase the AQI in that local area by one complete level.

- **Volatile Organic Compounds (VOC)**

  - All VOC sampling results exhibited minor increases to VOC background levels.

APPENDICES

APPENDIX A: LEVELS OF CONCERN FOR PARTICULATE MATTER

The Ministry of the Environment does not currently have standards for various sizes of particulate. Only TSP is regulated. Thus, to provide a useful level of comparison, we have had to use other criteria to assess particulate concentration. For convenience in this document, we refer to these as Levels of Concern.

- The Ambient Air Quality Criteria (AAQC) for Ontario is the maximum concentration or level (based on potential effects) of a contaminant that is desirable or considered acceptable in ambient air.

- Under Ontario Regulation 346, sources are required to limit their emissions of suspended particulate matter, such that the concentration mathematically predicted at a point-of-impingement (POI) does not exceed 100 $\mu g/m^3$ in any half hour period. The half-hour POI is meant to exclude the normal presence of background particulate levels. The half-hour POI is mainly used for emission modelling, and throughout this report, a one-hour average for TSP of 100 $\mu g/m^3$ was used as the level of concern.

- On November 18, 1997, Ontario introduced an interim AAQC for PM_{10} of 50 $\mu g/m^3$ based on a 24-hour average. The PM_{10} interim AAQC was based upon the potential health effects and serves as Ministry policy to provide guidance for environmental protection decisions in Ontario. Throughout this report, a one-hour average for PM_{10} of 50 $\mu g/m^3$ was used as the level of concern.

- The Canada Wide Standard (CWS) concentration for 24-hour $PM_{2.5}$ is 30 $\mu g/m^3$. The standard for $PM_{2.5}$ is based on a complex calculation that involves using the 98th percentile of the measurements annually, averaged over three consecutive years. The $PM_{2.5}$ CWS was agreed by all provinces and is to be achieved by the year 2010.

  The Ministry's Environmental Monitoring and Reporting Branch has determined that a three-hour average concentration of 45 $\mu g/m^3$ for $PM_{2.5}$ is statistically equivalent to the 24-hour CWS. (See Appendix 2 for a discussion of the AQI). In the case of this report we have adopted a 1-hour average for $PM_{2.5}$ of 45 $\mu g/m^3$ as the level of concern.

"Level of Concern" Used for This Report:

Particulate Size	Level of Concern
TSP	100 $\mu g/m^3$
PM_{10}	50 $\mu g/m^3$
$PM_{2.5}$	45 $\mu g/m^3$

APPENDIX B: THE AIR QUALITY INDEX - OVERVIEW

(From **http://www.airqualityontario.com/science/aqi_description.cfm**)

The Air Quality Index (AQI) is a rating scale for outdoor air in Ontario. The lower the AQI, the better the air quality. Based on data from its network of air monitoring stations, the Ministry of the Environment reports an AQI for many communities across Ontario to all major media outlets and the Ministry Web site several times daily.

Six key air pollutants are monitored by the Ministry as part of the AQI:

- Sulphur dioxide - SO_2
- Nitrogen dioxide - NO_2
- Carbon monoxide - CO
- Ozone - O_3
- Total reduced sulphur compounds - TRS
- Fine particulate matter - PM

These pollutants were chosen because they can have an adverse effect on human health and the environment at high concentrations.

The air monitoring data are compared to ambient air quality standards for each of the six air pollutants. These scientifically-based standards, which are updated from time to time, indicate the maximum safe level for each of the pollutants. Above this level, the pollutant begins to have an undesirable impact on people or the environment.

The monitoring data are converted into the AQI scale. The scale ranges from 0-15 (Very Good) to 100+ (Very Poor).

An AQI is calculated for each of the six pollutants. It is simpler and easier now to describe the relative impacts of the pollutants on human health and the environment.

Health Effects of Different AQI Levels Caused by Fine Particulate Matter ($PM_{2.5}$)

Category	AQI	$PM_{2.5}$ ($\mu g/m^3$)	Health Effects
Very Good	0 - 15	0 - 11	Sensitive populations may want to exercise caution.
Good	16 - 31	12 - 22	Sensitive populations may want to exercise caution.
Moderate	32 - 49	23 - 45	People with respiratory disease at some risk.
Poor	50 - 99	46 - 90	People with respiratory disease should limit prolonged exertion. General populations at some risk.
Very Poor	100 or over	> 90	Serious respiratory effects even during light physical activity; people with heart disease; the elderly and children at high risk. Increased risk for general population.

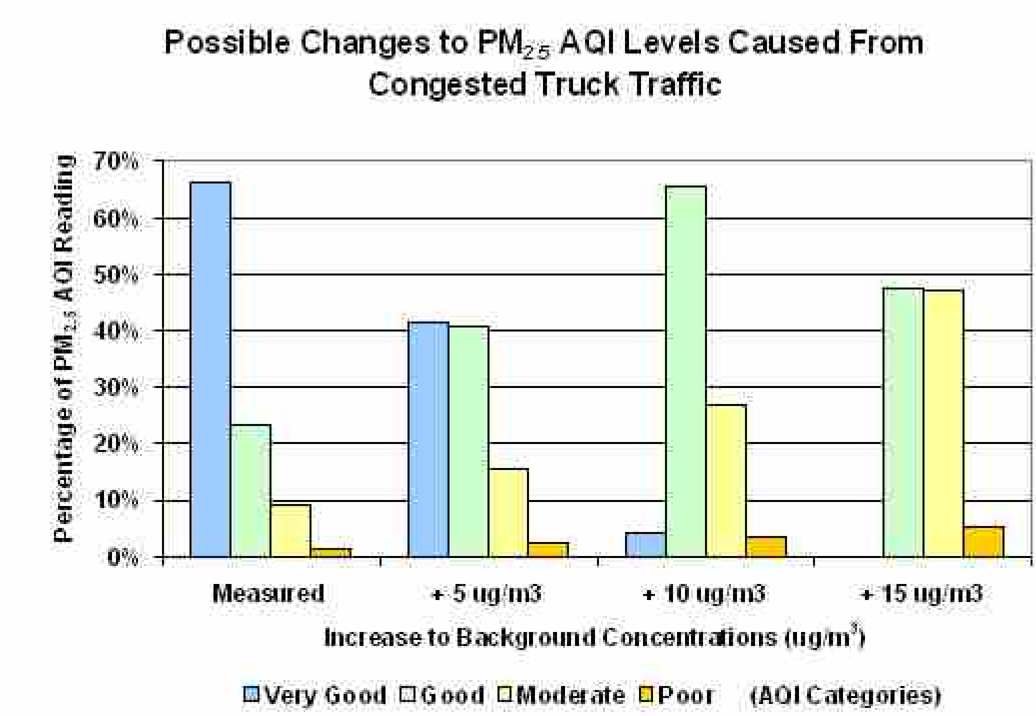
The pollutant with the highest AQI number, therefore, has the greatest impact. It becomes the "overall" AQI for a particular location. Say, for example, that at a location the AQI for ozone is 20, the AQI for nitrogen oxides is 12, and the AQI for particulate is 8. The AQI for ozone would be used and reported as "AQI of 20, reason: ozone".

The chart below shows the effects of fine particulate ($PM_{2.5}$) pollution from increasing traffic on the AQI. The "Measured" values reflect 12 months of particulate only AQI values at the West Windsor AQI station. The other three sets show how different across-the-board increases to particulate concentrations would effect the relative number of Good, Moderate and Poor AQI readings.

As traffic volumes increase, so will the particulate levels near the road. If the current levels mean that the particulate related AQI falls in the Very Good range 66 per cent of the time, then an annual increase of only 5 $\mu g/m^3$ will reduce this to about 41 per cent. Another 5 $\mu g/m^3$ increase will take the "Very Good" time to about 5 per cent and a further step will eliminate it altogether.

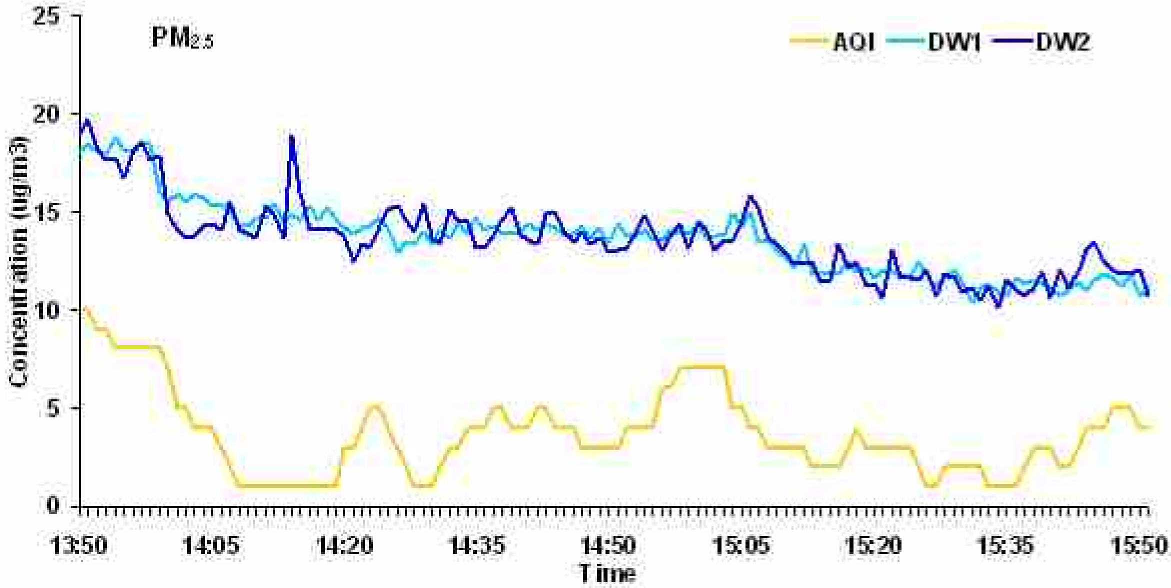
Many of the "Very Good" hours will still result in "Good" air quality at first. The graph also illustrates that even a 10 $\mu g/m^3$ increase means that "Moderate" hours have increased from just under 10 per cent of the time to more than 25 per cent and that "Poor" hours are noticeably higher as well. A 15 $\mu g/m^3$ increase would mean that over half of the time the air quality was either Moderate or Poor based upon particulate level alone.

The graph only illustrates changes to $PM_{2.5}$ AQI levels caused from congested traffic and that other factors should be remembered. Elevated levels of ozone, in particular, could mean that the reported number of "Good" hours is lower than the graph might suggest, especially during summer months. Furthermore, the current measurements will include some particulate from the traffic.



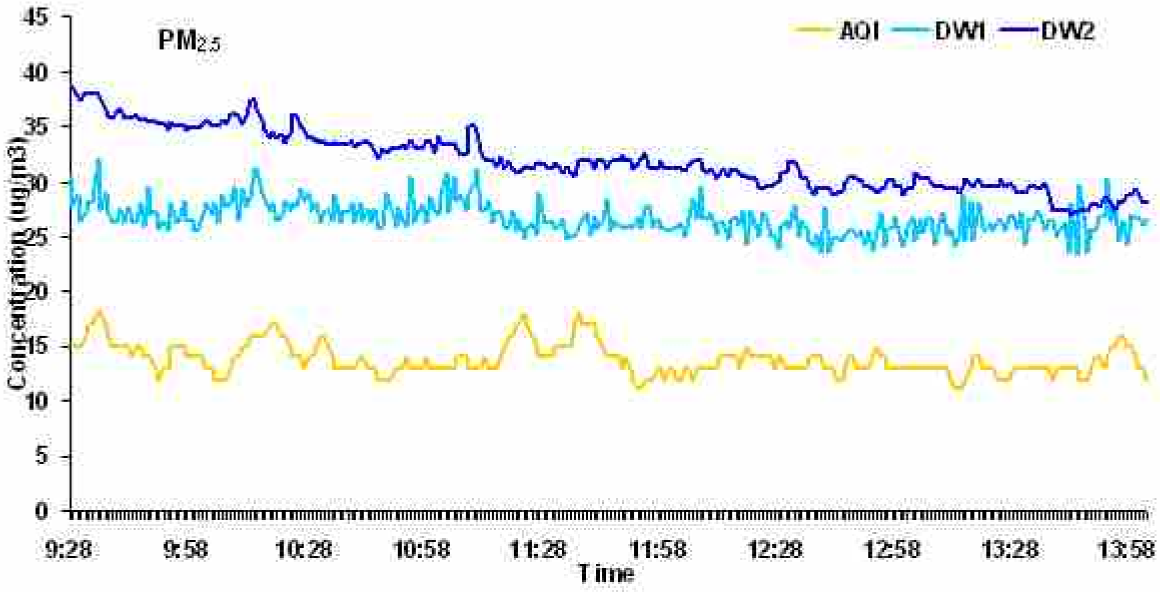
APPENDIX C: DETAILED PARTICULATE CONCENTRATIONS

November 12, 2002   13:50 to 15:50 E.S.T.



November 12, 2002 13:50-15:50 EST								
	Distance to (metres)		Particulate Concentration ($\mu g/m^3$)			Difference DW minus UW ($\mu g/m^3$)		
Station	Road	Source	PM_{10}	$PM_{2.5}$	PM_1	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		n/a	3.7	n/a			
DW1	15	15	24.2	13.7	10.4		10	
DW2	40	40	27.2	13.6	10.9		9.9	

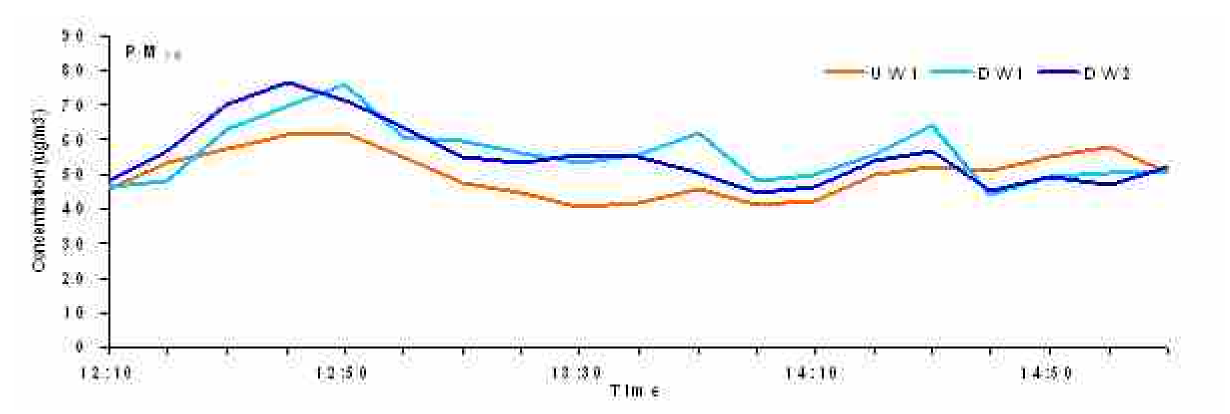
November 13, 2002 13:50 to 15:50 E.S.T.

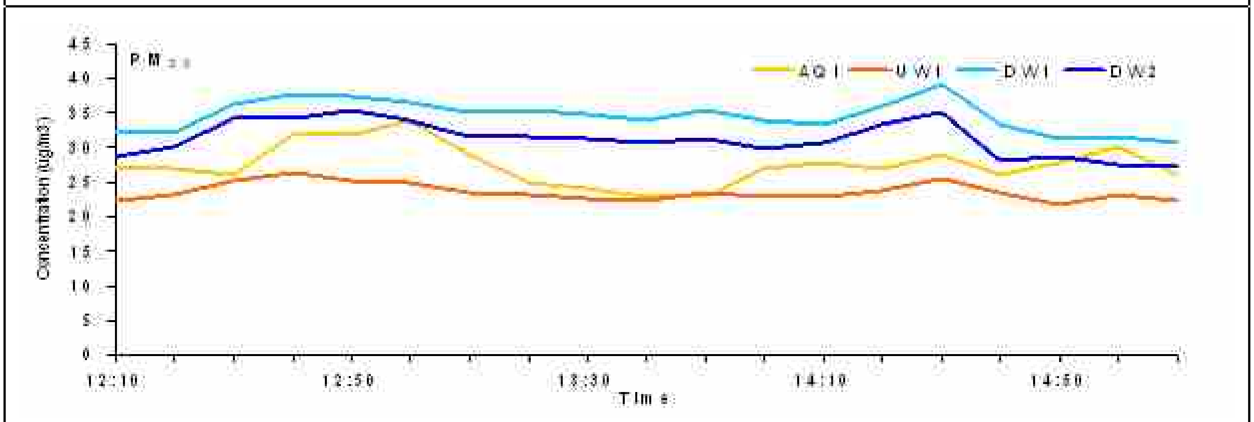


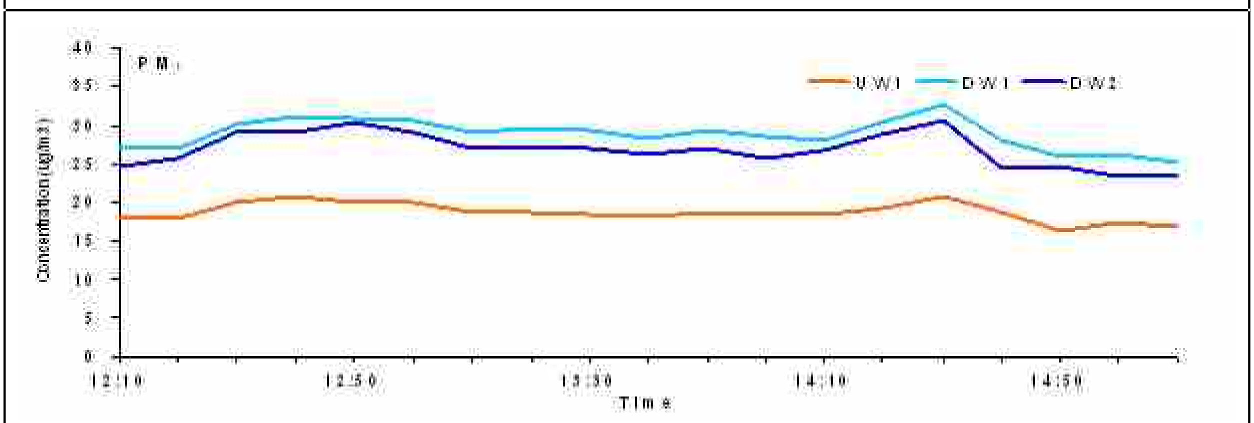
November 13, 2002 09:30-14:00 EST

	Distance to (metres)		Particulate Concentration ($\mu g/m^3$)			Difference DW minus UW ($\mu g/m^3$)		
Station	Road	Source	PM_{10}	$PM_{2.5}$	PM_1	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		n/a	13.8	n/a			
DW1	15	15	45.9	26.7	22.9		12.9	
DW2	40	40	38.6	32	28.7		18.2	

December 11, 2002   12:10 to 15:10 E.S.T.



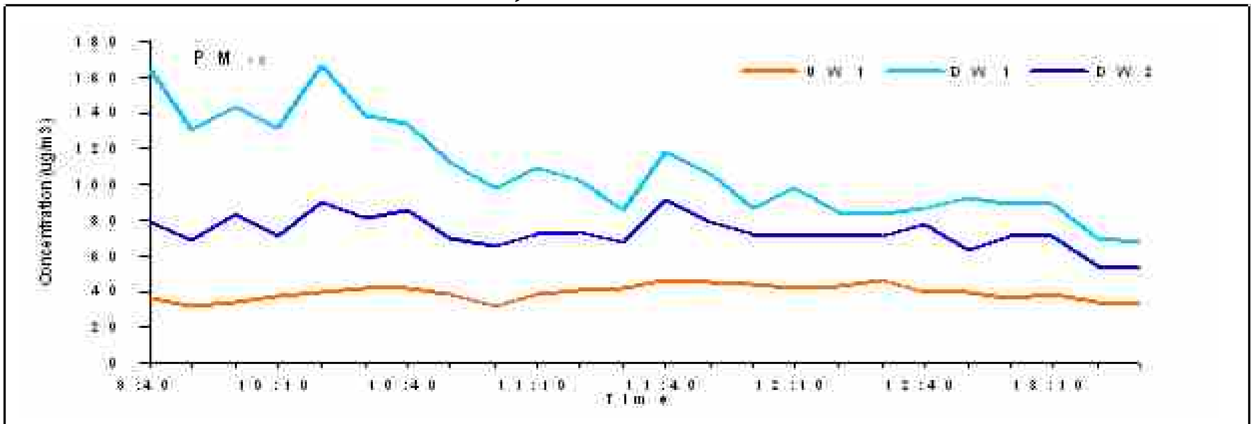


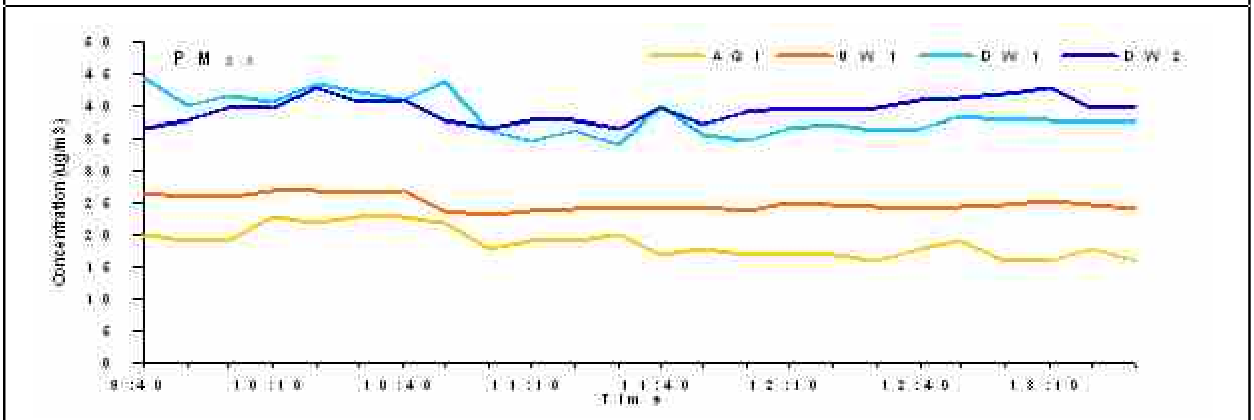


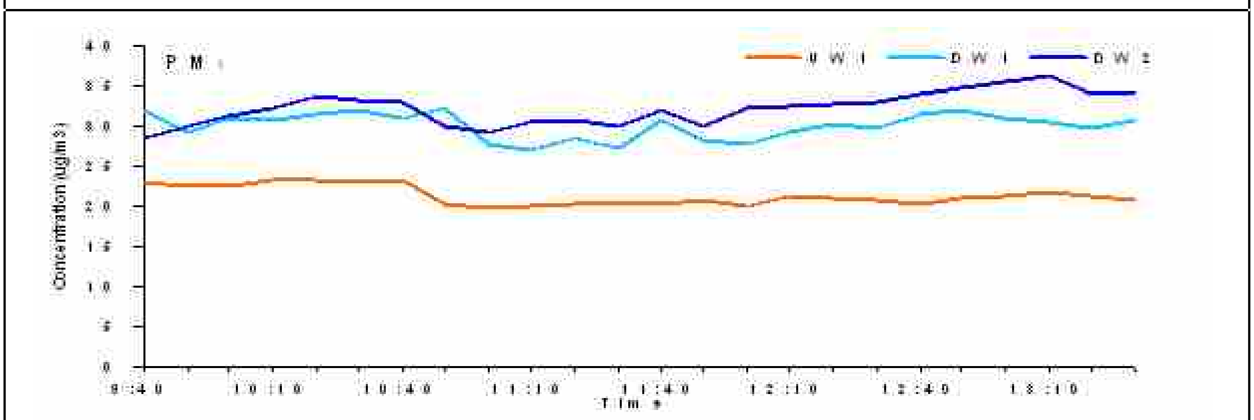
December 11, 2002   12:10-15:10 EST

	Distance to (metres)		Particulate Concentration ($\mu g/m^3$)			Difference DW minus UW ($\mu g/m^3$)		
Station	Road	Source	PM_{10}	$PM_{2.5}$	PM_1	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		n/a	27.5	n/a			
UW1	40	40	50.3	23.6	18.6			
DW1	15	15	56	34.5	28.7	5.7	10.9	10.1
DW2	40	40	55.3	31.3	26.8	5	7.7	8.2

December 12, 2002 09:40 to 13:30 E.S.T.

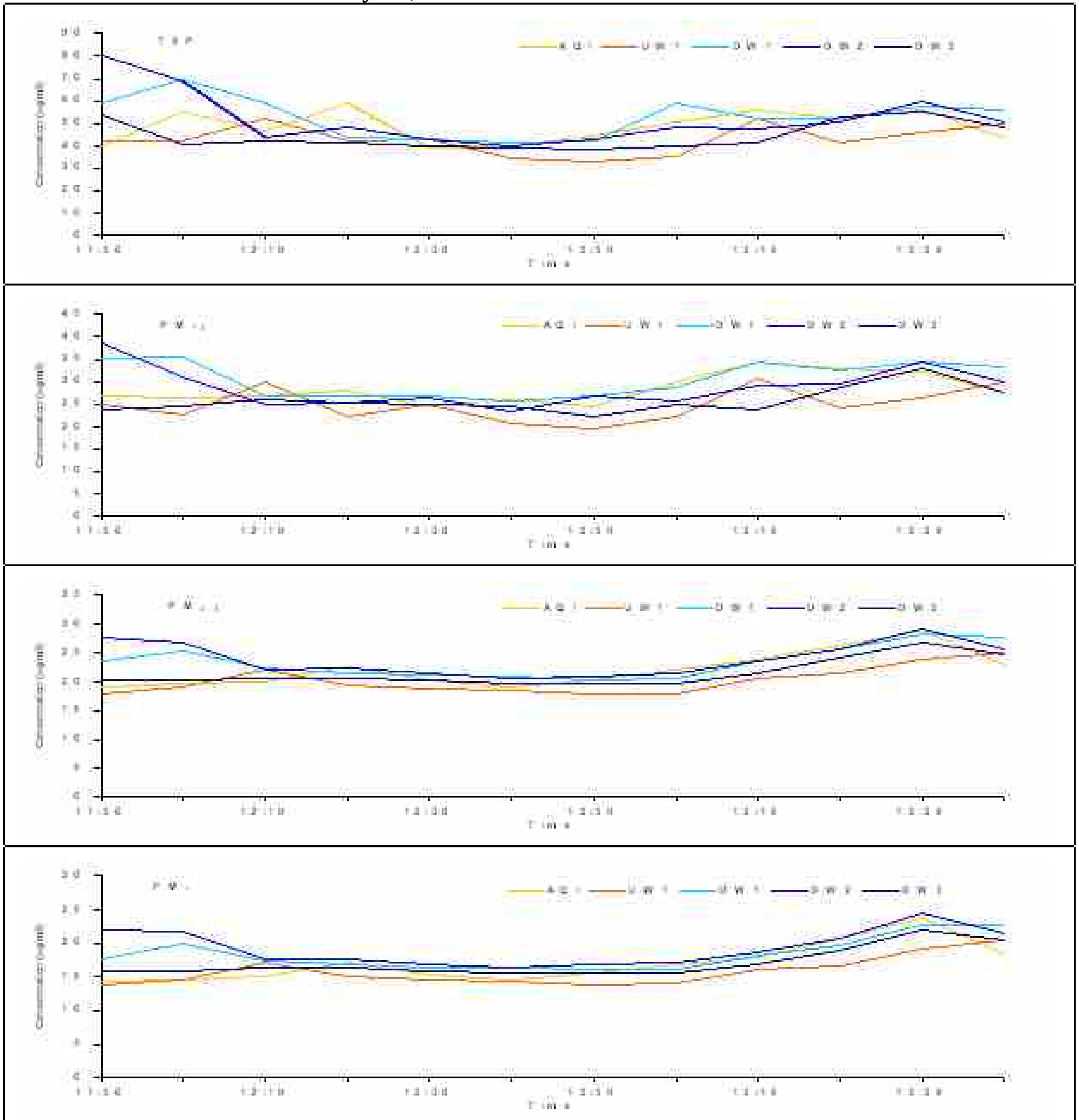






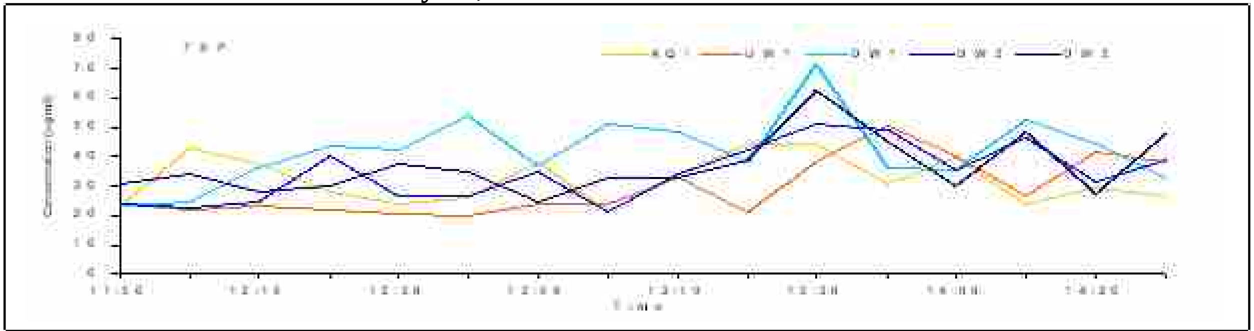
December 12, 2002 09:40-13:30 EST								
	Distance to (metres)		Particulate Concentration (µg/m^3)			Difference DW minus UW (µg/m^3)		
Station	Road	Source	PM_{10}	$PM_{2.5}$	PM_1	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		n/a	18.8	n/a			
UW1	40	60	39.1	24.9	21.4			
DW1	15	20	107.9	38.6	30.1	68.8	13.7	8.7
DW2	40	55	73	39.4	32.3	33.9	14.5	10.9

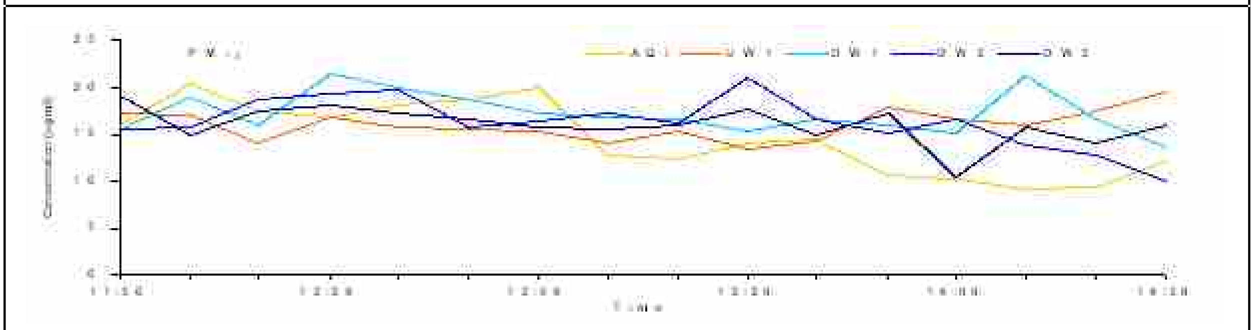
May 20, 2003   11:50 to 13:40 E.S.T.

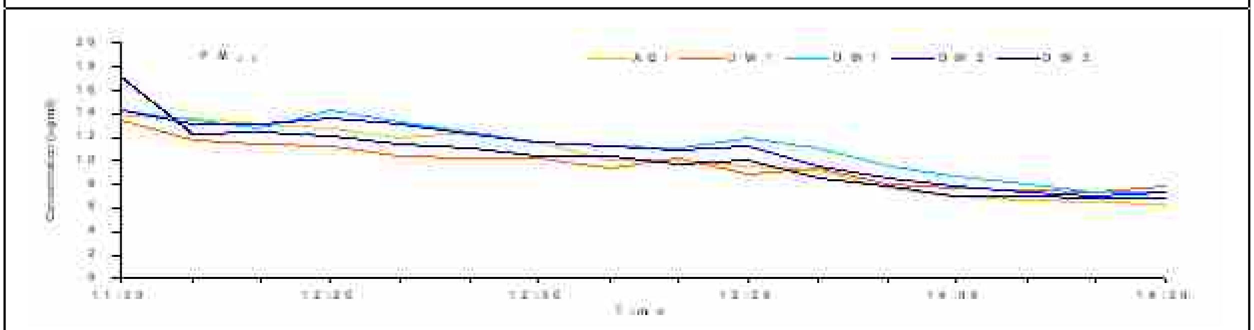


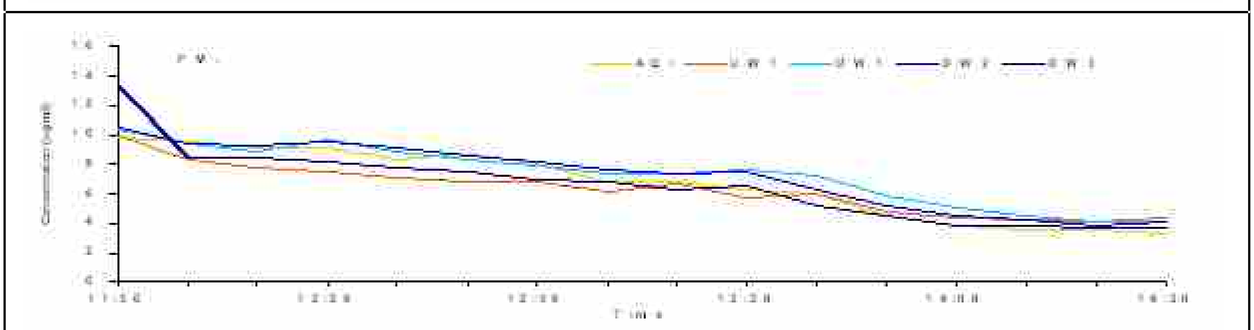
May 20, 2003 11:50-13:40 EST										
	Distance to (metres)		Particulate Concentration ($\mu g/m^3$)				Difference DW minus UW ($\mu g/m^3$)			
Station	Road	Source	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		48.5	28.4	22.1	17				
UW1	40	140	43	24.9	20.2	15.8				
DW1	20	60	53	30.7	23.4	18.3	10	5.8	3.2	2.5
DW2	65	180	52.1	28.8	24	19.3	9.1	3.9	3.8	3.5
DW3	115	290	44.5	25.8	21.5	17.1	1.5	0.9	1.3	1.3

May 20, 2003   14:00 to 16:30 E.S.T.





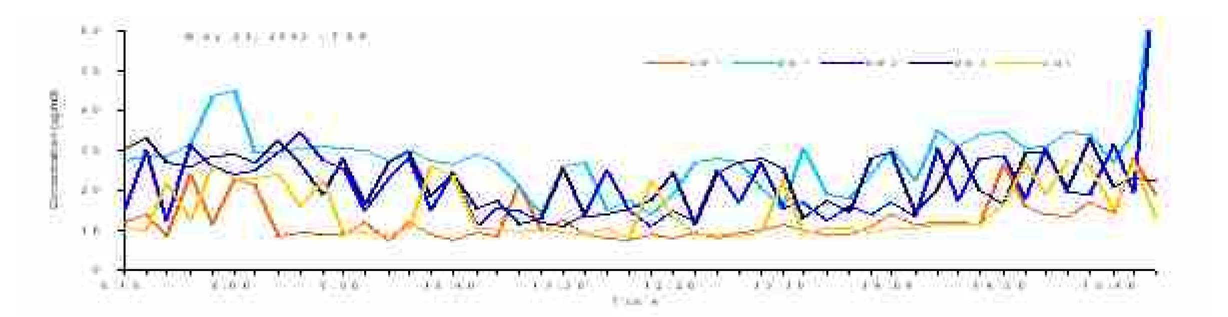


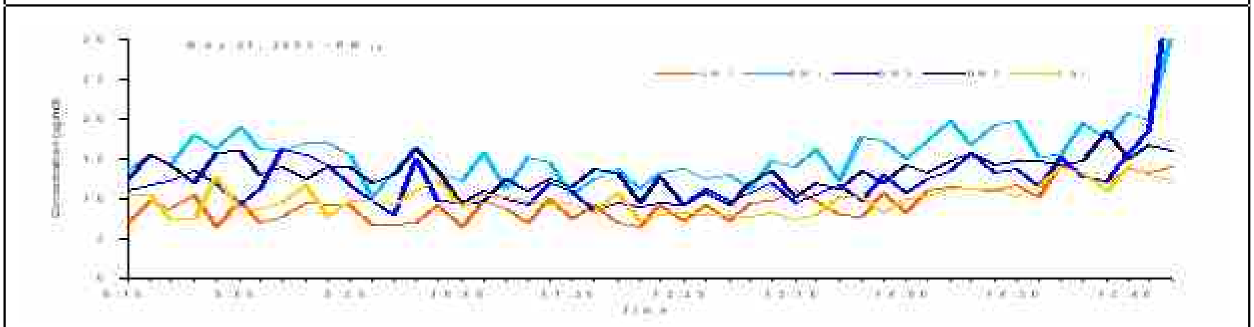


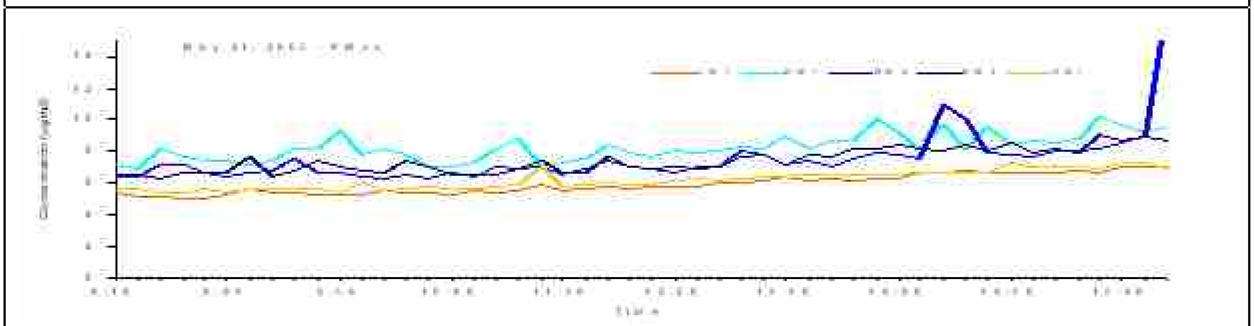
May 20, 2003   14:00-16:30 EST

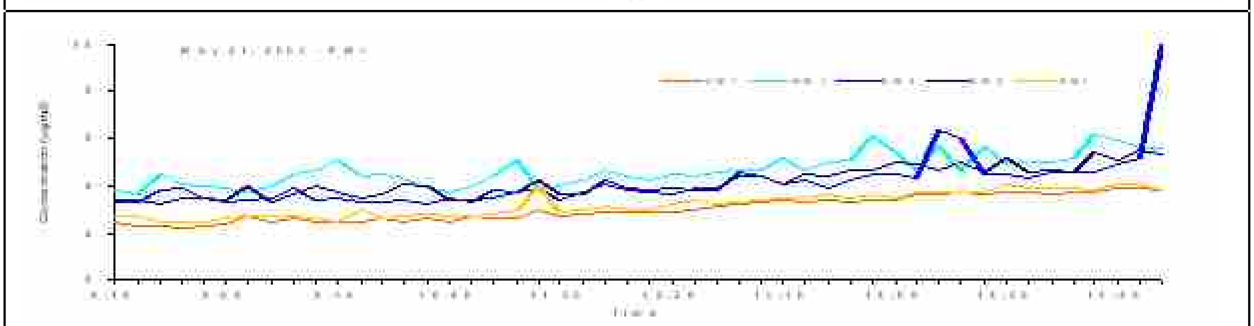
	Distance to (metres)		Particulate Concentration ($\mu g/m^3$)				Difference DW minus UW ($\mu g/m^3$)			
Station	Road	Source	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		32.2	14.6	10.2	6.7				
UW1	40	95	29.4	16	9.7	6.3				
DW1	20	50	41.9	17.3	11.2	7.3	12.5	1.3	1.5	1
DW2	55	110	34.3	16.3	10.8	7.2	4.9	0.3	1.1	0.9
DW3	85	165	36.7	16.1	10.1	6.6	7.3	0.1	0.4	0.3

May 21, 2003 08:10 to 16:00 E.S.T.



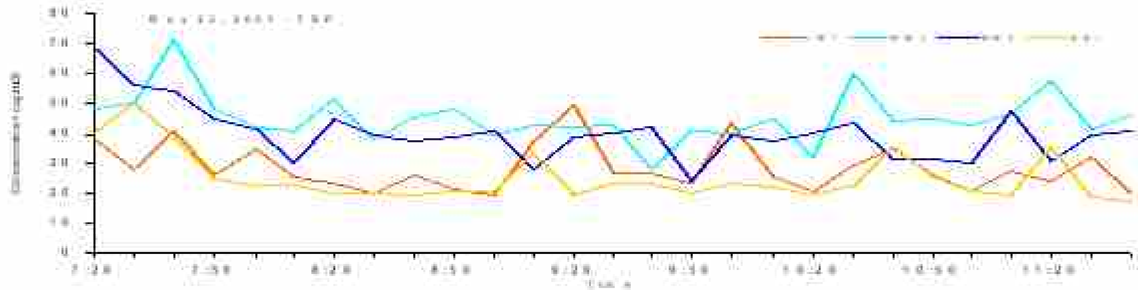


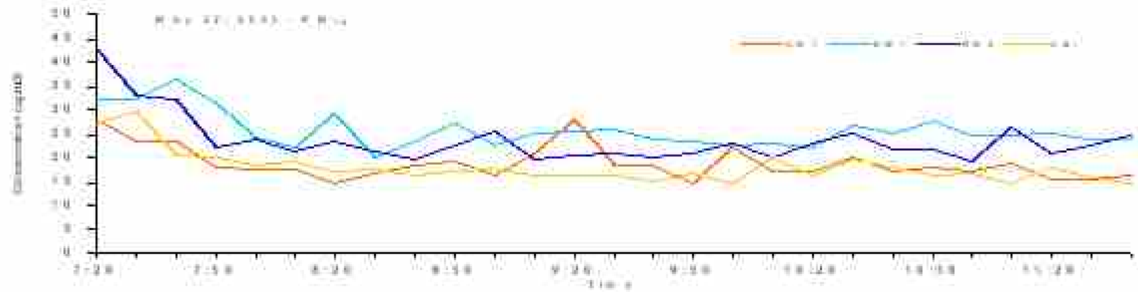


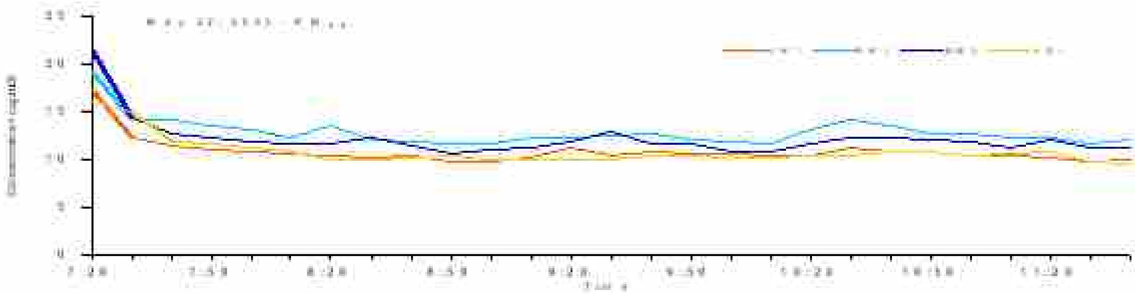


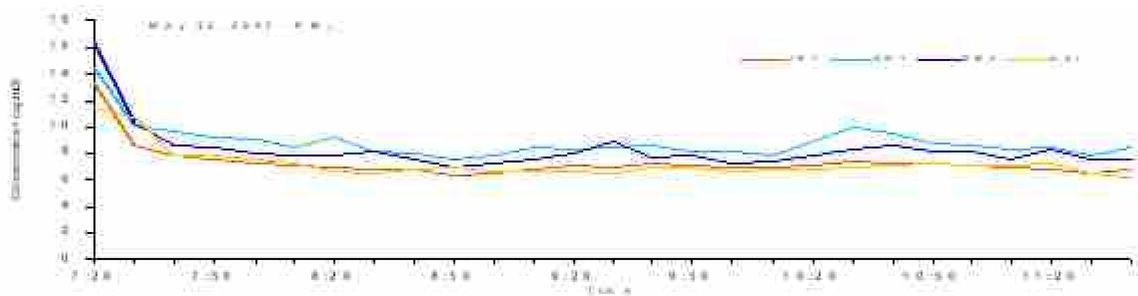
May 21, 2003 08:10-16:00 EST										
	Distance to (metres)		Particulate Concentration ($\mu g/m^3$)				Difference DW minus UW ($\mu g/m^3$)			
Station	Road	Source	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
UW1	45	45	12.5	9.4	5.9	3				
DW1	35	35	28.5	15.6	8.2	4.7	16	6.2	2.3	1.7
DW2	40	40	21.6	12.3	7.5	4.1	9.1	2.9	1.6	1.1
DW3	50	50	22.7	13.2	7.4	4.1	10.2	3.8	1.5	1.1
AOI	~1 K		15	9.9	6.2	3.2	2.5	0.5	0.3	0.2

May 22, 2003   07:20 to 14:40 E.S.T.





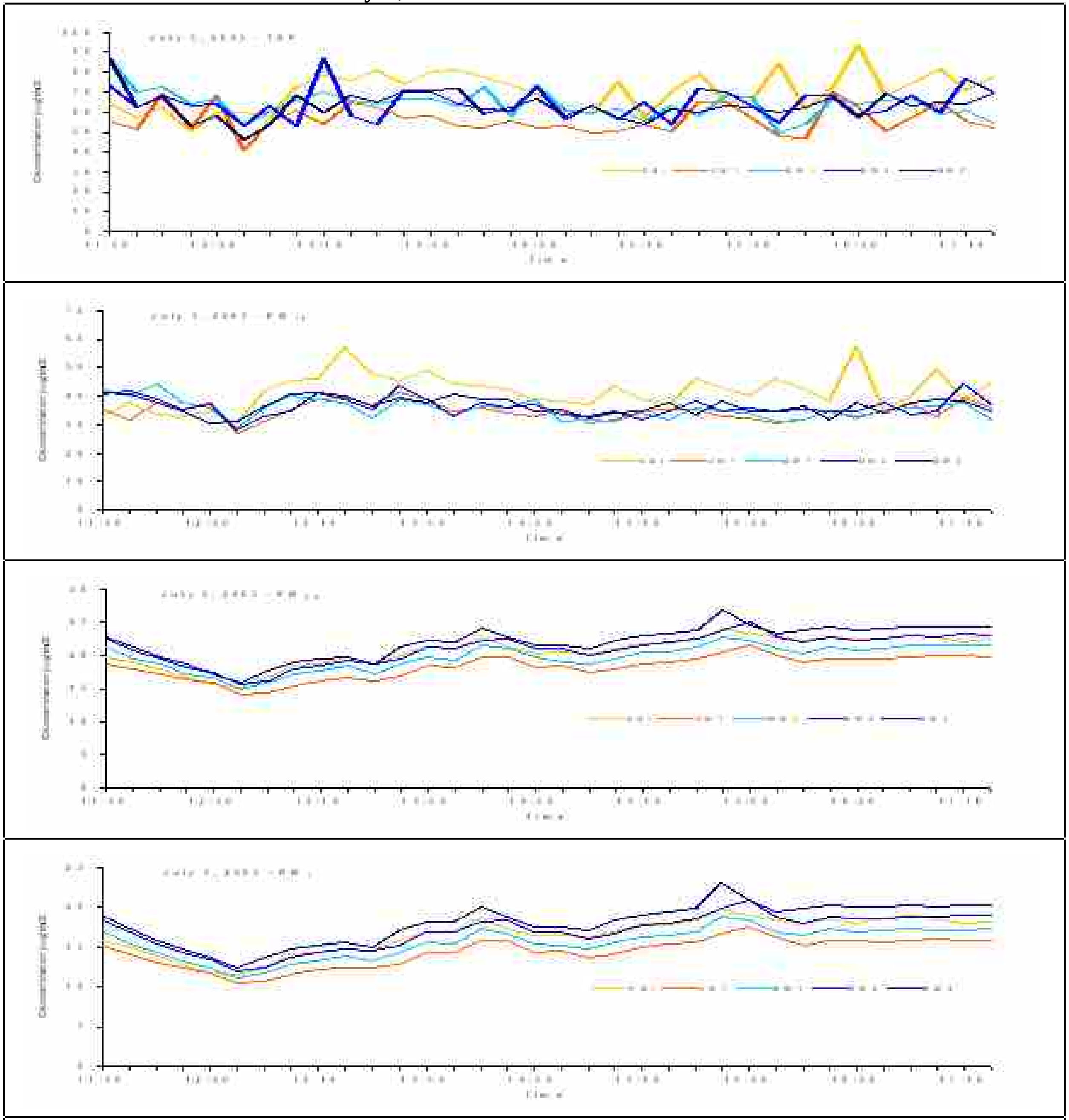




May 22, 2003   07:20-14:40 EST

	Distance to (metres)		Particulate Concentration ($\mu g/m^3$)				Difference DW minus UW ($\mu g/m^3$)			
Station	Road	Source	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
UW1	45	50	28.7	18.9	10.9	7.3				
DW1	15	20	45.4	25.7	12.9	8.8	16.7	6.8	2	1.5
DW2	45	50	40.2	23.7	12.2	8.3	11.5	4.8	1.3	1
AQI	~1 K	290	25.3	18.1	10.9	7.2	-3.4	-0.8	0	-0.1

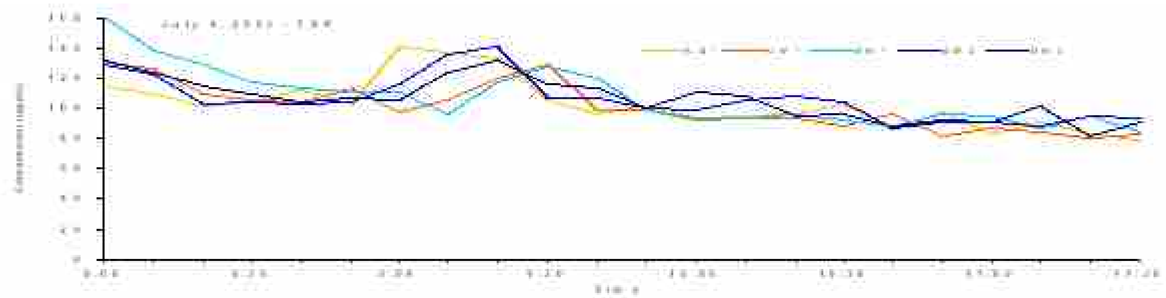
July 3, 2003   11:50 to 17:20 E.S.T.

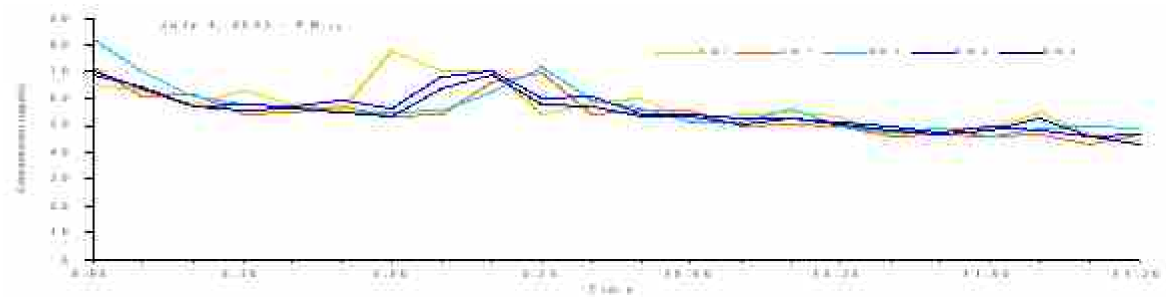


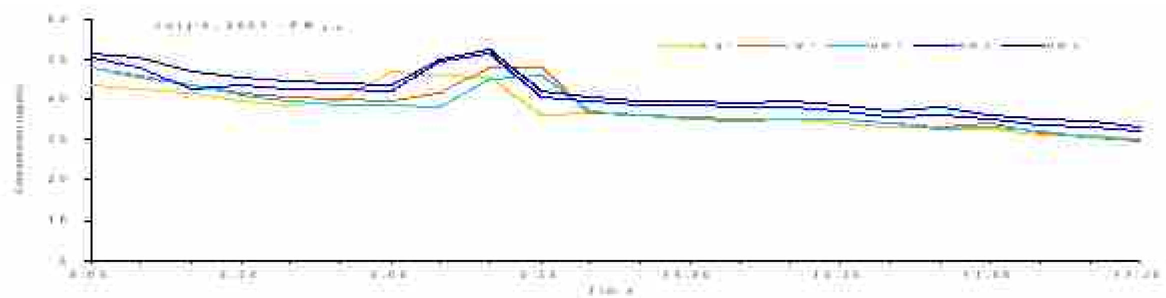
July 3, 2003   11:50-17:20 EST

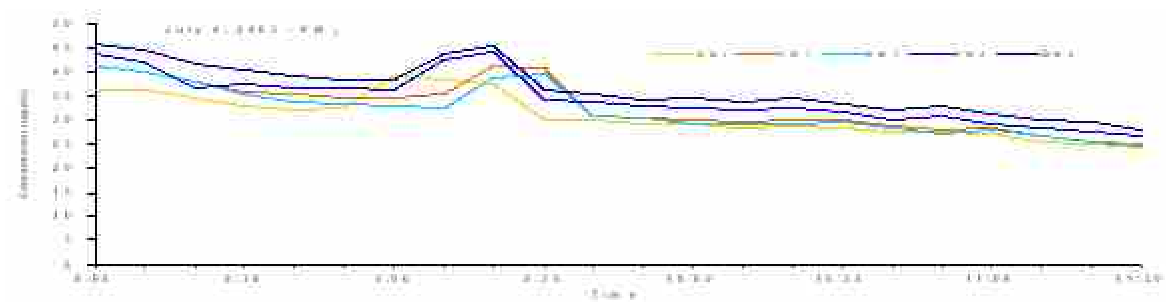
	Distance to (metres)		Particulate Concentration (µg/m³)				Difference DW minus UW (µg/m³)			
Station	Road	Source	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		70.3	41.7	20.6	16.5				
UW1	40	80	56.1	34.7	18.3	14.3				
DW1	30	60	64	35.3	19.7	15.5	7.9	0.6	1.4	1.2
DW2	70	130	64.2	36.3	21	16.9	8.1	1.6	2.7	2.6
DW3	130	260	63	36.6	22	18	6.9	1.9	3.7	3.7

July 4, 2003 08:00 to 11:30 E.S.T.









July 4, 2003 08:00-11:30 EST

	Distance to (metres)		Particulate Concentration (µg/m³)				Difference DW minus UW (µg/m³)			
Station	Road	Source	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
AQI	~1 K		103	57.1	37.3	30.9				
UW1	40	60	100.9	54.2	38.3	32.7				
DW1	25	35	107.1	56.3	37.7	32	6.2	2.1	-0.6	-0.7
DW2	65	80	106.2	55.8	40.4	34.5	5.3	1.6	2.1	1.8
DW3	120	150	106.2	54.8	41.8	36.4	5.3	0.6	3.5	3.7

Mobile Traffic Survey - May 21 and May 22, 2003

May 21, 2003 10:30-12:00 EST

	Average Particulate Concentration ($\mu g/m^3$)				"Corrected" Concentration ($\mu g/m^3$)			
Location	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
UW	11.7	8.3	5.6	2.7	3.6	1.2	-0.2	-0.2
Median	26.3	16.9	10.8	6.2	17.2	7.8	5.1	3.4
DW	17.1	12.9	8.5	4.7	7.1	3	2.6	1.7
50	18.9	13.9	8	4.3	7.5	7	2.5	1.7
100	16.6	13.2	7.3	3.7	7.9	4.4	1.9	1.1
150	13.6	11	6.9	3.4	4.1	1.4	1.4	0.7
200	14.4	9.7	6.7	3.4	5.3	0.5	1.3	0.8

May 22, 2003 07:45-09:20 EST

	Average Particulate Concentration ($\mu g/m^3$)				"Corrected" Concentration ($\mu g/m^3$)			
Location	TSP	PM_{10}	$PM_{2.5}$	PM_1	TSP	PM_{10}	$PM_{2.5}$	PM_1
UW	22.8	17.1	10.4	6.9	-14.4	-3.8	0.1	0.2
Median	41	29.7	14.2	9.2	21.5	13.3	4.3	2.7
DW	48	32.1	14.1	9.1	26.6	12.9	4.2	2.7
50	29.4	22.5	12.8	8.5	9.2	5.8	2.5	1.7
100	24.8	19.1	12.9	8.5	1	4.3	2.3	1.6
150	35	20.8	12.8	8.6	9.3	3.3	2.1	1.5
200	29	21.7	12.9	8.6	3.9	4.2	2.1	1.4
250	32.1	22.3	13.2	9	5.6	4.4	2.1	1.5

APPENDIX D: DETAILED VOC RESULTS

Detailed Cartridge Results

Results in the accompanying table are given in micrograms per cubic metre of gas sampled. Note that some results are accompanied either by the expression “<=W” or “<T”. These are called “flags”.

“<=W” indicates that the instrument was unable to detect anything in this sample. The number given in this case is called the “method detection limit.” All that can reliable be said in this case is that the concentration is below this value.

“<T” is a caution flag given to all results that exceed - but are less than 10 times - the method detection limit. This is a reminder that the quantity measured was actually very small and, thus, has a relatively high degree of uncertainty.

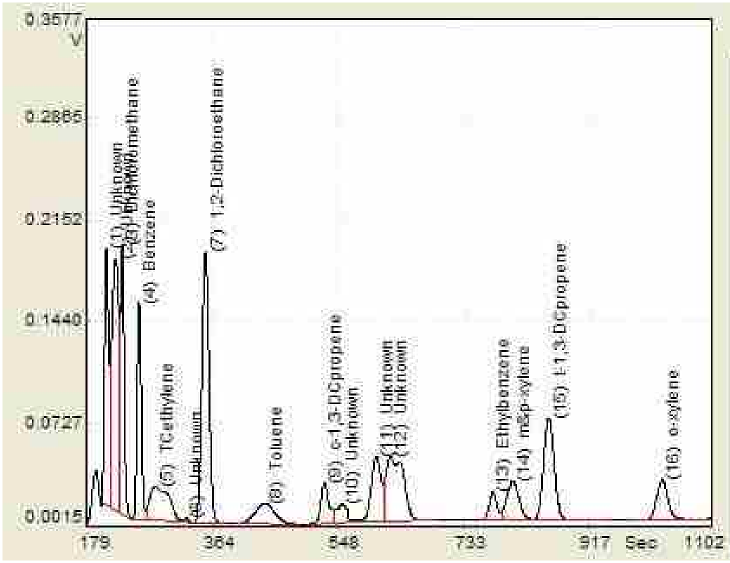
The final column lists the Ministry’s half hour standards where they are available. These standards are meant for use in evaluating emissions from point sources rather than assessing general air quality . Nonetheless, they provide a useful indicator of the relative concern associated with the substance. Note, however, that the standard does not necessarily relate to health factors, but may indicate other concerns. For example, the naphthalene standard is based upon its odour. In every case where a standard exists, the concentrations measured on Huron Church were orders of magnitude lower.

Not all of the substances have air standards. Generally this means that the substance does not pose a risk to health.

However, benzene is an exception. While it is known to be a carcinogen, it is also found in almost all petroleum products, including gasoline, and is difficult to eliminate from the air. Currently the provinces are working with the federal government to reduce the amount of benzene emitted across the country through the Canada Wide Standard process. Further details of this process may be found at http://www.ccme.ca/initiatives/standards.html?category_id=46.

Chemical	Upwind		Downwind		½ hr Std
	Sample Value µg/m^3	Flag	Sample Value µg/m^3	Flag	µg/m^3
Chloroethene	0.01	<=W	0.01	<=W	3
Butadiene	0.05	<T	0.06	<T	
Acrylonitrile	0.03	<T	0.03	<T	180
2-methyl-1,3-butadiene	0.06	<T	0.08	<T	
Dichloroethene	0.01	<=W	0.01	<=W	315
Dichloromethane	0.2	<T	0.16		5300
1,1-dichloroethane	0.01	<=W	0.01	<=W	600
Trichloromethane	0.06	<T	0.04	<T	300
Hexane	0.47		0.78		35000
1,2-dichloroethane	0.04	<T	0.03	<T	6
1,1,1-trichloroethane	0.17		0.13		350000
Benzene	0.58		0.86		
Carbon tetrachloride	0.66		0.5		7.2
Cyclohexane	0.07		0.1	<T	300000
1,2-dichloropropane	0.01	<=W	0.01	<=W	2400
Trichloroethene	0.09	<T	0.05	<T	3500
Bromodichloromethane	0.02	<=W	0.02	<=W	
cis-1,3-dichloropropene	0.01	<=W	0.01	<=W	
1,1,2-trichloroethane	0.02	<=W	0.02	<=W	
Toluene	1.93		2.22		2000
1,2-dibromoethane	0.02	<=W	0.02	<=W	9
Tetrachloroethene	0.1	<T	0.11	<T	10000
Chlorobenzene	0.02	<=W	0.02	<=W	4200
Ethylbenzene	0.21		0.35		3000
— and p-xylene	0.87		1.22		2300
Styrene	0.1	<T	0.13	<T	400
1,1,2,2-tetrachloroethane	0.02	<=W	0.02	<=W	
o-xylene	0.26		0.41		2300
a-Pinene	0.02	<=W	0.02	<=W	
1,3,5-trimethylbenzene	0.03	<T	0.1	<T	
1,2,4-trimethylbenzene	0.11		0.33	<T	500
1,3-dichlorobenzene	0.02	<=W	0.02	<=W	
1,2-dichlorobenzene	0.02	<=W	0.02	<=W	37000
1,4-dichlorobenzene	0.03	<T	0.03	<T	285
Naphthalene	0.16		0.27	<T	36
Acetone	0.98		1.13		48000
2-propanol	0.05	<T	0.06	<T	24000
Methyl ethyl ketone	0.39	<T	0.29	<T	30000
Diisobutylene	0.02	<T	0.03	<=W	
Methyl isobutyl ketone	0.02	<T	0.09	<=W	1200
Isopropyl ether	0.01	<=W	0.01	<=W	220
Butyl acetate	1.49		0.79		735
Methyl isoamyl ketone	0.05	<=W	0.05	<=W	460
Acetonitrile	0.31		0.31		
1,2,4-trichlorobenzene	0.05	<=W	0.05	<=W	100

Detailed Photovac Results



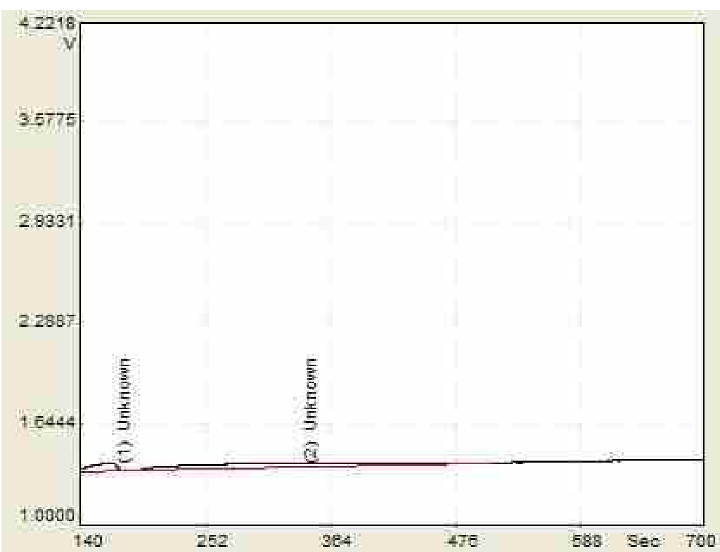
Results Notes Peaks

PEAK REPORT:

# Name	Conc (PPM)	Area (mVS)	Height (mV)
1 Unknown		1353	180
2 Unknown		2085	71.9
3 Dichloromethane		1155	48.6
4 Benzene	1.087	1087	151
5 TCethylene	0.756	743	15.7
6 Unknown		17.5	1.834
7 1,2-Dichloroethane	1.091	2283	190
8 Toluene	0.300	471	14.0
9 c-1,3-DCpropene	1.281	394	28.8
10 Unknown		239	3.617
11 Unknown		812	44.4
12 Unknown		1303	17.1
13 Ethylbenzene	1.330	268	19.3
14 m&p-xylene	1.171	556	27.0
15 t-1,3-DCpropene	1.406	1284	70.8
16 o-xylene	1.172	539	27.9

Photovac Calibration Run May 22, 2003

The above gas chromatograph displays a calibration run in which the analyser samples a known variety of volatile organic compounds. As each compound passes the analyser's detector a peak is displayed on the graph and concentration is calculated and reported in parts per million (PPM) in the "PEAK REPORT" table.



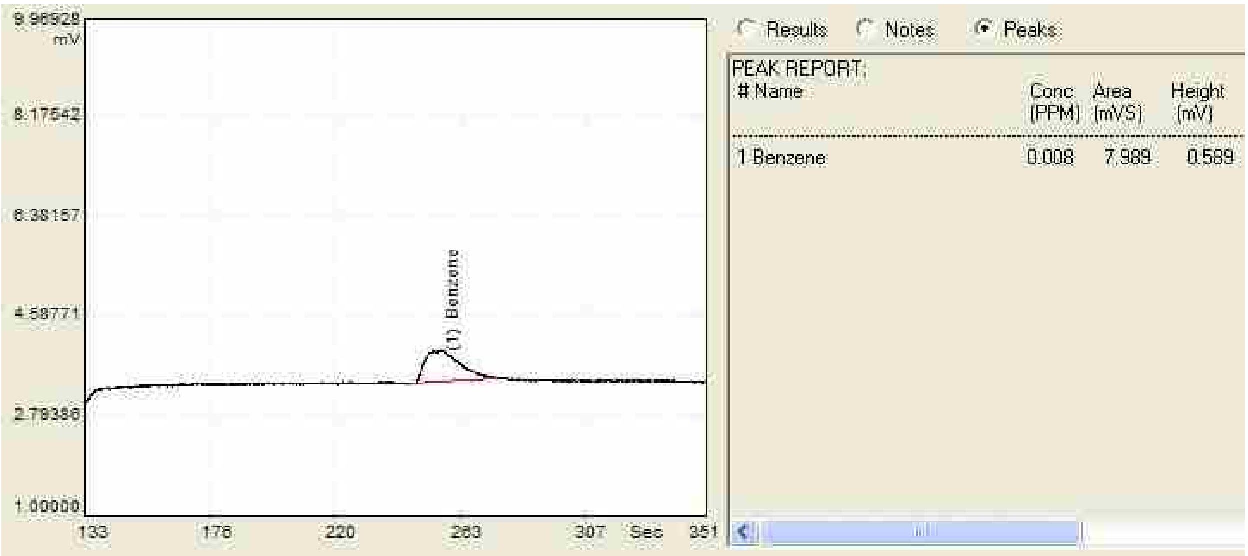
Results Notes Peaks

PEAK REPORT:

# Name	Conc (PPM)	Area (mVS)	Height (mV)
1 Unknown		1491	66.4
2 Unknown		5220	47.4

Upwind VOC Sample May 22, 2003

No identifiable peaks are seen in this sample



Downwind VOC Sample   May 22,2003

Only benzene was identified in this downwind sample. The concentration reported (.008 ppm) is the equivalent of 27.9 µg/m^3.

MAPS DISCLAIMER

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