A BREATHABLE CITY REQUIRES SUPPORT

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"100 years ago there were no cars in the Kensington Market; 100 years from now there won't be any". (Shamez Amlani – Street are for People)

Toronto could become a breathable city. Every step, however small, is important in order for this city to rethink itself and evolve.

During the June 2005 city council meeting, Councillor Olivia Chow presented a motion requesting financial support for Pedestrian Sundays in Kensington Market 2005 (P.S. Kensington). The vote was a tie, and the motion was not accepted. Some have argued that the city shouldn't fund some street festivals and not others. However, P.S. Kensington is more than just a street festival - it is an opportunity to address some of the most challenging and pressing issues Toronto faces today. Poor air quality and gridlock have considerable effects on our economy, health and quality of life. Alternative modes of transportation such as walking, cycling, and public transit can offer very effective and timely solutions to these problems. In comparison cleaner car technologies, while an important part of the solution, suffer from a long lag time between development and commercialisation and do not address gridlock at all.

The government is now supporting alternative transportation; if we are investing money we might as well do it right. The well-known interdependency between urban sprawl and car use illustrates the intimate relationship between transportation and urban form. In order to be successful, public transit investments must be accompanied by supportive neighbourhood design. Studies have shown that pedestrian areas in particular function well together with public transit.

Car exhaust contains many pollutants such as Carbon Monoxide (CO), Volatile Organic Compounds, nitrogen oxides and particulate matter. Some are known to have serious health effects while others are suspected to cause smog (see Table 1). We were able measure CO and a set of VOCs that are characteristic of automobile emissions: 1,3-butadiene, benzene, toluene, ethyl-benzene, m-xylene, p-xylene, o-xylene and styrene.

It is not easy to have a quantifiable representation of the amount of air pollution we are exposed to. Pedestrian Sundays in Kensington Market 2005 was an opportunity to take scientific measurements of the effect of cars on local air quality. Our sampling site was located at the heart of the Market at the intersection of Baldwin and Augusta.

The mixing ratio of Carbon Monoxide was recorded in real-time during both pedestrian and non pedestrian events (Figure 1 & 2) Vehicles passing-by, about 2 meters away from our sampling point, generate spikes of Carbon Monoxide (CO) of up to 6 parts per million (ppm). This is clearly different from the graph obtained on a car-free day where CO levels stay around 0.3 ppm. The daily averages for CO and VOCs concentrations confirm this trend (Figure 3). During a normal traffic day on August 21st, the average mixing ratio was 0.6 ppm for CO and 6 parts per billion (ppb) for VOCs. On August 28th, the last Pedestrian Sunday, these concentrations were 0.3 ppm and 2 ppb respectively.

This reduction in local pollution on pedestrian days is significant even though the wind was stronger on August 21st. Wind will mix the air, reducing pollutants concentrations to background levels and making it difficult to measure the pollution sources we are trying to catch. Weather conditions play a determinant role on pollution levels. In addition to the mixing effect of wind, rain will clean the air while the sun enables certain chemical reactions resulting in particular in (photo-chemical) smog. In order to be able to make meaningful comparisons, average wind speed (source: www.wunderground.com) are included on all our graphs.

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Table 1 : What's in your Tailpipe

Pollutant		Description	Health effects	Safety levels
Carbon Monoxide (CO)		Colourless, odourless and tasteless gas.	Asphyxiant, affects brain function and increases heart rate. Causes: headaches, nausea, dizziness, shortness of breath and 30% of early deaths related to air pollution. Pregnant women, children, the elderly, people with anemia and smokers are most at risk.	13.00 ppm per hour 5 ppm over 8 hours
Nitrogen Dioxide (NO_2)		Responsible for the brownish colour of smog. Combines with water molecules in air to form nitric acid.	Irritates the lungs, impairs lung function, lowers resistance to respiratory infection, responsible for 40% of deaths related to air pollution. Causes increased bronchitis in children, is mild accelerator of lung tumors and can alter the metabolism of lung cells.	0.12 ppm per hour
Volatile Organic Compounds (VOCs)	**Benzene**	Organic gases and vapours that quickly evaporate into air.	Affects: blood, bone marrow, immune system, Chromosomes Impairs fertility in women Increased risk of Leukemia	18.4 ppb
	Toluene		Affects Central Nervous System => Drowsiness, headaches, ataxia, tremors Irritation of Upper respiratory tract and eyes.	100 ppb
	Xylenes		Affects Nervous system: Headaches, fatigue, dizziness, inccordination. Impaired pulmonary function	N/A
	EthylBenzene		Irritation of eyes, throat and lungs	230 ppb
	Styrene		Affects Central Nervous System (CNS): headaches, fatigue, depression, CNS dysfunction Increased risk of Leukemia	235 ppb
	1,3 Butadiene		Irritation of eyes, nose, throat and lungs Increase chances of cancers and leukemia	4 ppb
Ground-level Ozone (O_3)		Colourless, odourless gas. Created through chemical reactions with NO_2 and VOCs in sunlight.	Very intense irritant, can sting the eyes and nose. Responsible for coughing and wheezing, causes inflammation of the lung and increases the effect of allergens. Reduces lung function, lung capacity and results in premature aging of the lung	0.10 ppm per hour
Sulfur Dioxide (SO_2)		Colourless, corrosive gas Combines with water molecules to form sulphuric acid.	Forms very damaging acid aerosols which can be drawn deep into the lungs. Causes respiratory problems, heart failure since the heart and lungs are very closely related.	0.20 ppm per hour
Particulate matter ($PM_{2.5}$)		Microscopic liquid droplets and particles of soot, ash, dirt, dust. Formed through reactions with NO_2, SO_2, VOCs.	Can penetrate deep into and damage the lungs, impairing lung function, causing lung infections, asthma, chronic bronchitis, emphysema and various forms of heart disease. Shortens life expectancy.	15 $\mu g/m^3$

Figure 1: CO Concentration August 21st - Kensington Market Regular day

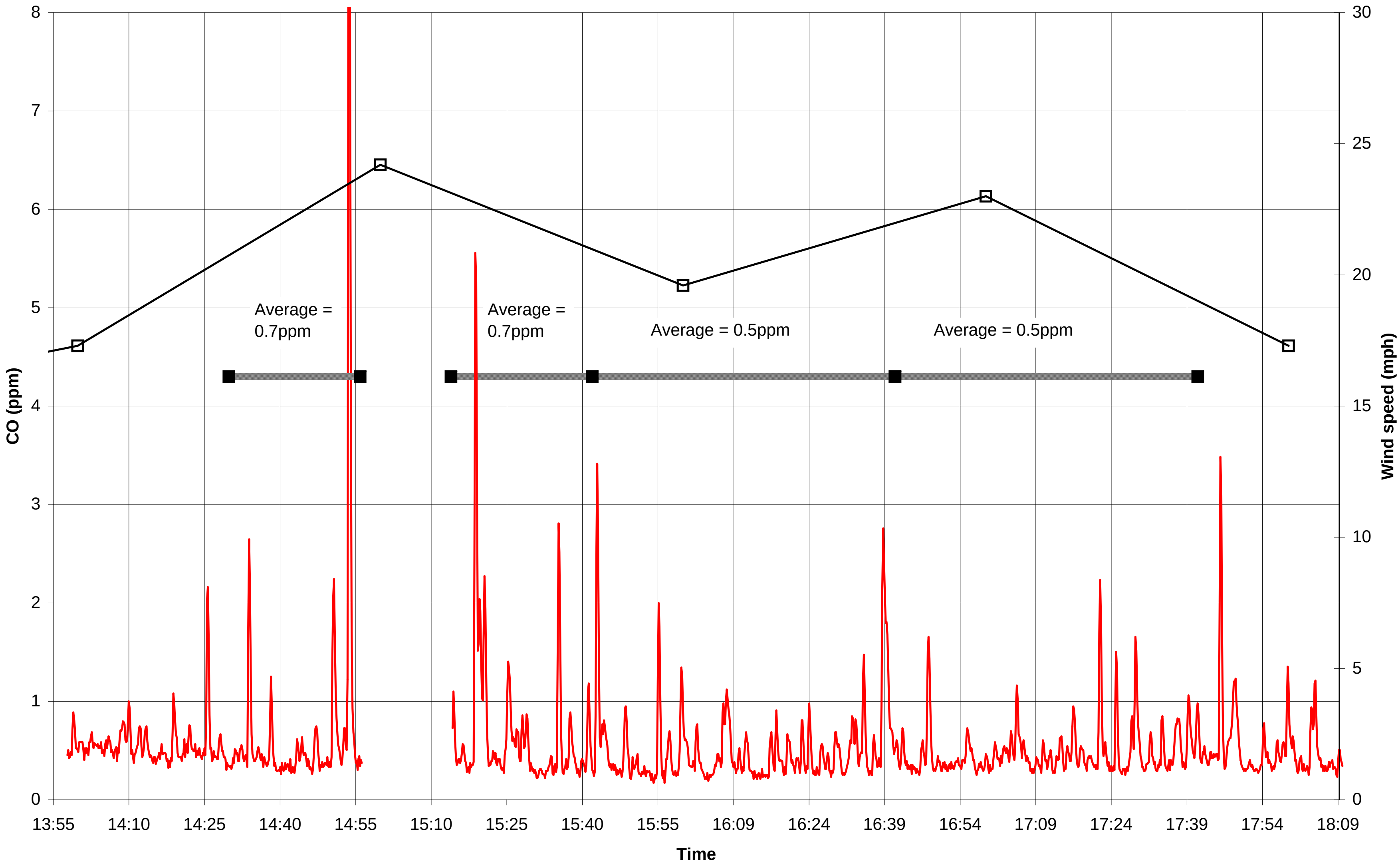


Figure 2: CO Concentration August 28th - Kensigton Market P.S. Kensington

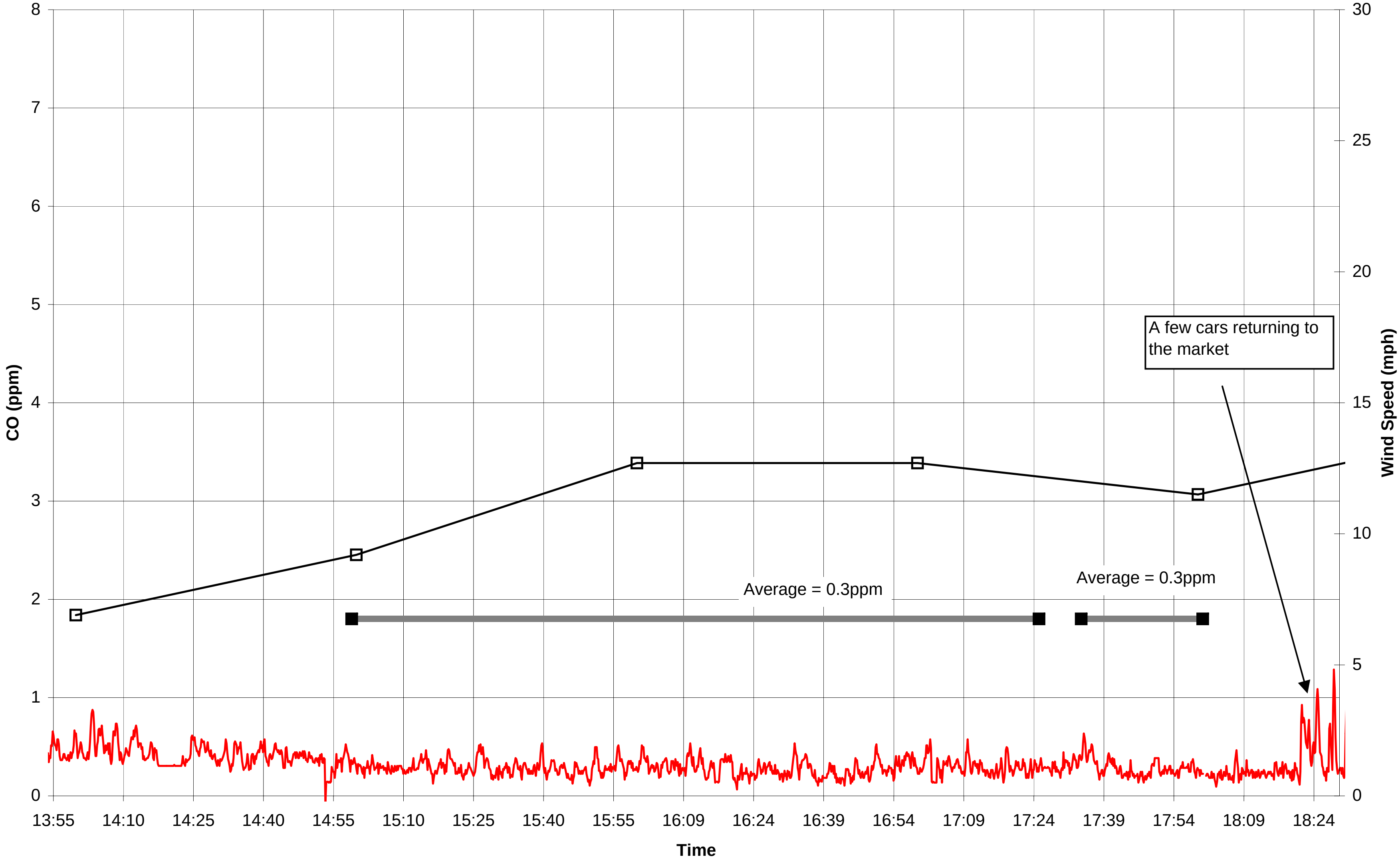
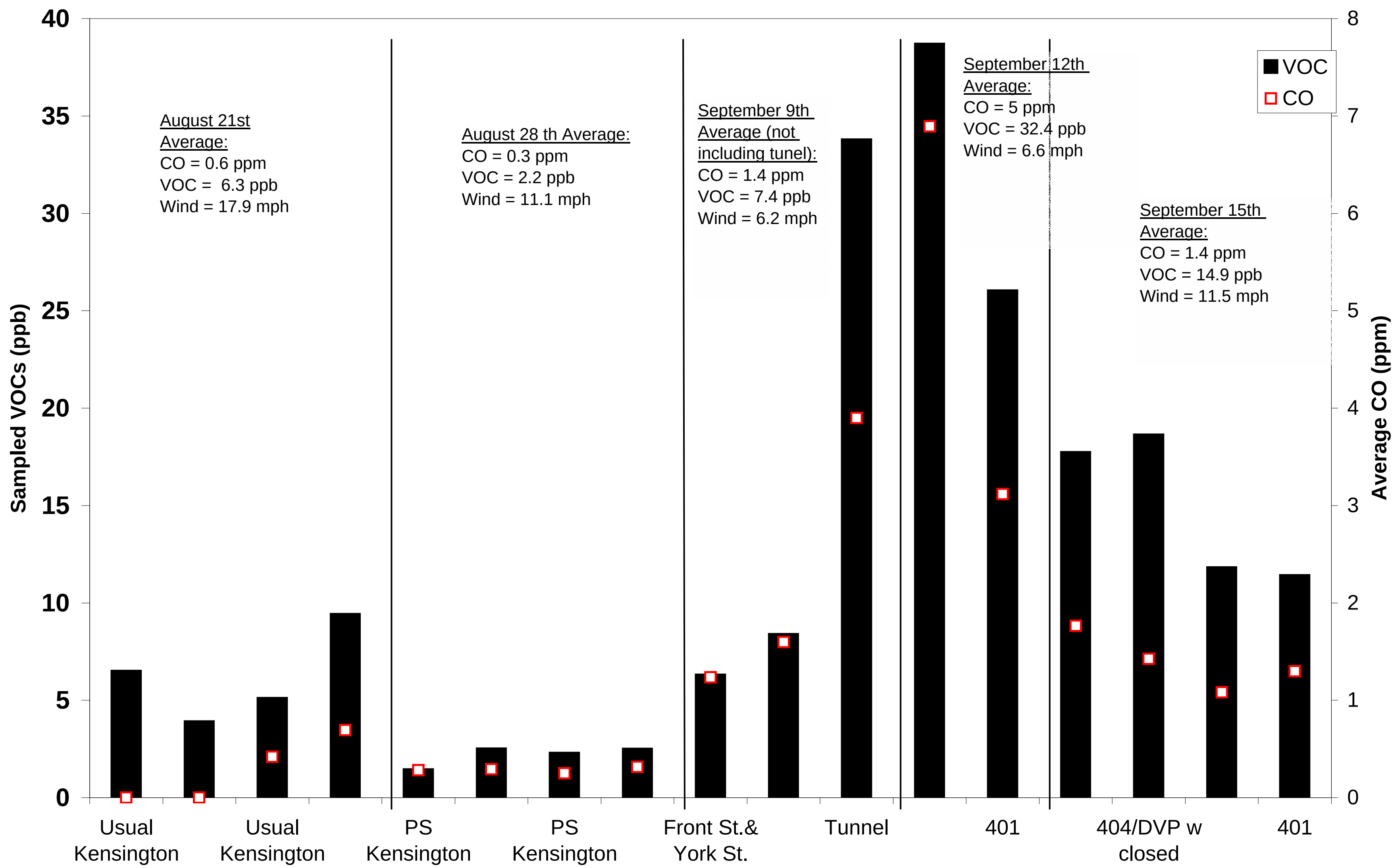


Figure 3: Sampled VOCs & CO Concentrations - Various locations



These Kensington Market measurements were performed on a one-way street with intermittent traffic, particularly on Sundays. How would it compare with other parts of the city with a higher volume of traffic? For this comparison, we chose a notoriously jammed spot of the downtown core: the intersection at Front street and York Street, near Union station. Many vehicles, in this area, in particular buses, are trying to get onto the Gardiner and often block others driving along Front street. It is also a site where there are a lot of pedestrians and therefore a lot of people being exposed to pollutants as they are getting into Union station. We set up on the south west corner, where pedestrians would normally wait to cross the street. The results (figure 4 and 3) show VOC concentrations (average total HC = 7 ppb) similar to the Kensington Market while CO concentrations were higher than in Kensington Market with an average at 1.4 ppm. Several of the peaks on the CO data could be attributed to specific vehicles passing by, in particular buses and trucks. Towards the end of the day, we rolled down our instruments into a nearby tunnel, which at that time of the day, is constantly filled with vehicles. Carbon Monoxide and Hydrocarbon levels increased dramatically, reaching an average of 4 ppm and 34 ppb respectively. The instruments were left immobile in the tunnel, the dip in the CO data, may be attributed to some fresh air passing through the tunnel. Pedestrians may want to avoid this tunnel, such levels of pollution are clearly unhealthy. Motorists who get stuck in there for several minutes are of course in a worse situation.

This leads us to wonder about all those motorists stuck on the highways every morning and every evening? How is the air quality on the DVP as it turns into an idling parking lot at rush hour? With the instrument on the back seat, a laptop on the passenger's lap recording the data, we set off on three occasions on the streets and highways of Toronto. First on August 26th, we went for an evening downtown ride from Keele and St Clair to the Kensington Market (Figure 5). Despite the fact that traffic was not too heavy at that time Carbon monoxide concentrations are above 1 ppm and averages at 2.2 ppm. This was done with the sampling inlet attached to the passengers head rest and the windows opened. As figure 6 shows, CO concentration spikes each time we stopped at a red light at street intersections or during traffic episode on Bloor (7:30pm-7:35pm) and especially College (7:37pm to 7:42pm).

Then, on September 12th we drove through the morning rush hour along Eglinton, Allen road, the DVP and the 401. We were a little late on the 12th but we were still able to catch a large amount of pollutants as we were stuck on Eglinton waiting to get on Allen road (Firgure 6 and 3). On that day, the windows were closed and the A/C on. Traffic patterns as we navigated back and forth on a busy but fluid 401 are clearly visible. CO concentration spikes when traffic slows down before major interchanges such as at the 400 and the 401 and when we must wait on the highway's exit road. Our results suggest however that pollutant's concentrations are much higher when traffic is stopped on a downtown street than on a jammed but still slowly moving highway. The averages for that day are much higher than downtown measurements and close to the levels observed in the tunnel (CO = 5 ppm, VOC = 32.4 ppb).

Similar traffic patterns can be observed on the CO data for September 15th. Thanks to an earlier rise, we were able to circle twice down the 404 passed the 401 onto the DVP from Finch to Lawrence and back up again. We did that from 7:30 to 8:20 a prime time for traffic. Our first circuit was done with the windows closed, they were opened for the second round (figure 7 and 3). In each case, the total amount of measured pollutants is in fact less when the windows are opened so there seem to be no benefit in closing the windows. We finished our morning in traffic hell with a ride on a slow moving 401 west and then east to finish at York University. All along CO concentration can be related to traffic episodes. The average values for that morning are: CO = 1.4 ppm and VOC = 14.9 ppb. These values are lower than what we observed on September 12th even though the highway was much more fluid then. This, can be attributed to higher wind speed on September 15th.

Figure 5: CO Concentration August 26th - Driving From Keele to the Kensigton Market

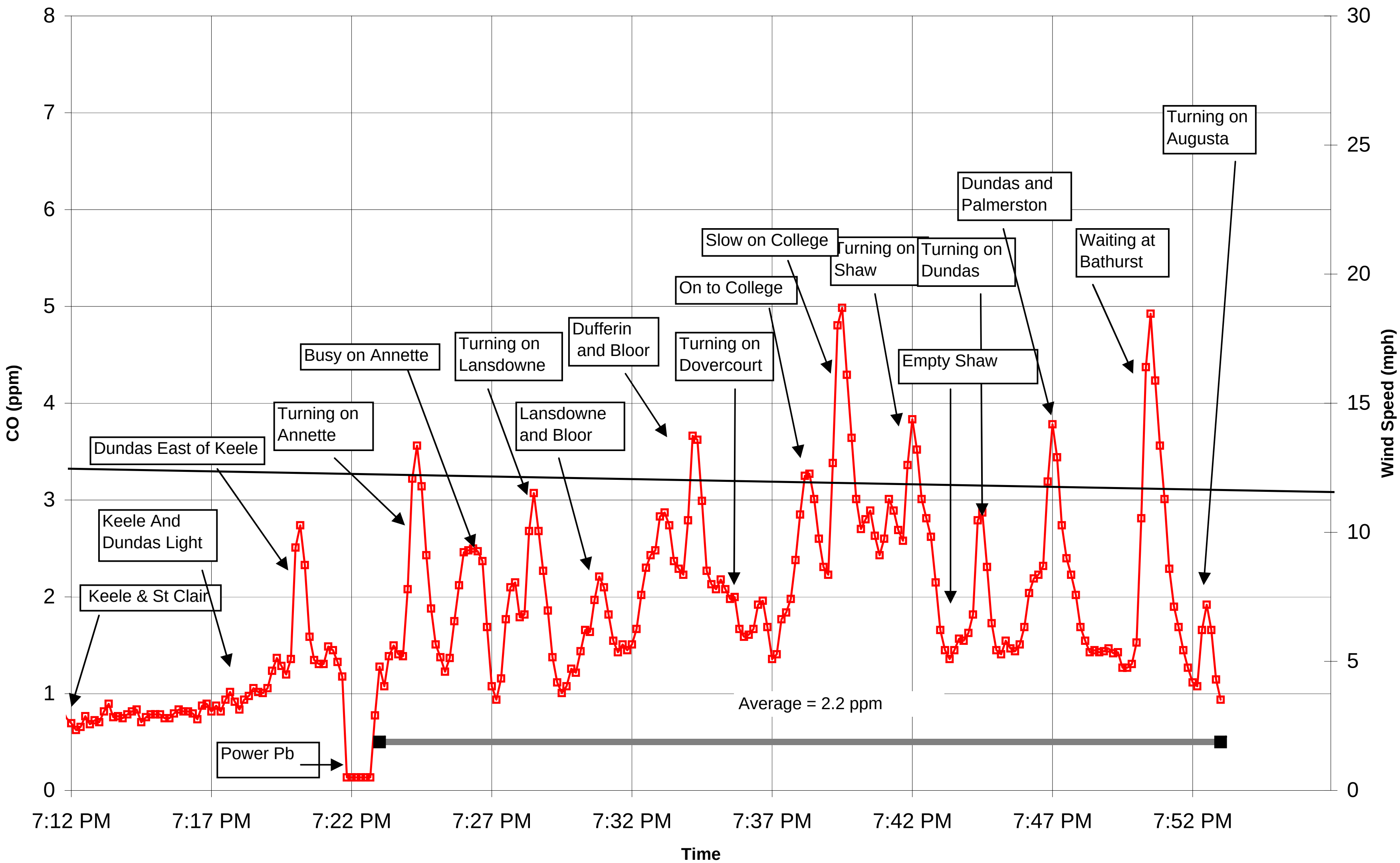


Figure 4: CO Concentration September 9th - York&Front + York Gateway tunnel

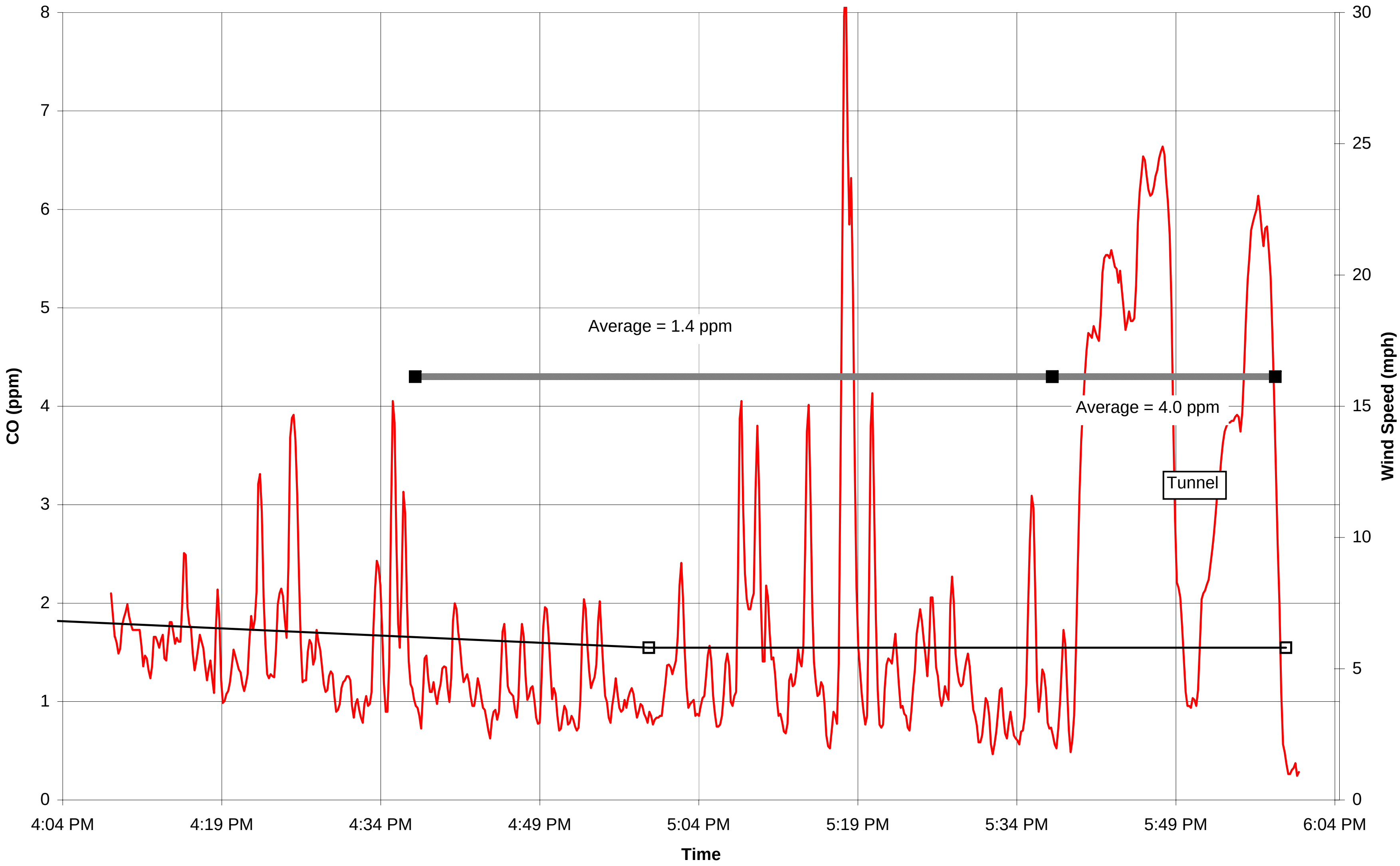


Figure 6: CO Concentration September 12th morning rush hour eglinton/401

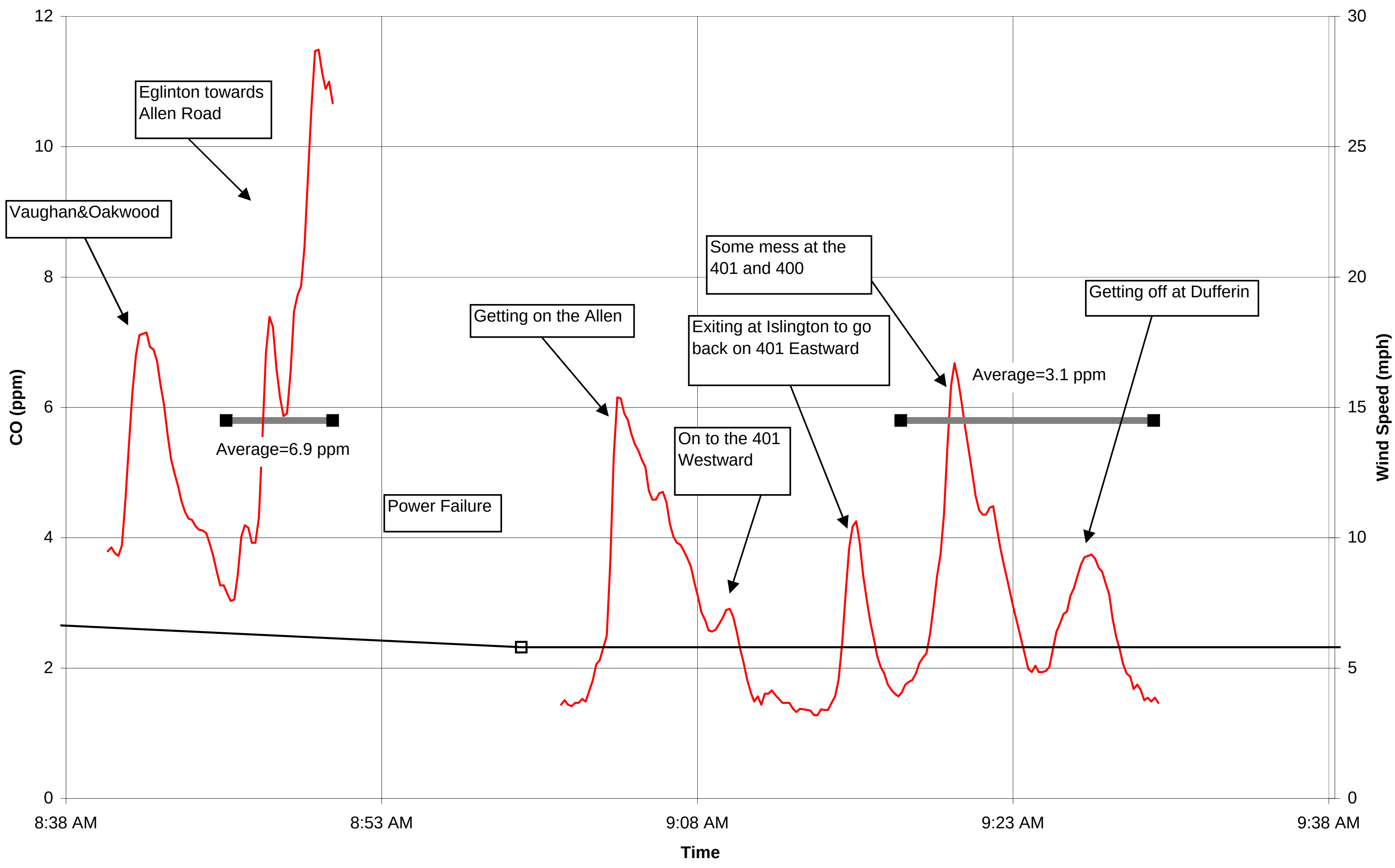
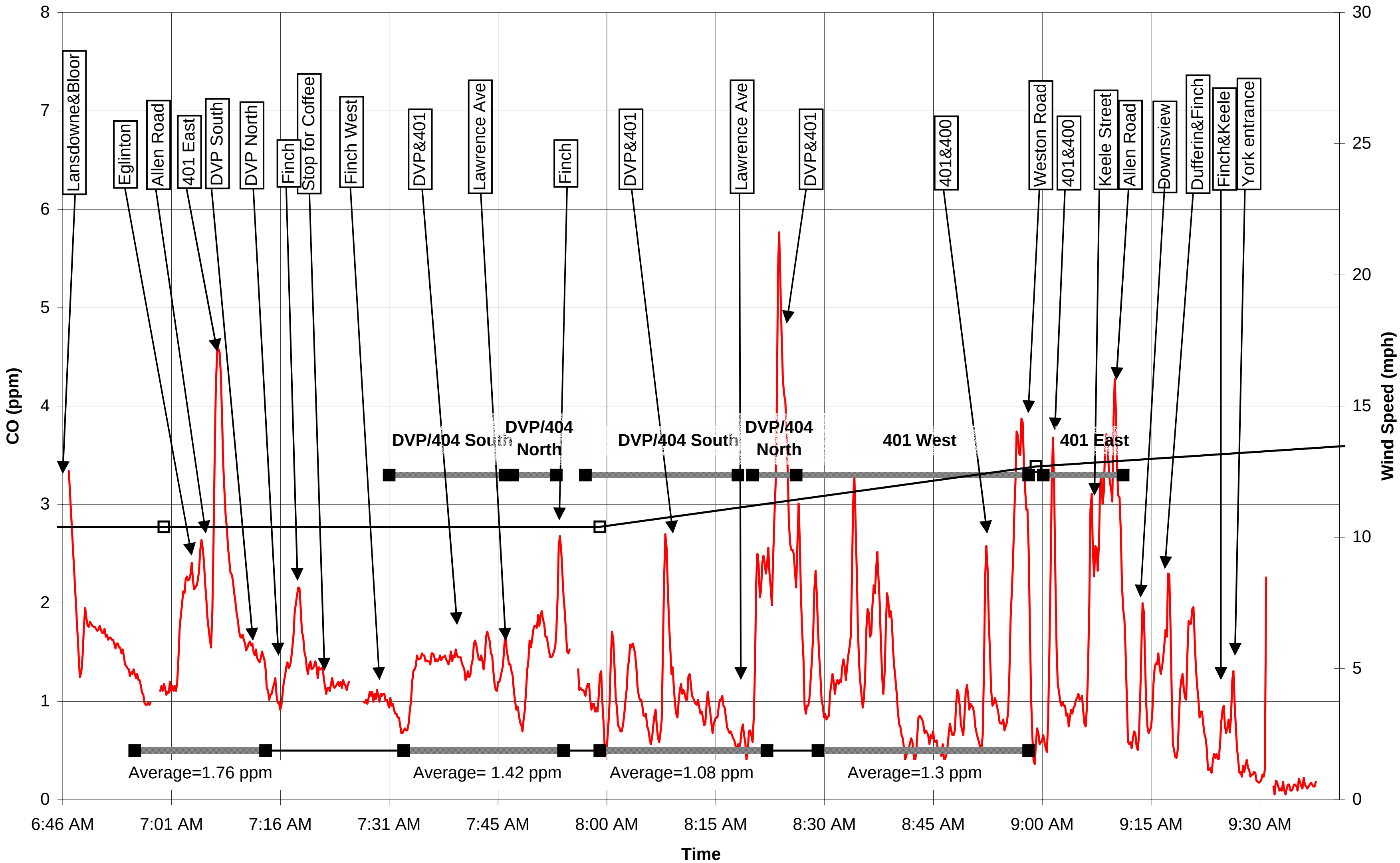


Figure 7: CO Concentration September 15th - morning rush hour DVP401



Each of the chemicals we have measured as well as the other component of car exhaust is a toxic in itself. We were not able to measure Particulate Matter, sulphurs and nitrogen oxides but we expect that they follow the same pattern than carbon monoxide and hydrocarbons. Put together all these poisonous compounds constitute a deadly cocktail which combined effect is potentially greater than the sum of its parts. For example, Carbon Monoxide takes the place, permanently, of oxygen in red blood cells. This results in a decrease of oxygen in the blood stream. This forces our heart to pump faster and our lungs to breathe more in order to increase the input of oxygen into the body. By doing so, we also increase the amount of the other pollutants in the body. The other chemicals we inhale have various effects on our respiratory system from irritant to cancer causing. Each weakens our bodies' ability to respond and potentially enhances each other's damage.
The background levels we have measured are for the most part too low to have a measurable effect on each individual health. However they put a constant stress on our ability to process these toxins. As well, certain chemicals cannot be processed by our body and thus, accumulate in our tissues. The situation is different on particularly polluted days and there is a direct correlation between pollution levels and the number of people becoming ill because of it. Those most sensitive give us a warning that these levels of exposure are reaching dangerous levels.
In addition to this, driving or walking in or near traffic, is equivalent to taking a puff of a more concentrated toxic mixture. We all know the health effects associated with smoking. Inhaling car-exhaust is very similar. Of course, the chemical composition of cigarette smoke is much different form car exhaust and contains many very toxic substances. Yet a single running engine produces a much larger volume of toxic gases. In order to illustrate this point, consider the following thought experiment (source: Shaun Merrit, P.S. Kensington contributor). What would happen if a group of chain smokers were left in a closed room for a night with a carton of cigarettes? They may, the next day, suffer from headaches, nausea and/or some coughing. What would happen if a small car were left running in that same room? Everyone would be dead after a few hours. This analogy is particularly relevant when one considers that everyday, 24 hours a day, tens of thousands of cars and trucks are releasing their exhaust in the streets of our cities. As our data shows, weather conditions will determine how much is there for us to breathe and urban air pollution can reach harmful and even lethal levels. This is another difference between smoking and car pollution: thanks to regulations, nowadays, one would not be exposed to cigarette smoke unless one chooses to. For all those living in the city, such choice does not exist regarding exposure to car-exhaust. A coherent public health policy would impose limitations on driving just as it imposes some on smoking.

Atmospheric pollution is not an isolated problem, the food we eat and the water we drink also contains many man-made chemicals, which may be disruptive to the natural working of our organisms. In order to visualise the mid to long term potential of environmental pollution, consider, that except from our brain cells, all the cells in our body will be replaced within 7 years. Our skin is regenerated every 3 months. The materials that our body use to constantly regenerate our biological structure is whatever we eat, drink or breathe. Whatever pollutants are present in these building materials will have to be disposed of by our body or gets incorporated and accumulates.
Pollution is a symptom of the dysfunctions of a society out of touch with its natural context. A sensible policy must deal with its root causes: poor energy efficiency, over-consumption and our contempt for the earth, our natural habitat, which we treat as a pool of resources and a dump. The good news is that if the raping of the earth is our doing, it may be our undoing. Today, declining energy supplies, failing ecosystems and climate change leave us no choice and very little time. Our future will be sustainable or will not be at all. But building a sustainable society is a formidable task that will require a tremendous collective effort. All over this great city, citizens are volunteering their time, energy and creativity for local initiatives that aims to initiate this evolution. The solutions they propose are often cost effective and tailored to their communities' needs. It is the role of all level of government to support and foster such initiatives. If there are dire times ahead, it is by strengthening our communities that we can best find means to cope.

In this view, P.S. Kensington is an excellent pilot project and an effective way to draw attention to these issues and open the sustainability debate. It also shows how complicated it can be to initiate change in this city. Pedestrian zones support alternative modes of transportation and contribute to improved air-quality. They are also relatively immune to traffic accidents while being conducive to social interactions and cultural events. However, there are many aspects to consider in the process of pedestrianization. It can trigger fears of gentrification and some merchants have complained that their business suffered during Pedestrian Sundays in 2004. Yet, for each merchant that lost some business, there was another who made extra profit. It all depended on the type of businesses. Delivery requirements are often cited as an impediment to businesses during pedestrian events. It is indeed unfortunate that, unlike many places around the world, provincial regulations under the Highway and Traffic Act strictly forbid any kind of vehicular traffic in Ontarian pedestrian zones. The community had to work around this and now offers a porter service for businesses and customers.

There are no easy answers to these complex community issues. There is little doubt however, that urban design and transit must be integrated in order to find a sustainable balance between different modes of transportation. In a time of rising oil prices it is wise to seek alternatives. We have known for decades of the adverse environmental impacts of vehicle emissions, and with each summer heat wave we are feeling the effects of pollution even more acutely. It is increasingly urgent to take steps to promote a renewed vision for the city and its transportation system.

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