Assessment of Air Quality in the Vicinity of ML Ready Mix, 29 Judson Street, Toronto

June 2015

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Abbreviations and Acronyms

AAQC	Ambient Air Quality Criteria
AQG	Ambient Quality Guideline
CAAQS	Canadian Ambient Air Quality Standards
CWS	Canada Wide Standards
ECA	Environmental Compliance Approval
ESDM	Emissions Summary Dispersion Modelling
EYCC	Etobicoke York Community Council
MOECC	Ministry of the Environment and Climate Change
PM	Particulate matter
$PM_{2.5}$	Particulate matter in a diameter of less than 2.5 micrometers
PM_{10}	Particulate matter in a diameter of less than 10 micrometers
PHO	Public Health Ontario
RMC	Ready Mix Concrete
SOCAAR	Southern Ontario Centre for Atmospheric Aerosol Research
TPH	Toronto Public Health
US EPA	United States Environmental Protection Agency
WHO	World Health Organization

Executive Summary

At the request of the Etobicoke York Community Council and the Toronto City Council, Toronto Public Health, with the assistance of Public Health Ontario, undertook an air quality assessment study in the vicinity of ML Ready Mix, located at 29 Judson Street, in the City of Toronto. The objective of the study was to assess air quality in the vicinity of the facility and determine impacts, if any, from its operation.

Ml Ready Mix is a concrete batching facility located in the south-west end of Toronto. The concrete batching operation consists of mixing of raw materials such as cement, sand, gravel that are stored on site, and delivery of the concrete product to construction sites. Community concerns have been raised about the facility, mainly pertaining to dust and potential air quality impacts. Particulate matter has been identified as the primary pollutant of concern related to the batching operations.

The air quality assessment study consisted of air quality monitoring, meteorological data collection, and qualitative observation near ML Ready Mix. Air quality monitoring was conducted for $PM_{2.5}$ and PM_{10}, both considered to be good indicators of emissions from such operations. Collected data was combined with site-specific meteorological information such as wind direction, wind speed, temperature and relative humidity. Furthermore, during the monitoring period detailed notes were made by Toronto Public Health staff about conditions and activities that may result in particulate matter emissions and contribute to localized air quality impacts. Amongst others, those include visible dust events, vehicular traffic and rail traffic.

For analysis, the results of the air quality monitoring were compared to the general background levels of particulate matter in Toronto, the concentration of $PM_{2.5}$ at the MOECC Kipling monitoring station (considered to be representative of the ML site), and the applicable health-based guidelines. The guidelines chosen for comparison where considered to be appropriate for the monitoring duration and to be protective of sensitive receptors, such as children and the elderly.

All air quality monitoring results were below health-based guidelines for both $PM_{2.5}$ and PM_{10}. The monitoring results were also consistent with the air quality measurements taken at the MOECC Kipling research station. The average 24 hour $PM_{2.5}$ concentration near ML Ready Mix was slightly above the MOECC annual mean for Toronto, however care should be taken when comparing the average 24 hour $PM_{2.5}$ concentrations near ML Ready Mix to the MOECC annual mean as the monitoring near the facility was only conducted over a fairly short time period. As there were several limitation associated with the study design, such as equipment and calibration, at this point it is unknown what the actual contribution of the facility to the monitored concentrations may be.

In general, the air quality in the vicinity of ML Ready Mix is similar to that in other parts of the City and it appears to meet the relevant health-based guidelines. As the air quality in the vicinity of ML Ready Mix is acceptable and not appreciably different from other parts of Toronto, no further air quality testing is needed.

1. INTRODUCTION

At the request of the Etobicoke York Community Council and the Toronto City Council, Toronto Public Health (TPH), with the assistance of Public Health Ontario (PHO), undertook an air quality assessment study in the vicinity of ML Ready Mix. The study measured ambient air particulate matter concentrations near the facility to assess general air quality and to determine impacts, if any, from the batching operation. This report presents the results of the assessment.

2. BACKGROUND

2.1 Decision History

ML Ready Mix is a concrete batching facility located at 29 Judson Street in Toronto, it has been operating in its current capacity since the late 2000's. In 2012, TPH began receiving health related complaints about the facility mainly pertaining to dust from its operation and air quality impacts from the associated truck traffic.

On November 19, 2013, the Etobicoke York Community Council (EYCC) approved a motion requesting the Medical Officer of Health to work with staff from Municipal Licensing and Standards and the Ministry of the Environment and Climate Change (MOECC) on issues related to 29 and 145 Judson Street, and to report back to the Community Council.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.EY29.46

On April 8, 2014, the EYCC received a report from the Medical Officer of Health titled *Investigation of Impacts Related to ML Ready Mix*. The EYCC deferred the consideration of the report to its meeting on May 13, 2014
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2014.EY32.40

On May 13, 2014, the EYCC requested the Medical Officer of Health to retain an outside Air Quality Expert to commence air quality monitoring at sensitive receptors (residential properties) within 50 metres of the ML Ready Mix operation at 29 Judson Street
http://app.toronto.ca/tmmis/viewAgendaItemDetails.do?function=getMinutesItemPreview&agendaItemId=49941

The Toronto City Council adopted the EYCC recommendation on June 10, 2014
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2014.EY33.14

2.2 Community Concerns

Starting in September 2011, MOECC began receiving complaints from the area residents related to various impacts from the activities at the site. In 2012, TPH began receiving health related complaints about the facility mainly pertaining to dust and air quality impacts. Additional concerns received by other city divisions pertained to noise, vehicular traffic, planning and construction, and esthetics. Various city divisions such as Municipal Licensing and Standards, Transportation Services, Buildings, and City Planning responded to the community concerns and several community meetings were organized to discuss the issues.

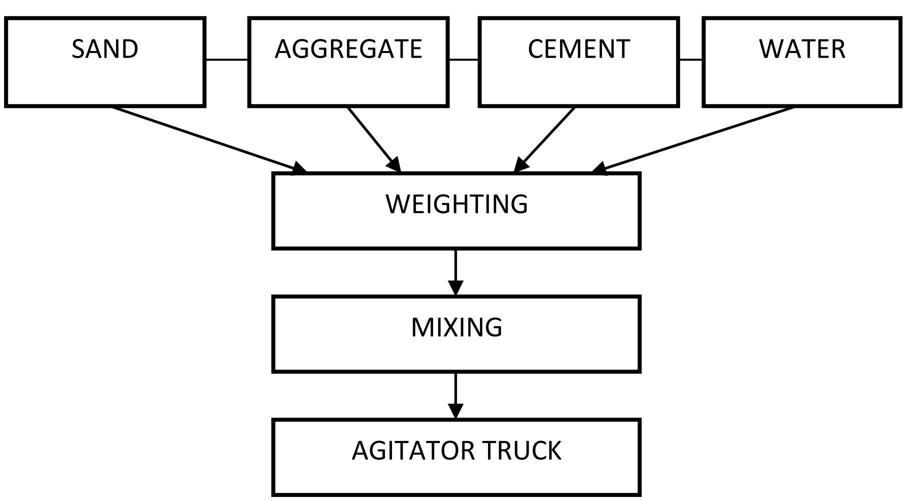
3. SITE DESCRIPTION

The ML Ready Mix facility is located in south-west Toronto, the former City of Etobicoke, south of Judson Street and east of Royal York Road, in Ward 6. Under City of Toronto Zoning By-law 569-2013 the site is zoned E1.0 (X54) which is an Employment Industrial zone category. Concrete batching plants are not permitted in the E1.0 zone, the use at this site has been determined to be a lawful non-conforming use. The site is located within, and at the edge of, an employment area. There are low density residential uses immediately to the north of the site, across Judson Street and a busy GO Lakeshore West and rail line to the south of the site.

3.1 Concrete Batching

ML Ready Mix is a ready-mix concrete (RMC) batching facility classified under the North American Industry Classification System code as 327320. Raw materials, such as cement, cement supplement, sand and stone are delivered to the facility and stored in either elevated silos (for cement) or aggregate storage piles (sand and stone). Measured amounts of cement, cement supplement, sand, gravel and water are fed into delivery trucks and concrete is mixed on route to the delivery site.

Figure 1. Flow Chart of the Concrete Batching Process



Ready mixed concrete typically consists of coarse and fine aggregates, cement and water. Coarse aggregate most often includes gravel and crushed stone, while fine aggregate is mostly sand. Often, admixtures or pozzolan minerals are added to improve the properties of the concrete, for example to reduce concrete's permeability or to increase its strength.

Table 1. Typical Composition of Concrete (CRMCA, 2004)

INGREDIENT	TYPICAL COMPOSITON
	% of volume
Coarse aggregate	31 – 51
Fine aggregate	24 – 28
Portland Cement	7 – 15
SCM	2 – 3
Water	14 – 18
Admixtures	NA
Entrained Air Content	4 – 8

Note: The typical composition of admixtures was not listed. TPH was informed by the MOECC that admixtures are added to the process at ML Ready Mix, however, their composition (% of volume) was not defined in the facility ESDM

3.2 Potential for Impacts from Batching Operations

Particulate matter, primarily from cements pozzolan admixes, and to lesser extent from the fine and coarse aggregate, is the primary pollutant of concern (US EPA, 2006). Majority of the emissions are fugitive in nature and are usually associated with the transfer of the aggregate materials, truck loading, mixer loading, vehicular traffic, and wind erosion from the storage piles. US EPA (2006) notes the fugitive emissions are closely associated with the moisture content of the aggregate materials and can vary widely from one facility to another. In a recent report, Canadian ORTECH Environmental (2004) reported the only sources of toxic releases are associated with fuel combustion and they are considered to be small.

In Ontario, concrete batching operations, including ML Ready Mix, are regulated by the MOECC through the Environmental Compliance Approval (ECA) process. Existing Ready Mix facilities are required to obtain the ECA from the Ministry and demonstrate they can meet all the relevant provincial regulations and guidelines. The ECA certificates regulate air quality, dust, and noise impacts through requirements such as acoustic audits, best management practices for fugitive dust, and community complaint response plans.

Ontario batching operations must demonstrate they meet the MOECC air quality standards as set out by Air Quality Regulation 419/05. This means that all of the facility emissions are modelled and the maximum impacts are determined at the point of impingement (property line) or off-site to determine they are below the air quality limits as set out in the regulation. Typically, that is achieved through the completion of the Emissions Summary Dispersion Modelling (ESDM) report as per the Ontario Regulation 419/05, Air Pollution - Local Air Quality requirements.

4. AIR QUALITY AND HEALTH CONSIDERATIONS

4.1 Particulate Matter

Particulate matter (PM) is the most significant contaminant of concern associated with concrete batching operations. PM is a type of widespread air pollutant closely related to haze (WHO, 2013; Pope & Dockery, 2006, as cited by Lu et al., 2015). Airborne PM is comprised of a mixture of solid and liquid particulates suspended in the air, varying in size and chemical composition (WHO, 2013). The varying composition of PM can include ammonium, nitrates, sulfates, biological components (e.g. allergens and microbial compounds), and other inorganic ions (e.g. sodium, potassium, magnesium ions, etc.) (WHO, 2013).

Particulate matter is usually classified according to the mass concentration of particles, namely particles with a diameter of less than 10 µm (PM_{10}) and particles with a diameter of less than 2.5 µm ($PM_{2.5}$) (WHO, 2013). PM greater than 10 µm in size is referred to as coarse PM, whereas PM less than 10 µm is referred to as fine PM.

Although human health effects of exposure to PM vary depending on physical characteristics (e.g. breathing mode, rate, and volume of a person), the size of PM is closely linked to adverse health effects (Brown et al., 2013, as cited by Kim, Kabir & Kabir, 2015). Specifically, the smaller the particle, the more deeply it can penetrate and deposit in the respiratory tract (Kim, Kabir & Kabir, 2015). Conversely, during nasal breathing, coarse PM is usually effectively filtered by nasal cilia and mucous (Kim, Kabir & Kabir, 2015). Studies, to date, indicate that particles having the most impact on human health are fine PM (Kim, Kabir & Kabir, 2015). Fine PM is able to penetrate the respiratory tract and travel deep within the lungs (Londahl et al., 2007, as cited by Kim, Kabir & Kabir, 2015).

Since PM_{10} and $PM_{2.5}$ are able to penetrate the thoracic region of the respiratory system, they can cause human health effects. Exposure to both particle types over the short term and long term can cause respiratory and cardiovascular morbidity (i.e. aggravation of asthma, respiratory symptoms and an increase in hospital admissions), as well as mortality from cardiovascular and respiratory diseases and from lung cancer (WHO, 2013). Studies suggest that mild health effects associated with inhaling $PM_{2.5}$ include shortness of breath, chest pain, as well as coughing and wheezing (Guaita et al., 2011, as cited by Kim, Kabir & Kabir, 2015).

Before 1987, EPA's standards regulated larger particles, the total suspended particulates, including those larger than 10 micrometers. By 1987, research had shown that the particles of greatest health concern were those equal to or less than 10 micrometers that can penetrate into sensitive regions of the respiratory tract (US EPA, 1997). In its 2012 review of the effects of particulate matter on human health Anderson et al stated that particles with a diameter greater than 10 um settle out quickly and are largely filtered out by the nose and upper airway (Anderson et al, 2012).

5. STUDY METHODOLOGY

The following methodology was employed in conducting the air quality assessment.

5.1 Preliminary site visit

Preliminary site visit was conducted in early July, 2014, to determine the location of emission sources in relation to the receptors in the area. In addition, observations were made with regards to other activities and conditions that may affect localized air quality in the area, such as road and rail traffic. Nearby locations were examined to determine the optimum placement of the air quality monitoring vehicle.

5.2 Air quality monitoring

Sampling for particulate matter was conducted using a TSI DustTrak DRX Aerosol monitor. This instrument uses photometric and optical sizing methods to simultaneously measure mass concentrations of $PM_{2.5}$ and PM_{10}. As the instrument had data logging capabilities, it was used continuously during the sampling period of July 10-15, July 20-23 and July 25-28, 2014. The equipment was located inside a secure van parked at Harold Street, approximately less than 5 meters north of Judson Street, and approximately 50 meters north of the Ml Ready Mix gate.

On the days when air quality monitoring was conducted, particulate matter readings were collected every 2 minutes. For reporting purposes and comparison of data to applicable standards and health guidelines, concentrations of particulate matter were averaged over 24 hours. For looking at daily trends, concentrations were reported in one hour or two minute increments. The 24 hour averages are the most significant as they allow for a direct comparison of data with the existing health-based standards and guidelines. Currently, there are no health standards developed for 1 hour and 2 minute averaging periods.

The TSI DustTrak is not as accurate as gravimetric methods supported as the Federal Reference Method by the United States Environmental Protection Agency. In Southern Ontario, studies conducted on the efficacy of the TSI DustTrak monitors indicate that readings from these instruments tend to be 2-3 times higher than particulate levels sampled with gravimetric instruments (PHO, 2015). As such, a calibration factor of 2.4 for $PM_{2.5}$ has been established for the Greater Toronto Area by the Southern Ontario Centre for Atmospheric Aerosol Research (SOCAAR) group and it is used in this report to present data (PHO, 2012). All data presented in this report represents the corrected particulate matter concentrations.

5.3 Meteorological data collection

Meteorological information such as wind direction, wind speed, temperature and relative humidity was collected using the Kestrel 4500 Weather Meter. The meteorological data was collected every two minutes and downloaded daily. Due to equipment storage limitations weather data was not available on certain days of the assessment.

5.4 Qualitative observations

During the sampling period detailed notes were made by Toronto Public Health staff about conditions and activities that may result in particulate matter emissions and contribute to the localized air quality impacts. The observations were collected for the duration of the monitoring period and were recorded between approximately 8:00 am and 5:00 pm, based on the availability of TPH staff.

6.0 FINDINGS

6.1 Particulate matter monitoring results

Data collected by the DustTrak monitor and the meteorological data are summarized in the Public Health Ontario report, attached in the Appendix A.

In general, the concentrations of particulate matter in the vicinity of 29 Judson Street varied greatly over the sampling period. The two-minute $PM_{2.5}$ concentrations ranged between 1.3 ug/m^3 and 131.7 ug/m^3. The lowest concentration was recorded on July 10, 2014 and the highest concentration was recorded on July 25, 2014. The average 24-hour concentration during the monitoring period was 8.0 ug/m^3.

Table 2: Daily Concentrations of $PM_{2.5}$ (ug/m^3)

Date	Minimum (2 min. Concentration)	Maximum (2 min. Concentration)	24 hr. Average Concentration	Meteorological Conditions
July 10, 2014	1.3	42.1	4.0	AM mainly clear; PM mostly cloudy, Hi 21.4°C, Low 12.0°C
July 11, 2014	2.5	30.4	6.1	AM mainly clear; PM mostly cloudy, Hi 24.8°C, Low 12.6°C
July 12, 2014	3.8	48.3	10.5	AM mostly cloudy, PM mostly cloudy, HI 23.0°C, Low 15.6°C
July 13, 2014	4.6	9.6	7.0	Hi 29.5°C, Low 20.2°C
July 14, 2014	3.3	98.8	8.3	AM mostly cloudy, PM cloudy, Hi 23.0°C, Low 16.5°C
July 15, 2014	3.8	28.3	7.3	Hi 25.3°C, Low 15.7°C
July 20, 2014	6.3	39.6	14.0	AM mainly clear, PM mostly cloudy, Hi 23.1°C, Low 17.3°C
July 25, 2014	3.8	131.7	7.4	AM mainly clear, PM mostly cloudy, Hi 25.6°C, Low 12.7°C
July 26, 2014	5.8	50.8	8.6	AM cloudy, PM mostly cloudy, Hi 27.0°C, Low 16.1°C
July 27, 2014	2.1	41.7	9.5	AM clear, PM mostly cloudy, Hi 29.6°C, Low 17.6°C
July 28, 2014	2.1	10.0	5.4	AM rain, PM mostly cloudy, Hi 21.0°C, Low 13.5°C
Average	**3.6**	**48.3**	**8.0**	**Hi 24.8°C, Low 14.9°C**

The two minute PM_{10} concentrations ranged from 1.3 ug/m^3 on July 10, 2014, to 359.8 ug/m^3 recorded on July 14, 2014. The average concentration during the monitoring period was 9.5 ug/m^3. The $PM_{2.5}$ and PM_{10} data appear to be correlated. Further information about meteorological conditions, mainly the predominant wind direction and the range of wind speeds for each day is provided in the attached PHO report (PHO, 2015).

Table 3: Daily Concentrations of PM_{10} (ug/m^3)

Date	Minimum (2 min. Concentration)	Maximum (2 min. Concentration)	24 hr. Average Concentration	Meteorological Conditions
July 10, 2014	1.3	133.2	7.3	AM mainly clear; PM mostly cloudy, Hi 21.4°C, Low 12.0°C
July 11, 2014	2.5	71.0	8.5	AM mainly clear; PM mostly cloudy, Hi 24.8°C, Low 12.6°C
July 12, 2014	3.8	140.3	12.6	AM mostly cloudy, PM mostly cloudy, Hi 23.0°C, Low 15.6°C
July 13, 2014	4.6	10.6	7.6	Hi 29.5°C, Low 20.2°C
July 14, 2014	3.3	359.8	11.2	AM mostly cloudy, PM cloudy, Hi 23.0°C, Low 16.5°C
July 15, 2014	3.8	72.3	8.4	Hi 25.3°C, Low 15.7°C
July 20, 2014	6.3	39.6	14.4	AM mainly clear, PM mostly cloudy, Hi 23.1°C, Low 17.3°C
July 25, 2014	5.0	132.7	8.8	AM mainly clear, PM mostly cloudy, Hi 25.6°C, Low 12.7°C
July 26, 2014	5.8	50.8	9.4	AM cloudy, PM mostly cloudy, Hi 27.0°C, Low 16.1°C
July 27, 2014	2.1	43.7	10.2	AM clear, PM mostly cloudy, Hi 29.6°C, Low 17.6°C
July 28, 2014	2.1	10.6	5.7	AM rain, PM mostly cloudy, Hi 21.0°C, Low 13.5°C
Average	**4.6**	**96.8**	**9.5**	**Hi 24.8°C, Low 14.9°C**

Particulate matter data was also collected between July 20 and July 24, 2014. Public Health Ontario report that TSI DustTrak was not calibrated during this sampling period, as such the data for July 21, July 22, and July 23 is excluded from further analysis. In addition, the quality of these data maybe further affected by the decreased reliability of TSI DustTrak in humidity conditions above 70% (PHO, 2015).

6.2 Meteorological results

Wind direction measurements collected during the study period indicate the data collection equipment was situated downwind of the ML Ready Mix for many of the assessment days, with the winds from the south and southeast being dominant (PHO, 2015). The meteorological data indicates the proportion of elevated $PM_{2.5}$ readings is similar for all the wind directions. The proportion of elevated PM_{10} readings was slightly higher in the readings paired with winds from the south and southeast direction (PHO, 2015). Regardless of the changes in wind direction, all particulate matter readings were below the applicable health guidelines.

6.3 Qualitative data results

The ML Ready Mix facility is located in an area of mixed industrial and residential land uses. There is also a busy railway corridor to the south of the site that is utilized by CP Rail and Go Transit. Observations made at the site revealed very frequent rail traffic on all days measurements were being taken. For example, on July 11, 2014, over 25 trains were observed passing east and west across the rail corridor between 6:30 am and 8:30 am.

In addition to the rail traffic, Judson Street is a busy east-west vehicular road that runs from Horner Avenue in the west to Royal York Road in the east. Staff observations indicate that traffic volumes are generally consistent with rush hour. Specifically, more vehicles were observed during peak morning, noon and afternoon hours.

Notable onsite activities also included trucks entering and exiting the facility, vehicular traffic along Judson Street and the movement of railway cars to the south of the site. There were also notes made when dust levels became visible and the direction of the wind.

With the exception of July 20, 2014, visible dust was observed everyday at different periods. These dust events usually coincided with the movement of trucks at or near the entrance of the facility.

On July 20th, it is also noted that the student observation logs reported frequent train traffic to the south of the subject site throughout the day. Vehicular traffic was constant throughout the day with the busiest period being from approximately 12:30 p.m. to 4:00 p.m.

It should be noted that July 20th was a particularly foggy day with rain in the afternoon. The TPH staff observation logs also indicate that winds were moving away from the Public Health Ontario van which housed the air testing equipment.

Graphical representation of the logged data is provided in the PHO report (PHO, 2015). There were noticeable peaks which appear as anomalies. It is unclear as to the cause of these readings as they did not correlate with any significant dust events from the observation logs. Often, such peaks can be attributable to equipment performance and meteorological conditions.

7.0 INTERPRETATION OF MONITORING RESULTS

7.1 Comparison of results with the Toronto background

For the past 42 years, the Ministry of the Environment and Climate Change monitored air quality related to six common air pollutants, including $PM_{2.5}$, across the province. In Toronto, the six pollutants are continuously measured at four stations across the city (Table 3). The last publically reported data set represents the year 2013. It is expected the $PM_{2.5}$ monitoring results for 2014 will be similar, if not lower, as key pollutants exhibit a decreasing trend over the last 10 years (MOE, 2012). The MOECC discontinued the monitoring of PM_{10}, but it is expected the PM_{10} values will be proportional to the measured $PM_{2.5}$ values.

Table 4: Summary of Toronto $PM_{2.5}$ data for 2012 (MOE, 2013)

Station ID	Station Name	Station Location	90%th Percentile (ug/m3)	Mean (ug/m3)	1 Hour Maximum (ug/m3)	24 Hour Maximum (ug/m3)
31103	Toronto Downtown	Bay St./Wellesley St. W.	14	6.4	45	26
33003	Toronto East	Kennedy Rd./Lawrence Ave. E.	14	6.3	70	21
34020	Toronto North	Hendon Ave./Yonge St.	16	7.3	43	24
35125	Toronto West	125 Resources Rd.	15	7.1	45	23
Average			14.8	6.8	50.8	23.5

The average 24 hour $PM_{2.5}$ concentration near ML Ready Mix was 8.0 ug/m^3, slightly above the MOECC annual mean of 6.8 ug/m3. However, the concentration was well below the average 24 hour maximum concentration at the four MOECC monitoring stations of 23.5 ug/m^3, and the average 90% percentile of 14.8 ug/m^3. Care should be taken when comparing the average 24 hour PM2.5 concentrations near ML Ready Mix to the MOECC annual mean as the monitoring near the facility was only conducted over a fairly short time period.

7.2 Comparison of results with the MOECC Kipling Research Station

In addition to the four Toronto monitoring stations, the MOECC also operates the Etobicoke South Research Station located at 461 Kipling Street, approximately 2 kilometers from the ML Ready Mix facility. The station monitors nitrogen oxides, particulate matter in the fraction of 2.5 microns, and ozone. The conditions at the station are considered to be similar to those at the ML Ready Mix facility based on its proximity to the highways and industrial activities. The research station $PM_{2.5}$ data was obtained from the MOECC for direct comparison to the measured $PM_{2.5}$ data. Although only $PM_{2.5}$ data was available for comparison, it is expected the PM_{10} values will be proportional to the measured $PM_{2.5}$ values.

Table 5: Comparison of Monitored $PM_{2.5}$ Values with the Kipling Research Station Data

Date	Kipling Research Station 24 hr. Concentration (ug/m^3)	Measured 24 hr. Concentrations (ug/m^3)
July 10, 2014	3.9	4.0
July 11, 2014	8.4	6.1
July 12, 2014	10.1	10.5
July 13, 2014	9.2	7.0
July 14, 2014	9.6	8.3
July 15, 2014	5.4	7.3
July 20, 2014	13.0	14.0
July 25, 2014	5.5	7.4
July 26, 2014	8.3	8.6
July 27, 2014	10.4	9.5
July 28, 2014	6.1	5.4
Average	**8.2**	**8.0**

During the monitoring period the average concentration of $PM_{2.5}$ near ML Ready Mix was 8.0 ug/m^3, similar to that at the Kipling Research Station, 8.2 ug/m^3. The slight daily variations could be attributed to the different instrumentation and the variability in site-specific activities.

7.3 Comparison of results with guidelines

Several agencies developed air quality standards or guidelines in order to reduce the health impacts of air pollution. Air quality standards are usually set by various jurisdictions to protect the health of its citizens and often take into account health risks, technological feasibility, economic considerations and various other political and social factors. Guidelines, on the other hand, are usually developed to protect public health in different contexts without such considerations (WHO, 2005). Available standards and guidelines where reviewed for relevance and the MOECC Ambient Air Quality Criteria (AAQCs), the Canadian Ambient Air Quality Standards, and the World Health Organization (WHO) guidelines for particulate matter where chosen for direct comparison with the monitoring data.

The MOE AAQCs represent a desirable concentration of a contaminants in the air that are protective against adverse effects on health or the environment (MOECC, 2012). The $PM_{2.5}$ AAQC is an adopted Canada Wide Standard (CWS) developed jointly by the federal government and the provinces as a step towards the long-term goal of minimizing risks to human health and the environment. The PM_{10} AAQC in an interim value and is provided as a guide for decision making.

Canadian Ambient Air Quality Standards (CAAQS) are health-based air quality objectives for pollutant concentrations in ambient air. At present time, CAAQS have been established for $PM_{2.5}$ and ozone, two pollutants of concern to human health. These standards are more stringent and health-protective than the previous Canada-Wide Standards for these pollutants (EC, 2015).

The WHO Air Quality Guidelines (AQGs) were developed to support actions to achieve air quality that protects public health. The WHO AQGs are based on the extensive body of evidence relating to air pollution and its consequences. The guidelines are based on population level impacts and as such, they may not provide the complete protection for every exposed individual (WHO, 2005). Nonetheless, it is generally recognized the exceedence of a numerical criteria does not necessarily indicate an adverse outcome.

Acute ambient air guidelines are typically compared to data averaged over 24 hours, whereas chronic guidelines are compared to annual averages. As the monitoring data was collected over a time period of less than one month, it is not appropriate to use chronic ambient air guidelines and only the acute guidelines where used for comparison. Health Canada cautions against characterizing short-term exposures as there are currently little evidence in the published literature that associates health effects with less than 24-hour particulate matter exposures (HC, 2011).

Table 6: Comparison of Monitored Particulate Matter Data to Guidelines

PM Fraction	Average Monitored 24-hour Concentration (ug/m3)	Highest Monitored 24-hour Concentration (ug/m3)	MOE AAQC	CAAQS (24-hour)	WHO AQG
$PM_{2.5}$	8.0	14.0	30	28 (2015) 27 (2020)	25
PM_{10}	9.5	14.4	50	N/A	50

The highest monitored $PM_{2.5}$ 24-hour concentration was 14.0 ug/m^3 and the average monitored 24-hour concentration was 8.0 ug/m^3, both were well below the MOE AAQCs, the CAAQS and the WHO AQC guidelines. Similarly with the PM_{10} 24-hour concentrations, both the highest monitored concentration of 14.4 ug/m^3 and the average monitored concentration of 9.5 ug/m^3 were below the MOE AAQCs and the WHO AQC guidelines. Based on the geographical placement of the monitoring equipment, at this point it is unknown what the actual contribution of the facility to the measured concentrations may be.

8.0 LIMITATIONS

There are a number of different potential sources of particulate matter at the sampling site making it impossible to determine what contribution can be attributed to ML Ready Mix. Other sources of particulate matter at the sampling site include vehicular traffic, roadway dust, residential heating sources, and transboundry pollution, amongst others.

There are also many uncertainties in the particulate matter data that was collected over an eleven (11) day period of a single month. These data may not be representative of the actual air quality data that often exhibits seasonal variations. Another source of uncertainty is the equipment itself. Equipment calibration challenges and other factors such as humidity can have a significant impact on the data that was recorded, either underestimating or overestimating the actual ambient concentrations. Typically, the DustTrak aerosol monitors are used for screening type air quality assessments.

Ambient air quality criteria and guidelines used in this assessment are largely based on epidemiological studies that explore population level impacts associated with exposure to particulate matter. The dose-response relationships obtained from epidemiological studies are used to set criteria and guidelines. It is not considered appropriate to extrapolate from these criteria to evaluate and quantify risks at the individual level.

9.0 CONCLUSIONS

In general, the air quality in the vicinity of ML Ready Mix is similar to that in other parts of the City and it appears to meet the relevant health-based guidelines.

All air quality monitoring results were below the health-based guidelines for both $PM_{2.5}$ and PM_{10}. The monitoring results were also consistent with the air quality measurements taken at the MOECC Kipling research station located nearby. The average 24 hour $PM_{2.5}$ concentration near ML Ready Mix was slightly above the MOECC annual mean for Toronto, however care should be taken when comparing the average 24 hour $PM_{2.5}$ concentrations near ML Ready Mix to the MOECC annual mean as the monitoring near the facility was only conducted over a fairly short time period

There were several limitation associated with the study design, such as equipment and calibration. Furthermore, there were a number of different potential sources of particulate matter at the sampling site that include vehicular traffic, roadway dust, residential heating sources, and transboundry pollution, amongst others. As such, at this point it is impossible to determine what contribution can be attributed to ML Ready Mix.

Despite these limitations, the study was able to establish that the air quality in the vicinity of ML Ready Mix is acceptable and not appreciably different from other parts of Toronto. This is consistent with the information from the nearby MOECC Kipling research station. Therefore no further air quality testing is needed.

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Appendix

Community Particulate Matter Assessments

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Key Findings

- **Particulate matter readings taken at the Judson Street sampling location were below applicable 24-hour Ontario air quality guidelines (AAQCs).**
- **Peak events above the guideline were documented at the site that were unique to the Judson St. sampling location and paired well with dust event logs.**
- **A higher proportion of short term PM_{10} elevations was noted when wind was coming from the south or southeast. These elevations did not result in an exceedance of applicable guidelines.**

Introduction

Short term monitoring was conducted in a residential area near the M&L concrete plant on 29 Judson Street. The purpose of the monitoring was to profile particulate matter exposures experienced by the community and to see how the data compared with another area in Toronto in the same time period.

Particulate Matter

$PM_{2.5}$ consists mainly of combustion particles from motor vehicles and the burning of coal, fuel oil and wood, but will also contain crustal materials from finely crushed road dust and soils. $PM_{2.5}$-10 (also referred to as the coarse fraction) consists mainly of crustal particles generated mechanically from agriculture, mining, construction, road traffic and other related sources, as well as particles of biological origin[1]. A detailed outline of these particles is shown in figure 1. Guidelines have been established for both $PM_{2.5}$ and for PM_{10} ($PM_{2.5}$ and the coarse fraction).

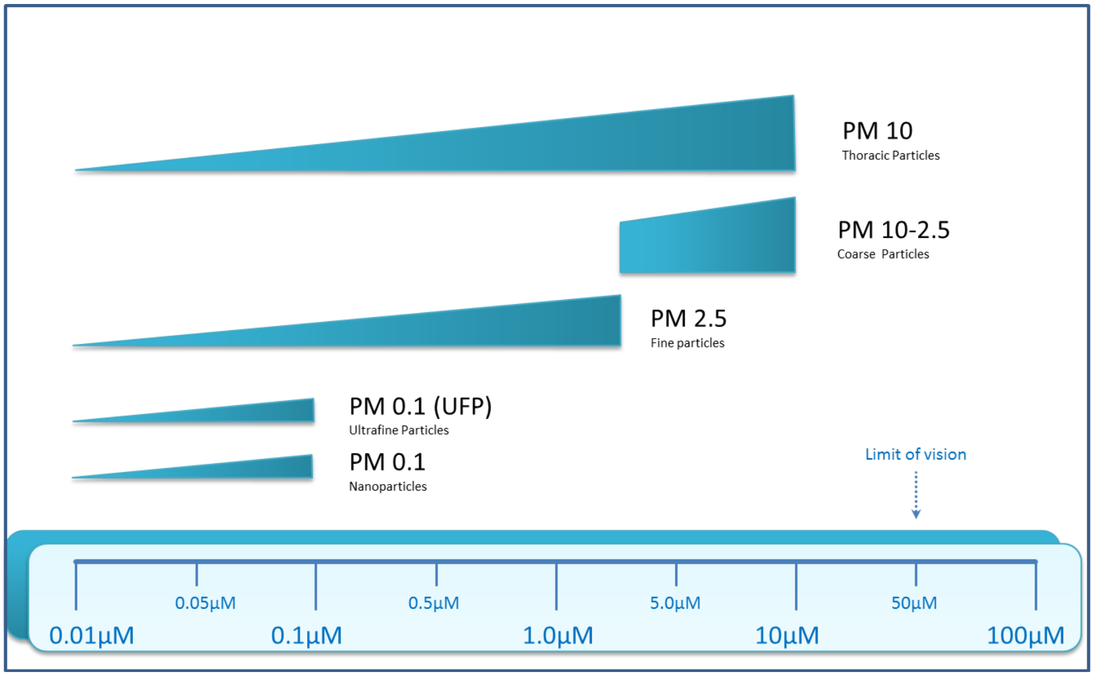

Figure 1 - Description of different particulate matter fractions

Methods

Locations Sampled

Short term monitoring was conducted in a residential area near the M&L concrete plant on 29 Judson Street and a second location was also measured independent of the sampling event at an outdoor residential location near Yonge St. and Sheppard Ave (Figure 2).

Figure 3- Photo of van used for sampling at Judson St. location

articulate matter

fractions of $PM_{2.5}$ and PM_{10}. Additionally, at the site near the cement plant, wind direction, speed,

temper

PM_{10} assessments.

Figure 2-Sites sampled for the Particulate Matter Assessment

Sampling Strategy

Sampling was conducted on July 10-12, July 13-15, July 20-23 and July 25-28. Wind direction and wind speed were paired with this data to assist in identifying sources of particulate matter, where possible. Wind direction, wind speed, temperature and relative humidty data were collected alongside the particulate matter data on the following days: July10-12, July 14, July 20 and July 25-28.

On the days data was collected, samples were taken every minute for particulate matter data and every two minutes for wind direction and wind speed. For reporting purposes and for comparisons to standards, particulate matter measurements were averaged to either 2 minutes, 1-hour, or based on the date of the sample. Similarly, meteorological conditions were also captured at a 2 minute time interval.

Site-specific dust event data for the Judson St. Location was also collected to see if dust events coincided with peak events as measured by the DustTrak instrument. These observations were recorded between 8:00 am and 5:00 pm.

DustTrak Instrument

TSI DustTrak monitors are used by Public Health Ontario for particulate matter assessments because of their ability to provide reliable data on particulate matter concentration with portability and relative ease in operation and maintenance compared to other measurement methods. An important advantage of this instrument is the continuous, direct reading capabilities, which allow for the determination of short-term temporal variation as well as spatial variation if multiple instruments are used.

The instrument is not as accurate as gravimetric monitors and is not approved by the U.S. Environmental Protection Agency under its Federal Reference Methods for $PM_{2.5}$ concentrations. As a result, the values collected with this instrument will not be used for compliance assessment. However, the DustTrak measurements provide useful information for community risk management and exposure information in different areas of the community.

In Southern Ontario, previous experiments conducted by other research groups have documented that readings from a DustTrak tend to be 2-3 times higher than particulate levels sampled with gravimetric methods (which are considered superior)[2]. This number is referred to as a calibration factor. A calibration factor of 2.4 for $PM_{2.5}$ has been previously established for the Toronto Area by members of the Southern Ontario Centre for Atmospheric Aerosol Research (SOCAAR) research group at the University of Toronto[3]. $PM_{2.5}$ results are presented in their corrected and uncorrected formats in this report.

Kestrel 4500 Weather Meter

The Kestrel 4500 Weather Meters are used by Public Health Ontario for measuring weather information because of their accuracy and portability. Relevant parameters gathered include wind direction, wind speed, temperature and relative humidity.

When collecting high resolution time information these meters (every 2 minutes), an operator must be present every day to download data due to storage limitations. As a result of this limitation, weather data was unavailable for certain days of the assessment.

Reference Guidelines

Guidelines used for comparison in this assessment were outlined in documents produced by the World Health Organization (WHO)[4] and the Standards development branch of the Ministry of Environment[5]. Ontario's Ambient Air Quality Criteria (AAQC) guideline for is slightly higher than the WHO guideline (30 µg/m^3), but makes an additional consideration for $PM_{2.5}$ emitted from a single facility that matches the WHO guideline (25 µg/m^3). The more conservative number (25 µg/m^3) was therefore used for this assessment (Table 1). 1-hour guidelines could not be found from either organization and the MOE documents clearly states that no conversion can be made from this standard to other averaging times[5].

Table 1 - 24-Hour Guidelines for Particulate Matter

24-hour PM_{10} Guideline (AAQC and WHO)	24-hour $PM_{2.5}$ Guideline
50 µg/m^3 (0.05 mg/m^3)	25 µg/m^3 (0.025 mg/m^3) (AAQC* and WHO) 30 µg/m^3 (AAQC)

* - the 25 µg/m^3 AAQC standard is meant to apply to emissions from single facilities, while the 30 µg/m^3 is based on the Canada Wide Standard for $PM_{2.5}$.

Results

Comparison Between the two sites

The two sites are compared in the figures below (Figures 3 and 4). For $PM_{2.5}$ measurements, the two sites were strongly correlated (0.65, Pearson).

Before applying the recommended correction factor, reducing the levels observed, the levels were largely below the Ontario AAQC (Figure 4). A period of exceedance was observed from July 20-23. A very similar (and more extreme) trend was observed at the second sampling location in this time period. After applying the correction factor, much of the data showed levels of $PM_{2.5}$ and PM_{10} that were well below the 24 hour AAQCs (Figures 4 and 5).

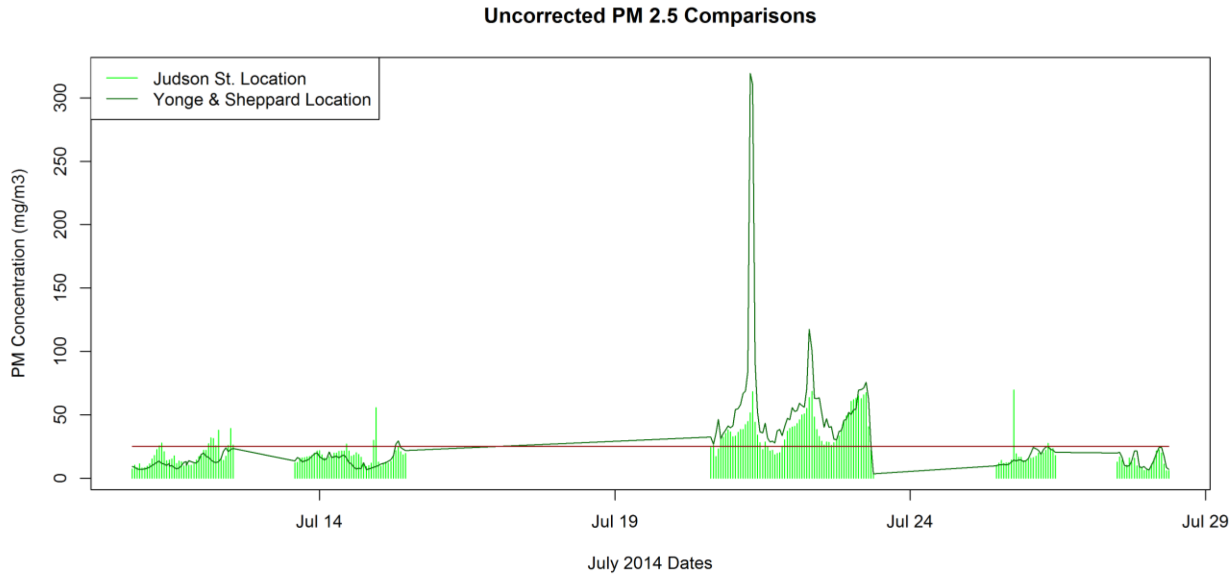

Figure 4 - Uncorrected PM2.5 Measurements (1-Hour Averages)
Results are presented here with no correction factor applied. The trends observed between the two sites are similar, and the measurements have a strong linear correlation (0.65), despite a geographical separation of 17 km between the two sites

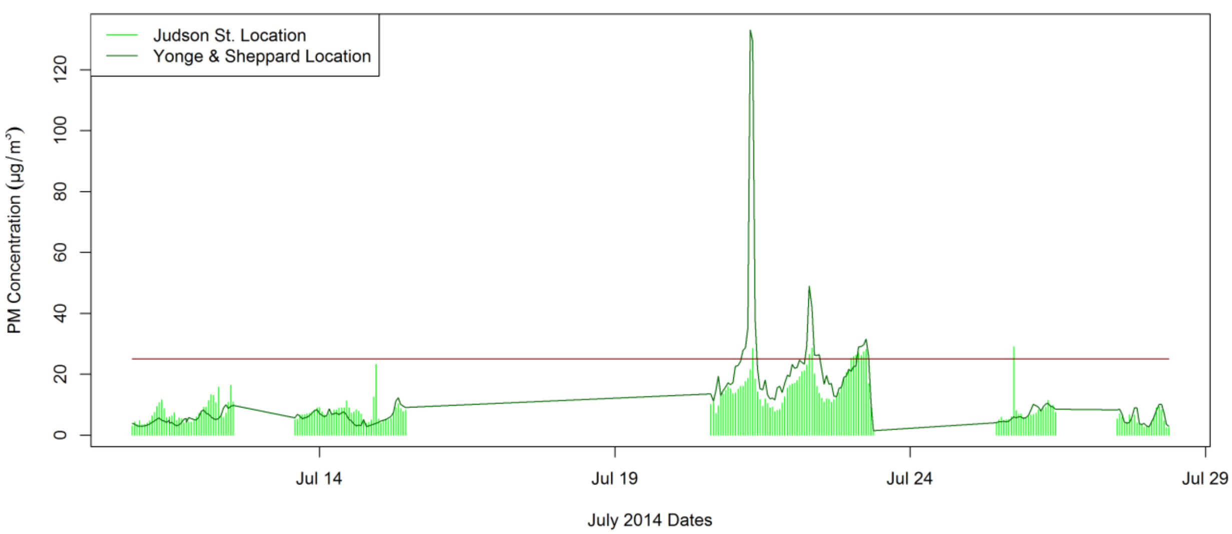

Figure 5 - Corrected $PM_{2.5}$ Measurements
This figure shows the measured values after a correction factor was applied. The elevated particulate levels are still present from July 20-23 after correction, but the trend observed is similar to the additional sampling site, and less extreme.

The current efforts underway to process the data include the following:

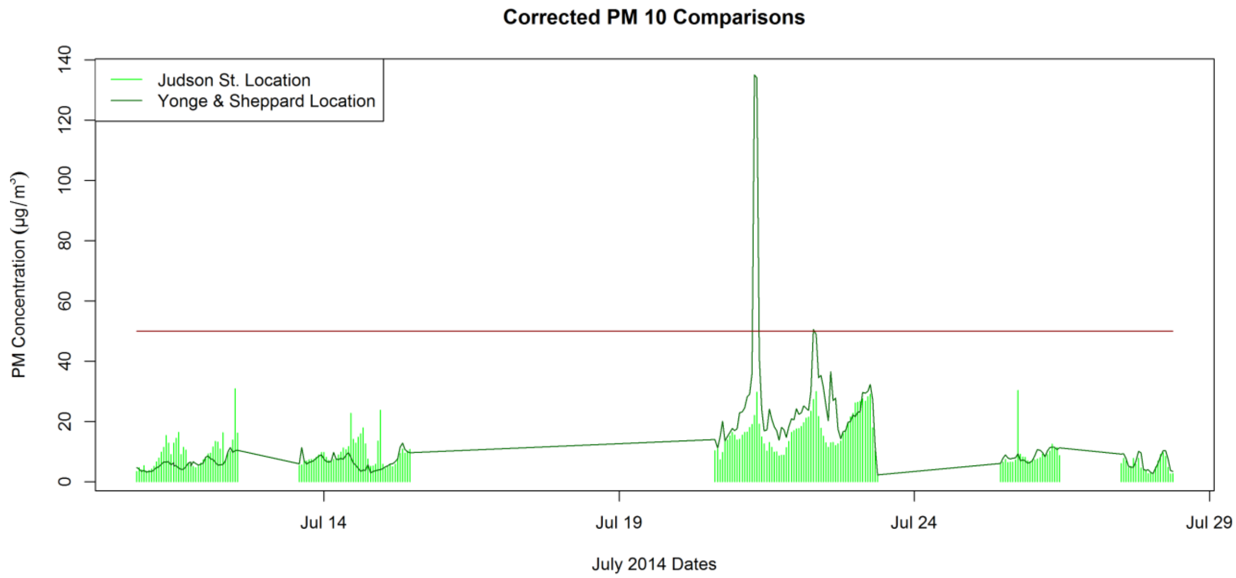

Figure 6- Corrected PM_{10} **Measurements**

This figure shows measured PM_{10} levels after the correction factor was applied. The trends are similar to the $PM_{2.5}$ readings and the peak events do not approach the AAQC.

Comparison between Judson Street and MOE site

The MOE Kipling monitoring station data is compared to the data collected at the Judson St. Location in Figure 7.. A summary of the daily averages is provided in Table 2. The elevated dust levels in July 20-23 were also detected in the MOE readings (Figure 7). The readings at the MOE site paired very well with the measurements taken by the Dusttrak Instrument for all days sampled and the measurements at the two sites were strongly correlated (0.79, pearson).

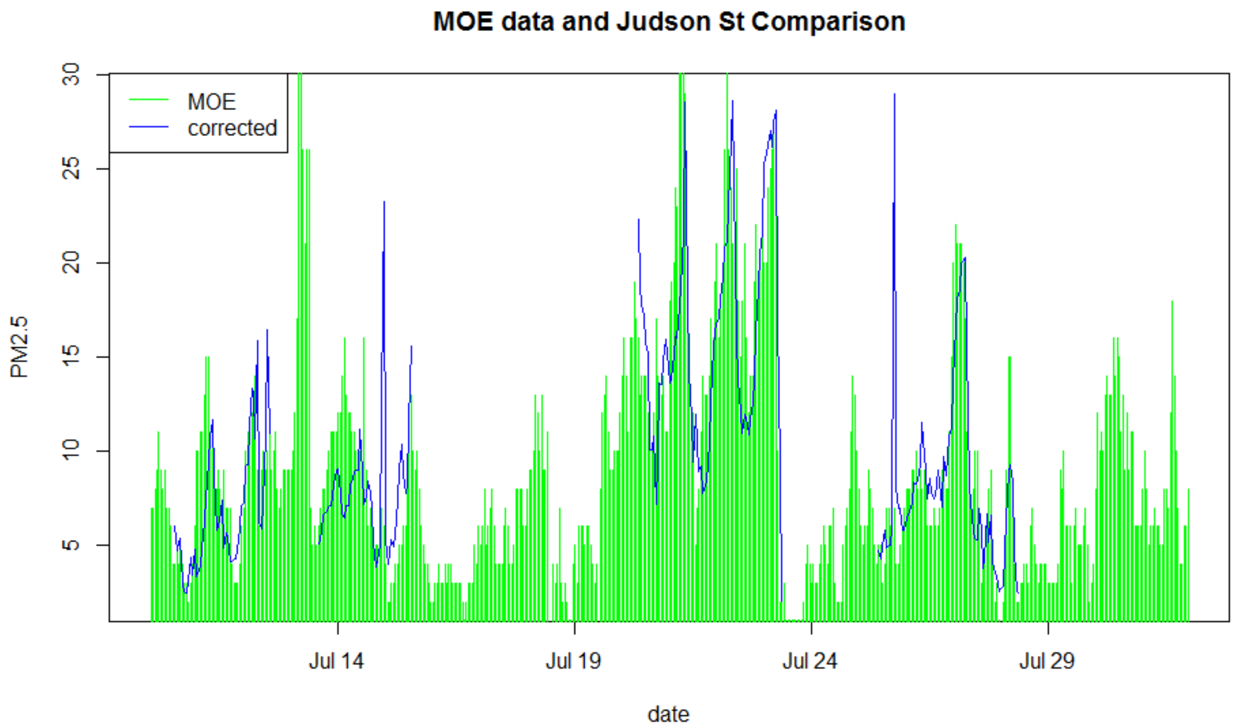

Figure 7 - Corrected PM 2.5 Data compared with MOE data from Kipling monitoring station
Measured $PM_{2.5}$ at the Judson St. Location (shown as a blue line in this figure) showed a similar trend to MOE data for all periods sampled and was strongly correlated at the two sites (0.79, pearson).

Table 2- Comparison of Judson Street and MOE measurements of $PM_{2.5}$ (corrected, $\mu g/m^3$)

	Judson	MOE
10/07/2014	4.013	4.333
11/07/2014	6.078	6.25
12/07/2014	10.51	10.83
13/07/2014	7.016	7.5
14/07/2014	8.287	8.917
15/07/2014	7.315	7.5
20/07/2014	13.95	14.75
21/07/2014	13.95	13.92
22/07/2014	17.25	18.08
23/07/2014	21.58	26.67
25/07/2014	7.417	7
26/07/2014	8.551	9.167
27/07/2014	9.501	7.417
28/07/2014	5.396	5

Logged Dust Events

Site-specific dust event data captured at the Judson St .location alongside the particulate matter measurement showed peak events on site coinciding with witnessed dust events recorded by TPH staff. Recorded dust events that coincided with short term elevations in measured particulate matter are presented in figure 7.

Statistical summaries of Particulate Matter

The captured particulate assessment showed average levels of PM_{10} and $PM_{2.5}$ that were on average below all applicable guidelines (Table 3, and Appendix 2)

Table 3- Summary levels of $PM_{2.5}$ and PM_{10} (corrected, µg/m^3)

	Average $PM_{2.5}$	Average PM_{10}
	PM2.5	PM10
10/07/2014	4.013	7.275
11/07/2014	6.078	8.458
12/07/2014	10.51	12.59
13/07/2014	7.016	7.558
14/07/2014	8.287	11.2
15/07/2014	7.315	8.427
20/07/2014	13.95	14.37
21/07/2014	13.95	14.67
22/07/2014	17.25	18.25
23/07/2014	21.58	22.37
25/07/2014	7.417	8.836
26/07/2014	8.551	9.447
27/07/2014	9.501	10.18
28/07/2014	5.396	5.689
24 hr. NAAQC	**25 µg/m^3**	**50 µg/m^3**

Wind and Direction measurements

Wind and direction measurements captured indicated that the Judson St. location was downwind of the cement facility for many of the assessment days, with the winds from the south and southeast being the dominant source during the periods tested (Appendix 3). The measurements suggested that despite the presence short term elevations in particulate matter, the levels of $PM_{2.5}$ and PM_{10} were generally low and below applicable guidelines. Because of the short testing period, samples of wind coming from the north, east and west were limited. Based on the observed testing period, the proportion of elevated

$PM_{2.5}$ readings is similar in all the directions sampled. The proportion of elevated PM_{10} readings were slightly higher in the readings paired with winds from the south and southwest (Figure 10).

Unlogged Dust Events

On July 25, 26 and 27, elevations occurred in particulate matter were logged by the DustTrak instrument between 6pm and 7pm (Appendix 1). This elevation appears to be unique to the Judson St. location, but no witness data is available as the elevation occurred after logging activities had finished for the day.

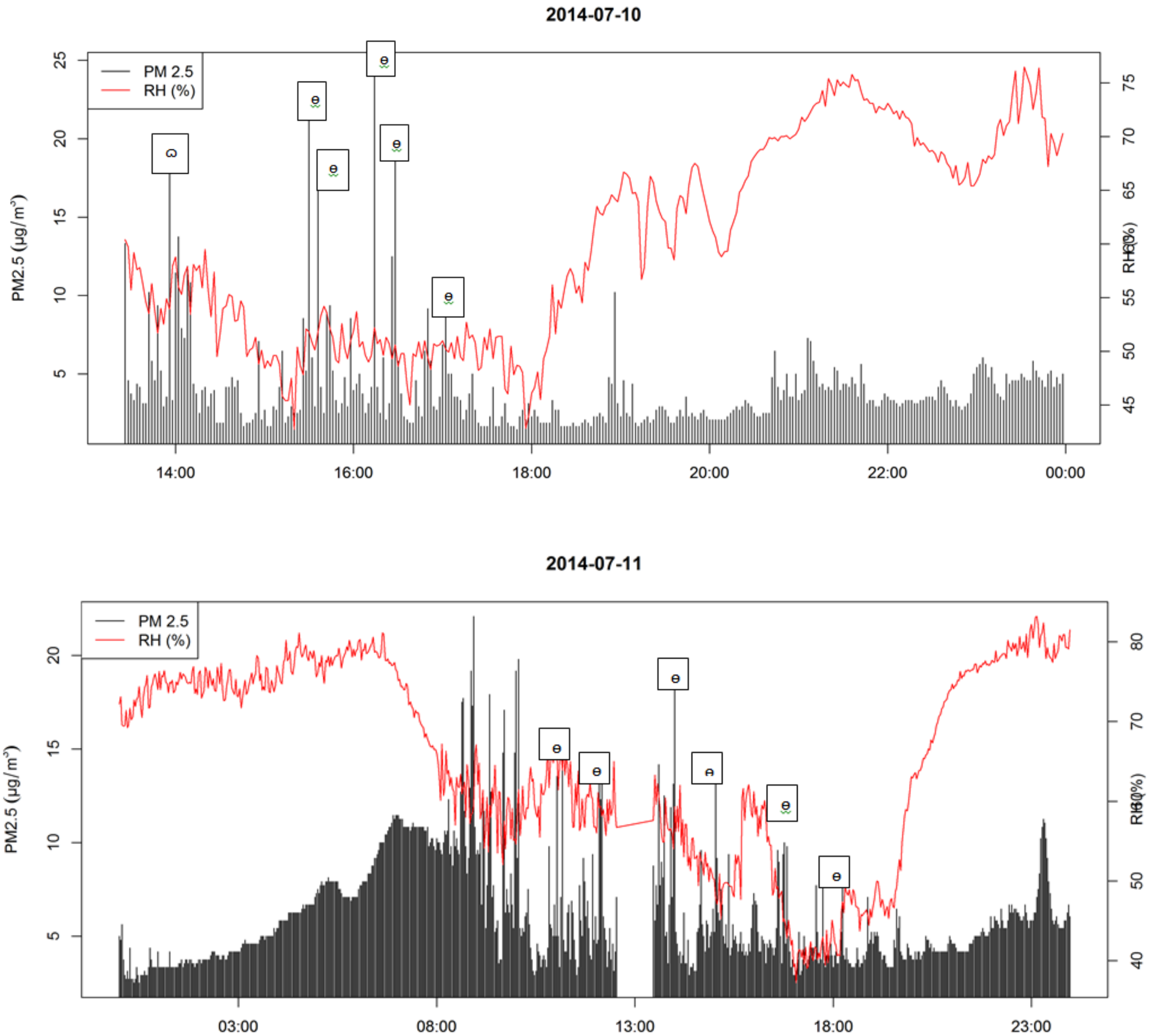

Figure 8 - Logged Dust events paired with observations for Days 1 and 2

Discussion

The strong correlation between the two sites the two sites (0.65) suggests that much of the hourly or daily variation in $PM_{2.5}$ would be due to characteristics of the Toronto air shed rather than due to dust emissions that are occurring only at the Judson St. location. This is consistent with other literature that has documented low spatial variation in $PM_{2.5}$ across an urban area. The MOE data for $PM_{2.5}$ also showed a similar trend in for all sampling periods and correlated strongly with the Judson St location (0.79). This comparison was made with no information about the equipment used at the MOE Kipling sampling location.

Peak events occurred at this site that pair well with dust event observations logged in the first two days of the particulate matter assessment. Similarly, the pollution rose results suggest that a larger proportion of elevated dust events in the PM_{10} range occurred when winds were blowing from the south and southeast (the direction of the cement plant). These dust events did not result in an exceedance of the AAQC when averaged out over longer periods of time.

The readings collected at the Judson St sampling location did not exceed AAQC guidelines. Because of the trend similarity to the second sampled site, the period of exceedance documented between July 20 and 23 was likely either due to characteristics of the Toronto air shed during those days or due to decreased reliability of DustTrak readings at both sites in humidity conditions above 70 per cent[3]. These conclusions are only valid for the days sampled, and conclusions about trends at either location are not possible based on the data collected.

Because no measurements were taken upwind of the cement facility, it cannot be conclude that the elevated dust events were a result of activities associated with the cement plant. However, the readings do represent an accurate profile of particulate exposure experienced by residents adjacent to the sampling location on the days sampled.

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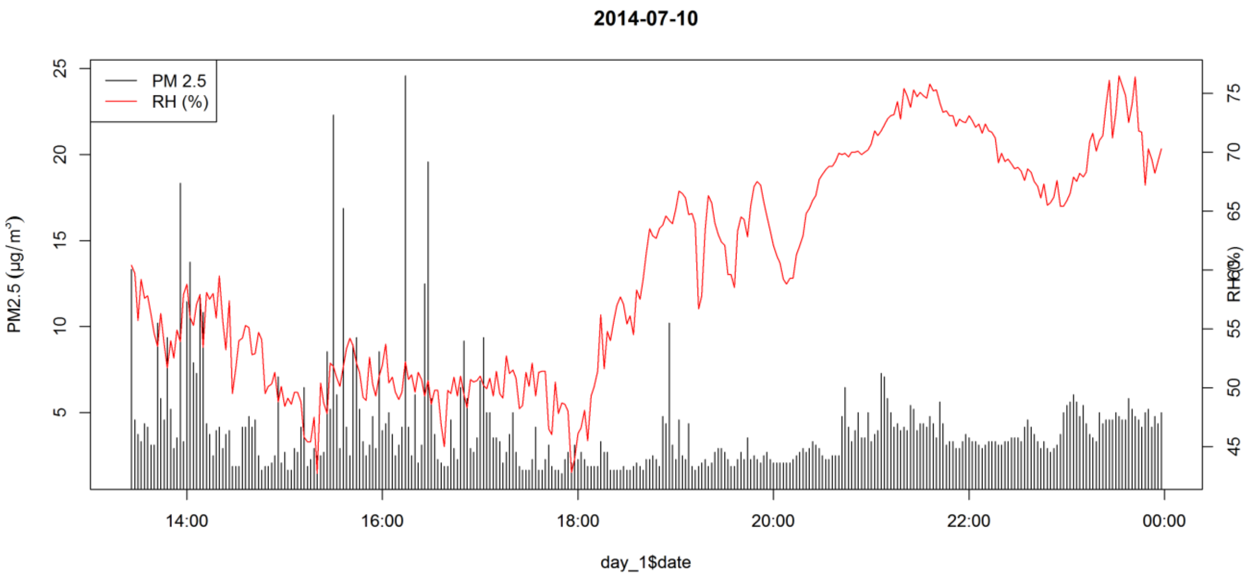
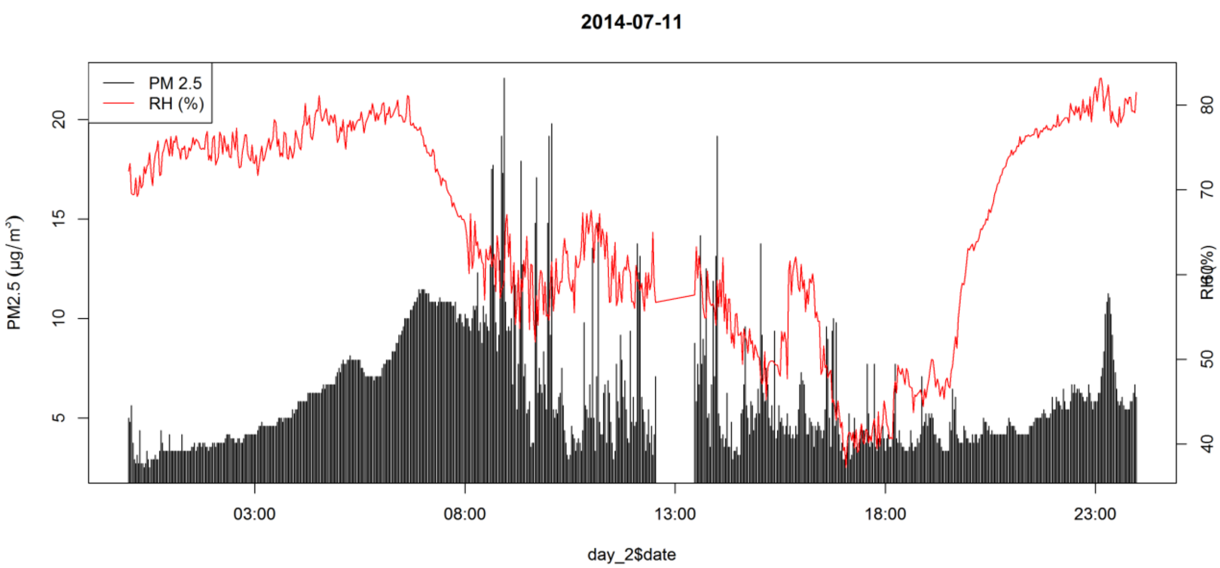
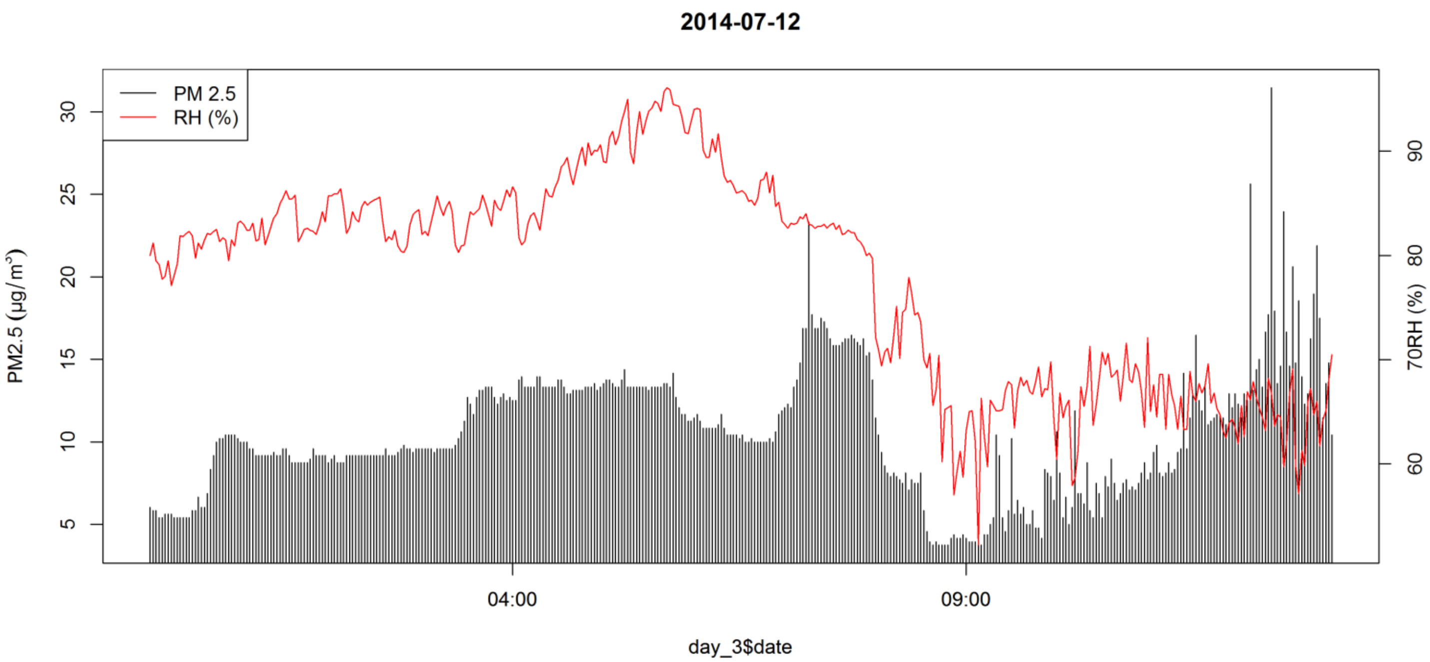
openair — an R package for air quality data analysis. Environmental Modelling & Software. ; 2012.

Appendices

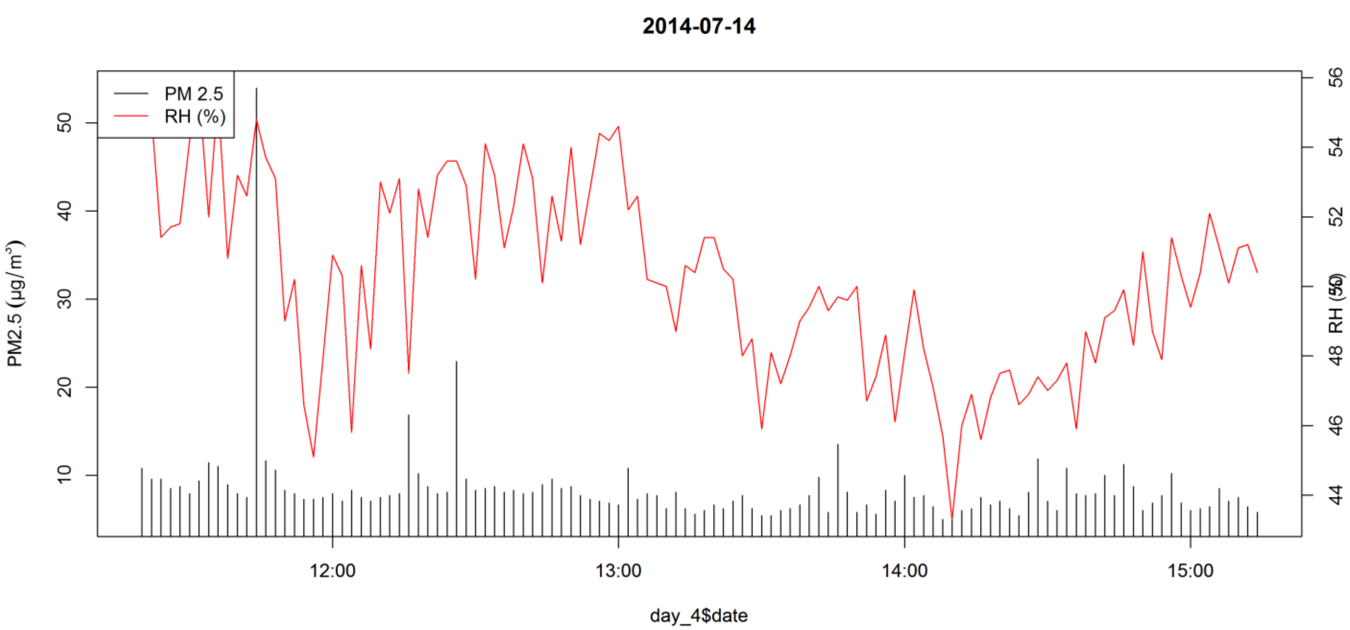
Appendix 1: Corrected $PM_{2.5}$ (μg/m³) readings paired with relative humidity (%) readings



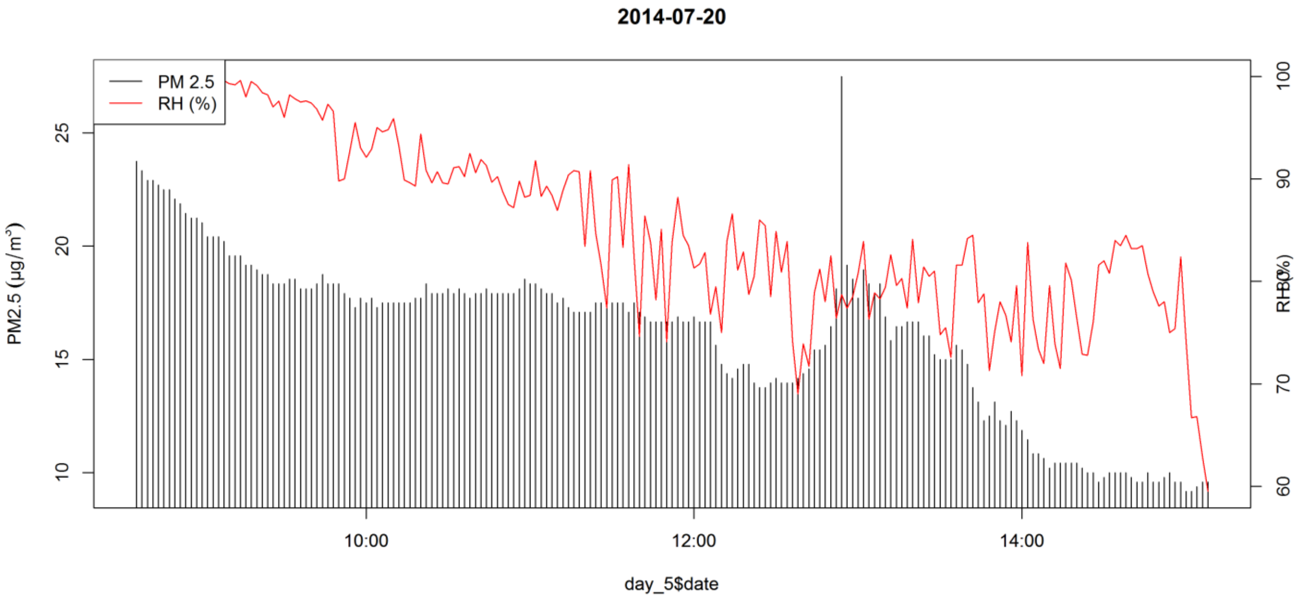


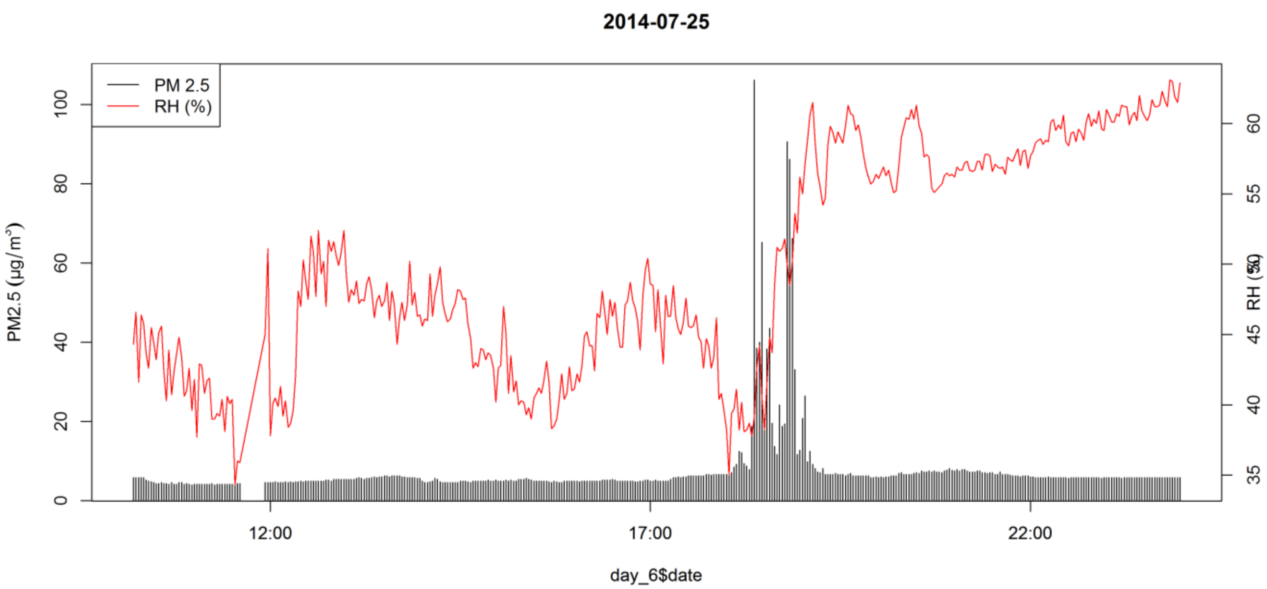


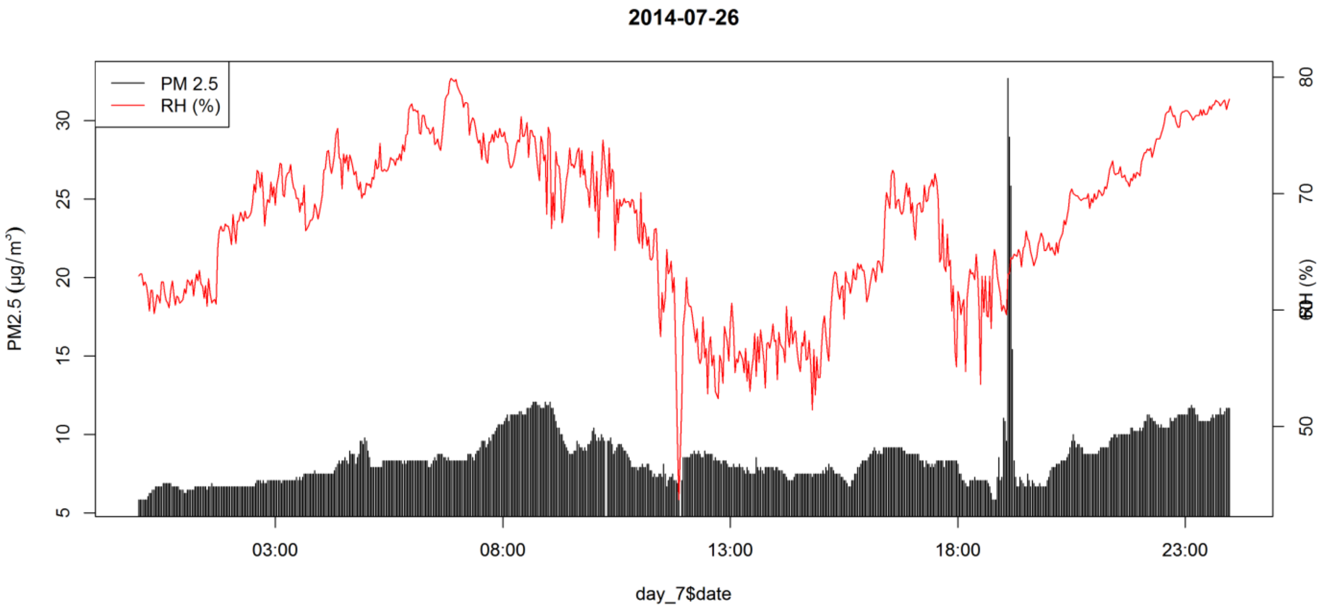
2014-07-12
PM 2.5
RH (%)
PM2.5 (μg/m³)
RH (%)
04:00
09:00
day_3$date

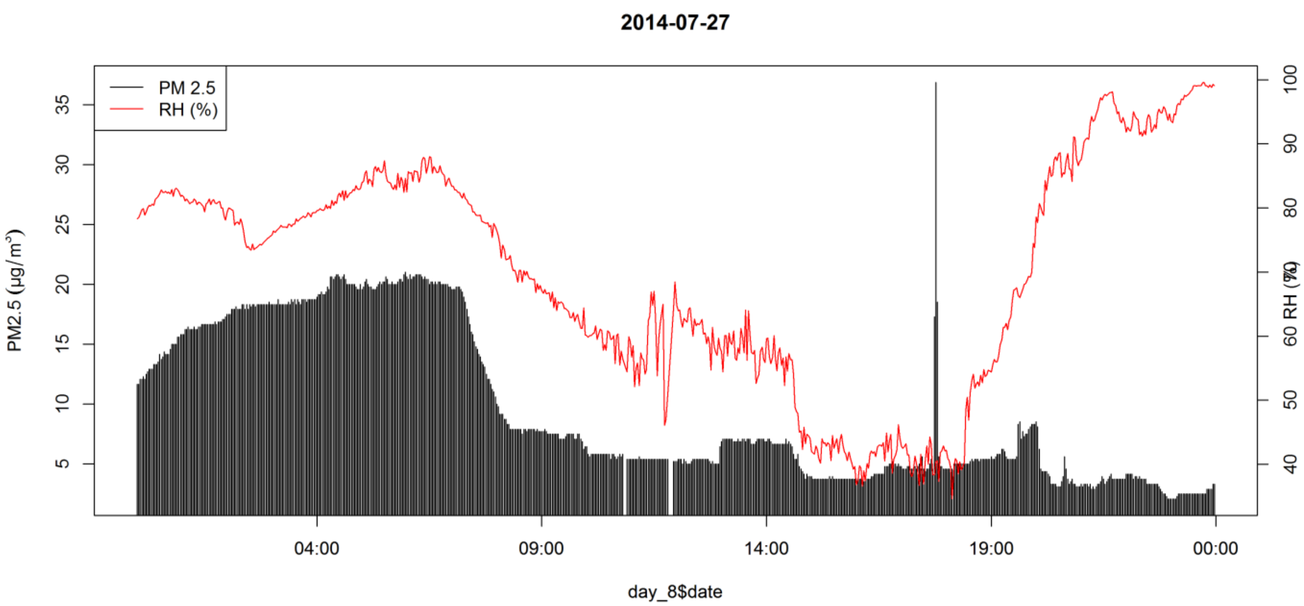


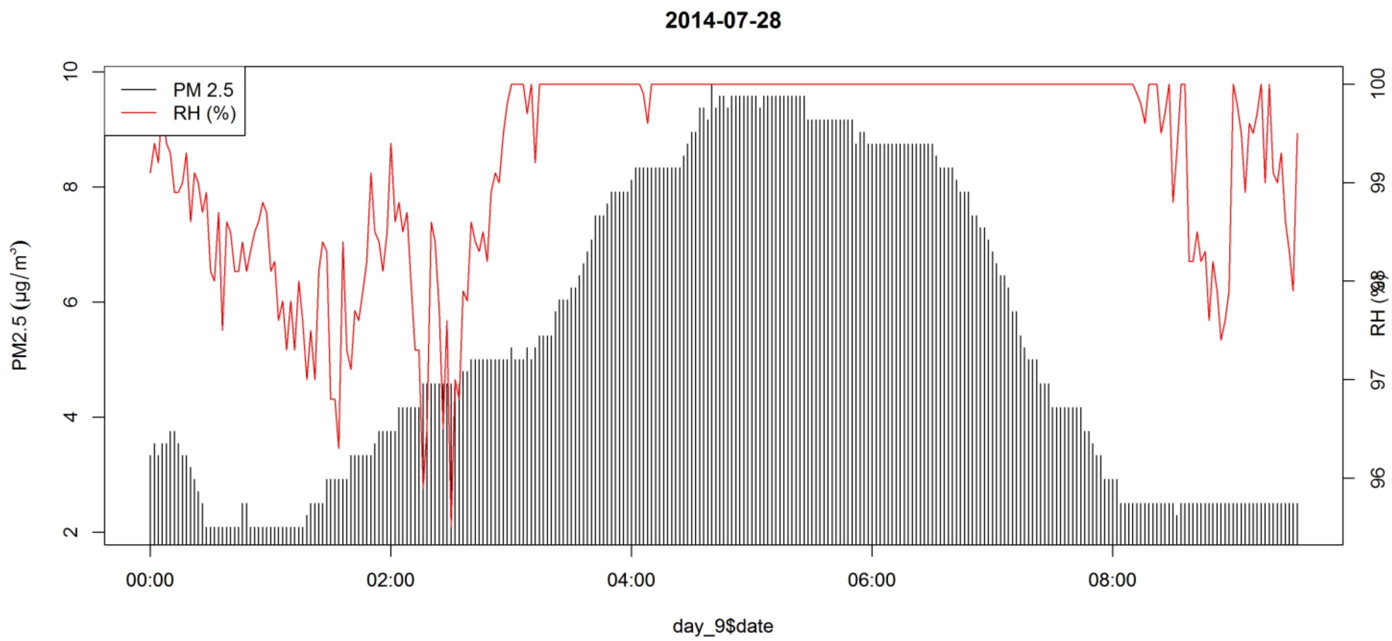
2014-07-14
PM 2.5
RH (%)
PM2.5 (μg/m³)
RH (%)
12:00
13:00
14:00
15:00
day_4$date


2014-07-20
PM 2.5
RH (%)
PM2.5 (µg/m³)
RH (%)
day_5$date
10:00
12:00
14:00


2014-07-25
PM 2.5
RH (%)
PM2.5 (µg/m³)
RH (%)
day_6$date
12:00
17:00
22:00


2014-07-26
PM 2.5
RH (%)
PM2.5 (µg/m³)
RH (%)
03:00
08:00
13:00
18:00
23:00
day_7$date

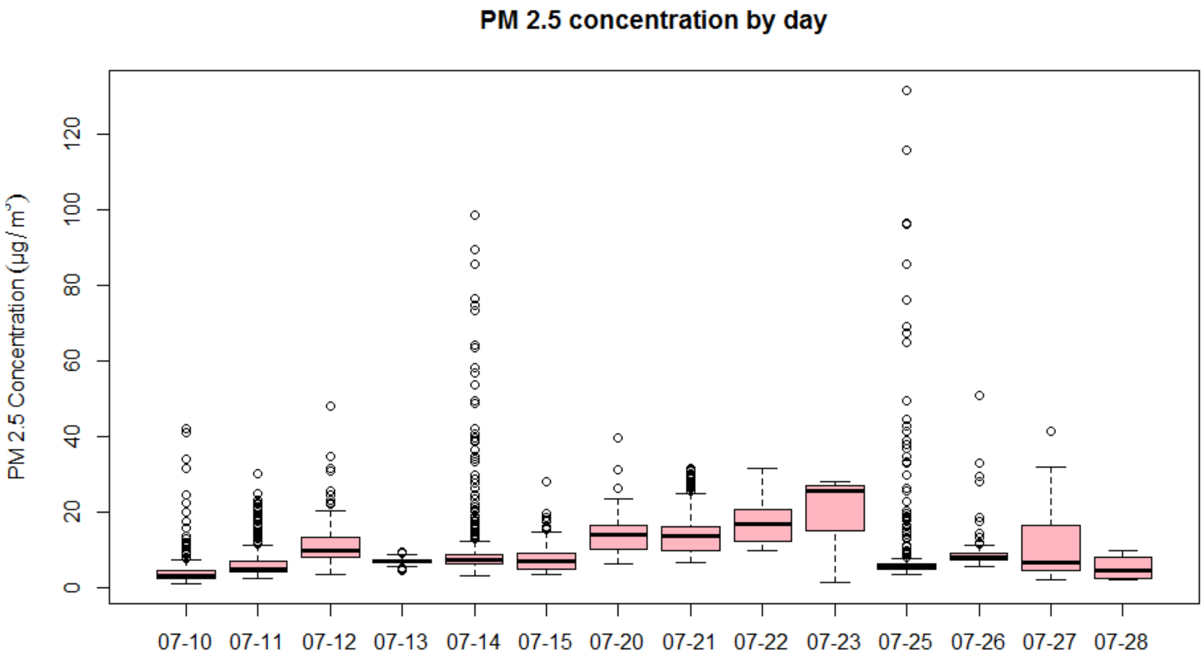

2014-07-27
PM 2.5
RH (%)
PM2.5 (µg/m³)
RH (%)
04:00
09:00
14:00
19:00
00:00
day_8$date



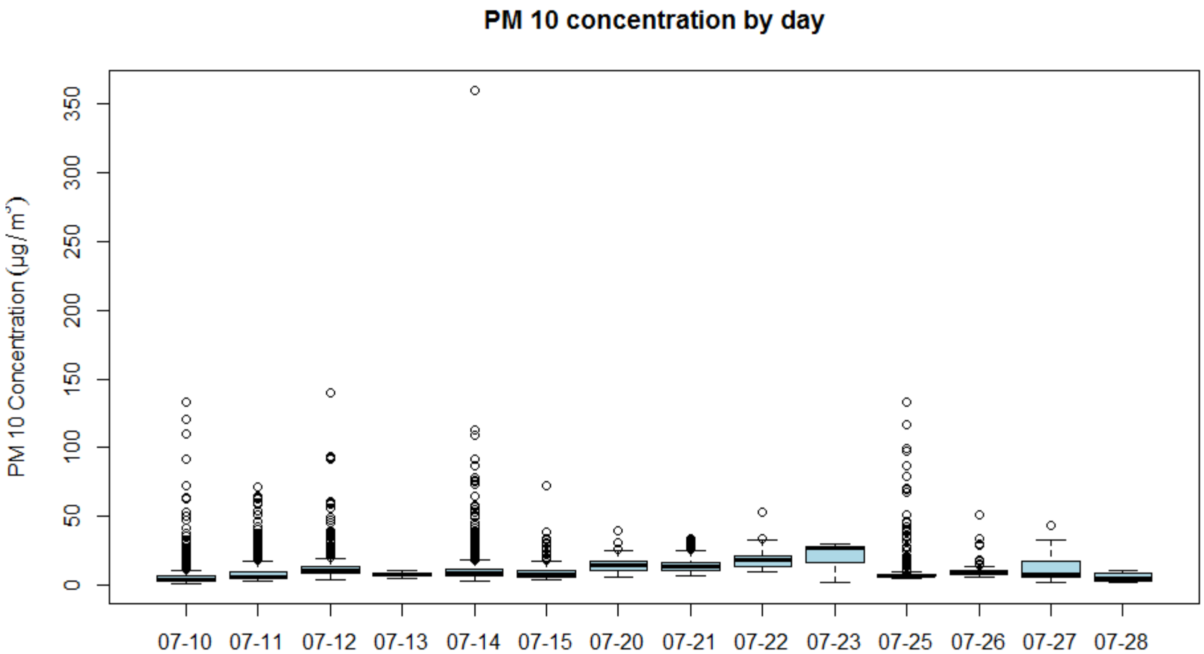
Appendix 2: Daily Descriptive Statistical summaries of $PM_{2.5}$ and PM_{10}

Daily concentrations for corrected $PM_{2.5}$ and PM_{10} at the Judson St. location are shown below. The graphs reveal levels that are generally well below applicable guidelines, with outliers (elevated dust events, shown as black circles on the graphs) being present on most of the days sampled.

PM$_{2.5}$ (Corrected Values)						
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10/07/2014	1.25	2.5	3.333	4.013	4.583	42.08
11/07/2014	2.5	4.167	5	6.078	7.083	30.42
12/07/2014	3.75	8.333	10	10.51	13.33	48.33
13/07/2014	4.583	6.667	7.083	7.016	7.5	9.583
14/07/2014	3.333	6.25	7.5	8.287	8.75	98.75
15/07/2014	3.75	5	7.083	7.315	9.167	28.33
20/07/2014	6.25	10.42	14.17	13.95	16.67	39.58
21/07/2014	6.667	10	13.75	13.95	16.25	31.67
22/07/2014	10	12.5	17.08	17.25	20.83	31.67
23/07/2014	1.667	15.31	25.83	21.58	27.08	28.33
25/07/2014	3.75	5	5.833	7.417	6.25	131.7
26/07/2014	5.833	7.5	8.333	8.551	9.167	50.83
27/07/2014	2.083	4.583	6.667	9.501	16.67	41.67
28/07/2014	2.083	2.5	4.583	5.396	8.333	10


PM 2.5 concentration by day
PM 2.5 Concentration (µg/m³)
0
20
40
60
80
100
120
07-10
07-11
07-12
07-13
07-14
07-15
07-20
07-21
07-22
07-23
07-25
07-26
07-27
07-28

PM_{10} (corrected Values)						
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10/07/2014	1.25	3.083	4.333	7.275	6.417	133.2
11/07/2014	2.5	4.75	6.25	8.458	10	71
12/07/2014	3.75	9.167	10.83	12.59	13.5	140.3
13/07/2014	4.583	6.667	7.5	7.558	8.5	10.58
14/07/2014	3.333	7.083	8.917	11.2	11.5	359.8
15/07/2014	3.75	5.417	7.5	8.427	10.33	72.33
20/07/2014	6.25	11	14.75	14.37	17.08	39.58
21/07/2014	7.083	11	13.92	14.67	16.83	33.67
22/07/2014	10	13.5	18.08	18.25	21.42	53.42
23/07/2014	1.667	16	26.67	22.37	27.67	30.33
25/07/2014	5	6.417	7	8.836	7.833	132.7
26/07/2014	5.833	8.083	9.167	9.447	10.38	50.83
27/07/2014	2.083	5.417	7.417	10.18	17.25	43.67
28/07/2014	2.083	3.083	5	5.689	8.333	10.58


PM 10 concentration by day
PM 10 Concentration (µg/ m³)
0
50
100
150
200
250
300
350
07-10
07-11
07-12
07-13
07-14
07-15
07-20
07-21
07-22
07-23
07-25
07-26
07-27
07-28

Appendix 3: Daily pollution rose graphics for $PM_{2.5}$

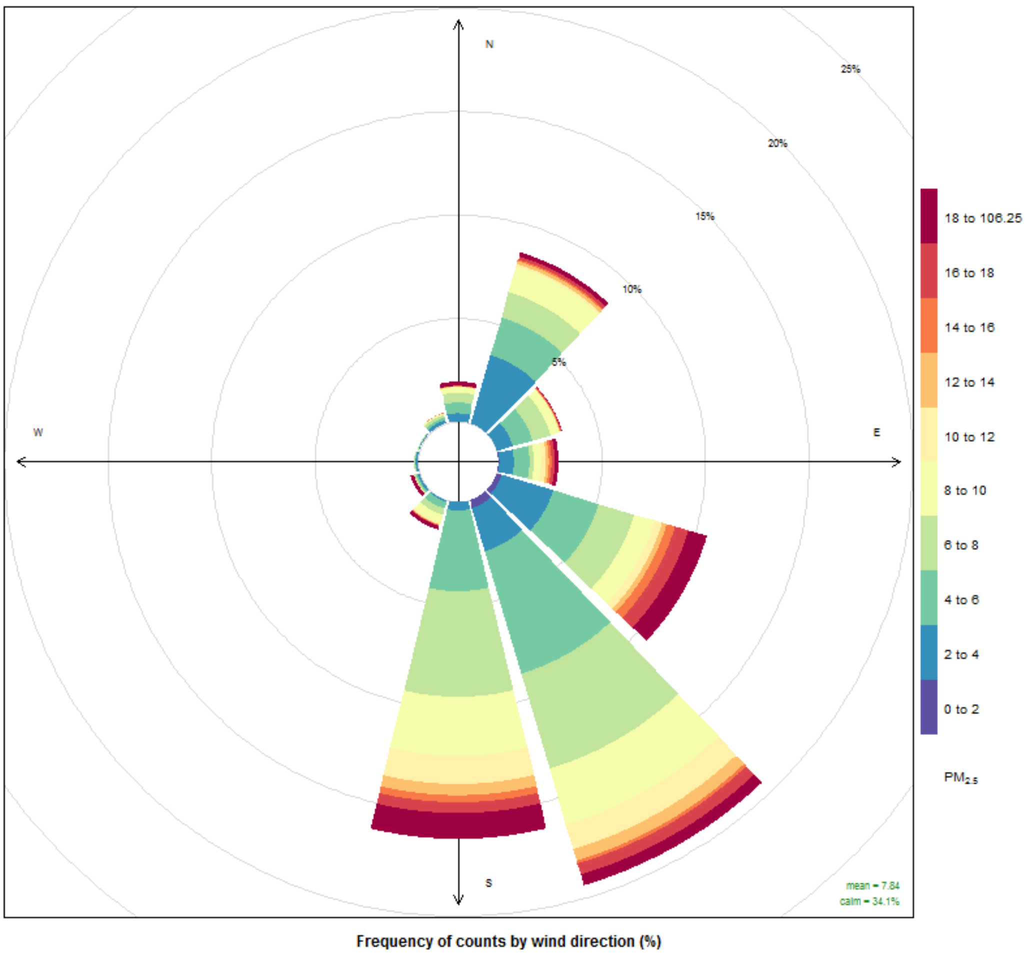


Figure 9 - Pollution Rose for $PM_{2.5}$[6]

This pollution rose represents all of the sampled days and wind direction paired with PM2.5 (in µg/m^3) readings in one graph. Based on this plot, wind was blowing from the south and southeast direction for the majority of the sampling period, and thus the van was downwind of the cement plant for most of the time sampled. The proportion of periods of elevated particulate matter (18 -18-187.96 µg/m^3, in maroon) is similar in all wind directions for $PM_{2.5}$.

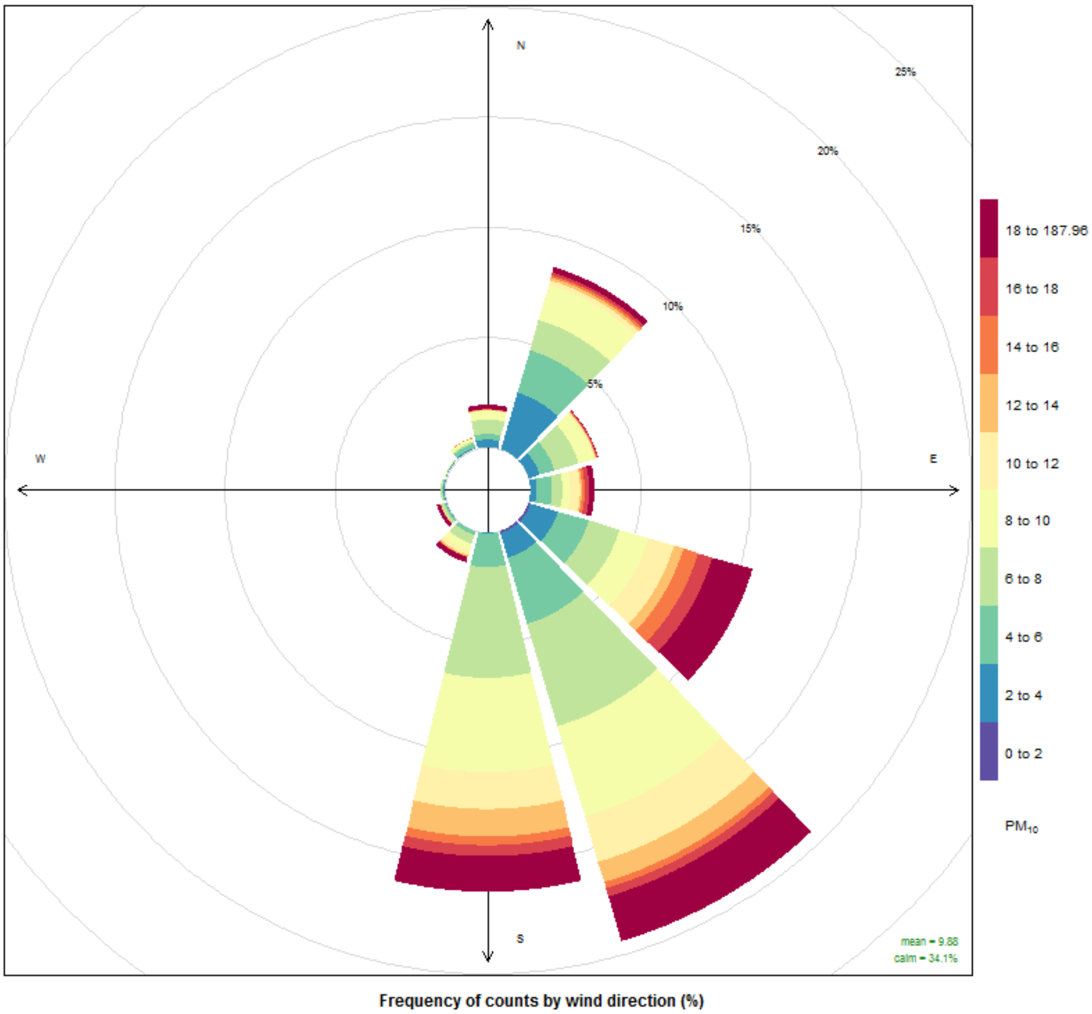


Figure 10 - Pollution Rose for PM_{10}[6]

This pollution rose represents all of the sampled days and wind direction paired with PM_{10} readings($\mu g/m^3$) in one graph. Based on this plot, wind was blowing from the south and southeast direction for the majority of the sampling period. The proportion of elevated particulate matter (18-187.96 $\mu g/m^3$, in maroon) was slightly higher when wind was blowing from the south and southeast directions than in other directions.

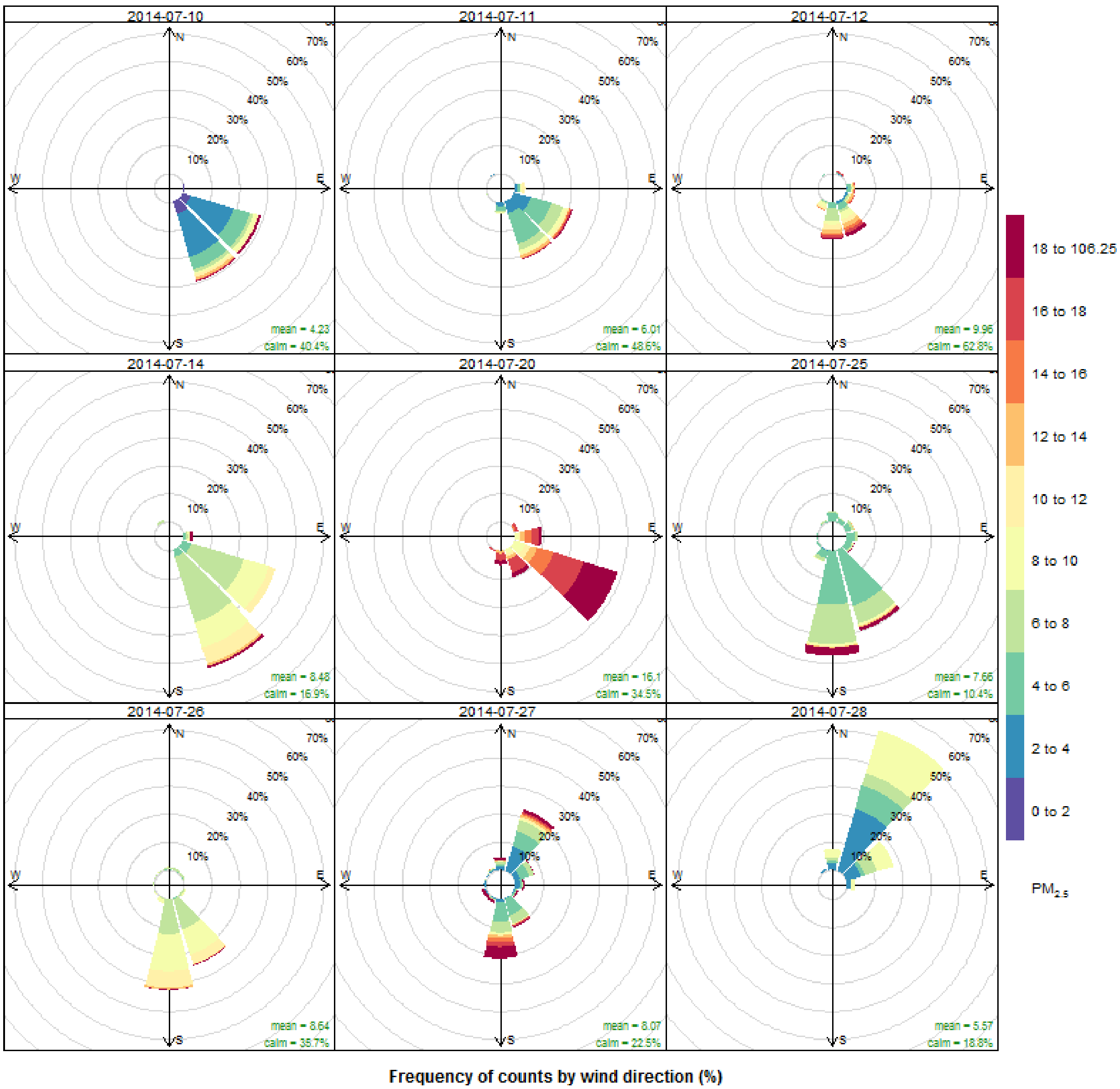


Figure 11-- Daily Pollution Rose Summaries for $PM_{2.5}$ [6]

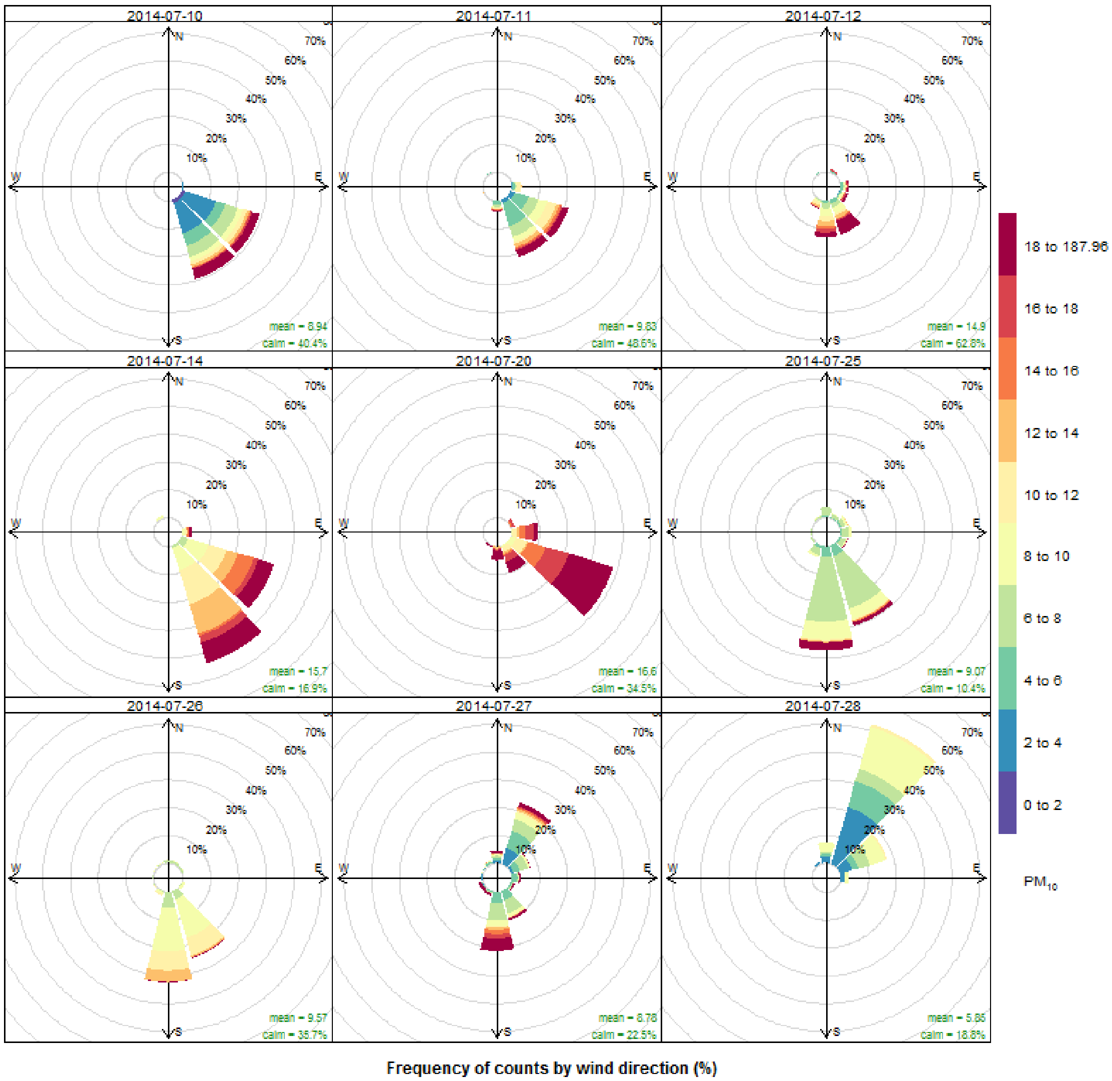


Figure 12-- Daily Pollution Rose Summaries for PM_{10}[6]

Appendix 4: Corrected Values for $PM_{2.5}$ and PM_{10}

Following consultation with the air pollution research group at University of Toronto[3], a correction factor was applied to the $PM_{2.5}$ and PM_{10} readings measured with the DustTrak instrument. Though a correction factor did not exist for PM_{10} data, the values needed to be altered since $PM_{2.5}$ constitutes a portion of the PM_{10} fraction. Keeping this in mind, the following formulas were used to alter the $PM_{2.5}$ and PM_{10} data:

corrected Values for $PM_{2.5}$

$$PM_{2.5}(\mathrm{corrected}) = \frac{\mathrm{PM}_{2.5}(\mathrm{uncorrected})}{2.4}$$

corrected Values for PM_{10}

First, the coarse fraction was established with the uncorrected readings:

$$PM_{10-2.5} = \mathrm{PM}_{10}(\mathrm{uncorrected}) - \mathrm{PM}_{2.5}(\mathrm{uncorrected})$$

Then the coarse fraction was added to the corrected $PM_{2.5}$ readings

$$PM_{10}(corrected) = PM_{10-2.5} + PM_{2.5}(\mathrm{corrected})$$