# 2017 Annual Ambient Air Quality Monitoring Report for the Durham York Energy Centre

FINAL REPORT

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Project No.: 160950528

April 20, 2018

# Sign-off Sheet

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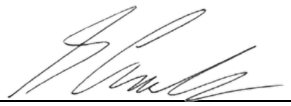
Reviewed by 
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# Executive Summary

The Regional Municipalities of Durham and York constructed the Durham York Energy Centre (DYEC) which is an Energy-from-Waste (EFW) Facility intended to provide a long-term, sustainable solution to manage municipal solid waste remaining after diversion from the Regions. The facility commenced commercial operation on February 1, 2016.

The Ambient Air Quality Monitoring Plan - Durham York Residual Waste Study (Stantec, 2012), was developed in 2011-2012 based on the Regional Council's mandate to provide ambient air quality monitoring in the area of the DYEC for a three-year period. An ambient air quality monitoring and reporting program was also a requirement in the Provincial Environment Minister's Notice of Approval to Proceed with the Undertaking, detailed in Condition 11 of the Notice of Approval (MOECC, 2010). The air monitoring plan was also developed to satisfy the conditions of the Environmental Compliance Approval and the environmental mitigation and commitments set out in the Environmental Assessment (Jacques Whitford, 2009). The predominantly downwind station is located along Rundle Road, south of Baseline Road. The predominantly upwind station is sited at the Courtice Water Pollution Control Plant (WPCP). Since May 2013, measurements of the following air contaminants have been made at the two stations as follows:

- Continuously monitored:
  - Sulphur Dioxide ($SO_2$)
  - Nitrogen Oxides ($NO_X$)
  - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$)
- Non-Continuously monitored:
  - Metals in Total Suspended Particulate (TSP) matter
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Dioxins and Furans

At the request of the Regional Municipality of Durham, dioxin and furan sampling that was outside the scope of the Ambient Monitoring Plan (Stantec, 2012) was conducted from July 18, 2017 to September 4, 2017. During this period the dioxin/furan sampling frequency at the Courtice WPCP and Rundle Road monitoring stations was increased from once every 24 days to once every 12 days. The results of the additional sampling in 2017 have been included in the analysis provided in this report.

A third Fence Line Station, which measures non-continuous parameters (metals and total particulate matter), was installed prior to full operation of the DYEC. As per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), the Fence Line station, which collects non-continuous parameters began operation on February 1, 2016 upon start of commercial operations. The

Fence Line Station was scheduled to run for a one-year period, however, this period was extended through 2017.

Meteorological data is also measured at the Courtice WPCP and Rundle Road Stations. Horizontal wind speed, wind direction, atmospheric temperature, relative humidity, and rainfall are measured at the predominantly downwind Rundle Road Station. The predominantly upwind Courtice WPCP Station measures atmospheric temperature, relative humidity, rainfall, and barometric pressure. Wind speed and wind direction data at the predominantly upwind location are measured and provided by the Courtice WPCP.

The Ministry of Environment and Climate Change (MOECC) requires that annual reports be issued for the measurements conducted in each calendar year. This annual report provides a summary of the ambient air quality data collected at the three stations (Courtice, Rundle and Fence Line) for the period January to December 2017.

The following observations and conclusions were made from a review of the measured ambient air quality monitoring data:

1. Measured concentrations of $NO_2$, $SO_2$ and $PM_{2.5}$ were below the applicable O. Reg. 419/05 Standards and human health risk assessment (HHRA) health-based criteria presented in **Table 2-2** of this report for hourly, 24-hour and annual averaging periods.
2. The 98$^{th}$ percentiles of the measured daily average $PM_{2.5}$ levels during the 2017 monitoring period were 19.8 µg/m$^3$ at the Courtice WPCP station and 20.3 µg/m$^3$ at the Rundle Road station. The annual average $PM_{2.5}$ concentrations measured at the Courtice WPCP and Rundle Road Station over the monitoring period were 6.4 and 6.3 µg/m$^3$, respectively. As detailed below, these values for the 2017 measurements should not be used for direct comparison against the Canadian Ambient Air Quality Standard as more data are needed to make a valid comparison.
3. The Canadian Ambient Air Quality Standards (CAAQS) for 24-hour and annual $PM_{2.5}$ both require a three-calendar year average for a valid comparison, with the data considered valid if an annual 98$^{th}$ percentile value is available for at least two of the three calendar years. Using the measured $PM_{2.5}$ data at each station for calendar years 2014 to 2017, average annual 98$^{th}$ percentile daily average and annual average $PM_{2.5}$ levels were calculated for the rolling three-year periods of 2014-2016 and 2015-2017 and compared to their CAAQS. The measured data (with statistics applied) on ambient $PM_{2.5}$ levels were below their respective CAAQS at both stations for both three-year periods.
4. The maximum measured concentrations of almost all TSP and all metals with MOECC air quality criteria were below their applicable criteria (presented in **Table 2-3** in this report), except for two TSP measurements at the Rundle Road Station. In both cases, the DYEC was not upwind of the Rundle Road Station, and the measured TSP concentrations were not expected to have resulted in an adverse effect on human health or the environment.

Discussion of the meteorology and potential sources for these events, which is required by the MOECC to be included in each annual report, is provided in Section 4.3.

5. The maximum measured concentrations of those PAHs with MOECC Ambient Air Quality Criteria (AAQC), were almost all below their applicable 24-hour criteria (presented in **Table 2-4**) at both stations. The exceptions are twelve (12) benzo(a)pyrene (B(a)P) measurements. Out of twenty-nine (29) samples collected at the Rundle Road Station, eight (8) samples exceeded the Ontario 24-hour B(a)P AAQC of 0.05 ng/m$^3$ by 7% to 216%. Out of thirty (30) B(a)P measurements collected at the Courtice WPCP Station, four (4) measurements exceeded the MOECC AAQC by 15% to 77%. However, the exceedances were below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health-based criteria. Discussion of the meteorology and potential sources for these events is provided in Section 4.4.

   Based on the air quality assessments completed during the Environmental Assessment Study and the Environmental Compliance Approval application for the DYEC, the facility will not be a significant contributor of B(a)P. Therefore, ambient B(a)P levels are not expected to be substantially impacted by the operation of the DYEC.

6. The maximum toxic equivalent dioxin and furan concentration measured over this period was below the applicable criteria presented in **Table 2-4**.

In summary, the concentrations of almost all measured air contaminants were below their applicable criteria during the 2017 monitoring period. The noted exceptions are benzo(a)pyrene and TSP, as described above. Further, except for TSP the measured levels of all other monitored contaminants were below their applicable HHRA health-based criteria.

# Abbreviations

| | |
|---|---|
| AAQC | Ambient Air Quality Criteria |
| ACB List | Air Contaminants Benchmark List: Standards, Guidelines and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants |
| CAAQS | Canadian Ambient Air Quality Standards |
| CAC | Criteria Air Contaminants |
| CDD | Chlorinated Dibenzo-p-dioxins |
| CDF | Chlorinated Dibenzo-p-furans |
| DAS | Data acquisition system |
| D/Fs | Dioxins and Furans |
| DYEC | Durham York Energy Centre |
| EFW | Energy from Waste |
| MOECC | Ontario Ministry of the Environment and Climate Change |
| $SO_2$ | Sulphur Dioxide |
| $NO_X$ | Nitrogen Oxides |
| $O_3$ | Ozone |
| PAH | Polycyclic aromatic hydrocarbons |
| Particulate | A particle of a solid or liquid that is suspended in air. |
| PCB | Polychlorinated biphenyl |
| PCDD/PCDF | Polychlorinated dibenzo-p-dioxins and dibenzofurans |
| PM | Particulate Matter |
| $PM_{2.5}$ | Particulate Matter smaller than 2.5 microns |
| TEQ | Toxic equivalent quotient |
| TEQs | Toxic Equivalents |
| TSP | Total Suspended Particulate |
| WPCP | Water Pollution Control Plant |
| **Elements** | |
| Cd | Cadmium |
| Hg | Mercury |
| Pb | Lead |
| Al | Aluminum |
| As | Arsenic |
| Be | Beryllium |
| Cr | Chromium |
| Cu | Copper |
| Mn | Manganese |

| | |
|---|---|
| Ni | Nickel |
| Ag | Silver |
| Tl | Thallium |
| Sn | Tin |
| V | Vanadium |
| Zn | Zinc |
| **Miscellaneous** | |
| °C | Temperature in degrees Celsius |
| N/A | Not available |
| % | Percent |
| ppm | Part per million |
| ppb | Part per billion |
| ppbv | Parts per billion by volume |
| ppt | Part per trillion |
| min | Minimum |
| max | Maximum |
| mm | Millimetre |
| m | Metre |
| km/hr | Kilometres per hour |
| $mg/m^3$ | Milligrams per cubic metre |
| $\mu g/m^3$ | Microgram per cubic metre |
| $ng/m^3$ | Nanograms per cubic metre |
| $pg/m^3$ | Picograms per cubic metre |
| pg $TEQ/m^3$ | Picograms of toxic exposure equivalents per cubic metre |

# 1.0 INTRODUCTION

## 1.1 BACKGROUND AND OJECTIVES

The Regional Municipalities of Durham and York constructed the Durham York Energy Centre (DYEC) which is an Energy-from-Waste (EFW) Facility intended to provide a long-term, sustainable solution to manage municipal solid waste remaining after diversion from the Regions. The site location of the DYEC is shown in **Figure 1-1.** The facility commenced commercial operation on February 1, 2016.

An Ambient Air Quality Monitoring Plan – Durham York Residual Waste Study (Ambient Monitoring Plan) was developed and included two monitoring stations referred to as the Courtice Water Pollution Control Plant (WPCP) Station and the Rundle Road Station (as well as a temporary Fence Line Station). The plan developed for these stations was based on the Regional Council's mandate to provide ambient air quality monitoring in the area of the DYEC for a three-year period.

The purposes of the ambient air quality monitoring program are to:

1. Quantify any measurable ground level concentrations resulting from emissions from the DYEC that may act cumulatively to influence local air quality, including validating the predicted concentrations from the dispersion modelling conducted in the Environmental Assessment (Jacques Whitford, 2009).
2. Monitor concentrations of EFW-related air contaminants in nearby residential areas.
3. Quantify background ambient levels of air contaminants in the area.

Two monitoring stations (Courtice WPCP and Rundle Road Stations) in the vicinity of the DYEC were set up in April 2013 by Stantec Consulting Ltd. (Stantec) and Stantec's equipment sub-consultant for this project, Valley Environmental Services Inc. (Valley Environmental). Since May 2013, the following air contaminants have been measured at the two stations:

- Continuously monitored:
  - Sulphur Dioxide ($SO_2$)
  - Nitrogen Oxides ($NO_X$)
  - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$)
- Non-Continuously monitored:
  - Metals in Total Suspended Particulate (TSP) matter
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Dioxins and Furans

Quarterly reports presenting the ambient air quality data collected at these two stations for 2017 were prepared by Stantec and submitted to the Region. This Annual Report summarizes the results of the ambient air monitoring from January to December 2017.

At the request of the Regional Municipality of Durham, dioxin and furan sampling that was outside the scope of the Ambient Monitoring Plan (Stantec, 2012) was conducted from July 18, 2017 to September 4, 2017. During this period the dioxin/furan sampling frequency at the Courtice WPCP and Rundle Road monitoring stations was increased from once every 24 days to once every 12 days. The results of the additional sampling in 2017 have been included in the analysis provided in this report.

A third Fence Line Station was installed prior to full operation of the DYEC. Non-continuous parameters (metals and total particulate matter) are measured at this station. As per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), the Fence Line Station, which collects non-continuous parameters began operation on February 1, 2016 upon start of commercial operations. The Fence Line Station was scheduled to run for a one-year period but the period was extended through 2017.

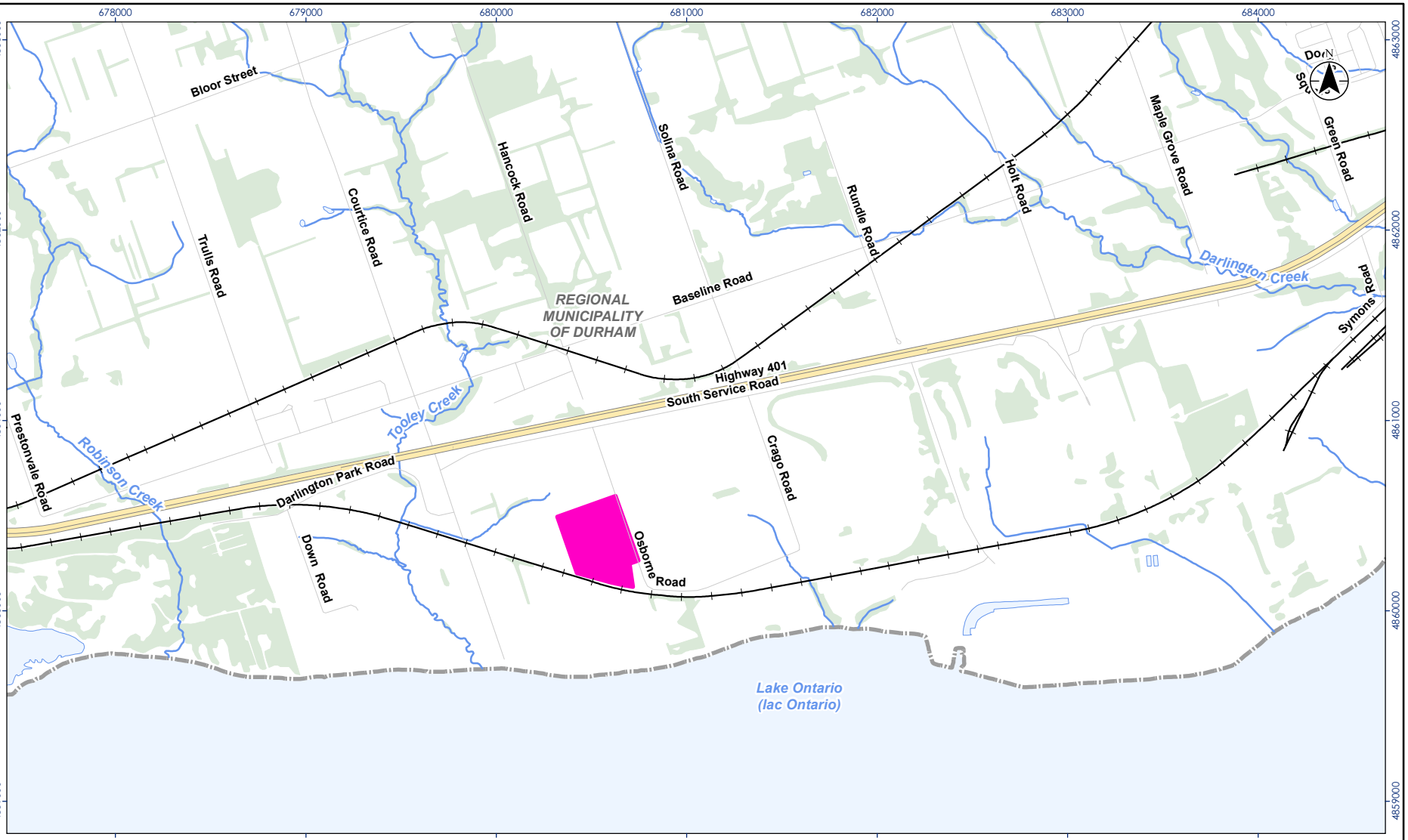
## 1.2 LOCATIONS OF AMBIENT AIR QUALITY MONITORING STATIONS

The selection of sites for the monitoring stations was done in consultation with the Ontario Ministry of Environment and Climate Change (MOECC) and Regional Municipality of Durham and York representatives based on the results of air quality modelling done in support of the environmental assessment for the project, the locations of nearby sensitive receptors, and general MOECC siting criteria. Two monitoring stations (one predominantly downwind and one predominantly upwind) were chosen for the ambient air quality program. The final locations of the monitoring stations were influenced by the availability of electrical power, accessibility of each location, and security. Details of the siting requirements are presented in the Ambient Monitoring Plan.

The Rundle Road Station is sited northeast of the DYEC in the vicinity of residential receptors predominantly downwind of the DYEC, and within the area where maximum annual concentrations are predicted to occur. This predominantly downwind station is located along Rundle Road, south of Baseline Road. Its location is shown in **Figure 1-2** and **Figure 1-3**. The monitoring station measures all the air contaminants listed in Section 1.1 and meteorological data.

The predominantly upwind Courtice WPCP Station is located at the Courtice WPCP to the southwest of the DYEC with the objective of measuring background air quality in a predominantly upwind location. The location is presented in **Figure 1-2** and **Figure 1-4**. This monitoring station measures the air contaminants presented in Section 1.1, as well as meteorological data, with the exception of wind speed and wind direction, which are measured and provided by the Courtice WPCP.

A third Fence Line Station, which measures non-continuous parameters (metals and total particulate matter), was installed prior to full operation of the DYEC. As per Section 1.2 of the Ambient Monitoring Plan (Stantec, 2012), non-continuous parameters are collected at the Fence Line Station, which began operation when the Facility commenced commercial operation on February 1, 2016. The location is presented in **Figure 1-2** and **Figure 1-5**.





Legend

- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse
- Waterbody
- Wooded Area

0 300 600 metres

1:30,000 (At original document size of 8.5x11)

**Notes**
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.

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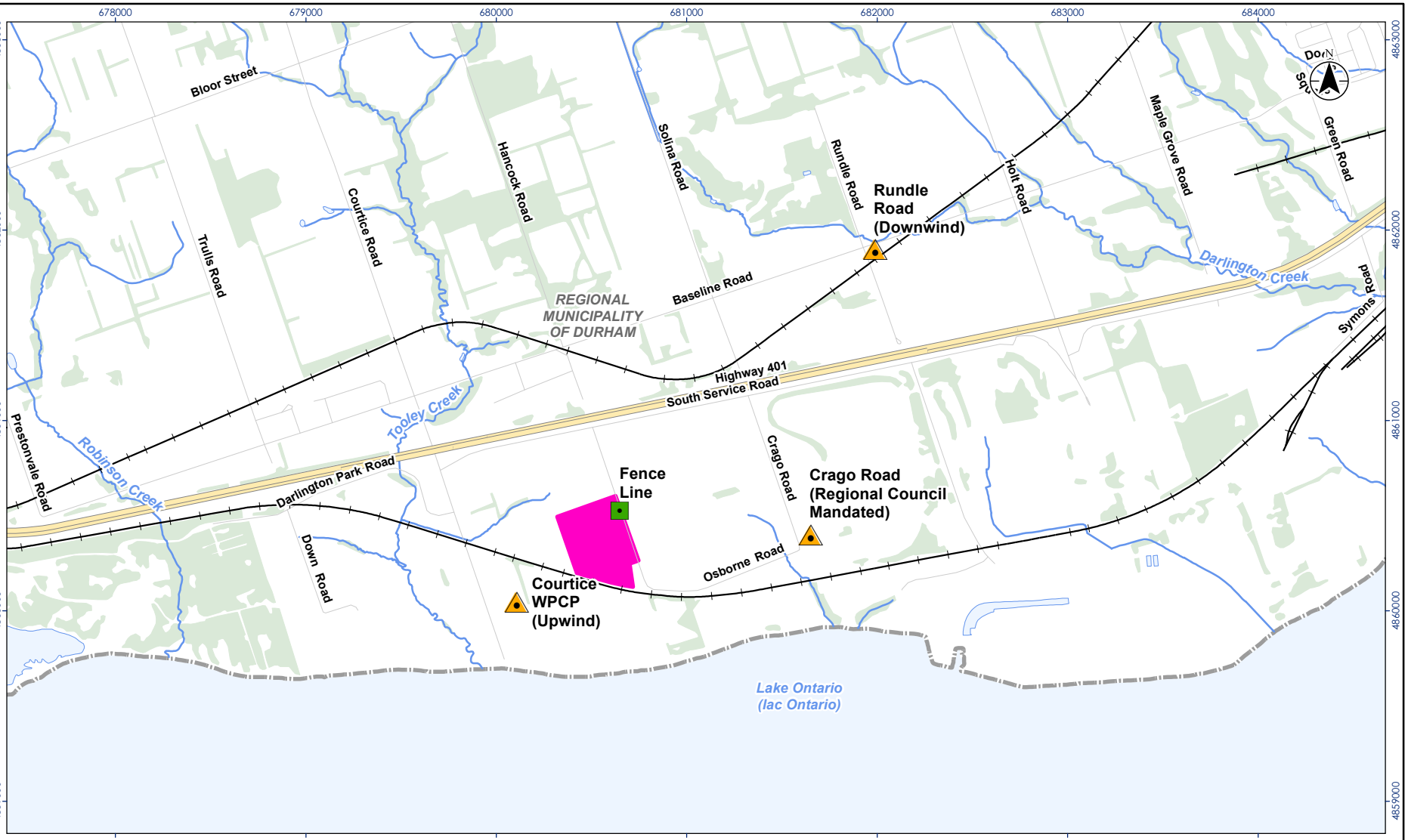
Project Location
REGIONAL MUNICIPALITY OF DURHAM

160950528 REVA
Prepared by BCC on 2018-02-05

Client/Project
THE REGION OF DURHAM
DURHAM YORK ENERGY CENTRE

Figure No.
**1-1**

Title
**Durham York Energy Centre Site Location Plan**





Legend

- Station Location
- Fence Line Station Location (Monitoring to begin after DYEC commissioning period)
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse
- Waterbody
- Wooded Area

0 300 600 metres

1:30,000 (At original document size of 8.5x11)

**Notes**
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.

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Project Location
REGIONAL MUNICIPALITY OF DURHAM

160950528 REVA
Prepared by BCC on 2018-02-05

Client/Project
THE REGION OF DURHAM
DURHAM YORK ENERGY CENTRE

Figure No.
**1-2**

Title
**Location of Ambient Air Quality Monitoring Stations**

**Figure 1-3 View of the Rundle Road Ambient Air Quality Monitoring Station**

**Figure 1-4 View of the Courtice WPCP Ambient Air Quality Monitoring Station**

**Figure 1-5 View of the Fence Line Ambient Air Quality Monitoring Station**

# 2.0 KEY COMPONENTS ASSESSED

## 2.1 METEOROLOGY

Meteorological parameters are measured at the Rundle Road and Courtice WPCP monitoring stations, as shown in **Table 2-1**.

**Table 2-1 Summary of Meteorological Parameters Measured at Each Station**

| Courtice WPCP (Upwind) Ambient Air Quality Monitoring Station | Rundle Road (Downwind) Ambient Air Quality Monitoring Station |
|---|---|
| Wind Speed and Direction at 20 m height | Wind Speed and Direction at 7.5 m height |
| Ambient Temperature at 2 m height | Ambient Temperature at 2 m height |
| Relative Humidity | Relative Humidity |
| Rainfall | Rainfall |
| Barometric Pressure | |

## 2.2 AIR QUALITY CONTAMINANTS OF CONCERN

The ambient air quality monitoring program for the DYEC includes the following contaminants specified in the Ambient Air Quality Monitoring Plan (Stantec 2012):

- Continuously monitored criteria air contaminants (CACs):
  - Sulphur Dioxide ($SO_2$)
  - Nitrogen Oxides ($NO_X$)
  - Particulate Matter smaller than 2.5 microns ($PM_{2.5}$)
- Non-Continuously monitored air contaminants:
  - Metals in Total Suspended Particulate (TSP) matter
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Dioxins and Furans

### 2.2.1 Nitrogen Oxides ($NO_X$)

Nitrogen oxides ($NO_X$) are produced in most combustion processes, and are almost entirely made up of nitric oxide (NO) and nitrogen dioxide ($NO_2$). Together, they are often referred to as $NO_X$. $NO_2$ is an orange to reddish gas that is corrosive with an irritating odour. Most $NO_2$ in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure. NO is a colourless gas. The levels of NO and $NO_2$, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight, are the most important factors in the formation of ground-level ozone ($O_3$). Further oxidation and combination with water in the atmosphere forms what is known as "acid rain".

Nitrogen oxides are emitted from a variety of combustion sources including vehicles, industrial heaters and boilers, and residential gas-fired furnaces and hot water boilers. Generally, for combustion, 5 to 10% of the initial total emissions of $NO_X$ are $NO_2$ with the remaining 90-95% being NO. The conversion of the majority of NO occurs after release to the atmosphere. The rate of conversion depends on the oxidizing potential of the atmosphere at the time of release. For example, if the ambient concentration of $O_3$ is high at the time of release, the conversion might be expected to be higher than if the ambient concentration of $O_3$ was low at that time.

### 2.2.2 Sulphur Dioxide ($SO_2$)

Sulphur dioxide ($SO_2$) is a colourless gas with a distinctive pungent sulphur odour. It is produced in combustion processes by the oxidation of sulphur in the fuel. The presence of $SO_2$ can, at high enough concentrations, cause damage to vegetation and health effects to animals through their respiratory system. The $SO_2$ can also be further oxidized and combines with water to form the sulphuric acid component of "acid rain."

Sulphur dioxide is emitted mainly from industrial sources utilizing coal, coke or oil fired heaters and boilers.

### 2.2.3 Particulate Matter

Total suspended particulate matter (TSP) is a measure of the particles in the atmosphere that are too small to settle out quickly, but remain suspended for significant periods of time. Generally, this means particles with an aerodynamic diameter of less than 44 µm. TSP is produced by a variety of emissions sources including wind erosion of agricultural fields and other open areas, abrasion of vehicle tires on paved and unpaved roads, agricultural activities, and combustion processes (e.g., industrial boilers and heaters, power generation, and vehicle emissions).

Although total suspended particulate matter is an excellent measure of the loading of particulate matter in the air, it does not necessarily reflect the health risks of the particulate matter. The larger aerodynamic particles ($PM_{10}$) are trapped by the upper airways, and do not enter the lungs. Smaller diameter particles ($PM_{2.5}$) can make their way deep into the lungs, and may become lodged there. Over the past few years, greater concern regarding these fine particles has led to research resulting in new sampling methods and criteria.

### 2.2.4 Metals

Metals may exist in elemental form or in a variety of inorganic or organic compounds. Most environmental regulators do not make distinctions between metal species, and refer to them as metals and their compounds. Both natural (biogenic) and man-made (anthropogenic) processes and sources may emit metals and their compounds into the air. The processing of minerals, fuel combustion, and the wearing out of motor vehicle tires and brake pads result in the emission of metals associated with particulate matter. Metals occur naturally in soil and rock - weathering of the rocks, mining/construction activities, etc. can release metals into air as particulate matter.

The following is a list of the specific metals being measured. The rationales for the choice of air contaminants being monitored are provided in the Ambient Air Quality Monitoring Plan (Stantec, 2012).

**Metals:**

- Aluminum (Al)
- Antimony (Sb)
- Arsenic (As)
- Barium (Ba)
- Beryllium (Be)
- Bismuth (Bi)
- Boron (B)
- Cadmium (Cd)
- Cobalt (Co)
- Copper (Cu)
- Chromium (Cr) (Total)
- Iron (Fe)
- Lead (Pb)
- Magnesium (Mg)
- Manganese (Mn)
- Mercury (Hg)
- Molybdenum (Mo)
- Nickel (Ni)
- Phosphorus (Ph)
- Selenium (Se)
- Silver (Ag)
- Strontium (Sr)
- Thallium (Tl)
- Tin (Sn)
- Titanium (Ti)
- Uranium (U)
- Vanadium (V)
- Zinc (Zn)
- Zirconium (Zr)

### 2.2.5 Polycyclic Aromatic Hydrocarbons (PAH)

Polycyclic aromatic hydrocarbons (PAHs) are a large group of organic compounds with two or more fused aromatic rings. PAHs are formed mainly as a result of pyrolytic processes, especially the incomplete combustion of organic materials during industrial and other human activities, such as processing of coal and crude oil, combustion of natural gas, vehicle traffic, cooking and tobacco smoking.

The following is a list of PAHs being measured for the ambient air monitoring program. Rationales for the choice of contaminants being monitored are provided in the Ambient Air Quality Monitoring Plan (Stantec, 2012).

**Polycyclic Aromatic Hydrocarbons:**

- 1-Methylnaphthalene
- 2-Methylnaphthalene
- Acenaphthene
- Benzo(b)fluoranthene
- Benzo(e)pyrene
- Benzo(g,h,i)perylene
- Indeno(1,2,3-cd) pyrene
- Naphthalene
- Perylene

- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)fluorene
- Benzo(a)pyrene
- Benzo(b)fluorene
- Benzo(k)fluoranthene
- Biphenol
- Chrysene
- Dibenz(a,h)anthracene
- Dibenz(a,c)anthracene
- Fluoranthene
- Phenanthrene
- Pyrene
- Tetralin
- o-Terphenyl
- Total PAH

### 2.2.6 Dioxins and Furans

"Dioxins and furans" refers to a family of toxic substances that share a similar chemical structure. Dioxins and furans contain chlorine and can occur in different configurations, called congeners. Most dioxins and furans are not produced intentionally, but are created when other chemicals or products are manufactured. Of all the dioxins and furans, one cogener 2,3,7,8-tetrachloro-p-dibenzo-dioxin (2,3,7,8 Tetra CDD) is considered the most toxic. International toxicity equivalency factors (I-TEFs) are applied to 17 dioxin and furan isomers to convert them into an equivalent 2,3,7,8 Tetra CDD concentration (I-TEQ) for comparison to ambient air quality criteria.

Concentrations of the following dioxins and furans are measured:

**Dioxins and Furans:**

- 2,3,7,8-Tetra CDD
- 1,2,3,7,8-Penta CDD
- 1,2,3,4,7,8-Hexa CDD
- 1,2,3,6,7,8-Hexa CDD
- 1,2,3,7,8,9-Hexa CDD
- 1,2,3,4,6,7,8-Hepta CDD
- Octa CDD
- Total Tetra CDD
- Total Penta CDD
- Total Hexa CDD
- Total Hepta CDD
- 2,3,7,8-Tetra CDF
- 1,2,3,7,8-Penta CDF
- 2,3,4,7,8-Penta CDF
- 1,2,3,4,7,8-Hexa CDF
- 1,2,3,6,7,8-Hexa CDF
- 2,3,4,6,7,8-Hexa CDF
- 1,2,3,7,8,9-Hexa CDF
- 1,2,3,4,6,7,8-Hepta CDF
- Octa CDF
- Total Tetra CDF
- Total Penta CDF
- Total Hexa CDF
- Total Hepta CDF
- Total toxic equivalency (I-TEQ)

## 2.3 AIR QUALITY CRITERIA

Two sets of criteria were used for comparison to the air quality data as specified in the Ambient Monitoring Plan (Stantec, 2012); one based on regulatory limits, and the second developed in the human health risk assessment (HHRA) completed as part of the Environmental Assessment of the DYEC. The regulatory criteria include:

- Schedule 3 Standards of O. Reg. 419/05
- Schedule 6 Upper Risk Thresholds (URT) of O. Reg. 419/05
- Ontario Ambient Air Quality Criteria (AAQC)

- Canadian Ambient Air Quality Standards (CAAQS)

In December 2016, O. Reg. 419/05 Standards, Guidelines, and Jurisdictional Screening Levels were consolidated into a new format known as the "Air Contaminants Benchmarks List: Standards, Guidelines, and Screening Levels for Assessing Point of Impingement Concentrations of Air Contaminants" (MOECC, 2016) (ACB List).

Not all chemicals have regulatory criteria. Therefore, in some instances updated health-based criteria were used in the human health risk assessment (HHRA) conducted in support of the Environmental Assessment (July 31, 2009 - December 10, 2009). These health-based values, which were reported in Table 7-2 (Summary of Inhalation TRVs and Inhalation Benchmarks Selected for CACs) and Table 7-3 (Inhalation TRVs and Inhalation Benchmarks for Selected COPCs) of the HHRA (Stantec, 2009) were used as the second set of criteria.

The previously applicable 24-hour Canada-Wide Standard (CWS) for $PM_{2.5}$ of 30 µg/m$^3$ (98$^{th}$ percentile averaged over 3 consecutive years) has been superseded by the new Canadian Ambient Air Quality Standard (CAAQS) of 28 µg/m$^3$ (98$^{th}$ percentile averaged over three consecutive years) and the annual objective of 10 µg/m$^3$ as noted in **Table 2-2**. The proposed CAAQS 24-hour objective for 2020 is 27 µg/m$^3$.

There is an AAQC for nitrogen dioxide ($NO_2$) as well as a Schedule 3 Standard for nitrogen oxides ($NO_X$) which is based on health effects of $NO_2$, as $NO_2$ has adverse health effects at much lower concentrations than nitric oxide (NO). At the request of the MOECC (MOECC, 2017), ambient $NO_X$ measurements are not compared with the $NO_2$ AAQC or Schedule 3 $NO_X$ Standard.

A summary of the relevant ambient air quality criteria is presented in **Table 2-2** to **Table 2-4**.

## Table 2-2 Summary of Air Quality Criteria for CACs

| Contaminant | CAS | Regulatory Criteria | | | HHRA Health-Based Criteria | | |
|---|---|---|---|---|---|---|---|
| | | 1-Hour (ppb / µg/m³) | 24-Hour (ppb / µg/m³) | Annual (ppb / µg/m³) | 1-Hour (ppb / µg/m³) | 24-Hour (ppb / µg/m³) | Annual (ppb / µg/m³) |
| Sulphur dioxide | 7446095 | 250 /690 | 100 / 275 | 20 / 55 | 250 / 690 | 100 / 275 | 11 / 29 |
| Nitrogen dioxide [A] | 10102-44-0 | 200 /400 | 100 / 200 | - | 200 / 400 | 100 / 200 | 30 / 60 |
| **Contaminant** | **CAS** | **Canadian Ambient Air Quality Standards (CAAQS)** | | | **HHRA Health-Based Criteria** | | |
| | | **1-Hour (µg/m³)** | **24-Hour (µg/m³)** | **Annual (µg/m³)** | **1-Hour (µg/m³)** | **24-Hour (µg/m³)** | **Annual (µg/m³)** |
| $PM_{2.5}$ | N/A | - | 28 [A] | 10 [B] | - | 30 [C] | - |

**Notes**:

A. The Schedule 3 Standard for $NO_X$ is based on health effects of $NO_2$, as $NO_2$ has adverse health effects at much lower concentrations than NO. Therefore, the Ontario AAQC is compared to $NO_2$ in this report. $NO_X$ and NO are not compared to regulatory criteria but are included for completeness.

B. Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the 98th percentile over 3 consecutive years.

C. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the three-year average of the annual average concentrations.

D. HHRA Health-Based criterion for $PM_{2.5}$ was selected referencing CCME (2006).

## Table 2-3 Summary of Air Quality Criteria for Metals

| Contaminant | CAS | Regulatory Criteria | | | HHRA Health-Based Criteria | | |
|---|---|---|---|---|---|---|---|
| | | 1-Hour (µg/m³) | 24-Hour (µg/m³) | Other time Period (µg/m³) | 1-Hour (µg/m³) | 24-Hour (µg/m³) | Annual (µg/m³) |
| Total Particulate | NA | - | 120 | - | - | 120 | 60 |
| Aluminum | 7429-90-5 | - | 4.8 | - | - | - | - |
| Antimony | 7440-36-0 | - | 25 | - | 5 | 25 | 0.2 |
| Arsenic | 7440-38-2 | - | 0.3 | - | 0.2 | 0.3 | 0.015 [A] 0.0043 [B] |
| Barium | 7440-39-3 | - | 10 | - | 5 | 10 | 1 |
| Beryllium | 7440-41-7 | - | 0.01 | - | 0.02 | 0.01 | 0.007 [A] 0.0024 [B] |
| Bismuth | 7440-69-9 | - | | | | | |
| Boron | 7440-42-8 | - | 120 | - | 50 | - | 5 |
| Cadmium | 7440-43-9 | - | 0.025 | 0.005; annual | 0.1 | 0.025 | 0.005 [A] 0.0098 [B] |

## Table 2-3 Summary of Air Quality Criteria for Metals

| Contaminant | CAS | Regulatory Criteria | | | HHRA Health-Based Criteria | | |
|---|---|---|---|---|---|---|---|
| | | 1-Hour (µg/m³) | 24-Hour (µg/m³) | Other time Period (µg/m³) | 1-Hour (µg/m³) | 24-Hour (µg/m³) | Annual (µg/m³) |
| Chromium (Total) | 7440-47-3 | - | 0.5 | - | 1 | - | 60 |
| Cobalt | 7440-48-4 | - | 0.1 | - | 0.2 | 0.1 | 0.1 |
| Copper | 8440-50-8 | - | 50 | - | - | - | - |
| Iron | 15438-31-0 | - | 4 | - | - | - | - |
| Lead | 7439-92-1 | - | 0.5 | 0.2; 30-day | 1.5 | 0.5 | 0.5 |
| Magnesium | 7439-95-4 | - | | | | | |
| Manganese | 7439-96-5 | - | 0.4 | - | - | - | - |
| Mercury | 7439-97-6 | - | 2 | - | 0.6 | 2 | 0.3 |
| Molybdenum | 7439-87-7 | - | 120 | - | - | - | - |
| Nickel | 7440-02-0 | - | 0.2 | 0.04; annual | 6 | - | 0.05 |
| Phosphorus | 7723-14-0 | - | - | - | - | - | $6.4 \times 10^7$ |
| Selenium | 7782-49-2 | - | 10 | - | 2 | 10 | 0.2 |
| Silver | 7440-22-4 | - | 1 | - | 0.1 | 1 | 0.01 |
| Strontium | 7440-24-6 | - | 120 | - | - | - | - |
| Thallium | 7440-28-0 | - | - | - | 1 | - | 0.1 |
| Tin | 7440-31-5 | - | 10 | - | 20 | 10 | 2 |
| Titanium | 7440-32-6 | - | 120 | - | - | - | - |
| Vanadium | 7440-62-2 | - | 2 | - | 0.5 | 1 | 1 |
| Uranium | 7440-61-1 | - | 1.5 | 0.03; annual | - | - | - |
| Zinc | 7440-66-6 | - | 120 | - | 50 | - | 5 |
| Zirconium | 7440-67-7 | - | 20 | - | - | - | - |

**Notes:**

A. Annual Average

B. Carcinogenic Annual Average

## Table 2-4 Summary of Air Quality Criteria for PAHs and D/Fs

| Contaminant | CAS | Regulatory Criteria | | | HHRA Health-Based Criteria | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1-Hour ($ng/m^3$) | 24-Hour ($ng/m^3$) | Other time Period ($ng/m^3$) | 1-Hour ($ng/m^3$) | 24-Hour ($ng/m^3$) | Annual ($ng/m^3$) | Toxic Equivalency Factor Annual [A, G] $(ng/m^3)^{-1}$ |
| 1-Methylnaphthalene | 90-12-0 | - | 12,000 | - | - | - | 3,000 | - |
| 2-Methylnaphthalene | 91-57-6 | - | 10,000 | - | - | - | 3,000 | - |
| Acenaphthene | 83-32-9 | - | - | - | 1,000 | - | - | 1 |
| Acenaphthylene | 208-96-8 | - | 3,500 | - | 1,000 | - | - | 10 |
| Anthracene | 120-12-7 | - | 200 | - | 500 | - | 50 | - |
| Benzo(a)anthracene | 56-55-3 | - | - | - | 500 | - | - | 100 |
| Benzo(b)fluoranthene | 205-99-2 | - | - | - | 500 | - | - | 100 |
| Benzo(k)fluoranthene | 207 -08-9 | - | - | - | 500 | - | - | 100 |
| Benzo(a)fluorene | 238-84-6 | - | - | - | 500 | - | 50 | - |
| Benzo(b)fluorene | 243-17-4 | - | - | - | 500 | - | 50 | - |
| Benzo (g,h,i) perylene | 191-24-2 | - | - | - | 500 | - | - | 100 |
| Benzo(a)pyrene | 50-32-8 | - | 0.05 [B]<br>5 [C]<br>1.1 [D] | 0.01; annual | - | 1 | 87 [A] | - |
| Benzo(e)pyrene | 192-97-2 | - | - | - | 500 | - | - | 10 |
| Biphenyl | 92-52-4 | - | - | - | - | - | 224,000 | - |
| Chrysene | 218-01-9 | - | | | | | | - |
| Dibenzo(a,c)anthracene | 215-58-7 | - | - | - | - | - | - | 100 |
| Dibenzo(a,h)anthracene | 53-70-3 | - | - | - | 500 | - | - | 1,000 |
| Fluoranthene | 206-44-0 | - | - | - | 500 | - | - | 1 |
| Indeno(1,2,3-cd) pyrene | 193-39-5 | - | - | - | 500 | - | - | 100 |
| Naphthalene | 91-20-3 | - | 22,500 | - | - | 22,500 | 3,000 | - |
| o-Terphenyl | 84-15-1 | - | - | - | 50,000 | - | 5,000 | - |
| Perylene | 198-55-0 | - | - | - | 500 | - | - | 1 |
| Phenanthrene | 85-01-8 | - | - | - | 500 | - | - | 1 |

## Table 2-4 Summary of Air Quality Criteria for PAHs and D/Fs

| Contaminant | CAS | Regulatory Criteria | | | HHRA Health-Based Criteria | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1-Hour ($ng/m^3$) | 24-Hour ($ng/m^3$) | Other time Period ($ng/m^3$) | 1-Hour ($ng/m^3$) | 24-Hour ($ng/m^3$) | Annual ($ng/m^3$) | Toxic Equivalency Factor Annual [A, G] $(ng/m^3)^{-1}$ |
| Pyrene | 129-00-0 | - | - | - | 500 | - | - | 1 |
| Tetralin | 119-64-2 | - | | | | | | - |
| Dioxins and Furans Total Toxic Equivalency [E] | NA | - | 0.1 (pg TEQ/$m^3$) [F]<br>1 (pg TEQ/$m^3$) [C] | - | - | - | - | - |

**Notes:**

A. Carcinogenic Annual Average. Units in $(ng/m^3)^{-1}$.

B. Ontario Ambient Air Quality Criteria - The Standard for benzo(a)pyrene (B(a)P) is for B(a)P as a surrogate for PAHs.

C. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds.

D. O. Reg. 419/05 24 Hour Guideline.

E. Application of the air Standard for dioxins, furans, and dioxin-like PCBs requires the calculation of the total toxicity equivalent (TEQ) concentration contributed by all dioxin-like compounds in the mixture. TEQ is calculated using the methodology as per the ACB List, and the corresponding $WHO_{2005}$ toxic equivalency factors (TEFs).

F. O. Reg. 419/05 Schedule 3 Standard phased in after July 1, 2016.

G. Toxic Equivalency Factors (TEFs) are shown as benzo(a)pyrene equivalents.

# 3.0 INSTRUMENTATION AND OPERATIONS SUMMARY

## 3.1 INSTRUMENTATION

The measurement program at the monitoring sites includes both continuous and non-continuous monitors to sample air contaminant concentrations.

Monitoring for respirable particulate matter ($PM_{2.5}$), nitrogen oxides ($NO_X$) and sulphur dioxide ($SO_2$) is conducted on a continuous basis. A summary of the continuous monitors and a brief description of their principle of operation are provided in **Table 3-1** below.

**Table 3-1 Summary of Continuous Ambient Air Quality Monitors**

| Contaminant | Monitor | Principle of Operation | Range | Time Interval |
|---|---|---|---|---|
| $PM_{2.5}$ | Thermo Sharp 5030 Synchronized Hybrid Ambient Real-time Particulate Monitor | Light Scattering Photometry / Beta Attenuation - Consists of a carbon14 source, detector and light scattering Nephelometer in a rack-mountable enclosure. The Thermo Sharp utilizes a continuous (non-step wise) hybrid mass measurement and a combination of beta attenuation and light scattering technology. The unit's filter tape is automatically advanced based upon a user defined frequency or particulate loading. | 0 - 10 $mg/m^3$ | 1 minute |
| NO, $NO_2$, $NO_X$ | API Model 200E Chemiluminescence Analyzer | Chemiluminescence - Uses a chemiluminescence detection principle and microprocessor technology for ambient continuous emissions monitoring (CEM). Measurements are automatically compensated for temperature and pressure changes. | 0 – 1000 ppb | 1 second |
| $SO_2$ | Teledyne Monitor Labs Sulphur Dioxide Analyzer Model T100 | Pulsed Florescence - $SO_2$ levels are measured based on the principle that $SO_2$ has a strong ultraviolet (UV) absorption at a wavelength between 200 and 240 nanometres (nm). The absorption of photons at these wavelengths results in the emission of fluorescence photons at a higher wavelength. The amount of fluorescence measured is directly proportional to the concentration of $SO_2$. | 0 – 1000 ppb | 1 second |

Two manually operated, High-Volume (Hi-Vol) air samplers are installed at both the Courtice WPCP (predominantly upwind) and Rundle Road (predominantly downwind) Stations to collect metals in total suspended particulate (TSP), polycyclic aromatic hydrocarbons (PAHs), and dioxins and furans. Sampling for these contaminants is conducted following the methodology and analyses described in the Ambient Monitoring Plan (Stantec, 2012), as presented in **Table 3-2**. Monitoring for metals in TSP is also conducted at the Fence Line Station. The samples were submitted to Maxxam Analytics Inc., a Canadian Association for Laboratory Accreditation Inc. (CALA)/Standards Council of Canada (SCC) accredited laboratory, for analysis.

**Table 3-2 Summary of Non-Continuous Ambient Air Quality Monitors**

| Contaminant | Sampler | Filter Media | Lab Analysis | Sampling Schedule |
|---|---|---|---|---|
| TSP and metals | Tisch Environmental TE-5170 mass-flow high volume sampler | Pre-weighed, conditioned Teflon coated glass fibre filters | Weighed for particulate loading and analysed using the Atomic Emission Spectroscopy / Inductively Coupled Plasma (AES/ICP) technique to determine metals content | 24-hour sample taken every 6 days |
| PAHs | Tisch Environmental TE-1000 mass-flow high volume air sampler | Dual chambered sampling module with a Teflon-coated glass fibre filter and a Poly-Urethane Foam (PUF) cartridge | Gas Chromatography / Mass Spectrometry (GC/MS) | 24-hour sample taken every 12 days |
| Dioxins and Furans | | | | 24-hour sample taken every 24 days. At the request of the Region this frequency was increased to once every 12 days from July 18, 2017 to September 4, 2017. |

Horizontal wind speed, wind direction, atmospheric temperature, relative humidity and rainfall are measured at the predominantly downwind Rundle Road station. The meteorological sensors at the Rundle Road Station are mounted on an external 7.5 m aluminum tower. Atmospheric temperature, relative humidity, rainfall, and barometric pressure are measured at the predominantly upwind Courtice WPCP Station. Wind speed and wind direction data at the predominantly upwind location are measured on a 20 m tower and are provided by the Courtice WPCP.

The meteorological equipment is summarized in **Table 3-3.**

**Table 3-3 Summary of Meteorological Equipment**

| Parameter | Equipment |
|---|---|
| Wind Speed/Wind Direction | Met One Instruments Inc. Model 034B |
| Temperature/Relative Humidity | Campbell Scientific Model HMP60 |
| Atmospheric Pressure | Campbell Scientific Model CS106 |
| Rainfall | Texas Electronic TE525M |

A Campbell Scientific CRX1000 station data acquisition system (DAS) is used to collect continuous instrument monitoring data and status codes from the ambient air quality monitors. Continuous station data are maintained in the data loggers, and data is viewed locally using a laptop and the relevant DAS software applications. Continuous monitoring data is remotely collected via cellular modem.

## 3.2 MONITORING STATION VISITS AND REGULAR MAINTENANCE ACTIVITIES

Visits to the monitoring stations were conducted by personnel from Stantec, Valley Environmental Services (Valley Environmental) or Rotek Environmental Inc. (Rotek) for routine maintenance, setup of the non-continuous monitoring runs, and on an as-needed basis to verify the operation of the monitoring equipment as prescribed by the Ambient Monitoring Plan (Stantec, 2012). During the station visits, the integrity and operation of the sampling and monitoring equipment and of the data acquisition systems were verified. These checks were done to ensure the collection of valid and complete data, as well as to support the continued safe and secure environment at the station.

Station visits in 2017 were documented in the site logbook, and visual checks of the equipment were documented during each site visit in an Ambient Pod Checklist. Rotek was retained by Stantec to replace Valley Environmental for maintenance and calibration of the monitoring stations in July 2017. A list of the regular and major preventative maintenance activities performed by Stantec, Valley Environmental or Rotek during the station visits in 2017, is presented in **Table A-1** in **Appendix A**. Due to scheduling conflicts during the transition between subcontractors, annual preventative maintenance of the temperature, relative humidity, rainfall, and barometric pressure measurement equipment at the Rundle Road Station was deferred to Q2 2018. The pneumatic leak checks of the $SO_2$ analyzers at both stations were also deferred to Q2 2018 due to scheduling conflicts.

Daily diagnostic tests were performed remotely on the continuous monitoring equipment and station parameters to check for anomalous data and assess whether the equipment was functioning normally. Any issues identified were immediately assessed and rectified as soon as possible. If required, Valley Environmental or Rotek were notified to dispatch a trained technician to address the issue.

## 3.3 DATA ACQUISITION/ARCHIVING

Data from the continuous monitors at each station are maintained in the data loggers. These data were viewed and collected via the automated data acquisition systems and cell phone modems.

- On a daily basis during weekdays, each data logger was remotely accessed and the current data were reviewed to check the operational status of each monitor and for anomalous data.
- Data was downloaded and backed-up once a week (to a separate file location) to avoid any file overwriting or data loss.
- The full set of collected data was reviewed including manual verification of values, invalidating false/suspicious/calibration data, etc. The protocols used to invalidate continuous data followed those provided in Table 5 of the MOECC Operations Manual (MOECC, 2008).

Details of the data editing are presented in the four Quarterly Ambient Air Quality Monitoring Reports for the Durham York Energy Centre (Stantec, 2017a; Stantec, 2017b; Stantec, 2017c; Stantec, 2018).

## 3.4 INSTRUMENTATION CALIBRATION

**Continuous Monitors**

On-going performance checks and external calibrations of the continuous monitors were performed monthly. This meets the recommended calibration schedule listed in the MOECC Operations Manual (MOECC, 2008). The external calibrations for the $NO_X$ and $SO_2$ monitors involved challenging each monitor with certified calibration gases (each referenced to a primary standard) for zero and span measurements.

**Non-Continuous Monitors**

The high-volume air samplers were calibrated at a minimum monthly (or after any motor maintenance) during the sampling period. The calibration frequency exceeded the MOECC Operations Manual (MOECC, 2008) requirement of quarterly calibrations.

A summary of the calibration tasks that are required and have been performed for each sampler are provided in **Table A-2** in **Appendix A**.

## 3.5 MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE MONITOR PERFORMANCE AND SITE AUDITS

Four MOECC audits of the continuous monitors ($PM_{2.5}$, $SO_2$, and $NO_X/NO_2/NO$) were conducted in 2017. These were done on February 23, June 20, September 29, and December 13 at both the Courtice WPCP and Rundle Road Stations. All the continuous monitors passed the MOECC performance and site audits on February 23, September 29, and December 13. The $NO_X$ monitor at the Courtice WPCP Station did not pass the site audit on June 20, 2017, while all monitors at the Rundle Road Station, and the $SO_2$ and $PM_{2.5}$ monitors at the Courtice WPCP Station passed the audit. The NOx monitor's span setting was found to be outside of the MOECC allowable range during the June 20 audit. The issue was determined to be due to Valley Environmental's calibration gas cylinder's certified concentration being 5% low. The monitor was immediately recalibrated during the audit using the MOECC's calibration gas. Span adjustments were applied to affected data and no data was lost. Following the June 20, 2017 audit, Stantec retained the services of Rotek to conduct maintenance and calibrations for the continuous monitors.

MOECC performance and site audits of the non-continuous air samplers (TSP/metals and PAH/Dioxin and Furans) were conducted on March 3, June 20, and September 29 in 2017. All non-continuous monitors passed the MOECC performance and site audits.

## 3.6 INSTRUMENTATION ISSUES

There were some instrumentation issues encountered during 2017. These were generally associated with power outages and wildlife interactions. There were some minor equipment issues that commonly occur when operating instrumentation continuously for extended periods of time including instrument repairs conducted under manufacturer's warranty.

A summary of operational issues and the resolution for each measurement parameter during the 2017 monitoring period is presented in **Tables A-3, A-4** and **A-5** in **Appendix A** for the Courtice WPCP, Rundle Road, and Fence Line Stations, respectively.

## 3.7 DATA RECOVERY RATES

Data recovery rates for each continuous monitor at the two monitoring stations during the 2017 sampling period (January to December 2017) are presented in **Table 3-4** and **Table 3-5**. The data recovery rates for the measured air contaminants at both stations met or surpassed MOECC requirements for data validity. Data recovery rates for the three stations ranged from 94% to 100%.

## Table 3-4 Summary of Data Recovery Rates for the Courtice WPCP Station (Upwind) – 2017 Monitoring Period

| Parameter | Valid Measurement Hours | Data Recovery Rate (%) |
|---|---|---|
| $SO_2$ | 8717 | 99.5% [A] |
| $NO_X$ | 8705 | 99.4% [A] |
| $PM_{2.5}$ | 8227 | 94% [A] |
| Temperature | 8760 | 100% [A] |
| Rainfall | 8760 | 100% [A] |
| Relative Humidity | 8760 | 100% [A] |
| Pressure | 8760 | 100% [A] |
| Wind Speed/Direction | 8732 | 99.7% [A] |
| TSP/Metals | 61 [B] | 100% |
| PAHs | 30 [B] | 100% |
| Dioxins and Furans | 16 [B, C] | 100% |

**Notes:**

A. Includes instrumentation issues summarized in Appendix Table A3, quarterly MOECC audit and monthly calibrations.

B. Number of filters/24-hour average samples.

C. Includes additional dioxins and furans sampling requested by the Regional Municipality of Durham

## Table 3-5 Summary of Data Recovery Rates for the Rundle Road Station (Downwind) – 2017 Monitoring Period

| Parameter | Valid Measurement Hours | Data Recovery Rate (%) |
|---|---|---|
| $SO_2$ | 8727 | 99.6% [A] |
| $NO_X$ | 8714 | 99.5% [A] |
| $PM_{2.5}$ | 8678 | 99% [A] |
| Temperature | 8760 | 100% [A] |
| Rainfall | 8760 | 100% [A] |
| Relative Humidity | 8760 | 100% [A] |
| Wind Speed/Direction | 8748 | 99.9% [A] |
| TSP/Metals | 60 [B] | 98% |
| PAHs | 29 [B] | 97% |
| Dioxins and Furans | 15 [B] | 94% |

**Notes:**

A. Includes instrumentation issues summarized Appendix Table A4, quarterly MOECC audit and monthly calibrations.

B. Number of filters/24-hour average samples.

**Table 3-6 Summary of Data Recovery Rates for the Fence Line Station – 2017 Monitoring Period**

| Parameter | Valid Measurements | Data Recovery Rate (%) |
|---|---|---|
| TSP/Metals | 61 [A] | 100% |

**Notes:**

A. Includes instrumentation issues summarized Appendix Table A5. Number of filters/24-hour average samples.

## 3.8 FIELD CONDITION OBSERVATIONS

During 2017, activities in the vicinity of the ambient air monitoring stations were observed that had the potential to affect air quality levels. These observations were noted by Stantec, Valley Environmental, and Rotek personnel during field visits and by Regional Municipality of Durham personnel located at the DYEC.

Construction of Highway 418, which will connect with Highway 401 between Courtice and Crago Roads, has been ongoing since April 2016. Highway 418 will provide a north-south link between Highway 401 and the Phase 2 expansion of Highway 407. The Highway 401/418 interchange will be located almost directly north of the DYEC.

Construction from January through March 2017 included a camp on Baseline Road, approximately 1.5 km west of the Rundle Road Station. **Figure 3-1** shows construction activities during this time. Between January and March, hydro crews were observed working in a large area immediately north of the DYEC between Energy Drive and Highway 401 for the relocation/re-alignment of South Service Road.

Excavator and dump truck crews were observed working in a large area immediately north of the DYEC between Energy Drive and Highway 401 for the relocation/re-alignment of South Service Road from April to June. A photograph of South Service Road re-alignment construction is shown in **Figure 3-2**.

Heavy vehicle operations were observed in late November that likely contributed to elevated TSP measurements at the Rundle Road Station on November 27, 2017. A photograph of the observed heavy vehicle operations during this time is included in **Figure 3-3**.

Other activities in the vicinities of the monitoring stations that had the potential to affect local air quality in 2017 included:

- a fire at the waste management transfer facility north of Highway 401 on August 26 and 27, 2017
- trucks idling while loading and unloading supplies at the WPCP Chemical Building (approximately 50 m north of the Courtice WPCP Station)

**Figure 3-1 View Looking North from Baseline Road at the Highway 418 Construction Area**

**Figure 3-2 Looking South from Existing South Service Road at South Service Road Realignment Construction (June 1, 2017)**

**Figure 3-3 Looking West from Rundle Road Station at Heavy Truck Operations on Adjacent Unpaved Road (November 28, 2017)**

# 4.0 SUMMARY OF AMBIENT MEASUREMENTS

The following sections provide summaries of the validated data for each measured parameter.

## 4.1 METEOROLOGICAL DATA

A summary of the maximum, minimum, arithmetic mean, and standard deviation of the hourly average meteorological parameters measured at the two monitoring stations for January - December 2017 is presented in **Table 4-1**.

**Table 4-1 Summary of Hourly Meteorological Measurements – 2017 Monitoring Period**

| Parameter | | Courtice WPCP (Upwind) | Rundle Road (Downwind) | Units |
|---|---|---|---|---|
| Temperature | Maximum | 29.4 | 29.8 | C |
| | Minimum | -23.6 | -24.4 | C |
| | Mean | 8.4 | 8.1 | C |
| | Standard Deviation | 9.8 | 10.1 | C |
| Rainfall | Maximum | 15.2 | 15.6 | mm |
| | Minimum | 0.0 | 0.0 | mm |
| | Mean | 0.10 | 0.11 | mm |
| | Standard Deviation | 0.56 | 0.62 | mm |
| Relative Humidity | Maximum | 95.7 | 100.0 | % |
| | Minimum | 21.0 | 24.9 | % |
| | Mean | 71.7 | 76.0 | % |
| | Standard Deviation | 13.9 | 15.3 | % |
| Pressure [A] | Maximum | 30.5 | - | in Hg |
| | Minimum | 28.8 | - | in Hg |
| | Mean | 29.7 | - | in Hg |
| | Standard Deviation | 0.2 | - | in Hg |
| Wind Speed [B] | Maximum | 55.9 | 43.6 | km/hr |
| | Minimum | 0.1 | 0.0 | km/hr |
| | Mean | 12.0 | 10.6 | km/hr |
| | Standard Deviation | 7.3 | 6.8 | km/hr |

**Notes:**

A. Pressure is not measured at the Rundle Road Station.

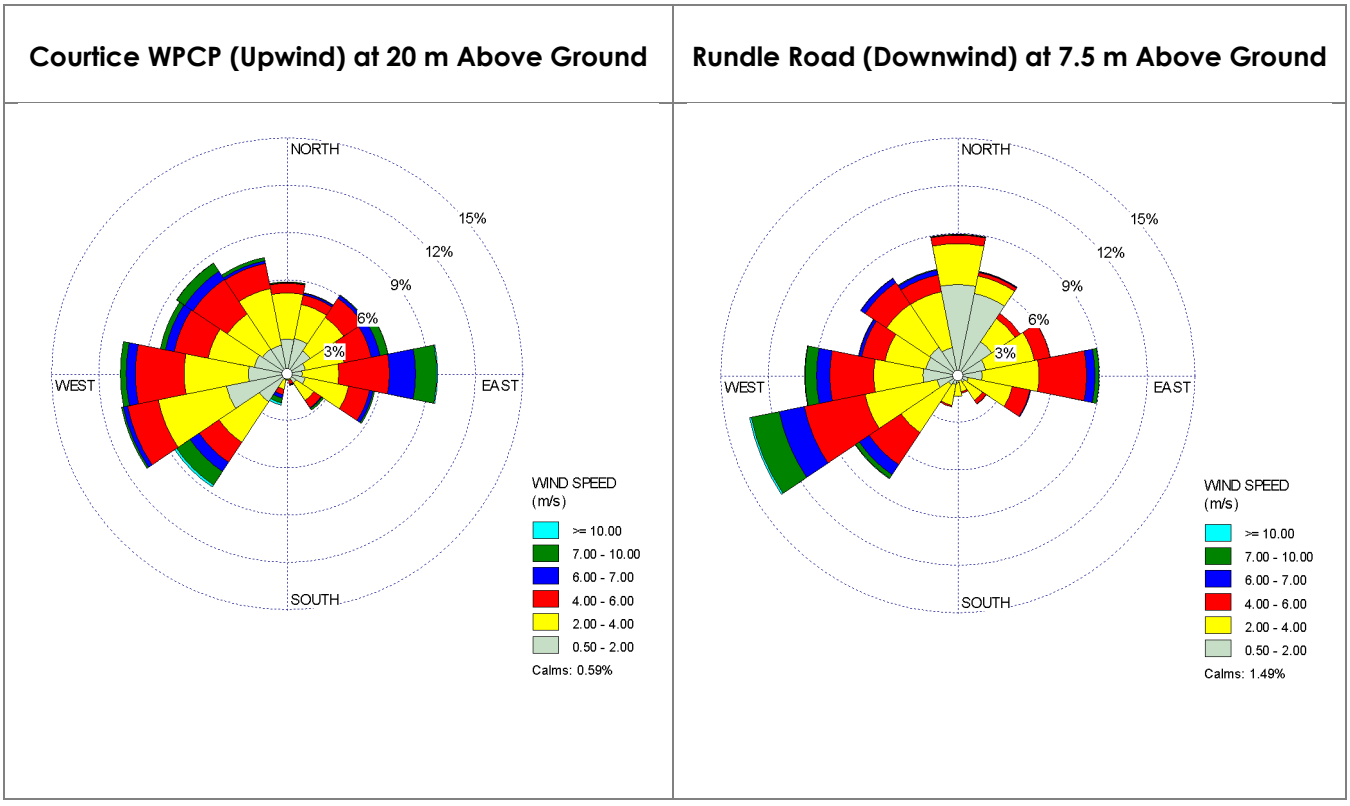
B. Wind speed at the Courtice WPCP Station is measured at 20 m and at the Rundle Road Station at 10 m.

At the Courtice WPCP (Upwind) Station (located near Lake Ontario), wind data were measured and provided by the Courtice WPCP on a 20 m tower, while at the Rundle Road (Downwind) Station they were measured on a 7.5 m tower.

Wind roses showing the directionality and speed at each location are presented in **Figure 4-1**. The length of the radial barbs gives the total percent frequency of winds from the indicated direction, while portions of the barbs of different widths indicate the frequency associated with each wind speed category.

Winds over the twelve-month monitoring period in 2017 at the Courtice WPCP Station occurred predominantly from southwesterly to northwesterly and easterly directions. Winds blew infrequently from the south. At the Rundle Road Station, the predominant wind directions were winds blowing from westerly to west-southwesterly along with northerly and easterly directions. As with the Courtice WPCP Station, the wind contribution from the south was low for the Rundle Road Station.

**Figure 4-1 Wind Roses for the 2017 Monitoring Period (Jan-Dec 2017)**



## 4.2 CAC AMBIENT AIR QUALITY MEASUREMENTS

A summary of the maximum, minimum, arithmetic mean, and standard deviation of the CAC pollutant concentrations measured at each station are presented in **Table 4-2**. Also presented in **Table 4-2** are the number of exceedances (if any) of the relevant Ontario ambient air quality criteria (AAQC) or health-based criteria for each contaminant.

The measured concentrations of the CACs monitored were all below their applicable hourly, 24-hour, and annual average criteria during 2017.

The concentrations of nitric oxide (NO) and nitrogen oxides ($NO_x$) have no regulatory criteria as discussed in Section 4.2.2 below.

A comparison of the maximum measured data to their respective air quality criteria is presented graphically in **Figure 4-2**.

## Table 4-2 Summary of Ambient CAC Monitoring Data - 2017 Monitoring Period

| Pollutant | Averaging Period | MOECC Criteria / HHRA Health-Based Criteria | | | Courtice WPCP (Upwind) | | Rundle Road (Downwind) | |
|---|---|---|---|---|---|---|---|---|
| | | ppb | µg/m³ | | Concentration (ppbv) | Concentration (µg/m³) | Concentration (ppbv) | Concentration (µg/m³) |
| $SO_2$ | 1 | 250 | 690 | Maximum | 95.6 | 257.7 | 61.0 | 159.7 |
| | | | | Minimum | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | Mean | 1.8 | 4.9 | 0.6 | 1.6 |
| | | | | Standard Deviation | 4.3 | 12.0 | 1.0 | 2.5 |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 |
| | 24 | 100 | 275 | Maximum | 18.7 | 50.8 | 5.2 | 13.7 |
| | | | | Minimum | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | Mean | 1.8 | 4.9 | 0.6 | 1.6 |
| | | | | Standard Deviation | 2.3 | 6.4 | 0.5 | 1.2 |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 |
| | Annual | 20 / 11 [A] | 55 / 29 [A] | Mean (Period) | 1.8 | 4.9 | 0.6 | 1.6 |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 |
| $PM_{2.5}$ | 24 | N/A | 28 [B] | Maximum | - | 70.6 | - | 35.8 |
| | | | | Minimum | - | 0.2 | - | 0.1 |
| | | | | Mean | - | 6.4 | - | 6.3 |
| | | | | 98th Percentile [C] | - | 19.8 | - | 20.3 |
| | | | | Standard Deviation | - | 5.5 | - | 4.8 |
| | | | | # of Exceedances | - | N/A[F] | - | N/A[F] |
| | Annual | N/A | 10 [D] | Mean (Period) | - | 6.4 | - | 6.3 |
| | | | | # of Exceedances | - | N/A[G] | - | N/A[G] |

## Table 4-2 Summary of Ambient CAC Monitoring Data - 2017 Monitoring Period

| Pollutant | Averaging Period | MOECC Criteria / HHRA Health-Based Criteria | | | Courtice WPCP (Upwind) | | Rundle Road (Downwind) | |
|---|---|---|---|---|---|---|---|---|
| | | ppb | µg/m³ | | Concentration (ppbv) | Concentration (µg/m³) | Concentration (ppbv) | Concentration (µg/m³) |
| $NO_2$ | 1 | 200 [E] | 400 [E] | Maximum | 42.8 | 89.4 | 42.9 | 90.8 |
| | | | | Minimum | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | Mean | 6.4 | 12.8 | 5.5 | 11.0 |
| | | | | Standard Deviation | 6.4 | 12.8 | 5.4 | 11.0 |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 |
| | 24 | 100 [E] | 200 [E] | Maximum | 26.4 | 55.8 | 30.5 | 64.5 |
| | | | | Minimum | 0.3 | 0.7 | 0.0 | 0.0 |
| | | | | Mean | 6.4 | 12.8 | 5.5 | 11.0 |
| | | | | Standard Deviation | 3.7 | 7.6 | 4.0 | 8.3 |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 |
| | Annual | 30 | 60 | Mean | 6.4 | 12.84 | 5.5 | 11.0 |
| | | | | # of Exceedances | 0.0 | 0.0 | 0 | 0 |
| NO [E] | 1 | NA | NA | Maximum | 128.9 | 168.8 | 88.5 | 121.3 |
| | | | | Minimum | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | Mean | 2.6 | 3.3 | 1.7 | 2.2 |
| | | | | Standard Deviation | 5.9 | 7.7 | 2.9 | 3.7 |
| | | | | # of Exceedances | NA | NA | NA | NA |
| | 24 | NA | NA | Maximum | 25.1 | 33.5 | 7.9 | 10.8 |
| | | | | Minimum | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | Mean | 2.6 | 3.3 | 1.7 | 2.3 |
| | | | | Standard Deviation | 3.0 | 3.9 | 1.2 | 1.6 |
| | | | | # of Exceedances | NA | NA | NA | NA |

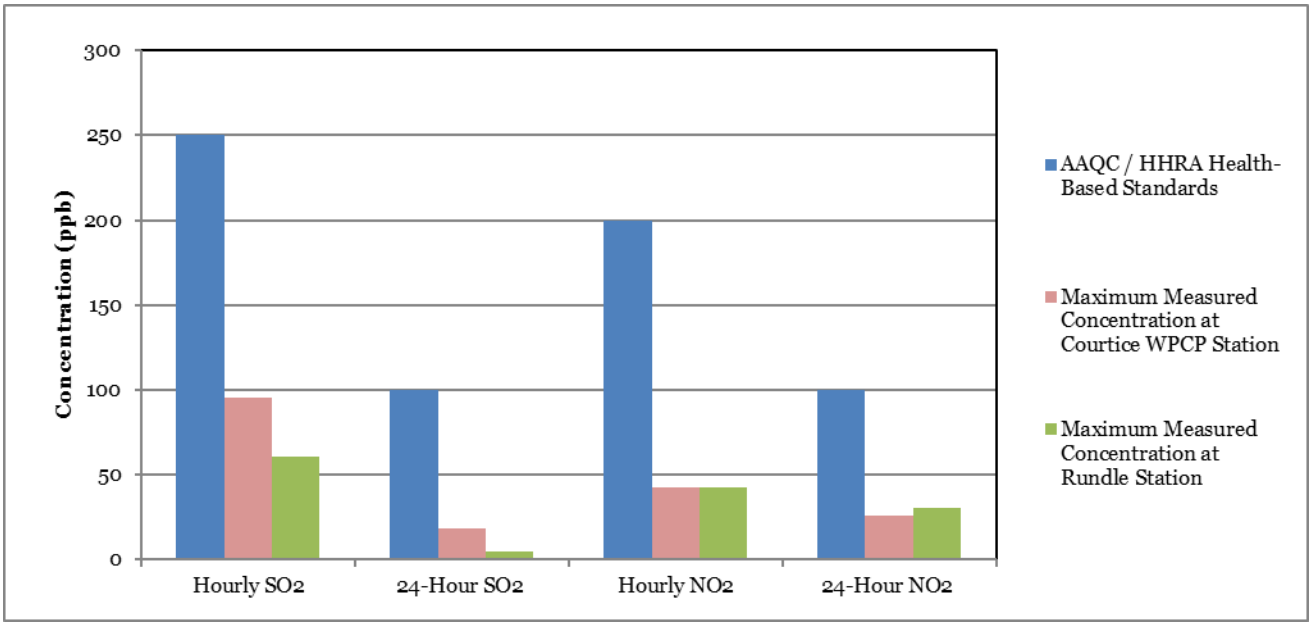
## Table 4-2 Summary of Ambient CAC Monitoring Data - 2017 Monitoring Period

| Pollutant | Averaging Period | MOECC Criteria / HHRA Health-Based Criteria | | | Courtice WPCP (Upwind) | | Rundle Road (Downwind) | |
|---|---|---|---|---|---|---|---|---|
| | | ppb | µg/m³ | | Concentration (ppbv) | Concentration (µg/m³) | Concentration (ppbv) | Concentration (µg/m³) |
| $NO_X$ [E] | 1 | NA | NA | Maximum | 146.9 | 295.2 | 89.3 | 187.7 |
| | | | | Minimum | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | Mean | 9.0 | 17.9 | 7.2 | 14.3 |
| | | | | Standard Deviation | 10.9 | 21.9 | 7.2 | 14.4 |
| | | | | # of Exceedances | NA | NA | NA | NA |
| | 24 | NA | NA | Maximum | 45.0 | 93.1 | 35.5 | 74.9 |
| | | | | Minimum | 0.6 | 1.2 | 0.0 | 0.1 |
| | | | | Mean | 9.0 | 17.9 | 7.2 | 14.3 |
| | | | | Standard Deviation | 6.1 | 12.3 | 4.8 | 9.8 |
| | | | | # of Exceedances | NA | NA | NA | NA |
| | Annual | NA | NA | Mean | 9.0 | 17.9 | 7.2 | 14.3 |
| | | | | # of Exceedances | NA | NA | NA | NA |

**Notes:**

A. Annual AAQC / Annual HHRA.
B. Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the 98th percentile over three consecutive years.
C. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.
D. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to a three-year average of the annual average concentrations.
E. NO and $NO_X$ have no ambient air quality criteria.
F. Daily $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires averaging the 98th percentile concentrations over three consecutive years, as compared to the 12-month period covered by this report.
G. Annual $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires a three-year average of the annual average concentrations over three consecutive years, as compared to the 12-month period covered by this report.

**Figure 4-2 Comparison of $NO_2$ and $SO_2$ Ambient Monitoring Data to Applicable Criteria – 2017 Monitoring Period**




Maximum measured hourly concentrations at each monitoring station in each quarter of 2017 along with other available local and regional air quality data, wind directionality, and potential emissions sources are presented in **Table 4-3** and **Table 4-4** for the Courtice WPCP and Rundle Road Stations, respectively.

Additional details on the results for each measured contaminant are presented in the following sections.

## Table 4-3 Maximum Measured Concentrations by Quarter in 2017 – Courtice WPCP Station

| Pollutant | Averaging Period (hr) | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
|---|---|---|---|---|---|---|
| $SO_2$ | 1 | Maximum Measured Concentration (ppb / µg/m³) | 39.4 / 112 | 56.4 / 152 | 95.6 / 258 | 84.6 / 234 |
| | | Wind Direction | East-northeast | East-northeast | Southeast | Northwest |
| | | Potential Emission Sources | Agricultural activities, the Courtice WPCP Plant and a CN railroad are potential emissions sources | Agricultural activities, the Courtice WPCP Plant and a CN railroad are potential emissions sources | The Courtice WPCP and agricultural activities are potential emissions sources | Highway 401 and a CN Railroad are potential emissions sources |
| $NO_2$ | 1 | Maximum Measured Concentration (ppb / µg/m³) | 42.8 / 89.4 | 40.9 / 82.7 | 37.8 / 71.5 | 37.3 / 79.2 |
| | | Wind Direction | Northwest | Northwest | Northwest | Northwest |
| | | Oshawa MOECC Station Concentration in the same hour (ppb) | 31 | 8 | 6 | 11 |
| | | Potential Emission Sources | Highway 401 and a CN Railroad are potential emissions sources | Highway 401 and a CN Railroad are potential emissions sources | Highway 401 and a CN Railroad are potential emissions sources | Highway 401 and a CN Railroad are potential emissions sources |
| NOx | 1 | Maximum Measured Concentration (ppb / µg/m³) | 107 / 224 | 64.5 / 124 | 79.7 / 154 | 147 / 295 |
| | | Wind Direction | Northwest | Northwest | West-northwest | North |
| | | Potential Emission Sources | Highway 401 and a CN Railroad are potential emissions sources | Highway 401 and a CN Railroad are potential emissions sources | Agricultural lands, a CN railroad and Highway 401 are potential emissions sources | Highway 401, a CN railroad and Highway 418 construction are potential emissions sources |

## Table 4-3 Maximum Measured Concentrations by Quarter in 2017 – Courtice WPCP Station

| Pollutant | Averaging Period (hr) | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
|---|---|---|---|---|---|---|
| $PM_{2.5}$ | 24 | Maximum Measured Concentration (µg/m$^3$) | 27.7 | 16.6 | 70.6 | 30.9 |
| | | Wind Direction | West-northwest | East-northeast | Northeast | Northeast |
| | | Oshawa MOECC Station Concentration in the same 24-hour period (µg/m$^3$) | 23.8 | 7.8 | 10.5 | 26.5 |
| | | Potential Emission Sources | Agricultural lands, a CN railroad and Highway 401 are potential emissions sources | Agricultural lands, the Courtice WPCP Plant and a CN railroad are potential emissions sources | A fire at the Waste Management transfer facility north of Highway 401 was the likely source of the maximum concentration measured in this quarter | Highway 401, local roads, and the DYEC are potential emissions sources |

## Table 4-4 Maximum Measured Concentrations by Quarter in 2017 – Rundle Road Station

| Pollutant | Averaging Period (hr) | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
|---|---|---|---|---|---|---|
| $SO_2$ | 1 | Maximum Measured Concentration (ppb / µg/m³) | 3.9 / 11.6 | 8.9 / 24.5 | 61.0 / 160 | 7.9 / 21.4 |
| | | Wind Direction | North-northwest | East-southeast | East-southeast | East |
| | | Potential Emission Sources | Agricultural activities and local roads are potential emissions sources | Highway 401, St. Mary's Cement and a CP railroad are potential emissions sources | Highway 401, St. Mary's Cement and a CP railroad are potential emissions sources | A CP railroad and Highway 401 are potential emissions sources |
| $NO_2$ | 1 | Maximum Measured Concentration (ppb / µg/m³) | 33.3 / 70.4 | 33.6 / 65.3 | 28.9 / 54.3 | 42.9 / 90.8 |
| | | Wind Direction | West | West-southwest | East-southeast | West |
| | | Oshawa MOECC Station Concentration in the same hour (ppb) | 31 | 12 | 20 | 12 |
| | | Potential Emission Sources | Local roads, commercial facilities along Baseline Road and Highway 418 construction are potential emissions sources | Highway 418 construction and a CP railroad are potential emissions sources | Highway 401, St. Mary's Cement and a CP railroad are potential emissions sources | Local roads, commercial facilities along Baseline Road and Highway 418 construction are potential emissions sources |
| NOx | 1 | Maximum Measured Concentration (ppb / µg/m³) | 89.3 / 188 | 52.4 / 102 | 56.7 / 107 | 63.9 / 129 |
| | | Wind Direction | Northwest | West | East-southeast | Northeast |
| | | Potential Emission Sources | Highway 418 construction, local | Local roads, commercial facilities | Highway 401, St. Mary's Cement and a CP | Local roads and agricultural activities |

**Table 4-4 Maximum Measured Concentrations by Quarter in 2017 – Rundle Road Station**

| Pollutant | Averaging Period (hr) | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
|---|---|---|---|---|---|---|
| | | | roads and agricultural activities are potential emissions sources | along Baseline Road and Highway 418 construction are potential emissions sources | railroad are potential emissions sources | are potential emissions sources |
| $PM_{2.5}$ | 24 | Maximum Measured Concentration ($\mu g/m^3$) | 35.8 | 15.9 | 16.4 | 27.6 |
| | | Wind Direction | North-northwest | East-northeast | Northwest | North-northeast |
| | | Oshawa MOECC Station Concentration in the same 24-hour period ($\mu g/m^3$) | 20.6 | 4.5 | 4.5 | 26.5 |
| | | Potential Emission Sources | Agricultural lands and local roads are potential emissions sources | A CP railroad, agricultural lands and local roads are potential emissions sources | Highway 418 construction, local roads, and agricultural activities are potential emissions sources | Local roads and agricultural activities are potential emissions sources |

### 4.2.1 Sulphur Dioxide ($SO_2$)

Time history plots of the hourly and 24-hour average $SO_2$ concentrations over the measurement period are presented in **Appendix B, Figures B1** and **B2**. For the hourly and 24-hour average plots, the Ontario AAQCs of 250 and 100 ppb (690 µg/m$^3$ and 275 µg/m$^3$) are shown with blue lines in the respective plot. As shown in these figures, measured ambient $SO_2$ concentrations at both stations were well below the Ontario AAQCs. The annual Ontario AAQC for $SO_2$ is 20 ppb (55 µg/m$^3$), and the annual HHRA criterion is 11 ppb (29 µg/m$^3$).

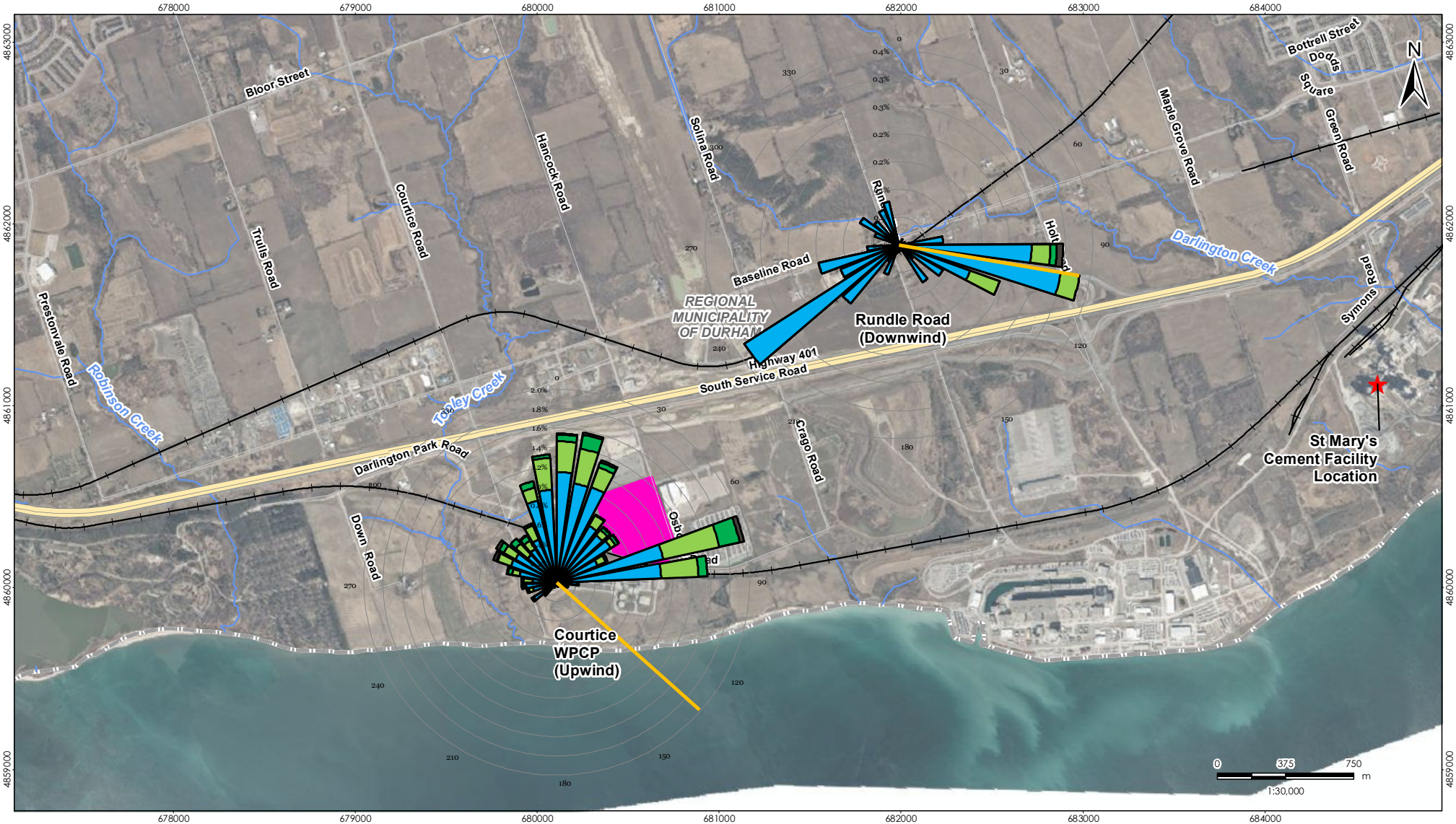
The maximum hourly, 24-hour, and annual average concentrations measured at the Courtice WPCP Station during the 2017 monitoring period were 95.6, 18.7, and 1.8 ppb (257.7, 50.8, and 4.9 µg/m$^3$) which are 38.2%, 18.7%, and 16.4% of the applicable ambient 1-hour, 24-hour, and annual air quality criteria.

The maximum hourly, 24-hour, and annual average concentrations measured at the Rundle Road Station during 2017 were 61.0, 5.2, and 0.6 ppb (159.7, 13.7 and 1.6 µg/m$^3$), respectively, which are 24.4%, 5.2%, and 5.5% of the applicable ambient 1-hour, 24-hour, and annual air quality criteria.

Pollution roses of hourly average $SO_2$ concentrations measured at the Courtice WPCP Station and the Rundle Road Station are presented in **Figure 4-3**. A pollution rose plot presents measured hourly average contaminant concentrations versus measured wind direction (over 10˚ wind sectors). Concentrations less than 2 ppb, which account for about 80% and 96% of the measurements at the Courtice WPCP and Rundle Road Stations, respectively, were removed from both plots to allow the distribution of maximum levels to be more clearly visible in the figure. Plots of the measured hourly average $SO_2$ concentrations versus wind direction are presented in **Appendix B, Figures B3** and **B4**.

Higher measured concentrations at the Courtice WPCP Station occurred for winds blowing from the north-northeast and east-northeast. The maximum measured concentration at this station occurred for a southeasterly wind – a direction in which the Courtice WPCP and agricultural fields were upwind of the monitoring station. For the Rundle Road Station, the measured hourly average concentrations were higher for east-southeasterly and southwesterly winds relative to other directions. The highest measured concentration at this station occurred for a wind blowing from the east-southeast for which St. Mary's Cement, Highway 401 and a CP railway were upwind of the Rundle Road Station.

At the Courtice WPCP Station, the highest measured 24-hour average $SO_2$ concentration was on April 4, 2017 with winds from the east for which the Courtice WPCP, agricultural activities and a CN railroad were upwind. The highest measured 24-hour average $SO_2$ concentration at the Rundle Road Station was on September 14, 2017 with winds blowing from the northeast for which a CP railroad and local roads were upwind.

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**Notes**

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2017.
4. Courtice WPCP: Concentrations less than 5µg/m³, which account for 80% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure. Rundle Road: Concentrations less than 5µg/m³, which account for 96% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

**Legend**

- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

**Concentration (µg/m³)**

- 100 - 260
- 50 - 100
- 20 - 50
- 5 - 20
- Direction of Maximum Measured Concentration

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

**4-3**

Title

**Pollution Roses of Measured Hourly Average $SO_2$ Concentrations - 2017 Monitoring Period**

A summary of the maximum measured hourly concentrations in each quarter of 2017 at each monitoring station along with other available local and regional air quality data, wind directionality and potential emissions sources are presented in **Table 4-3** and **Table 4-4**.

### 4.2.2 Nitrogen Dioxide ($NO_2$)

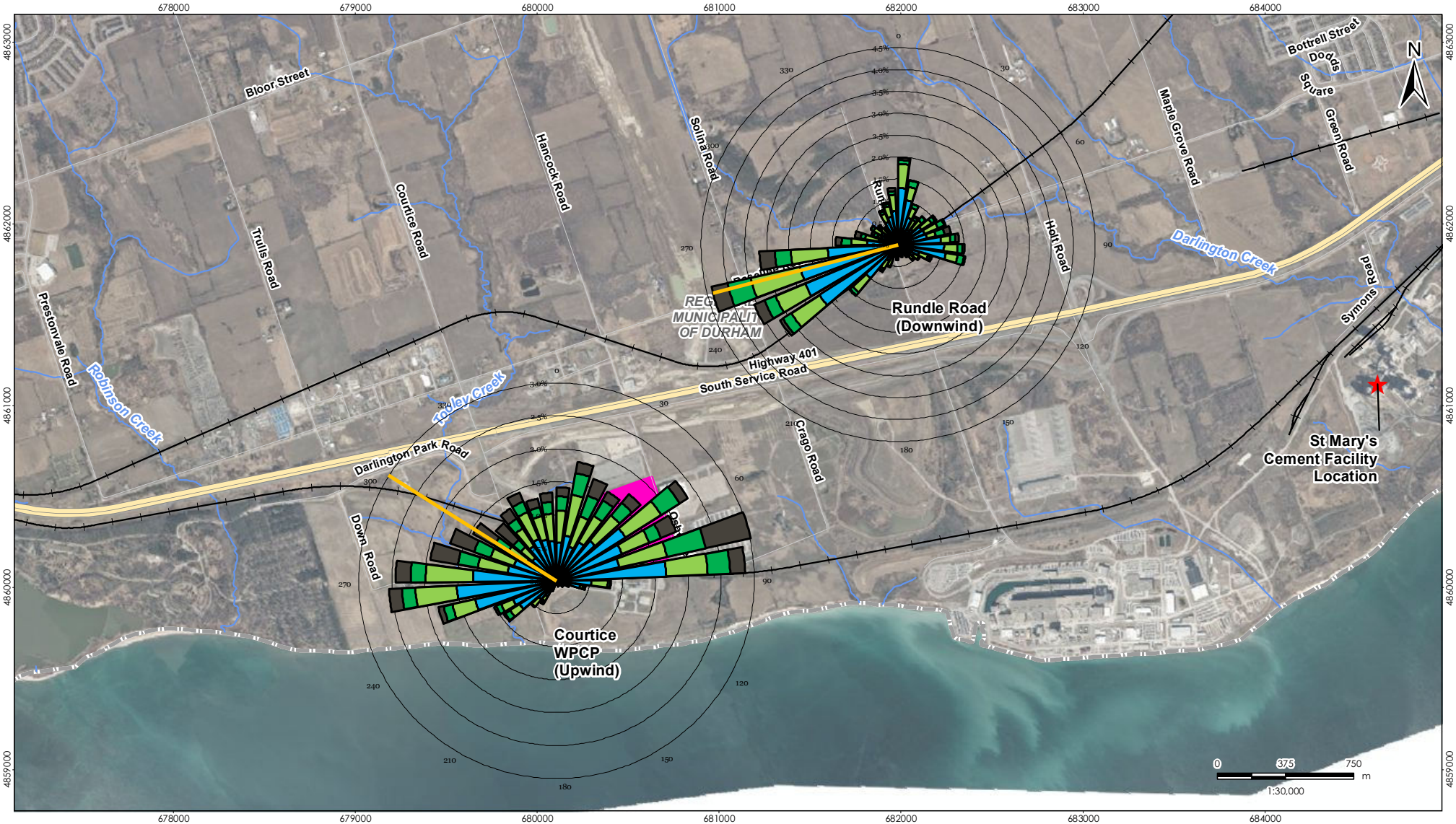
Nitrogen oxides ($NO_X$) are almost entirely made up of nitric oxide (NO) and nitrogen dioxide ($NO_2$). Together, they are often referred to as $NO_X$. Most $NO_2$ in the atmosphere is formed by the oxidation of NO, which is emitted directly by combustion processes, particularly those at high temperature and pressure. Exposure to both NO and $NO_2$ can result in adverse health effects to an exposed population. $NO_2$ is the regulated part of $NO_X$. Similar to other jurisdictions (e.g., Alberta Environment and World Health Organization), the O. Reg. 419/05 Schedule 3 Standards for $NO_X$ are based on health effects of $NO_2$, as health effects are seen at much lower concentrations of $NO_2$ than NO. In this report, because $NO_2$ is the regulated species of $NO_X$, the AAQC were compared to measured $NO_2$ concentrations (MOECC, 2012).

Time history plots of the hourly and 24-hour average $NO_2$ concentrations over the measurement period are presented in **Appendix C, Figures C1** and **C2**. For hourly and 24-hour averages, the respective Ontario AAQCs of 200 and 100 ppb (400 µg/m³ and 200 µg/m³) are shown as blue lines on the time history plots. The annual HHRA criterion is 30 ppb (60 µg/m³). As shown in these figures, measured ambient $NO_2$ concentrations at both stations were well below the criteria.

The maximum hourly, 24-hour, and annual average $NO_2$ concentrations measured at the Courtice WPCP Station during 2017 were 42.8, 26.4, and 6.4 ppb (89.4, 55.8, and 12.8 µg/m³), respectively which are 21.4%, 26.4% and 21.3% of the applicable ambient 1-hour, 24-hour and annual air quality criteria. At the Rundle Road Station, the maximum measured hourly, 24-hour, and annual average concentrations were 42.9, 30.5, and 5.5 ppb (90.8, 64.5, and 11.0 µg/m³), which are 21.5%, 30.5%, and 18.3% of the applicable air quality criteria.

Pollution roses of hourly $NO_2$ concentrations are presented in **Figure 4-4**. Concentrations less than 10 ppb which account for 57% and 56% of measurements at the Courtice WPCP and Rundle Road Stations, respectively were removed from the plots. Plots of measured hourly average $NO_2$ concentrations versus measured wind direction are presented in **Appendix C, Figures C3** and **C4**.

Higher measured hourly concentrations for the Courtice WPCP Station occurred more frequently from westerly and easterly directions. The maximum measured hourly average $NO_2$ concentration for the Courtice WPCP Station occurred during a northwesterly wind; which is a direction in which the CN railway, and Highway 401 are upwind of the station. The measured hourly $NO_2$ concentration at the MOECC Oshawa Station at the same time was 31 ppb which is comparable to the Courtice WPCP Station, suggesting regional sources influenced both stations.

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Revised: 2018-02-27 By: bcowper

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**Legend**

- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

**Concentration (µg/m³)**

- 40 - 100
- 30 - 40
- 20 - 30
- 10 - 20
- Direction of Maximum Measured Concentration

**Notes**

1. Coordinate System: NAD 1983 UTM Zone 17N
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3. Orthoimagery © First Base Solutions, 2013.
4. Courtice Concentrations less than 10µg/m³, which account for 57% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.
   Rundle Road: Concentrations less than 10µg/m³, which account for 56% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

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The Region of Durham
Durham York Energy Centre

Figure No.

**4-4**

Title

# Pollution Roses of Measured Hourly Average $NO_2$ Concentrations - 2017 Monitoring Period

At the Rundle Road Station, higher hourly average $NO_2$ concentrations were measured for winds blowing from the west-southwest. The maximum measured hourly average concentration at the Rundle Road Station was from the west-southwest for which a CP railroad, Highway 401 and Highway 418 construction are upwind of the station. The measured $NO_2$ concentration at the MOECC Oshawa Station in the same hour was 12 ppb which is lower than the Rundle Road Station suggesting local sources influenced the measurements at the Rundle Road Station.

The maximum measured hourly average $NO_2$ concentration at the MOECC Oshawa Station in 2017 was 41 ppb which is comparable to the maximum $NO_2$ concentrations measured at both the Rundle Road Station and Courtice WPCP Station in 2017.

The wind direction at the Courtice WPCP Station during the maximum measured 24-hour average $NO_2$ concentration of 26.4 ppb on December 15, 2017 was from the west for which agricultural lands and local roads are upwind. On the same day the MOECC Oshawa Station measured a comparable 24-hour $NO_2$ concentration of 25 ppb suggesting both stations were largely influenced by regional conditions in that period.

At the Rundle Road Station, the highest measured 24-hour average $NO_2$ concentration of 30.5 ppb was on December 15, 2017 with winds from the west for which Highway 418 construction activities and local commercial facilities along Baseline Road were upwind. The 24-hour average $NO_2$ concentration measured at the MOECC Oshawa Station on December 15, 2017 was 25 ppb which suggests that local sources were influencing the measurements at the Rundle Road Station.

Maximum measured hourly concentrations at each monitoring station in each quarter of 2017 along with other available local and regional air quality data, wind directionality, and potential emissions sources, are presented in **Table 4-3** and **Table 4-4**.

### 4.2.3 Nitrogen Oxides ($NO_X$)

Time history plots of hourly and 24-hour average $NO_x$ concentrations over the measurement period are presented in **Appendix D, Figures D1, and D2**.

As presented in **Table 4-2**, the maximum hourly average $NO_X$ concentration measured at the Courtice WPCP Station was 146.9 ppb (295.2 µg/m$^3$). The 24-hour and annual average $NO_X$ concentrations measured at this station were 45.0 and 9.0 ppb (93.1 µg/m$^3$ and 17.9 µg/m$^3$). At the Rundle Road Station, the maximum hourly, 24-hour, and annual average concentrations measured in 2017 were 89.3, 35.5, and 7.2 ppb (187.7, 74.9, and 14.3 µg/m$^3$).

Pollution roses of hourly average $NO_X$ concentrations for the Courtice WPCP Station and the Rundle Road Station are presented in **Figure 4-5**. The wind roses in this figure present measured concentrations above 30 ppb to allow the higher levels to be more easily visible (concentrations less than 30 ppb accounted for 78% and 82% of the NOx measurements at the Courtice WPCP

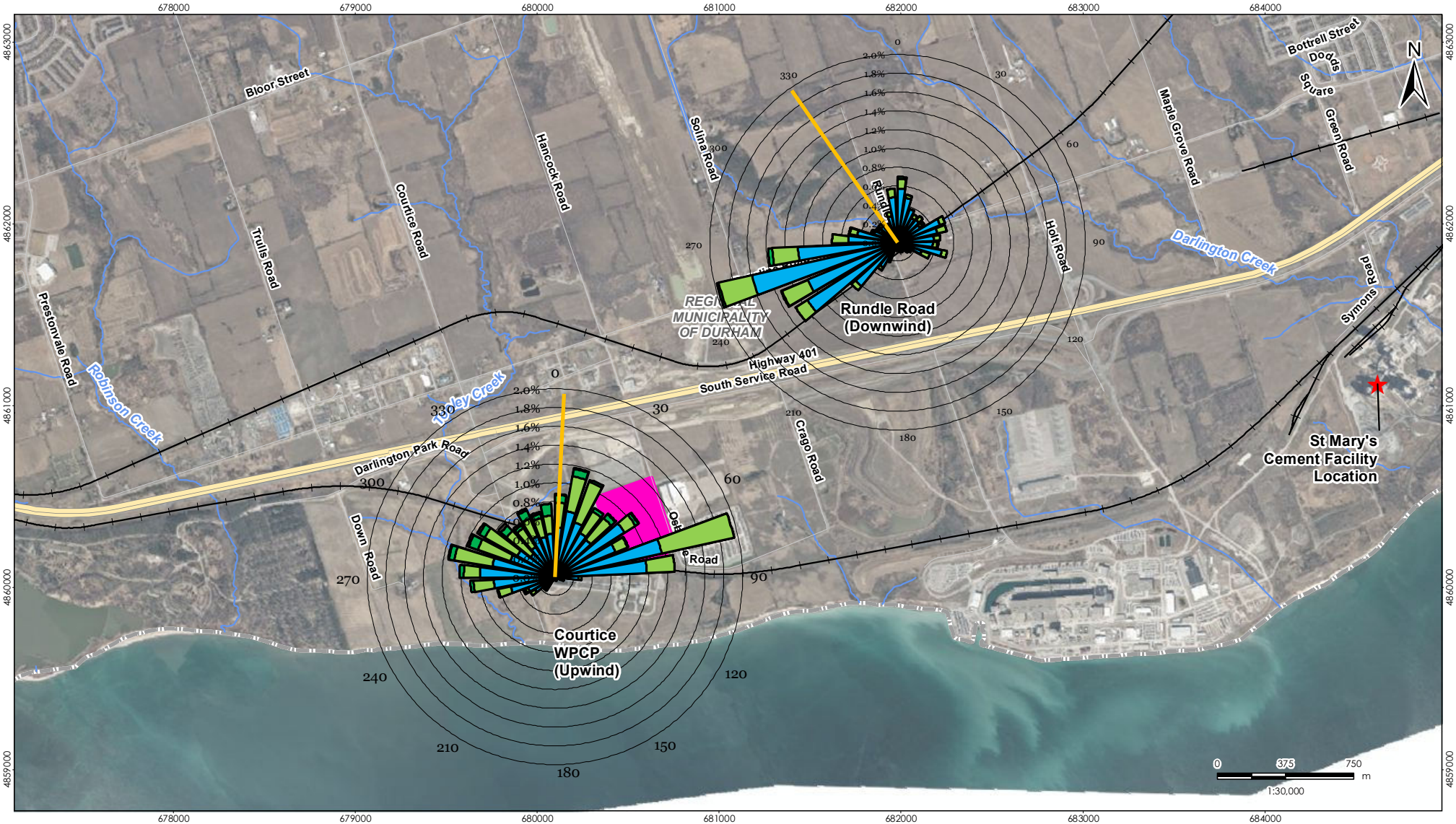
and Rundle Road Stations, respectively). Plots of wind direction versus measured $NO_X$ concentrations are presented in **Appendix D, Figures D3 and D4**.

Higher measured hourly average $NO_X$ concentrations for the Courtice WPCP Station typically occurred for winds blowing from west-northwest to east-northeast directions. The maximum measured concentration was on October 21, 2017 at 5:00 for a wind blowing from the north, for which Highway 401, Highway 418 construction and the CN railway were upwind.

At the Rundle Road Station, higher measured hourly average $NO_X$ concentrations occurred for northerly and west-southwesterly directions. The maximum measured hourly average $NO_X$ concentration occurred on March 15, 2017 at 8:00 for a north-northwesterly wind. In this direction agricultural activities and local roads were situated upwind of the monitoring station.

The maximum measured 24-hour average NOx concentrations at the Courtice WPCP and Rundle Road Stations were observed on January 17, 2017 and December 15, 2017, respectively. Wind directions during this period at the Courtice WPCP Station were blowing from the northwest while the Rundle Road Station experienced winds blowing from the west. Highway 401 and the CN railroad were upwind of the Courtice WPCP Station, while Highway 418 construction and local commercial facilities along Baseline Road were upwind of the Rundle Road Station for these days.

**Table 4-3** and **Table 4-4** present maximum measured hourly concentrations at each monitoring station in each quarter of 2017 along with other available local and regional air quality data, wind directionality and potential emissions sources.

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Revised: 2018-02-27 By: bcowper

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**Notes**

1. Coordinate System: NAD 1983 UTM Zone 17N
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3. Orthoimagery © First Base Solutions, 2013.
4. Courtice WPCP: Concentrations less than 25µg/m³, which account for 78% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure. Rundle Road: Concentrations less than 25µg/m³, which account for 82% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

**Legend**

- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

**Concentration (µg/m³)**

- 150 - 300
- 100 - 150
- 50 - 100
- 25 - 50
- Direction of Maximum Measured Concentration

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

**4-5**

Title

# Pollution Roses of Measured Hourly Average $NO_x$ Concentrations – 2017 Monitoring Period

### 4.2.4 Particulate Matter Smaller than 2.5 Microns ($PM_{2.5}$)

Time history plots of the measured 24-hour average $PM_{2.5}$ concentrations over the measurement period are presented in **Appendix E, Figures E1 and E2**.

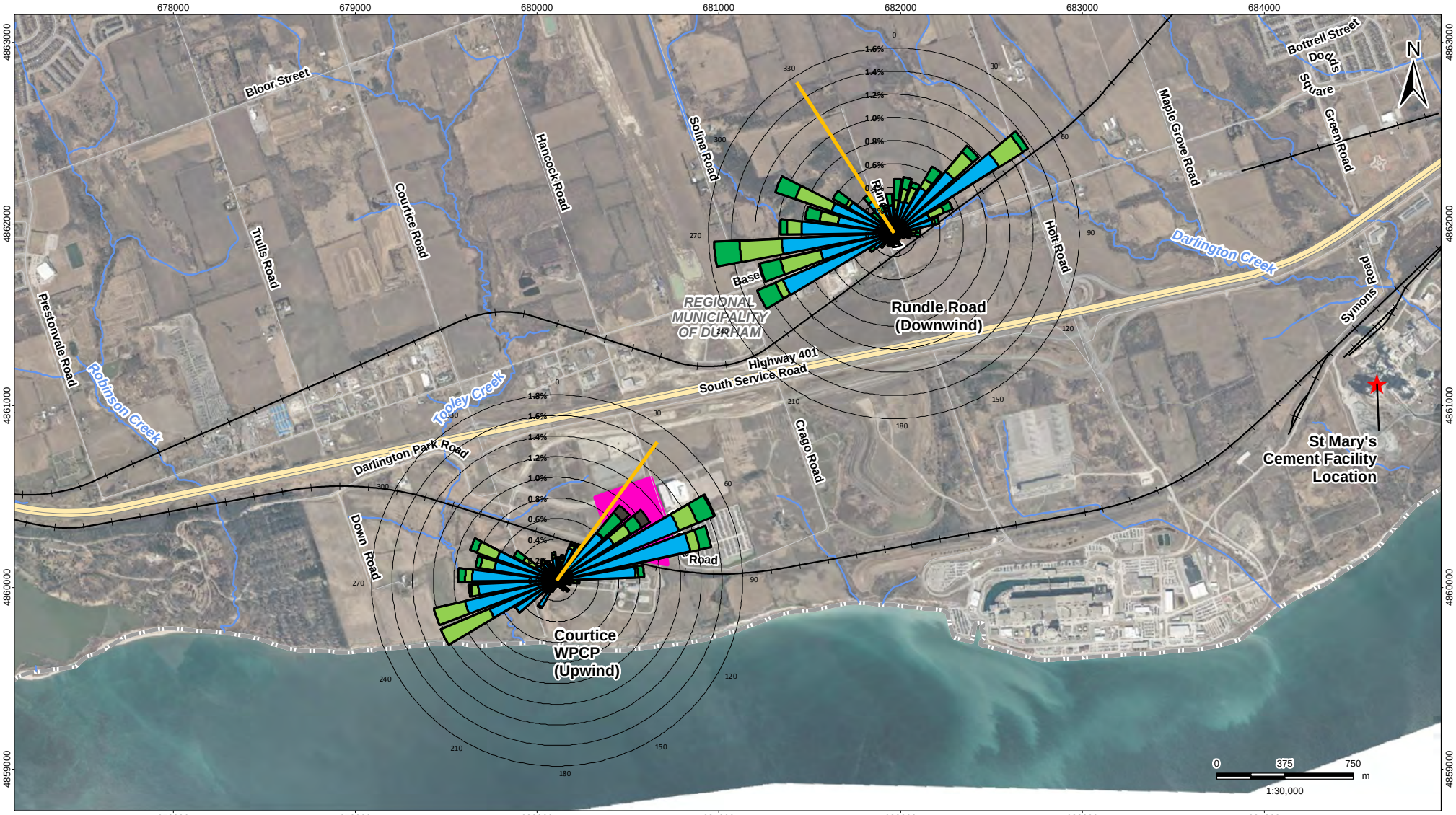
The maximum 24-hour average $PM_{2.5}$ concentration measured at the Courtice WPCP Station over the monitoring period was 70.6 µg/m$^3$. The maximum measured 24-hour average $PM_{2.5}$ concentration at the Rundle Road Station was 35.8 µg/m$^3$. In 2017, the 98$^{th}$ percentiles of the daily average $PM_{2.5}$ concentrations measured over the monitoring period were 19.8 µg/m$^3$ at the Courtice WPCP Station and 20.3 µg/m$^3$ at the Rundle Road Station. As detailed below, these values for the 98$^{th}$ percentile should not be used for comparison against the Canadian Ambient Air Quality Standard individually. The annual average $PM_{2.5}$ concentrations measured at the Courtice WPCP and Rundle Road Stations over the monitoring period were 6.4 and 6.3 µg/m$^3$, respectively.

Pollution roses showing measured 24-hour average ambient $PM_{2.5}$ concentrations versus wind direction are shown in **Figure 4-6** for both monitoring stations. Concentrations less than 10 µg/m$^3$ which accounted for approximately 76% of measurements at the Courtice WPCP and 82% at the Rundle Road Station were not included in this figure to more clearly show the distribution of higher levels. Plots of measured 24-hour average ambient $PM_{2.5}$ concentrations versus measured 24-hour average wind direction are presented in **Appendix E, Figures E-3 and E-4**.

Higher measured $PM_{2.5}$ concentrations at the Courtice WPCP Station occurred for east-northeasterly and west-southwesterly winds, with the maximum measured 24-hour concentration occurring on August 27, 2017 with winds from the northeast. During the same day, the MOECC Oshawa Station measured an ambient $PM_{2.5}$ level of 6.8 µg/m$^3$. The likely source of the elevated concentration was from a fire at the waste management transfer facility north of Highway 401 that occurred on the same day. Based on the DYEC's operational records, continuous emissions monitors during this period measured 0% opacity.

At the Rundle Road Station, higher measured 24-hour average $PM_{2.5}$ concentrations were measured in 2017 for west-southwesterly and northeasterly winds. The maximum measured concentration occurred on January 17, 2017 for a northwesterly wind. For this wind direction agricultural lands and local roads are located upwind of the Rundle Road Station. In this same period, the MOECC Oshawa Station measured 20.6 µg/m$^3$ suggesting a local source or sources may have influenced the Rundle Road Station.

A summary of maximum measured 24-hour average concentrations at each monitoring station in each quarter of 2017 along with other available local and regional air quality data, wind directionality, and potential emissions sources are presented in **Table 4-3** and **Table 4-4**.




February 2018
160950528

Stantec

**Legend**

- St Mary's Cement Facility Location
- Durham York Energy Centre Site
- Railway
- Road
- Highway
- Watercourse

**Concentration (µg/m³)**

- 40 - 75
- 20 - 40
- 15 - 20
- 10 - 15
- Direction of Maximum Measured Concentration

**Notes**

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthoimagery © First Base Solutions, 2013.
4. Courtice WPCP:Concentrations less than 10µg/m³, which account for 76% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure. Rundle Road: Concentrations less than 10µg/m³, which account for 82% of the measurements, have been removed from the plot to allow the distribution of maximum levels to be more clearly shown in the figure.

Client/Project

The Region of Durham
Durham York Energy Centre

Figure No.

**4-6**

Title

**Pollution Roses of Measured 24-Hour Average $PM_{2.5}$ Concentrations – 2017 Monitoring Period**

The 24-hour and annual $PM_{2.5}$ CAAQS criteria both require a 3-calendar year average for comparison, with the data considered valid if an annual 98$^{th}$ percentile value is available for at least two of the required three calendar years. Since **Table 4-2** only covers the year 2017, the measurements presented in that table were not explicitly compared to the CAAQS criteria.

However, with the completion of the 2017 monitoring period, four calendar years of $PM_{2.5}$ measurements (2014-2017) are now available to compare against the CAAQS criteria. The three-year average of the annual 98$^{th}$ percentile of the daily 24-hour average $PM_{2.5}$ concentrations and the three-year average of the annual average $PM_{2.5}$ concentrations (for calendar years 2014 to 2016, and 2015 to 2017) at both stations are compared in **Table 4-5.** The measured ambient $PM_{2.5}$ levels at both stations were below the respective CAAQS for both the 24-hour and annual averaging periods.

A summary of maximum measured 24-hour average concentrations at each monitoring station in each quarter of 2017 along with other available local and regional air quality data, wind directionality, and potential emissions sources are presented in **Table 4-3** and **Table 4-4.**

**Table 4-5 Comparison of Ambient $PM_{2.5}$ Levels to the CAAQS (2014 to 2016 Measurement Data)**

| Pollutant | Averaging Period | CAAQS Criteria (µg/m³) | Courtice WPCP Concentration (µg/m³) (Predominantly Upwind) | | Rundle Road Concentration (µg/m³) (Predominantly Downwind) | |
|---|---|---|---|---|---|---|
| | | | 2014 – 2016 | 2015 – 2017 | 2014 – 2016 | 2015 – 2017 |
| $PM_{2.5}$ | 24-hour | 28 [A] | 23.7 | 22.9 | 27.5 | 27.2 |
| | Annual | 10 [B] | 7.7 | 7.0 | 9.2 | 8.5 |

**Notes:**

A Canadian Ambient Air Quality Standard for Respirable Particulate Matter. The Respirable Particulate Matter Objective is referenced to the average of the 98$^{th}$ percentile of the daily average over three consecutive years.

B Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the three-year average of the annual average concentrations.

## 4.3 AMBIENT TSP/METALS CONCENTRATIONS

A summary of the maximum, minimum, and mean measured daily average TSP and metals concentrations for 2017 is presented in **Table 4-6**.

The maximum measured concentrations of almost all TSP and all metals with MOECC air quality criteria were below their applicable 24-hour criteria (shown in **Table 4-6**below) at all three stations with the exception of two TSP measurements at the Rundle Road Station on June 12, 2017 and November 27, 2017. The TSP concentrations for these 24-hour samples were 5% and 93% above the applicable MOECC and HHRA criteria, respectively.

On June 12, 2017, the measured TSP concentrations at the Fence Line and Courtice WPCP Stations were also elevated, suggesting elevated TSP levels across the region. Wind directions during this day were blowing from west-southwesterly to northerly directions, for which local roads, commercial businesses and Highway 418 construction activities would be upwind of the Rundle Road Station. The continuous emissions monitoring system at the DYEC indicated an opacity at 0% throughout this day from both boilers.

On November 27,2017, the measured TSP concentrations at the Fence Line and Courtice WPCP Stations were not elevated on this day, suggesting a local emissions source may have been influencing the Rundle Road Station. Wind directions during this day were blowing from the west-northwest. The DYEC was not upwind of the Rundle Road Station for the wind direction and the continuous emissions monitoring system at the DYEC indicated opacity at 0% throughout this day from both boilers.

Notifications of potential exceedance were prepared by Stantec and submitted to the Region of Durham, Region of York, MOECC, and the Medical Officer of Health, in accordance with Section 9 of the Ambient Air Quality Monitoring Plan (Stantec, 2012) for both exceedances. A root cause analysis was completed, and the potential impact on human health was evaluated by a toxicologist for both exceedances. For the June 12 exceedance, the likely cause of the TSP exceedance was high background TSP levels combined with Highway 418 construction activities. On November 27, the likely cause of the TSP exceedance was heavy truck traffic on roads near the Rundle Road Station. In both cases, the measured TSP concentrations were not expected to have resulted in an adverse effect on human health or the environment.

## Table 4-6 Summary of Measured Ambient TSP/Metals Concentrations – 2017 Monitoring Period

| Contaminant | Units | MOECC Standard (Daily Average) | HHRA Health Based Criteria (Daily Average) | Courtice WPCP (Predominantly Upwind) | | | | Rundle Road (Predominantly Downwind) | | | | Fence Line | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Max | Min | Period Arithmetic Mean | No. of Exceedances | Max | Min | Period Arithmetic Mean | No. of Exceedances | Max | Min | Period Arithmetic Mean | No. of Exceedances |
| Particulate | µg/m³ | 120 | 120 | 59.6 | 9.90 | 26 / 24 [B] | 0 | 232 | 11.1 | 38 / 31 [B] | 2 | 86.1 | 12.3 | 35 / 31 [B] | 0 |
| Total Mercury (Hg) | µg/m³ | 2 | 2 | 3.62E-05 | 5.99E-06 [A] | 9.03E-06 | 0 | 4.85E-05 | 5.94E-06 [A] | 8.80E-06 | 0 | 7.41E-05 | 5.79E-06 [A] | 1.05E-05 | 0 |
| Aluminum (Al) | µg/m³ | 4.8 | - | 4.49E-01 | 1.66E-02 [A] | 1.09E-01 | 0 | 1.08E+00 | 1.65E-02 [A] | 1.66E-01 | 0 | 5.83E-01 | 1.56E-02 [A] | 1.59E-01 | 0 |
| Antimony (Sb) | µg/m³ | 25 | 25 | 3.73E-03 [A] | 2.99E-03 [A] | 3.32E-03 | 0 | 3.69E-03 [A] | 2.97E-03 [A] | 3.31E-03 | 0 | 3.49E-03 [A] | 2.89E-03 [A] | 3.22E-03 | 0 |
| Arsenic (As) | µg/m³ | 0.3 | 0.3 | 4.14E-03 | 1.80E-03 [A] | 2.03E-03 | 0 | 2.21E-03 [A] | 1.78E-03 [A] | 1.98E-03 | 0 | 2.10E-03 [A] | 1.73E-03 [A] | 1.93E-03 | 0 |
| Barium (Ba) | µg/m³ | 10 | 10 | 2.05E-02 | 3.32E-03 | 7.94E-03 | 0 | 3.20E-02 | 2.84E-03 | 9.66E-03 | 0 | 2.76E-02 | 3.24E-03 | 9.72E-03 | 0 |
| Beryllium (Be) | µg/m³ | 0.01 | 0.01 | 3.73E-04 [A] | 2.99E-04 [A] | 3.32E-04 | 0 | 3.69E-04 [A] | 2.97E-04 [A] | 3.31E-04 | 0 | 3.49E-04 [A] | 2.89E-04 [A] | 3.22E-04 | 0 |
| Bismuth (Bi) | µg/m³ | - | - | 2.24E-03 [A] | 1.80E-03 [A] | 1.99E-03 | - | 2.21E-03 [A] | 1.78E-03 [A] | 1.98E-03 | - | 2.10E-03 [A] | 1.73E-03 [A] | 1.93E-03 | - |
| Boron (B) | µg/m³ | 120 | - | 5.39E-03 | 1.80E-03 [A] | 2.16E-03 | 0 | 6.12E-03 | 1.78E-03 [A] | 2.27E-03 | 0 | 6.67E-03 | 1.73E-03 [A] | 2.24E-03 | 0 |
| Cadmium (Cd) | µg/m³ | 0.025 | 0.025 | 7.45E-04 [A] | 5.99E-04 [A] | 6.63E-04 | 0 | 7.38E-04 [A] | 5.94E-04 [A] | 6.61E-04 | 0 | 2.69E-03 | 5.78E-04 [A] | 7.65E-04 | 0 |
| Chromium (Cr) | µg/m³ | 0.5 | - | 1.03E-02 | 1.50E-03 [A] | 2.19E-03 | 0 | 1.75E-02 | 1.49E-03 [A] | 2.31E-03 | 0 | 7.67E-02 | 1.44E-03 [A] | 5.01E-03 | 0 |
| Cobalt (Co) | µg/m³ | 0.1 | 0.1 | 7.45E-04 [A] | 5.99E-04 [A] | 6.63E-04 | 0 | 7.38E-04 [A] | 5.94E-04 [A] | 6.61E-04 | 0 | 6.99E-04 [A] | 5.78E-04 [A] | 6.43E-04 | 0 |
| Copper (Cu) | µg/m³ | 50 | - | 9.85E-02 | 3.45E-03 | 3.39E-02 | 0 | 2.29E-01 | 5.76E-03 | 5.20E-02 | 0 | 1.02E-01 | 4.42E-03 | 3.65E-02 | 0 |
| Iron (Fe) | µg/m³ | 4 | - | 1.01E+00 | 1.18E-01 | 3.52E-01 | 0 | 2.26E+00 | 1.01E-01 | 4.69E-01 | 0 | 1.66E+00 | 1.16E-01 | 4.81E-01 | 0 |
| Lead (Pb) | µg/m³ | 0.5 | 0.5 | 1.09E-02 | 9.33E-04 [A] | 2.39E-03 | 0 | 1.30E-02 | 9.23E-04 [A] | 2.53E-03 | 0 | 1.04E-02 | 8.69E-04 [A] | 3.05E-03 | 0 |
| Magnesium (Mg) | µg/m³ | - | - | 5.61E-01 | 3.85E-02 | 1.61E-01 | - | 1.76E+00 | 1.65E-02 [A] | 2.51E-01 | - | 1.07E+00 | 3.99E-02 | 2.62E-01 | - |
| Manganese (Mn) | µg/m³ | 0.4 | - | 5.25E-02 | 3.14E-03 | 1.15E-02 | 0 | 7.74E-02 | 2.91E-03 | 1.47E-02 | 0 | 9.69E-02 | 3.35E-03 | 2.06E-02 | 0 |
| Molybdenum (Mo) | µg/m³ | 120 | - | 4.44E-03 | 8.98E-04 [A] | 1.35E-03 | 0 | 3.13E-02 | 9.28E-04 [A] | 2.58E-03 | 0 | 3.49E-03 | 8.67E-04 [A] | 1.37E-03 | 0 |
| Nickel (Ni) | µg/m³ | 0.2 | - | 3.95E-03 | 8.98E-04 [A] | 1.21E-03 | 0 | 3.62E-03 | 8.91E-04 [A] | 1.14E-03 | 0 | 1.24E-02 | 8.67E-04 [A] | 1.49E-03 | 0 |
| Phosphorus (P) | µg/m³ | - | - | 9.76E-02 | 7.99E-03 [A] | 2.73E-02 | - | 1.45E-01 | 8.16E-03 [A] | 3.56E-02 | - | 1.07E-01 | 7.98E-03 [A] | 3.47E-02 | - |
| Selenium (Se) | µg/m³ | 10 | 10 | 3.73E-03 [A] | 2.99E-03 [A] | 3.32E-03 | 0 | 3.69E-03 [A] | 2.97E-03 [A] | 3.31E-03 | 0 | 3.49E-03 [A] | 2.89E-03 [A] | 3.22E-03 | 0 |
| Silver (Ag) | µg/m³ | 1 | 1 | 1.86E-03 [A] | 1.50E-03 [A] | 1.66E-03 | 0 | 1.85E-03 [A] | 1.49E-03 [A] | 1.65E-03 | 0 | 1.75E-03 [A] | 1.44E-03 [A] | 1.61E-03 | 0 |
| Strontium (Sr) | µg/m³ | 120 | - | 1.38E-02 | 1.13E-03 | 4.16E-03 | 0 | 7.54E-02 | 9.92E-04 | 7.62E-03 | 0 | 2.60E-02 | 9.97E-04 | 6.82E-03 | 0 |
| Thallium (Tl) | µg/m³ | - | - | 3.73E-03 [A] | 2.99E-03 [A] | 3.32E-03 | - | 3.69E-03 [A] | 2.97E-03 [A] | 3.31E-03 | - | 3.49E-03 [A] | 2.89E-03 [A] | 3.22E-03 | - |
| Tin (Sn) | µg/m³ | 10 | 10 | 3.73E-03 [A] | 2.99E-03 [A] | 3.32E-03 | 0 | 3.69E-03 [A] | 2.97E-03 [A] | 3.31E-03 | 0 | 3.49E-03 [A] | 2.89E-03 [A] | 3.22E-03 | 0 |
| Titanium (Ti) | µg/m³ | 120 | - | 2.08E-02 | 2.99E-03 [A] | 6.11E-03 | 0 | 6.46E-02 | 3.07E-03 [A] | 9.09E-03 | 0 | 3.35E-02 | 2.90E-03 [A] | 8.87E-03 | 0 |
| Vanadium (V) | µg/m³ | 2 | 1 | 1.86E-03 [A] | 1.50E-03 [A] | 1.66E-03 | 0 | 3.43E-03 | 1.49E-03 [A] | 1.68E-03 | 0 | 1.75E-03 [A] | 1.44E-03 [A] | 1.61E-03 | 0 |
| Zinc (Zn) | µg/m³ | 120 | - | 2.46E-01 | 9.23E-03 | 3.06E-02 | 0 | 2.95E-01 | 9.57E-03 | 3.08E-02 | 0 | 1.83E-01 | 6.66E-03 | 3.01E-02 | 0 |
| Zirconium (Zr) | µg/m³ | 20 | - | 1.86E-03 [A] | 1.50E-03 [A] | 1.66E-03 | 0 | 1.85E-03 [A] | 1.49E-03 [A] | 1.65E-03 | 0 | 1.75E-03 [A] | 1.44E-03 [A] | 1.61E-03 | 0 |
| Total Uranium (U) | µg/m³ | 1.5 | - | 1.68E-04 [A] | 1.35E-04 [A] | 1.49E-04 | 0 | 1.66E-04 [A] | 1.34E-04 [A] | 1.49E-04 | 0 | 1.57E-04 [A] | 1.30E-04 [A] | 1.45E-04 | 0 |

**Notes:**
A. Measured concentration was less than the laboratory method detection limit.
B. Period Arithmetic Mean/ Period geometric mean are presented for TSP.

## 4.4 AMBIENT PAH CONCENTRATIONS

A summary of the maximum, minimum, and arithmetic mean daily average ambient PAH concentrations measured in 2017 is presented in **Table 4-7**. In this summary both individual PAHs as well as a total PAH concentration are reported. The PAHs were monitored in accordance with the Ambient Monitoring Plan (Stantec, 2012).

Twelve (12) benzo(a)pyrene (B(a)P) measurements out of a total of fifty-nine (59) valid samples exceeded the MOECC air quality criteria. The concentrations of other PAHs at both stations were below the applicable 24-hour criteria (presented in **Table 4-7**).

The current Ontario 24-hour B(a)P AAQC was introduced in 2011 and levels above this AAQC are commonly measured throughout Ontario. In the period 2010-2013, B(a)P levels exceeding the Ontario 24-hour AAQC were measured in all years and at all Ontario stations monitoring this contaminant with the exception of one station for a single year out of the three-year period. Measurement data available from the National Air Pollutant Surveillance (NAPS) network for 2013 (the most recently available data for three stations reported in Ontario – Simcoe, Toronto and Hamilton) all had maximum levels above the AAQC (varying between 136% -6220% of the criteria). In 2011, NAPS data available for seven Ontario stations (Windsor, Toronto, Etobicoke, Hamilton, Simcoe, Pt. Petrie, and Burnt Island) showed exceedances at six of the seven stations, with only the remote Burnt Island Ontario station reporting a maximum level below the MOECC AAQC. In 2010, all of these stations, including the Burnt Island station, reported B(a)P levels above the AAQC.

Benzo(a)pyrene is a byproduct of a wide variety of natural and man-made combustion processes (including motor vehicles, natural gas, wood, refuse, oil, and forest fires) and is widely present in the environment.

Eight (8) out of twenty-nine (29) valid samples collected at the Rundle Road Station on January 7, 19, and 31, February 12, March 20, September 16, November 15, and December 9, 2017 exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 7% and 216%. Out of thirty (30) valid samples, four (4) measurements of B(a)P at the Courtice WPCP Station collected on January 7, March 20, September 16, and December 9, 2017 exceeded the MOECC Ambient Air Quality Criteria by levels varying between 15% and 77%. All twelve (12) samples were below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA health-based criteria (as shown in **Table 4-7**).

A summary of the wind directions and potential source contributions for these measurements (as required by the MOECC for inclusion in annual reports) is presented in **Table 4-8**.

Summary of Ambient Measurements
April 20, 2018

Based on the air quality assessments completed during the Environmental Assessment Study and the Environmental Compliance Approval application for the DYEC, the facility is not a significant contributor of B(a)P. Therefore, ambient B(a)P levels are not expected to be substantially impacted by the operation of the DYEC.

## Table 4-7 Summary of Measured Ambient PAH Concentrations – 2017 Monitoring Period

| Contaminant | Units | MOECC Daily Average Criteria | HHRA Health Based Daily Average Criteria | Courtice WPCP (Predominantly Upwind) | | | | Rundle Road (Predominantly Downwind) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Max | Min | Period Arithmetic Mean | No. of Exceedances | Max | Min | Period Arithmetic Mean | No. of Exceedances |
| Benzo(a)pyrene | ng/m³ | 0.05 [A]<br>5 [B]<br>1.1 [C] | 1 | 0.088 | 0.006[F] | 0.030 | 4<br>0<br>0 | 0.158 | 0.009 [F] | 0.043 | 8<br>0<br>0 |
| 1-Methylnaphthalene | ng/m³ | 12000 | - | 1.97E+01 | 1.06E+00 | 5.02E+00 | 0 | 2.94E+01 | 2.40E+00 | 8.82E+00 | 0 |
| 2-Methylnaphthalene | ng/m³ | 10000 | - | 3.35E+01 | 1.87E+00 | 8.38E+00 | 0 | 6.92E+01 | 4.11E+00 | 1.68E+01 | 0 |
| Acenaphthene | ng/m³ | - | - | 1.70E+01 | 2.46E-01 | 3.35E+00 | - | 4.41E+01 | 8.17E-01 | 8.69E+00 | - |
| Acenaphthylene | ng/m³ | 3500 | - | 7.63E-01 | 6.72E-02 [F] | 1.53E-01 | 0 | 1.18E+00 | 7.17E-02 [F] | 2.32E-01 | 0 |
| Anthracene | ng/m³ | 200 | - | 6.02E-01 | 6.72E-02 [F] | 1.38E-01 | 0 | 3.11E+00 | 7.05E-02 [F] | 4.74E-01 | 0 |
| Benzo(a)anthracene | ng/m³ | - | - | 1.10E-01 [F] | 6.72E-02 [F] | 8.97E-02 | - | 1.33E-01 [F] | 7.05E-02 [F] | 9.39E-02 | - |
| Benzo(a)fluorene | ng/m³ | - | - | 2.20E-01 [F] | 1.34E-01 [F] | 1.79E-01 | - | 3.95E-01 | 1.41E-01 [F] | 1.97E-01 | - |
| Benzo(b)fluoranthene | ng/m³ | - | - | 1.10E-01 [F] | 6.72E-02 [F] | 8.97E-02 | - | 4.36E-01 | 7.06E-02 [F] | 1.11E-01 | - |
| Benzo(b)fluorene | ng/m³ | - | - | 2.20E-01 [F] | 1.34E-01 [F] | 1.79E-01 | - | 2.66E-01 [F] | 1.41E-01 [F] | 1.88E-01 | - |
| Benzo(e)pyrene | ng/m³ | - | - | 2.20E-01 [F] | 1.34E-01 [F] | 1.79E-01 | - | 2.66E-01 [F] | 1.41E-01 [F] | 1.88E-01 | - |
| Benzo(g,h,i)perylene | ng/m³ | - | - | 1.10E-01 [F] | 6.72E-02 [F] | 8.97E-02 | - | 1.33E-01 [F] | 7.05E-02 [F] | 9.39E-02 | - |
| Benzo(k)fluoranthene | ng/m³ | - | - | 1.10E-01 [F] | 6.72E-02 [F] | 8.97E-02 | - | 1.33E-01 [F] | 7.05E-02 [F] | 9.39E-02 | - |
| Biphenyl | ng/m³ | - | - | 9.67E+00 | 4.75E-01 | 2.44E+00 | - | 1.42E+01 | 9.48E-01 | 4.02E+00 | - |
| Chrysene | ng/m³ | - | - | 1.10E-01 [F] | 6.72E-02 [F] | 8.97E-02 | - | 1.33E-01 [F] | 7.05E-02 [F] | 9.39E-02 | - |
| Dibenz(a,h) anthracene | ng/m³ | - | - | 1.10E-01 [F] | 6.72E-02 [F] | 8.97E-02 | - | 1.33E-01 [F] | 7.05E-02 [F] | 9.39E-02 | - |

## Table 4-7 Summary of Measured Ambient PAH Concentrations – 2017 Monitoring Period

| Contaminant | Units | MOECC Daily Average Criteria | HHRA Health Based Daily Average Criteria | Courtice WPCP (Predominantly Upwind) | | | | Rundle Road (Predominantly Downwind) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Max | Min | Period Arithmetic Mean | No. of Exceedances | Max | Min | Period Arithmetic Mean | No. of Exceedances |
| Dibenzo(a,c) anthracene + Picene [D] | ng/m³ | - | - | 2.20E-01 [F] | 1.34E-01 [F] | 1.75E-01 | | 2.66E-01 [F] | 7.48E-02 [F] | 1.80E-01 | - |
| Fluoranthene | ng/m³ | - | - | 2.64E+00 | 2.94E-01 | 8.60E-01 | - | 1.39E+01 | 3.82E-01 | 2.35E+00 | - |
| Indeno (1,2,3-cd)pyrene | ng/m³ | - | - | 1.10E-01 [F] | 6.72E-02 [F] | 8.97E-02 | - | 1.33E-01 [F] | 7.05E-02 [F] | 9.39E-02 | - |
| Naphthalene | ng/m³ | 22500 | 22500 | 9.22E+01 | 5.28E+00 | 2.54E+01 | 0 | 8.54E+01 | 9.48E+00 | 3.18E+01 | 0 |
| o-Terphenyl | ng/m³ | - | - | 2.20E-01 [F] | 1.34E-01 [F] | 1.79E-01 | - | 2.66E-01 [F] | 1.41E-01 [F] | 1.88E-01 | - |
| Perylene | ng/m³ | - | - | 2.20E-01 [F] | 1.34E-01 [F] | 1.79E-01 | - | 2.66E-01 [F] | 1.41E-01 [F] | 1.88E-01 | - |
| Phenanthrene | ng/m³ | - | - | 1.64E+01 | 7.23E-01 | 4.13E+00 | - | 6.98E+01 | 1.63E+00 | 1.15E+01 | - |
| Pyrene | ng/m³ | - | - | 1.16E+00 | 6.83E-02 [F] | 3.70E-01 | - | 5.59E+00 | 7.14E-02 [F] | 1.02E+00 | - |
| Tetralin | ng/m³ | - | - | 4.88E+00 | 5.87E-01 | 1.76E+00 | - | 3.84E+00 | 5.33E-01 | 1.83E+00 | - |
| Total PAH [E] | ng/m³ | - | - | 200 | 14.2 | 53.8 | - | 309 | 24.8 | 89.4 | - |

**Notes:**

A. Ontario Ambient Air Quality Criteria. The Standard for benzo(a)pyrene (B(a)P) is for B(a)P as a surrogate for PAHs.
B. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds
C. O. Reg. 419/05 24 Hour Guideline
D. Based on laboratory analyses, dibenzo(a,c)anthracene co-elutes with dibenz(a,h)anthracene. Picene elutes after dibenz(a,h)anthracene
E. The reported total PAH is the sum of all analyzed PAH species
F. Measured concentration was less than the laboratory method detection limit.

## Table 4-8 Source Contribution Analysis – 2017 B(a)P Exceedances

| Date | Station | % above the MOECC B(a)P Criterion | Wind Direction | Potential Source Contributions |
|---|---|---|---|---|
| 7-Jan-17 | Courtice WPCP | 77% | West-Northwest | Highway 401, local roads and the CN railroad are located upwind of the Courtice WPCP Station. Potential sources could be vehicle or locomotive exhaust emissions. |
| | Rundle Road | 216% | Northwest | Land use in this direction is mainly agricultural with some residences. Highway 418 construction activities were observed upwind of the Rundle Road Station during this quarter. Potential sources could be agricultural activities, a residence with a poorly controlled combustion source operating, construction vehicle exhaust, or Highway 418 construction activities. |
| 19-Jan-17 | Rundle Road | 17% | West | Land use in this direction is a mix of agricultural and commercial. Highway 418 construction activities were observed upwind of the Rundle Road Station during this quarter. Potential sources could be a nearby business with a poorly controlled combustion source operating, construction vehicle exhaust, or Highway 418 construction activities. |
| 31-Jan-17 | Rundle Road | 50% | East-Northeast | Land use in this direction is mainly agricultural with some residences and a CP railroad. Potential sources could be agricultural activities, a residence with a poorly controlled combustion source operating or locomotive exhaust emissions. |
| 12-Feb-17 | Rundle Road | 7% | North-Northeast | Land use in this direction is mainly agricultural with some residences. Potential sources could be agricultural activities or a residence with a poorly controlled combustion source operating. |

## Table 4-8 Source Contribution Analysis – 2017 B(a)P Exceedances

| Date | Station | % above the MOECC B(a)P Criterion | Wind Direction | Potential Source Contributions |
|---|---|---|---|---|
| 20-Mar-17 | Courtice WPCP | 38% | West-Southwest | Land use in this direction is primarily agricultural. Potential sources could be agricultural activities. |
| | Rundle Road | 36% | West | Land use in this direction is a mix of agricultural and commercial. Highway 418 construction activities were observed upwind of the Rundle Road Station during this quarter. Potential sources could be a nearby business with a poorly controlled combustion source operating, construction vehicle exhaust, or Highway 418 construction activities. |
| 16-Sep-17 | Courtice WPCP | 63% | Northeast | Highway 401, local roads, the CN railroad and DYEC are located upwind of the Courtice WPCP Station, as are agricultural and rural residential areas farther north. Potential sources could be vehicle or locomotive exhaust emissions, or agricultural activities |
| | Rundle Road | 125% | North | Land use in this direction is mainly agricultural with some residences. Potential sources could be agricultural activities, a residence with a poorly controlled combustion source operating, or vehicle exhaust. |
| 15-Nov-17 | Rundle Road | 50% | East-southeast | Highway 401, St. Mary's Cement, and a CP railroad are located upwind of the Rundle Road Station. Potential sources could be vehicle, locomotive, or other combustion exhaust emissions. |
| 12-Dec-17 | Courtice WPCP | 15% | Northeast | Highway 401, local roads, the CN railroad and DYEC are located upwind of the Courtice WPCP Station, as are agricultural and rural residential areas farther north. Potential sources could be vehicle or locomotive exhaust emissions, or agricultural activities. |
| | Rundle Road | 120% | Northeast | Land use in this direction is mainly agricultural with some residences. Potential sources could be agricultural activities, a residence with a poorly controlled combustion source operating, or vehicle exhaust. |

## 4.5 AMBIENT DIOXIN AND FURAN CONCENTRATIONS

A summary of the maximum, minimum, and arithmetic mean daily average ambient dioxin and furan concentrations is presented in **Table 4-9**. In this summary both individual dioxin and furan concentrations (pg/m$^3$) as well as the total toxic equivalency concentration (TEQ) are reported.

The maximum measured toxic equivalent dioxin and furan concentrations at both stations were well below the applicable 24-hour criteria AAQC of 0.1 pg TEQ/m$^3$ (as shown in **Table 4-9**) for the 2017 monitoring period (January to December 2017).

## Table 4-9 Summary of Measured Ambient Dioxin and Furan Concentrations – 2017 Monitoring Period

| Contaminant | Units | MOECC Criteria | HHRA Health Based Criteria | Courtice WPCP (Upwind) | | | | Rundle Road (Downwind) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Max | Min | Period Arithmetic Mean | No. of Exceedances | Max | Min | Period Arithmetic Mean | No. of Exceedances |
| 2,3,7,8-Tetra CDD * | pg/m³ | | | 7.83E-03 A | 3.70E-03 A | 4.85E-03 | | 1.11E-02 A | 3.84E-03 A | 5.43E-03 | |
| 1,2,3,7,8-Penta CDD | pg/m³ | | | 7.73E-03 A | 3.97E-03 A | 5.26E-03 | | 8.45E-03 A | 4.11E-03 A | 5.70E-03 | |
| 1,2,3,4,7,8-Hexa CDD | pg/m³ | | | 2.93E-02 | 4.10E-03 A | 6.41E-03 | | 3.72E-02 | 3.94E-03 A | 8.12E-03 | |
| 1,2,3,6,7,8-Hexa CDD | pg/m³ | | | 6.46E-02 | 4.36E-03 A | 1.06E-02 | | 8.24E-02 | 4.24E-03 A | 1.28E-02 | |
| 1,2,3,7,8,9-Hexa CDD | pg/m³ | | | 1.17E-01 | 4.08E-03 A | 1.49E-02 | | 1.47E-01 | 3.80E-03 A | 1.74E-02 | |
| 1,2,3,4,6,7,8-Hepta CDD | pg/m³ | | | 1.35E+00 | 4.73E-03 A | 1.46E-01 | | 1.67E+00 | 5.03E-03 A | 1.80E-01 | |
| Octa CDD | pg/m³ | | | 4.85E+00 | 2.41E-02 | 4.88E-01 | | 7.87E+00 | 3.42E-02 | 7.43E-01 | |
| Total Tetra CDD | pg/m³ | | | 2.42E-02 | 3.70E-03 A | 7.50E-03 | | 3.58E-02 | 4.29E-03 A | 9.62E-03 | |
| Total Penta CDD | pg/m³ | | | 2.72E-02 | 3.97E-03 A | 8.55E-03 | | 5.91E-02 | 4.11E-03 A | 1.22E-02 | |
| Total Hexa CDD | pg/m³ | | | 6.09E-01 | 4.73E-03 A | 8.02E-02 | | 7.76E-01 | 4.25E-03 A | 9.34E-02 | |
| Total Hepta CDD | pg/m³ | | | 2.47E+00 | 4.73E-03 A | 2.87E-01 | | 3.15E+00 | 6.66E-03 A | 3.54E-01 | |
| 2,3,7,8-Tetra CDF ** | pg/m³ | | | 1.36E-02 | 4.30E-03 A | 6.37E-03 | | 1.77E-02 | 4.00E-03 A | 7.00E-03 | |
| 1,2,3,7,8-Penta CDF | pg/m³ | - | - | 5.98E-03 A | 4.02E-03 A | 4.79E-03 | N/A | 1.12E-02 A | 4.11E-03 A | 5.44E-03 | N/A |
| 2,3,4,7,8-Penta CDF | pg/m³ | | | 6.12E-03 A | 3.91E-03 A | 4.81E-03 | | 1.05E-02 A | 4.11E-03 A | 5.38E-03 | |
| 1,2,3,4,7,8-Hexa CDF | pg/m³ | | | 4.94E-03 A | 3.57E-03 A | 4.40E-03 | | 1.19E-02 | 3.65E-03 A | 5.65E-03 | |
| 1,2,3,6,7,8-Hexa CDF | pg/m³ | | | 4.94E-03 A | 3.57E-03 A | 4.28E-03 | | 8.89E-03 A | 3.65E-03 A | 4.59E-03 | |
| 2,3,4,6,7,8-Hexa CDF | pg/m³ | | | 5.17E-03 A | 3.83E-03 A | 4.60E-03 | | 1.03E-02 A | 3.80E-03 A | 5.01E-03 | |
| 1,2,3,7,8,9-Hexa CDF | pg/m³ | | | 1.23E-02 | 4.10E-03 A | 5.33E-03 | | 1.07E-02 | 3.94E-03 A | 5.68E-03 | |
| 1,2,3,4,6,7,8-Hepta CDF | pg/m³ | | | 7.29E-02 | 3.35E-03 A | 1.74E-02 | | 5.88E-02 | 3.36E-03 A | 1.36E-02 | |
| 1,2,3,4,7,8,9-Hepta CDF | pg/m³ | | | 1.15E-02 | 3.94E-03 A | 5.34E-03 | | 9.47E-03 A | 3.65E-03 A | 5.31E-03 | |
| Octa CDF | pg/m³ | | | 7.12E-02 | 4.22E-03 A | 1.84E-02 | | 1.11E-01 | 3.98E-03 A | 1.95E-02 | |
| Total Tetra CDF | pg/m³ | | | 1.36E-02 | 4.30E-03 A | 7.05E-03 | | 6.99E-02 | 4.00E-03 A | 1.25E-02 | |
| Total Penta CDF | pg/m³ | | | 1.76E-02 | 4.05E-03 A | 6.07E-03 | | 1.80E-02 | 4.29E-03 A | 8.15E-03 | |
| Total Hexa CDF | pg/m³ | | | 1.71E-02 | 3.83E-03 A | 6.28E-03 | | 3.44E-02 | 3.80E-03 A | 1.05E-02 | |
| Total Hepta CDF | pg/m³ | | | 1.11E-01 | 3.65E-03 A | 2.48E-02 | | 1.35E-01 | 3.98E-03 A | 1.89E-02 | |
| **TOTAL TOXIC EQUIVALENCY** B | pg TEQ/m³ | 0.1 C<br>1 D | - | 0.052 | 0.014 | 0.019 | 0<br>0 | 0.065 | 0.013 | 0.022 | 0<br>0 |

**Notes:**
A. Measured concentration was less than the laboratory method detection limit.
B. Total Toxicity Equivalent (TEQ) concentration contributed by all dioxins, furans and dioxin-like PCBs calculated as per O. Reg. 419/05 methodology using corresponding $WHO_{2005}$ toxic equivalency factors (TEFs) and a value of half the minimum detection limit (MDL) substituted for concentrations less than the MDL.
C. O. Reg. 419/05 Schedule 3 Standard phased in after July 1, 2016.
D. O. Reg. 419/05 Schedule 6 Upper Risk Thresholds
* CDD - Chloro Dibenzo-p-Dioxin, ** CDF - Chloro Dibenzo-p-Furan

# 5.0 AMBIENT AIR QUALITY TRENDS

Ambient air quality measurements from both the Courtice WPCP and Rundle Road monitoring stations from 2013 to 2017 are compared in this section. The ambient monitoring program was initiated in 2013 and ambient air quality data were collected for the period May to December in that year. The MOECC requires that a minimum of nine months of data out of the 12 months in a year (a minimum 75% data recovery rate) be available for calculation of annual averages. Since the length of the measurement period in 2013 was less than nine months, the 2013 period averages were not compared to available MOECC annual criteria, nor are they directly comparable to the 2014 to 2017 annual averages.

## 5.1 CRITERIA AIR CONTAMINANT (CAC) COMPARISONS

A summary of the maximum, minimum, and arithmetic mean CAC concentrations, along with the number of exceedances of the relevant Ontario ambient air quality criteria (AAQC) or health-based criteria for each contaminant (if any occurred) at each station from 2013 to 2017, are presented in **Table 5-1** below. Also presented is the percentage of the applicable criteria for the maximum measured value in each year. The following observations were made from comparing the 2013 to 2017 CAC data:

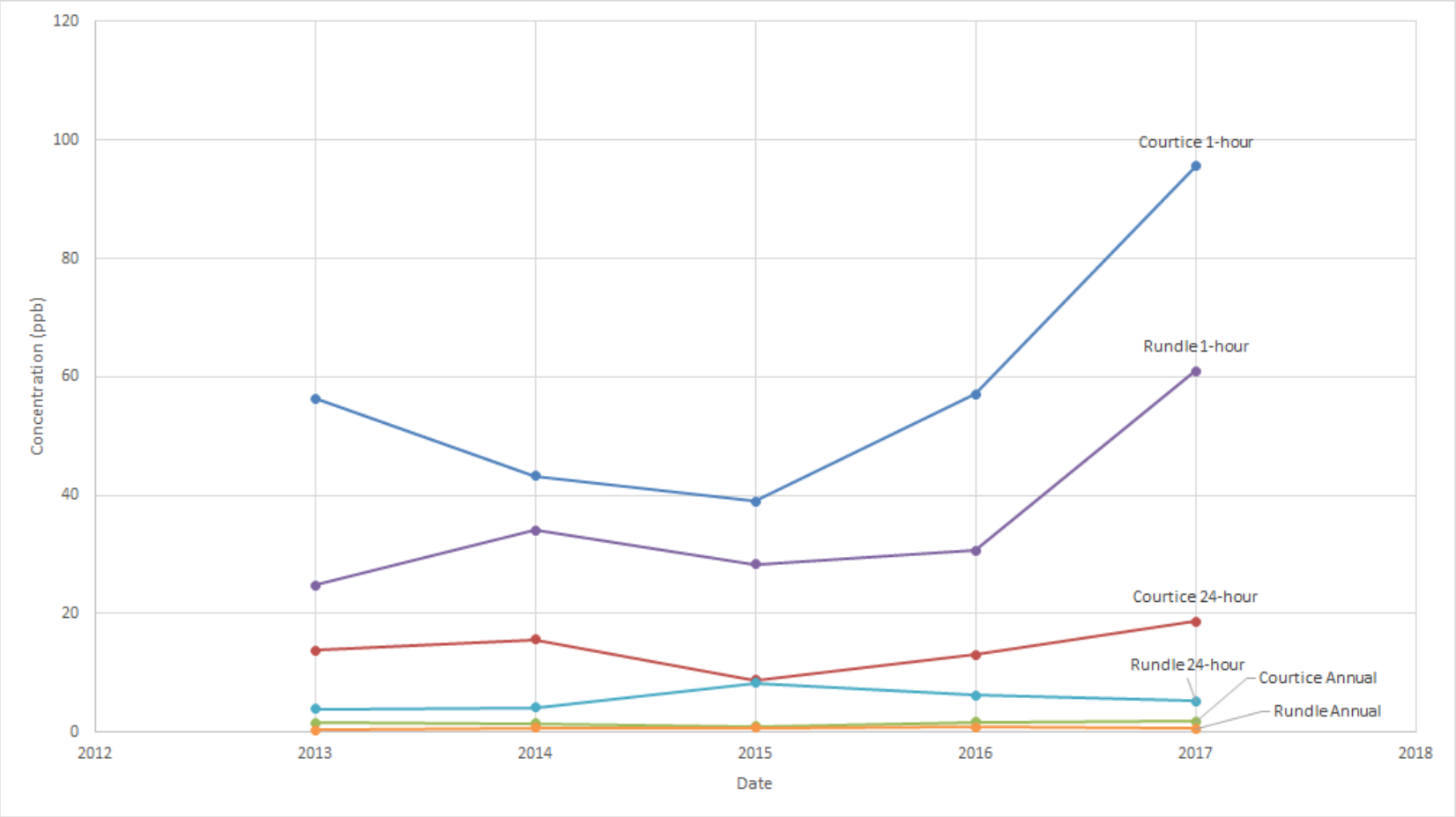
- All continuously monitored CACs were below their applicable hourly, 24-hour and annual average criteria for all five years.
- The maximum measured hourly and 24-hour average $SO_2$ concentrations were higher at the Courtice WPCP Station in all five years than at the Rundle Road Station, but were below their relevant MOECC criteria.
- The 98$^{th}$ percentile daily average $PM_{2.5}$ concentrations were similar in 2013, 2014, and 2017 at the Rundle Road Station (21.7, 21.1, and 20.3 µg/m$^3$, respectively), with higher levels measured in 2015 and 2016 (28.4 and 32.9 µg/m$^3$, respectively). The 98$^{th}$ percentile daily average $PM_{2.5}$ concentrations at the Courtice WPCP Station were similar in 2013, 2014, 2016, and 2017 (21.5, 22.3. 21.6, and 19.8 µg/m$^3$) with 2015 measuring higher levels at 27.3 µg/m$^3$. Both stations were below the 24-hour and annual CAAQS criteria for the period 2014 to 2017. $PM_{2.5}$ data for the MOECC Oshawa station shows relatively consistent $PM_{2.5}$ measurements from 2013 to 2015 with slight decreases in 2016 and 2017.
- From 2013 – 2016, maximum measured hourly, 24-hour, and annual average $NO_2$ concentrations at the Courtice WPCP Station were typically higher or similar in magnitude to those measured at the Rundle Road Station. In 2017, maximum measured hourly and annual average $NO_2$ concentrations were similar at both stations. The Rundle Road Station measured a slightly higher 24-hour average $NO_2$ concentration relative to the Courtice WPCP Station.
- The maximum measured hourly and 24-hour NO and $NO_X$ concentrations were higher at the Courtice WPCP Station relative to the Rundle Road Station for all five years.

It should be noted that since the monitoring period in 2013 was different versus 2014 - 2017 (eight months in 2013 versus 12 months in the subsequent three years), the data from 2013 are not directly comparable to 2014 to 2017, as the 2013 measurements did not encompass a full year including winter months (during which time there is normally a higher percentage of stable meteorological conditions).

The annual variations in measured data (hourly, 24-hour, and annual average $SO_2$, $NO_2$ and $PM_{2.5}$ concentrations) are presented in **Figure 5-1** to **Figure 5-3**. The following observations were noted from these plots:

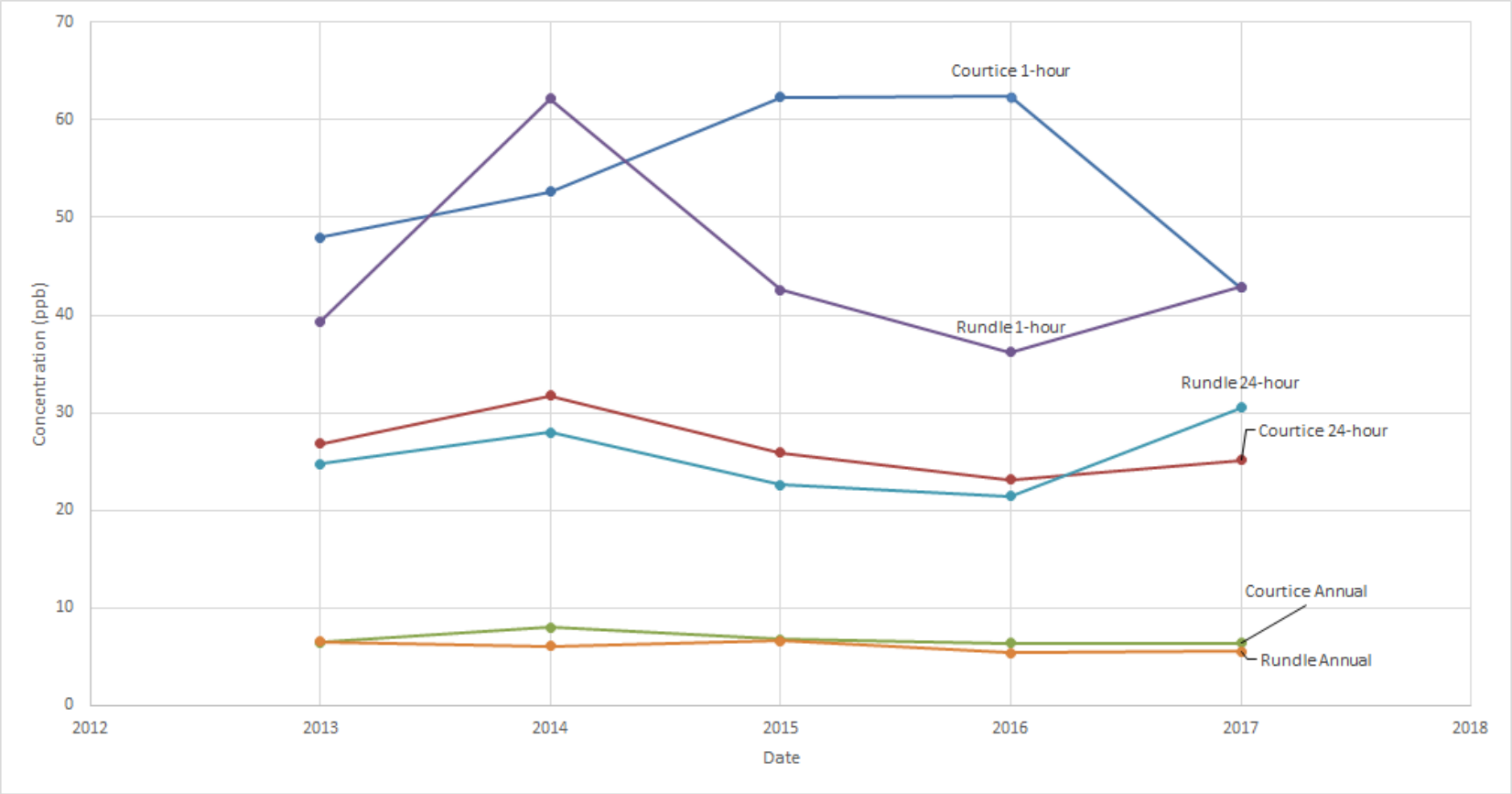
- The maximum measured hourly $SO_2$ concentrations at the Courtice WPCP and Rundle Road Stations had similar trends with decreases seen between 2014 and 2015 and increases between 2015 and 2017.
- The maximum 1-hour, 24-hour, and annual average $SO_2$ concentrations are generally higher at the Courtice WPCP Station than the Rundle Road Station from year-to-year.
- The maximum measured 24-hour and annual average $NO_2$ concentrations at both stations show similar trends (as seen in **Figure 5-2)**. Maximum measured 24-hour concentrations at both stations were elevated in 2014, decreased in 2015 and 2016, and increased in 2017. Measured annual average concentrations at both stations were relatively constant for all years.
- The maximum measured hourly average $NO_2$ concentrations at the two stations have shown opposite trends since 2014 with the Rundle Road Station measurements decreasing from 2014-2106 and then increasing in 2017; while the Courtice WPCP Station's measurements increased or stayed constant between 2014-2016 and decreased in 2017.
- Measured 98$^{th}$ percentile 24-hour $PM_{2.5}$ concentrations at both stations were similar in all years except for 2016 (as seen in **Figure 5-3**). The measured 98$^{th}$ percentile 24-hour $PM_{2.5}$ concentrations at both stations decreased in 2017 relative to 2016.
- Measured annual average $PM_{2.5}$ concentrations at the Rundle Road station were slightly higher than the Courtice WPCP Station in 2015 and 2016, otherwise they have been similar.

## Figure 5-1 Maximum Measured $SO_2$ Concentrations by Year (2013-2017)



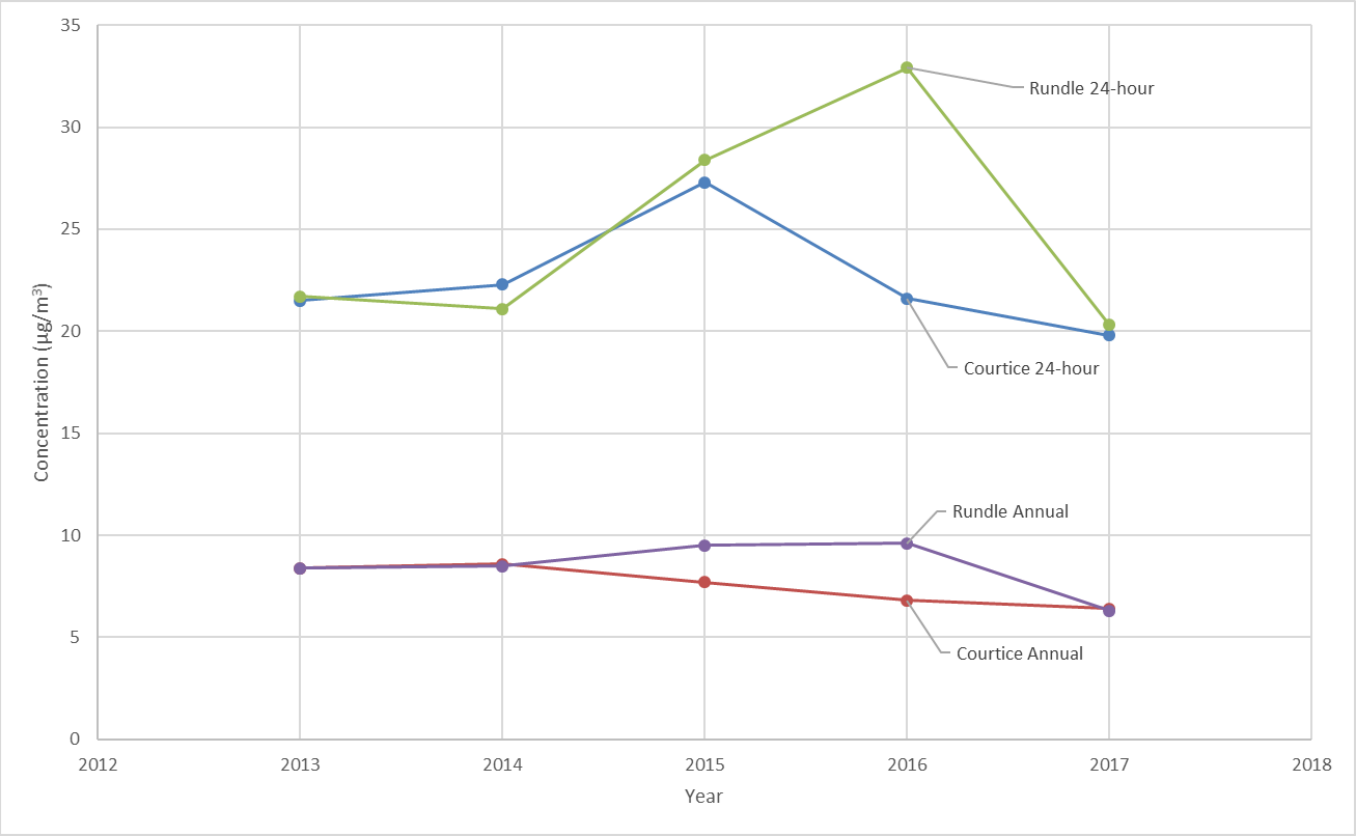

**Note**:
The length of the measurement period in 2013 was less than 9-months, averages presented for this year are not directly comparable to the other years but are included for reference.

## Figure 5-2 Maximum Measured $NO_2$ Concentrations by Year (2013-2017)




**Note:**
The length of the measurement period in 2013 was less than 9-months, averages presented are not directly comparable to the other years but are included for reference.

## Figure 5-3 Comparison of Measured 98th Percentile $PM_{2.5}$ Concentrations by Year (2013-2017)




**Notes:**

A. 24-hour averaging periods. Canadian Ambient Air Quality Standard for Respirable Particulate Matter. The Respirable Particulate Matter Objective is referenced to the average of the 98th percentile of the daily average over 3 consecutive years.

B. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the three-year average of the annual average concentrations.

C. The length of the measurement period in 2013 was less than 9-months, averages presented are not directly comparable to other years but are included for reference.

**Table 5-1 Comparison of Measured Ambient CAC Concentrations (2013 - 2017)**

| Pollutant | Averaging Period | AAQC / HHRA Standards | Units | | Courtice WPCP (Upwind) | | | | | | | | | | Rundle Road (Downwind) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measurement | | | | | % of Criteria | | | | | Measurement | | | | | % of Criteria | | | | |
| | | | | | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 |
| $SO_2$ | 1 | 250 | ppb | Maximum | 56.3 | 43.3 | 39.0 | 57.1 | 95.6 | 23 | 17 | 16 | 23 | 38 | 24.8 | 34.1 | 28.3 | 30.7 | 61.0 | 10 | 14 | 11 | 12 | 24 |
| | | | | Minimum | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | 24 | 100 | ppb | Maximum | 13.8 | 15.6 | 8.8 | 13.0 | 18.7 | 14 | 16 | 9 | 13 | 19 | 3.9 | 4.2 | 8.3 | 6.2 | 5.2 | 4 | 4 | 8 | 6 | 5 |
| | | | | Minimum | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | Annual | 20 / 11 [A] | ppb | Mean (Period) | 1.6 | 1.5 | 1.0 | 1.7 | 1.8 | N/A [B] | 7.3 | 4.8 | 8.5 | 9.0 | 0 | 0.7 | 0.7 | 0.8 | 0.6 | N/A [B] | 3.5 | 3.5 | 3.9 | 3.0 |
| | | | | # of Exceedances | N/A [B] | 0 | 0 | 0 | 0 | | | | | | N/A [B] | 0 | 0 | 0 | 0 | | | | | |
| $PM_{2.5}$ | 24 | 28 [C] | µg/m³ | Maximum | 27 | 43.2 | 59.6 | 34.7 | 70.6 | - | - | - | 85 | 82 | 50.6 | 41.3 | 64.7 | 43.1 | 35.8 | - | - | - | 98 | 97 |
| | | | | Minimum | 1.8 | 0.2 | 0.2 | 0.2 | 0.2 | | | | | | 0.6 | 0.2 | 0.2 | 0 | 0.1 | | | | | |
| | | | | Mean | 8.6 | 8.6 | 7.8 | 6.8 | 6.4 | | | | | | 8.4 | 8.5 | 9.5 | 9.6 | 6.3 | | | | | |
| | | | | 98th Percentile [D] | 21.5 | 22.3 | 27.3 | 21.6 | 19.8 | | | | | | 21.7 | 21.1 | 28.4 | 32.9 | 20.3 | | | | | |
| | | | | # of Exceedances | N/A [E] | N/A [E] | N/A [E] | N/A [E] | N/A [E] | | | | | | N/A [E] | N/A [E] | N/A [E] | N/A [E] | N/A [E] | | | | | |
| | Annual | 10 [F] | µg/m³ | Mean (Period) | 8.4 | 8.6 | 7.7 | 6.8 | 6.4 | - | - | - | 77 | 70 | 8.4 | 8.5 | 9.5 | 9.6 | 6.3 | - | - | - | 92 | 85 |
| | | | | # of Exceedances | N/A [G] | N/A [G] | N/A [G] | N/A [G] | N/A [G] | | | | | | N/A [G] | N/A [G] | N/A [G] | N/A [G] | N/A [G] | | | | | |
| $NO_2$ | 1 | 200 [H] | ppb | Maximum | 48.0 | 52.7 | 62.3 | 62.4 | 42.8 | 24 | 26 | 31 | 31 | 21 | 39.3 | 62.2 | 42.6 | 36.2 | 42.9 | 20 | 31 | 21 | 18 | 21 |
| | | | | Minimum | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | 24 | 100 [H] | ppb | Maximum | 26.8 | 31.7 | 25.9 | 23.1 | 26.4 | 27 | 32 | 26 | 23 | 26 | 24.7 | 28 | 22.6 | 21.5 | 30.5 | 25 | 28 | 23 | 21 | 31 |
| | | | | Minimum | 0.3 | 0.1 | 0 | 0.4 | 0.3 | | | | | | 0.2 | 0 | 0 | 0 | 0 | | | | | |
| | | | | # of Exceedances | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | Annual | 30 | ppb | Mean | 6.4 | 8.0 | 6.8 | 6.4 | 6.4 | N/A [B] | 27 | 23 | 21 | 21 | 6.5 | 6.1 | 6.6 | 5.4 | 5.5 | N/A [B] | 20 | 22 | 18 | 18 |
| | | | | # of Exceedances | N/A [B] | 0 | 0 | 0 | 0 | | | | | | N/A [B] | 0 | 0 | 0 | 0 | | | | | |
| NO [H] | 1 | NA | ppb | Maximum | 111.1 | 79.1 | 88.5 | 69.5 | 128.9 | - | - | - | - | - | 40.7 | 38.2 | 90.9 | 42.8 | 88.5 | - | - | - | - | - |
| | | | | Minimum | 0 | 0.1 | 0 | 0 | 0 | | | | | | 0 | 0 | 0.4 | 0 | 0 | | | | | |
| | | | | # of Exceedances | N/A | N/A | N/A | N/A | 0 | | | | | | N/A | N/A | N/A | N/A | N/A | | | | | |
| | 24 | NA | ppb | Maximum | 22.9 | 21.7 | 22.3 | 21.9 | 25.1 | - | - | - | - | - | 10.6 | 11.2 | 15.9 | 9.2 | 7.9 | - | - | - | - | - |
| | | | | Minimum | 0 | 0.5 | 0 | 0.1 | 0 | | | | | | 0.5 | 0 | 0.7 | 0.1 | 0 | | | | | |
| | | | | # of Exceedances | N/A | N/A | N/A | N/A | N/A | | | | | | N/A | N/A | N/A | N/A | N/A | | | | | |

## Table 5-1 Comparison of Measured Ambient CAC Concentrations (2013 - 2017)

| Pollutant | Averaging Period | AAQC / HHRA Standards | Units | | Courtice WPCP (Upwind) | | | | | | | | | | Rundle Road (Downwind) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measurement | | | | | % of Criteria | | | | | Measurement | | | | | % of Criteria | | | | |
| | | | | | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 |
| $NO_X$ [H] | 1 | N/A | ppb | Maximum | 151.3 | 122.2 | 148.5 | 97.1 | 146.9 | - | - | - | - | - | 68.5 | 70 | 102 | 71.3 | 89.3 | - | - | - | - | - |
| | | | | Minimum | 0 | 0 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| | | | | # of Exceedances | N/A | N/A | N/A | N/A | N/A | | | | | | N/A | N/A | N/A | N/A | N/A | | | | | |
| | 24 | N/A | ppb | Maximum | 49.6 | 52.1 | 42.6 | 44.7 | 45.0 | - | - | - | - | - | 34.9 | 38.6 | 31.9 | 28.3 | 35.5 | - | - | - | - | - |
| | | | | Minimum | 0.1 | 1.4 | 0 | 0.6 | 0.6 | | | | | | 0.3 | 0 | 0 | 0 | 0 | | | | | |
| | | | | # of Exceedances | N/A | N/A | N/A | N/A | N/A | | | | | | N/A | N/A | N/A | N/A | N/A | | | | | |
| | Annual | N/A | ppb | Mean | 9.6 | 10.8 | 9.1 | 8.8 | 9.0 | - | - | - | - | - | 8.0 | 7.8 | 8.2 | 7.1 | 7.2 | - | - | - | - | - |
| | | | | # of Exceedances | N/A | N/A | N/A | N/A | N/A | | | | | | N/A | N/A | N/A | N/A | N/A | | | | | |

**Notes:**

A. Annual AAQC / Annual HHRA
B. As the length of the measurement period in 2013 was less than 9-months, the period (i.e. 8-months) averages presented in this report were not compared to available MOECC annual criteria.
C. Canadian Ambient Air Quality Standard for Respirable Particulate Matter. The Respirable Particulate Matter Objective is referenced to the average of the 98th percentile of the daily average over 3 consecutive years.
D. The 98th percentile of the daily average $PM_{2.5}$ measurements in the period.
E. Daily $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires averaging the 98th percentile concentrations over three consecutive years, as compared to the 8-month period covered in 2013 and the 12-month period covered in 2014 and 2015.
F. Annual Canadian Ambient Air Quality Standard for Respirable Particulate Matter, effective by 2015. The Respirable Particulate Matter Objective is referenced to the 3-year average of the annual average concentrations.
G. Annual $PM_{2.5}$ concentrations were not compared to the Canadian Ambient Air Quality Standard shown in this table, which requires the 3-year average of the annual average concentrations compared to the 12-month period considered in this report for 2014 and 2015 and the 8-month period for 2013.
H. NO and NOx have no ambient air quality criteria.

## 5.2 TSP AND METALS COMPARISONS

A summary of the maximum measured daily average TSP and metals concentrations for 2013 - 2014, and 2016 - 2017 is presented in **Table 5-2**. The maximum measured 24-hour average concentrations of almost all TSP and all metals with MOECC air quality criteria during these three years were below their applicable 24-hour criteria at both stations, except for two TSP measurements in 2017. (See Section 4.3 for more details, including root cause analyses.) Since the measurement period in 2013 was eight months (April-December), six months (January-June) in 2014, and 11 months (February-December) in 2016, due to the non-continuous monitoring being temporarily discontinued as per the ambient monitoring plan, caution should be exercised in comparing the data as the measurement period lengths were different and cover different periods of each year (with different meteorological conditions).

The maximum measured daily average TSP concentrations were lowest in 2014 and highest in 2017. Iron is the metal with the highest percentage of its regulatory criterion for all years and stations, however, the measurements are still below the criterion.

## Table 5-2 Comparison of Measured Ambient TSP and Metals Concentrations (2013 to 2017)

| Contaminant | Units | MOE (Daily Average) Criteria | HHRA Health Based (Daily Average) Standard | Courtice WPCP (Predominately Upwind) | | | | | | | | | | Rundle Road (Predominately Downwind) | | | | | | | | | | Fence Line | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Maximum Measured Concentration | | | | | % of Criteria | | | | | Maximum Measured Concentration | | | | | % of Criteria | | | | | Maximum Measured Concentration | | % of Criteria | |
| | | | | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| Particulate (TSP) | µg/m³ | 120 | 120 | 62.0 | 57.0 | | 94.7 | 59.6 | 51.7 | 47.5 | | 78.9 | 49.7 | 78.0 | 59.0 | | 97.1 | 232 | 65.0 | 49.2 | | 80.9 | 193 | 80.2 | 86.1 | 66.8 | 71.8 |
| Total Mercury (Hg) | µg/m³ | 2 | | 3.12E-05 | 2.15E-05 | | 3.62E-05 | 3.60E-05 | 0.0 | 0.0 | | 0.0 | 0.0 | 5.14E-05 | 2.94E-05 | | 2.50E-05 | 4.80E-05 | 0.0 | 0.0 | | 0.0 | 0.0 | 4.79E-05 | 7.40E-05 | 0.0 | 0.0 |
| Aluminum (Al) | µg/m³ | 4.8 | - | 3.34E-01 | 3.57E-01 | | 6.78E-01 | 4.49E-01 | 7.0 | 7.4 | | 14.1 | 9.4 | 4.54E-01 | 2.90E-01 | | 7.86E-01 | 1.08E+00 | 9.5 | 6.0 | | 16.4 | 22.5 | 7.07E-01 | 5.83E-01 | 14.7 | 12.1 |
| Antimony (Sb) | µg/m³ | 25 | 25 | 2.69E-03 | 3.91E-03 | | 3.67E-03 | 3.73E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 2.86E-03 | 3.41E-03 | | 3.57E-03 | 3.69E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 3.53E-03 | 3.49E-03 | 0.0 | 0.0 |
| Arsenic (As) | µg/m³ | 0.3 | 0.3 | 3.79E-03 | 2.35E-03 | | 2.20E-03 | 4.14E-03 | 1.3 | 0.8 | | 0.7 | 1.4 | 1.76E-03 | 2.05E-03 | | 4.72E-03 | 2.21E-03 | 0.6 | 0.7 | | 1.6 | 0.7 | 2.12E-03 | 2.10E-03 | 0.7 | 0.7 |
| Barium (Ba) | µg/m³ | 10 | 10 | 1.58E-02 | 1.90E-02 | | 3.39E-02 | 2.05E-02 | 0.2 | 0.2 | | 0.3 | 0.2 | 1.61E-02 | 1.18E-02 | | 2.37E-02 | 3.20E-02 | 0.2 | 0.1 | | 0.2 | 0.3 | 2.29E-02 | 2.76E-02 | 0.2 | 0.3 |
| Beryllium (Be) | µg/m³ | 0.01 | 0.01 | 2.69E-04 | 3.91E-04 | | 3.67E-04 | 3.73E-04 | 2.7 | 3.9 | | 3.7 | 3.7 | 2.86E-04 | 3.41E-04 | | 3.57E-04 | 3.69E-04 | 2.9 | 3.4 | | 3.6 | 3.7 | 3.53E-04 | 3.49E-04 | 3.5 | 3.5 |
| Bismuth (Bi) | µg/m³ | - | - | 1.66E-03 | 2.35E-03 | | 2.20E-03 | 2.24E-03 | | | | | | 1.76E-03 | 2.05E-03 | | 2.14E-03 | 2.21E-03 | | | | | | 2.12E-03 | 2.10E-03 | | |
| Boron (B) | µg/m³ | 120 | - | 1.13E-02 | 5.61E-03 | | 8.50E-03 | 5.39E-03 | 0.01 | 0.00 | | 0.01 | 0.0 | 1.45E-02 | 4.43E-03 | | 7.45E-03 | 6.12E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 8.49E-03 | 6.67E-03 | 0.0 | 0.0 |
| Cadmium (Cd) | µg/m³ | 0.025 | 0.025 | 5.59E-04 | 1.18E-03 | | 7.34E-04 | 7.45E-04 | 2.2 | 4.7 | | 2.9 | 3.0 | 8.99E-04 | 6.83E-04 | | 7.13E-04 | 7.38E-04 | 3.6 | 2.7 | | 2.9 | 3.0 | 1.13E-02 | 2.69E-03 | 45.3 | 10.8 |
| Chromium (Cr) | µg/m³ | 0.5 | - | 3.82E-03 | 6.29E-03 | | 7.74E-03 | 1.03E-02 | 0.8 | 1.3 | | 1.5 | 2.1 | 1.78E-02 | 4.75E-03 | | 7.93E-03 | 1.75E-02 | 3.6 | 1.0 | | 1.6 | 3.5 | 8.22E-03 | 7.67E-02 | 1.6 | 15.3 |
| Cobalt (Co) | µg/m³ | 0.1 | 0.1 | 5.59E-04 | 7.83E-04 | | 7.34E-04 | 7.45E-04 | 0.6 | 0.8 | | 0.7 | 0.7 | 5.95E-04 | 6.83E-04 | | 2.78E-03 | 7.38E-04 | 0.6 | 0.7 | | 2.8 | 0.7 | 7.07E-04 | 6.99E-04 | 0.7 | 0.7 |
| Copper (Cu) | µg/m³ | 50 | - | 7.68E-02 | 5.95E-02 | | 1.27E-01 | 9.85E-02 | 0.2 | 0.1 | | 0.3 | 0.2 | 2.36E-01 | 1.93E-01 | | 1.16E-01 | 2.29E-01 | 0.5 | 0.4 | | 0.2 | 0.5 | 7.70E-02 | 1.02E-01 | 0.2 | 0.2 |
| Iron (Fe) | µg/m³ | 4 | - | 9.90E-01 | 9.26E-01 | | 1.58E+00 | 1.01E+00 | 24.8 | 23.2 | | 39.4 | 25.3 | 1.31E+00 | 9.30E-01 | | 1.83E+00 | 2.26E+00 | 32.8 | 23.3 | | 45.8 | 56.5 | 1.36E+00 | 1.66E+00 | 34.0 | 41.5 |
| Lead (Pb) | µg/m³ | 0.5 | 0.5 | 6.47E-03 | 5.50E-03 | | 7.52E-03 | 1.09E-02 | 1.3 | 1.1 | | 1.5 | 2.2 | 6.80E-03 | 7.34E-03 | | 7.25E-03 | 1.30E-02 | 1.4 | 1.5 | | 1.4 | 2.6 | 1.02E-02 | 1.04E-02 | 2.0 | 2.1 |
| Magnesium (Mg) | µg/m³ | - | - | 5.71E-01 | 4.13E-01 | N/A | 1.14E+00 | 5.61E-01 | | | N/A | | | 6.76E-01 | 2.97E-01 | N/A | 1.10E+00 | 1.76E+00 | | | N/A | | | 1.01E+00 | 1.07E+00 | | |
| Manganese (Mn) | µg/m³ | 0.4 | - | 3.31E-02 | 3.08E-02 | | 4.86E-02 | 5.25E-02 | 8.3 | 7.7 | | 12.1 | 13.1 | 1.02E-01 | 2.60E-02 | | 6.56E-02 | 7.74E-02 | 25.5 | 6.5 | | 16.4 | 19.4 | 4.65E-02 | 9.69E-02 | 11.6 | 24.2 |
| Molybdenum (Mo) | µg/m³ | 120 | - | 1.65E-03 | 2.36E-03 | | 3.15E-03 | 4.44E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 3.79E-03 | 2.76E-03 | | 6.24E-03 | 3.13E-02 | 0.0 | 0.0 | | 0.0 | 0.0 | 5.25E-03 | 3.49E-03 | 0.0 | 0.0 |
| Nickel (Ni) | µg/m³ | 0.2 | - | 4.35E-03 | 2.78E-03 | | 2.40E-03 | 3.95E-03 | 2.2 | 1.4 | | 1.2 | 2.0 | 4.67E-03 | 4.58E-03 | | 1.94E-02 | 3.62E-03 | 2.3 | 2.3 | | 9.7 | 1.8 | 3.39E-03 | 1.24E-02 | 1.7 | 6.2 |
| Phosphorus (P) | µg/m³ | - | - | 1.45E-01 | 1.05E-01 | | 4.60E-01 | 9.76E-02 | | | | | | 1.59E-01 | 1.85E-01 | | 1.03E-01 | 1.45E-01 | | | | | | 3.34E-01 | 1.07E-01 | | |
| Selenium (Se) | µg/m³ | 10 | 10 | 2.69E-03 | 3.91E-03 | | 3.67E-03 | 3.73E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 2.86E-03 | 3.41E-03 | | 3.57E-03 | 3.69E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 3.53E-03 | 3.49E-03 | 0.0 | 0.0 |
| Silver (Ag) | µg/m³ | 1 | 1 | 1.89E-03 | 1.96E-03 | | 1.83E-03 | 1.86E-03 | 0.2 | 0.2 | | 0.2 | 0.2 | 2.33E-03 | 1.71E-03 | | 1.78E-03 | 1.85E-03 | 0.2 | 0.2 | | 0.2 | 0.2 | 1.77E-03 | 1.75E-03 | 0.2 | 0.2 |
| Strontium (Sr) | µg/m³ | 120 | - | 1.10E-02 | 1.34E-02 | | 1.86E-02 | 1.38E-02 | 0.0 | 0.0 | | 0.0 | 0.0 | 1.95E-02 | 1.09E-02 | | 2.11E-02 | 7.54E-02 | 0.0 | 0.0 | | 0.0 | 0.1 | 1.86E-02 | 2.60E-02 | 0.0 | 0.0 |
| Thallium (Tl) | µg/m³ | - | - | 2.69E-03 | 3.91E-03 | | 3.67E-03 | 3.73E-03 | | | | | | 2.86E-03 | 3.41E-03 | | 3.57E-03 | 3.69E-03 | | | | | | 3.53E-03 | 3.49E-03 | | |
| Tin (Sn) | µg/m³ | 10 | 10 | 4.79E-03 | 3.91E-03 | | 3.67E-03 | 3.73E-03 | 0.1 | 0.0 | | 0.0 | 0.0 | 2.86E-03 | 3.41E-03 | | 4.12E-02 | 3.69E-03 | 0.0 | 0.0 | | 0.4 | 0.0 | 3.53E-03 | 3.49E-03 | 0.0 | 0.0 |
| Titanium (Ti) | µg/m³ | 120 | - | 1.73E-02 | 2.26E-02 | | 2.82E-02 | 2.08E-02 | 0.0 | 0.0 | | 0.0 | 0.0 | 2.40E-02 | 1.71E-02 | | 3.50E-02 | 6.46E-02 | 0.0 | 0.0 | | 0.0 | 0.1 | 4.63E-02 | 3.35E-02 | 0.0 | 0.0 |
| Vanadium (V) | µg/m³ | 2 | 1 | 1.92E-03 | 1.96E-03 | | 1.83E-03 | 1.86E-03 | 0.1 | 0.1 | | 0.2 | 0.2 | 3.22E-03 | 1.71E-03 | | 3.14E-03 | 3.43E-03 | 0.2 | 0.1 | | 0.3 | 0.3 | 1.77E-03 | 1.75E-03 | 0.2 | 0.2 |
| Zinc (Zn) | µg/m³ | 120 | - | 6.50E-02 | 1.14E-01 | | 9.54E-02 | 2.46E-01 | 0.1 | 0.1 | | 0.1 | 0.2 | 7.43E-02 | 1.24E-01 | | 6.66E-02 | 2.95E-01 | 0.1 | 0.1 | | 0.1 | 0.2 | 7.96E-02 | 1.83E-01 | 0.1 | 0.2 |
| Zirconium (Zr) | µg/m³ | 20 | - | 1.39E-03 | 1.96E-03 | | 1.83E-03 | 1.86E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 1.48E-03 | 1.71E-03 | | 1.78E-03 | 1.85E-03 | 0.0 | 0.0 | | 0.0 | 0.0 | 1.77E-03 | 1.75E-03 | 0.0 | 0.0 |
| Total Uranium (U) | µg/m³ | 1.5 | - | 1.24E-04 | 1.76E-04 | | 1.65E-04 | 1.68E-04 | 0.0 | 0.0 | | 0.0 | 0.0 | 1.32E-04 | 1.54E-04 | | 1.60E-04 | 1.66E-04 | 0.0 | 0.0 | | 0.0 | 0.0 | 1.59E-04 | 1.57E-04 | 0.0 | 0.0 |

## 5.3 PAH COMPARISONS

A summary of the maximum measured ambient PAH concentrations for 2013- 2014 and 2016 - 2017 for the Courtice WPCP and Rundle Road Stations are presented in **Table 5-3**. Both individual PAHs and total PAH concentrations are presented. Also presented are the numbers of exceedances of the applicable criteria for each PAH. As with TSP, since the measurement periods are not the same in each year, the data are not directly comparable.

The maximum measured concentrations of PAHs other than benzo(a)pyrene (B(a)P) were well below their applicable 24-hour criteria for each of the four years.

In 2013 (8-month monitoring period), three (3) B(a)P samples collected at the Rundle Road Station and one (1) sample collected at the Courtice WPCP Station exceeded the Ontario 24-hour B(a)P AAQC. In 2014 (6-month monitoring period), four (4) samples collected at the Rundle Road Station and three (3) samples collected at the Courtice WPCP Station exceeded the AAQC. In the 11-month monitoring period during 2016, seven (7) B(a)P samples collected at the Rundle Road Station and five (5) measurements of B(a)P at the Courtice WPCP Station exceeded AAQC. In 2017 (12-month monitoring period), eight (8) samples collected at the Rundle Road Station and four (4) samples collected at the Courtice WPCP Station exceeded the AAQC. The highest B(a)P concentration measured over all years (0.41 ng/ $m^3$) occurred at the Rundle Road Station in 2013 when the stations were measuring background air quality.

## Table 5-3 Comparison of Measured Ambient PAH Concentrations (2013 to 2017)

| Contaminant | Units | MOE Daily Average Criteria | HHRA Health Based Daily Average Standard | Courtice WPCP (Upwind) | | | | | | | | | | | | | | | | Rundle Road (Downwind) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Maximum Measured | | | | | % of Criteria | | | | | No. of Exceedances | | | | | | Maximum Measured | | | | | % of Criteria | | | | | No. of Exceedances | | | | |
| | | | | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Benzo(a)pyrene | ng/m³ | 0.05 [A] | 1 | 0.060 | 0.130 | | 0.104 | 0.088 | 129.6 | 264 | | 207 | 176 | 1 | 3 | | 5 | 4 | | 0.410 | 0.290 | | 0.207 | 0.158 | 826 | 576 | | 415 | 316 | 3 | 4 | | 7 | 8 |
| | | 5 [B] | | | | | | | 1.3 | 2.6 | | 2.1 | 1.8 | 0 | 0 | | 0 | 0 | | | | | | | 8.3 | 5.8 | | 4.1 | 3.2 | 0 | 0 | | 0 | 0 |
| | | 1.1 [C] | | | | | | | 5.9 | 12 | | 9.4 | 8.0 | 0 | 0 | | 0 | 0 | | | | | | | 37.5 | 26.2 | | 18.8 | 14.4 | 0 | 0 | | 0 | 0 |
| 1-Methylnaphthalene | ng/m³ | 12000 | - | 27.2 | 8.2 | | 24.0 | 19.7 | 0.2 | 0.1 | | 0.2 | 0.2 | 0 | 0 | | 0 | 0 | | 26.6 | 10.8 | | 238.2 | 29.4 | 0.2 | 0.1 | | 2.0 | | 0 | 0 | | 0 | 0 |
| 2-Methylnaphthalene | ng/m³ | 10000 | - | 54.3 | 13.9 | | 50.4 | 33.5 | 0.5 | 0.1 | | 0.5 | 0.3 | 0 | 0 | | 0 | 0 | | 45.4 | 18.7 | | 502.5 | 69.2 | 0.5 | 0.2 | | 5.0 | | 0 | 0 | | 0 | 0 |
| Acenaphthene | ng/m³ | - | - | 38.7 | 11.8 | | 29.6 | 17.0 | | | | | | - | - | | - | - | | 18.9 | 8.1 | | 303.2 | 44.1 | | | | | | - | - | | - | - |
| Acenaphthylene | ng/m³ | 3500 | - | 1.1 | 0.4 | | 0.3 | 0.8 | 0.03 | 0.01 | | 0.0 | 0.0 | 0 | 0 | | 0 | 0 | | 1.6 | 2.0 | | 3.3 | 1.2 | 0.1 | 0.1 | | 0.1 | | 0 | 0 | | 0 | 0 |
| Anthracene | ng/m³ | 200 | - | 13.1 | 1.1 | | 0.5 | 0.6 | 6.6 | 0.6 | | 0.3 | 0.3 | 0 | 0 | | 0 | 0 | | 1.5 | 0.7 | | 7.5 | 3.1 | 0.8 | 0.4 | | 3.8 | | 0 | 0 | | 0 | 0 |
| Benzo(a)anthracene | ng/m³ | - | - | 0.2 | 0.2 | | 0.1 | 0.1 | | | | | | - | - | | - | - | | 0.5 | 0.2 | | 0.2 | 0.1 | | | | | | - | - | | - | - |
| Benzo(a)fluorene | ng/m³ | - | - | 0.3 | 0.3 | | 0.2 | 0.2 | | | | | | - | - | | - | - | | 0.6 | 0.3 | | 0.4 | 0.4 | | | | | | - | - | | - | - |
| Benzo(b)fluoranthene | ng/m³ | - | - | 0.4 | 0.6 | | 2.5 | 0.1 | | | | | | - | - | | - | - | | 1.0 | 0.7 | | 0.5 | 0.4 | | | | | | - | - | | - | - |
| Benzo(b)fluorene | ng/m³ | - | - | 0.3 | 0.3 | | 0.2 | 0.2 | | | | | | - | - | | - | - | | 0.5 | 0.3 | | 0.2 | 0.3 | | | | | | - | - | | - | - |
| Benzo(e)pyrene | ng/m³ | - | - | 0.3 | 0.3 | | 0.2 | 0.2 | | | | | | - | - | | - | - | | 0.5 | 0.3 | | 0.2 | 0.3 | | | | | | - | - | | - | - |
| Benzo(g,h,i)perylene | ng/m³ | - | - | 0.4 | 0.3 | | 2.5 | 0.1 | | | | | | - | - | | - | - | | 0.6 | 0.3 | | 0.1 | 0.1 | | | | | | - | - | | - | - |
| Benzo(k)fluoranthene | ng/m³ | - | - | 0.4 | 0.3 | N/A | 2.5 | 0.1 | | | N/A | | | - | - | N/A | - | - | N/A | 0.3 | 0.2 | N/A | 0.1 | 0.1 | | | N/A | | | - | - | N/A | - | - |
| Biphenyl | ng/m³ | - | - | 14.9 | 4.5 | | 11.1 | 9.7 | | | | | | - | - | | - | - | | 7.4 | 5.8 | | 125.9 | 14.2 | | | | | | - | - | | - | - |
| Chrysene | ng/m³ | - | - | 0.2 | 0.5 | | 0.2 | 0.1 | | | | | | - | - | | - | - | | 0.9 | 0.7 | | 0.4 | 0.1 | | | | | | - | - | | - | - |
| Dibenz(a,h) anthracene | ng/m³ | - | - | 0.3 | 0.5 | | 2.8 | 0.1 | | | | | | - | - | | - | - | | 0.2 | 0.2 | | 0.1 | 0.1 | | | | | | - | - | | - | - |
| Dibenzo(a,c) anthracene + Picene [D] | ng/m³ | - | - | 0.3 | 0.3 | | 3.0 | 0.2 | | | | | | - | | | 0 | | | 0.4 | 0.3 | | 0.4 | 0.3 | | | | | | - | - | | 0 | - |
| Fluoranthene | ng/m³ | - | - | 4.5 | 4.0 | | 3.2 | 2.6 | | | | | | - | - | | - | - | | 7.7 | 3.5 | | 14.7 | 13.9 | | | | | | - | - | | - | - |
| Indeno(1,2,3-cd)pyrene | ng/m³ | - | - | 0.4 | 0.5 | | 2.8 | 0.1 | | | | | | - | - | | - | - | | 0.5 | 0.3 | | 0.2 | 0.1 | | | | | | - | - | | - | - |
| Naphthalene | ng/m³ | 22500 | 22500 | 143.0 | 38.7 | | 60.9 | 92.2 | 0.6 | 0.2 | | 0.3 | 0.4 | 0 | 0 | | 0 | 0 | | 94.1 | 92.6 | | 294.6 | 85.4 | 0.4 | 0.4 | | 1.3 | 0.4 | 0 | 0 | | 0 | 0 |
| o-Terphenyl | ng/m³ | - | - | 0.3 | 0.3 | | 0.2 | 0.2 | | | | | | - | - | | - | - | | 0.5 | 0.3 | | 0.2 | 0.3 | | | | | | - | - | | - | - |
| Perylene | ng/m³ | - | - | 0.3 | 0.3 | | 0.2 | 0.2 | | | | | | - | - | | - | - | | 0.5 | 0.3 | | 0.2 | 0.3 | | | | | | - | - | | - | - |
| Phenanthrene | ng/m³ | - | - | 33.9 | 14.2 | | 23.1 | 16.4 | | | | | | - | - | | - | - | | 29.4 | 13.0 | | 209.7 | 69.8 | | | | | | - | - | | - | - |
| Pyrene | ng/m³ | - | - | 1.7 | 2.5 | | 1.3 | 1.2 | | | | | | - | - | | - | - | | 3.2 | 1.9 | | 6.6 | 5.6 | | | | | | - | - | | - | - |
| Tetralin | ng/m³ | - | - | 5.8 | 25.3 | | 3.8 | 4.9 | | | | | | - | - | | - | - | | 5.1 | 4.0 | | 4.4 | 3.8 | | | | | | - | - | | - | - |
| Total PAH [E] | ng/m³ | - | - | 327.0 | 95.0 | | 208.7 | 200.0 | | | | | | - | - | | - | - | | 165.0 | 153.9 | | 1710.2 | 309.0 | | | | | | - | - | | - | - |

**Notes:**

A. Ontario Ambient Air Quality Criteria. The standard for benzo(a)pyrene (B(a)P) is for B(a)P as a surrogate for PAHs
B. O. Reg. 419 Schedule 6 Upper Risk Thresholds
C. O. Reg. 419 24 Hour Guideline
D. Based on laboratory analyses, dibenzo(a,c)anthracene co-elutes with dibenz(a,h)anthracene. Picene elutes after dibenz(a,h)anthracene
E. The reported total PAH is the sum of all analysed PAH species

## 5.4 DIOXIN AND FURAN COMPARISONS

The maximum measured ambient toxic equivalent dioxin and furan concentrations at each station in 2013-2017 are presented in **Table 5-4**.

**Table 5-4 Comparison of Maximum Measured Dioxin and Furan Concentrations (2013-2017)**

| Year | Measurement Period in each Year | Courtice WPCP (pg TEQ/m$^3$) | Rundle Road (pg TEQ/m$^3$) |
|---|---|---|---|
| 2013 | May - December | 0.036 | 0.029 |
| 2014 | January - June | 0.038 | 0.065 |
| 2015 | October - December | 0.017 | 0.021 |
| 2016 | February - December | 0.044 | 0.026 |
| 2017 | January – December | 0.052 | 0.065 |

The maximum measured toxic equivalent dioxin and furan concentrations at both stations were below the applicable 24-hour criteria of 0.1 pg TEQ/m$^3$ for all five years.

It should be noted that since the monitoring periods in each year, which follows the requirements of the Ambient Monitoring Plan (Stantec, 2012), were different (as shown in **Table 5-4**), the data between the four years are not directly comparable. Caution should be exercised in comparing the data as the measurement periods were different and cover different periods of each year (with different meteorological conditions). Only the 2017 measurements encompassed a full year as previous years sampling were dependent on the start-up date of the DYEC.

# 6.0 CONCLUSIONS

This report provides a summary of the ambient air quality data collected at the two monitoring stations located predominantly upwind and predominantly downwind in the vicinity of the DYEC for the 2017 monitoring period. The following observations and conclusions were made from a review of the measured ambient air quality monitoring data:

1. Measured concentrations of $NO_2$, $SO_2$ and $PM_{2.5}$ were below the applicable O. Reg. 419/05 criteria or human health risk assessment (HHRA) health-based criteria presented in **Table 2-2** of this report for hourly, 24-hour, and annual averaging periods.
2. The 98$^{th}$ percentiles of the measured daily average $PM_{2.5}$ levels during the 2017 monitoring period were 19.8 µg/m$^3$ at the Courtice WPCP Station and 20.3 µg/m$^3$ at the Rundle Road Station. The annual average $PM_{2.5}$ concentration measured at the Courtice WPCP and Rundle Road Stations over the monitoring period was 6.4 and 6.3 µg/m$^3$, respectively. As detailed below, these values for the 2017 measurements should not be used for direct comparison against the Canadian Ambient Air Quality Standard.
3. The Canadian Ambient Air Quality Standards (CAAQS) for 24-hour and annual $PM_{2.5}$ both require a three-calendar year average for a valid comparison, with the data considered valid if an annual 98$^{th}$ percentile value is available for at least two of the three calendar years. Using the measured $PM_{2.5}$ data at each station for calendar years 2014 to 2017, average annual 98$^{th}$ percentile daily average and annual average $PM_{2.5}$ levels were calculated for the rolling three-year periods of 2014-2016 and 2015-2017 and compared to their CAAQS. The measured data (with statistics applied) on ambient $PM_{2.5}$ levels were below their respective CAAQS at both stations for both three-year periods.
4. The maximum measured concentrations of almost all TSP and all metals with MOECC air quality criteria were below their applicable criteria (presented in **Table 2-3** in this report), except for two TSP measurements at the Rundle Road Station. In both cases, the DYEC was not upwind of the Rundle Road Station, and the measured TSP concentrations were not expected to have resulted in an adverse effect on human health or the environment. Discussion of the meteorology and potential sources for these events, which is required by the MOECC to be included in each annual report, is provided in Section 4.3.
5. The maximum measured concentrations of PAHs with MOECC Ambient Air Quality Criteria, were below their applicable 24-hour criteria (presented in **Table 2-4**) at both stations with the exception of twelve (12) benzo(a)pyrene (B(a)P) measurements. Out of twenty-nine (29) samples collected at the Rundle Road Station, eight (8) samples exceeded the Ontario 24-hour B(a)P AAQC by levels varying between 7% and 216%. Out of thirty (30) B(a)P measurements collected at the Courtice WPCP Station, four (4) measurements exceeded the MOECC Ambient Air Quality Criteria by levels varying between 15% and 77%. However, the exceedances were below the MOECC Schedule 6 Upper Risk Threshold, the MOECC O. Reg. 419/05 24-hour average guideline, and the HHRA healthbased criteria. Discussion of the

meteorology and potential sources for these events, which is required by the MOECC to be included in each annual report, is provided in Section 4.4.

Based on the air quality assessments completed during the Environmental Assessment Study and the Environmental Compliance Approval application for the DYEC, the facility will not be a significant contributor of B(a)P. Therefore, ambient B(a)P levels are not expected to be substantially impacted by the operation of the DYEC.

6. The maximum toxic equivalent dioxin and furan concentration measured over this period was below the applicable criteria presented in **Table 2-4**.
7. In summary, the concentrations of almost all measured air contaminants were below their applicable criteria during the 2017 monitoring period. The noted exceptions are benzo(a)pyrene and TSP, as described above. Further, except for TSP the measured levels of all other monitored contaminants were below their applicable HHRA health-based criteria.

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# Appendix A EQUIPMENT MAINTENANCE, CALIBRATION SCHEDULE AND SUMMARY OF EQUIPMENT ISSUES

**Table A-1 Summary of Preventative Maintenance**

| Parameter | Equipment Make/Model | Description of Maintenance Activities | Required Schedule (to meet MOE and Ambient Monitoring Plan requirements) | Schedule / Comments | 2017 Schedule Dates | | |
|---|---|---|---|---|---|---|---|
| | | | | | Courtice | Rundle | Fenceline |
| $SO_2$ | Teledyne Monitor Labs | Change particulate filter | Monthly | During monthly calibration | See note 1 | See note 2 | N/A |
| | | Replace critical flow orifice and filters | Annual | During annual maintenance | 7-Dec-17 | 7-Dec-17 | |
| | | Exchange chemical – external zero air scrubber | 3 months | Every 3 months | 28-Apr-17, 26-Jul-17 | 28-Apr-17, 26-Jul-17 | |
| | | Replace perm tube | 8 months | During annual maintenance | 28-Apr-17 | 28-Apr-17 | |
| | | Replace Pump diaphragm | 8 months | During annual maintenance | 7-Dec-17 | 7-Dec-17 | |
| | | Clean sample chamber, windows and filters | As required | During annual maintenance | 7-Dec-17 | 7-Dec-17 | |
| | | Yearly maintenance | Annual | During annual maintenance | 7-Dec-17 | 7-Dec-17 | |
| NOx | API Model 200E | Change particulate filter | Monthly | Done during monthly calibration | See note 1 | See note 2 | |
| | | Exchange chemical – external zero air scrubber | 3 months | 3 months | 28-Apr-17, 26-Jul-17 | 28-Apr-17, 26-Jul-17 | |
| | | Replace chemical – external dryer | 3 months | 3 months | 28-Apr-17, 26-Jul-17 | 28-Apr-17, 26-Jul-17 | |
| | | Chemical change – ozone filter | 3 months | 3 months | 28-Apr-17, 26-Jul-17 | 28-Apr-17, 26-Jul-17 | |
| | | Clean reaction cell window (annually or as necessary) | Annually | During annual maintenance | 9-Dec-17 | 9-Dec-17 | |
| | | Change particulate DFU filter | Annually | During annual maintenance | 9-Dec-17 | 9-Dec-17 | |
| | | Replace reaction cell O-rings & sintered filters | Annually or as required | During annual maintenance | 9-Dec-17 | 9-Dec-17 | |
| | | Rebuild pump head | When RCEL pressures exceeds 10 in Hg | As required | Not Required | 26-Jul-17 | |
| | | Replace inline exhaust scrubber | Annually | During annual maintenance | 9-Dec-17 | 9-Dec-17 | |
| | | Replace perm tube | Annually | During annual maintenance | 28-Apr-17 | 28-Apr-17 | |
| | | Replace inline exhaust scrubber | Annually | During annual maintenance | 9-Dec-17 | 9-Dec-17 | |
| | | Replace NO2 converter | Every 3 years or if conversion < 96% | Conversion checked every 6 months | Checked 26-Jul-17 | Checked 26-Jul-17 | |
| | | Yearly maintenance | Annual | During annual maintenance | 9-Dec-17 | 9-Dec-17 | |
| $PM_{2.5}$ | Thermo Sharp 5030 | Replace filter tape | Upon 10% remaining | As required | Not Required | Not Required | |
| | | Replace SHARP zeroing filters | 6 months | | 26-Jul-17 | 26-Jul-17 | |
| | | Clean PM2.5 inlet | Monthly | During monthly calibration | See note 1 | See note 2 | |
| | | Clean cyclone | Monthly | During monthly calibration | See note 1 | See note 2 | |
| | | Clean air inlet system | Annually | During annual maintenance | 8-Nov-17 | 8-Nov-17 | |

**Table A-1 Summary of Preventative Maintenance**

| Parameter | Equipment Make/Model | Description of Maintenance Activities | Required Schedule (to meet MOE and Ambient Monitoring Plan requirements) | Schedule / Comments | 2017 Schedule Dates | | |
|---|---|---|---|---|---|---|---|
| | | | | | Courtice | Rundle | Fenceline |
| | | Rebuild vacuum pump | 12-18 months | 12-18 months or when pump load reaches 80% | Not Required | Not Required | |
| | | Clean ambient temp/RH shield and assembly | Annually | During annual maintenance | 8-Nov-17 | 8-Nov-17 | |
| TSP/metals | TE-5170 | Ensure all gaskets sealing properly | Weekly | Check at weekly site visit | Maintenance performed weekly. | | |
| | | Power cord checks for damage/cracks | Weekly | Check at weekly site visit | | | |
| | | Inspect screen and remove foreign deposits | Weekly | Check at weekly site visit | | | |
| | | Inspect holder frame gasket | Every sample | Check at weekly site visit | | | |
| | | Replace motor brushes | Every 500 hours | Replace as needed | Replaced 9-Jan-17, 17-May-17, 18-Sep-17 | Replaced 6-Mar-17 | Replaced 11-Apr-17, 14-Aug-17, 26-Sep-17 |
| | | Check elapsed time meter | Weekly | Check at weekly site visit | Maintenance performed weekly. | | |
| | | Check flow recorder pen/tubing | Weekly | Check at weekly site visit | | | |
| | | Ensure all gaskets sealing properly | Weekly | Check at weekly site visit | | | |
| PAH and D/F | TE-1000 | Ensure all gaskets sealing properly | Weekly | Check at weekly site visit | Checked at every site visit and calibration day. | Checked at every site visit and calibration day. | N/A |
| | | Power cord checks for damage/cracks | Weekly | Check at weekly site visit | | | |
| | | Clean any dirt around module and filter holder | Weekly | Check at weekly site visit | | | |
| | | Inspect dual sampling module gaskets | Every sample | Check at weekly site visit | | | |
| | | Inspect and replace motor flange gasket and motor cushion | Routinely, minimum annually | | | | |
| | | Replace motor brushes | Every 400 hours | Replaced as needed | Replaced 5-Jan-17, 21-Jul-17 | Replaced 20-Jan-17, 21-Jul-17 | |
| Wind Speed and Direction (Rundle Road Station only) | Met One 034B | Physical inspection of equipment for signs of damage/erratic behavior | Weekly | Check at weekly site visit | N/A | Checked weekly | |
| | | Replace wind speed sensor bearings and calibrate | Annually | During annual maintenance | | 26-Jul-17 | |
| | | Replace wind vane potentiometer and bearings | 24-months | To be replaced at 2 years | | 26-Jul-17 | |
| | | Complete factory overhaul | 24-36 months | To be replaced at 2 to 3 years | | Not Required | |

**Table A-1 Summary of Preventative Maintenance**

| Parameter | Equipment Make/Model | Description of Maintenance Activities | Required Schedule (to meet MOE and Ambient Monitoring Plan requirements) | Schedule / Comments | 2017 Schedule Dates | | |
|---|---|---|---|---|---|---|---|
| | | | | | Courtice | Rundle | Fenceline |
| Temperature | CS 107 (Rundle)/ HMP 60 (Courtice) | Check radiation shield free from debris | Weekly | Checked at weekly site visit | Weekly | Weekly | |
| | | Annual maintenance | Annually | During annual maintenance | See Note 3 | See Note 3 | |
| Barometer | CS106 | Annual maintenance | Annually | During annual maintenance | See Note 3 | N/A | |
| Rainfall | TE525M | Inspect funnel and bucket mechanism for debris | Weekly | During weekly site visit | Weekly | Weekly | |
| | | Annual maintenance | Annually | During annual maintenance | See Note 3 | See Note 3 | |
| Relative Humidity | CS HMP60 | Change INTERCAP® Sensor | On out of spec calibration | As required | Not required | Not required | |
| | | Sensor cleaning | As required | As required | See note 1 | See note 2 | |
| | | Inspect/replace filter if blocked | Monthly | Done during monthly calibration | See note 1 | See note 2 | |
| | | Annual maintenance | Annually | During annual maintenance | See Note 3 | See Note 3 | |
| Pod / others | | Examine the external enclosure station conditions including the inlet probe for damage or blockage. Periodically review the station characteristics for any change or modification to the station | Weekly | Check at weekly site visit | Weekly | Weekly | |
| | | Examine the manifold, the transfer lines and the inlet filters for dirt buildup and replace or clean as required. Examine the seals in the sampling system, the scrubbing and drying agents and replace as required | Weekly | Check at weekly site visit | Weekly | Weekly | |
| | | Replace zero and span calibration cylinders when pressure is below 1,500 kPa (215 psig) | | Check at weekly site visit | NO replaced 22-Jun-17 | NO replaced 22-Jun-17 | |
| | | Ensure shelters and gates are locked upon departure | Weekly | Check at weekly site visit | Weekly | Weekly | |

**Notes:**

1. Courtice monthly calibration and maintenance dates in 2017: January 20, February 22, March 15, April 5, May 12, June 9, July 27, August 29, September 29, October 27, November 27, December 11.
2. Rundle monthly calibration and maintenance dates in 2017: January 25, February 22, March 15, April 5, May 12, June 9, July 27, August 29, September 29, October 27, November 27, December 11.
3. Maintenance for these components were deferred to Q2 2018 due to scheduling conflicts related to a change ins maintenance and calibration providers from Valley Environmental to Rotek.

**Table A-2 Summary of Equipment Calibration**

| Parameter | Equipment Make/Model | Description of Maintenance Activities | Required Schedule | Schedule / Comments | Schedule Dates | | |
|---|---|---|---|---|---|---|---|
| | | | | | Courtice | Rundle | Fenceline |
| $SO_2$ | API Model 100E | Verify test functions | Weekly | Checked weekly | Checked weekly | Checked weekly | N/A |
| | | Evaluate Zero/Span check | Weekly | Checked daily | Checked weekly | Checked weekly | |
| | | Zero/span external check | Monthly | Checked monthly | See note 1 | See note 2 | |
| | | Zero/span calibration | 3 months | Calibrated monthly | See note 1 | See note 2 | |
| | | Flow check | 6 months | Checked monthly | See note 1 | See note 2 | |
| | | Pneumatic leak check | Annually or after repairs | Done when flow drops or checked annually | See Note 5 | See Note 5 | |
| | | Calibrate UV lamp output | Prior to zero/span cal | Done prior to zero/span cal | See note 1 | See note 2 | |
| | | PMT sensor hardware cal | On PMT/preamp changes or slope changes as specified | Done when instrument slope is outside of acceptable range | Not Required in 2017 | Not Required in 2017 | |
| NOx | API Model 200E | Verify test functions | Weekly | Checked weekly | Checked weekly | Checked weekly | |
| | | Evaluate Zero/Span check | Weekly | Checked daily | Checked weekly | Checked weekly | |
| | | Zero/span external check | Monthly | Checked monthly | See Note 1 | See Note 2 | |
| | | Zero/span calibration | 3 months | Calibrated monthly | See Note 1 | See Note 2 | |
| | | Pneumatic sub-system check | Annually or after repairs | Checked after repairs | See Note 1 | See Note 2 | |
| | | PMT sensor hardware cal | On PMT/preamp changes or slope changes as specified | Done when slope exceeds the acceptable range | See Note 1 | See Note 2 | |
| $PM_{2.5}$ | Thermo Sharp 5030 | Ambient temperature | Audit monthly, calibrate annually | Audit monthly | See note 1 for audits. Annual calibration performed 8-Nov-17 | See note 1 for audits. Annual calibration performed 8-Nov-17 | |
| | | Ambient pressure | Audit monthly, calibrate annually | Audit monthly | See note 1 for audits. Annual calibration performed 8-Nov-17 | See note 1 for audits. Annual calibration performed 8-Nov-17 | |
| | | Flow | Audit monthly, calibrate annually | Audit monthly | See note 1 for audits. Annual calibration performed 8-Nov-17 | See note 1 for audits. Annual calibration performed 8-Nov-17 | |
| | | Leak check | Monthly | See note 4 | See note 4 | See note 4 | |
| | | Analog output | Annually | Done annually | See note 1 | See note 2 | |
| | | Proportional Counter | Audit annually | Done annually | See note 1 | See note 2 | |
| | | Nephelometer zero | Audit quarterly | Done Weekly | Checked weekly | Checked weekly | |

**Table A-2 Summary of Equipment Calibration**

| Parameter | Equipment Make/Model | Description of Maintenance Activities | Required Schedule | Schedule / Comments | Schedule Dates | | |
|---|---|---|---|---|---|---|---|
| | | | | | Courtice | Rundle | Fenceline |
| TSP/metals | TE-5170 | Flow calibration | Upon installation, monthly, or after any motor maintenance | Calibrated monthly and after motor maintenance. | Flows calibrated on the following dates:<br>05-Jan-17<br>09-Jan-17<br>2-Feb-17<br>27-Feb-17<br>22-Mar-17<br>29-Mar-17<br>27-Apr-17<br>17-May-17<br>30-May-17<br>27-Jun-17<br>28-Jul-17<br>31-Aug-17<br>18-Sep-17<br>20-Oct-17<br>17-Nov-17<br>13-Dec-17 | Flows calibrated on the following dates:<br>05-Jan-17<br>2-Feb-17<br>27-Feb-17<br>16-Mar-17<br>29-Mar-17<br>27-Apr-17<br>30-May-17<br>27-Jun-17<br>20-Jul-17<br>31-Aug-17<br>26-Sep-17<br>23-Oct-17<br>23-Nov-17<br>13-Dec-17 | Flows calibrated on the following dates:<br>05-Jan-17<br>2-Feb-17<br>27-Feb-17<br>29-Mar-17<br>11-Apr-17<br>27-Apr-17<br>30-May-17<br>27-Jun-17<br>28-Jul-17<br>14-Aug-17<br>14-Sep-17<br>26-Sep-17<br>23-Oct-17<br>17-Nov-17<br>13-Dec-17 |
| PAH and D/F | TE-1000 | Flow calibration | Upon installation, monthly, or after any motor maintenance | Calibrated monthly and after motor maintenance. | Flows calibrated on the following dates: 5-Jan-172-Feb-1727-Feb-1729-Mar-173-May-171-Jun-174-Jul-1728-Jul-1731-Aug-1726-Sep-171-Nov-1723-Nov-1713-Dec-17 | Flows calibrated on the following dates: 5-Jan-1726-Jan-1727-Feb-1729-Mar-173-May-171-Jun-1721-Jun-1728-Jul-1731-Aug-1726-Sep-1723-Oct-1723-Nov-1713-Dec-17 | N/A |
| Wind Speed and Direction | Met One 034B | Wind speed calibration | Annually | Annually | N/A | 26-Jul-17 | |
| | | Potentiometer calibration | Annually | Annually | N/A | 26-Jul-17 | |
| Temperature | HMP 60 | External calibration | Annually | Annually | See Note 5 | See Note 5 | |
| Rainfall | TE525M | Field Calibration. Factory calibration if field calibration not passed. | Annually | Annually | See Note 5 | See Note 5 | |
| Relative Humidity | CS HMP60 | Calibration (annually) | Annually | Annually | See Note 5 | See Note 5 | |
| Atmospheric Pressure | CS106 | Re-calibration (2-years) | 2-years | To be done at 2 years | Not Required in 2017 | N/A | |
| Data Acquisition | CS CR1000 | Calibration every three years | 3- years | To be done at 3 years | Not Required in 2017 | Not Required in 2017 | |

**Notes:**

1. Courtice monthly calibration and maintenance dates in 2017: January 20, February 22, March 15, April 5, May 12, June 9, July 27, August 29, September 29, October 27, November 27, December 11.
2. Rundle monthly calibration and maintenance dates in 2017: January 25, February 22, March 15, April 5, May 12, June 9, July 27, August 29, September 29, October 27, November 27, December 11.
3. On June 20, 2017, the MOECC audit found the NOX cal gas bottle was out of specification causing the Courtice NOX monitor to be out of specification.
4. Although a leak check is not formally possible with this model, the MOECC introduced a methodology using a leak checker designed for the Sharp 5030i which has been implemented. The procedure is a lengthy process and was only performed when data is suspect.
5. Maintenance for these components were deferred to Q2 2018 due to scheduling conflicts related to a change ins maintenance and calibration providers from Valley Environmental to Rotek.

## Table A-3 Summary of Instrument Issues at the Courtice WPCP Station (Predominately Upwind)

| Parameter | Issues | Time Frame | Remedial Action |
|---|---|---|---|
| $SO_2$ | UV Lamp Warning | 20-Jan-17, 22-Feb-17 | Lamp re-calibrated. All data intact. |
| | Equipment supplier identified potential internal power cable issue. | 14-Mar-17 | Supplier provided a new power cable under warranty, which was installed by VES. All data intact. |
| | Internal clock not synchronized with actual time | 27-Feb-17 | Adjusted internal clock. All data intact. |
| $NO_X$ | Equipment supplier identified potential internal power cable issue. | 14-Mar-17 | Supplier provided a new power cable under warranty, which was installed by VES. All data intact. |
| | NO, NOx, $NO_2$ measurements inconsistent | Noted 15-Mar-17<br>Addressed 20-Mar-17 | Adjusted analogue voltages. Data downloaded directly from monitor. All data intact. |
| | Evidence of power outage during site visit. | 21-Jun-17 | Data reviewed. Power was not lost for significant amount of time. Data valid. |
| | Measured concentration during an MOECC audit was 13.3% low due to off-specification calibration gas. | Audit: 20-Jun-17 | The issue was due to an inaccurate certified concentration of the calibration gas. A span correction was applied to all data from the time of previous MOECC audit (5-Apr-17) to account for the discrepancy. Monitor was recalibrated with spare calibration gas cylinder on 22-Jun-17. All data intact. |
| $PM_{2.5}$ | Pump not running. | 13-Apr-17 to 18-Apr-17<br>18-May-17 to 23-May-17<br>24-May-17 to 29-May-17 | Restarted pump. Invalidated measurements during these timeframes. Valley Environmental downloaded monitor error logs to further diagnose issue. |
| | | 30-May-17 | Monitor removed and sent to manufacturer for repair and replacement installed. Issue found with filter tape tension causing an error and subsequent pump shutdown. |

**Table A-3 Summary of Instrument Issues at the Courtice WPCP Station (Predominately Upwind)**

| Parameter | Issues | Time Frame | Remedial Action |
|---|---|---|---|
| | | 15-Jun-17 to 16-Jun-17<br>21-Jun-17<br>25-Jun-17 to 26-Jun-17<br>29-Jun-17 to 30-Jun-17 | Restarted pump on replacement unit. Invalidated measurements during these timeframes. Valley Environmental contacted equipment manufacturer to identify and repair this re-occurring issue. |
| | | 5-Jul-17 to 6-Jul-17; 2-Aug-17 | Restarted pump. Invalidated measurements during this time. |
| | Obstruction noted in inlet. | Discovered: 20-Jun-17<br>Addressed: 22-Jun-17 | Fly removed from inlet. Filter tape suggested obstruction may have been present for approximately 5 days prior to removal. Data reviewed and compared to other stations. Data appeared to be reasonably consistent with the other stations and was therefore considered valid. |
| Other | Power outages intermittently throughout the day. | 15-Jun-17 | Invalidated suspicious minute data. |
| TSP/Metals Hi-Vol. | Mass flow controller (MFC) unable to maintain consistent flow | Noted: 2-Feb-17 | Chart recorder for the 31-Jan-17 run showed a consistent flowrate through the sample and the sample results were comparable to other stations. The data was deemed valid.<br>The MFC was sent for repair and a spare immediately installed. The original MFC was re-installed after repair |
| PAHs/ D/ F Hi-Vol. | None. | | |

## Table A-4 Summary of Instrument Issues at the Rundle Road Station (Predominately Downwind)

| Parameter | Issues | Time Frame | Remedial Action |
|---|---|---|---|
| $SO_2$ | Lamp voltage drift greater than acceptable levels identified. | Noted 23-Feb-17<br>Addressed 14-Mar-17 | The equipment manufacturer was contacted and they identified a systemic issue with the internal power cables of all monitors of the same vintage as the DYEC equipment. Replacement power cables were provided (under warranty) and installed by VES. All data intact. |
| | Internal clock not synchronized with actual time | 23-Feb-17 | Adjusted internal clock. All data intact. |
| $NO_X$ | Evidence of brief power outage | 6-Jan-17 | Reviewed and invalidated 2 minutes of data |
| | Internal clock not synchronized with actual time | 2-Feb-17 and 16-Mar-17 | Adjusted internal clock. All data intact. |
| | Equipment supplier identified potential internal power cable issue. | 14-Mar-17 | Supplier provided a new power cable under warranty, which was installed by VES. All data intact. |
| | NO, NOx, $NO_2$ measurements inconsistent | Noted 15-Mar-17<br>Addressed 20-Mar-17 | Adjusted analogue voltages. Data downloaded directly from monitor. All data intact. |
| | Measured concentration during MOECC audit was 8.9% due to off-specification calibration gas. | Audit: 20-Jun-17<br>Re-calibrated: 22-Jun-17 | The issue was due to an inaccurate certified concentration of the calibration gas. A span correction was applied to all data from the time of previous MOECC audit (5-Apr-17) to account for the discrepancy. Monitor recalibrated with spare bottle on 22-Jun-17. All data intact. |
| $PM_{2.5}$ | Negative internal humidity reading | Noted 3-Mar-17<br>Addressed 20-Mar-17 | Recalibrated relative humidity sensor as per manufacturer's recommendation. No effect on data. |
| | Readings out of range. | 15-May-17 | Removed insect from instrument and invalidated 13 hours of data. |
| | | 30-May-17 to 31-May-17 | Removed insect from instrument and invalidated 11 hours of data. |

## Table A-4 Summary of Instrument Issues at the Rundle Road Station (Predominately Downwind)

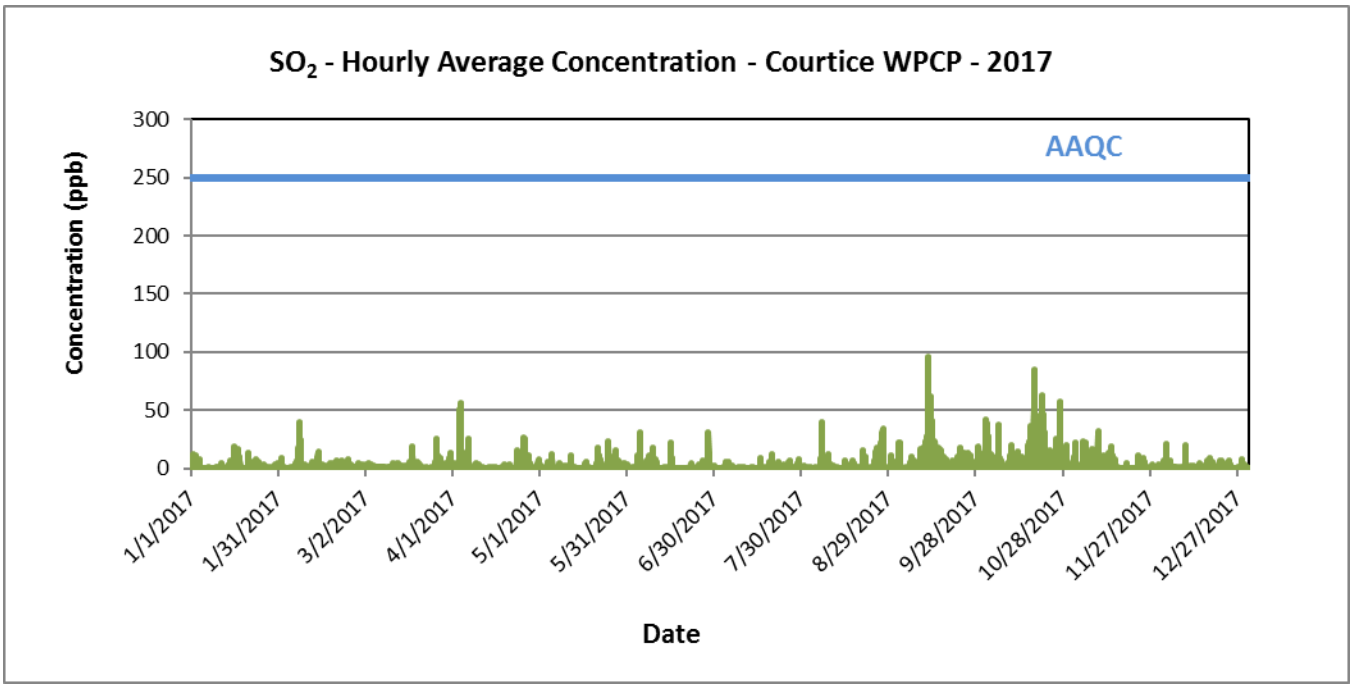
| Parameter | Issues | Time Frame | Remedial Action |
|---|---|---|---|
| TSP/Metals Hi-Vol. | GFI tripped during sample run. Sample did not run for sufficient duration. | 7-Apr-17 sample | Invalidated sample run. Resealed connector, add additional sealing and secured plugs underneath motor housing at all stations. |
| | Timer dial was 11 hours slow when filter was retrieved. | 13-Apr-17 sample | Reviewed sampling procedure with technician. Sample ran for 24 hours (based on elapsed time meter) and sample results are comparable to other stations. Data deemed valid. |
| | Small gouges in sample filters, potentially caused by small birds. | 12-June-17 and 18-Jun-17 samples | Installed bird barrier. Sample results reviewed and are consistent with other stations. Data deemed valid. |
| PAHs/ D/F Hi-Vol. | GFI tripped during sample run. | 24-Feb-17 | 24-Feb-17 PAH / D/F sample invalidated. Reset GFI. Additional sealing applied to electrical connections and secured connections under sampler housing for additional shielding from precipitation. |
| Other | Wind sensor frozen | 7-Feb-17 | Invalidated 12 hours of data |
| | Anemometer's potentiometer failed causing wind direction data to consistently read as 0°. | 8-May-17 to 10-May-17 | Spare installed and subsequently replaced. Invalidated 52 hours of data. |
| | Evidence of power outage. | 18-Apr-17, 14-Jun-17, 27-Jun-17 | Data reviewed and appears acceptable. Power outage was likely brief. Data deemed valid except for 27-Jun-17 for which 5 minutes of NOx measurements were invalidated. |
| | Enclosure air conditioning unit shut off. | 25-Aug-17 to 28-Aug-17 | AC Unit restarted. Data reviewed and deemed valid. |
| | Evidence of power outage. | 25-Aug-17 | Data reviewed and appears valid. |

## Table A-5 Summary of Instrument Issues at the Fence Line Station

| Parameter | Issues | Time Frame | Remedial Action |
|---|---|---|---|
| TSP/Metals Hi-Vol. | None | | |

# Appendix B $SO_2$ PLOTS

**Figure B-1 Time History Plots of Measured Hourly Average and 24 Hour Average $SO_2$ Concentrations – Courtice (WPCP) Station**



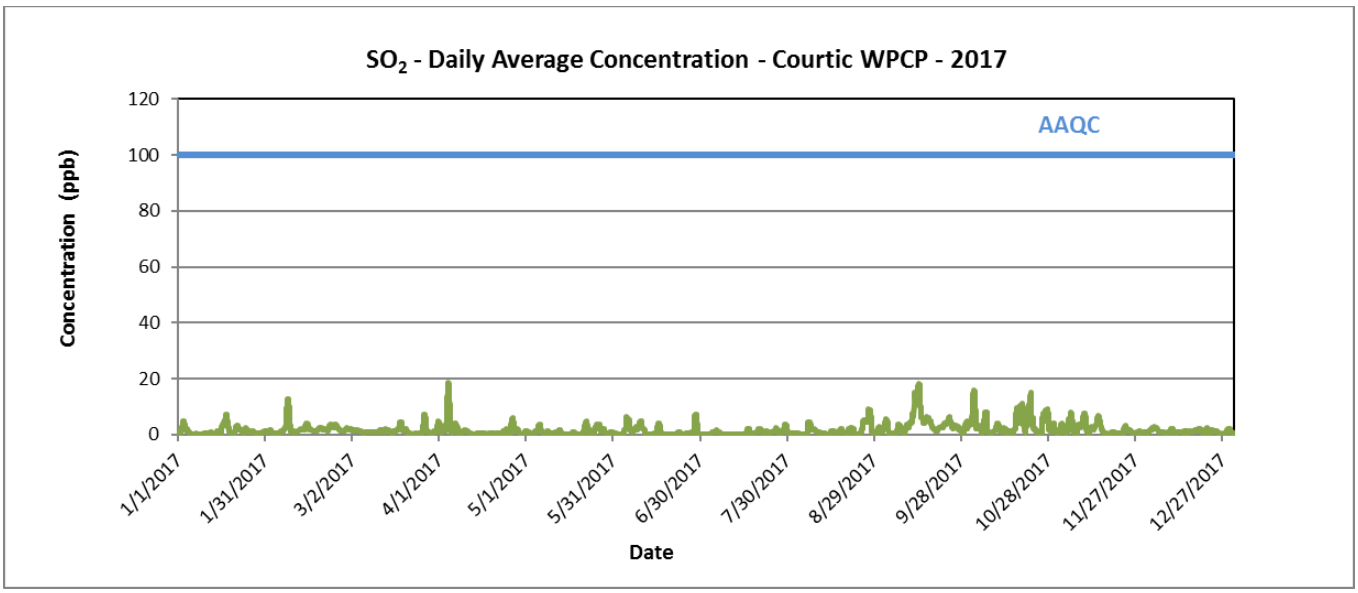
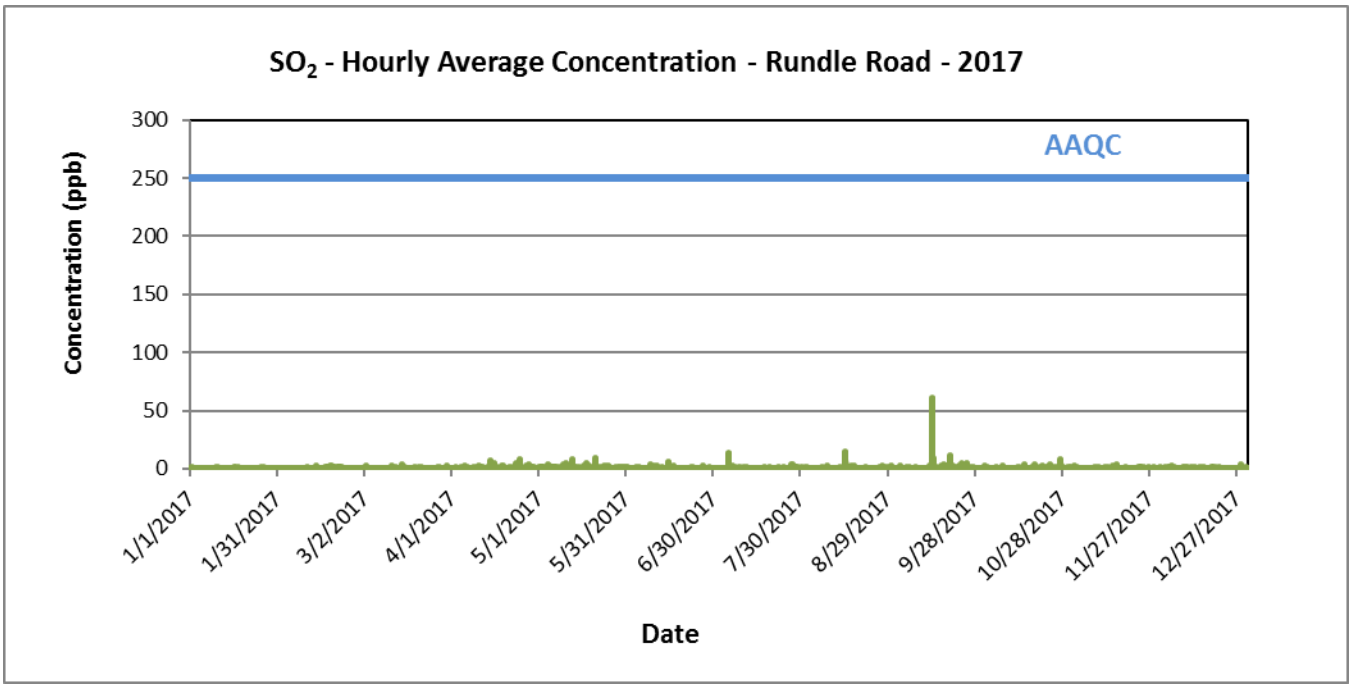



**Figure B-2 Time History Plots of Measured Hourly Average and 24 Hour Average $SO_2$ Concentrations – Rundle Road Station**



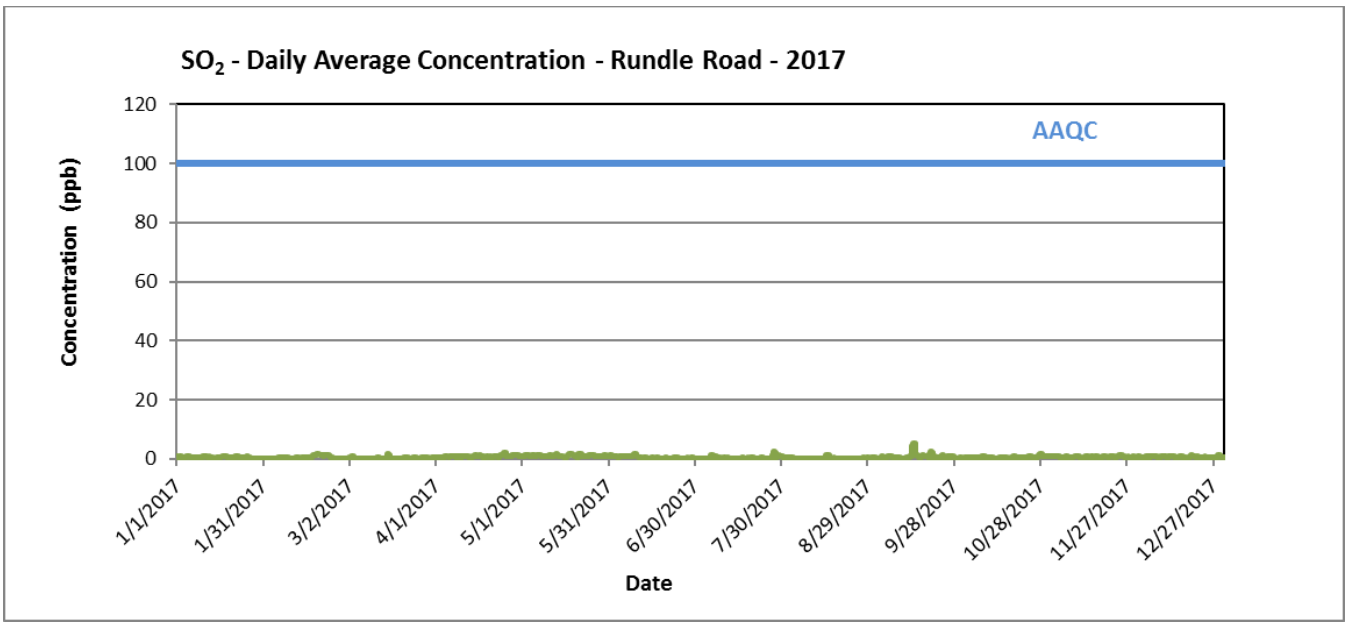



**Figure B-3 Measured Hourly Average $SO_2$ Concentrations vs. Wind Direction – Courtice WPCP Station**

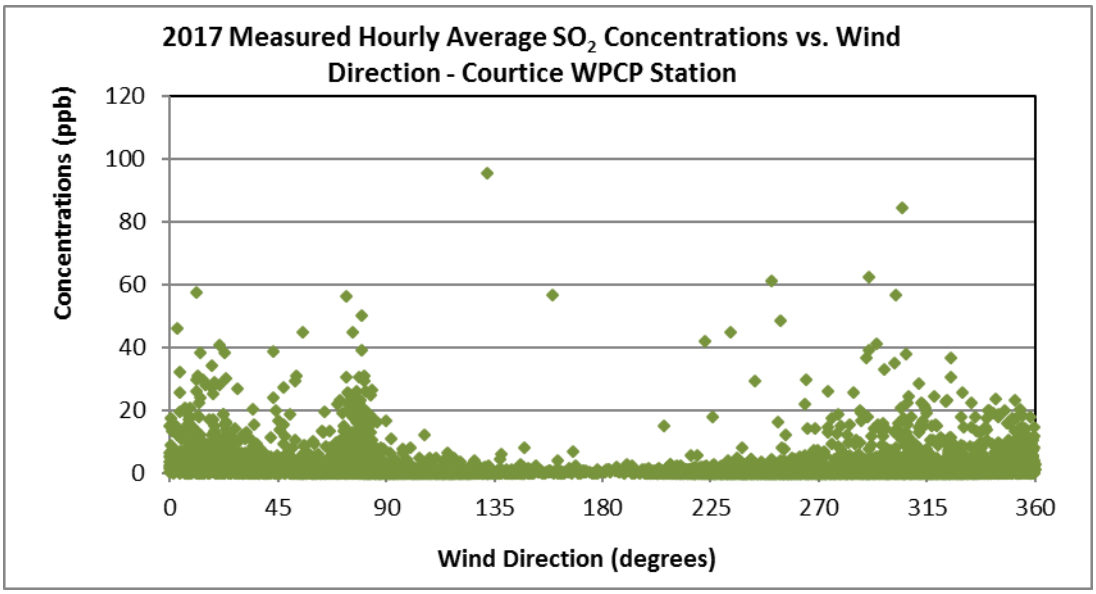
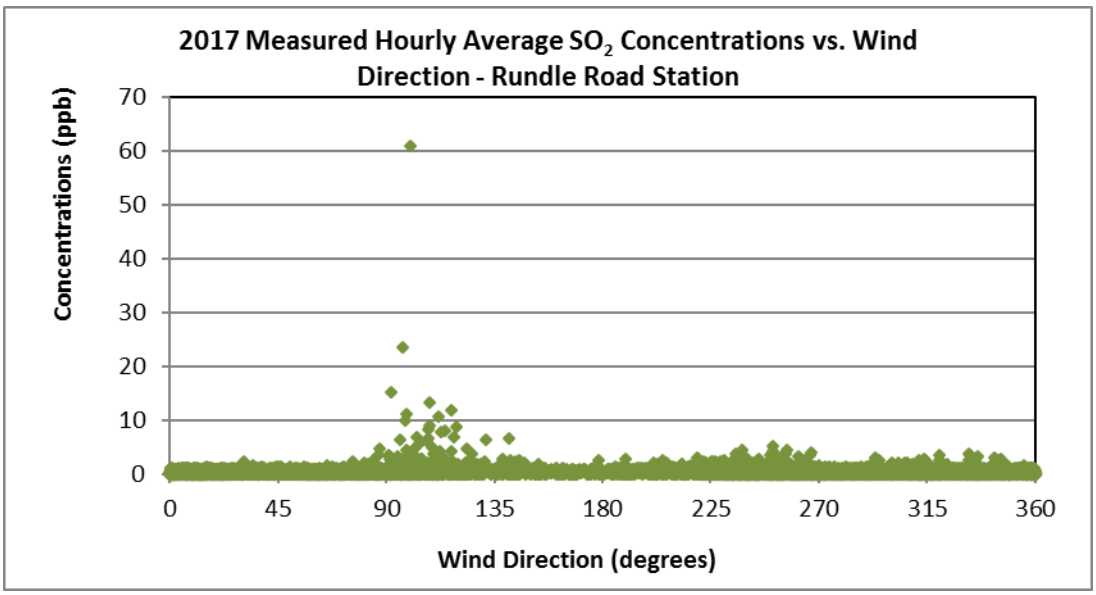
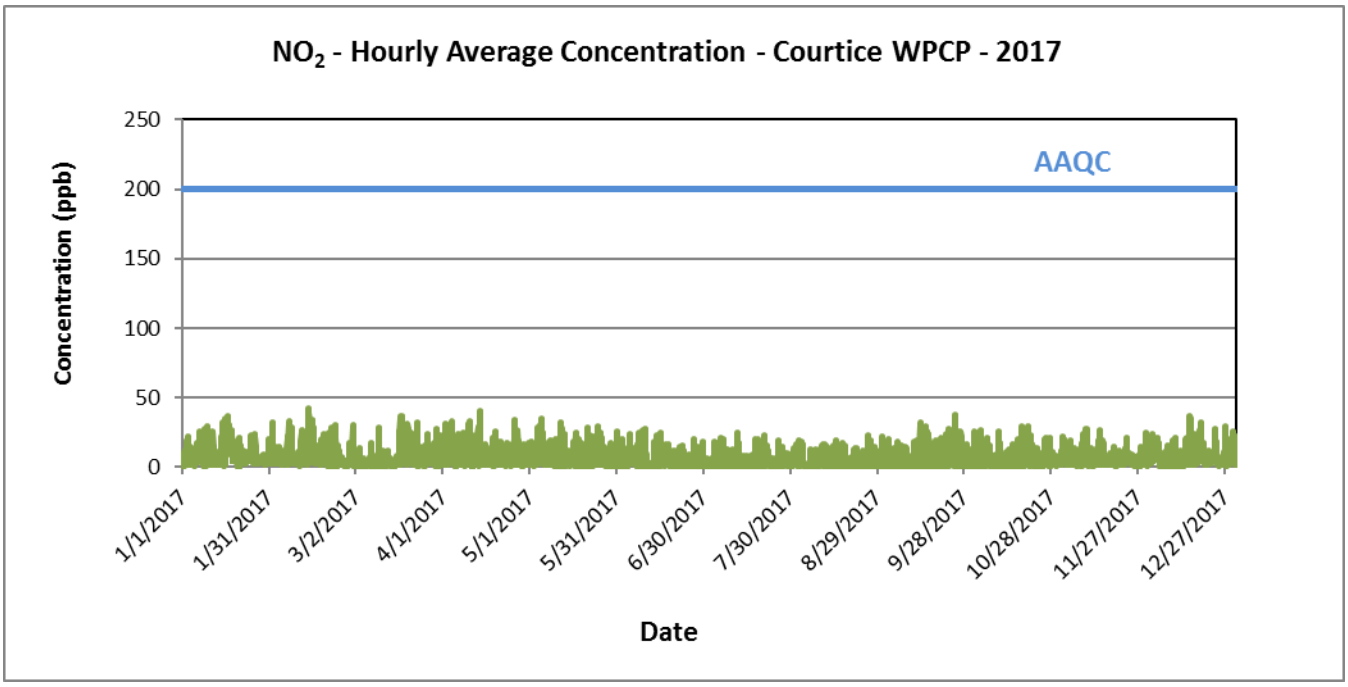



**Figure B-4 Measured Hourly Average $SO_2$ Concentrations vs. Wind Direction – Rundle Road Station**



# Appendix C $NO_2$ PLOTS

**Figure C-1 Time History Plots of Measured Hourly Average and 24 Hour Average $NO_2$ Concentrations – Courtice (WPCP) Station**



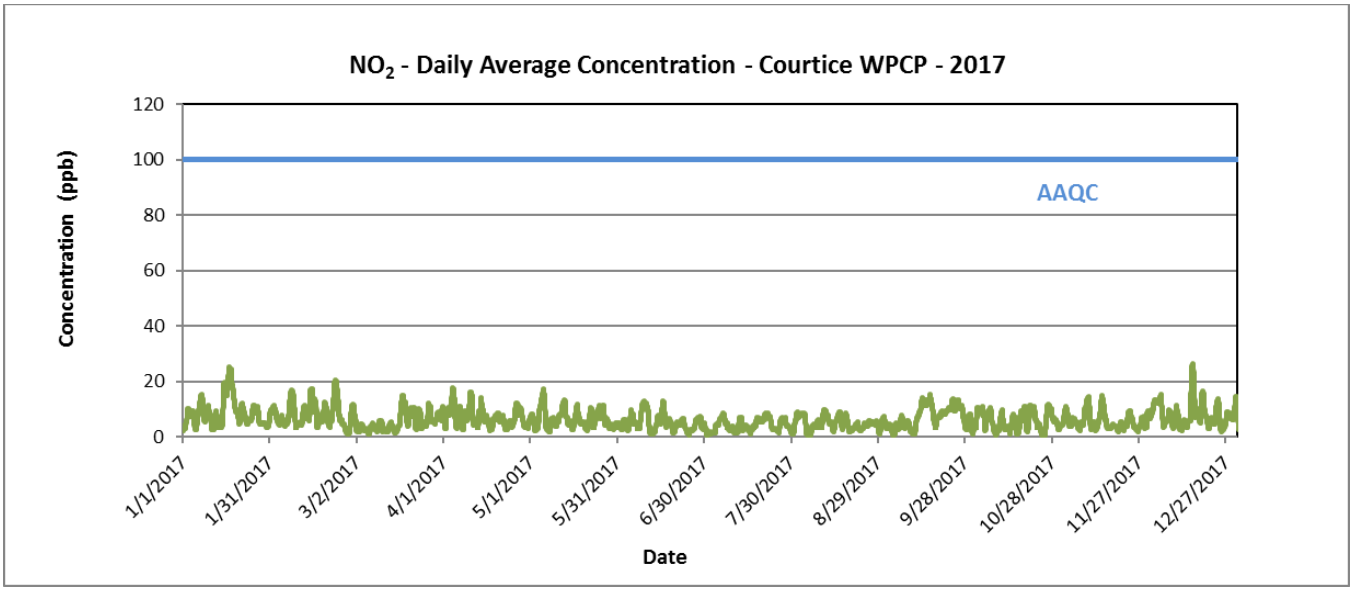
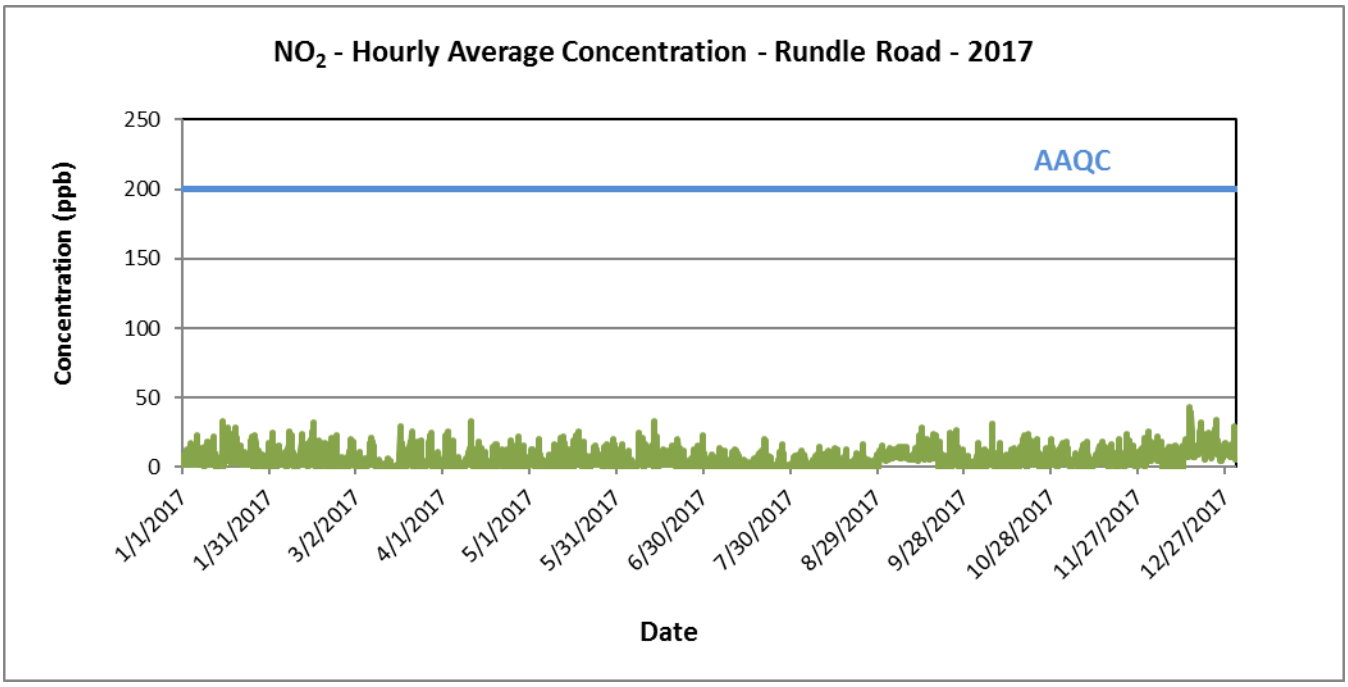



**Figure C-2 Time History Plots of Measured Hourly Average and 24 Hour Average $NO_2$ Concentrations – Rundle Road Station**



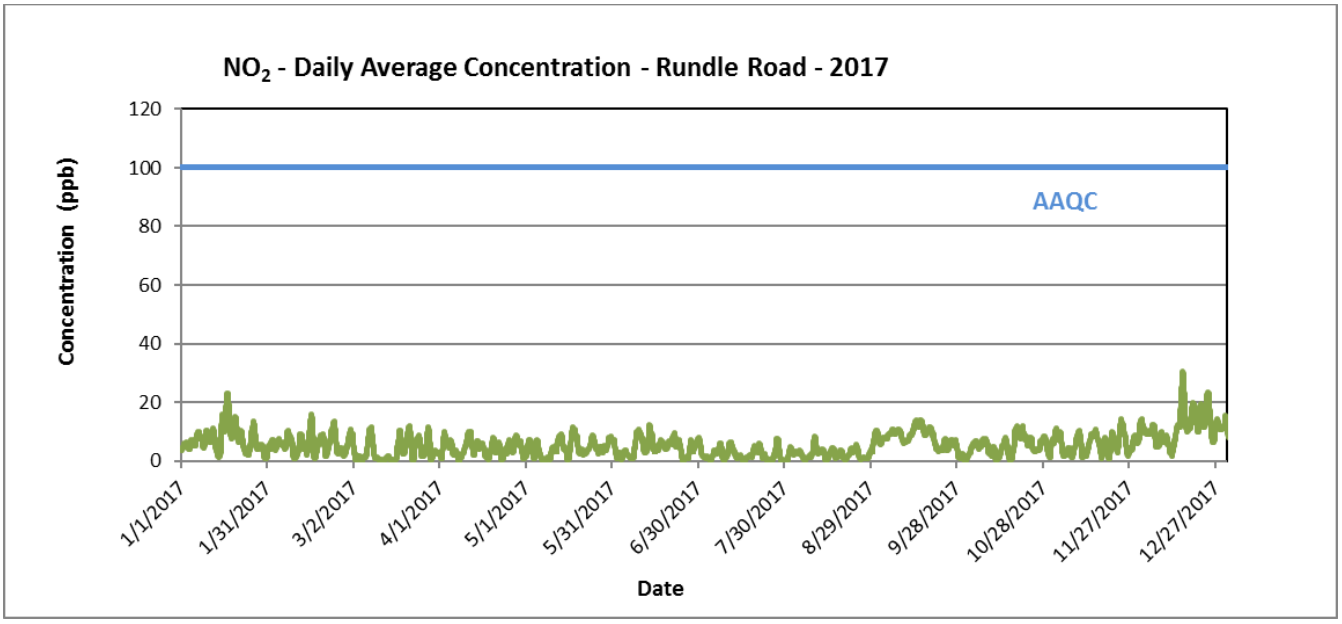



**Figure C-3 Measured Hourly Average $NO_2$ Concentrations vs. Wind Direction – Courtice WPCP Station**

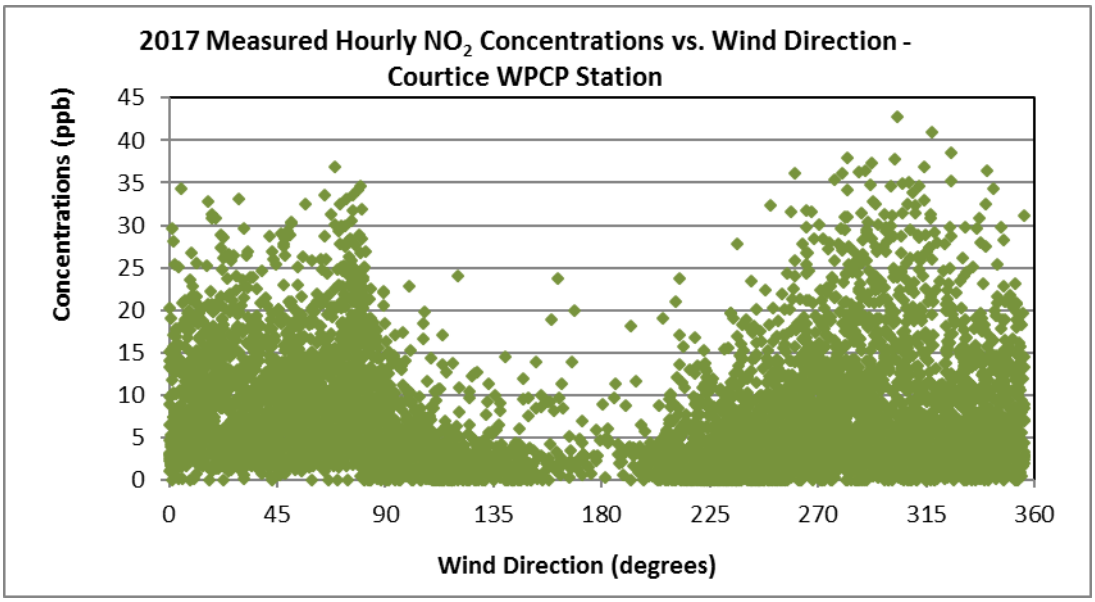
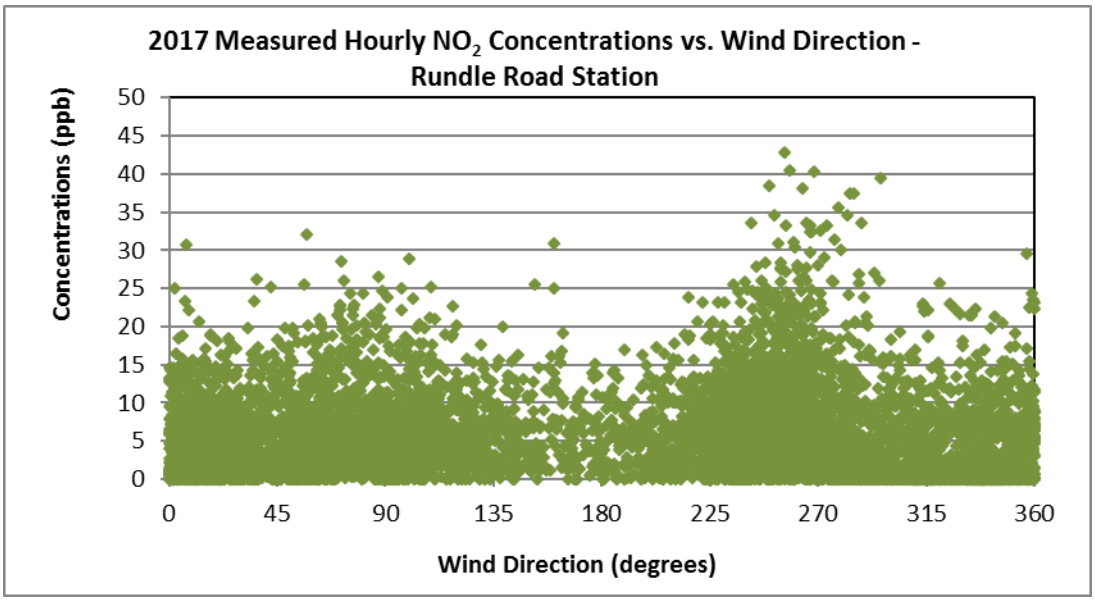
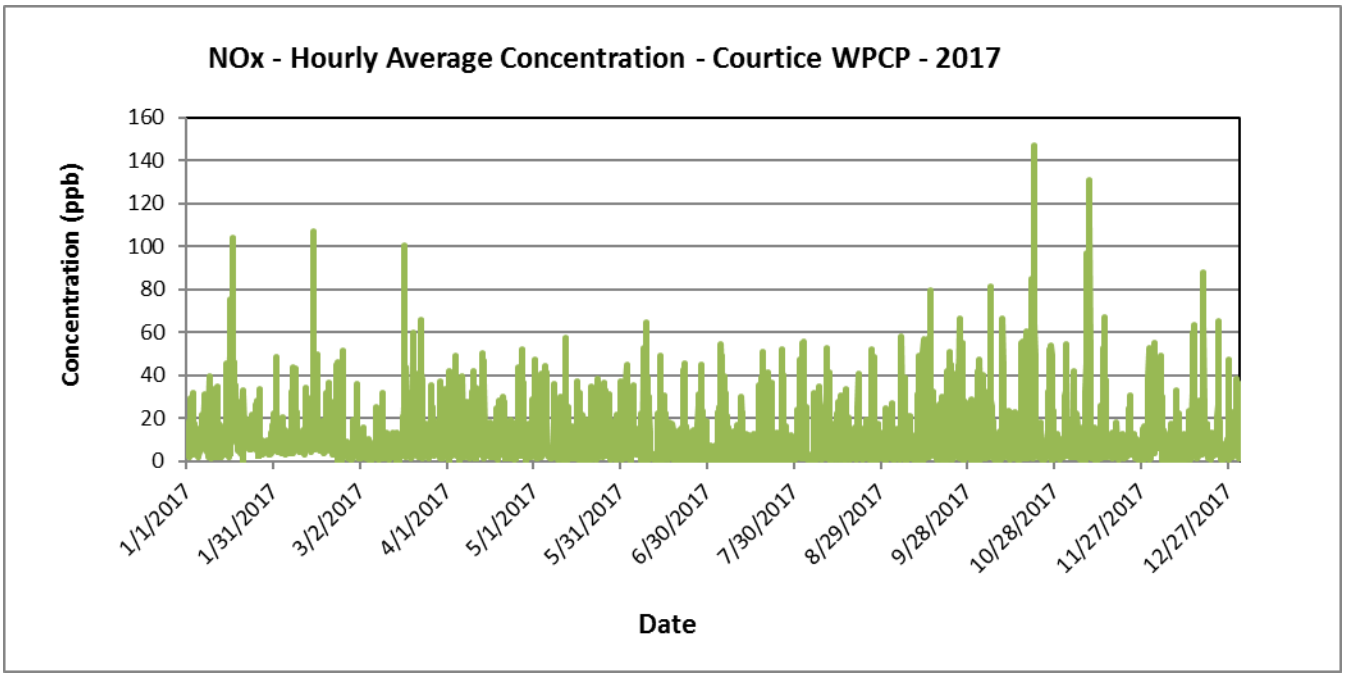



**Figure C-4 Measured Hourly Average $NO_2$ Concentrations vs. Wind Direction – Rundle Road Station**



# Appendix D $NO_X$ PLOTS

**Figure D-1 Time History Plots of Measured Hourly Average and 24 Hour Average $NO_x$ Concentrations – Courtice (WPCP) Station**



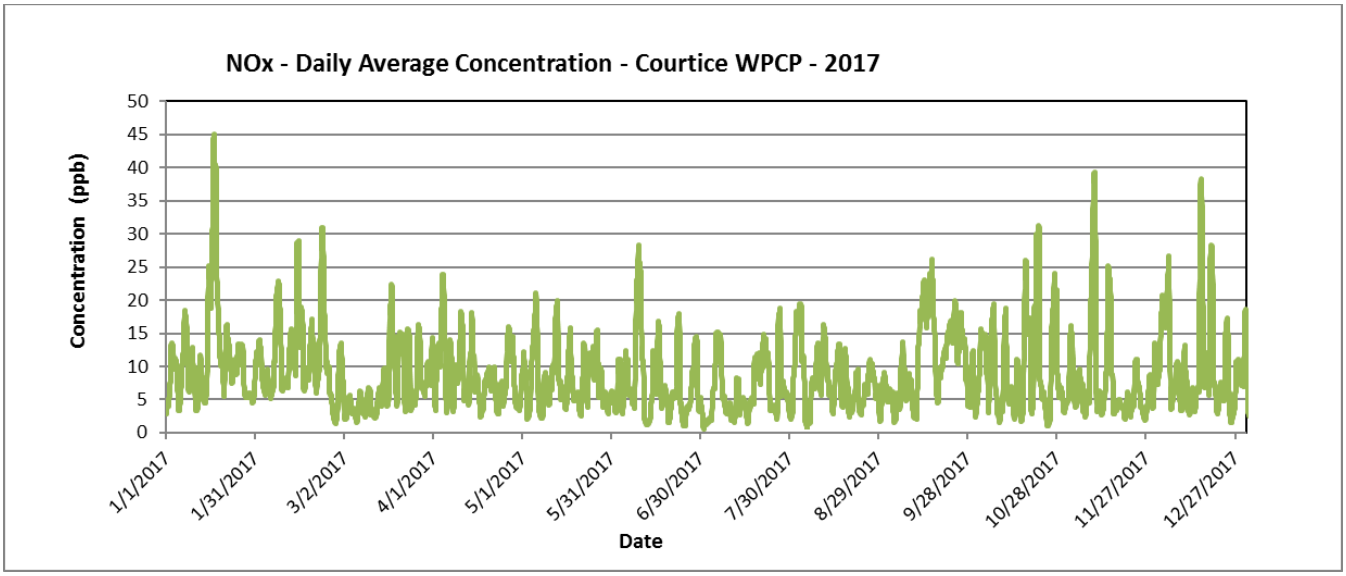
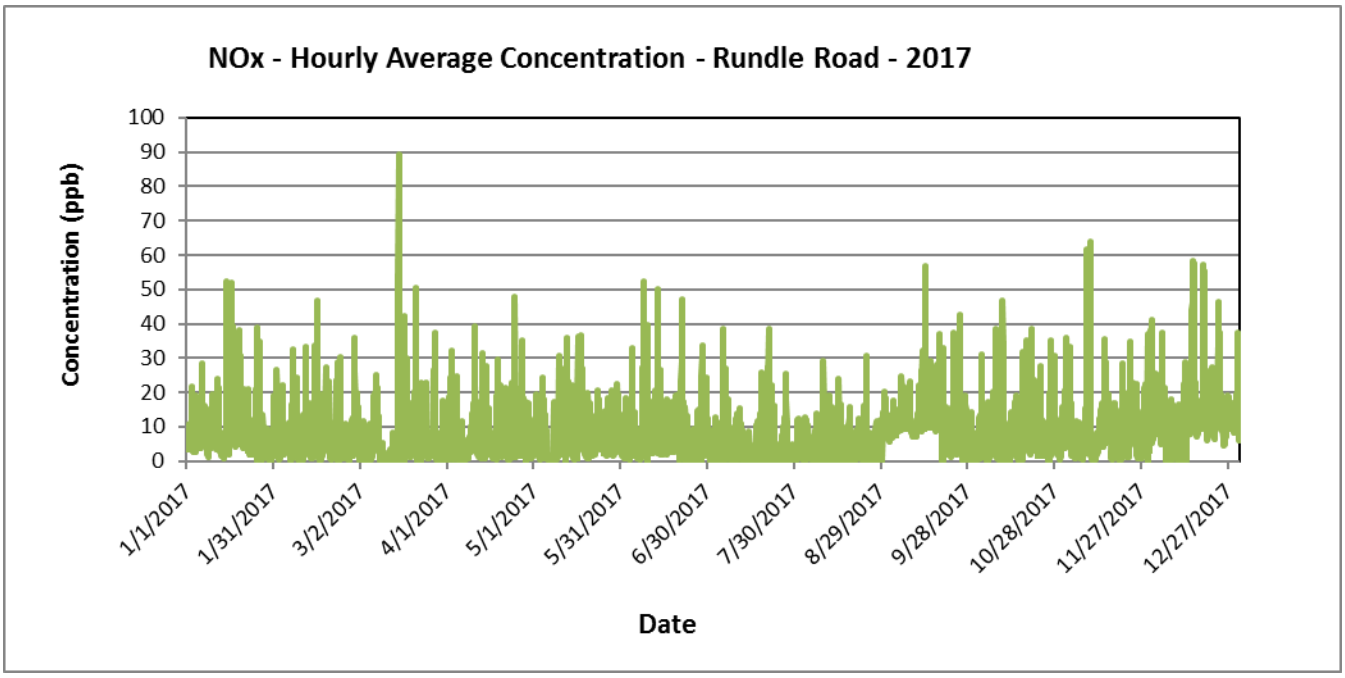



**Figure D-2 Time History Plots of Measured Hourly Average and 24 Hour Average $NO_X$ Concentrations – Rundle Road Station**



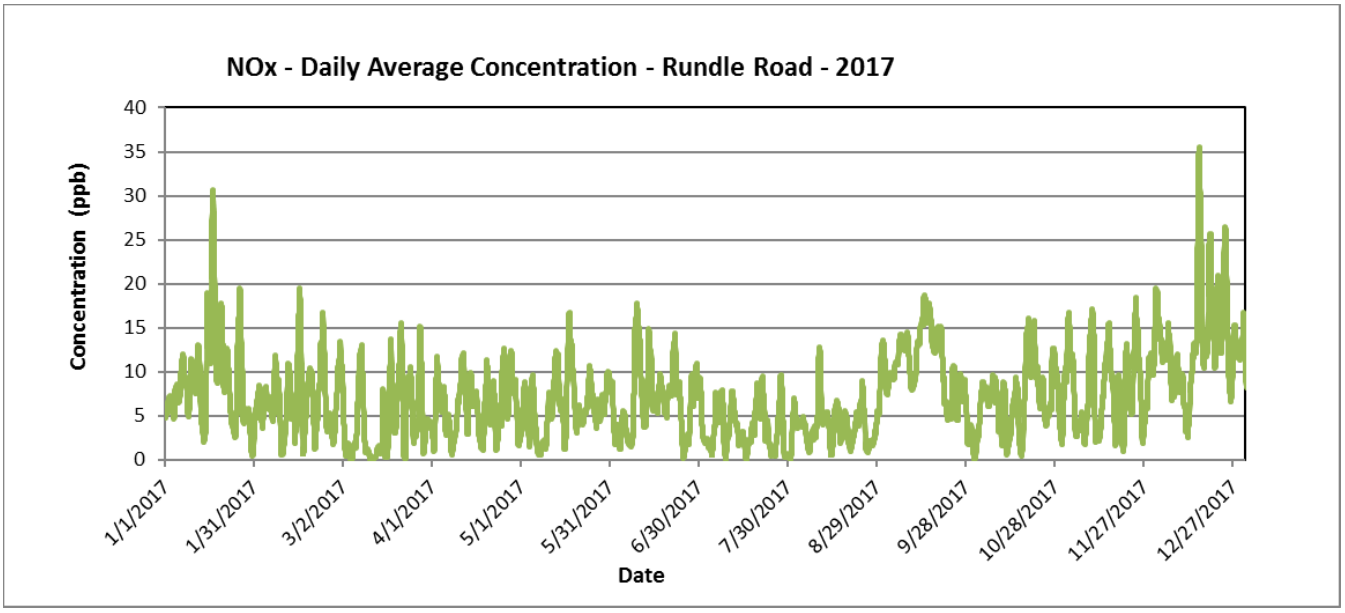



**Figure D-3 Measured Hourly NOx Concentrations vs. Wind Direction – Courtice WPCP Station**

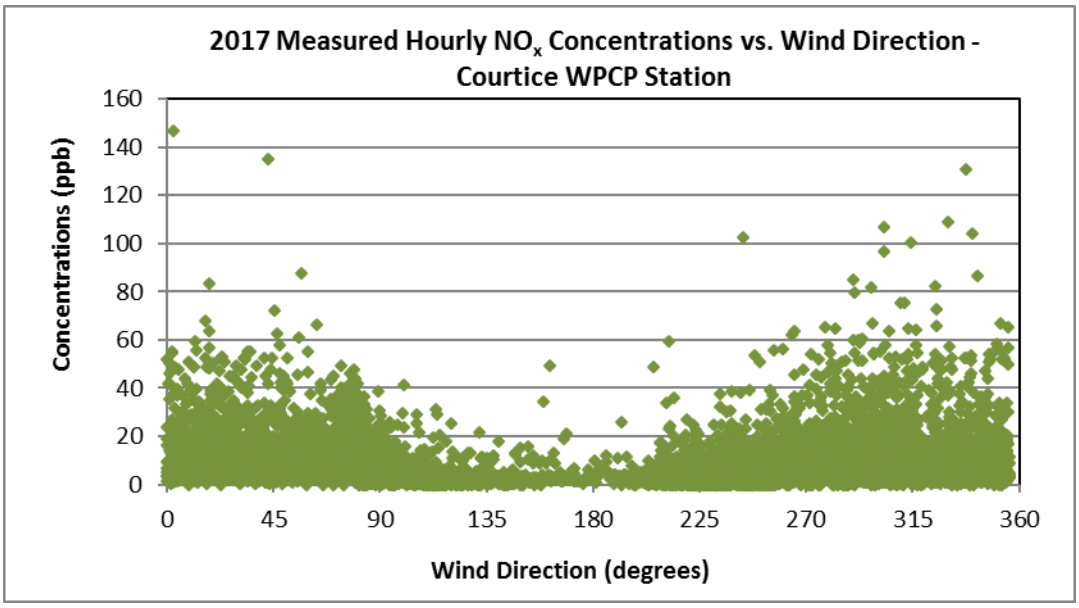
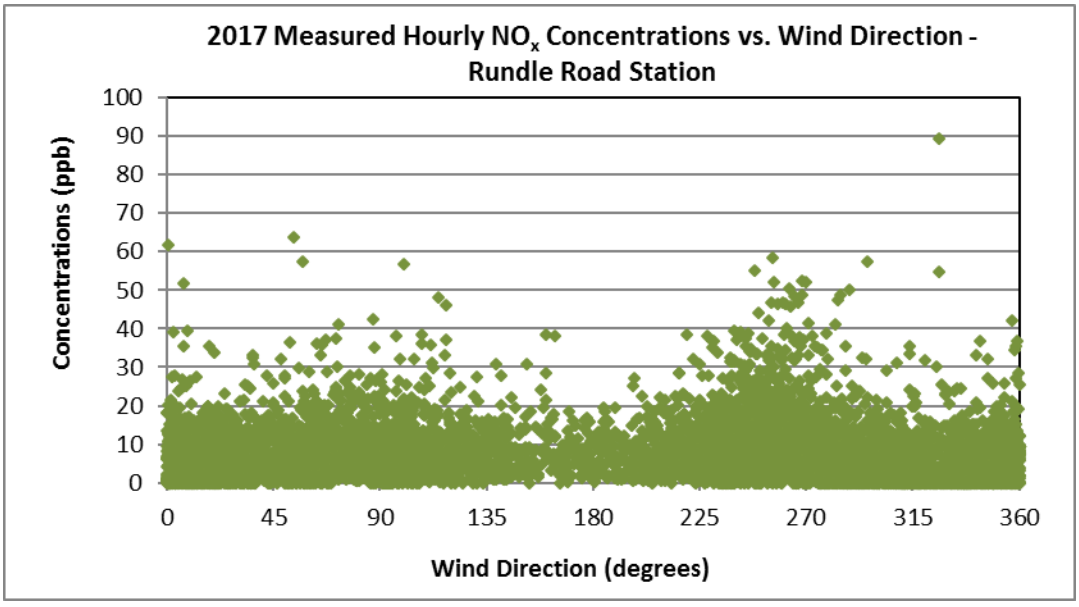



**Figure D-4 Measured Hourly NOx Concentrations vs. Wind Direction – Rundle Road Station**



# Appendix E PM2.5 PLOT

**Figure E-1 Time History Plot of Measured 24 Hour Average $PM_{2.5}$ Concentrations – Courtice WPCP Station**

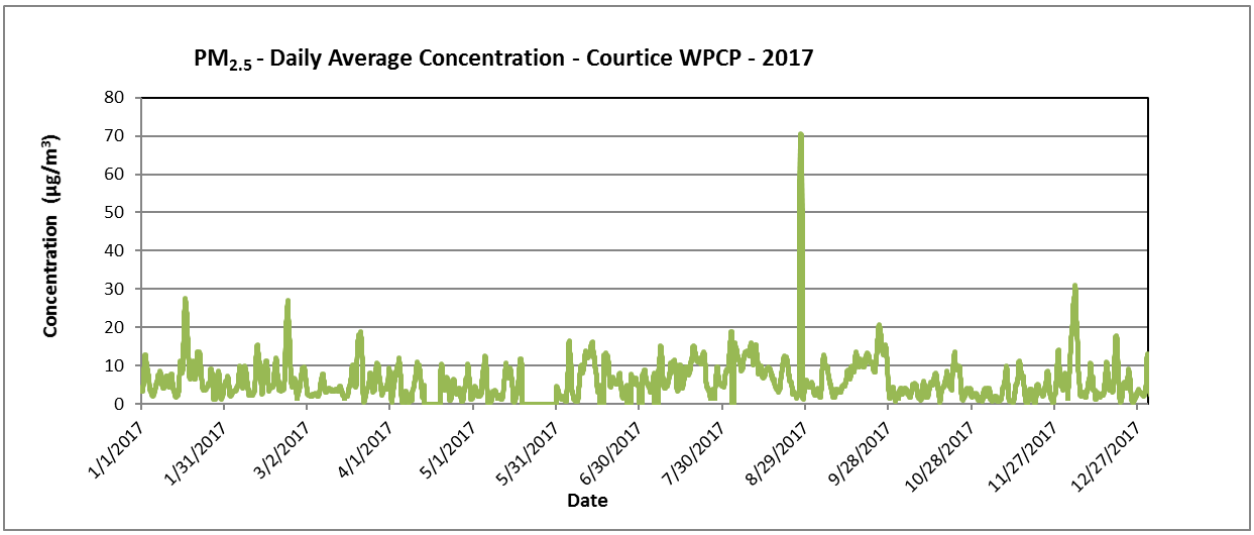



**Figure E-2 Time History Plot of Measured 24 Hour Average $PM_{2.5}$ Concentrations – Rundle Road Station**

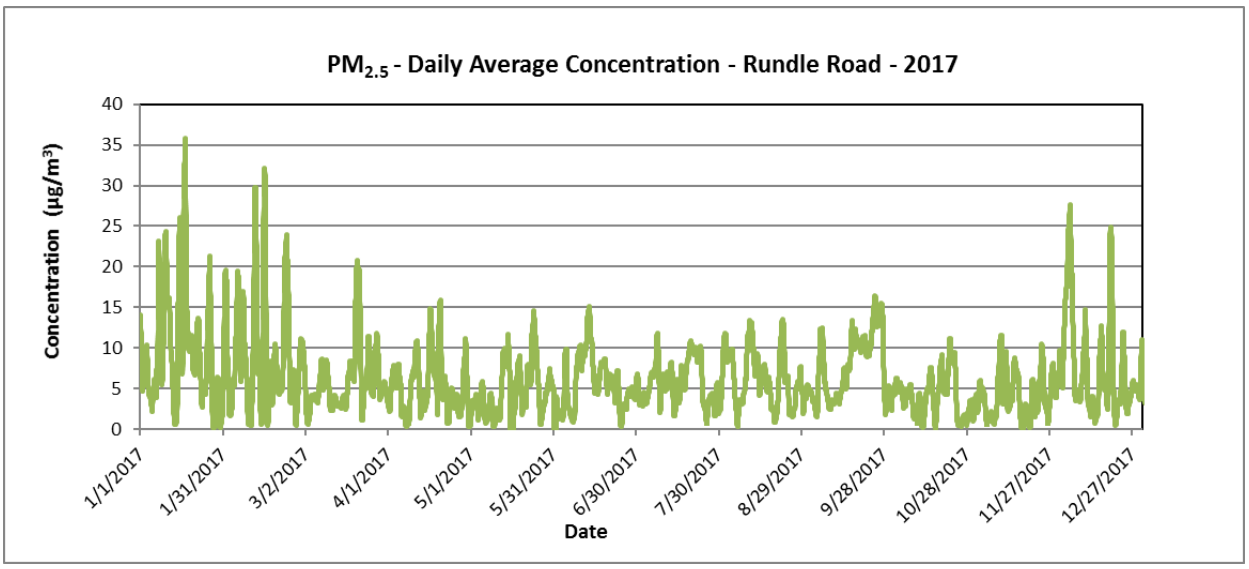


**Figure E-3 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction Courtice WPCP Station**

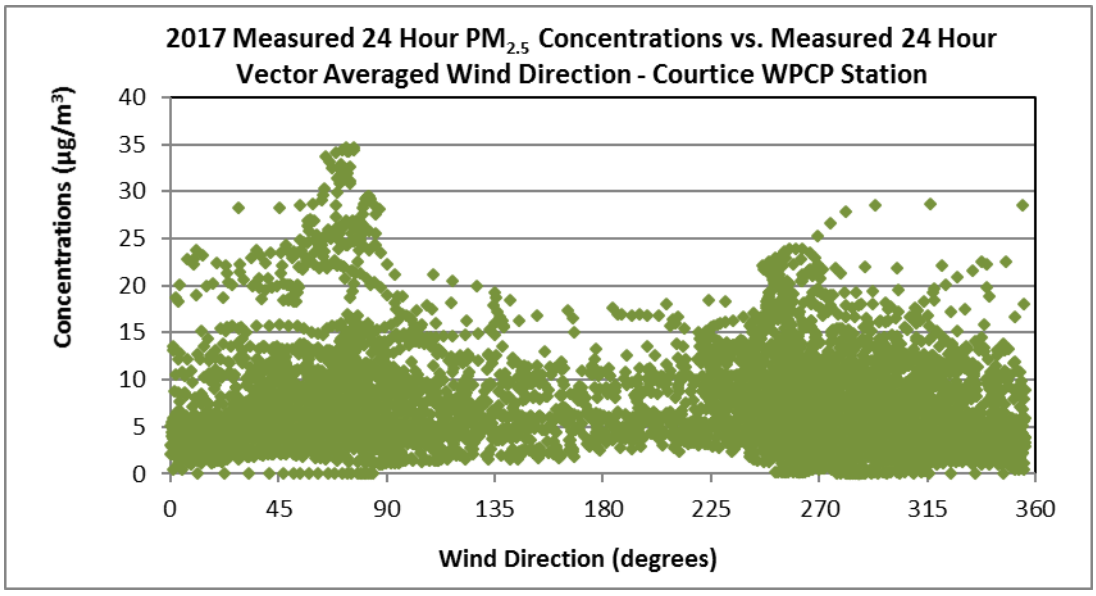



**Figure E-4 Measured 24-Hour Average $PM_{2.5}$ Concentrations vs. Measured 24-Hour Vector Averaged Wind Direction – Rundle Road Station**