

# Transurban Queensland

## CLEM7 Ambient Air Quality Monitoring Report

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## Glossary

The following terms and abbreviations may be found throughout this report:

°C	Degrees Celsius
µg/m <sup>3</sup>	Micrograms per cubic meter at standard temperature and pressure (0°C, 101.3kPa)
AT	Ambient Temperature
AQMS	Air Quality Monitoring Station
Calm	Wind condition where wind speed is below the operating range of the wind sensor
CO	Carbon Monoxide
CO (CoG)	Coordinator General's Report on EIS
Deg	Degrees (True North)
EPA	Environment Protection Authority
HVAS	High Volume Air Sampler
m/s	Meters per second
NO	Nitric Oxide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Nitrogen Oxides
PM <sub>10</sub>	Particulate matter of 10 microns or less aerodynamic equivalent size
PM <sub>2.5</sub>	Particulate matter of 2.5 microns or less aerodynamic equivalent size
ppb	Parts per billion
ppm	Parts per million
RH	Relative Humidity
SR	Solar Radiation
TSP	Total Suspended Particulate
W/m <sup>2</sup>	Watts per square meter
WD	Vector Wind Direction
WS	Vector Wind Speed

## 1. Executive Summary

This report contains the meteorological, gaseous and particulate data from the Clem 7 ambient air quality monitoring network located at Hawthorne Street, Royal Brisbane Hospital and Northey Street for May 2020.

The tables and graphs on the following pages summarise the maximum measured values for each pollutant during this period.

### Exceedance Reporting

There were nil exceedances of the PM<sub>10</sub> 24 hour average NEPM Limit (50 µg/m<sup>3</sup>) during the reporting period.

There were nil exceedances of the PM<sub>2.5</sub> 24 hour average NEPM Limit (25 µg/m<sup>3</sup>) during the reporting period.

#### Exceedances Recorded for Hawthorne Street

Parameter	Time Period	Allowable Limit	Value of Exceedance	Date of Exceedance
Carbon Monoxide	8 hour (rolling average)	8 ppm	-	-
Nitrogen dioxide	1 hour	120 ppb	-	-
PM2.5	24 hour	25 µg/m <sup>3</sup>	-	-
PM10	24 hour	50 µg/m <sup>3</sup>	-	-

## Notes

Data capture for all parameters collected at Hawthorne Street were above 95.0% for the reporting period.

Measurement of a number of parameters in this report do not comply with applicable standards and/or are not covered by Norditech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

The Land Centre site was decommissioned on 8/02/2018 at the request of BMS.

The Royal Brisbane Hospital site was decommissioned on 15/03/2019 at the request of BMS.

The Northey Street site was decommissioned on 8/11/2019 at the request of Transurban.



Maximum Values for Hawthorne Street						
Parameter	EPP Goal	Unit	Averaging Period	Maximum Value	Date & Time	Wind Direction
NO <sub>2</sub>	120	ppb	1 Hour	47	28/05/2020 17:00	44.0
CO	9	ppm	8 Hours	0.6	29/05/2020 00:00	241.0
PM <sub>2.5</sub>	25	µg/m <sup>3</sup>	24 Hours	8.6	04/05/2020	186.0
PM <sub>10</sub>	50	µg/m <sup>3</sup>	24 Hours	14.2	08/05/2020	36.0

Table 1 - Hawthorne Street maximum values

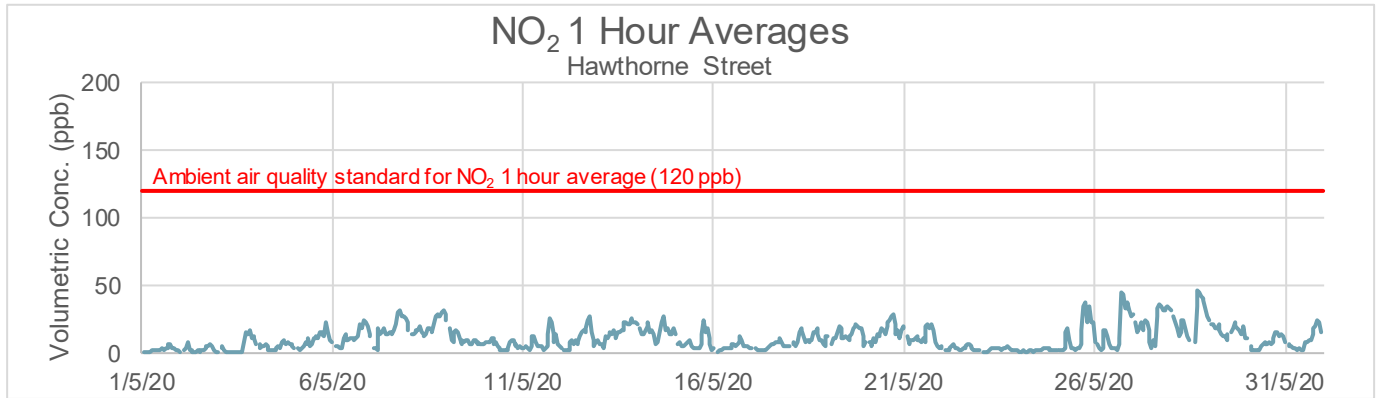


Figure 1 - Hawthorne Street Nitrogen Dioxide 1hr averages

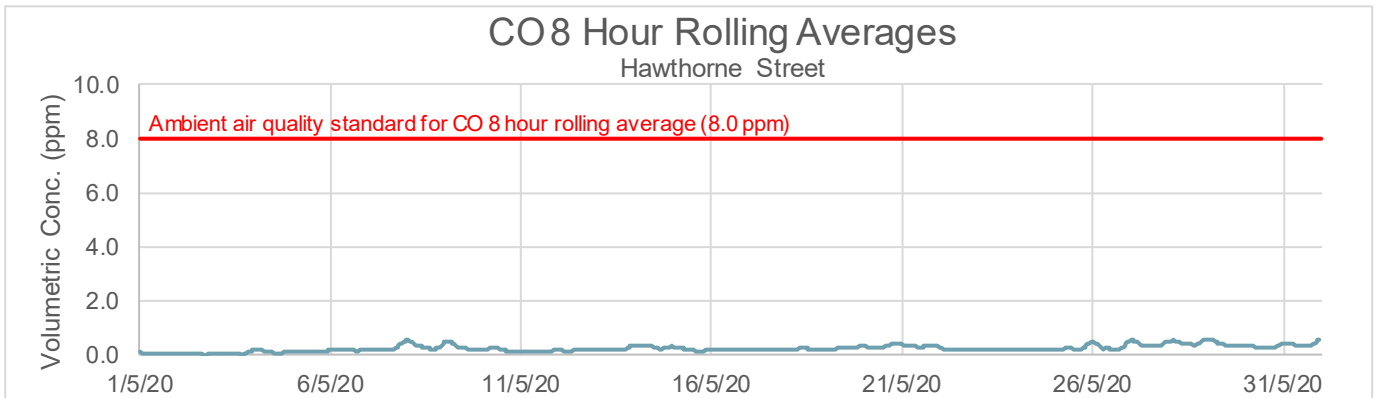


Figure 2 - Hawthorne Street Carbon Monoxide 8hr rolling averages

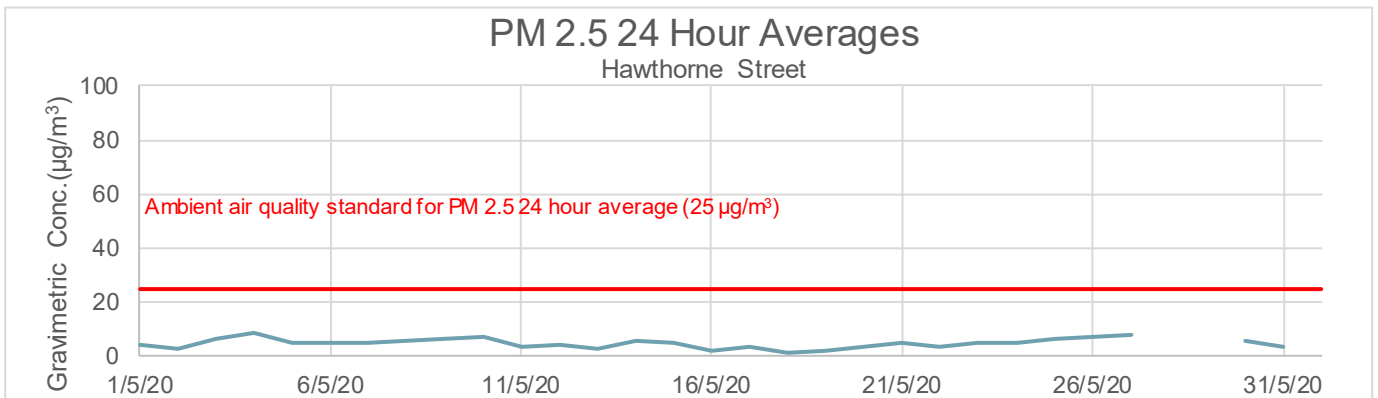


Figure 3 - Hawthorne Street PM2.5 24hr averages

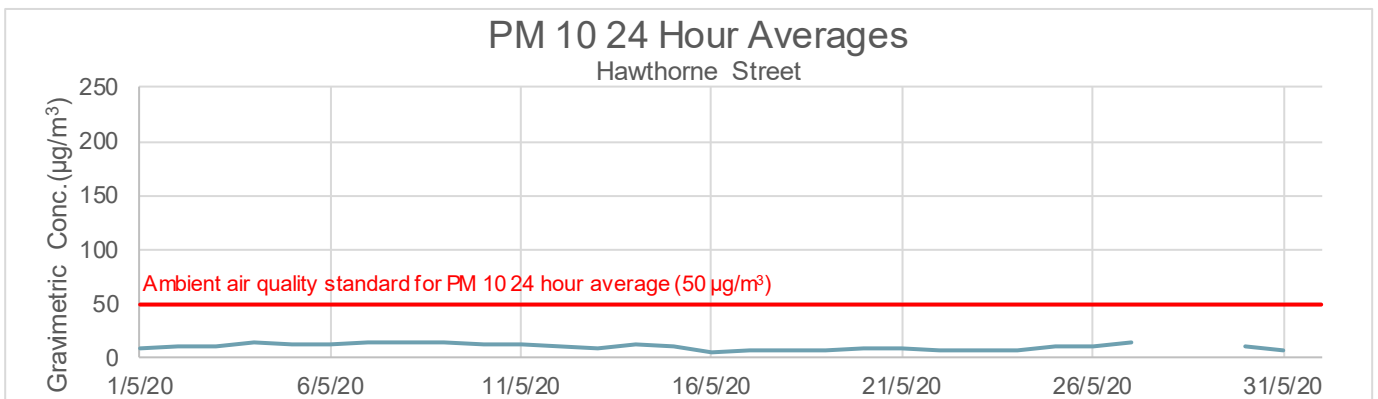


Figure 4 - Hawthorne Street PM10 24hr averages

## 2. Introduction

Norditech Pty Ltd was appointed by Brisbane Motorway Services in October 2017 to operate, maintain and report on the CLEM7 Air Quality Monitoring Network. The CLEM7 Air Quality Monitoring Network consists of four sites located as described in Table 2.

This report presents the data for May 2020.

- Describes air quality measurements
- Compares monitoring results
- Has been quality assured
- Complies with NATA accreditation requirements, where applicable

## 3. Monitoring and Data Collection

### 3.1. Site Locations

The sites consist of four ambient air quality monitoring stations. Station location and parameters monitored are described below.

CLEM7 Site Location Coordinates			
Site Name	Latitude	Longitude	Height Above Sea Level
Hawthorne Street	-27° 29' 14.40"	153° 2' 0.81"	25m
Royal Brisbane Hospital	-27° 26' 55.58"	153° 1' 38.78"	28m
Northey Street	-27° 26' 30.81"	153° 1' 38.13"	4m
Landcenter	-27° 29' 5.10"	153° 2' 7.86"	14m

Table 2 - Site Location Coordinates

Siting audits were conducted to assess for compliance with AS/NZS 3580.1.1:2016 Methods for sampling and analysis of ambient air. The stations are classified as neighbourhood stations according to AS/NZS 3580.1.1:2016.

The siting of the Hawthorne Street and Northey Street station do not fully comply with the guidelines in AS/NZS 3580.1.1:2016. Refer to section 3.3.1 for further details.

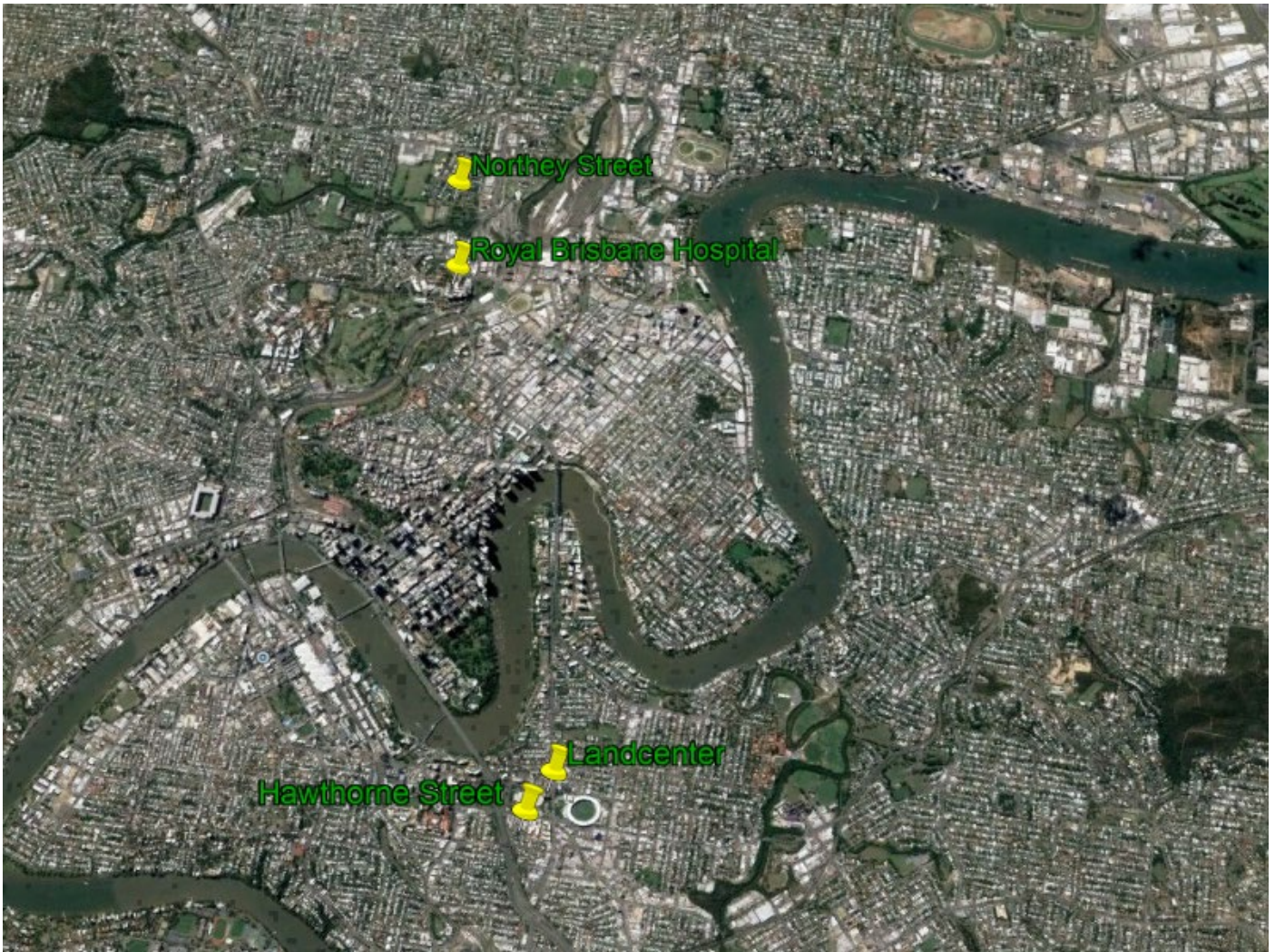


Figure 5 - Site Locations

### 3.2. Monitored Parameters

Table 3 below details the instruments used at the Clem 7 monitoring stations. Definitions of any abbreviated parameter names used throughout the report can be found in the glossary at the start of the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring stations.

CLEM7 Instrumentation Details	
Parameter Measured	Instrumentation Method Used
NO, NO <sub>2</sub> , NO <sub>x</sub>	Thermo 42i - chemiluminescence
CO	Thermo 48i – infrared absorption
PM <sub>10</sub>	Thermo 1405 - TEOM (Tapered Element Oscillating Microbalance)
PM <sub>2.5</sub>	Thermo 1405 - TEOM (Tapered Element Oscillating Microbalance)
TSP	Lear Siegler Australasia PK-2100 High Volume Sampler – gravimetric filter weighing method
Wind Speed (10m)	RM Young 05103V - cup and vane
Wind Direction (10m)	RM Young 05103V - cup and vane
Sigma (10m)	Calculation
Ambient Temperature (10m)	RM Young 41382V – 100 Ohm Platinum RTD
Relative Humidity (10m)	RM Young 41382V – Rotronic Hygrometer
Solar Radiation (10m)	RM Young 70201 – Pyranometer

Table 3 - Instrumentation Details

### 3.3. Data Collection Methods

Table 4 and 5 below show the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

CLEM7 Gaseous and Particulate Methods		
Parameter Measured	Instrumentation Method Used	Description of Method
NO, NO <sub>2</sub> , NO <sub>x</sub>	AS 3580.5.1-2011	Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method
	Norditech Laboratory Manual	In-house method TP.001-Oxides of Nitrogen
CO	AS 3580.7.1-2011	Methods for sampling and analysis of ambient air. Method 7.1: Determination of carbon monoxide - direct reading instrumental method
	Norditech Laboratory Manual	In-house method TP.003-Carbon Monoxide
PM <sub>10</sub> (TEOM)	AS/NZ 3580.9.13-2013	Methods for sampling and analysis of ambient air. Method 9.13: Determination of suspended particulate matter – PM <sub>2.5</sub> continuous direct mass method using a tapered element oscillating microbalance analyser.
	Norditech Laboratory Manual	In-house method TP.005-TEOM
PM <sub>2.5</sub> (TEOM)	AS/NZ 3580.9.13-2013	Methods for sampling and analysis of ambient air. Method 9.13: Determination of suspended particulate matter – PM <sub>2.5</sub> continuous direct mass method using a tapered element oscillating microbalance analyser.
	Norditech Laboratory Manual	In-house method TP.026-TEOM
TSP (HiVol)	AS/NZ 3580.9.3-2003	Methods for sampling and analysis of ambient air. Method 9.3: Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method
	Norditech Laboratory Manual	In-house method TP.011-HVAS TSP

Table 4 - Gaseous and Particulate Methods

CLEM7 Meteorological Methods		
Parameter Measured	Instrumentation Method Used	Description of Method
Vector Wind Speed (Horizontal)	AS 3580.14.2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Norditech Laboratory Manual	In-house method TP.006-Wind Speed and Direction
Vector Wind Direction	AS 3580.14.2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Norditech Laboratory Manual	In-house method TP.006-Wind Speed and Direction
Sigma	AS 3580.14.2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Norditech Laboratory Manual	In-house method TP.006-Wind Speed and Direction
Ambient Temperature	AS 3580.14.2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Norditech Laboratory Manual	In-house method TP.012-Ambient Temperature
Relative Humidity	AS 3580.14.2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Norditech Laboratory Manual	In-house method TP.014-Relative Humidity
Solar Radiation	AS 3580.14.2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Norditech Laboratory Manual	In-house method TP.024-Solar Radiation

Table 5 - Meteorological Methods

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Clem7 monitoring networks according to the methods detailed in Table 7 and 8 above.

#### **At all Clem 7 sites;**

- Due to the configuration and small volume of the equipment enclosures, rack temperature is not able to be maintained within the specified deviation from the set point ( $\pm 3^{\circ}\text{C}$ ) mandated by AS/NZS 3580.5.1.
- Wind sensors RM Young 05103 do not comply with the performance specifications of AS/NZS 3580.14 and data is not covered by Norditech's NATA scope of accreditation.
- The method used to measure PM10 (AS/NZ 3580.9.13-2013) sites is not covered by Norditech's NATA scope of accreditation. Australian Standard AS/NZ 3580.9.13-2013 *Methods for sampling and analysis of ambient air. Method 9.8: Determination of suspended particulate matter – PM2.5 continuous direct mass method using a tapered element oscillating microbalance analyser* does not specifically cover the measurement of PM10 by 1405-DF, however this is the most applicable standard to this type of instrument.
- Nightly zero and span checks are not currently being performed due to removal of gas cylinders by Ecotech and unreliable gas dilution equipment. Manual weekly Level 1 calibration checks are currently being performed at each site as per the requirements of the relevant Australia Standard.

In addition to the above, the following is applicable as listed below;

#### **Hawthorne Street**

- The location of the monitoring station does not fully comply with the guidelines of AS/NZS 3580.1.1: Methods for Sampling and Analysis of Ambient Air - Guide to Siting Air Monitoring Equipment due to the proximity of nearby trees.
- Siting of the wind speed and wind direction sensors at Hawthorne Street does not meet AS/NZS 3580.14 guidelines, due to possible air flow disturbances caused by nearby trees.

#### **Royal Brisbane Hospital**

- Royal Brisbane Hospital site was decommissioned on 15/03/2019 at the request of BMS.

#### **Northey Street**

- Northey Street site was decommissioned on 8/11/2019 at the request of Transurban.

#### **Landcenter**

- Landcenter site was decommissioned on 8/02/2018 at the request of BMS.



### 3.3.2. Data Acquisition

Data are recorded to a WinAQMS data logger located at each site at 5 minute averaging periods, calculated from 10 second samples. All data are retrieved periodically, approximately on an hourly basis, over a private 3G network, to a central WinCollect database where data validation is performed to remove any data not deemed as valid prior to reporting.

During automatic zero and span operations readings are flagged with a “Span” or “Zero” status. Up to 40 minutes of ambient readings are not measured during this period.

### 3.4. Data Validation and Reporting

#### 3.4.1. Validation

Norditech performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Norditech maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid. Validation is performed by the operator, and the validation is reviewed. All data is checked and graphs and reports are generated based on the verified 1-hour, 8-hour and 24-hour data.

#### 3.4.2. Reporting

The reported data is in three Microsoft Excel format files named “*202005 Clem7 Monthly Data Report.xlsx*”, “*202005 Clem7 Validated Annual Mean Data Report Year-To-Date.xlsx*” and “*202005 201907-202006 Clem7 Validated Annual Mean Data Report Financial Year.xlsx*”.

“*202005 Clem7 Monthly Dust Data Report.xlsx*” is validated monthly dust data and the TSP weighing results represented in this report. The file consists of eight Excel worksheets:

1. Cover
2. 5-minute Data
3. 1-Hour Data
4. Daily Data
5. TSP – Hawthorne St
6. TSP – Royal Brisbane Hospital
7. TSP – Northey St
8. TSP – Landcenter

“202005 Clem7 Validated Annual Mean Data Report Year-To-Date.xlsx” is validated monthly data as presented in this and previous reports for the calendar year to date. The file consists of nine Excel worksheets:

1. Cover
2. YTD 2020 PM2.5 5-minute Data
3. YTD 2020 PM2.5 1-hour Data
4. YTD 2020 PM2.5 Daily Data
5. YTD 2020 PM2.5 Monthly Data
6. YTD 2020 PM10 5-minute Data
7. YTD 2020 PM10 1-hour Data
8. YTD 2020 PM10 Daily Data
9. YTD 2020 PM10 Monthly Data

“202005 201907-202006 Clem7 Validated Annual Mean Data Report Financial Year.xlsx” is validated monthly data as presented in this and previous reports for the financial year to date. The file consists of nine Excel worksheets:

1. Cover
2. FY19-20 PM2.5 5-minute Data
3. FY19-20 PM2.5 1-hour Data
4. FY19-20 PM2.5 Daily Data
5. FY19-20 PM2.5 Monthly Data
6. FY19-20 PM10 5-minute Data
7. FY19-20 PM10 1-hour Data
8. FY19-20 PM10 Daily Data
9. FY19-20 PM10 Monthly Data

All averages greater than 5 minute averages are calculated from the 5 minute average data set. 75% valid data must be available to calculate re-averaged data. For example, to calculate a 1hr average from 5 minute data, there must be a minimum of 9 out of 12 valid 5 minute average data points available.

Averaging period of 8 hour rolling average is calculated at the end of the period, i.e. the 8 hour rolling average at 10:00am includes data from 02:00am to 10:00am. Averaging periods of 1 hour and 24 hours are reported for the beginning of the period, i.e. the hourly average 02:00am is for the data collected from 2:00am to 3:00am. One-hour averages are calculated based on a clock hour. One day and 1-year averages are calculated based on calendar days.

Annual averages start from January 1<sup>st</sup> and contain the average of the current year's data.

All data is recorded to Australian Eastern Standard Time.

## Wind Data Reporting

Wind speed, wind speed gust and wind direction data associated with calm wind conditions are reported in accordance with the requirements of AS 3580.14 2014. Calm wind conditions are defined as wind speeds below the starting threshold of the wind speed / direction sensors. Sensor starting thresholds are given in Table 10 under “Measurement Range”.

In this report, calm wind speed readings in tabulated data are reported as 0 m/s. Wind direction readings during calm periods are excluded from the tabulated data (reported as nulls).

Calm readings are excluded from wind roses; however, the percentage of calm data is indicated at the bottom of the graph. In all other graphic representations of the data, wind speed wind and direction values are reported as logged, without calm filters applied.

## 4. Air Quality Standards

The air quality standards for pollutants monitored at the Clem7 monitoring network are based on the Australian National Environmental Protection (Ambient Air Quality) Measure (NEPM) – 2011. These air quality standards are shown in Tables 6 and 7 below.

CLEM7 Air Quality Standards (NEPM)				
Parameter	Time Period	Exceedance Level	Units	Maximum Allowable Exceedances
CO	8 hours (rolling, based on 1 hour averages)	9.0	ppm	1 day a year
NO <sub>2</sub>	1 hour	120	ppb	1 day a year
NO <sub>2</sub>	1 year	30	µg/m <sup>3</sup>	None
PM <sub>10</sub>	1 day	50	µg/m <sup>3</sup>	None
PM <sub>10</sub>	1 year	25	µg/m <sup>3</sup>	None
PM <sub>2.5</sub>	1 day	25	µg/m <sup>3</sup>	None
PM <sub>2.5</sub>	1 year	8	µg/m <sup>3</sup>	None

Table 6 - CLEM7 Air Quality Standards (NEPM)

### CLEM7 Air Quality Goals (Queensland Environmental Protection Air Policy 2008)

Parameter	Time Period	Exceedance Level	Units	Maximum Allowable Exceedances
CO	8 hours (rolling, based on 1 hour averages)	9.0	ppm	1 day a year
CO (CoG)	8 hours (rolling, based on 1 hour averages)	8.0	ppm	1 day a year
NO <sub>2</sub>	1 hour	120	µg/m <sup>3</sup>	1 day a year
NO <sub>2</sub>	1 year	30	µg/m <sup>3</sup>	None
PM <sub>10</sub>	1 day	50	µg/m <sup>3</sup>	None
PM <sub>2.5</sub>	1 day	25	µg/m <sup>3</sup>	None
PM <sub>2.5</sub>	1 year	8	µg/m <sup>3</sup>	None

Table 7 - CLEM7 Air Quality Goals (Queensland Environmental Protection Air Policy 2008)

**Note:**

Exceptional events are excluded from this standard. As per the Ambient Air Quality NEPM, Exceptional event means a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1-day average standards in excess of normal historical fluctuations and background levels, and is directly related to: bushfire, jurisdiction authorised hazard reduction burning; or continental scale windblown dust.

Norditech will include any valid data identified as being associated with an exceptional event in all report tables and graphic representations. However, 1-day averages associated with exceptional events will not be counted as exceedances of the Air Quality standard.

## 5. Calibrations and Maintenance

### 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturers tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

Units and Uncertainties				
Parameter	Resolution	Units	Uncertainty	Measurement Range
NO, NO <sub>x</sub> (Thermo 42i)	1	ppb	±2.10% of reading + 2.22% of full scale K factor of 2.0	0 ppb to 500 ppb
NO <sub>2</sub> (Thermo 42i)	1	ppb	±2.10% of reading + 2.22% of full scale K factor of 2.0	0 ppb to 500 ppb
CO (Thermo 48i)	0.1	ppm	±2.10% of reading + 2.22% of full scale K factor of 2.0	0 ppm to 100 ppm
TSP	0.1	µg/m <sup>3</sup>	±7.19% of reading K factor of 20	7 µg/m <sup>3</sup> to full scale
PM <sub>10</sub> , PM <sub>2.5</sub> (TEOM)	0.1	µg/m <sup>3</sup>	±1.83% of reading + 0.22 µg/m <sup>3</sup> K factor of 2.0	0 µg/m <sup>3</sup> to 1 g/m <sup>3</sup>
Vector Wind Speed	0.1	m/s	±0.46 m/s or 3.96% of reading, whichever is greater K factor of 2.0	0 m/s to 15 m/s
Vector Wind Direction	1	deg	±5.05 deg K factor of 2.0	0 to 360 deg
Solar Radiation	1	W/m <sup>2</sup>	±15 W/m <sup>2</sup> or 3% of reading, whichever is greater K factor of 2.0	0 to 1100 W/m <sup>2</sup>
Ambient Temperature	0.1	°C	±0.26 °C K factor of 20	0°C to 50°C
Relative Humidity	1	%	± 3.62% K factor of 2.0	0 to 100%

Table 8 - Units and Uncertainties

## 5.2. Automatic Calibration Checks

Automatic span and zero calibration checks run each night for gaseous parameters.

See Table 9 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

Automatic span and zero calibration checks for NO <sub>x</sub> , NO <sub>2</sub> , NO and CO	
Station	Span / Zero cycle time (approximate)
Hawthorne Street	01:00 – 01:55
Royal Brisbane Hospital	01:00 – 01:55
Northey Street	01:00 – 01:55
Landcenter	01:00 – 01:55

Table 9 - Automatic span and zero calibration checks for NO<sub>x</sub>, NO<sub>2</sub>, NO and CO

## 5.3. Maintenance

The maintenance schedule is kept per the manufacturers recommendations and applicable standards.

### 5.3.1. Maintenance Notes

#### **Hawthorne St**

Scheduled 1 Monthly maintenance was undertaken on 27/03/2020

### 5.3.2. Calibration and Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to verification, to be performed at the next calibration cycle.

Tables 10 indicates when the particulate, gas and meteorological equipment were last calibrated.

Maintenance Table Hawthorne Street				
Parameter	Date of Last Maintenance	Maintenance Type	Last Calibration Date	Calibration Cycle
NO, NO <sub>2</sub> , NO <sub>x</sub>	30/04/2020	1 Monthly	30/04/2020	1 Monthly
CO	30/04/2020	1 Monthly	30/04/2020	1 Monthly
PM <sub>2.5</sub> , PM <sub>10</sub>	30/04/2020	1 Monthly	28/01/2020	12 Monthly
TSP	27/03/2020	2 Monthly	27/03/2020	2 Monthly
AT, RH	28/11/2019	3 Monthly	23/08/2019	6 Monthly
Solar Radiation	28/11/2019	3 Monthly	Not Available	12 Monthly
WS, WD	28/11/2019	3 Monthly	24/10/2017	12 Monthly

Table 10 – Maintenance Table Hawthorne Street



## 6. Results

### 6.1. Data Capture

Data capture is based on 5-minute data and refers to the amount of available data for the reporting period.

Data capture rates are calculated as per the following formula:

$$\text{Data Capture Rate \%} = \frac{\text{Available data points}}{\text{Total data points}} * 100$$

where:

Available data points = Total number of 5 minute averages for the reporting period in which valid data was recorded. This excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.

Total data points = Total number of 5 minute averages for the reporting period inclusive of invalid data.

Table 11 below displays the data capture statistics for May 2020. Bold values in the table indicate data capture below 95%.

Instruments disabled or removed from site have been grey-scaled.

Station	Data Capture (%)							
	CO	NO, NO <sub>2</sub> , NO <sub>x</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	WS, WD, Sigma	AT	RH	SR
Hawthorne Street	96.6	96.6	96.3	96.3	99.6	99.6	99.6	99.6

Table 11 – Monthly Data Capture Rates

## 6.2. Air Quality Summary

Tables 12 below, details any exceedances of the EPP Goal and NEPM Standard that were observed during this reporting period.

Exceedances Recorded for Hawthorne Street				
Parameter	Time Period	Allowable Limit	Value of Exceedance	Date of Exceedance
Carbon Monoxide	8 hour (rolling average)	8 ppm	-	-
Nitrogen dioxide	1 hour	120 ppb	-	-
PM2.5	24 hour	25 µg/m <sup>3</sup>	-	-
PM10	24 hour	50 µg/m <sup>3</sup>	-	-

Table 12 – Exceedances Recorded for Hawthorne Street

### 6.3. Tabulated Data for Hawthorne Street

#### *Hawthorne Street Gaseous and Particulate Data*

Hawthorne Street Gaseous and Particulate Data May 2020						
Date	NO ppb	NO <sub>2</sub> ppb	NO <sub>x</sub> ppb	CO ppm	PM <sub>2.5</sub> µg/m <sup>3</sup>	PM <sub>10</sub> µg/m <sup>3</sup>
1/05/2020	0.7	3	4	0.1	4.4	8.2
2/05/2020	0	3	4	0.1	2.5	10.2
3/05/2020	1	6	7	0.1	6.5	10.5
4/05/2020	1	6	7	0.1	8.6	14.2
5/05/2020	3	10	13	0.2	5.4	11.9
6/05/2020	5	13	18	0.2	4.7	12.1
7/05/2020	23	19	42	0.3	5.1	13.7
8/05/2020	18	21	38	0.3	6.0	14.2
9/05/2020	5	11	16	0.3	6.7	13.5
10/05/2020	1	6	7	0.2	7.2	13.3
11/05/2020	2	9	11	0.1	3.9	11.9
12/05/2020	4	11	15	0.2	4.0	10.7
13/05/2020	10	17	26	0.3	2.8	9.1
14/05/2020	11	17	28	0.3	5.4	11.9
15/05/2020	2	9	10	0.2	5.3	10.1
16/05/2020	1	5	7	0.2	1.9	5.2
17/05/2020	1	6	7	0.2	3.2	6.9
18/05/2020	5	11	16	0.2	1.7	6.6
19/05/2020	8	14	22	0.3	1.8	7.5
20/05/2020	11	16	28	0.4	3.7	9.7
21/05/2020	6	12	19	0.3	5.0	9.3
22/05/2020	1	4	5	0.2	3.3	6.7
23/05/2020	1	3	4	0.2	5.1	7.6
24/05/2020	1	3	3	0.2	4.8	6.9
25/05/2020	10	14	23	0.3	6.3	9.9
26/05/2020	10	16	26	0.3	7.5	10.6
27/05/2020	14	24	37	0.4	7.9	14.0
28/05/2020	13	26	39	0.5	-	-
29/05/2020	7	18	25	0.4	-	-
30/05/2020	2	8	10	0.3	5.9	10.1
31/05/2020	7	10	17	0.4	3.5	6.6
Minimum	0	3	3	0.1	1.7	5.2
Date of Minimum	2/05/2020	24/05/2020	24/05/2020	2/05/2020	18/05/2020	16/05/2020
Maximum	23	26	42	0.5	8.6	14.2
Date of Maximum	7/05/2020	28/05/2020	7/05/2020	28/05/2020	4/05/2020	8/05/2020

There will be no daily results if there is less than 75% valid data for that day

Table 13 – Hawthorne Street Gaseous and Particulate Data

*Hawthorne Street Gaseous Calibration Data*

Hawthorne Street Calibration Data May 2020												
Date	NO Zero	NO Precision	NO Span	NO <sub>2</sub> Zero	NO <sub>2</sub> Precision	NO <sub>2</sub> Span	NO <sub>x</sub> Zero	NO <sub>x</sub> Precision	NO <sub>x</sub> Span	CO Zero	CO Precision	CO Span
1/05/2020	0	406	407	1	1	1	1	407	407	0.0	12.3	12.4
2/05/2020	0	406	409	1	1	-1	1	407	408	0.0	12.3	12.3
3/05/2020	0	406	407	0	1	-1	1	407	405	0.0	12.3	12.4
4/05/2020	0	406	408	0	1	-1	1	407	407	0.0	12.3	12.4
5/05/2020	0	406	407	0	1	0	0	407	407	0.0	12.3	12.3
6/05/2020	0	406	406	1	1	-2	1	407	405	0.0	12.3	12.4
7/05/2020	0	406	408	0	1	-1	0	407	407	0.0	12.3	12.4
8/05/2020	0	406	410	0	1	-2	1	407	408	-0.1	12.3	12.4
9/05/2020	1	406	409	1	1	1	1	407	410	-0.1	12.3	12.4
10/05/2020	0	406	406	0	1	0	1	407	406	0.0	12.3	12.4
11/05/2020	0	406	408	1	1	-1	1	407	407	0.0	12.3	12.4
12/05/2020	0	406	408	0	1	-1	1	407	407	0.0	12.3	12.4
13/05/2020	0	406	407	0	1	-1	1	407	407	0.0	12.3	12.5
14/05/2020	0	406	408	1	1	-1	1	407	407	0.0	12.3	12.4
15/05/2020	1	406	408	1	1	0	1	407	408	0.0	12.3	12.4
16/05/2020	0	406	408	1	1	0	1	407	409	0.1	12.3	12.5
17/05/2020	0	406	408	1	1	0	0	407	408	0.0	12.3	12.5
18/05/2020	1	406	408	1	1	0	1	407	409	0.1	12.3	12.4
19/05/2020	0	406	408	1	1	2	1	407	410	0.0	12.3	12.5
20/05/2020	1	406	409	0	1	0	1	407	409	0.1	12.3	12.5
21/05/2020	0	406	407	0	1	0	1	407	407	0.1	12.3	12.5
22/05/2020	1	406	407	1	1	1	1	407	408	0.1	12.3	12.5
23/05/2020	0	406	408	1	1	-2	1	407	407	0.1	12.3	12.5
24/05/2020	1	406	406	0	1	0	1	407	406	0.1	12.3	12.5
25/05/2020	1	406	406	1	1	0	2	407	406	0.1	12.3	12.5
26/05/2020	1	406	408	0	1	0	1	407	408	0.1	12.3	12.5
27/05/2020	0	406	408	1	1	0	1	407	408	0.1	12.3	12.5
28/05/2020	1	406	408	0	1	0	1	407	408	0.1	12.3	12.5
29/05/2020	0	406	357	1	1	15	1	407	372	0.1	12.3	11.3
30/05/2020	0	406	402	0	1	1	1	407	403	0.1	12.3	12.4
31/05/2020	1	406	402	0	1	1	2	407	403	0.2	12.3	12.3

Table 14 – Hawthorne Street Gaseous Calibration Data

*Hawthorne Street Meteorological Data*

Hawthorne Street Meteorological Data May 2020					
Date	Wind Speed m/s	Wind Direction deg	Temperature °C	Relative Humidity %	Solar Radiation W/m <sup>2</sup>
1/05/2020	1.2	252.0	17.7	42.4	159.2
2/05/2020	1.0	252.0	17.4	40.5	162.4
3/05/2020	0.7	214.0	18.6	40.1	159.1
4/05/2020	1.0	186.0	17.8	51.7	148.2
5/05/2020	1.0	190.0	18.3	59.8	140.5
6/05/2020	1.0	162.0	19.1	68.5	86.9
7/05/2020	0.3	119.0	19.2	72.5	79.0
8/05/2020	0.4	36.0	19.8	73.0	101.9
9/05/2020	0.9	27.0	20.8	72.8	127.3
10/05/2020	0.6	235.0	20.9	62.5	89.7
11/05/2020	1.0	212.0	18.2	48.7	134.1
12/05/2020	0.8	196.0	17.5	61.5	94.4
13/05/2020	0.4	110.0	19.0	66.8	93.2
14/05/2020	0.4	192.0	18.7	71.7	115.7
15/05/2020	1.1	222.0	18.1	60.7	127.4
16/05/2020	1.2	189.0	18.8	65.2	102.4
17/05/2020	1.1	167.0	18.8	68.8	95.1
18/05/2020	1.2	153.0	19.2	67.8	103.7
19/05/2020	0.9	135.0	18.8	73.4	107.5
20/05/2020	0.3	188.0	18.5	82.6	49.9
21/05/2020	0.5	264.0	18.5	86.4	42.0
22/05/2020	1.1	261.0	15.1	53.5	97.7
23/05/2020	1.0	257.0	12.7	57.3	36.2
24/05/2020	1.0	256.0	14.7	53.6	113.4
25/05/2020	0.6	249.0	17.4	56.5	107.9
26/05/2020	0.5	247.0	17.8	47.0	114.9
27/05/2020	0.1	50.0	18.2	61.1	83.8
28/05/2020	0.1	240.0	18.3	73.3	50.8
29/05/2020	0.9	171.0	18.6	71.1	81.9
30/05/2020	0.8	168.0	18.2	68.1	105.5
31/05/2020	0.1	141.0	17.5	80.4	71.6
Minimum	0.1	27.0	12.7	40.1	36.2
Date of Minimum	31/05/2020	9/05/2020	23/05/2020	3/05/2020	23/05/2020
Maximum	1.2	264.0	20.9	86.4	162.4
Date of Maximum	18/05/2020	21/05/2020	10/05/2020	21/05/2020	2/05/2020

There will be no daily results if there is less than 75% valid data for that day

Table 15 – Hawthorne Street Meteorological Data

#### 6.4. Graphic Representations for Hawthorne Street

Validated 5-minute data for NO, NO<sub>2</sub>, Nox, CO, PM<sub>2.5</sub> and PM<sub>10</sub> were used to construct the following monthly graphical representations.

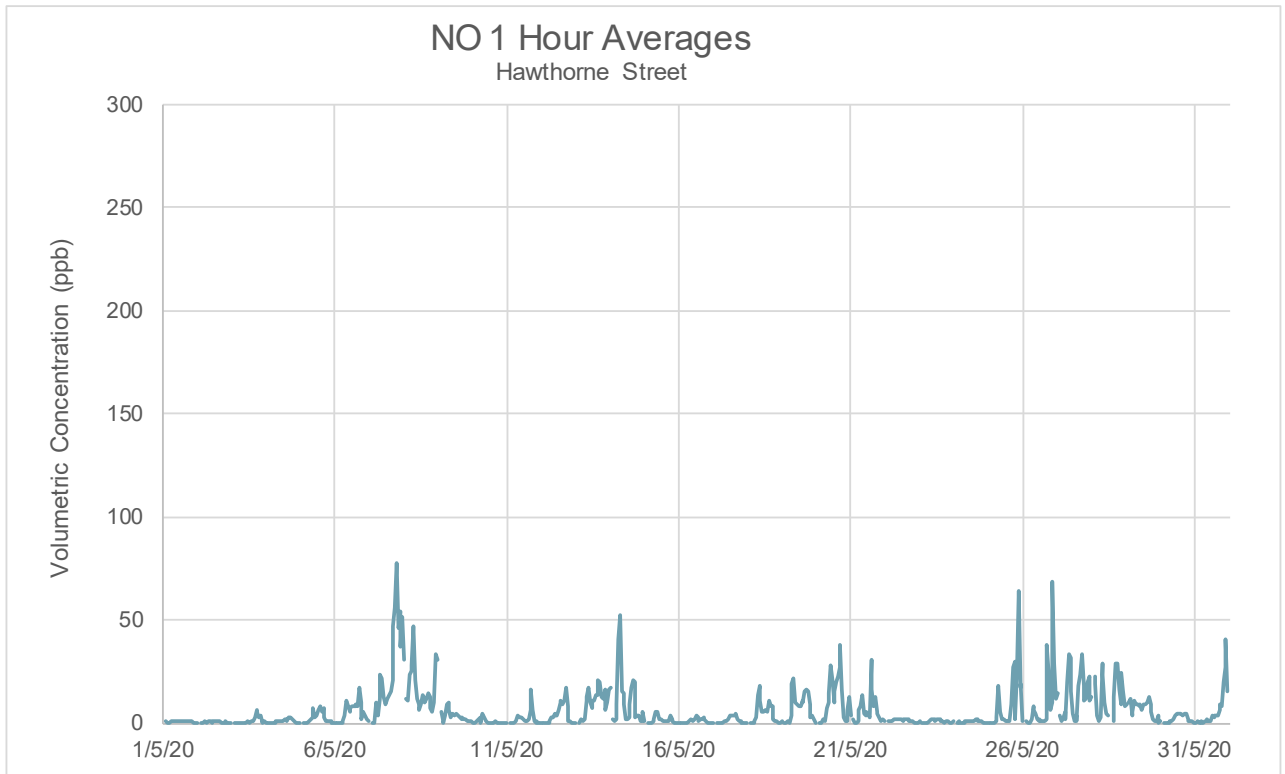


Figure 6 – Hawthorne Street 1 Hour Averaged NO Data

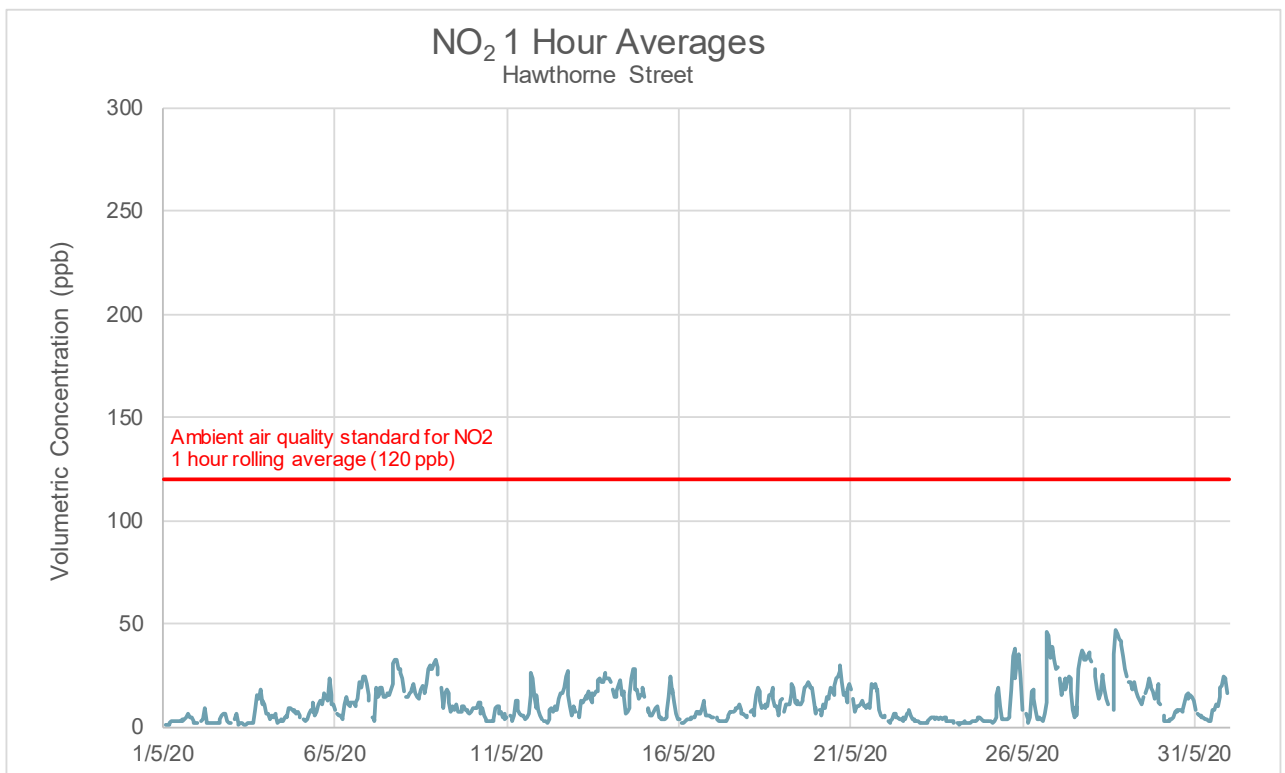


Figure 7 – Hawthorne Street 1 Hour Averaged NO<sub>2</sub> Data

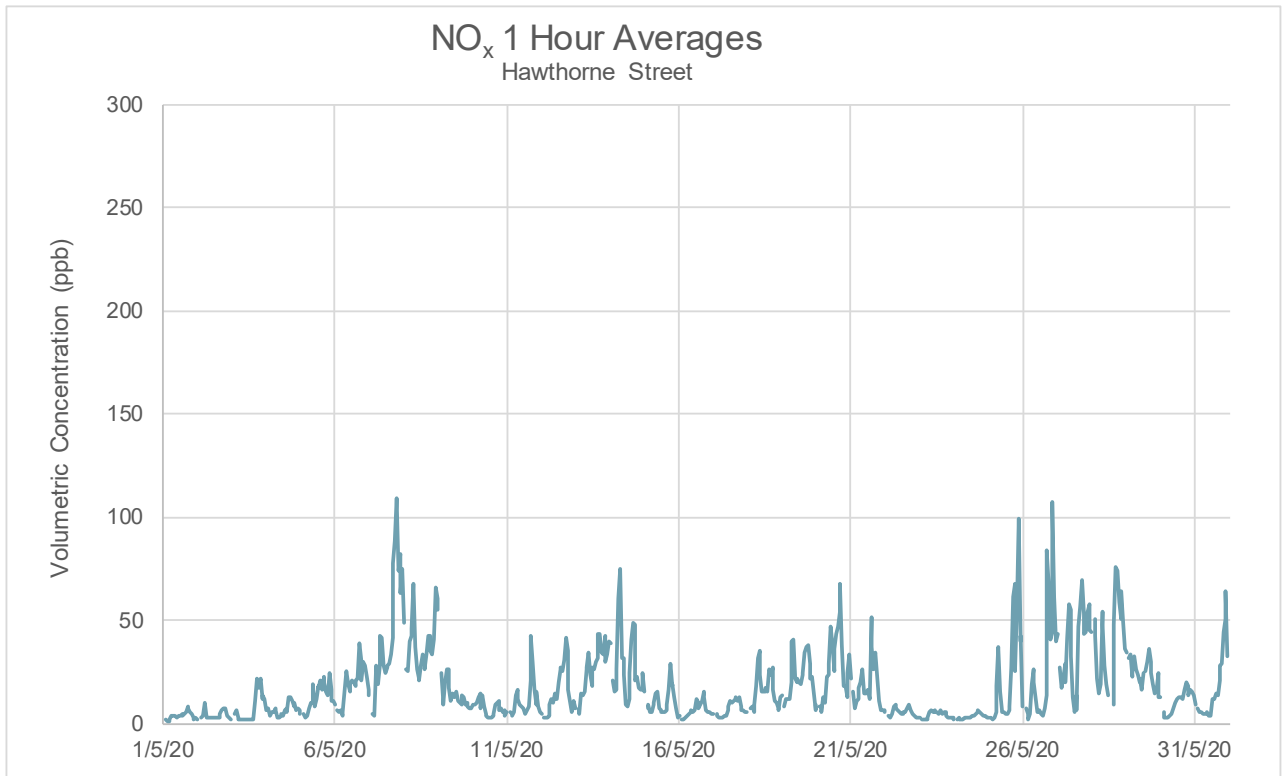


Figure 8 – Hawthorne Street 1 Hour Averaged NO<sub>x</sub> Data

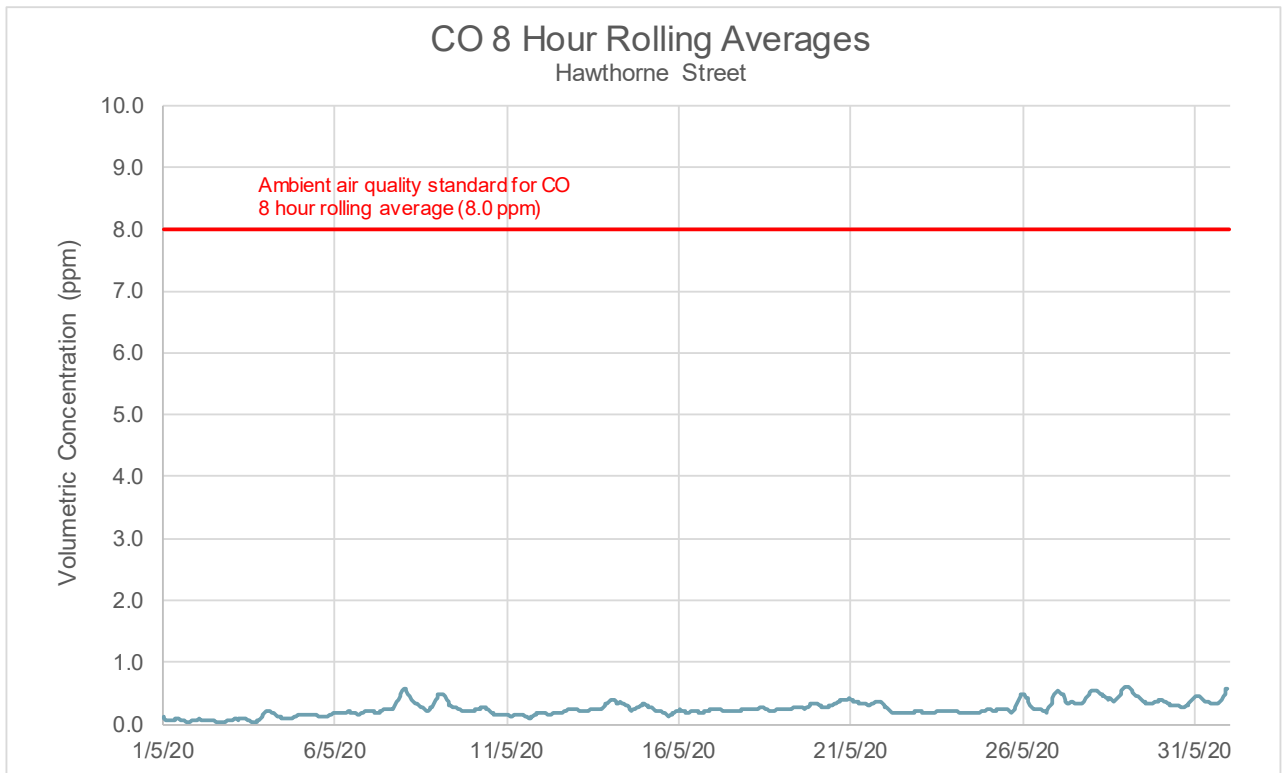


Figure 9 – Hawthorne Street 8 Hour Rolling Averaged CO Data

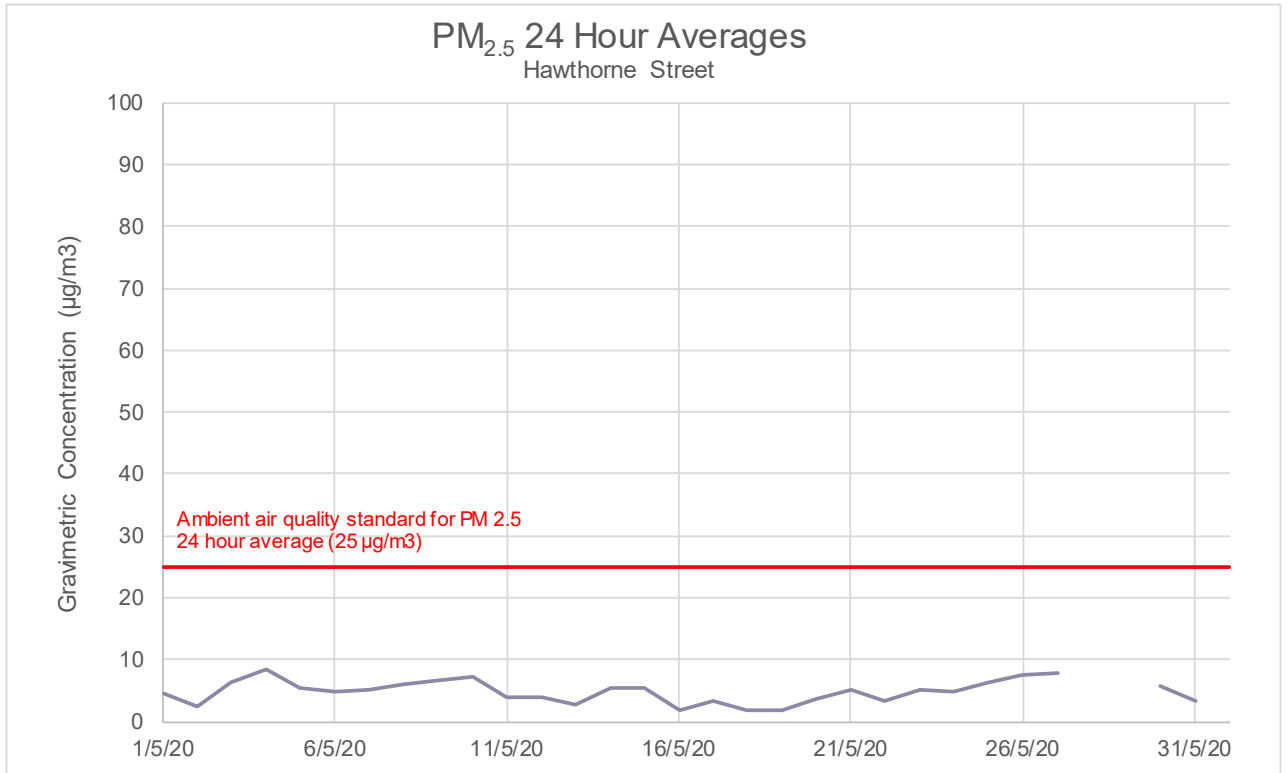


Figure 10 – Hawthorne Street 24 Hour Averaged PM<sub>2.5</sub> Data

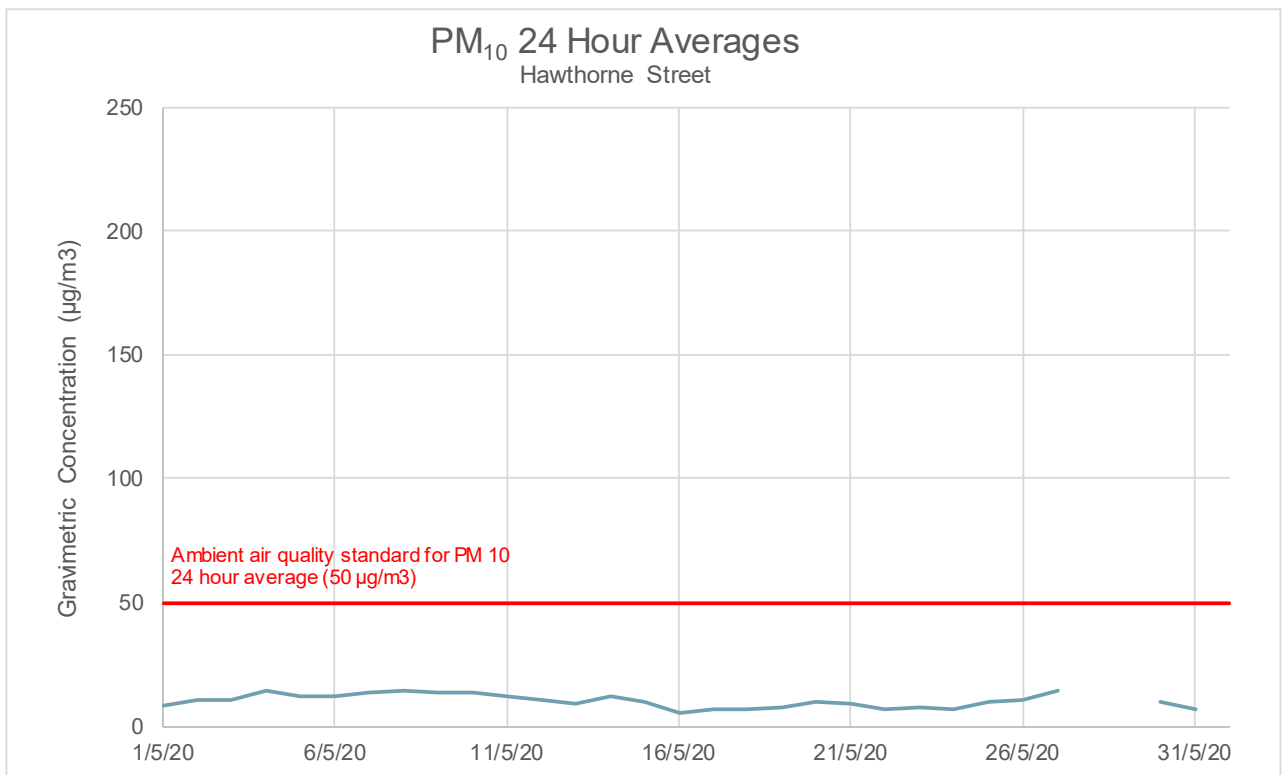


Figure 11 – Hawthorne Street 24 Hour Averaged PM<sub>10</sub> Data



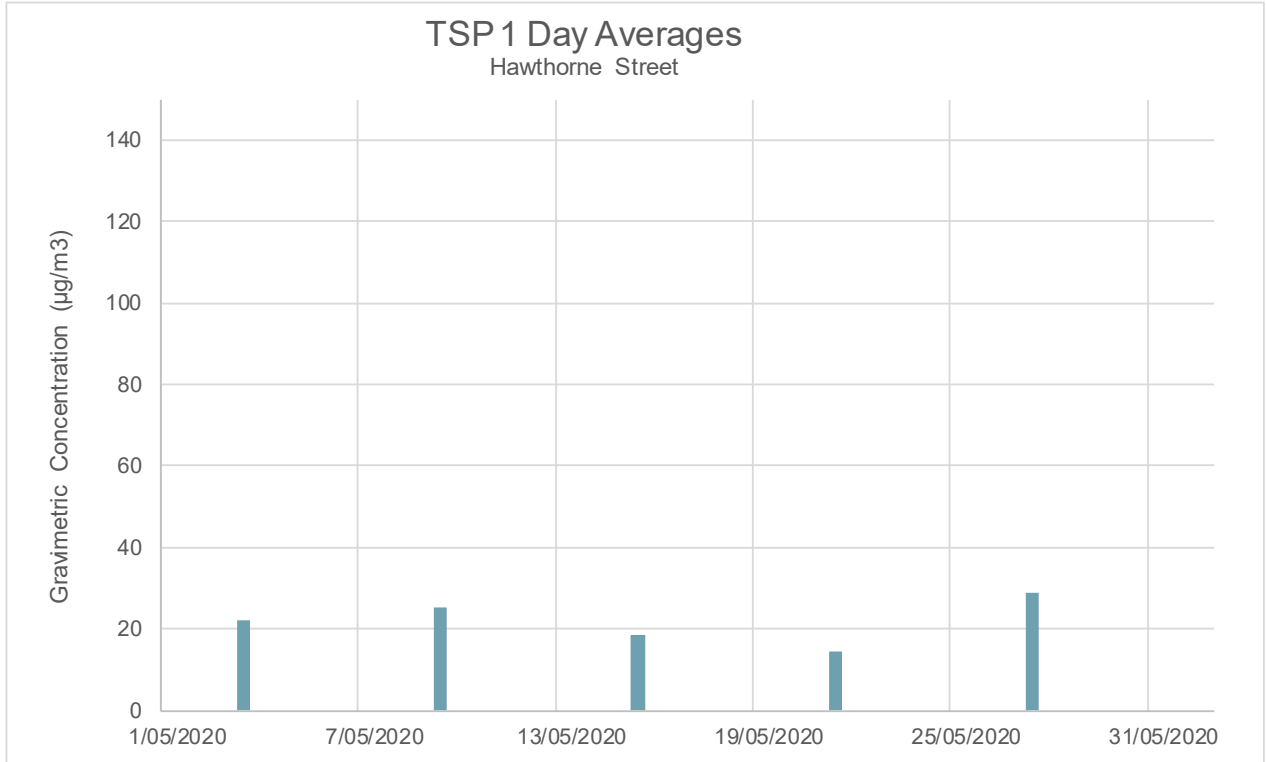


Figure 12 – Hawthorne Street TSP Data

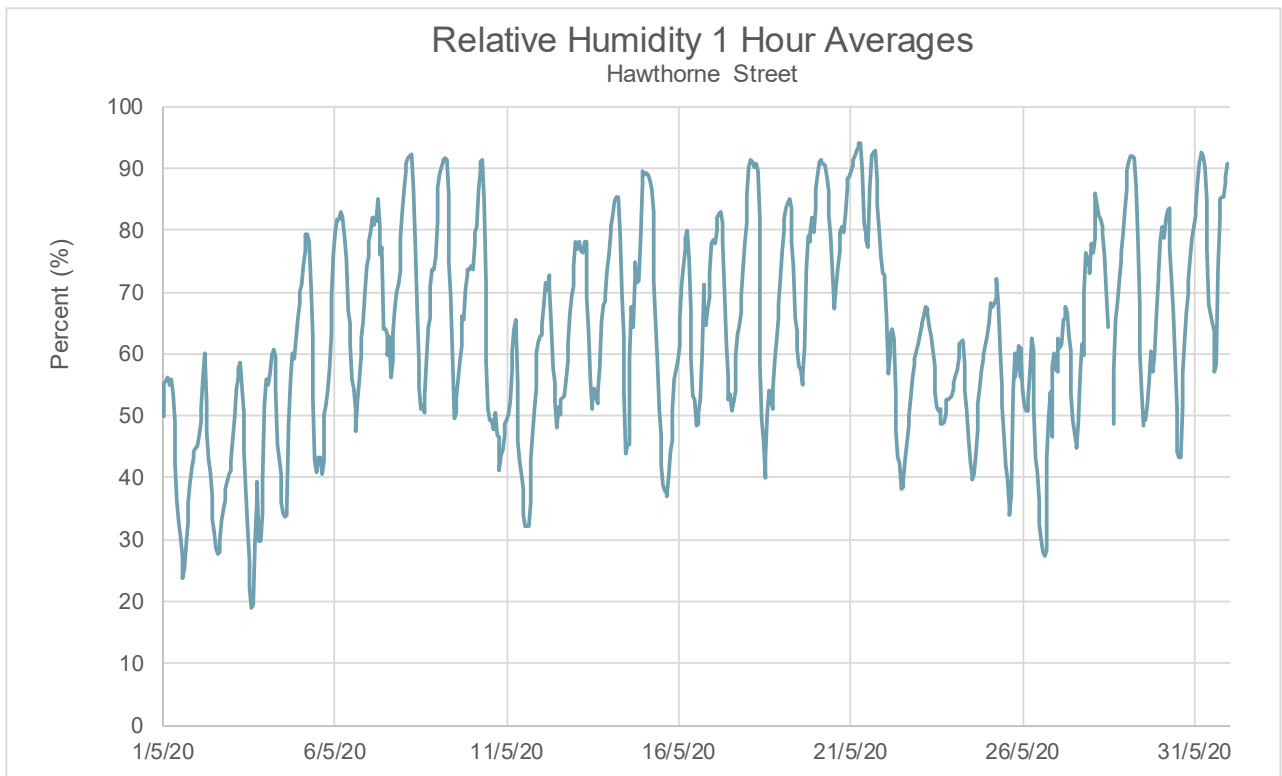


Figure 13 – Hawthorne Street 1 Hour Averaged Relative Humidity Data

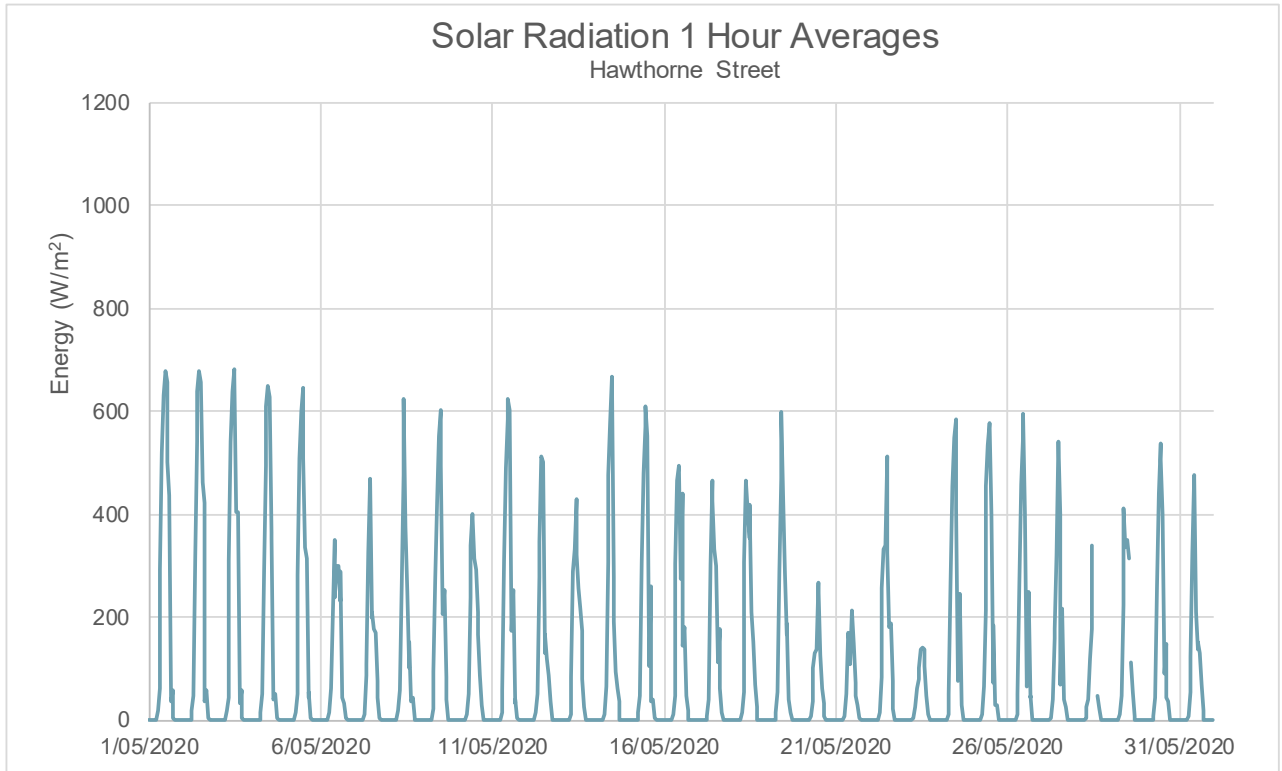


Figure 14 – Hawthorne Street 1 Hour Averaged Solar Radiation Data

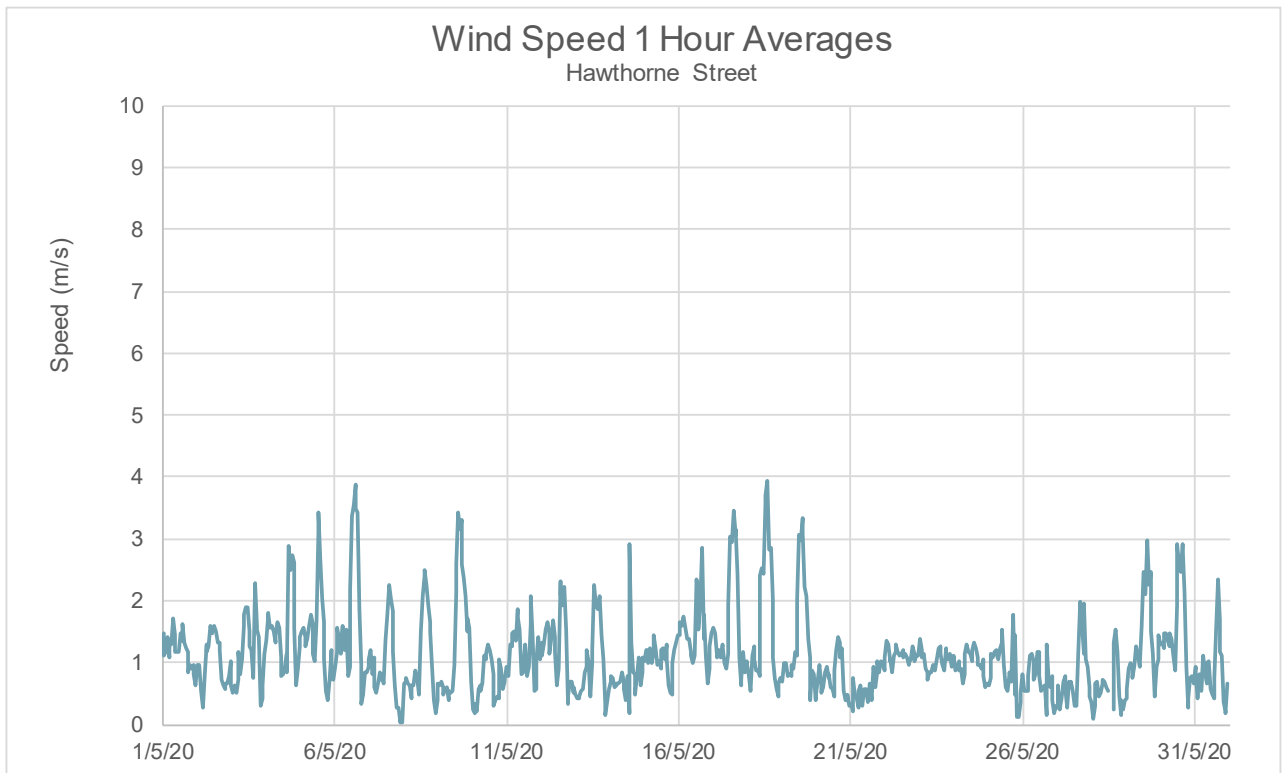


Figure 15 – Hawthorne Street 1 Hour Averaged Wind Speed Data

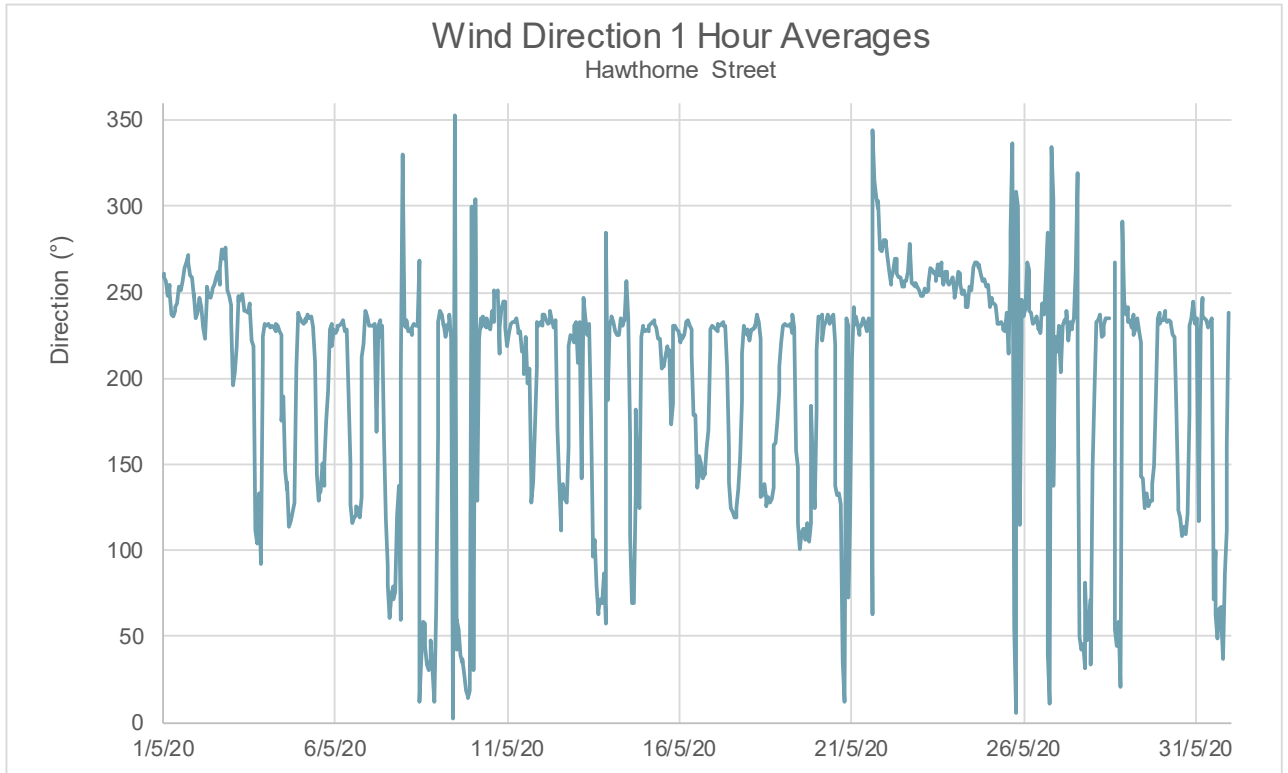


Figure 16 – Hawthorne Street 1 Hour Averaged Wind Direction Data

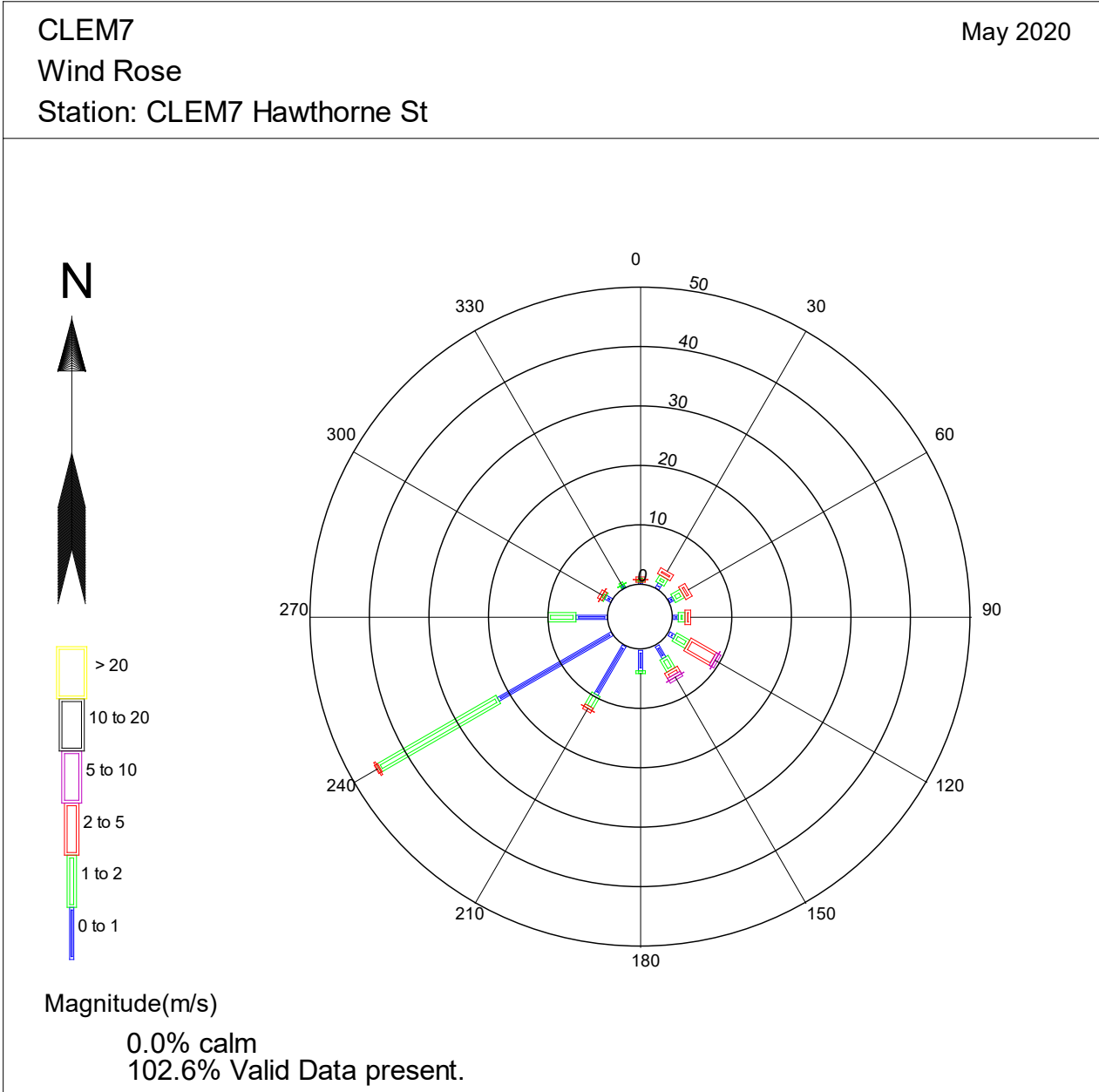


Figure 17 – Hawthorne Street 1 Hour Averaged Monthly Wind Rose

## 7. Validation Tables

The following tables outline any data removed during the data validation process, or automatically invalidated by the data acquisition system.

### Hawthorne Street Data Validation Table

Hawthorne Street Data Validation Table					
Start Date	End Date	Affected Parameters	Details of change	Validation Date	Changed By
28/05/2020 12:35:00	28/05/2020 14:15:00	All parameters	Maintenance	22/06/2020	TA
28/05/2020 14:20:00	29/05/2020 12:55:00	PM2.5, PM10	Maintenance	22/06/2020	TA
29/05/2020 13:00:00	29/05/2020 13:50:00	All parameters	Maintenance	22/06/2020	TA
29/05/2020 13:55:00	29/05/2020 16:55:00	PM2.5, PM10	Maintenance	22/06/2020	TA

Table 16 – Hawthorne Street Data Validation Table

## 8. Report Summary

Data capture for all parameters collected at Hawthorne Street were above 95.0% for the reporting period.

There were nil exceedances of the PM<sub>10</sub> 24 hour average NEPM Limit (50 µg/m<sup>3</sup>) during the reporting period.

There were nil exceedances of the PM<sub>2.5</sub> 24 hour average NEPM Limit (25 µg/m<sup>3</sup>) during the reporting period.

Exceedances Recorded for Hawthorne Street				
Parameter	Time Period	Allowable Limit	Value of Exceedance	Date of Exceedance
Carbon Monoxide	8 hour (rolling average)	8 ppm	-	-
Nitrogen dioxide	1 hour	120 ppb	-	-
PM2.5	24 hour	25 µg/m <sup>3</sup>	-	-
PM10	24 hour	50 µg/m <sup>3</sup>	-	-

Measurement of a number of parameters in this report do not comply with applicable standards and/or is not covered by Norditech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

## Appendix

### Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero-signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments, there may be a stabilisation period before normal operation commences. Data affected by environmental conditions – wind speed / wind speed gust spike refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

Equipment malfunction/instrument fault refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions. Gap in data/data not available refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

Instrument out of service refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Overnight zero out of tolerance** refers to when the automatic zero reading measured by the analyser falls outside the expected limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Shadow on sensor** refers to the same period of time every day when a shadow is cast over the solar radiation sensor causing unnatural low readings.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the start-up period of an instrument after power has been restored.