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AIR SCIENCES

NORTHCONNEX
AMBIENT AIR QUALITY MONITORING
INDEPENDENT AUDIT

Transurban

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Job Number 20071149

Prepared by

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NorthConnex
Ambient Air Quality Monitoring
Independent Audit

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1   INTRODUCTION

Todoroski Air Sciences have conducted an independent audit of the ambient air quality monitoring data collected for the NorthConnex Motorway (hereafter referred to as the Project).

This independent audit reviews the available ambient air quality and meteorological data collected for the Project during 1 November 2020 to 30 April 2021. A brief examination of a full year of data, including the previous six months, is also provided.

The auditor has previously conducted an independent review of the NorthConnex Project Air Quality Impact Assessment report for the NSW Department of Planning and Environment and independently reviewed the suitability of various monitoring locations for placement of the ambient monitoring equipment and presented the findings to the Air Quality Community Consultative Committee (AQCCC) for this Project. The auditor is also conducting the 6-monthly NorthConnex audits for the in-tunnel monitoring data, ventilation outlet monitoring data and air quality monitoring operating procedures and equipment.

Condition E7 of Infrastructure Approval SSI-6136 requires an audit of the monitoring data collected for the Project. The relevant part of the condition reads as follows:

The Ambient Air Quality - Monitoring

E7   …

> *Monitoring results shall be made publicly available and shall be subject to an independent audit at six-monthly intervals (or at a longer interval, if approved by the Secretary). The auditor shall be approved by the Secretary in consultation with the EPA and the AQCCC, and the auditor's report shall be directly provided to the Proponent and the AQCCC.*

1.1 Project Requirements

Under Condition E7 of Infrastructure Approval SSI-6136, the Project is required to monitor the following ambient air quality pollutants and parameters set out in **Table 1-1** below, following the specified sampling method, units of measure, and sampling frequency.

Monitoring is required to be conducted at a minimum at;

- ✦ two ground level receptors near the northern ventilation outlet, at locations suitable for detecting any impact on air quality from the outlet;

- ✦ two ground level receptors near the southern ventilation outlet, at locations suitable for detecting any impact on air quality from the outlet;

- ✦ one location along Pennant Hills Road, at a location suitable for detecting any impact on air quality along Pennant Hills Road; and,

- ✦ one location away from any of the locations set out above suitable for providing background ambient air quality reference data for the project area.

The quality of the monitoring results shall be assured through a NATA accredited process and results should comply with the ambient air quality goals set out for the Project under condition E8.

Under condition E9, should the monitoring results exceed any of the air quality goals for any given event, excluding extraordinary events such as bushfires and dust storms, the Project will immediately notify the Secretary, EPA and Ministry of Health.

The monitoring results shall be made publicly available and shall be subject to an independent audit at six-monthly intervals, which is the purpose of this report.

Table 1-1: Ambient air quality monitoring methodologies required under Condition E7

Pollutant/Parameter	Unit of measurement	Averaging Period	Frequency	Method
NO	pphm	1-hour	Continuous	AM-12 (AS/NZS 3580.5.1 –1993)
NO_2	pphm	1-hour	Continuous	AM-12 (AS/NZS 3580.5.1 –1993)
NO_x	pphm	1-hour	Continuous	AM-12 (AS/NZS 3580.5.1 –1993)
PM_{10}	µg/m³	24-hour	Continuous	AS 3580.9.8-2008
$PM_{2.5}$	µg/m³	24-hour	Continuous	AS 3580.9.13-2013
CO	ppm	1-hour, 8-hour	Continuous	AM-2 (AS/NZS 2923-1987) & AM-6 (AS 3580.7.1-1992)
Wind speed at 10m	m/s	1-hour	Continuous	AM-2 (AS/NZS 2923-1987) & AM-4 (USEPA (2000) EPA 454/R-99-005)
Wind direction at 10m	degrees	1-hour	Continuous	AM-2 (AS/NZS 2923-1987) & AM-4 (USEPA (2000) EPA 454/R-99-005)
Sigma theta	degrees	1-hour	Continuous	AM-2 (AS/NZS 2923-1987) & AM-4 (USEPA (2000) EPA 454/R-99-005)
Temperature at 2m	K	1-hour	Continuous	AM-4 (USEPA (2000) EPA 454/R-99-005)
Temperature at 10m	K	1-hour	Continuous	AM-4 (USEPA (2000) EPA 454/R-99-005)
Siting	-	-	-	AM-1 (AS 2922-1987) & AM-4 (USEPA (2000) EPA 454/R-99-005)

ppm = parts per hundred million
ppm = parts per million
µg/m³ = micrograms per cubic metre

2 AIR QUALITY MONITORING SITES

Ambient air quality monitoring, data collection and reporting was conducted by Ecotech Pty Ltd (Ecotech), a NATA accredited organisation. Monthly ambient air quality and weather monitoring validation reports are prepared by Ecotech (**ACOEM Ecotech, 2020 & ACOEM Ecotech, 2021a-e**).

Figure 2-1 presents the location of the ambient air quality monitoring sites for the Project.
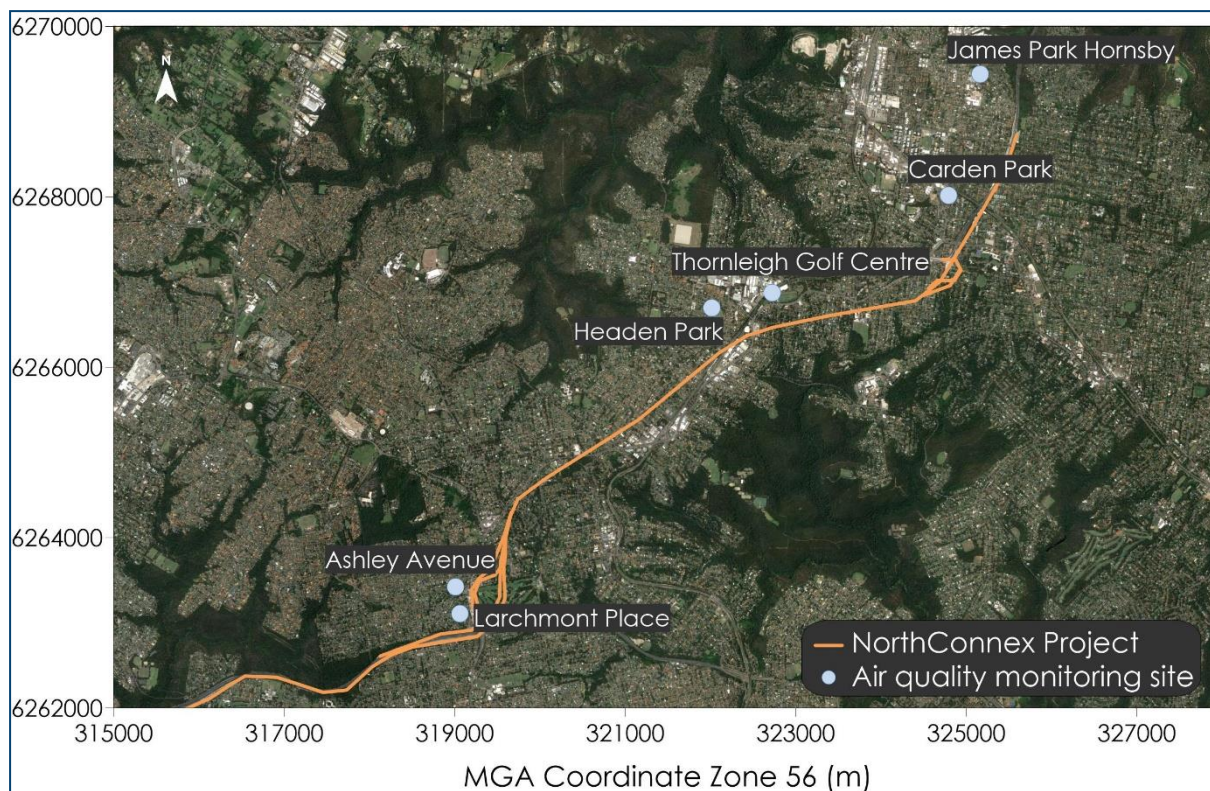

Figure 2-1: Monitoring site locations

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3 AIR QUALITY GOALS

3.1 Particulate matter

Particulate matter consists of dust particles of varying size and composition.   Two classes of particulate matter include PM_{10}, particulate matter with equivalent aerodynamic diameters of 10μm or less, and $PM_{2.5}$, particulate matter with equivalent aerodynamic diameters of 2.5μm or less.

PM_{10} particles are generated through various sources, which include but are not limited to, the abrasion or crushing of rock, the general disturbance of dusty material and from pollen generated by trees. Finer particulates, such as $PM_{2.5}$, are more often generated through combustion processes such as wood burning and vehicle exhaust or chemical processes in the atmosphere.

3.2 Nitrogen dioxide

Nitrogen dioxide (NO_2) is reddish-brown in colour (at high concentrations) with a characteristic odour and can irritate the lungs and lower resistance to respiratory infections such as influenza. NO_2 belongs to a family of reactive gases called oxides of nitrogen (NO_X). These gases form when fuel is burned at high temperatures, mainly from motor vehicles, power generators and industrial boilers (**US EPA, 2011**). It is important to note that when formed, NO_2 is generally a small fraction of the total NO_X generated in a combustion process.

3.3 Carbon monoxide

Carbon monoxide (CO) is an odourless, colourless gas. CO can be produced during incomplete combustion of carbon based materials such as fuel, coal or wood etc. It can inhibit the capacity of blood to transport oxygen in humans resulting in symptoms of headache, nausea and fatigue.

3.4 NorthConnex ambient air quality goals

Table 3-1 summarises the ambient air quality goals set out for the Project per Condition E8.

Table 3-1: NorthConnex ambient air quality goals

Pollutant	Averaging Period	Air quality goal
PM_{10}	24-hour	50 μg/m³
$PM_{2.5}$	24-hour	25 μg/m³
NO_2	1-hour	0.12 ppm
CO	8-hour rolling	9 ppm

ppm = parts per million
μg/m³ = micrograms per cubic metre

4   METEOROLOGICAL MONITORING DATA

Representative wind speed and direction data have been obtained from the Project's ambient monitoring stations. The data are presented as a series of windroses. For an example of how to read a windrose, refer to **Figure A-1** in **Appendix A**.

Figure 4-1 presents the windroses for the Project's monitoring stations during the review period. Detailed windroses are provided in **Appendix B.**

It is noted that most of the monitoring stations are positioned in sheltered locations which generally results in lower wind speeds, and broader wind distributions.

The Ashley Avenue monitoring station recorded a predominance of winds from the south. Higher wind speeds were recorded at the station from the north-northeast sector.

The Carden Park monitoring station recorded a high proportion of winds from the south-eastern quadrant.

The predominant wind directions recorded at the Headen Park monitoring station were from the southeast and east-southeast.

The James Park Hornsby monitoring station record predominant winds from the east-northeast, east and east-southeast sectors. Wind speeds at the James Park Hornsby monitoring were typically higher than at the other ambient monitoring stations. This would be expected give the more elevated location with low grassy ground cover nearby that is less sheltered from the prevailing winds relative to the other less elevated locations.

The Larchmont Place monitoring station experienced predominant winds from the southeast with a spread of winds from the east-southeast to the west-southwest.

Thornleigh Golf Centre monitoring station experiences predominant winds from the southeast quadrant and the north-northwest.

Figure 4-1 shows the differences between the distributions of winds at each of the ambient monitoring stations. The variation in localised winds is clear to see, however, the locations also display a similar underlying trend in the wind distribution patterns, with the winds tending to originate more from the south to eastern quadrant during the review period.
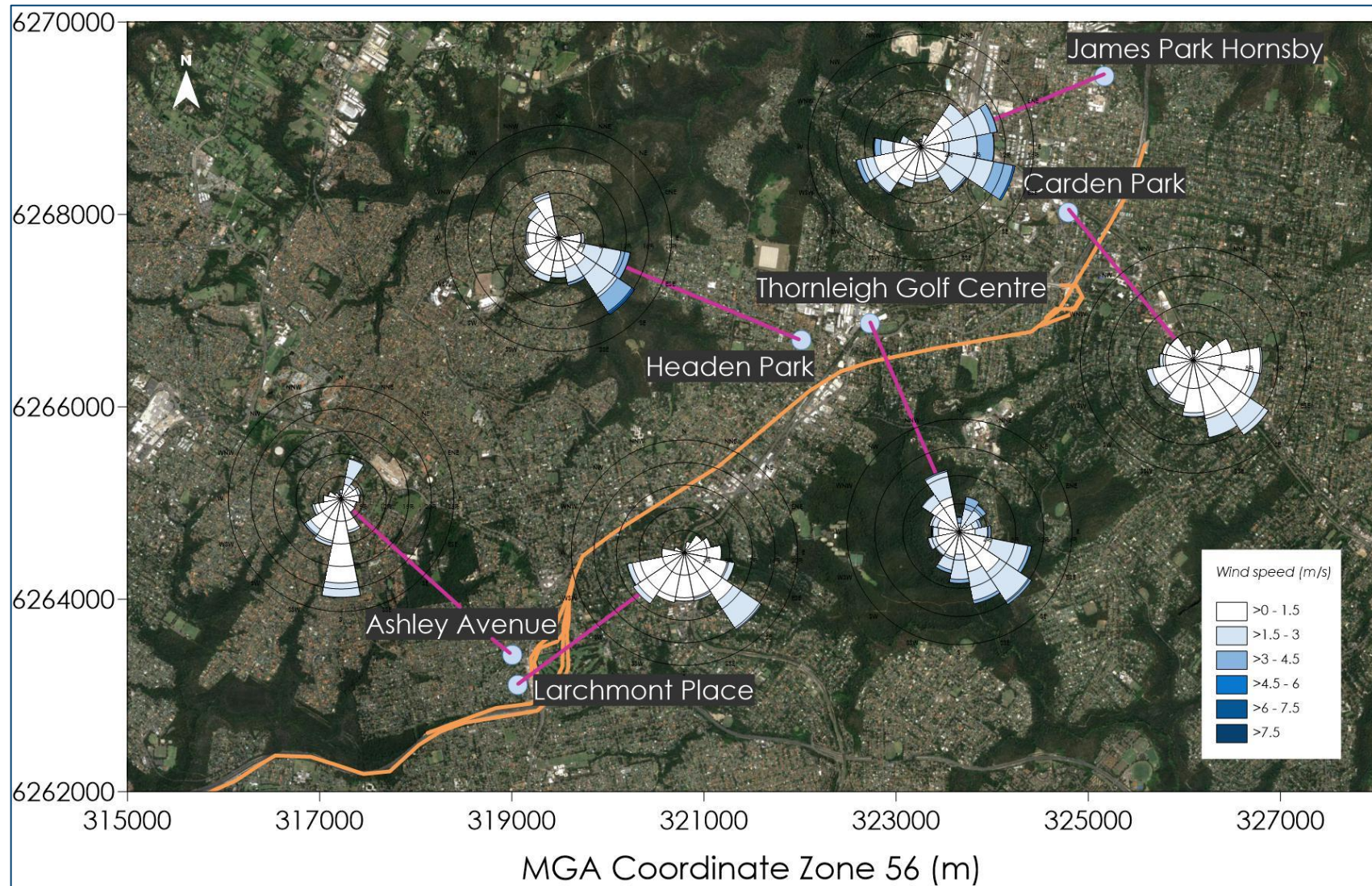
Figure 4-1: Windroses – 1 November 2020 to 30 April 2021

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5 AMBIENT AIR QUALITY MONITORING DATA

The monitoring data in this report are presented as provided to Todoroski Air Sciences.

All of the monitoring data provided to Todoroski Air Sciences are presented in graphical format in **Appendix C**.

It is noted that small negative concentration readings are due to the instrument noise at low/zero concentration levels and are a normal part of the operation of gas and particulate analysers and are thus considered to be valid data for reporting purposes. This is especially the case for short term readings (e.g., 5-minutes) and generally does not arise often for averaging periods of longer than an hour. When hourly particulate matter data shows negative readings they often coincide with high moisture or rainfall conditions.

Table 5-1 presents a summary of the measured pollutant levels occurring during the review period from 1 November 2020 and 30 April 2021.

The data in **Table 5-1** indicates:

- The recorded PM_{10}, NO_2 and CO levels were below the relevant air quality goal during the review period.

- All monitors, except Larchmont Place, recorded one 24-hour average $PM_{2.5}$ level above the respective daily air quality goal of $25\mu g/m^3$ during the review period.

Table 5-2 presents the percentage of data capture available over the review period. There was greater than 90% capture rate for all pollutants at all monitors over the review period with the exception of NO_2 at the Thornleigh Golf Centre which over the six-month review period only recorded approximately 86.1%.

The aim is to achieve an annual valid data capture rate of 90% or higher. This could be achieved if the next six-month period data capture rate was to be approximately 94% or higher. Allowing for necessary down time for calibrations, servicing etc., this is achievable.

Table 5-1: Summary of measured pollutant levels for review period

Site	PM$_{2.5}$ (µg/m³) 24-hour average	PM$_{10}$ (µg/m³) 24-hour average	NO$_2$ (ppm) 1-hour average	CO (ppm) 8-hour rolling average
	NorthConnex Ambient Air Quality Goal			
	25	**50**	**0.12**	**9**
Maximum pollutant level				
Ashley Avenue	**26.4**	40.9	0.04	0.5
Carden Park	**30.8**	39.4	0.04	0.6
Headen Park	**25.1**	38.9	0.03	0.6
James Park Hornsby	**38.5**	41.0	0.04	0.8
Larchmont Place	21.0	39.8	0.04	0.6
Thornleigh Golf Centre	**41.3**	40.8	0.03	0.7
Minimum pollutant level				
Ashley Avenue	-0.3	5.0	0.001	0.0
Carden Park	-0.9	5.5	0.001	0.00
Headen Park	0.4	4.9	0.001	-0.06
James Park Hornsby	-4.5	4.5	0.001	-0.01
Larchmont Place	-0.8	4.8	0.001	-0.07
Thornleigh Golf Centre	0.0	5.4	0.001	-0.01
Number of times recorded above criterion				
Ashley Avenue	1	0	0	0
Carden Park	1	0	0	0
Headen Park	1	0	0	0
James Park Hornsby	1	0	0	0
Larchmont Place	0	0	0	0
Thornleigh Golf Centre	1	0	0	0
6 Month average pollutant level				
Ashley Avenue	7.0	15.9	0.01	0.1
Carden Park	5.4	16.4	0.01	0.1
Headen Park	8.1	15.9	0.01	0.1
James Park Hornsby	3.8	16.7	0.01	0.1
Larchmont Place	5.3	15.8	0.01	0.1
Thornleigh Golf Centre	8.1	17.3	0.01	0.2
Rolling Annual Average				
Ashley Avenue	6.3	14.1	0.01	0.2
Carden Park	5.3	14.4	0.01	0.2
Headen Park	6.7	14.2	0.01	0.2
James Park Hornsby	4.3	14.5	0.01	0.2
Larchmont Place	5.2	13.9	0.01	0.2
Thornleigh Golf Centre	8.5	17.3	0.01	0.2

Table 5-2: Percentage of data capture available for the review period

Site	Data Capture %			
	PM$_{2.5}$	PM$_{10}$	NO$_2$	CO
Ashley Avenue	92.8	95.6	93.1	95.8
Carden Park	97.2	97.2	93.1	93.6
Headen Park	98.3	98.3	94.7	95.2
James Park Hornsby	96.7	97.2	94.2	93.4
Larchmont Place	97.8	97.8	94.2	97.1
Thornleigh Golf Centre	97.2	95.6	86.1	96.5

5.1 PM$_{2.5}$ monitoring data

Figure 5-1 presents the 24-hour average PM$_{2.5}$ monitoring data recorded during the review period. The data indicate that 24-hour average PM$_{2.5}$ levels were above the respective air quality goal of 25μg/m^3 on one occasion during the review period at 5 of the 6 monitor locations.

The elevated results occurred on 27 April 2021 at Ashley Avenue and on 29 April 2021 at Carden Park, Headen Park, James Park Hornsby and Thornleigh Golf Centre. The 24-hour average level exceedances have been reported in their respective monthly validation monitoring reports.

Figure 5-1 shows a trend of increasing concentrations towards the end of April 2021. It is understood that Sydney was impacted by smoke associated with hazard reduction burns during this time.

5.2 PM$_{10}$ monitoring data

Figure 5-2 presents the 24-hour average PM$_{10}$ monitoring results recorded during the review period. The data indicate that 24-hour PM$_{10}$ levels were below the respective air quality goal of 50μg/m^3 during the review period.

5.3 NO$_2$ monitoring data

Figure 5-3 presents the 1-hour average NO$_2$ monitoring data recorded for the Project during the review period. The data indicate the NO$_2$ levels were below the relevant air quality goal of 0.12ppm during the review period.

5.4 CO monitoring data

Figure 5-4 presents the 8-hour rolling average CO monitoring data recorded for the Project during the review period. The data indicate the CO levels were well below the relevant air quality goal of 9ppm during the review period.
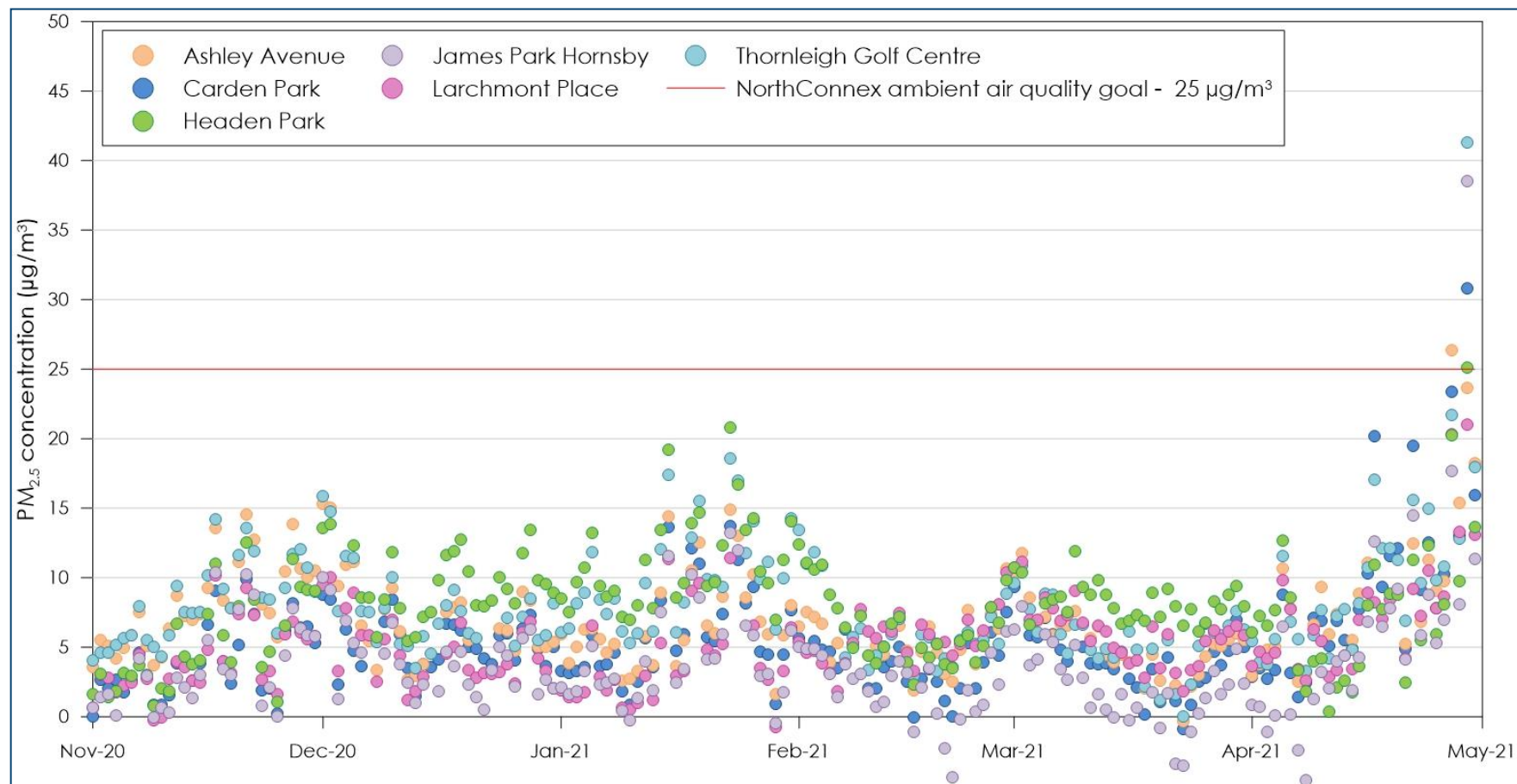
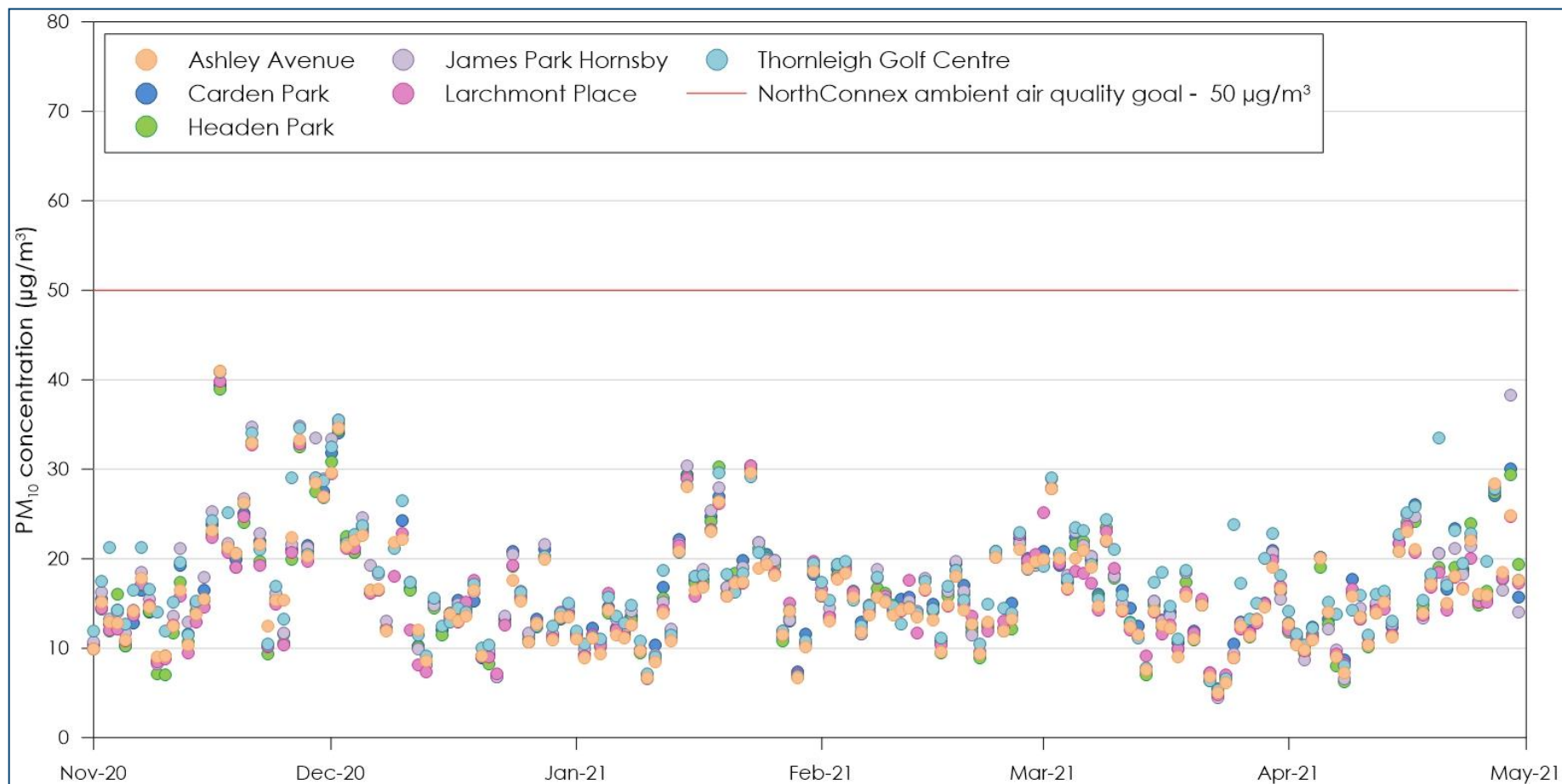**Figure 5-1: 24-hour average PM$_{2.5}$ levels**

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Figure 5-2: 24-hour average PM$_{10}$ levels
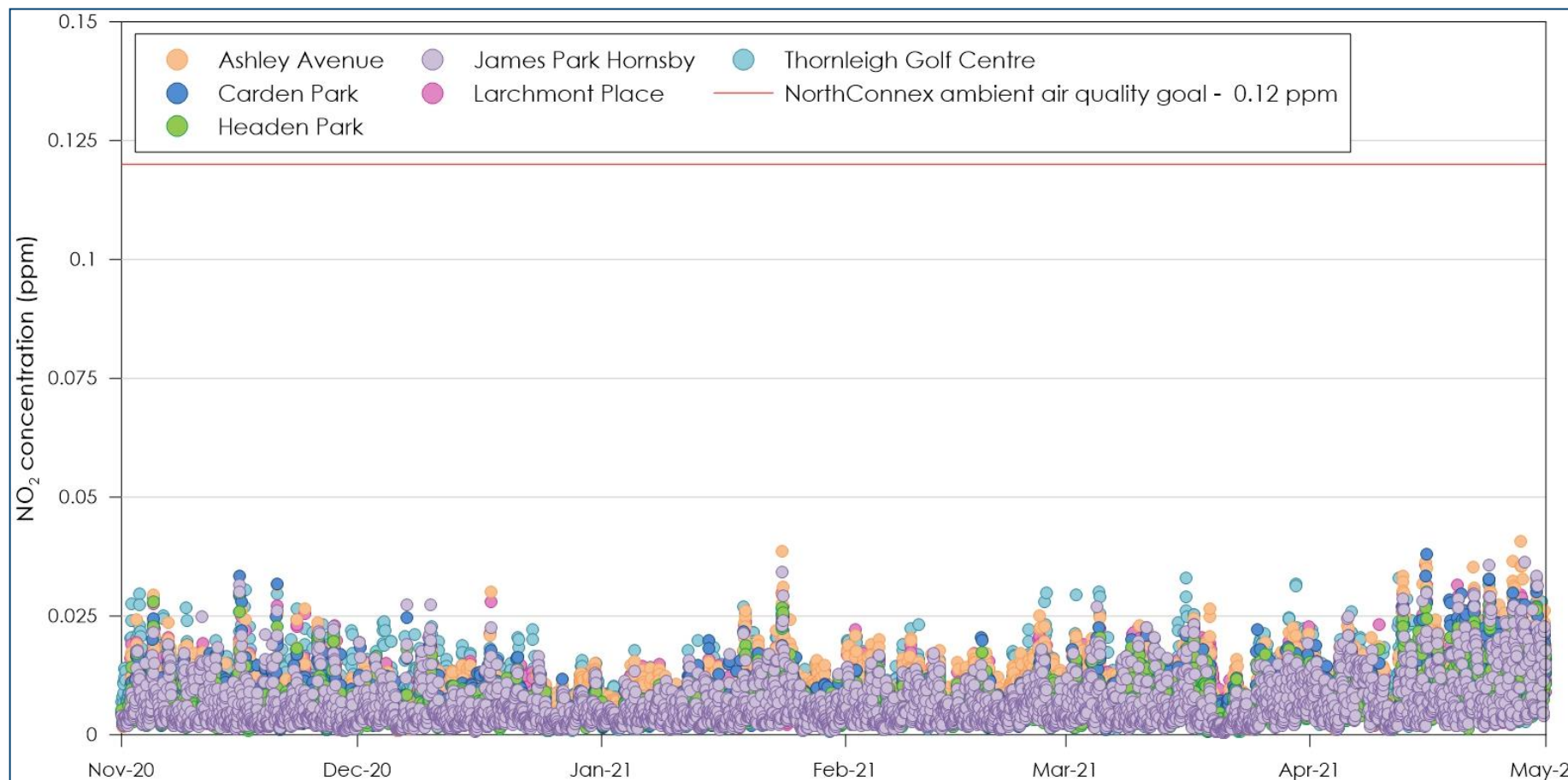
Figure 5-3: 1-hour average NO₂ levels
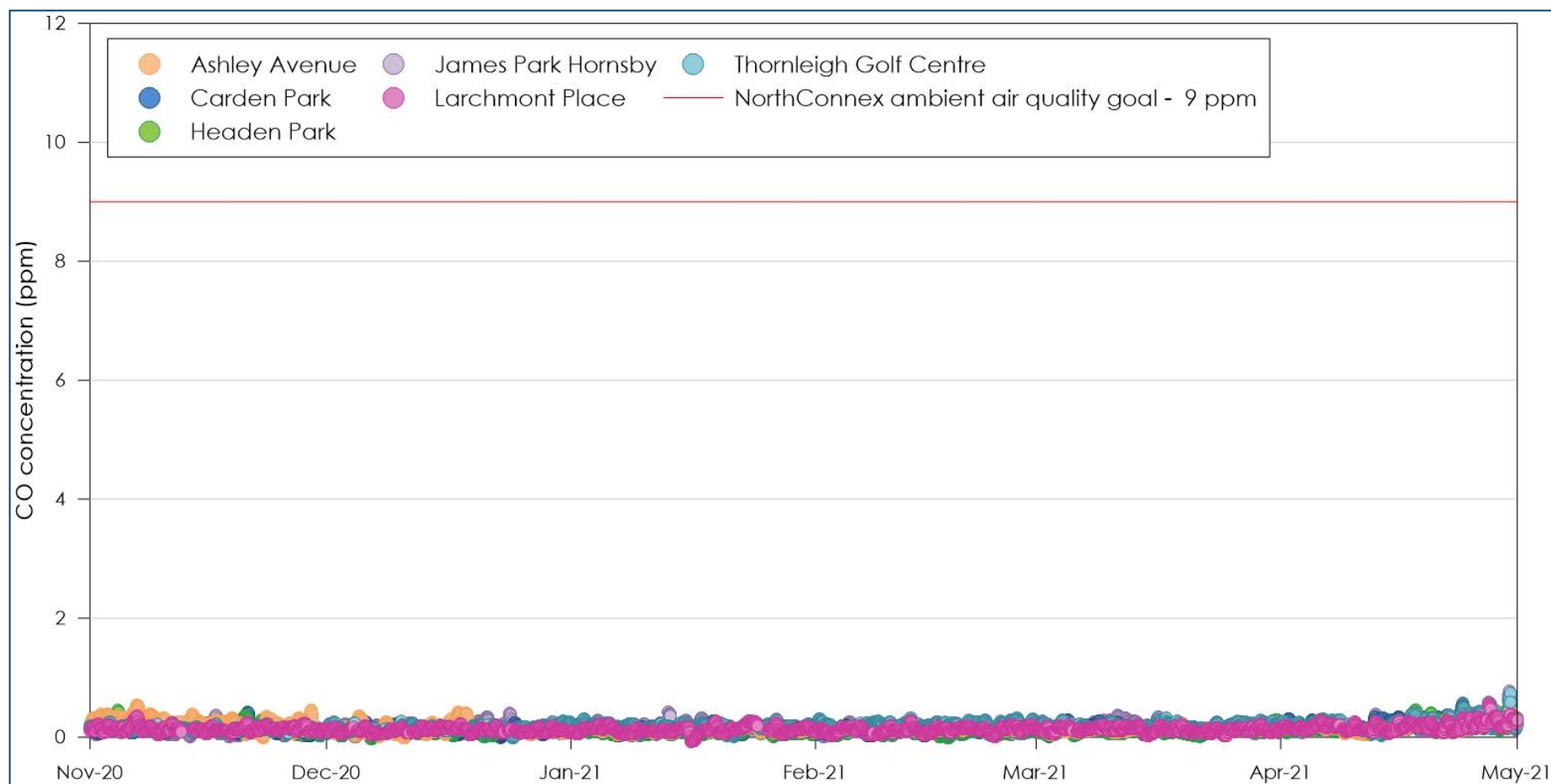
Figure 5-4: 8-hour rolling average CO levels

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6 DISCUSSION AND RECOMMENDATIONS

Todoroski Air Sciences have conducted an independent audit of the ambient air quality monitoring data collected for the NorthConnex Project.

The recorded ambient air quality monitoring data between 1 November 2020 and 30 April 2021 were generally below their respective ambient air quality goals as outlined in **Table 3-1**.

Exceedances for the 24-hour average $PM_{2.5}$ goal of 25µg/m^3 have been reported in their respective monthly validation monitoring reports. Elevated 24-hour average $PM_{2.5}$ levels recorded at the end of April appear to be impacted by smoke from hazard reduction burns.

24-hour PM_{10}, 1-hour average NO_2 levels and 8-hour rolling CO levels during the review period were below their respective air quality goals.

7 REFERENCES

ACOEM Ecotech (2020)

"NorthConnex Ambient Air Quality and Weather Monitoring Validated Report 1st November to 30th November 2020", prepared by Ecotech Pty Ltd (Ecotech) for Lendlease Bouygues Joint Venture, December 2020

ACOEM Ecotech (2021a)

"NorthConnex Ambient Air Quality and Weather Monitoring Validated Report 1st December to 31st December 2020", prepared by Ecotech Pty Ltd (Ecotech) for Lendlease Bouygues Joint Venture, January 2021

ACOEM Ecotech (2021b)

"NorthConnex Ambient Air Quality and Weather Monitoring Validated Report 1st January to 31st January 2021", prepared by Ecotech Pty Ltd (Ecotech) for Lendlease Bouygues Joint Venture, February 2021

ACOEM Ecotech (2021c)

"NorthConnex Ambient Air Quality and Weather Monitoring Validated Report 1st Februrary to 28th February 2021", prepared by Ecotech Pty Ltd (Ecotech) for Lendlease Bouygues Joint Venture, March 2021

ACOEM Ecotech (2021d)

"NorthConnex Ambient Air Quality and Weather Monitoring Validated Report 1st March to 31st March 2021", prepared by Ecotech Pty Ltd (Ecotech) for Lendlease Bouygues Joint Venture, April 2021

ACOEM Ecotech (2021e)

"NorthConnex Ambient Air Quality and Weather Monitoring Validated Report 1st April to 30th April 2021", prepared by Ecotech Pty Ltd (Ecotech) for Lendlease Bouygues Joint Venture, May 2021

US EPA (2011)

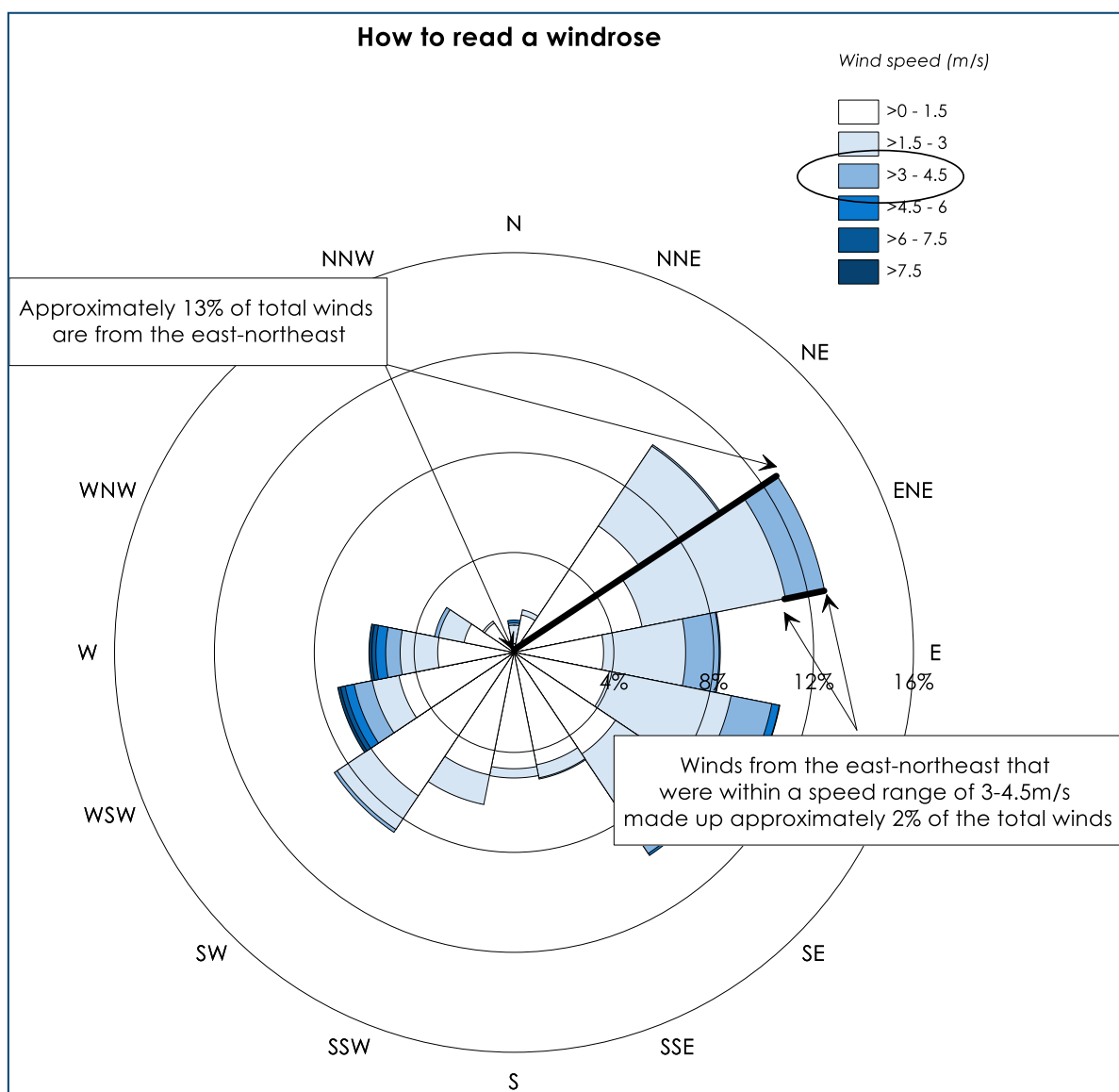"Health Effects of Pollution", United States Environmental Protection Agency website http://www.epa.gov/region07/air/quality/health.htm, 2011

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Appendix A

   How to Read a Windrose

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How to read a windrose

Figure A-1: How to read a windrose

Appendix B
   Windroses

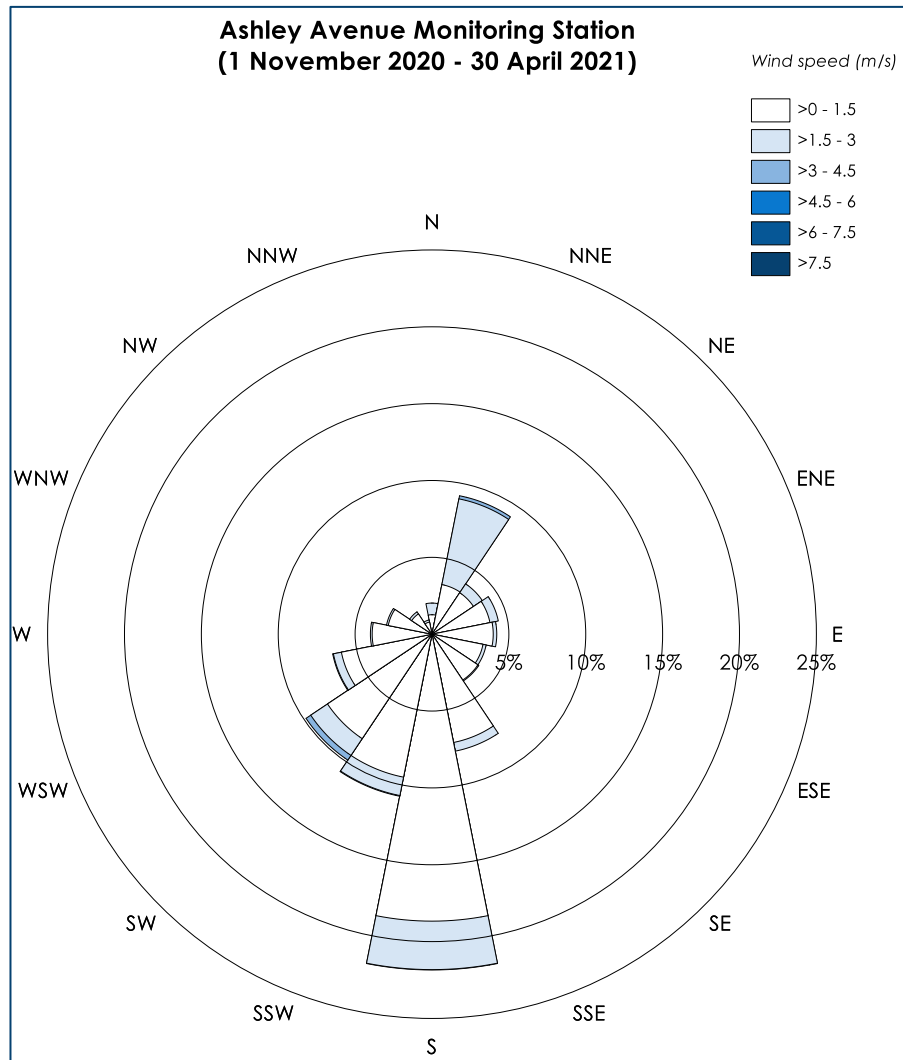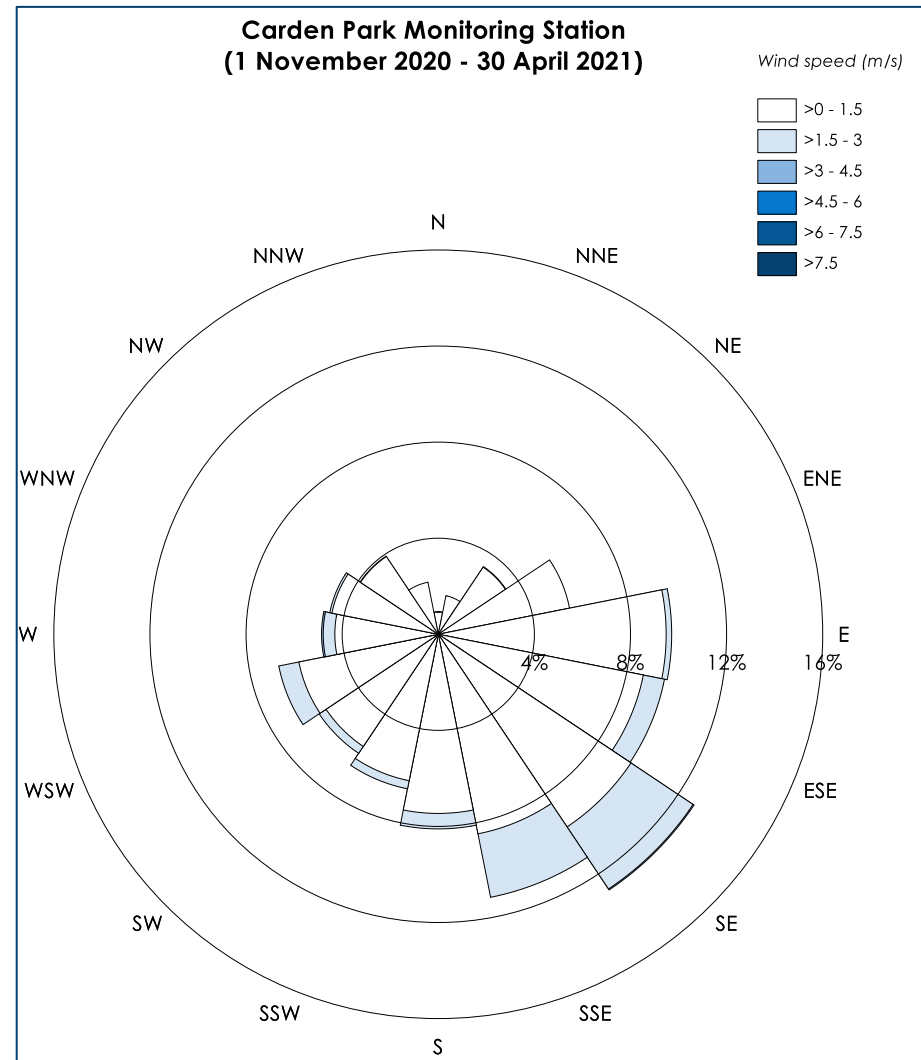TODOROSKI AIR SCIENCES | info@airsciences.com.au | 02 9874 2123

Figure B-1: Ashley Avenue windrose – 1 November 2020 to 30 April 2021

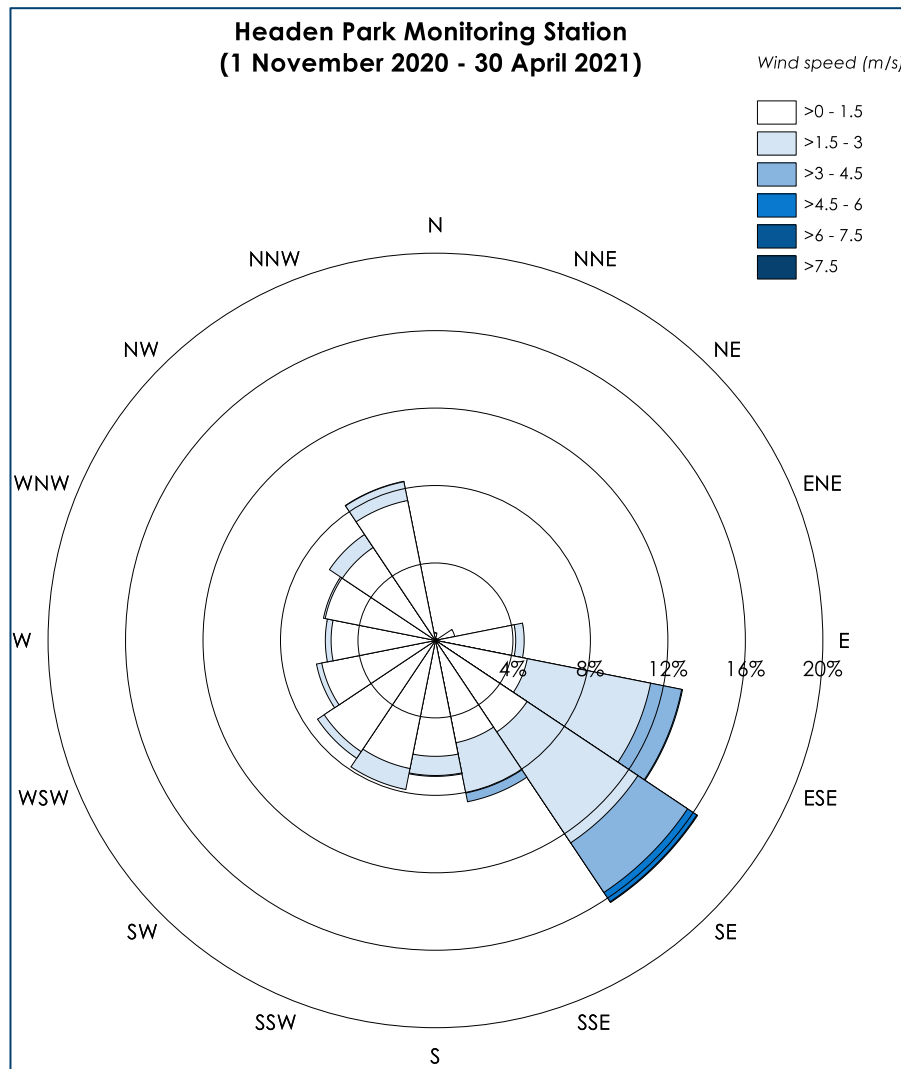**Figure B-2: Carden Park windrose – 1 November 2020 to 30 April 2021**
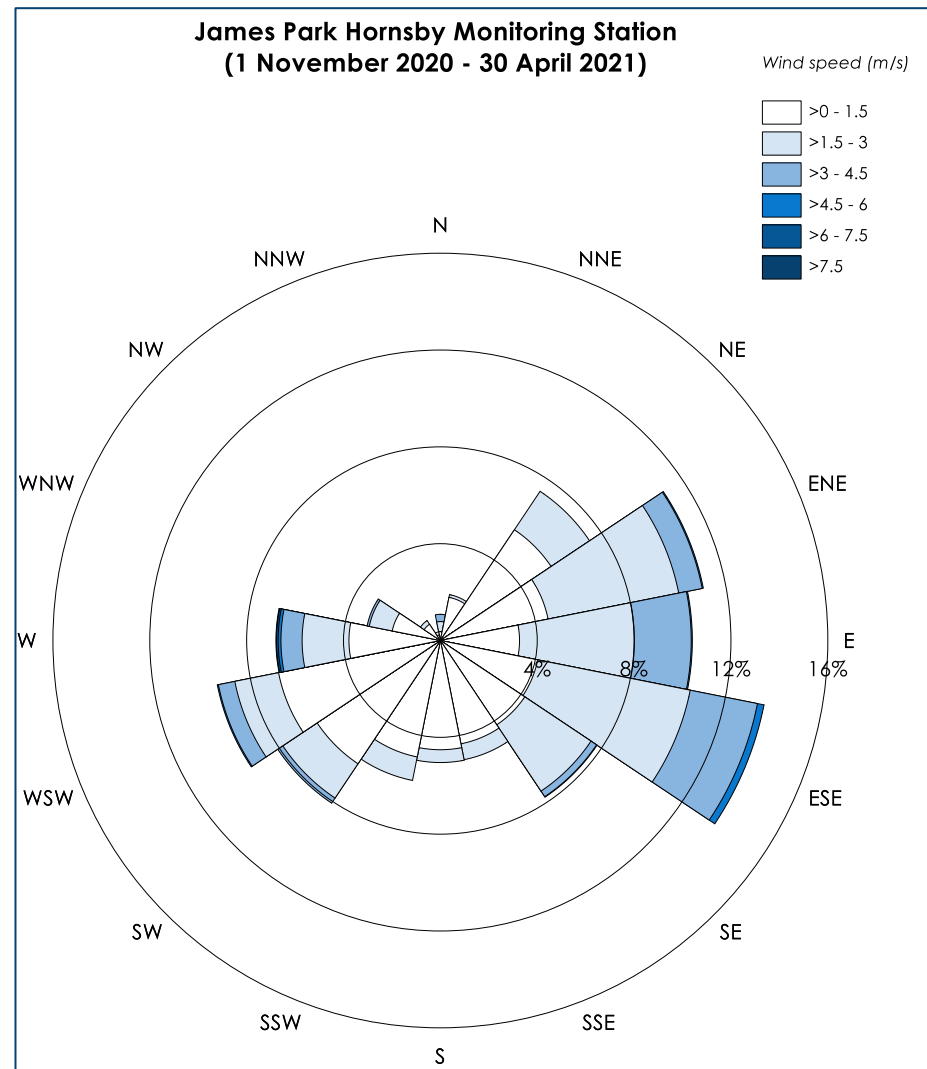
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Headen Park Monitoring Station
(1 November 2020 - 30 April 2021)

Wind speed (m/s)

>0 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5

Figure B-3: Headen Park windrose – 1 November 2020 to 30 April 2021

James Park Hornsby Monitoring Station
(1 November 2020 - 30 April 2021)

Wind speed (m/s)

>0 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5

Figure B-4: James Park Hornsby windrose – 1 November 2020 to 30 April 2021

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Larchmont Place Monitoring Station
(1 November 2020 - 30 April 2021)

Wind speed (m/s)

> >0 - 1.5
> >1.5 - 3
> >3 - 4.5
> >4.5 - 6
> >6 - 7.5
> >7.5

Thornleigh Golf Centre Monitoring Station
(1 November 2020 - 30 April 2021)

Wind speed (m/s)

> >0 - 1.5
> >1.5 - 3
> >3 - 4.5
> >4.5 - 6
> >6 - 7.5
> >7.5
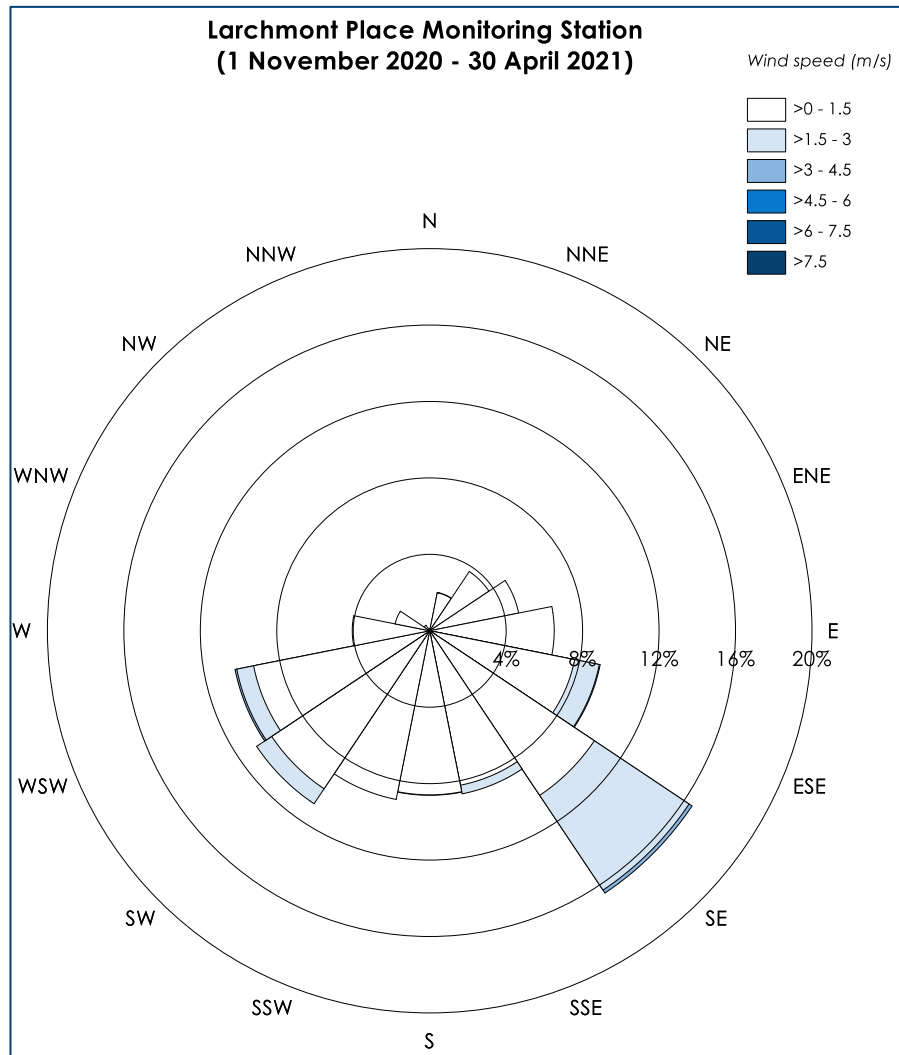
Figure B-5: Larchmont Place windrose – 1 November 2020 to 30 April 2021
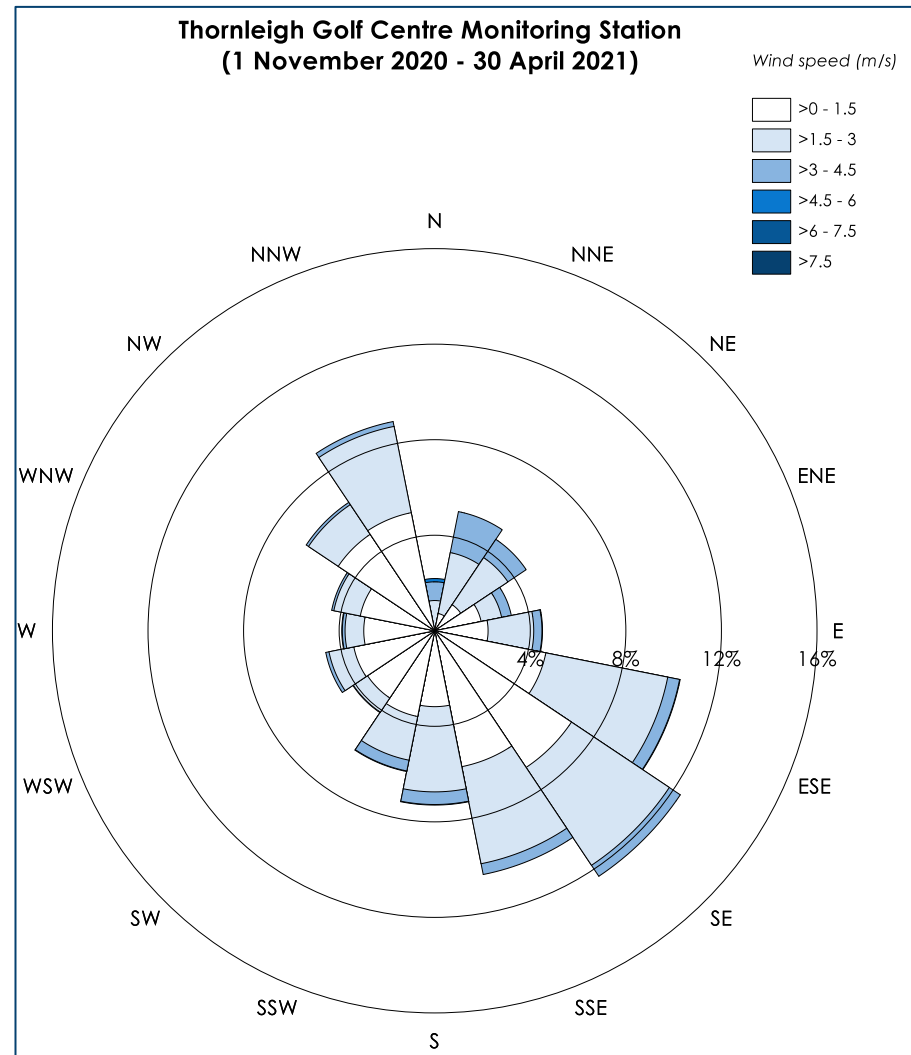
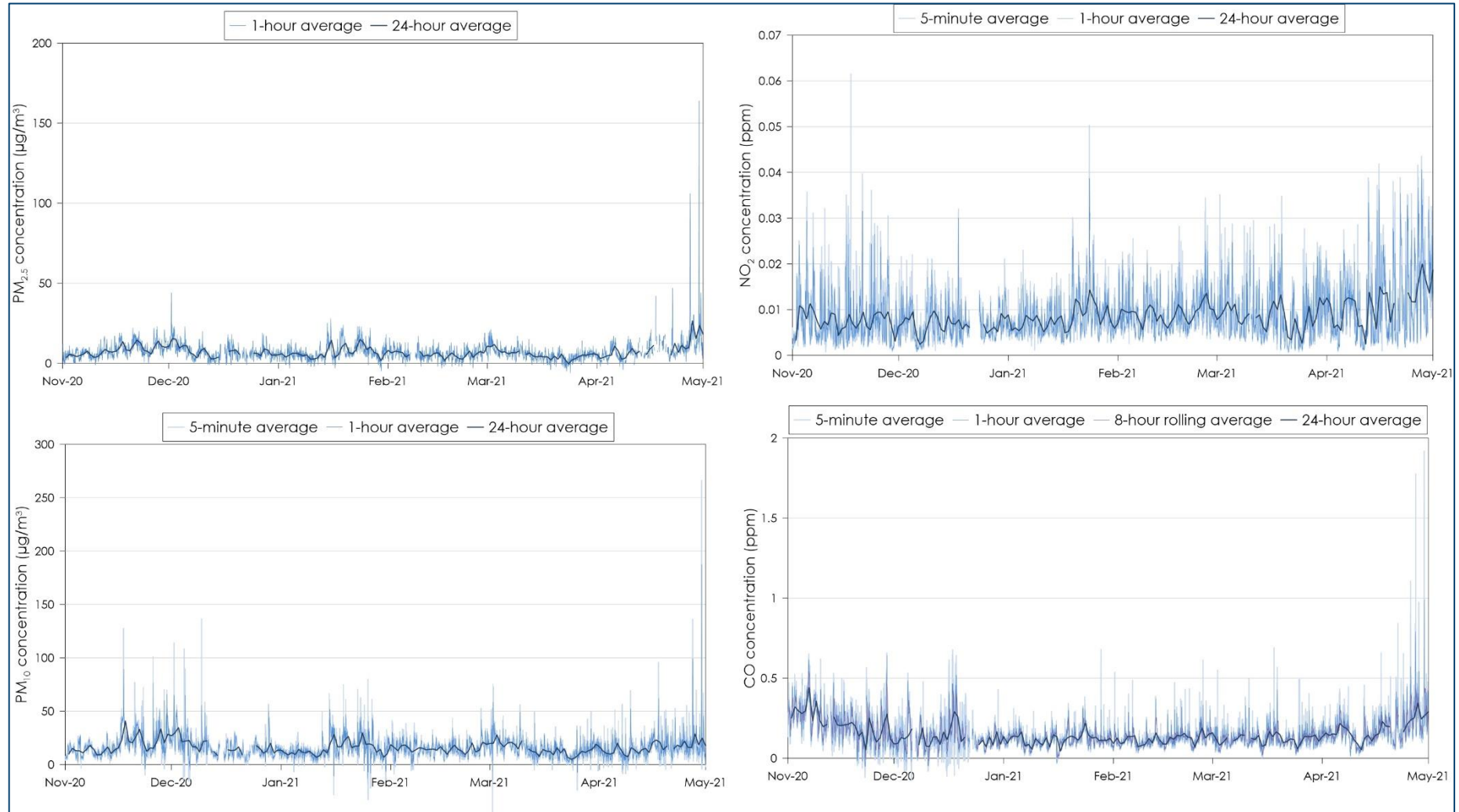**Figure B-6: Thornleigh Golf Centre windrose – 1 November 2020 to 30 April 2021**

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Appendix C

Monitoring Data (Graphical)

Figure C-1: Ashley Avenue monitoring data
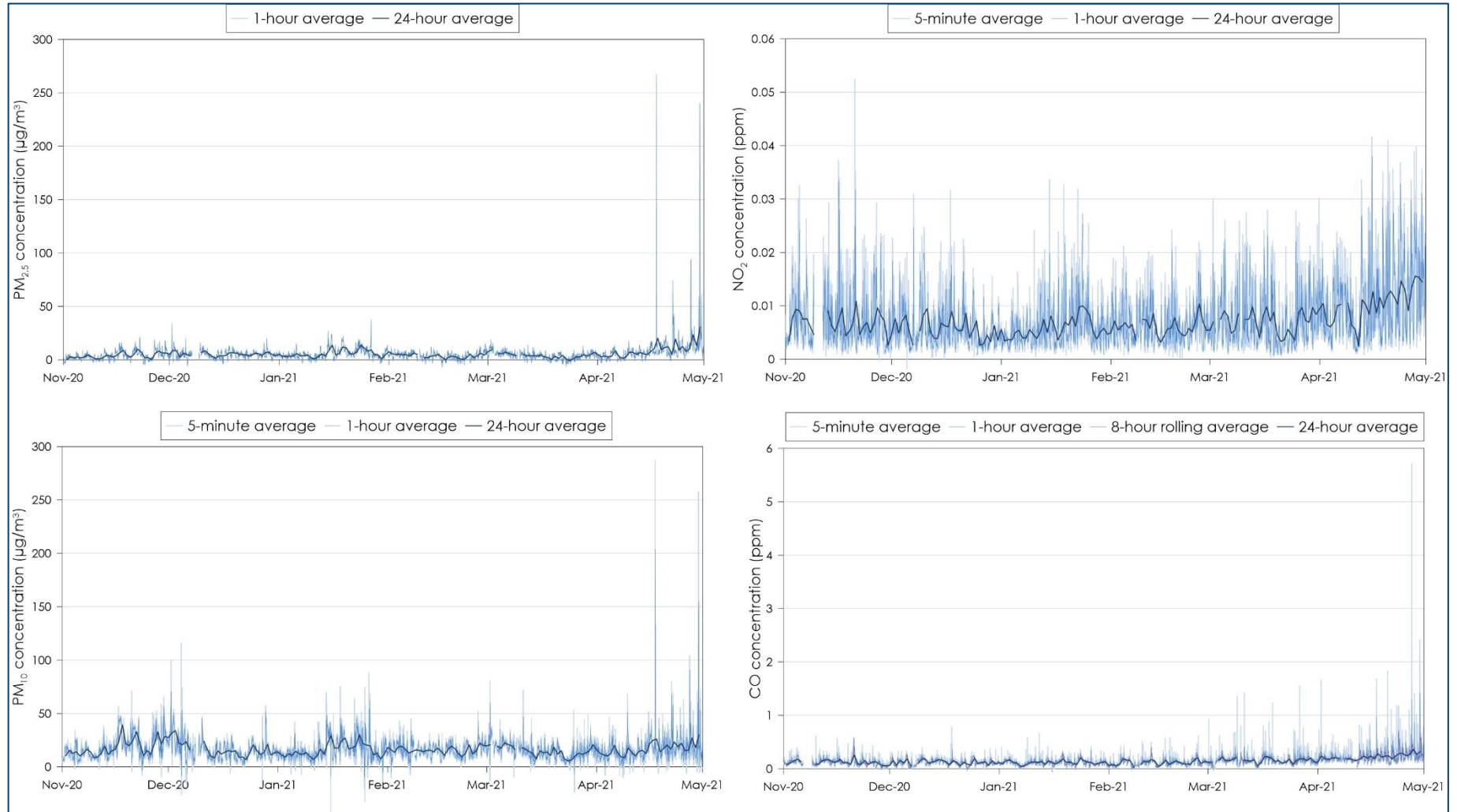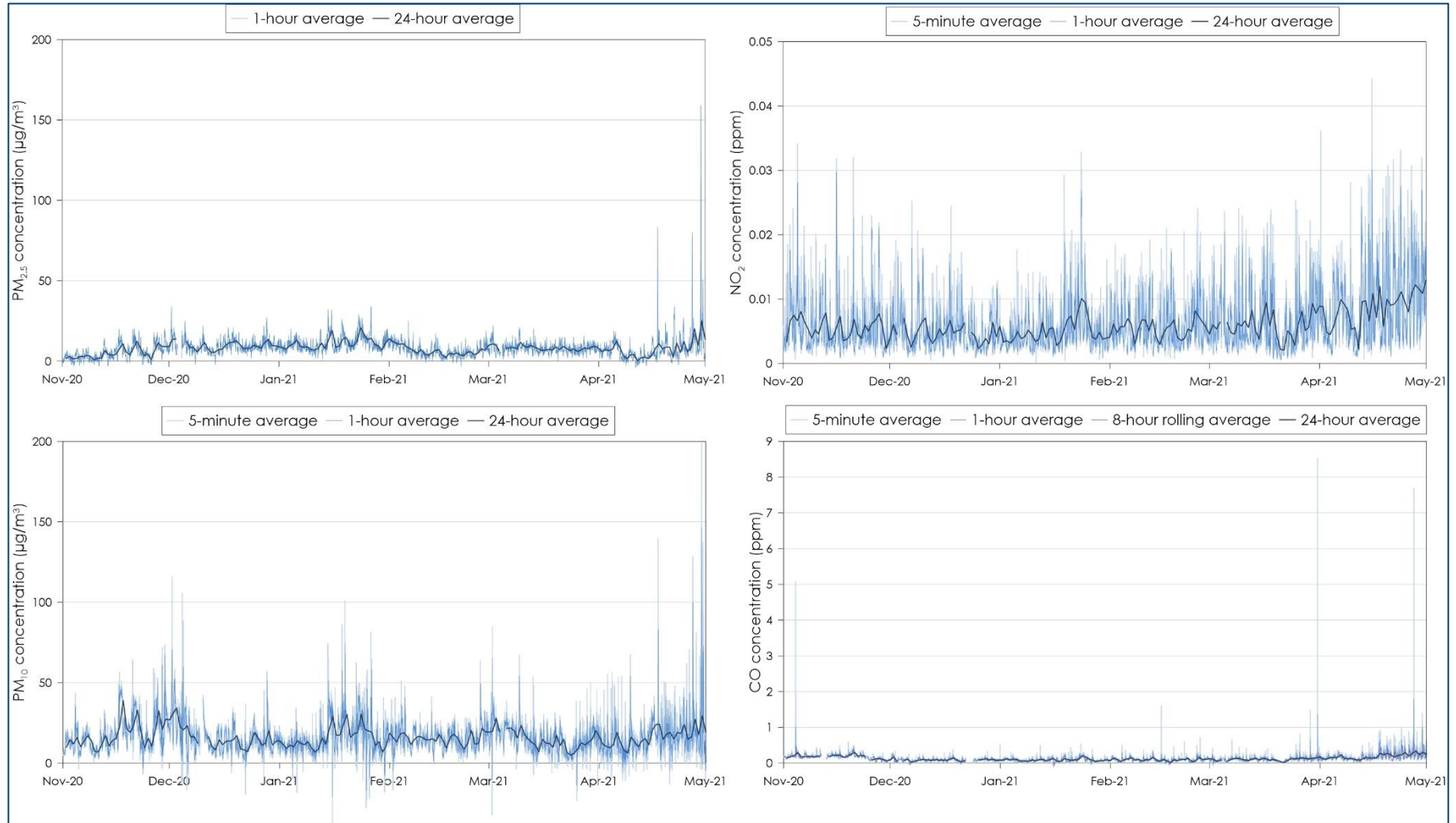
Figure C-2: Carden Park monitoring data

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Figure C-3: Headen Park monitoring data

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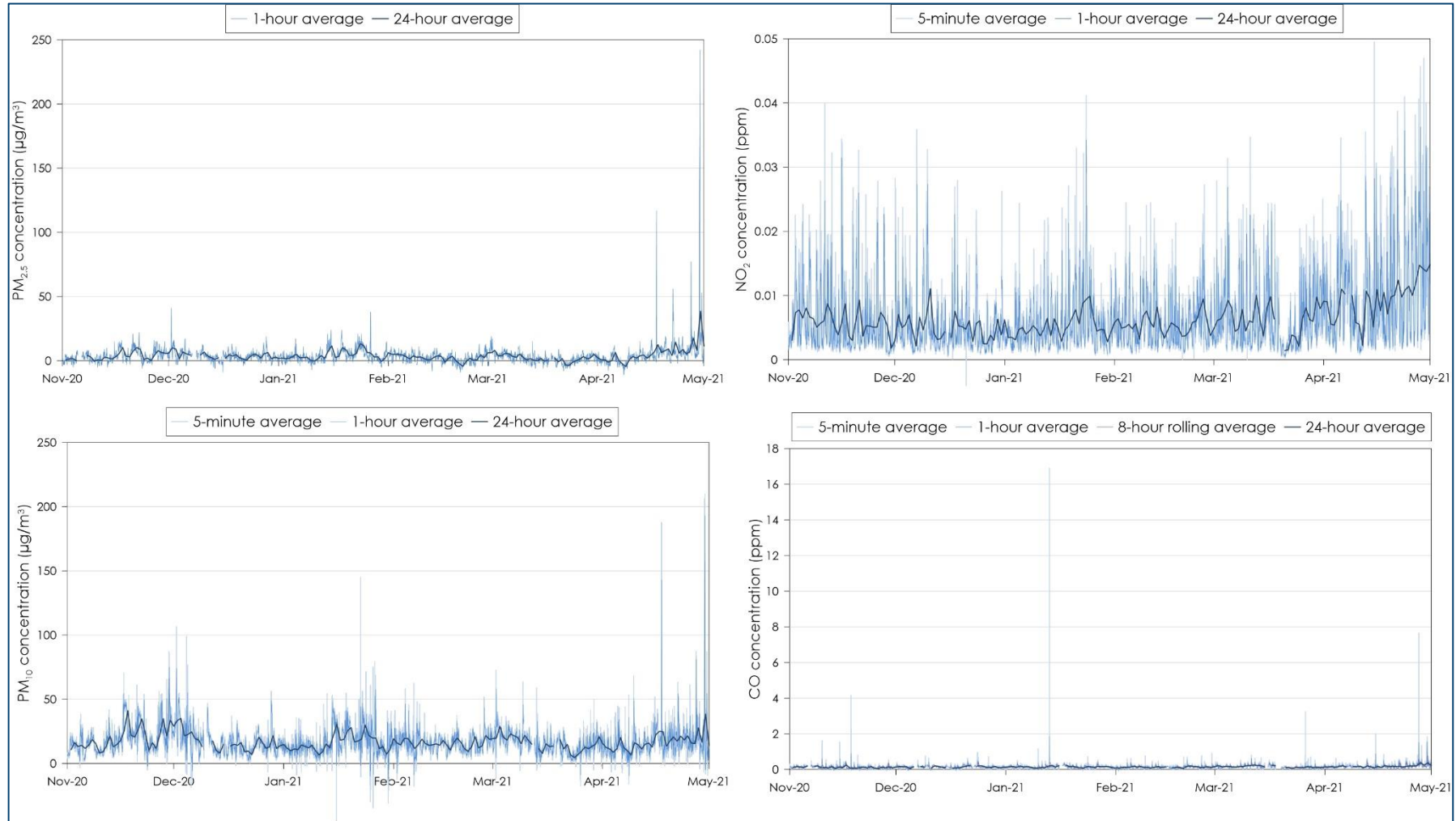
Figure C-4: James Park Hornsby monitoring data
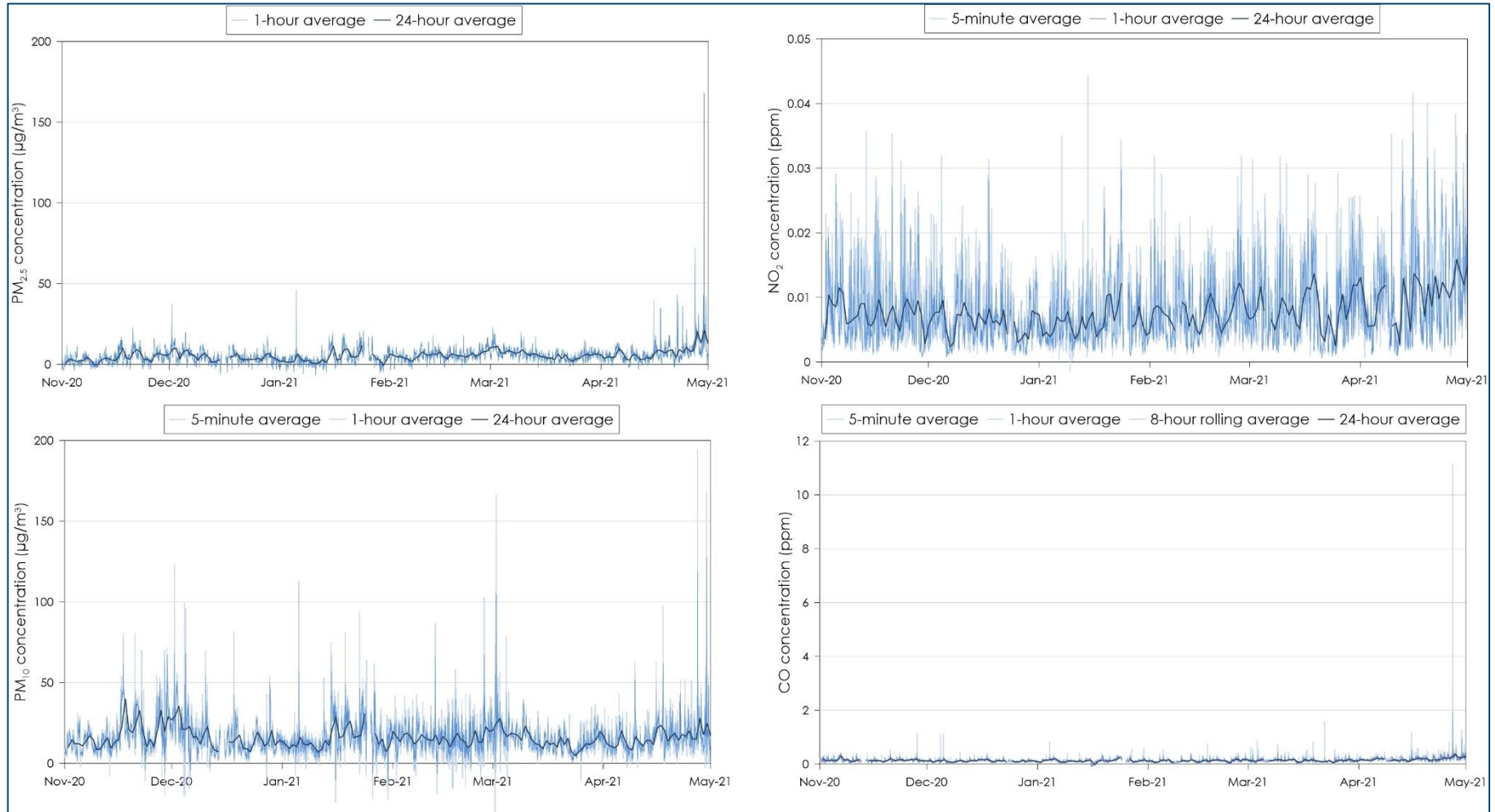
Figure C-5: Larchmont Place monitoring data

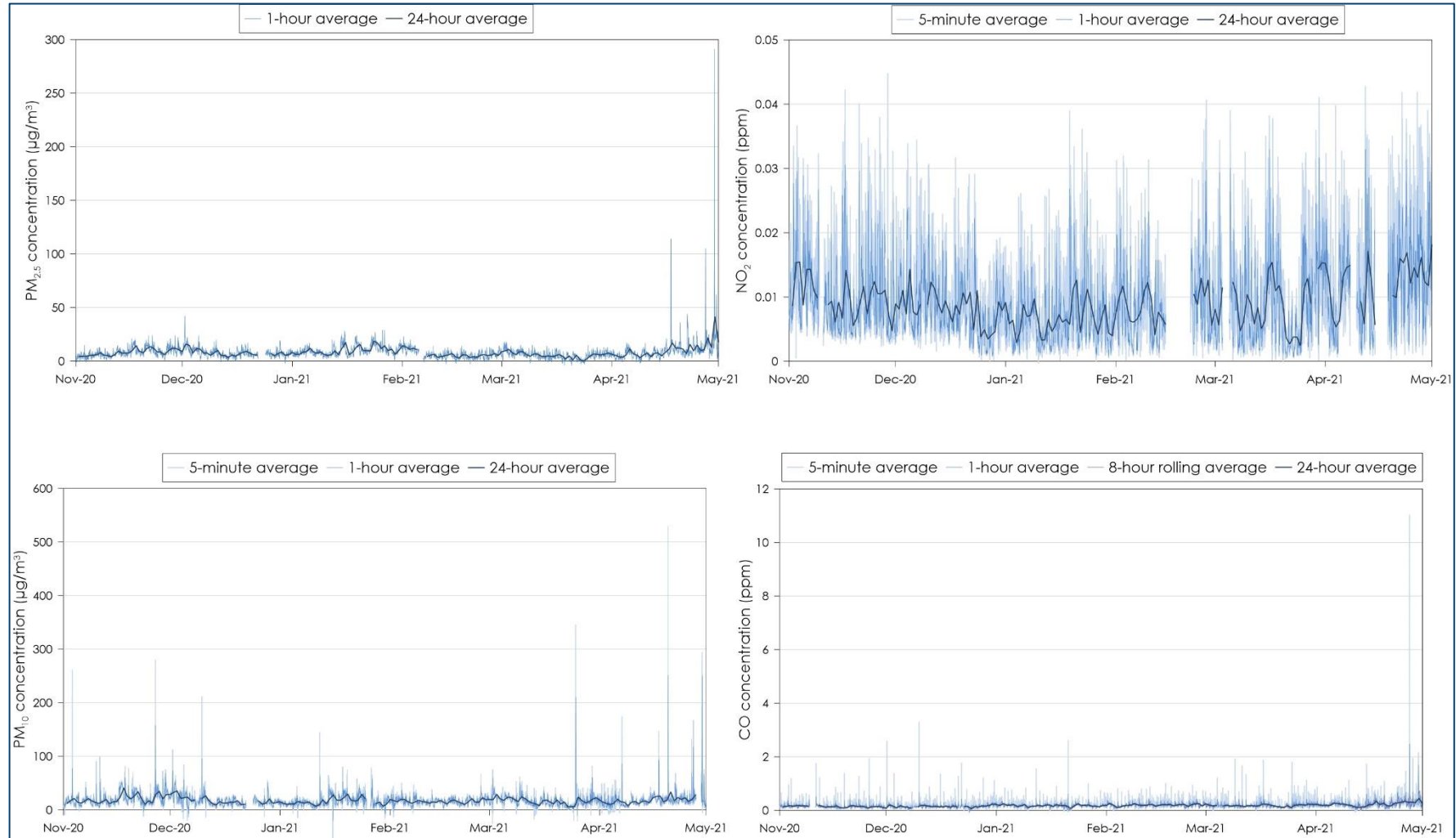TODOROSKI AIR SCIENCES | info@airsciences.com.au | O2 9874 2123

Figure C-6: Thornleigh Golf Centre monitoring data

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