

**REPORT**

# Ambient Air Quality Monitoring (AAQM) Report

## August - September 2018

*West Gate Tunnel Project*

Submitted to:

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## Executive Summary

Air quality monitoring for the West Gate Tunnel Project has been specifically established to develop a “baseline” of data from current local conditions. This baseline will be used to measure any changes once the tunnel opens in 2022. When the project opens, air quality monitoring will continue for up to 5 years.

The results of the West Gate Tunnel Project Ambient Air Quality Monitoring (AAQM) program for the period of 23 August 2018 to 30 September 2018 are presented below.

The following tables present the maximum measured concentration for each parameter at Stations 1, 2, 3, 4 and 5 during the reporting period. The maximum concentration for each parameter is compared with the respective objective. Station 6 at Millers Road was not commissioned at the time of reporting and will be reported in subsequent reports.

### Station 1 Summary September 2018

Parameter	Units	Averaging period	Maximum concentration	Air quality objective <sup>A</sup>	Exceedances
PM <sub>2.5</sub>	ug/m <sup>3</sup>	24 hour	25	25	Nil
PM <sub>10</sub>	ug/m <sup>3</sup>	24 hour	35	50	Nil

Note:

A - SEPP(AAQ) objective

### Station 2, Station 3 and Station 5 Summary September 2018

Parameter	Units	Averaging period	Maximum concentration			Air quality objective <sup>A</sup>	Exceedances
			Station 2	Station 3	Station 4		
PM <sub>2.5</sub>	ug/m <sup>3</sup>	24 hour	22	19	19	36	Nil
PM <sub>10</sub>	ug/m <sup>3</sup>	24 hour	29	28	31	60	Nil

Note:

A - SEPP(AQM) Intervention level

### Station 4 Summary – August 2018

Parameter	Units	Averaging period	Maximum concentration	Air quality objective	Exceedances
PM <sub>2.5</sub>	ug/m <sup>3</sup>	24 hour	13	36 <sup>A</sup>	Nil
PM <sub>10</sub>	ug/m <sup>3</sup>	24 hour	37	60 <sup>A</sup>	Nil
NO <sub>2</sub>	ppb	1 hour	41	140 <sup>A</sup>	Nil
CO	ppm	1 hour	0.7	29 <sup>A</sup>	Nil
Benzene	ppb	24 hour	0.8	3.0 <sup>B</sup>	Nil
Toluene	ppb	24 hour	3.2	1000 <sup>B</sup>	Nil
Total xylene isomers	ppb	24 hour	2.2	250 <sup>B</sup>	Nil

Note:

B - SEPP(AQM) Intervention level

A - Air NEPM Monitoring investigation level

The September ambient air quality monitoring programme results for this report period were less than the respective objectives for all parameters measured.

Data capture statistics for the reporting period 22 August to 30 September 2018 were above 90 percent for Station 3 and Station 4. Station 2 and 5 were below 90 percent data capture due to the power company disconnecting power supply. Station 1 was above 90 percent data capture for PM<sub>2.5</sub> and below 90 percent for PM<sub>10</sub>. Collected periods are not consistent for each measured parameter primarily due to the commissioning dates.

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Important Information Relating To This Report



## 1.0 INTRODUCTION

Air quality monitoring for the West Gate Tunnel Project has been specifically established to develop a “baseline” of data from current local conditions. This baseline will be used to measure any changes once the tunnel opens in 2022. When the project opens, air quality monitoring will continue for up to 5 years.

The results of the West Gate Tunnel Project West Gate Tunnel Project Ambient Air Quality Monitoring (AAQM) program for the period of 23 August 2018 to 30 September 2018 are contained in the following report.

The AAQM program was conducted in accordance with the Environmental Performance Requirement (EPR) AQP4 for the Project and consists of six AAQM stations (AAQMS) monitoring the following ambient air quality indicators:

- continuous measurement of particulate matter with an equivalent aerodynamic diameter less than 10 microns (PM<sub>10</sub>)
- continuous measurement of particulate matter with an equivalent aerodynamic diameter less than 2.5 microns (PM<sub>2.5</sub>)
- continuous measurement of wind speed and wind direction.

Additionally, one of the specified AAQMS (Primula Avenue) monitors the following additional air quality indicators in combination with PM<sub>10</sub> and PM<sub>2.5</sub>:

- continuous monitoring of oxides of nitrogen ([NO<sub>x</sub>] comprising of nitrogen dioxide (NO<sub>2</sub>) and nitric oxide [NO])
- continuous monitoring of carbon monoxide (CO)
- one in six day monitoring of benzene, toluene, ethylbenzene and xylene isomers (BTEX).

AAQMS Station 1 to Station 5 were installed and commissioned during the period 22/08/2018 to 31/08/2018. AAQMS Station 6 at Millers Road was not commissioned at the time of reporting. Specific installation dates can be found below in Section 2.1.

Details of the air quality indicators monitored at each AAQMS are provided in Table 1.

**Table 1: AAQMS monitoring details**

Site name	Location	Coordinates	Monitoring parameters
Station 1	Barbara Beyer Reserve, 2 Harris Street, Yarraville	-37.812730°S 144.900017°E	PM <sub>10</sub> and PM <sub>2.5</sub> Wind speed & direction
Station 2	51-53 Francis Street	-37.821800°S 144.894383°E	PM <sub>10</sub> and PM <sub>2.5</sub> Wind speed & direction
Station 3	Railway Reserve, Wood Street	-37.814063°S 144.891320°E	PM <sub>10</sub> and PM <sub>2.5</sub> Wind speed & direction
Station 4	44 Primula Avenue, Brooklyn	-37.826442°S 144.882133°E	PM <sub>10</sub> and PM <sub>2.5</sub> Wind speed & direction NO, NO <sub>2</sub> , NO <sub>x</sub> and CO BTEX – one in six day sampling (24 hour average)

Site name	Location	Coordinates	Monitoring parameters
Station 5	Donald McLean Reserve, Spotswood	-37.824284°S 144.846425°E	PM <sub>10</sub> and PM <sub>2.5</sub> Wind speed & direction
Station 6	44 Millers Road Brooklyn	-37.821252°S 144.848878°E	PM <sub>10</sub> and PM <sub>2.5</sub> Wind speed & direction

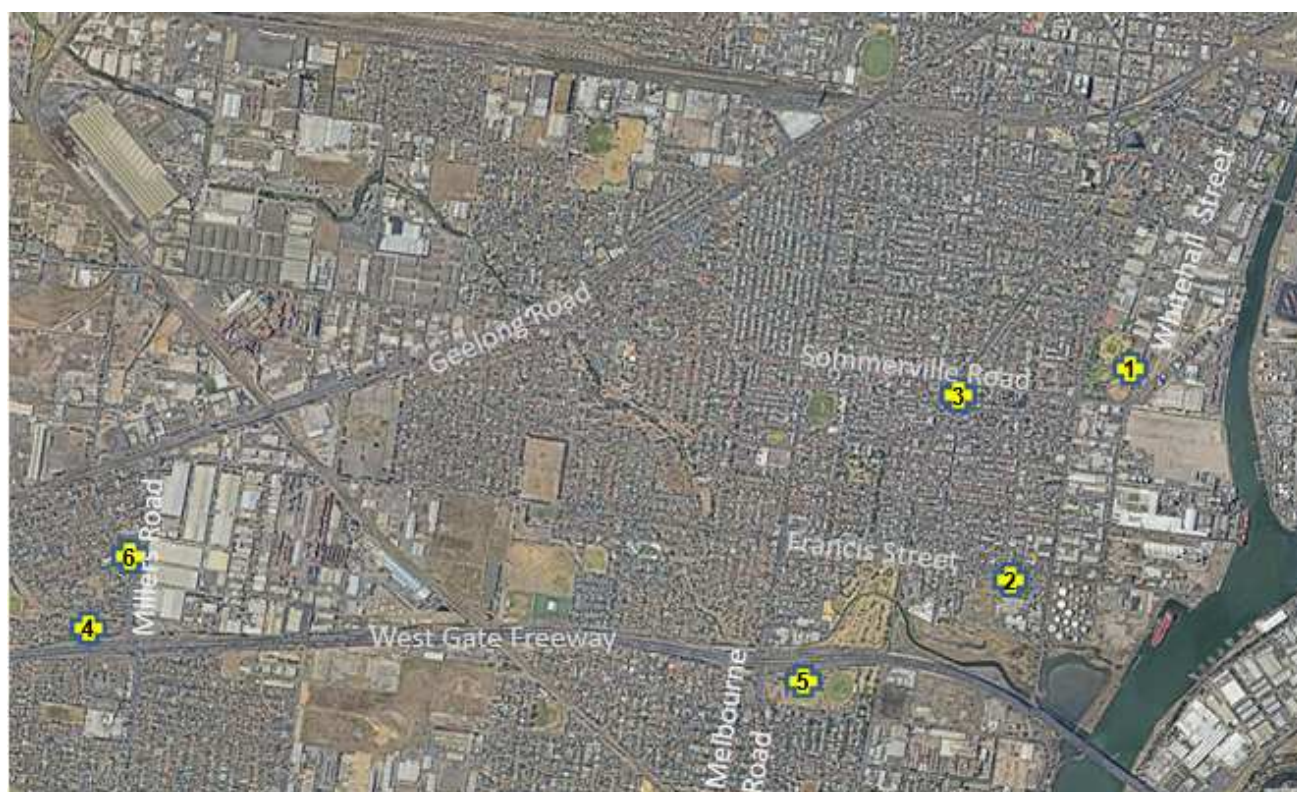
## 2.0 AAQMS DETAILS

### 2.1 Site locations

AAQMS Station 1 to Station 5 were installed and commissioned during the period 22/08/2018 to 31/08/2018. AAQMS Station 6 at Millers Road was not commissioned at the time of reporting and will be reported in subsequent reports. Meteorological sensors (windspeed and direction) were installed later due to delays in calibration from the instrument supplier. AAQMS commissioning dates are provided in Table 2. Figure 1 presents the locations of the AAQMS.

**Table 2: AAQMS commissioning dates**

Parameter	Station 1	Station 2	Station 3	Station 4	Station 5
AAQMS	23/08/2018	22/08/2018	22/08/2018	31/08/2018	22/08/2018
Wind speed & direction	07/09/2018	20/09/2018	14/09/2018	17/09/2018	10/09/2018



**Figure 1: West Gate Tunnel AAQMS site locations**

## 2.2 Siting assessment

Australian Standard AS/NZS 3580.1.1 “Methods for Sampling and Analysis of Ambient Air – Part 1.1. Guide to Siting Air Monitoring Equipment” provides general guidance for the siting of ambient air monitoring equipment and specific siting parameters for individual air pollutants. Table 3 provides a comparison between recommended criteria contained in the Standard for the parameters monitored at neighbourhood and peak monitoring stations with actual conditions at each AAQMS.

**Table 3: Australian standard AAQMS siting criteria compliance**

Station	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
Station type	Neighbourhood	Peak	Peak	Peak	Peak	Peak
Inlet height above ground level 1.0 m – 15 m	✓	✓	✓	✓	✓	✓
Clear sky angle 120° (Neighbourhood)	✓	-	-	-	-	-
Unrestricted 270° airflow around inlet (Neighbourhood)	✓	-	-	-	-	-
Unrestricted 180° airflow around inlet (Peak)	-	✓	✓	✓	✓	✓
Distance to supporting structure ≥ 1 m	✓	✓	✓	✓	✓	✓
10 m from drip line of trees	✓	✓	✓	✓	✓	✗ <sup>A</sup>
No extraneous sources nearby	✓	✓	✓	✓	✓	✗ <sup>B</sup>
Greater than 50 m from road (≤ 10,000 vehicles/day)	✓	-	-	-	-	-
Greater than 2 m from road (Peak station)	-	✓	✓	✓	✓	✓

**Note:**

A Tree drip line is <3 m from sampler inlets and meteorological monitoring equipment

B Residential chimney is <5 m from the sampler inlet.

## 2.3 Equipment specifications

Table 4 provides a list of the monitoring equipment installed at the AAQMS.

**Table 4: AAQMS instrumentation**

Parameter	Equipment item	Manufacturer	Model
PM <sub>2.5</sub>	Beta Attenuation Monitor (BAM)	Thermo Fisher Scientific Inc.	5014i
PM <sub>10</sub>	Beta Attenuation Monitor (BAM)	Thermo Fisher Scientific Inc.	5014i
Oxides of Nitrogen	Chemiluminescence	Thermo Fisher Scientific Inc.	42i
Carbon Monoxide	Infra-red gas filter correlation	Thermo Fisher Scientific Inc.	48i
Temperature	Pt100 resistive platinum sensor	Thermo Fisher Scientific Inc.	5014i
BTEX	Summa canister	Restek	6 litre
Relative humidity	Capacitive thin film sensor	Thermo Fisher Scientific Inc.	5014i

Parameter	Equipment item	Manufacturer	Model
Atmospheric Pressure	Beta Attenuation Monitor (BAM)	Thermo Fisher Scientific Inc.	5014i
Wind speed and wind direction	Ultrasonic anemometer	RM Young	Model 86000

### 3.0 AIR QUALITY OBJECTIVES

The ambient air quality objectives relevant to the West Gate Tunnel Project are derived from the following statutory documents:

- State Environment Protection Policy (Ambient Air Quality) [SEPP(AAQ)]
- State Environment Protection Policy (Air Quality Management) [SEPP(AQM)].
- National Environment Protection (Air Toxics) Measure Monitoring Investigation Levels (MILs)

#### SEPP(AAQ)

The SEPP(AAQ) adopts the requirements of the National Environment Protection (Ambient Air Quality) Measure (Air NEPM) and its environmental quality objectives (EQOs) for CO, NO<sub>2</sub>, and particles (as PM<sub>10</sub> and PM<sub>2.5</sub>). The SEPP(AAQ) EQOs apply to air quality within a region or sub-region considered to be representative of exposure of the general population in Victoria. These objectives have been adopted for the purposes of comparison with results from background/ neighbourhood monitoring stations for the West Gate Tunnel Project and are relevant to Station 1 (Yarraville Gardens).

#### SEPP(AQM)

The SEPP(AQM) sets out legislative requirements for managing and assessing air emissions in Victoria. The aim of the SEPP(AQM) is to ensure that prescribed air quality objectives are met and protect the beneficial uses of the air environment. Schedule B lists intervention levels which are used in the assessment of local or neighbourhood air monitoring data. Consistent with assessment of impacts described in the Environment Effects Statement for the West Gate Tunnel Project, the intervention levels have been adopted for purposes of comparison with results from peak monitoring stations for the West Gate Tunnel Project and are applicable to Station 2 (Francis Street), Station 3 (Railway Reserve), Station 4 (Primula Avenue), Station 5 (Don McLean Reserve) and Station 6 (Millers Road).

#### NEPM (Air Toxics)

The aim of the Air Toxics NEPM is to gain a greater understanding of the levels of air toxics at specific locations where elevated concentrations are likely to occur and where the potential for significant human exposure exists. The Air Toxics NEPM established monitoring investigation levels (MILs) relevant for the West Gate Tunnel Project for benzene, toluene and xylene isomers. The MILs are used purposes of comparison with results from the air toxics monitored at Station 4 (Primula Avenue).

Table 5 presents the air quality indicators and objectives for each AAQMS for the West Gate Tunnel Project.

**Table 5: Air quality indicators and objectives**

Location	Pollutant	Units	Air Quality Objective	Averaging period
Station 1	PM <sub>10</sub>	µg/m <sup>3</sup>	50	24 hour
			20	Annual
	PM <sub>2.5</sub>		25	24 hour
			8	Annual
Station 2 Station 3 Station 4 Station 5 Station 6	PM <sub>10</sub>	µg/m <sup>3</sup>	60	24 hour
	PM <sub>2.5</sub>		36	
Station 4	CO	ppm	29	1 hour
	NO <sub>2</sub>	ppb	140	1 hour
	Benzene	ppb	3	Annual
	Toluene	ppb	1000	24 hour
			100	Annual
	Ethylbenzene	ppb	NA	24 hour
	Xylene isomers	ppb	250	24 hour
			200	Annual

## 4.0 TEST METHODS

### 4.1 Particulate matter (PM<sub>2.5</sub>)

PM<sub>2.5</sub> concentrations are determined using a Beta Attenuation Monitor (BAM).

Suspended particulate matter in ambient air is measured using the attenuation of beta rays as a surrogate for continuous mass determination. Beta rays are high energy electrons generated from the radioactive decay of the radon isotope Rn-222. When contacting particulate matter beta rays are either absorbed or their energy level is diminished. The relationship between the attenuation of beta rays between the source and detector is used to determine the mass density.

The BAM is equipped with a flow control and measurement system. The flow control system volumetrically controls the flowrate to 16.7 l/min. The flowrate is used with the mass density to calculate the particulate matter concentration.

The sampler is fitted with a size selective inlet, which separates particles with an equivalent aerodynamic diameter greater than 10 microns from the sample stream. An in-line PM<sub>2.5</sub> particle size separator is also fitted to further separate particles; only those with an equivalent aerodynamic diameter less than 2.5 microns can pass through the particle size separator to the filter for mass determination.

The PM<sub>2.5</sub> monitoring method is based on the requirements contained within Australian Standard AS/NZS 3580.9.12 "Methods for Sampling and Analysis of Ambient Air – Method 9.12: Determination of Suspended Particulate Matter – PM<sub>2.5</sub> Beta Attenuation Monitors" (NATA Laboratory Accreditation No. 1910).



## 4.2 Particulate matter (PM<sub>10</sub>)

PM<sub>10</sub> concentrations are determined using a continuous BAM without an in-line PM<sub>2.5</sub> particle size separator. All other measurement processes remain the same as for the PM<sub>2.5</sub> test method.

The PM<sub>10</sub> monitoring method is based on the requirements contained within Australian Standard AS/NZS 3580.9.11:2016 *Methods for Sampling and Analysis of Ambient Air – Method 9.11: Determination of Suspended Particulate Matter – PM<sub>10</sub> Beta Attenuation Monitors* (NATA Laboratory Accreditation No. 1910).

## 4.3 Nitrogen dioxide (NO<sub>2</sub>)

Oxides of nitrogen concentrations were determined using a 42i Thermo Scientific chemiluminescence gas analyser.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The oxides of nitrogen (NO, NO<sub>2</sub> and NO<sub>x</sub>) monitoring method is based on the requirements of Australian Standard AS 3580.5.1, *Determination of Oxides of Nitrogen – Chemiluminescence Method*.

## 4.4 Carbon monoxide (CO)

Carbon monoxide concentrations are determined using a 48i Thermo Scientific infra-red gas filter correlation analyser.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The carbon monoxide monitoring method is based on the requirements of Australian Standard AS 3580.7.1, *Determination of Carbon Monoxide – Direct Reading Instrumental Method*.

## 4.5 Volatile organic compounds (BTEX)

A sample is collected in an evacuated electro-polished and passivated stainless steel canister. Analysis involves separation by gas chromatography (GC) and measurement by mass selective (MS) detector.

The procedure for sampling Volatile Organic Compounds (VOCs) using evacuated canisters, and for the subsequent analysis, is described in USEPA Method TO-15 *Determination of Volatile Organic Compounds (VOCs) in air collected in specially-prepared canisters and analysed by Gas Chromatography/Mass Spectrometry (GC/MS)*.

Samples were analysed by Queensland Health (NATA Laboratory Accreditation No. 41) based on USEPA method TO-15. The test method used was in accordance with Golder Source Test Method C9, "Canister (Evacuated) Sampling for VOC: In Ambient Air and Source Emissions".

## 4.6 Meteorological parameters

Monitoring of meteorological parameters; wind speed/direction, temperature, relative humidity, solar radiation and rainfall was conducted in accordance with Australian Standard AS 3580.14 *Methods for Sampling and Analysis of Ambient Air – Part 14: Meteorological Monitoring for Ambient Air Quality Monitoring Applications* (NATA Laboratory Accreditation No. 1910).

## 5.0 MEASUREMENT UNCERTAINTY

### 5.1 PM<sub>2.5</sub>

The measurement uncertainty for PM<sub>2.5</sub> by BAM is published by Thermo-Fisher as  $\pm 2 \mu\text{g}/\text{m}^3$  (24 hour average).

## 5.2 PM<sub>10</sub>

The measurement uncertainty for PM<sub>2.5</sub> by BAM is published by Thermo-Fisher as  $\pm 2 \mu\text{g}/\text{m}^3$  (24 hour average).

## 5.3 NO<sub>2</sub>

The measurement uncertainty for NO, NO<sub>2</sub> and NO<sub>x</sub> by Chemiluminescence is published in AS3580.5.1 as  $\pm 10\%$  (24 hour average).

## 5.4 CO

The measurement uncertainty for CO by Infra-red gas filter correlation is published in AS3580.7.1 as  $\pm 10\%$  (24 hour average).

## 5.5 Benzene

USEPA Method TO-15 cites the accuracy and precision for two ambient air quality studies conducted in the United States of America. The average replicate precision for a range of 16 compounds in both studies was 15%. Replicate precision was defined as the ratio of the average difference between replicates to the average value of replicates.

The reported accuracies for both studies ranged between  $\pm 4\%$  and  $\pm 31\%$ . The average accuracy for both studies for the range of 16 compounds was  $\pm 11\%$ . Accuracy is defined as the ratio of the difference between expected and observed audit results to the expected audit result.

## 5.6 Meteorological parameters

The estimated measurement uncertainty for each of the parameters is presented in Table 6.

**Table 6: Meteorological parameters measurement uncertainty**

Parameter	Measurement uncertainty <sup>A</sup>
Wind speed	Greater of $\pm 0.6 \text{ m/s}$ or 5%
Wind direction	$\pm 5^\circ$
Barometric pressure	$\pm 3 \text{ hPa}$
Temperature	$\pm 6\%$
Relative humidity	$\pm 5 - 7\% \text{ RH}$

**Note:**

A Measurement uncertainty estimates are as published in AS3580.14 "Methods for Sampling and Analysis of Ambient Air – Part 14 Meteorological Monitoring for Ambient Air Quality Monitoring Applications".

## 5.7 Calibration and maintenance

Sample flow rate calibration was conducted on a monthly basis using a NATA calibrated primary standard flowmeter. Calibration details for the reporting period are presented in Table 7.

**Table 7: Calibrations**

Location	Parameter	Calibration Date	Calibration Type
Station 1	PM <sub>10</sub>	23/08/2018	Monthly
	PM <sub>2.5</sub>	23/08/2018	Monthly
	Wind speed and direction	9/08/2018	Two yearly
Station 2	PM <sub>10</sub>	22/08/2018	Monthly
	PM <sub>2.5</sub>	22/08/2018	Monthly
	Wind speed and direction	7/08/2018	Two yearly
Station 3	PM <sub>10</sub>	22/08/2018	Monthly
	PM <sub>2.5</sub>	22/08/2018	Monthly
	Wind speed and direction	10/08/2018	Two yearly
Station 4	PM <sub>10</sub>	22/08/2018	Monthly
	PM <sub>2.5</sub>	22/08/2018	Monthly
	NO/ NO <sub>2</sub> / NO <sub>x</sub>	31/08/2018	6 monthly
	CO	31/08/2018	6 monthly
	BTEX	NA	Flow-controllers and canisters certified by lab
	Wind speed and direction	7/08/2018	Two yearly
Station 5	PM <sub>10</sub>	31/08/2018	Monthly
	PM <sub>2.5</sub>	31/08/2018	Monthly
	Wind speed and direction	7/08/2018	Two yearly

## 6.0 RESULTS

The monitoring results for 22 August 2018 to 30 September 2018 are presented in the following sections.

### 6.1 Particulate matter (BAM PM<sub>2.5</sub> & PM<sub>10</sub>)

PM<sub>2.5</sub> and PM<sub>10</sub> were continuously monitored and 5-minute averages logged. The 5-minute average data was transformed to 24 hour averages for reporting.



PM<sub>2.5</sub> and PM<sub>10</sub> concentration statistics from the reporting period for Station 1 to Station 5 are presented in Table 8 to Table 12. The 24 hour average concentration plots for Station 1 to Station 5 are presented in Figure 2 to Figure 6.

### 6.1.1 Station 1 – Yarraville Gardens

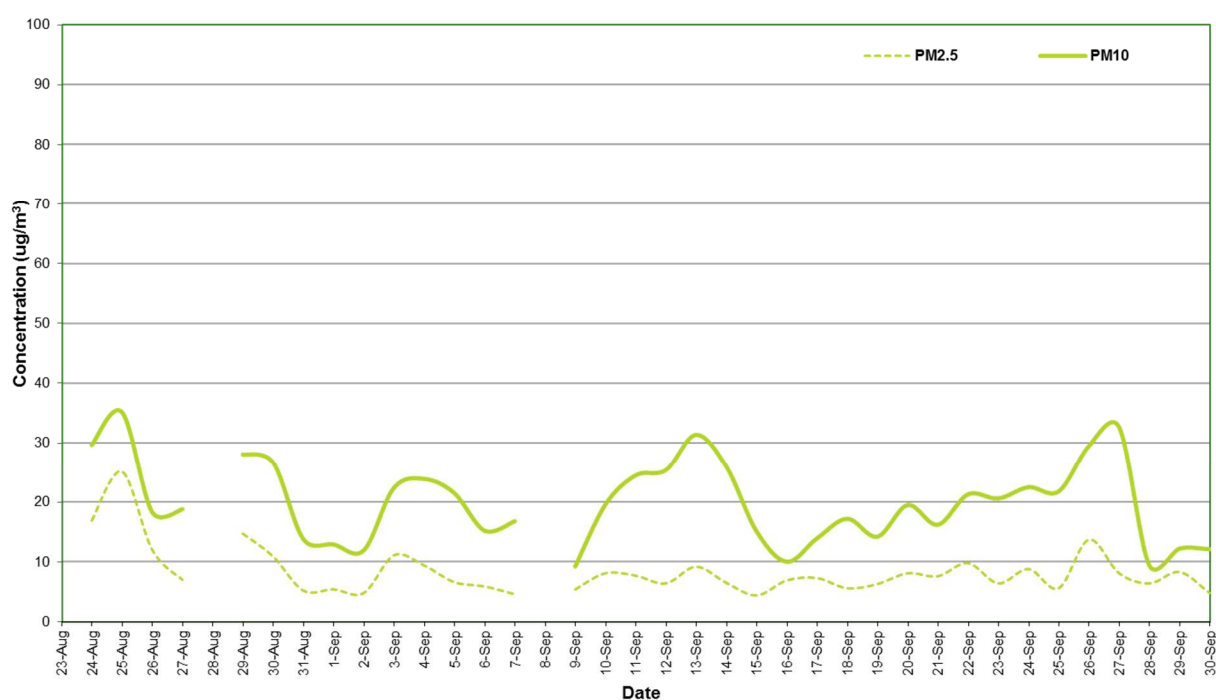
**Table 8: Station 1 (Yarraville Gardens AAQMS) PM<sub>2.5</sub> and PM<sub>10</sub> percentiles (24 hour average)**

Parameter	Concentration (µg/m <sup>3</sup> ) <sup>A</sup>							Air quality objective <sup>B</sup> (µg/m <sup>3</sup> )
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	
PM <sub>2.5</sub>	25	22	20	15	13	9.3	7.3	25
PM <sub>10</sub>	35	34	33	31	29	25	19	50

**Note:**

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AAQ) Objective



Note: Refer to Appendix A for data gap explanation.

**Figure 2: Station 1 PM<sub>2.5</sub> and PM<sub>10</sub> concentration (24 hour average) – Aug/Sep 2018**

### 6.1.2 Station 2 – Francis Street

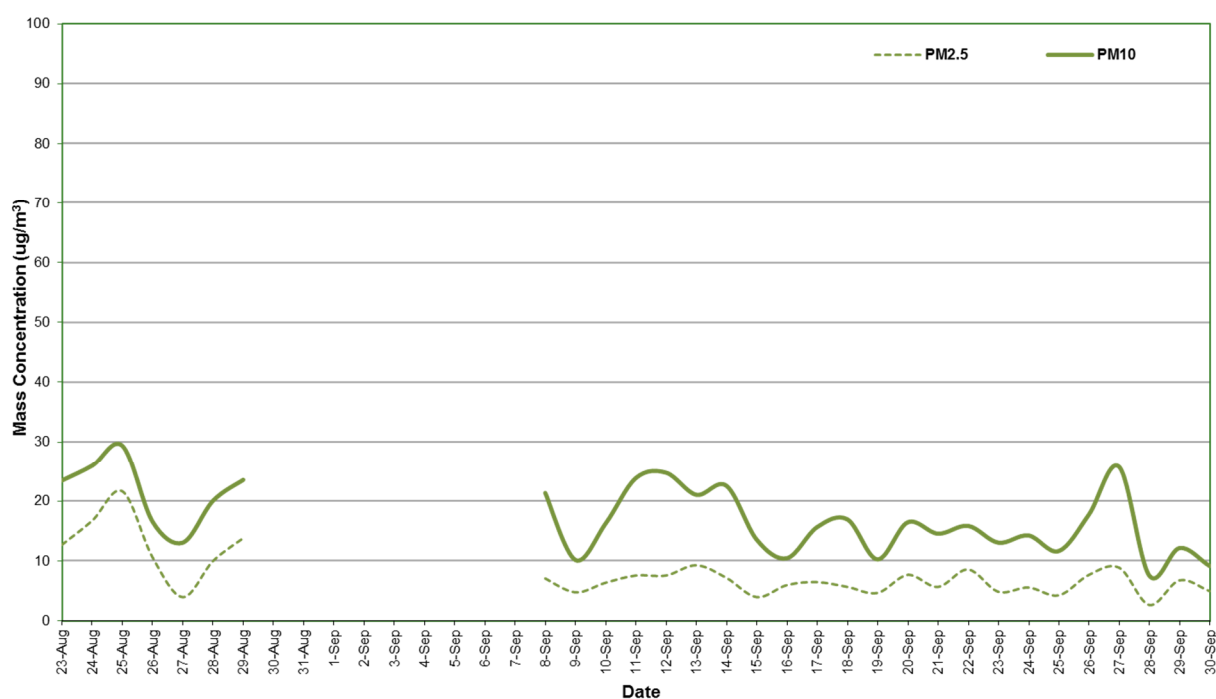
Table 9: Station 2 (Francis Street AAQMS) PM<sub>2.5</sub> and PM<sub>10</sub> percentiles (24 hour average)

Parameter	Concentration (µg/m <sup>3</sup> ) <sup>A</sup>							Air quality objective <sup>B</sup> (µg/m <sup>3</sup> )
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	
PM <sub>2.5</sub>	22	21	20	17	14	10	7.2	36
PM <sub>10</sub>	29	29	28	26	25	23	17	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level



Note: Refer to Appendix A for data gap explanation.

Figure 3: Station 2 PM<sub>2.5</sub> and PM<sub>10</sub> concentration (24 Hour Average) – Aug/Sep 2018

### 6.1.3 Station 3 – Railway Reserve

Table 10: Station 3 (Railway Reserve AAQMS) PM<sub>2.5</sub> and PM<sub>10</sub> percentiles (24 hour average)

Parameter	Concentration (µg/m <sup>3</sup> ) <sup>A</sup>							Air quality objective <sup>B</sup> (µg/m <sup>3</sup> )
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	
PM <sub>2.5</sub>	19	19	18	15	12	9.4	6.0	36
PM <sub>10</sub>	28	28	27	26	24	18	15	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level

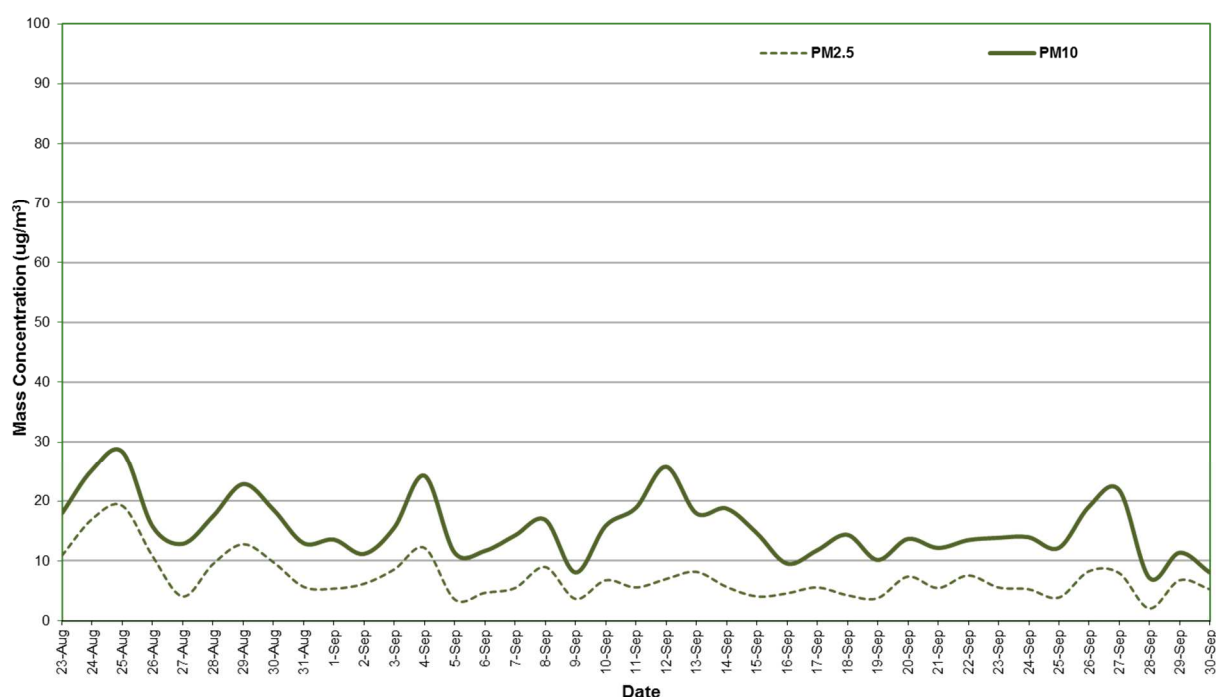


Figure 4: Station 3 PM<sub>2.5</sub> and PM<sub>10</sub> concentration (24 hour average) – Aug/Sep 2018

### 6.1.4 Station 4 – Primula Avenue

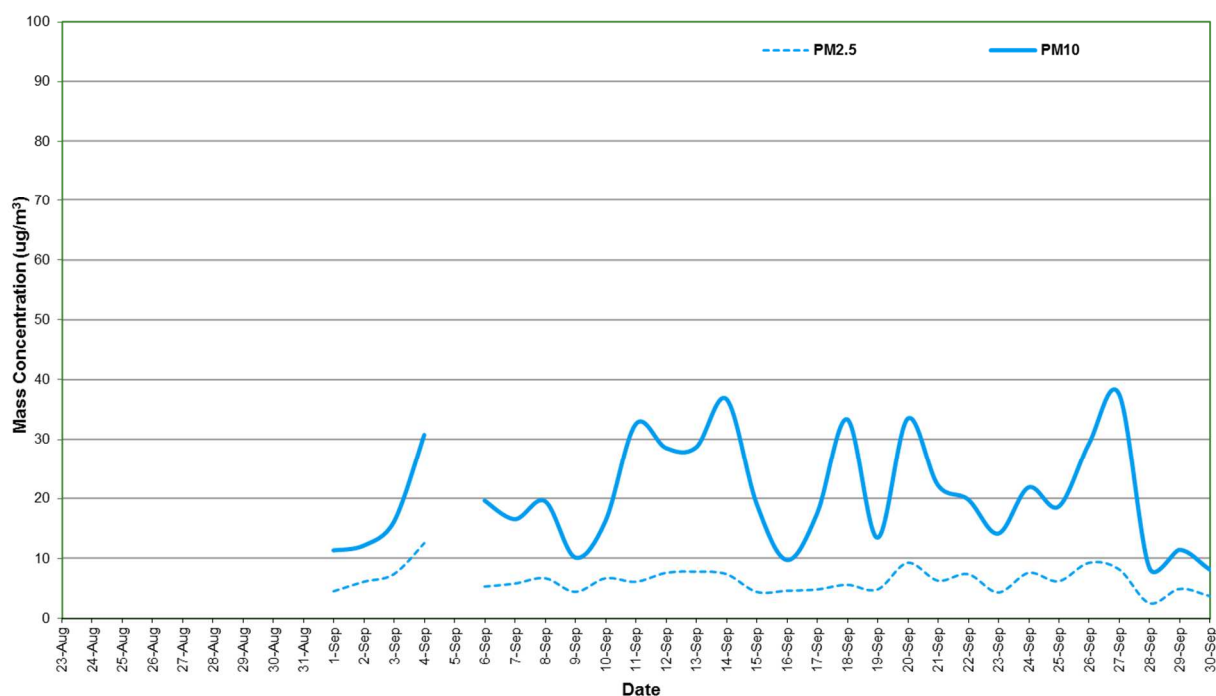
Table 11: Station 4 (Primula Avenue AAQMS) PM<sub>2.5</sub> and PM<sub>10</sub> percentiles (24 hour average)

Parameter	Concentration (µg/m <sup>3</sup> ) <sup>A</sup>							Air quality objective <sup>B</sup> (µg/m <sup>3</sup> )
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	
PM <sub>2.5</sub>	13	12	11	9.5	8.0	7.4	6.1	36
PM <sub>10</sub>	37	36	35	34	33	29	20	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level



Note: Refer to Appendix A for data gap explanation.

Figure 5: Station 4 PM<sub>2.5</sub> and PM<sub>10</sub> concentration (24 hour average) – Aug/Sep 2018

### 6.1.5 Station 5 – Don Mclean Reserve

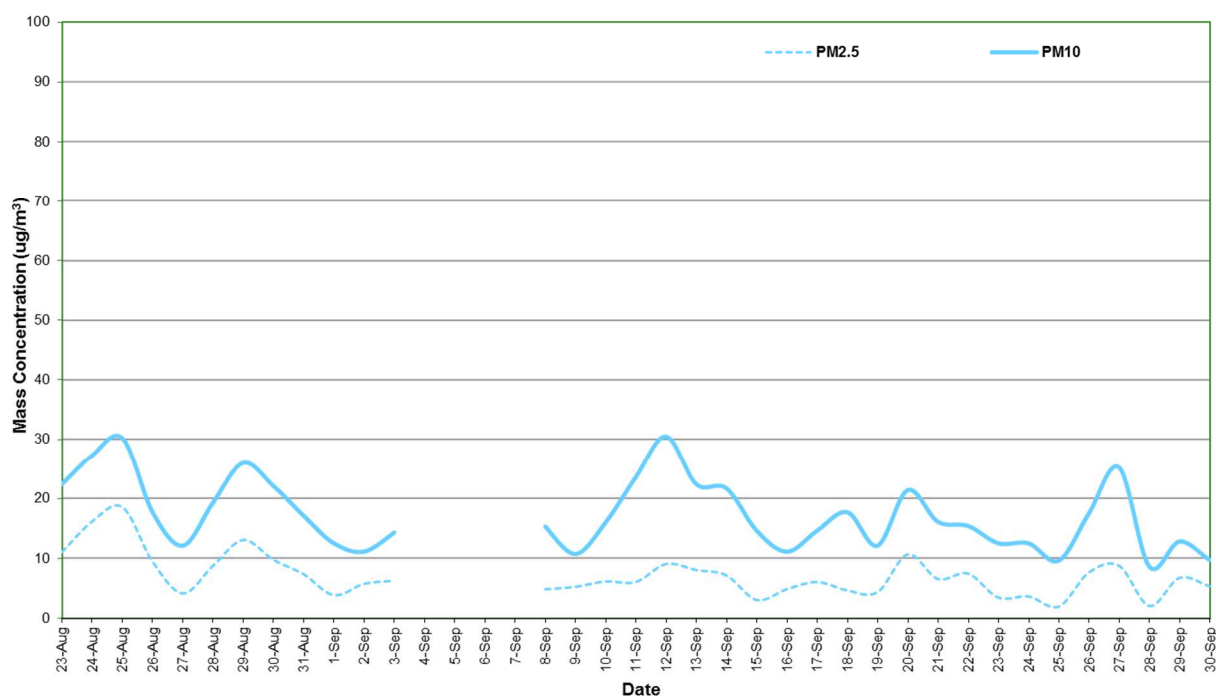
Table 12: Station 5 (Don Mclean Reserve AAQMS) PM<sub>2.5</sub> and PM<sub>10</sub> percentiles (24 hour average)

Parameter	Concentration (µg/m <sup>3</sup> ) <sup>A</sup>							Air quality objective <sup>B</sup> (µg/m <sup>3</sup> )
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	
PM <sub>2.5</sub>	19	18	17	15	12	9.3	6.4	36
PM <sub>10</sub>	31	30	30	30	27	22	17	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level

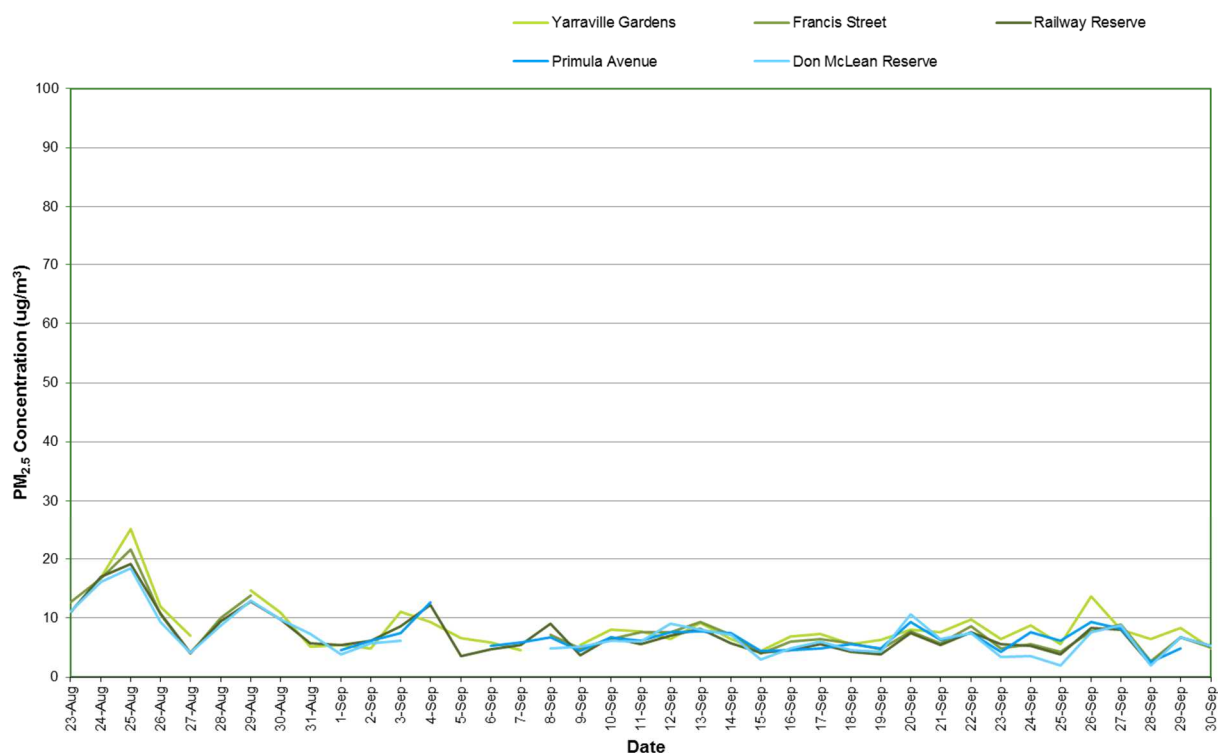


Note: Refer to Appendix A for data gap explanation.

Figure 6: Station 5 PM<sub>2.5</sub> and PM<sub>10</sub> concentration (24 hour average) – Aug/Sep 2018

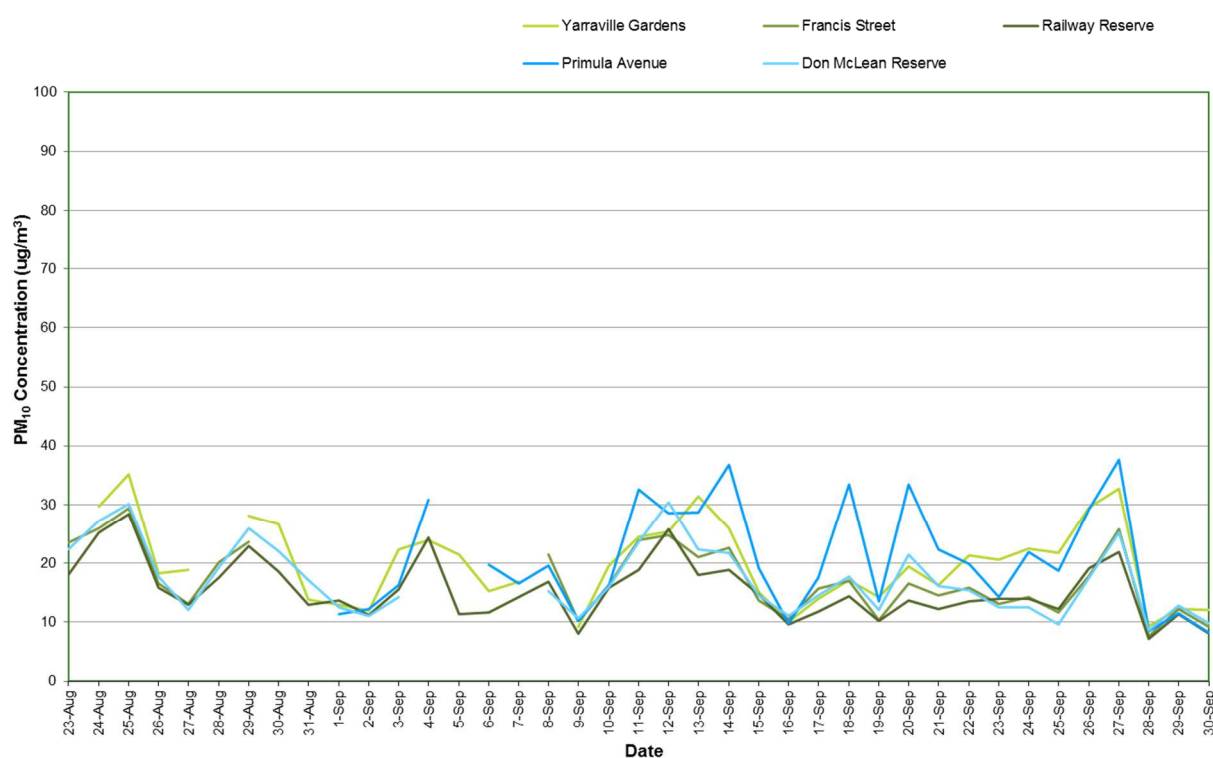
### 6.1.6 Combined PM<sub>2.5</sub> mass concentrations

Combined plots of the AAQMS PM<sub>2.5</sub> and PM<sub>10</sub> are presented in Figure 7 and Figure 8 respectively.



Note: Refer to Appendix A for data gap explanation.

**Figure 7: Combined PM<sub>2.5</sub> concentration (24 hour average) – Aug/Sep**



Note: Refer to Appendix A for data gap explanation.

**Figure 8: Combined PM<sub>10</sub> concentration (24 hour average) – Aug/Sep**

## 6.2 Nitrogen dioxide (NO<sub>2</sub>)

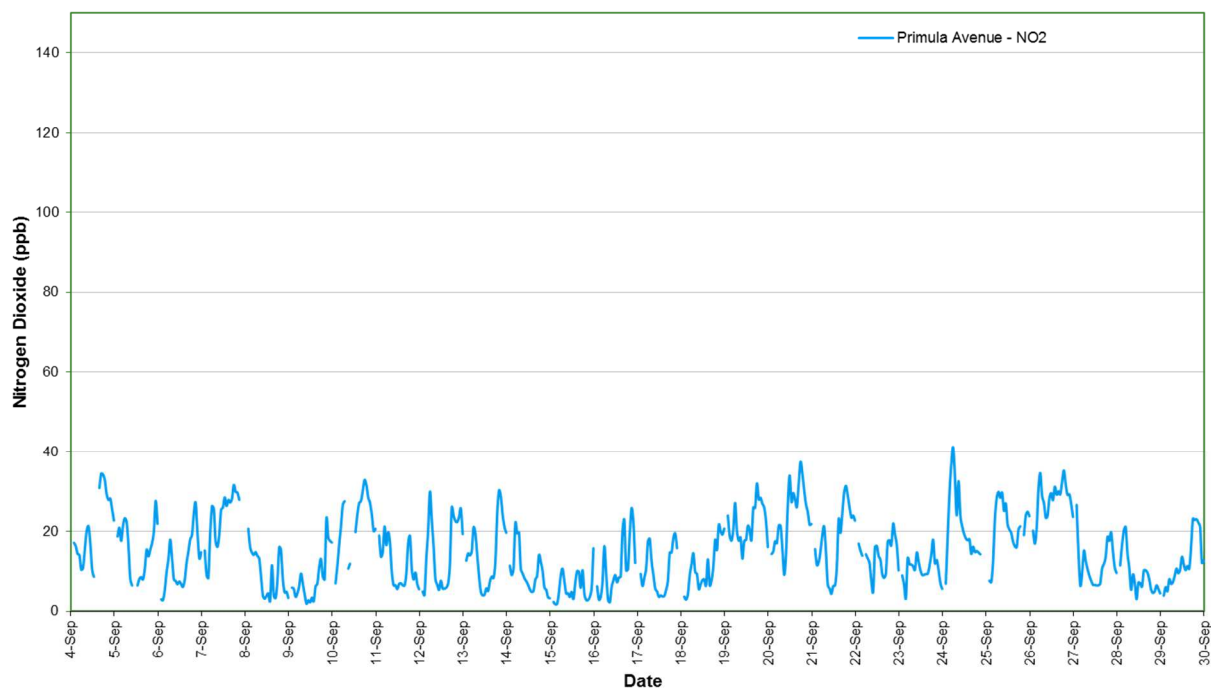
NO<sub>2</sub> (1 hour average) mass concentration statistics for the reporting period are given in Table 13. A plot of NO<sub>2</sub> (1 hour average) mass concentration for the reporting period is presented Figure 9

**Table 13: Station 4 Primula Avenue AAQMS NO<sub>2</sub> percentiles (1 hour average)**

Parameter	Concentration (ppb) <sup>A</sup>							SEPP (AQM) intervention level
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	(ppb)
NO <sub>2</sub>	41	34	33	30	27	21	14	140

**Note:**

A Parts per billion



Note: Refer to Appendix A for data gap explanation.

Figure 9: Station 4 NO<sub>2</sub> concentration (1 hour average) Primula Avenue AAQMS – Sep 2018



### 6.3 Carbon monoxide (CO)

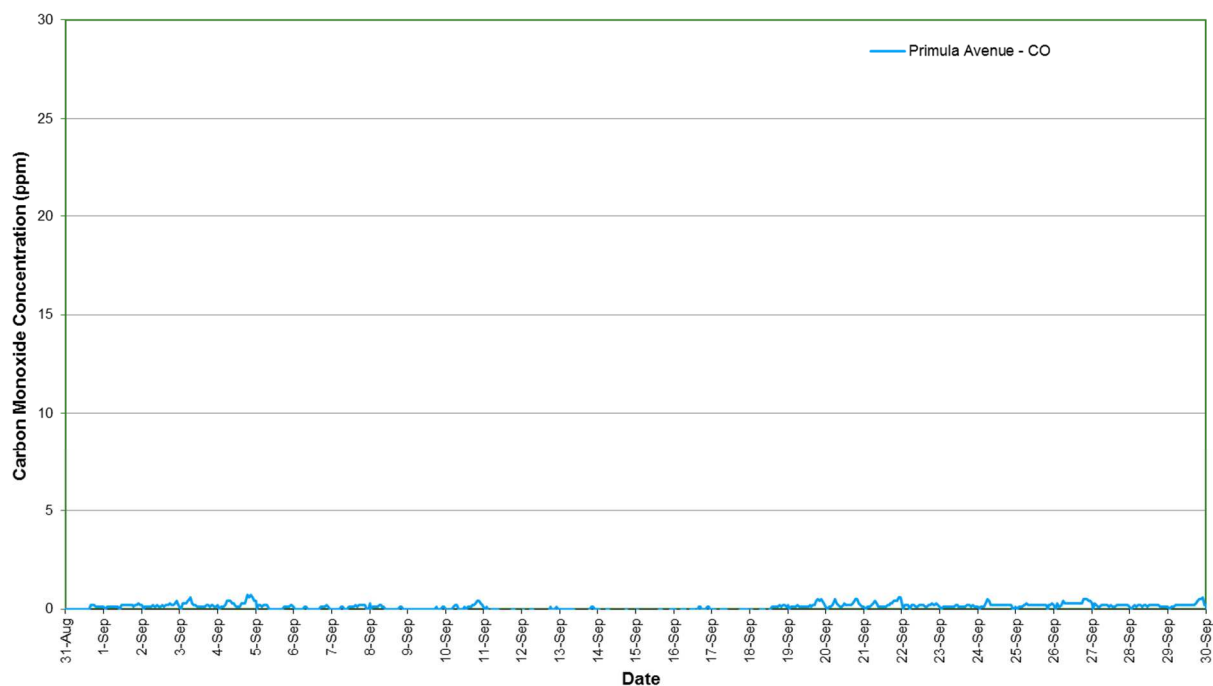
CO (1 hour average) mass concentration statistics for the reporting period are given in Table 14. A plot of CO (1 hour average) concentration for the reporting period is presented with the SEPP(AQM) Schedule B CO Intervention Level of 29 ppm (1 hour average) in Figure 10

Table 14: Station 4 Primula Avenue AAQMS CO percentiles (1 hour average)

Parameter	Concentration (ppm) <sup>A</sup>							SEPP (AQM) intervention level
	Maximum	99 <sup>th</sup>	98 <sup>th</sup>	95 <sup>th</sup>	90 <sup>th</sup>	75 <sup>th</sup>	50 <sup>th</sup>	(ppm)
CO	0.7	0.6	0.5	0.4	0.3	0.2	0.1	29

Note:

A Parts per million



Note: Refer to Appendix A for data gap explanation.

Figure 10: Station 4 CO concentration (1 hour average) Primula Avenue AAQMS – Aug/Sep 2018

## 6.4 Volatile organic compounds (BTEX)

VOC samples were collected from Station 4 (Primula Avenue), in an evacuated electro-polished and passivated stainless steel canister. Analysis involves separation by gas chromatography (GC) and measurement by mass selective (MS) detector.

The procedure for sampling Volatile Organic Compounds (VOCs) using evacuated canisters, and for the subsequent analysis, is described in USEPA Method TO-15 "Determination of Volatile Organic Compounds (VOCs) in air collected in specially-prepared canisters and analysed by Gas Chromatography/Mass Spectrometry (GC/MS)".

Samples were analysed by Queensland Health (NATA Laboratory Accreditation No. 41) based on USEPA method TO-15 (Laboratory Report Nos. SSP61744 and SSP61989).

The test method used was in accordance with Golder Source Test Method C9, "Canister (Evacuated) Sampling for VOC: In Ambient Air and Source Emissions".

BTEX (24 hour average) mass concentration statistics for the reporting period are given in Table 15.

**Table 15: Station 4 - Primula Avenue AAQMS BTEX concentrations (24 hour average)**

Date	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Total xylene isomers (ppb)
10/09/2018	0.8	3.2	<0.5	1.6
17/09/2018	<0.5	0.7	<0.5	<1
22/09/2018	<0.5	<0.5	<0.5	<1
28/09/2018	<0.5	0.7	<0.5	<1
NEPM MIL <sup>A</sup>	3.0 <sup>B</sup>	1000	NA	250

**Note:**

A National Environment Protection Measure (Air Toxics) Monitoring Investigation Level

B Annual average

Sample analysis conducted by Queensland Health, NATA Accreditation No. 41

## 6.5 Meteorological parameters

### 6.5.1 Temperature

Ambient Temperature data for all AAQMS sites are presented in Figure 11 for the reporting period.

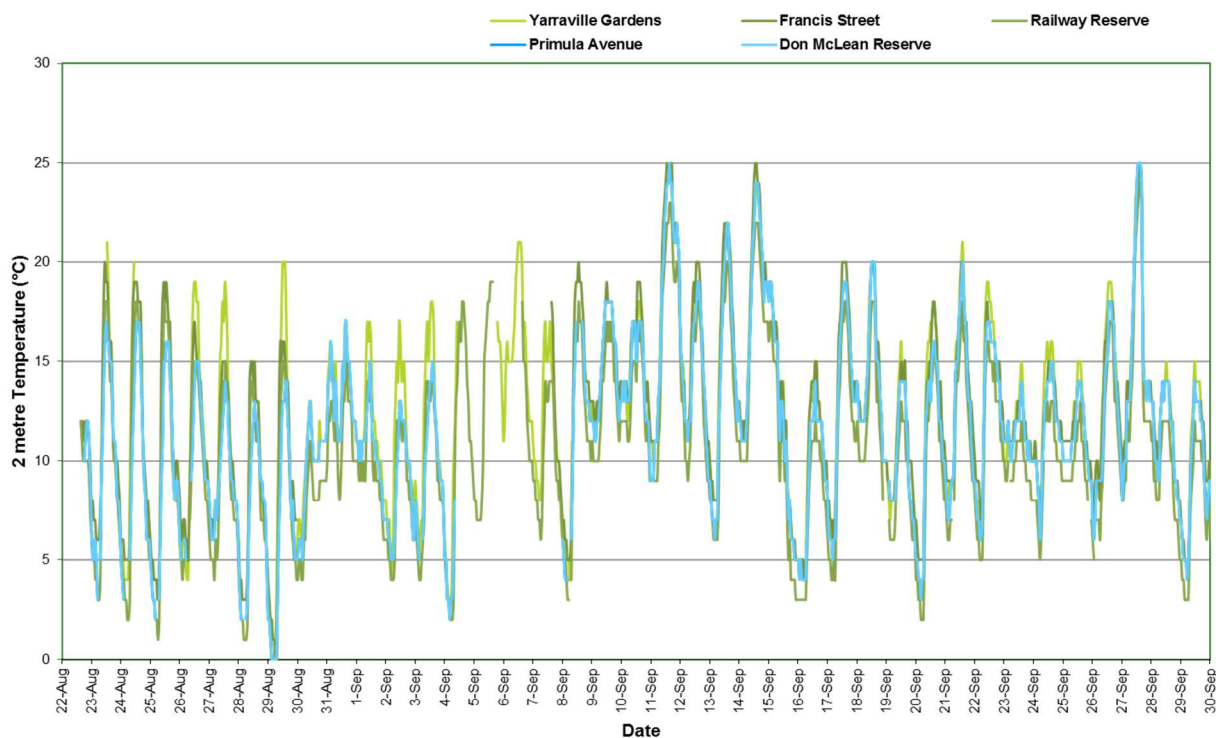


Figure 11: Ambient temperature (1 hour average) Station AAQMs – August/September 2018

### 6.5.2 Relative humidity

Relative Humidity data for all AAQMS sites are presented in Figure 12 for the reporting period.

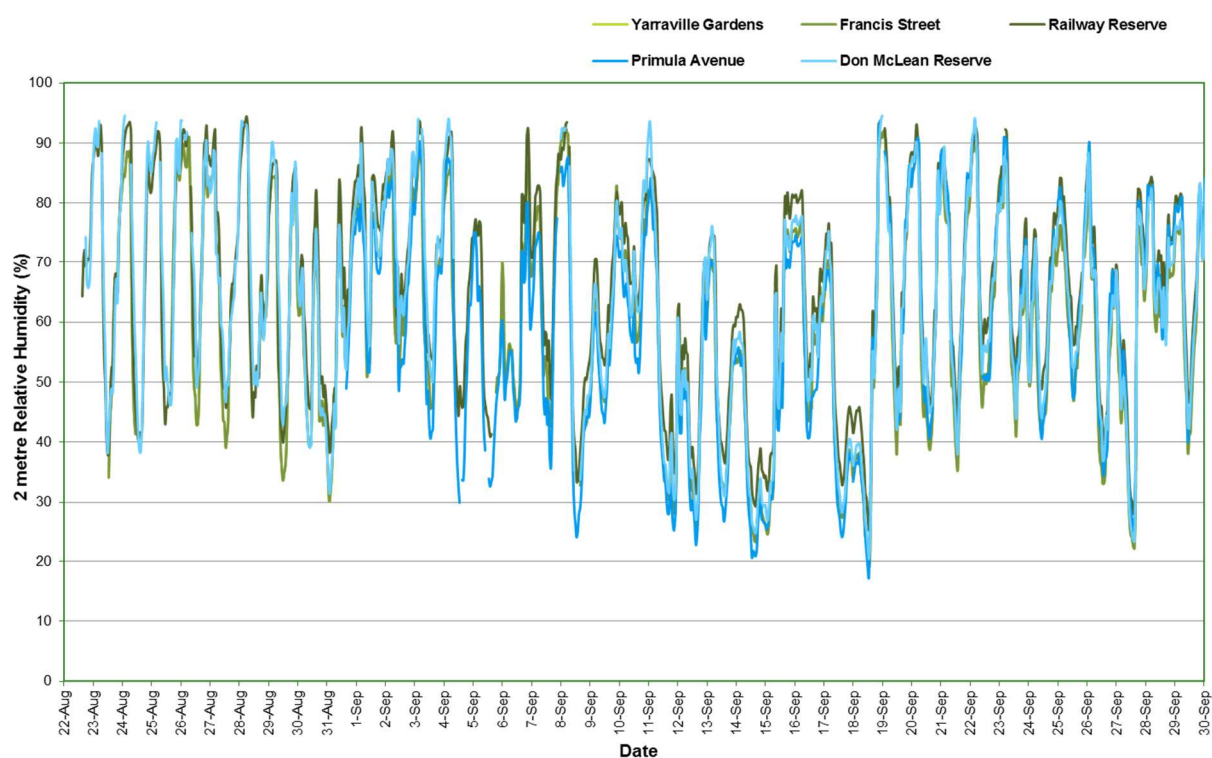


Figure 12: Relative humidity (1 hour average) Station AAQMs – August/September 2018

### 6.5.3 Wind speed

Wind Speed data for all AAQMS sites are presented in Figure 13 for the reporting period.

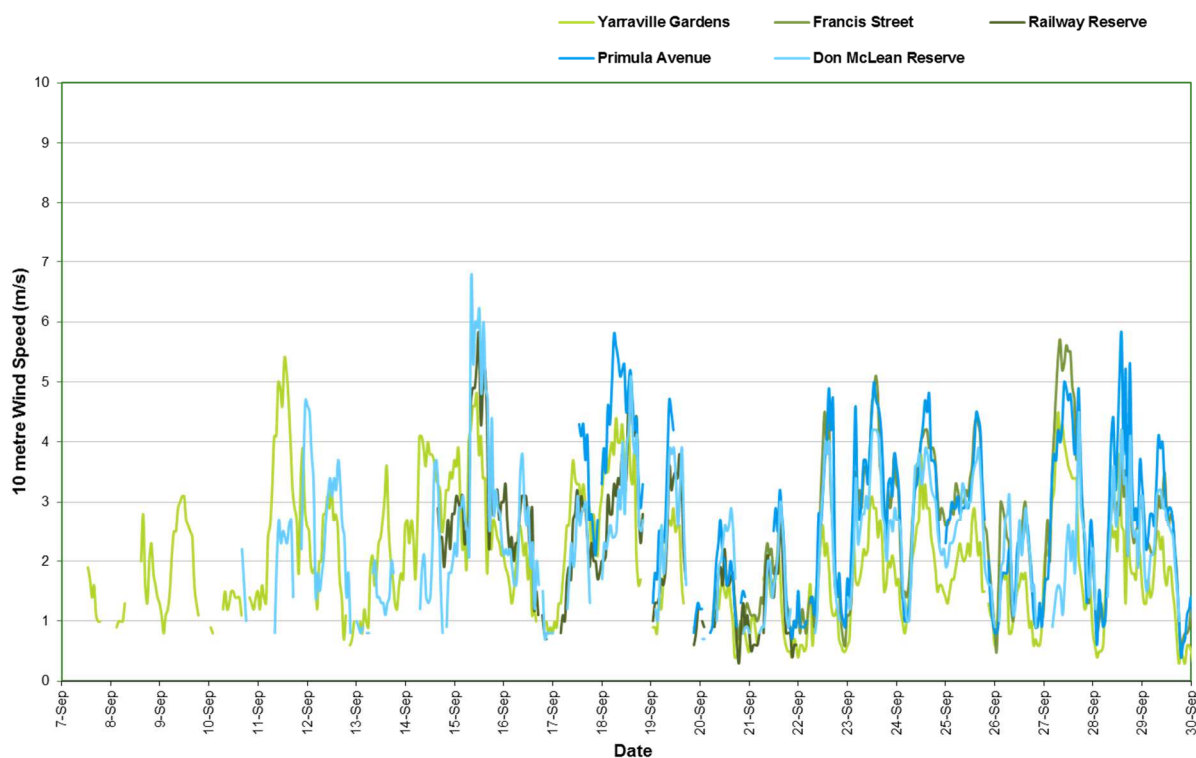


Figure 13: Wind speed (1 hour average) Station AAQMs – August/September 2018

### 6.5.4 Wind rose – Station 1 (Yarraville Gardens)

A wind rose (5-minute average) for Yarraville Gardens AAQMS is presented in Figure 14. Wind measurement at Station 1 commenced 13:50hrs 7 September 2018.

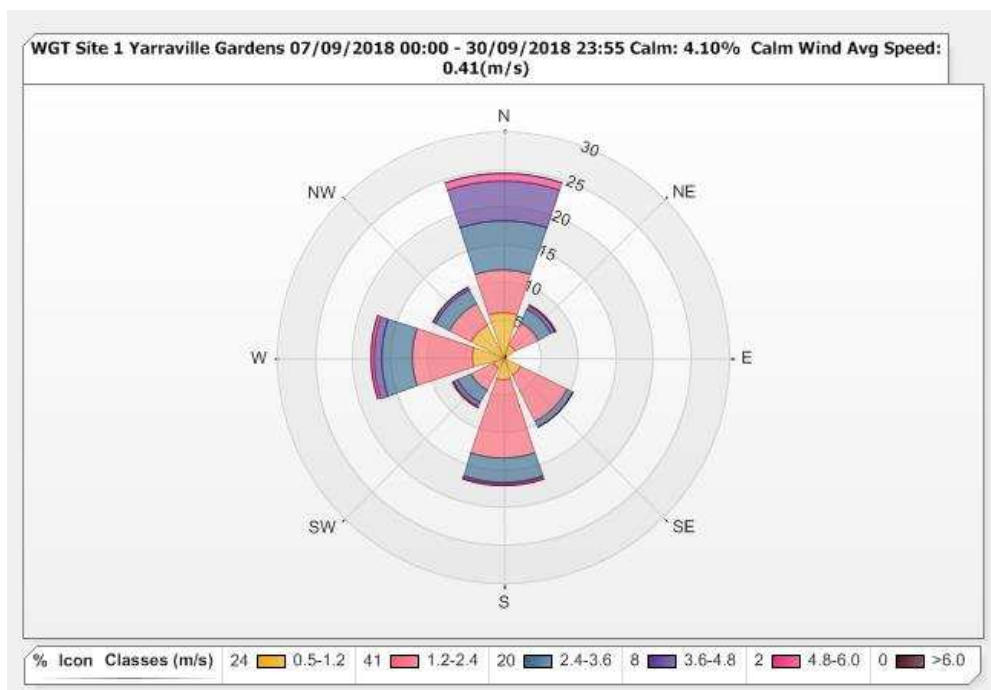


Figure 14: Wind speed (1 hour average) Station 1 Yarraville Gardens AAQMs

### 6.5.5 Wind rose – Station 2 (Francis Street)

A wind rose (5-minute average) for Station 2 (Francis Street AAQMS) is presented in Figure 15. Wind measurement at Station 2 commenced 16:05hrs 20 September 2018.

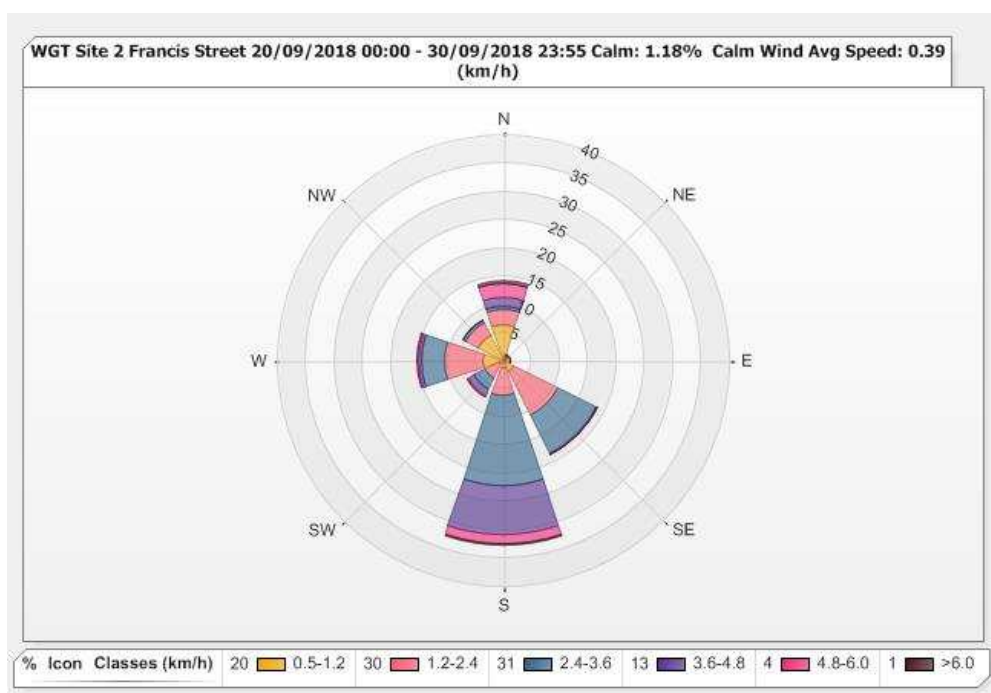


Figure 15: Wind speed (1 hour average) Station 2 Francis Street AAQMs

### 6.5.6 Wind rose – Station 3 (Railway Reserve)

A wind rose (5-minute average) for Station 3 (Railway Reserve AAQMS) is presented in Figure 16. Wind measurement at Station 3 commenced 15:20hrs 14 September 2018.

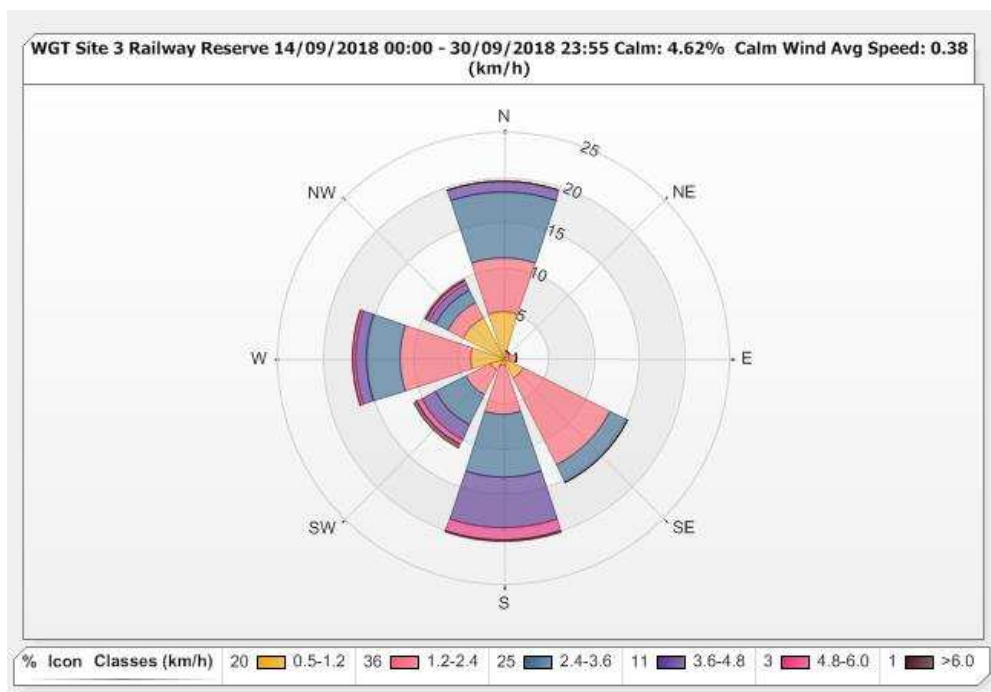


Figure 16: Wind speed (1 hour average) Station 3 Railway Reserve AAQMs

### 6.5.7 Wind rose – Station 4 (Primula Avenue)

A wind rose (5 minute average) for Station 4 (Primula Avenue AAQMS) is presented in Figure 17. Wind measurement at Station 4 commenced 12:20hrs 17 September 2018.

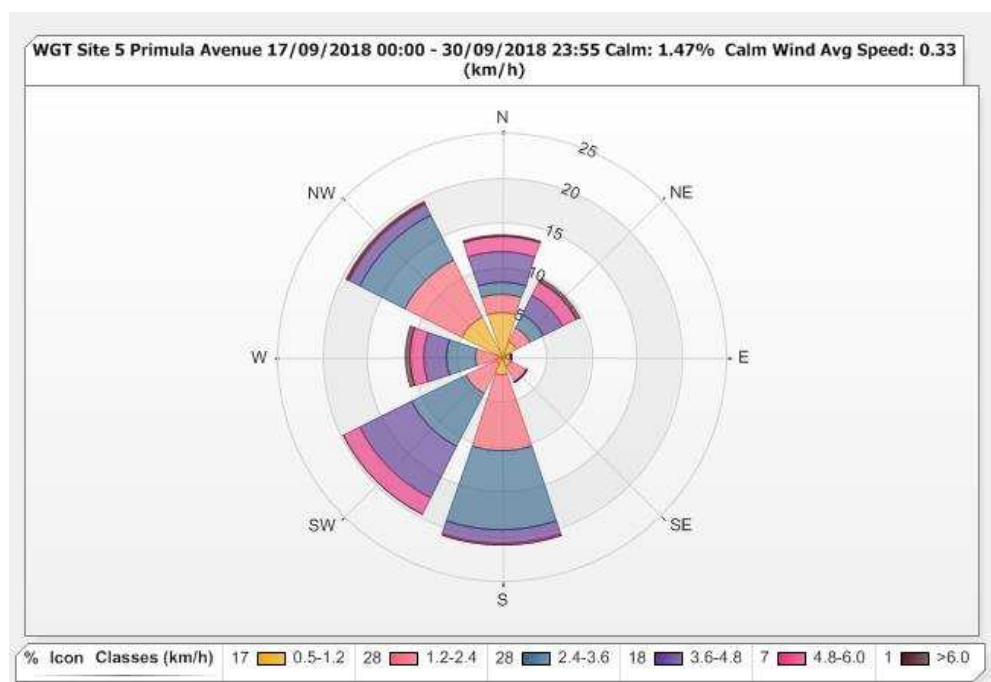


Figure 17: Wind speed (1 hour average) Station 4 Primula Avenue AAQMs

### 6.5.8 Wind rose – Station 5 (Don Mclean Reserve)

A wind rose (5-minute average) for Station 5 (Don Mclean Reserve AAQMS) is presented in Figure 18. Wind measurement at Station 5 commenced 15:55hrs 10 September 2018.

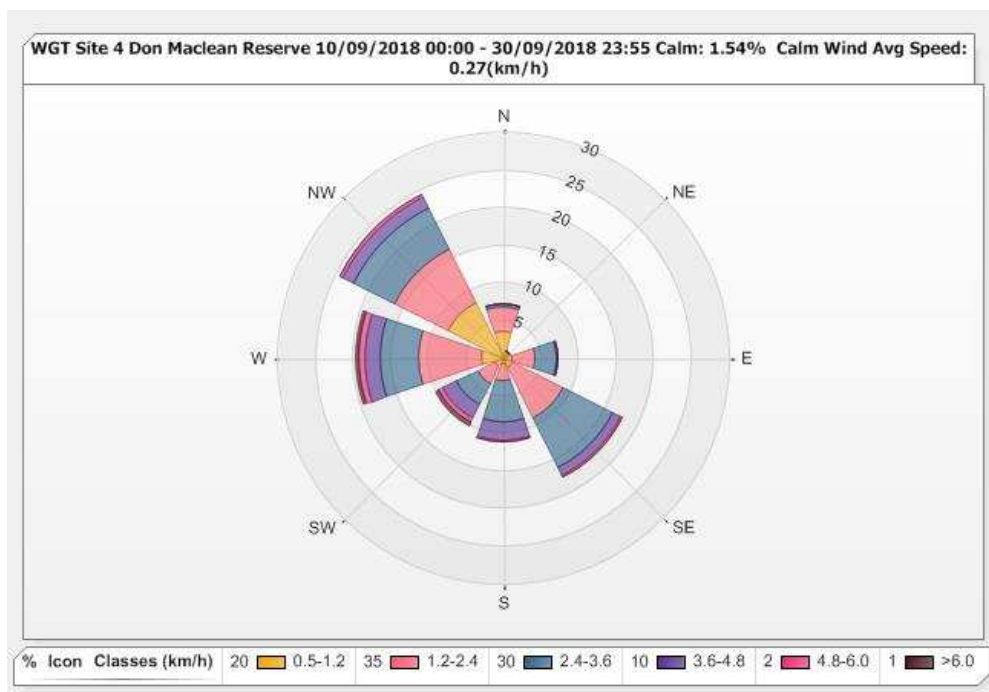


Figure 18: Wind speed (1 hour average) Station 5 Don Mclean AAQMs



## 7.0 QUALITY ASSURANCE

### 7.1 Data capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

Automatic calibrations are conducted for NO<sub>2</sub> and CO daily to monitor and correct instrument drift where necessary. NO<sub>2</sub> and CO automatic calibrations are conducted once per day between 01:00 and 01:45 hours.

Data capture statistics for the reporting period 22 August to 30 September 2018 are shown in Table 16. Averages were only collected for those periods where the 5 minute data constituted 75%<sup>1</sup> data capture.

Collected periods are not consistent for each measured parameter primarily due to the commissioning dates.

**Table 16: Data capture**

Parameter	Averaging period	Station	Collected periods	Available periods	Data capture
PM <sub>2.5</sub>	24 hour	1 – Yarraville Gardens	36	39	92.3%
	24 hour	2 – Francis Street	30	39	76.9%
	24 hour	3 – Railway Reserve	39	40	97.5%
	24 hour	4 – Primula Avenue	29	31	93.5%
	24 hour	5 – Don Mclean Reserve	35	40	87.5%
PM <sub>10</sub>	24 hour	1 – Yarraville Gardens	31	39	79.5%
	24 hour	2 – Francis Street	30	39	76.9%
	24 hour	3 – Railway Reserve	39	40	97.5%
	24 hour	4 – Primula Avenue	29	31	93.5%
	24 hour	5 – Don Mclean Reserve	35	40	87.5%
NO <sub>2</sub>	1 hour	4 – Primula Avenue	605	648	93.4%
CO	1 hour	4 – Primula Avenue	688	744	92.5%
Ambient temperature & relative humidity	1 hour	1 – Yarraville Gardens	832	936	88.9%
	1 hour	2 – Francis Street	737	960	76.8%
	1 hour	3 – Railway Reserve	908	960	94.6%
	1 hour	4 – Primula Avenue	715	744	96.1%
	1 hour	5 – Don Mclean Reserve	833	960	86.8%
Wind speed and direction	1 hour	1 – Yarraville Gardens	512	562	91.1%
	1 hour	2 – Francis Street	248	248	100%

<sup>1</sup> NEPM Technical Paper No. 5 – Data Collection and Handling (May 2001)



	1 hour	3 – Railway Reserve	367	393	93.4%
	1 hour	4 – Primula Avenue	289	323	89.5%
	1 hour	5 – Don Mclean Reserve	382	488	78.3%

## 7.2 Data validation

Data contained in this report has been validated against performance and calibration requirements for each instrument. Data during commissioning, maintenance and calibration periods has been removed from the validated data sets. Appendix A lists the data exceptions for all AAQMS. Missing data periods during automatic calibrations of the gaseous atmospheric contaminants NO<sub>2</sub> and CO are not shown.

## 8.0 DISCUSSION

Table 17 presents the maximum measured concentration during the reporting period at Station 1 for PM<sub>2.5</sub> and PM<sub>10</sub> compared with the respective objectives.

**Table 17: Station 1 Summary – September 2018**

Parameter	Units	Averaging period	Maximum concentration	Air quality objective <sup>A</sup>	Exceedances
PM <sub>2.5</sub>	ug/m <sup>3</sup>	24 hour	25	25	Nil
PM <sub>10</sub>	ug/m <sup>3</sup>	24 hour	35	50	Nil

Notes:

A - SEPP(AAQ) objective

Table 18 presents the maximum measured concentration during the reporting period at Station 2, Station 3 and Station 4 for PM<sub>2.5</sub> and PM<sub>10</sub> compared with the respective objectives.

**Table 18: Station 2, Station 3 and Station 4 Summary – September 2018**

Parameter	Units	Averaging period	Maximum concentration			Air quality objective <sup>A</sup>	Exceedances
			Station 2	Station 3	Station 4		
PM <sub>2.5</sub>	ug/m <sup>3</sup>	24 hour	22	19	19	36	Nil
PM <sub>10</sub>	ug/m <sup>3</sup>	24 hour	29	28	31	60	Nil

Notes:

A- SEPP(AQM) Intervention level

Table 19 presents maximum measured concentration during the reporting period at Station 5 for PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, CO and BTEX compared with the respective objectives.

**Table 19: Station 5 maximum results summary – August 2018**

Parameter	Units	Averaging period	Maximum concentration	Air quality objective	Exceedances
PM <sub>2.5</sub>	ug/m <sup>3</sup>	24 hour	13	36 <sup>A</sup>	Nil
PM <sub>10</sub>	ug/m <sup>3</sup>	24 hour	37	60 <sup>A</sup>	Nil
NO <sub>2</sub>	ppb	1 hour	41	140 <sup>A</sup>	Nil
CO	ppm	1 hour	0.7	29 <sup>A</sup>	Nil

Parameter	Units	Averaging period	Maximum concentration	Air quality objective	Exceedances
Benzene	ppb	24 hour	0.8	3.0 <sup>B</sup>	Nil
Toluene	ppb	24 hour	3.2	1000 <sup>B</sup>	Nil
Total xylene isomers	ppb	24 hour	2.2	250 <sup>B</sup>	Nil

Notes:

A - SEPP(AQM) Intervention level

B - Air NEPM Monitoring investigation level


The September ambient air quality monitoring programme results for this report period were less than the respective air quality objectives for all parameters measured.

## 9.0 IMPORTANT INFORMATION RELATING TO THIS REPORT

Your attention is drawn to the document - "Important Information Relating to this Report" (LEG04, RL2), which is included in Appendix B of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. We would be pleased to answer any questions the reader may have regarding this document.

## Signature Page

Golder Associates Pty Ltd



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AM/MDT/JAS/am

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APPENDIX A

# Data Exceptions

# Data exceptions - September 2018

4/08/2018 12:20	25/08/2018 15:45	1	All channels	Power outage
27/08/2018 21:00	28/08/2018 16:10	1	All channels	Power outage
4/09/2018 11:40	05/09/2018 18:20	1	All channels	Power outage
08/09/2018 09:30	08/09/2018 15:30	1	All channels	Power outage
21/09/2018 06:40	21/08/2018 07:25	1	All channels	Logger error
25/08/2018 20:50	25/09/2018 21:35	1	All channels	Logger error
28/08/2018 16:10	29/08/2018 18:55	1	PM <sub>2.5</sub> / PM <sub>10</sub>	calibration / maintenance
30/09/2018 12:45	30/09/2018 12:25	1	All channels	Logger error
30/09/2018 12:45	30/09/2018 12:25	1	All channels	Logger error
30/09/2018 12:50	30/09/2018 14:50	1	PM <sub>2.5</sub> / PM <sub>10</sub>	calibration / maintenance
30/08/2018 09:50	07/09/2018 15:00	2	All channels	Power company disconnected power supply
07/09/2018 15:05	27/09/2018 23:55	2	PM <sub>2.5</sub> / PM <sub>10</sub>	calibration / maintenance
06/09/2018 11:15	06/09/2018 14:50	3	PM <sub>2.5</sub> / PM <sub>10</sub>	calibration / maintenance
21/09/2018 05:50	21/09/2018 06:35	3	All channels	Logger error
24/09/2018 08:55	24/09/2018 09:40	3	All channels	Logger error
25/09/2018 21:40	25/09/2018 22:25	3	All channels	Logger error
26/06/2018 02:40	26/09/2018 03:25	3	All channels	Logger error
04/09/2018 09:05	08/09/2018 00:00	4	All channels	Power company disconnected power supply
07/09/2018 17:55	07/09/2018 23:55	4	PM <sub>2.5</sub> / PM <sub>10</sub>	calibration / maintenance
09/09/2018 11:45	09/09/2018 15:45	4	All channels	Power outage
04/09/2018 14:20	04/09/2018 16:20	5	NO <sub>x</sub> / CO	calibration / maintenance
04/09/2018 14:35	04/09/2018 15:15	5	PM <sub>2.5</sub> / PM <sub>10</sub>	calibration / maintenance
05/09/2018 11:20	05/09/2018 12:20	5	NO <sub>x</sub>	calibration / maintenance
05/09/2018 11:30	05/09/2018 21:05	5	PM <sub>2.5</sub> / PM <sub>10</sub>	calibration / maintenance
07/09/2018 22:40	07/09/2018 23:25	5	All channels	Logger error
10/09/2018 08:10	10/09/2018 08:35	5	NO <sub>x</sub>	calibration / maintenance
17/09/2018 12:00	17/09/2018 12:15	5	Wind sensor	Wind sensor maintenance
17/09/2018 22:50	17/09/2018 23:35	5	All channels	Logger error
18/09/2018 13:00	18/09/2018 13:50	5	CO	calibration / maintenance
19/09/2018 13:45	19/09/2018 18:20	5	Wind sensor	Wind sensor maintenance
20/09/2018 02:40	20/09/2018 04:30	5	Wind sensor	Intermittent wind sensor

20/09/2018 23:30	21/09/2018 11:50	5	Wind sensor	Wind sensor maintenance
23/09/2018 04:20	23/09/2018 05:35	5	All channels	Logger error
24/09/2018 22:30	24/09/2018 23:15	5	All channels	Logger error
25/09/2018 20:00	25/09/2018 20:45	5	All channels	Logger error

**APPENDIX B**

# Important Information Relating To This Report



## IMPORTANT INFORMATION RELATING TO THIS REPORT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

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The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

**Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification.**





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