

REPORT

Ambient Air Quality Monitoring (AAQM) Report July 2019

West Gate Tunnel Project

Submitted to:

Mr Tim Spawton

CPB JH Joint Venture
West Gate Tunnel Project
Level 11, 5 Bowen Crescent
Melbourne
VIC 3004

Submitted by:

Golder

Building 7, Botanicca Corporate Park 570 – 588 Swan Street Richmond, Victoria 3121
Australia

+61 3 8862 3500

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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 1 July 2019 to 31 July 2019 are presented below.

The following tables present the maximum measured concentration for each parameter at Stations 1, 2, 3, 4, 5 and 6 during the reporting period. The maximum concentration for each parameter is compared with the respective criteria.

Station 1 Summary July 2019

Parameter	Units	Averaging period	Maximum concentration	Air quality objective ^A	Exceedances ^B
PM _{2.5}	ug/m ³	24 hour	33	25	1
PM ₁₀	ug/m ³	24 hour	42	50	Nil

Note:

A - SEPP(AAQ) objective

B - Exceedances refers to the number of individual days the criterion was exceeded at any station

Station 2, Station 3, Station 5 and Station 6 Summary July 2019

Parameter	Units	Averaging period	Maximum concentration				Air quality objective ^A	Exceedances ^B
			Station 2	Station 3	Station 5	Station 6		
PM _{2.5}	ug/m ³	24 hour	45	29	40	23	36	1
PM ₁₀	ug/m ³	24 hour	71	47	63	80	60	1

Note:

A - SEPP(AQM) Intervention level

B - Exceedances refers to the number of individual days the criterion was exceeded at any station

Station 4 Summary July 2019

Parameter	Units	Averaging period	Maximum concentration	Air quality objective	Exceedances ^C
PM _{2.5}	ug/m ³	24 hour	39	36 ^A	1
PM ₁₀	ug/m ³	24 hour	61	60 ^A	1
NO ₂	ppb	1 hour	44	140 ^A	Nil
CO	ppm	1 hour	1.5	29 ^A	Nil
Benzene	ppb	24 hour	<0.5	3.0 ^B	Nil
Toluene	ppb	24 hour	1.4	1000 ^B	Nil
Total xylene isomers	ppb	24 hour	<1.0	250 ^B	Nil

Note:

A - SEPP(AQM) Intervention level

B - Air NEPM Monitoring investigation level

C - Exceedances refers to the number of individual days the criterion was exceeded at any station

PM_{2.5} results for the July 2019 ambient air quality monitoring programme at Station 3 (Railway Reserve) and Station 6 (Millers Road) were less than the respective air quality objectives. PM_{2.5} results at Station 1 (Yarraville Gardens), Station 2 (Francis Street), Station 4 (Primula Avenue) and Station 5 (Donald McLean Reserve) exceeded the PM_{2.5} air quality objective on one day (05/07/2019).

PM₁₀ results for the July 2019 ambient air quality monitoring programme at Station 1 (Yarraville Gardens) and Station 3 (Railway Reserve) were less than the respective air quality objectives. PM₁₀ results for Station 2 (Francis Street), Station 4 (Primula Avenue), Station 5 (Donald McLean Reserve) and Station 6 (Millers Road) exceeded the PM₁₀ air quality objective on one day (05/07/2019).

All other monitored parameters were less than their respective air quality objectives.

A construction area (Millers Road exit ramp and noise wall relocation) is now adjacent Station 4, as a result the measured PM₁₀ concentrations may be impacted by construction activities and may not be representative of traffic emissions.

Data capture statistics for July 2019 were above 90 percent for all parameters at all AAQMS.

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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 1 July 2019 to 31 July 2019 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 (PM₁₀)
- continuous measurement of particulate matter with an equivalent aerodynamic diameter less than 2.5 microns (PM_{2.5})
- 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 PM₁₀ and PM_{2.5}:

- continuous monitoring of oxides of nitrogen ([NO_x] comprising of nitrogen dioxide (NO₂) and nitric oxide [NO])
- continuous monitoring of carbon monoxide (CO)
- one in six day monitoring of benzene, toluene, ethylbenzene and xylene isomers (BTEX)
- continuous measurement of atmospheric pressure.

AAQMS Station 1 to Station 6 were installed and commissioned during the period 22/08/2018 to 12/10/2018. 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 ₁₀ and PM _{2.5} Ambient temperature, relative humidity, wind speed and wind direction
Station 2	51-53 Francis Street	-37.821800°S 144.894383°E	PM ₁₀ and PM _{2.5} Ambient temperature, relative humidity, wind speed and wind direction
Station 3	Railway Lot 64, (part) 15 Goulburn Street, Yarraville	-37.814063°S 144.891320°E	PM ₁₀ and PM _{2.5} Ambient temperature, relative humidity, wind speed and wind direction
Station 4	44 Primula Avenue, Brooklyn	-37.824284°S 144.846425°E	PM ₁₀ and PM _{2.5} NO, NO ₂ , NO _x and CO BTEX – one in six day sampling (24 hour average)

Site name	Location	Coordinates	Monitoring parameters
			Ambient temperature, relative humidity, atmospheric pressure, wind speed and wind direction
Station 5	Donald McLean Reserve, Spotswood	-37.826442°S 144.882133°E	PM ₁₀ and PM _{2.5} Ambient temperature, relative humidity, atmospheric pressure, wind speed and wind direction
Station 6	44 Millers Road Brooklyn	-37.821252°S 144.848878°E	PM ₁₀ and PM _{2.5} Ambient temperature and relative humidity

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 (Millers Road) was commissioned on 12/10/2018. Meteorological sensors (wind speed 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	Station 6
AAQMS	23/08/2018	22/08/2018	22/08/2018	22/08/2018	31/08/2018	12/10/2018
Wind speed & direction	07/09/2018	20/09/2018	14/09/2018	10/09/2018	17/09/2018	23/11/2018 ^A

A – wind sensor is not compliant with siting criteria specified in AS 3580.14

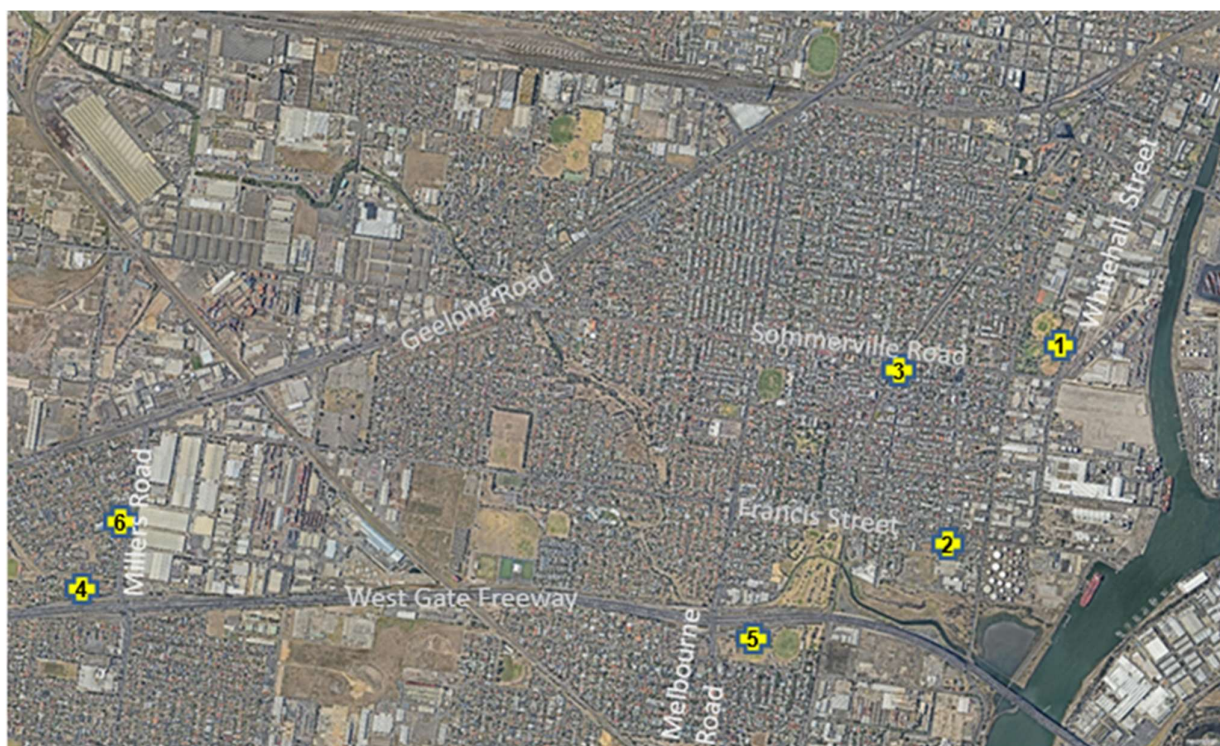


Figure 1: West Gate Tunnel AAQMS site locations

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	✓	✓	✓	✓	✓	✓

Station	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
Station type	Neighbourhood	Peak	Peak	Peak	Peak	Peak
10 m from drip line of trees	✓	✓	✓	✓	✓	✗ ^A
No extraneous sources nearby	✓	✓	✓	✗ ^B	✓	✗ ^C
Greater than 50 m from road ($\leq 10,000$ 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 Temporary construction area for Millers Road noise wall and exit ramp relocation works
 C 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 _{2.5}	Beta Attenuation Monitor (BAM)	Thermo Fisher Scientific Inc.	5014i
PM ₁₀	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
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 CRITERIA

The ambient air quality criteria applicable to the West Gate Tunnel Project are derived from the following legislation:

- 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, NO₂, and particles (as PM₁₀ and PM_{2.5}). 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 (Donald 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 ₁₀	µg/m ³	50	24 hour
			20	Annual
	PM _{2.5}		25	24 hour
			8	Annual
Station 2 Station 3 Station 4 Station 5 Station 6	PM ₁₀	µg/m ³	60	24 hour
	PM _{2.5}		36	
Station 4	CO	ppm	29	1 hour
	NO ₂	ppb	140	1 hour
	Benzene	ppb	3	Annual

Location	Pollutant	Units	Air Quality Objective	Averaging period
Station 4	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_{2.5})

PM_{2.5} 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_{2.5} 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_{2.5} 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_{2.5} Beta Attenuation Monitors”* (NATA Laboratory Accreditation No. 1910).

4.2 Particulate matter (PM₁₀)

PM₁₀ concentrations are determined using a continuous BAM without an in-line PM_{2.5} particle size separator. All other measurement processes remain the same as for the PM_{2.5} test method.

The PM₁₀ 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 – PM₁₀ Beta Attenuation Monitors”* (NATA Laboratory Accreditation No. 1910).

4.3 Nitrogen dioxide (NO₂)

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, NO₂ and NO_x) 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_{2.5}

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

5.2 PM₁₀

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

5.3 NO₂

The measurement uncertainty for NO, NO₂ and NO_x 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 ^A
Wind speed	Greater of ± 0.6 m/s or 5%
Wind direction	$\pm 5^\circ$
Barometric pressure	± 3 hPa
Temperature	$\pm 6\%$
Relative humidity	$\pm 5 - 7\%$ 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	Last Calibration Date	Calibration Type
Station 1	PM ₁₀	05/07/2019	Monthly
	PM _{2.5}	05/07/2019	Monthly
	Wind speed and direction	9/08/2018	Two yearly
Station 2	PM ₁₀	17/07/2019	Monthly
	PM _{2.5}	17/07/2019	Monthly
	Wind speed and direction	7/08/2018	Two yearly
Station 3	PM ₁₀	17/07/2019	Monthly
	PM _{2.5}	17/07/2019	Monthly
	Wind speed and direction	10/08/2019	Two yearly
Station 4	PM ₁₀	16/07/2019	Monthly
	PM _{2.5}	16/07/2019	Monthly
	NO/ NO ₂ / NO _x	16/07/2019	Monthly
	CO	16/07/2019	Monthly

Location	Parameter	Last Calibration Date	Calibration Type
Station 4	BTEX	NA	Flow-controllers and canisters certified by lab
	Wind speed and direction	10/08/2018	Two yearly
Station 5	PM ₁₀	17/07/2019	Monthly
	PM _{2.5}	17/07/2019	Monthly
	Wind speed and direction	7/08/2019	Two yearly
Station 6	PM ₁₀	16/07/2019	Monthly
	PM _{2.5}	16/07/2019	Monthly

6.0 RESULTS

The monitoring results for 1 July 2019 to 31 July 2019 are presented in the following sections.

6.1 Particulate matter (BAM PM_{2.5} & PM₁₀)

PM_{2.5} and PM₁₀ were continuously monitored and 5-minute averages logged. The 5-minute average data was transformed to 24 hour averages for reporting.

PM_{2.5} and PM₁₀ concentration statistics from the reporting period for Station 1 to Station 6 are presented in Table 8 to Table 13. The 24 hour average plots for Station 1 to Station 6 are presented in Figure 2 to Figure 7.

6.1.1 Station 1 – Yarraville Gardens

Table 8: Station 1 (Yarraville Gardens AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	33	29	24	17	13	7.1	5.2	25
PM ₁₀	42	38	34	26	22	14	10	50

Note:

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

B SEPP(AAQ) Objective

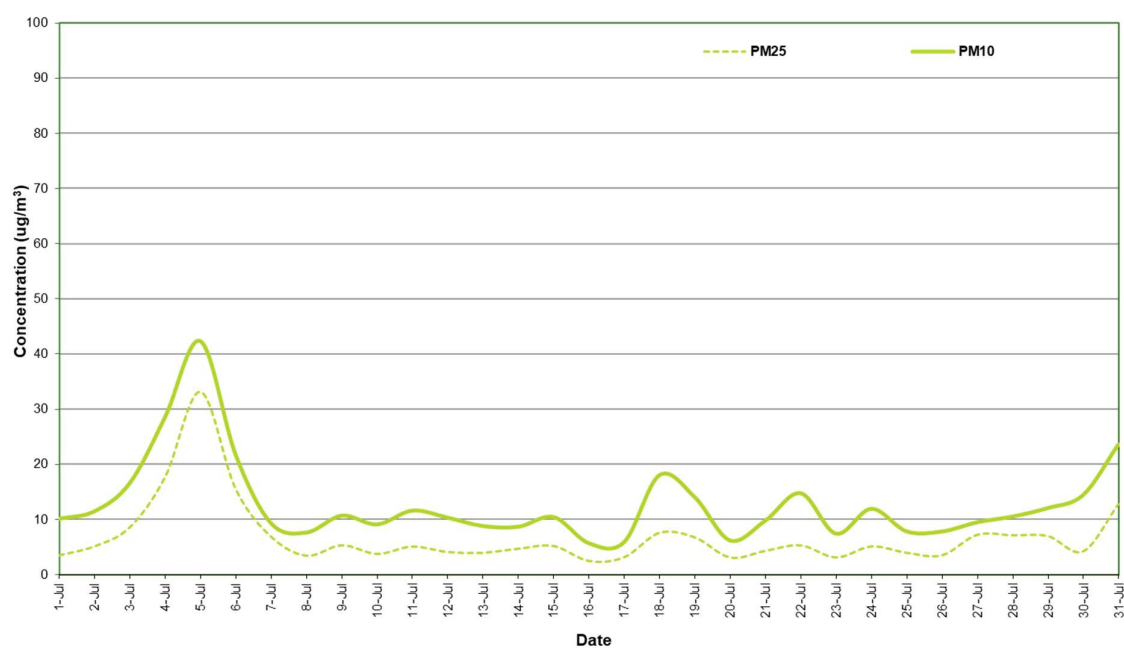


Figure 2: Station 1 PM_{2.5} and PM₁₀ concentration (24 hour average) – July 2019

6.1.2 Station 2 – Francis Street

Table 9: Station 2 (Francis Street AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	45	39	32	22	14	10	7.0	36
PM ₁₀	71	63	55	40	34	26	16	60

Note:

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

B SEPP(AQM) Intervention level

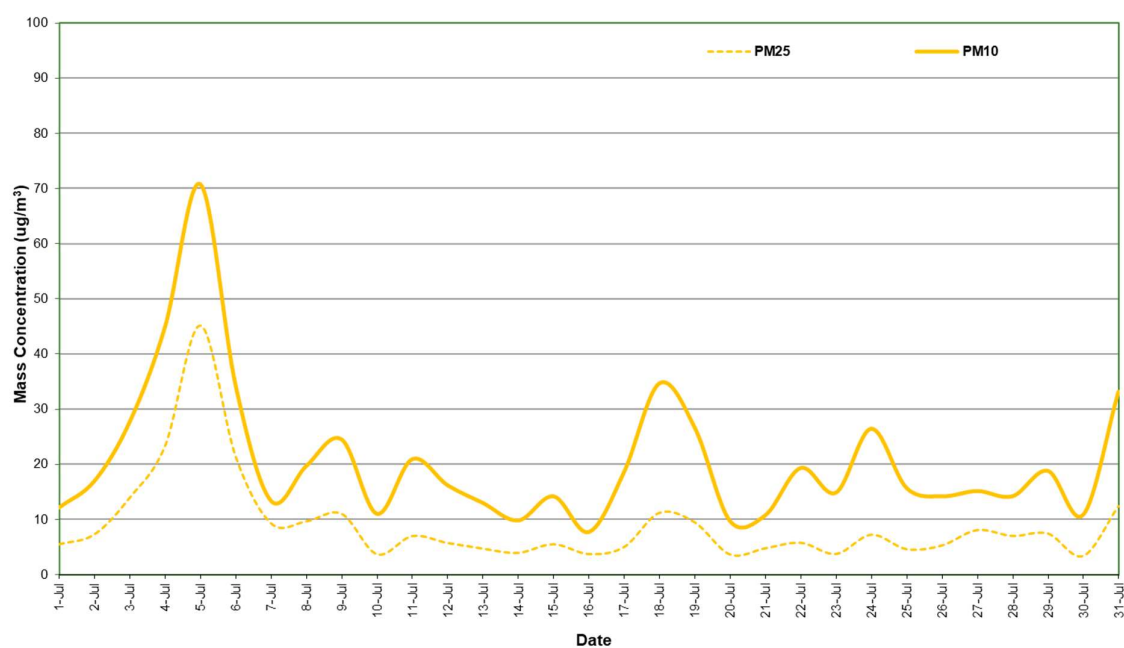


Figure 3: Station 2 PM_{2.5} and PM₁₀ concentration (24 Hour Average) – July 2019

6.1.3 Station 3 – Railway Reserve

Table 10: Station 3 (Railway Reserve AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	29	25	21	15	10	6.7	4.5	36
PM ₁₀	47	43	39	28	23	16	11	60

Note:

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

B SEPP(AQM) Intervention level

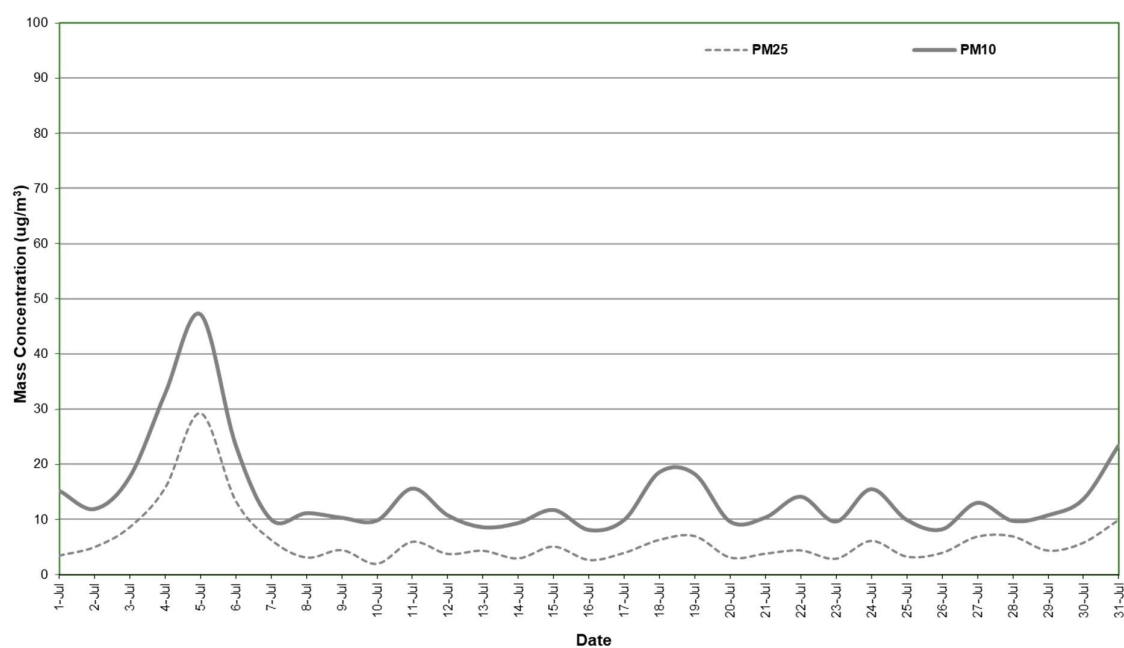


Figure 4: Station 3 PM_{2.5} and PM₁₀ concentration (24 hour average) – July 2019

6.1.4 Station 4 – Primula Avenue

Table 11: Station 4 (Primula Avenue AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	(µg/m ³)
PM _{2.5}	39	34	30	21	17	9.4	7.3	36
PM ₁₀	61	56	52	44	36	25	17	60

Note:

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

B SEPP(AQM) Intervention level

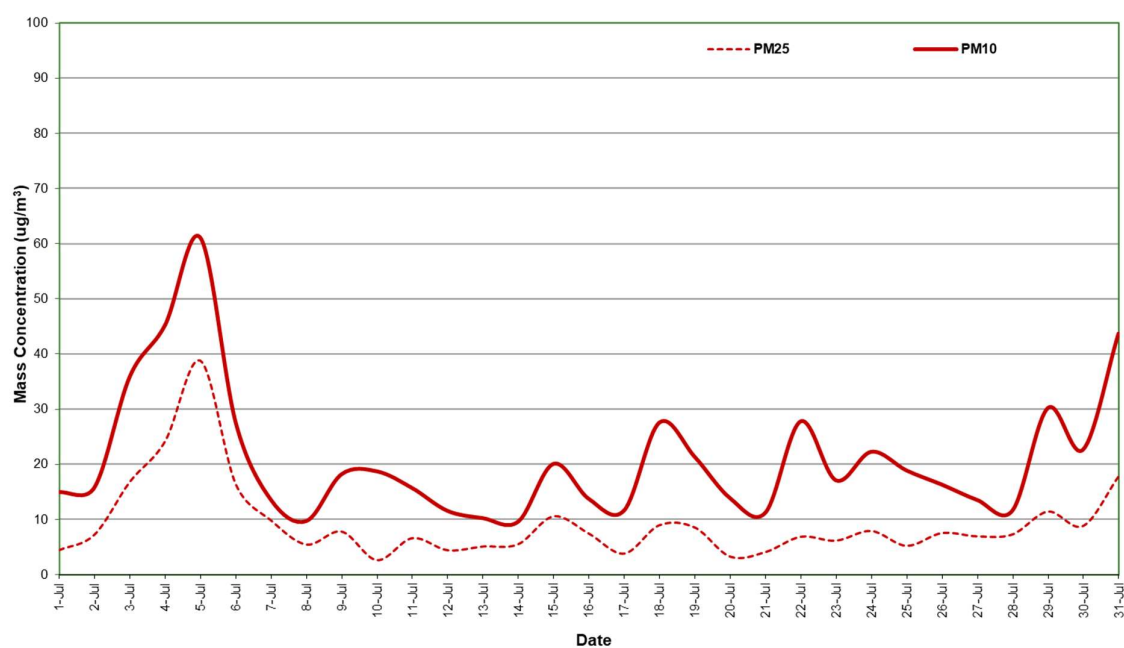


Figure 5: Station 4 PM_{2.5} and PM₁₀ concentration (24 hour average) – July 2019

6.1.5 Station 5 – Donald McLean Reserve

Table 12: Station 5 (Donald McLean Reserve AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	40	34	29	20	16	12	8.2	36
PM ₁₀	63	56	49	39	32	25	17	60

Note:

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

B SEPP(AQM) Intervention level

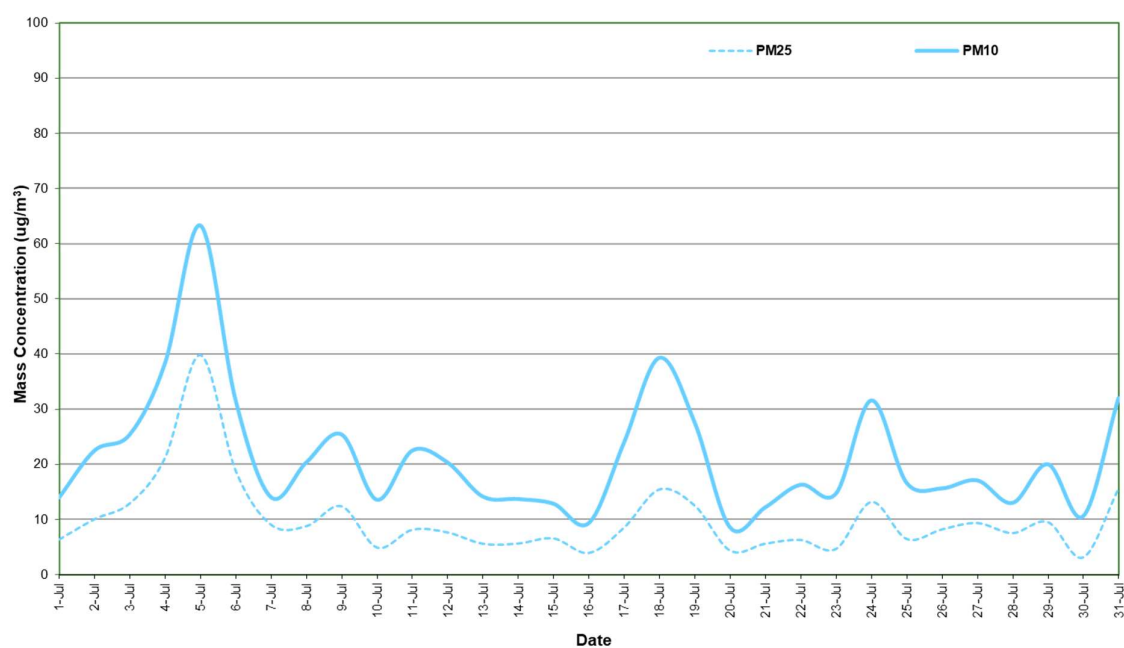


Figure 6: Station 5 PM_{2.5} and PM₁₀ concentration (24 hour average) – July 2019

6.1.6 Station 6 – Millers Road

Table 13: Station 6 (Millers Road AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	23	22	20	15	11	6.9	5.2	36
PM ₁₀	80	74	68	54	43	32	21	60

Note:

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

B SEPP(AQM) Intervention level

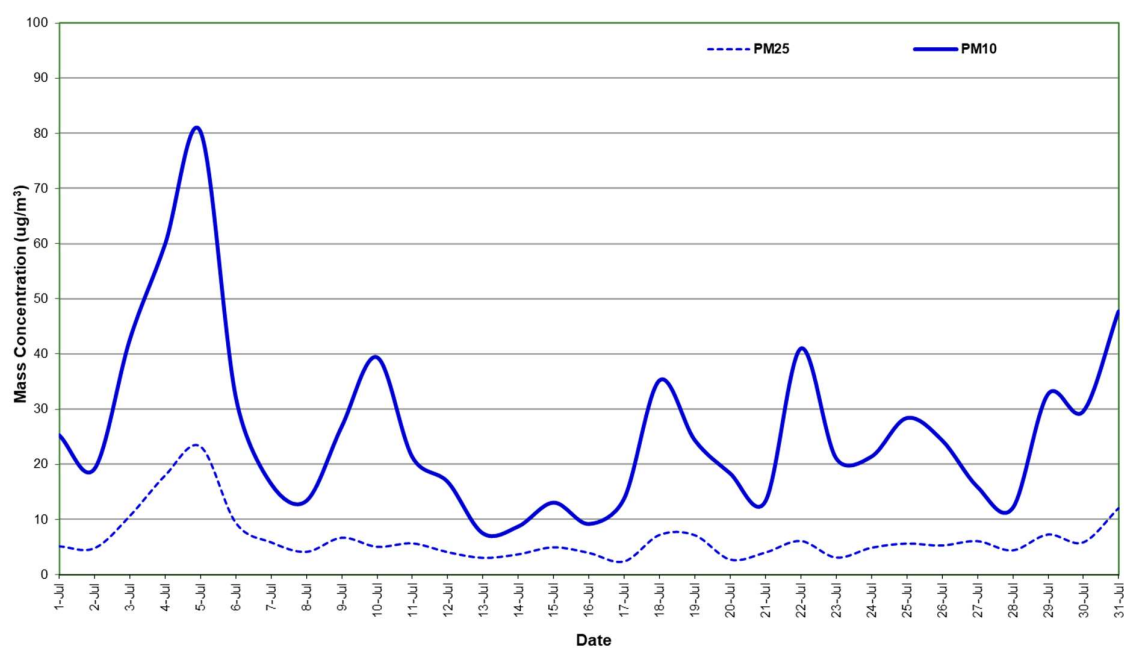


Figure 7: Station 6 PM_{2.5} and PM₁₀ concentration (24 hour average) – July 2019

6.1.7 Combined PM_{2.5} mass concentrations

Combined plots of the AAQMS PM_{2.5} and PM₁₀ are presented in Figure 8 and Figure 9 respectively.

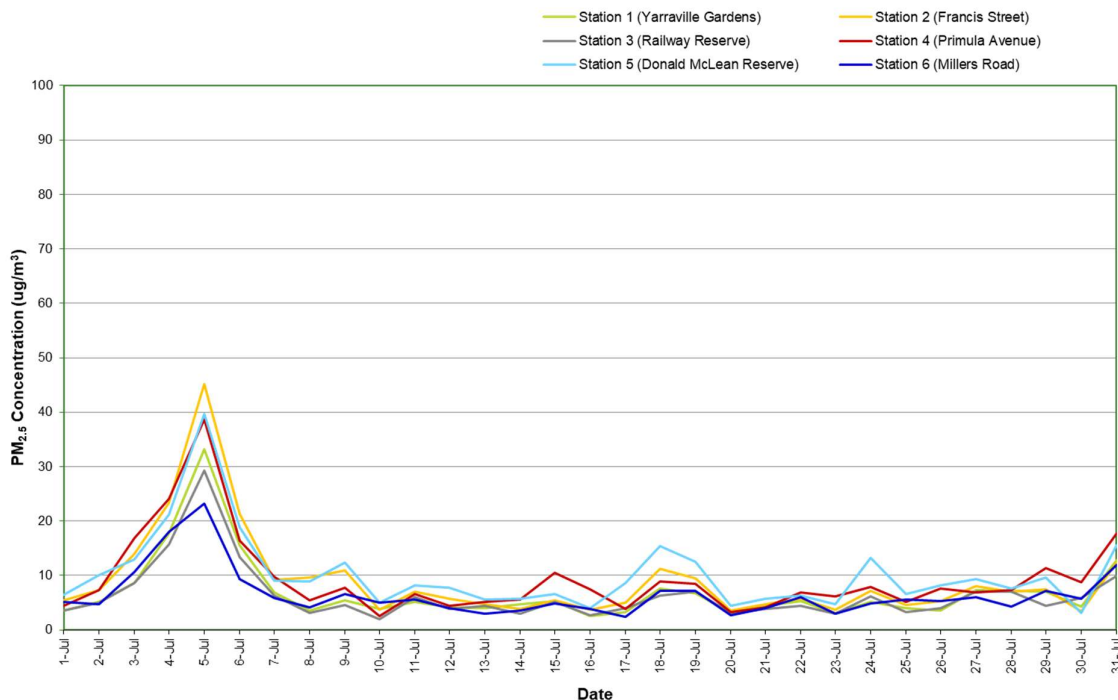


Figure 8: Combined PM_{2.5} concentration (24 hour average) – July 2019

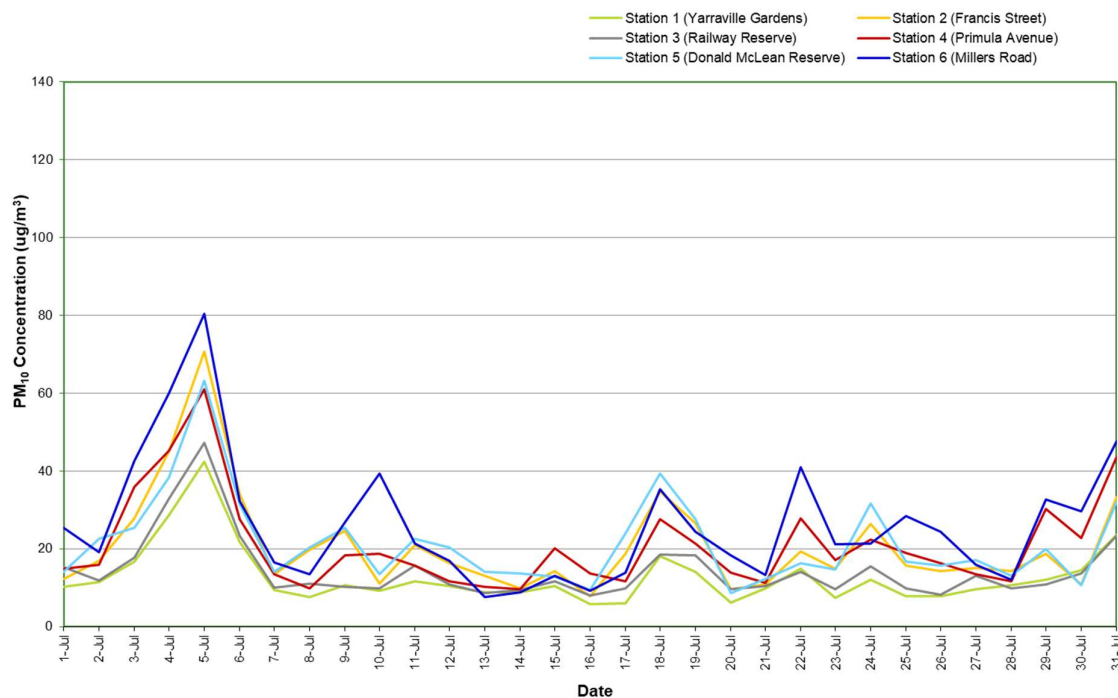


Figure 9: Combined PM₁₀ concentration (24 hour average) – July 2019

6.2 Nitrogen dioxide (NO₂)

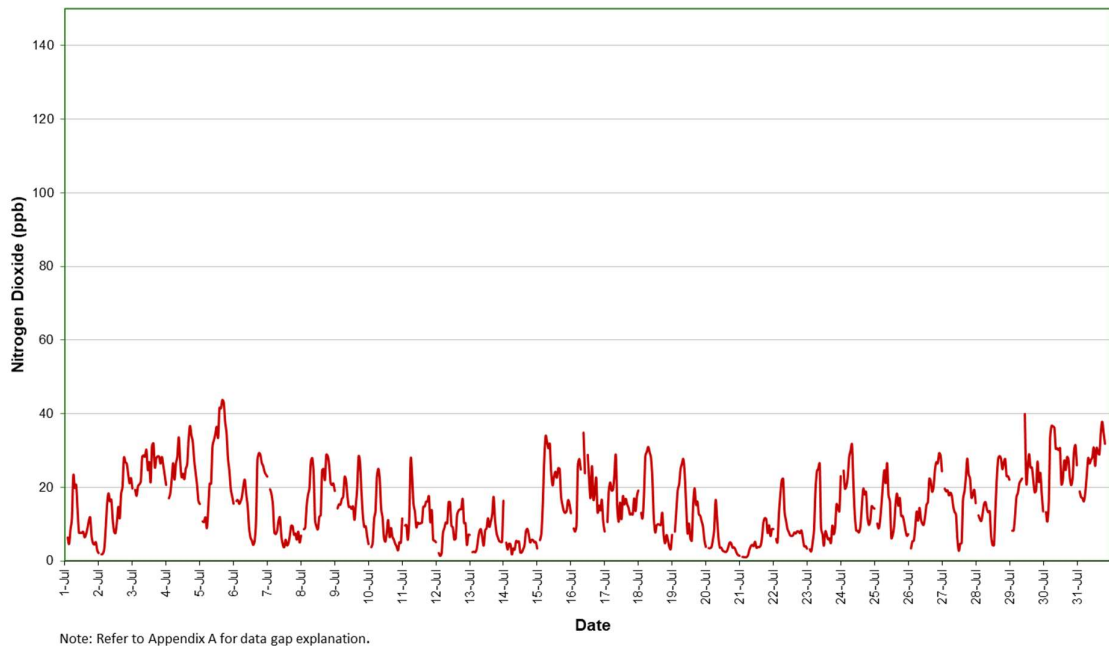
NO₂ (1 hour average) mass concentration statistics for the reporting period are given in Table 14. A plot of NO₂ (1 hour average) mass concentration for the reporting period is presented in Figure 10.

Table 14: Station 4 (Primula Avenue AAQMS) NO₂ percentiles (1 hour average)

Parameter	Concentration (ppb) ^A							SEPP (AQM) intervention level
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	(ppb)
NO ₂	44	37	35	31	28	22	14	140

Note:

A Parts per billion



Note: Refer to Appendix A for data gap explanation.

Figure 10: Station 4 NO₂ concentration (1 hour average) – July 2019

6.3 Carbon monoxide (CO)

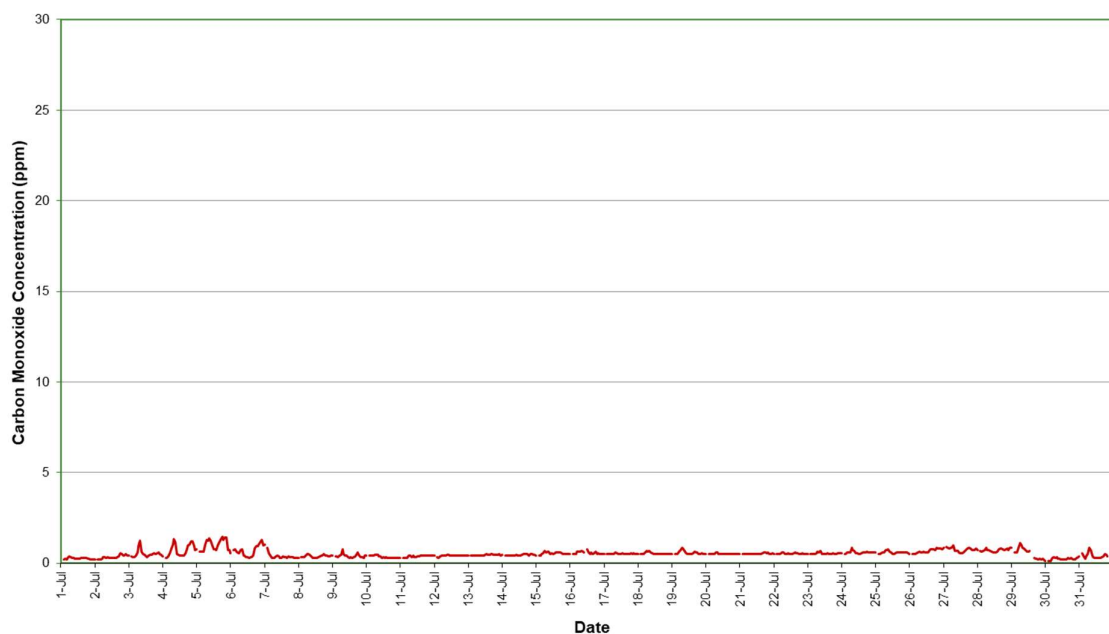
CO (1 hour average) mass concentration statistics for the reporting period are given in Table 15. A plot of CO (1 hour average) concentration for the reporting period is presented with the SEPP(AQM) Schedule B CO Intervention Level of 29 ppm (1 hour average) in Figure 11.

Table 15: Station 4 (Primula Avenue AAQMS) CO percentiles (1 hour average)

Parameter	Concentration (ppm) ^A							SEPP (AQM) intervention level
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	(ppm)
CO	1.5	1.3	1.2	0.9	0.8	0.6	0.5	29

Note:

A Parts per million



Note: Refer to Appendix A for data gap explanation.

Figure 11: Station 4 CO concentration (1 hour average) – July 2019

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. SSP65885 and SSP66197).

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 16. Laboratory certificates are presented in Appendix B.

Table 16: Station 4 - Primula Avenue AAQMS BTEX concentrations (24 hour average)

Date	Sample no.	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Total xylene isomers (ppb)
02-07-2019	19-940	<0.5	0.6	<0.5	<1.0
08-07-2019	19-1055	<0.5	0.8	<0.5	<1.0
14-07-2019	19-1054	<0.5	<0.5	<0.5	<1.0
20-07-2019	19-1076	<0.5	1.4	<0.5	<1.0
26-07-2019	19-1077	<0.5	<0.5	<0.5	<1.0
NEPM MIL ^A		3.0 ^B	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.

Analysis date: 11/07/2019 (19-940), 5/08/2019 (19-1055, 19-1054, 19-1076, 19-1077).

6.5 Meteorological parameters

6.5.1 Ambient temperature

Ambient Temperature data for all AAQMS sites are presented in Figure 12 for the reporting period.

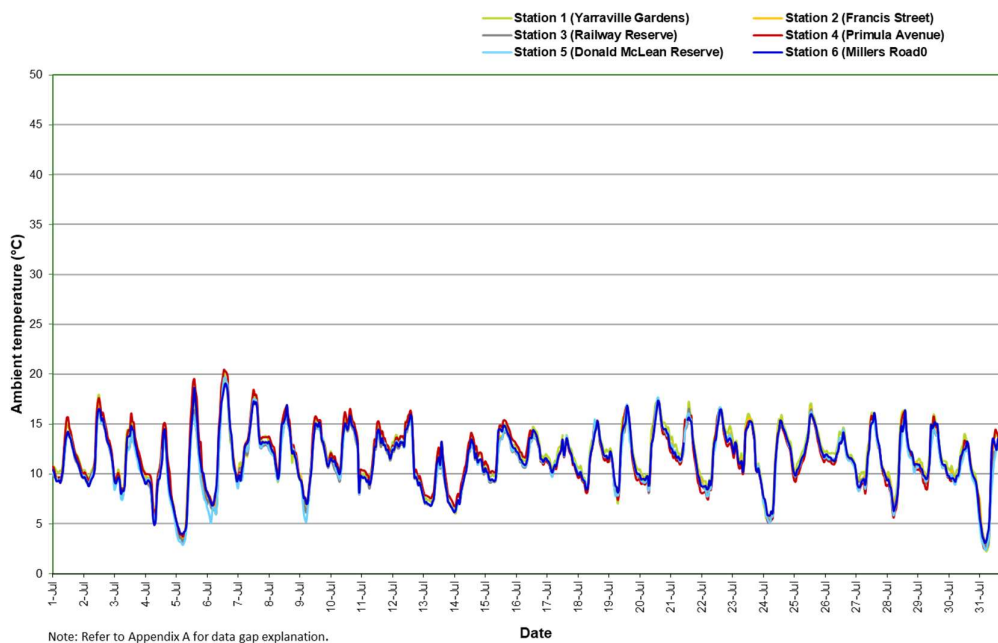


Figure 12: Ambient temperature (1 hour average) All AAQMS – July 2019

6.5.2 Relative humidity

Relative Humidity data for all AAQMS sites are presented in Figure 13 for the reporting period.

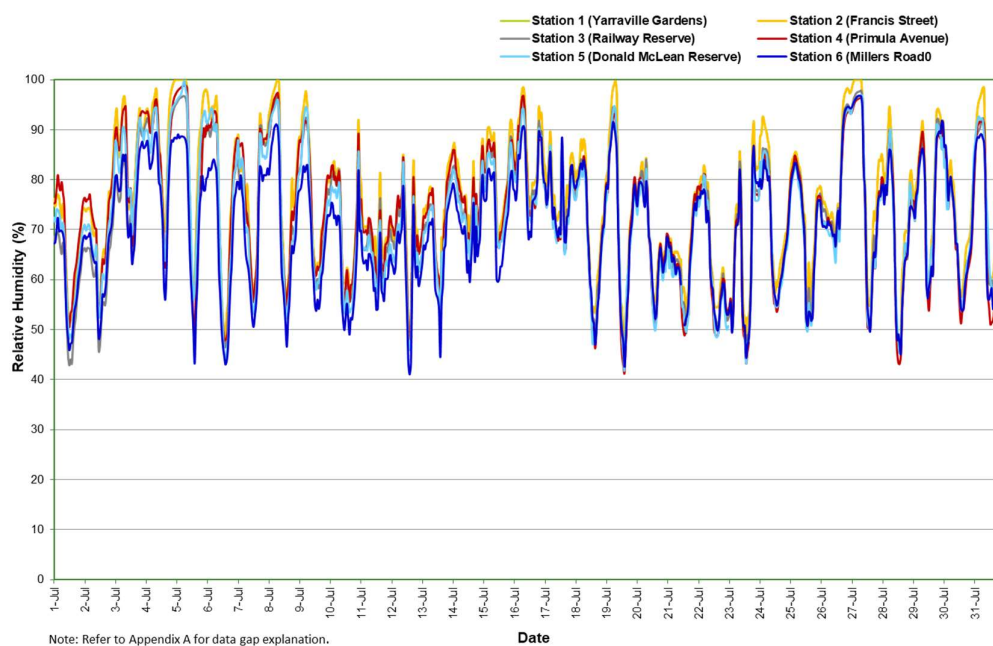


Figure 13: Relative humidity (1 hour average) All AAQMs – July 2019

6.5.3 Atmospheric pressure

Atmospheric pressure data for Station 4 (Primula Avenue AAQMS) is presented in Figure 14 for the reporting period.



Figure 14: Atmospheric pressure (1 hour average) Station 4 Primula Avenue - July 2019

6.5.4 Wind speed

Wind Speed data for all AAQMS sites are presented in Figure 15 for the reporting period.

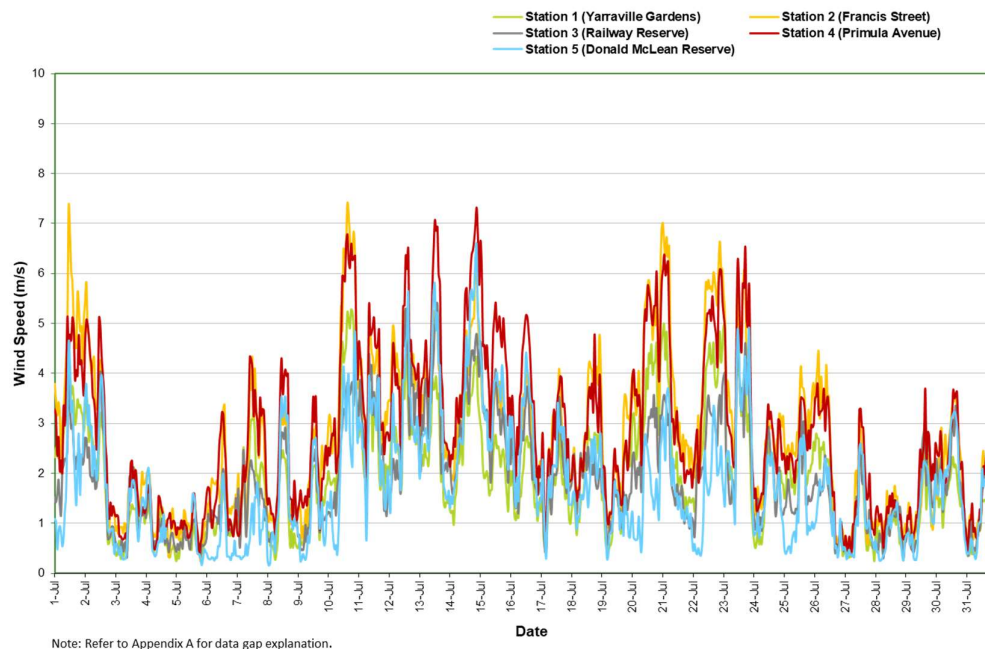


Figure 15: Wind speed (1 hour average) All AAQMs – July 2019

6.5.5 Wind rose – Station 1 (Yarraville Gardens)

A wind rose (1 hour average) for Yarraville Gardens AAQMS is presented in Figure 16.

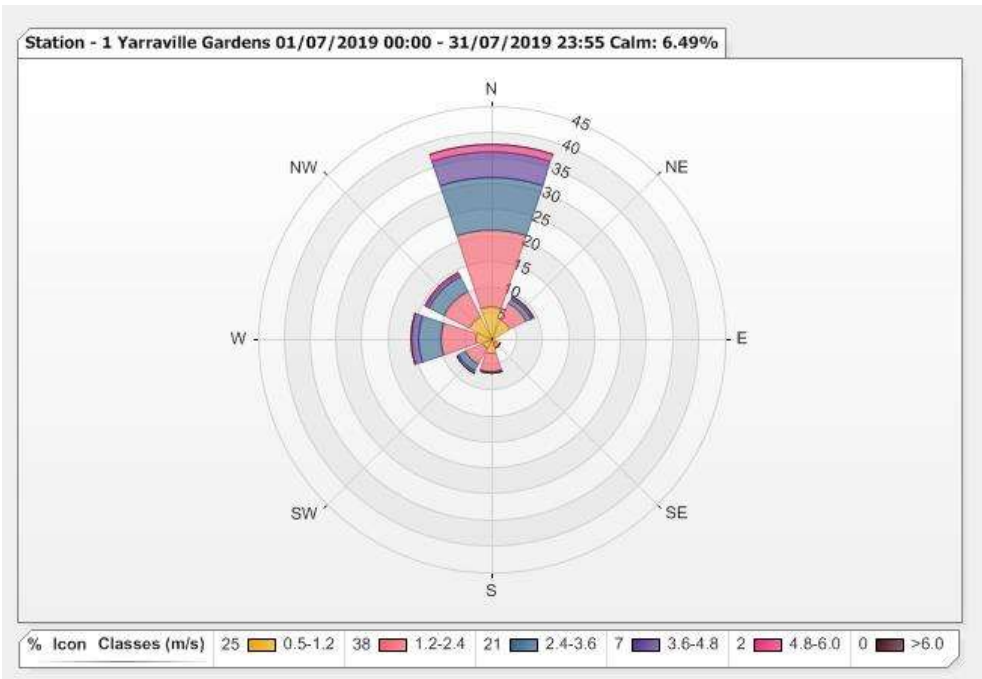


Figure 16: Wind speed (1 hour average) Station 1 - Yarraville Gardens

6.5.6 Wind rose – Station 2 (Francis Street)

A wind rose (1 hour average) for Station 2 (Francis Street AAQMS) is presented in Figure 17.

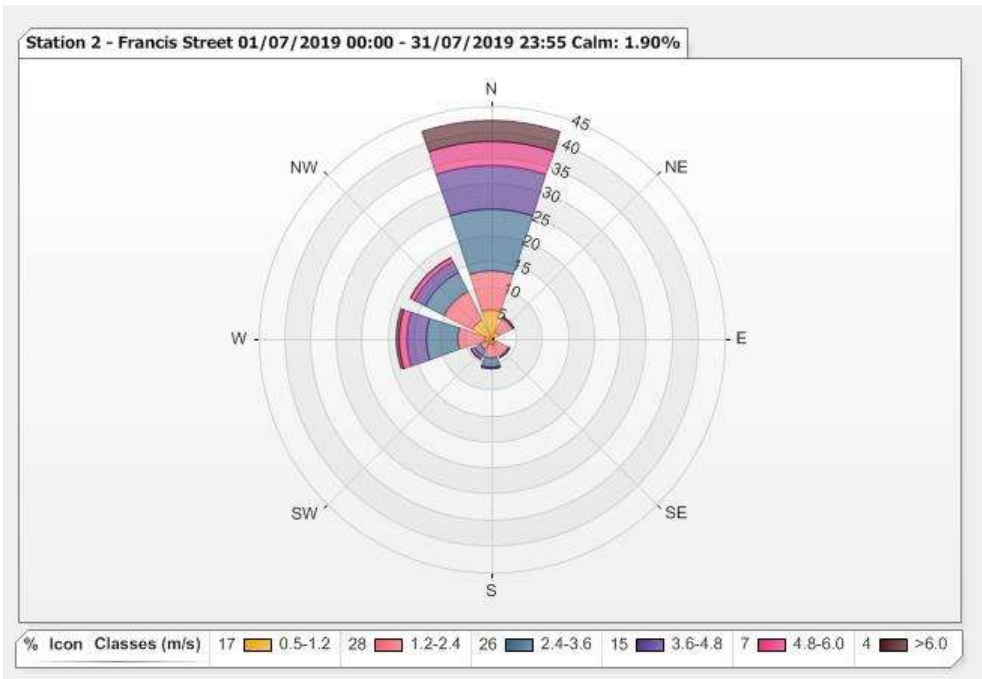


Figure 17: Wind speed (1 hour average) Station 2 - Francis Street

6.5.7 Wind rose – Station 3 (Railway Reserve)

A wind rose (1 hour average) for Station 3 (Railway Reserve AAQMS) is presented in Figure 18.

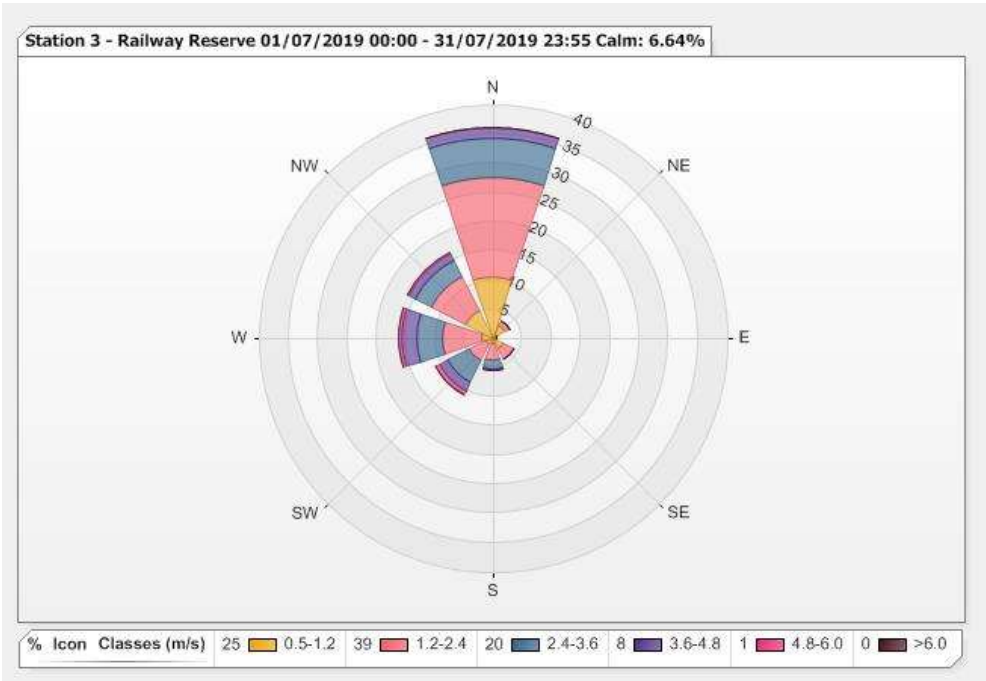


Figure 18: Wind speed (1 hour average) Station 3 Railway Reserve

6.5.8 Wind rose – Station 4 (Primula Avenue)

A wind rose (1 hour average) for Station 4 (Primula Avenue AAQMS) is presented in Figure 19.

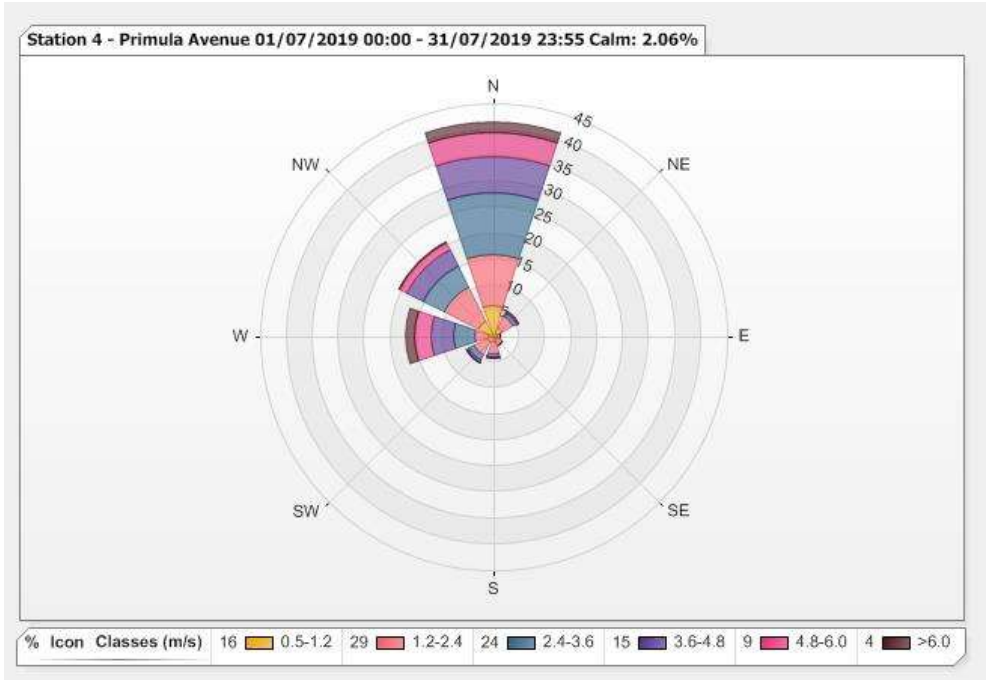


Figure 19: Wind speed (1 hour average) Station 4 Primula Avenue

6.5.9 Wind rose – Station 5 (Donald McLean Reserve)

A wind rose (1 hour average) for Station 5 (Donald McLean Reserve AAQMS) is presented in Figure 20.

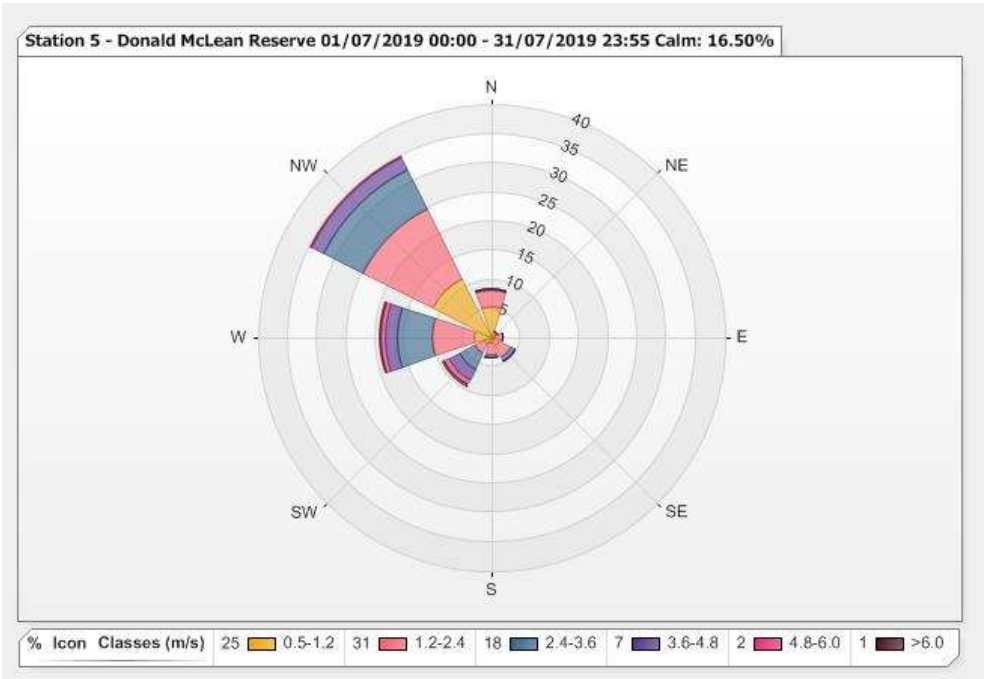


Figure 20: Wind speed (1 hour average) Station 5 Donald McLean Reserve

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 NO₂ and CO daily to monitor and correct instrument drift where necessary. NO₂ and CO automatic calibrations are conducted once per day between 01:00 and 01:45 hours.

Data capture statistics for the reporting period 1 July to 31 July 2019 are shown in Table 17. Averages were only collected for those periods where the 5 minute data constituted 75% data capture.

Data capture statistics for July 2019 were above 90 percent for all parameters at all stations.

Table 17: Data capture

Parameter	Averaging period	Station	Collected periods	Available periods	Data capture ¹
PM _{2.5}	24 hour	1 – Yarraville Gardens	31	31	100%
	24 hour	2 – Francis Street	31	31	100%
	24 hour	3 – Railway Reserve	31	31	100%
	24 hour	4 – Primula Avenue	31	31	100%
	24 hour	5 – Donald McLean Reserve	31	31	100%
	24 hour	6 – Millers Road	31	31	100%
PM ₁₀	24 hour	1 – Yarraville Gardens	31	31	100%
	24 hour	2 – Francis Street	31	31	100%
	24 hour	3 – Railway Reserve	31	31	100%
	24 hour	4 – Primula Avenue	31	31	100%
	24 hour	5 – Donald McLean Reserve	31	31	100%
	24 hour	6 – Millers Road	31	31	100%
NO ₂	1 hour	4 – Primula Avenue	708	744	95%
CO	1 hour	4 – Primula Avenue	708	744	95%
Ambient temperature & relative humidity	1 hour	1 – Yarraville Gardens	742	744	100%
	1 hour	2 – Francis Street	739	744	99%
	1 hour	3 – Railway Reserve	741	744	100%
	1 hour	4 – Primula Avenue	744	744	100%
	1 hour	5 – Donald McLean Reserve	732	744	98%
	1 hour	6 – Millers Road	743	744	100%
Atmospheric pressure	1 hour	4 – Primula Avenue	744	744	100%

Wind speed and direction	1 hour	1 – Yarraville Gardens	744	744	100%
	1 hour	2 – Francis Street	744	744	100%
	1 hour	3 – Railway Reserve	744	744	100%
	1 hour	4 – Primula Avenue	742	744	100%
	1 hour	5 – Donald McLean Reserve	726	744	98%

Note:

1 Rounded to two significant figures

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 NO₂ and CO are not shown.

8.0 DISCUSSION

Table 18 presents the maximum measured concentration during the reporting period at Station 1 for PM_{2.5} and PM₁₀ compared with the respective criteria.

Table 18: Station 1 Summary – July 2019

Parameter	Units	Averaging period	Maximum concentration	Air quality objective ^A	Exceedances ^B
PM _{2.5}	ug/m ³	24 hour	33	25	1
PM ₁₀	ug/m ³	24 hour	42	50	Nil

Notes:

A - SEPP(AAQ) objective

B - Exceedances refers to the number of individual days the criterion was exceeded at any station.

Table 19 presents the maximum measured concentration during the reporting period at Station 2, Station 3, Station 5 and Station 6 for PM_{2.5} and PM₁₀ compared with the respective criteria.

Table 19: Station 2, Station 3, Station 5 and Station 6 Summary – July 2019

Parameter	Units	Averaging period	Maximum concentration				Air quality objective ^A	Exceedances ^B
			Station 2	Station 3	Station 5	Station 6		
PM _{2.5}	ug/m ³	24 hour	45	29	40	23	36	1
PM ₁₀	ug/m ³	24 hour	71	47	63	80	60	1

Notes:

A - SEPP(AQM) Intervention level

B - Exceedances refers to the number of individual days the criterion was exceeded at any station

Table 20 presents maximum measured concentration during the reporting period at Station 4 for PM_{2.5}, PM₁₀, NO₂, CO and BTEX compared with the respective criteria.

Table 20: Station 4 Summary – July 2019

Parameter	Units	Averaging period	Maximum concentration	Air quality objective	Exceedances ^c
PM _{2.5}	ug/m ³	24 hour	39	36 ^A	1
PM ₁₀	ug/m ³	24 hour	61	60 ^A	1
NO ₂	ppb	1 hour	44	140 ^A	Nil
CO	ppm	1 hour	1.5	29 ^A	Nil
Benzene	ppb	24 hour	<0.5	3.0 ^B	Nil
Toluene	ppb	24 hour	1.4	1000 ^B	Nil
Total xylene isomers	ppb	24 hour	<1.0	250 ^B	Nil

Notes:

A - SEPP(AQM) Intervention level

B - Air NEPM Monitoring investigation level

C - Exceedances refers to the number of individual days the criterion was exceeded at any station.

PM_{2.5} results for the July 2019 ambient air quality monitoring programme at Station 3 (Railway Reserve) and Station 6 (Millers Road) were less than the respective air quality objectives. PM_{2.5} results at Station 1 (Yarraville Gardens), Station 2 (Francis Street), Station 4 (Primula Avenue) and Station 5 (Donald McLean Reserve) exceeded the PM_{2.5} air quality objective on one day (05/07/2019).

PM₁₀ results for the July 2019 ambient air quality monitoring programme at Station 1 (Yarraville Gardens) and Station 3 (Railway Reserve) were less than the respective air quality objectives. PM₁₀ results for Station 2 (Francis Street), Station 4 (Primula Avenue), Station 5 (Donald McLean Reserve) and Station 6 (Millers Road) exceeded the PM₁₀ air quality objective on one day (05/07/2019).

All other monitored parameters were less than their respective air quality objectives.

A construction area (Millers Road exit ramp and noise wall relocation) is now adjacent Station 4, as a result the measured PM₁₀ concentrations may be impacted by construction activities and may not be representative of traffic emissions.

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 C 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

Anthony Myszka
Environmental Technician

Mark Tulau
Senior Environmental Scientist

AM/MDT/am

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APPENDIX A

Data Exceptions

Date from	Date to	Station	Parameters	Reason
01/07/2019 00:05	01/07/2019 08:30	3	PM ₁₀	Invalid data ¹
01/07/2019 11:10	01/07/2019 11:30	1	PM _{2.5}	Invalid data ¹
01/07/2019 11:40	01/07/2019 14:00	1	PM _{2.5}	Invalid data ¹
02/07/2019 13:50	02/07/2019 15:10	1	PM _{2.5}	Invalid data ¹
03/07/2019 11:50	03/07/2019 12:35	2	Temperature, RH	Maintenance / calibration
03/07/2019 11:50	03/07/2019 16:55	3	PM ₁₀ , PM _{2.5}	Maintenance / calibration
03/07/2019 12:00	03/07/2019 14:00	2	PM _{2.5}	Maintenance / calibration
06/07/2019 14:30	06/07/2019 17:50	3	PM ₁₀	Invalid data ¹
09/07/2019 23:15	09/07/2019 23:50	4	PM ₁₀ , PM _{2.5}	Power failure
09/07/2019 23:15	09/07/2019 23:55	6	PM ₁₀	Power failure
09/07/2019 23:15	09/07/2019 23:55	6	PM _{2.5}	Power failure
11/07/2019 00:25	11/07/2019 02:45	3	PM ₁₀	Invalid data ¹
14/07/2019 08:30	14/07/2019 10:15	3	PM ₁₀	Invalid data ¹
16/07/2019 07:15	16/07/2019 11:00	3	PM ₁₀	Invalid data ¹
16/07/2019 07:55	16/07/2019 08:30	4	NO, NO ₂ , NO _x	Invalid data ¹
16/07/2019 11:05	16/07/2019 11:30	4	NO, NO ₂ , NO _x	Maintenance / calibration
16/07/2019 11:05	16/07/2019 11:40	4	CO	Maintenance / calibration
16/07/2019 12:10	16/07/2019 12:55	4	PM _{2.5}	Maintenance / calibration
16/07/2019 12:10	16/07/2019 17:00	4	PM ₁₀	Maintenance / calibration
16/07/2019 13:20	16/07/2019 14:00	6	PM ₁₀	Invalid data ¹
16/07/2019 13:45	16/07/2019 14:15	6	PM _{2.5}	Maintenance / calibration
17/07/2019 10:25	17/07/2019 13:05	5	PM _{2.5}	Maintenance / calibration

Date from	Date to	Station	Parameters	Reason
17/07/2019 10:35	17/07/2019 15:00	5	PM ₁₀	Maintenance / calibration
17/07/2019 11:25	17/07/2019 12:00	2	PM ₁₀ , PM _{2.5}	Maintenance / calibration
17/07/2019 11:25	17/07/2019 12:00	2	Temperature, RH	Maintenance / calibration
17/07/2019 12:40	17/07/2019 13:45	3	PM ₁₀	Maintenance / calibration
17/07/2019 12:40	17/07/2019 17:05	3	PM _{2.5}	Maintenance / calibration
17/07/2019 12:40	17/07/2019 13:10	3	Temperature, RH	Maintenance / calibration
17/07/2019 14:00	17/07/2019 19:10	1	PM ₁₀ , PM _{2.5}	Maintenance / calibration
18/07/2019 12:10	18/07/2019 12:50	1	PM _{2.5}	Maintenance / calibration
18/07/2019 12:20	18/07/2019 12:30	1	PM ₁₀	Maintenance / calibration
18/07/2019 13:15	18/07/2019 13:25	2	PM ₁₀	Maintenance / calibration
18/07/2019 13:15	18/07/2019 14:50	2	Temperature, RH	Maintenance / calibration
18/07/2019 13:20	18/07/2019 18:50	2	PM _{2.5}	Maintenance / calibration
19/07/2019 22:20	20/07/2019 11:15	3	PM ₁₀	Invalid data ¹
25/07/2019 04:00	25/07/2019 07:55	3	PM ₁₀	Invalid data ¹
26/07/2019 00:45	26/07/2019 03:35	1	PM _{2.5}	Invalid data ¹
29/07/2019 10:00	29/07/2019 10:40	4	NO, NO ₂ , NO _x	Invalid data ¹
29/07/2019 14:35	29/07/2019 15:20	4	CO	Maintenance / calibration

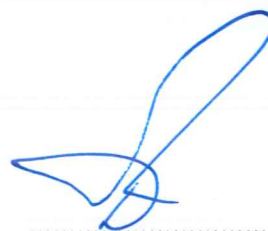
Note: 1 - In the opinion of the reviewer.

APPENDIX B

Laboratory Certificates

CERTIFICATE OF ANALYSIS

CLIENT:	Golder Associates Building 7, Botanica Corporate Park 570 - 588 Swan Street Richmond VIC 3121 ATTN: Laurent Campbell	Laboratory Reference : SSP66197 Client Order Number : PO 19289 Quote Number : n/a Client Project : 1789878 Client Batch Reference : n/a Date Received : 1-Aug-2019 Date Commenced : 5-Aug-2019 Laboratory Number/s : 19KS1139-1142
CC: Carl Van Brink		
<hr/>		
Submitting Authority	: Golder Associates	
Number of Samples	: Four (4) Summa canisters	
Reason for Analysis	: Analysis of Volatile Organic Compounds (VOCs) in air	
Method/s of Analysis	: QIS28237 V3.0 – Identification, Confirmation and Quantitation by GCMS Using the Shimadzu 2010+ and the EnTech 7200 Preconcentrator system	
Remarks	: Sample details and results are summarised in Table 1.	



David Pass
Senior Chemist, Organics Laboratory
6th August 2019

CERTIFICATE OF ANALYSIS

Laboratory Reference: SSP66197
Laboratory Number: 19KS1139-1142

Table 1: Results for Summa canister analysis

Client Reference		19-1055		19-1054	19-1076	19-1077
Sample Type		Silco Canister #1753		Silco Canister #1723	Silco Canister #1733	Silco Canister #5406
Sampling Time / Date		24:00 n/a		24:00 n/a	24:00 n/a	24:00 n/a
Sample Description		ambient air		ambient air	ambient air	ambient air
Method	Volatile Organic Compounds (VOCs) by GCMS	Units	Reporting Limit	19KS1139	19KS1140	19KS1141
28237	Benzene	ppbv	0.5	< LOR	< LOR	< LOR
28237	Toluene	ppbv	0.5	0.8	< LOR	1.4
28237	Ethylbenzene	ppbv	0.5	< LOR	< LOR	< LOR
28237	m- & p-Xylene	ppbv	0.5	0.7	< LOR	0.6
28237	o-Xylene	ppbv	0.5	< LOR	< LOR	< LOR

This report overrides all previous reports. The results relate solely to the sample/s as received and are limited to the specific tests undertaken as listed on the report. The results of this report are confidential and are not to be used or disclosed to any other person or used for any other purpose, whether directly or indirectly, unless that use is disclosed or the purpose is expressly authorised in writing by Queensland Health and the named recipient on this report. To the fullest extent permitted by law, Queensland Health will not be liable for any loss or claim (including legal costs calculated on an indemnity basis) which arise because of (a) problems related to the merchantability, fitness or quality of the sample/s, or (b) any negligent or unlawful act or omissions by Queensland Health that is connected with any activities or services provided by Queensland Health under this agreement (including the timing and/or method under which the sample/s were taken, stored or transported).

CERTIFICATE OF ANALYSIS

CLIENT: Golder Associates
Building 7, Botanica Corporate Park
570 - 588 Swan Street
Richmond VIC 3121

ATTN: Laurent Campbell

Laboratory Reference : SSP65885
Client Order Number : PO 19289
Quote Number : n/a
Client Project : 1789878
Client Batch Reference : n/a
Date Received : 8-Jul-2019
Date Commenced : 11-Jul-2019
Laboratory Number/s : 19KS1074-1075

CC: Carl Van Brink

Submitting Authority : Golder Associates

Number of Samples : Two (2) Summa canisters

Reason for Analysis : Analysis of Volatile Organic Compounds (VOCs) in air

Method/s of Analysis : QIS28237 V3.0 – Identification, Confirmation and Quantitation by GCMS Using the Shimadzu 2010+ and the EnTech 7200 Preconcentrator system

Remarks : Sample details and results are summarised in Table 1.



.....
David Pass
Senior Chemist, Organics Laboratory
12th July 2019



NATA Accredited
Laboratory 41
Accredited for compliance
with ISO/IEC 17025 -
Testing

SSP65885

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Enquiries David Pass
Phone (+61 7) 3096 2854
Email David.Pass@health.qld.gov.au

39 Kessels Road
Coopers Plains QLD 4108
AUSTRALIA

PO Box 594
Archerfield QLD 4108
AUSTRALIA

Phone (+61 7) 3096 2990
Fax (+61 7) 3096 2977
Email FSS@health.qld.gov.au

CERTIFICATE OF ANALYSIS

Laboratory Reference: SSP65885
Laboratory Number: 19KS1074-1075

Table 1: Results for Summa canister analysis

Client Reference				19-939	19-940
Sample Type				Silco Canister #1749	Silco Canister #1745
Sampling Time / Date				24:00 n/a	24:00 n/a
Sample Description				ambient air	ambient air
Method	Volatile Organic Compounds (VOCs) by GCMS	Units	Reporting Limit	19KS1074	19KS1075
28237	Benzene	ppbv	0.5	< LOR	< LOR
28237	Toluene	ppbv	0.5	2.0	0.6
28237	Ethylbenzene	ppbv	1.0	1.0	< LOR
28237	m- & p-Xylene	ppbv	0.5	1.1	0.5
28237	o-Xylene	ppbv	1.0	< LOR	< LOR

This report overrides all previous reports. The results relate solely to the sample/s as received and are limited to the specific tests undertaken as listed on the report. The results of this report are confidential and are not to be used or disclosed to any other person or used for any other purpose, whether directly or indirectly, unless that use is disclosed or the purpose is expressly authorised in writing by Queensland Health and the named recipient on this report. To the fullest extent permitted by law, Queensland Health will not be liable for any loss or claim (including legal costs calculated on an indemnity basis) which arise because of (a) problems related to the merchantability, fitness or quality of the sample/s, or (b) any negligent or unlawful act or omissions by Queensland Health that is connected with any activities or services provided by Queensland Health under this agreement (including the timing and/or method under which the sample/s were taken, stored or transported).

APPENDIX C

**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.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

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.

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