

Waterview Operational Air Quality Monitoring Report November 2017

Document No: [Subject]

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1 INTRODUCTION

1.1 OVERVIEW

The Waterview Tunnel opened on 02 July 2017. This report includes analysis of validated air quality monitoring data for Waterview Tunnel Joint Operations (WTJO) for the period November 2017. This air quality monitoring report has been prepared in accordance with Waterview Connection BOI Operational Air Quality Condition OA.4.

1.2 WATERVIEW OPERATIONAL AIR QUALITY REQUIREMENTS

Waterview Connection BOI Operational Air Quality Conditions OA.2 – OA.8 (refer Appendix A) set out the requirements for ambient air quality monitoring of traffic emissions to confirm that required National Environmental Standards for air quality and Auckland Regional air quality targets are met. Relevant ambient air quality criteria are shown in Table 1.

Table 1. WTJO ambient air quality criteria

Pollutant	Threshold concentration	Averaging period
Fine particles (PM ₁₀)	50 µg/m ³ 20 µg/m ³	24-hour Annual
Fine particles (PM _{2.5})	25 µg/m ³ 10 µg/m ³	24-hour Annual
Nitrogen dioxide	200 µg/m ³ 200 µg/m ³ 100 µg/m ³ 40 µg/m ³	1-hour 1-hour (rolling)* 24-hour Annual

* the rolling 1-hour average NO₂ is also reported for the assessment criteria under Condition OA.8.

Two ambient air quality stations (one in the north and one in the south of the WTJO) and one portal analyser are required to be operated for a minimum period of 2 years. The two ambient stations require measurement of particulates (PM_{2.5} & PM₁₀), nitrogen dioxide (NO₂), wind speed and wind direction. The portal analyser requires measurement of NO₂.

This monitoring must continue until the Air Quality Peer Review Panel (required under condition OA.7) recommend that it is no longer necessary. Results are required to be reported monthly for the first 12 months and quarterly thereafter (OA.4).

1.3 MONITORED PARAMETERS AND LOCATIONS

Monitoring locations are shown in Appendix B. Locations and types of instrumentation have been agreed with Auckland Council and the Air Quality Peer Review Panel.

A portal monitoring station with Cavity Attenuated Phase Shift Spectroscopy (CAPS) NO₂ analyser has been installed at the rear of 93 Hendon Avenue near the Southern portal, to monitor NO₂ in accordance with the requirements of consent condition OA.2 and to demonstrate compliance with consent condition OA.8. The portal station is located approximately 80 m from the southern tunnel portal on the residential boundary (40 m from SH20). SH20 is screened from the nearest receptors within the southern approach trench.

Two ambient air quality monitoring stations have been installed to monitor particulates (BAM-1020 analysers, PM₁₀ and PM_{2.5}), nitrogen dioxide (Chemiluminescence NO_x analyser), wind speed and wind direction in accordance with conditions OA.2 and OA.3.

The southern ambient air quality station is located in the approximate location of the original pre-construction baseline monitoring for the WTJO, near to 5 Barrymore Road. The southern station is also located near to the residential boundary approximately 470 m from the southern tunnel portal (25 m from SH20) where SH20 achieves grade.

Under condition OA.2, the northern ambient air quality station should be located at Waterview School subject to agreement by the School; this agreement was not secured. The northern station is therefore located in the approximate location of the original pre-construction baseline monitoring for the WTJO, near to the operation maintenance building. This station is located approximately 100 m from the northern tunnel portal in the prevailing wind direction (25 m from SH20, 330 m SH16 and 20 m from Great North Road), with no obstruction between the adjacent traffic sources and air quality station. This location will experience higher levels than the proposed location at the School and is therefore considered conservative.

1.4 DATA MANAGEMENT

Data is downloaded and checked daily by suppliers Ecotech and monthly validated reports provided to the WTJO. A daily summary of results (unvalidated data) is provided to the WTJO and, in the event that WTJO air quality criteria are exceeded, email/text alerts are sent, so investigation can be initiated.

Ecotech calibrate the air quality stations on a monthly basis, and attend the site if a fault is detected during the daily checks. Calibration and equipment fault reports are forwarded to the WTJO.

The valid data exception report for November 2017 is attached as Appendix C.

2 MONITORING RESULTS AND ANALYSIS

2.1 SUMMARY STATISTICS

A comparison of the monitored levels of NO₂, PM_{2.5} and PM₁₀ against the WTJO air quality criteria are shown in Table 2 for November 2017. This shows that measured air quality concentrations were below the WTJO ambient air quality criteria.

Monitoring sites used for compliance monitoring should achieve at least 95% data capture¹. All sites achieved at least 95% data capture during November 2017. Scheduled annual maintenance was carried out in November 2017 for all monitoring stations which may slightly reduce the percentage valid data capture.

Previous monthly data is shown in Appendix D and original baseline data in Appendix F.

Table 2. Air quality monitoring results for November 2017

AQ Station	Description	% valid data capture	Concentration in µg/m ³	WTJO air quality criteria in µg/m ³
Northern ambient air quality station	Maximum 1-hour average NO ₂	96.3	62.1	200
	Maximum rolling 1-hour average NO ₂		62.1	200
	Maximum 24-hour average NO ₂		26.5	100
	Maximum daily average PM _{2.5}	99.7	11.3	25
	Maximum daily average PM ₁₀	99.7	35.1	50
Southern ambient air quality station	Maximum 1-hour average NO ₂	96.8	50.5	200
	Maximum rolling 1-hour average NO ₂		56.0	200
	Maximum 24-hour average NO ₂		20.7	100
	Maximum daily average PM _{2.5}	99.6	9.8	25
	Maximum daily average PM ₁₀	99.3	22.0	50
Portal air quality station	Maximum 1-hour average NO ₂	95.5	55.5	200
	Maximum rolling 1-hour average NO ₂		63.5	200
	Maximum 24-hour average NO ₂		22.2	100

2.2 EXCEEDENCES OF AIR QUALITY CRITERIA

The Waterview Connection BOI Operational Air Quality Condition OA.5 requires that when an exceedance of the WTJO air quality criteria occur, an investigation shall be undertaken into the cause of the exceedance and that this be reported to the Air Quality Peer Review Panel and Auckland Council.

There were no exceedances of the WTJO air quality criteria in November 2017.

Measured concentrations at all air quality stations were less than 50% of the air quality criteria, with the exception of maximum daily average PM₁₀ concentrations at the northern station (maximum was 70% of the criterion). The elevated level of PM₁₀ at the northern station has been attributed to asphaltting work on nearby Great North Road for the construction of the Great North Road bus lane.

¹ Ministry for the Environment. 2009. Good Practice Guide for Air Quality Monitoring and Data Management 2009. Wellington: Ministry for the Environment.

2.3 POLLUTION ROSES

Pollution roses illustrate the relationship between wind direction and air pollutant concentrations. They are a useful tool to visualise the upwind direction of air pollution sources. The main sources are in the direction of the wind directions that show the highest concentrations.

Pollution roses based on the hourly monitoring data are provided in Appendix E for November 2017. Pollution roses show an expected reduction of pollutant concentrations coming out of the winter months.

In summary, the pollution roses show that:

- The main sources of NO₂ influencing the northern station are located in the direction of the adjacent SH20 alignment to the south, south-west and west, SH16 to the north-west and Great North Road in the easterly and south-easterly wind directions.
- The main source of PM₁₀ at the northern station in November is from the north-east to south-east wind directions. The likely source of PM₁₀ is from asphaltting work on nearby Great North Road for the construction of the Great North Road bus lane.
- The main source of NO₂ influencing the portal and southern stations is located in the direction of the adjacent SH20 alignment to the south and south-west. The second largest source was to the east-northeast, toward Hendon Ave. PM_{2.5} and PM₁₀ showed similar pollution roses with the dominant sources in similar directions.
- The NO₂ pollution roses indicate that the main source of NO₂ is traffic emissions. The PM₁₀ and PM_{2.5} pollution roses for November similarly indicate that traffic emissions are the dominant source.

2.4 TRAFFIC DATA AND POLLUTANT TRENDS

The daily traffic flow through the Waterview tunnel during November 2017 is shown in Figure 1 below with daily nitrogen dioxide concentrations. The traffic flow shows a distinct weekly pattern, with traffic flows generally increasing from Monday to Friday and dropping off at the weekend. The lowest traffic flow is on Sundays. This weekly pattern is similarly reflected in the NO₂ data, indicating the contribution of traffic emissions to measured NO₂ concentrations. The northern air quality station shows the highest measured levels of NO₂. The northern station is located closer to major traffic sources than the other two stations and has no obstruction between the adjacent traffic sources and air quality station. The portal and southern stations show similar NO₂ trends.

The weekly pattern of PM_{2.5} and PM₁₀ concentrations shows some similarity in peaks and troughs to the daily traffic flow, as shown in Figure 2 although the pattern is not as evident as with NO₂, indicating the influence of other background sources. The PM₁₀ and PM_{2.5} concentrations show similar trends at the northern and southern stations, although the northern station showed an anomalous peak on 28/11/2017 which is likely to be from construction works in the vicinity of the station.

The maximum hourly pollutant trends for nitrogen dioxide are shown in Figure 3. These show the pollutant level changes after tunnel opening in July 2017 and the monthly variation (seasonality) in pollutant concentrations. Measured pollutant levels in winter are generally higher than in summer months due to meteorological influences.

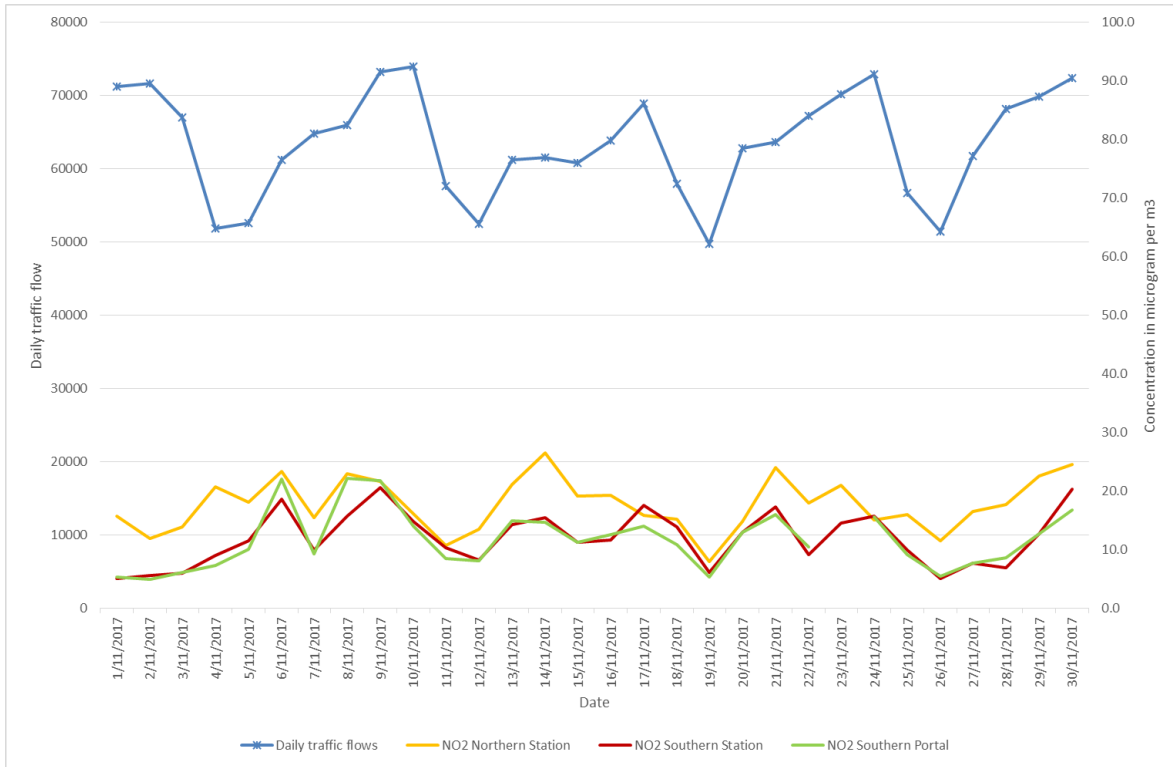


Figure 1: Waterview tunnel traffic flows and NO₂ November 2017

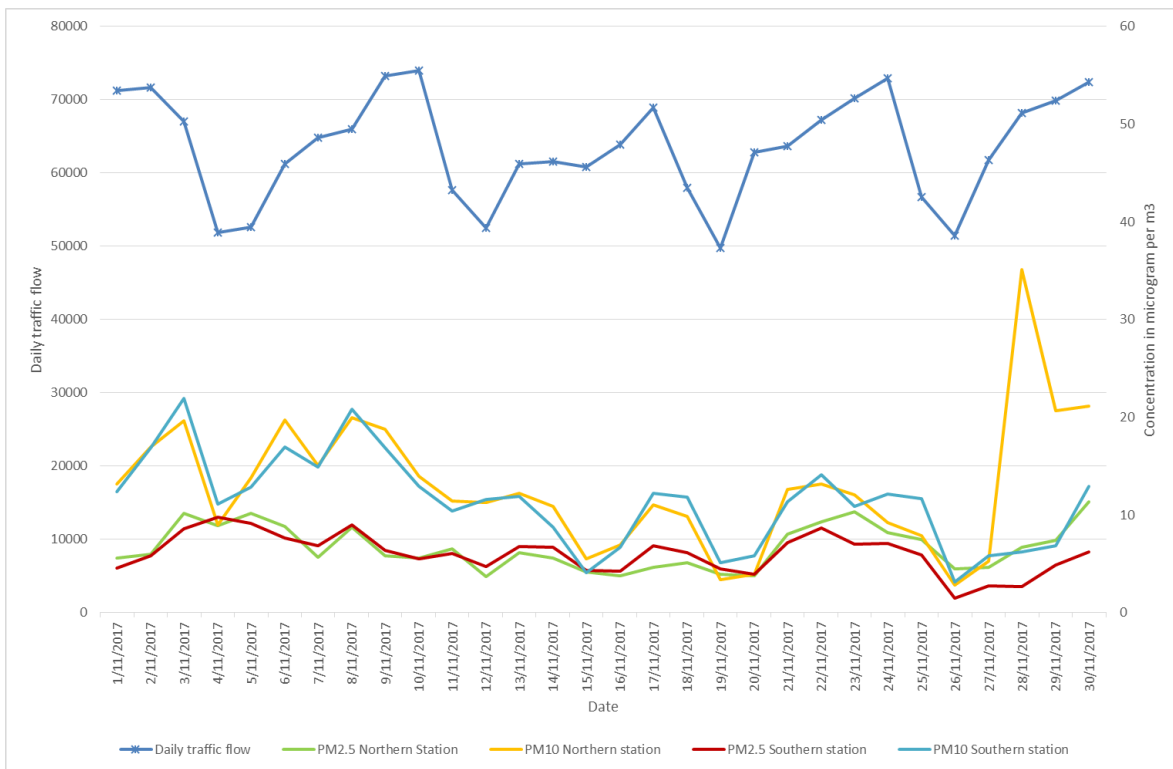


Figure 2: Waterview tunnel traffic flows and PM_{2.5}/PM₁₀ November 2017

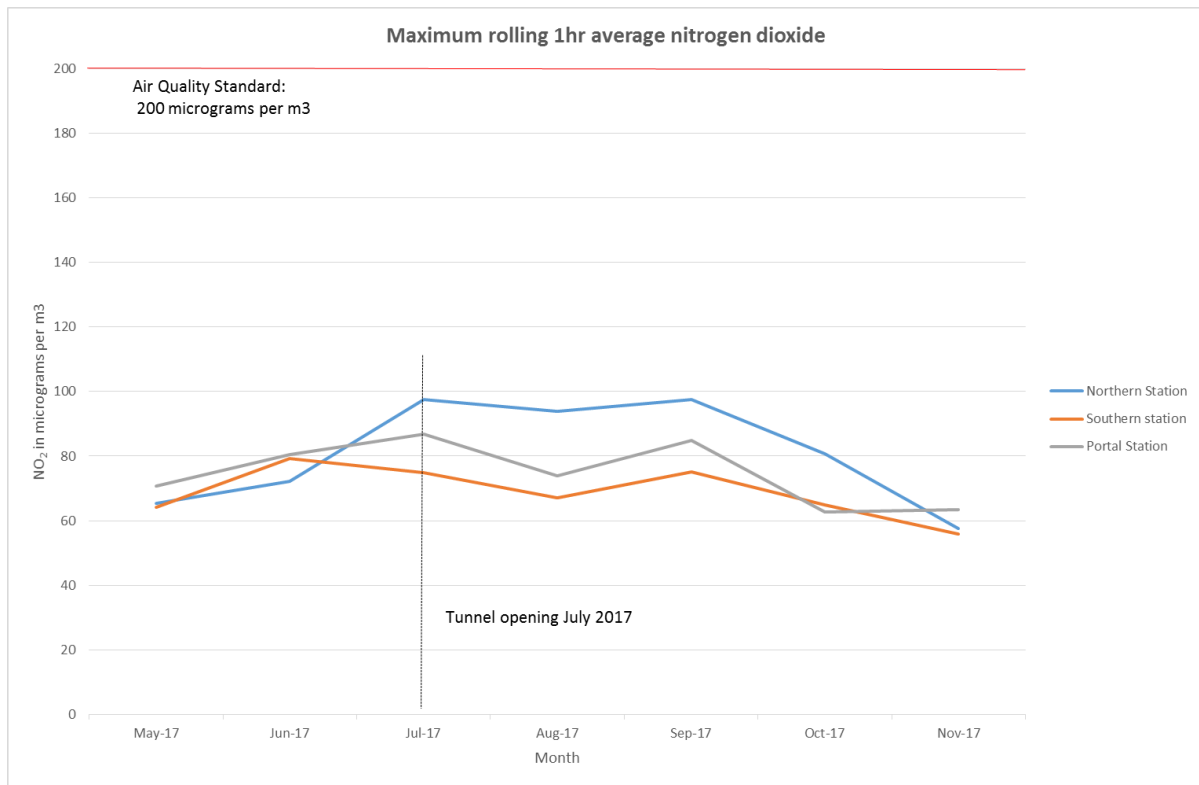


Figure 3: Waterview stations trends in hourly nitrogen dioxide concentrations

3 CONCLUSION

This air quality monitoring report has been prepared in accordance with Waterview Connection BOI Operational Air Quality Condition OA.4, and includes analysis of validated air quality monitoring data for November 2017.

The analysis of NO₂, PM_{2.5} and PM₁₀ data for the two ambient air quality stations and NO₂ data for the portal air quality station has shown that measured air quality concentrations were below the WTJO ambient air quality criteria during November 2017. The recommended data capture of 95% was achieved for all analysers.

NO₂ measurements in November were similar to October, and were lower than in the three (winter) months after opening. Highest measured concentrations of NO₂ were recorded at the northern station. This station is located closer to major traffic sources than the other two stations and has no obstruction between the adjacent sources and air quality station. The concentration of PM₁₀ (and PM_{2.5}) at the northern and southern stations were similar to each other, with the exception of 28 November 2017 when the northern station was affected by construction (paving) works on Great North Road.

Analysis of NO₂, PM₁₀ and PM_{2.5} pollution roses indicate that the main source of pollutant concentrations is traffic emissions.

APPENDIX A: AIR QUALITY CONDITIONS

OA.1 The vents used to discharge emissions in the tunnels shall discharge vertically into air at a height of 15m, as follows: (a) The northern ventilation stack will be at a height of 15m. This height shall be calculated from the lowest existing ground level along the Great North Road boundary, adjacent to the ventilation stack; and (b) The southern ventilation stack will be at a height of 15m calculated from the post-construction ground level of the Alan Wood Reserve averaged at a distance of 10m from the exterior walls the ventilation stack location and shall not be impeded by any obstruction that may in the opinion of the Peer Review Panel (Condition OA. 7) decrease the vertical efflux velocity (in other words, the average velocity of material emitted into the atmosphere).

OA.2 Prior to the tunnels becoming operational, the NZTA shall establish two ambient air quality monitoring stations and one portal air quality monitoring station. The location and types of these monitoring stations shall be selected by the NZTA in consultation with the Auckland Council and Peer Review Panel (Condition OA.7), providing that one ambient monitoring station will be located within the Waterview Primary School (subject to agreement by the School).

Ambient air quality shall be monitored continuously in real time, to monitor potential effects associated with the operation of the ventilation system from the tunnels. Ambient monitoring shall include fine particulates (PM₁₀ and PM_{2.5}) and nitrogen dioxide. Portal monitoring shall include nitrogen dioxide. Results shall be compared with the relevant National Environmental Standards for air quality and Auckland Regional air quality targets (as identified in Chapter 4 of the Auckland Regional Plan: Air, Land and Water, 2010). Monitoring shall be undertaken at each site until the Peer Review Panel recommends that monitoring is no longer necessary. The locations, operation and maintenance schedules of the continuous monitors shall, as far as practicable, comply with the requirements of AS/NZ 3580.1.1: 2007 Method for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment, and with methods specified in the National Environment Standards.

OA.3 Continuous monitoring of wind speed and direction shall be undertaken at each ambient air quality monitoring location as required by Condition OA.2. The locations of wind speed and direction monitors shall, as far as practicable, comply with the requirements of AS 2923:1987 Ambient Air – Guide for the Measurement of Horizontal Wind for Air Quality Applications.

OA.4 For the first 12 months of tunnel operation, the results of the ambient air quality monitoring shall be reported via validated reports and issued for information via the Project website (monthly). Following this period, and for a period of at least 12 months, reporting shall take place quarterly as follows: Quarter 1 (December to February) by 31 March, Quarter 2 (March to May) by 30 June, Quarter 3 (June to August) by 30 September and Quarter 4 (September to November) by 31 December.

OA.5. If the monitoring required by Condition OA.2 shows that concentrations of contaminants in ambient air at the monitoring locations exceeds the relevant National Environmental Standards for air quality, or Regional Air Quality Targets (as identified in Chapter 4 of the Auckland Regional Plan: Air, Land and Water), the NZTA shall undertake an investigation into the cause of the exceedance and report this to the Peer Review Panel (Condition OA.7) and the Major Infrastructure Team Manager, Auckland Council.

OA.6. The air quality monitoring shall be undertaken in general accordance with the Operational Air Quality Management Procedure (Appendix O of Technical Report G.1 Assessment of Air Quality Effects) submitted with this application.

OA.7. A Peer Review Panel shall be appointed by NZTA with the agreement of Major Infrastructure Team Manager, Auckland Council for the purpose of reviewing the ambient air quality monitoring programme and results. The Peer Review Panel shall consist of two independent experts in air quality with experience in ambient air quality monitoring and emissions from motor vehicles. The Peer Review Panel shall review all ambient monitoring, relevant traffic data and tunnel emissions and provide a summary report including any interpretation and recommendations to NZTA, Auckland Council and the Community Liaison Group(s) within 6 months of the tunnels becoming operational and annually thereafter.

O.A.8 The tunnel ventilation system shall be designed and operated to ensure that any air emitted from the tunnel portals does not cause the concentration of nitrogen dioxide (NO₂) in ambient air to exceed 200 micrograms per cubic metre, expressed as a rolling 1 hour average, at any point beyond the designation boundary that borders an air pollution sensitive land use.

Advice Note: The above standard reflects the National Environmental Standard for Nitrogen Dioxide (NO₂) concentration in ambient air.

APPENDIX B: MONITORING LOCATIONS

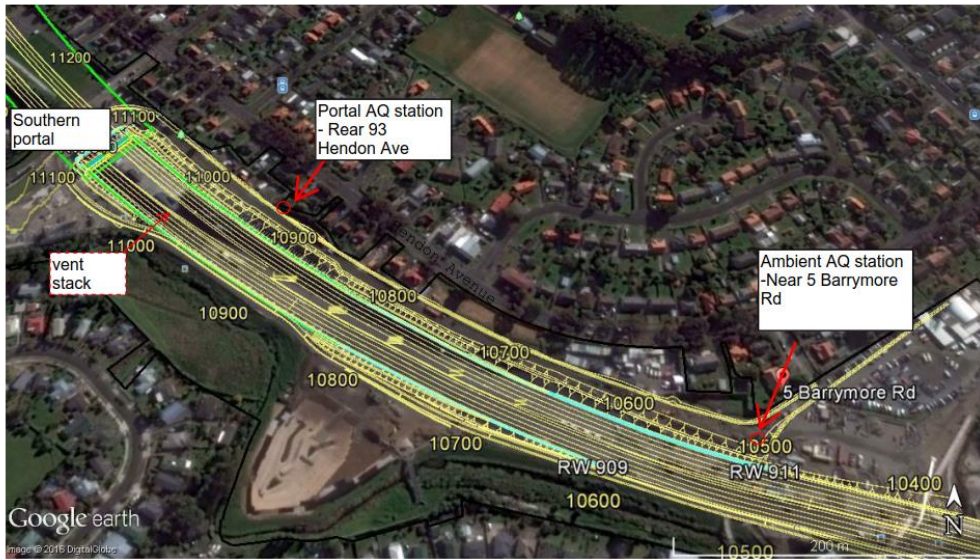


Figure B 1: Southern area stations



Figure B 2: Northern area station

APPENDIX C: VALID DATA EXCEPTION REPORT

North ambient air quality station

Start Date	End Date	Reason	Change Details
01/11/2017 0:00	30/11/2017 23:55	Static offset of 1.071µg/m ³ applied to correct negative baseline	NO ₂
01/11/2017 1:00	30/11/2017 1:40	Automatic overnight span calibration check from approximately 1:00 - 1:40	NO ₂
23/11/2017 8:40	23/11/2017 12:30	Scheduled yearly maintenance	All parameters

South ambient air quality station

Start Date	End Date	Reason	Change Details
01/11/2017 0:00	30/11/2017 22:55	Static offset of 0.669µg/m ³ applied to correct negative baseline	NO ₂
01/11/2017 1:00	30/11/2017 1:30	Automatic overnight span calibration check from approximately 1:00 - 1:30	NO ₂
07/11/2017 1:30	07/11/2017 1:35	Instrument stabilisation after automatic calibration cycle	NO ₂
18/11/2017 5:00	18/11/2017 6:15	Power interruption and subsequent instrument stabilisation. Data affected intermittently	All parameters
19/11/2017 5:00	19/11/2017 6:00	Power interruption and subsequent instrument stabilisation. Data affected intermittently	All parameters
23/11/2017 9:50	23/11/2017 12:45	Scheduled yearly maintenance	NO ₂
23/11/2017 13:00	23/11/2017 15:00	Scheduled yearly maintenance	PM ₁₀ , PM _{2.5}
23/11/2017 14:50	23/11/2017 15:05	Scheduled yearly maintenance	Wind speed and direction

Portal air quality station

Start Date	End Date	Reason	Change Details
01/11/2017 0:45	30/11/2017 0:50	Automatic background check, nightly for 5 minutes	NO ₂
01/11/2017 2:00	23/11/2017 2:45	Automatic overnight span calibration check from approximately 2:00 - 2:45	NO ₂
04/11/2017 7:35	04/11/2017 7:36	Unrealistic data	NO ₂
09/11/2017 16:00	30/11/2017 8:35	Intermittent data transmission errors	NO ₂
23/11/2017 9:25	23/11/2017 14:55	Scheduled 6-monthly maintenance	NO ₂
24/11/2017 2:00	30/11/2017 2:30	Automatic overnight span calibration check from approximately 2:00 - 2:30	NO ₂

APPENDIX D: PREVIOUS MONTHLY DATA

AQ Station	Description	Pre Tunnel Opening		Post Tunnel Opening					Project air quality criteria in µg/m ³
		May 2017 concentration in µg/m ³	June 2017 concentration in µg/m ³	July 2017 concentration in µg/m ³	Aug 2017 concentration in µg/m ³	Sept 2017 concentration in µg/m ³	Oct 2017 concentration in µg/m ³	Nov 2017 concentration in µg/m ³	
Northern ambient air quality station	Maximum rolling 1-hour average NO ₂	65.5	72.2	97.5	93.8	97.5	80.8	57.5	200
	Maximum 24-hour average NO ₂	30.2	36.9	46.4	54.1	44.8	39.4	26.5	100
	Maximum daily average PM _{2.5}	32.7	24.9	24.8	16.9	14.0	10.5	11.3	25
	Maximum daily average PM ₁₀	35.7	33.3	31.0	26.4	26.9	31.3	35.1	50
Southern ambient air quality station	Maximum rolling 1-hour average NO ₂	64.2	79.3	75.0	67.1	75.1	65.0	56.0	200
	Maximum 24-hour average NO ₂	30.0	30.8	38.2	34.7	27.4	25.5	20.7	100
	Maximum daily average PM _{2.5}	23.2	19.1	26.5	12.6	12.1	13.3	9.8	25
	Maximum daily average PM ₁₀	35.8	31.8	31.8	28.8	31.6	37.9	22.0	50
Portal air quality station	Maximum rolling 1-hour average NO ₂	70.8	80.6	86.9	73.8	84.9	62.6	63.5	200
	Maximum 24-hour average NO ₂	32.1	33.1	46.0	35.3	31.6	26.9	22.2	100

It should be noted that construction activities on site in the vicinity of the stations, including vehicle movements on haul roads, will be contributing to measured particulate levels pre tunnel opening. Baseline measurements of PM_{2.5} were also elevated in May during the night time due to domestic smoke from adjacent residential properties.

APPENDIX E: POLLUTION ROSES FOR NOVEMBER 2017

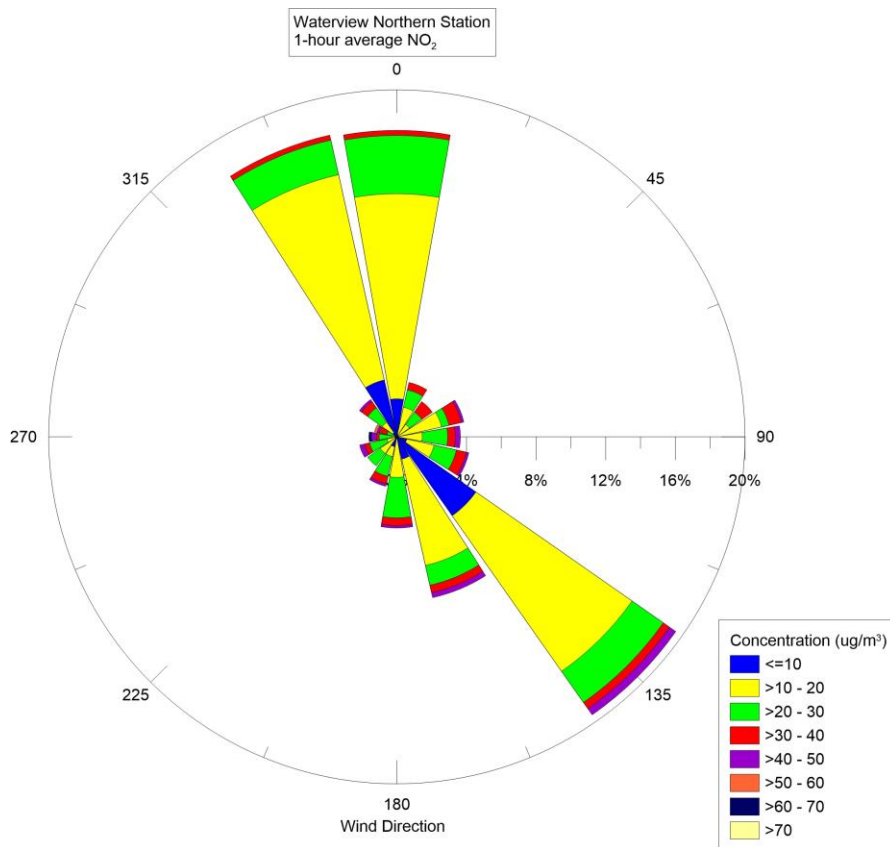


Figure D 1: Northern station 1-hour average NO₂

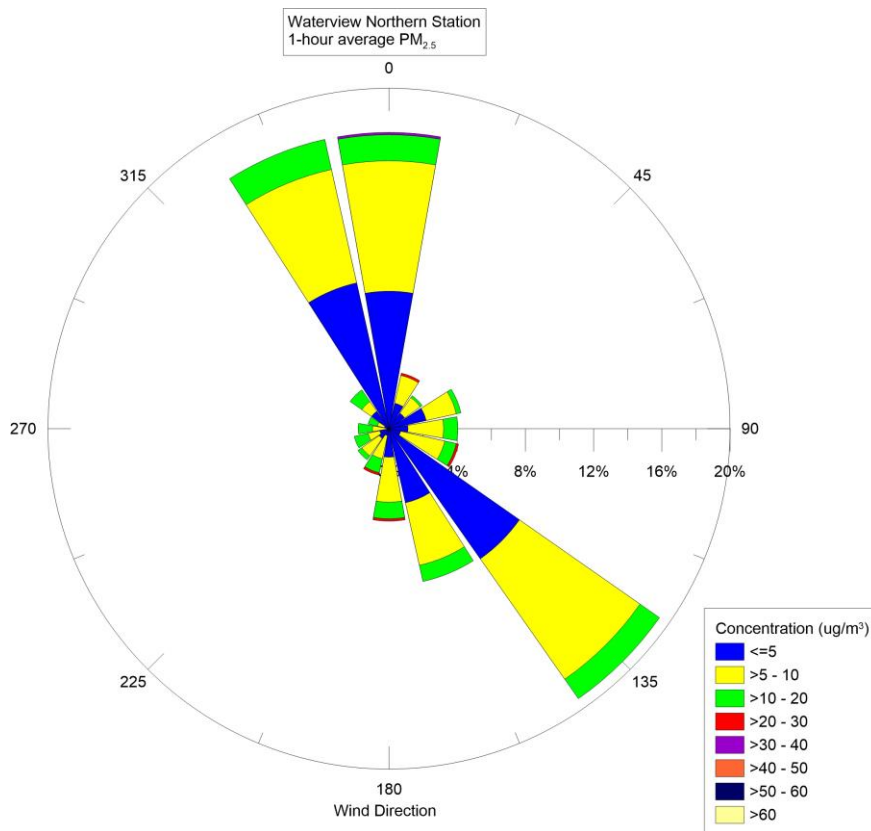


Figure D 2: Northern station 1-hour average PM_{2.5}

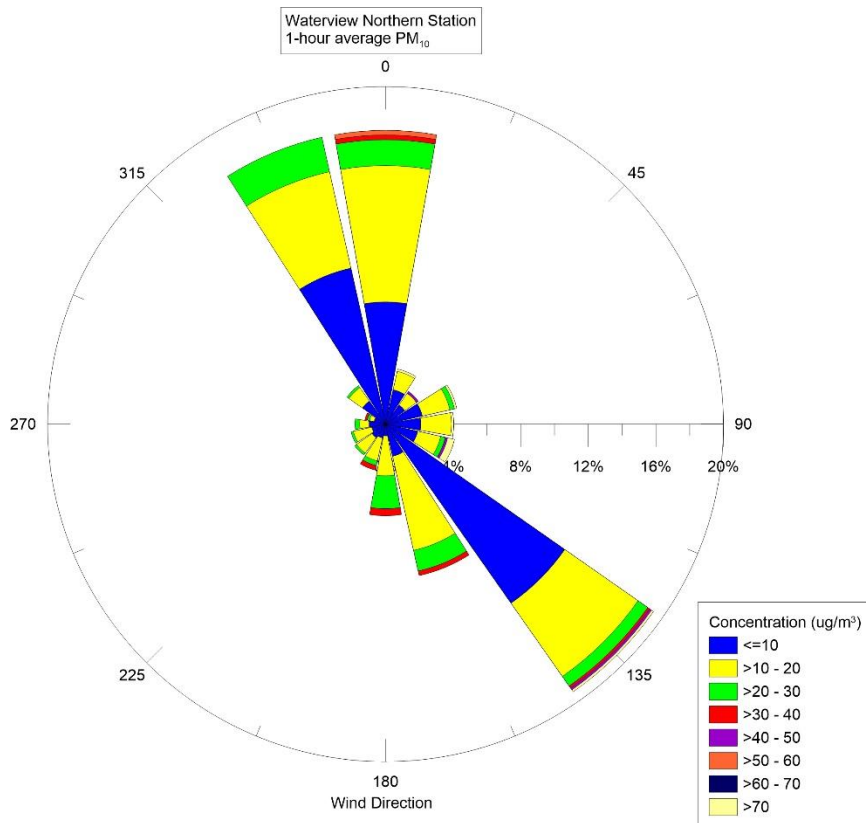


Figure D 3: Northern station 1-hour average PM₁₀

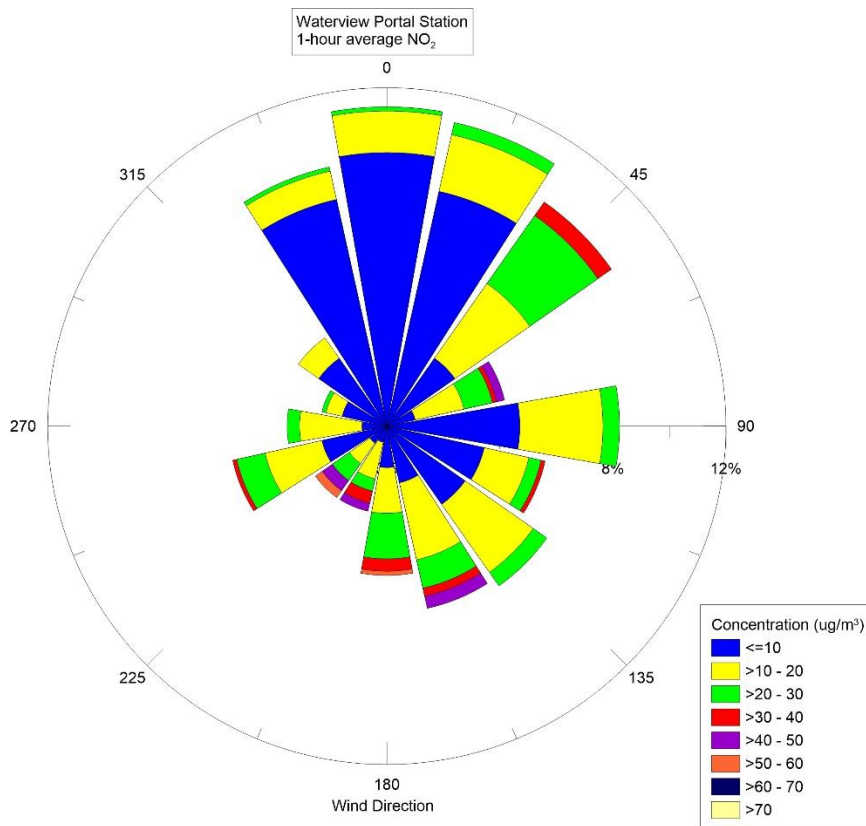


Figure D 4: Portal station 1-hour average NO₂

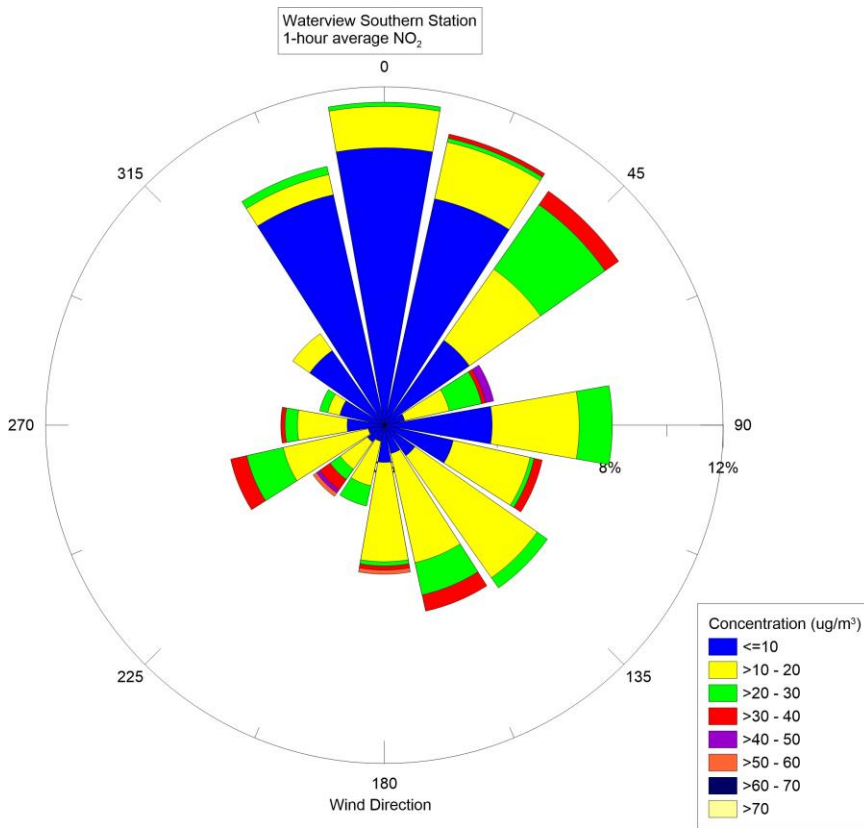


Figure D 5: Southern station 1-hour average NO₂

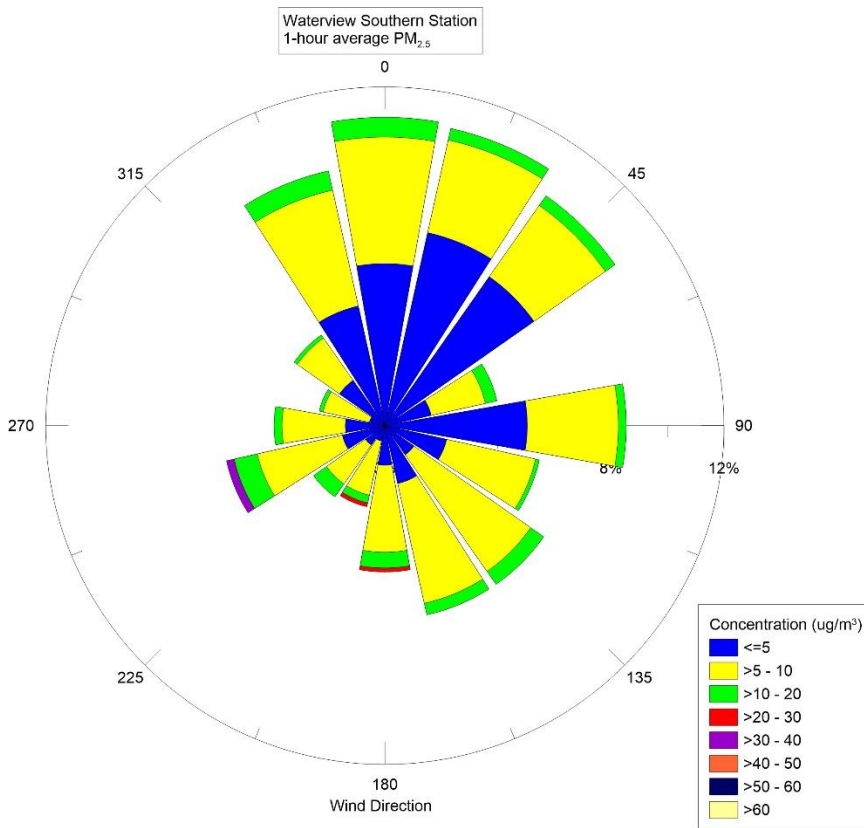


Figure D 6: Southern station 1-hour average PM_{2.5}

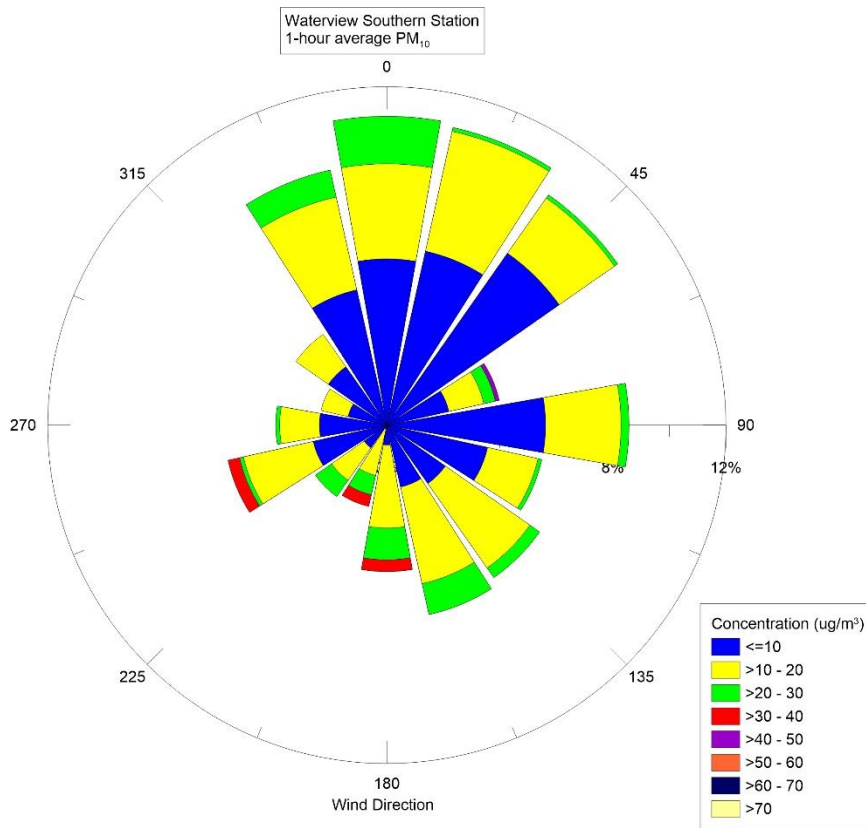


Figure D 7: Southern station 1-hour average PM₁₀

APPENDIX F: ORIGINAL BASELINE MONITORING DATA

Air Quality Station	Description	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06					
Northern Area - Cowley St air quality station	Maximum rolling 1-hour average NO ₂												
	Maximum 24-hour average NO ₂												
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀												
Southern Area - Alan Wood air quality station	Maximum rolling 1-hour average NO ₂	55	59	59	53	112	39	57					
	Maximum 24-hour average NO ₂	25	34	31	26	86	17	19					
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀	32	44	23	22	19	63	22					
Air Quality Station	Description	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07
Northern Area - Cowley St air quality station	Maximum rolling 1-hour average NO ₂								55	66	61	50	44
	Maximum 24-hour average NO ₂								29	36	28	30	23
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀								25	32	28	28	24
Southern Area - Alan Wood air quality station	Maximum rolling 1-hour average NO ₂	28	35	37	53	56	56	61	51	61	44	42	38
	Maximum 24-hour average NO ₂	10	13	15	27	34	32	28	20	25	18	17	13
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀	21	19	19	19	32	35	22	31	17	24	24	14
Air Quality Station	Description	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08
Northern Area - Cowley St air quality station	Maximum rolling 1-hour average NO ₂	38	43	46	57	71	71	81	71	62	66	119	62
	Maximum 24-hour average NO ₂	20	23	27	27	39	42	41	38	34	35	35	30
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀	29	21	22	24	37	31	33	16	18	20	27	18
Southern Area - Alan Wood air quality station	Maximum rolling 1-hour average NO ₂	26	38	42	54	59	67	58	52	45	43	34	36
	Maximum 24-hour average NO ₂		20	19	25	30	38	32	21	21	16	13	14
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀	24	18	21	19	37	27	30	17	15	19	22	15

Air Quality Station	Description	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Northern Area - Cowley St air quality station	Maximum rolling 1-hour average NO ₂	74	265				55	103	99	77	93	83	80
	Maximum 24-hour average NO ₂	37	48				26	56	48	44	45	30	39
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀	20	29	26	29	27	50	43	32	135	31	33	25
Southern Area - Alan Wood air quality station	Maximum rolling 1-hour average NO ₂	29	32	38	40	51	62	44	51	37			
	Maximum 24-hour average NO ₂	9	15	18	20	24	30	22	20	18			
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀	17	26	20	21	25	38	30	28	117			
Air Quality Station	Description	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
Northern Area - Cowley St air quality station	Maximum rolling 1-hour average NO ₂	52	57	58	56	55	23	265	70	41	93	101	85
	Maximum 24-hour average NO ₂	29	30	33	33	28	11	46	22	22	30	34	27
	Maximum daily average PM _{2.5}						16	29	34	10	10	13	8
	Maximum daily average PM ₁₀	21	27	23	20	28	20	35	39	26	27	22	30
Southern Area - Alan Wood air quality station	Maximum rolling 1-hour average NO ₂												
	Maximum 24-hour average NO ₂												
	Maximum daily average PM _{2.5}												
	Maximum daily average PM ₁₀						44	40	37	24	26	22	30

Results taken from: *Ambient Air Quality Monitoring Summary Report, Beca 09 May 2011.*