



ACT
Government



ACT AIR QUALITY REPORT 2015

Environment Protection Authority | June 2016

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LIST OF DEFINITIONS AND ABBREVIATIONS

Term	Definition
AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
ACT	Australian Capital Territory
CO	Carbon Monoxide
BAM	Beta Attenuation Monitor
NATA	National Association of Testing Authorities
ND	Not Demonstrated
NO ₂	Nitrogen Dioxide
O ₃	Ozone
PMS	Performance Monitoring Station
PM _{2.5}	Particles with an equivalent aerodynamic diameter less than or equal to 2.5 Micrometers
PM ₁₀	Particles with an equivalent aerodynamic diameter less than or equal to 10 Micrometers
ppm	Parts per million by volume – parts of pollutant per million parts of air
Q	Quarter (e.g. Q1 means the first quarter of the year)
SO ₂	Sulfur Dioxide
µg/m ³	micrograms per cubic metre

OVERVIEW

Purpose

This report presents the results of ambient air quality monitoring in the ACT for the 2015 calendar year and assesses them in accordance with the requirements of the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) which was made by the National Environment Protection Council on 26 June 1998. A Variation to the AAQ NEPM was published on 15 December 2015. However, the varied AAQ NEPM wasn't formally registered at the Federal Register of Legislation until March 2016. Therefore, air quality in 2015 has been assessed against the original AAQ NEPM standards and the associated goals shown in Table 3.

The AAQ NEPM establishes:

- requirements for monitoring air quality;
- air quality standards that are levels of specified pollutants against which air quality can be assessed; and
- a goal that the air quality standards be met to the extent specified in the NEPM. Recognising that certain events can impact on air quality, the NEPM specifies a maximum number of days on which it is permissible to exceed the standard.

ACT monitoring

The ACT monitors four of the six NEPM pollutants:

- carbon monoxide (CO);
- nitrogen dioxide (NO₂);
- photochemical oxidants as ozone (O₃); and
- particulate matter (particles less than 10 microns in diameter – PM₁₀ and particles less than 2.5 microns in diameter – PM_{2.5}).

Due to a lack of heavy industry, the ACT has never monitored sulfur dioxide (SO₂) as it is primarily an industrial pollutant, and lead monitoring ceased in 2002 with the phase out of leaded petrol.

Monitoring was performed in accordance with the ACT's monitoring plan, AAQ NEPM Technical Papers and ACT Health's accreditation by the National Association of Testing Authorities (NATA).

Outcomes

Monitoring results demonstrate that Canberra's air quality in 2015 was excellent, with no exceedences of the AAQ NEPM standards for carbon monoxide, nitrogen dioxide and photochemical oxidants as ozone. The major impacts on Canberra's air quality in 2015 came from the accumulation of combustion particles from wood heaters. Once during 2015, air quality was also impacted by a dust storm in the region. The long-term trends show the ACT is meeting the goals of the NEPM.

MONITORING SUMMARY

Current Performance Monitoring Stations

The ACT Government has been conducting ambient air quality monitoring in Canberra since the early 1990's. The Health Directorate is responsible for the Government's ambient air quality monitoring network. The Environment Protection Authority within the Chief Minister's, Treasury and Economic Development Directorate is responsible for annual reporting under the AAQ NEPM.

The AAQ NEPM monitoring network in the ACT consists of three monitoring stations: at Monash, Civic and Florey. The Monash station is about 300 metres west of Cockcroft Avenue in the Monash district playing fields. The Civic station is located at the northern end of the carpark on the western side of the Olympic swimming pool adjacent to Allara Street. The Florey station is located at the end of Neumann Place, Florey on public land. The compliance and non-compliance criteria for the above stations against the siting standard AS/NZS 3580.1.1:2007 are listed in Table 1 below.

Table 1 Summary of stations' siting compliance with AS 3580.1.1:2007

Station	Height above ground	Minimum distance to support structure	Clear sky angle of 120°	Unrestricted airflow of 270°/360°	20m from trees	No boilers or incinerators nearby	Minimum distance from road or traffic
Monash	✓	✓	✓	✓	✓	✓	✓
Civic	✓	✗	✗	✗	✗	✓	✗
Florey	✓	✓	✓	✓	✓	✓	✓

Both Monash and Florey stations contain instrumentation that continuously monitors carbon monoxide, nitrogen dioxide, photochemical oxidants as ozone and both types of particle matters. The Civic station only monitors photochemical oxidants as ozone and particulate matter PM₁₀.

Monitoring Methods

The ACT monitoring is conducted in accordance with the relevant Australian standards as shown in Table 2. Data not meeting the requirements of these Standards are identified as invalid and not included in this report.

Table 2 Methods used for monitoring AAQ NEPM pollutants

Pollutant	Standard	Title	Method Used
Carbon Monoxide	AS 3580.7.1-2011	Ambient Air – Determination of Carbon Monoxide – Direct Reading Instrument Method	Gas filter correlation/ Infrared.
Nitrogen dioxide	AS 3580.5.1-2011	Ambient Air – Determination of Oxides of Nitrogen – Chemiluminescence Method	Gas phase chemiluminescence.
Photochemical oxidant (ozone)	AS 3580.6.1-2011	Ambient Air – Determination of Ozone – Direct Reading Instrument Method	Non-dispersive ultraviolet.
Particles PM ₁₀	AS 3580.9.11-2008	Method for sampling and analysis of ambient air Method – Determination of suspended particles matter – PM ₁₀ beta attenuation monitors	Beta Attenuation Monitor (BAM)
PM ₁₀	AS/NZS 3580.9.6-2005	Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM ₁₀ high volume sampler with size-selective inlet - Gravimetric method	Gravimetric reference method
PM _{2.5}	AS/NZS 3580.9.10-2006	Reference Method for the Determination of Fine Particulate matter as PM _{2.5} in the Atmosphere	Gravimetric reference Method

NATA Accreditation Status

The ACT Government monitoring network is accredited by NATA for the measurement of all AAQ NEPM pollutants except sulfur dioxide as required under Clause 12 of the AAQ NEPM.

ASSESSMENT OF COMPLIANCE WITH STANDARDS AND GOALS

For the purpose of this report, air quality is assessed against the AAQ NEPM standards and goals as specified in Schedule 2 of the AAQ NEPM and reproduced in Table 3.

The standards against which air quality is assessed are concentrations in parts per million (ppm) or micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) (refer to column 3, Table 3).

The goal of the AAQ NEPM is to achieve the Standards as assessed in accordance with the monitoring protocol within 10 years of commencement (i.e. 2008) to the extent specified in Schedule 2 of the AAQ NEPM. The extent is expressed as a maximum allowable number of exceedences for each standard (shown in column 4, Table 3). These are set to account for unusual meteorological conditions and, in the case of particles, natural events such as dust storms and bushfires, which cannot be controlled through normal air quality management programs.

The AAQ NEPM also specifies advisory reporting standards for $\text{PM}_{2.5}$. The goal for $\text{PM}_{2.5}$ is to collect sufficient data to facilitate a review of the $\text{PM}_{2.5}$ standards, which has been completed through the variation of the AAQ NEPM.

Table 3: AAQ NEPM standards and goals

Pollutant	Averaging Period	Maximum concentration	Goal within 10 years Maximum allowable exceedences	Monitoring Station
Carbon monoxide	8 hours	9.0 ppm	1 day a year	Monash Florey
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year None	Monash Florey
Photochemical oxidants	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year	Monash Florey Civic
Sulfur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year None	Not monitored
Lead	1 year	$0.050 \mu\text{g}/\text{m}^3$	None	Not monitored
Particles as PM_{10}	1 day	$50 \mu\text{g}/\text{m}^3$	5 days a year	Monash Florey Civic
Particles as $\text{PM}_{2.5}$	1 day 1 year	$25 \mu\text{g}/\text{m}^3$ $8 \mu\text{g}/\text{m}^3$	Not applicable Not applicable	Monash Florey

The following tables (Table 4 to Table 8) summarise compliance with the standards and goals of the AAQ NEPM. For each pollutant, the data availability (quarterly and annual), the number of days when standards were exceeded, the annual mean (where an annual standard exists) and an assessment of compliance, are given for each monitoring station.

Air quality is assessed as complying with the AAQ NEPM (i.e. 'MET') if the number of exceedences is no more than the number specified in Schedule 2 of the AAQ NEPM and data availability was at least 75% in each quarter of the year.

Air quality is assessed as not complying with the AAQ NEPM (i.e. 'NOT MET') if there is more than the number of exceedences specified in Schedule 2 of the AAQ NEPM.

Air quality is assessed as 'NOT DEMONSTRATED' (ND) if there has been insufficient data collected to demonstrate that the standards and goal have been met or not met.

These categories (i.e. MET, NOT MET and ND) are used in the tables on the following pages.

Carbon monoxide

During 2015, no exceedences of the carbon monoxide standard were recorded in the ACT. Compliance against the AAQ NEPM goal was demonstrated.

Table 4: 2015 compliance summary for CO

AAQ NEPM standard - 9.0 ppm (8-hour average)

Performance monitoring station	Data availability rates (% of hours)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Monash	95.4	92.6	95.5	95.8	94.8	0	MET
Florey	95.5	93.8	94.3	95.8	94.9	0	MET

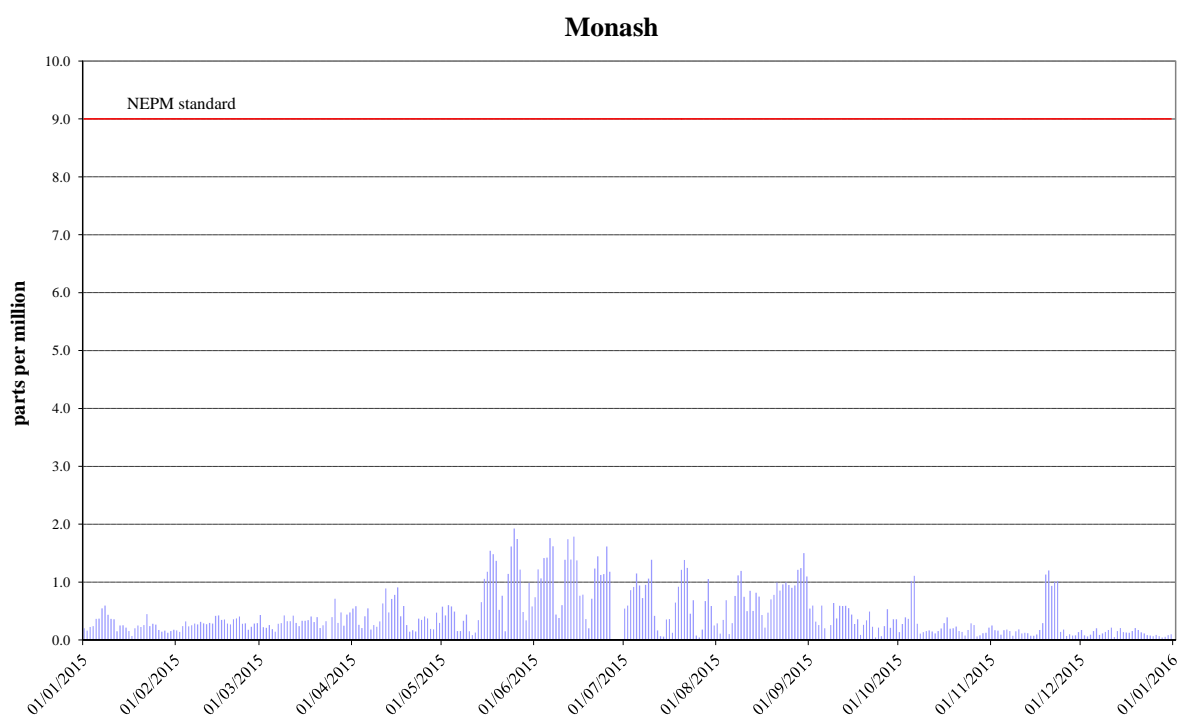


Figure 1: Daily max for CO 8-hour average – Monash

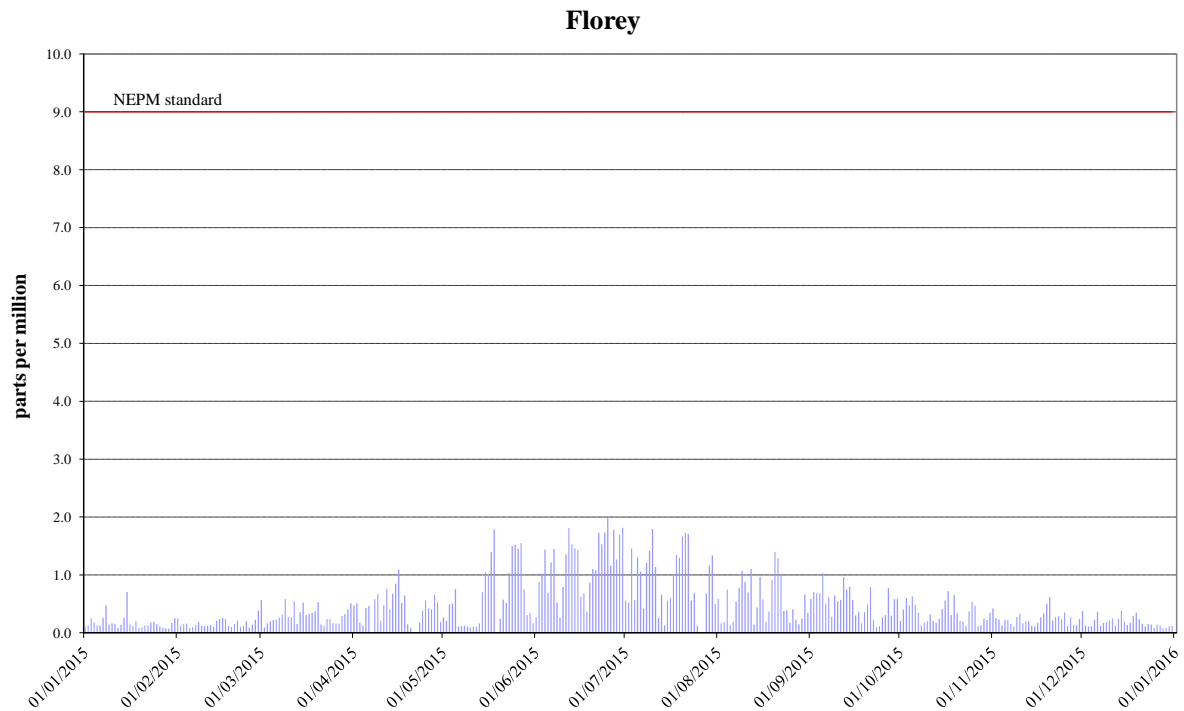


Figure 2: Daily max for CO 8-hour average – Florey

Nitrogen dioxide

During 2015, no exceedences of the nitrogen dioxide standards were recorded in the ACT. Compliance against the AAQ NEPM goal was demonstrated.

Table 5: 2015 compliance summary for NO₂

AAQ NEPM standard – 0.12 ppm (1-hour average), 0.03 ppm (1-year average)

Performance monitoring station	Data availability rates (% of hours)					Annual mean Concentration (ppm)	Number of 1 hour exceedences (days)	Performance against the standards and goal	
								1 hour	1 year
	Q1	Q2	Q3	Q4	Annual				
Monash	95.4	95.4	92.7	95.8	94.8	0.004	0	MET	MET
Florey	95.5	86.3	88.4	95.8	91.5	0.005	0	MET	MET

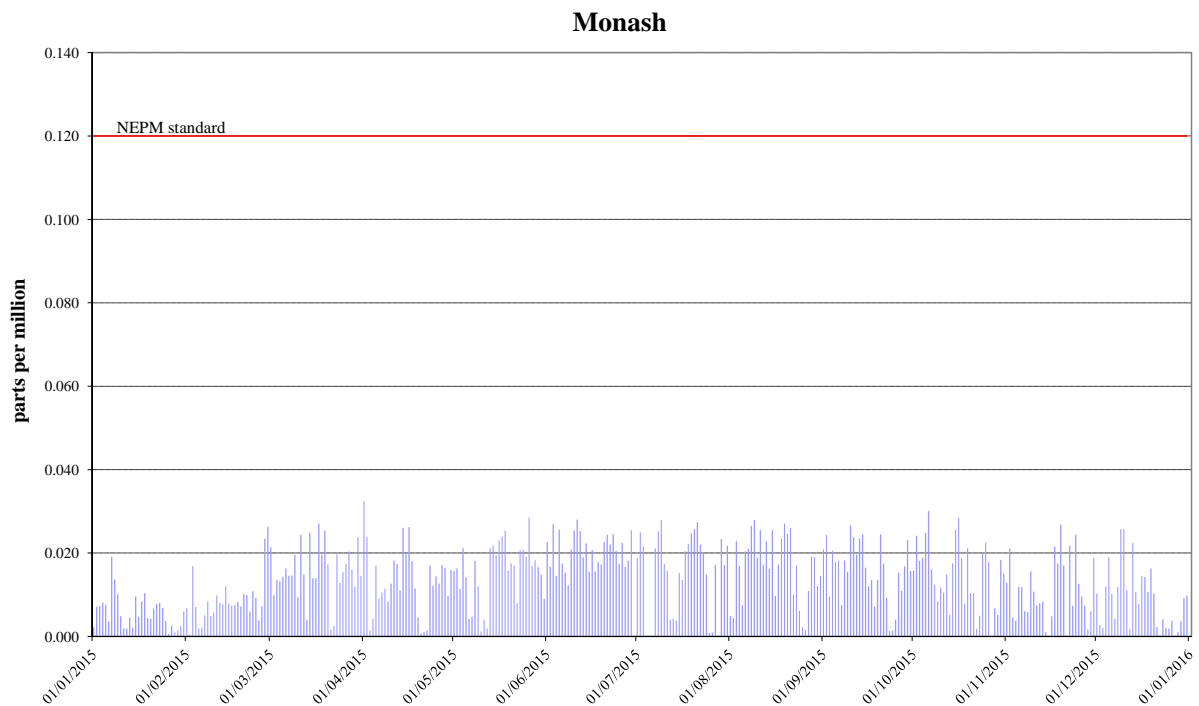


Figure 3: Daily max for NO₂ – Monash

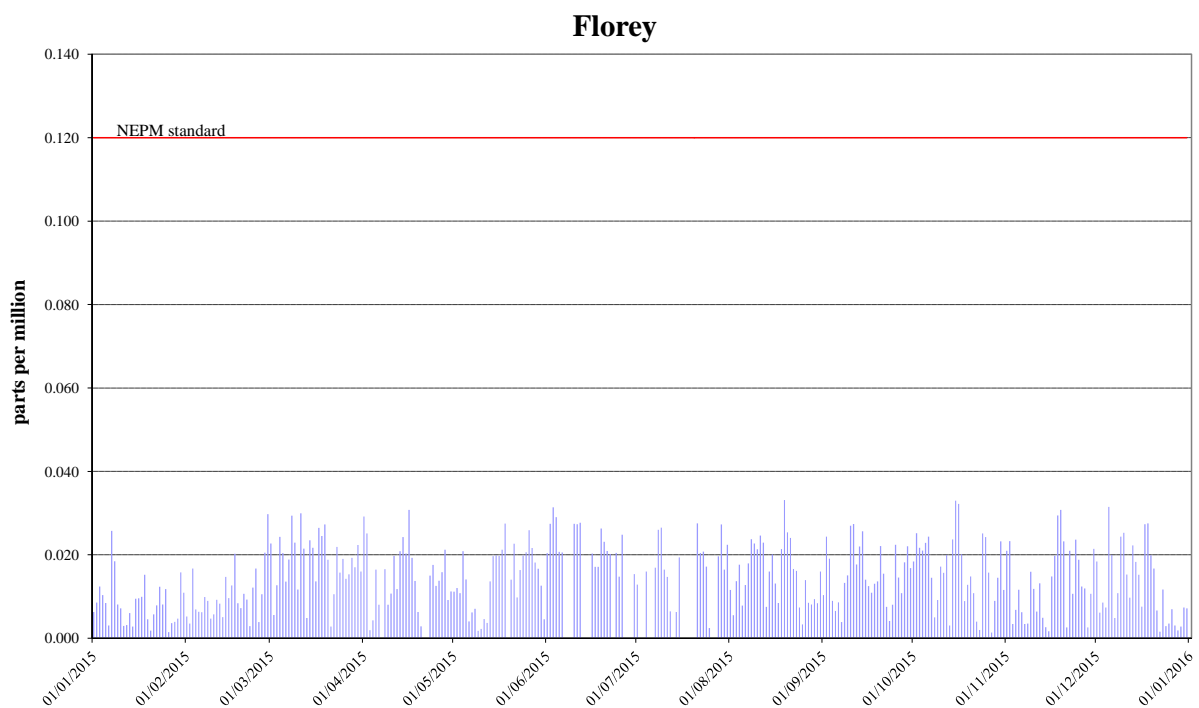


Figure 4: Daily max for NO₂ – Florey

Ozone

During 2015, no exceedences of the 1-hour and 4-hour standards for ozone were recorded in the ACT. Compliance against the AAQ NEPM goal was demonstrated.

Table 6: 2015 compliance summary for O₃

AAQ NEPM standard – 0.10 ppm (1-hour average), 0.08 ppm (4-hour average)

Performance monitoring station	Data availability rates (% of hours)					Number of exceedences (days)		Performance against the standards and goal	
	Q1	Q2	Q3	Q4	Annual	1 hour	4 hours	1 hour	4 hours
Monash	83.9	95.8	95.6	95.8	92.8	0	0	MET	MET
Civic	88.8	76.4	94.7	95.7	89.0	0	0	MET	MET
Florey	95.6	91.1	94.3	95.8	94.2	0	0	MET	MET

Monash

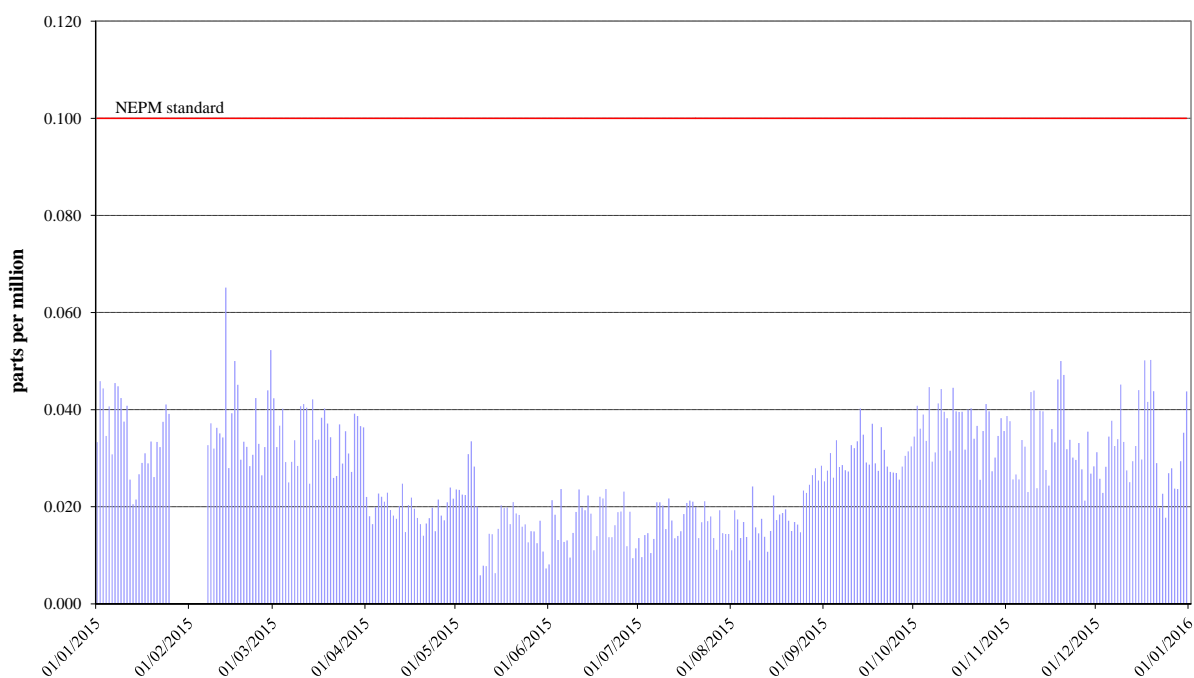


Figure 5: Daily max for 1 hour O₃ – Monash

Civic

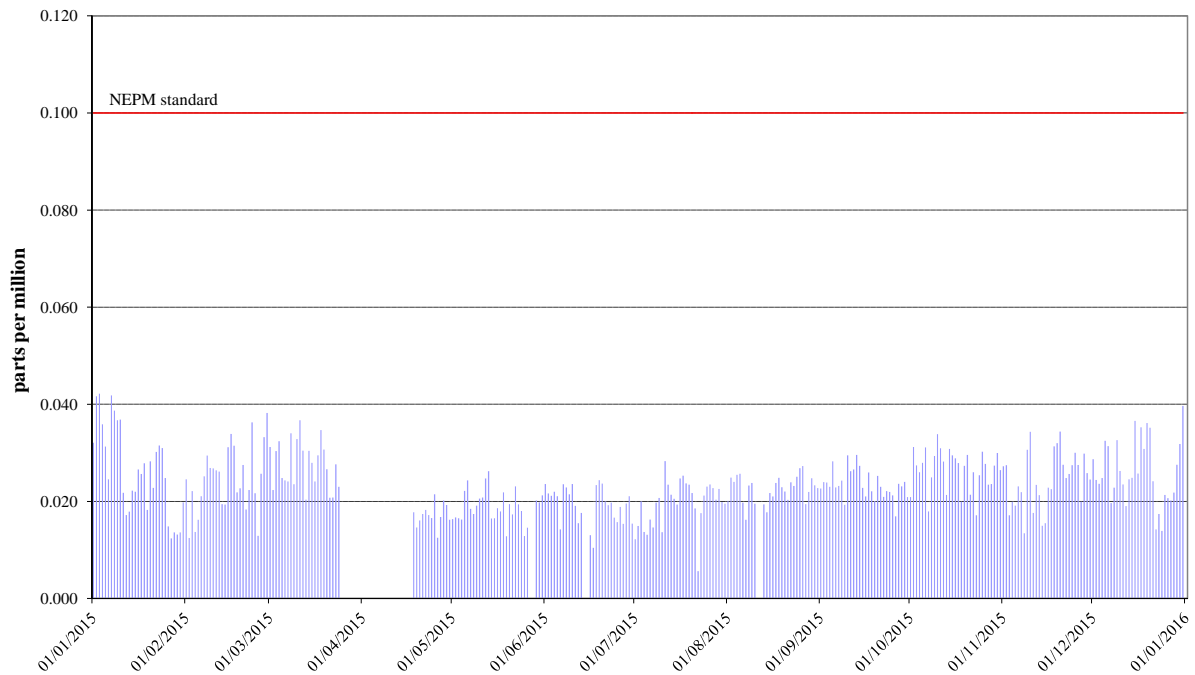


Figure 6: Daily max for 1 hour O₃ – Civic

Florey

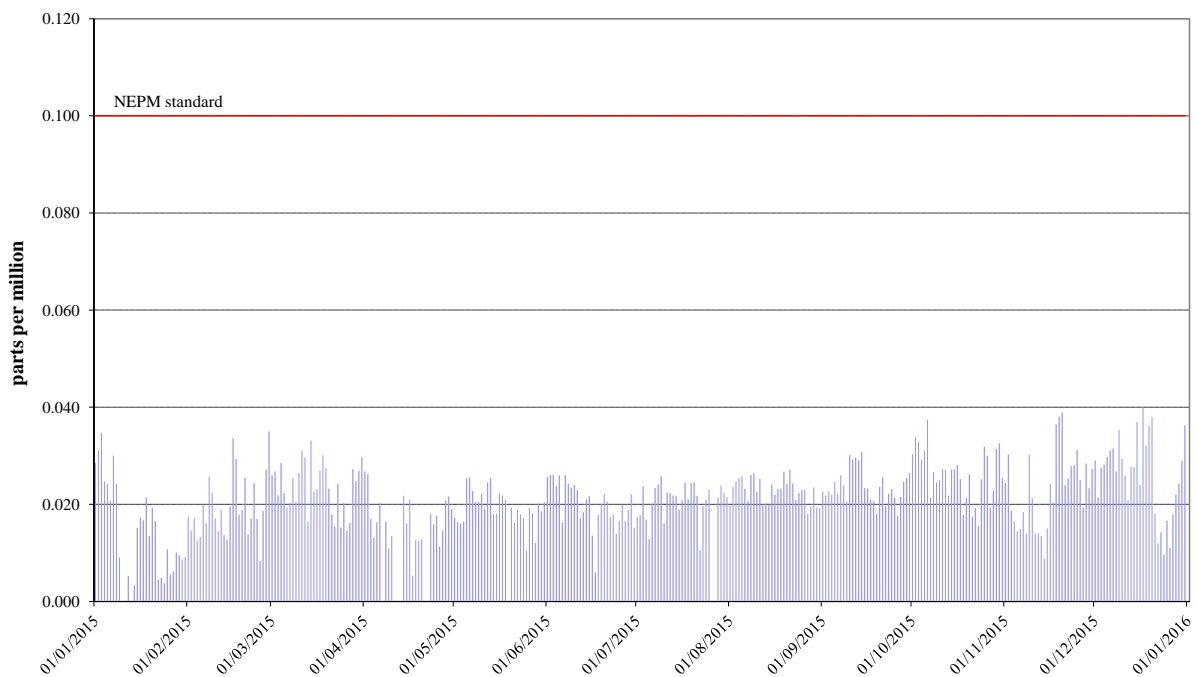


Figure 7: Daily max for 1 hour O₃ – Florey

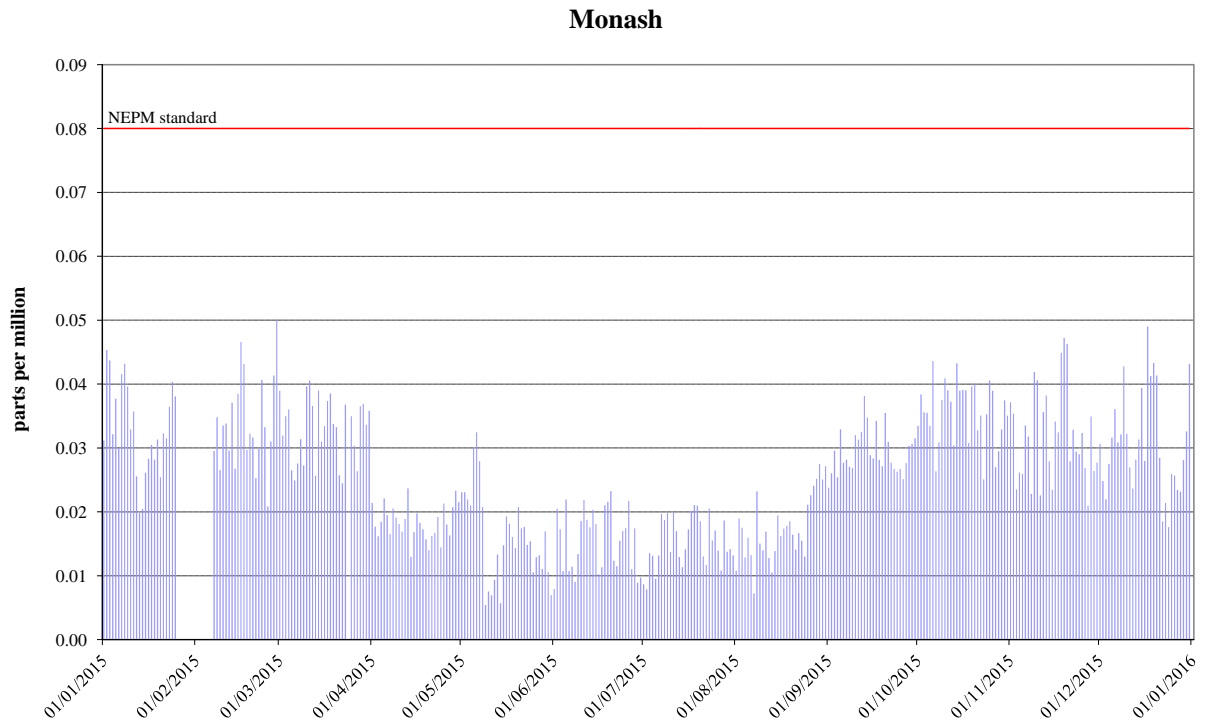


Figure 8: Daily max for 4 hours O₃ - Monash

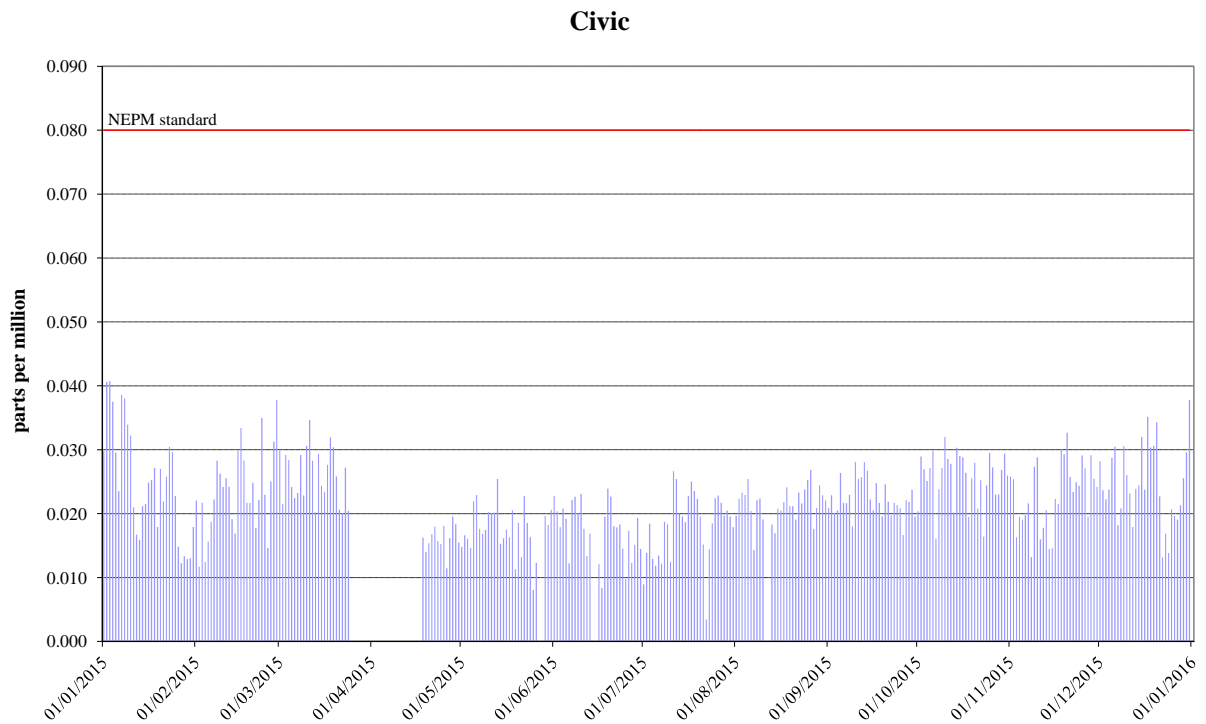


Figure 9: Daily max for 4 hours O₃ – Civic

Florey

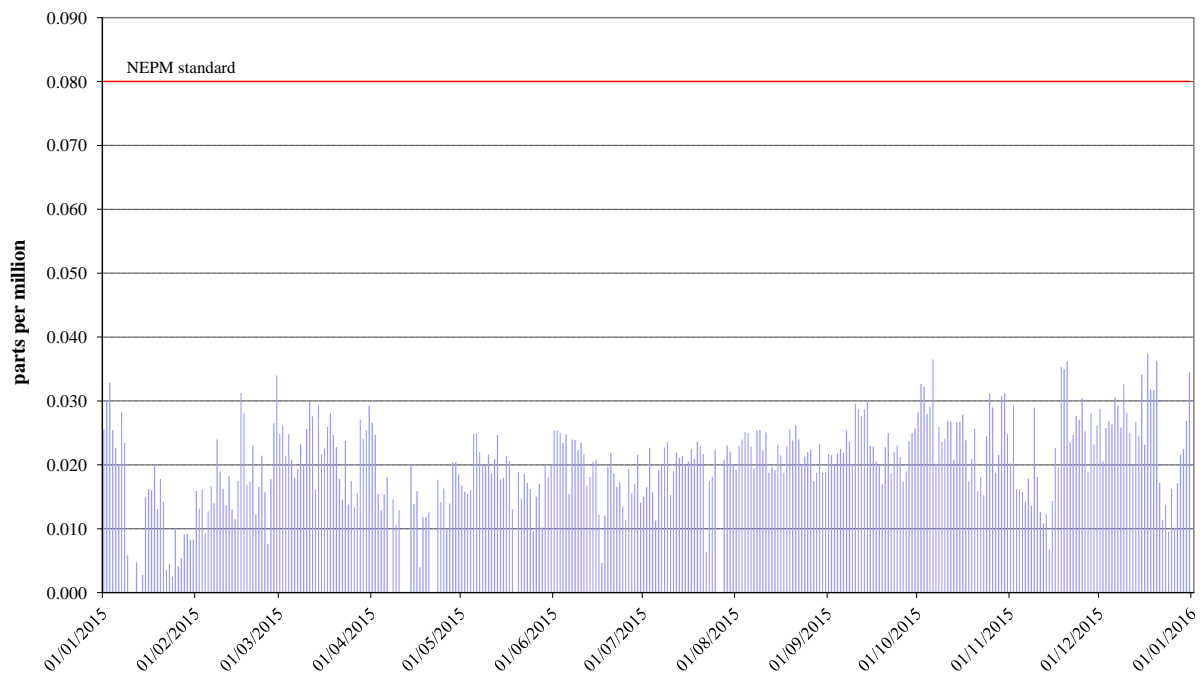


Figure 10: Daily max for 4 hours O₃ – Florey

Particulate matter PM₁₀

During 2015, two exceedences of the 24-hour PM₁₀ standard were recorded in the ACT. Compliance against the AAQ NEPM goal was demonstrated.

Table 7: 2015 compliance summary for PM₁₀

AAQ NEPM standard 50 µg/m³ 1-day average

Performance monitoring station	Data availability rates (% of days)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Monash	100	94.5	98.4	100	98.4	0	MET
Civic	95.6	97.8	96.8	99.2	97.5	1	MET
Florey	91.1	95.6	96.8	98.4	95.6	1	MET

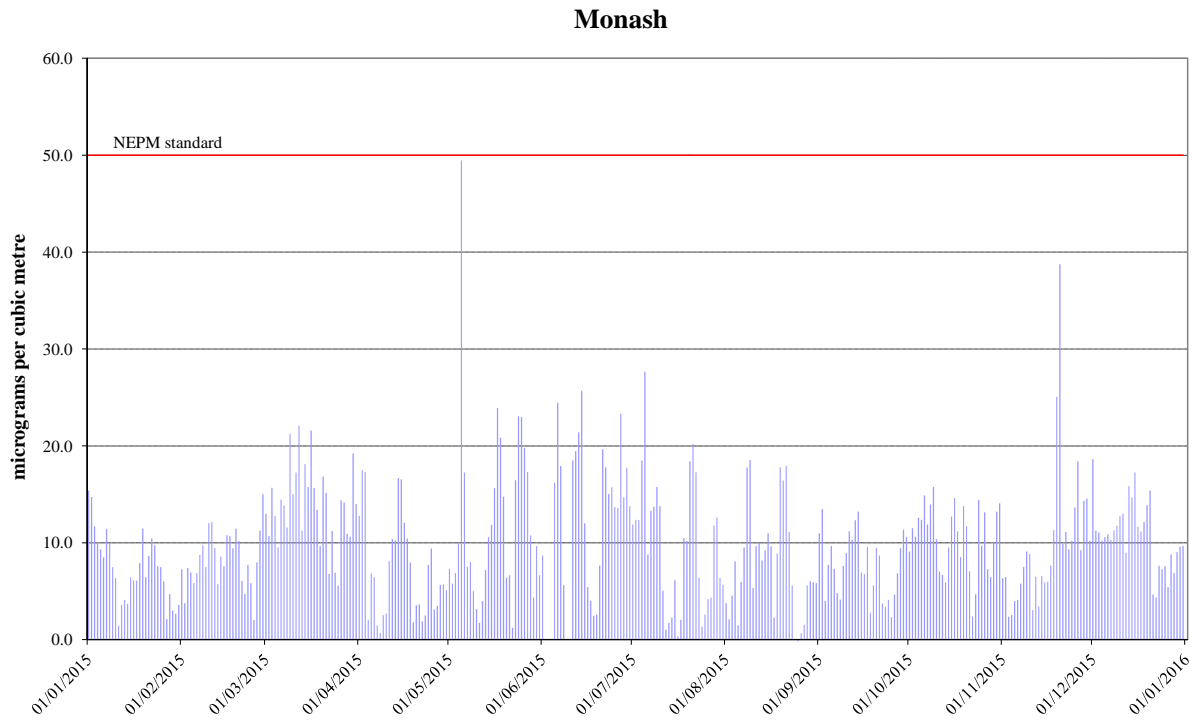


Figure 11: Daily max for PM₁₀ – Monash

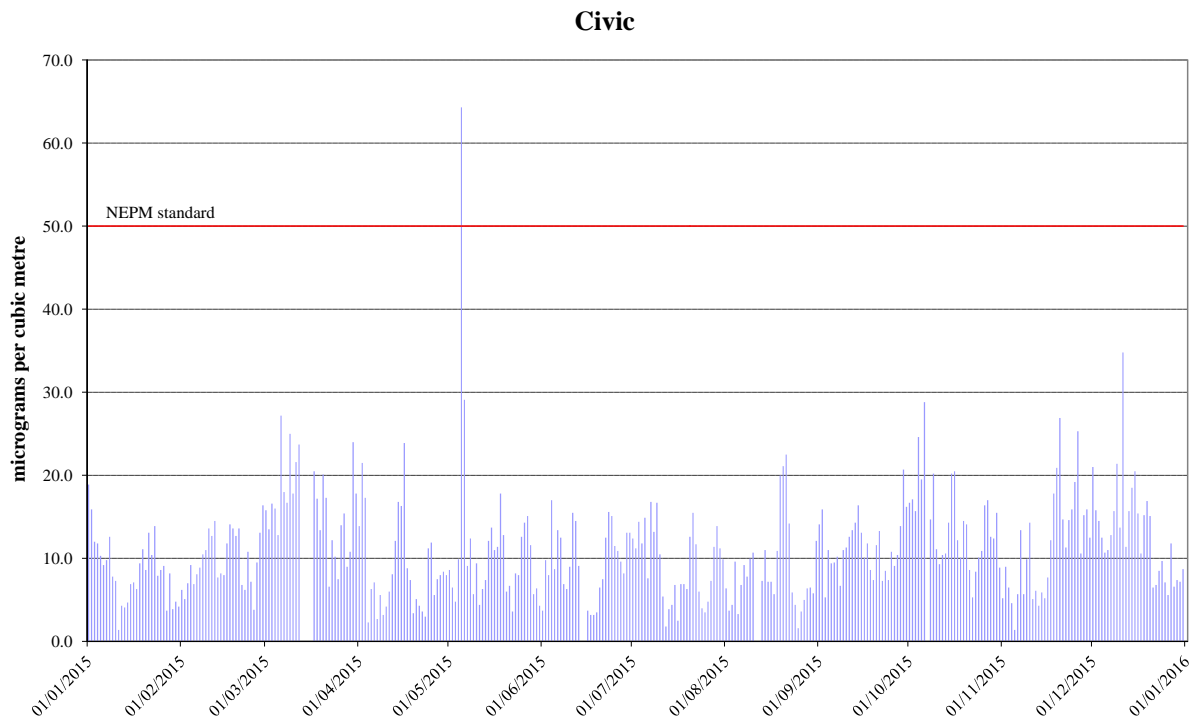


Figure 12: Daily max for PM₁₀ – Civic

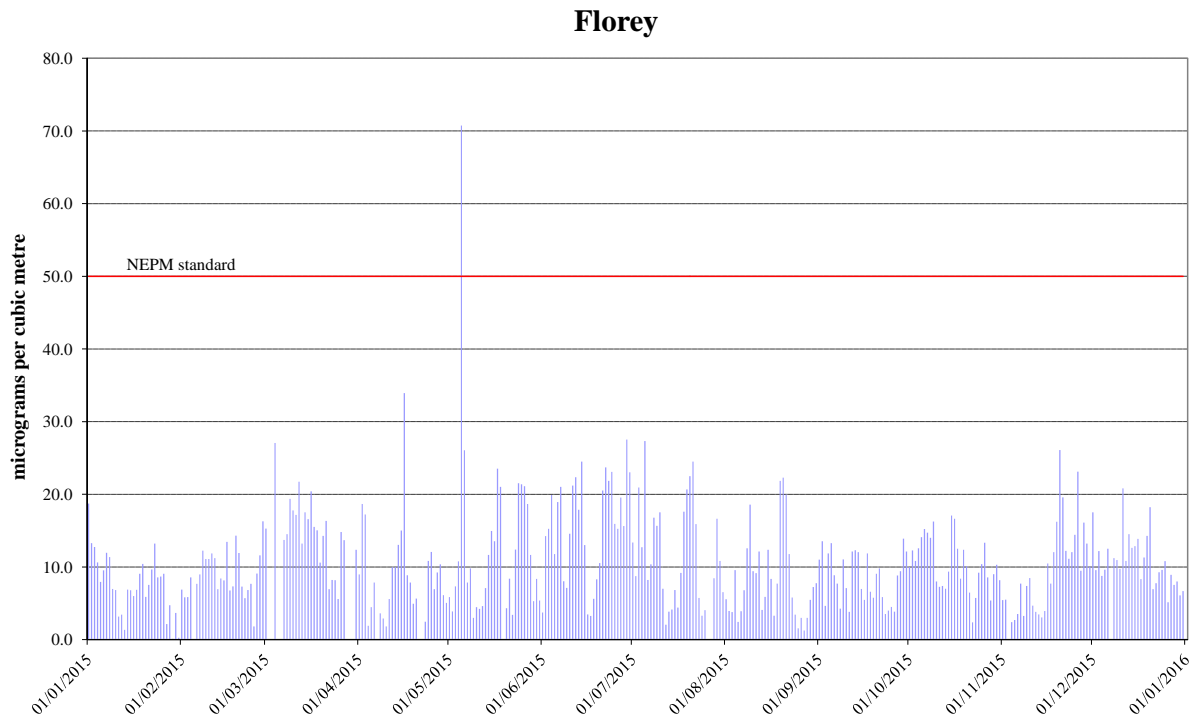


Figure 13: Daily max for PM₁₀ – Florey

Particulate matter PM_{2.5}

Six exceedences of the 24-hour advisory reporting standard were recorded, all at Monash, in 2015.

Table 8: 2015 compliance summary for PM_{2.5}

AAQ NEPM standard – 25 µg/m³ (1-day), 8 µg/m³ (1-year)

Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (µg/m ³)	Number of exceedences (days)
	Q1	Q2	Q3	Q4	Annual		
Monash	95.6	97.8	91.9	98.4	96.4	7.4	6
Florey	98.9	98.9	100	90.2	96.2	6.5	0

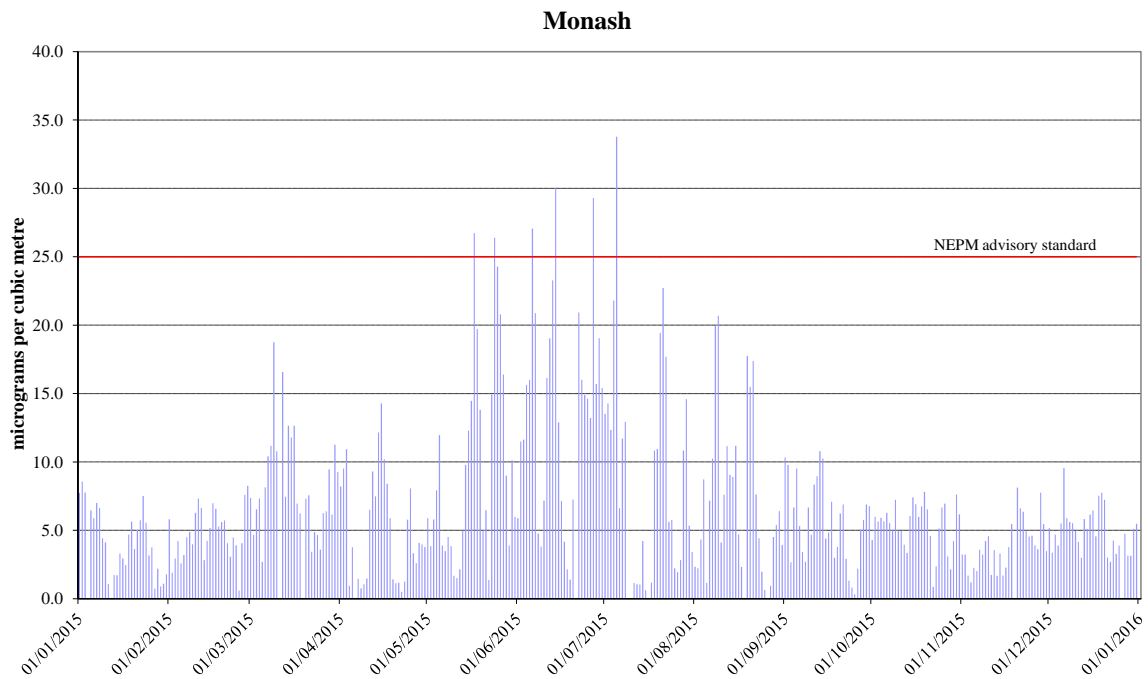


Figure 14: Daily max for PM_{2.5} – Monash

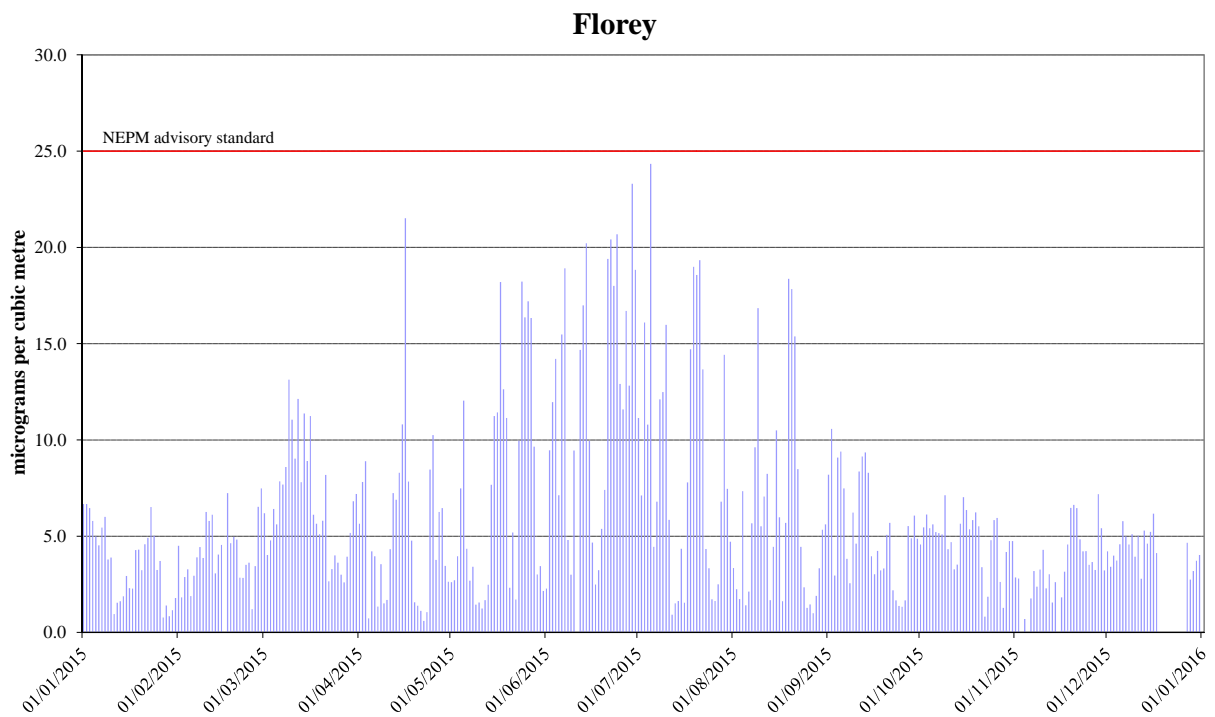


Figure 15: Daily max for PM_{2.5} – Florey

ANALYSIS OF AIR QUALITY MONITORING

Annual summary statistics contained in Table 9 to Table 14 below allow assessment of air quality against the standards and the extent of compliance with the goal. Instances where the standard or goal has been exceeded are highlighted in bold. The AAQ NEPM states that the short-term standards should not be exceeded on more than one day for carbon monoxide, nitrogen dioxide and ozone, and on no more than five days per year for particulate matter PM₁₀. The second highest daily value for the year (or the sixth for PM₁₀) indicates the extent to which the standards are or are not met.

Carbon monoxide

Carbon monoxide levels are well below the AAQ NEPM standard. The highest recorded value in the ACT during 2015 was 2.0ppm at Florey, which is 22% of the standard.

Table 9: 2015 summary statistics for daily peak 8-hour CO

AAQ NEPM standard - 9.0 ppm (8-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	365	1.9	25 May 05:00	1.8	14 Jun 04:00
Florey	365	2.0	25 Jun 04:00	1.8	30 Jun 04:00

Nitrogen dioxide

Nitrogen dioxide levels are well below the AAQ NEPM standard. The highest recorded 1-hour value during 2015 was 0.033ppm at Florey, which is 27.5% of the standard. The highest recorded annual average in 2015 was 0.005ppm at Florey (refer to table 5). This is 17% of the annual standard 0.03ppm.

Table 10: 2015 summary statistics for daily peak 1-hour NO₂

AAQ NEPM standard 0.12 ppm (1-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	365	0.032	20 Apr 20:00	0.030	06 Oct 21:00
Florey	365	0.033	19 Aug 23:00	0.033	15 Oct 20:00

Ozone

Ozone levels are below the AAQ NEPM standard. The highest recorded 1-hour value in the ACT during 2015 was 0.065ppm at Monash, which is 87% of the standard. The highest recorded 4-hour value in the ACT during 2015 was 0.050ppm at Monash, which is 62.5% of the standard.

Table 11: 2015 summary statistics for daily peak 1-hour O₃

AAQ NEPM standard 0.10 ppm (1-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	365	0.065	13 Feb 11:00	0.052	28 Feb 17:00
Civic	365	0.042	03 Jan 12:00	0.042	07 Jan 14:00
Florey	365	0.040	17 Dec 17:00	0.039	20 Nov 18:00

Table 12: 2015 summary statistics for daily peak 4-hour O₃

AAQ NEPM standard 0.08 ppm (4-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	365	0.050	28 Feb 18:00	0.049	17 Dec 17:00
Civic	365	0.041	03 Jan 15:00	0.041	02 Jan 16:00
Florey	365	0.037	17 Dec 17:00	0.037	06 Oct 17:00

Particulate matter PM₁₀

During 2015, the PM₁₀ standard was exceeded once at Civic and Florey respectively due to a dust storm. The highest PM₁₀ level recorded during 2015 was 70.8 µg/m³ at Florey on 05 May 2015.

Table 13: 2015 summary statistics for daily peak PM₁₀

AAQ NEPM standard 50 µg/m³ (24-hour average)

Performance monitoring station	Number of valid days	Highest (µg/m ³)	Highest (date)	6 th Highest (µg/m ³)	6 th Highest (date)
Monash	359	49.4	05 May	24.5	06 June
Civic	356	64.3	05 May	26.9	20 November
Florey	349	70.8	05 May	26.1	20 November

Particulate matter PM_{2.5}

The 24-hour advisory reporting standard for PM_{2.5} was exceeded six times at Monash. These exceedences occurred during late May and July due to domestic wood heater emissions.

Table 14: 2015 summary statistics for daily peak PM_{2.5}

AAQ NEPM standard 25 µg/m³ (24-hour average)

Performance monitoring station	Number of valid days	Highest (µg/m ³)	Highest (date)	6 th Highest (µg/m ³)	6 th Highest (date)
Monash	352	33.8	05 July	26.4	24 May
Florey	351	24.3	05 July	20.2	14 June

ASSESSMENT OF PROGRESS TOWARDS ACHIEVING THE GOAL

The goals and standards have been consistently met in the ACT for carbon monoxide, nitrogen dioxide and ozone since the commencement of the AAQ NEPM.

Historical monitoring results indicate that the only AAQ NEPM pollutant of concern in the Canberra airshed is particulate matter, which increases during winter because of emissions from domestic wood heaters. In more recent years exceedences of the particulate matter standards have also been attributed to dust storms and smoke from controlled burns.

The ACT Government for many years has actively worked on addressing the causes for the exceedences attributable to domestic wood heaters. For example, the ACT Government has introduced the licensing of firewood merchants, has a wood heater replacement program and has run a range of public awareness campaigns, such as the 'Burn Right Tonight' campaign. It will continue to implement an integrated program to address woodsmoke.



APPENDIX A: STATISTICAL SUMMARY AND TRENDS

The following section provides a basic statistical summary, using percentiles, for Monash and Civic stations and for each standard. Percentiles for daily maximum values are presented. As the Florey station was established in 2014, there is insufficient data to show the statistical summary and trends.

Carbon monoxide

Table 15: Statistical summary for daily maximum 8-hour CO Monash 2006 – 2015

Year	Data Availability (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	99.7	0	3.7	2.8	2.6	2.2	1.8	1.1	0.4
2007	95.3	0	2.6	2.5	2.4	2.0	1.5	0.7	0.4
2008	88.0	0	2.4	2.2	2.1	1.8	1.5	0.8	0.3
2009	96.4	0	2.0	1.7	1.5	1.4	1.1	0.6	0.3
2010	99.2	0	1.8	1.7	1.6	1.4	1.1	0.6	0.3
2011	98.6	0	2.2	1.9	1.8	1.5	1.1	0.5	0.2
2012	99.7	0	1.8	1.7	1.7	1.2	1.0	0.6	0.3
2013	95.9	0	2.1	1.9	1.8	1.5	1.2	0.6	0.3
2014	94.0	0	1.8	1.6	1.5	1.4	1.1	0.7	0.4
2015	94.8	0	1.9	1.7	1.6	1.4	1.1	0.6	0.3

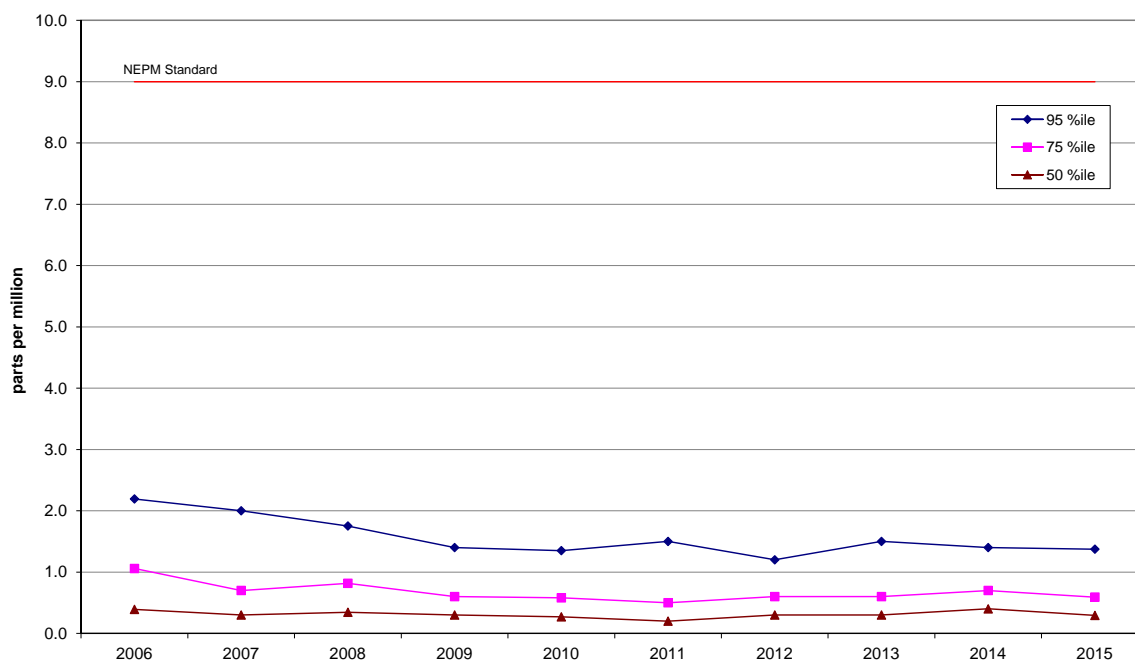


Figure 16: Statistical summary for daily maximum 8-hour CO Monash 2006 – 2015

Nitrogen dioxide

Table 16: Statistical summary for daily maximum 1-hour NO₂ Monash 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	98.4	0	0.044	0.036	0.033	0.031	0.029	0.024	0.019
2007	97.0	0	0.039	0.037	0.035	0.030	0.028	0.023	0.018
2008	86.5	0	0.103	0.040	0.032	0.031	0.028	0.025	0.019
2009	92.6	0	0.041	0.034	0.033	0.029	0.027	0.023	0.019
2010	89.1	0	0.037	0.029	0.028	0.025	0.023	0.021	0.017
2011	96.7	0	0.043	0.031	0.030	0.029	0.026	0.022	0.015
2012	97.5	0	0.033	0.030	0.029	0.026	0.025	0.021	0.014
2013	97.5	0	0.037	0.031	0.030	0.027	0.025	0.021	0.014
2014	94.1	0	0.036	0.030	0.029	0.027	0.025	0.020	0.015
2015	94.8	0	0.032	0.028	0.027	0.026	0.024	0.020	0.014

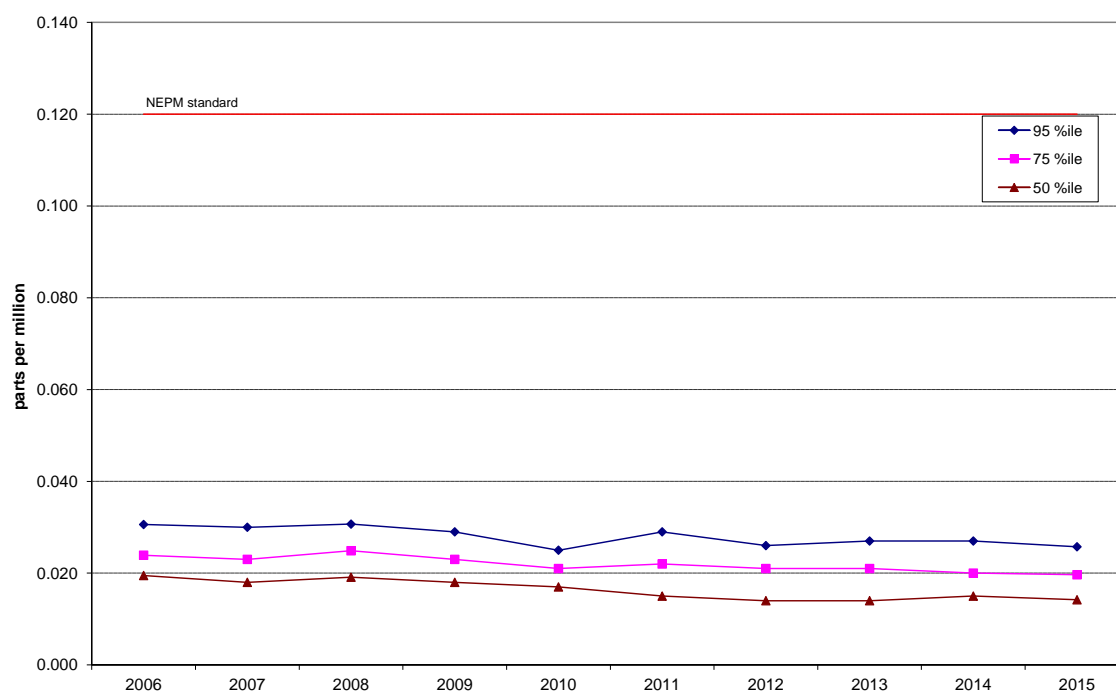


Figure 17: Statistical summary for daily maximum 1-hour NO₂ Monash 2006 – 2015

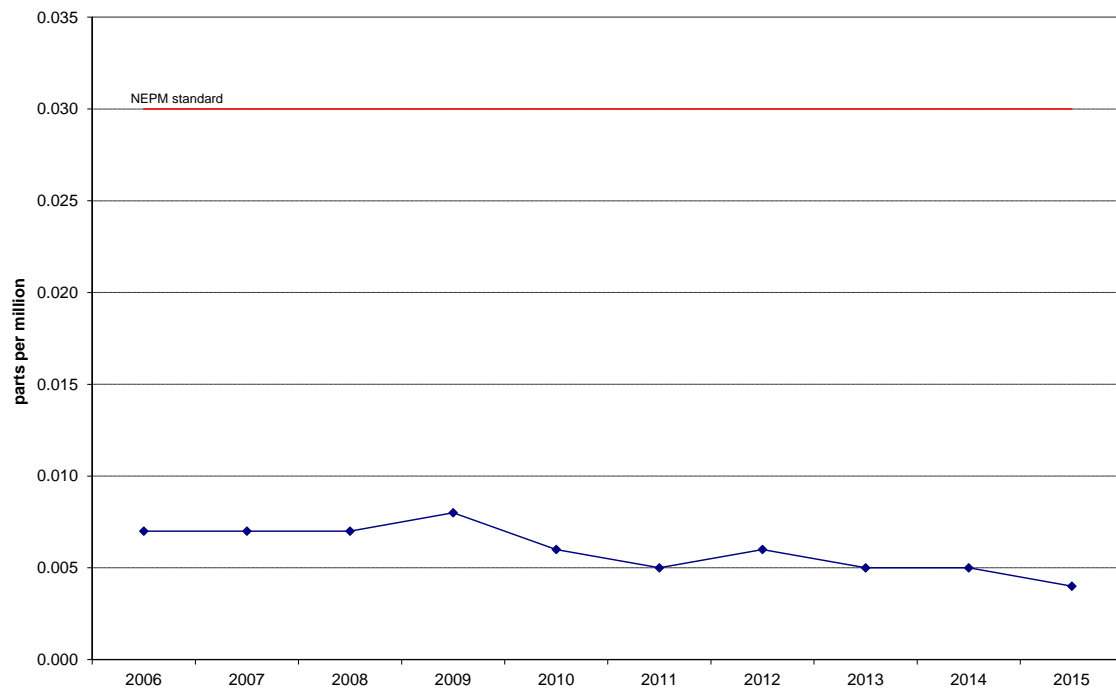


Figure 18: Annual average 1-hour NO₂ Monash 2006 – 2015

Ozone

Table 17: Statistical summary for daily maximum 1-hour O₃ Monash 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	99.7	0	0.067	0.060	0.057	0.052	0.049	0.040	0.032
2007	95.4	0	0.075	0.064	0.062	0.057	0.052	0.043	0.032
2008	84.2	0	0.065	0.055	0.053	0.047	0.040	0.031	0.026
2009	96.4	0	0.073	0.063	0.059	0.052	0.045	0.038	0.030
2010	86.6	0	0.051	0.048	0.046	0.042	0.037	0.033	0.030
2011	99.2	0	0.056	0.052	0.047	0.044	0.040	0.033	0.028
2012	100	0	0.055	0.048	0.046	0.043	0.040	0.034	0.029
2013	97.8	0	0.062	0.051	0.049	0.045	0.041	0.035	0.029
2014	94.8	0	0.087	0.060	0.057	0.050	0.044	0.036	0.030
2015	92.8	0	0.065	0.050	0.046	0.044	0.040	0.034	0.026

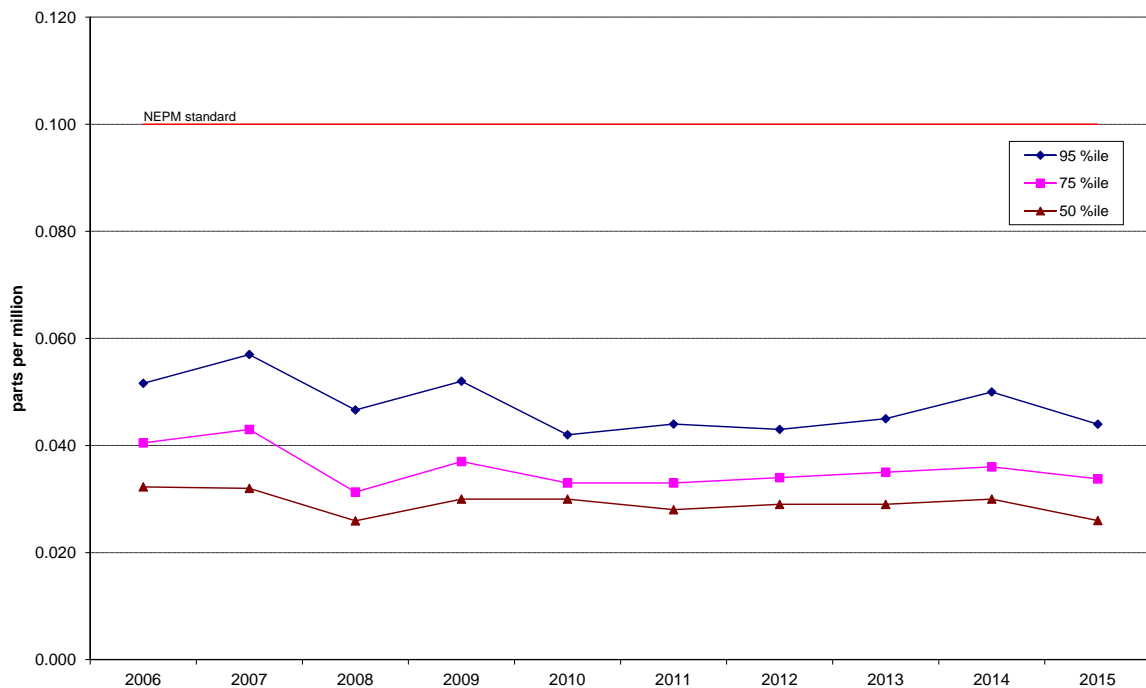


Figure 19: Statistical summary for daily maximum 1-hour O₃ Monash 2006 – 2015

Table 18: Statistical summary for daily maximum 1-hour O₃ Civic 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	95.5	3	0.252	0.084	0.060	0.049	0.043	0.034	0.027
2007	91.5	1	0.112	0.057	0.050	0.044	0.040	0.032	0.026
2008	91.4	0	0.052	0.050	0.044	0.039	0.034	0.028	0.023
2009	97.8	0	0.060	0.055	0.052	0.044	0.040	0.031	0.024
2010	99.2	0	0.058	0.050	0.048	0.040	0.036	0.029	0.025
2011	96.4	0	0.052	0.046	0.045	0.041	0.036	0.030	0.026
2012	100	0	0.053	0.041	0.038	0.034	0.030	0.024	0.020
2013	92.1	0	0.060	0.043	0.041	0.036	0.032	0.028	0.024
2014	94.0	0	0.060	0.050	0.046	0.039	0.036	0.028	0.022
2015	89.0	0	0.042	0.039	0.037	0.034	0.031	0.026	0.022

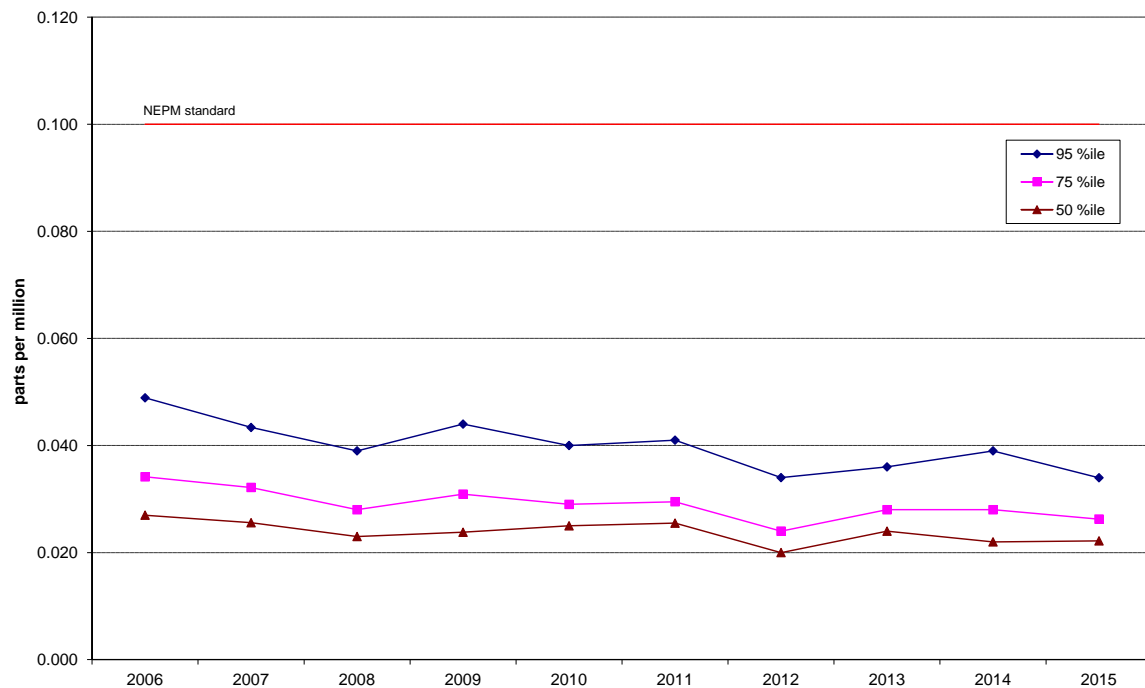


Figure 20: Statistical summary for daily maximum 1-hour O₃ Civic 2006 – 2015

Table 19: Statistical summary for daily maximum 4-hour O₃ Monash 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	99.7	0	0.061	0.056	0.055	0.050	0.046	0.038	0.031
2007	100	0	0.072	0.061	0.059	0.054	0.050	0.040	0.032
2008	84.2	0	0.061	0.052	0.049	0.045	0.038	0.030	0.025
2009	96.2	0	0.068	0.058	0.056	0.048	0.044	0.036	0.029
2010	86.6	0	0.049	0.046	0.043	0.040	0.037	0.032	0.029
2011	98.9	0	0.054	0.048	0.044	0.041	0.038	0.032	0.027
2012	99.7	0	0.052	0.048	0.046	0.043	0.040	0.034	0.029
2013	97.8	0	0.059	0.048	0.047	0.042	0.039	0.033	0.028
2014	94.8	0	0.060	0.055	0.052	0.046	0.042	0.034	0.029
2015	92.8	0	0.050	0.046	0.044	0.041	0.039	0.033	0.025

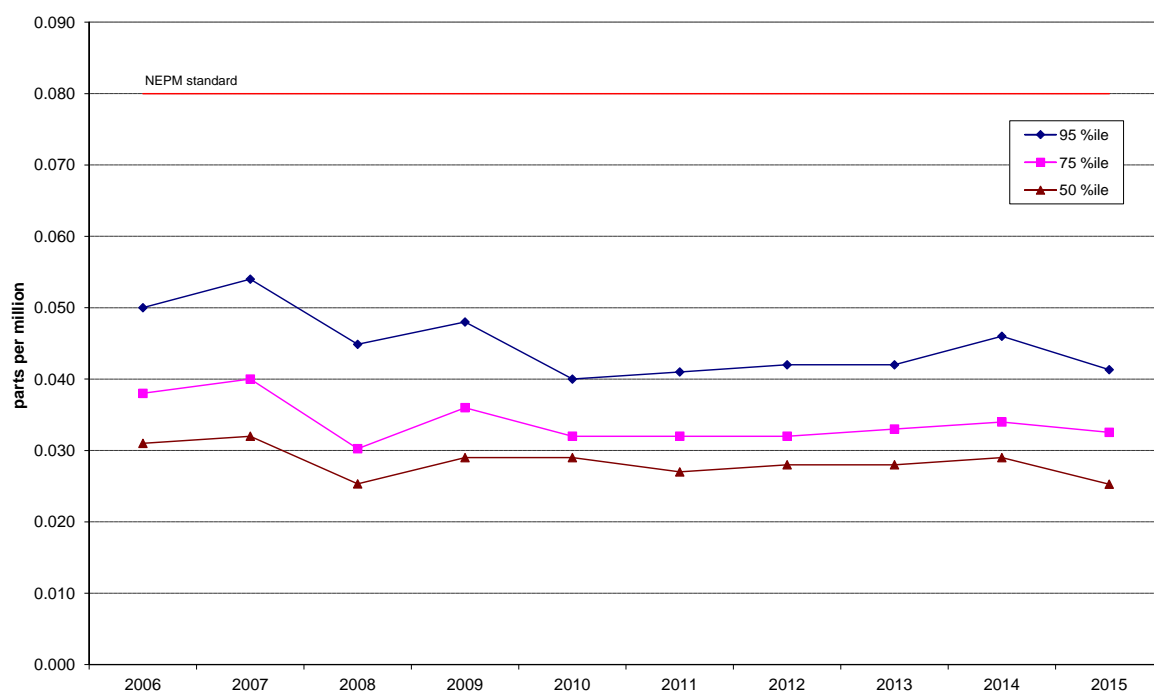


Figure 21: Statistical summary for daily maximum 4-hour O₃ Monash 2006 – 2015

Table 20: Statistical summary for daily maximum 4-hour O₃ Civic 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	95.5	1	0.145	0.066	0.053	0.045	0.040	0.032	0.026
2007	91.5	1	0.097	0.052	0.046	0.040	0.037	0.030	0.025
2008	91.4	0	0.051	0.047	0.039	0.036	0.033	0.027	0.022
2009	97.8	0	0.059	0.049	0.047	0.041	0.037	0.030	0.023
2010	99.2	0	0.056	0.047	0.044	0.037	0.034	0.028	0.024
2011	96.4	0	0.050	0.044	0.041	0.038	0.035	0.029	0.025
2012	100	0	0.042	0.037	0.036	0.032	0.028	0.023	0.019
2013	91.8	0	0.057	0.040	0.038	0.034	0.030	0.027	0.023
2014	94.0	0	0.047	0.045	0.040	0.036	0.034	0.026	0.020
2015	89.0	0	0.041	0.038	0.035	0.031	0.029	0.025	0.021

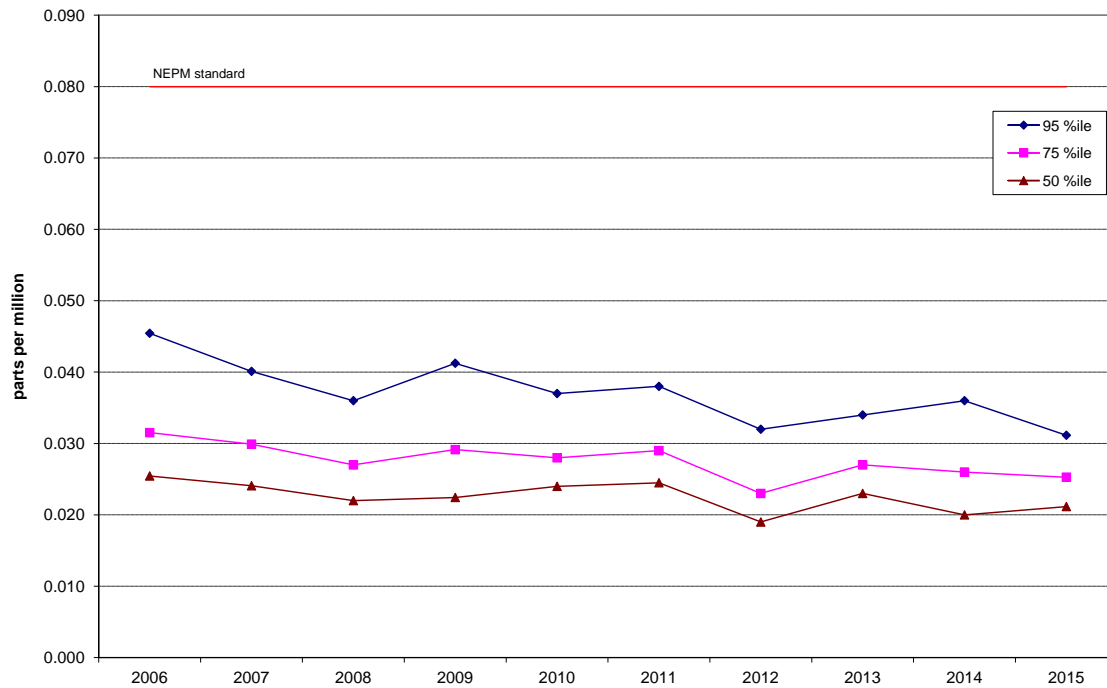


Figure 22: Statistical summary for daily maximum 4-hour O₃ Civic 2006 – 2015

PM₁₀

Table 21: Statistical summary for daily maximum 24-hour PM₁₀ Monash 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	83.8	4	55.2	51.0	44.9	33.9	28.3	22.7	16.9
2007	99.7	5	117.7	61.8	42.5	35.3	28.0	21.0	14.9
2008	82	3	96.6	45.8	35.7	29.9	26.6	20.1	14.8
2009	42.3	9	210.0	116.0	62.4	50.5	37.7	25.5	15.2
2010	95.4	0	48.4	35.6	27.4	23.5	20.2	14.7	10.0
2011	99.2	0	40.0	33.7	30.3	22.8	18.6	13.2	8.7
2012	98.6	0	41.0	24.2	21.8	19.7	17.4	13.7	9.7
2013	95.6	0	43.5	29.1	25.1	20.2	16.8	13.1	8.9
2014	97.8	0	39.3	27.1	23.1	19.1	16.4	12.9	9.6
2015	98.4	0	49.4	25.3	23.3	19.5	17.3	13.1	9.5

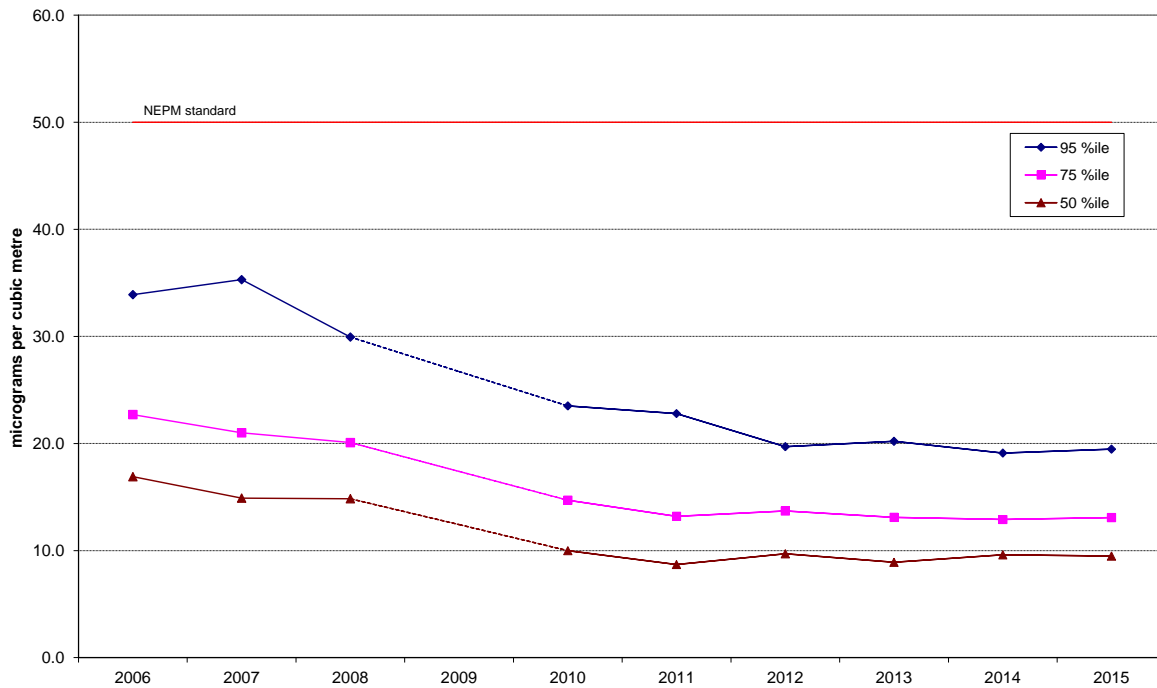


Figure 23: Statistical summary for daily maximum 24-hour PM₁₀ Monash 2006 – 2015

Note: 2009 data has not been included in Figure 23 as the percentile data has been skewed because of insufficient data in Q1 and Q2 (zero and twenty five percent respectively) and the extreme readings associated with the dust storm which affected most of eastern Australia on 22 and 23 September, 2009.

Table 22: Statistical summary for daily maximum 24-hour PM₁₀ Civic 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	13.2	2	70.8	61.2	51.5	46.5	35.1	26.0	17.6
2007	13.2	1	50.9	48.7	46.5	42.7	31.4	20.1	13.8
2008	12.0	1	53.3	42.5	31.7	26.1	24.2	17.3	11.9
2009	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2010	57.6	0	23.8	19.7	17.1	14.7	13.7	11.1	8.4
2011	97.0	0	29.2	22.3	20.9	16.9	14.4	11.0	7.9
2012	95.1	0	49.5	22.8	20.2	17.0	14.9	12.1	8.7
2013	92.9	1	57.8	26.5	24.4	19.9	15.8	12.0	8.6
2014	95.1	0	31.4	24.2	22.1	17.7	15.1	12.6	9.3
2015	97.5	1	64.3	27.9	25.0	20.9	17.6	14.1	10.4

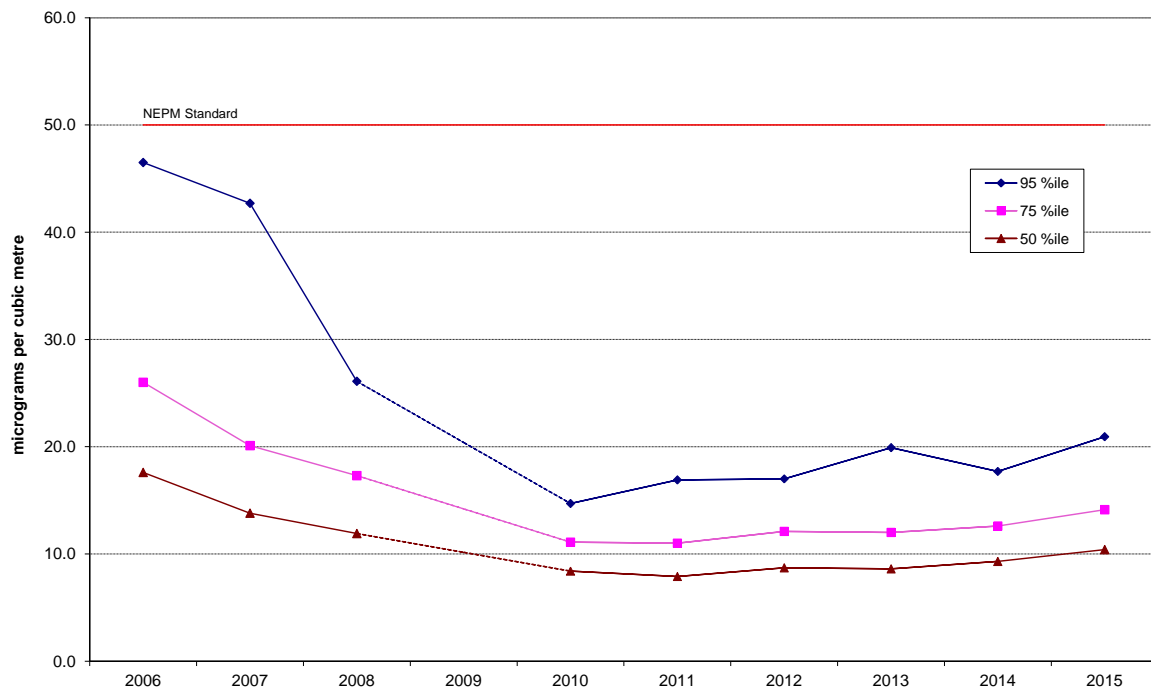


Figure 24: Statistical summary for daily maximum 24-hour PM₁₀ Civic 2006 – 2015

Note: No PM₁₀ monitoring was conducted at Civic in 2009.

PM_{2.5}

Table 23: Statistical summary for daily maximum 24-hour PM_{2.5} Monash 2006 – 2015

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99 th percentile (ppm)	98 th percentile (ppm)	95 th percentile (ppm)	90 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2006	83.3	20	46.9	35.6	33.3	27.8	15.6	8.7	5.8
2007	58.1	8	45.7	27.8	27.6	20.9	15.7	8.8	5.4
2008	45.4	6	30.7	28.0	25.7	23.5	19.7	12.4	6.3
2009	64.5	2	33.5	23.0	20.0	14.6	12.2	7.6	5.0
2010	95.1	2	52.4	22.1	20.9	17.4	14.3	7.8	4.4
2011	92.1	4	32.8	25.6	22.9	20.0	12.5	7.0	4.5
2012	95.1	3	29.2	23.8	19.8	16.5	13.2	8.3	5.0
2013	98.6	6	38.4	30.5	22.7	19.2	12.9	8.1	5.2
2014	87.7	4	31.5	25.7	21.6	18.7	14.4	8.6	5.6
2015	96.4	6	33.8	26.9	23.3	19.0	14.6	8.2	5.6

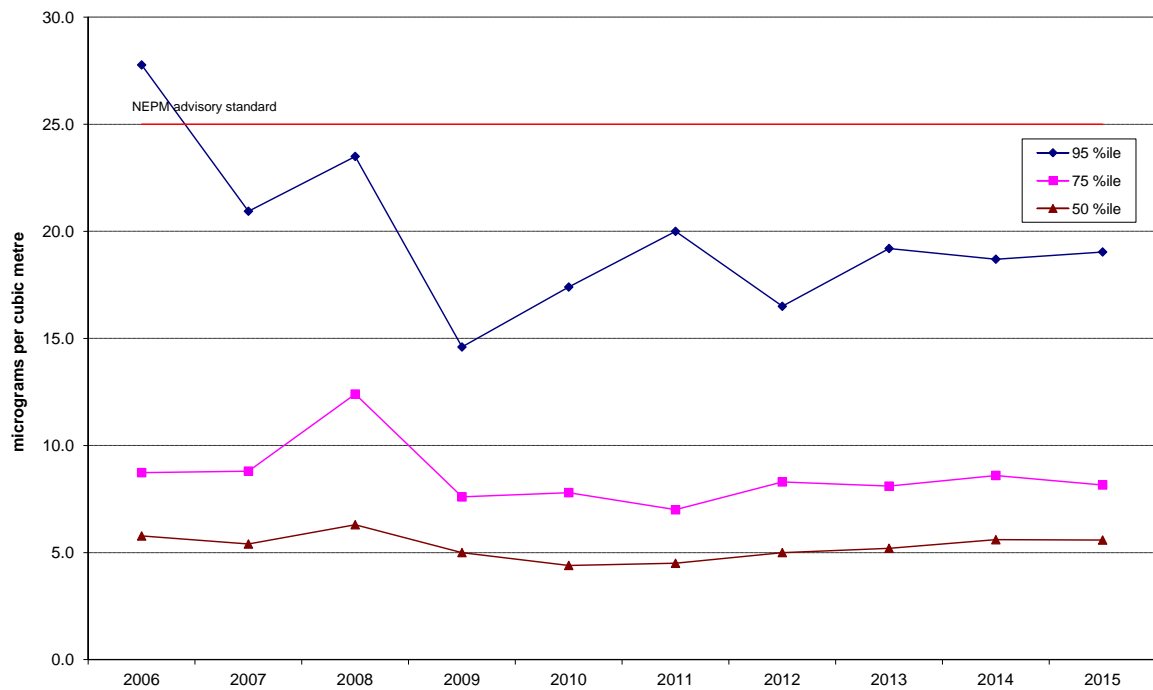


Figure 25: Statistical summary for daily maximum 24-hour PM_{2.5} Monash 2006 – 2015

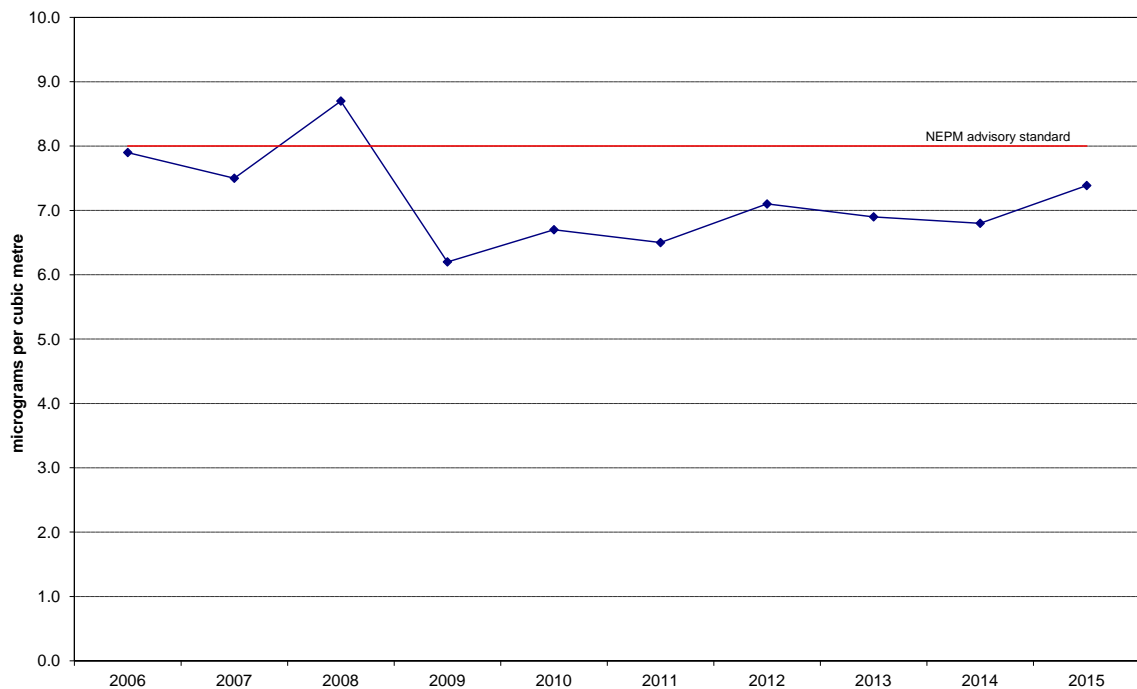


Figure 26: Annual average 24-hour PM_{2.5} Monash 2006 - 2015