



ACT
Government
Environment and
Sustainable Development



ACT AIR QUALITY REPORT 2012

Environment Protection Authority | June 2013



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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
NEPC	National Environment Protection Council
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)
SCEW	Standing Council on Environment and Water
SO ₂	Sulphur Dioxide
µg/m ³	micrograms per cubic metre



OVERVIEW

This report presents the results of ambient air quality monitoring in the ACT for the 2012 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 (NEPC) on 26 June 1998.

The ACT monitors four of the six NEPM pollutants, namely carbon monoxide (CO), nitrogen dioxide (NO₂), photochemical oxidants (as O₃) and particulate matter (particles less than 10 microns in diameter – PM₁₀ and particles less than 2.5 microns – PM_{2.5}). Due to a lack of heavy industry, the ACT has never monitored sulphur dioxide as it is primarily an industrial pollutant, and lead monitoring ceased in 2002 with the phase out of leaded petrol.

Monitoring results demonstrate that Canberra's air quality is excellent compared to other capital cities. The major impacts on Canberra's air quality in 2012, as in previous years, came from the accumulation of combustion particles from wood heaters in cold, highly stable air, hazard reduction burns and dust storms. With the exception of PM_{2.5}, all measured parameters are compliant with the AAQ NEPM standards.

There were three exceedences of the PM_{2.5} 24-hr advisory reporting standard which occurred in May and July 2012. These exceedences were attributed to domestic wood heater emissions in winter.

The ACT Government acknowledges that woodsmoke from domestic wood heaters is the largest source of air pollution in Canberra and has implemented a range of programs to address it. The monitoring results show that these programs have been effective in reducing woodsmoke with particle levels continuing to trend down. The figures have shown that the number of PM_{2.5} exceedences has fallen from 15 days in 2004 to 2 days in 2009 and kept at the similar low level since then. It is also pleasing to note that there were no exceedences of the PM₁₀ standard in 2012 because of wood heater emissions, although monitoring clearly shows that particle levels increase during the winter months. Since 2003 the 95th percentile for PM₁₀ at Monash station has fallen from 39.6µg/m³ to 19.7µg/m³.

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).



MONITORING SUMMARY

Current Performance Monitoring Stations

The ACT Government has been undertaking 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 and Sustainable Development Directorate is responsible for annual reporting under the AAQ NEPM.

The AAQ NEPM monitoring network in the ACT currently consists of two monitoring stations at Monash and Civic respectively. The Monash station is approximately 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 compliance and non-compliance criteria for both 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	☑	☒	☒	☒	☒	☑	☒

Under Clause 13 of the AAQ NEPM a performance monitoring station (PMS) should, to the extent practicable, be sited in accordance with AS/NZS 3580.1.1:2007 and must be located in a manner such that it contributes to obtaining a representative measure of the air quality likely to be experienced by the general population in the region. Unfortunately as can be seen from Table 1, the Civic station is not sited in accordance with the standard. In addition to this, it is located on the outskirts of the central business district of Civic and is not representative of general population exposure as required by Clause 13(2) of the AAQ NEPM.

The Health Directorate secured the budget in 2012-13 to establish another PMS that would be fully compliant with the AAQ NEPM. To minimise the delays a site has been identified in Florey for the establishment of the additional PMS. The Health Directorate has engaged a consultant to prepare the Building Application (BA) for establishing the station on the proposed site. It is anticipated that physical establishment of the PMS can commence after the BA is approved. The monitoring equipment for the additional PMS has already been procured.

Until the new AAQ NEPM monitoring station can be established, data from the Civic station, whilst not sited or located in accordance with Clause 13 of the AAQ NEPM, is being used for annual reporting purposes.



Both stations contain instrumentation that continuously monitors CO, O₃, and NO₂. PM₁₀ and PM_{2.5} monitoring is undertaken at Monash and only PM₁₀ monitoring at Civic.



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 3580.9.6-2003	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 SO₂ as required under Clause 12 of the AAQ NEPM.



ASSESSMENT OF COMPLIANCE WITH STANDARDS AND 2008

GOAL

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 (refer to 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 review of the AAQ NEPM.

Table 3: AAQ NEPM standards and goals

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

- Advisory reporting standards only

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.



A station's performance 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. A region demonstrates compliance with the AAQ NEPM when either all stations in the region demonstrate compliance, or when the region meets approved pollutant screening criteria.

A station's performance 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, even if the data availability rates are less than the 75% required.

A station's performance is assessed as 'NOT DEMONSTRATED' (ND) if it records exceedences on a number of days less than that allowed, but has data availability rates less than 75% in any quarter. This may be due to instrument failures, temporary closures for upgrading or closures to allow relocation of the station.

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



Carbon monoxide

During 2012, no exceedences of the CO standard were recorded in the ACT and compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 4: 2012 compliance summary for CO

AAQ NEPM standard - 9.0 ppm (8-hr 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	95.5	95.6	95.7	95.6	95.6	0	MET
Civic	95.7	95.4	95.7	80.1	91.7	0	MET

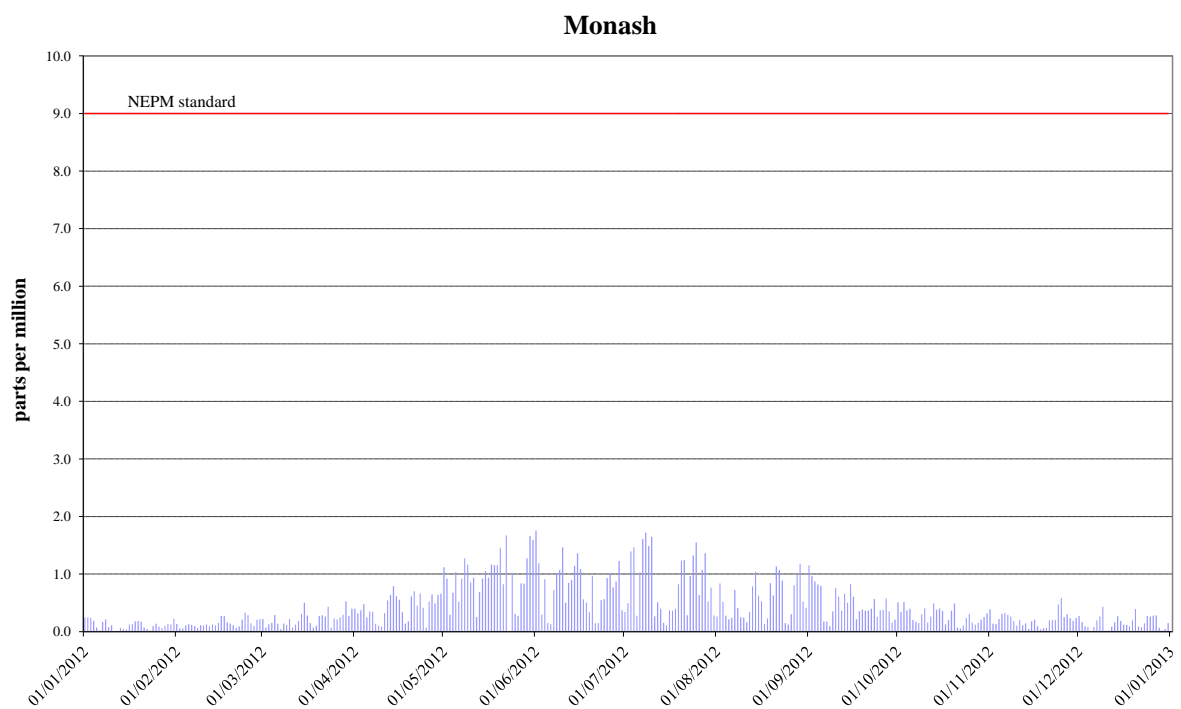


Figure 1: Daily max for CO 8-hr average - Monash

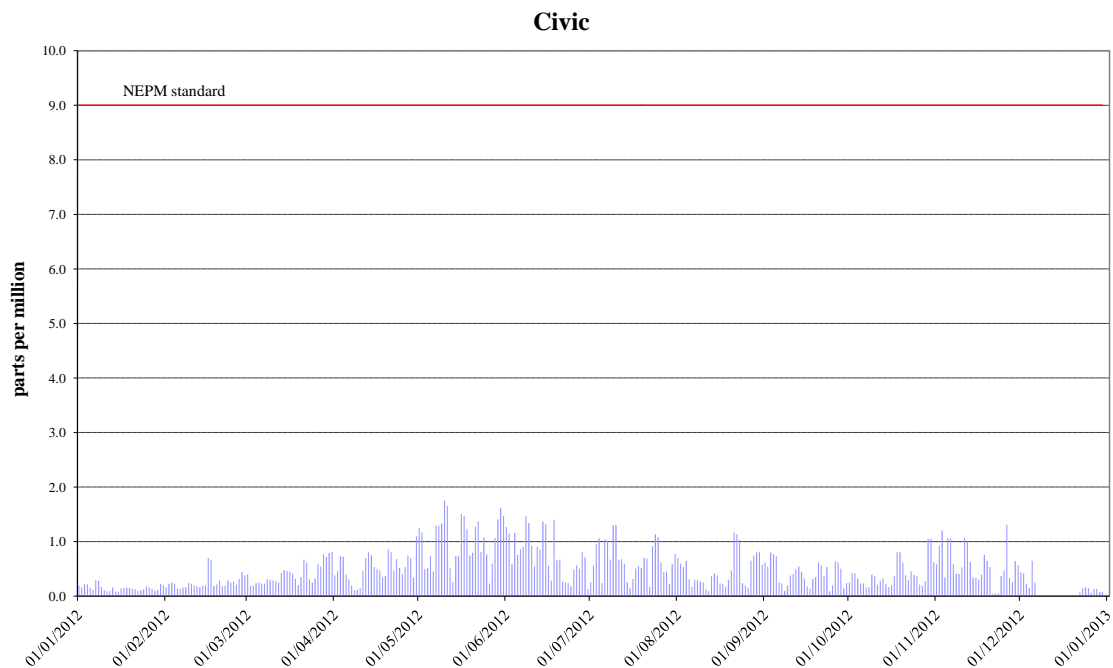


Figure 2: Daily max for CO 8-hr average - Civic

Nitrogen dioxide

During 2012, no exceedences of the NO₂ standards were recorded in the ACT. Compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 5: 2012 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	93.1	95.6	95.7	91.2	93.9	0.006	0	MET	MET
Civic	93.5	94.4	95.8	95.6	94.8	0.008	0	MET	MET

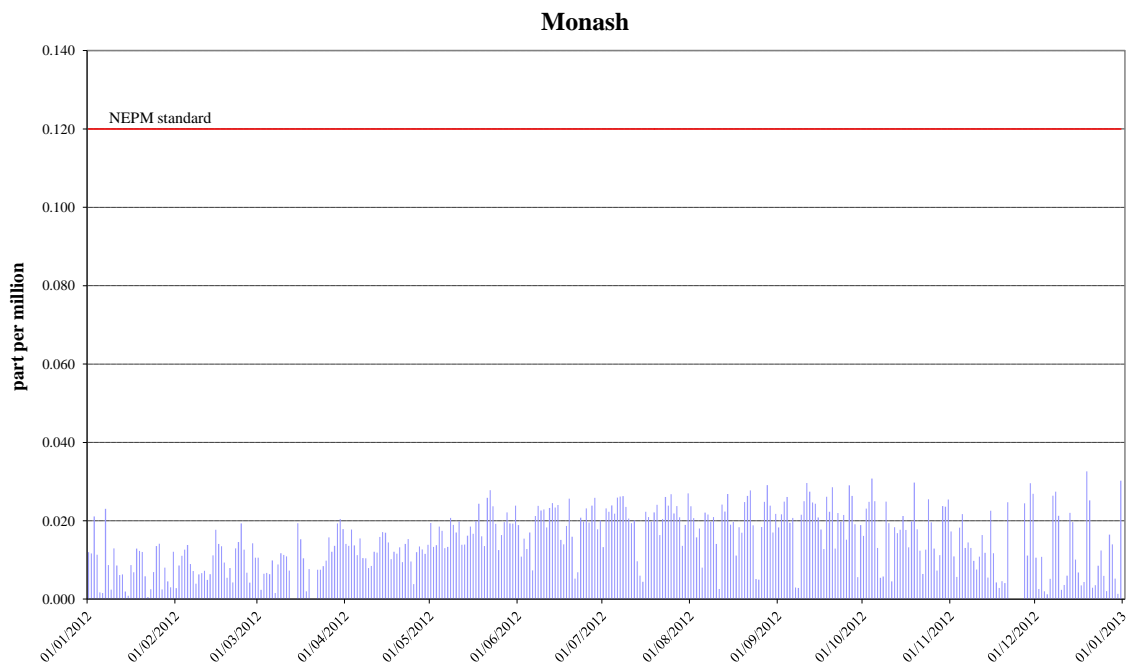


Figure 3: Daily max for NO₂ – Monash

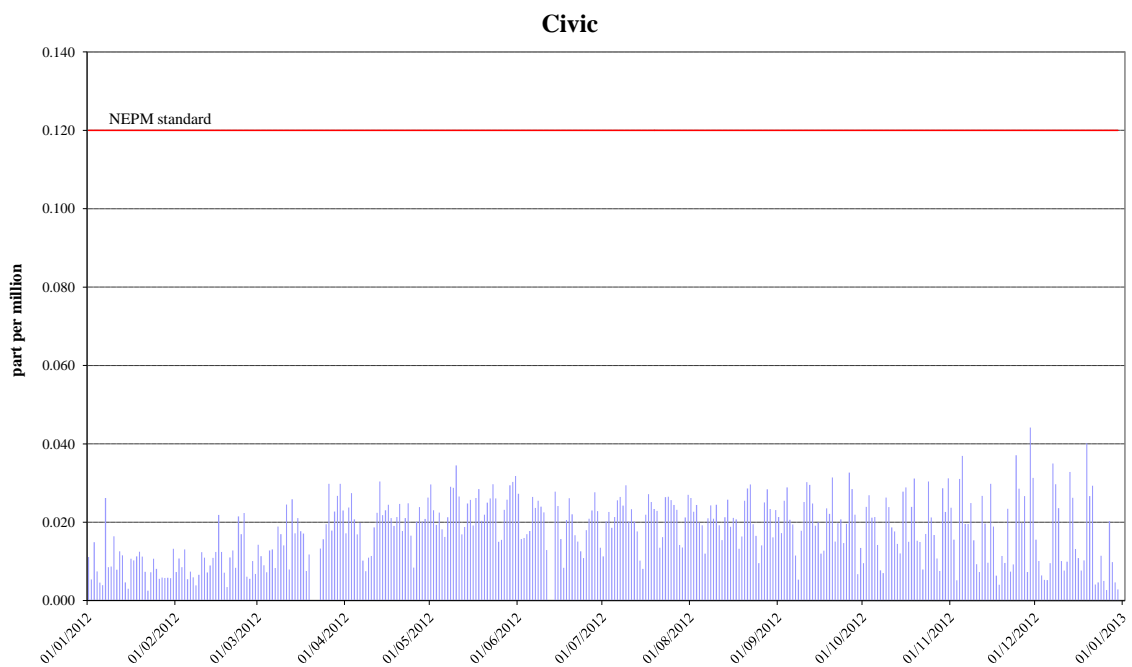


Figure 4: Daily max for NO₂ – Civic



Ozone

During 2012, no exceedences of the 1 hour and 4 hour standards for O₃ were recorded in the ACT, and compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 6: 2012 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	95.7	95.5	95.4	95.5	95.5	0	0	MET	MET
Civic	95.8	95.7	95.7	95.7	95.7	0	0	MET	MET

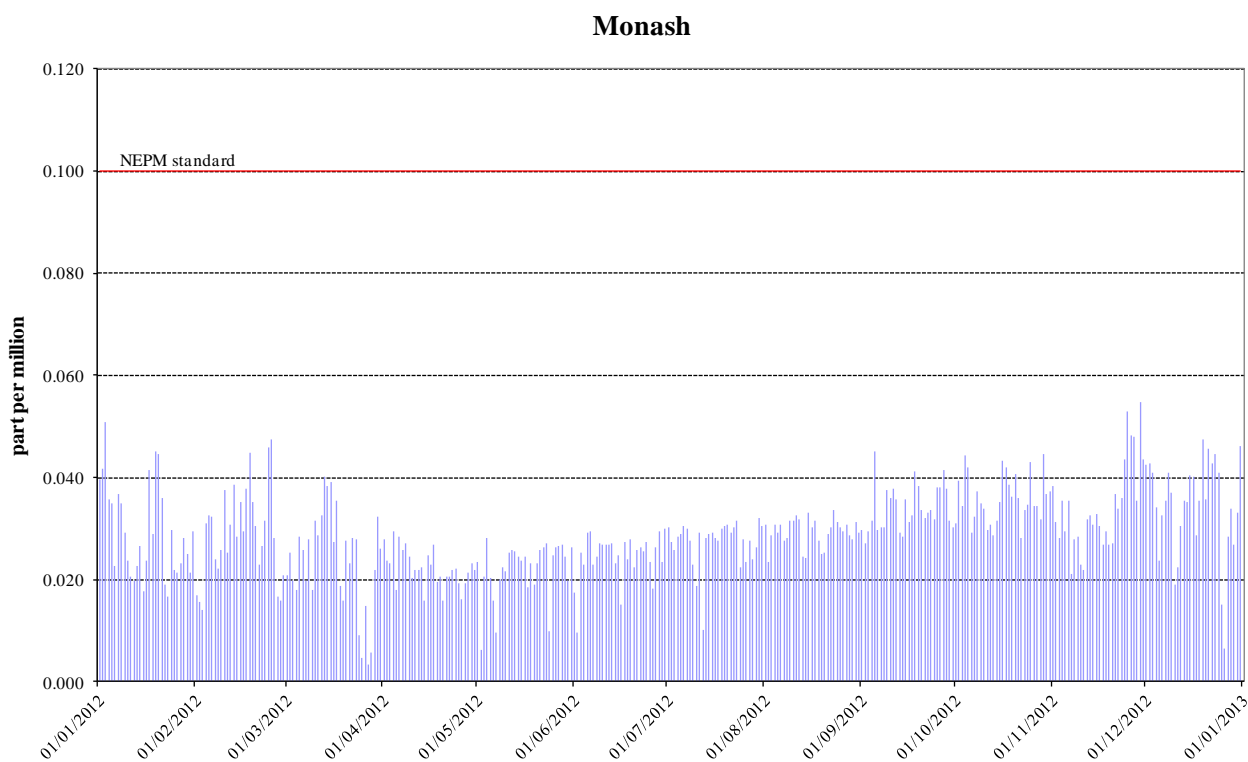


Figure 5: Daily max for 1 hour O₃ – Monash

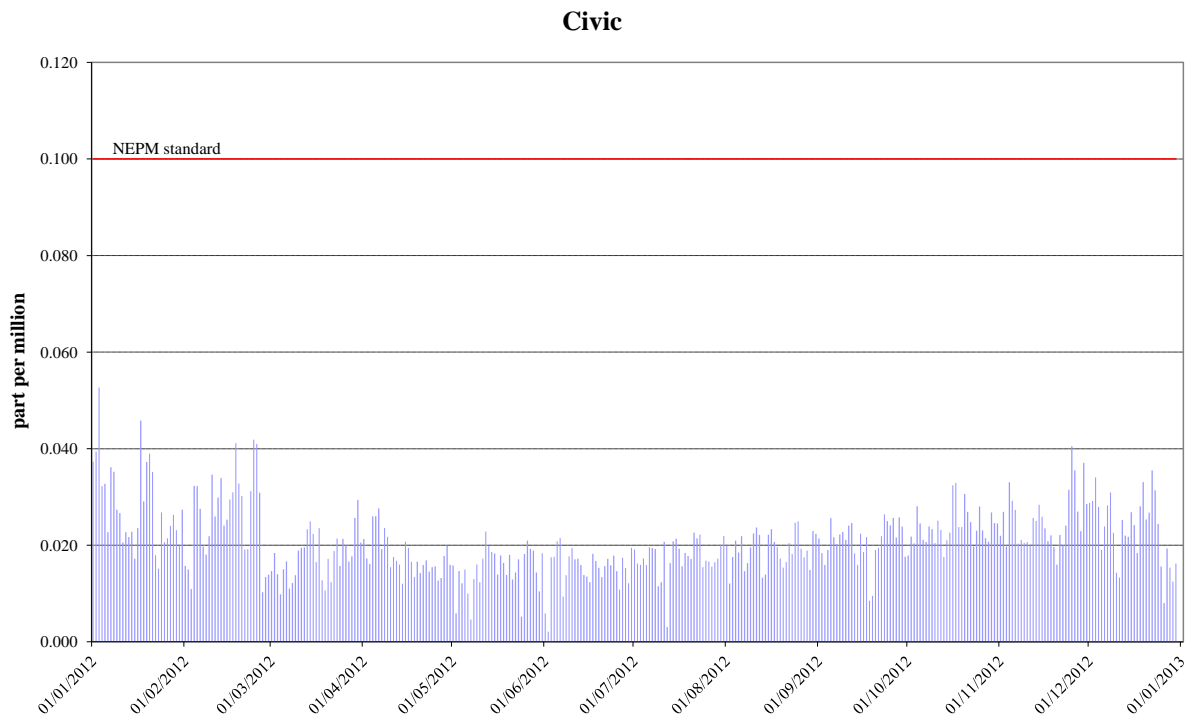


Figure 6: Daily max for 1 hour O₃ – Civic

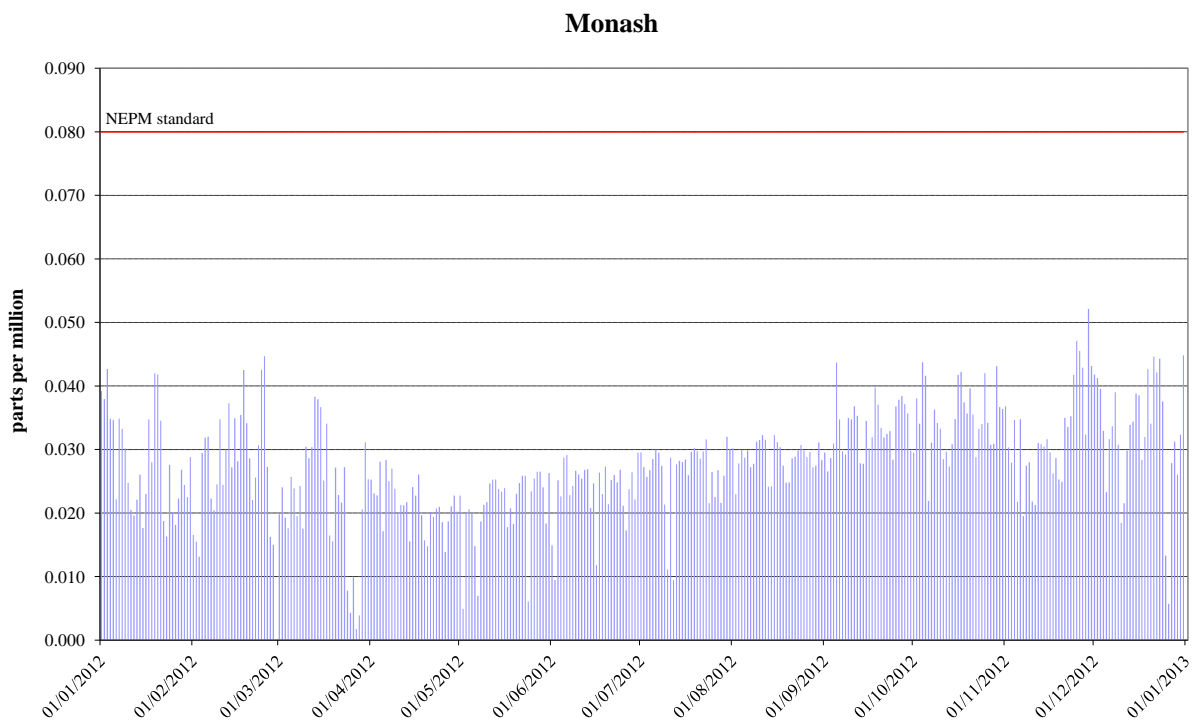


Figure 7: Daily max for 4 hours O₃ - Monash

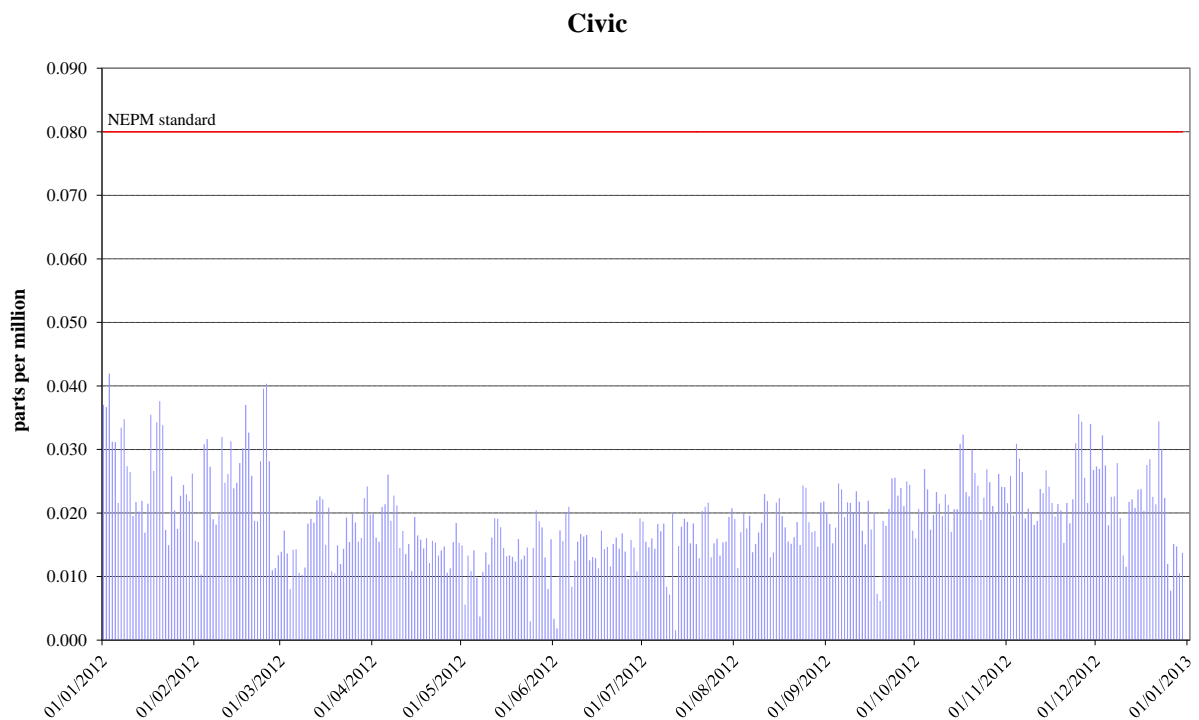


Figure 8: Daily max for 4 hours O₃ - Civic

PM₁₀

During 2012, there were no exceedences of the 24-hr PM₁₀ standard recorded in the ACT, and compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 7: 2012 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	98.9	97.8	96.8	100	98.6	0	MET
Civic	98.9	92.3	85.5	99.2	95.1	0	MET

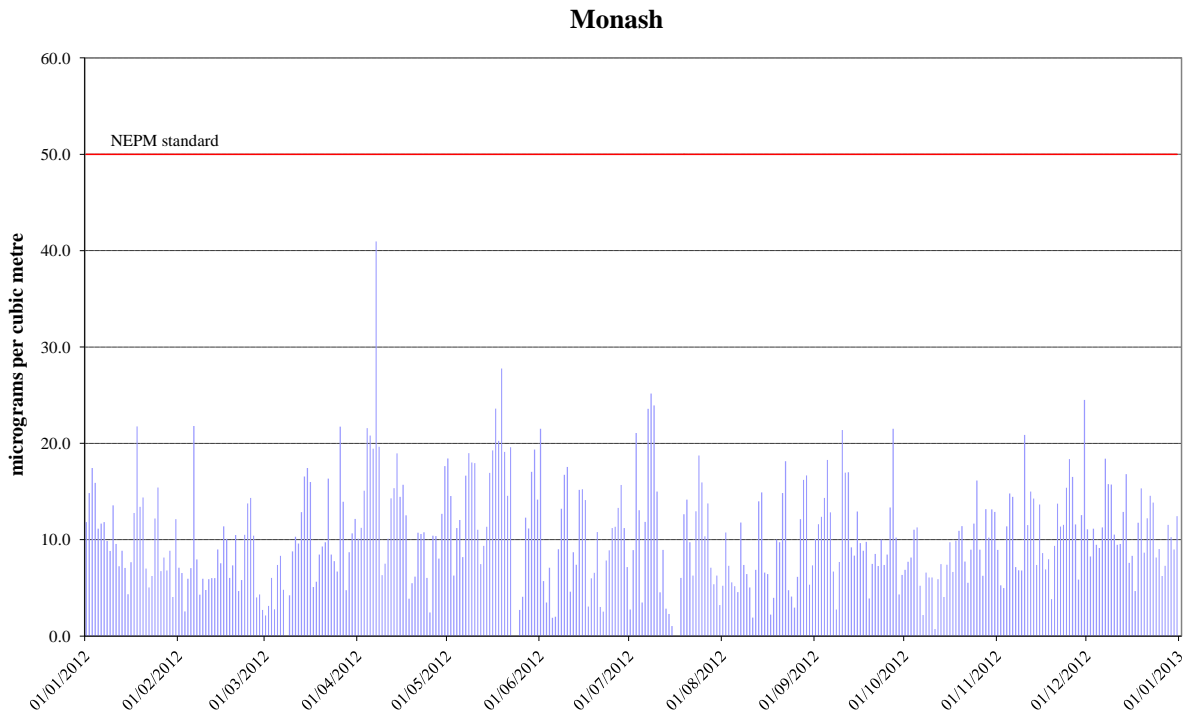


Figure 9: Daily max for PM₁₀ – Monash

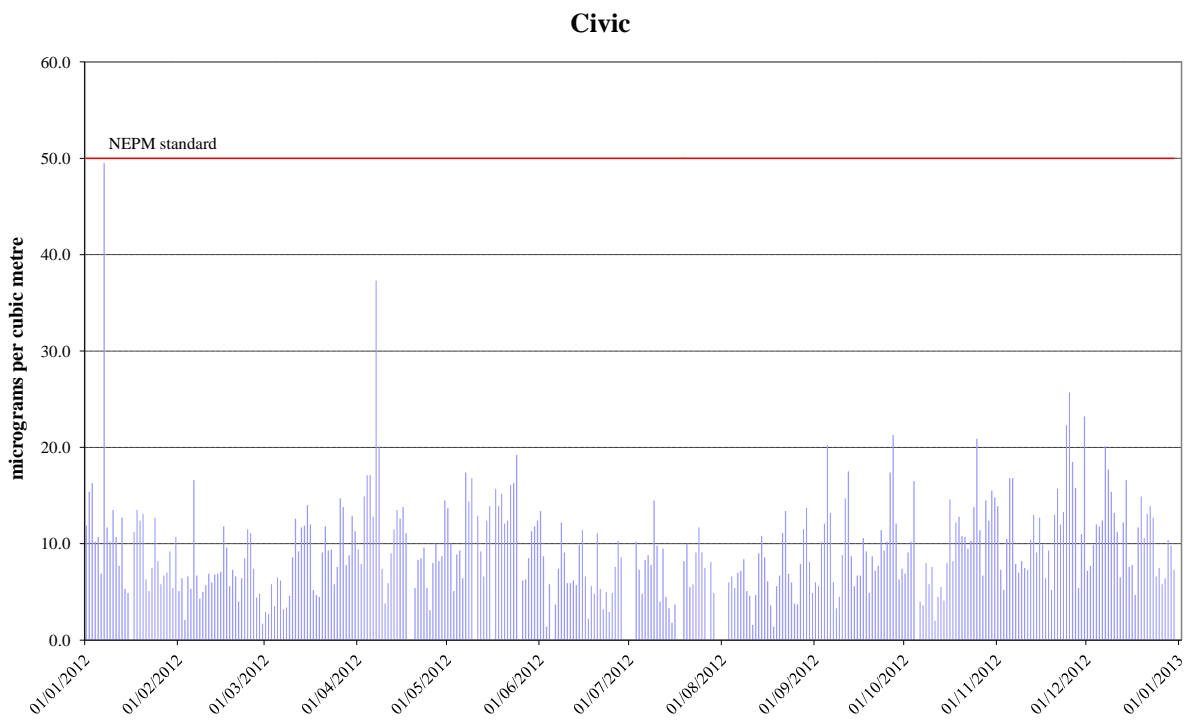


Figure 10: Daily max for PM₁₀ – Civic



PM_{2.5}

Three exceedences of the 24-hr advisory reporting standard were recorded at Monash during 2012.

Table 8: 2012 compliance summary for PM_{2.5}

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

Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (µg/m ³)	Number of exceedences (days)
	Q1	Q2	Q3	Q4	Annual		
Monash	100	89.0	91.9	97.5	92.3	7.1	3

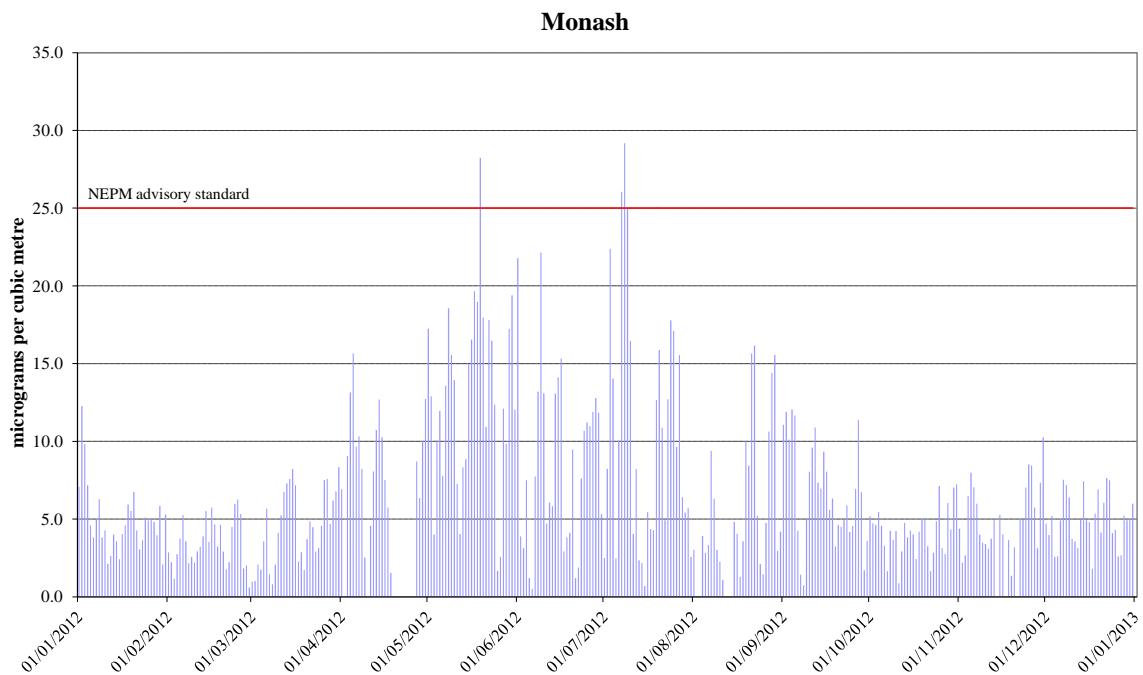


Figure 11: Daily max for PM_{2.5} – Monash



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 CO, NO₂ and O₃, and on no more than five days per year for 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

Table 9: 2012 summary statistics for daily peak 8-hour CO

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

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	365	1.8	01 Jun 04:00	1.7	08 Jul 04:00
Civic	351	1.8	10 May 22:00	1.7	11 May 01:00

Carbon monoxide levels are well below the AAQ NEPM standard. Because of both an improvement in vehicle emissions and a decline in wood heater numbers, levels are trending down (refer to Figure 12 and Figure 13). The highest recorded value in the ACT during 2012 was 1.8ppm at both stations. This is only 20% of the standard.

Nitrogen dioxide

Table 10: 2012 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	357	0.033	19 Dec 21:00	0.031	04 Oct 21:00
Civic	361	0.044	29 Nov 20:00	0.040	19 Dec 21:00

Nitrogen dioxide levels are well below the AAQ NEPM standard and have remained stable over the last decade. The highest recorded 1 hour value during 2012 was 0.044ppm at Civic, which is only



37% of the standard. The highest recorded annual average in 2012 was 0.008ppm at Civic. This is only 27% of the annual standard 0.03ppm.

Ozone

Table 11: 2012 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	366	0.055	29 Nov 18:00	0.053	25 Nov 11:00
Civic	366	0.053	03 Jan 10:00	0.046	17 Jan 20:00

Table 12: 2012 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	0.052	29 Nov 18:00	0.047	25 Nov 13:00
Civic	366	0.042	03 Jan 13:00	0.040	25 Feb 16:00

Ozone levels are below the AAQ NEPM standard. The highest recorded 1-hour value in the ACT during 2012 was 0.055ppm at Monash, which is 55% of the standard. The highest recorded 4-hour value in the ACT during 2012 was 0.052ppm at Monash. This is 65% of the standard.

PM₁₀

Table 13: 2012 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	361	41.0	7 Apr	23.6	17 May
Civic	348	49.5	7 Jan	21.3	27 Sept



PM₁₀ levels are below the AAQ NEPM standard. The highest PM₁₀ level recorded during 2012 was 49.5µg/m³ at Civic on 7 January 2012. This is close to but still below the AAQ NEPM standard.

PM_{2.5}

Table 14: 2012 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	348	29.2	21 May	22.1	09 Jun

The 24-hour advisory reporting standard for PM_{2.5} was exceeded three times at Monash. The exceedences happened during late May to early July 2012 and are attributed to particle emissions from wood heaters during winter.



ASSESSMENT OF PROGRESS TOWARDS ACHIEVING THE GOAL

The ACT is currently compliant with the goal specified in Schedule 2 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 acknowledges that woodsmoke is a problem and is working towards addressing the issue in an informed and measured manner to ensure a satisfactory outcome for all Canberrans.

It will continue to implement an integrated program to address woodsmoke. This will involve public education and enforcement activities, the licensing of firewood merchants, the implementation of the 'Don't Burn Tonight Campaign' and 'Burn Right Tonight Campaign', and the on-going administration of the Wood Heater Replacement Program.

The ACT is also working with the Commonwealth and other jurisdictions at a national level through the Standing Council on Environment and Water (SCEW) to progress actions to improve air quality. On 11 April 2013, SCEW agreed to the release the consultation regulation impact statement for reducing emissions from wood heaters for public consultation.



APPENDIX A: STATISTICAL SUMMARY AND TRENDS

The following section provides a basic statistical summary, using percentiles, for each station and for each standard. Percentiles for daily maximum values are presented.

Carbon monoxide

Table 15: Statistical summary for daily maximum 8-hour CO Monash 2003 – 2012

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)
2003	86.8	0	3.7	3.0	2.8	2.5	2.0	0.8	0.3
2004	94.1	0	3.2	2.7	2.5	2.0	1.6	0.9	0.5
2005	99.5	0	3.2	2.8	2.5	2.2	1.7	1.0	0.4
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

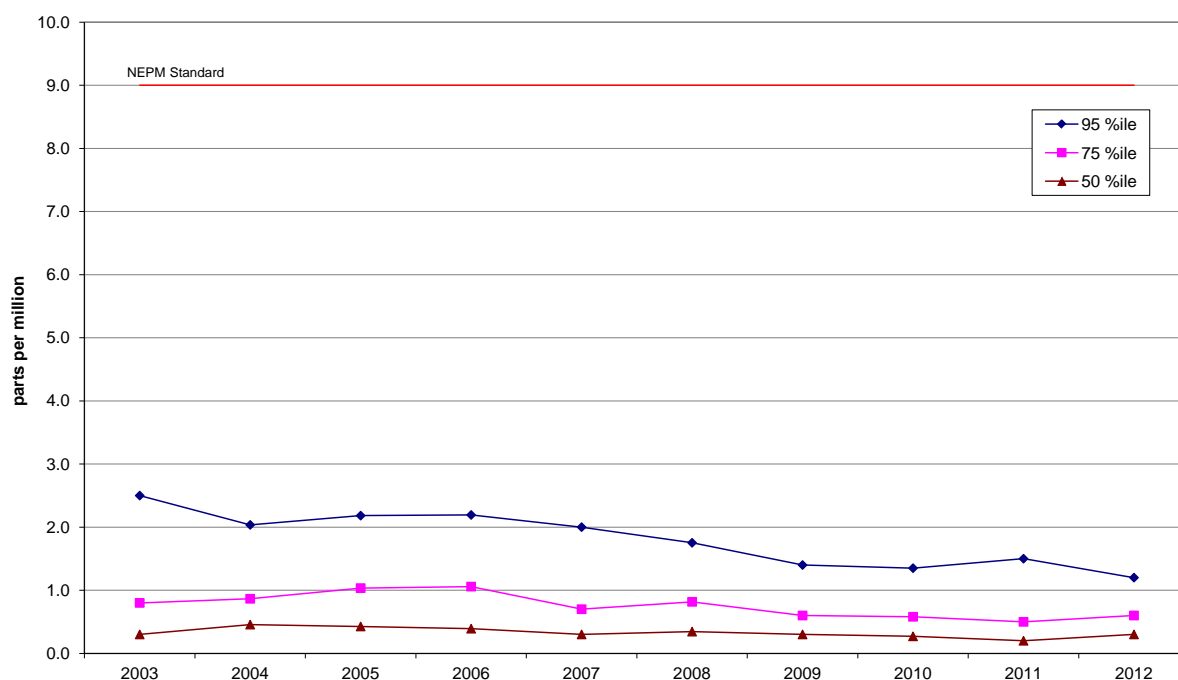


Figure 12: Statistical summary for daily maximum 8-hour CO Monash 2003 – 2012



Table 16: Statistical summary for daily maximum 8-hour CO Civic 2003 – 2012

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)
2003	95.7	0	3.5	2.8	2.6	2.2	1.8	1.0	0.6
2004	95.7	0	4.6	3.6	3.2	2.3	1.6	0.6	0.6
2005	95.6	0	3.7	3.4	3.2	2.6	1.7	1.1	0.7
2006	95.4	0	2.8	2.7	2.6	2.1	1.4	0.8	0.5
2007	93.2	0	2.8	2.3	2.0	1.6	1.3	0.8	0.5
2008	92.7	0	2.3	2.1	2.0	1.6	1.2	0.7	0.4
2009	95.1	0	1.9	1.6	1.2	1.0	0.8	0.6	0.4
2010	98.6	0	2.0	1.9	1.8	1.4	1.2	0.9	0.6
2011	97.8	0	2.0	1.8	1.6	1.4	1.0	0.7	0.5
2012	95.9	0	1.8	1.5	1.4	1.3	1.1	0.7	0.4

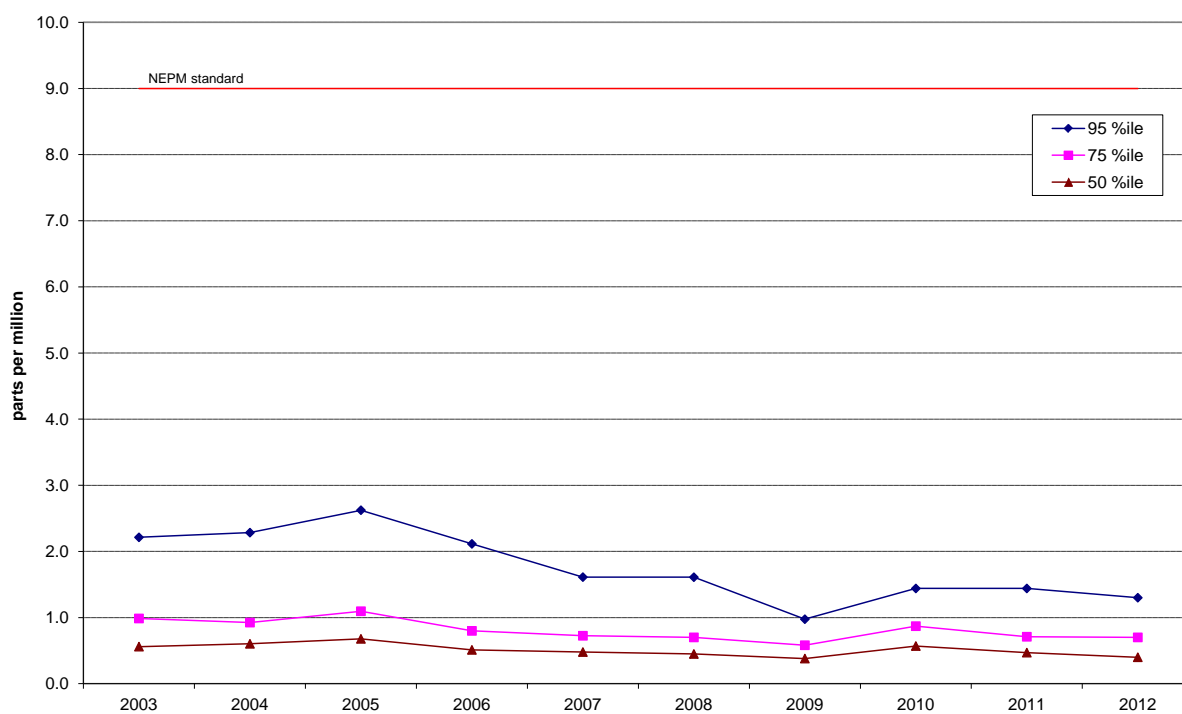


Figure 13: Statistical summary for daily maximum 8-hour CO Civic 2003 – 2012



Nitrogen dioxide

Table 17: Statistical summary for daily maximum 1-hour NO₂ Monash 2003 – 2012

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)
2003	90.4	0	0.064	0.042	0.033	0.028	0.025	0.021	0.016
2004	91.8	0	0.040	0.033	0.031	0.028	0.026	0.022	0.018
2005	97.8	0	0.041	0.034	0.031	0.028	0.027	0.024	0.018
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

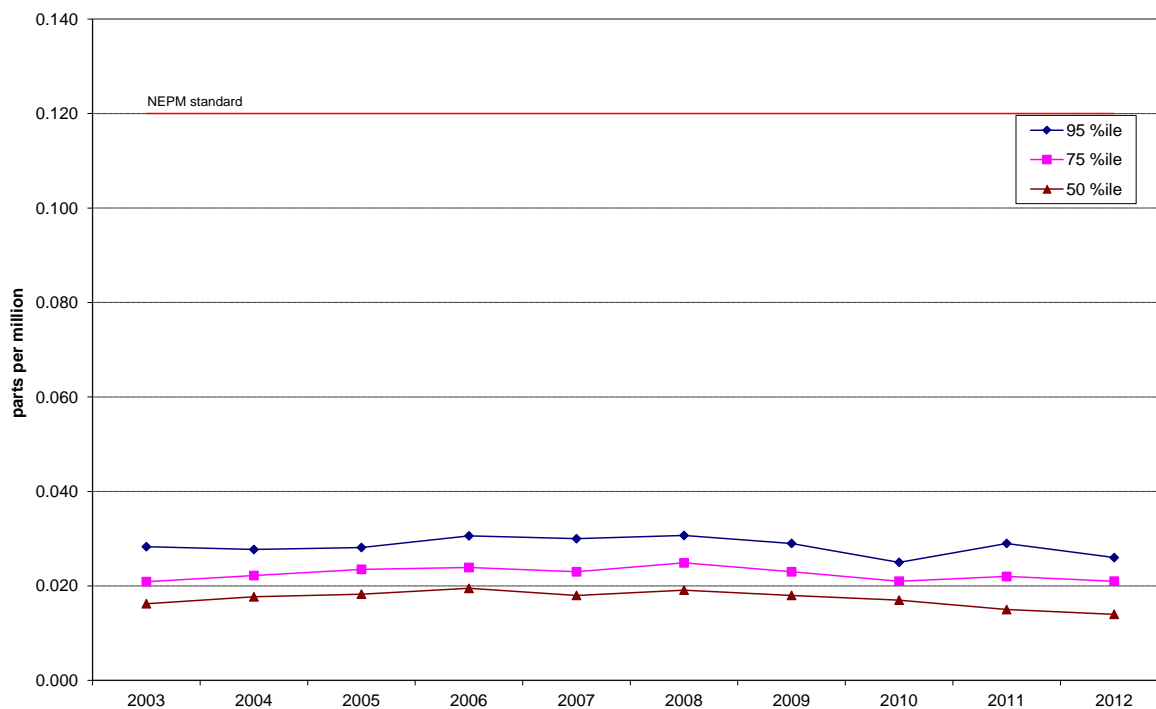


Figure 14: Statistical summary for daily maximum 1-hour NO₂ Monash 2003 – 2012



Table 18: Statistical summary for daily maximum 1-hour NO₂ Civic 2003 – 2012

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)
2003	83.6	0	0.087	0.050	0.045	0.034	0.028	0.022	0.018
2004	88.3	0	0.042	0.037	0.035	0.030	0.027	0.022	0.018
2005	95.3	0	0.040	0.036	0.033	0.030	0.029	0.024	0.020
2006	95.2	0	0.044	0.035	0.034	0.031	0.028	0.022	0.018
2007	92.8	0	0.059	0.042	0.039	0.035	0.030	0.025	0.021
2008	88.6	0	0.046	0.037	0.035	0.033	0.030	0.026	0.020
2009	79.5	0	0.044	0.038	0.036	0.030	0.027	0.023	0.018
2010	74.9	0	0.039	0.035	0.033	0.030	0.027	0.024	0.021
2011	88.8	0	0.046	0.036	0.035	0.032	0.029	0.023	0.018
2012	98.6	0	0.044	0.036	0.033	0.030	0.029	0.024	0.019

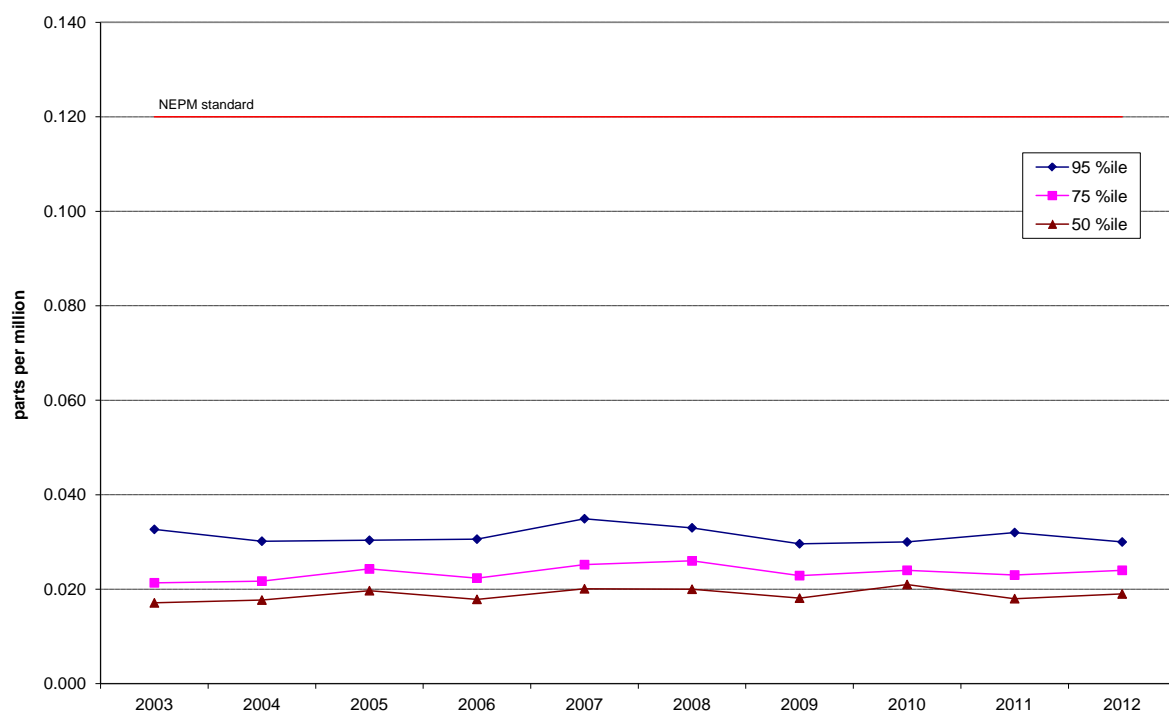


Figure 15: Statistical summary for daily maximum 1-hour NO₂ Civic 2003 – 2012

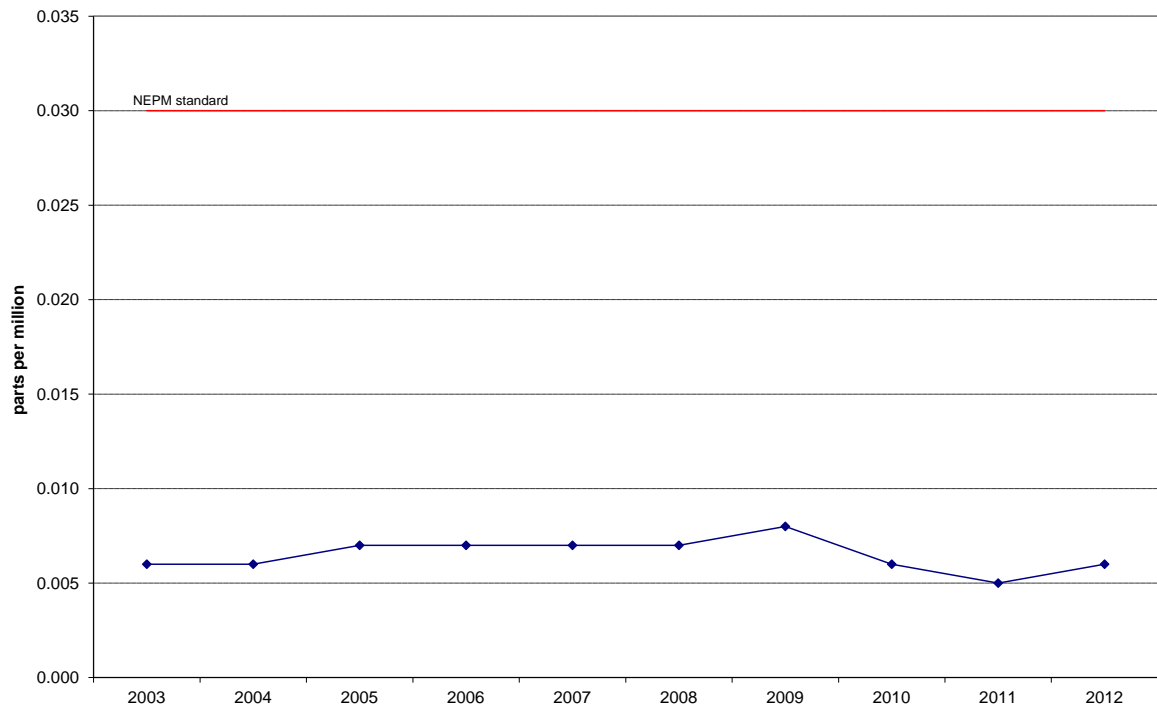


Figure 16: Annual average 1-hour NO₂ Monash 2003 – 2012

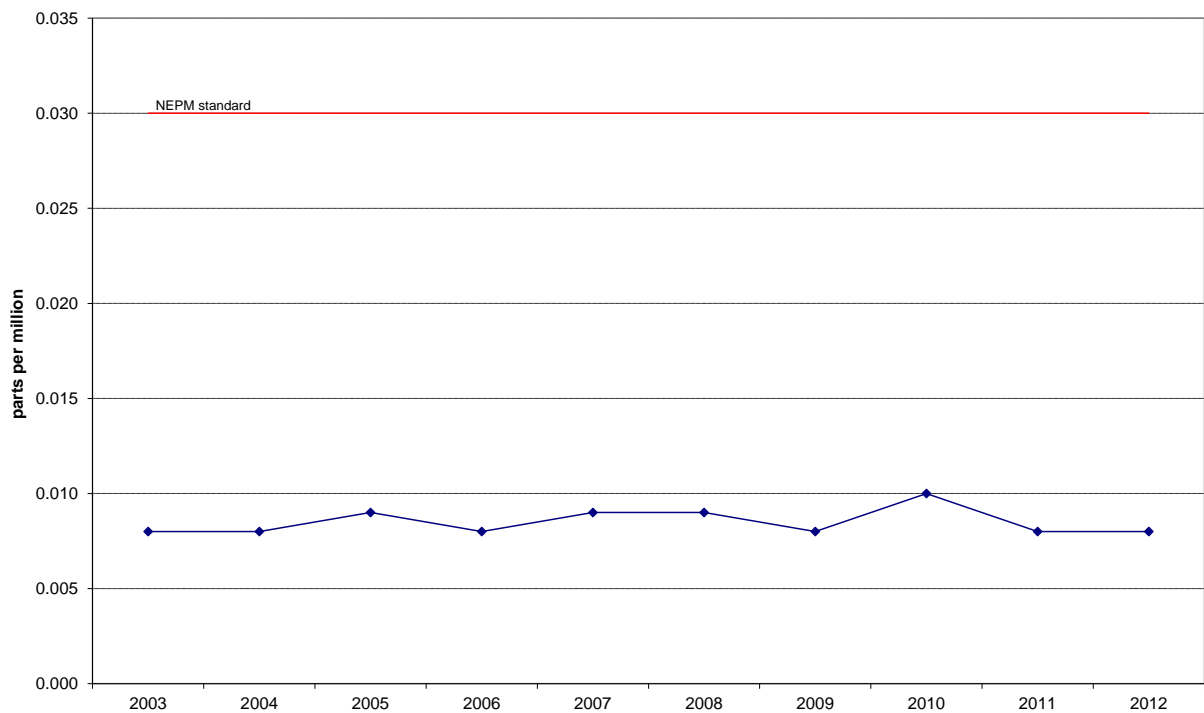


Figure 17: Annual average 1-hour NO₂ Civic 2003 – 2012



Ozone

Table 19: Statistical summary for daily maximum 1-hour O₃ Monash 2003 – 2012

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)
2003	92.4	0	0.102	0.069	0.061	0.050	0.045	0.035	0.025
2004	94.1	0	0.064	0.56	0.054	0.048	0.044	0.038	0.030
2005	97.8	0	0.065	0.058	0.053	0.045	0.041	0.034	0.030
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

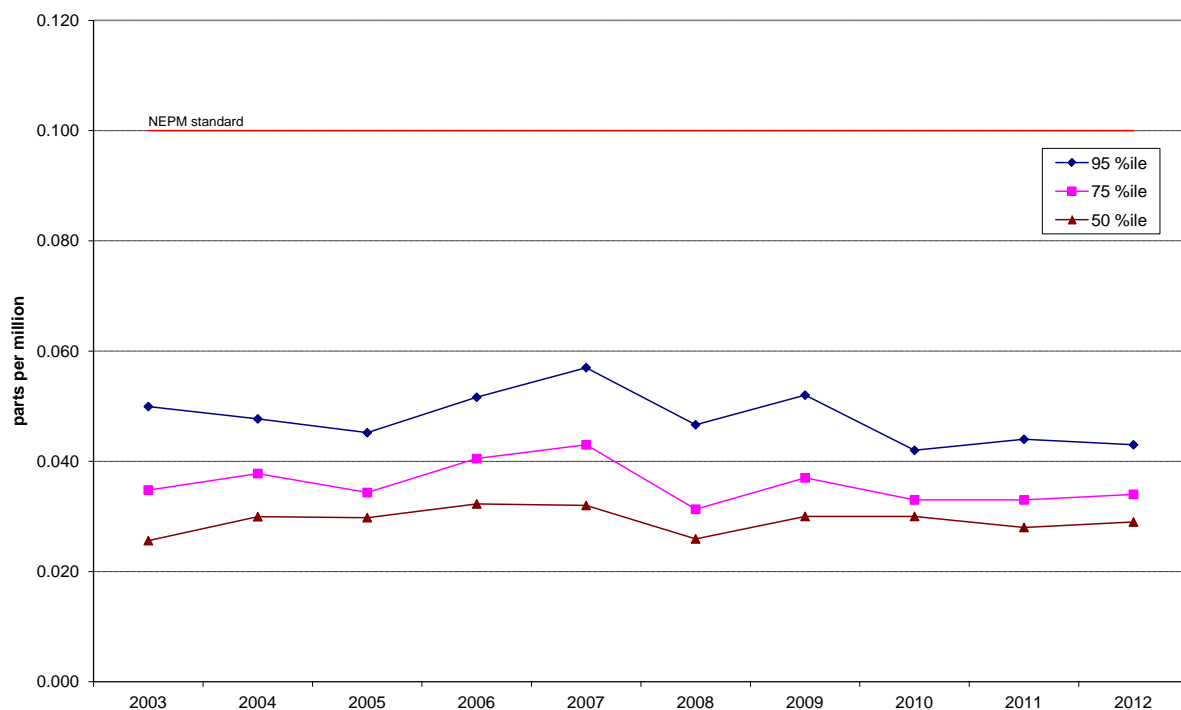


Figure 18: Statistical summary for daily maximum 1-hour O₃ Monash 2003 – 2012



Table 20: Statistical summary for daily maximum 1-hour O₃ Civic 2003 – 2012

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)
2003	93.6	0	0.094	0.065	0.055	0.049	0.045	0.037	0.031
2004	93.5	0	0.071	0.055	0.053	0.045	0.041	0.034	0.028
2005	85.5	0	0.070	0.061	0.051	0.042	0.038	0.032	0.028
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

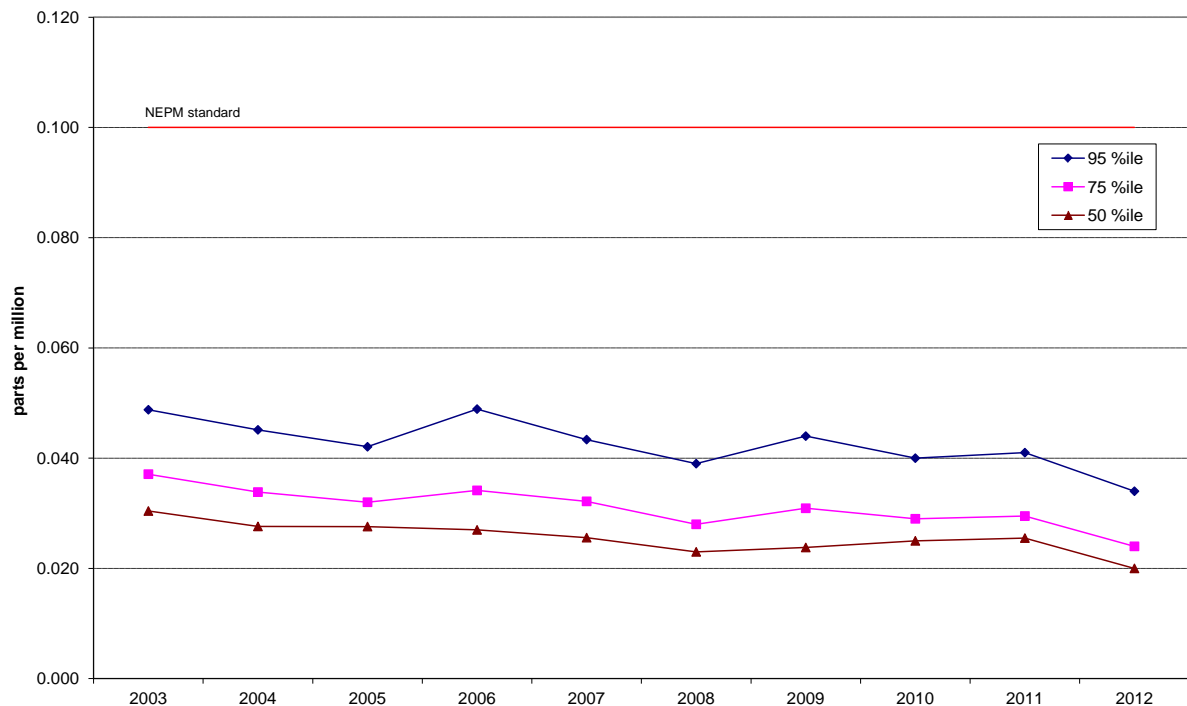


Figure 19: Statistical summary for daily maximum 1-hour O₃ Civic 2003 – 2012



Table 21: Statistical summary for daily maximum 4-hour O₃ Monash 2003 – 2012

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)
2003	92.4	1	0.082	0.063	0.058	0.048	0.043	0.033	0.025
2004	94.1	0	0.060	0.053	0.051	0.045	0.042	0.036	0.029
2005	97.5	0	0.062	0.054	0.049	0.044	0.039	0.033	0.029
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

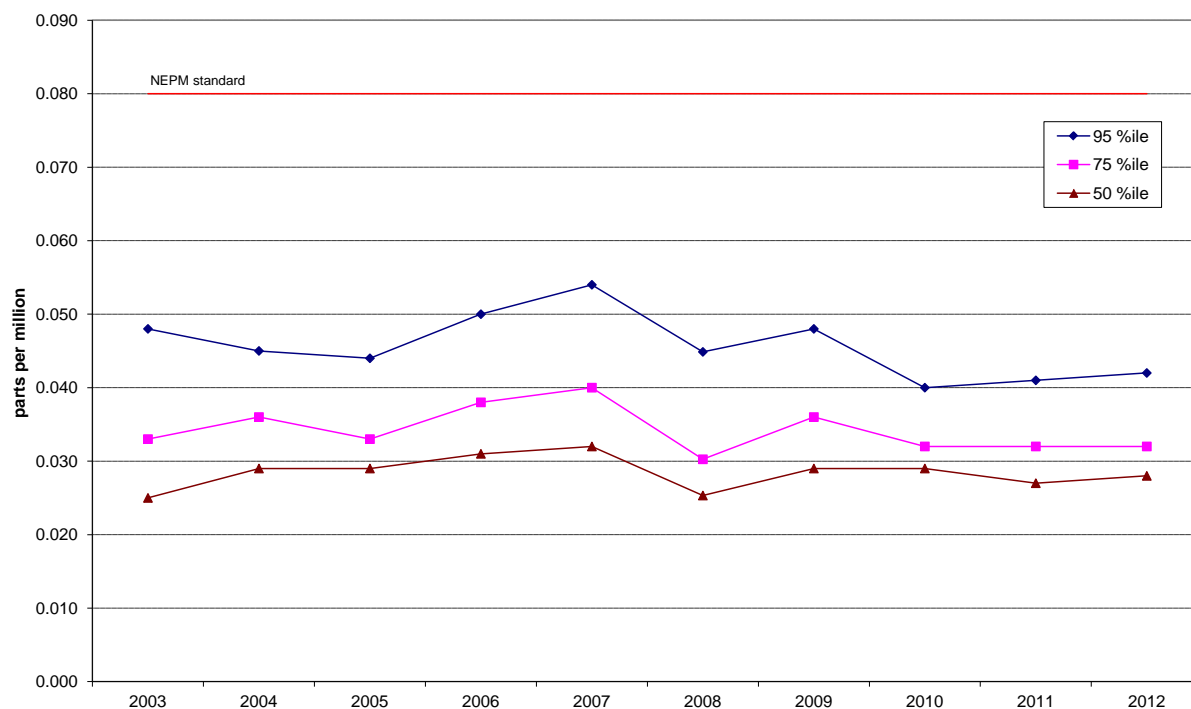


Figure 20: Statistical summary for daily maximum 4-hour O₃ Monash 2003 – 2012



Table 22: Statistical summary for daily maximum 4-hour O₃ Civic 2003 – 2012

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)
2003	93.6	0	0.078	0.055	0.051	0.046	0.042	0.036	0.029
2004	93.5	0	0.062	0.052	0.048	0.043	0.039	0.32	0.026
2005	85.5	0	0.061	0.054	0.047	0.040	0.036	0.031	0.026
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

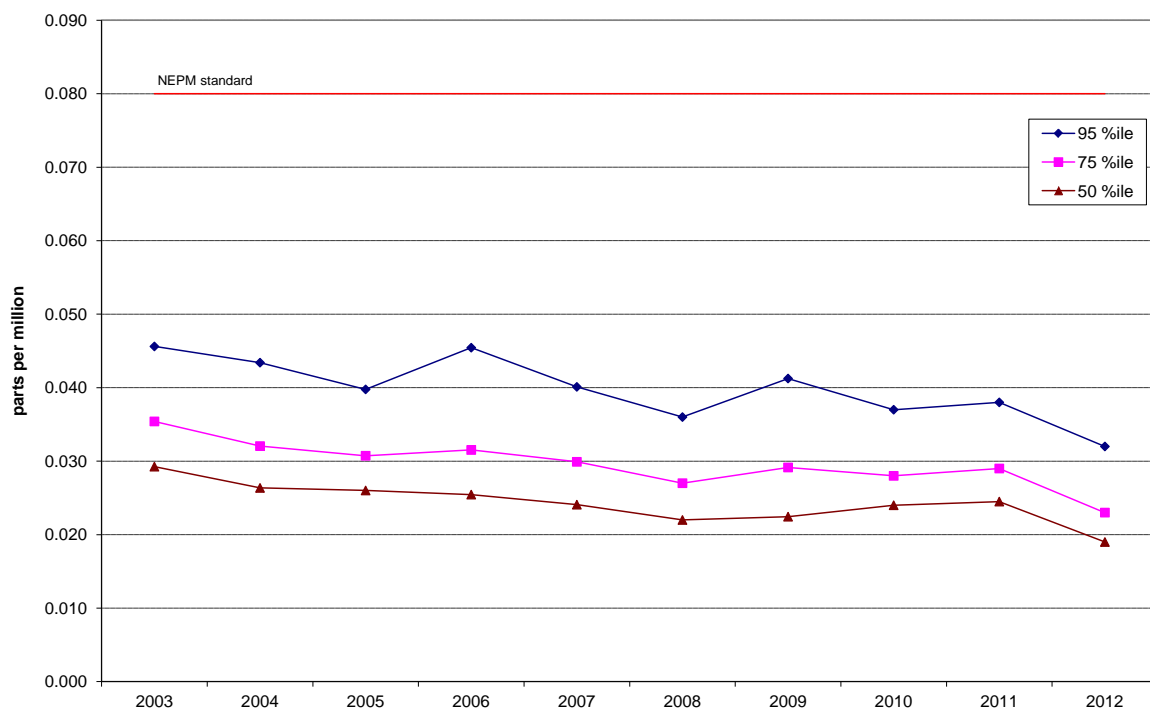


Figure 21: Statistical summary for daily maximum 4-hour O₃ Civic 2003 – 2012



PM₁₀

Table 23: Statistical summary for daily maximum 24-hour PM₁₀ Monash 2003 – 2012

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)
2003	97.5	13	350.4	136.4	105.3	39.6	30.3	21.2	14.6
2004	99.7	3	52.0	48.2	46.0	33.8	28.5	20.7	14.7
2005	97.5	10	98.8	57.6	52.7	37.3	31.0	21.2	14.5
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

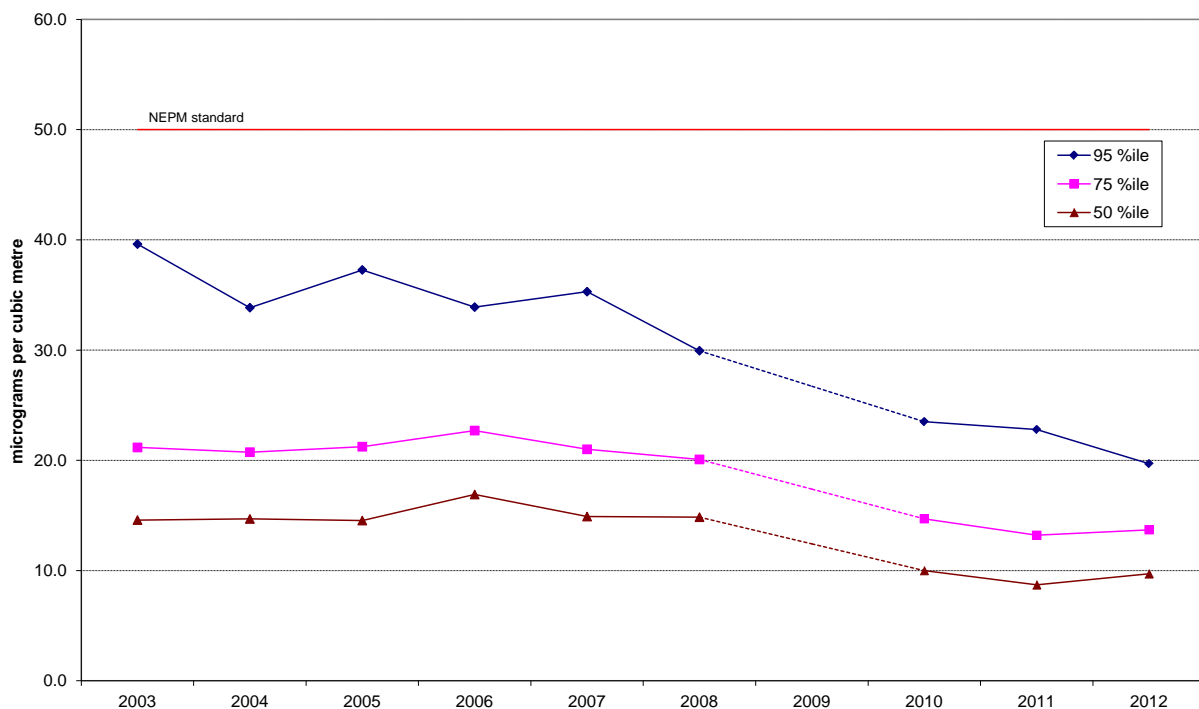


Figure 22: Statistical summary for daily maximum 24-hour PM₁₀ Monash 2003 – 2012

Note 2009 data has not been included in Figure 22 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 24: Statistical summary for daily maximum 24-hour PM₁₀ Civic 2003 – 2012

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)
2003	12.6	0	20.8	20.8	20.7	19.3	17.3	13.6	9.3
2004	16.7	0	33.2	32.4	32.0	28.1	22.5	17.9	14.4
2005	9.6	1	50.64	47.2	43.8	34.8	27.5	19.5	12.7
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

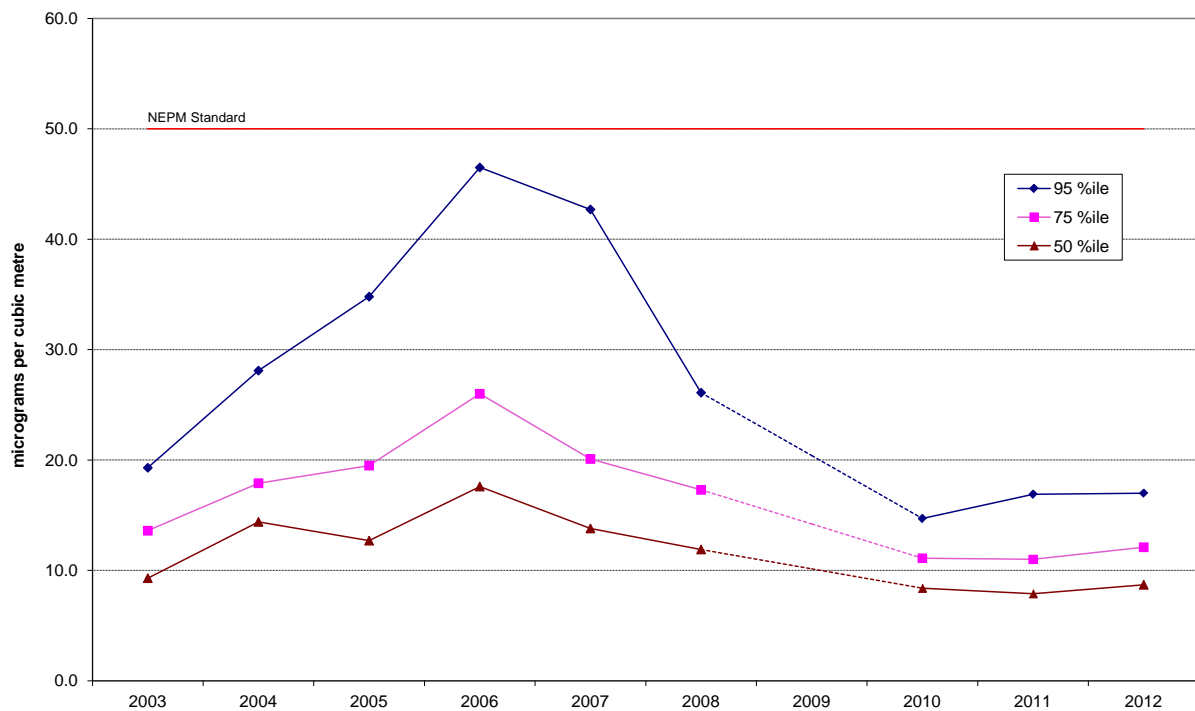


Figure 23: Statistical summary for daily maximum 24-hour PM₁₀ Civic 2003 – 2012

Note No PM₁₀ monitoring was conducted at Civic in 2009.



PM_{2.5}

Table 25: Statistical summary for daily maximum 24-hour PM_{2.5} Monash 2004 – 2012

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)
2004	93.1	15	38.3	35.8	31.5	23.5	16.6	9.5	6.2
2005	73.6	14	38.6	31.4	29.3	25.0	20.7	9.0	4.9
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

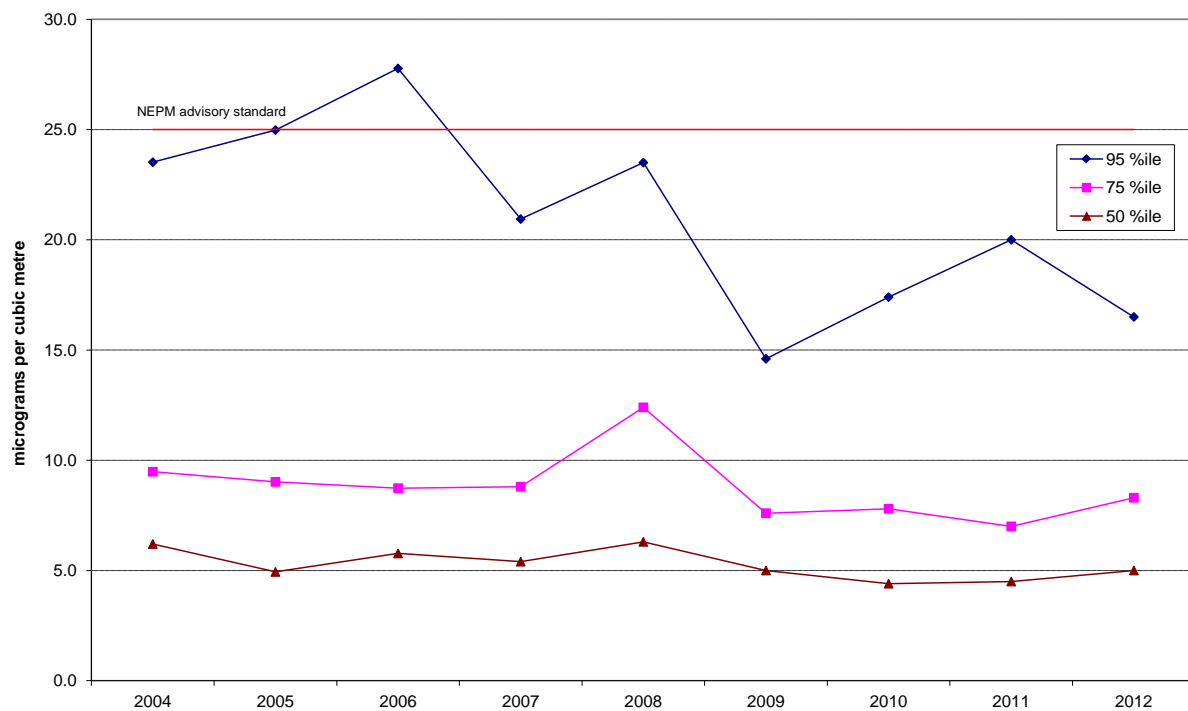


Figure 24: Statistical summary for daily maximum 24-hour PM_{2.5} Monash 2004 – 2012

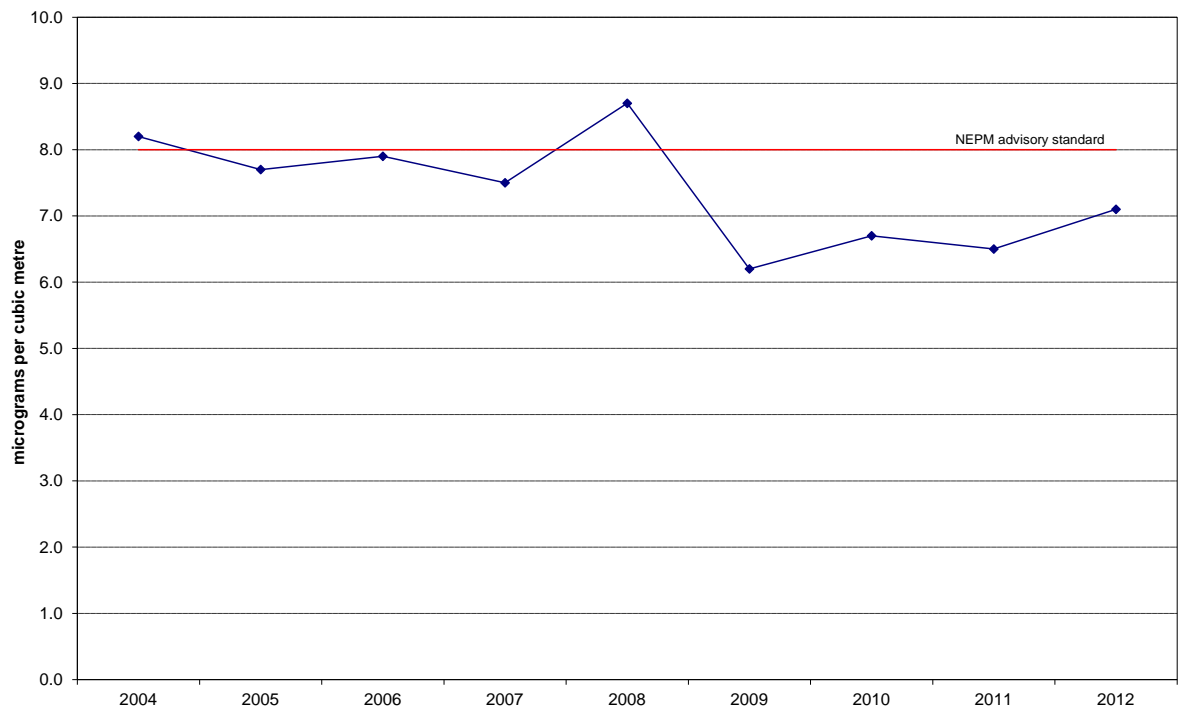


Figure 25: Annual average 24-hour PM_{2.5} Monash 2004 - 2012