



ACT
Government



ACT AIR QUALITY REPORT 2017

Environment Protection Authority | June 2018

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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
Exceptional event	Exceptional event means a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1 day average standards in excess of normal historical fluctuations and background levels, and is directly related to: bushfire; jurisdiction authorised hazard reduction burning; or continental scale windblown dust
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 micrometres
PM ₁₀	Particles with an equivalent aerodynamic diameter less than or equal to 10 micrometres
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

This report presents the results of ambient air quality monitoring in the ACT for 2017 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.

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 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.

Air quality in this report is assessed against the AAQ NEPM standards shown in Table 3. In accordance with its agreed policy position, the ACT assesses its compliance for the annual average for particulate matter less than 10 microns (μg) (PM_{10}) against a lower standard of $20 \mu\text{g}/\text{m}^3$ rather than the AAQ NEPM standard of $25 \mu\text{g}/\text{m}^3$ from 2016.

The ACT monitors four of the six NEPM pollutants:

- carbon monoxide (CO);
- nitrogen dioxide (NO_2);
- photochemical oxidants as ozone (O_3); and
- particulate matter (particles less than 10 microns in diameter – PM_{10} and particles less than 2.5 microns in diameter – $\text{PM}_{2.5}$).

Due to a lack of heavy industry, the ACT has never monitored sulfur dioxide (SO_2) as it is primarily an industrial pollutant, and lead monitoring ceased in 2002 with the phase out of leaded petrol.

Monitoring in the ACT 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 results in 2017 demonstrate that Canberra's air quality is generally good, with no exceedances of the AAQ NEPM standards for carbon monoxide, nitrogen dioxide and ozone. There was one exceedance of the 24-hour PM_{10} standard recorded at Civic. There were 13 exceedances of the daily $\text{PM}_{2.5}$ standard recorded at Monash and Civic. The daily reporting standard for $\text{PM}_{2.5}$ and PM_{10} were both exceeded at Civic on 30 August 2017 due to smoke coming from a hazard reduction burn but have not been included for compliance purposes under the exceptional event rule.

There were 12 days when PM_{2.5} exceeded the daily standard at Monash. These exceedances, which occurred between May and July, can be linked to increased domestic wood heater emissions during the cold winter months.

The major impacts on Canberra's air quality in 2017, as in 2016, came from the accumulation of combustion particles from hazard reduction burns and wood heaters. Noting there is no safe level of particle pollution, the EPA is concerned about the increase in the number of exceedances and levels of PM_{2.5}. Annual average levels in Florey and Monash are now very close to national standards. Given this trend and the comment in the Australia State of the Environment Report, 2016 that:

"Air quality is generally good to very good in Australian urban areas. However, evidence about the adverse impact of air pollution on human health has increased since 2011, and health effects have been observed at lower pollutant concentrations than those on which [national] guidelines are based"

The EPA, in conjunction with the Environment, Planning and Sustainable Development Directorate, will:

- undertake a review of the efficacy of the Government's woodsmoke programs; and
- look to establish tighter controls on the installation of solid fuelled heaters to drive the installation of lower emission models.

MONITORING SUMMARY

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 Protection Authority (EPA) within the Chief Minister, 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 located at:

- Monash - approximately 300 metres west of Cockcroft Avenue in the Monash district playing fields;
- Civic - at the northern end of the carpark on the western side of the Olympic swimming pool adjacent to Allara Street; and
- Florey at the end of Neumann Place, on public land.

The compliance and non-compliance criteria for the monitoring stations against the siting standard AS/NZS 3580.1.1:2008 are listed in Table 1 below.

Table 1: Summary of stations' siting compliance with AS 3580.1.1:2008

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	☑	☑	☑	☑	☑	☑	☑

The Monash and Florey stations contain instrumentation that continuously monitors carbon monoxide, nitrogen dioxide, ozone and particles as PM₁₀ and PM_{2.5}. Following the establishment of the Florey station on 28 February 2014, the Civic station only monitors ozone and particles as PM₁₀ and PM_{2.5}.

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	Methods for sampling and analysis of ambient air - Determination of carbon monoxide - Direct-reading instrumental method	Gas filter correlation/ Infrared.
Nitrogen dioxide	AS 3580.5.1-2011	Methods for sampling and analysis of ambient air - Determination of oxides of nitrogen - Direct-reading instrumental method	Gas phase chemiluminescence.
Photochemical oxidant (ozone)	AS 3580.6.1-2011	Methods for sampling and analysis of ambient air - Determination of ozone - Direct-reading instrumental method	Non-dispersive ultraviolet.
Particles PM ₁₀	AS/NZS 3580.9.11-2016	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 3580.9.6-2015	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 3580.9.12:2013	Methods for sampling and analysis of ambient air - Method 9.12: Determination of suspended particulate matter - PM _{2.5} beta attenuation monitors	BAM

NATA Accreditation Status

The ACT Government monitoring network is accredited by NATA for the measurement of all AAQ NEPM pollutants except sulfur dioxide and lead 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 Table 3, column 3).

The goal of the AAQ NEPM is to achieve the National Environment Protection Standards as assessed in accordance with the monitoring protocol to the extent specified in Schedule 2 of the AAQ NEPM.

The extent is expressed as a maximum allowable number of exceedances for each standard (shown in column 4, Table 3). For $\text{PM}_{2.5}$, there is an additional goal to further reduce concentrations to below a daily concentration of $20 \mu\text{g}/\text{m}^3$ and an annual concentration of $7 \mu\text{g}/\text{m}^3$ by 2025.

Table 3: AAQ NEPM standards and goals

Pollutant	Averaging Period	Maximum concentration	Maximum allowable exceedances	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	$0.50 \mu\text{g}/\text{m}^3$	None	Not monitored
Particles as PM_{10}	1 day 1 year	$50 \mu\text{g}/\text{m}^3$ $25 \mu\text{g}/\text{m}^3$	None None	Monash Florey Civic
Particles as $\text{PM}_{2.5}$	1 day 1 year	$25 \mu\text{g}/\text{m}^3$ $8 \mu\text{g}/\text{m}^3$	None None	Monash Florey Civic

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 exceedances 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 exceedances specified in Schedule 2 of the AAQ NEPM. For the purpose of reporting compliance against PM₁₀ and PM_{2.5} 1 day average standards, monitoring data that has been determined as being directly associated with an exceptional event has been excluded.

Air quality is assessed as '*NOT DEMONSTRATED*' (i.e. '*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 Tables 4 to 8 on the following pages.

Carbon monoxide

During 2017, no exceedances of the carbon monoxide standard were recorded and compliance was demonstrated at Monash and Florey.

Table 4: 2017 compliance summary for CO

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

Performance monitoring station	Data availability rates (% of hours)					Number of exceedances (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Monash	95.6	95.7	94.6	95.8	95.4	0	MET
Florey	94.4	95.8	92.7	95.8	94.7	0	MET

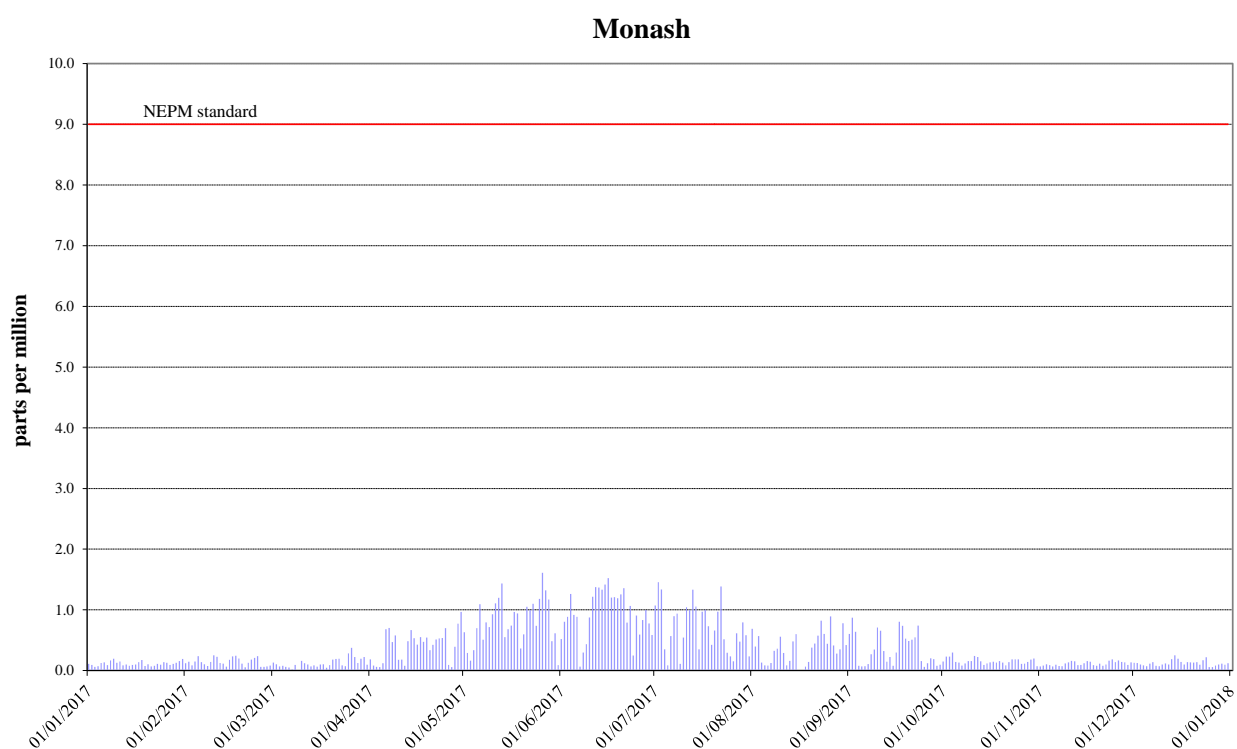


Figure 1: Daily max for CO 8-hour average – Monash

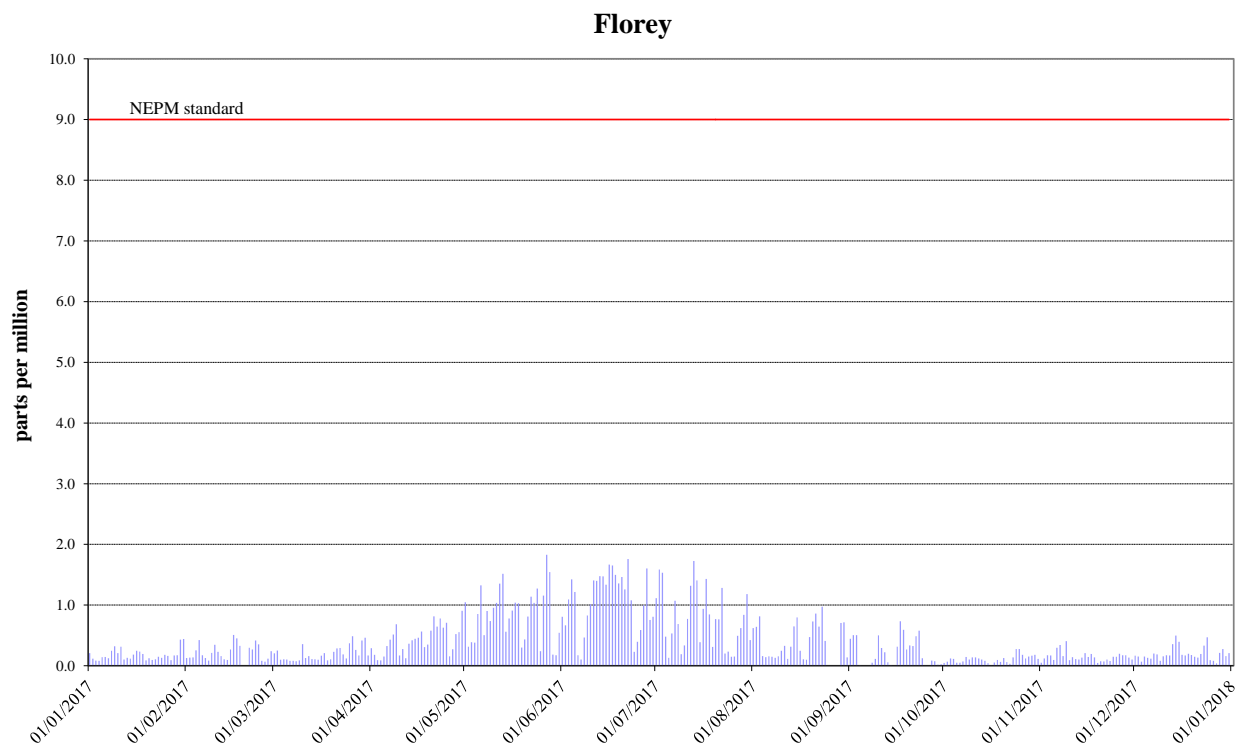


Figure 2: Daily max for CO 8-hour average – Florey

Nitrogen dioxide

During 2017, no exceedances of the nitrogen dioxide standards were recorded and compliance was demonstrated at Monash and Florey.

Table 5: 2017 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 exceedances (days)	Performance against the standards and goal	
								1 hour	1 year
	Q1	Q2	Q3	Q4	Annual				
Monash	95.1	95.7	95.7	95.8	95.6	0.004	0	MET	MET
Florey	87.5	95.5	95.7	95.8	93.7	0.005	0	MET	MET

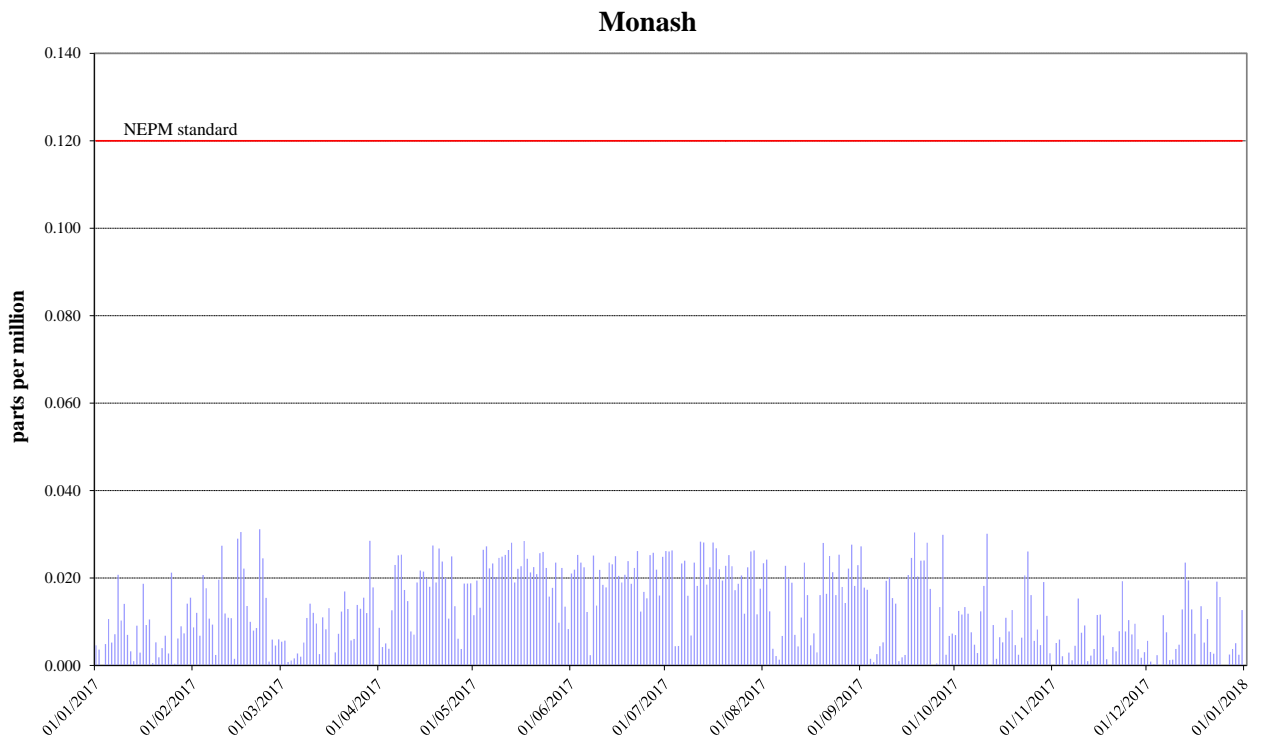


Figure 3: Daily max for NO₂ – Monash

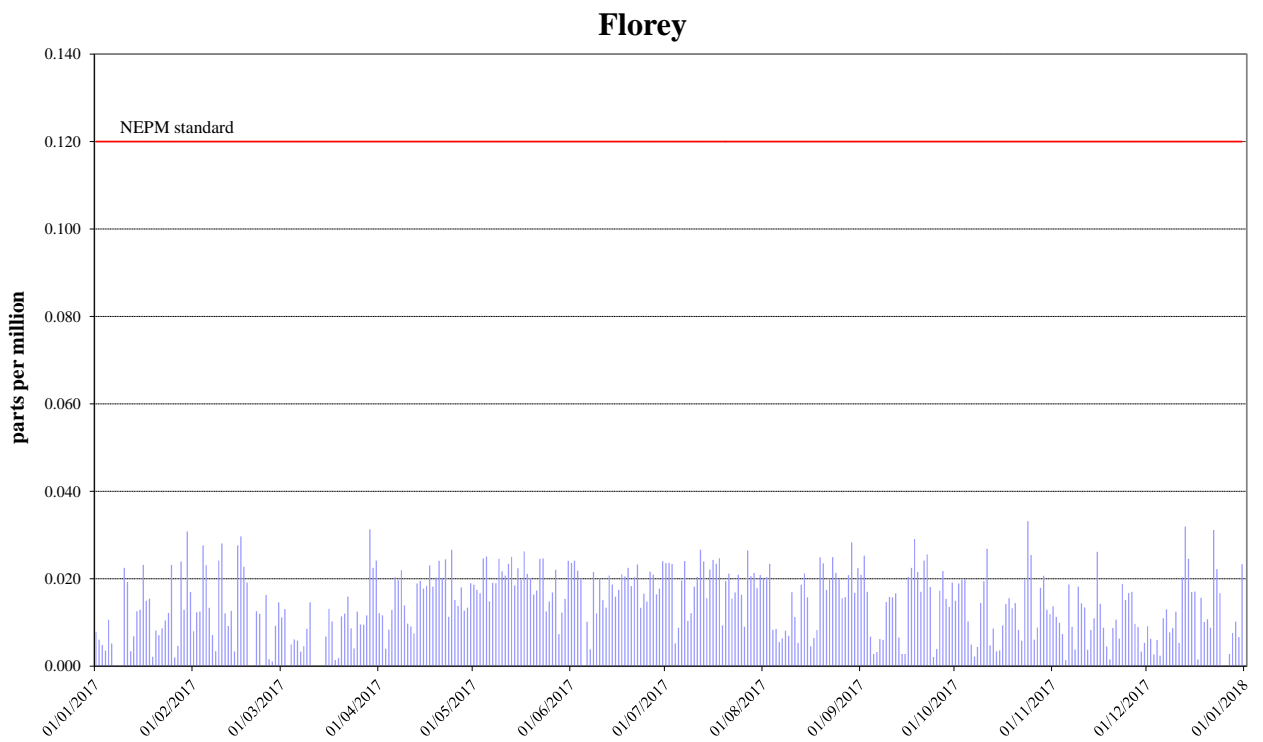


Figure 4: Daily max for NO₂ – Florey

Ozone

During 2017, no exceedances of the 1-hour and 4-hour standards for ozone were recorded and compliance was demonstrated at all monitoring stations.

Table 6: 2017 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 exceedances (days)		Performance against the standards and goal	
	Q1	Q2	Q3	Q4	Annual	1 hour	4 hours	1 hour	4 hours
Monash	95.8	94.6	95.7	95.8	95.5	0	0	MET	MET
Civic	95.8	95.8	95.8	95.8	95.8	0	0	MET	MET
Florey	94.4	95.8	95.8	95.8	95.5	0	0	MET	MET

Monash

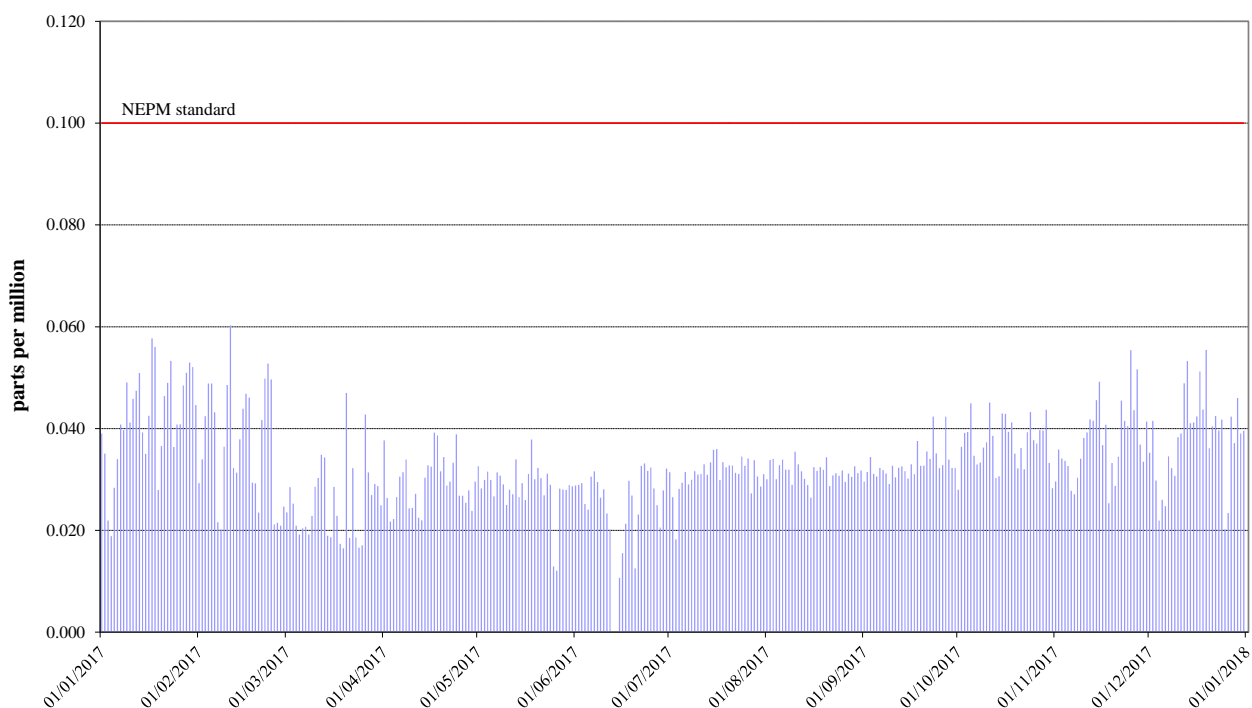


Figure 5: Daily max for 1 hour O₃ – Monash

Civic

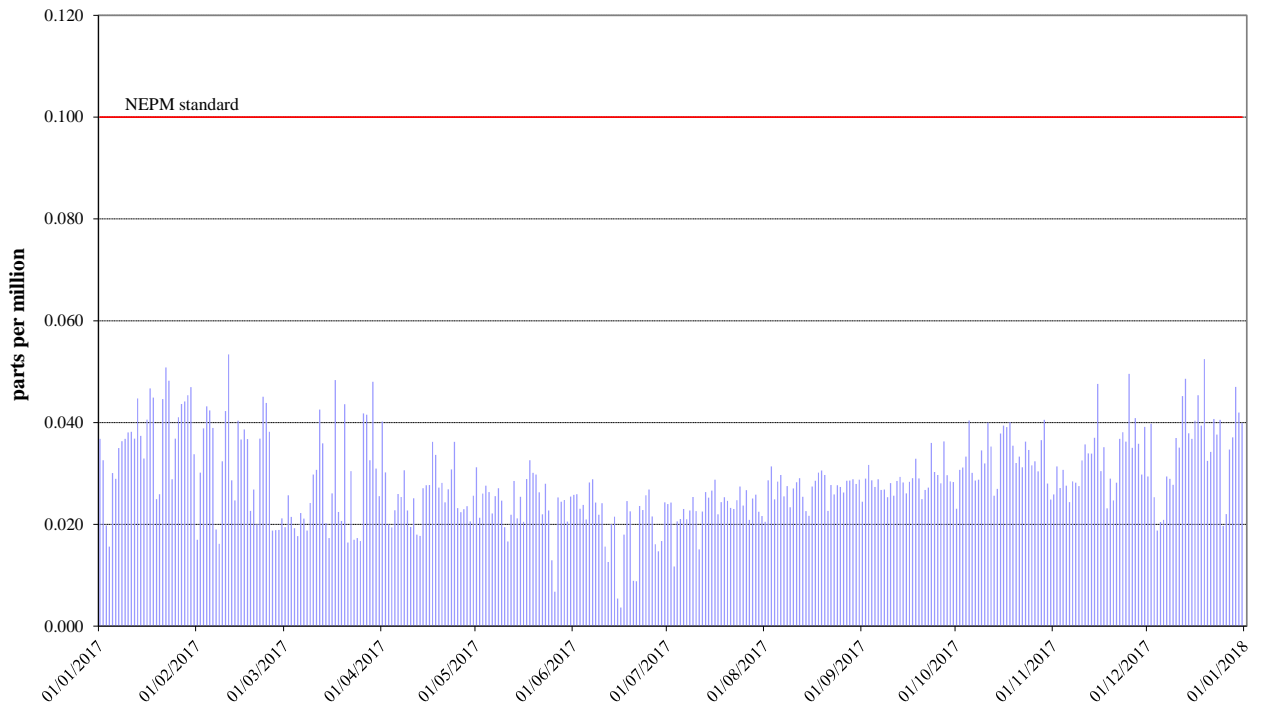


Figure 6: Daily max for 1 hour O_3 – Civic

Florey

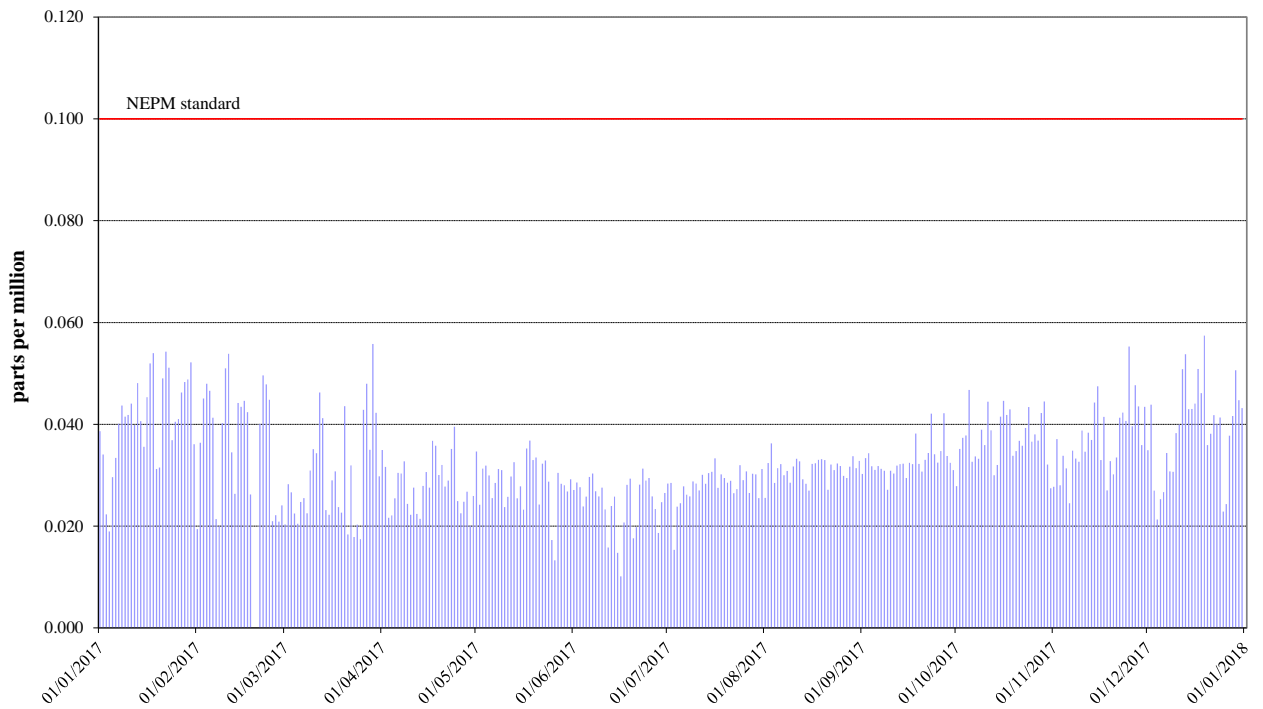


Figure 7: Daily max for 1 hour O_3 – Florey

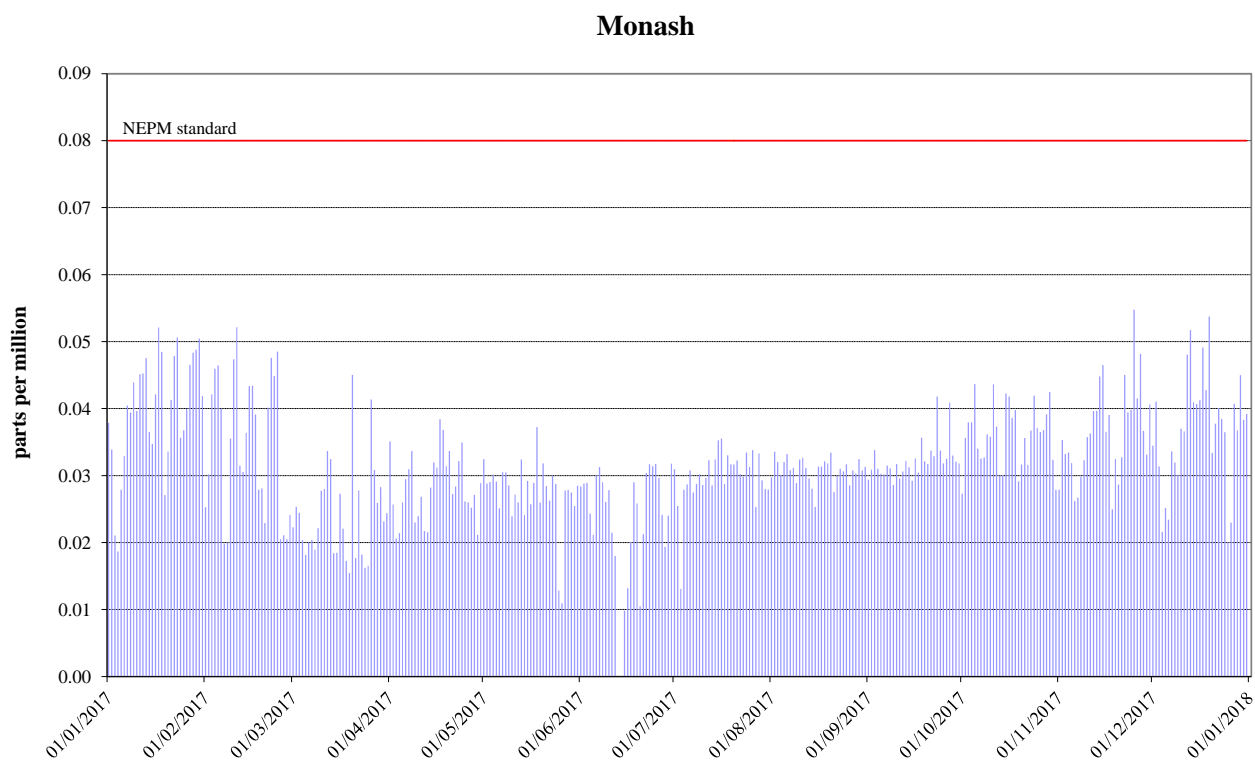


Figure 8: Daily max for 4 hours O₃ - Monash

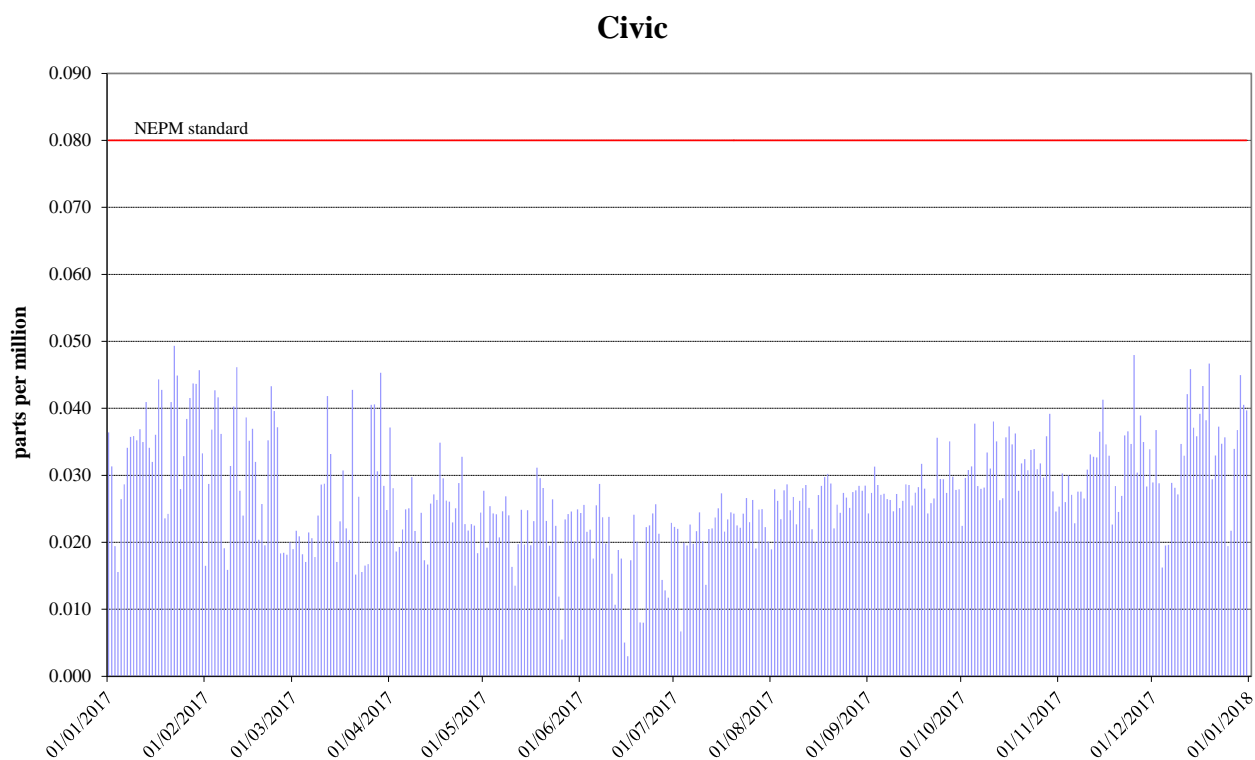


Figure 9: Daily max for 4 hours O₃ – Civic

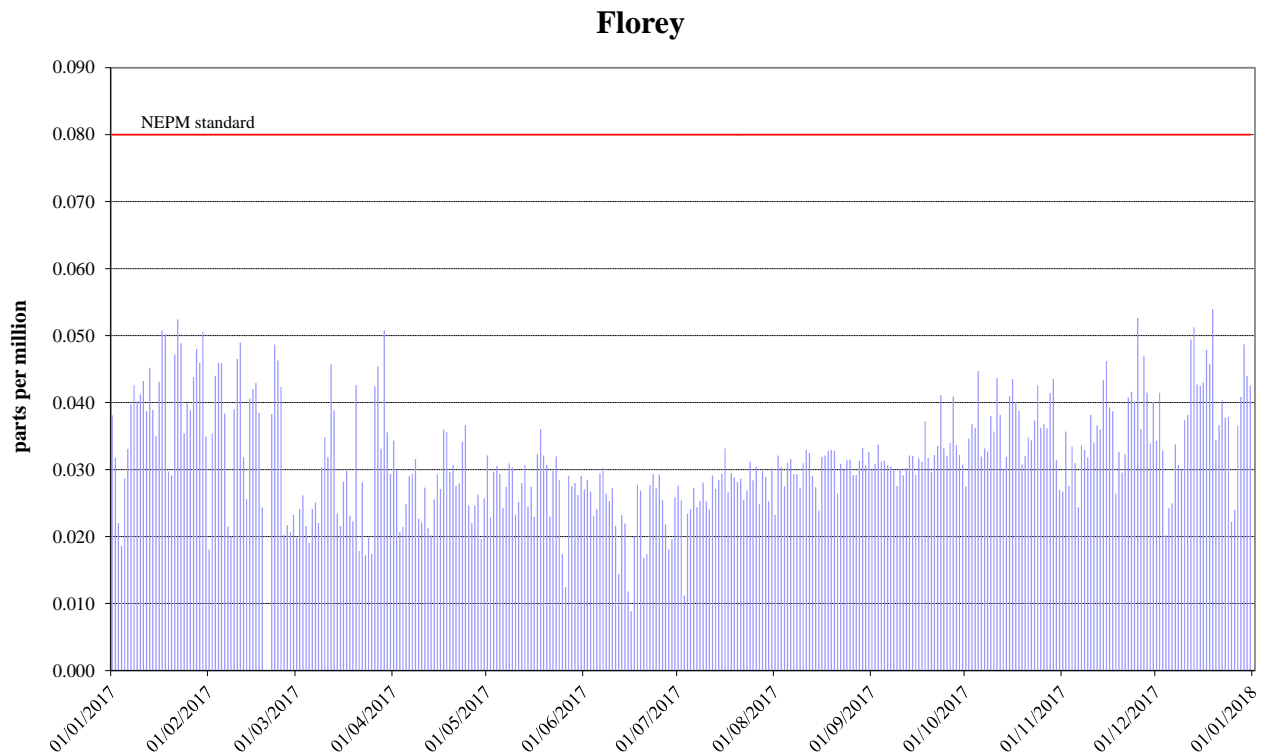


Figure 10: Daily max for 4 hours O₃ – Florey

PM₁₀

During 2017, there was one exceedance of the 24-hour PM₁₀ standard recorded at Civic. No exceedances of the daily and annual average PM₁₀ standards were recorded at Monash and Florey and compliance was demonstrated at both monitoring stations.

Compliance against the AAQ NEPM PM₁₀ standard was met at Monash, Florey and Civic, when the exceedance of 30 August 2017 is removed as an exceptional event.

Table 7: 2017 compliance summary for PM₁₀

AAQ NEPM standard 50 µg/m³ 1-day average, 20 µg/m³ (1-year average)*

Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (µg/m ³)*	Number of exceedances (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual			
Monash	98.9	100	98.9	97.8	98.9	9.8	0	MET
Civic	100	100	81.5	53.3	83.6	9.7	1	ND
Florey	95.6	100	97.8	100	98.4	9.8	0	MET

* ACT policy position 20 µg/m³ not AAQ NEPM standard of 25 µg/m³

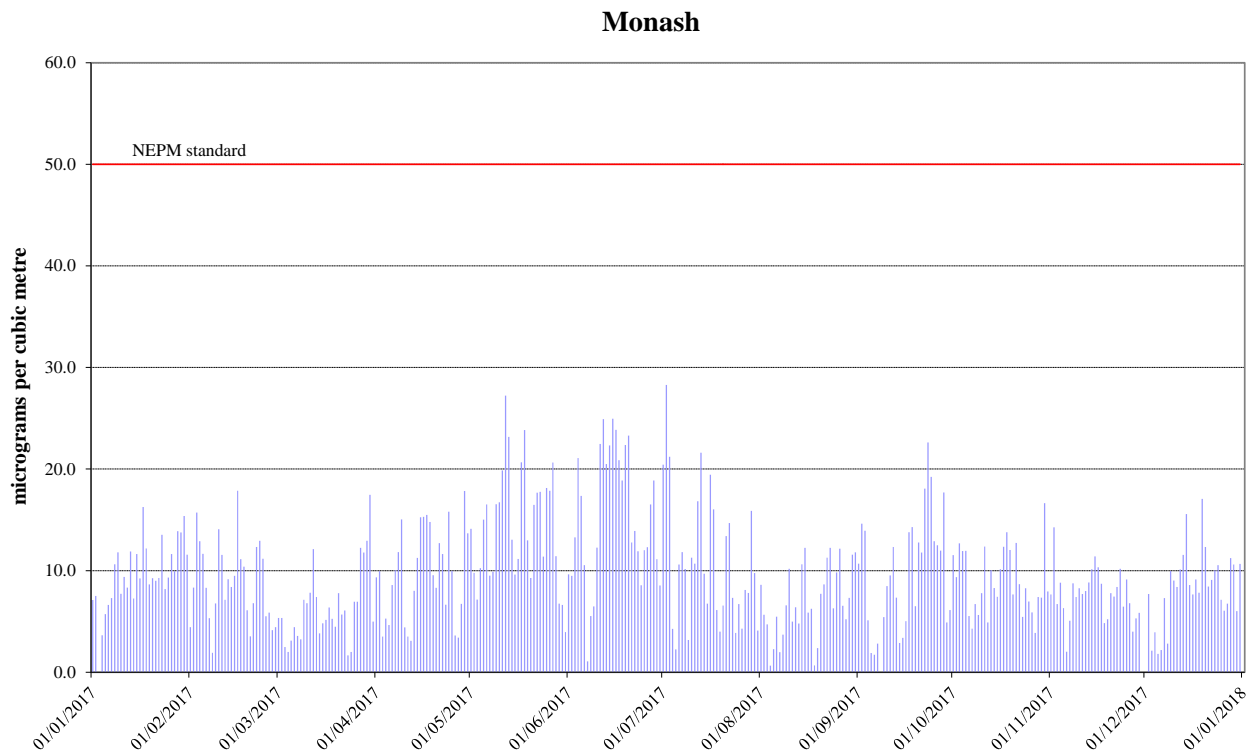


Figure 11: Daily max for PM₁₀ – Monash

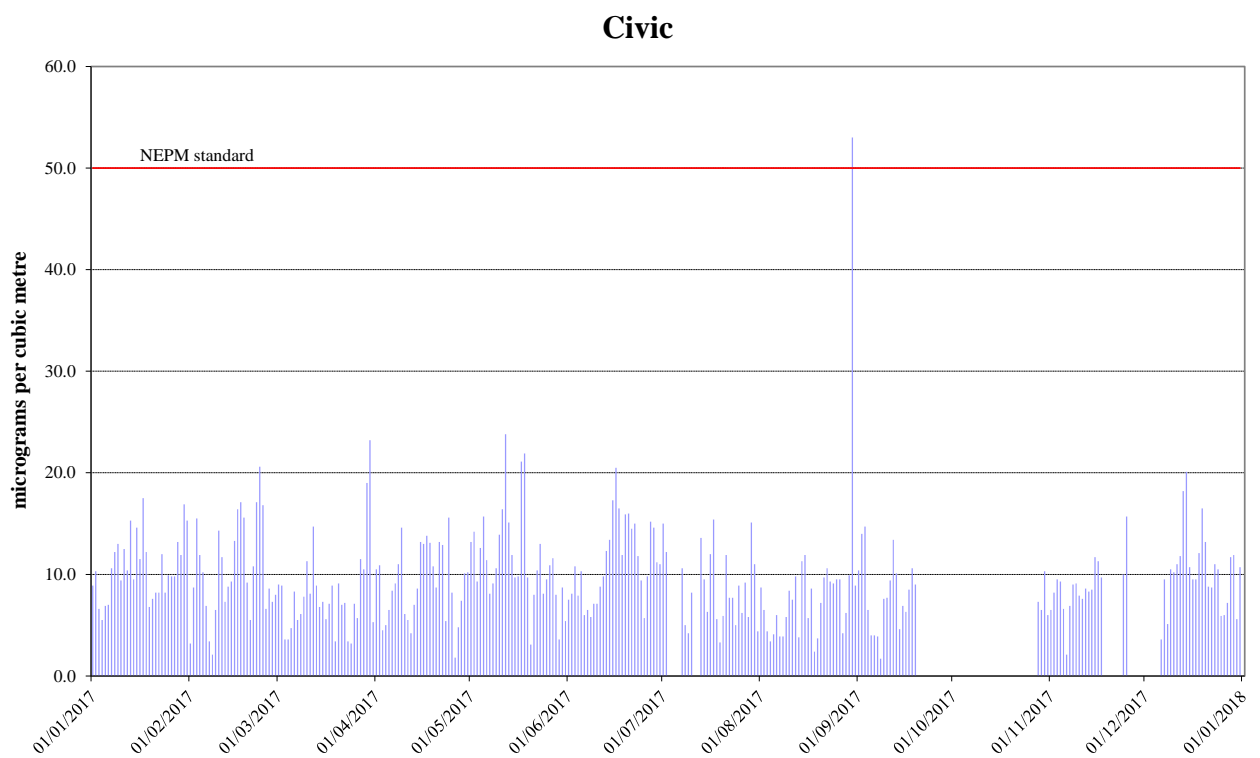


Figure 12: Daily max for PM₁₀ – Civic

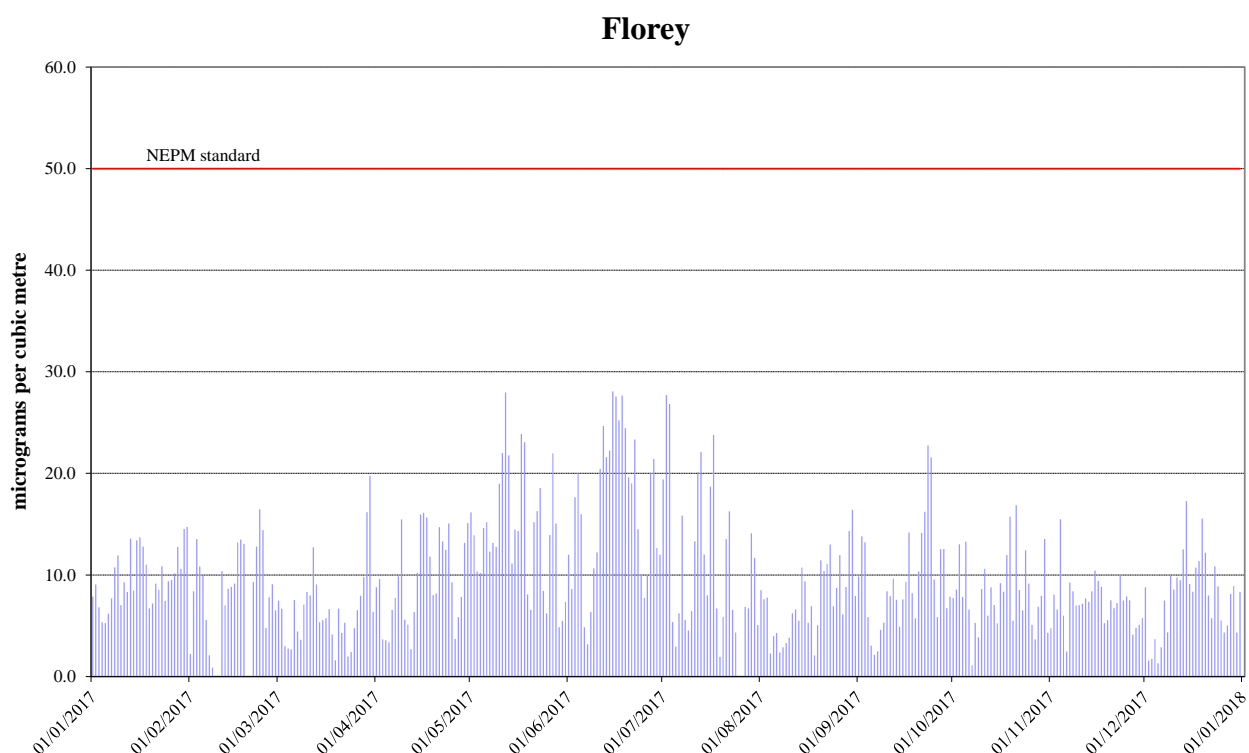


Figure 13: Daily max for PM₁₀ – Florey

PM_{2.5}

During 2017, while no exceedances of the annual average PM_{2.5} standard were recorded in the ACT, 13 exceedances of the daily PM_{2.5} standard were recorded at Monash and Civic. Compliance against the AAQ NEPM PM_{2.5} standard was met at Florey and Civic when the exceedance of 30 August 2017 is removed as an exceptional event.

Table 8: 2017 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 exceedances (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual			
Monash	97.8	100	98.9	97.8	98.6	7.7	12	NOT MET
Civic	100	79.1	100	91.3	92.6	5.8	1	MET
Florey	92.2	93.4	91.3	100	94.2	7.1	0	MET

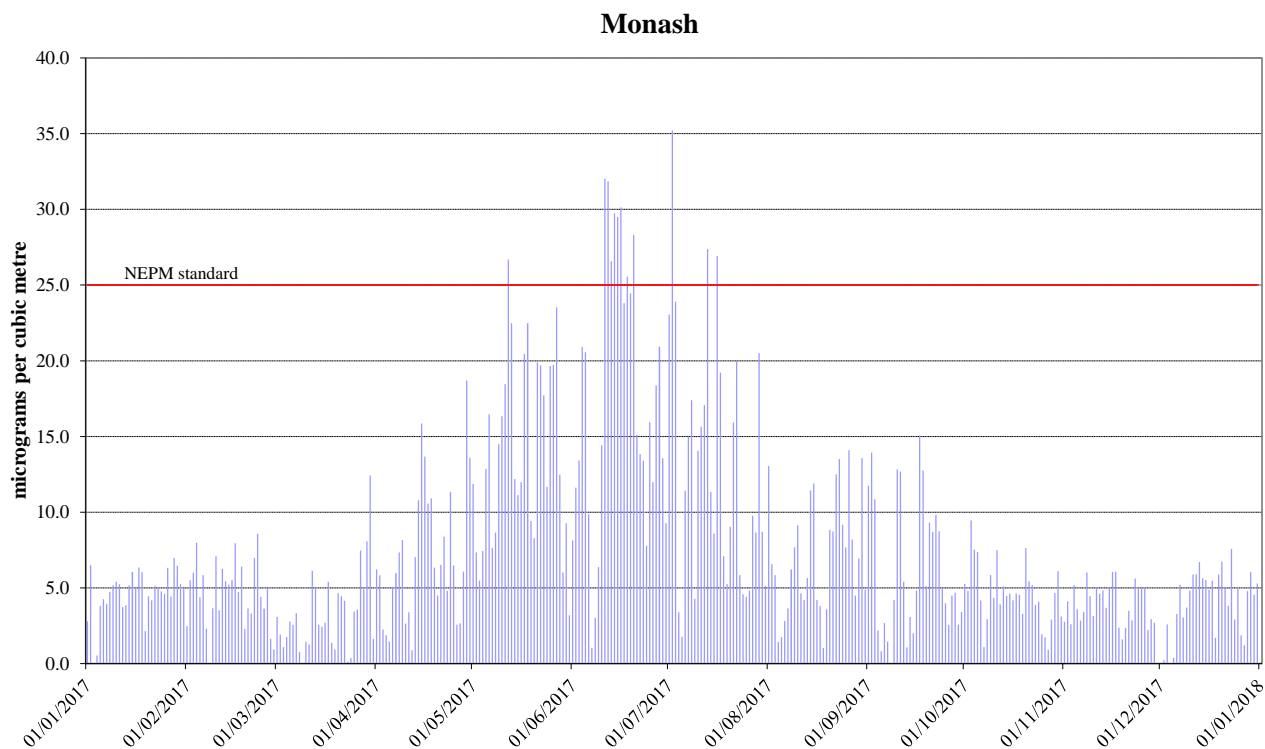


Figure 14: Daily max for PM_{2.5} – Monash

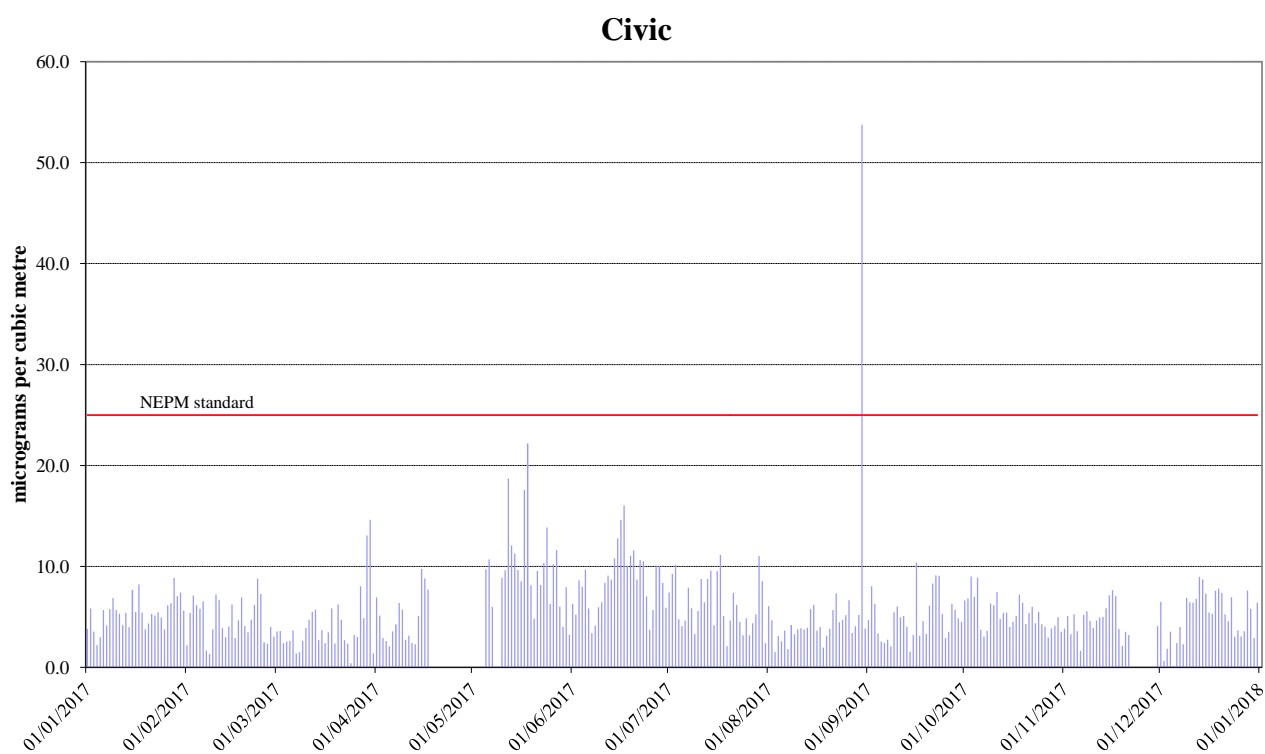


Figure 15: Daily max for PM_{2.5} – Civic

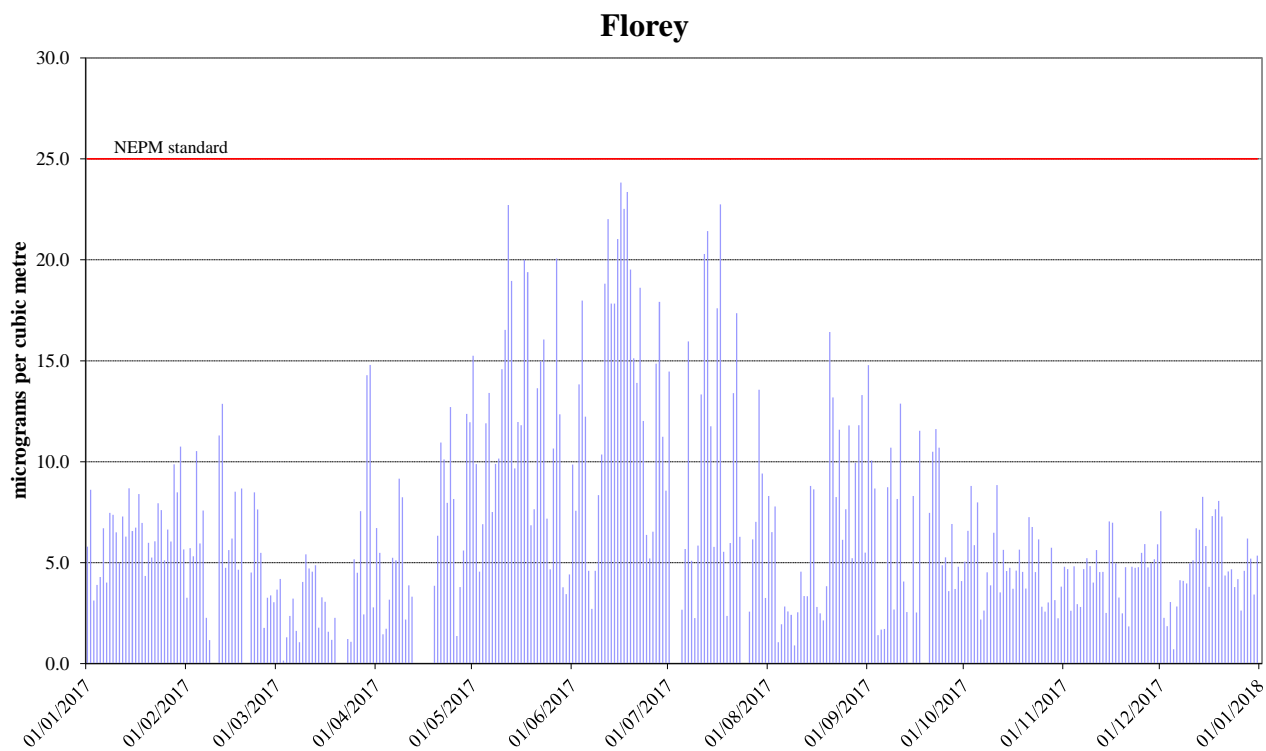


Figure 16: Daily max for PM_{2.5} – Florey

ANALYSIS OF AIR QUALITY MONITORING

Annual summary statistics contained in Table 9 to Table 14 below assess air quality against the standards and the extent of compliance with the goal. Instances where the standard has been exceeded are highlighted in bold.

Carbon monoxide

Table 9: 2017 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	1.6	26 May 03:00	1.5	16 Jun 03:00
Florey	365	1.8	27 May 05:00	1.8	22 Jun 04:00

Carbon monoxide levels are well below the AAQ NEPM standard at all monitoring stations. The highest recorded value in the ACT during 2017 was 1.8 ppm at Florey, which is 20% of the standard.

Nitrogen dioxide

Table 10: 2017 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	0.031	22 Feb 21:00	0.031	16 Feb 21:00
Florey	365	0.033	24 Oct 20:00	0.032	13 Dec 22:00

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 2017 was 0.033 ppm at Florey, which is only 27.5% of the standard. The highest recorded annual average in 2017 was 0.005ppm at Florey (refer to Table 5). This is 17% of the annual standard 0.03ppm.

Ozone

Table 11: 2017 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	363	0.060	11 Feb 11:00	0.058	17 Jan 10:00
Civic	365	0.053	11 Feb 11:00	0.052	19 Dec 11:00
Florey	363	0.057	19 Dec 11:00	0.056	29 Mar 17:00

Table 12: 2017 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	363	0.055	25 Nov 14:00	0.054	19 Dec 13:00
Civic	365	0.049	22 Jan 19:00	0.048	25 Nov 14:00
Florey	363	0.054	19 Dec 13:00	0.053	25 Nov 13:00

Ozone levels are below the AAQ NEPM standard. The highest recorded 1-hour value in the ACT during 2017 was 0.060 ppm at Monash, which is 60% of the standard. The highest recorded 4-hour value in the ACT during 2017 was 0.055 ppm at Monash, which is 69% of the standard.

PM₁₀

Table 13: 2017 summary statistics for daily peak PM₁₀

AAQ NEPM daily standard 50 µg/m³

Performance monitoring station	Number of valid days	Highest (µg/m ³)	Highest (date)
Monash	361	28.3	02 July
Civic	305	53.0	30 August
Florey	359	28.1	15 June

PM₁₀ levels at Monash and Florey are below the AAQ NEPM standard. The only exceedance recorded during 2017 was 53.0µg/m³ at Civic on 30 August 2017 due to hazard reduction burns. Excluding this exceedance under the exceptional event rule, PM₁₀ levels at Civic are well below the standard. The highest recorded annual average in 2017 was 9.8µg/m³ at Florey (refer to Table 7). This is 49% of the ACT policy standard annual of 20µg/m³.

PM_{2.5}

Table 14: 2017 summary statistics for daily peak PM_{2.5}

AAQ NEPM daily standard 25 µg/m³

Performance monitoring station	Number of valid days	Highest (µg/m ³)	Highest (date)
Monash	360	35.2	02 July
Civic	338	53.8	30 August
Florey	344	23.8	16 June

The daily reporting standard for PM_{2.5} was exceeded 12 times at Monash and once at Civic. The exceedances at Monash, occurred between May and July, and are a result of increased domestic wood heater emissions during the winter months.

The daily reporting standard for PM_{2.5} was exceeded at Civic on 30 August 2017 due to smoke coming from hazard reduction burns. The highest recorded annual average in 2017 was 7.7µg/m³ at Monash (refer to Table 8). This is 95% of the annual standard 8µg/m³.

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 in 1998.

Historical monitoring results indicate that the only AAQ NEPM pollutant of concern in the ACT air shed is particulate matter, which increases significantly during winter because of emissions from domestic wood heaters, especially in the Tuggeranong Valley where levels are also exacerbated by the topography of the valley which is subject to temperature inversions and poor pollution dispersion.

In more recent years exceedances of the particulate matter standards have also been attributed to dust storms and smoke from controlled burns.

PM_{2.5} is the pollutant that is the most affected by wood smoke as the majority of particles are less than 1 micron in diameter. Figures 14 and 16 clearly show that PM_{2.5} levels increase significantly during the cooler months of the year. In the last few years the annual average PM_{2.5} readings for Monash and Florey have also increased and are now approaching the NEPM standard. Excluding temporal variation, this rise is more than likely because of an increase in wood heater use and or installation as a result of the increasing cost of gas and electricity.

The ACT Government acknowledges that woodsmoke is a problem and will continue to implement an integrated program to address woodsmoke. This will involve public education and enforcement activities, the implementation of the 'Burn Right Tonight Campaign', the regulation of the sale of firewood and the on-going administration of the Wood Heater Replacement Program.

Noting there is no safe level of particle pollution, the EPA is concerned about the increase in the number of exceedances and levels of PM_{2.5}. Annual average levels in Florey and Monash are now very close to national standards. Given this trend the EPA, in conjunction with the Environment, Planning and Sustainable Development Directorate, will:

- undertake a review of the efficacy of the Government's wood smoke programs
- look to establish tighter controls on the installation of solid fuelled heaters to drive the installation of lower emission models.

APPENDIX A: STATISTICAL SUMMARY AND TRENDS

The following section provides a basic statistical summary, using percentiles, for Monash, Florey and Civic stations and for each standard in the past ten years. Percentiles for daily maximum values are presented.

Carbon monoxide

Table 15: Statistical summary for daily maximum 8-hour CO Monash 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2008	88.0	0	2.4	1.8	0.8	0.3
2009	96.4	0	2.0	1.4	0.6	0.3
2010	99.2	0	1.8	1.4	0.6	0.3
2011	98.6	0	2.2	1.5	0.5	0.2
2012	99.7	0	1.8	1.2	0.6	0.3
2013	95.9	0	2.1	1.5	0.6	0.3
2014	94.0	0	1.8	1.4	0.7	0.4
2015	94.8	0	1.9	1.4	0.6	0.3
2016	95.8	0	1.7	1.0	0.4	0.2
2017	95.4	0	1.6	1.2	0.6	0.2

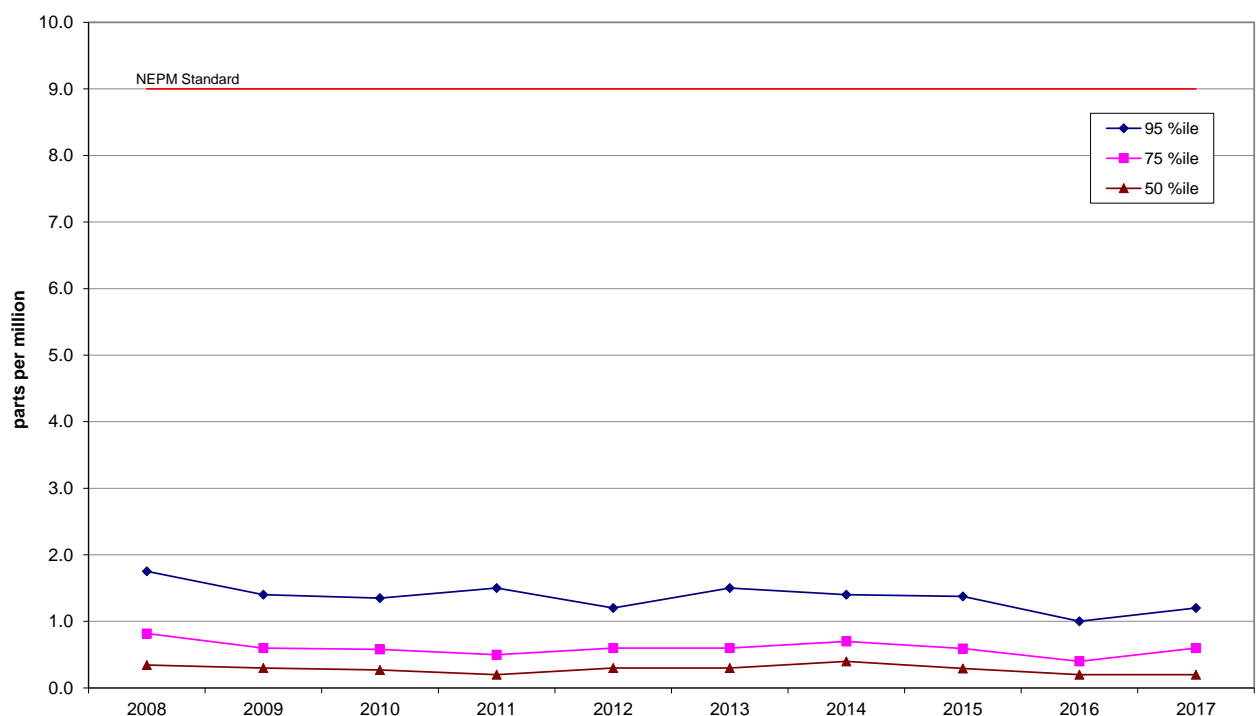


Figure 17: Statistical summary for daily maximum 8-hour CO Monash 2008 – 2017

Table 16: Statistical summary for daily maximum 8-hour CO Florey 2014 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	79.2	0	2.2	1.4	0.7	0.3
2015	94.9	0	2.0	1.5	0.6	0.3
2016	95.5	0	1.9	1.2	0.5	0.3
2017	94.7	0	1.8	1.4	0.5	0.2

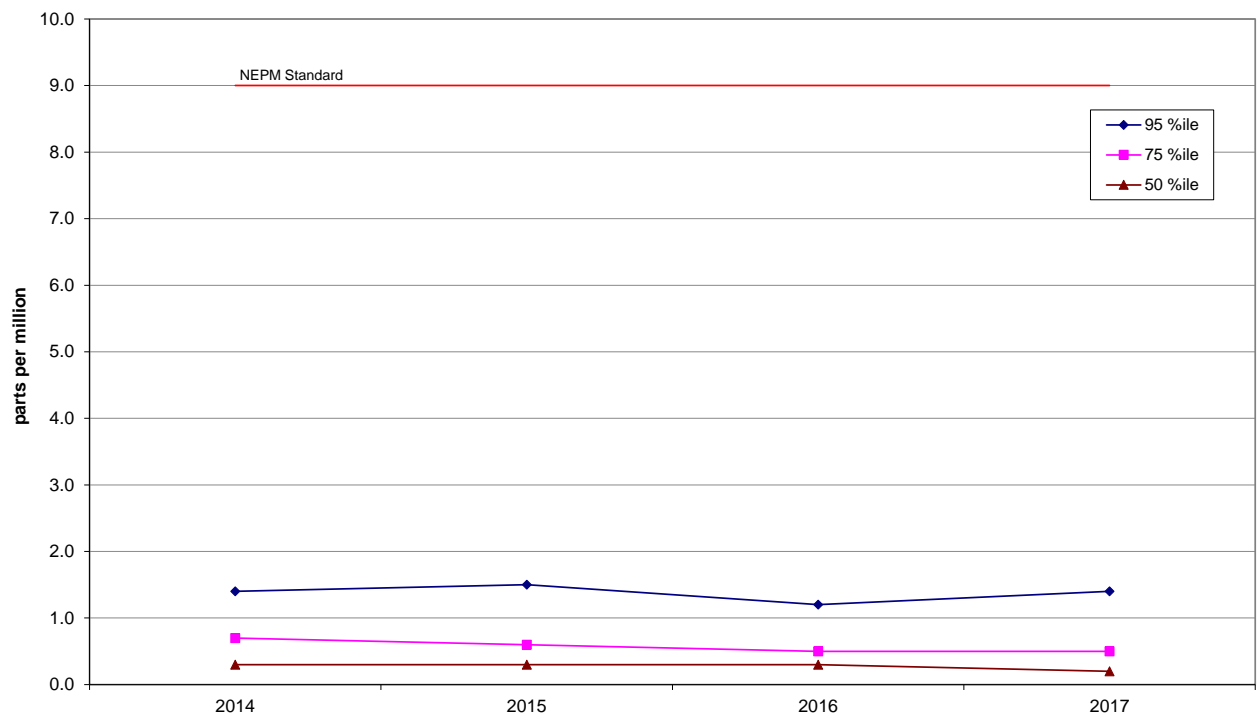


Figure 18: Statistical summary for daily maximum 8-hour CO Florey 2014 – 2017

Nitrogen dioxide

Table 17: Statistical summary for daily maximum 1-hour NO₂ Monash 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	Annual average (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2008	86.5	0	0.103	0.007	0.031	0.025	0.019
2009	92.6	0	0.041	0.008	0.029	0.023	0.019
2010	89.1	0	0.037	0.006	0.025	0.021	0.017
2011	96.7	0	0.043	0.005	0.029	0.022	0.015
2012	97.5	0	0.033	0.006	0.026	0.021	0.014
2013	97.5	0	0.037	0.005	0.027	0.021	0.014
2014	94.1	0	0.036	0.005	0.027	0.020	0.015
2015	94.8	0	0.032	0.004	0.026	0.020	0.014
2016	95.6	0	0.036	0.004	0.027	0.019	0.012
2017	95.6	0	0.031	0.004	0.027	0.021	0.013

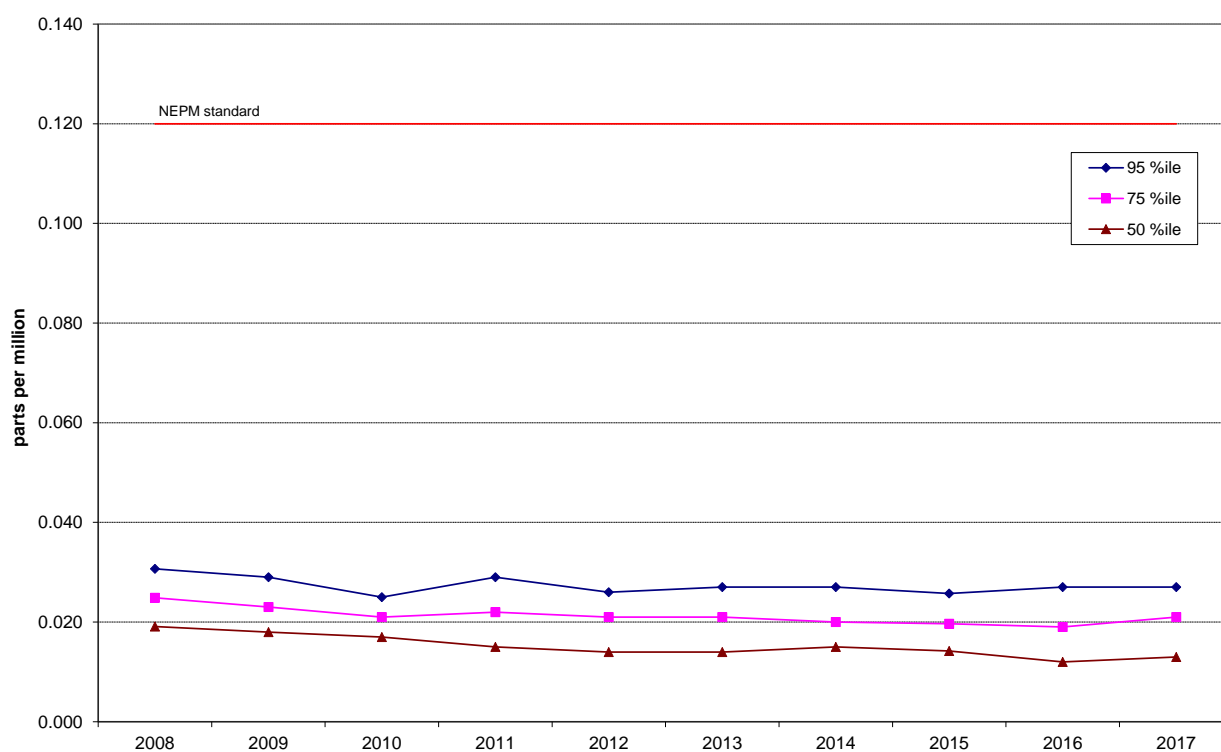


Figure 19: Statistical summary for daily maximum 1-hour NO₂ Monash 2008 – 2017

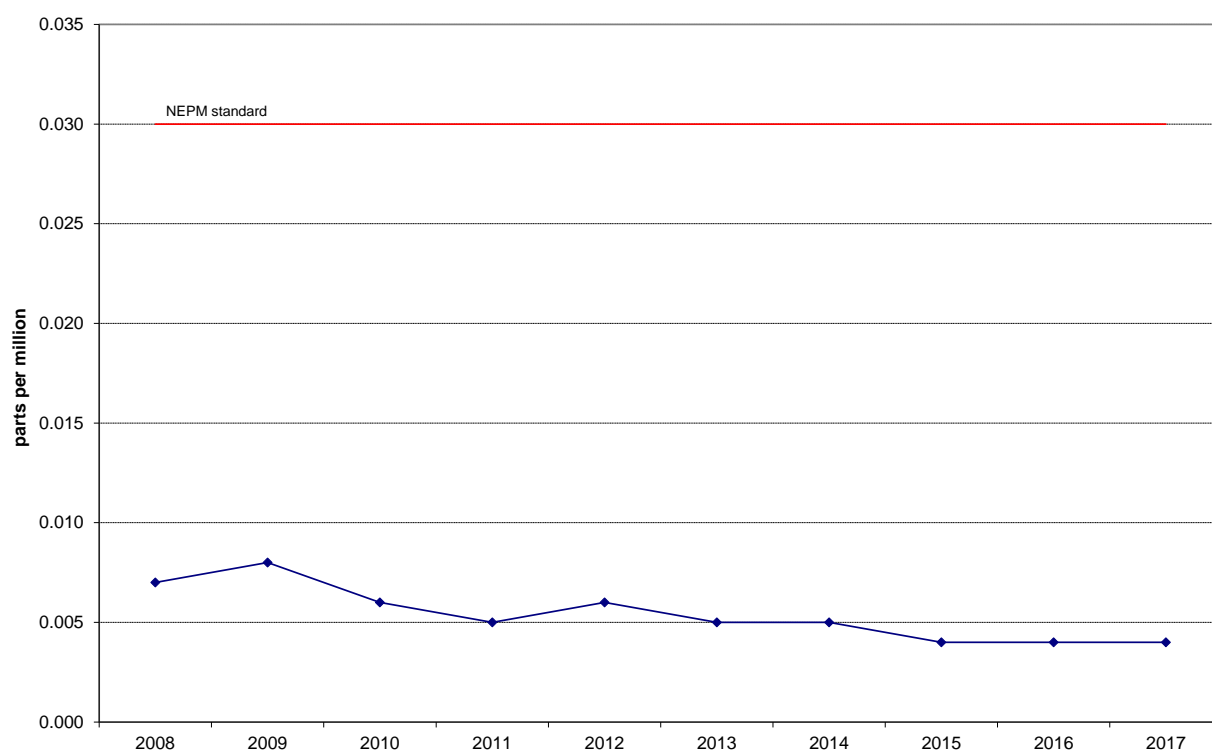


Figure 20: Annual average 1-hour NO₂ Monash 2008 – 2017

Table 18: Statistical summary for daily maximum 1-hour NO₂ Florey 2014 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	Annual average (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	78.3	0	0.045	0.006	0.027	0.020	0.015
2015	91.5	0	0.033	0.005	0.027	0.020	0.014
2016	94.7	0	0.034	0.004	0.027	0.019	0.013
2017	93.7	0	0.033	0.005	0.025	0.020	0.015

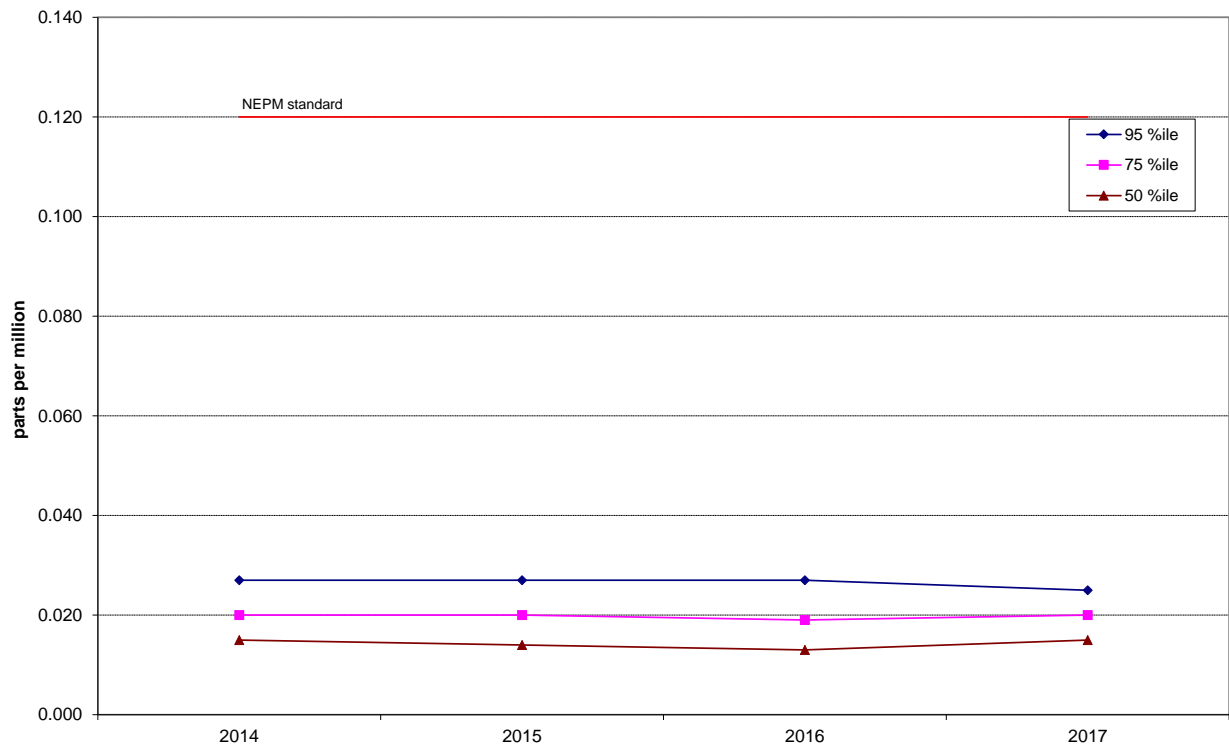


Figure 21: Statistical summary for daily maximum 1-hour NO₂ Florey 2014 – 2017

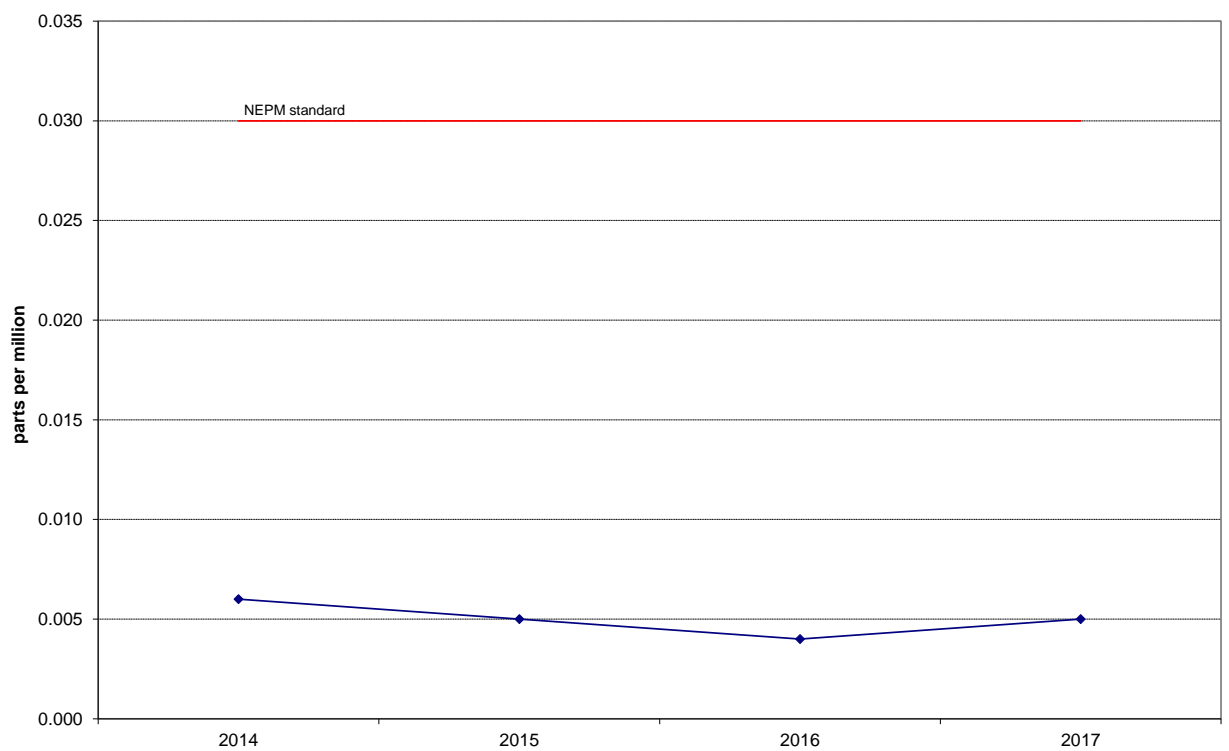


Figure 22: Annual average 1-hour NO₂ Florey 2014 – 2017

Ozone

Table 19: Statistical summary for daily maximum 1-hour O₃ Monash 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2008	84.2	0	0.065	0.047	0.031	0.026
2009	96.4	0	0.073	0.052	0.038	0.030
2010	86.6	0	0.051	0.042	0.033	0.030
2011	99.2	0	0.056	0.044	0.033	0.028
2012	100	0	0.055	0.043	0.034	0.029
2013	97.8	0	0.062	0.045	0.035	0.029
2014	94.8	0	0.087	0.050	0.036	0.030
2015	92.8	0	0.065	0.044	0.034	0.026
2016	95.2	0	0.057	0.044	0.032	0.026
2017	95.5	0	0.060	0.049	0.038	0.032

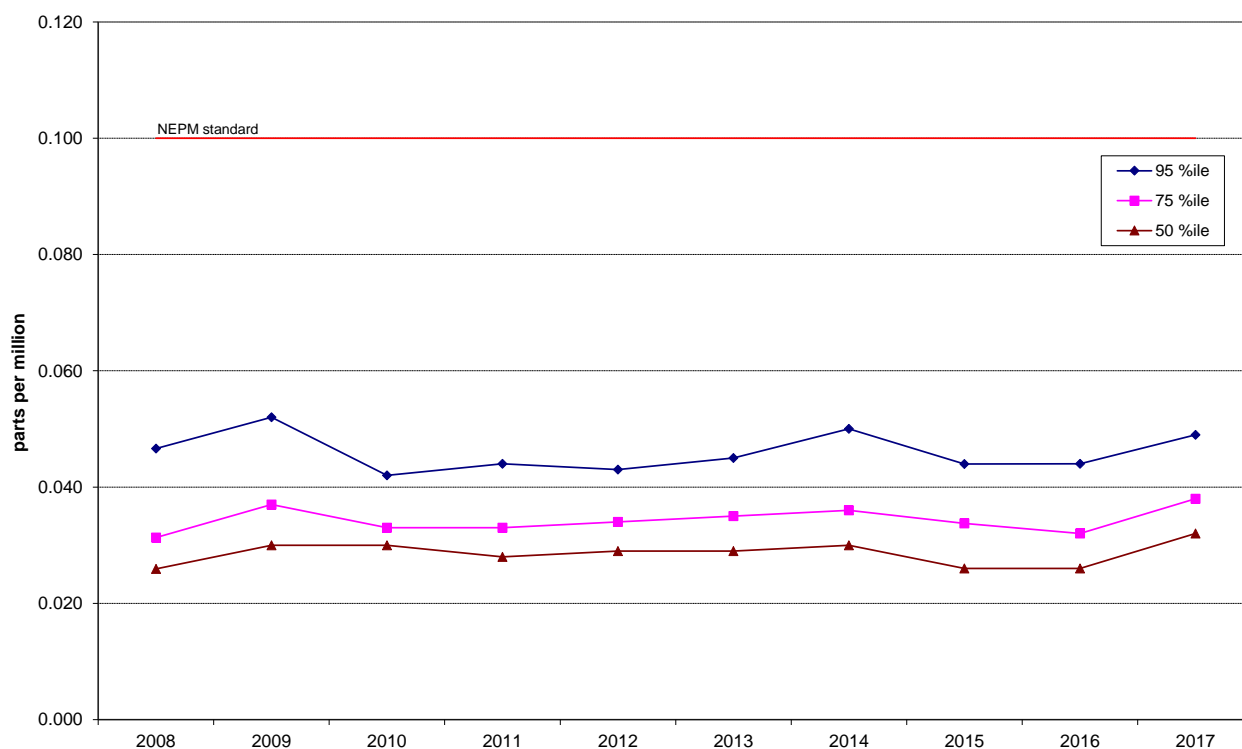


Figure 23: Statistical summary for daily maximum 1-hour O₃ Monash 2008 – 2017

Table 20: Statistical summary for daily maximum 1-hour O₃ Civic 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2008	91.4	0	0.052	0.039	0.028	0.023
2009	97.8	0	0.060	0.044	0.031	0.024
2010	99.2	0	0.058	0.040	0.029	0.025
2011	96.4	0	0.052	0.041	0.030	0.026
2012	100	0	0.053	0.034	0.024	0.020
2013	92.1	0	0.060	0.036	0.028	0.024
2014	94.0	0	0.060	0.039	0.028	0.022
2015	89.0	0	0.042	0.034	0.026	0.022
2016	95.8	0	0.047	0.036	0.028	0.024
2017	95.8	0	0.053	0.045	0.034	0.028

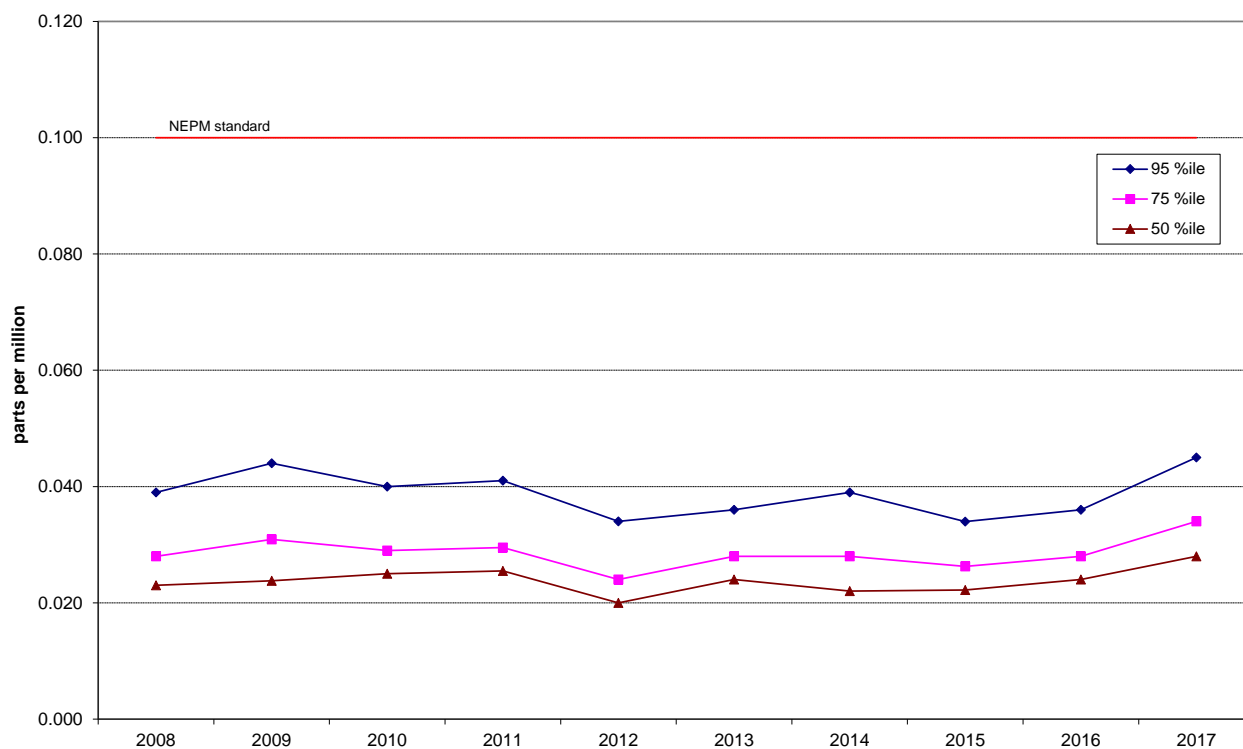


Figure 24: Statistical summary for daily maximum 1-hour O₃ Civic 2008 – 2017

Table 21: Statistical summary for daily maximum 1-hour O₃ Florey 2014 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	79.4	0	0.074	0.034	0.027	0.023
2015	94.2	0	0.040	0.032	0.025	0.021
2016	95.8	0	0.050	0.040	0.031	0.027
2017	95.5	0	0.057	0.048	0.038	0.032

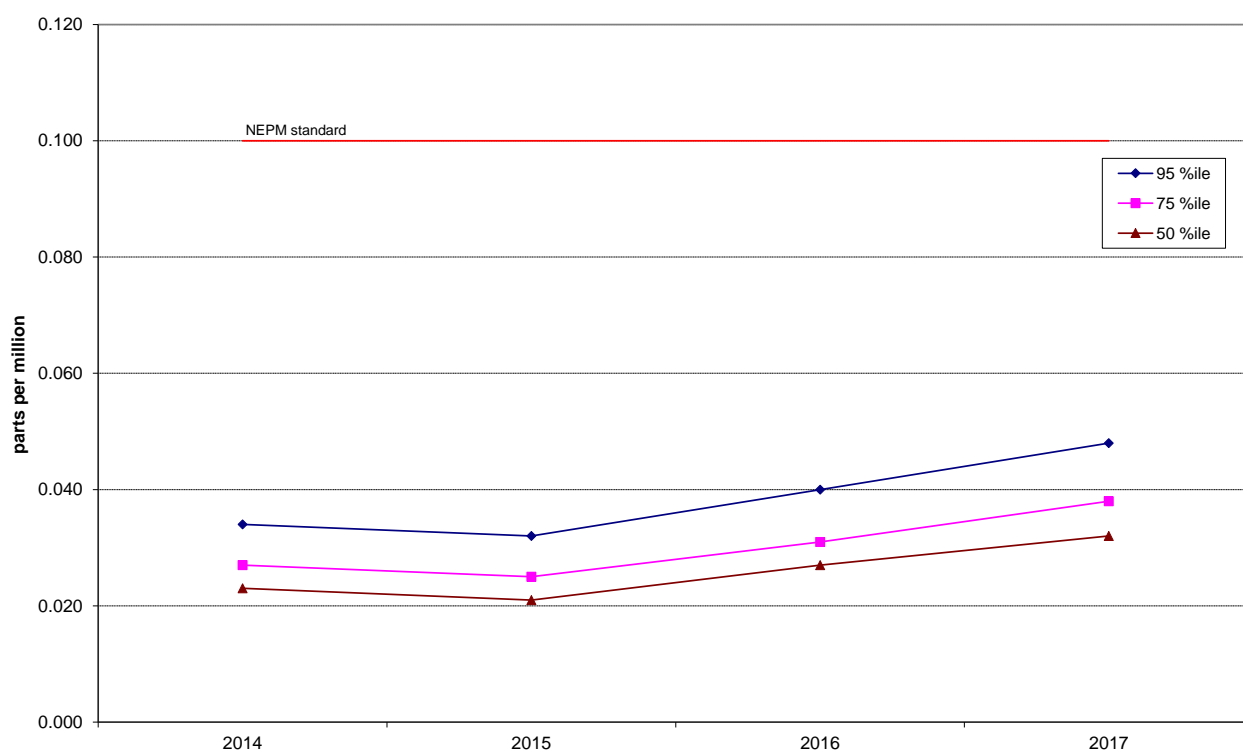


Figure 25: Statistical summary for daily maximum 1-hour O₃ Florey 2014 – 2017

Table 22: Statistical summary for daily maximum 4-hour O₃ Monash 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2008	84.2	0	0.061	0.045	0.030	0.025
2009	96.2	0	0.068	0.048	0.036	0.029
2010	86.6	0	0.049	0.040	0.032	0.029
2011	98.9	0	0.054	0.041	0.032	0.027
2012	99.7	0	0.052	0.043	0.034	0.029
2013	97.8	0	0.059	0.042	0.033	0.028
2014	94.8	0	0.060	0.046	0.034	0.029
2015	92.8	0	0.050	0.041	0.033	0.025
2016	95.2	0	0.055	0.042	0.030	0.025
2017	95.5	0	0.055	0.047	0.036	0.031

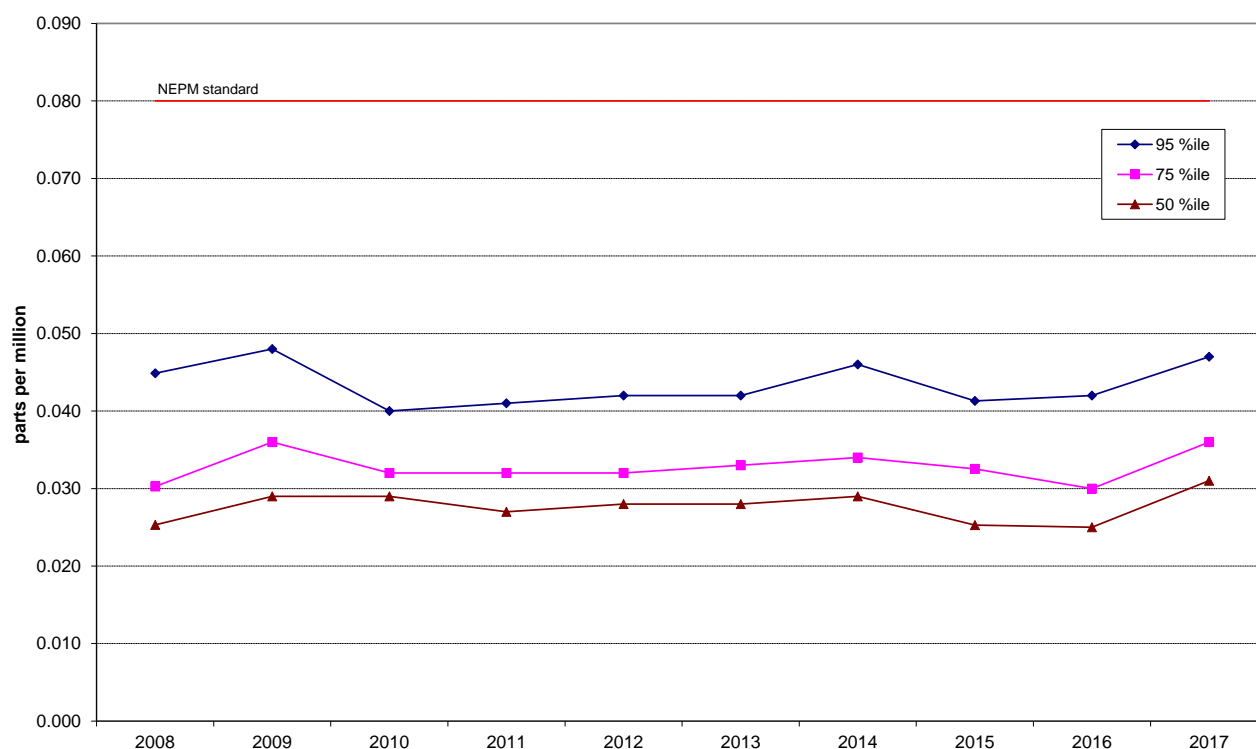


Figure 26: Statistical summary for daily maximum 4-hour O₃ Monash 2008 – 2017

Table 23: Statistical summary for daily maximum 4-hour O₃ Civic 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2008	91.4	0	0.051	0.036	0.027	0.022
2009	97.8	0	0.059	0.041	0.030	0.023
2010	99.2	0	0.056	0.037	0.028	0.024
2011	96.4	0	0.050	0.038	0.029	0.025
2012	100	0	0.042	0.032	0.023	0.019
2013	91.8	0	0.057	0.034	0.027	0.023
2014	94.0	0	0.047	0.036	0.026	0.020
2015	89.0	0	0.041	0.031	0.025	0.021
2016	95.8	0	0.045	0.035	0.027	0.023
2017	95.8	0	0.049	0.042	0.033	0.027

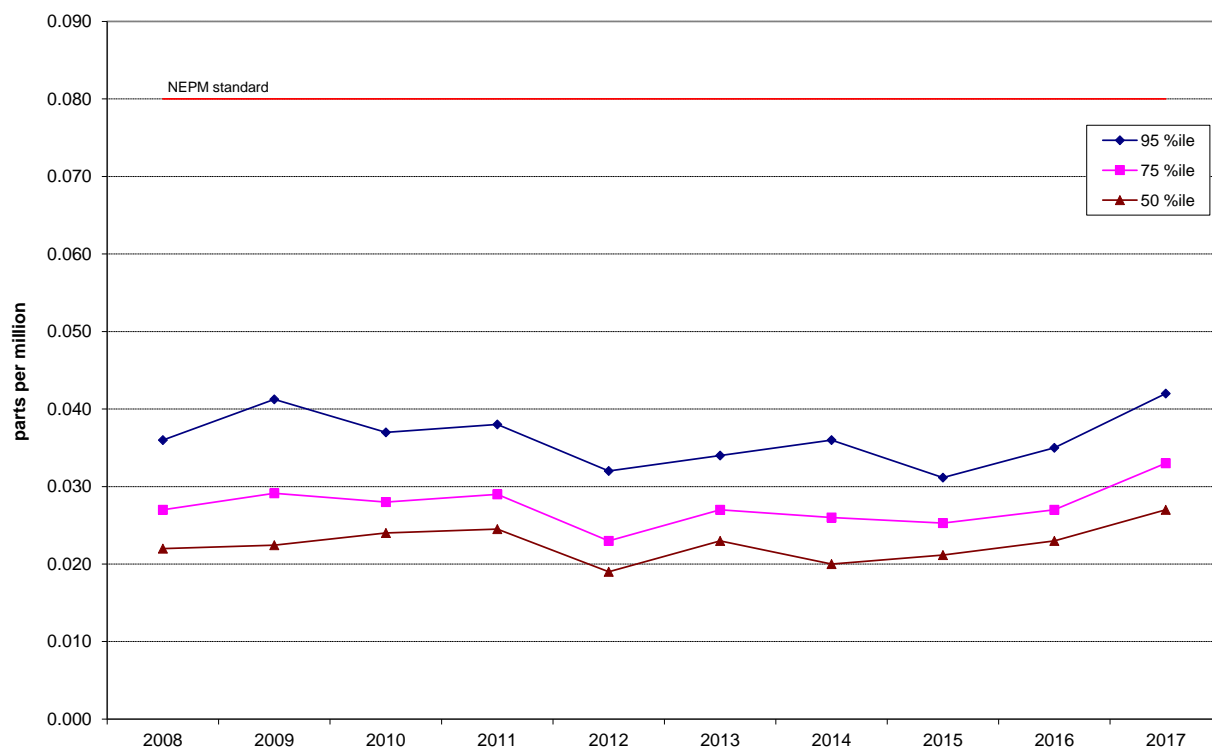


Figure 27: Statistical summary for daily maximum 4-hour O₃ Civic 2008 – 2017

Table 24: Statistical summary for daily maximum 4-hour O₃ Florey 2014 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	79.4	0	0.040	0.031	0.026	0.022
2015	94.2	0	0.037	0.031	0.025	0.020
2016	95.8	0	0.050	0.038	0.029	0.026
2017	95.5	0	0.054	0.046	0.037	0.031

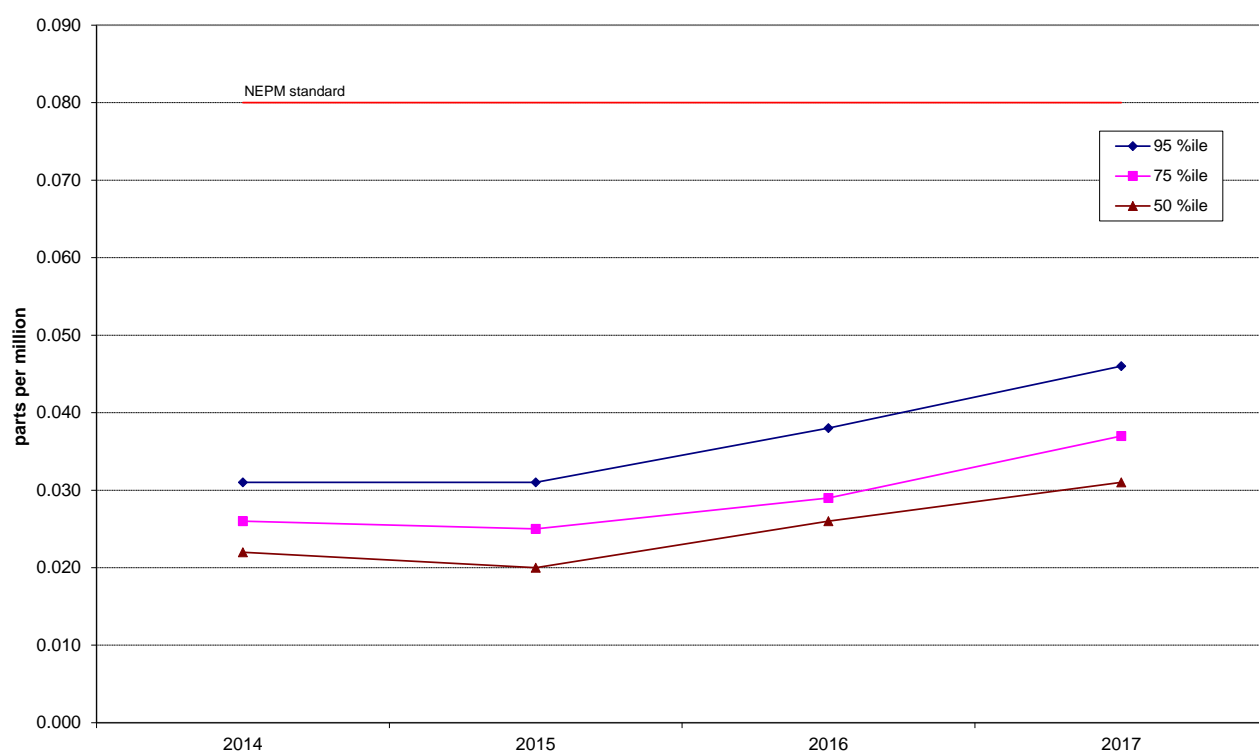


Figure 28: Statistical summary for daily maximum 4-hour O₃ Florey 2014 – 2017

PM₁₀

Table 25: Statistical summary for daily maximum daily PM₁₀ Monash 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2008	82	3	96.6	16.4	29.9	20.1	14.8
2009	42.3	9	210.0	20.3	50.5	25.5	15.2
2010	95.4	0	48.4	11.1	23.5	14.7	10.0
2011	99.2	0	40.0	10.4	22.8	13.2	8.7
2012	98.6	0	41.0	10.4	19.7	13.7	9.7
2013	95.6	0	43.5	9.8	20.2	13.1	8.9
2014	97.8	0	39.3	10	19.1	12.9	9.6
2015	98.4	0	49.4	9.9	19.5	13.1	9.5
2016	99.5	0	31.9	9.7	21.5	12.7	9.0
2017	98.9	0	28.3	9.8	20.5	12.3	9.0

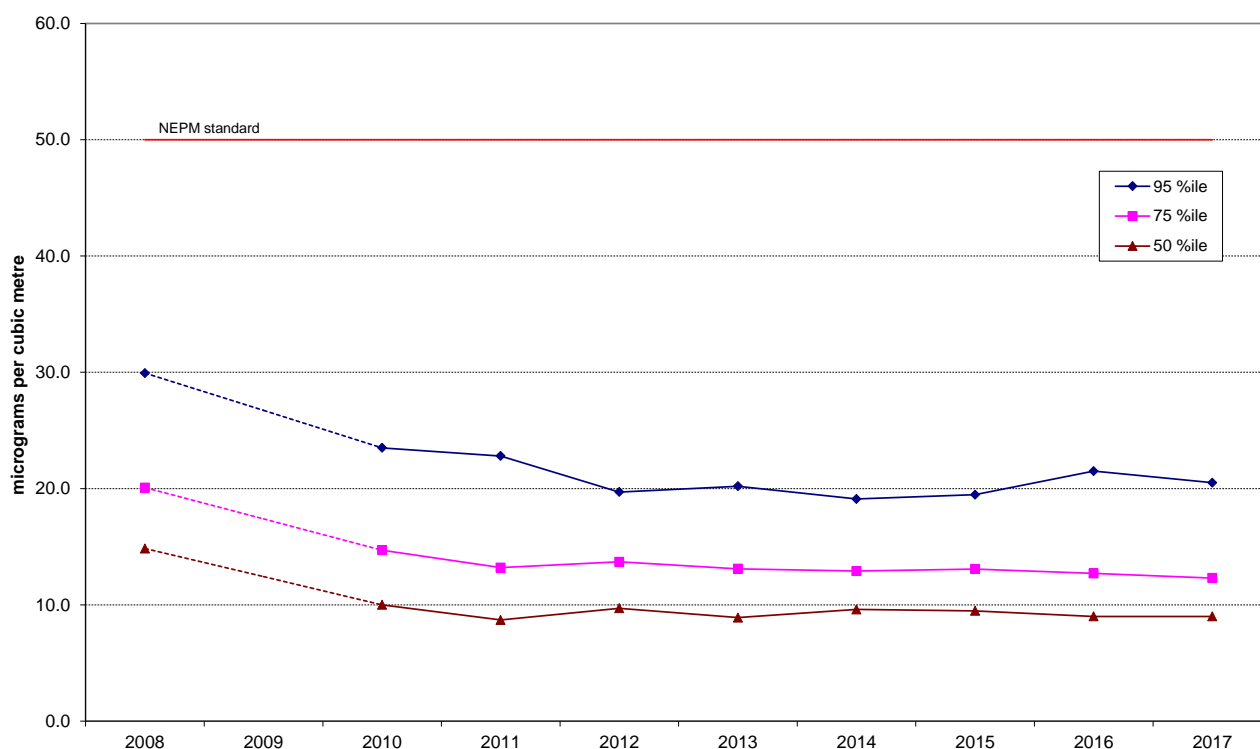


Figure 29: Statistical summary for daily maximum daily PM₁₀ Monash 2008 – 2017

Note: 2009 data has not been included in Figure 29 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.

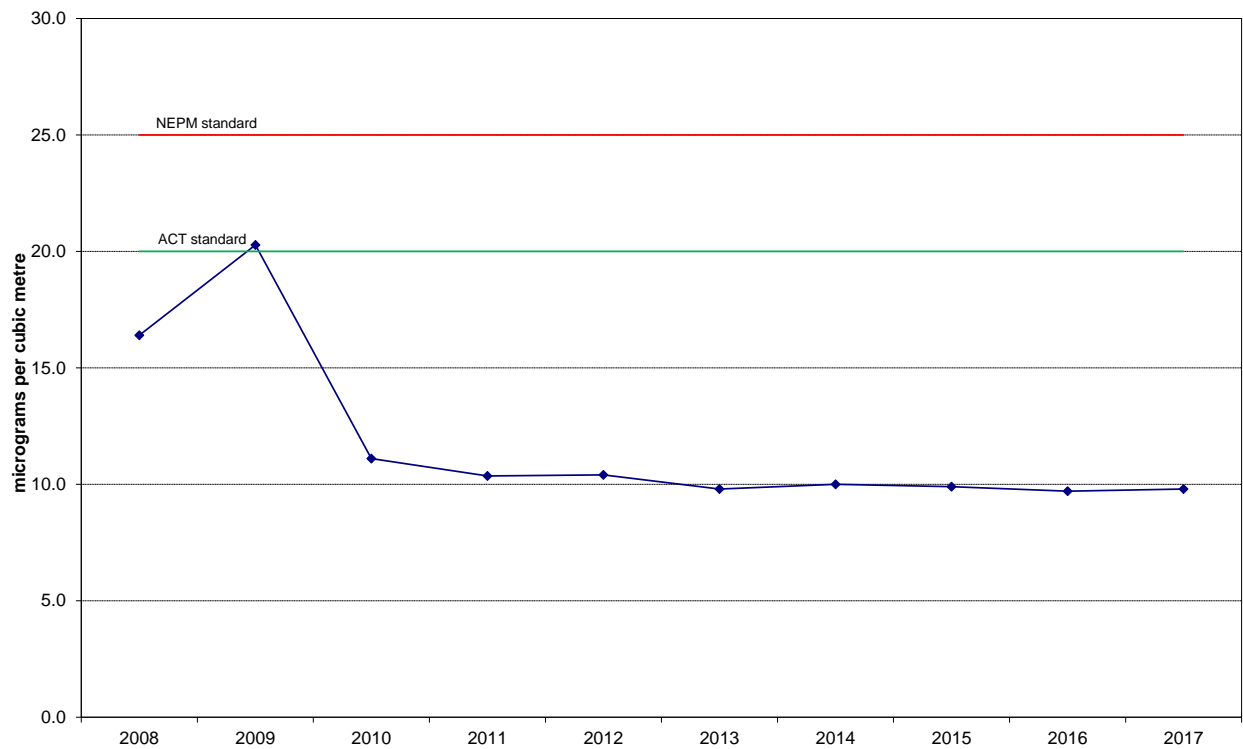


Figure 30: Annual average daily PM₁₀ Monash 2008 – 2017

Table 26: Statistical summary for daily maximum daily PM₁₀ Civic 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m³)	Annual average (µg/m³)	95 th percentile (µg/m³)	75 th percentile (µg/m³)	50 th percentile (µg/m³)
2008	12.0	1	53.3	14.3	26.1	17.3	11.9
2009	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2010	57.6	0	23.8	8.5	14.7	11.1	8.4
2011	97.0	0	29.2	8.7	16.9	11.0	7.9
2012	95.1	0	49.5	9.4	17.0	12.1	8.7
2013	92.9	1	57.8	9.7	19.9	12.0	8.6
2014	95.1	0	31.4	9.8	17.7	12.6	9.3
2015	97.5	1	64.3	11.1	20.9	14.1	10.4
2016	100	0	36.6	10.7	20.6	14.3	9.7
2017	83.6	1	53.0	9.68	10.8	7.1	5.2

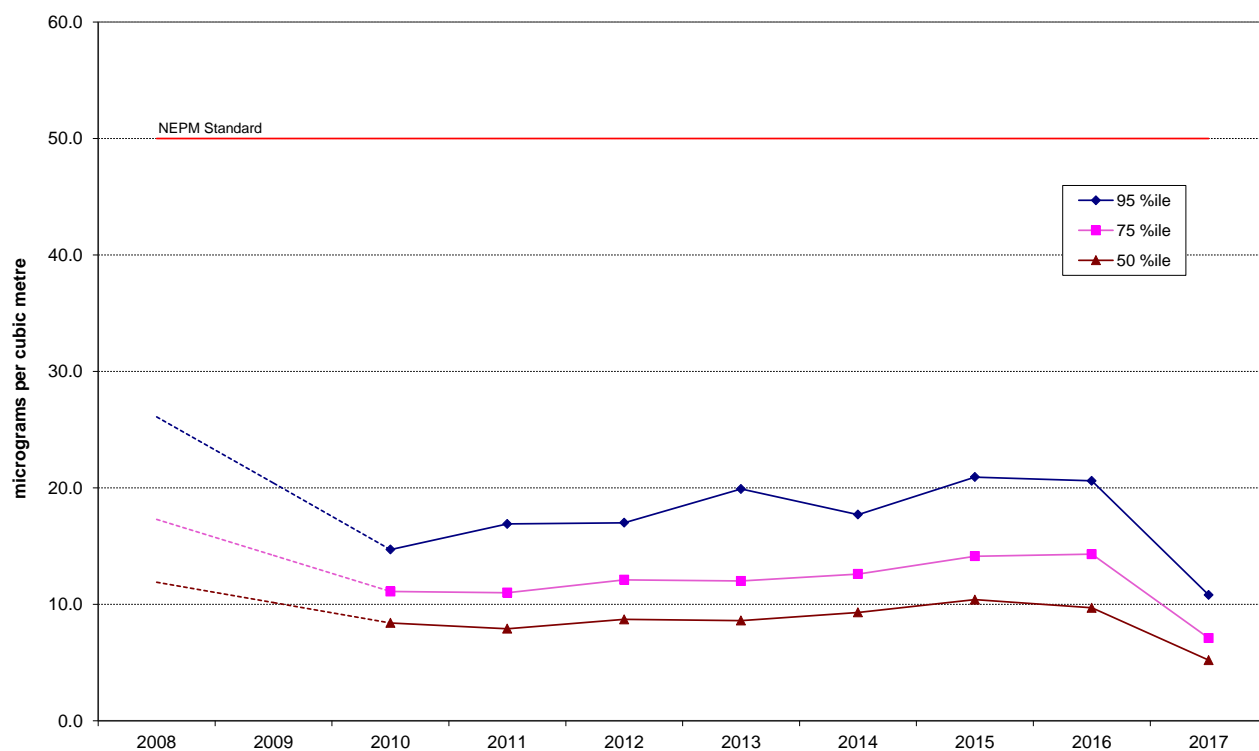


Figure 31: Statistical summary for daily maximum daily PM₁₀ Civic 2008 – 2017

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

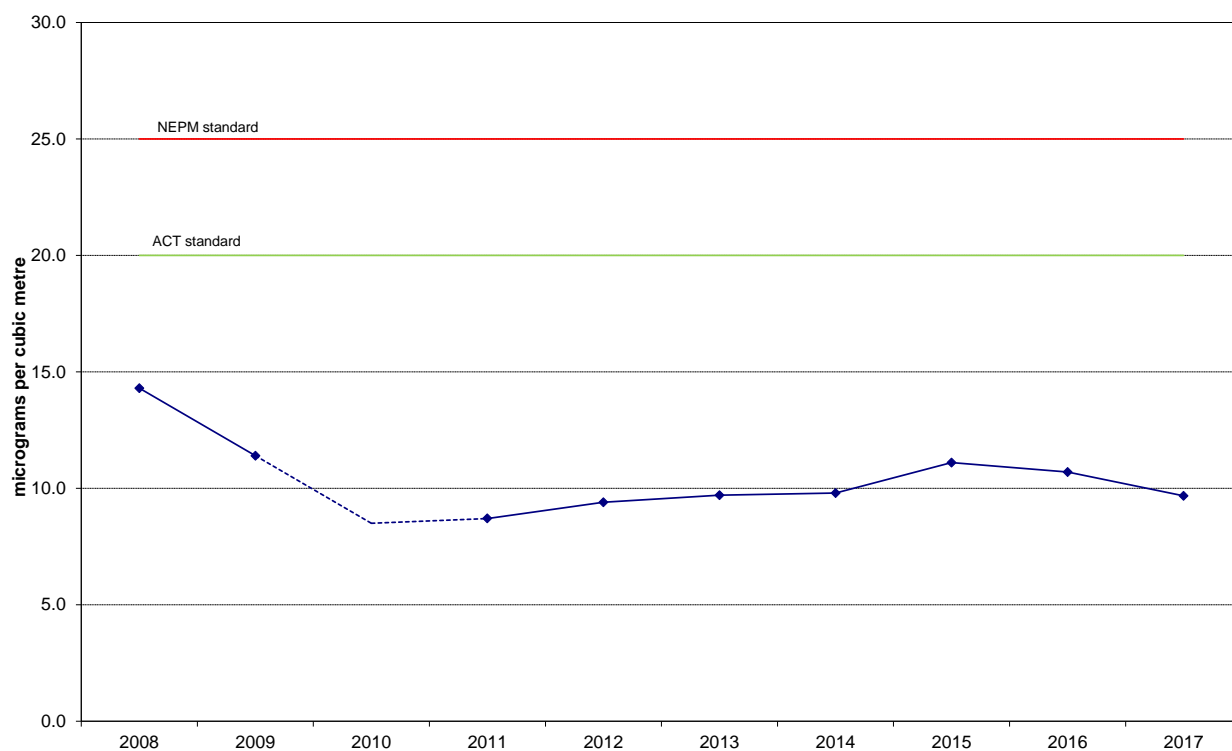


Figure 32: Annual average daily PM₁₀ Civic 2008 – 2017

Table 27: Statistical summary for daily maximum daily PM₁₀ Florey 2014 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2014	83.3	0	30.2	10.4	21.5	13.0	9.4
2015	95.6	0	70.8	10.7	21.8	13.7	9.4
2016	98.9	0	28.8	10.1	20.6	13.1	9.2
2017	98.4	0	28.1	9.84	21.8	12.8	8.5

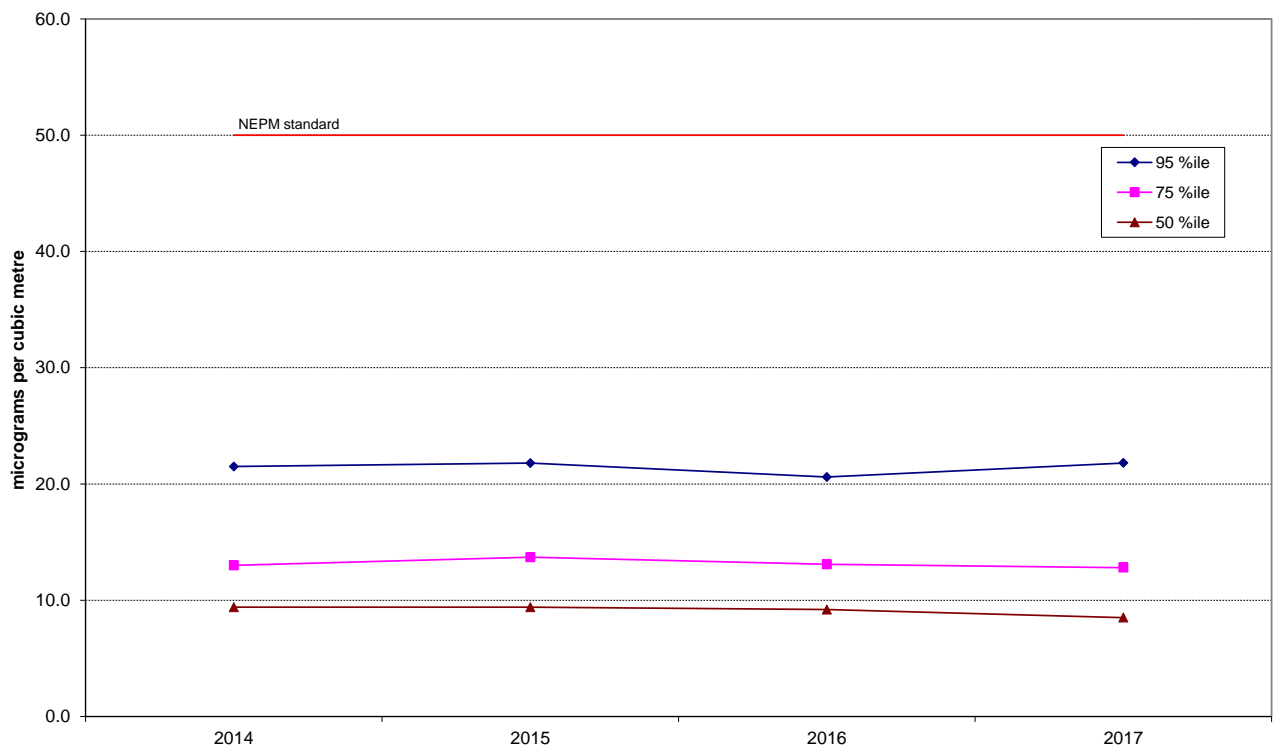


Figure 33: Statistical summary for daily maximum daily PM₁₀ Florey 2014 – 2017

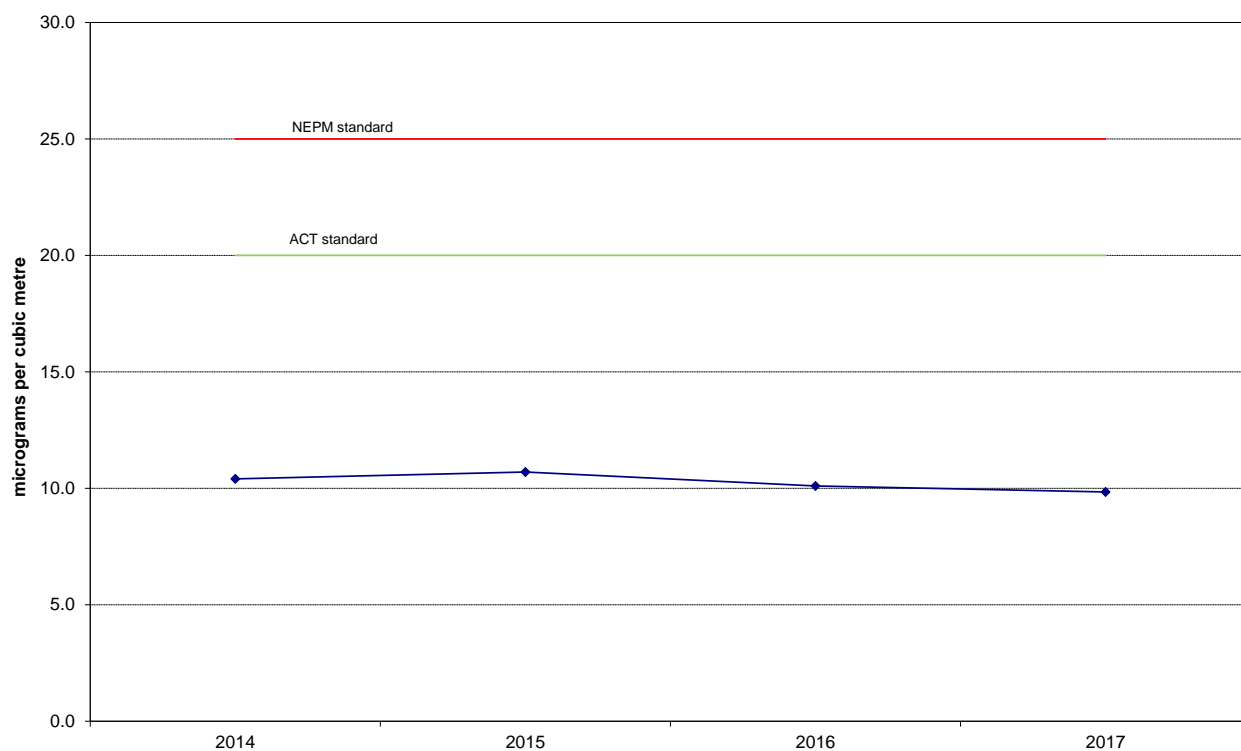


Figure 34: Annual average daily PM₁₀ Florey 2008 – 2017

PM_{2.5}

Table 28: Statistical summary for daily maximum daily PM_{2.5} Monash 2008 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m³)	Annual average (µg/m³)	95 th percentile (µg/m³)	75 th percentile (µg/m³)	50 th percentile (µg/m³)
2008	45.4	6	30.7	8.7	23.5	12.4	6.3
2009	64.5	2	33.5	6.2	14.6	7.6	5.0
2010	95.1	2	52.4	6.7	17.4	7.8	4.4
2011	92.1	4	32.8	6.5	20.0	7.0	4.5
2012	95.1	3	29.2	7.1	16.5	8.3	5.0
2013	98.6	6	38.4	6.9	19.2	8.1	5.2
2014	87.7	4	31.5	6.8	18.7	8.6	5.6
2015	96.4	6	33.8	7.4	19.0	8.2	5.6
2016	98.1	8	32.7	7.4	20.7	8.2	5.4
2017	98.6	12	35.2	7.7	22.5	9.3	5.3

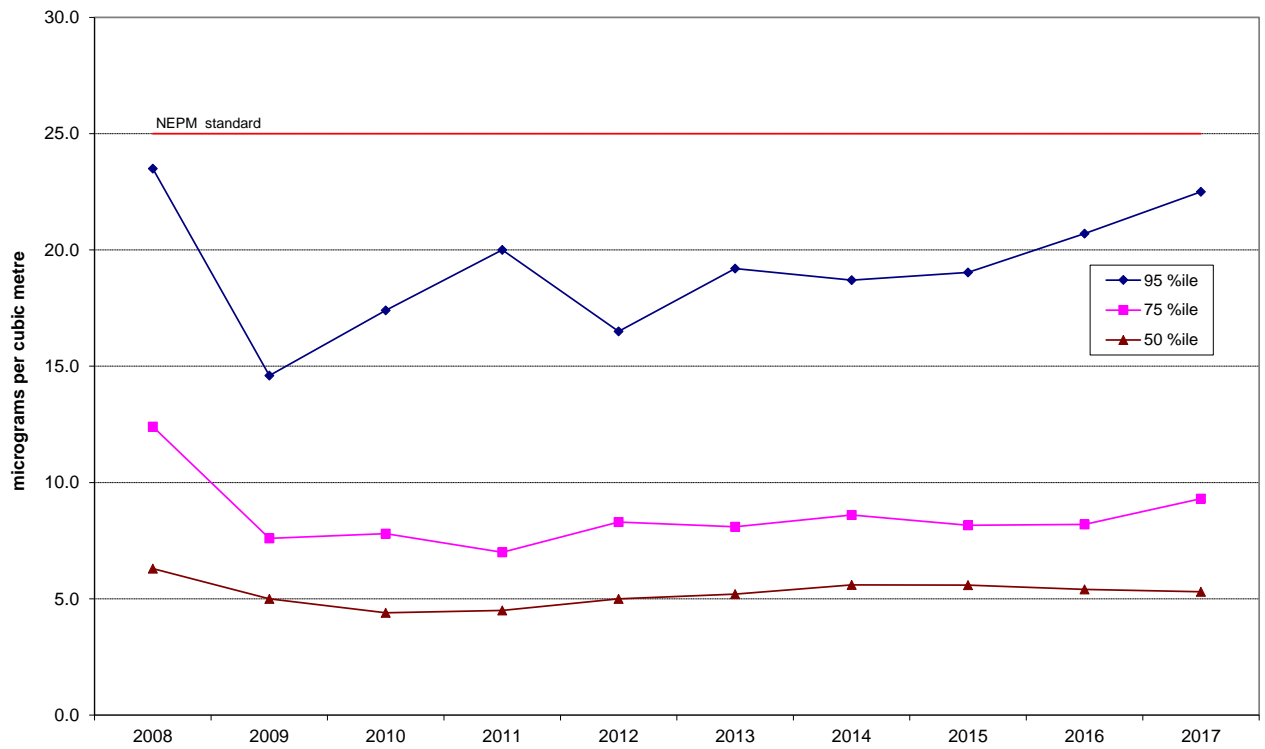


Figure 35: Statistical summary for daily maximum daily PM_{2.5} Monash 2008 – 2017

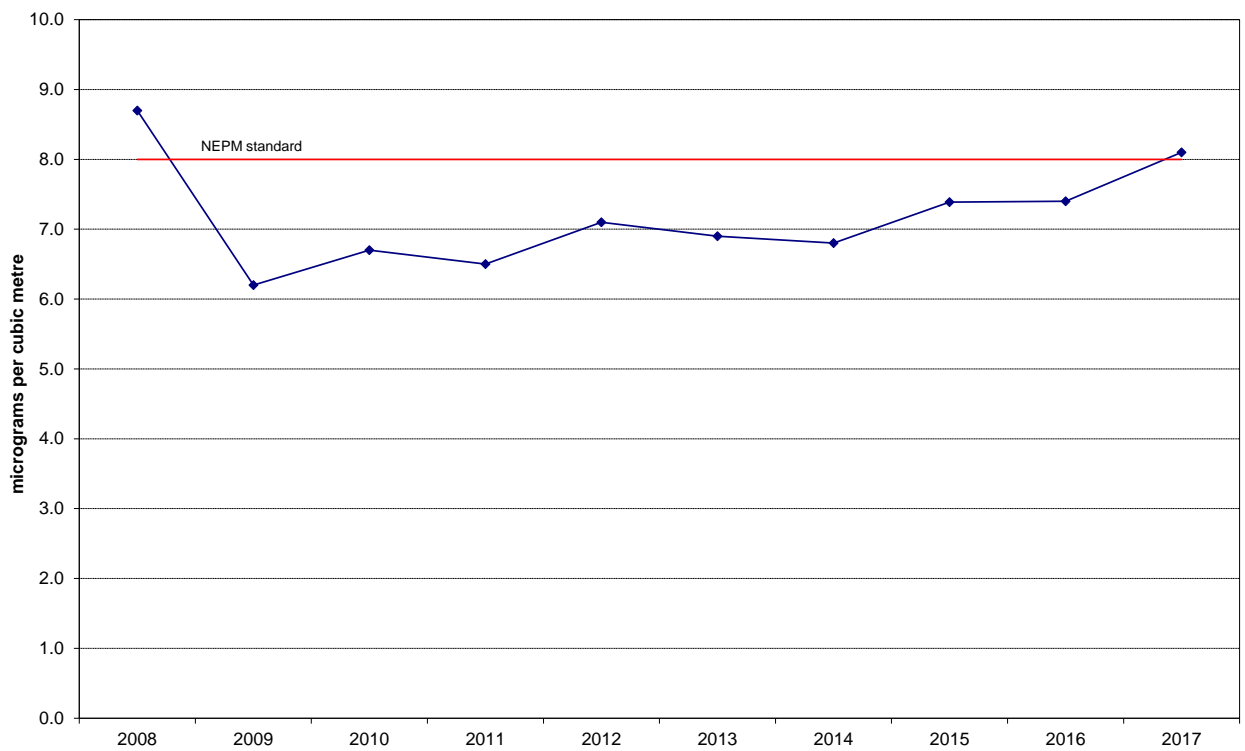


Figure 36: Annual average daily PM_{2.5} Monash 2008 – 2017

Table 29: Statistical summary for daily maximum daily PM_{2.5} Civic 2016 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2016	98.6	0	22.1	5.5	11.0	7.1	4.8
2017	94.2	1	53.8	5.9	10.8	7.1	5.2

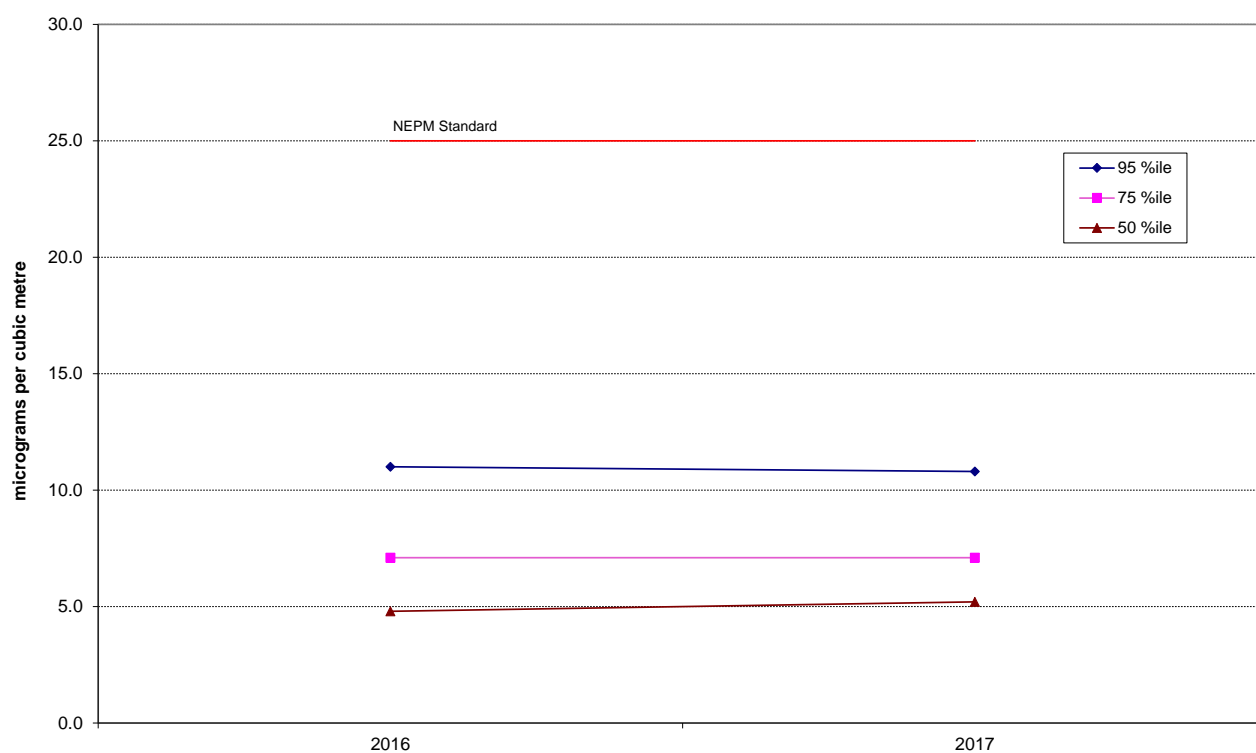


Figure 37: Statistical summary for daily maximum daily PM_{2.5} Civic 2016 – 2017

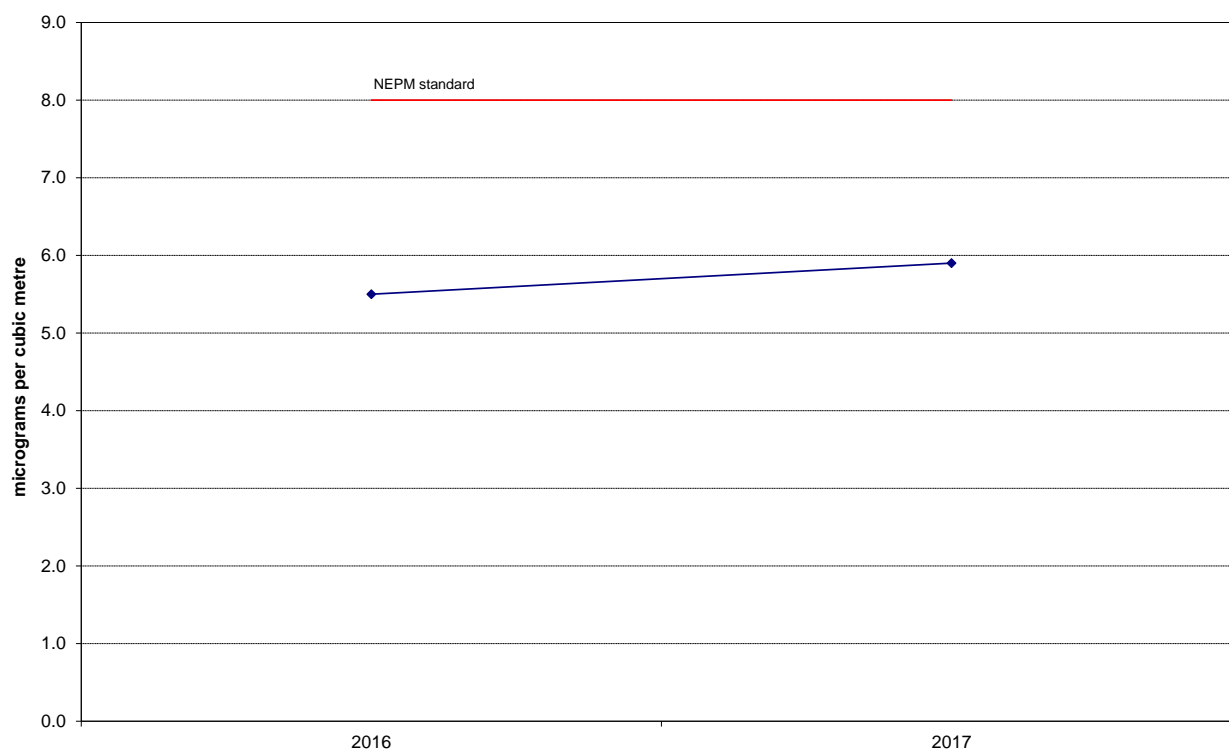


Figure 38: Annual average daily PM_{2.5} Civic 2016 – 2017

Table 30: Statistical summary for daily maximum daily PM_{2.5} Florey 2014 – 2017

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2014	74.2	0	22.8	5.8	15.0	7.1	4.9
2015	96.2	0	24.3	6.5	17.1	7.4	4.8
2016	98.6	1	27.2	7.3	17.4	8.6	5.8
2017	94.2	0	23.8	7.2	17.9	8.7	5.6

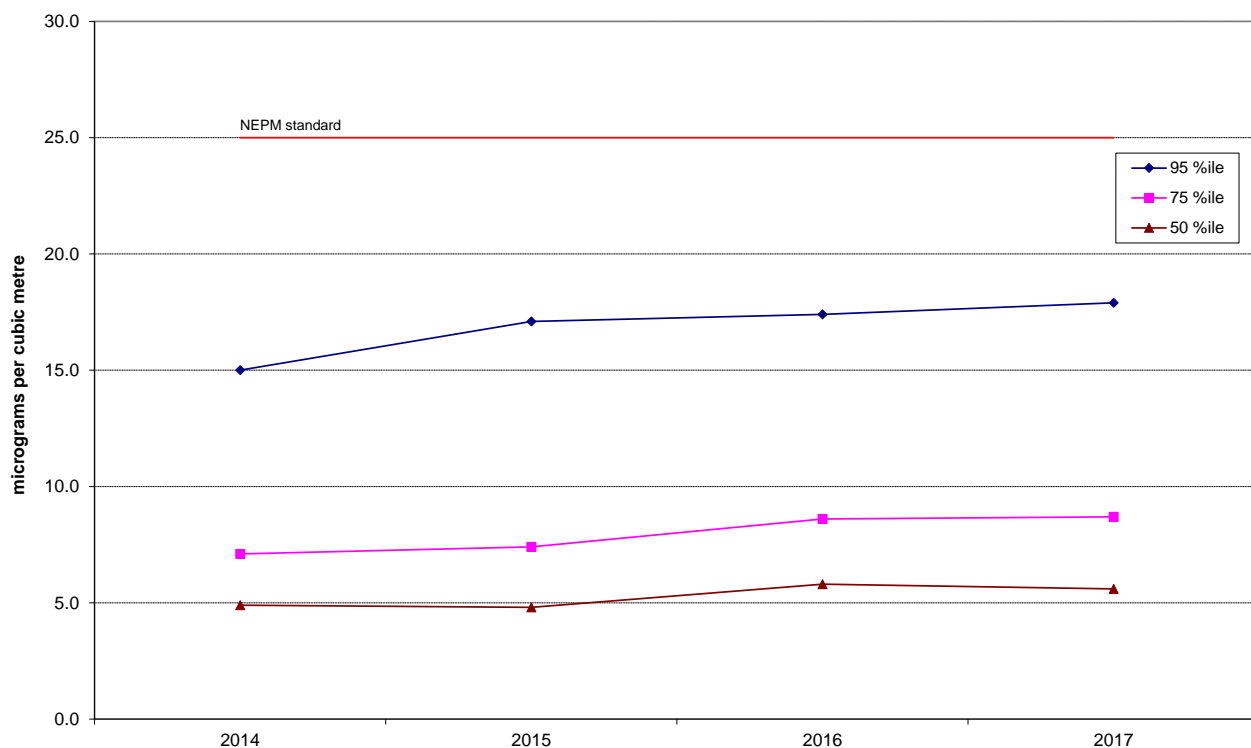


Figure 39: Statistical summary for daily maximum daily PM_{2.5} Florey 2014 – 2017

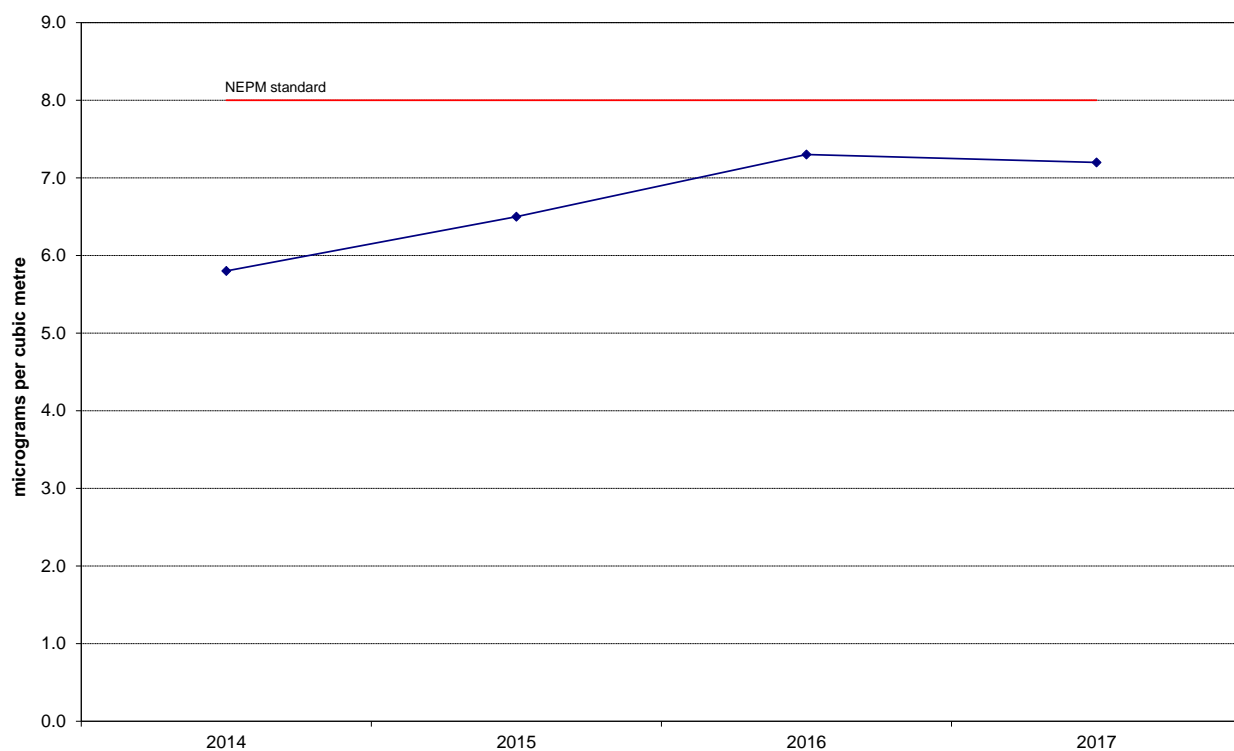


Figure 40: Annual average daily PM_{2.5} Florey 2014 – 2017