Air monitoring report 2018 – Compliance with the National Environment Protection (Ambient Air Quality) Measure

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This report presents the 2018 Victorian air quality monitoring results assessed against the National Environment Protection (Ambient Air Quality) Measure[1] (referred to as the Measure).

Executive summary

What is the Measure?

The Measure establishes national ambient air quality standards. It aims to guide policies around the protection of human health by providing a consistent framework for monitoring and reporting common air pollutants:

- nitrogen dioxide
- carbon dioxide
- ozone
- sulfur dioxide
- lead
- particles equal to or less than 10 µm in diameter (PM_{10})
- particles equal to or less than 2.5 µm in diameter ($PM_{2.5}$).

Environment Protection Authority Victoria (EPA) is responsible for monitoring and reporting Victoria's ambient air quality in accordance with the requirements of the Measure. EPA also provides air quality data (updated hourly) on its website[2] and produces annual air quality summaries.[3]

Compliance with the Measure

Air quality in Victoria is assessed against the standards defined in the Measure and its associated goals for each pollutant. Compliance with the Measure requires that air quality standards do not exceed more than the allowable number (as outlined in Schedule 2 of the Measure); and that at least 75 per cent of data for each quarter of the year for a given standard is available.

Air quality in Victoria in 2018

In general, Victoria's air quality in 2018 was catagorised as good due to levels of air pollution being below the air quality standards on most days. However, there were exceedances of air quality standards for $PM_{2.5}$, PM_{10} and ozone. Air quality trends over the last few years has remained consistent.

Urban sources, such as domestic wood heating, were a significant contributor to the number of exceedances of the $PM_{2.5}$ standard. These generally occured on cold, still nights, which are usually associated with increased usage of heating and meteorological conditions that limit the dispersion of smoke. Several days of $PM_{2.5}$ exceedances were also associated with land burns, which includes planned hazard reduction and private burns.

Wind blown dust also contributed to exceedances of the PM_{10} standard on several days during summer and early autumn. Some of these exceedances were likely associated with hazard reduction burns in May.

There was one day in 2018 when the 4-hour ozone standard was not met; this was likely to be associated with urban pollution sources.

The goals for carbon monoxide, nitrogen dioxide and sulfur dioxide were met, with no measured exceedances at any of EPA's air monitoring stations.

Separate to this report, EPA has a number of issue-specific air monitoring stations not included in the Measure. These are located at sites such as the Brooklyn Industrial Precinct and in the Latrobe Valley (excluding Traralgon air monitoring station). Results for these air monitoring stations are reported separately on EPA's website.[4]

[1] National Environment Protection Measure for Air Quality, National Environment Protection Council publication, available from https://www.legislation.gov.au

[2] EPA hourly data tables http://www.epa.vic.gov.au

[3] Air monitoring results around Victoria

[4] EPA publications http://www.epa.vic.gov.au/our-work/publications

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1 Monitoring summary

Current Measure performance monitoring stations

Victoria's air monitoring plan for the Measure was first approved in February 2001 by National Environment Protection Council Ministers. Data presented in this report has been produced in accordance with the monitoring plan, except where noted.

The Measure requires the monitoring of the pollutants carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), particles less than 10 micrometres in diameter (PM_{10}) particles less than 2.5 micrometres in diameter ($PM_{2.5}$), and lead (Pb). Lead concentrations are no longer monitored as levels have decreased significantly.

Eight regions are defined in the monitoring plan; these include:

- Port Phillip and Latrobe Valley regions, which have permanent performance monitoring stations.
- Ballarat, Bendigo, Shepparton, Warrnambool and Mildura, where campaign monitoring was previously conducted.
- Wodonga, where data from monitoring at Albury New South Wales has been used.

Stations at which monitoring was conducted in 2018 are shown in Figure 1 and Figure 2. The monitoring stations, pollutants monitored and site types are summarised in Table 1. Site types are defined as generally representative upper bound for community exposure sites and population-average sites.

Description of exposed population

The exposed population represented by each monitoring station is described qualitatively by the location category column in Table 1.

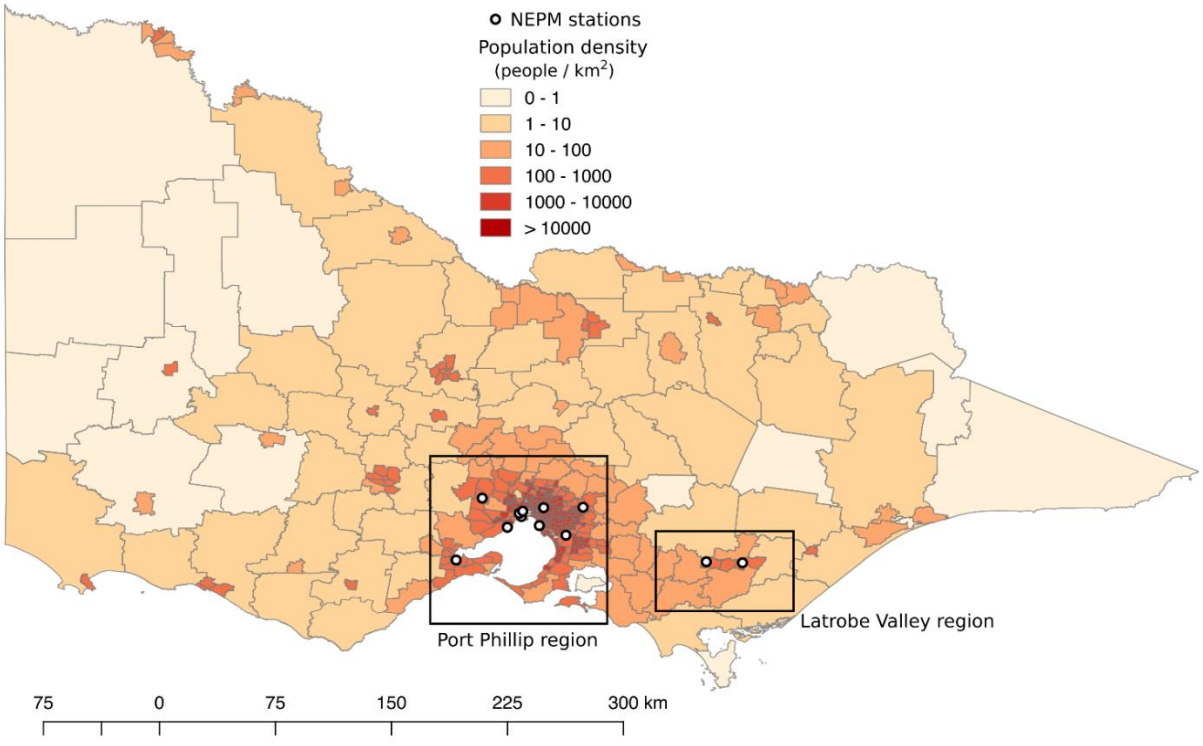

Figure 1: Defined regions and population density in Victoria

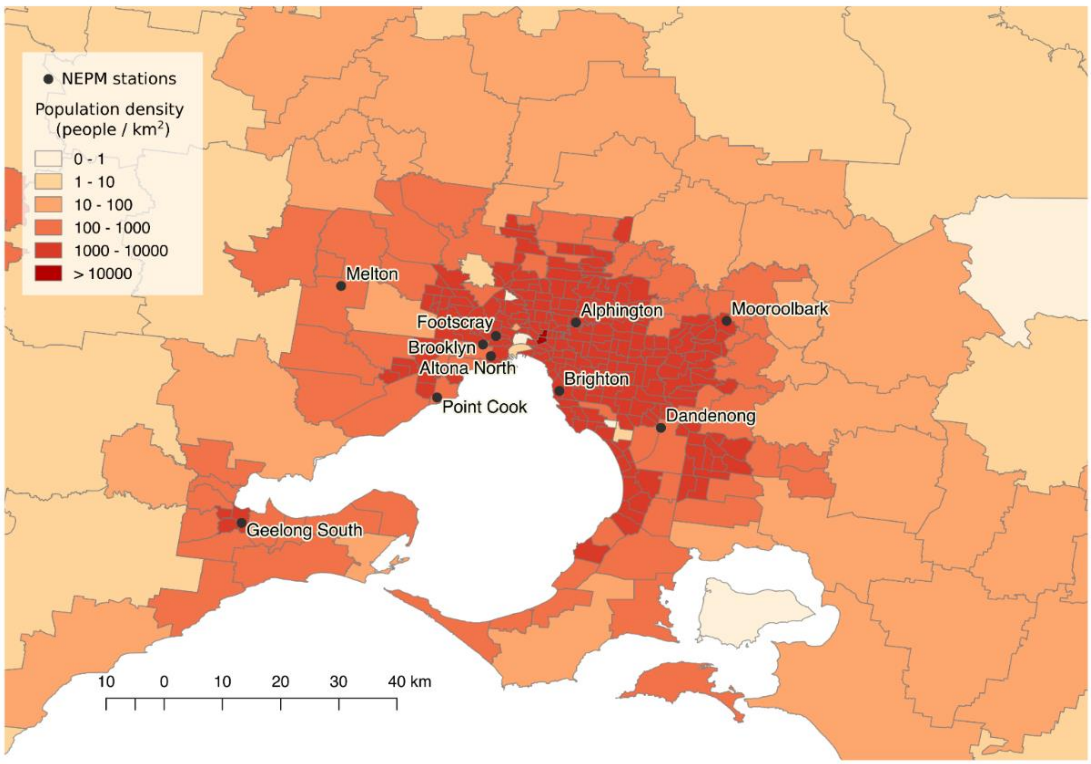

Figure 2: Monitoring stations and population density in Port Phillip region

Table 1: Victorian performance monitoring stations

Region	Location category	Site type					
Performance monitoring station		**CO**	**NO_2**	**O_3**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**
Port Phillip							
Alphington	Residential/light industrial	G*	G*	Pop	Pop*	G*	G*
Altona North	Industrial/residential				G		
Brighton	Residential		G	Pop*		Pop	
Dandenong	Light industrial			Pop		Pop	
Footscray[d]	Industrial/residential		G*	G*		G*	G*
Geelong South	Light industrial/residential	G*	G*	Pop*	G*	G*	G*
Melton	Residential			G			
Mooroolbark	Residential			Pop		Pop	
Point Cook	Rural/residential		Pop*	G*			
Point Henry [c]	Industrial/rural			Pop			
Richmond [e]	Residential	G				G	
RMIT (CBD) [a]	CBD	G*	G*		G	G*	
Latrobe Valley							
Moe [b]	Residential		Pop	G	G	G	
Traralgon	Residential		G*	G*	G*	G*	G*

* Trend station.
G Generally representative upper bound.[5]
Pop Population average.[5]
a RMIT station closed in 2006.
b Moe closed in 2009, monitoring for $PM_{2.5}$ (beta attenuation) started in 2015.
c Point Henry closed in 2011.
d SO_2 monitoring ceased in 2015.
e Richmond station closed in 2016.

[5] National Environment Protection (Ambient Air Quality) Measure Technical Paper No. 3, Monitoring Strategy, http://www.nepc.gov.au/resource/ephc-archive-ambient-air-quality-nepm

Implementation of the monitoring plan

Victoria's air quality monitoring program is continually examined and options for what is monitored and where are considered each year. Stations are located and setup according to the Australian Standard as shown in Table 2.

Generally, the monitoring stations remain stable over time, however changes to the network are made as needed. Changes include:

- The closure of the peak station for lead, in Collingwood, in December 2004 because levels were very low over a period of time compared to the air quality standard. This change to Victoria's monitoring plan was approved in accordance with procedures outlined in the Measure.
- The station at Paisley was renamed Altona North in June 2006 to better reflect its geographic location.
- Monitoring ceased at the CBD station (at RMIT University) in October 2006, when the lease was terminated due to building extensions.
- The station at Moe was closed in October 2009 when the lease was terminated due to building construction works, and following a review which found the Traralgon station was comparable to Moe and representative of Latrobe Valley. A new Moe station was established in 2015 after the Hazelwood mine fire to monitor for $PM_{2.5}$.
- Ozone monitoring was stopped at Point Henry in March 2011 as the Point Henry site was not representative of the general area.
- Monitoring ceased at the CBD station (at Richmond) in 2016, when the lease was terminated. A non-NEPM roadside station was established in the Melbourne CBD in 2017. Data from this station is available on EPA's website.

Screening procedure

The monitoring plan outlines how to demonstrate whether concentrations of pollutants are consistently below the standards. If screening procedures are satisfied, monitoring may not be required, or may be conducted at fewer locations.

Screening procedures conducted in accordance with the Measure have been satisfied for Victorian regions, except for PM_{10}, at Ballarat, Bendigo, Mildura, Shepparton, Wodonga and Warrnambool. EPA did not monitor air quality at Ballarat, Bendigo, Shepparton, Warrnambool, Wodonga and Mildura in 2018 as previous monitoring campaigns in these areas showed that pollutant levels were expected to be consistently below the relevant standards in the Measure. Additional information can be found in the following reports in EPA's publication database.

- Air monitoring at Warrnambool, October 2006 to October 2007
- Airborne particle monitoring at Mildura, December 2004 to June 2006
- Air monitoring at Ballarat August 2005 to August 2006
- Air monitoring at Bendigo, May 2004 to July 2005
- Airborne particle monitoring at Shepparton, December 2003 to December 2004

Monitoring methods

Victorian monitoring is conducted in accordance with the Australian Standard as shown in Table 2 & 3. Data not meeting the requirements of these Standards and EPA's quality assurance procedures were identified as invalid and not included in reporting.

TEOM PM_{10} data included in this report has been adjusted according to the approved procedure as outlined in *Technical Paper No. 10 – Collection and Reporting of TEOM PM_{10} Data*[6], using the temperature-dependent formula with a constant value of K equal to 0.04. The resulting adjustments vary from no change at daily average temperatures at or above 15°C, to an increase of 40 per cent at a temperature of 5°C. Particle concentration units of $\mu g/m^3$ refer to volumes at 0°C and one atmosphere of pressure.

$PM_{2.5}$ monitoring

On 25 February 2016, the Measure was varied to introduce a daily standard of 25 $\mu g/m^3$ for $PM_{2.5}$ and an 8 $\mu g/m^3$ annual standard for $PM_{2.5}$. The varied Measure also removed the number of allowable exceedances for $PM_{2.5}$ and PM_{10}.

Victoria monitors $PM_{2.5}$ by the reference method specified in the Measure (on a one-day-in-three basis) at two stations (Alphington and Footscray). It also monitors $PM_{2.5}$ continuously at these two stations along with Geelong and Traralgon using beta attenuation monitors (BAMs).

Prior to this, Victoria also participated in the $PM_{2.5}$ Equivalence Program, with tapered element oscillatinig microbalance (TEOM) monitors located at Alphington and Footscray. Alphington was substituted for Mooroolbark, which was originally proposed. TEOM $PM_{2.5}$ readings are taken with the inbuilt adjustment for PM_{10} removed (A and B constants set to 0 and 1) and no adjustment for loss of volatiles.

NATA status

All methods currently used by EPA for performance monitoring are covered by its National Association of Testing Authorities (NATA) accreditation (Number 15119) except for $PM_{2.5}$ using BAMs. Work is being carried out to incorporate monitoring for $PM_{2.5}$ using BAMs as part of EPA Victoria's NATA accreditation. Conformance or non-conformance of the siting is noted within this report. EPA was successfully reaccredited by NATA in 2016. As of February 2016, monitoring for PM_{10} and $PM_{2.5}$ using the Hivol and Partisol gravimetric methods were outsourced by EPA to Golder Associates (NATA accreditation Number 1910).

Table 2: Summary of stations' siting compliance with AS 3580.1.1-2016

Region station	Height above ground	Minimum distance to support structure	Clear sky angle of 120°	Unrestricted airflow of 270°/360°	20 m from trees [a]	No boilers or incinerators nearby	Minimum distance from road or traffic
Port Phillip							
Alphington	Y	Y	Y	Y	N	Y	N
Altona North	Y	Y	Y	Y	Y	Y	N
Dandenong	Y	Y	Y	Y	N	Y	N
Footscray	Y	Y	Y	Y	N	Y	Y
Geelong South	Y	Y	Y	Y	N	Y	N
Melton	Y	Y	Y	Y	N	Y	N
Mooroolbark	Y	Y	Y	Y	N	Y	N
Point Cook	Y	Y	Y	Y	N	Y	N
Latrobe Valley							
Traralgon	Y	Y	Y	Y	N	Y	N
Moe	Y	Y	Y	Y	N	Y	N

a. Trees near the station are annually assessed for proximity and EPA works with the landholders to address non-compliances

[6] *Technical Paper No. 10 – Collection and Reporting of TEOM PM_{10} Data,* National Environment Protection Council

Table 3: Methods for monitoring pollutants in the Measure

Pollutant		Applicable Standard "Title of Standard"	Method used
Carbon monoxide	CO	Australian Standard 3580.7.1 "Ambient air - Determination of carbon monoxide, direct instrumental method"	Gas filter correlation/infrared
Nitrogen dioxide	NO_2	Australian Standard 3580.5.1 "Ambient air — Determination of oxides of nitrogen —Direct reading instrument method"	Gas phase chemiluminescence
Photochemical oxidant (ozone)	O_3	Australia Standard 3580.6.1 "Ambient air — Determination of ozone — Direct reading instrument method"	Non-dispersive ultraviolet
Sulfur dioxide	SO_2	Australian Standard 3580.4.1 "Ambient air — Determination of sulfur dioxide — Direct reading instrument method"	Pulsed fluorescence
Particles	PM_{10}	Australian Standard 3580.9.8 "Determination of suspended particulate matter — PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser"	Tapered element oscillating microbalance (TEOM)
	$PM_{2.5}$	Australian Standard 3580.9.10 "Determination of suspended particulate matter – $PM_{2.5}$ low volume sampler – Gravimetric method"	Gravimetric reference method
		Australian Standard 3580.9.12 Determination of suspended particulate matter $PM_{2.5}$ beta attenuation monitors	Beta attenuation monitors (BAM)

2 Assessment of compliance with standards and goals

Air quality is assessed against the standards defined in the Measure and the associated goals shown in Table 4. The goal of the Measure 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 Measure. The extent is expressed as a maximum allowable number of exceedances for each standard (shown in column four of Table 4).

For $PM_{2.5}$, there is an additional goal to further reduce concentrations to below a daily concentration of 20 µg/m^3 and an annual concentration of 7 µg/m^3 by 2025.

The number of allowable exceedances associated with the standards has been set to account for unusual meteorological conditions and, in the case of particles, exceptional events such as bushfires, jurisdiction authorised hazard reduction burning or continental scale windblown dust that cannot be controlled through normal air quality management strategies. Air quality monitoring data from each monitoring site is assessed against these standards and the associated goals.

Air quality is assessed as complying with the Measure if the number of exceedances of the standard is no more than the number specified in Schedule 2 of the Measure and data availability was at least 75 per cent in each quarter of the year.

Regions also meet the standards and goal if they do not require monitoring on the basis that screening shows pollutant levels are reasonably expected to be consistently below the relevant standards. This includes lead, which was shown to be below standards over time until monitoring ceased in 2004.

Air quality is assessed as 'not met' if there has been insufficient data collected to demonstrate that the standards and goal have been met or not met. Regions may also be assessed as 'not demonstrated' if screening has not been completed.

Table 4: Air quality standards and goals in the Measure

Pollutant	Averaging period	Standard	Goal max. allowable exceedances
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year None
Ozone	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
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
Particles as PM_{10}	1 day 1 year	50 µg/m^3 25 µg/m^3	None None
Particles as $PM_{2.5}$	1 day 1 year	25 µg/m^3 8 µg/m^3	None None
Lead	1 year	0.50 µg/m^3	None

3 Summary of progress towards achieving the goals of the Measure

The Measure's goals for carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, PM_{10}, $PM_{2.5}$ and lead are to be below the standards within the extent specified, taking into consideration exceptional events as described in the measure.

A traffic light system has been implemented to indicate compliance.

- **Green** – standard and goal achieved.
- **Amber** – standard and goal not achieved due to insufficient data capture.
- **Red** – standard and goal not achieved.

Compliance in 2018

In general, Victoria's air quality in 2018 was good, though there were exceedances of air quality standards for $PM_{2.5}$, PM_{10} and O_3.

Urban sources, such as domestic wood heating, continue to be a significant contributor to the number of exceedances of the $PM_{2.5}$ standard. These generally occured on cold, still nights, which are usually associated with increased usage of heating and meteorological conditions that limit the dispersion of smoke.

Several days of $PM_{2.5}$ exceedances were also associated with land burns. These burns are carried out to reduce fuel loads and the risk of major bushfires in summer as well as for the protection of water catchment areas.

Wind blown dust also contributed to exceedances of the PM_{10} standard on several days during summer and early autumn. Some of these exceedances were also potentially associated with planned hazard reduction burns in May.

Compliance with the ozone goals were not demonstrated at Footscray and Traralgon where there were two days where the 4-hour ozone standard was not met; these exceedances were likely to be associated with urban pollution sources. There were also instrument issues at these sites which resulted in less than 75% data capture in quarter 3.

The goals for CO, NO_2 and SO_2 dioxide were met, with no measured exceedances at any of EPA's air monitoring stations. An instrument issue at Footscray resulted in less than 75% data capture in quarter 1 for CO, however the annual data capture was above 75%.

An instrument issue at Altona resulted in less than 75% data capture in quarters 1 and 4 for SO_2, however the annual data capture was above 75%.

4 Individual pollutant compliance

A Carbon monoxide (CO)

Assessment of compliance with standards and goals of the Measure for carbon monoxide

In Victoria, carbon monoxide is assessed against an 8-hour standard of 9.0 ppm, with one exceedance day allowed per year as shown in Table 5. Table 6 and Table 7 show the timing of the highest readings and percentile statistics for the reporting period.

The carbon monoxide standard was not exceeded and compliance was demonstrated at Alphington and Geelong South; insufficient data was collected at Footscray in Q1 due to an equipment fault. The highest reading occurred at Alphington, where carbon monoxide reached 20 per cent of the standard.

Table 5: 2018 compliance summary for carbon monoxide in Victoria

Region	Data availability rates (% of hours)					Number of exceedances (days)	Performance against the standard and goals
Performance monitoring station	Q1	Q2	Q3	Q4	Annual		
Port Phillip							
Alphington	99.1	97.5	97.0	94.7	97.1	0.0	MET
Footscray[a]	59.5	98.0	99.0	97.2	88.6	0.0	NOT MET
Geelong South	87.7	91.3	85.2	96.2	90.1	0.0	MET

a: less than 75% data capture due to equipment fault

Table 6: 2018 summary statistics for daily peak eight-hour carbon monoxide in Victoria

Region Performance monitoring station	Number of valid days	Highest reading (ppm)	Highest reading (date: hour)	2nd highest reading (ppm)	2nd highest reading (date:hour)
Port Phillip					
Alphington	345	1.8	Jun 27:02	1.4	Jun 26:23 Jul 13:02
Footscray	320	1.0	Jun 28:03	0.8	Jun 10:02 Jun 27:02
Geelong South	320	1.1	May 26:02	0.8	May 25:23 Jun 01:02 Jun 27:02 Aug 01:08 Aug 24:03

Table 7: 2018 percentiles for daily peak eight-hour carbon monoxide in Victoria

Region	Data availability	Max	Percentiles (ppm)					
Performance monitoring station	(% of days)	(ppm)	99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	94.5	1.8	1.3	1.1	0.9	0.7	0.4	0.3
Footscray	87.7	1.0	0.7	0.7	0.6	0.5	0.3	0.2
Geelong South	87.7	1.1	0.8	0.7	0.6	0.4	0.3	0.2

Trends and pollutant distributions for carbon monoxide between 2014 and 2018

Percentiles of 2018 daily peak concentrations (over an eight-hour averaging period) are provided for carbon monoxide for each station and standard in Figure 3. In these tables, daily peak values are formed only when at least 75 per cent of the data for the day are valid. Data for stations with less than 15 per cent data in the year are omitted and stations with less than 75 per cent data are shown in italics. The percentiles for eight-hour carbon monoxide is based on running averages, including those that overlap from one day to the next.

Figure 3 shows the annual eight hour carbon monoxide concentration percentiles for 2014–2018.

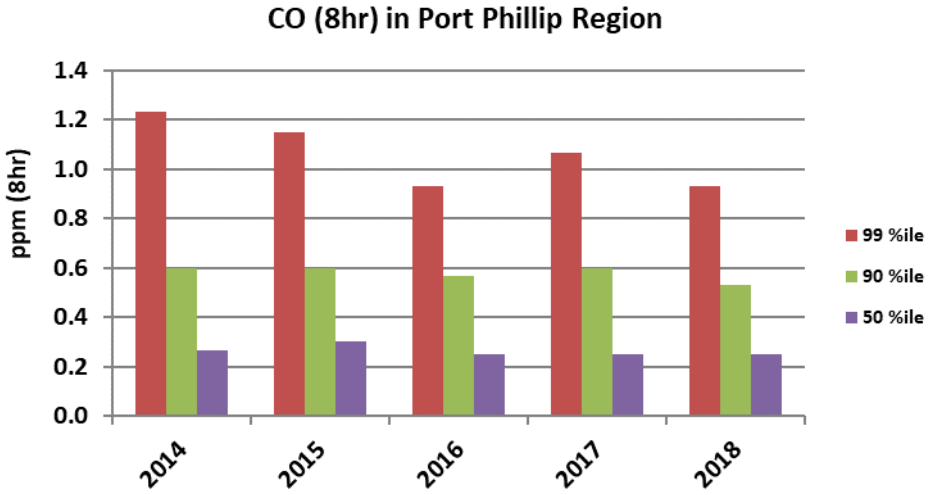

Figure 3: Percentiles of daily maximum carbon monoxide (average of Port Phillip stations 2014–2018)

The results for individual stations are shown in Tables 8 to 11. Monitoring at Richmond ceased in March 2015; as this station tended to record higher carbon monoxide levels, averages since 2016 may be relatively lower.

Table 8: Percentiles of daily maximum eight-hour carbon monoxide at Alphington (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	94.0	0	1.7	1.4	1.2	1.0	0.8	0.6	0.4
2015	92.1	0	1.7	1.5	1.3	1.1	0.8	0.5	0.4
2016	90.2	0	2.1	1.3	1.2	0.9	0.8	0.5	0.3
2017	94.2	0	1.6	1.4	1.2	1.1	0.9	0.4	0.3
2018	94.5	0	1.8	1.3	1.1	0.9	0.7	0.4	0.3

Table 9: Percentiles of daily maximum eight-hour carbon monoxide at Footscray (2016–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2016	93.4	0	1.3	0.7	0.7	0.6	0.5	0.3	0.2
2017	92.6	0	1.1	0.9	0.8	0.6	0.5	0.3	0.2
2018	87.7	0	1.0	0.7	0.7	0.6	0.5	0.3	0.2

Table 10: Percentiles of daily maximum eight-hour carbon monoxide at Geelong (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	100.0	0	1.4	1.0	0.8	0.6	0.4	0.2	0.1
2015	98.4	0	1.1	0.8	0.7	0.5	0.4	0.2	0.2
2016	92.3	0	1.7	0.8	0.8	0.6	0.4	0.3	0.2
2017	93.4	0	1.1	0.9	0.8	0.5	0.4	0.3	0.2
2018	87.7	0	1.1	0.8	0.7	0.6	0.4	0.3	0.2

Table 11: Percentiles of daily maximum eight-hour carbon monoxide at Richmond (2014–2015)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	100.0	0	1.6	1.3	1.0	0.8	0.6	0.4	0.3
2015 [a]	*19.5*	*0*	*0.5*	*0.4*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*

a: Data availability between 15 and 75 per cent, values displayed in italics.

Note: monitoring stopped in 2015

B Nitrogen dioxide (NO_2)

Assessment of compliance with standards and goals of the Measure for nitrogen dioxide

In Victoria, nitrogen dioxide is assessed against a one-hour standard of 0.12 ppm, with one exceedance day allowed per year and an annual standard of 0.030 ppm, with no exceedances allowed.

At all stations operated during 2018, the nitrogen dioxide standard was not exceeded and compliance achieved as shown in Table 12. The highest one-hour average at Traralgon was 44.2 per cent of the standard as shown in Table 13. Table 14 shows the percentile statistics for the reporting period.

Table 12: 2018 compliance summary for nitrogen dioxide in Victoria

Region	Data availability rates (% of hours)					Number of exceedances (days)	Annual mean (ppm)	Performance against the standard and goals	
Performance monitoring station	Q1	Q2	Q3	Q4	Annual			1-hour	Annual
Port Phillip									
Alphington	96.4	93.6	94.6	92.3	94.2	0	0.010	MET	MET
Footscray	96.9	94.5	95.4	94.0	95.2	0	0.010	MET	MET
Geelong South	92.4	79.7	79.8	93.8	86.4	0	0.006	MET	MET
Latrobe Valley									
Traralgon	95.7	95.2	94.9	91.0	94.2	0	0.006	MET	MET

Table 13: 2018 summary statistics for peak one-hour nitrogen dioxide in Victoria

Region Performance monitoring station	Number of valid days	Highest reading (ppm)	Highest reading (date | hour)	2nd highest reading (ppm)	2nd highest reading (date | hour)
Port Phillip					
Alphington	354	0.05	Apr 18:19	0.048	Apr 19:13
Footscray	361	0.046	Apr 22:17	0.044	Jan12:10 Apr 19:12
Geelong South	323	0.051	Aug 01:08	0.041	May 01:08
Latrobe Valley					
Traralgon	356	0.053	Apr 30:18	0.032	Jun 06:19 Jul 01:18

Table 14: 2018 percentiles for daily peak one-hour nitrogen dioxide in Victoria

Region	Data availability	Max	Percentiles (ppm)					
Performance monitoring station	(% of days)	(ppm)	99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	96.7	0.050	0.039	0.036	0.033	0.031	0.026	0.020
Footscray	98.6	0.046	0.041	0.038	0.035	0.032	0.027	0.021
Geelong South	88.3	0.051	0.038	0.034	0.030	0.026	0.019	0.014
Latrobe Valley								
Traralgon	97.3	0.053	0.031	0.030	0.027	0.025	0.020	0.012

Trends and pollutant distributions for nitrogen dioxide between 2014 and 2018

Percentiles of 2018 daily peak concentrations are provided for nitrogen dioxide for each station and standard as shown in Tables 15–20. In these tables, daily peak values are formed only when at least 75 per cent of the data for the day are valid. Data for stations with less than 15 per cent data in the year are omitted and stations with less than 75 per cent data are shown in italics.

Figure 4 shows the annual one-hour nitrogen dioxide concentration percentiles for 2014–2018.

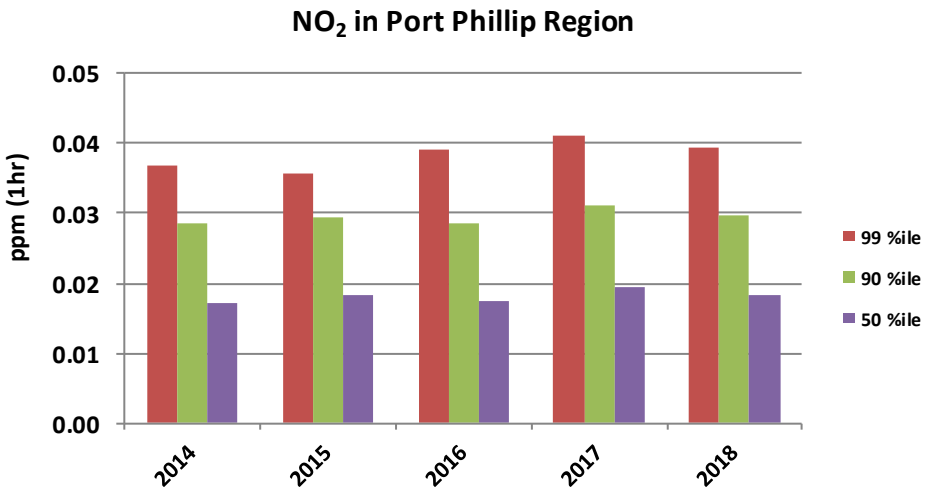

Figure 4: Percentiles of daily maximum nitrogen dioxide (average of Port Phillip stations 2014–2018)

Table 15: Percentiles of daily maximum one-hour nitrogen dioxide at Alphington (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	90.7	0	0.064	0.039	0.037	0.032	0.030	0.026	0.020
2015	93.4	0	0.043	0.035	0.033	0.032	0.030	0.025	0.021
2016	91.5	0	0.043	0.038	0.036	0.031	0.029	0.023	0.018
2017	92.6	0	0.057	0.038	0.036	0.033	0.031	0.027	0.020
2018	96.7	0	0.050	0.039	0.036	0.033	0.031	0.026	0.020

Table 16: Percentiles of daily maximum one-hour nitrogen dioxide at Brighton (2014–2015)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	95.9	0	0.044	0.038	0.036	0.033	0.030	0.025	0.019
2015[a]	*15.6*	*0*	*0.027*	*0.026*	*0.025*	*0.023*	*0.019*	*0.016*	*0.011*

a: Data availability between 15 and 75 per cent, values displayed in italics.
Note: monitoring stopped in 2015.

Table 17: Percentiles of daily maximum one-hour nitrogen dioxide at Footscray (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	97.3	0	0.064	0.045	0.040	0.036	0.033	0.027	0.021
2015	98.6	0	0.046	0.040	0.038	0.035	0.032	0.028	0.021
2016	95.1	0	0.052	0.042	0.038	0.035	0.032	0.026	0.020
2017	92.6	0	0.050	0.047	0.042	0.039	0.035	0.029	0.023
2018	98.6	0	0.046	0.041	0.038	0.035	0.032	0.027	0.021

Table 18: Percentiles of daily maximum one-hour nitrogen dioxide at Geelong South (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	99.5	0	0.036	0.030	0.029	0.027	0.025	0.019	0.014
2015	91.0	0	0.038	0.032	0.031	0.028	0.026	0.020	0.013
2016	90.3	0	0.044	0.037	0.031	0.028	0.025	0.021	0.014
2017	94.8	0	0.042	0.038	0.034	0.030	0.027	0.021	0.015
2018	88.3	0	0.051	0.038	0.034	0.030	0.026	0.019	0.014

Table 19: Percentiles of daily maximum one-hour nitrogen dioxide at Point Cook (2014–2015)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	98.9	0	0.044	0.032	0.031	0.028	0.025	0.020	0.012
2015[a]	*22.2*	*0*	*0.023*	*0.022*	*0.021*	*0.020*	*0.018*	*0.014*	*0.009*

a: Data availability between 15 and 75 per cent, values displayed in italics.
Note: monitoring stopped in 2015.

Table 20: Percentiles of daily maximum one-hour nitrogen dioxide at Traralgon (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	95.3	0	0.031	0.028	0.027	0.025	0.022	0.018	0.013
2015	95.1	0	0.034	0.029	0.029	0.026	0.022	0.017	0.012
2016	86.6	0	0.036	0.033	0.030	0.027	0.024	0.020	0.014
2017	90.4	0	0.034	0.031	0.030	0.027	0.024	0.020	0.013
2018	97.3	0	0.053	0.031	0.030	0.027	0.025	0.020	0.012

C Ozone (O_3)

Assessment of compliance with standards and goals of the Measure for ozone

In Victoria, ozone is assessed against a one-hour standard of 0.10 ppm and a four-hour standard of 0.08 ppm, with one exceedance day allowed per year as shown in Table 21. The one-hour and four-hour standards for ozone were met at all stations during 2018 where there was sufficient data captured. The highest one-hour average at Dandenong was 94 per cent of the standard. The highest four-hour average at Dandenong was 103 per cent of the standard.

Table 21: 2018 compliance summary for ozone in Victoria

Region	Data availability rates (% of hours)					Number of exceedances (days) annual mean (ppm)		Performance against the standard and goals	
Performance monitoring station	Q1	Q2	Q3	Q4	Annual	1-hour	4-hour	1-hour	4-hour
Port Phillip									
Alphington	95.8	93.5	95.0	93.3	94.4	0	0	MET	MET
Dandenong	93.2	93.5	95.4	92.8	93.7	0	1	MET	NOT MET
Footscray[a]	95.8	11.9	0.0	85.3	48.1	ND	1	NOT MET	NOT MET
Geelong South	93.4	80.6	70.8	93.0	84.4	0	0	MET	MET
Melton	96.1	94.0	95.5	93.1	94.7	0	0	MET	MET
Mooroolbark	96.0	92.2	94.9	93.0	94.0	0	0	MET	MET
Point Cook	96.2	95.1	91.8	94.0	94.3	0	0	MET	MET
Latrobe Valley									
Traralgon[a]	96.3	32.8	0.0	68.2	49.1	ND	ND	NOT MET	NOT MET

- ND: No exceedance detected.
- a: Insufficient data to calculate percentile due to instrument fault, <75 per cent data capture during year, values shown are excluded from trend analysis.

Table 22: 2018 summary statistics for daily peak one-hour ozone in Victoria

The Measure's standards: 0.10 ppm (one-hour average).

The Measure's goal: standards exceeded on no more than one day per year.

Region Performance monitoring station	Number of valid days	Highest reading (ppm)	Highest reading (date | hour)	2nd highest reading (ppm)	2nd highest reading (date | hour)
Port Phillip					
Alphington	359	0.081	Dec 26:18	0.067	Jan 17:18
Dandenong	355	0.094	Dec 26:15	0.063	Mar 09:18
Footscray	184	0.089	Dec 26:14	0.075	Mar 09:16
Geelong South	318	0.069	Jan 28:15	0.067	Mar 09:16
Melton	362	0.085	Feb 07:17	0.073	Dec 26:18
Mooroolbark	359	0.071	Dec 26:19	0.066	Jan 28:16
Point Cook	360	0.082	Dec 26:14	0.076	Feb 07:15
Latrobe Valley					
Traralgon	189	0.067	Jan 19:20	0.057	Feb 08:14

Table 23: 2018 summary statistics for daily peak four-hour ozone in Victoria

The Measure's standards: 0.08 ppm (four-hour average).

The Measure's goal: standards exceeded on no more than one day per year.

Region Performance monitoring station	Number of valid days	Highest reading (ppm)	Highest reading (date | hour)	2nd highest reading (ppm)	2nd highest reading (date | hour)
Port Phillip					
Alphington	358	0.076	Dec 27:18	0.064	Jan 28:17
Dandenong	355	0.083	Dec 27:17	0.061	Jan 28:17
Footscray	183	0.082	Dec 27:15	0.068	Jan 28:16
Geelong South	316	0.067	Jan 28:16	0.064	Mar 09:17
Melton	361	0.072	Feb 07:19	0.068	Jan 27:17
Mooroolbark	358	0.065	Jan 28:18	0.060	Dec 26:20
Point Cook	359	0.071	Dec 27:16	0.068	Feb 07:17
Latrobe Valley					
Traralgon	188	0.061	Jan 19:22	0.053	Mar 09:17

Table 24: 2018 percentiles for daily peak one-hour ozone in Victoria

Region Performance monitoring station	Data availability (% of days)	Max (ppm)	Percentiles (ppm)					
			99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	98.4	0.081	0.059	0.055	0.049	0.043	0.033	0.028
Dandenong	97.3	0.094	0.060	0.052	0.045	0.041	0.032	0.027
Footscray[a]	*50.4*	*0.089*	*0.070*	*0.062*	*0.052*	*0.048*	*0.038*	*0.030*
Geelong South	87.1	0.069	0.061	0.051	0.045	0.039	0.031	0.028
Melton	99.2	0.085	0.063	0.056	0.048	0.042	0.034	0.030
Mooroolbark	98.4	0.071	0.061	0.056	0.051	0.044	0.034	0.028
Point Cook	98.6	0.082	0.066	0.057	0.048	0.041	0.033	0.030
Latrobe Valley								
Traralgon[a]	*51.8*	*0.067*	*0.054*	*0.053*	*0.048*	*0.042*	*0.034*	*0.027*

a: Data availability between 15 and 75 per cent, values displayed in italics.

Table 25: 2018 percentiles for daily peak four-hour ozone in Victoria

Region Performance monitoring station	Data availability (% of days)	Max (ppm)	Percentiles (ppm)					
			99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	98.1	0.076	0.054	0.050	0.045	0.039	0.031	0.027
Dandenong	97.3	0.083	0.056	0.050	0.043	0.038	0.030	0.026
Footscray[a]	*50.1*	*0.082*	*0.067*	*0.059*	*0.049*	*0.044*	*0.036*	*0.028*
Geelong South	86.6	0.067	0.050	0.048	0.044	0.036	0.031	0.027
Melton	98.9	0.072	0.057	0.052	0.047	0.040	0.033	0.029
Mooroolbark	98.1	0.065	0.057	0.052	0.046	0.041	0.032	0.027
Point Cook	98.4	0.071	0.062	0.054	0.044	0.039	0.032	0.029
Latrobe Valley								
Traralgon[a]	*51.5*	*0.061*	*0.052*	*0.051*	*0.042*	*0.039*	*0.032*	*0.026*

a: Data availability between 15 and 75 per cent, values displayed in italics.

Trends and pollutant distributions for ozone between 2014 and 2018

Percentiles of 2018 daily peak concentrations are provided for ozone for each station and standard for one-hour and four-hour averaging periods. In Tables 26–43, daily peak values are formed only when at least 75 per cent of the data for the day are valid. Data for stations with less than 15 per cent data in the year are omitted and stations with less than 75 per cent data are shown in italics. Exceedances are shown in bold. The percentiles for four-hour ozone are based on running averages, including those that overlap from one day to the next.

Figure 5 and 6 show the annual one-hour and four-hour ozone concentration percentiles for 2014–2018 in the Port Phillip Region.

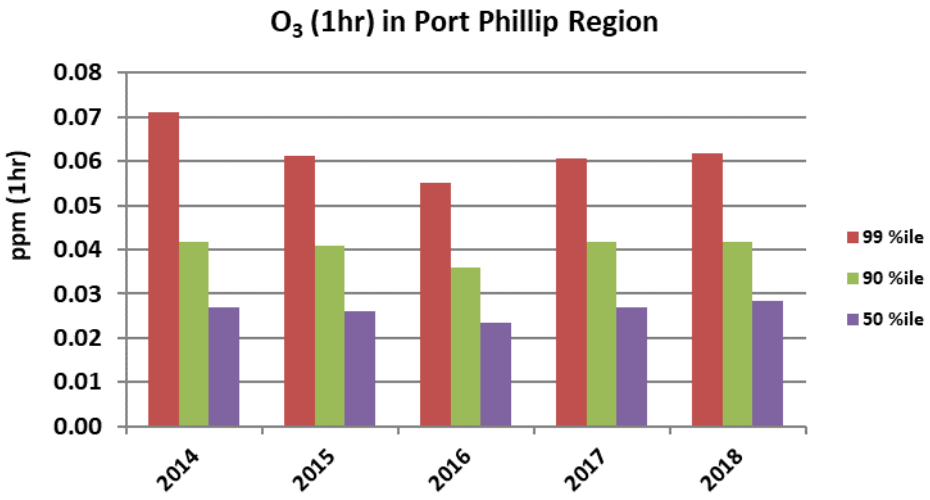

Figure 5: Percentiles of daily maximum one-hour ozone (average of Port Phillip stations 2014–2018)

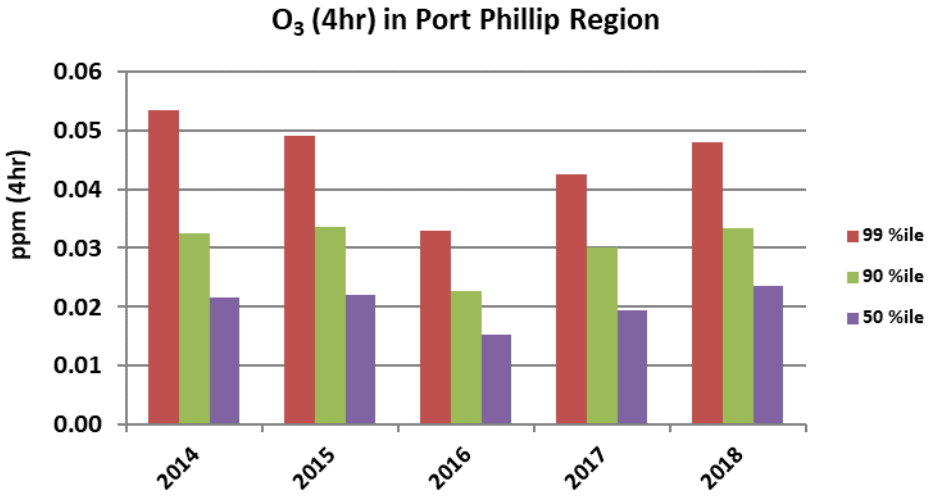

Figure 6: Percentiles of daily maximum four-hour ozone (average of Port Phillip stations 2014–2018)

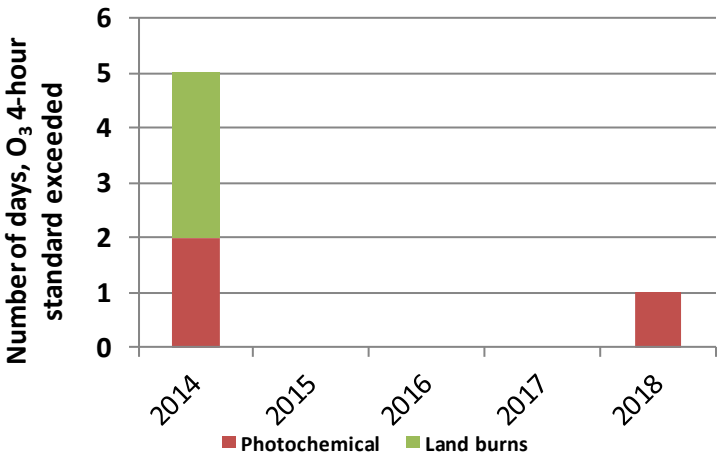

Figure 7: Inferred causes of exceedances of the ozone four-hour standard (Port Phillip region 2014–2018)

Exceedances of both the four-hour and (less frequently) one-hour standards have been recorded. Major bushfires in 2014 are likely to have caused or exacerbated the ozone exceedances observed. No exceedences of the four-hour standard have been recorded for 2015–2017 as shown in Figure 7.

One-hour ozone trends

Table 26: Percentiles of daily maximum one-hour ozone at Alphington (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[a]	97.0	1	**0.131**	0.076	0.065	0.052	0.043	0.031	0.026
2015	91.0	0	0.061	0.055	0.053	0.048	0.042	0.032	0.025
2016	96.7	0	0.066	0.058	0.054	0.047	0.037	0.028	0.022
2017	86.0	0	0.073	0.061	0.057	0.050	0.040	0.030	0.025
2018	98.4	0	0.081	0.059	0.055	0.049	0.043	0.033	0.028

a: Compliance with one hour O_3 not met, values displayed in bold.

Table 27: Percentiles of daily maximum one-hour ozone at Brighton (2014–2016)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[a]	*68.5*	*0*	*0.091*	*0.087*	*0.078*	*0.056*	*0.047*	*0.033*	*0.026*
2015	99.5	0	0.067	0.061	0.058	0.046	0.041	0.030	0.025
2016[b]	1.4								

a: Data availability between 15 and 75 per cent, values displayed in italics.
b: Data availability less than 15 per cent, no values displayed.

Table 28: Percentiles of daily maximum one-hour ozone at Dandenong (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[a]	*72.1*	*0*	*0.083*	*0.078*	*0.075*	*0.057*	*0.048*	*0.033*	*0.025*
2015	98.6	0	0.071	0.060	0.057	0.050	0.041	0.031	0.026
2016[a]	*42.1*	*0*	*0.060*	*0.058*	*0.057*	*0.053*	*0.046*	*0.036*	*0.026*
2017[a]	*46.6*	*0*	*0.069*	*0.067*	*0.062*	*0.058*	*0.053*	*0.042*	*0.031*
2018	97.3	0	0.094	0.060	0.052	0.045	0.041	0.032	0.027

a: Data availability between 15 and 75 per cent, values displayed in italics.

Table 29: Percentiles of daily maximum one-hour ozone at Footscray (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	99.5	0	0.100	0.077	0.063	0.050	0.042	0.031	0.026
2015	99.5	0	0.064	0.058	0.054	0.046	0.040	0.031	0.025
2016[a]	*64.8*	*0*	*0.065*	*0.055*	*0.052*	*0.044*	*0.040*	*0.030*	*0.024*
2017	98.1	0	0.079	0.063	0.057	0.051	0.043	0.031	0.027
2018[a]	*50.4*	*0*	*0.089*	*0.070*	*0.062*	*0.052*	*0.048*	*0.038*	*0.030*

a: Data availability between 15 and 75 per cent, values displayed in italics.

Table 30: Percentiles of daily maximum one-hour ozone at Geelong South (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	98.1	0	0.077	0.058	0.053	0.045	0.038	0.030	0.026
2015	99.7	0	0.079	0.062	0.054	0.044	0.038	0.030	0.026
2016	98.1	0	0.056	0.052	0.048	0.043	0.035	0.028	0.025
2017	97.5	0	0.067	0.058	0.057	0.048	0.042	0.032	0.029
2018	87.1	0	0.069	0.061	0.051	0.045	0.039	0.031	0.028

Table 31: Percentiles of daily maximum one-hour ozone at Melton (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	96.2	0	0.088	0.070	0.066	0.051	0.042	0.034	0.028
2015	99.5	0	0.072	0.066	0.057	0.048	0.042	0.033	0.028
2016[a]	*48.6*	*0*	*0.070*	*0.062*	*0.058*	*0.052*	*0.046*	*0.038*	*0.028*
2017[a]	*44.7*	*0*	*0.073*	*0.070*	*0.068*	*0.064*	*0.055*	*0.046*	*0.033*
2018	99.2	*0*	0.085	0.063	0.056	0.048	0.042	0.034	0.030

a: Data availability between 15 and 75 per cent, values displayed in italics

Table 32: Percentiles of daily maximum one-hour ozone at Mooroolbark (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[a]	*69.6*	*0*	*0.099*	*0.081*	*0.076*	*0.055*	*0.050*	*0.035*	*0.026*
2015[a]	*58.1*	*0*	*0.065*	*0.055*	*0.051*	*0.046*	*0.039*	*0.028*	*0.024*
2016[a]	*42.9*	*0*	*0.073*	*0.068*	*0.065*	*0.054*	*0.049*	*0.040*	*0.029*
2017[a]	*52.9*	*0*	*0.071*	*0.064*	*0.063*	*0.056*	*0.050*	*0.042*	*0.032*
2018	98.4	0	0.071	0.061	0.056	0.051	0.044	0.034	0.028

a: Data availability between 15 and 75 per cent, values displayed in italics.

Table 33: Percentiles of daily maximum one-hour ozone at Point Cook (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	98.9	0	0.093	0.075	0.067	0.054	0.043	0.032	0.028
2015	98.4	0	0.076	0.066	0.064	0.047	0.042	0.032	0.028
2016[a]	*54.9*	*0*	*0.066*	*0.061*	*0.059*	*0.049*	*0.043*	*0.033*	*0.026*
2017[a]	*46.8*	*0*	*0.080*	*0.066*	*0.062*	*0.058*	*0.052*	*0.041*	*0.029*
2018	98.6	0	0.082	0.066	0.057	0.048	0.041	0.033	0.030

a: Data availability between 15 and 75 per cent, values displayed in italics.

Table 34: Percentiles of daily maximum one-hour ozone at Traralgon (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	97.0	0	0.077	0.066	0.056	0.045	0.037	0.028	0.024
2015	97.5	0	0.059	0.053	0.049	0.041	0.035	0.028	0.023
2016	90.4	0	0.063	0.051	0.043	0.038	0.033	0.028	0.025
2017	97.8	0	0.064	0.052	0.049	0.043	0.038	0.030	0.026
2018[a]	*51.8*	*0*	*0.067*	*0.054*	*0.053*	*0.048*	*0.042*	*0.034*	*0.027*

a: Data availability between 15 and 75 per cent, values displayed in italics.

Four-hour ozone trends

Table 35: Percentiles of daily maximum four-hour ozone at Alphington (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[a]	96.7	1	**0.114**	0.066	0.055	0.048	0.039	0.030	0.025
2015	91.0	0	0.059	0.052	0.048	0.044	0.040	0.029	0.024
2016	96.4	0	0.058	0.052	0.050	0.044	0.035	0.027	0.022
2017	85.8	0	0.067	0.056	0.054	0.048	0.040	0.028	0.024
2018	98.1	0	0.076	0.054	0.050	0.045	0.039	0.031	0.027

a: Compliance with four hour O_3 not met, values displayed in **bold.**

Table 36: Percentiles of daily maximum four-hour ozone at Brighton (2014–2016)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[b]	68.5	1	**0.084**	0.078	0.071	0.053	0.044	0.031	0.024
2015	99.5	0	0.060	0.056	0.053	0.044	0.038	0.029	0.024
2016[a]	1.4	0							

a: Data availability less the 15 per cent, no values displayed.
b: Compliance with four-hour O_3 not met, values displayed in **bold.**

Table 37: Percentiles of daily maximum four-hour ozone at Dandenong (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[a]	*72.1*	*0*	*0.078*	*0.071*	*0.068*	*0.053*	*0.046*	*0.031*	*0.024*
2015	98.6	0	0.064	0.058	0.054	0.046	0.039	0.029	0.025
2016[a]	*42.1*	*0*	*0.057*	*0.055*	*0.054*	*0.049*	*0.043*	*0.033*	*0.025*
2017[a]	*46.6*	*0*	*0.064*	*0.059*	*0.057*	*0.054*	*0.051*	*0.039*	*0.029*
2018[b]	97.3	**1**	**0.083**	0.056	0.050	0.043	0.038	0.030	0.026

a: Data availability between 15 and 75 per cent, values displayed in italics.
b: Compliance with four-hour O_3 not met, values displayed in **bold.**

Table 38: Percentiles of daily maximum four-hour ozone at Footscray (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[b]	99.5	**1**	**0.082**	0.069	0.056	0.046	0.039	0.030	0.025
2015	99.5	0	0.055	0.051	0.049	0.043	0.037	0.029	0.024
2016[a]	*64.8*	*0*	*0.053*	*0.051*	*0.049*	*0.043*	*0.038*	*0.029*	*0.023*
2017	98.1	0	0.067	0.058	0.051	0.046	0.040	0.030	0.026
2018[ab]	*50.1*	***1***	***0.082***	*0.067*	*0.059*	*0.049*	*0.044*	*0.036*	*0.028*

a: Data availability between 15 and 75 per cent, values displayed in italics.
b: Compliance with four-hour O_3 not met, values displayed in **bold.**

Table 39: Percentiles of daily maximum four-hour ozone at Geelong South (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	98.4	0	0.075	0.053	0.049	0.042	0.036	0.029	0.025
2015	99.7	0	0.061	0.056	0.050	0.042	0.035	0.029	0.025
2016	98.1	0	0.051	0.047	0.044	0.039	0.033	0.027	0.024
2017	97.3	0	0.061	0.056	0.052	0.046	0.040	0.031	0.028
2018	86.6	0	0.067	0.050	0.048	0.044	0.036	0.031	0.027

Table 40: Percentiles of daily maximum four-hour ozone at Melton (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	96.2	0	0.078	0.063	0.057	0.049	0.041	0.033	0.027
2015	99.5	0	0.070	0.059	0.050	0.045	0.040	0.032	0.027
2016[a]	*48.6*	*0*	*0.058*	*0.057*	*0.053*	*0.049*	*0.044*	*0.036*	*0.027*
2017[a]	*44.7*	*0*	*0.067*	*0.064*	*0.062*	*0.059*	*0.052*	*0.044*	*0.032*
2018	98.9	0	0.072	0.057	0.052	0.047	0.040	0.033	0.029

a: Data availability is less than 15 per cent, percentile values not shown.

Table 41: Percentiles of daily maximum four-hour ozone at Mooroolbark (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014[ab]	*69.6*	*1*	***0.081***	*0.074*	*0.068*	*0.050*	*0.045*	*0.034*	*0.025*
2015[a]	*58.1*	*0*	*0.061*	*0.049*	*0.047*	*0.042*	*0.035*	*0.027*	*0.023*
2016[a]	*42.9*	*0*	*0.066*	*0.062*	*0.061*	*0.052*	*0.045*	*0.038*	*0.027*
2017[a]	*52.9*	*0*	*0.067*	*0.059*	*0.055*	*0.051*	*0.047*	*0.040*	*0.029*
2018	98.1	0	0.065	0.057	0.052	0.046	0.041	0.032	0.027

a: Data availability between 15 and 75 per cent, values displayed in italics.
b: Compliance with four hour O_3 not met, values displayed in **bold.**

Table 42: Percentiles of daily maximum four-hour ozone at Point Cook (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	99.2	0	0.080	0.070	0.061	0.050	0.040	0.031	0.027
2015	98.4	0	0.062	0.060	0.057	0.046	0.040	0.031	0.027
2016[a]	*54.9*	*0*	*0.057*	*0.057*	*0.055*	*0.046*	*0.040*	*0.032*	*0.026*
2017[a]	*46.8*	*0*	*0.071*	*0.061*	*0.056*	*0.055*	*0.048*	*0.038*	*0.028*
2018	98.4	0	0.071	0.062	0.054	0.044	0.039	0.032	0.029

a: Data availability between 15 and 75 per cent, values displayed in italics.

Table 43: Percentiles of daily maximum four-hour ozone at Traralgon (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	97.5	0	0.062	0.059	0.053	0.042	0.035	0.026	0.023
2015	97.5	0	0.053	0.047	0.045	0.036	0.033	0.026	0.022
2016	90.4	0	0.059	0.047	0.041	0.035	0.031	0.027	0.024
2017	97.8	0	0.056	0.049	0.045	0.040	0.036	0.029	0.025
2018[a]	*51.5*	*0*	*0.061*	*0.052*	*0.051*	*0.042*	*0.039*	*0.032*	*0.026*

a: Data availability between 15 and 75 per cent, values displayed in italics.

D Sulfur dioxide (SO_2)

Assessment of compliance with standards and goals of the Measure for sulfur dioxide

In Victoria, sulfur dioxide is assessed against a one-hour standard of 0.200 ppm, a daily standard of 0.080 ppm and an annual standard of 0.020 ppm, with one exceedance day allowed per year. There were no exceedances of the one-hour, daily or annual standard. The highest one-hour average at Traralgon was 39.5 per cent of the standard, the highest 24-hour average at Traralgon was 18.8 per cent of the standard.

Table 44: 2018 compliance summary for sulfur dioxide in Victoria

Region	Date availability rates (% of hours)					Exceedances (days)		Annual mean (ppm)	Performance against the standards and goal		
Performance monitoring station	Q1	Q2	Q3	Q4	Annual	1-hour	24-hour		1-hour	24-hour	1-year
Port Phillip											
Alphington	95.6	94.2	95.0	93.2	94.5	0	0	0.0004	MET	MET	MET
Altona North[a]	65.1	95.0	95.2	74.8	82.6	0	0	0.0015	NOT MET	NOT MET	MET
Geelong South	90.2	93.6	94.8	91.8	92.6	0	0	0.0004	MET	MET	MET
Latrobe Valley											
Traralgon	94.6	95.2	95.0	66.0	87.7	0.0	0	0.0007	MET	MET	MET

a: Data capture less than 75% in quarters 1 and 4

Table 45: 2018 summary statistics for daily peak one-hour sulfur dioxide in Victoria

The Measure's standard: 0.20 ppm (one-hour average).

The Measure's goal: standard exceeded on no more than one day per year.

Region Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date | hour)	2nd highest (ppm)	2nd highest (date | hour)
Port Phillip					
Alphington	355	0.013	Jun 27:16	0.008	Jan 03:04 Mar 14:09
Altona North	311	0.053	Jun 29:14	0.044	May 21:14
Geelong South	348	0.029	Mar 16:24	0.020	Jul 17:20
Latrobe Valley					
Traralgon	329	0.079	Apr 03:14	0.061	Feb 22:13

Table 46: 2018 summary statistics for daily sulfur dioxide in Victoria

The Measure's standard: 0.08 ppm (24-hour average).

The Measure's goal: standard exceeded on no more than one day per year.

Region Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date)	2nd highest (ppm)	2nd highest (date)
Port Phillip					
Alphington	355	0.003	Aug 3 Jun 1		
Altona North	311	0.014	Sep 08	0.013	Feb 12
Geelong South	348	0.002	Jun 29, Jul 17, May 18, Feb 28, Jul 27, Apr 06, May 16, May 27		
Latrobe Valley					
Traralgon	329	0.015	Jan 27	0.007	Jan 25

Table 47: 2018 percentiles of daily peak one-hour sulfur dioxide concentrations in Victoria

The Measure's standard: 0.20 ppm (one-hour average).

The Measure's goal: standard exceeded on no more than one day per year.

Region	Data availability	Max	Percentiles (ppm)					
Performance monitoring station	(% of days)	(ppm)	99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	97.3	0.013	0.007	0.007	0.005	0.003	0.002	0.001
Altona North	85.2	0.053	0.037	0.034	0.029	0.019	0.011	0.004
Geelong South	95.3	0.029	0.012	0.009	0.007	0.005	0.002	0.001
Latrobe Valley								
Traralgon	90.1	0.079	0.039	0.022	0.014	0.010	0.005	0.002

At the 50th percentile, levels of SO_2 are close to the limit of detection of the instruments.

Table 48: 2018 percentiles of daily sulfur dioxide concentrations in Victoria

The Measure's standard: 0.08 ppm (24-hour average).

The Measure's goal: standard exceeded on no more than one day per year.

Region	Data availability	Max	Percentiles (ppm)					
Performance monitoring station	(% of days)	(ppm)	99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	97.0	0.004	0.002	0.002	0.001	0.001	0.001	0.000
Altona North	85.0	0.015	0.009	0.009	0.005	0.003	0.002	0.001
Geelong South	95.1	0.003	0.002	0.002	0.002	0.001	0.001	0.000
Latrobe Valley								
Traralgon	89.6	0.010	0.005	0.003	0.002	0.002	0.001	0.000

Trends and pollutant distributions for sulfur dioxide between 2014 and 2018

Percentiles of 2018 daily peak concentrations are provided for sulfur dioxide for each station and standard. In these tables, daily peak values are formed only when at least 75 per cent of the data for the day are valid. Data for stations with less than 15 per cent data in the year are omitted and stations with less than 75 per cent data are shown in italics. Figure 8 shows the annual one-hour sulfur dioxide concentration percentiles for 2014–2018.

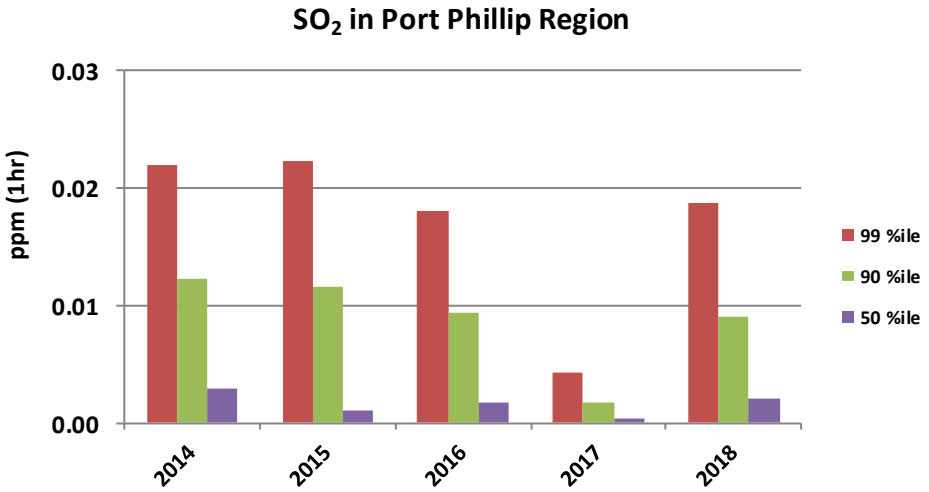

Figure 8: Percentiles of daily maximum one-hour sulfur dioxide (average of Port Phillip stations 2014–2018)

Table 49: Percentiles of daily maximum one-hour sulfur dioxide at Alphington (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Percentiles (ppm)						
			Max	99th	98th	95th	90th	70th	50th
2014	90.1	0	0.011	0.010	0.009	0.007	0.005	0.003	0.002
2015	86.6	0	0.012	0.009	0.007	0.006	0.004	0.003	0.001
2016	92.1	0	0.009	0.008	0.007	0.005	0.004	0.002	0.001
2017	95.9	0	0.003	0.002	0.002	0.001	0.001	0.001	0.000
2018	97.3	0	0.013	0.007	0.007	0.005	0.003	0.002	0.001

Table 50: Percentiles of daily maximum one-hour sulfur dioxide at Altona (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Percentiles (ppm)						
			Max	99th	98th	95th	90th	70th	50th
2014	99.7	0	0.041	0.033	0.031	0.027	0.023	0.012	0.005
2015	98.4	0	0.062	0.041	0.039	0.031	0.025	0.011	0.004
2016	75.4	0	0.044	0.039	0.033	0.024	0.020	0.008	0.003
2017	86.8	0	0.014	0.009	0.007	0.005	0.003	0.002	0.001
2018	85.2	0	0.053	0.037	0.034	0.029	0.019	0.011	0.004

Table 51: Percentiles of daily maximum one-hour sulfur dioxide at Geelong (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	87.4	0	0.029	0.023	0.017	0.012	0.009	0.005	0.002
2015	98.6	0	0.026	0.017	0.014	0.010	0.006	0.003	0.001
2016	97.3	0	0.010	0.007	0.006	0.005	0.004	0.002	0.001
2017	94.8	0	0.002	0.002	0.002	0.001	0.001	0.001	0.000
2018	95.3	0	0.029	0.012	0.009	0.007	0.005	0.002	0.001

Table 52: Percentiles of daily maximum one-hour sulfur dioxide at Traralgon (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	85.8	0	0.044	0.036	0.029	0.015	0.009	0.006	0.003
2015	96.4	0	0.061	0.023	0.020	0.013	0.010	0.006	0.003
2016	88.5	0	0.057	0.023	0.017	0.014	0.010	0.006	0.003
2017	94.8	0	0.063	0.036	0.022	0.012	0.009	0.006	0.003
2018	90.1	0	0.079	0.039	0.022	0.014	0.010	0.005	0.002

Table 53: Percentiles of daily sulfur dioxide at Alphington (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	89.9	0	0.004	0.003	0.002	0.002	0.001	0.001	0.000
2015	86.6	0	0.003	0.002	0.002	0.001	0.001	0.001	0.000
2016	92.1	0	0.002	0.002	0.002	0.001	0.001	0.001	0.000
2017	95.6	0	0.003	0.002	0.002	0.001	0.001	0.001	0.000
2018	97	0	0.004	0.002	0.002	0.001	0.001	0.001	0.000

a: Data availability between 15 and 75 per cent, values displayed in italics

Table 54: Percentiles of daily sulfur dioxide at Altona (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	99.5	0	0.011	0.009	0.007	0.006	0.004	0.002	0.001
2015	98.4	0	0.018	0.012	0.010	0.005	0.003	0.002	0.001
2016	75.4	0	0.013	0.008	0.006	0.004	0.003	0.002	0.001
2017	86.6	0	0.014	0.009	0.007	0.005	0.003	0.002	0.001
2018	85	0	0.015	0.009	0.009	0.005	0.003	0.002	0.001

Table 55: Percentiles of daily sulfur dioxide at Geelong (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	87.1	0	0.005	0.004	0.003	0.002	0.001	0.001	0.000
2015	98.6	0	0.003	0.003	0.002	0.002	0.001	0.001	0.000
2016	97.3	0	0.002	0.002	0.002	0.001	0.001	0.000	0.000
2017	94.5	0	0.002	0.002	0.002	0.001	0.001	0.001	0.000
2018	95.1	0	0.003	0.002	0.002	0.002	0.001	0.001	0.000

Table 56: Percentiles of daily sulfur dioxide at Traralgon (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (ppm)	Percentiles (ppm)					
				99th	98th	95th	90th	70th	50th
2014	85.8	0	0.010	0.005	0.004	0.003	0.002	0.001	0.001
2015	96.4	0	0.007	0.005	0.003	0.003	0.002	0.001	0.001
2016	88.5	0	0.006	0.005	0.004	0.003	0.002	0.001	0.001
2017	94.5	0	0.015	0.006	0.004	0.002	0.002	0.001	0.001
2018	89.6	0	0.010	0.005	0.003	0.002	0.002	0.001	0.000

E Particulate matter less than 10 µm (PM_{10})

Assessment of compliance with standards and goals of the Measure for PM_{10}

In Victoria, PM_{10} is assessed against a daily standard of 50 µg/m^3, with a goal of zero exceedance days allowed per year, excluding exceptional events. PM_{10} is also assessed against an annual standard of 25 µg/m^3.

The goal was not met in 2018 due to a combination of days impacted by wind blown dust, land burns and urban sources such as domestic wood heating. While there was an exceedance of the standard at Traralgon, it has been attributed to a land burn and is therefore excluded from the assessment against the PM_{10} goal, resulting in no exceedances of the standard.

The highest daily average for PM_{10} in the Port Phillip region, at Mooroolbark was 223 per cent of the standard. The high levels of PM_{10} have been attributed to a combination of land burns and domestic wood heater usage.

Table 57: 2018 compliance summary for daily PM_{10} in Victoria

Region	Data availability rates (% of hours)					Number of exceedances (days)	Annual average[a] (µg/m^3)	Performance against the standard and goals
Performance monitoring station	Q1	Q2	Q3	Q4	Annual			
Port Phillip								
Alphington	88.9	94.5	87.0	94.6	91.2	3	18.2	NOT MET
Dandenong	93.3	95.6	97.8	96.7	95.9	3	18.2	NOT MET
Footscray	92.2	94.5	95.7	100.0	95.6	1	18.4	NOT MET
Geelong South	95.6	91.2	95.7	93.5	94.0	6	19.5	NOT MET
Mooroolbark*	97.8	94.5	95.7	95.7	95.9	1	15.7	NOT MET
Latrobe Valley								
Traralgon*	97.8	95.6	100.0	89.1	95.6	1	14.4	NOT MET

* One exceedance associated with a land burn, so excluded when assessing performance against the daily goal.

Table 58: 2018 summary statistics for daily PM_{10} in Victoria

Region Performance monitoring station	Number of valid days	Highest reading (µg/m^3)	Highest reading (date)	2nd highest reading (µg/m^3)	2nd highest reading (date)
Port Phillip					
Alphington	333	74	Feb 14	59.5	May 01
Dandenong	350	89.7	May 01	67.2	Mar 18
Footscray	349	58.8	Feb 14	48.0	May 03
Geelong South	343	97.1	May 02	90.9	Dec 07
Mooroolbark	350	111.3	May 01	40	April 20
Latrobe Valley					
Traralgon	349	50.1	May 02	31	May 03

Table 59: 2018 PM_{10} exceedances

Date	Port Phillip					Latrobe Valley	Inferred cause
	Alphington	Dandenong	Footscray	Geelong South (µg/m³)	Mooroolbark (µg/m³)	Traralgon	
May 01[a]	**59.5**	**89.7**			**111.3**		Urban (wood heaters)/ land burns
May 02[a]	**51.6**			**97.1**		**50.1**	land burns
Dec 07				**90.9**			Wind blown dust
May 03[a]				**76.7**			land burns
Feb 14	**74**		**58.8**				Wind blown dust
Mar 17				**72.8**			Wind blown dust
Mar 18		**67.2**					Wind blown dust
Feb 28		**63.4**		**66.2**			Wind blown dust
Jan 06				**50.7**			Wind blown dust

Inferred causes include windborne dust (crustal material, often from distant sources), smoke from bushfires, and land burning (fuel hazard reduction, regeneration, agricultural burning, private burning) urban sources typically from motor vehicles, domestic wood heaters and commercial/industrial emissions resulting in particles accumulating in stable atmospheric conditions.
a: Considered to be an exceptional event as per the definition of exceptional event in the Measure.

Table 60: 2018 percentiles for daily PM_{10} concentrations in Victoria

Region Performance monitoring station	Data availability	Max (µg/m³)	Percentiles					
			99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	91.2	74.0	47.4	46.2	38.3	31.0	22.5	17.3
Dandenong	95.9	89.7	47.6	40.6	33.5	29.0	24.1	17.4
Footscray	95.6	58.8	46.2	42.3	35.0	29.5	23.4	17.2
Geelong South	94.0	97.1	70.1	46.7	41.4	33.8	25.0	17.5
Mooroolbark	95.9	111.3	34.6	33.7	29.1	25.3	20.2	15.3
Latrobe Valley								
Traralgon	95.6	50.1	34.1	28.5	25.9	22.9	18.9	14.8

Trends and pollutant distributions for PM_{10} between 2014 and 2018

Percentiles of 2018 daily peak concentrations are provided for PM_{10} for each station and standard. In tables 61 to 68, daily peak values are formed only when at least 75 per cent of the data for the day are valid. Data for stations with less than 15 per cent data in the year are omitted and stations with less than 75 per cent data are shown in italics. Exceedances are shown in bold. Figure 9 shows the daily average for PM_{10} concentration for 2014–2018.

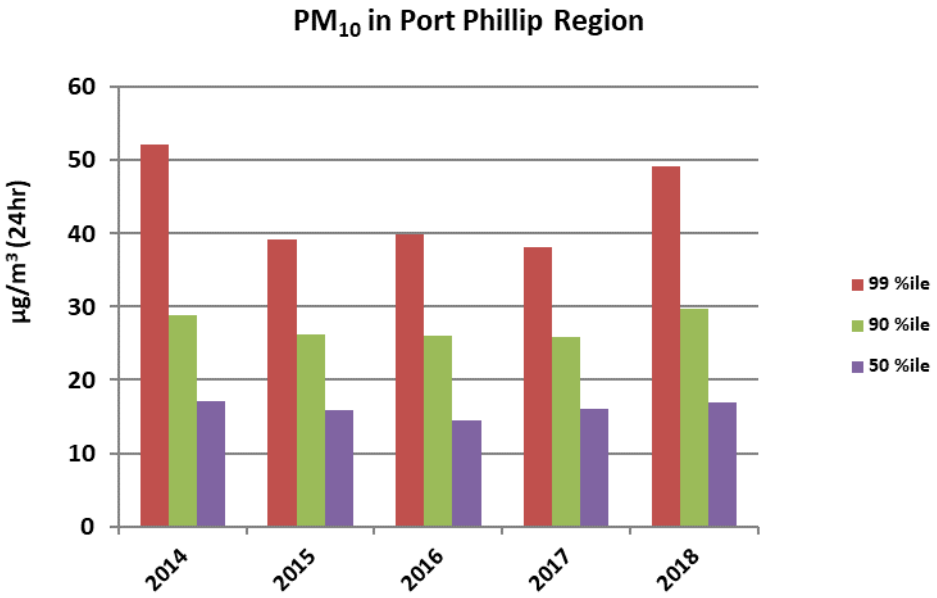

Figure 9: Percentiles of daily PM_{10} (average of Port Phillip stations 2014–2018)

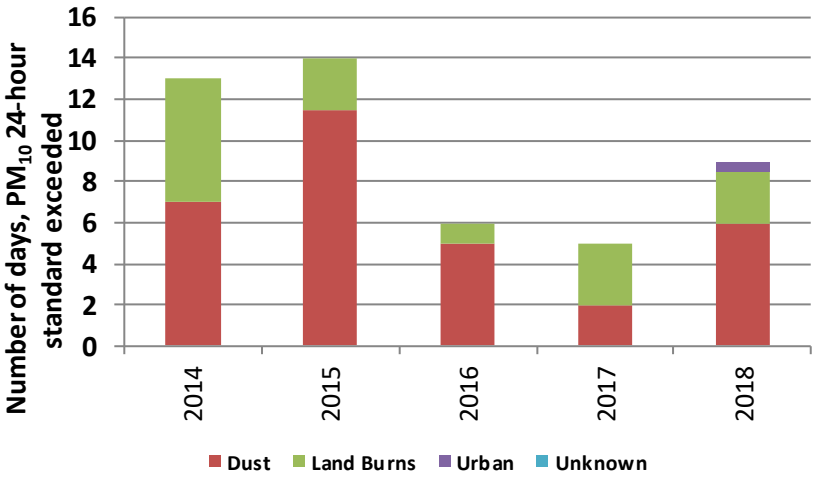

Figure 10: Inferred causes of exceedances of the PM_{10} standard (Port Phillip region 2014–2018)

In 2018, PM_{10} exceedances at Geelong South (four days) were due to non-continental scale wind blown dust, and two days were due to jurisdiction-authorised hazard reduction burns (land burns). There were also days when Alphington, Dandenong and Footscray were impacted by wind blown dust. The highest exceedance was recorded at Mooroolbark, which has been attributed to a combination of a hazard reduction burn and domestic wood heater usage. Bushfires and jurisdiction-authorised hazard reduction burns are considered exceptional events under the Measure.

Table 61: Percentiles of daily PM_{10} at Alphington (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[a]	96.2	**4**	**64.5**	45.9	33.4	30.7	24.6	20.4	16.3
2015	92.9	0	***108.0***[b]	38.4	33.3	27.5	24.7	20.0	15.3
2016	75.3	0	*37.9*	35.0	32.6	28.4	25.3	20.3	15.0
2017	95.9	0	41.1	32.5	31.2	27.3	24.1	20.0	15.8
2018[a]	91.2	**3**	**74.0**	47.4	46.2	38.3	31.0	22.5	17.3

a: Compliance with 24-hour PM_{10} not met, values displayed in bold.
b: Recorded on a day with less than 25 per cent data capture, not included in count of exceedances days.

Table 62: Percentiles of daily PM_{10} at Brighton (2014–2015)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[b]	97.3	**2**	**58.1**	38.1	36.1	29.6	25.6	20.1	16.0
2015[a]	*17.0*	*0*	*47.5*	*35.5*	*32.2*	*27.4*	*24.4*	*19.9*	*15.3*

a: Data availability between 15 and 75 per cent, values displayed in italics.
b: Compliance with 24-hour PM_{10} not met, values displayed in **bold.**
Note: Monitoring ceased in 2015.

Table 63: Percentiles of daily PM_{10} at Dandenong (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[b]	99.2	**4**	**68.6**	**53.0**	40.8	35.1	29.3	23.0	17.9
2015[a]	*69.9*	*0*	*47.8*	*41.9*	*38.1*	*32.9*	*26.5*	*22.6*	*17.5*
2016	95.9	0	41.8	37.1	33.9	30.2	26.3	20.0	14.6
2017[a]	*22.7*	*0*	*37.5*	*35.3*	*34.2*	*30.0*	*28.1*	*22.8*	*16.7*
2018[b]	95.9	**3**	**89.7**	47.6	40.6	33.5	29.0	24.1	17.4

a: Data availability between 15 and 75 per cent, values displayed in italics.
b: Compliance with 24-hour PM_{10} not met, values displayed in **bold.**

Table 64: Percentiles of daily PM_{10} at Footscray (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[a]	98.6	**6**	**79.2**	**63.0**	42.2	36.5	30.6	23.0	18.0
2015[a]	97.0	**3**	**71.8**	44.7	35.7	32.5	28.8	21.9	16.4
2016	94.2	0	42.7	37.9	35.1	29.3	25.9	20.2	14.1
2017	91.2	0	49.8	39.5	36.6	31.0	28.1	23.0	17.4
2018[a]	95.6	**1**	**58.8**	46.2	42.3	35.0	29.5	23.4	17.2

a: Compliance with 24-hour PM_{10} not met, values displayed in **bold.**

Table 65: Percentiles of daily PM_{10} at Geelong (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[a]	99.5	**8**	**75.8**	**58.8**	**51.7**	43.3	33.8	24.3	17.7
2015[a]	79.7	**10**	**286.1**	**84.4**	**64.1**	45.5	32.4	23.8	16.6
2016[a]	93.7	**5**	**68.3**	**56.9**	47.3	36.8	30.4	21.9	15.9
2017[a]	79.7	**3**	**73.7**	44.3	39.6	32.4	29.6	22.8	16.6
2018[a]	94.0	**6**	**97.1**	**70.1**	46.7	41.4	33.8	25.0	17.5

a: Compliance with 24-hour PM_{10} not met, values displayed in **bold.**

Table 66: Percentiles of daily PM_{10} at Mooroolbark (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[b]	98.4	4	**109.3**	**55.4**	40.9	34.1	30.1	23.2	17.5
2015[ab]	*15.6*	*0*	*39.5*	*37.5*	*35.5*	*31.8*	*27.2*	*22.0*	*17.5*
2016	96.4	0	44.7	32.4	29.7	26.3	22.4	17.4	12.5
2017[b]	81.9	**2**	**55.4**	36.3	31.2	24.5	21.6	18.5	14.4
2018[b]	95.9	**1**	**111.3**	34.6	33.7	29.1	25.3	20.2	15.3

a: Data availability between 15 and 75 per cent, values displayed in *italics.*
b: Compliance with 24-hour PM_{10} not met, values displayed in **bold.**

Table 67: Percentiles of daily PM_{10} at Richmond (2014–2016)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[a]	97.5	**4**	**63.4**	**50.7**	37.6	33.1	27.3	20.9	16.7
2015[a]	96.2	**1**	**52.4**	35.7	32.8	27.7	24.9	20.8	16.4
2016[b]	8								

a: Compliance with 24-hour PM_{10} not met, values displayed in **bold.**
b: Data availability less than 15 per cent, no values displayed.
Note: Monitoring ceased in 2016

Table 68: Percentiles of daily PM_{10} at Traralgon (2014–2018)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[a]	97.5	**3**	**84.9**	47.1	41.3	32.2	26	19.9	15.3
2015	84.4	0	45.0	29.7	29.0	26.2	21.9	17.2	13.9
2016	98.6	0	49.2	36.0	30.2	25.4	21.8	17.4	14.0
2017	91.8	0	42.8	32.2	28.4	24.6	21.8	18.0	14.7
2018[a]	95.6	**1**	**50.1**	34.1	28.5	25.9	22.9	18.9	14.8

a: Compliance with 24-hour PM_{10} not met, values displayed in **bold.**

F Particulate matter less than 2.5 µm ($PM_{2.5}$)

Assessment of compliance with standards and goals of the Measure for $PM_{2.5}$

$PM_{2.5}$ is monitored using two methods as part of the network; the first is the reference method and the second is the reference equivalence method. In Victoria, $PM_{2.5}$ is assessed against a one-day standard of 25 µg/m^3 and an annual standard of 8 µg/m^3. While the goal for Alphington and Footscray in 2018 was met using the reference method, this method only provides data on one day out of every three days. The goal for $PM_{2.5}$ was not met at any stations where continuous reference equivalence monitoring was carried out. The highest daily average for $PM_{2.5}$ at Alphington was 124 per cent of the standard as shown in Table 74. The highest annual average was 101 per cent of the standard at Traralgon as shown in Table 72.

Reference method (manual sample once every three days)

Table 69: 2018 compliance summary for daily $PM_{2.5}$ in Victoria (reference method)

Region	Data availability rates (% of days)					Number of exceedances (days)	Annual average (µg/m^3)	Performance against the standard and goals
Performance monitoring station	Q1	Q2	Q3	Q4	Annual			
Port Phillip								
Alphington	100.0	100.0	100.0	96.8	99.2	**1**	7.6	NOT MET
Footscray	76.7	100.0	100.0	93.5	92.6	**1**	7.1	NOT MET

Data availability rates are based on a one-day-in-three sampling regime.

Table 70: 2018 summary statistics for daily $PM_{2.5}$ in Victoria (reference method)

Region Performance monitoring station	Number of valid days	Highest (µg/m^3)	Highest (date)
Port Phillip			
Alphington	120	31	Apr 21
Footscray	113	32	Apr 21

Data availability rates are based on a one-day-in-three sampling regime.

Table 71: 2018 percentiles for daily $PM_{2.5}$ concentrations in Victoria (reference method)

Region Performance monitoring station	Data availability	Max (µg/m3)	Percentiles (µg/m^3)					
			99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	99.2	31.0	21.2	18.4	15.0	11.5	8.9	6.6
Footscray	92.6	32.0	16.5	16.4	13.8	11.0	8.7	6.2

Data availability rates are based on a one-day-in-three sampling regime.

Continuous equivalence methods

Victoria monitors $PM_{2.5}$ by the reference method specified in the Measure (on a one-day-in-three basis) at two stations (Alphington and Footscray). It also monitors $PM_{2.5}$ continuously at these four stations (Alphington, Footscray, Geelong and Traralgon) using equivalence reference method.

Table 72: 2018 compliance summary for daily $PM_{2.5}$ in Victoria (equivalence method)

Region	Data availability rates (% of hours)					Number of exceedances (days)	Annual average (µg/m³)	Performance against the standard and goals
Performance monitoring station	Q1	Q2	Q3	Q4	Annual			
Port Phillip								
Alphington	97.8	92.3	78.3	82.6	87.7	**8**	7.9	NOT MET
Footscray	95.6	94.5	95.7	*68.5*	88.5	**5**	7.7	NOT MET
Geelong	100.0	89.0	95.7	*63.0*	86.8	**1**	6.5	NOT MET
Latrobe Valley								
Traralgon	95.6	97.8	97.8	*56.5*	86.9	**2**	**8.1**	NOT MET

Table 73: 2018 summary statistics for daily $PM_{2.5}$ in Victoria (equivalence method)

Region Performance monitoring station	Number of valid days	Highest (µg/m³)	Highest (date)
Port Phillip			
Alphington	320	42	Jun 28
Footscray	323	31.2	Jun 28
Geelong	317	31.0	Jun 28
Latrobe Valley			
Traralgon	318	30.1	May 02

Table 74: 2018 $PM_{2.5}$ exceedances

Date	Port Phillip Region				Inferred cause
	Alphington (µg/m³)	Footscray (µg/m³)	Geelong (µg/m³)	Traralgon (µg/m³)	
Jun 28	**42**	**31.2**	**31.0**		urban (wood heaters)
May 01	**39.8**			**30.1**	wood heaters / land burns
Jun 27	**33.6**	**28.5**			wood heaters
April 20[a]	**28**	**30.4**			land burns
April 22[a]	**30**	**30.1**			land burns
Jul 13	**28**				urban (wood heaters)
April 21[a]	**27.5 – 31[b]**	**27.8 – 32[b]**			land burns
June 10	**26.7**				urban (wood heaters)
June 02				**25.6**	urban (wood heaters)

Inferred causes include smoke from bushfires and land burning (fuel hazard reduction, regeneration, agricultural burning, private burning) and urban sources typically from motor vehicles, domestic wood heaters and commercial/industrial emissions resulting in particles accumulating in stable atmospheric conditions, typically from motor vehicles or domestic wood heaters (urban). These causes are in addition to existing sources and weather conditions.

a: Considered to be an exceptional event as per the definition of exceptional event in the Measure.

b: value measured by the reference method

Table 75: 2018 percentiles for daily $PM_{2.5}$ concentrations in Victoria (equivalence method)

Region Performance monitoring station	Data availability	Max (µg/m³)	Percentiles (µg/m³)					
			99th	98th	95th	90th	75th	50th
Port Phillip								
Alphington	87.7	42.0	29.7	27.2	17.4	13.4	8.8	6.5
Footscray	88.5	31.2	28.3	20.9	15.3	12.5	8.8	6.7
Geelong	86.8	31.0	21.9	18.4	13.6	10.2	7.7	5.6
Latrobe Valley								
Traralgon	87.1	30.1	23.2	22.3	17.7	13.4	9.7	6.8

Trends and pollutant distributions for $PM_{2.5}$ between 2014 and 2018

Percentiles of 2018 daily peak concentrations are provided for $PM_{2.5}$ for each station. In Tables 76 to 81, daily peak values are formed only when at least 75 per cent of the data for the day are valid. Data for stations with less than 15 per cent data in the year are omitted and stations with less than 75 per cent data are shown in italics. Exceedances are shown in bold. Figures 11–12 shows the annual daily average for $PM_{2.5}$ concentration percentiles for 2014-2018 in the Port Phillip Region.

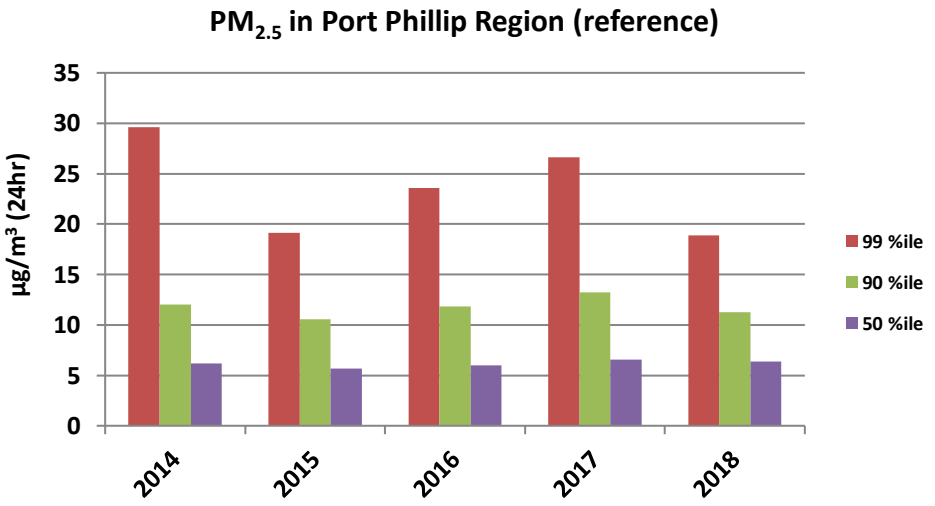

Figure 11: Percentiles of daily Partisol $PM_{2.5}$ (average of Port Phillip stations 2014–2018)

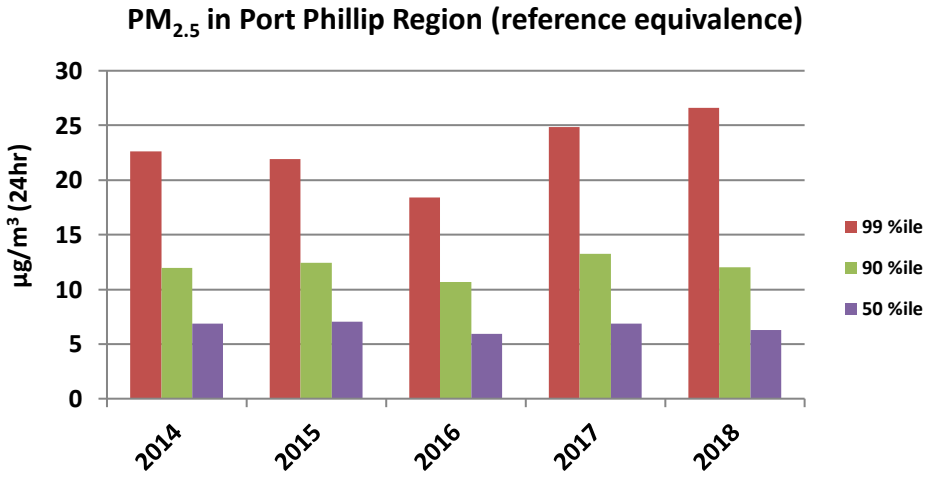

Figure 12: Percentiles of daily continuous $PM_{2.5}$ (average of Port Phillip stations 2014–2018)

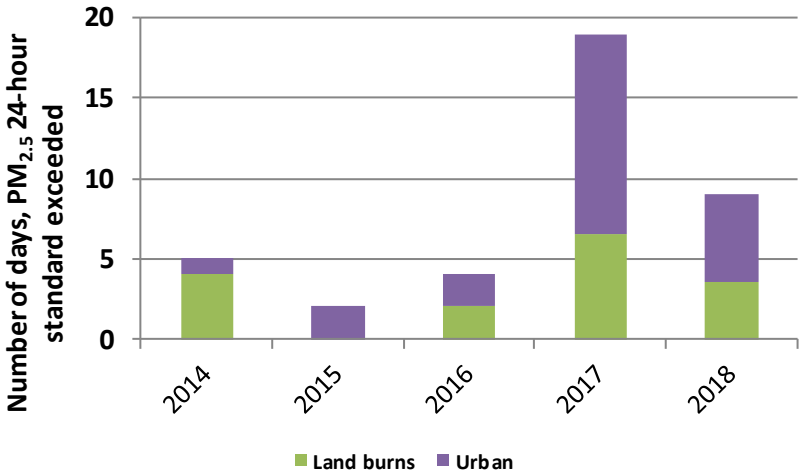

Figure 13: Inferred causes of exceedances of the $PM_{2.5}$ standard (Port Phillip region 2014–2018)

Population Weighted Concentration

For regions for which there are no NEPM air quality monitoring stations present, estimated hourly $PM_{2.5}$ concentrations across a 3 x 3 km grid determined from the Bureau of Meterology (BOM) / CSIRO air pollution modelling (AQFX system) air pollution (Figure 14) was used to determine the population weighted concentration. The model was operationalised by the BOM in May 2018. Data until April 2019 was used to obtain 12 months of data to calculate the annual averages and corresponding population weighted concentration. Future assessments will be based on calendar years.

The modelled mean $PM_{2.5}$ show that bushfires and land burns can have significant impact on annual concentrations (Figure 14). This data was weighted against population data collected during the 2016 census to calculate a population weighted annual concentration of 7.1 µg/m^3 for Victoria. The model also estimated that approximately 33.6% of the Victorian population experienced a concentration of 8 µg/m^3 or greater and 2.23% experienced a concentration of 9 µg/m^3 or greater.

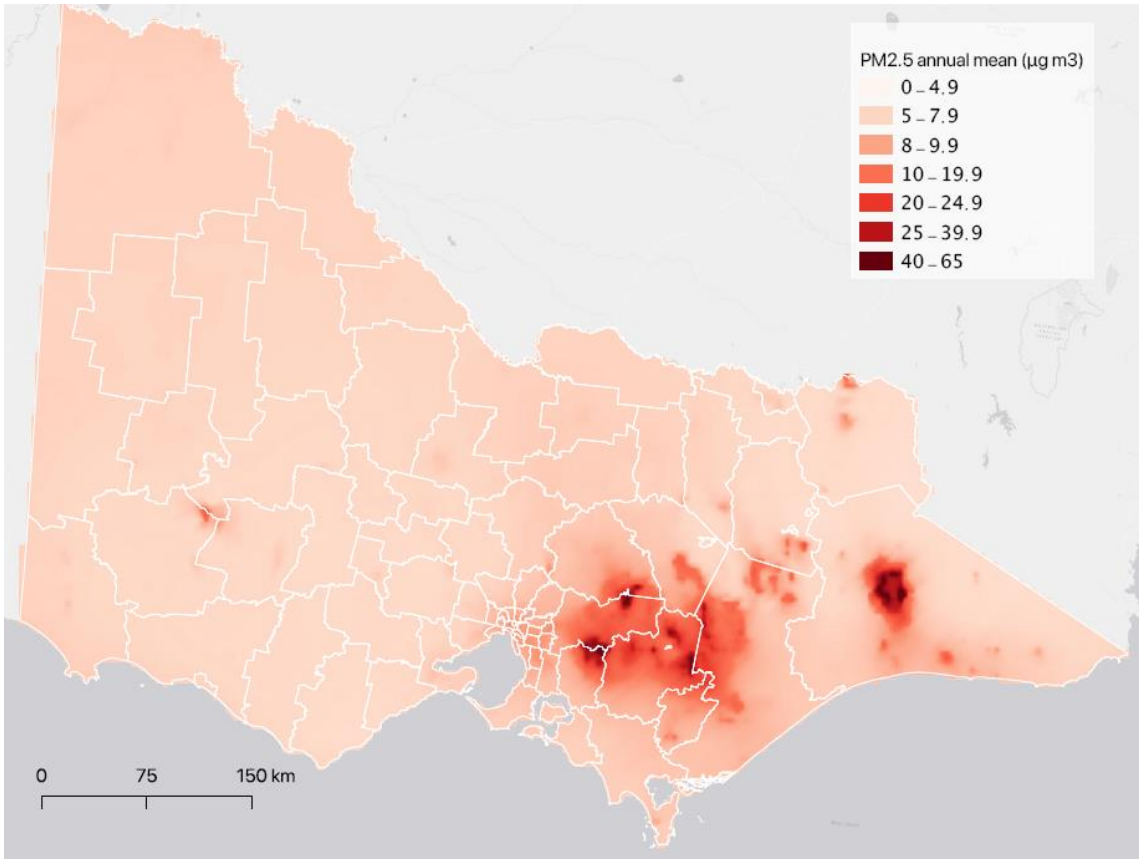

Figure 14: $PM_{2.5}$ Population weighted concentration

Table 76: Percentiles of daily $PM_{2.5}$ at Alphington (2014-2018) (Reference method)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014	97.5	**5**	**40.6**	**32.4**	23.8	16.5	12.7	8.7	6.4
2015	100	0	20.7	19.3	18.2	13.4	10.6	7.9	5.8
2016[a]	98.4	**2**	**26**	**24.1**	17.6	14.1	12.1	9.4	6.2
2017[a]	97.5	**4**	**33.1**	**27.1**	**26.4**	18.1	14.7	8.5	6.7
2018[a]	99.2	**1**	**31.0**	21.2	18.4	15.0	11.5	8.9	6.6

a: Compliance with 24–hour $PM_{2.5}$ not met, values displayed in **bold.**

Table 77: Percentiles of daily $PM_{2.5}$ at Footscray (2014–2018) (Reference method)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[a]	100.0	**2**	**39.1**	**26.8**	21.9	17.4	11.4	7.9	5.9
2015	100.0	0	20.8	19.0	14.0	12.3	10.5	7.8	5.5
2016[a]	94.3	**2**	**27**	23	17.4	14.0	11.6	9.0	5.8
2017[a]	100	**2**	**29.2**	**26.2**	19.5	16.0	11.8	8.6	6.4
2018[a]	92.6	**1**	**32.0**	16.5	16.4	13.8	11.0	8.7	6.2

a: Compliance with 24–hour $PM_{2.5}$ not met, values displayed in **bold**

Equivalence methods (continuous)

Victoria monitors $PM_{2.5}$ by the reference method specified in the Measure (on a one-day-in-three basis) at two stations (Alphington and Footscray). It also monitors $PM_{2.5}$ continuously at four stations (Alphington, Footscray, Geelong and Traralgon) using BAM.

Prior to this, Victoria also participated in the $PM_{2.5}$ Equivalence Program, with TEOM monitors located at Alphington and Footscray, exceedences for these are not reported.

Table 78: Percentiles of daily $PM_{2.5}$ at Alphington (2014–2018) (equivalence methods)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[b]	91.8	NR	44.8	31.5	22.1	15.8	13.8	9.8	7.2
2015[a]	79.5	**2**	**30.0**	24.5	23.3	19.2	13.3	10.0	7.3
2016[a]	84.4	**2**	**33.6**	23.0	22.3	14.5	11.9	8.6	6.3
2017[a]	92.6	**8**	**35.9**	**27.7**	**26.6**	20.3	15.7	10.2	7.4
2018[a]	87.7	**8**	**42.0**	**29.7**	**27.2**	17.4	13.4	8.8	6.5

a: Compliance with 24-hour $PM_{2.5}$ not met, values displayed in **bold.**
b: NR – Not reported due to method being assessed for suitability

Table 79: Percentiles of daily $PM_{2.5}$ at Footscray (2014–2018) (equivalence methods)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2014[ac]	*25.2*	*NR*	*18.1*	*13.7*	*13.1*	*11.8*	*10.1*	*8.1*	*6.5*
2015[a]	*73.4*	*0*	*23.3*	*19.3*	*16.4*	*13.4*	*11.6*	*9.0*	*6.8*
2016[b]	93.4	**2**	**25.9**	19.6	14.6	12.9	11.1	8.4	6.2
2017[b]	96.4	**4**	**34.8**	24.5	20.7	15.5	13.1	9.2	6.8
2018[b]	88.5	**5**	**31.2**	**28.3**	20.9	15.3	12.5	8.8	6.7

a: Data availability between 15 and 75 per cent, values displayed in *italics*.
b: Compliance with 24-hour $PM_{2.5}$ not met, values displayed in **bold.**
c: NR – Not reported due to method being assessed for suitability

Table 80: Percentiles of daily $PM_{2.5}$ at Geelong (2016 - 2018) (equivalence methods)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2016[a]	*51.4*	*0*	*15.5*	*12.6*	*11.6*	*10.0*	*9.0*	*6.8*	*5.3*
2017[b]	82.7	**2**	**26.8**	22.3	18.2	13.5	10.9	8.5	6.4
2018[b]	86.8	**1**	**31.0**	21.9	18.4	13.6	10.2	7.7	5.6

a: Data availability between 15 and 75 per cent, values displayed in *italics*.
b: Compliance with 24-hour $PM_{2.5}$ not met, values displayed in **bold.**

Table 81: Percentiles of daily $PM_{2.5}$ at Traralgon (2016 - 2018) (equivalence methods)

Year	Data availability (% of days)	No. of exceedances (days)	Max (µg/m³)	Percentiles (µg/m³)					
				99th	98th	95th	90th	70th	50th
2016[a]	95.1	**1**	**25.7**	22.9	20.6	15.6	12.4	9.3	6.9
2017[a]	86.8	**5**	**32.3**	**28.0**	22.0	18.3	14.8	9.8	7.2
2018[a]	87.1	**2**	**30.1**	23.2	22.3	17.7	13.4	9.7	6.8

a: Compliance with 24-hour $PM_{2.5}$ not met, values displayed in **bold.**