

# Particulate matter concentrations (PM<sub>10</sub>)

This factsheet presents indicators of particulate matter (PM<sub>10</sub>) concentrations at monitoring sites in New Zealand between 2006 and 2016. Concentrations are measured against the National Environmental Standard for Air Quality (NESAQ) and a WHO guideline for PM<sub>10</sub> exposure.

## Key facts



38 monitoring stations exceeded the daily (NESAQ) PM<sub>10</sub> standard on almost 3,700 occasions between 2006 and 2016.



More than three quarters of exceedances of the daily (NESAQ) PM<sub>10</sub> standard occur in the winter months.



22 out of 45 monitoring stations exceeded the annual average (WHO) guideline. The combined annual average PM<sub>10</sub> concentration decreased between 2006 and 2016.

## What is particulate matter?

The most significant impacts on human health from air pollution are due to exposure to particulate matter (PM). PM can affect more people than any other air pollutant and the relationship between health impacts and PM air pollution is therefore well researched (WHO 2013).

PM consists of small airborne particles, including solid matter and liquid droplets. PM<sub>10</sub> refers to particles with a diameter of less than 10 micrometres, which is the major air pollutant monitored in New Zealand. These particles are derived primarily through suspension of dust and soil and other materials from roads, farming, construction, or mining activities, and combustion of coal and oil. PM<sub>10</sub> also includes sea salts, mould, pollen and other plant parts (Pope & Dockery 2006; WHO 2013).

For information on PM<sub>2.5</sub> [Visit our website](#)

## PM<sub>10</sub> increases the risk of respiratory illnesses

Coarse particles such as PM<sub>10</sub> deposit in the upper airways, whereas small particles such as PM<sub>2.5</sub> deposit in the very small airways deep in the lungs (Pope & Dockery 2006).

Short-term and long-term exposure to PM<sub>10</sub> is associated with a wide range of health impacts. Mild impacts include shortness of breath or coughing. More severe impacts include premature death from cardiovascular and respiratory problems and an increased risk of lung cancer. Exposure to PM<sub>10</sub> can also worsen asthma symptoms (Ministry for the Environment and Stats NZ 2018; WHO 2013).

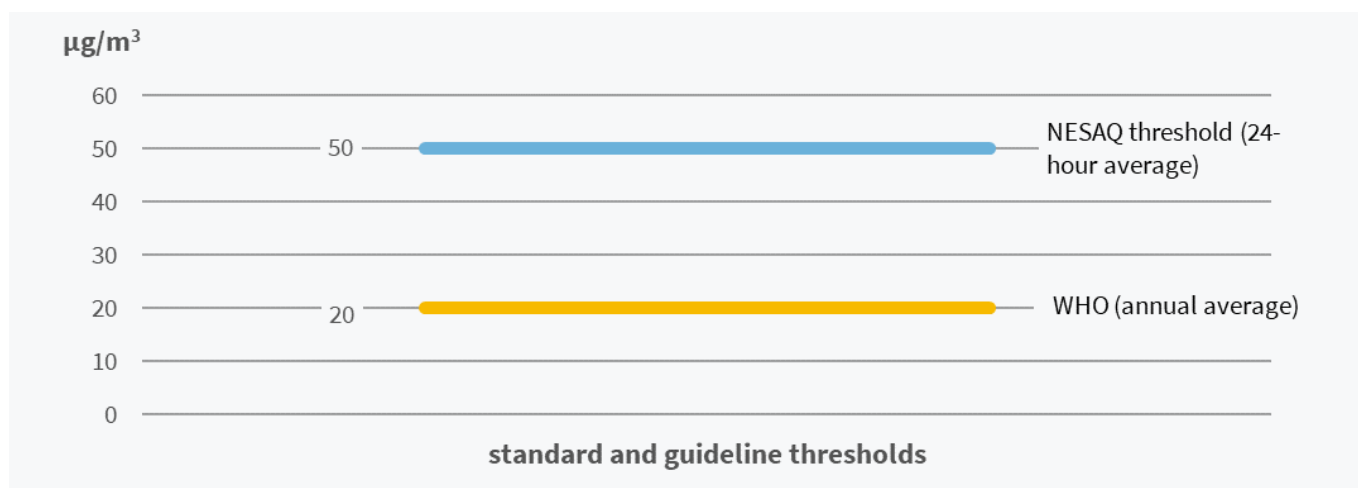
Children, the elderly, and people with pre-existing conditions such as cardiovascular or respiratory diseases are particularly vulnerable to health impacts from PM<sub>10</sub> air pollution (Ministry for the Environment and Stats NZ 2018).

## PM<sub>10</sub> air quality standards and guidelines

PM<sub>10</sub> air quality standards and guidelines have been developed to provide some level of protection against health risks. However, currently there is no evidence for a threshold below which health effects do not occur (WHO 2013). Daily concentrations (24-hour average) are measured against a threshold value of 50µg/m<sup>3</sup> in the National Environmental Standards for Air Quality (NESAQ). This value is allowed to be exceeded one time in a 12-month period (Ministry for the Environment and Stats NZ 2018).

Additionally, annual average concentrations can be compared against the international WHO guideline of 20µg/m<sup>3</sup> (Figure 1) (Ministry for the Environment and Stats NZ 2018).

**Figure 1: PM<sub>10</sub> standard (24-hour average) and guideline (annual average)**



**Note:** National Environmental Standards for Air Quality (NESAQ), World Health Organization (WHO). Exceedances occur when concentrations are greater than the stated values. One exceedance of the NESAQ threshold is allowed in a 12-month period.

**Source:** Ministry for the Environment and Stats NZ 2018.

## 45 out of 93 monitoring sites had valid data between 2006 and 2016

Between 2006 and 2016, 45 out of 93 monitoring sites had valid data for PM<sub>10</sub> exposure (see metadata sheet for more information) (Figure 2).

**Figure 2: Monitoring stations with valid data, by regional council, 2006-2016**

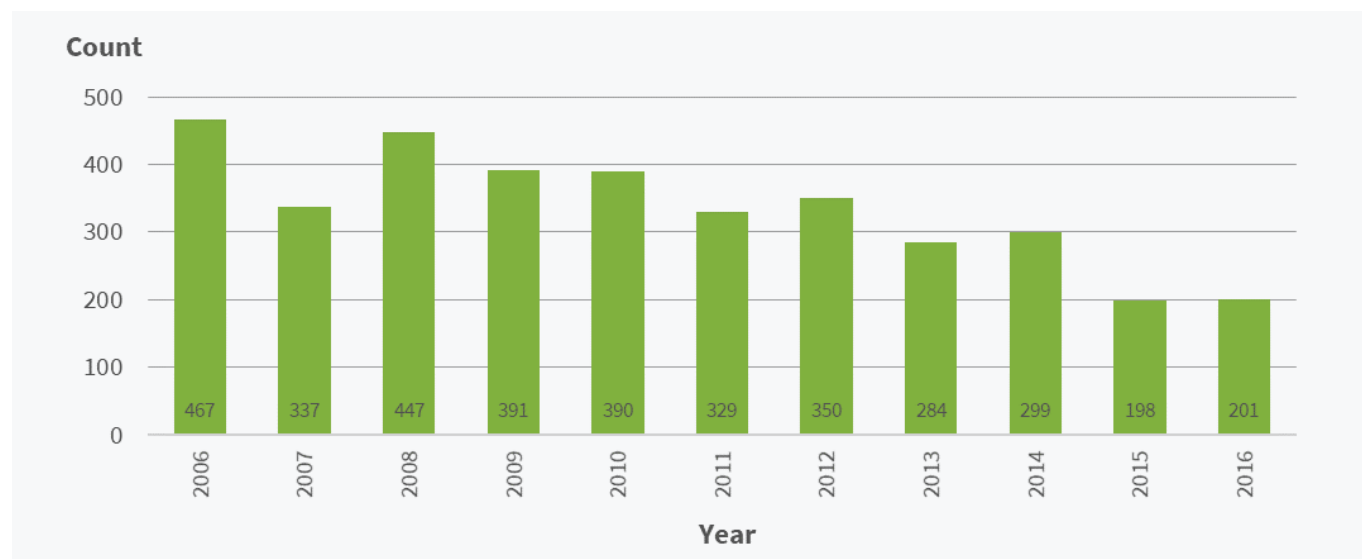


Source: Ministry for the Environment and Stats NZ.

## 38 out of 45 monitoring stations exceeded the NESAQ threshold between 2006 and 2016

Of the 45 monitoring stations, 38 exceeded the national 24-hour average standard on almost 3,700 occasions between 2006 and 2013 (Figure 3). The three monitoring stations that exceeded the standard the most between 2006 and 2016 were in the South Island (Figure 4): Alexandra (Otago), Arrowtown (Otago), and Timaru (Dunedin).

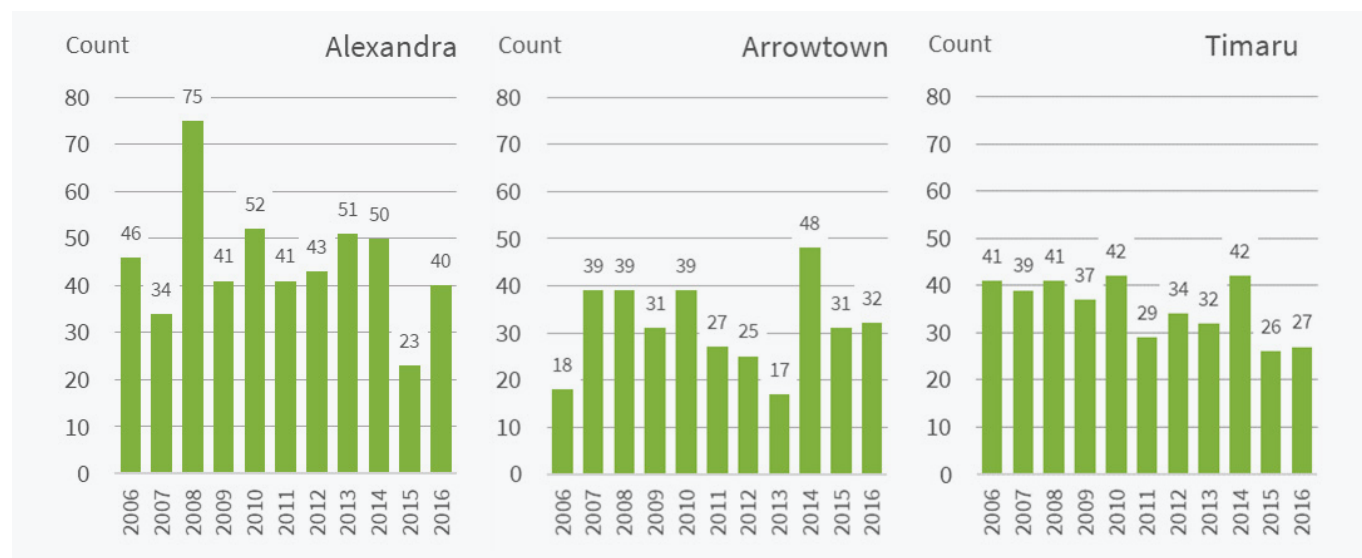
**Figure 3: Number of exceedances of the NESAQ's threshold (24-hour average) in New Zealand, 2006-2016**



**Note:** NESAQ 24-hour threshold:  $50\mu\text{g}/\text{m}^3$ . Number of exceedances are the sum of 38 monitoring stations.

**Source:** Ministry for the Environment and Stats NZ 2018.

**Figure 4: Number of exceedances of the NESAQ's threshold (24-hour average) at selected monitoring stations, 2006-2016**



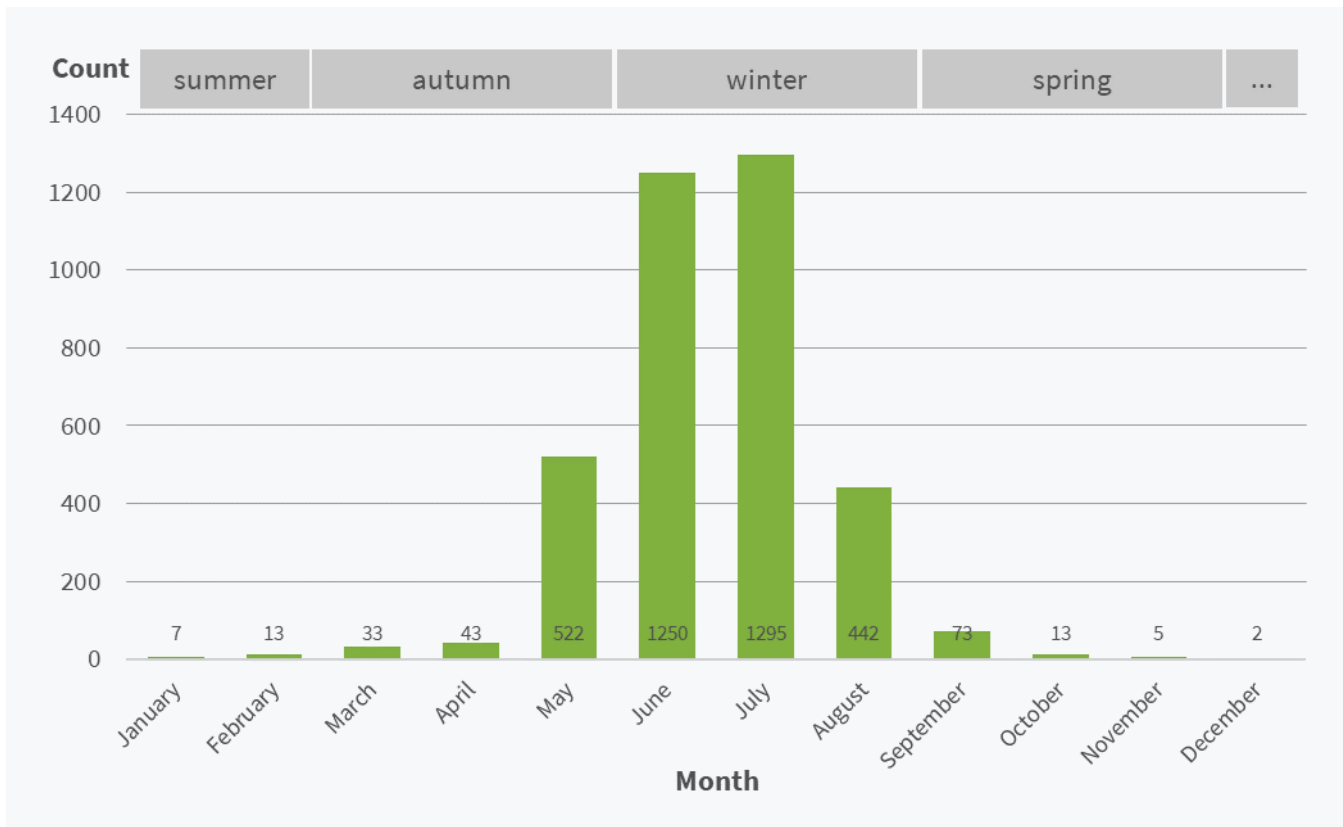
**Note:** NESAQ 24-hour threshold:  $50\mu\text{g}/\text{m}^3$ .

**Source:** Ministry for the Environment and Stats NZ 2018.

## Most exceedances occur in the colder months

Between 2006 and 2016, 80.8% (2,987) of all exceedances of the 24-hour average threshold occurred in the winter months (June/July/August) (Figure 5). Over 16% (598) of exceedances occurred in autumn (March/April/May). Most of the exceedances (96.9%) therefore happen in the colder months. During the cooler months, home heating emissions increase, contributing to worse PM<sub>10</sub> concentrations and therefore exceedances. Furthermore, calm and frosty weather conditions in the winter months more easily allow for a build-up of air pollutants (Ministry for the Environment and Stats NZ 2018).

**Figure 5: Number of exceedances of the NESAQ’s threshold (24-hour average) in New Zealand, by month, 2006-2016**

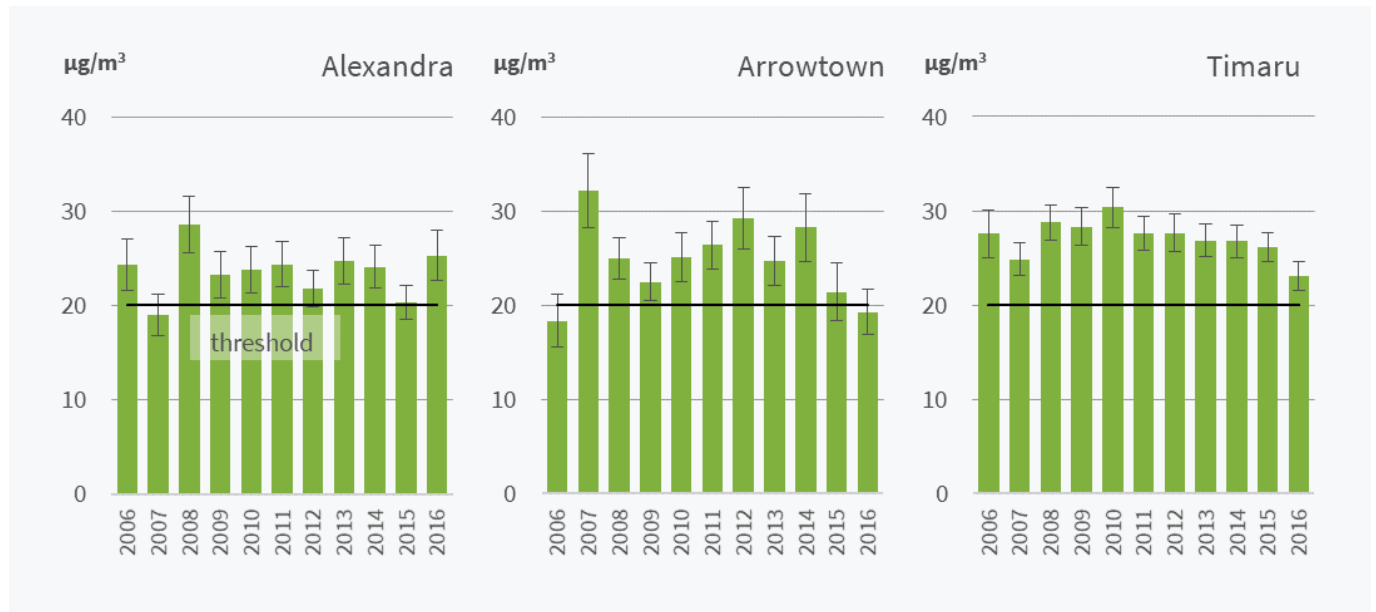


**Note:** NESAQ 24-hour threshold: 50µg/m<sup>3</sup>. Number of exceedances are the sum of 38 monitoring stations.  
**Source:** Ministry for the Environment and Stats NZ 2018.

## The annual average WHO guideline was exceeded by 22 out of 45 monitoring stations

22 out of 45 monitoring stations exceeded the WHO annual average guideline between 2006 and 2016. The monitoring stations Alexandra (Otago), Arrowtown (Otago), and Timaru (Canterbury) exceeded the guideline the most between 2006 and 2016. In 2007, the monitoring station Arrowtown (Otago) had the highest annual average ( $32.2\mu\text{g}/\text{m}^3$ ) of all monitoring stations between 2006 and 2016 (Figure 6).

**Figure 6: Annual average PM<sub>10</sub> concentrations at selected monitoring stations, 2006-2016**

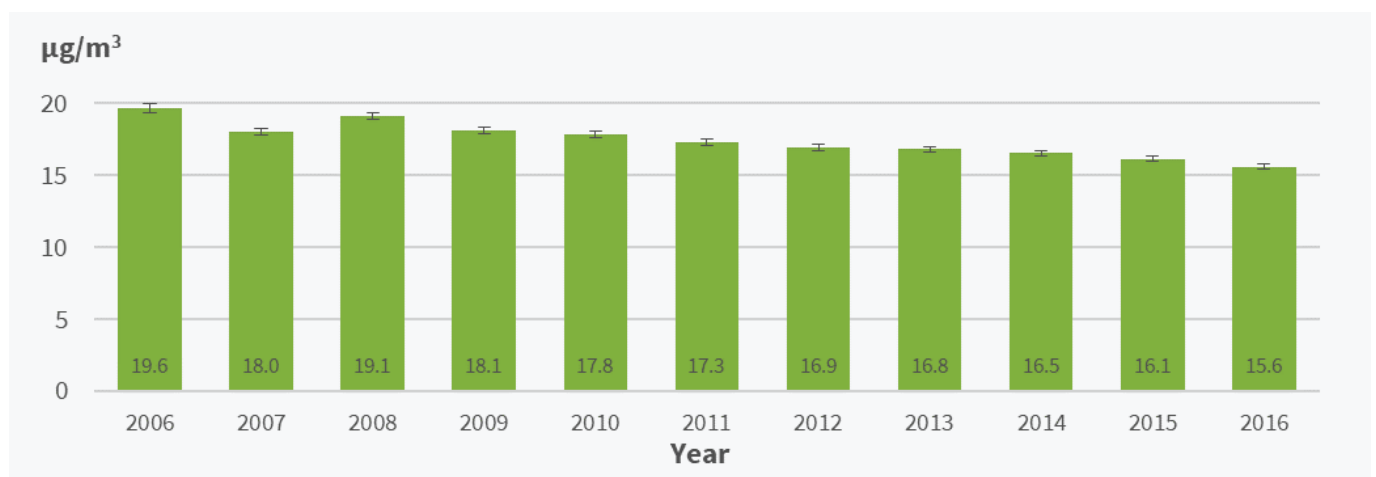


**Note:** WHO annual average guideline:  $20\mu\text{g}/\text{m}^3$

**Source:** Ministry for the Environment and Stats NZ 2018.

Between 2006 and 2016, the annual average PM<sub>10</sub> concentration (averaged across all 45 monitoring stations with valid data) decreased by  $4\mu\text{g}/\text{m}^3$  from  $19.6\mu\text{g}/\text{m}^3$  to  $15.6\mu\text{g}/\text{m}^3$  (Figure 7).

**Figure 7: Annual average PM<sub>10</sub> concentrations in New Zealand, 2006-2016**



**Source:** Ministry for the Environment and Stats NZ 2018.

## Data for these indicators

95% confidence intervals have been presented as error bars on graphs. Unless otherwise stated, all differences mentioned in the text between two values are statistically significant at the 5% level or less.

### Monitoring sites exceeding the national environmental standard (24-hour average) for PM<sub>10</sub>

24-hour average PM<sub>10</sub> concentration data comes from the Ministry for the Environment and Stats NZ (Ministry for the Environment and Stats NZ 2018) as part of New Zealand's Environmental Reporting Series. 24-hour average PM<sub>10</sub> concentrations (in  $\mu\text{g}/\text{m}^3$ ) are compared with the National Environmental Standard for Air Quality for sulphur dioxide. The threshold is exceeded when concentrations are above  $50\mu\text{g}/\text{m}^3$ . The threshold is allowed to be exceeded one time in a 12-month period. For additional information, see the metadata link below.

### Monitoring sites exceeding the WHO annual average guideline for PM<sub>10</sub>

Annual average PM<sub>10</sub> concentration data comes from the Ministry for the Environment and Stats NZ (Ministry for the Environment and Stats NZ 2018) as part of New Zealand's Environmental Reporting Series. Annual averages are calculated and measured against the WHO guideline. Exceedances occur when concentrations are above  $20\mu\text{g}/\text{m}^3$ . For additional information, see the metadata link below.

## References

Ministry for the Environment and Stats NZ. 2018. *Our air 2018. Data to 2017*. Wellington: Ministry for the Environment.

Pope CA & Dockery DW. 2006. Health effects of fine particulate air pollution: Lines that connect. *Journal of the Air & Waste Management Association* 56:709–42.

WHO. 2006. *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide. Global update 2005. Summary of risk assessment*. Geneva: World Health Organization.

WHO. 2013. *Review of evidence on health aspects of air pollution – REVIHAAP Project*. Copenhagen: WHO Regional Office for Europe.

## Other related topics include:

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## Citation

Environmental Health Intelligence. 2020. *Particulate matter (PM<sub>10</sub>) concentrations*. [Factsheet]. Wellington: Environmental Health Intelligence New Zealand, Massey University.

## Further information

For descriptive information about the data:

Metadata Sheet for 24-hour average concentrations [🔍 Metadata Sheet](#)

and Metadata Sheet for annual average concentrations [🔍 Metadata Sheet](#)

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