

## 6.2. 2022 Air Quality SOE Report

**Prepared for:** Environmental Science and Policy Comm  
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### PURPOSE

This annual report presents the results of the State of the Environment (SoE) monitoring for air quality for the calendar year 2022.

### EXECUTIVE SUMMARY

- [1] Monitoring of particulate matter - PM<sub>10</sub> and PM<sub>2.5</sub> - was undertaken at seven sites across Otago. Of the sites, Alexandra, Arrowtown and Mosgiel all recorded exceedances of the NESAQ<sup>1</sup> for PM<sub>10</sub> during the winter months, with a total of 17 exceedances.
- [2] PM<sub>2.5</sub> was monitored at Arrowtown, Central Dunedin, Clyde, Cromwell and Milton. There is currently no National Environmental Standard for PM<sub>2.5</sub> but one was proposed in 2020 and likely to be introduced in the updated National Environmental Standard for Air Quality (NESAQ).

### RECOMMENDATION

*That the Environmental Science and Policy Committee:*

- 1) **Notes** this report.

### BACKGROUND

- [3] Otago has several towns where air quality is considered degraded during winter, namely Alexandra, Arrowtown, Clyde, Cromwell and Milton. Under the Resource Management Act 1991 (RMA) regional councils are required to monitor air quality, and improve it where necessary. The main pollutant of concern is particulate matter which is measured as PM<sub>10</sub> and PM<sub>2.5</sub>. Particulate matter are products of combustion. PM<sub>10</sub> is all particle matter with a diameter of less than 10 micrometres (µm), while PM<sub>2.5</sub> consists of fine particles less than 2.5 µm.
- [4] In Otago the main source of particulate matter is home heating emissions in winter (Wilton, 2019). Long term exposure to PM<sub>10</sub> and PM<sub>2.5</sub> contribute to the risks of developing cardiovascular and respiratory conditions, or exacerbating existing conditions, which makes fine particulates a serious threat to human health (WHO, 2005). Furthermore, recent research provides evidence that air pollution is dangerous at lower concentrations than previously thought, and supports the lowering of existing guidelines (WHO, 2021).

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<sup>1</sup> National Environmental Standards for Air Quality - the limit for PM<sub>10</sub> is 50 µg/m<sup>3</sup> over a 24-hour average

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- [5] ORC has an SOE monitoring network to monitor PM<sub>10</sub> and is required under the NESAQ to report<sup>2</sup> exceedances (50 µg/m<sup>3</sup>, 24-hour average). The network is currently being upgraded to include monitoring for PM<sub>2.5</sub> in anticipation of the new standards being adopted. The upgrade process includes a twelve-month period of co-location and subsequent equivalence testing of the new instruments compared to the existing ones. Currently the instruments at Central Dunedin and Arrowtown have undergone this process for PM<sub>10</sub> and will need to do the same for PM<sub>2.5</sub>. For this reason, the PM<sub>2.5</sub> data presented in this report for these sites is uncorrected and cannot be compared to standards and guidelines.
- [6] In the past, ORC has implemented a work programme as part of the Air Quality Strategy 2018 to help improve air quality in targeted towns. This has led to the long-term reduction in PM<sub>10</sub> concentrations in Alexandra, Arrowtown, Cromwell, Clyde, and Milton (ORC, 2021). For regional context, Table 1 is reproduced from the 2021 air quality SOE report and shows the number of annual exceedances at monitoring sites from 2010-2019. Despite these improvements, significant reductions in emissions are still required for these towns to consistently comply with the NESAQ limit of 50 µg/m<sup>3</sup> (24-hour average) for PM<sub>10</sub>.

Site	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alexandra - 65 Ventry Street	51	40	40	46	51	22	38			
Alexandra - 5 Ventry Street								3	2	6
Arrowtown - School	39	27	24	15						
Arrowtown - Alexander Place					48	30	32	45	29	19
Balclutha	2	4	13	4	3	9	10	14	5	
Central Dunedin	11	14	1	1	0	0	0	0	1	0
Clyde	40	23	9	10	21	10	18	23	6	4
Cromwell	43	27	30	33	49	27	34	41	13	13
Milton	46	20	37	44	14	30	35	48	16	20
Mosgiel	8	8	NA	5	5	7	9	9	4	4

**Table 1. Number of NESAQ exceedances per site for 2010-2019. Shaded squares represent sites that were not in operation. Alexandra and Arrowtown monitors were relocated due to site availability (from ORC, 2021). See also Table 5 below.**

## AIR QUALITY ASSESSMENT FRAMEWORK

- [7] Under the RMA, councils are required to monitor air quality and work towards meeting the standards of the NESAQ. The NESAQ is currently being updated to include limits for PM<sub>2.5</sub>, with proposed limits released in 2020 (Table 2). The NESAQ is the legal standard for air quality in New Zealand. In 2021 the World Health Organization (WHO) released updated Air Quality Guidelines (AGL) which recommended new and stricter limits for pollutants (WHO 2021). The relevant standards and guidelines are given below (Table 2) alongside the WHO standards.

<sup>2</sup> The ORC currently reports exceedances monthly in the ODT by way of public notice.

**Table 2 Standards and guidelines for PM<sub>10</sub> and PM<sub>2.5</sub>**

Pollutant	Averaging Time	NESAQ 2004		Proposed NESAQ 2020		WHO 2021	
		Limit (µg/m <sup>3</sup> )	Allowable exceedances	Limit (µg/m <sup>3</sup> )	Allowable exceedances	Limit (µg/m <sup>3</sup> )	Allowable exceedances
PM <sub>10</sub>	24-hour	50	1 per year	50	1 per year	45	3-4 <sup>b</sup>
	Annual	20 <sup>a</sup>	NA	NA	NA	15	NA
PM <sub>2.5</sub>	24-hour			25	3 per year	15	3-4 <sup>b</sup>
	Annual			10	NA	5	NA

<sup>a</sup> AAQG (Ambient Air Quality Guideline, 2002) limit and NESAQ guideline

<sup>b</sup> 99<sup>th</sup> percentile, means there can be 3 to 4 allowable exceedances per year

- [8] The air quality results can also be categorised according to the Ministry for Environment (MfE) Environmental Performance Indicators (EPI), outlined in the Ambient Air Quality Guidelines (AAQG, 2002). The EPI categories indicate an appropriate action according to the concentrations (Table 3).

**Table 3 MfE Environmental Performance Indicators for air quality**

Category	Monitoring result compared to guideline	Description
Action	Exceeds the guideline	Unacceptable and action is required to reduce emissions
Alert	66-100%	Warning level which could lead to exceedances if trends are not curbed
Acceptable	33-66%	Maximum values might be a concern in sensitive locations, urgent action is not warranted
Good	10-33%	Peak measurements not likely to affect air quality
Excellent	0-10%	Not recommended for PM <sub>10</sub> monitoring, PM <sub>10</sub> in this range is classified as good instead

**SOE MONITORING RESULTS: PM<sub>10</sub>**

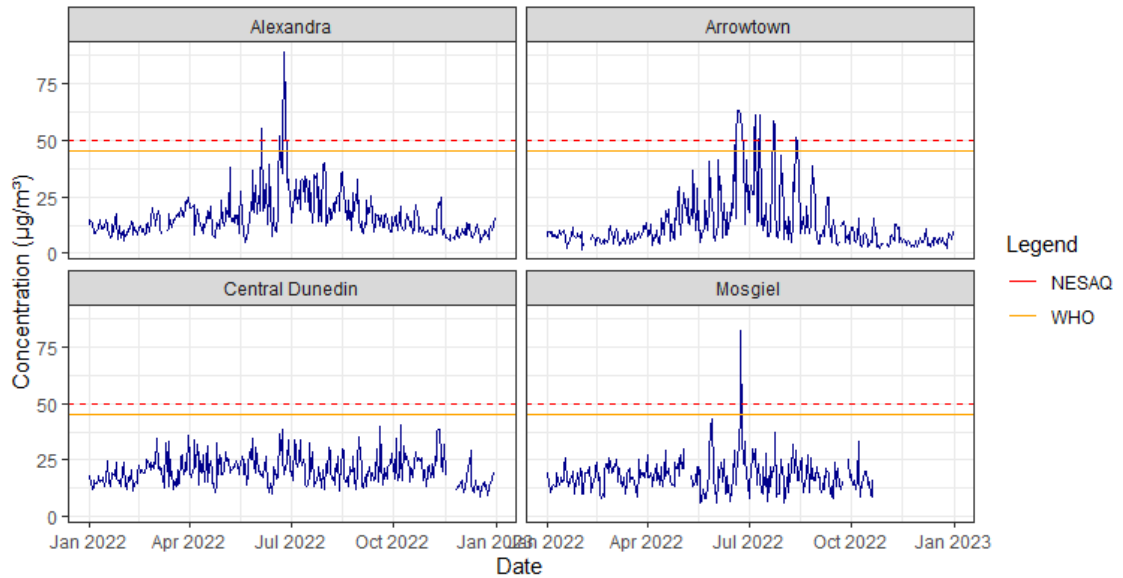
[9] PM<sub>10</sub> was monitored at four sites in 2022: Alexandra, Arrowtown, Central Dunedin and Mosgiel. A summary of the key PM<sub>10</sub> monitoring indicators for 2021 are given in Table 4, with a detailed breakdown of exceedances in Appendix 1. Arrowtown had the most NESAQ exceedances with 12, however Central Dunedin had the highest annual average of 20 µg/m<sup>3</sup>. Arrowtown and Alexandra had the highest winter means of 24 and 23 µg/m<sup>3</sup>, respectively. Alexandra and Mosgiel had the highest maximum 24-hour concentrations of 89 and 83 µg/m<sup>3</sup>, respectively.

**Table 4 Key indicators for PM<sub>10</sub>**

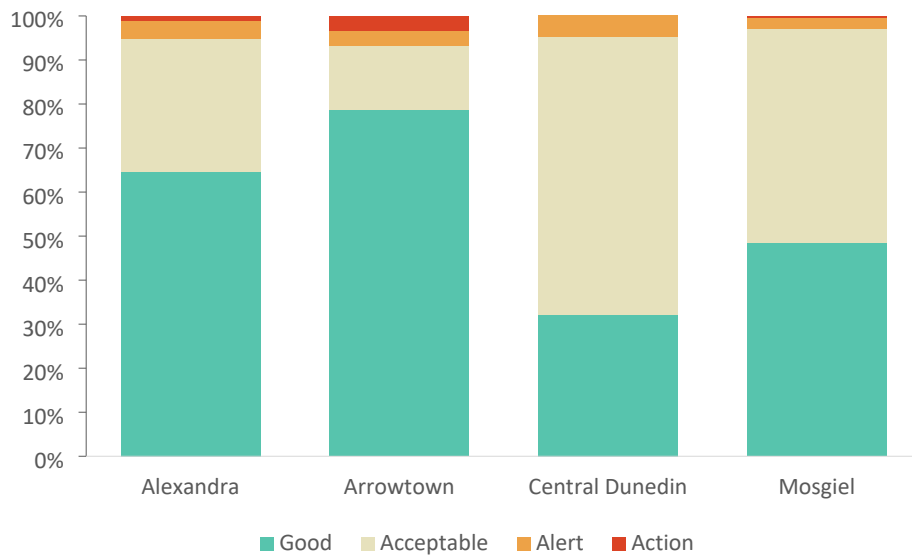
Site	Annual mean (µg/m <sup>3</sup> )	Winter mean (µg/m <sup>3</sup> )	Maximum daily concentration (µg/m <sup>3</sup> )	2nd highest daily concentration (µg/m <sup>3</sup> )	Number of NESAQ exceedances	Data capture (%)
Alexandra	16	24	89	64	4	98
Arrowtown	13	23	63	63	12	97
Central Dunedin	20	21	41	39	0	97
Mosgiel	18	20	83	46	1	76*

\*Due to the site upgrade Mosgiel is missing data from 21<sup>st</sup> October onwards

[10] Figure 1 PM<sub>10</sub> concentrations for 2022 (24-hour average)



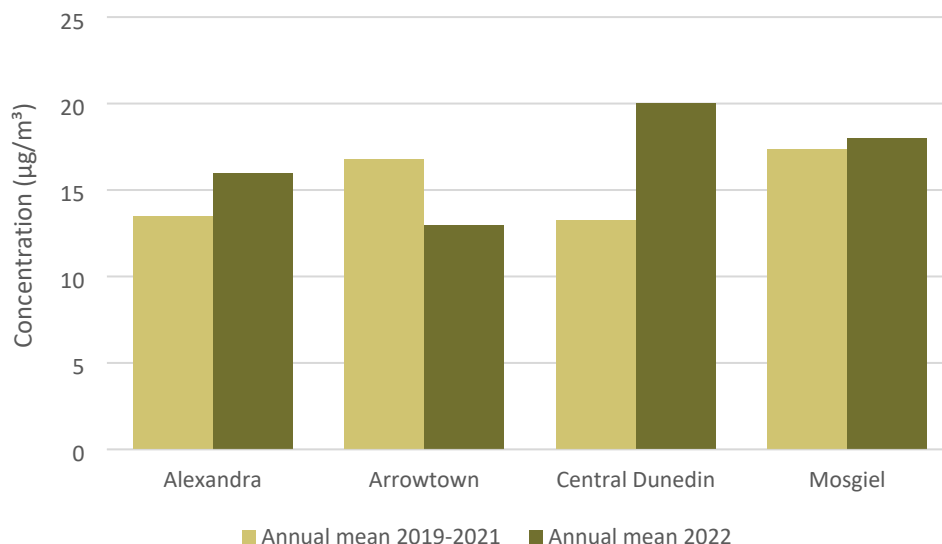
[11] Figure 2 PM<sub>10</sub> concentrations as air quality indicator categories for 2022 (24-hour average)



[12] When the PM<sub>10</sub> data is categorised into MfE indicator categories, Central Dunedin and Mosgiel have the most data within the “acceptable” categories compared to Alexandra and Arrowtown which have between 60-80% of days in the “good” category. All sites have less than 10% of data in the “alert” and “action” categories (Figure 2). Only 30% of Central Dunedin’s data was within the “good” category, compared to almost 70% in 2021. The most likely explanation for this is that there was significant construction taking place close to the air quality station during 2022. The air quality monitoring site has now been relocated 200m to the north-west.

[13] When compared to previous years, all sites except Arrowtown had higher annual averages. Both Arrowtown and Mosgiel had lower means than previous years (Figure 3). Arrowtown and Mosgiel had fewer exceedances than previous years (Table 5).

[14] **Figure 3 Annual PM<sub>10</sub> means for 2022 compared to 2019-2021**



**Table 5 Number of exceedances of PM<sub>10</sub> for 2013 – 2022**

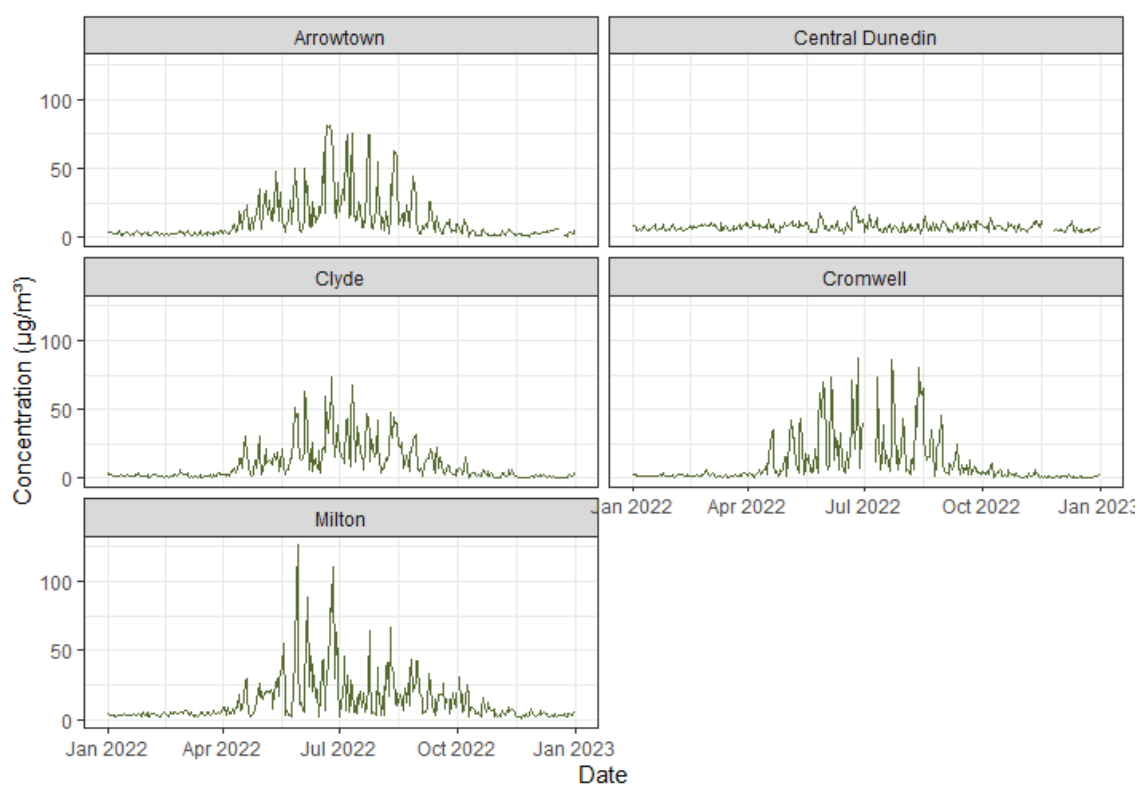
Site	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Alexandra					3	2	6	6	3	4
Arrowtown		48	30	32	45	29	19	25	23	12
Central Dunedin	1	0	0	0	0	1	0	0	1	0
Mosgiel	5	5	7	9	9	4	4	5	4	1

#### SOE MONITORING RESULTS: PM<sub>2.5</sub>

[15] PM<sub>2.5</sub> was monitored in five locations during 2022. Similarly, to PM<sub>10</sub>, all sites except for Central Dunedin had high concentrations during the winter (Figure 5). The sites with high winter concentrations also had very low summer concentrations, bringing their annual averages lower than that of Central Dunedin. Arrowtown had the highest winter mean of 27 µg/m<sup>3</sup>, and Milton had the highest daily concentration of 126 µg/m<sup>3</sup> (Table 6).

[16] Some of these values are higher than the PM<sub>10</sub> averages and concentrations for the same site. This is because in Arrowtown and Central Dunedin, the new instruments have been used and correction factors are still required before these data can be compared to PM<sub>10</sub> instruments, or to standards and guidelines. For Clyde, Cromwell and Milton, the instruments used are non-reference method and are unable to be compared to standards and guidelines, therefore the below data is provisional only.

**Figure 5 PM<sub>2.5</sub> concentrations for 2022 (24-hour average)**



**Table 6 Key PM<sub>2.5</sub> indicators for 2022**

Site	Annual mean (µg/m <sup>3</sup> )	Winter mean (µg/m <sup>3</sup> )	Maximum daily concentration (µg/m <sup>3</sup> )	2nd highest daily concentration (µg/m <sup>3</sup> )
Arrowtown	12	27	81	81
Central Dunedin	7	8	22	20
Clyde	10	23	73	67
Cromwell	11	25	87	77
Milton	13	26	126	111

## CONSIDERATIONS

### Strategic Framework and Policy Considerations

[17] The work outlined in this paper contributes to the following elements of ORC’s Strategic Direction

- a. Monitoring air quality in the region and investigate pollution sources
- b. Provide best available information on Otago’s air quality

### Financial Considerations

[18] The Air Quality work is a budgeted and planned activity.

### **Significance and Engagement Considerations**

[19] N/A

### **Legislative and Risk Considerations**

[20] N/A

### **Climate Change Considerations**

[21] N/A

### **Communications Considerations**

[22] ORC's Air quality communications ("Burn dry, breathe easy" campaign) will continue for winter 2023.

### **NEXT STEPS**

[23] Monitoring site upgrades (Wanaka and Queenstown) will continue in 2023

[24] New proposal for monitoring network upgrades, including monitoring of PM<sub>2.5</sub> and NO<sub>2</sub> will be included for the next LTP cycle

### **ATTACHMENTS**

Nil

### **REFERENCES**

Otago Regional Council, 2021. *Air Quality 2010 – 2019 SoE Report*. State of the Environment Report, September 2021. <https://www.orc.govt.nz/media/11935/soe-air-quality-state-and-trends-2010-2019.pdf>

Wilton, E. 2019. *Wanaka, Cromwell and Clyde Air Emission Inventory – 2019*. Environet Ltd

World Health Organisation, 2006. *Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide: Global update 2005: Summary of risk assessment*. Retrieved from <https://www.who.int/airpollution/publications/aqg2005/en/>

World Health Organisation, 2021. *WHO global air quality guidelines: particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*. Retrieved from <https://apps.who.int/iris/handle/10665/345329>



## APPENDIX 1: Exceedance table for 2022

Site	Alexandra	Arrowtown	Central Dunedin	Mosgiel
Date	Concentration ( $\mu\text{g}/\text{m}^3$ ) 24-hour average			
5/06/2022	55			
20/06/2022		52		
21/06/2022	52	63		
22/06/2022		63		
23/06/2022		61		
24/06/2022		61		83
25/06/2022	89	54		
26/06/2022	64			
6/07/2022		51		
7/07/2022		61		
11/07/2022		61		
23/07/2022		59		
24/07/2022		57		
12/08/2022		51		
Total number of exceedances	<b>4</b>	<b>12</b>	<b>0</b>	<b>1</b>