10.9. Annual Air Quality Report 2025

Prepared for: Council

Report No. S&R2604

Activity: Science

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PURPOSE

[1] This report presents the results of the State of the Environment (SOE) monitoring for air quality for the calendar year 2025.

EXECUTIVE SUMMARY

[2] This report provides a summary of the 2025 air quality data only. State and Trends reports, which contain long and short-term trend analysis, are produced every five years. The most recent one was published in June 2024.

[3] Monitoring of PM_{10} (particulate matter with a diameter less than 10 micrometres) was undertaken in the Alexandra, Arrowtown, Central Dunedin and Mosgiel airsheds in 2025. Alexandra, Arrowtown and Mosgiel recorded exceedances of the National Environmental Standard for Air Quality (NESAQ) during the winter months. The NESAQ limit for PM_{10} is 50 µg/m³ for a 24-hour average. Across the four monitored towns, there were a total of 16 exceedances in 2025. Alexandra and Arrowtown recorded four and ten exceedances, respectively, and Mosgiel recorded two.

[4] $PM_{2.5}$ (particulate matter with a diameter less than 2.5 micrometres) was monitored in Arrowtown, Central Dunedin, Clyde, Cromwell, Milton, Mosgiel, Queenstown (Frankton) and Wānaka in 2025. The site with the highest annual average was Clyde with 12 µg/m³. The site with the highest 24-hour average was Clyde with 77 µg/m³ on 18/07/2025. There are no current NESAQ limits for $PM_{2.5.}$

[5] Monitoring of black carbon (BC) was undertaken at Arrowtown in 2025. BC is a component of particulate matter and is an important pollutant affecting both climate and human health. There are no standards or guidelines for it currently. The data shows strong seasonal and daily patterns, similar to that of PM. The highest 24-hour average was 6 µg/m³ occurring on 23/07/2025.

RECOMMENDATION

That the Council:

1) ***Notes*** *this report.*

BACKGROUND

[6] Otago has several towns where air quality is considered degraded during winter, namely Alexandra, Arrowtown, Clyde, Cromwell, Milton and Mosgiel. The main pollutant of concern in Otago is particulate matter (PM) which is principally a product of combustion. In Otago, the main source of PM is home heating emissions (Wilton, 2019). Long-term exposure to PM_{10} and $PM_{2.5}$ contributes to the risks of developing and exacerbating existing cardiovascular and respiratory conditions, which makes them a serious threat to human health. Furthermore, recent research provides evidence that air pollution is dangerous at lower concentrations than previously thought (WHO, 2021).

[7] Otago Regional Council operates an SOE monitoring network for air quality monitoring and is required to report[1] exceedances of the NESAQ. The SOE network is currently being upgraded to include monitoring for $PM_{2.5}$ as well as expanded to add new sites. The upgrade process includes a period of co-location and subsequent equivalence testing of the new instruments compared to the existing ones to enable comparison. Further comparison data is still required to be able to correct for the new instruments and accurately report some of their data, but once completed, any data corrections can be backdated. During 2025, PM_{10} was monitored at four sites and $PM_{2.5}$ at eight sites.

AIR QUALITY ASSESSMENT FRAMEWORK

[8] Under the Resource Management Act (RMA), councils are required to monitor air quality in accordance with the NESAQ; any airshed at risk of exceeding the standard for any pollutant must be monitored. Otago currently has four gazetted airsheds, each comprised of multiple towns. By monitoring three of these four, ORC is compliant with NESAQ monitoring requirements which requires Regional Councils to monitor airsheds that likely experience exceedances (Otago's airshed 4 is likely not to experience exceedances). However, differences in emission sources and meteorology mean that it is unlikely that any one Otago town can accurately represent another.

[9] Air quality data can be compared to several standards and guidelines; however, the legal limit in Aotearoa New Zealand is 50 µg/m³ for a 24-hour average, under the NESAQ. The NESAQ is due to be updated, and limits for $PM_{2.5}$ were proposed in 2020. In 2021 the World Health Organization (WHO) released updated guidelines for many pollutants. In many cases, including for PM_{10}, the new WHO guidelines are stricter than they were previously, and $PM_{2.5}$ limits were added. The limits of the relevant standards and guidelines are listed in Table 1. The air quality data can also be categorised according to the Ministry for the Environment (MfE) Environmental Performance Indicators (EPI). The EPI categories indicate an appropriate action according to the concentrations (Table 2).

[1] ORC reports exceedances by way of public notice in the Otago Daily Times every month exceedances occur.

Table 1: Standards and guidelines for PM_{10} and $PM_{2.5}$

Pollutant	Averaging Time	NESAQ 2004		Proposed NESAQ 2020		WHO 2021	
		Value (µg/m³)	Allowable exceedances	Value (µg/m³)	Allowable exceedances	Value (µg/m³)	Allowable exceedances
PM_{10}	24-hour	50	1 per annum	50	1 per annum	45	3-4[b]
	Annual	20[a]	NA	NA	NA	15	NA
$PM_{2.5}$	24-hour			25	3 per annum	15	3-4[b]
	Annual			10	NA	5	NA

[a] Ambient Air Quality Guideline (AAQG) limit applies when there is no equivalent NESAQ limit
[b] 99th percentile, equating to 3-4 exceedances annually.

Table 2: Ministry for the Environment 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_{10} monitoring, PM_{10} in this range is classified as good instead

SOE MONITORING RESULTS: PM_{10}

[10] PM_{10} was monitored continuously at four sites across the region in 2025: Alexandra, Arrowtown, Central Dunedin and Mosgiel. A summary of the key PM_{10} indicators for 2025 are given in Table 3 and a list of the NESAQ exceedances are shown in Appendix 1. The highest annual mean occurred at the Mosgiel site with 14 µg/m³, meaning all sites met the WHO annual guideline of 15 µg/m³. The highest daily concentration, 78 µg/m³, was recorded at Alexandra on 25/07/2025. The most frequent number of exceedances occurred at the Arrowtown site, with daily concentrations exceeding the limit 10 times.

[11] Data capture was at least 97% at all sites, with the exception of Alexandra, where data capture was 87% due to an intermittent instrument error that occurred between 14/05/2025 and 19/06/2025 until the instrument could be replaced. Further data gaps occurred between 31/10/2025 and 03/11/2025 and between 06/11/2025 and 14/11/2025 due to maintenance and repairs, respectively.

Table 3: Key PM_{10} indicators for 2025

Site	Annual mean (µg/m³)	Winter mean (µg/m³)	Maximum 24-hour average concentration (µg/m³)	2nd highest 24-hour average concentration (µg/m³)	Number of NESAQ exceedances	Data capture (%)
Alexandra	13	21	78	70	4	87
Arrowtown	13	24	61	59	10	97
Central Dunedin	13	14	35	29	0	99
Mosgiel	14	20	64	59	2	98

[12] Figure 1 shows the seasonal patterns of the 24-hour average data in relation to the NESAQ limit and WHO guideline. Alexandra and Arrowtown have extreme seasonal variation, with high PM_{10} concentrations coming very close to and exceeding the limits. This data also shows that the concentrations can frequently approach the limit without becoming an exceedance. Mosgiel data also shows a slight seasonal pattern, while the Central Dunedin site has minimal annual variation. This data is reflective of PM sources in each airshed; Central Dunedin does not show a seasonal variation, as home heating emissions are not an important source compared to vehicle emissions and industrial activity. In addition, the Central Dunedin site has a milder climate, due to its coastal location. Mosgiel has a mixture of sources, while Alexandra and Arrowtown PM sources are primarily from winter home heating.

[13] When the data is sorted into the MfE indicator categories (Figure 2), all sites have over 70% of days in the "good" category. Arrowtown has approximately 10% of its data divided into the "alert" and "action" categories. Central Dunedin only had one day that can be categorised as "alert". The Alexandra and Mosgiel data showed that less than 5% of days were in either the "alert" or "action" categories.

[14] The number of exceedances varies year to year due to climate patterns and meteorology influencing the ability of pollutants to disperse. Compared to previous years, the number of exceedances in 2025 is most similar to 2022 and 2023 for the Alexandra and Arrowtown sites (Figure 3).

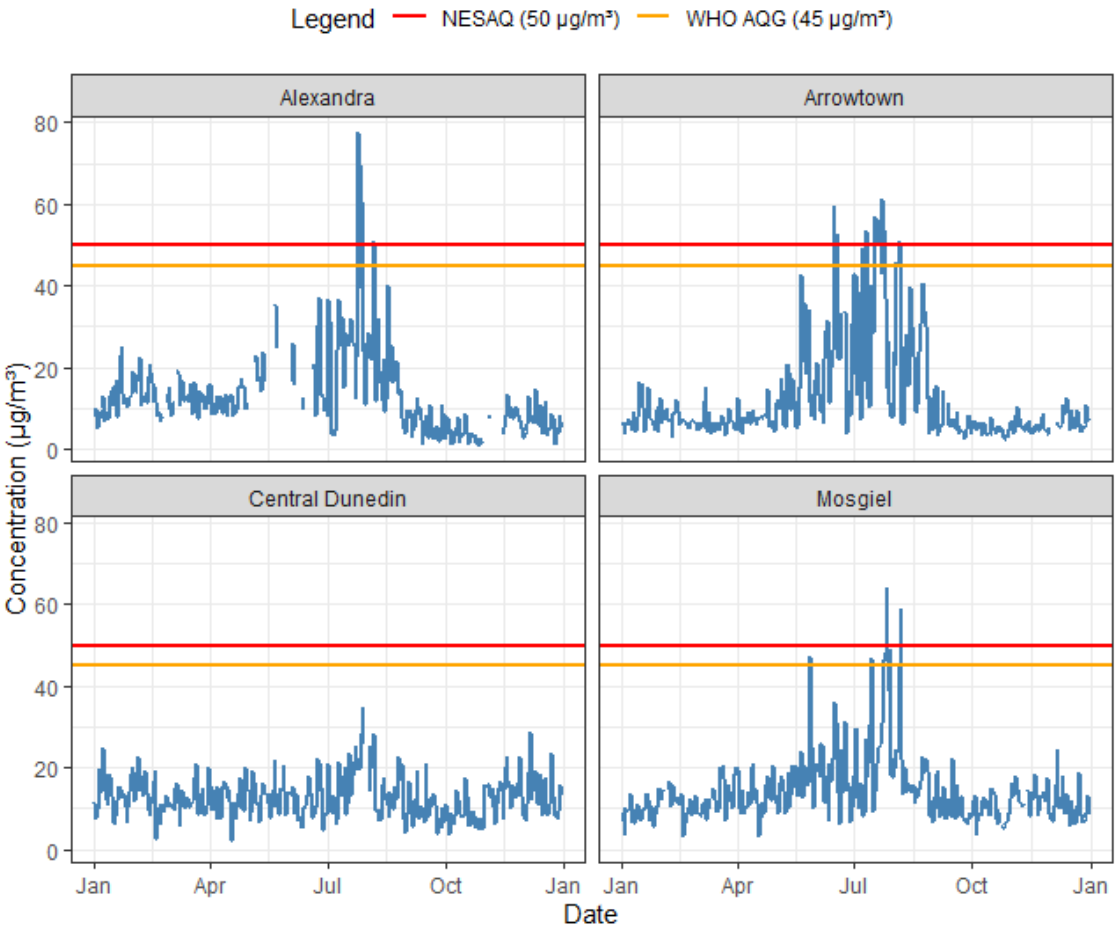

Figure 1: PM_{10} concentrations for 2025 (24-hour average)

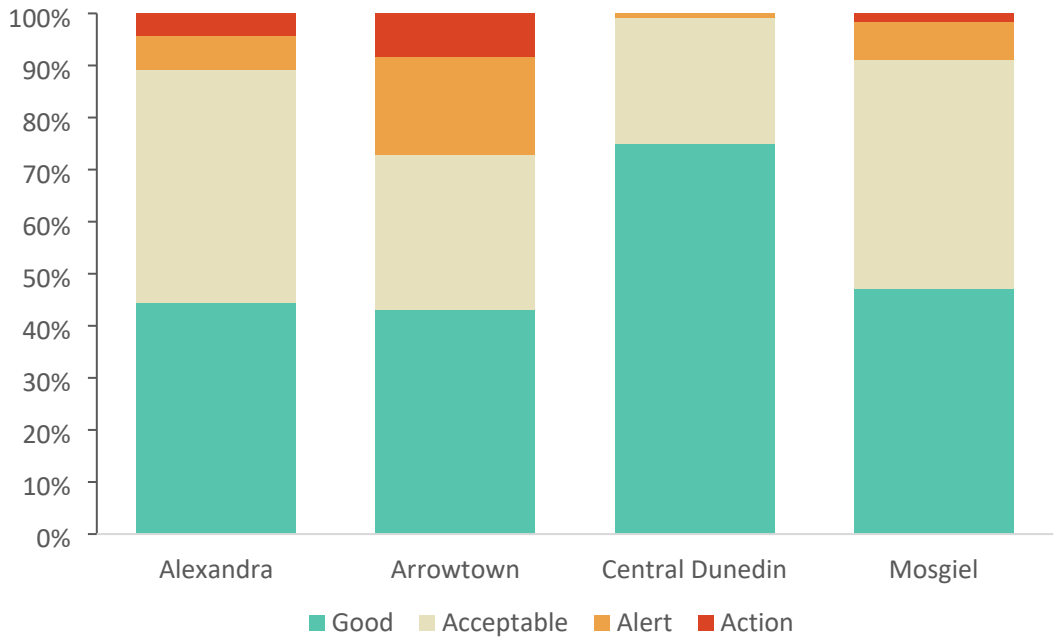

Figure 2: PM_{10} concentrations as air quality indicator categories for 2025 (24-hour average)

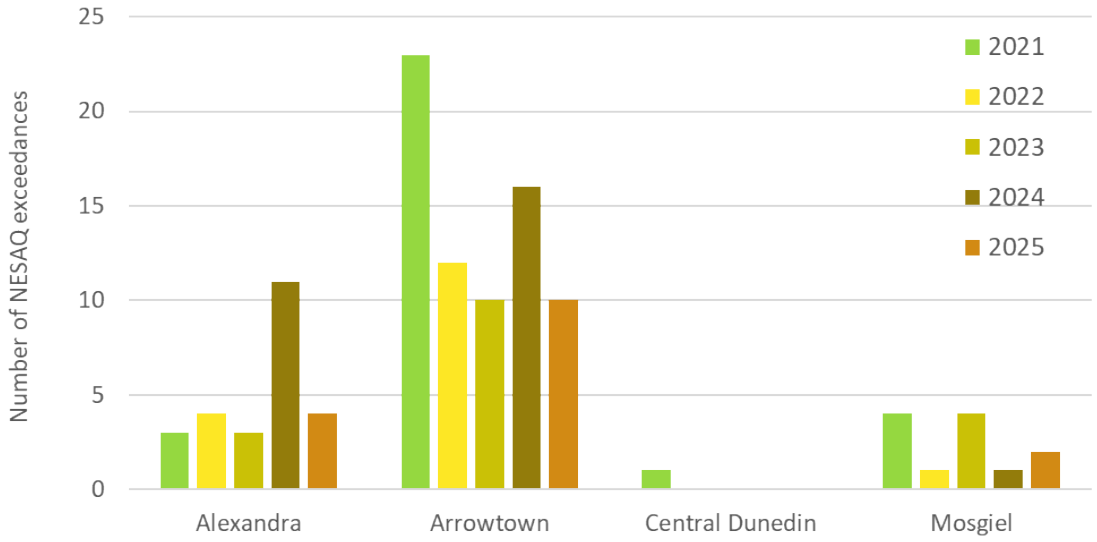

Figure 3: Number of PM_{10} exceedances 2021 – 2025. Note data was missing for the early part of winter 2025 in Alexandra and some exceedances may not have been recorded.

SOE MONITORING RESULTS: $PM_{2.5}$

[15] $PM_{2.5}$ was monitored continuously at eight sites across the region in 2025: Arrowtown, Central Dunedin, Clyde, Cromwell, Milton, Mosgiel, Queenstown (at Frankton) and Wānaka. $PM_{2.5}$ monitoring was added to the network in 2020 in anticipation of the update of the NESAQ. The instruments at Arrowtown, Central Dunedin and Mosgiel are considered equivalent to reference methods[2]. As such they will be able to be compared to standards and guidelines when these are established. However, a twelve-month period of co-location needs to be undertaken in order to establish a transformation factor for the data. As this twelve-month period began in December 2025, none of the $PM_{2.5}$ data has been compared to the proposed NESAQ limits or guidelines.

[16] A summary of the key $PM_{2.5}$ monitoring indicators for 2025 are given in Table 4. The highest annual mean occurred in Clyde with a concentration of 12 µg/m³; the lowest annual means occurred in Wānaka and Central Dunedin with concentrations of 5 µg/m³ and 6 µg/m³, respectively. The highest winter mean for 2025, 26 µg/m³, was recorded at the Clyde monitoring site. The highest daily concentration also occurred in Clyde, followed by Cromwell with 77 µg/m³ and 66 µg/m³, respectively. The data in Figure 4 shows very high winter concentrations in Arrowtown, Clyde, Cromwell and Milton. This seasonal pattern is evident (but less pronounced) in in Milton, Mosgiel, Queenstown and Wānaka. Central Dunedin does not show seasonal variation for $PM_{2.5}$. These patterns match those of PM_{10}.

[2] Monitoring methods required by NESAQ

[17] Data capture for $PM_{2.5}$ was between 91 and 100%. The Clyde, Cromwell and Queenstown site were removed from 2/12/2025 until the end of the year for planned maintenance, scheduled to occur outside of peak season.

Table 4: Key $PM_{2.5}$ indicators for 2025

Site	Annual mean (µg/m³)	Winter mean (µg/m³)	Maximum daily concentration (µg/m³)	Data capture (%)
Arrowtown	9	22	57	96
Central Dunedin	6	8	19	99
Clyde	12	26	77	91
Cromwell	9	21	66	94
Milton	8	16	58	99
Mosgiel	8	15	60	98
Queenstown	6	12	28	91
Wānaka	5	12	45	97

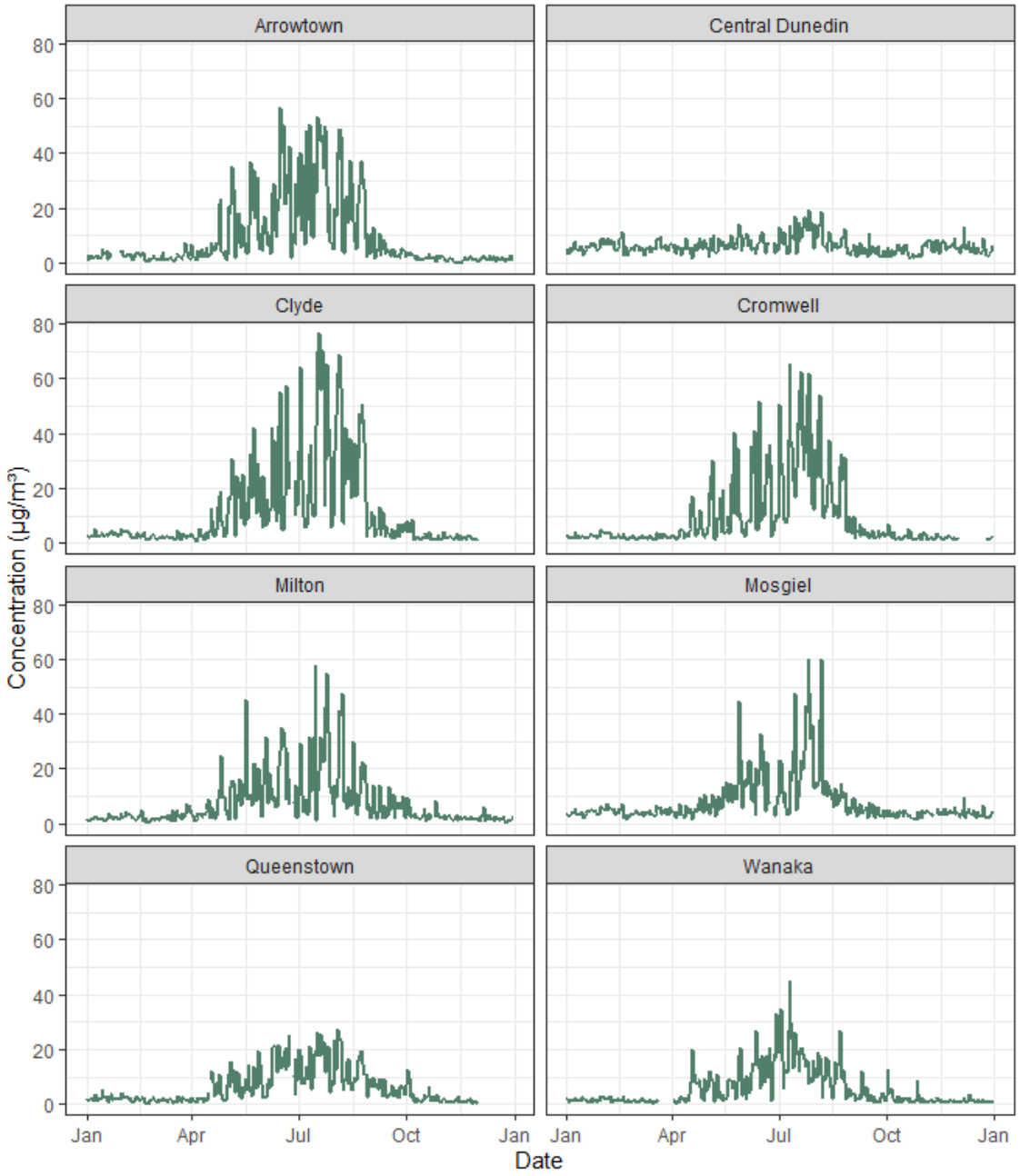

Figure 4: $PM_{2.5}$ concentrations for 2025 (24-hour average). Data cannot be compared to proposed standards or guidelines due to lack of co-location data (Arrowtown, Central Dunedin and Mosgiel), and due to the use of non-reference equivalent method instruments (all other sites).

SOE MONITORING RESULTS: MOBILE $PM_{2.5}$

[18] In late 2024, ORC procured a modified car trailer to be used as a mobile temporary air quality monitoring station (Figure 5). This enables the quick and efficient deployment of an instrument which is ideal for short-term or investigative monitoring and bypasses the more time consuming and expensive aspects of setting up a permanent site (access agreements, power supply, regulatory approval, etc). The trailer can be deployed multiple times per winter and could also be deployed during a significant event such as wildfire or pollution response.

Figure 5: Mobile monitoring trailer in operation at Albert Town

[19] In the winter of 2025, the trailer was deployed to two locations for the monitoring of $PM_{2.5}$; Albert Town during May and June and Hāwea during July and August. Albert Town sits within the Wānaka urban boundary but is not included within the airshed; it represents urban growth expanding outside of the airshed which was gazetted in 2005. Albert Town was monitored because previous investigations[3] in the Wānaka area indicated the potential for high PM concentrations, as it is low-lying and bordered by Mount Iron on one side and the Clutha Mata-Au on another. The results show that Albert Town frequently had higher concentrations than Wānaka (Figure 6), on average about 5 µg/m³. This data supports the inclusion of Albert Town into the Wānaka airshed in the future.

[20] Hāwea was monitored because a previous investigation[4] showed it was one of the most at risk airsheds for high PM concentrations among unmonitored airsheds in Otago. The results are comparable to Wānaka (Figure 5), compared here because it is the closest

[3] Spatial variation of air quality in Wanaka, 2019 https://www.orc.govt.nz/media/12356/spatial-variation-of-air-quality-in-wanaka-2019.pdf

[4] $PM_{2.5}$ investigation in Otago, 2021 https://www.orc.govt.nz/media/12900/pm2-5-investigation-in-otago-2021.pdf

similar site. However, the monitoring period only covered July to August, and PM across all sites dropped from mid-July onwards, indicating region-wide conditions that better enabled dispersion of pollution. It would be beneficial to repeat this study another winter, in order to obtain results that are representative of the coldest part of the year.

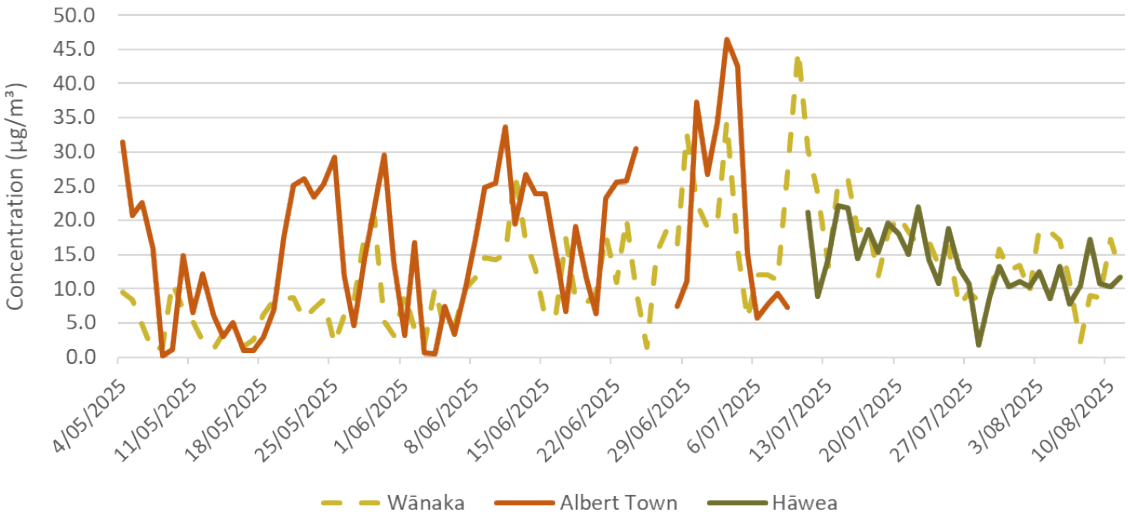

Figure 6: $PM_{2.5}$ at Albert Town and Hāwea, compared with Wānaka (24-hour average)

OTHER MONITORING RESULTS: BLACK CARBON

[21] Black carbon (BC) is both a climate change pollutant and human health pollutant. It is a very fine component of particulate matter. BC was monitored in Arrowtown during 2025, and the data shows very similar seasonal patterns (Figure 7) to PM_{10}. Because BC is only produced by combustion emissions, compared to PM_{10} which has other sources, it is comparatively very low during non-winter months. There are currently no standards or guidelines for BC, however monitoring is recommended by the WHO guidelines.

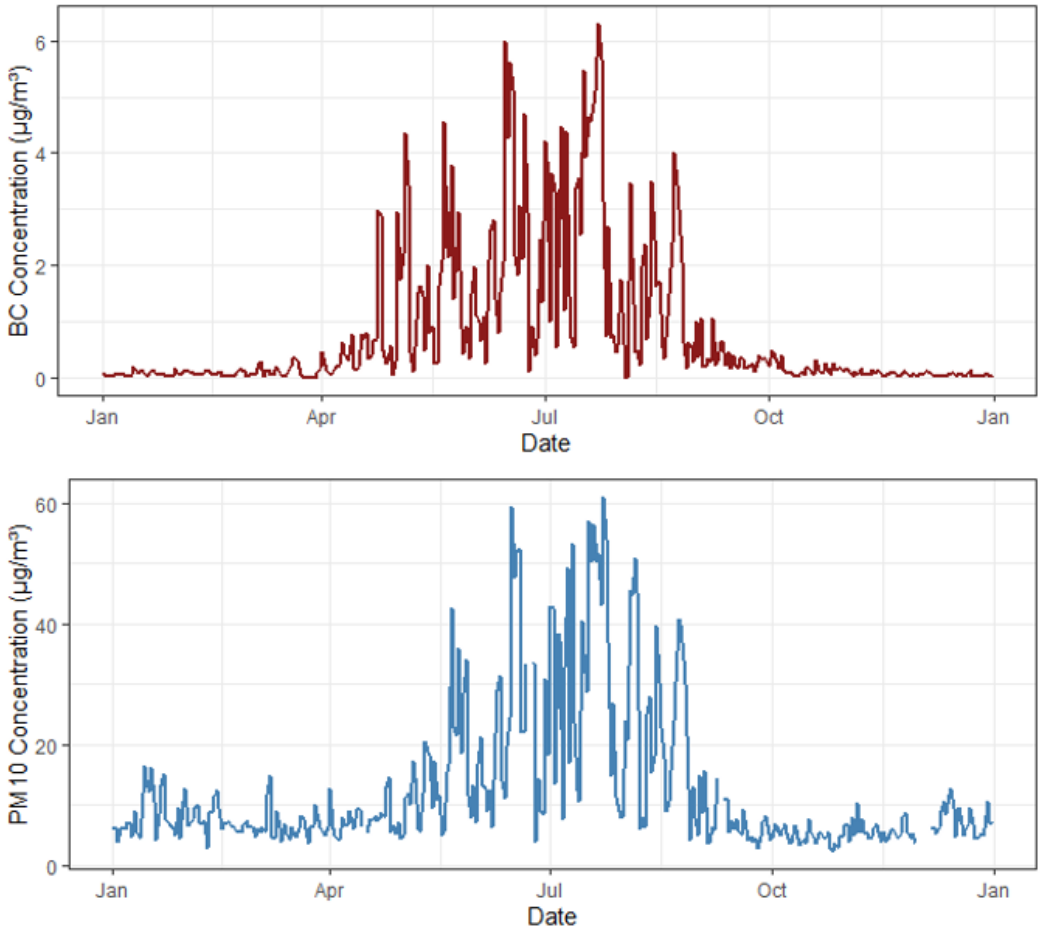

Figure 7: Black carbon and PM_{10} at Arrowtown for 2025 (24-hour average)

CONSIDERATIONS

Strategic Framework and Policy Considerations

[22] This programme supports the Environment focus area of the Strategic Directions by monitoring and investigating Otago's air quality for current and future pollutants.

Financial Considerations

[23] The air quality monitoring programme is a planned Long-Term Plan activity for Science and Environmental Monitoring.

[24] The indicative costs of the programme aspects covered in this report* are:

	Environmental Monitoring	Science
Opex	$40,000	$20,000
Staff Cost	$320,000	$64,000
Overheads/Vehicles	$125,000	$20,000
Capex	$290,000	-

* Note these costs cover the financial year 25-26, while the report presents data from the 2025 calendar year. These are expected to be broadly comparable.

Significance and Engagement

[25] N/A.

Legislative and Risk Considerations

[26] Managing air quality is a regional council requirement in accordance with the NESAQ.

Climate Change Considerations

[27] Monitoring black carbon contributes to ORC's understanding of this pollutant as a climate driver.

Communications Considerations

[28] Air quality communications will continue during 2026 with the Burn Dry Breathe Easy campaign.

[29] Air quality exceedances will continue to be reported in the ODT public notices and on the ORC website.

NEXT STEPS

[30] Monitoring network investigations and upgrades will continue in 2026.

APPENDIX 1: PM_{10} exceedance table for 2025

Site	Alexandra*	Arrowtown	Central Dunedin	Mosgiel
Date	**Concentration (µg/m³) 24-hour average**			
15/06/2025		59		
17/06/2025		52		
18/06/2025		53		
10/07/2025		53		
17/07/2025		57		
19/07/2025		56		
21/07/2025		52		
23/07/2025		61		
24/07/2025		54		
25/07/2025	78			
26/07/2025	70			64
28/07/2025	61			
5/08/2025		51		
6/08/2025	51			59
Total number of exceedances	**4**	**10**	**0**	**2**

* Data was missing for the early part of winter so some exceedances may not have been recorded.

ATTACHMENTS

Nil