



20 April 2023

Research and
Evaluation Unit

RIMU



Auckland Air Quality Report

Monthly update

Introduction

We are committed to continuously collecting air quality data to ensure compliance with national standards and aid policy development and evaluation. The data we collect provides a better understanding of ambient air quality in the region, including spatial and temporal variations. To provide regular updates on air quality in Auckland, this report presents a monthly summary. The report is divided into four sections, with sections A and B featuring tables and graphics that illustrate air quality status in the Auckland region based on data collected from continuous monitoring sites across the region.

For this edition, section C focuses on one monitoring site, Patumahoe. Section D provides monthly averages for 2023 and the past two to five years of pollutant concentrations (when data is available). The monthly update is prepared using validated data, which is typically available one month after raw data collection. This report covers data up to 28 February 2023. By providing regular updates on air quality, Auckland Council aims to promote awareness and encourage actions to improve air quality in the region.

Summary

Most monitoring sites have recorded lower concentrations of particulate matter (PM_{2.5} and PM₁₀) compared to the previous year. This reduction is likely due to increased rainfall in [January](#) and [February](#), resulting in reduced airborne particulates.

As expected, the city centre sites have recorded the highest levels of nitrogen dioxide (NO₂) concentrations, though these levels are lower than the same period in the previous year.

There has been an increase in sulphur dioxide (SO₂) levels at the two monitoring stations, and the reason for this is unclear. Further studies are needed to determine the cause of this increase.

It is important to note that air quality at a monitoring site can vary from year to year due to weather and other influences. For a trend analysis of change, please see Table 2 and [Auckland air quality report, October 2021](#).

Overall, the report highlights improvements in some areas, such as PM and NO₂ concentrations. However, it is essential to continue monitoring and analysing the data to ensure sustained progress and identify areas that require further action.

Glossary of terms

Term	Meaning
Aerodynamic diameter	Used to describe the behaviour of a particle as it moves around in the air; it compares the behaviour with that of a spherical particle of unit density.
Air pollutant/contaminant	Any substance in the air that could harm humans, animals, vegetation, or other parts of the environment when present in high enough concentrations.
Air pollution	The presence of one or more air pollutants in high enough concentrations to cause harm.
Air quality	Is the degree to which air is suitable or clean enough for humans, animals, or plants to remain healthy.
Air quality index (AQI)	Score out of 100, based on dividing a pollutant concentration by a relevant standard. It can be used to approximate relative impact of different pollutants.
Ambient air	The external air environment (does not include the air environment inside buildings or structures)
Black carbon (BC)	Is an air pollutant made up of tiny soot-like particles discharged into the atmosphere from combustion processes.
CO	Carbon monoxide, a type of air pollutant.
Exceedance	An exceedance defines a period of time during which the concentration of a pollutant is greater than the appropriate air quality criteria.
Ground-level ozone (O ₃)	At ground level, ozone is considered an air pollutant that can seriously affect the human respiratory system. It is a major component of photochemical smog.
Monitoring site	A facility for measuring the concentration of one or more pollutants in the ambient air; also referred to as 'monitoring station'
NESAQ	National Environmental Standard for Air Quality.
NO ₂	Nitrogen dioxide, a type of air pollutant
PM	Particulate matter is made up of a mixture of various sizes of solid and liquid particles suspended in air.
PM ₁₀	Particulate matter with an aerodynamic diameter of 10 micrometres or less; a type of air pollutant.
PM _{2.5}	Particulate matter with an aerodynamic diameter of 2.5 micrometres or less; a type of air pollutant.
SO ₂	Sulphur dioxide, a type of air pollutant
µg/m ³	Microgram of pollutant (1 millionth of a gram) per cubic metre of air, referenced to temperature of 0°C (273.15 K) and absolute pressure of 101.325 kilopascals (kPa)
n/a	Not applicable

Data can be viewed on the [environmental data portal](#) , [LAWA](#) or requested from environmentaldata@aucklandcouncil.govt.nz

Full state and trends analyses and reports are prepared every few years (the most recent report is [Trends in Auckland's air quality 2006-2018](#)).

The [2021 Annual data report](#) is available on the Knowledge Auckland website. The 2022 annual data report is in preparation.

See also, the [frequently asked questions](#) about the Auckland air quality monitoring programme.

What we monitor		Why we monitor
Air	Particulate matter (PM) - PM ₁₀ and PM _{2.5}	Tiny particles (particulate matter) from polluting sources such as vehicles and smoke get into the air. Breathing them may cause health problems.
	Nitrogen dioxide (NO ₂)	Vehicles are the main source of NO ₂ in Auckland. It can irritate the lungs, increasing susceptibility to asthma and lowering resistance to respiratory
	Other pollutants	Air pollutants ozone, sulphur dioxide, carbon monoxide, black carbon and volatile organic compounds (VOCs) like benzene cause adverse health effects at elevated concentrations.
Greenhouse gas emissions	Carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF ₆) and nitrogen trifluoride (NF ₃)	The climate is warming due to increased greenhouse gas (GHG) levels in the atmosphere caused by human activities. Reducing GHG emissions will limit temperature rise.

Section A – Data tables

Table 1. Summary information about Auckland air quality monitoring programme 1 January to 28 February 2023

Number of exceedances of NESAQ in 2023	0	
Number of exceedances of Auckland ambient air quality targets in 2023	0	
Maximum PM ₁₀ 24-hours mean (January to February 2023)	34.3 µg/m ³ (68.6% of NESAQ)	Recorded at Queen Street on 8 Feb 2023
Maximum PM _{2.5} 24-hour mean (January to February 2023)	17.3 µg/m ³ (69.2% of Auckland target)	Recorded at Patumahoe on 8 Feb 2023
Maximum NO ₂ 1-hour mean (January to February 2023)	78.0 µg/m ³ (39.0% of NESAQ)	Recorded at Khyber Pass Rd on 23 & 27 Feb 2023
Maximum SO ₂ 1-hour mean (January to February 2023)	15.0 µg/m ³ (4.3% of NESAQ)	Recorded at Customs Street on 15 Jan 2023
Maximum O ₃ 1-hour mean (January to February 2023)	66.0 µg/m ³ (44.0% of NESAQ)	Recorded at Patumahoe on 8 Jan 2023
Maximum CO running 8-hour mean (January to February 2023)	0.39 mg/m ³ (3.9% of NESAQ)	Recorded at Khyber Pass Rd on 22 Feb 2023
Number of continuous monitoring sites	10	
Location of monitoring sites	Queen Street, Customs Street, Khyber Pass Road, Penrose, Henderson, Takapuna, Glen Eden, Pakuranga, Papatoetoe, and Patumahoe	

Table 2. General changes in concentration of key contaminants monitored for the last 26, 38 and 50 months.

↑ indicates an increase ↓ indicates a decrease ↗ increase but not significant ↘ decrease but not significant

	PM ₁₀			PM _{2.5}			NO ₂			Black carbon			Ozone			CO			SO ₂			Air Quality Index(AQI)			
Site	Last 26 months	Last 38 months	Last 50 months	Last 26 months	Last 38 months	Last 50 months	Last 26 months	Last 38 months	Last 50 months	Last 26 months	Last 38 months	Last 50 months	Last 26 months	Last 38 months	Last 50 months	Last 26 months	Last 38 months	Last 50 months	Last 26 months	Last 38 months	Last 50 months	Last 26 months	Last 38 months	Last 50 months	Site
Customs Street*	n/a	n/a	n/a	↗	↓	n/a	↓	↓	n/a	↘	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↑	↑	n/a	n/a	n/a	n/a	Customs Street*
Glen Eden*	↘	↘	↓	↘	↘	↘	↗	↑	↑	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↘	↘	↓	Glen Eden*
Henderson	↘	↘	↓	n/a	n/a	n/a	↗	↗	↘	↘	↘	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↘	↘	↘	Henderson
Khyber Pass Road	↑	↑	↗	n/a	n/a	n/a	↘	↘	↓	n/a	n/a	n/a	n/a	n/a	n/a	↘	↓	↓	n/a	n/a	n/a	n/a	n/a	n/a	Khyber Pass Road
Pakuranga*	↗	↗	↘	↗	↘	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Pakuranga*
Papatoetoe	↓	↘	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Papatoetoe
Patumahoe	↓	↓	↓	↗	↗	↗	↗	↑	↗	n/a	n/a	n/a	↗	↘	↘	n/a	n/a	n/a	n/a	n/a	n/a	↘	↘	↓	Patumahoe
Penrose	↘	↘	↓	↘	↘	↓	↘	↘	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↑	↑	↑	↘	↘	↓	Penrose
Queen Street	↗	↑	↑	↗	↑	↑	↓	↓	↓	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↓	↘	↓	Queen Street
Takapuna	↗	↑	↘	↗	↗	↘	↗	↗	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↗	↗	↘	Takapuna
	PM ₁₀			PM _{2.5}			NO ₂			Black carbon			Ozone			CO			SO ₂			Air Quality Index(AQI)			

Notes

Change significance was determined using the Theil-Sen method: ↑ and ↓ mean change is statistically significant at the 0.05 level, 95% confidence intervals.

Effective dates: 26 months (1 January 2021 to 28 February 2023), 38 months (1 January 2020 to 28 February 2023), and 50 months (1 January 2019 to 28 February 2023).

PM₁₀ is monitored at Glen Eden, Henderson, Khyber Pass Rd, Pakuranga, Papatoetoe, Patumahoe, Penrose, Takapuna, and Queen St.

PM_{2.5} is monitored at Customs St, Glen Eden, Pakuranga, Patumahoe, Penrose, Takapuna, and Queen St.

NO₂ is monitored at Customs St, Glen Eden, Henderson, Khyber Pass Rd, Patumahoe, Penrose, Takapuna, and Queen St.

Black carbon is monitored at Customs St, and Henderson.

CO is monitored at Khyber Pass Rd.

Ozone is monitored at Patumahoe.

SO₂ is monitored at Customs St, and Penrose.

*PM_{2.5} data coverage for Glen Eden, Customs Street and Pakuranga is less than 75% due to instrument failure between September 2021 and January 2022. Weather changes significantly affect concentrations of air contaminants (see [Auckland air quality report, October 2021](#)). No data for Takapuna in Jan and Feb 2023 due to the Auckland floods.

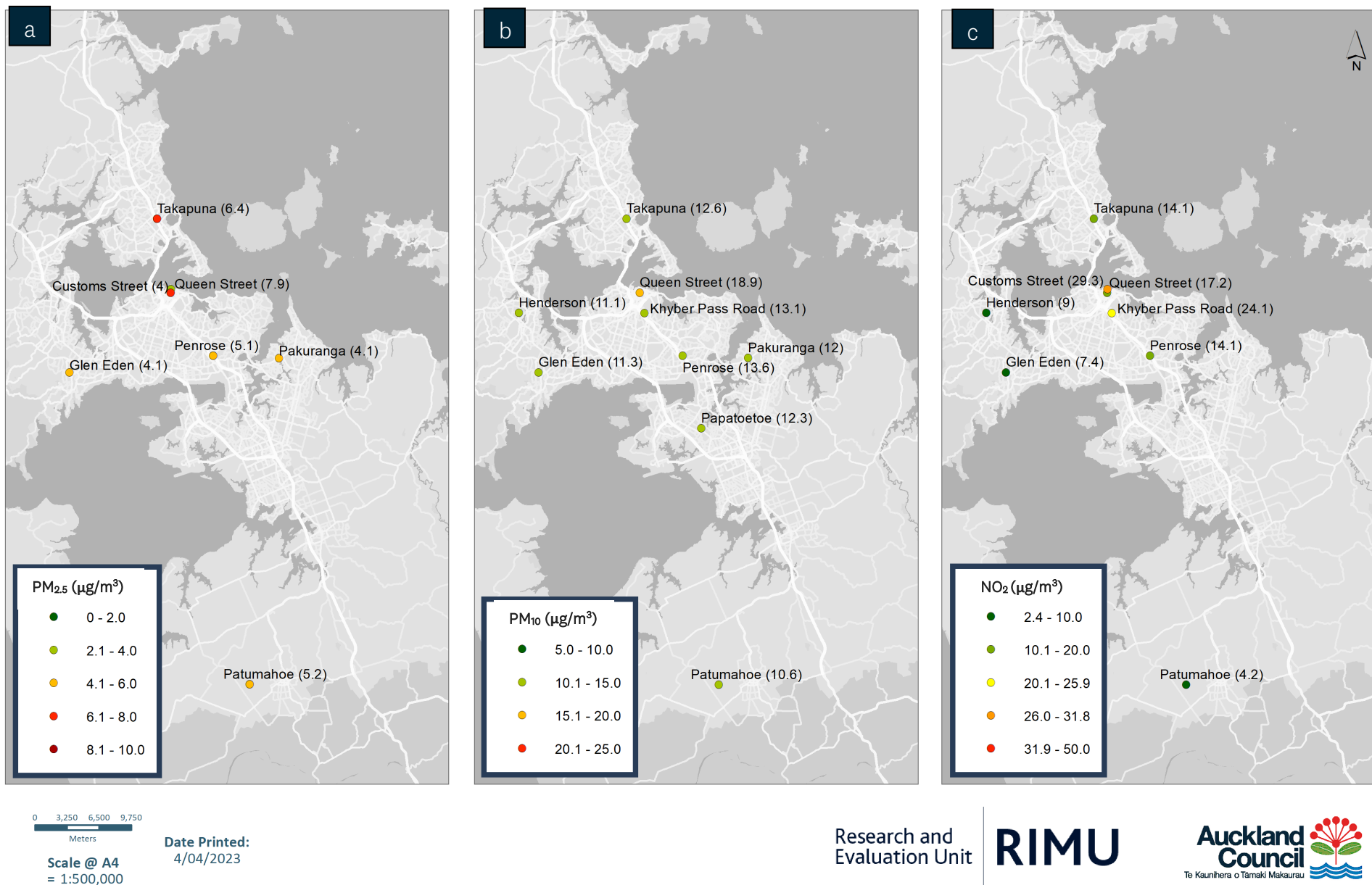


Figure 1. Maps a, b and c show the air quality monitoring sites and their last 12 months (1 March 2022 to 28 February 2023) average PM and NO₂ concentrations in brackets. Auckland city centre monitoring sites recorded the highest PM and NO₂ concentrations.

Section B. Key air contaminants across the 10 air quality monitoring sites (1 January 2023 to 28 February 2023)

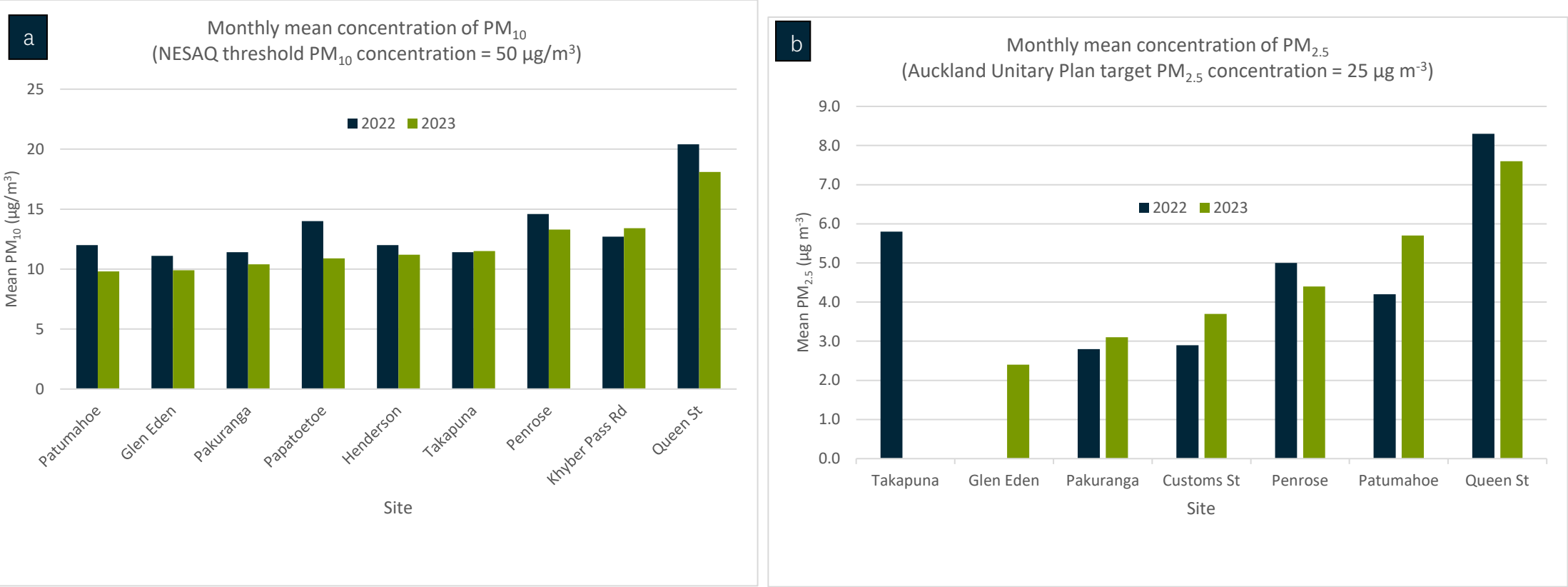


Figure 2. Monthly mean particulate matter concentration. As in the previous year, the highest concentrations of both PM₁₀ and PM_{2.5} were recorded at Queen St. Plots a and b represent PM_{2.5} and PM₁₀ respectively. The average particulate matter concentration at Queen St is lower than the same period of the previous year. PM₁₀ and PM_{2.5} have multiple sources including motor vehicles, sea salt, marine diesel, and soils (windblown soil, road dust, and dust generated by earthworks, construction, and road works).

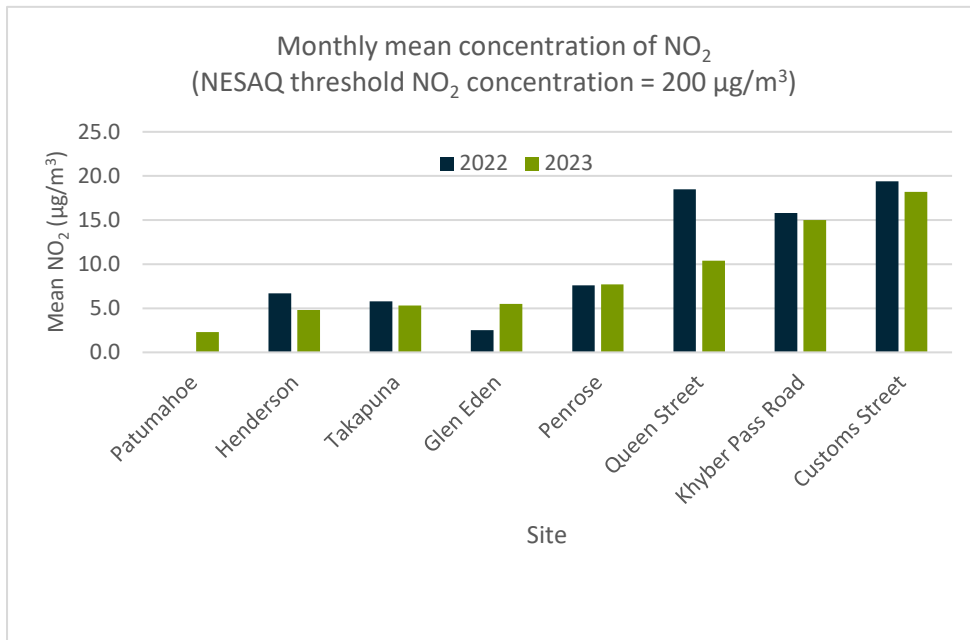


Figure 3. Monthly mean NO₂ concentration in Auckland. The highest concentrations were recorded at monitoring sites in the city centre, although they were lower than the previous year. Motor vehicles are the primary source of NO₂.

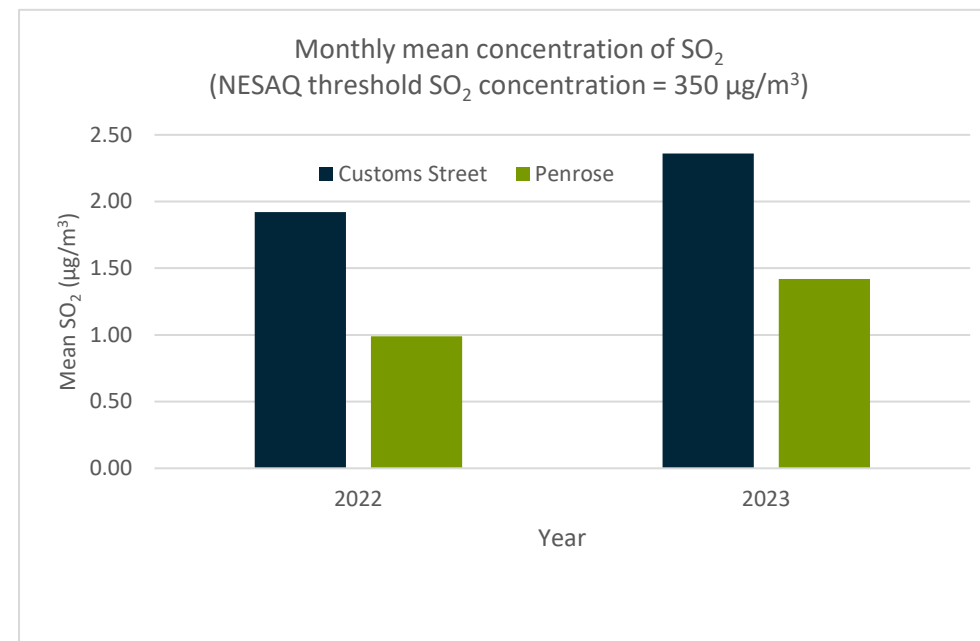


Figure 4. Monthly mean SO₂ levels at Customs Street and Penrose sites. The highest concentrations were recorded at the Customs Street monitoring site in the city centre. The mean concentrations at both sites were higher than the previous year. SO₂ is produced from the combustion of fossil fuels that contain sulphur, such as coal and oil (used for home heating, industry, and shipping). Motor vehicles also contribute to SO₂ levels in urban air.

Section C. Focus on a monitoring site: Patumahoe

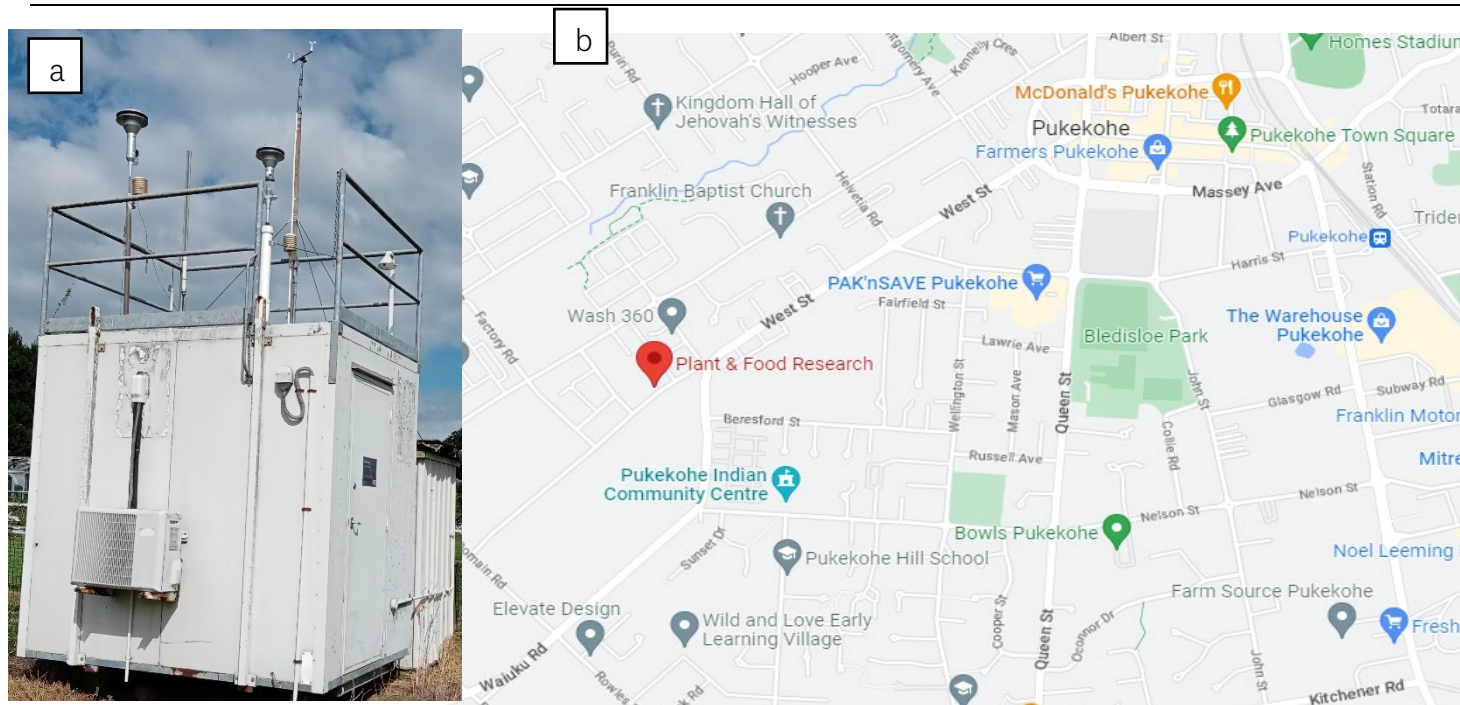


Figure 5. The Patumahoe air quality monitoring site is located within the Plant and Food Research Station at Cronin Rd, Patumahoe. Image a shows the air quality monitoring shed. Image b is an aerial view of the monitoring site and surroundings taken in April 2023 (Source: Google Maps). Air quality monitoring at this site commenced on 21 October 1996. PM_{10} , $PM_{2.5}$, NO_2 , and ground level ozone concentrations are monitored at this site. This site represents rural town and Auckland regional background air quality. The main sources of air contaminants are motor vehicles, home heating, and agricultural activities such as fertiliser application, crop tilling and green waste burning.

Key findings:

- On average, the PM_{10} and $PM_{2.5}$ concentrations at Patumahoe are respectively 18.5% and 16.4% lower than the average levels observed across Auckland.
- On average, the concentration of NO_2 at Patumahoe is 84.2% lower than the average concentration measured across Auckland.
- It is worth noting that the Patumahoe monitoring site is located in a rural area and is representative of Auckland's regional background air quality. Thus, lower air pollutant concentrations are expected at this site compared to Auckland's urban areas.
- The results of trend analysis reveal a long-term decrease in NO_2 concentration over the monitoring period. On the contrary, $PM_{2.5}$ is trending upwards, which is most likely due to increased biomass burning. Further studies needed.
- No significant trends were observed in PM_{10} and ground-level ozone concentrations.

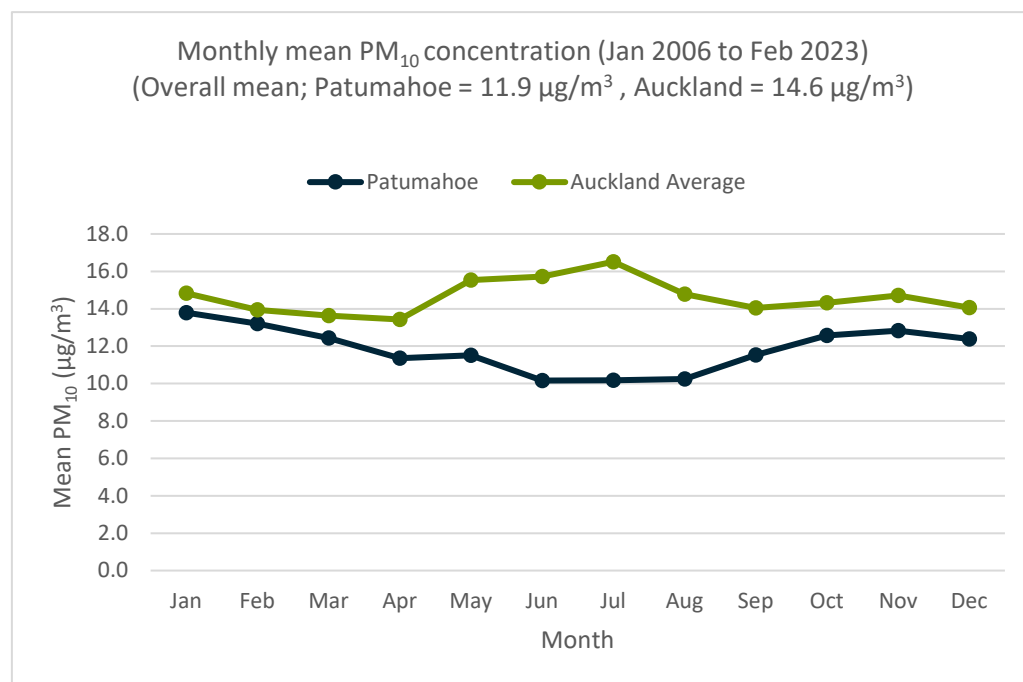


Figure 6. Monthly mean PM₁₀ concentrations over time - comparison between Patumahoe (Rural Site) and Auckland's Average. The average PM₁₀ concentration at Patumahoe site is 18.5% lower than Auckland's average.

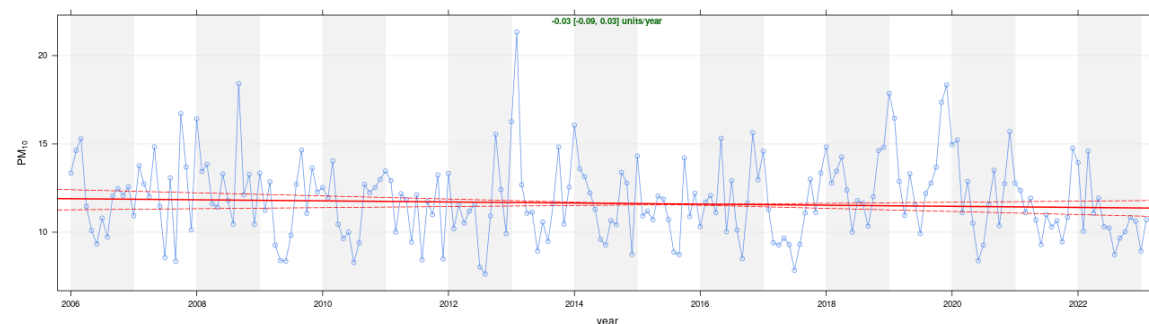


Figure 7. Trends in PM₁₀ Concentrations at Patumahoe from January 2006 to February 2023. The plot shows the deseasonalised monthly mean concentrations of PM₁₀. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as – 0.03 (µg/m³) per year (not statistically significant at the 0.05 level)

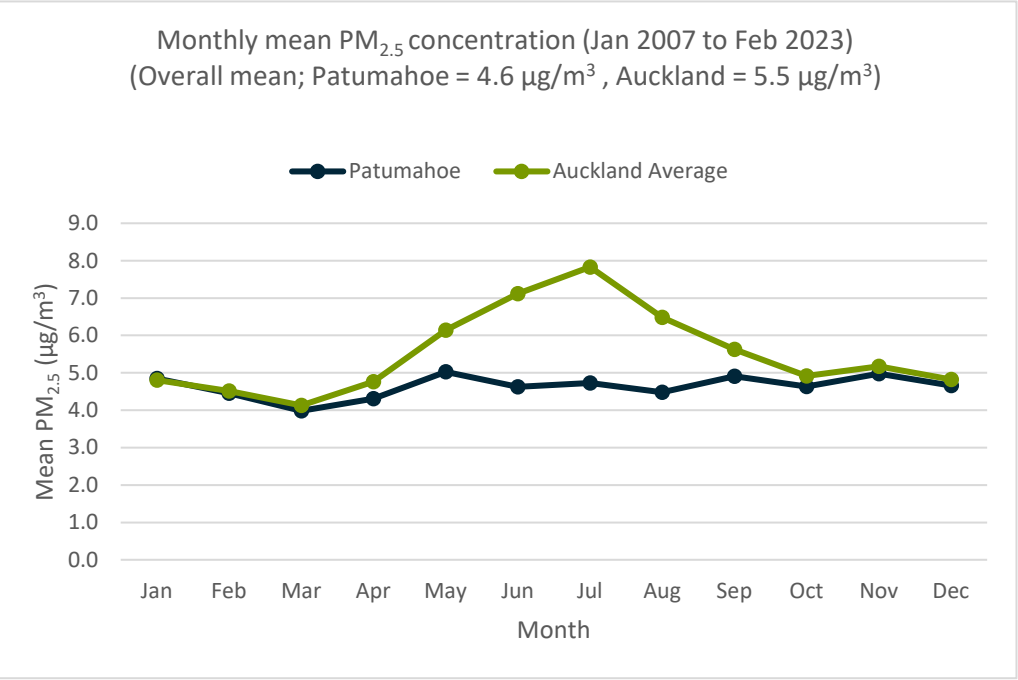


Figure 8. Monthly mean PM_{2.5} concentrations over time - comparison between Patumahoe and Auckland's Average. The average PM_{2.5} concentration at Patumahoe site is 16.4% lower than Auckland's average.

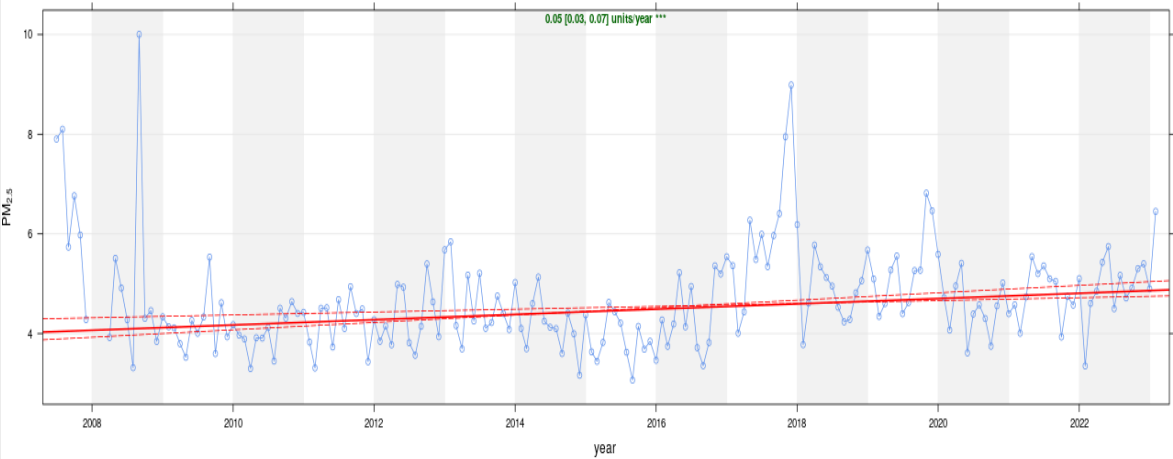


Figure 9. Trends in PM_{2.5} Concentrations at Patumahoe from January 2007 to February 2023. The plot shows the deseasonalised monthly mean concentrations of PM_{2.5}. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-right as 0.05 (µg/m³) per year (statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from 0.03 – (0.07) µg/m³/year.

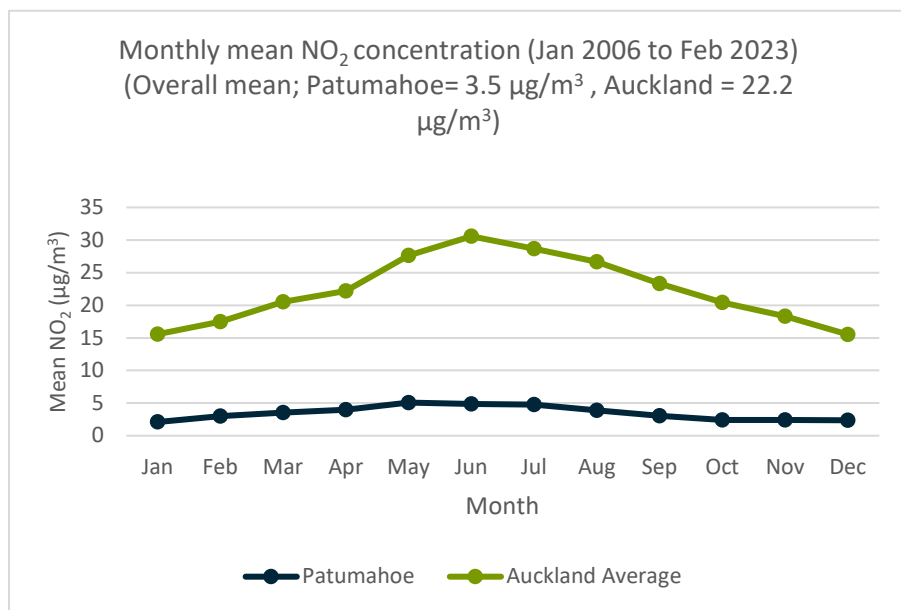


Figure 10. Monthly mean NO₂ concentrations over time - comparison between Patumahoe and Auckland's Average. The average NO₂ concentration at Patumahoe site is 84.2% lower than Auckland's average.

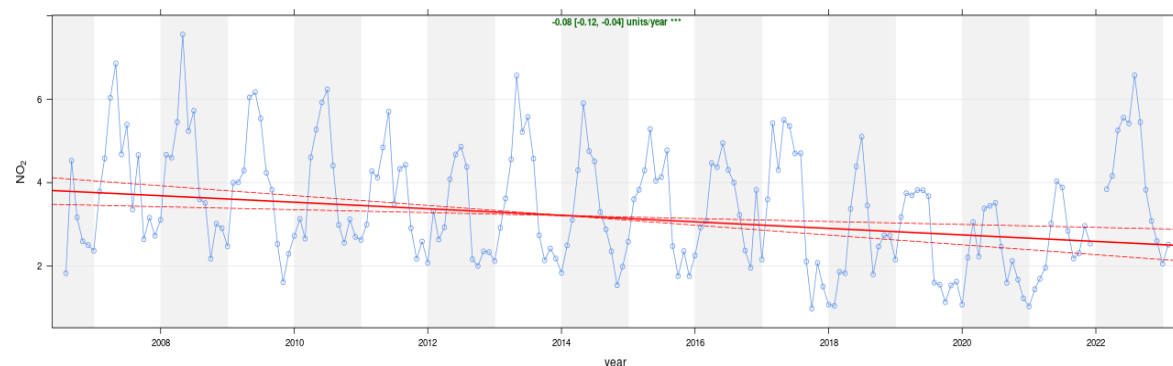


Figure 11. Trends in NO₂ Concentrations at Patumahoe from January 2006 to February 2023. The plot shows the deseasonalised monthly mean concentrations of NO₂. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as -0.08 ($\mu\text{g}/\text{m}^3$) per year (statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from -0.12 – (-0.04) $\mu\text{g}/\text{m}^3/\text{year}$.

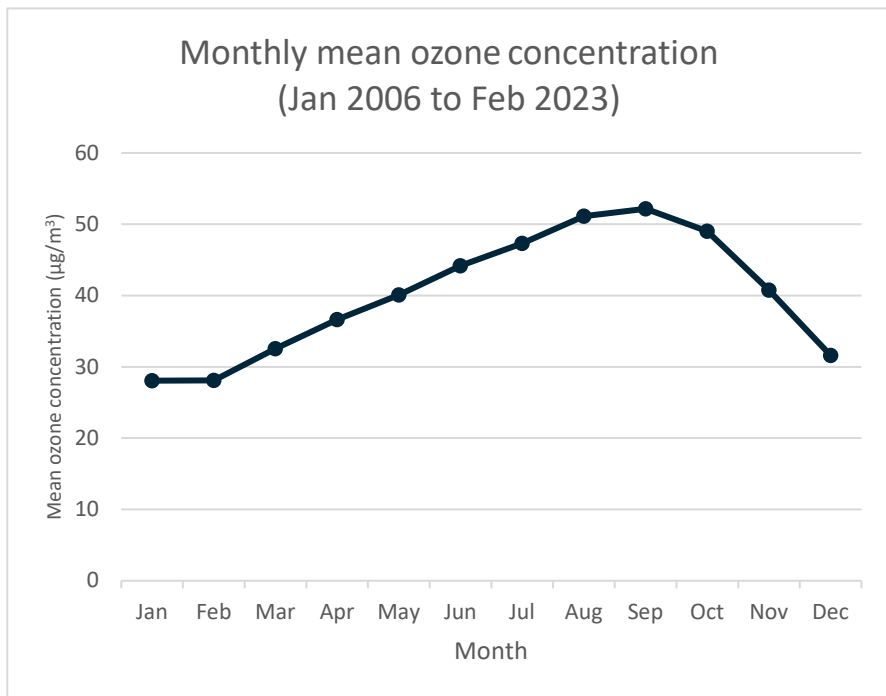


Figure 12. Temporal variation of monthly mean ozone concentrations at Patumahoe.

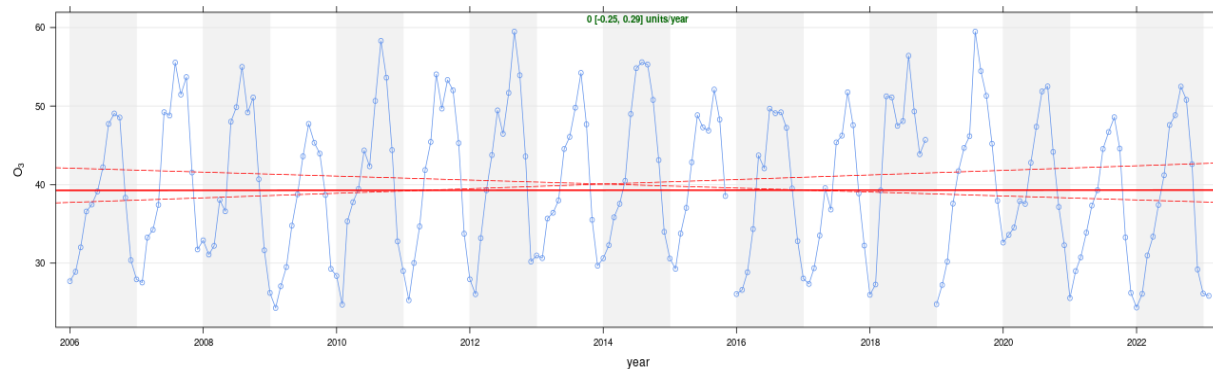


Figure 13. Trends in ozone concentrations at Patumahoe from January 2006 to February 2023. The plot shows the deseasonalised monthly mean concentrations of ozone. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as 0 (µg/m³) per year (not statistically significant).

Section D. Table 3. Monthly averages: 2023 and past two to five years (when data is available)

Pollutant	Site	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
PM ₁₀ (µg/m ³)	Glen Eden	2023	8.9	10.9											
		Past 5 years	11.6	11.1	9.6	11.1	12.9	15.4	15.6	13.8	11.5	10.2	11.9	12.9	
	Henderson	2023	10.1	12.2											
		Past 5 years	12.0	11.5	11.0	11.7	12.5	12.9	13.1	12.1	11.1	10.5	12.5	12.8	
	Khyber Pass Road	2023	12.2	14.6											
		Past 4 years	11.8	11.4	10.8	11.4	10.9	11.1	11.9	11.3	11.2	11.0	12.9	13.8	
	Pakuranga	2023	9.6	11.1											
		Past 5 years	12.1	11.5	10.0	10.7	12.4	13.3	14.2	13.0	11.4	10.9	12.6	12.7	
	Papatoetoe	2023	9.8	12.0											
		Past 5 years	14.2	13.6	12.4	13.1	14.0	14.0	15.6	14.3	13.5	13.0	14.5	14.7	
	Patumahoe	2023	8.9	10.7											
		Past 5 years	14.9	14.3	12.5	12.2	11.8	9.9	10.5	10.8	11.4	11.1	13.3	14.9	
	Penrose	2023	12.4	14.2											
		Past 5 years	15.6	14.9	14.1	14.3	15.5	14.2	14.9	13.9	13.5	12.9	15.0	15.9	
Queen Street	2023	16.8	19.5												
	Past 5 years	17.5	16.7	16.0	16.5	16.9	16.7	18.4	18.2	17.8	17.9	19.1	19.4		
Takapuna	2023	11.5	ND												
	Past 5 years	13.1	12.3	11.0	12.4	12.8	13.3	14.1	12.9	11.7	11.3	13.0	13.4		
PM _{2.5} (µg/m ³)	Customs Street	2023	3.7	3.8											
		Past 3 years	4.4	3.7	3.3	3.9	4.0	4.7	4.8	5.6	5.5	3.8	3.8	3.7	
	Glen Eden	2023	2.1	2.7											
		Past 4 years	2.7	2.5	2.0	3.1	5.7	9.8	9.7	7.7	5.0	3.2	3.5	3.2	
	Pakuranga	2023	2.9	3.2											
		Past 4 years	3.0	2.9	2.5	3.5	5.3	6.3	9.3	5.7	4.4	3.2	3.9	3.5	
	Patumahoe	2023	4.9	6.4											
		Past 5 years	5.4	4.5	4.3	5.0	5.4	5.1	4.7	4.8	4.7	4.4	5.2	5.3	
	Penrose	2023	4.2	4.7											
		Past 5 years	6.8	5.3	5.0	5.6	6.5	7.3	7.3	6.3	5.8	5.8	6.5	5.9	
	Queen Street	2023	7.2	8.0											
		Past 5 years	7.1	6.5	6.0	6.7	7.2	7.4	8.0	7.7	7.3	7.3	7.7	7.9	
Takapuna	2023	ND	ND												
	Past 5 years	5.9	5.4	4.9	5.7	6.8	8.2	8.8	7.7	6.6	6.1	6.7	6.3		
NO ₂ (µg/m ³)	Customs Street	2023	18.7	17.8											
		Past 3 years	34.8	36.9	39.1	30.8	37.1	52.4	37.4	35.6	30.8	29.1	24.1	23.9	
	Glen Eden	2023	6.0	5.0											
		Past 5 years	2.0	3.0	4.0	4.6	7.4	8.2	7.9	6.1	4.7	4.6	3.8	2.9	
	Henderson	2023	4.5	5.1											
		Past 5 years	3.9	7.3	8.4	8.7	12.0	12.8	11.7	9.2	7.5	6.5	6.1	4.7	
	Khyber Pass Road	2023	11.4	18.7											
		Past 4 years	21.5	19.5	22.4	23.8	32.8	33.8	35.1	30.8	30.2	24.9	30.0	20.1	
	Patumahoe	2023	2.1	2.5											
		Past 5 years	1.4	2.0	2.9	2.8	3.8	4.2	4.3	3.4	2.5	2.4	2.4	2.1	
	Penrose	2023	6.3	9.2											
		Past 5 years	9.0	10.8	13.4	16.9	22.3	22.8	22.8	18.7	16.6	12.6	12.9	8.5	
Queen Street	2023	10.8	10.0												
	Past 5 years	28.2	28.8	30.8	31.0	37.4	39.5	43.2	42.1	37.7	36.4	32.2	28.0		
Takapuna	2023	5.3	ND												
	Past 5 years	6.5	8.4	10.7	14.6	20.2	21.1	22.1	18.5	15.2	12.7	11.8	7.9		
SO ₂ (µg/m ³)	Customs Street	2023	2.3	2.4											
		Past 3 years	1.6	1.6	2.3	1.5	1.7	4.4	2.6	2.8	2.2	2.2	1.6	1.5	
	Penrose	2023	1.2	1.6											
		Past 5 years	0.5	0.8	1.1	0.8	1.2	1.2	1.0	0.8	1.0	0.8	1.0	0.5	
O ₃ (µg/m ³)	Patumahoe	2023	26.1	25.8											
Past 5 years		26.6	29.3	33.4	38.9	41.2	43.1	46.8	52.6	51.4	46.9	41.0	31.4		
CO (mg/m ³)	Khyber Pass Road	2023	0.105	0.159											
		Past 4 years	0.206	0.180	0.192	0.216	0.268	0.258	0.297	0.220	0.204	0.178	0.183	0.164	
Black carbon (ng/m ³)	Customs Street	2023	1095	1286											
		Past 3 years	1447	1535	1316	1094	1356	3363	1350	1326	1034	1016	1127	1047	
	Henderson	2023	247	316											
		Past 5 years	265	458	566	540	995	1204	1113	879	542	412	381	301	
ND= No data measured due to flooding at the monitoring station															

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