# CHARACTERISING SOURCES AND COMPOSITION OF PM2.5 IN INNER WEST MELBOURNE, AUSTRALIA

Rosemary Fedele[1], Perry Davy[2], Melita Keywood[3], Max Mclennan-Gillings[1], Jennifer Powell[3], Jacinda Shen[4], Sally Taylor[3] and Paul Torre[1]

[1] Applied Science, Environment Protection Authority Victoria, Macleod, 3085, Victoria, Australia

[2] GNS Science, Lower Hutt, 5011, New Zealand

[3] CSIRO, Aspendale, 3195, Victoria, Australia

[4] Major Road Projects Victoria, Melbourne, 3000, Australia

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## 1. Background

Exposure to airborne particles smaller than 2.5 µm in aerodynamic diameter ($PM_{2.5}$) results in adverse health outcomes. There are multiple sources of these particles in inner west Melbourne, such as vehicle emissions, wood heater emissions, industry, shipping and natural sources like sea salt. EPA monitored air pollution in inner west Melbourne between February 2021 and June 2022 to identify the major sources of these particles to inform programs aimed at reducing air pollution in the area.

Specifically, this study collected $PM_{2.5}$ samples to addresses the following research questions:

- What are the sources contributing to $PM_{2.5}$ in inner west Melbourne?
- What are the key chemical species in $PM_{2.5}$ in inner west Melbourne?
- What are the major anthropogenic activities contributing to $PM_{2.5}$ that we should focus our interventions on?

## 2. Method

$PM_{2.5}$ samples were collected at eleven sites in inner west Melbourne from 28 February 2021 to 25 June 2022. Two of the eleven sites were designated as generally representative of ambient air (Yarraville and Spotswood) where samples were collected predominantly every third day. At the remaining nine sites $PM_{2.5}$ samples were collected near specific sources such as shipping docks, roads with heavy vehicle traffic or general traffic, for different time periods for the express purpose of characterising the chemical composition of the targeted pollution source.

$PM_{2.5}$ samples at each sampling site were collected on two filters (PTFE membrane filters and quartz fibre filters) using ARA N-FRM $PM_{2.5}$ samplers (16.7 LPM).

$PM_{2.5}$ samples were analysed to determine the presence and concentration of 62 chemical species. The chemical composition of $PM_{2.5}$ samples were input into a chemical element mass balance (receptor) model (EPA PMF 5.0.14) to determine sources of particles at the two ambient air quality sites.

The receptor model was run using various input data, including sub-groupings by location, using the following sets of data:

- Single ambient sites on their own (Yarraville or Spotswood) – 124 or 140 samples respectively
- Both ambient sites together (Yarraville and Spotswood) – a total of 264 samples
- A single ambient site (Yarraville or Spotswood) with source specific samples – 174 or 190 samples respectively
- All sites – a total of 314 samples

Source specific samples weren't used on their own in the receptor model due to the small number of samples collected (50 samples).

Analysis was carried out assuming 7 or more factors would be present, as it is common to see this many factors in $PM_{2.5}$ at urban locations. We selected 8 factors for Spotswood when this site was run on its own and 11 factors for Yarraville when this site was run with source specific samples.

## 3. Results

Average $PM_{2.5}$ concentrations at the two ambient air quality sites during the study period (from 5 May 2021 to 12 May 2022) was 6 $\mu g/m^3$.

The key chemical species identified at the two ambient air quality sites were black carbon (BC) and organic carbon (OC), comprising ~ 60% of the average $PM_{2.5}$ concentrations at both ambient air quality sites. The sources identified reflect this chemical composition with major sources containing BC and OC as dominant chemical species.

Eleven sources were found to contribute to particle mass at the two ambient sites by the receptor model (Figure 1). Of these, eight sources were common to both sites: aged biomass burning, fresh biomass burning, diesel vehicles, petrol vehicles, crustal matter (road dust), ammonium sulphate, sea salt and nitrates (aged sea salt). Three additional sources were identified at Yarraville, which related to shipping and two local industry sources. The receptor model could not separate the shipping contribution from industrial sources at Yarraville without the source specific samples. With the addition of the source specific samples, a shipping factor was identified by receptor modelling for the first time in Australia.

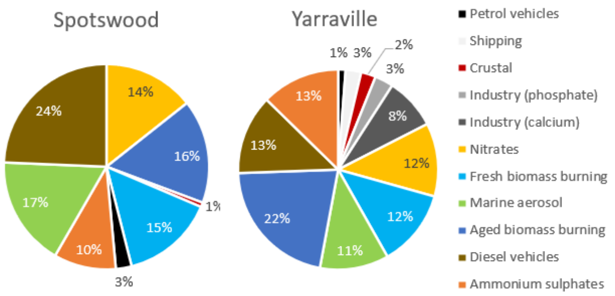


Figure 1. $PM_{2.5}$ average source contributions at two ambient sites from 5 May 2021 to 12 May 2022.

## 4. Conclusion

Most of the sources identified by the study are anthropogenic, the most predominant sources were diesel vehicle emissions and biomass burning (smoke from wood heaters in winter and hazard reduction burns in autumn). Targeting our interventions to human activities linked to major $PM_{2.5}$ sources such as diesel vehicle emissions and wood heater smoke will have the greatest impact on reducing $PM_{2.5}$ pollution and improving human health in inner west Melbourne.

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