

# Best Practice Guide

BP105 | Identify

## Air quality as a local issue



## Introduction

The World Health Organization (WHO) considers air pollution to be the single most significant environmental threat to public health worldwide. Awareness and understanding of the issue have increased significantly, and it is now acknowledged that there is no safe level of air pollution.

Some relevant facts to highlight the scale of the problem are as follows:

- Globally, nearly 4.2 million people die each year from stroke, heart disease, lung cancer, and chronic respiratory diseases caused by exposure to outdoor air pollution (WHO, 2022).
- Each year, poor air quality causes over 3,000 deaths in Australia (Australian Institute of Health and Welfare, 2021).
- The health-related costs of air pollution from vehicles in Greater Sydney, Newcastle, and Wollongong add up to AU\$3 billion per year (Electric Vehicle Council, 2019).
- Major sources of outdoor air pollution include residential heating (i.e. wood fires), vehicles, power generation, bushfires, and industry (NSW Health, 2022).
- Globally, around 2.4 billion people are exposed to dangerous levels of household air pollution. Outdoor and indoor air pollution combined is associated with 7 million premature deaths each year (WHO, 2022).

This OPENAIR Best Practice Guide chapter introduces air quality as a local issue with a significant impact on the health and well-being of Australian communities. It explores air quality as a critical issue for Australia, and describes the different types of air pollution that commonly affect communities in New South Wales (NSW) and around Australia. This chapter also outlines the impacts of air pollution on public health, social well-being, the economy, and climate change.

## Who is this resource for?

This chapter is intended to act as a guide for local governments tasked with designing and delivering a smart low-cost air quality monitoring project, and may be useful to staff in the following roles:

- people leading new air quality monitoring projects
- local government elected leaders and senior management
- urban designers
- community engagement teams
- planners
- environmental officers.

## How to use this resource

This chapter acts as an entry point and non-technical introduction to the topic of air quality at a local scale. It is written primarily for local governments seeking to understand and act on air quality issues in their local area.

## Air quality as an Australian concern



*Sydney Harbour Bridge in a bushfire smoke haze in December 2019*

By global standards, Australian towns and cities tend to have relatively clean air most of the time. However, poor air quality due to periodic extremes, local- and regional-specific challenges, and hyperlocal pollution ‘hotspots’ still poses a significant threat to the health and well-being of Australian communities (see Table 1).

*Table 1. Air quality as an Australian concern*

Issue	Description
Periodic extremes	Periodic, extreme air pollution events (caused by bushfires, hazard reduction burning, and dust storms) can create conditions comparable to the worst-polluted cities in the world.
Local and regional challenges	Certain communities – through a combination of geography, infrastructure, and demographic factors – experience regular poor air quality associated with specific local sources and conditions (e.g. wood-fired home heating, high traffic congestion, power generation, and heavy industry).
Hyperlocal hotspots	Air quality can vary significantly, even across short distances. Highly localised pollution spikes can occur in places close to where people live, work, and play (for instance, along major roads). However, these pollution hotspots are not accounted for when ‘good’ air quality is reported for the wider general area (through regulatory air quality monitoring). A 2017 Sydney study found that the average roadside concentration of particulate pollution was double the recommended limit in national guidelines.



UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS (United Nations, n.d)

Local action to improve air quality supports several **UN Sustainable Development Goals**:

1. Good health and well-being
2. Affordable and clean energy
3. Reduced inequalities
4. Sustainable cities and communities

## The impacts of poor air quality

Poor air quality affects everyone, and is a universal concern (see Figure 1). It can result in a range of negative impacts at a variety of scales, from highly localised pollution ‘hotspots’ to bushfire smoke that blankets an entire region.



### Public health

**Air pollution has a negative impact on all aspects of human health**, particularly on the lungs and heart. Evidence is mounting that air pollution also affects the brain and nervous system, reproductive health, and in utero and childhood development.



### Social well-being

**Air pollution disproportionately impacts marginalised and vulnerable communities**, including people in lower socio-economic and CALD communities; people with pre-existing health conditions; and people with disabilities. Air pollution and urban heat are associated with a higher risk of violent crime, domestic abuse, accidents, and shortened attention spans in children.



### The economy

**Air pollution has a negative impact on local economies.** Removing the local sources of air pollution (such as motor vehicles and wood-fired home heating) can help to support a thriving local economy, by creating places and communities that are pleasant, clean, cool, and walkable.



### Climate change

**Most sources of air pollution are also sources of carbon emissions, so action to reduce them doubles as climate action.** Climate change intensifies extreme heat events. These result in air pollution increases as well, by creating more ground-level ozone. This amplifies the health impacts of air pollution, by decreasing the body’s ability to cope, and by disproportionately impacting vulnerable people and communities.

Figure 1. The widespread impacts of poor air quality

The health impacts from specific types of air pollutants are summarised in Table 2.

Table 2. The health impacts of common outdoor air pollutants

Pollutant	Impacts - acute exposure	Impacts - chronic exposure
Particulate matter (PM)	<ul style="list-style-type: none"> <li>Irritation of the eyes, nose, and throat</li> <li>Worsening asthma and lung diseases, such as chronic bronchitis (also called chronic obstructive pulmonary disease, or COPD)</li> <li>Heart attacks and arrhythmia (irregular heartbeat) in people with heart disease</li> <li>Increases in hospital admissions and premature deaths due to diseases of the respiratory and cardiovascular systems</li> </ul>	<ul style="list-style-type: none"> <li>Reduced lung function</li> <li>Development of cardiovascular and respiratory diseases</li> <li>Increased rate of disease progression</li> <li>Reduction in life expectancy</li> </ul>
Ozone	<ul style="list-style-type: none"> <li>Irritation and inflammation of the eyes, nose, throat, and lower airways (e.g. coughing, sore and scratchy throat, or uncomfortable feeling in the chest)</li> <li>Reduced lung function (not able to breathe as deeply or vigorously as normal)</li> </ul>	<ul style="list-style-type: none"> <li>Exacerbation of asthma and chronic respiratory diseases, such as chronic bronchitis (also called chronic obstructive pulmonary disease, or COPD)</li> <li>Increased susceptibility to respiratory infections</li> </ul>
Nitrogen dioxide	<ul style="list-style-type: none"> <li>Increased susceptibility to lung infections in people with asthma</li> <li>Increased susceptibility to asthma triggers, such as pollen and exercise</li> <li>Worsened symptoms of asthma, and more frequent asthma attacks</li> <li>Airway inflammation in healthy people</li> </ul>	<ul style="list-style-type: none"> <li>May contribute to the development of asthma, and potentially increase susceptibility to respiratory infections (United States Environmental Protection Agency, 2022)</li> <li>Higher risk of cardiovascular and respiratory mortality (Huang, 2021)</li> </ul>
Carbon monoxide	<ul style="list-style-type: none"> <li>For people with certain types of heart disease, high ambient outdoor concentrations of carbon monoxide can reduce oxygen supply to the heart, causing chest pain (also known as angina)</li> </ul>	<ul style="list-style-type: none"> <li>May cause heart disease and damage to the nervous system (Department of Climate Change, 2022)</li> </ul>

Unless otherwise stated, all health impacts in Table 2 are sourced from the NSW Department of Health (NSW Health, 2022).

## Local leadership to support action

Air pollution is a serious issue for all Australians, and leadership and collaboration at all levels is needed to address it effectively. The NSW Government manages a state-of-the-art network of air quality monitoring stations, and is committed to providing accurate and up-to-date information, and to reducing the sources of air pollution (NSW EPA, 2021).

A complex mix of factors can make air quality a highly localised and place-based issue, requiring local interventions, policies, and leadership. By developing a good understanding of air quality through local monitoring, local governments can support place-based strategies that positively impact their communities. In recent years, emerging smart sensor technologies (and the data-informed insights they deliver) have enabled local governments to take the lead in encouraging action on air quality.

Local leadership strategies include a variety of policy and planning interventions that support place-making, walkability, public transport, and urban greening (such as creating car-free zones in civic centres and urban neighbourhoods, or reducing the use of wood-burning heaters in homes). It is essential that local governments also encourage and support participatory community engagement, education, and outreach related to any air quality initiatives.



*This car-free zone in Burwood (NSW) was created by transforming a one-way street into a pedestrian precinct in 2022.  
Image source: UTS*

## Common air pollutants and their sources

Air pollution can consist of a broad range of pollutant types, produced by a wide variety of sources (summarised in Table 3).

Table 3. A summary of air pollutants and pollution sources

Pollutant	Description	Human Sources										Natural Sources				
		Transport (road)	Transport ( maritime, rail, air)	Diesel generators	Domestic wood burning	Power stations and factories	Agriculture (land use)	Mines, quarries and construction	Climate change (extreme heat, urban heat islands, drought)	Waste management facilities	Hazard reduction burns	Thunder storms	Bushfires	Plants (pollen, turpenes)	Sea Salt	Wind-blown dust
<b>Particulate Matter</b>																
PM1	Very fine particulate matter ≤1µm	⊗	⊗	⊗	⊗	⊗	⊗	⊗		⊗	⊗		⊗			
PM2.5	Fine particulate matter ≤2.5µm	⊗	⊗	⊗	⊗	⊗	⊗	⊗		⊗	⊗		⊗			⊗
PM10	Particulate matter ≤10µm	⊗	⊗	⊗	⊗	⊗	⊗			⊗	⊗		⊗	⊗	⊗	⊗
<b>Gases</b>																
NO2	Nitrogen Dioxide	⊗	⊗	⊗	⊗	⊗				⊗	⊗		⊗			
SO2	Sulphur Dioxide	⊗	⊗	⊗	⊗	⊗				⊗	⊗		⊗			
CO	Carbon Monoxide	⊗	⊗	⊗	⊗	⊗				⊗	⊗		⊗			
O3	Ozone (ground-level) Forms through the reaction of NOx, SOx, VOCs and heat	⊗	⊗	⊗					⊗	⊗	⊗	⊗	⊗	⊗		
CO2	Carbon Dioxide	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗		⊗			
VOC	Volatile Organic Compounds					⊗	⊗			⊗	⊗		⊗	⊗		

Please note that one micrometre (µm) is one millionth of a meter (i.e., 1 µm = 1x10<sup>-6</sup> m) and one nanometre (nm) is one billionth of a meter (i.e., 1 nm = 1x10<sup>-9</sup> m).

## Air pollutants

Air pollutants can be divided into particulate matter (referred to as PM), and gases.

### Particulate matter (PM)

The term 'particulate matter' is used to describe a variety of extremely small particles, which can be either solid or liquid droplets. PM can range in size, from larger pollen grains, dust, and soil to much smaller soot, nitrates, sulphates, and organic chemicals.

Particulate matter is commonly classified into three groups, according to maximum particle diameter:

- 10 micrometres (PM<sub>10</sub>)
- 2.5 micrometres (PM<sub>2.5</sub>)
- 1 micrometre (PM<sub>1</sub>).

PM<sub>10</sub> can enter the lungs and cause respiratory and heart problems. PM<sub>2.5</sub> and PM<sub>1</sub> are so small that they can cross into the bloodstream (via the lungs), and be transported to all areas of the body. Awareness of the far-reaching negative health impacts of these smaller particles has increased significantly in recent years.

### Gases

A range of gas pollutants can have a harmful effect on human health and the environment, even at relatively low concentrations. The most common gas pollutants are nitrogen dioxide, sulphur dioxide, carbon monoxide, ozone, and volatile organic compounds (VOCs). A variety of other nitrogen and sulphur molecules are also considered to be pollutants (commonly referred to as NO<sub>x</sub> and SO<sub>x</sub>). There is a great deal of complexity to the study of gas pollutants because they chemically interact with each other in the atmosphere in constantly changing dynamic equilibrium.

## Air pollution sources

Air pollution sources can be broadly categorised as human/natural, and local/diffuse.

### Human vs natural sources

Human sources of air pollution relate to a broad range of human activities, including transport, agriculture, power generation, industry, and various forms of burning.

Natural sources of air pollution include thunderstorms, bushfires, allergens (plants and fungi), and dust. Key findings from the *Australia State of the Environment 2021* report (Australia State of the Environment, 2021) confirm that natural sources of air pollution (rather than human ones) tend to be responsible for the most extreme poor air quality conditions experienced in Australia.

### Local vs diffuse sources

When air pollution is localised, it impacts the immediate surrounding area (e.g. traffic emissions from a particular major road). Diffuse air pollution, on the other hand, can be transported across large distances to impact entire regions (e.g. bushfire smoke or dust storms).



## Additional resources

### **NSW Department of Planning and Environment | [Air quality basics](#)**

This set of resources provides a useful, accessible introduction to air quality issues.

### **NSW Department of Health | [Outdoor air pollution](#)**

This resource includes detailed information about the most common types of outdoor air pollution.

### **The Clean Air and Urban Landscapes Hub | [Air Quality](#)**

These resources focus on air quality in Australia, and include in-depth reports on pollution sources, human exposure, and health impacts.

### **World Health Organisation | [Air pollution](#)**

A comprehensive, global resource that includes factsheets, reports, databases, and practical tools related to a wide range of ambient air pollution issues.

### **C40 Cities | [Air Quality Network](#)**

The Air Quality Network convenes C40 cities to share best practices for developing and implementing air quality solutions that meet public health, equity, and climate goals.

### **BreatheLife | [BreatheLife Resources](#)**

BreatheLife is a joint initiative of the World Health Organisation, United Nations Environment Programme, World Bank, and Climate and Clean Air Coalition. It combines public health and climate change expertise with guidance on implementing solutions to air pollution in support of global development goals.

## Associated OPENAIR resources

### Factsheet

#### ***Air quality as a local issue***

This factsheet provides a high-level introduction to air quality as a local issue.

## References

- Australian Government. (2021). *Australia State of the Environment 2021*. Air Quality and Climate Change Theme. <https://soe.dcceew.gov.au/air-quality/pressures/climate-change#summer-201920-bushfires>
- Australian Institute of Health and Welfare. (2021). *Australian Burden of Disease Study 2018: Interactive data on risk factor burden*. <https://www.aihw.gov.au/reports/burden-of-disease/abds-2018-interactive-data-risk-factors/contents/air-pollution> <https://www.soe.epa.nsw.gov.au/all-themes/climate-and-air/air-quality#context>
- Department of Climate Change, Energy, the Environment and Water. (2022). *Carbon monoxide*. <https://www.dcceew.gov.au/environment/protection/npi/substances/fact-sheets/carbon-monoxide-0#:~:text=At%20very%20high%20levels%20carbon,damage%20to%20the%20nervous%20system>
- Department of Climate Change, Energy, the Environment and Water. (2021). *Australia State of the Environment*. <https://soe.dcceew.gov.au/>
- Electric Vehicle Council and Asthma Australia. (2019). *Cleaner and Safer Roads for NSW*. [https://electricvehiclecouncil.com.au/wp-content/uploads/2019/06/EVC-Cleaner-and-Safer-Roads-for-NSW\\_V3-Single.pdf](https://electricvehiclecouncil.com.au/wp-content/uploads/2019/06/EVC-Cleaner-and-Safer-Roads-for-NSW_V3-Single.pdf)
- Huang, S., Li, H., Wang, M., Qian, Y., Steenland, K., Caudle, W. M., Liu, Y., Sarnat, J., Papatheodorou, S., & Shi, L. (2021). Long-term exposure to nitrogen dioxide and mortality: A systematic review and meta-analysis. *Science of the Total Environment*, 776, 145968. <https://doi.org/https://doi.org/10.1016/j.scitotenv.2021.145968>
- NSW EPA. (2021). *NSW State of the Environment 2021*. Climate and Air Theme. <https://www.soe.epa.nsw.gov.au/all-themes/climate-and-air/air-quality>
- NSW Health. (2022). *Outdoor air pollution*. <https://www.health.nsw.gov.au/environment/air/Pages/outdoor-air-pollution.aspx>
- United Nations. (n.d). *Sustainable Development Goals*. <https://sdgs.un.org/goals>
- United States Environmental Protection Agency. (2022). *Nitrogen Dioxide (NO2) Pollution*. <https://www.epa.gov/no2-pollution/basic-information-about-no2>
- WHO. (2022). *Ambient (outdoor) air pollution*. [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)
- WHO. (2022). *Air pollution*. [https://www.who.int/health-topics/air-pollution#tab=tab\\_2](https://www.who.int/health-topics/air-pollution#tab=tab_2)

## Further information

For more information about this project, please contact:

*Peter Runcie*

Project Lead, NSW Smart Sensing Network (NSSN)

Email: [peter@natirar.com.au](mailto:peter@natirar.com.au)

This Best Practice Guide section is part of a suite of resources designed to support local government action on air quality through the use of smart low-cost sensing technologies. It is the first Australian project of its kind. Visit [www.openair.org.au](http://www.openair.org.au) for more information.

OPENAIR is made possible by the NSW Government's Smart Places Acceleration Program.

Document No: 20231024 BP105 Air quality as a local issue Version 1 Final

