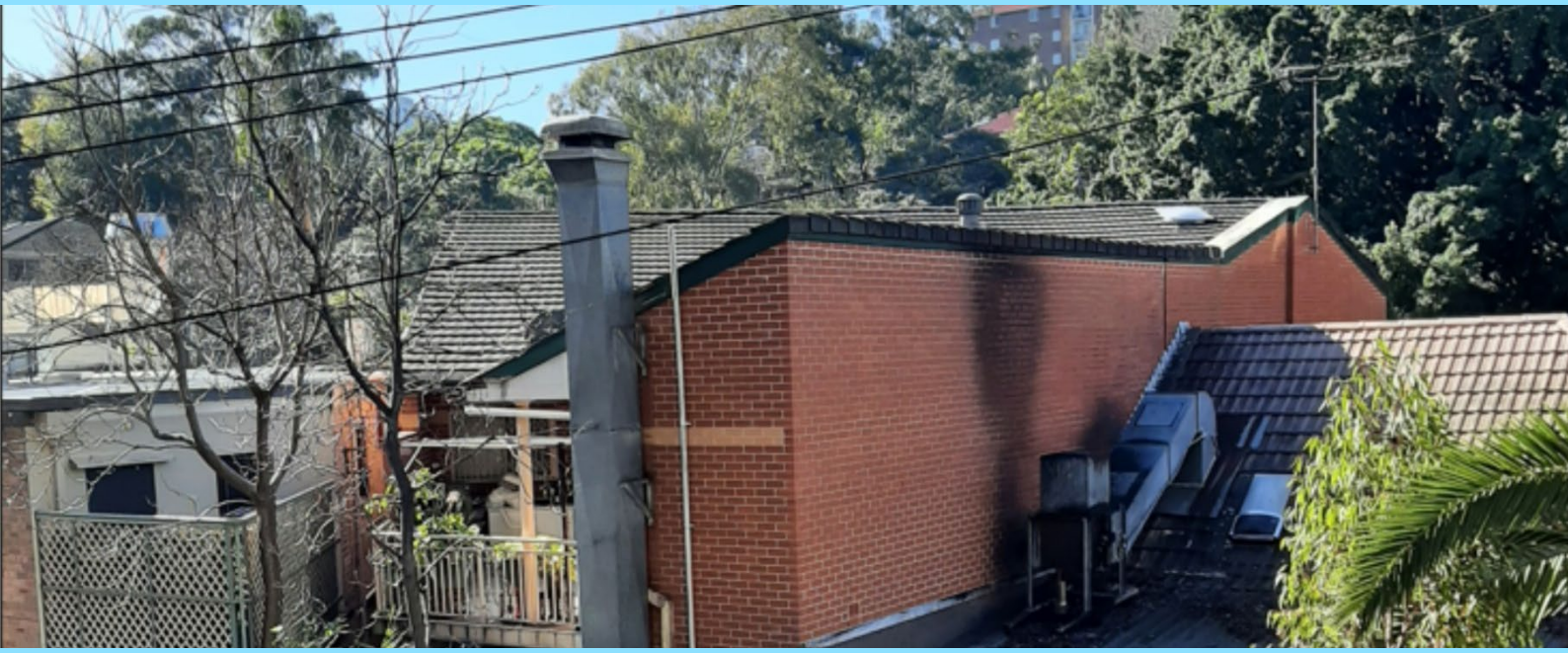

Local Government Air Quality Toolkit

Food outlets guidance note

Information on emissions to air from food and beverage outlets and how to manage these emissions

NSW GOVERNMENT

Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

The Local Government Air Quality Toolkit has been developed by Department of Climate Change, Energy, the Environment and Water in collaboration with the NSW Environment Protection Authority, the NSW Department of Planning, Housing and Infrastructure, Local Government NSW and local councils.

Cover photo: Two exhaust stacks on the rear of a food outlet. Zephyr Environmental

Artist and designer Nikita Ridgeway from Aboriginal design agency – Boss Lady Creative Designs, created the People and Community symbol.

Published by:
Environment Protection Authority and
Department of Climate Change,
Energy, the Environment and Water
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment and Heritage enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
Email info@environment.nsw.gov.au
Website www.environment.nsw.gov.au

ISBN 978-1-923200-63-0
EH 2024/0171 July 2024

Find out more at:

nsw.gov.au/dcceew

Contents

List of tables

List of figures

1. Introduction

1.1 Industry overview

This guidance note provides general information on emissions to air from food and beverage outlets, managing these emissions and key considerations for local councils. It does not apply to large breweries, which require a licence to be issued by the NSW Environment Protection Authority (EPA) if they produce more than 30 tonnes of alcohol or alcoholic products per day or 10,000 tonnes of alcohol or alcoholic products per year. This guidance note also doesn't cover work health and safety.

Restaurants and take-away food outlets are not scheduled activities under the *Protection of the Environment Operations Act 1997* (the POEO Act), and therefore do not require licensing by the EPA.

In New South Wales, day-to-day management of food outlets is regulated by local councils. The environmental management and resolution of any air pollution or off-site impacts caused by particulates or odour from food outlets is generally the responsibility of the site operator.

For the purpose of this guidance note, a 'food outlet' is considered to be a restaurant or take-away food / drink outlet (including barbecue chicken, wood-fired pizza, coffee roasters and craft breweries).

Note that for the purposes of this guidance note, a craft (or micro) brewery is a brewery or distillery that produces less than 30 tonnes of alcohol per day or 10,000 tonnes of alcohol per year and does not fall within the 'brewing and distilling' scheduled activity under the POEO Act Schedule 1, clause 5.

Food outlets vary in size and in the nature of the activities that occur in them. Typically, they involve the following types of activities:

- transporting raw materials to the food outlet
- storing and handling raw materials (e.g. raw chicken)
- preparing food (e.g. de-boning, grinding, mincing, pureeing or cutting foodstuffs)
- drying food
- cooking food products for sale to the public (e.g. boiling, braising, roasting, frying, barbecuing)
- cooking specific products such as barbecue chickens or wood-fired pizzas
- accumulating, storing and disposing of food wastes and food-preparation wastes
- packaging the final product for sale to the public (e.g. take-away food)
- transporting the final product from the food outlet
- cleaning.

The aim of these activities is to provide food products for sale to the public, either 'in-house' (i.e. at dine-in restaurants) or as take-away products.

The capacity of these businesses to manage air quality depends on their location and size. In very sensitive locations even the smallest retailers have a real challenge to achieve adequate control. Large operations may need to resort to controls beyond typical industry practice to prevent or minimise unacceptable impacts on their neighbours.

Local government officers have an important role in managing the compliance process for food outlets and delivering positive environmental outcomes via the use of statutory notices, orders and directions.

2. Sources of emissions to air

2.1 Overview

The main air emissions from food outlets, in order of priority, are:

- odours (from cooking / brewing)
- greasy fume and fallout
- fine particulate matter as both solid and aerosol material
- volatile organic compounds (VOCs)
- air toxics, including polycyclic aromatic hydrocarbons (PAHs), benzene and toluene.

Emissions may be discharged from a:

- point source that is venting a process, piece of equipment or cooking area, e.g. an exhaust point or stack
- fugitive source, e.g. emissions escaping from doors, windows or other building openings. Fugitive sources include storage areas, particularly where putrescible (rotting) food wastes are kept.

Activities that are potential sources of air emissions from food outlets include:

- handling and storing raw materials
- cooking (generating smoke, fumes, steam, particulates and air toxics)
- transporting putrescible waste products off site
- cleaning
- drying
- packaging final products
- brewing.

2.2 Odour

Nature

Odour can be a significant air emission generated from food outlets. It is primarily generated from the cooking process. Studies (including analysis of cooking fume emissions) have shown that many odorous hydrocarbons or VOCs (such as alkenes, aromatics, aldehydes and organic acids) are formed in the cooking process as breakdown products of natural fats and oils.

Strength

The strength and offensiveness of the odours varies widely, depending on what is being cooked (e.g. which type of meat) and the manner of cooking. For example, local tests show that emissions from charcoal roasting of chickens are 3–10 times more odorous than emissions from gas-heated or electrically heated roasting of chickens.

Sensation

An odour sensation is caused by gaseous molecules meeting the olfactory nerve (refer to the Local Government Air Quality Toolkit – Module 1, *Part 4: Odour assessment*). However, aerosols of odorous materials; for example, tiny organic droplets in cooking fumes, can apparently increase odour strength. This may be due to continued evaporation of the odorous materials from the droplets as they travel from the source to the olfactory nerves of the observer. Removing aerosols can halve the effective odour strength.

2.3 Particulate matter

Particulates are emitted from food outlets in the form of smoke and fumes from roasting, barbecuing, and wood-fired cooking.

Some wood-fired pizza ovens use gas for cooking with a small wood fire to add flavour. The gas fire probably reduces odours but not particles in the woodsmoke. The particles consist of partially burnt fats emitted from cooking food and woodsmoke. These are known to contain materials detrimental to health such as PAHs and fine particles ($PM_{2.5}$). Most of the particulate matter is in the $PM_{2.5}$ range.

Food outlets also emit particulates in the form of oil and grease mist from deep frying and wok-type cooking, and from fats released during roasting and barbecuing. This is not only a potential nuisance to nearby occupants (particularly sensitive land uses such as childcare centres, schools, hospitals or residential areas), but also has associated odour and fallout issues.

Backyard smokehouses are another source of woodsmoke problems. They may be used for only a couple of weekends in a year, but intensively on those occasions. They have no smoke or odour controls. There is probably no solution for such backyard operations other than stopping them or limiting their use to specific times.

3. Managing air pollution

3.1 General approach

Controlling emissions from food outlets is usually achieved using a combination of:

- capturing the cooking fumes at source
- removing oil and grease by filtration, impingement or scrubbing
- modifying the method of cooking, where feasible
- dispersing emissions through a stack
- separating the source from receptors
- good housekeeping, to avoid odours typically associated with a build-up of rancid fats and putrefaction of foods and food wastes
- regular cleaning and maintenance of filters.

Where a solution cannot be achieved using the above basic measures, more advanced control techniques are available, including:

- carbon adsorbers
- electrostatic precipitators
- high-energy wet scrubbers
- flameless catalytic oxidisers.

Full descriptions of these methods are set out in the Local Government Air Quality Toolkit – Module 3, *Air pollution control techniques*.

Management options for each of the potential sources of air emissions, as listed in Section 2.1 above, are provided in Table 1.

Table 1 Management options for air emission sources for food outlets

Source	Management options
Handling and storing of raw materials	Enclose the activity Cover materials during transport
Cooking (generating smoke, fumes and particulates)	Installation of: • fume extraction and ventilation • filtration to remove fumes and particulates • carbon adsorbers or more intensive techniques to remove odours • stack (with correct configuration) to aid dispersion of odours
Transporting putrescible waste products off site	Store wastes in closed containers away from direct sun Remove wastes promptly from premises Cover wastes during transport
Cleaning	Installation of fume extraction and ventilation
Drying	Installation of fume extraction and ventilation Clean filters
Packaging final products	Installation of fume extraction and ventilation
Brewing	Configure stacks for optimal dispersion of odours Installation of a condenser (note this will create a liquid waste stream)

3.2 Managing odour – dispersion and cooking methods

Management by dispersion

If collected and vented to a suitably configured stack (with appropriate height and discharge velocity), odours can be dispersed to concentrations that are acceptable. If the necessary stack height is too great for this to be a realistic option, then an odour control technology such as activated carbon or catalytic oxidiser can be used to treat the odour before discharge. Further detail on the sizing of stacks is discussed in the Local Government Air Quality Toolkit – Module 3, *Air pollution control techniques*.

The prevailing wind direction will indicate to shop operators which local areas will be most impacted by odours. A common concern for food outlets located near the coast is the prevailing sea breeze from mid-morning to late afternoon (refer to the Local Government Air Quality Toolkit – Module 1, *Part 1: Meteorology and air quality* for a description of sea breezes). If multi-storey residences are located behind the typical row of shops fronting the coastline they are likely to be subject to cooking odours for a long period of the day when food is being prepared.

Changing cooking method

In some cases, a change from charcoal-fired cooking to gas-fired cooking, with compensating modifications to the food preparation, may be a possible solution to the problem. It would need to be clearly demonstrated that emissions from the proposed change would be effective; for example, through trials involving planned odour and visual observations.

In many cases this will not be feasible, as the charcoal element in the preparation is one of the selling features of the product.

3.3 Managing odour – control equipment

Overview

Removal of the aerosol of fats and oils from cooking emissions should be practised in all food outlets. A simple mesh filter that relies on an impingement principle is the basic equipment usually installed as standard in cooking ventilation systems. While this is effective in reducing the nuisance of oily fallout, it will have at best only a marginal impact on odour reduction.

If dispersion is not likely to be effective in the situation (i.e. there are tall buildings surrounding the food outlet and a high stack is not feasible) then reducing the odour at source is essential.

High-energy wet scrubbers and electrostatic precipitators are largely ineffective in removing odours and VOCs. They can remove odorous aerosols from cooking fumes and so may marginally reduce the impact of the odours. They will effectively reduce greasy fallout.

Mechanical ventilation is required in most food shops. It should comply with clause H4D7 of the *National Construction Code 2022* (Australian Building Codes Board 2022) and Australian Standard AS 1668.2 (Standards Australia 2012). The business must provide a report certified by a mechanical ventilation engineer indicating compliance. Air capture velocities and air exhaust rates must demonstrate compliance.

The objective of efficient control is to make sure the most significant odour sources are captured and treated or dispersed. Odours from waste storage areas are best controlled by keeping surfaces clean and storing wastes in closed containers.

Activated carbon adsorbers

Activated carbon adsorbers or 'filters', and the accessories required to adapt such a system to a discharge stack, are readily available and are used in a wide range of commercial and industrial applications. The principles of carbon adsorption are described in the Local Government Air Quality Toolkit – Module 3, *Air pollution control techniques*.

Activated carbon filters are effective for a wide range of concentrations and odorous compounds that exist as a gas or vapour.

Activated carbon works by adsorbing odorous materials into the pores of the carbon, which is usually in a granular form and packed into a filter or bed through which the odorous gas is passed.

There must be a pre-filter to protect the carbon from excessive dust and grease, as these will block the pores and stop the carbon from adsorbing odours. Several stages of progressively finer filtration may be needed to ensure the activated carbon bed does not become clogged too quickly by the cooking fumes.

The capacity of the adsorber is reached when 'breakthrough' occurs; that is, when the odour can be detected on the discharge side of the filter. By that time a new filter should be installed and the old filter discarded as industrial waste. It may only be disposed of to landfills licensed to accept such wastes. Refer to the Local Government Air Quality Toolkit – Module 3, Section 4.11.

Removal of other gaseous emissions such as VOCs and air toxics, like benzene and toluene, can be achieved by carbon adsorption for odour control.

Breakthrough is the point at which the activated carbon has reached saturation and cannot absorb any further VOC / odorous material.

Flameless catalytic oxidisers

These oxidisers are prevalent in regions such as the Californian South Coast Air Quality Management District. At this location, chain-driven char broilers are fitted with flameless catalytic oxidisers to reduce emissions of odour, VOCs and particulates.

The catalyst bed consists of a porous ceramic disc (approximately 600 mm in diameter by 90 mm deep) coated with a metallic catalyst. It requires an entry temperature of greater than 320°C. Volatile organic matter from the cooking is adequate to maintain the oxidation on the catalyst without secondary gas fuel. The principle of thermal oxidisers is discussed in the Local Government Air Quality Toolkit – Module 3, Section 4.14.

Electrostatic precipitators

Electrostatic precipitators can be effective in removing oily aerosols from cooking fumes. They are generally suitable for larger establishments. They will not remove odours as such but do remove odorous aerosol materials. They are also effective in removing particulates formed in smoke.

They require regular cleaning to remove the greasy particulate build-up that adheres to the electrode collector plates. The principle of precipitators is discussed in the Local Government Air Quality Toolkit – Module 3, Section 4.10.

Wet scrubbers

Water scrubbers are found in some cooking facilities. They do not remove odours because most odorous compounds from cooking processes are relatively insoluble in water. Medium to high-energy scrubbers can remove aerosols and particulate matter from cooking fumes, with intermediate effectiveness.

Wet scrubbers have been used extensively in food outlets in places like Hong Kong, but they frequently create noise problems, due to air movement associated with the high pressure drop. They also create a liquid waste that has to be disposed of. The principle of wet scrubbers is discussed in the Local Government Air Quality Toolkit – Module 3, Section 4.4.

Condensers

A condenser may be employed in breweries, used on equipment such as the boil kettle to remove the atmospheric waste stream entirely. The condensers are designed to convert steam back into water. Consideration should be given to this requirement as it can be prohibitive from a whole of life cost perspective (the atmospheric waste stream becomes a liquid waste stream) and has significant demand on water supply.

Afterburners

For some activities, notably coffee roasters, an afterburner unit may be applicable. At many locations, an afterburner unit is not considered essential to mitigate odour; however, such units may be specified where operations are close to residential and other sensitive receptors. Afterburners are typically gas-fired and are considered effective in removing roasting odours, as exhaust air is heated to a temperature that can thermally oxidise such odours.

3.4 Controlling particulate matter

Particulate matter from cooking processes can be controlled by installing a filter in the ventilation system. However, for processes generating considerable smoke (such as charcoal cooking), a more rigid checking and maintenance program is required to make sure the particulate filtration system is performing satisfactorily. Cleaning and replacement needs to be done at regular intervals; for example, cleaning or replacing a grit arrestor. Typically for a commercial outlet or restaurant, cleaning may be required at least once a month with replacement of filters every 6–9 months.

3.5 Improving emission performance

Emission performance can be improved through the following management options:

- improving the manner in which the site is operated and maintained, e.g. training site operators to minimise odours when preparing and cooking food
- taking steps to minimise waste, e.g. recycling or reusing waste.

Cooking operations should also be checked for generation of fugitive air emissions, such as odour emissions that can escape through doorways or windows.

4. Considerations for local councils

4.1 Scheduled or non-scheduled activity

We note that the information in relation to possible planning controls and approvals required for restaurants and take-away foot outlets is high level and only general in nature. This is because what planning controls apply and therefore what approvals are required will depend on each individual proposal, and any required approvals will need to be considered on a case-by-case basis taking into account the local government area, any applicable planning controls, and the nature of the proposal.

As mentioned in Chapter 1, apart from large breweries, restaurants and take-away food outlets in New South Wales do not require an environment protection licence from the EPA to undertake their activities. Food outlets are therefore regulated at the local government level.

Authorised local government officers have an important role to play in managing the compliance process for these non-scheduled activities and enforcing positive environmental outcomes through the use of appropriate enforcement orders.

In some circumstances, local government officers can address issues in relation to emissions from restaurants and take-away food outlets in the following ways. We note that the 2 options detailed below are not the only ways that the local government officer can address the issue, but rather each proposal needs to be determined on a case-by-case basis:

- compliance with any relevant consent conditions under the *Environmental Planning and Assessment Act 1979* (the EP&A Act)
- environment protection notices under Chapter 4 of the POEO Act (see Local Government Air Quality Toolkit – Module 2 and Module 4), including:
  - a prevention notice or series of notices, where the ARA suspects the activity is being carried out in an environmentally unsatisfactory manner
  - a clean-up notice where there is a pollution incident within the meaning of the POEO Act
  - both a prevention notice and a clean-up notice.

If issues are identified, the following tools are available in the Local Government Air Quality Toolkit – *Resource pack*:

- Chapter 2 – a checklist for inspecting odour from food outlets
- Chapter 3 – checklists for investigating odour, fallout or other complaints
- Chapter 6 – checklists for reviewing air quality assessments and dispersion modelling.

Under the POEO Act notice provisions, local councils are empowered to direct a recipient to take clean-up action or preventative action; for example, requiring studies to be carried out by the operation's management. Time spent making sure the brief for any investigation is thorough and covers all the relevant aspects raised in this guideline, is time well spent – for the management, for council and for the neighbours and wider community.

4.2 Planning and development

Planning the location of new food outlets as part of the development consent process is a fundamentally important aspect of odour management. Separation from sensitive receptors and elevated release of emissions (via a stack) are the key factors in planning decisions, and they can be used in combination.

Medium to large outlets and restaurants should have an odour assessment performed by a competent consultant. See Section 4.3 below for further information. This is particularly the case if the business is planning to use known odorous processes, such as charbroiling, in substantial volumes and relatively close to sensitive receptors. It is essential that the influence of nearby buildings and large objects is fully incorporated into any odour assessment.

Caution should be exercised in requiring smaller outlets to comply with this requirement due to the cost of an odour assessment. Carbon adsorption or stack height elevation could be installed for a cost comparable to an odour assessment, with a known positive outcome (Figure 1).

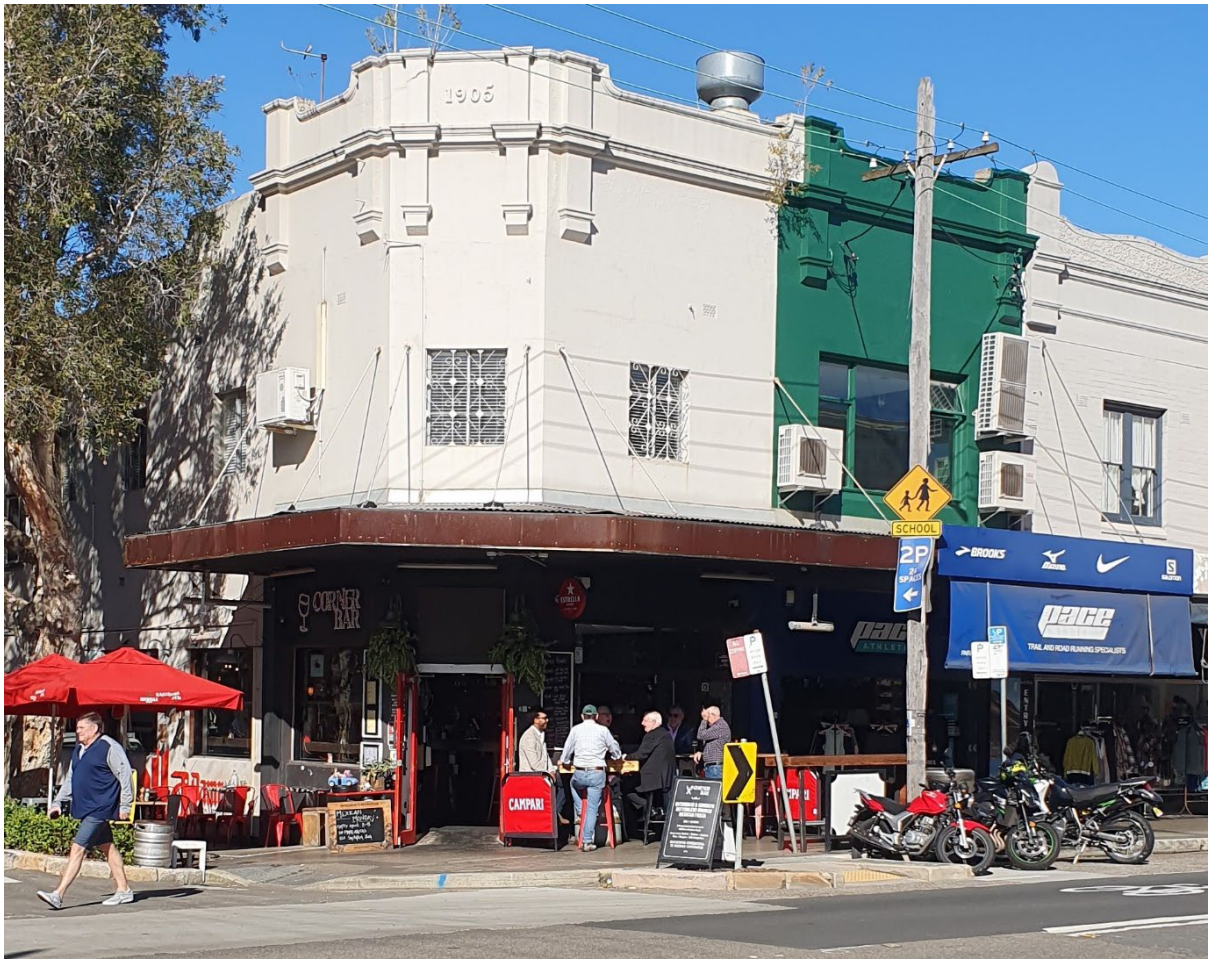

Figure 1 **An appropriately designed stack may be installed for a cost comparable to an odour assessment, with a known positive outcome**

Source: Damon Roddis/Zephyr Environmental

More information can be found in the Local Government Air Quality Toolkit *Land-use planning guidance note*.

4.3 Assessment and dispersion modelling

There are a few important aspects for local government to consider when reviewing external consultants' air quality (or odour) assessment and dispersion modelling studies, to make sure the best outcome is achieved. These are included in Chapter 6 of the Local Government Air Quality Toolkit – *Resource pack*.

4.4 Compliance testing

The need for compliance testing should be considered in each situation, balancing expense incurred by the operator against likely sensitivity and the extent of likely impact.

A typical compliance testing condition would require:

- tests to be carried out in accordance with the EPA *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (EPA 2022b) by an accredited testing body (NATA or equivalent), and within a reasonable time of commissioning (typically 3 months)
- results to be reported to council within a specified time (typically one month from the testing)
- interpretation and commentary on the test results to be provided to council.

Once a system has been optimised, compliance may be readily demonstrated by ensuring regular maintenance of filtration / carbon adsorption.

4.5 Odour complaints

Odours from food outlets commonly generate complaints from occupants of nearby premises, particularly sensitive land uses such as schools, hospitals or residential areas. For example, charcoal chicken shops and other similar take-away outlets are often located at street level in a multi-story building, or in a single-storey building surrounded by multi-storey buildings with residences on the upper levels. Air emissions from these shops can enter neighbours' homes leading to complaints.

Chapter 3 of the Local Government Air Quality Toolkit – *Resource pack* can help councils investigate odour complaints.

4.6 Operational and control recommendations

Consideration should be given to appropriate operational procedures to control and limit air emissions. Chapter 7 of the Local Government Air Quality Toolkit – *Resource pack* lists operational measures that are helpful in reducing emissions and impacts from food outlets.

The local council may be required to conduct a site inspection to investigate current management practices. Chapter 2 of the Local Government Air Quality Toolkit – *Resource pack* provides helpful information for council officers prior to these inspections including a checklist.

Before going on site for an inspection, council officers should be aware of the facility's status (scheduled or non-scheduled) and review any previously prepared reports (including diagrams, photographs and maps).

Case study – Cooking odours from food outlets

Note that this case study is for illustrative purposes only. It does not indicate a procedure that ARAs, authorised officers and enforcement officers should follow in all cases and does not constitute legal advice. Readers should seek their own legal advice in relation to their specific circumstances.

Issue: Residential home located in multiplex including both residential and commercial properties and multiple food outlets. Cooking odours from multiple food shops being smelt in residential home leading to complaints to the local council. Odour issue is between 9 am and 8 pm and occurs every day and gets worse as the day progresses.

Mechanical ventilation on the roof of the common area is servicing all food outlets. The most affected resident was living in the unit right next to the mechanical ventilation system (Figure 2).

Response: The council requested that the building owner undertake an odour impact assessment. This concluded that the discharge point of the mechanical ventilation did not meet the Australian Standard AS1668.2-2012 as the air was not discharged vertically or away from sensitive locations including air intakes or openings.

The building manager installed carbon cartridge filters and media with an action for these filters to be cleaned monthly. If odour complaints continue, the council will request additional and stringent odour control measures such as redesign of the exhaust stack.

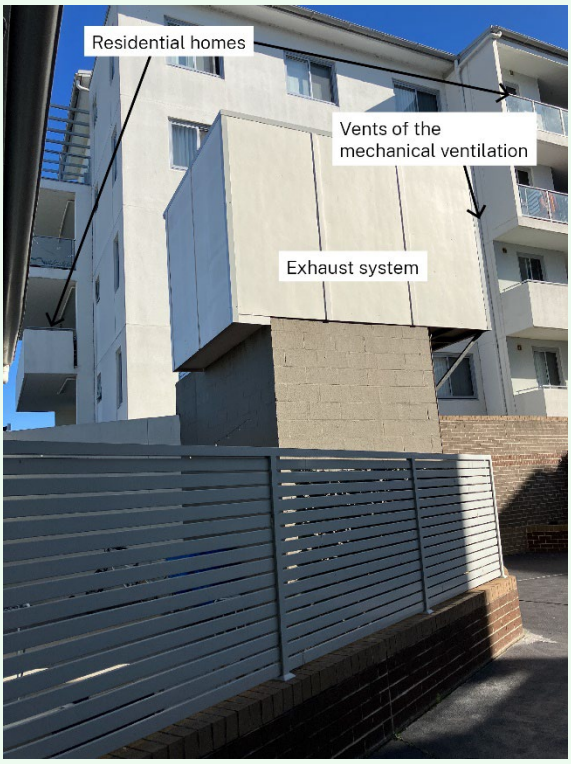

Figure 2 Food outlet exhaust venting near residential properties

Source: Annie Verghese/Cumberland City Council

Case study – Coffee roasting activities

Note that this case study is for illustrative purposes only. It does not indicate a procedure that ARAs, authorised officers and enforcement officers should follow in all cases and does not constitute legal advice. Readers should seek their own legal advice in relation to their specific circumstances.

Issue: Smoke and odour from a coffee roasting business observed at adjoining light industrial premises leading to a complaint to the local council. The odour has been identified in the showroom and storage area. The problem occurs once a week and is noticed during the first part of the start-up and about an hour before shut-down.

A development application was subsequently lodged with the council to seek retrospective approval for the coffee roasting facility.

Response: An air quality impact assessment was requested and undertaken. The assessment confirmed that the facility was roasting for a total of 5 hours per week and that there would be no impacts to the nearest residential receptor located at a distance of 370 m. The report stated that any issues with odour impacts from the facility could be effectively managed by the operator by considering the day and time of the roast.

The conditions of consent applied are:

1. Coffee processing operations shall be undertaken in accordance with the recommendations contained within the air quality assessment.
2. Certification from a suitably qualified environmental consultant shall be submitted to council within 30 days of the date of consent confirming that the assumptions and recommendations from the air quality assessment have been implemented.
3. Should the 30-day review reveal odour or particulate emissions are being produced by the roasting process in breach of the POEO Act, the consultant shall provide recommendations to address these emissions. These shall be implemented immediately following review by council.
4. The following applies to the coffee roasting process:
    a. The coffee roasting process (roasting and cooling) shall be restricted to a maximum of 5 hours per week.
    b. Plant must be maintained in a proper and efficient manner that does not cause air pollution.
    c. Materials must be handled in a proper and efficient manner that does not cause air pollution.
5. A record shall be kept of all odour complaints received, which must include the following details:
    a. date and time of the complaint
    b. method by which the complaint was made
    c. any personal details of the complainant that were provided by the complainant or, if no such details were provided, a note to that effect
    d. nature of the complaint including a description of the odour and the location where the odour was detected
    e. meteorological conditions at the time the odour was reported
    f. action taken in relation to the complaint, including any follow-up contact with the complainant
    g. if no action was taken, the reason why no action was taken.

Case study – Craft brewery

Note that this case study is for illustrative purposes only. It does not indicate a procedure that ARAs, authorised officers and enforcement officers should follow in all cases and does not constitute legal advice. Readers should seek their own legal advice in relation to their specific circumstances.

Issue: A craft brewery was located within a repurposed warehouse facility (Figure 3). The brewery operates a boil kettle to boil the wort required for each batch of beer. It operates in periods of about an hour for each boil.

From the boil kettle, the boiled wort is then transferred to a whirlpool vessel. There is no additional heating at this point of the brewing process, so the whirlpool vessel outlet (stack) vents the steam vapour from the pre-boiled beer.

From the point that the beer begins transferring into the whirlpool vessel, to the time it is finished / transferred out is approximately 90 minutes.

The craft brewery may make up to 5 separate batches per day, typically operating from 4 am through to 6 pm. Each batch takes approximately 2.5 hours to complete the process described above.

Following odour complaints by the local community, the local council required the brewery to complete an air quality assessment, including odour sampling and modelling.

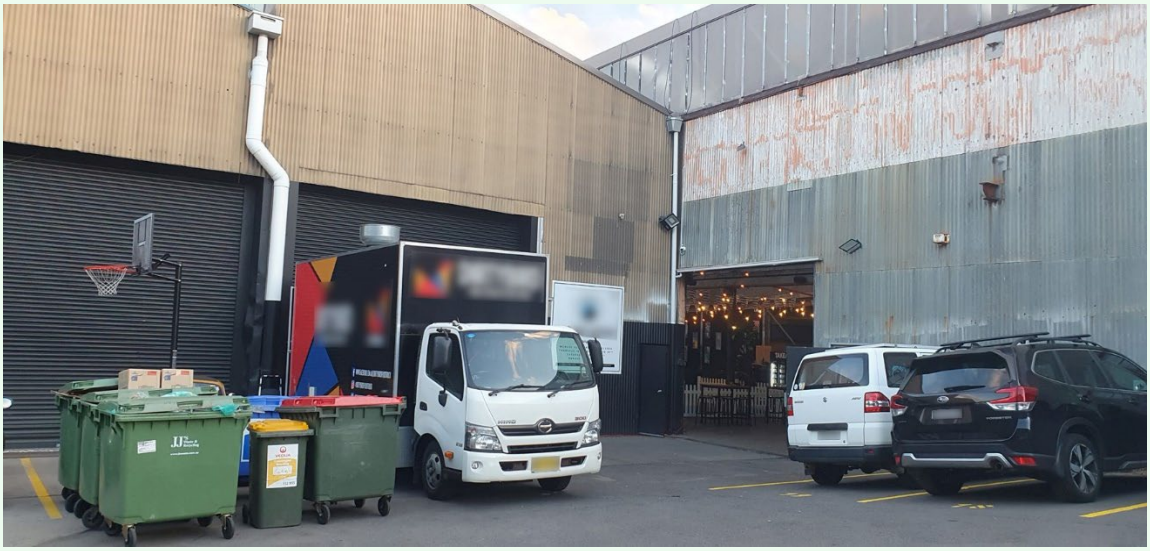

Figure 3 **Craft brewery in a repurposed warehouse**
Source: Damon Roddis/Zephyr Environmental

Response: An air quality assessment was requested and conducted. The air quality assessment concluded that the whirlpool vessel stack did not present an odour risk. However, the operation of the boil kettle had the potential to cause an exceedance of the odour criterion at the nearest residential receptors.

Odour modelling indicates that raising the boil kettle stack to 10 m above the warehouse roof height will appropriately mitigate the odour impact. Alternatively, a condenser may be employed on the boil kettle to remove this atmospheric waste stream entirely.

While the best mitigation for the boil kettle stack would be a condenser, the installation of a condenser introduces significant whole of life costs that would be prohibitive for the ongoing viability of the business. Even where the cost impact could be resolved, there would be a significant demand on the town water supply and electricity that needs to be considered from a sustainability and resource perspective. On this basis, the extension of the stack, with appropriate evaporation management measures, was selected as the best outcome (Figure 4).

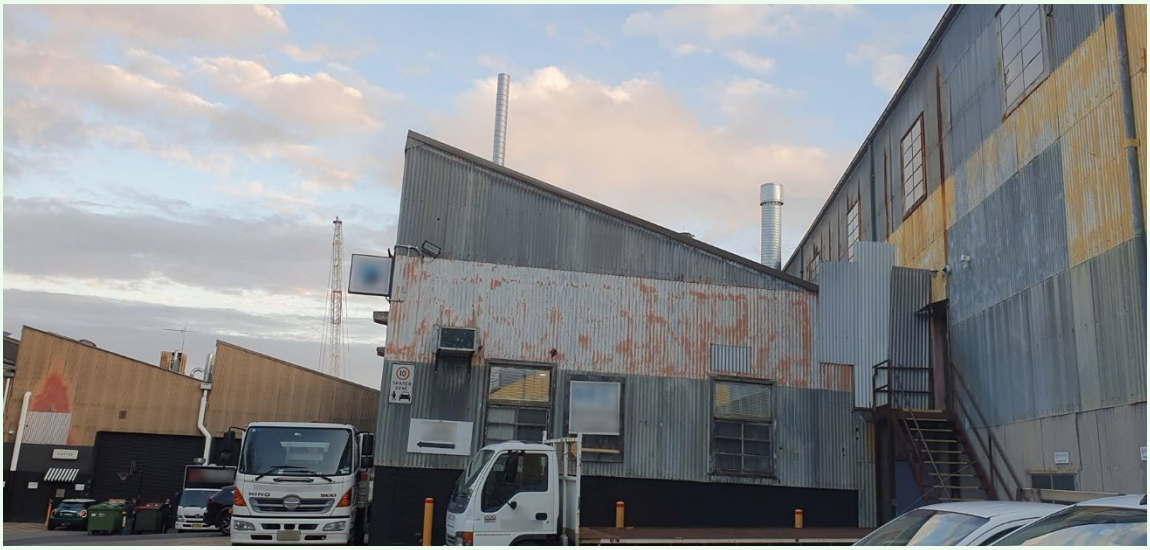

Figure 4 **Craft brewery with stack showing above roofline**
Source: Damon Roddis/Zephyr Environmental

5. References and other resources

All documents and webpages that are part of the Local Government Air Quality Toolkit are available from the EPA website.

ABCB (Australian Building Codes Board) (2022) *National Construction Code 2022*, Australian Building Codes Board, Canberra ACT, https://ncc.abcb.gov.au.

DEC (Department of Environment and Conservation) (2006a) *Technical Framework: Assessment and management of odour from stationary sources in NSW*, NSW Department of Environment and Conservation, Sydney South NSW, www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/air/20060440framework.pdf [PDF 259 KB].

DEC (2006b) *Technical Notes: Assessment and management of odour from stationary sources in NSW*, NSW Department of Environment and Conservation, Sydney South NSW, www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/air/20060441notes.pdf [PDF 254 KB].

EPA (2022a) *Approved methods for the modelling and assessment of air pollutants in NSW*, NSW Environment Protection Authority, Parramatta NSW, www.epa.nsw.gov.au/your-environment/air/industrial-emissions/approved-methods-for-the-modelling-and-assessment-of-air-pollutants.

EPA (2022b) *Approved methods for the sampling and analysis of air pollutants in NSW*, NSW Environment Protection Authority, Parramatta NSW, www.epa.nsw.gov.au/your-environment/air/industrial-emissions/sampling-analysing-air-emissions/approved-methods-sampling-analysing-air-pollutants.

Food Standards Australia New Zealand (2021) *Australia New Zealand Food Standards Code*, Food Safety Standard 3.2.3 – Food Premises and Equipment (Australia only), Food Standards Australia New Zealand, Majura ACT.

Standards Australia (2012) *Australian Standard AS 1668.2-2012 Amd 2:2016 The use of ventilation and air conditioning in buildings*, Part 2: Mechanical ventilation in buildings, Standards Australia Ltd, Sydney NSW.

Standards Australia (2015) *Australian Standard AS 1668.2-2015 The use of ventilation and air conditioning in buildings*, Part 1: Fire and smoke control in buildings, Standards Australia Ltd, Sydney NSW.

Whynot J, Quinn G, Perryman P and Votlucka P (1999) 'Control of fine particulate ($PM_{2.5}$) emissions from restaurant operations', *J Air Waste Manag Assoc*, 49(9):95–99, doi: 10.1080/10473289.1999.10463886.