Government of **Western Australia**
Department of **Water and Environmental Regulation**

Guideline

Odour emissions

Activities regulated under the:

- *Environmental Protection Act 1986*
- *Environmental Protection Regulations 1987*

June 2019

Enquiries

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1. Purpose

The purpose of the *Guideline: Odour emissions* (Guideline) is to ensure adequate odour data and information are provided to the Department of Water and Environmental Regulation (the Department) when assessing odour impact as part of an application under Part V of the *Environmental Protection Act 1986* (EP Act).

2. Scope

Guidelines provide direction on how the Department interprets and applies the legislation it administers, and its policies. Guidelines are not mandatory considerations, however, the Department's guidelines assist applicants to provide information in the best possible manner to ensure the efficient and effective assessment of their application. Applications that do not align with the appropriate guidelines may result in protracted assessment timeframes, and if the information provided is not sufficient for the Department to complete its assessment, the application may be declined or refused.

This Guideline applies to all applications for a works approval or licence under Part V of the EP Act with an identified odour emission component, except where the emission sources involve tall wake-free stacks. Where a proposal involves tall wake-free stacks, applicants should seek advice from the Department regarding appropriate analysis methods.

The Guideline only deals with odour impacts as an amenity or nuisance issue. It does not consider air toxics and impacts on human health.

The Guideline does not discuss how the Department uses the applicant's information to assess the risk of odour impact for the proposed activity. The Department will follow its regulatory risk assessment framework to assess the proposal and provide a decision report.

This Guideline should be read in conjunction with the regulatory framework guidance material located on the Department's webpage (Refer to the *Related documents* section for links).

The Guideline is not intended to apply to land-use planning proposals for odour-sensitive land uses situated near existing or planned odour-generating activities. Planning authorities are responsible for deciding planning applications.

NOTES:

1 Applicants may choose who will undertake the analysis and prepare the application. There is no obligation to engage external expertise however, prior to engaging external consultants, applicants should satisfy themselves that the expert has the relevant experience, qualifications and competency to undertake the work.

2 If applicants intend to use alternative guidance material or tools to those described in this Guideline, they should first discuss this with the Department

to ensure its suitability for informing the Department's assessment and decision-making processes.

3. Context

3.1 Description of odour

An odour is the property of volatilised chemical compounds perceived by our sense of smell. Odours emitted to the atmosphere may result in annoyance or nuisance to members of the public.

The following factors, described using the acronym **FIDOL**, are widely accepted as being important dimensions of odour nuisance:

- **F**requency of odour impacts;
- **I**ntensity (or strength) of the odour;
- **D**uration of the exposure events;
- **O**ffensiveness of the odour; and
- **L**ocation of the impacts (the sensitivity of the receiving environment).

Information relating to these factors will be captured by the analysis tools presented in this Guideline.

3.2 Sources of odour

Many different activities can generate odour. Typical odour-emitting activities that the Department investigates and regulates include:

- industrial premises;
- waste recovery facilities;
- wastewater treatment plants;
- abattoirs;
- animal renderers and feedlots;
- piggeries;
- landfills;
- recycling of biosolids; and
- composting facilities.

Odour from other non-prescribed sources (i.e. not regulated under Part V Division 3 of the EP Act), which may impact people include:

- some intensive livestock activities (e.g. chicken farms); and
- commercial premises (e.g. workshops, shops and restaurants).

3.3 Risk from odour

Reactions to odours can be very subjective. A smell may be pleasant to one person and unpleasant to another. Exposure to odour that affects general quality of life and wellbeing (amenity) may be regarded as annoying by an individual. 'Nuisance' may result from repeated exposure to annoying odours and lead to avoidance behaviour and complaints.

Nuisance and interference with amenity may include:

- disturbance of normal day to day activities and recreation; and
- inconvenience in the enjoyment of one's social surroundings.

4. Legislation

Part V Division 1 of the EP Act has general provisions for the regulation of pollution and environmental harm. Section 49 of the EP Act provides that it is an offence for any person to cause, or allow, pollution or unreasonable emissions.

For the purposes of this Guideline, an unreasonable emission is defined as:
'*An emission or transmission of odour which unreasonably interferes with the health, welfare, convenience, comfort or amenity of any person.'*

Part V Division 3 of the EP Act provides the Department with mechanisms for regulating odour, by way of conditions on works approvals and licences applied to prescribed premises.

5. Environmental objective

This Guideline aligns with the EPA's *Environmental Factor Guideline – Social Surroundings*. An environmental value is defined in the EP Act as "a beneficial use, or an ecosystem health condition".

The environmental value relevant to odour emissions is 'beneficial use', which relates to public health, safety and aesthetic enjoyment. The objective of this Guideline is to protect the environmental value of 'beneficial use' by:

- avoiding or minimising odour emissions from prescribed premises; and
- ensuring that odour emitted from prescribed premises does not unreasonably impact public health, safety and aesthetic enjoyment.

This objective links odour emissions and their impacts to the protection of the 'environment', as defined in section 3 of the EP Act.

6. Assessment overview

The Department's assessment and decision-making process is described in the suite of Regulatory Framework documents including *Regulatory best practice principles, Guideline: Industry Regulation guide to licensing, Guidance Statement: Risk*

Assessments and *Guidance Statement: Decision Making,* which can be found on the Department's webpage (See *Related documents* for links).

Prior to making an application, applicants should familiarise themselves with this framework and use it to self-assess the acceptability of an application.

NOTE: Details of the Department's assessment and decision-making criteria will be provided in a decision report, which is prepared for all application assessments.

7. Assessment criteria

The Department employs a risk-based approach to its assessment of applications for instruments under Part V of the EP Act.

In determining the risk posed by odour, the Department considers:

- the location, proximity and sensitivity of receptors;
- the management of odour sources and activities;
- the intensity and offensiveness of the odour;
- potential odour impacts from other nearby sources;
- the topography and complexity of terrain;
- the size and / or complexity of the facility when compared with other Australian operations;
- any unusual configuration of odour sources or technology compared with other Australian operations;
- whether the proposal is located in a Strategic Industrial Area (SIA);
- the presence of multiple industry categories which may emit odours on the same site;
- current and cumulative impacts from odour; and
- pathways and impacts on sensitive receptors.

The Department may approve deviations to the assessment criteria on a case-by-case basis.

8. Odour analysis overview

If the proposal has the potential to generate odour emissions, the applicant should undertake an odour analysis following the procedures described in this Guideline (*Figure 1*).

Key components of the information the Department requires from an odour analysis are:

- screening analysis; and
- detailed analysis (where required).

An odour analysis report, presenting the results and interpretation of the analysis, should be submitted with the application to inform the Department's risk assessment.

An overview of the odour analysis procedure is provided below.

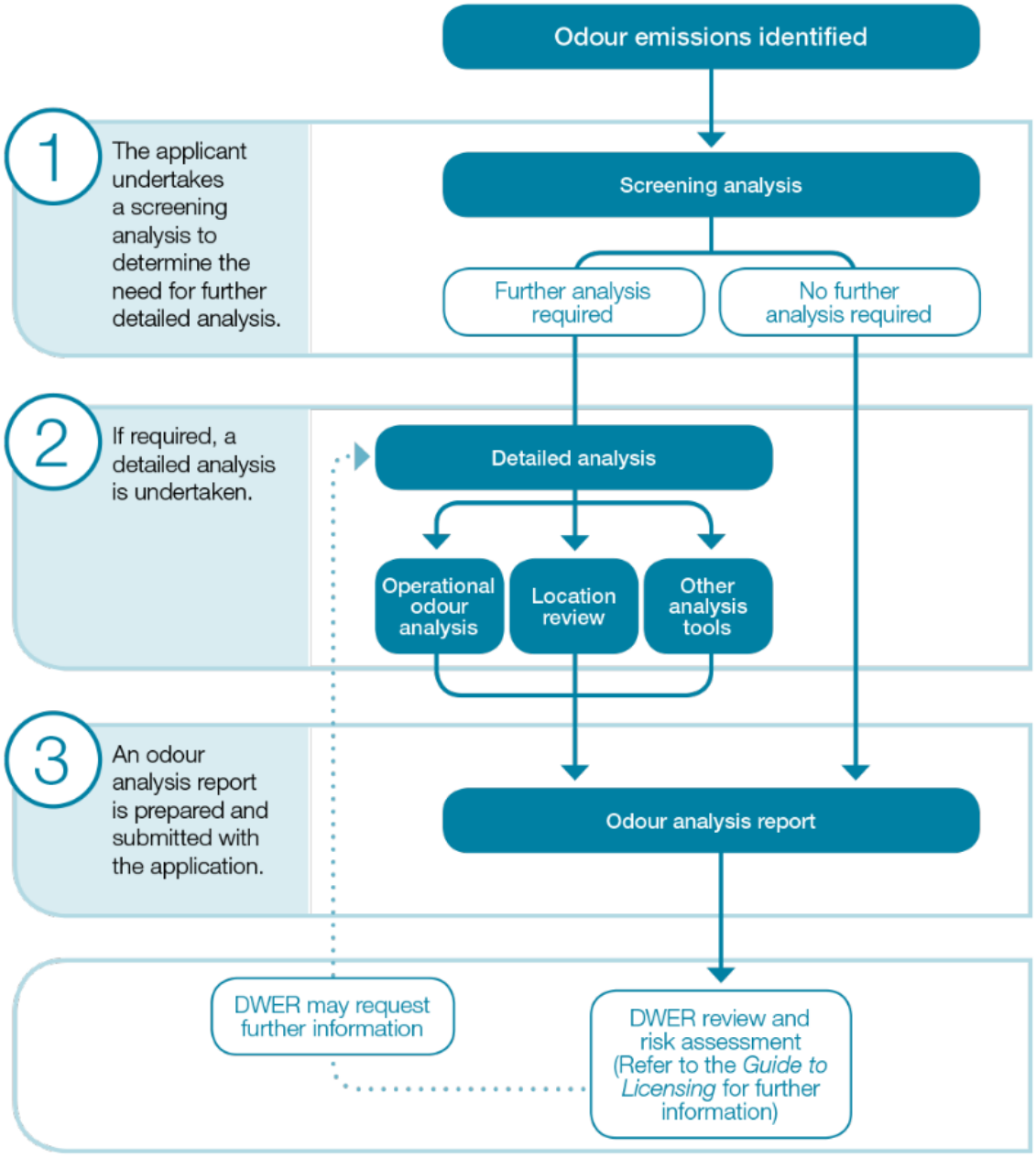

Figure 1: Overview of odour analysis procedure

8.1 Screening analysis

If odour emissions have been identified in an application, a screening analysis should be undertaken to assess whether emissions have a low risk of resulting in unreasonable impact, or if further detailed analysis is required.

The screening analysis is composed of questionnaires and flowchart worksheets for new premises or for existing premises (*Appendix 1*).

The analysis primarily involves comparison of the **screening distance** (*Appendix 2*) with the **sensitive receptor distance** (*Appendix 3*), and provides a conservative desktop indication as to whether odour is likely to be an issue.

The screening analysis comprises three steps:

> **Step 1:** Complete the questionnaire relevant to the application (for new or existing premises)
>
> **Step 2**: Use the flowchart and questionnaire responses to determine whether a detailed analysis is required
>
> **Step 3**: Compile information to support the screening analysis. This may include maps of sources and receptors, topographical maps, specifications for proposed emissions controls and details of **screening distance** calculations.

Where the screening analysis indicates that a detailed analysis is **not required**, the Department may still require the applicant to undertake a detailed analysis based on:

- the Department's knowledge of, and experience with, regulating similar premises in similar circumstances;
- known future changes in the proximity of receptors; and
- insufficient information to substantiate the screening analysis provided to the Department with the application.

8.2 Detailed analysis

The screening analysis may indicate that a detailed analysis of the potential odour impact is recommended.

A detailed analysis will assist the Department to conduct an odour impact risk assessment for the application.

The need for a detailed analysis does not imply that the potential odour impact is high. That is, the outcome of a detailed analysis may show a low risk of odour impact despite this not being identified in the screening analysis.

Tools to aid applicants in undertaking a detailed analysis are summarised in *Table 1* and described in *Appendix 4*. The tools provide information supporting the Department's risk assessment process described in *Guidance Statement: Risk Assessments*, which requires identification and evaluation of all potential emission sources, pathways and impacts on receptors.

There are two priority tools shown in *Table 1*, namely *operational odour analysis* and *location review*. The use of the priority tools will ensure the Department has the minimum information required to fully inform its review process.

In addition to the priority tools, applicants may select other tools in *Table 1* that are most appropriate for the application.

The detailed analysis comprises three steps:

> **Step 1:** Undertake an operational odour analysis (*Appendix 4 A4-1*) and location review (*Appendix 4 A4-2*).
>
> **Step 2:** Undertake further analysis using selected tools from *Table 1* as required.
>
> **Step 3:** Compile additional information to support the detailed analysis.

Tool selection will depend on a range of factors including:

- whether the application is for a new or existing premises;
- the type of activity; and
- the availability and reliability of existing site-specific data.

Each tool has its own strengths and limitations. Consequently, the value of the results of individual tools is enhanced if multiple independent lines of evidence that support each other are provided. For example, the value of odour complaints information from residents is significantly improved if odour field assessments independently confirm the presence of odour in the same area.

Tools that use observational / empirical data are generally of higher value than theoretical approaches.

The Department expects that applications with potentially significant odour impacts will include multiple tools in the detailed analysis, including the use of site-specific data where possible.

The level of detail provided in the analysis report should be commensurate with the potential for odour impacts related to the proposed works.

NOTES:

1. *Table 9* in *Appendix 5* enables the applicant to indicate which tools they have used.
2. Guidance material published by industry groups (e.g. for intensive agriculture) may include information and procedures relating to operational management that are aligned with the analysis tools in *Table 1*. If applicants intend to use alternative guidance material or tools to those described in the Guideline, it is recommended that they first discuss this with the Department to ensure suitability for informing Department assessment and decision making processes.

Table 1: Summary of detailed analysis tools

Detailed analysis tool	New premises	Existing premises
Emission source tools		
Operational odour analysis (OOA) **(priority tool)**	Information on operations and odour sources with emissions that have the potential to create offsite odour impacts, together with proposed monitoring and management procedures.	
Odour source assessment (OSA)	Characterisation of odour sources at a similar facility to provide information on emission rates.	Characterisation of odour sources on the premises to provide information on emission rates for each source.
Pathway and receptor tools		
Location review **(priority tool)**	Examination of the **sensitive receptor distance** in relation to the **screening distance**, the nature of receptors, and environmental factors such as local meteorology and topographical features.	
Odour field assessment (OFA)	Survey of odour in the field arising from other premises or sources in the area.	Survey of odour in the field arising from: • the existing premises; and • other premises or sources in the area.
Complaints data analysis	Analysis of odour complaint histories to indicate odour impacts from other premises or sources in the area.	Analysis of odour complaint histories to indicate odour impacts from: • the existing premises; and • other premises or sources in the area.
Community surveys	Survey of community members to identify current or past odour issues related to other premises or sources in the area.	Survey of community members to identify current or past odour issues related to: • the existing premises; and • other premises or sources in the area.
Comparative dispersion modelling	Computer modelling to compare different emissions scenarios (e.g. variations in emissions or changes in number, configuration or control of sources) through the analysis of the relative variations in predicted ground-level odour concentrations. **This tool does not involve odour modelling against criteria. Criterion modelling is not accepted.**	
Comparison with similar operations	Analysis of data from facilities of similar size, throughput, operational conditions, topography, meteorology and emission sources.	

9. Reporting

An odour analysis report should be submitted with applications containing deliverables from the screening analysis and the detailed analysis (if undertaken).

Screening analysis deliverables comprise:

- a statement of the screening analysis outcome;
- a completed screening questionnaire (*Appendix 1*);
- a discussion of the screening flowchart (*Appendix 1*) outcome; and
- supplementary documentation supporting the screening questionnaire responses, including information on special case factors.

Detailed analysis deliverables comprise:

- a detailed analysis summary report table (*Appendix 5*);
- conclusions from the detailed analyses; and
- attachments including:
    - the operational odour analysis;
    - location review;
    - outcomes of other analysis tools selected from *Table 1*; and
    - any other supporting documentation.

The level of detail provided in the analysis report should be commensurate with the potential for odour impacts related to the proposed works.

When reviewing the odour analysis report, the Department may consider a range of additional factors such as:

- proposed technology;
- any complaints recorded by the Department (existing premises); and
- the compliance history and annual audit compliance reports of existing premises.

NOTE: The Department may also require additional analyses to be undertaken.

10. Controls

Applicants are encouraged to consider a range of odour control technologies and management to mitigate the impact of odour from their operations.

Variables such as existing conditions, proximity of sensitive receptors and the choice of treatment, process management and control technologies should be considered in the selection and design of any odour control strategy.

The Department will apply conditions to works approvals and licenses commensurate with the risk of impact from the proposal.

Works approval or licence conditions may include implementation of odour control technologies and management practices such as:

- siting the activity so it is not in proximity to sensitive receptors;
- minimising odour generation at the source by:
  - covering or enclosing odour generating activities within structures maintained under negative pressure; and / or
  - capturing and directing the odorous gases to chemical, biological or thermal treatment prior to discharge;
- continuous monitoring and alarm systems to enable feedback for process control and corrective actions; and
- ambient field odour assessment, monitoring and reporting.

11. Implementation

This Guideline comes into effect on the day it is published. Applications received after publication of this Guideline will be assessed in accordance with the information contained herein.

The Guideline will not generally be used retrospectively, outside the Department's normal licensing processes, to re-assess existing facilities. However, in situations where there is evidence of unacceptable odour impacts from existing premises, the Department may initiate a review of the licence, informed by this Guideline, and new controls may be applied through licence conditions

Related documents

Document title / link
Environmental Protection Act 1986
Environmental Protection Regulations 1987
Environmental Factor Guideline – Social Surroundings
Regulatory best practice principles
Guidance Statement: Risk Assessments
Guidance Statement: Decision Making
National guidelines for beef cattle feedlots in Australia (Meat & Livestock Australia 2012)
National Environmental Guidelines for Indoor Piggeries (Australian Pork Limited 2018)
Air quality modelling guidance notes (2006)

Custodian and review

This Guideline will be continuously evaluated and reviewed no later than 5 years from the date of issue, or sooner as required.

Document details	
Authors	Better Regulatory Practice Branch, Air Quality Services Branch and Industry Regulation Division
Current version	Version 1.0, June 2019
Corporate file number	DER2015/001285

Appendices

Appendix 1 Screening analysis

Instructions

Applicants undertake a screening analysis to assess whether further detailed analysis of odour emissions and impacts is required.

The analysis primarily involves comparison of the **screening distance** (*Appendix 2*) with the **sensitive receptor distance** (*Appendix 3*), together with consideration of other information.

Screening distances are not provided for some activities. In these instances, applicants are generally required to undertake a detailed analysis.

Applicants are required to provide sufficient information with their application to enable the Department to substantiate the screening analysis.

Separate screening procedures are provided for applications for new or existing premises.

The screening analysis comprises three steps:

> **Step 1:** Complete the questionnaire relevant to the application (for new or existing premises)
>
> **Step 2**: Use the flowchart and questionnaire responses to determine whether a detailed analysis is required
>
> **Step 3**: Compile information to support the screening analysis. This can include maps of sources and receptors, topographical maps, specifications for proposed emissions controls and details of **screening distance** calculations.

If an industry category is not listed in *Appendix 2*, and the odour risk is considered to be low by the applicant, an exemption from the requirement for detailed analysis may be granted by the Department. In these cases, the Department can be contacted before commencing preparation of an application.

Questionnaires and flowcharts for new or existing premises are shown below.

An electronic reporting template of the questionnaire for new or existing premises is available on the Department website.

Screening analysis for new premises

Step 1: Questionnaire

Q1. Description of odour emissions Use the table below to provide brief information about activities and sources that emit odour.	
Activity / odour source	**Description, including proposed controls**
	Add more rows as required.

Q2. Screening distance	
Screening distances for categories of odour-generating activities are listed in *Appendix 2*. Select the appropriate option from the list below.	
Option 1: The ***screening distance*** is listed in *Appendix 2* for this industry category and throughput level. ***Screening distance*** (**A**) = _____m ***Sensitive receptor distance*** (**B**) =_____m	☐ **B < A**: Go to flowchart. ☐ **B ≥ A**: Go to Question 3.
OR **Option 2**: The ***screening distance*** for this industry category and throughput level is specified as 'case-by-case' in *Appendix 2*.	☐ **Case-by-case**: Go to flowchart.
OR **Option 3**: There is no entry for this industry category in *Appendix 2*.	☐ **Industry category is not listed**: Go to flowchart.

Q3. Special case factors	
Are there special case factors that might increase odour impacts beyond the **screening distance** shown in Question 2? Please tick all applicable special case factors: ☐ Odour impacts from nearby sources ☐ Presence of an existing elevated odour background ☐ Complex terrain (Refer to Glossary) ☐ Unusually large and / or complex facility when compared with other Australian operations ☐ Unusual configuration of odour sources or technology compared with other Australian operations ☐ The proposal is located in a Strategic Industrial Area (SIA) ☐ Multiple industry categories that emit odour are present on the same site	☐ **YES** or **Can't determine:** Go to flowchart. **OR** ☐ **NO:** Go to flowchart. Justification should be provided to support a 'NO' response.
Special case factors – justification for 'NO' response.	
Additional comments.	

Step 2: Flowchart - new premises

The screening analysis result is determined using the flowchart below and responses to the questionnaire overleaf.

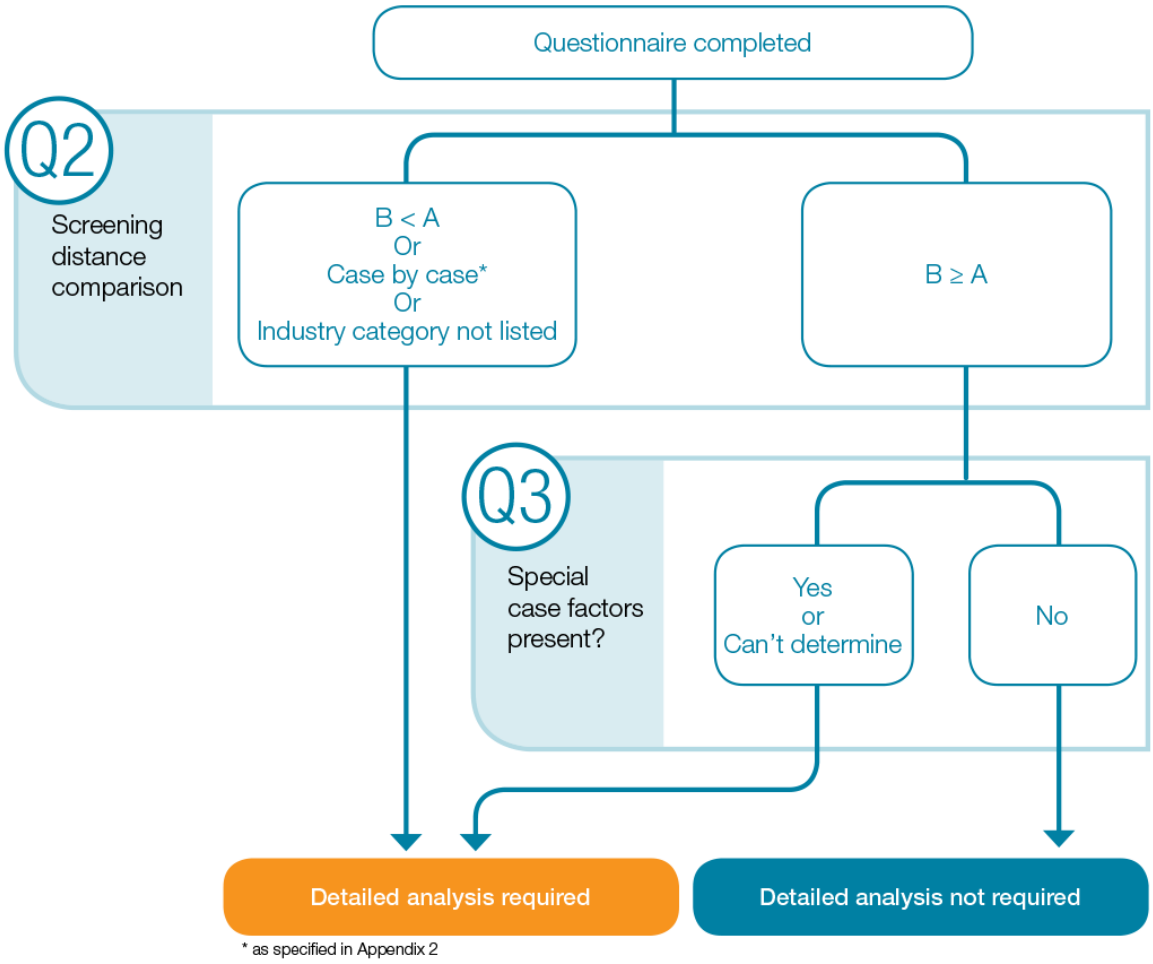

Figure 2: Screening analysis for new premises

Screening analysis for existing premises

Step 1: Questionnaire

Q1. Description of odour emissions Use the table below to provide brief information about activities and sources that emit odour.	
Activity / odour source	**Description, including proposed controls** **New source? (Yes or No)**
	Add more rows as required.

Q2. Identification of current odour impacts	
Have odour impacts occurred as a result of the current operational configuration and / or practices? Please tick all applicable boxes: ☐ Complaints ☐ Odour diaries ☐ Field odour assessments ☐ Community feedback ☐ Other._____	☐ **YES** or **Can't determine:** Go to flowchart. ☐ **NO:** Go to Question 3.

Q3. Changes to emissions	
Are there proposed changes to the existing premises that are likely to increase the odour emissions, or change the configuration of any source in the facility?	☐ **YES** or **Can't determine:** Go to Question 4. ☐ **NO:** Go to flowchart.

Q4. Screening distances

Screening distances for categories of odour-generating activities are identified in *Appendix 2*.

Select the appropriate option from the list below.

Option 1: The **screening distance** is listed in *Appendix 2* for this industry category and throughput level. ***Screening distance*** (**A**) = _____m ***Sensitive receptor distance*** (**B**) =_____m **OR**	☐ **B < A**: Go to flowchart. ☐ **B ≥ A**: Go to Question 5.
Option 2: The **screening distance** for this industry category and throughput level is specified as 'case-by-case' in *Appendix 2*. **OR**	☐ **Case-by-case**: Go to flowchart.
Option 3: There is no entry for this industry category in *Appendix 2*.	☐ **Industry category not listed**: Go to flowchart.

Q5. Special case factors

Are there special case factors that might increase odour impacts beyond the **screening distance** shown in Question 4? Please tick all applicable special case factors: ☐ Odour impacts from other nearby sources ☐ Presence of an existing elevated odour background ☐ *Complex terrain* (*Glossary*) ☐ Unusually large and/or complex facility when compared with other Australian operations ☐ Unusual configuration of odour sources compared with other Australian operations ☐ The premises is located in a Strategic Industrial Area (SIA) (*Glossary*) Multiple industry categories which emit odour are present on the same site	☐ **YES** or **Can't determine**: Go to flowchart. **OR** ☐ **NO**: Go to flowchart. Justification should be provided to support a 'No' response.

Special case factors – justification for 'NO' response.
Additional Comments.

Step 2: Flowchart - existing premises

The screening analysis result is determined using the flowchart below and responses to the questionnaire overleaf.

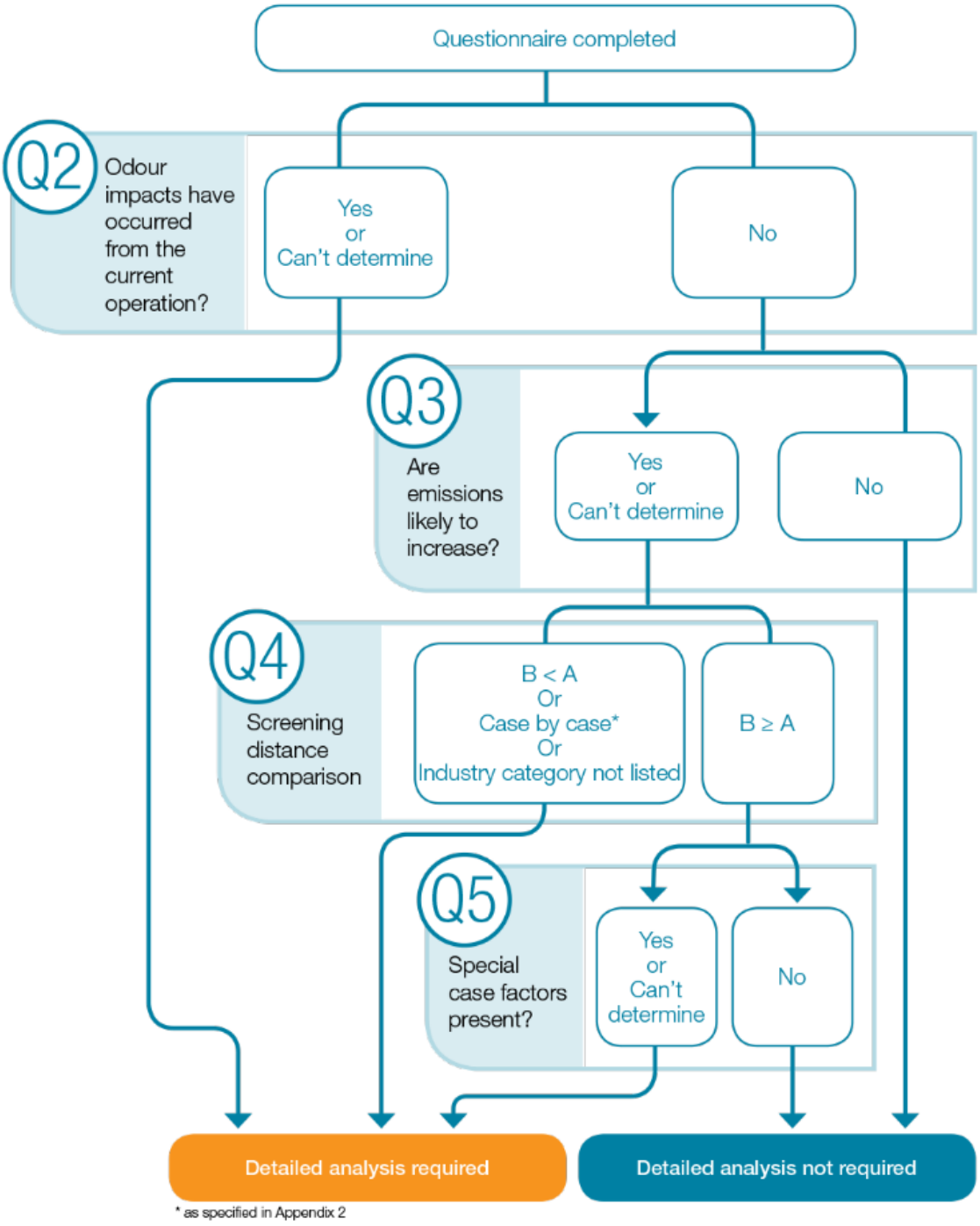

Figure 3: Screening analysis for existing premises

Appendix 2 Odour screening distances

Instructions

Odour **screening distances** are listed in *Table 2* (below). They are derived from previously established guidelines in Western Australia, other Australian guidelines, the experience of odour specialists and case studies from prescribed premises licensed by the Department.

The screening distances represent industry categories and scenarios typically assessed for odour impacts by the Department.

The category numbering is based on the *Environmental Protection Regulations 1987*, Schedule 1 - Prescribed premises.

Note that the category numbering below is sequential but not contiguous because odour is not a major emission for all industry categories.

Exceptions:

- For some categories, 'S-factor' equations are used to determine screening distances for some intensive livestock industries. The 'S-factor' equations take into account livestock numbers and site factors including:
  - design and management;
  - receptor type;
  - topography or terrain; and
  - vegetative cover.
- Where a 'case-by-case' determination of distance is referred to in place of a screening distance. This may be related to:
  - the facility's size or complexity;
  - the technology or feedstocks used; or
  - other regulatory factors.

  A detailed analysis will be required in these instances.
- Where an industry category is not listed in *Table 2*, and the odour risk is considered to be low by the applicant, the Department may exempt the applicant from the requirement to provide a detailed analysis.

Table 2: Odour screening distances

Category number and description[1]	Screening distance (metres)
1. Cattle feedlot (500 animals or more) *Premises on which the watering and feeding of cattle occurs, being premises:* *(a) situated less than 100m from a watercourse; and* *(b) on which the number of cattle per hectare exceeds 50.*	S-factor equations Refer to *National guidelines for beef cattle feedlots in Australia* (Meat & Livestock Australia 2012) for S-factor approach
2. Intensive piggery (1,000 animals or more) *Premises on which pigs are fed, watered and housed in pens.*	S-factor equations Refer to **Level 1 only** of the *National Environmental Guidelines for Indoor Piggeries* (Australian Pork Limited 2018)
15. Abattoir (1,000 tonnes or more per year) *Premises on which animals are slaughtered*.	Without wastewater treatment ponds 500 With wastewater treatment ponds 1,000
16. Rendering operations (100 tonnes or more per year) *Premises on which substances from animal material are processed or extracted.*	1,000
17. Milk processing (100 tonnes or more per year) *Premises on which:* *(a) milk is separated or evaporated (other than a farm); or* *(b) evaporated or condensed milk, butter, ice cream, cheese or any other dairy product is manufactured* *and from which liquid waste is, or is to be, discharged onto land or into waters*.	500
18. Food processing (200 tonnes or more per year) *Premises (other than premises within category 24):* *(a) on which vegetables are, or fruit or meat is, preserved, cooked, dried, canned, bottled or processed; and* *(b) from which liquid waste is or is to be discharged onto land or into waters.*	500

[1] Schedule 1, Part 1 *Environmental Protection Regulations 1987*.

Category number and description[1]	Screening distance (metres)
22. Seafood processing (200 tonnes or more per year) *Premises (other than a fish wholesaler) on which fish or other seafood is processed and from which liquid waste is or is to be discharged onto land or into waters.*	500
23. Animal feed manufacturing (1,000 tonnes or more per year) *Premises (other than premises within category 15 or 16) on which animal food is manufactured or processed.*	500
24. Non-alcoholic beverage manufacturing (200 kL or more per year) *Premises on which a non-alcoholic beverage is manufactured and from which liquid waste is or is to be discharged onto land or into waters.*	500
25. Alcoholic beverage manufacturing (350 kL or more per year) *Premises on which an alcoholic beverage is manufactured and from which liquid waste is, or is to be, discharged onto land or into waters.*	500
31. Chemical manufacturing (100 tonnes or more per year) *Premises (other than premises within category 32) on which chemical products are manufactured by a chemical process.*	1,000
32. Pesticides manufacturing *Premises on which herbicides, insecticides or pesticides are manufactured by a chemical process.*	1,000
33. Chemical blending or mixing (500 tonnes or more per year) *Premises on which chemicals or chemical products are mixed, blended or packaged in a manner that causes or is likely to cause a discharge of waste into the environment.*	500
34. Oil or gas refining *Premises on which crude oil, condensate or gas is refined or processed.*	2,000

Category number and description[1]	Screening distance (metres)
35. Asphalt manufacturing *Premises on which hot or cold mix asphalt is produced using crushed or ground rock aggregates mixed with bituminous or asphaltic materials for use at places or premises other than those premises.*	1,000
36. Bitumen manufacturing *Premises on which bitumen is mixed or prepared for use at places or premises other than those premises.*	1,000
38. Coke production (100 tonnes or more per year) *Premises on which coke is produced, quenched, cut, crushed or graded from coal or petroleum.*	2,000
39. Chemical or oil recycling *Premises on which waste liquid hydrocarbons or chemicals are refined, purified, reformed, separated or processed.*	1,000
41. Clay brick or ceramic products manufacturing (1,000 tonnes or more per year) *Premises on which refractory products, tiles, pipes or pottery are manufactured.*	500
43(a). Cement or lime manufacturing *Premises on which clay, lime sand or limestone material is used in a furnace or kiln in the production of cement clinker or lime.*	2,000
44. Metal smelting or refining (1,000 tonnes or more per year) *Premises on which metal ore, metal ore concentrate or metal waste is smelted, fused, roasted, refined or processed.*	Case-by-case
45. Metal melting or casting (100 tonnes or more per year) *Premises on which metal or scrap metal is melted in furnaces or cast.*	300
46. Bauxite refining *Premises (other than premises within paragraph (b) of category 5) on which alumina is produced from bauxite refining.*	Case-by-case

Category number and description[1]	Screening distance (metres)
54. Sewage facility (100 m^3 or more per day) *Premises:* *(a) on which sewage is treated (excluding septic tanks); or* *(b) from which treated sewage is discharged onto land or into waters.*	(a) Plants serving a population > 20,000: case-by-case (b) Mechanical/biological based plants (e.g. using oxidation ditch technology): case-by-case (c) Aerated pond-based plants serving a population < 20,000, screening distance is: • larger of 150m and $15.8n^{0.4}$ where 'n' is population served. (d) Facultative pond-based plants serving a population < 5000 screening distance is: • larger of 150m and $3.3n^{0.66}$ where 'n' is population served. (e) Reuse and irrigation schemes only: • spray irrigation 200 • other irrigation methods 50
55. Livestock sale yard or holding pen (10,000 animals or more per year) *Premises on which live animals are held pending their sale, shipment or slaughter.*	1,000
61. Liquid waste facility (100 tonnes or more per year) *Premises on which liquid waste produced on other premises (other than sewerage waste) is stored, reprocessed, treated or irrigated.*	1,000
61A. Solid waste facility (1,000 tonnes or more per year) *Premises (other than premises within category 67A) on which solid waste produced on other premises is stored, reprocessed, treated, or discharged onto land.*	Stored, reprocessed or treated 500 Biosolids application areas 1,000
62. Solid waste depot (500 tonnes or more per year) *Premises on which waste is stored, or sorted, pending final disposal or re-use.*	200
64. Class II or III putrescible landfill site (20 tonnes or more per year) *Premises on which waste (as determined by reference to the waste type set out in the document entitled 'Landfill waste classification and waste definitions 1996' published by the Chief Executive Officer and as amended from time to time) is*	1,000

Category number and description[1]	Screening distance (metres)
accepted for burial.	
65. Class IV secure landfill site *Premises on which waste (as determined by reference to the waste type set out in the document entitled 'Landfill waste classification and waste definitions 1996' published by the Chief Executive Officer and as amended from time to time) is accepted for burial.*	Case-by-case

67A. Compost manufacturing and soil blending (1,000 tonnes or more per year) *Premises on which organic material (excluding silage) or waste is stored pending processing, mixing, drying or composting to produce commercial quantities of compost or blended soils*	*Outdoor uncovered:* 400 for up to 2,000 tonnes/year 800 for up to 5,000 tonnes/year 1,300 for up to 12,000 tonnes/year 1,800 for up to 20,000 tonnes/year 2,500 for up to 35,000 tonnes/year Above 35,000 tonnes/year, then case-by-case *Outdoor covered, turned windrows*: 400 up to 2,000 tonnes/year 650 for up to 5,000 tonnes/year 1,100 for up to 12,000 tonnes/year 1,500 for up to 20,000 tonnes/year 1,900 for up to 35,000 tonnes/year 2,200 for up to 50,000 tonnes/year Above 50,000 tonnes/year, then case-by-case *Outdoor covered windrows with continuous aeration:* 400 for up to 2,000 tonnes/year 600 for up to 5,000 tonnes/year 850 for up to 12,000 tonnes/year 1,100 for up to 20,000 tonnes/year 1,300 for up to 35,000 tonnes/year 1,600 for up to 50,000 tonnes/year Above 50,000 tonnes/year, then case-by-case *In-vessel or enclosed composting with odour control:* 300 for up to 2,000 tonnes/year 350 for up to 5,000 tonnes/year 430 for up to 12,000 tonnes/year 500 for up to 20,000 tonnes/year 550 for up to 35,000 tonnes/year 600 for up to 50,000 tonnes/year Above 50,000 tonnes/year, then case-by-case

Category number and description[1]	Screening distance (metres)
68. Cattle feedlot (500 animals or more) *Premises on which the watering and feeding of cattle occurs, being premises:* *situated 100m or more from a watercourse; and* *on which the number of cattle per hectare exceeds 50*	S-factor equations Refer to *National guidelines for beef cattle feedlots in Australia* (Meat & Livestock Australia 2012) for S-factor approach.
69. Intensive piggery (more than 500 but less than 1,000 animals) *Premises on which pigs are fed, watered and housed in pens.*	S-factor equations Refer to **Level 1 only** of the *National Environmental Guidelines for Indoor Piggeries* (Australian Pork Limited 2018)
72. Chemical manufacturing (not more than 100 tonnes per year) *Premises on which chemical products are manufactured by a chemical process.*	500
73. Bulk storage of chemicals etc. (1,000 m^3 in aggregate) *Premises on which acids, alkalis or chemicals that*: *(a) contain at least one carbon to carbon bond; and* *(b) are liquid at STP (standard temperature and pressure),* *are stored.*	300
74. Chemical blending or mixing causing discharge (more than 50 but less than 500 tonnes per year) *Premises on which chemicals or chemical products are mixed, blended or packaged in a manner that causes or is likely to cause a discharge of waste into the environment.*	300
75. Chemical blending or mixing not causing discharge (5,000 tonnes or more per year) *Premises on which chemicals or chemical products are mixed, blended or packaged in a manner that does not cause or is not likely to cause discharge of waste into the environment.*	300
83. Fellmongering (1,000 or more skins or hides per year) *Premises on which animal skins or hides are dried, cured or stored.*	Storing packaged wet-salted and unprocessed hides 250 Other facilities 500

Category number and description[1]	Screening distance (metres)
85. Sewage facility (more than 20 but less than 100 m^3 per day) *Premises:* *(a) on which sewage is treated (excluding septic tanks); or* *(b) from which treated sewage is discharged onto land or into waters*	(a) For sewage treatment plants: 150 (b) Reuse and irrigation schemes only: • spray irrigation: 200 • other irrigation methods 50

Appendix 3 Measuring sensitive receptor distances

A3-1 How to measure sensitive receptor distances

Sensitive receptor distances should be measured from the 'activity boundary' of the industrial activity to the nearest sensitive land use. The activity boundary is the area (within a convex polygon) that includes all current or proposed industrial activities including the:

- industrial plant;
- stockpiles;
- windrows;
- leachate ponds;
- odour-control equipment; and
- buildings or other sources from which odour emissions may arise.

Measuring from the activity area allows for any separation that is provided within the property boundary of the industrial site to be considered. If an industry changes its use of the premises, or moves a relevant activity within the property boundary, these changes will be reassessed by the Department to consider adequacy of sensitive receptor distances.

Two methods to measure sensitive receptor distances are provided below. These methods of measurement differ depending on the measurement point chosen for the sensitive land use (e.g. property or activity boundary).

A3-2 Method 1 - Activity boundary to property boundary

Method 1 measures the distance from the activity boundary of the industry to the property boundary of the nearest sensitive land use ('urban method'), as illustrated in Figure 4.

Method 1 should be applied where the nearest sensitive land use is either:

- in an urban area or township; or on a site less than 0.4 hectares; or
- in a zone allowing subdivision to be less than 0.4 hectares.

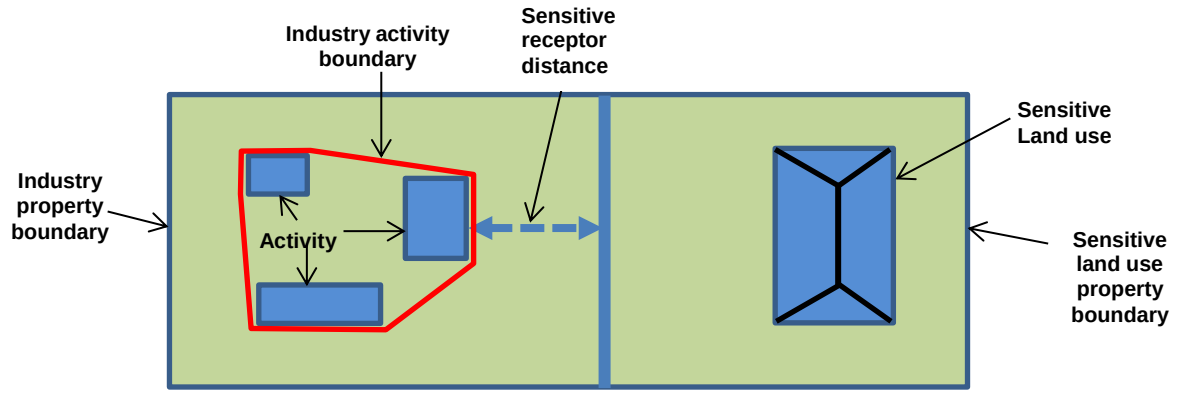

Figure 4: Method 1 - 'urban' method

A3-3 Method 2 - Activity boundary to activity boundary

Method 2 measures the separation distance from the activity boundary of the industry to the activity boundary of the nearest sensitive land use ('rural method'), as illustrated in *Figure 5*.

The activity boundary of the sensitive land use is the area (within a convex polygon) that includes all current or proposed sensitive uses (including residences, garages and carports, barbecue areas, clotheslines and swimming pools).

Method 2 should be applied where the nearest sensitive land use is both:

- not in an urban area or township; and
- on a site at least 0.4 hectares, or in a zone requiring subdivisions to be at least 0.4 hectares.

Irrespective, where offsite effects may be experienced, the industry producing emissions should be separated as far as possible from the nearest sensitive land use.

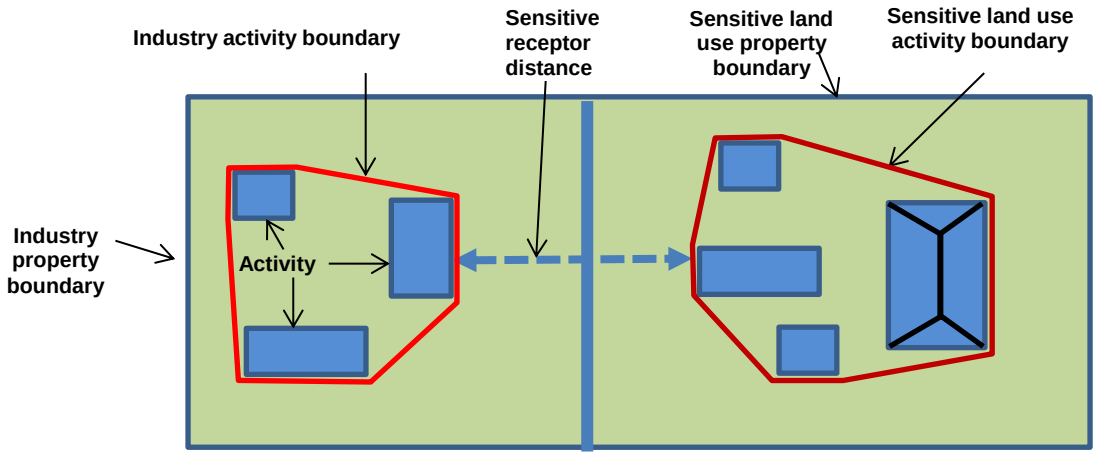

Figure 5: Method 2 - 'rural' method

Table 3 below illustrates which method should be used for measuring sensitive receptor distances in different circumstances.

Table 3: Selection of measurement method of sensitive receptor distance

		Site or subdivision size	
		Less than 0.4 ha	**At least 0.4 ha**
Urban area or township	**Yes**	Method 1	Method 1
	No	Method 1	Method 2

Source: EPA Victoria; Guideline: recommended separation distances for industrial residual air emissions (2013)

Appendix 4 Detailed analysis tools

Instructions

The screening analysis may indicate that a detailed analysis of the potential odour impact is required to allow the Department to conduct an odour impact risk assessment for the application.

This appendix provides further information on the detailed analysis tools listed in *Table 1*. There are two priority tools, namely *operational odour analysis* and *location review*. The use of the priority tools will ensure the Department has the minimum information required to fully inform its review process. In addition to the priority tools, applicants may select other tools that are most appropriate for the application.

Tool selection will depend on a range of factors including the type of activity and the availability and reliability of existing site-specific data.

Each tool has its own strengths and limitations. Consequently, the value of the results of individual tools is enhanced if multiple independent lines of evidence that support each other are provided. Tools that use observational / empirical data are generally of higher value than theoretical approaches.

The Department expects that applications with potentially significant odour impacts will include multiple tools in the detailed analysis, including the use of site-specific data where possible.

The level of detail provided should be commensurate with the impact potential of the proposed works.

The detailed analysis comprises three steps:

Step 1: Undertake an operational odour analysis (see *Appendix 4 A4-1*) and location review (see *Appendix 4 A4-2*).

Step 2: Undertake further analysis using selected tools from *Table 1* as required.

Step 3: Compile additional information to support the detailed analysis.

A4-1 Operational odour analysis (OOA)

An operational odour analysis (OOA) is a document detailing operations at a premises that are likely to emit odour, and how odour emissions are to be managed to minimise offsite odour impacts including:

- monitoring;
- corrective actions; and
- contingency actions.

The preparation of an OOA is a **priority component** of a detailed analysis. The OOA demonstrates the applicant's understanding of potential odour sources at their premises, and the ongoing management of odour.

An OOA:

- is primarily intended as a management tool for the applicant;
- is risk-based and site-specific;
- should include normal and foreseeable abnormal conditions; and
- may include outcome and / or management-based measures.

Some industries may have an existing analysis tool, which has similar content and achieves the same outcomes as an OOA. Following consultation with the Department, such documentation may be submitted as part of the application in lieu of an OOA.

Odour sources, and the emission control options available, will vary widely depending on the industry category and the types of processes involved.

The required content of an OOA is provided in *Table 4,* it allows for these different levels of management through the specification of both corrective and contingency actions for abnormal operating conditions.

For some industries, management options may be more limited and the OOA will be less detailed as a result. Notwithstanding the type of operation, applicants should provide a clearly articulated and considered description of the controls to be implemented to mitigate identified odour emissions.

An example OOA based on case studies is presented in *Table 5*. An electronic reporting template for the OOA is provided on the Department website.

NOTE: Supporting information, such as site detail maps and technical drawings, should accompany the OOA.

Table 4: Required content of an operational odour analysis (OOA)

Odour emission operations review
Identification of all existing or proposed operations on the premises likely to emit odour. This review should consider all normal and foreseeable abnormal conditions (e.g. batch or continuous production, start-up, shut-down etc.).
Odour sources and emissions
Description of major odour sources and significant secondary sources (including fugitive sources) associated with the existing or proposed operations for each operating condition including: • dimensions, geometry and location of sources plotted to scale on a site detail map; and • estimation of frequency, levels (intensity or concentration) and volumes of odour emissions for each source.
Process controls
Identification of process controls (mitigation, monitoring and management[1]) to be implemented for odour sources. Include details of the type and frequency of controls for each source for all normal operating conditions. Critical operational parameters should be selected for monitoring that: • are indicative of process performance; • can be surrogate parameters[2] that are continuously monitored; and • can be used to identify malfunctions that result in odour emissions (triggers).

Triggers and corrective actions

Specification of monitored parameters (operational and / or environmental)[3] that will be used to initiate corrective actions when pre-determined trigger levels are reached.

Specification of corrective actions, which are implemented in case of process malfunction, that may lead to increased odour emissions. Their purpose is to bring the process back to normal operating conditions.

This section should include:

- a list of parameters adopted for the process;
- details of the pre-determined trigger level(s) for each parameter; and
- details of the corrective actions to be implemented when a pre-determined trigger level is reached.

Corrective action evaluation

Evaluation of each corrective action to assess its effectiveness in response to the issue that triggered it.

Evaluation procedures should include:

- selection of parameters to evaluate the effectiveness of corrective actions. These parameters may be the same or different to those specified in the **Process controls** and the **Triggers and corrective action** sections above;
- the method to be used to monitor those parameters; and
- the decision protocol that will be used to establish the necessary monitoring duration before:
    - resuming normal process operations (corrective action successful); or
    - pursuing contingency actions (corrective action not successful).

Contingency actions

Specification of contingency actions that will be implemented if corrective actions are not successful. These should include:

- the actions to be taken with sequence of implementation; and
- the decision protocol used to verify if normal operations can be resumed.

Residual odour impact potential

The residual odour impact potential is a rating of low, medium, high or extreme, based on the likelihood and consequence of odour from operations impacting on sensitive receptors. The proposed controls, corrective and contingency actions, and information from the location review (Section 2 of this Appendix), need to be considered in the rating.

The residual odour impact potential should be rated by the applicant for each process, under both normal and foreseeable abnormal conditions.

The risk matrix in *Appendix 2* of the Department's *Guidance Statement: Risk Assessment* should be used for this assessment to provide a systematic framework for rating the impact potential.

[1] Controls may include specific actions / programs established by the applicant such as in-house sniffing patrols or odour assessment panels in the field.

[2] Operational parameters that are readily and continuously measured, and better suited to detecting upset conditions than measuring odours directly.

[3] This may include onsite measurements (process parameters, odour surrogates, emissions) or odour monitoring on and off site.

Table 5: Example of an operational odour analysis (OOA)

Odour emission operations review		Operational Condition[1]
Batch production within a building		Normal
Odour sources and emissions	• Building fugitive emissions – infrequent access to the building from a large door on the north-east facade during the batch (otherwise kept closed), possible large volume of odour emitted with a low intensity level (see site detail map and emissions details attached). • Building air treatment biofilter (see process flow chart and emission details attached). • Stack emissions post-production odour treatment unit during the batch operation (see stack configuration and emission details attached).	
Process controls	• Odorous air is extracted from the building and directed to the biofilter. • Building air temperature (T), relative humidity (RH) and backpressure (P) are continuously monitored at the biofilter air inlets. • The first stage of the production odour treatment unit is in operation (prior to stack emissions). • Compounds X and Y (surrogates) monitored in the stack with a Continuous Emission Monitoring System (CEMS). • Offsite odour monitoring is undertaken using an in-house odour panel following an internal odour Standard Operating Procedure (SOP) between one and two hours after the batch commences.	

Triggers and corrective actions	• If the concentration of compound X is above 5 mg/m^3 (trigger 1) then the second stage of the production odour treatment unit is activated.
	• If the inlet air temperature (T) is above 40ºC for more than 3 hours (trigger 2) or the relative humidity (RH) is below 85% for more than 3 hours (trigger 3), then the volumetric air flow rate at the biofilter inlet should be reduced by 20%. The expected outcomes of this corrective action are a decrease in the air temperature (T) and/or increase in the relative humidity (RH) under similar humidification conditions while maintaining the negative pressure within the building above 7 kPa.
	• If the offsite odour intensity level is above Level 2 of the in- house odour intensity scale for more than 30% of the measurement duration indicated in the internal SOP (trigger 4):
	  ○ the second stage of the production odour treatment unit is activated;
	  ○ the air exchange rate within the building is increased which will increase the negative pressure within the building and limit offsite fugitive emissions; and
	  ○ a site inspection is performed to identify any specific operations, actions or abnormal configurations that may be the source of the elevated odour emissions and consequent offsite impacts.

Corrective action evaluation	The corrective actions are effective if: • the monitoring of compound X concentration is consistently below 3 mg/m^3 within 30 minutes; • compound Y (treated through the second stage of the production odour treatment unit and continuously measured post second stage) is consistently below 1 mg/m^3 within 30 minutes; • the inlet air temperature (T) is below 40ºC and/or the relative humidity is above 85% within the next 3 hours and these limits are maintained even under worst-case conditions (period of the day when ambient air temperature is the highest and ambient relative humidity is the lowest); or • offsite odour intensity levels are below Level 1 of the in-house odour intensity scale for more than 10% of the measurement duration indicated in the internal SOP.

Contingency actions	• If compound X concentration is above 3 mg/m^3 but below 8 mg/m^3 then emissions post second stage of the production odour treatment unit are to be diverted to the carbon filter. • The batch process shall be stopped following an internal SOP if any of the following conditions are encountered: ○ compound X concentration is above 8 mg/m$^{3;}$ ○ the biofilter inlet air temperature cannot be maintained below 40ºC and/or the relative humidity above 85% within the next 3 hours and under worst-case conditions (period of the day when ambient air temperature is the highest and ambient relative humidity is the lowest). In addition, air should not be directed to the biofilter to protect the bacterial population and the building should be isolated (no door opening); or ○ the offsite odour intensity level is above the Level 2 of the in- house odour intensity scale for more than 30% of the measurement duration indicated in the internal SOP (under the current abnormal conditions) and no operations, actions or abnormal configurations have been identified onsite.

Residual odour impact potential			
Operation/odour source	**Consequence**	**Likelihood**	**Impact potential**
Batch production, normal operations	Minor	Rare to Unlikely	Low to Moderate

[1] A separate table is required for foreseeable abnormal conditions.

A4-2 Location review

A location review considers the sensitive receptor distance, the nature of receptors, local meteorology and topographical features. This review is a **priority component** of a detailed analysis.

The **sensitive receptor** distance in relation to the **screening distance** is an important component of the odour impact potential of an activity and should be reported.

In undertaking a risk assessment, the Department will:

- consider the type and sensitivity of receptors in the vicinity of the proposed works. This should be explicitly identified in the location review; and

- require a map showing the receptors' location in relation to the activity and the screening distance for the activity. Electronic copies of Google Earth (.kmz files), or inclusion of a map in the report that includes the activity boundary or, at a minimum, markers for the activity and receptor locations, are useful for the Department assessment.

If a screening distance is defined as 'case-by-case', or if the industry category is not listed in *Appendix 2*, the applicant may include a comparison with separation distances from other published guidance for similar activities.

The location review should also include information on local meteorology and topography, which can have important implications for how odour emissions disperse over adjacent areas. For example, valleys can channel air flows from a source towards a receptor location. At a minimum, the location review should include a topographical map along with wind roses showing long-term wind data from the nearest Bureau of Meteorology (BoM) or Department monitoring station, with commentary on the potential for complex topographical and meteorological effects. Wind roses from BoM showing only 9am and 3pm average conditions are not a reliable indicator of average wind conditions for daily periods, or for periods when emissions occur, and are not used in the Department assessment. Applicants may use data from their own weather stations provided the data can be shown to be valid.

A4-3 Odour field assessment

An odour field assessment (OFA) is a program of targeted field surveys and analysis designed to characterise ambient odour for new and existing premises.

For existing premises ambient odour from the premises, and from other potential sources, are measured at specific locations during specific meteorological and operational conditions prior to the proposed changes at the premises.

For new premises measurement of cumulative odour impacts from other potential sources in the vicinity of the future location of the premises.

For both existing and new premises odour surveys can be carried out for odour management purposes.

Outcomes of surveys carried out prior to commissioning may be used as benchmarks for similar post-commissioning surveys to identify any changes in the odour background between the two surveys due to the modified or new premises.

NOTE: There is no expectation that industries maintain regular OFAs during normal operations.

Essential components of the OFA include:

- clearly established objectives;
- a review of operational conditions and associated odour emissions (existing premises);
- a review of meteorological conditions;
- odour field survey implementation; and
- analysis of survey results.

OFA surveys are undertaken by trained odour panellists who follow a strict methodology to record odour at specific locations.

Several surveys typically occur over several days, and the duration and number of surveys are chosen according to the purpose of the assessment including:

- to assist in determining which odour sources most affect a community (the odour characteristics differ sufficiently for odour panellists to confidently distinguish between them in the field);
- OFAs carried out for works approval and licensing purposes which are typically based on odour plume measurement protocols with assessment of the intensity and character of ambient odours at locations downwind of premises; and/or
- OFAs as an effective odour monitoring and management tool, provided the design and execution adheres to strict protocols, enabling reliable comparisons between analyses over time.

Further information is provided in the published standards referenced below.

Odour field survey standards

Australian standards have not yet been developed for odour field surveys, however several European and German standards are widely referred to in this context in Western Australia and other Australian jurisdictions. These standards are listed below in order of relevance for Department application.

It is anticipated that EN 16841-2:2016 and VDI 3940.3:2010 will be most commonly be used for applications where odour field surveys are undertaken.

1. **European standard EN 16841-2:2016** *Ambient Air – Determination of odour in ambient air by using field inspection – Part 2: Plume method.*

   This standard constitutes the primary reference for plume measurement campaigns and replaces the former German standard VDI 3940-2:2006. The stationary plume method in the European standard is preferred due to the experience gained with this method in Western Australia during the past 15 years using the former German standard.

   A new method (dynamic plume method) is included in the European standard and will also be accepted. However, this new method requires very specific

experience and reporting is expected to clearly justify the use of this method as well as the outcomes and limitations associated with the results.

NOTE: Sections of the European standard relating to reverse calculation of source emission rates from field survey results are **not supported** owing to the significant associated uncertainties.

2. **German standard VDI 3940-3:2010** *Measurement of odour impact by field inspection – Determination of odour intensity and hedonic tone.*

   This standard is for the measurement of odour intensity and hedonic tone in the ambient air (field environment).

   NOTE: For works approvals and licensing applications, only odour intensity measurement should be applied in parallel with plume measurements. The capture of hedonic tone during measurements is at the applicant's discretion.

3. **European standard EN 16841-1:2016** *Ambient Air – Determination of odour in ambient air by using field inspection – Part 1: Grid method.*

   This standard is for the measurement of the frequency of odour impact in the vicinity of industrial premises. It replaces the former German standard VDI 3940-1:2006.

   NOTE: Limit values from this standard and the German Guideline on Odour in Ambient air (GOAA 2003) (e.g. 10% 'odour hours') have not been demonstrated to be applicable to Western Australian conditions. As such, these values **should not be used** to measure the extent of odour impact for works approvals and licensing applications.

Important notes: methods

1. The odour intensity scale used for field odour assessment includes a descriptor and a number that are common to both the intensity measurements for field assessments (VDI 3940-3:2010) and for intensity measurements under laboratory conditions (VDI 3882-1:1992). The Department requires that **German standard VDI 3940-3:2010** be used to record odour intensity levels under field conditions. According to this standard, an intensity level of 1 or above is selected if the recognition threshold in the field is reached or exceeded. This means that the odour being assessed is 'clearly recognisable' and assigned an odour quality so there is no uncertainty or guessing involved.
2. Section 1.1 'Objective' of the **German standard VDI 3940-3:2010** clearly states that '*under field conditions, it is possible to determine the odour intensity in the ambient air at a specific location, but not the associated odorant concentration and the intensity curve as a function of the odorant concentration*'. Weber-Fechner or Stevens laws **should not be used** to convert odour intensities recorded by an odour panellist in the field to odour concentrations.

Important notes: interpretation and limitations

1. Detection of distinct or stronger odour intensity levels (according to **German standard VDI 3940-3**), at distances similar to sensitive receptor distances, may warrant additional consideration and / or investigations.
2. While field surveys are useful for confirming the presence of odour impacts offsite, they should not be relied on to demonstrate the absence of impacts. It may simply be the case that at the time of the survey, the emission or meteorological conditions conducive to impacts were absent, or the measurement location was not within the odour plume.
3. The more limited the field surveys are, in terms of time and resources allocated, the more difficult it is to reliably infer the extent of the odour impact footprint of a premises or other nearby sources.
4. Averaging the odour intensity levels during odour field assessments **is not permitted**.

Odour field assessment using plume measurement

At a minimum, plume measurement OFAs, supporting applications to the Department, comprise the five steps discussed below.

These OFAs begin with establishing clear objectives and end with the analysis and reporting of results and outcomes as per the recommendations of the EN 16841-2:2016 standard.

Step 1: *Define the odour field assessment objective*

Clear assessment objectives should be defined before undertaking an OFA. Typical issues requiring consideration include the factors that triggered the request for the field assessment and the expected outcomes.

Step 2: *Process management and environmental review*

Before undertaking an OFA to support an application to make changes to an existing premises, the following steps should be considered:

- gain a thorough understanding of the facility's processes and gather information regarding its odour impact history and the local environment - including meteorology and topography;
- examine details of past process upset occurrences, management practices, number and type of existing odour sources, frequency (time cycle) of emissions and their odour emission rates (OERs) (if available);
- identify all proposed new or modified odour sources and, for each one, estimate the frequency, concentration / intensity (including peaks) and volumes of odour emissions and potential areas of impact; and
- identify nearby odour sources for assessment of potential cumulative impacts.

For new premises, the following steps should be considered:

- collect information on the local environment including meteorology and topography;
- if it is intended to perform post-commissioning field surveys, predict (based on sensitive receptor location and meteorological conditions) the areas where potential emissions will most likely impact once the premises is operational; and
- identify nearby odour sources for the assessment of potential cumulative impacts.

Step 3: *Odour field assessment strategy*

Effective OFAs require well-designed strategies that include:

- identification of factors that are relevant to odour plume impacts at locations of interest. These should include prevailing wind directions, specific terrain features and locations of sensitive receptors and complainants. Wind patterns

should be selected with consideration of annual and seasonal influences;

- for existing premises, identification of the process, management and logistical factors associated with odour emissions at the premises, and selection of operational conditions to perform field surveys;
- selection of areas to be surveyed with reference to the meteorological and operational conditions (including source types), and reconnaissance of these areas for safety and practicability reasons. This step includes pre-location of the measurement points;
- specification of the odour field survey duration, with reference to the OFA objectives and the meteorological and operational conditions;
- identification of the minimum number of odour panelists required for the OFA. Although a minimum of 5 panelists is recommended for stationary plume method in the standard EN 16842-2:2016, the Department considers a minimum of 3 odour panelists and an operator is reasonable. This number may increase with the size of the area to be covered and the public accessibility around the facility to be assessed;
- development of the procedures to select, train and communicate with panelists; and
- documentation of any deviations from the EN 16841-2 and VDI 3940-3 standards.

Step 4: *Field survey implementation*

Surveys should be implemented under the supervision of an experienced field operator and follow the assessment strategy previously established.

For existing premises unplanned process conditions that occur at the premises should be recorded.

For existing and new premises unplanned events occurring in the field during the surveys should be recorded. Any impacts of these events on the results should be identified and reported.

Step 5: *Data analysis and reporting*

OFA results may be reported in various formats depending on the assessment objective. However, as a minimum, the following should be reported:

- objective of the assessment;
- measurement strategy, measurement conditions and the odour field survey standards that were followed;
- field survey panellist identification and single measurement locations;
- odour intensity levels recorded at each measurement point during each single measurement;
- odour characters recorded at each measurement point during each single

measurement;

- time of each single measurement;
- map(s) depicting the assessment area, odour sources associated with the premises (for existing facility) and other odour sources;
- wind speed and direction for each single measurement;
- any deviations from the conditions targeted in the OFA strategy and those occurring during the measurement (conclusions should reflect the influence of such deviations on the results); and
- detailed analysis, interpretation and conclusions with regard to the objectives of the assessment.

NOTE: A useful visual depiction of results is a map of the survey area with each single measurement superimposed as a pie chart at the measurement point showing, for each panellist, the various odour intensity levels as a percentage of the single measurement.

Management strategies using plume measurement

Plume measurement campaigns may be used to assess odour impacts before and after modifications to existing premises, or after construction of a new premises. This approach may aid odour management strategies by providing:

- an understanding of the odour impacts of an existing premises before and after modifications;
- an understanding of contributions from other nearby odour sources to odour impacts and the cumulative odour footprint, and their contribution to the cumulative odour footprint post-commissioning; and / or
- a benchmark against which ongoing performance of a new or existing premises may be measured.

A4-4 Complaints data analysis

Complaints data analysis is the assessment of odour complaints made in the vicinity of a new or existing premises. The analysis can help identify likely odour sources in the area, the typical odour character and levels of impact. Such analysis can also be used as a benchmark against which ongoing performance of a new or existing premises can be measured.

Complaints data may be held by the applicant or be available from local councils or nearby premises. Applicants are expected to review publicly / readily available information.

The presence of odour complaints from a community in the vicinity of an odour source may indicate an unreasonable level of ambient odour. However, caution should be applied in interpreting complaints data as several factors may influence complainant behaviour, and the extent of odour impact inferred from this data may be over or underestimated.

The absence of complaints does not necessarily indicate the absence of an odour

problem.

In the case of existing premises, the number and details of odour complaints received (attributable to the premises), and the actions taken by the occupier of the premises in response to those complaints, should be considered for both screening and detailed analyses.

The Department may refer to its internal complaints databases, and other sources of information, when reviewing applications for both new and existing premises. All reasonable efforts will be made by the Department to validate internally sourced complaint information used in the screening analyses.

Reporting of complaints data analyses should include:

- details of how the data were obtained;
- a data summary showing the number of complainants, the total number of complaints and the dates and times complaints were made;
- verification of the source of the odour;
- actions taken in response to complaints (if known);
- discussion of the odour characteristics reported, likely odour sources;
- the meteorological conditions at the time of complaints; and
- map(s) showing the location of odour complaints and potential sources in the area.

A4-5 Community survey and diary study analysis

Community telephone or door-to-door surveys and diary studies can provide valuable information regarding the level and extent of odour impacts from existing sources.

Surveys and diary studies:

- may show whether odours at a site have altered over time;
- can be used to gauge the level of community dissatisfaction with previous odour episodes; and
- can capture information regarding odour episodes that did not trigger the lodging of complaints.

The design, execution and analysis of surveys requires highly specialised knowledge, and should be undertaken by those with demonstrated expertise in this field.

Caution should be applied in designing survey questionnaires and interpreting results, as responses that rely on memory recall may result in oversights.

In general, it is easier for community members to identify changes in odour intensity levels and frequencies over time, as opposed to providing accurate details regarding impact frequencies and levels.

Surveys should:

- have a clearly defined purpose; and
- be undertaken over a short timespan to limit opportunities for community members to share their responses, which may bias the survey.

A guarantee of anonymity of respondents is an important principle to encourage participation in the survey.

Reporting of community survey and diary study analyses should include:

- qualifications and experience of the person(s) designing, conducting and reporting on the survey or diary study;
- details of the survey or diary study plan including purpose, methods, target population and timeframes;
- a copy of the survey questionnaire or instructions provided to diarists;
- a copy of the raw survey / diary data;
- interpretation of the survey / diary results; and
- conclusions reached.

A4-6 Odour source assessment

An odour source assessment (OSA) is a program of targeted source sampling and analysis designed to characterise odour sources at an existing premises.

For existing premises an OSA can obtain odour emission rates (OERs) for specific sources that will be modified or impacted by proposed changes. These OERs may be used in comparative modelling, for example to:

- test various scenarios, as a benchmark against which post-commissioning OERs will be compared; or
- to establish a source hierarchy at the facility to identify odour mitigation priorities.

For new premises an OSA may be implemented to obtain OERs for sources at another facility that have been assessed as being representative of sources at the new premises. OERs may also be established post-commissioning for odour source management purposes including ongoing performance verification.

NOTE: Further information is provided in the published standards cited in Step 4, below.

Odour source assessment steps

Procedures for the identification of major odour sources, and for developing effective sampling strategies, are described below. Applicants may wish to seek Department advice for odour source assessment at large and complex sites.

***Step 1:** Assessment objectives*

Setting clear objectives for an odour source assessment is a critical first step when identifying sources for sampling.

When defining objectives, consideration should be given to:

- factors that triggered the requirement for an odour source assessment and how the source assessment will assist in addressing these factors; and
- whether characteristics of any offsite impacts (e.g. frequency, timing and / or odour character) may aid in identification of particular odour sources at a facility that will require detailed investigation during the OSA.

***Step 2:** Process and management review*

Identification of significant odour sources at a premises requires a thorough understanding of all operations and processes. Discussions with operations staff and review of each of the processes greatly assists with achieving this understanding.

Important elements of Step 2 include identifying:

- the main odour-generating processes at the facility;
- inputs and outputs of these processes;
- the levels (concentration or intensity) and frequency of emissions from sources within these processes;
- changes in emissions due to upset conditions or process failure; and
- contingency plans and management responses for upset conditions or process failure.

***Step 3**: Odour sampling strategy*

The design of the OSA sampling strategy should be based on the objectives of the assessment and should include:

- expected outcomes of the assessment;
- the steps required to achieve those outcomes; and
- any limitations of the strategy and its impact on assessment outcomes.

The strategy will also detail:

- which sources are to be sampled;
- how those sources will be sampled (sampling devices, monitoring locations);
- the sampling duration and chronology;
- number of samples to be taken;
- key process conditions that influence emission rates;
- meteorological conditions under which the sample should be collected (if any); and

- a brief justification for each of these strategy details.

At a minimum, sampling strategies for batch processes should ensure that the following are identified:

- peak emission conditions; and / or
- emission conditions responsible for controlling adverse impacts on amenity.

Where multiple similar odour sources are present, odour concentration and flowrate measurements for one suitably representative source may be sufficient to characterise all sources.

Sampling strategies may be unavoidably constrained by various factors. Any constraints encountered, which have influenced the adopted sampling strategy or outcomes, should be documented.

Step 4: *Odour sampling - standards and minimum requirements*

a. Standards

Unless otherwise specified, odour sampling and concentration analysis should be undertaken in accordance with:

- **AS/NZS 4323.1:1995** *Stationary source emissions – Selection of sampling positions*; and
- **AS/NZS 4323.3:2001** *Stationary source emissions – Determination of odour concentration by dynamic olfactometry*.

The use of the **AS/NZS 4323.4:2009** *Stationary source emissions – Method 4: Area source sampling – Flux chamber technique for determining emission rates of area sources* is **not supported** by the Department.

The German standard **VDI 3880:2011** *Olfactometry static sampling* is **recommended** by the Department for area source sampling.

Deviation from standard sampling and analysis protocols is occasionally unavoidable. Deviations should be recorded and their impacts on results discussed in the assessment report.

b. Sampling duration and process conditions

The choice of sampling time generally depends on source geometry and / or accessibility, process characteristics (for example, intermittent, batch or continuous emissions) and meteorological conditions.

Selected sampling times should be documented and justified in the sampling strategy with actual sampling times (and reasons for any variations) detailed in the assessment report.

Depending on the assessment objectives, OSAs may require sampling of several emission scenarios including:

- normal operating conditions;

- plant start-ups and shut-downs;
- maintenance events; and
- upset conditions.

c. Sampling of pipes and ducts

The sampling of under-pressure or over-pressure pipes and ducts should be performed as described below. In either case, the sampling procedure should ensure that:

- there is no condensation or captured particles in the sample bag; and
- sample gas streams avoid contamination by not passing directly through the pump.

When sampling an *over-pressure pipe or duct*, the sample bag should be filled using the pressure of the source gas stream. A restriction on the flow rate (for example, at a critical orifice) may be necessary to achieve a sufficiently long sampling period.

When sampling an *under-pressure pipe or duct*, the empty sample bag should be located inside a sealed container. The pressure in the container is subsequently reduced by a pump such that the odorous air sample is drawn into the bag (the lung principle).

d. Pre-dilution

Pre-dilution of samples should be performed with dry odourless neutral gas such as air or nitrogen. Pre-dilution may be necessary to:

- avoid condensation in the sample bag, which can affect sample integrity and contaminate the olfactometer;
- cool the air stream before entering the sampling bag or container; and / or,
- dilute and adjust sample concentrations to be within the operating range of a particular dynamic olfactometer.

Static and dynamic pre-dilution should be performed in accordance with AS/NZS 4323.3:2001; these techniques are also discussed in VDI 3880:2011.

e. Filtration

Filtering of sampled air may reduce the odour concentration because any odorous compounds adsorbed on the filtered particles will be removed at the same time. For this reason, filtering should be avoided if possible.

On the other hand, particles can contaminate the olfactometer. As a result, filtration remains an option when sampling a gas stream with a significant particle concentration, as indicated in AS/NZS 4323.3:2001.

Any filtration used during sampling should be reported together with a discussion of the degree to which the filtration may have affected the reported odour concentrations.

f. Number of samples

A minimum of one duplicate sample (i.e. sample collected simultaneously in 2 bags) should be collected at each source from a single location or from multiple locations (composite sample).

For area or volume sources, a composite sample containing air collected from multiple locations over the source is recommended where practicable.

g. Sample transport and storage

Samples should be kept in containers that guarantee the mechanical integrity of the sample bag and be stored under conditions that prevent sample deterioration by exposure to low or high temperature and light (especially sunlight).

Variation of ambient pressure should be avoided and it is recommended that air-tight containers be used to transport samples by air.

AS/NZS 4323.3:2001 requires analysis to be performed as soon as possible and within 30 hours of collection.

The Department strongly recommends samples be analysed **within 6 hours of collection**. This shorter time is in line with recent trends in Europe (e.g. VDI 3880:2011) and recognises that odorous compounds in samples degrade significantly with time.

Where remote or isolated area sampling precludes analysis within 6 hours, the Department expects the impacts of delayed olfactometry on concentration measurements to be discussed.

Ideally, the extent of odour concentration decay with time should be established empirically. The Department recommends this is done following the methodology in VDI 3880:2011 *Olfactometry static sampling*.

Victorian EPA Publication 1666.1 - *Determination of odour concentration* is another reference that provides useful information relating to odour sample management.

***Step 5**: Emission rate measurements and calculation*

Procedures for measurement of emissions, and the calculation of emission rates from various types of odour source, are outlined below.

a. Point source emission measurement

Emissions that emanate from a small opening such as a stack or a vent are conventionally referred to as ‘point source’ emissions.

Methods used for sampling point sources and measuring fluxes may also be applied where no emissions to the atmosphere are present to assess control efficiency (e.g. in ducts connecting two pieces of equipment).

Odour emission rates (OERs) for point sources are calculated by multiplying the exhaust gas odour concentration (OC) in odour units (ou) by the volumetric flow rate Q (in m^3/s); OER is expressed in $ou.m^3/s$.

The flow rate is obtained from velocity measurements made in accordance with a standard method, such as USEPA Method 2 (Refer to References). The calculation of the OER is detailed in Appendix G of the Australian Standard AS 4323.3.2001.

$$OER = Q.OC$$

Important note - calculations

Odour emission rate calculations should be reported with uncertainties related to the sample concentration (from sampling through to the measurement of the odour concentration) and flow rates.

b. Volume source emission measurement

The term ‘volume source’ refers to a fully or partially enclosed structure such as a building from which odorous air escapes through openings that may not have well-defined geometry.

Sampling and flow-rate measurements

The sampling strategy for an enclosed structure depends on the geometry of the structure, the number and types of openings and the air flow patterns within and through the structure.

The number of samples required, and the sampling locations, depend on various factors including air inlet and outlet locations and wind directions.

When well-defined outlets can be identified and safely accessed, it is recommended that sampling and flow-rate measurements be undertaken at these outlets.

Sampling at identified inlets should also be carried out if it is likely that the inlet air is already odorous.

When well-defined outlets are not present, or are not able to be safely accessed, an alternative procedure involves calculation of the odour concentration of the air escaping the structure using an average concentration of simultaneous measurements at various interior locations.

Where interior locations are generally inaccessible, a conservative estimate of the odour concentration may be arrived at by assuming that the average concentration measurement of the most odorous locations applies to the entire volume. All details of this estimation process should be provided in the report.

The exit flow rate Q (m^3/s) from an enclosed structure (required to complete the OER calculation) may be difficult to determine.

A simple method involves a grid of velocity measurements across main exit points or vents. The Q value for each outlet can be estimated from the average velocity v (m/s) across the outlet area A (m^2).

Significant uncertainty is attached to this value owing to the potential variations of the velocity across the outlet area during the time required for the grid velocity measurements.

The average exit flow rate Q may then be calculated according to:

$$Q = v.A$$

Alternatively, Q can be estimated from the air exchange rate (AER) within the structure. The AER is the number of times the air in the volume source is renewed per unit time. Q is calculated from the product of the AER and the building volume V (m^3). For example (assuming no significant dead-zones or accumulation):

- for a building of volume 5,000 m^3; and
- an AER of 6/h (i.e. 6 complete air changes per hour)
- the air flow rate Q (m^3/h) through the building can be calculated from:

$$Q = AER.V = 6/h \times 5{,}000\ m^3 = 30{,}000\ m^3/h$$

The AER may be determined by various methods including monitoring changes in concentration of a tracer gas. This method is recommended for naturally ventilated structures without clearly defined outlets for odorous air, as referenced in VDI 3880:2011.

When designing the sampling methodology, consideration should be given to the fact that building ventilation rates may depend on the speed and direction of prevailing winds.

The methodology selected to assess the exit flow rate from an enclosed structure should be detailed in the assessment report, including an estimate of individual and total uncertainties.

OER calculation

From estimates of the exit flow rate Q, and odour concentration OC, the OER ($ou.m^3/s$) can be calculated from:

$$OER = Q.OC$$

c. Area source emission measurement

Important notes – surface area sampling

Although standards exist for surface sampling of area sources, there are numerous measurement issues that have not been resolved despite substantial international research efforts. These issues are related to both the type of equipment used and the source itself, and result in high levels of uncertainty.

Consequently, characterisation of area source emission rates via surface sampling is **not recommended** unless there is clearly identified value. If implemented, detailed information should be provided on configuration of the sampling device, the reason for its choice and operational conditions under which the sample was collected.

Use of the AS/NZS 4323.4:2009 *Stationary source emissions – Method 4: Area source sampling – Flux chamber technique* for determining emission rates of area sources **is not supported** by the Department.

Emissions from area sources depend on a number of environmental factors including:

- the atmospheric temperature, pressure and relative humidity;
- wind speed and direction; and
- the temperature, composition, viscosity and volatility of the surface.

Sampling, flowrate measurements and OER calculation

Commonly used area source sampling devices include:

- flow-through hoods (some configurations are referred to as wind tunnels);
- isolation flux-hoods (also called isolation flux chambers);
- sampling hoods for active sources (also called ‘witch’s hats’); and
- equilibrium chambers.

Flow-through hoods are preferred for sampling passive surfaces.

Isolation flux-hoods generally underestimate passive area-source emission rates compared with flow-through hoods.

‘Witch’s hats’ or flow-through hoods are preferred for sampling aerated (active) surfaces.

The choice of sampling methodology should be justified in the assessment report.

As indicated in Step 4, the use of the **AS/NZS 4323.4:2009** *Stationary source emissions – Method 4: Area source sampling – Flux chamber technique for area source emissions measurement* is **not supported** by the Department.

The specific odour emission rate (SOER) is defined as the quantity of odour emitted per unit surface area per unit time (units: $ou.m^3/s/m^2$). It can be calculated from the

sampling device footprint area and the sweep air flow rate. The total OER (ou.m^3/s) for an area source is calculated by multiplying the SOER by the surface area A (m^2) of the source:

$$OER = SOER.A$$

Care should be taken to ensure that SOERs are representative of the whole surface.

Odour emissions are affected by factors such as effluent flow rates, turbulence, temperature and composition that generally vary across the surface.

Heterogeneities over both the micro-scale (footprint of the hood) and the macro-scale (the entire surface) can be significant. For example, an effluent pond SOER close to the inlet (where fast- moving, highly turbulent and untreated effluent is exposed) may be much higher than near the outlet (slow-moving, treated effluent). Windrows may also emit unevenly across their surfaces with emission rates at the crest being higher than those of the mound sides.

Temporal and spatial variations may occur at sources that are difficult to characterise. Such variability can be dealt with either by adopting conservative emission rates based on worst-case measurements, or by undertaking composite measurements.

These additional considerations apply to the following types of area sources:

Liquid surfaces:

A sampling program should consider the following source characteristics:

- flow patterns (i.e. fast and slow motion zones);
- inlet and outlet locations;
- gradients of temperature across the surface;
- aerated or non-aerated zones; and
- potential contamination from foam, sludge or other material that may be carried along with the sweeping air into the sampling tube and bag.

Management and production cycles should be reviewed to capture key information regarding flow rates and chemical loads.

Active surfaces:

The Department recommends the methodology in Section 5.2.2 of VDI 3880:2011 be used for estimation of emission rates of active surfaces, noting that use of wind tunnels is acceptable for active liquid surfaces. This section provides strategies and methods for sampling such sources, including the number of individual areas to be sampled and calculation of an OER for the whole surface.

Windrow emissions are generally highest when the windrows are first formed, turned or collapsed at the fermentation phase of the composting process. Sampling programs should aim to characterise these peak emissions periods.

Passive surfaces:

For large sources, such as extensive ponds or landfill cells, variations in emissions are more difficult to identify and therefore more difficult to characterise using traditional methods. Alternative methods may be used, but should be sufficiently documented for the Department to assess the method's reliability.

d. Emissions measurement of other source types

Sources with fugitive odour emissions

Sources with fugitive odour emissions generally have no specific geometry or configuration from which sampling and flow-rate measurements may easily be undertaken, and their emissions points may be difficult to identify.

Fugitive emissions may arise from leaks in plant equipment (valves, flanges, pump seals) or activities such as shredding, grinding, turning or disturbing odorous material, and the loading of trucks.

NOTE: Emissions from area and volume sources are sometimes referred to as fugitive emissions. However, in this Guideline, these source types are considered separately as described above.

No published standards or guidelines for sampling fugitive emissions are available at present. However, techniques for characterising fugitive source emissions include:

- direct sampling of odour (using appropriate equipment such as temporary enclosures);
- plume sampling close to source; and
- estimation of likely OER based on process calculations.

NOTE: Large uncertainties are associated with fugitive OER estimates.

Spray drift odour emissions

No methods for reliably quantifying OERs from activities involving spray drift are available at present. Odour impact assessments dependent on OER estimates from spray drift **will not be accepted** by the Department.

Landfill odour emissions

Landfill odour emission rates may be highly variable, both temporally and spatially, across the active faces and capped cell surfaces depending on factors such as management practices, type of waste delivered, weather patterns and capping material. These factors contribute to landfill odour emission rates and are very difficult to reliably quantify.

Odour impact assessments that are dependent on OER estimates from landfill active faces **will not be accepted** by the Department.

Step 6: *Odour source assessment reporting*

Odour source assessment reports should contain the following information:

a. Assessment objective and outputs

The objective of an odour source assessment should be clearly stated.

b. Odour source assessment strategy

The following information should be documented and submitted to the Department:

- all significant odour sources as applicable, and the reasons for excluding any odour sources from the assessment;
- diagrams clearly illustrating the location of the sources within the premises boundary; and
- an odour source information summary table (*Table 6*), containing the source details and planned sampling strategy, should be provided for each source being sampled. The table should detail why specific plant operating conditions were selected to characterise source OERs in support of the assessment objectives.

Table 6: Odour source information summary

Odour source information summary	
Description of the source/reference/location (map attached)	
Type of source	
Dimensions	
Elevation	
Planned operating conditions during sampling	
Sample location	
Planned sampling equipment	
Planned number of samples	
Planned sampling times	
Planned pre-dilution factor at the sampling stage	

c. Sample analysis summary

A summary of each odour concentration measurement should be provided using *Table 7*, along with supporting documentation including all laboratory analysis reports.

Table 7: Odour sample analysis summary

Odour sample analysis summary	
Source	
Sample identification number	
Time of the measurement	
Static pre-dilution factor prior to any measurement	
Number of panellists	
Average panel odour detection threshold	
Odour concentration of the air emitted at the source (after considering any pre-dilution factors)	
Odour laboratory repeatability and accuracy	
Uncertainty (upper and lower limits)	
Any comment on limitations on the results or deviation from AS/NZS 4323.3:2001	

d. Source sampling conditions and OER summary

A list of all sources sampled, the sampling conditions and their OERs should be provided using *Table 8*.

Table 8: Odour source sampling conditions and OER summary

Odour source sampling conditions and OER summary			
Source			
Actual number of samples			
Sample identification number/s	Sample ID 1	Sample ID 2	Sample ID 3
Actual sampling conditions (source or process attached to the source)			
Actual sampling times			
Actual pre-dilution factor at the sampling stage			
Sample OER			
Average OER for source			

e. Interpretation of results and conclusion

The outcomes of the odour source assessment should be detailed, and interpretations and conclusions should be discussed with reference to the objectives of the assessment.

Any deviations between the operational conditions targeted in the sampling strategy and the conditions at the time of the measurements should be provided.

Conclusions should reflect the influence of such deviations on the results.

NOTE: Electronic reporting templates for the source information, analysis and summary tables above are available on the Department website.

A4-7 Comparative dispersion modelling

Comparative dispersion modelling refers to the comparison of two or more modelling scenarios (e.g. using different pollution control equipment) without specific reference to air emission criteria.

> **Important note – criterion modelling**
>
> 'Criterion modelling', which compares the predicted concentrations at sensitive receptor locations against regulatory criteria, **is not accepted** for odour impact assessment purposes owing to the large associated uncertainties.

Comparative modelling may be used in the context of odour impact assessments where changes in emission rates, resulting from proposed changes to an existing facility, can be reliably characterised.

Comparative modelling may also assist applicants to identify which odour sources, on a site with multiple sources, are best controlled, configured or managed to most cost-effectively limit impacts.

Applicants need to be aware of the usual requirements for dispersion modelling as specified in the Department's *Guideline - Air quality modelling guidance notes (DoE 2006)*. This modelling guidance should be followed to the extent that it applies to comparative odour modelling and this Guideline.

NOTE: The air quality modelling guidance is subject to change from time to time and applicants are advised to refer to the most current version available on the Department website.

Modelling percentile and averaging time

The Department recommends that 99.5th percentile hourly averaged concentrations be reported for comparative dispersion modelling assessments.

Concentrations of this percentile are less prone to issues relating to intermittent emissions than lower percentiles, and are less sensitive to the statistical robustness issues of higher percentiles.

Meteorological data

Odour dispersion modelling should be performed using a minimum of one complete and continuous year of high quality (validated) meteorological data.

It is the applicant's responsibility to ensure the data used is representative of the site and of sufficient quality.

A wind speed resolution of 1 knot (0.51 m/s) is coarser than desirable for odour modelling purposes; use of such datasets should be avoided where possible.

Any procedures used in pre-processing meteorological data, or prognostic programs to synthesise data, should be documented.

Hours of receptor sensitivity

Comparative modelling assessments should include all hours of source emissions as input to the model. Modelled hours of emission should not be limited to those hours during which receptors are deemed to be odour sensitive.

Model selection

Model selection is at the applicant's discretion, however the model should be appropriate for use.

NOTE: Simpler models, such as steady-state Gaussian models, may provide acceptable results for some comparative odour modelling scenarios.

Comparative dispersion modelling reporting

Reporting for comparative modelling should include:

- the objective of the modelling exercise;
- electronic copies of the model configuration and input files;
- a description of meteorological data used, and procedures used to prepare these data;
- a description of the sources included in the modelling and their emissions characteristics; and
- conclusions.

A4-8 Comparison with similar operations

This tool allows for the performance of similar facilities to be used in support of an application. It involves gathering information on the extent of impact and source characteristics of a similar operation.

The outputs of this tool may be incorporated into other detailed analysis tools such as the 'location review' tool. Points for consideration when comparing odour studies or experience of similar operations include:

- size;
- operational throughput;
- operational conditions, technology levels and management;
- similarity of the surrounding topography;
- meteorology;
- emission sources;
- seasonal or other temporal factors that affect odour emissions;
- the aim of referenced studies; and
- completeness of the data.

Appendix 5 Summary table for detailed analysis

Table 9 below should be completed by the applicant and provided as part of the detailed analysis.

NOTE: An electronic reporting template for *Table 9* is available on the Department's website.

Table 9: Summary of detailed analysis tools used by the applicant

Detailed analysis tools	Tick if used	Comments
Source		
Operational odour analysis (OOA) **(priority tool)**	☐	
Odour source assessment (OSA)	☐	
Pathway and receptor		
Location review **(priority tool)**	☐	
Odour field assessment (OFA)	☐	
Complaints data analysis	☐	
Community surveys	☐	
Comparative dispersion modelling	☐	
Comparison with similar operations	☐	

Glossary

Area source	A solid or liquid odour-emitting surface such as a pond, biofilter or stockpile. Examples include wastewater treatment ponds, windrow mounds and uncovered cattle feedlot pads.
Annoyance	The complex of human reactions that occurs as a result of an immediate exposure to an ambient stressor (odour) that, once perceived, causes negative cognitive appraisal that requires a degree of coping. Annoyance may or may not lead to 'nuisance' and a complaint action (van Harreveld et al. 2002).
CEN	The Comité Européen de Normalisation (European Committee for Standardisation).
Complex terrain	Topographic features that may influence the odour plume pathway, such as hills and valleys.
Dilution factor, dilution ratio	The ratio of total gas flow volume (after dilution) divided by sample flow volume in a gas stream; that is: $\frac{\text{Total volume (diluent + odorous sample)}}{\text{Volume of odorous sample}}$
Dynamic olfactometer	A dilution apparatus that delivers accurately controlled flows of pure neutral odourless gas and mixtures of neutral and odorous gases with known dilution factors to sniffing ports (olfactometry). Dynamic olfactometers are primarily used to determine the concentration or concentration-intensity relationship of an odorous gas sample.
Fugitive emissions	Pollutants emitted to the air that are not caught by a capture system and do not originate from a stack, chimney, vent or other functionally equivalent opening designed specifically for the release of emissions. These also include small releases from leaks in plant equipment such as valves, flanges, pump seals and buildings. Emissions from surfaces such as ponds are also considered to be fugitive emissions.
Measurement cycle	The time required for a single measurement at a measurement point during a field survey - typically 10 minutes in duration.
Measurement point	The panellist's position at which one or more single measurements are carried out during a field survey.
Odorant	A substance that stimulates a human olfactory system so that an odour is perceived (AS 4323.3:2001).

Odour concentration	The dilution factor required to dilute the sample to the odour detection threshold (1 odour unit) using dynamic olfactometry.
Odour detection threshold (ODT)	The lowest concentration (highest dilution factor) at which 50% of a human panel can identify the presence of an odour without being able to recognise the odour under olfactometry laboratory conditions.
Odour emission rate (OER)	The amount of odour emitted per unit of time from an odour source expressed in ou.m^3/s (AS 4323.3:2001).
Odour intensity	The relative perceived strength of an odour. Intensity descriptor scales should be applied differently according to the German standards for the determination of odour intensity under laboratory conditions (VDI 3882-1:1992) and under field conditions (VDI 3940-3:2010).
Odour nuisance	The cumulative effect on humans, caused by repeated events of annoyance over an extended period of time that leads to modified behaviour (van Harreveld et al. 2002).
Odour panellist (panellist) or odour panel (panel)	A person or group of people who have been tested and are qualified to undertake odour measurements in an odour laboratory or in the field in compliance with AS 4323.3:2001 and EN 16841-2 and VDI 3940-3 standards respectively.
Odour sample (sample)	An odorous gas collected and contained in a sample bag for subsequent analysis.
Odour unit (ou)	The unit of the odour concentration in Australia and New Zealand. One odour unit is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one reference odour mass (ROM) of n-butanol evaporated in 1 cubic metre of neutral gas at standard conditions for olfactometry (AS 4323.3:2001). **NOTE:** A number of jurisdictions including many European countries consider odour concentration to be similar to a chemical concentration with units of ou/m^3. These units are sometimes used in Australian and New Zealand publications.
Operator	A person who directly coordinates and instructs an odour panel in the field or in an odour laboratory.
Point source	A source from which emissions emanate from a specific opening such as a stack or vent.

Prescribed premises	A site where an activity listed in Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) is carried out at, or above, the specified production or design capacity.
Reference odour mass (ROM)	The accepted reference value for the odour unit equal to a defined mass of a certified reference material. One ROM is equivalent to 132 µg n-butanol (CAS No. 71-36-3) which, evaporated in 1 cubic metre of neutral gas at standard conditions for olfactometry produces a concentration of 40 ppb (0.04 µmol/mol). Reference: AS 4323.3:2001.
Screening distance	The industry-specific recommended distance between the activity boundary and nearest sensitive receptor or land use that is used to screen low odour risk (see *Appendix 2*).
Screening distance equation	An equation or formula used in this Guideline to determine screening distances from facilities using site-specific data. In some cases, these are referred to as S-factor equations.
Sensitive receptors/ Sensitive land use	Places where people live or regularly spend time, and which are therefore sensitive to emissions from industry with implications for human health or amenity. They include, but are not limited to, residences, health care establishments, places of accommodation, places of study, childcare facilities, shopping centres, places of recreation, and some public buildings. Commercial, industrial and institutional land uses that require high levels of amenity, or are sensitive to particular emissions, may also be considered sensitive land uses.
Sensitive receptor distance	The actual distance measured between the activity boundary of a facility and a sensitive receptor (see *Appendix 3*).
Single measurement	The measurement of odour impact at a measurement point over a defined measurement cycle.
Specific odour emission rate (SOER)	The odour emission rate per unit of surface area for area sources expressed in $ou.m^3/s/m^2$.
Standard conditions for olfactometry	In Australia (AS 4323.3.2001), this is a temperature of 0°C (273.15 K) and a pressure of 1 Atmosphere (101.3 kPa) on a wet basis.
Strategic Industrial Area (SIA)	Industrial land areas designed for investment in downstream processing and other heavy or strategic industrial activities.
Tall wake-free stack	The term ‘tall stack’ generally refers to stacks that protrude out of the surface boundary layer (e.g. over 30m tall). A stack that has the stack

tip sufficiently elevated to avoid wake effects of nearby structures and terrain features is considered to be wake-free. For the purposes of this Guideline, a tall stack is considered to be wake-affected if it is less than 2.5 times the height of structures located within a distance of 5L (where L is the lesser of the height or width of the building) measured from ground-level elevation at the base of the stack, and wake-free if greater than this height.

Volume source A fully or partially enclosed structure such as a building from which odorous air is escaping through one or more openings that may or may not have well defined geometry.

References

Australian and New Zealand Standard (AS/NZS) 3580 series, *Methods of sampling and analysis of ambient air*, Standards Australia, Sydney.

AS/NZS 4323.1:1995, *Stationary source emissions – Selection of sampling positions*, Standards Australia, Sydney.

AS/NZS 4323.3:2001, *Stationary source emissions Part 3: Determination of odour concentration by dynamic olfactometry*, Standards Australia, Sydney.

AS/NZS 4323.4:2009: *Stationary source emissions area source sampling – Flux chamber technique*, Standards Australia, Sydney.

DEC NSW 2005, *Approved methods for the modelling and assessment of air pollutants in New South Wales*, Department of Environment and Conservation, Sydney.

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