

Air quality guidance note

Dairies

This guideline deals with air pollution issues. It does not deal with water pollution or noise.

1 Industry description

Dairies that are intended to accommodate more than 800 animals in milk production are scheduled under the POEO Act. They need to hold an Environment Protection Licence and DECC is the Appropriate Regulatory Authority.

Local government has administrative responsibility for environment protection for dairies with smaller capacity.

Councils can influence the initial siting of all intensive agricultural industries through the development approval process. This is usually the most important decision on air quality management for these premises.

The environmental management and resolution of any air pollution-based nuisance or off-site impacts caused by odour and dust from such premises are the primary responsibility of the site operator.

This guidance note provides general information on good design and management practices to reduce air emissions from dairies. It does not apply to water quality management, nutrient management, cattle health, occupational health and safety, cattle productivity or greenhouse gas emissions.

Guidance on good dairy design and management can be obtained from:

- *Dairy Cattle Feedpad Guidelines for the Goulburn Broken Catchment*—Shepparton Irrigation Region Implementation Committee, 2002.
- *Queensland Dairy Farming Environmental Code of Practice*—Queensland Department of Primary Industries & Queensland Dairyfarmers' Organisation Limited, 2001.
- *Feed Pads Down Under*—Davison and Andrews, 1997.
- *Agriculture Notes—Dairy Effluent Management*, www.dpi.vic.gov.au, Department of Primary Industries, Victoria. This series includes notes on pumped sumps, pumps, trafficable solids traps and ponds.

1.1 Industry structure

Dairy production systems in NSW are either conventional grazing, free-stall or feedpad. Free-stall systems can increase milk production by providing dairy cows with protection from summer sun and winter mud while feeding, but there are not many free-stall systems in NSW.

Conventional grazing dairy farms are by far the most common.

Pasture-based farms are the norm, with feedlot dairying being relatively uncommon in Australia.

Supplementary feeds such as hay, silage and grains are widely used. There are also a few goat and sheep farms which produce sheep or goat's milk, specialty cheeses and yogurts.

Over recent decades the trend in the dairy industry has been for increasing milk production from a decreasing number of larger dairies. In 2003/2004 there were 1,096 registered dairy farms in NSW, producing 1,271 ML of milk from 248,000 dairy cows. The average number of milk-producing animals per farm was 226, well below the schedule limit of 800. **Most dairies are regulated by local government in respect of the POEO Act.**

1.2 Dairy structure and design

Conventional grazing systems

In conventional grazing systems, the cows graze during the day, and move to the shed morning and night for milking. Effluent is created as the milking shed floor is flushed with water (after each milking) to remove manure, urine and any spilt milk. This effluent usually runs into a small basin, where suspended solid material settles. From here the effluent drains to a holding pond, where it is treated. It remains there until it is used for irrigation.

Free-stall systems

Free-stall systems accommodate the cows in stalls within sheds or barns. Through the centre of the barn is a laneway, where feeding takes place. Along each wall of the barn are drains that flush the manure and urine that accumulates. These drains lead to sediment traps, where suspended solids settle, and the effluent then drains through to holding ponds



A modern free-stall dairy

Feedpad systems

In a feedpad dairy system the cows are fed a prepared ration, similar to a feedlot but with a greater roughage or silage component. The cows then move to a shed for milking. This system is similar to conventional grazing. The only difference is the cows' diet is partially or fully supplemented by the farmer, in addition to, or instead of grazing pastures.

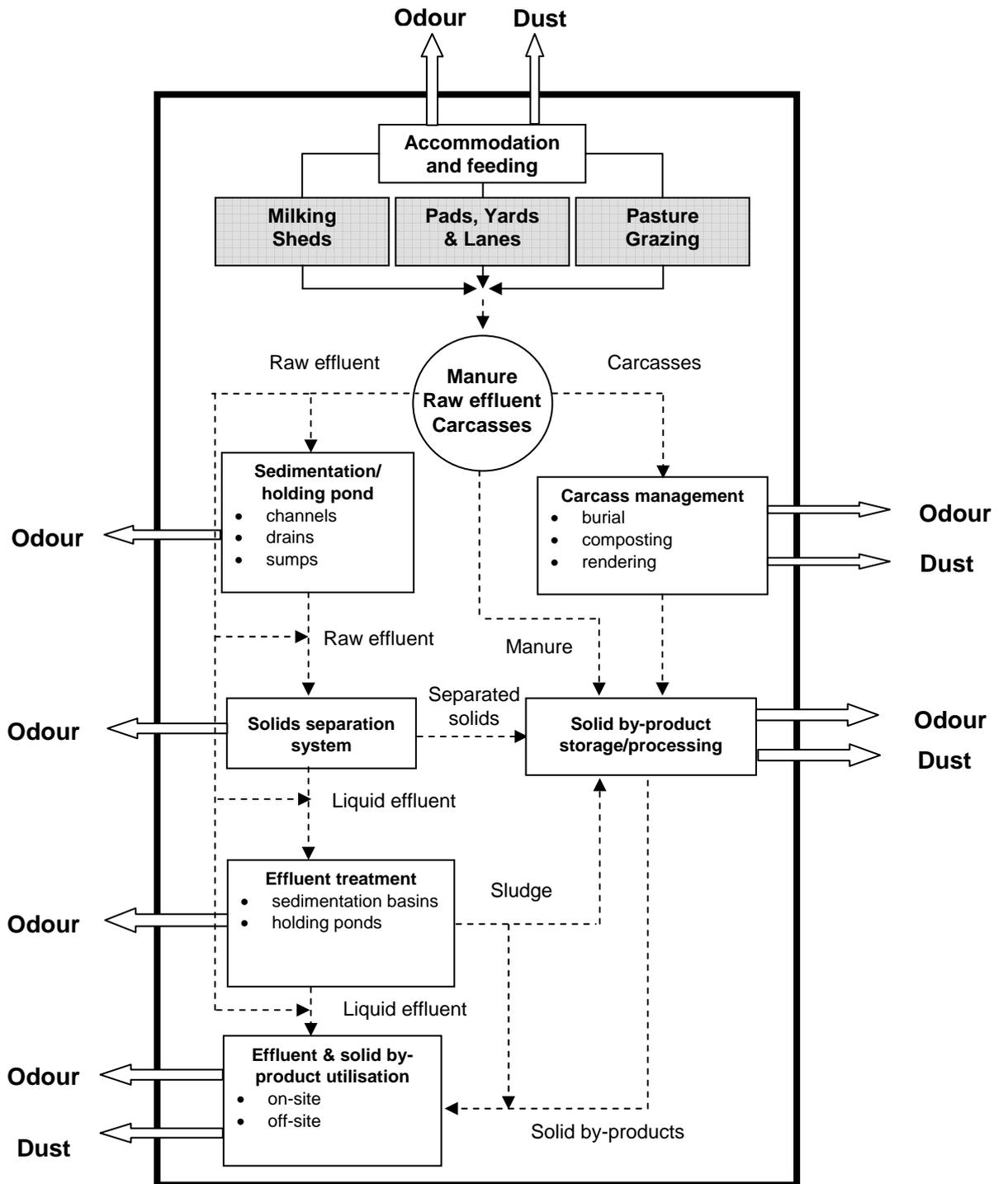
Feedpads can be a source of effluent run-off, dust and odour, and need to be managed accordingly. Problems can occur, particularly in feeding areas and where manure collects. Seasonal weather variation means that farmers are often faced with either too much or too little moisture, leading to either boggy or dusty conditions. However, there are several management practices that can help reduce potential problems.



Dairy feedlot

1.3 Production cycle

The following diagram shows the flow of by-products through different dairy designs and the relevant air quality issues with each stage of the production system.



2 Potential emissions to air

Before going on site for an inspection or assessment the following should be checked:

- the consent conditions for the premises or the activity, and
- any previous reports on file including diagrams, photographs, maps, etc.

Air pollutants which can be emitted from dairy farms are odour and dust.

Conventional pasture-fed dairy farms are not usually identified as a major source of odour or dust compared to other intensive animal systems.

2.1 Odour

Odours at dairies arise from:

- accumulated manure in the milking sheds, laneways and holding areas
- feed storage and spillage
- run-off collection and treatment
- storage and processing of solids
- land application of effluent and solids
- disposal of carcasses.

2.2 Dust

Dust from dairies arises from:

- movement of animals in the milking shed, laneways and holding areas
- storage and processing of solids
- land application of effluent and solids
- disposal of carcasses.

3 Managing air pollution

Factors for consideration in controlling air pollution from dairies are:

- anaerobic processes are necessarily involved
- odorous surface areas of solids or liquids can be exposed.

3.1 Location of premises

Where there are sensitive neighbours, initial location of premises is important, since dispersion is the main method of amelioration of both odours and dust. This is discussed in Module 3 Part 1, 'Air pollution control techniques' sections 3 and 5.3.

Most smaller-sized dairies are located in areas where the activity has become a long-established tradition or, in the case of newer, larger dairies, in areas relatively remote from urban settlement.

3.2 Odour

Milking shed, yard and laneway surfaces

Measures which can be adopted to minimise emission of odours from surfaces accommodating cows include:

- cleaning sheds of manure and spilt feed after every milking
- making sure yards, laneways and feeding areas are well drained:
 - surfaces with low permeability
 - slope of 2 to 5% to ensure run-off; the wetter the locality, the greater the slope needed
 - run-off directed away from yards or feed areas
- maintaining water troughs to prevent wet patches in yards and feeding areas:
 - avoiding leaky watering points
 - providing good drainage
- designing accommodation sheds so they have proper orientation and good ventilation.

Feed storage

Measures which can be adopted to minimise emission of odours from feed storage facilities include:

- controlling moisture content
- aeration, and
- controlling temperature.

Silage pits can produce nuisance odours and need to be sufficiently separated from receptors.

Handling and treating run-off

Drains convey manure from the milking shed, holding yard, free-stall barn (if used) and feedpads (if used) to a treatment and holding system.

The effluent treatment system at most dairies consists of a sedimentation basin and holding ponds. Some dairies use sediment traps to capture solids before the effluent is discharged to the holding ponds. Holding ponds are used to treat effluent before it is used for irrigation or as flushing water in the holding yard.

Measures to manage odours from run-off treatment and handling include:

Drain design

- Provide adequate slope (generally 0.5%).
- Provide an appropriate surface (to prevent scouring) for self-cleaning drains.

Drain management

- Drains should be kept free of manure.



Flushing drain in free-stall dairy

Sediment trap design

Factors to consider are:

- weir design
- trap volume
- vehicle access for solids removal, and
- using parallel sediment traps, allowing one to dry out while the other is in use.



Sediment trap

Sediment trap operation

Factors are:

- weir maintenance
- regular removal of solids, and
- maintaining the inflow area.

Holding pond design

Factors are:

- volume—adequate capacity to treat incoming effluent
- volume changes after an inflow event, and
- using parallel ponds, to alternate de-sludging and treatment.

Holding pond management

Factors are:

- retaining some effluent in the holding ponds at all times, providing sufficient capacity is available to prevent overtopping during inflow events
- frequency of pond de-sludging
- where pond capacity is inadequate, the following options are available to increase the pond treatment volume:
 - increase frequency of de-sludging
 - improve solids separation before discharge to the effluent treatment pond
 - install a second treatment pond in parallel, requiring diversion of some of the untreated effluent into the new pond.

Sludge removal using a vacuum tanker

Factors to consider are:

- minimal disturbance of the pond
- having sufficient land close to the pond for immediate spreading
- appropriate health and safety precautions due to toxic hydrogen sulfide gas which can be released in handling sludge. Refer to guidelines such as the WorkCover NSW publication *Toxic gas generated by micro-organisms in confined spaces*, www.workcover.nsw.gov.au/Publications/OHS/SafetyGuides/toxic_gas.htm.

Sludge removal using an excavator

Using an excavator completely empties the pond and may disturb the pond lining.

- Sludge is likely to be an odour source when wet and may take time to dry.
- De-sludging should be done in dry weather only.

Sludge removal by agitating the sludge and pumping it out:

This also causes a large disturbance to the pond volume. Sufficient land must be available close to the pond for applying the effluent or sludge mix.

Use of dairy by-products

Dairy by-products are usually reused through application to land as a fertiliser. In most instances, the material is applied to each area in small quantities.

The **key design factors** influencing odour emissions from by-product application areas are:

- the quantity of aerosols formed during application, and
- the odour potential of the effluent.

The potential for aerosols to impact on receptors depends largely on the proximity of receptors to the application area and the dispersion conditions at the time of application.

Land application of effluent

The **key management factors** in land application of effluent are:

- application rate
- quantity of material remaining on the soil surface after application
- odour potential of the material being applied
- prevailing and forecast weather conditions and the location of the land application relative to receptors; avoid spreading in calm conditions or when there are very low variable winds
- avoiding weekend application if local odour impacts are likely.

The **key design factors** influencing odour emissions from effluent application areas are:

- level of treatment achieved—effluent should be aerobic if applied by spray
- quantity of aerosols formed during application.



Travelling effluent irrigator with droppers



Tanker spreading of effluent

Potential effluent **application methods** include:

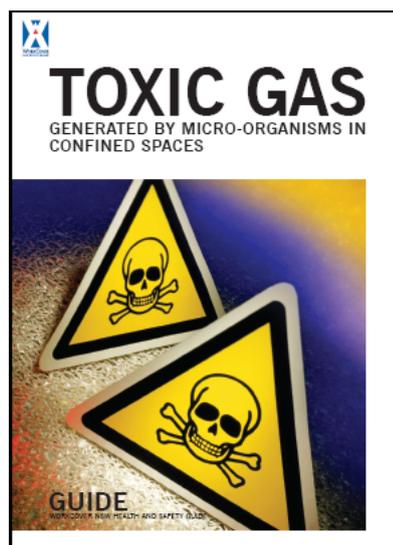
- spray irrigation
- surface irrigation
- irrigation with droppers
- drip irrigation
- tanker spreading
- deep injection.

Surface, drip or trickle (surface or subsurface) irrigation will produce less aerosols than spray irrigation, but are often not a viable alternative for effluent application.

The method used and management of the application process influence odour emissions.

The use of sludge tankers for spreading effluent can also pose a health and safety risk for workers:

- follow appropriate health and safety precautions, and
- refer to guidelines such as the WorkCover NSW guide *Toxic gas generated by micro-organisms in confined spaces*, www.workcover.nsw.gov.au/Publications/OHS/SafetyGuides/toxic_gas.htm.



Solid waste handling and land application

Measures to manage solid waste handling and land application odours include:

- Odour emissions are minimised by maintaining a dry surface and preventing water-logging of materials.
- Solid by-products should be formed into piles where possible.
- Material piles should be established on a low-permeability, slightly sloping surface.
- Operations disturbing stockpiled material should be undertaken away from neighbouring receptors and during the middle of the day as much as possible, or when weather conditions are most likely to disperse any odours.
- Solid wastes (manure, settled solids from sedimentation and treatment ponds, carcasses, spilt feed and grain dust) should be treated as soon as possible after collection.

Moisture content of solid waste

The moisture content of materials is influenced by:

- rainfall
- pile shape
- drainage from the pile base
- typical particle size of the material, and
- frequency of pile disturbance.

Downwind odour

Downwind odour concentrations are influenced by the timing of operations that disturb stockpiled materials (e.g. shifting piles or spreading material).

Anaerobic activity in solid waste

Anaerobic activity in solid wastes can be avoided by composting the material, but it requires extra management and access to appropriate equipment.

- Composting requires expert design and close management for effective results.
- Moisture levels, degree of aeration and other factors influence the odour emissions (see Module 3 Part 1, section 5.6).

Delays between collection and treatment of solid by-products increase the likelihood of odour emissions.



Carcass composting

Treatment of carcasses

Carcasses at dairies can be treated by composting, burial or rendering.

Composting carcasses

Carcasses are readily composted, but the volume of material used to cover the carcass is important for odour emissions.

Composting and the POEO Act Schedule

Composting which:

- receives over 200 tonnes per year of animal waste, food waste, sludge or bio-solids, or
- receives over 5,000 tonnes per year of wood waste, garden waste, or natural fibrous material, or
- receives any organic waste and is located within 500 metres of any residentially zoned land, or within 250 metres of a school, hospital or a dwelling not associated with the facility

renders the operation scheduled under the POEO Act and the premises become the administrative responsibility of DECC.

Rendering carcasses

Rendering carcasses is an excellent disposal method for producers located near a rendering plant.

Rendering and the POEO Act Schedule

Rendering plants with an intended production capacity of more than 200 tonnes per year of tallow, fat or their derivatives, or proteinaceous matter, are scheduled under the POEO Act and the premises are the administrative responsibility of DECC.

Burying carcasses

For carcasses that are buried, adequate soil cover is needed to prevent odour emissions.

Treatment of odour emissions

Odour emissions from composting can be minimised by maintaining adequate moisture and oxygen supply. Guidance should be obtained regarding proper design and management of composting systems.

Solid by-products should be treated as soon as possible after collection to minimise odours.

Where by-products are stored, temperature and exposure to wind and water should be minimised as much as possible.

A good depth of soil or compost substrate should cover carcasses (1 m minimum) and surface water run-off should not be able to enter the area.

3.3 Dust

Dust emissions from dairies are unlikely to cause impacts unless receptors are located nearby.

- **Dispersion conditions** (separation from sensitive sources) adequate for managing off-site odour impacts will usually also be adequate for managing off-site dust impacts.
- Manure, grain dust and composted material contain fine particles that contribute to dust emissions when these materials are dry.

Minimising dust emissions

The following practices can help minimise dust emissions:

- Lanes should be relatively narrow, fenced and well-drained.
- Yards should be flushed regularly using a properly designed flushing system.
- Yards should be constructed to exclude run-off from other areas.
- Changes to ration mixes may reduce dust.
- Vegetated wind breaks can be installed around dust sources.
- Roads within the dairy can be designed and managed to minimise dust generation.
- Water sprays can settle dust and consolidate dusty surfaces, but in some situations may increase odour generation, so would need to be considered on a site-by-site basis.
- Operations involving the movement of large quantities of solids can be timed or managed to minimise dust.
- Solids processing and storage areas can be sited away from receptors.

Dust from feedstuffs

Dust can arise from the feedstuffs used. Attention should be paid to:

- possible use of pelletised feed in place of finely ground feed
- siting of storage and processing areas
- installing wind breaks, and
- design and management of feed processing areas.

Dust emissions can be reduced by establishing vegetative screens, watering the surface or by removing manure more regularly from yards, feeding areas and laneways, and using surface materials that do not readily create dust.

4 Considerations for consent conditions

Other conditions may be necessary to control environmental impacts other than air pollution.

4.1 Standards to be met

- In cases where odour modelling and testing is to be undertaken, odours from the premises to comply with the requirements of DEC draft policy *Assessment and management of odour from stationary sources in NSW* (2001).
- Solid particle emissions to comply with POEO (Clean Air) Regulation 2002 for any stack discharges on the site:
 - 400 mg/m³ for plant installed before 1 Aug 1997 (not for a new development consent)
 - 250 mg/m³ for plant installed between 1 Aug 1997 and 1 Sept 2005 (not for a new development consent)
 - 100 mg/m³ for plant installed after 1 Sept 2005.

- Smoke emissions to comply with Ringelmann 1 or 20% opacity.
- Plant to be operated and maintained in a proper and efficient manner which does not cause air pollution, in accordance with s. 124 and 125 of the POEO Act.
- Materials to be handled in a proper and efficient manner which does not cause air pollution, in accordance with s. 126 of the POEO Act.

4.2 Operational and control requirements

- Odours from the premises not to be detectable at the nearest sensitive land use.
- All yard and feeding areas to have adequate slope, a hard surface and shed water directly to a drain.
- All drains to have a hard, even surface to prevent scouring and adequate slope so that solids do not settle in the drain.
- Drains to be maintained in a dry condition.
- The sediment trap to have adequate volume to pond the inflowing effluent for slow release through a weir.
- The sediment trap to be maintained so that adequate capacity is retained for settling solids from effluent inflow.
- Yard and feeding areas to be cleaned regularly, including under fences.
- Yard and feeding areas to be checked after cleaning to make sure the surface is hard and even.
- All operations and activities occurring at the dairy to be carried out in a manner that will minimise dust at the boundary of the premises.
- All solid by-products (e.g. manure, settled solids) to be stored in an impervious, free-draining and bunded area.
- Solids to be stored as far away from sensitive receptors as practicable.
- Movement of solids to be carried out wherever possible in weather conditions which minimise the emission of odours.
- Application of solids to land to be carried out in weather conditions which minimise odour, dust emissions and impact on sensitive receptors. Solids to be incorporated into soil immediately after application.
- Spray from effluent application not to drift beyond the boundary of the premises.
- Carcasses to be disposed of in a manner which minimises odour and dust emissions.
- Carcasses which are buried to be covered with sufficient soil to prevent odour emissions.

Dairies: air quality management checklist

This checklist has been designed for:

- local government officers—to help identify potential air emission problems and provide advice to operators.
- operators—to help identify and manage potential air emission problems.

Company

Address

Site location

Contact	Permit assessment
	Complaint response
Phone	Compliance inspection
Fax	Time & date of inspection
Email	Inspector's name

A Site location and context

What are nearby sensitive land uses?

	Land use	Distance	Comments
North			
South			
East			
West			

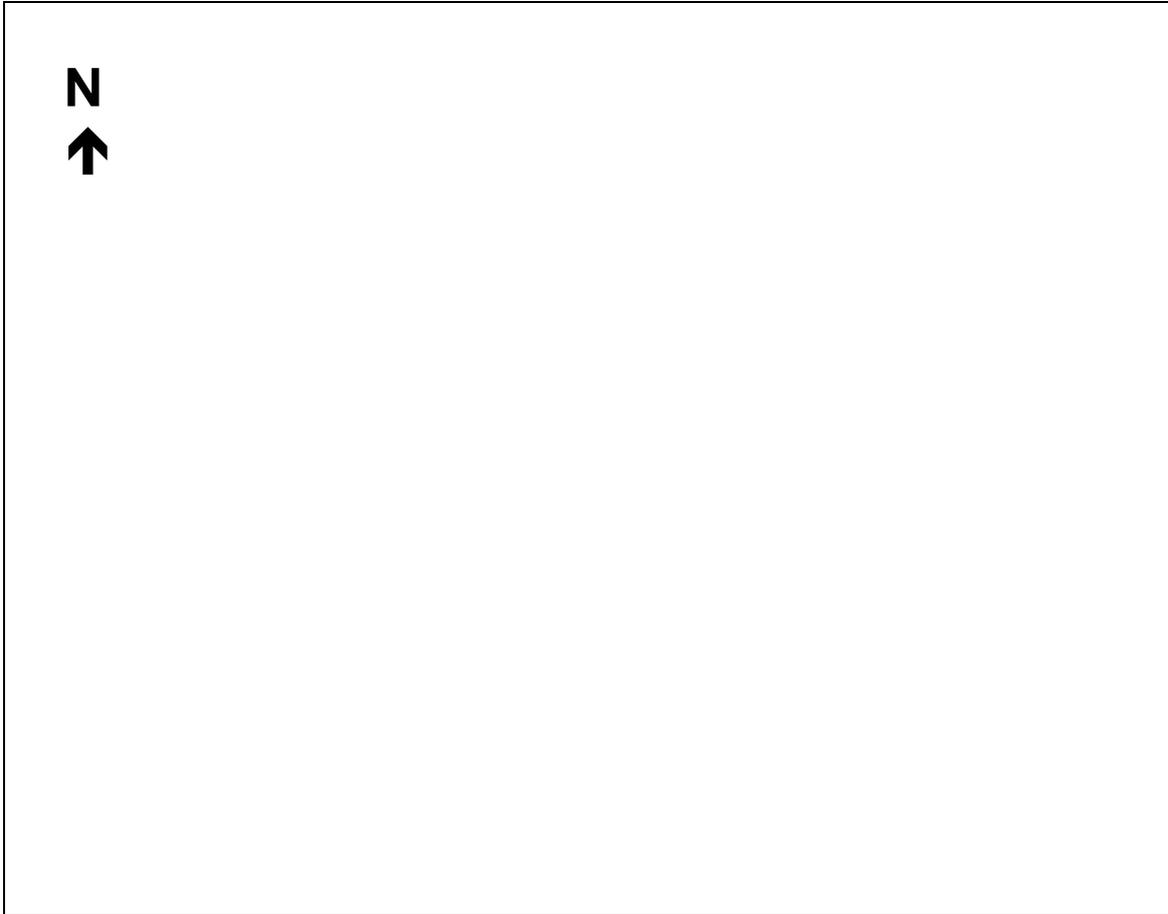
What are the prevailing winds at the site (morning/afternoon/night)?

Summer		Autumn	
Winter		Spring	

How will the surrounding topography or nearby buildings affect dispersion of any air pollution that is emitted from the site?

B Sketch plan of the site

Draw a sketch plan of the site showing the surrounding land uses, nearby buildings and local topography.



Note particularly:

- nearby sensitive land uses (schools, homes, other affected premises)
- locations of any complainants
- locations and heights of nearby buildings or trees
- wind directions during times of complaint (night and day)
- any other relevant features.

Comments:

D Core business and activities

Tick if yes and add comments as appropriate.

Types of operation

Operation	No.	Size (milking animals)	Comments
Sheds			
Holding yards			
Drainage			

Treatment of wastes

Wastes treated	Method	Comments
Liquid effluent	Sedimentation	
	Holding ponds	
Manure	Sedimentation	
	Piles	
Solids and sludge	Application	
Carcasses	Composting	
	Rendering	
	Burial	

Operational conditions

Aspect	Condition/activity	Yes/no/NA
Accommodation— sheds, yards, feedpads, laneways	Is the accommodation clean?	
	No wet patches in yard or pad surface?	
	No holes in yard or pad surface?	
	No mounds of manure under fences?	
	Yards and pads well drained?	
	No piles of spilt feed around feed areas?	
	Laneways relatively narrow?	
Effluent collection, storage and treatment	Effluent drains mostly clear of manure?	
	Effluent drain surfaces hard and even?	
	Sedimentation basin relatively dry?	
	Sedimentation basin weir clear?	
	Pond not odorous?	
	No solids visible on or through pond surface?	
	Are ponds pink/purple in colour? (good)	
	No bubbles visible breaking the pond surface?	
Solids treatment and storage	Is the area tidy?	
	Solids stored in well defined piles?	
	Area dry and well drained?	
	Carcasses well covered?	
	Stormwater excluded?	
	Operations during day only?	
Land application	No by-products visible on soil surface?	
	Vegetation on soil surface?	
	Spreading operations done during day?	

Comments and recommendations on operations:

E Management of odorous materials

How are odorous materials stored?

	Open storage	Covered storage	Bin or hopper storage	Comments
Manure				
Carcasses				
Compost				

How are odorous materials moved?

Operation	Weather considered?	Comment
Manure		
Pond de-sludging		
Land application		

Comments on the general standard of housekeeping:

F Complaints from nearby premises

Odours

Date	Complainant	Distance and direction from dairy	Time of day	Comments

Dust

Date	Complainant	Distance and direction from dairy	Time of day	Comments

