MEAT & LIVESTOCK AUSTRALIA

BIOSECURITY **MANUAL**

Indonesia Biosecurity Support Project

AUSVET

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Contents

Tables

Figures

Abbreviations and acronyms

Abbreviation	Definition
AH&W	animal health and welfare
ERP	emergency response plan
FMD	foot and mouth disease
IPM	integrated pest management
LSD	lumpy skin disease
MLA	Meat & Livestock Australia
QR codes	quick response codes
RFID	radio frequency identification

Summary

Foot and mouth disease (FMD) and lumpy skin disease (LSD) appeared in Indonesia in 2022, causing widespread outbreaks amongst susceptible animals – particularly cattle. Meat & Livestock Australia engaged the services of Ausvet to assist the Indonesian beef supply chain in preventing and managing these outbreaks through provision of technical services.

These technical services include the *Biosecurity Manual*, which provides stakeholders with the information to implement high-level biosecurity measures to protect their businesses. The *economic tool* that has been developed can be used to assist managers in deciding on the most sustainable and cost-effective biosecurity measures to implement. The *risk assessment* tool that has been developed can assist managers in identifying gaps in their current biosecurity practices.

The measures outlined in this manual can be applied to any transboundary animal disease (FMD and LSD examples have been used due to the current outbreak). The measures follow the basic principles of preventing disease transmission by preventing contact between infected and susceptible animals. The measures are separated into:

1. Structural and geographical features
2. Management of cattle and cattle products
3. Zones, people, vehicles and equipment
4. Input management
5. Proximity management
6. Record keeping.

The manual is designed to be used alongside the *Animal Health and Welfare Manual* during 'business as usual' periods, and with the *Emergency Response Plan Manual* during outbreak situations.

Introduction

Biosecurity practices are crucial components of livestock production. The aims of biosecurity are:

- Prevent the introduction of diseases.
- Minimise the spread of a disease within and beyond a facility if an outbreak occurs.
- Minimise the economic impact of an outbreak.

Good biosecurity requires an investment (financial and resources), and failures in biosecurity will result in increased losses due to disease and pest introduction, reduced animal productivity and rising production costs.

Good biosecurity focuses on assessing the risk associated with different transmission pathways and identifying cost-effective ways to manage risk. Figure outlines common transmission pathways associated with FMD and LSD.

Risk is a combination of the probability of transmission occurring through a pathway (transmission probability) and the consequence of disease introduction. The consequence of disease introduction is dependent on the disease and facility. For intensive facilities, the consequence of FMD or LSD introduction is likely to be major or catastrophic.

Matrices, like that shown in Table 1, can be used to determine risk when the transmission probability and consequences are known. Table 2 is an example of how facilities might list possible transmission pathways and then use risk matrices to identify high-risk transmission pathways.

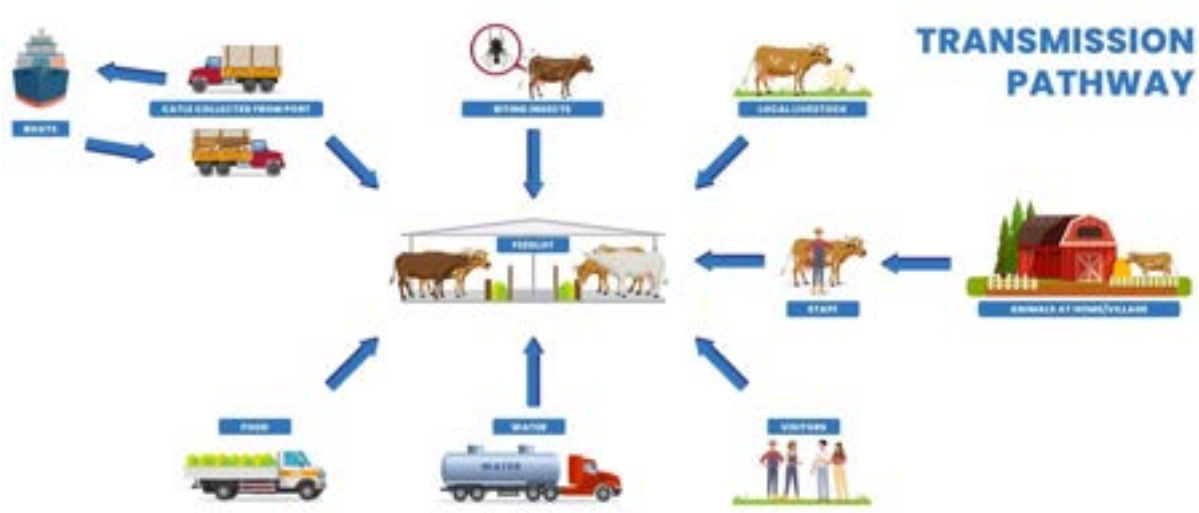


Figure 1 Transmission pathways

Table 1 Risk matrix template

Probability or likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Very likely	Low-medium	Medium	Medium-high	High	High
Likely	Low-medium	Low-medium	Medium	Medium-high	High
Possible	Low	Low-medium	Medium	Medium-high	Medium-high
Unlikely	Low	Low-medium	Low-medium	Medium	Medium-high
Very unlikely	Low	Low	Low-medium	Medium	Medium

Table 2 Facility transmission pathways and their associated risk

Transmission pathway	Probability	Consequence	Overall transmission pathway risk
New animals – Australian-sourced direct from boats	Unlikely	Major	Medium
New animals – Australian sourced, vaccinated and spent 7–14 days in an offsite quarantine facility	Very unlikely	Major	Medium
New animals – local-sourced	Very likely	Major	High
New animals – local-sourced, vaccinated and spent 7–14 days in an offsite quarantine facility	Possible	Major	Medium-high
Staff (residing off site)	Possible	Major	Medium-high
Visitors – official	Possible	Major	Medium-high
Visitors – unofficial	Very likely	Major	High
Feed suppliers	Possible	Major	Medium-high
Bedding suppliers	Possible	Major	Medium-high
Vehicles	Possible	Major	Medium-high
Insects	Likely	Major	Medium-high
Water sources	Possible	Major	Medium-high
Airborne transmission	Possible	Major	Medium-high
Neighbouring farms	Likely	Major	Medium-high
Feral/free-ranging livestock	Likely	Major	Medium-high
Wildlife (birds, monkeys, vermin)	Likely	Major	Medium-high

The risk associated with a transmission pathway can be reduced through effective biosecurity (risk management). For example, in an 'all in/all out' system, a facility only receives livestock at one time point. The facility will not receive any more groups until that consignment is sent to slaughter and full decontamination of housing is conducted[1]. This practice recognises the introduction of new animals as a high-risk transmission pathway and aims to reduce this risk. Examples of other practices that target different transmission pathways include ensuring trucks are clean when they enter a facility and requiring staff to present to work in clean clothing. The processing of identifying high-risk transmission pathways and deciding how to manage them can be supported by risk assessment tools, such as that shown in Appendix A.

For most intensive facilities, once a highly infectious diseases such as FMD and LSD enters, transmission throughout the facility is impossible to control. As a result, this manual focuses on transmission pathways that contribute to disease entering intensive facilities.

How to use this manual

This manual outlines best practice biosecurity procedures that can be implemented in feedlots and associated facilities[2]. While some facilities and diseases may require tailored biosecurity practices, those outlined in this manual can be applied to various facilities, including those housing other livestock species. In addition, the measures described here will protect against a range of diseases, not only FMD and LSD.

The manual is designed to be used alongside the *Animal Health and Welfare* (AH&W) *Manual* during 'business as usual' periods, and with the *Emergency Response Plan* (ERP) *Manual* during outbreak situations. The risk assessment tool can be used for annual auditing so facilities can monitor their progress (see Appendix A).

The technical contents of this manual are intended for people at management level or highly trained animal health staff such as veterinarians.

[1] Decontamination refers to the thorough cleaning and use of a suitable disinfectant – see the ERP manual for a list of suitable disinfectants for FMD and LSD.

[2] 'Associated facilities' is used throughout this manual to refer to quarantine facilities, breeding farms or abattoirs.

Disease-specific information

Foot and mouth disease

- Direct contact or close proximity will help the spread of the disease.
- Multiple species can be affected.
- Any part of the sick animal can spread the disease.
- Good hygiene of people, equipment and vehicles is important.
- Prevent the entry of sick animals and vaccinate animals in the facility.
- Report sick animals.

The FMD virus affects ungulates – species with two toes per foot. The main domestic species affected are cattle, buffalo, goats, sheep and pigs. The virus can spread via direct (animal-to-animal) or indirect (air, water, or contaminated clothing and equipment) contact. Once the animal is infected, the virus quickly becomes established systemically, spreading throughout the animal's body. This means that:

- Meat, blood or any other part from infected animals can play a role in spreading disease.
- Treatment of lesions in the mouth and around the feet or other parts of the animal will have no effect on the duration of the infection.

The FMD virus is highly contagious. When it is introduced to naïve herds, up to 100% of the herd will become infected. Different species play different roles in the transmission and maintenance of the virus. Pigs amplify the virus and aerosolise it, which helps infect cattle and buffalo. Cattle and buffalo are most susceptible to inhaling the virus. The differences in routes of infection are shown in Figure 2.

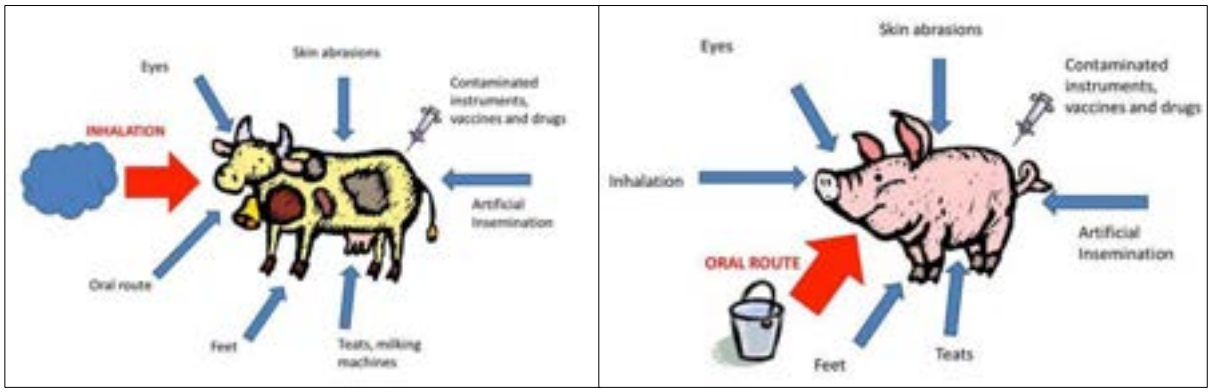
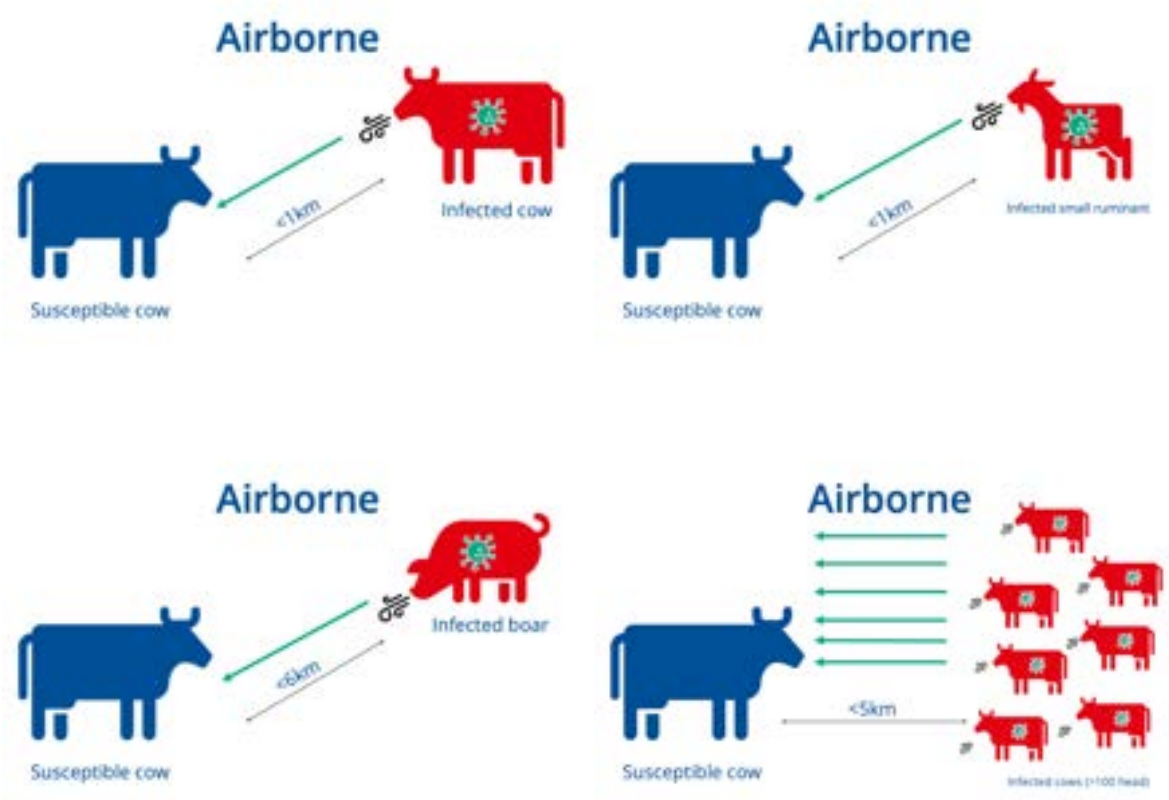


Figure 2 Foot and mouth disease routes of infection for cattle/buffalo and pigs (Source: University of Sydney and Local Lands Services – South East)

With FMD, practising good biosecurity and hygiene is essential as the virus can be transmitted from secretions and excretions and can also become airborne over short distances.

FMD can spread via aerosol but only over short distances



The fluid in the blisters that develop in FMD has the greatest amount of virus and is a major transmission source. Actively infected animals will also secrete the virus from urine, faeces, semen, ocular and nasal discharge, blood and their breath. The virus can travel on air and in water. Animals can start shedding two

days before showing clinical signs. **Apart from vaccination, the key prevention strategy is preventing the introduction of infected animals into a facility**.

Lumpy skin disease

- Only cattle and buffalo are affected.
- Prevent the entry of sick animals and vaccinate animals in the facility.
- Control biting insects and their breeding sites in the facility.
- Do not buy animals from infected regions.
- Report sick animals.

Cattle and buffalo are the only species affected by LSD. Generally, only 5–20% of the herd become diseased when LSD enters the herd. However, higher levels of disease may be seen in naïve cattle, such as those recently imported from Australia that have never been exposed to the disease. LSD is most commonly transmitted by biting insect vectors. Other routes of transmission include contaminated feed and water, saliva, secretions and semen. LSD can spread over long distances with the movement of infected animals in the presence of insect vectors. The virus can survive for a long time in the environment, so insect control and good hygiene practices are important. Apart from vaccination, prevention strategies include carefully selecting and minimising the introduction of new animals (particularly those that are infected with LSD or come from an area where there are cases of LSD), reducing the number of insect breeding sites within the facility, and preventing biting insects from feeding on cattle.

Table 3 illustrates the key differences between the modes of transmission for FMD and LSD.

Table 3 Modes of transmission for FMD and LSD

Mode of transmission	FMD	LSD
Direct contact between animals	+++	+
Insect vector	+	+++
Bodily secretions and excretions	+++	+
Multiple species involvement	+++	+
Windborne	++	++ (assists in insect spread)
Contaminated fomites	++	–
Infectious before clinical signs	++	–

+ plays a minor role in transmission; ++ plays a moderate role in transmission; +++ plays a major role in transmission; – does not seem to play a role in transmission

1 Structural and geographical features

1.1 Facility layout and entry/exit points

In this section, individual facilities should insert schematics of the premises.

Features to be included in the schematic of a feedlot if present could include:

- animal housing (such as pens or sheds)
- feed bunks and feeding lanes
- drains and drainage routes
- induction loading ramp
- induction facilities
- quarantine housing and hospital facilities
- hospital facilities and pens
- handling yards
- general loading ramp for sale
- effluent ponds
- manure stockpiles and composting pads
- feed mill and feed storage facilities such as silage or dry storage
- warehouse storage for consumables such as chemicals or medication
- workshop for vehicle and equipment maintenance
- vehicle, animal and equipment washdown facilities
- personnel quarters/staff housing
- office and visitor reception areas
- staff change areas
- neighbouring risk features, including animal facilities and forage collection areas
- breeding herds or other livestock species (if present)
- entry and exit points for external vehicles
- external boundaries
- high and low biosecurity zones (see 1.3 and Figure 6).

Example schematics for a demonstration site are shown in Figure 3Figure 4 Figure 5 but they should be tailored to each individual facility. Figure 3 shows the local area of the feedlot, and can be generated by getting a local map and labelling features that may generate disease risk such as access roads and local cattle around the site.

Figure 4 shows the internal layout of a pen; however, multiple schematics may be required if your site has differing styles of pens. This demonstrates the location of feed bunks and drainage; if there is poor drainage then disease risk can increase if insect vectors are present.

Figure 5 shows the layout of the feedlot itself, demonstrating important access points and buildings. In 1.3, the concept of biosecurity zones will be further explained, and this map can be updated to include the high and low biosecurity zones as shown in Figure 6. Developing a feedlot map can allow easy understanding of the flow of people, equipment and animals that may contribute to disease risk.

Figure 3 Example local area map for feedlot

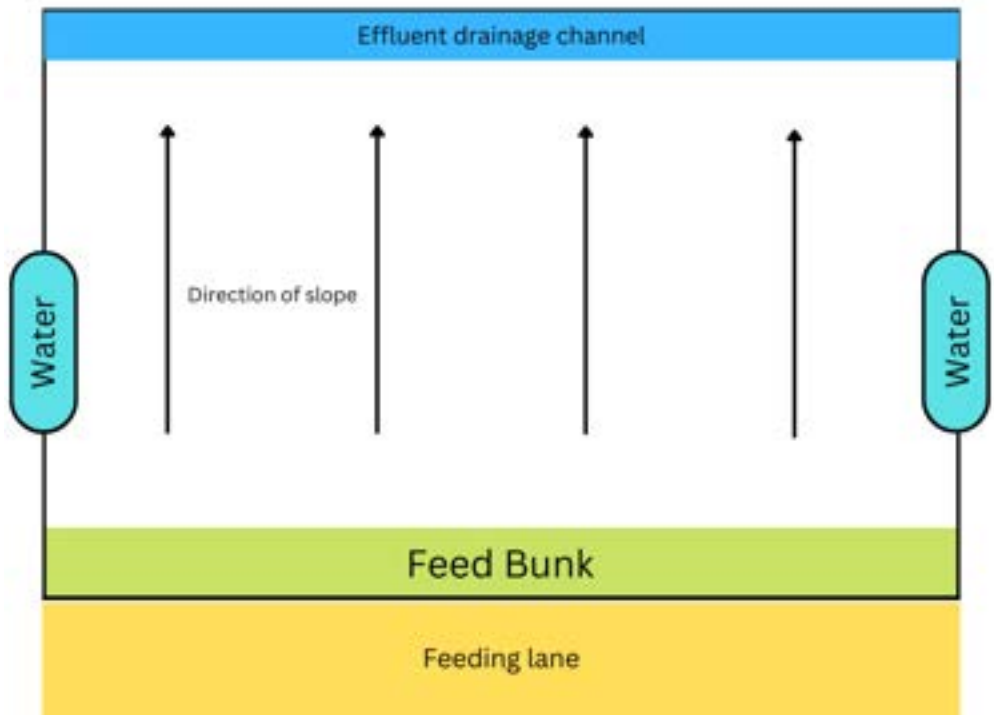


Figure 4 Internal pen diagram demonstrating locations of feed bunks, drainage and effluent channels

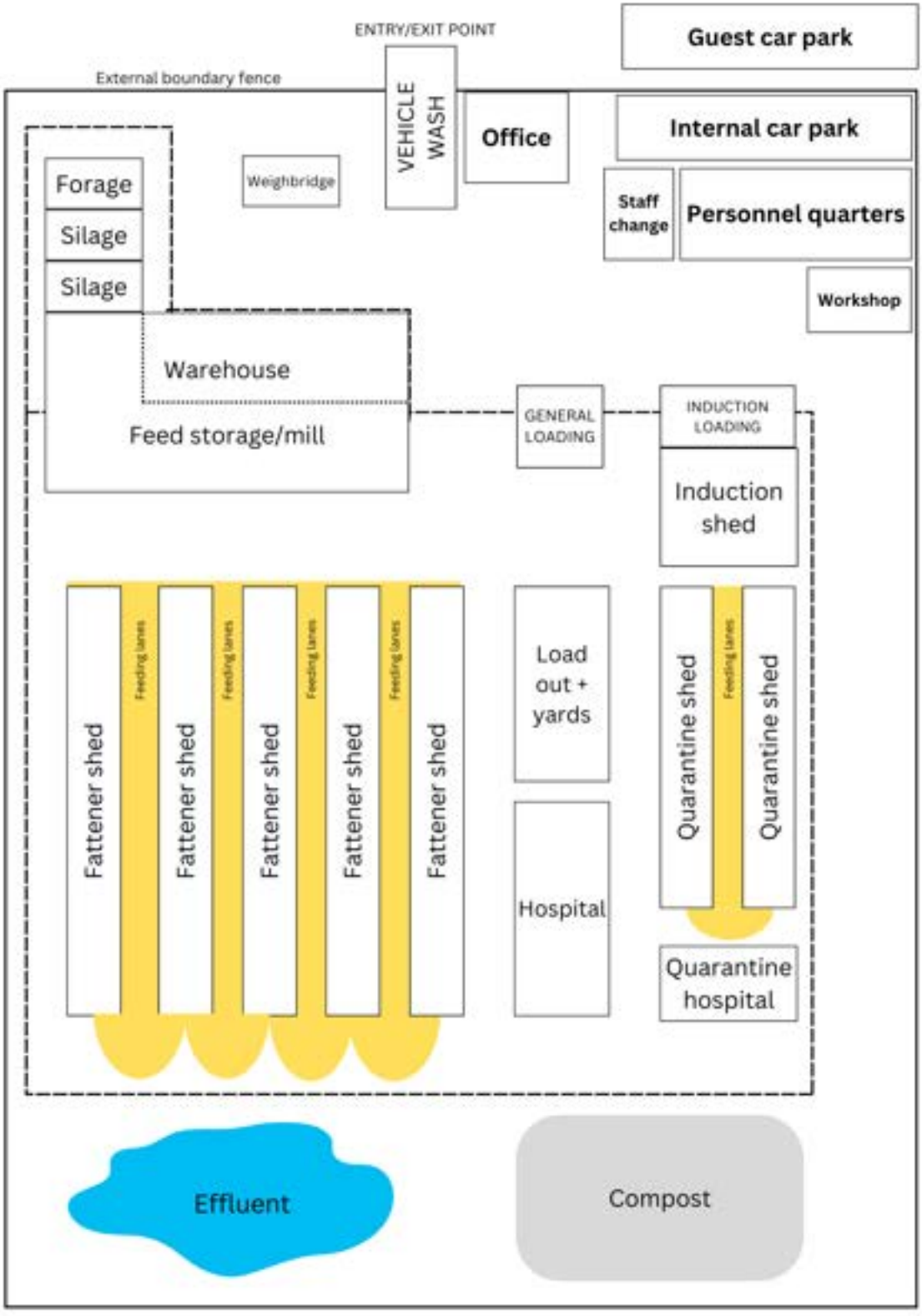


Figure 5 Example internal feedlot map without biosecurity zones labelled

Features to be included in the schematic of an abattoir if present include:

- animal holding areas
- 'clean' areas – e.g. meat processing areas and staff/office areas
- drainage and wastewater pens
- truck washdown facilities
- knocking box and slaughter rooms.

Features to be included in a schematic of a breeding facility if present include:

- holding/quarantine areas
- semen collection yards
- laboratories
- pens or paddocks
- drains and ponds
- stock lanes and feed alleys
- manure stockpiles and composting pads
- feed mill and feed storage facilities
- stock and vehicle washdown facilities
- map with entry/exit points.

1.2 Relevant geographical and environmental factors

To be populated by each facility, factors to consider include:

- **number of animals**
  This may impact the ability to control disease, the length and extent of an outbreak, and the ability to adequately manage and support sick animals back to health.
- **land size**
  This may impact the type of quarantine measures that can be implemented and the ability of a facility to separate infected and unprotected animals.
- **water sources (distance to potable water sources; contamination/environmental risk)**
  Some diseases can be spread via water, and water sources can provide breeding sites for insects. Carcass disposal and effluent management can also pose a contamination risk to water sources for the wider community.
- **run-off and contamination (sources of run-off; use of topography to manage site run-off)**
- **surrounding livestock and other intensive animal production facilities**
  Livestock population (intensive, smallholder and unmanaged) can pose a disease transmission risk.
- **surrounding feral animals**
  Feral and wild animals can pose a disease transmission risk. Animals like birds and monkeys may act as fomites, spreading disease from neighbouring animal populations to the facility.
- **surrounding residential areas**
  These communities need to be considered regarding effluent management and carcass disposal. Residents may also pose a biosecurity risk if they have regular contact with external and facility livestock.

- **surrounding ecological communities**
  Are there any important flora/fauna/biodiversity considerations?
- **access to water**
  Are there any legal considerations?
- **flood/fire risk**
- **groundwater/water table considerations**
- **available space/land for effluent and manure management**
- **access to safe feed and bedding**
  Commodities that need to be brought into a facility can pose a risk as they may be contaminated with disease, or the vehicles and personnel delivering them may be.
- **access to reputable abattoirs**
  Abattoirs may pose a risk to the supplying feedlot if they have diseased animals present; personnel and vehicles may become contaminated. If animals are held for more than 2–3 days, animals can become clinical with FMD, and the feedlot may not receive a premium price for what was a premium product on arrival.
- **distance from ports.**
  Longer distances travelled increase the risk of animals being exposed to FMD or LSD-carrying insects.

1.3 Biosecurity zones

A facility or part of a facility can be classified as a high biosecurity zone or a low biosecurity zone. A high biosecurity zone status is achieved by taking actions to reduce the probability of disease transmission into that zone. This is best achieved by understanding how to block transmission pathways that are high risk. Generally, areas with live animals should be made into high biosecurity zones. Other areas like offices can be considered low biosecurity zones. Setting up facilities in this way may require initial investment but is likely to be highly cost-effective in the long term.

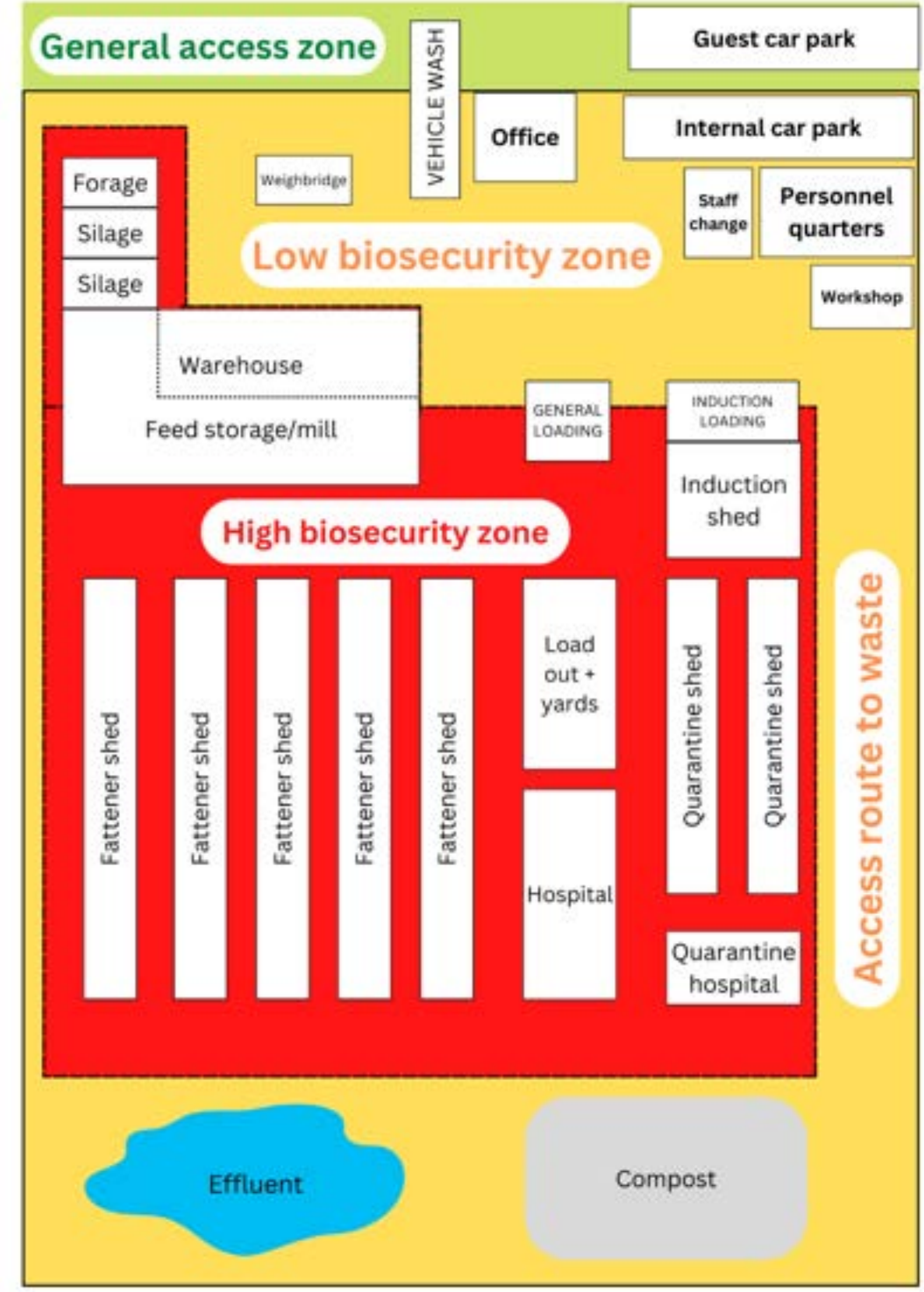
Staff and visitors should be aware of the different zones and transmission pathways when conducting their daily activities. For example, staff should aim to move from high biosecurity zones to low biosecurity zones, acknowledging that their movement may create a transmission pathway. If staff have been in a low biosecurity zone, they should not move to a high biosecurity zone without conducting decontamination procedures, such as showering and changing coveralls, hats/hijabs and boots (see the ERP manual for further instructions).

High biosecurity zones

Many industries use the concept of clean or secure zones, for example surgical theatres and airports. In intensive cattle facilities, the clean zone is an area of high biosecurity. Two important concepts should guide decision-making around movement between low and high biosecurity zones.

1. Only staff or equipment that absolutely need to be in the high biosecurity zone should go into this zone.
2. Crossing from a low biosecurity zone to a high biosecurity zone requires compliance with a protocol (such as washing and gloving). Individuals who cross back to the low biosecurity zone for any time are required to go through the same protocol again.

While these measures may create a point of resistance amongst staff, clients and other visitors, becoming comfortable with them is an important part of managing infectious disease risk.



High and low biosecurity zones are shown in red and yellow respectively.
Boundary fence is shown as a solid black line.

Figure 6 Example feedlot map with biosecurity zones labelled

2 Management of cattle and cattle products

2.1 Newly introduced cattle

'Newly introduced cattle' refers to animals arriving at a facility or a new section of the facility. Introduction of new animals is a high-risk transmission pathway. Animals may be infected before or during their transportation to a facility. In systems that do not practice 'all in/all out', newly introduced animals should undergo a period of quarantine. Quarantine is when new animals are kept physically separate from other animals for a set period. For FMD and LSD, newly introduced animals should be quarantined for 14 days. In most facilities in Indonesia, 14 days of quarantine is mandatory. Some animals may complete a quarantine period in a separate facility or in a dedicated area of the facility they are being introduced to.

Animals can become infected with a disease during their transportation

Each facility should undergo an assessment to determine the most suitable location to house quarantine animals. The assessment will consider the available infrastructure, biosecurity measures currently implemented and vaccination coverage of animals already present.

Animals in quarantine should be managed by a dedicated team of staff who do not interact with other animals in the facility. This prevents the creation of a high-risk transmission pathway. If this is not

possible, biosecurity measures should be implemented to manage the risk of this transmission pathway. For example, quarantined animals should be tended to after other animals and staff should be required to present in freshly laundered clothes each morning. Separate equipment should be used to feed and water these animals and different clothing should be worn when interacting with them (see 3.3 for more information).

If the facility is large and animal groups are moved to different areas periodically, the animal health status of any animal being moved should be checked before movement. Animal movements should follow a path that reduces the risk of introducing disease to animals already in that area of the facility.

Error! Reference source not found. lists the key actions to manage the risk of transmission pathways along the supply chain. Depending on the features, infrastructure and workforce capacity, these practices can be tailored to each facility. In addition, the AH&W manual contains more detailed information on vaccination and LSD-specific parasite control protocols.

Table 4 Biosecurity practices for newly arriving animals

Transport includes shipping, disembarkation and transport to feedlot. Feedlot includes feedlot induction through to fattening. Finishing refers to feedlot finishing. Abattoir refers to transport through to slaughter. This table will be tailored for individual participating facilities depending on the components of the supply chain involved.

Biosecurity Practice	Transport	Feedlot+	Finishing+	Abattoir
Confirm animal health status				
Confirm identity of animals*	✓	✓	✓	✓
Confirm vaccination status and parasite treatment**	✓	✓		
Identify any sick animals and remove from the group	✓	✓	✓	✓
Check condition of hides (LSD)	✓	✓	✓	
Check for lameness and drooling (FMD)	✓	✓	✓	✓
Transportation – have there been any FMD or LSD outbreaks (in the last 4 weeks) along the transport route?	✓	✓		✓
Quarantine animals				
Keep animals physically separate from 'free-roaming' animals (fencing)		✓	✓	✓
Keep animals separate from other animal groups at the site		✓	✓	✓
Tend to these animals last		✓	✓	✓
Use separate feed and watering equipment for each group		✓	✓	
Use separate clothing for each group	✓	✓	✓	
Personnel should move through the site from high biosecurity areas to low biosecurity areas		✓	✓	✓
When animals leave the quarantine area it should be thoroughly cleaned and disinfected		✓	✓	✓
Record keeping				
Animal health status	✓	✓	✓	✓
Animal health treatments		✓	✓	✓
Personnel, visitor and animal movements and tasks	✓	✓	✓	✓

*Animals should be identifiable by unique identifies such as RFID tags or rumen boluses and ear tags; **Refer to the AH&W manual for specific protocols; +a breeding facility may separate these classifications into 'bulls and non-pregnant animals' and 'pregnant animals'

2.2 Community vaccination

Presence of local livestock within a certain radius of a facility[3] and livestock owned by staff can create a transmission pathway for disease introduction. This risk can be managed through provision of FMD and LSD vaccinations to livestock in nearby villages and livestock owned by staff (if they reside elsewhere).

2.3 Livestock husbandry and management

All animals should undergo daily inspections by personnel trained in animal health and husbandry. Animals of the highest value should be inspected first. Animals should be examined for signs of:

- lameness (generalised, or foot stamping or shifting weight)
- excessive salivation/drooling
- reduced feed intake
- recumbency and reluctance to move
- depression or dull mentation
- obvious blisters or erosion on the mouth (dental pad or tongue), nasal plane, teats or feet
- lumps on the hide
- scabs on the hide
- generalised swelling on the head or neck
- nasal discharge
- difficulty breathing.

Any animal identified as unwell (but not showing clinical signs of FMD) should immediately be removed from the pen and placed in isolation (i.e. hospital pen). As FMD is highly infectious prior to clinical signs appearing, there may be little value in moving animals with FMD to a hospital pen and this movement in itself could create a transmission pathway to animals in other areas of the facility. If clinical signs of FMD or LSD are detected, it should be reported to management as soon as possible. Refer to the ERP manual for further instructions on protocols to be implemented in the event of an FMD or LSD outbreak in a facility.

Animals in the hospital pens should be attended to by staff dedicated to the hospital animals, i.e. the staff do not interact with the general livestock population of the facility. If this is not possible, these animals should be attended to last and strict biosecurity and hygiene measures should be implemented. The hospital pen should be considered a low biosecurity zone. Where possible, clean clothing or coveralls should be applied before entering the hospital areas and any outer clothing worn in these areas be removed before exiting. If the amenities are available, clothing should be laundered onsite. All feed, watering and animal health equipment should remain in the hospital areas and be regularly cleaned of any organic material and disinfected (see 3.3 for more information).

[3] The radius will be determined for each facility based on a facility-specific risk assessment, which will define the Appropriate Level of Protection (ALOP).

Managing cattle and cattle products (e.g. manure and carcasses) in an environmentally safe way is a critical component of maintaining a biosecure site, protecting the animals onsite and those in neighbouring villages.

2.4 Disposal following slaughter/euthanasia/humane slaughter

Decision trees for humane euthanasia/slaughter are presented in the AH&W and ERP manuals.

Carcasses should be removed from transport vehicles and pens in a way that reduces the risk of contamination of the facility. Dragging bodies from pens to the disposal site is not recommended, as bodily fluids will be spread throughout the site. Instead, machinery (loader or carry-all) that can scoop up the carcasses is best practice. There needs to be easy access for vehicles to move between the pens and the disposal site, but access to the disposal site should be restricted.

There are three main methods of disposal – burial, burning or composting. See Appendix B for a list of considerations when selecting a disposal method/site. Disposal sites must be secured with fencing that prevents wildlife or free-roaming animals from accessing the carcasses. Not every site will have the space or infrastructure required to dispose of carcasses, especially if the number of carcasses needing disposal increases significantly during a major outbreak. For sites where disposing of numerous carcasses safely is unlikely to be practical, an alternative solution should be identified in advance.

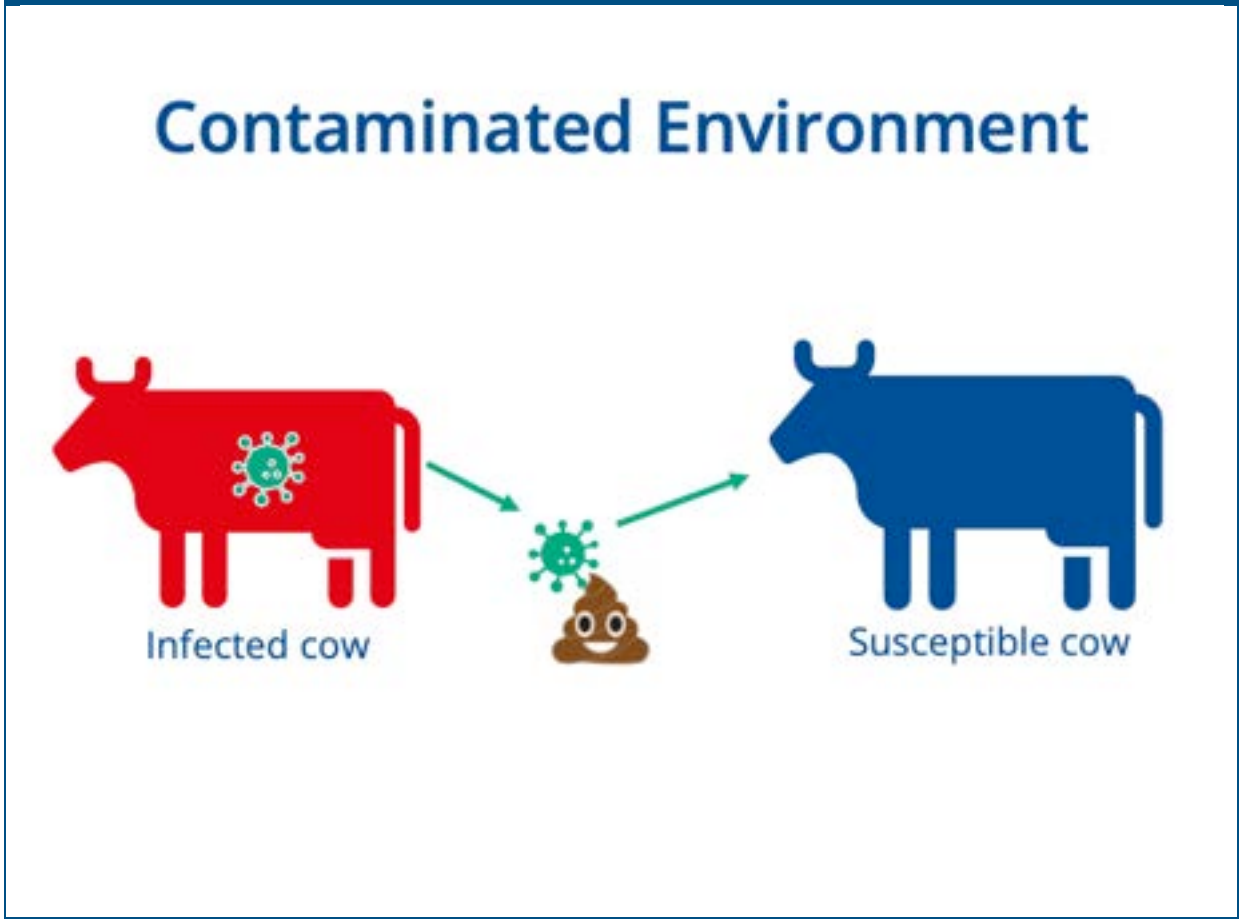
Burning cattle carcasses is very difficult (they are > 80% water) and requires an enormous amount of energy in the form of fuel, wood or electricity. As a result, it is very unlikely to be practical unless rendering capacity is available.

Disposal should occur promptly after carcasses are found, as many diseases can still be spread from dead animals. Any wastewater used to clean an area after carcass removal should be kept away from stock; if recycled, it should not be used to water animals or pens. It should not be allowed to drain off or leach out into areas of the site or surrounding areas as this can introduce disease to animals within the facility and neighbouring villages. Similarly, water containing chemicals for disinfection should not be allowed to contaminate water or crops. If composting of manure is being used, excessive disinfectant can slow or stop the composting process.

2.5 Manure and effluent management

Effluent and manure can be a source of disease. Manure and effluent management should aim to move products from animal pens in a way that does not risk contamination of other pens or 'clean' areas. Manure and effluent/wastewater from hospital or quarantine pens should not pass through the regular pens.

Effluent and manure can be a source of disease



Effluent and wastewater management may be difficult to improve as many infrastructural components are in-built/permanent. Facility managers must be aware of the transmission pathways that result from inadequate wastewater and effluent management. Effluent and sediment ponds, if present, should be in an area that will not be impacted by flooding and should not be located near any feed storage areas.

If manure is stockpiled, the pile should be located away from the animal pens and feed storage facilities. If visitors come to the facility to collect manure, their entry access must be controlled (see 3). Access by visitors should ideally be by the most direct route that does not cross paths with any animals in pens. High-value animals should be housed as far as possible from the manure piles and visitor access routes.

Any machinery used to move manure must be thoroughly decontaminated after use if it is to be used for any other purpose on the site. Machinery used for manure management and moving carcasses should never be used for feed.

2.6 Management of cattle at an abattoir

Abattoirs are a special case for management of animals affected by FMD or LSD. In the absence of vaccination, abattoirs may become a point of concentration for disease. Where vaccination is practiced, it is unlikely that cases will be seen amongst vaccinated cattle, although transport stress may influence this.

As abattoirs may be receiving animals from different sources, animal movements within the site should be kept to a minimum. Records should be kept, including where animals came from and where in the

abattoir they were held. Animals from different origins/consignments should not be mixed if they are to be held in lairage for more than three days. All pens should be thoroughly decontaminated after use (cleaned and disinfected).

If animals start to show clinical signs of FMD or LSD in lairage, slaughter should commence as soon as possible. It is likely that these animals will have already infected other livestock. In this situation the abattoir should continue to slaughter all animals in the lairage before buying any new cattle. After the last animal has been slaughtered, full decontamination will prevent new arrivals from becoming infected.

Abattoir staff are likely to be exposed to FMD virus and LSD in bodily fluids and excretions if infected animals are being slaughtered. Staff who have their own livestock or live near these livestock should take precautions to clean thoroughly and change into clean clothes before returning home.

Carcasses of animals that die naturally or were euthanised but cannot enter the food chain should not enter any areas of the abattoir that process carcasses for human consumption. The standards for the production of meat for human consumption are detailed in the Guideline Standards for Operational Procedures for Processing Livestock Products (Meat) (*Pedoman Standar Prosedur Operasional Pengolahan Hasil Peternakan (Daging)* in Bahasa). However, in summary and in relation to disease control, key points include:

- Condemned carcass parts should be safely disposed of without contaminating other products in the abattoir.
- Dedicated 'condemned material' waste containers can be used to collect the parts and should be emptied and decontaminated regularly.
- Condemned material can be disposed of the same way as carcasses – by burial, burning or composting. Personnel responsible for emptying and disinfecting these containers must follow strict biosecurity and hygiene procedures.
- Clothing and equipment used when processing carcasses should not be worn when emptying these containers. Clean clothing should be worn when re-entering the processing areas of the abattoir.

In an abattoir, the manure from holding pens should not be moved near or past any part of the site used to slaughter and process animals. Wastewater should drain from the meat processing (clean) areas to the slaughtering floor to other areas of the site.

3 Zones, people, vehicles and equipment

Where possible, unnecessary movements of people and vehicles onto the site should be limited. The number of people interacting with animals should be restricted to those responsible for care and feeding. In feedlots and breeding facilities, the movement of people, vehicles or equipment should follow a biosecurity gradient from low biosecurity zones to high biosecurity zones. In abattoirs, animals most at risk of disease should be dealt with/slaughtered first to reduce the risk of their condition deteriorating and infecting other animals. Equipment should be decontaminated before being used for other animals.

Signage should be used throughout the facility, in the relevant languages and with corresponding images.

3.1 Entry/exit points and vehicles

Entry and exit points should be designed to ensure sites can monitor the vehicles entering and control the areas that vehicles have access to. There should be a dedicated carpark for staff and visitors at the facility's entry and not near any livestock pens.

Vehicles can be a source of disease. Only vehicles that must enter the feedlot should be allowed entry; other vehicles are recommended to unload at the gate.

Vehicles can be a source of disease

The site office should be located at the site's entry to ensure vehicles and individuals entering can be monitored. Records of vehicles and people entering, including the reason for their visit, location of origin, areas of the site they will have access to, and time of departure, should all be recorded (see Table C.2 for an example of a visitor/vehicle log).

Washdown bays or similar infrastructure[4] that allow decontamination of vehicles should be located at the entry to each site. Run-off from these should be prevented from spreading within the facility. Any 'outside' vehicles and site vehicles taken offsite must be inspected and passed through the washdown bays before entering the site. Where possible, facility vehicles should be dedicated to the facility and not taken

[4] This can include normal hoses and scrubbing implements such as long-handled utility/scrubbing brushes as the goal is to remove all organic material from the vehicle before disinfectant is applied. High-pressure hoses are not recommended due to the increased risk of virus particles being aerosolised.

offsite. Vehicles should pass through the washdown bays when exiting the site to ensure they do not take any potential contaminants into the neighbouring areas.

'Outside' vehicles should not be allowed access to the feedlot pens – they should only have access to the quarantine pens, feed storage or manure stockpiles. Any outside vehicle requiring entry must have wheels and undercarriage inspected before entry and have any organic matter, including plant material and mud removed, and a disinfectant applied, if necessary, before entry. Vehicles entering with new livestock should be unloaded away from other animals. Ideally, unloading ramps will be located close to the entry point. If this is not possible, facilities should aim to have animals safely unloaded away from high-value animals.

If vehicles deliver feed or other commodities, the drop-off zone should not be near feedlot pens. Vehicles collecting animals for the abattoir should be inspected and found to be thoroughly decontaminated (have all organic material removed from the truck bed, undercarriage and wheels and a disinfectant applied) before entry. Ideally, the collection point for these animals is away from other high-value animals.

3.2 Staff and visitors

People can carry pathogens even when they are not susceptible to the disease. Anyone entering a facility should be recorded and the risk associated with their entry assessed (see Appendix C). Any non-rostered staff entering should be recorded in the visitor log. If the risk associated with a staff member's entry is assessed as high, they should not be able to access areas with animals. If the risk associated with a visitor's entry is assessed as high, they should not be able to access the facility at all, on that occasion. There should be a clearly defined list of items prohibited from being brought onsite, including animal-based products such as meat and dairy (this will be tailored for individual facilities).

People can carry pathogens even when they are not susceptible to a disease

Once access is granted, new staff and visitors should immediately undergo a detailed biosecurity induction that explains low and high biosecurity zones and how to move between them (if that movement is necessary). Anyone entering the facility should be wearing clean clothing, such as coveralls and boots, which is removed at the end of the shift or visit and laundered onsite if possible. If someone is required to move from a low biosecurity zone to a high biosecurity zone, they must apply new coveralls and boots, and preferably shower before entering the high biosecurity area.

Footbath and handwashing stations should be located at numerous points within the site, particularly when moving into high biosecurity zones. Footbath stations should include a footbath with detergent to

remove organic material, a hose to rinse the shoes and a footbath with a suitable disinfectant. Handwashing stations should include soap and a scrubbing brush. Individuals must be educated on the importance of maintaining these to ensure their effectiveness.

When staff and families live onsite, they should change into clean clothes whenever they leave the site with the intention of travelling somewhere with livestock or livestock products (e.g a market). If they encounter livestock or livestock products when outside the site, they should change their clothes before returning to the site.

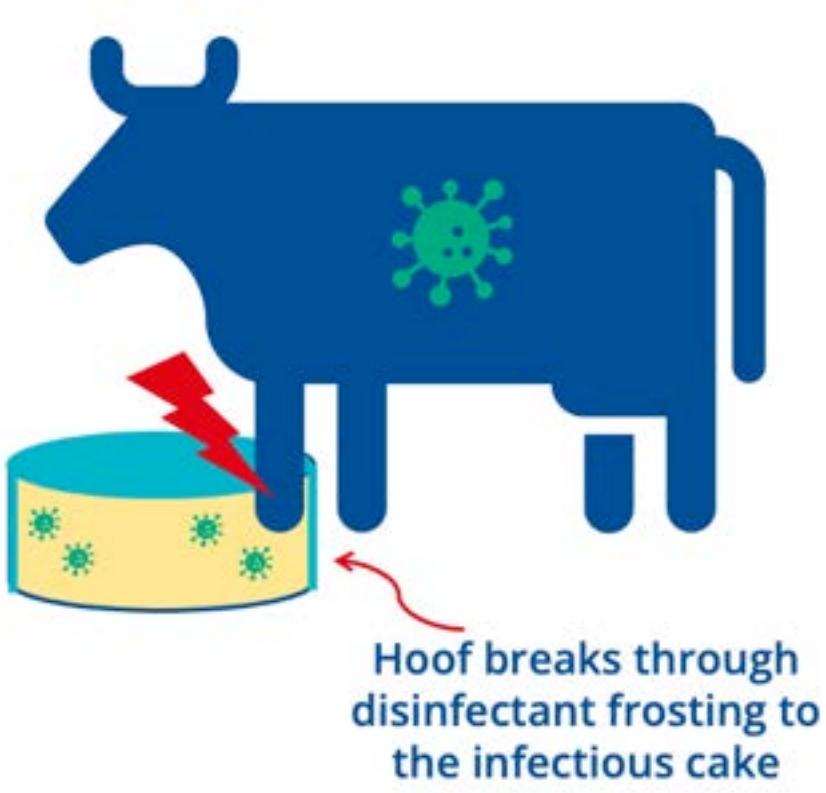
In abattoirs, appropriate work practices are outlined in the Guideline Standards for Operational Procedures for Processing Livestock Products (Meat). In summary, all staff should undergo training to understand the importance of handwashing and personal hygiene (recently showered, freshly laundered clothes and clean footwear) to prevent the spread of contaminants in other areas of the facility, as well as preventing them from introducing contaminants from outside the facility, or taking contaminants out of the facility. Clothing or coveralls should be provided for staff and visitors and laundered onsite.

3.3 Equipment

Different areas should have dedicated colour-coded equipment, including clothing (coveralls and boots), where possible. If it is not possible to buy items of different colours, using a basic base colour (e.g. black or navy) and then using different coloured swatches sewn on or tape applied to equipment can be a solution. The colours should be bright and highlight the biosecurity level of the zone. For example, clothing and equipment used in the low biosecurity zone could be coded with red. If it is not possible to do this, efforts should be made to ensure high biosecurity zones have dedicated equipment and any equipment that is shared between different zones is decontaminated after use.

Decontamination refers to the thorough cleaning and use of a suitable disinfectant. Disinfecting without decontamination is not effective as disinfection will only kill pathogens located on the surface of the organic material, much like changing the frosting on a cake. It will not change the inside of the cake.

Disinfection without cleaning is like cleaning the frosting on a cake



All equipment, including machinery, storage containers and tools, should be regularly cleaned of organic material and disinfected with a product that has been listed as effective against the pathogen of interest. In addition, equipment should be stored in a location that reduces the risk of contamination when not in use.

3.4 Management of high biosecurity zones

Entry of vehicles, people and animals is critical to maintaining business continuity in intensive cattle facilities. The risk associated with these transmission pathways can be managed by limiting access to high biosecurity zones. Good management of these zones has the potential to reduce the ongoing expenditure on disinfection. This may require changes in procedure and facility layout. An early goal is to create a map of the facility (see 1.1) and consider creating high biosecurity zones (if these don't already exist). Often a clear marker of the zone (gates, fences, markings on the roads) helps to improve compliance

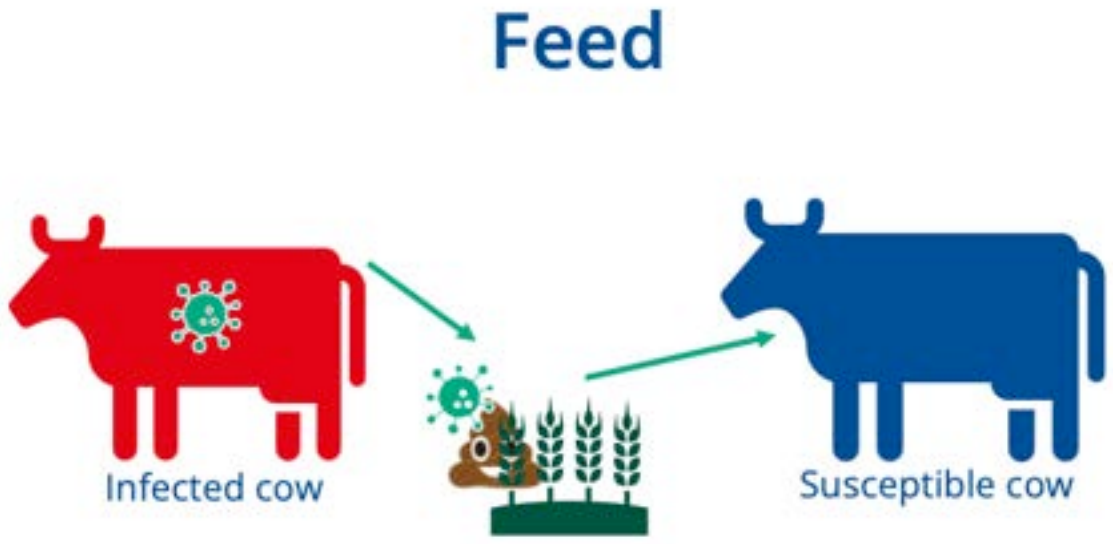
For example, if the only vehicles that go into animal pens are roto-mixer trucks and cleaning equipment, and these vehicles never cross over roads that bring feed, forage and other materials, the risk associated with this transmission pathway is reduced. Similarly, if the trucks delivering cattle to quarantine pens never have to drive any closer to the pens than an unloading ramp, and the drivers do not leave the vehicles while in the high biosecurity zone, the risk associated with this transmission pathway is reduced.

4 Input management

4.1 Feed

Feed should be sourced from a reliable and safe provider[5] – they should have evidence of an implemented biosecurity plan. Feed can be a source of disease. Ideally, stock feed providers should keep records of chemical treatments applied to feed products and guarantee that stock feed does not contain any Restricted Animal Material[6].

Feed can be a source of disease'



Feed should be stored in a safe and secure location. Access should be restricted to staff involved in feeding animals. If feed is brought in by contractors, vehicles (especially wheels and undercarriage) should

[5] 'Safe provider' or 'safe sources' refers to suppliers who implement their own biosecurity plans to ensure feed, water or bedding is not contaminated or posing a disease transmission risk. For example, a provider who is currently located in an outbreak area would not be classed as a safe provider for the duration of the outbreak. A provider that supplies spoiled feed or bedding with insect or vermin contamination would not be classed as a safe provider.

[6] Restricted Animal Material refers to any material taken from a vertebrate animal, excluding gelatin, milk products, oils extracted from fish, mineralised sea bird guano, treated tallow or treated cooking oil

be cleaned before entering the site. The feed drop zone should be located away from the animal pens and outside the high biosecurity zone.

Staff involved in feeding animals should be trained and be aware of the risks to cattle if feed is contaminated with chemicals that might be present onsite. Soiled or waste feed should be regularly removed from the feed bunks to discourage insects from breeding.

Equipment used for feeding must be regularly decontaminated. Machinery for feeding, ideally, is not used for other purposes on the site.

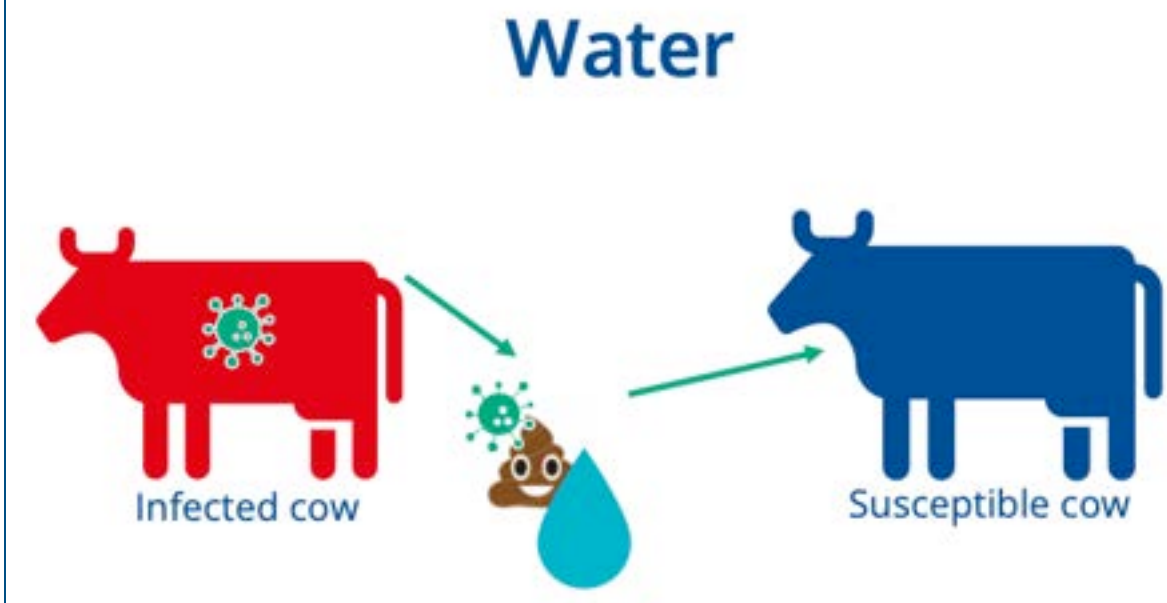
Wastewater must be managed so there is minimal risk of contaminating feed. Wastewater or run-off from the feed areas must be managed to ensure it does not contaminate the surrounding surface or groundwater.

4.2 Water

Water should be sourced from 'safe' sources – it should be free of faeces from birds or other animals and any other organic material such as leaf litter or mud. Water can be a source of disease. If the water's safety status is not guaranteed, then it should be treated before use. If water is treated, then the process and quality should be regularly monitored – records should be kept of any processes and chemicals used.

Any water being used at an abattoir should be of a high quality to meet food safety standards.

Water can be a source of disease



4.3 Bedding material

The goal of good bedding material biosecurity is to reduce the risk of disease from the introduction and movement of bedding material to the facility.

Bedding should be sourced from safe providers[5] and be suitable for facility's the infrastructure and climatic conditions. Bedding material should be kept clean and dry and replaced once soiled. If clean bedding is stored onsite, it should be stored in a dry location with good vermin control.

Sand is a good substrate as it does not promote the growth of pathogens. Fine-grain sand, or sand mixed with a lot of manure will hold too much moisture and pathogens will grow. Too coarse a grain will be uncomfortable for the cows. Sand can be difficult to remove from manure if manure is collected for other purposes.

Sawdust and wood shavings are a suitable substrate. They can be broken down by microorganisms, so can be included in manure sold as compost. However, they can also promote the growth of pathogens so the bedding needs to be removed and changed before this occurs.

Straw composts in manure better than sawdust and wood shavings and is quite comfortable for animals. As with sawdust and wood shavings, it needs to be removed and replaced before pathogens start to grow.

When bedding is removed from pens, it should be removed in the same manner as manure to reduce the risk of disease introduction to other pens.

4.4 Medications and treatment materials

Medications and treatments should be supplied by a reputable provider and stored safely and securely. Access should be restricted to those individuals who are responsible for treating animals. Administering staff should be educated about the importance of withholding periods associated with certain treatments and how this can impact food safety. Antimicrobials should be used with consideration of antimicrobial stewardship and withholding periods.

5 Proximity management

5.1 Neighbouring village livestock

The facility should be separated from neighbouring villages and free-roaming livestock species by perimeter fencing that is regularly maintained. The pens should be located at a distance from the perimeter fence, preventing facility animals and external animals or people from having direct contact. Site entry points must be secured by gates that prevent entry by external livestock.

Ideally, a feedlot or breeding facility does not have other intensive livestock farming facilities nearby. However, if there are, special consideration of animal health and biosecurity protocols is required. For example, if intensive piggeries are located nearby, the potential risk of FMD introduction is increased, especially because the FMD virus replicates very well in pigs. Goats and sheep can also host FMD and other cattle pathogens.

If staff are returning to neighbouring villages after work or they own livestock, they should undergo decontamination, including showering and changing into clean shoes and clothes, before leaving.

5.2 Feral and wild animal management

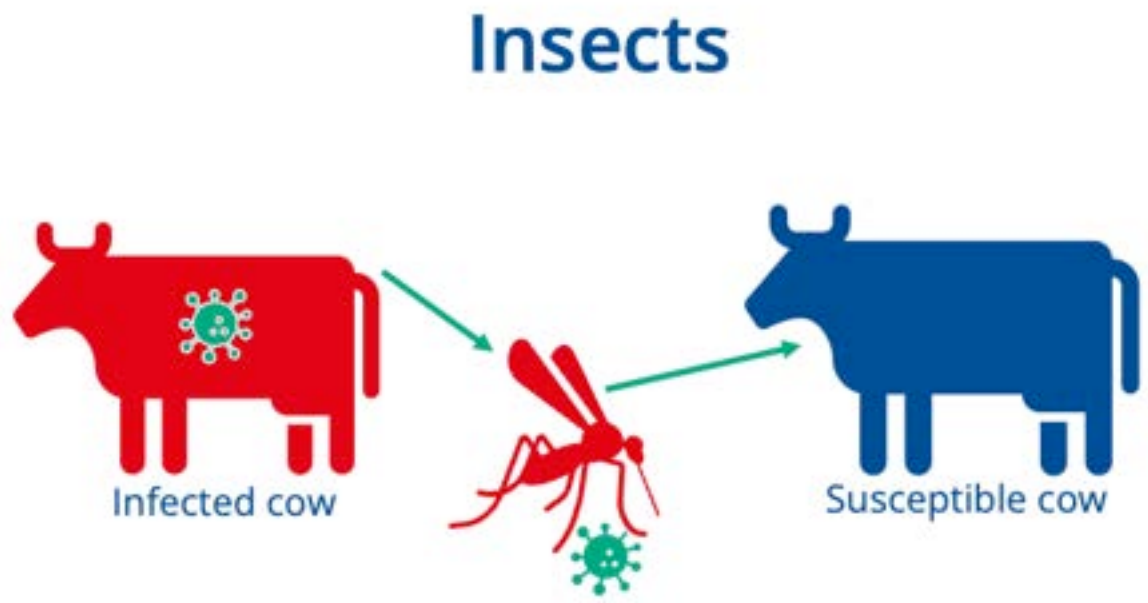
Unmanaged domestic and wild animals (including birds) can create transmission pathways. Some wild animals, such as birds and monkeys, are not easily excluded by fencing and can carry disease. Once they have access to facilities, they may be able to contaminate water and feed sources and move between pens of animals.

Ensuring feed is securely housed and inaccessible to wild animals can reduce their opportunity and desire to enter a facility. Feed waste should be disposed of away from animal pens, such as in a composting pit and in a way that does not promote insect breeding. Water sources should be adequately protected, and the facility should have the infrastructure required to treat water if wildlife faeces can easily contaminate it. The facility should have a wild animal management plan. This may differ depending on the most problematic wild animal species.

5.3 Pest and vector management

Many diseases can be transmitted by vectors and pests. LSD is primarily transmitted by biting insects; therefore, controlling these is critical to managing the risk associated with this transmission pathway. A high biting insect burden can also negatively impact the productivity of cattle. The AH&W manual will outline the animal treatments to assist with insect control for the cattle.

LSD is primarily transmitted by biting insects



Vector and pest management is also important for protecting the health of staff.

All pest and vector management strategies should focus on reducing environmental impact; minimal chemical control should be used. However, cats are not recommended for vermin control – they can move freely between animal groups and act as a disease carriers themselves.

Integrated pest management (IPM) is the concept that combines different control methods in an overall program. It is generally more successful than chemical control programs alone. The basic concepts of IPM are:

- reducing fly breeding sites as much as possible
- reducing mosquito breeding sites as much as possible (e.g. open water) – water troughs should be emptied, cleaned and refilled regularly to prevent larvae from maturing to adult mosquitoes
- using insecticides selectively and rotating to prevent the development of resistance
- adopting a feedlot design that is unfavourable to high insect populations, such as having limited areas that allow the collection of damp organic material
- enhancing populations of biological control agents such as parasitic wasps (*Spalangia endius*)
- systematically monitoring fly populations.

These strategies can be tailored to each facility. See Appendix D for more information on IPM.

5.4 Security

Security measures such as enhanced perimeter fencing (e.g. electrified if legally permitted) and lockable gates can reduce the probability of unauthorised visitors. After-hours premises monitoring, with staff adequately trained in biosecurity, can improve security without compromising the biosecurity of a facility. Guard dogs are not recommended as they can carry disease. Security cameras are unlikely to prevent unauthorised visitors but may act as a mild deterrent and provide evidence of unauthorised entry.

6 Record keeping

Records are critical to identifying the sources of an outbreak and tracking the spread of an outbreak beyond the facility (trace-back and trace-forward). Record keeping should be integrated into every biosecurity practice discussed in this manual.

6.1 Management of cattle and cattle products

Record keeping should begin when the animals disembark from the boats (or truck if local cattle). Incoming consignments should include information on the property of origin, any health events during transit and previous animal health treatments.

Daily inspections should be recorded for each pen, and if an animal is transferred to the hospital pens, the reasons why and any treatments received should be documented. Animal movements within a site should be recorded. If animals are found dead or euthanised, this information should be recorded, including a suspected diagnosis if a post-mortem is conducted or obvious clinical signs are present. Methods of disposal should also be recorded.

Manure and effluent management should have associated records. This may include dates it was removed from pens, any treatments applied, when and where it was sold to, and who collected the manure (what part of the facility they have access to and whether they own or work with livestock). If there are any adverse weather events, such as flooding or monsoonal winds, this information should also be recorded, as it may result in the spread of manure beyond the stockpile site.

6.2 People, vehicles and equipment

Visitor and staff logs should be maintained, including parts of the site they accessed. QR (quick response) codes can help record who is accessing what zones and where visitors have been prior.

Information should be collected on whether staff or visitors own or have recently interacted with livestock, or if they been to an area with an active FMD or LSD outbreak (see Appendix C).

Vehicle movements should be recorded, especially movements on and off the site. A register should be kept of each vehicle or piece of machinery, their uses and when they are decontaminated.

6.3 Input management

Records should be kept regarding any products brought into a facility. Feed, water and bedding sources, and any associated treatments, should be recorded. Any adverse events, such as vermin or pest contamination, should be recorded.

Contractors entering the facilities to deliver any of these inputs, or who are involved in construction, should be recorded as outlined above in ‘people, vehicles and equipment’.

6.4 Facility proximity management

Records should be maintained for any perimeter issues, such as perimeter breakdowns and maintenance. Any unmanaged or free-roaming livestock entering the facility should be recorded, including where they gained access.

Any evidence of pest or vermin access to feed or bedding should be recorded, along with any control methods. This is especially important for any chemicals that are used.

7 Contacts and resources

7.1 Key contacts

Key contacts for each facility should be listed here.

7.2 Key resources

- Farm Biosecurity:
  https://www.farmbiosecurity.com.au/toolkit/
- Better On-farm Biosecurity (Animal Health Australia):
  https://animalhealthaustralia.com.au/better-on-farm-biosecurity/
- Veterinary personal biosecurity and personal protective equipment (Australian Veterinary Association):
  https://www.ava.com.au/library-resources/other-resources/veterinary-personal-biosecurity/
- National Biosecurity Manual for Beef Cattle Feedlots:
  https://www.farmbiosecurity.com.au/wp-content/uploads/2019/03/National-Biosecurity-Manual-for-Beef-Cattle-Feedlots1.pdf
- AUSVETPLAN FMD Manual:
  https://animalhealthaustralia.com.au/download/1641/
- AUSVETPLAN LSD Manual:
  https://animalhealthaustralia.com.au/download/1653/
- AUSVETPLAN Disposal Manual:
  https://animalhealthaustralia.com.au/download/9130/
- AUSVETPLAN Beef Cattle Feedlots Manual:
  https://animalhealthaustralia.com.au/download/5599/
- AUSVETPLAN Meat Processing Manual:
  https://animalhealthaustralia.com.au/download/1747/
- Bedding options for dairy cows
  https://ag.umass.edu/sites/ag.umass.edu/files/fact-sheets/pdf/BeddingOptionsforDairyCows%2811-48%29.pdf
- Pedoman Standar Prosedur Operasional Pengolahan Hasil Peternakan (Daging)
  http://repository.pertanian.go.id/handle/123456789/17266
- Mad Cow information – Bahasa
  https://karantina.pertanian.go.id/files/Sapi%20Gila.pdf

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Appendix A Facility risk assessment

Below is an example of a facility risk assessment – this is available as an excel worksheet. It can be amended and updated regularly as biosecurity practices change. It is recommended that it is reviewed annually at a minimum.

Item	Standard	Standard met (Y/N)	Biosecurity priority level	Likelihood of disease incursion occurring	Risk
Site location					
1.1	The nearest abattoir is >5km away.		High	Very likely	High
1.2	The nearest large unvaccinated group of cattle and small ruminants (~4000 head +) is >10km away.		High	Likely	Medium-high
1.3	The nearest medium unvaccinated group of cattle and small ruminants (100–4000 head) is >5km away.		High	Very likely	High
1.4	The nearest small group of unvaccinated cattle and small ruminants (100 or less) is >1km away.		High	Very likely	High
1.5	The nearest unvaccinated piggery is >6km away.		High	Likely	Medium-high
1.6	The nearest smallholding of unvaccinated pigs (<100) is >1km away.		High	Very likely	High
Site facilities					
2.1	The facility has capacity to implement 'all in/all out'[1] or an alternative equivalent system. Ideally the whole site should be depopulated and decontaminated with integrated pest management activities focussing on removing insect breeding sites. There should then be a 50-day wait before induction.		High	Likely	Medium-high
2.2	There is a dedicated hospital for sick animals that is clearly separated from other pens and has effluent run-off directed away from pens and other animals.		High	Very likely	High

Item	Standard	Standard met (Y/N)	Biosecurity priority level	Likelihood of disease incursion occurring	Risk
2.3	Pens are located away from perimeter fencing, and perimeter fencing effectively prevents feral animals from contacting feedlot animals.		High	Very likely	High
2.4	Insect vector breeding sites can be kept to a minimum.		Moderate	Likely	Medium-high
2.5	Dedicated facilities for induction/vaccination (i.e. race, crush).		High	Likely	Medium-high
2.6	Footbath and handwashing stations are located at the facility entry/exit and within the facility.		Moderate	Likely	Medium-high
2.7	Facilities to clean and disinfect equipment.		Moderate	Very likely	High
2.8	Clothing laundry facilities and provision of clean clothing/boots to staff and visitors.		Moderate	Likely	Medium-high
2.9	Facilities for decontamination of staff after managing sick animals.		Moderate	Very likely	High
2.10	There is dedicated clothing and equipment for each area of the facility.		Moderate	Very likely	High
2.11	Washdown bays are located at the site entry and every incoming car must use them before entering.		High	Very likely	High
2.12	Cold-chain infrastructure is present and maintained.		High	Possible	Medium-high
Site access					
3.1	There is only one access for entry and exit onto the site (including dedicated loading area) and all visitors report to site office on arrival.		Moderate	Likely	Medium-high
3.2	Parking area is located away from feedlot pens at the edge of the site and vehicles do not enter the feedlot site.		Moderate	Likely	Medium-high

Item	Standard	Standard met (Y/N)	Biosecurity priority level	Likelihood of disease incursion occurring	Risk
3.3	Site office is located next to site entry.		Moderate	Possible	Medium-high
3.4	Feedlot access can be restricted to necessary personnel only (people and vehicles).		Moderate	Very likely	High
3.5	Entry of all staff and visitors to the site can be documented.		Moderate	Likely	Medium-high
3.6	Staff and visitors complete a biosecurity risk assessment to determine access.		High	Likely	Medium-high
3.7	All visitors undergo a biosecurity induction before entry is granted.		Moderate	Possible	Medium-high
3.8	All food waste is disposed of in scavenger-proof bins.		Moderate	Possible	Medium-high
3.9	Access to hospital pens is restricted to authorised staff only.		High	Likely	Medium-high
3.10	Outside vehicles are not allowed access to feedlot pens.		High	Likely	Medium-high
3.11	If feedlot vehicles leave the premises they must undergo thorough cleaning and disinfection before re-entry.		High	Likely	Medium-high
3.12	Delivery vehicles are provided with a direct route to their drop point but do not pass feedlot pens.		High	Likely	Medium-high
Transport and management of new animals					
4.1	Transport route to site from port can avoid any FMD or LSD outbreaks.		High	Likely	Medium-high

Item	Standard	Standard met (Y/N)	Biosecurity priority level	Likelihood of disease incursion occurring	Risk
4.2	There are dedicated transportation vehicles between port and facility with appropriate access to decontamination facilities.		High	Very likely	High
4.3	Animals are vaccinated for FMD and LSD on arrival.		High	Very likely	High
4.4	Animals are given parasite treatments in line with the Integrated Pest Management Protocol.		Moderate	Very likely	High
4.5	Condition of hides is checked (LSD) – animals with damaged hides are removed from group.		High	Very likely	High
4.6	Animals are checked for lameness and drooling (FMD) – any animals showing signs are removed from the group.		High	Very likely	High
4.7	Animals are kept physically separate from 'free-roaming' animals (by fencing) for 14 days after arrival.		High	Likely	Medium-high
4.8	Animals are kept separate from other animal groups at the site for 14 days.		Moderate	Likely	Medium-high
4.9	Animals are tended to based on their biosecurity risk to other animals***.		High	Likely	Medium-high
4.10	Separate feed and watering equipment for quarantine or hospital animals to other groups.		High	Likely	Medium-high
4.11	Separate clothing is used for these quarantine and hospital animals.		High	Likely	Medium-high
4.12	The quarantine area is thoroughly cleaned and disinfected when these animals leave/are moved.		High	Possible	Medium-high
Waste management					
5.1	Manure stockpiles and effluent ponds are located away from feedlot pens.		High	Very likely	High
5.2	Wastewater/effluent drainage is controlled so effluent from FMD-affected pens does not travel past high-value animals.		Moderate	Very likely	High

Item	Standard	Standard met (Y/N)	Biosecurity priority level	Likelihood of disease incursion occurring	Risk
5.3	Access paths to manure stockpile or effluent ponds should not pass by feedlot pens.		Moderate	Likely	Medium-high
5.4	Burial or composting pits should not allow wastewater or fluids to leach out into the environment.		Low	Possible	Medium-high
5.5	Burial pits or composting sites are adequately fenced to prevent wild animals scavenging.		Low	Possible	Medium-high
5.6	Dead animals are removed from pens with machinery.		Moderate	Likely	Medium-high
5.7	Machinery is cleaned after carcass or manure removal.		High	Likely	Medium-high
Food, bedding, water and medications					
6.1	Bedding and feed are stored in a location free from vermin and insects, and are kept dry.		Moderate	Possible	Medium-high
6.2	Bedding is available from a reliable source.		Moderate	Likely	Medium-high
6.3	Feed is available from a reliable provider.		Moderate	Likely	Medium-high
6.4	Water sources are protected from contamination from bird or other wild animal faeces and other organic material.		Moderate	Possible	Medium-high
6.5	Water is sourced from a 'safe' source (free of contaminants) or water treatment is available onsite.		Moderate	Possible	Medium-high
6.6	Medications (including vaccines) are purchased from reputable sources.		Moderate	Likely	Medium-high

Item	Standard	Standard met (Y/N)	Biosecurity priority level	Likelihood of disease incursion occurring	Risk
Staff training					
7.1	Staff are trained in vaccine handling and administration to prevent vaccine failure and iatrogenic disease spread.		High	Likely	Medium-high
7.2	There are dedicated feed and bedding providers and transporters that have been trained in biosecurity measures.		Moderate	Likely	Medium-high
General livestock husbandry					
8.1	Animals in pens are checked every 4–5hrs for signs of lameness and general illness.		Moderate	Likely	Medium-high
8.2	Sick animals are identified and removed from the group.		High	Very likely	High
8.3	Staff undergo decontamination procedure after dealing with sick animals.		High	Very likely	High
Pest and vector management					
9.1	An integrated pest management plan is implemented (LSD).		High	Very likely	High
9.2	Fly breeding sites are managed and kept to a minimum (LSD).		High	Very likely	High
External features					
10.1	Perimeter fence prevents entry of feral or free-roaming animals.		High	Likely	Medium-high
10.2	Perimeter fence is regularly maintained.		High	Likely	Medium-high
10.3	A wild animal management plan is enforced.		High	Possible	Medium-high

Appendix B Guidelines and considerations for disposal methods

Carcass disposal methods are an important part of general 'business as usual' biosecurity measures for any facility that houses or processes animals.

As not every site will be able to accommodate the disposal of many carcasses, preparedness planning is vital to ensure method, site and transportation are identified and agreed to prior to an outbreak.

There are three common disposal methods: burial, burning/incinerating and composting. These are explained in more detail in Table B.1.

Table B.1 Explanation of disposal methods available for carcass disposal

Disposal method	Explanation
Burial	
Trench burial onsite	A trench is excavated into the earth, and the excavated earth is used to backfill the trench once filled.
Mounding (above-ground burial)	Carcasses are placed on a natural surface and then covered with earth that has come from somewhere else. Will need a by-product management plan as the risk of leachate and scavenging may be high depending on the location and soil type.
Mass burial	Used when a large number of carcasses need disposal – trench burial is preferred over mounding. Need to consider the by-product (e.g. leachate and methane) management. The site requires a prior assessment as soils need to be assessed – if porous, the base should be lined to prevent leachate leakage.
Burning/Incinerating	
Pyre burning	Carcasses are burned on open pyres constructed of solid fuel (e.g. dry wood). Placement of carcasses needs to ensure good airflow through the fuel.
Air-curtain incineration	Carcasses are burned in an earthen pit or a metal refractory box using fan-forced air, which is forced across the pit/box. This creates turbulence that enhances the incineration process.
Composting	
Windrows	These are long narrow piles of carcasses and other organic material encased in uncontaminated co-compost material (other organic material). Passive aeration occurs – but still requires turning.
Bins	These are enclosures with at least three sides, on a hard stand and may be covered by a roof. Requires turning.
Vessels	Enclosed in a sealed chamber or vessel so may not be suitable for whole carcasses. Temperature and aeration can be well controlled.

General location requirements for a disposal site are listed below:

- It should not be in a drinking water catchment area due to the risk of leachate contamination.
- The seasonal maximum groundwater level should be below the base of the burial or compost pit – that is, the base of the pit should be above the average flood level.
- It should not be near any natural or manmade water courses due to contamination risks.

- It should be away from major roads or villages to reduce odour or visual pollution.
- Soil should preferably be clay-based to reduce permeability and the risk of leachate seeping out.
- It should not be near the coast or conservation areas to reduce the risk of contamination.
- It must be accessible to truck and earth moving equipment.

Table B.2 outlines the general factors to be considered when selecting a suitable disposal method. Table B.3 outlines factors to be considered for each specific method.

Table B.2 Factors to be considered when deciding a disposal method for carcasses

Factor	Considerations
Environmental impact	Will the carcasses pollute the area through contamination by decomposition fluids, smell and sight? Will native flora and fauna be negatively affected?
Climate or season	Will the disposal method be able to withstand or be suitable in all weather events that might occur? This includes fires, flooding, extreme wind events.
Groundwater, water table and surface water	Will any water sources be contaminated by decomposition by-products, and what will be the consequences if this occurs?
Suspected pathogen	Not all pathogens will be killed by burial or composting (e.g. anthrax requires the carcasses to be burned). How easily can the disease be spread from the dead animals, and does the facility have the appropriate machinery to move carcasses and reduce the risk of spreading the disease? Is there a health risk to the staff?
Acceptance	Will the local and international community accept the chosen method?
Legislative requirements	Does the national or local government have rules or regulations associated with the disposal methods? Are there any legal environmental considerations?

Table B.3 Disposal method-specific considerations when determining the most appropriate disposal method.

Factor	Consideration
Burial	
Current and future land use	Will a burial site reduce the amount of land required for other vital functions required for running the facility – e.g. will it take up forage growing land? Will the burial of carcasses impact the integrity of the land and affect what it can be used for in the future – e.g. will it be able to support built structures?
Work health and safety	There will be risks to staff when moving carcasses into the burial pits and covering pits. Poorly managed burial pits can create health hazards for humans as well as animals.
Post-burial management	Leachate (fluids from decomposition) can leach out of the pits and can contaminate the surrounding environment, including water.
Number of carcasses expected	Numerous smaller pits can be chosen over one big pit, depending on the available resources.

Burning/Incinerating	
Proximity to neighbours	There will be substantial air and odour pollution from the smoke while carcasses are being burned.
Availability of fuel	Enough fuel for the number of carcasses will be required to completely burn the carcasses; it is also important to consider the economic cost of the fuel.
Fire risk to surrounding area	This may vary throughout the year depending on the seasonal conditions. Burning may not be suitable during the monsoonal seasons due to the challenges of keeping fuel dry enough to burn.
Infrastructure present	Above and below-ground infrastructure, such as cables, may be affected by the burning.
Site access	It must be easily accessible to ensure ease of maintenance and disposal of any by-products and to manage the burning safely.
Composting	
Odour	Properly managed compost should not have significant odour except after turning. This odour can be noticeable but should be short-lived.
Risk of groundwater contamination	This can be minimised by the proper use of co-composting material, and the base of the pits should be higher than the groundwater level, as with burial pits.
Soil contamination	Composting and decomposition by-products may leach out to the surrounding soil.
Significant rainfall events	Water and moisture can affect the composting process and increase the risk of run-off from the composting pits.

Appendix C Biosecurity risk assessment and record keeping template examples

Sample risk assessment tool (Table C.1) – Information can be tailored for specific facilities and should include a small number of questions to identify whether any visitors pose a biosecurity threat to the facility.

Table C.1 Sample risk assessment table

Sample risk assessment questions	Green/ low risk	Amber/ medium risk	Red/ high risk
Q1) Do you have livestock (cattle, sheep, goats, pigs or buffalo) at home?	No	Yes	Yes
Q1a) Have any of these animals had signs of FMD (drooling, lameness, reluctance to eat) in the last 2 weeks?	-	No	Yes*
Q2) Do you live in a village with livestock (cattle, sheep, goats, pigs or buffalo)?	No	Yes	Yes
Q2a) Have any of these animals had signs of FMD (drooling, lameness, reluctance to eat) in the last 2 weeks?	-	No	Yes*
Q3) Do you regularly visit other feedlots, breeding facilities or abattoirs?	No	Yes	Yes
Q3a) Have any of these animals had signs of FMD (drooling, lameness, reluctance to eat) in the last 2 weeks?	-	No	Yes*
Q4) Has your vehicle or equipment been cleaned today?	Yes	Yes	No

* Automatically designates a visitor as HIGH risk.
Low risk – minimal restrictions applied to facility access.
Medium risk – moderate restrictions placed on access, e.g. can't have access to high-value animals.
High risk – must undergo complete decontamination on arrival if they MUST have contact with animals, otherwise must NOT have any access to animals within the facility.

The following tables provide examples of information to collect for different areas of the facility:

Table C.2 Sample visitors register for facilities. Information can be tailored to individual facilities

Date	Name	Company	Signature	Contact	Risk assessment	Time in	Time out	Areas visited	Vehicle registration
					Low/medium/high				

Table C.3 Sample log for incoming animals

Date	Property of origin	Method of travel		Duration of travel (hrs)		Health events during transit	Previous animal health treatments (date and medication)
		Air	Truck	Air	Truck		

Table C.4 Sample register for daily pen inspections

Date	Pen ID	Number of cattle	Animals pulled from the pen?			Animals found dead		
			Yes/No	Animal ID	Reason for removal	Yes/No	Animal ID	Post-mortem conducted?

Table C.5 Sample of hospital pen record log

Date	Animal ID	Reason in hospital	Treatments			Euthanised – not emergency slaughter			Post-mortem		Disposal
			Drug name	Dose rate	Duration of treatment	Yes/no	Method	Reason	Yes/No	Findings	Bury/burn/ compost

Table C.6 Sample manure management record log

Date	Method of removal	Treatments applied	Location it is stored	When it was removed	Who removed it	Adverse weather events while it was being stored

Table C.7 Sample record log for feed or bedding - can be replicated for both

Date	Source and date delivery	Evidence of pest/vermin contamination	Location it is stored	Are chemicals stored with it	Vermin control strategies	Insect pest control strategies

Table C.8 Sample record log for perimeter and feral animal monitoring

Date	Fence		Non-permitted animals found within the perimeter?			
	Issue found	Solution	Type of animal	Location found	Estimated time present	Removal method

Table C.9 Sample record log for monitoring water

Date	Evidence of contamination	Suspected contamination source	Treatment method
	Yes/No	e.g. bird faeces to decomposing leaf litter	Include date conducted and date follow-up is required

Table C.10 Sample record log for monitoring animal movements

Date	Pen of origin	Pen of destination	Pens passed while moving animals
			Can include map

Table C.11 Sample record log for monitoring feed or bedding supply

Date	Evidence of infestation	Suspected infestation	Method of control/eradication
	Yes/No	e.g. insect or rats	Include date conducted and date follow-up is required

People's movements within the facility

QR codes placed at various points around the facility (where the biosecurity risk will change). Information collected can be presented as below.

Table C.12 Sample output of data collected with QR code stations

Date	Time	Name	QR code station

Table C.13 Sample log for hospital pens – can also be used for normal pens

Date	Name	Time entered	Time exited	Reason
				e.g. animals treated (include animal ID), to check supplies, to feed animals, to clean etc

Table C.14 Sample log of equipment/vehicle use and cleaning

Date	Equipment/vehicle	Pen/location used in	Purpose of use	Decontamination details
			e.g. feeding	Date cleaned, disinfectant used including concentrations and contact time

Appendix D Integrated pest management fact sheet

What is integrated pest management?

LSDV spreads through biting insects like stable flies, mosquitoes, and ticks. Controlling these pests is a crucial tool in preventing LSD outbreaks.

Integrated pest management (IPM) utilises different pest control methods to reduce your need to rely on chemical agents, which are expensive and can become less effective over time. These controls can be:

- **environmental management**
  Changing the conditions present at the facility to make it less attractive to pests (e.g. regular removal of manure and cleaning feed bunks)
- **physical methods**
  Preventing the entry of pests to the facility (e.g. insect mesh over open windows or doorways)
- **biological methods**
  Controlling predators, parasites or microbial pathogens (e.g. parasitic wasps or fungi)
- **chemical options**
  Using chemicals to repel or kill pests
- **regulatory methods**
  Adopting biosecurity and quarantine measures to prevent pest entry (e.g. ensuring incoming trucks are free from pests before entering the site).

When should I use integrated pest management?

An IPM program should be implemented before insect populations become problematically large, or the program will not be effective.

If implemented when populations are low and before conditions are favourable to population growth, an IPM program can prevent the populations from increasing. If populations are allowed to undergo rapid increase, IPM practices will not succeed, and chemical control will need to be utilised to get populations down to a level where IPM practices can be effective. The different control methods used need to be tailored to the specific situation of the facility to ensure the most effective strategies are implemented.

The important factors of IPM include:

- **pest identification**
  Understanding the pest population, their lifecycle and preferred breeding habitats
- **forward planning**
  IPM should be implemented BEFORE pest populations become a problem
- **regular monitoring**
  Pest populations need to be regularly monitored to ensure IPM strategies are working and to identify when pest population are increasing, either due to a failure in IPM strategies or because climate and environmental conditions have become favourable to population increases.

- **timely decision making**
  Pest populations can increase rapidly if the conditions are favourable. Decision points need to be identified early and action needs to be taken promptly if the information at hand indicates pest populations are increasing or changing.

How do I set up an integrated pest management program?

Before setting up an IPM, the feedlot design and sanitation should be assessed to identify any areas that may need special attention in a program. Feedlot design and sanitation assessment should consider:

- **pen foundations and slope**
  Flooring should be durable to withstand regular cleaning and sloped to promote rapid drainage after rainfall and cleaning. Pens, including hospital pens, should be regularly cleaned to prevent the build-up of manure.
- **feed and water troughs**
  These should be designed for easy and regular cleaning, and eliminate the build-up of spilt feed or manure. Avoid spillage – if it occurs, make sure it is promptly cleaned. Feed residues should not be left in feed bunks for an extended period. Water troughs should be able to be emptied, cleaned and refilled regularly to prevent mosquito larval development.
- **fences**
  Fence posts should be spaced widely enough to facilitate easy cleaning underneath. Manure under fence lines creates an ideal breeding location and should be removed regularly.
- **drains, sedimentation systems and effluent holding ponds**
  Wastewater should move rapidly through drains so that sediment does not collect, and they should be designed to allow easy cleaning and be durable. Vegetation around sediment should be well maintained to reduce breeding areas.
- **manure stockpile and composting areas**
  These should be established on durable, well-drained earth pads and be well managed – the general temperatures of a properly functioning compost will be too high for flies to breed. Dry manure is unfavourable for breeding, so manure should not be allowed to sit wet or moist; it should be removed from drainage and sedimentation systems.

Feedlot managers and staff should aim to implement good general facility maintenance to reduce the features of the environment that are favourable for flies to breed.

At a feedlot and associated facilities, IPM incorporates feedlot design, sanitation systems, biological control and focused insecticide use. Designing an IPM program should then follow a four-step approach:

1. **Monitor and identify pests.**

   Accurately identify pests and monitor their population and behaviours to help detect action thresholds. Different pest species may have different breeding sites and seasonality may differ – monitoring and control strategies should reflect these. Knowledge of lifecycles and how these may change throughout the year is required to ensure that control strategies, such as cleaning frequency, are altered as needed. Monitoring and accurate identification ensures the correct control method is implemented.

2. **Prevent pests from becoming a threat.**

   Remove areas or features that are favourable for insects. Beware of manure under fence lines as this is an ideal breeding ground for some species of fly. Maintain clean and hygienic spaces – some areas may need to be cleaned more frequently as seasons change and conditions become more favourable to pest population growth. Apply physical barriers to prevent pest entry.

3. **Set action thresholds.**

   An action threshold is the point at which pest populations or environmental conditions indicate a control action should be taken to prevent the pests from becoming an economic threat.

4. **Control.**

   Prioritise methods that present the least risk to the environment and human health, such as trapping, highly targeted chemical controls (e.g. pheromones to disrupt reproduction) and targeted use of pesticides.

Fly populations need to be regularly monitored to ensure IPM can succeed. Regular monitoring can identify risk periods, provide an early warning system and allow for alterations in the program to be made to prevent populations from exploding. Monitoring the larval populations is useful for providing an early warning of adult population increases. This can be done by examining manure (turning manure) and counting visible larval populations. Adults can be monitored with sticky sheets, traps or animal observations.

Which control measures should I use in my integrated pest management plan?

Once you have identified the pests present in your site, appropriate controls can be developed to prevent their breeding and growth (see Table D.1).

Table D.1. Vector control methods for LSD

Vector type	Physical control methods	Chemical control methods
Hard ticks	Inspect fresh forage for tick accumulation Regularly assess cattle for the presence of ticks	Topical acaricides (dips, sprays and pour-ons) Hormone-assisted control measures (pheromones)
Mosquitoes	Prevent accumulation of standing water for >7 days Drain and refill water troughs Inspect drainage channels for areas of pooling Protect any standing water tanks or effluent ponds with physical barriers like netting or biological agents (if available)	Thermal fogging (rotate ingredients, use based on action thresholds) Ultra-low-volume sprays
Stable flies	Remove, cover or dehydrate manure Provide back rubbers for cattle to remove flies in the pen	Topical repellents (cattle dips, sprays and pour-ons) Fly baits Environmental repellents (e.g. Agita)

Insecticides can be used in IPM but should only be used if other control methods have been adequately implemented. Without adequate implementation of the other features of IPM, insecticide use will only provide short-term population suppression. Chemical control methods should be used carefully as some can be lethal to cattle if applied incorrectly. As such, they should be reserved for situations defined by your feedlot's action thresholds.

When implementing chemical control, it is important to consider:

- **mode of action/life stage targeted**
  Larvicides will provide better long-term population control than adulticide. Fly baits can provide good, targeted control. Cyromazine (moulting inhibitors) are preferred as they are less likely to affect any beneficial insects.
- **muration of action**
  'Residual' insecticides are preferred over 'knockdown' insecticides as there is less risk of environmental contamination.
- **sites for use**
  Target areas that are resting sites for adult flies, or have a high detectable population. Do not apply near feed or in areas where feed is used.
- **active ingredients**
  Make sure chemical groups are regularly rotated to prevent resistance developing in the populations.
- **withholding periods**
  Ensure withholding periods are respected if they can potentially leave residues in the animals.

Example of a fly rubber for cattle from https://www.ottofarms.com/cattle-fly-control/