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National procedures and guidelines for intensive sheep and lamb feeding systems

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Preface

This document has been developed to provide a set of national recommendations for intensive feeding of sheep and lambs as an initiative of the Australian Lamb Finishers Group (ALF) and the Sheepmeat Council of Australia (SCA). Funding has been managed by Meat and Livestock Australia (MLA).

This guide is the first of its kind for the Australian lamb finishing industry, and has resulted in a framework of recommended procedures and guidelines encompassing industry best practice that will be valued by all stakeholders. Lambs finished outdoors or in sheds, as well as containment areas, are covered by this guide and include environmental, nutritional, design, management, supply chain, animal health and welfare recommendations. Topics within each section include all aspects of the subject, and may appear in multiple sections to avoid the need for cross referencing when using this guide as a reference.

The development of the guide was preceded by an extensive review of the literature relating to the lamb finishing industry. The literature review was published by Meat & Livestock Australia in March 2007, titled “Best practice for production feeding of lambs: A review of the literature” (see www.mla.com.au or www.productivenutrition.com.au/facts.html). The development phase of this guide included extensive stakeholder consultation to ensure it serves all members of the industry, is sustainable and relevant.

Thank you to all of the stakeholders who have contributed to this project to date. Special thanks to ALF, SCA, MLA, Kevin de Witte (Animal Health Australia (AHA)) and the consultants for their invaluable work.

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Introduction

Purpose

The purpose of this document is to provide the intensive feeding sector of the sheep and lamb industry with recommended procedures for management that align with current environmental, animal welfare and community expectations as well as guidelines for current best practice.

The recommended procedures provide the basis for the *Planning and Management Checklists* that are designed to assist producer's benchmark and assess their system against this document.

Scope

These recommended procedures and guidelines encompass requirements for intensive sheep and lamb feeding systems (from hereon referred to as intensive feeding system(s)), within conventional outdoor and intensive indoor shed systems, as well as the use of containment areas. While the recommendations in this document may be applied to all containment areas, adherence is not intended for containment areas that are only constructed and used for drought feeding (also known as drought lots) during periods of severe or serious rainfall deficiency. Definitions of each system are provided in the glossary of terms.

These recommendations apply to those responsible for the care and management of sheep and lambs in intensive feeding systems, including owners, managers and livestock handlers.

Where legislation requires a higher standard than that recommended here, the higher standard will apply.

This document is not intended to be enforceable under legislation.

Documents that are enforceable under legislation which are referenced in this document include the Australian Standards and Guidelines for the Welfare of Animals – Land Transport of Livestock (Animal Health Australia (AHA), 2008) and the Model Code of Practice for the Welfare of Animals: The Sheep (CSIRO, 2006).

Note: The Model Code of Practice for the Welfare of Animals: The Sheep (CSIRO, 2006) is currently being updated. More information is available from Animal Health Australia or on-line http://www.animalwelfarestandards.net.au

Interpretation

This document contains chapters each including:

Heading - identifies the subject matter of the chapter

Objective - the intended outcome(s) for each chapter

Recommended procedures - the minimum recommendations that should be met for agreement with this guide. The recommended procedures are intended to be clear, essential and verifiable statements. Prescriptive recommendations are only written where they can be substantiated through proven scientific research. However, not all issues are well defined by scientific research or are able to be quantified, and as a result, simply written recommendations that are not prescriptive but focused on an outcome are also provided.

Guidelines - the recommended practices to achieve more productive and sustainable intensive feeding systems, or to provide a safe environment for contained sheep which may be considered in addition to the recommended procedures.

Notes - explanation of the context of the recommended procedures and guidelines, (the notes are advisory statements for background information).

The term sheep includes sheep and lambs where appropriate except where otherwise stated.

Glossary of Terms

ad libitum	A term which refers to sheep and lambs being able to access feed or water freely at will.
aerobic lagoon	A pond in which the breakdown of organic wastes occurs in the presence of dissolved or free oxygen.
agro-chemical	A contraction of agricultural chemical is a generic term for the various chemical products used in agriculture including insecticides, herbicides, and fungicides.
alkaloid	A naturally occurring organic compound with toxic properties to sheep.
anaerobic lagoon	A pond in which the breakdown of organic wastes occurs without the presence of dissolved or free oxygen.
aquifer recharge point	An area of land that acts to supply water to an underground water resource.
body condition score	An assessment of the amount of tissue and fat covering the backbone and short ribs of mature and/or breeding sheep. Used as an indication of animal wellbeing and measured on a scale of 1 (poor condition) to 5 (fat).
buffer zone	An area of land specifically designed to separate one land use from another with which it is incompatible.
cadastral plan	A map defining land ownership and boundaries.
community amenity	A fact or condition being agreeable to the community.
composite site factor	A combination of factors relating to stocking density, receptor type, topography and vegetation used to calculate separation distances.
condition score	see body condition score.
containment area	A containment area is used for the purpose of providing feed and water for production or maintenance of lambs or sheep on a regular, semi-regular or annual basis. A containment area may assist with short term land and sheep management when minimal pasture or forage is available due to seasonal variation.
design storm event	A rainfall event with a specified size and occurrence used to calculate runoff volume and peak discharge rate.

downward effluent	Irrigation equipment used for the purpose of discharge nozzle spreading effluent which projects liquid towards the earth.
drainage system	A system of watercourses, drains, pipes and/or ponds that are used to collect and manage runoff at the site.
drought lot	A containment area that is used for the purpose of providing feed and water for production or maintenance of lambs or sheep on an irregular basis and only during periods of drought.
effluent	Contaminated runoff from the controlled drainage area which is typically directed into a treatment system that may include a sedimentation system and is stored in a holding pond.
effluent utilisation area	An area of land over which effluent may be sustainably dispersed.
environmental management plan	An environmental management plan (EMP) is a site specific plan developed to mitigate, monitor and provide action plans in order to protect the environment and comply with environmental legislation.
evaporative system	A shallow broad pond which collects and stores effluent after treatment in a sedimentation system. The large surface area is designed to efficiently evaporate water through exposure to sunlight and ambient temperatures.
extremes of weather	Temperature and climatic conditions (eg rain, hail, snow, wind, humidity and heat) that, individually or in combination, are likely to predispose livestock to heat or cold stress.
fat score	An assessment of the amount of tissue and fat covering the long ribs of lambs estimated and measured 110mm from the backbone on the 12th rib. Used as an indication of animal wellbeing and carcase fat deposition; described on a scale of 1 (very poor) to 5 (fat).
feeding system	see intensive feeding system.
few trees, long grass, crops	A vegetation description used to calculate separation distances. Refers to open, flat country with a light scattering of timber and a permanent covering of tall grass with vegetation distributed continuously across the separation distance. Isolated clumps of trees or cropping land also fit into this category.

Flockcare	An on-farm quality assurance program for sheep and lamb producers.
freeboard	Vertical distance from the normal water surface to the top of a confining wall.
groundwater	Water that occurs beneath the land surface and fills the pore spaces in which it is situated. It excludes soil moisture, which refers to water held by capillary action in the upper unsaturated zones of soil or rock.
heavy timber and forest	A vegetation description used to calculate separation distances. This is a forest with dense stands of tall timber forming a complete canopy. There is limited understorey. The trees must be at least 4 metres tall and cover the greater of at least 400 metres or 60 percent of the distance between the feedlot and the receptor.
hills and valleys	A description of terrain used to calculate separation distances. This describes the situation where one or more lines of hills which are sufficiently large to influence air movement exist between the feedlot and the receptor.
holding pond	A pond used to collect and store effluent after treatment in a sedimentation system prior to utilisation of the effluent.
impervious strata	A layer of soil, rock or other material impermeable to water.
intensive feeding system	This term is used to describe the entire area in which a feeding system operates. It typically includes the pens, drainage system, manure stockpile area, carcase disposal area, feed storage and preparation facilities and administrative buildings that are located on site.
isotonic electrolyte	A solution of equal osmolarity to that of the fluids of the body used to treat certain conditions in sheep.
katabatic wind	Wind created as a result of cold, dense air flowing downhill.
keyhole crutch	Also known as a sale crutch or bung hole crutch this procedure removes a minimal amount of wool from the breech area and is typically conducted before sale to remove any stained or soiled wool prior to slaughter.
lamb	A young sheep of either sex with no permanent incisor teeth.

late pregnancy	For the purposes of this document this is considered as the last 50 days of pregnancy.
level wooded landscape	A vegetation description used to calculate separation distances. This refers open forest country with trees at least 4 metres high, and in which the tree density is not sufficient to form a complete canopy, but is able to influence air movement. Lower storey vegetation would commonly be absent or sparse. This description does not apply to scattered clumps of trees. The density is such that the vegetation can be considered as a continuous belt.
manure	Animal excrement (faeces and urine).
manure utilisation area	An area of land over which manure may be sustainably dispersed.
mycotoxin	A toxic compound produced by fungus that are poisonous to humans and animals.
national heritage properties	The Environment Protection and Biodiversity Conservation Act 1999 establishes the National Heritage List, which includes natural, Indigenous and historic places that are of outstanding heritage value to the nation. Source: www.environment.gov.au
neophobia	The fear of new objects or experiences, used in reference to new feeds and feeding equipment in this document.
peak inflow rate	The maximum rate of water movement into a system.
pond spillway	A channel that carries excess water from the holding pond in a controlled manner.
probiotic	A food or supplement containing live micro-organisms which provide benefit to the health of the host when administered.
Ramsar wetlands	A wetland, or part of a wetland, designated by the Commonwealth under Article 2 of the Ramsar Convention for inclusion in the List of Wetlands of International Importance kept under that Article is a declared Ramsar wetland as long as the wetland or part is not: (a) excluded by the Commonwealth from the boundaries of a wetland in the List under that Article; or (b) deleted by the Commonwealth from the List under that Article. Source: Environment Protection and Biodiversity Conservation Act 1999.

	More information about Ramsar and Ramsar listed wetlands can be found at: http://ramsar.wetlands.org/.
receptor	An area, object or feature that may be impacted upon by the intensive feeding system. Typically discussed in this document in reference to separation distances.
restricted feeding	A feeding system whereby the desired amount of feed is only delivered to animals at certain intervals.
runoff coefficient	A coefficient relating the amount of runoff to the amount of precipitation received.
sedimentation system	A component of the drainage system designed to remove entrained settleable solids from runoff.
self feeder	A feeding system that provides continual feed supply to animals.
separation distance	The distance between the feedlot complex and sensitive receptors.
sheep	Ovis aries and other members of the genus Ovis.
sick pen	A pen reserved for those animals requiring additional attention and treatment for any health and/or welfare reason.
standard sheep unit	Refers to a sheep or lamb with a liveweight of 60 kilograms.
stocking density	The number of animals in a given unit of area at any point in time.
storage pond	See holding pond
surface water	Water above the ground surface that may include lakes, rivers, streams, ponds, floodwater, and runoff.
tail water	Surface water having fallen as rain or flowing through a field as irrigation.
terminal system	A series of ditches, pipes and pumping mechanisms designed to return tailwater to a reservoir or other holding structure.
topographic plan	A map which accurately illustrates the physical features and relief of an area.
undulating hills	A description of terrain used to calculate separation distances. Generally low level rolling terrain, with no significant vegetation. If significant vegetation exists the values for wooded or timbered country may apply.

water diversion system	A drainage system which prevents off-site runoff entering the intensive feeding system.
world heritage properties	United Nations Educational, Scientific and Cultural Organisation (UNESCO) manage a list of properties determined to be of universal significance. More information and a list of properties can be found at www.environment.gov.au

Abbreviations

BVD	By-product vendor declaration
CP	Crude protein
CVD	Commodity vendor declaration
DM	Dry matter
DSE	Dry sheep equivalent
HACCP	Hazard analysis and critical control points
LPA	Livestock production assurance
LPAS	Livestock production accreditation scheme
ME	Metabolisable energy
MLA	Meat and livestock Australia
MSA	Meat standards Australia
NDF	Neutral detergent fibre
NLIS	National livestock identification system
NVD	National vendor declaration
PIC	Property identification code
RAM	Restricted animal material
SCARM	Standing committee on agriculture and resource management
SSU	Standard sheep unit

Approval Process and Planning

1. Approval process

Objective

To ensure applications for intensive feeding systems meet the requirements of the appropriate government entity and that all relevant information is included to avoid unnecessary delay and cost.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
1.1 General	
- Approval be sought from the relevant planning authority. - The approval process ensures that intensive feeding systems meet environmental and animal welfare standards, are compatible with surrounding land use, its likely future use and community amenity. - Developments that are likely to impact on areas of national significance be approved under the Commonwealth Environment Protection and Biodiversity Conservation Act (1999). Areas of national environmental significance include: o world heritage properties o national heritage properties o Ramsar wetlands of international importance o listed threatened species and communities o migratory species protected under international agreements. - Applications for intensive feeding systems include: o applicant and site information o description of subject land o locality plans o climatic information o intensive feeding system information o soil and groundwater information o solid waste utilisation information o liquid waste utilisation information o odour, dust, noise and pest control information	- The local council planning department should be consulted early in the development phase to determine any potential limitations to intensive livestock industries before significant investment is made. In particular for shedded operations, local council should be consulted early in the development process to determine regulations for these operations as commercial requirements may apply demanding significant works and/or expense.

o animal welfare o composting o environmental management plan	

The following is an outline of information that may be required when compiling an application for approval from a relevant authority(s). Individual state requirements vary and may require some or all of the following information to be provided:

Applicant and site information

Name, postal and email address, telephone and facsimile numbers of:

- applicant
- owner of subject land
- intensive feeding system's manager
- type of feeding system
- area of land within the system
- capacity
- stocking density.

Description of subject land

- including title(s), hundreds, section numbers, county, local government authority and total farm area.

Locality plans

- Cadastral plan of vicinity (preferably 1:50,000).
- Topographic plan (1:50,000) showing location of all buildings, commercial and recreation facilities and clearly denoting occupancy, use and separation distances.
- Topographic plan showing:
- location of all watercourses and drainage lines
- limit of a 1 in 100 year flood, and
- environmentally sensitive areas
- Land use plan showing local government zoning and land use in vicinity of the feedlot
- Aerial (survey) photograph of site.

Note: The data required in the locality plans may be shown on one plan providing that the data is clear.

Climatic information

- Mean annual rainfall
- Average monthly rainfall
- Rainfall intensity data:

- 1 in 20 year, 24 hour storm
- 1 in 100 year, 1 hour storm

- Average monthly evaporation
- Monthly maximum and minimum temperatures
- Wind speed and direction frequency by month.

Note: Data should be from nearest recording station. Data limitations and collection site must be indicated.

Intensive feeding system information

- Outline of proposal
  - Documentation outlining the proposal including:
    - capacity, numbers to be fed annually and market weight
    - stocking density
    - feedlot class (see Table 6-8, page 36)
    - pen floor construction specifications
    - proposed management program
    - operational timetables
    - separation distances: actual and calculated from separation distance Equation 6-2, page 28.
- Site plan
  - showing location on subject property of feedlot pens and infrastructure, buildings, roads, drainage lines and waste utilisation areas.
- Visibility
  - statement outlining the degree of public visibility of the development.
- Pen layout plan
  - showing layout of pens, lanes, feed alleys, induction facility, etc. Pen dimensions and water/feed facilities to be shown.
- Drainage plan
  - showing water diversion system, drainage system, pen slopes, drains, sedimentation basins, holding ponds, etc.
- Waste plan
  - showing the location, area and proximity to watercourses of all land on which wastes will be utilised, estimates of quantities and types of wastes per annum.
- Native vegetation plan
  - documentation showing the location, area and species of existing native vegetation and extent of proposed clearing.
- Revegetation plan
  - showing the location and numbers of trees and shrubs to be planted around buildings and pens, as wind breaks or visual screens. Include names of species to be planted, and numbers.
- Traffic
  - details of traffic volumes, routes and access to be used.

- Water supply
  - documentation on source, quality and adequacy of supply, emergency supply, water harvesting, annual consumption and water licenses.
- Carcass disposal plan
  - showing location and method of disposal of carcasses, estimates of numbers.
- Development plan
  - documentation outlining the work and development schedule for the construction of the intensive feeding system and associated infrastructure.

Note: The data required in the various plans may be shown on one plan providing that the data is clear.

Soil and groundwater information

- Soil description
  - data showing the suitability of soils for purposes intended, basic physical and chemical properties for pens, ponds, irrigation and waste utilisation.

Table 1-1 - Soil classification and analysis requirements for a range of feeding system areas.

Documentation required	
Soil description in feedlot pens, roadways, laneways, and controlled drainage areas	▪ Soil classification in accordance with the soil classification system described in Appendix A of Australian Standard (AS) 1726 Soil Classification. ▪ Particle size distribution and plasticity limits: ▪ The visual identification methods described in AS 1726 may be used by suitably qualified and experienced persons, for classifying soils in the field. However, if there is doubt about the suitability of the material, the administering authority may direct the applicant to arrange for laboratory testing, in accordance with the appropriate sections of AS 1289. All such laboratory testing must be carried out by a soils laboratory, accredited by the National Association of Testing Authorities (NATA)
Soil Description in Waste Utilisation Areas	▪ Texture, pH, ECe, Total N, Nitrate N, Total P, Colwell P, Exchangeable Sodium Percentage (ESP), Organic carbon, Chloride
Clay Lining of effluent drains, settling areas, storage or treatment ponds, manure stockpile areas, composting areas	▪ Soil classification in accordance with the soil classification system described in Appendix A of AS 1726. ▪ Particle size distribution and plasticity limits: ▪ The visual identification methods described in AS 1726 may be used by suitably qualified and experienced persons, for classifying soils in the field. However, if there is doubt about the suitability of the material, the administering authority may direct the applicant to arrange for laboratory testing, in accordance with the appropriate sections of AS 1289. All such laboratory testing must be carried out by a soils laboratory, accredited by the NATA.

- Bore locations
  - plan showing location, depth of and depth to standing water level (SWL) of all bores on the property and all neighbouring properties.
- Springs, seeps and salt scalds
  - plan showing location of any of these.

- Ground water analysis
  - chemical and microbiological analysis of existing ground water.
- Geology
  - documentation of geology underlying the property from existing geological maps.
- Hydro-geological assessments
  - site specific detailed report assessing impacts on ground water.

Solid waste utilisation

- Soil conservation plan
  - details showing location of existing and proposed soil conservation works on the solid waste application area.
- Drainage plan
  - showing drainage from waste application area and distance from watercourses.
- Nutrient and salt balance
  - documentation showing that the size of the application area is sufficient to handle the nutrient and salts expected in the wastes; any off farm disposal arrangements to be specified.
- Manure stockpile
  - plan showing size and location of manure stockpile and runoff controls.
- Manure spreading programme
  - documentation outlining method, frequency and management program for manure spreading.

Liquid waste management information

- Soil conservation plan
  - details showing location of existing and proposed soil conservation works on the solid waste application area.
- Drainage plan
  - showing drainage from waste application area and distance from watercourses.
- Holding/evaporation pond
  - documentation indicating capacity, annual runoff volumes, overflow frequency.
- Sediment control system
  - documentation showing size and method of operation.
- Effluent irrigation water balance
  - documentation showing that the size of the utilisation area is sufficient to handle the volume of effluent expected without runoff or seepage at flow-rates or strengths liable to cause pollution.
- Nutrient and salt balance
  - documentation showing that the size of the application area is sufficient to handle the nutrient and salts expected in the effluent.

- Irrigation method
  - documentation outlining irrigation method.

Odour, noise, dust & pest control information

- Odour
  - assess generation, impact and control of odour nuisance. Odour assessment using odour source modelling may be required, depending on the size of the feedlot and sensitivity of adjacent land.
- Noise
  - statement outlining noise control measures.
- Dust
  - statement outlining dust control measures.
- Pest control
  - outline of proposed pest control measures (rodents, birds, flies, feral animals).

Animal welfare

- Statement of compliance with the Model Code of Practice for the Welfare of Animals: The Sheep (CSIRO, 2006) or its subsequent editions.

Composting

- refer to State Environment Protection Authority for guidelines
- outline of composting methods.

Environmental management plan

- draft environmental management plan
- plan of ongoing monitoring
- audit process.

Environment and Design

The intensive sheep and lamb feeding industry is a relatively immature industry with limited research completed in the areas of site design and environmental protection. The information contained in this section is based on available research and extrapolation of data from documents such as the National Guidelines for Beef Cattle Feedlots in Australia, SCARM Report 47 (PISC, 2002).

The recommended procedures and guidelines in this section are not considered exhaustive or applicable under all possible circumstances. Situations should be assessed on a site by site basis and, provided environmental objectives are achieved and relevant environmental authorities are satisfied, alternative methods or practices may be acceptable.

2. Environmental protection

Objective

To site, construct and manage intensive feeding systems in a manner which addresses environmental sustainability and encourages community acceptance.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
2.1 General	
- Intensive feeding systems be sited, constructed and operated so that nutrients, salt, organic matter and water components of effluent and manure are effectively contained and sustainably utilised.	- Effluent and manure management strategies should include; o sale o land application.
2.2 Water protection	
- Intensive feeding systems be sited, constructed and operated so that underground and surface water resources do not become contaminated.	- Where the site is to be located above groundwater resources at risk of infiltration/contamination an expert independent assessment should be conducted prior to establishment. - Groundwater management strategies should include infiltration reduction around the intensive feeding area and manure stockpiles. - Groundwater quality should be monitored on a regular basis. Monitoring frequency should be included in the intensive feeding system's environmental management plan. - Surface water management strategies should include management of; feeding area and manure stockpile runoff, effluent, irrigation tail waters and contaminated stormwater runoff from effluent irrigation areas, contaminated sub-surface flow, or discharge of contaminated groundwater.

2.3 Land protection	
- On site waste utilisation areas be of sufficient size and capacity to accommodate the wastes generated from the intensive feeding systems' activities with no deleterious build up of waste constituents in the soil.	- Effluent and manure utilisation areas and the spreading of effluent and manure should ensure that land is not degraded. Land degradation issues that should be considered include; o decline in soil structure o salinisation o acidification o waterlogging o chemical contamination o erosion.

3. Site selection

Objective

To ensure the site selected for intensive feeding systems takes into consideration availability of feed and water supplies, infrastructure, natural site features, animal welfare and environmental sustainability.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
3.1 General	
- The site has suitable all weather access. - The site not be developed in flood prone areas unless safeguards are incorporated. - Where development is proposed on an environmentally unfavourable site, engineering solutions or superior management practices be implemented to prevent any negative environmental impact.	- All-weather access to storage and feed preparation areas should be provided. - Site selection will affect the economics, animal welfare and the environmental management of the site. The site selected should be one which avoids the need for costly environmental protection and community amenity measures. - To ensure the intensive feeding systems has minimal impact on the surrounding environment it should be located close to: o feed supplies o finisher lambs o saleyards o abattoirs o transport routes, and o labour. - Site selection should minimise the effects of extreme weather.
3.2 Soil	
- Soil types at the site be suitable for or modified to suit water, manure and stock management. The key elements are: o smooth, stable, compactable soil types to prevent infiltration through the surface of pen areas o soil types for holding ponds be	- The pens should be located on a stable, smooth compacted area. This will prevent infiltration of water, prevent breakdown of the pen floor, facilitate drainage, manure collection and removal and enhance animal welfare. Areas which have natural springs, or expansive heavy clays are unsuitable. - Feedlots and containment areas constructed

impermeable to water and of a suitable nature for dam construction o soils in the manure utilisation area have sufficient buffering capacity to sustain the continuous application of water, nutrients, salts and organic matter present in manure o suitability for sheep under all weather conditions. - Where rocky outcrop areas are identified as aquifer recharge points, they not be used as sites for intensive feeding systems or containment areas.	should have suitable clay or gravely clay applied and compacted to a depth of up to 300 mm dependent on soil type and local council guidelines. - Impermeable pond linings may include impermeable barriers such as clay which may be imported, or other materials such as polyethylene. - Soil types for effluent utilisation areas should be deep and well drained, and suitable for cropping under continuous irrigation.
3.3 Water	
- The site have access to an adequate supply of suitable quality water to service the needs of all livestock on site and for feed preparation. - The site have access to an adequate supply of water for activities such as dust and fire control.	- When assessing water requirements it is necessary to determine: o daily requirements: up to 6.5 litres of water per head per day in hot weather, averaging 3-4 litres per head per day over a 12 month period o total annual requirement o peak short-term requirements o flow rates o trough cleaning requirements. - Water licenses and allocations may be required therefore water resource officers should be consulted to ascertain the legal requirements for the site. - At least 3 days of peak drinking water supply should be held in storage in case of emergencies. - A contingency plan should be in place in the event of prolonged interruption of water supply.
3.4 Waste management	
- On site waste utilisation areas be of sufficient size and capacity to accommodate the wastes generated from intensive feeding system's activities with no deleterious build up of waste constituents in the soil. - Holding ponds be impermeable and if not they be lined with an impermeable lining.	- For land application the spreading rate of effluent and manure should be determined by the nutrient component of the effluent which requires the largest area for spreading, after considering soil nutrient composition and utilisation by the crop to be grown.

3.5 Community amenity	
- A buffer zone be maintained between intensive feeding systems, watercourses and sensitive community receptors.	- The desirable separation distance from the intensive feeding system and each sensitive receptor should be a function of the source, strength and frequency of the odour, dust or noise, the prevailing weather, and the nature of the intervening terrain (refer to section 6.2 (Separation distances) page 27). - Siting of sheds will be subject to local government planning approval and building permits. - Sites should not be selected where there is a reasonable expectation that developments incompatible with intensive feeding systems are likely within its lifetime. - Consideration should be made of the impacts of increased traffic on: o road infrastructure o noise and dust o road safety.

4. Design and construction

Objective

To design and construct intensive feeding systems that are environmentally sustainable, efficient and provide for animal welfare.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
4.1 General	
- Intensive feeding systems be sited, constructed and operated so that odour, noise or dust does not cause unreasonable interference with neighbouring properties. - Adequate fire fighting equipment be available to control a fire within an intensive feeding system.	
4.2 Feeding area pens	
- When designing high use areas such as feeding and watering points the following be considered: o slope o aspect o location and size o shade o shelter o surface and equipment protection. - Outdoor pens be constructed across the slope and aligned with the natural contour of the land, to avoid pen to pen drainage. - Pen slopes be adequate to ensure that water drains freely. - Feeding areas within outdoor pens be located on the high side of the pens.	- Intensive feeding areas should be designed with a northerly aspect to maximise solar radiation and evaporation rates. - Outdoor pen surfaces should be evenly graded and compacted to form a smooth surface with no hollows. - Naturally occurring or artificially created pen slopes should be between 2% and 8%. Slopes greater than 6% should only be utilised if the length of the pen slope is reduced to avoid erosion. - Concrete aprons or compacted rubble should be constructed around high use areas such as feeding and watering points to a minimum width of 2.0 metres. - Mounds should not be constructed within pens as they impede drainage, can increase odour generation, and make pen cleaning more difficult.

	- Sick pens should be constructed to accommodate sheep and lambs requiring treatment and allow animals to recover in a less competitive environment. - Sick pens should: o be close to the main pen area to reduce the distance sick animals must travel o have a stocking density of no more than 50% of the main pens o be downwind of the main pens to minimise the risk of air borne disease transmission.
4.3 Fences and laneways	
- Fences, laneways and facilities be constructed in a way that minimises the risk of injury to sheep.	- Careful consideration should be given to the layout of pens, lanes and gates. The intensive feeding systems can only operate at maximum efficiency when it has been designed with consideration of the day to day activities, their timing, and ease of operation. Avoid having to open or close laneway gates to access the feeding area with feed out machinery. - Fences and laneways should not hinder the movement of equipment or stock, and within sheds and feedlots, should not interfere with pen cleaning. - Outdoor laneways should be wide enough for vehicle access, but narrow enough to promote the efficient movement of stock.
4.4 Shade and shelter	
- Shade or shelter not substantially impede the drying of the pen surface, or pen cleaning. - The potential fire risk of shade and shelter materials be considered.	- Design and construction of the site should take into account the potential for extreme weather. - Shelter should be provided to minimise exposure to extremes of cold and hot weather, and reduce exposure to high mid-summer solar radiation. - Shade or shelter may be provided by securely fenced off straw bales or trees, galvanised sheeting, shade cloth or sheds. - The design of the shade structures should: o ensure that both ventilation beneath the structure and afternoon shade area are

	maximised o have their axes oriented to allow the shade to move across the pen during the day and to encourage drying of the pen floor o be angled towards the north-west to maximise available shaded area during the hottest part of the day. Shade structures should be located in the western half of the pen o be high enough to enable pen cleaning equipment to drive beneath without damage from the machine or accumulation of exhaust fumes and/or be easily removed to facilitate pen cleaning. - Engineering advice should be sought in the design and placement of shade due to the potential load the structure must bear, wind loading and the requirement for air circulation. - The current recommendation for shade allowance for outdoor feeding systems is $0.4m^2$ per lamb. - Natural or artificial windbreaks may be used to reduce the wind velocity through intensive feeding systems. - Windbreaks to reduce the effects of cold should be provided in the form of scrub or planted trees, long grass or artificial shelter.
4.5 Sheep handling facilities	
	- When building or modifying sheep handling facilities the following should be considered: o construction and maintenance to minimise the risk of injury and disease o passageways, races, entrances and exits should account for the behavioural patterns of sheep o the floors of sheds and yards should have surfaces that minimise the risk of injury and disease and allow sheep to stand and walk comfortably o appropriate provision of feed and water.

4.6 Feeding and watering equipment	
- Water troughs be well separated from feeding areas. - Feeding equipment be designed and constructed in a way that ensures efficient and safe feed delivery to sheep and lambs whilst minimising wastage and contamination. - Feeding equipment ensures all sheep and lambs have sufficient access to feed. The trough length allocation will depend upon feeding method – *ad libitum* or restricted feeding. - Feed and water troughs be of a construction that prevents sheep and lambs being able to climb into or through them. - Water troughs be designed and constructed in a way that ensures all sheep and lambs have sufficient access whilst minimising wastage and contamination from feed, manure and urine. - Water pressure and/or flow rates and capacity be sufficient to supply water in troughs at all times.	- Feeding and watering equipment should be designed to minimise spillage and the accumulation of waste, manure and urine beneath them. - Watering equipment should be able to be easily cleaned, with the waste water being directed away from the pen area. - The optimum positioning of feeding and watering within feedlot pens has not been determined. However, equipment should be located in such a position as to: o optimise access to minimise the effect of dominant behaviour o avoid injury to sheep and lambs o minimise stress o avoid contamination. - As the temperature of the drinking water can affect intake, water reserves should be kept as cool as possible. To prevent temperature build up in the water troughs from limiting intake, facilities should provide a rapid supply of cool water. - Water supply pipes should be underground. - While shade over water troughs can assist with maintaining cooler water, provision of extended shade areas around the trough should be avoided as this will encourage sheep to camp in the area and may prevent others having access to water.
4.7 Stocking density	
- The size of feedlot, shed and containment area pens be large enough to provide adequate feeding, watering and living area per animal while minimising the rate of build up of manure and spilt feed.	- Sufficient space within outdoor feeding systems and sheds should be provided to facilitate normal social behaviour. - The optimum stocking density for outdoor intensive feeding systems is yet to be determined. Current recommendations suggest 3 – 5 m^2 per head. - The optimum stocking density for shedded intensive feeding systems is yet to be determined.

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- Table 4-1 below shows the current recommended <u>minimum</u> area per lamb for different numbers of lambs per pen in intensive shed finishing systems. Anecdotal evidence suggests that to optimise lamb growth and performance greater area may be required.

Table 4-1 - Minimum area per lamb for various group numbers in intensive finishing sheds.
<table>
<tr><th>No. of lambs</th><th>Area/lamb (m^2)</th></tr>
<tr><td><8 lambs</td><td>0.9</td></tr>
<tr><td>8-15 lambs</td><td>0.8</td></tr>
<tr><td>16-30 lambs</td><td>0.6</td></tr>
<tr><td>>31 lambs</td><td>0.5</td></tr>
</table>
The above guide is intended for an average liveweight of 40-55kg. If heavier sheep are to be fed a greater area per head should be provided.

Source: Australian Animal Welfare Standards and Guidelines for the Welfare of Sheep (CSIRO, 2006).
</td>
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<td colspan="2">4.8 Drainage system</td>
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- Spillage and waste water drains directly into a drainage system.
- A drainage system minimises the risk of groundwater and surface water contamination, and promotes the rapid drying of the pen surface after a rainfall event.
This drainage system includes where appropriate:
o diversion banks or drains upslope of outdoor feeding pens to divert external freshwater away from the complex
o drains within the controlled drainage area to convey runoff to the treatment and storage systems
o solids separation by gravity settling where the runoff is retained for sufficient time on a pond, terrace, or basin to allow the majority of the entrained solids to settle out by gravity
o holding or storage ponds of sufficient
</td>
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- Diversion banks or drains should be designed to carry peak flow rates from a design storm event which has an average recurrence interval of 20 years. Diversion banks and drains should carry this flow at a non-scouring velocity.
- Catch drains should be designed to carry peak flow rates resulting from a design storm with an average recurrence interval of 20 years, with a runoff coefficient of 0.8, at a non scouring velocity.
- Sedimentation systems should be designed to cater for the peak flow rate of runoff from a design storm having an average recurrence interval of 20 years, and using runoff coefficients for the feedlot pens, roadways and other hard areas of 0.8 and 0.4 for grassed areas. The system should be designed to deposit solids settling at a maximum velocity of 0.005 m/s.

The volume required to achieve settling at
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size to contain major storm events and/or extended periods of storage.

- Where composting areas exist, all runoff from this area be controlled and managed.

the required velocity is determined by the equation:

Equation 4-1 – Volume required for settling at a prescribed velocity.

V = Qp x (l/w) x (⌠/v)

where,

V = sedimentation system volume (cubic metres)
Qp = peak inflow rate from a design storm having an average recurrence interval of 20 years (cubic m/s)
l/w = length to width ratio, where l is along the direction of flow
⌠ = Lambda is a scaling factor which accounts for silt accumulation and removal frequency. Values are shown in Table 4-2 for three types of sedimentation systems.

Table 4-2 - Scaling factor.

Sedimentation system type	l/w	⌠
Basins	2 – 3	2.5
Terraces	8 – 10	1
Ponds	2 - 3	6

v = flow velocity (m/s), maximum = 0.005m/s

- **Holding ponds or evaporative systems** should capture and store effluent following treatment in a sedimentation system. Evaporative systems are not the preferred method of effluent treatment however where annual evaporation is significantly greater than average rainfall they may be used. Consideration must also be given to the seasonality of rainfall and the predicted time and duration of intensive feeding.
  - Where holding ponds are used the volume needed to contain major storm events and for extended storage periods (annual water balance) should both be calculated and the pond sized to accommodate whichever is the greater.

    Major storm event: Holding ponds should be able to contain the runoff from a 1 in 20 year 24 hour storm event, with runoff coefficients of 0.8 for pens, roadways and other hard areas, and 0.4 for grassed and

	other areas. Annual water balance: Holding ponds should be capable of containing at least the runoff from a 90 percentile wet year using a water balance calculation which uses at least monthly inflow, evaporation and water withdrawal information. Runoff coefficients should be determined on a site by site basis, and should be from 0.3 to 0.5. Your local authority should be consulted to determine state specific requirements as other specifications may be applicable. o Evaporative systems should be broad and shallow and able to contain the runoff from a 96 percentile wet year. Runoff coefficients should be determined on a site by site basis, and should be from 0.3 to 0.5. - Pond spillways should be designed to discharge a 1 in 50 year design storm event at non scouring velocity. - The minimum pond freeboard (vertical distance from the normal water surface to the top of a confining wall) is 0.9 metres - Where effluent is spread onto irrigation areas a **terminal system** should be included as part of the drainage system to collect irrigation tailwater and manage contaminated stormwater runoff from effluent irrigation areas. - The terminal system should be able to accommodate the effluent tailwater volume plus storm water runoff from the irrigation area. As determined by the equation: **Equation 4-2 - Volume required for terminal system.** **V = a + b** where, **V** = volume of terminal system (cubic metres) **a** = effluent irrigation tailwater (cubic metres) **b** = storm water runoff from the effluent irrigation area (cubic metres). 12 mm runoff allowance is recommended for

	environmentally sensitive locations (eg unprotected water courses). In environmentally non-sensitive locations other means of managing the runoff may be suitable such as vegetated buffer strips or artificial wetlands. - The drains, sedimentation system, holding or evaporation ponds, and terminal systems should be lined with a material which prevents the infiltration of water. The permeability standard used in many states is 1×10^{-9} m/sec. This requires a good quality, non dispersive clay as a source material and may need compaction to achieve the desired permeability standard. Where suitable clay is not available an artificial membrane such as a geotextile or High Density Polyethylene (HDPE) will be required.
4.9 Manure stockpiles	
- An area be set aside within the controlled drainage scheme of feeding systems for use as a manure stockpile. The ground surface of the manure stockpile area be prepared in a way which makes it impervious, and promotes runoff into the drainage system.	- The stockpile area should be used for the temporary storage of manure when the soil conditions are unsuitable for land spreading of manure. Manure and mortalities may be composted in the stockpile area.
4.10 Effluent and manure utilisation areas	
- On site waste utilisation areas be of sufficient size and capacity to accommodate the wastes generated from intensive feeding system's activities with no deleterious build up of waste constituents in the soil.	- Sufficient area of crop or pasture should be available for effluent and manure spreading. Application rates will depend on soil type and current nutrient load of both soil and effluent. Harvesting crops and grazing pastures should prevent nutrient build up. This should be verified through annual testing of soils to verify the sustainable reuse of nutrients. - The annual loading rate of each of the major constituents of the effluent and manure (nitrogen, potassium, phosphorus, salt, water) should be calculated. The area required for effluent or manure utilisation will be the largest calculated for any individual constituent. o Effluent irrigation: The design criteria should be based on effluent utilisation in a 90 percentile wet year. Loading parameters which must be considered

	include hydraulic (water) load from effluent and all other sources, biological oxygen demand, nitrogen, potassium, phosphorus and salt. Annual loading rate of effluent should be determined by the constituent requiring the largest area, or lowest application rate to match the amount spread with the amount removed. o Manure spreading: The nutrient composition (nitrogen, potassium, phosphorus) and salt content of the manure, and the yield and nutrient composition of the crop should be estimated and balanced to determine the area required for manure utilisation.
4.11 Carcass disposal	
	- **General carcass disposal** should be conducted by composting within a suitable composting site, including, a composting bunker, manure stock pile or windrow. All runoff from the composting area must be controlled and managed. The windrow is one of the simpler methods which can be used to compost carcasses. 1. Place a layer of dry organic matter 30 centimetres deep on the ground over an area slightly larger than the carcass. Straw, sawdust or hay are all suitable. 2. Place the dead animal on the bed and cover with another layer of the dry organic material to a depth of 30 centimetres. 3. Cover all of this with semi-dry organic material such as feedlot pen manure, stockpiled manure, or silage. This layer needs to be at least 60 centimetres deep to contain odours and exclude scavengers. 4. Allow the pile to "work" for 20 days undisturbed. Internal temperatures should reach between 65 - 75°C. 5. After 20 days, or when the internal temperature falls below 60°C, turn the pile and expose the carcass. Cover the

	carcass again with 30 centimetres of dry organic material and 60 centimetres of semi-dry material. 6. Allow the pile to "work" for another 20 days undisturbed. Internal temperatures should reach 70°C and then slowly decrease. After the 40 days only large bones and some wool will remain. The composted carcass can then be incorporated with manure or solid wastes for spreading on land. - Where carcass disposal through composting can not be conducted burial is a suitable method. - For **mass mortalities or disposal of infected stock** burial is the preferred method of disposal. In this method carcasses should be deeply buried in a completely sealed pit to prevent the escape of fluids and/or infectious agents. If sufficient good quality clay is not available the pits may need to be lined with high density polyethylene (HDPE) or other such material to prevent leakage. - The Environment Protection Authority (EPA) in your state may have specific regulations in relation to burial as a method of disposal and requirements for the location, construction, sealing and monitoring of pits. Contact your state EPA office for details. - During construction topsoil should be separated from subsoil to allow replacement when the pit is sealed. Where appropriate, excavated soil should be placed on the upslope side of the pit to divert surface runoff from entering the pit. - The following dimensions are recommended for disposal of stock through burial: o depth: approximately 4 metres o width: no greater than 3 metres o length: will be dependent on number and size of carcasses for burial

	o backfill: 1.5 – 2 metres of backfill should be placed over carcasses ▪ as carcasses decompose additional soil should be added to accommodate subsidence ▪ the pit should be monitored over the following months and when subsidence has stopped the surface of the pit should be sealed with clay and levelled then covered with topsoil.

5. Requirements for intensive shed feeding systems

Objective

Intensive shed feeding systems are managed in a way that ensures the health and welfare of stock is maintained.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
5.1 General	
- Intensive shedded feeding systems have adequate natural ventilation, or mechanical ventilators to assist in the removal of excessive heat, moisture, carbon dioxide, dust, noxious gases and infectious organisms from the ambient environment. - Adequate fire fighting equipment be available to control shed fires. - Reasonable action be taken to protect sheep from predation. - Lighting be adequate to allow inspection of all sheep.	- Where shed floors are elevated, they should be high enough for the safe operation of people and machinery. - Shed orientation should account for potential extremes of temperature that may be encountered during the operation of the facility. - All ventilation equipment (ie shutters, fans, removable panels) should be checked regularly to ensure it is fully operational. - Sheds with controlled or forced ventilation that rely on automatic equipment should be inspected daily or have a back-up system in the event of mechanical failure. - Fire alarms should be fitted and regularly checked for function in all sheds. There should be a contingency plan in the event of fire. - Natural or artificial light should be made available for a minimum of nine hours per day. - A portable source of lighting should be available to inspect sheep at night or in times of insufficient light. - Flooring for sheep should be installed and maintained in a manner that minimises slipping, falling and injury. Appropriate materials may include wooden slats, steel grating or woven wire mesh. - Where woven wire mesh is used as pen

	flooring the mesh should be constructed to provide adequate support for the sheep's feet. 5mm diameter wire with 18mm aperture is considered an appropriate mesh size. - Shed flooring should be designed and maintained in a way that reduces the build up of manure. Where plastic/rubber mats are used they should be woven to allow manure to pass through. - Loading facilities should be designed to efficiently and safely move sheep into and out of the shed. - Pests such as birds and rodents should be controlled within sheds.

6. Community amenity

Objective

Intensive feeding systems implement strategies to encourage community amenity through consideration of separation distances, odour and dust minimisation, pest management and visual impacts.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
6.1 General	
- Offensive odours, noise and dust be minimised to ensure that negative effects on neighbouring properties and/or sensitive areas are kept to a minimum. - Pests be controlled within intensive feeding systems.	- Intensive feeding areas should be designed with a northerly aspect to maximise solar radiation and evaporation rates. - Dust should be controlled within intensive feeding systems. See section 8.1 for further information regarding dust control measures. - Intensive feeding systems (including associated buildings) should be sited so that topography and vegetation are used effectively to reduce the visual impact of the operation.
6.2 Separation distances	
- Separation distances exist between intensive feeding systems and sensitive areas to address community amenity. - Separation distances be preserved between all effluent treatment systems or land disposal areas and sensitive features at all times.	***Note**: Separation distances below refer to the distance from the closest point of the intensive feeding system's boundary to the receptor. For the purposes of deriving separation distances the intensive feeding system includes pens, handling facilities, sedimentation systems, holding ponds and manure stockpile and composting areas.* - Intensive feeding systems should consider separation distances in two contexts: 1. **Fixed separation distances** – these separation distances are not dependent on individual site information and will be the same for all sites.

Table 6-1 - Fixed separation distances

Feature	Distance
Public road - except as below	200 m
Public road - unsealed with less than 50 vehicles per day excluding feedlot traffic	50 m
Major watercourse	200 m
Other watercourse	100 m
Property boundary	20 m

2. **Variable separation distances** - are based on the dispersion of odours from their source. They are used to determine allowable sheep numbers and management practices necessary to satisfy adopted air quality objectives for individual sites.

   The following equations provide estimates of:

   - the maximum allowable standard sheep units at any one time for a site from a sensitive receptor at a given distance;

     Equation 6-1 - Maximum allowable standard sheep units for site.

     $$N = (D \div S)^2$$

   - the minimum allowable distance for a specified number of standard sheep units from a sensitive receptor.

     Equation 6-2 - Minimum allowable distance of site from sensitive receptor.

     $$D = \sqrt{N} \times S$$

     where,

     N = Maximum number of standard sheep units at any one time.
     A standard sheep unit is defined as a sheep of 60 kilograms live weight, see Table 6-2.

     D = Separation distance in metres between the closest points of the feedlot, including the pens, manure storage areas, effluent system and loading or unloading facilities and the most sensitive receptor or impact location.

     S = Composite Site Factor (= S1 x S2 x S3 x S4)

The factors S1, S2, S3, and S4 relate to stocking density, receptor type, terrain and vegetation and can be determined from the tables below.

Standard Sheep Units (SSU)

Different operations cater for different sized animals. Larger sheep and lambs usually produce more manure than smaller animals, and hence have a greater potential for odour production. The guidelines allow the manure and odour potential of different weight sheep and lambs to be derived from SSUs by the use of Table 6-2.

The equivalent cattle SCU figure should be used when cattle and sheep feedlots are built as one development or in close proximity to each other in order to determine the separation distance for the combined feedlots.

Note: Standard Sheep Units (SSU) are not equal to Dry Sheep Equivalents (DSE).

Table 6-2 - Standard sheep units conversion table

Sheep liveweight (kg)	Standard Sheep Unit (SSU)	Equivalent Standard Cattle Unit (SCU)
≤25	0.519	0.071
26-30	0.595	0.081
31-35	0.667	0.091
36-4	0.738	0.101
41 45	0.806	0.110
46-50	0. 2	.119
51-55	0.937	0.128
56-60	1.000	0.137
61-65	1.062	0.145
66-70	1.123	0.15
71-75	1.182	0.162
>75	1.241	0.170

Composite site factor (S)

The composite site factor is calculated from a range of factors to account for site specific information and is determined by the following equation:

Equation 6-3 - Equation to determine the composite site factor (S).

S = S1 x S2 x S3 x S4

The tables below detail the information required to derive the value for 'S'

S1 - Stocking density factor

First determine the class of the feedlot from Table 6-8, page 36.

Then determine the stocking density which is the area available per standard sheep unit held in the pen.

Table 6-3 provides the S1 factor for each class of feedlot by stocking density.

Table 6-3 - Site factor S1

Stocking density (m^2/SSU)	S1 factor		
	Class 1	Class 2	Class 3 & 4
1.0	49.5	67.9	83.8
1.5	46.5	63.3	78.1
2.0	43.5	58.7	72.4
2.5	40.5	54.1	66.7
3.0	37.6	49.5	60.9
3.5	32.1	42.6	52.4
4.0 and over	26.6	35.7	44.0

S2 - Receptor factor

The receptor factor will vary depending on the likely receptor type and is determined from Table 6-4.

For a town, the distance is measured from the closest point of the proclaimed town boundary. For a rural farm residence, the distance is the closest part of the residence itself, excluding any yards.

Rural residential (or rural living) developments result from land subdivision into blocks of land which are larger than town residential blocks but smaller than traditional commercial agricultural blocks. This usually results in houses being spaced closer than farming residences but further apart than in towns and cities. Where more than 5 rural residential blocks adjoin each other they can be considered a rural residential development. These developments can be broadly divided into two categories:

- Intensive rural residential developments are defined as individual blocks of less than 1 hectare.
- Extensive rural residential developments are individual blocks which range from 1 – 10 hectares.

Public areas are those subject to occasional community use. Higher values are appropriate for public areas used frequently or sensitive in nature such as schools and frequently used halls and recreation areas.

Table 6-4 - Site factor S2

Receptor Type	Value
Large towns (>2000)	1.6
Towns (100 - 2000)	1.2
Small towns (20 - 99)	1.0
Intensive rural residential developments	1.0
Extensive rural residential developments	0.7
Rural farm residence or rural school	0.3
Rural church/community centre	0.2
Public area	0.05

S3 - Terrain factor

The terrain factor varies according to topography and is determined from Table 6-5. This factor is primarily concerned with air drainage flow paths at night time (the katabatic wind effect), or the impact of low level night time temperature inversions.

High relief is regarded as up-slope terrain or a hill that projects above the 10% rising grade line from the feedlot. Thus the receptor location will be either uphill from the feedlot or be behind a significant obstruction which would deflect low velocity air movement away from the receptor.

Low relief is regarded as terrain which is generally below the 2% falling grade line from the feedlot. Thus the receptor will be downhill from the feedlot.

A valley drainage zone has topography at low relief (as above) with significant confining side walls.

Topographical features of the selected site may adversely affect the odour impact under certain circumstances. During the early evening or night time under low wind speed conditions, population centres located in a valley complex at a lower elevation than a feedlot may be subject to higher odour concentrations as a result of down-valley wind or the occurrence of low-level inversions. Unless site specific information has been gathered under conditions dominated by low wind speeds, the value for the S3 factor given in Table 6-5 should apply.

Table 6-5 - Site factor S3

Topography	Value
Flat	1.0
High relief >10%	0.7
Low relief >2%	1.2
Valley drainage	2.0

S4 – Vegetation and surface roughness factor

The vegetation and surface roughness factor will vary according to vegetation density and intervening topography between the intensive feeding systems and the receptor. The factors in Table 6-6 assume that the selected factor is continuous between the feeding systems and the receptor. Where the vegetation and roughness is variable or not continuous, judgement should be used in selecting an appropriate composite factor.

The tree cover may disappear during the life of the intensive feeding system requiring a reassessment of stock numbers.

The values suggested for S4 given in Table 6-6 for tree covered areas should be used with care by regulatory bodies and a number of provisions should qualify an approval given on this basis. For example, no concession should be given for an intention to plant a barrier, and should an occupier fail to maintain a stipulated barrier then a reduction in the allowed number of stock would be necessary. However, operators

should be encouraged to plant and maintain upper storey and lower storey vegetation between the system and the receptor. This will modify wind speed through the system, improve visual amenity, odour dispersion, dust reduction and noise attenuation. If these trees cast shade onto the pen areas consideration should be given to the procedures and guidelines in section 4.4 (Shade and shelter) of this document.

Table 6-6 - Site factor S4

Intermediate Landscape	Value
Few trees, long grass	1.00
Pasture, crops, no trees	1.00
Undulating landscape	0.93
Level wooded landscape	0.85
Heavy forest	0.77
Heavy timber	0.77
Hills and valleys	0.68

- For large scale intensive feeding systems with complex topographic or meteorological features or other significant odour sources nearby, then it may be more appropriate to determine the potential odour impact by odour source modelling. On site meteorological data may be required.
- Effluent treatment systems which are adjoining or in close proximity to the feedlot should adhere to the separation distances determined from Equation 6-2 except for the separation distances prescribed for roads, water courses and property boundaries, these are described in Table 6-7.
- Solid and liquid waste disposal areas should adhere to the separation distances detailed in Table 6-7 dependent upon the disposal methods described below. Where more than one category of disposal to land is used the method which requires the greatest separation distance is used to determine the separation distance.

  Method A
  - discharge by injection directly into the topsoil at a rate not exceeding either the hydraulic or nutrient and salinity limits determined for the soil type.

Method B

- solids that have been completely composted
- effluent having a solids content of not more than 1%.

Method C

- mechanical spreaders in combination with “ploughing-in” type equipment
- downward effluent discharge nozzles
- discharged material is not projected to a height of more than 2 metres above ground level.

Method D

- all effluents that are discharged or projected to a height in excess of 2 metres above ground level
- liquid effluent in which water remains visible on the soil surface for periods in excess of one hour
- separated solids or sludge (except fully composted solids) that remain on the soil surface for more than 24 hours (i.e. are not immediately ploughed in).

Table 6-7 - Separation distances surrounding waste disposal areas.

	Distance in metres			
Disposal method	A	B	C	D
Large towns >2000 persons	500	1000	1500	2000
Towns >100 persons	500	500	1000	1500
Small towns >20 persons	200	400	500	1000
Rural farm residence not owned by feedlot	100	300	400	500
Public area (minimum value)	50	100	150	200
Public road - except as below	50	100	150	200
Public road - unsealed with less than 50 vehicles per day excluding feedlot traffic	50	50	50	50
Major watercourse	100	200	200	200

	Other watercourses	50	100	100	100
	Property boundary	20	20	20	20

Table 6-8 - Description of intensive feeding systems classes

Class	Permitted stock numbers	Design standard	Construction standard	Operation standard	Pen floor construction	Operating season
1	Limited by separation distances and environmental impacts	▪ High ▪ May be close to impact locations ▪ Buffer zones and separation distance must be within the property boundary	High	High	Graded and compacted hard pen floor	All year
2	Limited by separation distances and environmental impacts	▪ High ▪ Removed from impact locations	High	Less stringent than class 1	Graded and compacted hard pen floor	All year
3	Up to 5,000 standard sheep units depending on separation distances and environmental impacts	▪ Basic ▪ Well removed from impact locations	Basic	Basic	Graded pen floor on clay soils having low, intermediate and high plasticity, clayey sands and clayey gravels. ***Note:*** sandy soils are not suitable as a class 3 pen floor. For year round operation on sandy soils refer to class 1 or 2.	All year
4	Up to 5,000 standard sheep units depending on separation distances and environmental impacts	▪ Basic ▪ Well removed from impact locations	Basic	Basic	No special preparation Non compacted sandy soils	Dry season operation only

NOTE: *Supplementary feeding for production in a paddock is classed as a Class 4 system when the paddock is unable to sustain more than 50% of the feed required from pastures or crops which have a yield which is reasonable or commonly accepted for the district.*

7. Resolution of complaints

Objective

To ensure that managers of intensive feeding systems respond to complaints in a timely and accountable manner.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
7.1 General	
- All complaints received by intensive feeding systems enterprises be recorded.	- Once a complaint is received by a manager of an intensive feeding system it should be recorded, investigated and appropriately acted upon, including responding to the claimant. - Managers of intensive feeding systems should retain a copy of any reports to provide a permanent record of complaints and any follow-up action.

Feeding System Management

8. Daily operations

Objective

To ensure intensive feeding systems are managed in a sustainable, efficient and welfare-conscious manner.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
8.1 Operation and records	
- Relevant information be recorded to satisfy authorities in the event of an official inquiry. - An environmental management plan be implemented at all times. - Medications used to treat sheep or lambs be recorded and withholding periods (WHP) and/or export slaughter intervals (ESI) noted and adhered to. - Any individual animals treated with medication subject to WHP or ESI be clearly identified. - A National Vendor Declaration (NVD) and National Health Statement be provided with all stock both introduced and leaving the property with copies retained for 7 years. - Where necessary the movement of stock is updated on the NLIS database. - The loading, transport and unloading of stock be conducted in accordance with *Australian Standards and Guidelines for the Welfare of Animals: Land Transport of Livestock* (2008) Animal Health Australia, Canberra (or subsequent editions of this publication). - Contingency plans be in place in the event of: o water supply or quality failure	- All equipment should be maintained through regular cleaning, checking, repair of damage and re-calibration. - Shy feeders within intensive feeding systems should be removed and either sold, returned to the paddock (subject to biosecurity considerations) or penned separately, but not alone. - The following records should be maintained: o numbers of sheep or lambs by property identification code (PIC) o sheep or lamb purchases by PIC o sheep or lamb sales by PIC o sheep or lamb deaths by PIC o sheep or lamb treatments o feeding regimes o weather data o waste management o audits and/or annual reviews o register of non-conformance and corrective action o complaints register o occupational health and safety – accident and near miss register o growth rate and/or fat or body condition score. - The following checks should be conducted

o feed supply or quality failure o significant health or disease outbreaks o extreme weather conditions o personal accident or injury o fire or flood.	and recorded prior to sale: o animal has an appropriate NLIS tag in place and associated documentation o weight, fat score and fleece length o dentition o health status o sheep or lambs within withholding periods and/or export slaughter intervals o time off feed o time off water o excess mud or dirt on skins. - Transport of sheep or lambs either in or out of intensive feeding systems should be by the shortest and most comfortable route possible. Travel permits (such as waybills) and any other required documentation should be carried by the appropriate party. - Lighting should be provided for loading or unloading at night. - Avoid transporting sheep and lambs during hot weather. - If animals have been injured during transport, action should be taken to minimise further injury. - Purchased sheep or lambs should be given access to quality hay and clean water immediately on arrival and given at least 36 hours rest prior to induction. - Newly arrived sheep or lambs should be carefully inspected for disease or injury and treated appropriately. - Sheep should be moved quietly through yards with the minimum forcing by dog or person. - Working dogs within intensive feeding systems should be muzzled. - Horned and polled sheep or lambs within intensive feeding systems should preferably be segregated. - Dust generated from containment areas, feedlot pens and roads should be kept to a minimum. - The presence of dust should be controlled or

	prevented by implementation of the following strategies: o Dust should be minimised in areas such as handling yards through the use of water sprinklers o Dust should be minimised in laneways through resurfacing with compacted rubble or hard surfaces, or alternatively through the use of water or soil stabilising agents o Dust should be minimised within feedlot pens and containment areas through; ▪ correct selection of soil types that create minimal dust, or ▪ resurfacing of pen area with suitable material(s). - Water applied for dust control should be applied during the early evening hours to reduce the affect of humidity during hot weather.
8.2 Monitoring	
- Sheep and/or lambs and infrastructure in an intensive feeding system be monitored daily to ensure that any problems concerning feeding or watering systems, sick animals, shy feeders or pen condition are identified and resolved.	- Daily checking should include: o the early identification of shy feeders o faecal consistency score (refer Appendix 1 Faecal consistency scores) - Lamb growth rate and fat score should be monitored on a regular basis. - Sheep in containment areas should have body condition score monitored on a regular basis.
8.3 Pen and waste management	
	- Manure spreading or effluent irrigation, should be performed when the prevailing weather conditions will cause the least odour emission and impact on sensitive receptors. - Pens should be cleaned regularly to reduce depth of manure build up and allow faster drying as odour generation is likely to be much higher from a deep moist manure pack than from a shallow drier pack.

8.4 Pest management	

	- Pest management should include:
	  o Removal of waste feed around silos, storage areas and equipment on a regular basis
	  o Feed spills should be cleaned up without delay.
	  o Control weed growth to remove nesting habitats
	  o Bird netting to exclude birds from sheds
	  o Bait stations for rodents around sheds.
	  o Fly traps
	- Fly management should include:
	  o Waste management – manure and waste feed in pens, drains or stockpiling areas should be managed to reduce potential fly breeding sites
	  o Pen moisture – sites should have a drainage system that promotes rapid drying to reduce fly breeding potential

8.5 Animal health	
- Sick and injured animals be appropriately treated at the first opportunity. - All medications be administered in strict accordance with the manufacturer's instructions or under veterinary supervision. - In the event of a disease outbreak, notifiable diseases be reported to the appropriate authorities. - Reasonable action be taken to protect sheep from predation. - All reasonable precautions be taken to minimise heat stress, cold stress and other environmental impacts.	- Deaths should be appropriately investigated.

9. Feed and water

Objective

Sheep and lambs have sufficient access to suitable quality feed and water.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
9.1 General	
- Ruminant feed bans be adhered to. - Frequent assessment be made of the changing requirements of sheep and lambs in relation to the amount, quality and ongoing supply of feed and water. - Palatable and fresh feed be provided at a rate adequate to meet physiological requirements (see section 15.2. - Troughs be cleaned as frequently as necessary to optimise water and dry matter intake. - Gloves be worn when cleaning feed and water troughs to reduce the risk of disease transmission - An adequate supply of clean, good quality water be available to sheep and lambs at all times (other than when adhering to curfew requirements).	- Feed spills should be cleaned up without delay. - Feed should meet the nutrient requirements of sheep and lambs, be free from contaminants, rodents and insects. - A vendor declaration should accompany all purchased feeds. - Water should be provided in troughs rather than dams. - Water troughs and float valves should be maintained to minimise overflows and spillage. - Wetting of the area surrounding the water trough should be minimised.

10. Induction procedures

Objective

To ensure optimal animal health and welfare outcomes during the transition from an extensive to an intensive production system and from a roughage-based diet to a grain-based diet.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
10.1 General	
- Dogs be under control at all times when working sheep and lambs and those that habitually bite be muzzled while working. - All sheep and lambs be identified with an NLIS tag.	- If shearing is required, it should be undertaken a minimum of one week prior to induction to reduce animal stress. - Lambs should be drafted into weight ranges and penned in groups according to the guidelines for stocking density (refer page 17). - Sheep and lambs should be moved quietly through the yards with minimum forcing by dogs or people. - All sheep and lambs entering an intensive feeding system should be identified according to current state-specific NLIS policy.
10.2 Feed and water	
	- Purchased lambs for intensive finishing should be given access to quality hay and clean water immediately upon arrival and provided with 36 hours rest before induction. - Sheep entering containment areas should be provided with access to clean water and roughage of an appropriate nutritive value to meet requirements.
10.3 Health	
	- On arrival sheep or lambs should be carefully inspected for evidence of disease

	or injury and treated appropriately. - All sheep and lamb groups should be inspected on arrival at an intensive feeding system for parasites and, if found to be infested, should be treated and quarantined for sufficient time to prevent spread to other animals. - Faecal egg counts and drench resistance testing should be undertaken for sheep and lambs and repeated when and if internal parasites are suspected. - Sheep and lambs should be vaccinated against enterotoxaemia prior to commencing grain feeding. A 3-in-1 vaccine will suffice. Vaccination site should be the loose skin behind the back of the ear or head. - Sheep or lambs that appear unwell should not be admitted into an intensive feeding system, but managed accordingly.

11. Releasing sheep from containment areas

Objective

To optimise animal health, welfare and productivity of sheep during transition from an intensive feeding systems to an extensive grazing system and to minimise the risk of a break in the wool staple.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
11.1 General	
	- Sheep should be released late in the day to ensure gut fill and reduce gorging on lush pasture. - The transition from confinement to pasture may be assisted by gradual daily increases in the amount of time spent grazing.
11.2 Feed and water	-
	- Sheep should have access to quality roughage for 12 hours prior to release from a containment area. - Dry sheep should be released into an extensive grazing system onto a minimum of 500kg DM/ha when daily pasture growth rates exceed flock requirements. - Ewes in late pregnancy should not be released from the containment area without the provision of supplementary feed, until at least 1000kgDM/ha pasture is available in the paddock. - Lactating ewes should not be released from the containment area without the provision of supplementary feed, until at least 1200kgDM/ha pasture is available in the paddock (single lamb) or 1500kg DM/ha for ewes with twin lambs at foot.

	- Where DM/ha is less than 1000kg, the containment area ration should be offered in the paddock during the transition period of 14 days. - Ewes that will be grazing cereals or grass dominant pastures should have ongoing access to salt and finely ground limestone or an appropriate calcium-rich supplement. - Consideration to the timing of shearing (if required) should be given with respect to potential wool breaks and timing of lambing. Shearing should not be undertaken during the last 50 days of pregnancy.
11.3 Health	
	- Sheep should be vaccinated against enterotoxaemia prior to release, a 3-in-1 vaccine will suffice.

12. Personnel

Objective

All people involved in the operation of intensive feeding systems are competent, responsible and dedicated to the efficient, sustainable, productive and welfare-conscious operation of the feeding system.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
12.1 General	
- Managers, superintendents or supervisors of intensive feeding systems ensure that high standards are maintained in relation to: o stock handling o appointment of staff competent in stockmanship o training and supervision of staff. - All personnel be responsible for the welfare of sheep and lambs within their care. These responsibilities include: o stress avoidance and minimisation o understanding and working with animal behaviour o early recognition of stress and disease and the prompt initiation of appropriate remedial action. - A person involved in handling, inspection, assessment, loading, transporting and unloading livestock be competent or be supervised by a competent person. - All staff be aware of their responsibilities and these be clearly defined. - Emergency contact details of the responsible officer be clearly displayed. - All staff and visitors on site be aware of	- Documentation of staff responsibilities should include: o job description o procedure manual o Occupational Health & Safety (OH&S). - Staff should be competent in: o livestock handling o inspecting and assessing livestock o maintaining records o planning and contingency planning, including: ▪ animal health ▪ feed and nutrition requirements ▪ compliance with withholding periods ▪ stock movements to ensure journeys satisfy welfare standards and address contingencies that may arise, with consideration to extremes of weather, nature of the journey, class and condition of livestock, and time off feed and water o humane destruction. - Supporting evidence of competency should

workplace health, safety, emergency and biosecurity procedures. - Accurate personnel records be kept. - Sheep and lambs be handled in a manner that minimises pain or injury to the animal. Specifically: o sheep and lambs not be lifted by only a single leg, the head, ears, horns, neck, tail or wool o sheep and lambs not be thrown or dropped o sheep and lambs not be struck in an unreasonable manner, punched or kicked o dragged by one leg but may be caught by one leg o dragged by the ears, tail, or wool o dragged by mechanical means, except in an emergency for the minimum amount to allow safe handling, lifting, treatment or humane destruction. - Electric prodders are not be used: o on genital, anal, udder or facial areas o on sheep under three months old o on sheep that are unable to move away o excessively on any sheep. - To avoid carcase and pelt damage electric prodders not be used.	include any of the following: o induction and training o records of on-the-job training o relevant experience o recognised training and staff training registers o supervisor sign-off for specific tasks. - Professional development of all staff should be encouraged. - Non-compliance should be identified, discussed with the relevant individual(s), recorded, corrected and measures put in place to ensure prevention in the future. - Handling procedures should ensure minimisation of stress to all sheep, whether handled directly or indirectly.

13. Biosecurity

Objective

Management of intensive feeding systems ensures that the risk of introduction of disease to an enterprise or the spread of disease to other farms or enterprises is minimised.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
13.1 Health	
- A veterinarian or government official be notified in the event of death or illness due to a suspected notifiable disease. - Dead stock be removed promptly and if not required for post-mortem disposed of appropriately (refer to section 4.11 Carcass disposal).	- Records of sickness and death should be kept for easy reporting and assessment of mortality and morbidity rate changes. - Sick or diseased animals should be removed and isolated in a sick pen and treated accordingly. - A health management plan should be devised and implemented at all times.
13.2 Feed and water	
- Restricted animal material (RAM) not be fed. - All staff involved in the feeding of stock be aware of restricted animal materials (RAM) that cannot be fed to stock. - Stockfeed subject to Withholding Period (WHP) and/or Export Slaughter Interval (ESI) restrictions not be fed.	- Stockfeed should be sourced from suppliers who operate under a quality assurance program that has a biosecurity component. - Stockfeed should be protected from contamination by vermin or feral and domestic animals - Feed and water resources should be protected from pest and weed contamination. - Feed and water troughs should be cleaned out regularly. - Feed should be stored in a clean, dry area to prevent contamination and spoilage. - Purchased feed should always be accompanied by a commodity vendor declaration (CVD) or by-product vendor declaration (BVD) to ensure it is fit for purpose. - Feed should not contain a high content of weed seeds that could germinate on the

	property. - Old, spilt or contaminated feed should be disposed of safely, ensuring that stock and pests do not have access. Disposal methods may include burial or composting. - Visitors should not feed stock. - Labels of purchased feed should be checked to ensure that it is fit for purpose and specifically does not contain RAM.
13.3 Animal movement	
- All newly introduced stock be inspected on arrival to ensure they are in good health. - All stock be fit for travel before loading for travel. - A National Vendor Declaration (NVD) and National Health Statement be provided with all stock both introduced and leaving the property with copies retained for 7 years. - Where necessary the movement of stock is updated on the NLIS database. - All stock be identified with appropriate NLIS ear tags.	- Records of all stock transactions and movements should be kept up to date and maintained. - Introduced stock should be appropriately vaccinated and treated for parasites. - Introduced stock should be kept separate from existing stock for a minimum period of seven days in a quarantine area to determine health status and identification of diseases.
13.4 Pests and weeds	
- Pests be controlled within intensive feeding systems.	- A pest animal control program should be developed and implemented. - Rubbish dumps and carcass disposal areas should be operated in such a manner that does not attract pest animals to the area and the property. - Silos, storage bins and feed storage sheds should be in good repair and inspected regularly for any pest incursions.
13.5 Vehicles and equipment	
	- Visitor vehicles should be clean and parked in a designated area away from livestock. - A high pressure wash-down facility should be established away from livestock and feed storage areas to clean vehicles and equipment. Any run off should be directed away from livestock or feed storage areas into a controlled drainage system.

	- Any equipment to be used in an intensive feeding system should be clean.
13.6 People	

	- All visitors should report to management on arrival and sign a visitor register.
	- People involved with or visiting intensive feeding systems should exercise good hygiene practices such as:
	  o wearing clean clothes and footwear
	  o washing hands after contact with:
	  ▪ livestock, working dogs and pets
	  ▪ manure, dirt and other waste material
	  ▪ feed material
	  o avoid wearing dirty clothes and/or footwear out of the feeding system.
	- All visitors (eg working veterinarians, consultants, sales/company representatives) should be individually assessed with respect to the risk they pose to farm biosecurity with this risk recorded in the visitor register.
	- Visitors that pose a high biosecurity risk should be subject to appropriate mitigation measures such as:
	  o cleaning or changing clothing and footwear
	  o washing hands
	- Visitor contact with livestock should be limited as much as possible
	- All staff and visitors should be briefed on the biosecurity measures implemented on-farm and have an understanding of how diseases, pests and weeds are spread.
	- All staff should be aware of the restricted animal material feeding ban.

13.7 Design	
	- Only one entry point to the feeding system enterprise should be used to facilitate easy recording of all movements into and out of the complex.

	- Signage regarding biosecurity measures implemented on-farm should be clear, concise, visible to all and frequent enough to support the message. - Damaged signs should be replaced or fixed as soon as possible. - Carcass disposal areas should be in a separate area to the feeding area. - The relevant environmental agency(s) should be consulted in relation to site selection of carcass disposal areas in the event of a major disease outbreak or large losses due to extreme weather or any other cause.

Animal Health

Note: *The following information is designed to provide general information on specific health issues and diseases pertinent to intensive sheep and lamb feeding systems. This is not a substitute for professional veterinary consultation or care and does not constitute legal, managerial or veterinary advice nor does it imply endorsement of any product. Care and effort has been taken to ensure that the information provided in this document is accurate however no responsibility will be accepted for any losses that result through the use of this material.*

14. Health management

Objective

To ensure that disease and injury are minimised, detected quickly and treated appropriately.

Recommended procedures It is recommended that:	Guidelines Further guidelines include:
14.1 General	
- Managers or staff responsible for the health and well-being of sheep and lambs ensure that appropriate preventative measures for diseases that are commonplace in intensive feeding systems are in place, operational and clearly understood. - All sheep and lambs admitted to intensive feeding systems be in good health. - Sick, injured or diseased sheep and lambs be given prompt and appropriate treatment or be humanely destroyed. - All medications be administered in strict accordance with the manufacturer's instructions or under veterinary supervision. - Medications used to treat sheep or lambs be recorded and withholding periods (WHP) and/or export slaughter intervals (ESI) noted and adhered to. - Any individual animals treated with medication subject to a specified WHP or ESI be clearly identified. - Stockfeed subject to Withholding Period (WHP) and/or Export Slaughter Interval (ESI) restrictions not be fed. - If an illness or death is encountered without the cause being known or reasonably anticipated, it is the responsibility of management to carry out an appropriate investigation. - Dead sheep and lambs be removed promptly and, if not required for post-mortem	- A health management plan should be devised and implemented at all times. - Disease prevention measures, such as drenching, vaccination, mineral or vitamin supplementation and shearing/crutching, should be implemented as appropriate. - Procedures carried out should be done in a manner that minimises or avoids stress. - Precautions should be taken to eliminate contamination of feed and water by rodents and birds. - Exposure to environmental and/or feed dust should be minimised. - Effective and humane methods of euthanasia which cause a quick and painless death should include firearm, captive bolt followed by bleeding out, bleeding-out or lethal injection under veterinary supervision. - A firearm should deliver at least the power of a standard 0.22 long rifle cartridge. The poll method (shown as position B in Figure 14-1) is the recommended position and direction of fire for humane destruction of sheep.

examination, disposed of appropriately.

- Where sheep and lambs need to be euthanised, and the animal(s) is not immobile, it be restrained and all OH&S principles be complied with.
- Where sheep and lambs need to be euthanised, it be conducted in a manner that results in immediate loss of consciousness and death while unconscious.
- Humane destruction of animals be carried out by a competent person or under direct supervision of a competent person.
- Reasonable action be taken to protect sheep from predation.

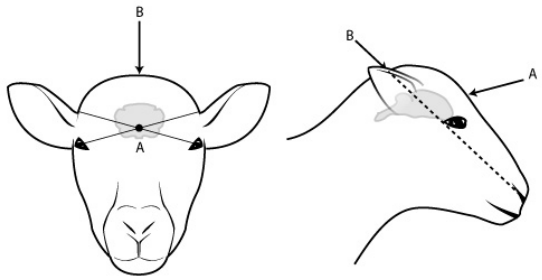

Figure 14-1 - Recommended position and direction of fire for humane destruction of sheep.

15. Feed and water

Objective

To ensure that lamb growth and health is optimised and a satisfactory body condition score is maintained for sheep by the provision of feed and water of a quality that is palatable and meets nutrient requirements.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
15.1 General	
- Market requirements be investigated before considering using antibiotics.	- Sheep and lambs should not be exposed to noxious chemicals and exposure to dust should be minimised.
15.2 Feed	
- Lambs be provided with a diet which is nutritionally adequate to maintain health and meet the appropriate physiological requirements for growth. - Sheep be provided with a diet which is nutritionally adequate to maintain health and meet their appropriate physiological requirements. - Intensively fed lambs be provided with feed at a minimum rate of 2.8% of bodyweight per day with due consideration being given to the provision of adequate nutrients. - Minimum daily feed intake as a percentage of liveweight (dry matter basis) for the following classes of mature stock be provided with due consideration being given to the provision of adequate nutrients; o wethers – 1.68% o dry, non-pregnant ewes – 1.68% o ewes in early pregnancy – 2% o ewes in late pregnancy – 2.5%. - Rations be formulated on a “dry matter”	- Optimal nutrient requirements of lambs vary according to age, live weight and genetic potential. Specialist advice should be sought to ensure rations are correctly formulated. - Pregnancy scanning should be undertaken so that rations can be formulated to meet the requirements of single and twin bearing ewes. - Nutrient requirements of mature sheep vary according to age, live weight, and stage of pregnancy. Specialist advice should be sought to ensure rations are correctly formulated. - Feed trough length allocation will depend upon feeding method – *ad libitum* or restricted feeding. - Sheep and lambs being introduced to an intensive feeding system should be given time to adjust to the new dietary regime, feeding environment and equipment. - Where cereal grain constitutes less than 60% of the diet, 7-14 days should be allowed for adaptation to the ration. Where high

basis. - Daily feed requirements be allocated on an "as fed" basis. - Rations be formulated with at least current average nutritive values for each feedstuff and contain a minimum of: o 10 megajoules of metabolisable energy per kg dry matter and 12 percent crude protein for lambs o 8 megajoules of metabolisable energy per kg dry matter and 8 percent crude protein for wethers and dry, non pregnant ewes o 8 megajoules of metabolisable energy per kg dry matter and 8.7 percent crude protein for single bearing ewes in late pregnancy o 10 megajoules of metabolisable energy per kg dry matter and 10.5 percent crude protein for twin bearing ewes in late pregnancy. - Stockfeed within prescribed WHP or ESI not be fed - All stock have sufficient access to feed. - High quality, palatable roughage be available *ad libitum* to sheep and lambs during the introductory period to grain except in the case of total mixed rations where the grain content is increased gradually and roughage is incorporated. - Sheep and lambs being introduced to grain-based pellets have high quality roughage available at all times.	starch grains constitute more than or equal to 60% of the diet or when feeding grain based pellets, introduction to this ration should be conducted over 14-21 days. - Sheep and lambs being introduced to hay-based pellets should have high quality roughage available for the first 7 days of introduction. - Sheep and lambs should be introduced to grain feeding prior to induction to the feedlot or containment area to help reduce stress and neophobia that can be associated with new feeds and an unfamiliar environment. - All individual feeds should be tested by an accredited laboratory for: o Dry matter (DM) % o Crude protein (CP) % o Metabolisable energy (ME) o Neutral detergent fibre (NDF) % o Calcium & phosphorus % - Hay should be sampled with the use of a bale corer. Core samples from 5-10 large bales or 10-20 small square bales, totalling 500 g, should be mixed thoroughly and sent directly to the laboratory. - Testing of baled silage should be conducted as for hay. If sampling silage pit(s), samples should be taken with a corer from 5 locations across an uncovered pit or from 10 positions across a freshly cut face. Sample(s) should be mixed thoroughly and total 500g in weight, should be sealed in an air tight plastic bag and sent to the laboratory. Refrigerate sample if it cannot be posted immediately. - Testing of bagged grain or pellets should be conducted through sampling at least 6 bags to make up to an amount of no more than 500g. Sampling of grain or pellets in silos should be conducted through periodically sampling feed as it is augured into the silo to make a sample of no more than 500g.

15.3 Water	
- Sheep and lambs not have access to water which contains potentially toxic levels of salts, or other deleterious substances. - Where water is supplied through the use of nipple drinkers or water bowls, sufficient access points be present to allow all sheep and lambs access throughout the day. Regardless of the number of sheep or lambs within a pen there be no less than two drinkers per pen.	- Water trough length will vary according to number of sheep or lambs per pen, number of water access points, trough design and water pressure. - A minimum of 4 litres of water per head per day and up to 6.5 litres during sustained hot and/or humid weather should be available on demand. At least 3 days water supply should be available in case of breakdown or emergency. - Where water is supplied through the use of nipple drinkers there should one per 15-20 animals with a minimum of two drinkers per pen. - Where water is supplied through the use of water bowls there should be one per 60 animals with a minimum of two bowls per pen. - Where sheep are fed grain, water troughs should be cleaned regularly to minimise contamination. - Water resources should be fresh, palatable and cool with less than 4000ppm soluble salts for lambs and 7000ppm for mature sheep.
15.4 Curfew	
- Total time off water not exceed the time periods given below: o lambs less than 4 months of age - 28 hours o sheep and lambs greater than 4 months of age - 48 hours o ewes known to be more than 14 weeks pregnant, excluding the last 2 weeks - 24hrs. - Ewes in the last two weeks of pregnancy not be deprived of water. - Total time off feed prior to slaughter not exceed 48 hours.	- Sheep and lambs should not be deprived of water for more than 20 hours. This period should be reduced in the event of hot weather.

16. Acidosis

Also known as grain poisoning, ruminal stasis or grain engorgement.

Predisposing Factors:

Acidosis is caused by accumulation of large amounts of ruminal lactic acid following ingestion of diets that are high in fermentable carbohydrate or low in effective fibre. Acidosis occurs most commonly in grain fed animals.

Acidosis commonly occurs:

- when sheep are first given access to grain
- when there is a sudden increase in the amount of grain being fed
- if excessive grain is consumed
- when there is a change in the type of grain or concentrate being fed or even the same grain type but from differing sources
- as a result of accidental access to bagged grains in sheds, spilt grain under silos or other grain stores or depots
- as a result of inadequate supply of effective/long fibre or a fibre source that is unpalatable.

Sheep should be introduced gradually to grain over a two week period whilst ensuring adequate palatable roughage is available. Equally any ration changes should be conducted gradually to ensure time for ruminal adjustment.

Wheat, triticale, rye, barley and oats are (in that order) the most likely grains to cause acidosis.

Overeating does not usually occur when animals are first offered grain because they have not developed a 'taste' for the new feed. Overeating is more likely to occur when animals are:

- offered large amounts of grain after a period of abstinence,
- offered a sudden increase in amount or sudden change to a more 'dangerous' grain, or
- allowed access to their normal full ration after a short period of starvation or cold stress.

High moisture rations can reduce rumen pH due to reduced saliva production. Silage for example requires less chewing to reduce particle size to allow flow of digesta through the rumen. High quality silage may also be acidic with a pH reading below 5. Reduced chewing, reduced saliva production and acidic silage may increase acid load.

Adding unsaturated fats and oils (such as vegetable and fish oils) may increase acidosis risk through reducing fibre digestibility and rumen pH.

Signs and Symptoms:

Symptoms associated with acute (rapid onset) acidosis:

- rumen contents become acidic, falling below 5.0
- excessive fluid build up within rumen and intestinal contents lead to a distension of the abdomen
- inappetence, depression, isolation, panting, dehydration,
- laminitis (lameness)
- diarrhoea/scouring and possibly
- death.

Symptoms associated with subclinical (before symptoms are readily observed) acidosis include:

- a reduction in rumen pH, and motility
- a reduction in rumination (cud chewing)
- great daily variation in feed intake, reduced feed efficiency and a reduction in average daily growth rates
- faeces may vary from firm to diarrhoea and may appear foamy, with gas bubbles and/or contain undigested fibre or grain and/or mucin/fibrin casts.

Control and Prevention:

The gradual introduction of high risk feeds (starch rich grains and/or high starch, low fibre feeds such as grain-based pellets) to sheep and lambs is the most effective prevention option.

Whole grain should be gradually introduced to sheep and lambs over the following periods:

- Oats: 3-5 days
- Barley, triticale, rye, sorghum and wheat: 14 days
- Lupins: 3-5 days
- Beans: 5 days
- Peas: 14 days.

Processed grains need to be introduced to stock over a longer period of time.

Total mixed ration systems can assist in the prevention of acidosis through providing a balanced ration containing hay and grain. These rations can reduce grain engorgement, reduce the rate of feed fermentation and the rate of passage through the gut.

Antibiotics, ionophores and rumen buffers can be incorporated into the feed as a prophylactic measure.

Antibiotic compounds active against gram positive bacteria are very effective against acidosis. These compounds include avoparcin and virginiamycin. They have the potential to reduce feed costs and greatly simplify management when switching sheep from all roughage to high-grain diets.

Rumen buffers commonly used to reduce acidosis risk include:

- sodium bicarbonate (at 0.75 to 1.5% w/w)
- magnesium oxide (at 0.5 to 0.975% w/w) plus sodium bicarbonate, and
- calcium carbonate at 1-2% w/w (barley or triticale) or 3% w/w (wheat).

Buffers like sodium bicarbonate, sodium bentonite or limestone may however be ineffective at the rates at which they are included in diets. For example to neutralise the amount of acid produced during fermentation of 1 kilogram of grain requires 300 to 500 g of sodium bicarbonate. Inclusion of sodium bicarbonate at 2% (20kg per tonne) equates to only 20 grams of bicarbonate per kilogram of grain consumed. A combination of buffers, adequate fibre within a ration (to promote rumination and saliva/bicarbonate production by the animal) and a slow introduction of grain will however help to reduce acidosis risk.

Grain selection is also important. Safer grains are generally those with lower starch content or where the hull has not been removed (eg oats). Wheat is high in starch and its starch is very soluble, more soluble than barley starch. Oat starch is soluble but oats are relatively low in starch. Lupins contain very little starch and are relatively high in fat.

When feeding cereal grains without acidosis preventatives feeding frequency is important. Animals fed grains on a daily basis will perform much better than those fed irregularly as they will almost certainly be subject to acidosis.

When changing feeds, there should be a gradual changeover. For example if changing from wheat to oats or oats to barley, mix the new feed into the old feed over at least four feeds before the old feed is finished.

Faecal consistency score should be monitored daily to identify potential problems before they become significant (refer Appendix 1 Faecal consistency scores).

Treatment:

'Treatment' of an affected flock involves changing the ration to avoid initiating new cases - affected sheep are generally left to recover on their own. Grain should be removed from the diet and good quality roughage (hay) offered *ad libitum* until recovered.

Treatment is based on neutralising the excessive ruminal lactic acid. Treat with 60 g magnesium oxide (causmag) and 15 g sodium bicarbonate in 1 litre of water as a drench for each sheep.

Drafting off the affected cases may be practical in large mobs with small numbers affected. Valuable stock or animals that fail to respond to treatment should receive veterinary attention.

Treatment should also focus on re-establishing the rumen microbe population. This can be achieved through drenching with a probiotic.

17. Arthritis

Arthritis describes any inflammation within an animal's joint. Often described as acute (short) or chronic (long term) with (suppurative) or without (non-suppurative) pus present. This condition is caused by *Erysipelothrix*, *Actinomyces, Streptococci, Staphylococci, Chlamydia* and *Histophilus* organisms.

Arthritis is common in Australian sheep. Most cases begin in lambs prior to weaning. It commonly occurs when the bone surfaces in one or more joints become damaged, most cases as a result of bacteria circulating in the bloodstream, settling and multiplying in the joints.

Predisposing Factors:

The pathogens that cause arthritis are all present in the environment. Some can survive for up to 9 months under favourable conditions or may only survive a few days within the gastrointestinal tract or faeces. Most cases of arthritis are associated with wound contamination (particularly at marking and dipping time). Lambs are the most susceptible to infection. Many sheep yards and high use areas such as feedlots have the bacteria in the soil.

Signs and Symptoms:

Joint fluid is increased in volume, joints may increase in size and be soft to touch, sheep may appear lame, depressed and have an elevated temperature. In chronic cases joints are enlarged, firm to touch and have restricted movement.

Control and Prevention:

Facilities, equipment used during marking, shearing etc and the immediate environment need to be clean. Dust is to be avoided. Yards should preferably be temporary with a grass base and the environment dry. Allow 2 weeks for shearing cuts to heal before introducing sheep to a feedlot or containment area.

The risk of infection can also be reduced through minimising stress as stress reduces immune function and resistance to infection.

A vaccine is currently available for prevention of *Erysipelothrix* induced arthritis.

Treatment:

Sheep will respond to early antibiotic treatment to reduce the extent of joint damage. Once infection has been present for 2-3 weeks, antibiotic treatment is of little benefit as damage to the bone surfaces in the joint has already occurred. Penicillin is effective in most instances. Antibiotic therapy must be carried out for at least 4 days, or the infection may reappear. Chronic cases of arthritis may need to be euthanised.

18. Bloat (ammonia induced)

Ammonia-induced bloat (as opposed to frothy-bloat) results from ruminants eating feed containing high levels of rumen-degradable nitrogen. In the rumen, the ingested nitrogen is rapidly converted to ammonia, which is then converted into microbial protein and other forms of nitrogen. The ingestion of excessive quantities of such nitrogen can result in a build-up of ammonia gas in the rumen.

Predisposing Factors:

Rations high in rumen-degradable protein (such as legume based silage) may predispose animals to bloat.

Signs and Symptoms:

Excess ammonia may lead to:

- alkalosis (abnormally high alkali levels in blood or body fluids)
- rumen stasis (cessation of normal rumen contractions)
- lack of eructation (belching to release stomach gas via the mouth)
- bloating (gut distension).

Control and Prevention:

The following management practices are recommended:

- provide a high energy concentrate. This concentrate provides the extra energy required to metabolise the high levels of nitrogen, and thus reduces the build-up of ammonia gas.
- minimise the proportion of feeds containing high levels of rumen degradable protein.

Treatment:

Treatment of ammonia bloat may include the following:

- 60ml of paraffin oil or similar
- induce animals to walk until eructation (belching)
- provide low quality hay to stimulate rumen function.

If not administered early, treatment is unlikely to be effective.

19. Coccidiosis

The majority of young sheep harbour coccidia however the disease (coccidiosis) is much less common and generally occurs in animals less than 3 months of age. Coccidiosis is caused by a microscopic protozoan parasite known as *Eimeria spp* found in the intestinal wall of affected sheep.

Predisposing Factors:

Predisposing factors include:

- stress
- poor nutrition,
- worm infestations,
- faecal contamination of feed
- overstocking of lambs and weaners under moist conditions.

In intensive feeding systems lambs are most susceptible to coccidiosis soon after their introduction into the feedlot or containment area.

Signs and Symptoms:

Between 20 to 60% of the mob are usually affected. Sheep almost invariably have a concurrent problem such as a heavy worm burden, *E.ovis* infection or nutritional or physical stress.

Acute scouring persists for a few days. Recovery period may be several weeks, during which time there is no scouring, but the appetite is poor and weight gains and wool production are reduced.

Acute symptoms include:

- anorexia
- abdominal pain
- diarrhoea or dysentery.

Chronic symptoms include:

- lack of appetite, and poor growth rates
- dehydration
- weakness
- soft, grey faeces which may contain blood
- recumbency and death.

Control and Prevention:

Keep stress to a minimum, control concurrent disease problems and ensure lambs are well fed.

Avoid placing lambs and weaners in situations where faecal contamination of feed may occur.

Coccidiosis may be prevented with good management and the use of coccidiostats (lasalocid) in the feed or mineral additive. If outbreaks of coccidiosis have occurred previously within an intensive feeding system the use of coccidiostats should be employed.

Treatment:

Seek veterinary advice, separate infected lambs from the mob and treat with prescribed drugs or drenches. Sulphonamide drugs or drenches are commonly used.

20. Feed toxins

A wide range of organic and inorganic compounds may occur in feedstuffs. Residues in animal products destined for human consumption are of primary concern.

Animal feeds are routinely subject to contamination from many sources, including environmental pollution, insects, microbes and toxins of both plant and microbial origin.

Toxins originating from plants are called **phytotoxins**. These include alkaloids, glucosinolates, and saponins, many of which are bitter and/or have unpleasant odours which reduce palatability.

Toxins originating from microbial action and/or animals are called **mycotoxins**, and **zootoxins** respectively.

Fungal contaminants include those responsible for mould growth within feeds. Such feeds are generally:

- less palatable, may reduce dry matter intake and lead to performance losses of 5 - 10%
- may have reduced digestibility and energy content (by as much as 10%) due to moulds deriving energy from the feed's protein, fat and carbohydrate
- may produce harmful levels of potent mycotoxins and cause health problems.

To prevent mould formation:

- minimise grain moisture content at harvest (<15%)
- remove old-grain, damaged kernels, and any foreign matter from storage silo’s etc
- check grain periodically for temperature, moisture, and insect damage
- if moulds and mycotoxins are suspected test a sample and formulate ration to account for quality of contaminated feed and class of stock to be fed (mature stock before feeding to younger stock)
- dilute contaminated feed with good quality feed
- consider the feeding of binder materials such as bentonite.

Feed toxins can be identified through laboratory analysis. Where a toxin is suspected the feed should be tested and a veterinarian consulted for specific treatments.

Stockfeed declarations should be obtained from suppliers including a description of the feed, chemical residue status and withholding periods and a statement detailing any contamination risk.

By-products should be analysed by an accredited laboratory to avoid mineral toxicities.

21. Flies and parasites

Control and Prevention:

Sheep and lambs that become fly struck should be treated without delay in an appropriate manner

To help ensure that fly strike does not occur within intensive feeding systems an operator should employ any or all of the following preventative techniques:

- tactical crutching/shearing during high prevalence periods
- worm control to prevent scouring
- strategic chemical use
- use of fly traps
- selecting sheep with reduced susceptibility to strike
- selecting sheep with correct tail length.

Sheep and lambs must be regularly inspected and tested for parasites.

Parasites such as worms, fluke and lice should be controlled within intensive feeding systems.

All sheep and lamb groups should be inspected on arrival to an intensive feeding system for parasites, and if found to be infested should be treated and/or quarantined for sufficient time to prevent spread to other animals.

Faecal egg counts and drench resistance testing should be undertaken for sheep and lambs prior to admission to an intensive feeding system.

If drench resistance testing is not undertaken, then the property of origin drench resistance should be considered before drenching.

Sheep and lambs should be regularly inspected for parasites before and after treatment to ascertain its effectiveness and identify any parasite resistance problems.

Stress should be minimised on sheep and lambs to optimise immune function and thus assist against parasite burden.

For the latest information on managing flystrike or worms see www.flyboss.org.au or www.wormboss.com.au.

22. Hypocalcaemia

See Mineral deficiency – Calcium

23. Hypomagnesaemia

See Mineral deficiency – Magnesium

24. Laminitis

Laminitis is caused by the release of toxins within the bloodstream following consumption of excess dietary energy or protein. This causes a swelling of the sensitive part of the hoof, cutting off blood flow to the bone part of the hoof which then becomes soft and weak and easily bruised or damaged.

Predisposing Factors:

- excessive consumption of grain, lush grass or legumes
- rapid changes in diet
- excess protein in diet relative to forage
- purulent infections.

Signs and Symptoms:

Affected animals appear lame and are hesitant to stand or move unless provoked. Animals can also suffer from a fever. Chronic laminitis may lead to hoof malformation.

Control and Prevention:

Provision of good-quality roughage and/or removal of affected animals form the feeding system will facilitate recovery.

Treatment:

Usual treatments are:

- prolonged rest
- pain relief
- anti-inflammatory drugs
- carefully balanced rations.

25. Minerals

As well as energy and protein, sheep are known to need at least 14 different minerals in order to maintain good health and production.

Conduct a risk analysis of potential mineral deficiency(s) by obtaining information relating to the animals past (0-3 months) feed and management conditions.

All feeds should be individually analysed to identify any deficiencies.

Professional nutritional advice should be sought in regards to ensuring the diet contains sufficient vitamin and mineral content.

Table 25-1 below lists sheep mineral requirements and toxicity levels.

Table 25-1 - Mineral requirements of sheep per kilogram of dry matter intake.

Mineral	Requirement	Toxic Level
Calcium	0.22-0.82 %	-
Phosphorus	0.16-0.38 %	-
Magnesium	0.12-0.18 %	-
Potassium	0.50-0.80 %	-
Sulphur	0.14-0.26 %	-
Sodium	0.09-0.18 %	-
Iodine	0.10-0.80 ppm	50 ppm
Iron	30-50 ppm	500 ppm
Copper	7-11 ppm	25 ppm
Molybdenum	0.50 ppm	10 ppm
Cobalt	0.10-0.20 ppm	10 ppm
Manganese	20-40 ppm	1000 ppm
Zinc	20-33 ppm	750 ppm
Selenium	0.10-0.20 ppm	2 ppm
Fluorine	-	60-150 ppm

26. Mineral deficiency - Calcium

Calcium is needed for:

- the formation and maintenance of bones and teeth
- transmission of nerve impulses
- muscle contraction
- blood clotting
- activation of a number of enzymes.

A dynamic system involving calcium, phosphorus and vitamin D exists to maintain a relatively stable concentration of calcium in the blood. Calcium and phosphorus are stored in bone and mobilised into the circulatory system to maintain adequate levels in the system.

The small intestine is the major site of calcium absorption.

Hypocalcaemia (or milk fever) is an abnormally low level of blood calcium. In sheep it is usually seen in ewes in late pregnancy but can be seen in all classes of animals.

The disease may occur when the body fails to mobilise enough calcium from the bones to maintain normal blood calcium levels.

Predisposing Factors:

Factors inducing hypocalcaemia include:

- grain based diets with inadequate calcium supplementation
- sudden drops in temperature
- sudden stress
- sudden change in diet.

Signs and Symptoms:

The disease strikes suddenly and usually affects a number of animals in the flock. Stock go down suddenly and may show any of the following signs:

- neck turned back
- muscle weakness
- paralysis
- muscle tremors
- “proppy” or staggering gait with head held high
- going down and refusing to rise
- falling over when stood up
- vaginal prolapse.

Control and Prevention:

Finely ground limestone (calcium carbonate) is commonly included(1 – 1.5% w/w) when feeding grains. Acid salts (ammonium sulphate, magnesium sulphate etc)

included at 0.5% (w/w) may increase Calcium absorption from within the small intestine, improving overall calcium availability.

Treatment:

Consult your veterinarian regarding the best options for diagnosis and treatment.

Affected animals generally respond quickly to an injection of commercial calcium solution at the recommended dose rate if treated quickly.

Blood calcium level is not a good indicator of a dietary calcium deficiency because blood calcium is reflective of both calcium intake and calcium mobilization from bone.

27. Mineral deficiency - Copper

Copper is a component of at least 10 enzymes and is involved in body, bone and wool growth.

Predisposing Factors:

Predisposing factors include:

- low soil copper
- sandy soils
- winter-spring season
- poor autumn break
- wet winter
- poor clover growth, and
- ingestion of high levels of molybdenum, sulphur, zinc, iron, cadmium and calcium may decrease copper availability.

28. Mineral deficiency - Magnesium

Magnesium is an activator of many metabolic enzymes. These enzymes control reactions that range from the breakdown of glucose for energy to the replication of DNA, which is necessary for cell division.

Most magnesium is stored in the skeleton, but it is only in growing lambs that this store can be used to replete a magnesium deficient diet.

Grass staggers/hypomagnesaemia may affect stock in late autumn, winter and spring. It can cause significant losses in production, even when there are no signs of illness. Grass tetany or grass staggers occurs when blood magnesium levels fall below a critical level. This occurs when animals are consuming feed that has low available levels of magnesium, or as a result of increased body demands for magnesium. This condition is not commonly experienced in intensive feeding systems however it is important to monitor for stock on pastures (ie after release from containment areas).

Predisposing Factors:

Hypomagnesaemia within intensive feeding systems is rare but may occur if:

- cold, wet and windy conditions with little or no shelter resulting in short periods of fasting
- animals are either fat and losing condition, or very thin
- roughage used within the ration was produced from pasture heavily fertilised with nitrogen and/or potash fertiliser
- calcium intake is excessive in comparison to magnesium intake.

Forages that are prone to causing hypomagnesaemia are generally deficient in magnesium and sodium and have an excess of potassium. Sodium is involved in transporting magnesium into cells, so it is critical to maintain adequate sodium to facilitate proper magnesium utilisation. Excess potassium consumption interferes with magnesium absorption from the gut, thus exacerbating the condition of low dietary magnesium. In areas where grass tetany is prevalent, it is critical to consider not only dietary magnesium intake but also dietary levels of sodium and potassium.

Signs and Symptoms:

Symptoms of the disease include:

- restlessness and/or an over-alert appearance
- staggers
- excitability
- in some cases aggressiveness.

In severe cases animals may convulse or die without warning.

Control and Prevention:

Prevention is preferable to treatment as hypomagnesaemia often occurs without warning. Magnesium stored in the body is not rapidly available so prevention

involves supplementing the animals with magnesium during the period of greatest risk.

There are several magnesium supplements available from rural suppliers or veterinarians that can be used – Causmag (magnesium oxide), magnesium chloride, magnesium sulphate (Epsom salts) and grass tetany blocks.

Supplementation may involve:

- spraying magnesium oxide onto hay. This is one of the cheapest and most reliable methods of providing magnesium. A mixture of 500 grams of magnesium oxide and molasses mixed in two litres of water is poured evenly onto the cut edge of the bale about 12 hours before feeding. Feed this treated hay at the rate of 100 sheep per bale. Don't feed untreated hay until this hay has been eaten.
- treating hay before baling allowing 500 grams of magnesium oxide, to a 'bale length' of windrow or adding magnesium oxide as a dry powder (500 g/bale) during baling, by means of a salting applicator attached to the baler
- grass tetany blocks provide magnesium as a palatable 'lick'. A major disadvantage of this method is that all the animals may not consume sufficient magnesium.
- epsom salts or magnesium chloride may be added to the ration or water supply. This can be done at a rate of 500g per 100 litres of drinking water for Epsom salts and 420g per 100 litres of water for magnesium chloride. There are several disadvantages in using this method. Epsom salts are unpalatable and not readily accepted by stock and water consumption is variable with environmental conditions (eg temperature and feed moisture levels) and can therefore influence the amount consumed by each animal.
- drenching stock with magnesium oxide or Epsom salts mixed in water is an effective but time consuming, method.

Hypomagnesaemia risk can also be reduced through:

- providing adequate salt
- a high fibre and high energy diet
- minimising physiological and environmental stress so as to not reduce magnesium absorption.

Treatment:

Treatment must be prompt to be effective. It is best to inject a combined calcium and magnesium solution (100ml for sheep) under the skin in the area behind the shoulder and over the ribs. Massage the area well after injecting the solution to spread the fluid and aid its rapid absorption into the blood stream.

Treated animals should be given adequate shelter and identified so that a response to treatment can be judged. In some cases, repeat treatment may be needed.

29. Mineral deficiency - Phosphorus

Phosphorus works in conjunction with calcium in the formation of bone and is a component of DNA, the molecules that make up chromosomes and control genetic inheritance. Phosphorus is also involved in the chemical reactions of energy metabolism.

75 to 80% of a sheep's phosphorus is stored in the skeleton.

Due to their mutual role in bone metabolism, calcium and phosphorus supplementation are usually considered simultaneously. The recommended calcium-to-phosphorus ratio in ruminant diets is 2:1. Significant deviation from this ratio can result in abnormal bone growth and a condition known as urolithiasis (see urinary calculi below).

Phosphorus deficiencies, although rare, may occur when sheep are fed:

- dry, mature plants
- a ration with a high Ca:P ratio
- a ration low in Vitamin D.

Signs of a severe P deficiency include depressed appetites, poor growth rates, softening of the bones, lameness and an increased susceptibility to bone fractures, defective teeth and reproductive problems.

Acute phosphorus deficiency is unusual in intensive feeding systems as cereal grains typically have sufficient levels of phosphorus. Calcium phosphates can be used to correct deficiencies.

30. Mineral deficiency - Potassium

Required for normal functioning, potassium is a major intracellular cation essential for some enzyme functions, the normal contractibility of muscle, nerve impulse transmission and other functions of the nervous system. Potassium is also important to renal function, acid-base balance as well as electrolyte and water balance.

Potassium deficiency may lead to poor appetite, reduced performance, and stiffness, especially in the joints of the front legs. High levels of potassium may also interfere with magnesium absorption and may lead to a magnesium deficiency.

Grain often contains less than 0.5% potassium and supplementation may be necessary in high-concentrate rations containing limited quality fibre.

Hays, haylage or silage made from lush pastures generally contain adequate levels of potassium.

31. Mineral deficiency - Sodium

The requirement for sodium and chlorine is commonly expressed as a salt requirement. Both sodium and chlorine function to maintain the volume, pH and osmolarity of body fluids.

Sodium is involved in muscle and nerve function. Chlorine is essential for hydrochloric acid production in the abomasum and for carbon dioxide transport.

The salt requirement for sheep on complete mixed rations is met when salt comprises approximately 0.5% of the total diet. Problems may occur if salt content of water is high. Sheep can tolerate water containing 1.0 to 1.3 percent salt over a relatively long period of time but cannot tolerate water containing more than 1.5 to 2.0 percent salt.

32. Mineral deficiency - Zinc

Zinc is required for normal immune system function and by enzymes needed during the metabolism of protein and carbohydrate.

Deficiency symptoms of zinc include:

- ill thrift
- excessive salivation
- scabby skin on the legs
- slow wound healing
- loss of hair
- dermatitis.

A deficiency of zinc is rare under normal feeding conditions. High calcium intakes may interfere with zinc absorption in the gut and induce a zinc deficiency and calcium supplementation should therefore be carefully monitored and controlled in an intensive feeding system.

33. Nitrate/nitrite poisoning

Nitrate in the diet of ruminants is normally broken down by microbial action in the rumen, first to nitrite and then to ammonia. Ruminants can tolerate fairly high levels of nitrate in their diet if the intake is spread over the whole of the feeding day and if their diet is also high in readily available carbohydrate, which is needed to fuel the microbial activity in the rumen.

If an animal's nitrate intake is too high, or if conditions are not right for the conversion of nitrite to ammonia in the rumen, nitrite will accumulate and may be absorbed into the blood.

Nitrite may also be directly absorbed from wet or mouldy fodder as microbial action may convert nitrate to nitrite under these conditions.

Nitrite reduces the ability of the blood to transport oxygen throughout the body of the animal. Excessive nitrite levels effectively induce a drop in available oxygen within the system and death may occur.

Predisposing Factors:

Some important factors leading to a build-up of nitrate in the plant include:

- continuous cloudy conditions for 4 to 5 days
- high temperatures
- low moisture
- frost
- high applications of nitrogen fertiliser (over 60 - 100 kg N/ha in one application).

These conditions, in isolation, may not lead to a significant rise in plant nitrate levels. If, however, several of these factors coincide and are sustained for a period of 4 to 5 days, then an appreciable rise in plant nitrate levels is likely.

Signs and Symptoms:

Symptoms of nitrate poisoning in the live animal include:

- marked anaemia
- bright-red (changing to brown) blood
- diarrhoea
- abdominal pain
- profuse salivation and purging, and
- muscular spasms
- paralysis.

Signs of nitrite poisoning include:

- difficulty in breathing, with gasping, rapid breaths
- weakness, trembling and staggering
- severely affected animals will go down, convulse and die

- blood has a dark brown appearance which is obvious at post mortem, however the blood returns to its normal colour a few hours after death
- pin-point haemorrhages may be present in the heart and trachea along with general congestion of the blood vessels.

Control and Prevention:

Where feed is suspected to be high in nitrates a sample should be analysed for N-nitrates prior to use. High risk feeds should not be fed or fed sparingly with additional low-risk feeds so as to dilute the nitrate and/or nitrite intakes.

Hungry stock must never have access to feeds containing potentially toxic levels of nitrates or nitrites.

If nitrate or nitrite poisoning is suspected remove the high risk feed and provide palatable good quality hay.

Treatment:

Nitrate toxicity is difficult to diagnose as affected animals are usually found dead.

If you suspect nitrate or nitrite poisoning, seek immediate veterinary advice.

34. Pink eye

Also known as contagious ophthalmia or conjunctivo-keratitis.

Predisposing Factors:

Outbreaks of pink eye are common in intensive feeding systems and are caused by specific bacterial infections (*Chlamydia psittaci* or *Rickettsi).* Pink eye is further aggravated by Vitamin A deficiency or irritations due to dust, flies, grass seed infestation or windy conditions.

Signs and Symptoms:

The eyeball of infected animals becomes white or pink, and if infected in both eyes the animal may be blind. Affected animals lose weight and may die of thirst if unable to find water. Recovered animals have resistance for varying lengths of time, usually longer than nine months.

Control and Prevention:

Reduce dust by carefully selecting the site for the feedlot or containment area (see section 8.1 for ways to reduce/prevent dust). Remove sheep and lambs showing symptoms (blindness in both eyes) and place them on to good feed out of the feedlot or containment area. Check all eyes for infection or grass seeds when introducing animals to the feeding system.

Treatment:

Many proprietary ointments are available but recent research indicates that treatment may have little effect on the course or severity of the disease. Unless the condition is severe and results in ulceration of the cornea, most sheep and lambs recover with or without treatment.

Antibiotic ointment should be used in severe cases. Most sheep will recover if left alone but ensure that they have access to feed and water and any grass seeds should be removed from the eye.

35. Pleurisy/pneumonia

Pneumonia is an acute infectious disease that causes widespread financial losses from death, reduced live weight, delayed marketing, treatment costs and unthriftiness among survivors.
Pneumonia occurs in all breeds and both sexes. Although adult sheep are susceptible, it is more common in lambs 5 to 7 months old and young nursing lambs.

Predisposing Factors:

Pneumonia is caused by *Mannheimia haemolytica* (formerly known as *Pasteurella haemolytica*) but risk and incidence are increased during periods of:

- high humidity,
- excessive heat
- dust (see section 8.1 for ways to reduce/prevent dust)
- damp bedding
- irritating gases such as ammonia.

Signs and Symptoms:

Pneumonia strikes quickly. The first sign of the disease may be sudden deaths within 2-3 days of infection. More often, affected animals will exhibit the following symptoms during the first 5-6 days of an outbreak:

- fever of 41-42ºC
- nasal discharge
- droopy ears and lowered head
- lack of appetite
- gauntness
- loss of weight
- laboured and rapid breathing
- coughing and lameness (caused by arthritis).

Control and Prevention:

Effective management of pneumonia requires reducing stress factors. For example, try to avoid transport of sheep and lambs during inclement weather. Similarly, you can take steps to avoid excessive crowding, overheating, chilling or combining stress factors. If sheep are shedded ensure the facility is well ventilated.

Treatment:

Must be based on early identification of affected individuals. Injectable antibiotics are the best way to achieve rapid response and recovery. Antibiotics such as penicillin, tetracyclines and others are commonly used. In serious outbreaks treatment of all exposed sheep and lambs for several days is advisable.

36. Polioencephalomacia

Also know as Vitamin B1 deficiency, Polio, PEM or Star Gazing Disease.

Polioencephalomacia is a condition that is induced through thiamine or Vitamin B1 deficiency. This is usually a result of the production or ingestion of thiaminases which destroy thiamine.

Predisposing Factors:

Sudden changes to or high grain diets can result in the production of thiaminases which break down and destroy thiamine, predisposing the animal to thiamine deficiency. Ingestion of thiaminases from certain plants or chemicals can also lead to polioencephalomacia.

Signs and Symptoms:

Sheep may appear ‘blind’ with a ‘star-gazing’ posture and/or move in circles. Most outbreaks involve less than 5% of the mob with deaths often occurring over a period of weeks.

Control and Prevention:

Dietary supplementation with thiamine is recommended to aid in the prevention of the disease. Control once cases are suspected within a flock can include measures such as providing additional roughage and/or changing feed type. Providing additional thiamine through subcutaneous injection or oral drenches can be implemented to help control further cases.

Treatment:

Treatment must begin early in the course of the disease as irreversible brain damage will occur if the disease progresses.

Inject 10mg/kg IV initially then repeated IM every 12 hours for a total of 4 treatments, if necessary. Response to treatment is generally good if it is given early in the course of the disease. Mildly affected animals generally respond within 6-8 hours and may fully recover within 24hrs.

37. Prolapse

Predisposing Factors:

Rectal prolapse is a complex disease condition in sheep. The following factors have been proven or suggested as causative factors;

- Sex: ewe lambs are more likely to have a rectal prolapse than wether lambs. Females lay down more internal fat, particularly in the pelvis. When a lamb strains or coughs, fat can't hold the rectal tissue and hind gut in place.
- Diet: rectal prolapses occur most commonly in feedlot lambs and other lambs being finished on high concentrate diets. Overly fat lambs are more prone to prolapsing.
  Inadequate fibre within a diet may lead to constipation, increased straining and ultimately prolapse.
- Age: lambs in the post-weaning period are more likely to experience a rectal prolapse than young lambs or adult sheep.
- Coughing: chronic coughing, due to infection or dusty feeds, may lead to an increased incidence of rectal prolapses.
- Diarrhoea: coccidiosis and diarrhoea cause irritation and straining, which may cause prolapse in susceptible lambs.
- Genetics: some breeds or crosses may have a genetic predisposition to rectal prolapses.
- Short tail docks: several studies have implicated short-tail docks as a cause of rectal prolapses in lambs fed high-concentrate diets. When tails are docked too short (above the 3rd palpable joint), muscles attached to the tail bone are weakened and prolapse may occur.

Signs and Symptoms:

Rectal prolapse in lambs usually begins as a small round area protruding, often when the lamb coughs or lies down. The prolapse will swell and tears in the rectum are commonly seen. Over time, the length of prolapsed rectum increases.

Control and Prevention:

Balanced diets with adequate fibre to reduce the risk of constipation and bowel irritation should reduce the incidence of rectal prolapse. Minimising the use of dusty feeds and dust levels within a feedlot will also reduce coughing (see section 8.1 for ways to reduce/prevent dust).

Treatment:

Veterinary advice must be sought to treat affected animals.

While treatment may be successful it is usually costly. Generally immediate euthanasia is recommended.

38. Pulpy kidney

Also known as enterotoxaemia.

Caused by the sudden increase in the intestine of *Clostridium perfringens, type D*. All ages of sheep may be affected but rapidly growing lambs between 3 and 24 weeks of age are most at risk.

High-grain diets can predispose lambs to pulpy kidney. It is essential that lambs are vaccinated, before entering the intensive feeding systems, with at least a 3-in-1 vaccine. If lambs have not been previously vaccinated, a second vaccination may be needed if they are in the intensive feeding system for more than four to six weeks.

Predisposing Factors:

Occurs mainly in heavily grain fed sheep, lambs grazing lush rapidly growing pasture or cereal crops.

Two things are necessary for the bacteria to start rapid multiplication:

- highly nutritious food material in the intestines
- the movement of food along the intestinal tract must temporarily stop.

These conditions occur most often when sheep are introduced to grain or grain feeding is rapidly increased. Those with the greatest feed intake (usually the best lambs in the mob) are the most susceptible.

Feed conditions containing little fibre such as grain, nuts, concentrated rations and lush improved pastures which do not stimulate bowel movements have been associated with some outbreaks.

Signs and Symptoms:

There will be signs of kicking with froth at the mouth. The carcass becomes distended and decomposes rapidly and the skin will have a purple colour.

A post mortem conducted more than one hour after death will show the kidneys to be lighter in colour than normal and jelly-like. The small intestine is very distended with gas, even at the time of death.

Clinically affected cases show deep depression, lag behind the mob, stagger and knuckle over, lie down, become comatosed and die. Most show signs of central nervous system stimulation including ataxia, champing of the jaws, salivation, hyperventilation and convulsions before death (signs similar to polioencephalomalacia).

The disease typically develops very quickly and death occurs within hours of disease signs becoming apparent. Mature sheep survive longer than lambs, but usually no more than 24 hours.

Control and Prevention:

The most effective preventative measures currently available include vaccination and avoidance of sudden changes in feed. Where sheep or lambs are purchased, a National Vendor Declaration (NVD) detailing the animal's vaccination history should be received at the time of delivery.

Vaccinate sheep and lambs before commencing feeding regardless of vaccination history. If the lambs are purchased and their vaccination history can not be obtained, two vaccinations 4-6 weeks apart should be given to ensure protection.

To help control an outbreak reduce grain intake and increase roughage in diet. Burn infected carcasses to reduce organism numbers.

Treatment:

Impractical as 90% of cases are found dead.

39. Salmonellosis

Predisposing Factors:

Causal bacteria include *Salmonella typhimurium* and *Salmonella bovis-morbificans*. Outbreaks of salmonellosis are usually associated with:

- over-crowding
- food deprivation for more than 36 hours
- stress related factors including transport
- consuming feed or water contaminated by vermin or faecal material.

Stress is a key factor in most outbreaks of salmonellosis, increasing susceptibility to infection and increasing the number of bacteria passing out in the faeces.

Signs and Symptoms:

The disease generally occurs in outbreaks with morbidity rates of 5% to 30% and cause mortality rates of 25%. Some affected animals die within hours of the onset of signs, most die within 1 to 5 days.

Infected animals may appear:

- depressed
- dehydrated
- with severe, putrid, very fluid diarrhoea, sometimes with strands of mucosa and blood.

Recovery in survivors is slow and these sheep lose much body weight over the course of the illness.

Control and Prevention:

Reduction of stocking density, removal of affected/dead sheep and removal of the entire mob to another area may help limit an outbreak.

Preventative measures include:

- minimising stress
- reduce contamination of soil, flooring and water
- isolate and treat infected animals
- antibiotic treatment to control outbreak.

Pen surfaces should be evenly graded and compacted to form a smooth surface with no hollows to prevent lambs drinking pooled, stagnant water.

Treatment:

Veterinary advice should be sought. Antibiotics effective against Salmonella can be given either as an injection or drench. Unfortunately the results are usually disappointing as by the time a sheep shows obvious signs of scouring, severe damage has already occurred.

40. Scabby mouth

Also known as Orf.

A highly infectious viral disease caused by a strain of the *Parapoxvirus* family that can affect sheep at any age. The condition leads to scabs around the mouth as well as other areas of exposed skin. Death rates amongst infected sheep are generally relatively low.

Predisposing Factors:

The virus is capable of remaining within the soil for many years. Minimising stress and injury to the soft tissues of the mouth will reduce risk of infection. Use of coarse, hard fibre in a ration should be minimised to reduce damage to the lips of confined animals.

Signs and Symptoms:

The disease takes three weeks to run its course. It is characterised by pustules and/or ulcers located on the lips and inside the mouth.

Eating appears painful and therefore intake is reduced significantly during this time, although affected lambs can usually consume smooth grains such as lupins.

Lesions on the pasterns causing acute lameness may also occur.

All lesions are susceptible to fly strike or secondary infection.

Control and Prevention:

All sheep and lambs should be inspected for sign of scabby mouth prior to entering an intensive feeding system.

Vaccination at marking or several weeks prior to lambs entering a feedlot is effective at preventing outbreaks of the disease.

Treatment:

Spread in a flock through direct contact with infected sheep or infective material is rapid and can lead to a large proportion of the flock becoming infected.

In the advent of an outbreak all affected sheep should be isolated to prevent transmission to other stock. If required and practical the remaining stock should be vaccinated if susceptible. There is no specific treatment available and generally the disease will clear up in about three to four weeks. Infected animals should be provided with palatable feed and treated to prevent blowfly strike.

41. Urea poisoning

Also known as ammonia toxicity

Urea poisoning is usually caused by the ingestion of pure urea.

Predisposing Factors:

Ingestion of excessive amounts of urea in blocks, in mixed feed, or when sheep drink pools of water on the top of urea blocks after rain.

Excessive rumen ammonia is absorbed through the rumen wall into the blood stream, leading to paralysis of the muscles and brain. This condition is usually fatal.

Signs and Symptoms:

Abdominal pain, nervous signs including excess salivation, and sudden death. Animals also tend to show extreme nervous symptoms.

Control and Prevention:

Ensure that urea is mixed thoroughly with feed when used as a supplement. Keep blocks out of the rain in sheltered areas to ensure excessive intake cannot be achieved through drinking water pooled on top the block.

Treatment:

Not usually successful.

42. Urinary calculi

Also known as water belly, urolithiasis or bladder stones.

Urinary calculi is a common disease of male sheep caused by the formation of small stones (calculi) in the urinary tract that block urine flow and may lead to the rupture of the bladder or urethra.

The calculi usually lodge in either the sigmoid flexure, a large “s”-shaped curve of the penis just behind the scrotum, or in the urethral process.

The main cause is thought to be an imbalance of calcium in relation to phosphorus and is therefore commonly seen in sheep and lambs fed a predominantly cereal based diet.

Predisposing Factors:

Nutritional and seasonal factors are associated with the incidence of urinary calculi such as:

- feeding concentrates, high in phosphorus, without calcium supplementation
- silicates, present in either grasses or grain
- reduced water intake (cold weather, inadequate supply etc)
- alkaline water (pH greater than 8.5)
- inadequate fibre intake.

Several factors contribute to the development of urinary calculi, most relating to a low calcium to phosphorus ratio. This ratio should be maintained at a minimum of 2:1. Concentrates are generally high in phosphorus relative to calcium, so that calcium-phosphorus ratios of 1:1 are not unusual in cereal based rations.

Signs and Symptoms:

Symptoms may vary from mild to severe depending on the degree of urinary tract obstruction.

Symptoms may include:

- an arched back and the lamb may appear to ‘kick’ at its belly
- dull and disinterested in feed or water
- slow urine flow with straining
- tail twitching.

If the urethra has ruptured, swelling along the penis will be observed, indicating the presence of urine in the tissues. Close examination of animals affected with the disease will often reveal salt crystals adhered to the wool around the prepuce.

Control and Prevention:

Veterinary advice must be sought to treat affected animals.

The most important preventive measure is to ensure a correct calcium-phosphorus ratio. Chemical analysis of the ration is advisable to ensure calcium intake is adequate.

Preventative measures include:

- provision of good quality water
- inclusion of 1 to 1.5% (w/w) feed grade limestone within the ration
- addition of between 1 to 5% of sodium chloride to ration to increase water intake
- ensure a balanced mineral intake
- addition of between 0.5 to 1% (w/w) of acid salts such as ammonium chloride to acidify the urine and help prevent the formation of calculi.

Treatment:

In a feedlot or containment area situation treatment is seldom practical and rarely successful.

43. Vitamins

Vitamins are important for the control of many physiological processes in the body.

Inadequate intake of vitamins A, D and E are the most common deficiency conditions. Vitamin B_{12} deficiency occurs when cobalt intake is inadequate.

Injectable forms of vitamin A, D, E and B_{12} are commercially available. These are reasonably cheap, and are generally recommended if sheep and lambs have not had access to green feed within three months of entering an intensive feeding system, or are from cobalt-deficient areas.

Conduct a risk analysis by obtaining information relating to the animals past (0-3 months) feed and management conditions.

Professional nutritional advice should be sought in regards to ensuring the diet contains sufficient vitamin and mineral content.

44. Vitamin A

Many authors consider vitamin A to be the most important vitamin in the body because of its role in normal growth, protective mucous membranes, reproduction and sight.

Vitamin A is produced in sheep through the conversion of beta-carotene (found in green feed) into Vitamin A in the intestine and liver. Symptoms can often be subclinical and pass unnoticed.

Predisposing Factors:

Green feed is a major source of Vitamin A for sheep and lambs. Unfortunately 'curing' of hay destroys most of the beta carotene contained within green feed. Hay, combined with the use of high rates of cereal grains containing little beta carotene, may therefore lead to a Vitamin A deficiency within a feedlot program.

Vitamin A is particularly susceptible to damage during processing of feeds. Availability can be reduced through:

- oxidation by moisture or heat
- hay making
- grinding or pelleting of feeds
- extended storage periods.

Signs and Symptoms:

Signs and symptoms of Vitamin A deficiency include:

- night blindness
- conjunctivitis and a blue haze over the eyeball
- inappetence
- in-coordination
- muscular weakness
- scouring
- lameness
- partial paralysis
- abortions
- urinary calculi
- convulsions culminating in death.

Control and Prevention:

Adult sheep normally have sufficient stores within the liver of Vitamin A for up to 6 months without supplementation. Lambs however, do not have the same amount of bodily stores and if they are born during drought will need supplementation once they reach 4 months of age.

Green feed or a Vitamin A injection or drench can be used to prevent deficiency occurring. Dose rate of 1 million International Units (IU) (drench) or ½ million IU's (injection) gives sufficient Vitamin A for 2 months.

Sheep fed dry rations in a shed should receive supplementary vitamin A as a routine management procedure.

Treatment:

Sheep with signs of Vitamin A deficiency respond rapidly to treatment which can include access to green feed or injection or drenches of vitamin A.

45. Vitamin B_{12}

Also known as cobalt deficiency

Cobalt is required for the production of Vitamin B_{12} by micro-organisms in the rumen. Absorption of Vitamin B_{12} occurs primarily in the small intestine and is enhanced by slower rates of movement of material through the intestine. The principle storage organ for Vitamin B_{12} is the liver. Vitamin B_{12} is essential for the growth of cells, energy production and wool production in sheep. Production losses, particularly in young sheep can be significant if Vitamin B_{12} levels are low.

Predisposing Factors:

Spring pastures generally have lower levels of trace elements due to faster growth, and lower uptake of elements from the soil. Feeds used for finishing lambs sourced from these pastures may conceivably be cobalt deficient.

Signs and Symptoms:

If symptoms are observed they may include:

- diminished appetite
- poor condition
- weakness
- wool becomes open and lifeless
- anaemia
- discharge from the eyes
- death.

Growth rates and wool production are affected by marginal cobalt/Vitamin B_{12} deficiency, with these losses exceeding 15% in severely cobalt-deficient areas. A marginal deficiency is of greatest concern because production losses may go unnoticed. A 'tail' in the flock is characteristic of this form of the deficiency.

Control and Prevention:

Sub-cutaneous injection of vitamin B_{12} is recommended for the immediate treatment of deficient animals and for short-term (up to 3 months) prevention of deficiency. It is often administered at marking time.

Intra-ruminal cobalt pellets ('bullets') are the most efficient method of long-term prevention in endemically deficient areas. They are usually administered to weaners or hoggets. Older, larger sheep are easier to dose with pellets.

Oral drenches of cobalt salts are used but give only short-term protection. Salt licks and mineral blocks may be effective provided sheep ingest sufficient amounts to meet requirements.

Treatment:

Intramuscular and sub-cutaneous injections of Vitamin B_{12} are available.

46. Vitamin D

Vitamin D is formed by the action of sunlight or other sources of ultraviolet light rays upon sterols in the skin of animals or in plant tissue.

Ewes can supply sufficient vitamin D in their milk for the first 4-6 weeks of a lamb's life. Vitamin D is stored in the animal's fat so an adult animal is less susceptible compared to younger classes simply due to higher fat reserves.

Vitamin D increases the absorption and metabolic use of calcium and phosphorus. It helps regulate blood calcium levels and the conversion of inorganic to organic phosphorus.

Predisposing Factors:

Deficiencies are rare in Australia.

Shedded animals and areas within Tasmania and parts of southern Victoria where there is often insufficient sunlight for vitamin D production are however high risk areas.

Sheep with black pigmented skins or long wool receive less sun exposure than white skinned and short wooled sheep.

Signs and Symptoms:

Commonly seen symptoms include:

- ill thrift
- stiffness
- shifting lameness
- hunched back
- abnormally high incidence of broken bones
- rickets.

Control and Prevention:

Provision of good quality sun-cured hay will generally prevent Vitamin D deficiencies. Injectable and oral vitamin D supplements are also available.

Treatment:

Blood tests may be misleading. Diagnosis is usually made at post mortem.

Consult your veterinarian regarding the best options for diagnosis and treatment.

47. Vitamin E

The specific physiological function of vitamin E is not clear.

Health issues such as stiff-lamb and white-muscle disease can be prevented through administering supplemental Vitamin E. A close relationship exists between selenium and vitamin E.

Predisposing Factors:

Vitamin E deficiency is often associated with:

- feeding weaners on hay or grain over extended periods
- high-grain rations with limited or no roughage, especially high-moisture harvested grains
- feeding grains or roughages that are low in selenium
- high fat levels in ration
- lengthy storage of feeds
- high drying temperatures for feeds.

Signs and Symptoms:

As lambs increase their dry feed consumption and begin to gain weight rapidly, the fastest growing lambs are the most susceptible to showing signs of Vitamin E deficiency.

Vitamin E deficiency symptoms include:

- ‘stiff muscled’ appearance
- recumbency
- animals appear bright and alert but are reluctant to stand
- death through heart failure when stressed or excited
- pale muscles upon autopsy.

Control and Prevention:

Vitamin E supplements can be used to help ensure sufficient levels are in the diet.

Treatment:

When the diagnosis is confirmed, treat with an oral drench of water-soluble Vitamin E using a dose rate of 3000 IU per animal.

48. Wool biting / coat chewing

Once sheep start wool biting, some seem to become habitual biters and are difficult to stop. In some systems, principally shedded operations, wool biting does not occur for some years but in others it has appeared as soon as three months.

Predisposing Factors:

The primary predisposing factor for wool biting is believed to be diets low in effective fibre. Other suspected factors include:

- mineral imbalance (particularly zinc)
- parasitism
- boredom
- habit
- depraved and/or deprived appetite
- shortage of fibre
- bullying.

Signs and Symptoms:

Sheep that have been bitten often show patches of raw skin. Sheep become distressed and lose condition.

Control and Prevention:

When wool biting occurs, watch closely what is happening. This may give an indication as to which of the above is the main problem.

Provision of low quality roughages such as straw will, in many situations, alleviate boredom, improve ration fibre levels and reduce the incidence of wool biting.

Treatment:

Provision of low quality roughage such as cereal straw.

Supply Chain Management

49. Food safety and quality

Objective

Production principles implemented by intensive feeding systems ensure the highest possible standards of food safety and quality.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
49.1 Food safety	
- Export slaughter intervals and/or withholding periods be satisfied and declared prior to sale, processing or export. ***Note**: For information regarding up to date withholding periods and/or export slaughter intervals visit www.apvma.gov.au.*	- Sheep and lambs should be free from manure and soil to minimise the risk of meat contamination. - Sheep and lambs with dags should be keyhole crutched prior to sale. - Excessively dirty sheep and lambs should not be sent for slaughter to minimise risk of carcass contamination.
49.2 Food quality	
- To avoid carcase and pelt damage electric prodders not be used. - To avoid stress which affects meat quality electric prodders not be used.	- Transport operators should be accredited with TruckCare and adhere to the *Australian Standards and Guidelines for the Welfare of Animals: Land Transport of Livestock*. (2008) Animal Health Australia, Canberra (or subsequent editions). - Stressors which affect meat quality should be minimised or avoided; these include: o excessive time off feed and/or water o rapid mustering o poor handling facilities and techniques including lifting lambs by the wool o the use of non muzzled dogs o the presence of dogs o transport o minimising sheep and lamb movements where possible. For example, where sheep and lambs are being sold for

	slaughter, direct delivery to the processor will reduce handling and stress which will result in improved meat quality. - To optimise eating quality lambs should: o be gaining at least 100g/day for crossbreds and 150g/day for Merinos for two weeks prior to slaughter o be at the consignment property for a minimum of two weeks prior to dispatch to slaughter. - Vitamin E should be included in the diet to optimise meat shelf life. ***Note:*** *Meat Standards Australia (MSA) has detailed information regarding factors affecting meat quality. Links to this information can be found on the MLA website.* *MLA has published a Tips & Tools (Aug 2010) :"Vitamin E stabilises the colour of out of season lamb meat".*
49.3 Curfew	
- Total time off water not exceed the time periods given below: o lambs less than 4 months of age - 28 hours o sheep and lambs greater than 4 months of age - 48 hours o ewes known to be more than 14 weeks pregnant, excluding the last 2 weeks - 24hrs. Source: *Australian Standards and Guidelines for the Welfare of Animals: Land Transport of Livestock* (2008) Animal Health Australia, Canberra. - Ewes in the last two weeks of pregnancy not be deprived of water. - Feed curfews (on-farm) for transport not exceed 24 hours. The total time off feed (including transport time) not exceed 48 hours. ***Note:*** *Curfew periods are currently under review. Seek latest information from MLA website.*	

49.4 On-farm quality assurance	
	***Note**: Quality assurance programs change from time to time and while the following information is correct at the time of publishing, it is recommended that regular contact is maintained with program providers or updates are sought as required. It should also be noted that new programs become available or replace existing programs from time to time and the information provided in this section is not an exhaustive list of all programs available.* - Livestock Production Assurance (LPA) is an on-farm food safety certification program designed to help the red meat industry strengthen the food safety systems currently in place. The LPA program was developed in accordance with Hazard Analysis Critical Control Points (HACCP) principles and presents producers with basic animal production and record keeping requirements designed to ensure the production of safe food. Independent audits are conducted to ensure the program's integrity is maintained. LPA is required by all producers who use National Vendor Declaration forms for the sale of sheep and lambs. There are five requirements each of which has its own food safety outcome ensuring that meat from producer's livestock is fit for human consumption; o property risk assessment – making sure that stock are not exposed to areas contaminated with persistent chemicals. o safe and responsible animal treatments – ensuring stock at sale don't contain unacceptable chemical residues. o stock foods, fodder crops, grain and pasture treatments – ensuring stock are not exposed to feeds that contain unacceptable chemical residues. o preparations for dispatch of stock – ensuring stock are fit for transport, not stressed and contamination is minimised during transport to destination. o livestock transactions and movements – ensuring that stock can be traced if

	required. - AgriSure is an on-farm quality management program. The AgriSure program ensures that management activities are conducted in a consistent and repeatable manner, provides a “building block” upon which a producer can readily introduce and implement additional specific market requirements and also be utilised as a training tool for staff (including family members). - The AgriSure program provides a framework for optional market specific modules, one of which is LPAS. For meat to be eligible to be labelled as grain fed lamb or hogget, it must have been sourced from an LPAS certified enterprise accredited by AUS-MEAT. - Further information about AgriSure can be found at www.mla.com.au and further information about grain fed lamb and hogget standards can be found at www.ausmeat.com.au

50. Supply chain management systems

Objective

To foster the supply of quality product to meet market requirements and expectations in a profitable and sustainable manner.

Recommended procedures It is recommended that:	Guidelines Further guidelines include:
50.1 General	
	- Sheep and lamb husbandry procedures should maximise carcass and skin quality. This includes ensuring vaccinations are administered in the loose skin behind the ear or back of the head, ensuring that sheep and lambs are free of weed seeds and that electric prodders are not used. - The health of sheep and lambs should be checked prior to sale. Financial returns will generally be discounted where sheep and lambs have conditions such as arthritis, tapeworm, excessive burr or seed and pleurisy. - The *Australian Standards and Guidelines for the Welfare of Animals: Land Transport of Livestock* (2008) Animal Health Australia, Canberra mandates that sheep and lambs must be fit for travel. - Vertical supply chains and alliances may include any or all of the following participants: o seedstock producer and finisher or processor o store lamb breeder alliance with finisher o finisher(s) and agent - provides the benefits of increased throughput and security for the agent, more secure market outlets for stock meeting specification and hence reduced risks for producers, scope for value based marketing, lower selling costs through negotiated rates and improved

	understanding of customer's needs. o producer(s)/finisher(s) and/or processor - the customer obtains the security of the supply of specific stock and opportunities to differentiate product on the basis of region or Quality Assurance (QA) programs. Members of such an alliance gain an improved understanding of partners and customers needs, improved feedback, opportunity to negotiate value based marketing, lower selling costs through fewer transactions, greater security of throughput for finisher and processor. o finisher(s) and retailer or exporter - well established producer groups may decide to enter into a supply chain alliance with a retailer or exporter as a means of improving their longer term business prospects by getting closer to ultimate customers. Thus the group could maintain ownership of the carcase through the processing stage and use a service works for processing and boning. The customer gains for greater security of supply and reduced seasonality through dealing with a large supply group. The members of such an alliance benefit with improved knowledge of the customers needs, feedback on matching carcase attributes with consumer requirements, lower marketing costs through single sale direct to retailer or exporter instead of two transactions and a greater opportunity to improve security of supply and to reduce seasonality of supply for retailers and exporters. o processor and retailer or exporter o all supply chain individuals - provides the customer with trace back for quality assurance. Also offers a reduction in transaction costs for all involved. - Feedback systems between producers/finishers and customers should be in place to provide information on product performance that can be utilised to improve productivity of all parties.

51. Marketing

Objective

Intensive feeding systems market their product in a way that exploits the product's positive attributes while minimising risk associated with market fluctuations or sub-standard product.

Recommended procedures It is recommended that:	**Guidelines** Further guidelines include:
51.1 General	
	- Intensive feeding systems enterprises and/or supply chain managers should select from or use a combination of the following marketing systems: o over the hooks - price schedule grids o over the hooks - trading o forward contracts o on-farm purchases o saleyards. - All associated advantages and disadvantages of each marketing system should be considered. - Gross margin budgets should be completed prior to sheep and lambs entering intensive finishing systems and marketing agreements being put in place. - Feedback between processors and producers should be freely available and unreserved - The following factors should be considered that will influence dressing percentage of lambs: o breed - Merino and first cross lambs tend to have lower dressing percentages than second cross lambs by 1.5 – 3.5%. o sex - ram and wether lambs will dress approximately 0.5–1.5% lower than ewe lambs of similar carcase weight. o time off feed - dressing percentages

increase by; 1% after 4 hours off feed, 2% after 12 hours and 4% after 24 hours.

- fat score

Table 51-1 - Effect of fat score on dressing percentage.

Fat score	Indicative dressing % for second cross lambs
1	41
2	43
3	45
4	47
5	49

- wool length - freshly shorn lambs have higher dressing percentages than woolly lambs.
- processing - there will be variances in dressing percentages between sheep and lamb processed for the export and domestic markets and between processors.

Appendix

1. Faecal consistency scores

Faecal consistency can be estimated on a scale of 1 to 5, where hard pellets would be considered 1, and fluid faeces are a 5. Monitoring faecal consistency is an important tool in identifying and managing acidosis and other health and nutritional disorders.

Figure 1-1 – Faecal consistency score 1 – hard pellets

Figure 1-2 - Faecal consistency score 2 – thick manure

Figure 1-3 - Faecal consistency score 3 - porridge-like consistency; forms a soft pile

Figure 1-4 - Faecal consistency score 4 - runny manure; forms a loose pile

Figure 1-5 - Faecal consistency score 5 - very liquid manure; includes diarrhoea

Source: N. Linden, 2006