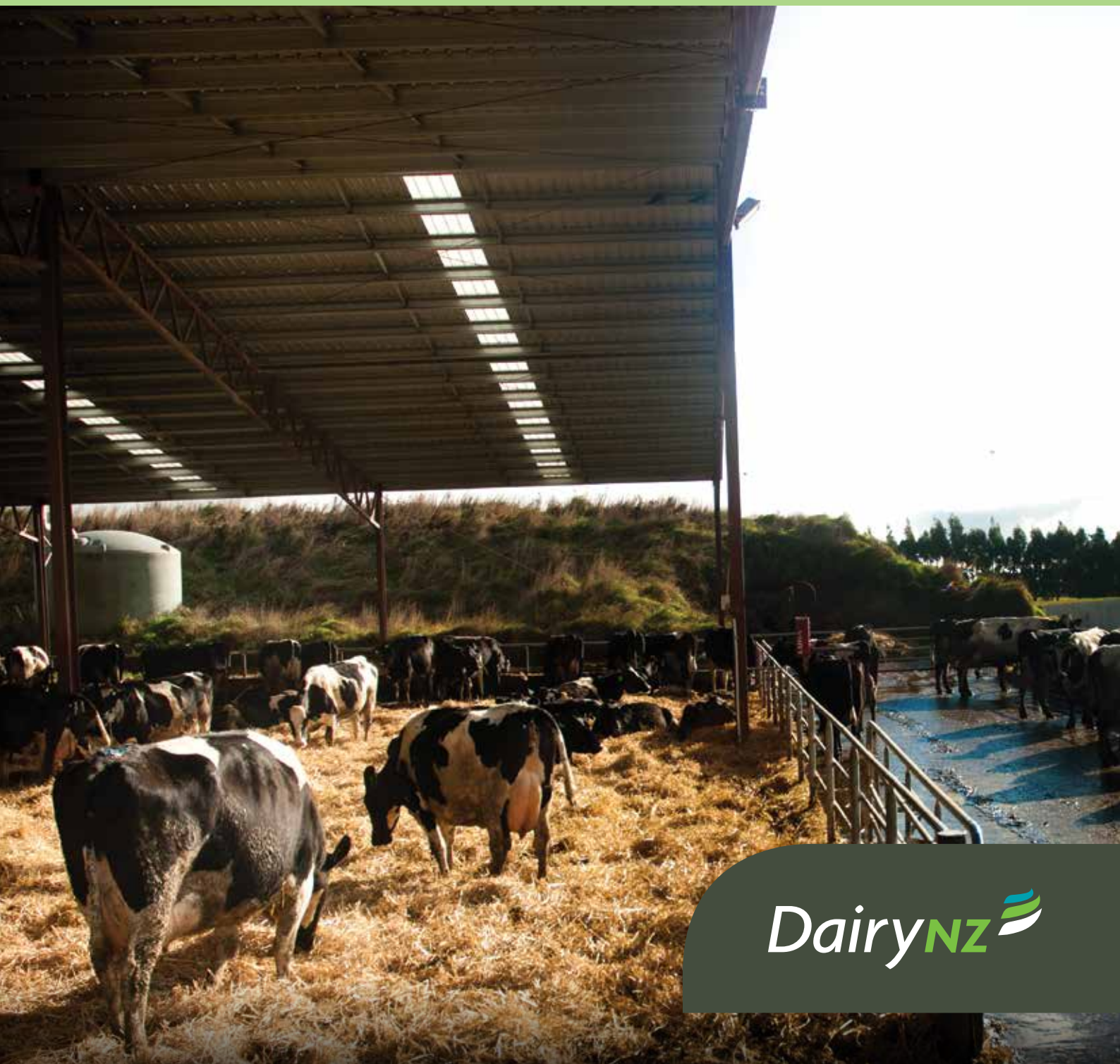
Dairy cow housing

A good practice guide for dairy housing in New Zealand - Version 2 October 2019



DairyNZ

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Manatū Ahu Matua

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Note

All dairy farm operators must comply with the MPI Animal Products (Dairy Processing) specifications for milking and animal health as set out in the registered Risk Management Programme covering their operation. If you alter the farm system by adding a housed facility, talk to your milk supply company about any additional milk supply requirements.

DNZ50-007

This booklet covers:

About this booklet

This booklet is designed for farmers who are planning to build a housed cow facility or who already have one and would like more information on how to achieve good practice.

Reading this guide will help you understand the:

1. Design aspects to consider when looking at housing system options.
2. Factors affecting housed cow comfort.
3. Good practice management principles for housed cows.
4. Options for future-proofing your barn.
5. Code of Welfare minimum standards.

STAY UPDATED

These boxes state the minimum standards from the Dairy Cattle Code of Welfare.

STAY FLEXIBLE

These boxes show future proof pointers to make sure you can stay flexible.

STAY INFORMED

These boxes highlight key facts and figures in good practice.

In this resource, a housed cow is a cow that spends a significant proportion of her day or year in a housed cow unit. This booklet does not refer to uncovered or covered stand-off pads and feed pads.

If you would like information on feed pads and stand-off pads DairyNZ have a number of resources on dairynz.co.nz. Resources include:

- *Farmfacts*
  - Feed pads design and construction 8-2
  - Feed pads management and maintenance 8-3
- *Stand-off pads* design and management resource
- *IPENZ27 Dairy Farm Infrastructure – Part 5*

We recommend you get professional advice, from a reputable source, before making any significant changes or investments in your system.

If you are considering integrating a robotic milking system within your housing facility please go to www.dairynz.co.nz and system manufacturers for more information and talk to your milk supply company about supply requirements.

For other housed cow resources go to www.dairynz.co.nz

Assumptions for dairy cow weights in this guide

Most dimensions for space requirements and building design are related to weight and assumptions of cow dimensions are based on these weights.

Standard assumptions on weight for breed

Breed Type	Mature (Dry) Cow Weight kg	Herd average LWT kg LIC statistics
Jersey	370 -395	375
75% Jersey (J12 F4)	400 - 440	445
75% Friesian (F12 J4)	445 - 470	445
Friesian	475 - 500	480
NZ Holstein-Friesian	510 - 600	-

Source: DairyNZ Facts and Figures

Average herd live weight should be determined by weighing at least 20% of the herd with a cross-section of cow age.

Designing the system around the average herd weight can be problematic as many cows will be much lighter and much heavier than the average. The table shows the weight variations across three farms.

The variation in cow weights for all breeds at different stages in the production cycle

Production point	Min kg	Max kg
Dry	308	790
Peak Lactation	294	796
Late Lactation	345	770

Source: Lye, Scott and WTARS Research Farms

Although weight is a good indication of size, the actual dimensions of the cow are the most important factor. We tend to look at the lighter and heavier cows as the smaller and larger. These cows may not be provided for when average dimensions are used.

Weight gain and increased condition normally go hand in hand with a higher feed input system and therefore most housed cows will gain condition due to changes in diet, feed utilisation and protection from adverse weather conditions.

Before you start planning, weigh the largest 20% of cows and take some height and width measurements to get a good understanding of the size of cows you will need to provide for, especially if planning a freestall system.

"I TALKED TO OTHER FARMERS TO GET AN IDEA OF HOW CONDITION, WEIGHT OR SIZE CHANGED WHEN THEY HOUSED THEIR HERD."


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1. Cow comfort

The principles of what a cow needs to be comfortable, healthy and achieve optimum production are central to good housing design and good animal welfare. Badly designed, overstocked or poorly managed housed systems will lead to a decline in health, welfare and comfort which quickly affects production.

STAY UPDATED

Minimum Standard No 9 – Housing Cows and Calves

(a) i Buildings and facilities for managing dairy cattle off-paddock, and all fittings and internal surfaces, including entry races and adjoining yards, must be designed, constructed and maintained so as not to cause injury and to meet the health and welfare needs of the dairy cattle.

(b) All fittings and internal surfaces, including entry races and adjoining yards that may be used by the housed animals, must be constructed and maintained to ensure there are no hazards likely to cause injury to the animals.

(e) All sharp objects protrusions and edges, including damaged flooring likely to cause injury to dairy cattle, must be removed, repaired or covered.

1.1 Regulatory requirements

The Animal Welfare Act 1999 places the onus on all owners and people in charge of animals to ensure that they meet the physical, health and behavioural needs of animals. These needs are defined as:

- proper and sufficient food and water
- adequate shelter
- opportunity to display normal patterns of behaviour
- physical handling that avoids unreasonable or unnecessary pain or distress
- avoidance or treatment of injury and disease.

The Animal Welfare Act makes it an offence not to meet these needs, and it lays out offences in other areas including transport, export, and ill-treatment.

The Act does not define what the needs are or how to meet them for every situation. This is left up to the codes of welfare issued under the Act. Codes of welfare establish minimum standards and recommended best practice. They have a legal effect, and failure to meet a minimum standard in a code of welfare can be used as evidence to support a prosecution for an offence under the Act. Conversely, meeting a minimum standard can be used as a defence against a prosecution under the Act.

1.2 Cow comfort factors

These icons represent the different areas of cow comfort and what the cow needs. How to achieve all these factors through design and management is discussed in the guide.

COW TRAFFIC

Cows need to move freely from area to area, turn around, and back in and out of stalls without injury or hindrance.

LOAFING AREAS

Cows must be given the correct space and environment to be able to pass each other, socialise and groom.

LYING

Cows need to be able to lie in dry, clean and comfortable conditions.

FLOORING

Cows need to walk confidently on non-slip reasonably clean flooring.

FEED & WATER

Cows need the correct feed and trough space at the right dimensions including height.

AIR QUALITY

Cows need good quality air supplied through an effective ventilation system.

SOCIAL INTERACTION

Herds or groups of cows have a social pecking order with higher and lower rankings. Cows will be most settled if there is minimal competition for space, feed and water.

BEDDING

Cows need dry and comfortable bedding that offers stability to get up and out of, and to spend long periods of time lying on.

LIGHTING

Cows need uniform distribution of light to make best use of lying areas and cow traffic. Good lighting also makes it easier for staff to observe heat detection or health problems.

SHADE

Cows require shade to reduce the impact of heat stress.

All aspects of cow comfort should be achieved to provide an environment for optimum welfare, health and production.

"AT THE CENTRE OF DESIGN WAS THE COW."

Fitting cow brushes in any barn is beneficial. Grooming is very important, due to the health and wellbeing benefits it provides.

Only build if you can afford to do it right. Poorly designed facilities that compromise cow comfort affect feed intake, return on capital investment and cow health.


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1404

2. Defining and considering systems

2.1 Defining your housing system

Ultimatley design and management of a housing system is influenced by how long the cows will use it e.g. all winter or for twelve hours a day. Irrespective of how the building is integrated within your farm system, it must provide a clean, dry and comfortable environment that does not compromise cow health, welfare, comfort or production.

The longer the building is expected to house cows, the greater the consideration for key factors like structural robustness, effluent management and cost. The level of design detail required when housing cows for long periods should not be underestimated.

When selecting a housing option, it is important to be clear on the purpose of the building. There are many factors to consider. Each of the following points is covered in more detail in this guide:

- the suitability of the facility to house lactating and dry cows
- the local climate requirements for housing during hot and wet periods
- access to resources such as water and a sustainable supply of bedding material
- construction costs
- on-going management and maintenance costs
- animal health and welfare implications
- effluent management systems and intended use for old bedding, effluent and potentially separated effluent products
- building lifespan
- specific regional and district council requirements
- future proofing.

Make an informed decision

To ensure you are running your farm as efficiently as possible, the decision to invest needs to be based on sound analysis of the farm business.

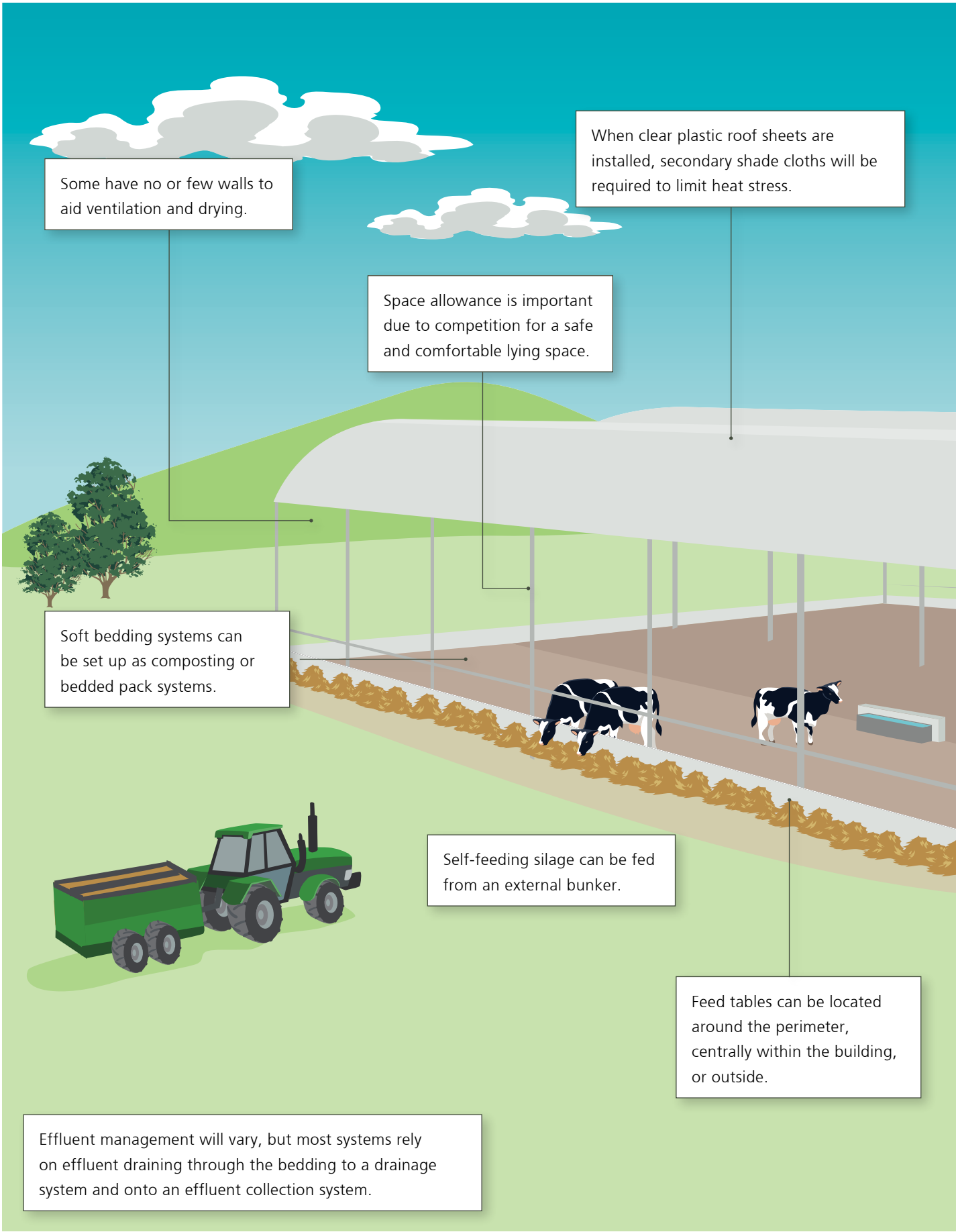
Do your homework

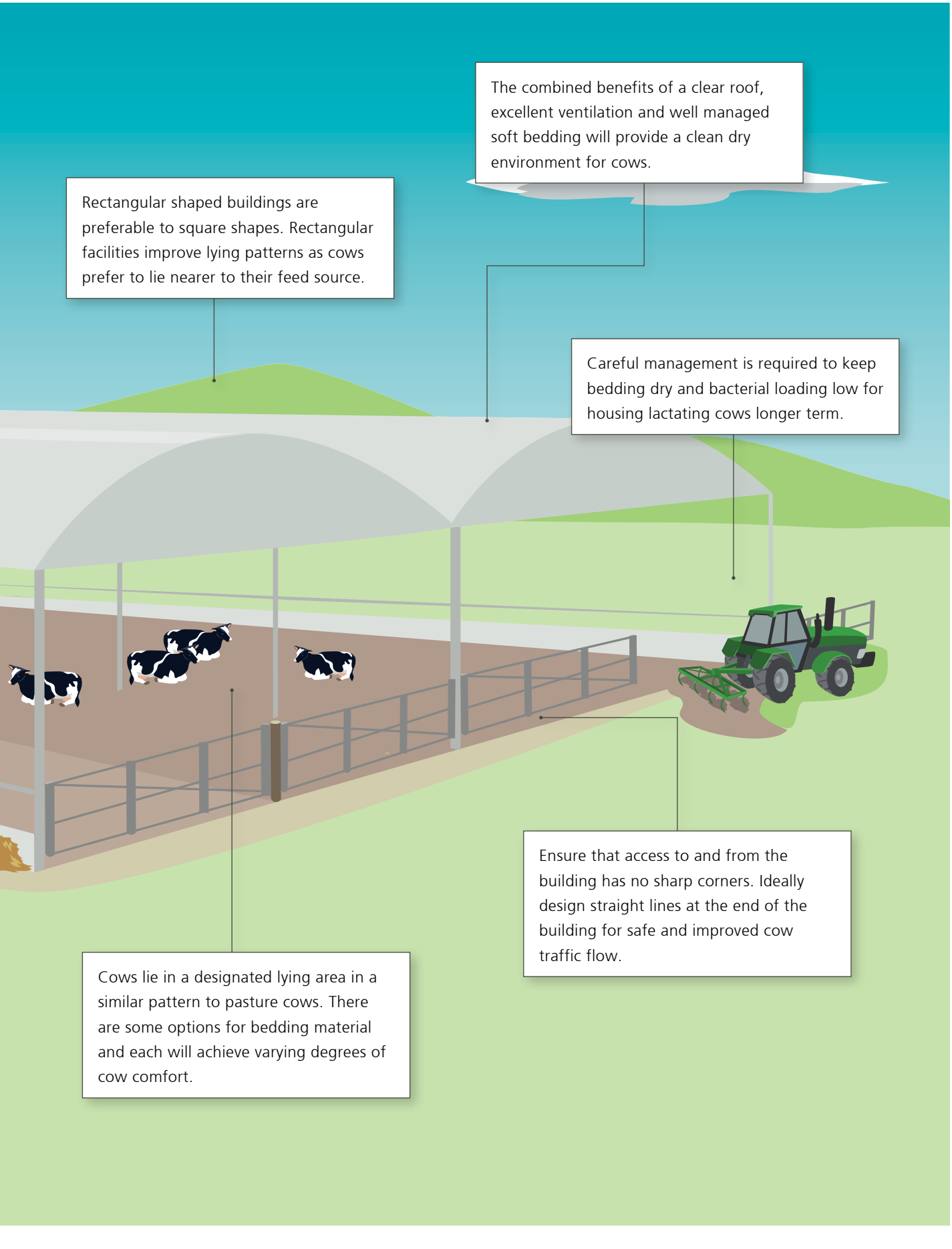
- Be sure any changes you want to make will solve the problem you want to address and fit with your goals.
- Confirm proposed changes with independently qualified people.
- Use the correct capital investment tools (net present value).
- Ancillary costs (e.g. effluent, labour, machinery) could add 30%-100% of the build cost.
- Understand the risks and the skills associated with running a system with off-paddock facilities.

Run your farm as efficiently as possible

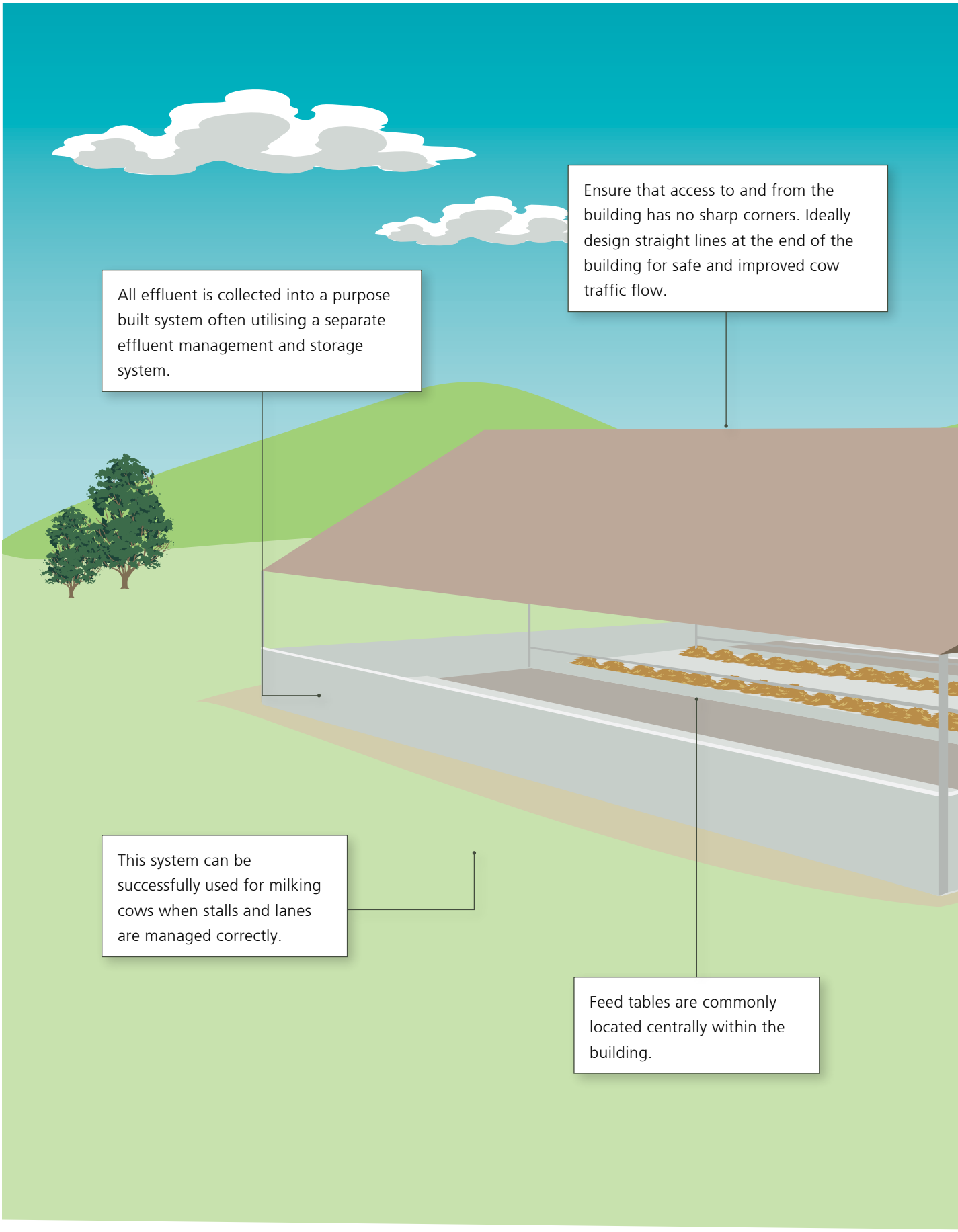
- Know your own farm and situation.
- Identify areas through benchmarking where efficiency can be gained and apply practices that minimise wastage.
- Make appropriate infrastructure responses to environmental challenges.
- Avoid over reliance on expensive imported feed sources.

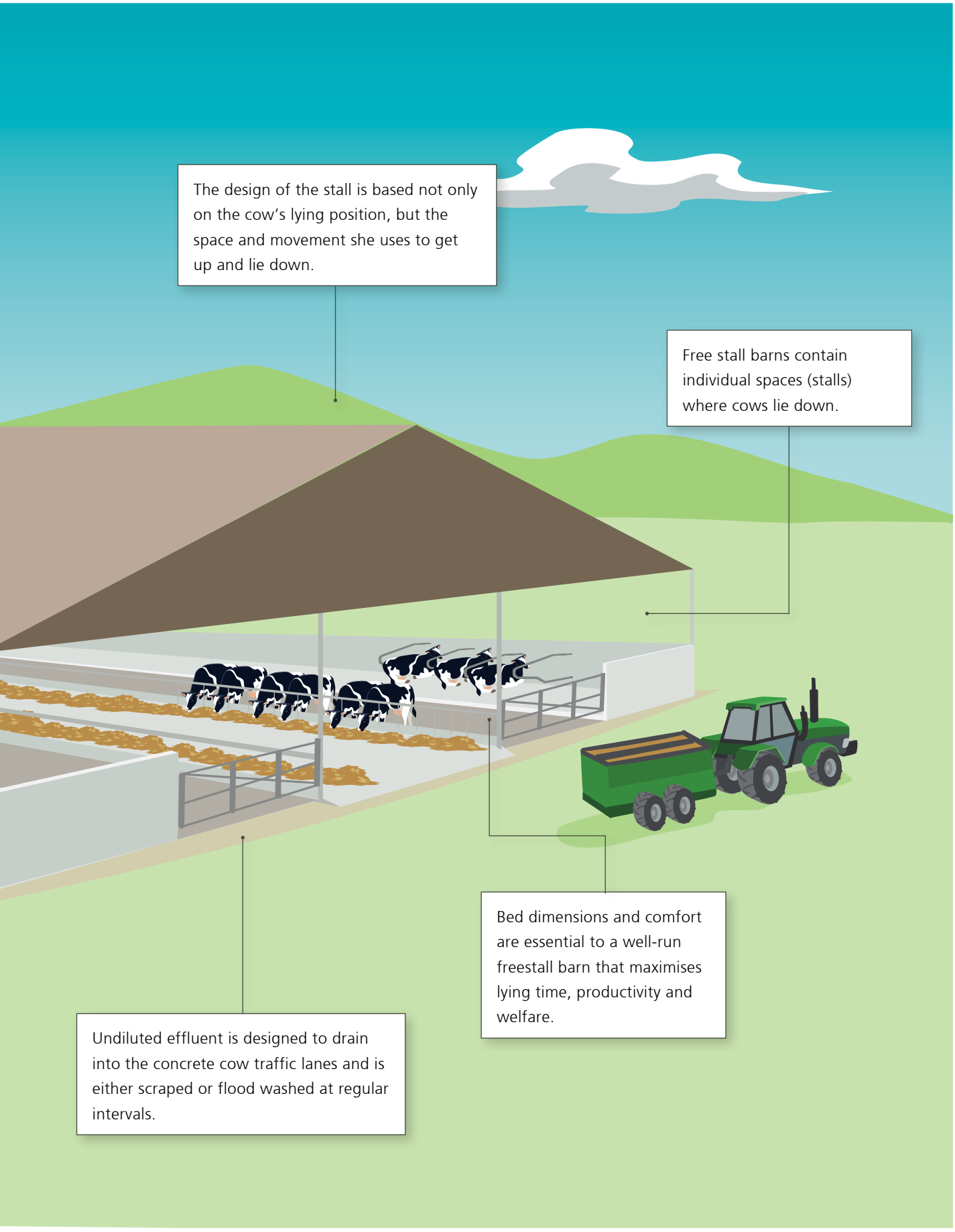
Loose housed:




The combined benefits of a clear roof, excellent ventilation and well managed soft bedding will provide a clean dry environment for cows.
Rectangular shaped buildings are preferable to square shapes. Rectangular facilities improve lying patterns as cows prefer to lie nearer to their feed source.
Careful management is required to keep bedding dry and bacterial loading low for housing lactating cows longer term.
Ensure that access to and from the building has no sharp corners. Ideally design straight lines at the end of the building for safe and improved cow traffic flow.
Cows lie in a designated lying area in a similar pattern to pasture cows. There are some options for bedding material and each will achieve varying degrees of cow comfort.

Freestall:


Ensure that access to and from the building has no sharp corners. Ideally design straight lines at the end of the building for safe and improved cow traffic flow.
All effluent is collected into a purpose built system often utilising a separate effluent management and storage system.
This system can be successfully used for milking cows when stalls and lanes are managed correctly.
Feed tables are commonly located centrally within the building.


The design of the stall is based not only on the cow's lying position, but the space and movement she uses to get up and lie down.
Free stall barns contain individual spaces (stalls) where cows lie down.
Bed dimensions and comfort are essential to a well-run freestall barn that maximises lying time, productivity and welfare.
Undiluted effluent is designed to drain into the concrete cow traffic lanes and is either scraped or flood washed at regular intervals.

2.2 Stocking rates

It is essential to get stocking rates right. High stocking rates can lead to a number of issues:

Required stocking rates for cow comfort

	Loose housed systems		Freestall system
	Integrated paddock and housed systems.	**Wintering system or other long term use.**	
Stocking rate per adult cow	**6 – 8m²**	**9 – 11m²**	Refer to required design specifications including: stall, passageways and feed alleys to determine total stocking rate. **Ensure 1 stall per cow.**

2.3 Lying areas in housed facilities

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Minimum Standard No 6 – Providing Behavioral Needs

(a) Dairy cattle must be able to walk, turn around, lie in a natural position, lie down and rise freely, and express normal feeding behaviour and appropriate social interactions.

(b) Dairy cattle must be able to lie and rest comfortably for sufficient periods to meet their behavioural needs.

(MS 9 ci) they must be provided with a well-drained lying area with a compressible soft surface or bedding that is maintained to avoid manure accumulation, and artificial or natural shelter or other means of minimising the effects of exposure to the weather.

Housed cows need to lie down comfortably on compressible, dry bedding for ideally 10-13 hours (minimum of 8 hours) per day to optimise health and efficiency.

Compressible

Cows housed on hard surfaces, such as concrete, solid or slatted floors and river stones have increased lameness, stiffness and agitated behaviour, decreased lying times and dry matter intakes as well as reduced Body Condition Scores. Additional bedding material must be added to hard flooring to create a comfortable lying surface.

Rubber overlays can be used to improve comfort for standing cows. Think about how you will maintain the rubber as it can be slippery when wet and becomes unhygienic as it deteriorates.

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Knee test A. Drop to your knees from standing on the bedding to test how comfortable it is. Two thirds of a cow's weight is on her front knees when she goes to lie down.

Dry and clean

Keeping the lying area dry and clean is essential for comfort and animal health particularly for calving cows. Good design of the lying area, stocking rate, drainage, management of the lying surface and ventilation all go toward keeping lying surfaces dry.

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Knee Test B. Try kneeling on the lying surface for 10 seconds and see how wet and dirty your knees get. Wet knees mean you should assess some of the factors that influence dry and clean beds.

In an integrated system cows spend time inside and outside every day. If cows are not comfortable inside, they will lie down when let out to pasture in preference to grazing, potentially resulting in underfeeding.

There is a direct link between lying time and production.

3. Loose housed systems

3.1 Bedding area design

There are a few basic designs of loose housed systems depending on the position of the feed passage.

Feed table accessed from inside with soft bedded feed passage

In designs like this, ensure the lying area is correctly calculated to achieve the right stocking rate. Do this by removing the section shaded green from the total barn area. Allow two metres for the length of the feeding cow and multiply by the total feed table length.

Lying area for loose housed system housing 150 cows

a) Calculate total barn area
70m x 25m = 1500m^2

b) Calculate Feeding area
65m x 2m = 130m^2

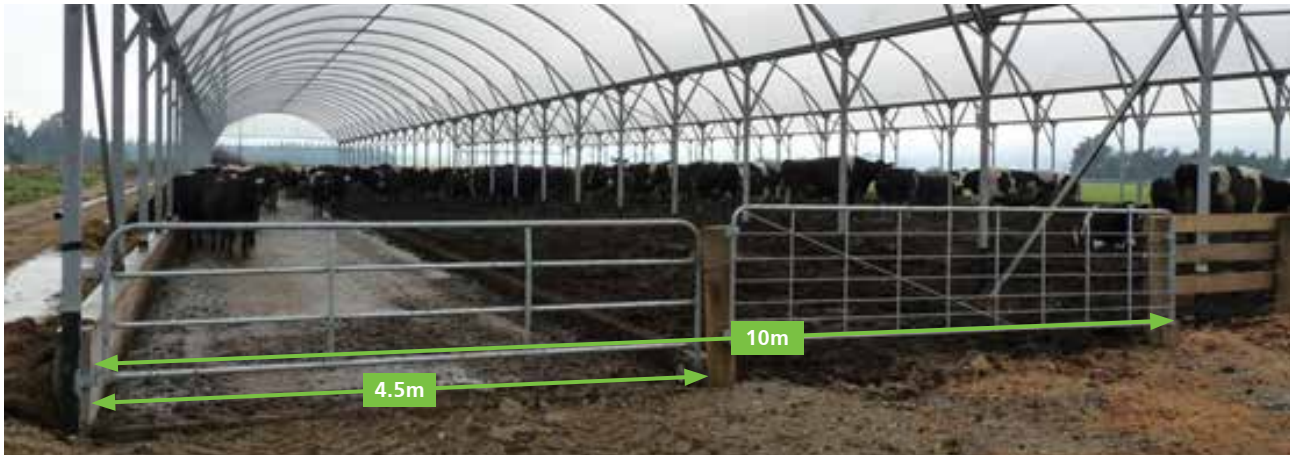
c) Subtract feeding area from total area
1500 – 130 = 1372m^2

d) Divide by the maximum number of cows that will use the barn to give space allowance per cow.
1372m^2 / 150cows = 9.1 m^2/cow

Feed table accessed from the inside with scraped concrete passage

The distance from the feeding area to the centre of the bedding area (if feeding along both sides) should not exceed 10m. This improves the lying pattern and cows are distributed more evenly. Feed access passageways should be 4.5 metres wide to allow enough space for cows to pass behind others that are feeding.

There should be open access along all sides of the bedding area to the feed passage. This will prevent localised congestion, pugging and a reduction in the available bedding area. A drain should be located behind the feeding area as this will have high traffic and will be where most of the dung and urine accumulates.



Provide wide entry and exit points for good cow flow.

Feed table accessed from the outside with scraped concrete feed passage

Design a building where cows can be removed from the feeding area and closed onto the bedded area so that the passage can be scraped once or twice a day. This is easily achieved with a reel and standards. A nib wall should be positioned between the bedding pack and the feed passage. This will prevent water run-off from the feed passage into the bedded area and also help contain the bedding material. Ensure the concrete feed table is more than 1.2 metres wide to reduce wastage.

This system allows rain water to enter the effluent system which should be included in the effluent storage calculations.

Consider wider concrete feed tables (1.2 - 1.5 metres) and hard machinery tracks to reduce feed wastage and pugging. See feed barrier section for the best design to suit the cows.

3.2 Bedding materials

Wood products:

By-products from the timber industry are commonly used as cow bedding.

Wood products are unlikely to require topping up daily or weekly and cow traffic stirs up the material, but every week, and some farmers advocate daily, the following maintenance options need to be considered:

- Scratching the first 10cm of the surface with a tractor and implements (such as grubbers, tines, rippers) to break down faecal matter and flatten the overall surface.
- Check if any top-up is required to maintain approximately 50cms of soft dry bedding.

Top-up woodchips to keep the layer in contact with the cow both dry and comfortable.

"WE HAVE FOUND BY RUNNING OVER THE BED EVERY DAY WITH A SET OF TINES OUR BEDDING SURFACE IS SO MUCH BETTER, I WISH WE HAD DONE THIS FROM THE FIRST WINTER WE USED IT."

There are many types of wood products available. Some of them are more suitable for bedding than others:

- Square chips provide a balance of good drainage and comfort. If particle size is too small and soft the bed will clog up and inhibit drainage. When chips are too large they can be uncomfortable and provide a poor walking surface.
- Before ordering, ensure woodchip is from untreated timber. Some wood treatments may be toxic to livestock.
- Do not source Macrocarpa chippings as this tree has been linked to late stage abortions.
- Recycled wood product chips may be at risk of containing nails and staples.
- The drier the woodchips are before use, the longer they will last as their capacity to absorb moisture is higher. Kiln dried woodchips are available.
- Woodchips must be kept in covered storage to keep them dry.

Use pine or a timber type that chips square and not stringy.

Some mixes can contain sharp parts that could cause discomfort and injury for cows.

Large wood chips mixes may not be as comfortable for the cow.

Straw

If straw is used for bedding, it will require topping up much more regularly than woodchip. Straw is relatively difficult to source in large volumes in many areas of New Zealand.

Compost systems

Composting systems can be set up in loose housed facilities. A composting system, if managed correctly, provides dry bedding that does not require any further composting after removal and very little further top up over the year. These beds are built using fine wood chippings with a moisture content of 45–55% and a minimum depth of 45-60cm. The bedding pack builds up over time and needs to reach temperatures of between 43 to 60°C in order for the material to compost. The top 20cm of material is cultivated twice a day to incorporate the urine and faecal matter and aerate the top layer to aid the composting process. Cultivation needs to take place when all cows are out of the barn.

The bacteria levels in compost bedding packs are very high. Maintaining a dry lying surface is critical to minimise material sticking to the cow or its udder and why these systems can work well. At certain times of low temperature and high humidity, adequate ventilation is critical to maintain the integrity of the bedding. Milk quality risks can exist in poorly managed systems due to the high levels of bacteria that may come into contact with the cow's udder. Bedding must be topped up regularly. Starting a composting pack off well will reduce the need for regular top ups. Good composting systems will only need topping up every eight weeks, poorly managed packs will need weekly top ups.

Bedding material sources, DM% of cow dung (25% or higher), labour requirements for twice a day tillage and low stocking rates are all important considerations when planning to build this type of system.

Waste bedding products

Utilising the waste woodchip or straw can be beneficial for farms. Correct composting of woodchips means they can be used as either as a soil conditioner or reused as bedding. Seek expert advice around post-use composting of woodchips or straw and check regulations around spreading of waste products.

Cows should remain clean on a well managed loose housed system.

"BUILD BIG ENOUGH TO HOUSE THE WHOLE HERD IF YOU CAN AFFORD IT AS YOU WILL WANT TO DO THIS LATER ON ANYWAY."

3.3 Drainage

Poor drainage is major contributing factor to bedding pack failure. Although this can be affected by the bedding material a good drainage system will need to be installed under the bedding material to ensure that the liquid effluent is removed from the bedding pack. It is also a good idea to install drains in exit ways to minimise the amount of muck brought onto the bedding area. All liquid effluent should be captured on a sealed surface and drained to the effluent system.

STAY INFORMED

If the barn is used for housing the milking herd it is important to ensure the cows remain standing for a minimum of 30 minutes after milking to give the teat canal time to close before it comes into contact with potential mastitis causing pathogens. This can be achieved by providing fresh feed after milking and enough feed space per cow so that all cows can feed comfortably at the same time.

Freestall

4. Freestall

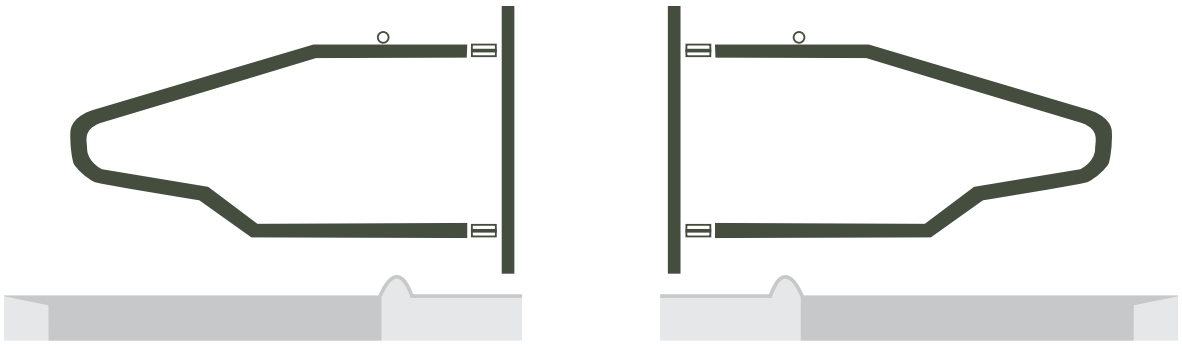
A freestall building designed according to the needs and size of the herd provides flexibility for separating specific mobs of cows based on age or stage of lactation, as well as separating groups for differential feeding by using dividers (gates) to partition the building. Ensure design and management allows for as required in the Dairy Cattle Code of Welfare.

4.1 Layout and design

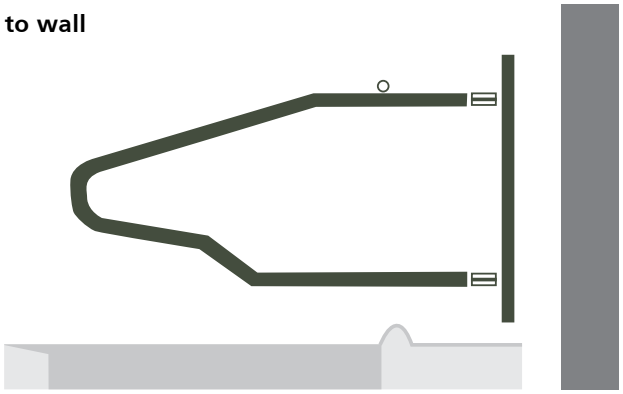
A conventional design with a central feed passage is likely to contain multiple rows of stalls on each side of the lane. Layout should be matched to herd size, building use and feed space per cow. Keeping cows clean and passageways free of effluent build up is critical to achieving best performance.

Stalls will either be facing the outer walls/outside or a head to head. Dimensions are important for both types.

Head to head



Head to wall



There should be no dead ends in the building with cow traffic and access to feed and water a design priority. Ultimately the feed space per cow drives the length of the building e.g. 70cm per (crossbred cow) with 100 stalls on each side will equate to a 70-metre barn in length (70cm per cow x 100 cows = 70m). The total width of the barn is driven by the number of rows of stalls and the width of the passageways.

4.2 Cow uniformity

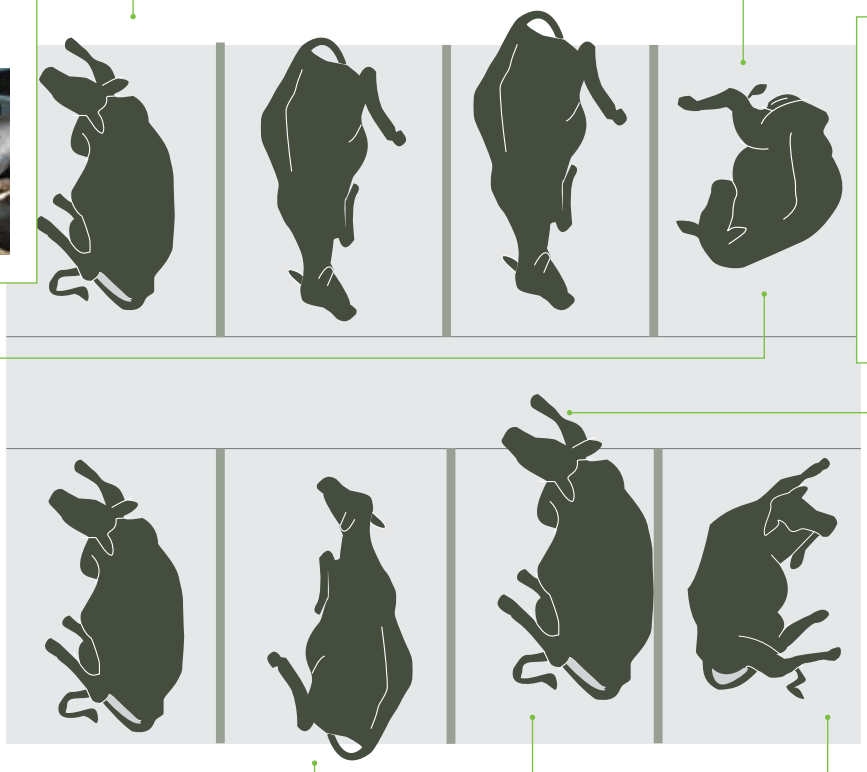
The dilemma for any farmer moving from an open lying area i.e. pasture or loose housed system, to a freestall design, is the issue of herd size uniformity. It is unlikely the whole herd will be uniform, and heifers will always make up around 20% of the herd, but some improvements in uniformity might be possible.

Future goals in terms of production and genetics will drive the size of your cows and therefore the correct stall dimensions. The focus needs to be on the appropriate stall size and lunge space for the bigger cows and accepting that the beds of small cows and heifers will need cleaning. Overseas specifications generally relate to large cows so check if those measurements are relevant for your herd.

Cow size and stall design outcomes

Cows may lie the wrong way round due to incorrect stall design, draughts, or sunlight in the head space.

Cows that hangover the edges of stalls will not achieve full comfort and will be knocked by automatic scrapers. This cow is probably lying this way because the design of her lunge space is affecting her comfort when lying and rising.



Cows that lie diagonally are at risk of injury. As they are at a greater risk of getting legs stuck under dividers during rising.

Small cows will be able to lie diagonally as the stalls will be too wide for them.

Cows will fill lunge space with their heads, making head to head lying awkward. So plenty of space between rows allows higher comfort levels for cows.

Tails lying in the passageway can be an indicator that the stall design is incorrect or some cows are too large for the stalls.

Large cows will rub their backs on dividers if the stalls are too narrow. Lying time reduces if stalls are too narrow.

Smaller cows will lie forward and defecate on the bed, meaning more scraping for the farm team.

4.3 Passageway widths and layouts

Passages and crossover passages provide escape routes for submissive cows, turning spaces, areas of social interaction and improve cow traffic flow:

- Crossovers should be located every 20–25 stalls.
- All passageways and crossovers should be scraped or washed regularly.
- They must provide adequate turning room and a non slip floor, to reduce risk of falling or pushing.

When deciding on width, consider how busy the passageway will be, some passageways have a lot of cow traffic.

Auto-scraper width may determine width of passage way. If narrower than 5m, cleaning must be more frequent.

A feeding cow takes up 2 metres in length.

The minimum width of any loafing scrape passage should be 3m, consider increasing width if cows are exiting stalls into the passageway.

Stalls that exit onto a feed face passage way have high levels of cow traffic. These stalls are at the greatest risk of splashing from effluent and soiling of bedding, so should be 5.0 – 5.2m wide.

To ensure good cow traffic flow, a crossover should be at least 3m wide. When a drinking trough is installed in the crossover, the width should be increased to 4.3m to allow cows to pass behind others drinking. Provide even more space where a grooming brush is located at the crossover.

Consider placing slatted cross channels or grates in longer scraped passages. When using automatic scrapers, the accumulated effluent can be deposited before it builds up in front of the blade. If manually scraping, a cross-passage drain will speed up the process and limit the risk of overflow of effluent onto beds during scraping.

Dry matter content of feed affects the dung which in turn affects how well these drains will work.

Central passage: Feed lane passages facilitate machinery movement. The machinery used is likely to be a mixer feeder wagon.

STAY FLEXIBLE

As the size and capacity of tractors and feeder wagons increases, the central passageway dimensions may also need to allow for this. Think about possible future requirements.

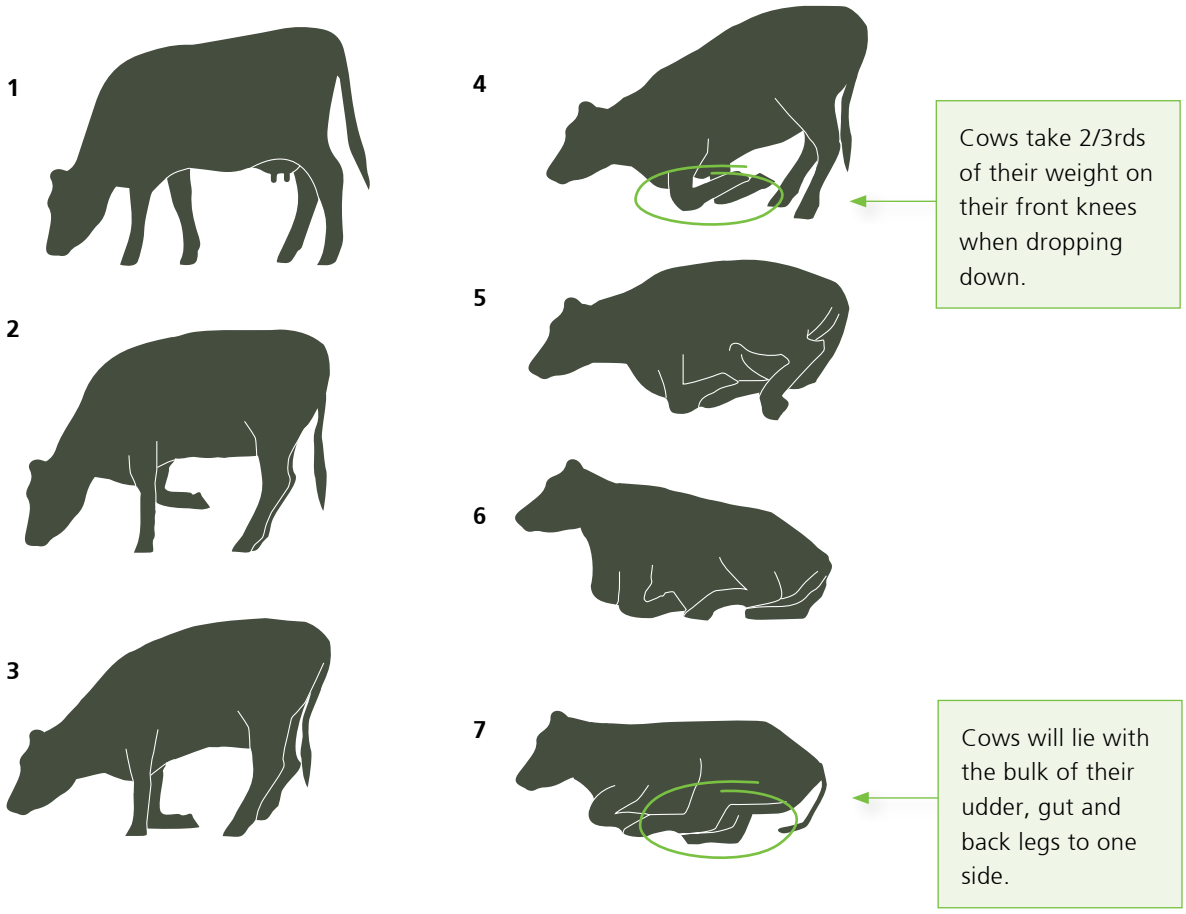
Areas to consider for a central passage:

- Machinery must be able to enter the building easily.
- Machinery should be able to operate effectively inside.
- There must be adequate space outside at either end of the feed passage for a turning area.
- There must be enough height clearance to deal with downer cows and remove dead stock.
- Ensure floor strength matches machinery weights.
- Take into account the width of the feed table when deciding on the central passage width. Cows should not walk within the tractor turnaround as a biosecurity precaution.

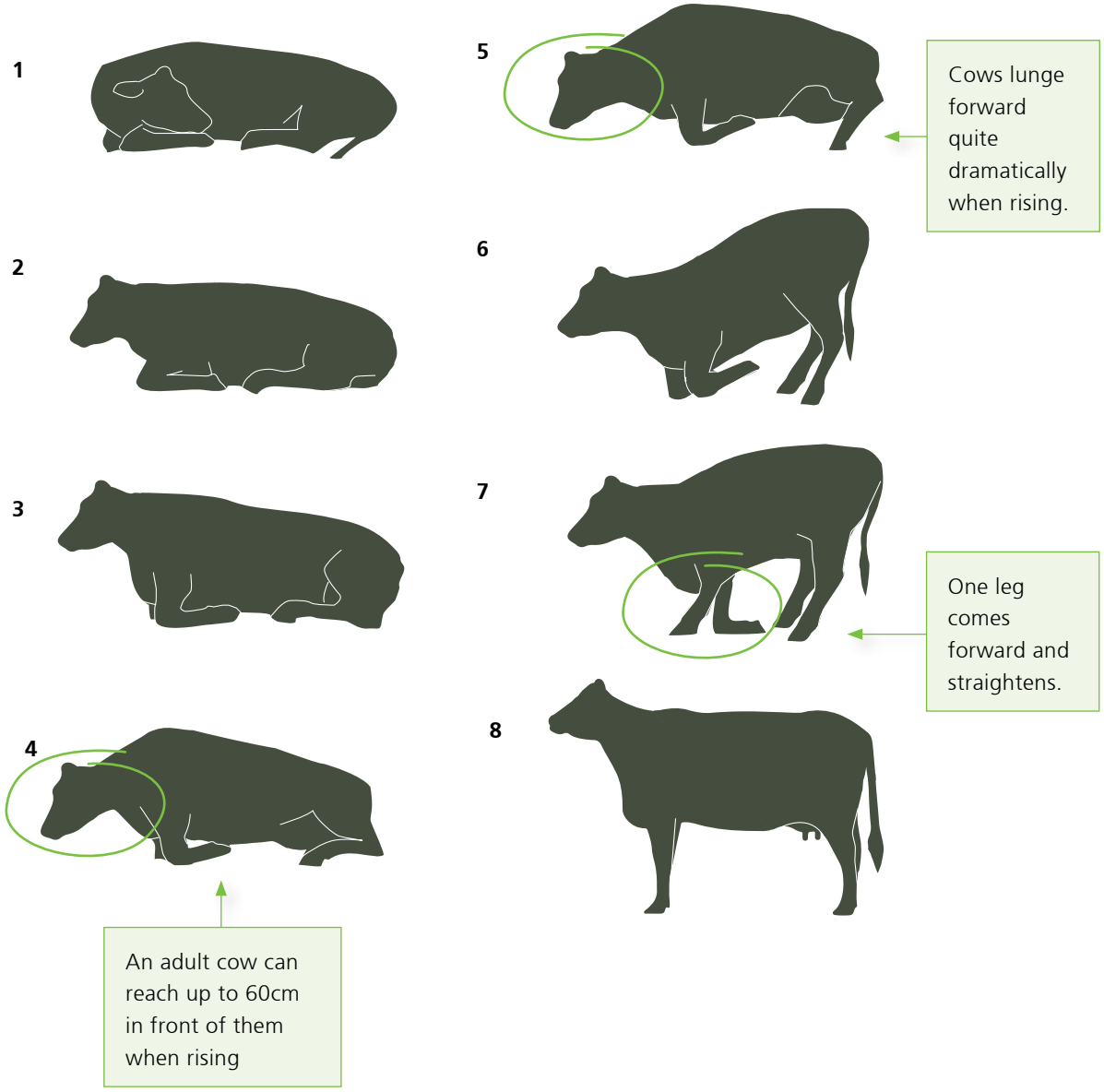
4.4 Stall design factors

The dimensions of a freestall depend on the size of the cow. It is important to understand the space requirements of a cow when she lies down, rises and rests.

The stages of lying down



The stage of rising



Stall design factors have an effect on use and cow comfort.

Bed Length – The area the cow has to place most of her body. This does not include the lunging space.

Lunge space – The space the cow has to lunge forward into when getting up. Stalls that are located too close to a wall have little or no lunging space, making it difficult for cows to stand up, compromising the lunging space, reducing stall use and lying time, and forcing cows to lie diagonally.

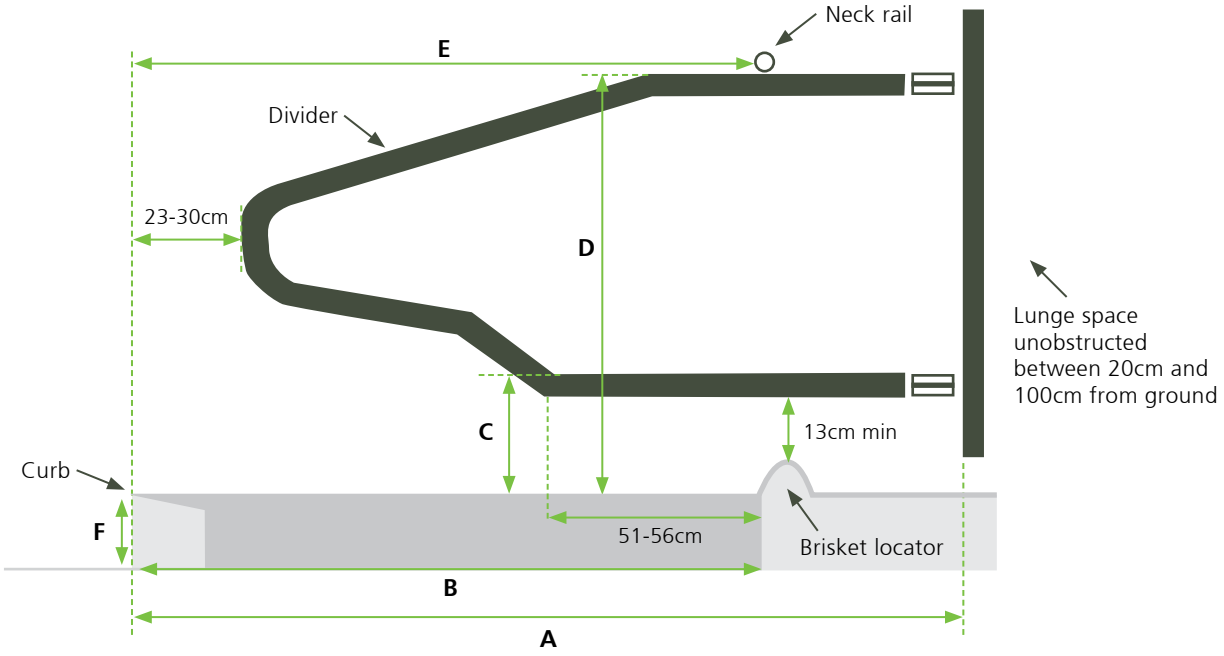
Head space – The space at the front of the cow when she is lying down. (Also referred to as the lunge space). Cows do not normally sit head to head. They need room to ensure they do not intrude into each other's "threat" or personal space. Cows do not like a wall blocking their natural head position or extension. They will lie diagonally when there is not enough head space.

Freestall length – The combined length of the stall; bed length + headspace/ lunge space.

Brisket Locator – This raised area helps the cow locate herself in the correct position within the stall.

4.5 Freestall dimensions

These measurements are guidelines. It is good practice to fit stalls that can be adjusted to allow some movement once cows are in the barn and you have assessed their comfort levels. Always start the process of design by measuring your cows and consider how much bigger they may get on different a different diet.

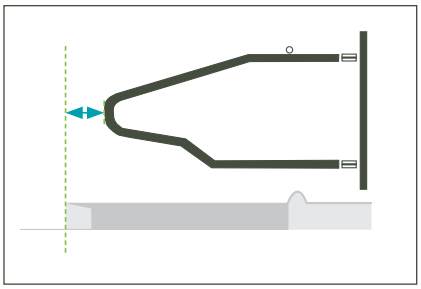


Stall Dimensions for Mattress Stalls	Body Weight Estimate (kg)			
	455	**545**	**636**	**727**
Total stall length facing a wall **(A)**	244	244	274	305
Full length of head to head stall	488	488	518	518
Rear kerb to rear of brisket locator **(B)**	163	168	173	178
Stall width (centre to centre)	112	117	122	127
Height of upper edge of bottom stall divider rail from bed **(C)**	28	28	30	30
Height of neck rail above mattress surface **(D)**	112	117	122	127
Horizontal Distance between rear edge of neck rail and rear kerb (mattress stall) **(E)**	163	168	173	178
Rear kerb height **(F) Not including mattress thickness.**	20	20	20	20

Adapted from The Dairyland Initiative, University of Wisconsin, Madison – Freestall Dimensions.

There should be 23–30cm from the back of the divider to the kerb. Longer than 30cm, cows may walk or lie along the back of the bed.

Freestall width



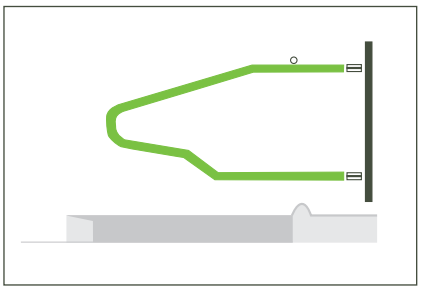
The stall should be wide enough to allow the cow to recline and rise easily without banging her hip bones on the dividers.

Stall width is determined by the width of the gut of a fully fed cow lying down, with extra allowance for late pregnancy.

It is possible to calculate the correct width of the stall by taking hip measurements. Hip Measurement x 1.8 = hook bone to hook bone measurement.

Divisions that allow horizontal adjustment help ensure appropriate stall widths.

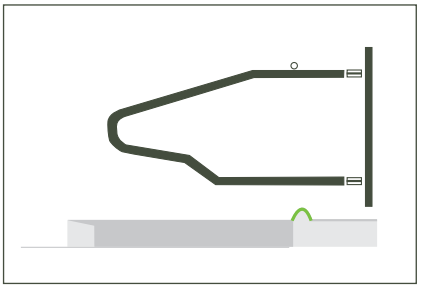
Freestall division



There are many freestall divider designs. The overall requirement of any divider is to ensure the cow is correctly positioned while not causing any discomfort or injury. Dividers must not catch the legs while manoeuvring in and out of the stall. The rear of the divider should not be attached to the ground to avoid obstructing rear legs, tail or udder, as lying cows naturally extend their back legs away from their bodies. The front end of the divider must be designed to minimise front legs getting caught in positions that restrict rising or cause injury, while keeping the cow positioned correctly.

Conventional dividers are metal but other materials and designs are available. Ensure the design you choose provides cow comfort, minimises injury and increases lying time in the correct position. Talk to other farmers when looking into options.

Brisket locator



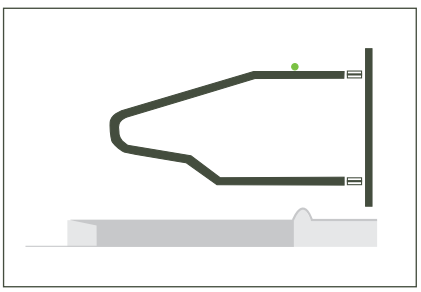
The purpose of the brisket locator is to position the cow correctly when she lies down. When the brisket locator is correctly positioned, it prevents the cow lying too far forward or creeping forward when lying. If a cow lies too far forward, it leads to bed soiling, causes difficulty when rising and can interrupt the lunge space of the opposite cow in any head to head stalls.

The height of the brisket locator is important as the cow will swing her front leg forward before rising; 10cm provides the cow with easy clearance, 8cm is more suitable for smaller cows.

The brisket locator should be rounded and have no sharp edges to allow for the natural shape of the cow's leg.

Many brisket locator designs are available and thick pipes are an inexpensive option.

Neck rail



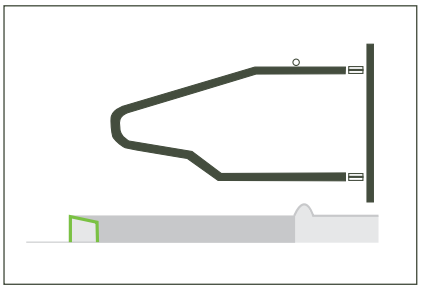
The purpose of the neck rail is to position the cow when she enters the stall, before she lies down. The position of the neck rail needs to be correct both horizontally and vertically. It is difficult to get a neck rail in the right place without compromising either the standing cow or the rising cow, especially if the herd contains cows of varying size. Fitting adjustable neck rails is a sensible choice.

Too far back: Will limit the occupancy of the stall and lead to cows perching (two feet on the stall and two feet in the passage) or avoid the stalls and stand in passageways.

Too low: Can cause injury to the cow when she reclines and rises and also reduces stall occupancy.

Increasingly, neck rails are being moved right forward or removed completely as they are difficult to position correctly. If neck rails are removed, the structural integrity of the dividers can be reduced, so the design and strength of the dividers needs to be considered before neck rails are removed.

Kerb

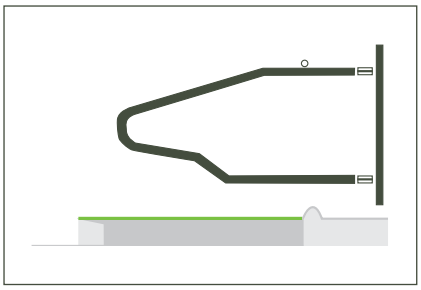


The kerb is the drop between the back of the bed and the cow passageway and keeps effluent off the stalls. Height will depend on the scraper type, floor type and length of passageway. Long scrape passages may require a slightly higher kerb e.g. 200mm to prevent effluent soiling the beds, while fully slatted passages will allow the kerb to be reduced in height e.g. 150mm.

If mattresses are fitted, their height should be considered when calculating kerb depth. It is important for the cow exiting the stall that the kerb is not too high as the pressure on her back legs increases when she backs out.

As with all aspects of stall design, kerbs should not have sharp edges, be slippery or be too wide to prevent cows' hocks resting or rubbing on the kerb when lying down.

Slope of bed



Stall beds should be installed with a slight fall of 1–2% from the front to the rear. As well as providing cow comfort the fall provides drainage. Well-designed mattresses incorporate slope and grooving to draw fluid away from the cow.

Where the slope is greater than 3%, there can be problems retaining secondary soft bedding in the stall.

STAY FLEXIBLE

Think about fitting freestalls that are either adjustable or do not have designated widths to allow for change and expansion.

Minimum Standard No 9 d – Providing Behavioral Needs

(iv) Where free-stalls are provided within the off-paddock facility: stocking rate must allow a minimum of one free-stall per animal housed. The design and size of the free-stalls must allow all dairy cows in the facility to lie without the body extending outside or overhanging the end of the free-stalls.

Freestall lying surface

As with any lying surface the stall bed must be clean, dry, comfortable, safe, provide sufficient grip and be made from resilient and durable material.

There are a number of bedding options, which may be used alone or in combination, usually on top of a concrete or stone base. These include:

- Mattresses – foam or rubber mattresses, usually encased in an impermeable synthetic envelope.
- Waterbeds – these need internal baffles or divisions to be successful. They can take longer for cows to get used to than other bed options, especially if the waterbeds are not well stabilized.
- Sand – offers the highest comfort and cleanliness for cows. It requires daily grooming and replacing. Sand can also be separated, washed, dried and reused.

Additional bedding material on rubber mattresses/mats can provide improved cow comfort, drier beds, easier stall scraping and encourage cows to lie down.

Drying powders are often used on top of free stall mattresses, or in additional bedding. Even with drying powders, daily scraping of faecal matter from the back of stalls is necessary.

Sand reduces pressure or abrasion points for lying cows and provides high levels of leg and hoof health.

"ASK FARMERS WHO HAVE BUILT BARNS AND USED THEM FOR 3-5YRS WHAT THEY WOULD DO DIFFERENTLY."

There is considerable worldwide research being undertaken to develop better stall and bedding designs. Reputable suppliers offer lengthy guarantees on the durability of their products, backed up by research. Ensure you choose a reputable supplier to guarantee the lifespan of the product.

The essentials of any bedding choice are that it:

- provides a soft and non-abrasive surface
- supports the cow's weight
- does not create pressure points that the cow finds uncomfortable
- is made of a material that can be kept dry and hygienic
- ensures secure footing – important for cows to feel confident lying down and rising.

STAY INFORMED

Could you sleep on it? Drop to your knees from standing or kneel on it for long periods, would you be comfortable?

4.6 Managing scraped passages

The busiest loafing areas or passageways, usually the feeding passageway, are the dirtiest.

Continuous exposure of cows' feet to faecal material and the pathogens contained within it is highly likely to increase the prevalence of lameness, weakening of the hoof or digital dermatitis.

Digital dermatitis is prevalent in the UK, Europe and USA. Although not yet common in NZ, incidences are highly likely to increase if housing systems are not managed correctly.

A higher stocking rate will require more frequent scraping or washing. The target is to keep the building and the cows as clean and as possible.

Floor slope can aid drainage but will interfere with scraper systems which need both solid and liquid parts to work properly. Cows prefer standing on flat surfaces. Flat surfaces are particularly important on the feeding lanes where cows will be standing for longer periods of time.

The scraper needs reasonable levels of liquid to ensure good scraping, so in hot weather or when stocking densities are low, scraping systems may not work as efficiently.

Large bow waves of effluent in front of the scraper blade are an indicator that the scraping routine needs to be altered.

Ensure scrapers run regularly enough to stop effluent pooling. You will need to adjust the scraping routine depending on the length of time the barn is used.

Ensure the scraper runs frequently enough to keep the volume of scraped slurry from overflowing onto the beds.

Flood washing

An alternative to scraping is flood washing. The floor should be laid with a 2–3% fall and 10mm wide groves cut in the floor in the direction of the water flow. Bedding material pulled off the beds can be difficult to move with flood water. Flood washes are not as common as scrapers and it is better if the barn is empty when the washing occurs. The volume of water required will depend on the slope of the floor and the width of the passage. Seek expert advice to get this system right. The slope required for flood wash is not suitable to convert successfully to a scraped system without changing concrete levels.

4.7 Flooring

Floors must:

- be anti-slip
- allow confident walking
- allow standing on three legs and grooming with the fourth
- allow expression of oestrus
- prevent injury
- be durable.

Flooring design is complex and advice should be obtained.

Concrete flooring:

For detailed information on concrete surfacing, refer to IPENZ Practice Note 27 (PN27), Part 4, Section 7.2 (pages 122-123). The durability, and particularly abrasion resistance, needs to be considered in the concrete specification for a feed passage floor.

On slatted floors gap width between slats is critical. Cattle slats are typically spaced 40mm apart; larger gaps create issues for cows when they walk, while smaller gaps create issues with drainage. The edges of the slats should be rounded to prevent hoof injuries.

Improving traction on new concrete floor surfaces

There are many options available to provide anti-slip flooring for cows. If the direction of cow flow is known and not random, i.e. on access passageways, parallel grooves can be formed in the concrete. The grooves should be placed at right angles to the movement of the cattle.

Consider the scraping system that will be installed and the affect the grooving might have on the scraping ability. If using straight line grooves, ensure they run in the direction of the scraper.

Estimates of risk factor ratios for cows slipping on different concrete floor finishes and effluent conditions

Floor surface	Risk factor of slipping
Dry un-grooved concrete	1.0
Un-grooved concrete and effluent	3.5*
Grooved concrete and effluent	0.60*

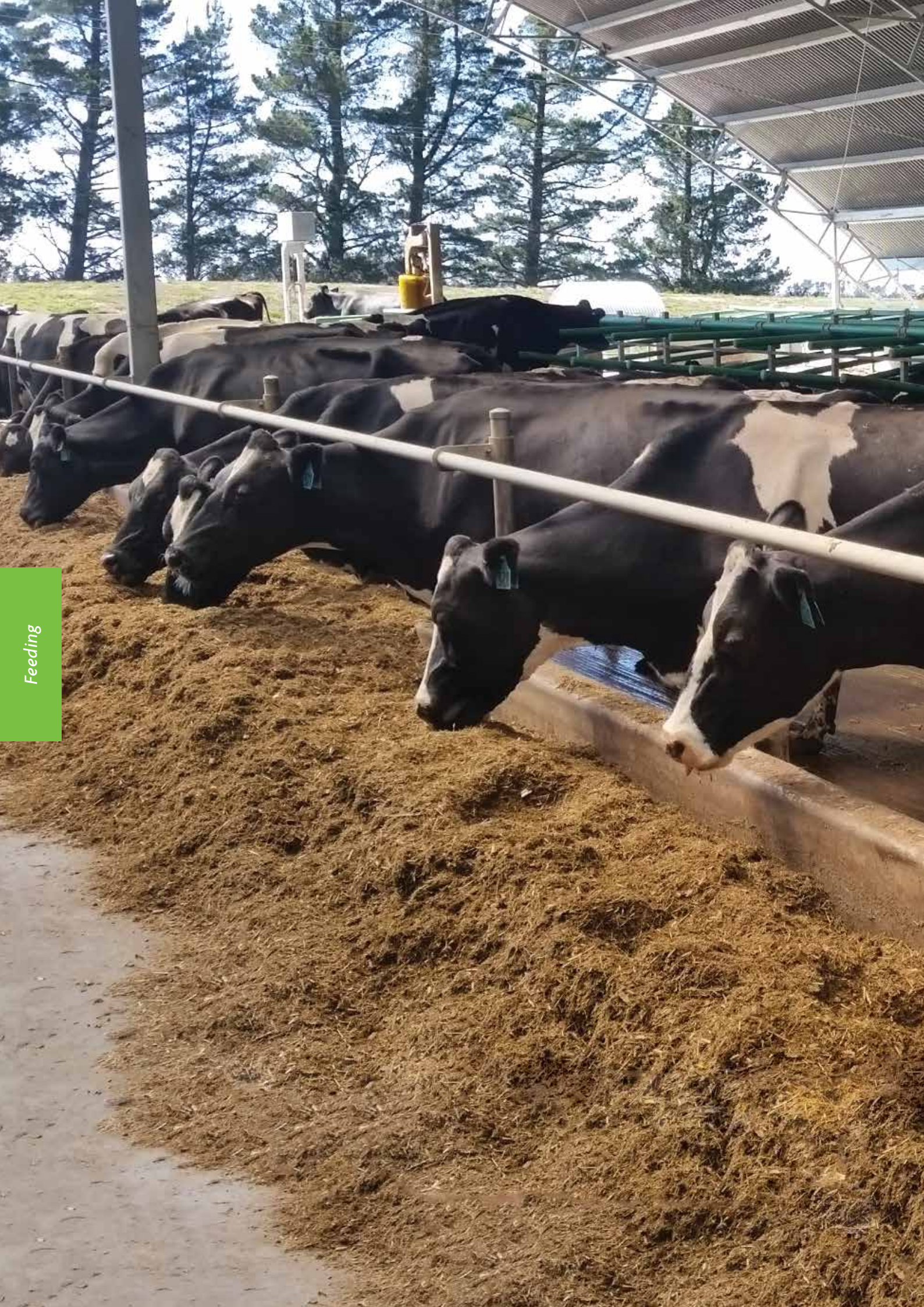
** Compared to dry un-grooved concrete with a slip ratio of 1.0*

"WE TRIED BRUSHED CONCRETE TO START WITH BUT QUICKLY WENT OVER THE GROOVED CONCRETE SCRAPER LANES, WE FOUND TOO MANY PROBLEMS WITH COWS SLIPPING ON THE BRUSHED CONCRETE."

Rubber matting

Installing rubber matting on passage floors reduces pressure on cows' feet. However rubber matting is expensive and cows should lie in designated lying areas and not be encouraged to stand or lie in passageways. Rubber can become very slippery when wet and bacteria grows in cracked worn rubber.

There are different thicknesses of rubber available; some thinner mats provide no real extra cushioning. Select a material with proven design from a reputable company and a contractor with experience in laying rubber matting, as there can be issues with long term fixing to the floor.



Feeding

5. Feeding

STAY UPDATED

Minimum Standard 2 – Food

a) Dairy cattle of all ages must receive sufficient quantities of food and nutrients to enable each animal to:

I. Maintain good health

II. Meet their physiological requirements; and

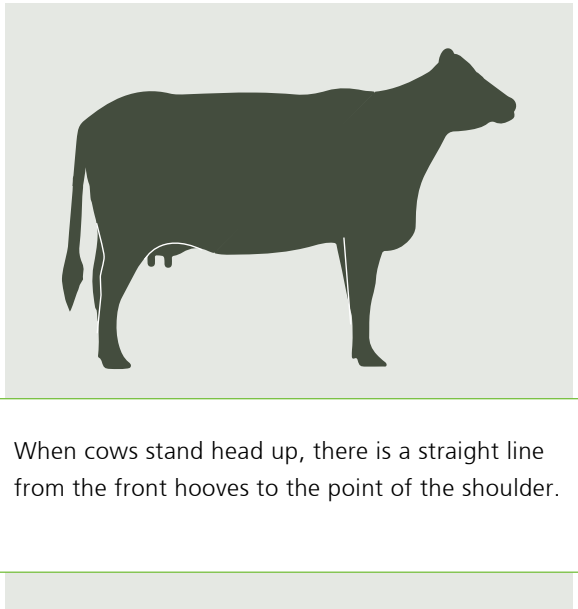
III. Minimise metabolic and nutritional disorders.

5.1 Feeding system principles

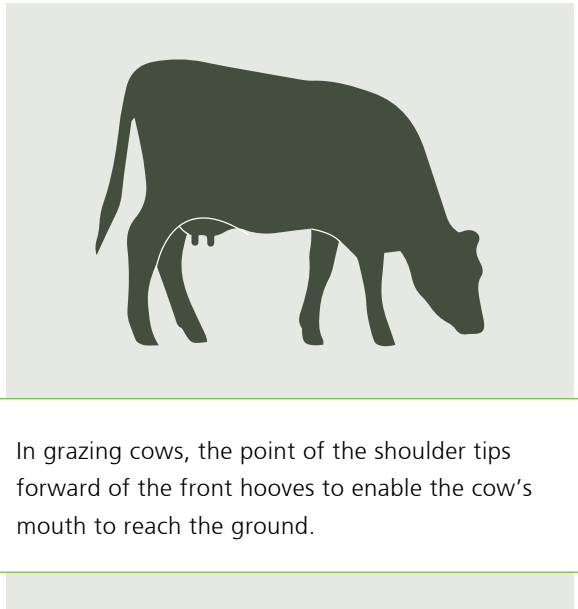
The principles applied to the feeding area are to:

- ensure easy and comfortable access to feed
- limit contamination from weather and pests
- limit feed wastage
- provide a non-injurious environment
- make feeding out easy for farm staff.

Standing and grazing stance:



When cows stand head up, there is a straight line from the front hooves to the point of the shoulder.



In grazing cows, the point of the shoulder tips forward of the front hooves to enable the cow's mouth to reach the ground.

The natural stance (grazing stance) can be hindered when cows feed from behind a barrier. Correct design of the barrier will help reduce this impact.

5.2 Feed barrier dimensions

How the feed table height affects feed utilisation

Height of the feed table above cows feet	Reach of the cow	Outcome
0cm	60cm	Feed will be pushed away by cows trying to eat which increases the risk of wastage, and requires more regular "push up".
10cm	90cm	Good muscular action and salivary production will be achieved.

Feed face per cow

These dimensions are a guide and you will need to measure your own herd to get the correct measurements.

Weight of animal	Width of feed face per cow
450-500kg	70cm
>500kg	1m

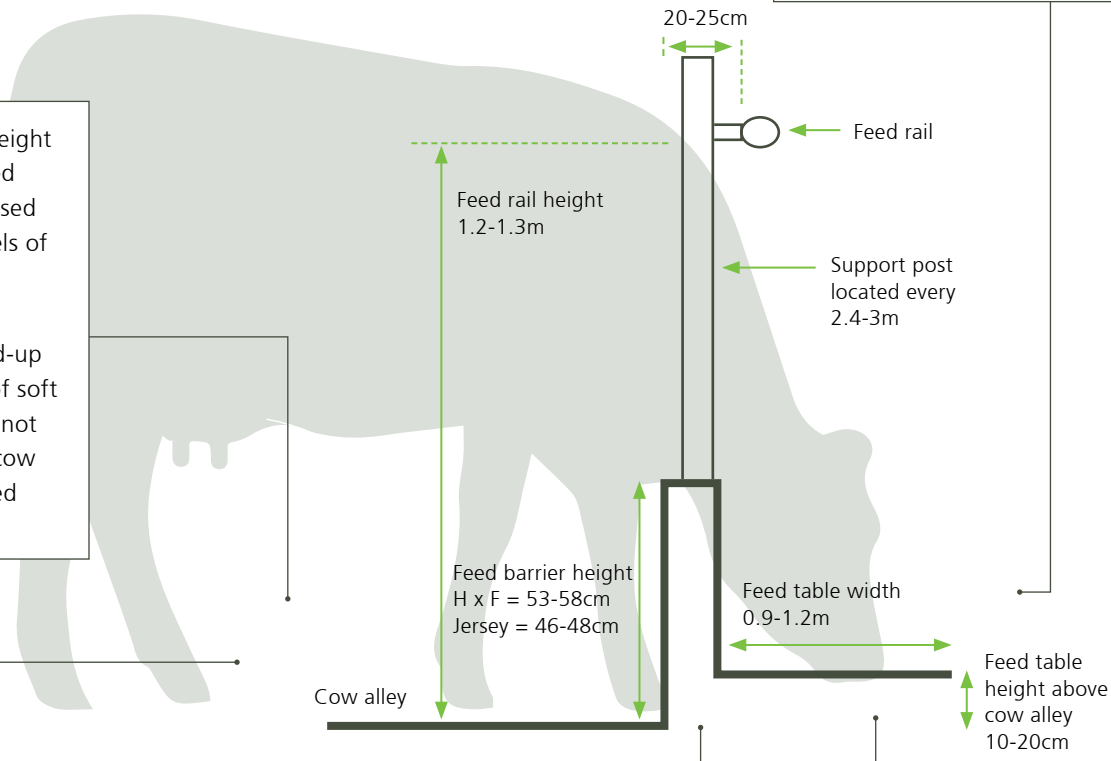
The correct space per cow provides stress-free feeding, correct feed intakes and keeps cows on their feet for 30 minutes after milking.

It is the width through the gut of a fully fed pregnant cow that will determine ideal space, along with timing of use and diet type. Regardless of the level of occupancy of the system it is good practice to allow enough space that all cows can feed simultaneously. Cows will naturally want to feed after milking and when fresh feed is delivered.

If you notice bald areas on the neck it is an indicator that the feed rail is in the wrong position and or the feed is not getting regularly pushed up.

To achieve the correct feeding stance the feed rail should be mounted on the feed table side to allow the cow maximum reach with minimum rail contact.

Corners that collect feed should be eliminated and be coved or rounded.



Feed barrier height can be affected in a loose housed system by levels of soft bedding.

Ensure that excessive build-up or reduction of soft bedding does not occur on the cow side of the feed face.

If cows are on their knees at the feed face the feed rail is too low, or the feed table is too low because the soft bedding has built up.

The feed barrier must be high enough to:

- stop any effluent being splashed onto feed
- stop most cows standing with their front feet in the feed
- stop cows escaping.

The feed barrier must not be too high to:

- put pressure onto the bottom of the throat or neck of the normally positioned eating cow
- cause rubbing abrasions and swelling on the brisket.

Make sure any dividers are smooth edged to reduce discomfort.

The eating surface should be as smooth as possible to:

- facilitate licking clean
- stop old feed spoiling on any rough surfaces
- withstand wear and abrasion from acidic feeds
- eliminate tongue abrasion.
- Many farmers are using a sealant on the feed table to reduce concrete damage

5.3 Feed barrier design options

Fresh feed provision and correct feed space allowance must be achieved to make any barrier successful.

Post and rail barriers Relatively inexpensive. Can be adjustable.

Individual metal feed spaces Check the width of the individual spaces before purchasing. Ensure they are fitted at an angle to provide better feeding position.

Self-locking yokes Expensive. Varied opinions on the negative or positive outcomes for feeding cows.

It is possible to install a few locking yokes at the end of the feed face to provide a cow handling area. Alternatively consider including a vet race in the building design.

It is better to have a few smaller cows that will put their feet through the feed barrier than to cause bigger cows to rub their necks or disrupt their access to feed.

In the absence of any division, cows can disturb each other when feed space is restricted or there is not enough available feed spread along the entire length of the feed table.

5.4 Managing the feed face

Pushing up (pushing feed that cows cannot reach back into their reach) is required because when cows eat they push the feed around over a large area.

Unless all cows have adequate space to all eat their fill at once, and if the time from feeding to first push up is too long e.g. 2 hours, the dominant cows will return back to the feed first. Pushing up more regularly will increase the likelihood of submissive cows getting a better opportunity to feed.

An alternative to a standard feed table is a trough. A trough eliminates the need for pushing up but trough design and sizing is important. If troughs are too wide, cows cannot reach all the feed. Troughs are labour intensive as they require cleaning which is difficult, due to corners.

Reducing Waste:

- Getting feeding levels correct is the first step to minimising wastage and keeping the feed table clean.
- Outside uncovered feed tables will have higher wastage and contamination, so consider the extra cost of covered feed tables. Central feed lanes and feed tables are by location, covered.
- Self-feed silage bunkers can be wasteful unless managed correctly.
- Run-off from the feed table will need to be contained in the farm effluent system.

"THE HIGHER YIELDS WE ACHIEVED AFTER OUR COWS WERE HOUSED AFFECTED OUR FILTER SIZING AND COOLING SYSTEMS IN THE SHED. LOOK AT THESE AREAS AS WELL AS THE DESIGN OF THE HOUSE."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6. Water requirements

Providing enough water for cows is just as important as managing their feed.

STAY UPDATED

Minimum Standard No.5 – Water

All dairy cows must have access to a daily supply of drinking water sufficient for their needs and that is not harmful to their health.

The water delivery systems must be reliable and maintained to meet daily demand.

In the event of a water delivery system failure remedial action must be taken to ensure that daily water requirements are met.

It is important to get professional assistance with stock water design. While farmers often identify plumbing as a project they can undertake themselves to save money, incorrect fitting choices, pipe sizes and installations can compromise the system. A system that does not meet demand may cause queuing around the troughs, limit intake and be costly to rectify once the system is in place.

Consideration needs to be given to:

- future expansion
- feed type
- dosatron use
- hose points for shed cleaning
- DM% of mixed rations and supplementary feeding
- milk yield goals.

Depending on the water source and restrictions, consents may be required to meet council regulations.

STAY FLEXIBLE

Set the water system up to cope with the highest potential seasonal demand.

6.1 Drinking water requirements

Dairy cows typically spend less than 30 minutes a day drinking and intakes are variable, depending on diet, stage of production, temperature and humidity conditions. Roughly 1kg of dry matter utilises up to 5 litres of drinking water and as the dry matter content of mixed ration will be higher than that of pasture, cows will need to drink more water. Housed cow intake has been measured between 76 to 114 litres per cow per day. Higher producing cows can drink a lot more as cows need at least 3 litres of water to produce one litre of milk.

Access to water in dairy housing is challenging as cows are sociable and drinking is a herd behaviour, especially after milking and around sunset when up to 50% of the cow's daily requirement can be consumed. It is essential that enough space is provided to allow for this and the water supply rate is at least 10 litres per minute, but aim for 20 litres per minute. Modern high pressure valves can easily achieve this flow rate. Because cows drink large volumes of water the supply needs to be replaced quickly enough for the next cow. It is not only the total water consumed per day, but the rate of consumption at peak times that needs to be considered.

Heat stress can begin at only 23°C when humidity is 80% and can increase cows' water intake to around 189 to 227 litres per cow per day.

Current recommendations suggest providing at least 10cm of accessible trough perimeter per cow, with at least 2 watering locations per group.

Example calculation for 600 cows

Each trough is 4m long x 0.5m wide

Accessible perimeter is 400cm + 50cm + 50cm = 500cm

500cm/10cm = 50. Therefore 50 cows could drink from this one trough.

Therefore 600 cows require 12 troughs of this size.

Keep water troughs clean by regular checking and have an effective and easy cleaning policy. Seeing the bottom of the trough is a good sign the water is clean.

Troughs can quickly become dirty when cows are housed. Dry feed sticks to cow muzzles and falls into the trough.

Would you drink this water? Plugs can be positioned in the bottom or side of the troughs so that they can be quickly drained and cleaned regularly.

Watch out for pugging from leaks and over full troughs.

Tipping troughs provide a quick and easy solution to cleaning. The tipped water can help clean the passageways in freestall systems. Make sure the tipped water drains away from the bedded area.

STAY FLEXIBLE

Consider your region and climate and the need for frost protection for pipes.

High producing cows will have higher water requirements. Consider your genetic and production direction to ensure the highest water requirement is met.

6.2 Locating water troughs

Loose housed: Troughs should be located around the perimeter and available on at least two sides of the building. Position the troughs outside the bedded area.

Freestall: Most troughs are located on the crossovers. This allows three sides of the trough to be utilised and one trough can be shared by cows from two adjacent passageways. Be generous with trough size to fill the crossover to increase availability of water.

STAY INFORMED

Placing water troughs at the exit race of the milking shed will improve availability and potential intake, as cows have their highest water intake after milking, especially afternoon milking.

Ventilation and shade

7. Ventilation and shade

STAY UPDATED

Minimum Standard – No 9 – Housing Cows and Calves:

(a) iii) Natural or artificial ventilation must be sufficient to maintain temperature and humidity at levels that do not cause the dairy cattle heat or cold stress, that prevent direct draught onto animals and the build-up of harmful concentrations of dust or noxious gases.

iv) If ammonia levels of 25ppm or more are detected at animal level, immediate action must be taken to reduce ammonia levels

(c) Ventilation must be sufficient to prevent a build-up of harmful concentrations of gases such as ammonia and carbon dioxide.

(d) If Ammonia levels of 25ppm or more are detected within the housing, immediate action must be taken to reduce the ammonia levels.

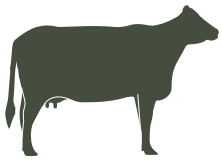
As a guide, a level of 10–15 ppm of ammonia in the air can be detected by smell and an ammonia level over 25ppm may cause eye and nasal irritation in people. Ammonia levels should not consistently exceed levels of 10 – 15ppm. Such levels compromise animal welfare and may predispose dairy cattle to respiratory disease and reduced performance.

Ventilation is an air exchange process that:

- brings fresh air into the building through planned inlets
- thoroughly mixes incoming and inside air
- picks up heat, moisture, and air contaminants
- removes warm, moist, contaminated air from the building.

7.1 Cow temperature requirements

The comfort zone or thermoneutral zone for a dairy cow varies depending on breed, production levels and health. The coldest temperatures a cow can exist in before needing to utilise additional energy to keep warm is called the Lower Critical Temperature (LCT). The Upper Critical Temperature (UCT) is the temperature a cow can exist in before it becomes heat stressed. The thermoneutral zone for a cow will feel uncomfortably cool to people.

LOWER CRITICAL TEMPERATURE		UPPER CRITICAL TEMPERATURE
Cold stress	**Thermoneutral Zone**	**Heat stress**
• Cows increase dry matter intake • Convert feed energy to heat • Reduce milk production • Turn away from wind/rain • Hunch and huddle together	 **Optimum health and performance requires proper ventilation**	• Cows drool and pant • Reduce activity • Reduce feed intake as rumen function creates heat • Reduce milk production

7.2 Ventilation principles

Correct building design is critical to ensure adequate ventilation that will maintain air quality and temperature all year round regardless of outside weather conditions.

Ventilation will maximise cow comfort and health by:

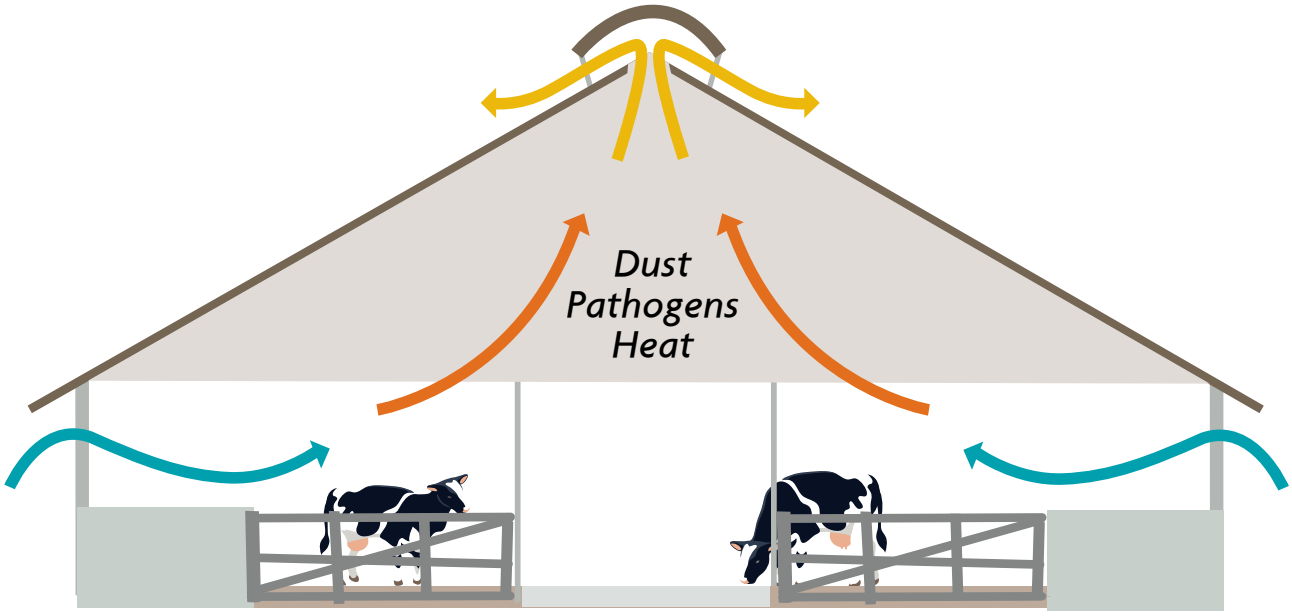
- removing excess heat
- removing excess water vapour (respiration and sweat) and reducing effects of humidity
- removing microorganisms, dust and gases, especially ammonia
- providing a uniform distribution of air
- minimising draughts at stock height.

Passive or natural ventilation relies on external wind speeds and the design of inlets and outlets. Active or forced ventilation uses internal and external fans, sometime in conjunction with natural ventilation. All forms of active or forced ventilation require an energy source.

Buildings will naturally ventilate best when they are sited at right angles to the prevailing wind direction; have no wind disruption from other obstacles such as buildings or tree lines; and have adequate eave height and roof design.

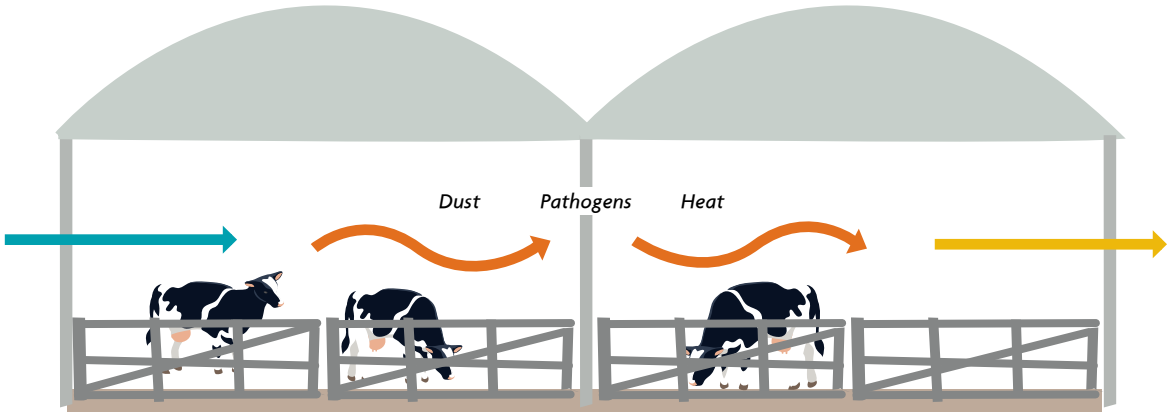
The chimney effect using a central ridge outlet

The chimney, or stack effect, occurs in a livestock building when warm air from the cows rises and escapes through an outlet, and cool air from the sides is pulled in. For the chimney effect to work efficiently, there must be a suitable balance between air inlet and air outlet and adequate roof pitch.



Basic cross-ventilation in an open-sided building

Passive ventilation systems usually have open sides, with no or minimal side walls, and utilise wind break curtains. When cows have access to a building with a central ridge outlet for short periods of time for feeding, it is most likely that only cross ventilation will be achieved.

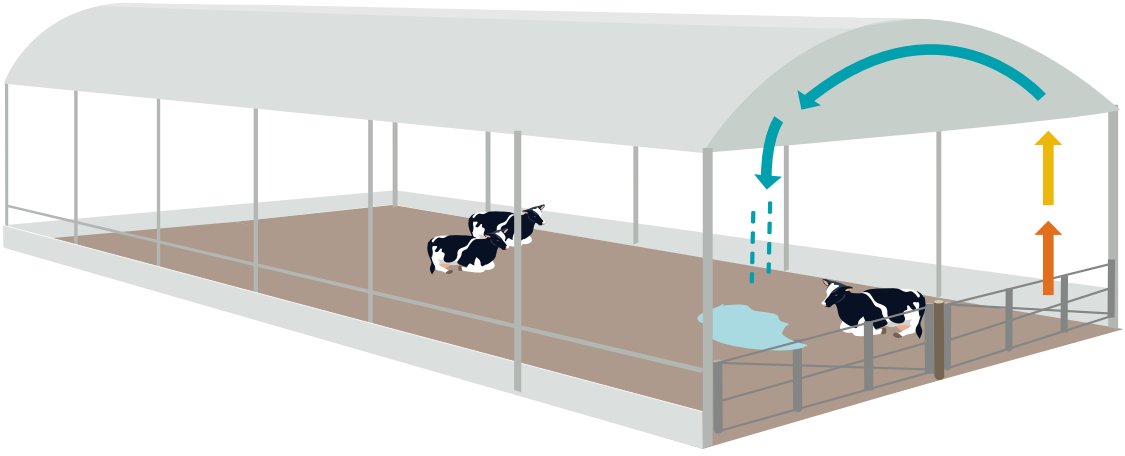


Height restriction may be applied by some local councils. If height is restricted, find a resolution to ensure that ventilation will not be affected. Seek expert advice in this area.

> Detailed information of ventilation options are available in the IPENZ practice Note 29 and should be a key discussion point with your builder and housing supplier.

Condensation

Condensation forms when warm moist air rises and has no way of escaping, it collects under the cooler roof surface and forms droplets that fall down onto the bedding. If the droplets fall on lying areas it can increase the risk of pathogen growth and make some areas less appealing for cows to lie on. Good ventilation reduces the risk of condensation.



7.3 Shade

Cows prefer shade that provides at least a 50% blockage of solar radiation. Provision of shade under a clear plastic roof will reduce the solar radiation but care needs to be taken to avoid shadows. You must provide enough shade to cover the entire lying area to ensure that all cows can lie under shade.

10. Management and stockmanship

Housing dairy cattle, whether for short or long periods, requires a different set of management skills than those required for pasture management.

Health and welfare problems can quickly develop and management systems need to be in place to monitor key indicators of successful housing so that in the event of a problem appropriate action can be taken quickly.

Areas of particular concern are:

- lameness
- cow cleanliness
- body condition score variation
- rub marks and hair loss patches
- injuries
- swellings and skin lesions
- digital dermatitis is prevalent in overseas systems and has been identified in New Zealand.

The majority of these concerns can be managed by ensuring cows:

- have sufficient space
- are clean, dry and comfortable-which leads to optimum lying times
- are feeding properly and
- have access to good quality water
- any 'at risk' cows should be removed from the housing system and treated promptly.

STAY INFORMED

Consider measuring the levels of each of these areas of concern before housing cows so you have a benchmark from which to monitor.

10.1 Exercise

Integrated systems provide access to the outdoors or grazing for some periods of the production cycle. Some farmers have designed systems that allow cows to exit and enter the barn at will during certain times of the day. Providing access to the outdoors, which in turn provides exercise, can have benefits including more settled cows, better foot health, improved observation of cows by farm staff, and better calving and reduction of ketosis.

STAY FLEXIBLE

It is likely that in the future, some countries or milk supply companies will require cows to have some outside access for exercise or grazing. Consider this when designing a system.

10.2 Cleaning policy

It is essential to have a cleaning policy and procedure to ensure good hygiene in the barn.

Daily routines should include scraping the backs of the beds; ensuring the scraper systems are set correctly by visually checking levels of effluent in the passageways and manually scraping crossovers.

Weekly routines should include cleaning water troughs.

Depending on how the barn is used, it may be good practice to carry out a deep clean at appropriate times during the year. This will also help with maintenance and checks on equipment. For a soft bed system it would be practical to combine this with total bed removal.

Consideration needs to be given to the products used in the cleaning process. These products will need to be recognised for use by AsureQuality. There is a residue risk that can lead to teat contamination.

If the barn is becoming very dirty very quickly, investigate the reasons why it may be getting unhygienic and put management practices, or designs in place to reduce the need to carry out an annual deep clean.

Bed scraping is essential.

Avoid this by investing in bird proofing or a regular cleaning policy.

10.3 Lighting

STAY UPDATED

The Code of Welfare states: Natural and/or artificial lighting levels must be at least 50lux during the light phase, for a minimum of nine continuous hours and a maximum of 18 hours each day, so that the dairy cattle can see each other and their surroundings.

Lighting has many uses in housed cow facilities. It:

- alters calving patterns in enclosed barns
- extends lactation and encourages feed intake
- facilitates cow movement and avoids shadows that interrupt cow flow
- makes it easier to observe cows on dull days or at night.

Ideal ratio of dark to daylight hours:

- lactating cows 16 hours light, 8 hours dark
- dry cows 8 hours light, 16 hours dark.

Target level of illumination at 0.9m above the stall surface is 160 to 215 lux. This can be measured with a Lux Meter.

Night lights or dim red lights (15W) can be used to facilitate observation of cows by staff at key times of the year.

Fit timer switches to standardise your lighting routine and reduce energy costs.

10.4 Introduction and adaptation

In a well-managed system with good cow comfort, cows will easily find the most desirable places to lie down and where to find food and water. The simpler the system, the less time a cow will need to adjust to it. Whatever the system, daily observations are required and these should be increased in frequency when introducing cows into any building.

Introducing cows to housed facilities as transition cows, e.g. springers or newly calved, can increase cow stress. Introduce cows in late lactation or early dry period, initially using the barn for just 3-4 hours a day as a feed pad. If cows cannot be introduced slowly, introduce them in smaller groups.

In-calf heifers should be introduced to any barn at least eight weeks before calving.

> "REVIEW THE SYSTEM, INCLUDING HOW THE COWS ARE BEHAVING, AGAIN AND AGAIN AND AGAIN."

Introduction to a free stall building

Young stock

Keeping young animals inside for a few hours a day for two to three weeks is enough to make later introduction easier. Correct lying behaviour is unlikely during this introduction period in a freestall building, but an understanding of where the lying area is can be achieved.

You may notice some stalls, such as those located by the feed area are always occupied first.

All stock

STAY UPDATED

Minimum Standard

(c) ii) they must be trained or allowed to adapt to an off-paddock facility before being confined to it, and dairy cattle that do not adjust must be provided with alternative management.

You should have a plan for all stock being introduced to the building for the first time. Ideas to include in the plan are:

- Cows that lie in passageways continuously for three days should go back out to the paddocks and be reintroduced again later.

- Use palatable feed such as hay or molasses-rich concentrate in the head space of the stalls to encourage entry and lying.
- Introduce small groups at a time so they have lots of space.
- Put neck rails as far forward as possible to encourage cows into the stalls.
- Older cows can train younger cows, but some all-heifer pens work just as effectively.
- Run the scraper regularly so they get used to it, it will also prevent cows lying in passageways.

Targets for the plan:

- Have 90% of cows using stalls within one week of introduction.
- Have one third to half the herd lying between four to six hours after being fed.

Look for warning signs that indicate cows are unsettled and not adapting well. These include:

- increased standing/reduced lying
- a general increase in movement i.e. agitated
- arched backs
- lying down in the paddock when let out to graze
- stressed or unconfident looking cows (flighty or head low, tail tucked in).

10.5 Special care cows

Calving

The requirements for a calving area are the same regardless of the housed system. Cows should calve in designated calving areas e.g. clean paddocks, dedicated calving pens or areas of loose housed soft bedding material and be moved to these areas in good time.

STAY UPDATED

Minimum Standard

(d) i) The stocking density and facility design and management must allow dairy cows to separate themselves for calving, or they must be separated to another area for calving.

ii) Calving areas must be clean, well-drained and have an anti-slip surface

iii) Dairy cows must be provided with clean and dry bedding, including, but not limited to, rubber matting or deep straw, when calving on hard surfaces or on slats.

iv) Dairy cows must not calve in free-stalls.

The calving area should have:

- Cows should be able to remove themselves from the group to calve. Think about lowering stocking rates to achieve this.
- clean and dry bedding with good drainage
- good ventilation but free of draughts
- access for a tractor

- be within reach of calving equipment and handling facilities to assist calving
- good lighting; frequent observations and lower stocking rates will improve record keeping at calving.

When managing calving areas consider:

- Calving cows on rubber or concrete slats is not acceptable because calves can get their legs stuck between the slats.
- All hard surfaces including rubber matting must have a layer of bedding, such as straw or woodchip, over the top to create comfort and an anti-slip surface for cow, calf and staff.
- It is not acceptable to calve cows in free stalls.

It is not acceptable to calve cows on concrete, in scraper lanes, or on slatted floors. Soft bedding material should be placed on top of hard surfaces.

Calving cows need space and should still be within sight of their herd mates and have free access to feed and water.

First Aid Facilities

All housed facilities must contain or be near locking yokes or a vet race for treating cows and assisting calving.

Ensure design provides for correct downer cow lifting and removal. Each farm must have a downer cow policy. Included in this is the provision for correct equipment for lifting, moving and treating downer cows e.g. slings.

Barn design needs to include easy access for dead stock removal.

Design soft bedded pens for treatment cows.

10.6 Mastitis

Environmental mastitis: Housed cows are in closer contact with faecal material so their teats are more at risk of becoming dirty between milkings. Housed cows may also be fed more supplements, which increases the starch content of the diet, and can increase numbers of E. coli bacteria in the dung. More contamination of teats with such bacteria can lead to a more acute form of environmental mastitis, sometimes known as coliform mastitis. Maintaining clean and healthy teat skin is vital for successful prevention of this acute form of mastitis.

Thermodurics: Thermoduric bacteria can survive pasteurisation and subsequently grow in pasteurised milk. Sources of thermodurics in the cows' environment can be found in silage, bedding and faeces. Poor management of lying areas, ineffective effluent removal and poor silage quality can increase risk. Seek expert advice around mastitis monitoring and control in a housed system.

Refer to SmartSAMM section of dairynz.co.nz for further resources on Mastitis management.

10.7 Hoof quality and lameness

It is good practice to monitor the levels of lameness before and after any transition to different systems; especially if factors such as walking distance, hours a day spent off-pasture, and standing in effluent increase.

Consider contacting a certified hoof trimmer and your farm veterinarian to put together a lameness policy. Discuss training staff to recognise lameness in housed and pasture-based systems. In addition talk about facilities needed to inspect and trim hooves and design and cost them into the build budget.

Healthy Hoof Programme

The Healthy Hoof Programme focuses on prevention of lameness in conjunction with information and training on management and treatment of lame cows. Visit dairynz.co.nz to download the brochure.

Continuous exposure to effluent can affect hoof health.

STAY FLEXIBLE

Consider adding a footbath to the facility. This will provide an easy treatment point for any future foot problems.

10.9. People management

Off-paddock systems require core skills of stockmanship, feeding, welfare and hygiene.

Staffing a housed system.

When selecting staff for housed systems points to consider are:

- A very high level of stockmanship is required when working in close proximity with cows. There is a need for safety from both a human and animal perspective.
- The person in charge of the animals will need to be observant and take time to check cows individually, and the safety and functionality of the building every day. Recording and acting quickly on the information is also part of a well-managed system.
- Maintaining high levels of cleanliness is essential as animal health issues can escalate quickly in an artificial environment.
- There is likely to be tractor work that will also need a higher degree of precision.

STAY UPDATED

Minimum Standard

v) Automated systems, including for feeding, water reticulation, cleaning and milking, must be checked daily and provisions must be made to safeguard animal welfare in case these systems fail.

vi) A contingency plan, containing fire prevention measures, emergency evacuation procedures, and pest and disease management plans, must be in place.

10.10 Farm biosecurity

Biosecurity is the set of measures to prevent the entry, establishment and spread of pests and diseases onto a farm (or country). A biosecurity plan should be implemented on every dairy farm; this not only protects and benefits the health and welfare of livestock, but also the wellbeing of staff. This can easily be achieved by completing a Biosecurity WOF found here.

Feed

- Bagged and bulk feed must be appropriately stored as per the manufacturer's instructions and must be kept dry and covered and free from pests and vermin.
- Ensure all spilt or uneaten feed is removed to reduce vermin.

People

- People, animals, equipment and feed can introduce unwanted pests and diseases. Visitors should not be allowed to wander or drive freely over the farm unless their footwear and vehicles are clean on arrival.
- Restrict entrance to essential visitors. Provide coveralls and as a minimum, boots or boot covers to reduce risk of incoming disease.
- Offer hand washing facilities to staff and visitors to reduce the risk of zoonotic diseases.
- Take time to ensure all new staff and contractors are aware of the biosecurity policies. Consider a visitors' book to track visitors to the farm.

Policy/Facilities

- Stop the build-up of pathogens by adhering to a comprehensive hygiene policy and implementing regular deep cleaning.
- Control pests and vermin. Possums, birds, rodents and flies can spread diseases such as tuberculosis, salmonella and leptospirosis directly to cattle, or by contaminating feed and water supplies.
- Update your biosecurity policy in conjunction with your vet if there is a change to disease risk in the local area or if your facilities change.

Stock

- Inspect stock on a regular basis to check their general health. Take particular notice of feet, dung consistency, eye and nose discharges and incidence of coughing.
- Young stock: Consult your vet when looking at purchasing new stock to join your herd to minimise risk of disease entering your herd.

13. Effluent management from off-paddock facilities

During the design stage of new housing, thought needs to be given to how effluent will be captured and utilized as there may be significant additional costs involved depending on the type of housing selected. Care must be taken when captured effluent is applied to land to ensure that the district and regional council rules are met; particularly in relation to the paddock selection for solids application, odour management and the high nutrient content of the effluent produced from these facilities in both liquid and solids.

Effluent management systems must be designed to cope with the additional volume of effluent generated from off-pasture facilities. Existing effluent systems from the farm dairy could incorporate the extra effluent from the housing system if there is sufficient storage capacity available and sufficient land area to apply the additional volume. Alternatively a stand-alone system may be designed to manage the additional effluent captured from an off-pasture system.

13.1 Regulations

Most regional councils have nitrogen loadings of 150 kg/ha/year from farm dairy effluent which means significant land area is required to irrigate/spread the effluent captured from the building.

It is not recommended to apply 150 kg N in one application; three applications of around 50kgN/ha/year are recommended for both solids and liquids. This is often a very small depth per application when dealing with high nitrogen concentrate products from housing.

We recommend that the effluent from these systems be tested at least three to four times a year to give a good representation of the nutrient loading.

An Overseer nutrient budget will give an estimate of the area needed to meet nutrient loadings but additionally, it is a useful exercise to determine how much effluent is captured and the likely land area required. This will enable the farmer to better estimate costs and farm irrigation strategy.

13.2 How much effluent is generated?

A significant volume of effluent is captured when housing dairy cows and varies between dry and lactating stages.

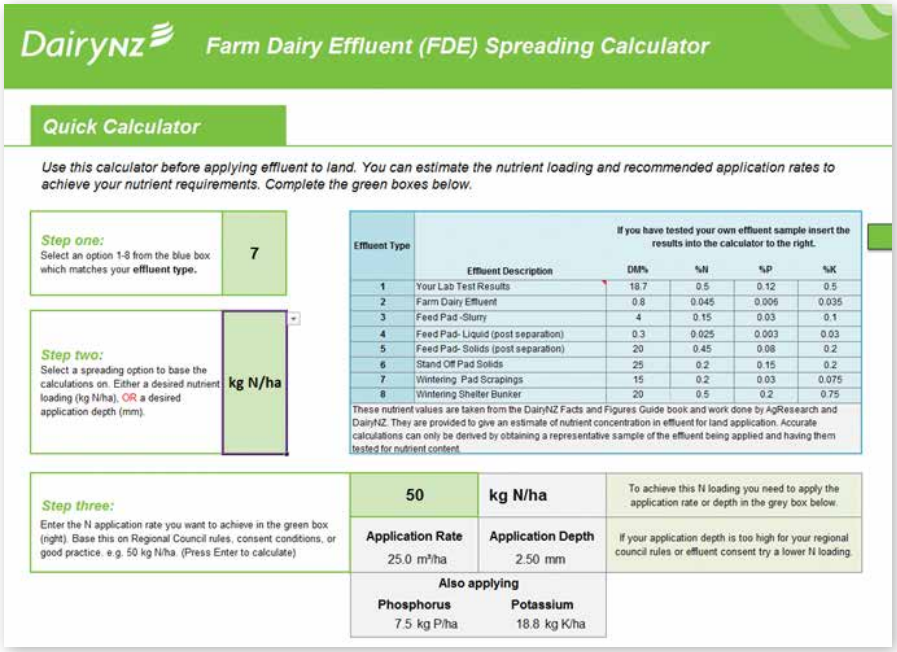
Below is a table that describes likely volumes generated in off-paddock facilities.

Animal	**Heifer**		**Mixed age cow**	
Status	**Dry**	**Lactating**	**Dry**	**Lactating**
Weight	**400kg**	**400kg**	**500kg**	**500kg**
Effluent generated, per hour(L)	2.3 (12kgDM)	3.0 (16kgDM)	2.6 (14kgDM)	3.4 (18kgDM)
Effluent generated, per Day(L)	55.2	72	62.4	81.6

DairyNZ has developed the 'Dairy Effluent Spreading Calculator' that can help you estimate nutrient loadings and application rates from different sources of effluent.

This is broken down into three areas

1. The 'Quick Calculator' helps you estimate the nutrient loading and recommended application rates to achieve nutrient requirements from different sources:



DairyNZ Farm Dairy Effluent (FDE) Spreading Calculator

Quick Calculator

Use this calculator before applying effluent to land. You can estimate the nutrient loading and recommended application rates to achieve your nutrient requirements. Complete the green boxes below.

Step one: Select an option 1-8 from the blue box which matches your **effluent type.** 7

Step two: Select a spreading option to base the calculations on. Either a desired nutrient loading (kg N/ha), OR a desired application depth (mm). kg N/ha

Effluent Type	Effluent Description	DM%	%N	%P	%K
		If you have tested your own effluent sample insert the results into the calculator to the right.			
1	Your Lab Test Results	18.7	0.5	0.12	0.5
2	Farm Dairy Effluent	0.8	0.045	0.006	0.035
3	Feed Pad -Slurry	4	0.15	0.03	0.1
4	Feed Pad- Liquid (post separation)	0.3	0.025	0.003	0.03
5	Feed Pad- Solids (post separation)	20	0.45	0.08	0.2
6	Stand Off Pad Solids	25	0.2	0.15	0.2
7	Wintering Pad Scrapings	15	0.2	0.03	0.075
8	Wintering Shelter Bunker	20	0.5	0.2	0.75

These nutrient values are taken from the DairyNZ Facts and Figures Guide book and work done by AgResearch and DairyNZ. They are provided to give an estimate of nutrient concentration in effluent for land application. Accurate calculations can only be derived by obtaining a representative sample of the effluent being applied and having them tested for nutrient content.

Step three: Enter the N application rate you want to achieve in the green box (right). Base this on Regional Council rules, consent conditions, or good practice. e.g. 50 kg N/ha. (Press Enter to calculate)

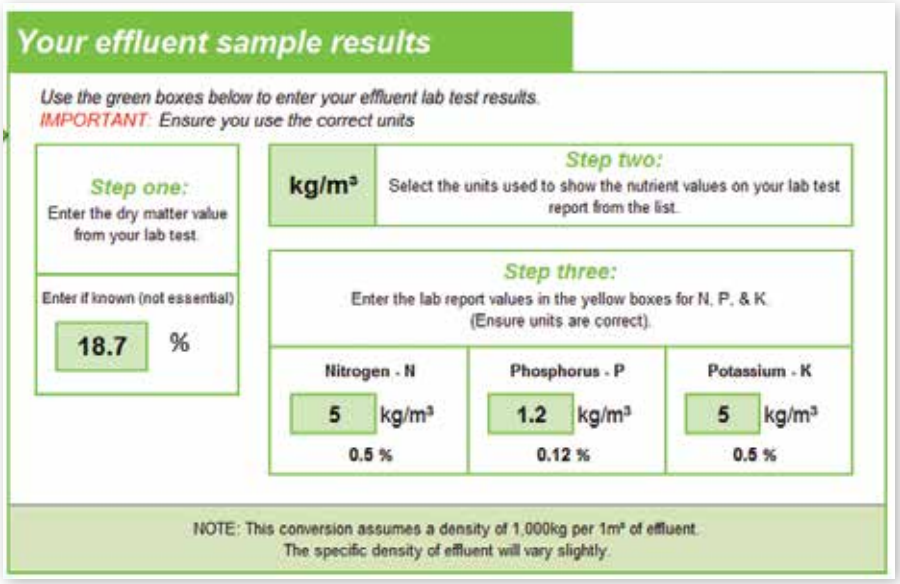
50 kg N/ha — To achieve this N loading you need to apply the application rate or depth in the grey box below.

Application Rate	Application Depth	
25.0 m³/ha	2.50 mm	If your application depth is too high for your regional council rules or effluent consent try a lower N loading.

Also applying

Phosphorus	Potassium
7.5 kg P/ha	18.8 kg K/ha

2. If you have your effluent sampled, the nutrient content can be entered in the calculator:



Your effluent sample results

Use the green boxes below to enter your effluent lab test results.
IMPORTANT: Ensure you use the correct units

Step one: Enter the dry matter value from your lab test.

Enter if known (not essential) 18.7 %

kg/m³

Step two: Select the units used to show the nutrient values on your lab test report from the list.

Step three: Enter the lab report values in the yellow boxes for N, P, & K. (Ensure units are correct).

Nitrogen - N	Phosphorus - P	Potassium - K
5 kg/m³	1.2 kg/m³	5 kg/m³
0.5 %	0.12 %	0.5 %

NOTE: This conversion assumes a density of 1,000kg per 1m³ of effluent. The specific density of effluent will vary slightly.

3. The 'Advanced Calculator' helps you determine the areas required when spreading solids or slurries based on the nutrient content of the effluent and the vehicle travelling speeds to achieve the desired application of nutrients:

Advanced Calculator

Use this calculator to see specific spreading details and areas required for various levels of nutrient application.
Appropriate for slurry tankers and muck spreaders.

Select an option from the blue box above	7	**For a more advanced calculation for effluent application:** **Step One:** Enter an option 1-8 from the blue box on the table (above) in the green box (left). **Step Two:** Enter your own values into the green boxes below. **Step Three:** Read the values for application depth/nutrient loading from the table below. In the Nutrient Loading section, scroll down the N column to find the N application rate you are aiming for e.g. 50kg N/ha, then read across the row to find the application depth and rate to meet that loading.

Volume of spreader (m^3)	12	Width of spread (metres)	14	Time to empty (seconds)	480	Total volume of effluent to spread (m^3)	400

Tractor Speed		Application Depth & Rates			Nutrient Loading			Spreading Details			
metres /min	km/hour	Area Covered	Application Depth	Application Rate	N	P	K	Distance per load	Loads per hectare	Total Area Required	Total Loads
		(ha/load)	(mm)	(m^3/ha)	(kg/ha rate)			(m)		(ha)	
16	1.0	0.18	6.7	67.0	133.9	20.1	50.2	120	5.6	6	33.3
32	1.9	0.36	3.3	33.5	67.0	10.0	25.1	256	2.8	12	
48	2.9	0.54	2.2	22.3	44.6	6.7	16.7	384	1.9	18	
64	3.8	0.72	1.7	16.7	33.5	5.0	12.6	512	1.4	24	
80	4.8	0.90	1.3	13.4	26.8	4.0	10.0	640	1.1	30	
96	5.8	1.08	1.1	11.2	22.3	3.3	8.4	768	0.9	36	
112	6.7	1.26	1.0	8.6	19.1	2.9	7.2	896	0.8	42	
128	7.7	1.43	0.8	8.4	16.7	2.5	6.3	1024	0.7	48	
144	8.6	1.61	0.7	7.4	14.9	2.2	5.6	1152	0.6	54	
160	9.6	1.79	0.7	6.7	13.4	2.0	5.0	1280	0.6	60	
176	10.6	1.97	0.6	6.1	12.2	1.8	4.6	1408	0.5	66	
192	11.5	2.15	0.6	5.6	11.2	1.7	4.2	1536	0.5	72	
208	12.5	2.33	0.5	5.2	10.3	1.5	3.9	1664	0.4	78	
224	13.4	2.51	0.5	4.8	9.6	1.4	3.6	1792	0.4	84	
240	14.4	2.69	0.4	4.5	8.9	1.3	3.3	1920	0.4	90	

Note: Ensure you have enough land available to spread the effluent before a contractor arrives.

The calculator can be downloaded as a spread sheet or an app for your mobile phone visit dairynz.co.nz/environment/effluent/tools.

Example:

A 500 mixed age cow herd housed all day in a freestall barn for 90 days could produce up to 3,672,000 L or 3,672 m^3 of effluent.

This captured effluent at an average nutrient concentration of 5 kgN/m^3 will need to be spread over 122 hectares to avoid breaching the 150 kg/ha/yr rule.

13.3 Systems and factors

There are a range of factors that need to be considered for managing effluent from housed facilities. This chart illustrates some of them including guidelines for likely nutrient concentrations from the different systems.

	Storage	Guideline Nutrient Concentration	Land Application	Things to Consider
Slatted floor, Covered roof	Under-floor bunker	~5kgN/m^3, ~ 2kgP/m^3	Muck spreader, if straight from bunker. Slurry tanker, adding water and stirring in bunker to enable pumping of slurry.	Odour management under animals. Finite volume of storage. Ability to stir if using slurry tanker.
Loosed housed, Organic bedding, Covered roof	Drainage to storage system	~4kgN/m^3, ~1kgP/m^3	Muck spreader to spread organic material.	Drainage to sealed storage. Further composting of bedding material prior to spreading.
Loosed housed, Organic bedding, Covered roof, Compost system	Drainage to storage system	Test these systems	Muck spreader to spread organic material.	Skills to manage compost system.
Freestall barn, no solids separation	All effluent to sealed pond/tank	~5 kg N/m^3, ~1 kg P/m^3	Slurry tanker Stirrer land application	Nutrient loading in effluent, apply to large area at low depth. High risk of odour issues, install stirrers in storage system to minimise.
Freestall barn, mechanical solid separation	Solids stored on sealed bunker	~4kgN/m^3, ~1kgP/ m^3(solid); ~0.5 kgN/ m^3 and ~0.06kg P/m^3 (liquid)	Muck spreader	Need solid storage bunkers with drainage to storage pond for liquid or rain water.
Freestall barn, passive solid separation	Solids stored in weeping walls or bunkers	~4kgN/m^3, ~1kgP/m^3 (solid); ~0.5 kgN/m^3 and ~0.06kg P/m^3 (liquid)	Muck spreader Slurry tanker	Solids stored in large weeping wall system. With drainage to storage pond for liquid or rain water.

Unless the barn effluent in the storage pond is regularly irrigated to land, then solids separation is strongly recommended. Significant odour issues are likely with unseparated solids, especially if the effluent is contained in the storage pond for extended periods when soils are too saturated to irrigate to land.

Mechanical solids separation systems are generally recommended but weeping wall systems may be considered. Weeping wall systems will need multiple beds and deeper bunkers to cope with the thicker consistency of effluent from off-pasture systems.

The lined storage pond/tank should be regularly stirred which will help reduce potential odour issues whether solids are separated or not.

13.4 Managing effluent solids

There is some variation in how solids can be handled based on the size of the solid particles and the solids percentage (i.e. wetness of the separated solids):

- Slurry tankers can generally pump and spread effluent less than 15% solids.
- Muck spreaders are best at handling effluent above 20% solids.
- Effluent between 15-20% solids is generally the most difficult to handle with loading equipment, and requires a sealed muck spreader.

Note: If travelling along public roads between paddocks, all effluent must be contained so a sealed muck spreader will be required.

DairyNZ resources to assist

IPENZ Practice Note 29 Dairy Housing Effluent Management section

'A farmer's guide to managing farm dairy effluent: A good practice guide for land application systems'

IPENZ Practice Note 27 Dairy Farm Infrastructure especially Part 2 Solids Separation

IPENZ Practice Note 21 Farm Dairy Effluent Pond Design and Construction

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