Section 3

Winter **Facilities**

by **Pat Clarke**

Introduction

Choice of winter facilities is key, particularly for expanders or new entrants to dairying.

1. How much should winter accommodation cost?
2. What are the advantages/disadvantages of each system?
3. How can I ensure animals have adequate feed space?
4. What slurry facilities do I need?

Winter Facilities

1 How much should winter accommodation cost?

There are many different combinations of winter accommodation and slurry storage facilities that can be used at farm level. Each has their own merits, but there are some basic considerations before choosing a system.

Factors to consider include:

- initial capital cost
- availability and cost of capital
- annual running costs
- annual labour input
- potential to increase capacity.

Table 1: The effect of winter accommodation system on construction costs, operating & annualised housing costs for a 16-week winter.

	Conventional cubicle shed	Out-wintering pad/Earth-lined store
Slurry storage requirement (m^3/cow/year)	5.3	7.8
Total housing/slurry storage cost (€/cow)	1,218	371
Depreciation & interest (€/cow/year)	125	38
Bedding & slurry spreading (€/cow/year)	17	75
Total annualized cost (€/cow/year)	142	113

Winter facilities drawings: Contact your local Teagasc office for a copy of the different winter facility options (up to 30 different designs available).

② What are the advantages/disadvantages of each system?

Table 2. Advantages and disadvantages of different types of winter accommodation.

	Advantages	Disadvantages
Cubicle shed	• Low maintenance • Independent of weather for cows and farmer • Suitable for lactating cows, e.g. liquid herds, autumn, late spring	• High initial cost • Repayments subject to interest rate changes where capital is borrowed • Inflexible, as size of cubicles determines animal use • Design may not allow for expansion
Straw-bedded shed	• Flexible shed for livestock • Shed can be used for other purposes	• Annual straw cost • High labour requirement • High machinery cost • Dungstead required where sheds are cleaned out during winter closed period • Low number of animals per m^2 of shed
Out-wintering pad	• Low initial capital cost • Flexible • Animals outdoors – improved animal performance when managed correctly	• Annual cost of woodchips • Cost of spreading woodchips, plus effluent • Not suitable for lactating cows over a long period • Less suitable on marginal land • Farmer exposed to weather for management activities
Winter crops, e.g. kale/rape	• No capital cost • Animals outdoors • No machinery running costs	• Slurry storage facility required (by law) • Weather dependent, e.g. heavy frost • High level of management required • Good yield of crops required
Saved grass	• No capital costs • Less machinery required	• Slurry storage facility required (by law) • Large land area required e.g. 0.5-1.0 ha per cow

Winter **Facilities**

Cubicle shed

Construction of a cubicle shed for cows is a major project requiring significant design and financial planning before construction begins. Cubicle shed plus slurry storage could cost between €1,200 and €1,500 per cow place, which is approximately €200,000 for 150 cow places.

Considerations when designing a cubicle house include:

- number of cubicles (i.e. cows to be housed)
- potential to expand in future
- number of rows of cubicles
- location of feeding passage and feed space per cow
- water supply to shed
- access from shed to paddocks and milking parlour.

Table 3: Features and dimensions of cow cubicles

Cubicle width (centre to centre)	1.15m +/- 0.025
Total length (rows towards wall)	2.3 – 2.6m
Total length (rows head to head and single rows with no front wall)	2.21 – 2.45m
Brisket board/pillow from rear kerb (if fitted)	1.75m +/- 0.05m
Neck rail from rear kerb, (measured horizontally)	1.70m +/- 0.05m
Height of neck rail	1.15m +/- 0.05
Cubicle bed slope	5% +/- 1%
Bedding height above the passageway floor	0.2 – 0.25m

Refer to DAFM specifications **S101** for full details for construction of a cubicle shed for cows.

Figures 1 and 2 show the plan and cross-section of a typical shed with 126 cubicle places.

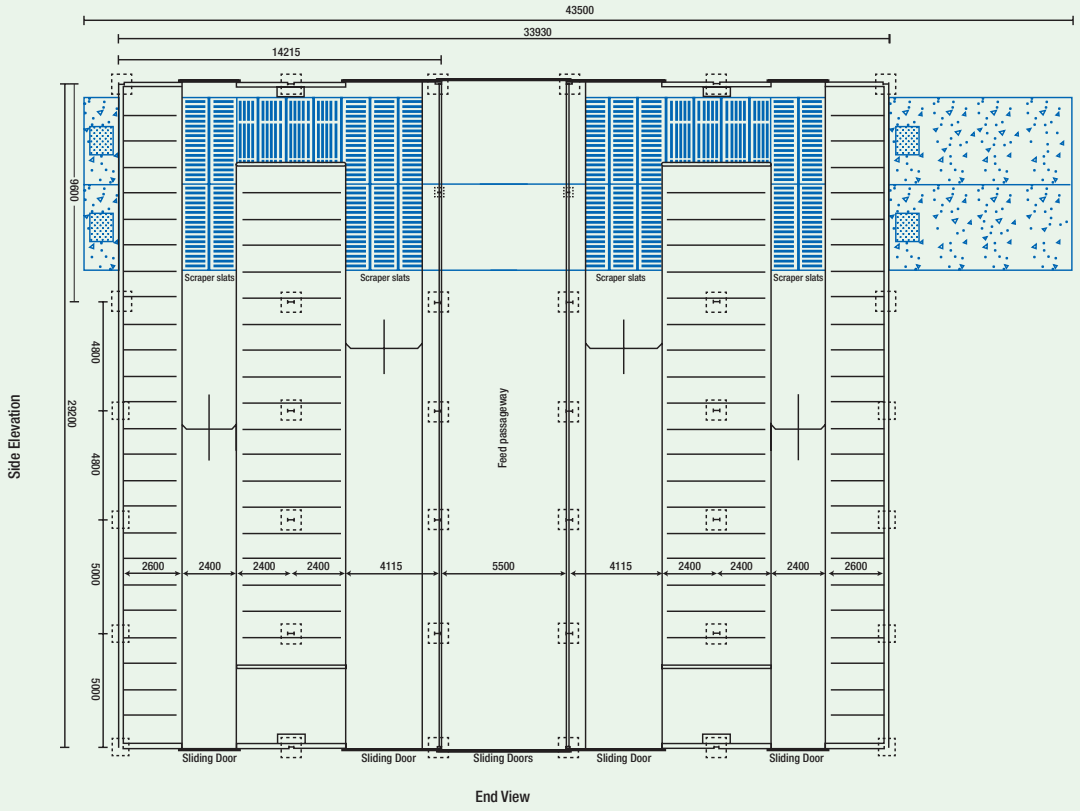

Figure 1: Plan of cubicle house with 126 cow places.

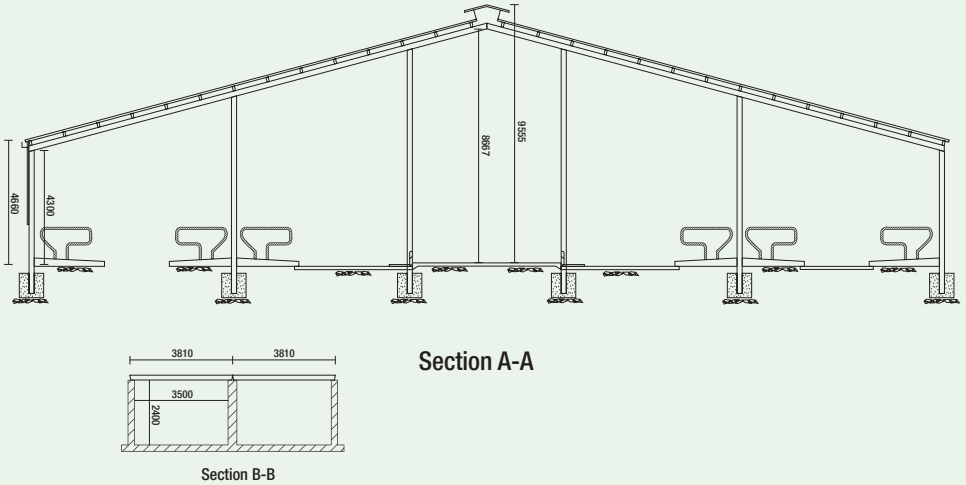

Figure 2: Plan of cubicle house with 126 cow places.

Winter Facilities

Alternatives

Cubicle kennels

Cubicle kennels are an alternative to a full cubicle shed. In this design, only the cubicles are roofed, the passages and feed area are unroofed. This reduces the cost of construction. Slurry is scraped from the passages and feed area to an external slurry storage facility.

Out-wintering pads

Out-wintering pads (OWP) are a new development in Ireland. Pads are bedded with woodchip and the drainage system underneath removes urine and rainwater. The cow feed area can be located on the pad or off the pad. Some slurry is removed from the feed area (by scraper), with the remainder incorporated into the woodchip.

Key facts

Out-wintering pad

Space allowance	12m^2 lying area/cow
Storage required	All slurry from cows plus rainwater on OWP
Rainfall level	As specified under nitrates rules
Drainage	Ridges and drainage pipes leading to storage facility
Ridges	3m apart and 150mm high
Drainage stone	300mm above drainage pipe
Woodchip height	200mm above drainage stone

How to
Calculate the area for an OWP

E.g. For a 150 cow herd	
Pad area required (150 cows x 12m^2 per cow)	= 1,800m^2
Feed area required for silage only (150 cows x 300mm/cow)	= 45m
Pad area (1,800 divided by 45)	= 45m x 40m
Feed standing area (concrete)	= 3m
Overall pad area	**= 45m x 43m**

Woodchips: Woodchips will compact by about 30% when spread on a pad. Therefore a 1,800m^2 pad will require 360m^3 of compacted woodchip, which is equivalent to 514m^3 fresh woodchip. The approximate bulk density for sawmill by product is 400kg/m^3 and 250kg/m^3 for recycled timber

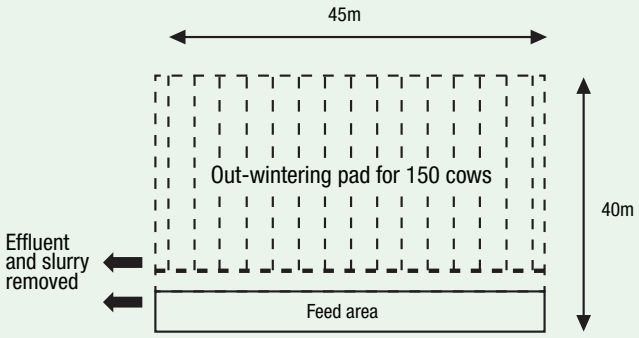

Figure 3: Layout of out-wintering pad for 150 cows with feed space of 300mm per cow

Earth-lined or geo-membrane lined

A site assessor, approved by the local authority, will inspect the site, and carry out a site analysis and characterisation prior to construction. Following site assessment, a decision can be made whether an earth-lined or geo-membrane liner is required. There are minimum accepted criteria that determine whether the site is suitable to be earth-lined, e.g. clay content, sub-soil thickness, sub-soil suitability, water-table height, etc. There are four steps to site assessment:

(A) collation of background information

(B) visual assessment

(C) trial holes and site tests

(D) decision-process and preparation of recommendations.

Check DAFM specifications for details of on-site assessment.

- **S132** Minimum Specification for Out-wintering Pads - Feb 2007
- Guidance Document for Out-wintering Pads
- **S132A** Accepted Contractors for Geo-membrane Lined

Figure 4 (overleaf) shows the cross section area of an out-wintering pad that requires a geomembrane liner. Figure 5 shows an earth lined pad where the clay content of the subsoil is at least 10%. The depth of compacted sub soil layer will depend on the clay content of the soil.

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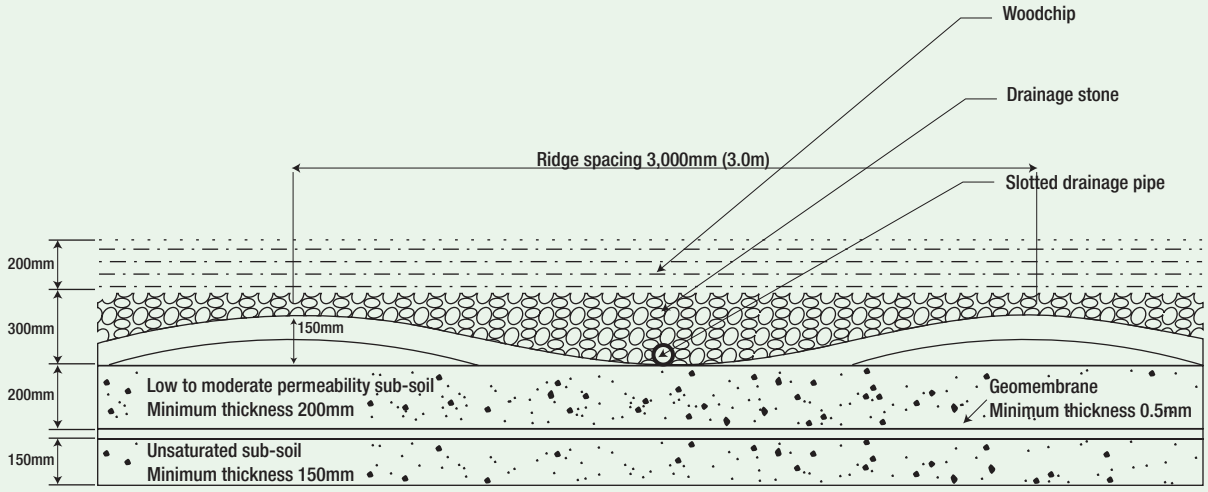

Figure 4: Cross section of out-wintering pad showing geo-membrane liner (from DAFM specifications)

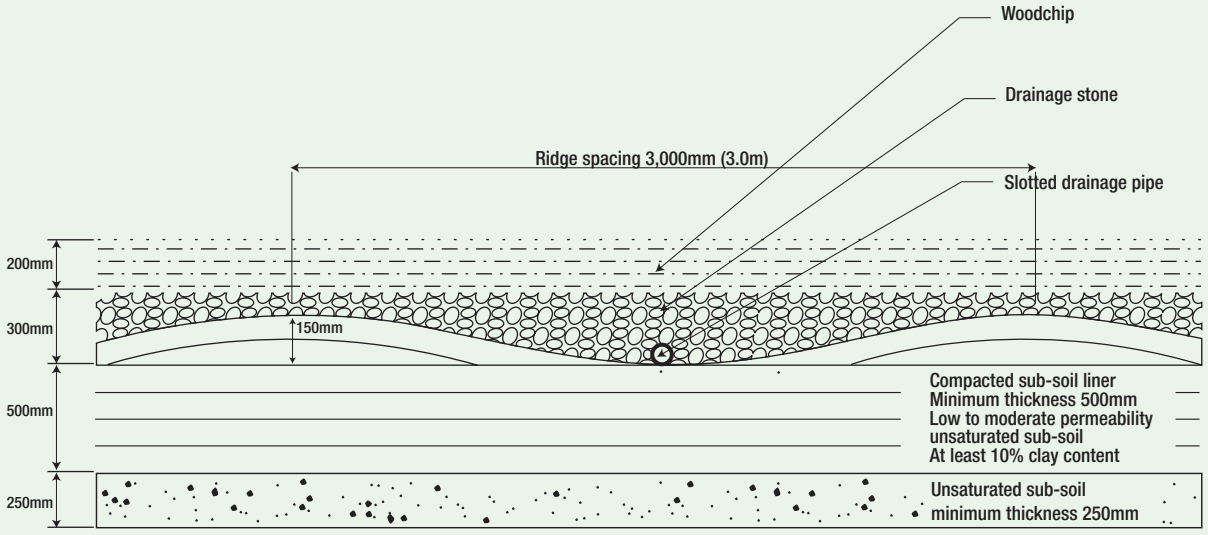

Figure 5: Cross section of out-wintering pad showing compacted earth liner (from DAFM specifications)

On-pad feeding/off-pad feeding

There is an option to place silage on top of the pad and allow the cows to self-feed. In this case the space allowance is 20m^2/cow on the pad. This includes the silage pit. The silage pit should be filled from outside the pad, to prevent damage to the drainage system by machinery.

The pit should be a maximum of 1.8m high to allow cows to fully eat the pit face without having to feed out the silage. For 150 cows this would require a pad size of approx. 3,000m^2, i.e. 50m x 60m.

Grazing crops over the winter

Grazing feeds *in situ* reduces the cost of feed per cow over the winter. Also, there is no requirement for wintering facilities but full slurry storage is required (under legislation) for all dairy cows on the farm. Options include swede, kale, fodder beet, rape, turnips and winter grazing of grass.

Successful over-wintering on crops requires:

- high crop yields
- suitable soil type for growing crops
- suitable soils for grazing
- grassland management that allows cows go to grass full-time after calving
- alternative forage supply during difficult weather, e.g. wet conditions, frost
- back-up forage if crops fail, e.g.due to heavy frost.

The land area required will depend on the yield potential of the crop and the sowing date. See Table 4 for potential carrying capacity of the different crops.

Table 4: Potential grazing capacity of crops during a 100-day winter

	Fodder Beet	Kale	Swede	Rape	Deferred grass
Yield (t DM/ha)	18	10	12	4.2	2.8
Utilisation (%)	70	70	70	70	60
Energy (NE/kg DM)	1.12	1.05	1.12	1.03	0.85
Supplement required as baled silage (kg DM/day)	3	3	3	3	0
No. of cows wintered per hectare for 100-day winter	29	15	19	6	2
Hectares required for 150 cow herd (100-day winter)	5.2	10	8	25	75

Straw-bedded shed (no dungstead)

The cost of straw makes this system extremely expensive. In addition, there is increased labour with bedding, mucking out and spreading of the farmyard manure generated. Approximately 55kg of straw per cow is required each week to absorb all urine. This is equivalent to four small square bales of straw.

Manure pit and dungstead

Bedding material for calving and calf rearing cannot be stored on grassland over the winter closed period. Effluent must be collected where this material is removed from sheds over the winter. Refer to DAFM specification for manure pits and dungsteads for construction details.

- S108 Manure Pits and Dungsteads

3 How can I ensure animals have adequate feed space?

Feed barriers

- There are two main methods, easy feed and self-feed.

Easy feed

Barrier design is crucial. Cows must have a good reach with neck-rail, stub wall and feed passage height giving cows maximum reach without impacting on animal posture. Similarly, space per cow must be sufficient for the feeding system so that no bullying, lameness or health issues are caused by the feed barrier. For head space, there are two recommendations:

(a) Silage fed ad-lib - 300mm/cow

(b) Meal feeding - 600mm/cow

An increasing number of farms are feeding supplements at feed barriers, e.g. no feeders in parlour, feeding high quality baled silage in spring/autumn. In these scenarios, it is essential that adequate feed space is available for the herd.

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Key facts

Feed barriers

Head-rail height from cow standing area (adjustable):	1,175mm
Stub wall height from cow standing area:	550mm
Feed passage height above cow standing area:	125mm
Concrete apron to slat in cow area:	600mm
Head-rail location on stanchion:	on feed passage side
Silage feed space per animal:	300mm
Meal feed space per animal:	600mm
Stub wall thickness:	100mm

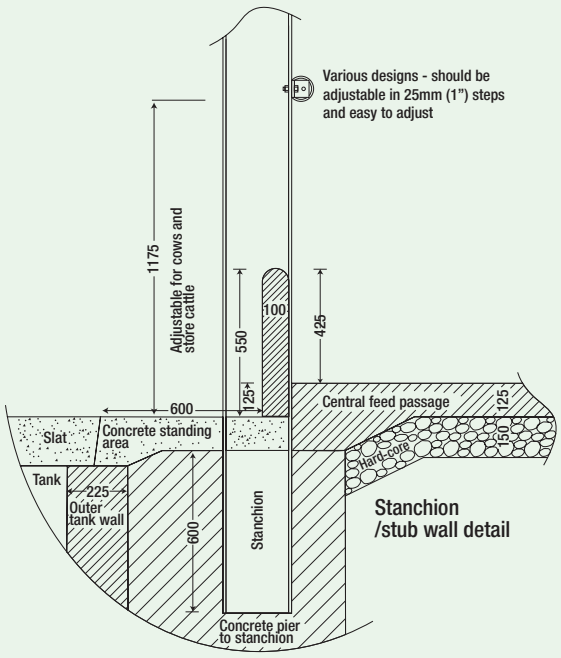


Figure 6: Typical stub wall and feed barrier.

Self-feed

Self-feed systems are operated by electrical wire where cows can eat above and below the electrical wire. This wire must be flexible. Pit height should be a maximum of 1.8m high.

4 What slurry facilities do I need?

Slurry storage

Slurry produced during winter is a major resource. Recycling this slurry to the grassland area is an essential part of nutrient planning on dairy farms and reduces the amount of P and K fertilizer needed. Similarly, slurry can be used to replace N fertilizer, especially when applied early in the grazing season.

Legislation defines minimum slurry storage capacities required on dairy farms. These range from 16 to 22 weeks, depending on the zone a farm is located in. Similarly there are minimum closed periods when slurry cannot be spread. These range from 12 to 16 weeks.

Key facts

Slurry storage

Slurry produced per week:

Dairy cow	0.33m^3
0-1-year-old cattle	0.08m^3
1-2-year-old cattle	0.15m^3

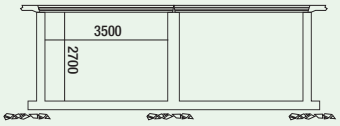
Winter slurry storage required per cow by law

16-week zone:	5.28m^3
18-week zone:	5.94m^3
20-week zone:	6.6m^3
22-week zone:	7.26m^3

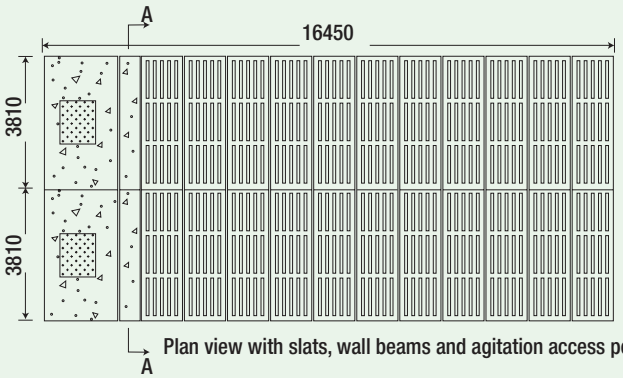
	Advantages	Disadvantages
Slatted tank	• Low labour requirement • Low maintenance • No running costs • Where all passages are slatted – eliminates requirement for scrapers	• Expensive to construct • Difficult to increase capacity/expand tanks
Steel tank	• Cheaper to construct • Can increase capacity by adding extra height • Can locate outside farmyard to allow for extra expansion within farmyard	• Slurry must be pumped into tank • Slurry collecting system required, i.e. scrapers/ slurry channel • Rainwater is collected
Lagoon (earth lined or geo membrane lined)	• Cheap to construct • Some sites suited to earth-lined lagoon • Slurry is dilute – more efficient use of N fraction in spring	• Collects rainwater, extra volume to be spread • Slurry collecting system required i.e. scrapers/ slurry channel • Some local authorities don't allow earth lined lagoons

Slatted tanks

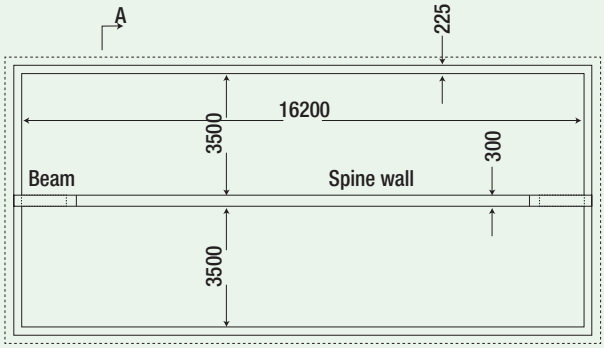
Figure 7 shows the typical slatted tank design. Internal width is 3.5m with a 3.81m (12'6") slat on top. The spine wall is 300mm to support the two slats with outer wall 225mm. Net capacity of the tank is the internal length (16.2m) by the internal width (3.5m) by the net height. A freeboard allowance of 200mm is taken from internal tank height to get the net height. Therefore the slurry capacity of each tank is 16.2m x 3.5m x 2.5m which is 141.75m^3.



Section A/A



Plan view with slats, wall beams and agitation access point



Plan view without the slats

Figure 7: Cross-section of standard double slatted tank with 4.1 metre slat

Winter Facilities

How to

Calculate slurry tank size

Slurry produced – 150 cows x 0.33m^3/week x 18 weeks = 891m^3

Slatted tank – 2.7 m deep (net depth 2.5m), 3.81m (12'6") slat (3.5m internal width)

Capacity per metre of tank = 2.5m deep x 3.5m internal
= 8.75m^3 per metre length of tank
Required tank length - 891 divided by 8.75 = 102m

This tank will usually be in sections e.g. four tanks each 25 metres long or alternatively tank size could be wider i.e. 4.4m, 5.0m etc. increasing the capacity and therefore reducing the total length of tank required.

Refer to DAFM specifications for construction of slatted tanks

- **S123** Bovine Livestock Units and Reinforced Tanks - March 2006.

Collecting rainwater

Outdoor collection facilities e.g. overground steel tanks, lagoons must also collect rainfall and therefore require additional capacity for rain storage over the winter period. There is also a freeboard requirement of 300mm with outdoor storage facilities.

Table 5: Average net rainfall during the specified storage period.

County	Millimetres per week	County	Millimetres per week
Carlow	24	Longford	23
Cavan	27	Louth	20
Clare	32	Mayo	40
Cork	37	Meath	19
Donegal	38	Monaghan	23
Dublin	17	Offaly	20
Galway	34	Roscommon	26
Kerry	45	Sligo	32
Kildare	18	Tipperary	27
Kilkenny	23	Waterford	31
Laois	22	Westmeath	21
Leitrim	33	Wexford	25
Limerick	26	Wicklow	33

Where the rainfall level is 32mm per week and the winter period is 18 weeks then a total of 576mm of rainwater will fall during this period. Outdoor storage must allow for this rainfall. Also 300mm freeboard must be included in tank capacity.

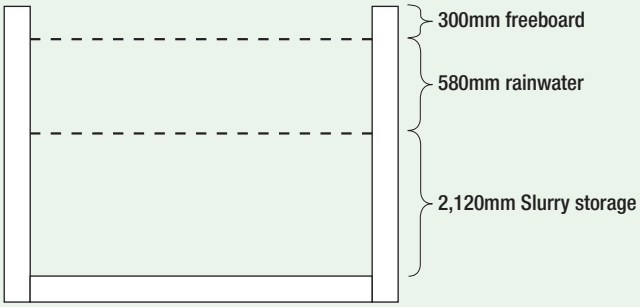


Figure 8: Outdoor tank 3.0m high showing freeboard, rainwater and slurry storage for 18-week zone with 32mm rain per week (not to scale)

Overground circular tank

Overground tanks (steel and concrete) are available in a range of sizes. Normally their height is two rings, but some have the option to increase height by one ring and therefore increase the capacity.

The capacity of a circular tank is pi (3.14) multiplied by the radius squared by the height. But remember that freeboard and rainfall must also be allowed for. For example, the net capacity for a tank that is 3.0m high, radius of 10m, rainfall of 32mm per week and storage requirement of 18 weeks is pi (3.14) x radius squared (10 x 10) x net height (3-(0.3+0.58)) = 666m^3.

Refer to DAFM specifications for full details of construction of overground slurry stores.

- **S122** Minimum Specification for Proprietary Over-Ground Circular Slurry/Effluent Stores - Feb 2006.
- **S122A** Accepted Contractors for Proprietary Over-Ground Circular Slurry/Effluent Stores - March 2009.

Lagoons

Lagoons are cheap to construct and can accomodate large volumes of effluent. As for out-wintering pads, the proposed site must be assessed to determine whether an earth or geo-membrane liner is suitable. In calculating the slurry capacity of a lagoon, multiply the average height (excluding freeboard and rainwater) by the average width by the average depth. For example, in Figure 9 the capacity is 2.4m x 15m x 15m which is 540m^3 (120,000 gallons) (1m^3 = 220 gallons)

Key facts

Earth-lined lagoon (ELL)

Maximum liquid depth	3.0m
Minimum freeboard depth	0.75m
Minimum ground level to top of banks	0.6m
Maximum inner bank slope	33^0
Maximum outer bank slope	33^0
Minimum width of top of bank	3.0m

Lagoons and out-wintering pads (OWP)

Where out-wintering pads are linked to a lagoon the capacity of the lagoon must be sufficient to hold:

- effluent produced from the pad
  - – slurry from the cows
  - – proportion of rainfall on the pad
- Rainfall on the lagoon.

How to

Calculate effluent produced from an out-wintering pad

The formula is:

E = (P×R) + (N×V) - (P× 0.013)
where:

E = effluent produced, (m^3 per wk)
P = pad area, (m^2)
R = net rainfall on the pad, (m per wk)
N = no. of animals on the pad,
V = excreta produced per animal per week (m^3 per wk).

e.g. 150 cows for 18 weeks with 32mm rainfall per week

= (1,800 x 0.032) + (150 x 0.33) – (1,800 x 0.013)
= 83.7m^3 per week
= 1,507m^3 for 18-week winter

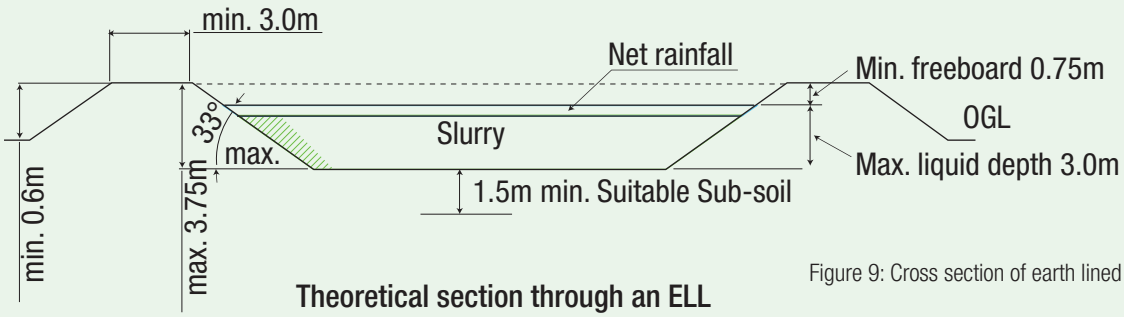


Figure 9: Cross section of earth lined lagoon

Winter Facilities

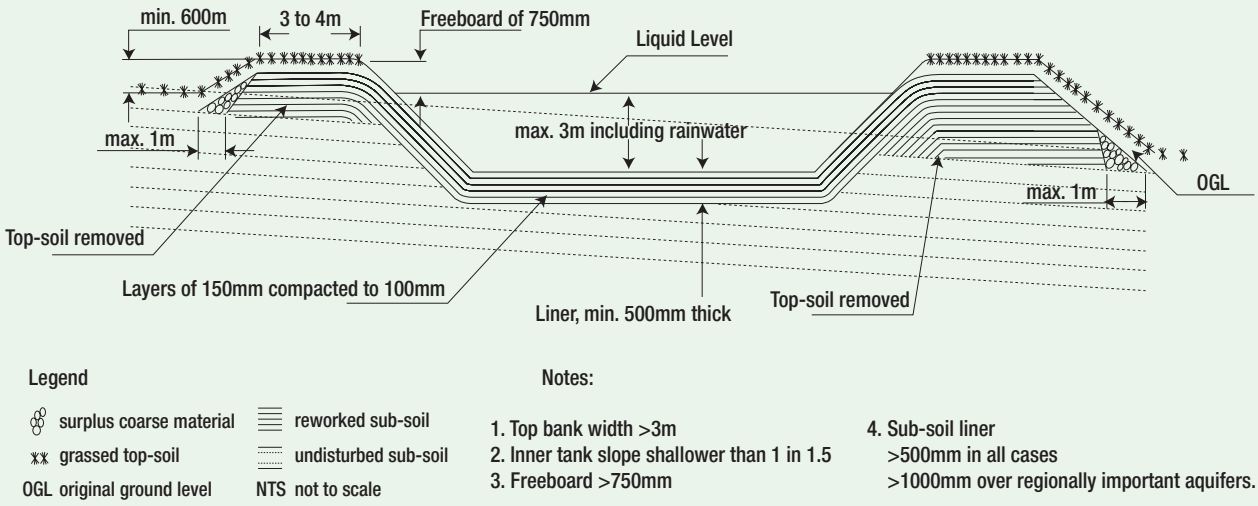


Figure 10: Cross-section of earth-lined lagoon

Refer to DAFM specifications for construction of lagoons

S126 Minimum Specification for Geomembrane-lined Slurry/ Effluent Stores, and Ancillary Works - Nov 2002

S126A Accepted Contractors for Geomembrane Lined Slurry/ Effluent Stores - June 2010

S131 Minimum Specification for Earth-Lined Slurry/Effluent Stores - Oct 2005

Earth lined lagoons and out-wintering pads are not permitted in some local authority areas due to the nature of the sub-soil. Check before proceeding.