Section D:

Case Studies

Section D: - Case Studies

To assist with both the development and implementation of the Guidelines, five dairy feedpad 'Case Studies' have been selected and a comparison made between these existing feedpads and the provisions in the Guidelines. While a brief site visit and discussion with the landholder was undertaken for each Case Study, detailed site investigations were not undertaken.

This process has been undertaken to:

- Describe the planning and decision making process employed by the landholders.
- Draw from the collective experience of existing practitioners
- Demonstrate the practical value of the Guidelines
- Provide an indication of how the Guidelines would be employed in individual cases **however**, there is no desire to recommend any particular system over its rivals.

The five case studies have been chosen to represent a broad range of different situations, from simple arrangements to complex feedpad systems.

The Case Studies consist of:

- Case Study A
  - Hay rings in a small, formed 'sacrifice' paddock
- Case Study B
  - Formed soil and rock with a conveyor belt feed 'trough'
- Case Study C
  - Formed soil and rock with wooden plank feed trough
- Case Study D
  - Formed soil and concrete pad, flood washed with concrete feedbay
- Case Study E
  - Formed soil and concrete pad, flood washed, roofed with concrete feed bay and stalls

It should be recognised that during the life of a feedpad system, changes are often instituted such as labour saving strategies or cow flow improvements and the feedpads examined would have inevitably undergone these types of changes and will most likely undergo more changes in the future. All the landholders have recognised changes in layout or management that would be advantageous.

The critical issues in the case studies are the provision of adequate waste storage and the availability of adequate land for waste reuse to avoid nutrient overload.

17.0 Case Study "A"

17.1 Snapshot

Cow Numbers	370
Management	Spring Calving
Production	5400 L/Cow
Stocking Rate	2.4 cows / ha
Feedpad	Formed with Mt Scobie rock & hay rings
Feedpad Use - Daily	$^3/_4$ hour a day
Feedpad Use - Annually	All year round

Figure 6: *Old calving pad - formed earth with Mt. Scobie rock & hay rings. The cows wander through the pad & eat straw on their way back to the pasture.*

17.2 Initial Clarification

- The feedpad is in the Goulburn Broken Catchment
- The feedpad fits the Guidelines definition
- The feedpad is not in a Declared Special Water Supply Catchment
- The feedpad caters for more than 50 and less than 5,000 head

17.3 Animal Loading

The feedpad loading needs to be determined to calculate buffer distances. This calculation requires:

- The number of dairy cows' on the feedpad = 370
- The average weight of dairy cows on the feedpad = 500 kg
- The duration the dairy cows' are located on the pad = ¾ hr

The number of DCU's is then calculated by multiplying the number of cows, by a weight conversion factor multiplied by the fraction of the day that the cows occupy the pad (refer to Appendix E).

370 x 0.94 x (¾/24) = 11 DCU

17.4 Feedpad Details

This feedpad was originally a calving pad that was formed from excess soil material and was not compacted but covered with 100mm (4 inches) of Mt. Scobie rock.

The pad is 30 x 45 m and covers an area of 1,350m^2. The total cost of construction is estimated at less than $10,000.

It is estimated that the feedpad has a lifespan of at least 20 years.

The feedpad is categorised as a dirt pad as per the categories listed in these Guidelines in Appendix C.

17.5 Feedpad Cleaning

The feedpad is scraped once a year with a front-end loader. The material collected is stockpiled and applied to paddocks during re-lasering and pasture establishment. Any drainage runoff is collected for reuse via flood irrigation on the farms pasture.

17.6 Feedpad Siting

Considerations for the siting of the feedpad include:

• Access for cows	-	good, near milking shed & central laneway - good cow flow
• Visibility	-	good from milking shed
• Environment	-	no waterways or native vegetation
• Neighbours	-	500 m away from neighbour
• Prominence	-	set well back from roads
• Prevailing winds	-	nothing downwind for northerly and southwesterly winds
• Topography	-	Elevation and gradient provide for adequate drainage
• Soils	-	Soil type is 'Lemnos Loam', which has a medium clay subsoil with a low permeability and is adequate for pad construction
• Groundwater	-	2.0 metres below the site
• Flooding	-	none
• Waste	-	very limited

17.7 Buffers

Stocking Intensity Factor – S1

11 DCU for 1,350 m^2 equates to 123m^2/DCU and the S1 Factor is then determined from Appendix H. For a dirt pad cleaned annually and at the lowest stocking rate, the S1 Factor is 37.

Separation Distances and Receptor Factor – S2

The nearest receptor to the feedpad is a single residence located 500 m away. This type of receptor is designated an S2 Factor of 1 from Appendix H.

Terrain Factor - S3

The topography of the site is flat and is therefore desingated an S3 Factor of 1 from Appendix H.

Vegetation Factor - S4

Areas surrounding the feedpad site would be classified as having no tree cover and would therefore be designated an S4 factor of 1 from Appendix H.

Buffer Distance Calculations

The require data collaborated to calculate the buffer distance is as follows:

- DCU = 11
- S1 Factor = 37
- S1 Factor = 1
- S1 Factor = 1
- S1 Factor = 1
- Composite S Factors
  S1 x S2 x S3 x S4 = 37
- Distance
  S x $\sqrt{DCU}$ = 123 m

The feedpad should be located more than 123m from the nearest receptor, the single residence.

It is a recommendation that a feedpad should be located at least 300m from any neighbouring residence and therefore this default value applies.

17.8 Design

Pad Slope

The pad is slightly mounded to facilitate drainage with a slope of approximately 0.5%.

Troughs

5 hay rings are used on the feedpad. As not all 370 cows occupy the feedpad at any one time, ample access to the straw is available.

Sizing

Laneways are 5.0 metres wide, gateways 4.5 metres wide and the cow flow is direct.

If the entire herd was on the feedpad at once, the 1,350m^2 feedpad would provide 3.7m^2 per cow however, as only 25 % of the herd is ever on the feedpad at any one time, 15m^2 is available for each cow.

Location/Access

The feedpad is located 20m from the dairy, 250 m from the house and adjacent to the farm central laneway.

17.9 Estimated Liquid Effluent Storage Sizing

Rainfall Runoff

To determine the size of the effluent pond required for the feedpad, the runoff for a 1 in 20 year 24 hour storm event needs to be determined. The estimated storage volume required is calculated as follows:

$$Q = [\,[(Af + Ab) \times (Rf \times Ro)] \times Fs\,] + (As \times Rf)/1000$$

Where:

Q = volume (m^3)
Af = Area of actual pad (m^2)
Ab = Balance of catchment area (m^2)
Rf = 80% of the 1 in 20 years 24 hour rainfall event

Ro = Runoff coefficients for a dirt pad

> 600 mm per annum	= 0.40
501 - 600 mm	= 0.35
400 - 500 mm	= 0.30
< 400 mm	= 0.25

Fs = Safety Factor of 1.25
As= Area of storage (m^2)

The area of the actual pad is 1,350 m^2, and the feed storage area and laneways surrounding the pad total a similar area of 1,350 m^2. The feedpad is a dirt pad and is in a 400 - 500 mm per annum rainfall area and therefore has a coefficient of 0.3. Any proposed reuse dam that would collect runoff is estimated at covering an area of 5m by 10 m or 50m^2. From Appendix J, an interpolated value for the 24 hour rainfall 20 year recurrence interval for this area is 90 mm. The runoff coefficient adopted is:

Q = volume (m^3)
Af = 1,350 m^2
Ab = 1,350 m^2
Rf = 80% of the 90 mm = 72 mm
Ro = 0.30
Fs = 1.25
As = 50 m^2

The calculation is then;

$$Q = [[(1,350 + 1,350) \times (72 \times 0.3) \times 1.25] + (50 \times 72)] / 1000$$

$$Q = [[2,700 \times 21.6 \times 1.25] + 3,600] / 1000$$

$$Q = 76,500 / 1000 = 76.5\ m^3$$

Therefore a storage with an estimated volume of 76.5 m^3 or 0.08 ML is required. As this volume is less than 0.1 ML, a separate effluent storage is not deemed necessary for this feedpad. Any runoff is directed to the farm irrigation reuse system.

Flood Washing

There is no flood washing system

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Winter Storage/Total Volume

As any rainfall runoff is minimal, the existing irrigation reuse system can cater for any over winter storage of pad runoff. Any runoff from the pad enters the irrigation reuse system and is reused as part of the irrigation reuse strategy.

17.10 Estimated Solid Manure Generation

Based on the default values of:
- 500 kg dairy cow fed on harvested feed
- Raw manure 40 kg/cow/day
- Solids 4.2 kg/cow/day

adjusted for the apportionment of time (¾ hour on the pad)
- Raw manure 1.25 kg/cow/day
- Solids 0.13 kg/cow/day

In this case where the 370 cows occupy the pad for 365 days of the year, this equates to an estimated 18 tonnes of solids.

Some of these accumulate to form a biological layer on the pad surface and the remainder is scraped off the pad and stock piled to be applied to paddocks prior to re-lasering.

Estimated Nutrient Generation

Default figures for production of nutrients of dairy cattle for a 500 kg animal are as follows;

N = 0.225 kg/day
P = 0.047 kg/day
K = 0.145 kg/day

Based on the apportionment of time where the cows spend ¾ hour on the pad, the values would be.
N = 0.007 kg/day
P = 0.002 kg/day
K = 0.005 kg/day

Where the 370 cows occupy the pad for 365 days of the year the estimated total nutrients produced per annum therefore equate to approximately;
N = 950 kg of N
P = 270 kg of P
K = 680 kg of K

Nutrient Budget

A typical dairy pasture producing 10t of dry matter/ha will use the following nutrients;

N Removal (kg/ha/yr.)	P Removal (kg/ha/yr.)	K Removal (kg/ha/yr.)
400	40	200

Therefore based on the estimated nutrient generation of the feedpad, the following areas will be required to reuse the manure generated;
N = 950 = 2 ha
P = 270 = 7 ha
K = 680 = 3 ha
If the solids are spread over 7 ha of pasture, the reuse of all the nutrients and especially the phosphorus is allowed for. The farm consists of 100 ha of pasture providing ample area to reuse the wastes.

17.12 Water Supply

Water is supplied in two 1,500 litre troughs, providing 8 litres per cow. As the cows are only on the feedpad for ¾ hour per day this is equivalent to 256 L/cow/day, which is ample.

17.13 Feed Storage & Supply

Adequate area is provided to store and supply the straw required for the feedpad. Any runoff from this feed storage area is directed to the irrigation reuse system.

17.14 Detailed Drawing

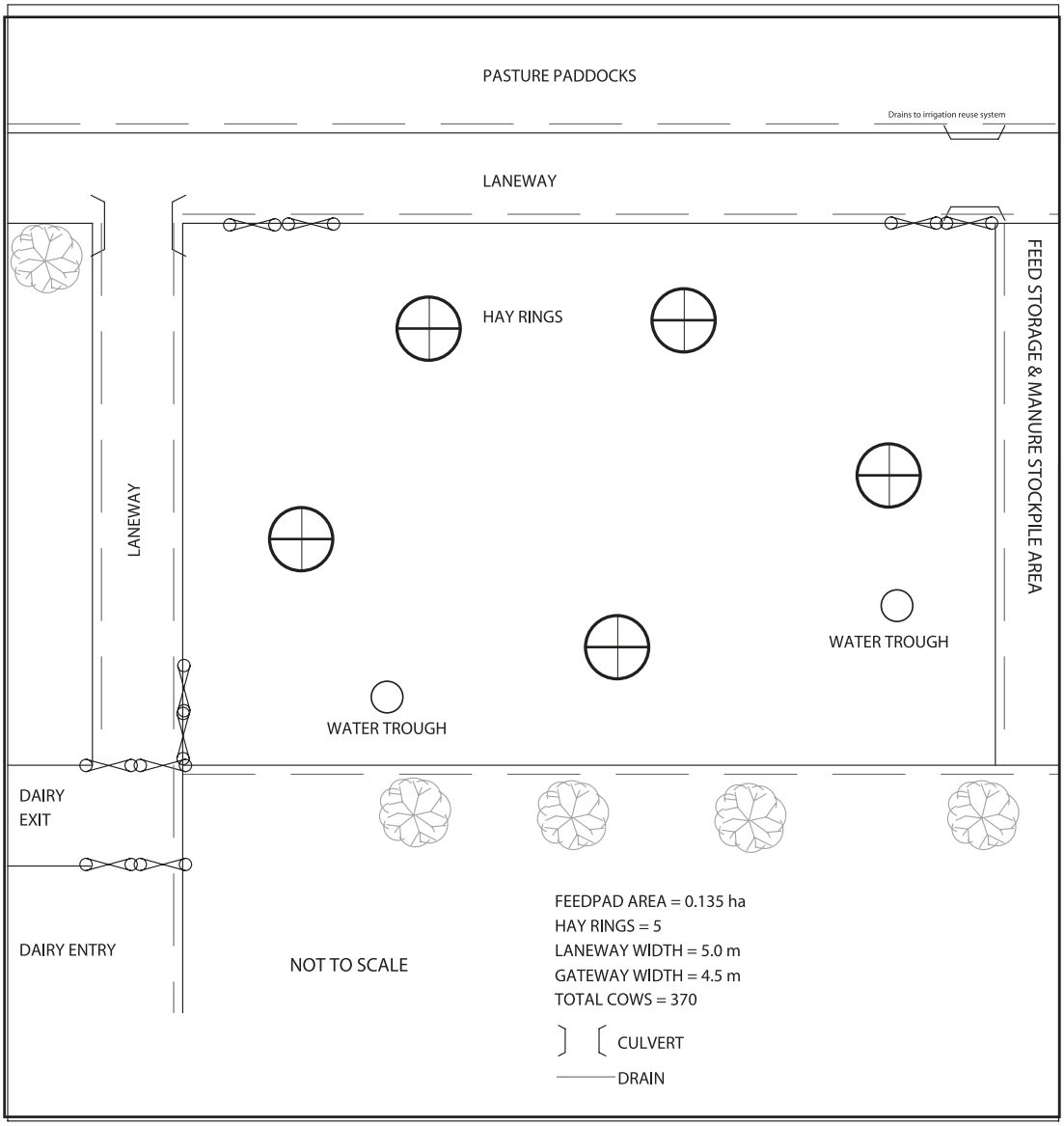


Figure 7: *Feedpad Drawing - See Figure 20 for an example of an appropriate detailed feedpad drawing and refer to section 10.4 for details to include in the feedpad drawing.*

17.15 Application to Municipal Council

The feedpad is in a Rural Zone, is not affected by any overlays and the associated earthworks did not effect flooding or discharge from the property. It is therefore not likely that a planning permit would have been required for this feedpad, however, this would have been at the discretion of the Municipal Planning Officer on submission of this application to the Municipal Council.

17.16 Approval

If this feedpad was assessed under these new Guidelines, the feedpad would be acceptable. Considering the low intensity of stocking and the low volume of runoff (less than 0.1 ML), common sense dictates that no effluent storage is required providing the irrigation reuse is utilised as described.

17.17 Feedpad Management

While not part of an application for approval to construct, some of the management practices associated with this feedpad could be of interest.

Benefits

The feedpad provides for the supplementary feeding of straw and could be utilised for other feed supplements such as salt blocks.
The provision of water is considered to be of significant benefit to the herd

Problems

The only problem experienced with the pad was with mastitis when it was used for a calving pad, hence the conversion to a feedpad. Calving is now done in the paddock.

18.0 Case Study "B"

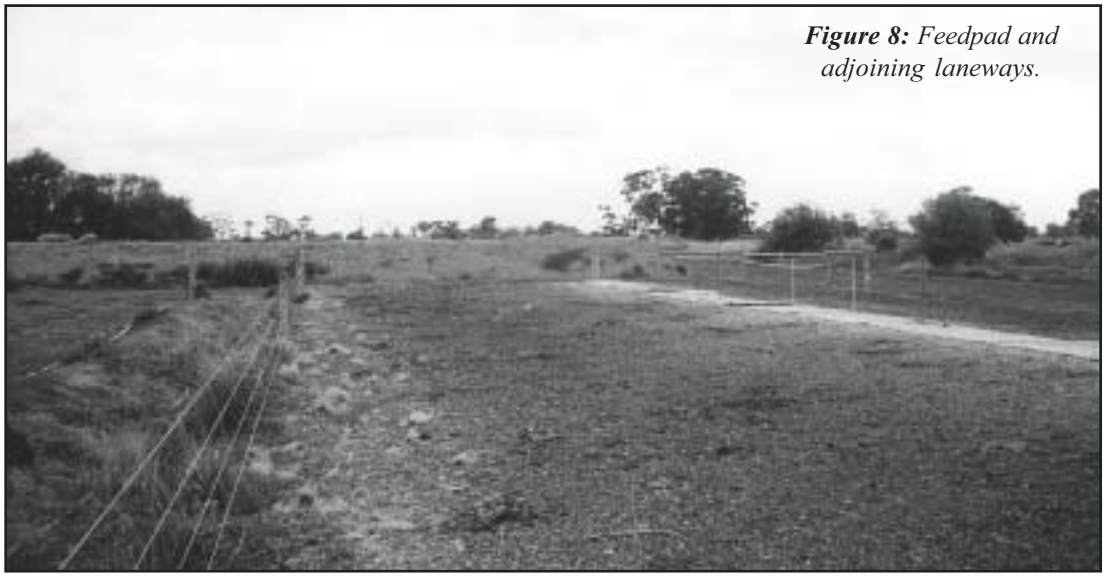


Figure 8: *Feedpad and adjoining laneways.*

18.1 Snapshot

Cow Numbers	500
Production	7,000 L/Cow
Stocking Rate	4.2 cows/ha
Feedpad	Formed + Mt Scobie rock + conveyor belt
Feedpad Use - Daily	$^3/_4$ hour a day (am only)
Feedpad Use - Annually	All year round

18.2 Initial Clarification

- The feedpad is in the Goulburn Broken Catchment
- The feedpad fits the Guidelines definition
- The feedpad is not in a Declared Special Water Supply Catchment
- The feedpad houses more than 50 and less than 5,000 head

18.3 Animal Loading

The feedpad loading needs to be determined to calculate buffer distances. This calculation requires:

- The number of dairy cows' on the feedpad = 500
- The average weight of dairy cows on the feedpad = 550 kg
- The duration the dairy cows' are located on the pad = ¾ hr

The number of DCU's is then calculated by the number of cows, multiplied by a weight conversion factor multiplied by the fraction of the day that the cows occupy the pad (refer to Appendix E).

500 x 1.00 x (¾/24) = 16 DCU

18.4 Feedpad Details

Soil from effluent and reuse dams was used to form a pad up to 400 mm high in the centre. This was then compacted and covered with 75 mm (3 inches) of Mt. Scobie rock.

The pad covers an area of 2,772m^2 and the total cost of construction was approximately $10,000. The feedpad is categorised as a dirt pad as per the (categories listed) in these Guidelines in Appendix C.

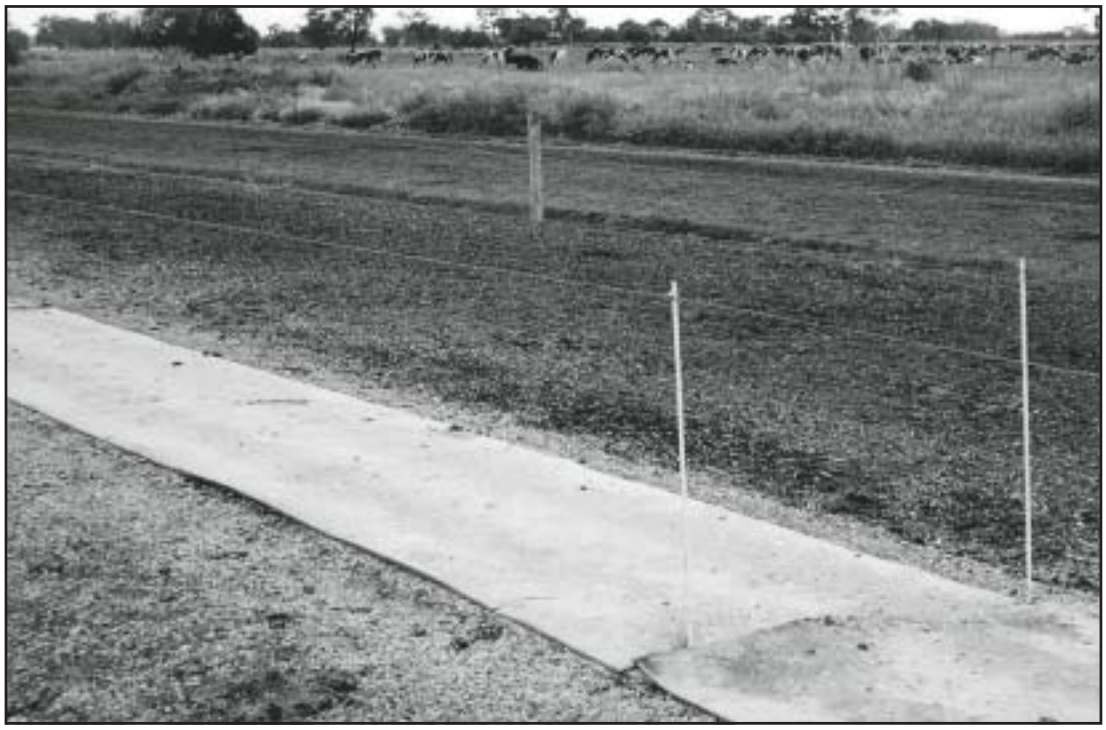


Figure 9: *Two hot wires over the top of the old conveyor belt.*

18.5 Feedpad Cleaning

The feedpad is scraped with a 2.7 metre wide smudger every 3 months and the solids are placed in a silage wagon with a front-end loader and then distributed on the farms pasture paddocks.

The solids are stockpiled if they are to wet for spreading however, this is rare as the pad cleaning is timed when the solids are at an ideal moisture content.

18.6 Feedpad Siting

Considerations for the siting of the feedpad included:

- Access for cows - good - near milking shed & central laneway - good cow flow
- Visibility - good from the milking shed
- Water supply - good - near existing trough line
- Environment - no waterways or native vegetation
- Neighbours - 1,200 m away from nearest neighbour
- Prominence - set back behind the dairy
- Prevailing winds - nothing downwind for northerly and southwesterly winds
- Topography - elevation and gradient provide for adequate drainage
- Soils - soil type is 'Shepparton Fine Sandy Loam' and prior stream soils are in the district therefore care was required during construction to avoid permeable soil types which increase the change of groundwater contamination.
- Groundwater - 2.0 metres below the site which is adequate for the proposed storages
- Flooding - no flooding in the area
- Liquid Waste - while limited runoff is anticipated, any runoff will be directed to the effluent dam adjacent to the feedpad
- Liquid Waste Reuse - is linked to irrigation reuse system
- Solid Waste Reuse - spread on adjoining paddocks

18.7 Buffers

Stocking Intensity Factor – S1

16 DCU for 2,772 m^2 equates to 173m^2/DCU and the S1 Factor is then determined from Appendix H. For a dirt pad cleaned annually (the worst case scenario has been adopted here as the pad is cleaned every 3 months) at the lowest stocking rate, the S1 Factor is 37.

Separation Distances and Receptor Factor – S2

The nearest receptor to the feedpad is a single residence located 1,200 m away. This type of receptor is designated an S2 Factor of 1 from Appendix H.

Terrain Factor - S3

The topography of the site is flat and is therefore designated an S3 Factor of 1 from Appendix H.

Vegetation Factor – S4

Areas surrounding the feedpad site would be classified as having no tree cover and would therefore be designated an S4 Factor of 1 from Appendix H.

Buffer Distance Calculations

The required data collaborated to calculate the buffer distance is as follows;

- DCU = 16
- S1 Factor = 37

- S1 Factor = 1
- S1 Factor = 1
- S1 Factor = 1
- Composite S Factors = S1 x S2 x S3 x S4 = 37
- Distance = S x $\sqrt{DCU}$ = 148 m

The feedpad should be located more than 148m from the nearest receptor, the single residence.

It is a recommendation that a feedpad should be located at least 300m from any neighbouring residence and therefore this default value applies.

18.8 Design

Pad Slope

The sides of the pad have a slope of 6.0 %.

Troughs

The 'trough' consists of 7 mm thick and 0.5m wide rubber conveyor belt. Two hot wires are suspended 1 m above the belt. A total trough length of 152 m with access from both sides provides 600 mm of trough length per cow for the 500 cows.

Sizing

The laneways are 8.0 metres wide and access to the pad is also 8.0 metres wide. The cows do not have to turn more than 90° to access and exit the feedpad. The feedpad area covers 2,772 m^2, which allows 5.5m^2 per cow.

Location/Access

The feedpad is located 60m from the dairy, 200 m from the house and adjacent to the farm central laneway and the dairy/feedpad effluent dam.

18.9 Estimated Liquid Effluent Storage Sizing

Rainfall Runoff

To determine the size of the effluent pond required for the feedpad, the runoff for a 1 in 20 year 24 hour storm event needs to be determined.

The estimated storage volume required is calculated as follows:

$$Q = [\,[(Af + Ab) \times (Rf \times Ro) \times Fs] + (As \times Rf)]\,/\,1000$$

Where;

Q = volume (m^3)

Af = Area of actual pad (m^2)

Ab = Balance of catchment area (m^2)

Rf = 80% of the 1 in 20 years 24 hour rainfall event

Ro = Runoff coefficients for a dirt pad

> 600 mm per annum =	0.40
501 - 600 mm =	0.35
400 - 500 mm =	0.30
< 400 mm =	0.25

Fs = Safety Factor of 1.25

As = Area of storage (m^2)

The area of the actual pad is 2,772 m^2, and additional lanes and drains total another 1,900m^2. The feedpad is a dirt pad and is in a 400 - 500 mm per annum rainfall area and therefore has a coefficient of 0.3. The effluent storage covers an area of 20m by 20 m or 400m^2.

From Appendix J, an interpolated value for the 24 hour rainfall 20 year recur-rence interval for this area is 90 mm.

We therefore end up with;

Q = volume (m^3)

Af = 2,772 m^2

Ab = 1,900 m^2

Rf = 80% of the 90 mm = 72 mm

Ro = 0.30

Fs = 1.25

As = 400 m^2

The calculation is then:

$$Q = [[(2{,}772 + 1{,}900) \times (72 \times 0.3) \times 1.25] + (400 \times 72)]\,/\,1000$$

$$Q = [[4{,}672 \times 21.6 \times 1.25] + 28{,}800]\,/\,1000$$

$$Q = 154{,}944\,/\,1000 = 154.9\ m^3$$

Therefore a storage with an estimated volume of 155 m^3 or 0.16 ML is required.

Flood Washing
There is no flood washing system.

Winter Storage
As any liquid waste is reused as irrigation, storage volume needs to be provided for the winter period when irrigation will not be feasible. By referring to the Rainfall and Evapotranspiration graphs in Appendix K and allowing for the warmer climate it is determined that rainfall exceeds evapotranspiration for 8 months of the year for perennial pasture.

To calculate the rainfall runoff from the feedpad and feedpad works area over this period, the default figure used is 20% of the runoff from a 1 in 20 year 24 hour storm event per month or 8 x 0.2 x 0.16 = 0.256 ML

Total Volume
An estimated total effluent storage volume of 0.16 + 0.256 = 0.416 ML is required.

The feedpad runoff will be directed to the dairy effluent pond which was purpose built to cater for both the dairy and the feedpad and has a volume of 2.5 ML, which allows 0.5 ML for the feedpad.

18.10 Estimated Solid Manure Generation

Based on the default values of:

500 kg dairy cow fed on harvested feed
Raw manure - 40 kg/cow/day
Solids - 4.2 kg/cow/day

adjusted for the apportionment of time (¾ hour on the pad) and the proportionate weight (550 kg) of cows.

Raw manure - 1.4 kg/cow/day
Solids - 0.14 kg/cow/day

In this case where the 500 cows occupy the pad for 365 days of the year, this equates to an estimated 250 tonnes of raw manure or an estimated 26 tonnes of solids.

The solids collected from scraping the feedpad are placed in a silage wagon and spread over the pasture paddocks.

Estimated Nutrient Generation
Default figures for production of nutrients of dairy cattle for a 500 kg animal are as follows:
N = 0.225 kg/day
P = 0.047 kg/day
K = 0.145 kg/day

For the 550 kg animals we are dealing with in this case the values would be:
N = 0.248 kg/day
P = 0.052 kg/day
K = 0.16 kg/day

Based on the apportionment of time where the cows spend ¾ hour on the pad the values would be.
N = 0.008 kg/day
P = 0.002 kg/day
K = 0.005 kg/day

Where the 500 cows occupy the pad for 365 days of the year the estimated total nutrients produced per annum therefore equate to
N = 1,460 kg of N
P = 360 kg of P
K = 900 kg of K

Nutrient Budget
A typical dairy pasture producing 10t of dry matter/ha will use the following nutrients:

N Removal (kg/ha/yr.)	P Removal (kg/ha/yr.)	K Removal (kg/ha/yr.)
400	40	200

Therefore based on the estimated nutrient generation of the feedpad, the following areas will be required to reuse the manure generated;

N = 1,460 = 4 ha
P = 360 = 9 ha
K = 900 = 5 ha

Therefore the solids need to be spread over 9 ha of pasture to allow for the reuse of all the nutrients and especially the phosphorus. The farm consists of 100 ha of pasture providing ample to reuse the wastes.

18.11 Water Supply

There are no plans for stock drinking water for the feedpad at present however this may be considered in the future.

18.12 Feed Storage & Supply

Adequate area is provided to store and supply feed based on each cow consuming 4 kg/head/day of feed on the feedpad. The feed is stored on a raised rock base, covered with plastic and is vermin and weather proof. The feed storage area is separate from the feedpad and is located 500 m away. Any runoff from this feed storage area is directed to the irrigation reuse via bunding. The feed storage area is cleaned on a regular basis (every 3 months minimum).

18.13 Detailed Drawing

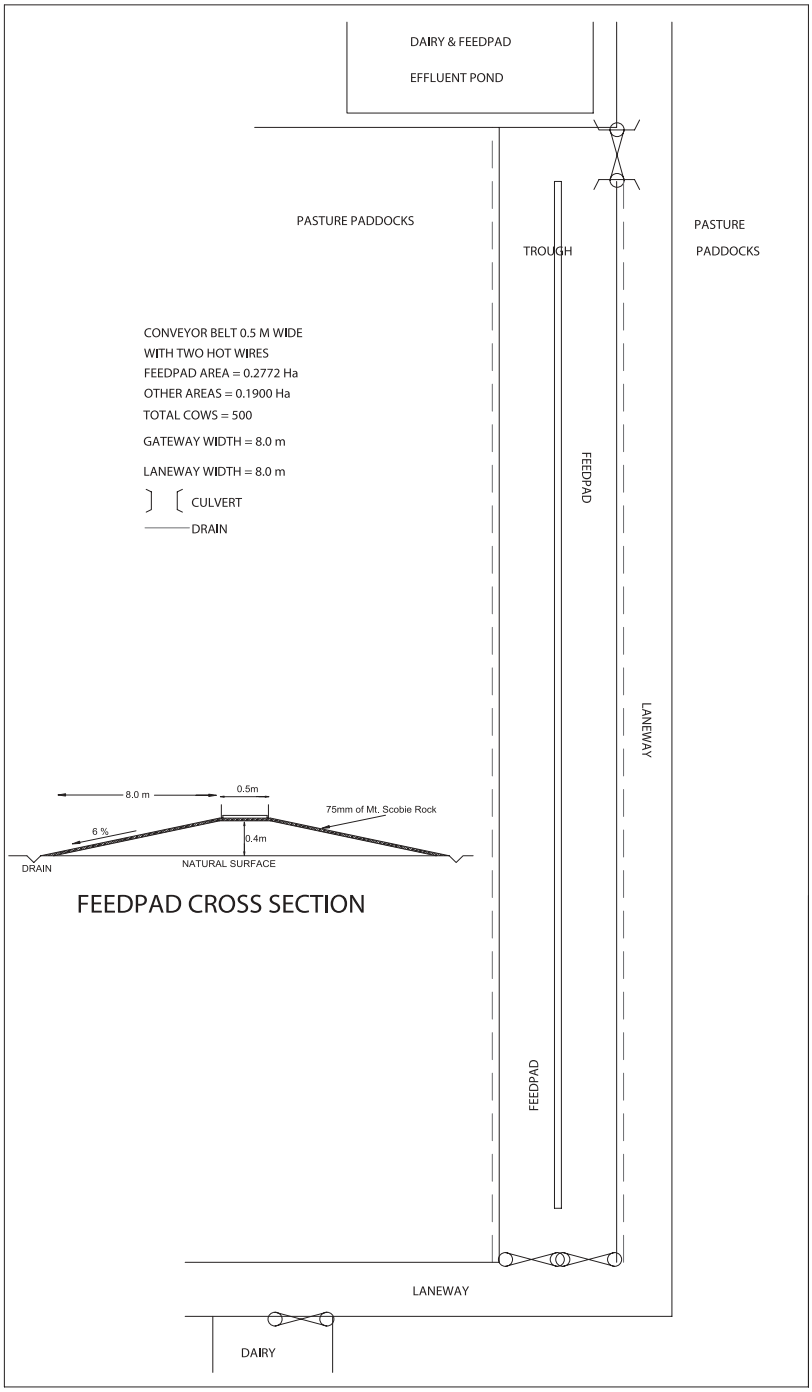


Figure 10: *Feedpad Drawing - See Figure 20 for an example of an appropriate detailed feedpad drawing and refer to section 10.4 for details to include in the feedpad drawing.*

18.14 Application to Municipal Council

The feedpad is in a Rural Zone and is not affected by any overlays. If a proposal similar to this was lodged to the Municipal Council today, a planning permit would be required if the assoicated earthworks were going to affect flooding or discharge from the property, however this would be at the discretion of the Municipal Planning Officer.

18.15 Approval

If this proposal for a feedpad were assessed under these new Guidelines, the feedpad would be acceptable.

18.16 Feedpad Management

While not part of an application for approval to construct, some of the management practices associated with this feedpad could be of interest.

Benefits

The conveyor belt is easy to clean and very rarely requires cleaning.

Problems

The cows can drag feed off the conveyor belt and then trample this under the belt causing it to lift or causing water to collect and the pad surface to wear. This is patched up periodically with additional Mt. Scobie rock.

Figure 11: *Conveyor belt lifting and pad surface breaking down - this is periodically patched up with additional rock.*

19.0 Case Study "C"

Figure 12: *Formed earth with rock feedpad and wooden plank troughs.*

19.1 Snapshot

Cow Numbers	500
Milking	All Year Round
Production	5400 L/Cow 432kg MS/com
Stocking Rate	6 cows / ha
Feedpad	Formed soil with rock, wooden plank troughs + electric wire
Feedpad Use - Daily	4.5 hours a day
Feedpad Use - Annually	All year round

19.2 Initial Clarification

- The feedpad is in the Goulburn Broken Catchment
- The feedpad fits the Guidelines definition
- The feedpad is not in a Declared Special Water Supply Catchment
- The feedpad houses more than 50 and less than 5,000 head

19.3 Animal Loading

The feedpad loading needs to be determined to calculate buffer distances. This calculation requires:

- The number of dairy cows' on the feedpad = 500
- The average weight of dairy cows on the feedpad = 600 kg
- The duration the dairy cows' are located on the pad = 4.5 hrs

The number of DCU's is then calculated by multiplying the number of cows, by a weight conversion factor multiplied by the fractionof the day that the cows occupy the pad (refer to Appendix E).

500 x 1.06 x (4.5/24) = 99.4 DCU

19.4 Feedpad Details

Approximately 2000 m^3 of soil was extracted from the effluent and reuse dams and used to build and shape the two pads. A road grader, compacting roller and water cart were utilised to compact the soil material. Rock from a quarry at Tungamah was brought in, and the initial 175 mm (7 inch) layer compacted to 75 mm (3 inch) thick.

The total cost of construction including associated laneways and the provision of water was approximately $30,000. It is estimated

that the feedpad has a lifespan of at least 20 years.

The feedpad is categorised as a dirt pad as per the categories listed in these Guidelines in Appendix C.

19.5 Feedpad Cleaning

Solids are harvested as required (up to 8 times per year) by scraping the pad with a front-end loader. The pad is not scraped entirely clean but a small layer of manure is left and this absorbs moisture and reduces runoff from rainfall. There is ample room for this operation and while solids are spread directly onto the farms 100 ha of pasture paddocks, there is ample area set aside for stockpiling solids should this be required.

Figure 13: *Feedpad trough made from red gum planks with two hot wires.*

19.6 Feedpad Siting

Considerations for the siting of the feedpad include:

- Access for cows - good near milking shed & central laneway - good cow flow
  - for feed - good - near feed storage area
  - for labour - good - access from road and laneway
- Expansion opportunities - good - room to the west to expand
- Visibility - good from both milking shed and farmhouse
- Water supply - good - near existing trough line
- Environment - no waterways or native vegetation
- Neighbours - 400 m away from neighbour
- Prominence - off the road and behind dirt mounds
- Shading - ample already on other parts of farm
- Prevailing winds - nothing downwind for northerly and southwesterly winds
- Topography - elevation and gradient provide for adequate drainage
- Soils - soil type is 'Muckatah Clay', a clay dominant soil with a very low permeability in the subsoil and is suitable for storage and pad construction purposes
- Groundwater - 4.5 metres below the site which is adequate for the depth (2.0 m below natural surface) of associated storages
- Flooding - check 1 in 100 year flood overlay with GBCMA
- Liquid Waste - while limited runoff is anticipated, any runoff will be directed to the irrigation reuse dam adjacent to the feedpad
- Liquid Waste Reuse - directly linked to irrigation reuse system
- Solid Waste Reuse - spread on pasture paddocks

19.7 Buffers

Stocking Intensity Factor – S1

99 DCUs for 0.52 ha equates to 52m^2/DCU and the S1 Factor is then determined from Appendix H. For a dirt pad cleaned annually (the worst case scenario has been adopted here as the pad is cleaned approximately every 3 months) at the lowest stocking rate, the S1 Factor is 37.

Separation Distances and Receptor Factor – S2

The nearest receptor to the feedpad is a single residence located 400 m away. This type of receptor is designated an S2 Factor of 1 from Appendix H.

Terrain Factor - S3

The topography of the site is flat and is therefore designated an S3 Factor of 1 from Appendix H.

Vegetation Factor – S4

Areas surrounding the feedpad site would be classified as having no tree cover and would therefore be designated an S4 Factor of 1 from Appendix H.

Buffer Distance Calculations

The required data collaborated to calculate the buffer distance is as follows;

- DCU = 99
- S1 Factor = 37
- S1 Factor = 1
- S1 Factor = 1
- S1 Factor = 1

Composite S Factors
- S1 x S2 x S3 x S4 = 37

Distance -S x $\sqrt{DCU}$ = 368 m

The feedpad should be located more than 369m from the nearest receptor, the single residence.

19.8 Design

Pad Slope

The sides of the pad have a slope of 6.3% and the drain between the pads has a slope of 0.2%.

Troughs

The troughs are constructed from red gum planks (measuring approximately 200 x 75 mm by 2.85 m long or 1.5 x 8 in by 9.5 feet) laid on their sides to form a trough approximately 1 metre (3 foot) wide and 200 mm deep. The planks are joined by 4 mm steel plate brackets and are braced with galvanised pipe in the centre of the trough. An electric wire is placed 1 m above the troughs. A total trough length of 197 m with access from both sides provides 790 mm of trough length per cow for the 500 cows.

Sizing

Laneways are 8.5 metres wide, gateways are 4.5 metres wide and the cows do not have to turn more than 90^o to access and exit the feedpad. The entire feedpad area covers 0.88 ha, which allows 17m^2 per cow however, the actual pads cover an area of 0.52 ha, which allows 10.4m^2 per cow.

Location/Access

The feedpad is located 90m from the dairy, 150 m from the house and adjacent to the farm central laneway, feed storage area and several irrigation reuse dams.

19.9 Estimated Liquid Effluent Storage Sizing

Rainfall Runoff

To determine the size of the effluent pond required for the feedpad, the runoff for a 1 in 20 year 24 hour storm event needs to be determined. The estimated storage volume required is calculated as follows:

$$Q = [\,[(Af + Ab) \times (Rf \times Ro) \times Fs] + (As \times Rf)\,] / 1000$$

Where:

Q = volume (m^3)
Af = Area of actual pad (m^2)
Ab = Balance of catchment area (m^2)

Rf = 80% of the 1 in 20 years 24 hour rainfall event
Ro = Runoff coefficients for a dirt pad
> 600 mm per annum = 0.40

501 - 600 mm = 0.35
400 - 500 mm = 0.30
< 400 mm = 0.25

Fs = Safety Factor of 1.25
As = Area of storage (m^2)

The area of the actual pad is 0.52 ha, areas surrounding the pad total 0.46 ha and the feed storage area covers 0.91 ha. The feedpad is a dirt pad and is in a 400 - 500 mm per annum rainfall area and therefore has a coefficient of 0.3. The effluent storage covers an area of 40m by 40 m or 1,600m^2. From Appendix J, an interpolated value for the 24 hour rainfall 20 year recurrence interval for this area is 90 mm

We therefore end up with:
Q = volume (m^3)
Af = 5,200 m^2
Ab = 13,700 m^2
Rf = 80% of the 90 mm = 72 mm
Ro = 0.30
Fs = 1.25
As = 1,600 m^2

The calculation is then:

$$Q = [[(5{,}200 + 13{,}700) \times (72 \times 0.3) \times 1.25] + (1{,}600 \times 72)] / 1000$$

$$Q = [[18{,}900 \times 21.6 \times 1.25] + 115{,}200] / 1000$$

$$Q = 625{,}500 / 1000 = 625.5\ m^3$$

Therefore a storage with an estimated volume of 626 m^3 or 0.63 ML is required.

Flood Washing
There will we no flood washing system.

Winter Storage
As any liquid waste is reused as irrigation, storage volume needs to be provided for the winter period when irrigation will not be feasible. By referring to the Rainfall and Evapotranspiration graphs in Appendix J and allowing for the warmer climate it is determined that rainfall exceeds evapotranspiration for 6 months of the year for perennial pasture. To calculate the rainfall runoff from the feedpad and feedpad works area over this period, the default figure used is 20% of the runoff from a 1 in 20 year 24 hour storm event per month or:

6 x 0.2 x 0.63 = 0.76 ML

Total Volume
An estimated total effluent storage volume of 0.76 + 0.63 = 1.4 ML is required. The existing adjacent irrigation reuse and effluent dam is 1.5ML which is adequate.

19.10 Estimated Solid Manure Generation

Based on the default values of:
- 500 kg dairy cow fed on harvested feed
- Raw manure - 40 kg/cow/day
- Solids - 4.2 kg/cow/day

adjusted for the apportionment of time (4.5 hours on the pad) and the proportionate weight (600kg) of cows

- Raw manure- 9 kg/cow/day
- Solids - 0.95 kg/cow/day

In this case where the 500 cows occupy the pad for 365 days of the year, this equates to approximatelly 1600 tonnes of raw manure or 170 tonnes of solids.

The solids collected from scraping the feedpad will be placed directly in a small tip-truck with a front-end loader and spread over the pasture paddocks.

Estimated Nutrient Generation
Default figures for production of nutrients of dairy cattle for a 500 kg animal are as follows:
N = 0.225 kg/day
P = 0.047 kg/day
K = 0.145 kg/day

For the 600 kg animals we are dealing with in this case the values would be:
N = 0.270 kg/day
P = 0.056 kg/day
K = 0.174 kg/day

Based on the apportionment of time where the cows spend 4.5 hours on the pad the values would be:
N = 0.05 kg/day
P = 0.011 kg/day
K = 0.033 kg/day

Where the 500 cows occupy the pad for 365 days of the year the estimated total nutrients produced per annum therefore equate to:
N = 9000 kg of N
P = 2000 kg of P
K = 6000 kg of K

Nutrient Budget
A typical dairy pasture producing 10t of dry matter/ha will use the following nutrients:

N Removal (kg/ha/yr.)	P Removal (kg/ha/yr.)	K Removal (kg/ha/yr.)
400	40	200

Therefore based on the estimated nutrient generation of the feedpad, the following areas will be required to reuse the manure generated:
N = 9000 = 22 ha
P = 2000 = 50 ha
K = 6000 = 30 ha

Therefore the solids need to be spread over 50 ha of pasture to allow for the reuse of all the nutrients and especially the phosphorus. The farm consists of 100 ha of pasture providing ample area to reuse the wastes.

19.11 Water Supply

The existing two troughs will be increased to four troughs to cater for stock drinking requirements and these will have a total capacity of 6,000 L or 12 L/cow for the 4.5 hours which equates to 64 L/cow/day. This water is accessed from the existing paddock trough supply system.

19.12 Feed Storage & Supply

Adequate area is provided to store and supply feed based on each cow consuming 4 kg/head/day of feed on the feedpad. The feed is stored on a raised rock base, covered with plastic and is vermin and weather proof. Any runoff from the feed storage area is directed to the effluent pond via bunding. The feed storage area is cleaned on a regular basis (every 3 months minimum).

19.13 Landscaping

A mound of soil obscures the facility from the public road located 200 meters to the west of the site. Native trees have been established on the perimeter of the facility.

19.14 Detailed Drawing

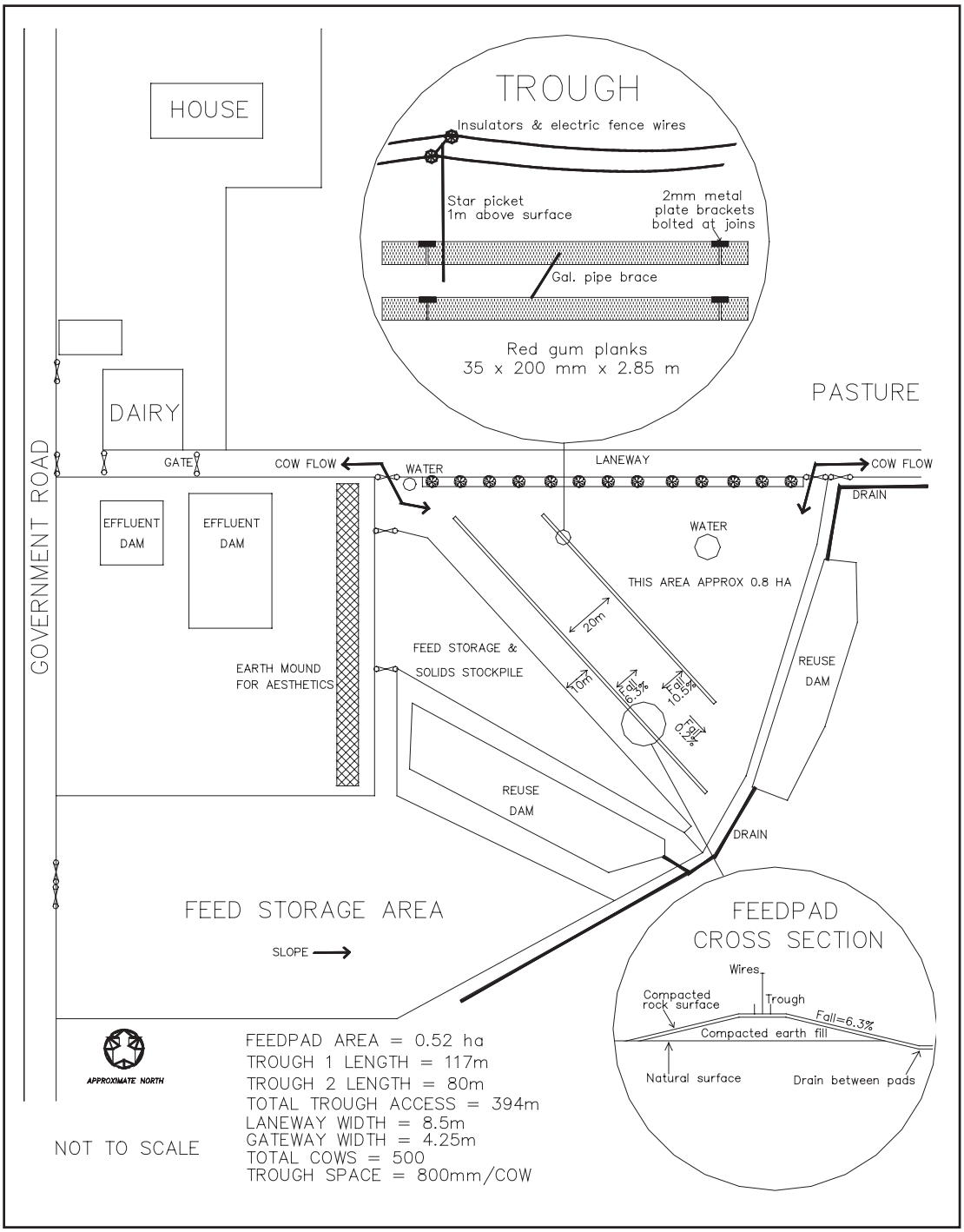


Figure 14: *Feedpad Drawing - See Figure 20 for an example of an appropriate detailed feedpad drawing and refer to section 10.4 for details to include in the feedpad drawing.*

19.15 Application to Municipal Council

The feedpad is in a Rural Zone and is not affected by any overlays however, the 1 in 100 year flood overlay should be checked as mentioned previously. If a propsal similar to this was lodged to the Municipal Council today, a planning permit would be required if the associated earthworks were going to affect flooding or discharge from the property, however, this would be at the discretion of the Municipal Planning Officer.

19.16 Approval

If a proposal for this feedpad was assessed under these new Guidelines, the feedpad would be acceptable providing the adjacent irrigation reuse dam was constructed as a 1.12 ML turkey's nest effluent dam separate from the irrigation reuse system. This should then have a provision to transfer effluent to the irrigation recycle system. The dam that is currently adjacent to the feedpad is actually part of the irrigation reuse system.

This is not of concern to the owner as very little runoff has been observed from the pad and this is put down to the very absorptive nature of cow manure. Small areas of ponding in the cow manure can occur at the low end of the feedpad. If any runoff did occur it would end up in the adjacent irrigation reuse system and would then be reapplied to pasture as irrigation.

19.17 Feedpad Management

While not part of an application for approval to construct, some of the management practices associated with this feedpad could be of interest.

Benefits

The cows are fed a ration of silage, hay, whey concentrate and some orange peel on the feedpad and get the majority of their daily requirements from the dairy supplementary feeding system and from the feedpad.

Because the cows know the feed is there, they are not 'herded' but come up to the feedpad of their own accord, saving on labour and cow stress.

The feedpad is considered a very useful 'buffer' between the dairy and the pasture paddocks and is used to observe the herd or to access cows for treatment or heat detection.

Little trouble has been experienced with lameness and mastitis levels are very low (in the last 180 days BMCC did not exceed 120,000). It is preferred that the cows do not sit down while on the feedpad and therefore the cows are not left on the feedpad for prolonged periods.

If clean feed is used the feed troughs rarely require cleaning - on the rare occasion when cleaning has been required, the troughs are cleaned out using a pitchfork prior to pad scraping.

The slope on the feedpad (6.3%) provides for the movement of manure away from the feed troughs by the action of the cows hooves keeping the trough relatively manure free (see Figure 15).

The majority of solids are removed in late summer and early autumn when the manure is a dry 'free running' dust that is relatively easy to handle.

Problems

A recent change in feed type to a ration with higher levels of sodium, has meant a bigger demand for water and additional troughs are required.

An original silage wagon with large tyres had good flotation however, to provide for the mixing of feed and especially for adding protein to feed, a new feed wagon was purchased.

The combination of additional weight, standard tyres and the extra power required to drive the wagon, has necessitated a firm and even feedpad surface and suitable tractor to prevent flotation problems.

Scraping the feedpad surface correctly is critical in maintaining the pad surface.
The slope on one part of the feedpad (10.5%) is too steep and the feed wagon slides sideways down the slope when conditions are wet.

Provision needs to be made for the shrink/swell potential of the wooden planks used for the troughs.

It was found if spilt feed was not cleaned away from the front of the troughs, the pressure the cows exert, forces moisture and the spilt feed under the planks and causes them to lift. Using good quality feed has prevented this problem.

Figure 15: *Feedpad (due for scraping) showing manure moved away from trough by cows.*

20.0 Case Study "D"

20.1 Snapshot

Cow Numbers	550
Production	7000 L/Cow
Stocking Rate	4.5 cows / ha
Feedpad	Formed, concreted and flood washed
Feedpad Use - Daily	3 hours a day
Feedpad Use - Annually	All year round

Figure 16: *View from the top of the 200 m long concrete feedpad.*

20.2 Initial Clarification

- The feedpad is in the Goulburn Broken Catchment
- The feedpad fits the Guidelines definition
- The feedpad is not in a Declared Special Water Supply Catchment
- The feedpad will house more than 50 and less than 5,000 head

20.3 Animal Loading

The feedpad loading needs to be determined to calculate buffer distances. This calculation requires:

- The number of dairy cows' on the feedpad = 550
- The average weight of dairy cows on the feedpad = 550 kg
- The duration the diary cows' are located on the pad = 3.0 hrs

The number of DCU's is then calculated by the number of cows, multiplied by a weight conversion factor multiplied by the fraction of the day that the cows occupy the pad (refer to Appendix E).

550 x 1.0 x (3/24) = 69 DCU

20.4 Feedpad Details

All dimensions and volumes of the feedpad are provided on the detailed plans in Section 20.14 "Detailed Drawing".

It is estimated that the feedpad has a lifespan of at least 20 years.

The feedpad is categorised as a 'paved pad' as per the categories listed in these Guidelines in Appendix C.

20.5 Feedpad Cleaning

The feedpad is flood washed once a day with 50,000 litres of fresh water from a tank located at the top of the pad. 4 x 300 mm diameter plastic pipes, 2 per side, deliver this flood washing water to the feedpad and these are operated by manual gate valves. Solids are collected in a solids trap, which is cleaned out approximately once every 4 months.

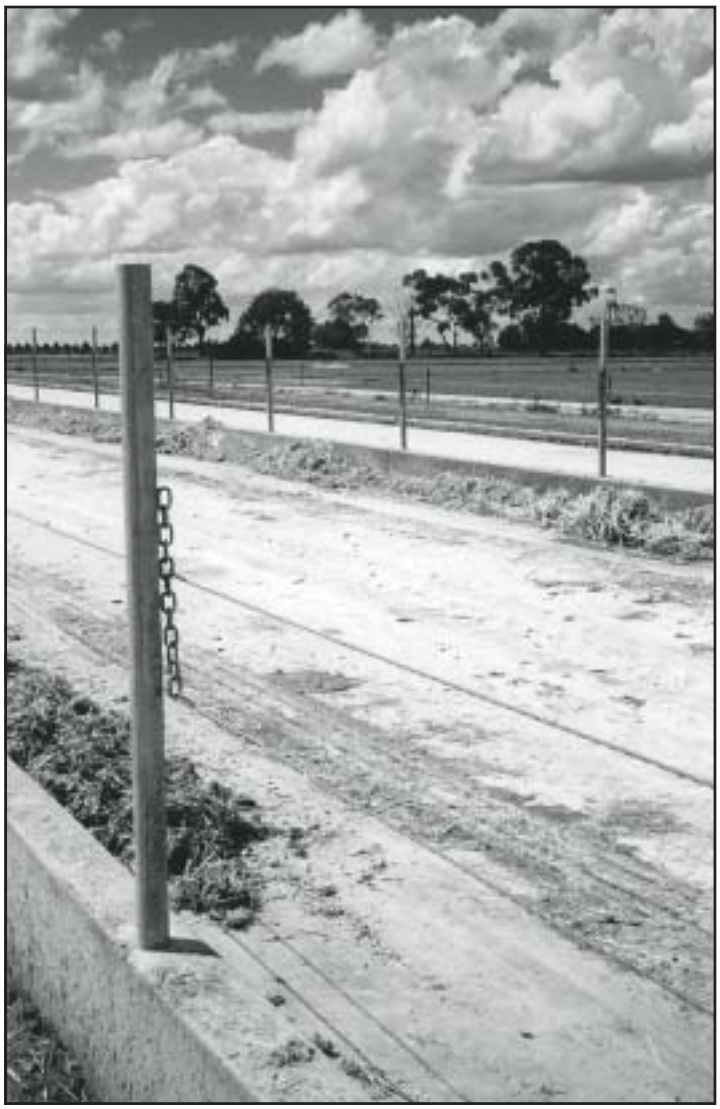


Figure 17: *Concrete feedpad showing feed bay with cable and chain restraints.*

These solids are spread directly onto the farms 100 ha of pasture and there is ample area set aside for stockpiling solids should this be required. Liquid effluent is stored in the adjacent 7 ML effluent pond prior to transferal to the irrigation reuse dam for dilution and application to pasture.

20.6 Feedpad Siting

Considerations for the siting of the feedpad include:

• Access for cows	-	good - near milking shed & central laneway - good cow flow
• Orientation	-	north/south
• Visibility	-	good from both milking shed and farmhouse
• Water supply	-	good - near existing fresh water line
• Environment	-	no waterways or native vegetation
• Neighbours	-	350 m away from neighbour
• Prominence	-	set back off roads in the centre of the property
• Prevailing winds	-	nothing downwind for southwesterly winds
• Topography	-	has been significantly modified
• Soils	-	soil types are 'Lemnos Loam' and 'Goulburn Loam' clay dominant soils with low permeability in the subsoil, which will help prevent groundwater contamination, and these soils are suitable for storage and pad construction purposes.
• Groundwater	-	2.5 metres below the site which is adequate for the depth (2.1 m below natural surface) of associated storages
• Flooding	-	outside 1 in 100 year flood overlay
• Liquid Waste Reuse	-	flows to effluent sump adjacent to the irrigation reuse dam
• Solid Waste Reuse	-	this central site is adjacent to surrounding pasture paddocks

20.7 Buffers

Stocking Intensity Factor – S1

69 DCU for the 2,000m^2 that constitutes the actual stocked area of the pad, equates to 29m^2/DCU and the S1 Factor is then determined from Appendix H. For a paved pad flood washed daily at the proposed stocking rate, the S1 Factor is 21.

Separation Distances and Receptor Factor – S2

The nearest receptor to the feedpad is a single residence located 350 m away. This type of receptor is designated an S2 Factor of 1 from Appendix H.

Terrain Factor - S3

The topography of the site is flat and is therefore designated an S3 Factor of 1 from Appendix H.

Vegetation Factor – S4

Areas surrounding the feedpad site would be classified as having no tree cover and would therefore be designated an S4 Factor of 1 from Appendix H.

Buffer Distance Calculations

The required data collaborated to calculate the buffer distance is as follows;

• DCU	=	69
• S1 Factor	=	21
• S1 Factor	=	1
• S1 Factor	=	1
• S1 Factor	=	1
• Composite S Factors = S1 x S2 x S3 x S4	=	21
• Distance = S x $\sqrt{DCU}$	=	174 m

The feedpad should be located more than 174 m from the nearest receptor, the single residence. It is a recommendation that a feedpad should be located at least 300m from any neighbouring residence and therefore this default value applies.

20.8 Design

All design details are provided on the detailed plans in Section 20.14 "Detailed Drawing".

Surface

Various sections of the pad have various slopes however, the main part of the pad has a slope of 1.0%. The concrete surface has a relatively rough finish but is not grooved or scored.

Feed Bay

The feed bay is 6 m wide and has a slope of 3.3% into the center to provide drainage. 400 mm diameter, 1.8m galvanised pipe poles spaced every 5.0 m support two steal cables by a chain welded to the posts. The total trough length of 200 m with access from both sides provides 720 mm of trough length per cow for the 550 cows.

Sizing

Laneways and gateways are 8.5 metres wide and the cows do not have to turn more than 90° to access and exit the feedpad. The concrete feedpad area available for the cows, along with the loafing areas covers 0.48 ha, which allows 8.7m^2 per cow however, the actual concrete pad available for the cows covers 0.2 ha, which allows 3.6m^2 per cow.

Location/Access

The feedpad is located 10m from the dairy yard and 300 m from the house and is adjacent to the farm central laneway. The feed storage area is located 200m away from the feedpad.

20.8 Estimated Liquid Effluent Storage Sizing

Rainfall Runoff

To determine the size of the effluent pond required for the feedpad, the runoff for a 1 in 20 year 24 hour storm event needs to be determined. The estimated storage volume required is calculated as follows:

$$Q = [\ [(Af + Ab) \times (Rf \times Ro) \times Fs\ ] + (As \times Rf)] / 1000$$

Where:

Q = volume (m^3)
Af = Area of actual pad (m^2)
Ab = Balance of catchment area (m^2)
Rf = 80% of the 1 in 20 years 24 hour rainfall event
Ro = Runoff coefficients for a dirt pad

> 600 mm per annum	= 0.40
501 - 600 mm	= 0.35
400 - 500 mm	= 0.30
< 400 mm	= 0.25

Runoff coefficient for a concrete pad*	= 0.6-0.8
Runoff coefficient for a roofed pad	= 0.9

Fs = Safety Factor of 1.25
As = Area of storage (m^2)

* *The runoff coefficient for a concrete pad assumes the presence of indentaitons and absorbent material on the surface and the actual coefficient used between this range should reflect the degree of indentaitons and abosrbent material present.*

The area of the actual pad is 0.32 ha and the areas surrounding the pad total 0.88 ha. The feedpad is in a 400 - 500 mm per annum rainfall area and has a relatively rough concrete surface and therefore a runoff coefficient of 0.6 is adopted. The effluent storage covers an area of 25m by 250 m or 6,250m^2. From Appendix J, an interpolated value for the 24 hour rainfall 20 year recur-rence interval for this area is 90 mm We therefore end up with:

Q = volume (m^3)
Af = 3,200 m^2
Ab = 8,800 m^2
Rf = 80% of the 90 mm = 72 mm

Ro = 0.60
Fs = 1.25
As = 6,250 m^2

The calculation is then:

$$Q = [[(3,200 + 8,800) \times (72 \times 0.6) \times 1.25] + (6,250 \times 72)] / 1000$$

$$Q = [[12,000 \times 43.2x \, 1.25] + 450,000] / 1000$$

$$Q = 1,098,000 / 1000 = 1098 \, m^3$$

Therefore a storage with an estimated volume of 1098 m^3 or 1.1 ML is required.

Flood Washing

The flood washing system adds another 50,000 litres/day or 1.5 ML per month. While this water is not sourced from existing effluent water as yet, it is proposed to be in the future. The flood washing system volume then needs to be totaled for the period when wastes need to be stored, in this case this period is 8 months.

The calculation is then;

$$50,000 \times (30 \times 8) / 1,000,000 = 12 \text{ ML}$$

Therefore the storage needs to accom-modate the 12 ML of liquid generated by the flood wash system over winter.

Winter Storage

As any liquid waste will be reused as irrigation, storage volume needs to be pro-vided for the winter period when irrigation will not be feasible.

By referring to the Rainfall and Evapo-transpiration graphs in Appendix K and it is determined that rainfall exceeds evapo-transpiration for 8 months of the year for perennial pasture. To calculate the rainfall runoff from the feedpad and feedpad works area over this period, the default figure used is 20% of the runoff from a 1 in 20 year 24 hour storm event per month or

$$8 \times 0.2 \times 1.1 = 1.76 \text{ ML}$$

Total Volume

An estimated total effluent storage volume of:

Rainfall Runoff	1.1 ML
Flood Washing System	12.0 ML
Winter Storage	1.76 ML

Total Effluent Storage Required = 14.86 ML

The proposed effluent storage requires an estimated volume of 14.9 ML. When the feedpad is flood washed using recycled water, the required estimated volume would be reduced significantly to 2.9 ML.

The effluent storage dam has a volume of 7 ML and the remaining 7.9 ML will be transferred to the adjoining recycle dam which has a volume of 12 ML.

20.10 Estimated Solid Manure Generation

Based on the default values of:

- 500 kg dairy cow fed on harvested feed
- Raw manure- 40 kg/cow/day
- Solids - 4.2 kg/cow/day

adjusted for the apportionment of time (3 hours on the pad) and the proportionate weight (550 kg) of cows.

Raw manure	-	5.5 kg/cow/day
Solids	-	0.58 kg/cow/day

In this case where the 550 cows occupy the pad for 365 days of the year, this equates to an estimated 1,100 tonnes of raw manure and an estimated 100 tonnes of solids per annum.

The solids are collected from the solids trap and spread over the pasture paddocks.

Estimated Nutrient Generation

Default figures for production of nutrients of dairy cattle for a 500 kg animal are as follows:

N = 0.225 kg/day
P = 0.047 kg/day
K = 0.145 kg/day

Figure 18: *Drinking water trough, flood wash outlets and flood washing system tank at top of pad.*

For the 550 kg animals we are dealing with in this case the values would be:
N = 0.248 kg/day
P = 0.052 kg/day
K = 0.16 kg/day

Based on the apportionment of time where the cows spend 3 hours on the pad the values would be:
N = 0.031 kg/day
P = 0.0065 kg/day
K = 0.02 kg/day

Where the 550 cows occupy the pad for 365 days of the year the estimated total nutrients produced per annum equates to:
N = 6000 kg of N
P = 1300 kg of P
K = 4000 kg of K

Nutrient Budget
A typical dairy pasture producing 10t of dry matter/ha will use the following nutrients;

N Removal (kg/ha/yr.)	P Removal (kg/ha/yr.)	K Removal (kg/ha/yr.)
400	40	200

Therefore based on the estimated nutrient generation of the feedpad, the following areas will be required to reuse the manure generated:
N = 6,000 = 15 ha
P = 1300 = 336 ha
K = 4000 = 20 ha

Therefore, all wastes from the feedpad need to be spread over 33 ha of pasture to allow for the reuse of all the nutrients and especially the phosphorus.

The farm consists of 120 ha of pasture, 90 ha on which the solids are reused and 30 ha that is accessible from the irrigation recycle system on which the liquid wastes are reused.

This provides ample land on which to reuse the wastes from the feedpad.

20.11 Water Supply

Eight troughs have been installed to cater for stock drinking requirements and these have a total capacity of 5,600 L or 10 L/cow for the 3 hours which equates to 80 L/cow/day. This water is accessed from the existing paddock trough supply system.

Figure 19: *Solid traps and effluent storage in background*

20.12 Feed Storage & Supply

Adequate area is provided to store and supply feed based on each cow consuming 4 kg/head/day of feed on the feedpad.

The feed is stored on a raised rock base, covered with plastic and is vermin and weather proof. Any runoff from the feed storage area is directed to the irrigation reuse system. The feed storage area is cleaned on a regular basis (every 3 months minimum).

20.13 Landscaping

Native trees will be established on the perimeter of the facility, but will be set back an adequate distance to prevent shade causing the development of damp areas on the pad.

20.14 Detailed Drawing

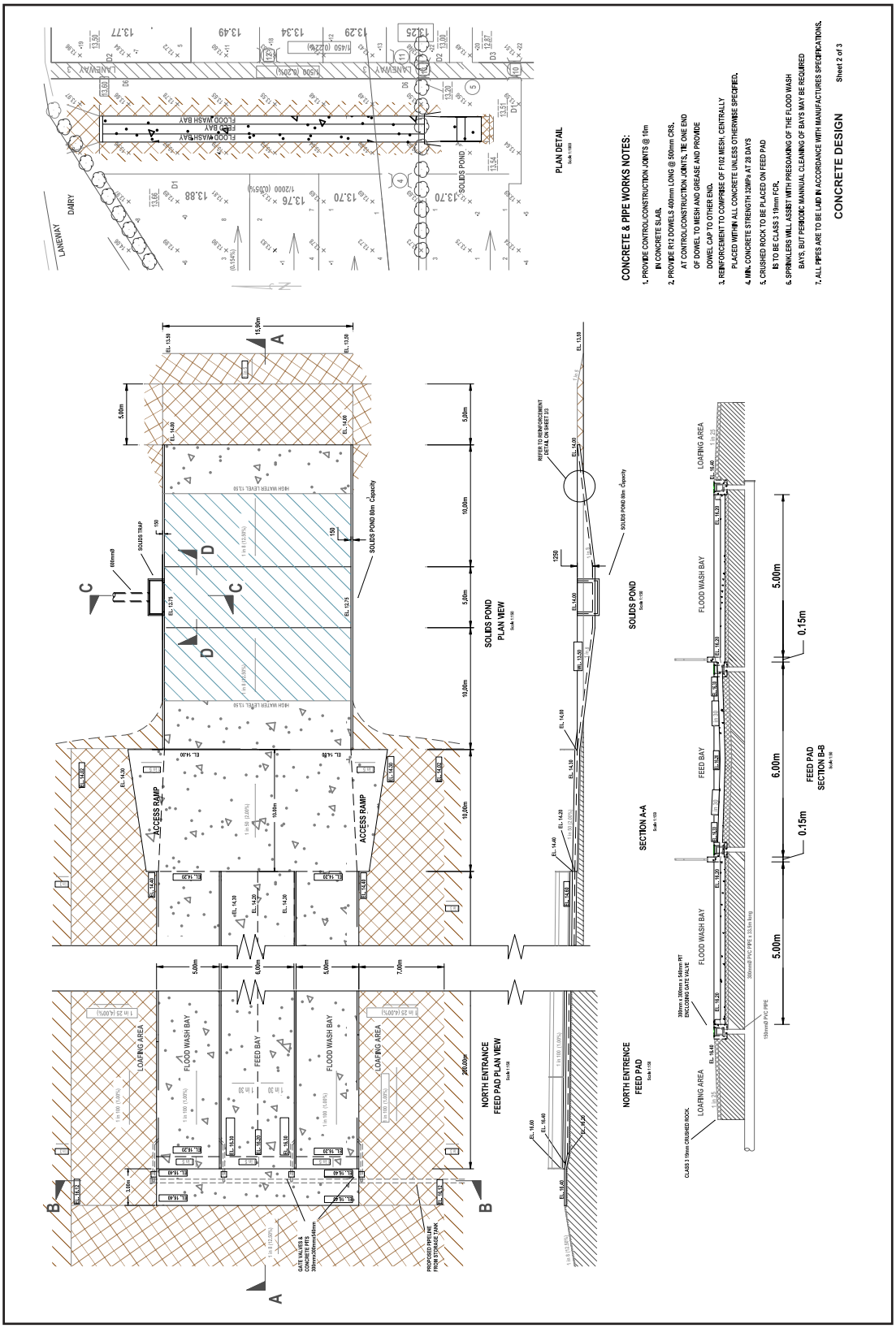
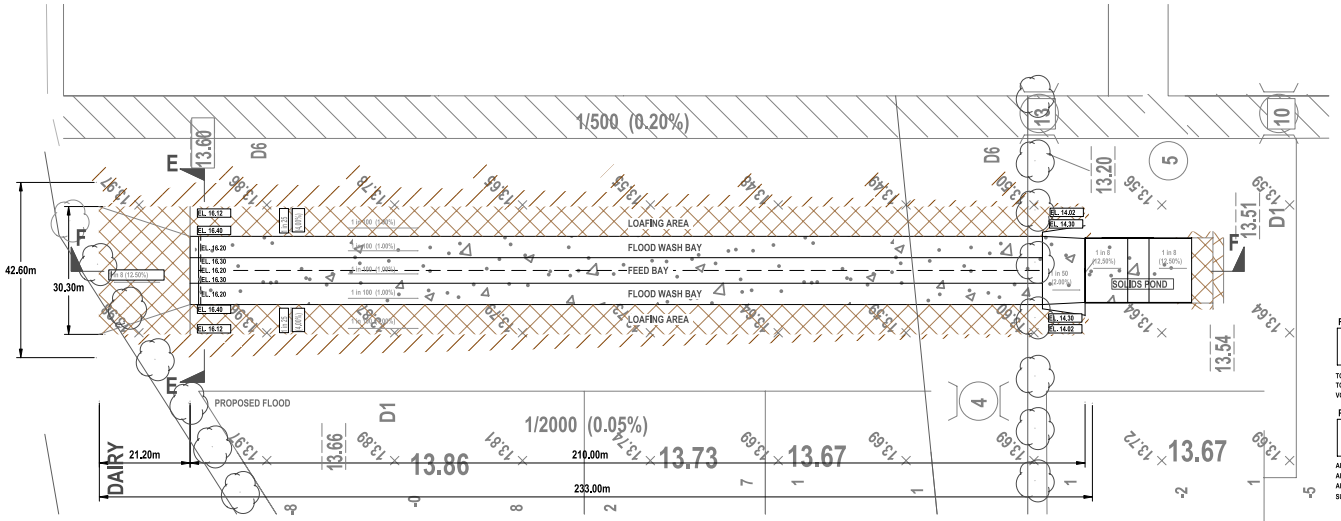
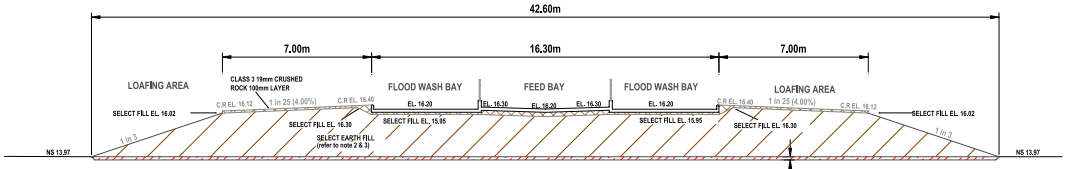


Figure 20: *Feedpad Drawing - These plans provide a good example of the level of detail that should be included in a feedpad plan.*



PROPOSED FEED PAD
DIMENSIONS
Scale 1:500

FEED PAD
SECTION F-F
Scale 1:500



FEED PAD
SECTION E-E
Scale 1:100

EARTHWORK NOTES:

1. ALL VOLUMES SHOWN HAVE BEEN CALCULATED WITH A COMPACTION RATIO (For every metre of Solid FILL = 1.3 metres of excavation).
2. FEED PAD EARTH MATERIAL SHALL BE PLACED AND COMPACTED IN LAYERS NOT EXCEEDING 150mm LOOSE THICKNESS FOR THE FULL WIDTH OF PAD.
3. PAD LAYERS SHALL BE COMPACTED AT A MINIMUM DRY DENSITY OF AT LEAST 98% OF STANDARD MAXIMUM DRY DENSITY OF THE MATERIAL USED AT A MOISTURE CONTENT BETWEEN 1% DRY & 2% WET OF OPTIMUM WHEN DETERMINED IN ACCORDANCE WITH AS1289.E.7.1 & AS1289.E.3.1
4. CRUSHED ROCK TO BE PLACED ON FEED PAD IS TO BE CLASS 3 19mm FCR.

FEED PAD VOLUME

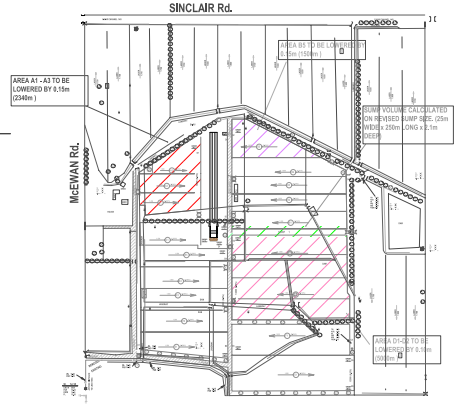
FEED PAD	CRUSHED ROCK (m^3)	EARTH FILL (m^3)	TOP SOIL STRIPPING (m^3)	TOTAL VOLUME REQUIRED (m^3)
	690	11630	1310	12940

TOP SOIL STRIPPING TO FROM FEED PAD FOOT PRINT TO BE PLACED IN AREAS A, B, D
TOP SOIL STRIPPING TO BE A MINIMUM 0.15m IN DEPTH OVER FOOTPRINT OF FEED PAD
VOLUMES ARE CALCULATED AS SOLID VOLUMES (COMPACTION 1.3:1)

POTENTIAL BORROW VOLUMES

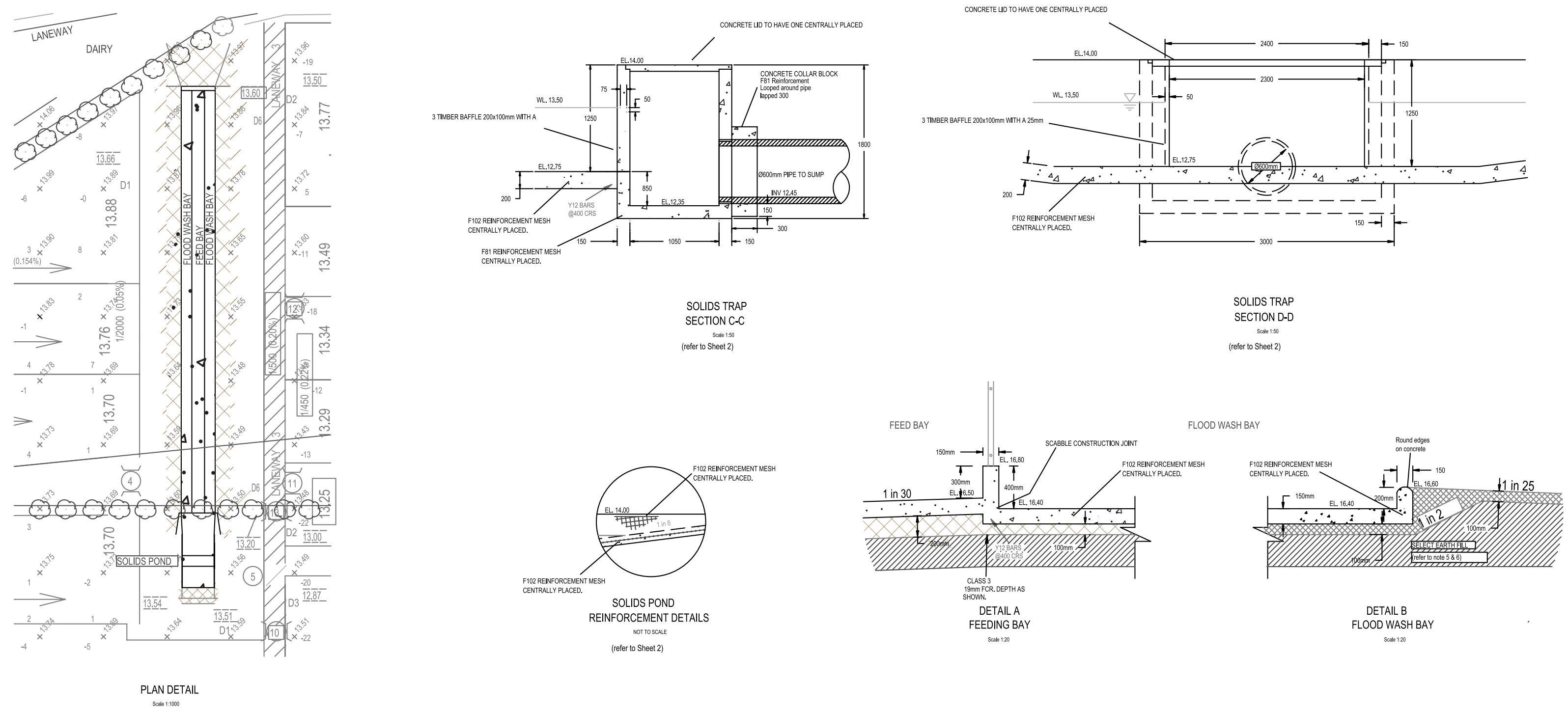
BORROW	REUSE SUMP (m^3)	AREA A1-A3 (m^3)	AREA B5 (m^3)	AREA D1-D2 (m^3)	TOTAL
	8000	2340	1500	5000	16840

AREA A1 - A3 TO BE LOWERED BY 0.15m (2340m)
AREA B5 TO BE LOWERED 0.15m (1500m)
AREA D1 - D2 TO BE LOWERED BY 0.10m (5000m)
SUMP VOLUME CALCULATED ON REVISED SUMP SIZE. (25m WIDE x 250m LONG x 2.1m DEEP)



LOCALITY PLAN
Scale 1:5000

EARTHWORKS DESIGN Sheet 1 of 3



CONCRETE WORK NOTES:

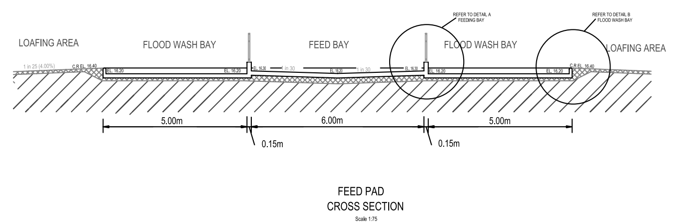
1. PROVIDE CONTROL/CONSTRUCTION JOINTS @ 10m IN CONCRETE SLAB.
2. PROVIDE R12 DOWELS 400mm LONG @ 500mm CRS. AT CONTROL/CONSTRUCTION JOINTS. TIE ONE END OF DOWEL TO MESH AND GREASE AND PROVIDE DOWEL CAP TO OTHER END.
3. REINFORCEMENT TO COMPRISE OF F102 MESH, CENTRALLY PLACED WITHIN ALL CONCRETE UNLESS OTHERWISE SPECIFIED.
4. MIN. CONCRETE STRENGTH 32MPa AT 28 DAYS
5. CRUSHED ROCK TO BE PLACED ON FEED PAD IS TO BE CLASS 3 19mm FCR.
6. SPRINKLERS WILL ASSIST WITH PRESOAKING OF THE FLOOD WASH BAYS, BUT PERIODIC MANNUAL CLEANING OF BAYS MAY BE REQUIRED

Concrete Volumes

	Cross-sectional Area (m^2)	Distance(m)	Volume of concrete (m^3)
Flood wash And Feeding Bay	2.55	200	510
North Access Ramp	0.76	16.3	12.4
Solids Pond Base	3.12	25	78
Solids Pond Walls			7.0
South Access Ramp			39
		Total volume of concrete	646

Mesh Reinforcement Area

	Type of mesh	Area (m^2)
Flood wash And Feeding Bay	F102	4460
North Access Ramp	F81	48.9
Solids Pond Base	F102	397.5
Solids Pond Walls	F102	46.6
South Access Ramp	F102	194.2
	Approximate Area of Mesh	
	F81	49
	F102	5098



CONCRETE DETAILS Sheet 3 of 3

20.15 Application to Municipal Council

The feedpad is in a Rural Zone and is not affected by any overlays. If a proposal similar to this was lodged to the Municipal Council today, a planning permit would be required if the assoicated earthworks were going to affect flooding or discharge from the property, however, this would be at the discretion of the Municipal Planning Officer.

20.16 Approval

If this proposal for a feedpad were assessed under these new Guidelines, the feedpad would be acceptable.

20.17 Feedpad Management

While not part of an application for approval to construct, some of the management practices associated with this feedpad could be of interest.

Benefits

- Improved cow health, especially mastitis
- Improved utilisation of supplementary feed

Problems

The restrictive chains along the feed bay are wearing where the cable goes through them. By changing the chain link through which the cable runs, this problem will most likely be rectified.

21. 0 Case Study "E"

Figure 21: *View from the bottom of the free stall barn. Feed bay on left, cow alley and cow stalls on right.*

21.1 Snapshot

Cow Numbers	750
Production	7000/Cow
Stocking Rate	2.8 cows / ha
Feedpad	Free-stall barn, concreted and roofed
Feedpad Use - Daily	16 hrs/day
Feedpad Use - Annually	All year round

21.2 Initial Clarification

- The feedpad is in the Goulburn Broken Catchment
- The feedpad fits the Guidelines definition
- The feedpad is not in a Declared Special Water Supply Catchment
- The feedpad houses more than 50 and less than 5,000 head

21.3 Animal Loading

The feedpad loading needs to be determined to calculate buffer distances.

This calculation requires:

- The number of dairy cows' on the feedpad = 750
- The average weight of dairy cows on the feedpad = 550 kg
- The duration the dairy cows' are located on the pad = 16.0 hrs

The number of DCU's is then calculated b y multiplying the number of cows, by a weight conversion factor multiplied by the fraction of the day that the cows occupy the pad (refer to Appendix E).

750 x 1.0 x (16/24) = 500 DCU

21.4 Feedpad Details

All dimensions and volumes of the feedpad are provided on the feedpad plan in figures 26 and 27. It is estimated that the feedpad has a lifespan of at least 50 years.

The feedpad is categorised as a 'roofed pad' as per the categories listed in these Guidelines in Appendix C.

21.5 Feedpad Cleaning

The feedpad is scraped daily using an old tyre mounted to the front of a bobcat. The feedpad is then flood washed once a day with up to 0.17 ML 170,000 litres) (depending on requirements) of water supplied from a tank located at the top of the feedpad. A 450 mm pipe supplies the water to air operated 'truck air bag' valves located at the top of each bay. One flood washing event is carried out by opening the valve at the top of the bay for 20 seconds, and this may be repeated up to 304 times to facilitate effective washing. The feed bay in the centre of the shed is scraped daily and is not flood washed.

Solids are removed in a solids trap which is cleaned out once a month. These solids are then spread directly onto the farms 480 ha of pasture and there is ample area set aside for stockpiling solids should this be required. Liquid effluent is be stored in the adjacent 25 ML effluent pond prior to transferal to an 80 ML irrigation reuse dam for dilution and application to pasture.

21.5 Feedpad Siting

Considerations for the siting of the feedpad include:

• Access for cows	-	good - near milking shed & central laneway - good cow flow
• Orientation	-	east west to provide maximum shading from summer sun
• Visibility	-	good from the milking shed
• Water supply	-	good - near existing fresh water line
• Environment	-	no waterways or native vegetation
• Neighbours	-	1,000 m away from neighbour
• Prominence	-	set back off road behind dairy
• Prevailing winds	-	nothing downwind for northerly or southwesterly winds
• Topography	-	has been significantly modified
• Soils	-	soil types are 'Goulburn Loam' and 'Lemnos Loam' which are clay dominant soils with low permeability in the subsoil and are suitable for storage and pad construction purposes
• Groundwater	-	2.5 metres below the site which is adequate for the depth (2.0 m below natural surface) of associated storages
• Flooding	-	outside 1 in 100 year flood overlay
• Liquid Waste Reuse	-	flows to 25 ML effluent pond adjacent to 80ML irrigation reuse dam
• Solid Waste Reuse	-	this central site is adjacent to surrounding pasture paddocks

Figure 22: *The bobcat with an old tyre used for scraping the bays prior to flood washing.*

21.7 Buffers

Stocking Intensity Factor – S1

500 DCU for the 0.64 ha that constitutes the actual stocked area of the pad, equates to 12.8m^2/DCU and the S1 Factor is then determined from Appendix H. For a roofed pad flood washed daily at the proposed stocking rate, the S1 Factor is 19.6 (interpolated value).

Separation Distances and Receptor Factor – S2

The nearest receptor to the feedpad is a single residence located 1,000 m away. This type of receptor is designated an S2 Factor of 1 from Appendix H.

Terrain Factor - S3

The topography of the site is flat and is therefore designated an S3 Factor of 1 from Appendix H.

Vegetation Factor – S4

Areas surrounding the feedpad site would be classified as having no tree cover and would therefore be designated an S4 Factor of 1 from Appendix H.

Buffer Distance Calculations

The required data collaborated to calculate the buffer distance is as follows:

- DCU = 500
- S1 Factor = 19.6
- S1 Factor = 1
- S1 Factor = 1
- S1 Factor = 1
- Composite S Factors = S1 x S2 x S3 x S4 = 19.6
- Distance = S x $\sqrt{DCU}$ = 438 m

The feedpad should be located more than 438 m from the nearest receptor, the single residence.

21.8 Design

Design details are provided on the plans in figures 26 and 27. Approximately 33,000 m^3 of soils was moved during the construction of the feedpad and was sourced from the solids trap, the effluent dam, the fresh water storage and from lasering some adjoining paddocks. This material was compacted using a sheepsfoot roller.

Footings

Approximately 1m^3 of concrete was used for each of the footings.

Surface

Various sections of the pad have various slopes however, the main part of the pad has a slope of 1.0%. The concrete is finished with grooves and then scored with a roller. Sand from the stalls also aids in the cows maintaining their footing.

Yarding

75 mm diameter galvanised steel yarding will be used inside the feedpad and the perimeter will consist of 4 plain wires covered with light poly pipe for visibility.

Feed Bay

The feed bay will be 6 m wide, 252 m long and will be accessed from both sides. This provides 504 m of trough access or 672 mm of trough length per cow for the 750 cows. Two cables threaded through chain links welded to the 75 mm diameter galvanised steel yarding will prevent the cows from entering the feed bay. The cable will be suspended from the yarding by a post spaced every 3 metres.

Stalls

Depending on gate configuration, each set of stalls contains 22 to 23 stalls per side or 44 to 46 stalls in total and with the 16 sets of stalls, this equates to 730 stalls in the entire shed. Each stall is approximately 1.1m wide and has approximately 40 cm of sand overlying a clay base. A strategically placed shoulder bar prevents the cows from defecating in the stalls. Any faeces that does end up in the stalls is removed daily and the stalls are raked smooth with an implement mounted to the front of the bobcat. New sand is added to the stalls when required (typically weekly to monthly) and approximately 100 m^3 of new clean sand is used each month. Drainage pipes allow any water that collects in the stalls to drain away.

Sizing

Laneways and gateways are 6.0 m wide and the cows do not have to turn more than 90° to access and exit the feedpad. The feedpad consists of the following areas:

Shed total area	0.88 ha
Loafing area	2.52 ha
Feed storage area	1.00 ha
Associated laneways	0.20 ha
Total Feedpad Area	**4.6 ha**

Stocked area - (shed only)	0.64 ha
Stocked area - (shed + loafing)	3.16 ha

If contained in the shed, the cows have 8.5 m^2 available per cow however, when the cows also have access to the loafing area, the cows have 42 m^2 available per cow.

Access

The feedpad contains 72 gates to allow for a range of movement options between the stalls, the feed bay and entry/exit from the pad. From the dairy, the cows access the center of the feedpad. From the lower end of the feedpad the cows have access to the farm central laneway.

Location

The feedpad is located 100m from the dairy yard and 400 m from the house and is adjacent to the farm central laneway. The feed storage area is located 50m away from the feedpad.

Loafing Area

At six points along the perimeter of the feedpad the cows can access the adjoining loafing areas along side the feedpad. In total the loafing areas cover 2.52 ha. When the loafing area gates are open, very few if any cows utilise this areas as they prefer to use the beds.

21.9 Estimated Liquid Effluent Storage Sizing

Rainfall Runoff

To determine the size of the effluent pond required for the feedpad, the runoff for a 1 in 20 year 24 hour storm event needs to be determined. The estimated storage volume required is calculated as follows:

$$Q = [\ [(Af + Ab) \times (Rf \times Ro) \times Fs] + (As \times Rf)\ ]/\ 1000$$

Where:

Q = volume (m^3)
Af = Area of actual pad (m^2)
Ab = Balance of catchment area (m^2)
Rf = 80% of the 1 in 20 years 24 hour rainfall event
Ro = Runoff coefficients for a dirt pad
- > 600 mm per annum = 0.40
- 501 - 600 mm = 0.35
- 400 - 500 mm = 0.30
- < 400 mm = 0.25

= Runoff coefficient for a concreted pad* = 0.6-0.8

= Runoff coefficient for a roofed pad = 0.9

Fs = Safety Factor of 1.25
As = Area of storage (m^2)

* *The runoff coefficient for a concrete pad assumes the presence of indentaitons and absorbent material on the surface and the actural coefficient used between this range should reflect the degree of indentations and absorbent material present.*

The actual feedpad covers 0.88 ha and the remaining areas cover another 3.72 ha giving a total feedpad area of 4.6 ha. The feedpad is in a 400 - 500 mm per annum rainfall area and as the pad has a canopy, a runoff coeffecient of 0.9 is adopted. The proposed solid traps will cover an area of 500m^2 and the effluent storage will cover an area of 1,050m^2 giving a total storage area of 1,550m^2.

From Appendix J, an interpolated value for the 24 hour rainfall 20 year recurrence interval for this area is 90 mm.

We therefore end up with:

Q = volume (m^3)
Af = 8,800 m^2
Ab = 37,200 m^2
Rf = 80% of the 90 mm = 72 mm
Ro = 0.90
Fs = 1.25
As = 1,550 m^2

The calculation is then:

Q = [[(8,800 + 37,200) x (72 x 0.9) x 1.25] + (1,550 x 72)] / 1000

Q = [[46,000 x 64.8 x 1.25] + 111,600] / 1000

Q = 3,837,600 / 1000 = 3,837.6 m^3

Therefore a storage with an estimated volume of 3838 m^3 or 3.8 ML is required.

Flood Washing

The flood washing system adds another 0.17 ML per day or 5.1 ML per month. While this water is not sourced from existing effluent water as yet, it is proposed to be in the future.The flood washing system volume then needs to be totaled for the period when wastes need to be stored, in this case this period is 7 months. The calculation is then:

0.17 x 30 x 7 / = 35.7 ML

Therefore the storage needs to accommodate the 35.7 ML of liquid generated by the flood wash system over winter.

Winter Storage

As any liquid waste will be reused as irrigation, storage volume needs to be provided for the winter period when irrigation will not be feasible. By referring to the Rainfall and

Figure 23: *Flood washing tank and outlet.*

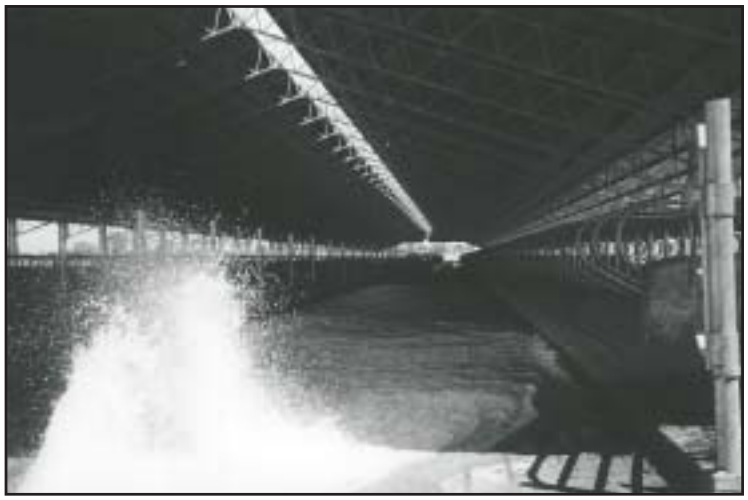


Figure 24: *Flood washing.*

Evapotranspiration graphs in Appendix K it is determined that rainfall exceeds evapotranspiration for 7 months of the year for perennial pasture.

To calculate the rainfall runoff from the feedpad and feedpad works area over this period, the default figure used is 20% of the runoff from a 1 in 20 year 24 hour storm event per month or 7 x 0.2 x 3.8 = 5.32 ML.

Total Volume

A total effluent storage volume of:

Rainfall Runoff		3.8 ML
Flood Washing System		35.7 ML
Winter Storage		5.32 ML
Total effluent storage required	=	**44.8 ML**

The effluent storage requires an estimated volume of 45 ML. When the feedpad is flood washed using recycled water, the required estimated volume would be reduced significantly.

The effluent storage dam has a volume of 25 ML and this will be linked to an 80 ML reuse dam providing ample storage volume for the proposed effluent.

The associated storages have been deliberately over engineered to cater for worse case scenarios or future developments.

21.10 Estimated Solid Manure Generation

Based on the default values of:

- 500 kg dairy cow fed on harvested feed
- Raw manure = 40 kg/cow/day
- Solids = 4.2 kg/ cow/day

Adjusted for the apportionment of time (16 hours on the pad) and the proportionate weight (550 kg) of cows.

Raw manure	-	29.3 kg/cow/day
Solids	-	3.08 kg/cow/day

In this case where the 750 cows occupy the pad for 365 days of the year, this equates to an estimated 8,000 tonnes of raw manure and an estimated 840 tonnes of solids.

The solids are collected from the solids trap weekly and spread over the 480 ha of pasture.

Nutrient Generation

Default figures for production of nutrients of dairy cattle for a 500 kg animal are as follows:

N = 0.225 kg/day
P = 0.047 kg/day
K = 0.145 kg/day

For the 550 kg animals we are dealing with in this case the values would be:

N = 0.248 kg/day
P = 0.052 kg/day
K = 0.16 kg/day

Based on the apportionment of time where the cows spend 16 hours on the pad the values would be:

N = 0.165 kg/day
P = 0.035 kg/day
K = 0.107 kg/day

Where the 750 cows occupy the pad for 365 days of the year the estimated total nutrients produced per annum therefore equate to:

N = 45,000 kg of N
P = 9,500 kg of P
K = 29,000 kg of K

Nutrient Budget

A typical dairy pasture producing 10t of dry matter/ha will use the following nutrients;

N Removal (kg/ha/yr.)	P Removal (kg/ha/yr.)	K Removal (kg/ha/yr.)
400	40	200

Therefore based on the estimated nutrient generation of the feedpad, the following areas will be required to reuse the manure generated:

N =	45,000	=	115 ha
P =	9,500	=	240 ha
K =	29,000	=	150 ha

Therefore the solids need to be spread over 240 ha of pasture to allow for the reuse of all the nutrients and especially the phosphorus.

The farm consists of 480 ha of pasture on which both the solids and liquids are reused. This provides ample land on which to reuse the wastes from the feedpad.

21.11 Water Supply

Twenty-four troughs have been installed along the perimeter of the shed to cater for stock drinking requirements and these have a total capacity of 18,000 L or 24 L/cow for the 16 hours which equates to 36 L/cow/day. This water is accessed from the existing paddock trough supply system.

Figure 25: *The solids trap at the end of the feedpad collects the sand and any remaining solids are removed in the long thin settling pond (in background) prior to effluent entering an effluent pond.*

21.12 Feed Storage & Supply

Adequate area has been provided to store and supply feed based on each cow consuming 4 kg/head/day of feed on the feedpad. The feed is stored on a raised rock base, covered with plastic and is vermin and weather proof.

Any runoff from the feed storage area is directed to the feedpad effluent system. The feed storage area is cleaned on a regular basis (every 3 months minimum).

21.13 Landscaping

Native trees will be established on the perimeter of the facility, but will be set back adequate distance to prevent shade causing the development of damp areas on the feedpad.

21.14 Detailed Drawing

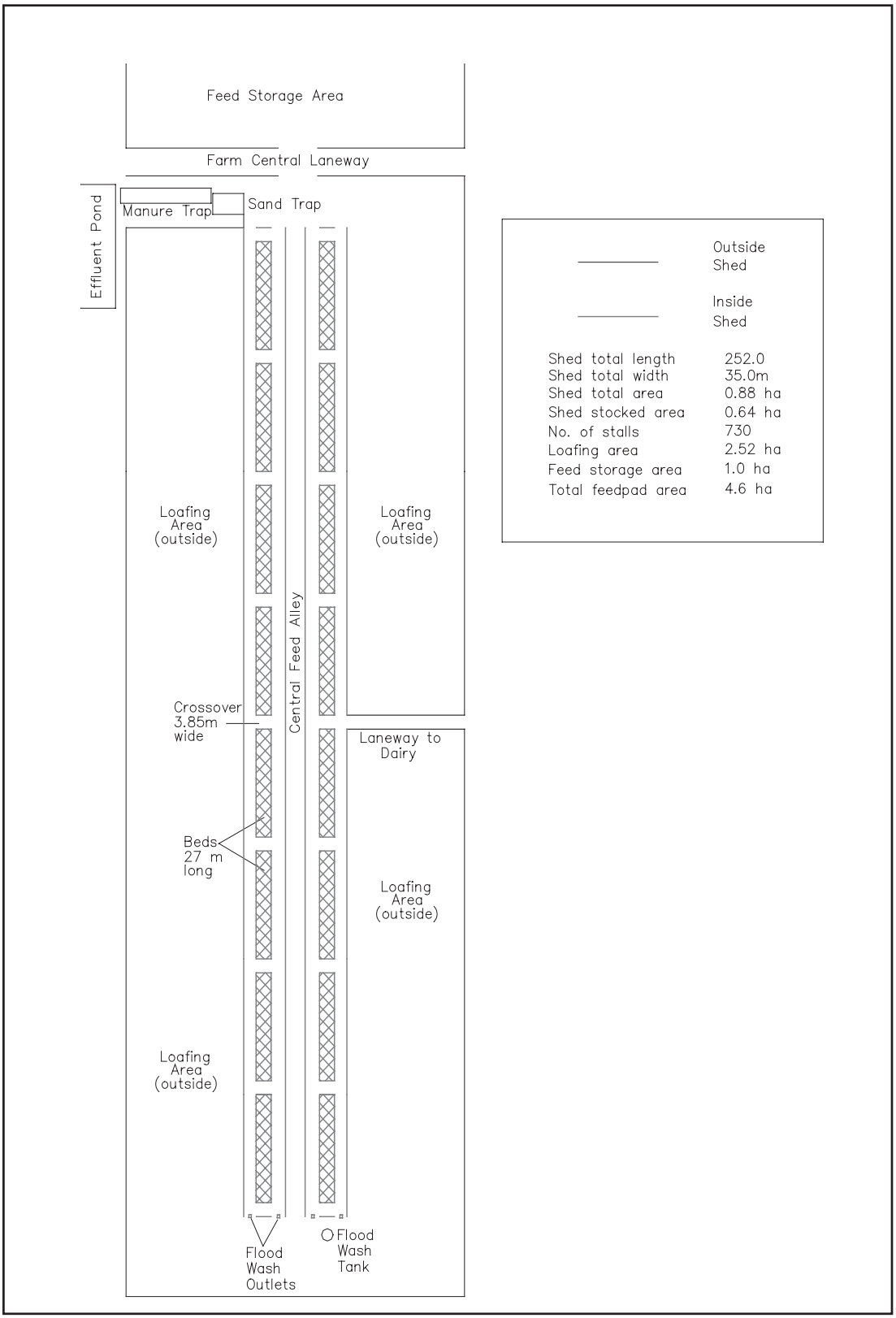


Figure 26: *Feedpad Drawing - See Figure 20 for an example of an appropriate detailed feedpad drawing and refer to section 10.4 for details to include in the feedpad drawing.*

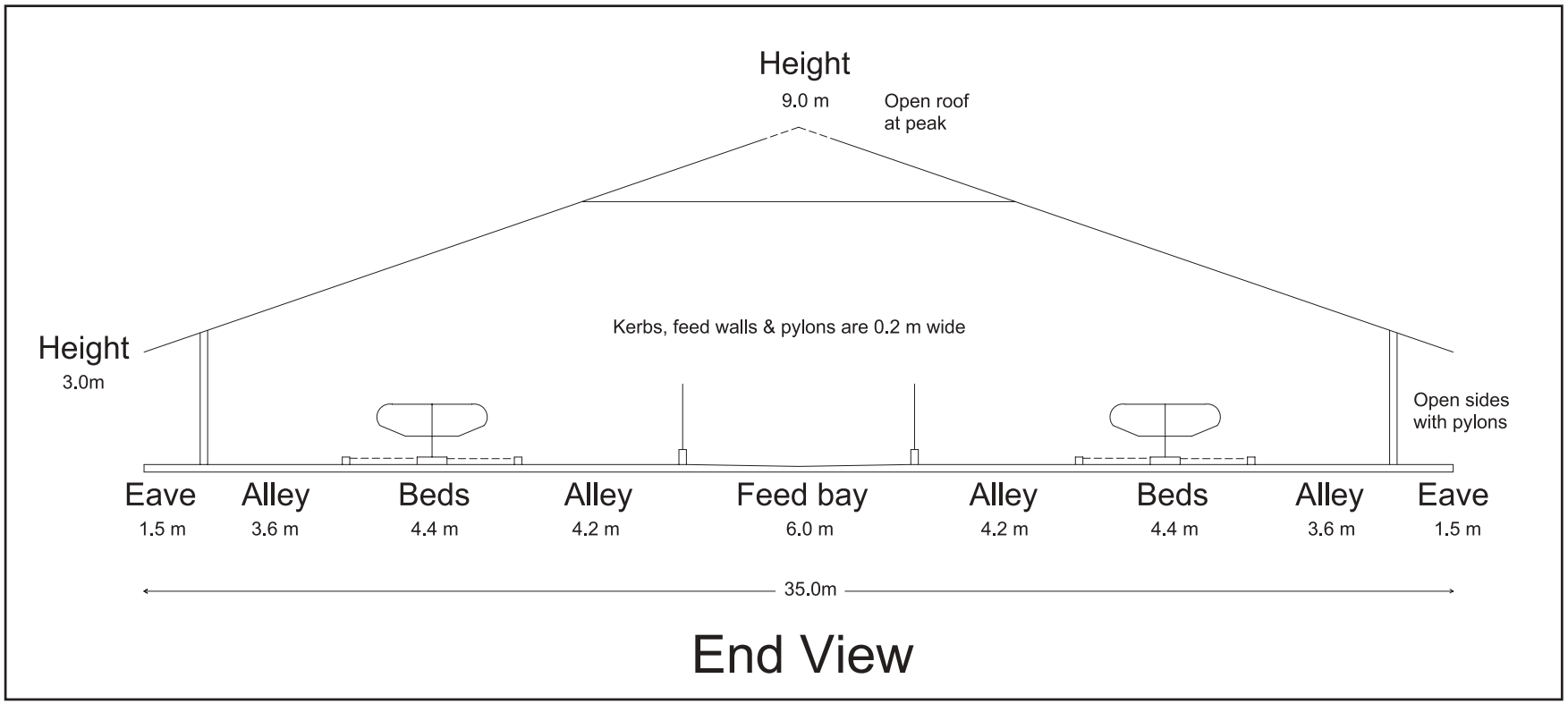


Figure 27: *Feedpad Drawing - See Figure 20 for an example of an appropriate detailed feedpad drawing and refer to section 10.4 for details to include in the feedpad drawing.*

21.15 Application to Municipal Council

The feedpad is in a Rural Zone and is not affected by any overlays. If a proposal similar to this was lodged to the Municipal Council today, a planning permit would be required if the assoicated earthworks were going to affect flooding or discharge from the property, however, this would be at the discretion of the Municipal Planning Officer

21.16 Approval

If this proposal for a feedpad were assessed under these new Guidelines, the feedpad would be acceptable.

21.17 Feedpad Management

While not part of the application for approval to construct, some of the management practices associated with this feedpad could be of interest.

Benefits

Improved cow health, especially mastitis. Improved utilisation of supplementary feed. Large capacity pumps and pipes provide for the rapid conveyance of water around the water supply and liquid effluent systems. The flood washing tank can be filled in 20 minutes.

Problems

The amount of clean sand required on a regular basis is considered excessive and methods of cleaning and recycling sand that is washed out during flood washing are being investigated.

Figure 28:
Cows feeding in the feedpad.

Figure 29:
Cows using the stalls in the feedpad.