CHAPTER 4

EFFLUENT FROM FEED PADS, STAND-OFF AREAS AND OTHER SOURCES

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4.1 OVERVIEW

As herd sizes and stocking rates increase, feed pads and stand-off areas are becoming more common. They can be an effective way to manage on-off grazing, protecting soils in wet conditions while achieving more efficient supplement feeding. However, effluent capture and management from these areas is often overlooked, with many pads not having adequate effluent management in place.

Like effluent from farm dairies, effluent from feed pads and stand-off areas must be collected and treated.

Building a properly designed stand-off area will be better for cow health and for the environment than the use of sacrifice paddocks, crops or laneways where effluent capture is not possible, treading damage may compact soils and muddy or stony surfaces can cause foot problems.

Regional Councils have various rules regarding effluent from feed pads and stand-off areas (refer to 4.5.2 Regional Council requirements). In general, these require appropriate effluent containment and treatment, including:

- sealing or lining of pads
- collection and treatment of effluent draining underneath pads
- adequate capacity of a pond system for the extra volume of effluent (if pond treatment is acceptable)
- sufficient storage capacity and land area if irrigating.

In most cases, addition of a feed pad or stand-off area will require the existing effluent management system to be extended or upgraded to cater for a greater volume and more concentrated effluent.

Planning is required to prevent overflows and blockages because effluent from feed pads contains a greater amount of fibrous material. A back-up plan in the event of mechanical breakdown or extreme weather conditions is necessary.

For large-scale developments, alternative means of removing solids should be considered (e.g. solids separation) so that the effluent from these pads can be easily irrigated onto land (refer to 2.12 Processing options prior to land application). Other sites on the farm where effluent may require collection and treatment include **crossings, underpasses, races and silage facilities.**

It is a good idea to plan for effluent collection from all these areas in the design stage as retrofitting will be expensive.

Where effluent is poorly managed, there is high potential for nutrient leaching to groundwater, or overland runoff contaminating waterways due to excessive effluent concentration in these areas, creating nutrient loss 'hotspots'.

4.1.1 Types of pads

The types of pads built include:

- stand-off or loafing pad (refer to Figure 4.1-1): a specially built area where stock can be taken off pasture during wet periods to minimise damage. These pads are constructed of free-draining material such as sawdust, bark, woodchips, lime or soft rock. There is no provision for stock feeding while on the pad but space is provided for stock to lie down
- feed pad (refer to Figure 4.1-2): a hard surface area specifically designed for feeding. The pads are normally sited near the farm dairy where stock can be held for 1-2 hours either before or after milking and given supplementary feed. The primary purpose is to provide higher feed input. Space is allowed for feeding but not for lying down
- wintering pad (refer to Figure 4.1-3): a specially built area where animals are taken off pasture for extended periods and supplementary feeds are brought to them. The herd may spend several months on the pad and space is needed for both feeding and lying down
- wintering barns and 'Herd Homes' (refer to Figure 4.1-4): similar to the wintering pad except that it is covered. A 'Herd Home' has a pre-stressed concrete slatted floor that allows effluent to drop through to an underground bunker, where it dries, assisted by the raised temperature provided by the clear plastic roof of the herd home. Some 'Herd Homes' are used year-round to feed cows and avoid heat stress - shade cloth is used over the roof to lower the temperature. In this case effluent in the bunkers does not dehydrate fully.

FIGURE 4.1-1

STAND-OFF OR LOAFING PAD

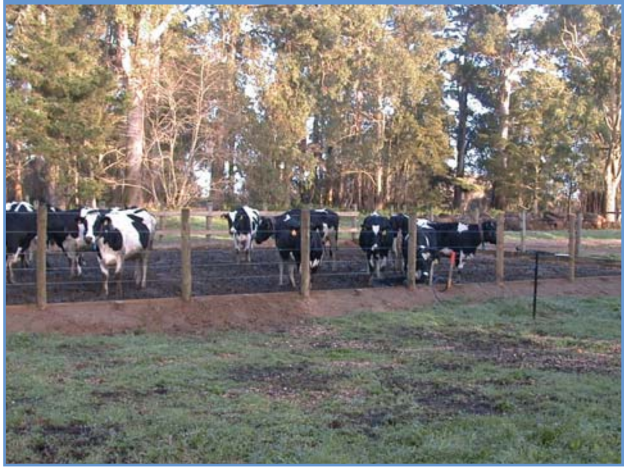


FIGURE 4.1-2

FEED PAD

FIGURE 4.1-3

WINTERING PAD

FIGURE 4.1-4

HERD HOME

4.1.2 Changes required to existing systems

Stand-off and feed pad effluent differs to dairy shed effluent in that:

- **it has a higher solid content,** due to a number of factors, including feed wastage being combined with effluent during cleaning and a higher fibre diet because of the supplementary feeding
- **it usually has a higher nutrient content.** Nutrient content is affected by feed type and feed quantity (refer to 4.2.2 Effluent content) as well as how long cows spend on the pad between cleanings.

If cows spend a lot of time on a pad, large volumes of effluent can be deposited.

Effluent treatment systems must be able to handle the combined volume of:

- the effluent – liquid and solid, including liquid draining through soft surfaces like sawdust on a stand-off pad
- all water used in the cleaning process
- any rainfall that enters the effluent treatment system off pad surfaces.

As with farm dairies, minimising the amount of water used is beneficial, as is diverting stormwater from the pad when not in use and from surrounding land.

In most cases, effluent from the feed pad will be combined with dairy shed effluent and an upgrade to the farm's existing system will be required. This may include greater storage through extra ponds or bigger ponds, more land area irrigated, more frequent desludging, and changes in irrigation equipment to deal with the high fibre content of feed pad effluent.

4.1.3 Top tips to avoid trouble

- **Plan how you will deal with your effluent as you plan your stand-off area or feed pad. Calculate effluent volumes based on high use scenarios. Trying to make changes later will be more costly.**
- **Have a nutrient analysis done on an effluent sample from any holding pond where feed pad effluent is held to determine the nutrient concentrations before land application.**
- **Desludge anaerobic ponds more frequently to remove the extra solids from feed pad effluent (at least annually). Solids separation techniques could be considered to remove the extra solids before irrigating.**
- **Scraping of sealed surfaces will reduce the volume of water required for cleaning.**
- **Soft surfaces on pads (sawdust, chips or sand) will need to be sealed or lined underneath to prevent nitrogen leaching to groundwater. Drains under these areas should direct effluent to a treatment system.**
- **Use chopper pumps in the effluent holding pond to reduce fibre size of solids. This will minimise blockages and increase the surface area available for solids breakdown in a pond system.**
- **Feed pads can be a large surface area capturing stormwater. Plan for stormwater loadings and install a mechanism to divert clean stormwater off the area when not in use.**

4.1.4 Further reading

Dexcel Farm 4 Tomorrow. 2003 "Standing-Off: A Cow's Perspective". Dexcel, Hamilton.

Dexcel, 2005. "Minimising Muck, Maximising Money" Vol. 1 Stand-off and Feedpads, Design and Management Guidelines. Vol. 2 Case Studies. Dexcel. Hamilton.

4.2 VOLUME AND CHARACTERISTICS OF EFFLUENT

4.2.1 Amount of effluent generated

The effluent generated on a feed pad includes:

- solid and liquid effluent from the cows
- stormwater from the concrete surface (where there is no roof)
- water used in wash down.

Total volume will vary according to factors such as cow numbers, time spent on the pad and number of days in use, feed pad area, annual rainfall and method / frequency of washdown.

Accurate estimation of this volume is required in the planning stages to ensure the farm effluent system will cope, or to plan for an upgrade in the existing treatment system. The use pattern or type of feed may change over time so the system should be designed accordingly.

The nutrient content of feed pad effluent is highly variable, but tends to be more concentrated than farm dairy effluent in a grazing system due to higher nutrient content in concentrated supplements and a longer time spent on the pad between washdowns.

Analysis of feed pad effluent is recommended so that accurate calculations can be made of pond loading or area required for land irrigation or application of solids.

4.2.1.1 Effluent from the cows

An average cow will excrete 55 litres of raw effluent per day over the 16 hour period it is active, or about 3.4 l/hr. The amount of effluent that falls on a feed pad depends on how many cows are there, for how many hours.

The following is an example of this calculation for a herd of 250 cows that spends two hours on a feed pad:

- Daily volume of effluent =250 cows x 3.4 l/cow/hr x 2 hours per day
  =1700 l/day

To get an annual amount, this daily volume can be multiplied by the number of days the cows spend on the pad, and divided by 1000 to give the amount in m^3/yr (1 m^3 = 1000 litres).

If the 250 cows in the example above use the feed pad 270 days per year, then:

- Annual volume of effluent = $\frac{1700 \text{ l/day} \times 270 \text{ days}}{1000 \text{ l/m}^3}$ = 459 m^3/yr

4.2.1.2 Stormwater volume

The expected stormwater off the pad depends on uncovered pad area and rainfall. If a pad is covered (i.e. a wintering barn situation), rainwater should be captured from the roof and diverted away from the effluent system.

Note that an area of **3.5m^2 per cow** is the minimum recommended for a feed pad that is used for short periods of time.

For the example given above of 250 cows:

- Pad size = 250 cows x 3.5 m^2 per cow
  = 875 m^2

Storm water volume can be calculated by multiplying pad size in m^2 by annual rainfall in mm and dividing by 1000 to get stormwater volume in m^3.

From the example above, if annual rainfall is 1200 mm:

- Stormwater volume = $\frac{875 \text{ m}^2 \times 1200 \text{ mm rainfall}}{1000}$ = 1050 m^3 of stormwater volume annually

4.2.1.3 Washdown water

The amount of washdown water depends on what sort of cleaning system is used (scraping, hosing or flooding). Scraping solids first will reduce the amount of water used.

Cleaning will not generally occur every day on a feed pad, but may happen 2 or 3 times per week. Therefore total number of days used should be divided by the number of days between cleanings to get total annual number of cleanings. From the example above, if the pad is cleaned every 3 days:

- $\frac{\text{270 days' use}}{\text{3 days between washdowns}}$ = 90 washdowns per year

The calculation of volume used for hosing down assumes that 6.4 litres of water is used per m^2 of pad area. Flooding systems use slightly less water, around 6.1 litres per m^2.

From the example above, if hosing is used as a cleaning method:

- Washdown water volume = $\frac{875 \text{ m}^2 \text{ pad area x } 6.4 \text{ l/m}^2}{1000 \text{ l/m}^3}$ = 5.6 m^3 per washdown

  x 90 washdowns per year = 504 m^3/yr

4.2.1.4 Total effluent volumes

Total volume captured from the feedpad is the sum of effluent from the cows plus stormwater volume plus washdown water. From the example above:

- Total volume = 459 m^3 from cows +1050 m^3 stormwater volume +504 m^3 washdown volume = 2013 m^3

If feed pad effluent is being combined with farm dairy effluent, then this must be added to the volume above (refer to 1.6.1 Effluent characteristics and volumes).

4.2.2 Effluent content

The nutrient value of effluent will vary significantly from farm to farm depending on:

- feed type and volume fed
- volume of water from stormwater and washdown
- time spent on pad and volume of effluent deposited
- storage and pre-treatment of effluent before application.

In general, feed pad effluent is much more concentrated than farm dairy effluent (refer to Table 4.2-1). This is due to higher nutrient content in the feed and a greater build-up of effluent quantity if cows spend longer periods on the feed pad and washdown occurs only every 2 or 3 days. 'Herd Home' effluent can also be concentrated by dehydration occuring within the bunkers.

TABLE 4.2-1

SOME MEASURED NUTRIENT CONCENTRATIONS (%) IN VARIOUS EFFLUENTS COMPARED TO FARM DAIRY EFFLUENT				
Source	**%DM**	**%N**	**%P**	**%K**
Farm dairy effluent	0.8	0.45	0.006	0.035
Feed pad				
Slurry	4.0	0.150	0.030	0.100
Effluent post separation	0.3	0.025	0.003	0.030
Separated solids	20	0.450	0.080	0.200
Stand-off pad				
Solids	25	0.200	0.150	0.200
Wintering pad (ad-lib feeding)				
Scraped manure	15	0.200	0.030	0.075
Herd Home				
Bunker manure	15-25	0.500	0.200	0.750

Note: Nutrient concentrations vary depending on feed quality, washdown frequency, etc. These figures should be used as a guideline only and a nutrient analysis of the effluent carried out to determine the appropriate area for applying effluent to land.

TABLE 4.2-2

DRY MATTER CONTENT AND NUTRIENT CONCENTRATIONS IN A RANGE OF GOOD QUALITY SUPPLEMENTARY FEEDS				
Supplementary feed	**%DM**	**N (%DM)**	**P (%DM)**	**K (%DM)**
Grass silage	23	2.90	0.25	2.50
Maize silage	33	1.14	0.20	0.92
Lucerne hay	85	3.36	0.30	2.40
Pea straw	85	1.30	0.20	1.40
Turnips	10	3.20	0.26	2.00
Palm kernel meal	88	2.72	0.62	1.36
Molasses	75	0.72	0.11	3.84

Because nutrient concentrations vary, the best way to determine effluent strength is to do an analysis (refer to 2.2.2 Nutrient analysis). **A nutrient budget can help work out the right area for land application of your effluent** to make the best use of the fertiliser value and avoid nitrate loss or metabolic problems from excessive potassium (K). Your fertiliser programme can then be adjusted to account for feed pad effluent in addition to farm dairy effluent being applied.

Feed type will influence nutrient concentration in effluent. Some indicative values for nutrient concentrations in different feed supplements are in Table 4.2-2

4.3 OPTIONS FOR EFFLUENT MANAGEMENT

No matter what surface type is used, it is necessary to collect any effluent that comes from the pad.

Concrete has advantages in being easy to clean and maintain but is a high cost option and is not the best surface for animal health where stock are held for long periods.

If soft surfaces are used such as woodchip or sawdust, effluent draining through must be collected and treated, either with subsurface drainage pipe or by having a sealed or lined surface underneath sloping towards an effluent collection point.

The soft materials will also absorb effluent and the top layer will need to be scraped to remove dung. This material can be stored on a sealed surface and applied to land when soil conditions permit. Nutrient content in these solids should be allowed for in adjusting fertiliser rates to keep within total loadings permitted by Regional Council regulations.

Liquid effluent is treated in the same way as farm dairy effluent by ponds or land application. However feed pad effluent has a high fibre content and this must be taken into account for pond operation (higher solids loading) and for land application (possibility of equipment blockages).

4.3.1 Options for cleaning the pad and effluent capture

Different options for cleaning and capturing effluent will apply depending on whether the area is:

- a feed pad with a concrete surface used for a short duration every day
- a stand-off pad with a soft surface used for longer durations in wet periods
- a wintering pad with a combination of the above
- a wintering barn or herd home with permanent housing for cows.

Effluent is generally removed from solid surfaces by scraping and washing down.

Soft surfaces can be scraped and composted or incorporated directly into cultivated soil, while the liquid effluent draining through needs to be captured and directed into the effluent system.

Some wintering barns (e.g.'Herd Homes') have slatted floors where effluent is collected underneath as it drops through and becomes desiccated before being removed with machinery for land application.

4.3.1.1 Feed pad cleaning options

Feed lanes (refer to Figure 4.3-1) should be cleaned daily so that food quality is maintained. A couple of dry scraping passes is usually sufficient. Cow lanes collect a lot of effluent and require regular cleaning. If the same scraper is used for cow lanes and feed lanes, it should be cleaned before use in feed lanes.

FIGURE 4.3-1

FEED LANES

FIGURE 4.3-2

FLOOD WASHDOWN SYSTEM

FIGURE 4.3-3

SCRAPING SOLIDS FROM A FEED PAD

Washdown options include hoses or flooding systems. Figure 4.3-2 shows a flood system in operation. Flooding and hosing use comparable amounts of water, (flooding slightly less than hosing). The volume of water required will be reduced where solids are scraped off first (refer to Figure 4.3-3). A 3m wide scraper blade is quick and effective.

Scraping and hosing have low capital cost but higher labour cost than flooding. Hosing can create some splashing of the feed area, which is avoided in flooding.

Flooding will require high flow rates (12-15m^3/min) and large diameter pipes (300 mm). If a flooding system is used, wide channels where manure has accumulated may result in meandering of the flush water. These channels should be divided into multiple narrow channels.

Unlike in a dairy shed and yard, the use of recycled effluent water is permitted to clean the surface of a feed pad. A separate water washdown system would need to be installed. **Do not use recycled water to clean feed bins or feed lanes.**

As with a dairy shed, the entrance is a collection point for effluent. Managing this area well will also help avoid lameness. To do this, stones in hooves should be removed before cows step onto the concrete surface by:

- using a soft surface leading to the start of the concrete area (e.g. limestone, rotten rock or sand for 100m length to a depth of 150-200 mm
- installing a foot bath at the entrance to wash stones away
- installing a step barrier or nib wall (refer to 1.7.2 Effluent collection).
- installing a metal grating in front of gateways.

Adequate provision is needed to collect the effluent from these areas.

4.3.1.2 Soft surfaces

Soft surfaces from stand-off areas (sawdust or wood chip) can be scraped and composted for land spreading or incorporated directly into cropping land. Sand can become soupy and cold when drainage is insufficient and cannot be composted or used in cropping.

Scraped material needs to be stored on a sealed surface and any leachate collected to prevent N leaching to groundwater.

Before the onset of the wet winter months, the pad should be topped up with fresh bedding material.

During use, it may be necessary to scrape the top off the pad periodically. Removing cow pats off the pad after use will lengthen its life, and provide a more comfortable lying surface for cows.

At the end of winter the stand-off pad should be scraped down to a firm surface – usually 100-200 mm below the pad surface. A firm surface will indicate that the under-pad drainage is functioning correctly. The remaining bedding should be windrowed to allow drying over the summer months.

With all soft surfaces on stand-off pads, subsurface drainage is crucial and isolation from groundwater is essential. Unless the subsoil is impervious, stand-off areas should be lined with a plastic liner, clay or concrete and the soft surface laid on top. Effluent should be directed to an outlet point, collected and treated. Subsurface drainage pipes laid under the surface material can also be directed into an effluent treatment system (refer to Figure 4.4-1).

4.3.1.3 Slatted floors

Some wintering barns also known as 'Herd Homes' have slatted concrete panels on the floor this allows effluent to fall and be collected in an underground concrete bunker containing a base layer (100 mm-200 mm) of topsoil (or other carbon based material such as sawdust, woodchip or hay) to absorb the effluent.

The roof of the Herd Home is made of clear plastic (refer to Figure 4.3-4) that allows light onto the pad. This helps to kill bacteria on the concrete floor and dries out the effluent in the bunkers.

The dried effluent product is extracted by removing the concrete panels and digging out the bunkers (refer to Figure 4.3-5). This can all be done using a tractor and front-end loader.

This is required every 13 weeks (if being used 24/7) to 1 year (if moderate use), depending on intensity of use. The solid waste is then applied onto land. Because of its high nutrient concentration, (refer to Table 4.2-1) the effluent must be applied to sufficient land area to avoid excessive N or K loadings - a nutrient analysis and nutrient budget will help determine exact areas. For more information on spreading effluent solids onto land refer to section 2.8.2 Sludge spreading. For more information on Herd Homes go to www.herdhomes.co.nz

FIGURE 4.3-4

PLASTIC ROOF ON A HERD HOME

FIGURE 4.3-5

REMOVING DRIED EFFLUENT FROM A BUNKER

4.3.2 Land application

Feed pads and stand-off areas will create considerable extra volume and nutrient content, and effluent from feed pads will have a high fibre content. To manage this, consider:

- **increasing storage capacity (refer to 4.3.2.1 Storage)**
- **expanding the land area for land application (refer to 4.3.2.2 Land area for feed pad effluent)**
- **making changes to deal with the fibre content of the effluent.**

For effluent from feed pads and wintering pads where there is considerable fibrous material from the feed, irrigator nozzle size may need to increase (to 16 mm at least) for direct land application (without storage in ponds). However, wider nozzles may create pasture fouling or palatability issues. The use of conical shaped nozzles on irrigators may help avoid blockages.

Feed pad effluent held in ponds for storage or initial treatment will have less fibre content as fibre will settle out with solids.

A separate solid settling pond can be installed with an adequate baffle to exclude solids in feed pad effluent from entering the pond used for irrigation.

Storage ponds containing effluent from feed pads should be agitated to prevent crusting and avoid equipment blockages. Chopper pumps are useful in situations where highly fibrous feeds are fed. Stir effluent thoroughly before irrigation to avoid blockages. Alternatives can be investigated to produce a more dilute liquid effluent, especially for larger herds where extra capital investment can be justified. These include solids separation and methane digestion (refer to 2.12 Processing options prior to land application).

4.3.2.1 Storage

If effluent is to be stored before irrigating, then storage pond capacity must be adjusted. Storage capacity can be estimated using the following calculation:

$$\text{Storage volume required} = \frac{\text{Total annual volume of effluent x storage period required (days)}}{\text{number of days pad used}}$$

From the example in 4.2.1.4 above, if 2 months' storage was required for the feed pad effluent:

- $$\text{Storage volume required} = \frac{2013\ \text{m}^3 \text{ total volume of feed pad effluent x 60 days' storage}}{\text{270 days in use}}$$

= 447 m^3 storage volume required in addition to storage for farm dairy effluent.

4.3.2.2 Land area for feed pad effluent

The increase in land area required for effluent irrigation will depend on factors including:

- the amount of time spent on the pad
- the amount and type of feed given
- herd size.

When a nutrient budget is done for a 'typical' Waikato dairy farm of 250 cows stocked at 2.8 cows/ha and feeding maize silage at 2t DM/ha/yr, the land areas shown in Table 4.3-1 are required to irrigate the effluent (in addition to land area for existing farm dairy effluent treatment). These would meet an N loading of 150 kg N/ha/yr.

This shows that the time spent on the pad has a large influence over the amount of effluent generated. Grass silage, because of its higher N content, could be expected to produce higher nutrient levels (refer to Table 4.2-2). Attention to K levels is also important to avoid animal health problems.

TABLE 4.3-1

INCREASED AREA NEEDED WHEN SUPPLEMENTS FED ON FEED PAD TO MEET N LOADING OF 150KG/N/HA/YR (From an OVERSEER nutrient budget simulation)

Time on Pad	Nutrients in Effluent (kg)			Effluent Area	
(Maize silage fed at 2t DM/ha)	N	P	K	ha	% of farm
Fed on pasture	1670	200	1670	11	12
0.5 hrs on pad	2095	250	2170	14	16
1.0 hours on pad	2520	300	2610	17	19
2.0 hours on pad	3370	400	3490	22	25

Note: Assumes a stocking rate of 2.8 cows/ha and 250 cows being fed maize silage at 2tDM/ha/yr

The percentage of farm used for irrigation would need to rise to maintain an N loading of 150 kgN/ha/yr if there were any increase in the number of hours spent on a feed pad or the number of days the feed pad was in use (refer to Table 4.3-2).

TABLE 4.3-2

PERCENTAGE OF FARM REQUIRED FOR DIRECT IRRIGATION AREA ACCORDING TO TIME SPENT ON FEED PAD

	Hours on feed pad						
Days in use	0.0	0.5	1.0	1.5	2.0	2.5	3.0
100	11%	14%	15%	16%	18%	19%	20%
150	11%	15%	17%	19%	21%	23%	25%
200	11%	16%	19%	21%	24%	27%	30%
250	11%	17%	20%	24%	27%	31%	34%
300	11%	18%	22%	26%	31%	35%	39%
350	11%	19%	24%	29%	34%	39%	43%

Note: Assumes a stocking rate of 2.8 cows/ha and lactation length of 270 days with a feed pad area of 4 m^2/cow.

When solids separation is used (refer to 2.12 Processing options prior to land application), the resulting effluent is far less concentrated than the initial slurry or untreated effluent.

Nitrogen concentrations may drop from 0.12% down to 0.02% after solids separation. Since N concentrations are the main limitation from a Regional Council point of view on area for land application, reducing solids and therefore N content would reduce the area of land needed for irrigation. **After solids separation the effluent in the example used in Table 4.3-2 could be spread over 8-10% of the farm even with high feed pad use. However, K content may still be high in post-separation liquid and needs to be considered in setting land area for irrigation.**

4.3.3 Pond treatment

For pond systems a new feed pad or stand-off area may mean increasing pond area or installing a new pond and desludging more regularly (e.g. annually). **Because pond size is based on the volume of effluent entering and the levels of nutrients, bacteria and solids it is most likely that the farm's existing system will not be adequate.**

Increasing pond capacity or changing volume or type of effluent may require a variation to any existing resource consent.

Consider installing a separate solids retention pond that will take the effluent from your stand-off or feed pad area. Ensure that the size of this is adequate for the volume from the pad. Install an effective baffle or T-piece to prevent solids entering the existing anaerobic treatment system.

More frequent desludging of ponds will be required as feed pad effluent has a high solids content. **Anaerobic ponds taking effluent from feed pads should be desludged annually.**

4.4 SITING, DESIGN AND CONSTRUCTION

Siting, design and construction of feed pads and stand-off areas can all be carried out with a view to maximising the ease of effluent collection and treatment. Other key considerations are practical management and labour input as well as cow comfort and feed management. Dexcel's 'Minimising Muck, Maximising Money' publications contain useful information on these considerations.

4.4.1 Siting

In choosing a site for a pad, effluent management considerations are:

- siting the pad near the existing effluent system where this is to be used for treatment, or near to a suitable site for new storage or treatment ponds
- the pad must be at least 20 m from the farm dairy to meet Food Safety requirements
- an adequate water supply is required for washdown
- take advantage of any gentle slope that will enhance the collection of drainage water under a soft surface pad
- if the pad is located on a farm dairy entry/exit race then it might not be possible to divert stormwater unless this area is cleaned on a daily basis
- the pad should be well away from neighbours or property boundaries
- it should be well away from bores or waterways (refer to 4.5.2 Regional Council requirements)
- water tables in winter should be well below the pad so that effluent can be drained and captured without risk of leaching to groundwater.

Other practical considerations include ease of cow flow and vehicle access, the use of existing shelter and accessibility to feed bunkers.

Consideration should also be given to future herd size and scope for expansion at that site.

4.4.2 Concrete surfaces

A feedpad needs enough slope to assist with drainage. **Between 2-4º is common, or a rise of 35-75 mm for every 1 m horizontal.**

Stormwater accounts for a large percentage of the total volume of effluent from an uncovered pad. A rainwater diversion system should be in place around the exterior of the pad. Clean stormwater can be diverted from the pad when not in use but care is required to ensure that all effluent is collected when the pad is in use.

Covering the pad will greatly reduce the stormwater volume from the pad. Where a concrete area is covered by a roof, the rainwater from the roof should be diverted from the pad and clean water directed to a drain or waterway.

Any liquid containing effluent needs to be collected and treated. A raised lip around the edge of the pad will keep drainage water out and effluent in. The pad should be sloped so that effluent is easily collected and directed to the treatment system.

Hydrants should be installed at several points around the pad to facilitate wash down where hosing is the method used.

To calculate the surface area of the concrete pad for estimating effluent volume, the recommended minimum surface area for feeding purposes only is 3.5 m^2 per cow when the pad is used for short periods of time. (By comparison, when cows stand in the yard before milking they have about 1.0 m^2 each). Where a wintering pad is used permanently with no on-off grazing then a minimum lying area of 9m^2 per cow with a soft surface is required plus a 1 m^2 concrete area for feeding.

4.4.3 Other surfaces

For short periods of feeding, concrete is the recommended surface. Alternatives such as metal rock are not recommended as they are harder to clean and require more maintenance.

Where cows will be standing for longer periods e.g. 12 hours per day then cows require a comfortable lying area of 6 m² per cow (with no provision for a feeding area).

This area should have a soft surface, but needs to be sealed underneath with either compacted clay, an artificial liner or concrete. Some Regional Councils have regulations requiring sealing of stand-off areas.

Below the soft surface, drainage coil can be used to collect the liquid effluent and direct it to the treatment system.

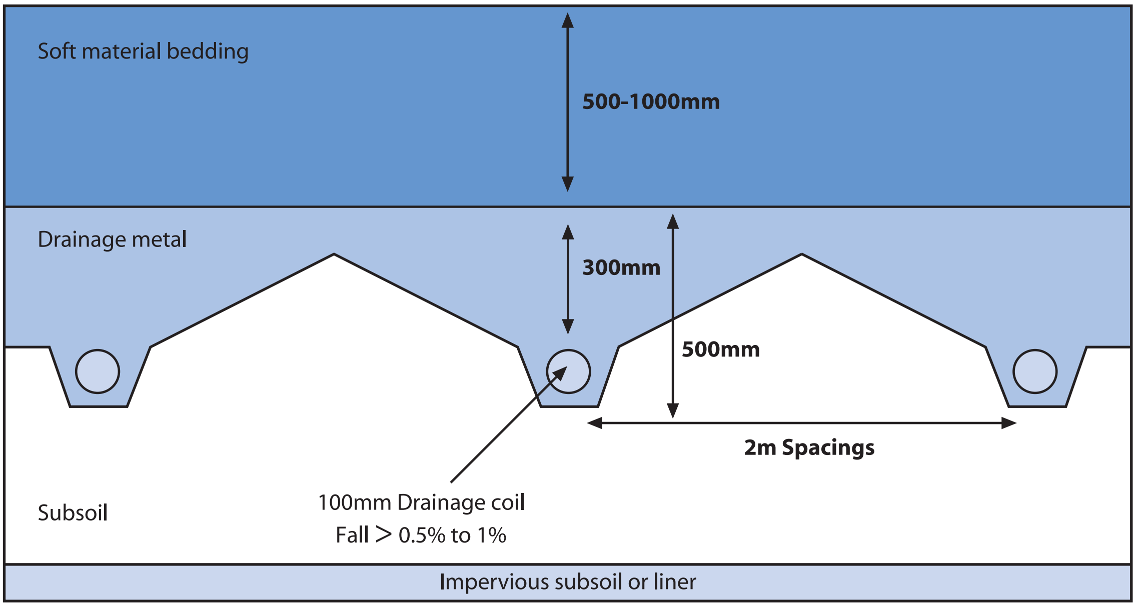
When constructing the pad over compacted clay, **100 mm PVC slotted subsurface drainage pipes should be laid 1.5-3 m apart with at least a 1% fall.**

Drainage pipes should be buried to a depth of 500mm with pea gravel and then 500 - 1000 mm of the selected surface material (see Figure 4.4-1).

Drainage pipes can become a home to rats. Outlets should be covered with wire netting and rodent control carried out. **All drainage pipes should be directed into the effluent collection system.**

FIGURE 4.4-1

DRAINAGE DESIGN PROFILE



4.5 FEED PAD AND STAND-OFF AREA REGULATIONS

Increasing attention is being paid by Regional Councils and farmers to the environmental impacts of poorly managed stand-off areas and feed pads. These areas are now seen as potential 'nutrient loss hot spots' unless effective effluent management is in place.

Food Safety regulations relate mainly to the siting of pads (proximity to the farm dairy). Unlike in the farm dairy, recycling of washdown water is permitted on feed pads.

Regional Council requirements vary but focus on sealing or lining of pads and appropriate treatment capacity for the extra volume and concentration of nutrients in effluent deposited on pads.

4.5.1 Food safety and dairy industry requirements

NZ Food Safety Authority and Dairy Industry concern is primarily focused on **human and animal health** as effluent may contain transmissible animal diseases, including bacteria, viruses, cysts, and eggs and larvae of parasites (e.g. hookworm, roundworm and tapeworm).

The survival of various pathogens during effluent storage and treatment is summarised in 2.13.1.1 Food safety and dairy industry requirements.

For feed pads, the main requirement is that these areas **not be sited within 20 m of the farm dairy.**

Effluent storage facilities must not be within 45 m of the farm dairy.

Recycling of water from washdown of feed pads is permitted.

Animal feed should not be contaminated with effluent. Different scrapers should be used in feed lanes and cow lanes or the scraper should be thoroughly cleaned before use in a feed lane.

Rodent control is recommended around feed pads.

4.5.2 Regional Council requirements

Regional Council concern is focused on the quality of effluent discharged into groundwater and surface waterways. In the case of poorly sealed or managed pads there is a high risk of **nitrate loss to groundwater. This is not visible as the nitrate will enter the ground directly underneath the pad if systems are not in place to capture all effluent as it drains.**

Nitrate in groundwater is considered a health risk and elevated nitrate levels in groundwater aquifers are difficult to reverse.

There is also potential for overland flow of effluent to waterways. Effluent discharged into a waterway can cause elevated nutrient levels, increased water turbidity and increased pathogenic micro-organism levels. It can also adversely affect aquatic life.

Most Regional Councils apply the same sorts of regulations to feed pad effluent as to normal farm dairy effluent treatment. They require that the effluent system have sufficient capacity to deal with the feed pad effluent in addition to farm dairy effluent. Some specific regulations regarding feed pads and stand-off areas also exist. Contact your Regional Council for more detail when planning your feed pad or stand-off area.

Additional water will be required to operate a feed pad system and **your water take conditions should be checked** to ensure you will have sufficient volume under your existing consent.

4.6 OTHER AREAS OF CONCENTRATED EFFLUENT BUILD-UP

There are several other sites on farms that have the potential to cause significant build up of effluent. These sites need to be managed to reduce environmental impacts as unconsented discharges to waterways are illegal.

4.6.1 Races

Correct design and construction of races is important for good cow flow and minimising lameness problems. There are also environmental considerations to take into account. **Runoff from tracks can contribute significant amounts of sediment, nutrients and faecal material to water. Keeping tracks and races in good condition and avoiding effluent build-up has benefits for both cow comfort and the environment.**

Ensure tracks are constructed to prevent the build-up of effluent and mud, which may then be washed into water. Install frequent cut-offs on sloping land to divert runoff onto pasture or rough vegetation, away from waterways.

Using races as a stand-off or feeding area will speed up deterioration. Where cows are being stood off on races, ensure that effluent is collected so that it cannot run into drains and waterways. If races are being used extensively for cow stand-off, consider construction of a stand-off pad (refer to 4.1.1 Types of pads).

4.6.1.1 Concreted entry / exit races

Concreting of entry/exit races creates an accumulation of effluent, washwater and stormwater that need to be planned for. Once concreted, these races are much smoother and less impervious and therefore runoff occurs more rapidly and in much larger quantities than from unsealed races.

In many cases **a nib wall along the edge of the concrete race can allow wastewater to be diverted into the existing effluent treatment system.** However, this extra volume of effluent, washwater and stormwater may increase the requirement for effluent storage prior to spreading onto land. **If the concreted race is not being washed after every milking then clean stormwater cannot be diverted away from the treatment system.**

If the concreted entry/exit race slopes away from the farm dairy and cannot be diverted into the existing effluent treatment system then adequate collection and storage systems need to be considered. Work out the runoff expected from the size of the concreted area and probable rainfall in worst-case scenarios before the effluent could be applied to land in order to determine the required storage facility.

To calculate the effluent volume generated by a race

- Volume = $\frac{\text{area of race (m}^2\text{) x rainfall (mm)}}{\text{1000 mm/m:}}$

  (Where area of race = length (m) x width (m))

For example, for a race 20m long and 5m wide, with a 20mm rainfall event

- Area of race = 20 m x 5 m = 100 m^2
- Volume of effluent = $\frac{100 \text{ m}^2 \text{ x } 20 \text{ mm}}{1000} = 2 \text{ m}^3$

For the same race with rainfall of 250mm over a 30 day period

- Volume of effluent over 30 days = $\frac{100 \text{ m}^2 \text{ x } 250}{1000} = 25 \text{ m}^3$

Therefore, when designing collection and/or storage facilities for entry/exit races, planning ahead can reduce the need to upgrade treatment systems after installation.

4.6.2 Bridges / culverts

Research suggests that cows are 50 times more likely to deposit their waste in a stream than on a race. Crossings are now a focus of Dairy Industry and Regional Council concern to prevent effluent being deposited into waterways. Bridges and culverts often require a consent. Check with your Regional Council for regulations.

Good stream crossings also make a difference to the stream environment by:

- preventing stock damage to the stream bed
- protecting stream habitat for fish and insects, and
- improving water quality by reducing the amount of sediment and bacteria getting into the stream from stock movement.

Putting in stream crossings will benefit the farm business by:

- making travel time faster for farm staff and stock
- improving stock health by reducing stress, lameness and the incidence of liver fluke and
- providing easier access when streams are running high.

Crossings need to be carefully planned and regularly maintained. Construct your bridge with raised lips on the edges of the deck to prevent effluent from entering the waterway. Channel runoff from the bridge out into a grassy filter area where it cannot enter the stream below. If the bridge is in a high use area (i.e. crossed once or twice a day) then it might be worth installing a storage system so effluent from the bridge can be collected. It could then be pumped to the existing effluent treatment system at the farm dairy or applied to land using a simple irrigation system.

4.6.3 Silage leachate

Due to the strength of silage leachate, it is highly toxic to aquatic life if it reaches a waterway. **On average, silage leachate is 40 times stronger than farm dairy wastewater.** The leachate is very acidic, contains high levels of nutrients, and has levels of ammonia likely to be toxic to fish.

The quantity of leachate produced depends on the moisture content of the cut pasture when it was ensiled in the bunker. **The key to minimising silage leachate is making good quality silage.** If grass is cut and ensiled without wilting, over 100 litres of leachate per tonne of grass can be produced. If the grass is wilted to 25% dry matter, less than 30 litres per tonne is produced.

Due to the high nutrient content of silage it must be contained and managed appropriately so that it does not enter groundwater or surface waterways. Some considerations to manage silage leachate appropriately include:

- **silage storage facilities must be located at least 45 m away from the farm dairy**
- **silage storage facilities should be sealed to ensure silage can be collected and to prevent seepage of leachate to groundwater**
- **silage leachate must be contained with at least 3 m^3 storage per 100 tonnes of grass ensiled**
- **cover stacks with a plastic cover to prevent the entrance of rainwater and reduce the volume of leachate produced**
- **leachate can be mixed with farm dairy effluent or water before disposing to land**
- **if the leachate is fresh and comes from good quality silage it can be fed to stock undiluted**
- **design silage bunkers with a sloping floor that links up with a drainage channel across the front of the bunker**
- **site silage pits away from places where surface water can pond or groundwater can rise into the pit.**

Silage stacks should be located at least 20 m from watercourses and property boundaries and 100m from houses and groundwater bores. However, some Regional Councils may have more restrictive rules regarding location and design of silage stacks / pits.

4.6.4 Road crossings and underpasses

Underpasses are installed in a variety of localities and are generally required on busy roads where stock cross regularly. If not sited and designed appropriately underpasses can become a collection point for water. In some cases groundwater intrusion requires constant pumping of effluent from the underpass for it to be used for the purpose it was intended. In other cases stormwater runoff from the road above and/or the surrounding landscape causes ponding or runoff from the underpass site.

In both cases outlined above, the water will be mixed with sediment and effluent. Therefore it is not possible to divert, discharge or pump this water into a nearby watercourse without a resource consent. It will instead have to be applied to land in conjunction with the Regional Council's rules for applying farm dairy effluent to land (which may also require a resource consent).

When siting and designing underpasses, effluent and water management are best considered in the initial design rather than necessitating the retrofitting of systems further down the track.

Road crossings can also be a collection point for effluent. If stock are being crossed over a road without the use of a removable mat then many District Councils require the road to be washed. This generally involves the use of a high-pressure hose, generating a significant amount of washwater that needs to be managed. In many cases a storage facility for containing effluent may need to be built. When designing the storage facility, consider the length of time hosing takes and the volume produced by the hose. Care is needed because much of the storage area can be quickly filled if stormwater runoff from the road cannot be diverted away from the effluent storage facility.