Dairy effluent management systems
Technical Note E02

What is effluent?

On dairy farms, the liquid waste stream from milking sheds and associated yards is generally referred to as effluent. It consists of the manure and urine excreted in the milking shed and yards, mixed with the wash-down water used to remove the waste from these areas and concrete yard runoff following rainfall. Consequently, it contains dissolved and suspended nutrients, salts and organic matter. Detergents and small amounts of spilt milk may also be present in effluent.

It should be noted that large quantities of milk should not be disposed of through the effluent system.

Other intensively stocked farm areas such as feed pads, earth yards, loafing areas and regularly used laneways are generally cleaned by dry scraping rather than by wash down. However, runoff from these areas following rainfall also contains relatively high concentrations of nutrients, salts and organic matter. This runoff is also commonly referred to as effluent.

Why manage effluent?

There are sound practical and economic reasons for paying close attention to effluent management:

- Effluent contains valuable water and nutrient resources that can be utilised to promote crop or pasture growth, and potentially reduce inorganic fertiliser and irrigation water requirements.
- Effluent may be harmful to the quality of underground and surface water resources, and to the chemical and physical characteristics of soil if it is not managed appropriately.
- Every Queenslander is subject to the general environmental duty defined under the Environmental Protection Act 1994. To demonstrate compliance with this duty, all dairy farmers need to take all reasonable and practicable measures to manage their effluent responsibly, thereby avoiding adverse environmental impacts.

Types of effluent management systems

The two major types of effluent management systems are:

1. continuous application systems; and
2. treatment and storage systems.

Continuous application systems

These systems are not designed to treat effluent and have limited storage capacity. Consequently, they rely on regular collection and application of effluent, usually twice daily following each milking. The effluent is generally collected in a concrete sump and applied directly to pasture.

The main types of continuous effluent application systems are:

- sump and gravity flow (generally through a moveable hose);
- sump, pump and moveable sprinkler; and
- sump and effluent tanker.

To protect pumps and to avoid pipe blockages, each of the above systems needs a stone trap, screen, or trafficable solids trap to remove coarse solids and foreign material from the effluent stream before it enters the sump.

Advantages

- Higher effluent nutrient concentrations compared to effluent treated in a pond where nitrogen is volatilised (released as ammonia gas) and sludge settles out.
- Solid wastes are applied to land with the liquid effluent; so there is no pond sludge to deal with.
- Low capital cost for sump and gravity flow system, however, medium-to-high capital cost for pump and sprinkler and effluent tanker systems.

Disadvantages

- Regular shifting of sprinkler/hose required (every couple of days) to avoid overloading land areas with nutrients and salts.
- Limited storage capacity (often less than one-day's wash-down, flushing and hosing volume) means that effluent is inevitably applied to wet land during periods of prolonged wet weather. This can potentially result in contaminated runoff entering watercourses and/or leaching into groundwater.
- Limited area over which effluent can be applied.
- Effluent application area must be well removed from watercourses.
- Sump-pump systems require a reliable pump capable of handling high levels of solids. Pump breakdowns have to be fixed very promptly because of very limited storage capacity.
- No scope for recycling of effluent for yard flushing purposes.
- Tankers may be difficult or impossible to operate in wet conditions on most soil types.

Treatment and storage systems

These systems employ one or more ponds (generally one or two) to treat the daily inflow of effluent from the milking shed and yards and to store both the liquid effluent and solids (sludge) that settle out of the effluent. Pond systems can also collect, treat and store runoff from concrete and earth yards, and in some cases, feed pads and regularly used laneways. The liquid effluent is stored until it is either irrigated onto crop or pasture, or recycled for yard flushing purposes.

A number of effluent ponds may be constructed in series to treat and store dairy effluent. The first pond in such a series is generally referred to as the primary pond and the second pond as the secondary pond. While systems employing three or more ponds are uncommon, the third pond may be referred to as a tertiary pond. The quality of the treated effluent in the final pond generally improves as the number of ponds in the effluent management system increases.

Sludge accumulates in the primary pond and is removed at regular intervals. Primary ponds are commonly designed to store between one and ten years' accumulated sludge. The sludge storage capacity generally depends on the intended method of sludge removal. For example, if a farmer wishes to employ a contractor with an excavator to remove the sludge, he / she may prefer to limit desludging operations to a frequency of once every ten years. Alternatively, if the farmer has ready access to a vacuum tanker, he / she may be prepared to pump out and apply the sludge much more frequently, for example, annually.

Regardless of the number of ponds in the effluent management system, the following three storage / treatment volume components must be provided:

- Active treatment volume – to maintain the necessary bacterial population to treat and break down the organic matter in the effluent stream.
- Sludge storage volume – to store the solids that settle out of the effluent during treatment.
- Wet weather storage volume – to store liquid effluent during periods when the land is too wet for effluent irrigation, or until the timing of effluent irrigation suits other farm management considerations.

In a single pond system, each of the three treatment / storage volumes described above must be provided in the primary pond (figure 1).

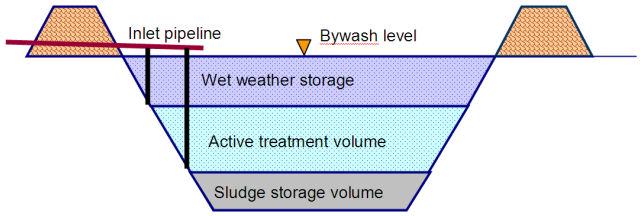

Figure 1. Single effluent pond storage / treatment volume components

In a double pond system, the active treatment volume and sludge storage volume must be provided in the primary pond and the wet weather storage volume in the secondary pond (figure 2).

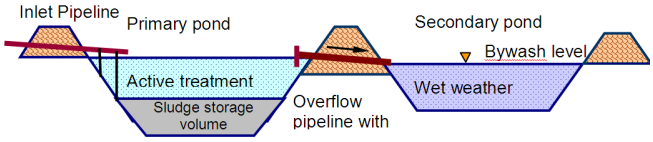

Figure 2. Double effluent pond storage / treatment volume components

Dairy effluent ponds should have sufficient wet weather storage capacity to limit effluent spills (overtopping) to a frequency not exceeding once every ten years. Effluent ponds should not generally be located close to watercourses, however, if this is unavoidable, additional wet weather storage capacity may be required to further limit effluent spills.

DAFF's principal environmental engineer, Alan Skerman, developed Dairy pond (2004), a computer spreadsheet calculator for determining the required treatment and storage volumes for single (figure 1) and double pond (figure 2) effluent storage and treatment systems.

Advantages

Pond systems do not require daily attention.

Pond systems allow the timing of effluent irrigation to be managed to suit pasture or cropping requirements, and other farming practices and constraints.

Pond systems can often be designed to collect contaminated runoff (by gravity flow) from feed pads, earth yards and regularly used laneways located close to the milking shed.

Well managed effluent irrigation from a suitable pond system reduces the potential for contamination of surface and groundwater by runoff and deep drainage of nutrients, pathogens and other contaminants contained in the effluent.

Pond systems enable effluent irrigation to be integrated into the main farm irrigation system. This may allow shandying of effluent and the more effective utilisation of the nutrient value of the effluent over a larger, more productive area of the farm.

Pond systems provide opportunities for recycling effluent for yard washing. Recycling is better suited to multiple pond systems because of the lower effluent solids content, the ability to use pumps not designed to handle high levels of solids and the reduced risk of pipe blockages.

Table 1 Comparison of different effluent management systems (adapted from Dairying Better 'n Better CD).

System	Reliability	Wet weather storage	Water recycling	Labour cost	Capital cost
Continuous application					
Sump & gravity flow	Low	None	No	High	Low
Sump, pump & sprinkler	Medium	None	No	High	Medium
Sump & tanker	Medium	None	No	High	High
Ponds					
Single	High	High	No [1]	Low	Medium
Double or multiple	High	High	Yes	Low	High

[1] Effluent recycling may be possible in some single pond systems.

Disadvantages

Need suitable soil types to construct a low permeability pond.

May not be feasible in areas with high groundwater levels.

Lower nutrient value in liquid effluent compared to continuous application systems.

Ponds require regular desludging. Sludge generally requires drying and processing (eg composting) before application to land.

Ponds occupy potentially productive land areas.

Ponds may be odourous, primarily if they are not designed and operated correctly, but also during start up and following desludging.

Pond systems may require more pumping equipment, unless they are supplied by gravity flow from the milking shed and associated yards.

Ponds may not be feasible in extremely wet climates (average annual rainfall greater than approximately 1800 mm) where the rainfall exceeds evaporation for extended periods.

Conclusion

Dairy farms require some form of effluent management system. A range of site specific factors such as herd size, proximity to creeks, gullies and underground aquifers, climate, soil type, availability of labour etc, should be considered when selecting the most appropriate system for a particular farm.

In most situations, pond systems are more desirable than continuous application systems. They are generally better able to protect the environment and enable farmers to make the most effective use of the nutrient and water value of the effluent. However, well-designed and managed continuous application systems may be quite acceptable, or perhaps even more suitable than pond systems, in some situations.

It is strongly recommended that farmers obtain specialist advice when considering the installation of new dairy effluent systems or modifications to existing systems. Good advice may avoid the need for costly and difficult modifications of unsatisfactory systems at some future time.

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More technical notes can be found at:
www.dairyinfo.biz including

E01 Clay lining and compaction of effluent ponds

E02 Dairy effluent management systems

E03 Dairy effluent systems for high rainfall areas

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