



Managing wet soils: surface drainage

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Surface drainage is very useful in removing excess above ground water from land in a controlled manner and as quickly as possible. It may be drained, to a natural watercourse such as a stream or dam or to an artificial drainage system. This should be planned and implemented to cause nil or minimal damage to the environment.

Wet soil problems on dairy pastures are usually due to either excess surface and/or sub surface water. It is important to realise that surface drains will only remove surface water, and in most soil types, are almost useless for draining the soil water from the soil profile.

None the less surface drains are essential and a very useful tool to manage wet soils when used in the right location for the right reasons. Typical applications for using surface drains include:

- draining large volumes of surface water off land quickly
- intercepting water flowing down from upper slopes to lower lying land.
- intercepting run off water from other sources (eg. road side drains, neighbouring properties, dam overflows, etc.
- acting as collector system for sub surface (mole or tile drains) drainage systems.

Types of surface drainage systems

There are different types of surface drainage systems used on farms. These are:-

1. Ditches or open drains
2. Grassed waterways
3. Humps and hollows (bedding)
4. Levees or graded banks
5. Laser levelling (grading)

1. Ditches or open drains

These vary in size and length and can be simply categorised as follows:

- Shallow surface drains
- Medium sized drains
- large open drains or canals

Shallow surface drains (up to ~0.3m deep)

These are formed by hand shovel or “spinner cuts” are most useful for removing ponded water from shallow depressions to larger drains or streams. They are generally not suitable for draining large flat areas. They tend to be temporary in nature since they are often pugged by animals, silt up quickly, over grow with less desirable species, wrecked by machinery in wet weather, etc. They are very inconvenient for operating equipment when feeding out or making silage or hay and for other types of vehicles such as motor bikes.

Medium sized drains (0.3m to ~ 1m deep)

These are constructed by excavators or specific drainage machines and are usually “V” shaped or have battered sides with a flat bottom. They should be installed with enough slope (gradient) to ensure that the water is removed quickly but not cause scouring of the drain walls or bottom. This is usually not a problem because they are used on the flatter areas of land.

Caution: be very wary of constructing open drains in dispersive soil as they are highly prone to erosion.

The slope of the drain floor should be such that the velocity of water flow should be slow, especially on the sandy and sandy clay loam soils but can be quicker on the clays and clay loams.

The slope or batter of the drain banks should be such that the banks do not collapse when wet. Each soil type has its own natural slope that will not collapse and machine formed banks should be similar or even less steep. If made too steep, the banks will “find” their own batter by sloughing into the drain until their natural slope is reached.

Clays may have a batter of 1:1, silty and clay loams 1:1 to 1:1.5, and sandy loams 1:1.5 to 1:2. Looser sandier soils should be 1:2 to 1:3+. Figure 2 shows what happens to drains with insufficient batter angle.

The size of open drains depends on the amount of water to be removed or intercepted and formulae are available to calculate the required design parameters.

The correct time to construct open drains is when the topsoil and sub soil are damp or soft enough to dig and

when water presence is not a problem, usually in late spring, early summer and autumn.

Large open drains (several meters deep and wide)

Large drains and canals can be made with dragline excavators, scrapers or bulldozers. The large drain systems should be designed to carry very large volumes of water. They are generally not applicable to most dairy farms apart from possibly delivering irrigation water or removing its drain waters so will not be covered here.



Figure 1. Medium sized "V" shaped open drain.



Figure 2. Open drain with incorrect bank matter.

Disadvantages of open drains

- They need regular cleaning (sediment and weeds)
- Can be dangerous to animals, machinery, and people (if unfenced)
- If fenced, cleaning is more difficult
- Fencing adds extra cost and maintenance
- Tend to become deeper and wider if not maintained by professional machinery operators
- Not suitable for sub-surface drainage
- Loss of ground

2. Grassed waterways

Grassed waterways are usually shallow, varying in width from narrow to meters wide, but are constructed such that they are often grazed as part of the paddock. They are sometimes used to allow drainage outlets to flow down slopes to prevent erosion without considerable expense.

Their steepness should be less than 1:4 (vertical: horizontal). A dense and unbroken grass sward is essential and should be established before it is used to discharge

water. Avoid grazing the waterway while it is wet or draining water, particularly if the pasture is not well established.

The amount of water to be removed and the steepness of the slope will determine the size and shape of the waterway. A good rule of thumb is that the steeper the fall the wider the waterway. The bottom of the waterway should be as near as possible to horizontal in cross section so that the water spreads out evenly over the base.

If the waterway must be constructed in soils prone to erosion, ensure topsoil is retained or returned as soon as possible and sown to a dense pasture to prevent erosion. Water moving down slopes which have clay sub soils should be designed to avoid saturation of this subsoil as doing so may result in landslips. Dense pasture swards assist greatly in soil stabilisation.

3. Humps and hollows (bedding)

Hump and hollows, sometimes called "ploughing in lands" (see Figure 3) is the practice of forming (usually while renovating pastures) the ground surface into parallel convex (humps) surfaces separated by hollows. The humps shed excess moisture relatively quickly into the hollows which are sloped gently to act as shallow surface drains.

Humps and hollows are useful in areas or on soil types that are not suitable for tile or mole drainage. They are also useful where the lack of suitable outfalls prohibit the use of tile drains, usually due to insufficient depth or fall.



Figure 3. Humps and hollows in newly sown pasture.

The humps and hollows system comprises lateral surface drains which discharge into headland drains which in turn discharge via short open drains or shallow pipes into natural watercourses or open drains (see figure 4). If possible these areas should not be grazed while the drains are still wet because they will become pugged. If not then end of season maintenance must ensure that all the hollows are reshaped to allow quick drainage. If they drain into constructed open drains, these must also be maintained so that drainage water clears from the hollows quickly.

The size of this drain type depends on the amount of water to be removed or intercepted and formulae are available to calculate the required design parameters.

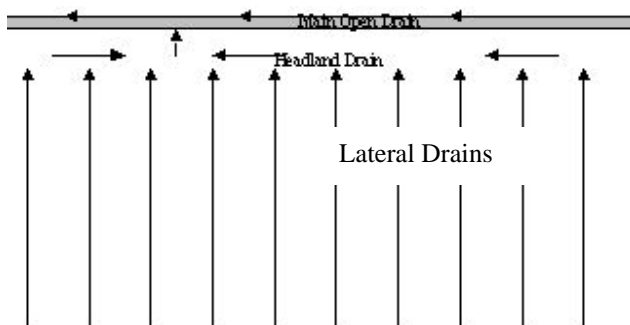


Figure 4. A typical design for hump and hollow drainage system

Dimensions:

Hump spacings may vary from 10 – 20 m but the wider the hump, the more soil must be moved to form them and the water run off may be substantially slower. Humps spaced wider than recommended above may not drain at all in their centres. Gippsland experiences suggest a spacing of approximately 15 m width and with hollows of approximately 0.4 – 0.5 m depth. For drains discharging in one direction, lengths should not exceed about 150 m, but can be longer if discharging in two directions.

Disadvantages:

Humps and hollows make it more difficult for machinery operation such as fodder conservation. The humps may be overgrazed while the hollows may become pugged.

The depth of topsoil must be satisfactory to allow the humps and hollows to be formed without exposing the poorer and nutrient deficient subsoil. Alternatively more soil may have to be removed to ensure a covering of topsoil in the hollows for resowing pasture.

If the edge of the hump is too steep, cattle trampling will cause soil movement into the hollows and possibly into watercourses.

4. Levees or graded banks

These are surface channels, often formed on sloping land, in such a way that the earth removed forms a bank or levee on the downslope of the channel. Where used on slopes, the main purpose of graded banks is to prevent surface runoff from building up volumes and velocity that may cause erosion.

The banks must follow the contour of the slope with a gradual decline so that water flows constantly and does not build up in depressions, thus rendering land below susceptible to “landslips”.

The outfalls of the graded banks may possibly lead to dams for water collection for irrigation, stock water, etc. Bank spacing will depend on slope gradient, amount of water to be collected, outfall locations, slope topography and amount of rainfall.

Dimension:

Spacings of about 30 - 50 m for slopes with gradients of 5⁰ - 12⁰ have proven acceptable in most areas. Each bank should service a total area of up to about 3 hectares, with length not exceeding about 400m.

The channel will be at risk to erosion immediately after construction until a grass cover is established. Care must be taken on slopes that may have shallow topsoil over dispersive subsoil, as severe erosion is possible in these soil types.

Levee banks may be used to confine large flows of water to certain areas and are often used to control floodwaters along streams. However approval for use of levee banks in this situation is required from the local or regional water authorities.

5. Laser levelling (grading)

Laser levelling is a relatively new practise used on irrigation farms to even out and speed up the water flow down flood irrigation bays. When constructed and managed correctly, water runoff should be minimal, thereby reducing water and nutrient runoff.

Although not commonly used on the “flats” in high rainfall areas, laser levelling could be used to ensure water is moved off quickly and does not remain in depressions.

The Water Act

The Water Act (1989) provides guidance for the management of waterways and swamps. Before considering draining a wet area you should contact your local Catchment Management Authority for advice, as a permit may be required.

The previous version of this note was published in February 2002.

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