Sugar Research Australia

Information Sheet

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Surface drainage and maintenance

Correct design of surface drains and related structures at the individual field and property level is essential for effective field and subcatchment drainage.

Drainage design at the subcatchment scale

Principles of effective surface drainage design

Effective surface drainage should:

- Increase the productivity of sugarcane areas.
- Remove residual surface water within the acceptable period of inundation.
- Not substantially increase the peak flow rate.
- Have drains with sufficient capacity to cope with the design discharge.
- Maintain non-erosive water flow velocities.
- Not impact negatively on downstream on downstream neighbours, water quality or water quantity.
- Be constructed so that it has limited impact on the groundwater hydrology of the area. (Sugarcane yields can also be reduced by high water tables and waterlogging).

The effect of flooding and waterlogging in the foreground, in contrast to the well-drained cane in the background.

Surface drainage design event

- Current best practice suggests that a maximum period of inundation between three and five days is acceptable.
- High intensity, short duration rainfall and longer duration events of sustained lower rainfall intensity can cause three days of inundation.
- On-farm drainage should be designed to remove residual surface water within three days:
  - With little or no ponding in the cane field.
  - Without substantial increase in the peak flow rate.
- The design event is calculated from statistical analysis of rainfall (at least 25 years).
- Technical assistance may be required to assess the design event.

GPS or laser guided levelling

- Although undertaken on an individual farm basis, GPS or laser guided levelling is one of the most influential practices affecting hydrologic response in any subcatchment.
- For every cubic metre of ponded water removed by levelling, a similar compensating storage must be provided to mitigate increased downstream flow rate.
- A network of co-ordinated shallow drains constructed through levelled paddocks is probably the most efficient mechanism for on-farm drainage.

Order of drainage works

- The likely impacts of increased flow on watercourses both locally and further down the catchment should be assessed before drainage works commence.
- Drains should be built from the downstream end working upstream, to ensure adequate outflow.
- Detention basins should be built from the upstream end working downstream to ensure that the basin is not overloaded by upstream flows and sediment.

Impacts of unplanned surface drainage

Unplanned surface drainage will result in:

- Increased flow and associated erosion or siltation.
- Poorer water quality resulting from increased turbidity, dissolved nutrients, salts, acids, heavy metals and possibly pesticides.

On-farm drainage design

Objectives of well designed on-farm surface drainage

- Minimal impacts on farm operations eg. trafficability and cane harvesting.
- Maximise productivity.
- Maintain or perhaps improve the quality of the water leaving the farm.
- No increase in the peak flow rate of water leaving the farm.

Farm development planning

- An integrated drainage plan for the property is an important component of the Farm Development Plan.
- The farm drainage plan should complement a subcatchment drainage plan.

Water flow velocities

- Water flow velocities in drains must be slow enough to be non-erosive and fast enough to prevent siltation.
- In most cane-growing areas water flow velocities should be:
  - Greater than 0.3 m/s to promote flow and prevent ponding and stagnation.
  - 0.6 m/s or less in loams and silts to prevent erosion.
  - 1.2 m/s or less in clays and gravel.
- Water flow velocities can be calculated using the desired flow rate and cross-sectional area of drains. Technical assistance may be required.

Drain size and shape

- Farm drains must be of sufficient size to carry the design discharge.
- Deep open drains should avoided unless they are in very stable soil types. In any case they tend to widen and meander, resulting in loss of valuable soil, cane headlands and increased turbidity.
- Traditional trapezoidal-shaped drains require regular maintenance and cleaning using machinery.
- Shallow, grassy spoon-shaped drains are easy to maintain and clean but require more room to construct.

Row direction and length

- Row length, direction and profile influence the amount of runoff and infiltration of water into the subsurface.

Shallow grassy drain with intact riparian vegetation on one bank.

- Rows should have a continuous fall to a drainage outlet.
- Grass buffer strips for trapping sediment should be incorporated between the end of the rows and the drainage outlet.
- Very long rows (of about 2 km) are not usually successful, as it is extremely difficult to prevent dips and depressions and ponding of water.

Detention structures

Flood detention measures complement natural detention systems and are essential to mitigate increased flows.

Proven effective structures include:

- Silt traps.
- Widened drain sections.
- Detention lagoons.
- Small dams in drains with a design discharge pipe of safe overflow or bypass.
- Tailwater recycling dams in irrigation areas.

These structures reduce erosive water flow velocities and soil loss while catering for the removal of surface water.

Widened drain section and drop structure detains floodwater and improves water quality.

Drain maintenance

A regular program of drain maintenance will assist in removing excess surface water and maintain high productivity.

Timing

- Drainage construction or maintenance works should be planned so they have minimum impact on the surrounding environment.
- Usually best done immediately following the wet season to avoid soil erosion, increased turbidity, etc, and to enable disturbed land to revegetate prior to the next wet season.

Vegetation management

- Rank grasses and weeds should be controlled to allow surface drains to function.
- Trash spill should be removed from watercourses and drains.
- Vegetative matter removed from drains during maintenance operations should be placed at a reasonable distance from the drain to prevent organic decomposition within standing or flowing water.
- Regular mowing of wide, shallow, grassed drains (commonly referred to as spoon drains) allows these drains to function as designed.
- For deeper drains, the use of slotted drain rakes is best practice for cleaning and maintenance of drains.
- Credit® and Weedmaster Duo® are glyphosate based products that are registered for use in aquatic areas. Other glyphosate products must not be used on weeds growing in or over water.
  (® is the registered trademark of Nufarm Australia Limited.)
- Excessively frequent or unnecessary maintenance and slashing on headlands and spoon drains, so that the vegetation is too low, can cause unwanted removal of vegetation promoting bank erosion.
- Frequent grading of minor drains removes the grass cover enhancing drain erosion.

Drain rake removes vegetative matter and leaves silt behind.

Silt management

- Soil loss from fields and subsequent buildup in surface drains will be minimised if the field has adequate soil conservation measures installed.
- Soil removed from drains should be replaced on adjacent fields to further improve the grading of the field.
- Soil from drain maintenance should not be mounded adjacent to surface drains as this will interfere with the flow of water across the floodplain during intensive rainfall events and may also expose potential acid sulphate soils to oxidation.