# FURROW IRRIGATORS' HANDBOOK

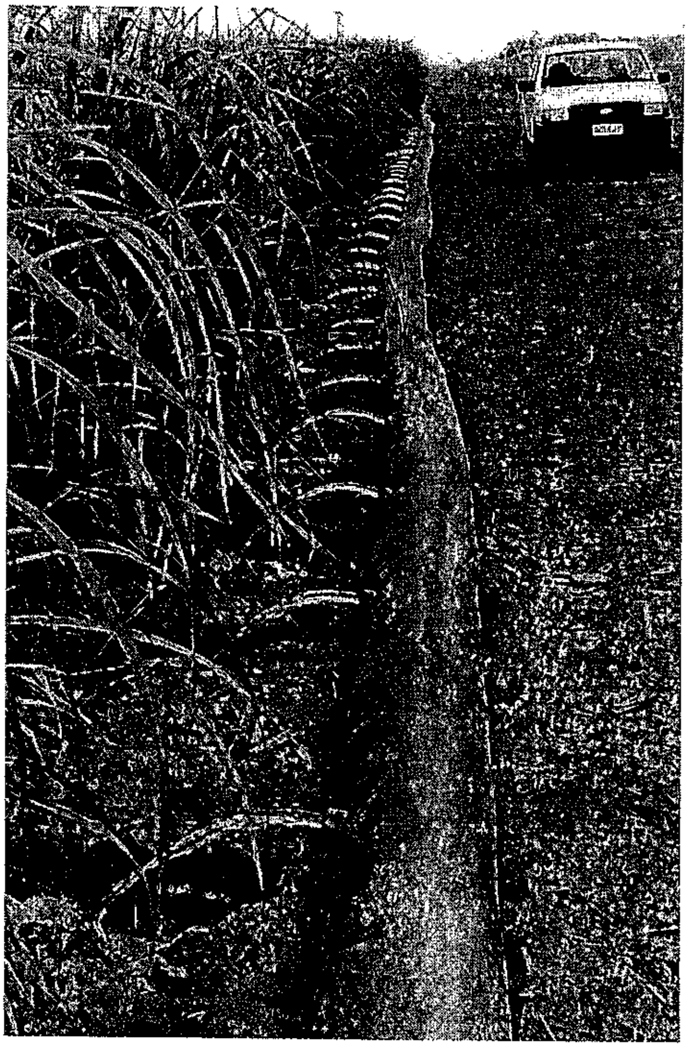
## Bundaberg District

### About this handbook

The nature of furrow irrigation means that the natural characteristics of soils, and our cultivation practices, have a direct and strong influence on its efficiency. If the operational settings do not suit the soil characteristics and condition, an uneven and probably wasteful irrigation will result.

This handbook sets out, in a practical way, how to manage the main aspects of furrow irrigation to ensure that the operational settings best suit the block conditions. Each of the major operational settings is considered, as are their effects on each other.

The guide also gives practical, low-cost ways to counteract problems, which lead to poor irrigation efficiency. By improving application efficiency, crop requirements are better met, and water available for irrigation is made that much more effective overall. This is particularly important under restricted water conditions.



*Information contained in this handbook was derived from an SRDC irrigation monitoring project (BS206) conducted by BSES and Millaquin/Qunaba Cane Protection and Productivity Board, 1998 – 2001.*

## HOW MUCH WATER DOES YOUR SOIL HOLD?

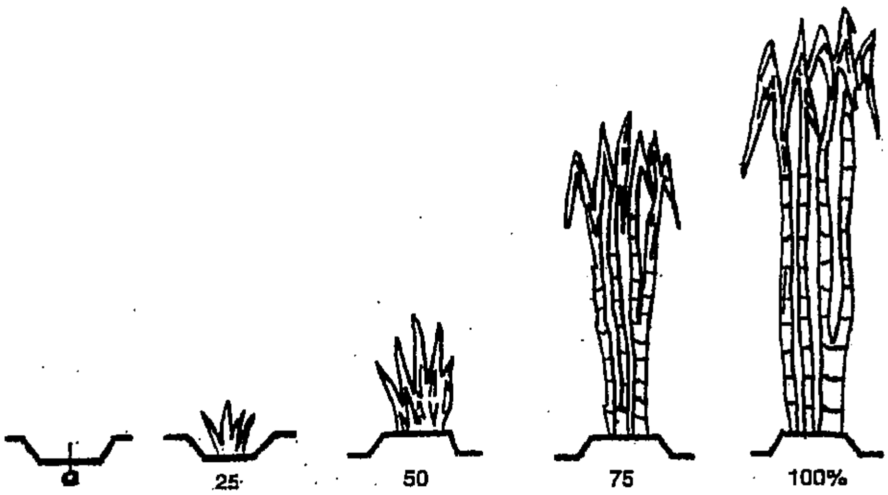
*Bundaberg soils have highly varying natural characteristics that affect furrow irrigation efficiency. The most important of these is how much water the soil can hold.*

*If the amount of irrigation applied exceeds this level, run-off and/or deep drainage will occur. Scarce water supplies can be wasted in this way, thus lessening the number of irrigations possible with limited water supplies.*

One measure of a soil's irrigation capacity is called Readily Available Soil Water (RASW). The table below shows the level of RASW for each common soil type in the Bundaberg district. **These levels represent the safe upper limit for the total amount of water applied in any single irrigation.**

Crop water requirements increase as growth takes place. Young crops require only low amounts of irrigation. For first irrigations (especially in loose soil conditions encountered in young plant cane and cultivated ratoons), apply half to two-thirds of the RASW value only as shown in the table. This will result in an adequate "starter" irrigation with virtually no waste, while maintaining the same irrigation cycle.

### Readily available soil water and irrigation amounts for Bundaberg soils




Ground Cover

| Soil type | RASW value (mm) | Early irrigation (mm) 50% ground cover | Mid-crop irrigation (mm) 75% ground cover | Later irrigation (mm) 100% ground cover |
|---|---|---|---|---|
| Grey forest | 50 | 30 | 35 | 50 |
| Yellow forest | 60 | 35 | 45 | 60 |
| Red forest | 80 | 50 | 55 | 80 |
| Red volcanic | 80 | 50 | 55 | 80 |
| Alluvial | 60-80 | 35-50 | 45-55 | 60-80 |
| Black earth | 40-60 | 25-35 | 30-40 | 40-60 |
| Sand | 40 | 25 | 30 | 40 |

# OPERATIONAL EFFICIENCY FACTORS

*Extensive monitoring of furrow irrigation practices in the Bundaberg district has identified five important operational factors, that affect application efficiency.*

*These are:*

- *Inflow variability*
- *Inflow rate*
- *Advance rate*
- *Duration of irrigation*
- *Cut-off time*

The five efficiency factors are closely related: if one is not suited to the conditions, it is likely to adversely affect the others eg highly variable inflow causes uneven advance rates, which results in some rows reaching the outlet end of a block well before the others. If the irrigation is extended to allow the "slow" rows to reach the end, heavy end-fill, or out-flow, is likely to occur in the "fast" rows.

**It is important that the operational settings for the five factors are appropriate to achieve the desired amount of irrigation for the conditions prevailing in the block.**

Correct settings can be achieved in the following ways.

## Inflow variability

*A major cause of variable inflow is unevenly cut cups. To remedy this, use only* ***moulded*** *cups, or cups cleanly punched with a properly sized hollow punch. Avoid hand-cut cups. Where gated fluming is in use, variations in pressure strongly influence inflow variability; minor adjustment to one or more gates alters the flow of the remainder.*

***Moulded cups*** come in different sizes, eg Chino cups - small (22 mm), medium (30 mm) and large (40 mm). Generally, cups with the larger holes are suitable for early irrigations (say 1st and 2nd), followed by the medium size during the middle irrigations, and the small size for later waterings. They are also useful when inflow rates need adjustment to match prevailing soil conditions, pressure differentials, and varying row lengths.

With gated fluming, **gate size** should be matched to inflow requirements: 38 mm (1.5 inch) gates are best for flow rates up to 3 L/sec, and 57 mm (2.25 inch) gates are best for flow rates up to 6 L/sec.

### How to check

Check inflow at each cup or gate once delivery lines are full. Ensure that (a) the rate is appropriate, and (b) variability is no greater than + or – 7% from average. If inflow reduces noticeably the further cups are away from the pump, reduce the number of outlets until inflow is more even.

Adjust inflow rates to suit soil type and condition as follows:

- Relatively **high** for absorptive, cultivated conditions and for early irrigations;
- Relatively **low** for fast setting, uncultivated and/or compacted conditions and for late irrigations;
- Decrease inflow rates as the irrigation season progresses.

A guide to suitable inflow rates for a range of usual conditions is shown in the table:

| **Soil type** | **Inflow rate (litres/sec)** | | |
|---|---|---|---|
| | **Early season or freshly cultivated conditions** | **Mid-season and/or uncultivated or compacted conditions** | **Late season and/or uncultivated or compacted conditions** |
| Red volcanic | 4-6 | 2–4 | 2-4 |
| Red forest and sandy soils | 3-5 | 1-3 | 1-3 |
| Grey forest, yellow forest, black earth | 2–4 | 1-2 | 1–1.5 |

## Advance

*The rate at which water advances down a furrow is strongly influenced by:*

- *Inflow rate*
- *Size and shape of the furrow*
- *Slope*
- *Soil condition*

*A slow, uneven advance can lead to deep infiltration and high end-fill or run-off. Manage advance rates by adjusting inflow rates and ensuring correct furrow shape and size for the soil type and conditions.*

Match the furrow shape and size with the absorptive capacity of the soil:

- Use **narrow V-shaped furrows for highly absorptive soils** such as red volcanics, red forest soils, and sandy soils;
- Use **wide, shallow furrows for soils with low absorption** characteristics such as grey forest soils, yellow forest soils, and black earths.

**Tips**

Time the advance on the first run in each block.

- If the time taken to advance in the second half of the block is *more than twice* that for the first half, *increase* inflow rate.
- If the time taken for the second half is *less than twice* taken for the first half, *decrease* the inflow rate.

## Duration of irrigation and cut-off

*The time taken for a single irrigation determines the total amount of water applied. This should be long enough to ensure an even wetting to the target depth, but not exceeding the water holding capacity of the soil. High inflow rates reduce irrigation time and generally result in application of less water. Heavy infiltration losses and/or run-off, and extreme wetting of the outflow end of fields occur when irrigation duration is too long.*

- Ensure inflow rates, and advance rates, result in a suitable duration time for the soil type and its condition (see previous notes).
- Match inflow rate, row shape and size, and duration with the rate of advance and cut-off to achieve a total application not exceeding the RASW.
- Check that the advance is relatively even and there is no necessity to wait long periods for "slow rows" to come through.
- Bank row ends.
- Cut off flow in individual rows once water reaches the end.
- Where high inflows are applied to highly absorptive soils, consider cut-off *before water reaches the ends*.
- *Do not practise end-filling*.

**Monitoring**

*Knowing how much water goes on, and where it ends up, are good practical indicators of irrigation efficiency. Relating water applied to growth of cane gives the irrigator the information needed to judge how much, and how often, water is needed. Monitoring of these factors can be achieved at low cost using a number of simple methods.*

**Total water use** is easily monitored by recording water meter readings before and after irrigation takes place. Details of how to read various meters are on the back cover of this handbook.

*Soil moisture levels* can be monitored by use of **tensiometers** placed in, or near, cane rows. Using 30 cm and 60 cm tensiometers in pairs will provide a graphic picture of changes in soil moisture, and signal when irrigation is required.

*Moisture probes* such as Diviner 2000 and Enviroscan can provide rapid, accurate assessment of moisture down the soil profile and show rate of water use. Similar instruments are available at lower cost but are probably not as reliable as the two exampled.

Comparing **growth measurements** to soil moisture levels, or those of a water evaporation pan, will also signal when irrigation is needed.

These techniques not only help select start-up times after rain, scheduling and other management considerations but also help prevent losses from over-wetting. As a result, scarce water supplies can be better used. The result is improved income for total water applied through an increase in marginal returns after core production expenses (fertilizer, cultivation, pesticides, etc) have been met.

*A monitoring audit and establishment service is provided by Sugar Services. To find out how to set up a low-cost monitoring program on your farm phone 41 325200 for further information.*

## Tailwater and run-off

When it occurs, tailwater should be harvested and stored in small tailwater structures or on-farm water storages. These also trap run-off from rainfall thus providing additional water for irrigation. Run-off in the Bundaberg area approximates 0.7-1.0 ML/ha/year, worthy of saving where opportunity allows.

## CHECK LIST

- Read the water meter before and after irrigation to check application rates.
- Check that inflow from individual outlets does not vary by more than 7% from the average inflow.
- Adjust inflow rate to suit soil type and condition:

  - relatively fast for absorptive soils and/or cultivated conditions
  - relatively slow for fast setting soils, uncultivated or compacted conditions.

- Take particular care with first irrigations – use relatively high inflow and short duration.
- Use narrow furrows for highly absorptive soils, wide furrows for soils with low absorption.
- Decrease inflow rates with successive irrigations.
- Monitor advance times on the first run in each block:

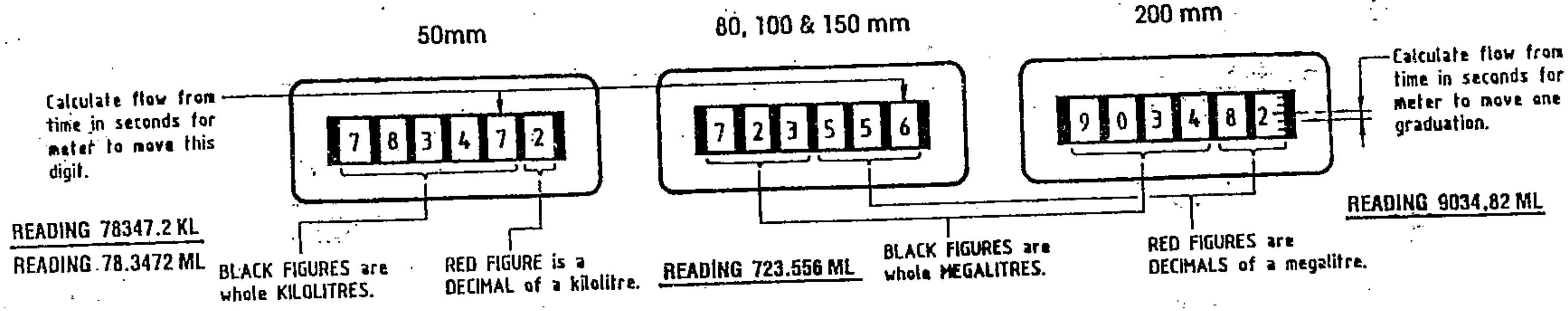
  - increase inflow if time elapsed in the second half of the advance is more than twice that of the first half
  - decrease inflow if time elapsed is *less* than twice that for the first half.

- Adjust cut-off to ensure a controlled recession or end-fill. (This may mean cutting off before water reaches the end).
- Avoid long end-fills. Cut off "fast" rows once water reaches the end.
- Block ends.
- Where trash blanketing, form furrows and hill up rows adequately in plant cane to help maintain suitable row profiles in ratoons.
- Irrigate *alternate rows* in ratoons and past out-of-hand stage in plant cane, except where soils have poor lateral wetting characteristics.
- Adjust inflow to suit trash blanketing conditions.
- Try surge techniques where relatively long rows (>400 m) and low grades exist.

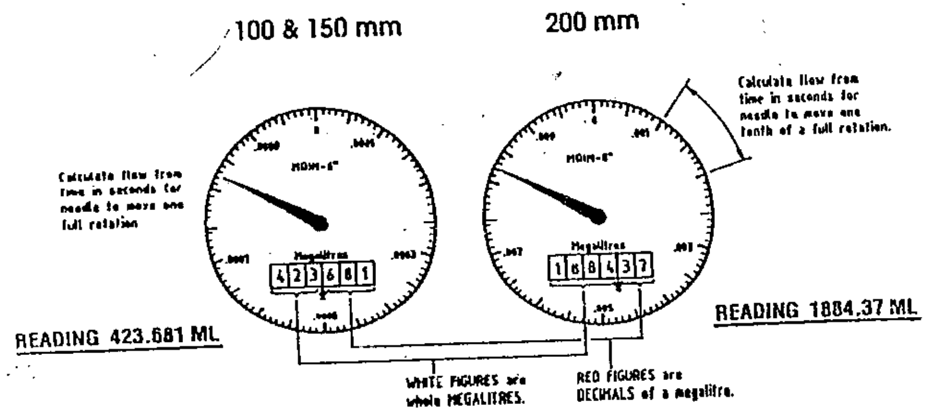
*For further information on how to check your irrigation operation settings, or for other advice on irrigation, call SUGAR SERVICES on 41 325200.*

# HOW TO READ YOUR METER & CALCULATE FLOW RATE

## DAVIES SHEPHARD METERS




## BADGER METERS




## RMC METERS

### 80 & 100mm