

How to improve every irrigation bay

An effective system for faster and more uniform irrigations

AGRICULTURE VICTORIA

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WHAT'S THE PROBLEM WITH CONVENTIONAL IRRIGATION BAYS?

Border-check irrigations have a fundamental problem that arises because drainage of excess surface water from bays is very much slower than the process of applying the water. Excess surface water at the top of bays must find its way to the drain at the foot of the bay by flowing across the entire downslope surface in a process that can take days to complete and produces non-uniform irrigations.

Longer periods of ponding also increase the duration of saturation in the rootzone with each irrigation. This can reduce root zone oxygen, stressing pasture and crop species while favoring weeds adapted to waterlogging. Longer periods of root zone saturation also increase vulnerability to damage by stock and machinery.

WHY IS THIS IMPORTANT NOW?

With system modernisation irrigators have the opportunity to more precisely schedule irrigations to better meet plant water need. At the same time, new and improved systems for irrigation scheduling are the focus of active ongoing research, development and extension.

Optimal irrigation schedules for the top of conventional bays will favour unproductive swamp plants at the bottoms of bays. Optimising schedules for the bottom of bays will cause regular periods of water stress at the top.

Reducing the duration of surface water ponding on bays can also save water otherwise lost to deep drainage or evaporation, provided that surface drainage and reuse systems are efficient.

SO WHAT IS THIS BAY MODIFICATION?

The bay modification consists of very shallow surface drains that run parallel with check-banks. The drains are installed only 1 to 2 cm deep and about 20 cm wide. They are spaced 10 to 15 metres apart, and extend from the paddock drain at the foot of the bay to between 10 and 20 metres from the top of the bay (Figure 1).

The drains are installed with a tractor mounted rotary digger. Care is taken to cut shallow drains – they do not need to be any deeper than about 2 cm. By installing the drains at a shallow depth, they can be cut relatively quickly, reducing the cost of installation and reducing the impact the drains can have on vehicles.

In 2016 we measured surface water after irrigating a one hectare conventional perennial pasture bay. The bay had been laser landformed in the previous year and looked in excellent condition with new pasture not yet fully established.

We then repeated the measurements after installing the bay modification (Figure 2).



Figure 1: Shallow surface drain installed on a pasture bay

With the surface drains installed, all areas of the bay received a similar irrigation and experienced shorter durations of surface water ponding. The irrigation schedule for this bay could be optimized and be optimal for the whole bay.

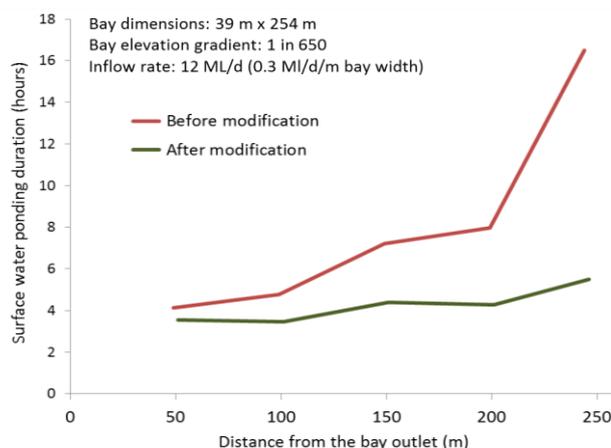


Figure 2: Measured average duration of surface water ponding after border-check irrigation on a bay before and after bay surface modification

HOW DID YOU ARRIVE AT THIS BAY SURFACE MODIFICATION?

The modification has been used on a small number of dairy farms in northern Victoria for more than a decade, and farmers who have implemented the design are convinced of its value.

In 2015 we adapted the ANUGA inundation model to use as a two dimensional surface irrigation model. We used the model to compare a large variety of potential bay surface modifications under a wide range of bay dimensions, slopes, inflow rates, soil types and crops. The simple modification described here was the stand-out of all the bay modifications we tested, achieving rapid surface drainage and much greater irrigation uniformity on a wide range of simulated bay slopes, dimensions, inflow rates, surface roughness and soil types. While most of our field assessments have been on perennial pasture, the modification would have application on other shallow rooted crops.

Farmers with practical experience and using trial and error, and researchers taking a theoretical, computer modelling approach have independently arrived at the same modification to improve the performance of irrigation bays.

WHAT IS REQUIRED?

Surface drainage and reuse

An efficient drainage and reuse system is essential with these bays. When compared to a conventional bay, the modified bay surface will increase surface runoff from a given irrigation because

- less water is lost to deep drainage,
- less water remains ponded on the bay surface
- early in the irrigation some water completely bypasses the bay surface in the surface drains.

The peak runoff flow rate will also be higher because drainage from the bay surface will be much faster.

Installation

The drain layout is measured and marked out before the drain is installed. The surface drains are installed with a rotary drain digger set to a depth of about 2 cm. Because the drains are shallow and require relatively little material to be removed, they are relatively quick to install and have minimal impact on machinery and stock.

The recommended 10 to 15 metre drain spacing is based on the experience of irrigators using the system.

For bays between 40 and 60 metres wide (i.e. most bays) this works out to between 3 and 5 drains per bay.

Experience indicates that if there is a borderline choice, opt for more rather than fewer drains.

Maintenance

Drain cleaning is necessary to ensure the drains provide unimpeded water flow. On the farm where our experimental site was located in northern Victoria, the drains are cleaned with a rotary digger after every second grazing during the irrigation season. Care is taken to ensure minimal removal of material to prevent the drains becoming deeper.

On other sites, farmers have reduced maintenance costs by using herbicide to control plant growth in the surface drains, reducing the frequency of mechanical cleaning.

WHAT ARE THE BENEFITS?

Farmers using the modified bays believe their pasture production is consistently high and more uniform in modified bays. Bays with surface drains are trafficable sooner after irrigations and after heavy rainfall, reducing damage.

We have not been able to show a statistically significant difference in pasture production between conventional and modified bays because of the high degree of uncertainty in pasture production measurements. To overcome this would require a field experiment on many replicated modified and conventional bays, with tight control over all the factors that affect production other than the bay modification.

We have been able to measure substantial improvements in bay hydrology. Deep drainage losses are reduced. Farmers report that improved drainage of bay surfaces allows grazing within 48 hours after irrigations and gets winter rainfall off bays quickly, reducing damage by cows.

With supply system modernisation and irrigation automation, these modified bays will enable more precise irrigation scheduling for the entire bay and make possible optimization of irrigations across the entire bay area.

WHAT DOES IT COST?

A cost analysis based on the bay management practices of a farmer using modified bays indicates that his bay surface drain installation cost was approximately \$29 per hectare, with ongoing drain maintenance costs of approximately \$71 per hectare each year. Labour and fuel comprise 80% of this cost.

FOR FURTHER HELP

A Technical Note with more information is available at: agriculture.vic.gov.au

ACCESSIBILITY

If you would like to receive this publication in an accessible format, please telephone Mike Morris, Agriculture Victoria on 03 5833 5283.

This document is also available in PDF format at agriculture.vic.gov.au