"Surge Flow Irrigation"

(or Increased Pressure Head Irrigation)

Funded through the
South East Natural Resources Management Board
Irrigation Efficiency Project
September 2008 – June 2010

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Introduction

Irrigation efficiency on-farm is the effectiveness of irrigation (applying the right amount of water at the right time, evenly and reliably so that the crop can use the water), the profitability of the irrigation enterprise ($/ML) and ensuring the sustainability of the resource for future generations.

The purpose of this project was to upgrade existing infrastructure (ie open channels and gates) to suit a modified Surge Flow irrigation management strategy. We were aiming to increase the precision of each irrigation and reduce losses to deep percolation – drainage beyond the rootzone.

The greatest water loss associated with surface irrigation in the South East was through deep percolation beyond the rootzone – commonly related to slow water advance and excessive infiltration opportunity time for each application.
Large losses to deep percolation contribute to poor application efficiency, wastes energy and resources and may have a negative impact on groundwater resources.

Extending on from the implementation of the Surge Flow system, the next stage was to establish automated irrigation control structures and to look at methods of reducing delivery losses further.

The main purpose of the proposed management system is to reduce irrigation time by delivering an increased, but controlled, surge of water into each bay; thereby reducing infiltration opportunity time. The enhanced surge is a result of higher head in the delivery channel, created by enhancing channel capacity. Application efficiency improves with higher application precision as the volume of water delivered better suits the plant requirements.

Methodology

The following changes in infrastructure and methods were implemented through the life of the project

- **Levelling of bays**
  All bays were previously laser levelled to ensure a fall of 1 in 1600 per bay.

- **Installation of Soil Moisture monitoring equipment – G Dots**

  The GDot is a simple, robust, highly visible device which displays soil moisture tension (or the ability for the plant to extract water from the soil) from a sensor buried in the crop's root zone. When the soil is very wet and it's easy for the roots to access water, the GDot shows a full complement of seven yellow dots. As the soil dries out, the plants have to work harder and the yellow dots disappear. When only a few dots remain, most crops are on their way to experiencing water stress, and that is the cue to irrigate.

  In the past watering was done on a average 10 day cycle, however with the use of the soil moisture monitoring system we were able to water when the plant required it.

- **Drilling of new bore**

  This was done to increase the amount of megalitres being pumped into the channel. Due to the drop in pumping flow rates per bore it has been found to be more efficient to have a greater number of bores contributing to the channel per watering. Through the life of the project there were 5 bores contributing to each irrigation with an average flow rate 160 – 200 kL/hr. In the past bores were producing flow rates up to 500 kL/hr, with two pumps contributing to each irrigation event.

- **Upgrading of channels**

  The channels throughout the property became fully interconnected to allow all pumps to be utilized.
  Following surveying of channels to ensure the correct fall, leveling was undertaken, with limestone rubble being used due to its sealing properties. Following this process all channels were compacted using a padfoot roller to reduce losses due to seepage.
  Channel height and width was increased so that the system now holds 3.5 megalitres of water at full capacity. We are looking at increasing this further in the future.

- **Installation of "Padman Stop" gates, bay sensors and controllers**
  A "Padman Stop" fully sealed gate (see below pictures), with an opening of 4 foot, was installed in each bay opening of the channel.
  A "Padman Stop" is a 100% watertight rubber flap set in a concrete structure that makes it easy to automate gravity flow water, thus reducing the loss of water from leaking bay outlets.

  These gates are used with a bay sensor, used in sequence with the radio timer which is mounted on each gate and a float system.

  The bay sensor is placed strategically down the bay, so that when the water reaches the unit it sends a radio signal to close the watered bay. Each sensor was placed in such a position to allow the end of the bay to be watered without wastage, this position was determined from historical records. In the event of bays being overwatering due to malfunctions, there was a small check bank installed at the end of the paddock to force the water into the next bay, to prevent flow onto roadways and adjoining paddocks, ie wastage.

  Once that gate has closed the channel then is allowed to refill before tripping the float at a predetermined level, which then notifies the controller to open the next gate in the sequence.

Results

2009/10 Watering No	Hours to water	Ave Hours/Bay	mgL/ha	Comments
1	47.5	3	1.74	In 2007 the first watering took 156 hrs and used 4.79 mgL/ha.
2	40.25	2.5	1.61	
3	38.25	2.5	1.53	
4	42.5	2.65	1.5	
5	42.75	2.67	1.1	
6	??	??	1.6	Records not kept of end time
7	46.5	2.5	1.52	
8	41.5	2.3	1.35	

The above table shows individual watering for Paddock 9 which is a total of 18 hectares and is planted to Sirosa Phalaris.

As you can see from the above table each watering averaged 1.5 megalitres/hectares with an average pumping time of 42.5 hours for the entire paddock.

In 2007, prior to upgrading our system, the same paddock and crop required from 90 to 150 hours pumping time and an average 3.3 megalitres per hectare.

Our yields for 2010 were 600 kilograms per hectare, which were approximately 200 kilograms per hectare above the district average.

Seed testing also showed an increase in germination from 65% in 2007 to above 85% in 2009/10.

Summary

Even though this was an expensive trial our expectations from this project were exceeded on almost all levels. If we had not undertaken some changes to our operation we would not have had the water available (from license) or accessible (physically) to be able to maintain our current production standards.

We did anticipate some improvements, but the fact that we saw improvements in watering time, quantity of water used, yields and seed quality was an extremely pleasing result. It is our believe that the results from our trials could be applied to any surface irrigation system in any district.

In the coming weeks we are endeavouring to upgrade all of our irrigation areas to replicate this trial.

There are several other areas we are now looking at trialling to improve this efficiency further. This includes trialling various plant row spacings, both at time of sowing and through the use of a shielded sprayer, to assist the path of the water over the bay.

Another important area of interest demonstrated through this project was the importance of accurate record keeping, for both management of the current watering and also to allow us to be aware of trends as they are occurring through the years.

This has been a very worthwhile exercise for us and has returned our enthusiasm for irrigating.

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