



Australian Government  
Cotton Research and  
Development Corporation



# Real-time, web-enabled adaptive control and monitoring of surface and overhead irrigation systems

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# Irrigation control system



Surface irrigation system



Overhead irrigation system



1. Sensors

2. Control strategy

3. Real-time  
irrigation  
adjustment

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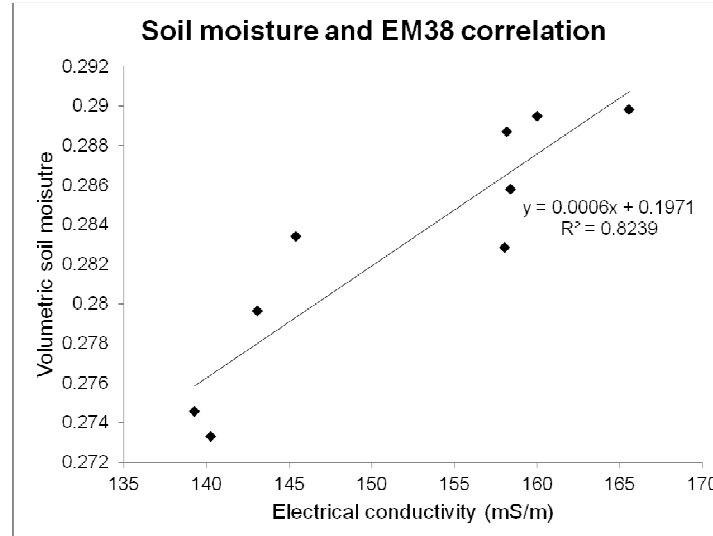
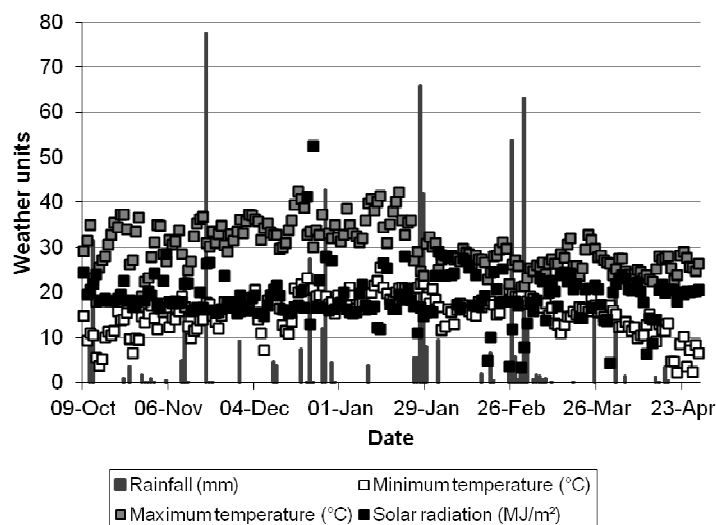
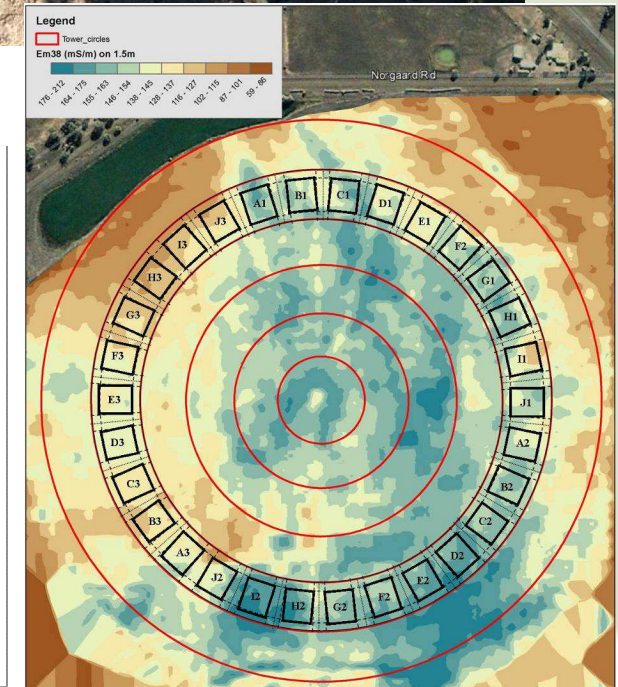
# Internet-enabled infield sensors



## ■ Data uploaded to server from:

- Weather station
- Soil moisture sensors

## ■ Variability estimated from EM surveys



# Fruit load estimation sensor



Overhead-mounted platform for centre pivots/lateral moves



Ground-based platform for surface irrigation



# Irrigation application

- Advance meters
- Flow meters on surface and overhead systems



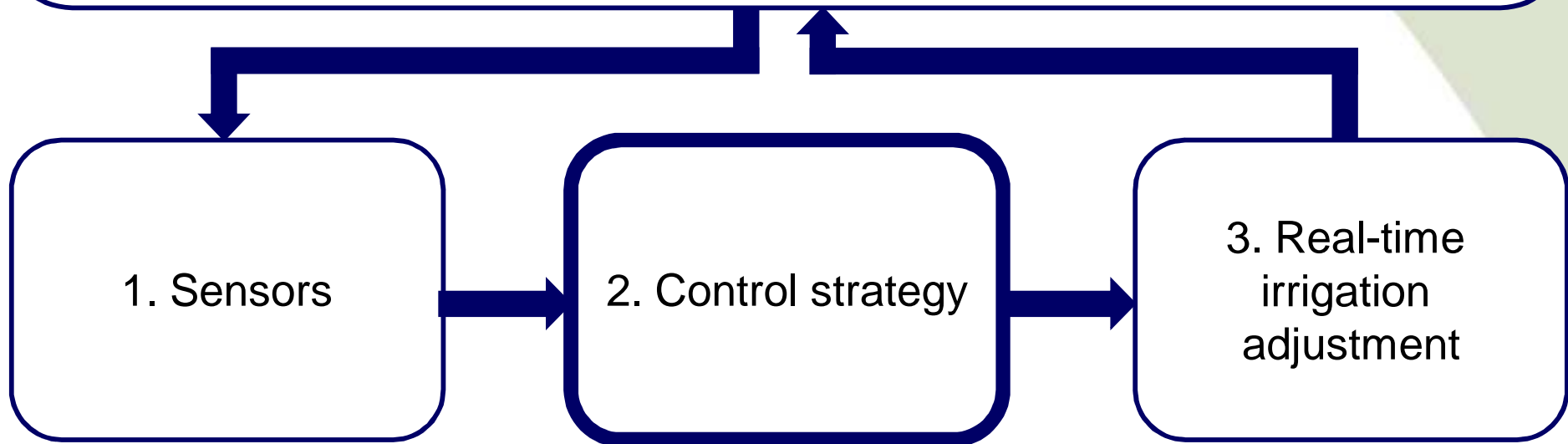
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# Irrigation control strategies

- Use sensed data to determine irrigation application/timing
- Developed adaptive control frameworks:
  - AutoFurrow – real-time surface irrigation event optimisation
  - VARlwise – site-specific surface/overhead irrigation control



# AutoFurrow



## ■ Real-time optimisation of irrigation along surface irrigated fields

- Requires advance and flow measurements
- Simulates hydraulics
- Determines flow rate and cut-off time to optimise application efficiency or distribution uniformity

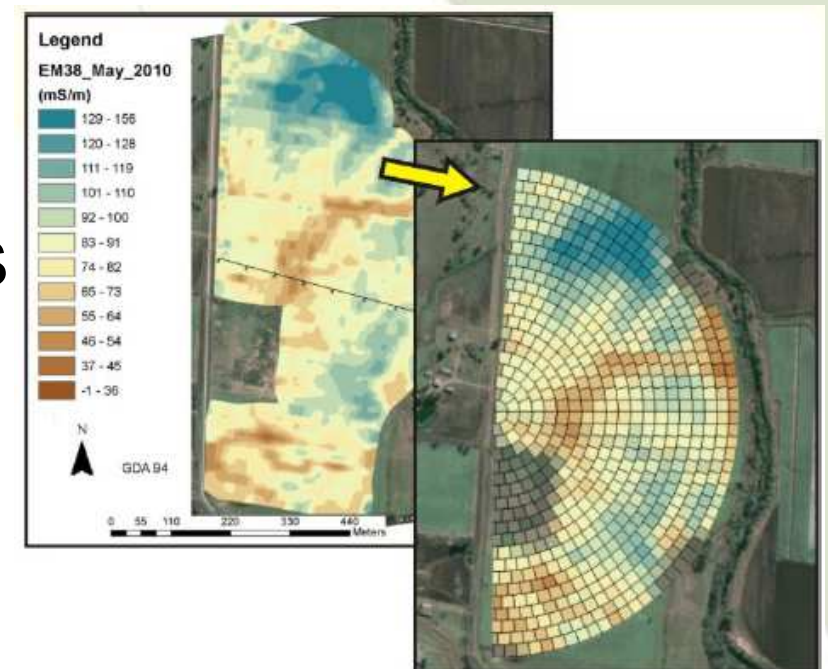
The screenshot displays the 'Furrow Irrigation Control' software interface. The window title is 'Furrow Irrigation Control'. The interface is divided into several sections:

- Field Data:** Includes input fields for Field Length (970 m), Manning n (0.04), Spacing (1 m), and Slope (0.0007 m/m).
- Furrow Dimension:** Includes input fields for Top Width (0.8 m), Middle Width (0.52 m), Bottom Width (0.25 m), and Max Depth (0.15 m).
- Infiltration Parameters:** A red box highlights this section, containing parameters: a (0.2264), k (0.01329), f (0), r (0.8635), and Deficit (80 mm).
- Inflow Data:** Includes a checkbox for 'Over-ride inflow data with manual value', Flow Rate (6 L/s), Area (A0) (0.0525612587 m x m), and Advance Distance (500 m).
- Field Survey:** A table with columns 'Distance (m)' and 'RL'. A red box highlights the 'Strategy' section below it, which includes: DU >= 55 %, RE >= 90 %, AE >= 65 %, and Min Depth 0 mm.
- Inflow:** A table showing 'Time', 'Flow Rate (l/s)', and 'P (m)'. The first row is highlighted in blue.
- Result:** A table showing 'AE', 'DU', 'RE', 'Time to cut off', 'Advance time', 'Scaling Factor', 'a', 'k', 'f0', and 'Min depth'. The 'Time to cut off' row is highlighted in red, showing 280.00 min.

# VARlwise



- Simulates and develops irrigation control strategies at spatial resolution to  $1\text{m}^2$  and any temporal resolution
- Control strategies based on difference between measured and desired performance
- Analyses irrigation hydraulics and updates irrigation control signals



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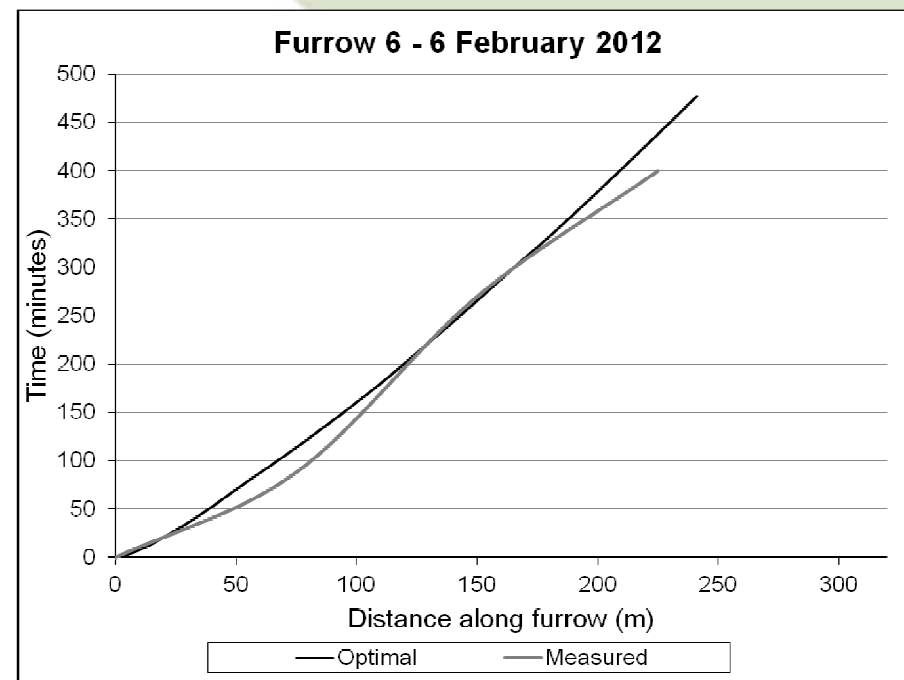


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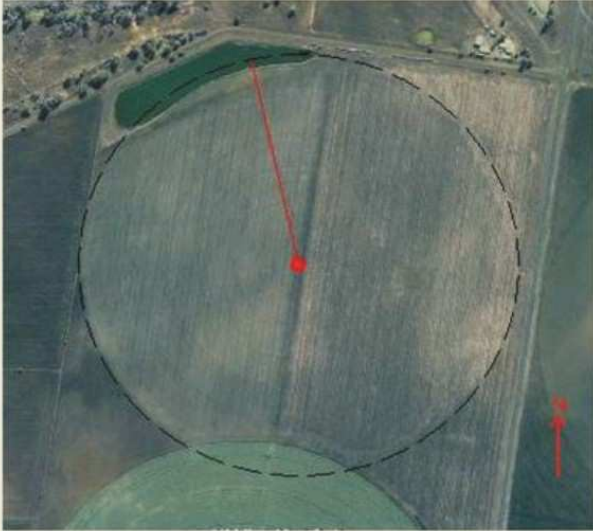
# Real-time surface irrigation adjustment



# Real-time overhead irrigation adjustment



Irrigation valve control LogMeIn - Remote Session

Servo	Open	Closed	Flow rate
1	120	150	0.373
2	107	148	0.403
3	100	148	0.376
4	95	152	0.363
5	105	160	0.37
6	114	145	0.345
7	126	156	0.393
8	105	150	0.375
9	105	160	0.435
10	105	151	0.463
11	105	146	0.412
12	95	144	0.431
13	106	153	0.426
14	120	151	0.4
15	119	153	0.47

All valve details

Current location: -27.392621458°S, 151.60634491°E, at bearing 347.2°

Bearing	Latitude	Longitude	Direction	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
228	-27.5560	151.91716	CW	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
240	-27.5560	151.91716	CW	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
252	-27.5560	151.91716	CW	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
264	-27.5560	151.91716	CW	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
276	-27.5560	151.91716	CW	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
288	-27.5560	151.91716	CW	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
300	-27.5560	151.91716	CW	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
312	-27.5560	151.91716	CW	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
324	-27.5560	151.91716	CW	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
336	-27.5560	151.91716	CW	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
348	-27.5560	151.91716	CW	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75



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# Irrigation control system implementation



- Bay irrigated dairy fields in Victoria
- Siphon surface irrigated cotton farms
- Centre pivot irrigated cotton
- Setting up for gated pipe implementation



# Conclusion



- Created frameworks that enables spatial/point-based databases
- Developed Internet-enabled sensors for input to control strategies
- Forms basis for automated irrigation decision-making



# Acknowledgements



- Cotton Research and Development Corporation
- Nigel Hopson and Lindsay Evans for providing field trial sites
- Dr Malcolm Gillies for surface irrigation model support
- Dr Jochen Eberhard for data collection assistance