



Sapphire Irrigation Consulting

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‘Limestone Park’ Irrigation Systems

May 2017

Irrigation performance

- Irrigation systems evaluated March 2016
- Measures include: uniformity, application depth, application rate, pressure, flow rate, pump efficiency
- Adjustments made to each system:
 - new pumps
 - new water meters
 - control panels recalibrated
 - Original nozzles re-installed, pressure restored (LM)
 - sprinkler positions adjusted (Flats CP)
- Systems re-evaluated January and March 2017



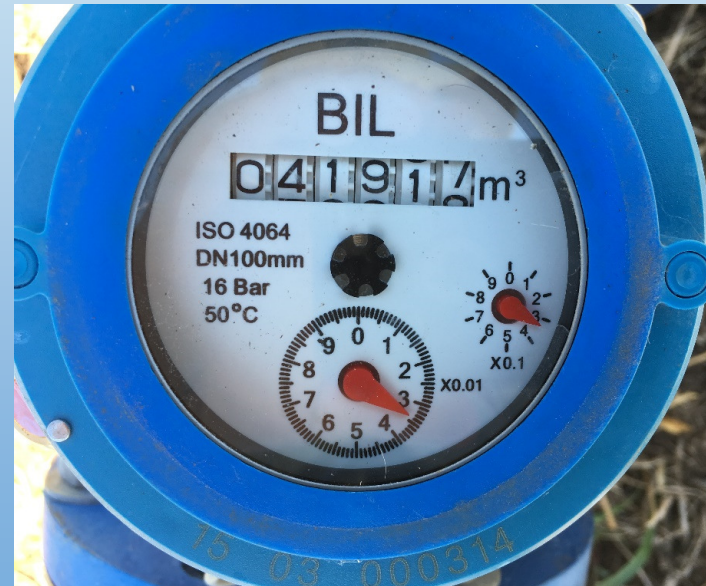
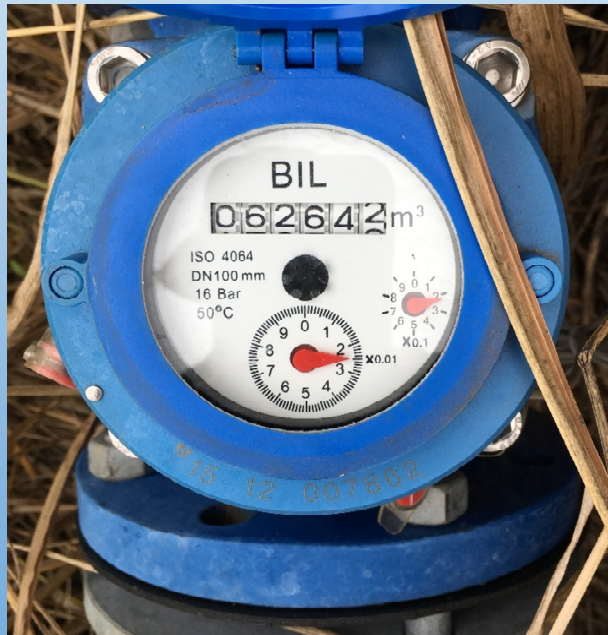
Pump specs

	River pump		Well pump	
Brand:	Old: Grundfos	New: Goulds	Old: Stalker	New: Davey
Model:	2RPSGC2C	GIS	65 HL	ISO Spec
Inlet/Outlet:	80 x 50 – 250	80 x 50 – 200	N/A	80 x 65 – 160
Impeller size:	257 mm	210 mm	271 mm	163 mm
Suction lift:	5 m est	5 m est	4 m est	3.75 m
Suction pipe:	8 m of 6 inch poly, foot-valve, coarse strainer plus shade cloth		4.1 m of 6 inch poly, foot-valve, coarse strainer, 90 degree gal curve, offset reducer	
Motor:	Teco, 22 kW, 2935 rpm	Monarch, 18.5 kW, 2840 rpm	Western Electric, 30 or 37 kW, 2955 rpm	Davey ISO Spec, 7.5 kW, 2928 rpm



Water meters

- **Water meter validation** April 2016 by Certified Meter Installer: river meter +22.8%, well meter +9.9%
- Two new water meters installed



Irrigation performance

Improved

Same

Worse

	'Hill' centre pivot		'Flats' centre pivot		Lateral Move	
	2016	2017	2016	2017	2016	2017
Power use	26 kW	18 kW	27 kW	6 kW	30 kW rated	8.7 kW
Pump efficiency	46%	63%	12%	75%	Not obtained	68%
Pump flow rate	-3%	-3%	-26%	-8%	+12%	+12%
Pump pressure	505 kPa	469 kPa	165 kPa	179 kPa	103 kPa	205 kPa
Centre/cart pressure	214 kPa (-6%)	128 kPa (-44%)	155 kPa (+41%)	155 kPa (+41%)	69 kPa (-33%)	172 kPa (+23%)
End pressure	200 kPa (+98%)	103 kPa (0%)	135 kPa (+29%)	N/A	0 kPa (-100%)	70 kPa (-30%)
Application depth	-25%	+8%	-28%	+4%	+268%	-10%
Application rate	32 mm/hr	32 mm/hr	34 mm/hr	32 mm/hr	36 mm/hr	29 mm/hr
Runoff	nil	nil	nil	nil	much	nil
End-gun throw	8m short	8m short	7.7m short	12.7m short	2m long	3m short
Uniformity (CU)	83%	86%	86%	86%	79%	82%

Irrigation performance

Centre pivots

- River pump efficiency much improved for both duties – theoretical efficiency not achieved for Hill CP, exceeded for Flats CP
- Control panels on both CPs re-calibrated – depth applied now close to what is indicated
- New water meter appears to be reading accurately
- Design System Capacity for the 'Hill' CP is 17.7 mm/day – for lucerne, 11 hours a day of operation is needed
- Design System Capacity for the 'Flats' CP is 18.0 mm/day – for lucerne, 10 hours a day of operation is needed
- New electric motor 18.5 kW – 'Hill' CP 17.8 kW, 'Flats' CP 6 kW – comfortably within its range
- The 'Flats' CP had 20 emitters fitted to spans 2 and 3 but 21 specified – not fixed for the second evaluation – since rectified



Irrigation performance

Lateral Move

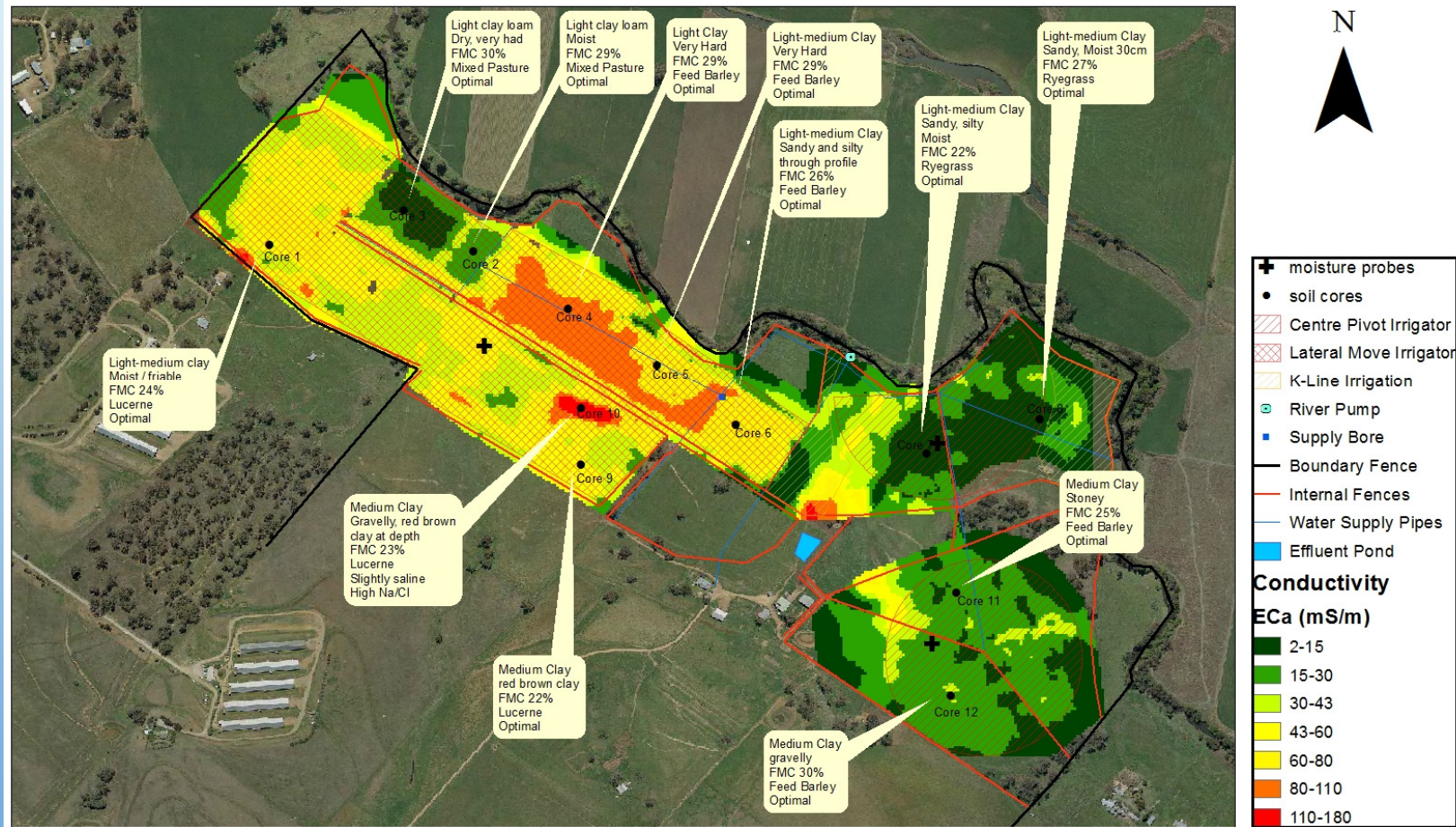
- Performance much better – original sprinkler package reinstalled, pump replaced
- Average amount applied 18.0 mm – only 10% lower than control panel – improved from +268%
- Water movement within the field was low and no runoff – much lower Average Application Depth 18 mm compared to 44 mm
- End-gun radius a little shorter than specified 20 m compared to 23 m – reverse of first evaluation 25 m – specified, smaller nozzle reinstalled
- Pump efficiency much better 68% – but did not attain 75% indicated on performance curve
- New electric motor capacity 7.5 kW but measured power usage 8.71 kW – extra power maybe used in cable from meter to motor – but new motor has little extra capacity to allow for wear, etc.
- Investigate how to improve the pressure in the overhang
- Reposition and secure the first half-throw sprinkler on Span 1
- Leak on Span 2 near the first sprinkler needs to be repaired



Irrigation scheduling

Soil moisture monitoring – selected sites by 'majority' soil type from EM survey

Limestone Park' Rex Tout - Irrigation, EM Survey and Soil Type



Irrigation scheduling

Soil moisture monitoring

- One site for each system
 - ‘Hill’ CP: 15 and 40 cm, rain gauge
 - ‘Flats’ CP: 15, 40, 120 cm
 - Lateral move: 15, 40, 120 cm
- ‘Watermark’ porous-media tension blocks – indicate plant stress
- ‘Tain’ loggers, telemetry, internet graphics
- Also ‘Scheduling Irrigation Diary’ (NCEA) and ‘IrriSat’

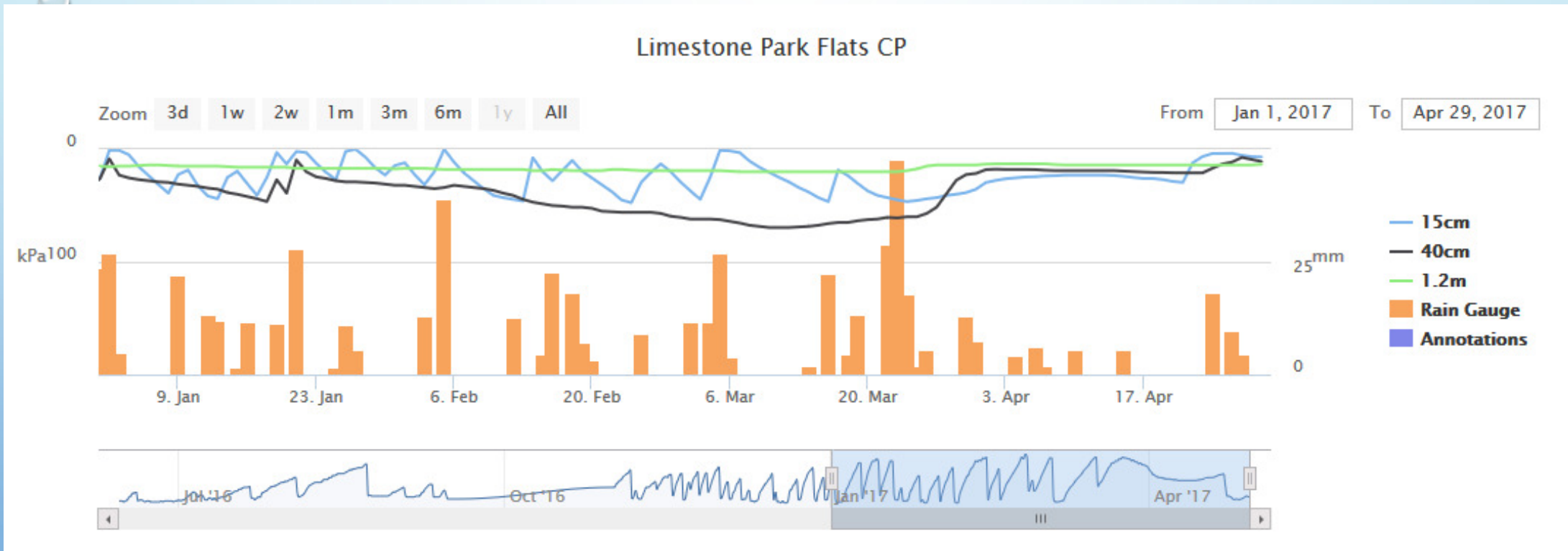


Irrigation scheduling

- **Main learning: the crops were using more water than Rex thought**
- Realised irrigation not starting soon enough – crops suffered from under watering
- Soil probes and ETo data from 'IrriSat' generally reinforced Rex's view of what was occurring – usually pointed in same direction about when to irrigate – but did not always exactly agree
- Scheduling improved – visibly evident in better pasture growth
- After one season, Rex wants to continue using the soil probes – would not need to download data as often
- Downloading is a disincentive – real-time data direct to mobile or G-Dot preferable
- Soil probes and loggers required r&m several times during the season
- Later in the season, odd responses from a couple of sensors created doubt about the reliability




Irrigation scheduling



Irrigation scheduling

- ‘Scheduling Irrigation Diary’ useful for pulling down rainfall and ETo from BOM and understanding general principles of scheduling – but not sufficiently accurate or user-friendly for Rex to continue using it



Scheduling Irrigation Diary

[KMSI Home](#)[Change Password](#)[rtout](#)














[Home](#)> [Set up](#)> Enter Data

Step 1
Set up

↓

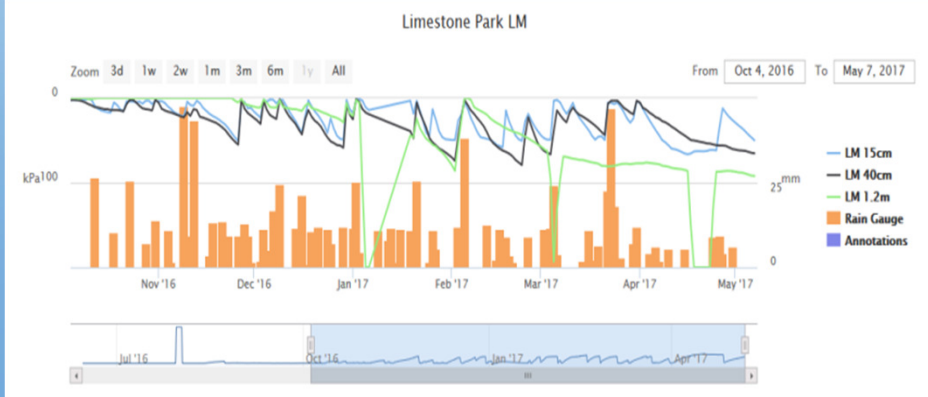
Step 2
Enter data

↓

LIMESTONE PARK			MON 24 APR	TUE 25 APR	WED 26 APR	THU 27 APR	FRI 28 APR	SAT 29 APR	SUN 30 APR	Total in-seas on rain (mm)	Total irrig. (mm)	Irrig. due in (days)	Actual harvest date	Graphs
Field	Crop		◀						▶					
		tamworth airport	0	0	11	6	0	0	0					
LATERA L 2	lucerne (other cutting cycles)	Irrigation	0	0	0	0	0	0	0	1005.6	340	overdue		  
LATERA L 6	lucerne (other cutting cycles)		0	0	0	0	0	0	0	1005.6	220	overdue		  
Top Pivot	ryegrass		0	0	0	0	0	0	0	117.0	22	overdue		  
Flat Pivot	ryegrass		10	0	0	0	0	0	0	117.0	22	overdue		  
		Evapo- transpiration	3.4	3.9	3.5	1.4	2.7	2.6	3.4					

Irrigation scheduling

- 'IrriSat' compared by NSW DPI – provided useful data but Rex did not use it enough to know if he would continue
- Generally both soil and satellite sources pointed in the same direction eg. crop water requirement (green line) v total water applied (purple line) – deviate 1 Feb to 29 April – deficit not overcome until rain late March. Soil moisture (red line) shows mining.





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Irrigation systems specs

	'Hill' CP	'Flats' CP (part circle)	Lateral move
Irrigator make	Reinke	Reinke	Reinke, end-feed
Designed Flow Rate	20.0 L/s	18.3 L/s	18 L/s
Designed pressure (at centre)	33 psi, 228 kPa	16 psi, 110 kPa	15 psi, 103 kPa
Number of Spans	3 + overhang	3 + overhang	2 + overhang
Total length	150.4 metres	176.5 metres	135 metres
Emitter model	IWob UP3	IWob UP3	IWob UP3 #16 nozzle pack
Number of emitters along span – spec	Span 1: 11, Span 2: 16, Span 3: 16	Span 1: 12, Span 2: 21, Span 3: 21	Span 1: 16, Span 2: 21
Number of emitters along span – actual	Span 1: 11, Span 2: 16, Span 3: 16	Span 1: 12, Span 2: 20, Span 3: 20	Span 1: 16, Span 2: 21
Wetted width (diameter) – end span	15.9 metres	14.0 metres	10.5 metres
Number of emitters on overhang	3	2	7
End gun	Nelson SR100 18deg 0.65	Nelson SR75 18deg 0.55	Nelson SR75 18deg 0.4
End gun radius – specified	33 metres	27.7 metres	22.8 metres
End gun radius – measured	25 metres	20 metres	25 metres
Pressure regulators	10 psi Senninger	10 psi Senninger	10 psi Senninger
Wetted area	9.6 ha	8.1 ha	22 ha

