Measuring and Modelling Soil Acidification on Eyre Peninsula

RURAL SOLUTIONS SA
PIRSA

Soil Acidity Technical Update

17th October 2016.

Brett Masters

Soil and Land Management Consultant,

PIRSA Rural Solutions SA

Natural Resources Eyre Peninsula

Government of South Australia
Department of Environment, Water and Natural Resources

Australian Government
National Landcare Programme

LEADA
Lower Eyre Agricultural Development Association

GRDC
Grains Research & Development Corporation
Your GRDC working with you

Agricultural Bureau of South Australia Inc.
PATHWAY TO IMPROVEMENT

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

SOUTH AUSTRALIA

Government of South Australia
Primary Industries and Regions SA

PROJECT BACKGROUND.

- Natural Resources Eyre Peninsula (NREP) surveillance sampling on 40 sites
- Surface (0-10 cm) pH has on average dropped by 0.5 pH units in 4-5 years

These pH changes indicate that with the seasonal conditions during this period and current farming practices acidification is occurring more rapidly than historical estimates

FACTORS INFLUENCING ACIDIFICATION RATES

- Highly productive crops requiring very high fertiliser N inputs
  - Canola/Wheat rotations
  - Urea applications in excess of 150 kg/year.
  - Increased use of Ammonium sulphate fertiliser.
- Wet winters - increased nitrate leaching

If not treated and farming practices remain the same then the area affected by acidity will increase.

ACIDIFICATION MEASURED IS SUPPORTED BY MODELLING.

Paddock name:	Enter	Top Soil Texture:	Select
	DEMO		Sandy Loam

Year		1	2	3	4	5	6	7	
Year (20.....)	Enter	2015	2014	2013	2012	2011	2010	2009	Clear Rainfall
Annual Rainfall	Enter	550	600	525	483	470	520	600	
Saturated Soil	Select		Yes					Yes	
Leaching %		50%	75%	50%	50%	50%	50%	75%	
Product Removal									
Crop Type	Select	Cereal grain	Cereal grain	Oilseed	Grain legume	Cereal grain	Oilseed	Grain legume	Clear Crop and Yield
Yield (tonnes/ha)	Enter	4.1	3.5	1.8	2	4.2	1.8	1.5	
Lime replacement/tonne grain yield (kg/ha)		9	9	2	20	9	2	20	
Lime required due to product removal (kg/ha)		36.9	31.5	3.6	40	37.8	3.6	30	Total (kg/ha) 183.4
Legume Fixed Nitrogen									
kg N fixed per tonne legume production		0	0	0	60	0	0	60	
Legume fixed nitrogen (kg/ha)		0	0	0	120	0	0	90	
Leaching adjusted lime requirement (kg/ha)/kg N		0.0	0.0	0.0	1.8	0.0	0.0	2.7	
Lime required due to legume fixed N (kg/ha)		0	0	0	216	0	0	243	Total (kg/ha) 459.0
Fertilisers Inputs									
Fertiliser 1. (Seeding)									
Fertiliser Type	Select	32:10	27:12	DAP	32:10	32:10	MAP	32:10	Clear Fertilizer # 1
Rate fertiliser (kg/ha)	Enter	110	90	80	100	100	90	80	
Product N (%)		32.0	27.0	18.0	32.0	32.0	10.0	32.0	
Rate of nitrogen		35.2	24.3	14.4	32	32	9	25.6	
Leaching adjusted lime requirement (kg/ha)/kg N		3.2	6.3	3.6	3.2	3.2	5.4	4.3	
Lime required due to seeding fertiliser applications (kg/ha)		110.9	153.1	51.8	100.8	100.8	48.6	109.4	Total (kg/ha) 675.5
Fertiliser 2.									
Fertiliser Type	Select	S.O.A	Urea	S.O.A		Urea	S.O.A		Clear Fertilizer # 2
Rate fertiliser (kg/ha)	Enter	150	110	100		120	60		
Product N (%)		21.0	46.0	21.0	0.0	46.0	21.0	0.0	
Rate of nitrogen		31.5	50.6	21	0	55.2	12.6	0	
Leaching adjusted lime requirement (kg/ha)/kg N		5.4	2.7	5.4	0.0	1.8	5.4	0.0	
Lime required due to in-crop fertiliser applications (kg/ha)		170.1	136.6	113.4	0.0	99.4	68.0	0.0	Total (kg/ha) 587.5

The model can be used to calculate;

- Average annual replacement lime required to offset acidification.

- Lime application rate required to maintain current surface pH over a 10 year period

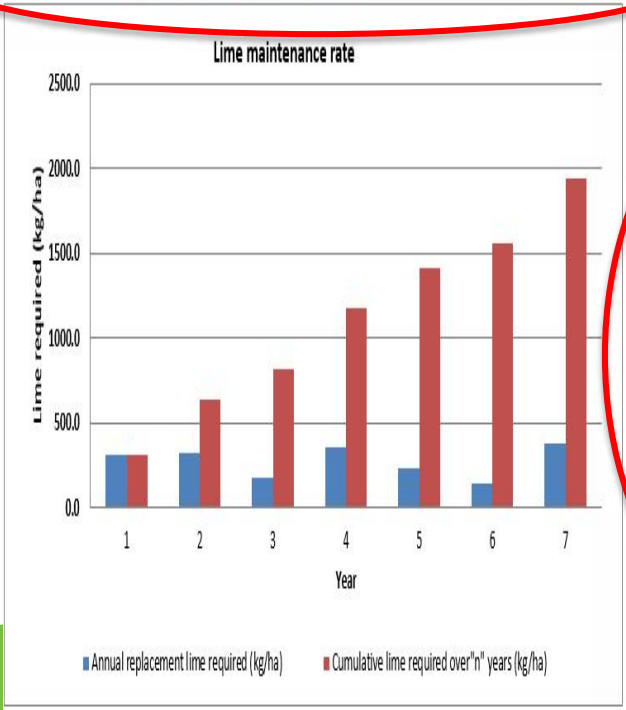
- Relative contribution of different management decisions to soil acidification.

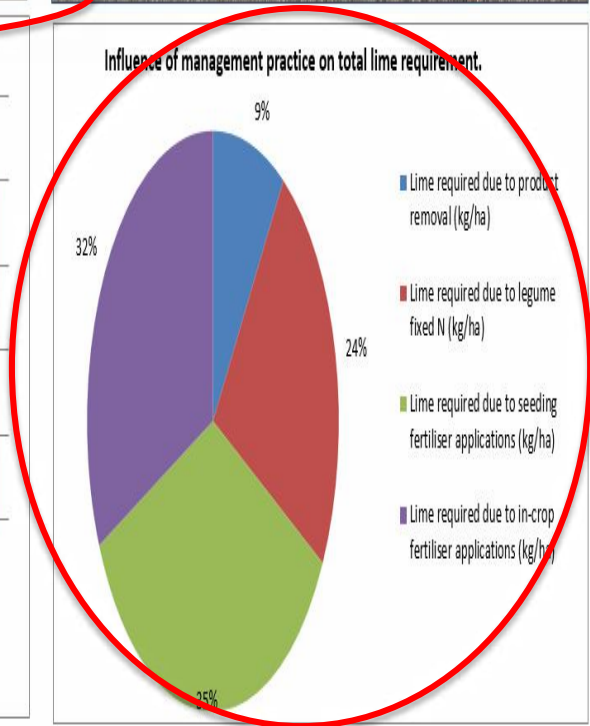
Summary of lime requirement to address annual acidification

Number of years of management data (n=)	7

Cumulative replacement lime required by management practice (kg/ha)

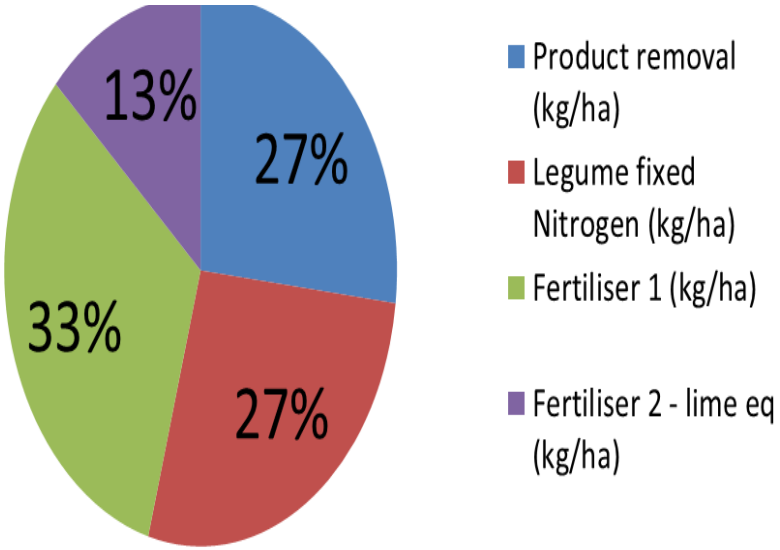
Lime required due to product removal (kg/ha)	183.4
Lime required due to legume fixed N (kg/ha)	459.0
Lime required due to seeding fertiliser applications (kg/ha)	675.5
Lime required due to in-crop fertiliser applications (kg/ha)	621.4
Total cumulative lime required over "n" years (kg/ha)	1939.2
Average annual replacement lime required (kg/ha)	277.0
Recommended lime application rate for 10 year period (t/ha)	2.8





MODELLING ACIDIFICATION UNDER DIFFERENT CROP ROTATIONS

- Rotation: 3 - 4 year (Cereal crop with pulse crop/legume pasture)
- Medium input/Medium production
- Lime replacement required: 130 to 200 kg lime/ha/year
- 46% of lime required to balance acidification is due to nitrogen fertiliser applications.

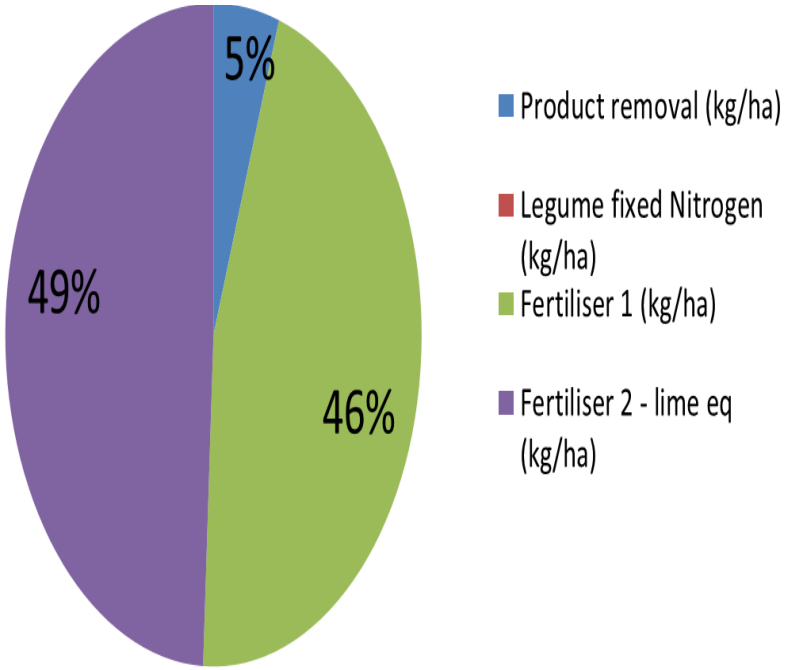


Fertiliser 1: 80-100 kg DAP at seeding,

Fertiliser 2: 80 kg – 100 kg Urea in cereal/oilseed crop

HIGH INPUT CROPPING ROTATION

- Rotation – 3 year (Canola/Cereal/Cereal)
- High input/High production
- Lime replacement required: 200 to 430 kg lime/ha/year
- 95% of lime requirement to balance acidification is due to nitrogen fertiliser inputs.

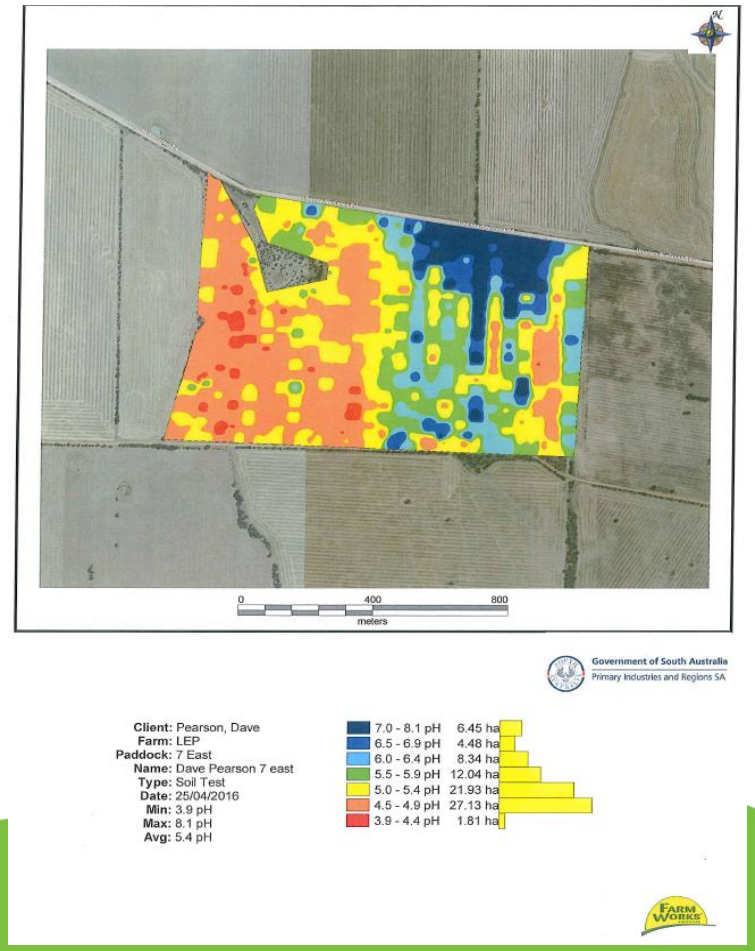


Fertiliser 1: 100-120 kg at seeding
Fertiliser 2: 120 – 200 kg in crop

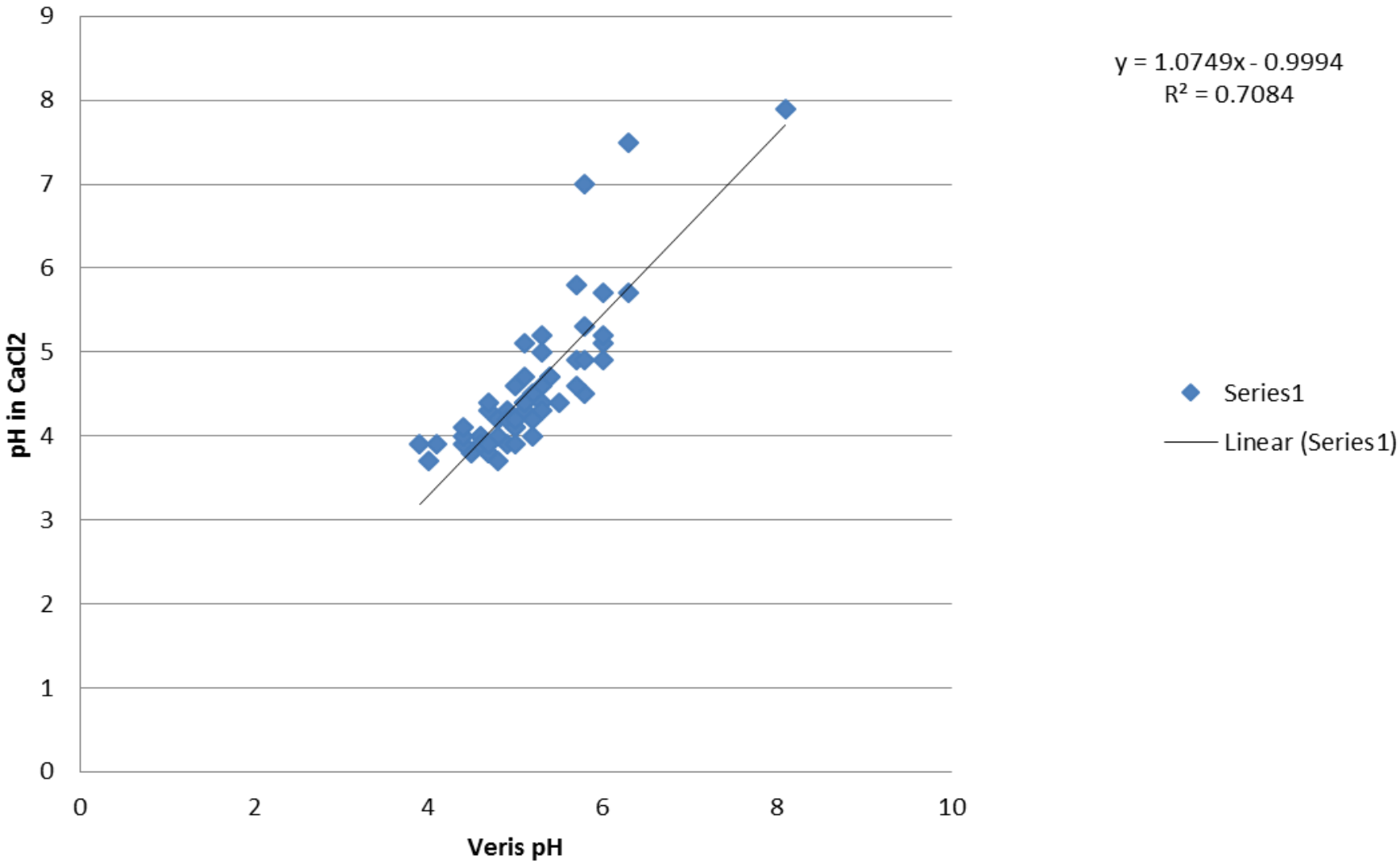
RESULTS OF pH MAPPING

- 16 paddocks (1080 ha) mapped using on-the-go mapper under the NREP “Farming acid soils champions” project
- pH highly variable with an average pH variation of 3.5 pH units within the paddock

pH Range	% of total area
<4.4	8
4.5 – 4.9	25
5.0 – 5.4	30
5.5 – 5.9	15
6.0 – 6.4	9
6.5 – 6.9	4
>7.0	9

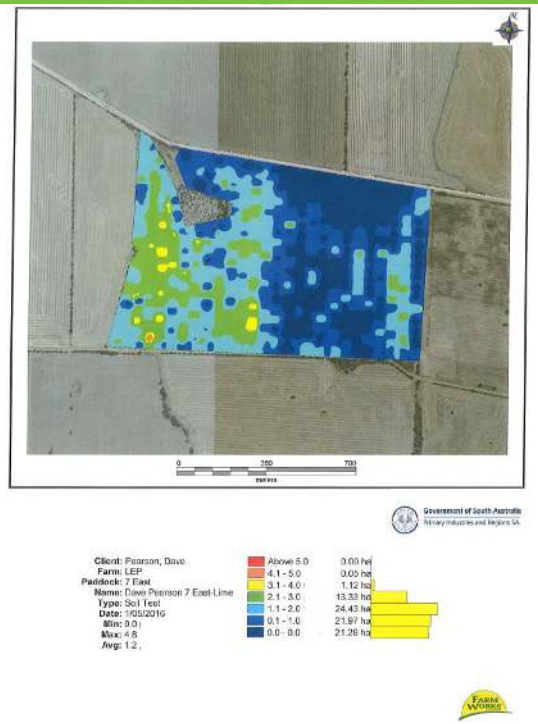


Validation of Veris Machine

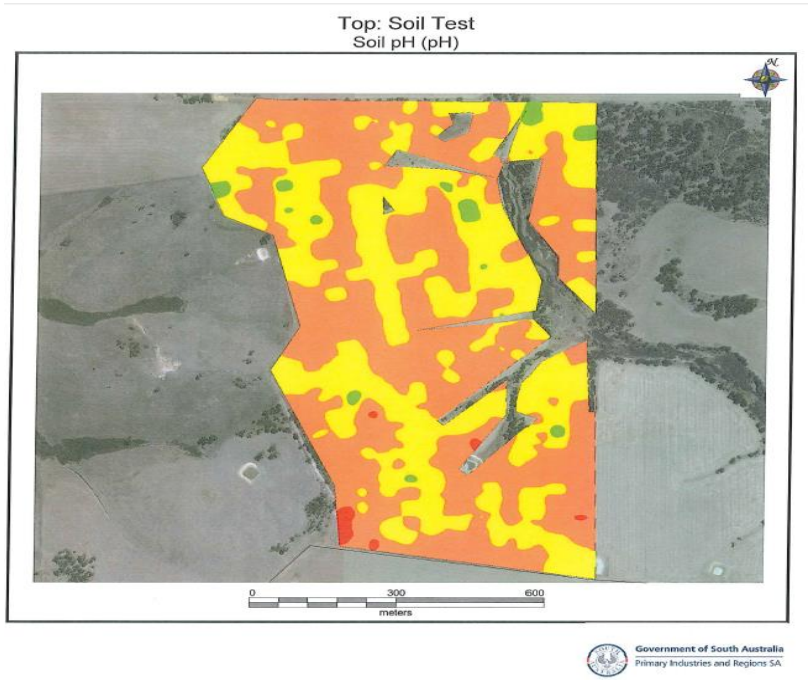


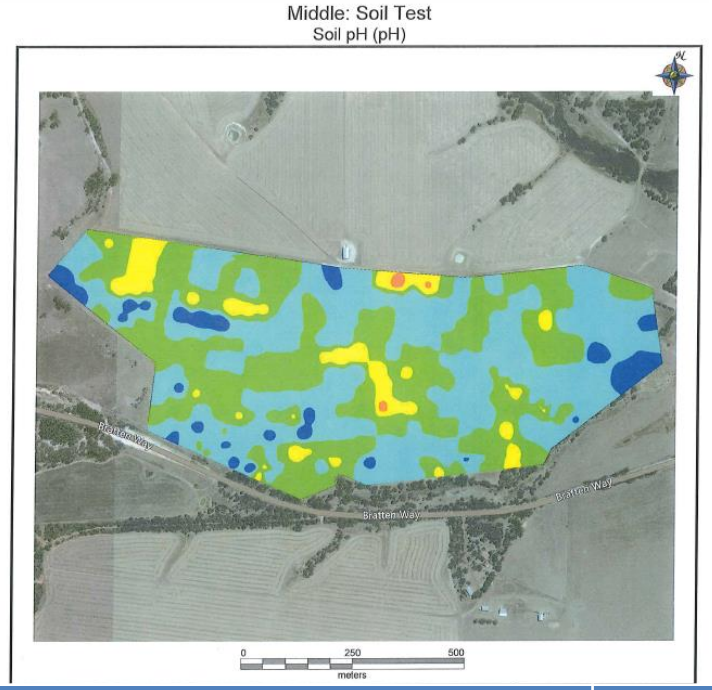
Lime Prescription Maps

- Cost of liming operation was calculated for the lime prescription maps ***compared to applying a uniform rate of 2.5 t/ha of lime over the whole paddock.***
- Average (mean) potential cost savings of $2242 (41 %) on liming operation per paddock
- Lowest potential savings on paddocks with a high proportion paddock area requiring more than 2.5 t/ha to bring surface pH above target 5.5 ($CaCl_2$)
- Highest potential savings on paddocks with a high proportion of alkaline areas in the paddock.



pH Mapping reflects the impact of liming





Claughton- Top (71 ha)	pH units
Minimum pH value	4.3
Average pH	5.0
Area Below target 5.5	70 (98%)
Area below critical 5.0	39 (55%)

Claughton Middle (limed 2012)	pH units
Minimum pH value	4.9
Average pH	6
Area Below target 5.5	4 (7%)
Area below critical 5.0	0 (0%)

CONCLUSIONS

- Range of tools available to better understand soil acidity and tailor cost effective solutions for managing the issue.
- Paddock scale pH mapping demonstrates the effectiveness of lime applications for raising soil pH and shows the areas of the paddock where low soil pH may still be the overarching issue.
- Soil pH should be mapped spatially (within and between paddocks) and temporally (over time)
- This information can increase landholder confidence in their liming applications and provides a starting point for managing the site.