VRT in the SAMDB: Making It Work !!

Project VRT Methodology

This project is jointly funded through the South Australian Murray-Darling Basin Natural Resources Management Board and the Australian Governments National Landcare Programme

Government of South Australia | Natural Resources SA Murray-Darling Basin | Australian Government | National Landcare Programme | Rural Solutions SA PIRSA | wisdom DATA & MAPPING

Why VRT makes sense in the Mallee

Mallee soils can vary greatly both within and between paddocks, including:

- deep sandy rises, with poor water retention and low fertility, and high risk of crop failure,
- mid-slope sands, with greater yield potential, but often higher nutrient requirements required to yield well,
- loamy flats which are fairly reliable with good nutrition and plant roots able to access deep moisture,
- heavy flats with high subsoil constraints, which are highly fertile, but have low plant available water (PAW) in dry years,
- stony flats, which are high in pH and nutrient tie up, can have limited rooting depth and soil moisture.

Each of these soil types vary greatly in their:

- Natural fertility
- Ability to retain and supply plant available water (PAW) to crops
- Yield potential and fertiliser requirements to meet that yield
- Risk to producing good crop/pasture outcomes in a variety of seasons
- It is logical that different soil types require different fertiliser and seed rates to most efficiently achieve the best outcomes for the farming business.

The skill in applying Variable Rate Technology (VRT) is to know:

- what the optimal rates to apply are,
- into which soil types or areas,
- in what years or seasonal conditions.

Successful VRT is therefore not necessarily about evening up paddock yields across soil types, although this may be an outcome in some circumstances. It is more about applying appropriate amounts of inputs to suit each paddock zones' needs while accounting for the risks involved and resources available, so that farmers can most efficiently distribute their resources for maximum benefit.

There are many different methods and resources that can be used to achieve these outcomes, and this project is using, developing and refining techniques that suit the SA Mallee and those involved. Whatever methods are used to achieve successful VRT, the following principles are believed to be important:

1. **Paddock mapping and zoning according to soil potential, risks and needs, including adequate soil testing and ground truthing with the farmer to understand soils inherent characteristics.**

2. **An estimation of paddock zone yield potentials or targets as a basis for working out suitable input requirements and distribution.**

3. **The ability to convert maps and paddock rate plans to a format that works within the machinery involved. (Lack of farmer technical support here is a major impediment to the growth of VRT).**

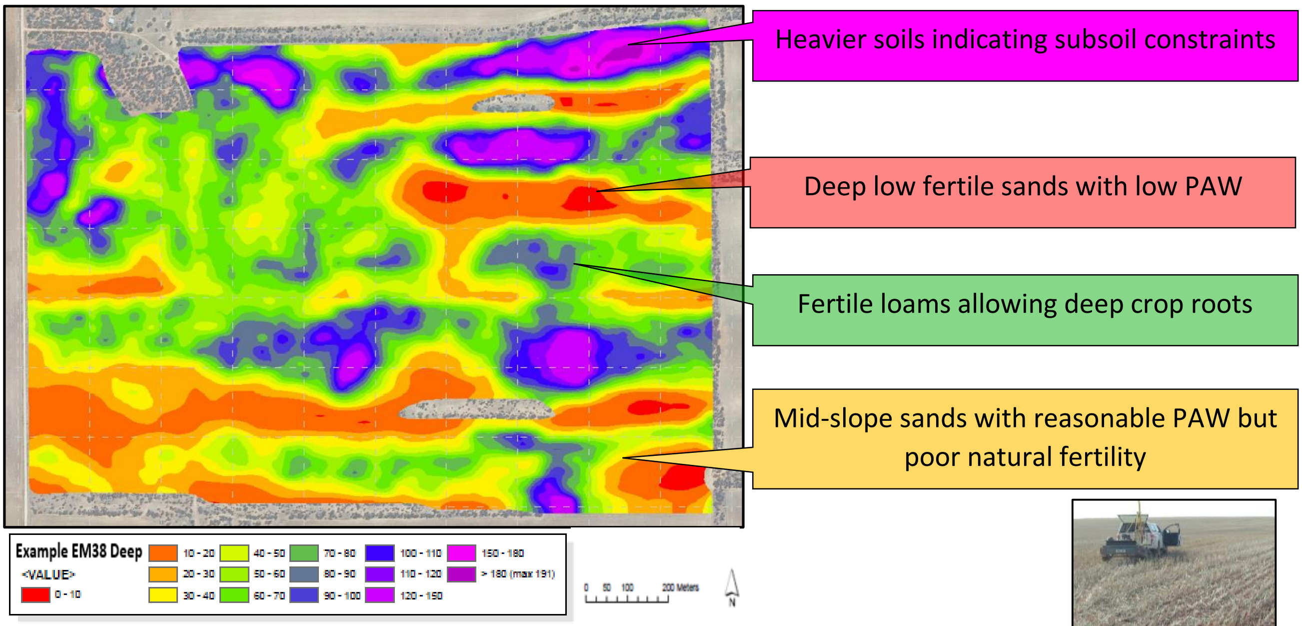
4. **It is preferable if actual inputs and yields results can be spatially mapped, including test strips across zones, so that soil responses can be analysed (in terms of production and financial value) and improvements made for following years.**

The VRT Project Methodology Guide

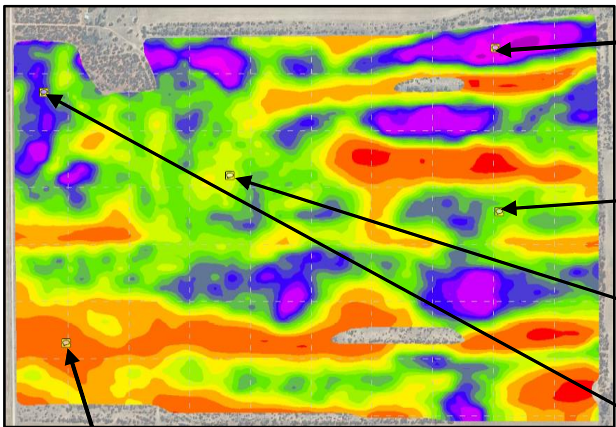
The following process has been developed for Natural Resources South Australian Murray-Darling Basin (Natural Resources SAMDB) 2015 VRT in the SA Mallee: Making it Work project. This involves 15 farms across the SAMDB region and the following process has been developed as a guide for farmers to achieve success with VRT.

While these general principles are being used, there are always a wide range of factors influencing decisions, and some flexibility is required to achieve practical outcomes that best suit each farmers own set of circumstances, capabilities, preferences, budgets and aspirations. This is an important strength of this program as is builds on a participatory farmer based approach, and not just adhering to "one size fits all" formulas.

1. **Paddock soil mapping using EM38 spatial analysis. In the Mallee we find that generally EM38 gives a very good correlation with soils ranges in crop lower limits based on water holding capacity and subsoil constraints. Stony soil have, however, shown some inconsistencies which require a heavier dependence on ground truthing.**



2. **These EM38 maps are used to target 5 key soil testing areas to ground test the map information. The deep soil testing is done at 4 depths to 80cm, and analysed for texture, fertility, moisture content and subsoil constraints.**



Hv	Water			Field	Nitrogen					pH		Cation %					
Depth	Total	Unavail.	Avail.	Capa.	Total	Avail.	Text	Sulpur	EC 1:5	CaCl	H20	Ca	Mg	Na	K	CEC	Boron
0-10	7.1	7.6	-0.4	16.5	2.1	1.8	SL	4.8	0.097	7.7	8.5						
10-32	15.1	16.1	-0.9	31.4	5.5	4.2	SCL	26.796	0.182	8.3	9.5	54	11	11	7	17	5.1
32-60	38.1	44.3	-6.2	66.6	19.6	7.9	SCL	66.64	0	8.5	10	32	31	29	8	17	13.96
60-80	28.2	31.2	-3.0	47.6	19.0	7.9	SCL	80.08	0.439	8.5	10	34	26	28	8	15	13.17
Total	88.6	99.1	-10.5	162.2	46.3	21.8	EM38	150	P	13	OC	0.4					

Md	Water			Field	Nitrogen					pH		Cation %					
Depth	Total	Unavail.	Avail.	Capa.	Total	Avail.	Text	Sulpur	EC 1:5	CaCl	H20	Ca	Mg	Na	K	CEC	Boron
0-10	0.8	8.0	-7.2	17.4	6.0	5.1	SL	3.45	0.028	6.2	6.9						
10-25	1.3	6.4	-5.1	14.7	6.4	5.6	S	4.845	0.028	6.9	7.6	77	1	1	6	3	0.41
25-65	13.6	31.8	-18.2	69.6	30.0	19.5	SL	9	0.032	7.4	8.2	73	17	3	7	2	0.3
65-80	27.5	14.8	12.8	26.1	10.5	5.5	SL	39.375	0.343	8.5	9.9	36	31	24	6	16	9.09
Total	43.2	60.9	-17.7	127.8	52.9	35.6	EM38	70	P	24	OC	0.4					

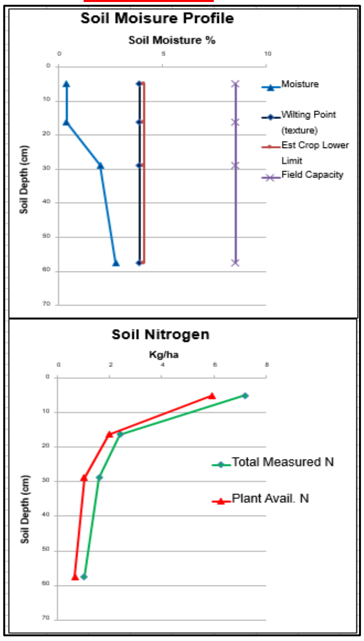
LtMd	Water			Field	Nitrogen					pH		Cation %					
Depth	Total	Unavail.	Avail.	Capa.	Total	Avail.	Text	Sulpur	EC 1:5	CaCl	H20	Ca	Mg	Na	K	CEC	Boron
0-10	2.0	6.4	-4.4	13.6	19.2	15.9	LS	6.4	0.087	7.6	8.8						
10-25	3.1	9.6	-6.5	20.4	6.0	4.9	LS	4.56	0.033	7.8	8.4	67	1	1	5	8	0.37
25-40	5.7	9.6	-3.9	20.4	2.4	1.5	LS	2.4	0.049	7.3	8.4	82	12	0	5	5	0.39
40-80	22.5	25.6	-3.1	54.4	8.0	5.1	LS	9.6	0.062	7.6	8.8	80	14	0	3	7	0.49
Total	33.4	51.2	-17.8	108.8	35.6	27.4	EM38	40	P	24	OC	0.6					

Lt	Water			Field	Nitrogen					pH		Cation %					
Depth	Total	Unavail.	Avail.	Capa.	Total	Avail.	Text	Sulpur	EC 1:5	CaCl	H20	Ca	Mg	Na	K	CEC	Boron
0-10	0.6	6.4	-5.8	13.6	7.2	5.9	LS	3.52	0.033	7.1	7.7						
10-22.5	0.8	8.0	-7.2	17.0	3.0	2.5	LS	1	0.028	7.9	8.4	76	1	0	4	4	0.41
22.5-35	4.0	8.0	-4.0	17.0	2.0	1.3	LS	1	0.07	8.1	8.8	80	15	0	4	4	0.37
35-80	19.8	28.8	-9.0	61.2	4.6	2.9	LS	12.96	0.049	8	8.9	78	14	0	3	7	0.55
Total	25.2	51.2	-26.0	108.8	16.8	12.6	EM38	10	P	16	OC	0.1					

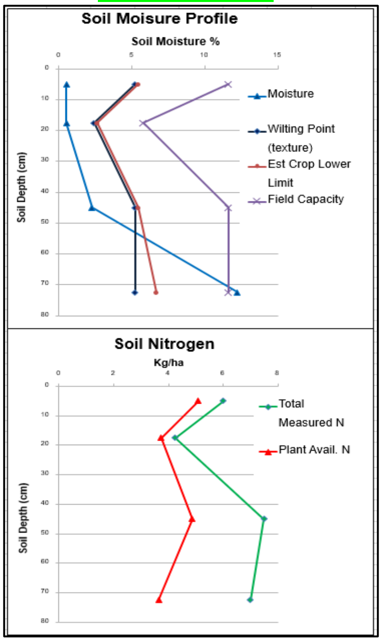
MdHv	Water			Field	Nitrogen					pH		Cation %					
Depth	Total	Unavail.	Avail.	Capa.	Total	Avail.	Text	Sulpur	EC 1:5	CaCl	H20	Ca	Mg	Na	K	CEC	Boron
0-10	2.6	8.0	-5.4	17.4	21.0	17.8	SL	4.95	0.054	6.1	6.9						
10-22.5	3.2	9.9	-6.8	21.8	20.6	17.4	SL	15	0.128	7.8	8.6	67	7	7	8	10	1.24
22.5-50	36.7	41.3	-4.6	76.8	11.0	6.1	LC	80.08	0.324	8.4	9.7	45	26	21	6	20	6.15
50-80	30.2	33.2	-3.0	52.9	15.6	7.0	LC	380.52	0.538	8.3	9.5	39	22	27	5	18	11.1
Total	72.6	92.4	-19.8	168.9	68.2	48.2	EM38	110	P	19	OC	0.5					

3. **The soil test results are analysed for key soil characteristics through the "Your Soil Potential" Program to estimate crop lower limits (CLL), PAW and plant available nitrogen based on soil textures, chemical constraints and measured moisture and N levels. This helps to characterise differences in yield potential, inherent fertility and the risk profile of the various soil types.** (NB. Actual numbers must be treated as more indicative than precise given the nature of the testing procedure and natural soil variation, while still providing key foundational data to base paddock zone to general management requirement upon. The graphs present % moisture at the midpoint of soil testing depths. This is converted into mm moisture based on soil bulk density and the depth range of each sample, ie. 7% moisture over 30cm depth represents more mms than over 10cm).

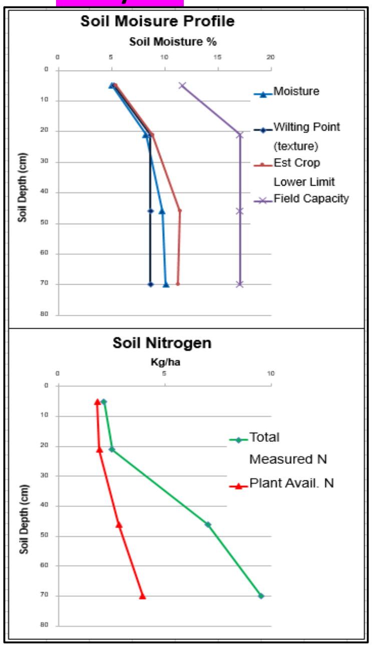
Deep Sand



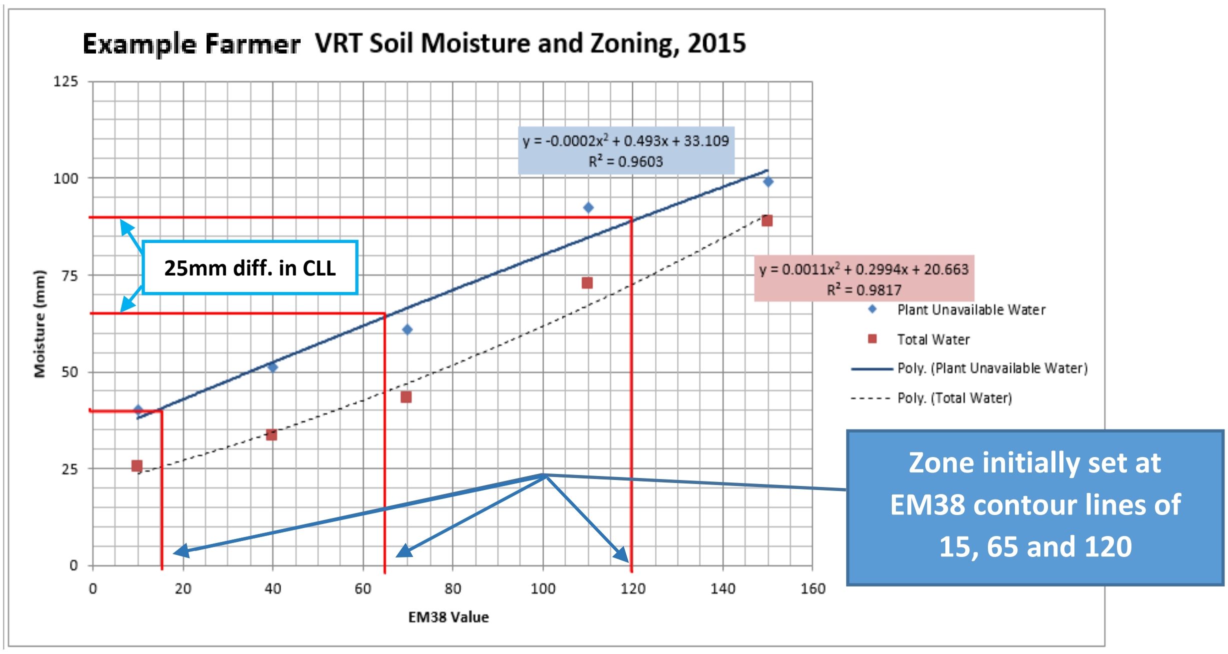
Medium Loam



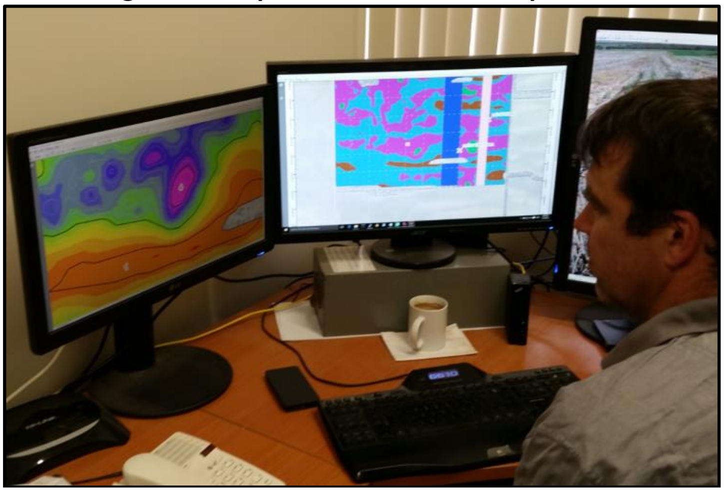
Heavy Flat



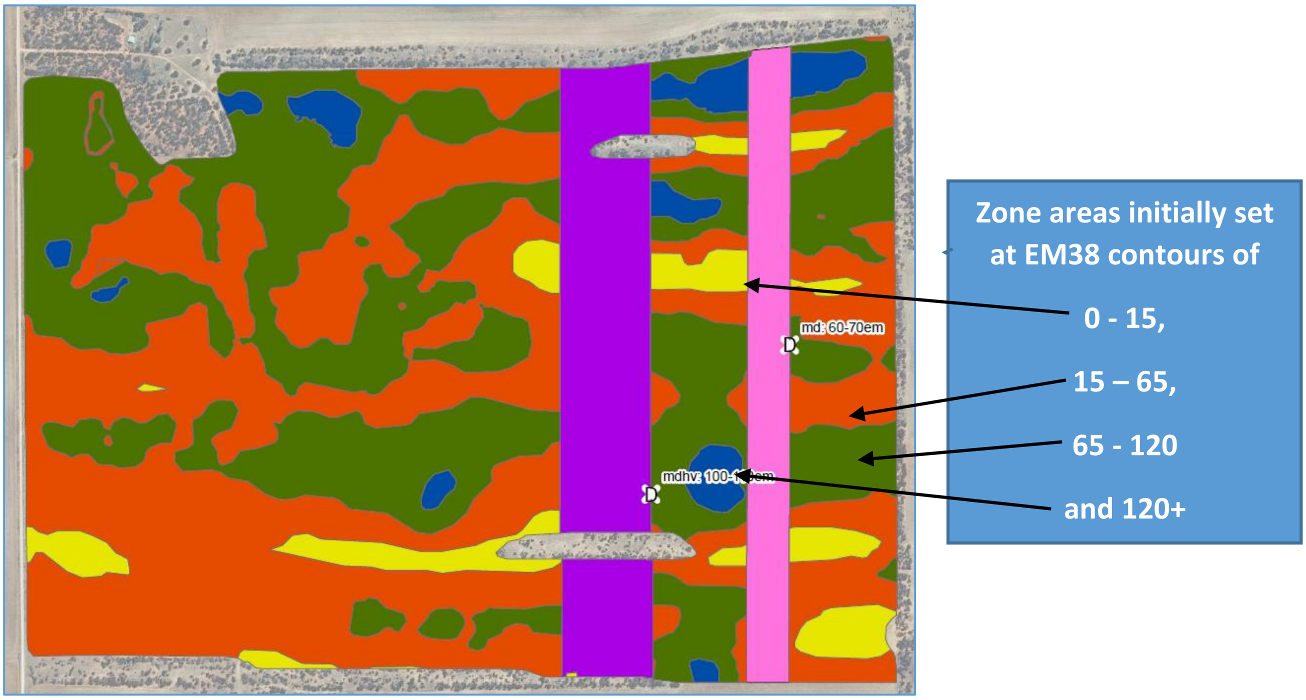
The program is then used to find a line of best fit between the estimated plant unavailable water (or CLL – Crop Lower Limit) and EM38 values at each soil testing site. Every 25mm difference CLL can theoretically mean a 0.5t/ha difference in yield potential and worthwhile treating differently. This then becomes the initial basis for separating paddock zones. (NB. This method may well not be as suitable in other regions and higher rainfall areas, but has been useful in the SA mallee. It is only the first step in this zoning method, and requires ground truthing to verify and adjust.)



Converting EM38 map to Paddock Zone Map



This data is then used to convert the EM38 map into a zone map, with potential high and low rate strip areas indicated that pass across all zones. Maps are produced and also placed on a GPS tablet to assist in ground truthing the paddocks with the farmers.



Paddock EM38 and zone maps on GPS tablet to assist with ground truthing information.

4. **Paddocks are ground truthed with farmers using GPS tablets with paddock maps and a gouge auger, which often leads to an adjustment of zone boundaries. Key points to clarify include:**

- **How poor is the sand and at what point does it change from deep sand where it is too risky to apply high rates of fertiliser, and where it becomes a mid-slope sand that can more safely reach yield potentials with higher inputs.**
- **Where stony areas have distorted EM38 readings in ways that do not adequately reflect yield potential and risk, and may need to be manually draw and overlayed into zone maps.**
- **Where the shallow EM38 mapping may be more appropriate to use than the deep EM38 maps for best delineating paddock zones.**
- **Are the highest EM38 areas heavily textured and fertile enough to warrant significantly lower seeding and fertiliser rates.**

5. **Fertiliser and seeding rates for each zone are discussed and established for each zone with the farmers, using tools such as the "Your Soils Potential" model, the Mallee Calculator and fertiliser rates and costing guides. These work through the basic principles of:**

- **What is the yield potential or target yield of the intended crop in each zone given its PAW at the start of the growing season and the average or targeted growing season rainfall decile for that district,**
- **What nutrition inherently is available to the crop (derived from soil test results of P, N, Organic Carbon etc. and estimated nutrient mineralisation),**
- **What extra nutrition needs to be applied to meet the crops requirements to meet its' target yield (which can be based on growing season rainfall decile data),**
- **What adjustments need to be made to manage the risks for each zone, including input levels and nitrogen timing strategies (ie. How much needs to be applied up front in each zone, and how much may be spread later if sufficient rainfall or subsoil moisture is available).**

The final zone rates and strategy plans are established with each farmer taking into account these paddock zone potentials, needs and risks, as well as the farmers' available resources, capabilities and preferences. Various helpful programs are used in this process to assist in decisions making. This project utilised the Mallee Calculator and a Zone Fertiliser Calculator excel spreadsheet.

Example of estimating yield potential and crop needs to reach that potential using the "Mallee Calculator" program as a general guide.

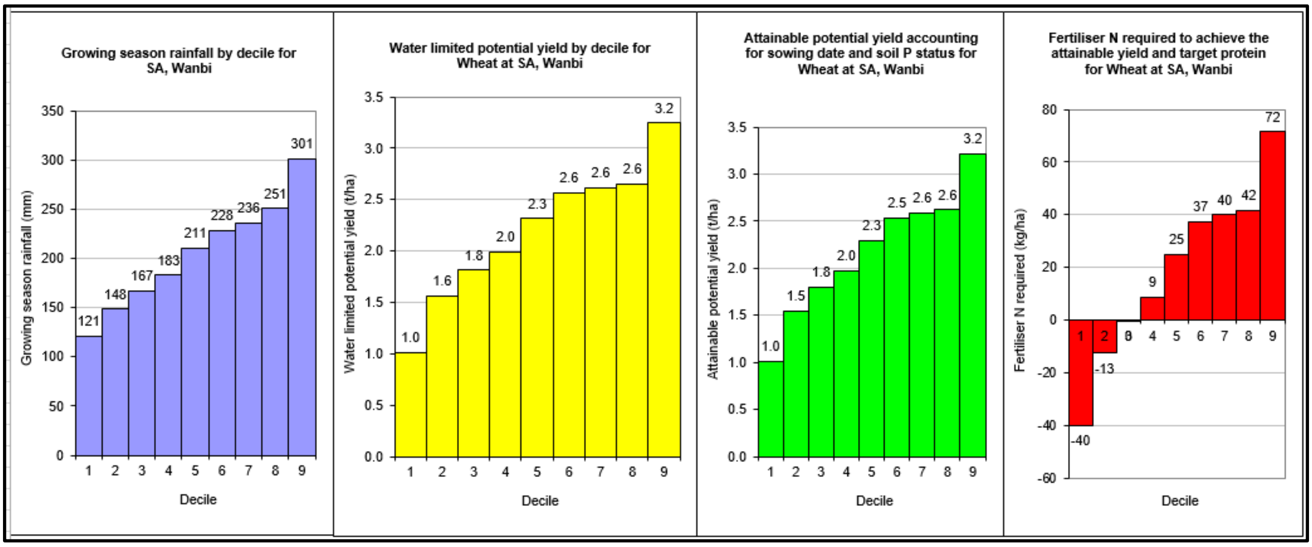
Name: Example farmer
Paddock: Medium Loam
Year: 2015

Inputs		
Location	SA, Wanbi	
Rainfall risk (decile)	5	
Crop	Wheat	
Target grain protein (%)	10.5	
Optimum sowing date (defined by crop and available water for growing season)	15-05-15	Restore default optimum sowing
Yield penalty for late sowing (kg grain/day) (default value is 15 kg/day)	15.0	Restore default sowing penalty
Actual or planned sowing date	Month	May
	Day	5
Previous crop	Wheat	
Previous crop yield (kg/ha)	1000	
Percent stubble removed	0	
Surface soil type	sandy loam	
Plant available soil water on 1 April (mm)	0	
Plant available soil N at sowing (kg/ha)	58	
% Organic carbon (0-10 cm layer)	1.0	
Phosphorus soil test (mg P/kg soil or ppm)	24	
Soil N mineralisation percentage	3	

Outputs	
Growing season rainfall (Apr-Oct mm)	211
Total available water (mm)	211
Potential yield with given rainfall and soil water (t/ha)	2.3
Potential yield accounting for sowing date (t/ha)	2.3
Potential yield accounting for soil P status and sowing date (t/ha)	2.3
Attainable yield (accounts for maximum and all constraints) (t/ha)	2.3
N requirement to achieve the attainable yield/protein (kg/ha)	117
Plant available soil N at sowing (kg N/ha)	58
N from in-crop mineralisation of soil organic matter (kg/ha)	39
N contribution or uptake due to stubble (kg/ha)	-7
Total available N (soil profile + stubble + soil) (kg/ha)	91
Estimated fertiliser requirement (kg N/ha) - if this is<0, some fertiliser N should be applied at sowing to optimise crop establishment	26

Potential yield associated with decreasing fertiliser N application (assuming constant grain protein)

Percentage of estimated fertiliser N requirement	N rate (kg/ha)	Predicted yield (t/ha)
100%	26	2.3
75%	20	2.2
50%	13	2.1
25%	7	1.9
0%	0	1.8
N required for penalty (ie cool wet Spring & high P applied*)	26	2.3



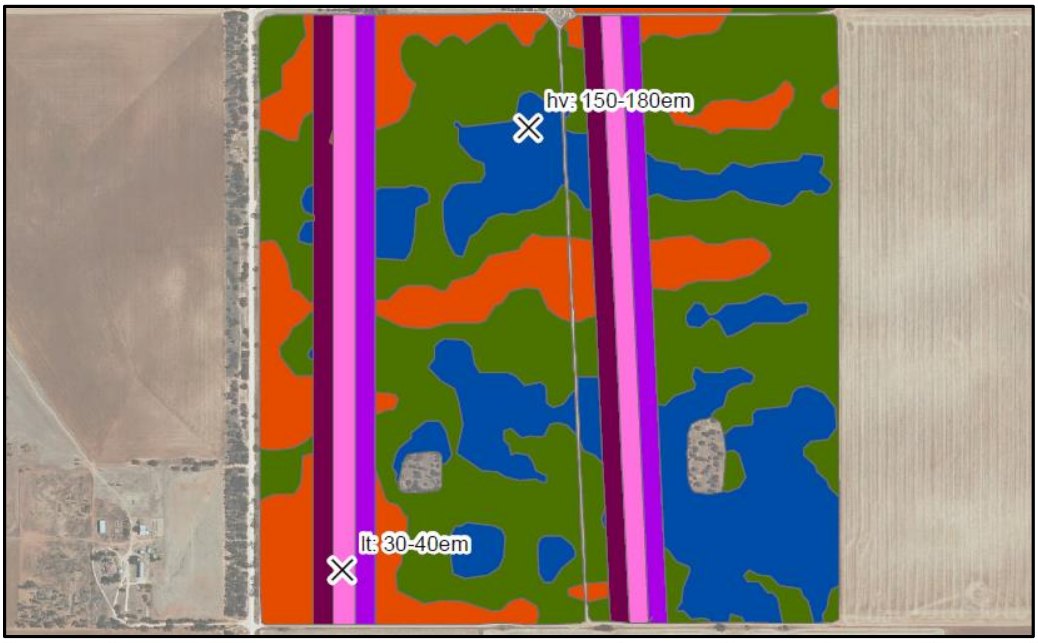
Extract from Zone Fertiliser calculator excel sheet used to help farmers assess the costs of applying various VRT strategies across the whole paddock

Paddock Zone Fertiliser Summary Sheet — Farmer: Example 2

Zone	Description	Area	Fert Target (Kg/ha)		DAP		Urea		Fert Costs	
		ha	N	P	kg/ha	Tonnes	Kg/ha	Tonnes	Cost $/ha	Total
1	Deep Sand	25	14	7.5	37.5	0.94	16	0.39	35	$880
2	Mid Slope Sand	95	30	7.5	37.5	3.56	51	4.80	53	$5,062
3	Loam	120	25	6.5	32.5	3.90	42	5.00	44	$5,230
4	Shallow Stone	7	14	5	25	0.18	21	0.14	29	$201
5	Heavy Flat	20	10	4	20	0.40	14	0.28	22	$433
	Total Area (ha)	267			Total	8.98	Total	10.6	Total Cost	$11,806
					Cost	$6,462	Cost	$5,519		

6. **Paddock input maps are devised (including trial strips across zones of higher and lower inputs) and information translated to appropriate data maps for the farmer's machinery. Using the technology correctly is a barrier for many farmers so expert support is provided to farmers to help configure their machinery for the application of planned variable rates of seed and fertilisers.**

Example Paddock Zone Application Plan



Map Colour	Zone Description Both deep and shallow EM38 used to help determine zones for this paddock.	Fert1 (kg/ha)	Urea (kg/ha)	post urea (kg/ha)	Area (ha)
	Sand Requires slightly higher inputs to maximise potential	80	60	80	37
	Loam Majority of the paddock fits into this category.	60	50	60	168
	Heavy Loam Reduced inputs on heavier soils are advisable in case of a drier finish.	40	30	40	29
	High Test Strip Testing higher inputs across all soil types to identify potential gains.	80	60	80	9
	Standard Test Strip	60	50	60	9
	Low Test Strip Testing lower inputs across all soils to identify potential savings.	40	30	40	9

Assistance provided to farmers for machinery and data application and information storage.

7. **Mid-season monitoring occurs through crop inspections or other tools such as NDVI to assess or confirm the need for post N application. The mallee calculator can also be used to estimate mid-season N requirements by entering up-to-date growing season rainfall. Further data maps are supplied to farmers for post N application if required. All fertiliser applications are recorded for later assessment of the economics of yield results.**

Crop showing signs of N deficiencies and need for post N application

Further extract from Mallee Calculator program showing potential N requirements for given decile finishes

Reassessing N requirements during the growing season

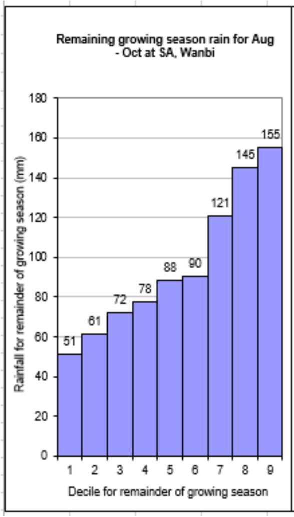
Input data from the start of the growing season	
Location	SA, Wanbi
Crop grown	Wheat
Surface soil type	sandy loam
Plant available water at sowing (mm)	0
Plant available N (soil+stubble+Nmin) (kg/ha)	91
Phosphorus soil test (mg P/kg soil or ppm)	19
Optimum sowing date	15-05-15
Actual sowing date	05-05-15
Yield penalty for late sowing (kg/day)	15

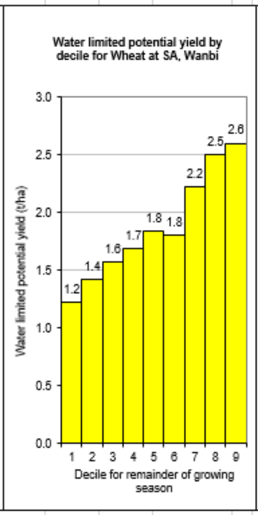
Inputs required for revison of targeted grain yield and protein	
Growing season remaining	Aug - Oct
Growing season rain received to date (mm)	80
Initial fertiliser N applied (kg N/ha)	25
Revised grain protein target (%)	12.5

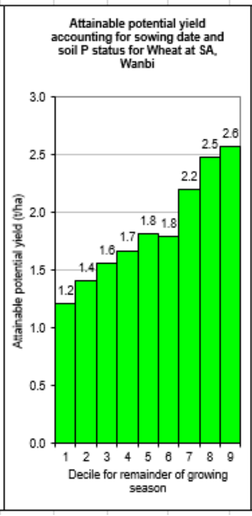
Inputs required for calculation of gross margins							
At silo/port base prices for grain quality classes							
Wheat		Barley		Oats		Canola	
Feed	$ 350	Feed	$ 283	feed	$ 150	class1	$ 250
ASW	$ 357	Malting1	$ 346	class1	$ 160	class2	$ 300
APW	$ 362	Malting3	$ 321	class2	$ 170		
Hard	$ 366						
Durum	$ 600						
Grain type and quality class targeted				Wheat - APW			

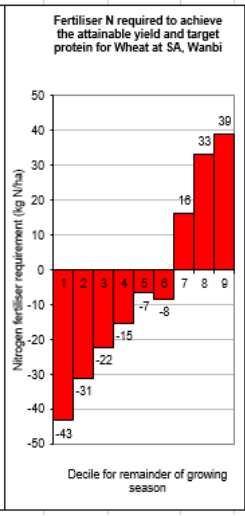
Fertiliser N sources, costs and N contents		Cost ($/ton) (include transport)	N content (%)	N cost ($/kg)
	Urea	500	46	1.09
	Amm Sulphate	500	21	2.44
	Amm Nitrate	500	35	1.45
	Other	500	48	1.04
Type of N fertiliser to be used		Urea		

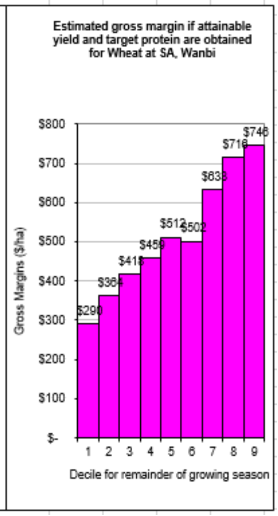
Cost of grain transport to silo/port ($/t	10
Total variable cost ($/ha) (includes costs of fertiliser applied at sowing)	150





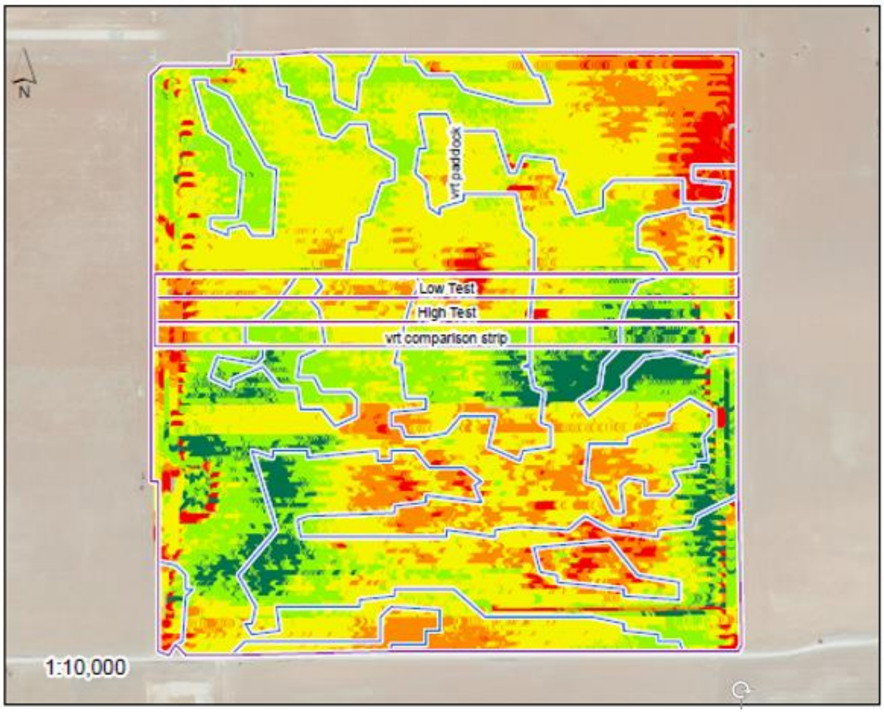




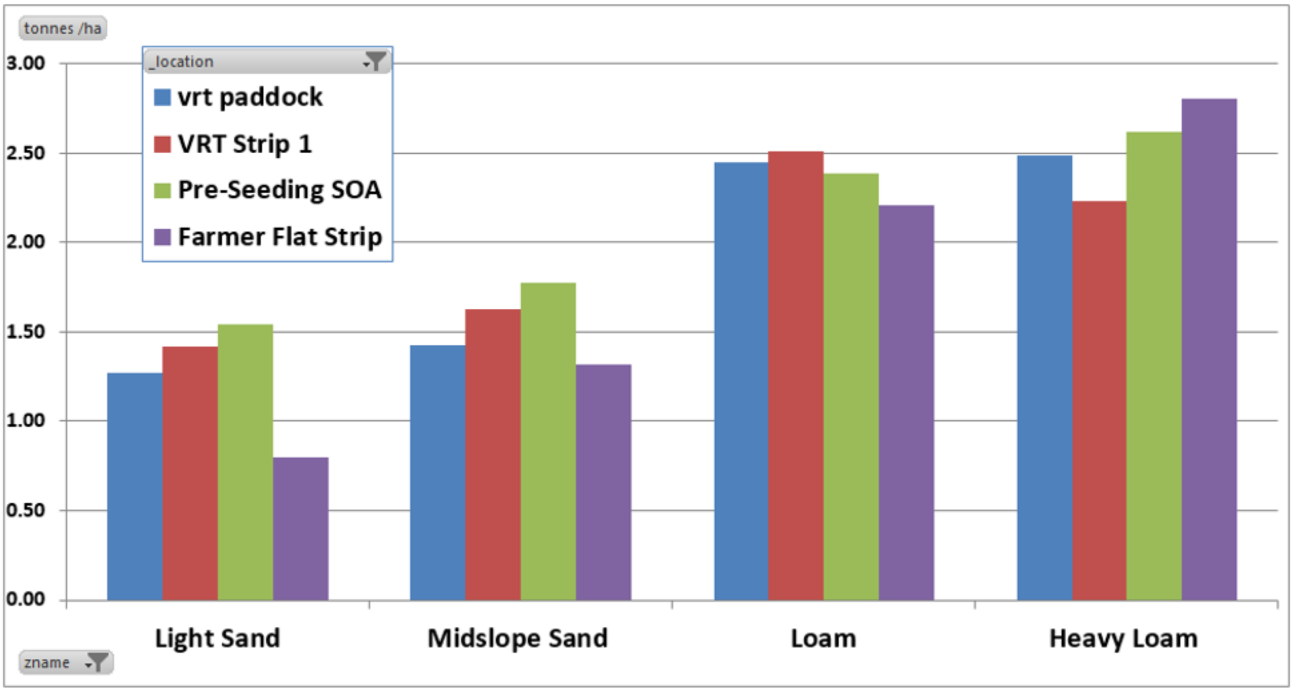


8. Yield maps are analysed against zones, EM38 ranges, trial strips and input costs to determine the economic benefit of the rates applied, as well as which soil types and zones are most responsive to higher or lower inputs. This forms the basis for further adjustment to VRT plans in the future.

Example of yield map with treatment strip identified for yield and gross margin comparisons



Example of comparative yield of treatment strips over different soil zones



Direct comparisons are best made with a VRT comparison strip right alongside the other treatment test strips, rather than the whole paddock VRT. This is because often there are other issues affecting yield performance in the wider paddock such as frost, wind, rain, paddock history and subtle variations that would lead to a distortion of results, and it is far better to try and compare "like with like" using more close and direct analysis.

Extract from report of economic comparisons of treatments with varying input costs and yields.

Analysis of VRT Paddock Results

Farmer	Braun	
Paddock ID	Trial Paddocks	
Year	2015	
Crop	Wheat	
Variable Inputs	Type	Price ($/t)
Seeding Fert 1	MAP	720
Seeding Fert 2	SOA	520
Seed	Wheat	250
Post Nitrogen 1	Urea	520
Post Nitrogen 2		

VRT Paddock

Approx. Variable Costs other than Seed and Fertiliser ($/ha)		$80	Seeding Fert 1	Seeding Fert 2	Seed Rate	Post Fert 1	Post Fert 2	Total Seed & Fert Cost ($/ha)	2015 Harvest Results					
Zone	Description	Area in Paddock (ha)	MAP (kg/ha)	SOA (kg/ha)	Wheat (kg/ha)	Urea (kg/ha)	0 (kg/ha)		Yield (t/ha)	Protein (%)	Screen-ings (%)	Grade	Grain Price ($/T)	Gross Margin ($/ha)
1	Sand	6	35		50	25		51	1.27				250	186
2	Midslope	147	45		50	60		76	1.43				250	201
3	Loam	124	55		50	50		78	2.45				250	453
4	Heavy Loam	49	55		50	32		69	2.48				250	472
All Zones	Total Hectares	326	Ave Paddock Costs ($/ha)			155	Ave Paddock Yield (t/ha)			1.97	Ave Paddock GM ($/ha)			338
							Total Margin if treatment applied for whole paddock							$110,064

VRT Strip

Farmer	Braun													
Paddock ID	Trial Paddocks													
Approx. Variable Costs other than Seed and Fertiliser ($/ha)		$80	Seeding Fert 1	Seeding Fert 2	Seed Rate	Post Fert 1	Post Fert 2	Total Seed & Fert Cost ($/ha)	2015 Harvest Results					
Zone	Description	Area in Paddock (ha)	MAP (kg/ha)	SOA (kg/ha)	Wheat (kg/ha)	Urea (kg/ha)	0 (kg/ha)		Yield (t/ha)	Protein (%)	Screen-ings (%)	Grade	Grain Price ($/T)	Gross Margin ($/ha)
1	Sand	6	35		50	25	0	51	1.42				250	224
2	Midslope	147	45		50	60	0	76	1.62				250	250
3	Loam	124	55		50	50	0	78	2.51				250	468
4	Heavy Loam	49	55		50	32	0	69	2.23				250	409
All Zones	Total Hectares	326	Ave Paddock Costs ($/ha)			155	Ave Paddock Yield (t/ha)			2.05	Ave Paddock GM ($/ha)			356
							Total Margin if treatment applied for whole paddock							$116,195

Pre-seeding SOA

Farmer	Braun													
Paddock ID	Trial Paddocks													
Approx. Variable Costs other than Seed and Fertiliser ($/ha)		$80	Seeding Fert 1	Seeding Fert 2	Seed Rate	Post Fert 1	Post Fert 2	Total Seed & Fert Cost ($/ha)	2015 Harvest Results					
Zone	Description	Area in Paddock (ha)	MAP (kg/ha)	SOA (kg/ha)	Wheat (kg/ha)	Urea (kg/ha)	0 (kg/ha)		Yield (t/ha)	Protein (%)	Screen-ings (%)	Grade	Grain Price ($/T)	Gross Margin ($/ha)
1	Sand	6	40	60	50	40		93	1.54				250	211
2	Midslope	147	40	60	50	40		93	1.77				250	270
3	Loam	124	40	60	50	40		93	2.39				250	424
4	Heavy Loam	49	40	60	50	40		93	2.62				250	481
All Zones	Total Hectares	326	Ave Paddock Costs ($/ha)			173	Ave Paddock Yield (t/ha)			2.1	Ave Paddock GM ($/ha)			359
							Total Margin if treatment applied for whole paddock							$117,051

Farmer Flat Rate

Farmer	Braun													
Paddock ID	Trial Paddocks													
Approx. Variable Costs other than Seed and Fertiliser ($/ha)		$80	Seeding Fert 1	Seeding Fert 2	Seed Rate	Post Fert 1	Post Fert 2	Total Seed and Fert Cost ($/ha)	2015 Harvest Results					
Zone	Description	Area in Paddock (ha)	MAP (kg/ha)	SOA (kg/ha)	Wheat (kg/ha)	Urea (kg/ha)	0 (kg/ha)		Yield (t/ha)	Protein (%)	Screen-ings (%)	Grade	Grain Price ($/T)	Gross Margin ($/ha)
1	Sand	6	40		50	40		62	0.80	10.8	5.61		250	58
2	Midslope	147	40		50	40		62	1.32	13.3	3.7		250	188
3	Loam	124	40		50	40		62	2.20	14.1	3.88		250	409
4	Heavy Loam	49	40		50	40		62	2.80	15.1	3.27		250	559
All Zones	Total Hectares	326	Ave Paddock Costs ($/ha)			142	Ave Paddock Yield (t/ha)			1.9	Ave Paddock GM ($/ha)			325
							Total Margin if treatment applied for whole paddock							$106,075

The economic analysis of each treatment zone is then summarised in the following comparative table. NB: The Gross Margin calculation has used the varying costs of seed and fertiliser for each zone treatment, which is then added to an estimated standard value across all treatments for other variable costs (herbicides, fuel, maintenance, insurances, etc) to give total variable costs. This is then subtracted from the income (price x yield) to define each Gross Margin.

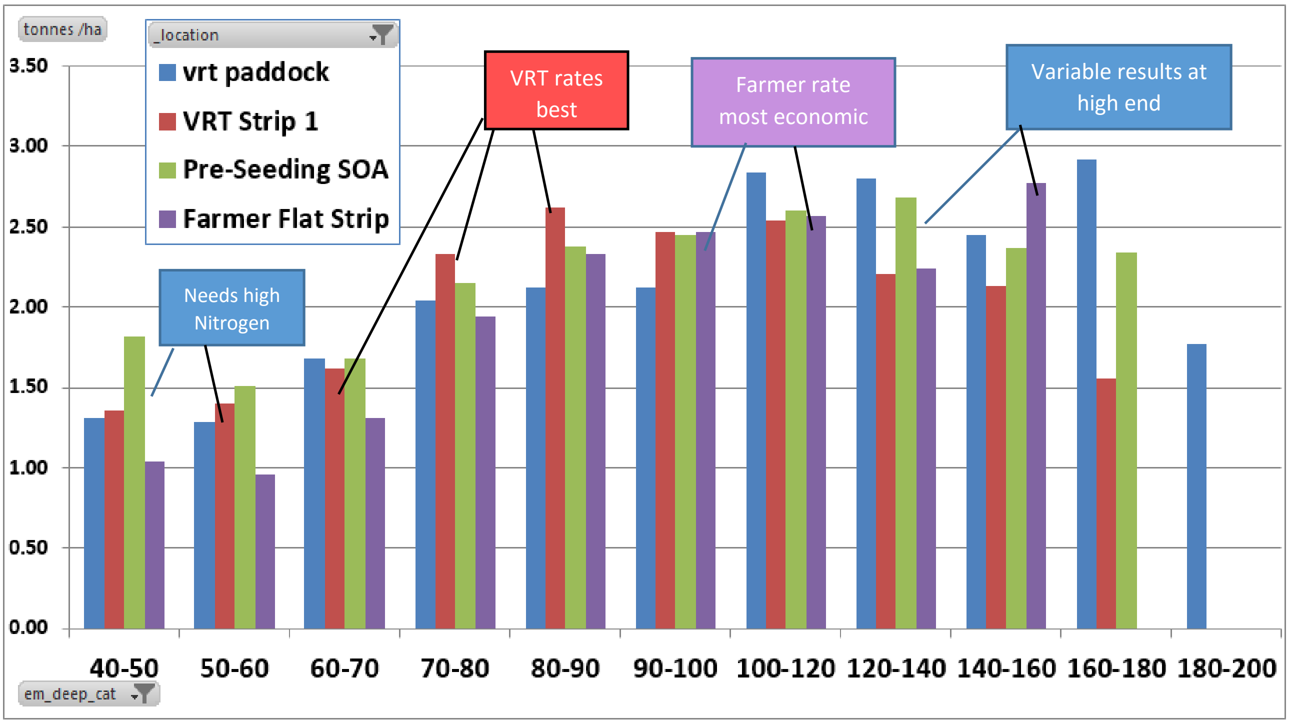
The best economic treatment rate is then chosen for each zone, and placed in the yellow section, along with the actual rates applied. This is then tallied to form an average paddock gross margin, which works on the overall result that would be achieved if these rates were applied to each zone area of the whole paddock. This new paddock Gross Margin can then be compared to the existing treatment option gross margins to assess the advantage of applying this particular VRT strategy.

Comparative gross margins of input strategies, leading to optimal rates across each zone

Zones Description	Zone Area	VRT Paddock		VRT Strip		Pre-seeding SOA		Farmer Flat Rate		Optimal Rates From Paddock Trials					
		Yield	Gross Margin	Yield	Gross Margin	Yield	Gross Margin	Yield	Gross Margin	Seeding MAP	Seeding SOA	Seed Rate	Post N	Yield	Gross Margin
	ha	t/ha	$/ha	t/ha	$/ha	t/ha	$/ha	t/ha	$/ha	kg/ha	kg/ha	kg/ha	kg/ha	t/ha	$/ha
Sand	6	1.27	186	1.42	224	1.54	211	0.80	58	35	0	50	25	1.42	224
Midslope	147	1.43	201	1.62	250	1.77	270	1.32	188	40	60	50	40	1.77	270
Loam	124	2.45	453	2.51	468	2.39	424	2.20	409	55	0	50	50	2.51	468
Heavy Loam	49	2.48	472	2.23	409	2.62	481	2.80	559	40		50	40	2.8	559
Paddock Ave		1.97	338	2.05	356	2.1	359	1.9	325	Ave Paddock Gross Margin ($/ha)					388
										Total Margin if applied to paddock					$ 126,457

Although initial paddock zones may be defined by EM38 ranges of 30-50 units or more, the comparisons of yield results can be analysed at intervals of EM38 units, allowing for a clear assessment of soil type responses allowing for a more objective adjustment of zones and management strategies.

Example of comparing treatment yield responses against EM38 units (lighter soil to heavier soil) to help assess optimal input rates and refine potential zone boundaries.



Example where the previous EM38 unit comparison graph has led to zone and rate refinement.

Zone	EM38 Range	Fertiliser Rates			Comments
		MAP	SOA upfront	Post Urea	
Gutless Sand	**0-50**	**35**	**30**	**30**	Needs improved fertility but too risky to economically justify high inputs
Mid slope Sand	**50-90**	**50**	**50**	**40**	Highly responsive to higher N inputs
Loam	**90-120**	**40**		**40**	Variable N reponse but some required
Heavy Flat	**120+**	**40**		**20**	Generally best reponse to no urea

Paddock plans and processes are refined with each farmer to improve their strategies and confidence to continue with successful VRT application into the future. (NB. Within the years comparitive analysis it is important to account for specific seasonal conditions or events that may have influenced results. Decisions to change approaches based on limited results may be premature, if seasonal conditions are significantly different next year. This is where local experience and an objective understanding of influencing factors is important, as well as the value of assessing comparitive data over a number seasons). Farmers individual reports are presented with final paddock result analysis and individual recommendations for the future application of VRT.

9. **Project farmers finally meet together with project consultants and facilitators to discuss farmer results and evaluate the success of the project methodologies, information presentation and support, as well as recommendations for improving VRT processes in the future that will enable more farmers to adopt and benefit from it.**

   It is emphasised to the farmers that successful VRT farming is a process of continuing learning and adjustment, working towards a robust managent system that can best apply the right rates into the different zones, allowing for the risks and opportunities associated with varying seasonal conditions.

This project is jointly funded through the South Australian Murray-Darling Basin Natural Resources Management Board and the Australian Governments National Landcare Programme

Government of South Australia | Natural Resources SA Murray-Darling Basin | Australian Government | National Landcare Programme | Rural Solutions SA PIRSA | wisdom DATA & MAPPING

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