FINAL REPORT 2014

Applicants must read the *SAGIT Project Funding Guidelines 2014* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

Final reports must be emailed to admin@sagit.com.au as a Microsoft Word document in the format shown ***within 2 months*** after the completion of the Project Term.

PROJECT CODE	**:**	PCT0111

PROJECT TITLE	Increasing the economic returns of agronomic management using Precision Agriculture

PROJECT DURATION

*These dates **must** be the same as those stated in the Funding Agreement*

Project Start date	1st April 2011
Project End date	31st March 2014

PROJECT SUPERVISOR CONTACT DETAILS

The project supervisor is the person responsible for the overall project

Title:	**First Name:**	**Surname:**	
Mr	Michael	Wells	
Organisation:			
Precision Cropping Technologies			
Mailing address:			
Telephone:	**Facsimile:**	**Mobile:**	**Email:**

Office Use Only

Project Code	
Project Type	

ADMINISTRATION CONTACT DETAILS

The Administration Contact is the person responsible for all administrative matters relating to the project

Title:	First Name:	Surname:
Mrs	Genevieve	Wells

Organisation:
Precision Cropping Technologies
Mailing address:

Telephone:	Facsimile:	Mobile:	Email:

PROJECT REPORT

Provide clear description of the following:

Executive Summary (200 words maximum)

A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs

Key Outcomes from activities:

- Overall EM38 provided the strongest understanding of soil variability across all sites, except on Lower EP where Gamma Radiometrics proved an essential addition to EM38.
- Collection of good quality yield was a key factor in being able to understand value of the different sensors in the way that the crop responded across varying soils.
- Not all environments responded to increases in inputs using VR, with soil modification and/or amelioration found to have much greater potential as a profit making management decision. Using soil sensors proved to be very effective at identifying these areas, both depth to clay using EM and deep ripping of 'Bleached' layers using EM and Gamma Radiometrics
- Relationships with EM and soil water were identified in some environments – a key component of risk management with inputs particularly nitrogen. Economic benefits were found to reducing inputs on heavy soils in low rainfall environments, while in medium rainfall environments there were economic gains both from increased inputs on better soils and reduced inputs on poorer soils. These benefits were influenced heavily by rotation.
- N sensors and the response across soil zones showing great potential as a management tool to maximise yield within certain soil zones in some growing environments
- Concise decision support tool developed, including relevant case studies, giving growers and agronomists a simple step by step guide to implementing PA outcomes from the project based on soil surveys.

Project Objectives

A concise statement of the aims of the project in outcome terms should be provided.

The project sought to develop Precision Agriculture as both a decision support tool and management tool that reduces risks and increases returns for South Australian growers.

This was achieved by focusing on 5 farms across the state and following a consistent and strategic approach to:

- Isolate critical management and agronomic challenges facing farmers in each region
- Optimize the use of PA technologies for each region
- Integrate local decision support into practical solutions
- Evaluate the benefits of PA as a management tool through practical and effective trials
- Quantify the economic benefits achieved from targeted management through in-depth trial analysis

This process was supported by the evaluation of various sensors for gathering spatial data. Different sensors were found to have varying levels of effectiveness in understanding soil variability depending on the issues that the growers wanted to look at, and also the geological history of the soil.

Throughout the process existing grower groups, and the wider community were updated with project progress and outcomes, and the final community document - a Decision Support Tool clearly outlying the approach required to achieve economic outcomes from PA tools such as soil surveys. This document includes case studies of the various outcomes from 2 years of trial work and describes the approach used.

Results were continually presented to local grower groups and to the wider community through SPAA.

Overall Performance

A concise statement indicating the extent to which the Project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.

The project objectives were generally achieved, with the outcomes at some sites being more successful than others depending on growing seasons, the results of the ground-truthing and the outcomes being sought by growers in the region.

Some sites provided a much greater opportunity to explore multiple factors, whereas others had impediments to production that could not be resolved, so variable input management was the main focus.

Key personnel included Peter Treloar and Felicity Turner who worked with Michael Wells (Precision Cropping Technologies) in co-ordinating activities on the farms. The main site that caused difficulties was the site at Padthaway where there were issues with equipment, and the ability of the co-operator to collect data – in particular good quality yield data.

Key Performance Indicators (KPI)

*Please indicate whether KPI's were achieved. The KPI's **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

KPI	***Achieved (Y/N)***	***If not achieved, please state reason.***
Report including Economic Analyses of Trial Treatments (annually)	Y	

In-person delivery of trial progress & results (2x/yr)	Y	
Final Report including "Decision Tree"	Y	

Technical Information (Not to exceed **three** pages)

Provide sufficient data and short clear statements of outcomes.

At each of the 5 sites, a consistent and strategic approach was adopted to

1. **Quantify the growing environment** – use of sensors to measure, map and quantify changes in growing environment using DualEM, Gamma Radiometrics, Elevation and derivatives.
2. **Ground Truth** - to determine the agronomic nature of the variation in growing environment including soil coring and analysis, tissue testing
3. **Analyse Impact on Production** - using yield maps and GIS techniques in analysis to understand the relationship between the growing environment and yield.

Having established the economic impact of variations in growing environment on production outcomes, decisions on management response were then determined using one or more of the following strategies.

- **Focus on an issue specific to co-operator concerns.**
- **Low Yield Areas** - Identify and correct limiting factor to increase productivity or reduce the annual cropping inputs in line with yield capacity
- **High Yield Areas** – no apparent limiting factor therefore assess productivity gains by increasing inputs to these regions.

At each of the sites trials were then established to determine potential benefits to management changes in response to spatial variability in the growing environment. Harvest data from the end of each season was used to analyse responses to treatments and establish economic outcomes. Outcomes from trial results were extrapolated over the entire field using the created zones to establish total cost/benefit.

Edillilie Site – Trevor and Craig Gameau

- Combination of Gamma Radiometrics and EM was the most useful in identifying soil types/profiles over this project area.
- DualEM readings had strong correlations with various chemical soil properties including pH, exchangeable sodium, exchangeable aluminium, and the CEC. These findings allowed for targeted gypsum and lime applications to be made across the farm.
- Important to assess where fields are located in the general landscape prior to planning soil coring. Zone sampling in addition to point sampling may provide the more robust interpretation of the nature of soil variability detected by the soil sensors.

Key Outcomes

- Creation of VRT gypsum applications; reduced total requirements by 25%, but targeted use better.
- Identification of "yield zones" and targeted application of VR fertiliser according to these yield zones; resulted in responses of up to $50/ha.
- Long-term liming trial established.
- Identification of areas of different land use capabilities; identification of areas where money has been lost that is better suited to grazing.
- Utilisation of elevation data to evaluate drainage and assess options to reduce waterlogging impacts.
- Success outcome with positive yield responses to deep ripping and liming acid soils.

Hart Site – Robbie Wandel

- EM38 survey had a very strong correlation with a range of soil properties including Salinity, Sodicity, Boron and Soil Texture.
- All of these factors suggested a strong correlation with Crop Lower Limits (CLL), which was confirmed with targeted end of season moisture cores. In-season coring also revealed a strong correlation with Drained Upper Limit (DUL)

Key Outcomes

- VR gypsum maps created from the strong correlation to Sodicity with EM38 found from Soil Testing.
- Lack of VR equipment meant trials were simplified to only 3 zones. First year of Wheat on Legumes there were only marginal gains to higher inputs, but no penalty to reducing inputs on the high constrained soils.
- Second year trials of Wheat on Wheat saw responses on all soil types to increased fertiliser, but the biggest gains were seen on the low constrained soils up to $70/ha. If VR was applied across the simplified 3 zones the benefit would of averaged $25/ha. It is expected this would improve with the ability to target specific soils using fully automated VR.

Kimba Site – Dion Woolford

- EM38 proved the dominate soil sensor, showing a good correlation to yield especially in below average years. EM also showed good correlations with depth to clay
- Strong relationship found between EM38 and estimated “bucket size' for soil water using 'Soil Water Express'

Key Outcomes

- Increased inputs on the Sandy Soils did not increase production – this is in contrast to experiences in other regions of similar soil types and rainfall.
- Reduced inputs on highly constrained soils, as identified by the EM38, did not reduce yield but improved the gross margin while reducing risks.
- Using the correlation to depth to clay, one field was ameliorated very successfully, clearly identifying areas best suited to Clay Spreading, Clay Delving and no treatment. Also Clay Pits could be located using the EM to supply the Clay Spreading. Overall this improved the efficiencies of all operations.

Yumali Site – Hansen Farms

- Correlations between Dual EM and Gamma Radiometrics and the soil texture (eg. clay content of the soil) did not exist. This is thought to be due to the presence of limestone layer which varies in depth below the soil.
- The soil sensors layers alone were ineffective in directly distinguishing between deep sand and limestone areas

Key Outcomes

- Intensive soil coring and field observation showed potential in selected fields for being able to define the presence of and depth to limestone under the surface. The ability to understand where limestone is present and what depth will allow for targeted soil modification work to occur.
- Monitoring of long term test strips suggest that no yield loss is occurring by managing inputs to soil zones.
- Crop sensor data correlated well with final yield in respective soil zones suggesting potential for production increases through targeted N applications matched to yield potential and nitrogen supply.

Padthaway Site – Tony Mackereth

- Soils were highly variable over a short distance which may limit ability for large scale spatial management.
- DualEM was strongly correlated to depth of soil over limestone.
- DualEM appeared to be the more effective sensor for detecting soil variability at this site.

Key Outcomes

- Combining NDVI data with soil data resulted in improved post-emergent Nitrogen management outcomes (when compared with using soil zones alone)
- Use of elevation data to track the movement of water over the field suggested that changing the direction of sowing would reduce the traffic through depressions improving the trafficability for farming operations, and potentially improving the total yield across the paddock (from modelling responses).

Conclusions Reached &/or Discoveries Made (Not to exceed one page)

Please provide concise statement of any conclusions reached &/or discoveries made.

- Soil Sensors - Multi Depth EM was the dominant sensor for detecting spatial soil variability at 4 sites and provided important and applicable soil definitions. Edillilie site was the exception where the Gamma Radiometrics was a valuable addition to Multi Depth EM. A combination of sensors was essential in understanding agronomically important soil variability.

- Positive economic returns were achieved through trials to assess the targeting of inputs to soil type and differing yield potential. Planting fertiliser and post seeding applications of urea were of note.

- A significant database of spatial information has been systematically accumulated for each site. This information has enduring application for agronomic decision making and provides an excellent foundation for continued research into the applications of Precision Agriculture at all 5 sites.

Intellectual Property

Please provide concise statement of any intellectual property generated and potential for commercialisation.

Not Applicable.

Application / Communication of Results

A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:

- *Main findings of the project in a dot point form suitable for use in communications to farmers;*
- *A statement of potential industry impact*
- *Publications and extension articles delivered as part of the project; and,*
- *Suggested path to market for the results including barriers to adoption.*

Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.

Annual updates and extension of results was conducted;

Edillilie - LEADA pre sowing forum. CumminsAg annual spring cropwalk.
SPAA – PrecisonAg Conference 9th Sept 2011, Mawson Lakes.
SPAA – PrecisionAg Expo 15th Feb 2012, Pt Lincoln.
SPAA – PrecisonAg Expo 8th Feb 2013, Nuriootpa.
SPAA – PrecisonAg Conference 3rd Sept 2014, West Lakes.
FIFA Conference 1st Oct 2014, Glenelg.
Cookes Plains – Crop Walk, Sept 2012
Coomandook – NRM forum, March 2014
Naracoorte – July 2012, MacKillop Precision Ag Machinery day
Frances 2013 – update of project at MacKillop Field Days
Hart Field Day 2013 & Results published in Annual Results book each year
SPAA and EP Farming Systems Field Day at Kimba - 2013
Results were presented to the Buckleboo Farm Improvement Group and Crossville Ag Bureau at Cleve - 2014

Future Activities for extension include;
Delivery of Decision Support Fact Sheets and Case Studies to industry – October 2014
SPAA Tech Newsletter Autumn 2015 (to be printed)
MFMG Annual Trial Results booklet 2015; Padthaway site summary (to be included)
LEADA Booklet Autumn 2015

POSSIBLE FUTURE WORK

Provide possible future directions for the research arising from the project including potential for further work and partnerships.

Issues to be resolved.

Hart – Successful mapping of Variations in Soil Water by EM38 at Hart opens the door for substantial work on Nitrogen Management. Particularly managing Nitrogen at different stages of the rotation.

Kimba – Lifting yields on Sandy Soils is a major opportunity in the low rainfall environment of Kimba. Soil Amelioration is a key component but not all sites have affordable access to Clay. As seen in other Low Rainfall environments lifting yields on lighter soils is a key component in improving farm viability during below average seasons.

Yumali – Crop Sensors and managing in season nitrogen decisions based on soiltype/yield potential and nitrogen supply.

Edillilie – Opportunities for further investigations for targeting of potassium fertilizer in combination with nitrogen to further increase profit on typically high producing soils. In addition the management of low pH and variable rate liming in these complex soil landscapes provides scope for subsequent research.

AUTHORISATION
Name:
Position:
Signature:
Date:

Submit report via email to admin@sagit.com.au as a Microsoft Word document in the format shown ***within 2 months*** after the completion of the Project Term.