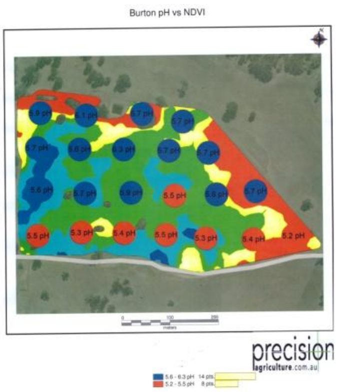
PPS

PERENNIALPASTURESYSTEMS

MAKING PASTURE GO THE DISTANCE

# Variable Lime Application Trial

2013 - 2016





*Funded with the assistance of*

Glenelg Hopkins CMA

Wimmera CMA

CARING FOR OUR COUNTRY

*Technical Assistance provided by*

precision agriculture.com.au

# Perennial Pasture Systems

# Variable Lime Application Trial 2013 - 2016

Final Report September 2017

Final Report prepared by Rob Shea PPS Project Manager

*Reviewed by*
*Dr Wayne Burton; PPS President 2015/17*
*and Rachael Campbell, Extension Officer; Agriculture Victoria, Ballarat*

Perennial Pasture Systems

C/O 6 Coad St Ararat Vic 3377

0438 521 357

yadin@netconnect.com.au

www.perennialpasturesystems.com.au

The PPS Variable Lime Application Trial
was funded with the assistance of

Technical Assistance provided by

# Contents

# PPS Variable Lime Application Trial

# 2013 -2016

# Final Report


## *Abstract*

Soils in much of the Upper Wimmera and Central Victorian region are naturally acidic and are often at pH levels which restrict plant growth or allow the release of aluminium which may be at levels toxic to plant such as phalaris.

The application of lime is used to increase the soil pH and take it to levels that are not detrimental to plant growth. In most cases this is done after a soil test is done on amalgamated samples from a paddock and the standard recommendation is an application of 2.5 tonnes of lime per hectare over the whole paddock.

Soil mapping shows that soil pH usually varies within paddocks and that a blanket lime application may not be the most effective way of raising the paddock pH to the required level. Some areas of the paddock may require a higher lime application than the standard rate, while other areas may need less or even not require lime at all.

The Variable Lime Application Trial was set up to test the use of variable pH testing and the effect of variable lime applications based on the results of the testing technique.

The variable lime technique involves whole paddock pH testing and the production of soil pH maps that reflect the pH variation within the paddock, the rate of lime application for each area of the paddock is then recommended. Lime is then applied at the variable rate.

PPS also used NDVI testing prior to the lime application to investigate pasture growth differences in the mapped pH ranges within the paddock.

Variable P and K testing was added to the final stage of the project to assess the possibilities of the method being a tool for efficient nutrient management in pasture systems.

# History of PPS

The Perennial Pasture Systems (PPS) group was formed in mid 2007 after a meeting convened by Julie Andrew and Ewan Letts from the Victorian Dept of Primary Industries was conducted at Halls Gap reacting to concerns about the lack of research and extension into productive pastures in the Upper Wimmera and Central Highlands region of Victoria

A management committee was formed at the meeting which initiated the PPS group. Simon Brady from Jallukar became the groups first President and PPS commenced three paddock scale projects to trial new pasture varieties which had recently become available. Planning of the projects and paddock walks were the main activities through 2008.

PPS was able to gain funding to progress the group through Project Platypus and in March 2009 it hired a part time project manager who oversaw the establishment of three MLA PDS trial sites as well the EverGraze phalaris and lucerne trial site at Mooneys Gap. Also during 2009 the group's newsletter was commenced and PPS held their first annual conference and dinner.

During 2010 PPS continued their extension work with the newsletter, field days and the annual conference. A second EverGraze trial site at Tottington was also commenced.

PPS continued to gain new farmer members as well as attracting several members from industry such as agronomists and seed suppliers who are regular attendees at PPS events. In 2011 a soil amelioration project was commenced with funding from the A W Howard Trust. At the Annual conference dinner Ben Greene from Elmhurst was elected as the group's second president. Also in 2011 PPS became an affiliated member of the regional Landcare umbrella group Project Platypus, which was a natural progression of the close cooperation between Perennial Pasture Systems and Project Platypus since PPS was formed.

In 2012 PPS started another major project with the establishment of four replicated plant variety trials set up to test pasture species under the different soil and climatic conditions in the region. 2013 saw the commencement of the Variable Lime Trial and the Stawell Cocksfoot Comparison Project as well as Paul Harrington of Mt Cole Creek starting a two year term as President.
In 2014 and 2015 PPS commenced a phalaris persistence project and a Gibberellic Acid demonstration funded through MLA research projects, other smaller projects have also been undertaken by the group.
Wayne Burton from Mt Dryden became group President at the Annual Conference in 2015 and will complete the fixed two year term. In 2016 PPS formed a partnership with the Grampians Pyrenees Primary Care Partnership which will focus on health issues in the rural community.

Since its inception in 2007 143 farm businesses across the Southern Wimmera and Central Victoria have joined PPS. Members are heavily involved in prime lamb, mutton, wool and beef production. PPS also has 35 members involved in agribusiness and agronomic services. The total area farmed by producers who have joined PPS is 151,800 Ha and they manage approximately 987,000 DSE's, made up of 589,000 sheep and 12,500 cattle; cropping and export hay operations are also conducted on many of the farms. The smallest farm in the group is 20 ha and the largest is 8200 ha. The average farm size is 1101 ha and an average of 7010 dse's is managed by group member enterprises.

***The aim of the group is to push the boundaries of perennial pasture research in the Upper Wimmera and Central Highlands region of Victoria, and to provide information on productive pasture management to PPS members.***

PERENNIALPASTURESYSTEMS
MAKING PASTURE GO THE DISTANCE

# PPS Variable Lime Application Trial
# Executive Summary

***Background:*** At the 2012 PPS annual conference, PPS member farmer Steven Start from Crowlands & consultant John Robertson; Agwise Horsham gave presentations on the use of variable lime application technology in cropping systems. Both presentations created a lot of interest in the technique and discussion was held at the September 2012 PPS management committee meeting on exploring the topic further for the benefits of members and other pasture farmers in the region.

***Variable lime technique:*** The variable lime technique involves whole paddock pH testing and the production of soil pH maps that reflect the pH variation within the paddock; the rate of lime application for each area of the paddock is then calculated. Lime is then applied at variable rates within the paddock in line with the recommendations for the calculated results.

***Claimed benefits:*** The variable lime technique is a more accurate method of applying the correct amount of lime to raise soil pH to the desired level than the usual blanket recommendation of 2.5 tonnes per ha. The technique has the possible benefit of reducing the cost of lime applications by reducing the total amount of lime needed in specific paddocks.
It may also increase total costs where higher applications are recommended after mapping but if this is the case then the money invested in lime applications is achieving the desired result rather than money being invested into sub optimal lime applications.

***Discussion:*** The PPS management committee discussed the variable lime application technology and raised the following questions:
*Is the variable lime technique applicable/economic in a pasture system or is it more suited to cropping systems?*
*Is it viable in the smaller size paddocks that are usual in pasture systems?*
*Can you measure economic gains using the technique in pasture paddocks?*
It was noted that the technique is still fairly new and that yield data was not yet available for paddocks in our region that have used the method. It was decided that more information was needed before pasture farmers would consider using the technique.

***Trial:*** PPS decided to implement a trial to address the questions raised, which commenced in 2013. The trial was conducted from 2013 until 2016 and went through the following stages –

| | |
|---|---|
| Soil pH Testing | Soil pH Validation |
| NDVI testing | NDVI Vs pH analysis |
| Variable Lime Application | Lime rate Trial |
| Soil pH testing post the variable lime application | Soil Phosphorus and Potassium testing |

***The results of the trial are contained in this final report.***


*Figure 1: John Robertson; Agwise Horsham (left) and Steven Start; PPS member, Crowlands (second from right) with other presenters and PPS President Ben Greene at the 2013 PPS conference, where they did presentations on the use of variable lime technology in cropping systems.*

# Key Findings

The variable lime technology soil pH testing and subsequent variable lime rate applications have the potential to be an efficient method of ensuring that soil pH is in the target range for optimum plant growth.

The variable lime technology has the potential to create savings for farmers addressing soil pH in pasture systems as evidenced in the case study on page 14. It should be noted though, that in some cases the variable lime technology soil measurements may identify a higher requirement for lime than that calculated from conventional testing.

The trial analysis suggested that six out of the seven paddocks in the trial would have potential cost savings if variable or targeted liming was implemented when compared to conventional testing and lime application rates.
The seventh paddock had a pH below target levels over the entire area and required a blanket lime application and there would have been no cost saving benefit in this case.

The results suggest that the variable pH testing and variable lime application technology (if required, depending on the results) is especially suited to previously limed pastures to ensure that are still within the required pH range.

The results suggest that the variable lime technology is likely to have the best cost benefit outcome in previously limed paddocks in regions that have acid soils.

The variable lime application on two selected paddocks was successful in raising the pH to target levels.

A trial was generated from one of the tested paddock which sowed nearly all the points tested having a pH below the target level at which aluminium toxicity can become an issue.
PPS decided to test if the usual recommended rate of 2.5 tonnes/ha of lime was sufficient to raise all areas of the paddock to the desired pH of 5.4 (water) or 4.5 (CaCl).
This proved to be the outcome although the paddock may require a further lime application in the medium term as the pH levels were only raised to a level slightly higher than the target range to avoid the risk of aluminium toxicity.

Biomass testing was carried out using NDVI technology and the results were overlayed with the pH maps showing the different pH range areas.
PPS believes that more research is needed to quantify the measured relationship between NDVI and soil pH data when assessing pasture growth differences within paddocks. Quantifiable results showing higher pasture growth at Target pH levels would increase the use of lime on pastures to reduce soil acidity.

Variable P and K testing was added to the final pH testing on two paddocks. The results and maps produced showed interesting findings which could aid producers in their fertiliser decisions and allowing target applications of P and K within paddocks.

PPS believes that research is required to validate the variable P & K testing and to formulate recommendations on the frequency of testing to achieve the best outcomes. Variable P and K testing would likely need to be carried out at shorter interval than pH testing.

## Trial Locations

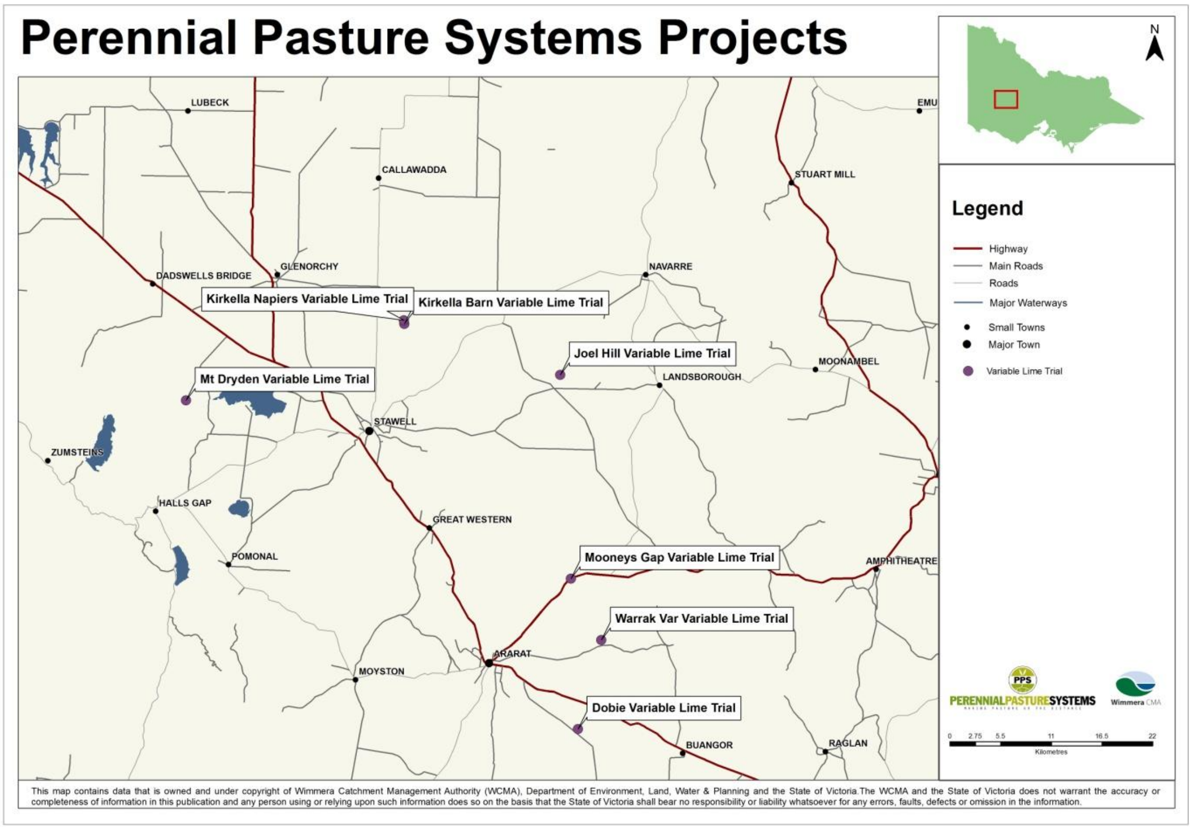
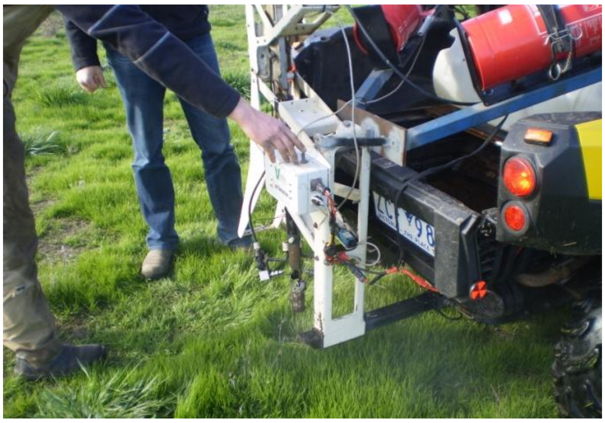



*Figure 2; Map of pH testing sites*

## Variable Lime Application Trial; Soil pH Testing

Seven paddocks on PPS member farms were selected to reflect the varying soil types and management within the region. These were tested in June 2013 for pH using 0 – 10 cm samples collected on a 0.4 ha grid using the Precision Agriculture testing machine. The samples were tested for pH and paddock maps generated by Precision Agriculture showing individual tests as well as schematic maps showing the paddock in sections showing the estimated pH.



Figures 3 & 4; Precision Agriculture pH testing rig

| Paddock name | Location | Ha | Previous History | Comments |
|---|---|---|---|---|
| Gorrinn | Dobie, 10 km SE of Ararat | 10 | Old phalaris pasture, limed 6 years ago | Basalt soil, next to PPS Dobie pasture variety trial |
| Stevens | Warrak Rd, 10 km east of Ararat | 8 | Unlimed, degraded annual pasture | |
| Mooneys Gap | Pyrenees Hwy 10, NE of Ararat | 12 | Limed in 2009,<br>Soil pH 2009 4.6 CaCl<br>Soil pH 2012 4.9 CaCl | PPS EverGraze supporting site |
| Joel Hill | Joel Joel | 28 | Lime applied with variable rate technology 2012 | Cropping paddock |
| Kirkella Napiers | 12 km NE of Stawell | 56 | Lime applied with variable rate technology 2012 | |
| Kirkella Barn | 12 km NE of Stawell | 42 | Lime applied with standard rate technology 2012 | 2.5 t/ha lime applied in 2012 |
| Marenda | 20 km west of Stawell | 12 | Old phalaris pasture | |

*Figure 5: Stage 1 paddock details*

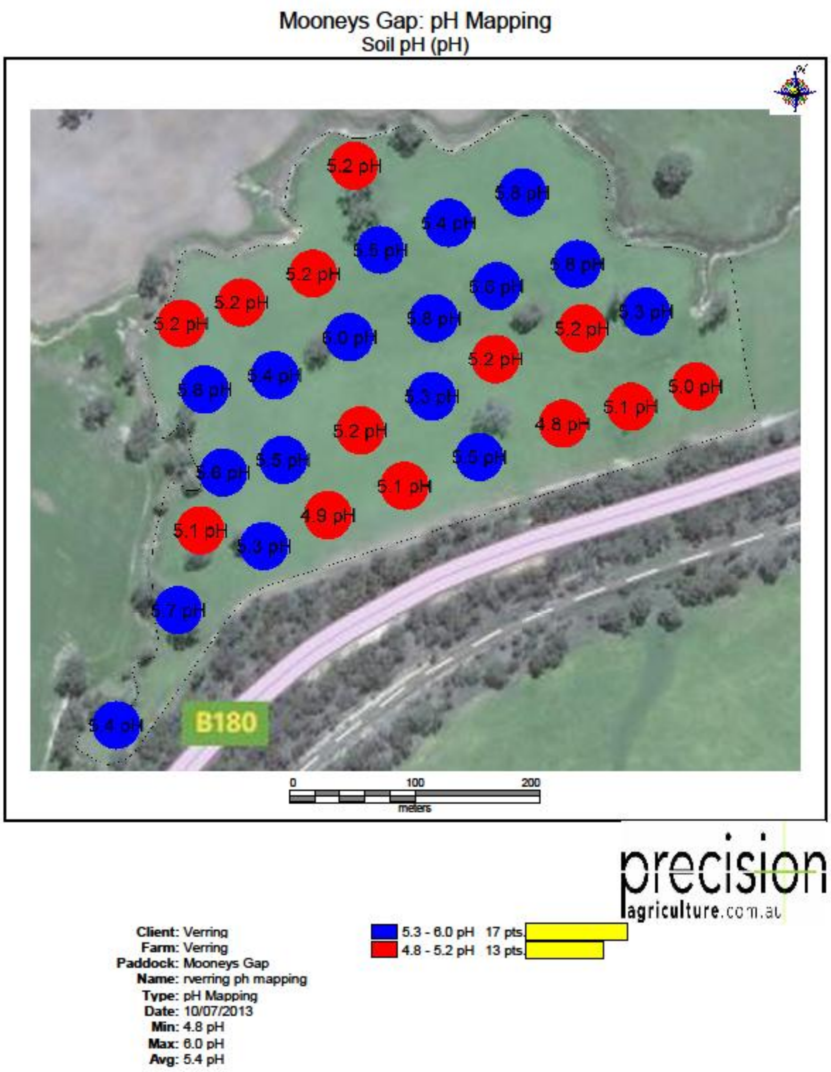



*Figure 6; Map showing testing point results at Mooneys Gap*

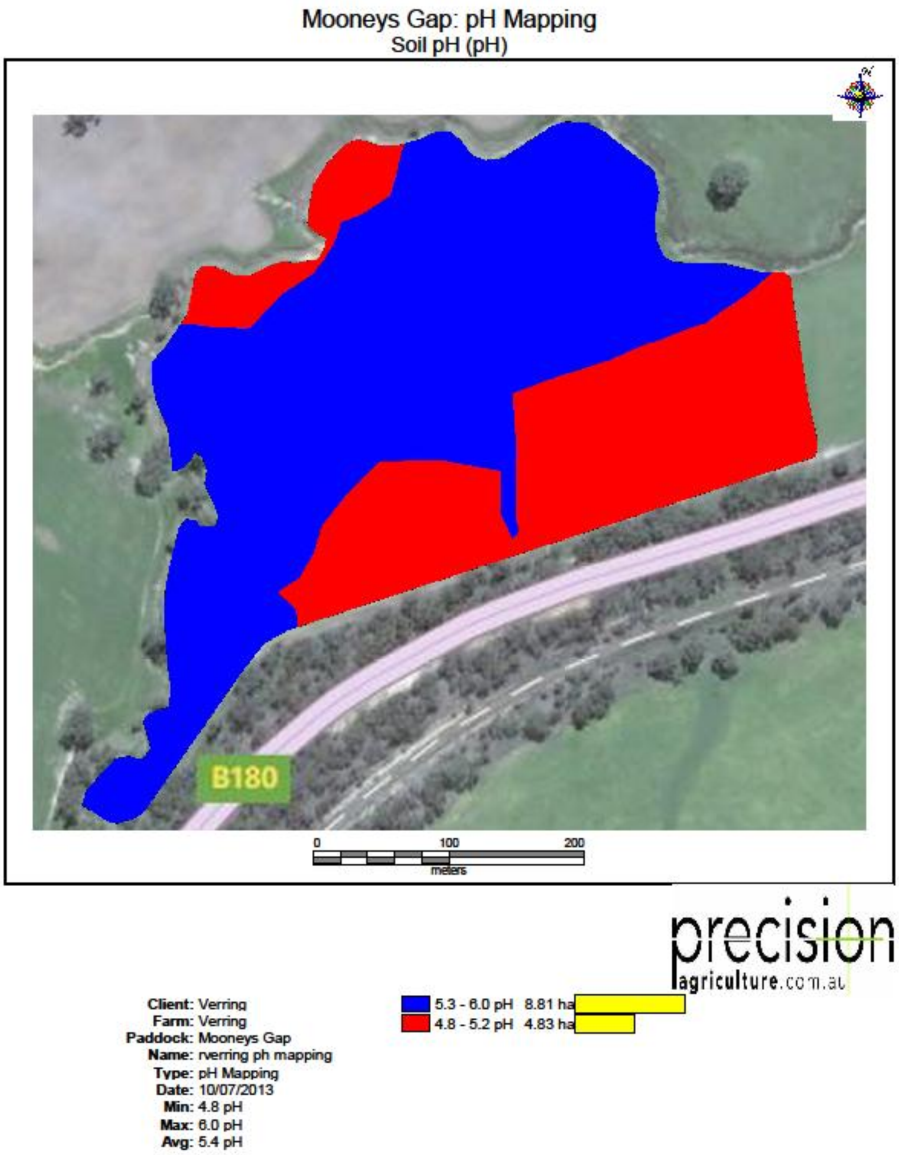



*Figure 7: Schematic map showing pH ranges at Mooneys Gap*

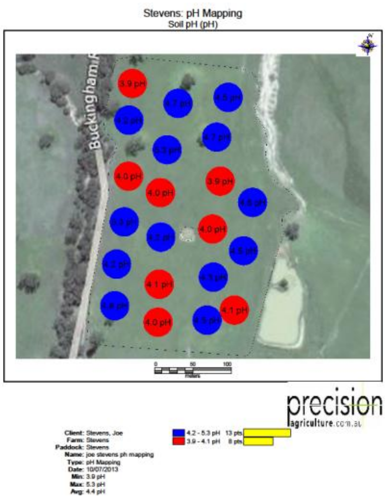
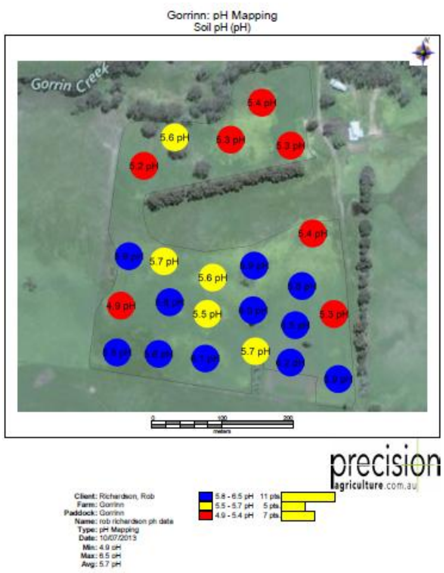



*Figure 8 (left) testing point results; Stevens*

*Figure 9 (right) testing point results; Gorrinn North*



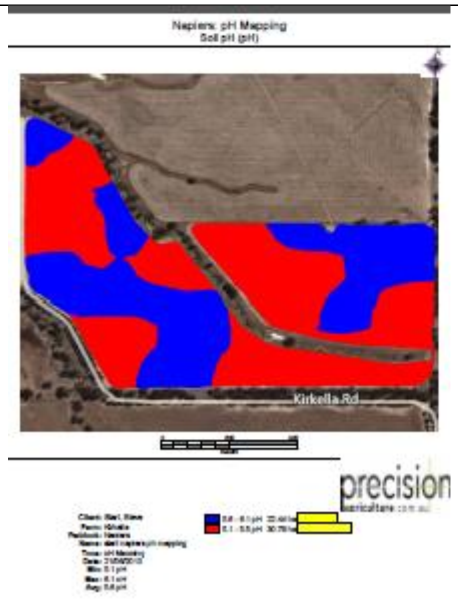
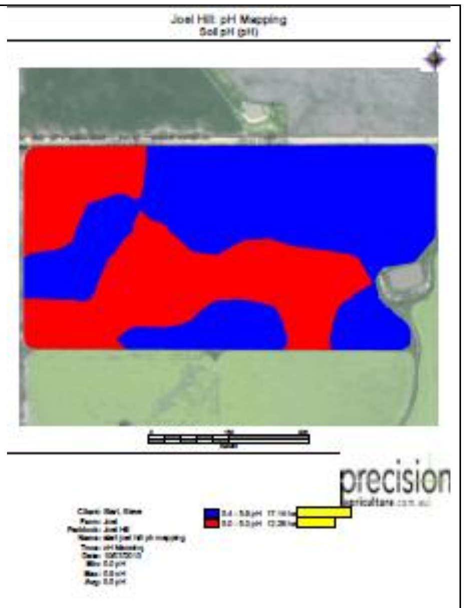



*Figure 10 (left) schematic pH map; Kirkella – Napiers*

*Figure 11 (right) schematic pH map; Joel Hill*



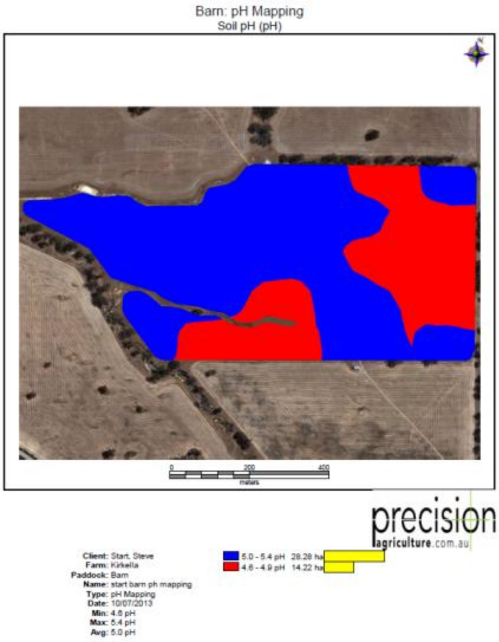




*Figure 12: Schematic pH map Kirkella - Barn*

*Figure 13: Kirkella – Barn paddock near Stawell*

## Variable Lime Application Trial; Soil pH Validation

Soil samples were taken on 31/7/13 using conventional soil test methods to get the average pH results from targeted areas of three paddocks. Two combined samples were taken using the red (low pH) and blue (high pH) zones from the variable pH schematic maps. The results are listed in the table below. The Gorrinn and Mooneys Gap paddocks showed a good correlation between the conventionally tested and variable rate tested zones. The results at Joel Hill showed no difference between the zones when conventionally tested, it should be noted that the conventional testing samples were taken using a visual interpretation on the maps which may have resulted in small sampling errors.

| Zone | Customer | pH Level (CaCl2) | pH Level (H2O) | Exc. Aluminium meq/100g |
|---|---|---|---|---|
| Red | Gorrinn | 4.7 | 5.7 | 0.159 |
| Blue | Gorrinn | 5.7 | 6.5 | 0.045 |
| Red | Joel Hill | 5.6 | 6.4 | 0.014 |
| Blue | Joel Hill | 5.6 | 6.4 | 0.026 |
| Red | Mooneys Gap | 4.9 | 5.9 | 0.137 |
| Blue | Mooneys Gap | 5.2 | 6.1 | 0.225 |

*Figure 14: Conventional Soil Test results July 2013*

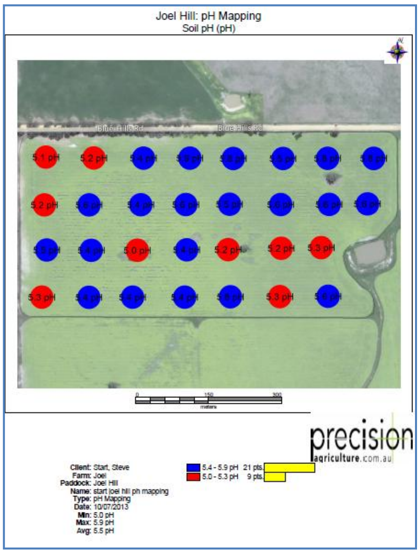



*Figure 15: Variable pH test results, point map, Joel Hill June 2013*

**Case Study**

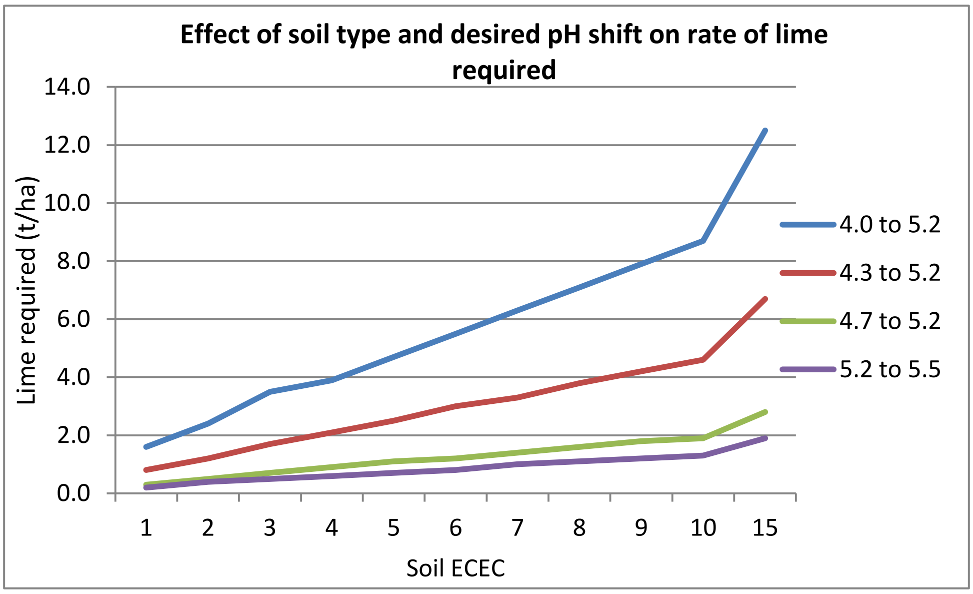
A case study on the effects and cost of using the variable pH results to calculate the amount of lime requires to bring a paddock to the desired pH range was conducted on the Marenda paddock using the data below.

*Lime requirement (t/ha) to lift the pH of the top 10cm of soil up to 5.2 for a range of Effective Cation Exchange Capacities (ECEC) & pH normally encountered when making liming recommendations.*
*The additional lime required to lift the pH from 5.2 to 5.5 is also given.*

Lime required (t/ha) to lift the pH of the top 10cm

| ECEC (cmol+/kg) | 4.0 to 5.2 | 4.3 to 5.2 | 4.7 to 5.2 | 5.2 to 5.5 |
|---|---|---|---|---|
| 1 | 1.6 | 0.8 | 0.3 | 0.2 |
| 2 | 2.4 | 1.2 | 0.5 | 0.4 |
| 3 | 3.5 | 1.7 | 0.7 | 0.5 |
| 4 | 3.9 | 2.1 | 0.9 | 0.6 |
| 5 | 4.7 | 2.5 | 1.1 | 0.7 |
| 6 | 5.5 | 3 | 1.2 | 0.8 |
| 7 | 6.3 | 3.3 | 1.4 | 1 |
| 8 | 7.1 | 3.8 | 1.6 | 1.1 |
| 9 | 7.9 | 4.2 | 1.8 | 1.2 |
| 10 | 8.7 | 4.6 | 1.9 | 1.3 |
| 15 | 12.5 | 6.7 | 2.8 | 1.9 |

*Assumptions: bulk density of soil is 1.4; 70% lime dissolves in one year.*
*Note: this table will give an overestimate of the lime required for a cracking clay.*
*It is recognised that low rates are difficult to apply, but over-liming can cause nutrient deficiencies, particularly in light soils (i.e. with ECEC 5 or less).*
*For soils with subsoil acidity problems - need to maintain topsoil (0-10cm) at pH 5.5 (Cacl2) to help lime move down the profile.*
*More lime is required to shift the pH by 1 unit at a lower pH (e.g. 4.0) than at a higher pH*

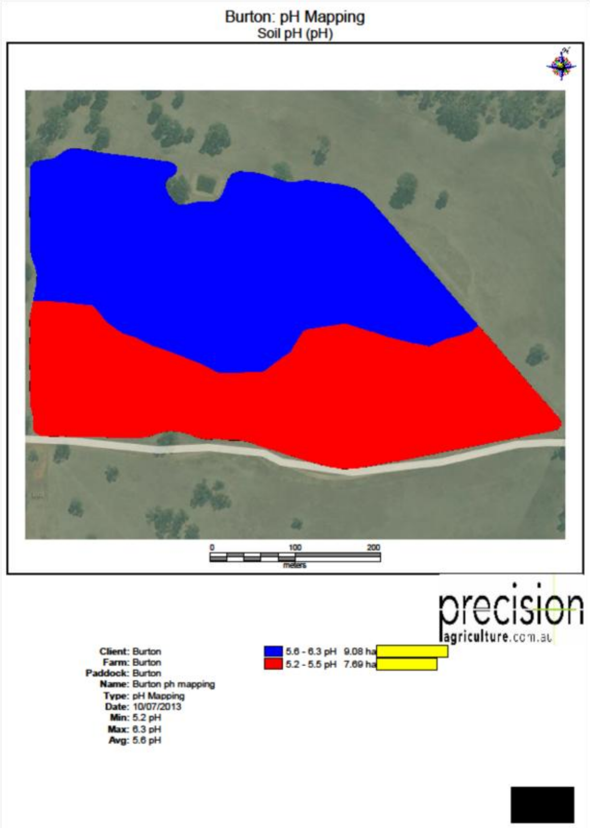



*Figures 16 & 17: Lime calculation data*

**Lime requirements**

The amount of lime required to raise pH to desired levels has been calculated from advice by Lisa Warn in an article in the Melbourne University McKinnon newsletter May 2011 titled "When lime is a good investment". This paper should be referenced when talking about the lime rates used in the PPS trial.

# Case Study Mt Dryden




**AIM**
Increase soil pH to 5.5 pH (water)

**No variable pH mapping.**
Apply maintenance lime @ 1.05 tonne/ha – cost $74/ha
16.77 ha - $1241

**Variable pH mapping**
Testing & mapping @$12/ha - $202
Calibration pH test $50
Area which needs lime @ 1.05 t/ha = 7.69 ha Cost $569
Total cost testing & lime $821

**Cost to achieve aim**
**No variable pH mapping - $1241**
**With variable pH mapping - $821**

*Figure 18: Results from case study on "Marenda" Mt Dryden paddock*

The map from the soil testing points at Mt Dryden shows distinct regions within the paddock with the area in blue being above the target pH and the area in red below the target pH.
A conventional soil test which combines multiple samples for testing showed the average for the paddock was 5.7 pH (water); this would suggest that no lime was required. The pH map using the data showed that this was not the case and that approximately 8 ha or nearly half the paddock required lime to bring it up to the desired pH level.
The calculations suggested that a rate of 1.05 tonnes/ha would achieve this; lime was applied at this rate in stage 3 of the project and the results are shown on page 25.
In this case there was a definite advantage in using the variable pH testing which identified that the entire paddock did not require lime and that then using the appropriate rate in the sections of the paddock would achieve the desired result.
Without the variable pH rate information the host farmer may have used the normal soil test and decided that no lime was required but would still have had nearly half the paddock below the desired pH level. Alternatively he may have decided to apply a maintenance level over the entire paddock which would have resulted in a higher cost than the variable pH testing and subsequent lime treatment.
Note: the results from the case study do not suggest that there will be a positive financial outcome in every paddock; individual paddocks will produce differing results.

*Figures 19 & 20: Marenda, Mt Dryden*

## Variable Lime Application Trial; NDVI testing

As part of the variable pH trial, PPS decided to conduct NDVI testing on three of the permanent pasture paddocks that were assessed as a part of the variable pH testing and mapping.
The NDVI (normalised difference vegetation index) assess differences in biomass which show the level of pasture growth in the paddocks.

The paddocks were the PPS/EverGraze paddock at Mooneys Gap, the paddock adjacent to the PPS plant variety trial at Gorrinn Dobie and a paddock on the Marenda property at Mt Dryden between Lake Lonsdale and the Grampians. The paddocks were spelled prior to the measurement to even up plant growth.

PPS contracted Precision Agriculture to use their Greenseeker technology to do the NDVI measurements in November 2013.

**NDVI measurements**

NDVI (normalised difference vegetation index) is an index with a scale of -1 to 1.

NDVI is calculated as follows:
NDVI = (near infrared) – (red)/(near infrared) + (red)
Where near infrared and red are the light reflectances from vegetation that is measured in each band respectively. Basically low biomass/unhealthy vegetation reflects more red light and less near infrared light compared to high biomass/healthy vegetation.
Typical NDVI values are:
Healthy plant = 0.8
Dead plant = 0.1
Concrete or roads = 0
Water =<0
The results were mapped schematically by Precision Agriculture to show the NDVI readings.

**What do NDVI maps show?**

NDVI maps will have a typical scale of 0.3 to 0.9. The colour scale is from red to blue (red = low biomass/unhealthy vegetation, yellow/green = medium biomass/medium health vegetation, blue = high biomass/healthy vegetation). The maps show where biomass/vegetation health varies across your paddocks.

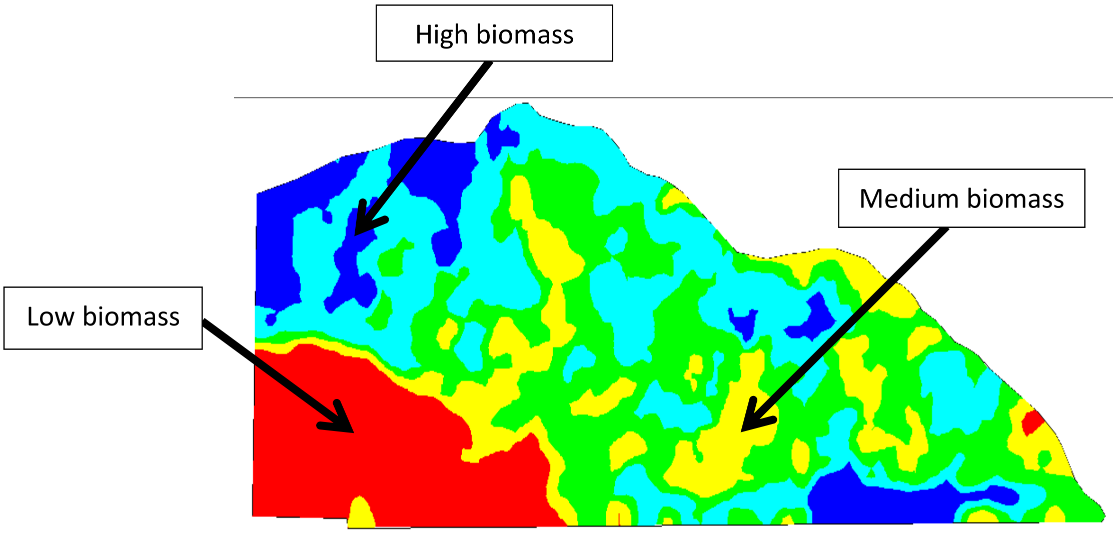



*Figure 21: Example of NDVI map, NDVI notes supplied by Precision Agriculture*

Maps of the NDVI readings were produced and then overlayed with the pH points measured during the variable pH testing.

*Figures 22 & 29: Brendan Torpy from Precision Agriculture operating the Greenseeker machine*

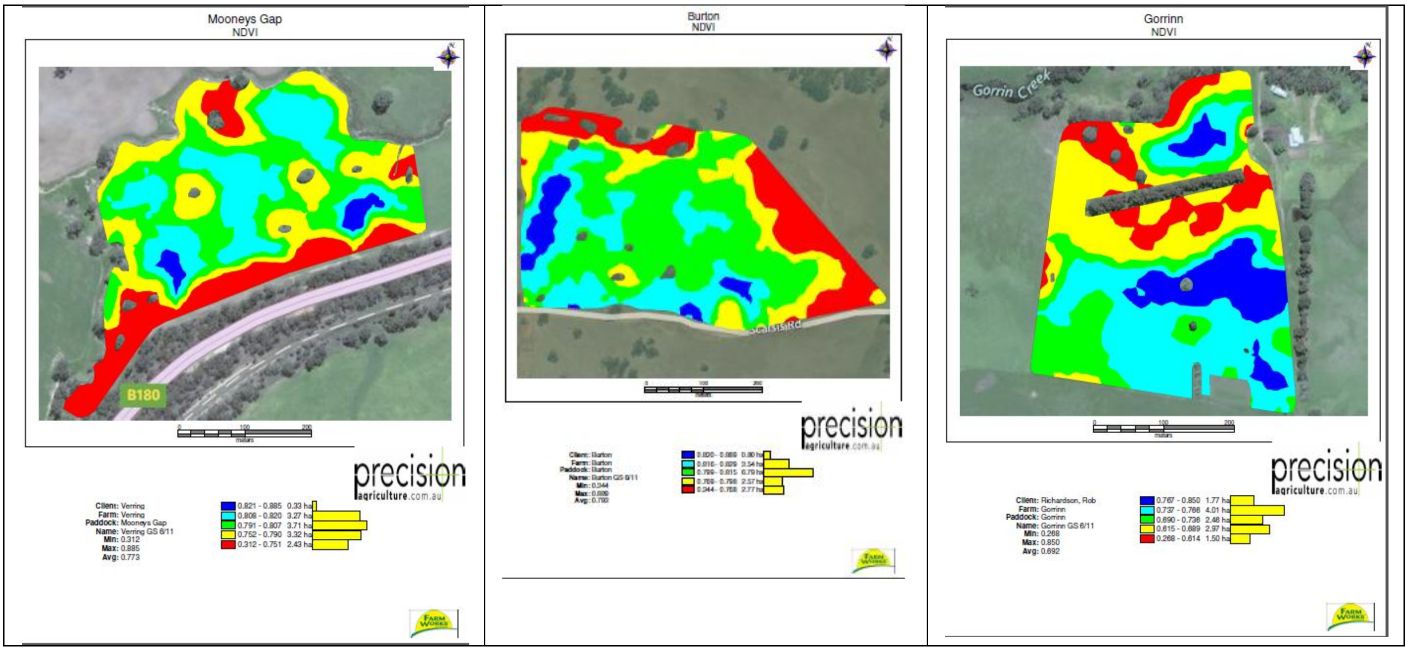



*Figure 24: NDVI maps; red = low biomass/unhealthy vegetation, yellow/green = medium biomass/medium health vegetation, blue = high biomass/healthy vegetation*

**NDVI and pH**

The results from the NVDI testing and the pH testing were combined into maps which showed the differences in pasture mass and the soil pH. PPS then calculated each group of pH points against the NDVI colour under the point and measured the frequency of each before graphing them as a percentage of the total points.

The results are shown in figures 25 – 43.

**PPS believes that more trial work is needed to quantify any measured relationship between NDVI and soil pH data when assessing pasture growth differences within paddocks.**

**NDVI Vs pH results**

**Gorrinn**

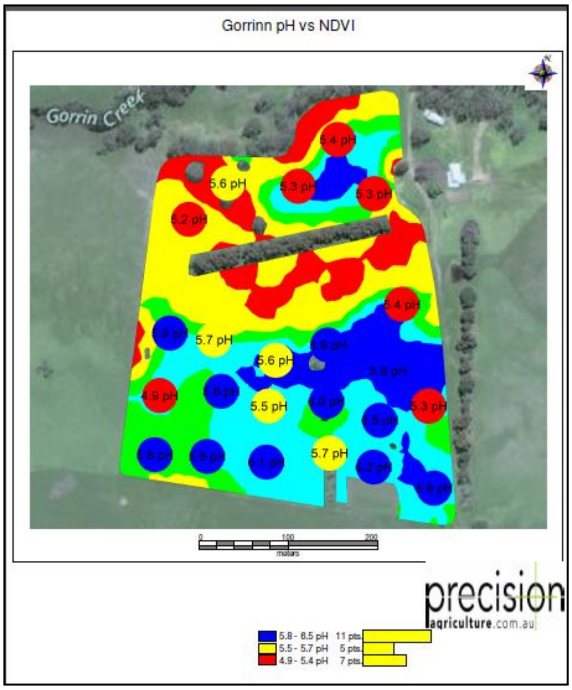
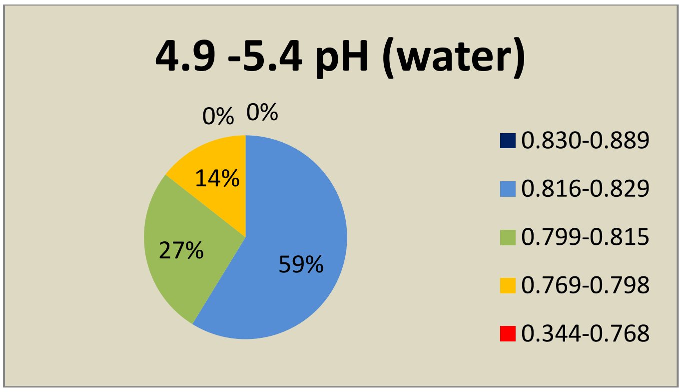
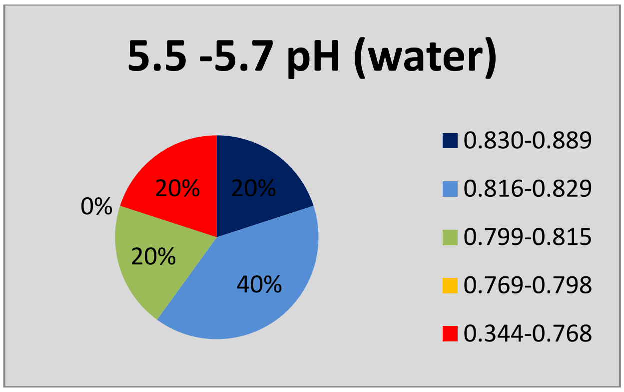


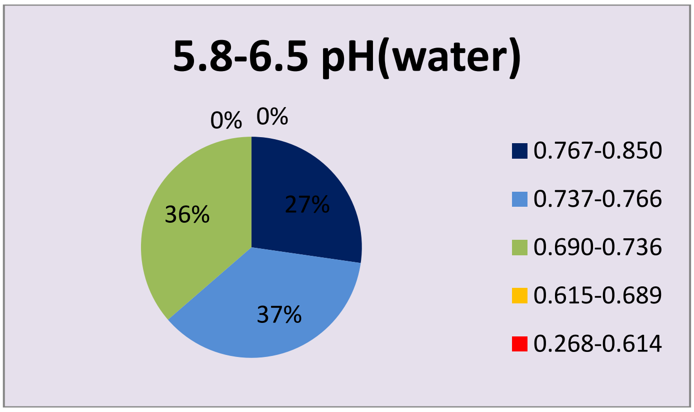

*Figure 25: Gorrinn NDVI & pH results (NDVI contours, pH dots).*

**Gorrinn cont.**

pH points were divided into the ranges 4.9 – 5.4 (water),5.5 – 5.7 (water) and 5.8 – 6.5 (water) and then overlayed with the NDVI results.




*Figures26 - 28: NDVI results for soil pH ranges.*

**Gorrinn cont.**
The results showed a higher biomass result in the higher soil pH areas.

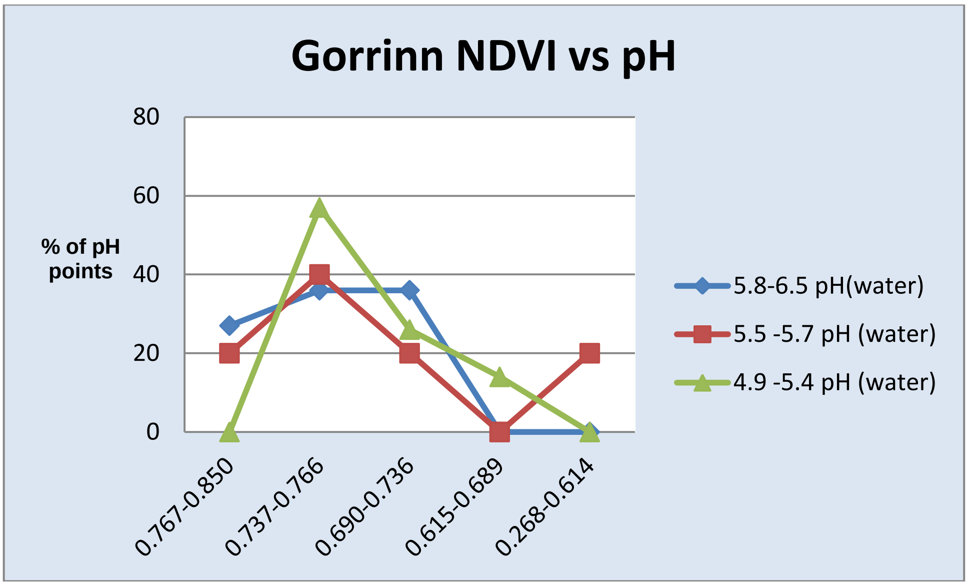



*Figure 29: The Gorrinn results show the range of pH and biomass.*

The Gorrinn results were also analysed for soil pH areas > 5.4 & < 5.4 pH (water). When soil pH drops below 5.4 (water) or 4.5 (CaCl) aluminium becomes soluble in soils where it occurs; this has a detrimental effect on plants such as phalaris.

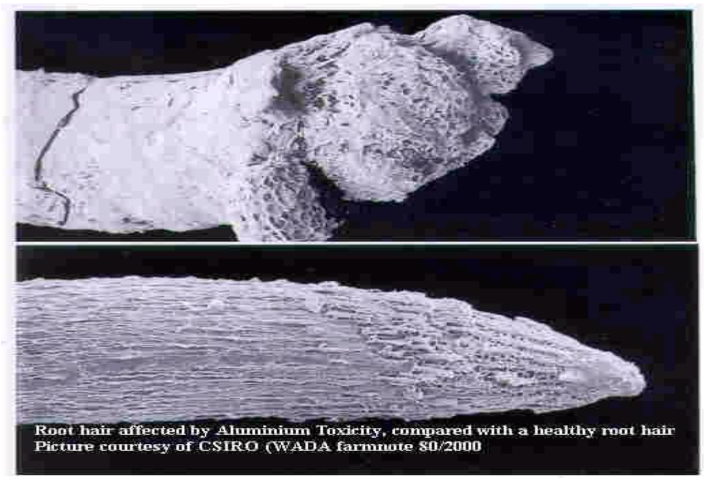
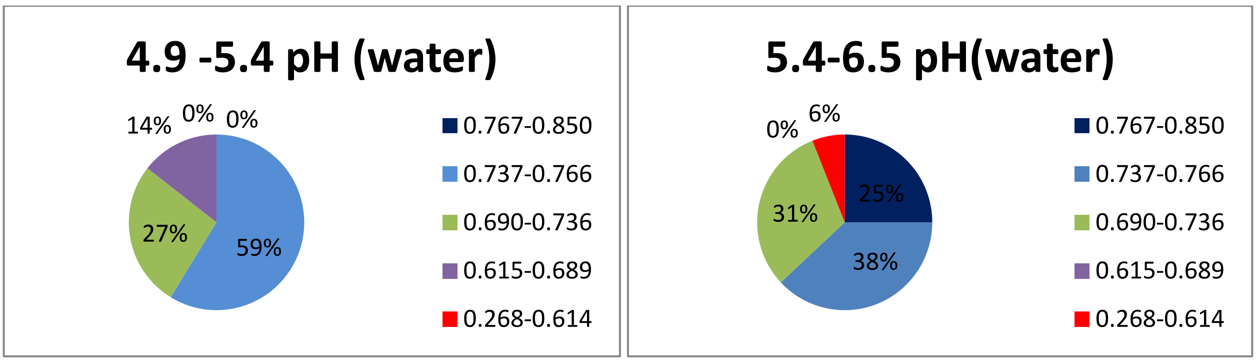



*Figure 30: comparison of phalaris root hair affected by aluminium toxicity with a healthy root hair. Photo courtesy of CSIRO, supplied by Andrew Speirs; Meridian Ag*




*Figures 31 & 32: NDVI results for soil pH ranges.*

**Gorrinn cont.**

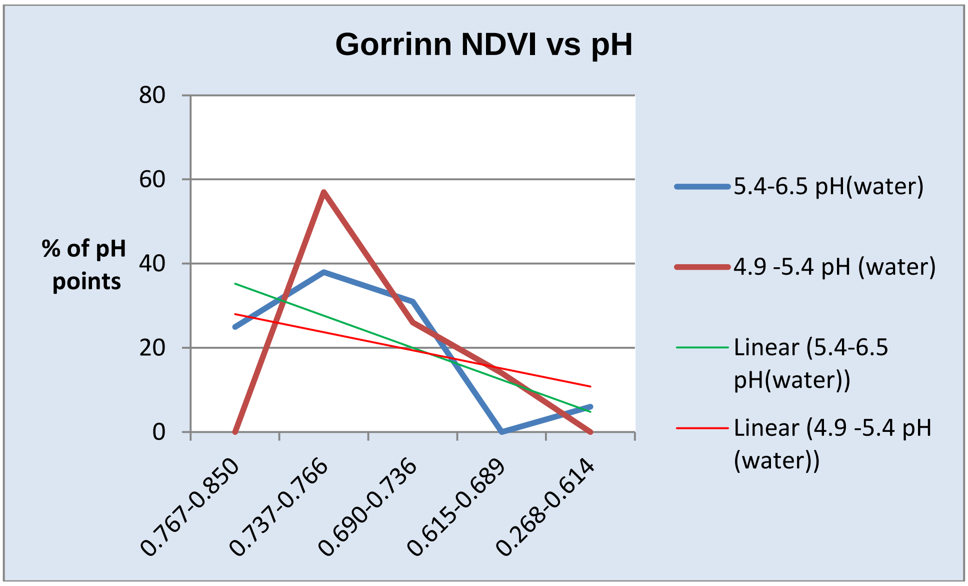



*Figure 33: The Gorrinn > 5.4 & < 5.4 pH (water) results show the range of pH and biomass.*

*Figure 34: Gorrinn variable lime trial paddock*

**Mooneys Gap**

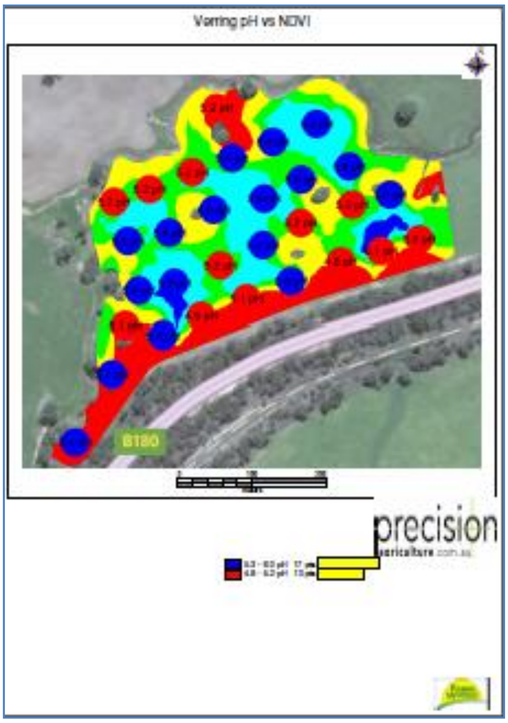
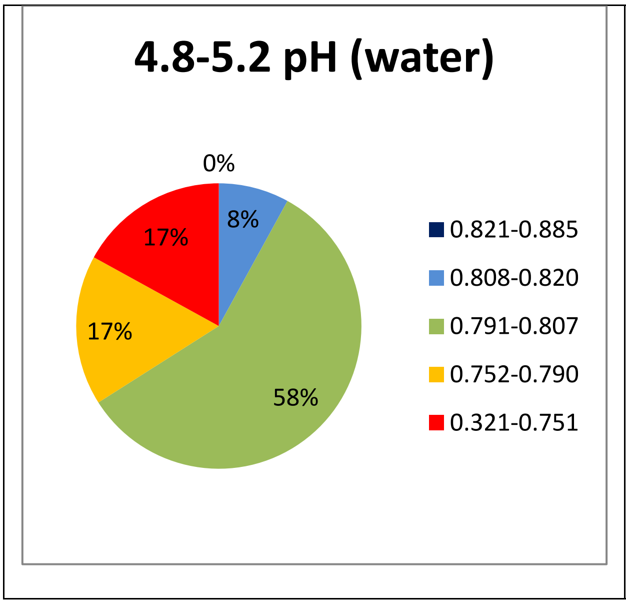
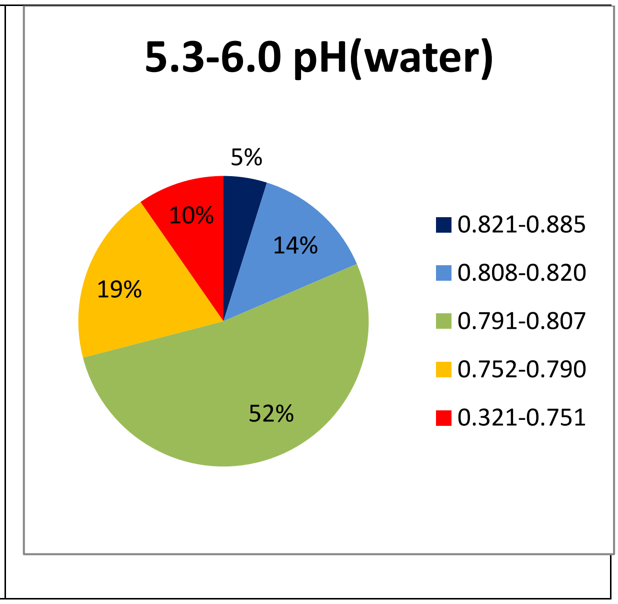



*Figure 35: Mooneys Gap NDVI & pH results (NDVI contours, pH dots).*




*Figures 36 & 37: pH points were divided into the range above and below 5.3 (water) and overlayed with the NDVI results*

**Mooneys Gap cont.**

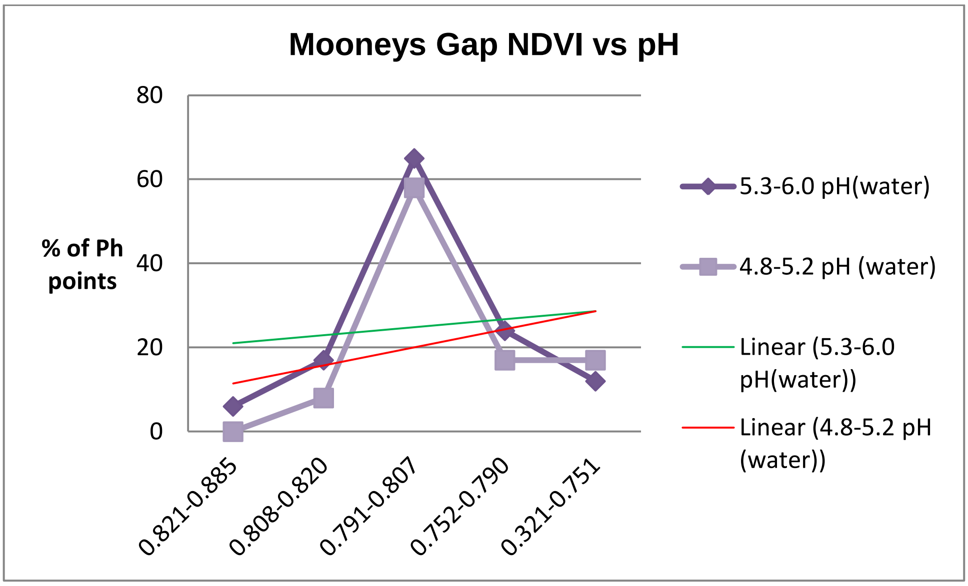



*Figure 38: The Mooneys Gap results show the range of pH and biomass.*

**Marenda**

The original map at Marenda showed areas of low biomass (red areas); host farmer Wayne Burton suggested that the low growth areas may have affected by water logging. The maps were redrawn with those areas excluded before the analysis was done.

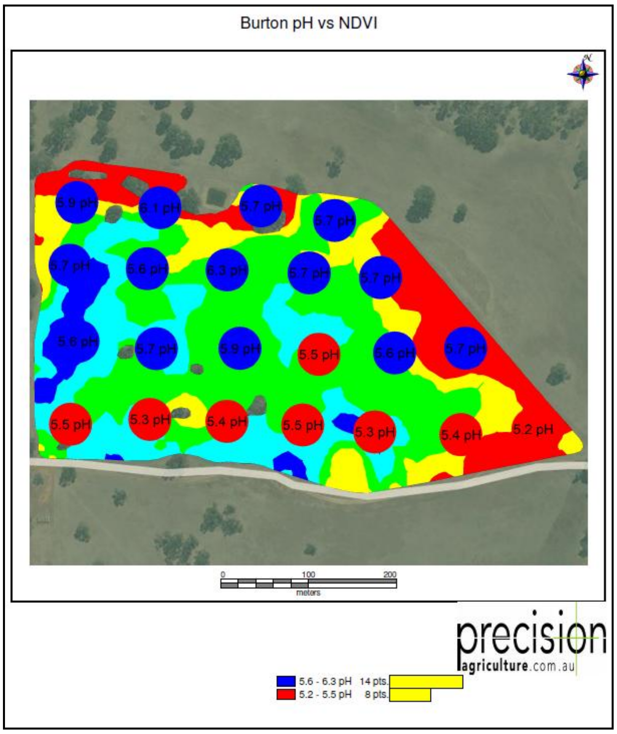



Figure 39: Original pH Vs NDVI map

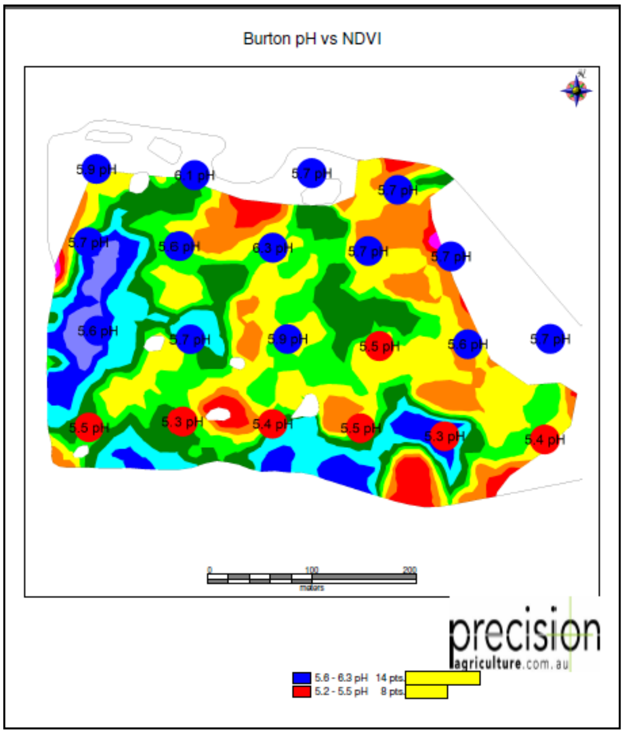



Figure 40: Redrawn pH Vs NDVI map

**Marenda cont.**

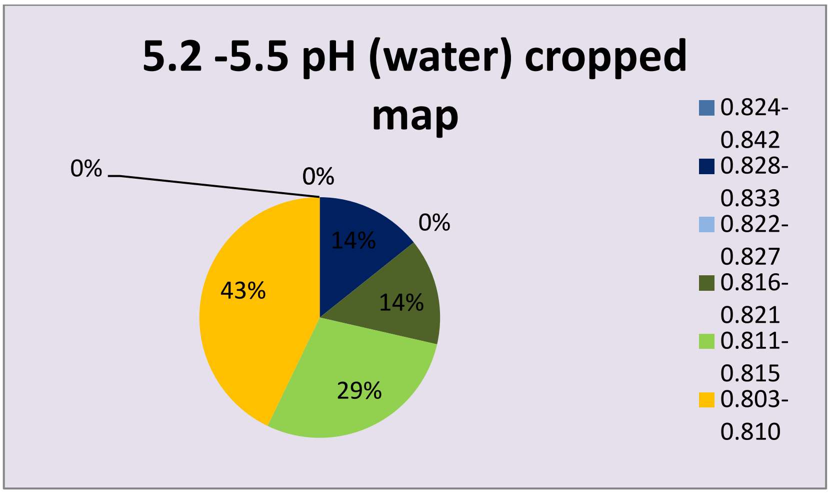



*Figure 41: Marenda NDVI results for soil pH 5.2 -5.5 (water) range*

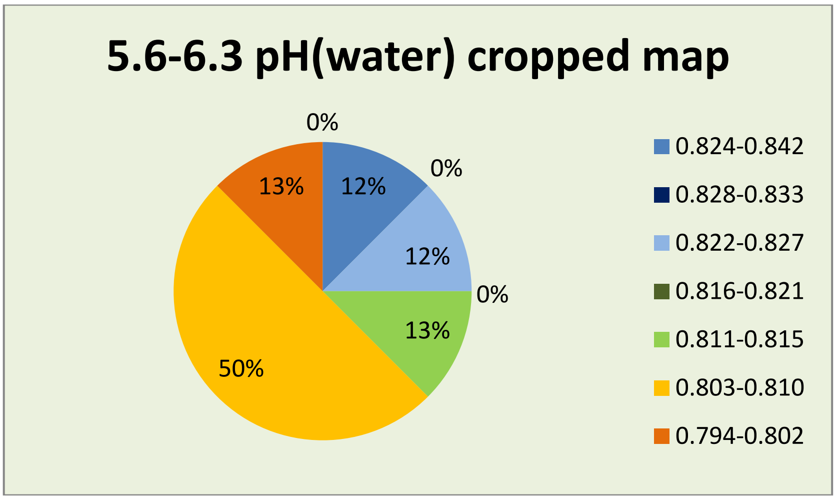



*Figure 42: Marenda NDVI results for soil pH 5.6 -6.3 (water) range*

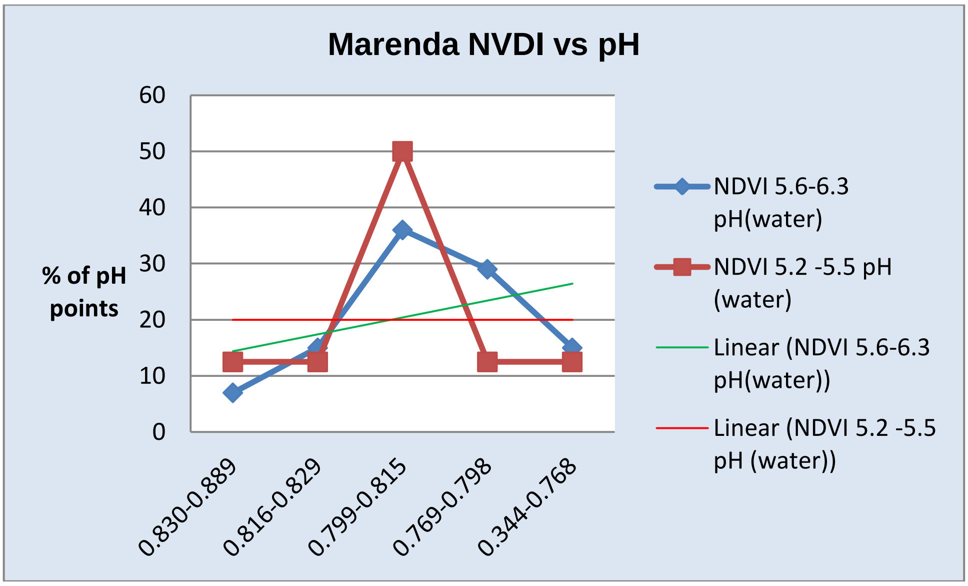



*Figure 43: The Marenda results show the range of pH and biomass.*

.

## Variable Lime Application Trial; Variable Lime Application

Two of the permanent pasture paddocks in the trial were selected for a variable lime application and it was carried out in May 2015. The paddocks selected had defined areas above and below the desired pH level to prevent aluminium toxicity. Lime was applied to these specific areas as detailed in the table below. The lime application was partly funded by the host farmers.

| Paddock name | Paddock size; Ha | Ha limed 2015 | Rate tonnes/ha |
|---|---|---|---|
| Marenda | 16.77 | 7.6 | 1.8 |
| Mooneys Gap | 13.64 | 4.83 | 2.7 |

*Figure 45: Lime applications May 2015*

*Figure 46: Loading lime for application, May 2015*


Figure 47: Lime being applied. May 2015

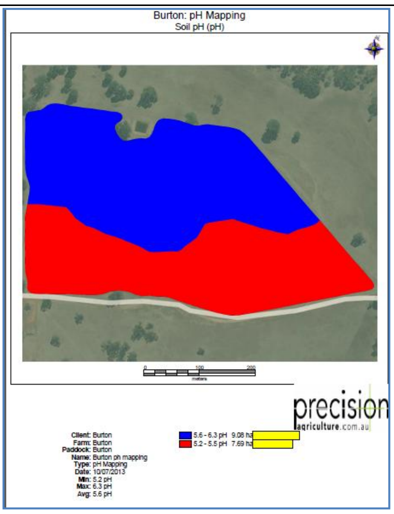
## Variable Lime Application Trial; Results of Variable Lime Application

The two paddocks that had the lime applied to the target pH areas in May 2015 were tested with the variable pH method in July 2016 by Precision Agriculture.

*Figure 48: Rain and hail for the variable pH testing at Mooneys Gap, July 2016*

The 2016 pH samples tested using the CaCl method whilst the 2013 pH samples were tested using the PH (water) method due to an upgrade in testing procedure by Precision Agriculture. While this means that the 2013 and 2016 pH results are not directly comparable, the colours used on the contoured maps give a good comparison between the pre limed results in 2013 and the results taken in 2016 after the targeted parts of the paddocks were limed in 2015.
The red sections are below the desired range to mitigate the effects of aluminium toxicity while the yellow and blue sections are above the desired range.
The maps show that in 2013 parts of each paddock were below the target level, while after the partial liming in 2015 both paddocks are completely in the target pH rang suggesting that the variable lime application achieved its aims. The 2016 Mooneys Gap show two areas in orange which are just above the target range; they may require a lime application to move the pH to a higher level.

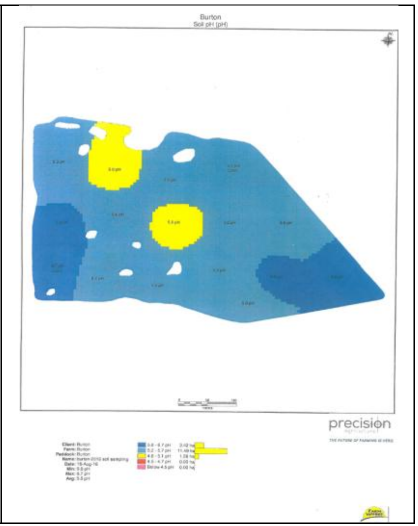
**Marenda**



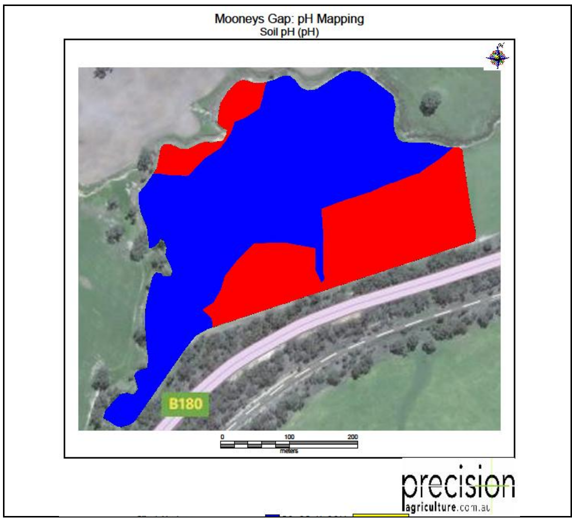

*Figures 49 & 50: Marenda*

*Left; 2013 pH map*

*Right; 2016 pH map*



**Mooneys Gap**




*Figures 51 & 52: Mooneys Gap*

*Left; 2013 pH map*

*Right; 2016 pH map*


**Summary**

Conventional soil pH tests were taken in both the paddocks prior to the lime application. Marenda measured 4.80 (CaCL) while Mooneys Gap pH was 4.90 (CaCl); this would put the average pH for both paddocks above the level of potential aluminium toxicity.

The maps produced from the variable pH testing showed that there were areas with a pH below the target level; 45% of the paddock at Marenda and 35% at Mooneys Gap. If the average soil pH had been used for the decision making on any lime application, the likely outcome would have been that no lime would be applied to either paddock. This may have left large areas of the phalaris based pasture vulnerable to aluminium toxicity and the resultant suboptimal growth and persistence of the phalaris plants.

In the case of these two paddocks, variable pH testing and the subsequent targeted lime applications have raised the pH in the areas identified.

*Cost/Benefit*

The cost of the variable pH testing and mapping is $14/ha (2016 prices) and the approximate cost of lime spread is $55 per tonnes (2016 prices). Any cost/benefit analysis depends on the individual paddock results but the case study on the Marenda paddock (page 14) and the results from five other paddocks in the trial would suggest that the variable pH testing, mapping and targeted lime applications would have proven to have a positive outcome in reducing costs of keeping the paddock above the target pH level.

The other paddock in the trial had a low pH and analysis suggested that paddocks in the case would not have a cost benefit in using the variable technology. A blanket application of lime was more suited in this case.
A follow up testing using the variable point testing would be beneficial in this case in two to years after the lime application.

The results show that the variable lime technology is likely to have the best cost benefit outcome in previously limed paddocks in regions that have acid soils.

Previously unlimed paddocks which have acid soils are likely to need a blanket lime application and are less likely to show a cost benefit from the variable lime technology.

## Variable Lime Application Trial; Lime Rates

One of the paddocks tested in 2013 was an unimproved and previously unlimed paddock near Warrak. The soil pH (water) results showed that the entire paddock had a pH (water) below the target of 5.4 (water) that would be required for a successful phalaris pasture establishment. The 2016 pH samples tested using the CaCl method whilst the 2013 pH samples were tested using the PH (water) method due to an upgrade in testing procedure by Precision Agriculture. While this means that the 2013 and 2016 pH results are not directly comparable, the colours used on the contoured maps give a good comparison between the pre limed results in 2013 and the results taken in 2016


*Figure 53: Contour map prior to liming.*

It was decided to test the convention of applying 2.5 tonnes/ha of lime that is the normal recommendation for raising the soil pH to see it was effective on a paddock with low pH levels..
The Eastern half (right) of the paddock had 2.5 tonnes/Ha of lime applied and the Western half (left)had a higher rate of 4 tonnes/Ha. The lime application was done in May 2015 and variable soil pH testing was carried out in July 2016. The lime application was partly funded by the host farmer.

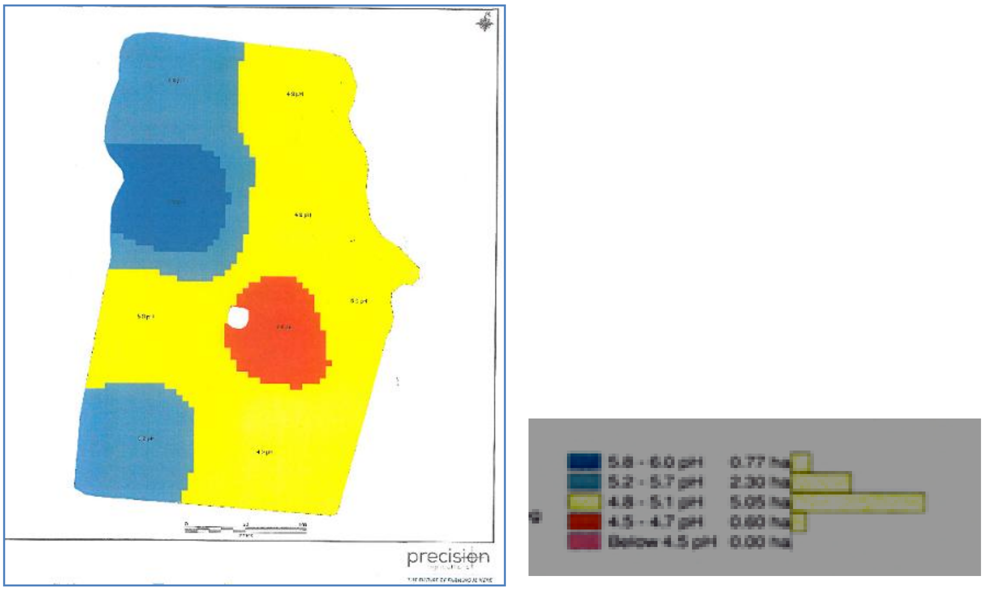



*Figure 54: Contour map 14 months after liming*

The results show that both rates of lime raised the pH above the target levels although the 2.5 tonnes/Ha has an area coloured orange which is 4.6 (CaCl) which is just above the target of 4.5 (CaCl). The rest of the 2.5 tonnes/ha area which is coloured yellow are in the 4.9 – 5.0 pH (CaCl) range suggesting that the 2.5 tonnes/ha rate was sufficient to raise the pH levels into the desired range. The 4 tonnes/ha area coloured blue and yellow is well into the target and should have a longer interval before requiring a follow up lima application than the 2.5 tonnes/ha area of the paddock.

## Variable Lime Application Trial; Variable Phosphorus and Potassium testing

During the 2016 soil pH testing planning, the opportunity arose to include testing the samples for soil Phosphorus (P) and Potassium (K) levels. PPS included them in the testing process. Two paddocks were tested; Marenda at Mt Dryden and Mooneys Gap near Ararat.

This added a cost of $9 per ha to the cost of the soil pH testing ($14/ha) giving a total figure of $23/Ha for the combined pH, P and K results. (2016 prices)

### P Results

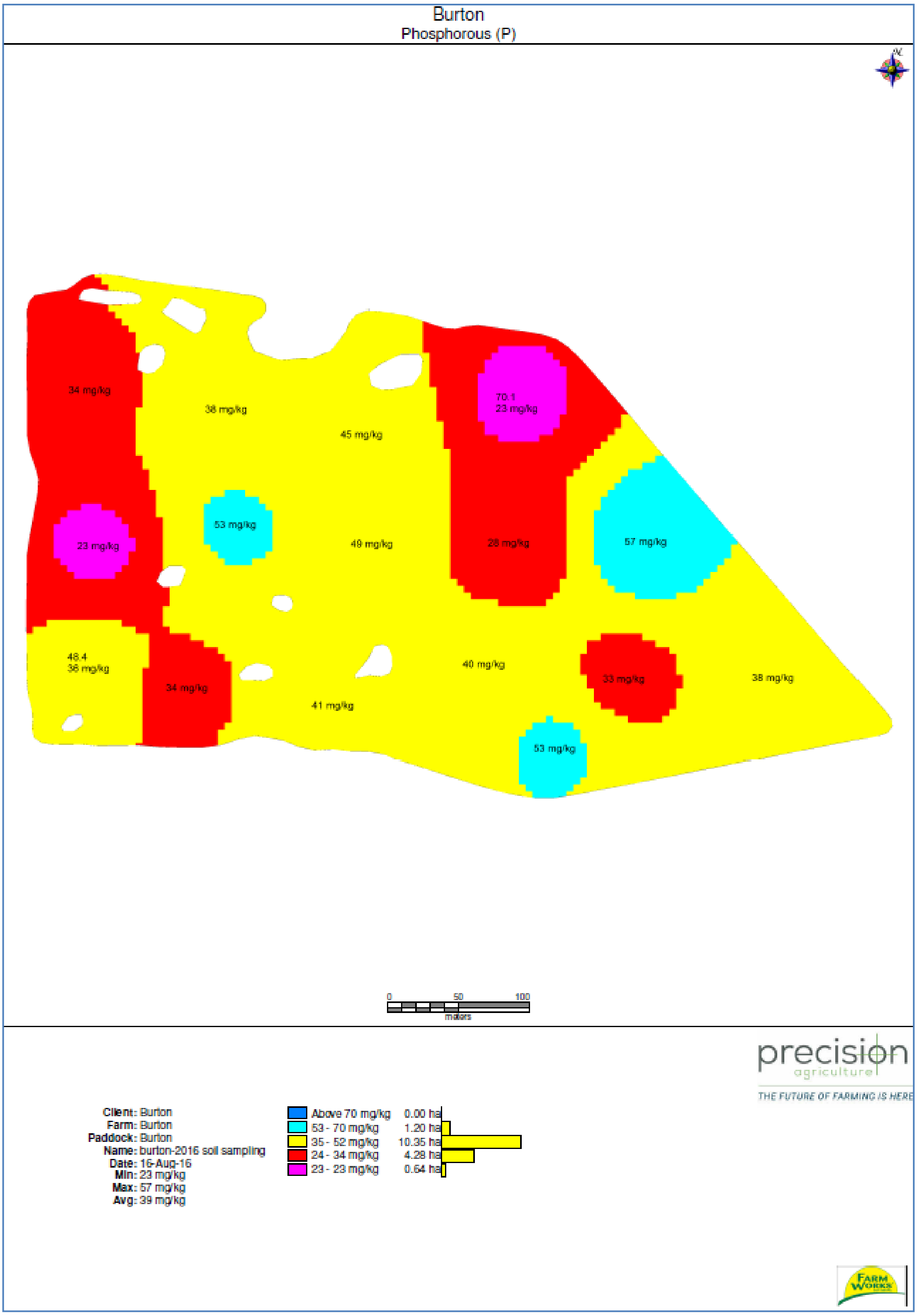



Figure 55: Contoured map from phosphorus results; Marenda

The paddock had a conventional soil test done in May 2015 and had a Colwell P result of 20

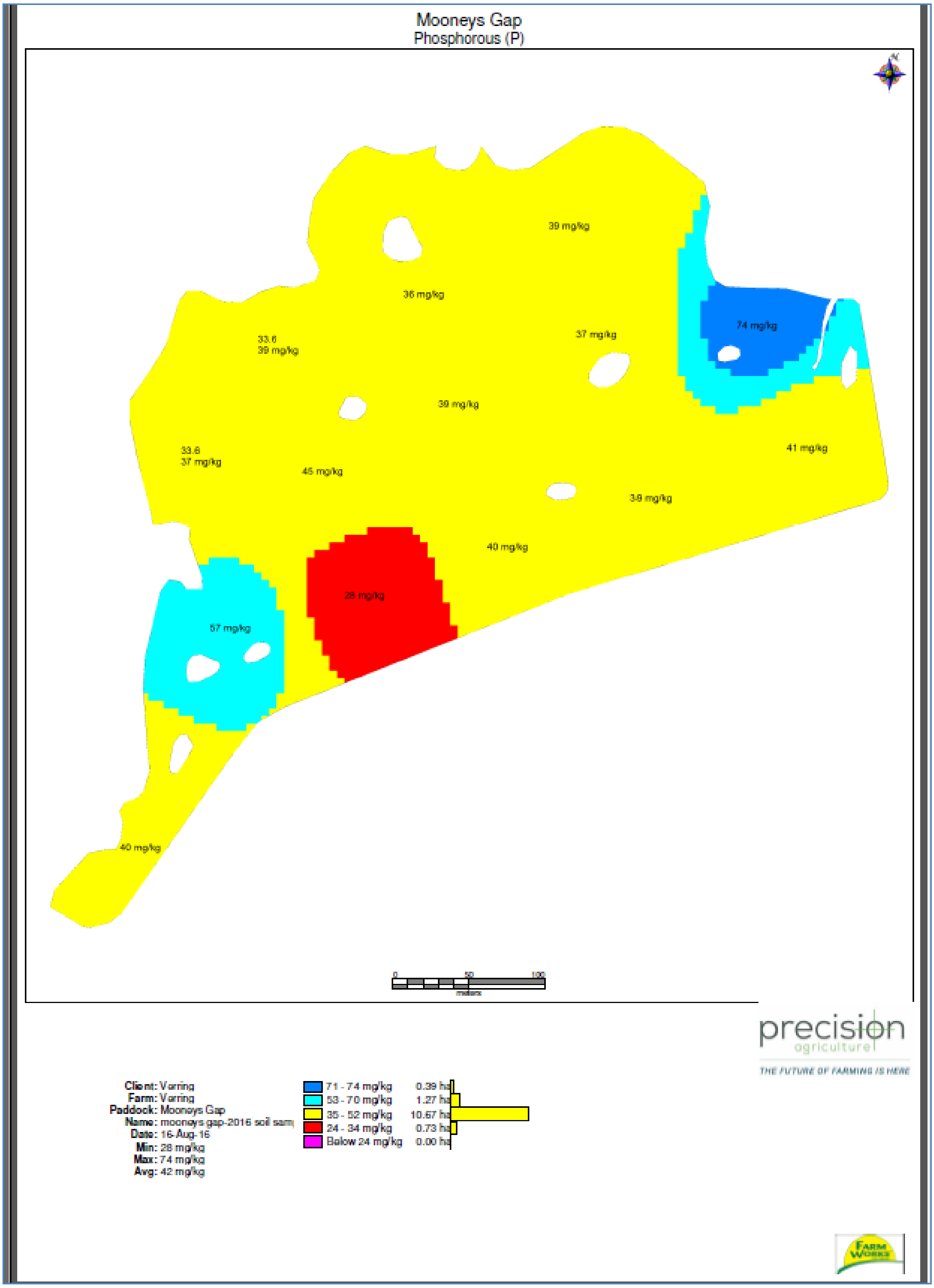



*Figure 56: Contoured map from phosphorus results; Mooneys Gap*

The paddock had a conventional soil test done in May 2015 and had a Colwell P result of 24

**K Results**

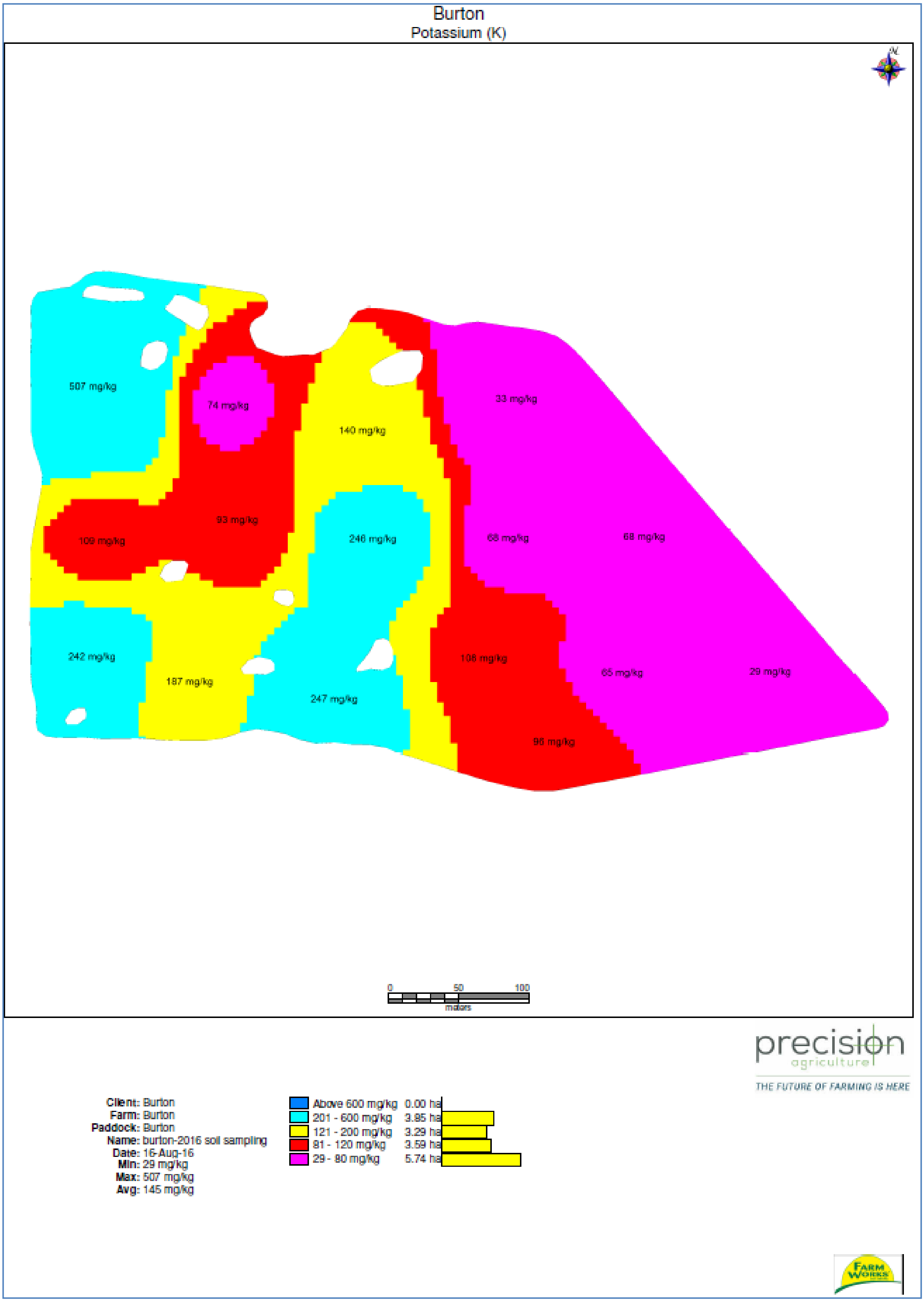



*Figure 57: Contoured map from potassium results; Marenda*

The paddock had a conventional soil test done in May 2015 and had a Colwell K result of 70

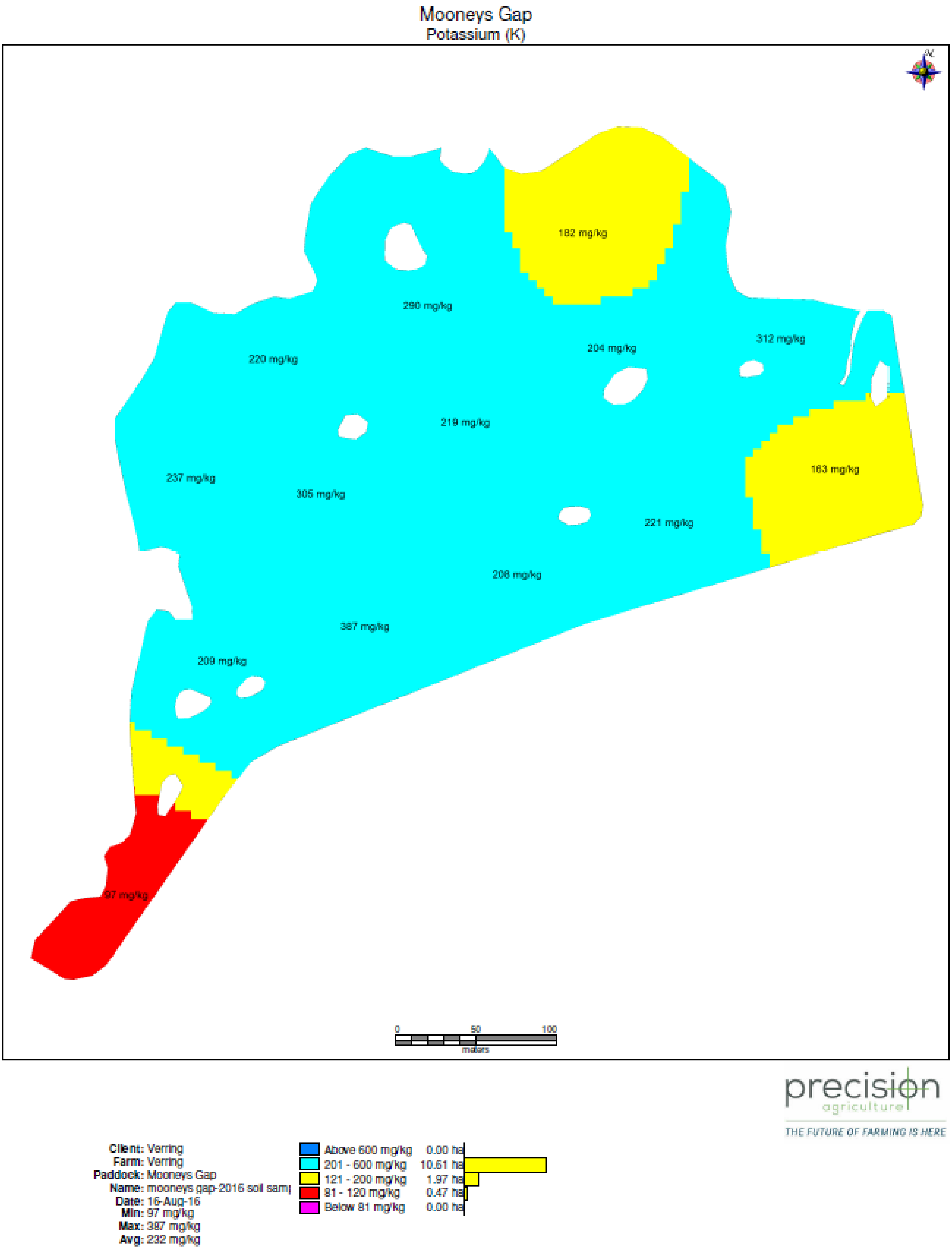



*Figure 58: Contoured map from potassium results; Mooneys Gap*

The paddock had a conventional soil test done in May 2015 and had a Colwell K result of 184

## Variable Phosphorus and Potassium testing

### Summary

The results at Marenda (figures 55 and 57) show that most of the paddock is in the low to moderate range for phosphorus. This would suggest that whole paddock, capital applications of phosphorus are required before any adoption of variable rate p fertiliser could be implemented.
The potassium results show a large variation in K levels with the low K areas, shown in pink and red on the map largely coinciding with low lying areas of the paddock which do get water logged in some years. The K results suggest that an application of K in these areas might be worthwhile.

The maps of Mooneys Gap show fairly uniform results for both P and K with the P levels being at moderate levels. This would suggest that uniform applications of P fertiliser at maintenance or slightly higher annually should be adequate. The K levels are fairly uniform and appear to be at adequate levels.

### Comments

PPS believes that the grid soil testing and mapping of P and K will become a useful tool in soil fertility management but needs further research before it will be widely adopted in pasture systems. A research project to quantify the accuracy of the testing and to recommend the intervals between testing for the best economic results would be a useful addition to the information currently available.
Further paddock testing to provide case studies would give producers the cost benefit information which would allow them to make decisions regarding the implementation of the technique on their own pastures.

*Figure 59: Mooneys Gap phalaris based pasture, October 2016*

# Communication of Results

The project has been continuously reported to PPS members and other interested people throughout the trial in conjunction with wider PPS activities. This communication has taken various forms which are summarised below.

**PPS Newsletters**

The 4-page PPS newsletter is produced quarterly and 140 copies are sent to PPS members and sponsors. The newsletter is also sent by email to another 250 people who have shown interest in the PPS project. These include Dept of Primary Industry and Catchment Management Authority staff, CSIRO pasture scientists, MLA staff and pasture industry contacts. Copies are also sent to others groups who have links with PPS including Evergreen in Western Australia, Victorian No Till Farmers Association, and the Holbrook Landcare Group. The newsletter is also emailed to several PPS contacts in New Zealand.

Progress of the Variable Lime Trial has been regularly reported in the newsletter.

**Final Report**

This final report will be posted on the PPS website and copies will be printed for distribution to the host farmers and trial supporters.

**PPS Annual Conferences**

The use of variable lime technology in cropping systems was outlined at the 4th Annual PPS Conference in 2012 which had the theme "Technical Farming needn't be Alarming; you can't go forward by looking back".

PPS member Steve Start, a farmer at Crowlands and consultant John Robertson gave presentations on the use of variable lime technology in cropping systems.

The project was commenced in 2013 and at the 5th Annual PPS Conference titled "Having a crack at what's holing us back; what's limiting us in perennial grazing systems", PPS management committee member Wayne Burton outlined the pH mapping results.

Andrew Whitlock from Precision Agriculture also gave a presentation on identifying within paddock variations.

Progress reports on the site was included in the PPS Project Manager's report at the2014, 2015 and 2016 PPS Annual Conferences and a poster on the trial was included in the display area

**Personal Communication**

The host farmers are enthusiastic members of PPS and have communicated the progress of the site to other district farmers.

**Other Group Visits**

Other farmer groups have visited PPS sites and information on the Variable Lime Project has been presented.

Groups include the Yarram Landcare Pasture Group, Maryborough and Stawell Bestwool/Bestlamb groups as well as the Central West Branch of the Grasslands Society of Southern Australia.

**External Presentations**

*The PPS Project Manager has given presentations on the PPS project which included information and results from the Variable Lime Trial to:*

Upper Barwon Landcare Pasture Group at Winchelsea in August 2012.

Farmplan 21 group at Joel Joel in May 2013

Catchment Management Authority representatives at a conference hosted by Wimmera CMA at Hall's Gap in April 2015.

Drought seminar at Edenhope in April 2016.

Powlett Plains pasture group in April 2016.

Glenthompson – Dunkeld Bestwool/Bestlamb group in April 2017


*Figure 60: PPS Variable Lime Project poster*

# References and Acknowledgements

**References:**
***Lime rates***
**Soils -their properties & management** Edited by Peter Charman and Brian Murphy
3rd edition 2007 NSW Govt, Dept Natural Resources  Oxford University Press, Sth Melb.
Fenton, G. and Helyar, K.R. (2007). "Soil acidification". Chapter in *Soils -their properties & management"*. 3rd Edition. Ed. Charman, P and Murphy, B. NSW Government. Oxford University Press, Sth Melb

**When lime is a good investment**; The amount of lime required to raise pH to desired levels has been calculated from advice from Lisa Warn produced in an article for the Melbourne University McKinnon Project newsletter; May 2011 titled "When lime is a good investment" with the author's permission.

**Aluminium toxicity;**
Soil Acidity and Lime Requirement for Phalaris: presentation by Andrew Speirs for PPS March 2010

Soil Quality Factsheet; Soil Quality.org website

**Acknowledgments;**
**Funding**
Australian Government "Caring for our Country" through the Glenelg Hopkins and Wimmera Catchment Management Authorities

**PPS Annual Conference presentations**
John Robertson; Agwise Horsham, Steven Start; PPS member, Crowlands, Dr Wayne Burton, PPS member, Mt Dryden.

**Technical Assistance**
Andrew Whitlock, Brendan Torpy, Meera Dawson, Andrew Lay; Precision Agriculture Ballarat
Westlake Fertilisers Lake Bolac
Lisa Warn; Warn Ag Melbourne
*Special thanks to Brendan Torpy from Precision Agriculture for his expertise and patience in constructing the maps and then reconstructing them a few times at the PPS project manager's request.*

**Final Report:**
Wayne Burton; PPS President (2015 – 2017) - assistance final report
Rachael Campbell, Extension Officer; Agriculture Victoria, Ballarat – assistance with report review

**Photos**
PPS
Peter Ring; Victoria University

**Host Farmers**
Burton Family; Marenda, Mt Dryden
Start Family; Mundaring, Crowlands
Vearing Family; Mooneys Gap, Ararat
Stevens Family; The Valley, Warrak
Thomas Family; Kirkella, Concongella

*Report prepared by Rob Shea PPS Project Manager*

*Reviewed by*
*Dr Wayne Burton Senior Breeder Seednet; PPS President 2015/17*
*and Rachael Campbell, Extension Officer; Agriculture Victoria, Ballarat*

PPS
C/O 6 Coad St Ararat Vic 3377
0438 521357
yadin@netconnect.com.au
www.perennialpasturesystems.com.au

PPS
PERENNIALPASTURESYSTEMS
MAKING PASTURE GO THE DISTANCE