A PRECISION AGRICULTURE JOURNEY TO AMELIORATE SOIL CONSTRAINTS, INCREASE PRODUCTIVITY AND PROTECT SWAMPS IN HIGH RAINFALL ZONE (HRZ) FARMING SYSTEMS

Introduction

Glenelg Hopkins CMA's 'Our Catchment, Our Communities' focus region is a productive high rainfall region in a landscape of wetlands, many of which are not permanently wet.

Due to the seasonal variability of these wetlands, in dry years these wetlands are trafficable and have therefore historically been considered part of the arable area.

This project aims to encourage cropping farmers to use precision agriculture strategies to improve their productivity whilst managing their wetlands.

Focus Farm: South Springs

The Blomeley family are managing approximately 1870Ha between Pura Pura, Nerrin Nerrin and Darlington. They are running both sheep and cropping enterprises, with 62% of the total land area under crop in a Canola, wheat, Faba bean rotation.

Precision ag strategies have long been in place with the management of the farms, with regular Grid Soil Sampling undertaken on a 3-4 year cycle. This is used to prescribe amelioration projects such as lime and gypsum. In addition, there is an annual yield map analysis that is used to manage a variable rate P replacement strategy. The yield maps have also been used to create production zones which leads to a variable rate nitrogen strategy.

"I love the opportunity that PA has to enhance our farm. Observations made over previous years is it can maximise our productivity whilst also reducing product wastage (especially nutrients). We know we have huge variation within our land so we are now targeting each area to its potential." – Nathan Blomeley.

The project area comprises of Hill Paddock totalling to about 150ha at Nerrin Nerrin. A portion of the project area includes identified 'temporary freshwater marsh and meadows' (Figure 2).

The northern half of Hill paddock has a long history of being continually cropped, while the southern portion was previously in a perennial Phalaris. The Blomeley family acquired the property in late 2019 and has been cropping the entire block since 2020. The paddock has been in a wheat-canola rotation since purchased, and is sown to wheat for the 2024 season, and some of the identified wetland areas are already excluded from the current cropping program.

Figure 1: Identified project paddock in Nerrin Nerrin which highlights the current excluded cropping areas.

There is a small portion of identified wetland area that is trafficked, however while seed is planted, application of synthetic fertilizers are minimum to nil in these areas. The PA journey has already commenced on this paddock, with grid soil sampling undertaken in 2020 to kick start the knowledge of the new land and rapidly ameliorate key constraints. As a part of this project the paddock will be resampled to assess the efficacy of previous management as well as using an EM38 survey to identify soil management zones.

Wetlands

Wetlands are areas where fresh or saltwater gather, either permanently or temporarily. They may be as small as a farm dam or as large as a lake, hold standing or very slow-moving water and can be wet or dry depending on seasonal conditions. They support a wide range of water-based flora and fauna which change with the slope and depth.

Seasonal herbaceous wetlands are isolated freshwater wetlands that fill seasonally with rainfall. They are generally inundated by water in winter/spring and dry by late summer. So while they are regarded as wetlands, surface water is not always present.

Program, which will assist in securing their viability into the future.

This is particularly evident when assessing identified wetlands in Hill paddock. Some of the wetlands have been clearly identified and are not cropped, however there are certainly portions of wetlands extremities that have been considered arable, as well as the identified purple wetland in Figure 2 below. However, while this detailed wetland map identifies the type and location of many of the wetlands found in the Western Districts, the quality of those wetlands is not evident until ground truthing.

There are 4 wetlands in this paddock that have been identified and are now part of the Stewardship

Figure 2: Wetlands GIS layer identifying numerous Temporary Freshwater marshes and meadows in the Nerrin Nerrin region, including the identified project paddocks outlined in red. Each identified wetland has a unique colour identification. The project paddock has 5 major wetland regions that are defined as Temporary Freshwater Marshes and meadows within the paddock boundaries. There are also 11 additional wetlands within 500m of the paddock boundaries.

Method

Precision Ag's research has shown that grid soil sampling is the best approach to the targeted amelioration of surface soil properties as the different surface soil characteristics rarely correlate with each other or yield and NDVI based management zones.

Compiled farm and paddock spatial data, including wetland layers are utilised to devise a grid soil sampling plan using a 2-hectare size grid sampling strategy. In this instance, the sampling plan from 2020 was reused to ensure consistency. For each grid, 8 soil cores were collected along a 120m transect within each grid to a depth of 10 cm, with the cores combined into a composite soil sample for each grid. Each soil sample was submitted to an independent NADA-accredited soil laboratory and analysed for Phosphorus (Colwell), Exchangeable Cations (Ca, K, Mg, Na, CEC) & pH (1:5 CaCl2). Phosphorus Buffer Index (PBI) is also tested at strategic sites.

Once laboratory analysis was completed, the soil data was processed and contoured using Precision Ag's Soli software. Following on from consultations with Nathan and his relevant consultant/s, key soil constraints and amelioration strategies were developed. On-farm prescription files were created and where appropriate wetland areas were excluded from cropping inputs.

Alongside the grid sampling, EM38 and elevation data were collected to build a better understanding of the subsoil conditions and soil types.

Previously, management zones were formulated through stacked multi-year yield data analysis and some NDVI. While these are great tools to establish initial management zones for variable rate applications, both data sets are indicators of crop performance, and there are inevitable assumptions made about what are the driving factors for yield. By collecting additional data sets with EM238 and elevation, it is possible to identify some of those factors at depth that drive yield, including soil type, elevation and salinity.

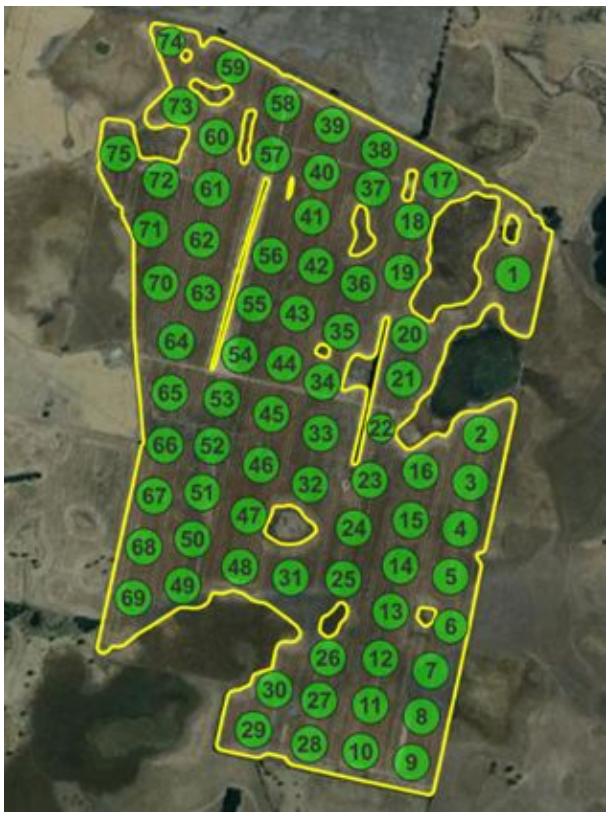


Figure 3: Sampling plan with each point representative of a 2 hectare region. The sampling plan has been designed collect samples in the currently cropped regions.

Soil Test Results and Variable Rate Applications

As part of their long-term strategy, grid soil sampling has been an integral part of top-soil amelioration for the Blomeley family. This is the second time this paddock has been sampled, with the plan for any additional amelioration to occur in the autumn following the sampling.

The overall average pH has lifted from 5.4 to 5.5, however the more acidic regions (red zone) in 2020 were on average lifted by 0.5pH units whereas the more alkaline region (dark blue) in 2020 had an average reduction if 0.3pH units. This comparison highlights the rate of acidification for this particular paddock and identifies the long-term strategic management decision to progressively raise the soil pH to an average of 5.8.

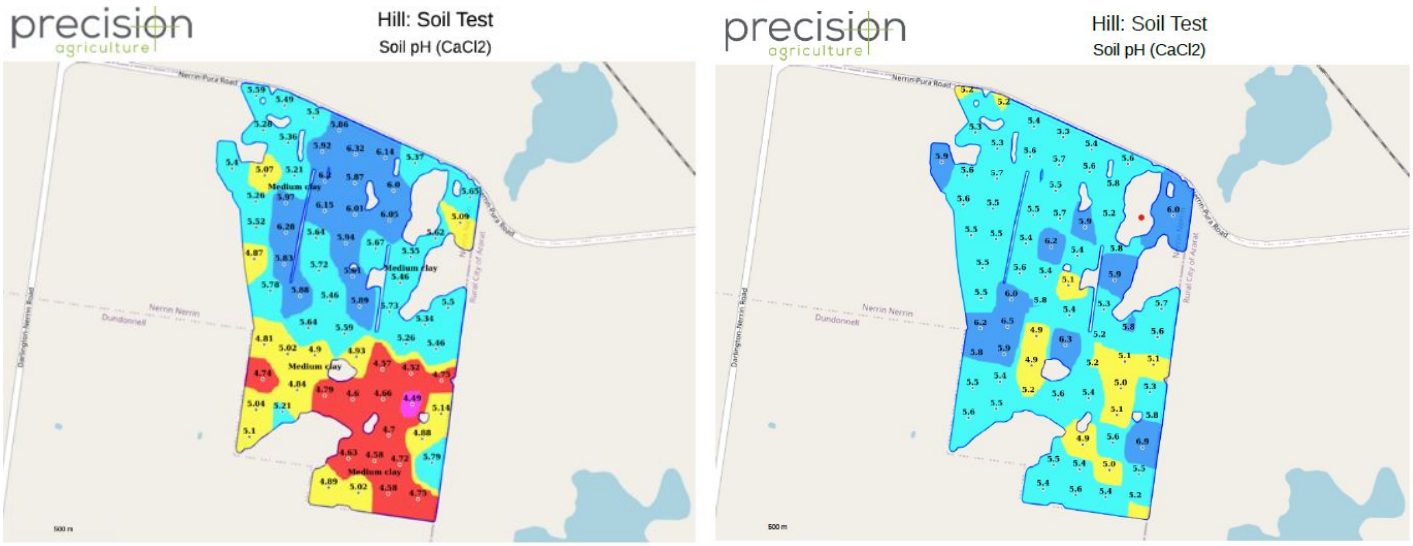


Figure 4:The initial grid soil sampling results from June 2020 compared to the following grid soil sampling results in December 2023.

In comparison, the Colwell Phosphorus maps show a different story, where P levels have been progressively mined over the 3 year period. With a decrease in average Colwell P from 55.6mg/kg to 28mg/ka. The decline in Colwell P may in part also be affected by time of sampling, with the initial sampling in June and the second sampling occurred post-harvest when P levels are likely to be at their lowest. For future sampling, greater care should be taken to ensure that follow up sampling occurs at a similar time as the original sampling – a fact that was made challenging given the timeframe for this particular project.

Based on the soil results, Nathan created a variable rate MAP program for the 2024 seeding program, this included the identified trafficable wetlands where the MAP rates were reduced from 150kg MAP to 50kg MAP. It should be noted that the trafficable wetlands are already significantly degraded and are not likely to be able to be rehabilitated. However, with the commencement of the Stewardship Program and the ongoing education on wetland management, and utilization of variable rate technologies, the improved nutrient management will undoubtedly work in favour of maintaining and preserving the surrounding wetlands.

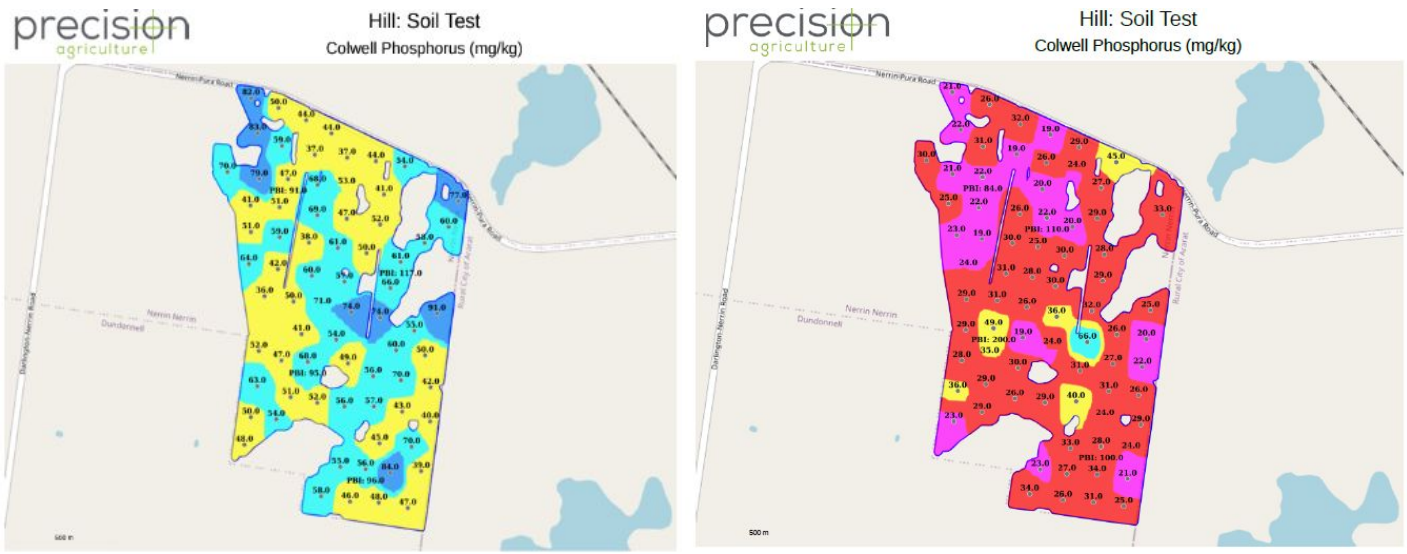


Figure 5: L-R Colwell Phosphorus (mg/kg) in 2020 compared to Colwell Phosphorus in 2023. The average P rates fell from 55.6mg/kg to 28mg/kg.

The inclusion of the EM38 and elevation datasets lead to the next phase of the precision agriculture journey for Nathan and his family. As they have already got a great understanding for what is happening in the topsoil (0-10cm), there was little knowledge of what was happening at depth.

Previously, multiple years of yield data were used to create production zones, which in turn were used to create variable rate applications for fertilisers. However, this did little to understand the driving factors for that production. Therefore, the deep (0-1.5m) EM38 map, which measures soil conductivity (moisture and salinity) is useful to start to identify soil types and their associated production trends. Typically a 3-zone management map is made from the deep EM38 data layer, and as we can see in figure 5, it highlights in green and blue the soils with high soil conductivity with in this case are the wetland areas. This is a significantly more stable dataset to use as a base for management zones, as soil type is stable and does not fluctuate.

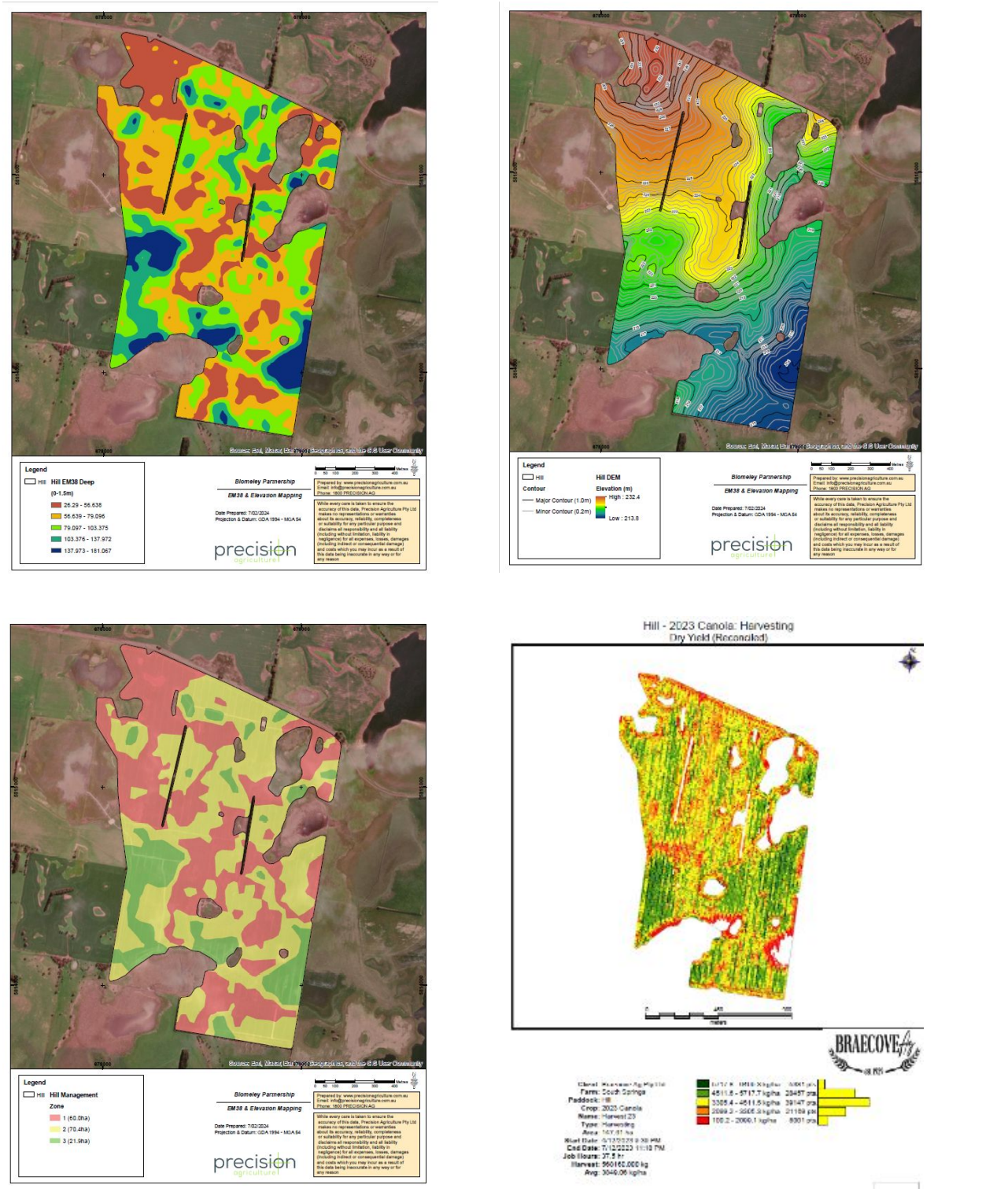


Figure 6 L-R: EM38 map, Elevation map, Proposed Management Zone map, 2023 yield map

Next Steps

The Blomeley family are about to enter into an 8 year Swamp Stewardship Agreement with GHCMA for four of their five wetlands at their South Springs, Nerrin Nerrin property.

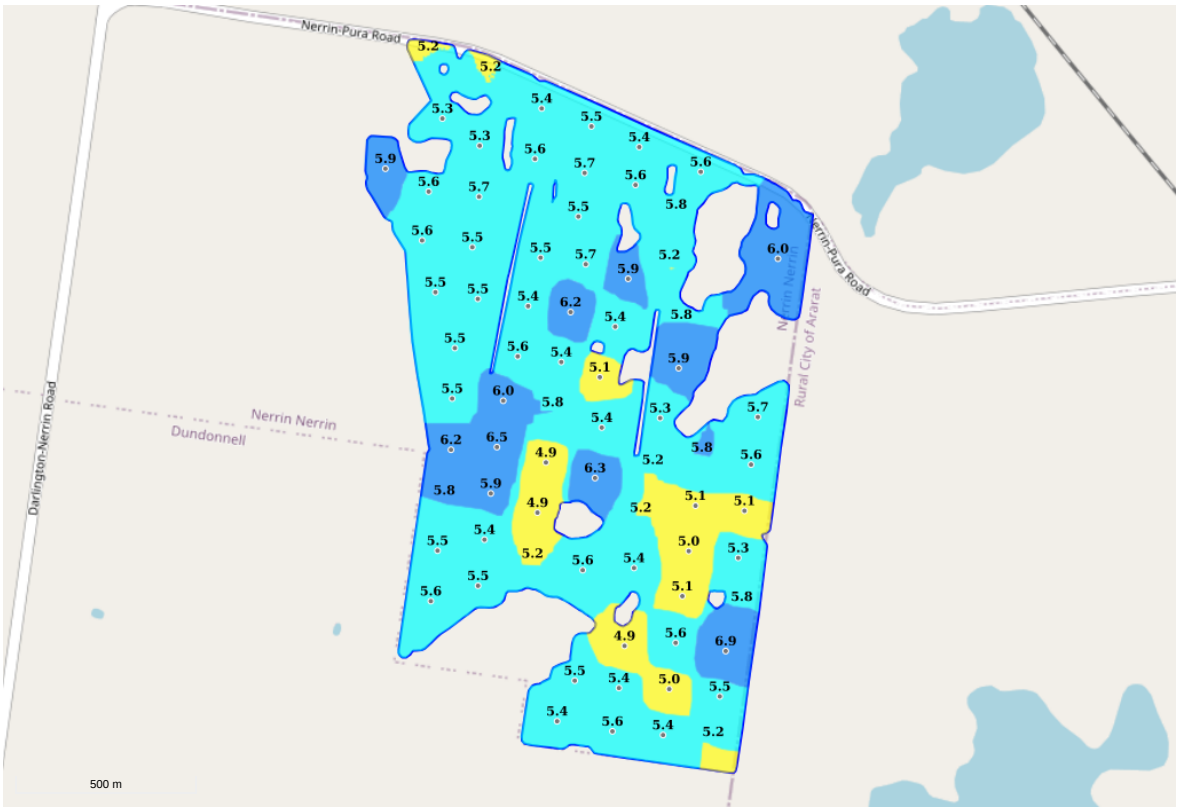
In that agreement they will be paid per hectare to not crop those wetlands for the first 4 years and agree to a wetland management plan which includes controlling weeds (including Spear Thistle, Yorkshire Fog-grass and Toowoomba Canary-grass) and pest animals (foxes and rabbits).

In terms of their Precision Agriculture journey, they will continue to have grid soil sampling occurring every 4 years to measure and ameliorate the topsoil.

In the coming 12 months, they will undertake a deep soil sampling project in accordance with the EM38 driven management zones, which will quantify the soil types within each of the identified zones and ground truth the survey. This sampling will be segmented, likely 0-10cm, 10-30cm, 30-60cm which will identify soil constraints at depth.

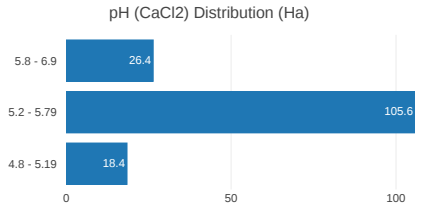
Hill: Soil Test

Soil pH (CaCl2)



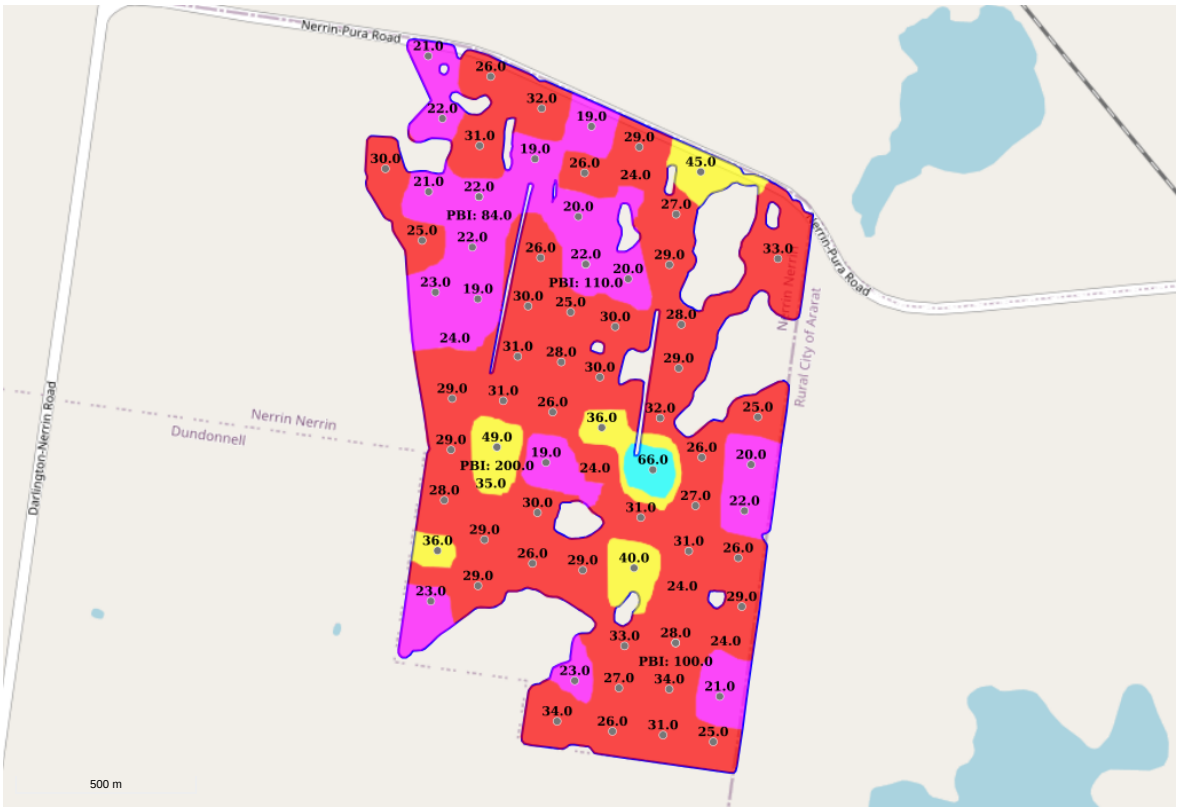
Client:	Blomeley Partnership
Farm:	Heatherlea
Paddock:	Hill
Name:	Hill
Type:	Soil Test
Date:	11/12/2023
Min:	4.9 pH
Max:	6.9 pH
Avg:	5.5 pH

- Above 5.8 pH
- 5.2 - 5.79 pH
- 4.8 - 5.19 pH
- 4.5 - 4.79 pH
- Below 4.49 pH



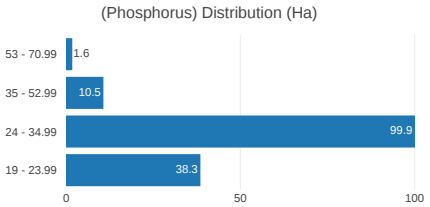
Hill: Soil Test

Colwell Phosphorus (mg/kg)



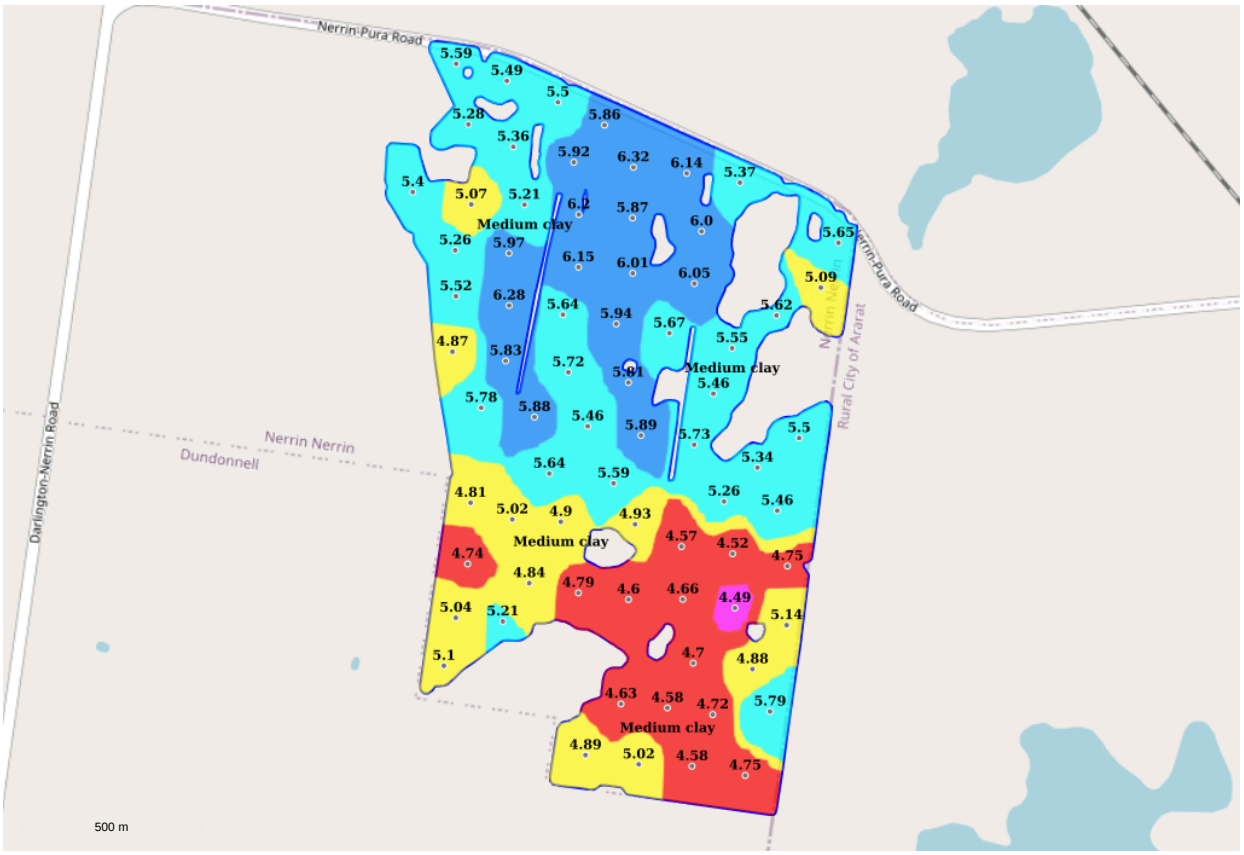
Client:	Blomeley Partnership
Farm:	Heatherlea
Paddock:	Hill
Name:	Hill
Type:	Soil Test
Date:	11/12/2023
Min:	19.0 mg/kg
Max:	66.0 mg/kg
Avg:	28.0 mg/kg

- Above 71 mg/kg
- 53 - 70.9 mg/kg
- 35 - 52.9 mg/kg
- 24 - 34.9 mg/kg
- Below 23.9 mg/kg



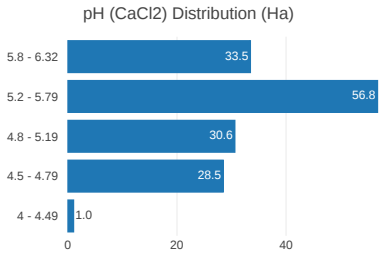
Hill: Soil Test

Soil pH (CaCl2)



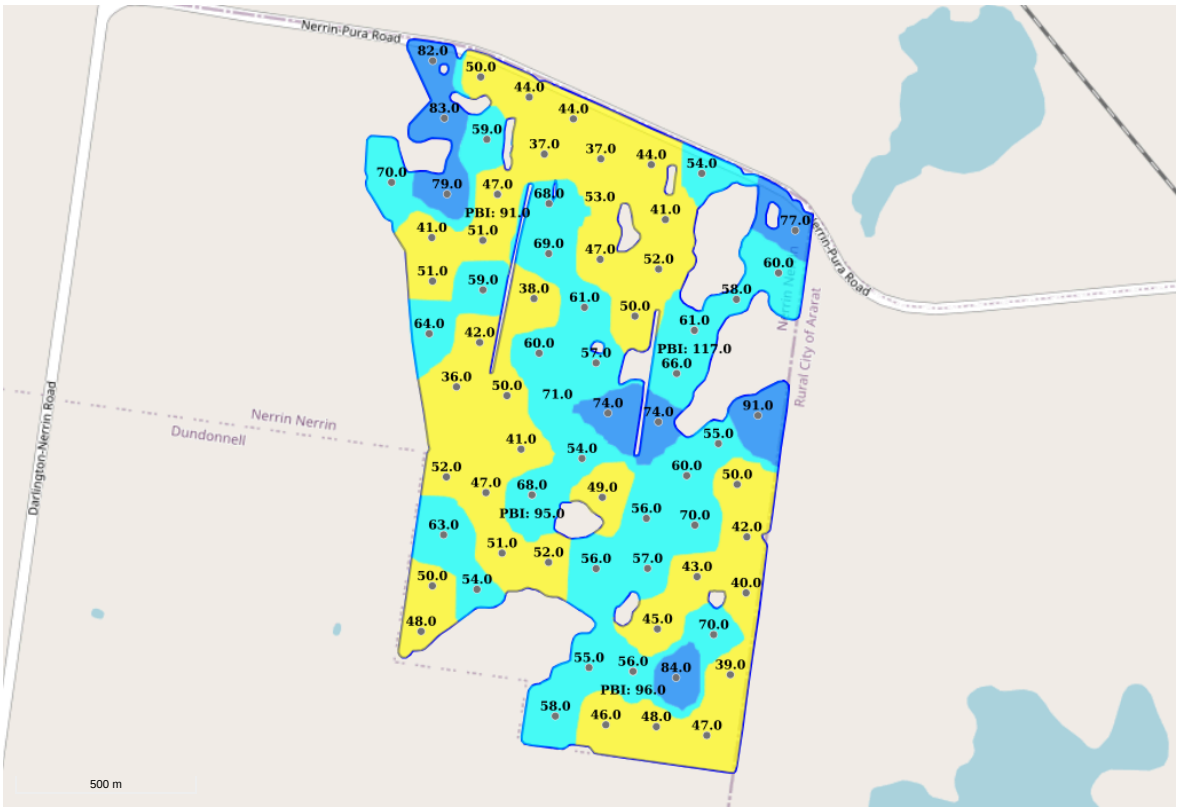
Client:	Blomeley Partnership
Farm:	Heatherlea
Paddock:	Hill
Name:	Hill
Type:	Soil Test
Date:	16/06/2020
Min:	4.5 pH
Max:	6.3 pH
Avg:	5.4 pH

- Above 5.8 pH
- 5.2 - 5.79 pH
- 4.8 - 5.19 pH
- 4.5 - 4.79 pH
- Below 4.49 pH



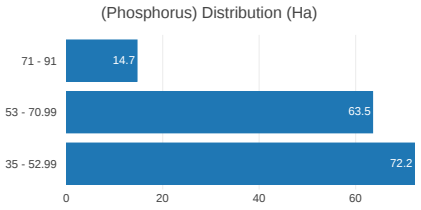
Hill: Soil Test

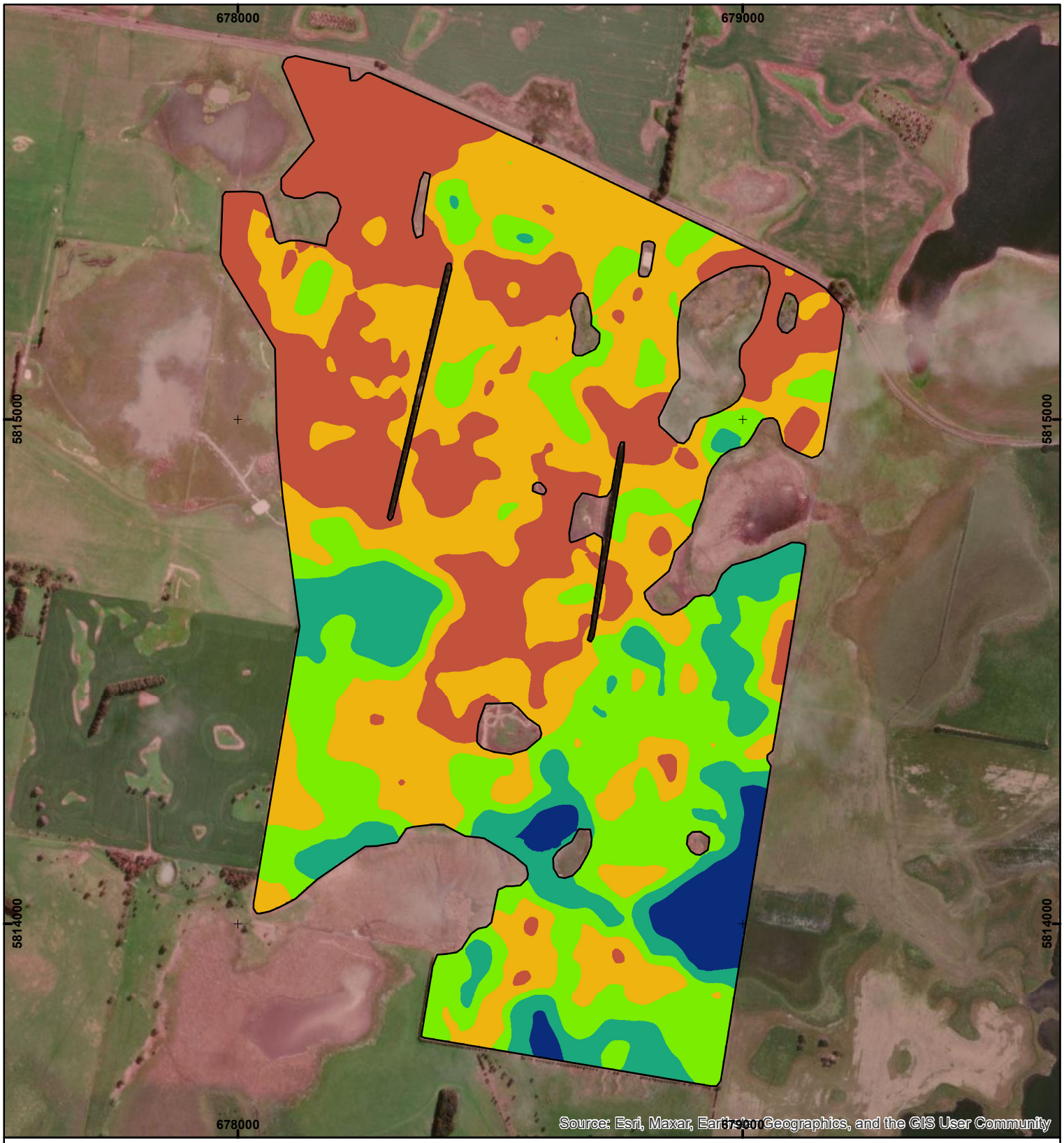
Colwell Phosphorus (mg/kg)



Client:	Blomeley Partnership
Farm:	Heatherlea
Paddock:	Hill
Name:	Hill
Type:	Soil Test
Date:	16/06/2020
Min:	36.0 mg/kg
Max:	91.0 mg/kg
Avg:	55.6 mg/kg

- Above 71 mg/kg
- 53 - 70.9 mg/kg
- 35 - 52.9 mg/kg
- 24 - 34.9 mg/kg
- Below 23.9 mg/kg





Legend

Hill **Hill EM38 Shallow (0-0.75m)**

- 23.595 - 48.857
- 48.858 - 71.46
- 71.461 - 98.716
- 98.717 - 140.598
- 140.599 - 193.116

0 50 100 200 300 400 Metres

N

Blomeley Partnership

EM38 & Elevation Mapping

Date Prepared: 7/02/2024

Projection & Datum: GDA 1994 - MGA 54

precision agriculture

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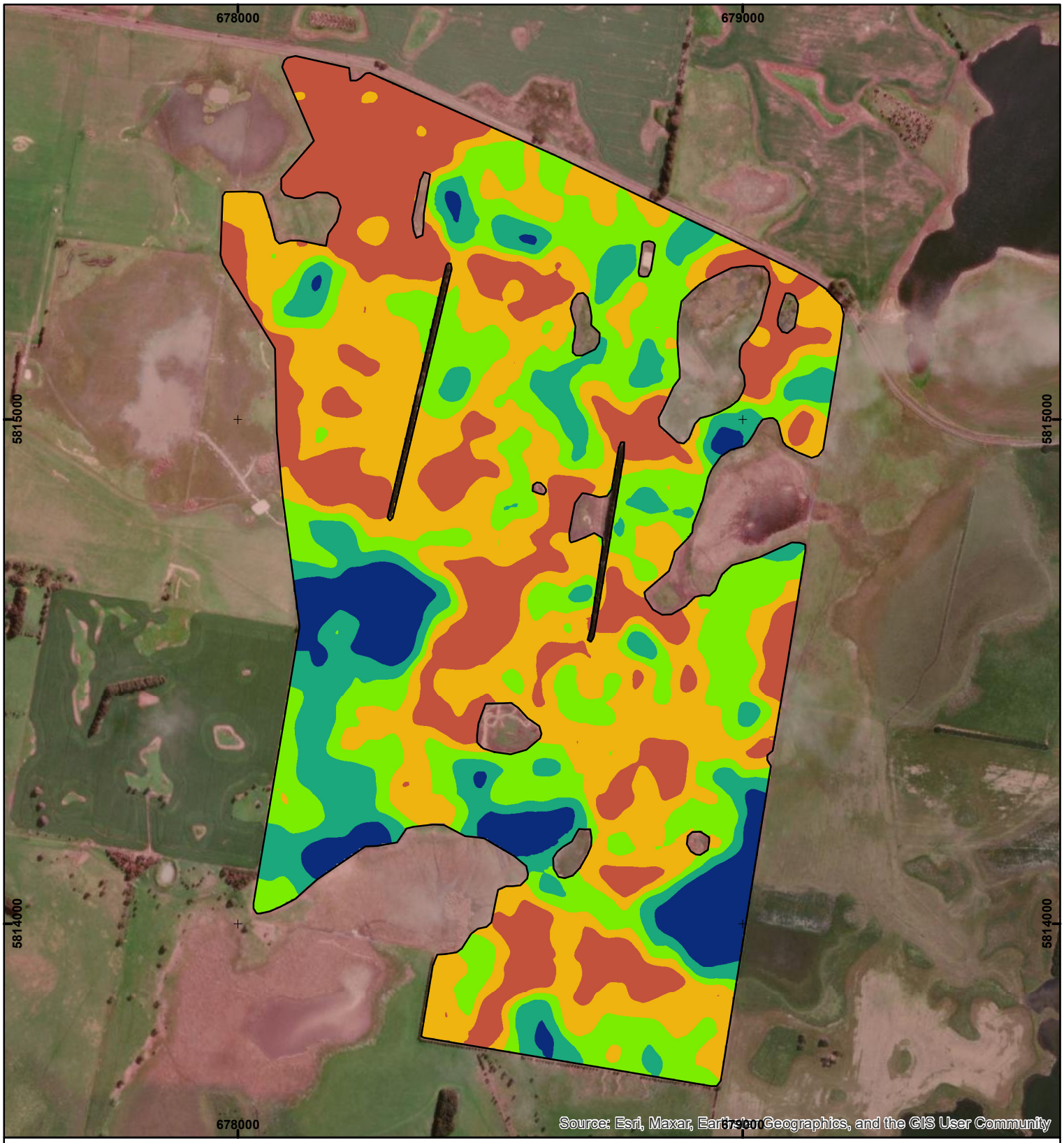

Legend

Hill **Hill EM38 Deep (0-1.5m)**

- 26.29 - 56.638
- 56.639 - 79.096
- 79.097 - 103.375
- 103.376 - 137.972
- 137.973 - 181.067

0 50 100 200 300 400 Metres

N

Blomeley Partnership

EM38 & Elevation Mapping

Date Prepared: 7/02/2024

Projection & Datum: GDA 1994 - MGA 54

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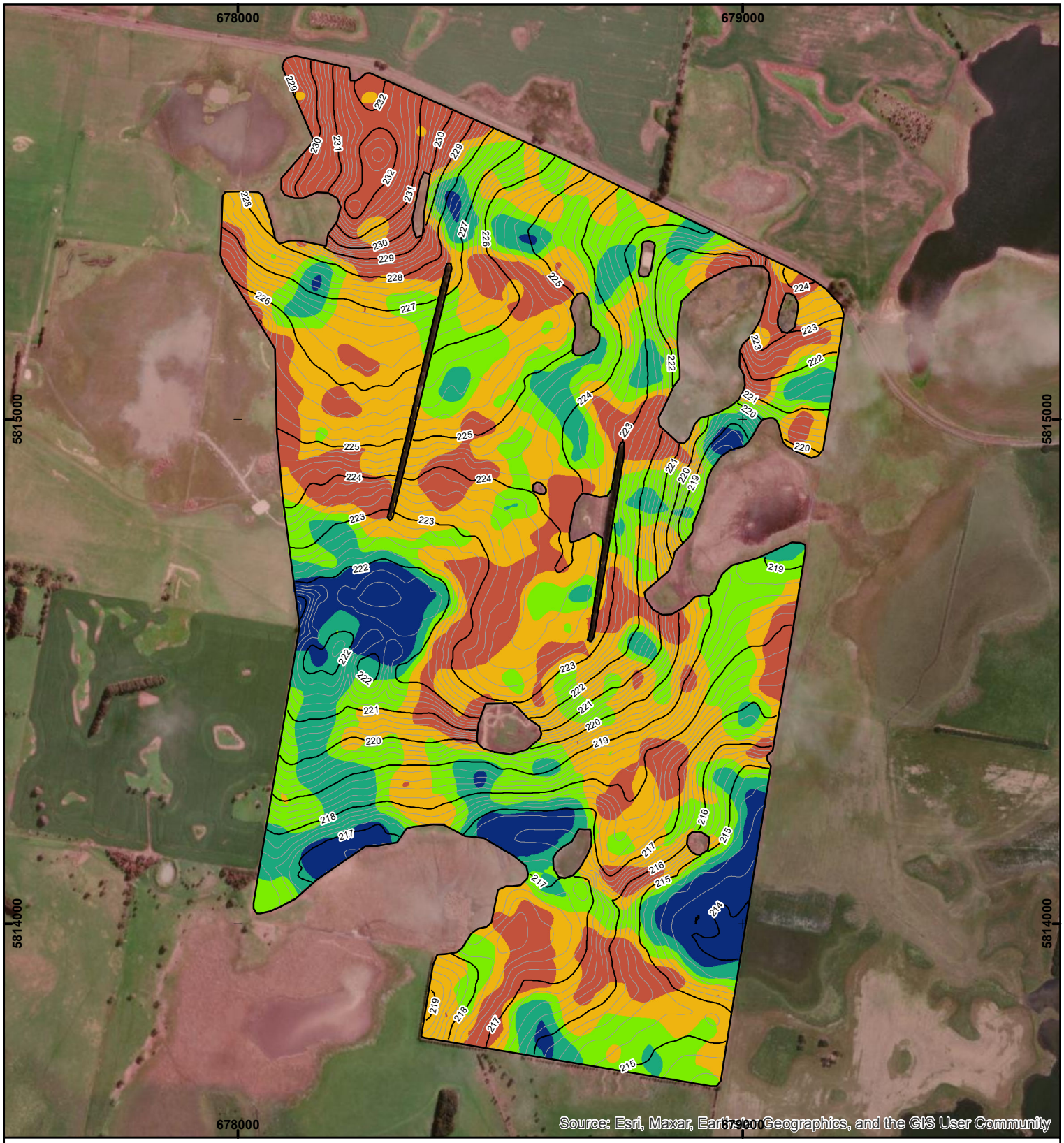

Legend

Hill

Contour

Major Contour (1.0m)

Minor Contour (0.2m)

Hill EM38 Deep (0-1.5m)

26.29 - 56.638
56.639 - 79.096
79.097 - 103.375
103.376 - 137.972
137.973 - 181.067

0 50 100 200 300 400 Metres

N

Blomeley Partnership

EM38 & Elevation Mapping

Date Prepared: 7/02/2024

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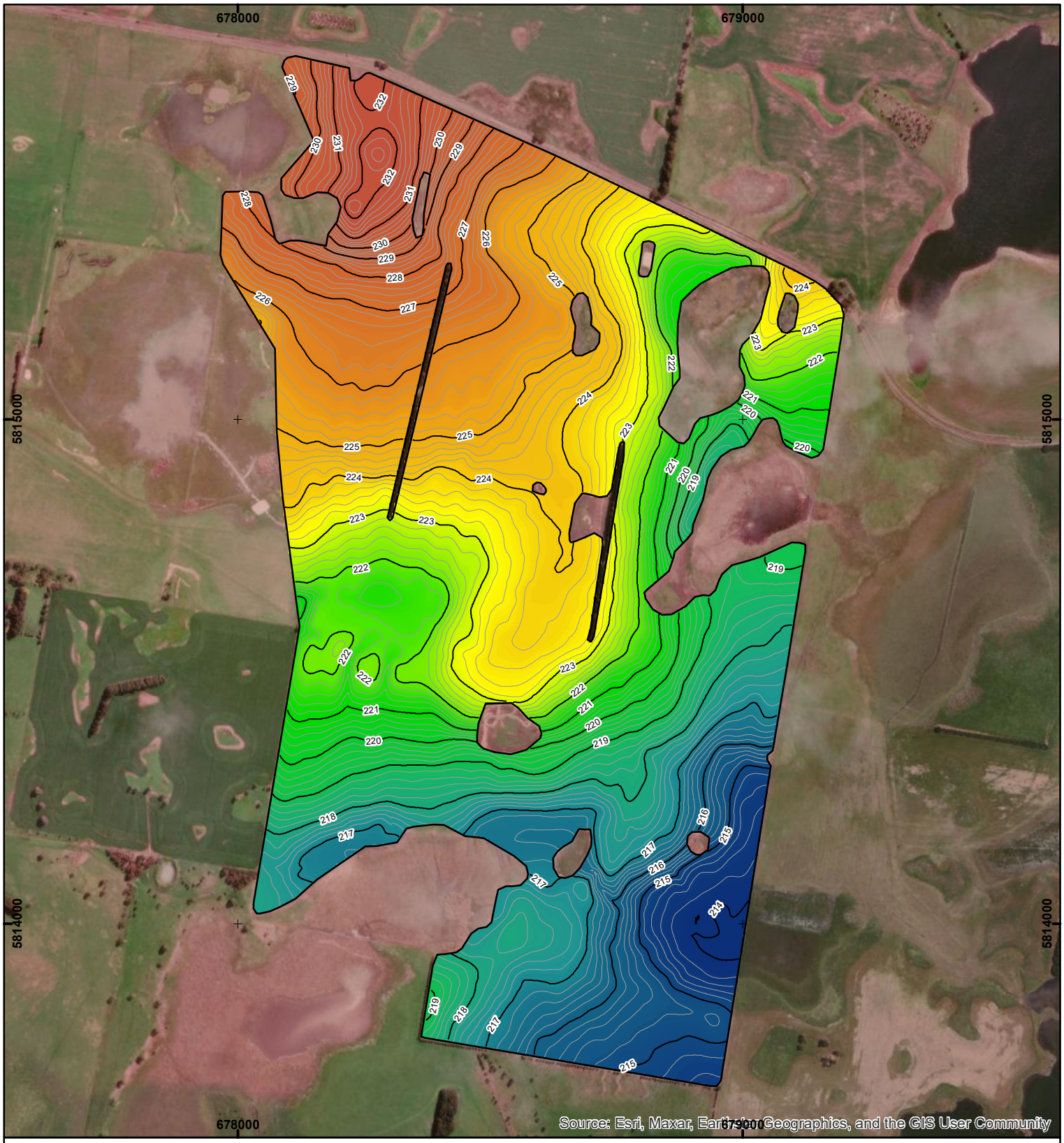

Legend

Hill

Contour

Major Contour (1.0m)

Minor Contour (0.2m)

Hill DEM

Elevation (m)

High : 232.4

Low : 213.8

0 50 100 200 300 400 Metres

N

Blomeley Partnership

EM38 & Elevation Mapping

Date Prepared: 7/02/2024

Projection & Datum: GDA 1994 - MGA 54

precision agriculture

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Legend

Hill **Hill Management Zone**

- 1 (60.0ha)
- 2 (70.4ha)
- 3 (21.9ha)

0 50 100 200 300 400 Metres

N

Blomeley Partnership

EM38 & Elevation Mapping

Date Prepared: 7/02/2024

Projection & Datum: GDA 1994 - MGA 54

precision agriculture

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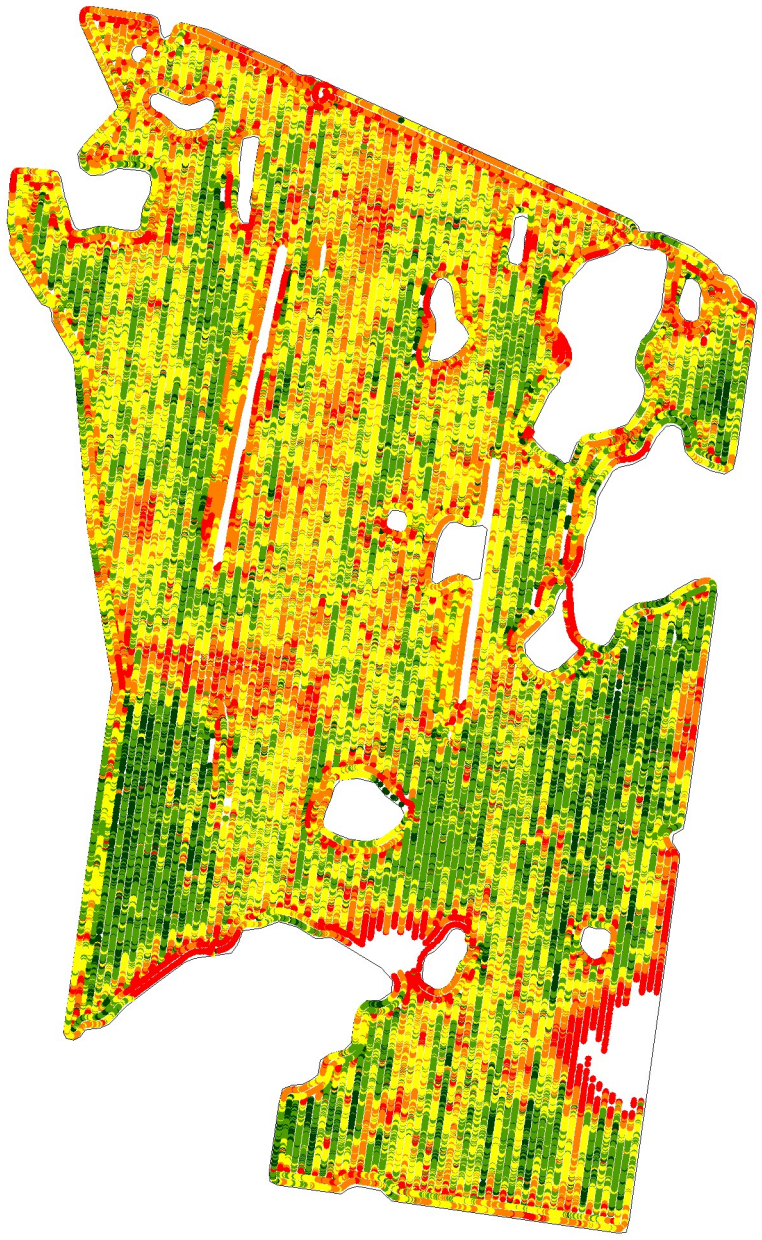
Hill - 2023 Canola: Harvesting
Dry Yield (Reconciled)



Client: Braecove Ag Pty Ltd
Farm: South Springs
Paddock: Hill
Crop: 2023 Canola
Name: Harvest 23
Type: Harvesting
Area: 147.61 ha
Start Date: 4/12/2023 9:39 PM
End Date: 7/12/2023 11:18 PM
Job Hours: 37.5 hr
Harvest: 568160.000 kg
Avg: 3849.06 kg/ha

5717.8 - 6499.3 kg/ha	5381 pts.	
4511.6 - 5717.7 kg/ha	28457 pts.	
3305.4 - 4511.5 kg/ha	39147 pts.	
2099.2 - 3305.3 kg/ha	21169 pts.	
100.2 - 2099.1 kg/ha	8001 pts.	