PA and the Three I’s principle: *Interoperable Interactive Interpretable*

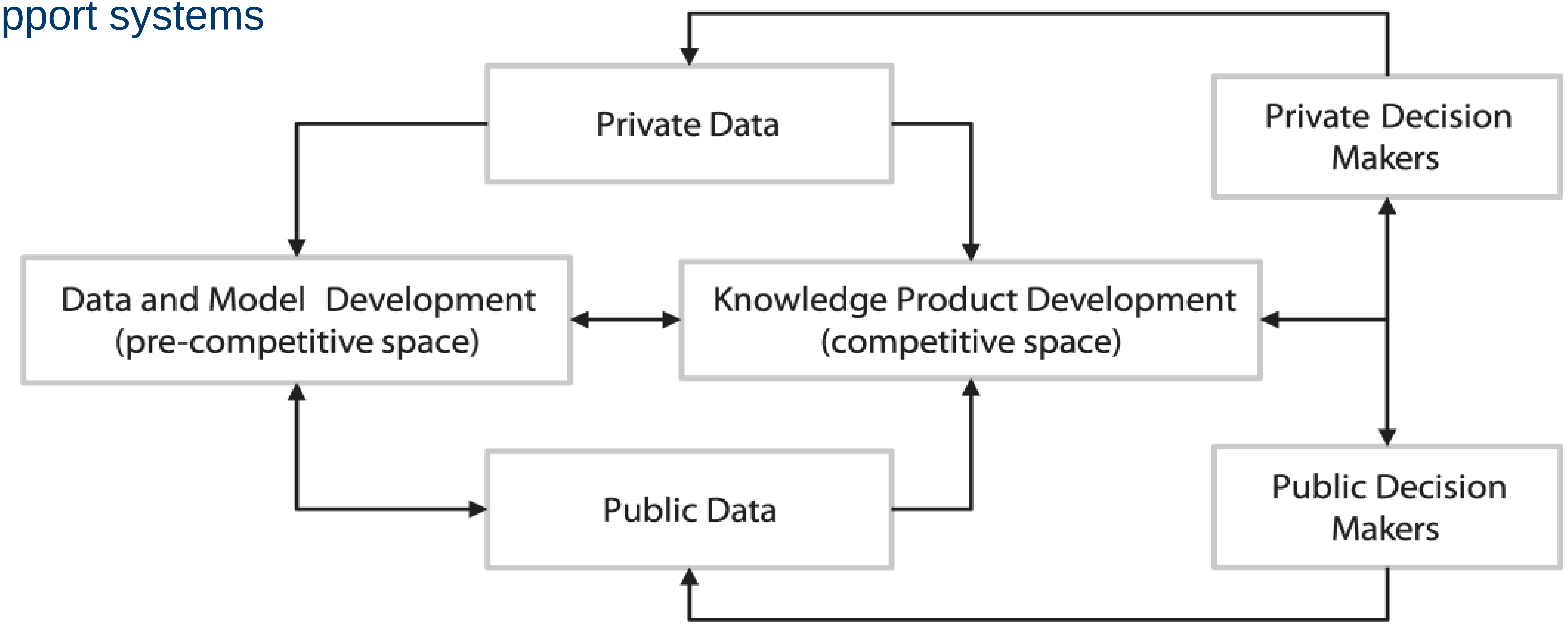



Nathan Robinson, Andrew MacLeod, Peter Dahlhaus, Megan Wong, Helen Thompson, Heath Gillett, Ben Fleay, Meera Cameron

Key philosophies

- Ensuring end-user tools and applications are fast, intuitive and easy-to-use.
- Making sure that applications work seamlessly across a variety of platforms, operating systems and browsers to the extent possible.
- Use of open-source and standards compliant software and technologies, wherever possible.
- Building upon existing collaborative software initiatives and contributing enhancements/tools back to the community.
- Ensuring the flexibility of the developed system to consume data from a variety of sources so as not to interfere with existing provider work practices.
- Use of software based in the cloud: no end-user requirement for software, updates, computation power or plug-ins.

Logical linkages in next generation decision support systems



Antle, J.M., Basso, B., Conant, R.T., Godfray, H.C.J., Jones, J.W., Herrero, M., Howitt, R.E., Keating, B.A., Munoz-Carpena, R., Rosenzweig, C., Tittonell, P. and Wheeler, T.R. (2017). Towards a new generation of agricultural system data, models and knowledge products: Design and improvement. *Agricultural Systems*.

Shared vision

- Co-creating innovative precision agriculture …. in response to farmer and farm adviser needs
- Real-world projects focused on advancing agribusiness decision making through data, insight and action
- Increased farm productivity and sustainability through the practical application of spatial technologies
- Integrating agricultural data from disparate sources using international standards for the interoperable exchange of data

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Challenge:

Farmers understanding the value proposition for adopting and using Precision Agriculture

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Interoperable

Solution

- Interoperability between software platforms and machinery is an ongoing challenge
- More data collected now through sensors – the ‘data deluge’
- Make data standardised – using protocols and agreed terminology (vocabularies)
- Examples include: ANZSoilML, FarmML, PAML

For example – did you know:

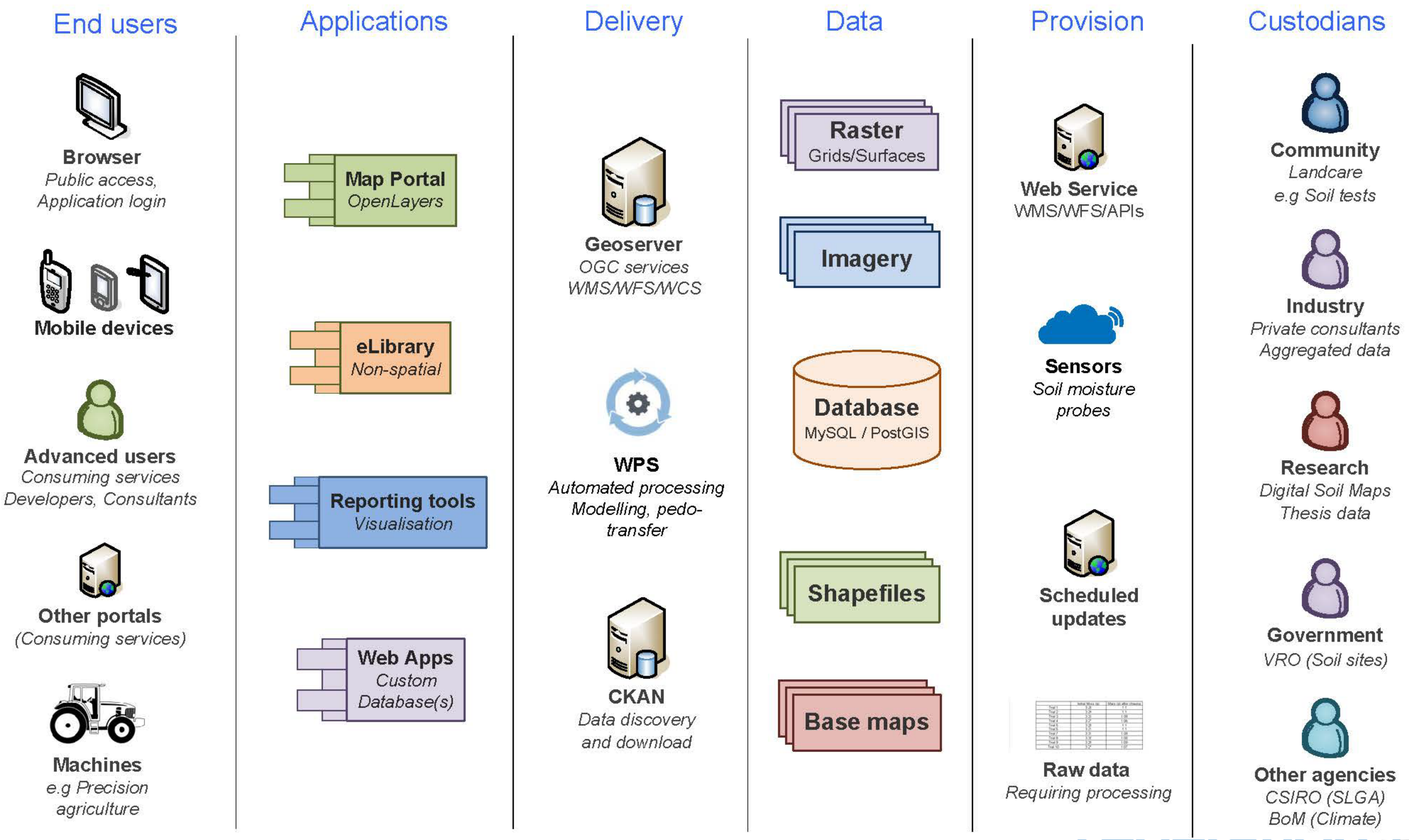
- There are **32** different soil phosphorus test methods recognised in Australia (Rayment & Lyons, 2011)
- Terms used to describe methods: *extractable*, *total*, *available*, *index*, *saturation*, *ratio*
- Units of measure: *%*, *mg P/kg*, *µg P/kg*, *X/C*, *PBI*, *colour*
- Common soil P assays include: *Colwell, Olsen, DGT*

Rayment G, Lyons D. 2011. Soil chemical methods – Australasia. CSIRO Publishing.

Enabling interoperability - spatial infrastructure

Use-cases:
Co-creation using real-world examples,

"A farmer uses her iPad to view the yield maps for a selected paddock over the past ten years and compares that to the fertiliser, soil moisture and waterlogging histories over the same period."



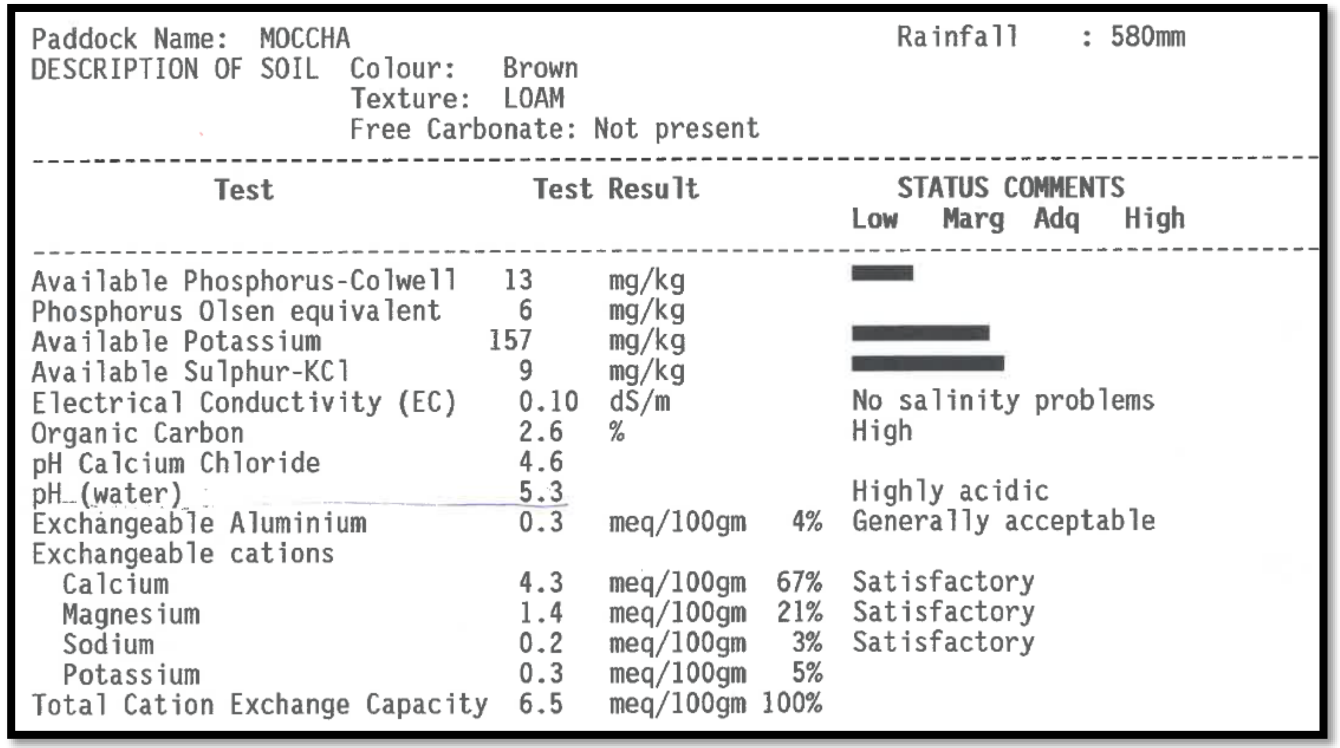
Interoperable – examples

1. Looking at the data – a simple workflow (as easy as it gets?)

   (e.g. laboratory data ➡ ANZSoilML ➡ map view ➡ analysis tools ➡ end use)

2. Public and private data – combining for new insights

Example 1



Paddock Name: MOCCHA Rainfall : 580mm
DESCRIPTION OF SOIL Colour: Brown
Texture: LOAM
Free Carbonate: Not present

Test	Test Result			STATUS COMMENTS
				Low Marg Adq High
Available Phosphorus-Colwell	13	mg/kg		
Phosphorus Olsen equivalent	6	mg/kg		
Available Potassium	157	mg/kg		
Available Sulphur-KCl	9	mg/kg		
Electrical Conductivity (EC)	0.10	dS/m		No salinity problems
Organic Carbon	2.6	%		High
pH Calcium Chloride	4.6			
pH (water)	5.3			Highly acidic
Exchangeable Aluminium	0.3	meq/100gm	4%	Generally acceptable
Exchangeable cations				
Calcium	4.3	meq/100gm	67%	Satisfactory
Magnesium	1.4	meq/100gm	21%	Satisfactory
Sodium	0.2	meq/100gm	3%	Satisfactory
Potassium	0.3	meq/100gm	5%	
Total Cation Exchange Capacity	6.5	meq/100gm	100%	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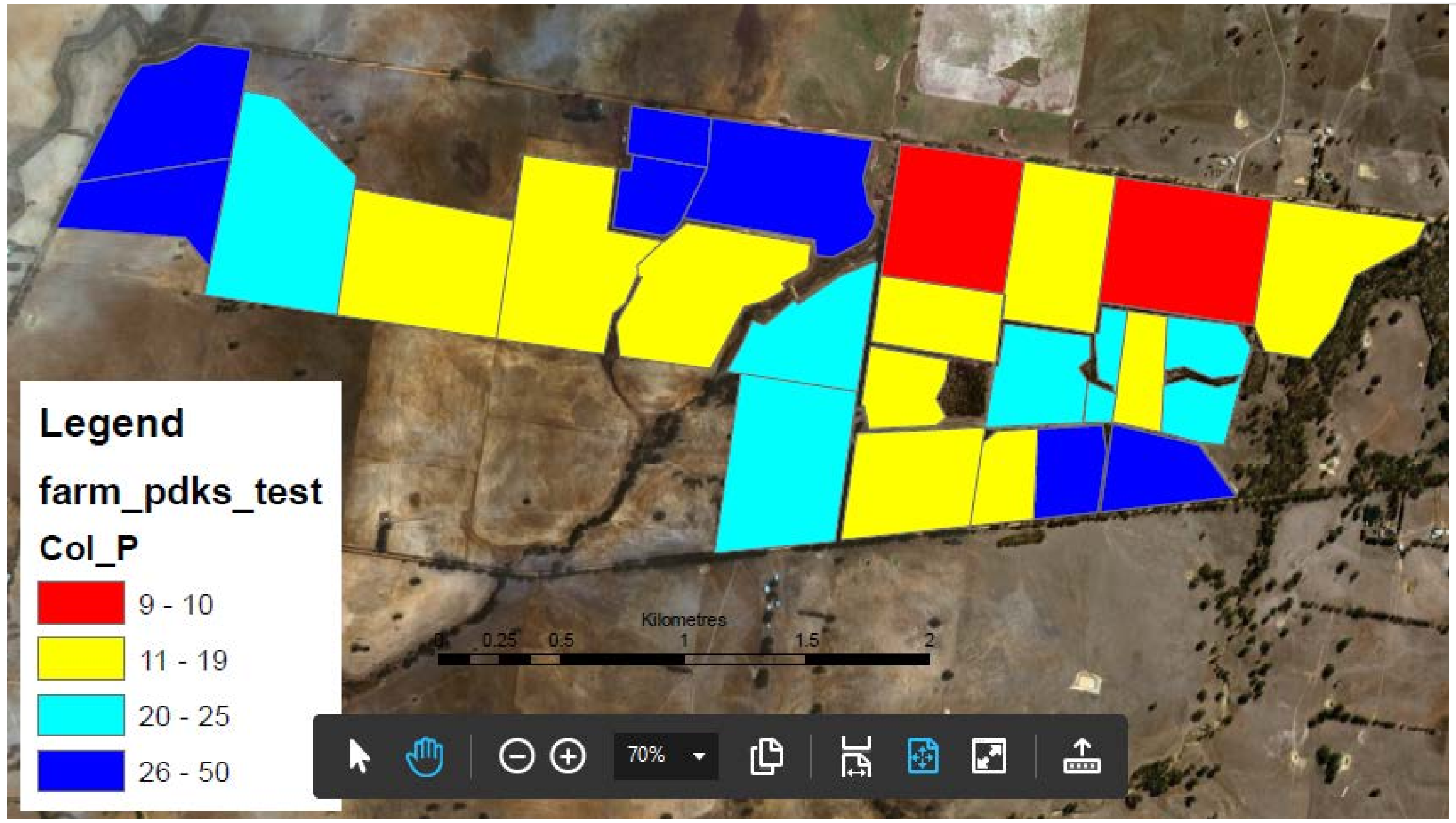

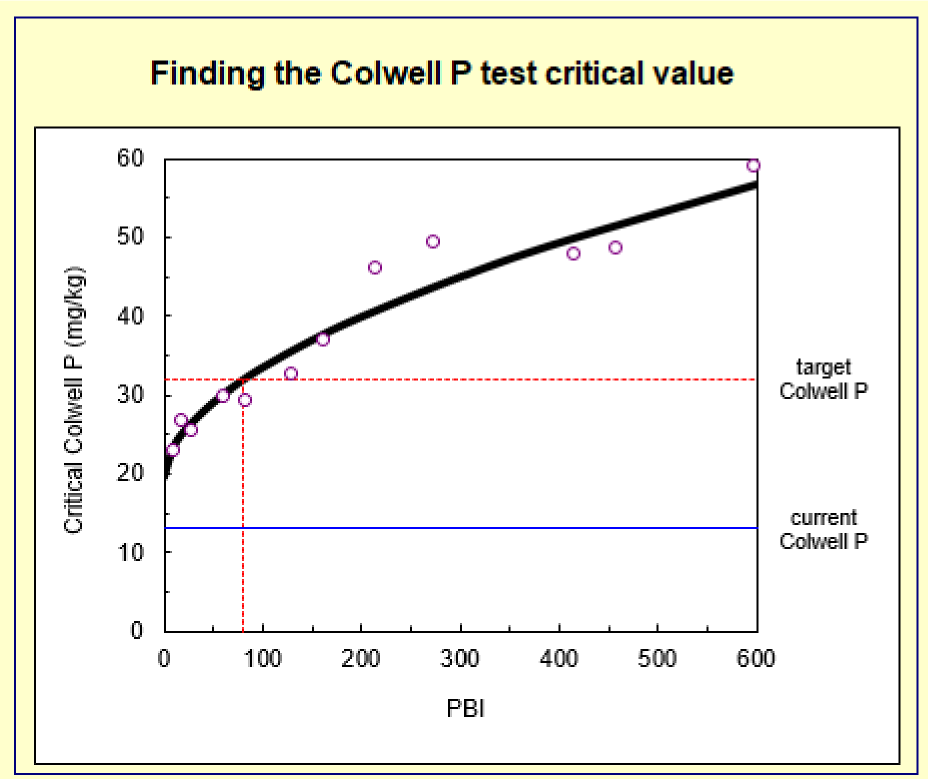

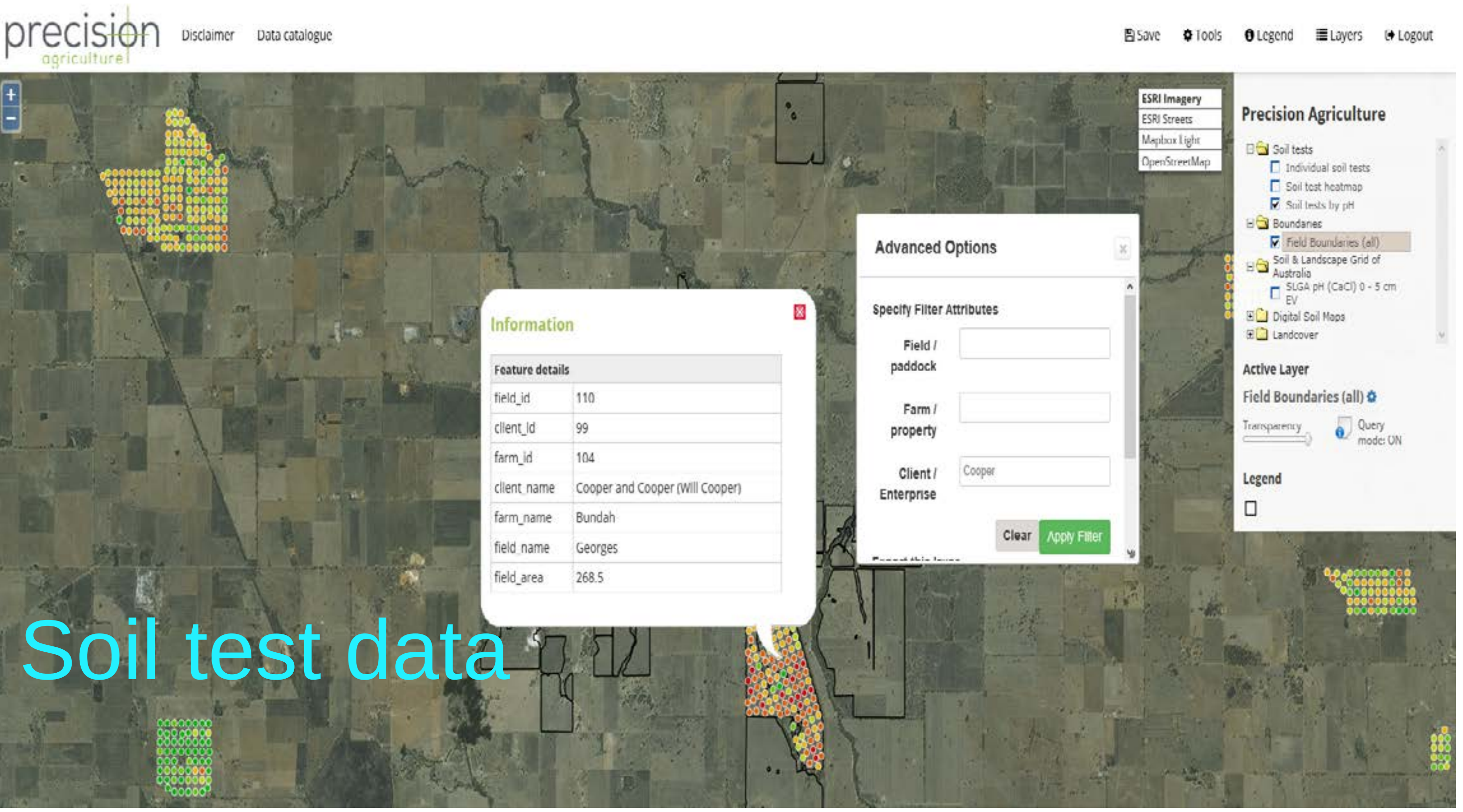

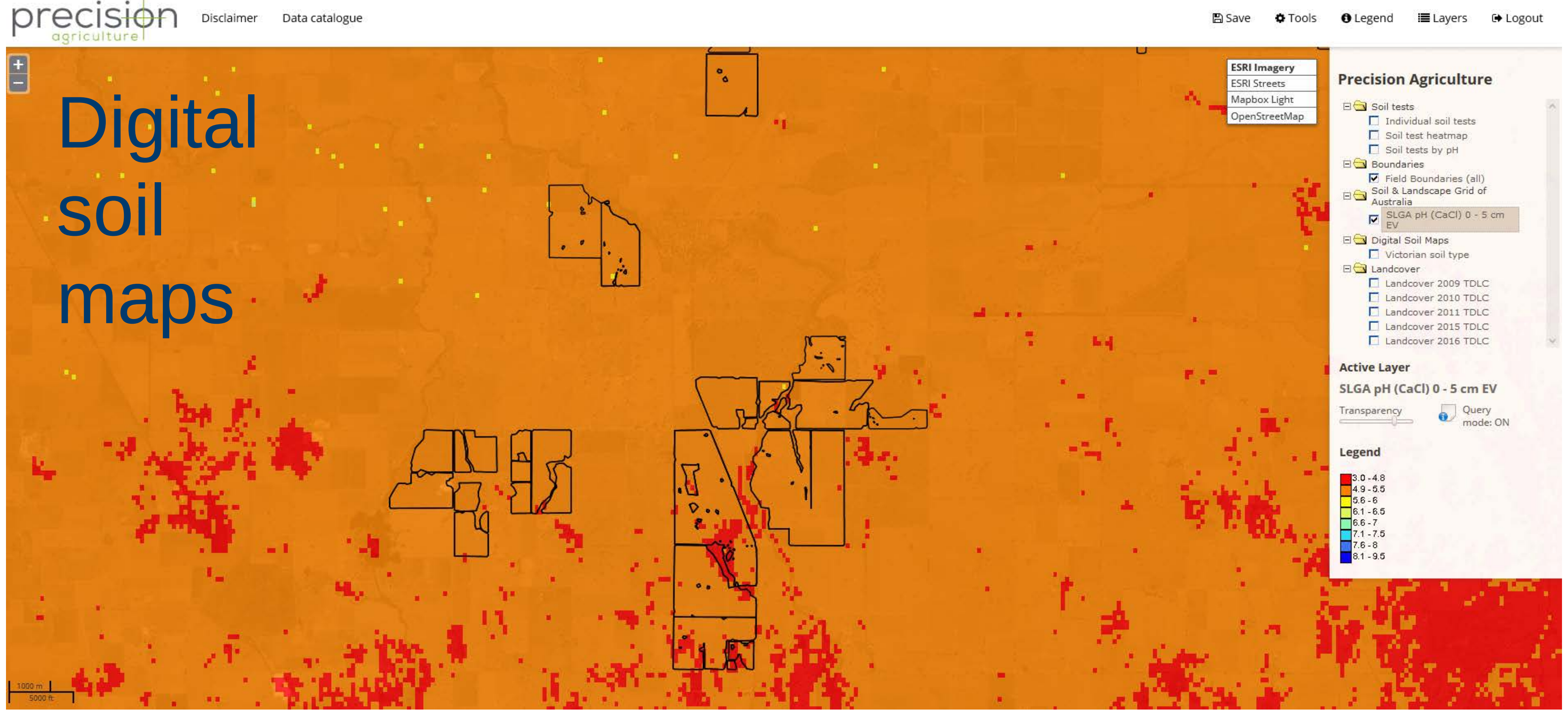

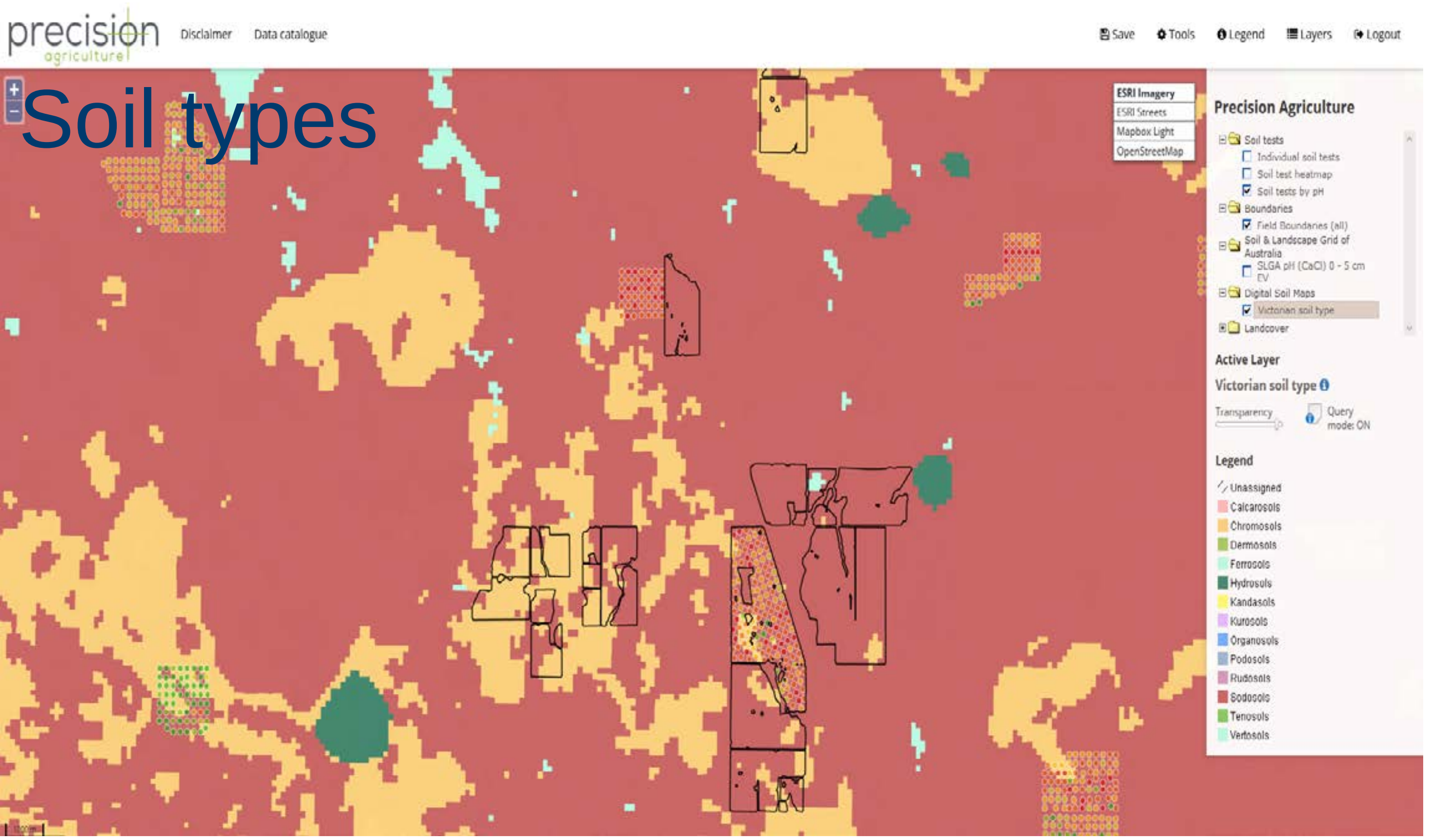

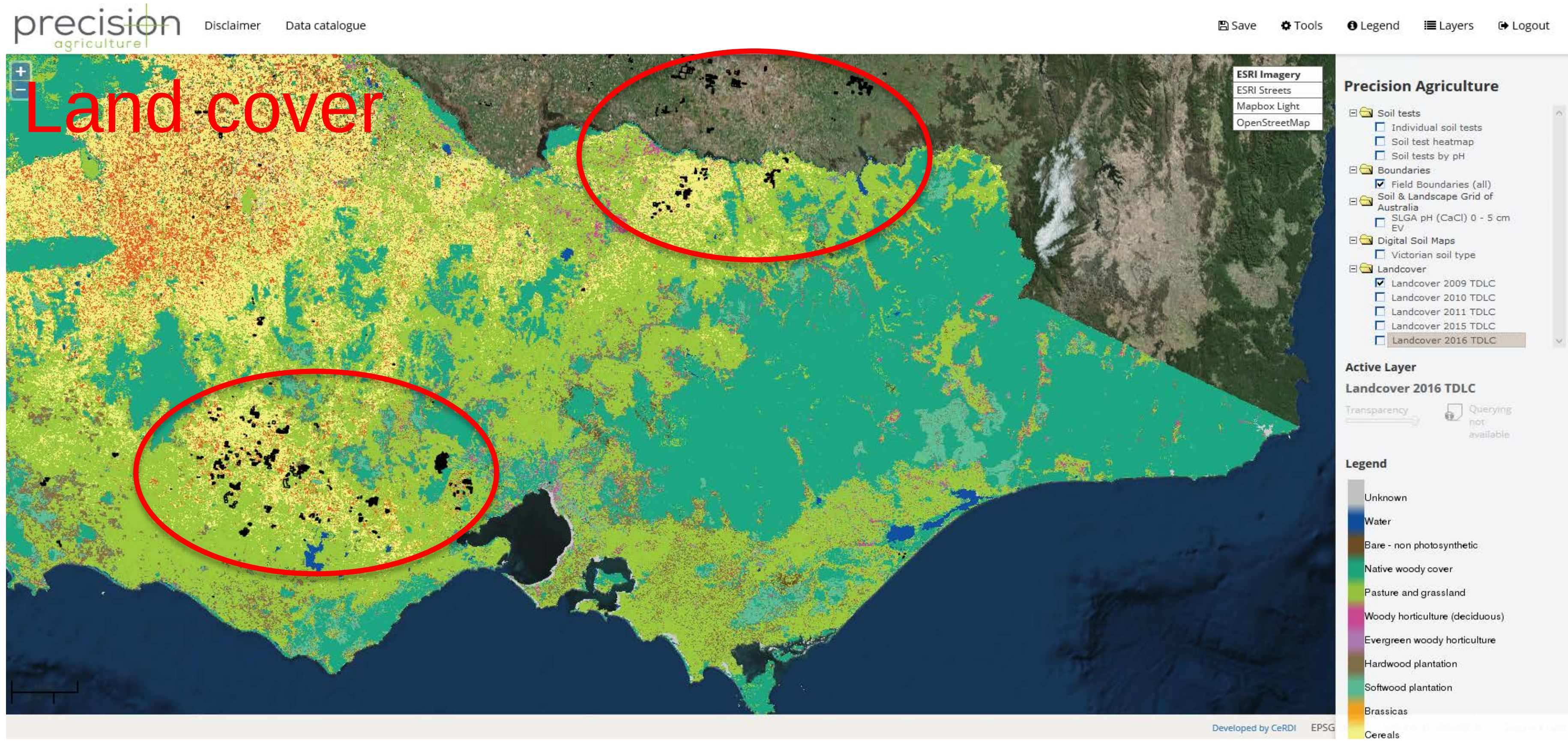

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Other contextual data and information

Victorian Resources Online
Corangamite

ESAS9

Location: Mingay

Australian Soil Classification: Vertic, Mottled-Mesonatric, Grey SODOSOL

General Landscape Description: Gently undulating plain.
Site Description: Raised bed (2 metre wide) cropping paddock. Gilgai micro relief present.
Geology: Quaternary Basalt.

ESAS9 Landscape

Soil Profile Morphology:

Surface Soil

A1	0-12 cm	Dark greyish brown (10YR4/2); hardsetting and crusting in the surface; *fine sandy clay loam*; moderate coarse blocky, parting to medium blocky structure; significant amount of buckshot present; pH 5.9:
A2	12-20/40 cm	Brown (10YR5/3) conspicuously bleached (10YR7/1d); *fine sandy clay loam*; fine polyhedral structure; pH 5.9; wavy change to: NOTE: depth to subsoil varies due to gilgai.

Subsoil

B21	20/40-50 cm	Dark grey (10YR4/1) with strong brown (7.5YR4/6) mottles; *heavy clay*; coarse blocky structure; vertic shrink/swell properties; pH 7.1:
B22	50-75 cm	Yellowish brown (10YR5/4); *heavy clay*; lenticular structure; pH 7.8:
B23	75-110 cm	Light yellowish brown (2.5Y6/4); *heavy clay*; coarse lenticular, parting to fine lenticular structure; slickensides evident; pH 8.7.

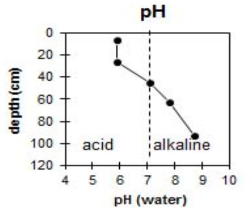
ESAS9 Profile

Soil Profile Characteristics:

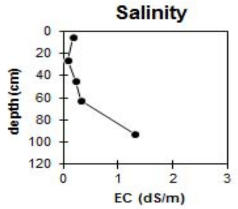
Soil Profile Characteristics:

	pH	Salinity Rating	Sodicity	Dispersion
Surface (A1 horizon)	Moderately Acid	Low	Non-Sodic	None
Subsoil (B21 horizon)	Slightly Alkaline	Low	Strongly Sodic	Strong[1]
Deeper subsoil (at 80-120 cm)	Strongly Alkaline	Medium - High	Strongly Sodic	Strong[2]

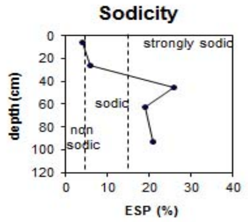
[1] Complete dispersion after remoulding. [2] Moderate dispersion after remoulding.



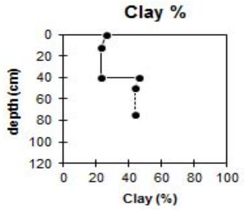
The surface is moderately acid. The subsoil is slightly alkaline and the deeper subsoil is strongly alkaline.



The salinity rating in the surface is low. The subsoil has a medium to high salinity rating.



The surface is non-sodic. The subsoil is strongly sodic.



The clay content increases significantly at the subsoil boundary.

Horizon	Horizon Depth (cm)	pH (water)	pH ($CaCl_2$)	EC dS/m	NaCl %	Exchangeable Cations Ca	Mg	K	Na
						meq/100g			
A1	0-12	5.9	5.4	0.17		7	2.9	0.38	0.73
A2	12-40	5.9	5.0	0.07		2.3	1.4	0.11	0.48
B21	40-50	7.1	5.9	0.22		6	8.9	0.41	5.3
B22	50-75	7.8	6.7	0.32	0.04	6.6	10	0.32	6.7
B23	75-110	8.7	8.3	1.3	0.2	7.9	14	0.37	11

Horizon	Horizon Depth (cm)	Oxidisable Organic Carbon %	Exchangeable Aluminium mg/kg	Exchangeable Acidity meq/100g	Field Capacity pF2.5	Wilting Point pF4.2	Coarse Sand (0.2-2.0 mm)	Fine Sand (0.02-0.2 mm)	Silt (0.002-0.02 mm)	Clay (<0.002 mm)
A1	0-12	2.2	<10	7.2	24.8	11.4	17	41	11	26
A2	12-40		<10	3.9	17.5	5.9	26	44	6	23
B21	40-50				39.9	20.5	5	33	12	46
B22	50-75				34.5	24.9	5	33	16	44
B23	75-110				46.0	24.3				

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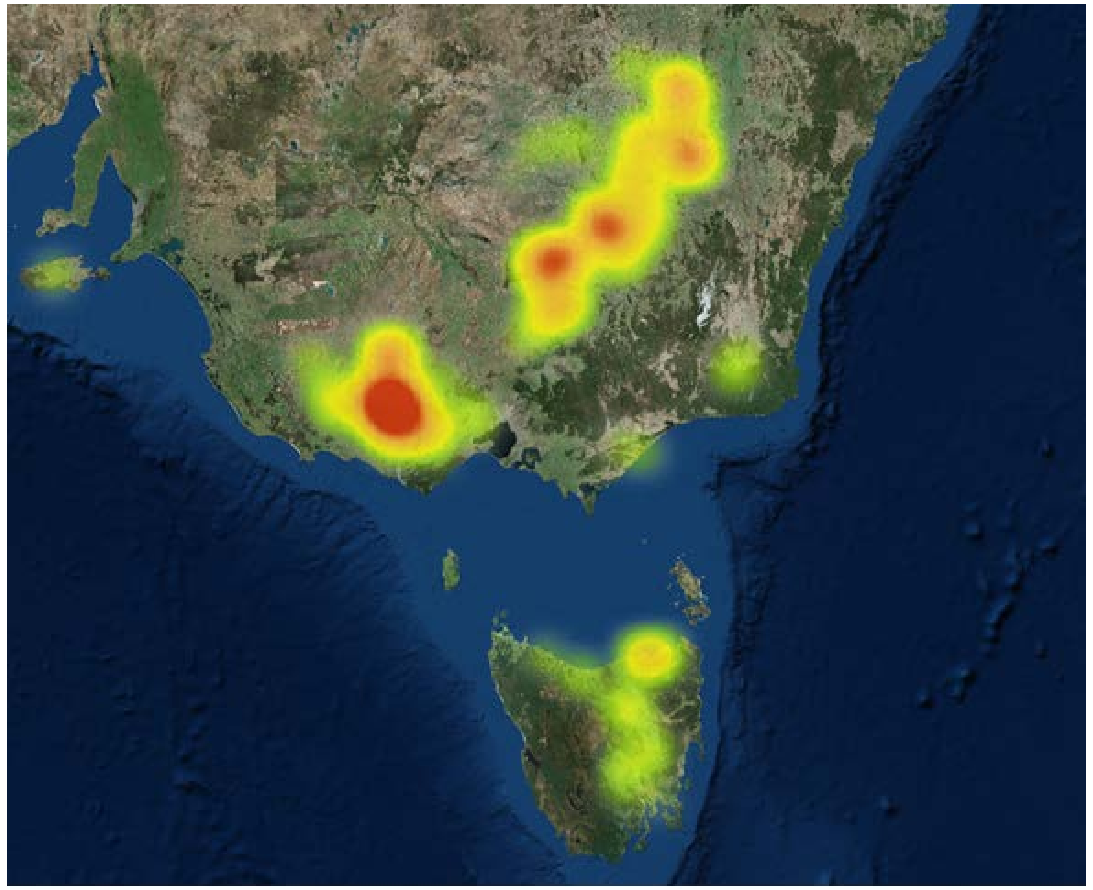
Interactive

- Often data and information is only useful to the domain expert.
- Online services such as Web Feature Service (WFS), Web Coverage Service (WCS) or Web Processing Service (WPS).
- Ability to bring data together from a variety of different sources.
- Data that is private and publicly managed.

- By bringing data together – develop new understandings via the ability to query and interrogate with little effort (for the user)
- Data visualisation – trends in data (e.g. yield zone performance, inputs, discount cash flows)



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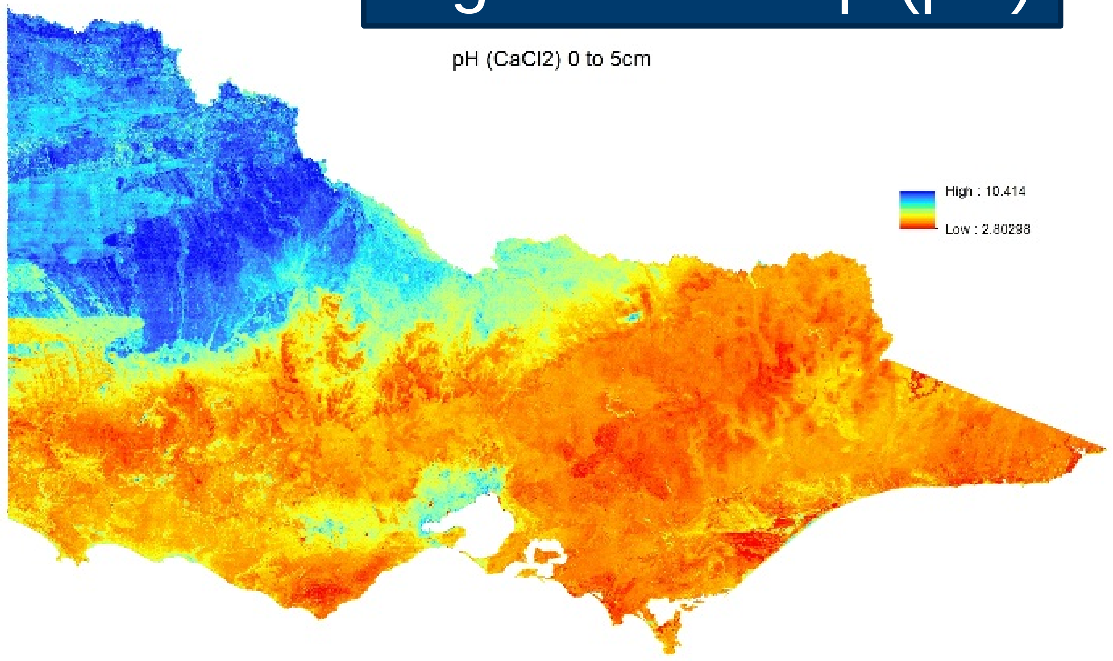
Bringing this data together

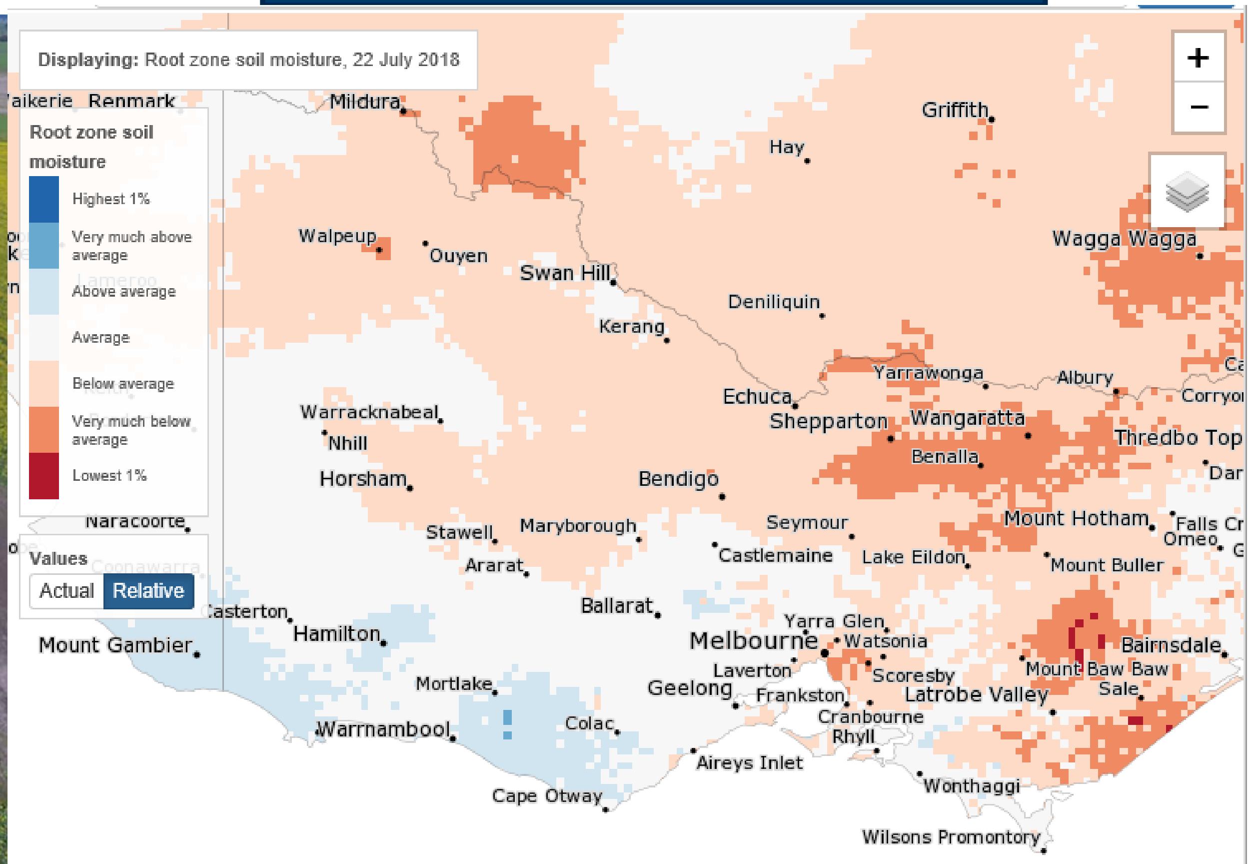
- Soil test data
- Digital Soil Maps
- Experimental data – e.g. farm trials
- Climate data
- Soil moisture
- In-season biomass and groundcover

Digital Soil Map (pH)

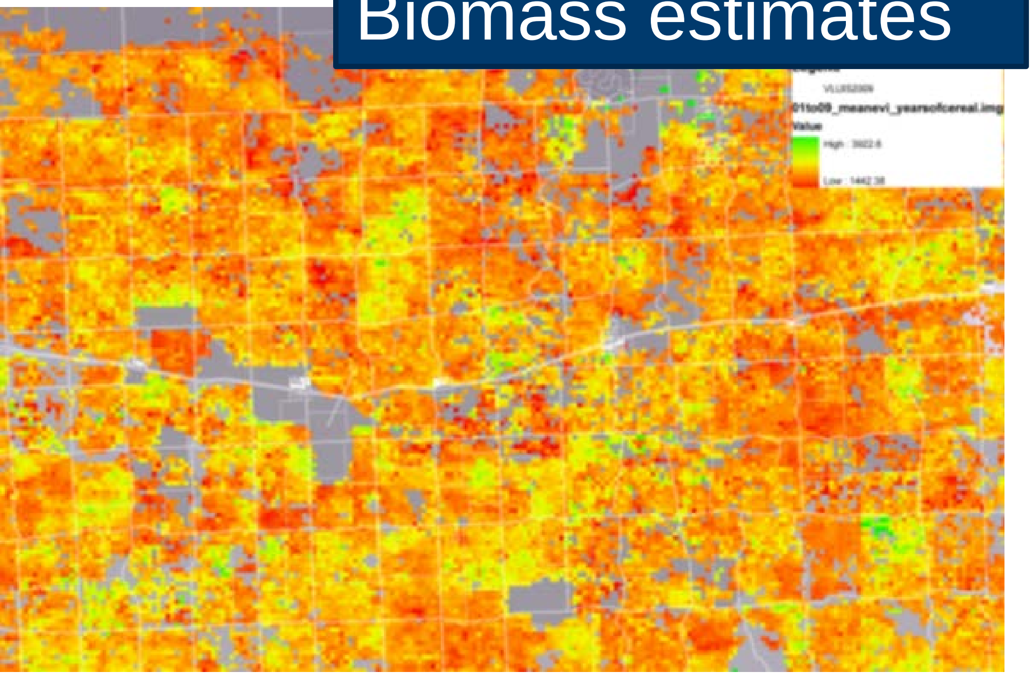


Trials

Soil moisture data

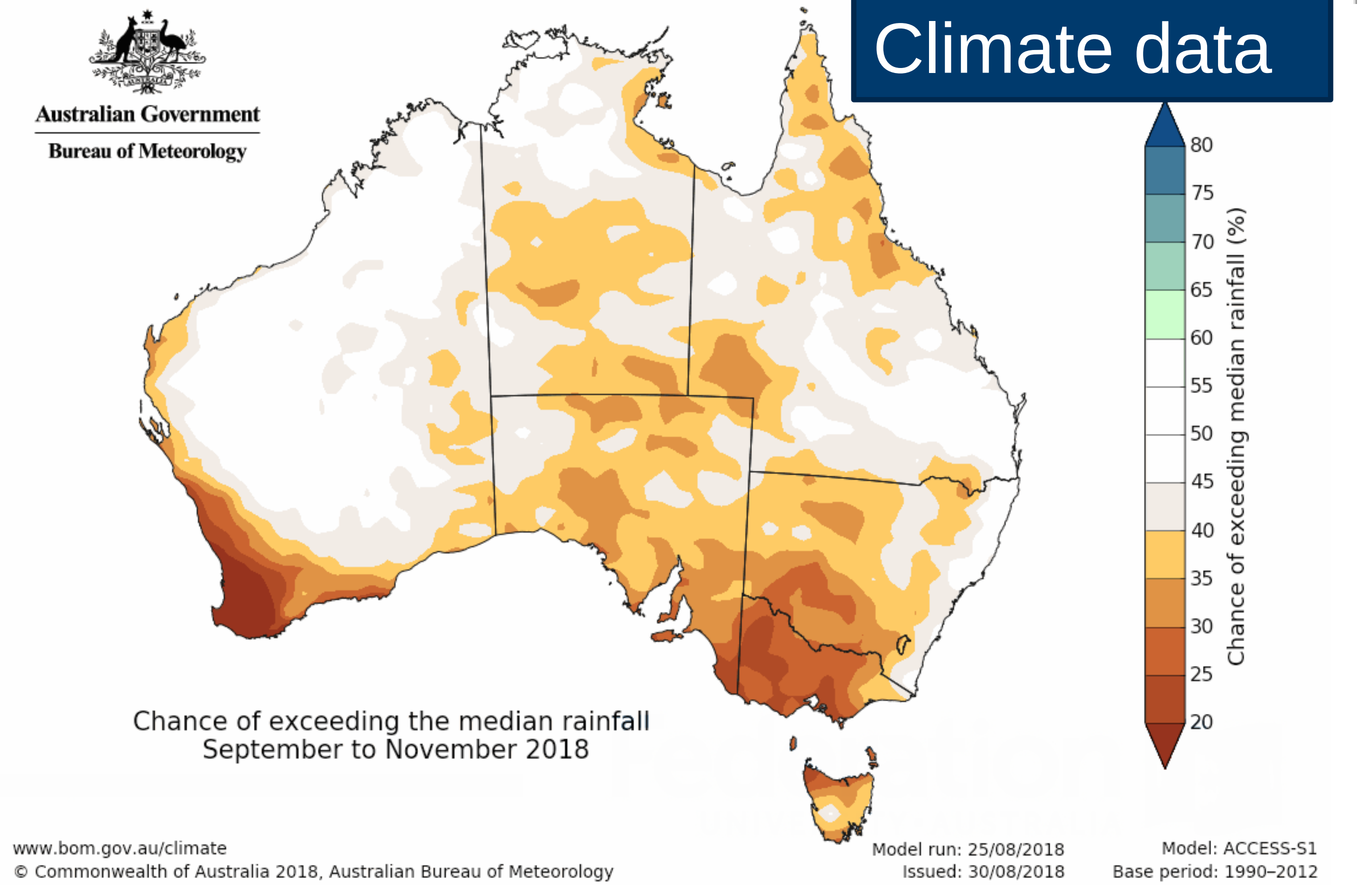


Biomass estimates



Other data?

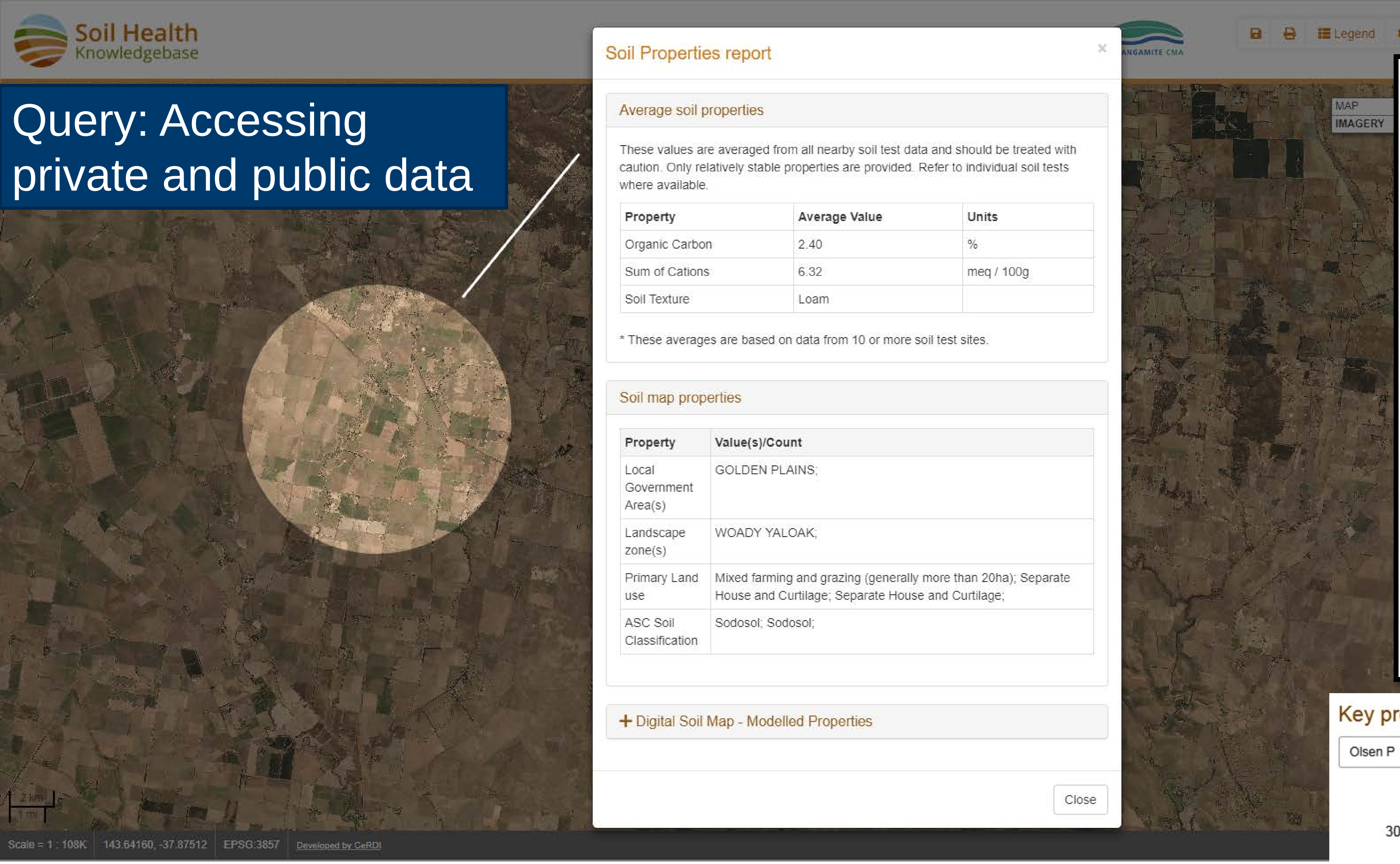
Climate data



Interpretable

- Coupling data with tools and systems – translation into meaningful (actionable) information
- User interface easy and intuitive
- Use and contribute to tools/DSS in existence, or being developed, e.g. benefit cost analysis for variable rate liming – in development by AgVic.

Query: Accessing private and public data



Soil Properties report

Average soil properties

These values are averaged from all nearby soil test data and should be treated with caution. Only relatively stable properties are provided. Refer to individual soil tests where available.

Property	Average Value	Units
Organic Carbon	2.40	%
Sum of Cations	6.32	meq / 100g
Soil Texture	Loam	

* These averages are based on data from 10 or more soil test sites.

Soil map properties

Property	Value(s)/Count
Local Government Area(s)	GOLDEN PLAINS;
Landscape zone(s)	WOADY YALOAK;
Primary Land use	Mixed farming and grazing (generally more than 20ha); Separate House and Curtilage; Separate House and Curtilage;
ASC Soil Classification	Sodosol; Sodosol;

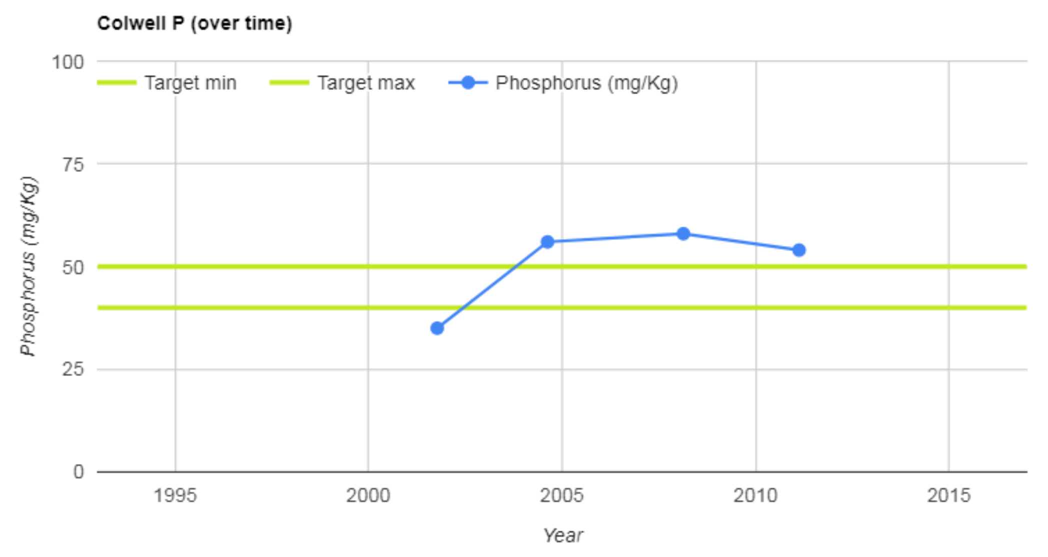
+ Digital Soil Map - Modelled Properties

Close

Samples	Date	Sample Depth
FS 85298 - RACECOURSE 2008 ...... 0 - 10 CM	February-2008	0 - 10 CM
FS 114130 - RACECOURSE 2011 ...... 0 - 10 CM	February-2011	0 - 10 CM
FS 50526 - RACECOURSE 2004 ...... 0 - 10 CM	August-2004	0 - 10 CM
FS 23646 - RACECOURSE 2001 ...... 0 - 10 CM	October-2001	0 - 10 CM
FS 90912 - RACE COURSE 1998 ...... 0 - 10 CM	September-1998	0 - 10 CM

Key properties - Temporal Charts

Olsen P | Colwell P | KCl Sulphur | Colwell K | pH Water | pH CaCl2 | Salinity as EC | Organic Carbon



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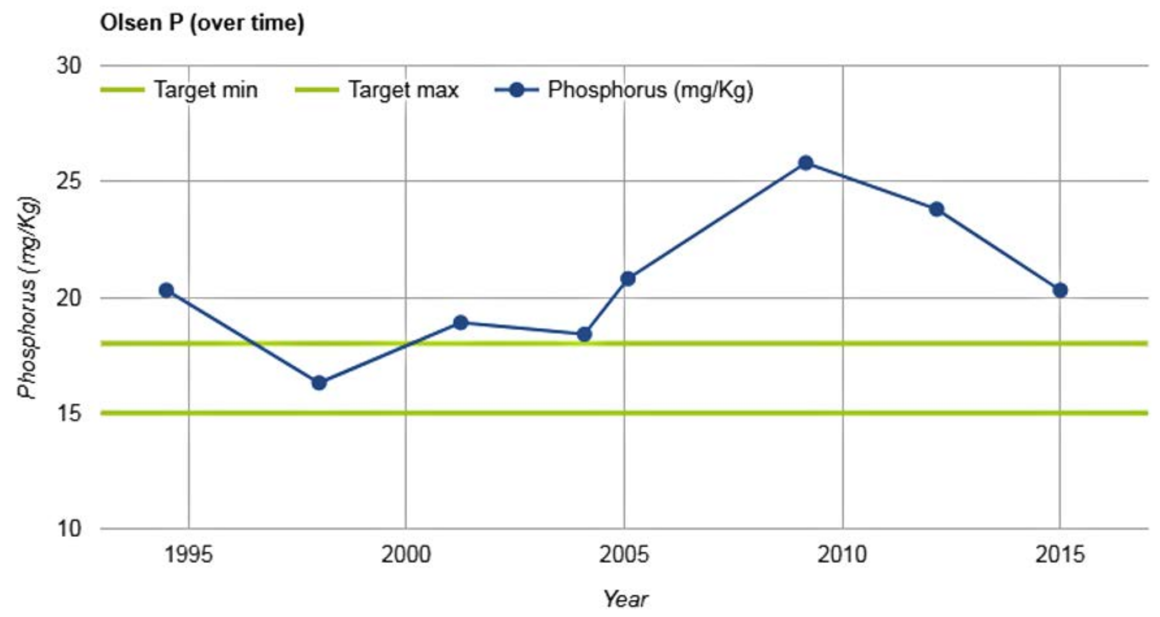
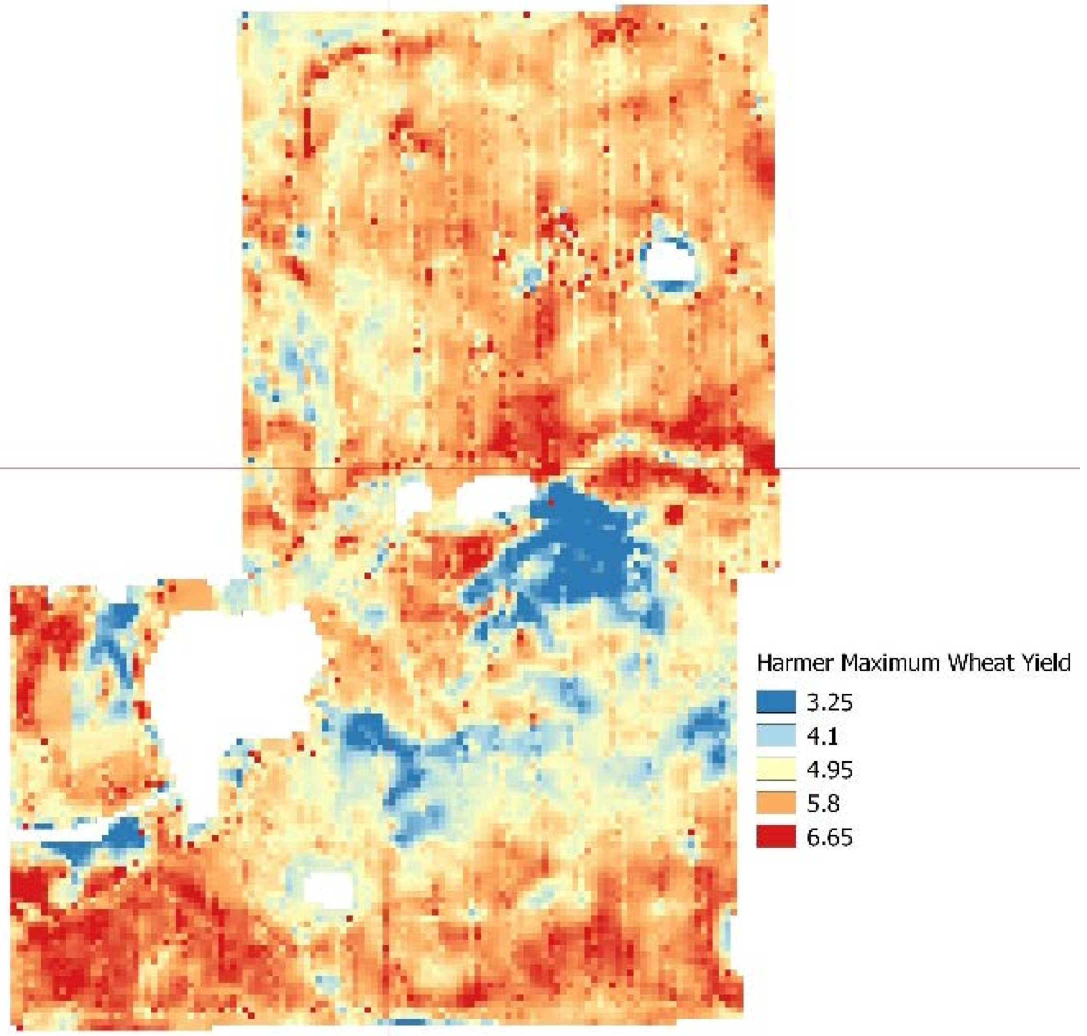


Woady Yaloak Productive Catchment Management

Soil test results (phosphorus) with target range values (green lines)

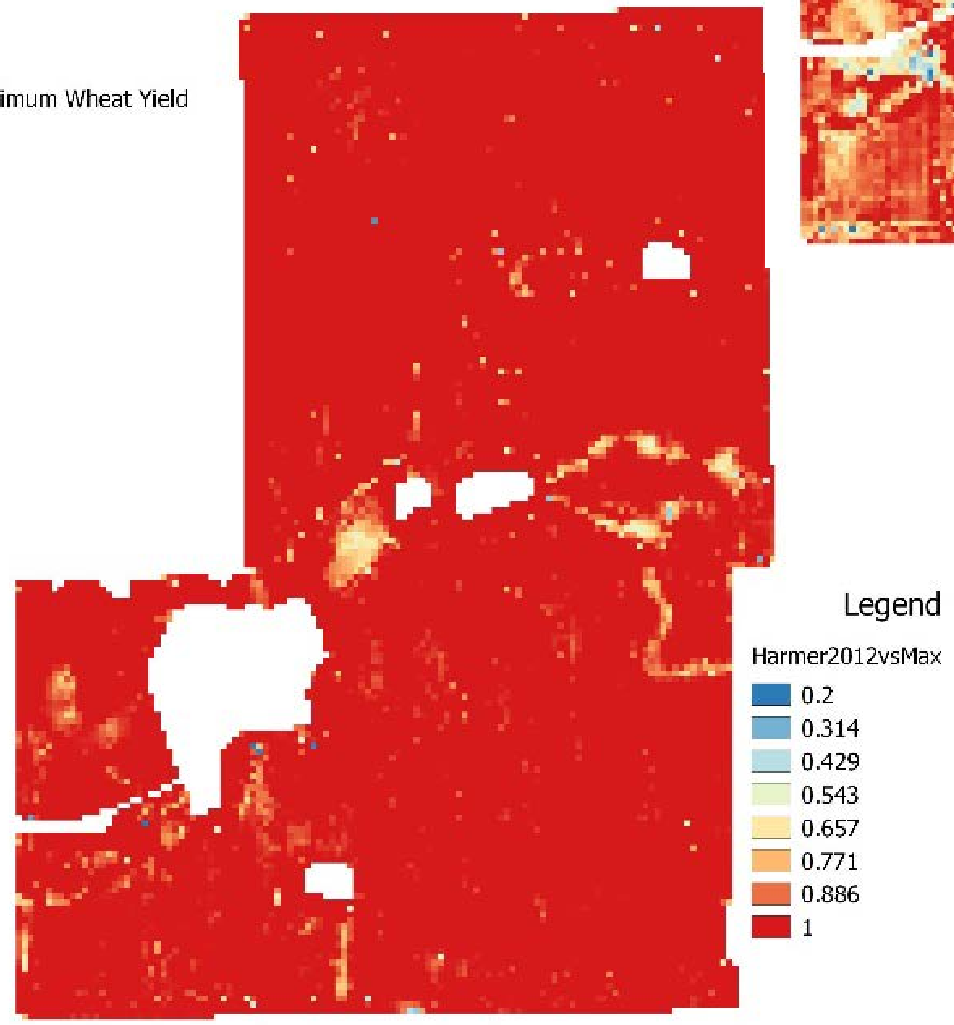
Other data … treatments/experiments

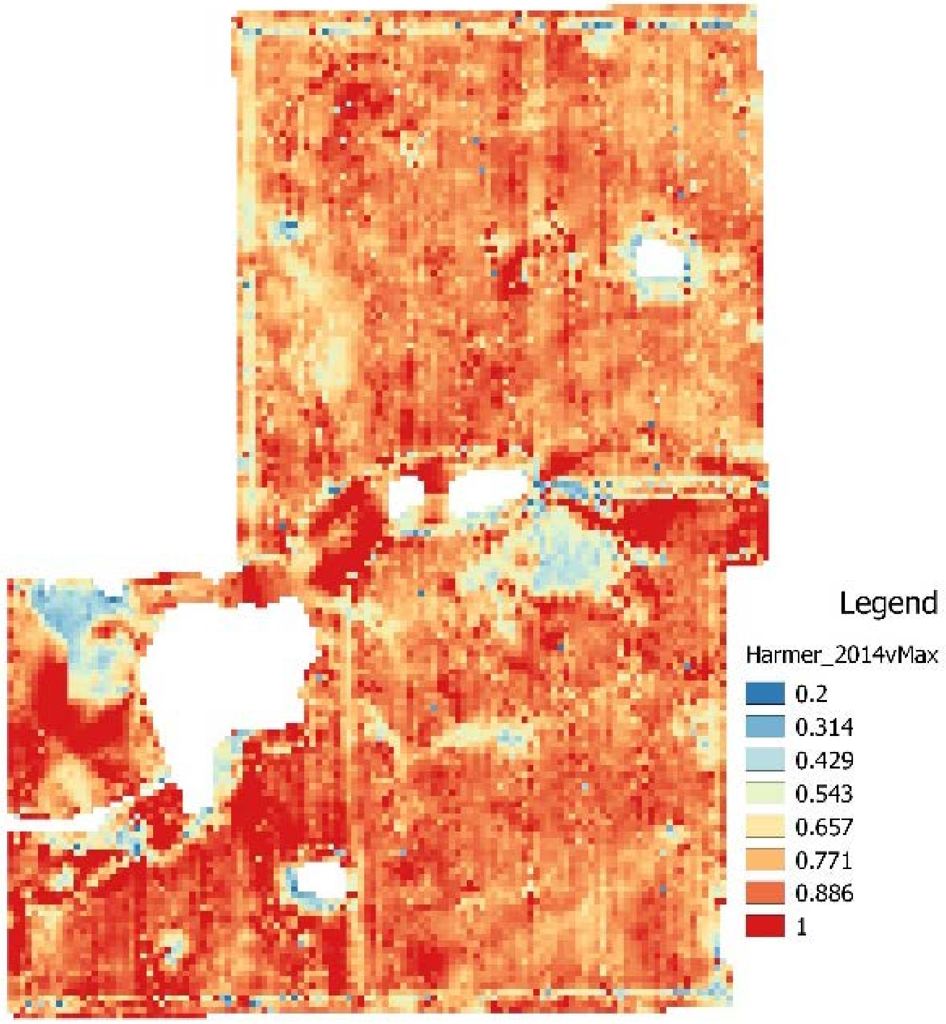
Yield comparison



Max. wheat yield (7yrs wheat yield data)

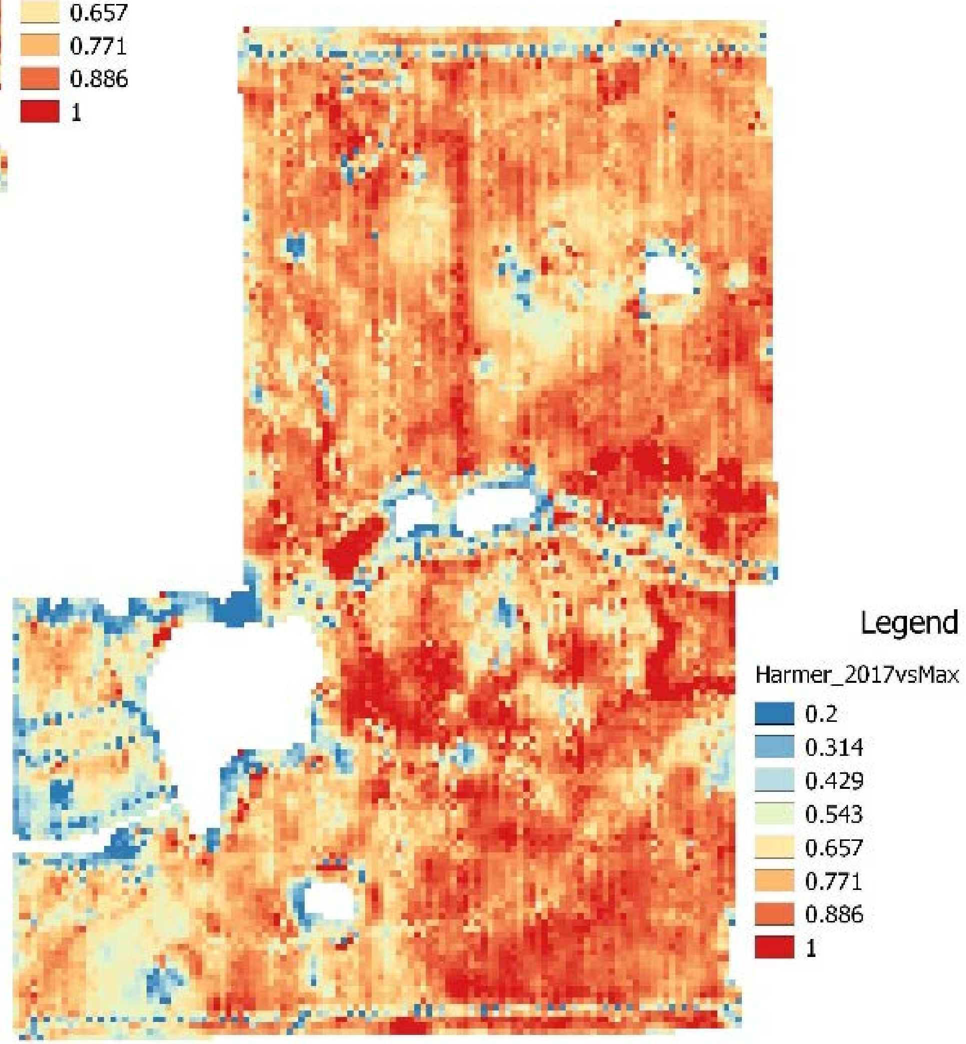
2012 yield

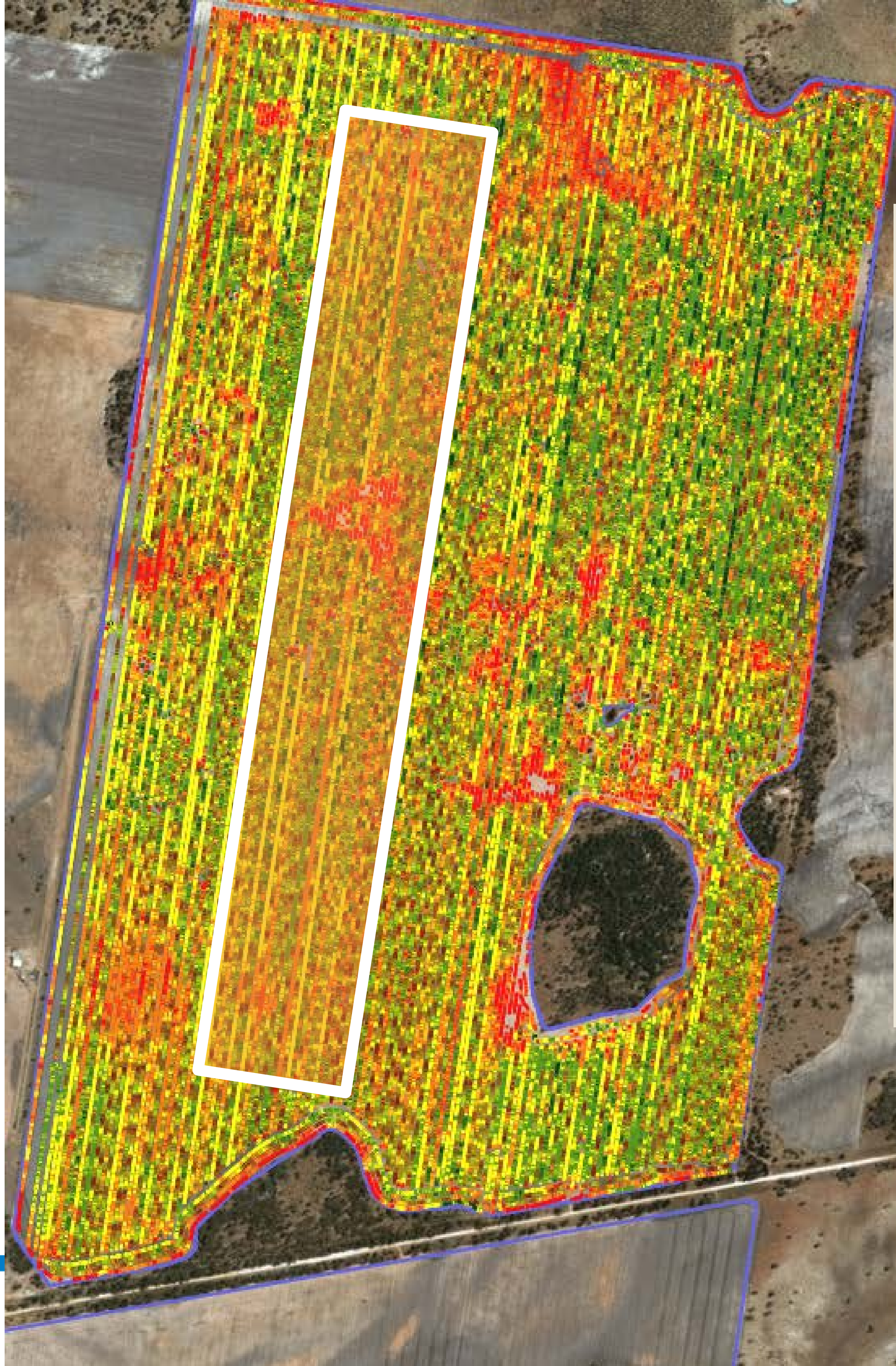


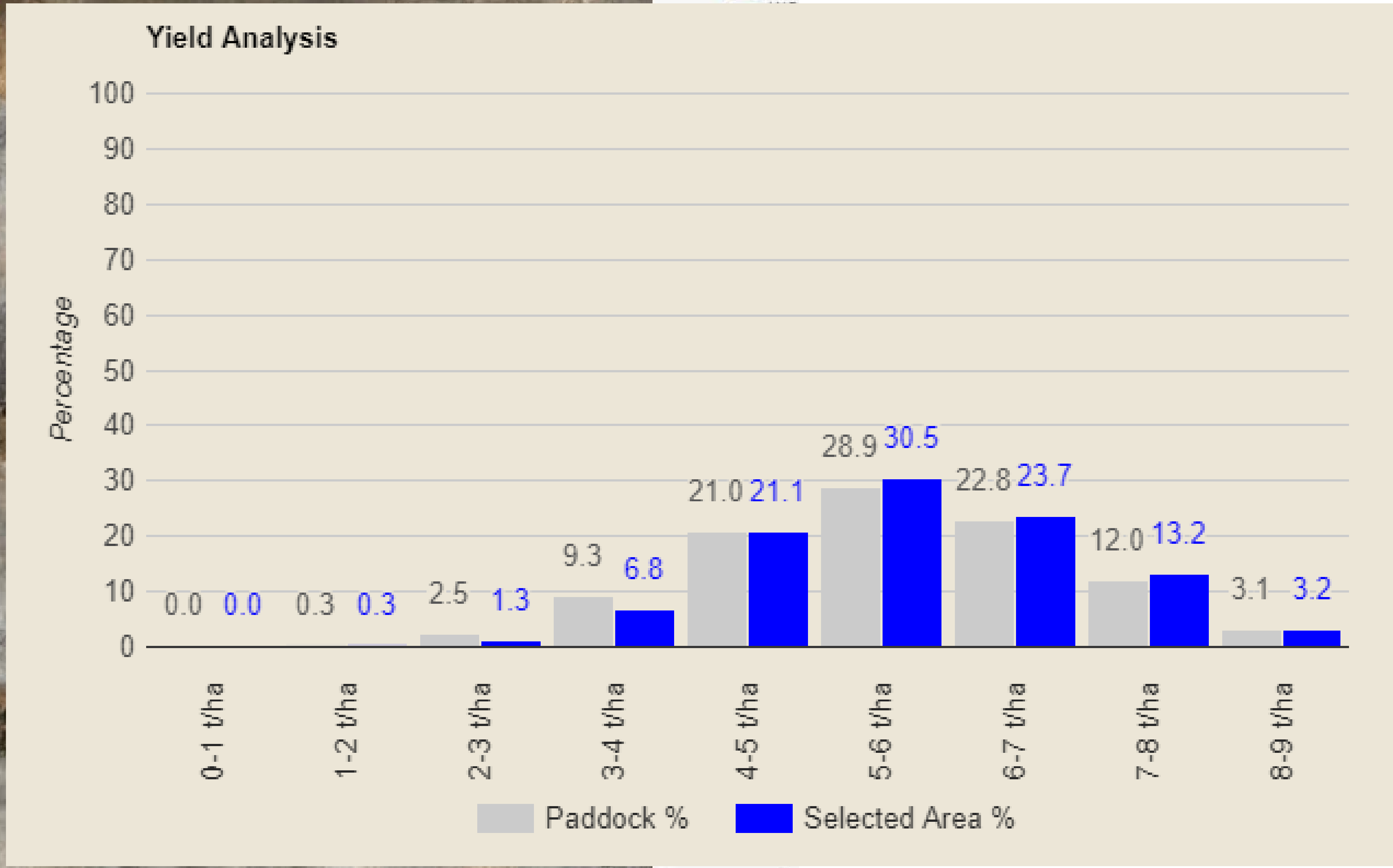


2014 yield

2017 yield







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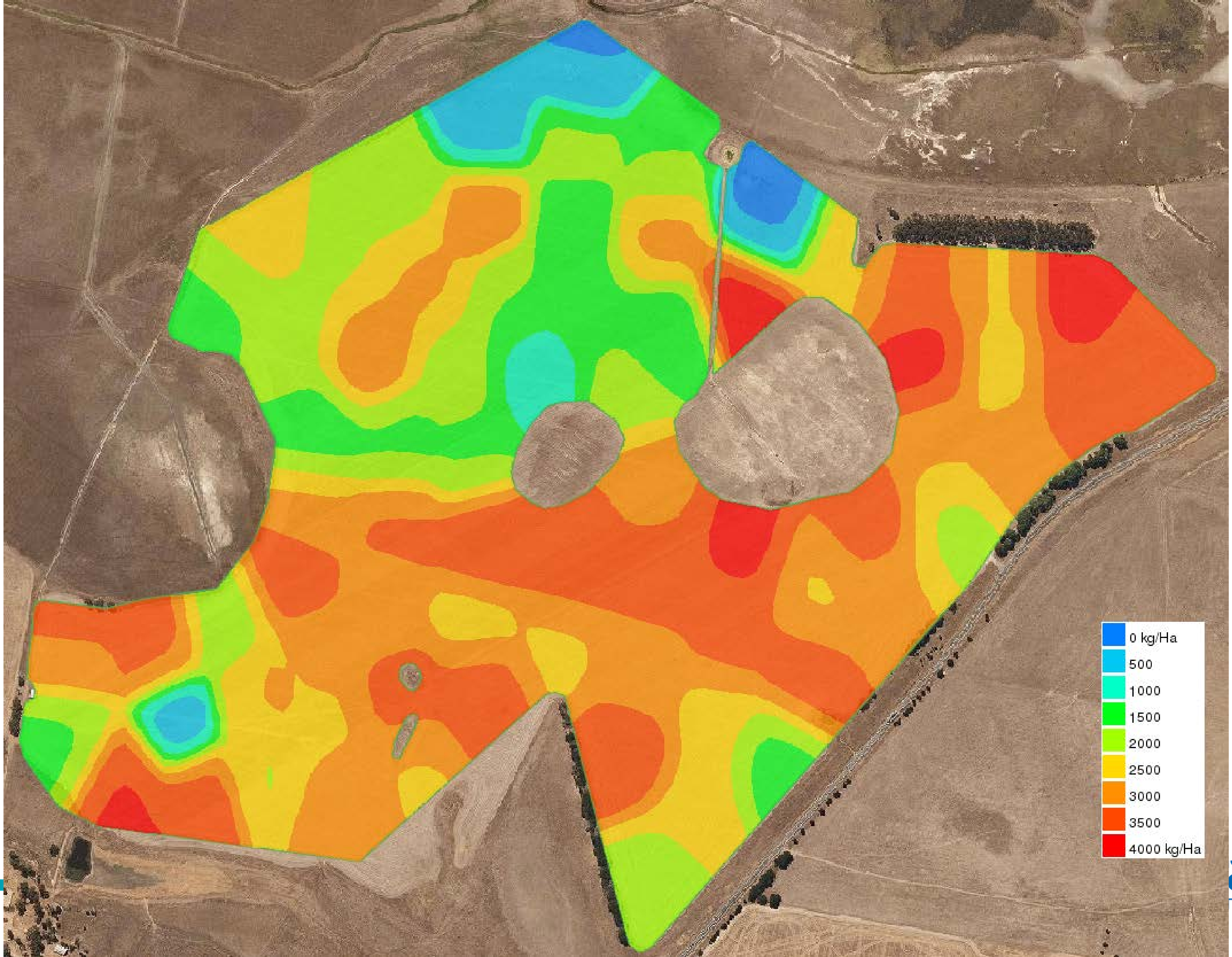
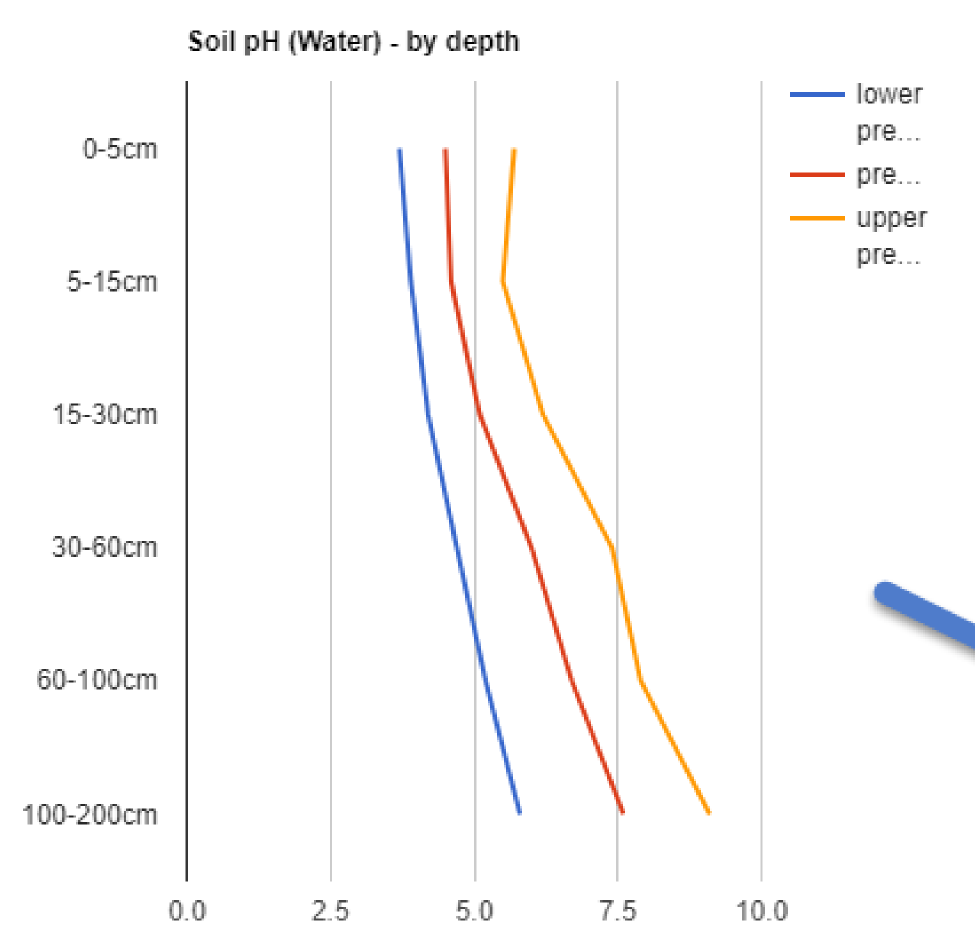
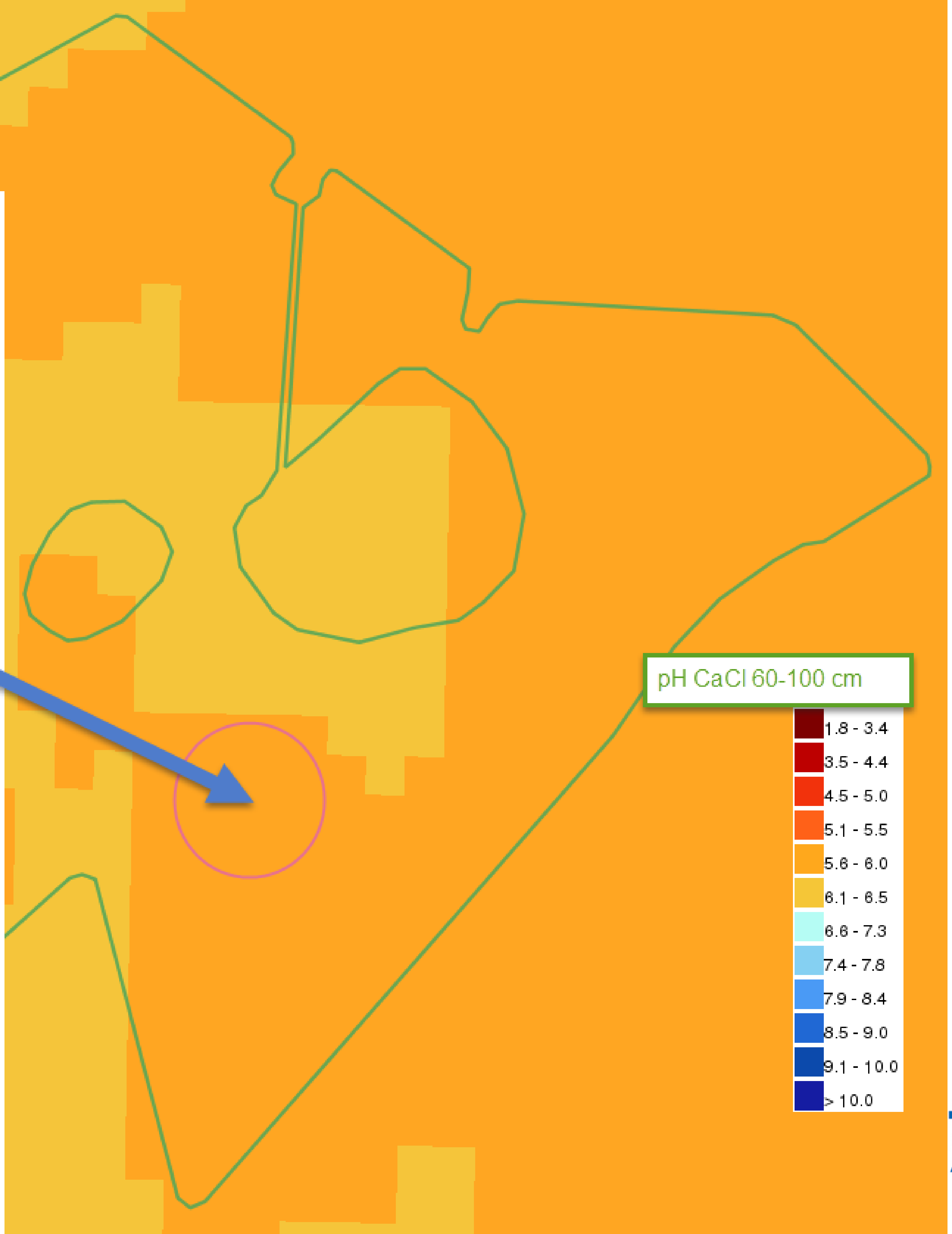

0 kg/Ha
500
1000
1500
2000
2500
3000
3500
4000 kg/Ha

Soil Properties Report



Property	Value
pH caCl 0 to 5 lpm	3.7
pH caCl 0 to 5	4.5
pH caCl 0 to 5 upm	5.7
pH caCl 5 to 15 lpm	3.9
pH caCl 5 to 15	4.6
pH caCl 5 to 15 upm	5.5
pH caCl 15 to 30 lpm	4.2
pH caCl 15 to 30	5.1



Key lessons learnt

- *Co-creating/development/implementation*
- *Understanding needs – use cases*
- *Harnessing the benefits of private and public data*
- *Interoperability – making things compatible and usable*
- *Interactive – enabling users to have control*
- *Interpretable – delivering the right information at the right time*
- *Small changes – big outcomes: Tuning management to maximise returns*

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THANK YOU