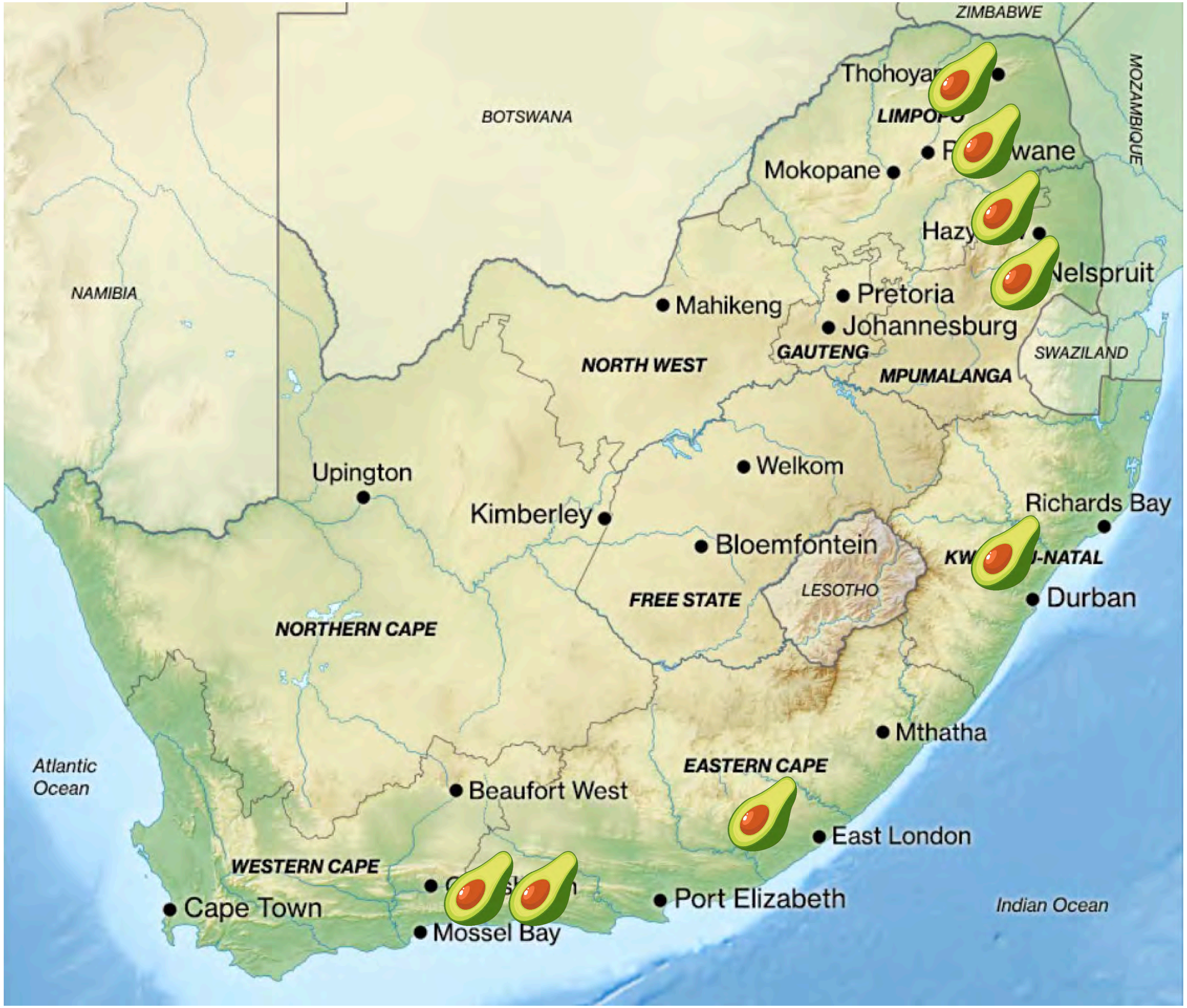
How innovation and technology are being used to develop new avocado groves in South Africa

Guy Witney, Independent Agricultural Consultant, George, South Africa



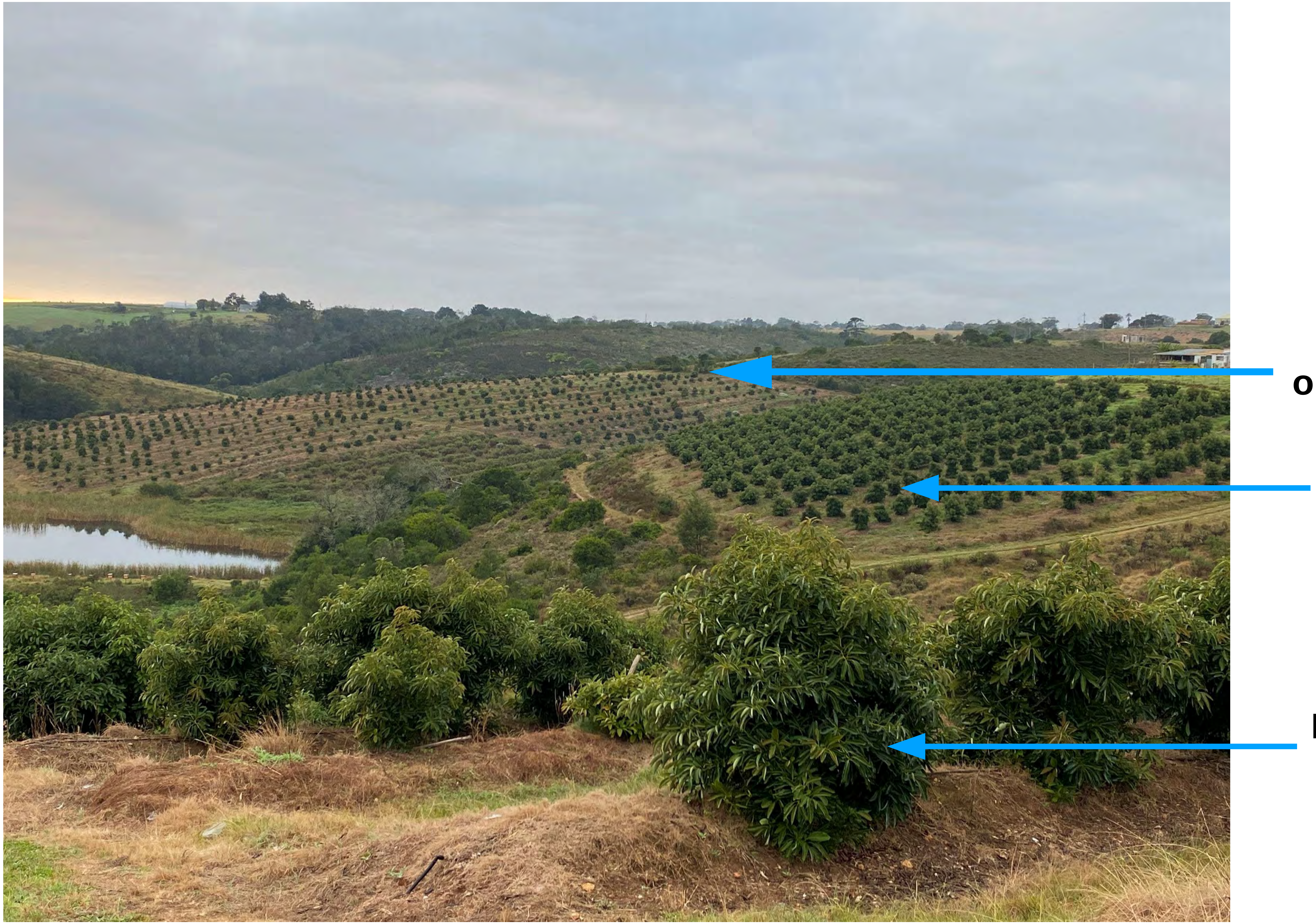
Traditionally avocados were grown in the northeastern parts of South Africa where climate, soil type, and water availability/ quality were considered highly suited to commercial production of export quality fruit.

In the last two decades advances in variety and rootstock breeding, propagation techniques, orchard soil preparation, precision agriculture and crop protection have allowed the industry to expand into new production areas.

The role of clonal rootstocks in opening new avocado production areas in South Africa:

Advances in clonal rootstocks, particularly the introduction of Dusa and Bounty has allowed expansion into areas with soils previously considered marginal for avocado production.

Work by David Crowley at UCR was some of the first to show ‘Dusa’ as an excellent rootstock in saline conditions.


Hass and Reed
on WI seedling YR 5
Hass and Reed
on Dusa YR 4
Maluma on Dusa
YR 5

The role of new cultivars in opening new avocado production areas in South Africa:

Maluma, Lamb Hass, and GEM, all introduced in the last three decades, have expanded the seasonality of Hass-like fruit on markets.

When grown in the late season, cooler, maritime climate of the Southern Cape coast, these have allowed for year-round avocado production in South Africa.

This provides critical local market and export continuity.

Advances in nursery propagation techniques have opened new avocado production areas in South Africa:

Work by the late Andre Ernst and Reuben Hofshi on perfecting a modified Frolich propagation technique for avocados now called micro-clonal propagation has revolutionized the South African avocado nursery business.

Tens of thousands of micro-clonal trees can be moved by air and road freight to distant locations to be grown out in local nurseries.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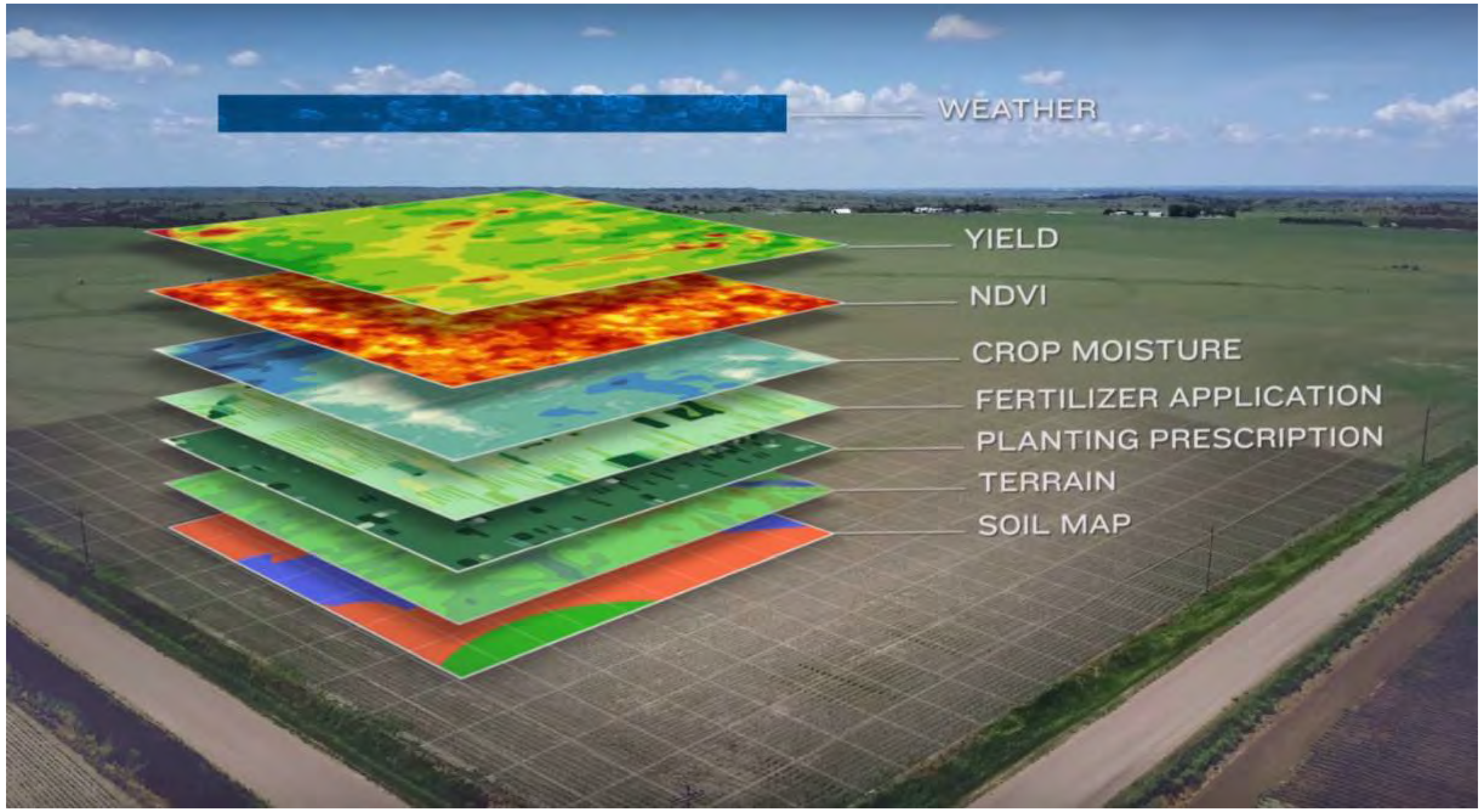
CW 350

Precision agriculture is opening new avocado production areas by reducing risks through information gathering:



New areas, often with non-conventional soil, water and weather conditions for avocado growing, require collection of multiple layers of specialized and precise information to ensure success.

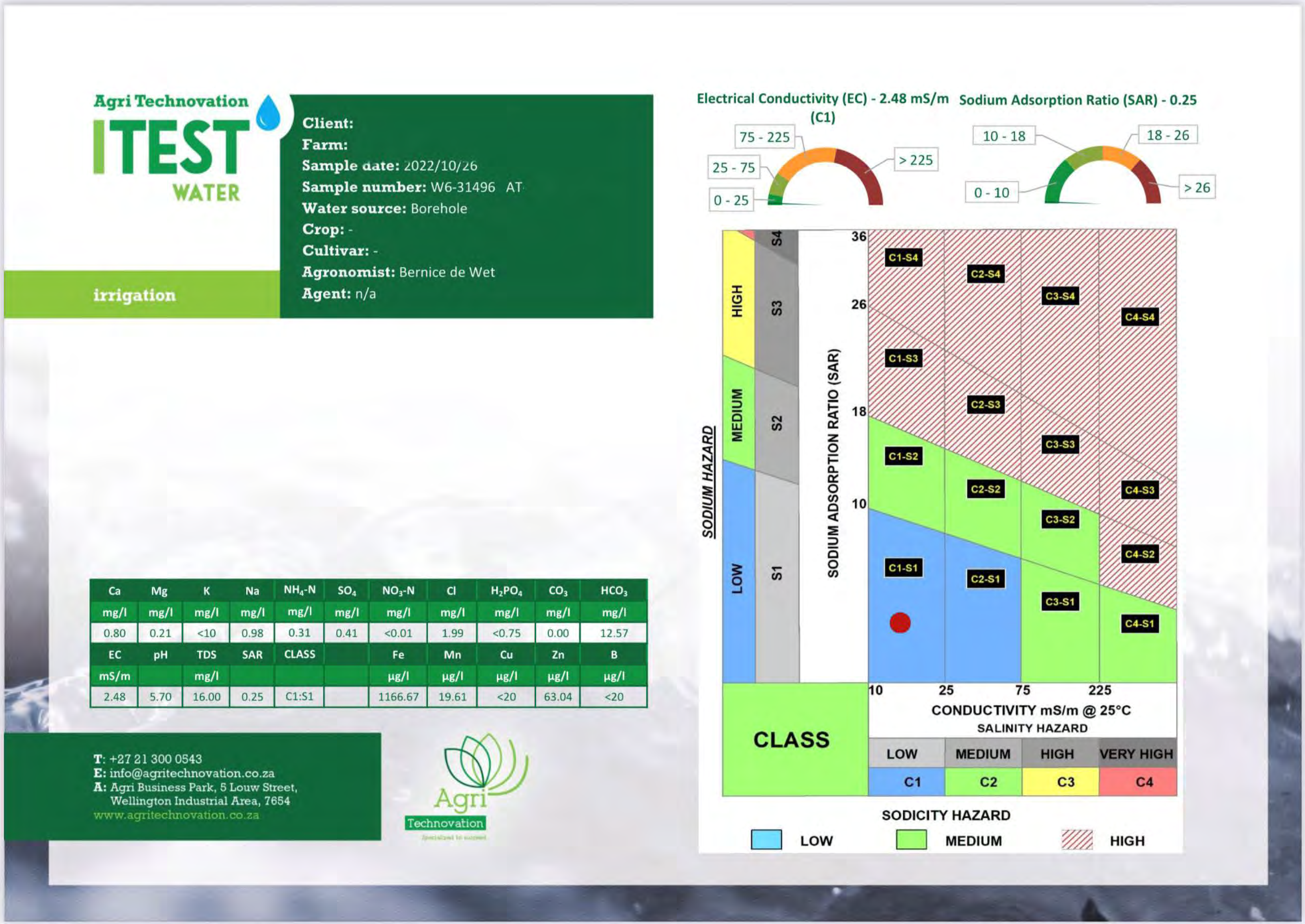
Growers on the southern coast of the Western Cape Province use state of the art site analyses to determine what adjustments need to be made to soil nutrient content, pH, water permeability, water runoff and other parameters.

Adjustments are made with GPS driven systems that deliver precise amounts of ameliorate materials on a predetermined grid.

Irrigation Water

We have started avocado farming in a water scarce area.

The first and most important thing is to determine there is a secure licensed allocation of sufficient, reliable, good quality irrigation water for the property.



Agri Technovation ITEST WATER

irrigation

Client:
Farm:
Sample date: 2022/10/26
Sample number: W6-31496 AT
Water source: Borehole
Crop: -
Cultivar: -
Agronomist: Bernice de Wet
Agent: n/a

Ca	Mg	K	Na	NH_4-N	SO_4	NO_3-N	Cl	H_2PO_4	CO_3	HCO_3
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
0.80	0.21	<10	0.98	0.31	0.41	<0.01	1.99	<0.75	0.00	12.57
EC	pH	TDS	SAR	CLASS		Fe	Mn	Cu	Zn	B
mS/m		mg/l				µg/l	µg/l	µg/l	µg/l	µg/l
2.48	5.70	16.00	0.25	C1:S1		1166.67	19.61	<20	63.04	<20

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A: Agri Business Park, 5 Louw Street, Wellington Industrial Area, 7654
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Irrigation Water

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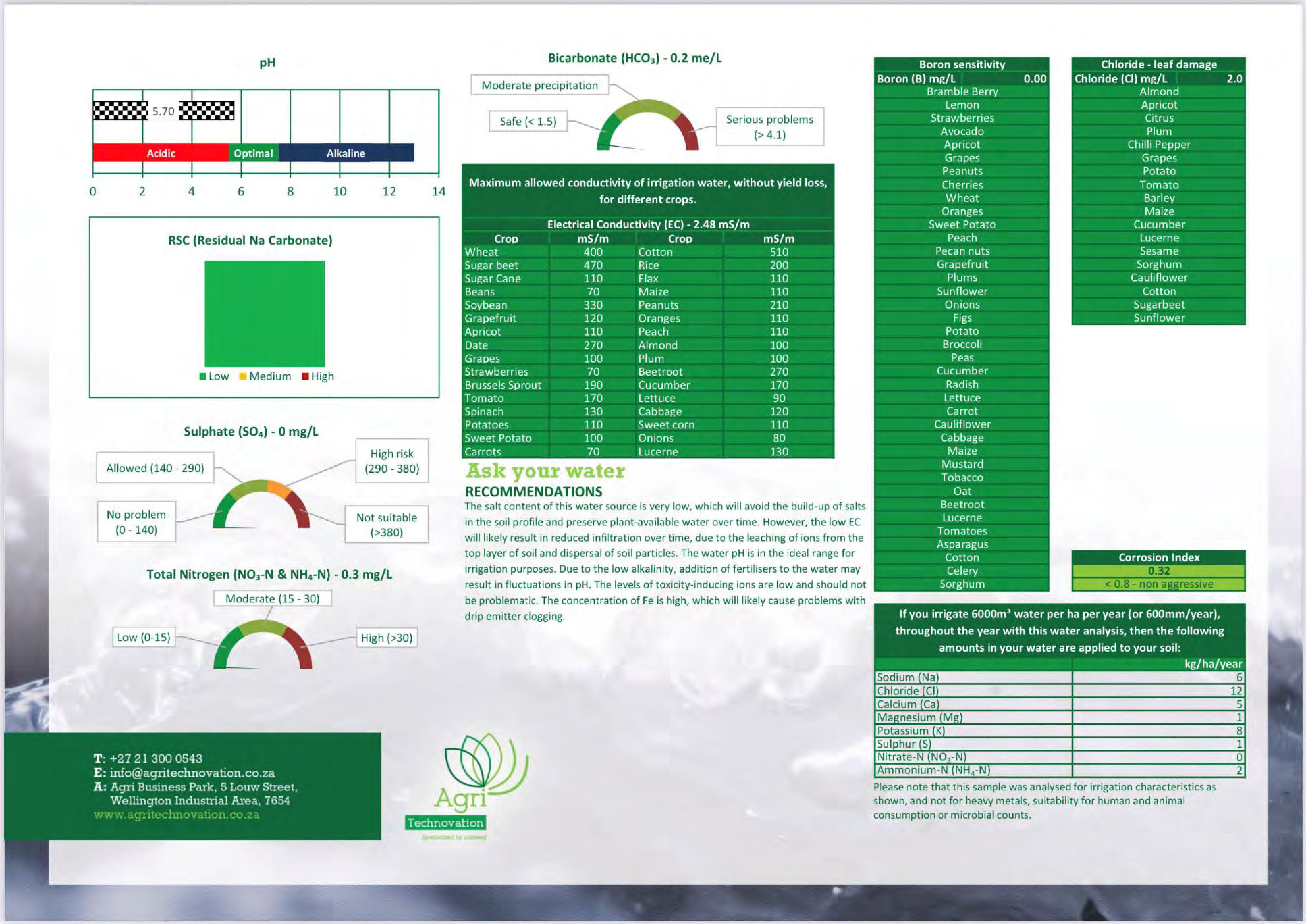

pH

5.70

Acidic | Optimal | Alkaline

0 2 4 6 8 10 12 14

RSC (Residual Na Carbonate)

Low | Medium | High

Sulphate (SO_4) - 0 mg/L

Allowed (140 - 290)

High risk (290 - 380)

No problem (0 - 140)

Not suitable (>380)

Total Nitrogen (NO_3-N & NH_4-N) - 0.3 mg/L

Moderate (15 - 30)

Low (0-15)

High (>30)

Bicarbonate (HCO_3) - 0.2 me/L

Moderate precipitation

Safe (< 1.5)

Serious problems (> 4.1)

Maximum allowed conductivity of irrigation water, without yield loss, for different crops.

Electrical Conductivity (EC) - 2.48 mS/m

Crop	mS/m	Crop	mS/m
Wheat	400	Cotton	510
Sugar beet	470	Rice	200
Sugar Cane	110	Flax	110
Beans	70	Maize	110
Soybean	330	Peanuts	210
Grapefruit	120	Oranges	110
Apricot	110	Peach	110
Date	270	Almond	100
Grapes	100	Plum	100
Strawberries	70	Beetroot	270
Brussels Sprout	190	Cucumber	170
Tomato	170	Lettuce	90
Spinach	130	Cabbage	120
Potatoes	110	Sweet corn	110
Sweet Potato	100	Onions	80
Carrots	70	Lucerne	130

Ask your water

RECOMMENDATIONS

The salt content of this water source is very low, which will avoid the build-up of salts in the soil profile and preserve plant-available water over time. However, the low EC will likely result in reduced infiltration over time, due to the leaching of ions from the top layer of soil and dispersal of soil particles. The water pH is in the ideal range for irrigation purposes. Due to the low alkalinity, addition of fertilisers to the water may result in fluctuations in pH. The levels of toxicity-inducing ions are low and should not be problematic. The concentration of Fe is high, which will likely cause problems with drip emitter clogging.

Boron sensitivity	
Boron (B) mg/L	0.00
Bramble Berry	
Lemon	
Strawberries	
Avocado	
Apricot	
Grapes	
Peanuts	
Cherries	
Wheat	
Oranges	
Sweet Potato	
Peach	
Pecan nuts	
Grapefruit	
Plums	
Sunflower	
Onions	
Figs	
Potato	
Broccoli	
Peas	
Cucumber	
Radish	
Lettuce	
Carrot	
Cauliflower	
Cabbage	
Maize	
Mustard	
Tobacco	
Oat	
Beetroot	
Lucerne	
Tomatoes	
Asparagus	
Cotton	
Celery	
Sorghum	

Chloride - leaf damage	
Chloride (Cl) mg/L	2.0
Almond	
Apricot	
Citrus	
Plum	
Chilli Pepper	
Grapes	
Potato	
Tomato	
Barley	
Maize	
Cucumber	
Lucerne	
Sesame	
Sorghum	
Cauliflower	
Cotton	
Sugarbeet	
Sunflower	

Corrosion Index
0.32
< 0.8 - non aggressive

If you irrigate 6000m³ water per ha per year (or 600mm/year), throughout the year with this water analysis, then the following amounts in your water are applied to your soil:

	kg/ha/year
Sodium (Na)	6
Chloride (Cl)	12
Calcium (Ca)	5
Magnesium (Mg)	1
Potassium (K)	8
Sulphur (S)	1
Nitrate-N (NO_3-N)	0
Ammonium-N (NH_4-N)	2

Please note that this sample was analysed for irrigation characteristics as shown, and not for heavy metals, suitability for human and animal consumption or microbial counts.

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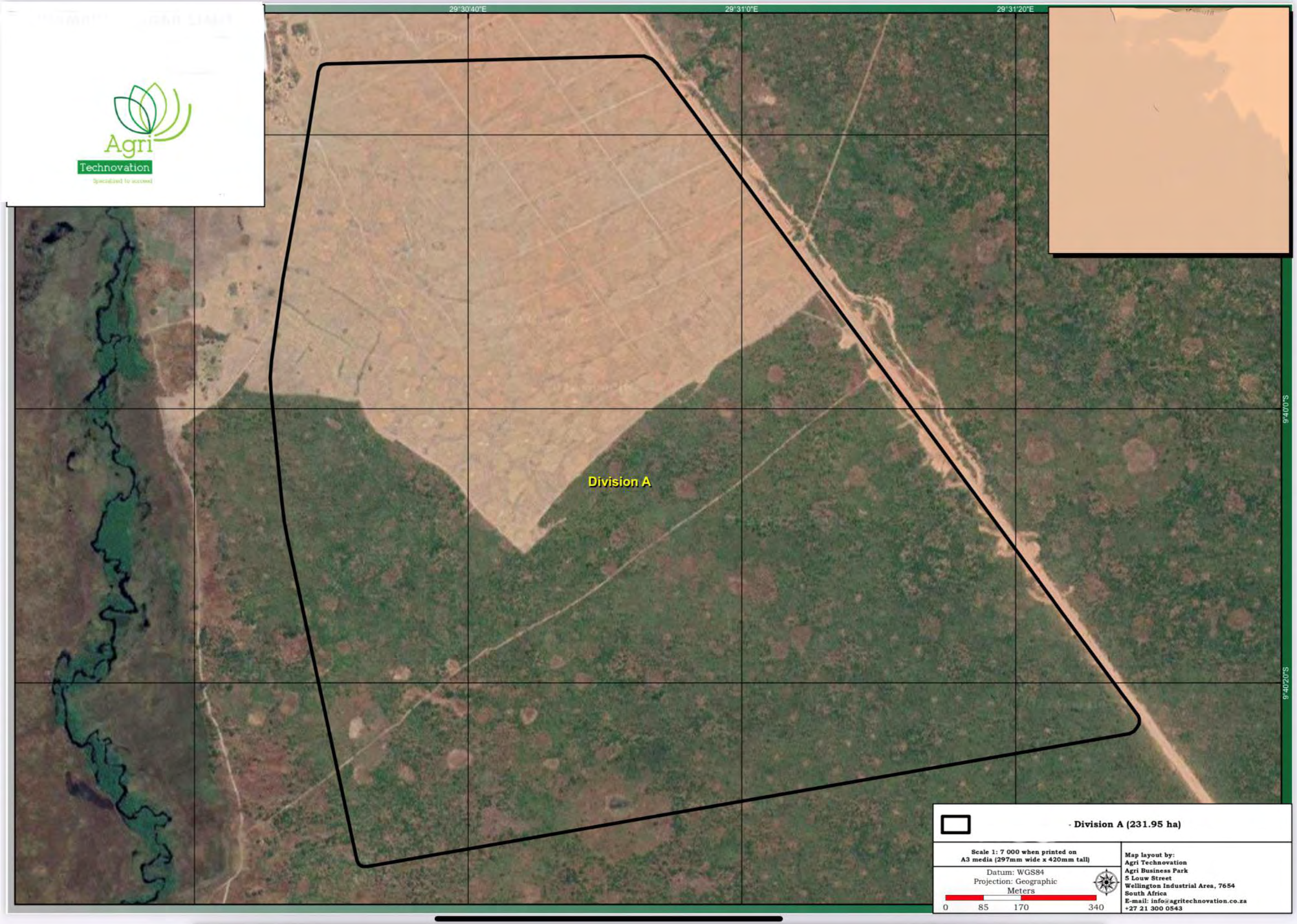
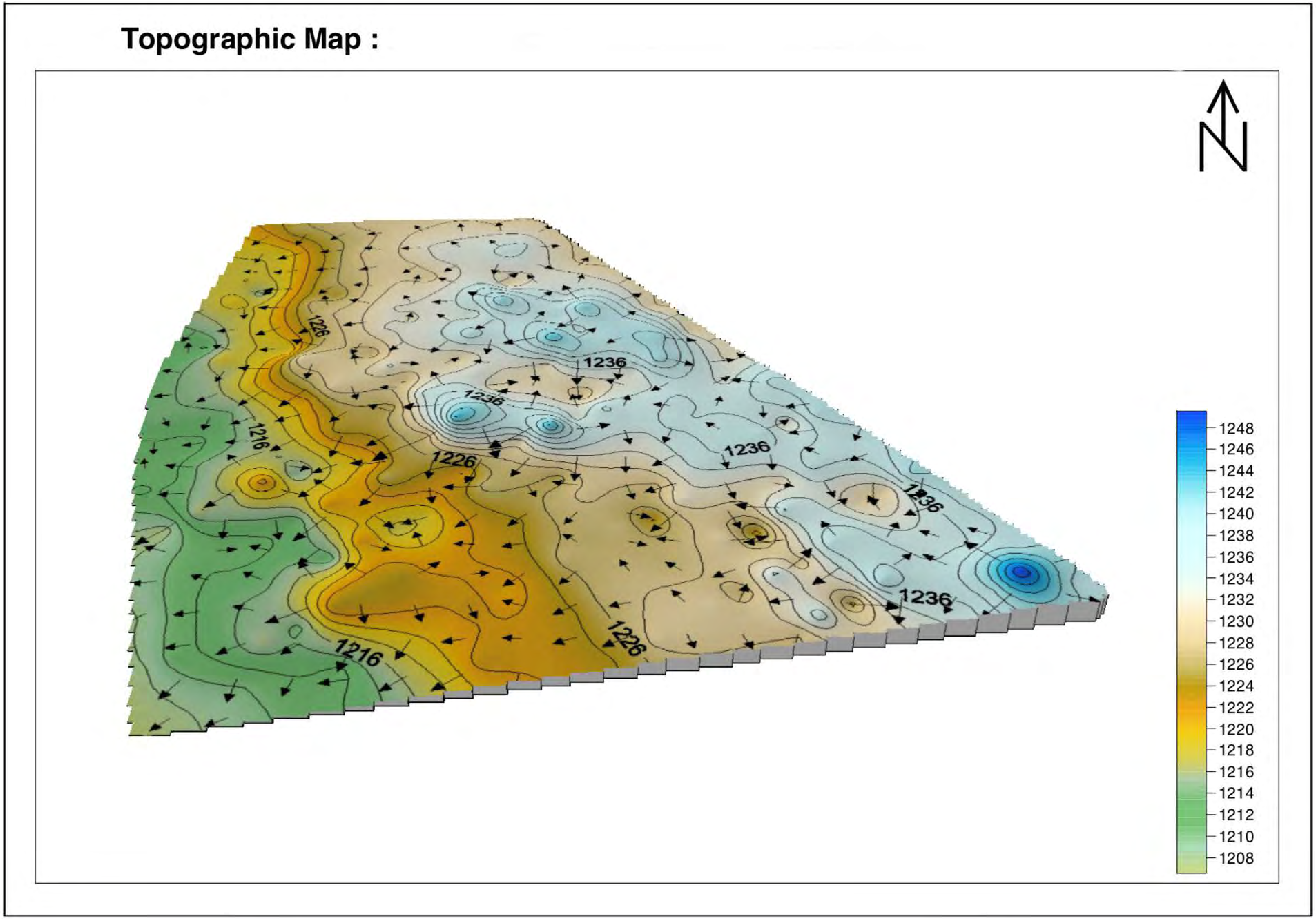


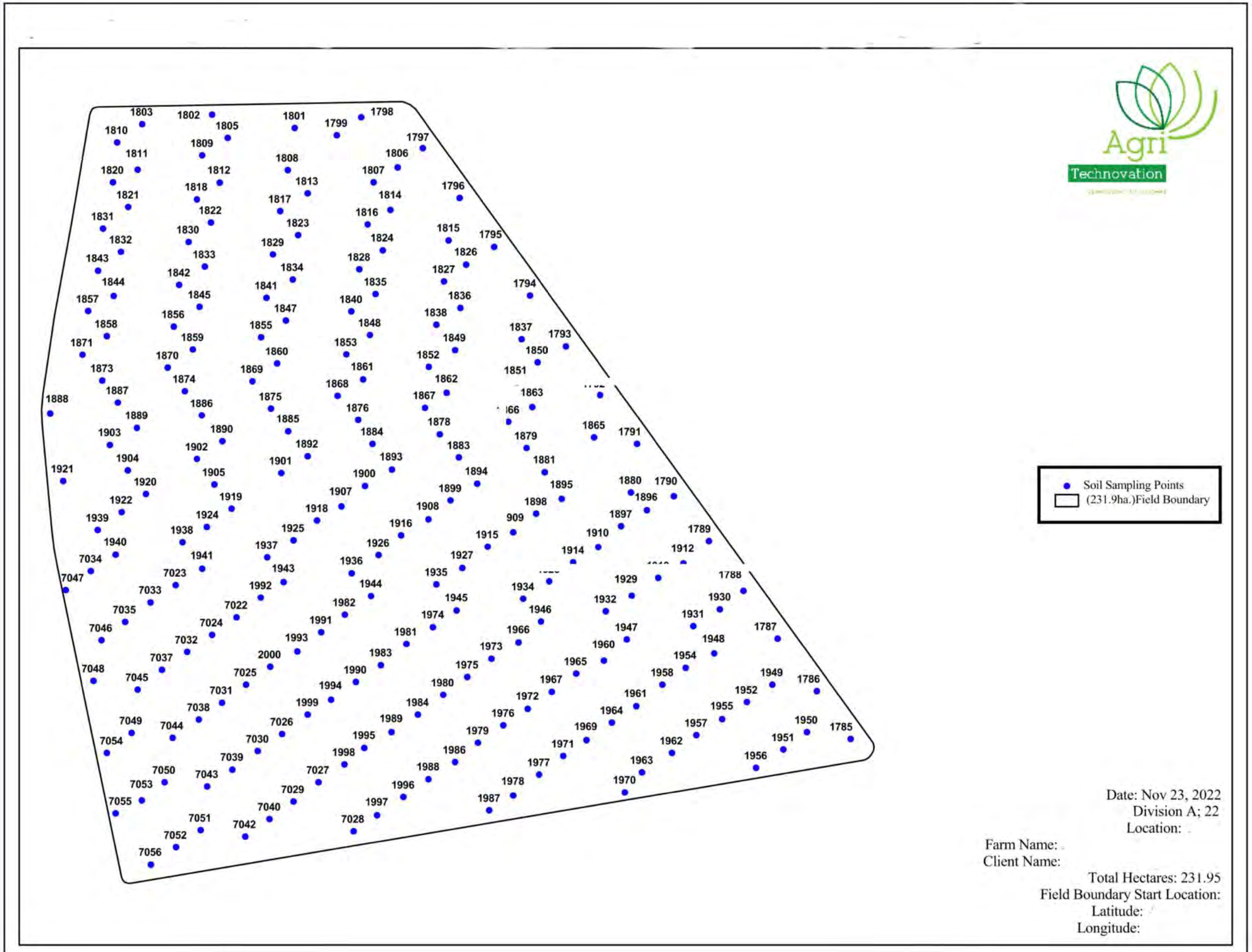
Example of mapping a site:

In order to build the information layers we need to determine whether a potential site is suitable for avocados - we start with a basic satellite view of the site and determine the initial mapping boundary.

Example of mapping a site:

The first map generated is a topographic map which will help determine row direction, roads, and water flows to prevent water logging in planted areas and help with erosion control.

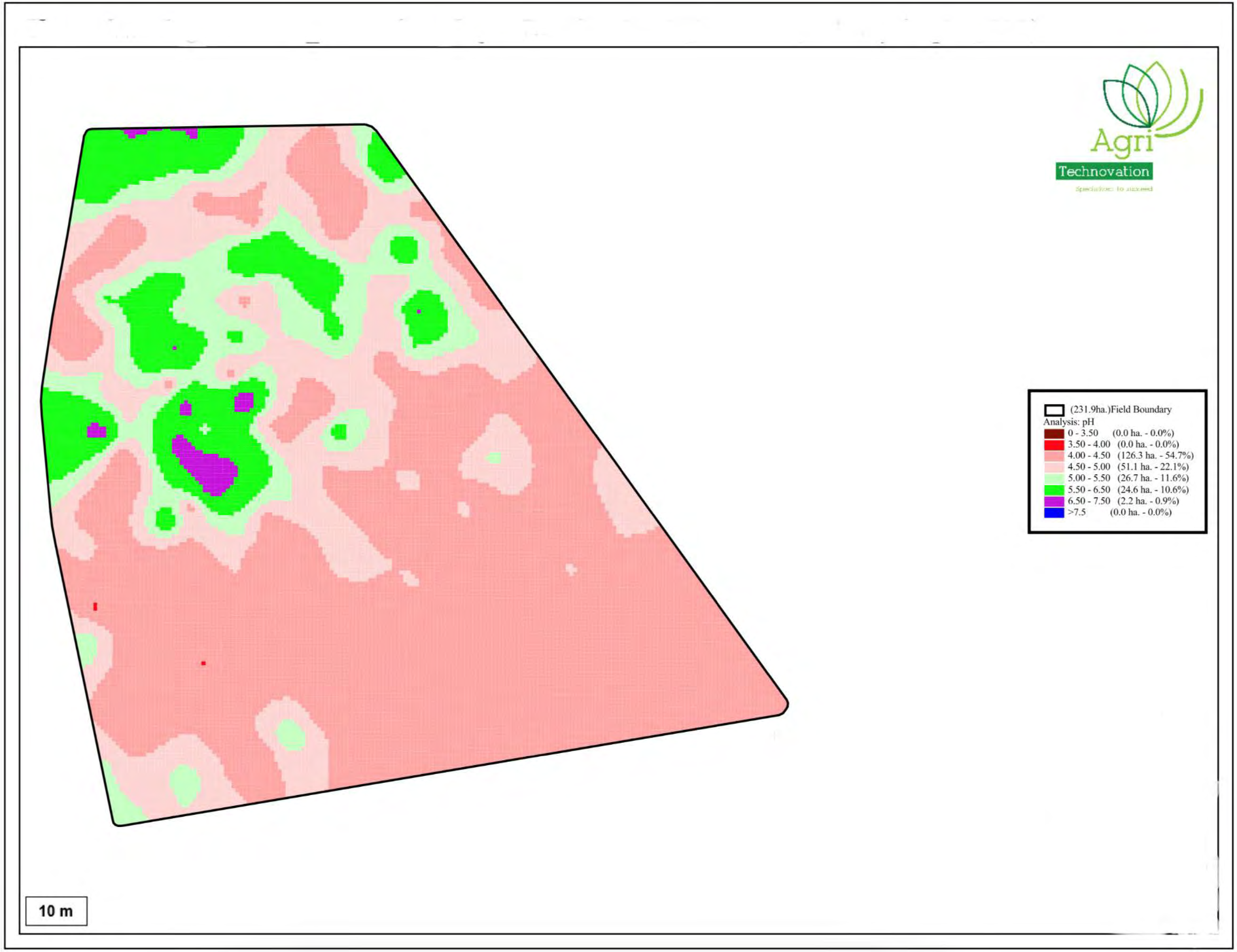




Example of mapping a site:

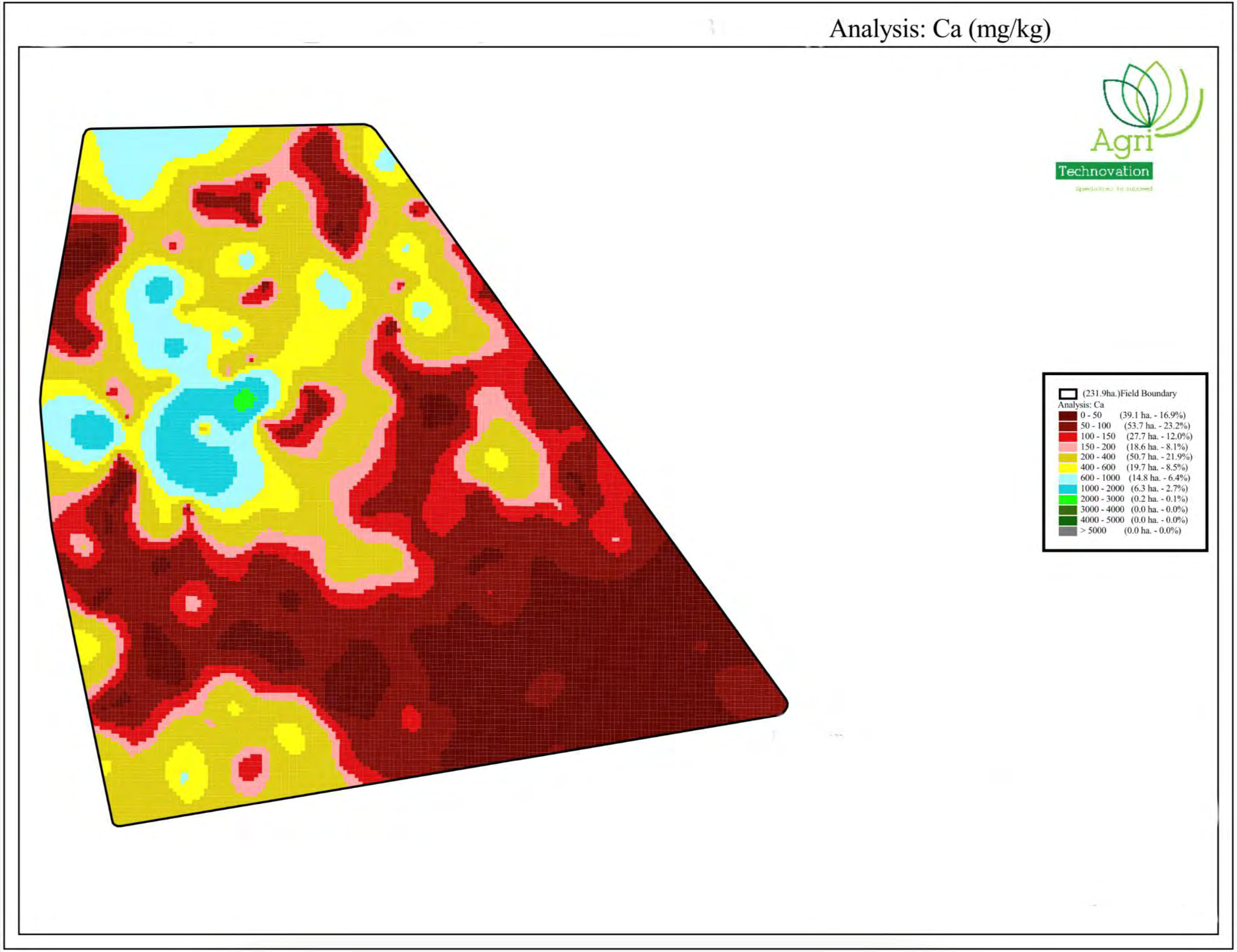
A grid system of sampling points is plotted for the GIS enabled equipment. This precisely pinpoints each soil sampling position in the grid.

Example of mapping a site:



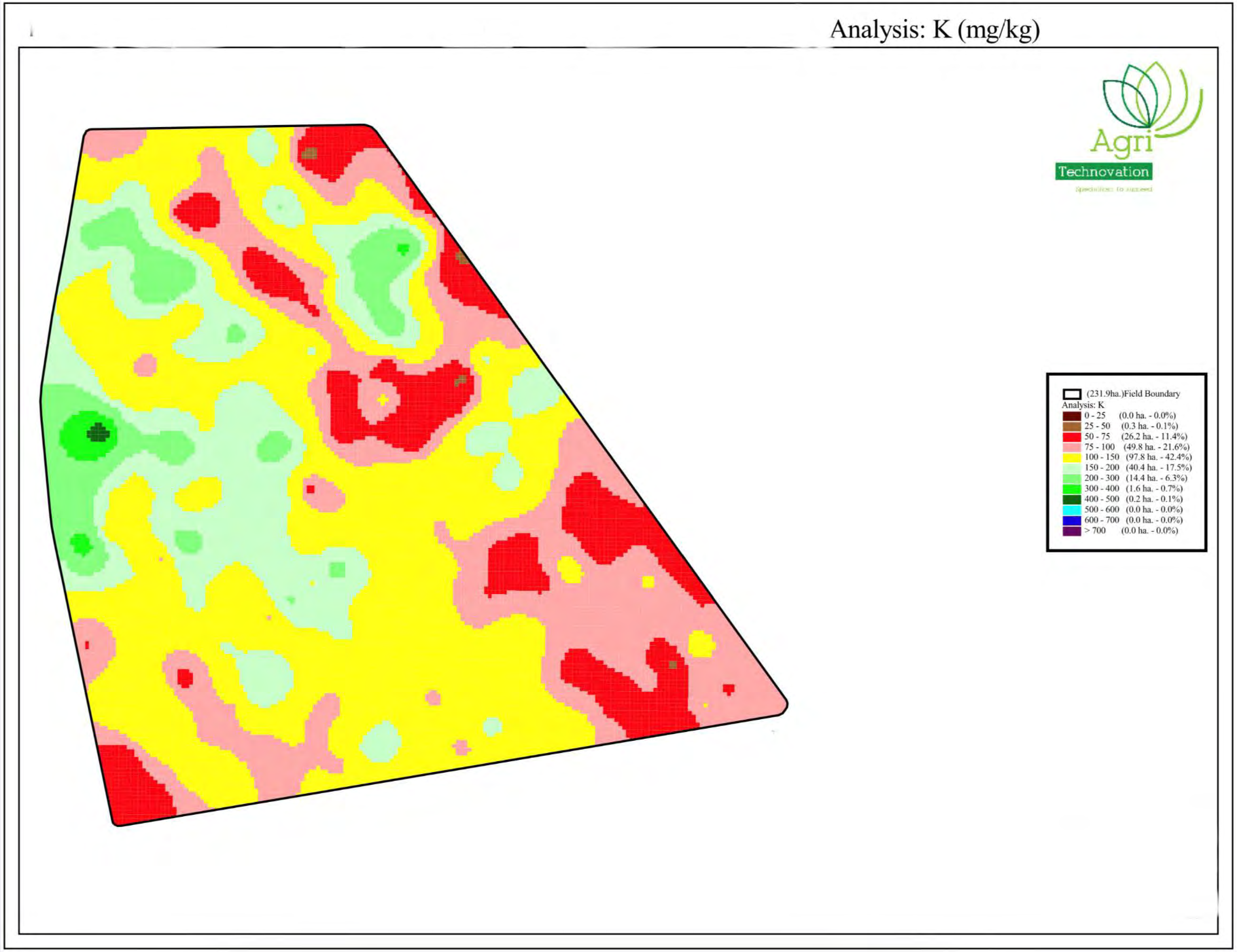
Results: pH

Example of mapping a site:



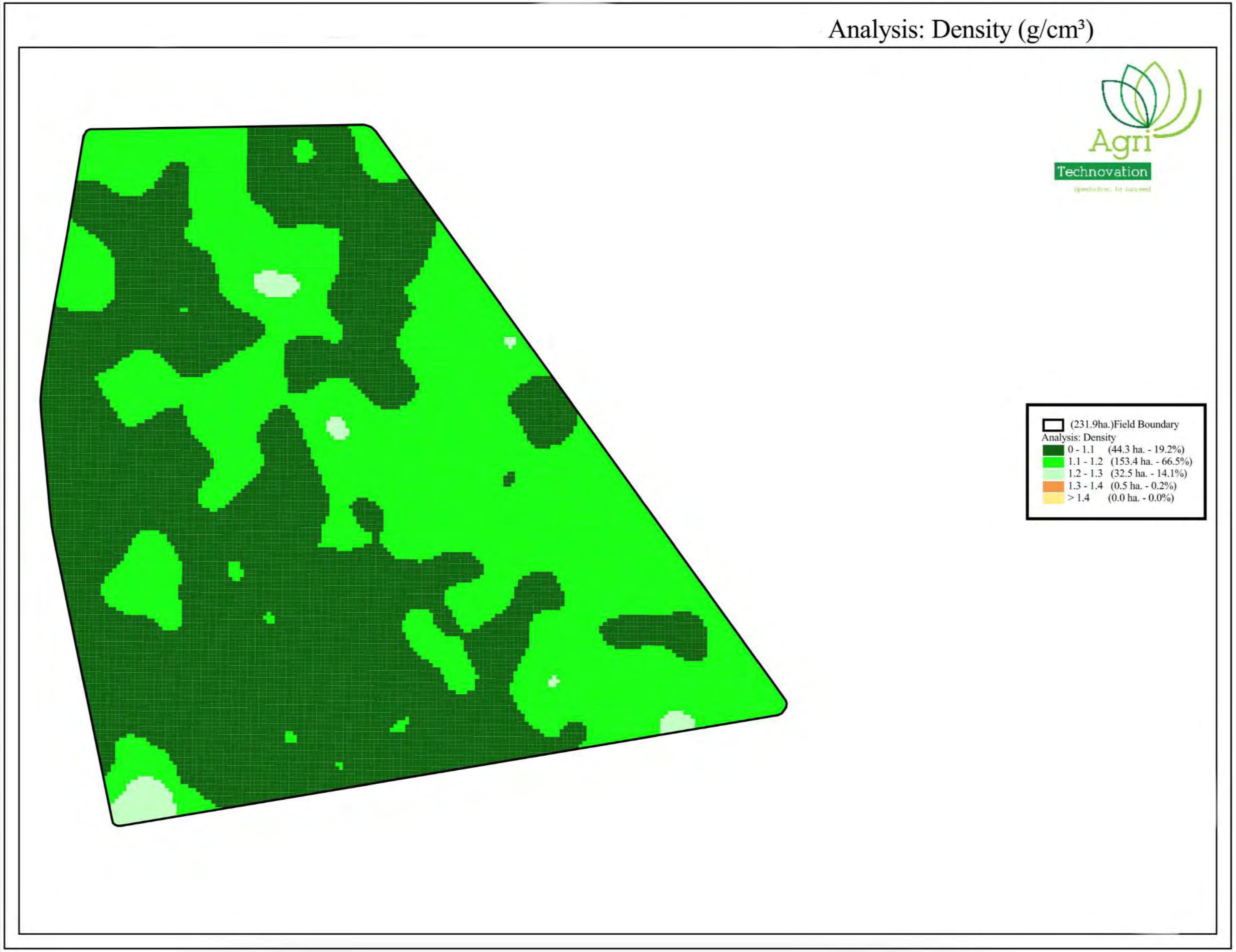
Results: Ca (mg/kg)

Example of mapping a site:



Results: K (mg/kg)

Example of mapping a site:



Results: Density (g/cm^3)

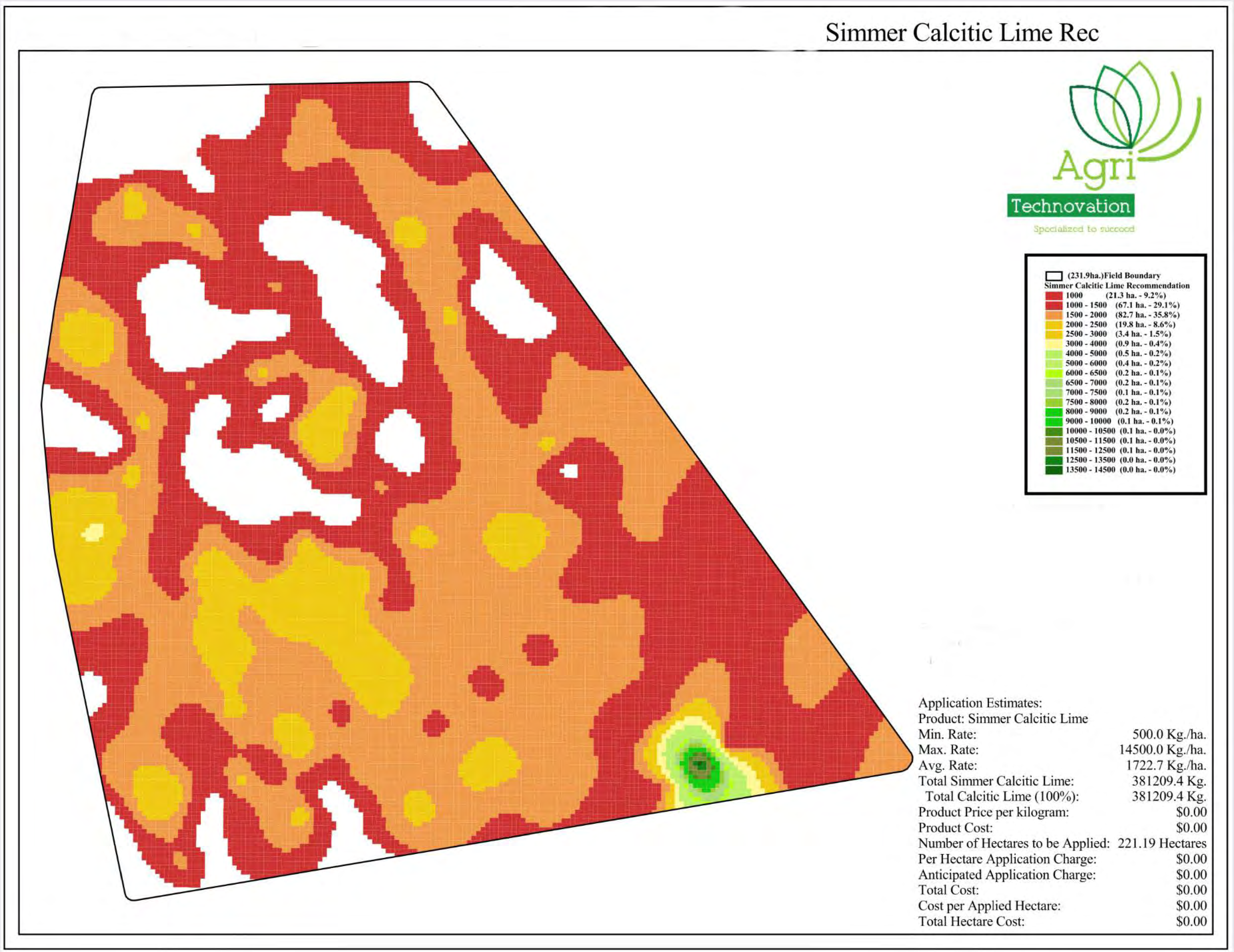
pH	PBray I	K	Na	Ca	Mg	Ex Acid KCl	%Ca	%Mg	%K	%Na	Acid Sat	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	CEC	Density	Sulphur	Zn	Mn	Cu	Fe
-	mg/kg	mg/kg				cmol(+)/kg	%				%	1.5-4.5	10.0-20.0	3.0-4.0	cmol(+)/kg	-	cmol(+)/kg	g/cm3	mg/kg	mg/kg DTPA			
4.14	2	90	10	55	86	0.28	17.94	45.89	14.98	2.82	18.37	0.39	4.26	3.06	1.25	0.19	1.53	1.18	9.88				
4.24	8	81	8	45	50	0.33	18.81	33.95	17.13	2.9	27.21	0.55	3.08	1.98	0.88	0.17	1.21	1.25	7.69				
4.04	2	75	9	47	63	0.75	13.53	29.87	11	2.33	43.27	0.45	3.94	2.71	0.98	0.21	1.73	1.16	9.06				
4.12	2	60	8	34	49	0.42	14.45	34.09	13.01	2.86	35.59	0.42	3.73	2.62	0.76	0.22	1.18	1.15	7.7				
4.63	1	75	8	62	69	0	28.29	51.01	17.45	3.24	0	0.55	4.54	2.92	1.1	0.19	1.1	1.22	6.85				
4.95	1	86	8	142	95	0	40.68	44.77	12.51	2.04	0	0.91	6.83	3.58	1.75	0.16	1.75	1.23	8.82				
4.14	1	80	9	108	51	0.42	33.33	25.94	12.53	2.29	25.91	1.29	4.73	2.07	1.21	0.18	1.63	1.15	8.45				
4.3	8	195	11	62	72	0.28	17.83	34.19	28.88	2.77	16.33	0.52	1.8	1.18	1.44	0.1	1.72	1.12	10.58				
4.78	1	82	7	149	57	0	51.31	32.19	14.5	2	0	1.59	5.76	2.22	1.45	0.14	1.45	1.26	5.67				
4.3	2	74	8	98	68	0.18	33.88	38.53	13.02	2.35	12.22	0.88	5.56	2.96	1.27	0.18	1.45	1.17	8.2				
4.32	1	56	9	166	83	0.1	46.26	37.97	8.01	2.07	5.69	1.22	10.51	4.74	1.69	0.26	1.79	1.23	7.52				
4.21	2	73	9	84	32	0.69	26.25	16.58	11.56	2.5	43.12	1.58	3.71	1.43	0.91	0.22	1.61	1.1	5.96				
6.37	2	90	9	726	171	0	68.51	26.41	4.36	0.71	0	2.59	21.75	6.05	5.3	0.16	5.3	1.18	11.81				
4.22	6	64	8	57	29	0.48	23.99	19.53	13.59	2.82	40.08	1.23	3.2	1.44	0.72	0.21	1.2	1.13	4.75				
4.37	3	37	9	81	52	0.27	32.95	34.48	7.78	3.05	21.73	0.96	8.67	4.43	0.96	0.39	1.23	1.17	7.39	0.15	25.52	0.3	17.7
4.41	1	71	11	130	92	0.22	35.22	40.78	9.81	2.53	11.66	0.86	7.75	4.16	1.63	0.26	1.85	1.15	10.08				
4.73	1	186	10	266	119	0	47.1	34.61	16.81	1.47	0	1.36	4.86	2.06	2.83	0.09	2.83	1.11	11.56				
6.51	2	129	14	980	108	0	79.28	14.37	5.34	1.01	0	5.52	17.53	2.69	6.18	0.19	6.18	1.17	8.83				
6.46	9	85	9	675	90	0	77.24	16.91	5	0.85	0	4.57	18.82	3.38	4.37	0.17	4.37	1.22	6.83	0.16	37.01	0.24	8.16
5.67	1	313	10	263	155	0	38.33	37.1	23.31	1.26	0	1.03	3.24	1.59	3.43	0.05	3.43	1.05	13.25				
6.38	1	75	7	553	105	0	71.79	22.4	5	0.81	0	3.21	18.85	4.48	3.85	0.16	3.85	1.24	7				
4.21	3	103	10	61	46	0.49	20.64	25.56	17.7	3.06	33.05	0.81	2.61	1.44	0.99	0.17	1.48	1.13	6.89				
4.22	1	76	9	72	84	0.44	20.93	39.89	11.3	2.32	25.55	0.52	5.38	3.53	1.28	0.21	1.73	1.05	9.8				
4.44	2	134	8	84	105	0.14	23.32	47.98	19	1.88	7.83	0.49	3.75	2.53	1.66	0.1	1.8	1.11	9.67				
5.38	1	149	8	314	85	0	58.49	26.03	14.18	1.31	0	2.25	5.96	1.84	2.69	0.09	2.69	1.12	7.85				
5.98	6	100	9	637	113	0	72.33	21	5.79	0.88	0	3.44	16.11	3.62	4.4	0.15	4.4	1.19	7.77				
5.51	1	164	10	972	125	0	76.55	16.13	6.62	0.69	0	4.75	14	2.44	6.35	0.1	6.35	1.22	8.62				
4.25	2	64	8	54	31	0.38	24.47	22.79	14.99	3.27	34.48	1.07	3.15	1.52	0.72	0.22	1.1	1.21	6.9				
5.01	1	205	8	447	161	0	54.28	32.1	12.74	0.89	0	1.69	6.78	2.52	4.12	0.07	4.12	1.13	12.81				
4.38	1	137	8	71	85	0.17	22.03	43.43	21.82	2.15	10.58	0.51	3	1.99	1.44	0.1	1.61	1.13	10.56				
6.22	1	331	11	662	212	0	55.71	29.27	14.24	0.79	0	1.9	5.97	2.06	5.94	0.06	5.94	1.03	14.09				
4.24	4	181	8	45	73	0.37	13.3	35.62	27.34	2.03	21.71	0.37	1.79	1.3	1.32	0.07	1.69	1.17	8.86				
4.24	2	101	8	63	47	0.29	24.54	30.23	20.13	2.81	22.29	0.81	2.72	1.5	1	0.14	1.29	1.19	6.67				
4.92	1	55	7	310	78	0	65.65	27.06	5.96	1.33	0	2.43	15.55	4.54	2.36	0.22	2.36	1.08	6.23	0.1	23	0.24	12.65
4.33	2	93	9	69	137	0.58	14.89	48.38	10.23	1.72	24.79	0.31	6.18	4.73	1.75	0.17	2.33	0.97	13.73				
5.78	1	128	8	330	87	0	60.6	26.17	11.98	1.24	0	2.32	7.24	2.18	2.73	0.1	2.73	1.1	7.59				
4.25	1	245	10	108	107	0.3	22.53	36.74	26.22	1.84	12.67	0.61	2.26	1.4	2.09	0.07	2.39	1.05	12.66				
4.72	1	83	12	231	74	0	56.92	30.12	10.41	2.55	0	1.89	8.36	2.89	2.03	0.24	2.03	1.18	8.93				
6.13	1	90	8	331	112	0	58.35	32.34	8.12	1.19	0	1.8	11.17	3.98	2.84	0.15	2.84	1.15	9.25				
4.87	2	197	9	115	135	0	25.86	49.75	22.64	1.74	0	0.52	3.34	2.2	2.22	0.08	2.22	1.12	13.75	0.2	16.12	0.26	20.18
4.25	2	356	11	54	80	0.36	11.96	29.12	40.66	2.09	16.18	0.41	1.01	0.72	1.88	0.05	2.24	0.92	16.32				
5.21	1	111	9	429	65	0	71.44	17.87	9.44	1.25	0	4	9.46	1.89	3	0.13	3	1.15	6.82				
4.47	1	163	9	92	95	0.1	25.64	43.46	23.13	2.1	5.67	0.59	2.99	1.88	1.7	0.09	1.8	1.15	10.28				
6.24	3	92	8	670	51	0	82.94	10.42	5.82	0.83	0	7.96	16.05	1.79	4.04	0.14	4.04	1.24	2.77				
6.44	2	64	7	788	55	0	85.89	9.86	3.59	0.66	0	8.71	26.66	2.75	4.59	0.18	4.59	1.22	4.04				
4.49	4	198	10	105	117	0.12	24.46	44.59	23.58	1.93	5.44	0.55	2.93	1.89	2.03	0.08	2.15	1.1	12.13				
4.55	5	234	9	46	120	0	12.39	53.2	32.34	2.07	0	0.23	2.03	1.65	1.85	0.06	1.85	1.16	11.3				
4.19	4	146	10	65	64	0.33	20.33	32.66	23.49	2.68	20.84	0.62	2.26	1.39	1.26	0.11	1.59	1.16	8.97				
5.42	2	243	9	438	202	0	48.56	36.73	13.79	0.91	0	1.32	6.18	2.66	4.51	0.07	4.51	1.03	15.57				

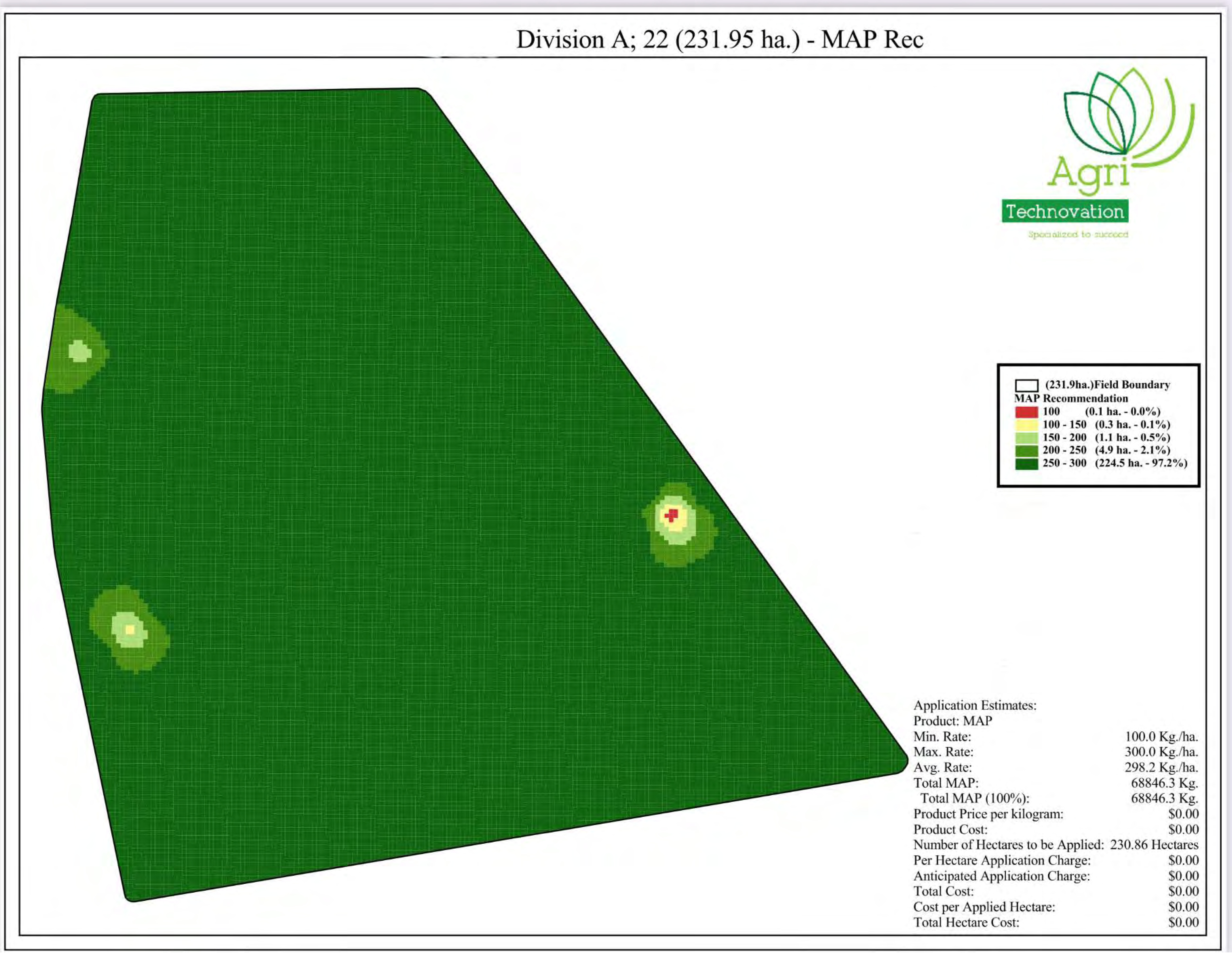
Example of mapping a site:

Results: Masses of data

Example of mapping a site:

Data is used for the precision application of soil nutrient amendments - here for calcitic lime.





Example of mapping a site:

Data is used for the precision application of soil nutrient amendments - here for MAP.


WEATHER
YIELD
NDVI
CROP MOISTURE
FERTILIZER APPLICATION
PLANTING PRESCRIPTION
TERRAIN
SOIL MAP

Ridging and terracing:

Almost all new avocados are planted on aggressively built ridges or terraces depending on terrain.

Ridging and terracing provides:

Improved rooting volume

Better root aeration

Reduced compaction

Improved pH/ nutrient correction

Less root disease

Better drainage

Better field water runoff control


JSS 398 MP


JCB
JCB

Ridging and terracing:

Mulching with coarse organic material to improve soil health, water relations, temperature, organic content, and suppress weeds.

Ridging and terracing:

Ridges with an established soybean cover crop to control erosion, stabilize ridges and add organic material/ N.

Wind protection:

Most new avocado growing areas in the Southern Cape of South Africa are in severe wind corridors and wind protection is essential.

Traditional Casuarina (boxwood) and Populus (poplar) windbreaks have largely fallen out of use in favor of artificial wind protection methods.

This can be as simple as providing early wind protection around each tree until they are established and removing the screen after one or two years.

More often these are expensive, tall structures which are erected every 5-7 rows in the path of the wind direction and are expected to last for 10-15 years.


QUESTIONS?