

# Soil, Water and Topography Maps



**Cory Willness**  
@CropProCory



# What's the Variable-rate Starting Point?

Les Henry – Grainews – March 2017

- “Basic information about the soils, topography, agronomic history and area climate should be the starting point”
- “At the same time as EC is mapped a topographic map can also be made... It is all about water”





# Fertilizer Response Variability

## ■ Soil

- Topsoil depth and organic matter levels
- salinity, sandy to heavy clay soils, peat soils, solonetzic influence yield potential and fertilizer response

## ■ Water

- Most profound factor on yields and fertilizer response, dry (knolls), wet (depressions), groundwater relationships
- Mobile nutrients moving in water

## ■ Topography

- Landscape position (knoll-midslope-depression) influences moisture, erosion history, organic levels, pH, soil fertility levels



# N Mineralization Potential?

Midslope: 4% OM

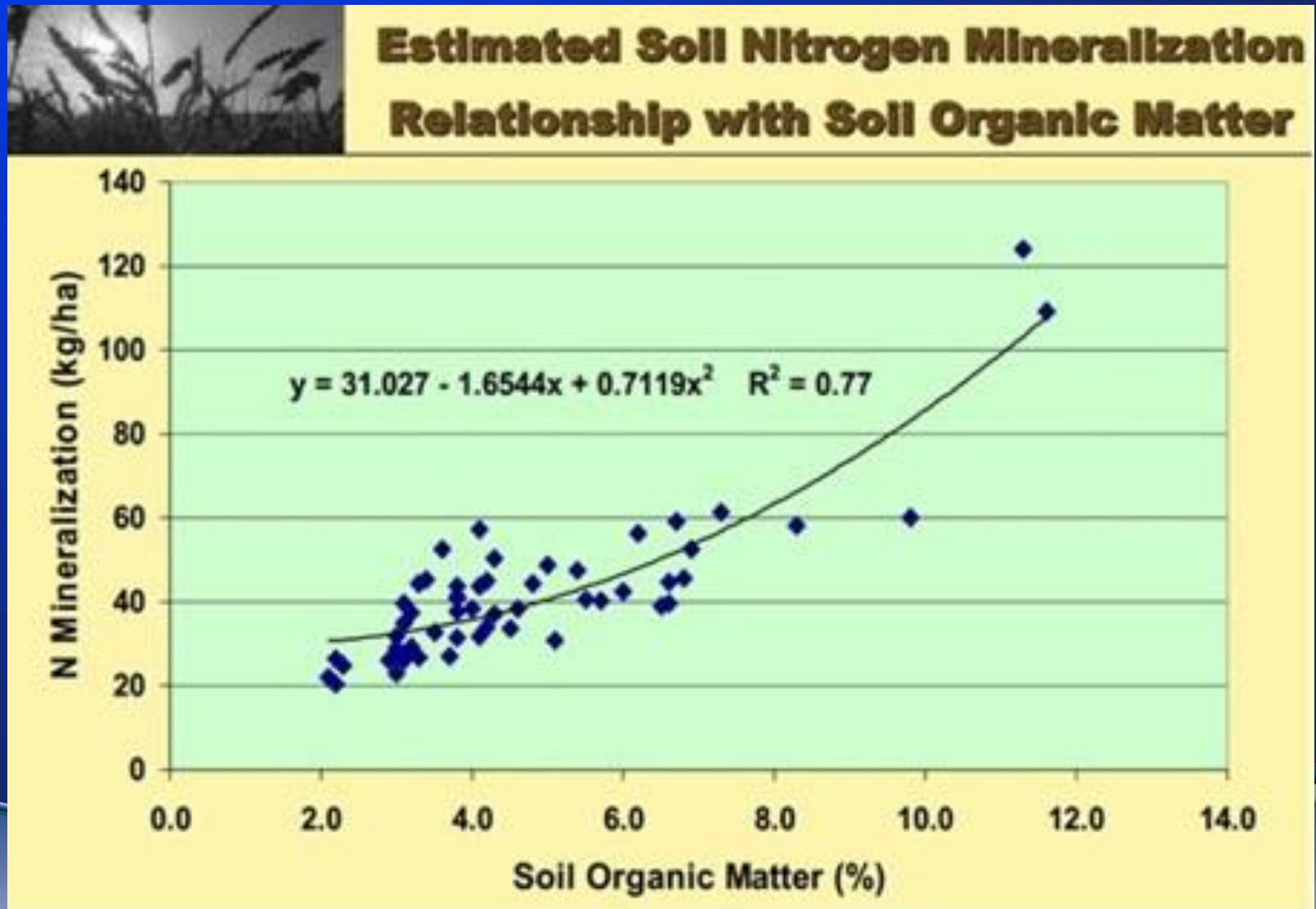
Depression: 6% OM

Eroded Hilltop: 2% OM



# Mineralization of N from OM

Ross McKenzie, Alberta Ag





# Sulphur levels?

S: 60 lbs/ac

S: 200 lbs/ac

S: 20 lbs/ac



# Phosphorus levels?

Phos: 8ppm

pH: 8.0

Phos: 20ppm

pH: 7.8

Phos: 3ppm

pH: 8.2



# Wheres the Water?

Water accumulation areas

High OM – more stored water

Water runoff areas, less snow

Low OM – less stored water



# We have identified fertility based response characteristics

## How do we get a map of this?



**Cory Willness** @CropPr... · 2017-10-12 ✓

How do nutrients vary in a field? And then how should you soil test? By....

**Soil,water,topography**

**78%**

**Biomass,yield**

**22%**

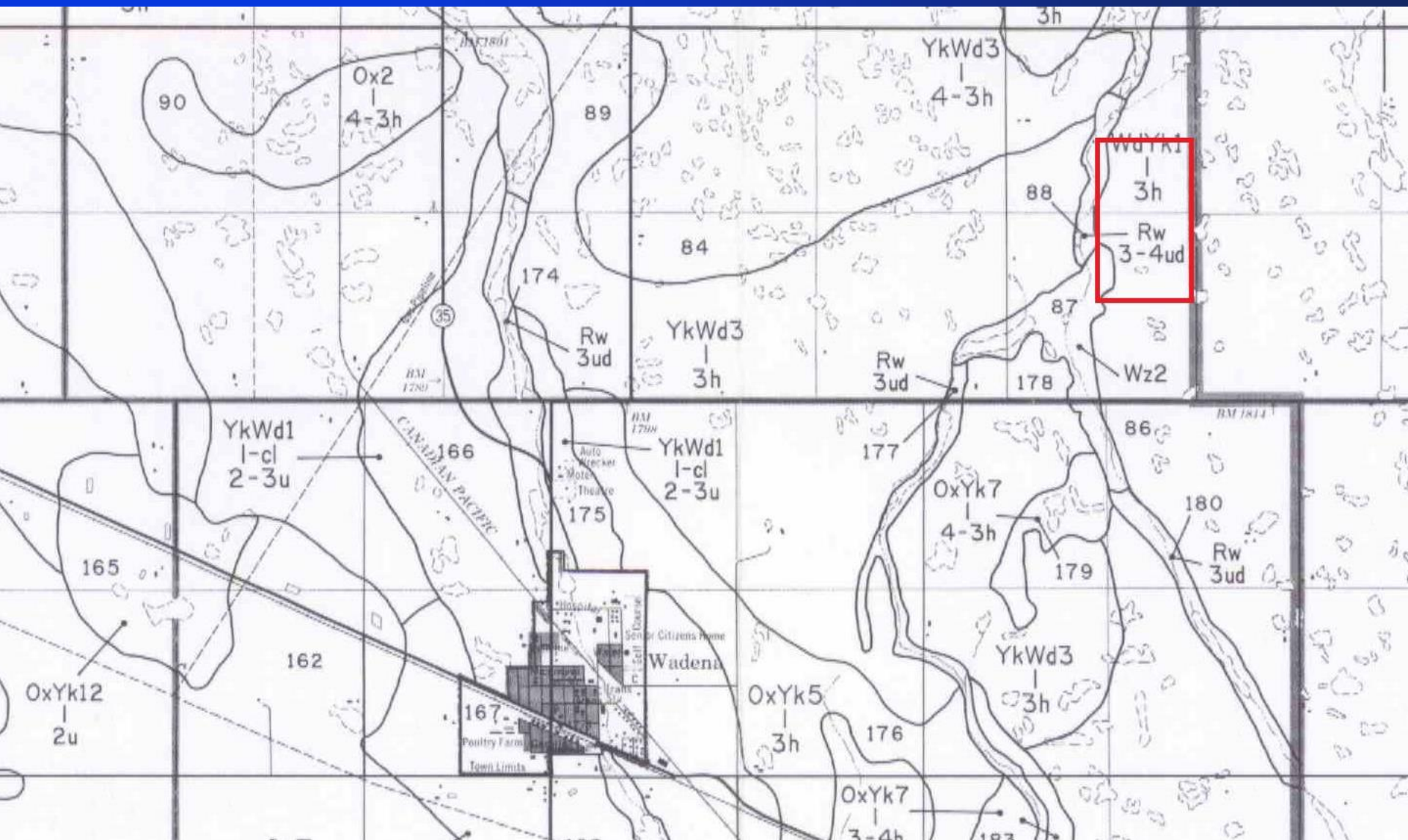
252 votes · Final results



Can we use CANSIS  
or SKSIS Soil  
Survey polygons to  
make these maps?



# Soil Survey SK - Books





# Soil Survey – SKSIS

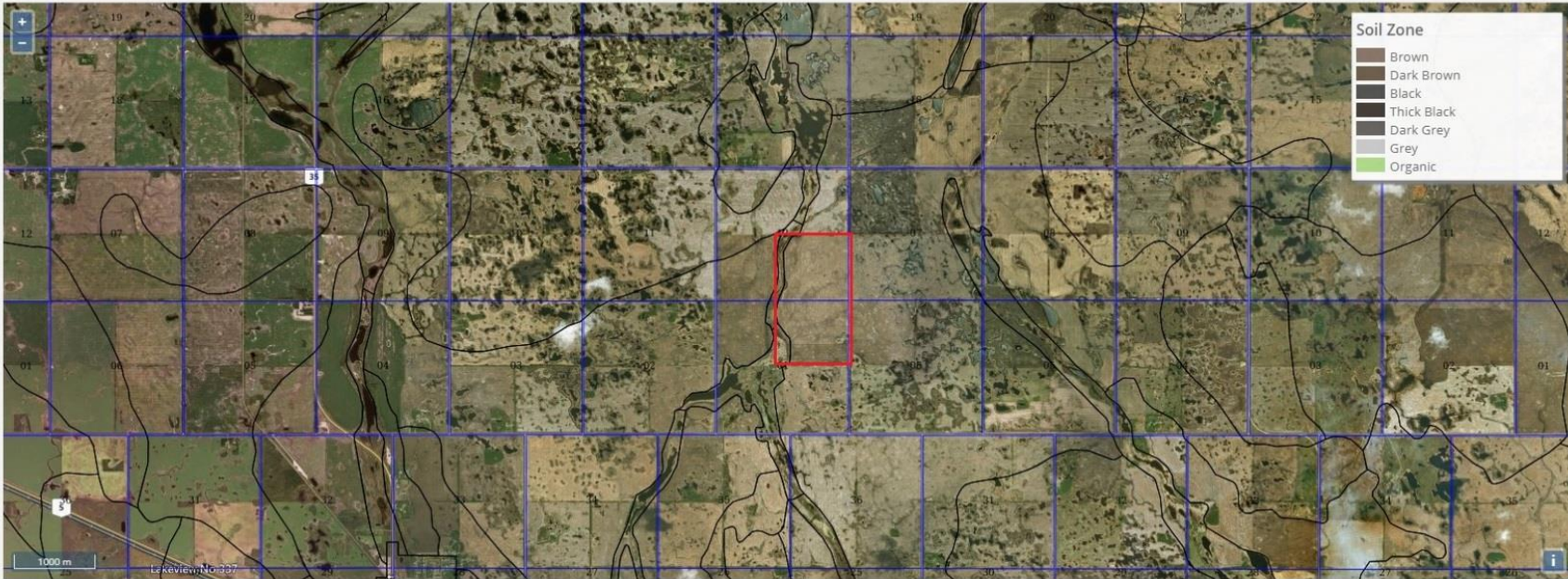
(section resolution polygons)

Secure | <https://sksoilweb.usask.ca/sksis-beta/#/map>

Apps ★ Bookmarks Suggested Sites Web Slice Gallery New Tab Agvise - Login sept 2014 dec 2014 2016

Hello, guest

- Map
- Add Data
- Your Account
- Tutorials
- Contact
- Acknowledgments



**Soil Zone**

- Brown
- Dark Brown
- Black
- Thick Black
- Dark Grey
- Grey
- Organic

1000 m

Leview No: 337

**Tools**

Theme: Soil Zone

Basemap: Hybrid

Toggle polygons ON

**Query**

Filter polygons where:

Dominant Slope Class

is

any

Clear

**Information**

Map Polygon Component

Please select a polygon



Map Polygon **Component**

WADENA O.BLC WADENA R.BLC GLEYSOLIC  
YORKTON CA.BLC YORKTON GLR.BLC

**Soil name:** WADENA O.BLC**% of polygon:** 35**Classification:** Orthic Black Chernozem CH**Parent material:** Till (Morainal)**Soil name:** WADENA R.BLC**% of polygon:** 30**Classification:** Rego Black Chernozem CH**Parent material:** Till (Morainal)**Soil name:** GLEYSOLIC**% of polygon:** 15**Classification:****Parent material:** Undifferentiated mineral**Soil name:** YORKTON CA.BLC**% of polygon:** 10**Classification:** Calcareous Black Chernozem CH**Parent material:** Till (Morainal)**Soil name:** YORKTON GLR.BLC**% of polygon:** 10**Classification:** Gleyed Rego Black Chernozem CH**Parent material:** Till (Morainal)Map Polygon **Component****Polygon ID:** SKDSS3360097**Surface Expression:** HUMMOCKY (h)**Slope Description:** GENTLE SLOPES 2 - 5% (CLASS 3)**Stoniness:** Nonstony**Polygon Label:** WdYk1:L3h2-3**Surface Texture:** Loam**Ag Capability:** 2( 7)MT3(1)W 5(2)NW

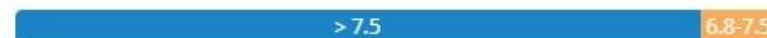
Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.

**Salinity Class:** 2SP

Salinity affect on productivity: Slight

**pH Class:** D3

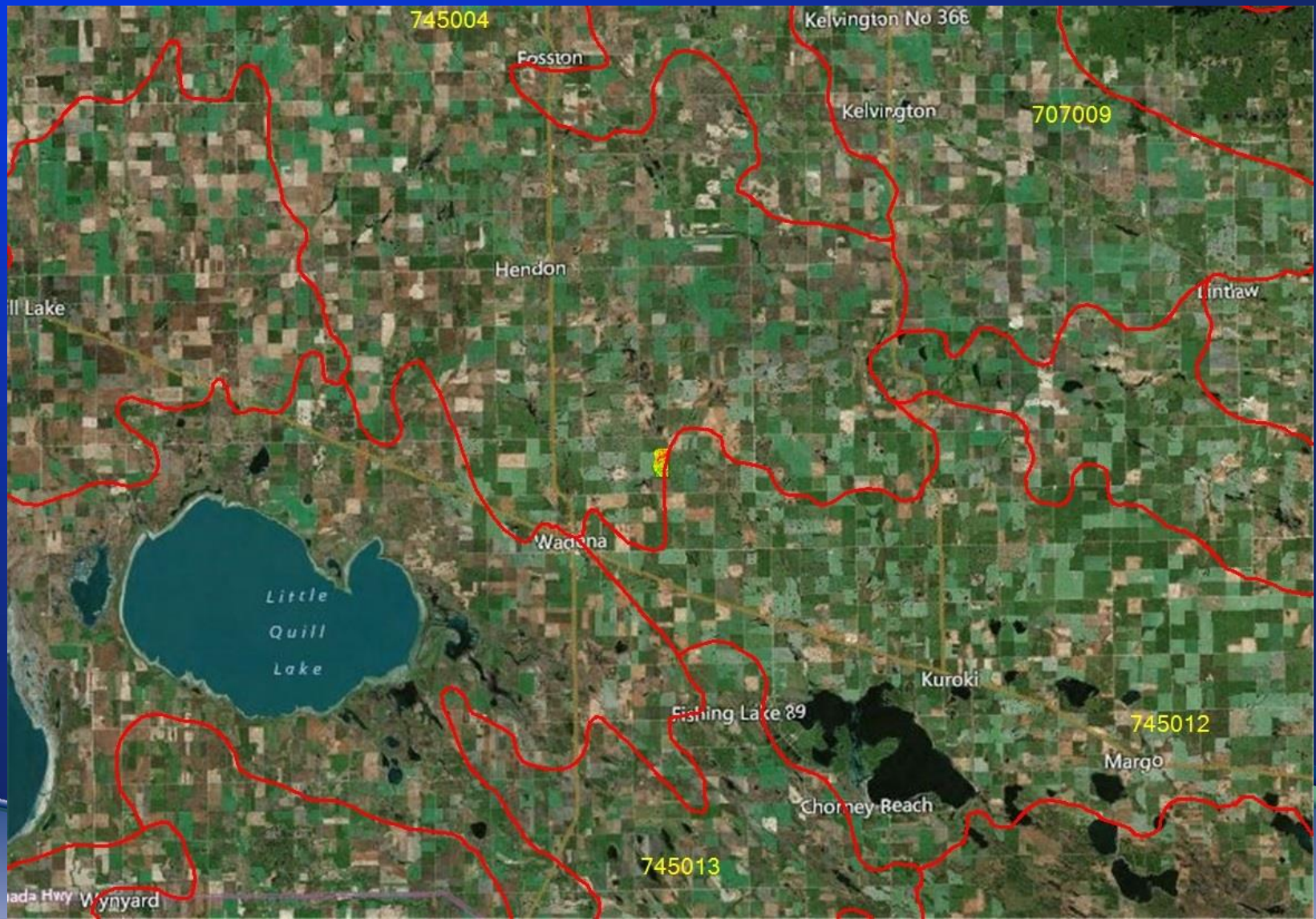
90% &gt; 7.5, 10% 6.8-7.5

**Area:** 2195 ha



# Soil Survey Data – CANSIS

(township resolution soil polygons)





CMP	%	Slope	Stone	Soil Name	Water Table	Root Restriction	Restriction Type	Drainage	PMTexture1	PMTexture2	PMChem	Mode Of Deposition	Soil Great Group	Soil Order	Soil SubGroup				
1	34	A	S	YORKTON CA.BLC	Never	None	None	Well drained	Medium	N/A	Moderately / Very Strongly Calcareous	Till (Morainal)	Black Chernozem	Chernozemic	Black Chernozem				
		Layer	Upper Depth	Lower HZNMAS Depth	HZNSUF	Very Fine Sand	Total Sand	Total Silt	Total Clay	Texture	Organic Carbon #	PHCA	PH2	CEC	KSat	BD	EC	CACO3	
		1	0	20	A	p	10%	46%	34%	20%	Sandy Clay Loam	3.8	7.4	7.5	26	5.36	1.2	1	0
		2	20	37	B	mk	9%	39%	38%	23%	Clay Loam	1.1	7.7	7.8	19	3.76	1.4	1	10
		3	37	100	C	k	11%	50%	30%	20%	Sandy Clay Loam	0.3	7.9	8	14	6.21	1.5	3	21
CMP	%	Slope	Stone	Soil Name	Water Table	Root Restriction	Restriction Type	Drainage	PMTexture1	PMTexture2	PMChem	Mode Of Deposition	Soil Great Group	Soil Order	Soil SubGroup				
2	24	A	S	YORKTON R.BLC	Never	None	None	Well drained	Medium	N/A	Moderately / Very Strongly Calcareous	Till (Morainal)	Black Chernozem	Chernozemic	Black Chernozem				
		Layer	Upper Depth	Lower HZNMAS Depth	HZNSUF	Very Fine Sand	Total Sand	Total Silt	Total Clay	Texture	Organic Carbon #	PHCA	PH2	CEC	KSat	BD	EC	CACO3	
		1	0	19	A	pk	10%	46%	34%	20%	Sandy Clay Loam	3.8	7.4	7.5	26	5.36	1.2	1	5
		2	19	100	C	k	11%	50%	30%	20%	Sandy Clay Loam	0.3	7.9	8	14	6.21	1.5	3	21
CMP	%	Slope	Stone	Soil Name	Water Table	Root Restriction	Restriction Type	Drainage	PMTexture1	PMTexture2	PMChem	Mode Of Deposition	Soil Great Group	Soil Order	Soil SubGroup				
3	20	A	U	GLEYSOLIC	Growing Season	None	None	Poorly drained	Moderately Fine	N/A	Weakly Calcareous	Undifferentiated mineral	N/A	Gleysolic	N/A				
		Layer	Upper Depth	Lower HZNMAS Depth	HZNSUF	Very Fine Sand	Total Sand	Total Silt	Total Clay	Texture	Organic Carbon #	PHCA	PH2	CEC	KSat	BD	EC	CACO3	
CMP	%	Slope	Stone	Soil Name	Water Table	Root Restriction	Restriction Type	Drainage	PMTexture1	PMTexture2	PMChem	Mode Of Deposition	Soil Great Group	Soil Order	Soil SubGroup				
4	11	A	S	OXBOW O.BLC	Never	None	None	Well drained	Medium	N/A	Moderately / Very Strongly Calcareous	Till (Morainal)	Black Chernozem	Chernozemic	Black Chernozem				
		Layer	Upper Depth	Lower HZNMAS Depth	HZNSUF	Very Fine Sand	Total Sand	Total Silt	Total Clay	Texture	Organic Carbon #	PHCA	PH2	CEC	KSat	BD	EC	CACO3	
		1	0	15	A	p	10%	47%	32%	21%	Sandy Clay Loam	3.2	7.1	7.3	24	5.39	1.3	1	0
		2	15	37	B	m	10%	46%	31%	23%	Sandy Clay Loam	1	7.2	7.4	19	4.87	1.4	1	0
		3	37	100	C	k	10%	43%	32%	25%	Clay Loam	0.3	7.7	7.8	17	4.09	1.5	3	18
CMP	%	Slope	Stone	Soil Name	Water Table	Root Restriction	Restriction Type	Drainage	PMTexture1	PMTexture2	PMChem	Mode Of Deposition	Soil Great Group	Soil Order	Soil SubGroup				
5	11	B	S	YORKTON CA.BLC	Never	None	None	Well drained	Medium	N/A	Moderately / Very Strongly Calcareous	Till (Morainal)	Black Chernozem	Chernozemic	Black Chernozem				
		Layer	Upper Depth	Lower HZNMAS Depth	HZNSUF	Very Fine Sand	Total Sand	Total Silt	Total Clay	Texture	Organic Carbon #	PHCA	PH2	CEC	KSat	BD	EC	CACO3	
		1	0	20	A	p	10%	46%	34%	20%	Sandy Clay Loam	3.8	7.4	7.5	26	5.36	1.2	1	0
		2	20	37	B	mk	9%	39%	38%	23%	Clay Loam	1.1	7.7	7.8	19	3.76	1.4	1	10
		3	37	100	C	k	11%	50%	30%	20%	Sandy Clay Loam	0.3	7.9	8	14	6.21	1.5	3	21





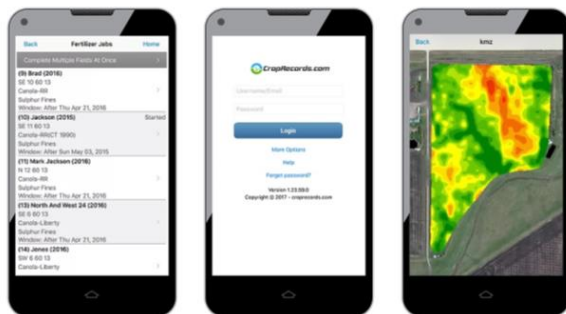
# CropRecords.com

where farmers and consultants sync

SaskTel 4:52 PM 25%	
Back	Field Soil Survey Home
Field Name	(18_20) Sowa's East 5
Land Location	S 12 & N 1 35 13 & S 7 & NW 6 35 12
Acres Nominal	790
Acres GPS	779.4
Soil Survey	
Polygon ID	745004
Components	
34%	YORKTON CA.BLC
24%	YORKTON R.BLC
20%	GLEYSOLIC
11%	OXBOW O.BLC
11%	YORKTON CA.BLC

Back	Component Details	Home
CMP 1		34%
Soil Name	YORKTON CA.BLC	
Slope		A
Stone		S
Water Table		Never
Root Restriction		None
Restriction Type		N/A
Drainage		Well drained
Parent Material Texture 1		Medium
Parent Material Texture 2		N/A
Parent Chem		Moderately / Very Strongly Calcareous
Mode Of Deposition		Till (Morainal)
Soil Great Group		Black Chernozem
Soil Order		Chernozemic
Soil Subgroup		Calcareous Black Chernozem
Component Layers		
1 (0 to 20cm)		Sandy Clay Loam
2 (20 to 37cm)		Clay Loam
3 (37 to 100cm)		Sandy Clay Loam

Back	Component Details	Home
CMP 2		24%
Soil Name	YORKTON R.BLC	
Slope		A
Stone		S
Water Table		Never
Root Restriction		None
Restriction Type		N/A
Drainage		Well drained
Parent Material Texture 1		Medium
Parent Material Texture 2		N/A
Parent Chem		Moderately / Very Strongly Calcareous
Mode Of Deposition		Till (Morainal)
Soil Great Group		Black Chernozem
Soil Order		Chernozemic
Soil Subgroup		Rego Black Chernozem
Component Layers		
1 (0 to 19cm)		Sandy Clay Loam
2 (19 to 100cm)		Sandy Clay Loam





# Hybrid by Soil Type?



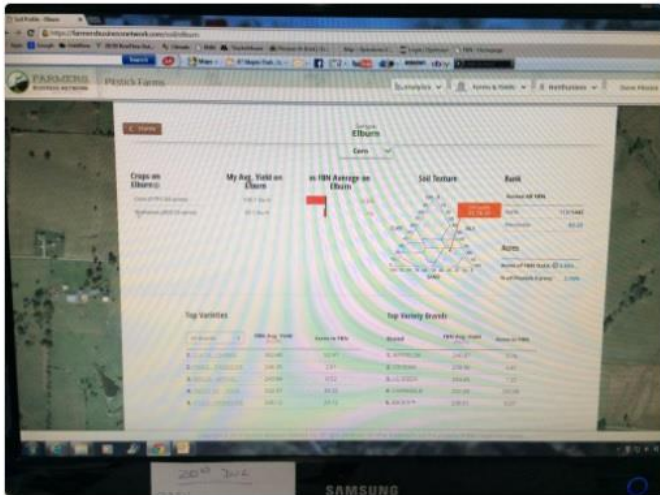
FieldView @FieldView · 9 Nov 2017

Analyze performance **by hybrid, soil type**, or field w/ yield analysis so you can make the best decisions for #plant18 [bit.ly/2AhtwIZ](http://bit.ly/2AhtwIZ)



Steve Pitstick @PitstickFarms · 14 Feb 2015

Extremely impressed w startup #Smartdata company I met w in CA [farmersbusinessnetwork.com](http://farmersbusinessnetwork.com) **hybrid by soil type** report





# Soil Survey Polygons Summary

- Not high enough resolution for making zones for soil maps or for data analytics
- Excellent data on the soil properties in an area to create “A foundation to think in”



# *SWAT MAPS*

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*Soil, Water And Topography MAPS*

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Trademarked

Patented







# Field Mapping for SWAT MAPS

RTK antenna



EM38 sled

RTK base station



EM38  
dual depth



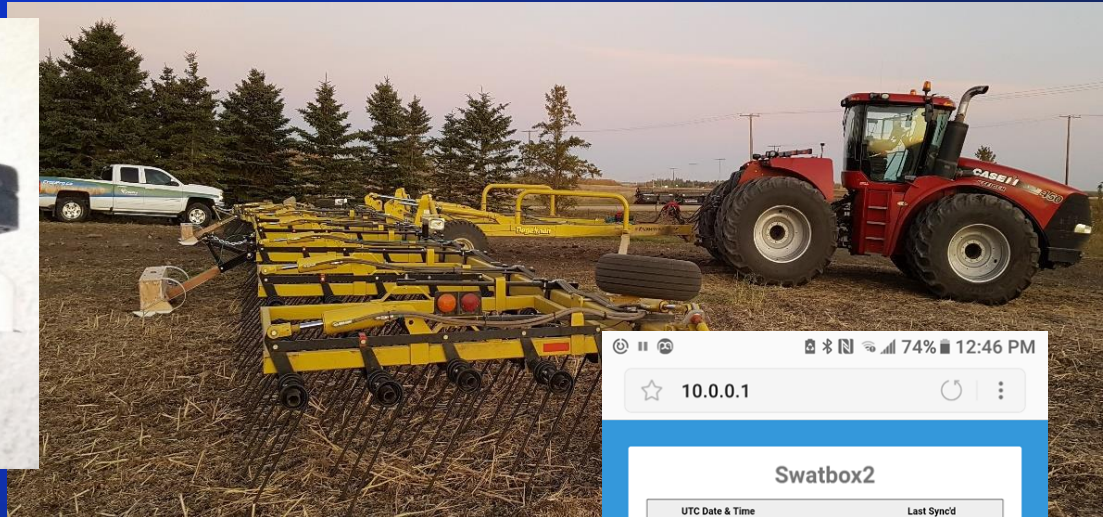
Autosteer

Mapping  
software





# SWATBOX Version 2



10.0.0.1 74% 12:46 PM

### Swatbox2

UTC Date & Time 2017-09-29 18:46 UTC Local Date & Time 2017-09-29 12:46 CST-0600	Sync'd Status 	Last Sync'd 2017-09-29 18:44:33 UTC Battery Volts 12.2
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### Sensor Unit A

Latitude 52.1625 Longitude -105.0544717	Speed kph 15.53828	QC 0.5m 451.328125 QC 1m 58.203125
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### Sensor Unit B

Latitude 52.1624283 Longitude -105.0543517	Speed kph 14.74192	QC 0.5m 417.734375 QC 1m 66.8359375
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### Logs (Latest towards the top)

2017

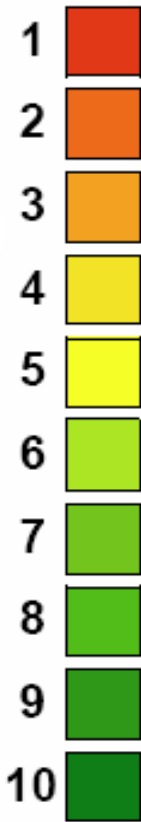
- [swat2log20170929.csv](#)
- [swat2log20170928.csv](#)
- [swat2log20170920.csv](#)
- [swat2log20170919.csv](#)
- [swat2log20170918.csv](#)

Back Forward Home Bookmarks Tabs



# SWAT MAPS

## Zone



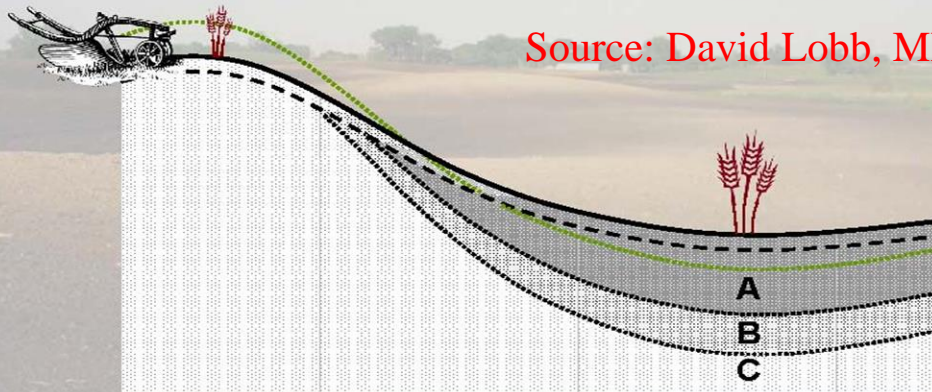
- **Zone 1,2:** eroded knolls, hills, sands, low organic, driest areas
- **Zone 3,4:** shoulder slopes, upper slopes, water runs off
- **Zone 5,6:** midslopes, flat areas, average
- **Zone 7,8:** toe slopes, lower flats
- **Zone 9,10:** depressions, saline areas, clay, water collection, peat, high organic, wet



### Soil-landscape variability in a hilly landscape

- several decades of cultivation (~1980)
- mature state of erosion

Source: David Lobb, MB



The extent and severity of soil erosion had worsened  
→ 30-60 cm of soil loss on hilltops and 30-60 cm of soil accumulation at the base of hills.

### Zone

1

2

3

4

5

6

7

8

9

10

1

2

4

8

6

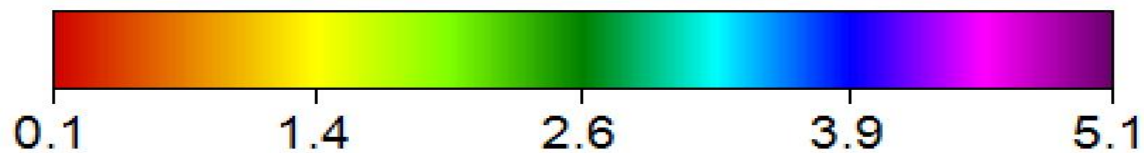
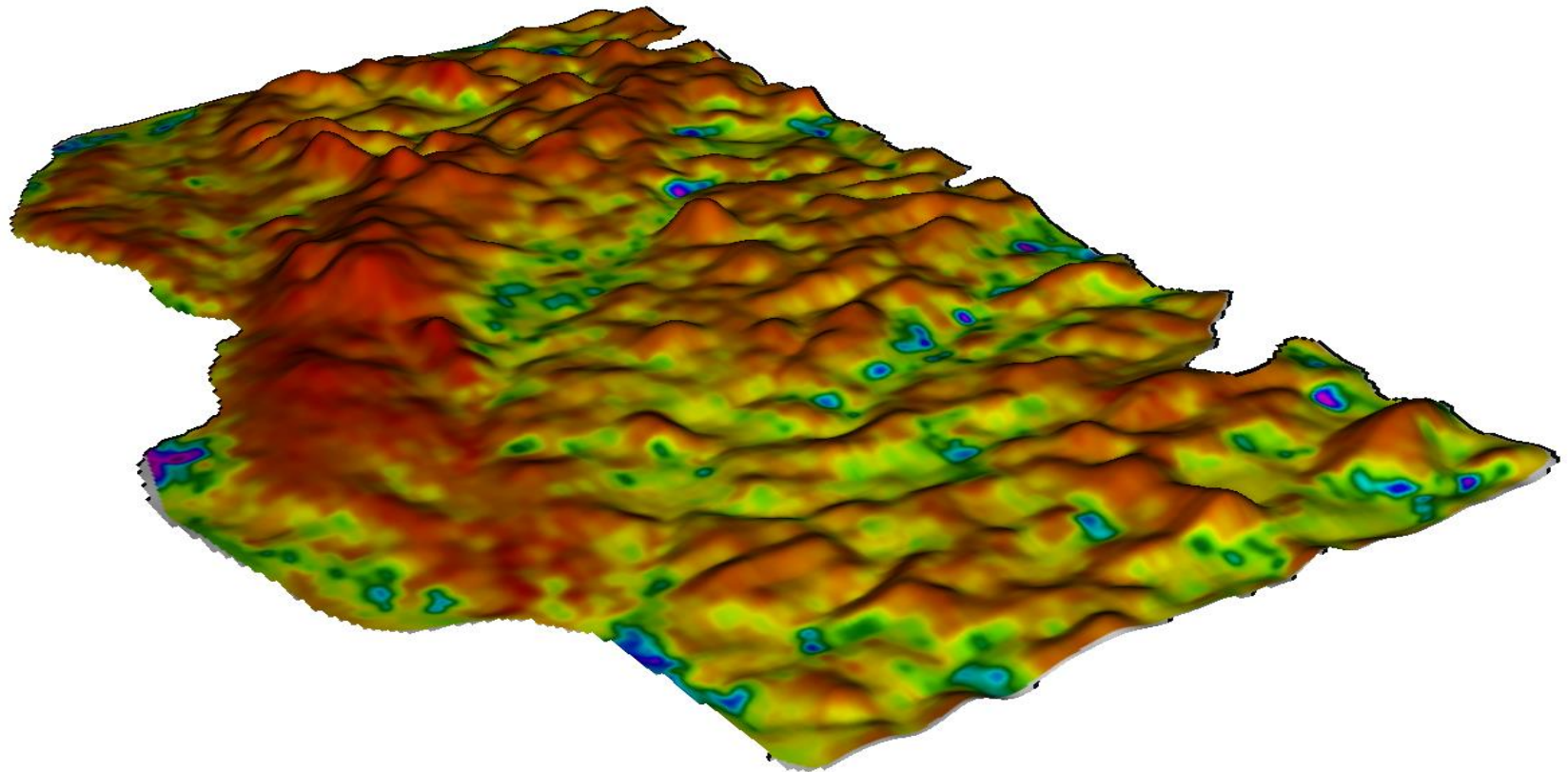
10



# Example Field Wadena, SK



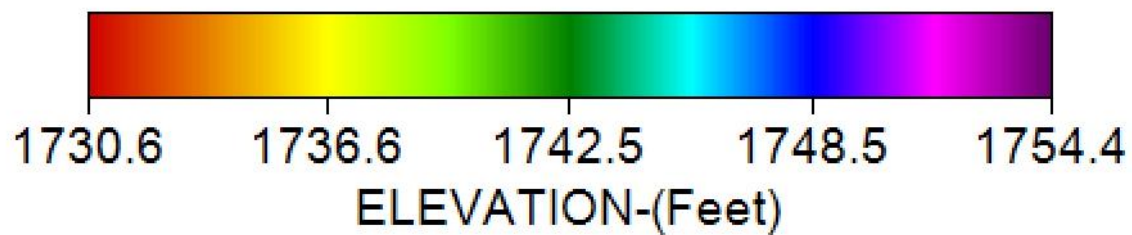
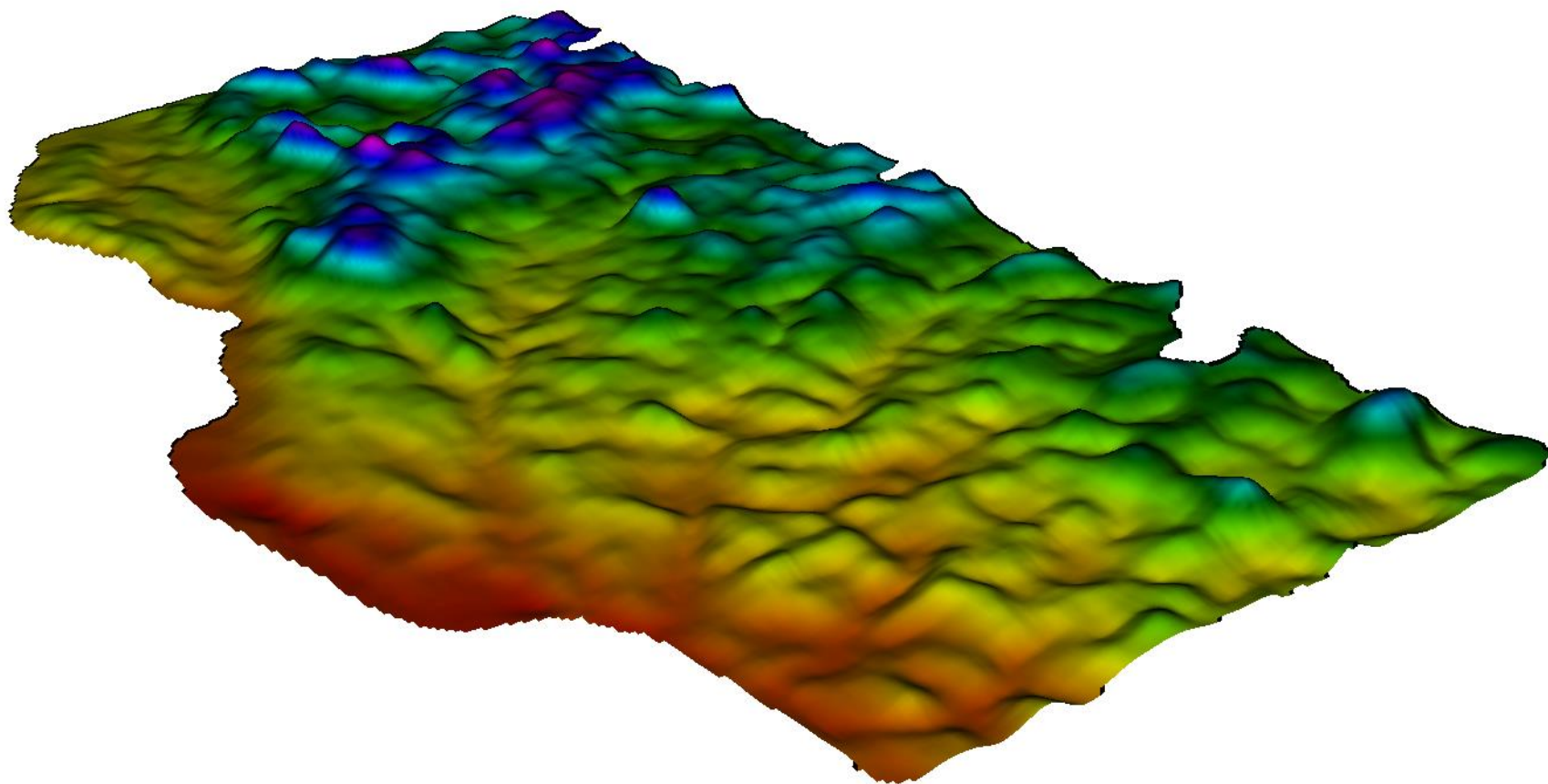
# 3-D Electrical Conductivity



**Electrical Conductivity**

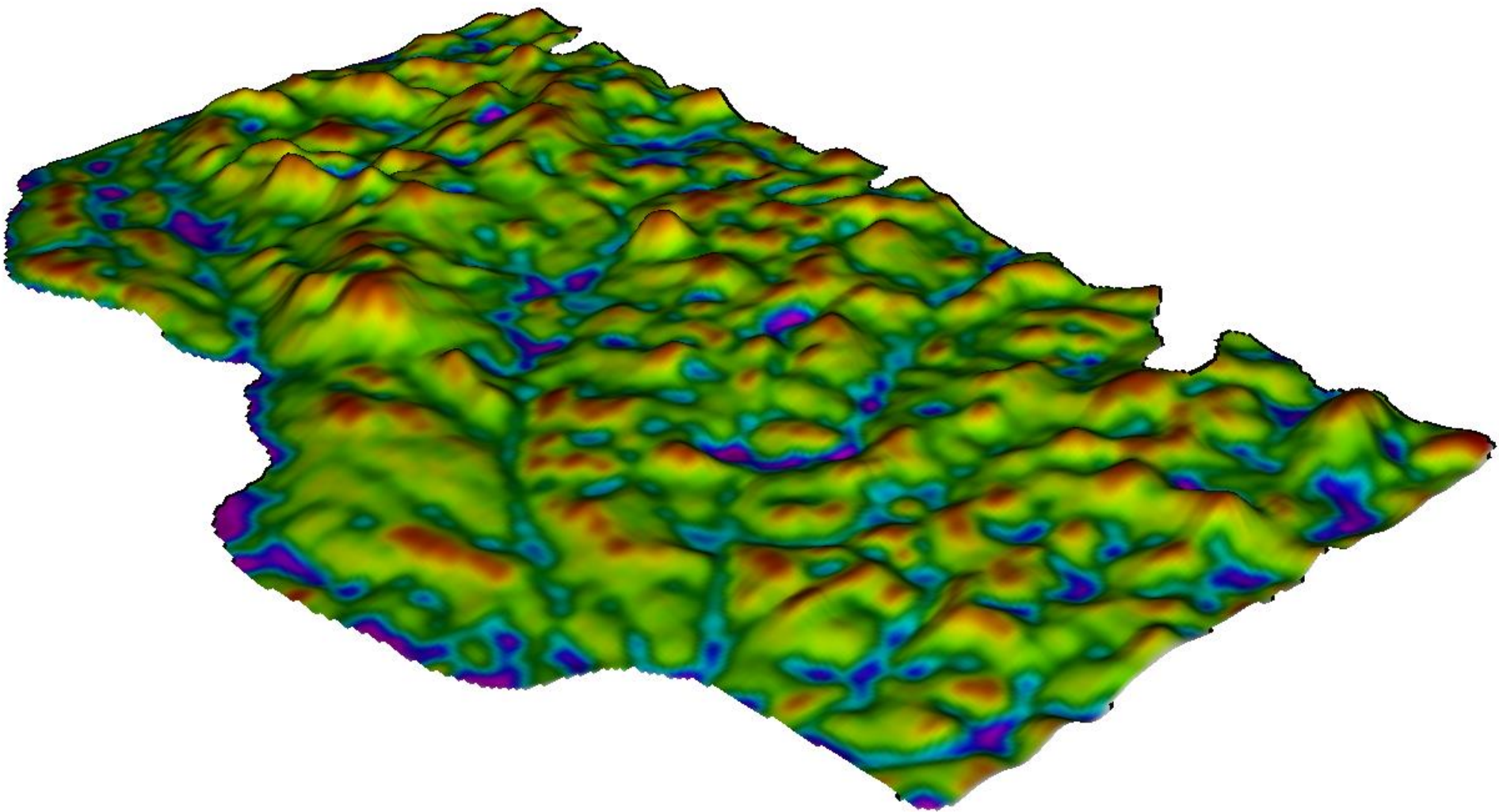


# 3-D RTK Elevation

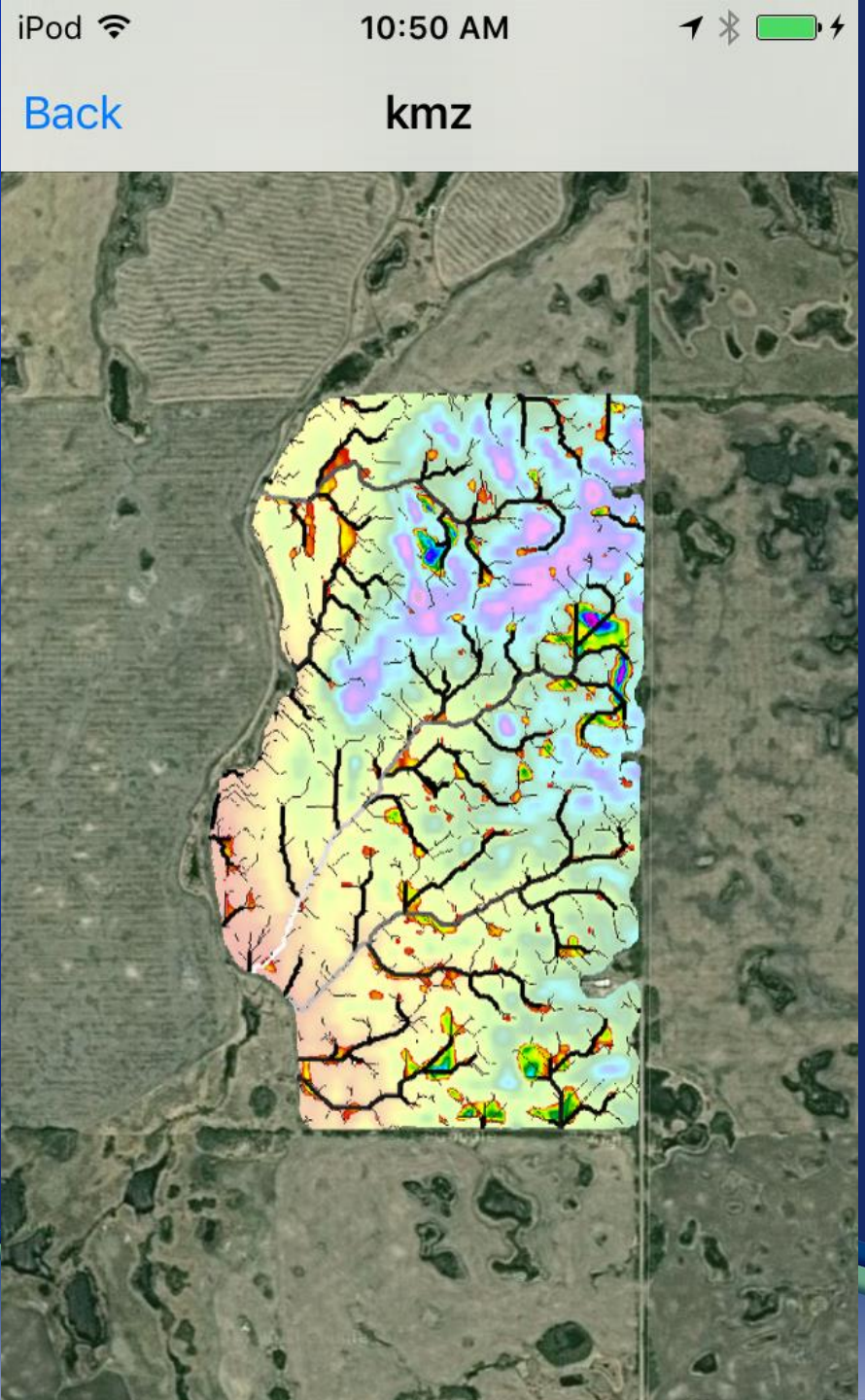




# Topography (McMillan Model)



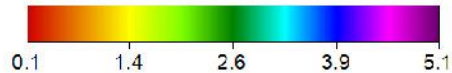
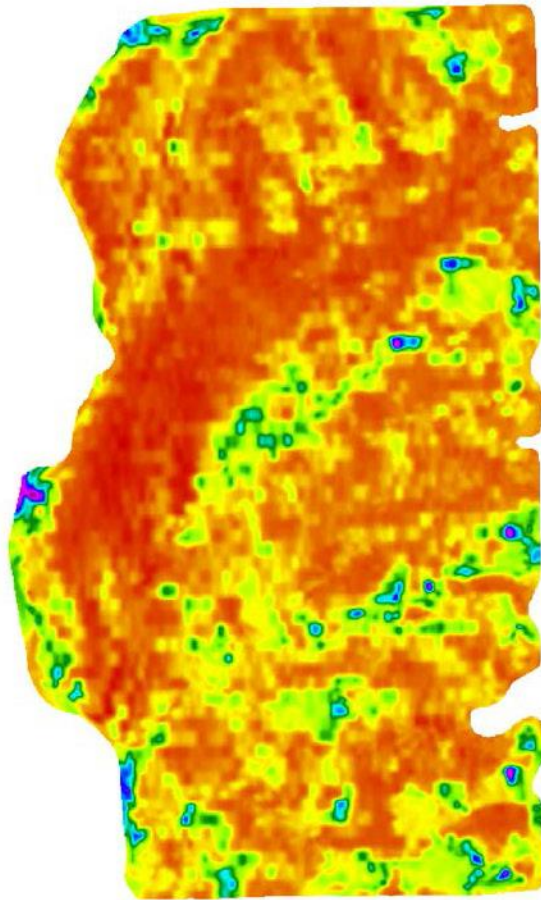




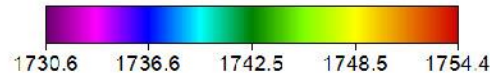
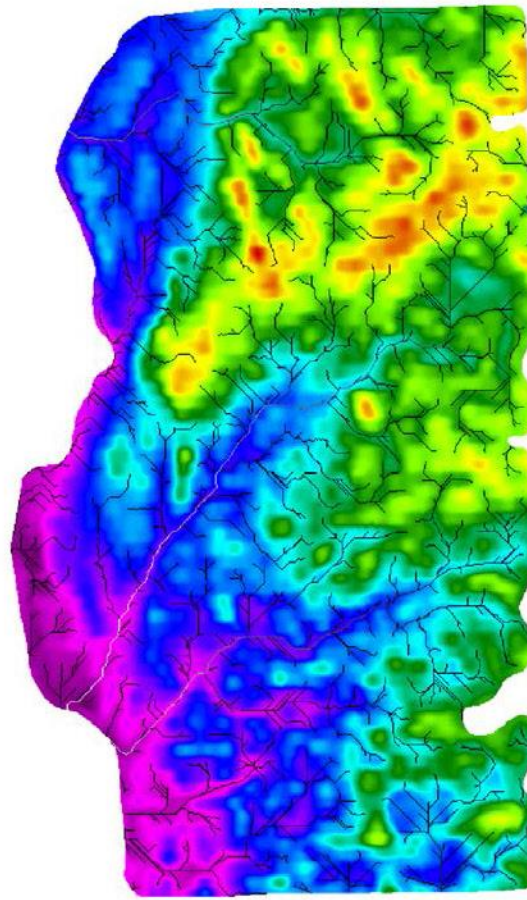


# SWAT MAPS

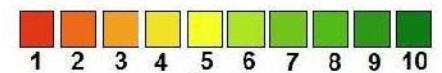
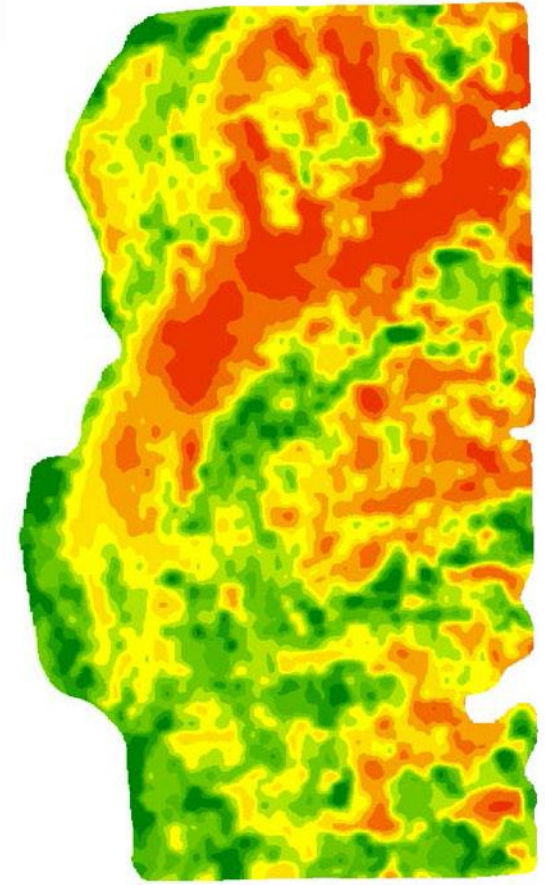
*Soil, Water And Topography MAPS*



Electrical Conductivity



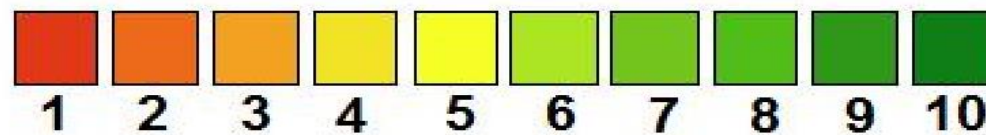
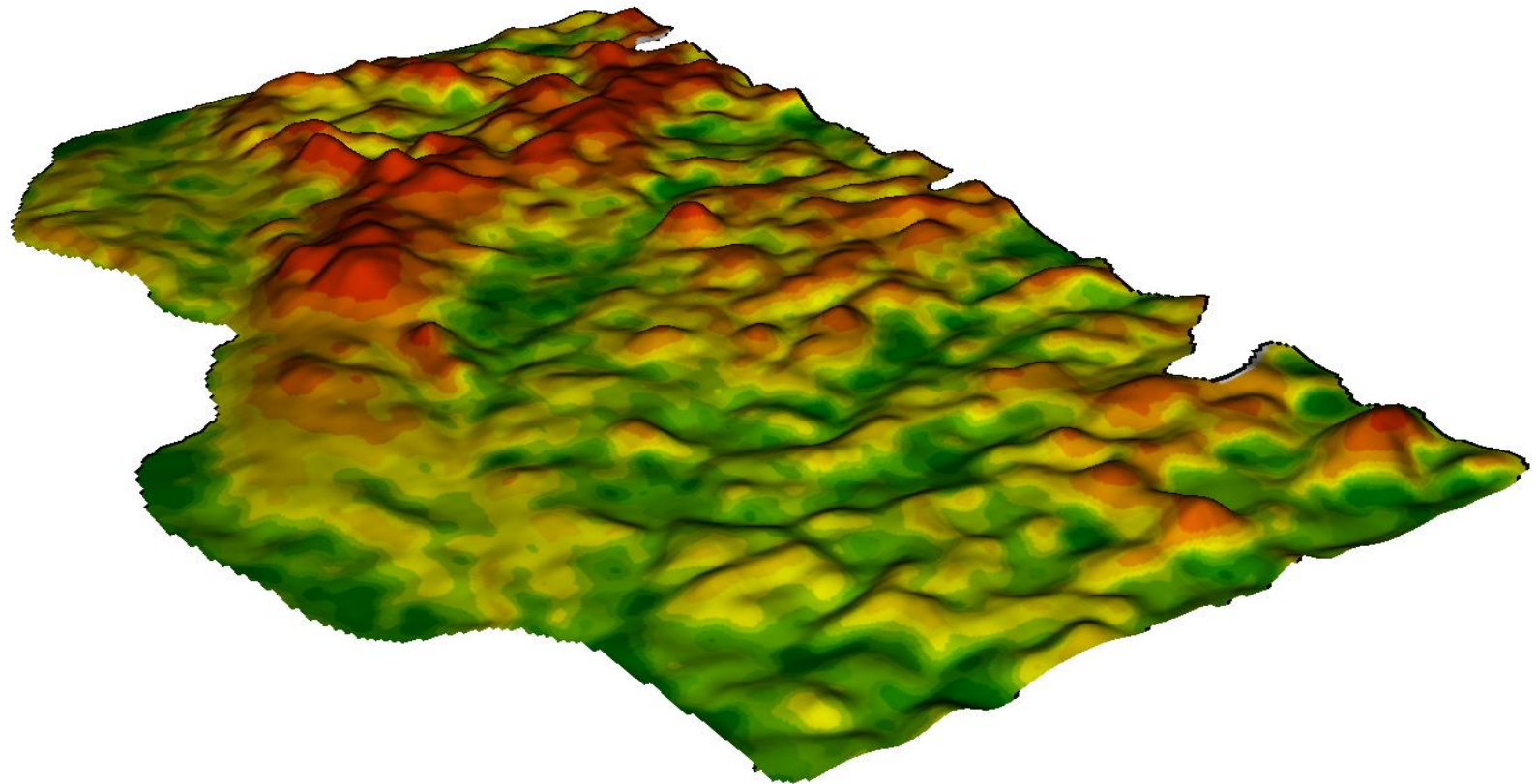
RTK Elevation (Feet)



SWAT Soil Potential Zones



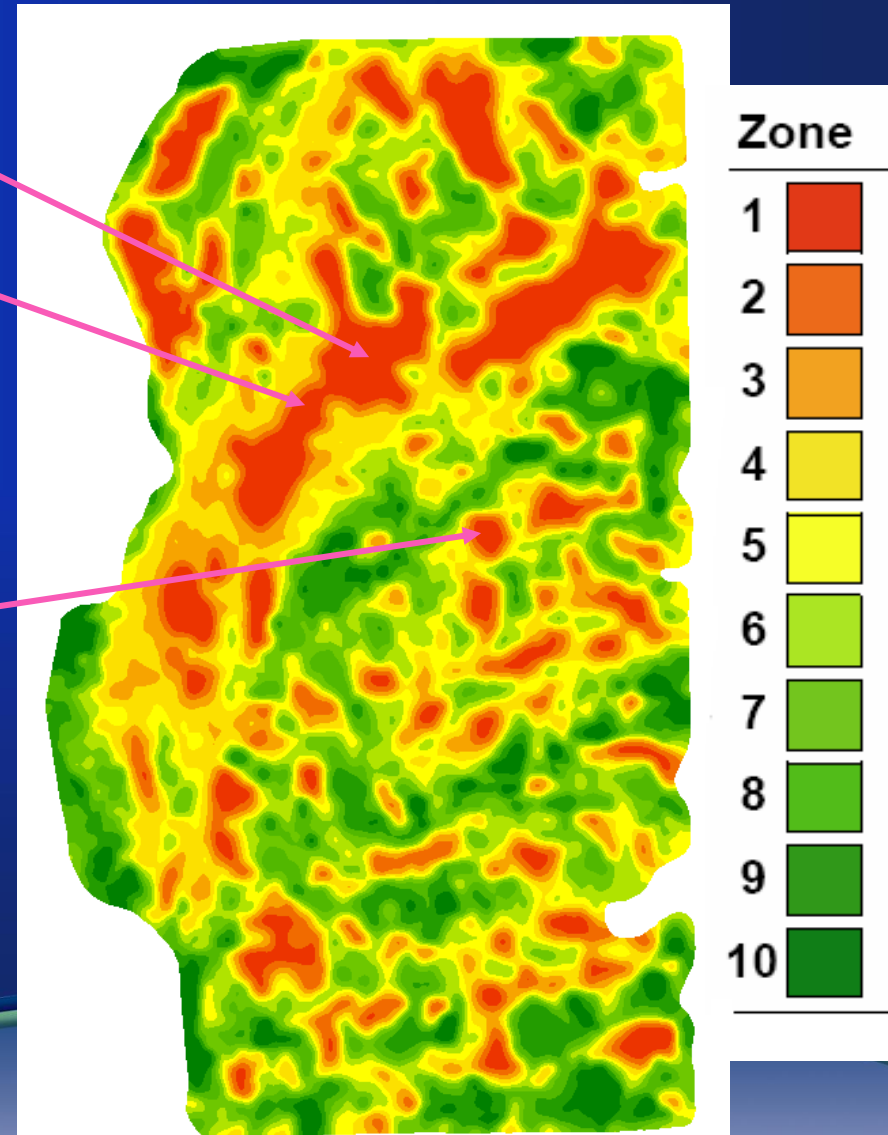
# 3-D SWAT MAPS



**SWAT Zone Map**



# Zone 1 - knolls



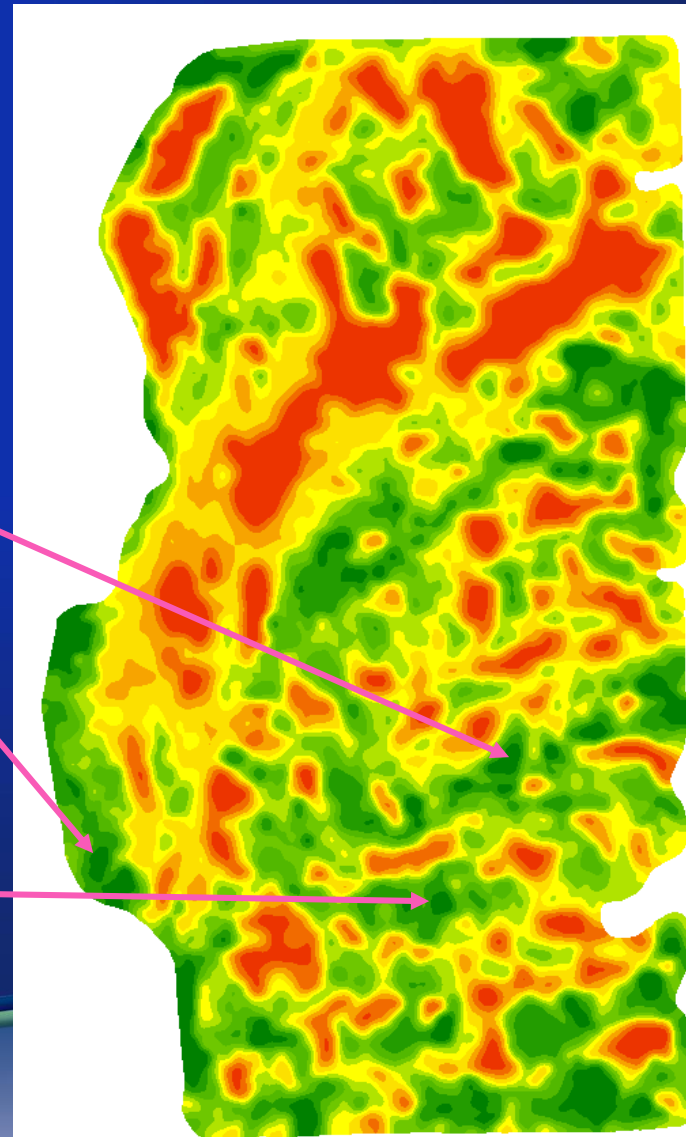


Zone 1- Highest Water Shedding  
Zone 2 – Lower Water Shedding





# Zone 10 - saline



Zone

1



2



3



4



5



6



7



8



9

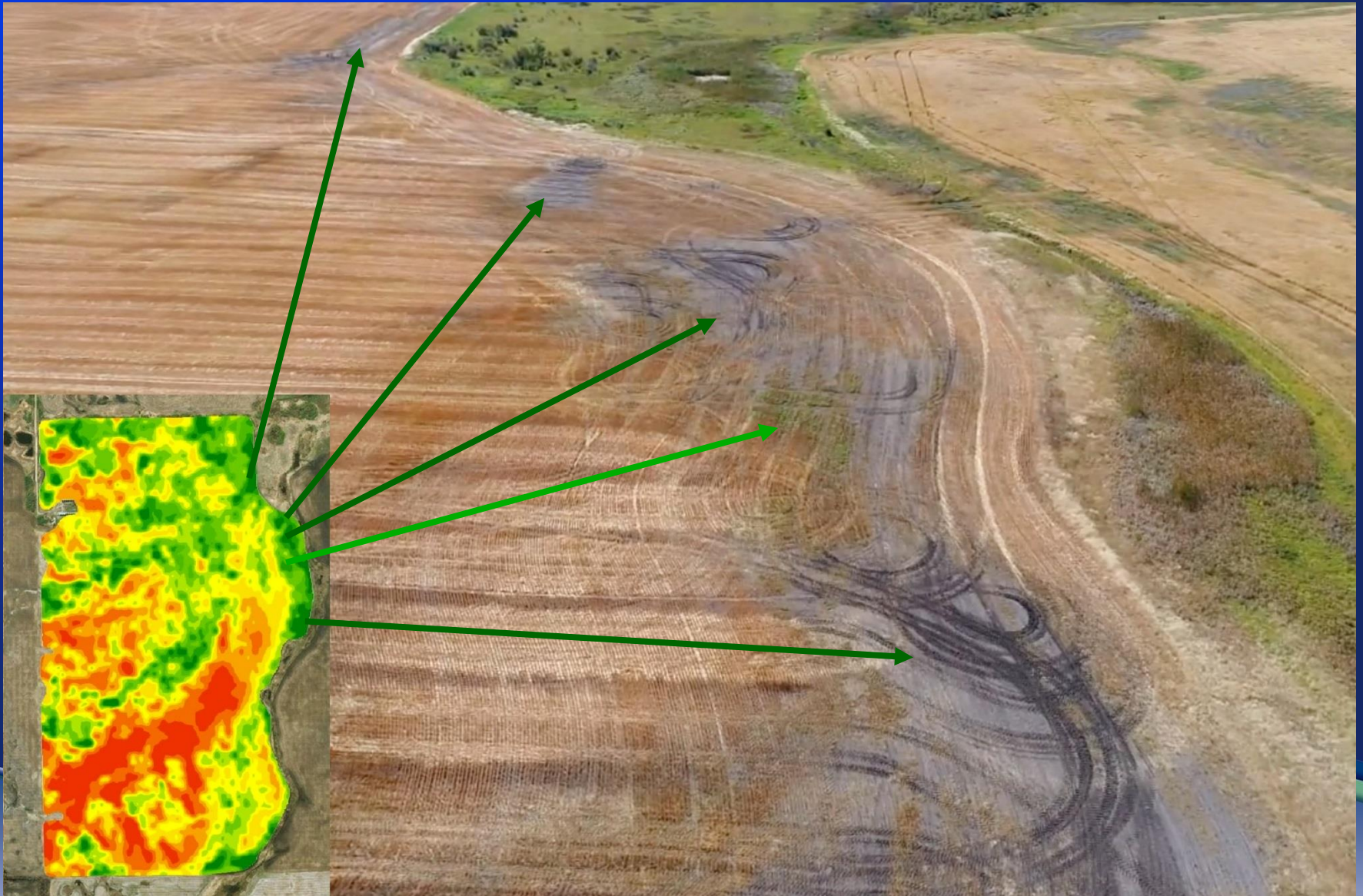


10





Zone 9 – Light Salinity  
Zone 10 – High Salinity

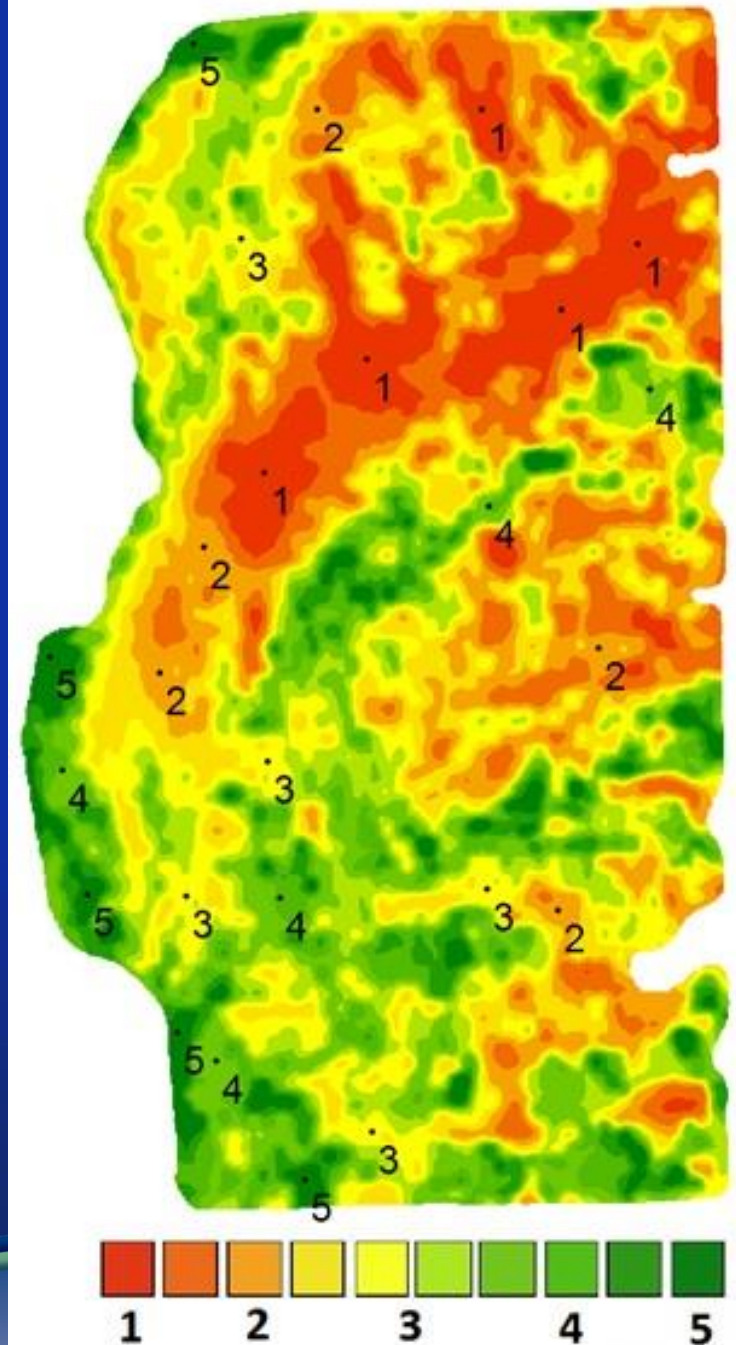




# SWAT MAPS

## Soil Sampling

- Sample 10 zones on MAPS into 5 zones
- select points that will represent the most acres of the zones
- Best compromise on detail versus costs



SWAT MAPS Soil Test





Wintex  
1000

1

2

3

4

5



## Zone 1 Hills

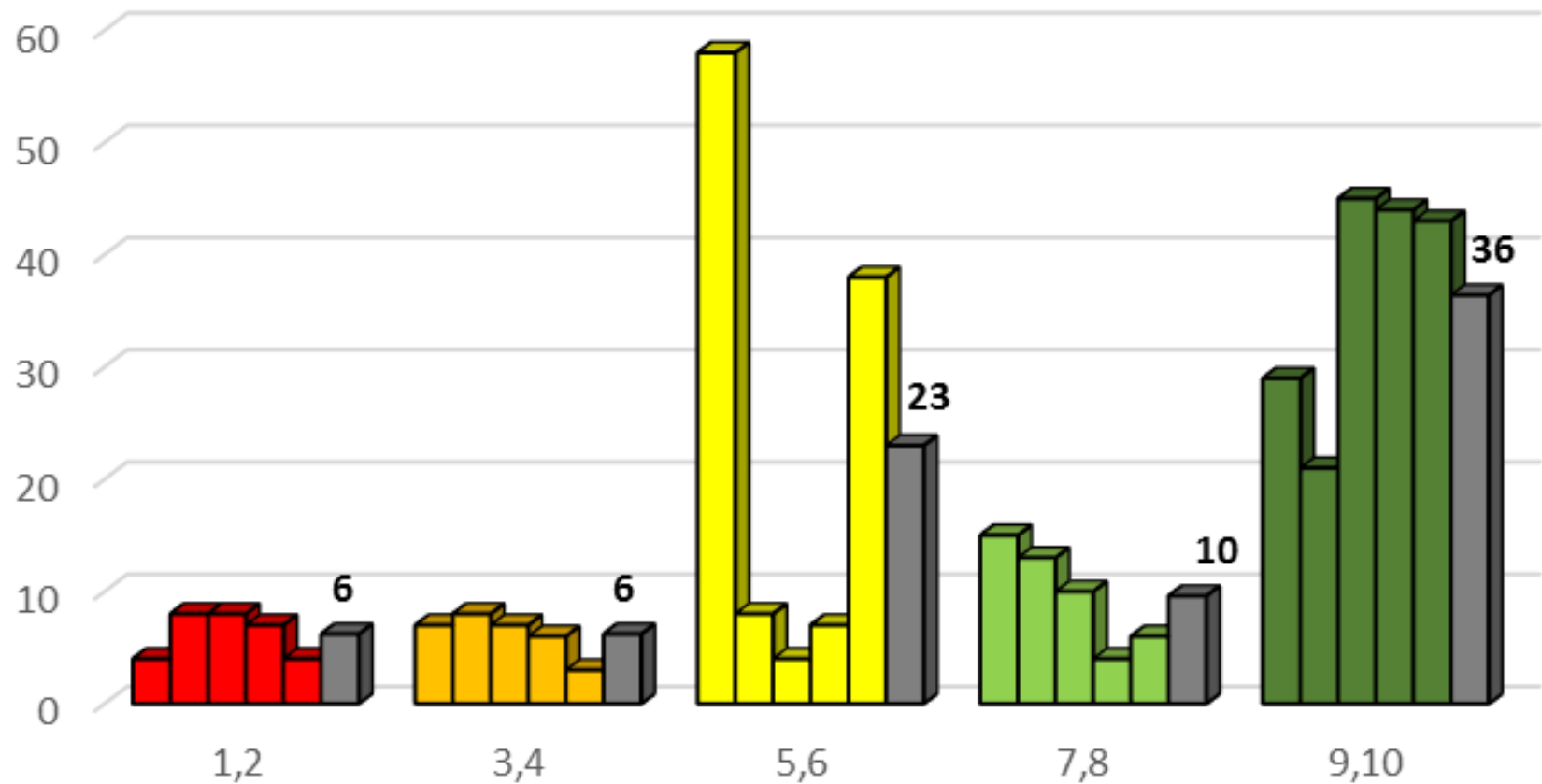


## Zone 8 Non-saline depressions



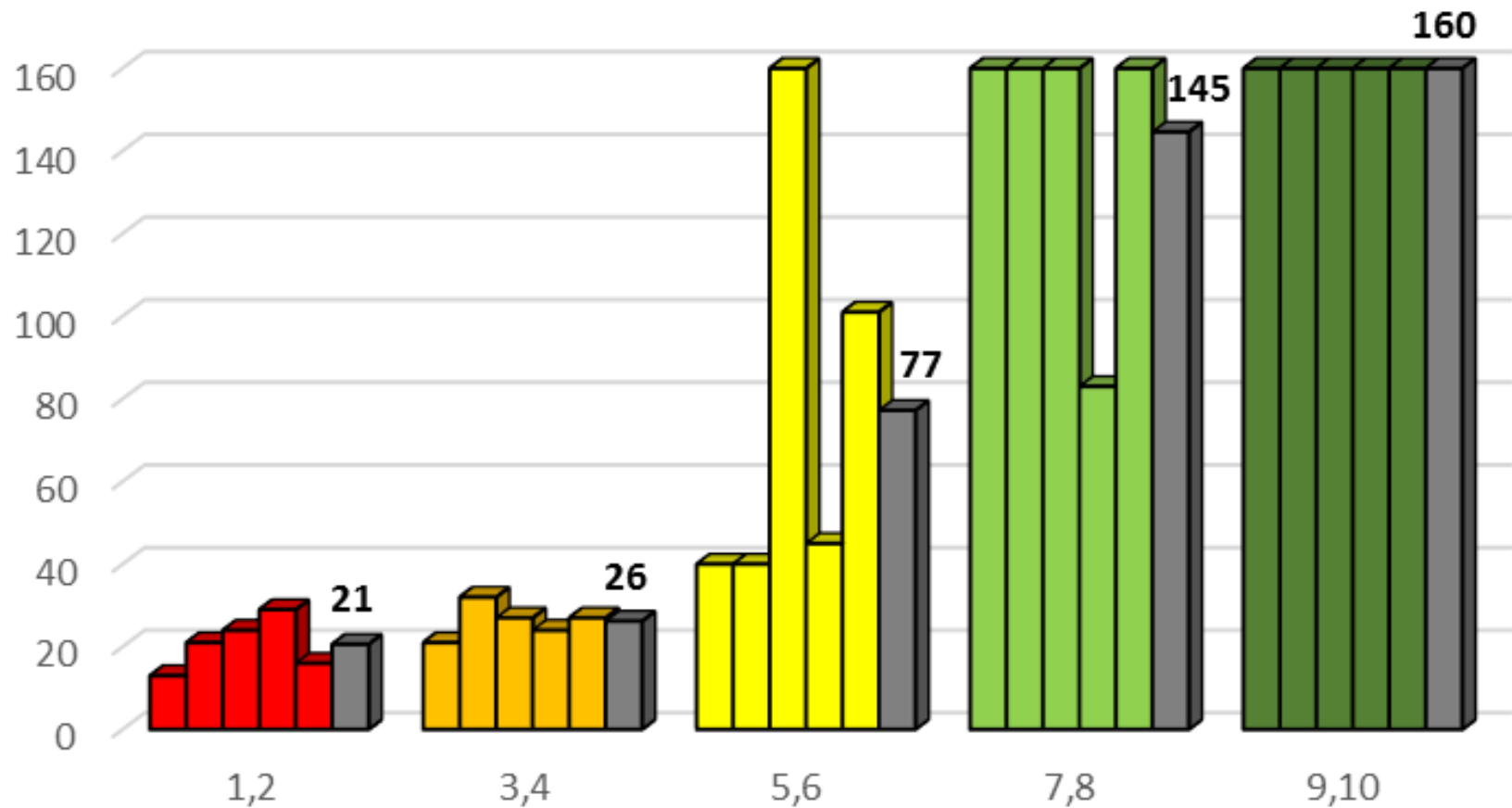


## Phosphorus (ppm 0-8")



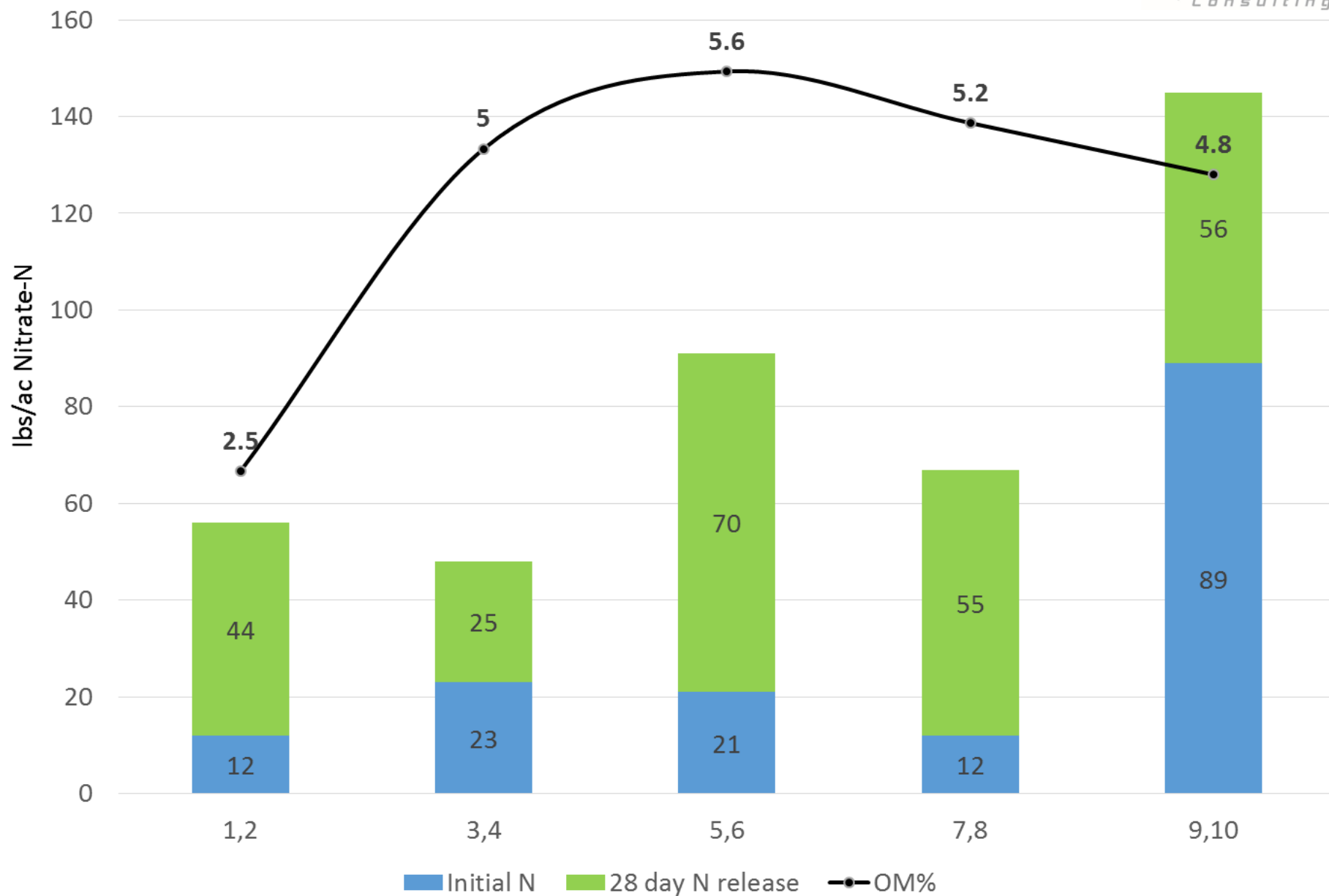


## Sulphate (lbs/ac 0-8")





# CF (Sowas East) - Henry Test 2015



# Summary:

## Soil, Water and Topography Maps

- Are high resolution soil surveys
- Are the “starting point” of a successful variable-rate fertilizer and seed process



Precision Ag Abandoning "Soils"... It's Shameful.

Published on August 22, 2016



Cory Willness  
Crop Consultant and President at CropPro Consulting



5,995



232



49



47



# Thank You



***YOUR FIELD  
IS OUR OFFICE***