# HOW GOOD IS YOUR DATA?

by


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# Precision Ag is about…

# INFORMATION MANAGEMENT

- What you know
- How you interpret what you know
- What you do with what you know

Data – Information – Knowledge – Decisions

COLLECT DATA – ANALYZE DATA – INTERPRET DATA – TAKE ACTION

# X-TREME FARMING

What did you think we did with all those
government subsidies - buy tractors???

\o/ MotivatedPhotos.com

Spraying weeds  Columbia, South America

# SOIL TEST DATA

## GRID - ZONE - COMPOSITE?

Mobile Nutrients – Nitrate Nitrogen, Sulfur

(Negatively charged, same as soil)

(Influenced by water movement in soil)

Immobile Nutrients – Phosphorus, Potassium,

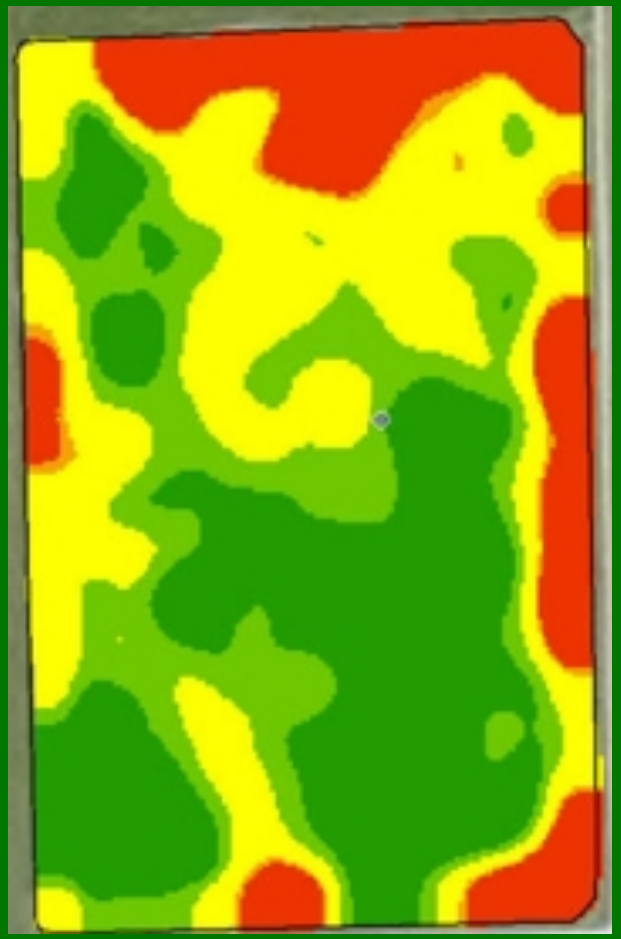
(Positively charged, adheres to soil)

Calcium, Magnesium, Zinc, Iron, etc

N S P K

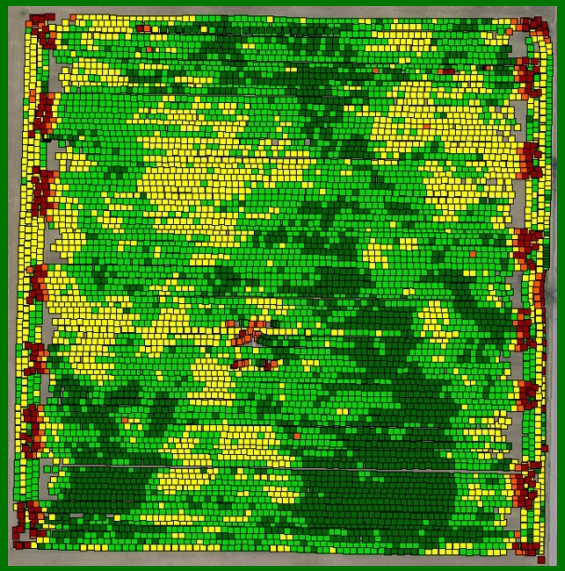
# ZONE CREATION BY WHAT DATA?

Yield Map?
NRCS Maps?
Farmer Input?
Field Topography?
(LandScape Position)



# YIELD MAP ACCURACY

- Poor or Inaccurate Calibration
- Time Delays - Data Spikes
- Position Offsets - Missing Data
- Wobbly GPS - Data Overload
- Overlaps
- Multi-Harvesters



# SOIL TEST DATA

Influenced by:

Manure applications (not done by soil type)

Small fields to large fields (soils disregarded)

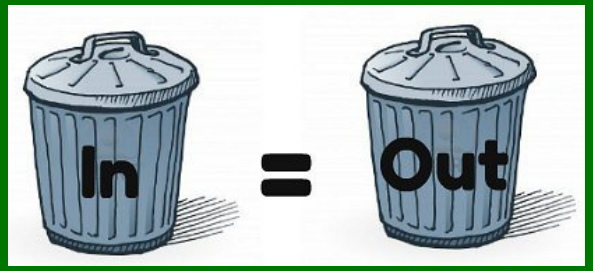
Drainage patterns (random, pattern, etc)

Native fertility – not consistent across soil types which are identified mainly by physical characteristics

# GARBAGE IN - GARBAGE OUT

How quality consistent is field soil sampling?

- Depth of cores, tilled or compacted soil
- Placement of cores, Number of cores
- Probe – Auger – Machine – Manual
- Time of sampling – Spring, Fall?
- Some field softwares are not adequate



# FARMER INPUT ON MAPS??

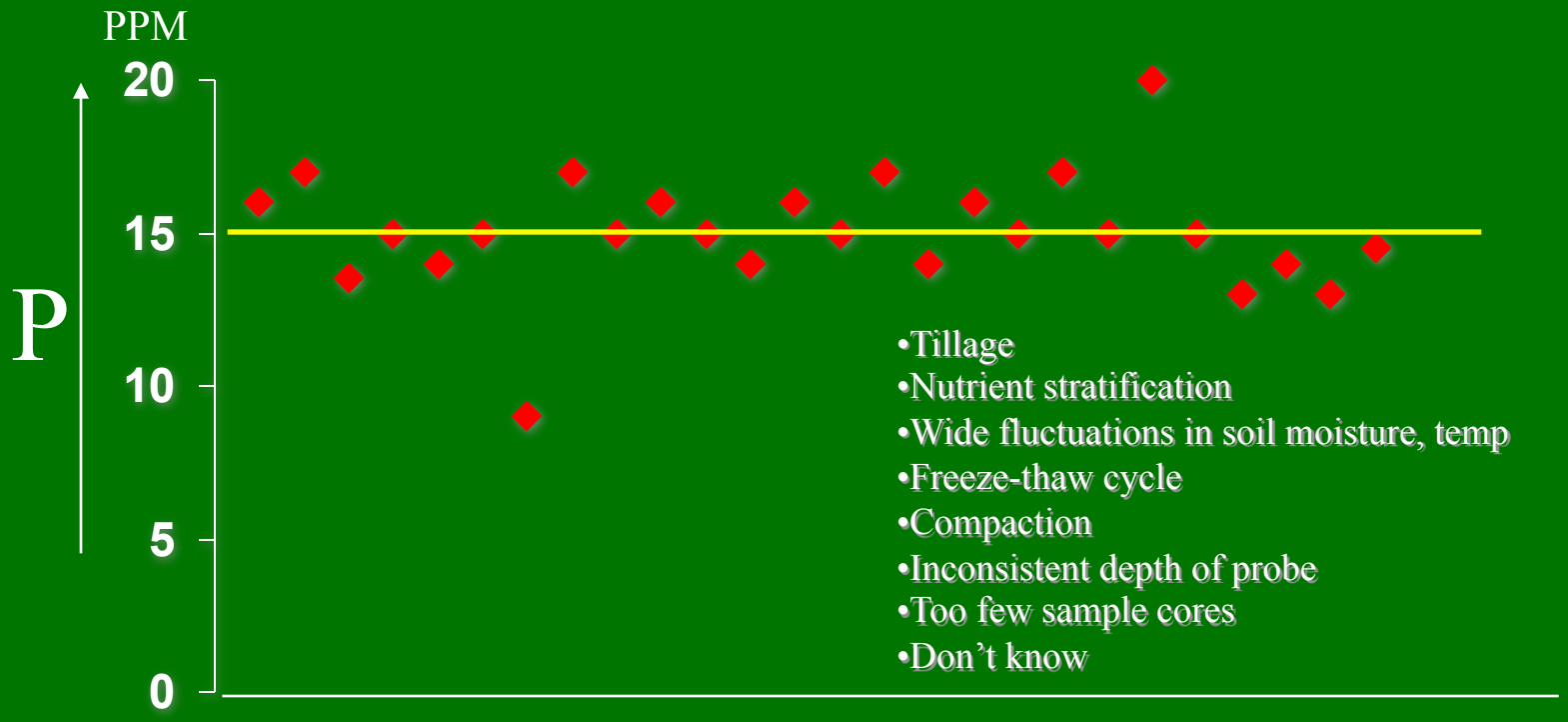
- Farmer may have recently acquired land.
- Large farmer may not drive field equipment.
- May not have all information for decisions.
- Disease, insects, nutrients, etc cannot always be seen by the naked eye.
- All farmers, agronomists, consultants have biases.

# DATA INPUT FOR VARIABLE RATE AND/OR SENSOR DECISIONS

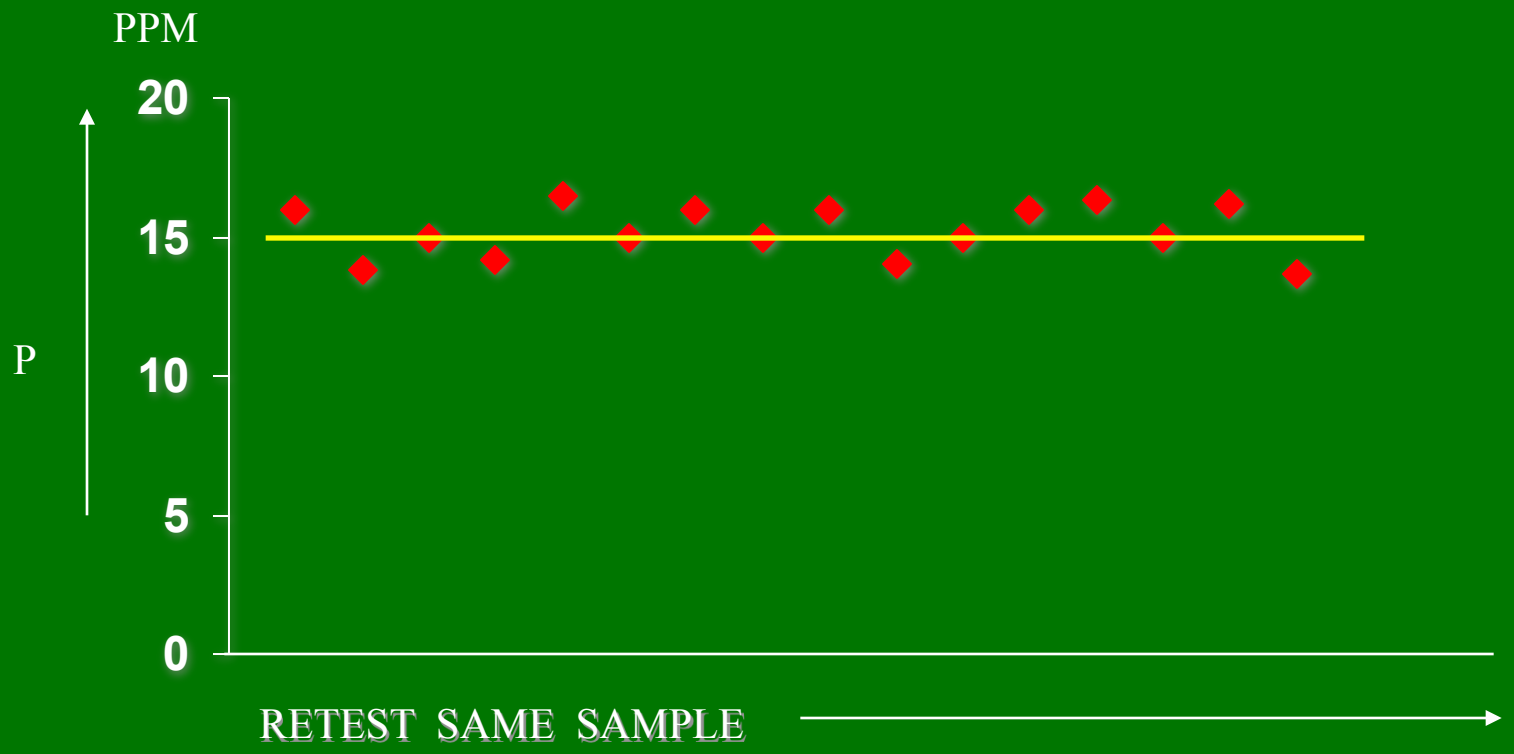
| | |
|---|---|
| •Soil map/topography by EC/EM | 80-100% |
| •Farmer input | 5-60% |
| •Nutrient & pH maps | 20-60% |
| •Yield map | 5-40% |
| •NDVI map | 5-40% |
| •Satellite imagery | 0-5% |
| •Bare soil imagery | 0-5% |

•DOES THE MAP TELL YOU WHAT AND/OR WHY **IT DEPENDS**

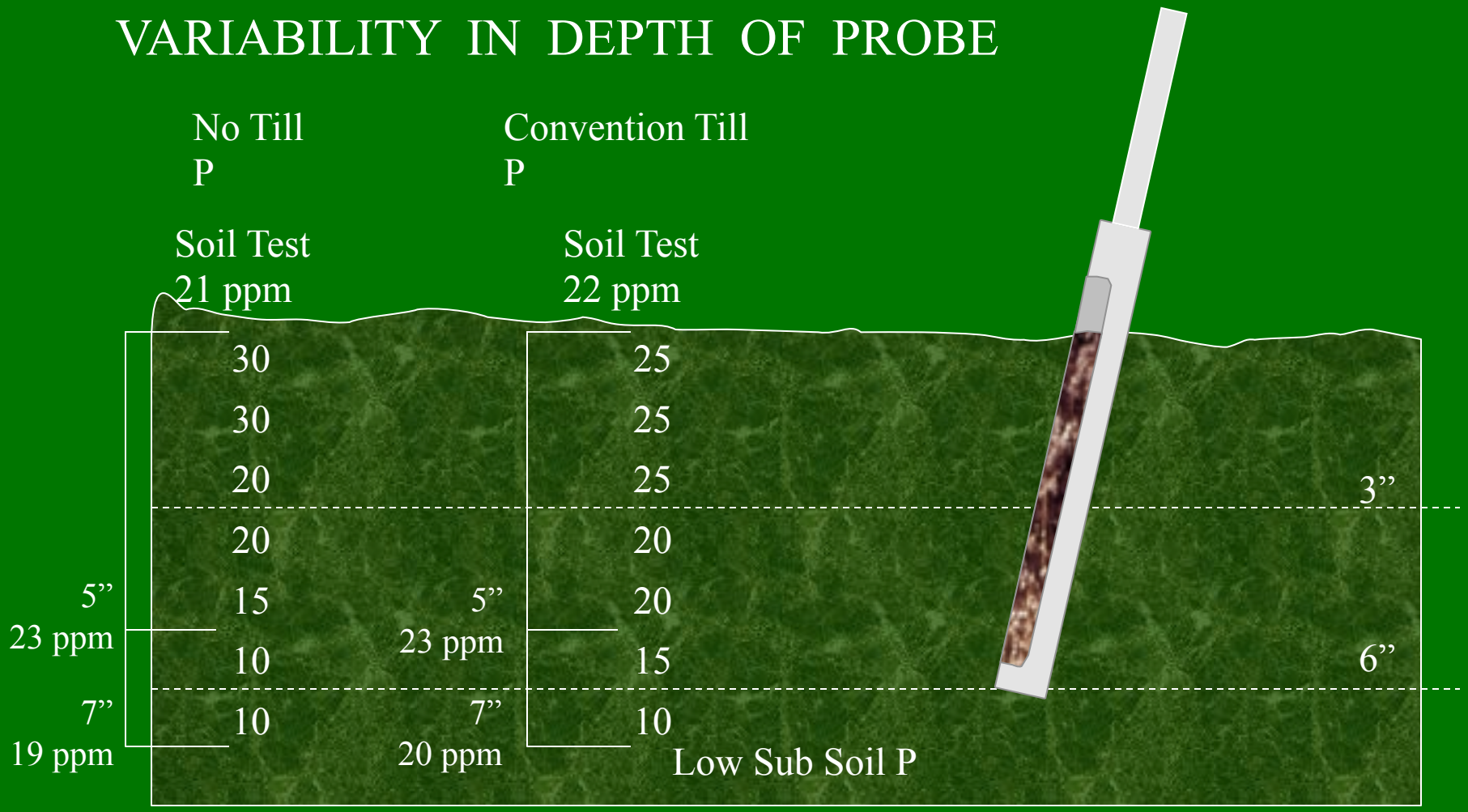
# SOIL NUTRIENT TEST FIELD SAMPLING ACCURACY + / - 15 %, 90% OF THE TIME



# SOIL NUTRIENT TEST LAB ACCURACY +/- 10%



# VARIABILITY IN DEPTH OF PROBE

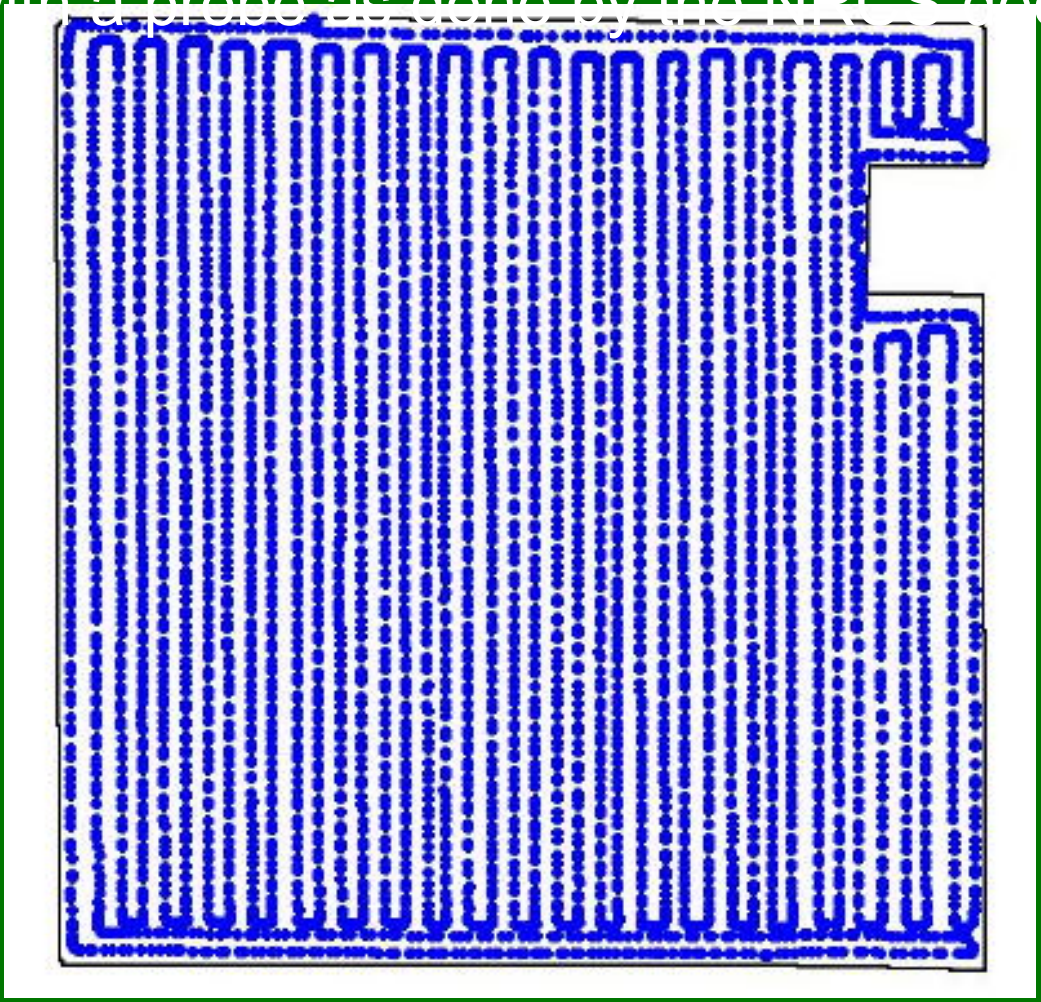



High Sub Soil P would change the soil test very little

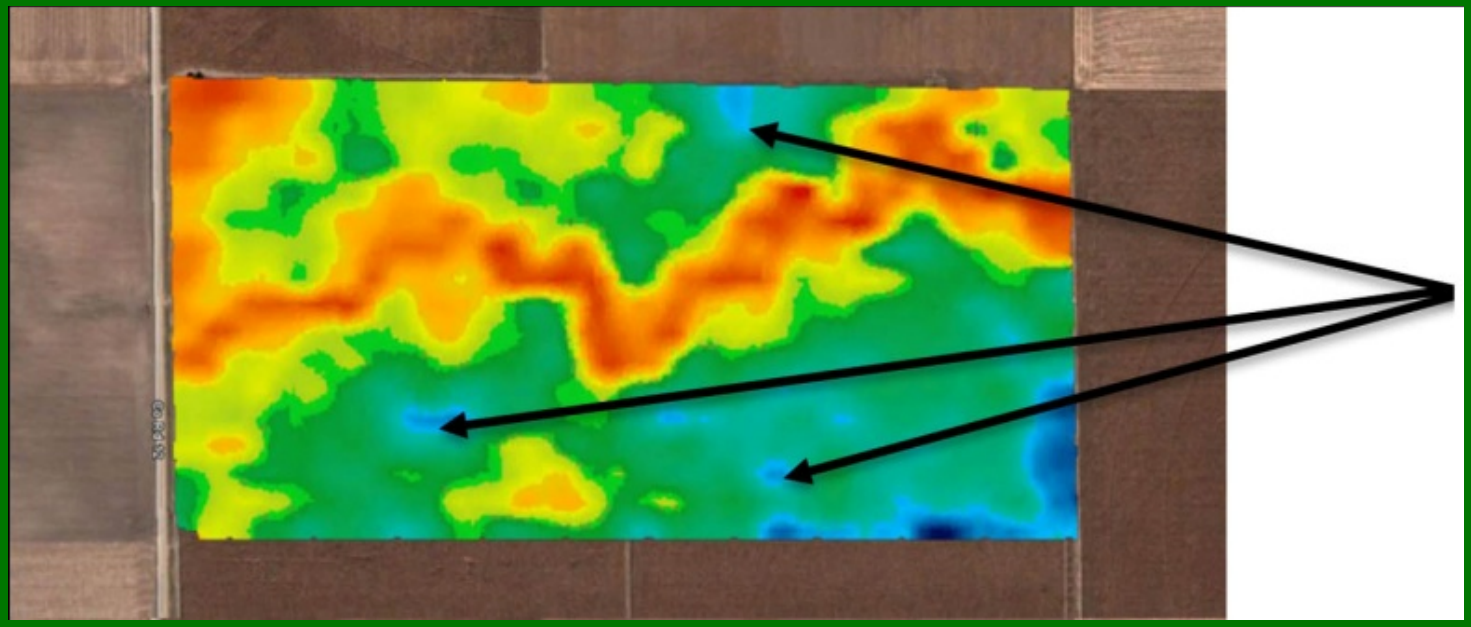
TRACKING MAP OF EM/EC COLLECTION POINTS

Each dot represents a data collection point

An immense amount of data compared to walking the field with a probe as done by the NRCS decades ago



# How can data layers help correct over-irrigation?

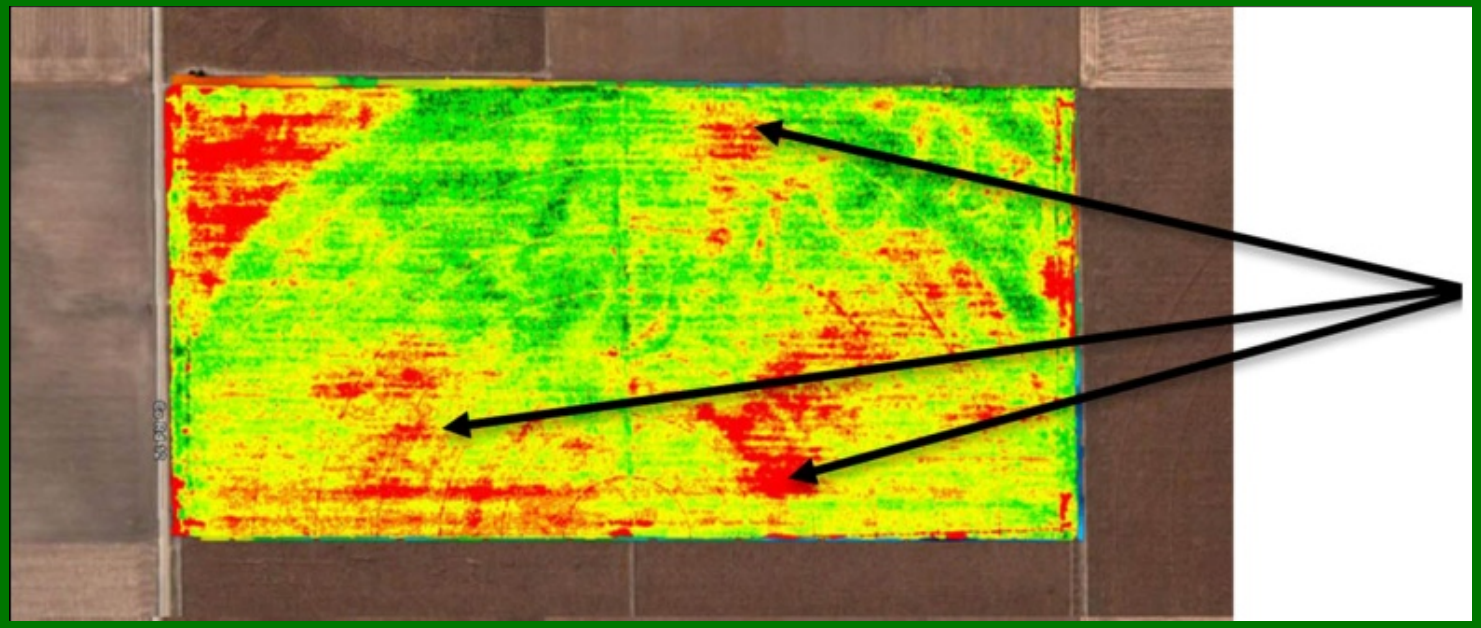


Blue color from EM data layer indicates heavier subsoil with greater water holding capacity

# CROP METRICS

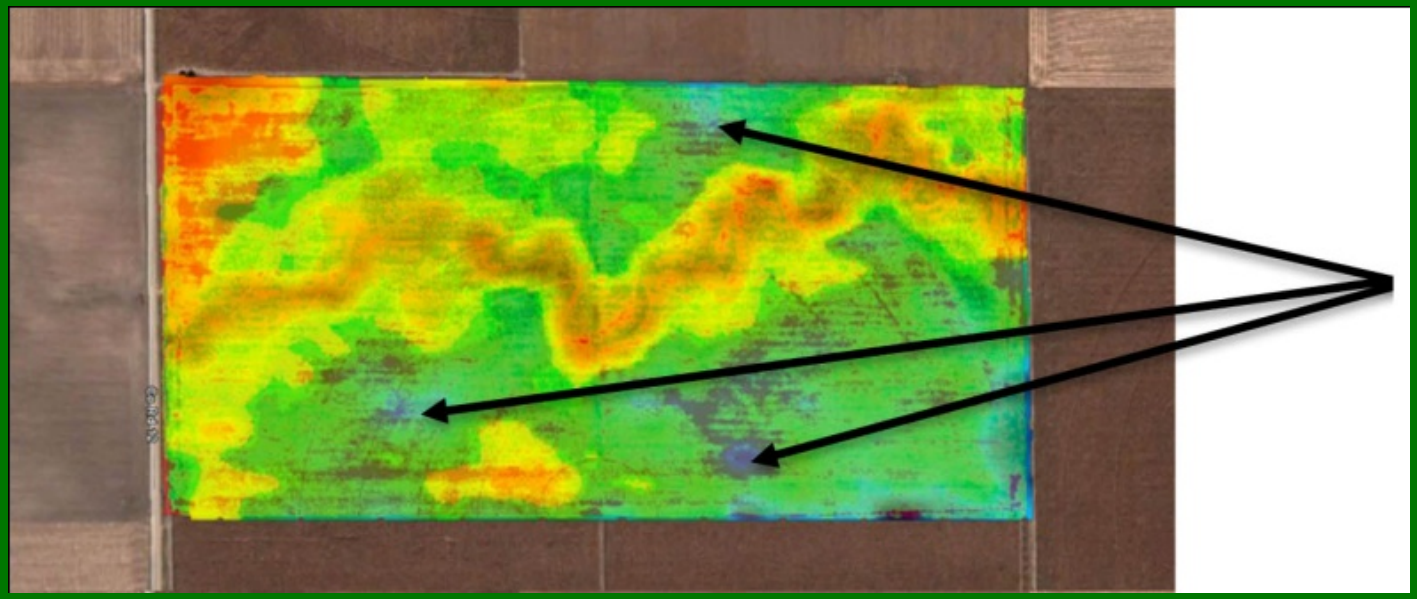
## Agronomic VRI Management

This information from the EC subsoil map where much heavier soil contributes to water logged roots and nitrate losses.



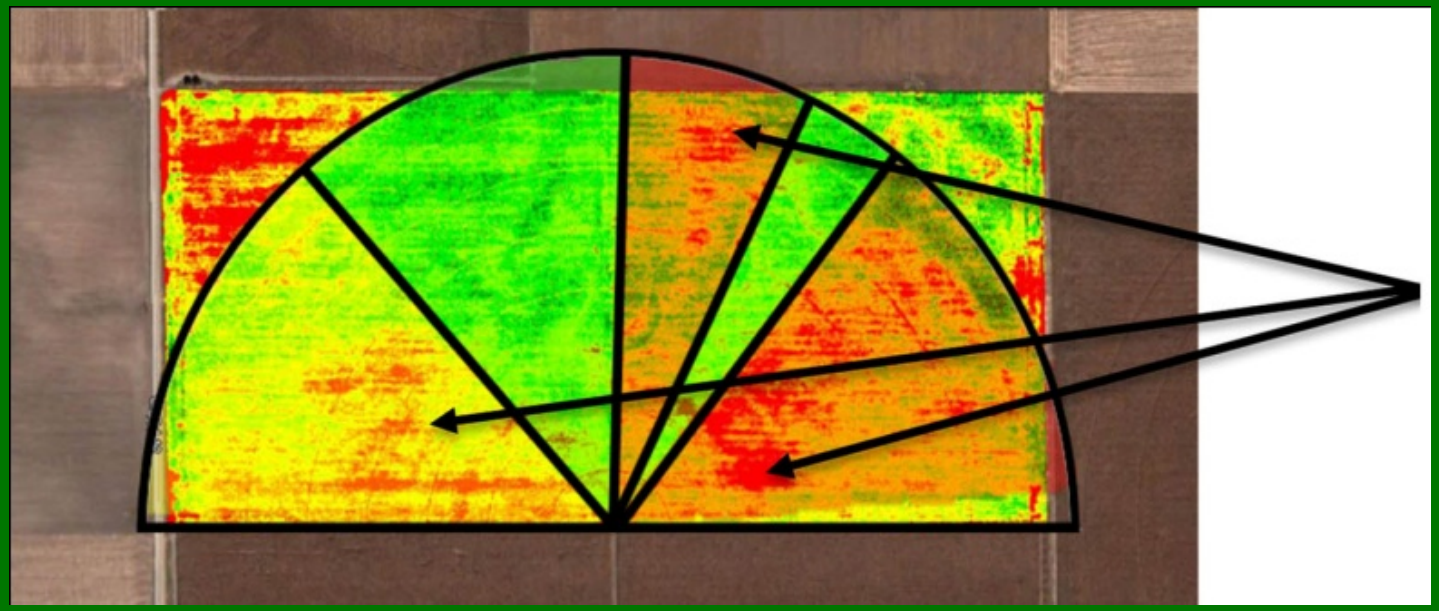
Red color from NDVI data layer (aerial image) indicates areas with high crop stress or low plant health

# CROP METRICS



When above data layers are combined we can see how areas of high crop stress (red) correspond with the heavier soils (blue)

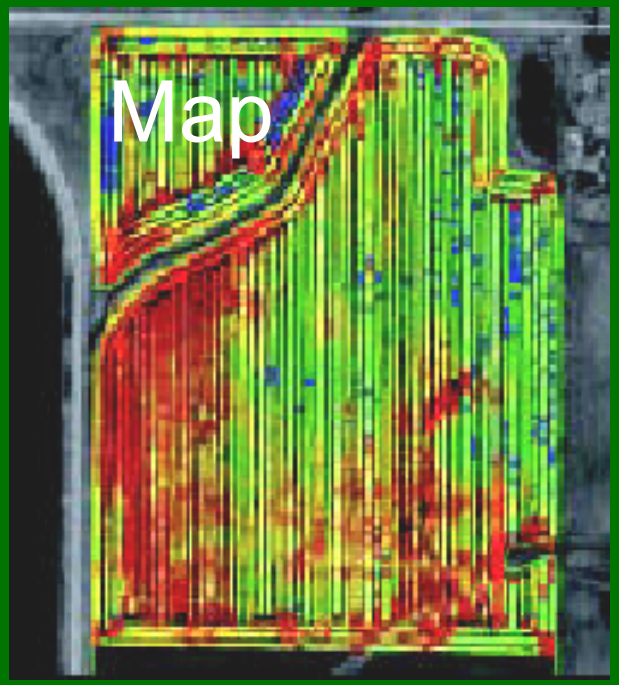
Nick Emanuel founded Crop Metrics and this information is from land the family farms.



Specialized VRI software allows **CropMetrics** to generate zones that reduce irrigation applications in the heavier soils to eliminate the negative effects of over irrigation

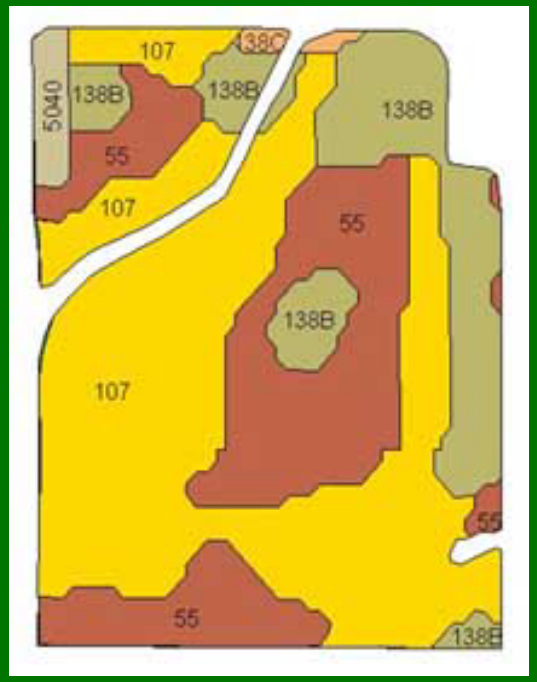
The subsoil EM maps shows where to place water sensors to determine amount and time of irrigation scheduling.

Yield Map



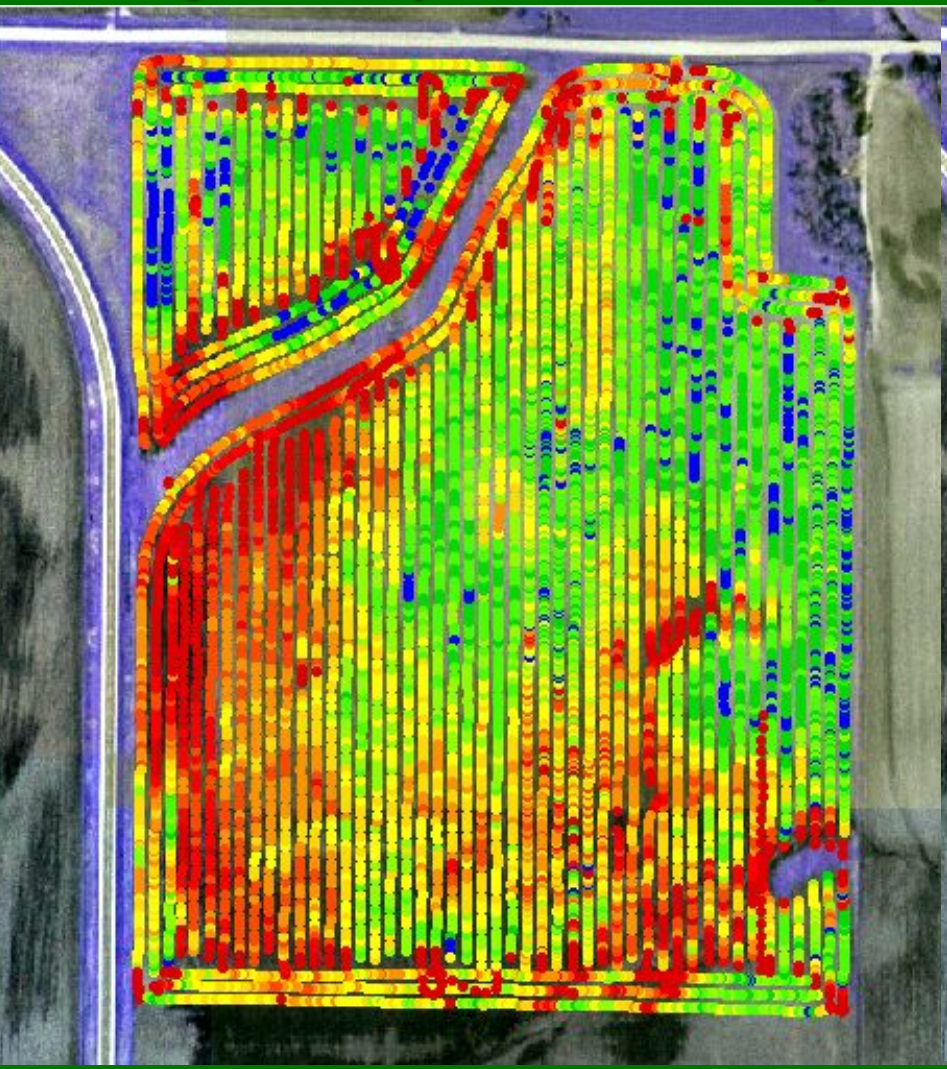
EC/EM Soil Map

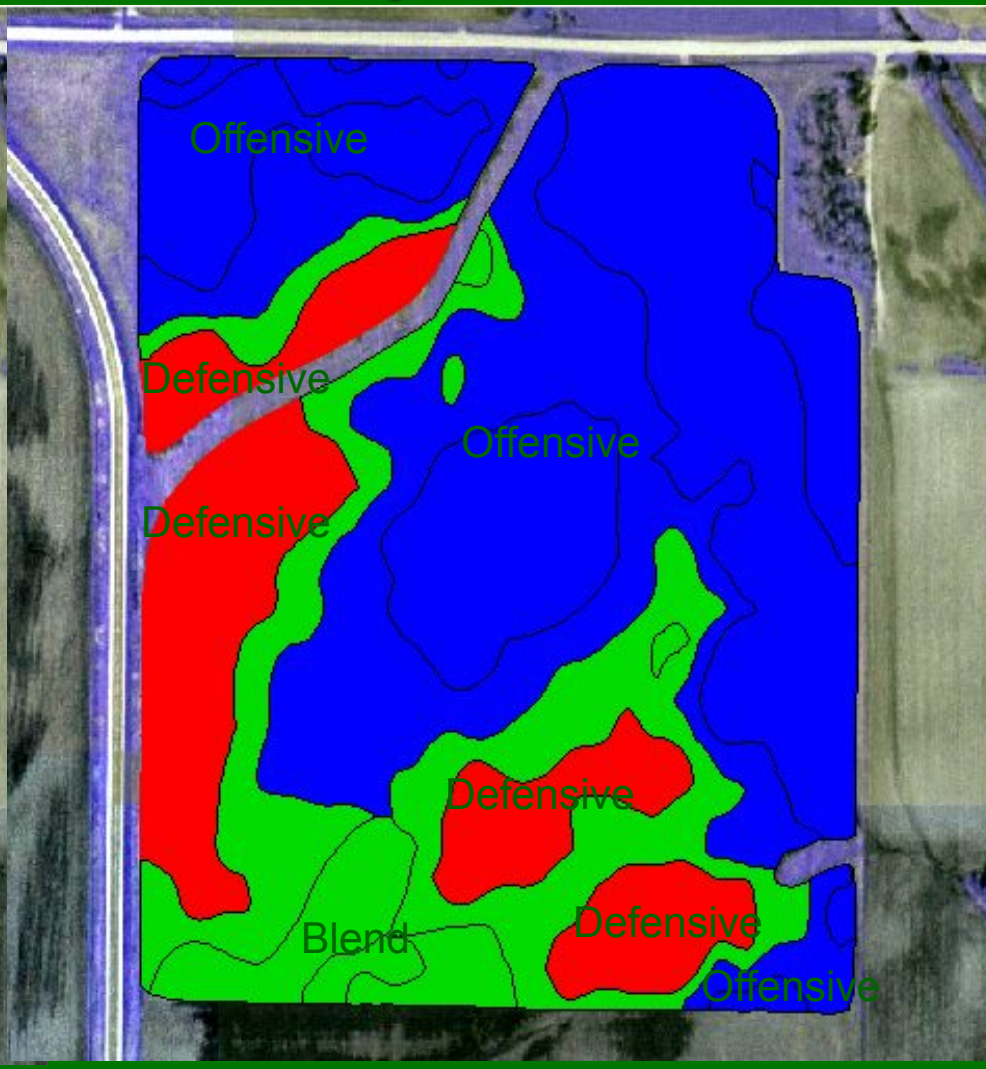
NRCS Soil




Accurate soils map + yield, track closely for iron chlorosis in glacial till soils

# *MAPS MVP*
# (Multiple Variety Placement)





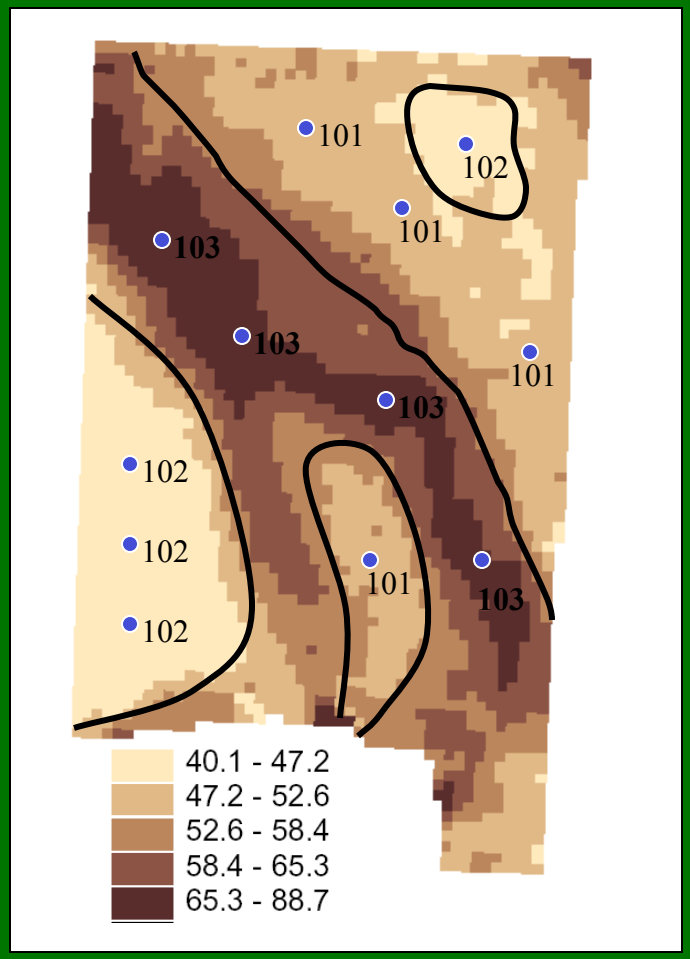
# SOILS MAPPING BY EC

April – June referred time for EC maps

Elevation map (not RTK) also supplied.

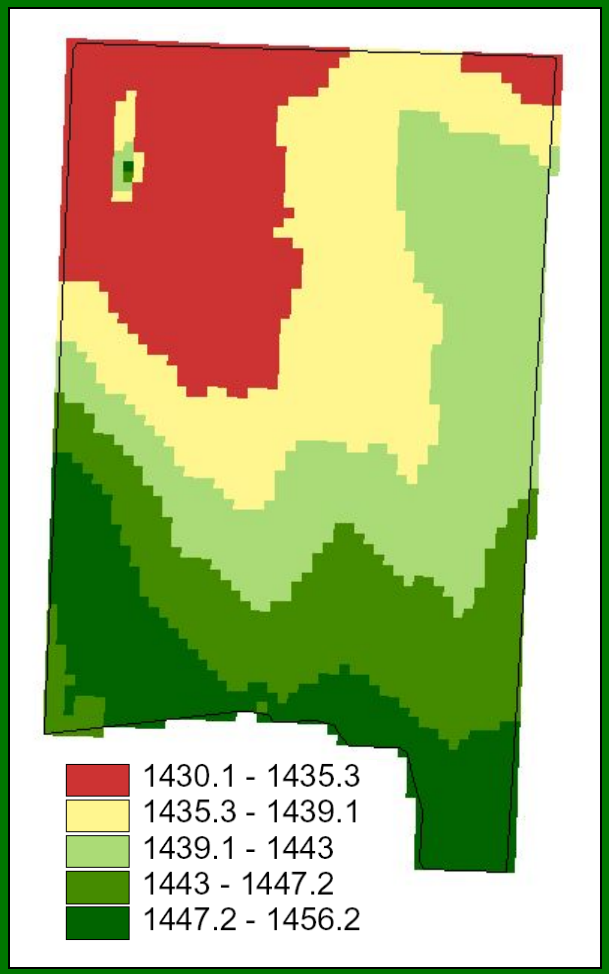
| Sample # | P Test Level |
|---|---|
| 101 | 14 ppm |
| 102 | 28 ppm |
| 103 | 11 ppm |

P applications are twice the rate for #103 as for #102

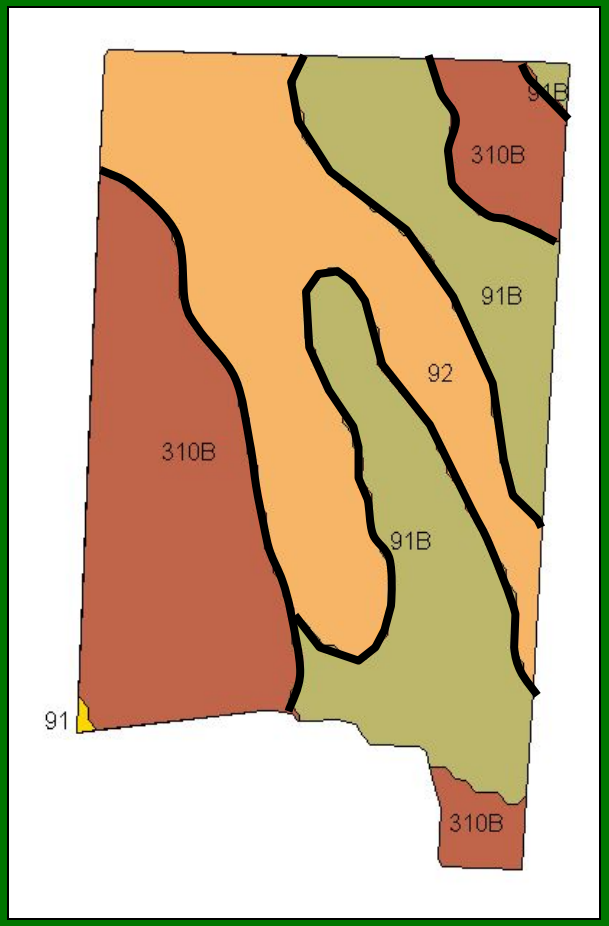



One time fee. Since soils are essential in ag productions, an accurate soil map is necessary to make good agronomic decisions.

# Zone/Soil Type Sampling



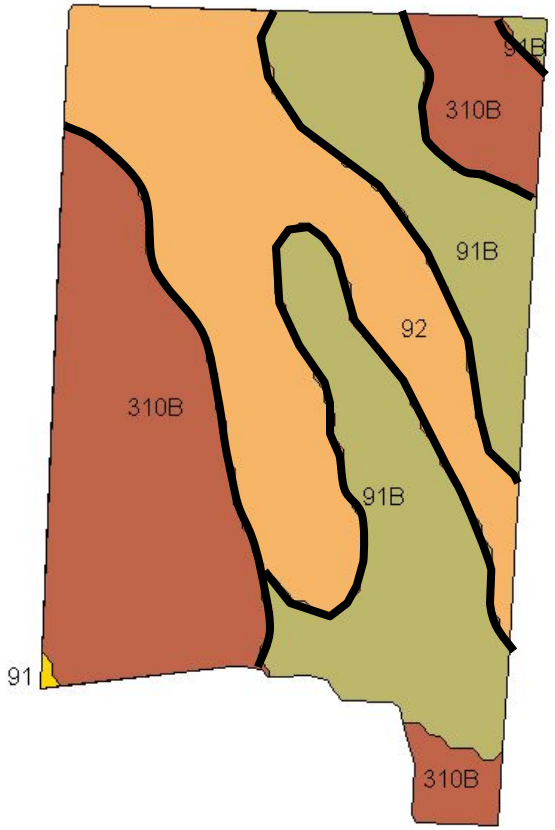

- Landscape Positions
- NRCS Soils Map
- No Agreement



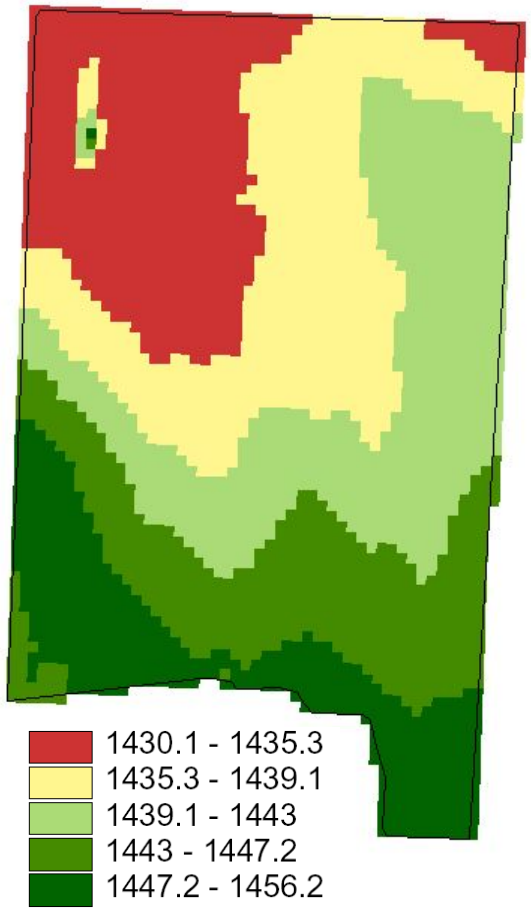
# Zone/Soil Type Sampling

EC Map


NRCS Soil Type

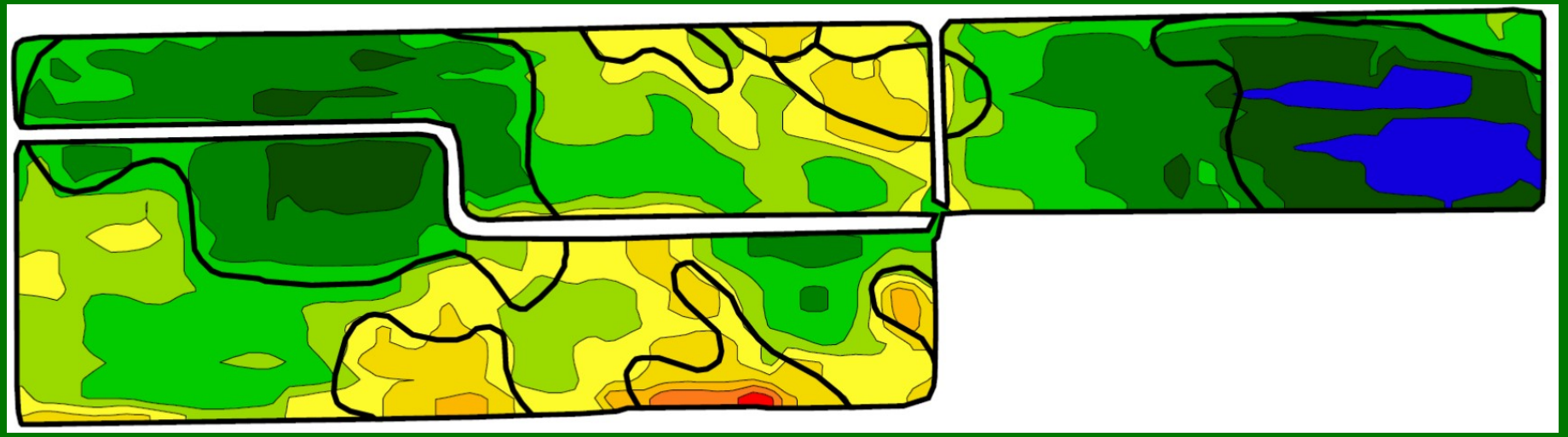



Elevation



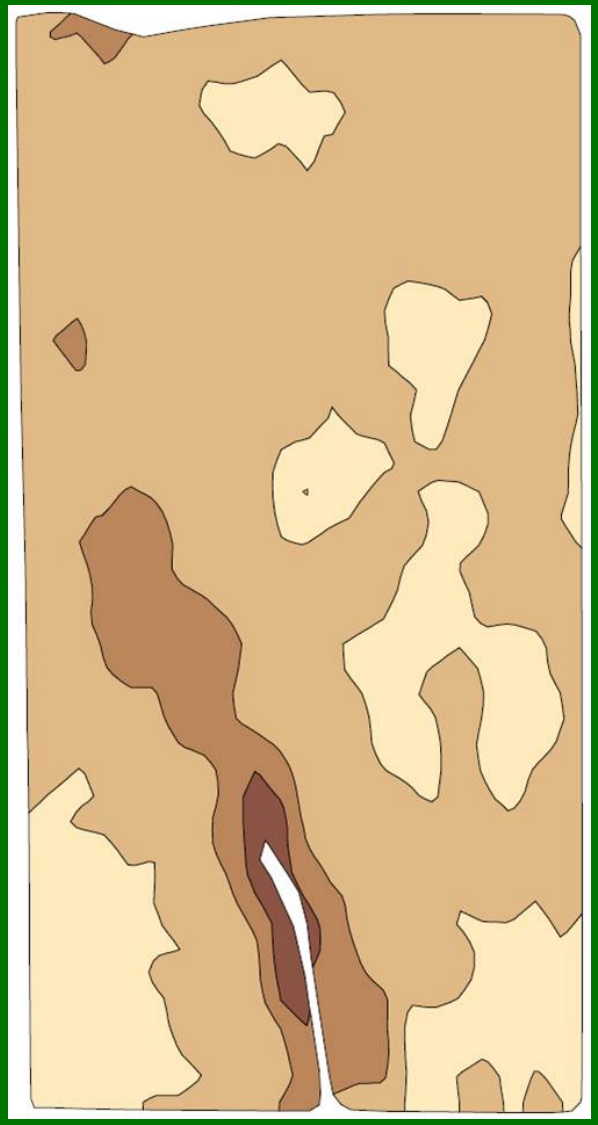
# GLACIAL TILL SOILS, SOUTHERN MINNESOTA

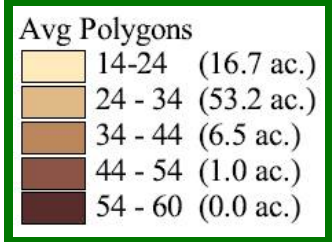
## Elevation with Soil Type Lines



Ele Polygons
- 1075.3 - 1077.3 (5.1 ac.)
- 1077.3 - 1079.2 (10.8 ac.)
- 1079.2 - 1081.2 (24.3 ac.)
- 1081.2 - 1083.2 (28.3 ac.)
- 1083.2 - 1085.1 (21.8 ac.)
- 1085.1 - 1087.1 (17.0 ac.)
- 1087.1 - 1089.1 (8.3 ac.)
- 1089.1 - 1091 (1.1 ac.)
- 1091 - 1093 (0.5 ac.)
- 1093 - 1095 (0.1 ac.)

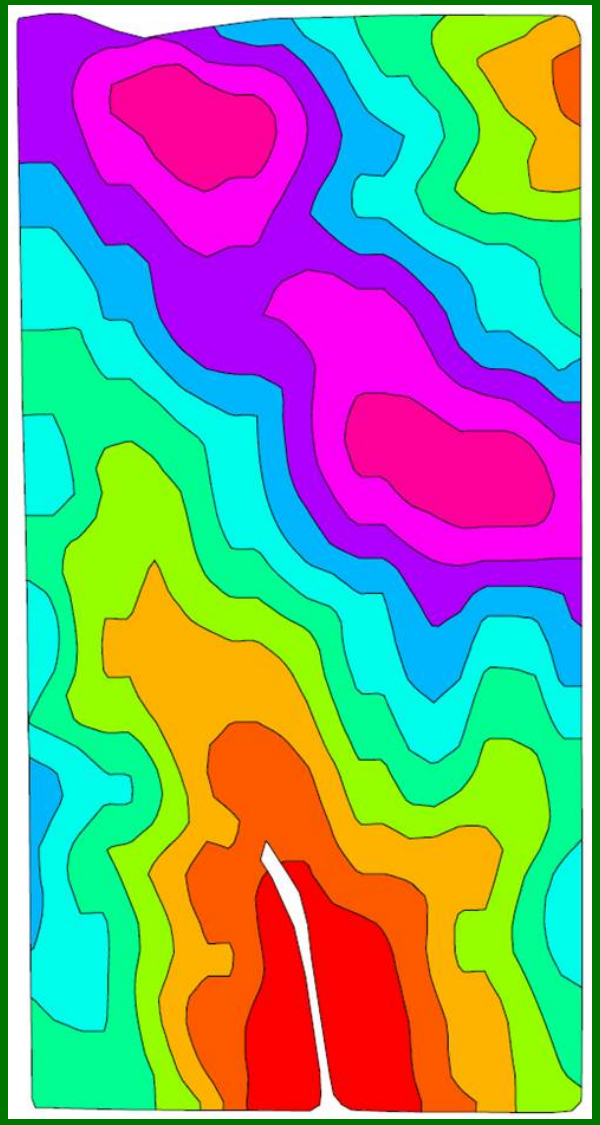
## Average EM Map

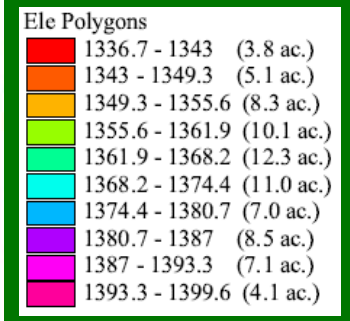





Small Change in Soils

## RTK Elevation Map





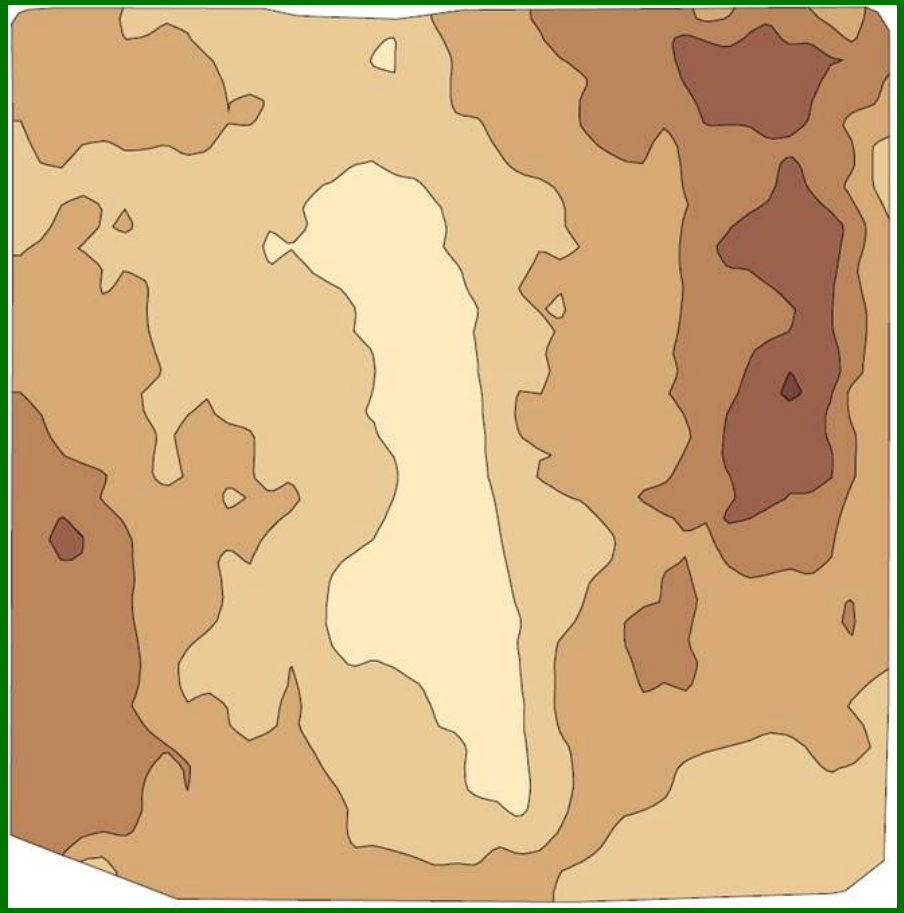

33 feet Elevation Change

# LANDSCAPE POSITION

Lincoln County, SD

77.38 Acres

## Average EM Map
Same Scale - 7 Breaks

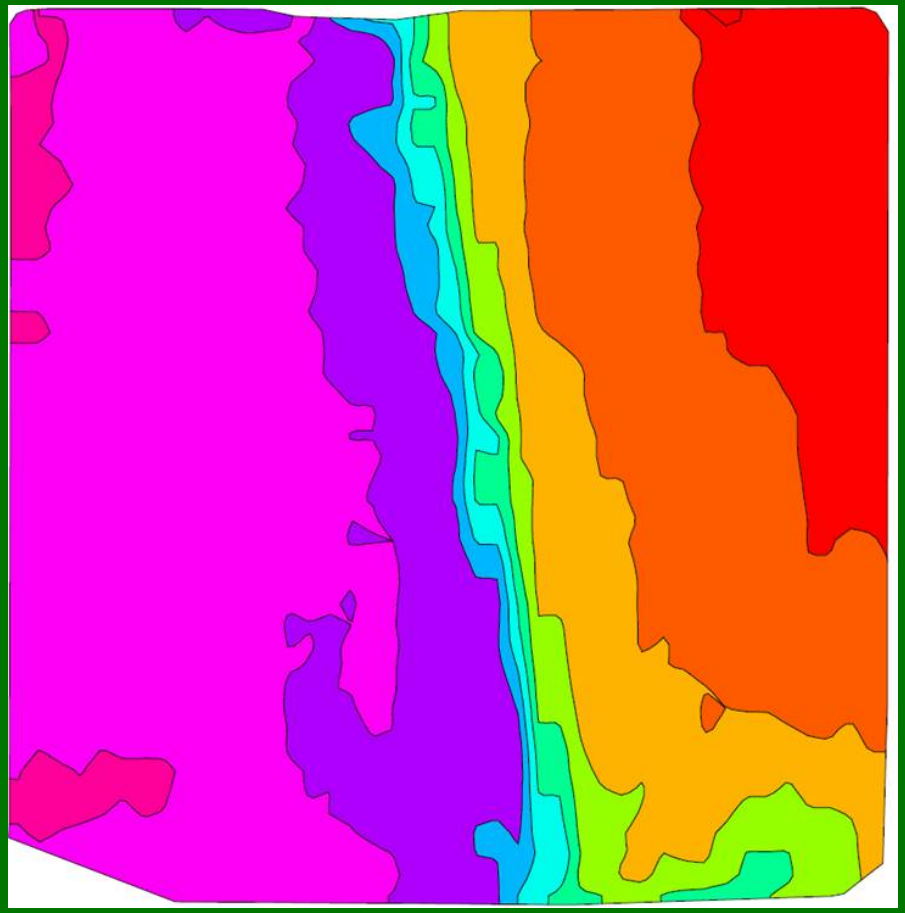


Avg Polygons

| | |
|---|---|
| 18 - 62 | (14.8 ac.) |
| 62 - 106 | (47.8 ac.) |
| 106 - 150 | (52.5 ac.) |
| 150 - 194 | (24.6 ac.) |
| 194 - 238 | (7.8 ac.) |
| 238 - 282 | (0.1 ac.) |
| 282 - 325 | (0.0 ac.) |

Wide range of soils

## RTK Elevation Map



RTK Polygons

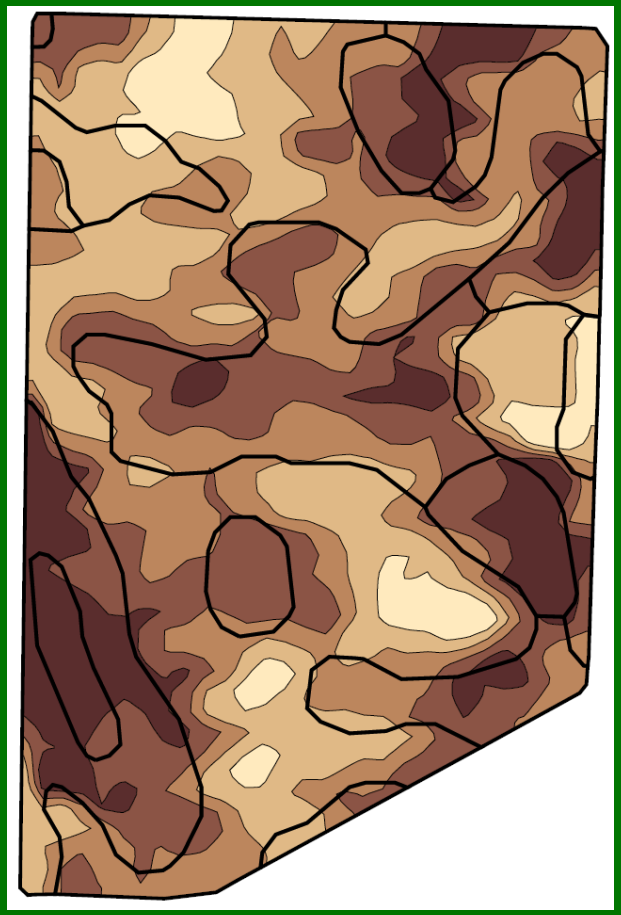
| | |
|---|---|
| 901.2 - 902.3 | (15.8 ac.) |
| 902.3 - 903.5 | (25.8 ac.) |
| 903.5 - 904.6 | (15.7 ac.) |
| 904.6 - 905.7 | (6.8 ac.) |
| 905.7 - 906.8 | (3.5 ac.) |
| 906.8 - 908 | (3.0 ac.) |
| 908 - 909.1 | (3.5 ac.) |
| 909.1 - 910.2 | (19.6 ac.) |
| 910.2 - 911.3 | (50.1 ac.) |
| 911.3 - 912.5 | (3.8 ac.) |

10 feet Elevation Change

Walsh County, ND

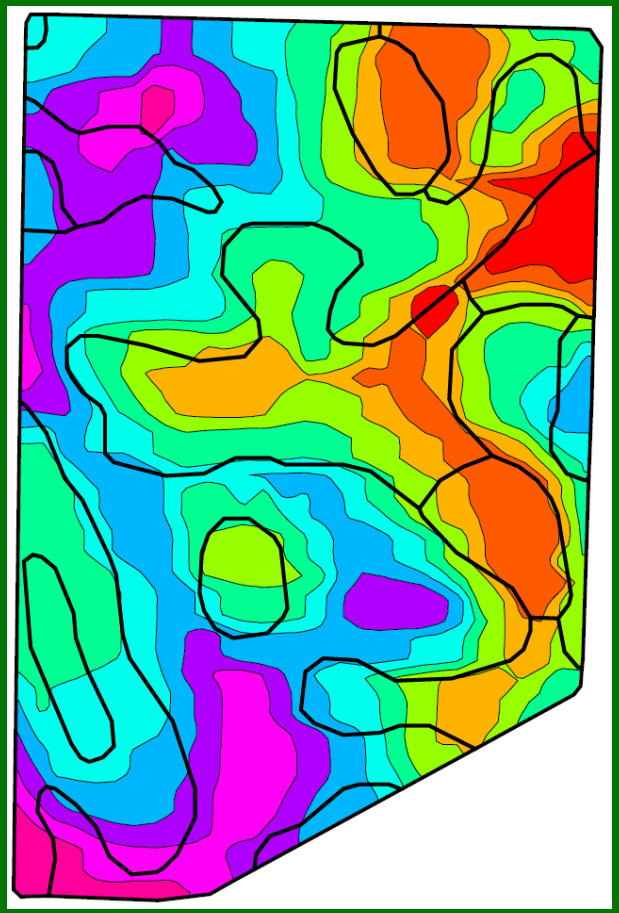
147.62 Acres

# Subsoil EC Map with NRCS Soil Type Lines



Subsoil Polygons
- 16.1 - 29.3 (5.4 ac. - 5.6%)
- 29.3 - 37.5 (23.0 ac. - 24.2%)
- 37.5 - 44.5 (29.1 ac. - 30.6%)
- 44.5 - 50.8 (24.7 ac. - 26.0%)
- 50.8 - 62.0 (12.9 ac. - 13.6%)

# RTK Elevation Map with NRCS Soil Type Lines



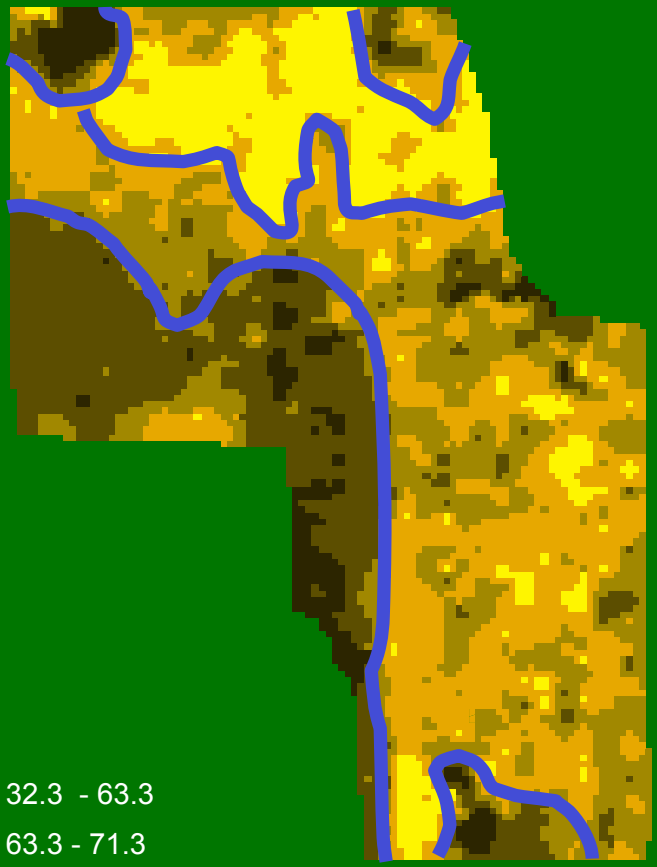
RTK Polygons
- 637.2 - 638.2 (2.4 ac.)
- 638.2 - 639.3 (7.4 ac.)
- 639.3 - 640.3 (9.1 ac.)
- 640.3 - 641.4 (13.0 ac.)
- 641.4 - 642.4 (17.2 ac.)
- 642.4 - 643.5 (14.3 ac.)
- 643.5 - 644.5 (14.2 ac.)
- 644.5 - 645.6 (10.6 ac.)
- 645.6 - 646.6 (5.3 ac.)
- 646.6 - 647.7 (1.6 ac.)

NRCS maps are not accurate enough for Precision Ag

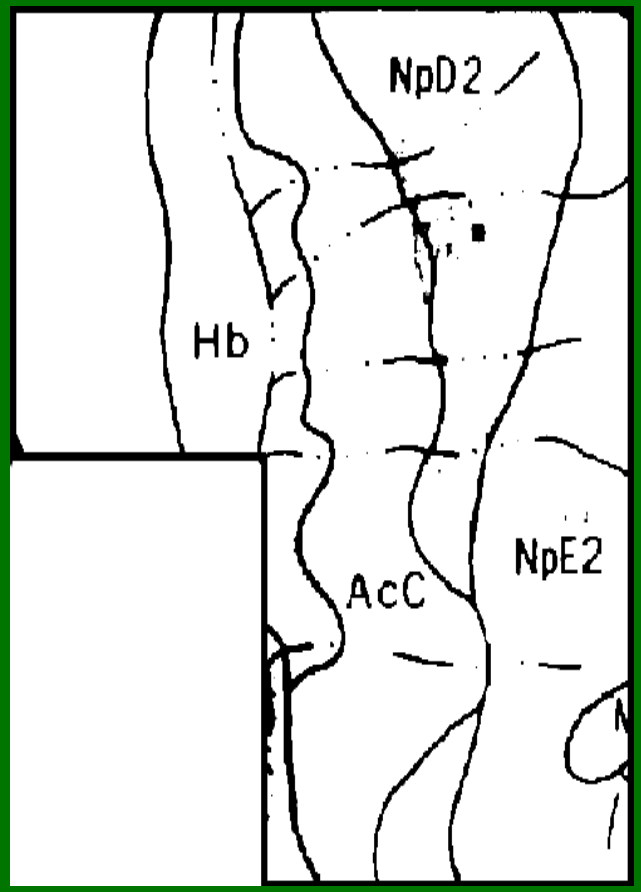
De Witt Co, IL

95.17 Acres

# East Central Nebraska - EC soil map vs NRCS soil map

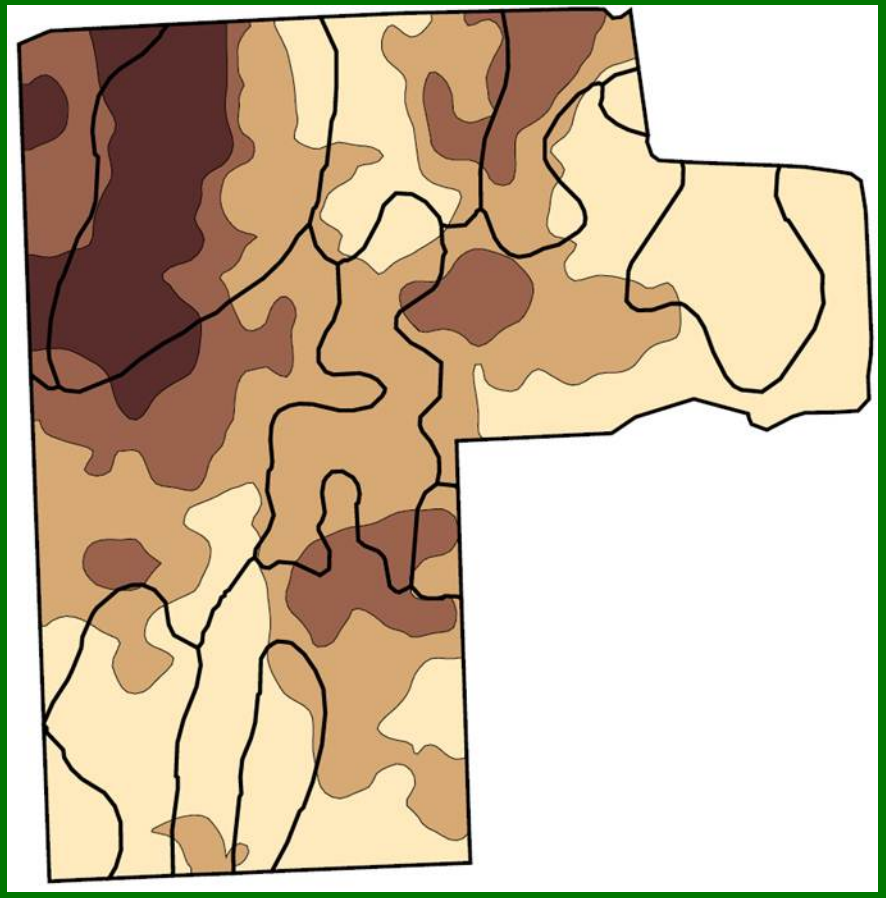


32.3 - 63.3
63.3 - 71.3
71.3 - 79.5
79.5 - 89.6
89.6 - 128.6



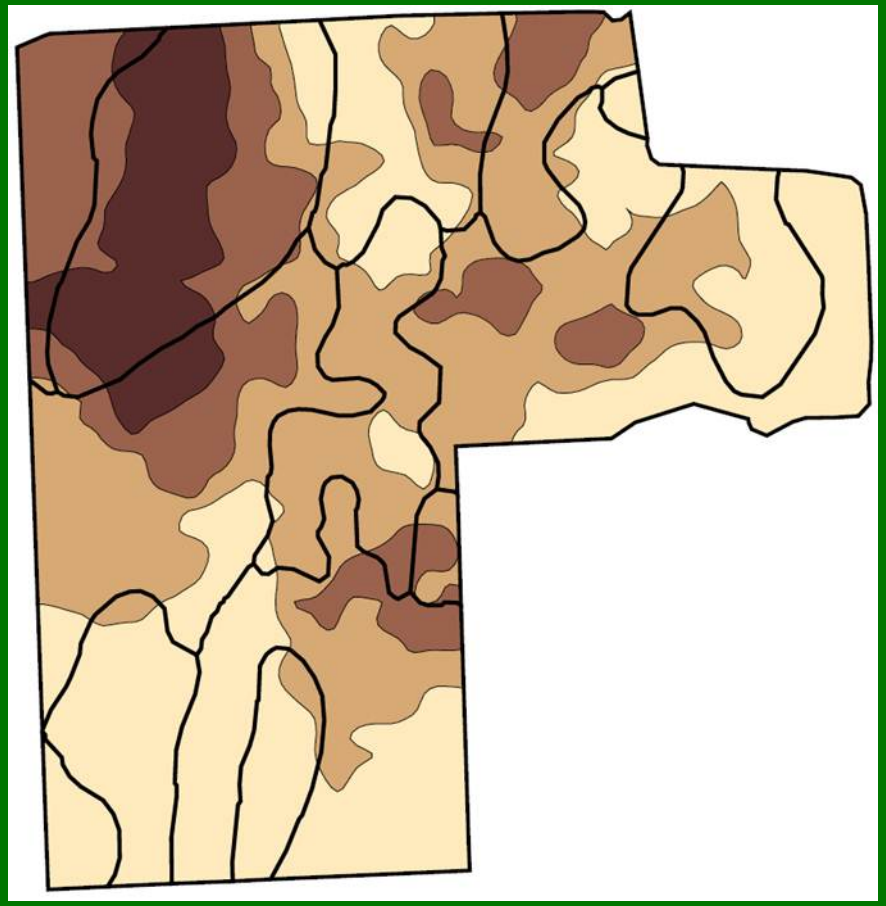

The accuracy of NRCS maps vary widely from state to state and soil type to soil type.

# Subsoil EM Map with NRCS Soil Type Lines



Subsoil Polygons
- 12.7 - 62.7 (42.7 ac.)
- 62.7 - 108.2 (38.7 ac.)
- 108.2 - 167.3 (19.7 ac.)
- 167.3 - 274.7 (11.1 ac.)

# Topsoil EM Map with NRCS Soil Type Lines



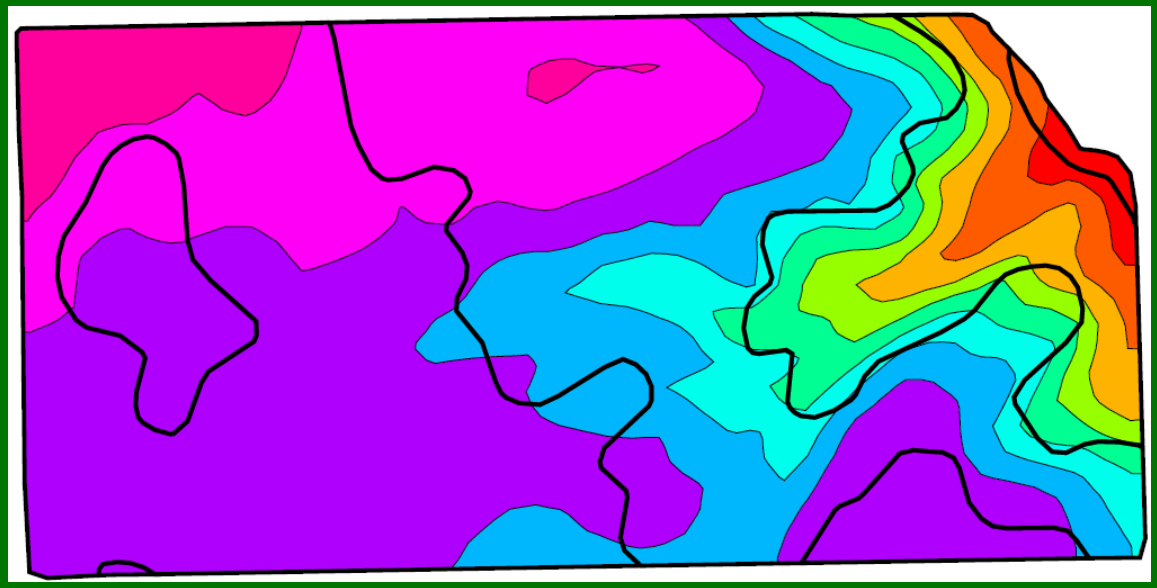
Topsoil Polygons
- 21.5 - 60.3 (43.3 ac.)
- 60.3 - 100.6 (38.6 ac.)
- 100.6 - 160.1 (19.9 ac.)
- 160.1 - 257.8 (10.4 ac.)

Wilkin Co, MN

112.21 Acres

# Subsoil EM Map with NRCS Soil Type Lines

Subsoil Polygons
- 20.0 - 32.7 (1.8 ac.)
- 32.7 - 40.5 (28.4 ac.)
- 40.5 - 45.4 (23.0 ac.)
- 45.4 - 50.9 (18.4 ac.)
- 50.9 - 60.0 (8.3 ac.)



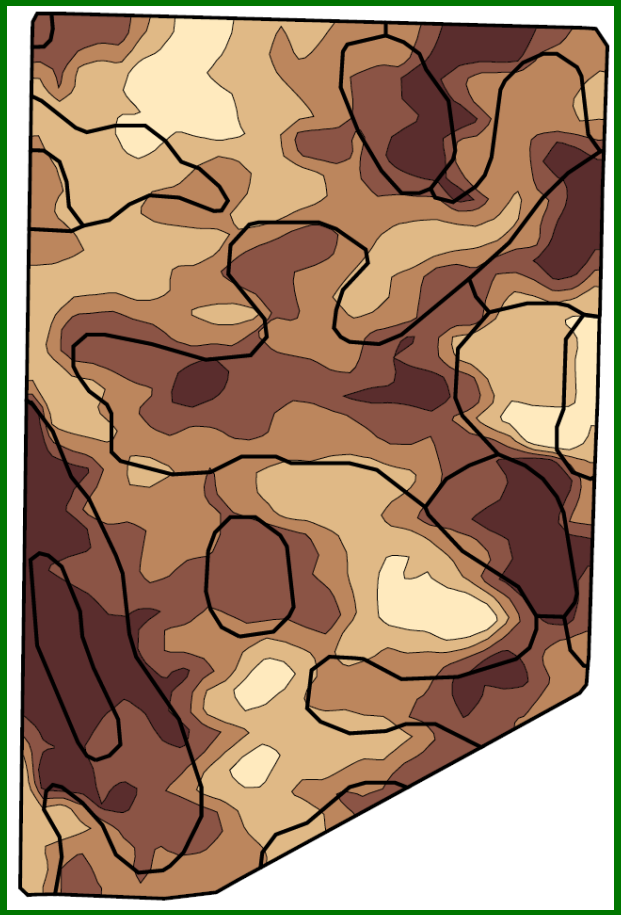
# RTK Elevation Map with NRCS Soil Type Lines

Elevation Polygons
- 770.7 - 773.6 (0.9 ac.)
- 773.6 - 776.4 (2.2 ac.)
- 776.4 - 779.3 (2.7 ac.)
- 779.3 - 782.1 (2.7 ac.)
- 782.1 - 785 (4.0 ac.)
- 785 - 787.9 (6.1 ac.)
- 787.9 - 790.7 (11.9 ac.)
- 790.7 - 793.6 (30.2 ac.)
- 793.6 - 796.4 (15.3 ac.)
- 796.4 - 799.3 (4.2 ac.)

Knox Co, IL

79.97 Acres

# Subsoil EM Map with NRCS Soil Type Lines



Subsoil Polygons

| | |
|---|---|
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| | 37.5 - 44.5 (29.1 ac. - 30.6%) |
| | 44.5 - 50.8 (24.7 ac. - 26.0%) |
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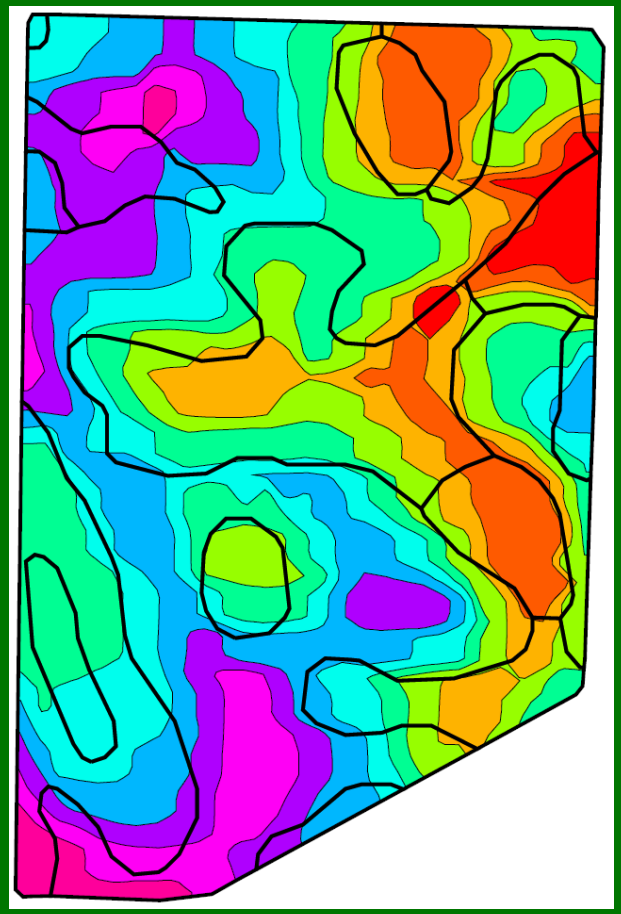

RTK Polygons

| | |
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| | 637.2 - 638.2 (2.4 ac.) |
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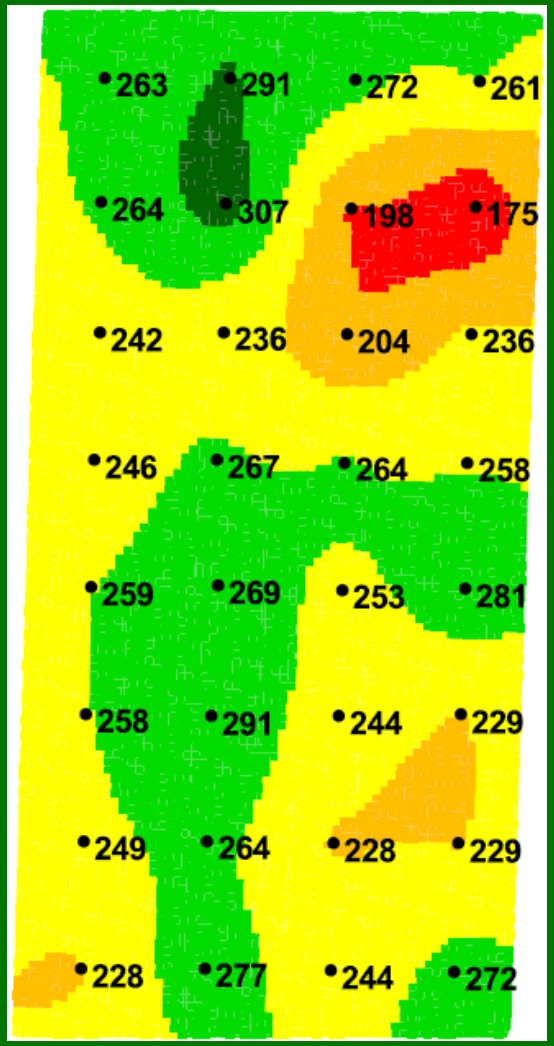
| | 645.6 - 646.6 (5.3 ac.) |
| | 646.6 - 647.7 (1.6 ac.) |

De Witt Co, IL

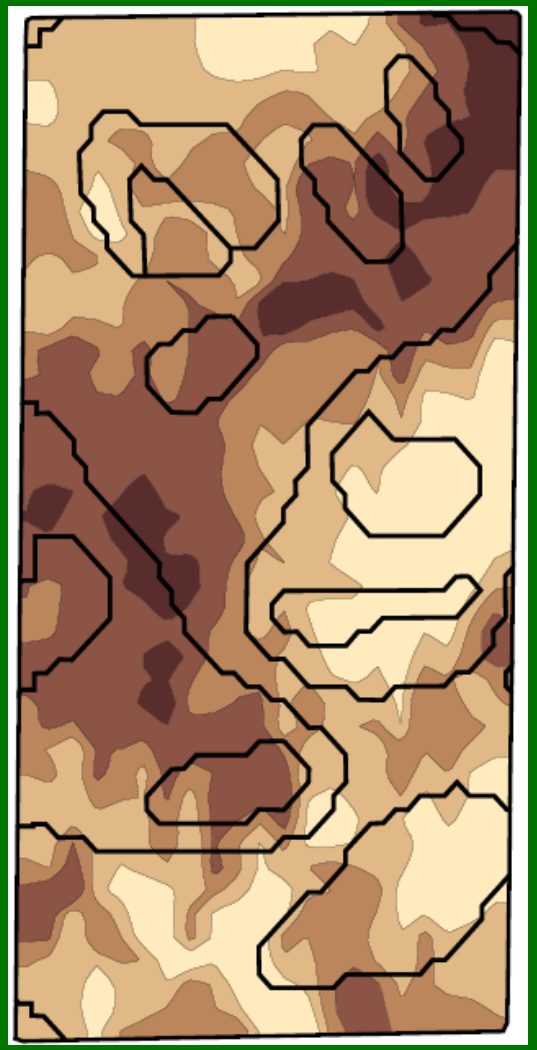
95.17 Acres

ASNT Surface




ASNT Surface
0 - 150
150 - 200
200 - 230
230 - 260
260 - 290
290 - 1000

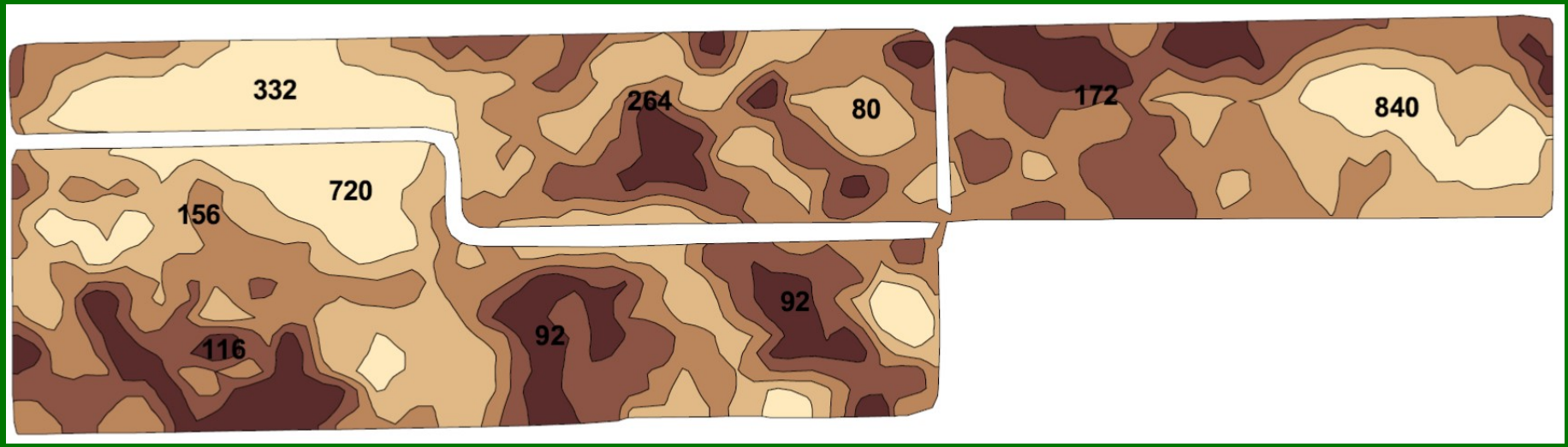
EC Surface



Soil Types
EC Polygons
28.7 - 37.7 (12.8 ac. - 16.8%)
37.7 - 43.4 (22.9 ac. - 30.2%)
43.4 - 49.1 (17.4 ac. - 22.9%)
49.1 - 55.4 (17.8 ac. - 23.5%)
55.4 - 69.2 (5.0 ac. - 6.5%)

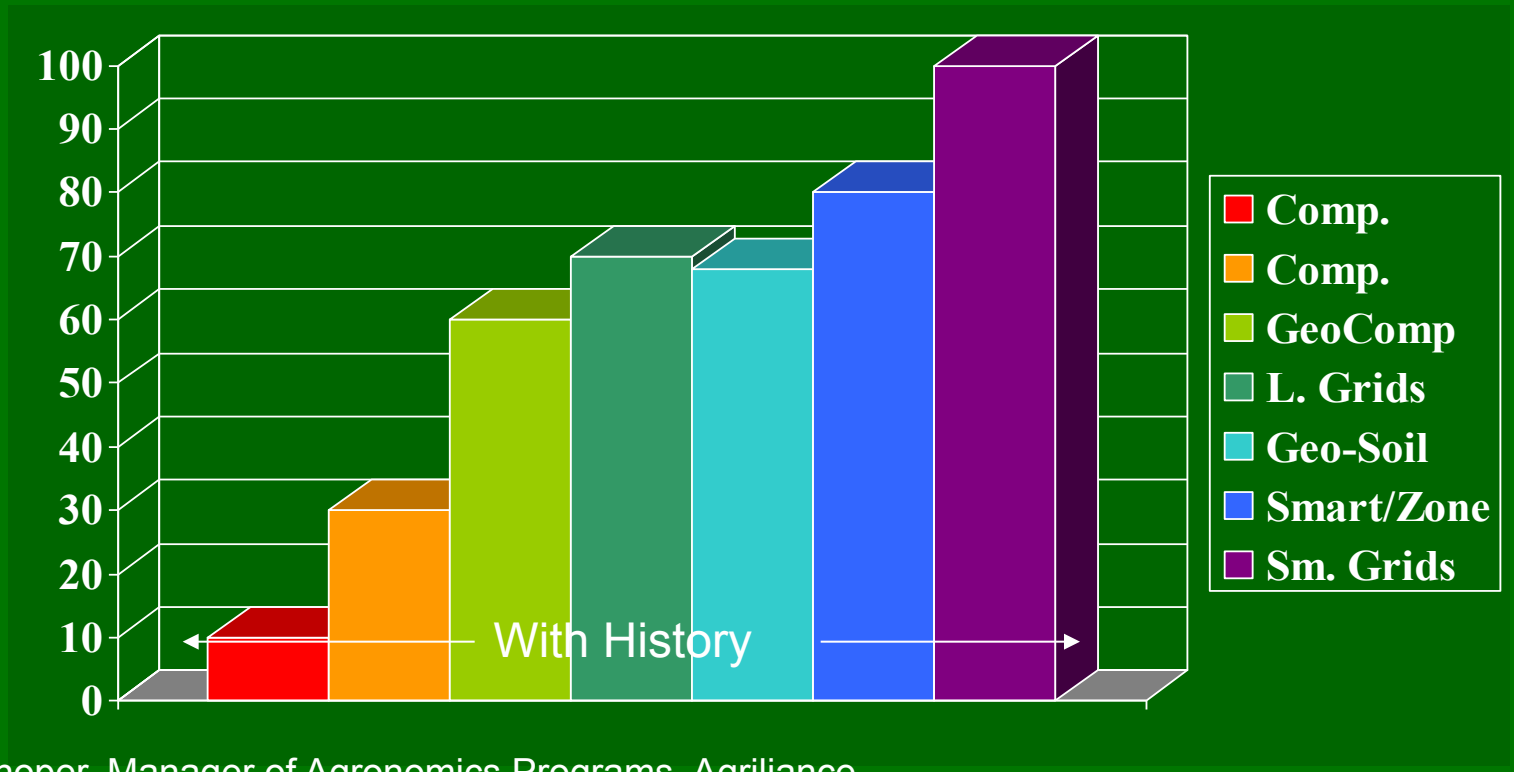
## Topsoil EC with Soil Type Lines


## Topsoil EC with Nitrate Results



Dr. Paul Fixen, Americas Director, International Plant Nutrient Institute, says, "All fields should be **PROPERLY GRID SAMPLED** at least once.

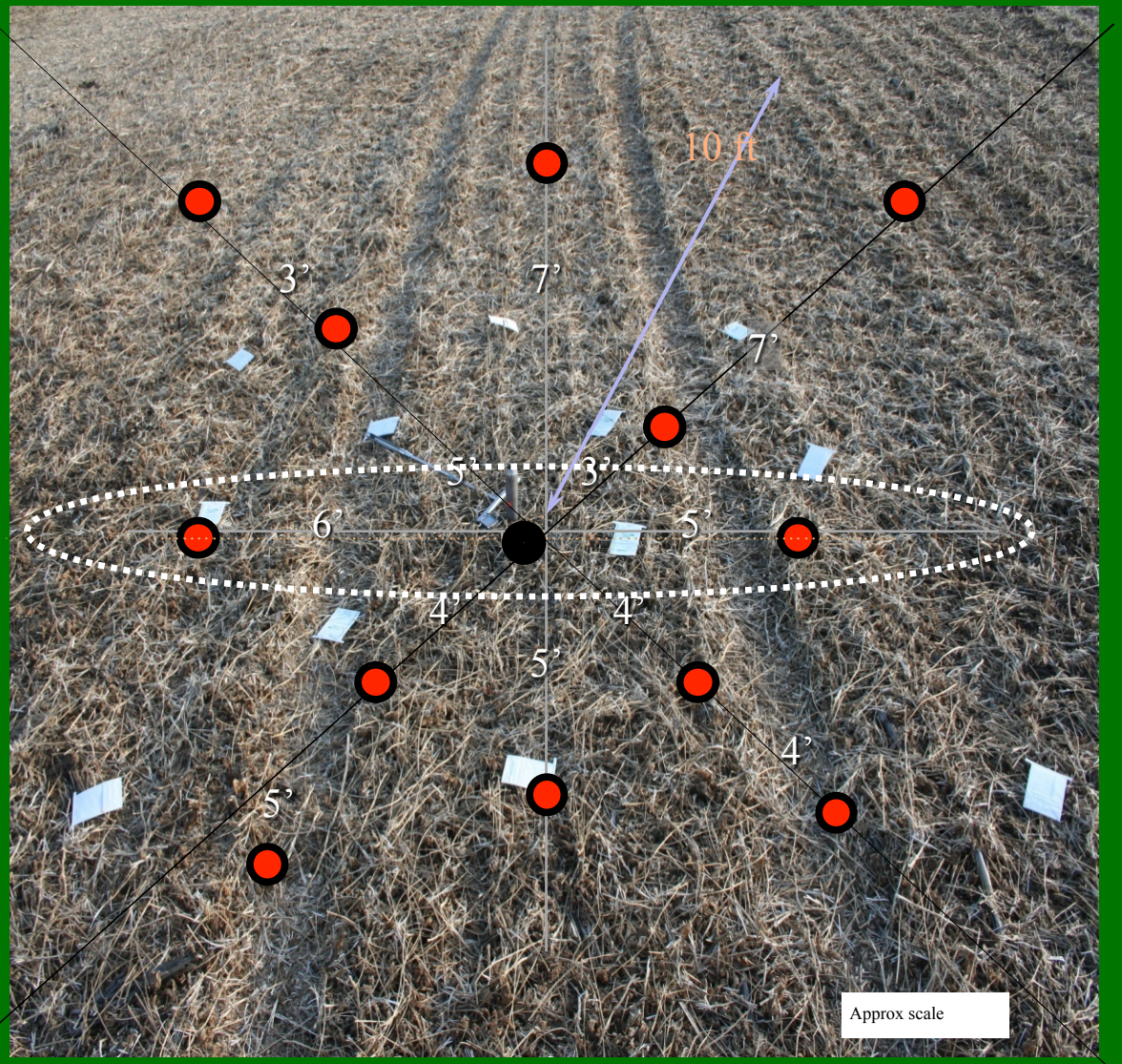
Soil Sampling Systems Decision-making Value*




*Bob Schoper, Manager of Agronomics Programs, Agriliance

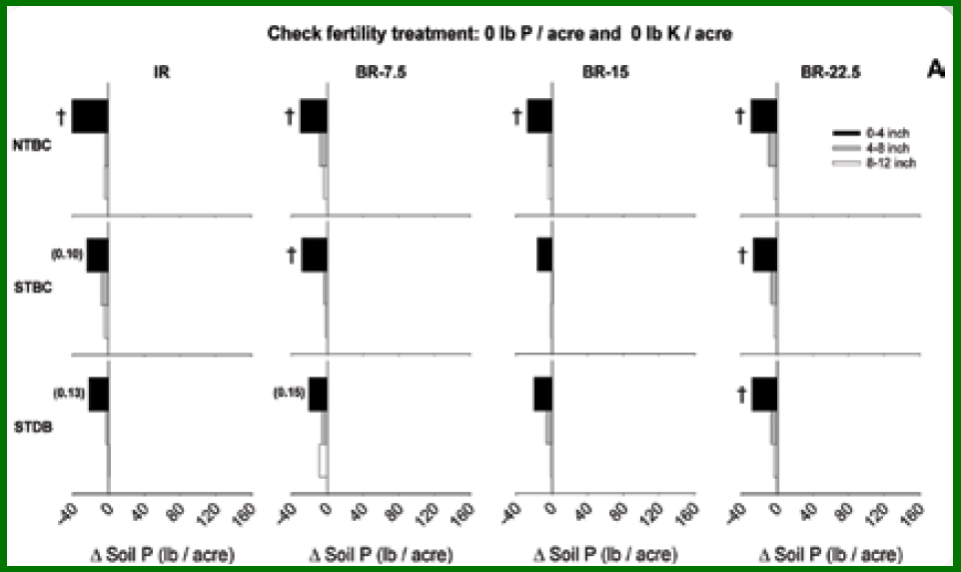
# Sampling Project

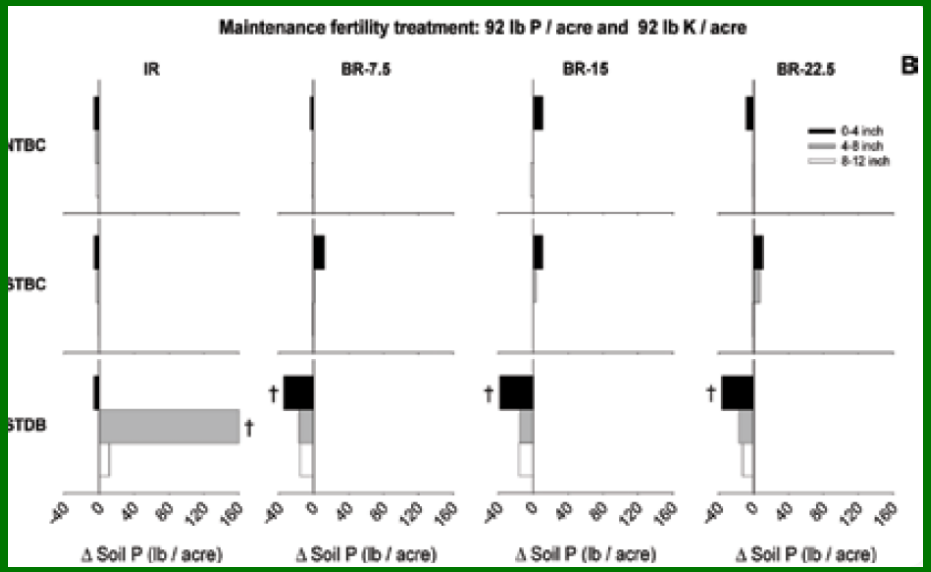
Grid Point
Sampling Layout




Research by:
Dr. Robert Miller
Colorado State Univ.
Director ALPA
(Agricultural
Laboratory
Proficiency
Association)

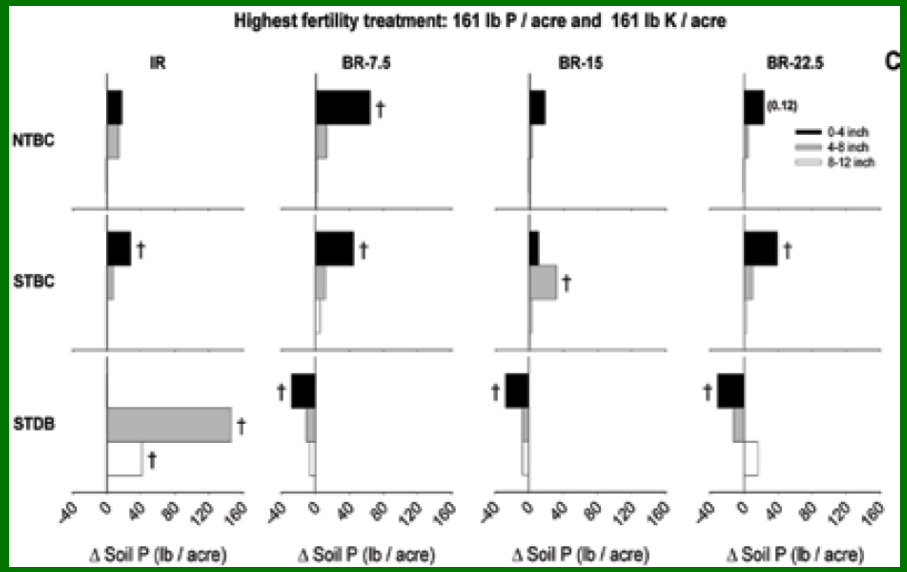
Miller, 2011



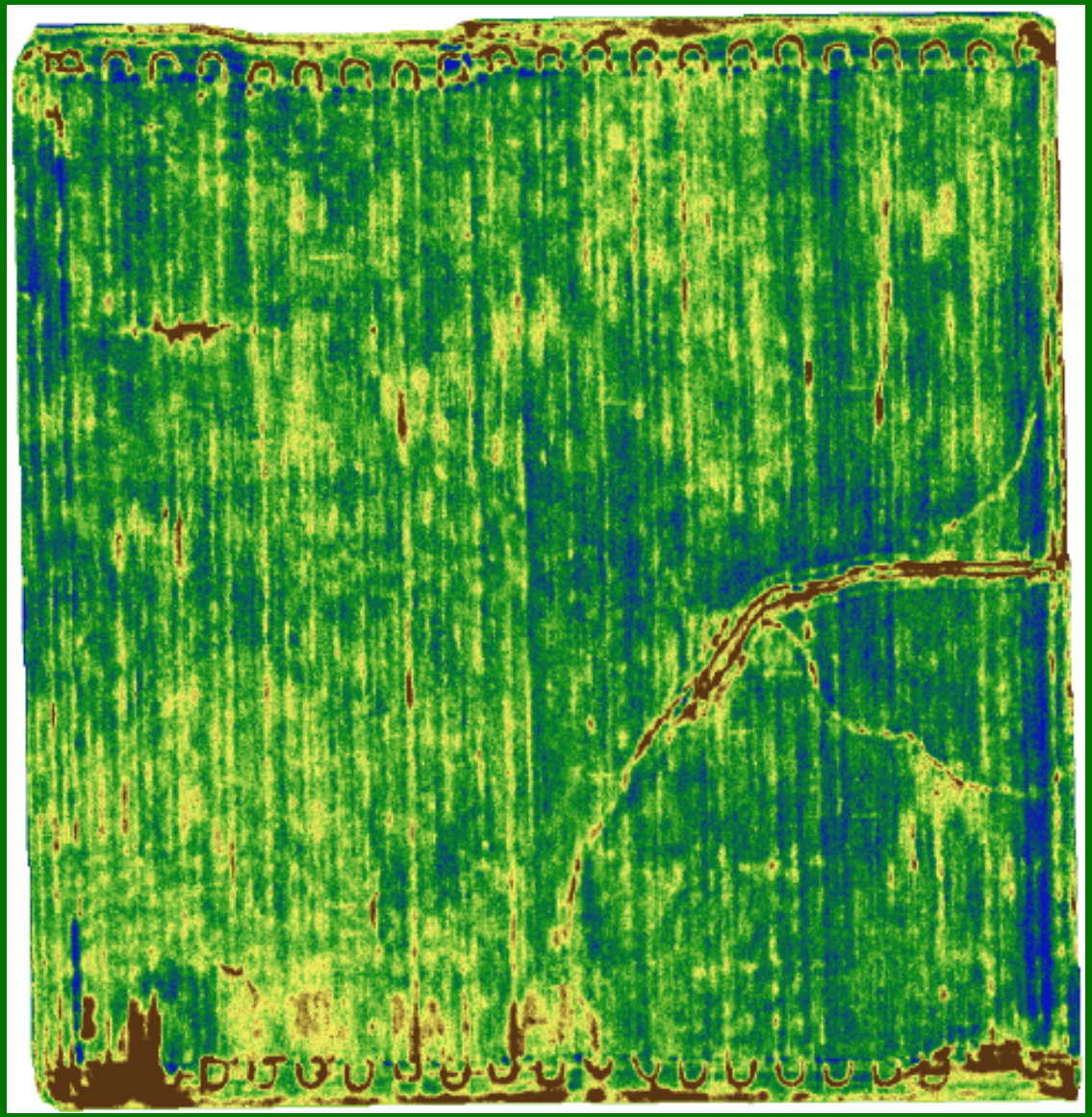




Core position in no till, strip till, or min. till

Crops & Soils Aug 2012




Research by Dr. Fabian Fernandez, U of Ilinois



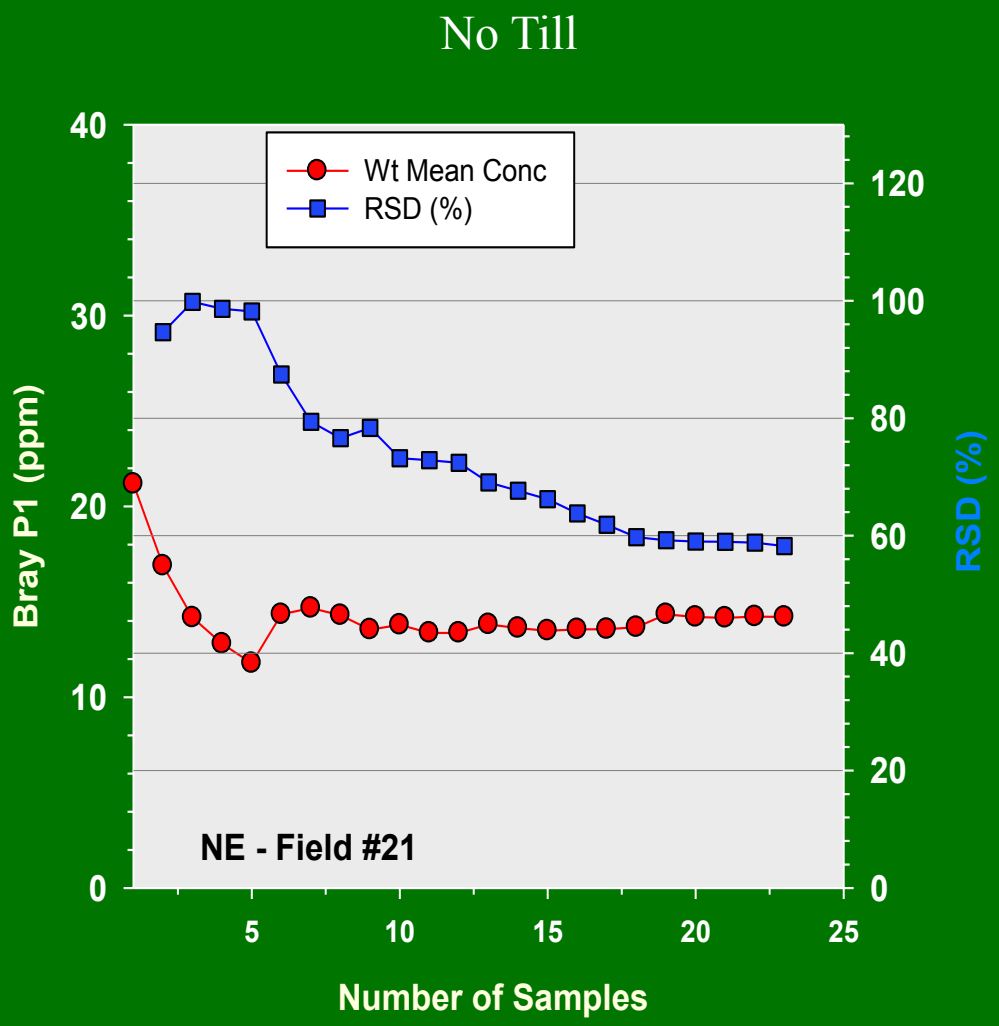
What causes those streaks?????
imagery shows end turns of side dress N applications.

Row to row variability
Yield monitor check
160 – 216 Bu
170 – 251
198 – 220
183 – 274

One meter imagery
Satellite 5-10m
Yield map 6-10m

SMI26SW

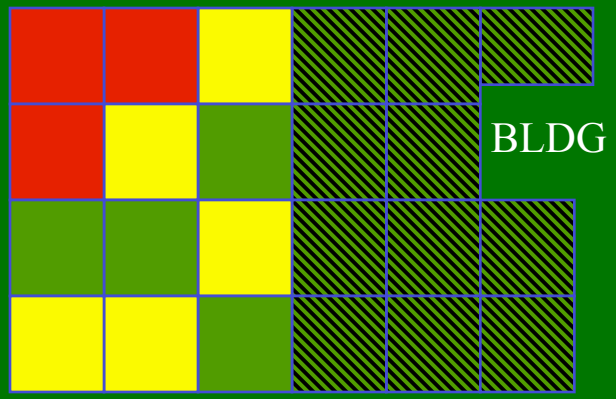
# Can More Cores Improve Precision for No Till



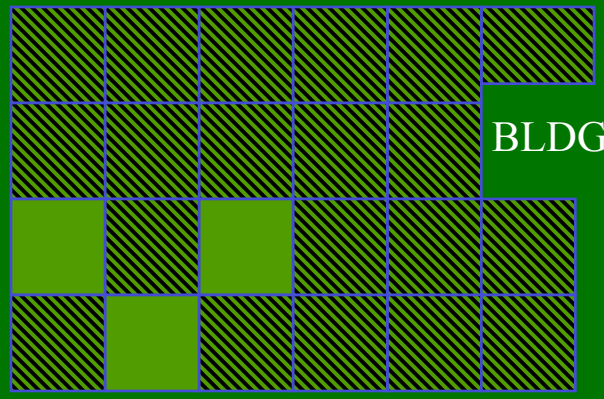

Increasing the number of samples beyond 12 cores at a highly variable site, does not significantly improve the estimate of the mean or reduce the variance for P.

| N | 24 |
|---|---|
| Mean | 14.1 |
| Stdev | 8.7 |
| RSD % | 58 |

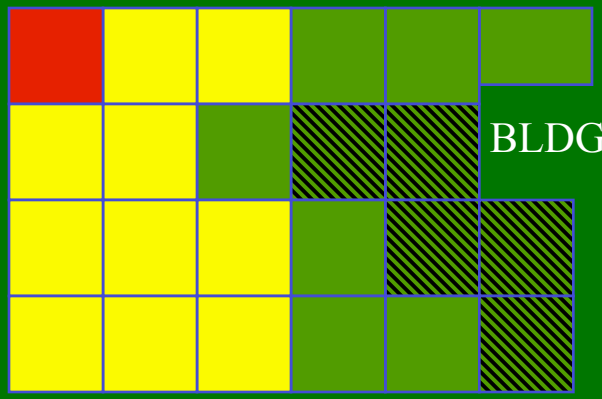
Miller, 2011




## PHOSPHORUS




## POTASSIUM


## ZINC

**Midwest Independent Soil Samplers**

K

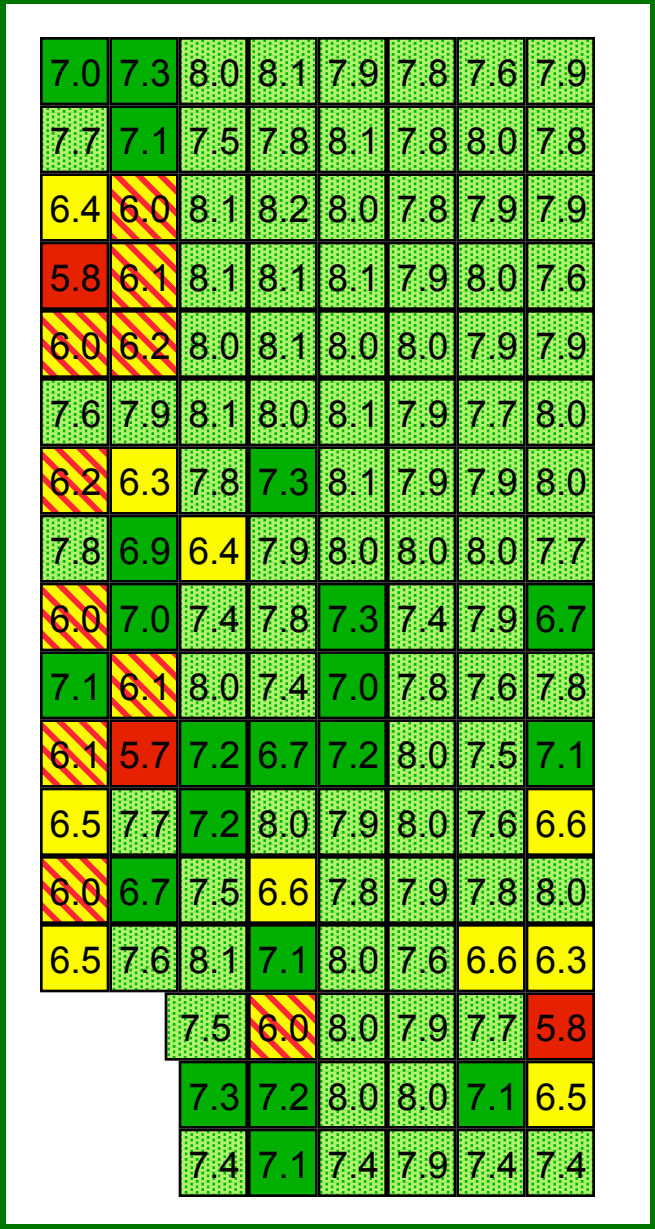
4-21-98

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 128 | 170 | 147 | 124 | 164 | 132 | 130 | 132 |
| 234 | 157 | 132 | 116 | 139 | 271 | 106 | 218 |
| 196 | 146 | 132 | 137 | 187 | 236 | 163 | 203 |
| 173 | 162 | 137 | 154 | 167 | 122 | 159 | 134 |
| 156 | 193 | 133 | 137 | 336 | 126 | 181 | 161 |
| 126 | 153 | 122 | 177 | 106 | 154 | 235 | 106 |
| 136 | 139 | 130 | 144 | 143 | 144 | 176 | 146 |
| 158 | 162 | 133 | 182 | 127 | 116 | 123 | 93 |
| 123 | 121 | 140 | 123 | 108 | 110 | 144 | 117 |
| 164 | 170 | 157 | 116 | 115 | 98 | 121 | 126 |
| 130 | 154 | 157 | 97 | 111 | 100 | 187 | 105 |
| 147 | 147 | 252 | 150 | 167 | 212 | 234 | 68 |
| 143 | 148 | 190 | 126 | 133 | 107 | 177 | 110 |
| 155 | 349 | 202 | 169 | 124 | 162 | 77 | 120 |
| | | 624 | 188 | 146 | 127 | 135 | 54 |
| | | 652 | 209 | 218 | 111 | 107 | 93 |
| | | 825 | 301 | 112 | 192 | 136 | 62 |

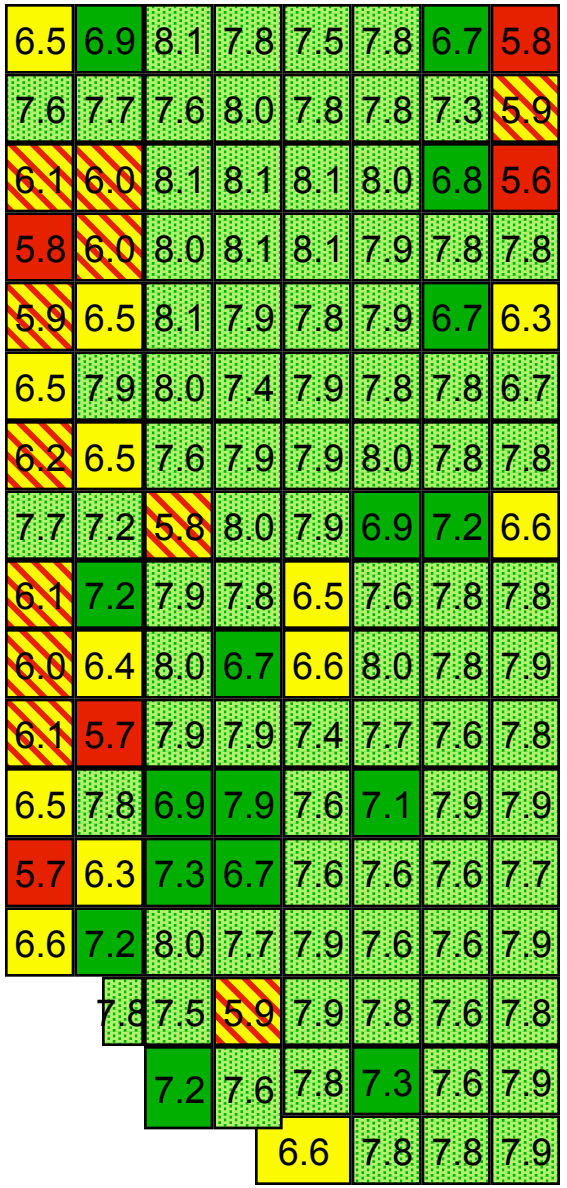
6-4-98

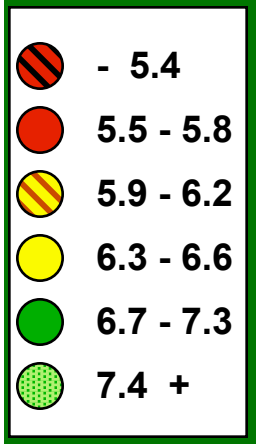
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 137 | 150 | 148 | 226 | 213 | 161 | 157 | 165 |
| 190 | 213 | 163 | 164 | 188 | 235 | 155 | 173 |
| 156 | 122 | 135 | 160 | 159 | 293 | 158 | 133 |
| 185 | 147 | 151 | 165 | 138 | 157 | 139 | 124 |
| 147 | 137 | 201 | 154 | 335 | 175 | 207 | 170 |
| 195 | 147 | 167 | 254 | 161 | 231 | 241 | 127 |
| 157 | 154 | 157 | 167 | 198 | 221 | 248 | 184 |
| 228 | 116 | 160 | 218 | 216 | 115 | 150 | 180 |
| 140 | 155 | 155 | 152 | 147 | 160 | 191 | 127 |
| 157 | 172 | 176 | 150 | 143 | 148 | 210 | 124 |
| 133 | 157 | 164 | 158 | 151 | 166 | 262 | 201 |
| 182 | 133 | 292 | 218 | 250 | 329 | 288 | 144 |
| 159 | 157 | 198 | 156 | 150 | 157 | 309 | 158 |
| 147 | 321 | 249 | 174 | 173 | 222 | 278 | 152 |
| | | 620 | 528 | 200 | 219 | 196 | 290 | 236 |
| | | | 541 | 177 | 230 | 158 | 225 | 230 |
| | | | | | 134 | 163 | 167 | 188 |

## SPRING 4-21-98

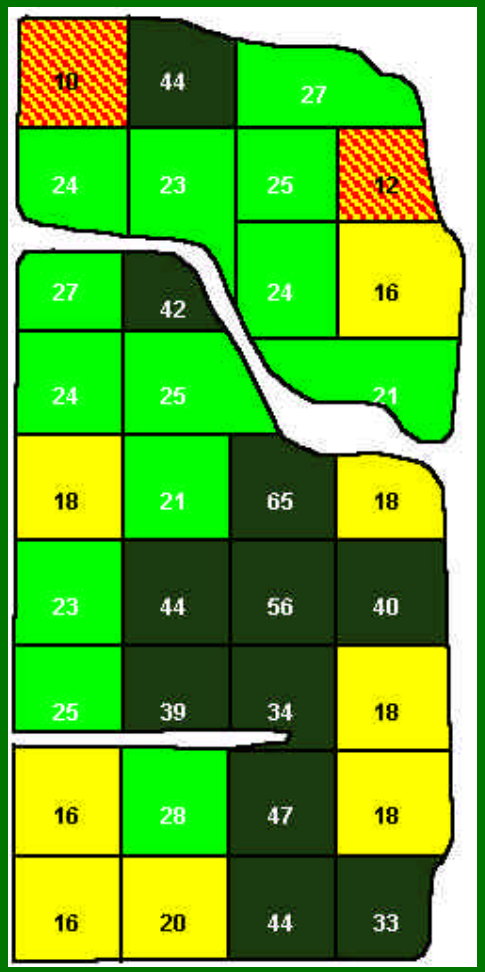



## SUMMER 6-4-98



# Phosphorus Grid vs Zone

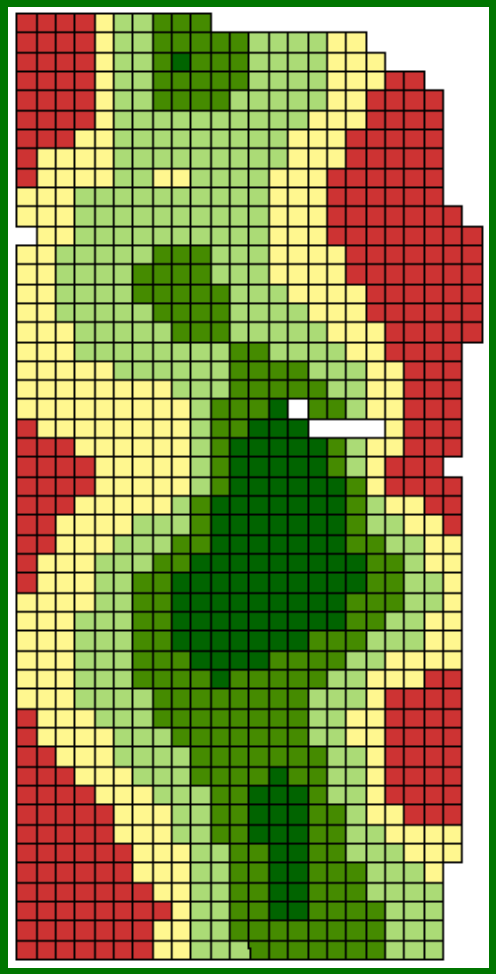




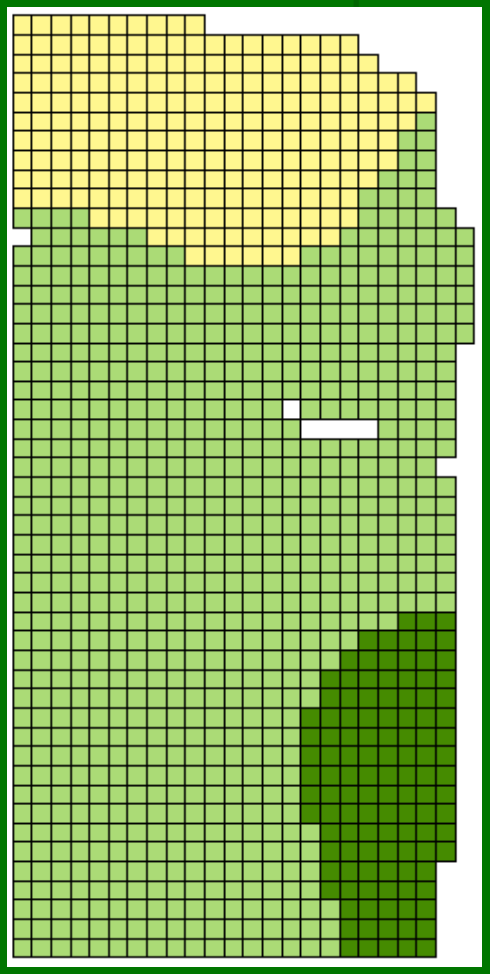
FBK05ESW

# Phosphate Application

2.5 A



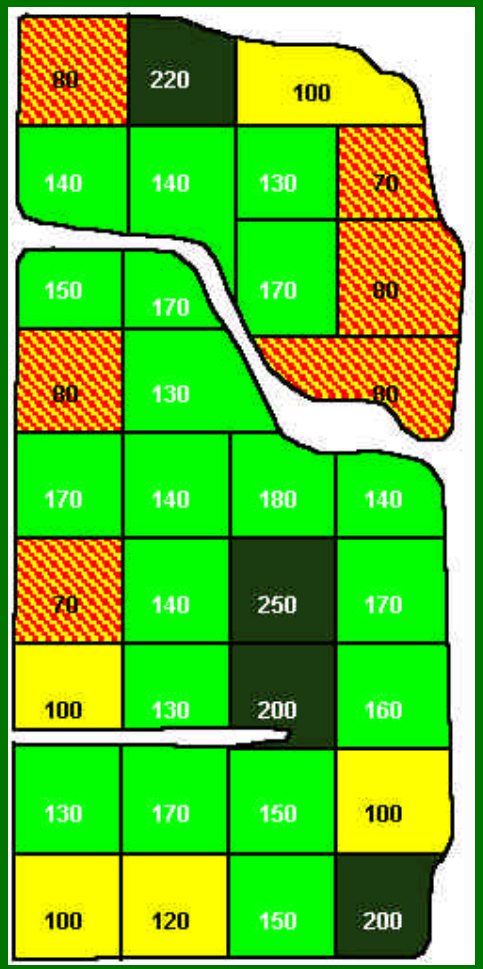
20 A Composite



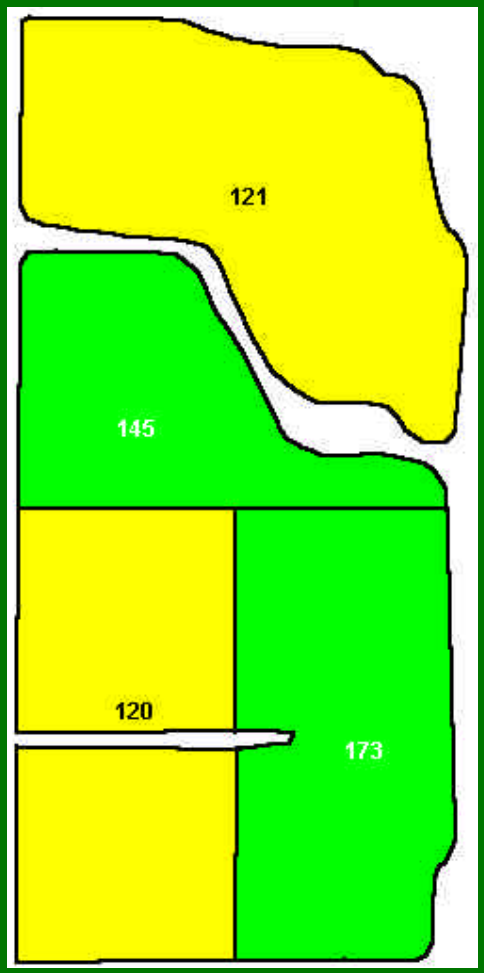
FBK05ESW

# Potassium Grid vs Zone

2.5 A



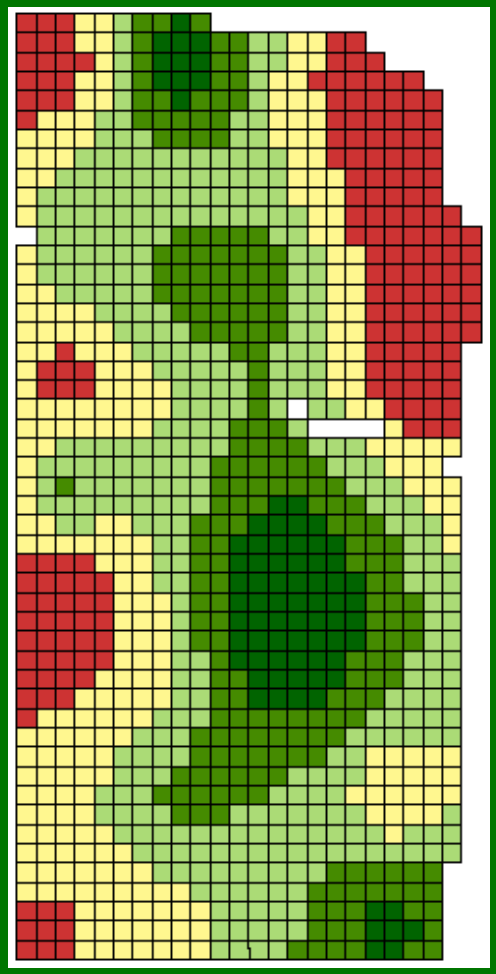

20 A Composite



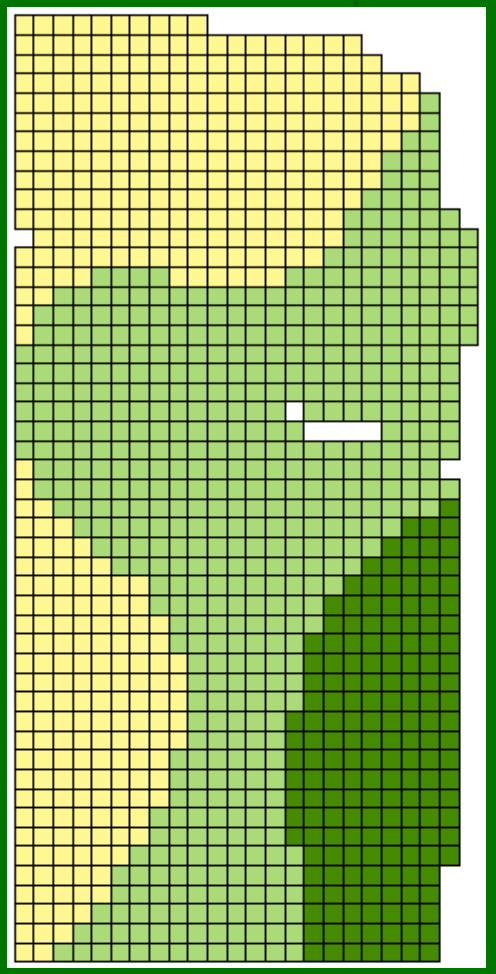

FBK05ESW

# Application Map for K

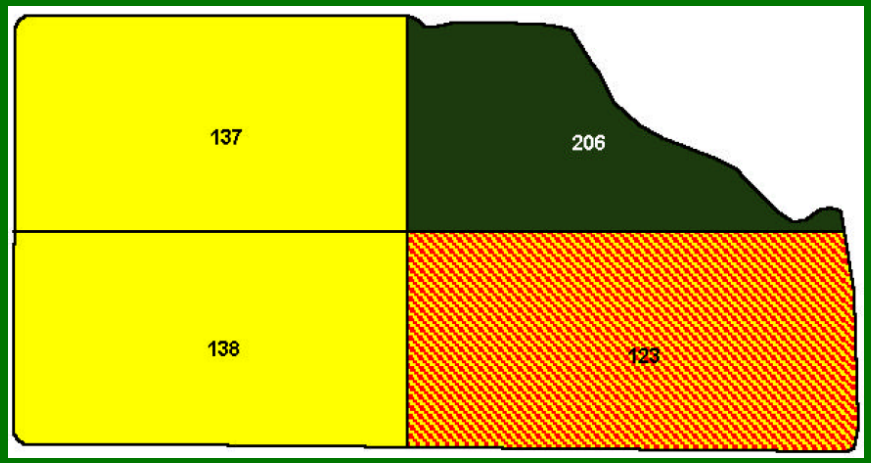
2.5 A

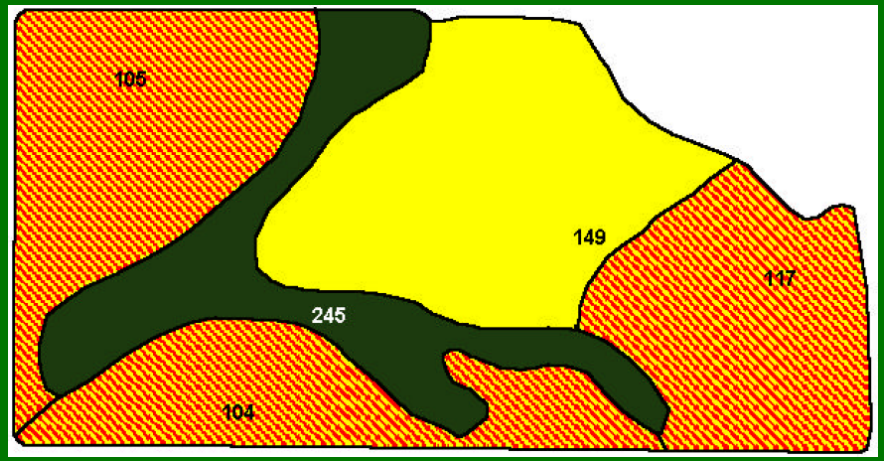


20 A Composite

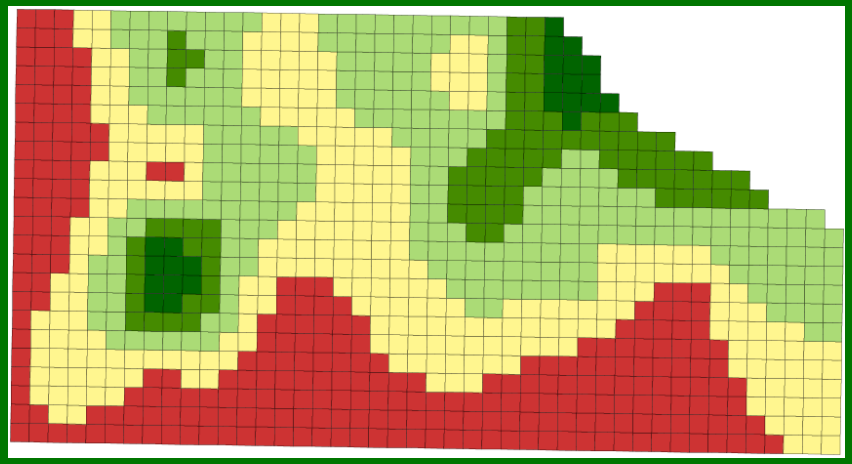


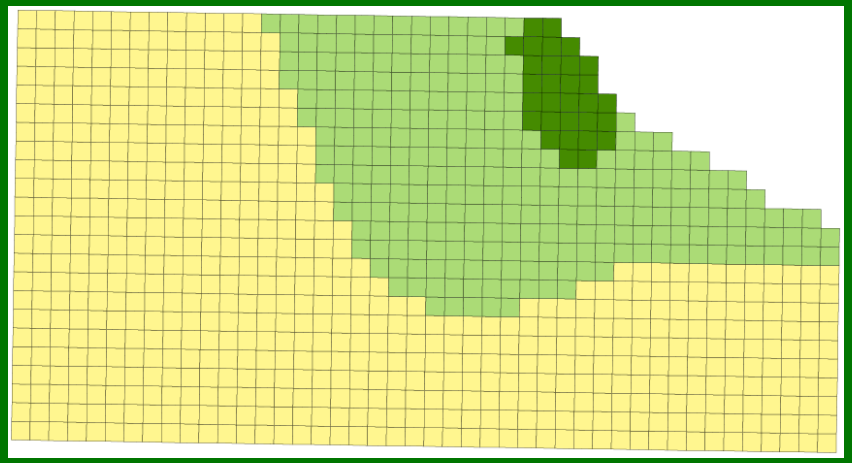
FBK05ESW

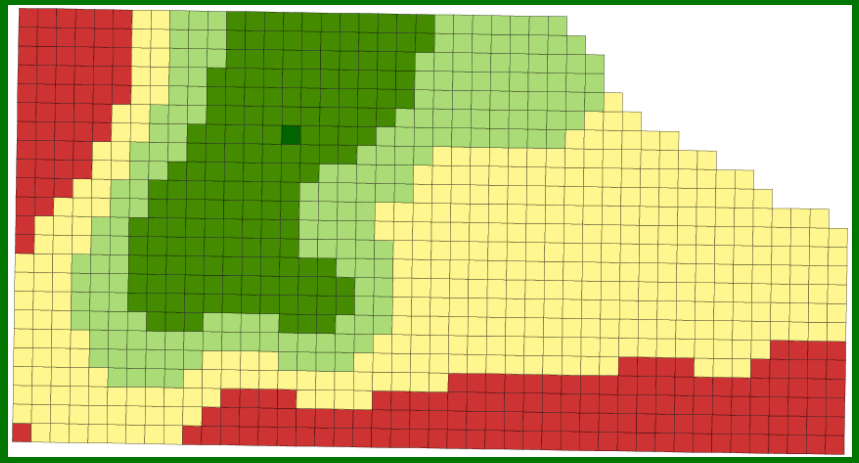




# Potassium Test by Grid (2.5A) Zone (20A) Soil Type




# Potash Application

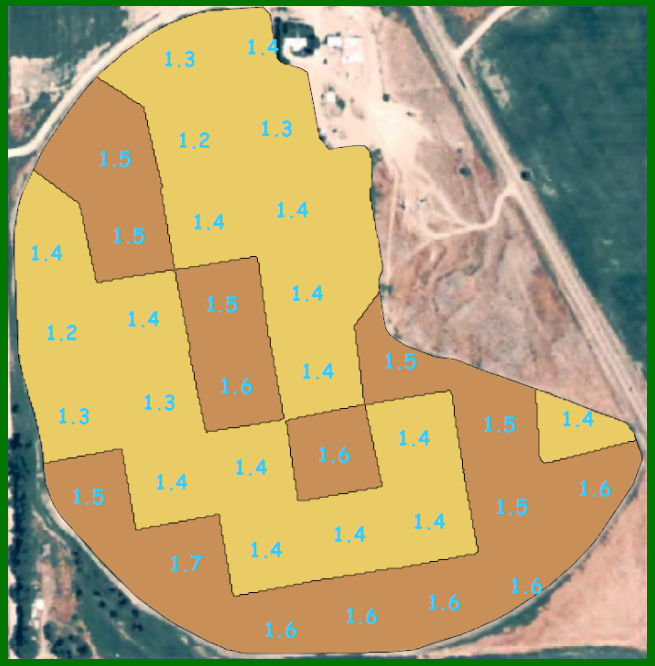
# Topsoil Surface EC Map

Topsoil Polygons
- 3.4 - 7.4 (24.1 ac.)
- 7.4 - 9.4 (21.7 ac.)
- 9.4 - 11.3 (26.2 ac.)
- 11.3 - 13.5 (16.3 ac.)
- 13.5 - 17.9 (4.9 ac.)

# Subsoil Surface EC Map

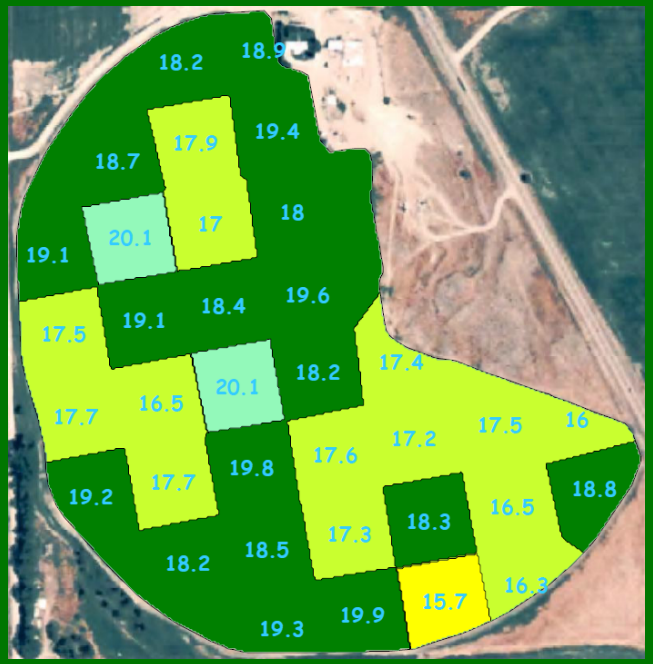
Subsoil Polygons
- 24.1 - 30.0 (21.0 ac.)
- 30.0 - 33.3 (18.7 ac.)
- 33.3 - 36.4 (25.3 ac.)
- 36.4 - 39.7 (21.8 ac.)
- 39.7 - 45.8 (6.4 ac.)

# Organic Matter Map




OM
- Very Low
- Low
- Medium
- High
- Very High

# CEC Map




CEC
- <10
- 10-12
- 12-14
- 14-16
- 16-18
- 18-20
- 20-22
- 22-24
- >24

Morrill Co

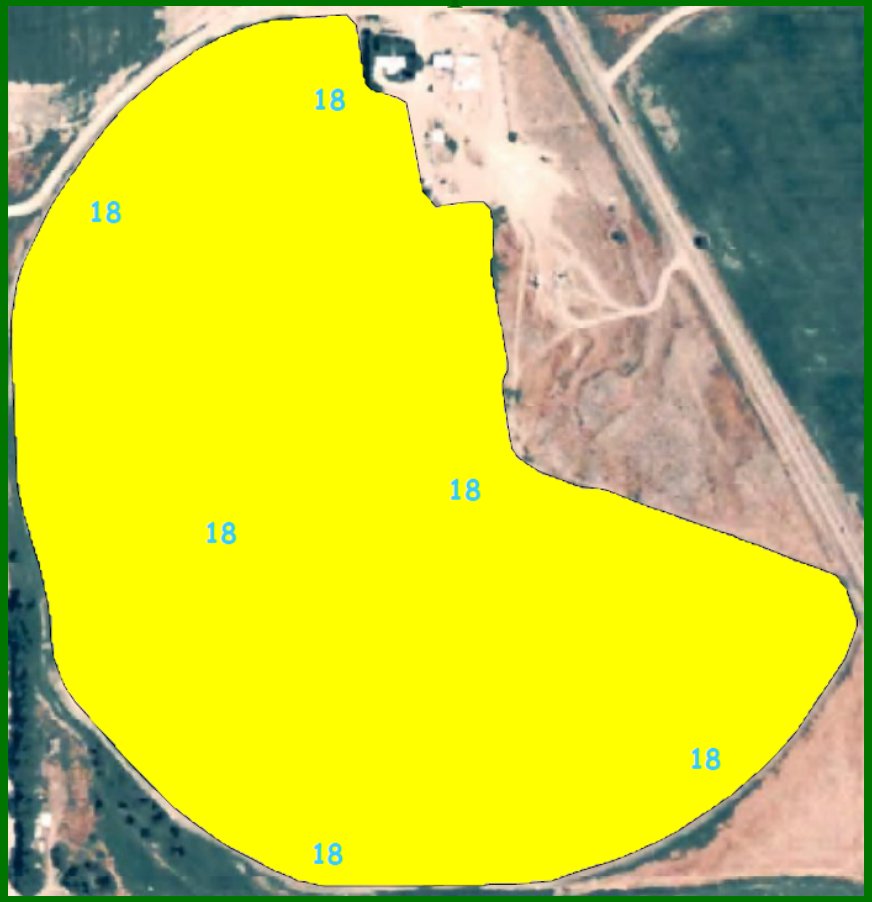
93.17 Acres

# Phosphorous Maps

## Grid


P
- Very Low
- Low
- Medium
- High
- Very High

## Zone

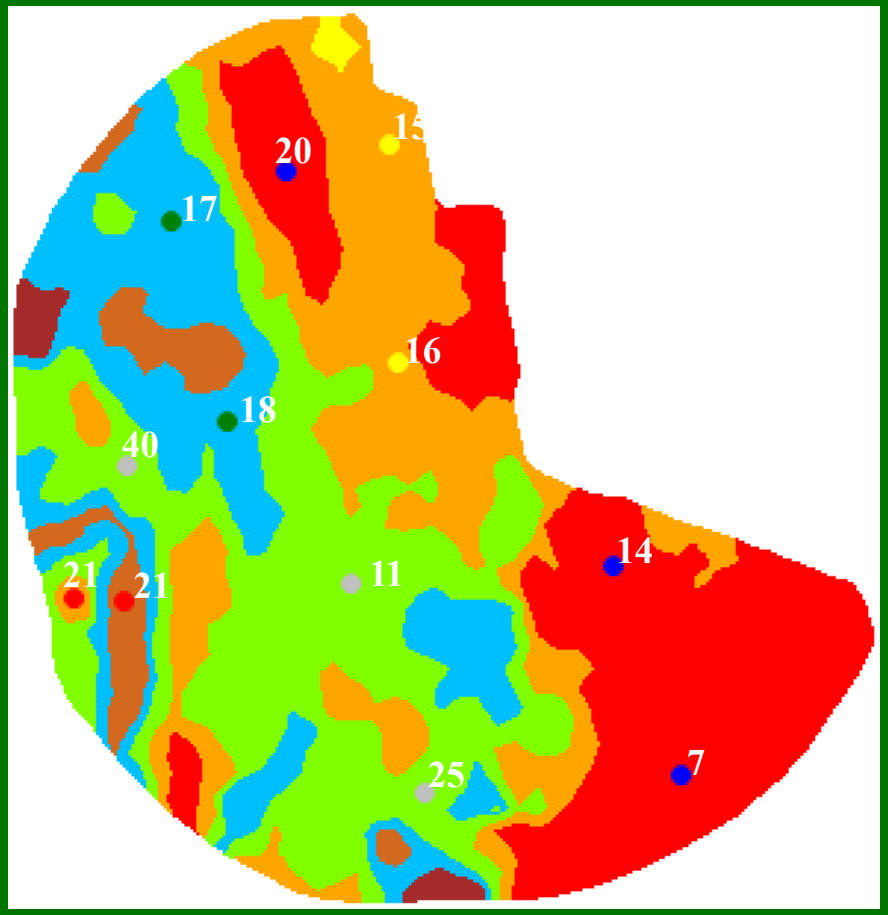



P
- Very Low
- Low
- Medium
- High
- Very High

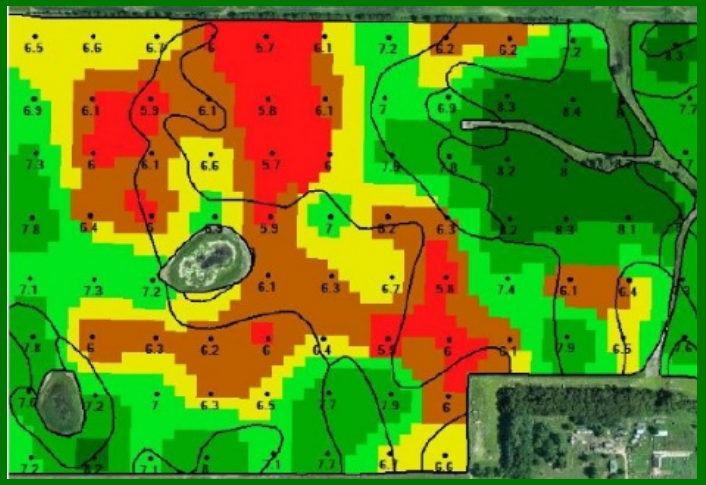
# Phosphorous Maps

Grid

Soil Type

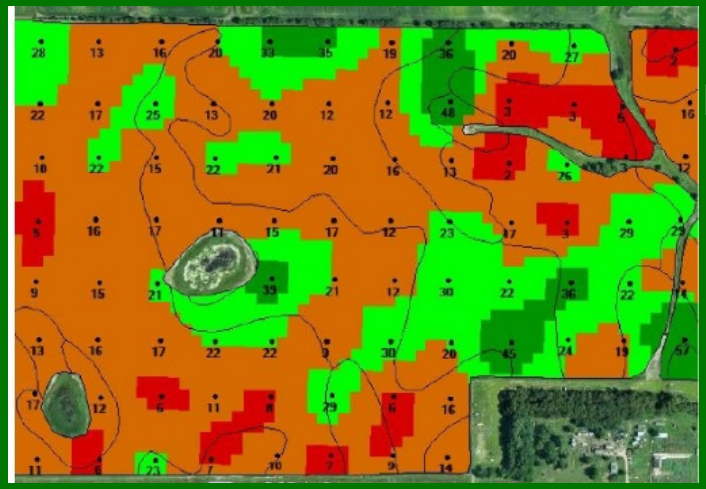




P
- Very Low
- Low
- Medium
- High
- Very High

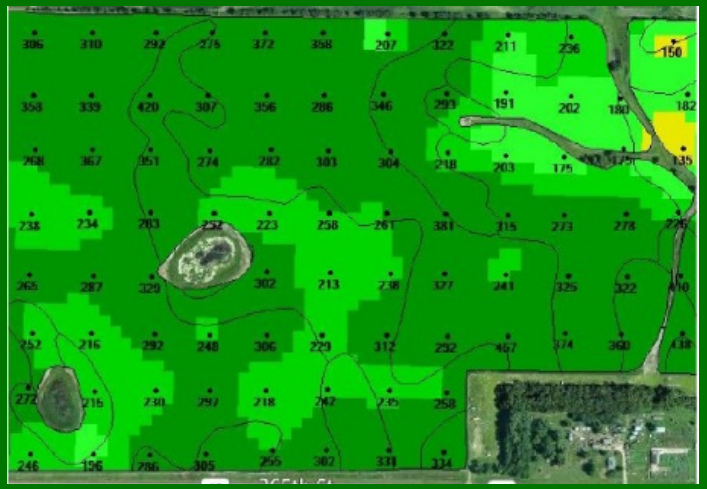
pH

| |
|---|
| 5.7 – 6.1 |
| 6.1 – 6.5 |
| 6.5 – 6.8 |
| 6.8 – 7.2 |
| 7.2 – 7.8 |
| 7.8 – 8.3 |



Phosphorus

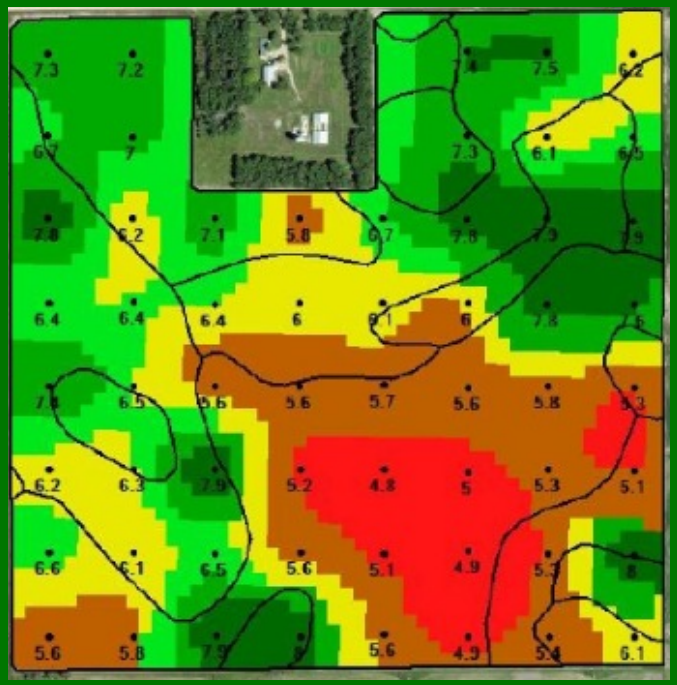
| |
|---|
| 0 - 10 |
| 10 - 20 |
| 20 - 30 |
| 30 - 1000 |



Potassium

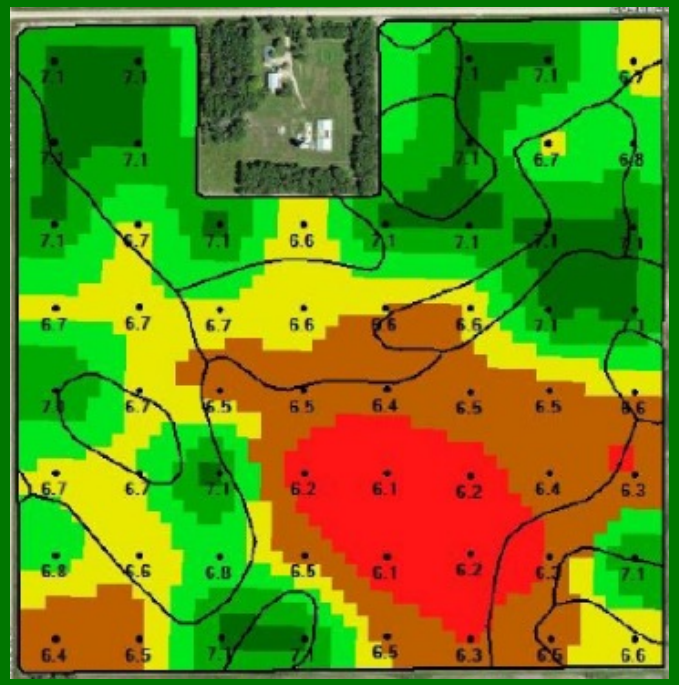
| |
|---|
| 0 - 100 |
| 100 - 140 |
| 140 - 180 |
| 180 - 220 |
| 220 - 260 |
| 260 - 1000 |

South Dakota



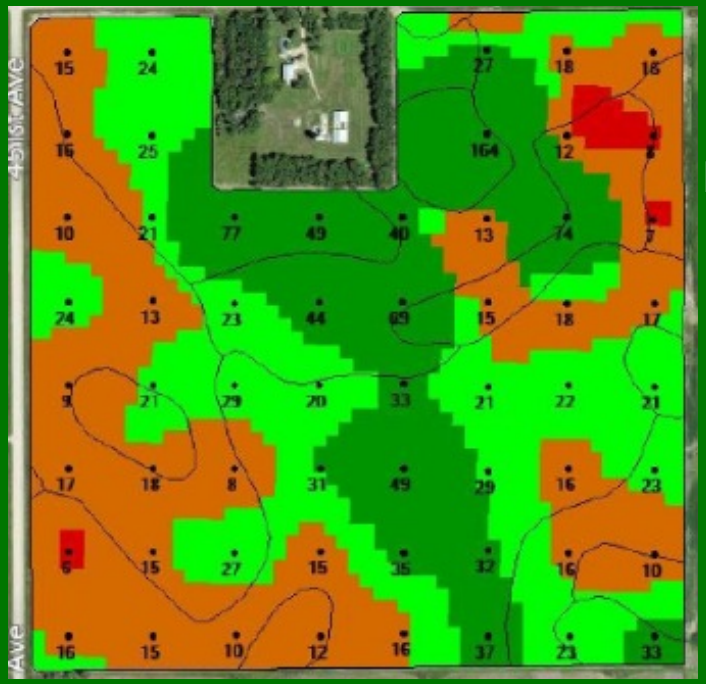
pH

- 4.9 – 5.3
- 5.3 - 6
- 6 – 6.4
- 6.4 – 6.8
- 6.8 – 7.3
- 7.3 - 8



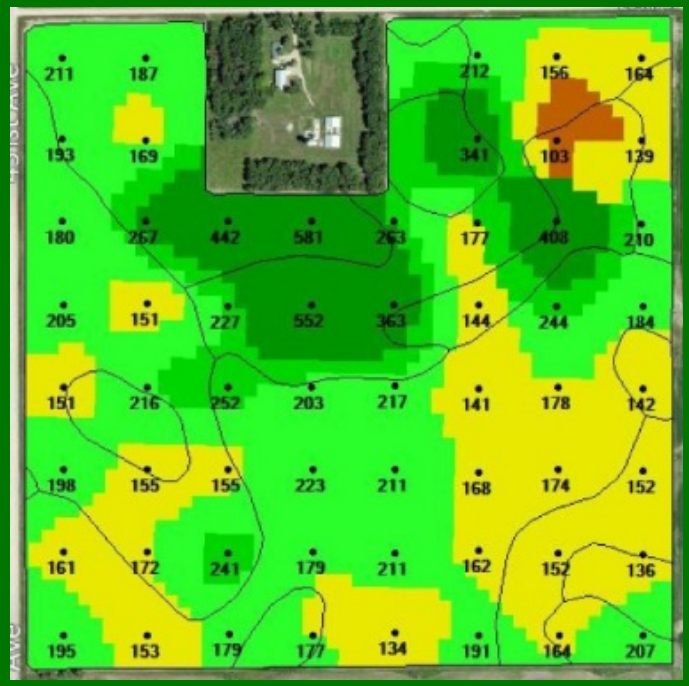
Buffer pH

- 6.1 – 6.4
- 6.4 – 6.6
- 6.6 – 6.7
- 6.7 – 6.9
- 6.9 - 7
- 7 – 7.1



Phosphorus

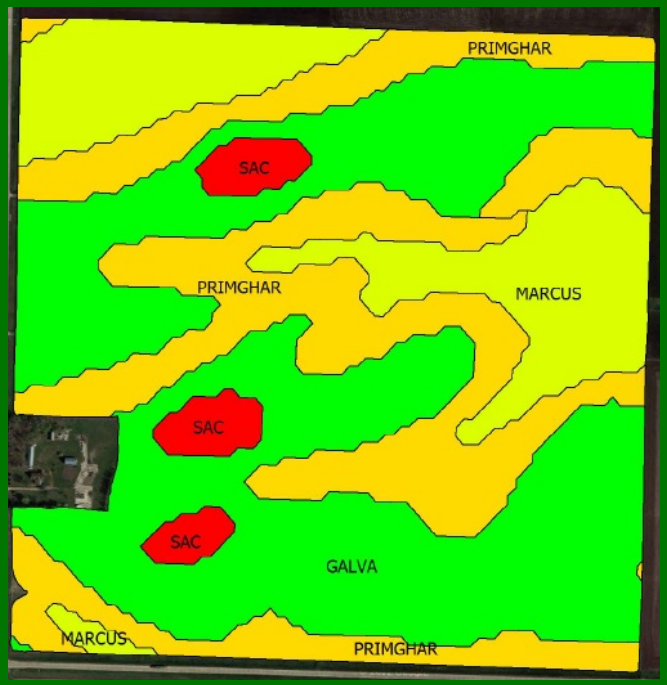
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 1000



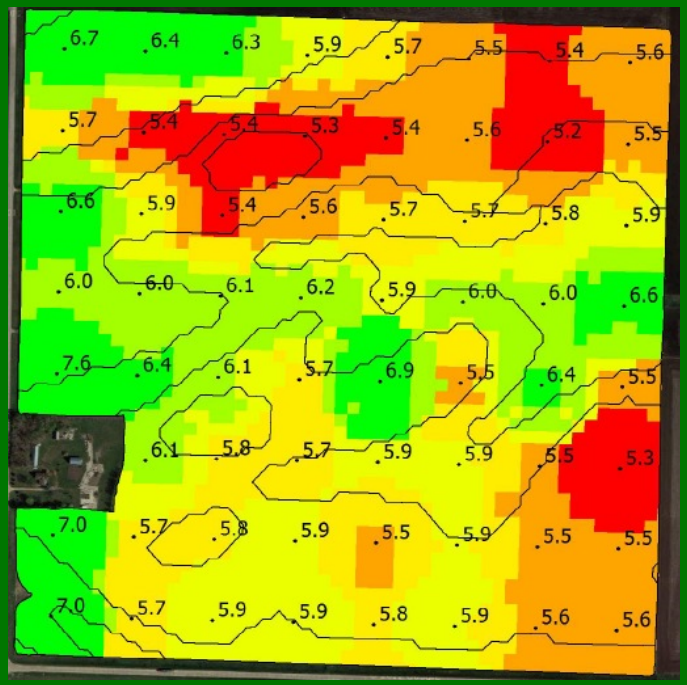
Potassium

- 0 - 100
- 100 - 140
- 140 - 180
- 180 - 220
- 220 - 260
- 260 - 1000

South Dakota

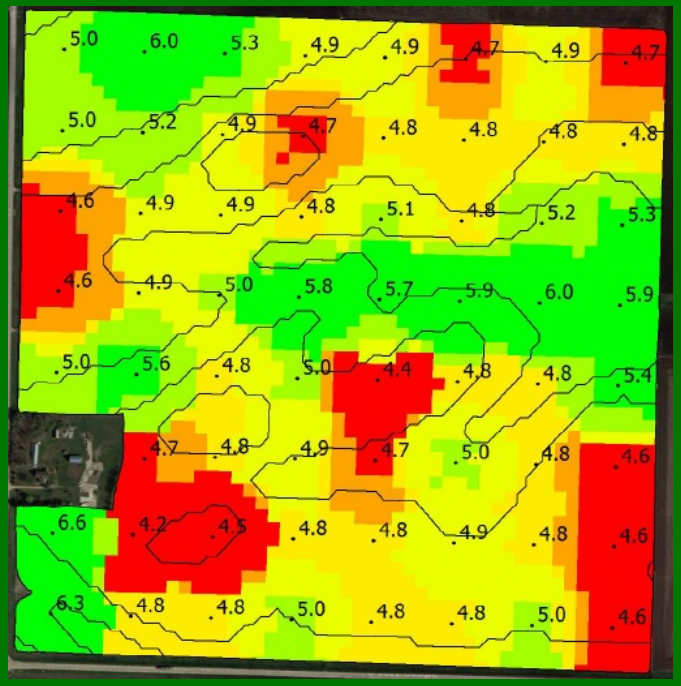



Soil Types



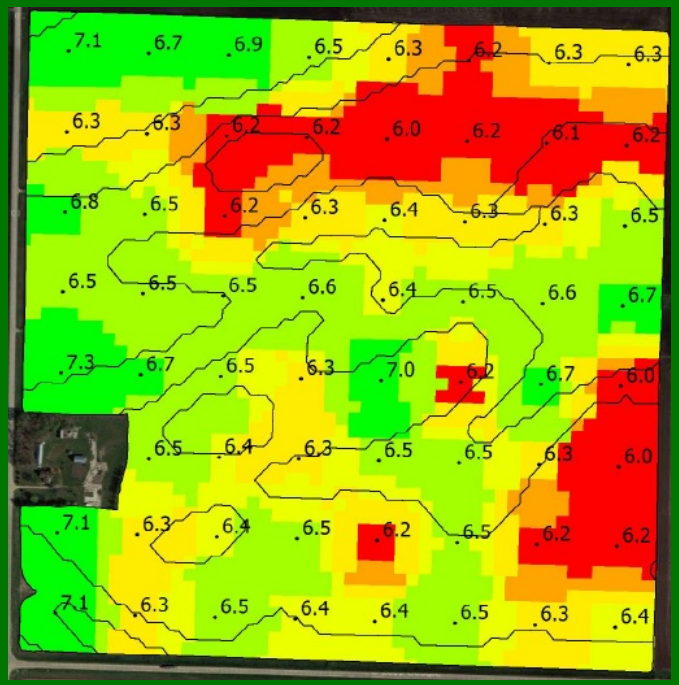

pH

| |
|---|
| 6.3 – 7.6 |
| 6.0 – 6.3 |
| 5.8 – 6.0 |
| 5.6 – 5.8 |
| 5.5 – 5.6 |
| 5.2 – 5.5 |




Organic Matter

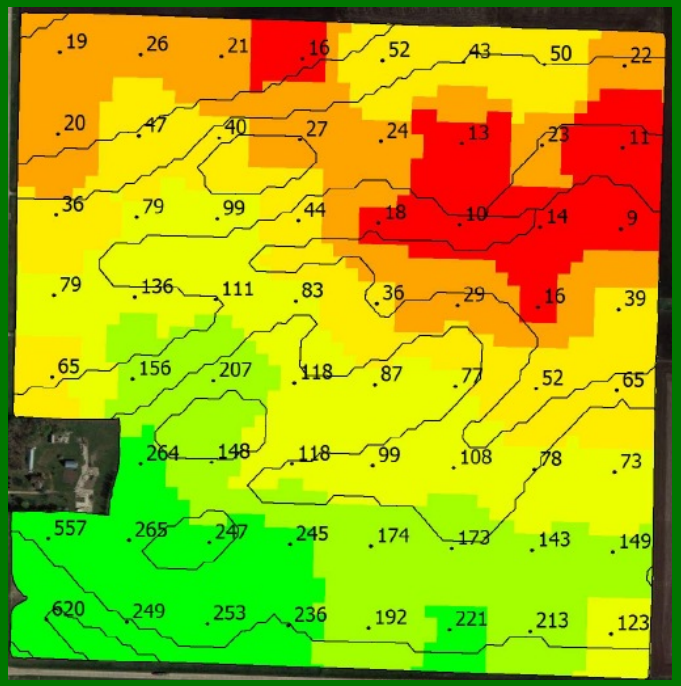
| |
|---|
| 5.3 – 6.6 |
| 5.0 - 5.3 |
| 4.84 – 5.0 |
| 4.8 – 4.84 |
| 4.7 – 4.8 |
| 4.2 – 4.7 |




Buffer pH

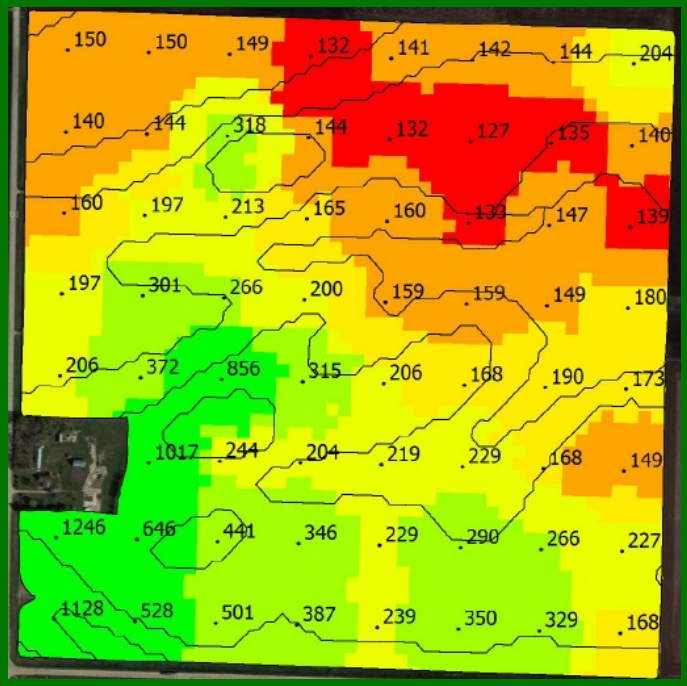
| |
|---|
| 6.7 – 7.3 |
| 6.4 – 6.7 |
| 6.4 – 6.4 |
| 6.3 – 6.4 |
| 6.2 – 6.3 |
| 6.0 – 6.2 |

NW Iowa



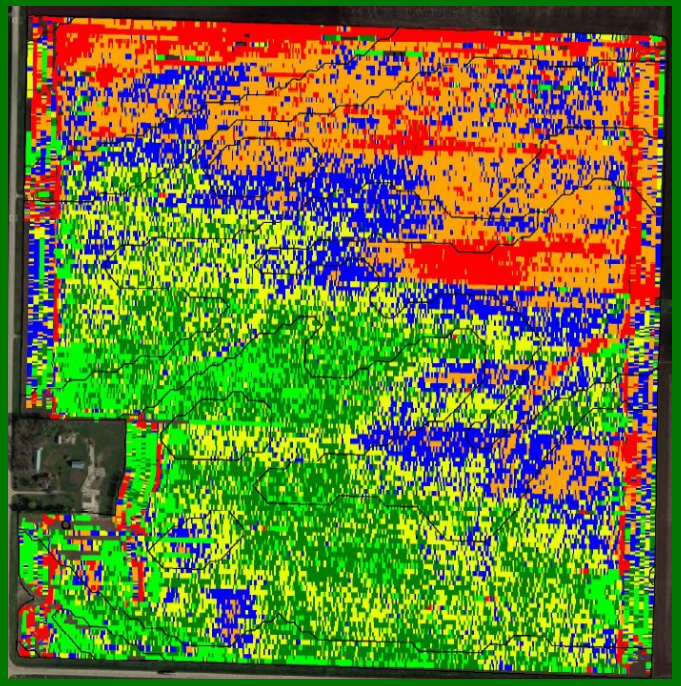

## Phosphorus

| |
|---|
| 217 - 620 |
| 136 - 217 |
| 72 - 136 |
| 34 - 72 |
| 19 - 34 |
| 9 - 19 |



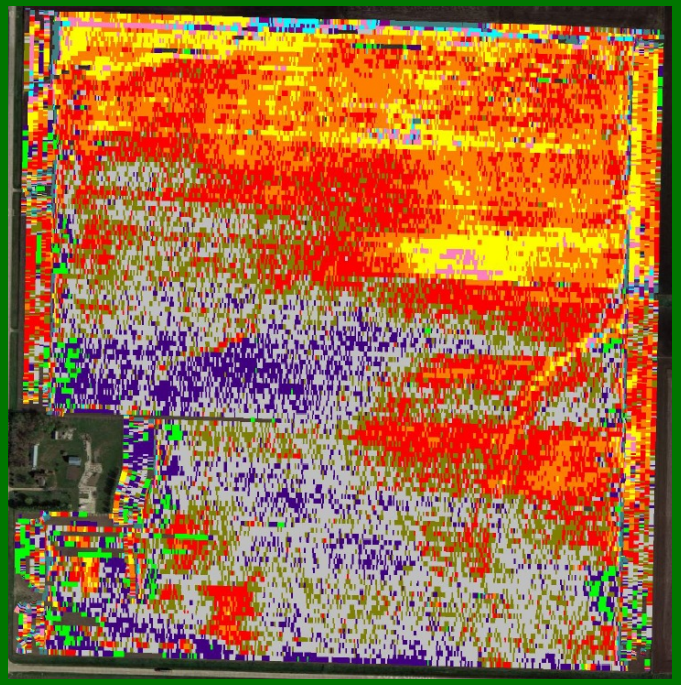

## Potassium

| |
|---|
| 505 - 1246 |
| 251 - 505 |
| 192 - 251 |
| 163 - 192 |
| 140 - 163 |
| 127 - 140 |



## Yield Estimated Volume (Dry)

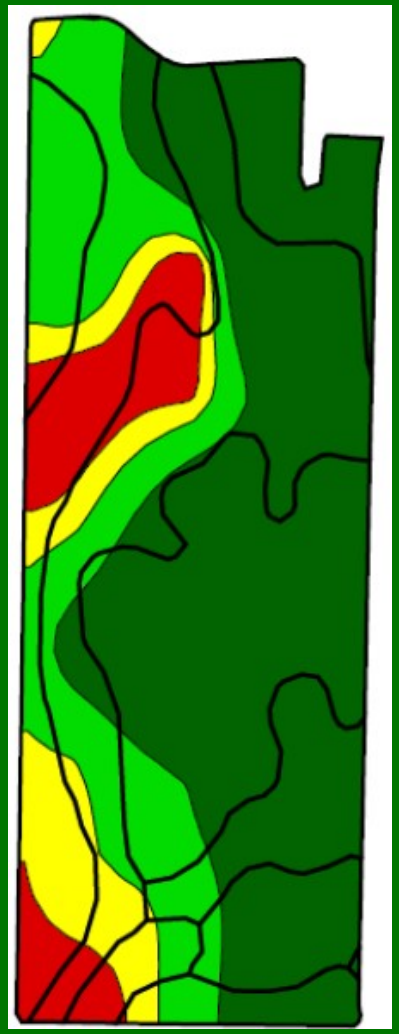
| |
|---|
| 227 - 2538 |
| 213 - 227 |
| 200 - 213 |
| 180 - 200 |
| 157 - 180 |
| 6 - 157 |

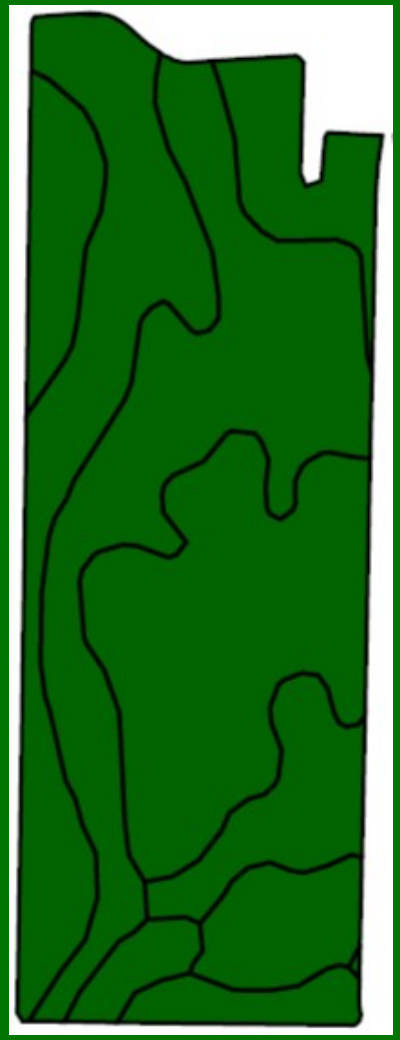


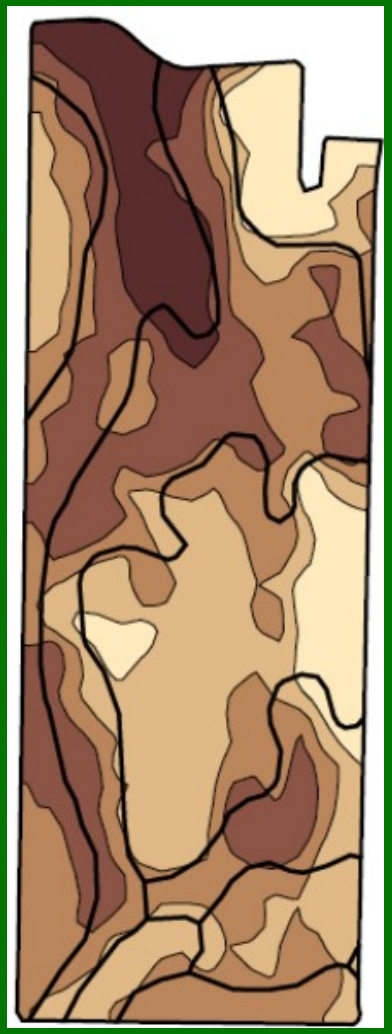
## Yield Estimated Volume (Dry)

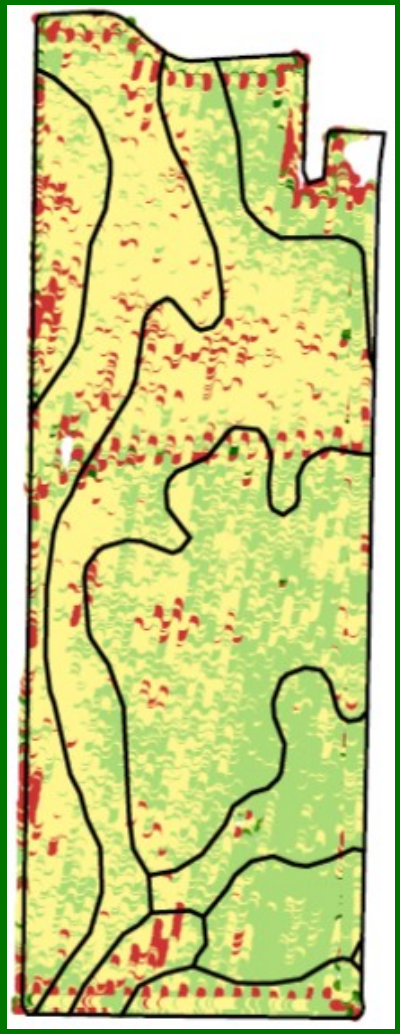
| |
|---|
| 250 - 300 |
| 225 - 250 |
| 210 - 225 |
| 200 - 210 |
| 180 - 200 |
| 160 - 180 |
| 140 - 160 |
| 120 - 140 |
| 100 - 120 |
| 75 - 100 |
| 0 - 75 |

NW Iowa









P ppm Polygons

| | |
|---|---|
| < 7 | (0.0 ac.) |
| 7 - 15 | (5.2 ac.) |
| 15 - 20 | (5.6 ac.) |
| 20 - 30 | (12.2 ac.) |
| 30 > | (29.4 ac.) |

K ppm Polygons

| | |
|---|---|
| < 90 | (0.0 ac.) |
| 90 - 130 | (0.0 ac.) |
| 130 - 170 | (0.0 ac.) |
| 170 - 200 | (0.0 ac.) |
| 200 > | (52.5 ac.) |

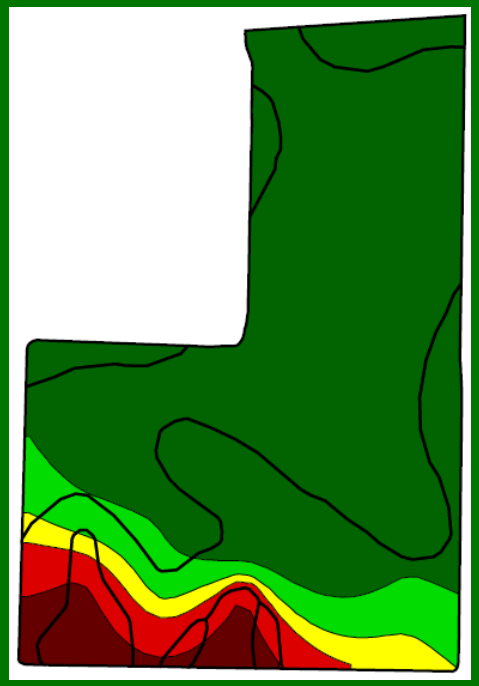
Topsoil Polygons

| | |
|---|---|
| 14.5 - 24.1 | (5.4 ac.) |
| 24.1 - 30.6 | (14.3 ac.) |
| 30.6 - 36.8 | (16.9 ac.) |
| 36.8 - 44.2 | (11.7 ac.) |
| 44.2 - 57.7 | (4.2 ac.) |

Yield

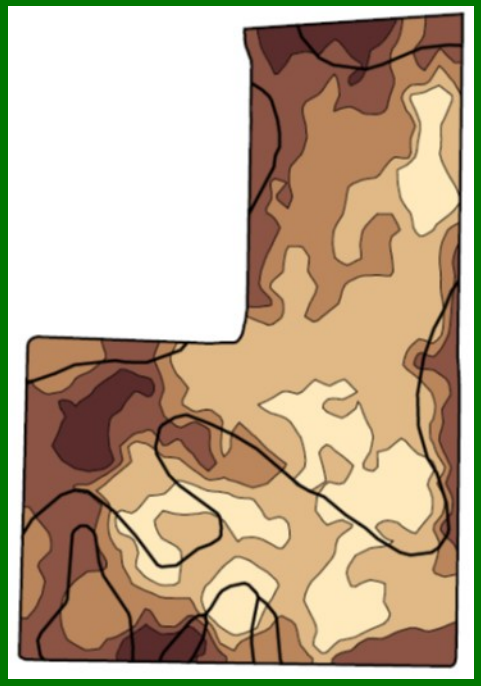
- 10.06 - 44.752
- 44.752 - 60.493
- 60.493 - 115.072
- 115.072 - 231.853
- 231.853 - 383.754

South Central Minnesota

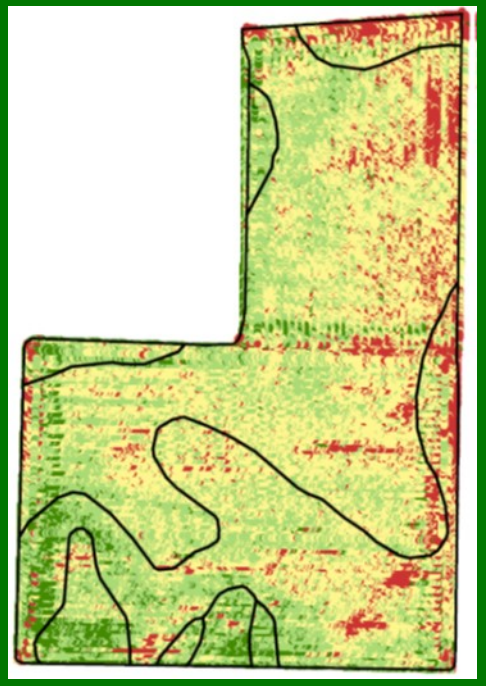


P Polygons
< 7 (4.1 ac.)
7 - 15 (4.5 ac.)
15 - 20 (3.5 ac.)
20 - 30 (7.1 ac.)
30 > (58.2 ac.)

K Polygons
< 90 (0.0 ac.)
90 - 130 (7.3 ac.)
130 - 170 (18.3 ac.)
170 - 200 (15.1 ac.)
200 > (36.8 ac.)

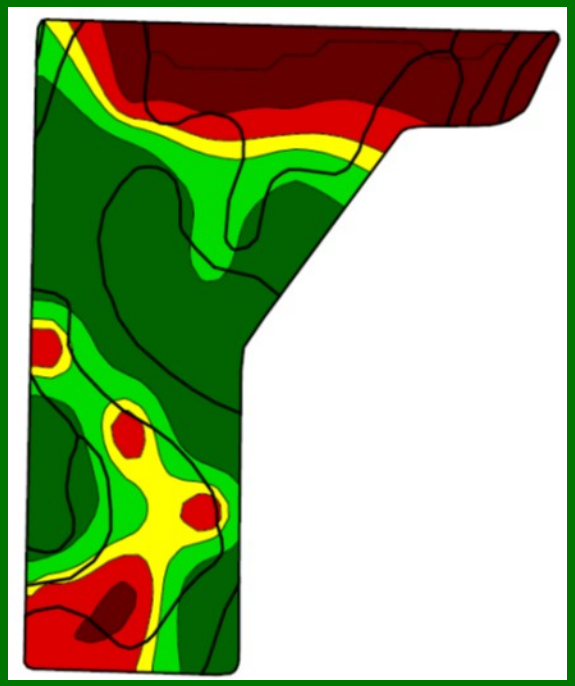


Topsoil Polygons
19.1 - 25.8 (13.1 ac.)
25.8 - 30.6 (26.0 ac.)
30.6 - 35.6 (17.7 ac.)
35.6 - 41.8 (16.4 ac.)
41.8 - 55.6 (4.3 ac.)



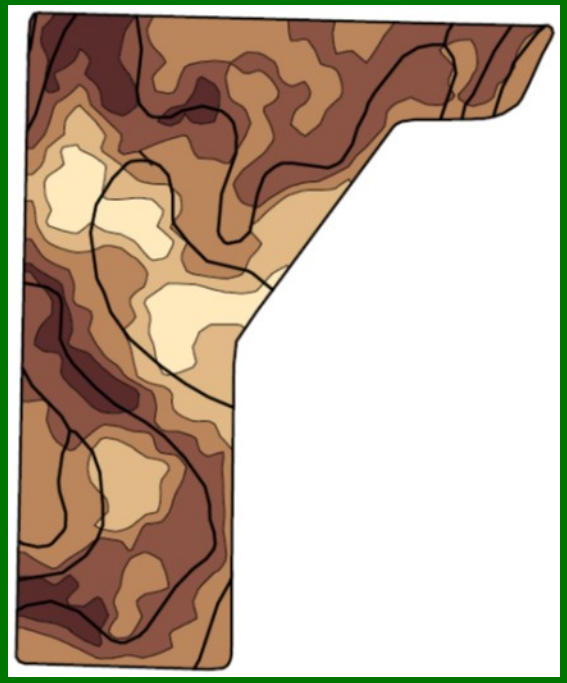
Yield
23.13 - 120.166
120.166 - 145.092
145.092 - 174.342
174.342 - 315.138
315.138 - 591.897

South Central Minnesota

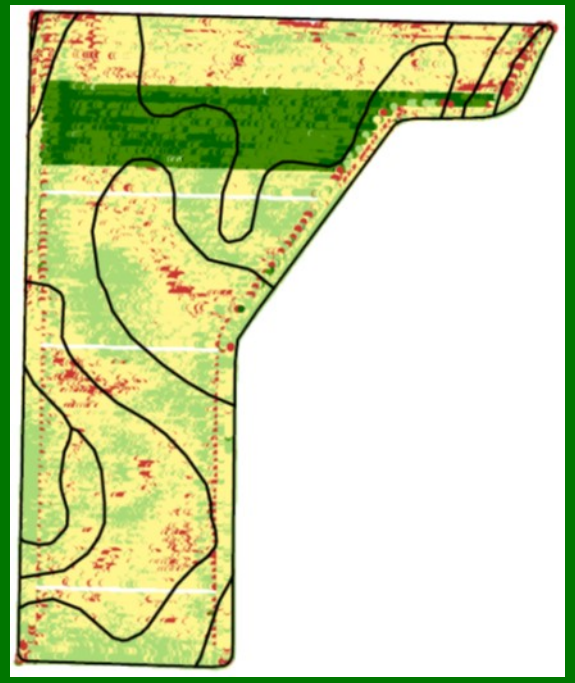


P Polygons
- < 7 (13.9 ac.)
- 7 - 15 (8.8 ac.)
- 15 - 20 (6.3 ac.)
- 20 - 30 (12.5 ac.)
- 30 > (25.9 ac.)

K Polygons
- < 90 (0.0 ac.)
- 90 - 130 (0.0 ac.)
- 130 - 170 (5.2 ac.)
- 170 - 200 (8.0 ac.)
- 200 > (54.2 ac.)

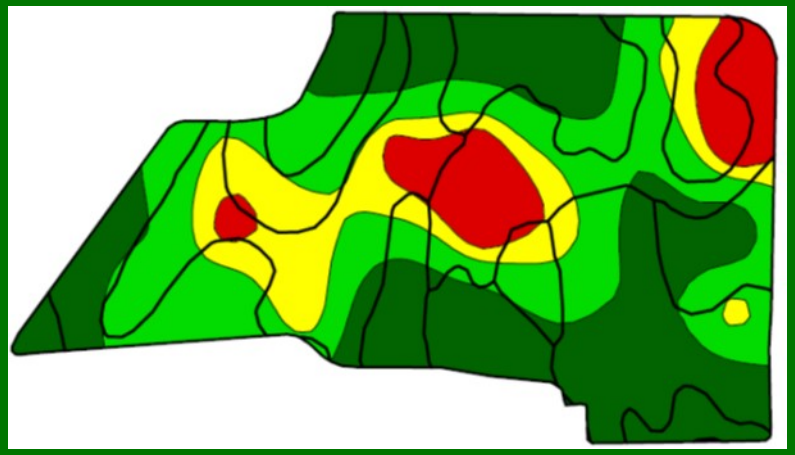


Topsoil Polygons
- 17.8 - 28.4 (4.8 ac.)
- 28.4 - 36.2 (9.7 ac.)
- 36.2 - 43.5 (24.3 ac.)
- 43.5 - 50.7 (22.8 ac.)
- 50.7 - 61.8 (5.8 ac.)



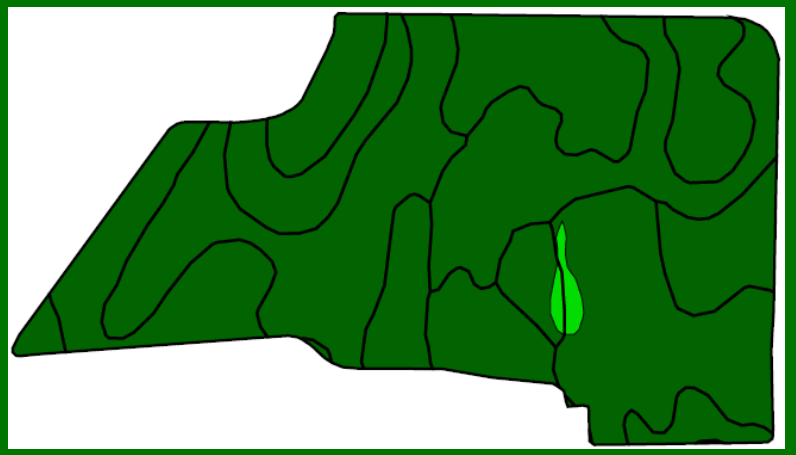
Yield
- 20.314 - 137.215
- 137.215 - 176.421
- 176.421 - 331.019
- 331.019 - 541.331
- 541.331 - 798.457

Central Minnesota



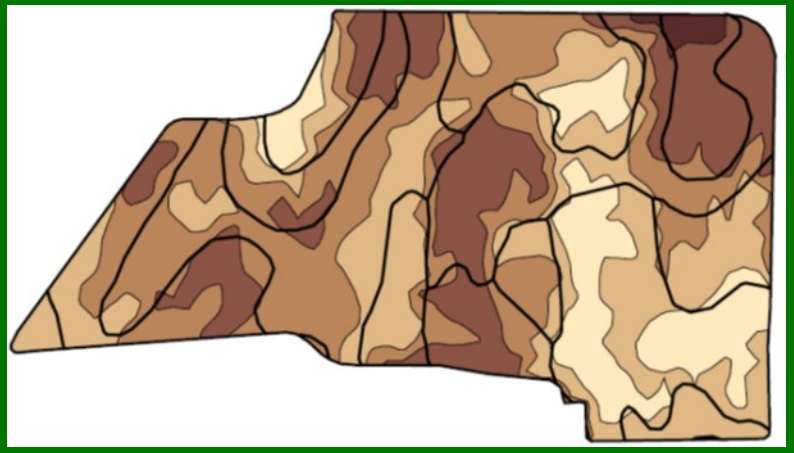
P ppm Polygons

| | | |
|---|---|---|
| | < 7 | (0.0 ac.) |
| | 7 - 15 | (8.4 ac.) |
| | 15 - 20 | (12.3 ac.) |
| | 20 - 30 | (27.6 ac.) |
| | 30 > | (30.5 ac.) |



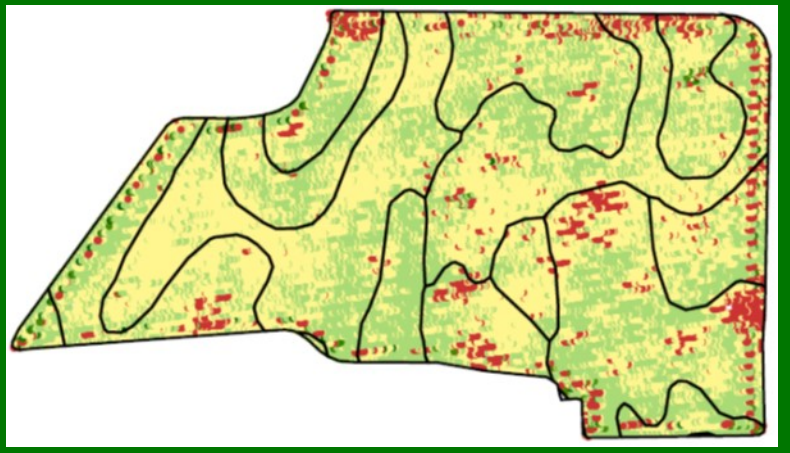
K ppm Polygons

| | | |
|---|---|---|
| | < 90 | (0.0 ac.) |
| | 90 - 130 | (0.0 ac.) |
| | 130 - 170 | (0.0 ac.) |
| | 170 - 200 | (0.7 ac.) |
| | 200 > | (78.2 ac.) |



Topsoil Polygons

| | | |
|---|---|---|
| | 11.8 - 23.8 | (10.4 ac.) |
| | 23.8 - 30.1 | (24.3 ac.) |
| | 30.1 - 36.6 | (26.6 ac.) |
| | 36.6 - 46.2 | (16.8 ac.) |
| | 46.2 - 64.8 | (0.8 ac.) |



Yield

| | |
|---|---|
| | 5.051 - 39.452 |
| | 39.452 - 55.456 |
| | 55.456 - 104.303 |
| | 104.303 - 207.249 |
| | 207.249 - 368.618 |

South Central Minnesota

# REVIEW

CPI may or may not change with soil type.

Yield map does not indicate whether nutrients levels are excessive or deficient.

Even OM or pH levels do not necessarily follow USDA soil maps or EM/EC maps.

Proper grid sampling is essential for fixed nutrients plus OM& pH.

# CONCLUSIONS:

For mobile nutrients, (nitrate nitrogen) sample by zone made from EC/EM maps

For immobile nutrients, (P & K) use a grid system of 2.5A or less.

All soil collection software are not created equal.