# A Variable-Rate Pivot Irrigation Control System

Presented by:


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for the Precision Agriculture Team
The University of Georgia
Biological & Agricultural Engineering
and NESPAL
Tifton Campus


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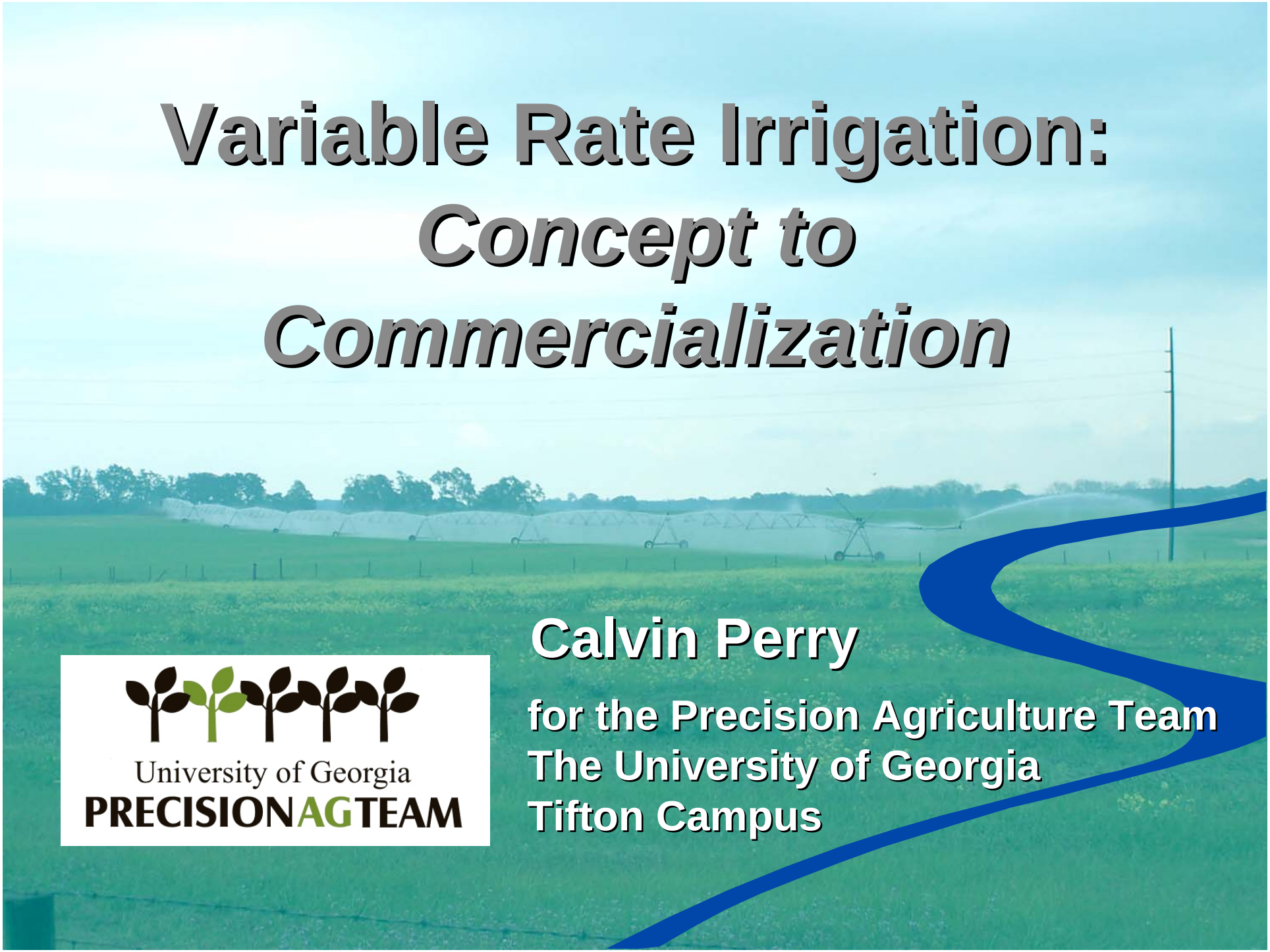
# Variable Rate Irrigation: *Concept to Commercialization*

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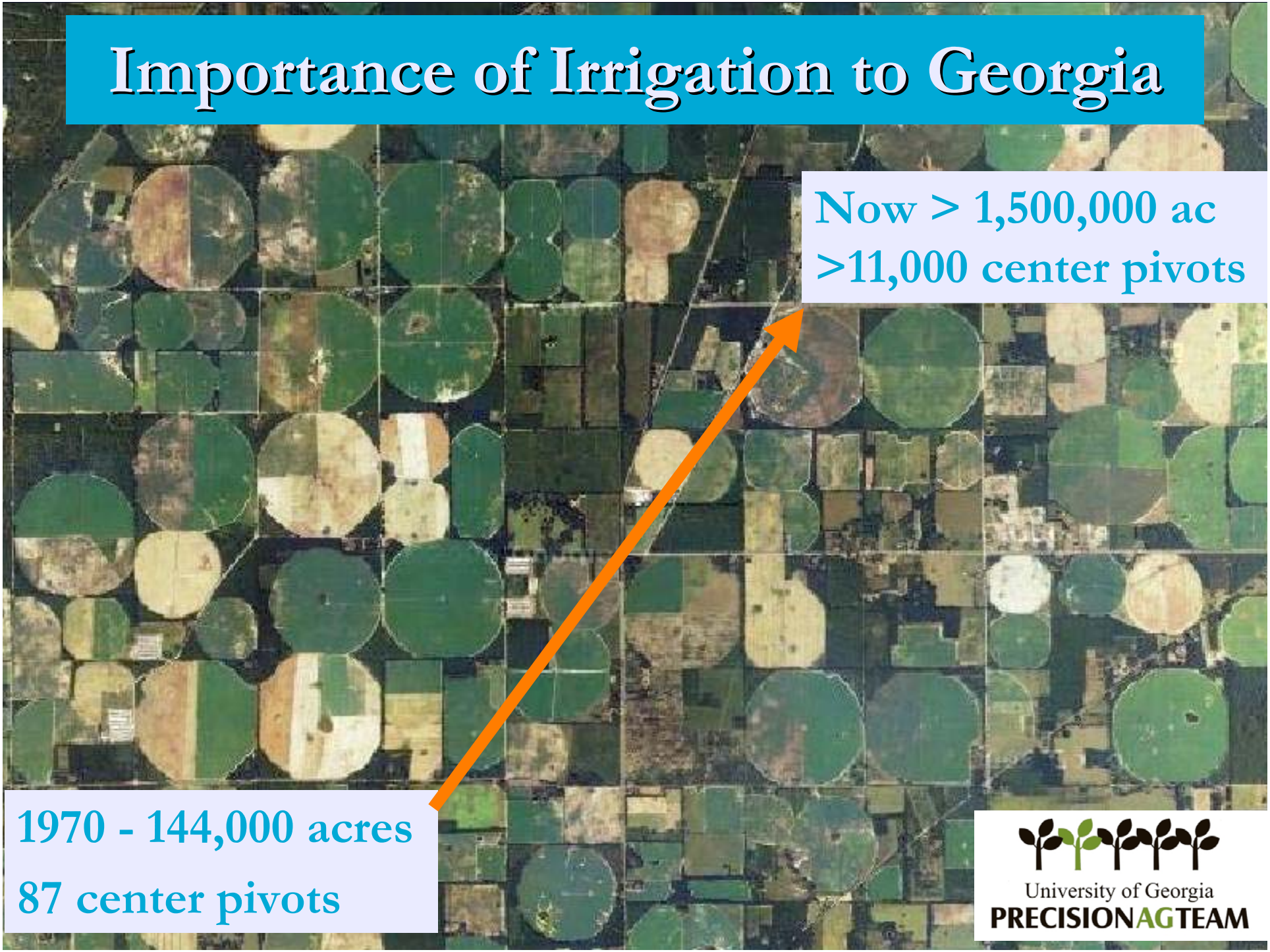
# Importance of Irrigation to Georgia



# Not All Irrigation Water is Applied Optimally…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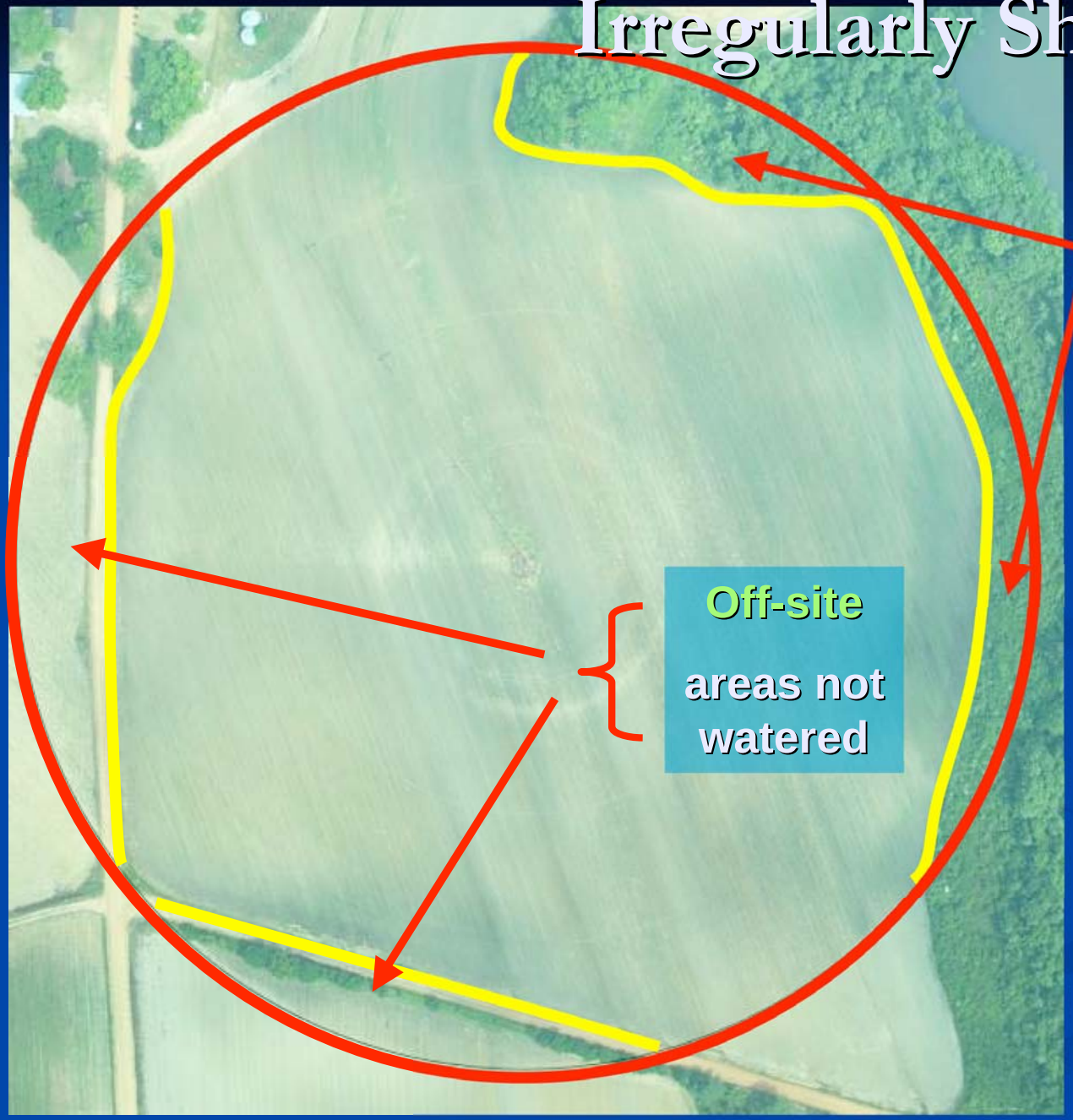
# Irregularly Shaped Fields

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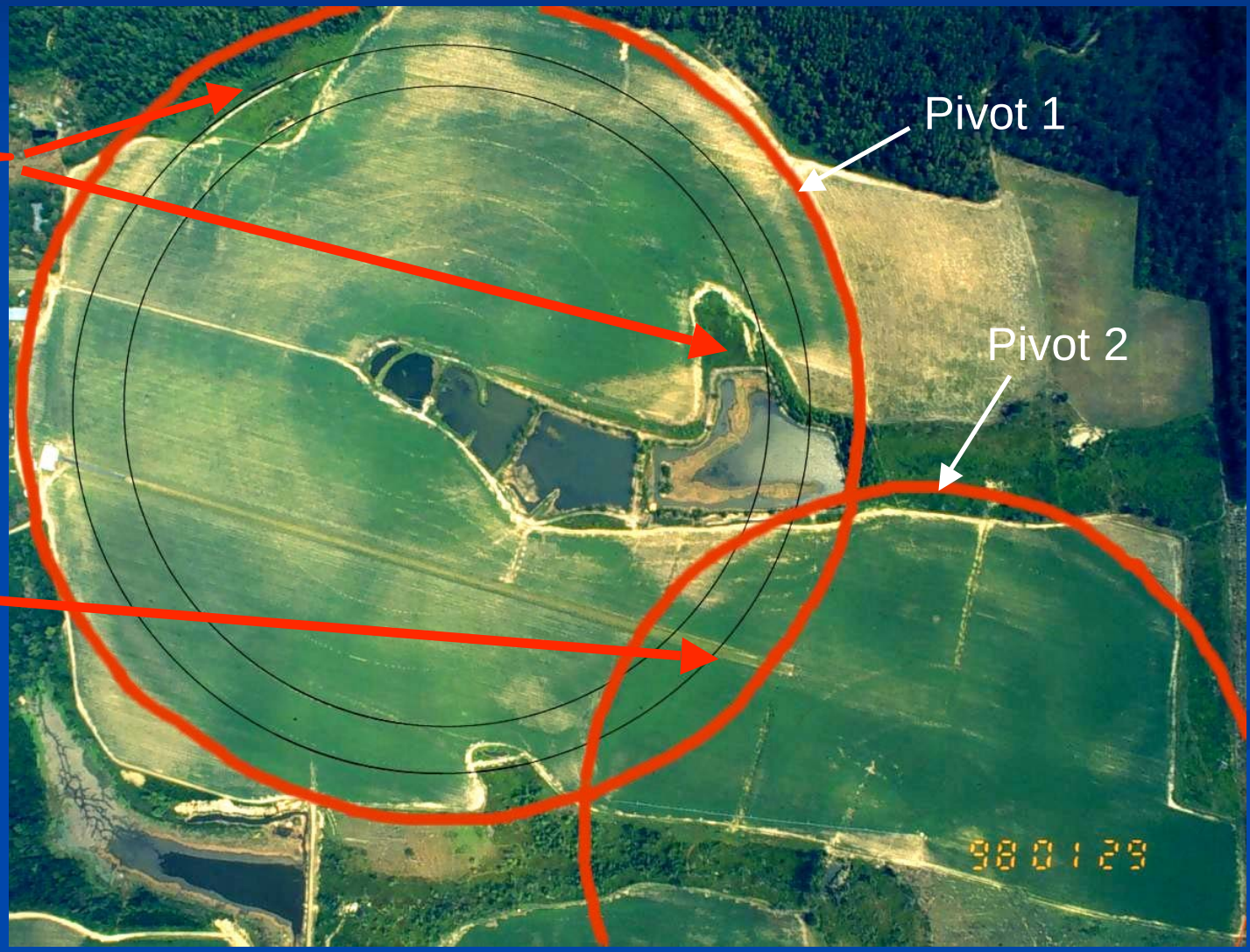
# Overlapping Pivots

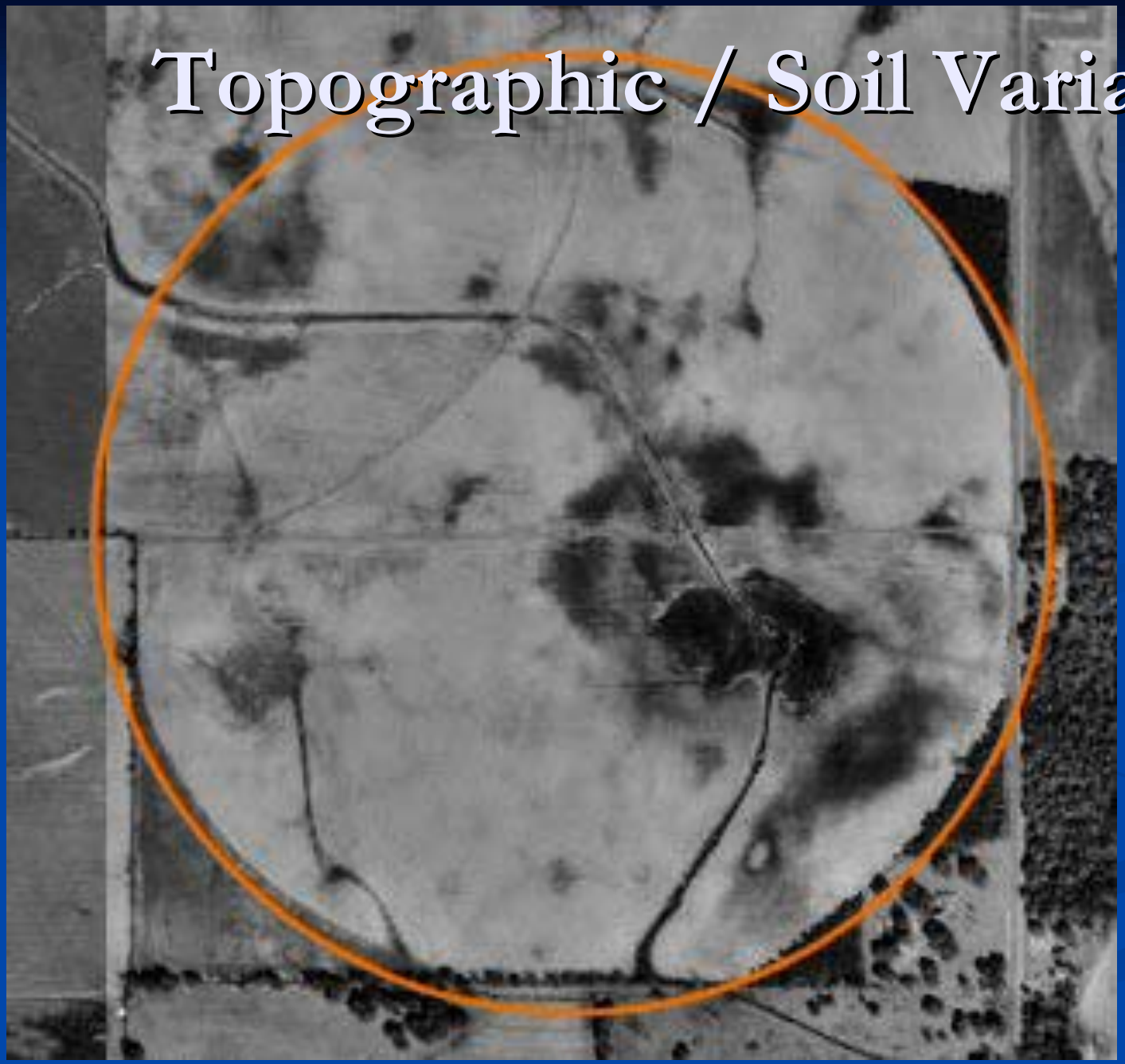


# Non-crop Inclusions

Field opposite Marine Corps Logistic Base, Albany, GA, 2001

# Topographic / Soil Variability

# Topographic / Soil Variability



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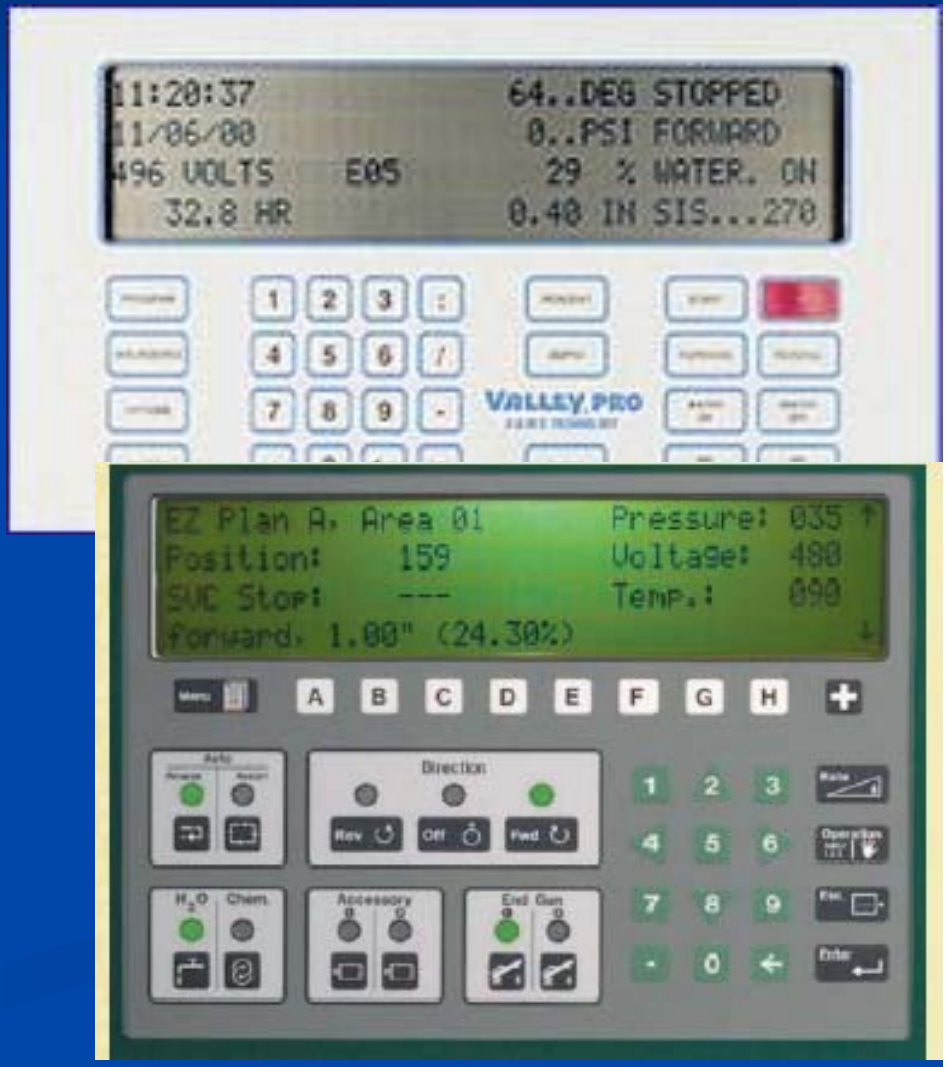
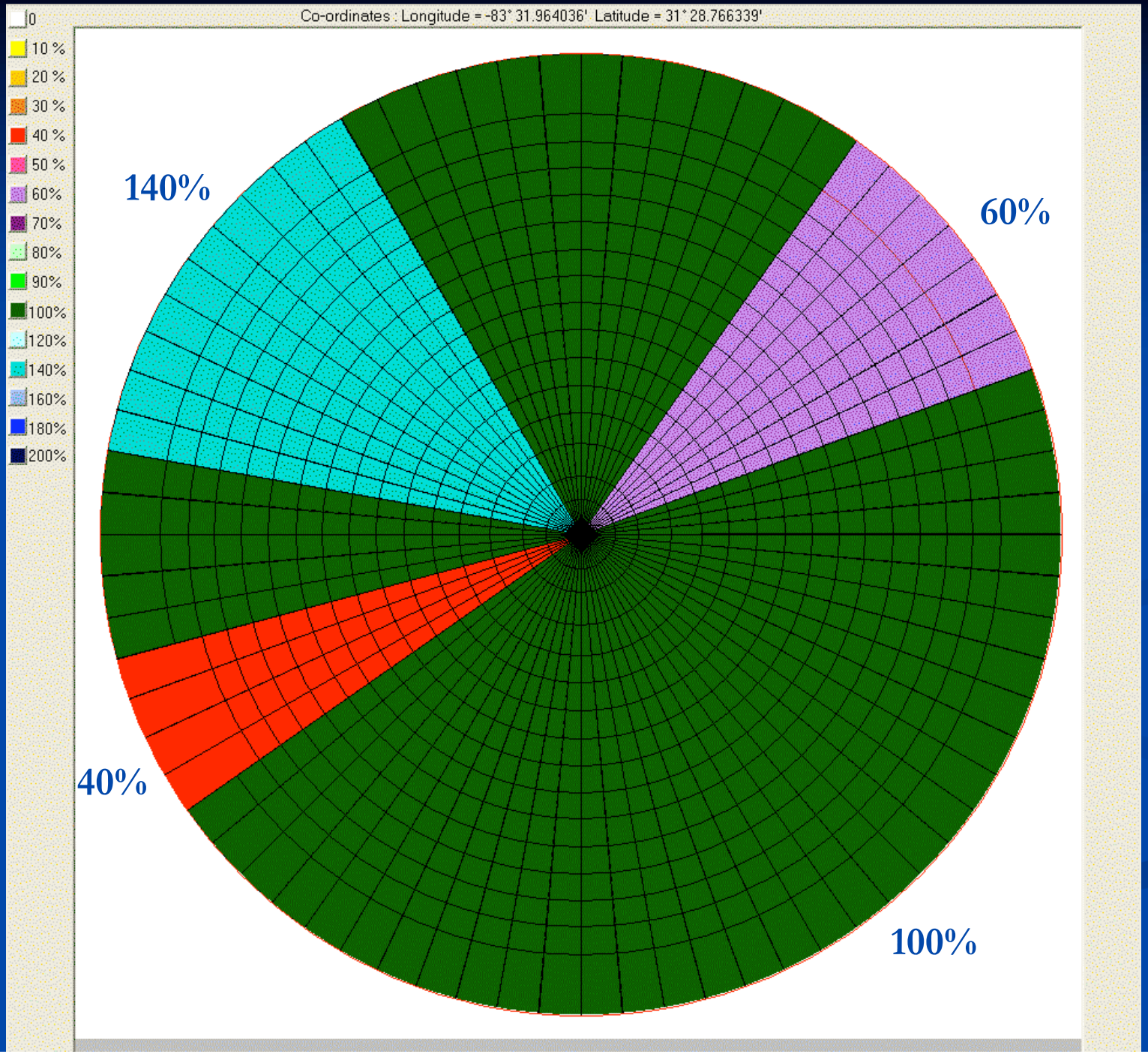
# Multiple Crops/ Multiple Crop Stages

# Off-site Application

# VRI from Manufacturers


Co-ordinates : Longitude = -83° 31.964036' Latitude = 31° 28.766339'
0
10 %
20 %
30 %
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160%
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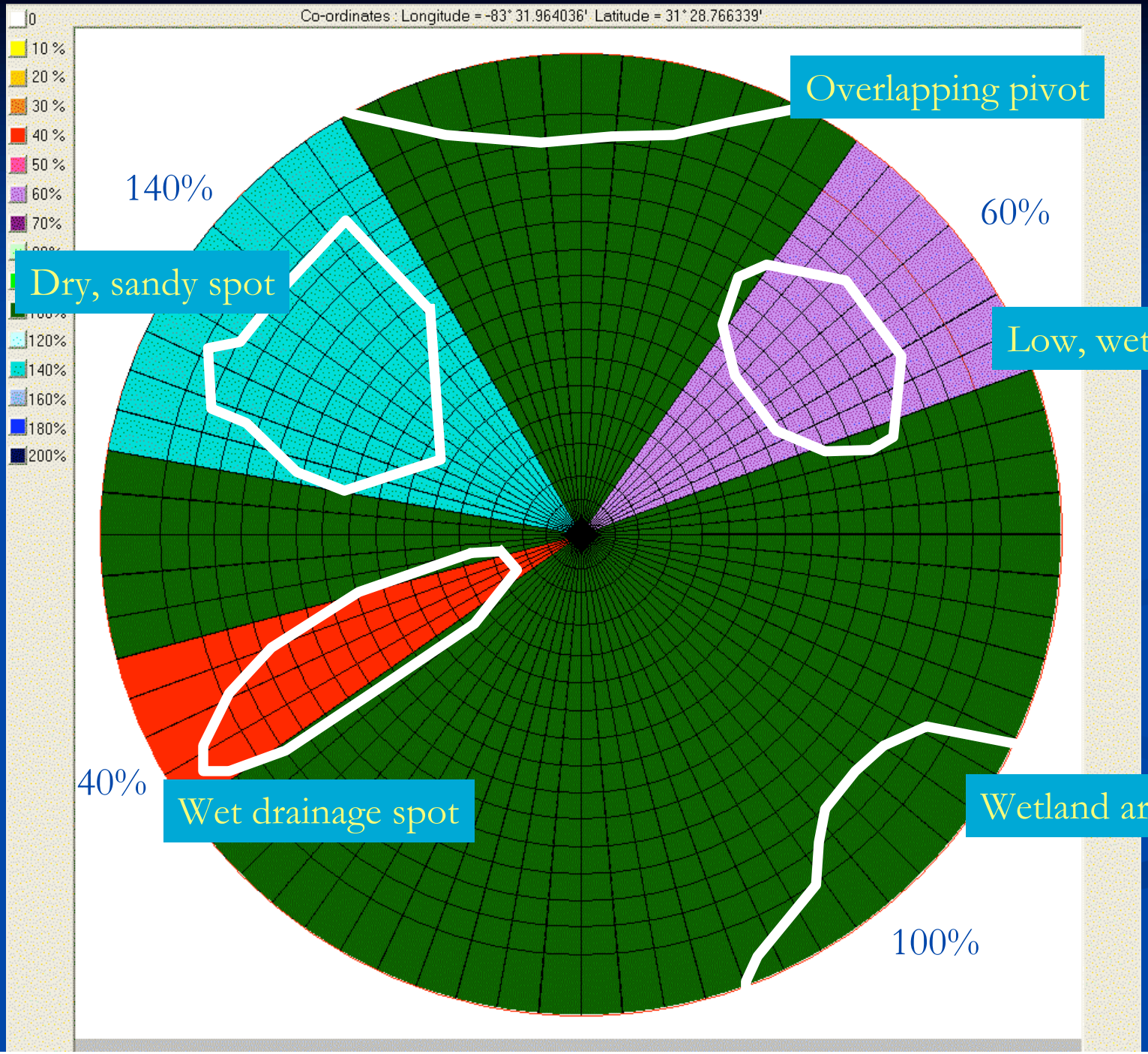
140%
60%
40%
100%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0
10 %
20 %
30 %
40 %
50 %
60%
70%
120%
140%
160%
180%
200%
Overlapping pivot
140%
60%
Dry, sandy spot
Low, wet spot
40%
Wet drainage spot
Wetland area
100%

# What If We Could…

- Develop irrigation management zones
- Apply just the right amount of irrigation water to those zones
- Apply no water to non-cropped zones

- Enter VARIABLE-RATE IRRIGATION

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# What is Variable-Rate Irrigation?

- Also called precision irrigation
- VRI refers to the application of different volumes or rates of water to different segments of a field
  - rates are based on perceived or measured water requirements of sub-field zones

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# Why Should a Grower Consider VRI?

- to reduce water waste
- to increase effective water use efficiency (increase yield per unit of water applied)
- to reduce weeds in non-cropped areas of fields
- to meet the needs of high water use soil types
- to decrease over-watering in low and/or flooded areas
- to increase flexibility in fields with multiple crops
- to optimize irrigation speed

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# University of Georgia VRI System

- Teamed with Farmscan, Perth, Western Australia
- Developed a distributed control system using Farmscan electronics
  - main controller
  - main controller circuit board
  - node control circuit boards along the mainline
  - sub-units communicate via RS485

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# Water Application Depth

- Application Depth: the amount of water applied by the pivot over the entire area; ie. x inches of water applied
- Applic. Depth: a function of flow rate of water thru pipe and pivot travel speed
- Can be varied by
  - changing pivot travel speed
  - cycling sprinklers on/off as pivot moves

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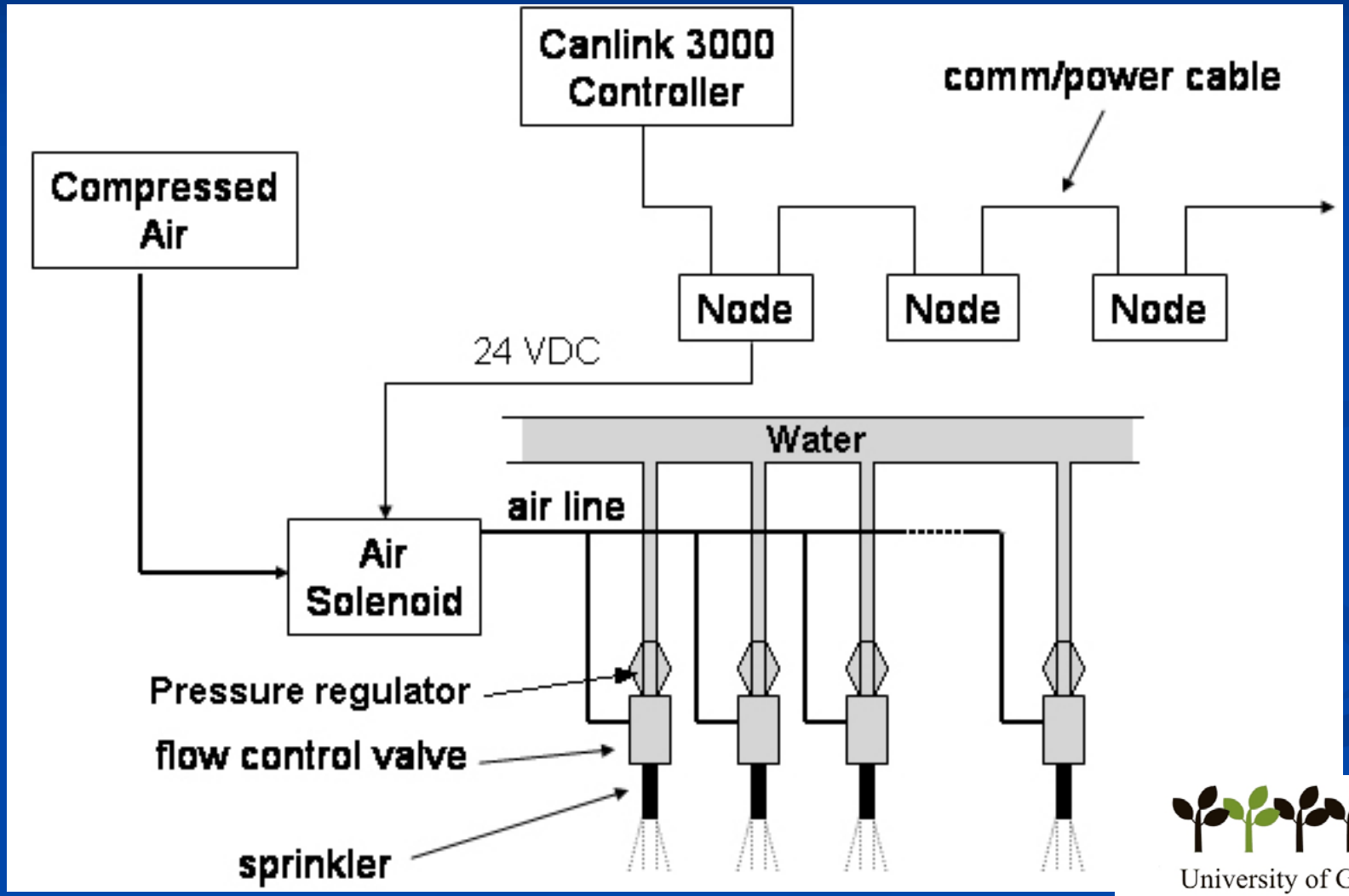
# University of Georgia VRI System

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# U of Ga VRI Components

## Valves / Regulators

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# U of Ga VRI Components

## Compressed Air Supply

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# U of Ga VRI Components


**GPS Receiver (WAAS)**

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# U of Ga VRI Components


**Master Controller & Canlink3000**

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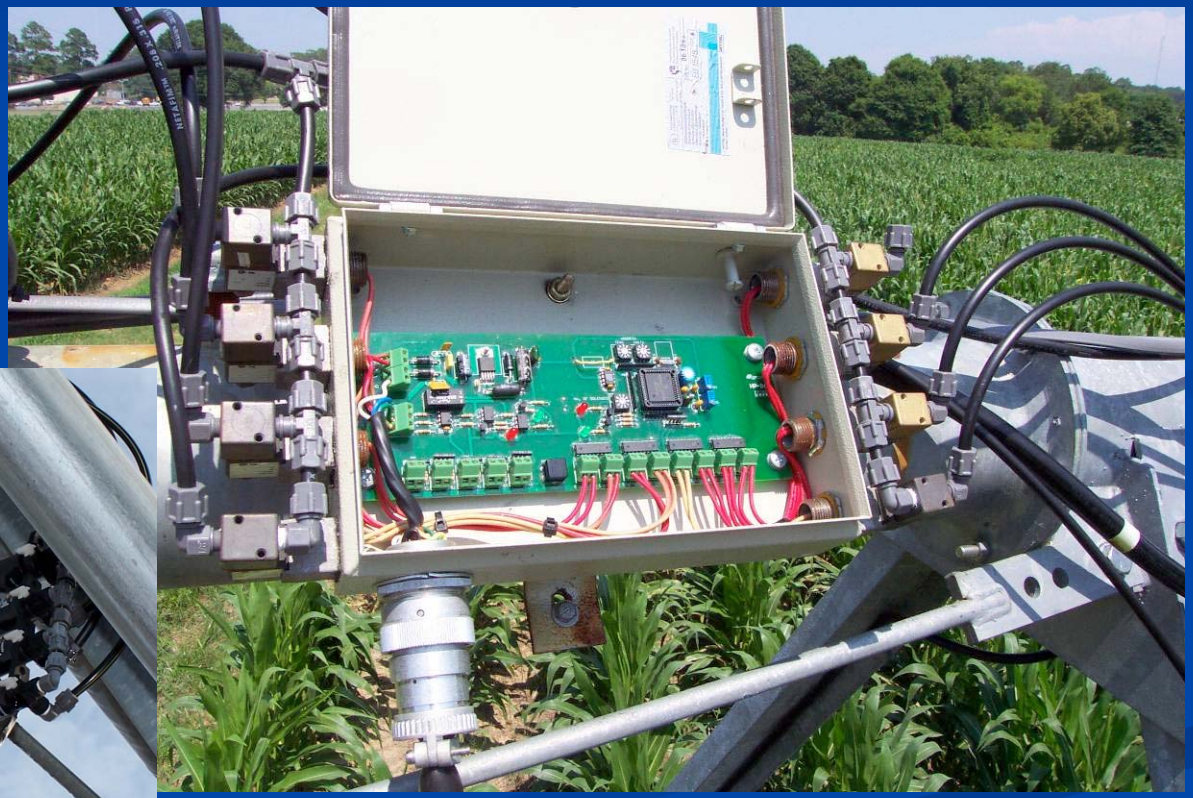
# U of Ga VRI Components

**Node Circuit**
**&**
**Solenoids**



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# VRI – Variable Rate Irrigation

# VRI in action
## (sprinklers cycling on/off)


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# End Gun and Sprinklers Off in Non-Cropped Area

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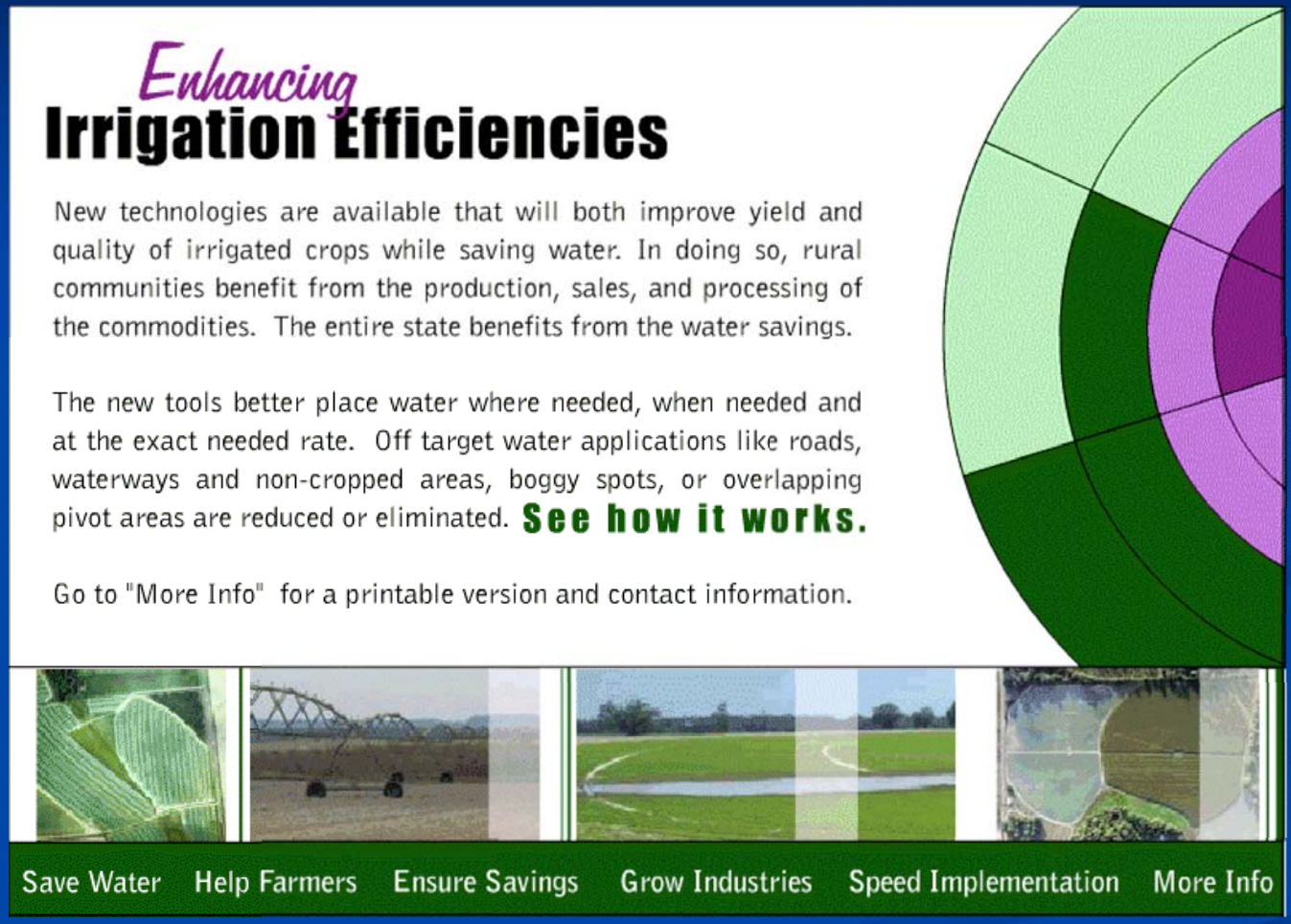
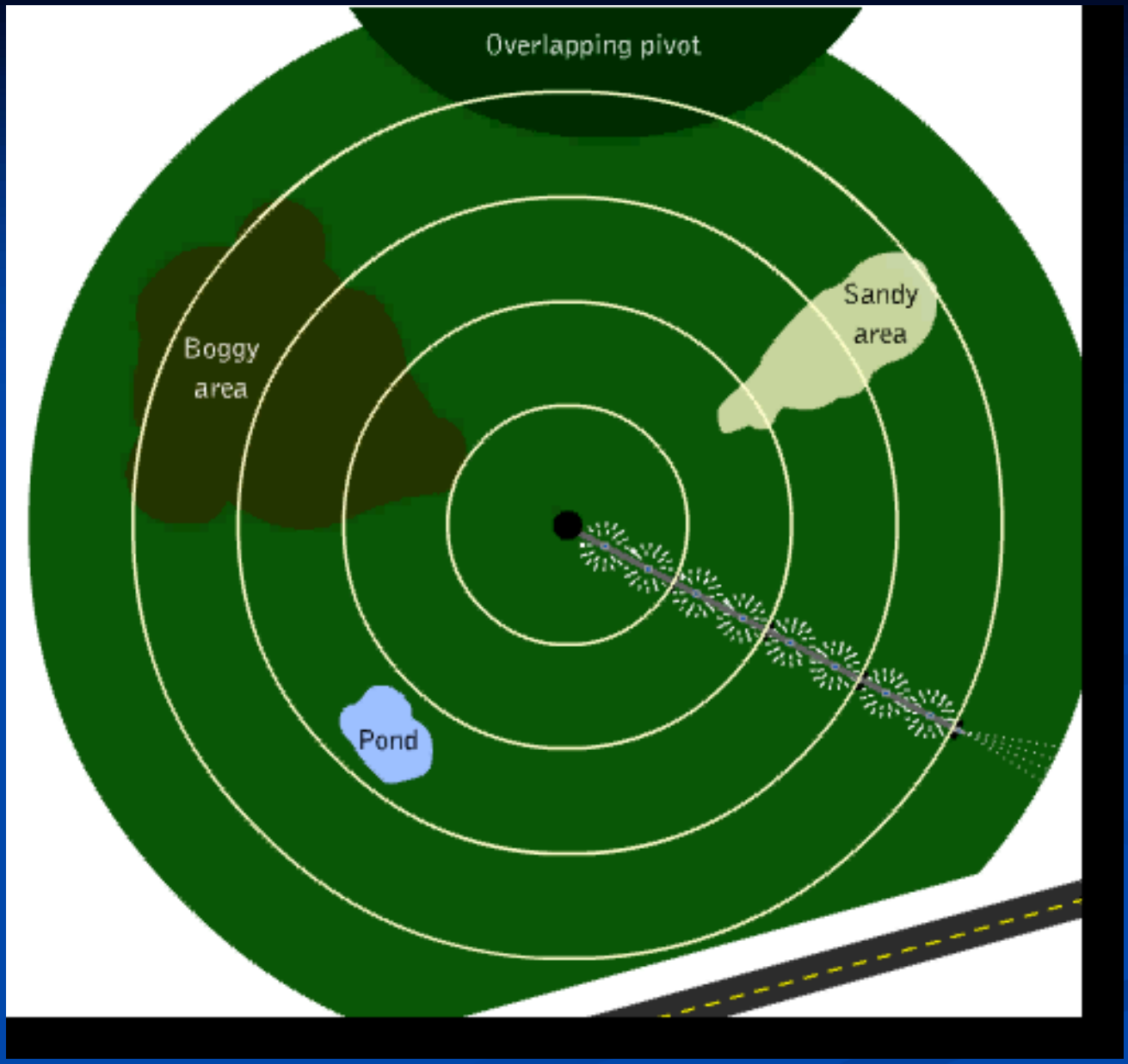



# www.nespal.org/irreff




www.nespal.org/irreff

# Why VRI Research?

- Cannot realize benefits from variable rate fertilization, lime, seed, etc. if we do not first properly **manage** water.
- Water **conservation** issues are becoming more important in the southeast.
- Current systems **waste** a considerable amount of the applied water.
- Future state/federal **regulatory** actions may necessitate the use of water conservation measures.

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# Hardware Testing

# Accuracy Assessment

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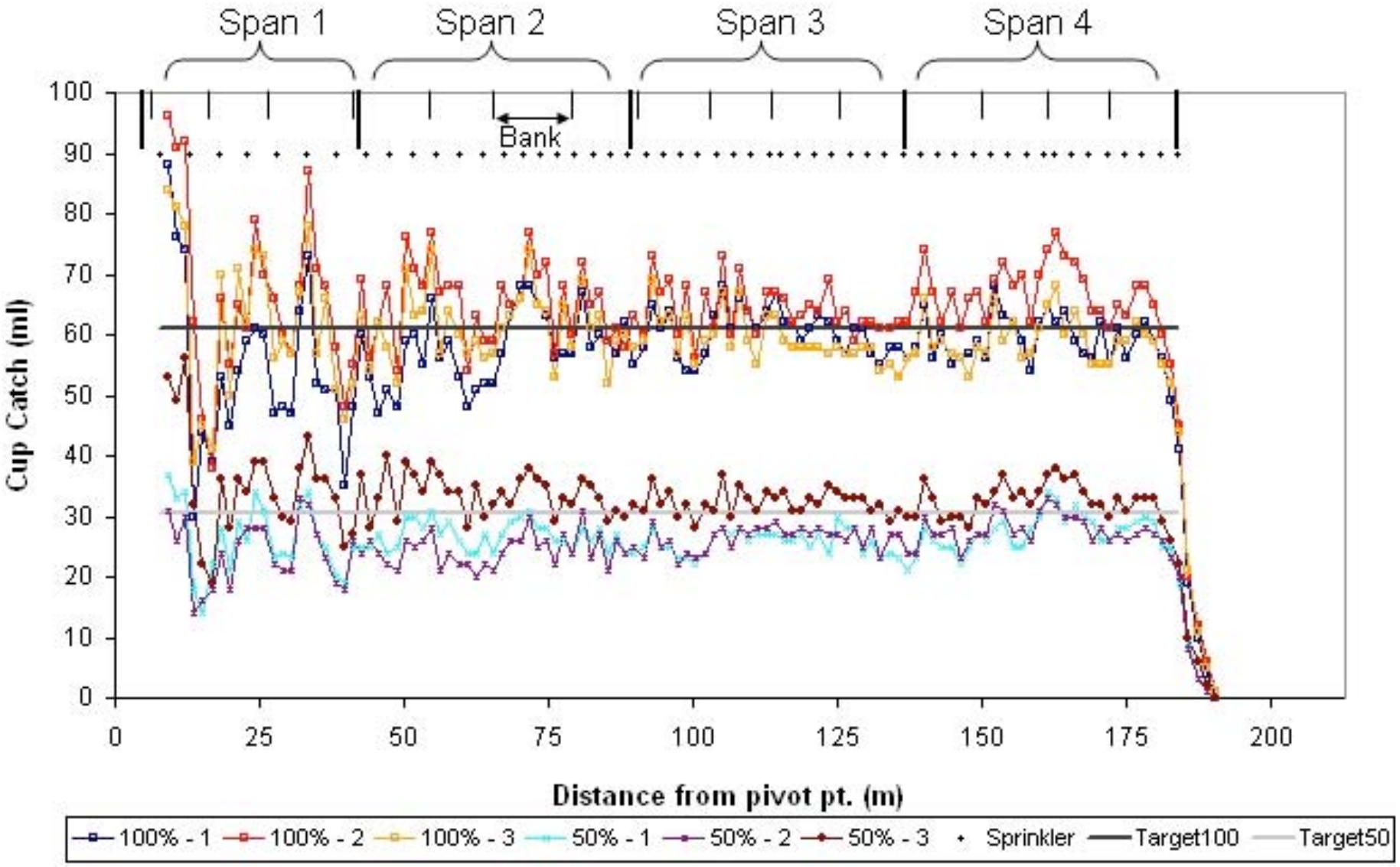
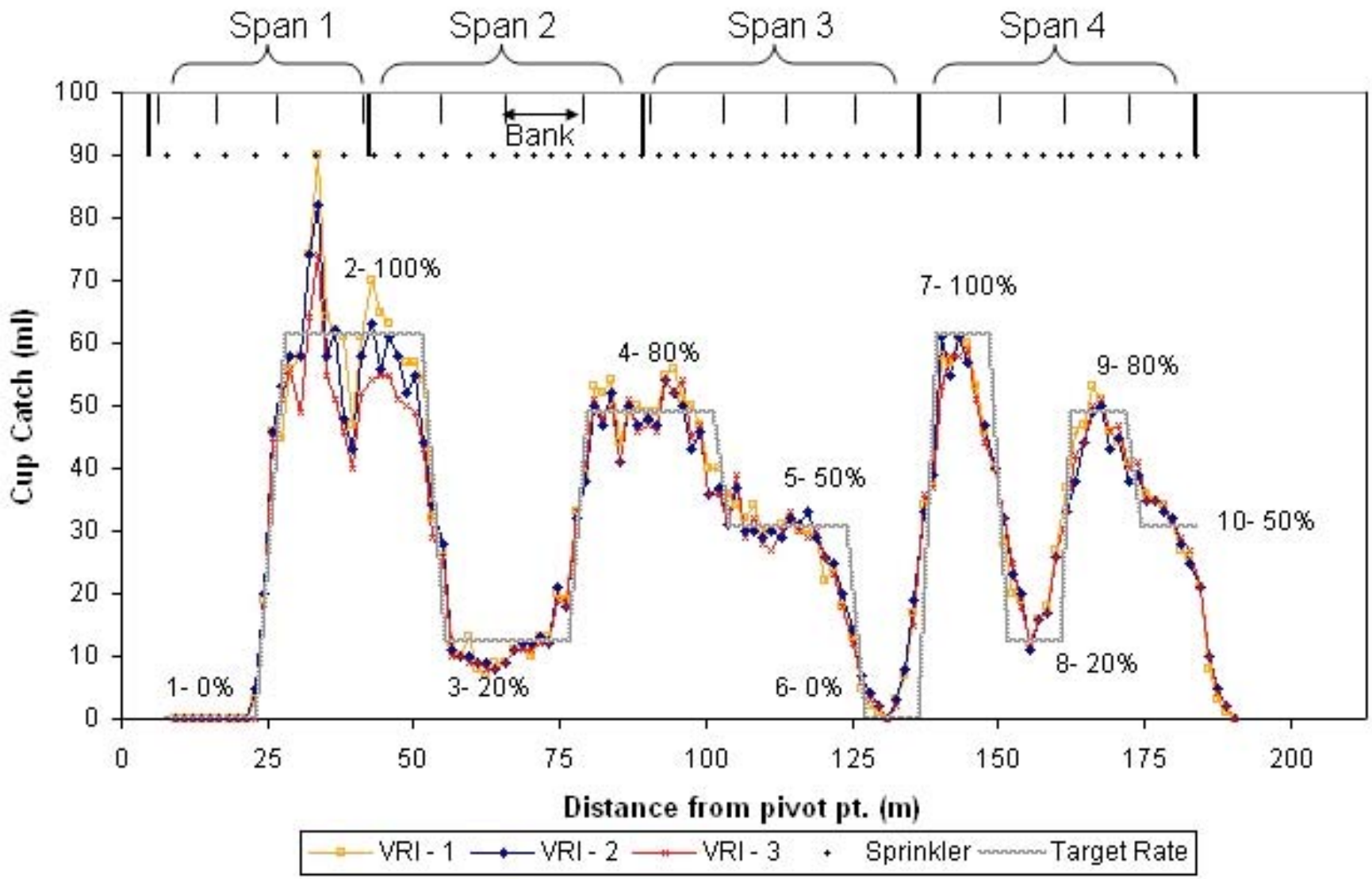
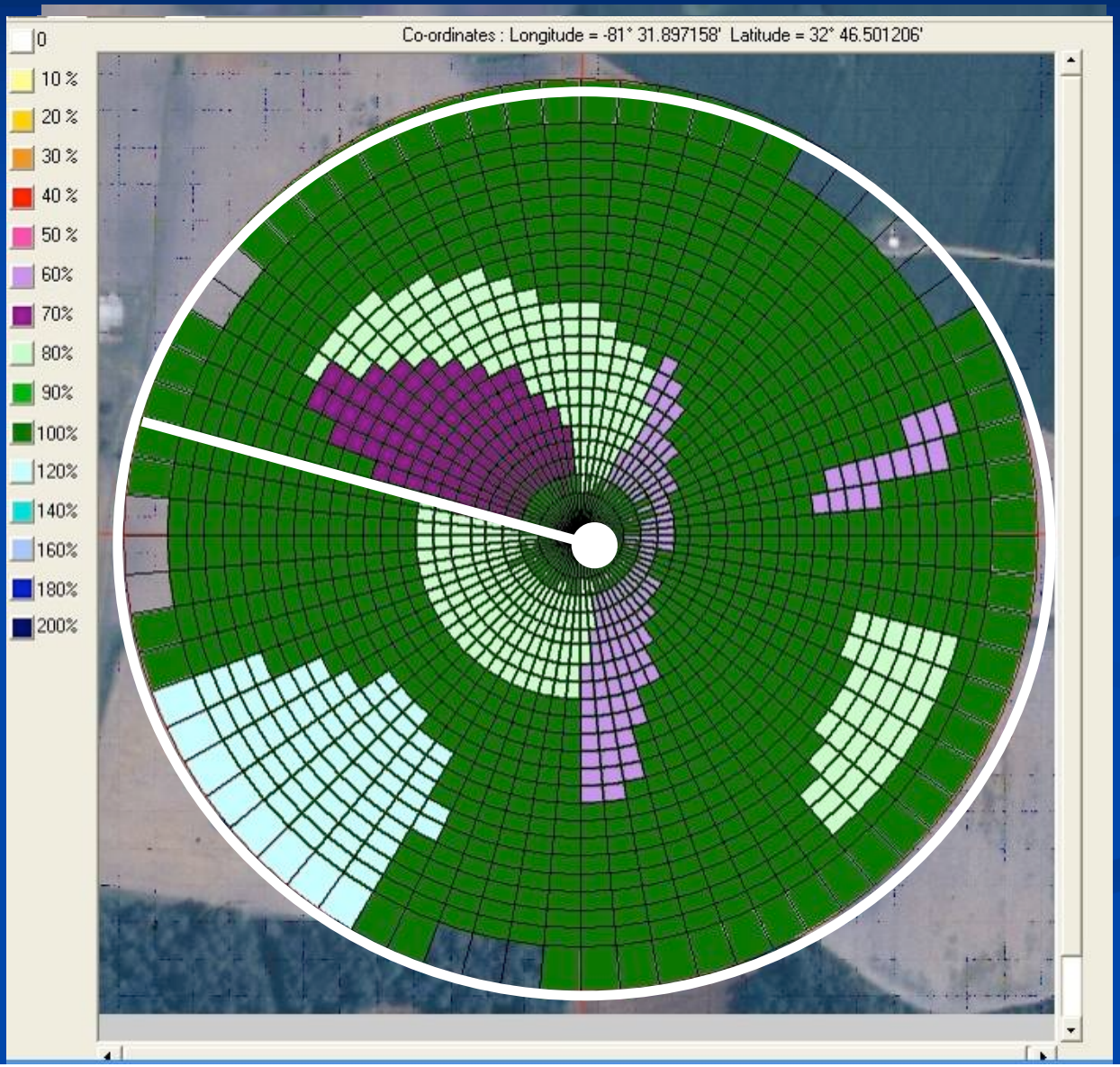

Span 1
Span 2
Span 3
Span 4
Bank
Cup Catch (ml)
Distance from pivot pt. (m)
100% - 1
100% - 2
100% - 3
50% - 1
50% - 2
50% - 3
Sprinkler
Target100
Target50


Span 1
Span 2
Span 3
Span 4
Bank
Cup Catch (ml)
Distance from pivot pt. (m)
1- 0%
2- 100%
3- 20%
4- 80%
5- 50%
6- 0%
7- 100%
8- 20%
9- 80%
10- 50%
VRI - 1
VRI - 2
VRI - 3
Sprinkler
Target Rate

# Application Map Development



# Other Research Opportunities

- Level of GPS accuracy required?
- How much water is really being saved?
- Will profits **increase**?
- Better irrigation scheduling needed?
- How to better generate water application map?
  - new real-time sensors (crop and/or soil water)
  - remote sensing data
  - just soil info?
  - or a combination?

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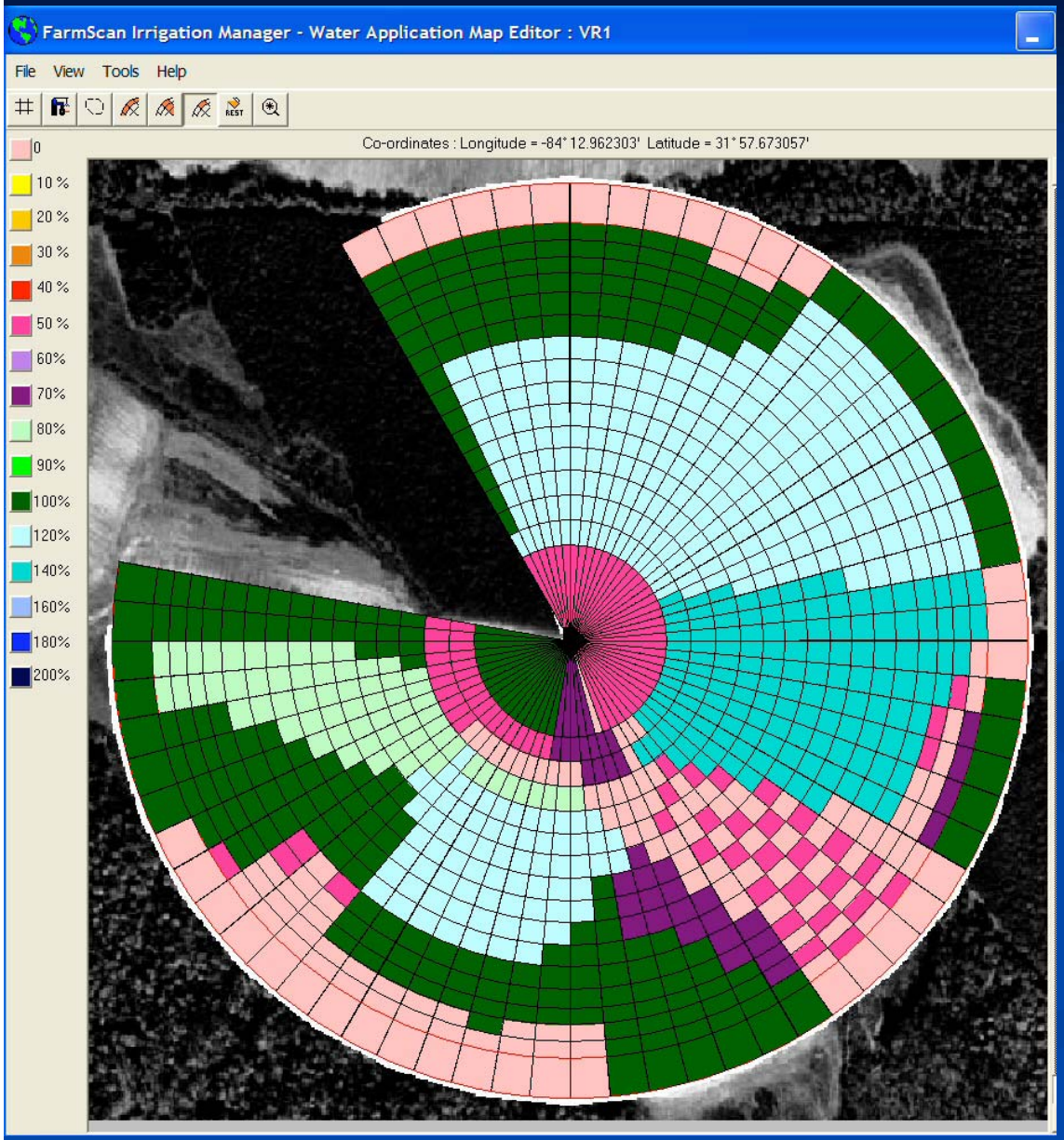


76 acre field

Sumter County Georgia

VRI controls on all sprinklers and end gun

Some zones require extra water

15% water savings

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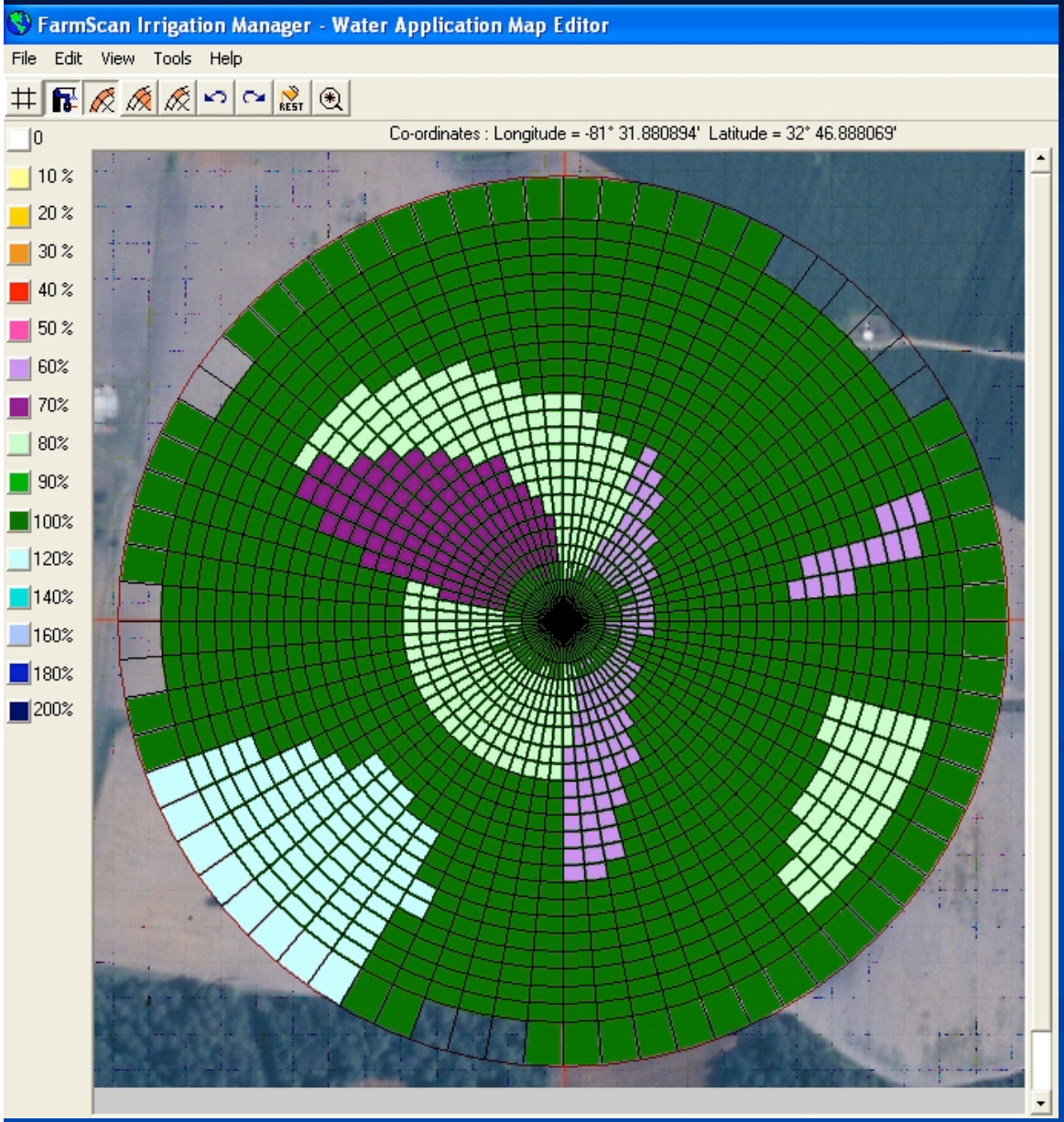


87 acre field

Screven County Georgia

VRI controls on all sprinklers and end gun

Some zones require extra water

7.5% water savings

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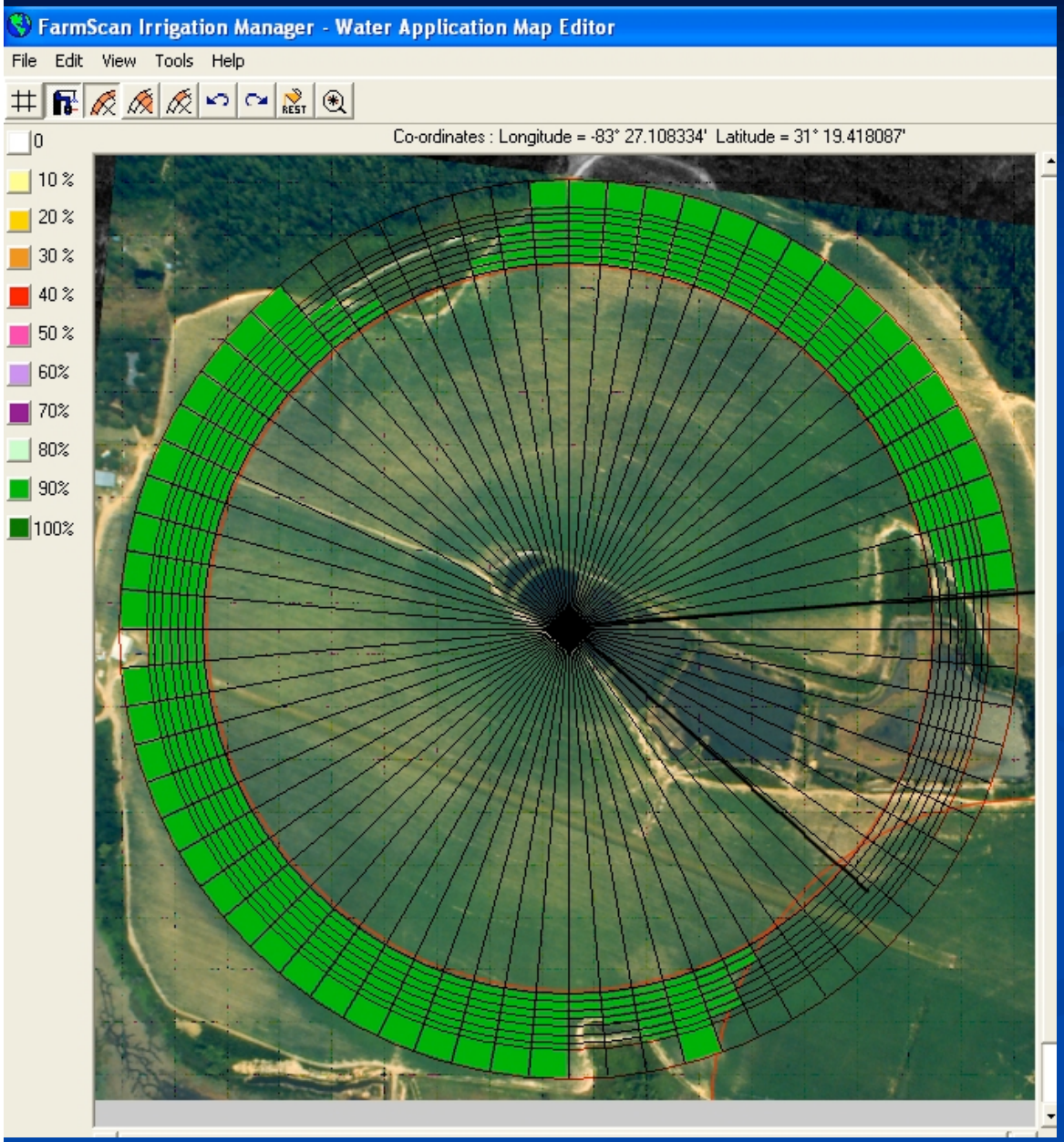


160 acre field

Cook County Georgia

VRI controls on last span, overhang, end gun

No variable rates – just on or off

8.1% water savings

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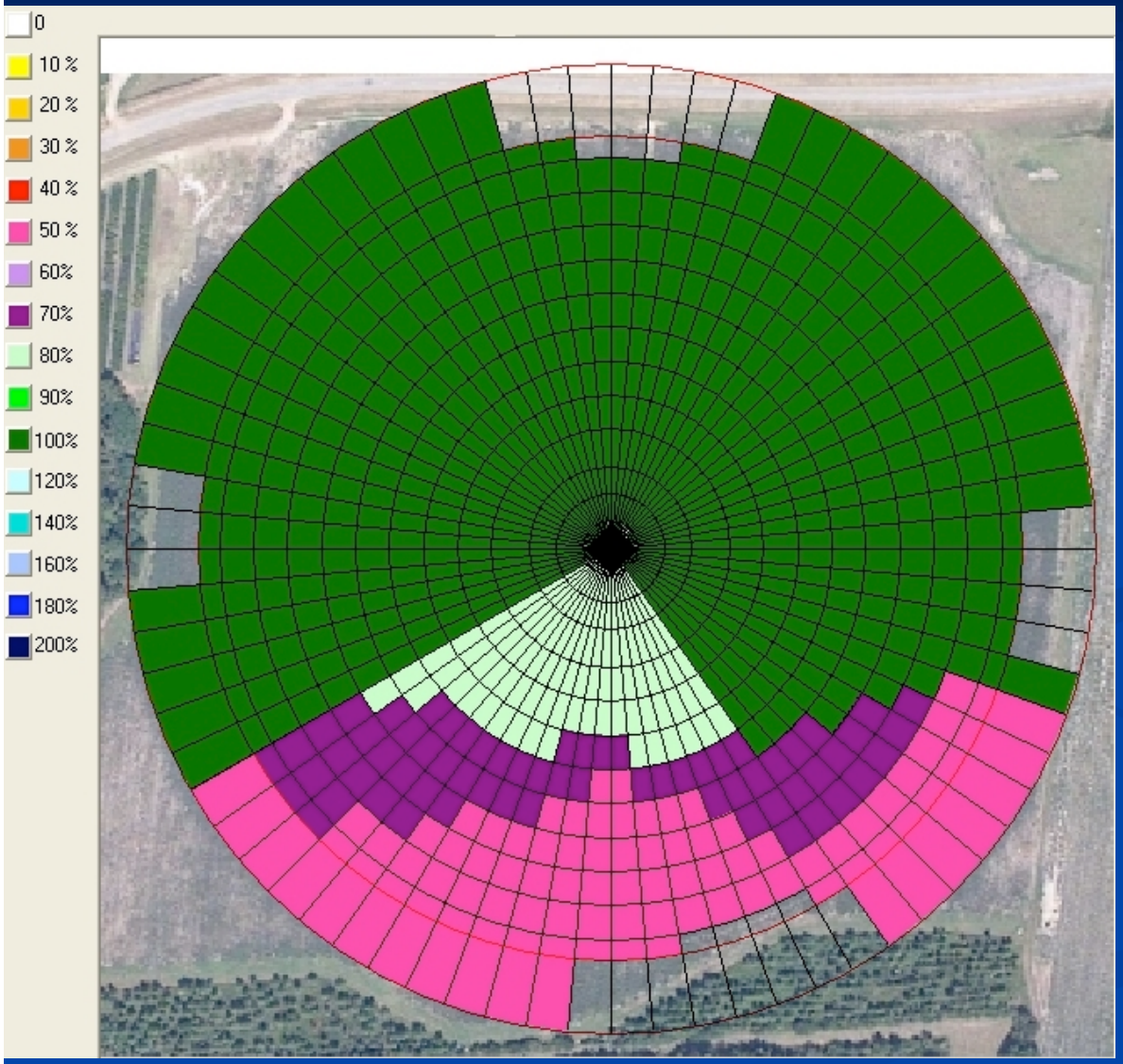


32 acre field

Colquitt County Georgia

VRI controls on all sprinklers and end gun

36% water savings

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# VRI (Potential) Benefits

- Save water
- Prevent double watering in overlap areas
- Improve irrigation management decisions
- Improve efficiency (don't under- or over-water)
- Reduce weeds in non-cropped areas
- Reduce nutrient leaching
- Reduce disease
- Reduce/optimize pumping costs
- Increase yields
- Future regulatory benefits

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# Potential Roadblocks For Implementing VRI

- Cost (in today's economic situation)
  - Farm Bill includes potential cost-share funds
- Potential for lightning damage
- Technology still fairly new and unproven
- Fairly steep learning curve (grower can't be technology shy)
- Pressure fluctuations when sprinklers or end gun cycled
- Pumps need to match changing conditions (steep vs. flat pump curves)
- Age / diversity of current pivot systems

# VRI Now Commercialized

- Hobbs & Holder LLC, Ashburn GA
  - www.betterpivots.com
- USDA-NRCS EQIP cost share funds directed at VRI installations in Flint River Basin in SW Ga
  - ~30 systems installed '04/'05/'06
- Many partners making this happen
  - Univ of Ga, Flint River Soil & Water Conserv. Distr, NRCS, The Nature Conservancy

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Variable Rate Pivot Irrigation - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address http://www.betterpivots.com/

Google Search Web 1228 blocked AutoFill Options

Precision Irrigation Technologies

Hobbs & Holder PRECISION IRRIGATION TECHNOLOGIES
www.betterpivots.com

BetterPivots.com
Variable Rate Irrigation (VRI)

*Navigate our site:*

- Home
- Frequently Asked Questions
- How does a farmer benefit from VRI?
- Installation Picture Gallery *Updated,* 12/18/04
- Letter for VRI Producers 11/17/04
- Project Partners New 12/6/04
- Technical Support

*Other Links:*

*I know of no pursuit in which more real and important services can be rendered to any country than by improving its agriculture, its breed of useful animals, and other branches of a husbandman's cares.* - **George Washington**

## *Technology to conserve water, the environment, crops, and farmer profits.*

**CONSERVATION, a word that we are hearing more and more. Now, you can put variable amounts of water on different parts of your field! Retrofitting existing center pivots with the VRI technology conserves water and soil. Click on the links to learn more.**

The system does this by

1. Controlling which nozzles are on and which are off.
2. Turning the end gun on and off.
3. Controlling the pivot speed.

Using a computer to set irrigation maps, irrigation controller, GPS, and

SEE HOW IT WORKS!

Pivot ANIMATION (NESPAL website demo, "avi" file)

Pivot MOVIE (7,700 KB) View a clip on pivot movement and nozzles cycling on and off, "avi" file.

Applet counter started

Internet

start Prec Irrigation Jasc Paint Sho... VRI at NCR180... Variable Rate Pi... 12:32 AM

# Suitability Index

- NRCS needed to Rank systems to determine which growers would receive cost share $$$
- Suitability index developed to rank systems
- GIS used to determine off-site irrigation, non-crop inclusions, reduced irrigation and other features

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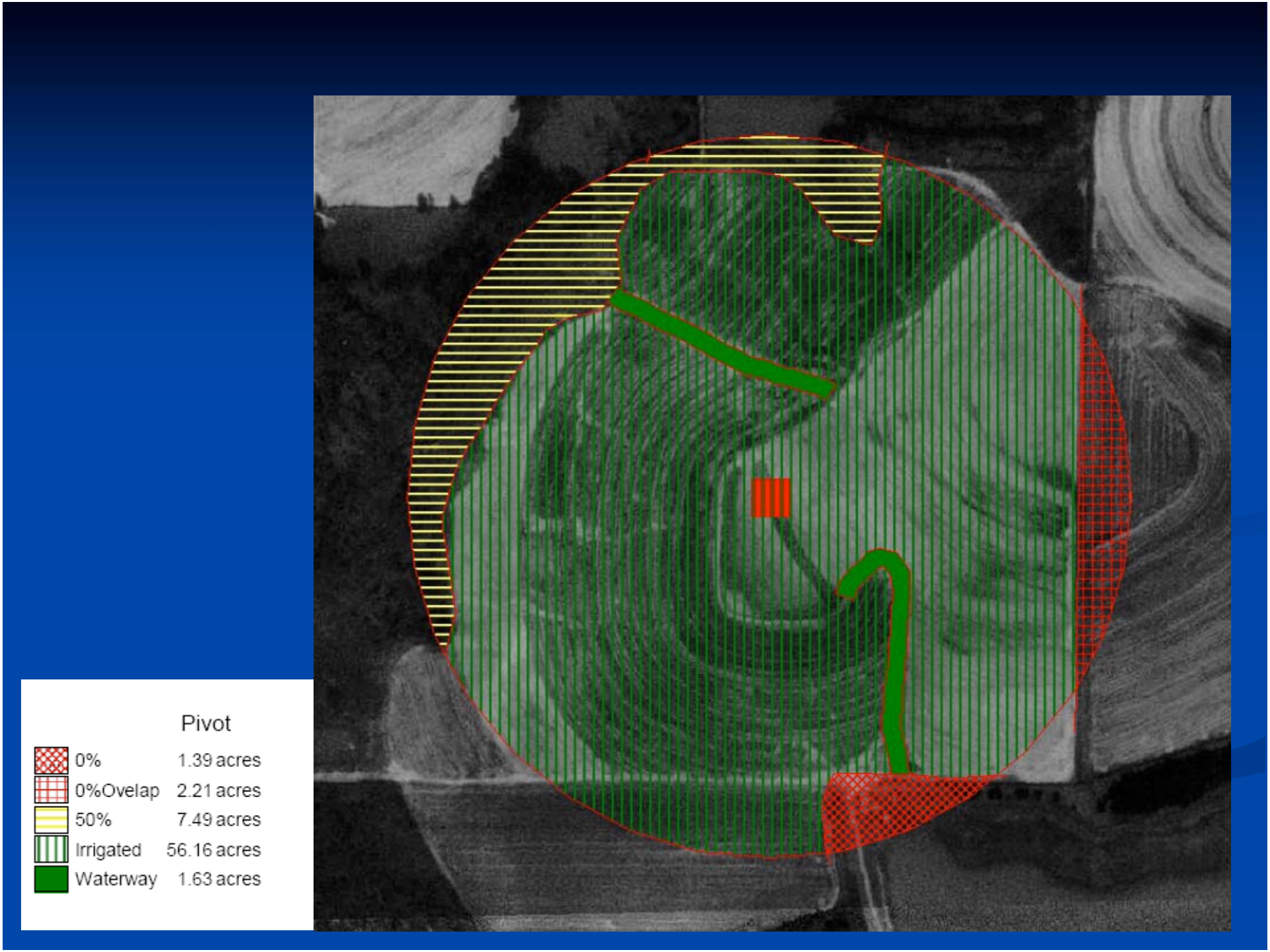
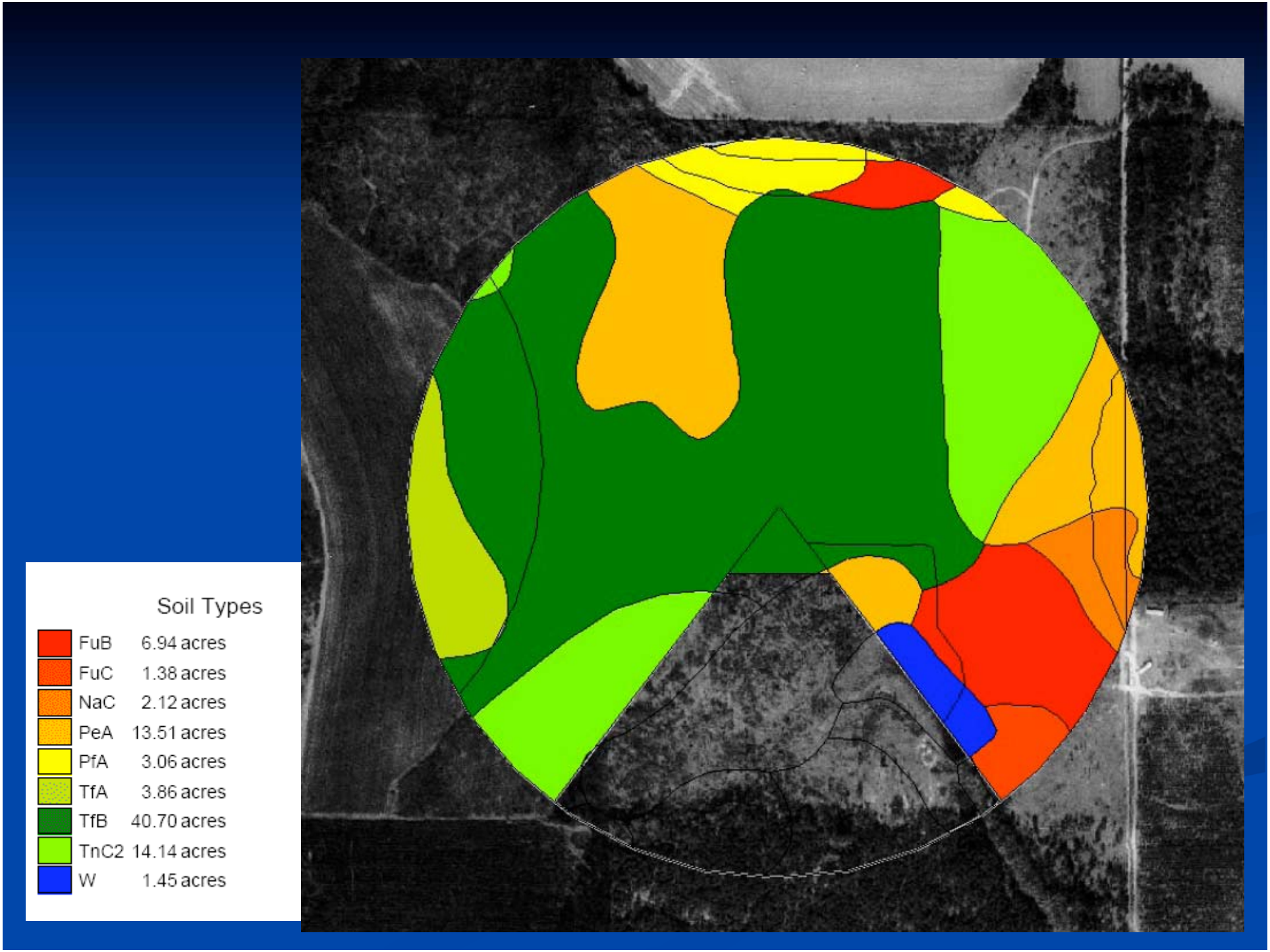

Pivot
0% 1.39 acres
0%Ovelap 2.21 acres
50% 7.49 acres
Irrigated 56.16 acres
Waterway 1.63 acres


Soil Types
FuB 6.94 acres
FuC 1.38 acres
NaC 2.12 acres
PeA 13.51 acres
PfA 3.06 acres
TfA 3.86 acres
TfB 40.70 acres
TnC2 14.14 acres
W 1.45 acres


Layout %
Cultivated 69.73 acre
End Gun,0% 0.89 acre
Overlap,0% 9.65 acre
Wet, Pond, Etc, 0% 6.96 acre

# Latest Grant Funding

- USDA-NRCS Conservation Innovation Grant
  - $501,000 over 3 yrs
  - GA and SC (Perry and Khalillian)
  - Install add'l VRI systems, conduct trainings, workshops, web resources, etc.
  - Have installed approx. 18 VRI systems 04-07

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# Additional EQIP Funding

- South Carolina – 75%/25%
- Mississippi – 50%/50%

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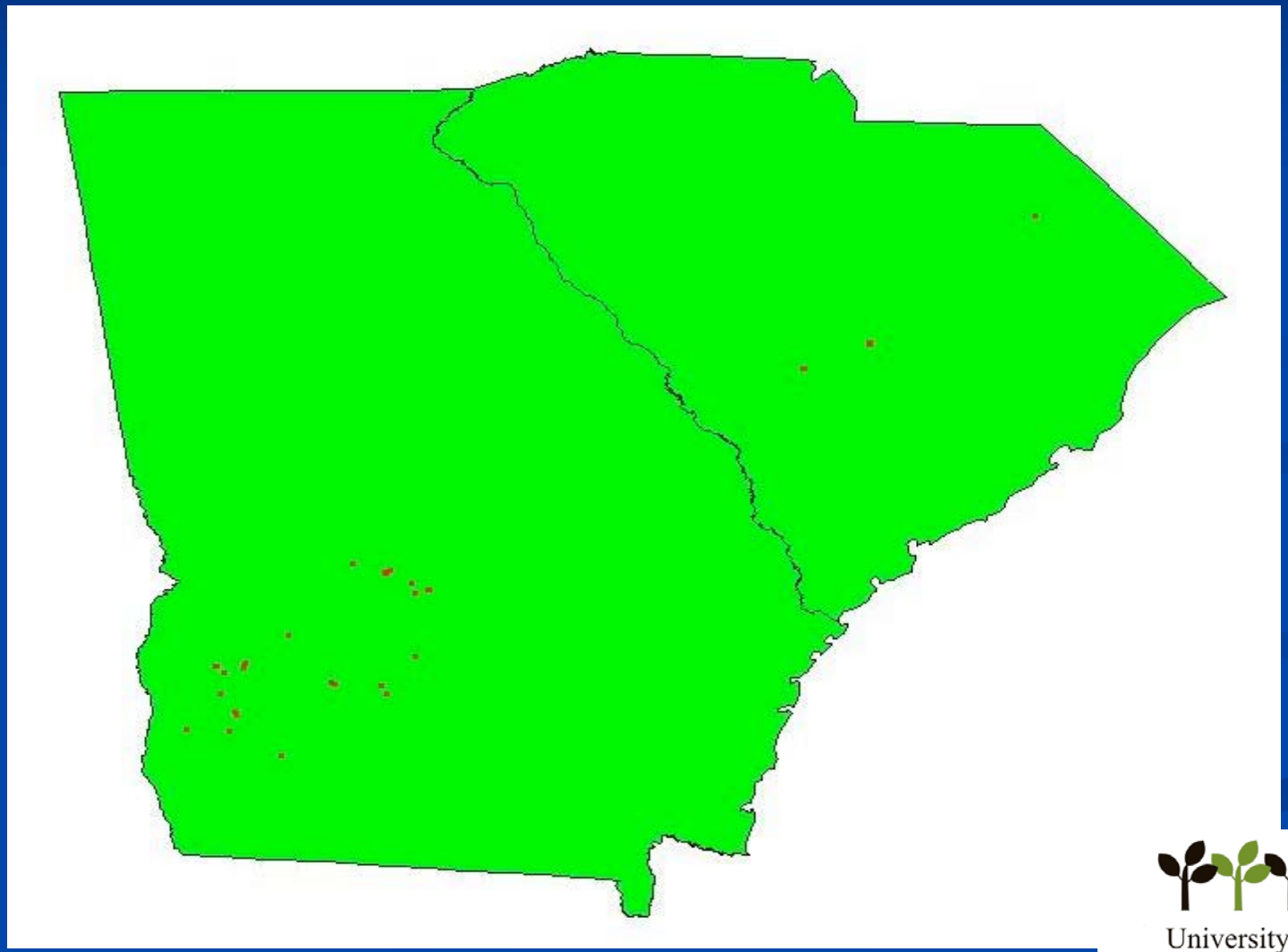
# VRI Installations, 2005



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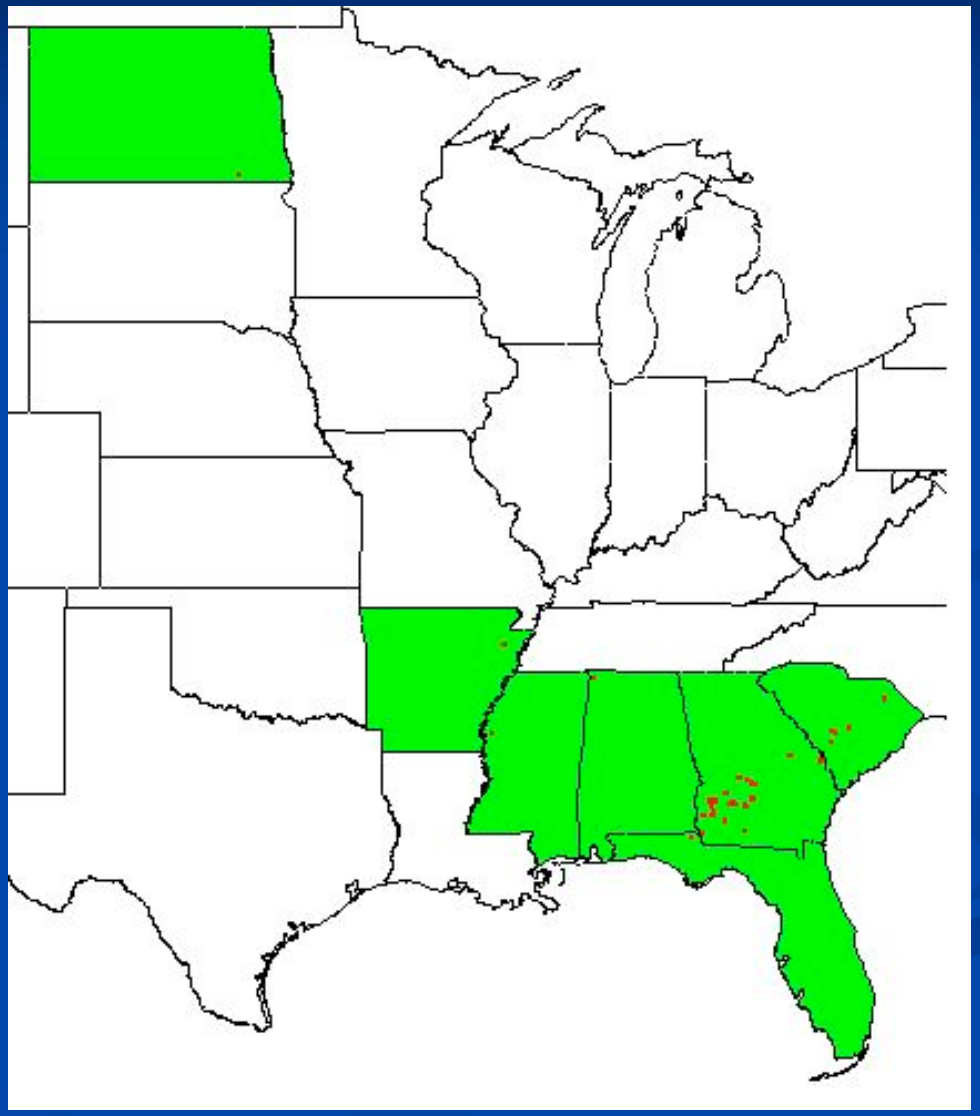
# VRI Installations, 2007

- 31 in Georgia
- 5 in South Carolina
- 1 in Arkansas
- 1 in Florida
- 1 in North Dakota
- 1 in Alabama (Mar 07)
- 1 in Mississippi (Mar 07)
- 2 more on drawing board for Mississippi

*41 Installed or on schedule, as of February 5, 2007*



# New Life Turf

## Norway, SC

"On our farm, sod quality is our number one priority. One key to sod quality is to have uniform soil moisture. The VRI unit on our pivot allows us to apply the perfect amount of water depending on the different soil types in the field. By heavily irrigating sandy soils and lightly irrigating clay soils we ensure sod uniformity, and save water as well." Martin Williams, New Life Turf

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# Iron Oak Turf

## Oakfield, GA

"I have had a pretty easy time writing new maps to adjust rates. Getting them to the controller has been easy, too." – Jerry Moore, Iron Oak Turf, Oakfield, GA

IRON OAK TURF FARMS

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# Singletary Farms

## Blakely, GA

"Our pivot pulls from a holding pond replenished from a well. Until we added VRI, our pivot would not make a circle at 3/4" without stopping to let the pond catch up." – Steve Singletary

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# Rodney Dawson

## Hawkinsville, GA

"It's working pretty well.  I have had more than one person ride by and call to tell me that nozzles on my pivot were stopping up.  As soon as you know about funding, my brother and I may want to apply for two more." – Rodney Dawson

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# Jenny Crisp Farm

## Sumter Co., GA

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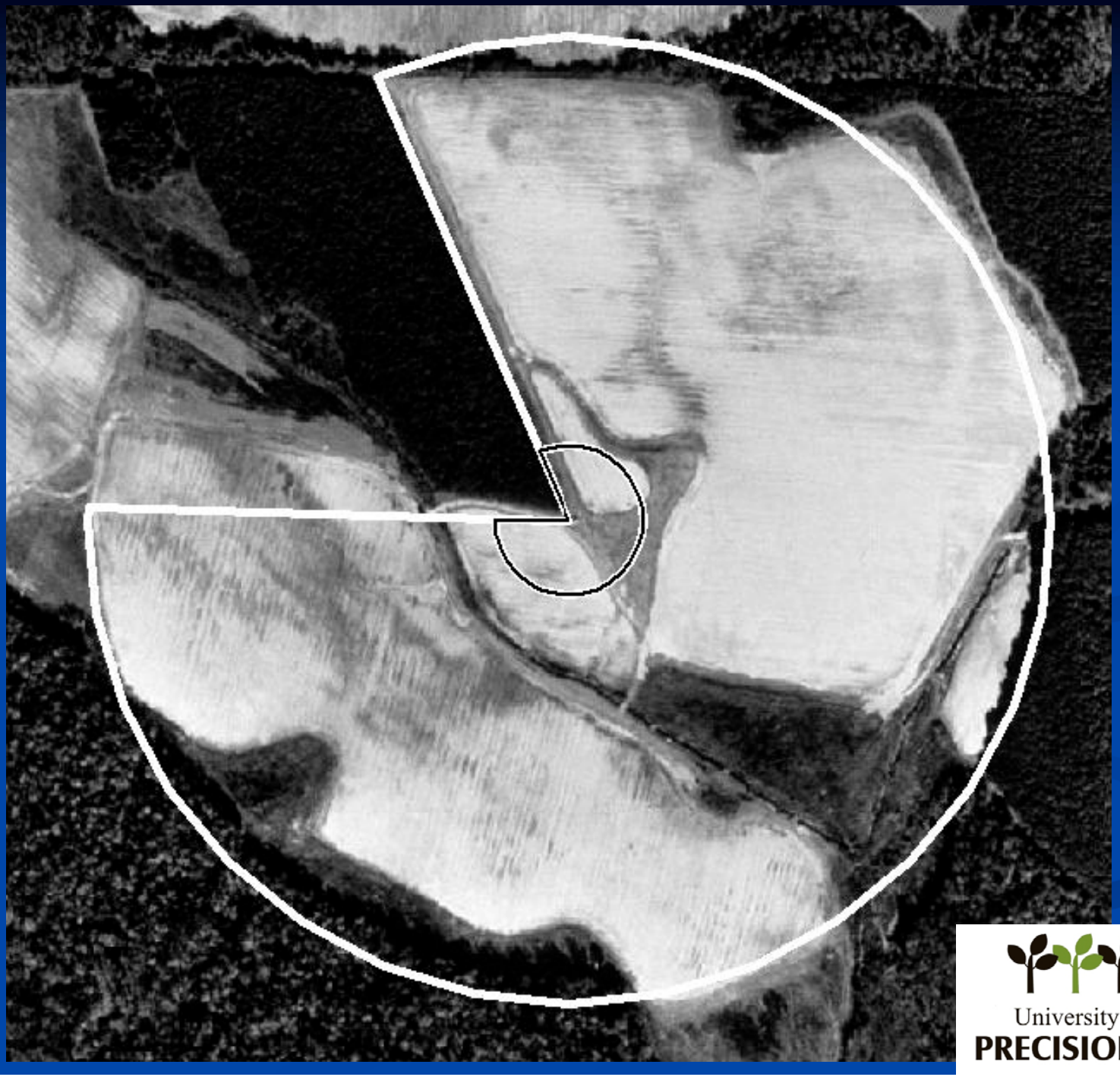

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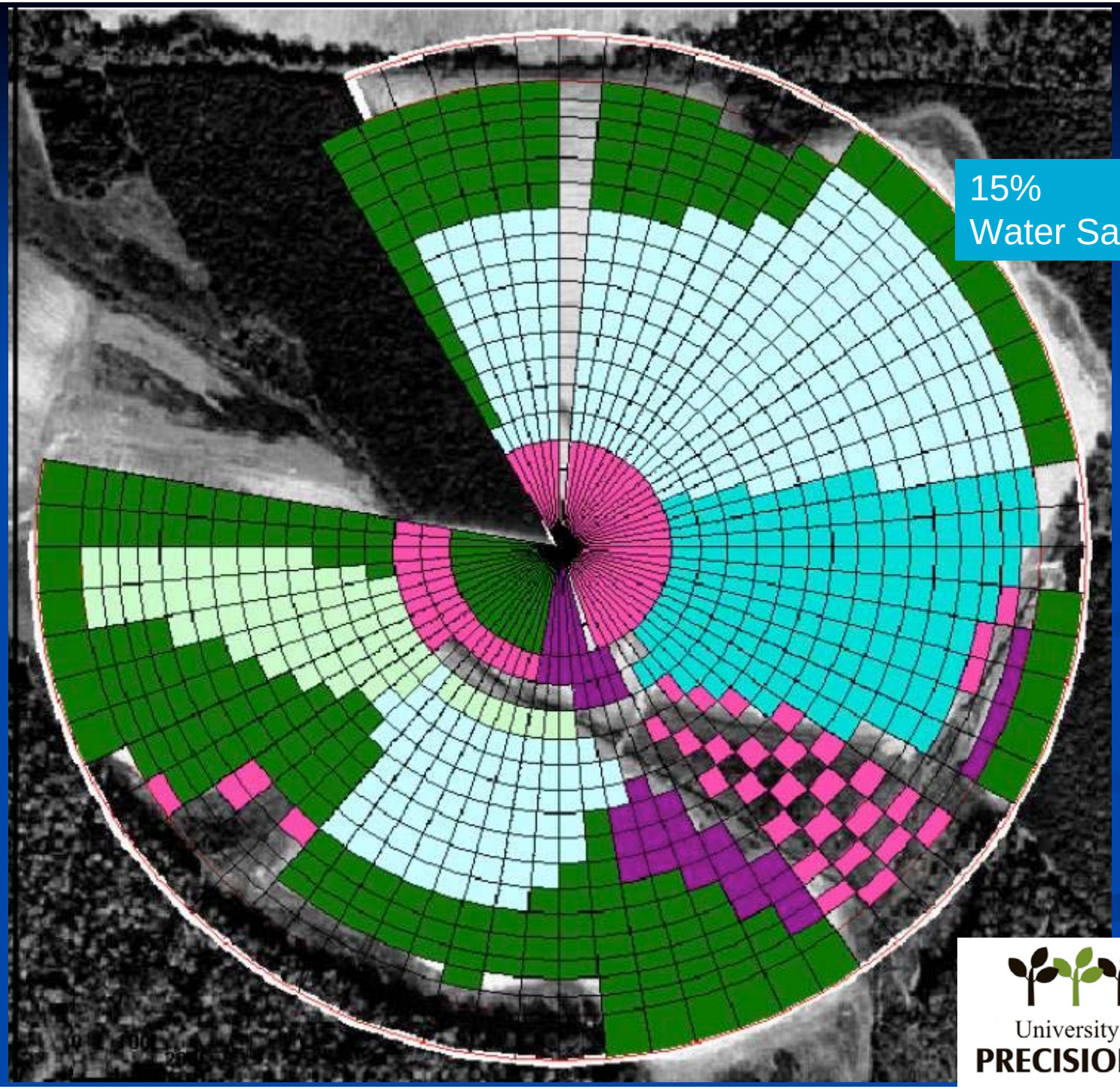


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Near
Trumann, AR

VRI installed
In 2006

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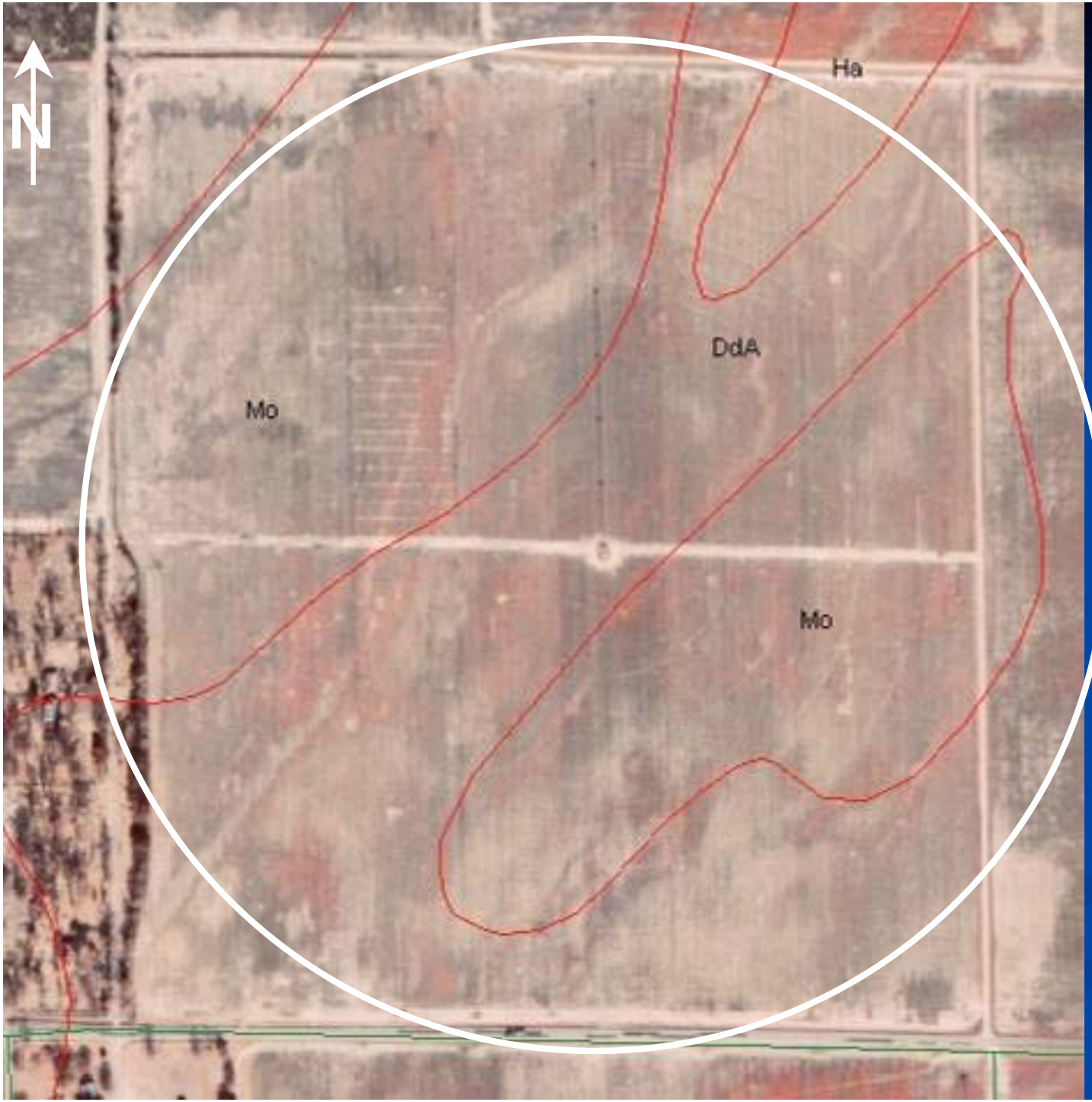


# Judd Hill VRI Pivot Soil Types

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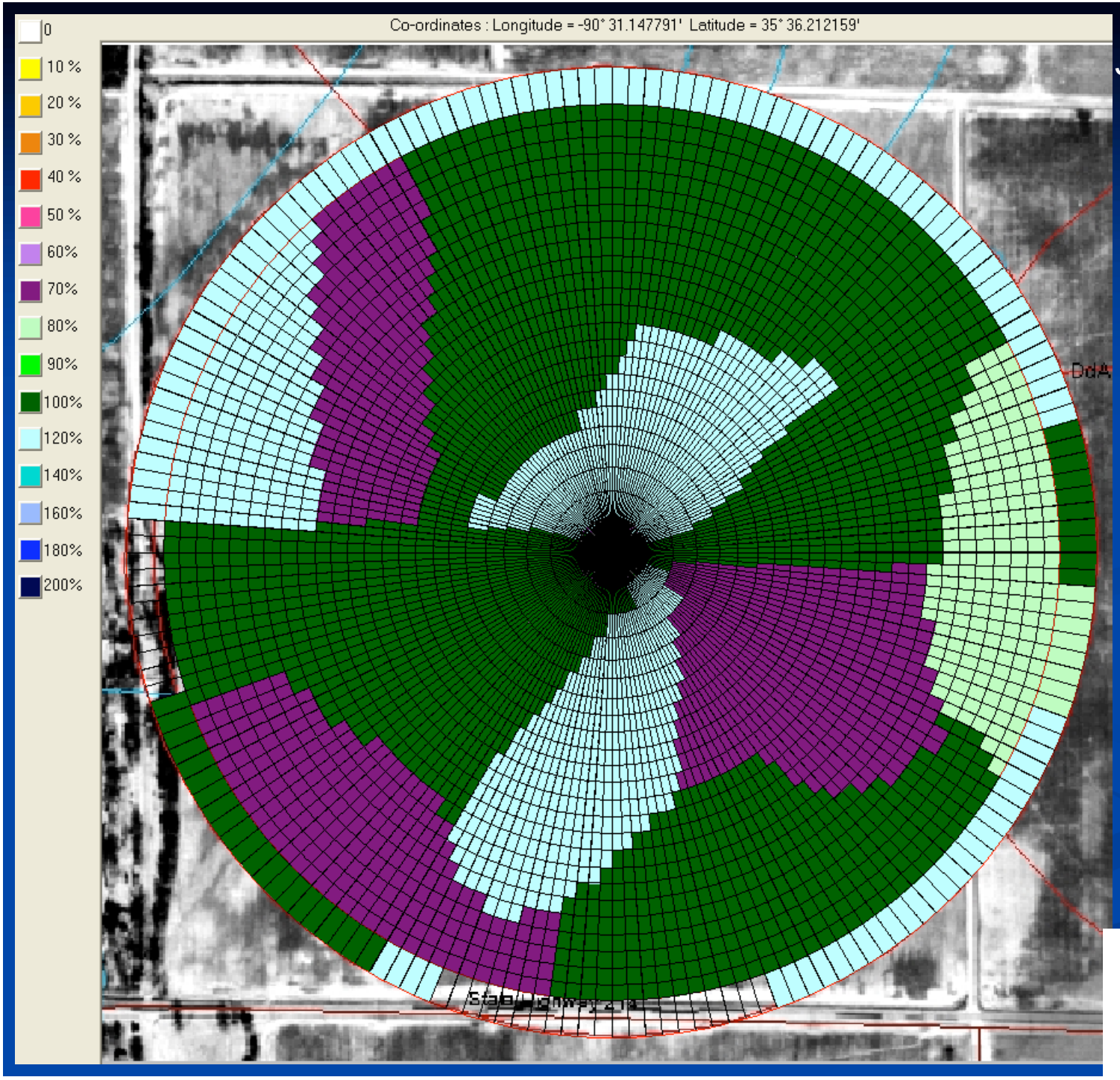


# Judd Hill VRI Pivot Irrigation map

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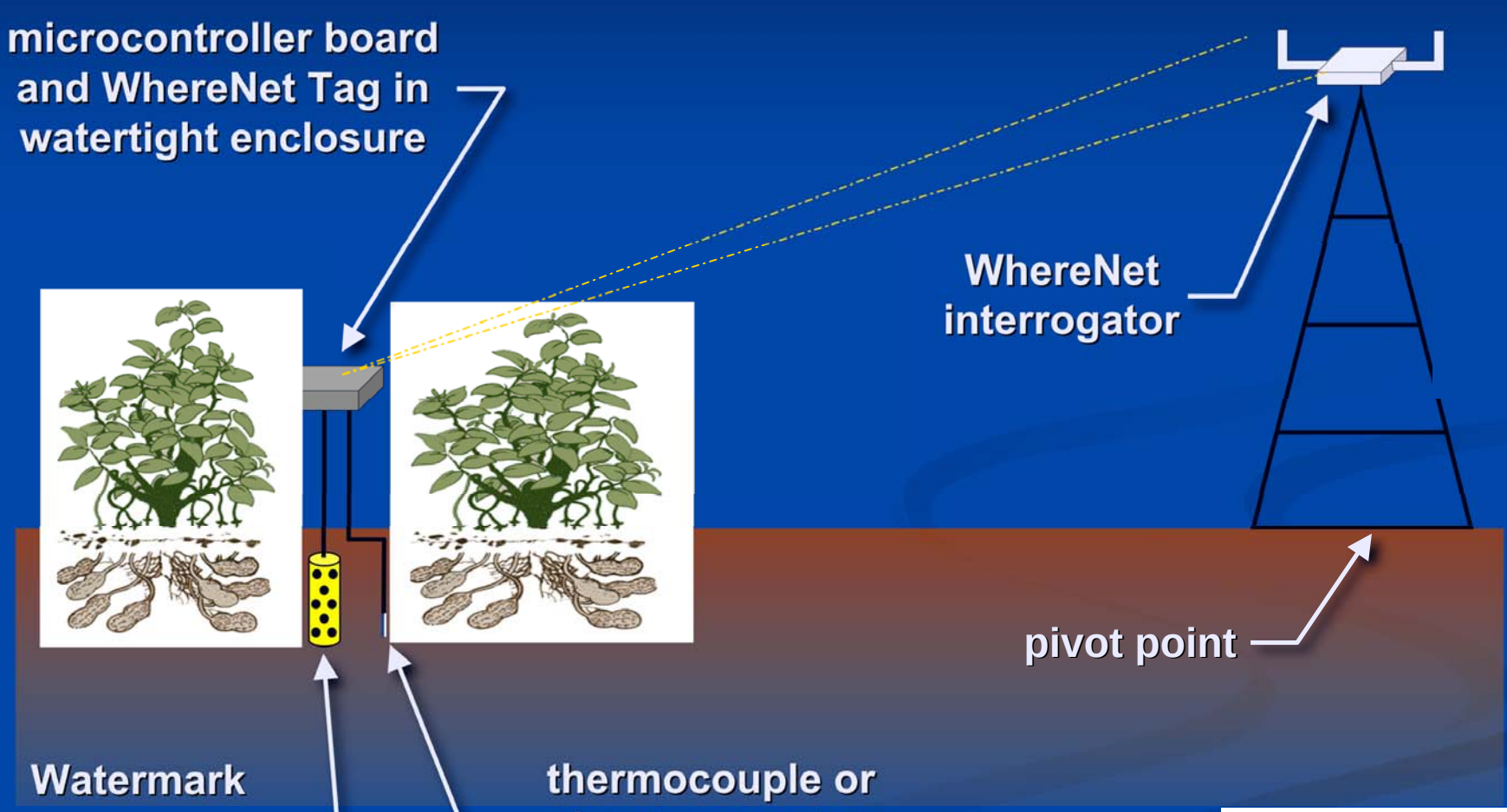
# New Developments

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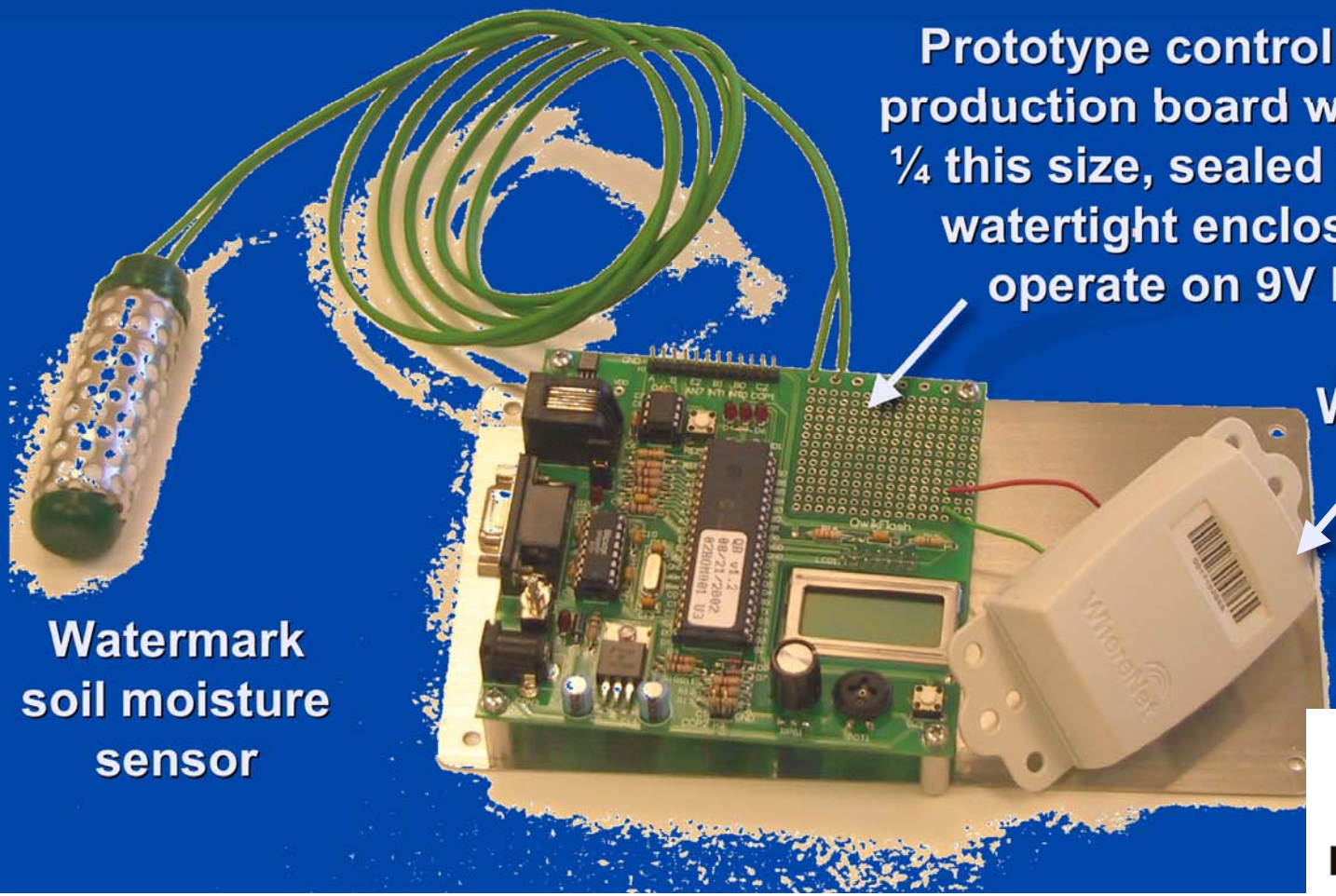
# New Developments

## Prototype System: Sensor

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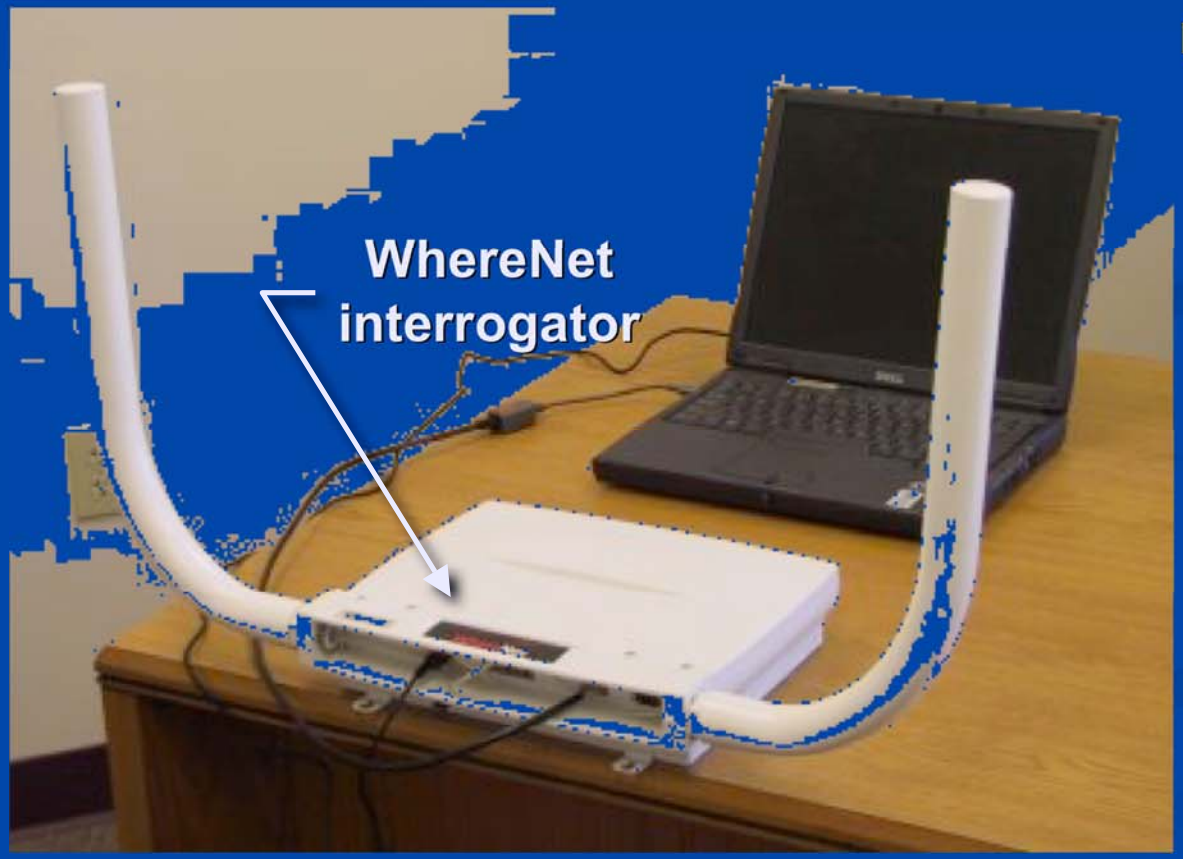
# New Developments

## Prototype System: Interrogator




- Interrogator
  - polls sensors on timed interval
  - 1000 ft range (possibly more)
  - transmits data to pivot controller or computer

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# New Developments

Wherenet Interrogator

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Thanks for your attention !!
website:
www.nespal.org/PrecAg/
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