Out of the Box Thinking to Improve Rooting and Playability

Gerald Henry, PhD
University of Georgia

Performance Testing

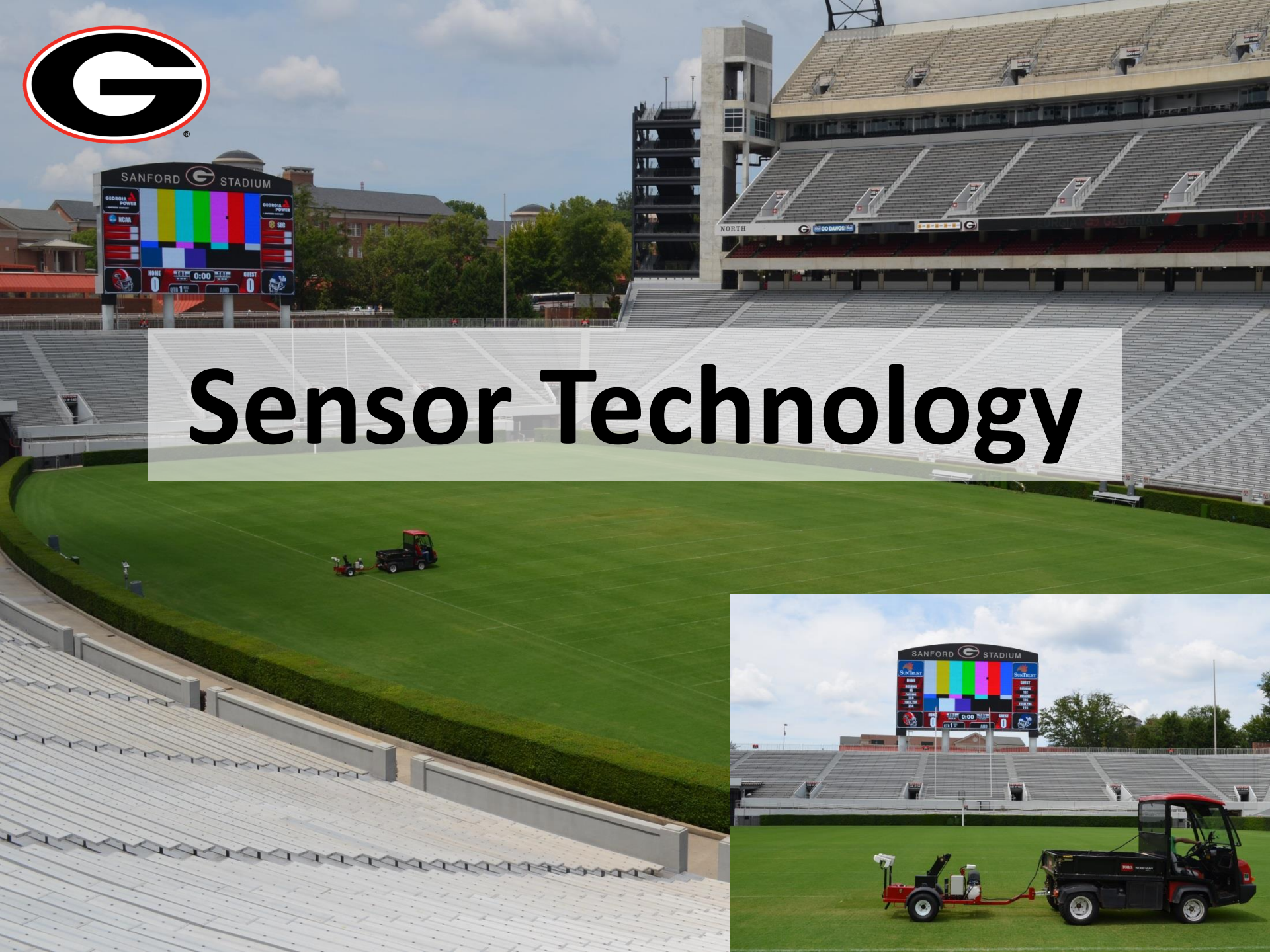
- Utilized to evaluate athletic fields
- Driving Forces:
  - Player Safety
  - Field Playability

Richard Lipski, Associated Press

Performance Testing

- Player-Surface Interactions:
  - Compaction
  - Hardness
  - Traction
  - Uniformity
  - Wear Tolerance

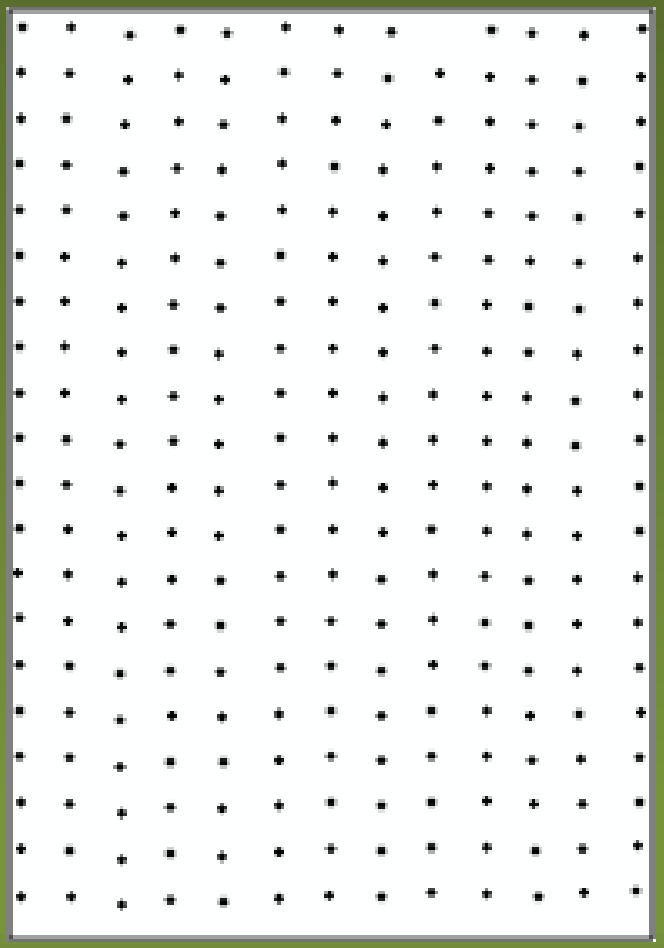
Sensor Technology

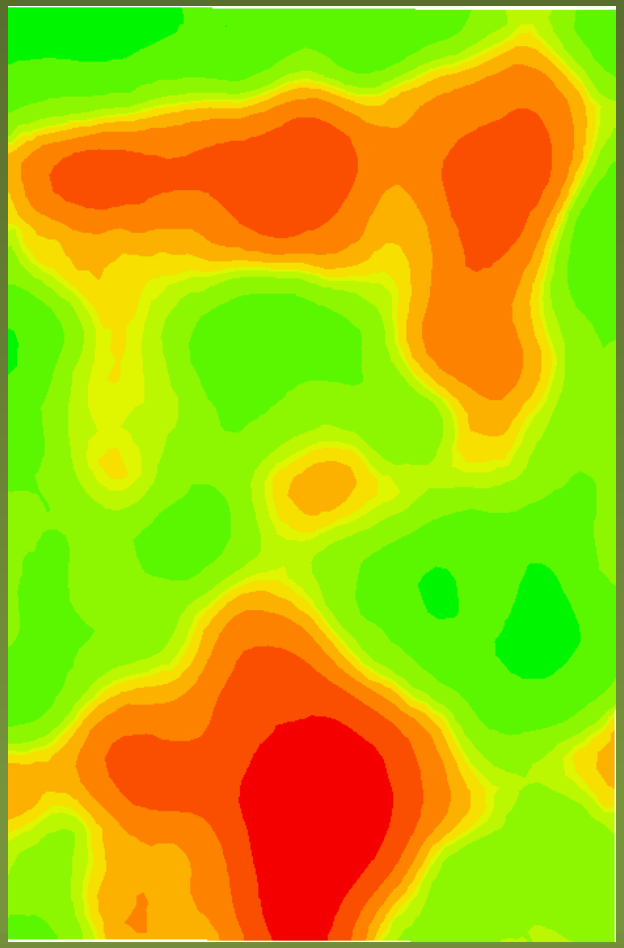


Hand-held Sensors

Mobile Sensors

Field Measurements



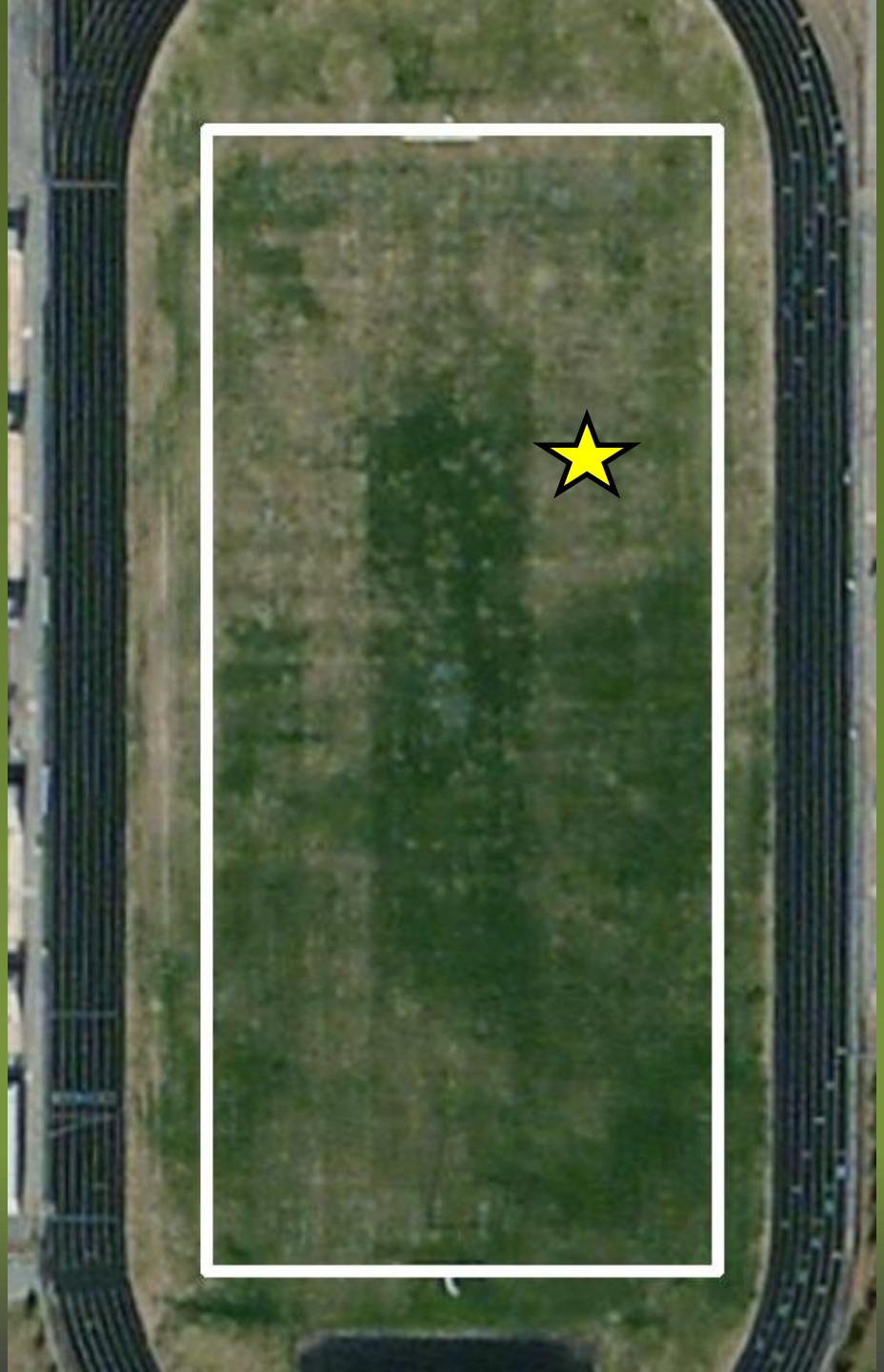


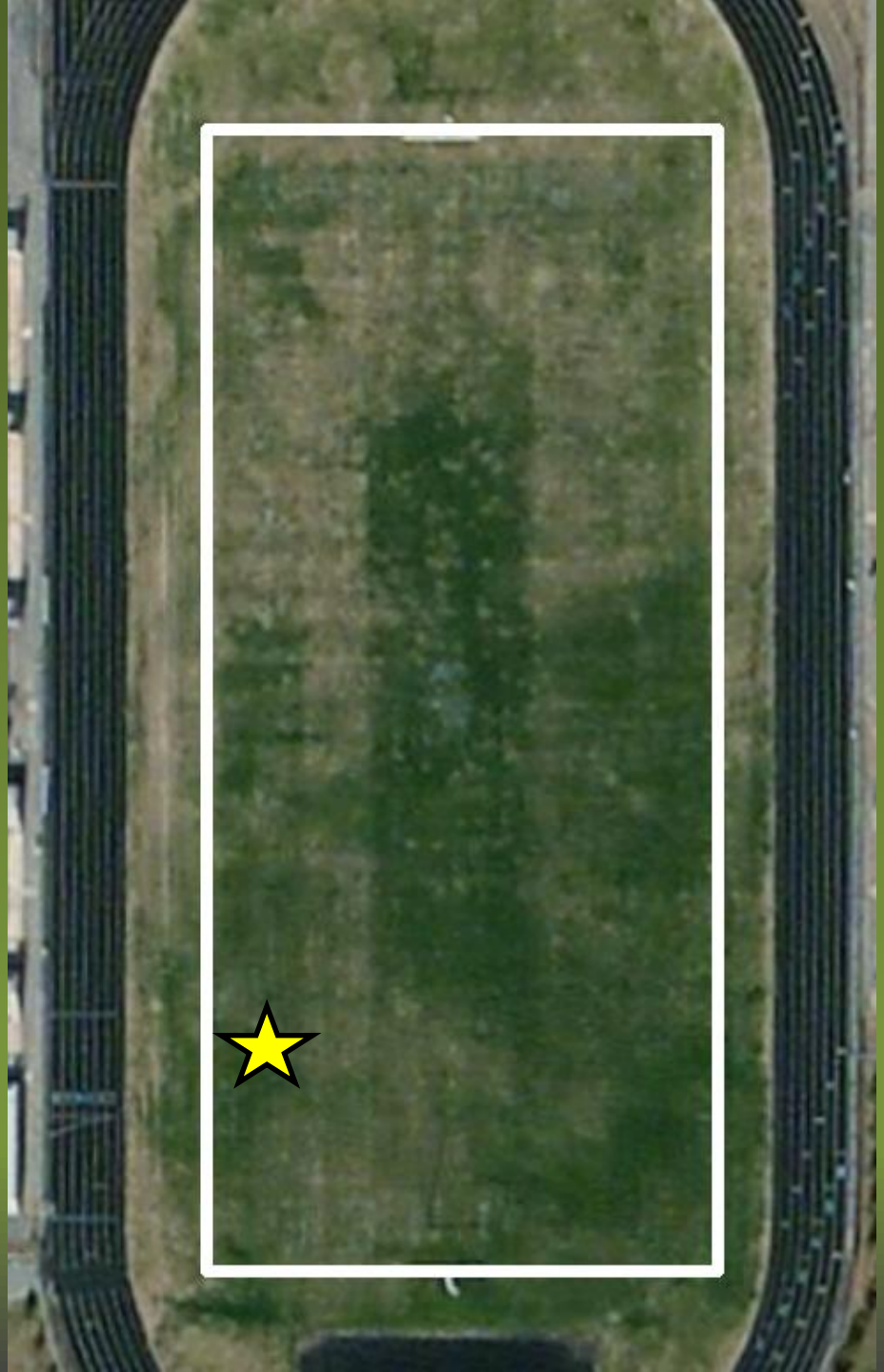
Sample points → Spatial Maps

Variability

- Occurs when a measured quantity is different across and between locations

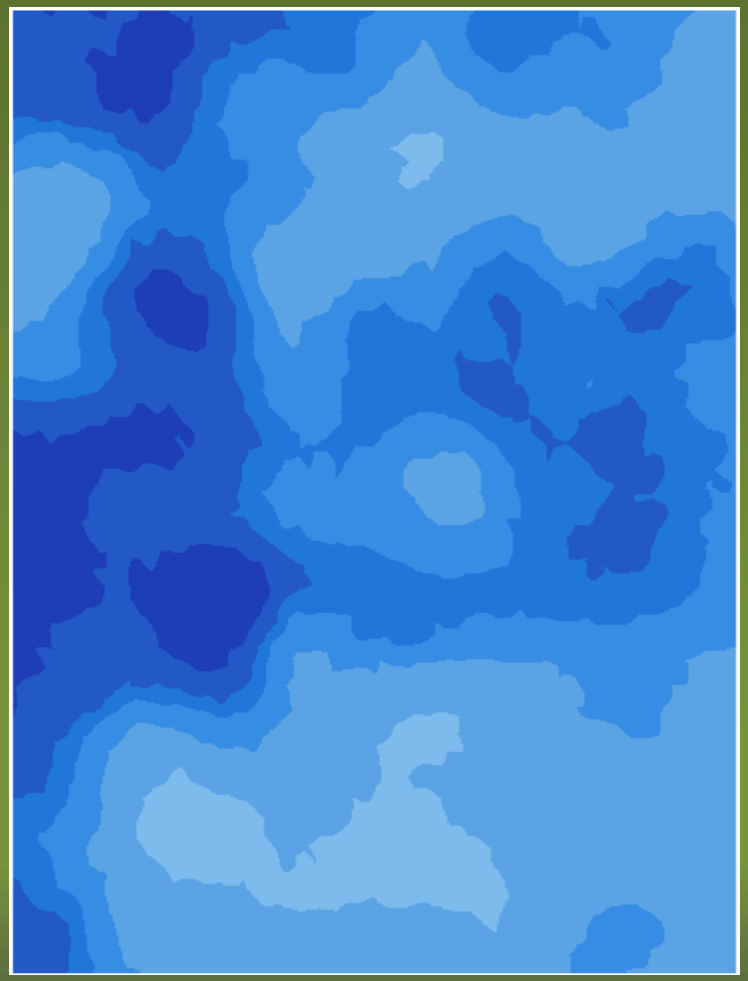
Soil Moisture





Measurable Variables

- Soil Moisture
- Soil Compaction
- Surface Hardness
- Turfgrass Health
- Shear Strength
- Turfgrass Thatch



Links Between Variables

Case Study: Oconee County H.S., GA

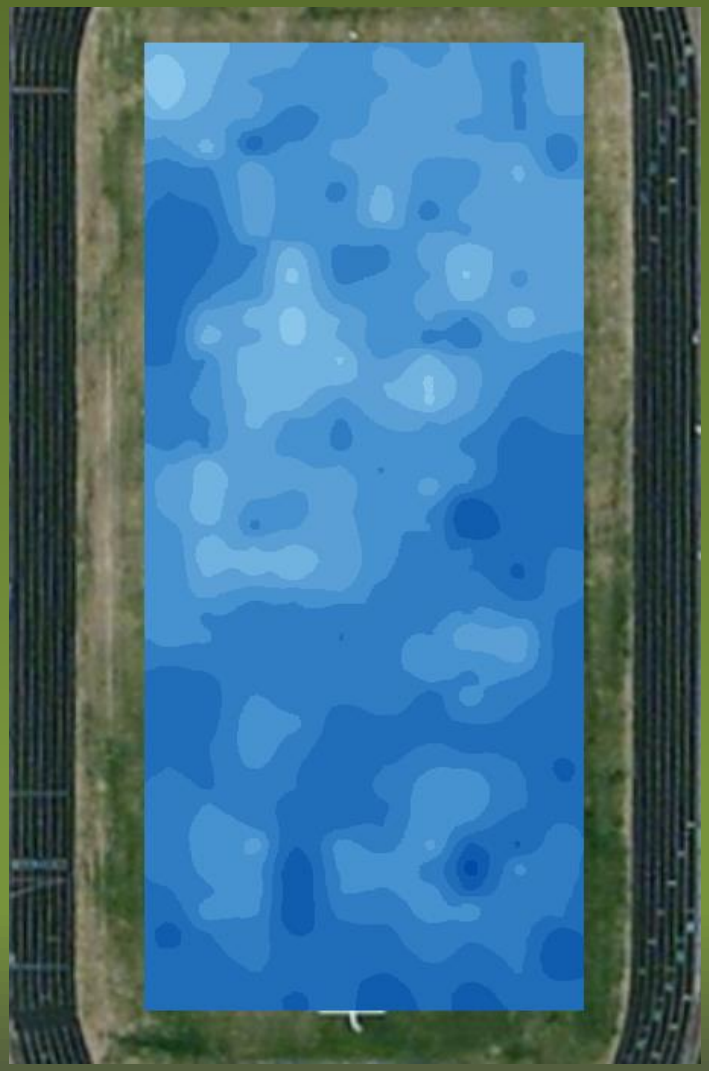
- Measured Variables
  - Soil moisture (VWC)
  - Soil compaction (PR)
  - Turf quality (NDVI)
  - Surface hardness (Gmax)
  - Thatch depth
  - Root mass
    - 0-2 inch depth
    - 2-5 inch depth

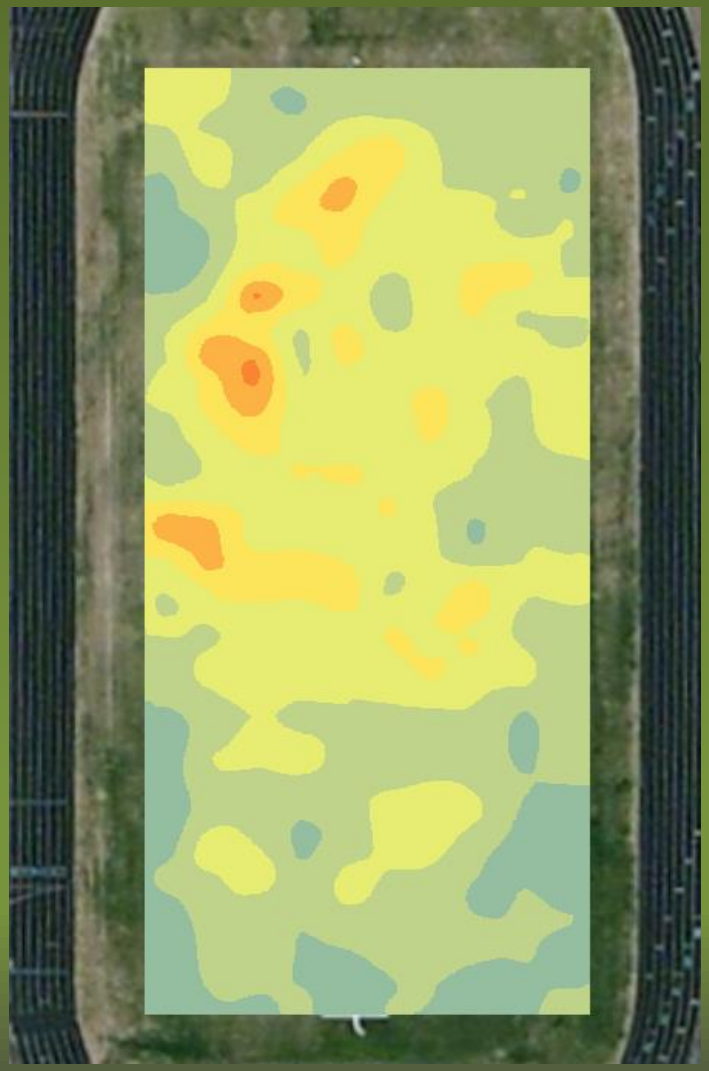
VWC	-0.71	-0.82	0.49	-0.11	-0.23	0.02	-0.13
Comp		0.73	-0.49	0.04	0.13	-0.08	0.03
		Hard	-0.58	0.05	0.21	-0.03	0.12
			NDVI	0.06	-0.10	0.12	0.01
				Thatch	0.12	0.02	0.06
					Roots (upper)	0.53	0.86
						Roots (lower)	0.87
							Roots (total)

Spatial Variability

VWC (%)

- 0 - 4
- 4 - 8
- 8 - 12
- 12 - 16
- 16 - 20
- 20 - 24
- 24 - 28
- 28 - 32
- 32 - 36
- 36 - 40





PR

(lbs. force)

- 0 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- 300 - 350
- 350 - 400
- 400 - 450
- 450 - 500

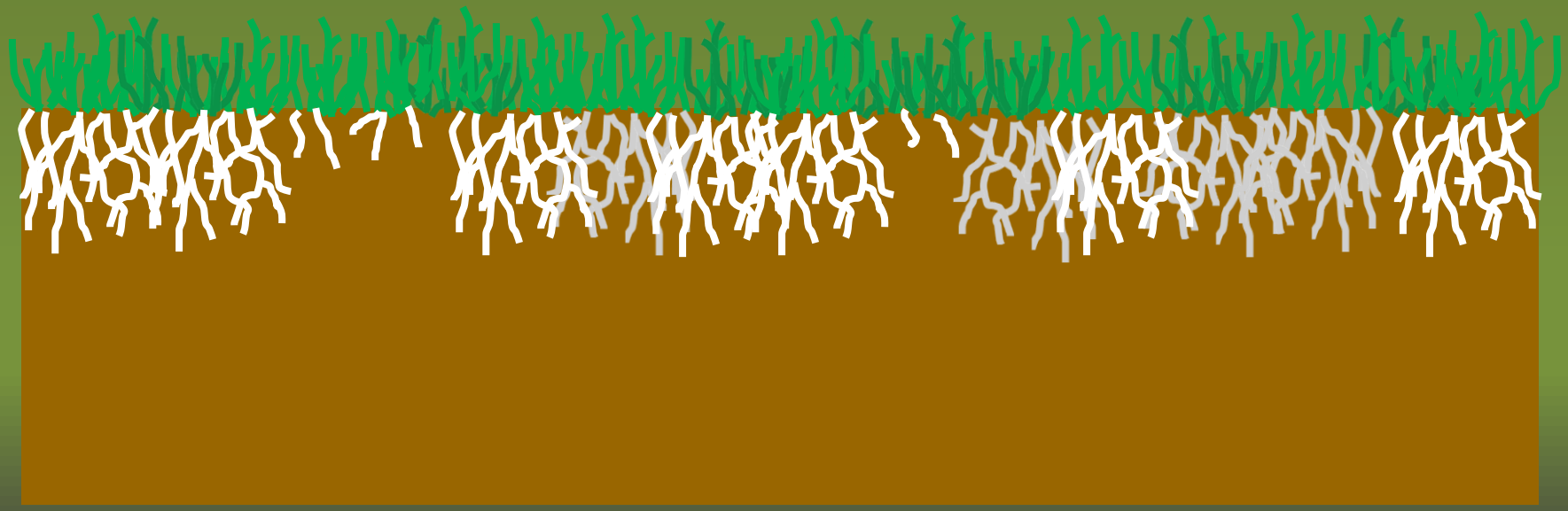
Measurable Variables

- Soil Moisture
- Soil Compaction
- Surface Hardness
- Turfgrass Health
- Shear Strength
- Turfgrass Thatch

- Root Length and Mass

Managing Variability

- Can’t be eliminated
- Proper cultural practices
- Increasing rooting depth/mass



Journal of Soil and Water Conservation 2018

Uniformity and spatial variability of soil moisture and irrigation distribution on natural turfgrass sports fields

C.M. Straw, R.N. Carrow, W.J. Bowling, K.A. Tucker, and G.M. Henry

Abstract: Emerging technology that couples spatial irrigation distribution data with spatial plant and soil property data may provide a more robust assessment of irrigation system performance than conventional methods. Research was conducted on native soil and sand capped

Irrigation Association suggests the target catch can DU_{lq} for turfgrass and landscape areas be between 65% and 75% for rotary irrigation heads (Irrigation Association 2010).

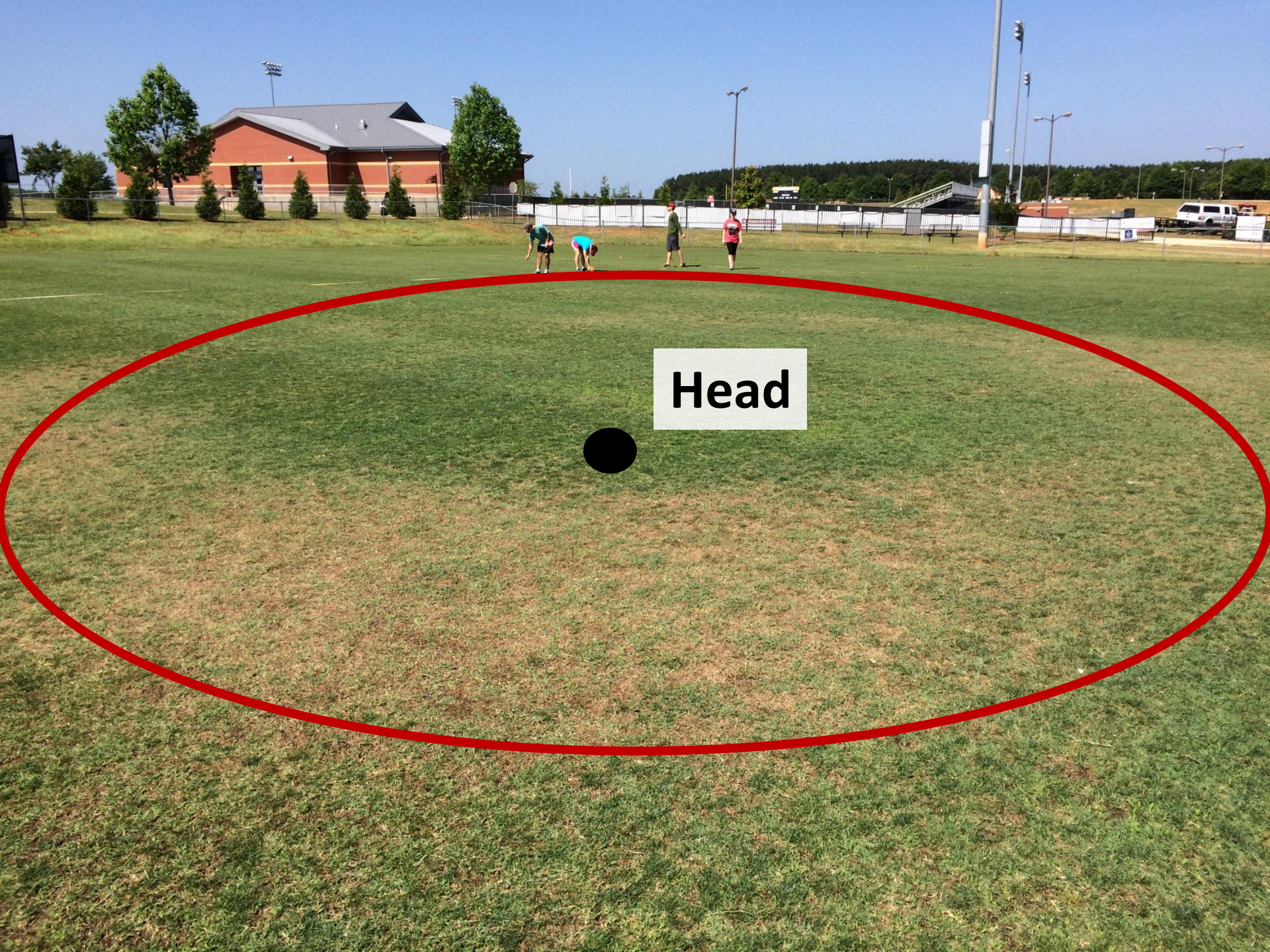
The catch can DU_{lq} method provides insight on distribution uniformity of an irrigation system, but it does not indicate water infiltration or redistribution (Li and Rao 2000; Dukes et al. 2006; Kiefer and Huck 2008). Devices that measure soil moisture (volumetric water content [VWC]) are becoming more readily available to turfgrass managers (Mecham 2001; Dukes et al. 2006; Kieffer and O'Conner 2007; Vis et al. 2007; Straw et al. 2016). It is not uncommon to determine VWC DU_{lq} of irrigated areas using the same sample locations as catch cans

Improving the efficiency of your irrigation system

Irrigation audit - Catch Can Method

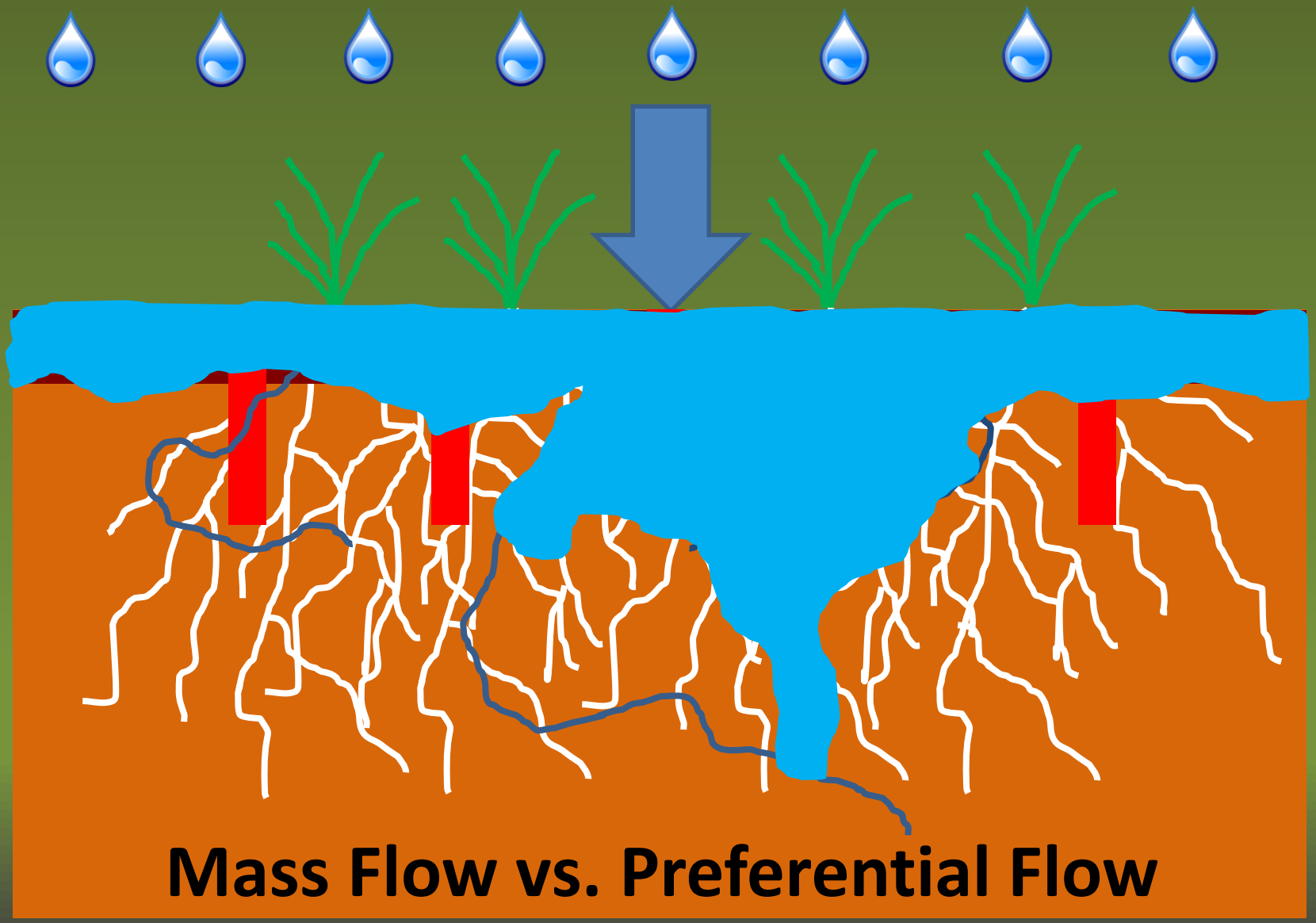
- Assessment usually based on a small number of samples
- Measures distribution uniformity
- No indication of “effective” irrigation

Catch Can Method


Head

Water Infiltration

Fate of Irrigation



Uniformity vs. Efficiency

- The use of a soil moisture meter following irrigation application will provide more valuable information
  - Water infiltration location
  - Rewetting potential
  - Soil compaction/thatch issues
  - Need for wetting agent applications

Soil Moisture Meter

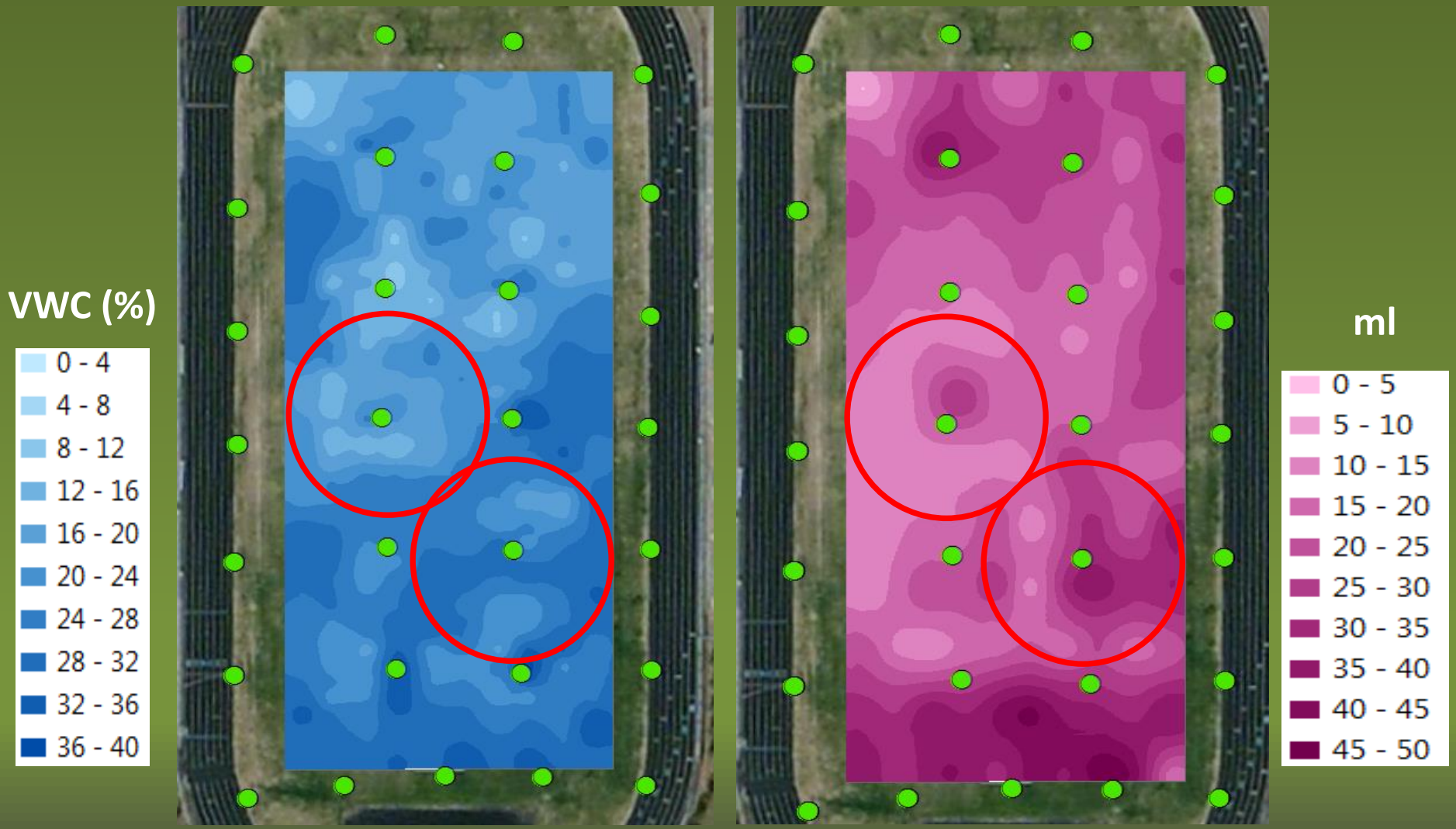
- TDR Probe
- Measures soil moisture from a depth of 1.5 to 8 inches
- Recorded as % volumetric water content (%VWC)
- GPS compatible

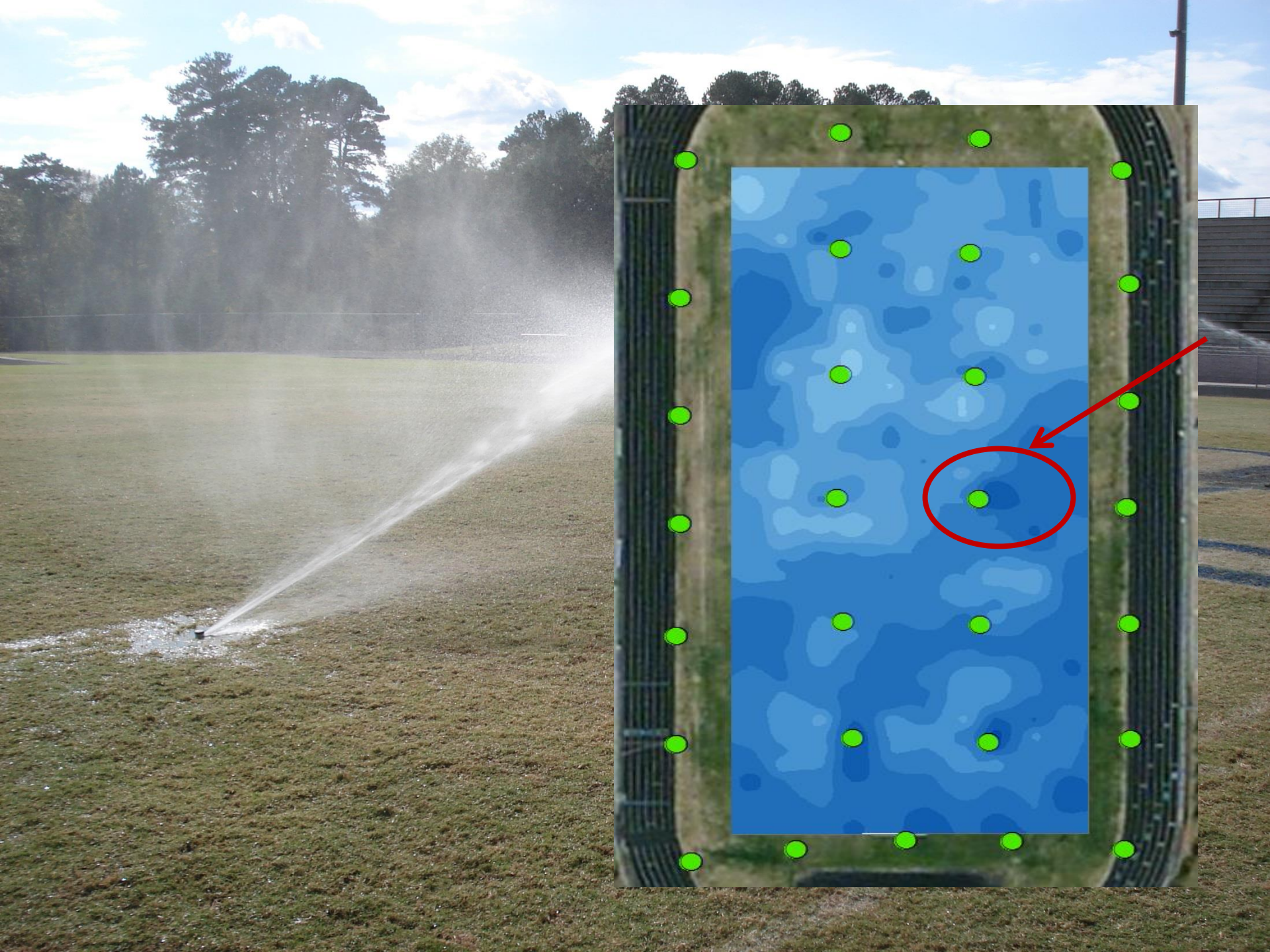
New Water Audit Approach

- Initial mapping:
  - Conducted under “drier” conditions
  - Determine areas of concern (poor drainage, localized dry spot, leaking heads, etc.)
- Map following irrigation application:
  - Conducted after loss of gravimetric water

Irrigation Efficiency Audits

Soil Moisture vs. Catch Can



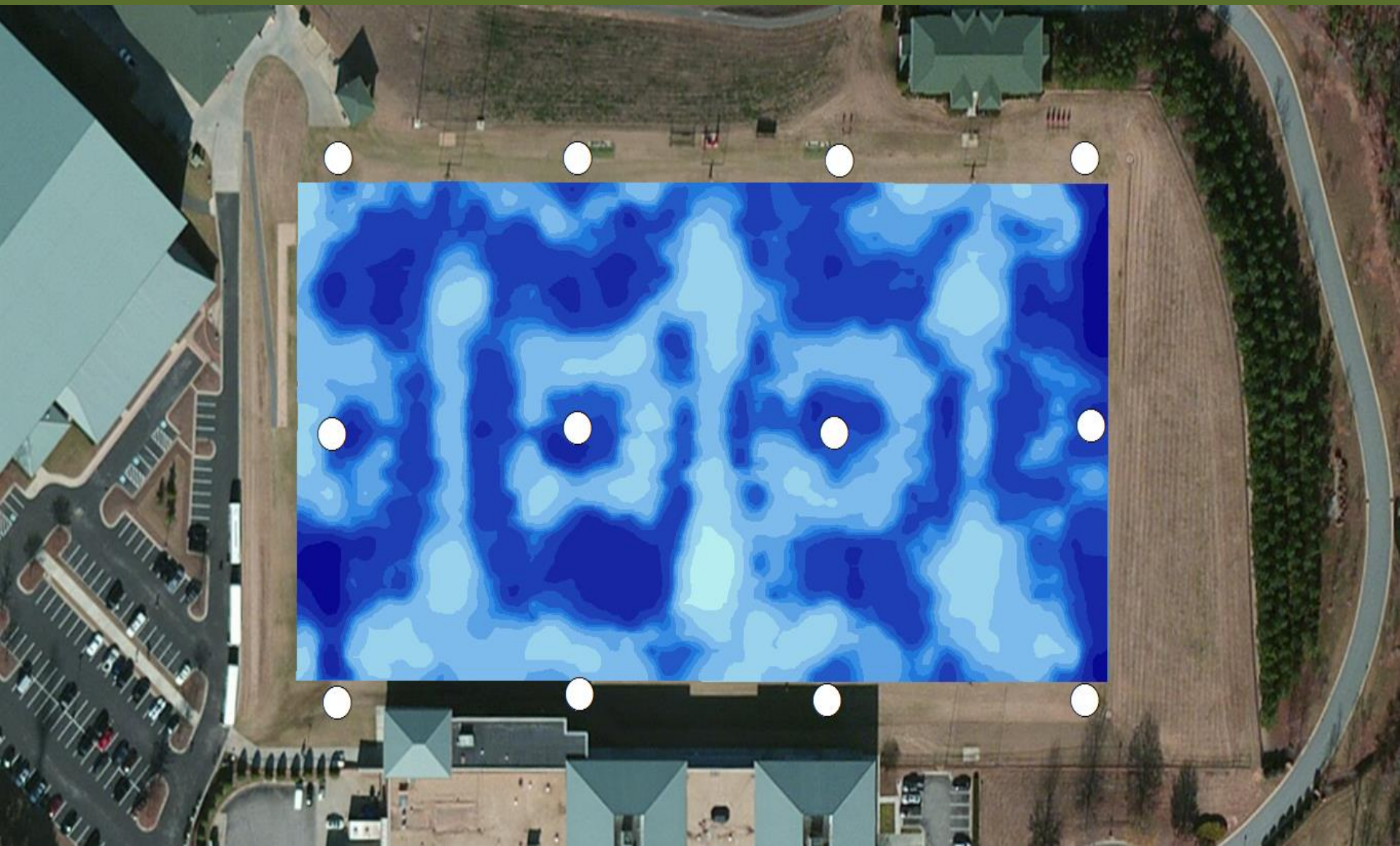


ID of Easily Correctable Problems

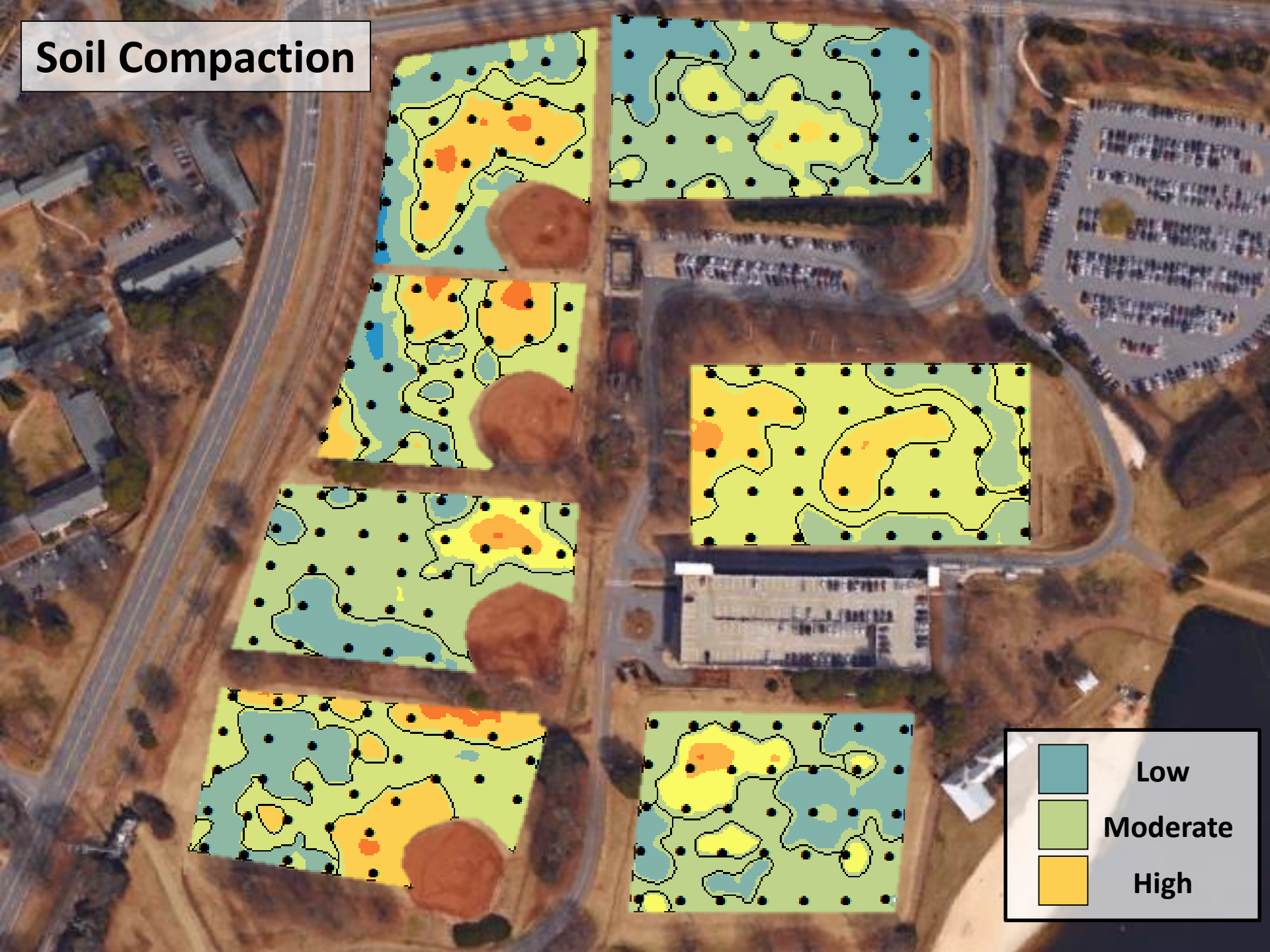
When a problem head is identified, field investigation is conducted to determine:

- Incorrect scheduling
- Localized dry spot
- Head alignment
- Head not operating
- Head spacing
- Wrong nozzle size
- Sprinkler or nozzle wear
- Mismatched sprinklers or nozzles

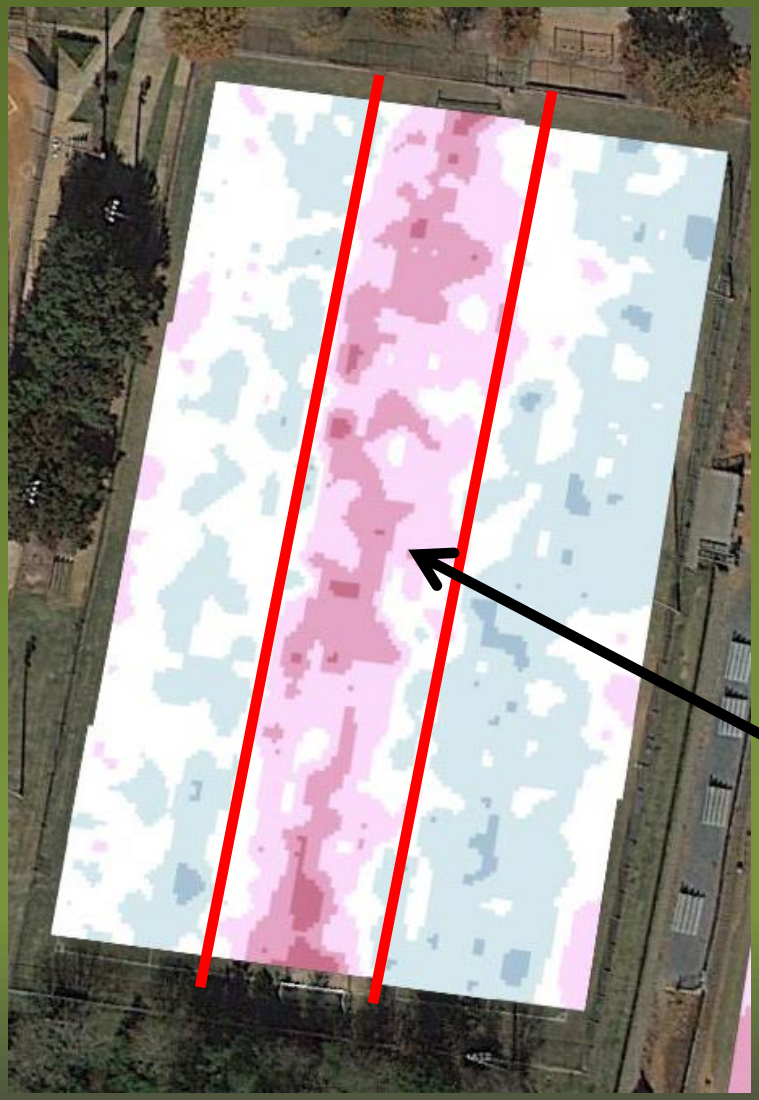
Water Cannons – Highly Variable

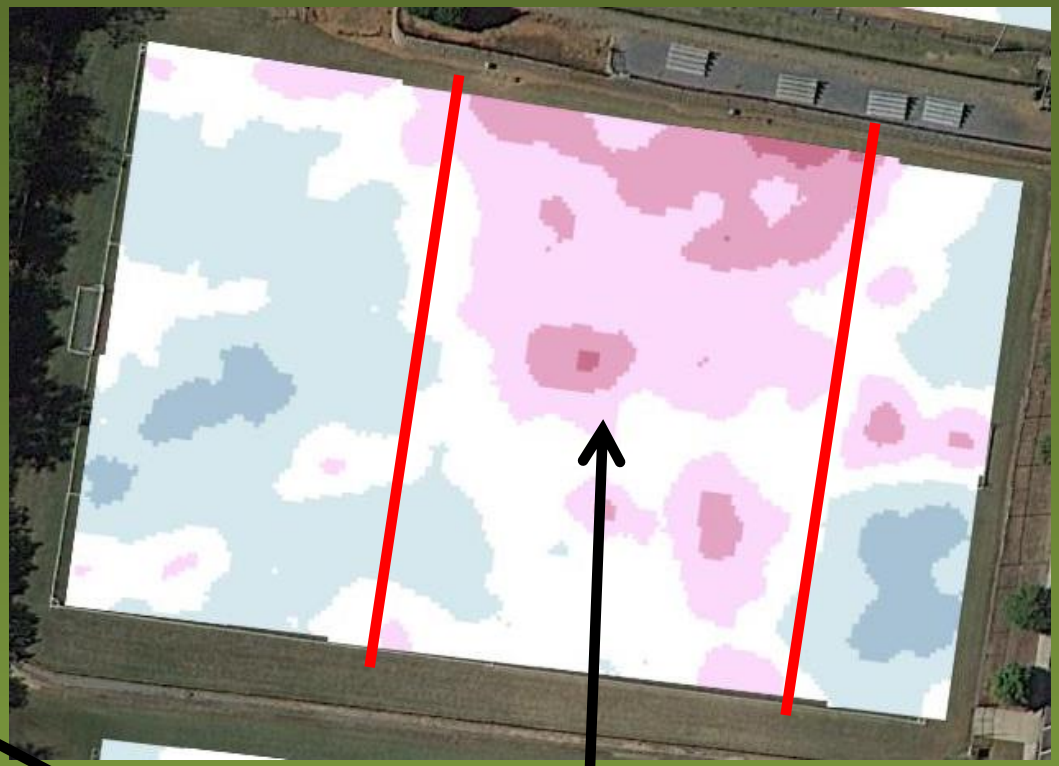



Aerification


Soil Compaction
Low
Moderate
High

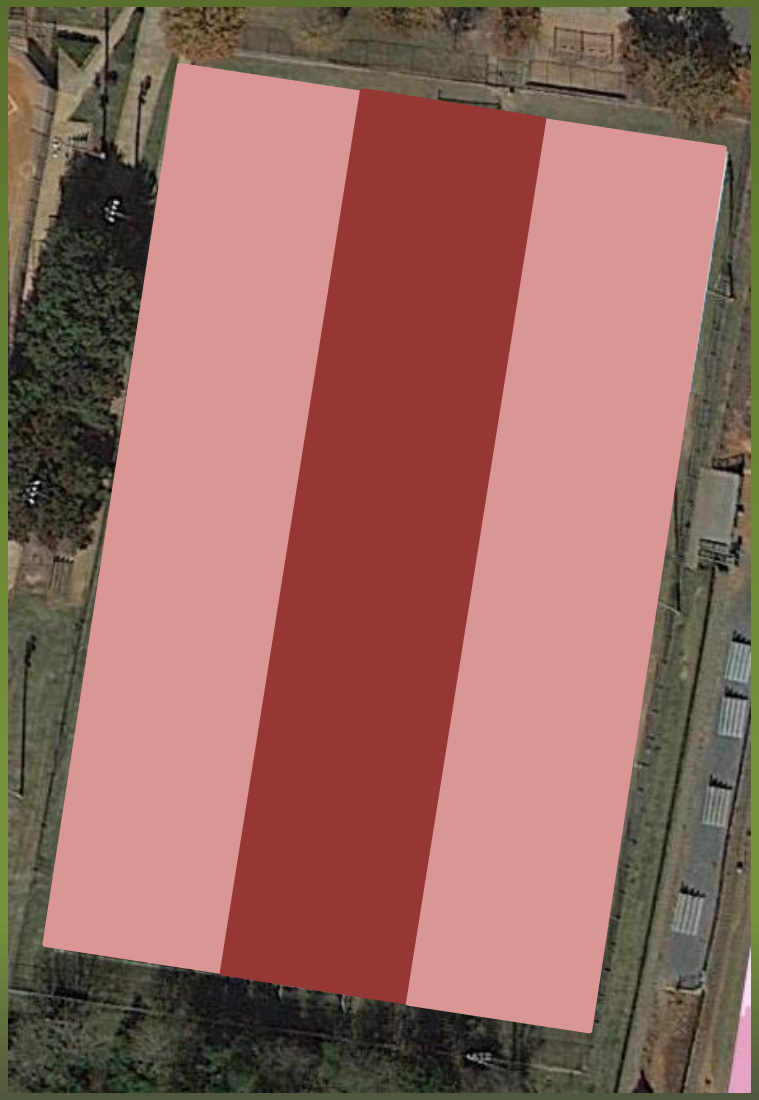
Site-Specific Cultivation





Areas of high soil compaction

Site-Specific Cultivation



Identify 2 different management zones

Aerification Issues

- Aerification methods vs. soil compaction alleviation
- Aerification depth

Published December 28, 2016

Long-term Effect of Open-Spoon Aerification on Plant and Soil Properties of Community Level Sports Fields

Chase M. Straw,* Rebecca A. Grubbs, Gerald M. Henry, Robert N. Carrow, and Van Cline

Applied Turfgrass Science

ACCEPTED

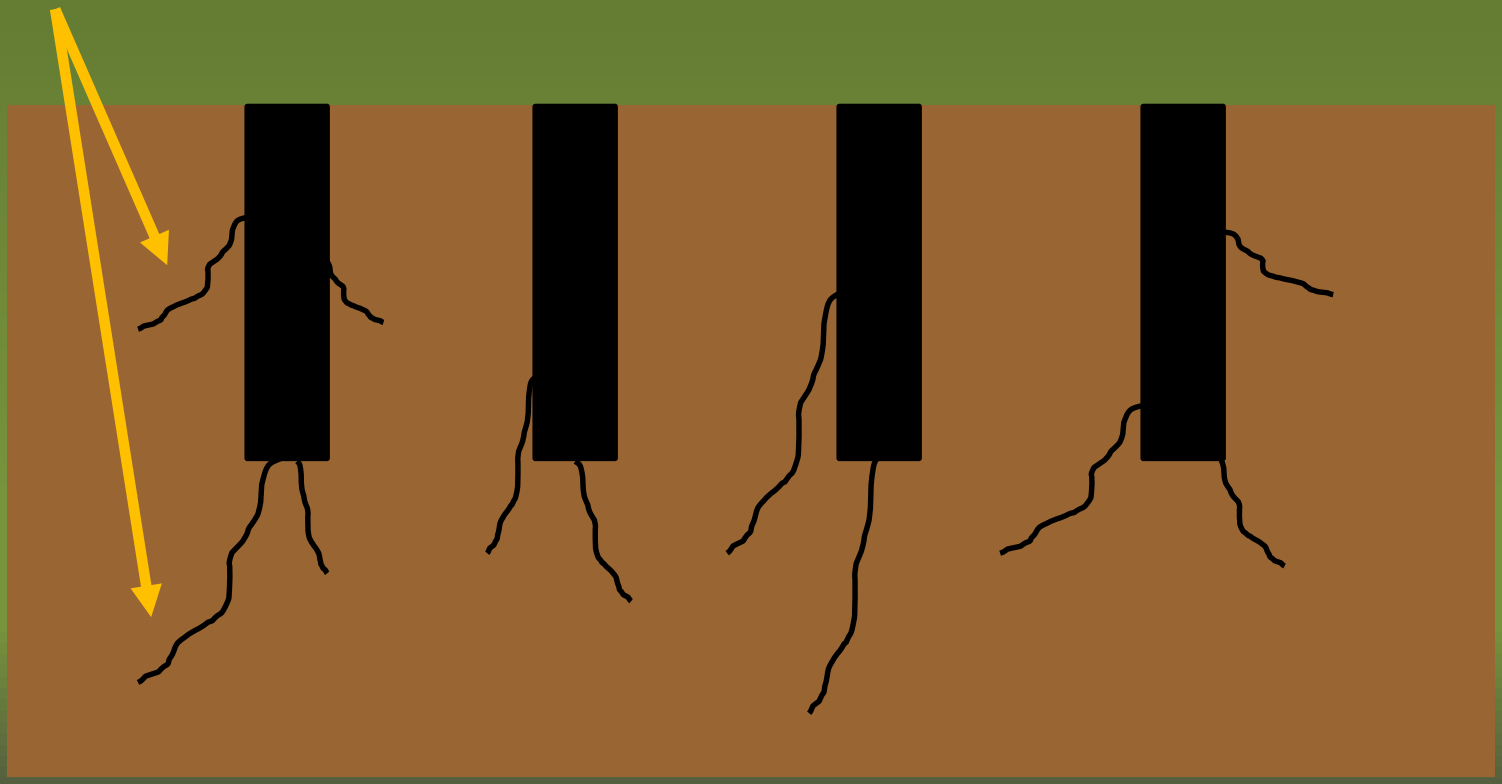
Core Ideas

- In 2013, 47% of sports turf managers reported using open-spoon aerification.
- Long-term effect of open-spoon aerification was minimal on measured properties.
- It is recommended that sports turf managers

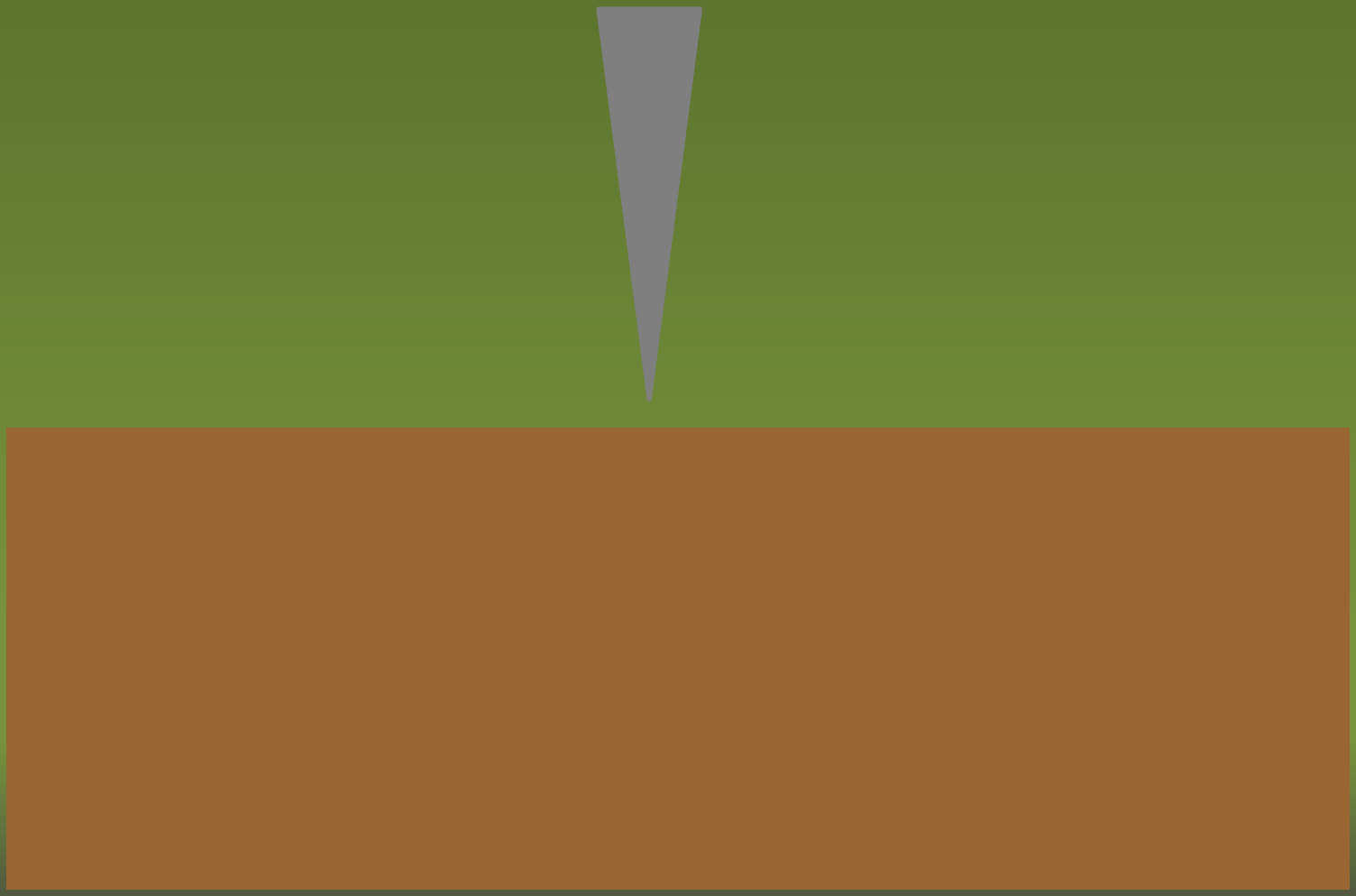
- **STMA survey (2013) – 47% reported using OS aerification**
- **Aerification events – 0, 1, 2, 3, or 4 times/year – 2 year study**

Core Aerification

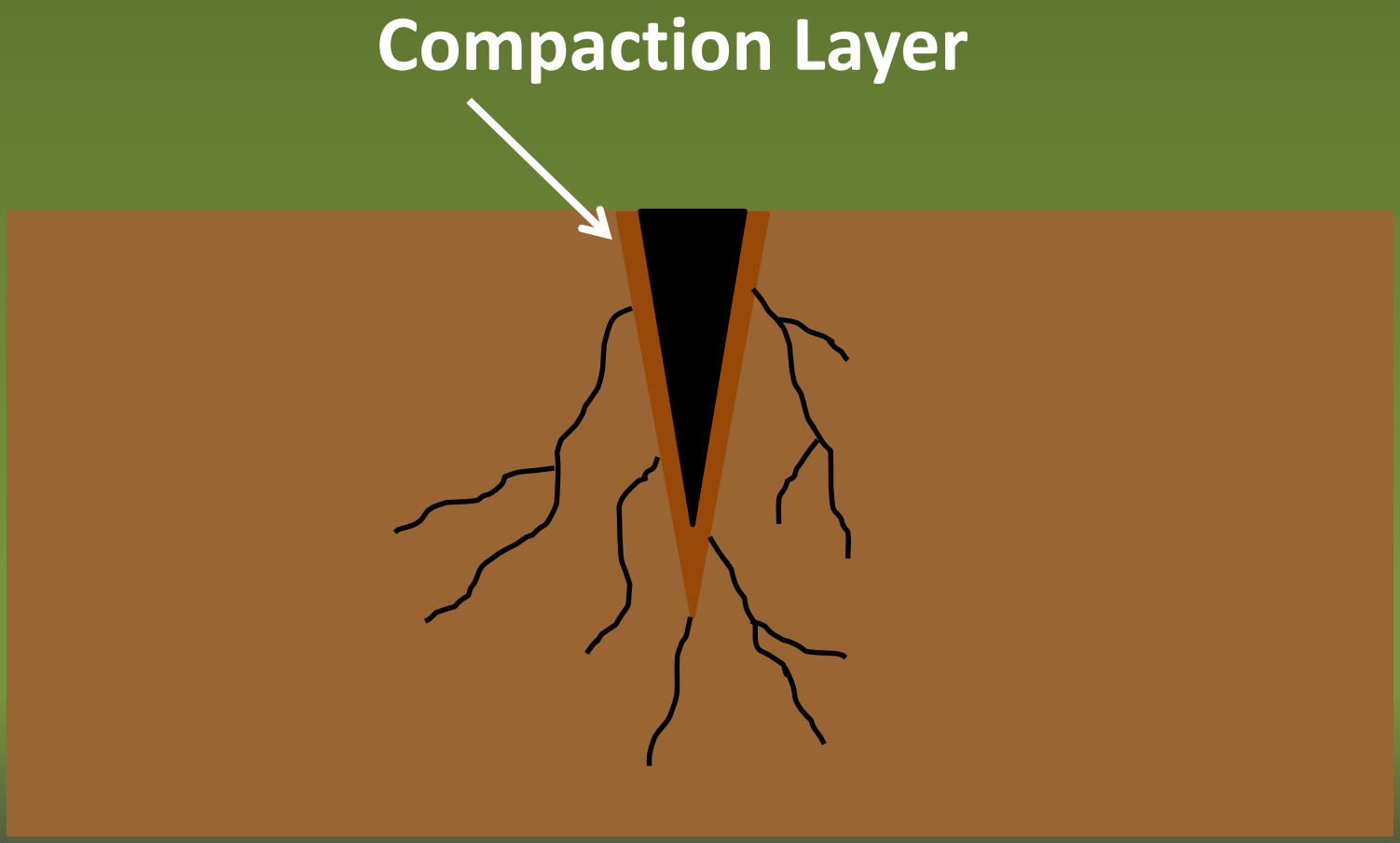
Fracturing caused by the weight plus impact of the device



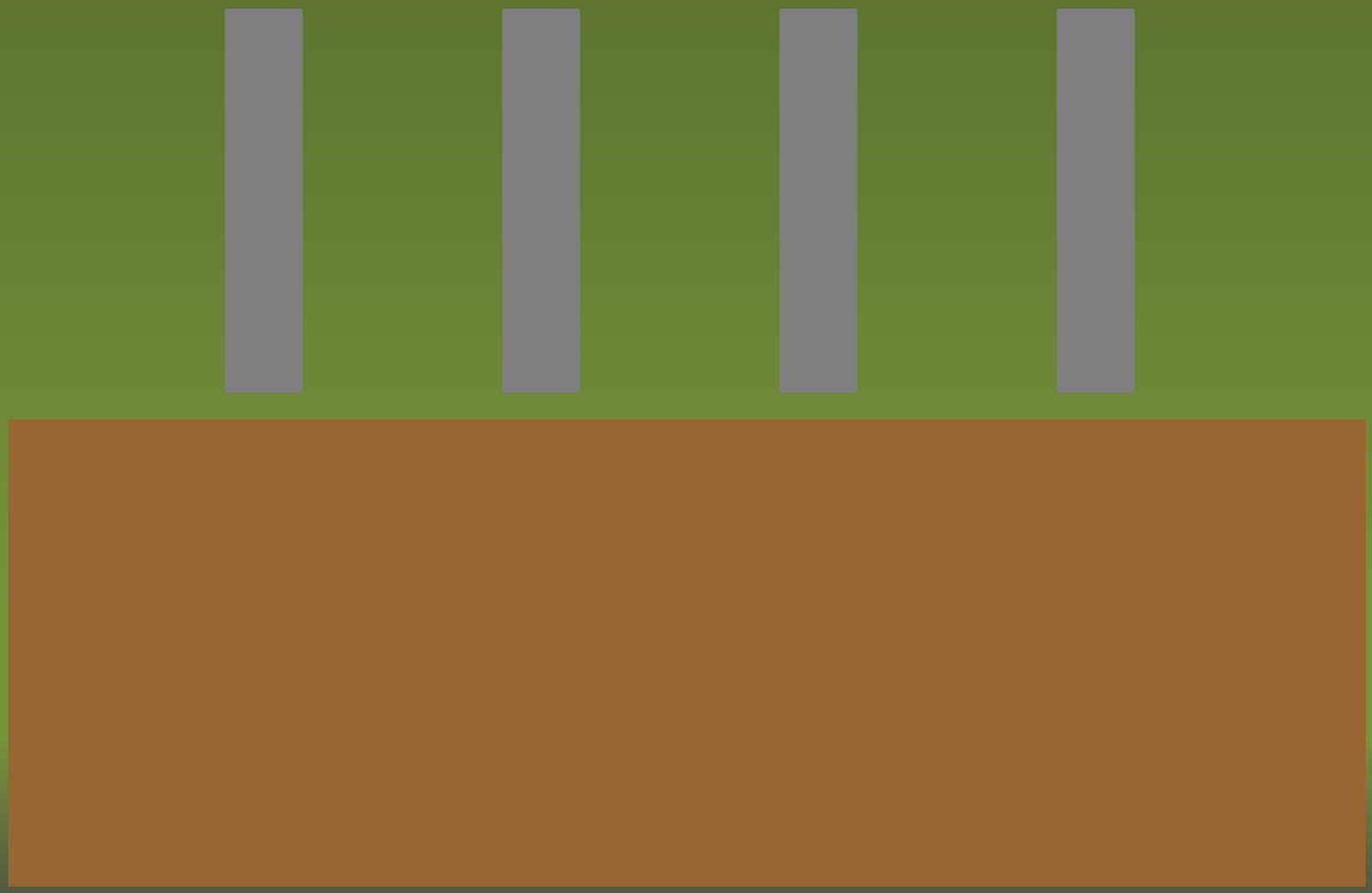
Solid-tine Aerification



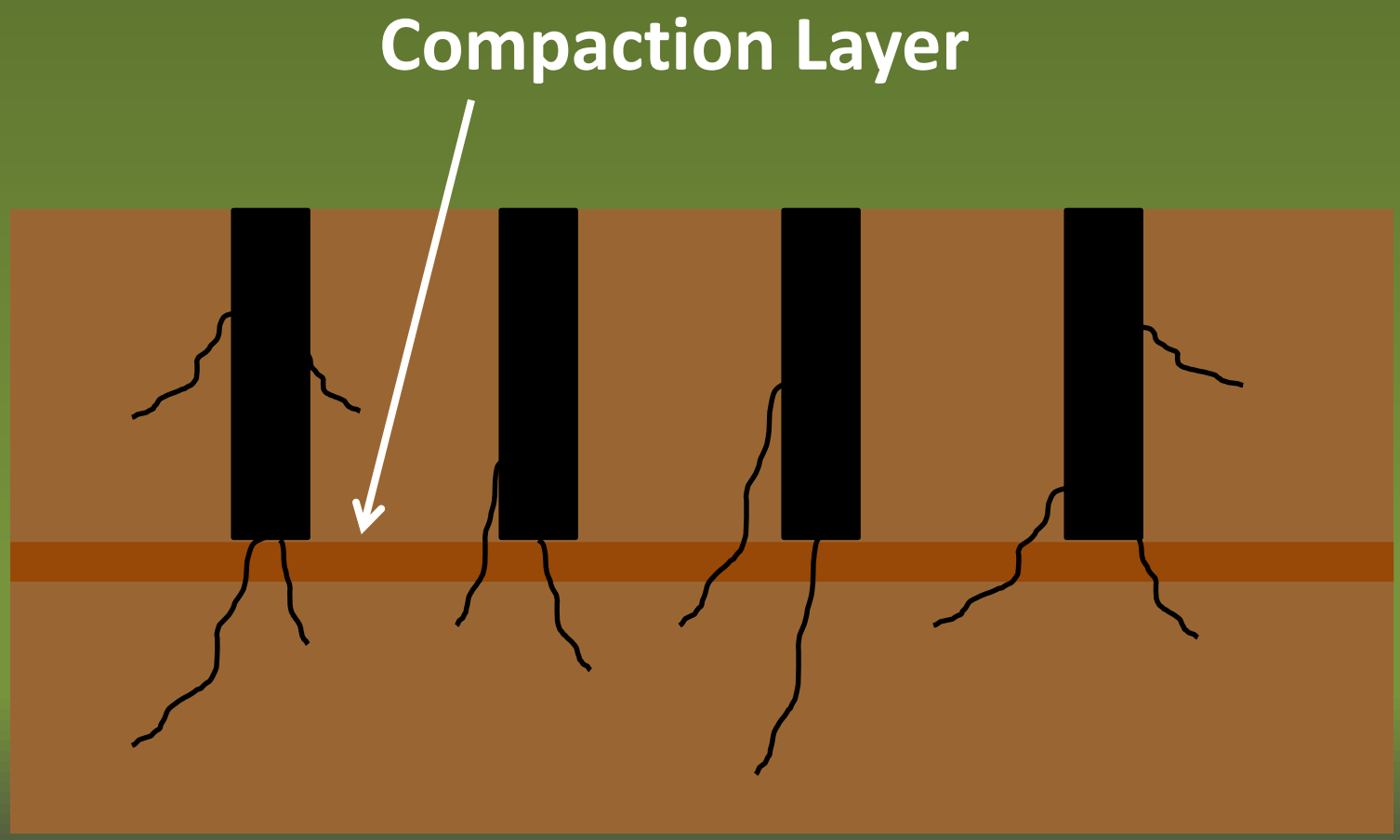
Solid-tine Aerification



Aerification Depth



Aerification Depth



Plow pan layer in agriculture

New Sprayer Technology

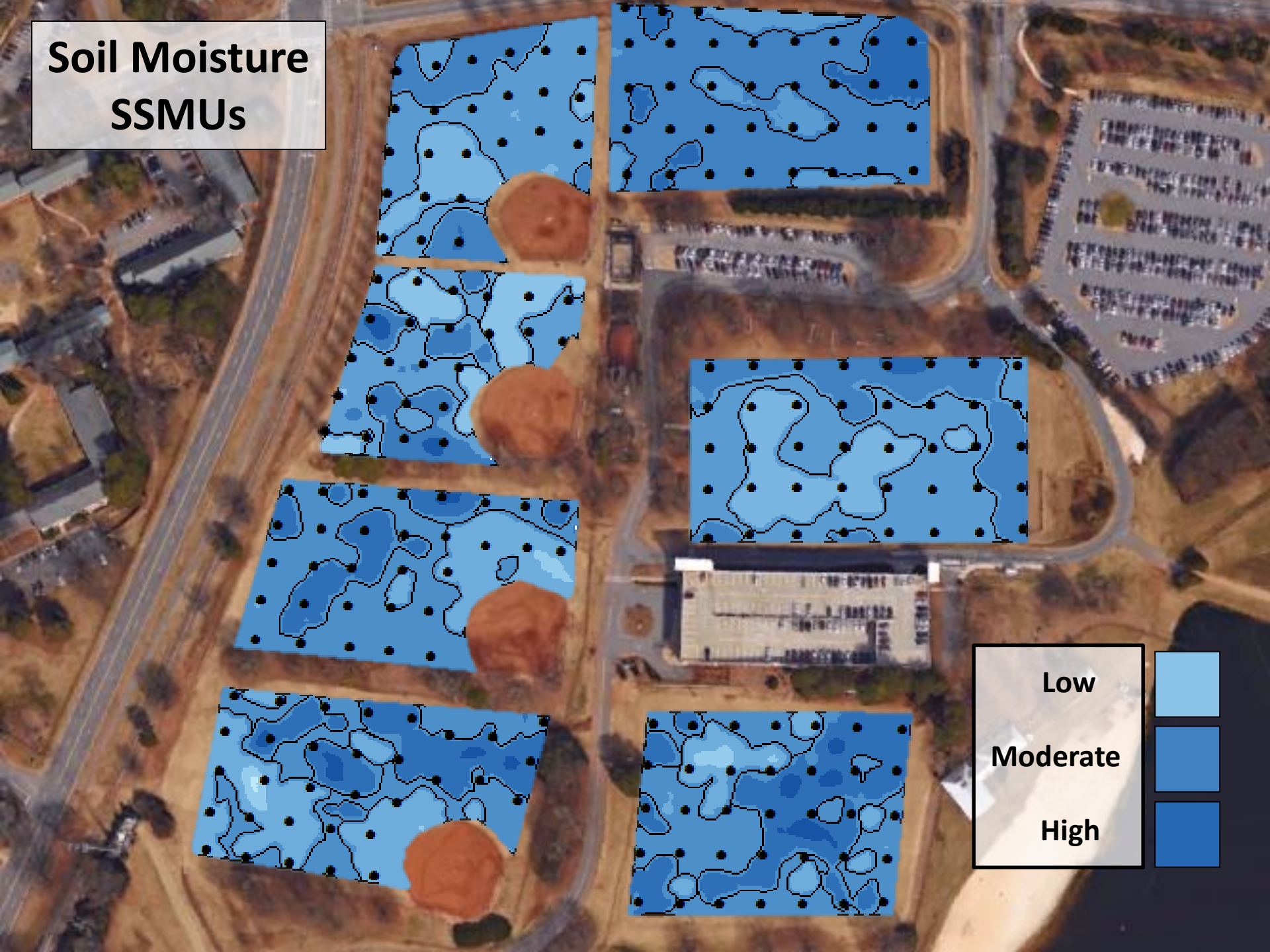
Smithco Star Command

- Capstan SharpShooter

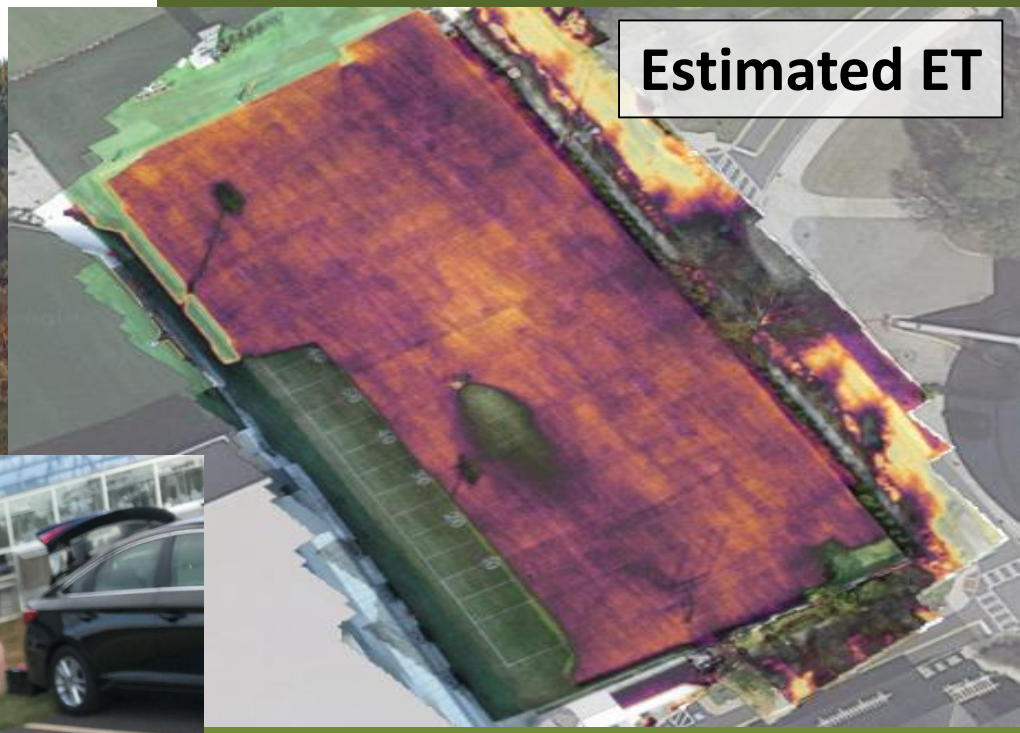
- Raven Envizio GPS Pro

Star Command System

- On/off spray function controlled at nozzle tip
- Any application rate from 0.4 gal/1000 ft^2
- Operating speed from 2 to 10 mph
- Proper flow and pressure is maintained
- No overspray
- Records/Maps of applications


Soil Moisture
SSMUs
Low
Moderate
High


Spray Zones



Drone Technology

Precision Agriculture
https://doi.org/10.1007/s11119-018-9593-2

CrossMark

Predicting spatial structure of soil physical and chemical properties of golf course fairways using an apparent electrical conductivity sensor

Rebecca A. Grubbs[1] · Chase M. Straw[1] · William J. Bowling[1] · David E. Radcliffe[1] · Zach Taylor[2] · Gerald M. Henry[1]

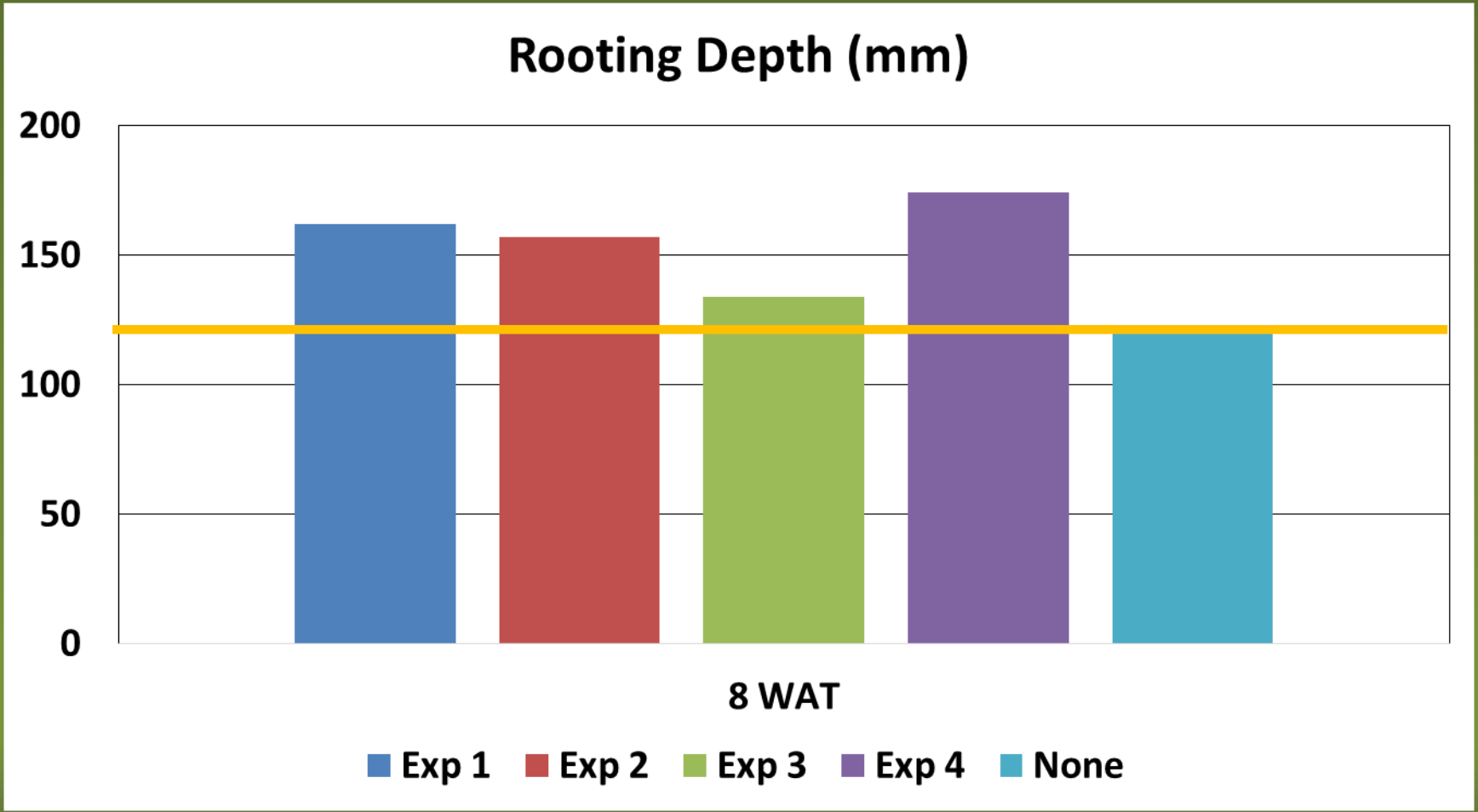
- **Using soil EC to predict soil texture differences**
- **Positive correlations between soil EC and organic matter and soil pH**

Increasing Root Length/Mass

- Wetting agents/soil surfactants
- Fertilizers, soil conditioners, and biostimulants

Wetting Agents – Rooting Depth

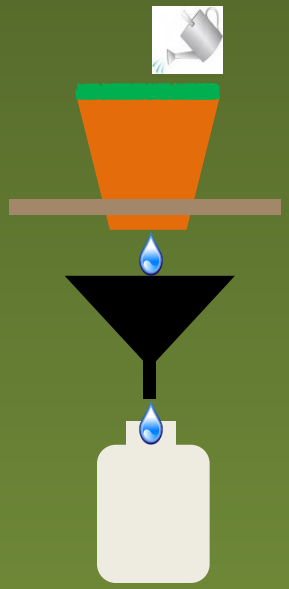
Wetting Agents – Rooting Depth



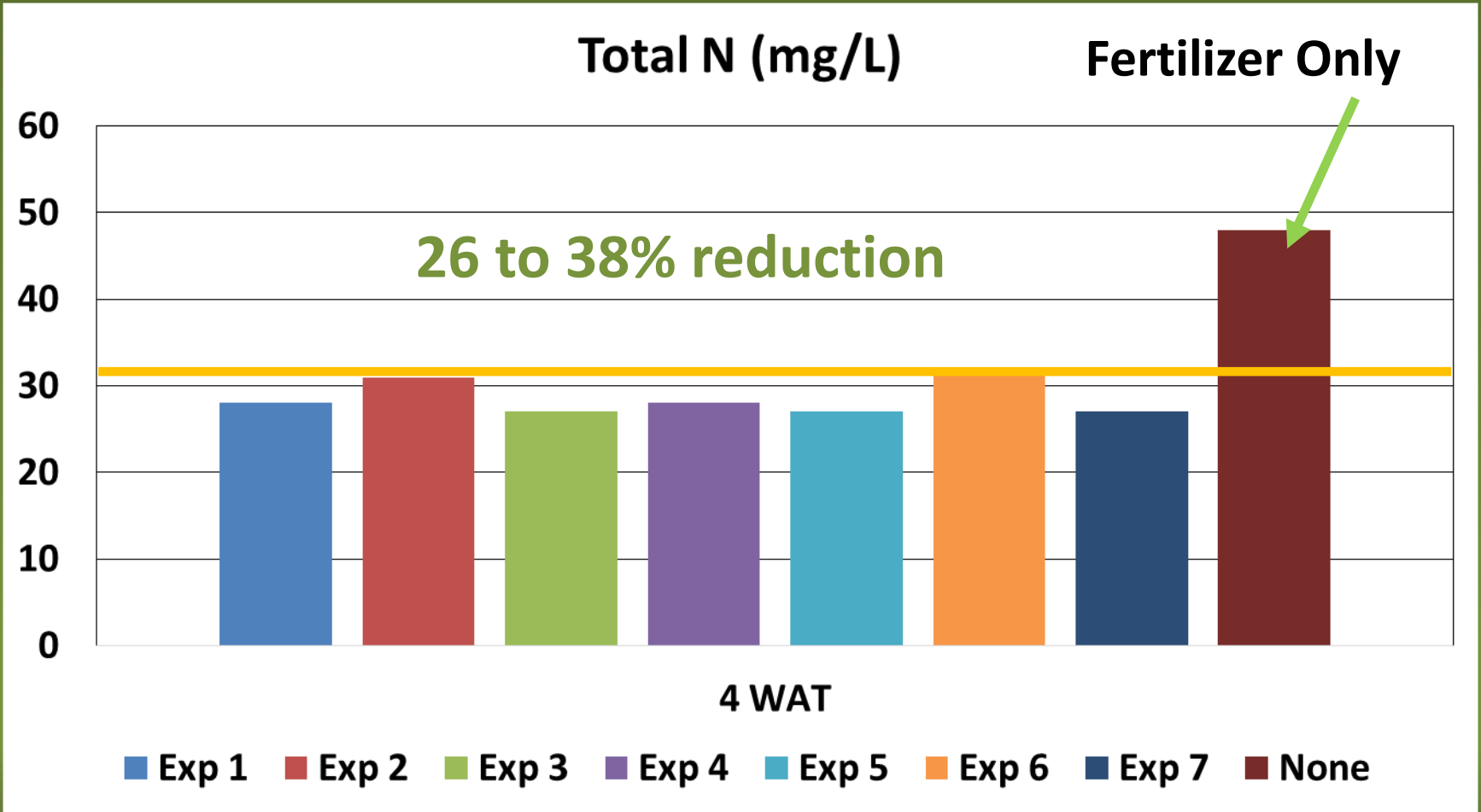
Wetting Agents

- Increase the uniformity of soil moisture throughout the soil profile
- Retain soil moisture deeper in the soil profile
- Decrease fertility leaching which may increase length of availability

Wetting Agents – Total N Leaching



Wetting Agents – Total N Leaching



12-3-12 Fertilizer + Wetting Agents

Biostimulants

- Organic-based products that increase plant health, improve root and shoot growth, and enhance stress tolerance
- Active ingredients – amino acids, humic/fulvic acids, seaweed extracts, biochar, compost tea, enzymes, vitamins, etc.

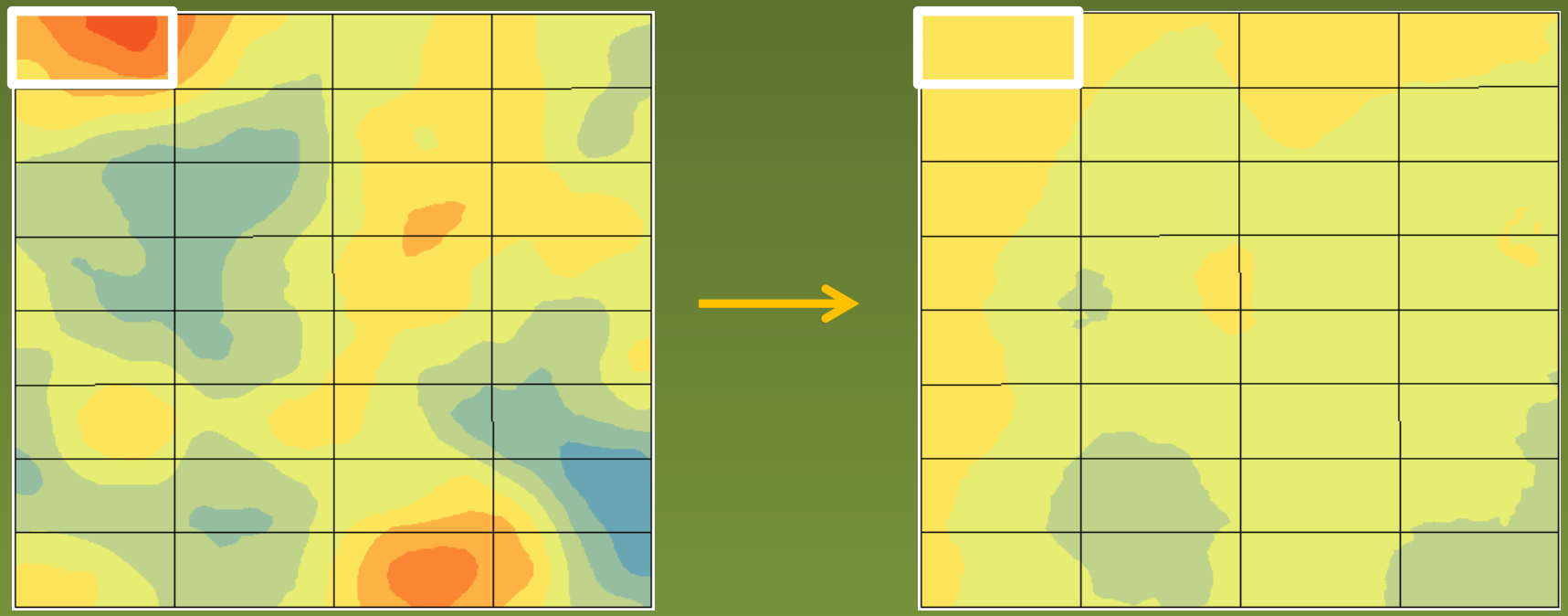
Biostimulants - Seeding

Treated

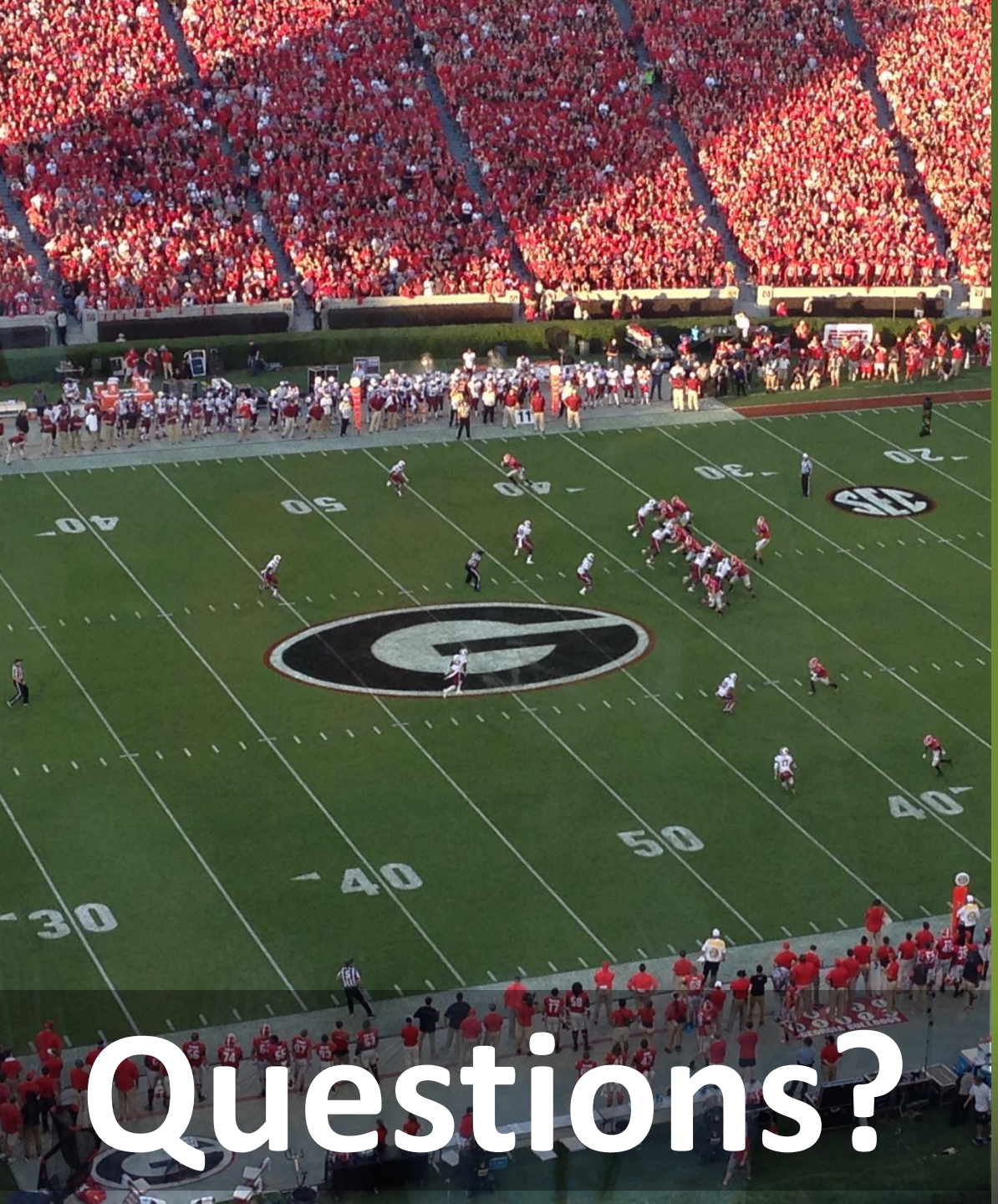
Non-treated

Biostimulants - Sodding

Soil Conditioners + Fertilizers



Retain soil structure, increase water infiltration, and encourage deeper rooting



Questions?

E-mail:
gmhenry@uga.edu

@UGATurfgrass