ASIC 2016
NORTHEAST REGIONAL CONFERENCE

APRIL 21 – 22, 2016

Westchester, NY

ASIC 2016 REGIONAL CONFERENCES

Southeast, Southwest, Northeast, & California

American Society of Irrigation Consultants

Theresa Backhus

USGBC Update
LEED v4: Impact on the Irrigation Industry

Theresa Backhus, USGBC

Presentation Provided by: USGBC


LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN
LEED

The Evolution of LEED: Where has it been?

LEED 2009 (v3)

CREATIVE TENSION

LEED 2009

Must comply with environmental **laws**

Must be a complete, **permanent** building or space

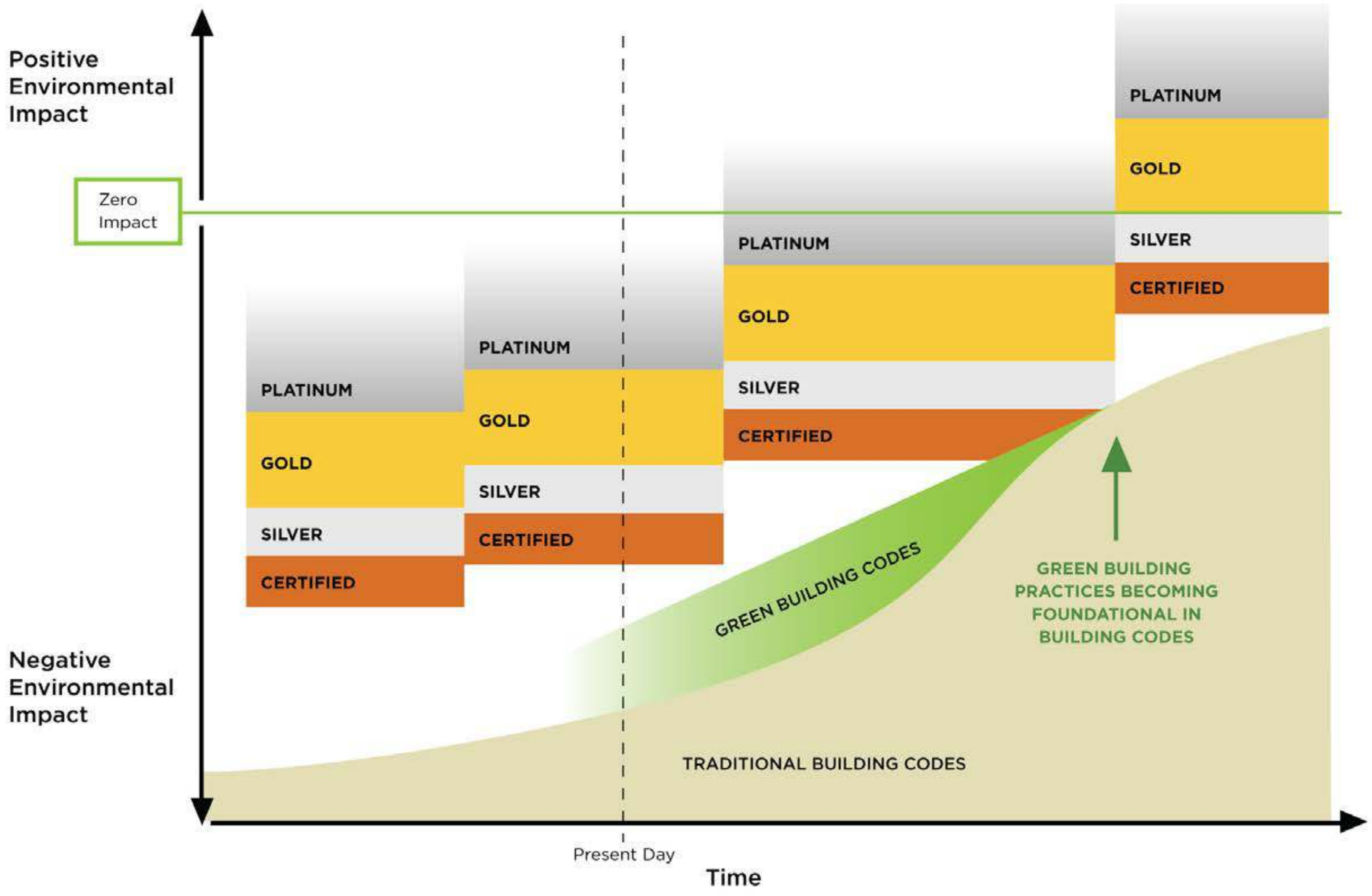
Must use a reasonable site **boundary**

Must comply with minimum **floor area** requirements

Must comply with minimum **occupancy rates**

Must commit to **sharing** whole-building energy and water usage **data**

Must comply with a minimum building area to site area **ratio**


Positive Environmental Impact
Zero Impact
Negative Environmental Impact
PLATINUM
GOLD
SILVER
CERTIFIED
PLATINUM
GOLD
SILVER
CERTIFIED
PLATINUM
GOLD
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PLATINUM
GOLD
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CERTIFIED
GREEN BUILDING CODES
GREEN BUILDING PRACTICES BECOMING FOUNDATIONAL IN BUILDING CODES
TRADITIONAL BUILDING CODES
Present Day
Time

Sunset Dates

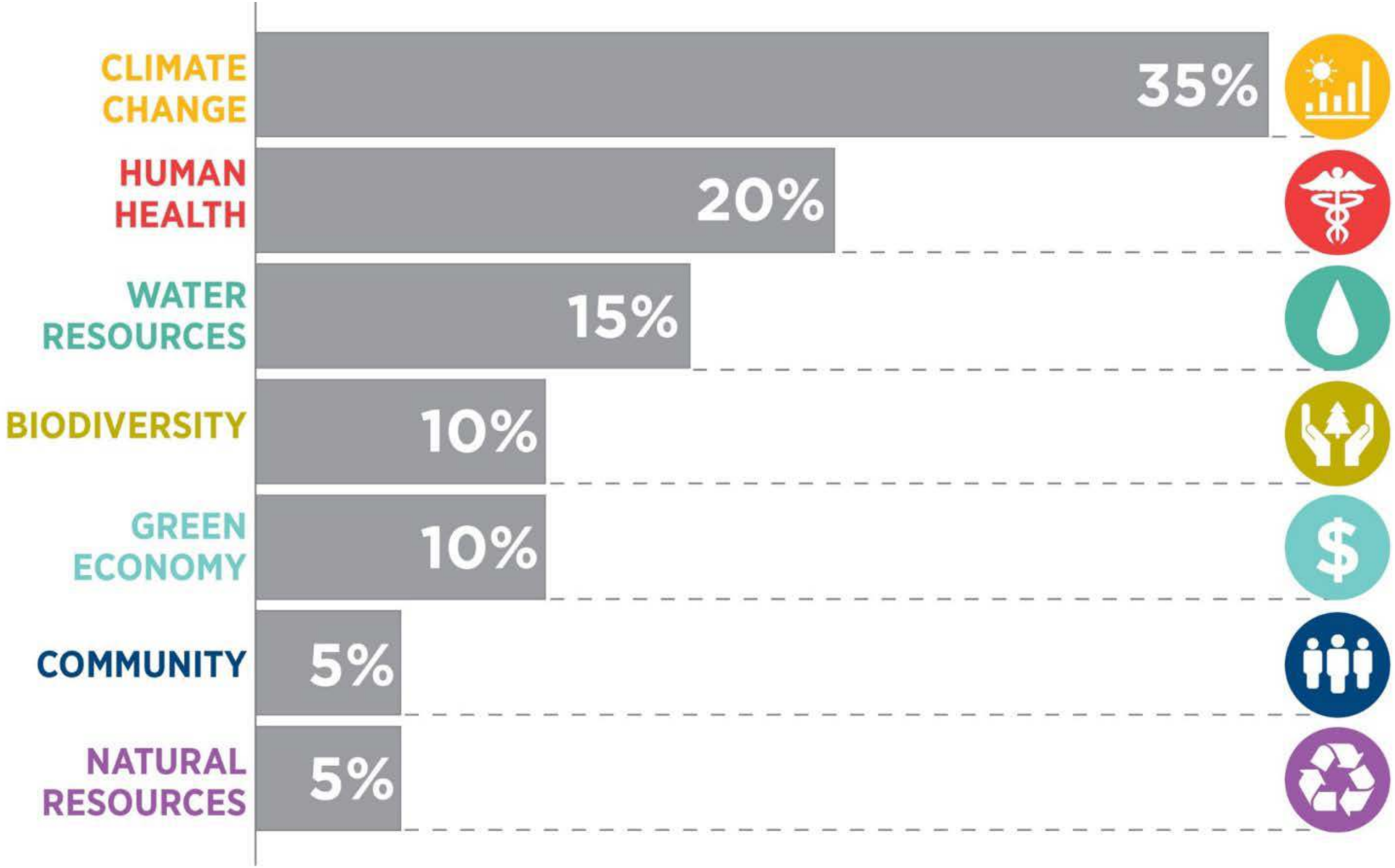
Rating system	REGISTRATION CLOSE	CERTIFICATION SUNSET
V2008		
Homes	10/31/16	6/30/21
Existing Buildings: Operations and Maintenance	6/27/09	6/27/15
V2009		
New Construction (and Italia NC)	10/31/16	6/30/21
Core and Shell	10/31/16	6/30/21

The Evolution of LEED:
Where is it now?

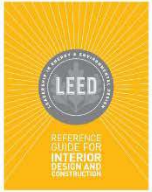
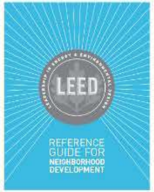
v4 FOCUS ON PERFORMANCE

Global Adaptations

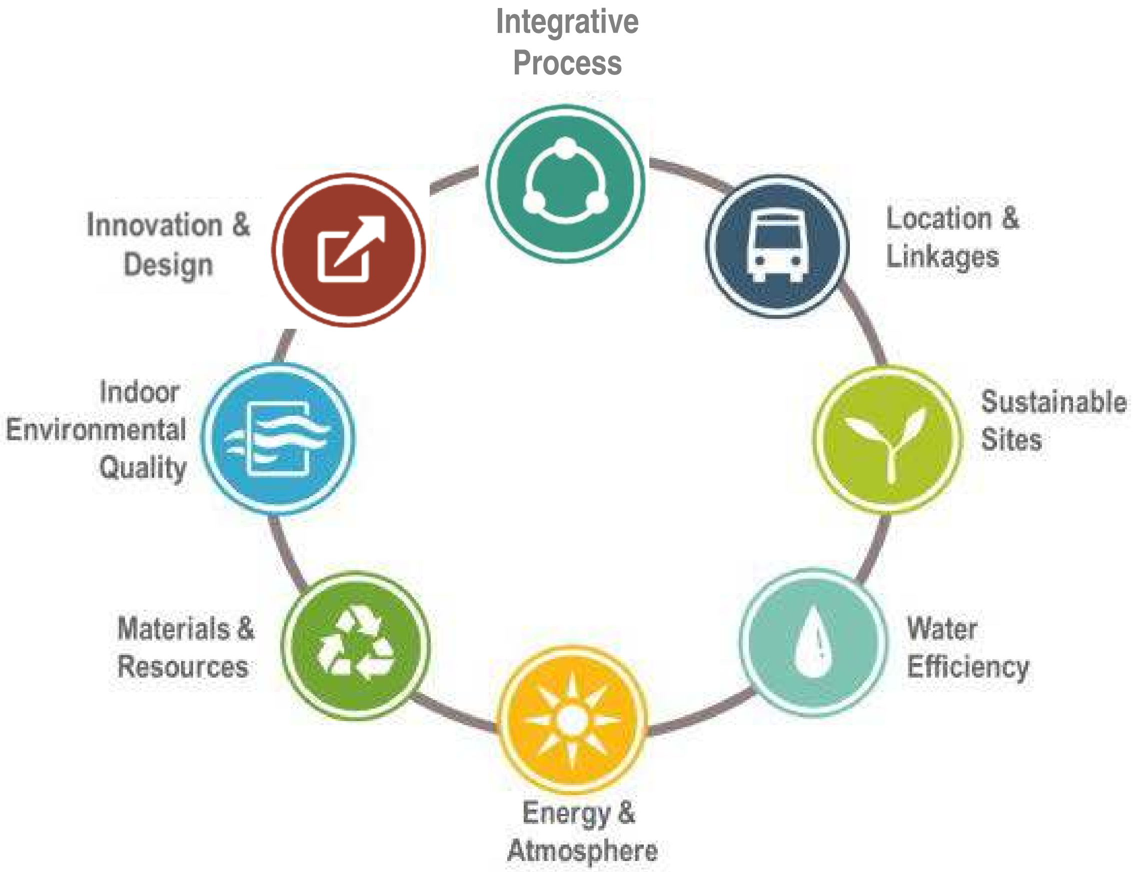
LEED v4 System Goals



Rating System Families

RATING SYSTEMS	LEED® for Building Design and Construction	LEED® for Interior Design and Construction	LEED® for Building Operations and Maintenance	LEED® for Neighborhood Development™
REFERENCE GUIDES				
MARKET SECTOR ADAPTATIONS	New Construction Core and Shell Schools Retail Healthcare Data Centers Hospitality Warehouses and Distribution Centers Homes Multifamily Midrise	Commercial Interiors Retail	Existing Buildings Data Centers Warehouses and Distribution Centers Hospitality Schools	Plan Project

LEED v4

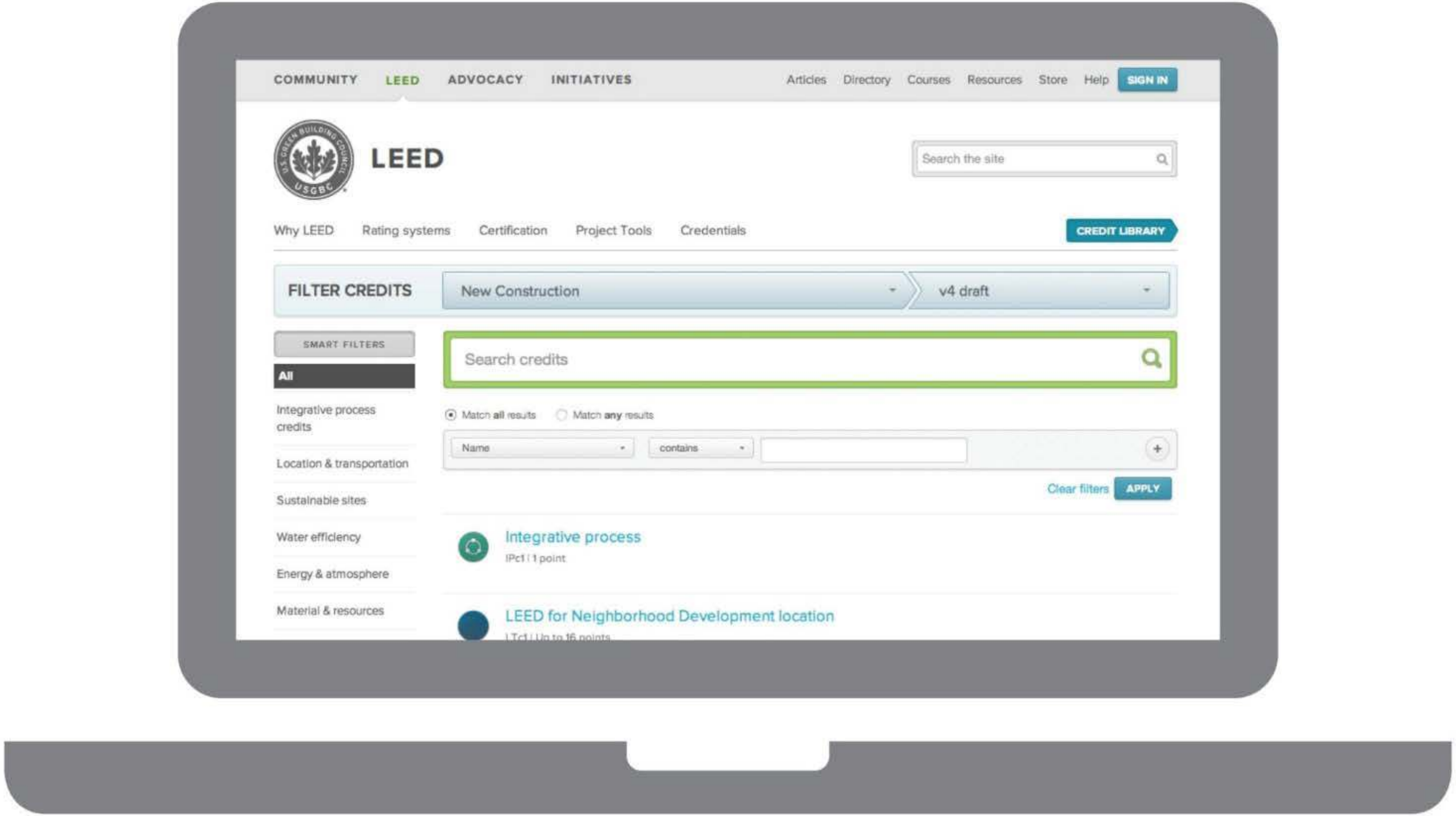


Must be in a **permanent** location on **existing** land

Must use reasonable LEED **boundaries**

Must comply with project **size requirements**

LEED Credit Library



LEED Documentation

Fewer Forms.

Reduced forms by 80% compared to LEED 2009 to improve system performance and consistency.

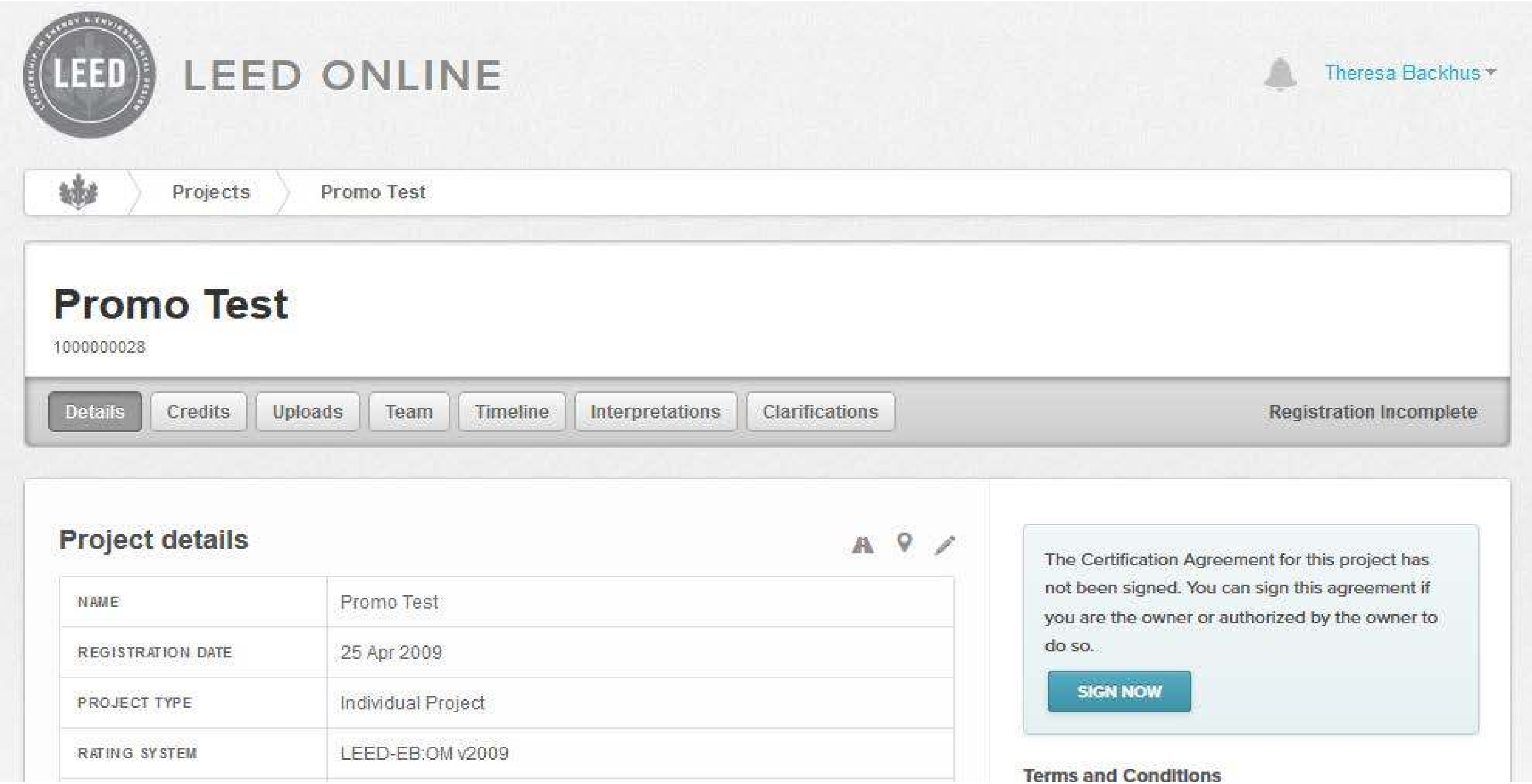
- Alignment across rating systems
- Includes campus, multiple building, recertification

Fewer fields to document.

Removed low-value documentation requirements.

- Removed required signatories
- Removed duplication of content

The New LEED Online



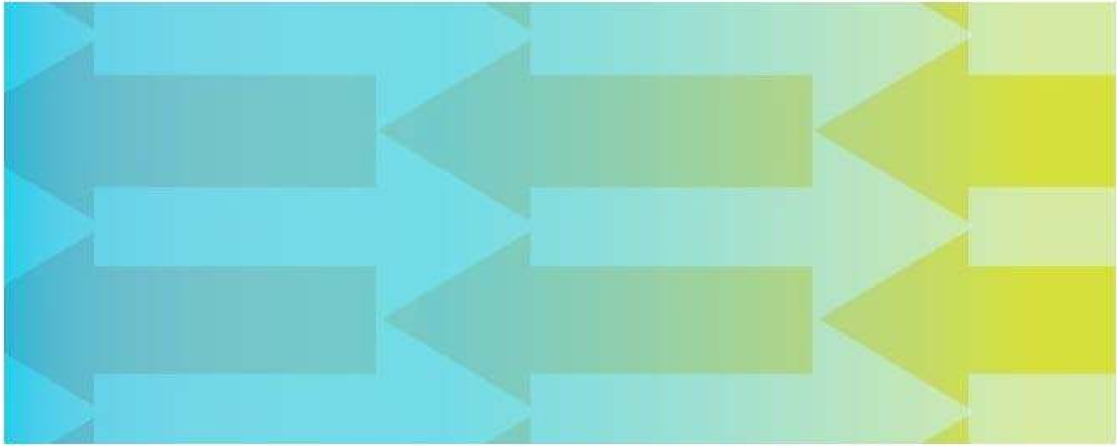
Credit Substitutions

LEED

+10

Use v4 credits on your v2009 project

Published on **10 Jan 2014** | Written by **Batya Metalitz** | Posted in LEED



Excited to start using LEED v4, but not sure you're ready to make the switch on your existing projects?

WATER EFFICIENCY

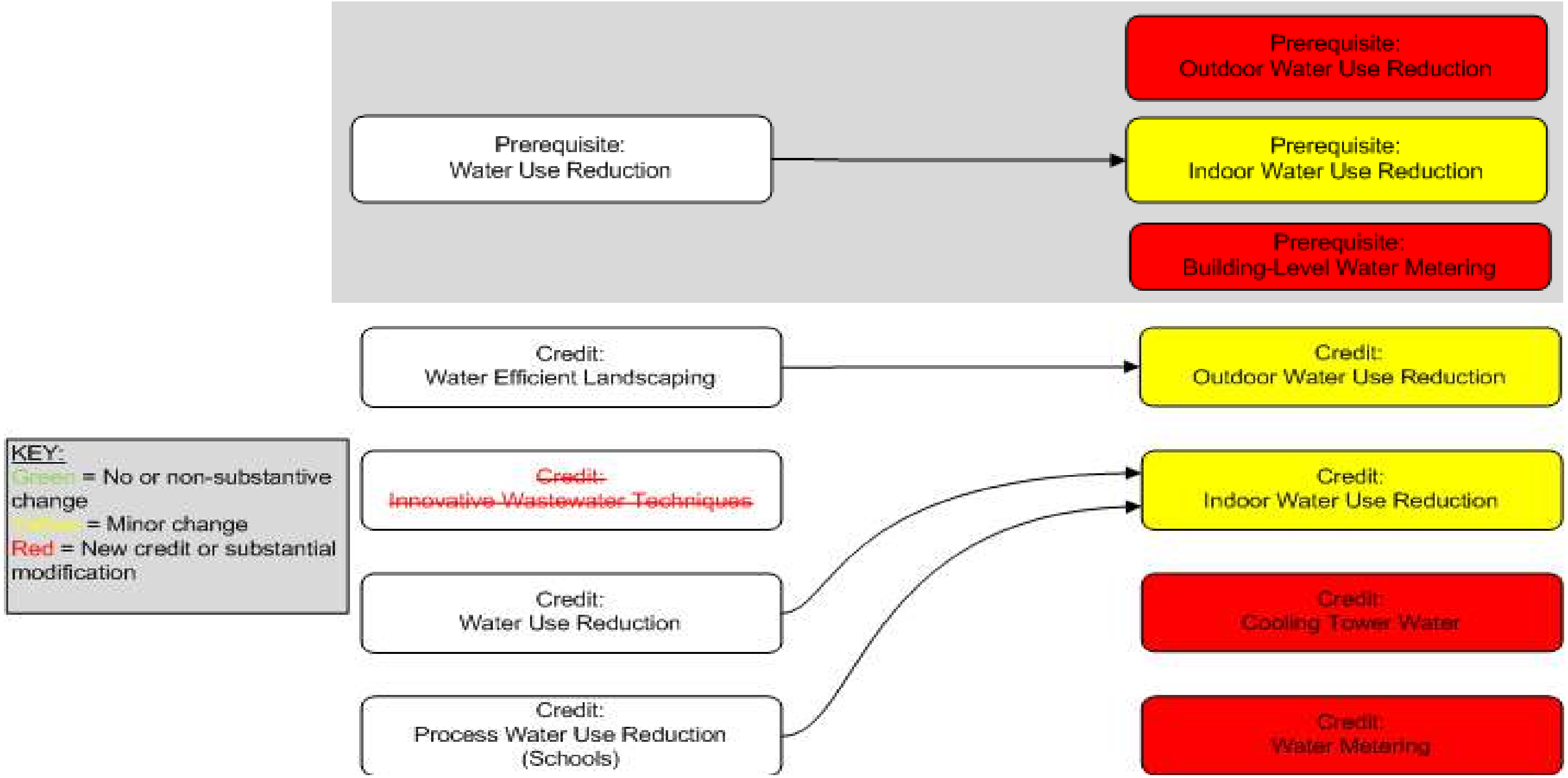
LEED v4 Technical Improvements: WE

Addresses **more water uses** including fixtures & fittings, processes, appliances, cooling towers, and landscape water use.

Focuses on **measuring water use** through a new water metering prerequisite and credit.

Outdoor Water Use is now a **prerequisite** (in addition to the credit).

LEED v4 Technical Improvements: WE



WEp/c Outdoor Water Use Reduction (BD+C)

Option 1: No Irrigation Required

Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

Option 2: Reduced Irrigation

Reduce the landscape water requirement (LWR) by at least 50% (30% prereq) from calculated baseline (first by plant selection and irrigation system efficiency via EPA WaterSense Water Budget Tool)

>30% reduction: use any combination of efficiency, alternative water sources, and smart scheduling technologies

2009 WEc1 Water Efficient Landscaping (BD+C)

Option 1: Reduce by 50%

Reduce irrigation water use by 50% through plant species, density, irrigation efficiency, captured or recycled water, etc.

Option 2: No potable water use or irrigation

Meet Option 1 and:

Path 1. Use only alternative water sources.

Or

Path 2. No permanent irrigation

WEc Outdoor Water Use Reduction (O+M)

Option 1: No Irrigation Required

Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

Option 2: Calculated Water Budget

Use the existing landscape to calculate the LWR using the EPA WaterSense Water Budget Tool. Install an irrigation meter and demonstrate a reduction in water use.

Option 3: Irrigation Meter

Establish a baseline using the annual average of at least 3 years of consecutive data out of the last 5 years and demonstrate a reduction in water use over the most recent 12 months.

2009 WEc3 Water Efficient Landscaping (O+M)

Option 1: Baseline vs. Actual Use

Calculate baseline and compare to metered irrigation water use.

Option 2: Baseline vs. Estimated Use

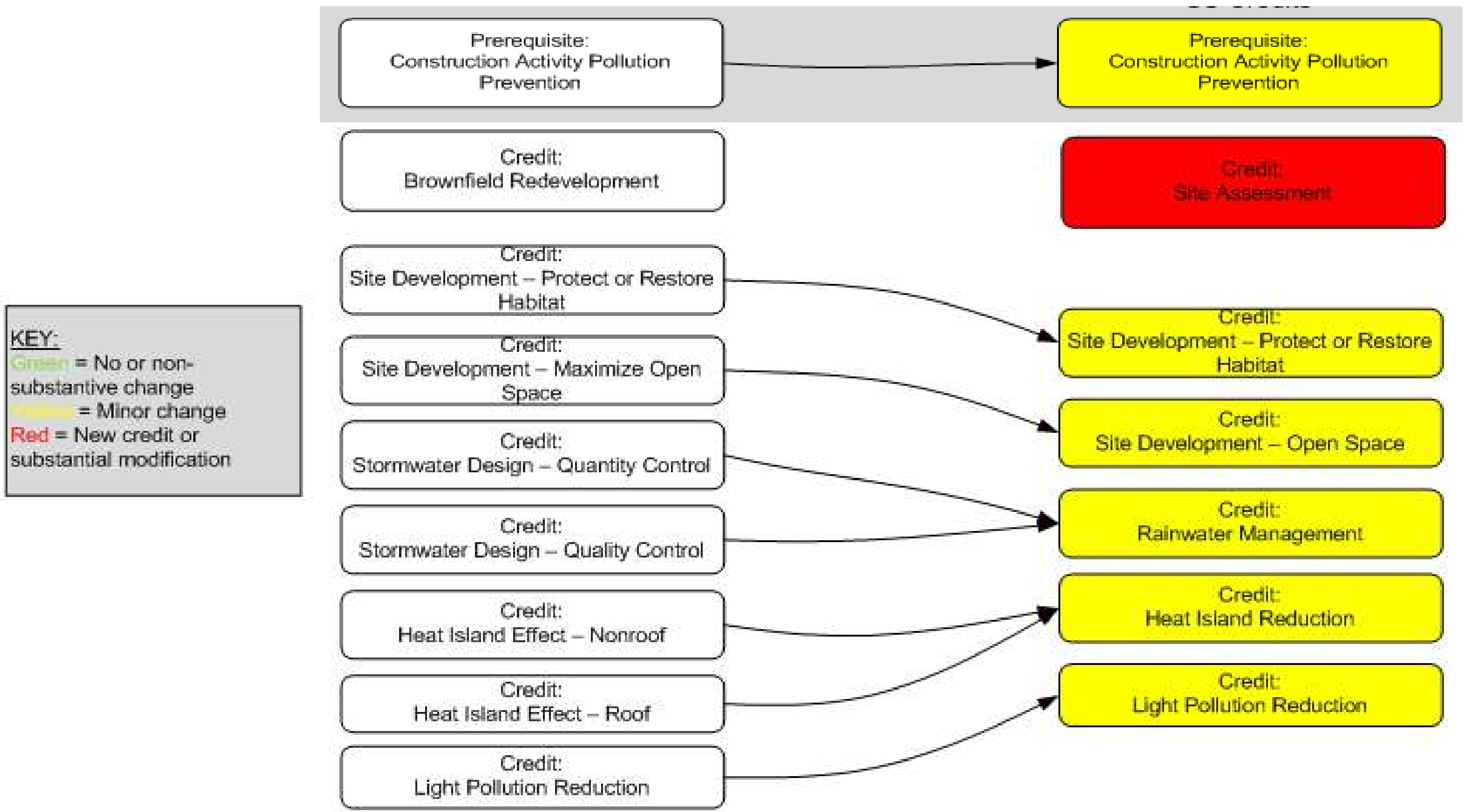
Calculate baseline and compare to estimated irrigation water use. Determine ET0, species/ density/ microclimate factors. Calculate landscape coefficient and estimated water use.

Option 3: Independent Tools

Use local, regional, provincial, state, territorial or national performance or ranking tools to demonstrate reductions in water use.

SUSTAINABLE SITES

LEED v4 Technical Improvements: SS



SSc Rainwater Management

Intent: To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.


Photo by *Nevue Ngan Assoc.*

SSc Rainwater Management (BD+C)

Option 1: Percentile of Rainfall Events

- **Path 1: 95^{th} Percentile**
  - Replicate natural site hydrology
  - Manage runoff for 95^{th} percentile
  - Use LID and GI
- **Path 2: 98^{th} Percentile**
  - Replicate natural site hydrology
  - Manage runoff for 98^{th} percentile
  - Use LID and GI
- **Path 3: 85^{th} Percentile**
  - Replicate natural site hydrology
  - Manage runoff for 85^{th} percentile
  - Use LID and GI
  - Only for zero lot line projects

Option 2: Natural Land Cover Conditions

- Manage increase in runoff from natural land cover conditions

Synergies with Other Credits

WEp/c: Water Metering: submeter irrigation water systems serving at least 80% of the irrigated landscaped area. Calculate the percentage of irrigated landscape area as the total metered irrigated landscape area divided by the total irrigated landscape area. Landscape areas fully covered with xeriscaping or native vegetation that requires no routine irrigation may be excluded from the calculation.

SSc Open Space: irrigation of qualifying vegetated open spaces

Synergies with Other Credits

WEc Total Water Use (Homes, Multifamily): use the EPA WaterSense Water Budget Tool to calculate the baseline landscape water consumption and the design landscape water consumption. Implement measures to further reduce landscape water consumption. Add the savings associated with the following measures to the reduction from the LWR: Install smart scheduling technology; captured rainwater; reclaimed water; water treated on site or conveyed by a public agency specifically for nonpotable uses

Synergies with Other Credits

SSp Site Management Policy (O+M): monitor irrigation systems manually or with automated systems at least every two weeks during the operating season for appropriate water usage, system times, leaks, or breaks)

SSc Heat Island Reduction: vegetated roof irrigation

SSc Site Improvement Plan (O+M): rainwater reuse opportunities, potable water-use reduction

LEED Outdoor Water Use Calculator

Landscape Water Requirement

Average monthly rainfall for the site's peak watering month (in/month)	2.88

Table: Landscape water requirement

Zone ID	Hydrozone or Landscape Feature Area (sq ft)	Plant Type or Landscape Feature	Water Requirement	Landscape Coefficient (K_L)	Irrigation Type	Distribution Uniformity (DU_{LQ})	LWH_H (gal/month)
1	7,800	Turfgrass	High	0.8	Micro spray	70%	50,098
2	1,500	Groundcover	Low	0.2	No irrigation	N/A	0
3	1,500	Shrubs	Medium	0.5	Drip (press comp)	90%	4,233
4	1,000	Trees	Low	0.2	No irrigation	N/A	0
5	396	Trees	Medium	0.5	No irrigation	N/A	0
							0
							0
							0
							0
							0

Total hydrozone or landscape feature area (sq ft)	12,196
Landscape water requirement based on the site's peak watering month (gal/month)	54,332

Add Rows

Delete Rows

LEED Outdoor Water Use Calculator

Summary

Note: All information on this tab is READ-ONLY. To edit, see previous tabs.

Landscape water allowance (LWA) (gal/month)	34,694	
Landscape water requirement (LWR) (gal/month)	54,332	
Percentage reduction from baseline (%)	-57%	Must be at least 30%

EPA WaterSense Water Budget Tool

STEP 1 Location and Area | STEP 2 Plants and Irrigation | STEP 3 The Results

Fill out the chart below with all the appropriate information to calculate your landscape's water needs.

	Zone	Area (sq. ft.)	Plant Type / Landscape Feature	Water Demand	Irrigation Type	Impact on Water Use	Required Water (gal/month)
×	1						
×	2						
×	3						
×	4						
×	5						
×	6						
	Total:	0					

+ add zone

15,000 Remaining Area (sq. ft.)	42,802 Water Allowance (gal/month)	0 Total Water Requirement for the Site (gal/month)	42,802 Below Allowance (gal/month)

NEXT STEP >

LEED Outdoor Water Use Form

WE Prerequisite Outdoor Water Use Reduction
WE Credit Outdoor Water Use Reduction

Select one of the following:

- ○ **Option 1.** No irrigation required (0-2 points)
- ● **Option 2.** Reduced irrigation (0-2 points)

Option 2. Reduced Irrigation

Upload: EPA WaterSense Tool or Outdoor Water Use Reduction Calculator
Provide the completed EPA WaterSense Water Budget Tool (accessible at epa.gov/watersense/water_budget) OR Outdoor Water Use Reduction Calculator (found under the prerequisite's "Resources" tab in the Credit Library).

The EPA WaterSense Water Budget Tool only accommodates zip codes in the U.S. or Canada.

Upload: Site plan

The Evolution of LEED: Where is it going?

PROVEN PERFORMANCE

Upcoming Changes and Additions

Whole Project Water Use Reduction Pilot Alternative Compliance Path: measure the baseline water use of the entire project (including irrigation) and demonstrate a reduction. Replaces most credits in the WE category.

Green Walls: inclusion of exterior green walls in calculations.

Water Quality Pilot Credit: especially important outside of the U.S. India and Mexico have proposed requirements for consideration.

Sustainable
SITES
Initiative

The **Sustainable Sites Initiative (SITES®)** offers a systematic, comprehensive rating system designed to define sustainable sites, measure their performance, and ultimately elevate the value of landscapes. Administered by GBCI, the SITES rating system can apply to development projects located on sites with or without buildings, including open spaces, streetscapes and plazas, commercial, residential, educational/institutional, infrastructure, government, military and industrial.

The **LEED® Dynamic Plaque™** is a building performance monitoring and scoring platform for LEED-certified projects, providing annual LEED recertification and global benchmarking. The plaque displays a LEED performance score, which reflects the measured performance of the building across five categories: energy, water, waste, transportation and human experience. The LEED Dynamic Plaque makes the invisible actionable and offers a means for interaction with the building on multiple levels.

Resources

www.usgbc.org/credits

www.usgbc.org/leed/v4

www.usgbc.org/leedonline

www.usgbc.org/sampleforms

www.usgbc.org/leed-interpretations

www.usgbc.org/pilotcredits

www.gbig.org/

www.sustainablesites.org

www.leedon.io

www.leeduser.com

ASIC

Thank you!

Theresa Backhus

USGBC

tbackhus@usgbc.org

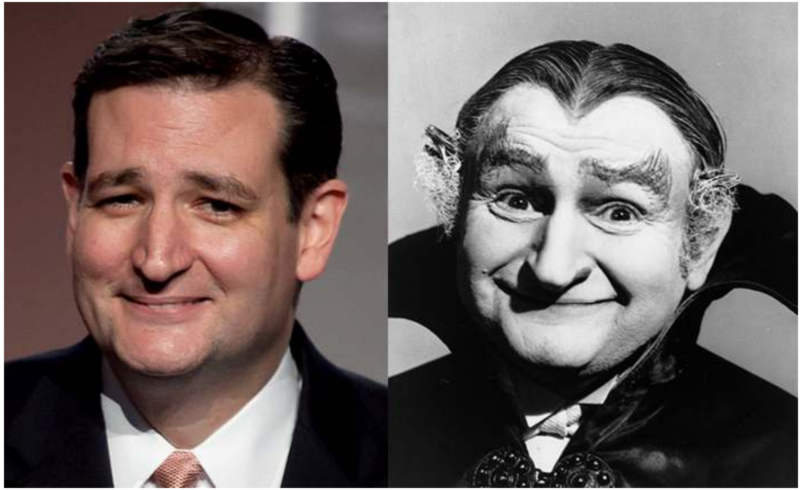
John Farner

Smart Practices.
Sustainable Solutions.

Regulating Irrigation

The centuries old battle over water has just begun…

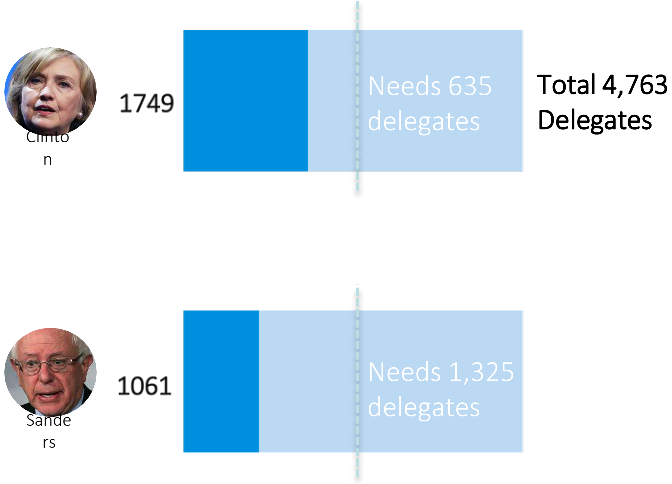
Let’s talk politics…



Democratic Delegate Count

Allocated Delegates

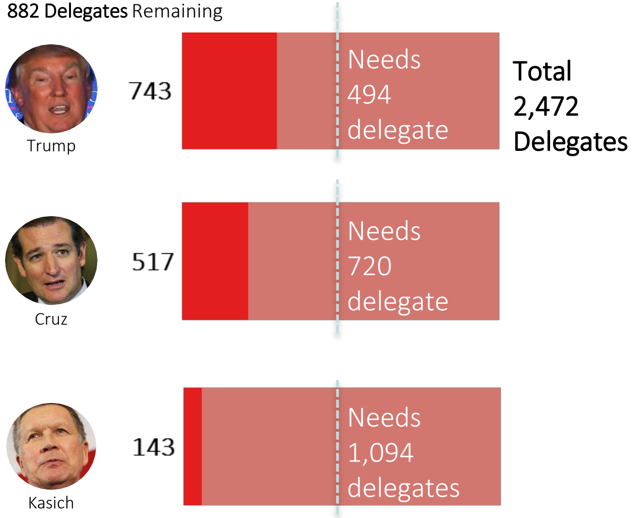
2,383 Delegates Needed to Win the Democratic Nomination
1,959 Delegates Remaining



Republican Delegate Count

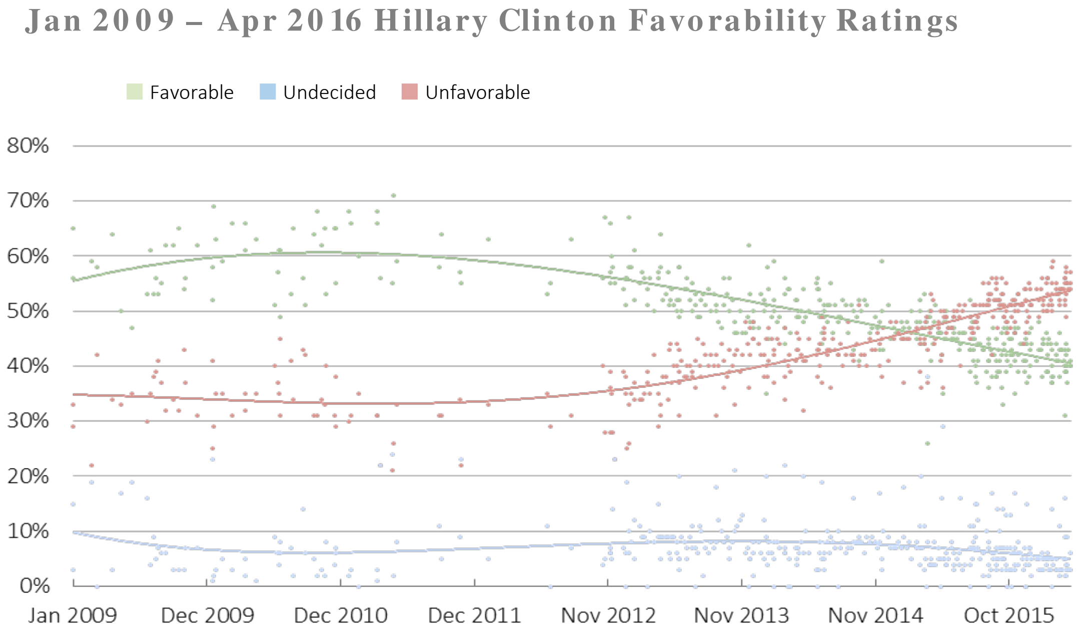
Allocated Delegates

1,237 Delegates Needed to Win the Republican Nomination
882 Delegates Remaining



**Delegate count as of April 8, 2016*

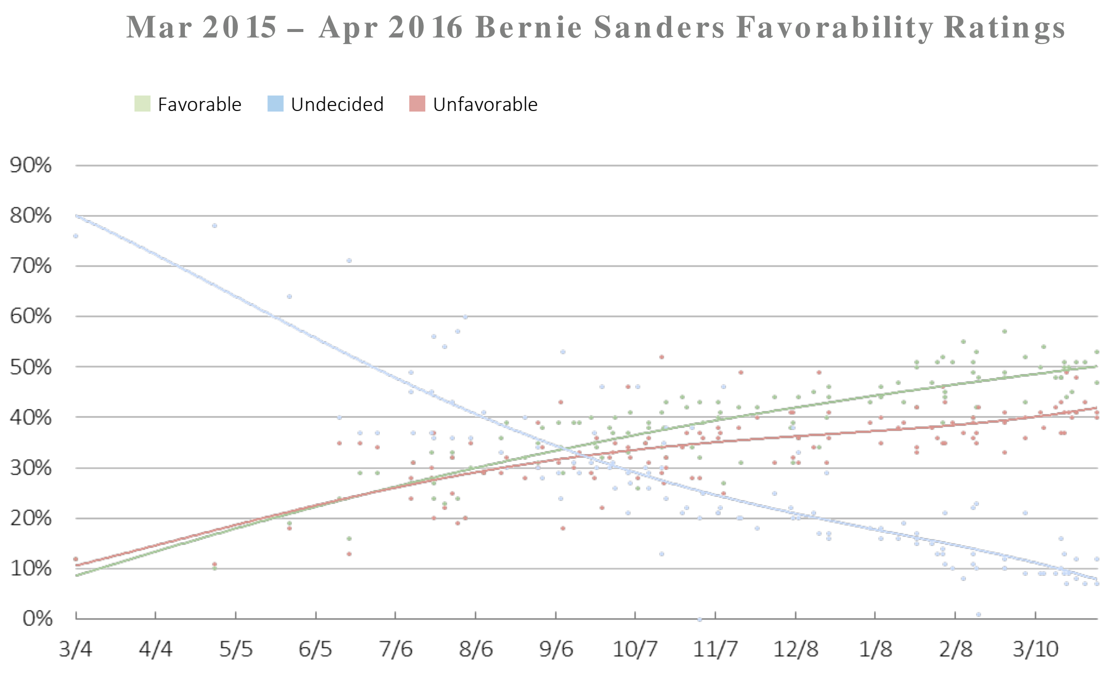
Hillary Clinton's Favorability Has Declined Since 2011



Analysis

- Hillary Clinton's favorability has steadily declined over the past few years
- She has been more unfavored than favored since mid-2015

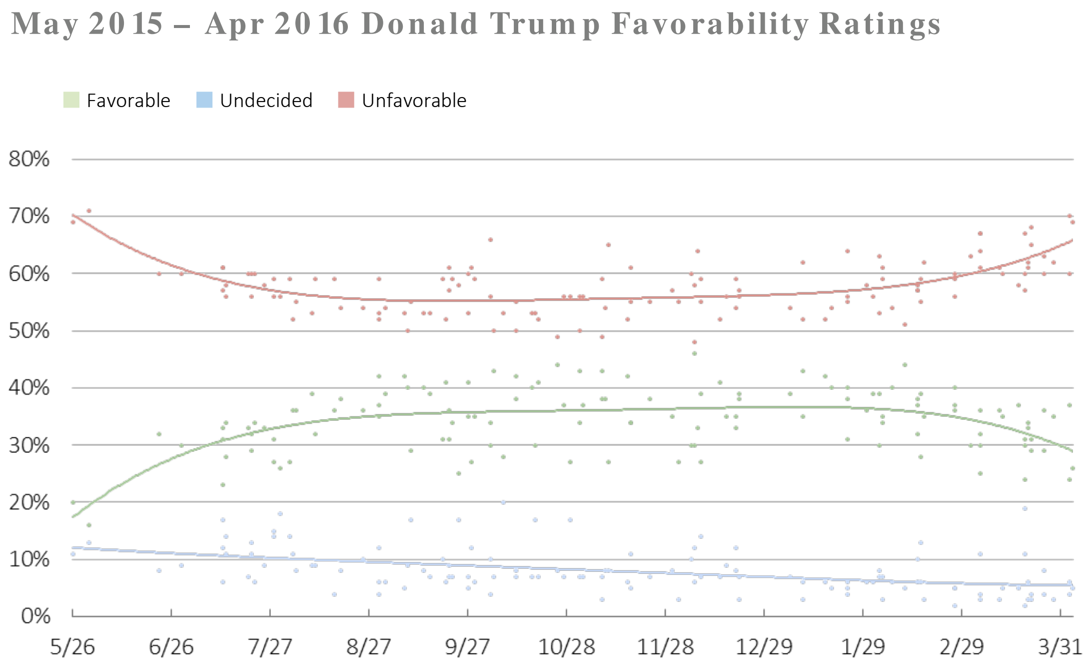
Bernie Sanders' Favorability Has Consistently Risen Since March 2015



Analysis

- Sanders' favorability has steadily increased since March 2015
- The percentage of people undecided about Sanders has dropped significantly as he became more well known over the course of his campaign
- The percentage of people who see Sanders unfavorably has also risen, but Sanders has generally been seen more favorably than unfavorably since July 2015

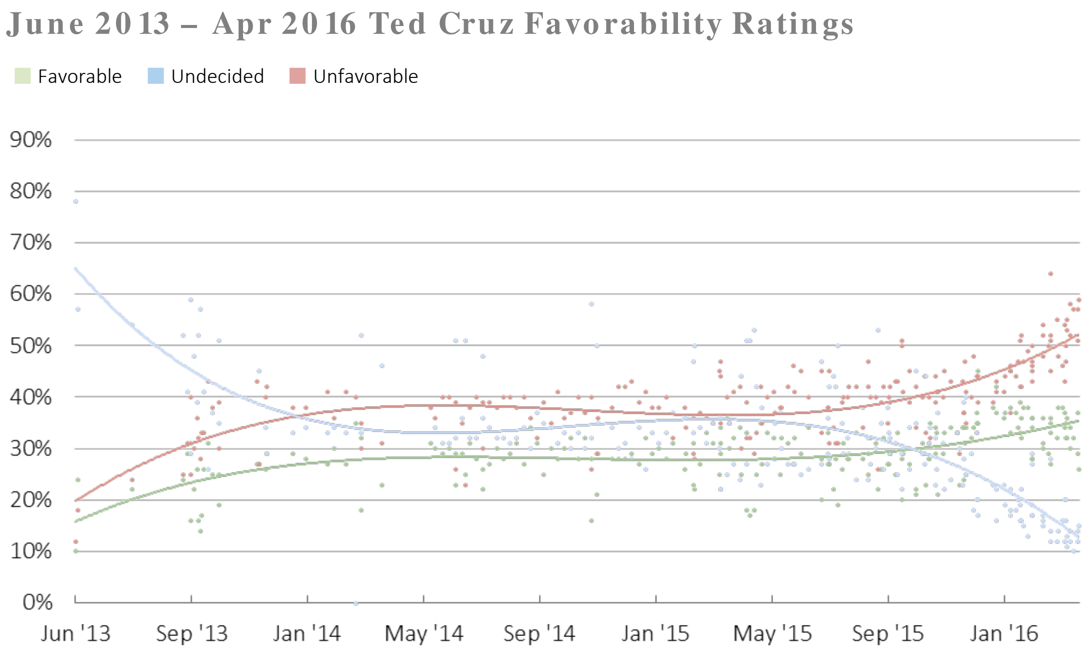
Donald Trump's Favorability Has Decreased in Recent Months



Analysis

- Donald Trump has consistently been more unfavored than favored since May 2015
- Over the past few months, his favorability rating has decreased and his unfavorability rating has increased

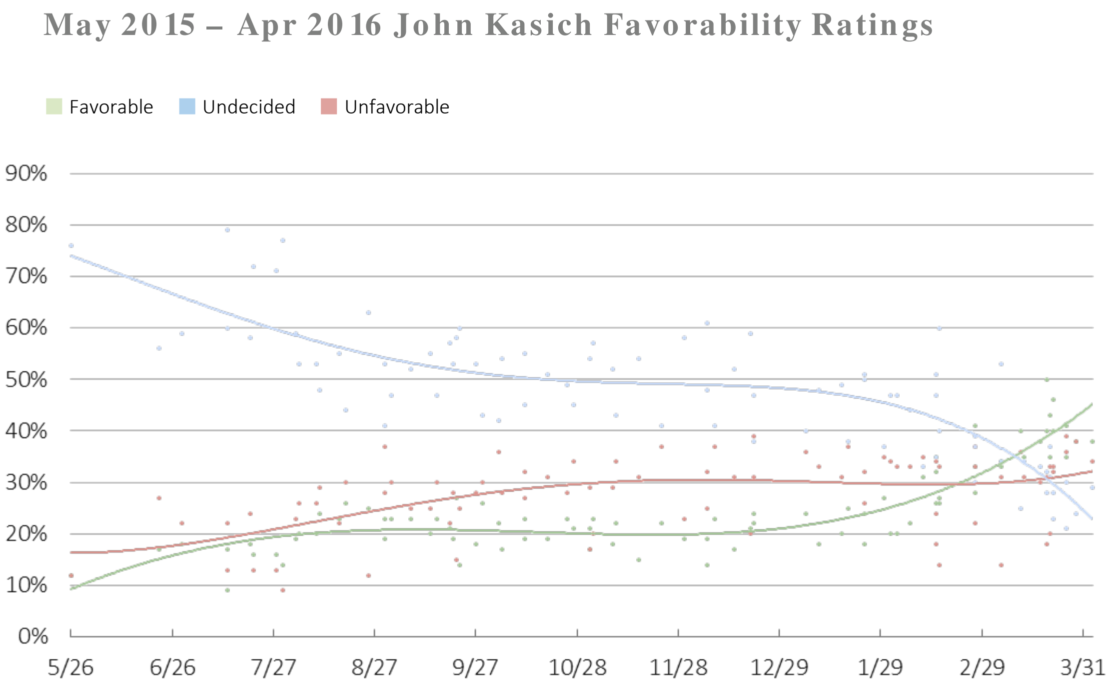
Ted Cruz Has Been More Unfavored than Favored Throughout His Tenure as Senator



Analysis

- Ted Cruz has always been more unfavored than favored, since June 2013
- While his favorability has slightly increased over the past few months, his unfavorability rating has also increased

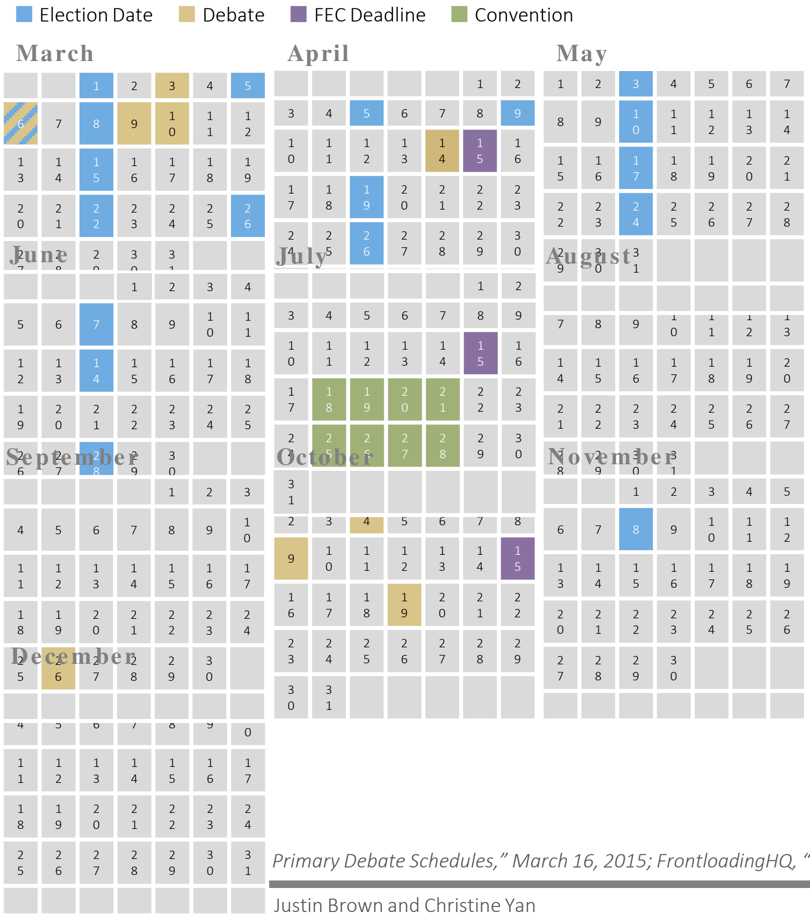
John Kasich's Favorability Has Risen Since January 2016



Analysis

- John Kasich has had a higher favorable rating than unfavorable rating since the end of January
- His favorability rating has risen, while his unfavorable rating has mostly stayed the same

2016 Election Calendar



Mar. 1: Caucuses (AK GOP, CO Dem., CO GOP, MN, ND GOP, WY GOP)
Primaries (AL, AR, GA, MA, OK, TN, TX, VT, VA)
Mar. 3: Fox News GOP Primary Debate
Mar. 5: LA Primary, GOP Caucuses (KY, ME, KS), Dem. Caucuses (KS, NE)
Mar. 6: ME Dem. Caucus, PR GOP Primary, Democratic Primary Debate
Mar. 8: Primaries (MI, MS, ID Rep.), HI GOP Caucus
Mar. 9: Univision/The Washington Post Democratic Primary Debate
Mar. 10: CNN/Salem Radio GOP Primary Debate
Mar. 15: Primaries (IL, MO, FL, NC, OH), MP GOP caucus
Mar. 22: AZ Primary, Caucuses (ID Dem., UT Dem., UT Rep.)
Mar. 26: Dem. Caucuses (AK, HI, WA)

Apr. 5: WI Primary
Apr. 9: WY Dem. Caucus
Apr. 14: CNN/NY1 Democratic Primary Debate ***RECENTLY ADDED***
Apr. 15: FEC Filing Deadline
Apr. 19: NY Primary
Apr. 26: Primaries (CT, DE, PA, MD, RI)

May 3: IN Primary
May 10: Primaries (NE GOP, WV)
May 17: Primaries (KY Dem., OR)
May 24: WA GOP Primary

June 7: Primaries (CA, MT, NJ, NM, SD), ND Dem. Caucus
June 14: DC Dem. Primary
June 28: UT Primary

July 15: FEC Filing Deadline
July 18-21: Republican Nat'l Convention (Cleveland, OH)
July 25-28: Democratic Nat'l Convention (Philadelphia, PA)

Sept. 26: First Presidential Debate

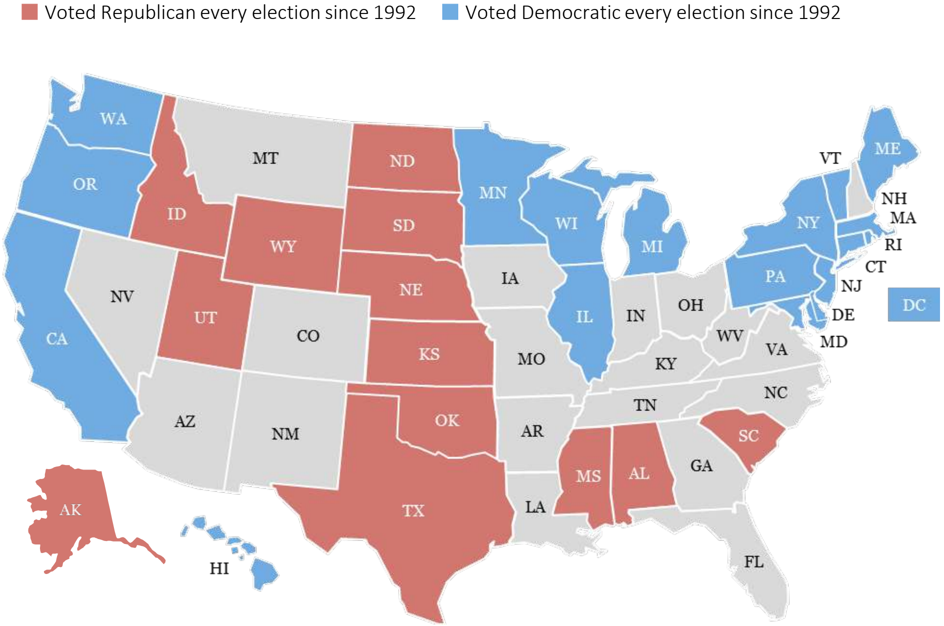
Oct. 4: Vice Presidential Debate
Oct. 9: Second Presidential Debate
Oct. 15: FEC Filing Deadline
Oct. 19: Third Presidential Debate

Nov. 8: Election day

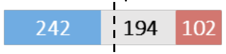
So[…] *Primary Debate Schedules," March 16, 2015; FrontloadingHQ, "The 2016 Presidential Primary Calendar," 2016.*

Based on Past Presidential Elections, Democrats May Hold a Slight Advantage Heading into 2016 General Election

States That Voted Consistently in the Past Six Presidential Elections



Share of Electoral Votes Historically Won by Democrats and Republicans since 1992

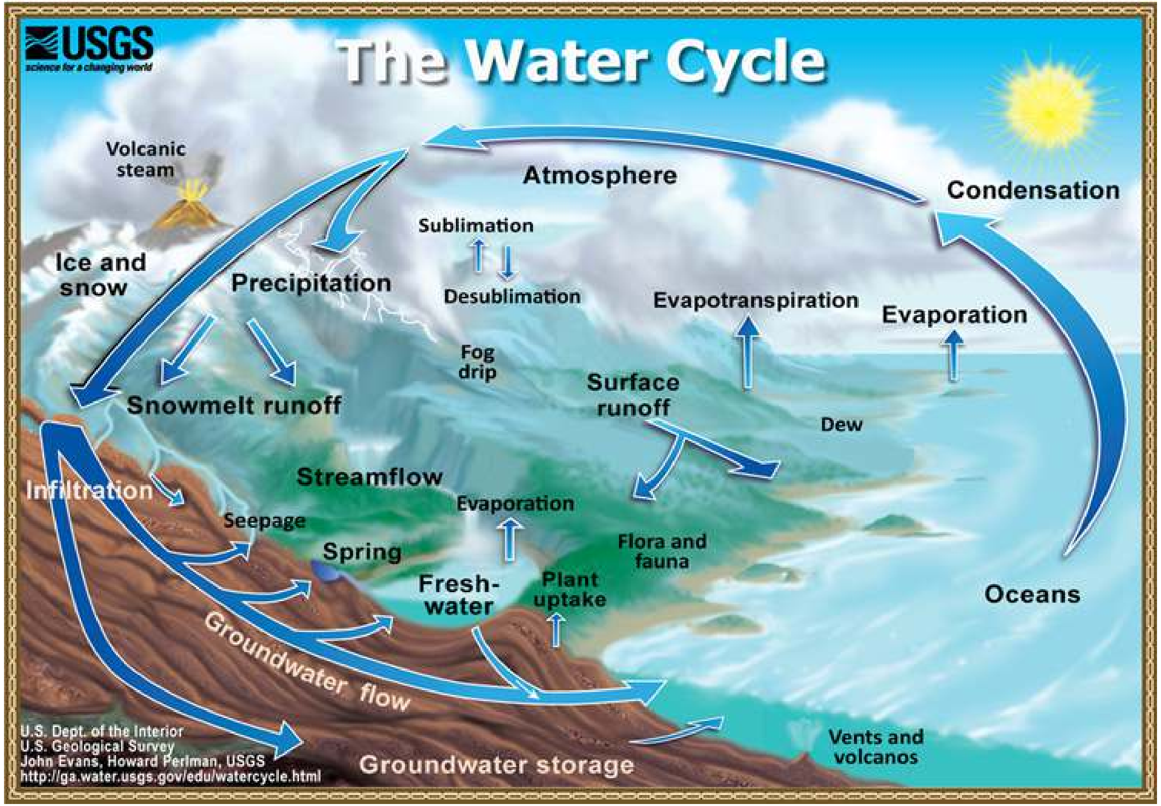


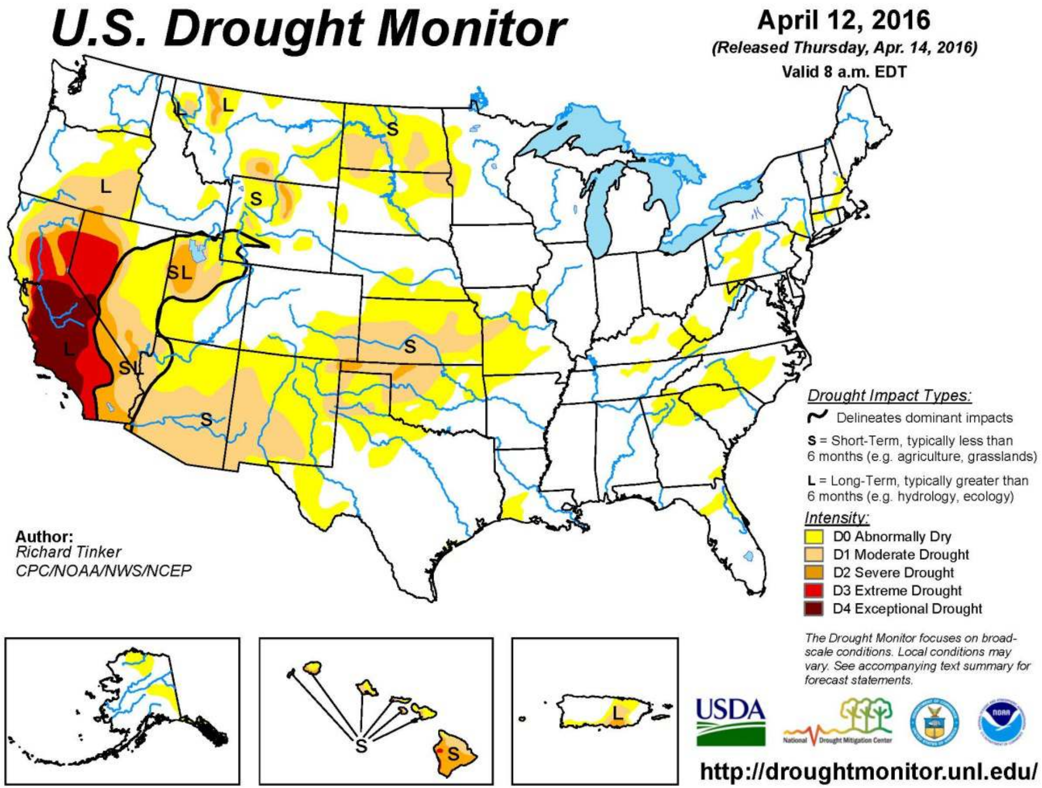
270 needed to win presidential election

Analysis

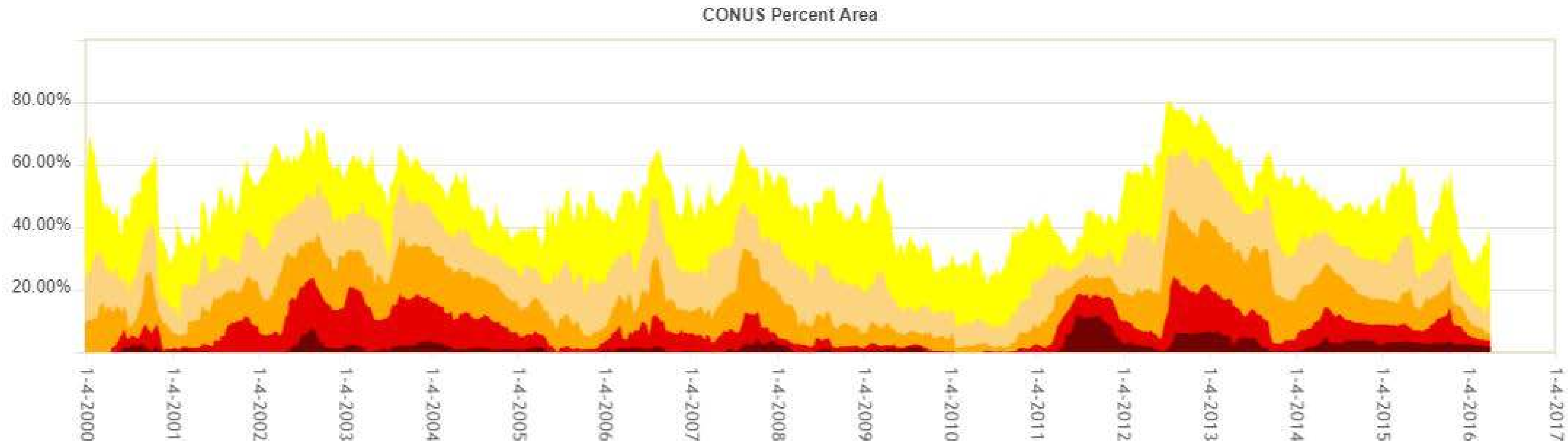
- Democrats won 18 states plus the District of Columbia six times in a row, which in 2016 would earn **242 electoral votes**, about 90 percent of the 270 electoral votes needed to win.
- In contrast, Republicans consistently carried 13 states over the last six elections, which in 2016 would earn the party **102 electoral votes**, 38 percent of the 270 needed to win.
- For more information on the political climate of the presidential primary, read Charlie Cook's analysis.

Sources: Archives.gov, "US Electoral College"; National Journal, Charlie Cook, "Is Clinton's Tide Shifting?"; Politifact.com, "18 States Have Voted Democratic in Six Consecutive Elections with 242 Electoral Votes, George Will Says"


USGS
science for a changing world
The Water Cycle
Volcanic steam
Atmosphere
Condensation
Sublimation
Desublimation
Ice and snow
Precipitation
Evapotranspiration
Evaporation
Fog drip
Surface runoff
Snowmelt runoff
Dew
Streamflow
Infiltration
Seepage
Evaporation
Spring
Flora and fauna
Fresh-water
Plant uptake
Oceans
Groundwater flow
U.S. Dept. of the Interior
U.S. Geological Survey
John Evans, Howard Perlman, USGS
http://ga.water.usgs.gov/edu/watercycle.html
Groundwater storage
Vents and volcanos



U.S. Drought Monitor
April 12, 2016
(Released Thursday, Apr. 14, 2016)
Valid 8 a.m. EDT
Drought Impact Types:
Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)
Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
Author:
Richard Tinker
CPC/NOAA/NWS/NCEP
USDA
http://droughtmonitor.unl.edu/



CONUS Percent Area
80.00%
60.00%
40.00%
20.00%
1-4-2000
1-4-2001
1-4-2002
1-4-2003
1-4-2004
1-4-2005
1-4-2006
1-4-2007
1-4-2008
1-4-2009
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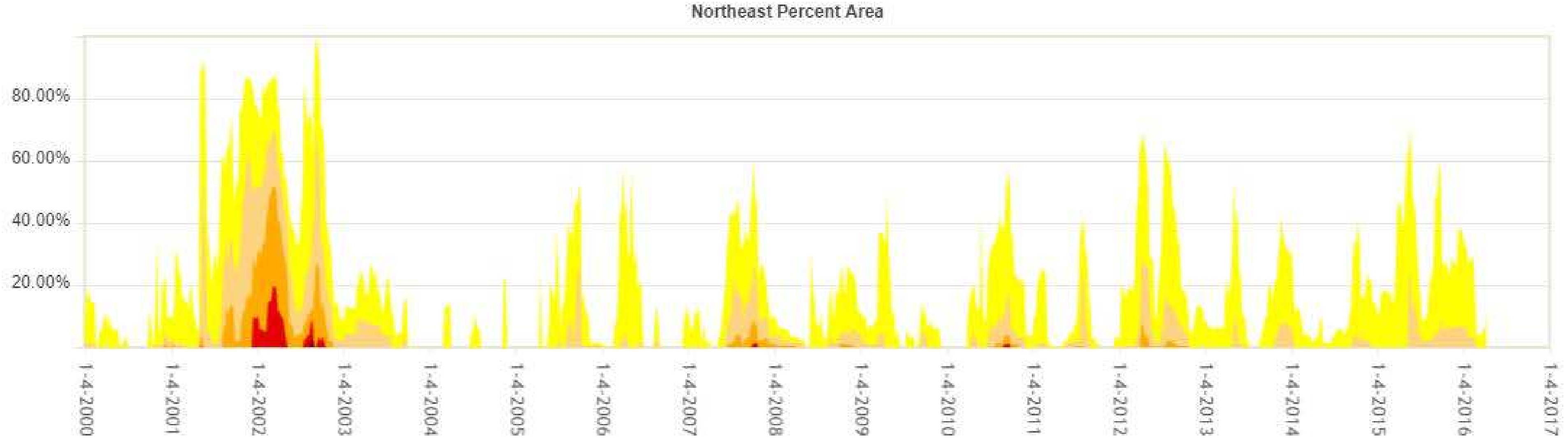
1-4-2015
1-4-2016
1-4-2017



Northeast Percent Area
80.00%
60.00%
40.00%
20.00%
1-4-2000
1-4-2001
1-4-2002
1-4-2003
1-4-2004
1-4-2005
1-4-2006
1-4-2007
1-4-2008
1-4-2009
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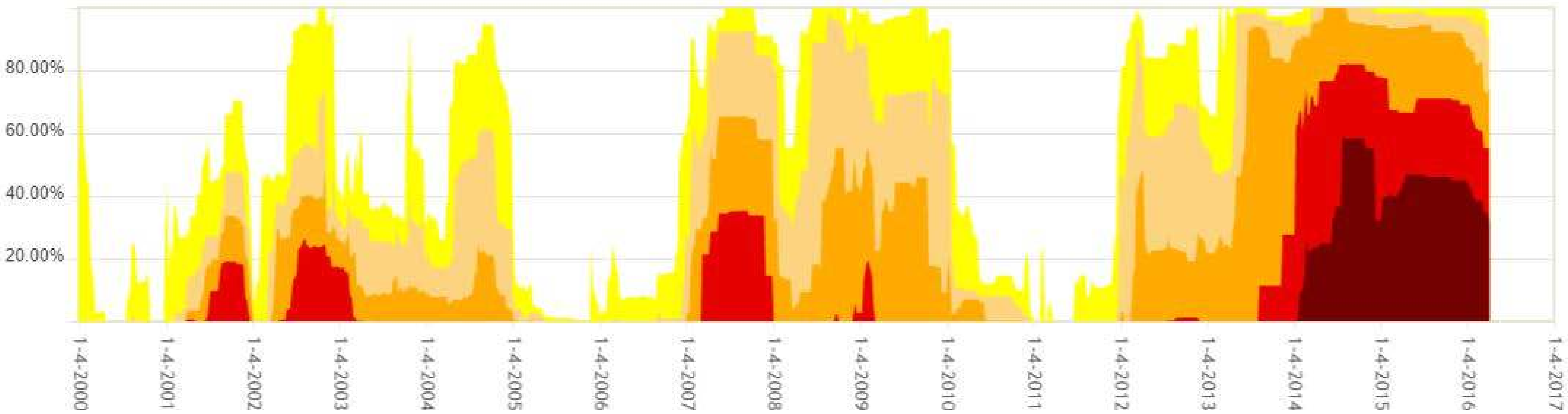
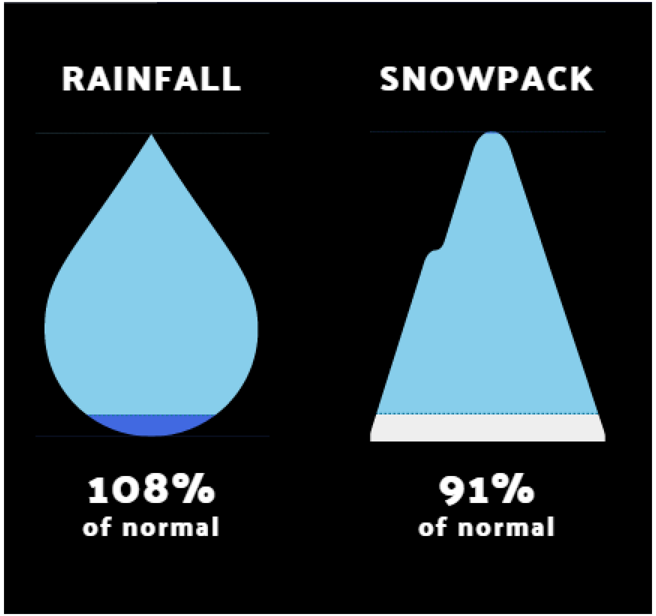
1-4-2015
1-4-2016
1-4-2017

California Percent Area

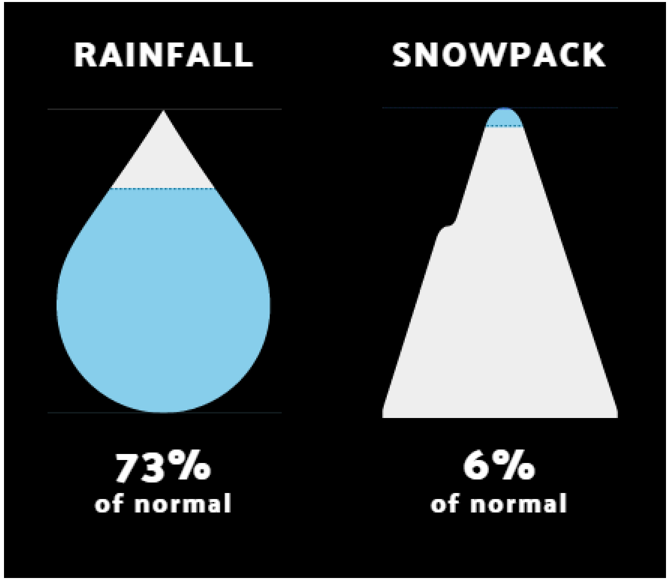



THE WEATHER CHANNEL
EL NIÑO

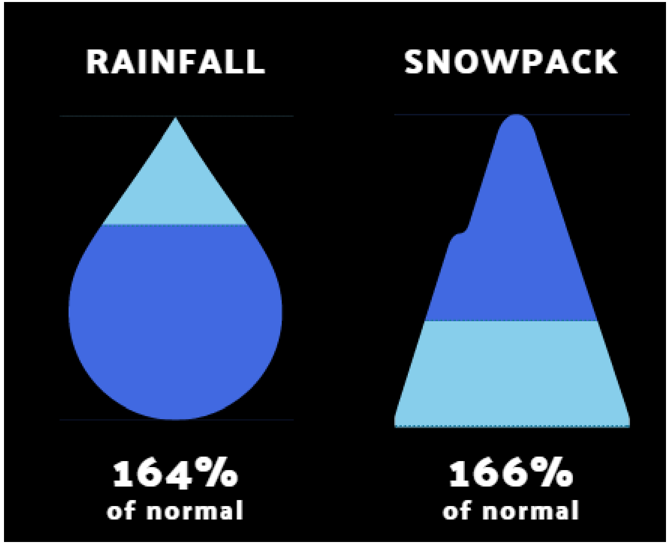
April 4, 2016

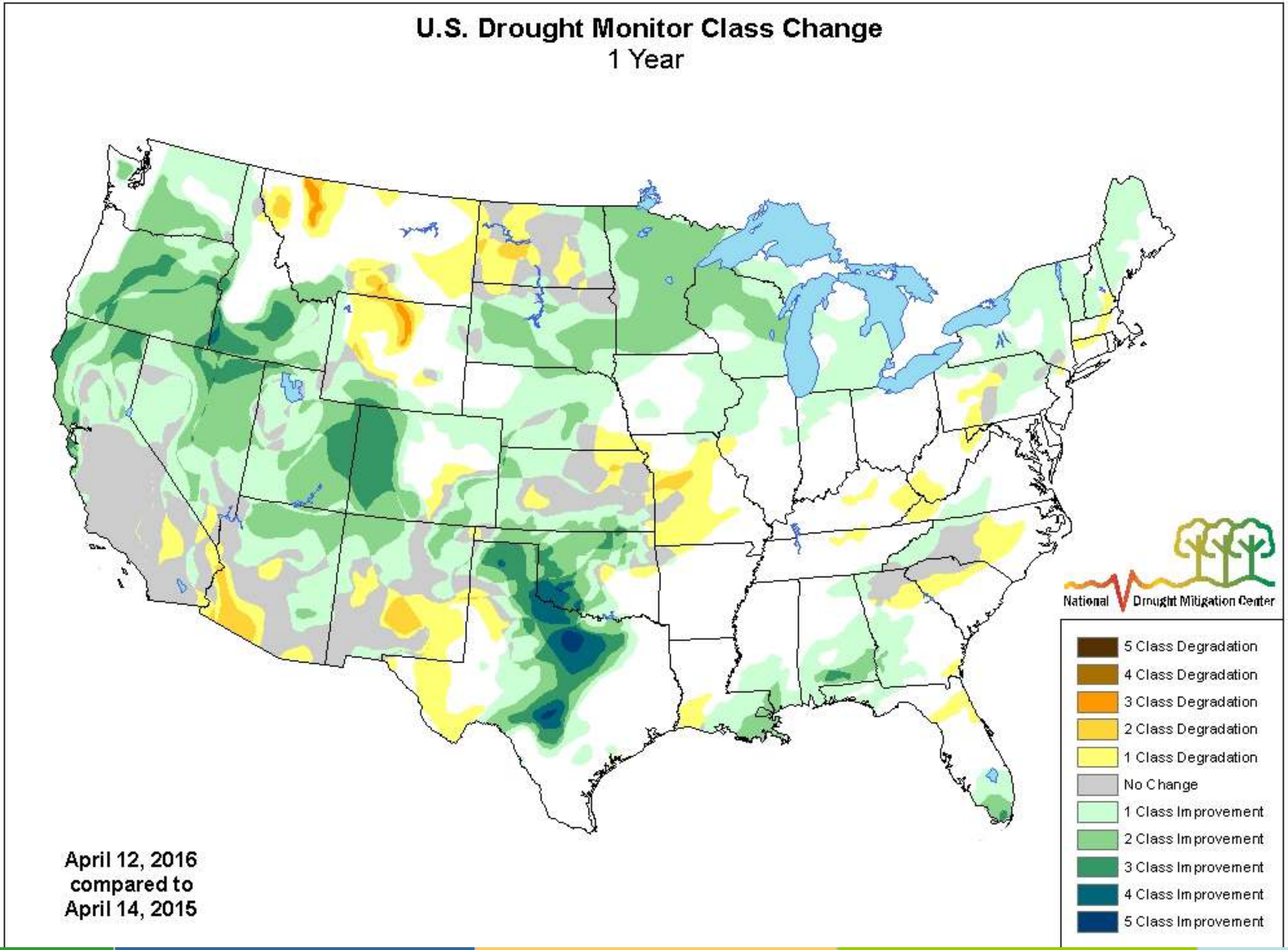

RAINFALL
SNOWPACK
108%
of normal
91%
of normal

April 14, 2015



1997-1998 El Nino





U.S. Drought Monitor Class Change
1 Year
National Drought Mitigation Center
5 Class Degradation
4 Class Degradation
3 Class Degradation
2 Class Degradation
1 Class Degradation
No Change
1 Class Improvement
2 Class Improvement
3 Class Improvement
4 Class Improvement
5 Class Improvement
April 12, 2016
compared to
April 14, 2015

Fuse lit: April 1, 2015 – Executive Order on Drought from Governor Jerry Brown

2015: Updates to Model Water Efficient Landscape Ordinance Completed

2016: California Water Plan Updated


THIS AIN'T
CALIFORNIA

Who is driving the future?

Market Trends

- Native-type landscapes that won’t require irrigation.
- Minimal turf grass areas.
- No potable water for irrigation.

Voluntary

- BMPs
- Standards
- Green Initiatives
- Consumer Expectations

Mandatory

- Ordinances
- Codes
- Regulations

Irrigation BMPs

BMP & Practice Guidelines

Design

Installation

Management

Appendices

Inspection & Commissioning

Water Budgeting

Scheduling

IRRIGATION ASSOCIATION & AMERICAN SOCIETY OF IRRIGATION CONSULTANTS

Landscape Irrigation Best Management Practices

May 2014

Prepared by the Irrigation Association and American Society of Irrigation Consultants

Chairman: John W. Ossa, CID, CLIA, *Irrigation Essentials, Mill Valley, California*

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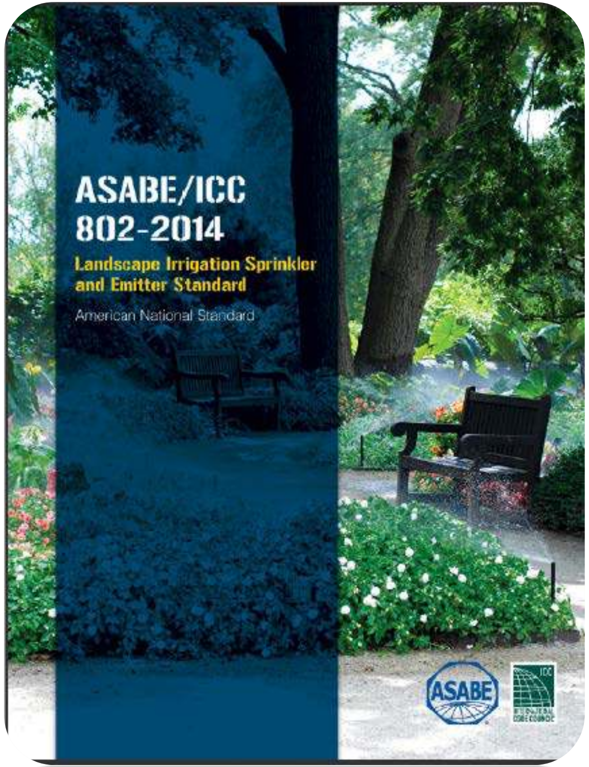
The Irrigation Association and the American Society of Irrigation Consultants have developed the *Landscape Irrigation Best Management Practices* for landscape and irrigation professionals and policy makers who must preserve and extend the water supply while protecting water quality. The BMPs will aid key stakeholders (policy makers, water purveyors, designers, installation and maintenance contractors, and consumers) to develop and implement appropriate codes and standards for effective water stewardship in the landscape.



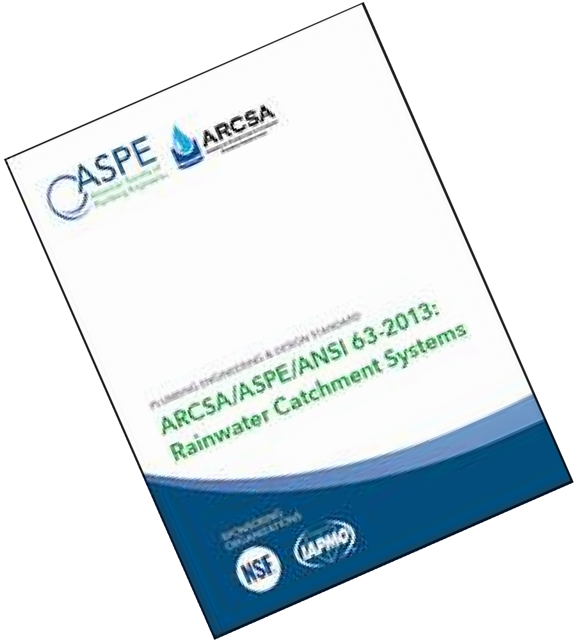
Tests—Sprinklers & Bubblers

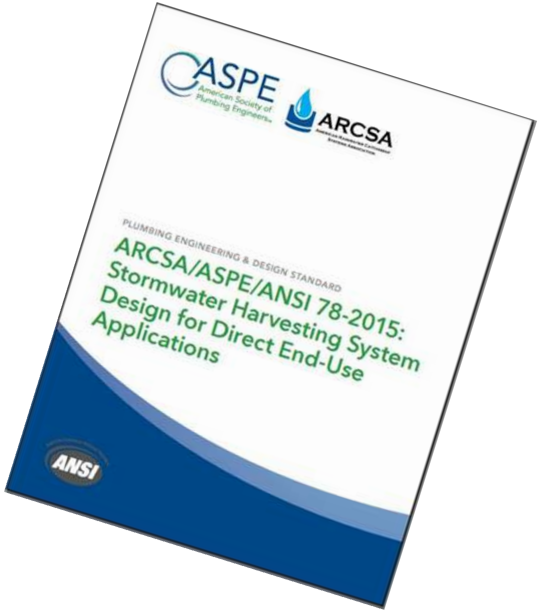
- Flow Rate
- Distance of Throw
- Distribution Uniformity
- Burst Pressure
- Check Valve
- Pressure Regulation

Tests—Emitters and Microsprays

- Uniformity of flow rate
- Flow rate as a function of pressure
- Emitter exponent for PC emission devices
- Check valve function

ANSI/ASABE S623
Determining Landscape Plant Water Demands





Standards in Progress

- ASABE S626 20__ **Landscape Irrigation System Uniformity and Application Rate Testing**
- ASABE S627 20__ **Weather-based Landscape Irrigation Control Systems**
- Both are out for public comment to ASABE
- ASABE S633 draft **Soil Moisture Sensor for Landscape Irrigation** in beta testing

Codes

- Shift to write standards in mandatory language.
- Adopted by code setting bodies or rating systems
- ICC, IAPMO, CalGreen

Observation

- Efficiency = reduction or elimination
- Assumes no benefit comes from plants
- Natives are superior
- No points for superior irrigation systems
- No follow up to the water budget

Strategy

- Use of BMP document
- IA has written a model landscape irrigation ordinance
  - Works with existing landscape ordinances
  - Modify for local circumstances
- Separate landscape issues from irrigation issues

Irrigation ASSOCIATION™

Irrigation Association - Th | Model Irrigation Ordinanc

www.irrigation.org/modelordinance.aspx

Apps For quick access, place your bookmarks here on the bookmarks bar. Import bookmarks now...

Water resources are increasingly targets of legislation and regulation. IA provides a powerful ally to represent and protect your interests, nationally and locally.

Home > Policy > Public Policy Issues > Model Irrigation Ordinance

POLICY

- Grassroots Advocacy
- State Legislative Tracking
- Legislative Coordinators
- Position Statements
- Public Policy Issues
  - California Drought
  - Clean Water Act
  - Farm Bill
  - Product Labeling
  - Research
  - Restrictions & Regulations
  - WaterSense
  - Model Irrigation

Public Policy Issues

Model Irrigation Ordinance

Version 1.0 of the model irrigation ordinance, released on October 5, 2015, provides design parameters for new landscape irrigation systems and guidelines for existing irrigation systems. The ordinance works in conjunction with established landscape codes/ordinances and can be modified to meet local needs. In addition to the model irrigation ordinance, sample reports and checklists are available below.

- Model Irrigation Ordinance
- Irrigation Inspection Affidavit
- Example Irrigation Plan Checklist
- Certifier Report

If you have questions, please contact IA Government and Public Affairs Director John Farner at johnfarner@irrigation.org or IA Senior Policy and Advocacy Manager Elizabeth McCartney at elizabethmccartney@irrigation.org

§ 4.0 Irrigation Design Plan.

(a) This section applies to landscaped areas requiring permanent irrigation. For the efficient use of water, an irrigation system shall be planned and designed according to the most current version of the *Landscape Irrigation Best Management Practices*, by the Irrigation Association and the American Society of Irrigation Consultants.

(b) An irrigation design plan meeting the following design criteria shall be submitted for review and approval by the jurisdiction having authority and a permit issued if required.

(1) Plan requirements:

(a) The irrigation design plan, at a minimum, shall contain:

(1) a scaled plan showing property lines, easements, existing or proposed structures, impervious surfaces, and existing natural features and if a new landscape project then consistent with the approved landscape plan;

(2) location and size of the point of connection to the water supply and meter locations along with static water pressure at the point of connection to the water supply and dynamic water pressure for proper system operation;

(3) reclaimed/recycled water or alternative water sources such as gray water shall comply with local plumbing codes including marking of pipes and system components;

(4) location, type and size of all components of the irrigation system, including, backflow preventer, smart irrigation controllers, main and lateral lines, manual valves, remote control valves, sprinkler heads, moisture sensing devices, rain switches, quick couplers, pressure regulators;

(5) an irrigation legend showing the identification of irrigation components;

(6) flow rate (gallons per minute), application rate (inches per hour), and design operating pressure (pressure per square inch) for each irrigation zone;

(7) installation details for each of the irrigation components.

(b) Designer statements and signature:

(1) the following statement: "I have complied with the criteria of the ordinance and applied them accordingly for the efficient use of water in the irrigation design plan"; and

(2) the signature of a qualified irrigation professional such as licensed landscape architect with irrigation credentials, certified irrigation designer, licensed/certified landscape contractor, or any other person authorized to design an irrigation system within the jurisdiction.

(2) Irrigation system requirements:

(a) Backflow prevention devices shall be required to protect the potable water supply from contamination by the irrigation system and comply with local plumbing codes.

(b) Manual shut-off valves (such as a gate valve, ball valve, or butterfly valve) shall be required, as close as possible to the point of connection of the water supply and to

Concern

- Lack of understanding that plants provide and create ecosystem services that gets more valuable with time.
- Benefits are enhanced with actively growing plants—they need water.

Support of the initiative…

Authorization – Congressional (in)Action

Products

- Sprinklers
- Soil moisture- based irrigation controllers

Incentives

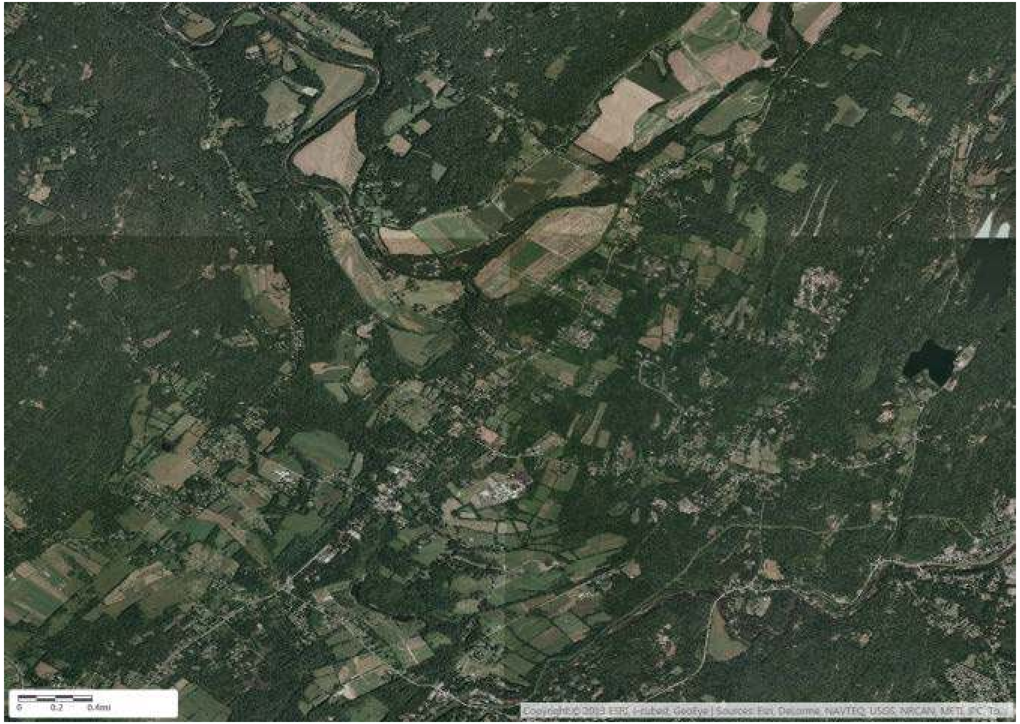
- State incentives and federal tax exemption

Interpretations of Clean Water Rule by the EPA and Opposing Groups

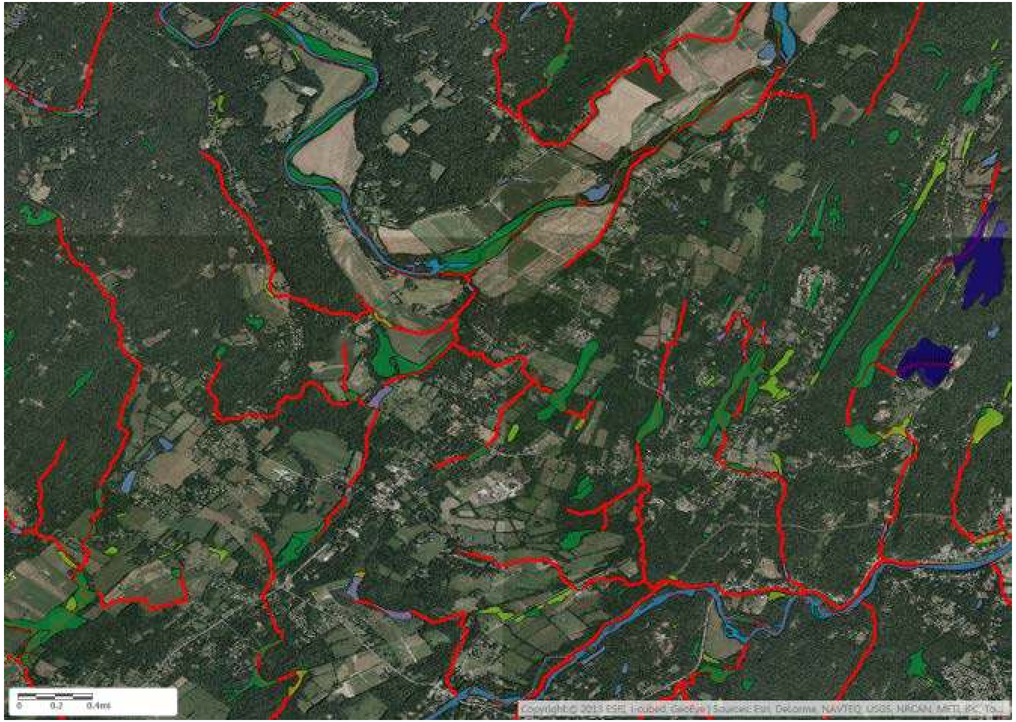
Role	EPA Interpretation	Opposing Groups Interpretation	Takeaway
Purpose of Rule	Clarifies which waters fall under Clean Water Act (CWA) jurisdiction by adding site-specific information to definitions; for example, seasonal streams are defined as sites that have water beds, banks, and high water marks	Expands CWA jurisdiction over waters by adding site-specific information to definitions; for example, seasonal streams are defined as all sites with seasonal water flow	The EPA characterizes the CWA Rule as clarifying the CWA's jurisdiction, but many opposing groups characterize it as expanding the CWA's jurisdiction
Scope of Rule	Scope unchanged; rule merely clarifies definitions of waterways already under CWA jurisdiction	Scope increases; rule would subject 3% more of U.S. waters to CWA jurisdiction	Many groups are debating the CWA's scope under the rule; the EPA maintains the rule will not expand CWA jurisdiction, but opposing groups fear the rule will bring more waters under CWA authority
Rule's Impact on Private Sector	Minimal impact; for example, rule identifies 50 agriculture conservation practices that will not be subject to clean water dredge and fill permitting requirements	Major impact; for example, rule expands CWA jurisdiction to ephemeral waters often found on agricultural and industrial sites	Most private sector groups expect increased compliance costs under the rule

“Waters of the U.S.” in New York Farmland

Maps by Geosyntec
Analysis by American Farm Bureau Federation

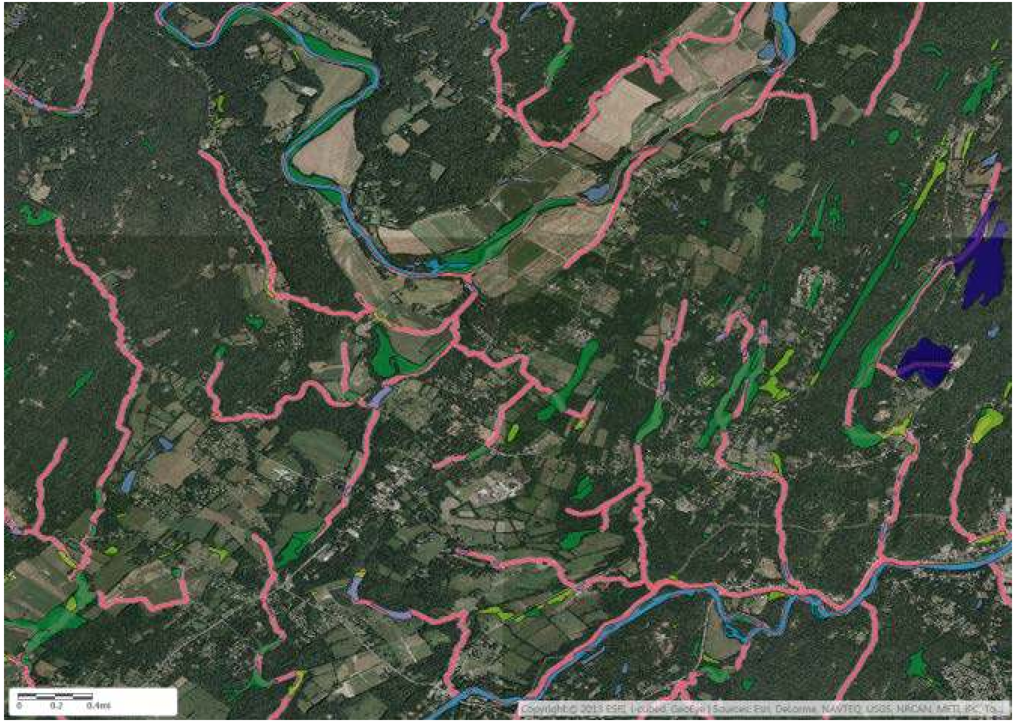


Area of focus is near Hurley, New York in Ulster County.



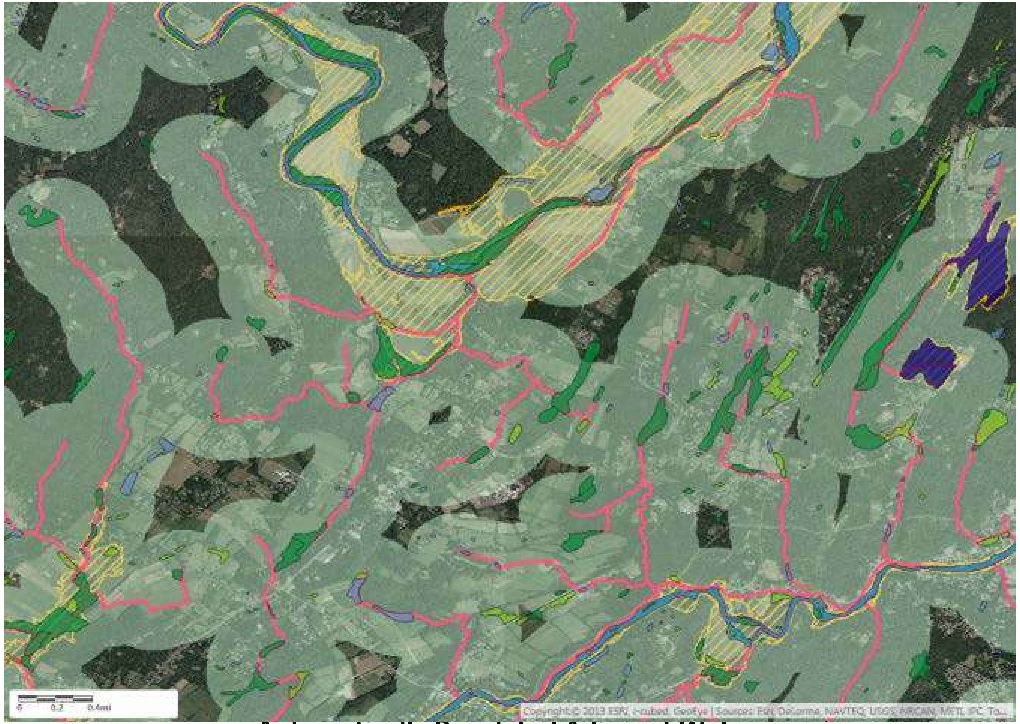
Automatically Regulated “Tributaries”

<u>Perennial, intermittent and **ephemeral** tributaries</u> and adjacent wetlands all deemed jurisdictional without further analysis. (Under prior rules, only perennial and intermittent tributaries were jurisdictional without case-by-case analysis.) Ditches also regulated if “excavated in” or “relocated” a tributary. This map does not show smaller ditches that may be jurisdictional. (Note: light blue shapes designate freshwater ponds, dark blue shapes designate lakes, aqua blue shapes designate riverine, green shapes designate wetlands.)



Automatically Regulated Adjacent Waters

Includes all “waters”—including wetlands—that lie even partially within a 100-foot buffer (pink shading) around all perennial, intermittent and ephemeral tributaries.

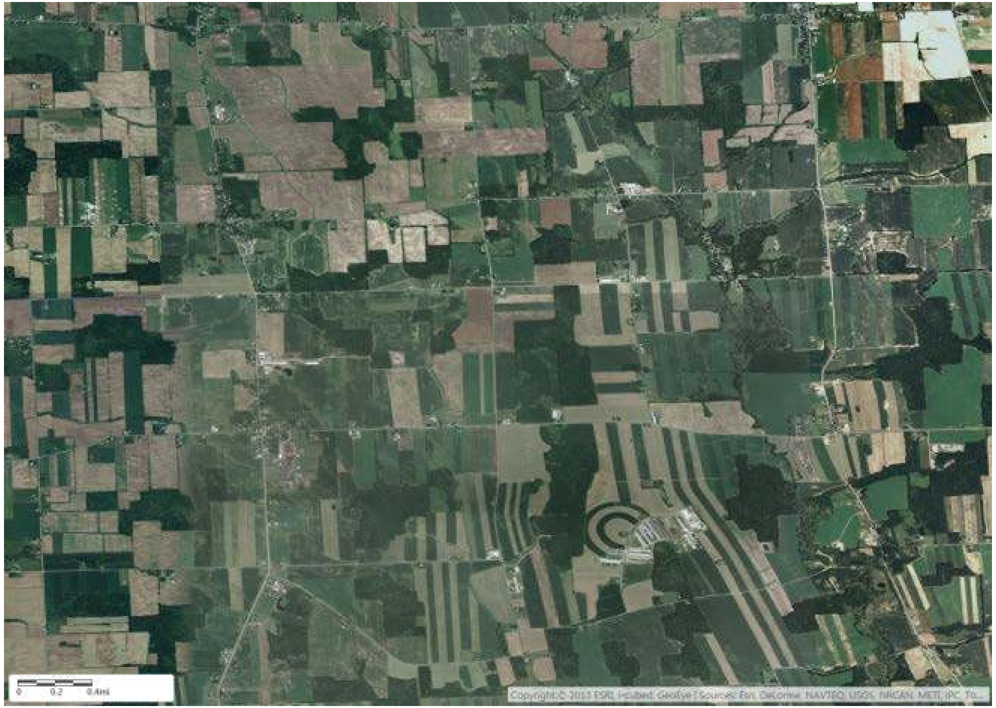


Automatically Regulated Adjacent Waters

Includes all "waters"—including wetlands—where <u>any part</u> is within the 100-year floodplain and not more than 1,500 feet from a tributary. Light green shading shows the 1,500-feet zone and hash marks show the known FEMA 100-year flood zone (which may be out-of-date or may not be relied upon by the Corps). **Absent definitive flood zone information from the Corps, any water partially within the light green shading is a possible "adjacent water."**

Maybe Regulated “Significant Nexus” Waters

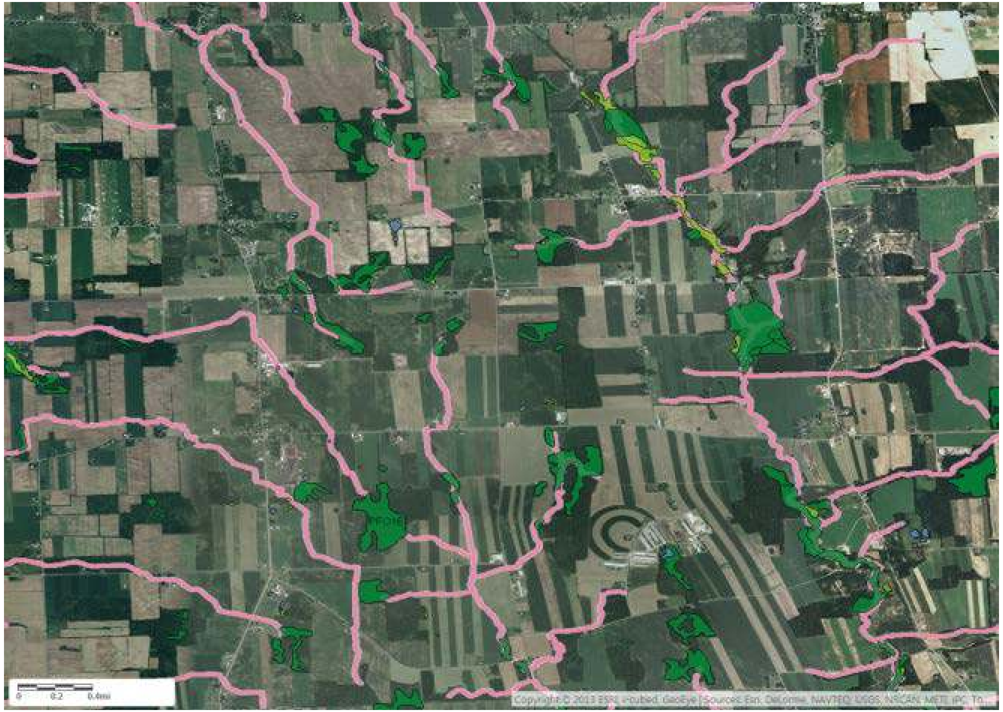
Water/wetlands even partially within 4,000 feet (about ¾ mile) of a tributary can be regulated on a “significant nexus” finding. Orange shading shows land outside the possible adjacency zone but within the 4,000 feet zone. **Even without mapping smaller jurisdictional ditches, the area of possible regulation covers the entire map.**



Area of focus is near Scipio, New York in Cayuga County.

Automatically Regulated "Tributaries"

<u>Perennial, intermittent and **ephemeral** tributaries</u> and adjacent wetlands all deemed jurisdictional without further analysis. (Under prior rules, only perennial and intermittent tributaries were jurisdictional without case-by-case analysis.) Ditches also regulated if "excavated in" or "relocated" a tributary. This map does not show smaller ditches that may be jurisdictional. (Note: light blue shapes designate freshwater ponds, green shapes designate wetlands.)



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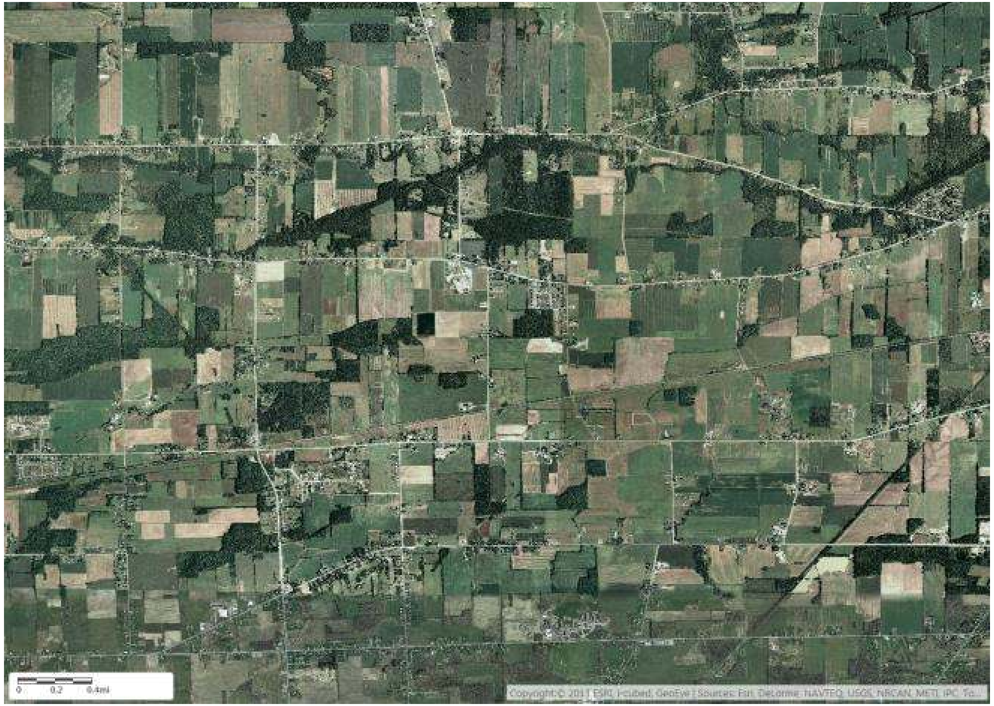
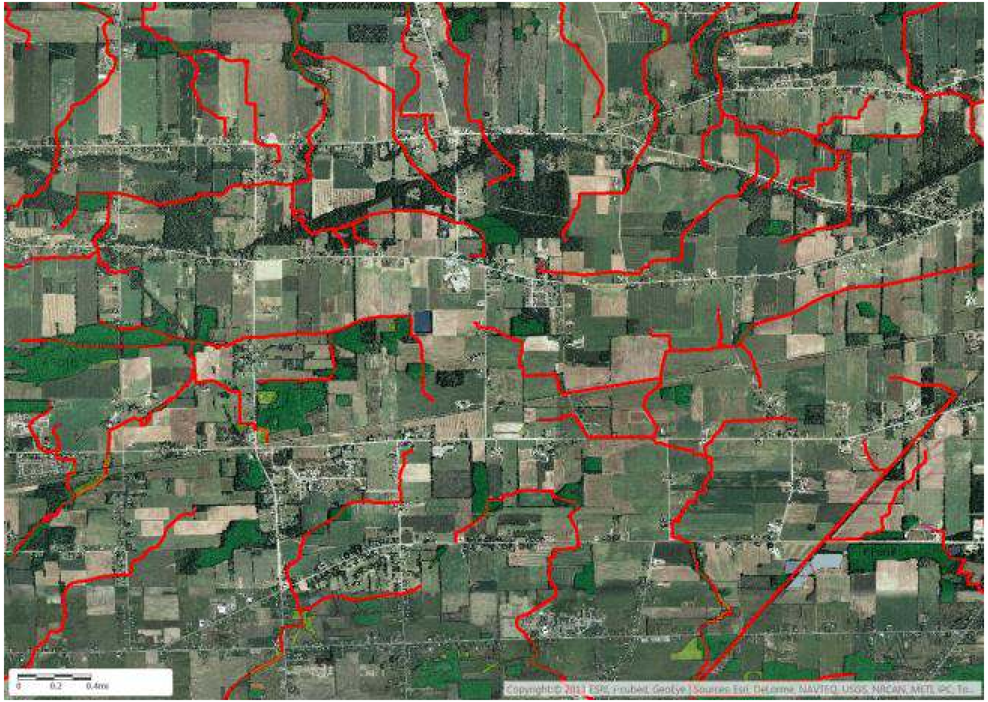
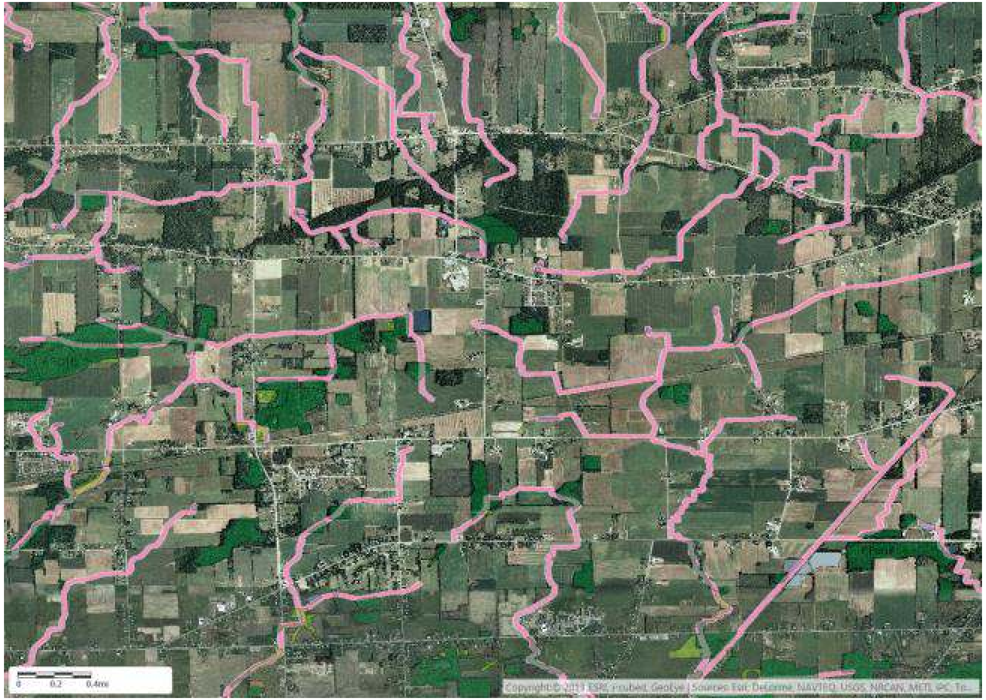


Area of focus is near Mapleton, New York in Niagara County.



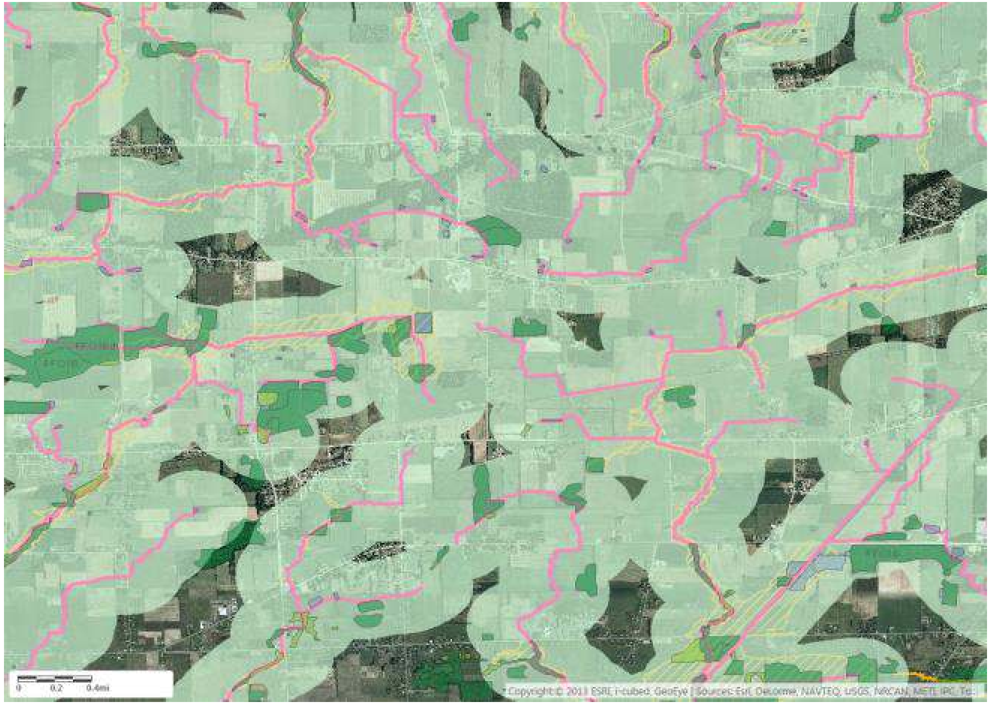
New WOTUS Rule – More Automatically Regulated “Tributaries”

<u>Perennial, intermittent and **ephemeral** tributaries</u> and adjacent wetlands all deemed jurisdictional without further analysis. (Under prior rules, only perennial and intermittent tributaries were jurisdictional without case-by-case analysis.) Ditches also regulated if “excavated in” or “relocated” a tributary. This map does not show smaller ditches that may be jurisdictional. (Note: light blue shapes designate freshwater ponds, green shapes designate wetlands.)



Automatically Regulated Adjacent Waters

Includes all “waters”—including wetlands—that lie even partially within a 100-foot buffer (pink shading) around all perennial, intermittent and ephemeral streams.



Automatically Regulated Adjacent Waters

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Water/wetlands even partially within 4,000 feet (about ¾ mile) of a tributary can be regulated on a "significant nexus" finding. Orange shading shows land outside the possible adjacency zone but within the 4,000 feet zone.

Even without mapping around all jurisdictional ditches, the area of possible regulation covers the entire map.

The scope of the final rule's impact in the focus area is similar to the rest of the state

What Activities May Trigger CWA Liability and Permit Requirements?

- The application from a mechanical applicator (sprayer/spreader/nozzle) of any "pollutant" *in any amount* into a WOTUS requires a section 402 NPDES permit issued by state regulatory agencies or directly from EPA. A permit is required even if the WOTUS is dry at the time of application. Pollutants include, among other things:
  - chemical or biological pesticides (herbicides, insecticides, fungicides and coated seeds)
  - fertilizers (nitrogen, phosphorus, potassium and micro nutrient)
  - manure and manure products (including compost)
- A discharge of "dredged or fill material" can occur as a result of farming or ranching activities that involve moving dirt in a WOTUS. These discharges require a section 404 "dredge and fill" permit issued by the Corps of Engineers (again, even if the feature is dry at the time)—unless the activity qualifies for an exemption explained below. Possibly regulated activities include:
  - manipulating the soil on a field, such as grading, laser leveling, terracing, plowing, deep ripping, etc.;
  - construction and maintenance of roads, fences, ditches, ponds and culverts.
- Congress established several exemptions from the section 404 "dredge and fill" permit requirement. Under these exemptions, farmers and ranchers may not need a permit for plowing, seeding, cultivating, and harvesting (defined as "normal" farming practices), or for certain other activities like minor drainage, upland soil and water conservation practices, drainage ditch maintenance, construction and maintenance of irrigation ditches, farm/stock ponds, farm/forest roads and maintenance of levees/dams.

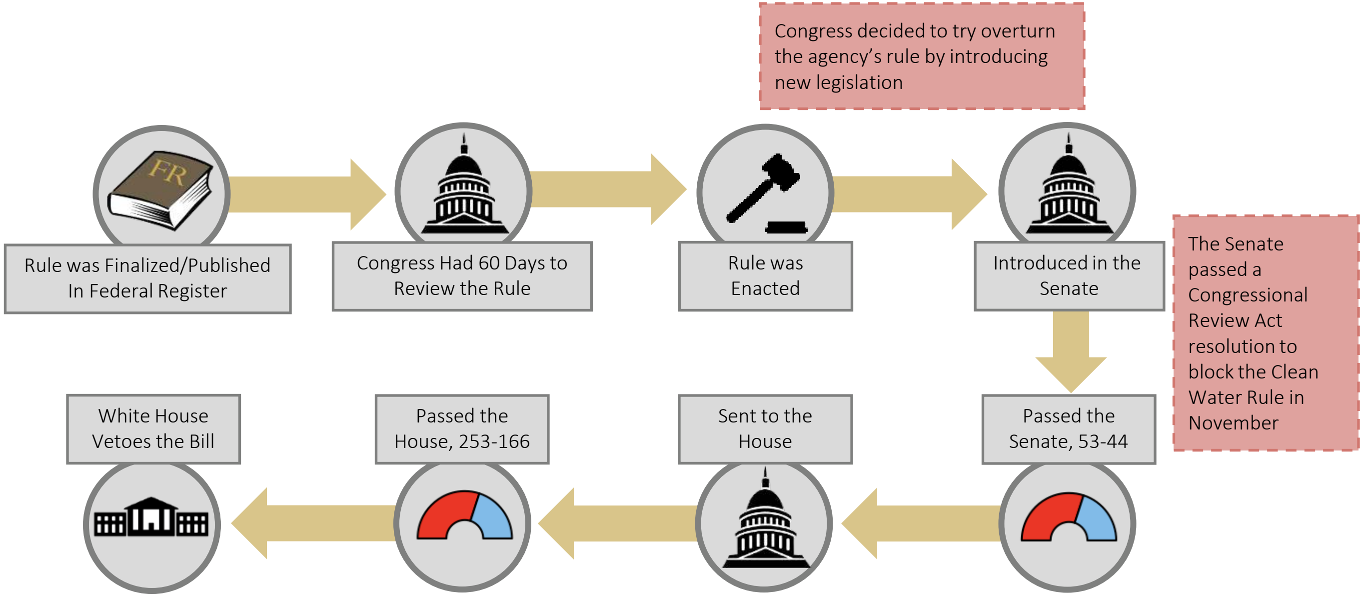
  It is very important to understand that the Corps of Engineers has interpreted these exemptions *very narrowly* and its interpretations will generally be controlling in any enforcement action. As a result, many common farming practices that involve moving dirt in a WOTUS will NOT qualify for an exemption and will trigger a need for a 404 permit.

"Waters of the U.S." Zones in New York

New York	Acres	Share of Total Acres
Total Acres in State	31,079,144	
Total Acres w/i 4,000-foot buffer	30,458,484	98%
Total Acres w/i 1,500-foot buffer	24,225,363	78%
Total Acres w/i 100-foot buffer	2,317,069	7%

President Obama Vetoes Congress' Attempt to Kill the Clean Water Rule

Steps for "Waters of the United States" Rule Submitted by the Environmental Protection Agency and the Corps of Engineers



Source: Devin Henry, "House to Take Up Bill Blocking EPA Water Rule," The Hill, January 7, 2016; Timothy Cama, "House Votes to Overturn Obama's Water Rule," The Hill, January 13, 2016; Gregory Korte, "Obama Vetoes Attempt to Kill Clean Water Rule," USA Today, January 19, 2016.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AK

Realities

1) Policymakers' involvement in the landscape irrigation industry will increase, not decrease
2) Landscape water use will be reduced (mandated)
3) Potable water will not be the main source for irrigation water
4) Landscapes will not look the same 10 years from know as they do today
5) Our industry needs to partner with governments and other stakeholders to form sustainable solutions

Irrigation ASSOCIATION™

John Farner
Irrigation Association
Government and
Public Affairs Director
johnfarner@irrigation.org

Stacy Bonos

RUTGERS
New Jersey Agricultural Experiment Station

What's Happening in Turfgrass Research?

Stacy A. Bonos, Ph.D.

Dept of Plant Biology and Pathology

New Jersey Agricultural Experiment Station

2016 ASIC Northeast Regional Conference, April, 21, 2016

The Changing Climate

- Variable weather patterns
  - Higher temperatures and drought stress
  - Polar vortex during winters
- Results in additional stresses on turfgrasses including additional and more intense disease/insect outbreaks
- Need to develop turfgrasses that can tolerate these temperature extremes and related stresses


We're not raising grass -
We're raising families!
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A large tractor sprays toxic chemical pesticides on the grass
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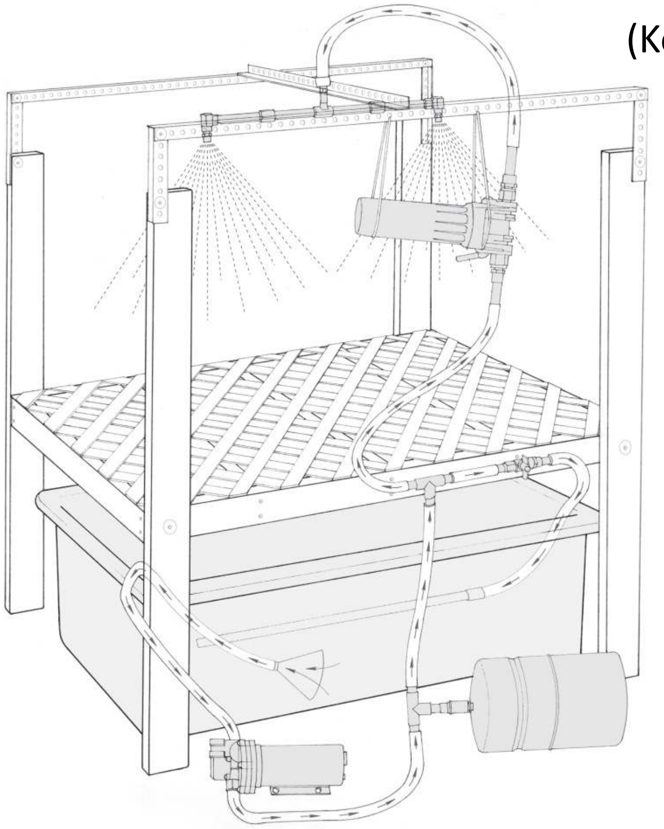
Turfgrass Breeding Objectives

- Drought
- Heat
- Diseases
- Salinity
- Low Maintenance

Breeding for Salt Tolerance

Greenhouse Screening Technique

(Koch and Bonos, Crop Sci. 2010)



Results

(10 weeks)

Treatment 1 (Control)

EC = 1

Treatment 4

EC = 15 dS/m

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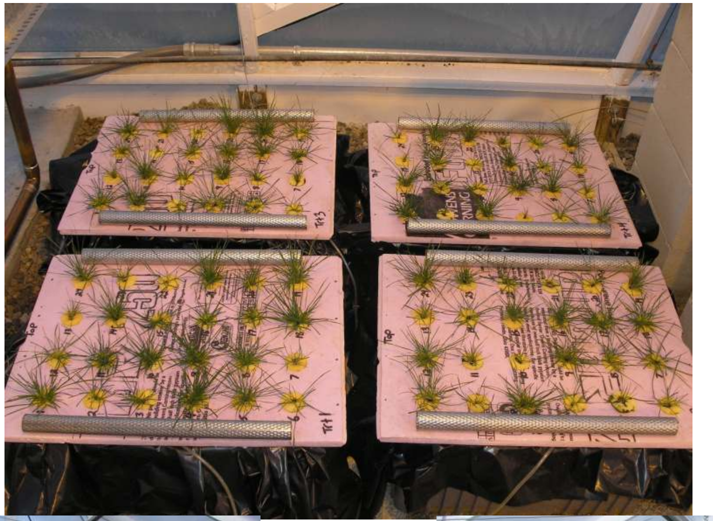
Experiment Station

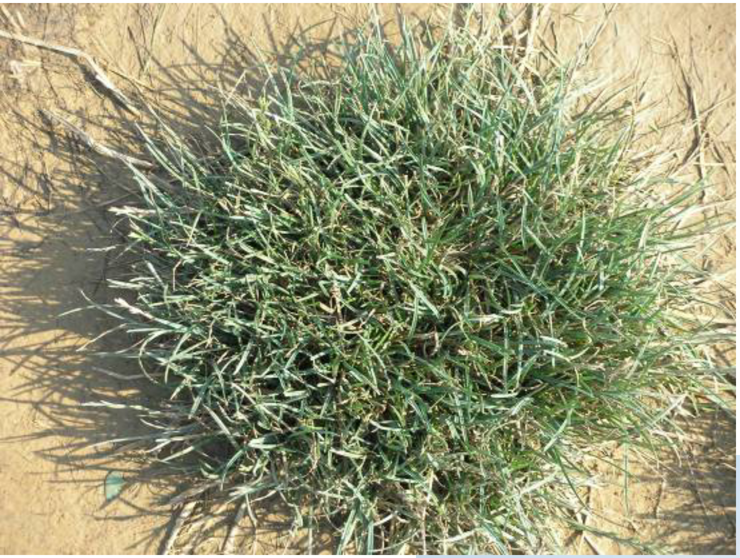
Hydroponic Greenhouse Method



Field Method

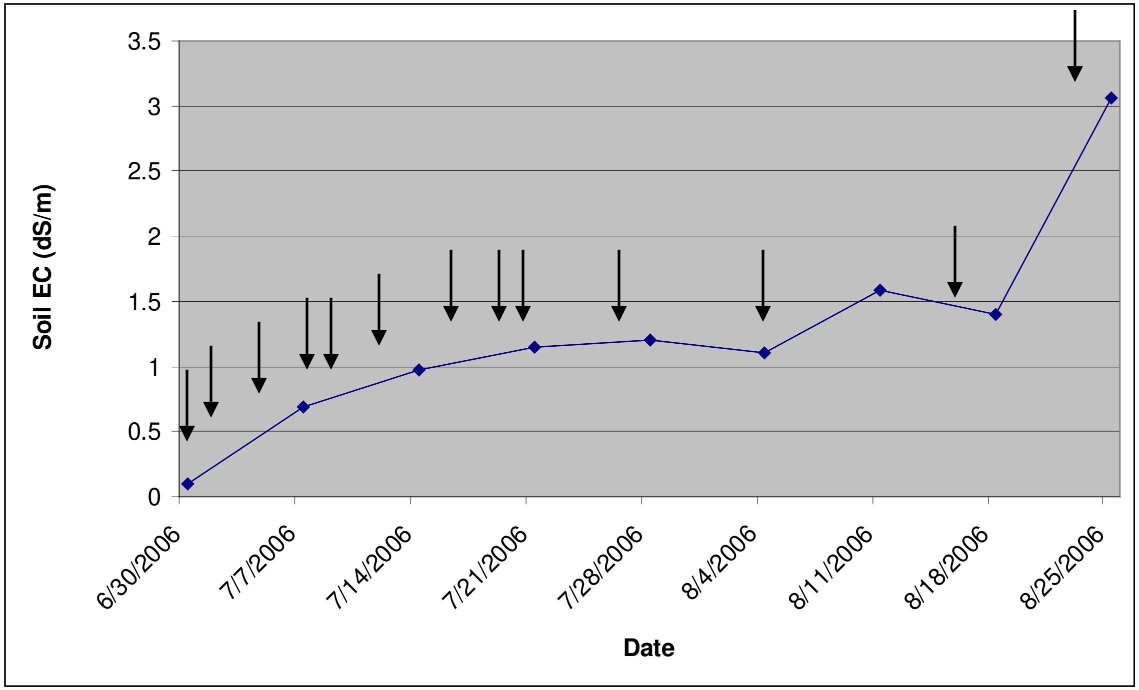
- Salt solution is made from NaCl and CaCl
- Solution: EC = 10 dS/m
- 0.125 gallons / plant
  - Flowmeter is used
  - 3 times / week
- Weekly soil tests
- % Green ratings (1-10 scale)

Salt Stress Injury



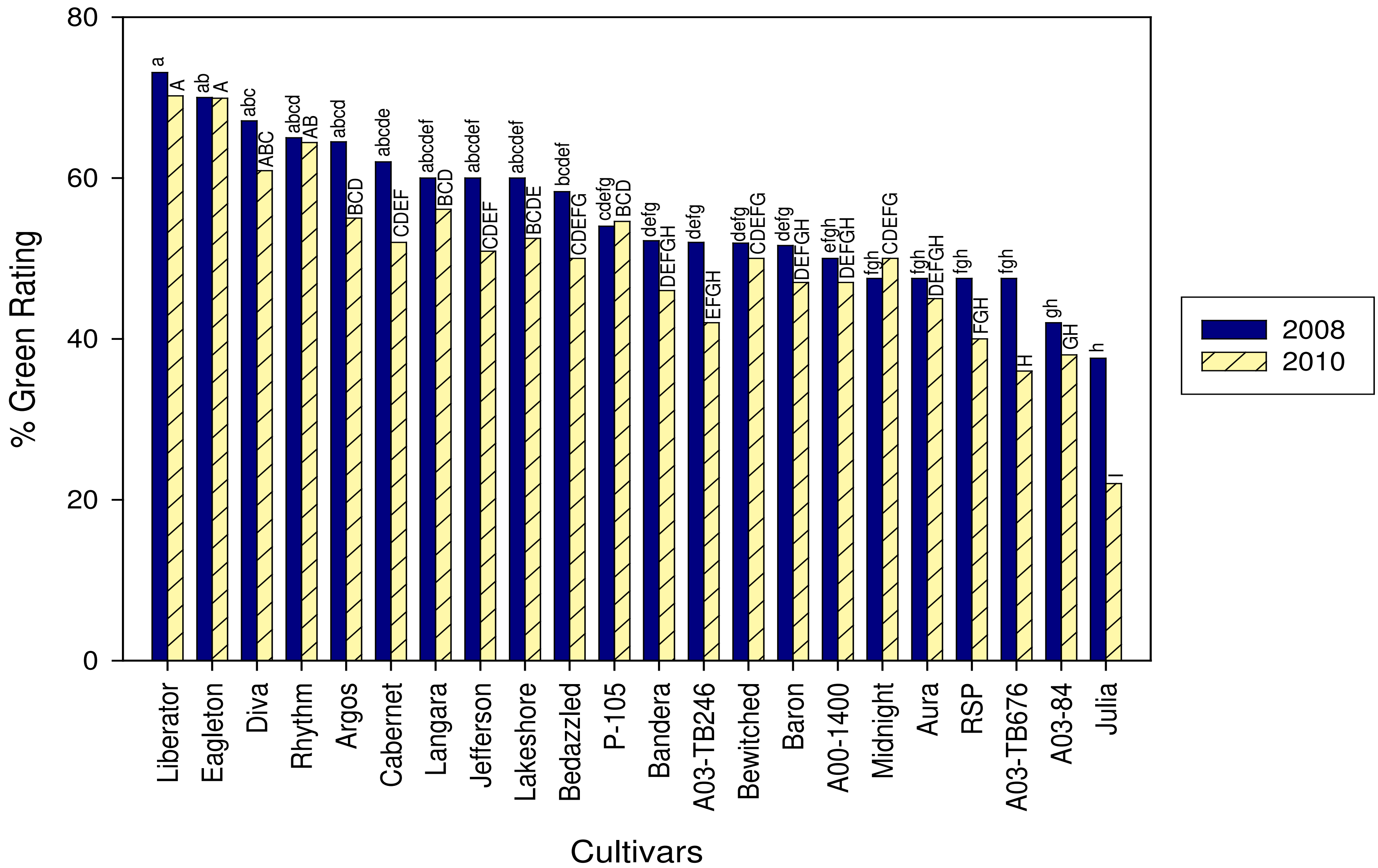

Spring 2006

Soil EC of Kentucky Bluegrass Treated with Salt Solution

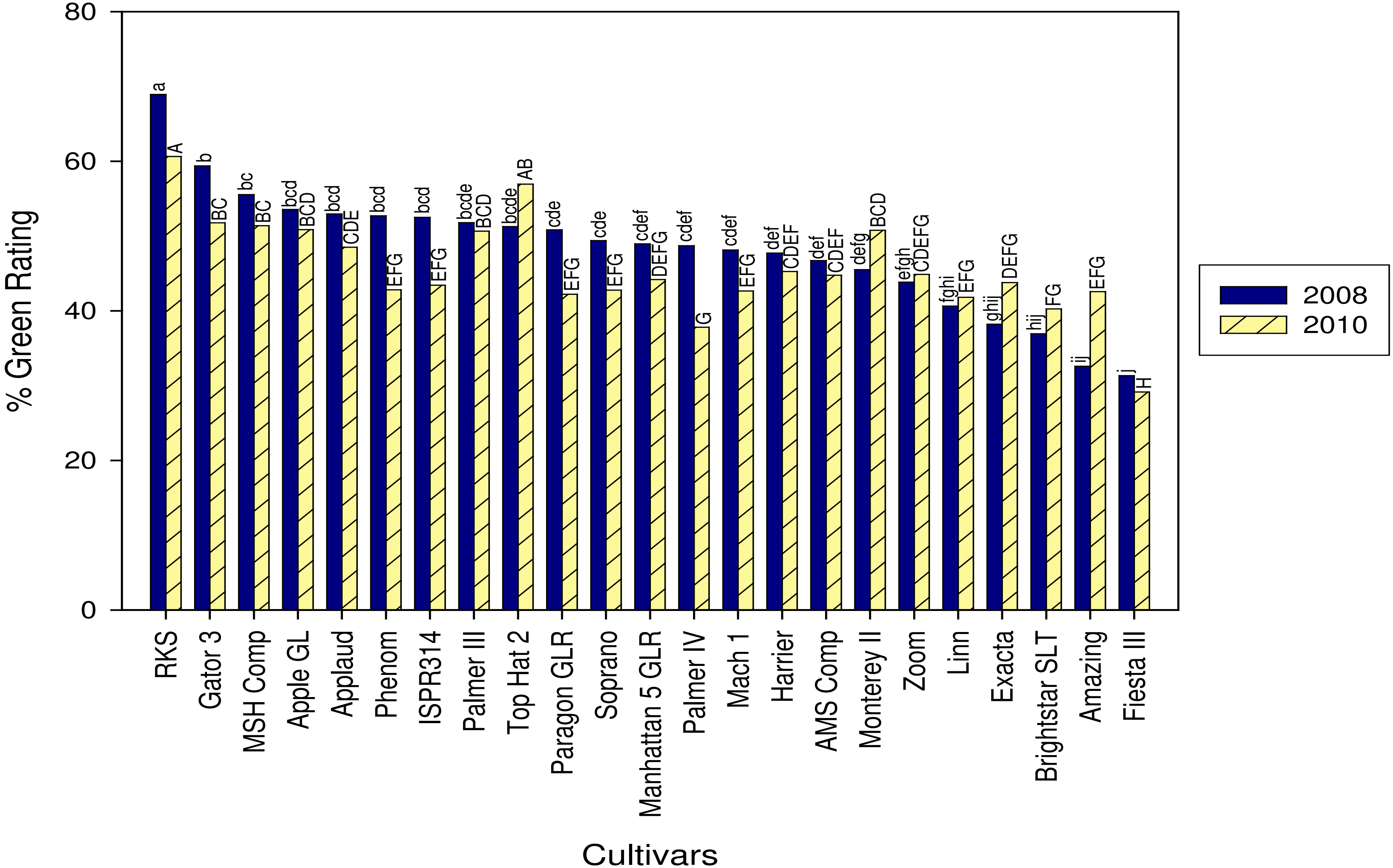


Field Screening of Kentucky Bluegrass for

Kentucky Bluegrass Cultivar Rankings

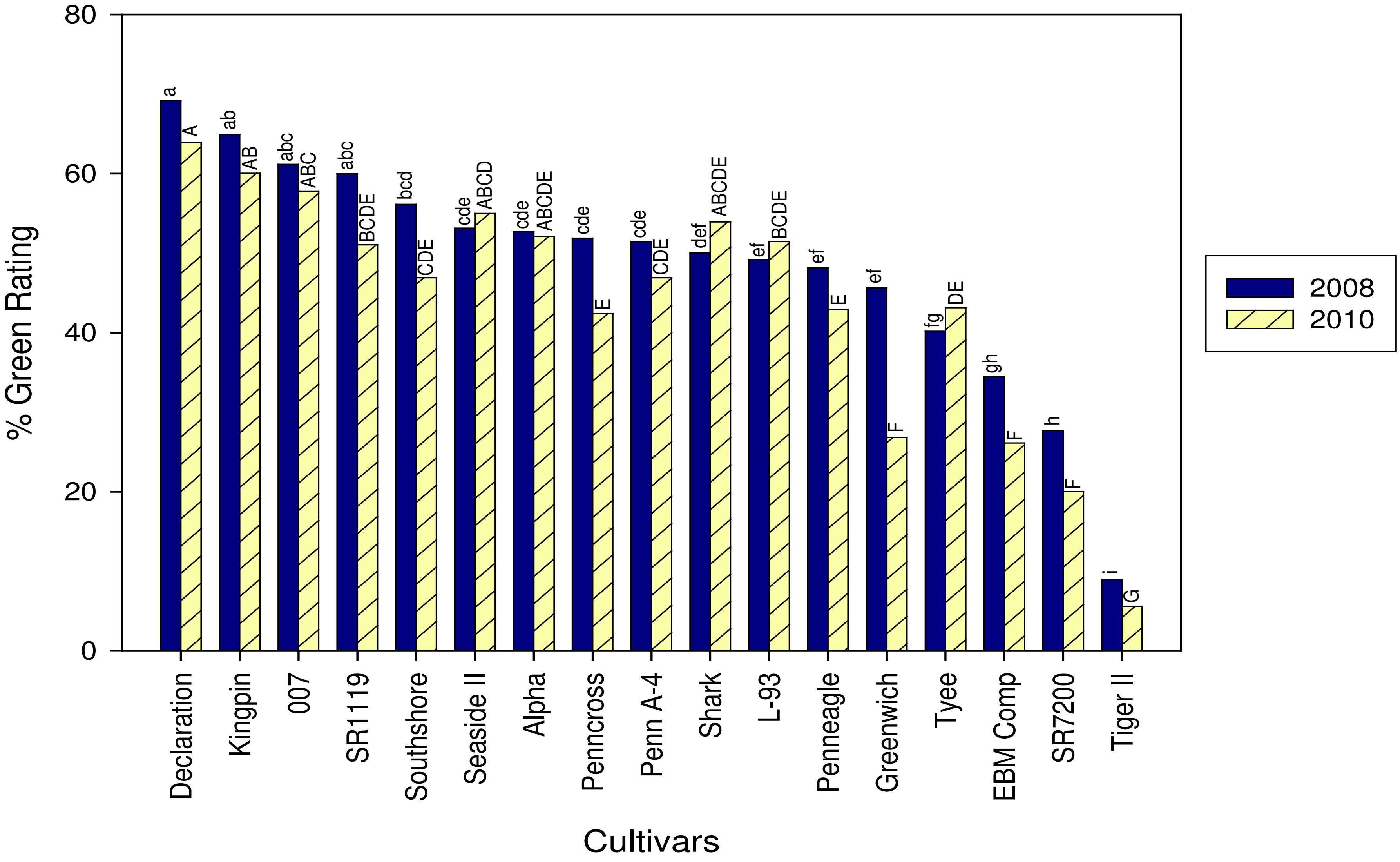


Perennial Ryegrass Cultivar Rankings

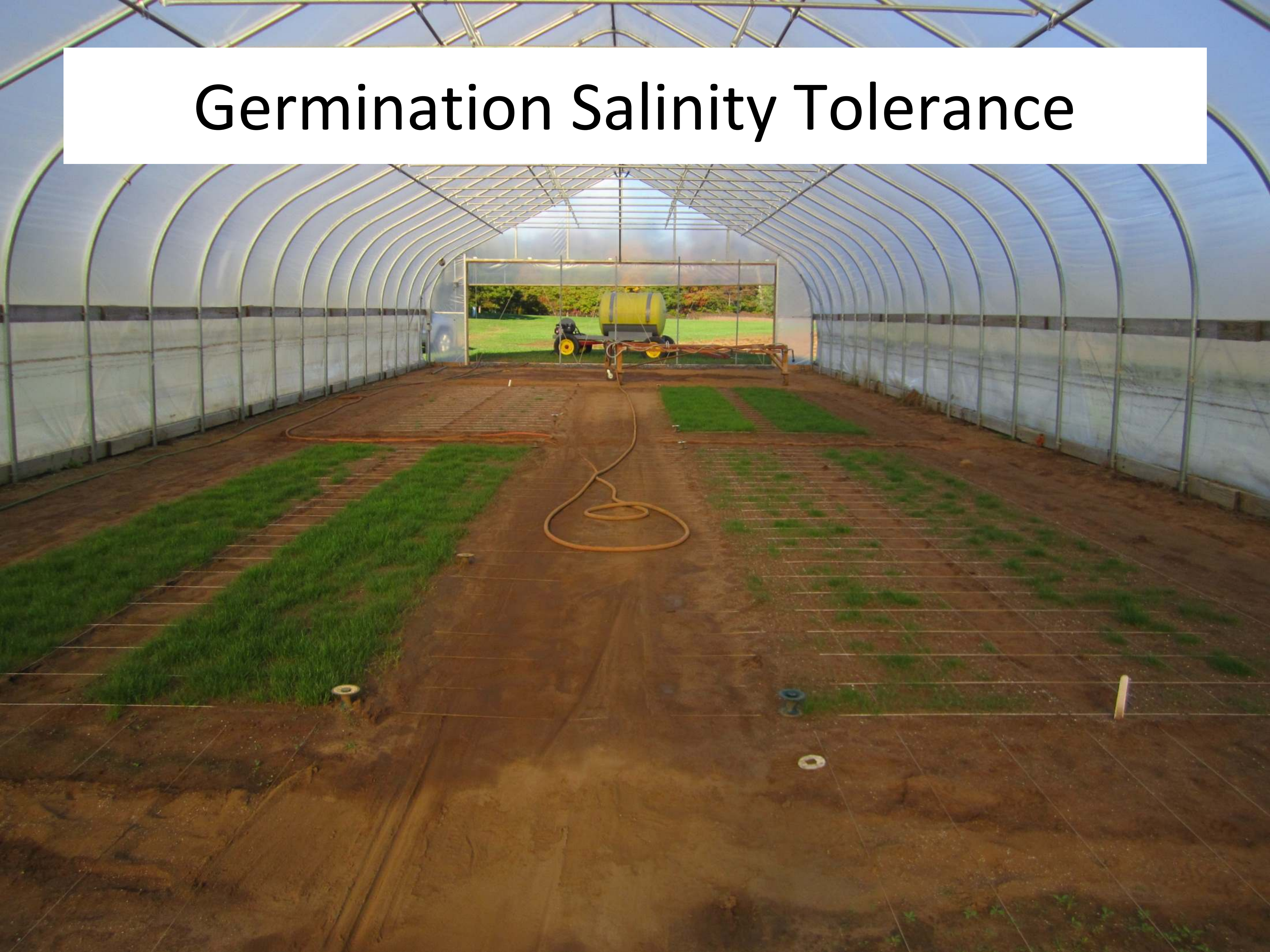


Salt Tolerance of Bentgrasses

Bentgrass Cultivar Rankings



Germination Salinity Tolerance



Germination Tolerance to Salinity

- Cultivars with quick germination also those that germinate quickly under salinity
- No cultivar by treatment interaction

Potential Grasses for Low Maintenance

Turfgrasses for Low Maintenance

- Kentucky bluegrass requires more fertility than other species - 1.5/ 2.0 lbs N/1000 each year
- Other species – fine fescues/tall fescues - 1.0 lb N/1000
- No fungicides
- No supplemental irrigation
- Mowed weekly with Toro Groundsmaster 2.5 inches

No Mow Hard Fescue

Hudson National golftripper.com

Hard Fescue – Drought Tolerant

Summer Patch of Hard Fescue

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New Jersey Agricultural
Experiment Station

Germplasm Improvement of Low-Input Fine Fescues in Response to Consumer Attitudes and Behaviors

USDA-NIFA , Specialty Crop Research Initiative
award number 2012-51181-19932.

Eric Watkins, Chengyan Yue, Kristen Nelson, Brian Horgan

University of Minnesota

Paul Koch, *University of Wisconsin*

Stacy Bonos, William Meyer, James Murphy, Bruce Clarke, Bingru Huang

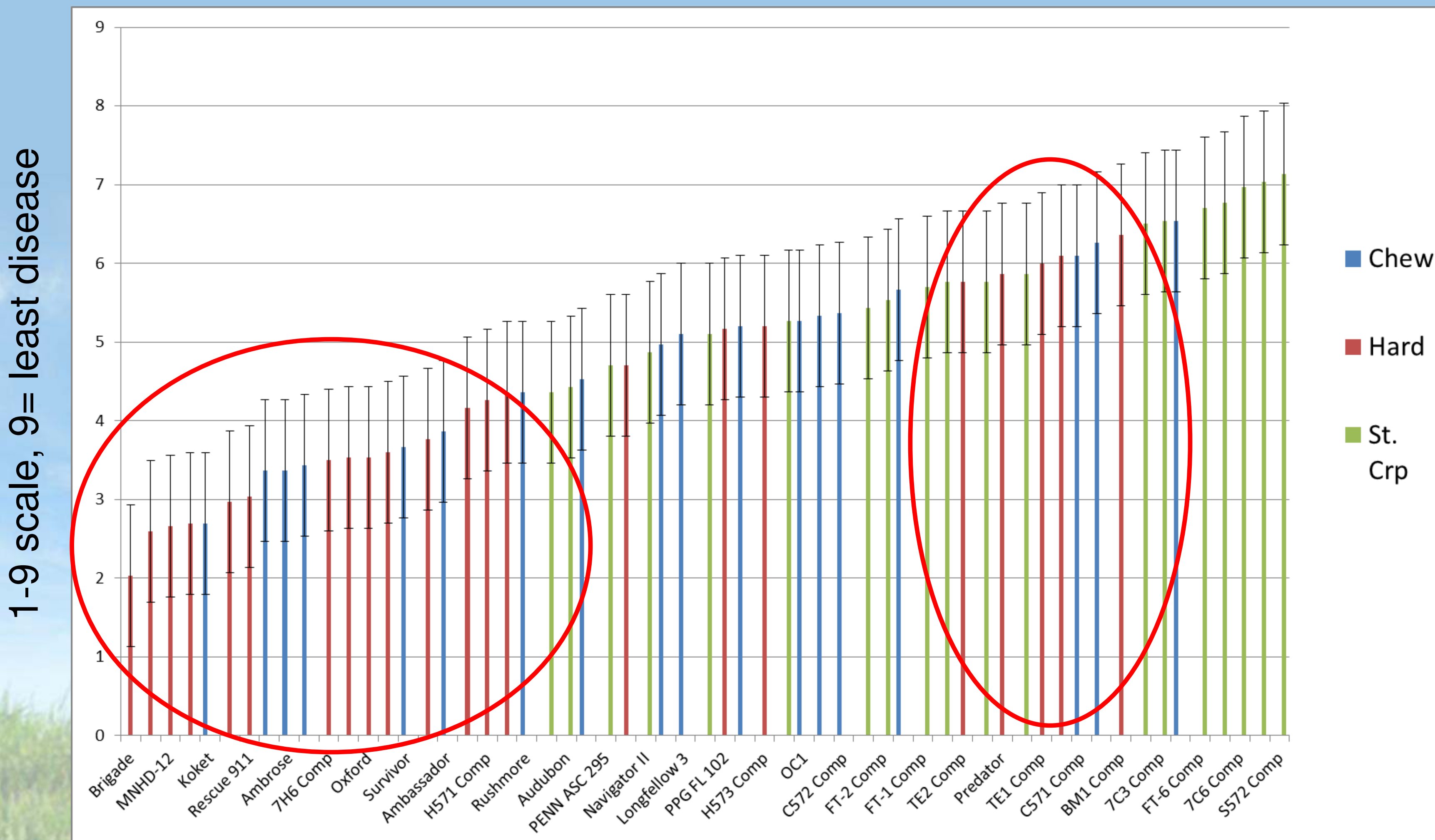
Rutgers University

RUTGERS
New Jersey Agricultural
Experiment Station

Germplasm Improvement of Low-Input Fine Fescues in Response to Consumer Attitudes and Behaviors.

- Collaborative Project - Univ. of Minn, Rutgers, Univ. of Wisc.
- Breeding and evaluation of fine fescues for improved quality, disease resistance, heat and drought tolerance, wear tolerance
- Marketing, Social and Extension Components

Fine Fescue Turf Quality in Presence of Summer Patch Disease



Tiller Plots

Spaced-plant nurseries inoculated with summer patch disease

Diallel Crossing

 ×  = **RS**

 ×  = **RR**

 ×  = **SS**

Seedlings

Wear Tolerance of Fine Fescues

Low Maintenance Kentucky Bluegrass Test 2013

2013 Kentucky Bluegrass A-List

2014-15 Turf Quality Ratings

Rank	Entry	Turf Qty		Rank	Entry	Turf Qty
1.	A00-2882	6.4		14.	Merit	4.3
2.	Mercury	6.3		15.	Armada	4.3
3.	Bolt	6.2		16.	Rhythm	4.2
4.	LTP-A-03-38	6.0		17.	SR 2284	4.1
5.	Volt	6.0		18.	Baron	4.1
6.	Kenblue	5.7		19.	Raven	3.9
7.	Cabernet	5.4		20.	Zinfadel	3.9
8.	Langara	5.4		21.	Midnight	3.9
10.	Fielder	4.9		22.	Arrowhead	3.9
11.	Legend	4.9		23.	Fahrenheit 90	3.9
12.	Shiraz	4.8		24.	Bordeaux	3.8
13.	Bluenote	4.4		25.	LTP-A-08-6	3.4

Turf Quality rated on 1-9 scale, where 9 = best overall turf quality.
Data average of the 2014 and 2015 growing seasons. Lsd at 5% = 0.9

2013 Low Maintenance Kentucky Bluegrass
2014-15 Turf Quality Ratings – Top Performers

Rank	Entry	Turf Qty		Rank	Entry	Turf Qty
1.	PST-T10-18	6.7		11.	Pick 033	6.2
2.	A09-305	6.7		12.	Bluenote	6.1
3.	A07-783	6.6		13.	Juliet	6.1
4.	KB11-22	6.5		14.	A00-1400	6.0
5.	Avalanche	6.5		15.	PST-K8-88	6.0
6.	A04TB-7	6.5		16.	RAD-1409	5.9
7.	Touche	6.4		17.	Keeneland	5.9
8.	A07-782	6.3		18.	PST-K11-123	5.9
9.	Washington II	6.3		19.	4724-8	5.9
10.	Bolt	6.2		20.	A03-38	5.9

Turf Quality rated on 1-9 scale, where 9 = best overall turf quality.
Data average of the 2014 and 2015 growing seasons. Lsd at 5% = 0.9

2013 Low Maintenance Kentucky Bluegrass
2014-15 Drought Quality Ratings – Top Performers

Rank	Entry	Turf Qty		Rank	Entry	Turf Qty
1.	98-10 Purple	6.7		11.	KB11-47	5.7
2.	A09-305	6.7		12.	A05-930	5.7
3.	A07-783	6.2		13.	Legend	5.7
4.	A04TB-7	6.2		14.	A13-22	5.7
5.	A05-347	6.0		15.	103-585	5.5
6.	Fullback	6.0		16.	A08-2	5.3
7.	A07-782	6.0		17.	PST-K8-88	5.3
8.	Pick 033	5.8		18.	Keeneland	5.3
9.	KB11-28	5.8		19.	A98-233	5.3
10.	RAD-1409	5.8		20.	A13-1	5.3

Drought Quality rated on 1-9 scale, where 9 = best overall turf quality under drought conditions.
Data average of the 2014 and 2015 growing seasons. Lsd at 5% = 1.5

Selection of Kentucky Bluegrass for Deep Root Production

Mid-Atlantic types have deeper root production under high temperature stress

Mid-Atlantic Type - Cultivars

Aura
Bandera
Cabernet
Eagleton*
Fahrenheit 90
Longhorn
Spitfire
Starburst*

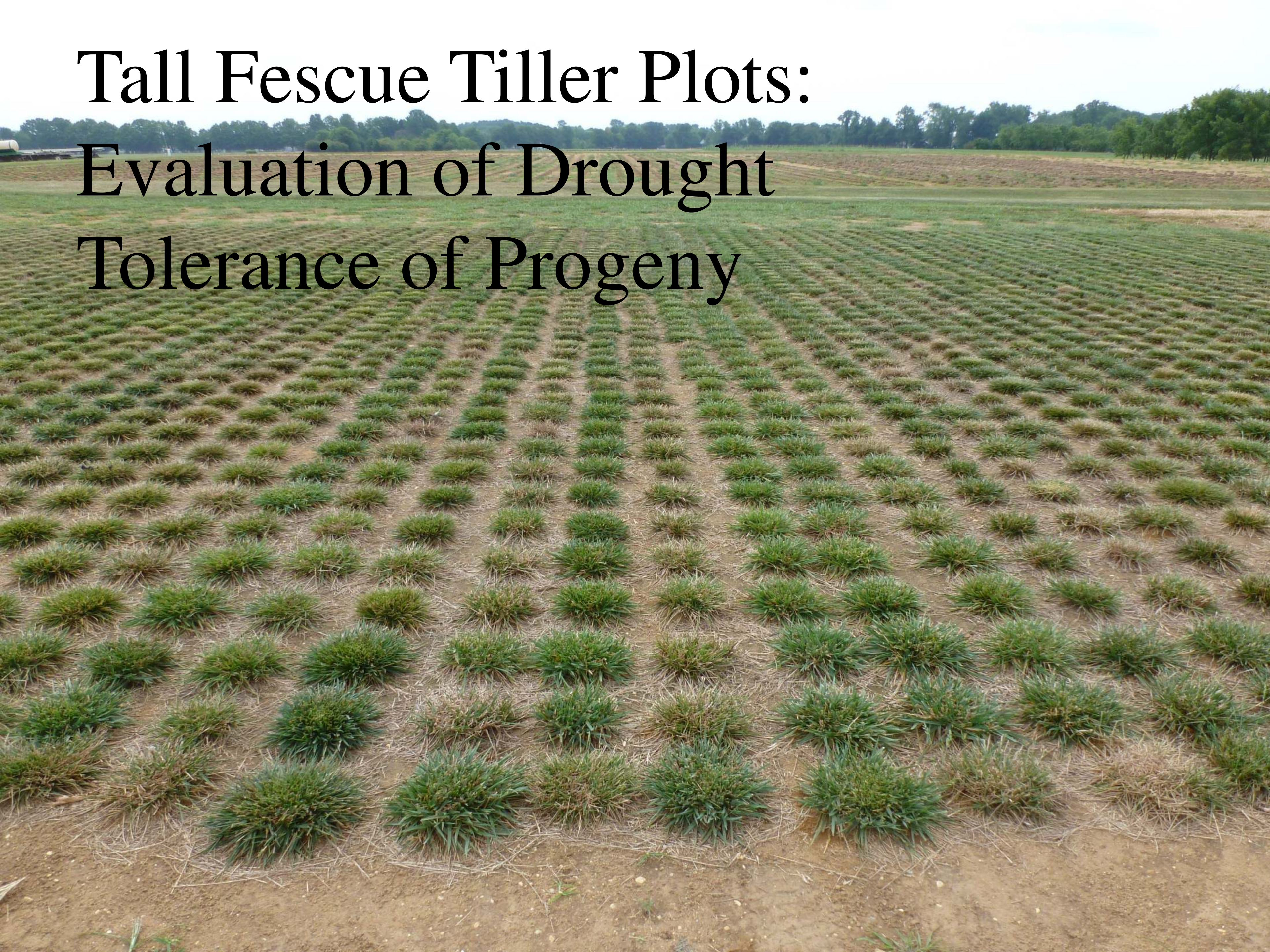
* Limited quantities available

Comparison of Tall Fescue and Kentucky Bluegrass

KB TF TF KB

Tall Fescue Drought/Heat Stress Injury - 2010

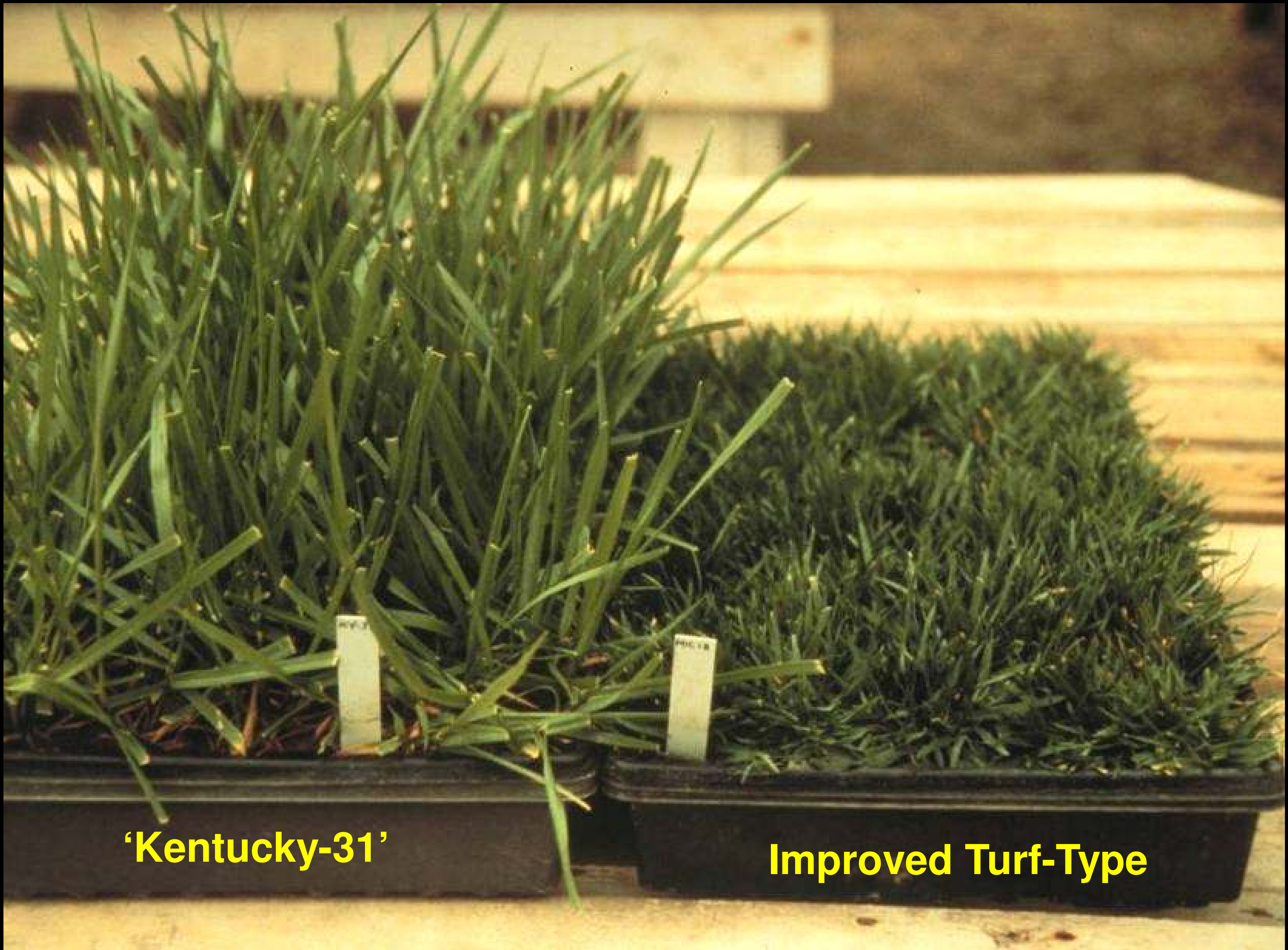
Tall Fescue Tiller Plots: Evaluation of Drought Tolerance of Progeny




Drought Tolerance Screening in Tall Fescue
Water withheld 75 days
(June-August)


Water withheld 75 days
(June-August) Tall Fescue
spaced plants

Improvements through breeding




black butte

Low Maintenance Mixture Trial – North Brunswick, NJ

- Mixtures bought from local stores
- Costume mixtures put together
- Tall fescue, Kentucky bluegrass (light or dark), hard fescue, strong creeping red fescue, Chewings, perennial ryegrass

2011 Turfgrass Mixture Trial

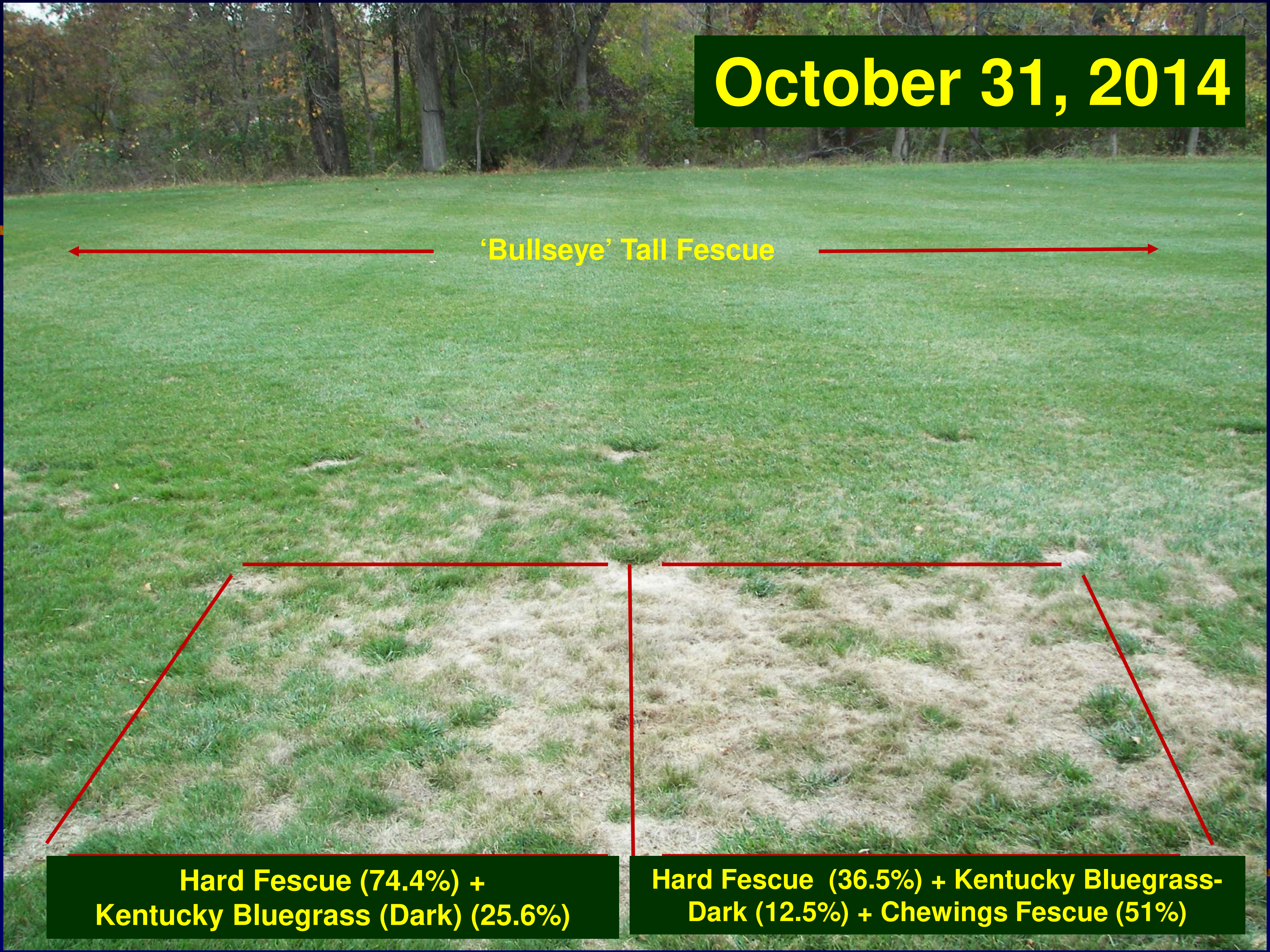
- Components of species blends were created using equivalent quantities by weight based on seed counts performed for each species
  - Tall fescue
    - Bullseye + Faith + Mustang 4 (33.3:33.3:33.3 %)
  - Hard fescue
    - Beacon + Firefly (50:50 %)
  - Kentucky bluegrass "Dark"
    - Midnight II + Bewitched (50:50 %)
  - Kentucky bluegrass "Light"
    - Bluenote + A05-361 (50:50 %)
  - Chewings fescue
    - Fairmont + Intrigue II (50:50 %)
  - Strong Creeping Red fescue
    - Celestial + Wendy Jean (50:50 %)
  - Perennial Ryegrass
    - Fiesta 4 + Paragon GLR + Grand Slam GLD (33.3:33.3:33.3 %)

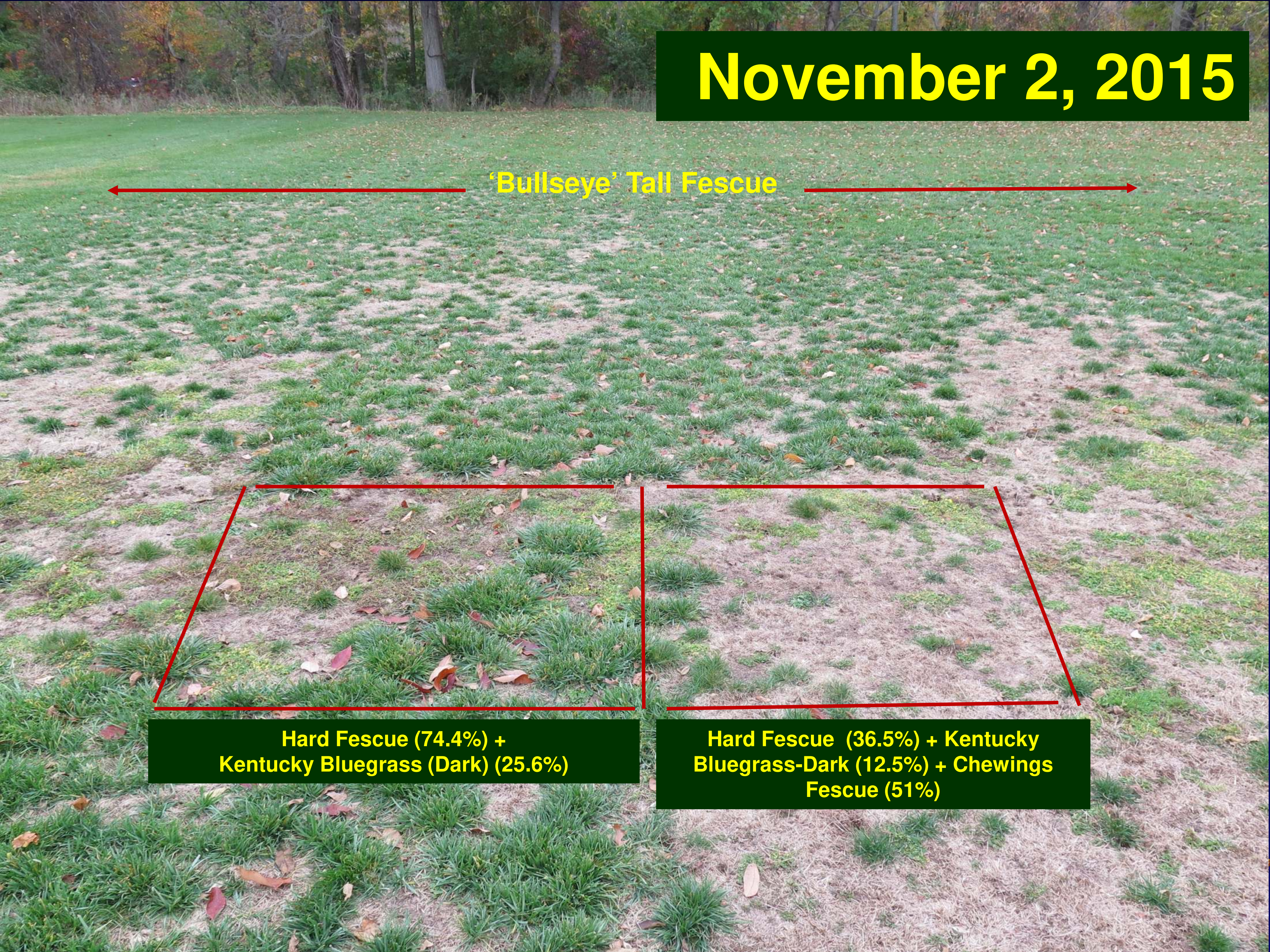

2014 vs 2015
September 4, 2014


2014 vs 2015
September 10, 2015
Acceptable turf quality?

First irrigation event since 2013: September 22, 2015


November 2, 2015


October 31, 2014
'Bullseye' Tall Fescue
Hard Fescue (74.4%) +
Kentucky Bluegrass (Dark) (25.6%)
Hard Fescue (36.5%) + Kentucky Bluegrass-
Dark (12.5%) + Chewings Fescue (51%)


November 2, 2015
'Bullseye' Tall Fescue
Hard Fescue (74.4%) +
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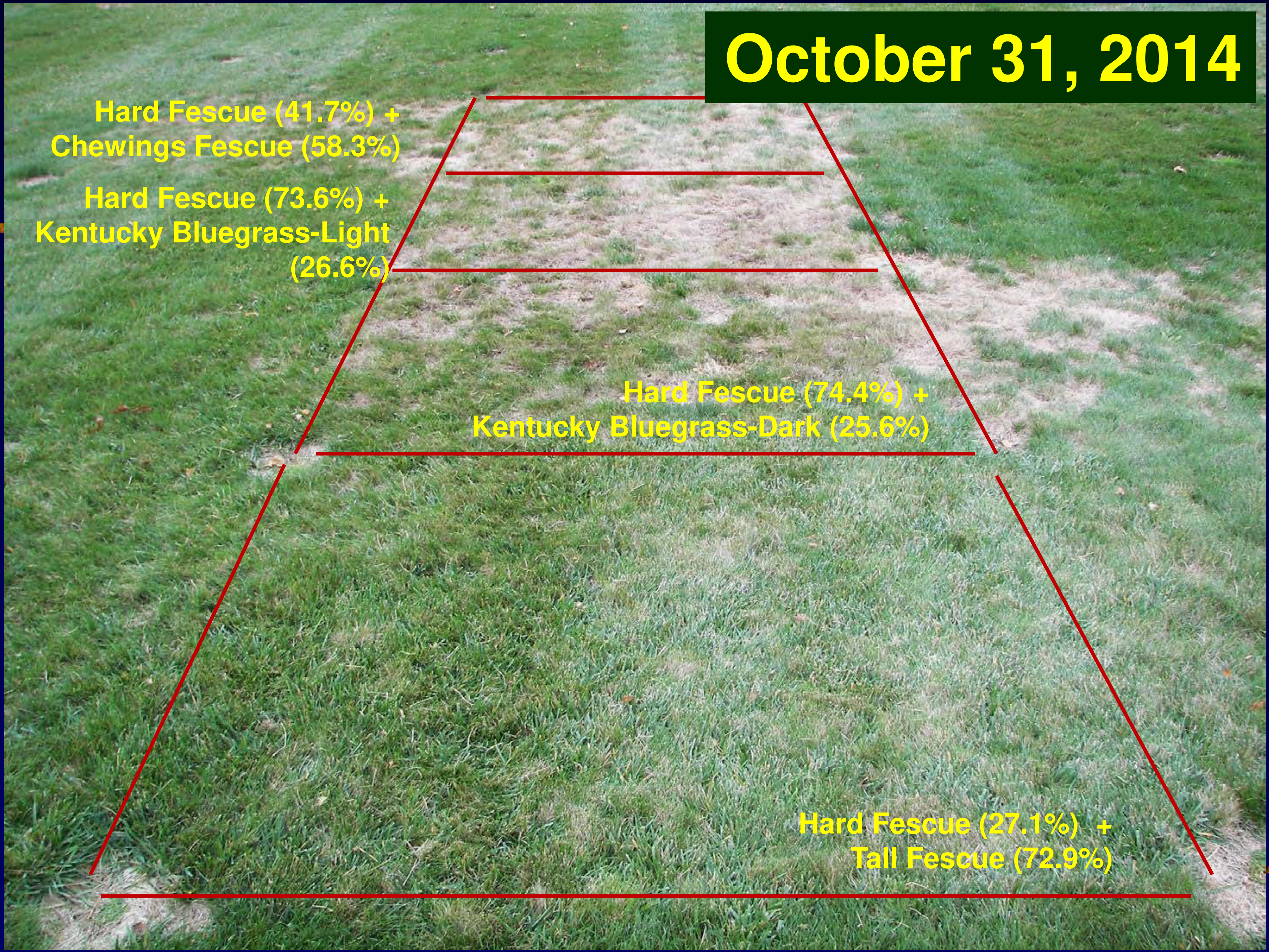
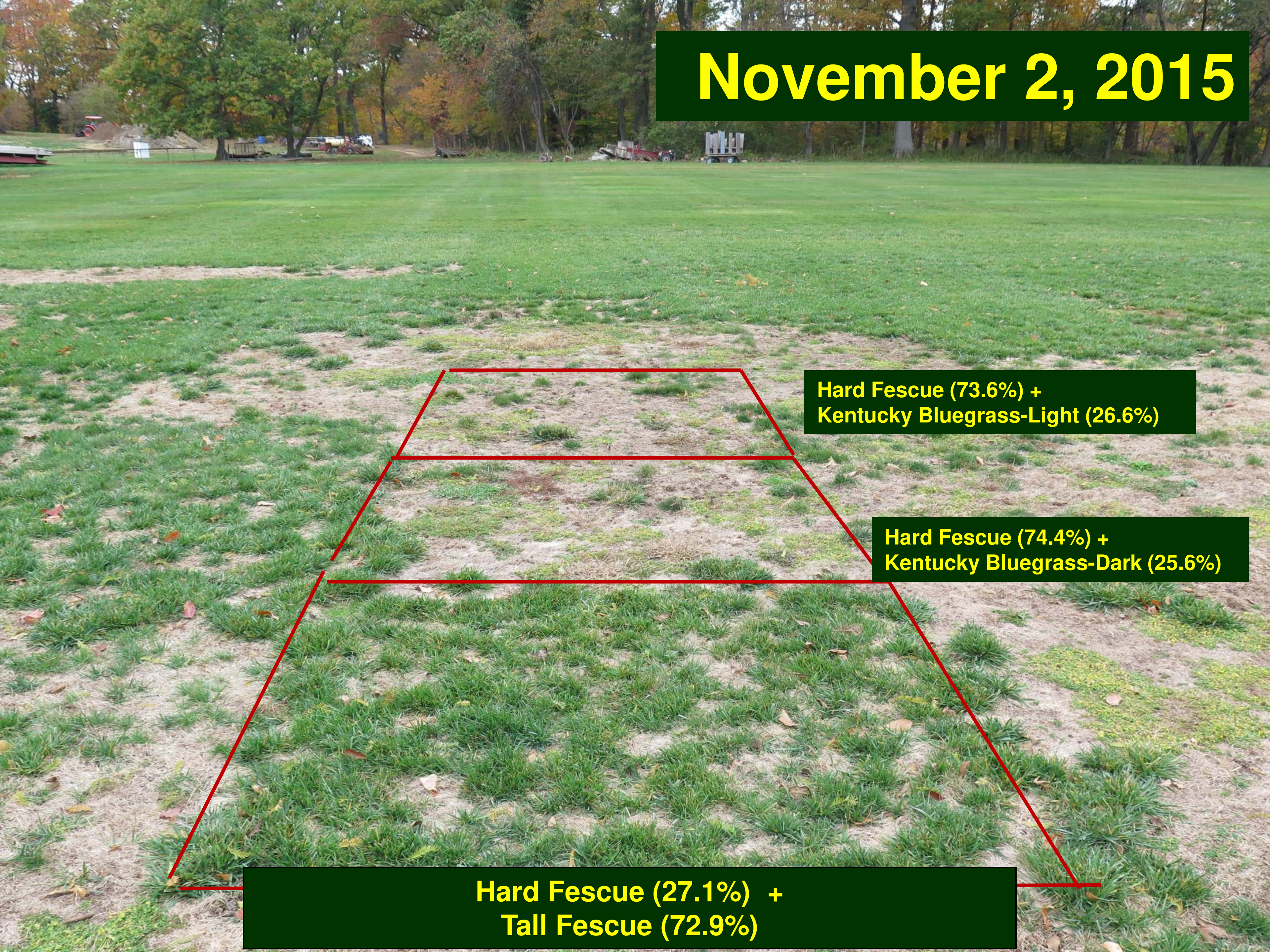
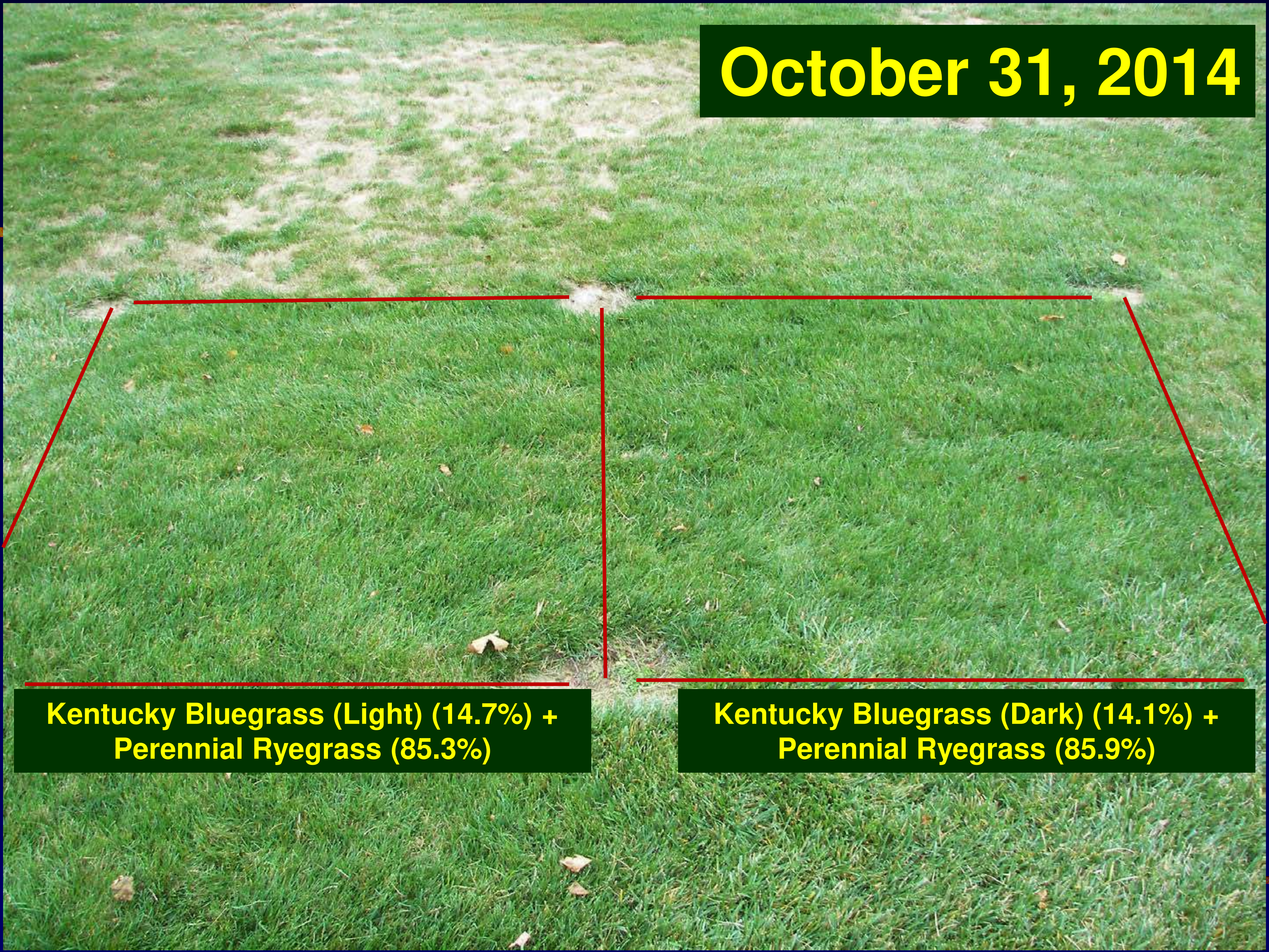
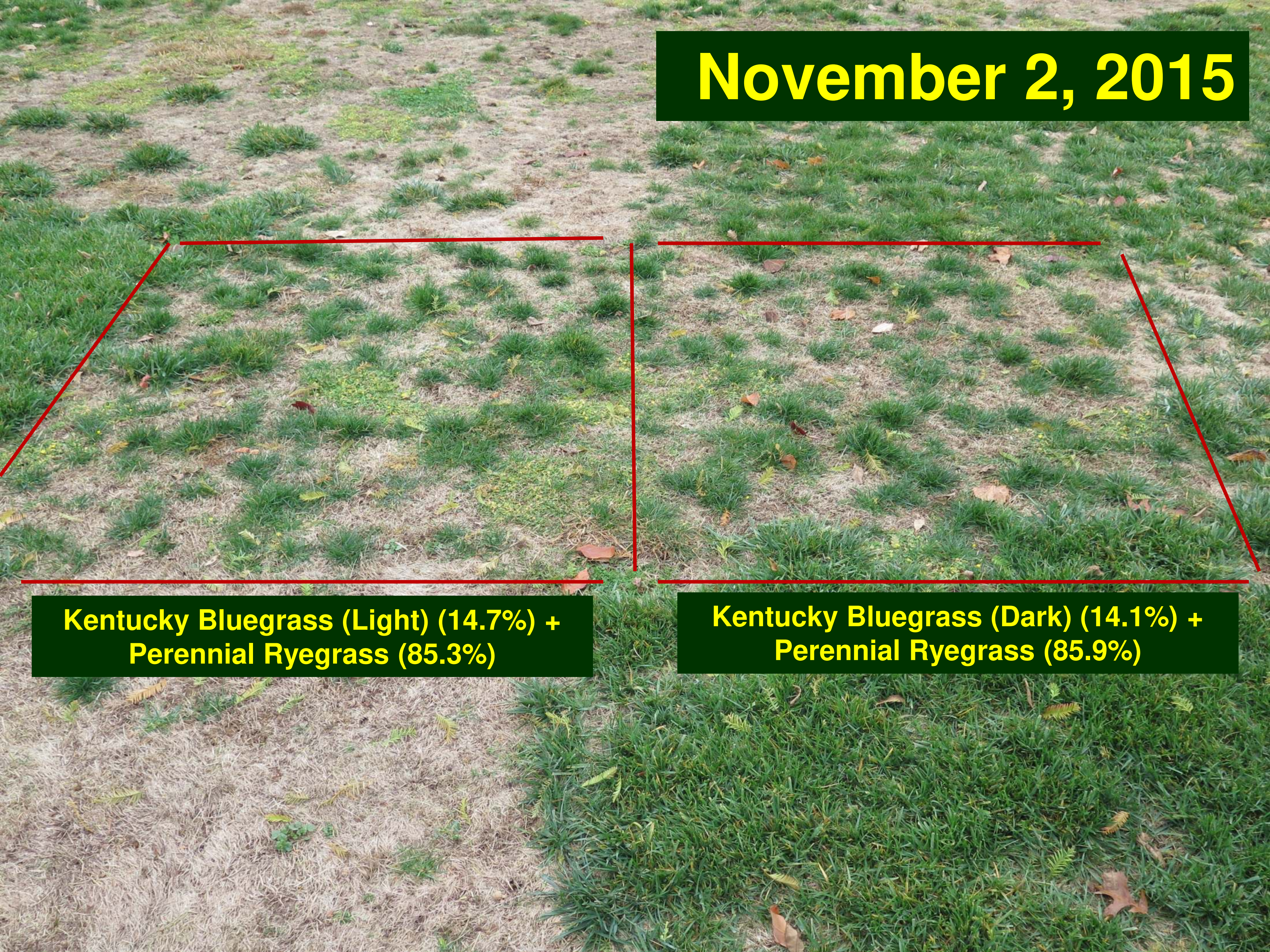
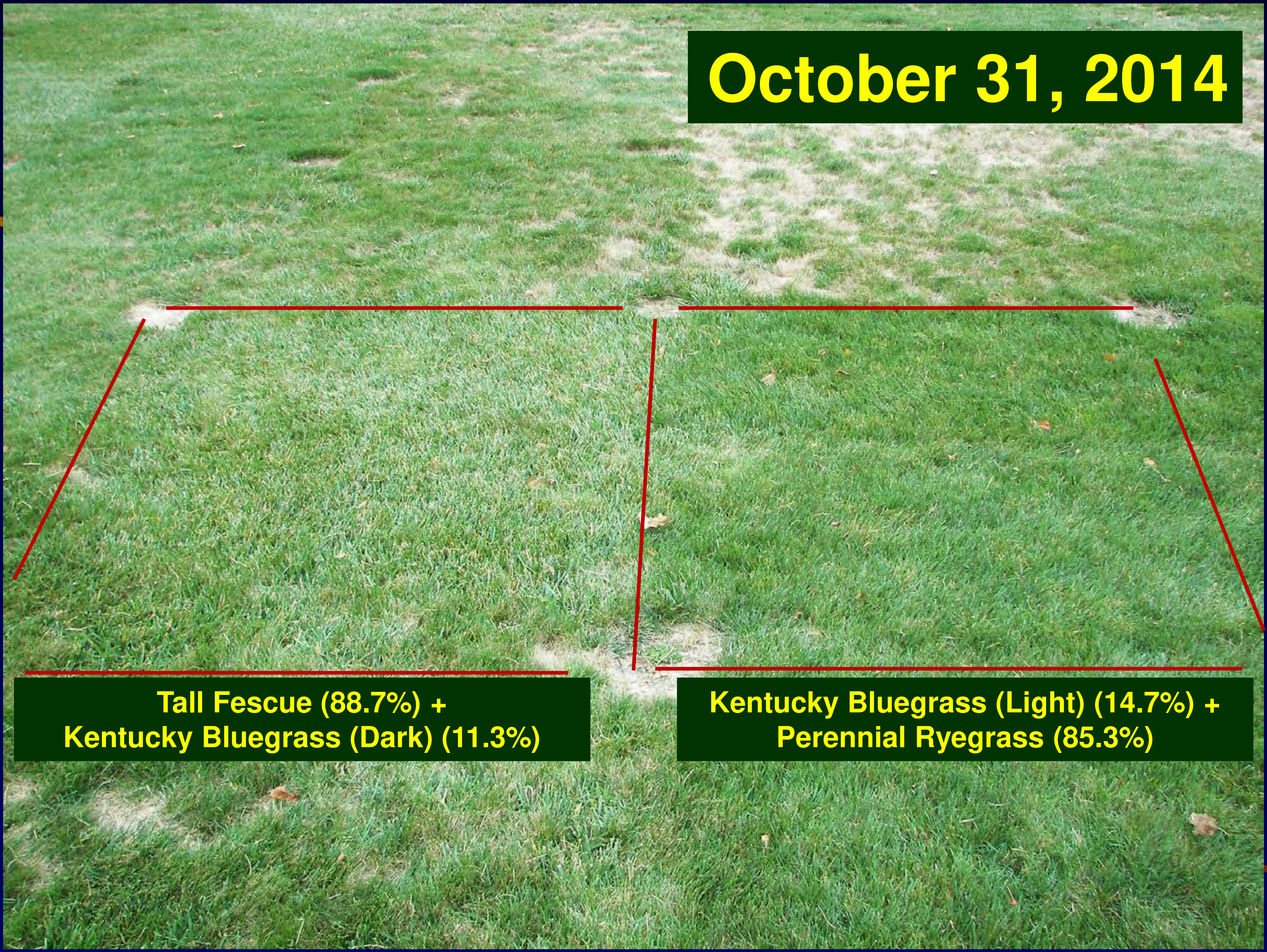
Hard Fescue (36.5%) + Kentucky
Bluegrass-Dark (12.5%) + Chewings
Fescue (51%)

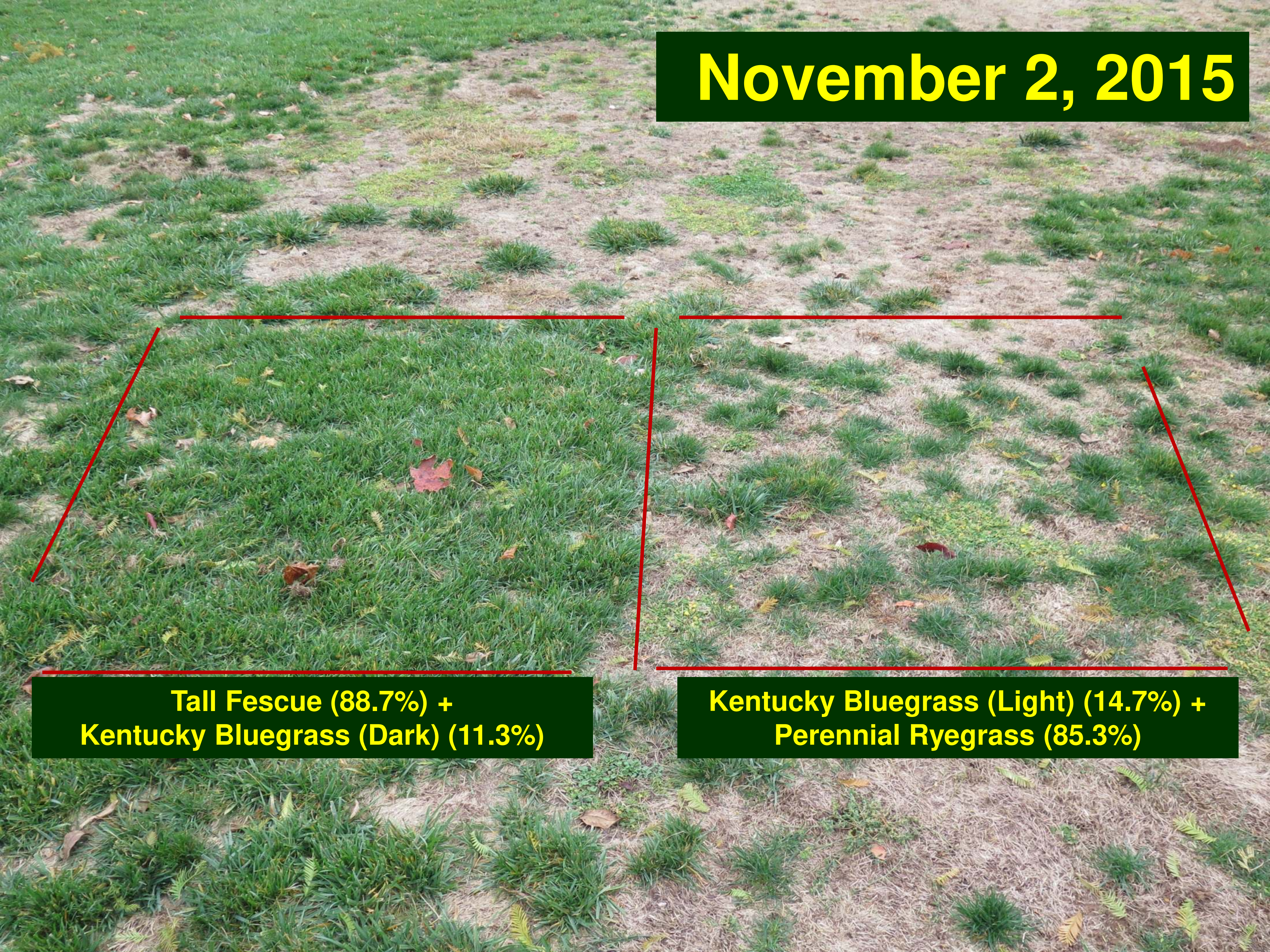

October 31, 2014
Hard Fescue (41.7%) +
Chewings Fescue (58.3%)
Hard Fescue (73.6%) +
Kentucky Bluegrass-Light
(26.6%)
Hard Fescue (74.4%) +
Kentucky Bluegrass-Dark (25.6%)
Hard Fescue (27.1%) +
Tall Fescue (72.9%)

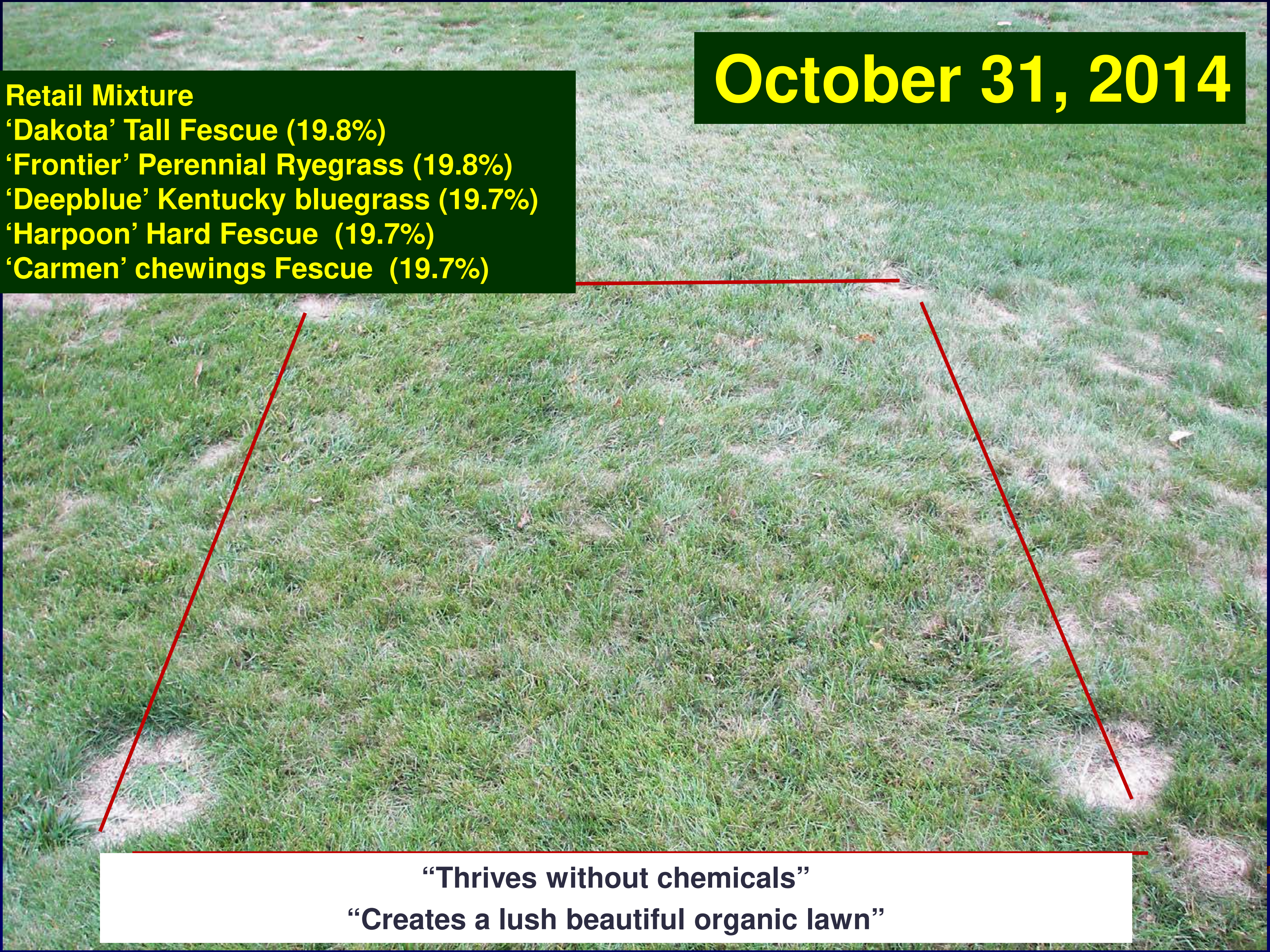

November 2, 2015
Hard Fescue (73.6%) +
Kentucky Bluegrass-Light (26.6%)
Hard Fescue (74.4%) +
Kentucky Bluegrass-Dark (25.6%)
Hard Fescue (27.1%) +
Tall Fescue (72.9%)

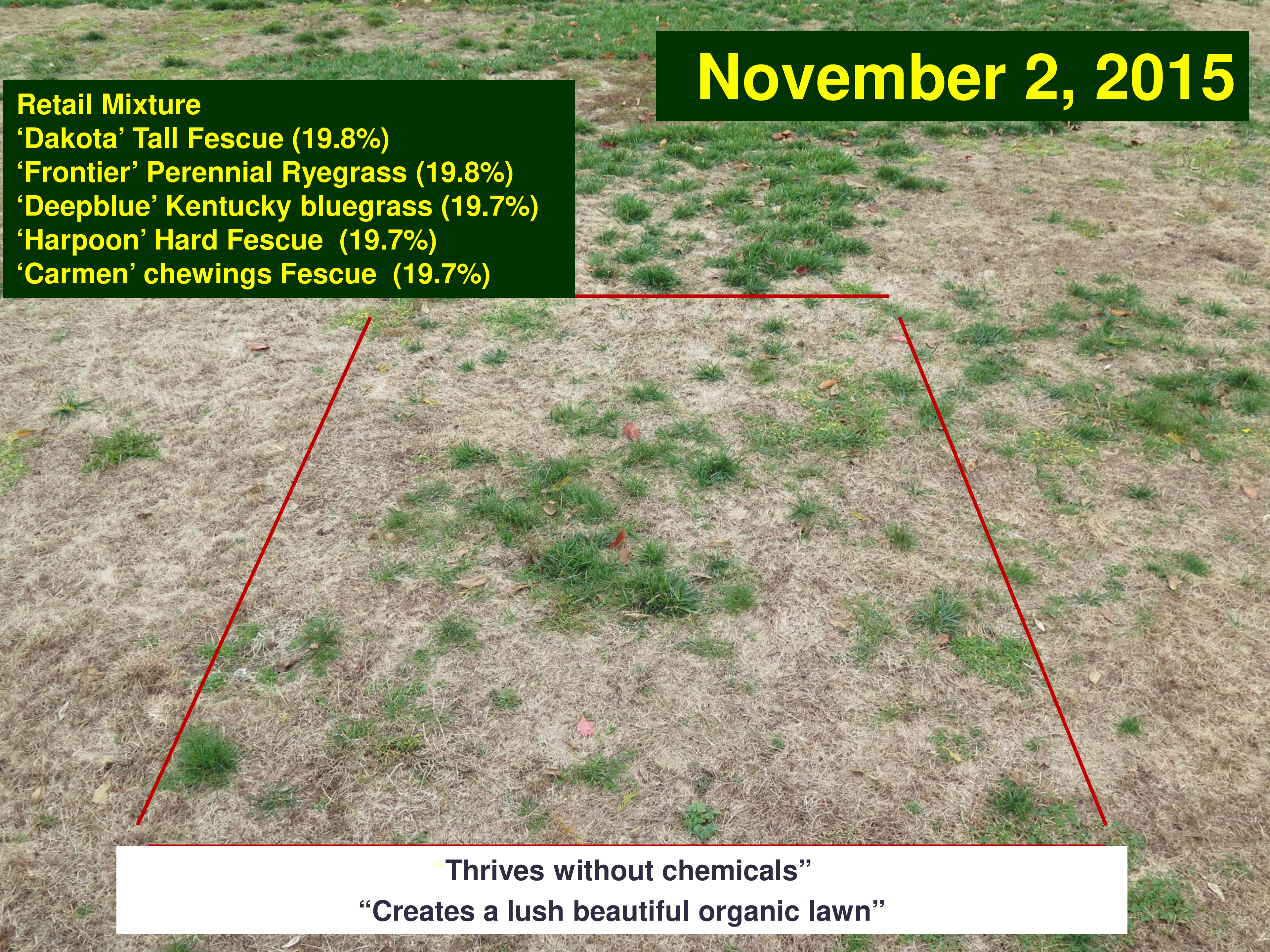

October 31, 2014
Kentucky Bluegrass (Light) (14.7%) +
Perennial Ryegrass (85.3%)
Kentucky Bluegrass (Dark) (14.1%) +
Perennial Ryegrass (85.9%)


November 2, 2015
Kentucky Bluegrass (Light) (14.7%) + Perennial Ryegrass (85.3%)
Kentucky Bluegrass (Dark) (14.1%) + Perennial Ryegrass (85.9%)


October 31, 2014
Tall Fescue (88.7%) +
Kentucky Bluegrass (Dark) (11.3%)
Kentucky Bluegrass (Light) (14.7%) +
Perennial Ryegrass (85.3%)


November 2, 2015
Tall Fescue (88.7%) +
Kentucky Bluegrass (Dark) (11.3%)
Kentucky Bluegrass (Light) (14.7%) +
Perennial Ryegrass (85.3%)


October 31, 2014
Retail Mixture
‘Dakota’ Tall Fescue (19.8%)
‘Frontier’ Perennial Ryegrass (19.8%)
‘Deepblue’ Kentucky bluegrass (19.7%)
‘Harpoon’ Hard Fescue (19.7%)
‘Carmen’ chewings Fescue (19.7%)
“Thrives without chemicals”
“Creates a lush beautiful organic lawn”


November 2, 2015
Retail Mixture
‘Dakota’ Tall Fescue (19.8%)
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‘Deepblue’ Kentucky bluegrass (19.7%)
‘Harpoon’ Hard Fescue (19.7%)
‘Carmen’ chewings Fescue (19.7%)
“Thrives without chemicals”
“Creates a lush beautiful organic lawn”

2011 Turfgrass Mixture Trial

2012-15 Turf Quality Ratings – Top Performing Tall Fescue Mixtures (% by weight)

Rank	Tall Fescue	Hard Fescue	Ky Blue Dark	Ky Blue Light	Chew-ings	Strong Crp Red	Per. Rye	Turf Qty 2012-15
1.	**88.3**			**11.7**				5.3
2.	**88.7**		**11.3**					5.3
3.	**100**							5.1
4.	**41.3**		**5.2**		**21.5**		**32**	5.1
5.	**52.6**		**6.7**				**40.7**	4.9
6.	**72.9**	**27.1**						4.8
7.	**56.4**						**43.6**	4.8
8.	**Pennington Tall Fescue (“Rebel + Rebel Advance + Brockton”; 39.1:39.1:19.5)**							4.8
9.	**66.7**	**24.8**	**8.5**					4.7
10.	**42.1**			**5.6**		**19.8**	**32.5**	4.7
11.	**41.2**			**5.5**	**21.4**		**31.9**	4.7
12.	**34.6**		**4.4**		**18**	**16.3**	**26.7**	4.7
13.	**36.5**	**13.5**	**4.6**			**17.2**	**28.2**	4.7

Turf Quality rated on 1-9 scale, where 9 = best overall turf quality.
Data average of the 2012 through 2015 growing seasons. Lsd at 5% = 0.8

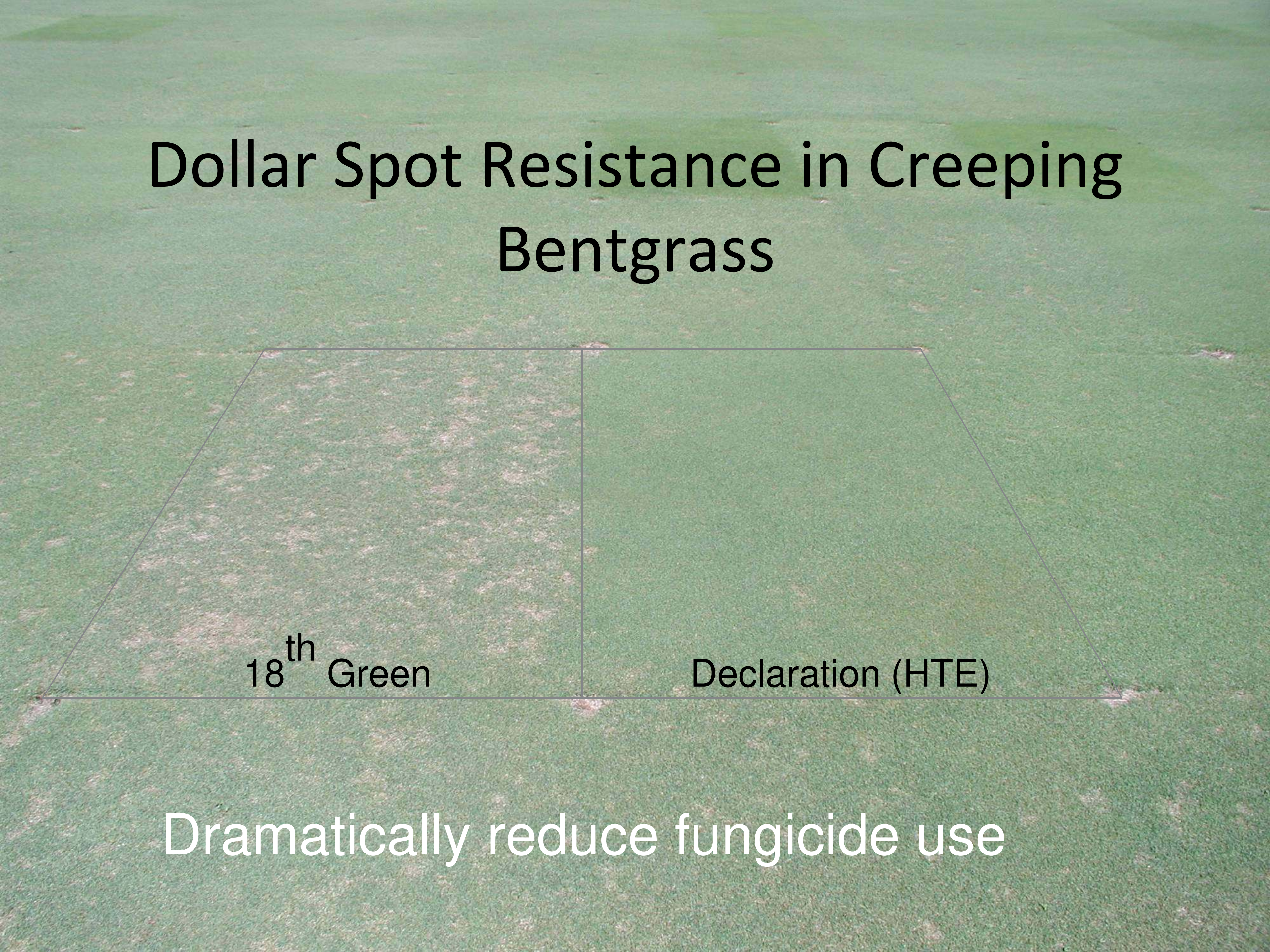
Low Maintenance Turfgrass Selections

- Tall fescue first choice
- Can be mixed with Kentucky bluegrass for a high quality low maintenance lawn
- Needs to be the right Kentucky bluegrass
- Fine fescues are improving

What about Bentgrasses?


Not selected
Selected
Dollar Spot Disease Following Natural Infection

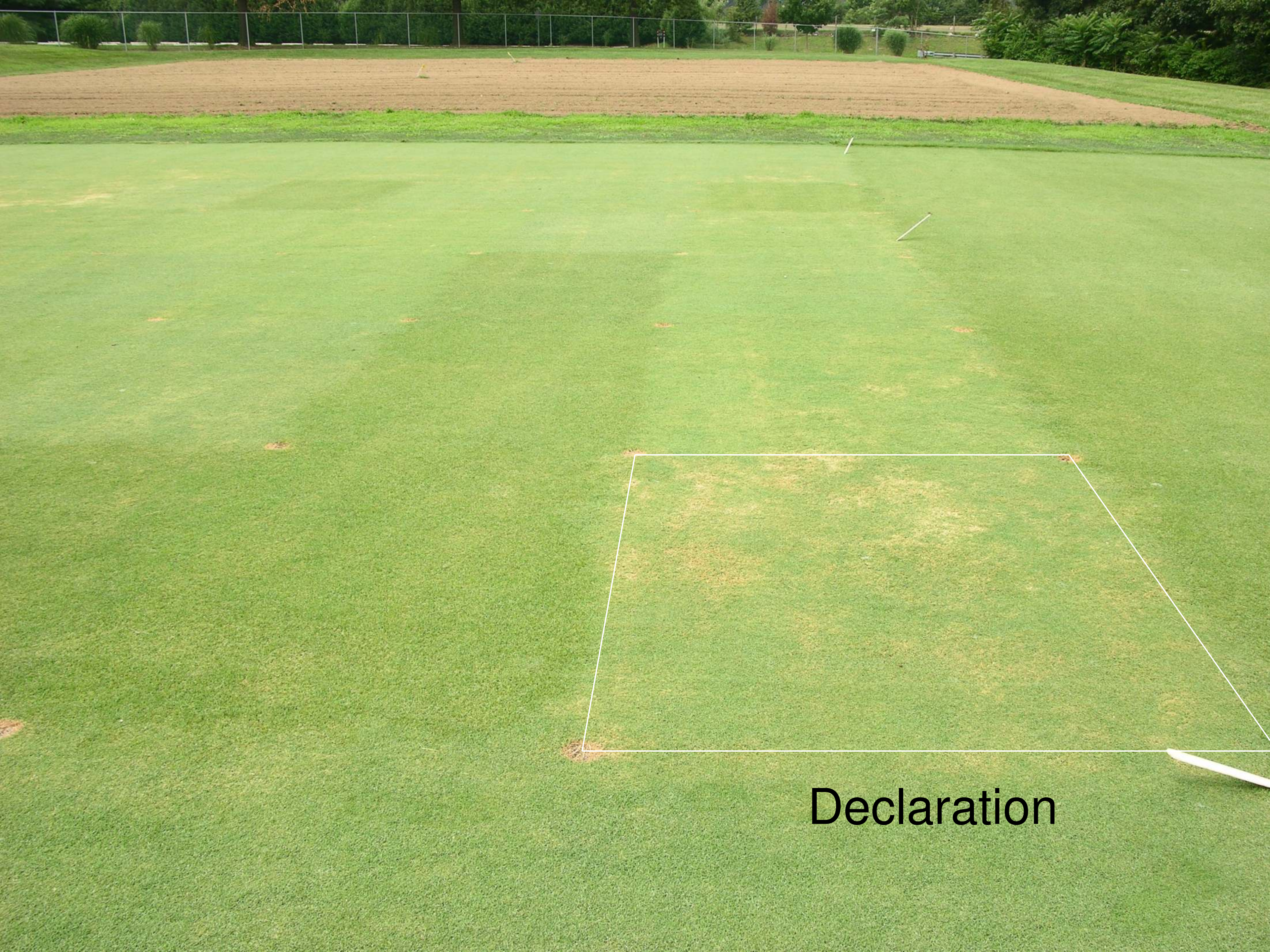
Dollar Spot Resistance in Creeping Bentgrass



Dramatically reduce fungicide use

Bentgrass Breeding

- Brown Patch Resistance
- Anthracnose Resistance
- Copper Spot Resistance
- Traffic Tolerance
- Low Mowing Tolerance
- Salt Tolerance
- Drought Tolerance


Declaration

NTEP Bentgrass Fairway Trial – Drought Tolerance

Cultivar	Qty	Cultivar	Qty
A08-EBM	9.0	007	6.0
A08-FT12	9.0	Authority	6.0
BCD	8.7	Penncross	5.7
Greentime	8.7	Princeville	5.3
Tiger II	8.7	Pure Select	5.3
L-93	7.3	Barracuda	5.0
PST R9D7	7.3	Declaration	4.3
Crystal Blue Links	7.0	Luminary	4.3
CY-2	7.0	Memorial	4.3
Proclamation	7.0	Pin-Up	4.3
T-1	7.0	Benchmark DSR	1.7
SRP-1WM	6.3	LSD	3.1

Drought ratings based on a 1-9 scale, 9=best


Breeding for Growth Habit in Creeping Bentgrass
Declaration Type
Prostrate Type

Creeping Bentgrass Cultivars

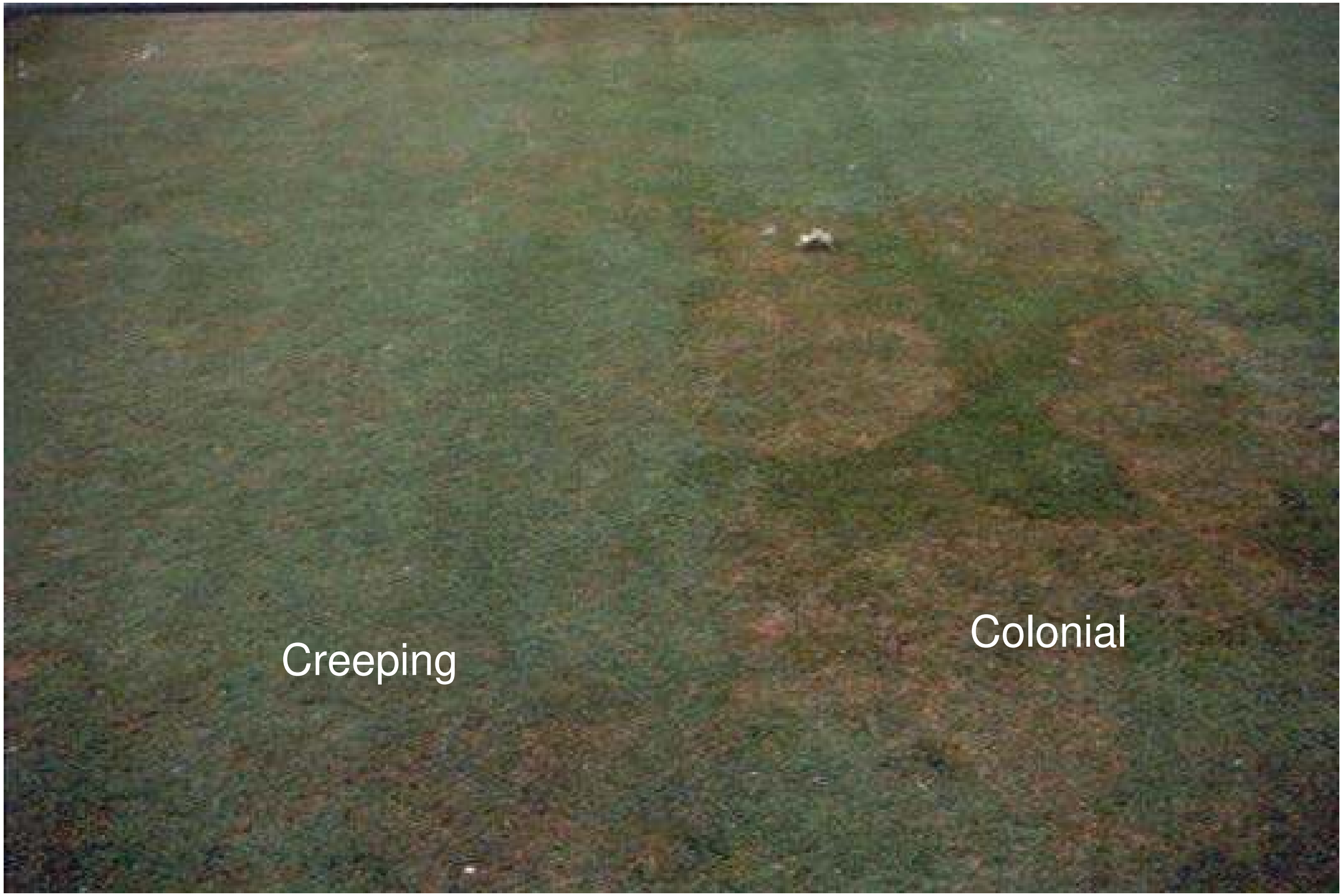
007	Focus	Penn G-6	Seaside II	777
13M	Independence	Penncross	Shark	Nightlife
96-2	Kingpin	Penneagle II	Southshore	Armor
Alpha	L93	Pennlinks II	SR 1119	Kingdom
Authority	Luminary	Pin Up	SR 1150	Piranha
Barracuda	Mackenzie	Proclamation	T-1	L93XD
Cobra 2	Mariner	Pure Distinction	Tyee	
Crystal Bluelinks	Memorial	Pure Select	V8	
CY-2	Penn A-1	Putter		
Declaration	Penn A-4	Runner		
Flagstick	Penn G-2	Sandhill		

RUTGERS
New Jersey Agricultural
Experiment Station

New Cultivars to Look For

- L93XD, 777, Piranha
- Excellent wear, heat, drought, disease resistance (multiple diseases)
- Very high shoot density

Brown Patch in Colonial Bentgrass



Brown Patch in Colonial Bentgrass

New Improved Colonial Bentgrasses

- Capri
- Puritan
- Musket
- Heritage

Low Maintenance Fairway Trial

- Creeping, Colonial, Fine fescues, mixtures with colonial and Chewings, colonial and hard, etc.
- Mowed at ½ inch
- Curative fungicide and weed control treatments
- Limited irrigation
- Wear applied with a golf cart

Conclusions

- Mixtures had the best turf quality, wear tolerance
- They were better than both the individual cultivars by themselves
- Chewings, Hard and Slender creeping red fescue had the best disease resistance while creeping and colonial bentgrasses had the poorest
- Colonial/Chewings and Colonial/Hard fescue proved to be promising mixtures for low maintenance fairways

- Overall, our goal is to improve cool-season grasses for low maintenance and other stresses such as drought, heat and diseases


ITPF
INTERNATIONAL TURF PRODUCERS FOUNDATION
New Jersey Turfgrass Association
O.J. Noer Research Foundation
Sustaining Turfgrass Research
USGA
The United States Golf Association
RUTGERS Center For Turfgrass Science
RUTGERS
New Jersey Agricultural Experiment Station
Email: bonos@aesop.rutgers.edu
http://turf.rutgers.edu

Bret Ramsey

Testing Ground Resistance

Bret Ramsey, Golf Field Service Manager

ASIC – April 21, 2016

The Intelligent Use of Water.™

Today's Agenda

Grounding & Surge Protection

1. What is Surge?
2. Why is Grounding Important?
3. Typical Grounding & Surge Protection Equipment
4. What Influences Soil Resistance?
5. Testing Grounds
6. Case Studies
7. How can Bad Grounding be Improved?
8. Shielding Wire

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What is Surge?

Power surges, or spikes are fast, short duration electrical transients in voltage (voltage spikes), current (current spikes), or transferred energy (energy spikes) in an electrical circuit.

Typical causes for voltage spikes:

- Lightning strikes
- Power outages
- Tripped circuit breakers
- Short circuits
- Power transitions in other large equipment on the same power line
- Malfunctions caused by the power company
- Electromagnetic pulses (EMP) with electromagnetic energy distributed typically up to the 100 kHz and 1 MHz frequency range.
- Inductive spikes

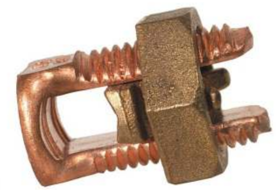
Why is Grounding Important?

For Your System's Protection…

The theory behind most surge protection is to provide a path of least resistance for electrical surges so they dissipate harmlessly in the ground. Such surge protection involves both surge arrestors and proper grounding.

No Ground = No Surge Protection

Grounding Equipment



PLUSCU

PG11L

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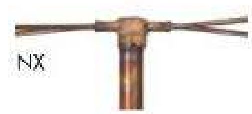

NX

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Surge Protection Equipment

Examples of Surge Protection Components:

- **ICSD = Integrated Control Surge Device**
- **MSP-1 = Protection for ICI**

MSP-1

ICSD

Polyphaser

LSP-1

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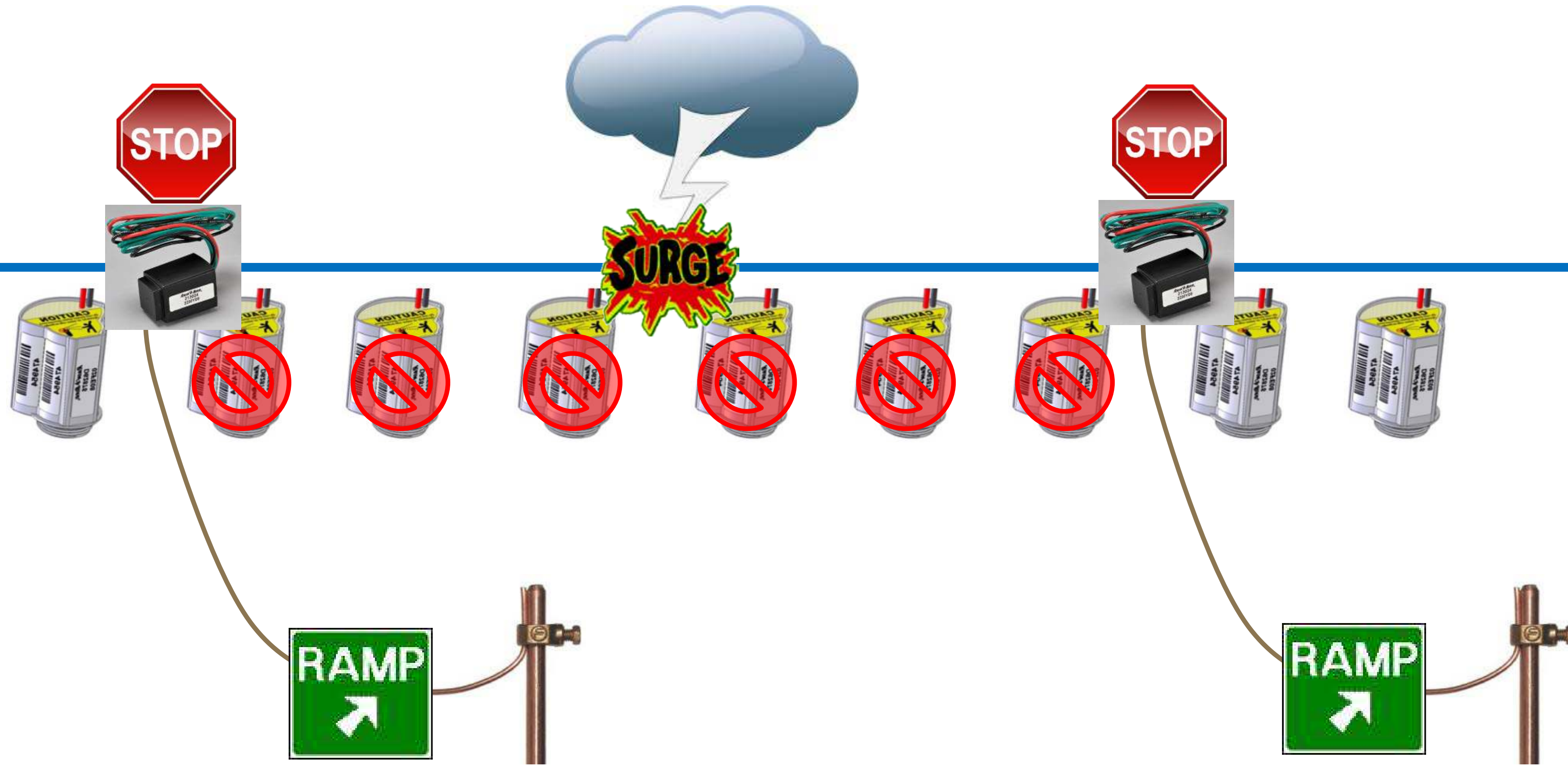
Grounding & Surge Protection

WITHOUT Surge Protection:

Grounding & Surge Protection

Purpose of **ICSD** is to **CONTAIN** Surge:



Improving Grounding Conditions

Ground Resistance is Affected by:

1. Soil Type
   - Sandy/Rocky Soils = High Resistance (Typ.)
   - Clay/Silt/Loam Soils = Low Resistance (Typ.)

	Resistivity (approx), Ω-cm		
Soil	**Min.**	**Average**	**Max.**
Ashes, cinders, brine,waste	590	2,370	7,000
Clay, shale, gumbo, loam	340	4,060	16,300
Same, with varying proportions of sand and gravel	1,020	15,800	135,000
Gravel, sand, stones with little clay or loam	59,000	94,000	458,000

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Improving Grounding Conditions

Ground Resistance is Affected by:

2. Soil Moisture
   - As Soil Moisture Increases, Ground Resistance Decreases
   - Resistance increases dramatically when soil moisture falls below 20%
   - Where Possible, Locate Ground Rods/Plates in IRRIGATED Areas

Moisture content	Resistivity Ω-cm	
% by weight	Top soil	Sandy loam
0	$>10^9$	$>10^9$
2.5	250,000	150,000
5	165,000	43,000
10	53,000	18,500
15	19,000	10,500
20	12,000	6,300
30	6,400	4,200

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Improving Grounding Conditions

Ground Resistance is Affected by:

3. Temperature
   - Cooler temperatures increase soil resistance
   - Not easily influenced

4. Mineral Content
   - + Salt = <Resistance
   - Typical Enhancement Ingredient

THE EFFECT OF SALT* CONTENT ON THE RESISTIVITY OF SOIL

(Sandy loam, Moisture content, 15% by weight, Temperature, 17°C)

Added Salt (% by weight of moisture)	Resistivity (Ohm-centimeters)
0	10,700
0.1	1,800
1.0	460
5	190
10	130
20	100

Grounding Test Equipment

- **Fall of Potential Tester**
  - Requires disconnect from utility power.
- **Clamp on Tester**
  - Requires connection to utility power.

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Grounding Test Equipment

- **Fall of Potential Tester**
  - Many Earth Ground Test Instruments offer multiple test capabilities.
  - 2, 3 & 4 Probe Tests are Common
  - Use **ONLY the 3 Probe**, Fall of Potential test when testing ground electrodes.

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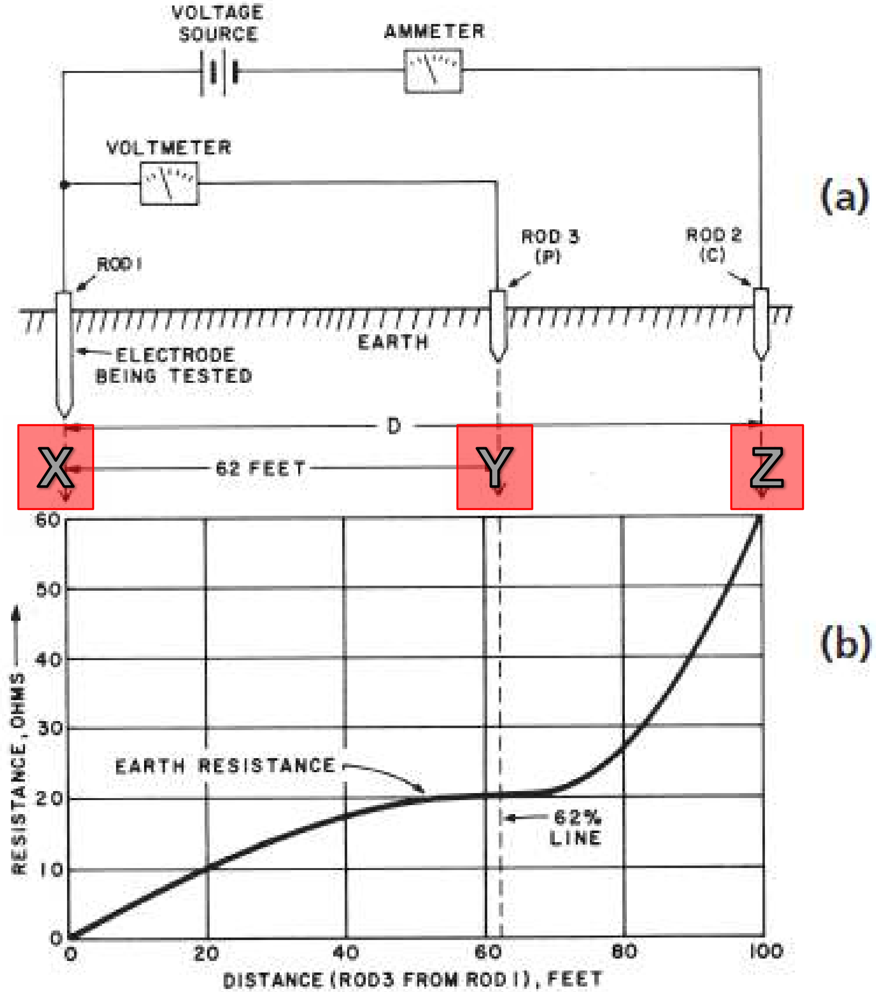
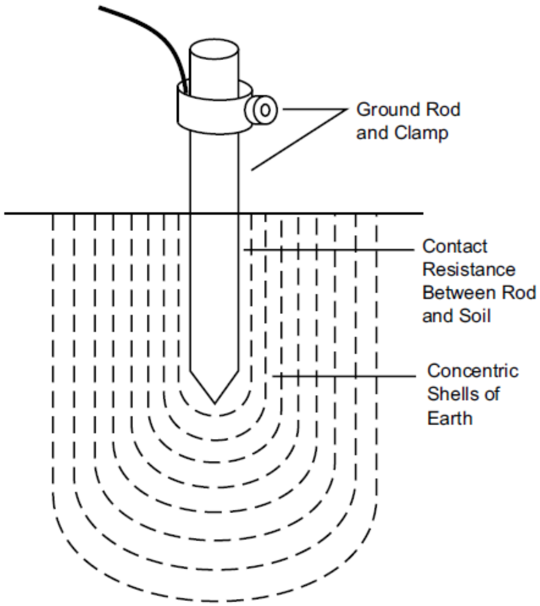
Testing a Grounding Electrode

By Ohm's Law:
(R = E/I) you can determine the earth resistance at any point measured. For example, if the measured voltage *E* between rods 1 and 3 is 30 V and the measured current I is 2 A, the resistance of the earth *R* at that point would be 15 Ω.

(Megger- *Getting Down to Earth*)



Testing a Grounding Electrode



"The electrode can be thought of as being surrounded by ***concentric shells of earth or soil****, all of the same thickness. The closer the shell of the electrode, the smaller its surface; hence the greater the resistance. The farther away the shells are from the electrode, the greater the surface of the shell; hence the lower the resistance."* (AEMC-3640-4610-Manual)

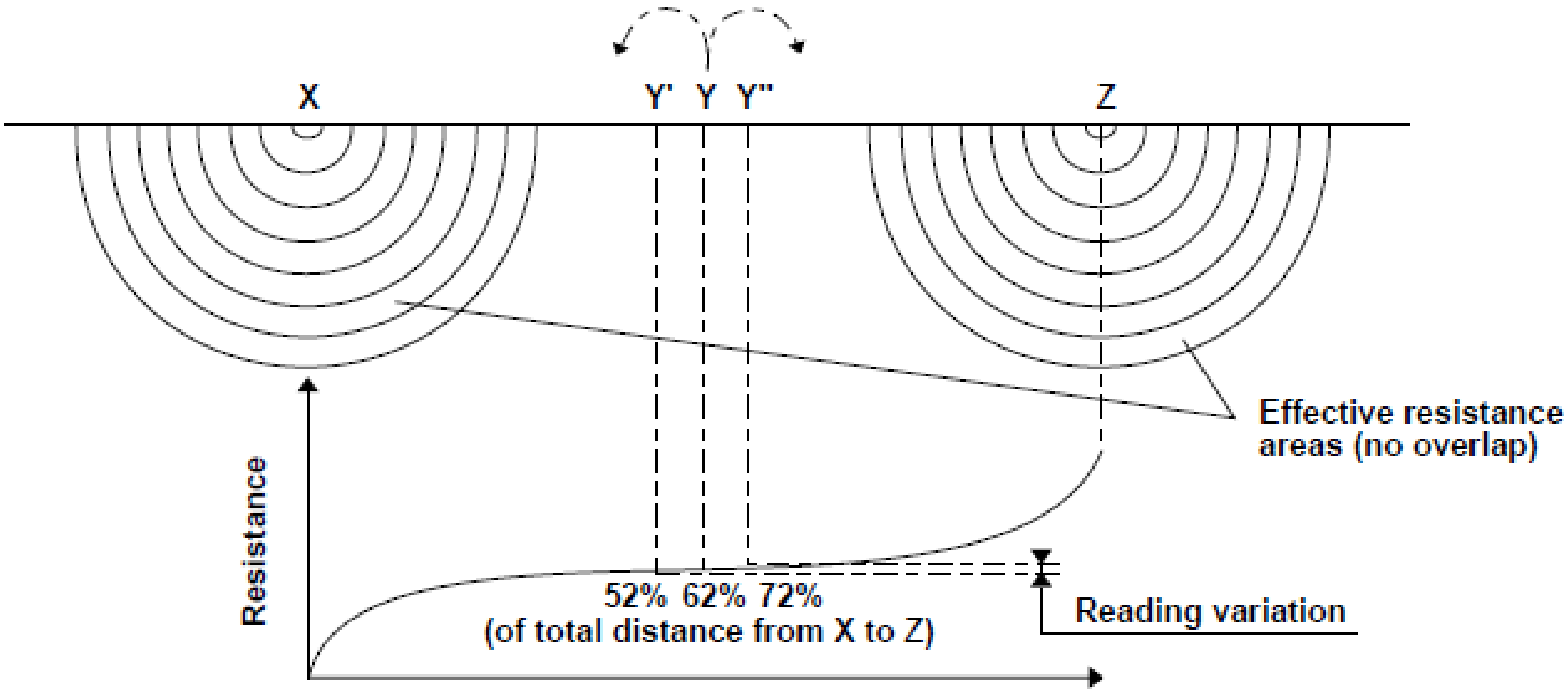
Testing Resistance of the Grounding Grid

Distance to Auxiliary Electrodes using the 62% Method		
Depth Driven	Distance to Y	Distance to Z
6 Feet	45 Feet	72 Feet
8 Feet	50 Feet	80 Feet
10 Feet	55 Feet	88 Feet
12 Feet	60 Feet	96 Feet
18 Feet	71 Feet	115 Feet
20 Feet	74 Feet	120 Feet

Testing Resistance of the Grounding Grid

Proper Spacing of Test Probes:

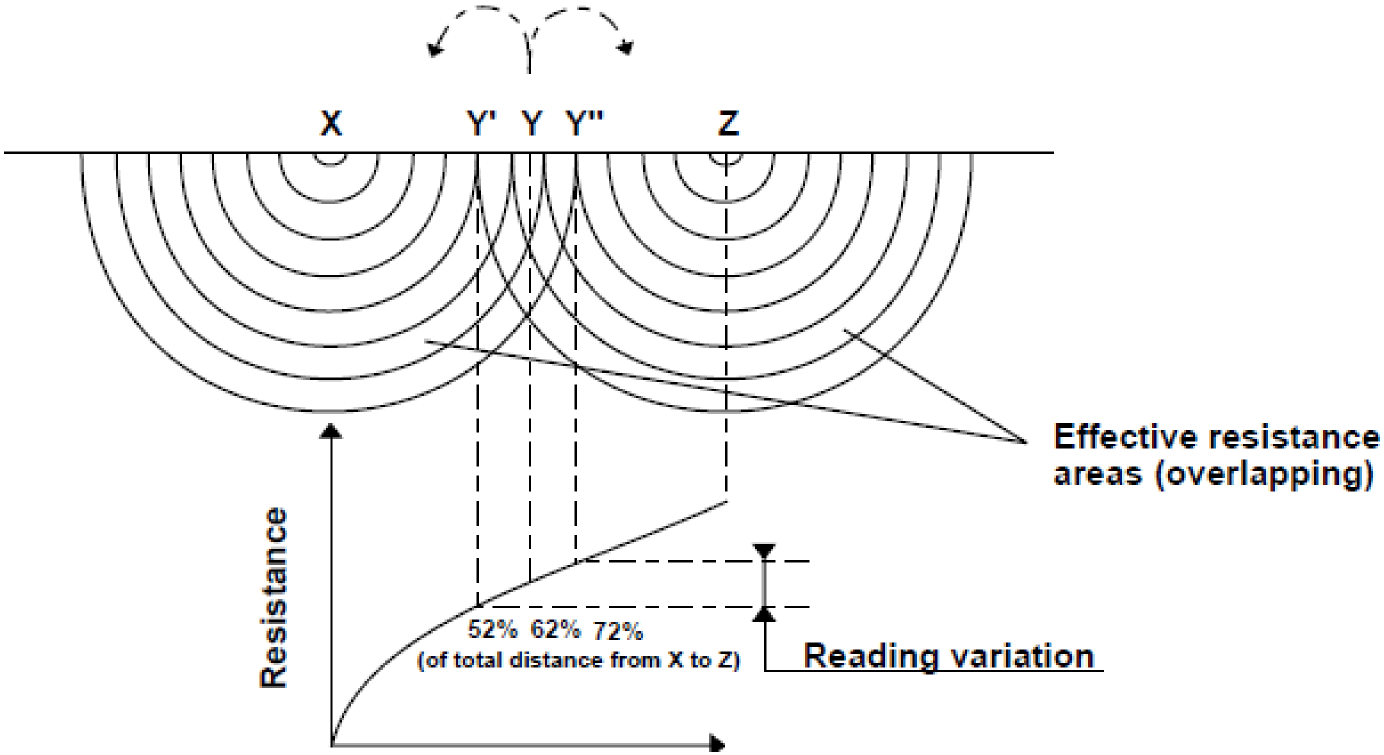
- Z Probe – far enough from X for **no overlap** of Effective Resistance areas
- Resistance should not vary if Y probe is moved 10% towards X or Z



Testing Resistance of the Grounding Grid

IMPROPER Spacing of Test Probes – Z TOO CLOSE to X:

- Z Probe – too close to X, Effective Resistance spheres overlapping
- Resistance will vary significantly if Y probe is moved 10% towards X or Z



Grounding & Surge Protection

- **Testing Earth Ground Resistance**
  - Resistance readings must be taken **WITHOUT** the bonding/shielding wire connected (grounding electrode only).
  - Each ICSD must have a local earth ground resistance of less than 50 ohms (without bonding/shielding wire).
  - Combination of grounding electrodes may be necessary to obtain proper resistance.

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Case Study – Tampa, FL

					Ground Resistance (Ohms)		
WPT	Course	Phase	Hole	Description	Grid	Rod	Elevation
336	Hills	2	3F	Strike Location	N/A	N/A	62
337	Hills	2	3F	ICSD	8.0	609	73
338	Hills	2	3T	ICSD	5.6	589	70
339	Hills	2	2T	ICSD	5.5	229	[illegible]
341	Pines	3	8F	Strike Location / IC[illegible]	5.0	366	72
342	Pines	3	8F	ICSD	5.2	58	52
343	Lakes	1	17[illegible]	[illegible]	2.9	484	61
344	Lakes	1	18[illegible]	[illegible]	2.8	393	44
345	Lakes	1	18/[illegible]	[illegible]	N/A	124	51
346	Lakes	1	1[illegible]	[illegible]	2.2	370	45
347	Lakes	1	4[illegible]	[illegible]	N/A	33	38
348	Lakes	1	6[illegible]	[illegible]	2.9	1,133	50
349	Lakes	1	8G	ICSD	2.4	289	51
350	Lakes	1	15/16	ICSD	2.6	89	30
351	Lakes	1	12/13	ICSD	2.7	655	75
352	Hills	2	10F	ICSD	3.5	195	63
353	Hills	2	13G	ICSD	3.1	397	56
354	Hills	2	15F	ICSD	1.8	436	59
355	Hills	2	17G	ICSD	2.1	936	37
356	Pines	3	10T	Strike Location / ICSD	4.2	789	43
357	Pines	3	10F	Strike Location / ICSD	2.1	419	38
359	Pines	3	10F	Strike Location / ICSD	3.0	335	59
360	Pines	3	13F	ICSD	3.7	239	49
361	Pines	3	16F	ICSD	1.3	251	32
362	Pines	3	17F	ICSD	2.0	256	37

Bonding Wire Connected

Rod Only, Bonding Wire Disconnected

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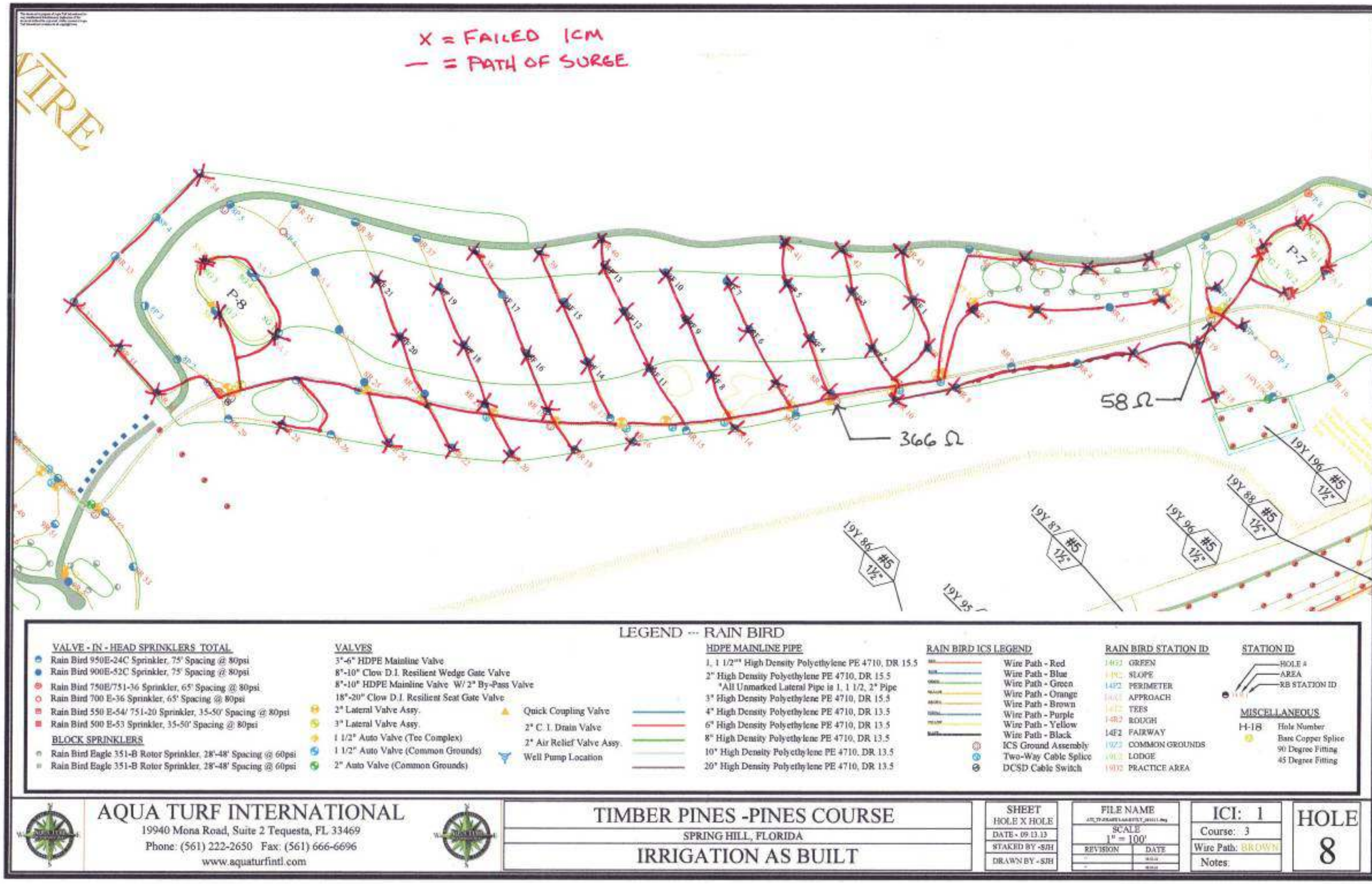
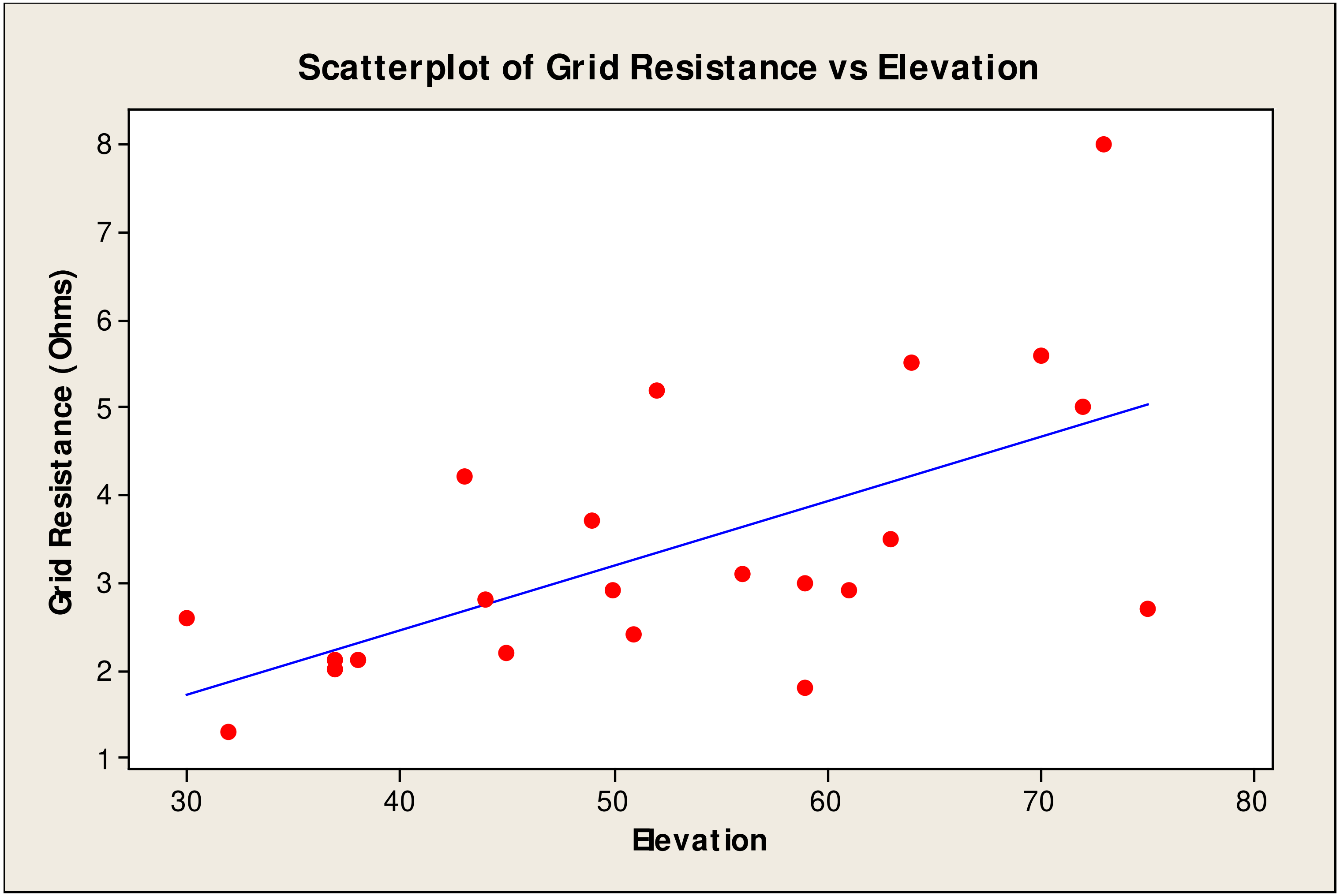
Case Study – Tampa, FL



Improving Grounding Conditions



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Case Study – Armonk, NY

“Direct Strike”

– Properly Grounded (tested to 50 Ohms or less)

– Proper ICSD locations

– Result = Damage contained to 14 ICM’s

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Improving Grounding Conditions

Ground Resistance may be Reduced by:

- Adding Rods
- Adding Plates
- Adding Grounding Enhancement Material such as POWER SET or GEM

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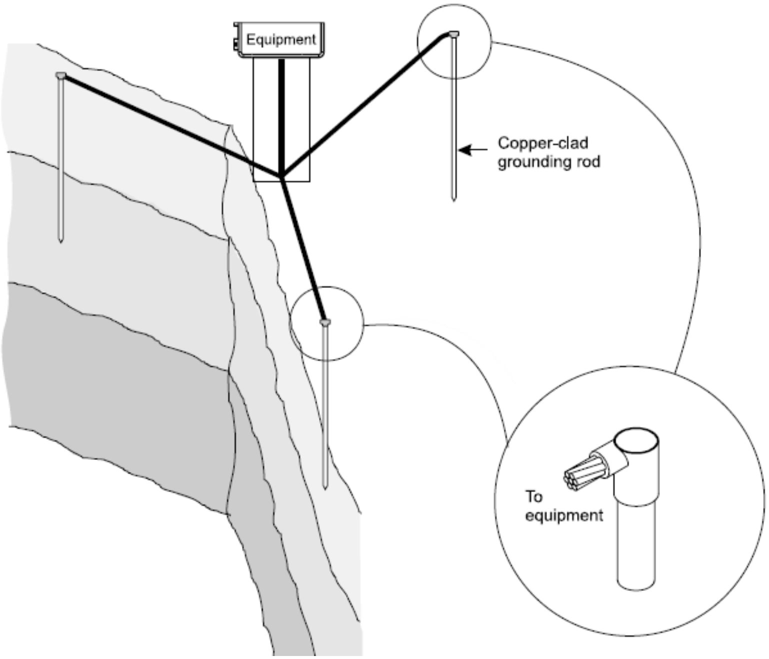
Improving Grounding Conditions

Ground Resistance may be Reduced by:

- Adding Rods



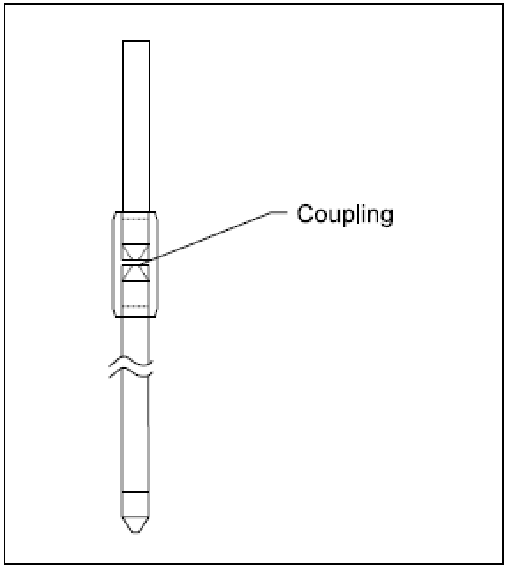


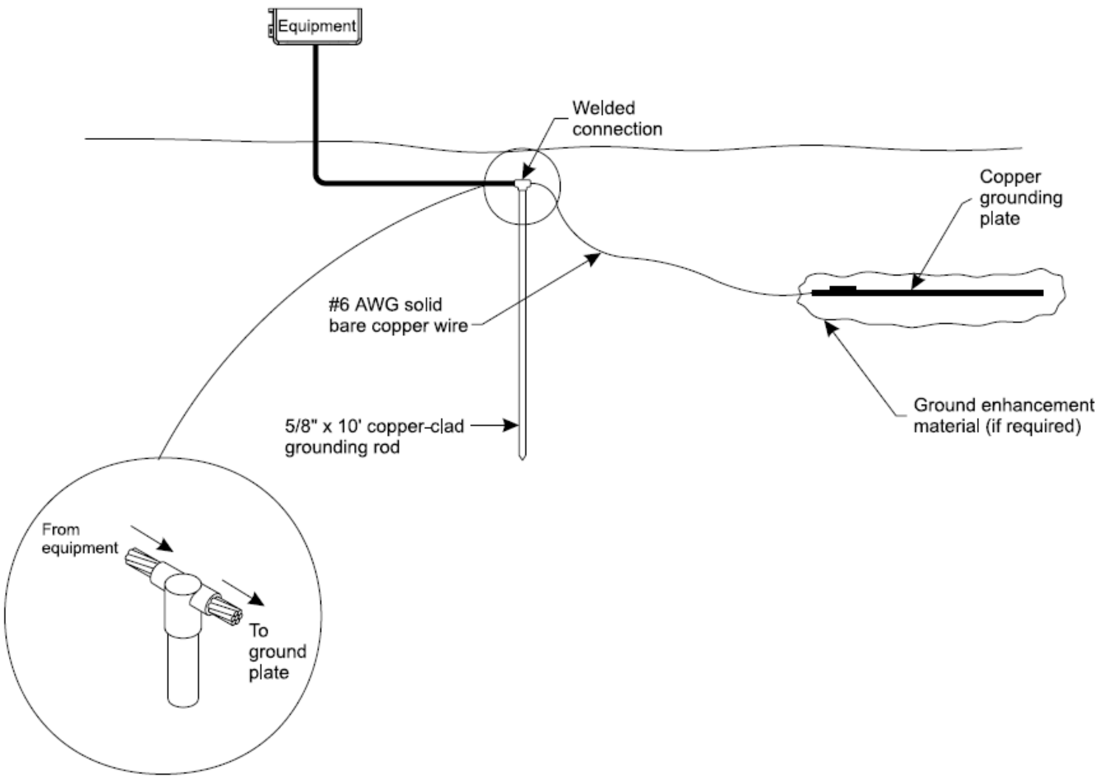
Figure 2: Stacking grounding rods with threaded couplers can help decrease ground resistance.

Improving Grounding Conditions

Ground Resistance may be Reduced by:

- Adding Rods
- Adding Plates

  4”x96”x.0625” Min.



Conducting a Grounding Survey

1. Install a **5/8" x 10' copper clad ground rod** and test for resistance
   - If resistance is 50 Ohms or less, a single rod will suffice at this location
   - If resistance is > 50 Ohms, an enhancement strategy is required
2. Install a **grounding plate** 15' away from the ground rod at a 3' depth and measure its resistance
   - If the grounding rod is not at or below the resistance of the plate (measured independently), couple a **second rod** and drive the total length to a depth of 20'
   - If the resistance of the 20' rod is **50% or less** of that of the 10' rod, **coupling rods is a good strategy**
   - If the resistance of the 20' rod is **not 50%** or less than that of the 10' rod, adding a second 10' rod that is **20' away** (preferably in an irrigated area) is a better strategy.

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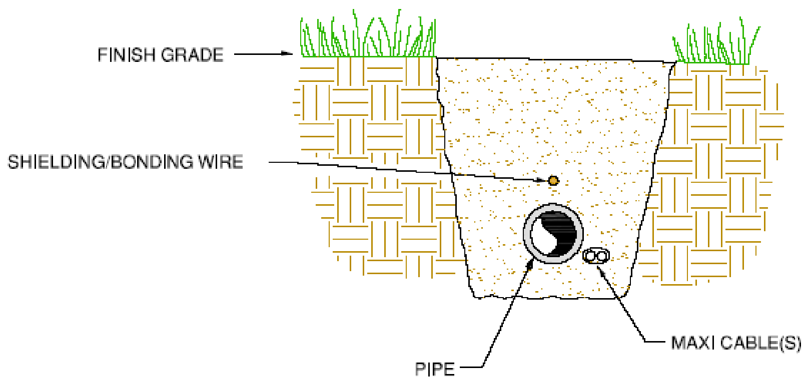
Optional Bonding/Shielding Wire

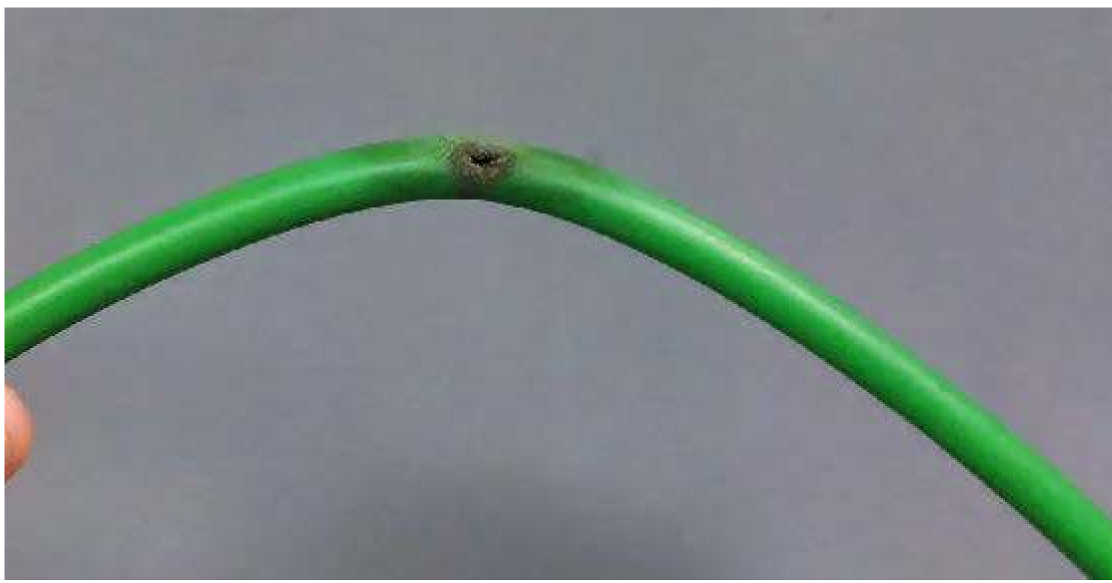
Purpose of Bonding/Shielding Wire:

1. To protect wires and cables from lightning surges - When lightning strikes the ground, its electro-magnetic energy is dissipated into the soil in an area as far as 15-20 miles from the point of impact. This electro-magnetic energy is then induced on the underground wires and causes thousands of amperes to flow in the copper conductors. At times, this high flow of current is sufficient to melt the copper conductor, which in turn melts the insulation of the wire.

ASIC

Optional Shielding Wire





Revolutionizing the way we manage water

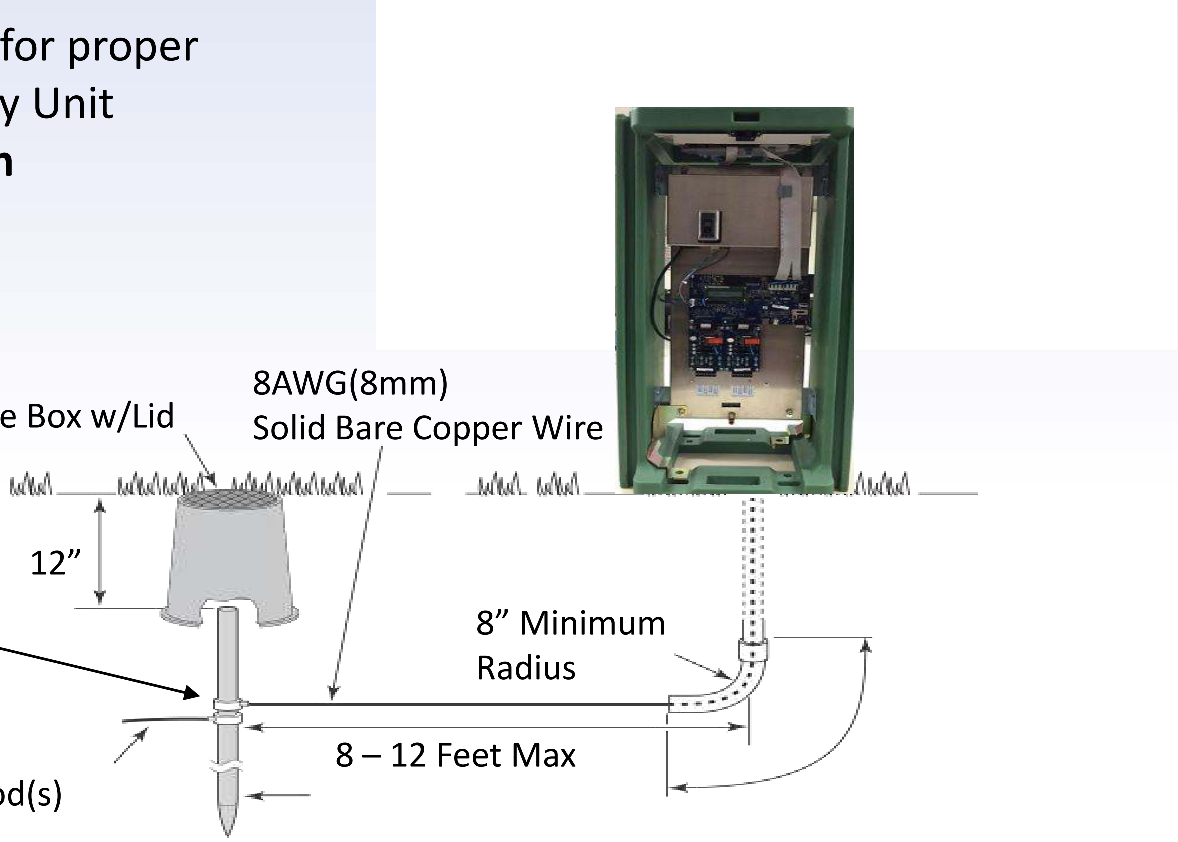
Install Confidence.
Install Rain Bird®.

Jerry Riley

Grounding / Clamp Tester

Earth ground should be attained for proper ground protection at the Gateway Unit

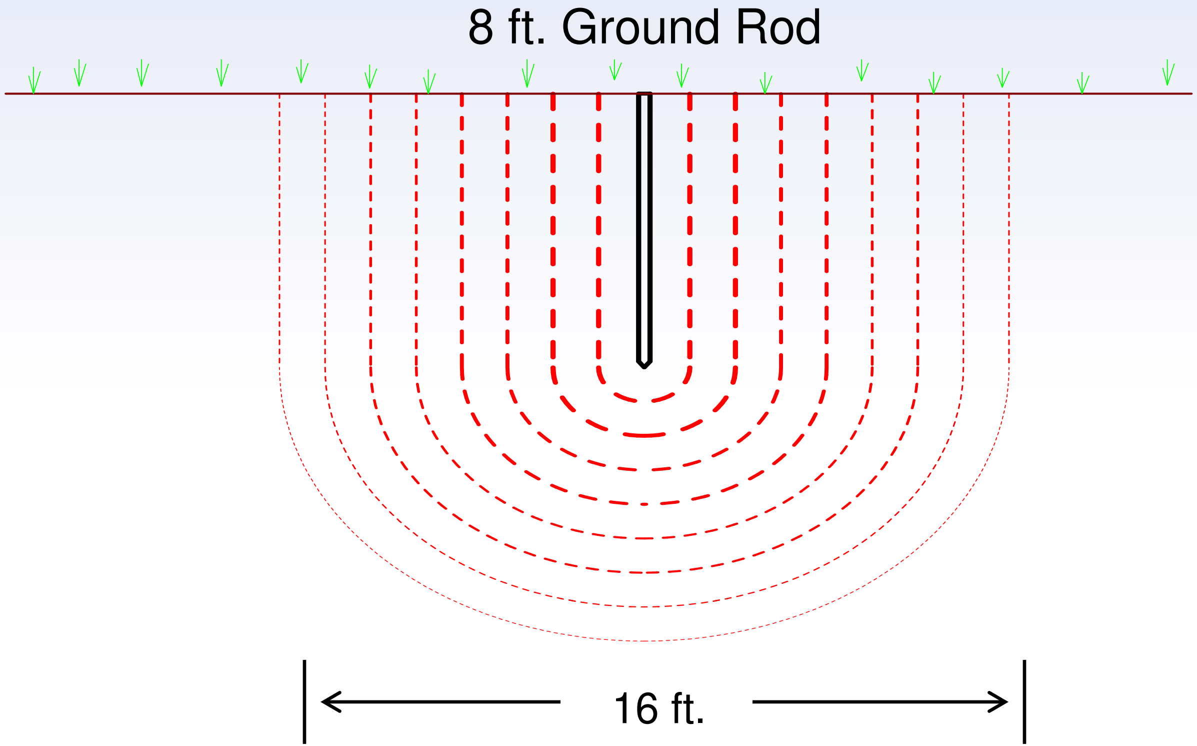
0 - 10 Ohms - Optimum



Toro recommends a 5/8” clamp or “Cad Weld” fastener for the wire to rod connection.

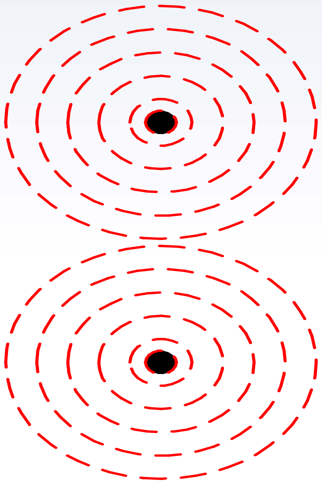
"The sphere of influence"

(For ground rods)

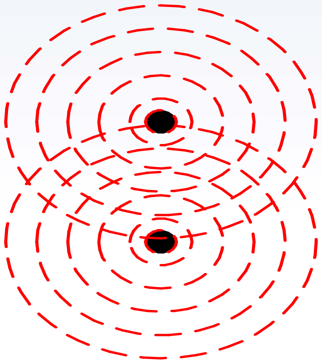


Ground rod spacing

(Top view)



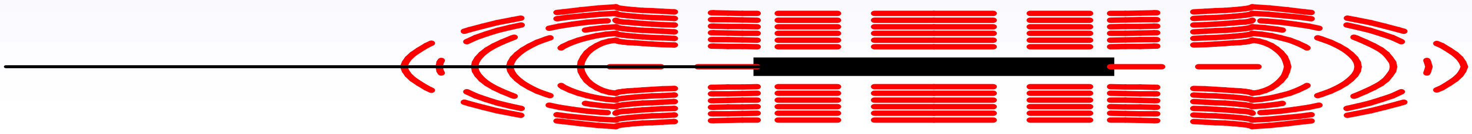
CORRECT
(2 times the ground rod length)



INCORRECT

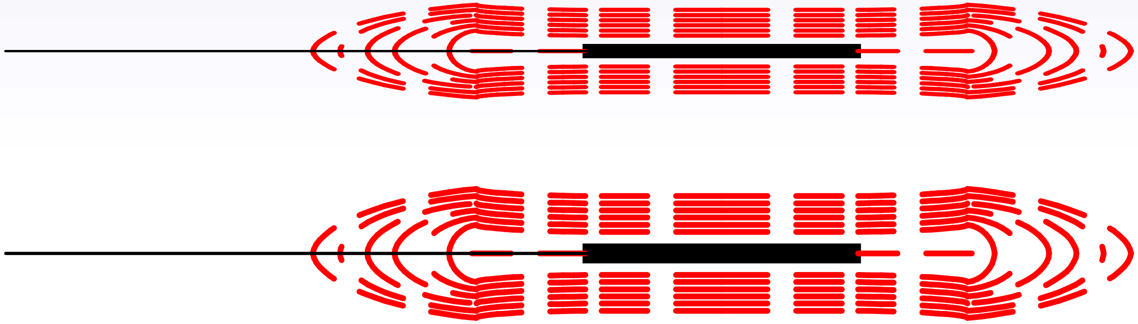
"The sphere of influence"

(For ground plates)



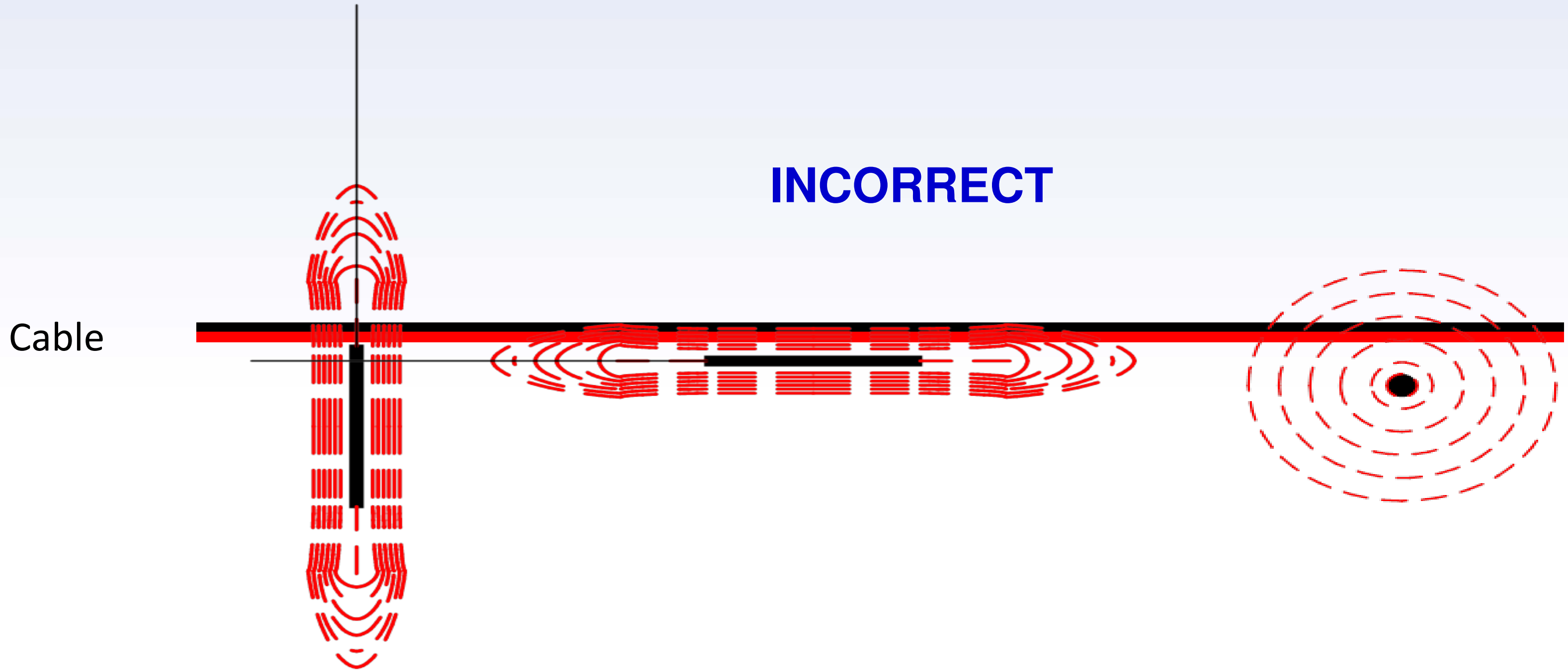
Ground plate spacing

(Top view)



CORRECT
(2 times the ground plate width)

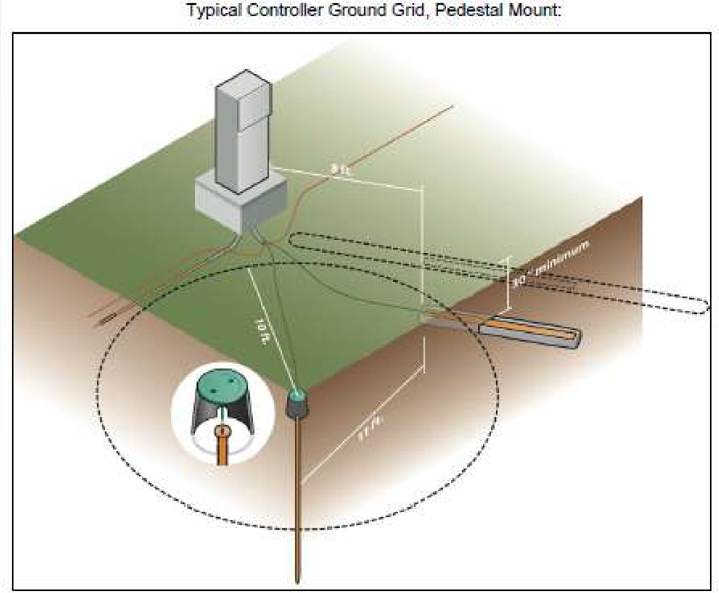
Ground rod/plate spacing



Ground rod/plate spacing

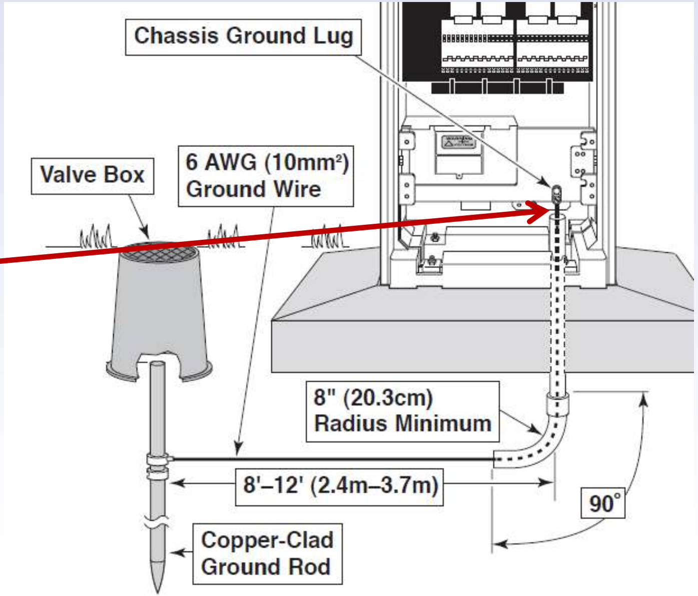
CORRECT

ASIC



When checking a resistance reading, make sure no other devices are connected to the same ground rod / plate.

Good ohm readings is less than 10 ohms



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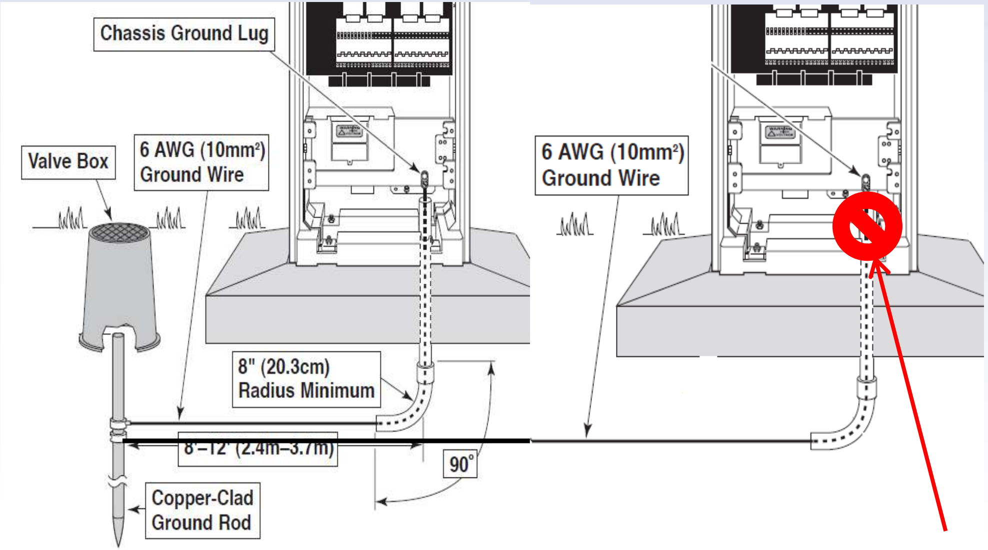
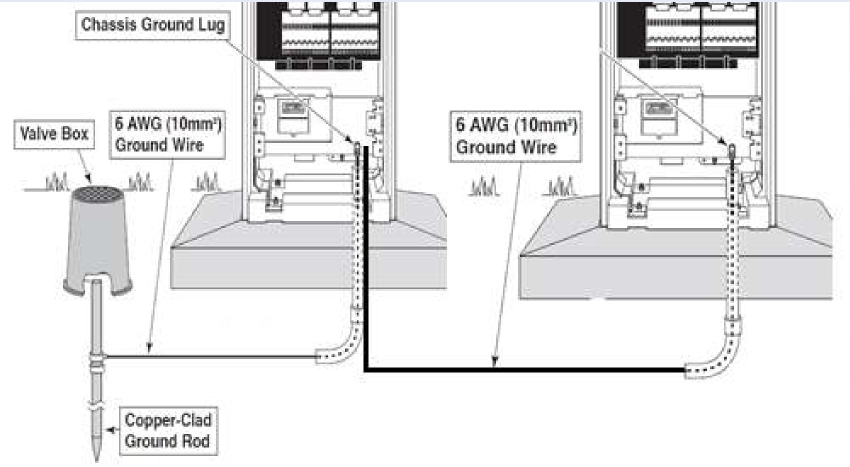
ASIC



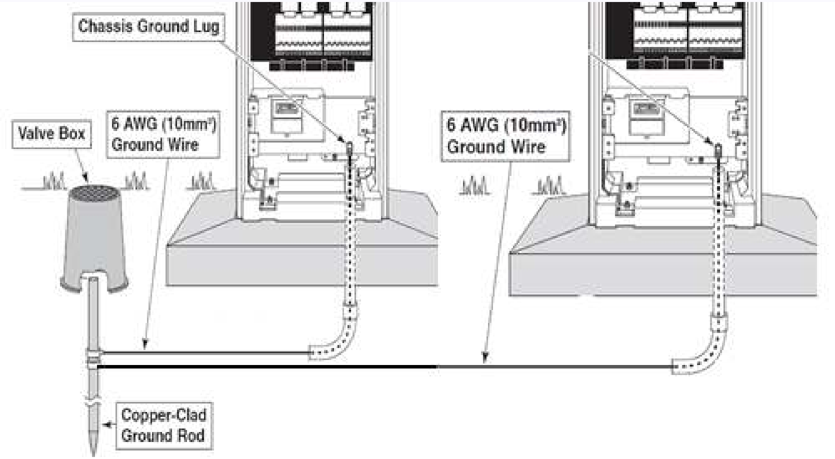
Disconnect ground wire

When a reading shows "Loop" above the ohm reading, that means other devices are connected to the same ground rod / plate



Incorrect

Correct



ASIC

Questions

Larry Spain

Tow Behind Sensor Technology

Larry Spain, LI 575, C.L.I.A.
The Toro Company

ASIC 2016 REGIONAL CONFERENCES
Southeast, Southwest, Northeast, & California
American Society of Irrigation Consultants

Precision Turf Management


Measuring & understanding variability
in site conditions is the challenge.

Precision Turf Management

Precision Irrigation Management
Site-specific Irrigation Management

Efficiency requires **Precision** requires **Information** requires **Sensors & GIS**

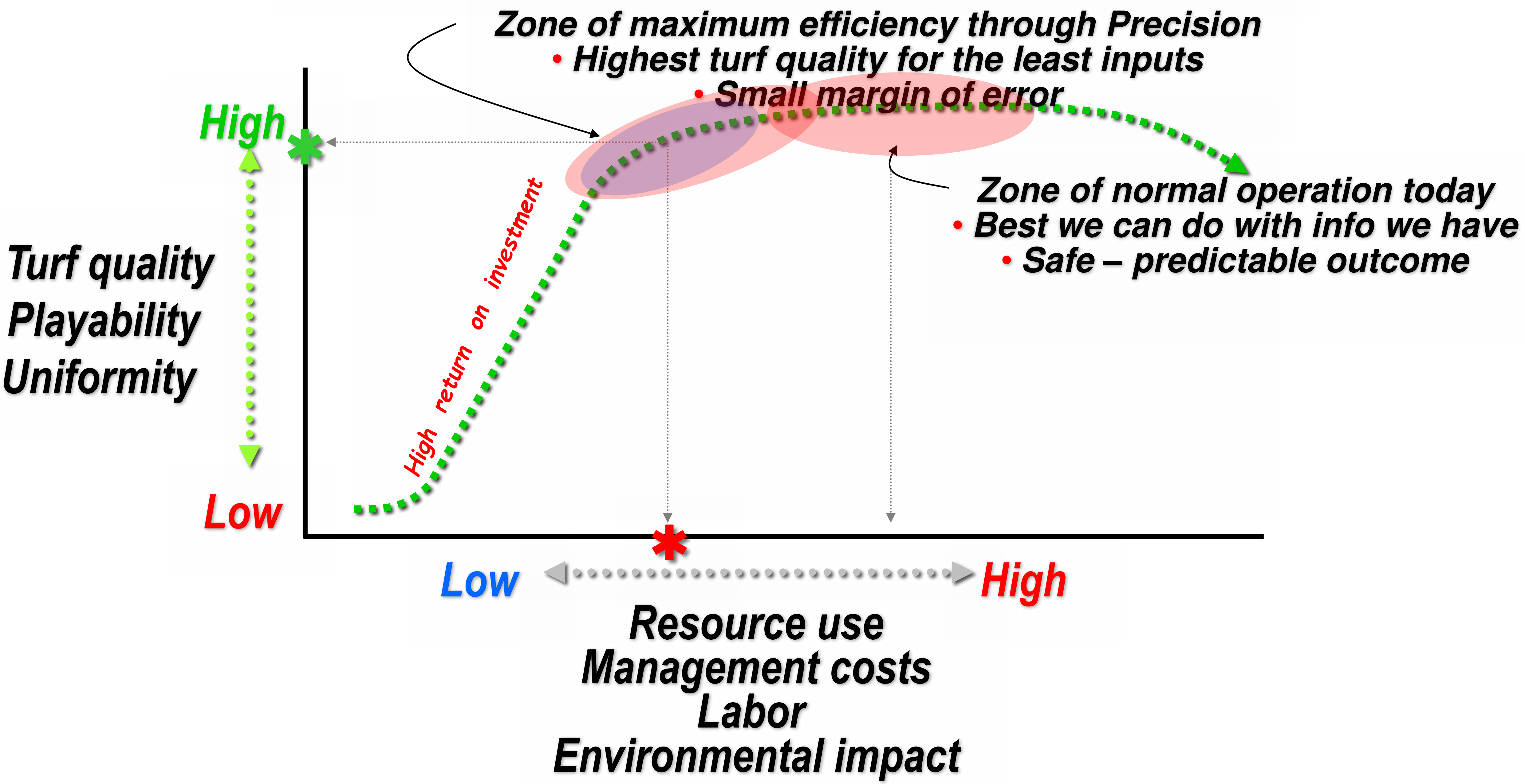
Efficiency
- Water use
- Operating budgets
- Labor
- Chemicals
- Fertilizers
- Equipment

Precision
- Precise application & management of all inputs

Information
- Critical agronomic site conditions
- Equipment performance

Sensors & GIS
- Soil Properties
  - Moisture
  - Compaction
  - Fertility
  - Salinity
- Turf Performance/Quality
- Topography/Relief
- Weather
- GPS

Precision Turf Management:
Turf Quality vs. Inputs



Efficient Water Distribution

- Precise Nozzles
- Precise Spacing
- Precise Patterns
- Precise Pressure
- Precise Trajectory
- Precise Scheduling
- Precise Frequency

Site Variability

- Soil Type
- Plant Type
- Root Depth
- Precipitation Rate
- Infiltration Rate
- Elevation/Slope
- Exposure
- Outside Factors

Real-Time Soil Monitoring

- Soil Moisture
- Salinity
- Temperature
- Measurement
- Durations

TORO. Count on it.

Efficient Water Distribution

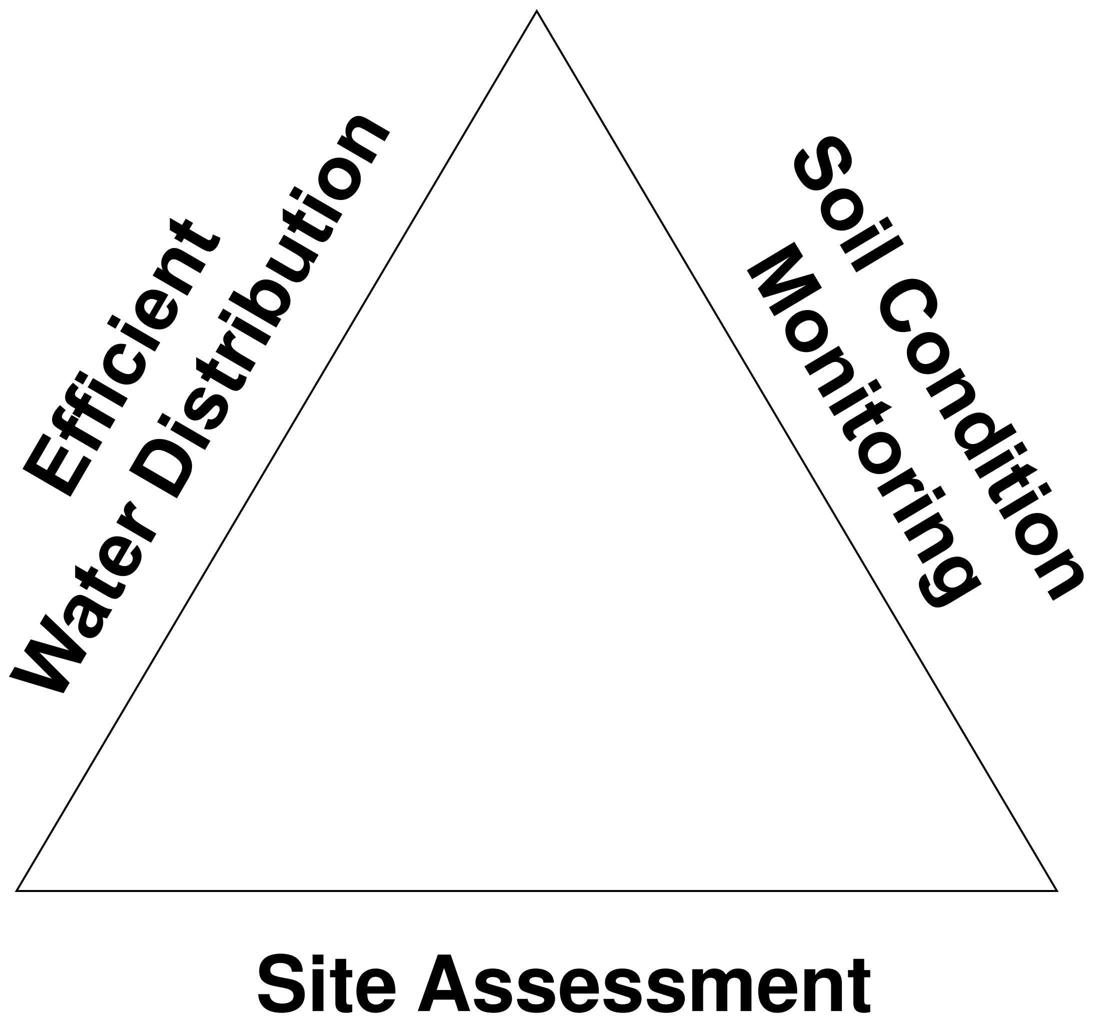
- Infinity Sprinkler
- LYNX Software
- P.A.C.E. Software
- Audit Kits

Site & System Variability

- Soil Type
- Plant Type
- Root Depth
- Precipitation Rate
- Infiltration Rate
- Compaction
- Elevation/Slope
- Exposure
- Outside Factors

Real-Time Soil Monitoring

- Turf Guard Soil Sensors
- Hand-Held Sensor


Efficient
Water Distribution
Soil Condition
Monitoring
Site Assessment

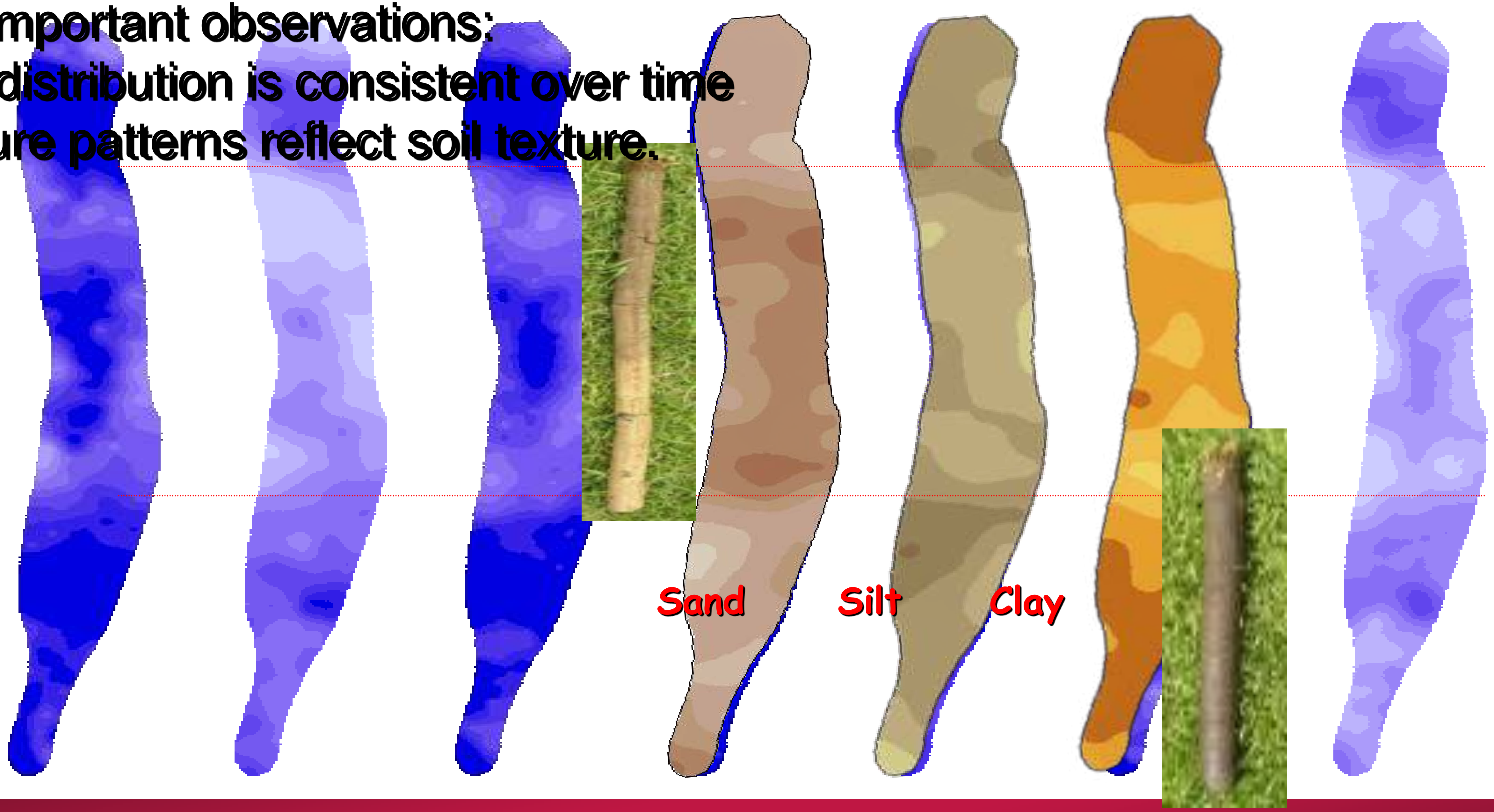
Decagon Soil Moisture Sensors

2003

Two important observations:

1) Soil moisture distribution is consistent over time

2) Soil moisture patterns reflect soil texture.



TORO Count on it.

Precise placement of Wireless Soil Sensors based on site evaluations will provide constant verification of soil conditions in like areas with minimal sensors

2007

PrecisionSense™ Site Assessment

PrecisionSense™ Data Collection Vehicle

PrecisionSense™ maps give you the information to help with Precision Turf Maintenance practices

TORO Count on it.

PrecisionSense™ Site Assessment

Sampling pattern

TORO. Count on it.

PrecisionSense™ Data Collection Vehicle

- *Decision-support system*
- *Data collection & analysis*
- *The product is Information*

Three Components:

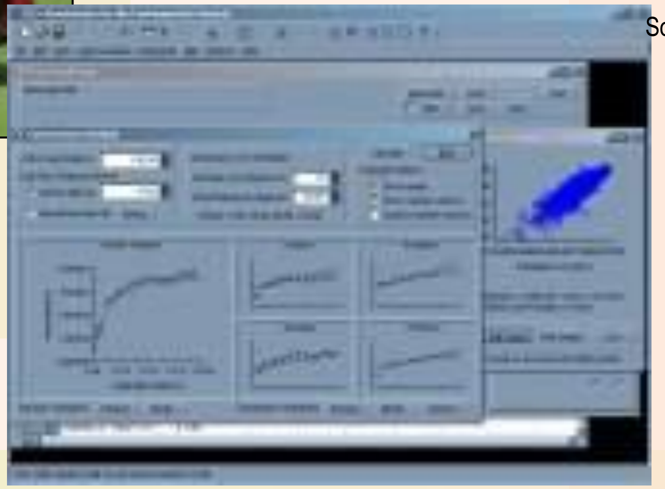
1) Data collection tools "PS 6000"
2) Data processing & analysis using GIS
3) Data interpretation & consulting

Data collection & analysis process

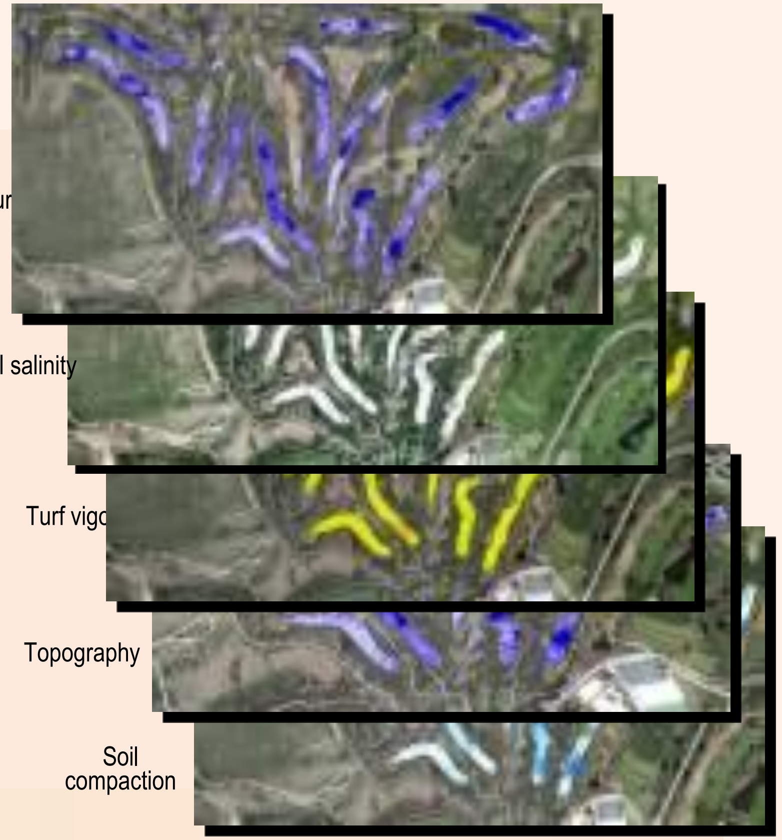
1 ***Data collection***
On-site – Distributor technician

Data transmitted electronically to Toro

2 ***GIS ArcView processing & analysis***
Toro



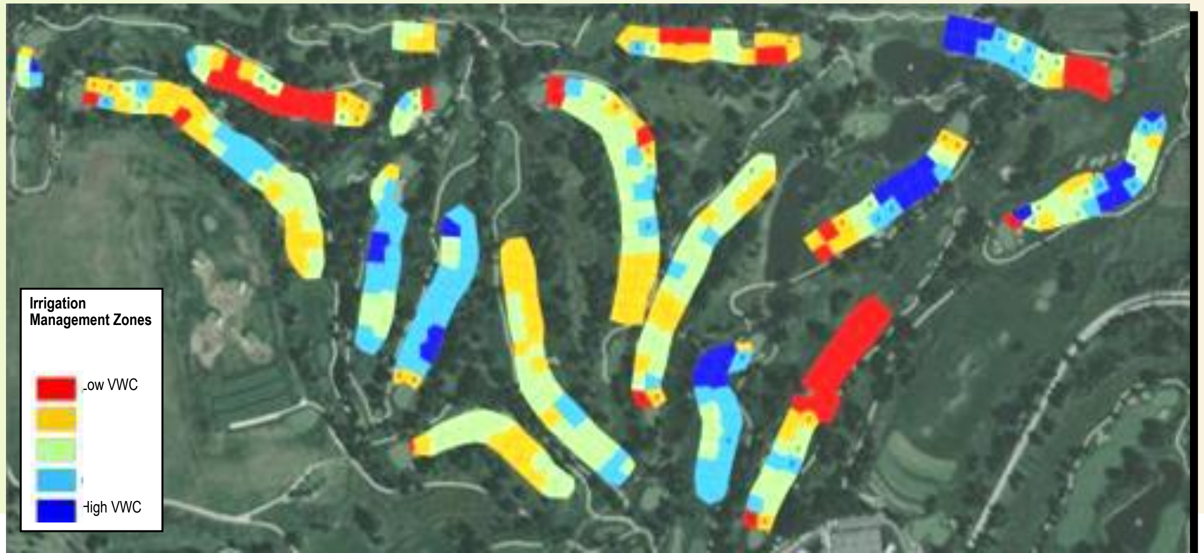
3 ***Primary Data Products (Google Earth format)***
Toro



4 ***GIS application analysis***
Toro

Analysis products delivered to consultant & customer electronically

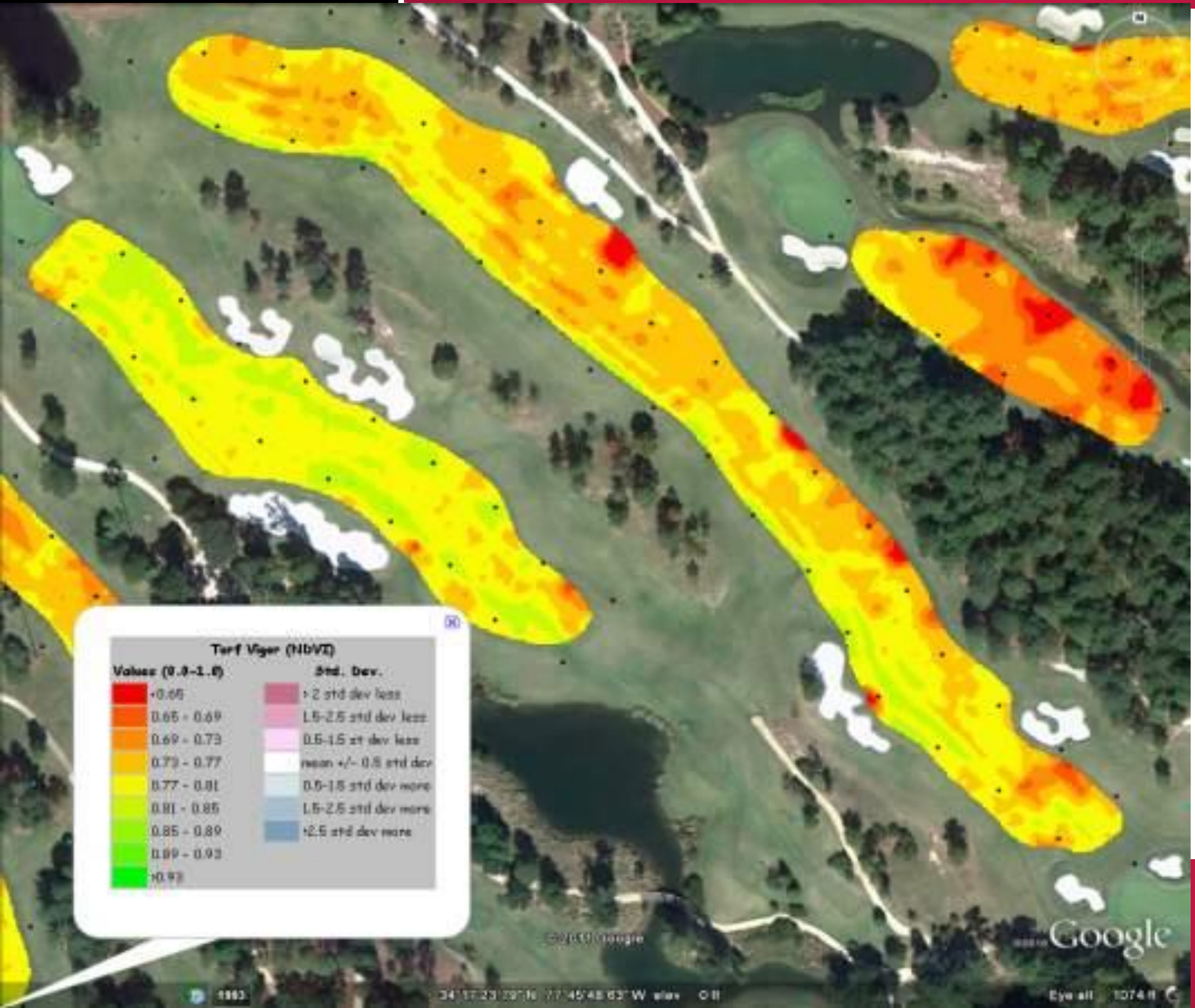
5 ***Application Data Products & Implementation***
On-site – Distributor consultant
- ***Irrigation management zones defined***
- ***Turf Guard sensor placement***
- ***SitePro/Lynx customization***



Services Offered

Base Maps

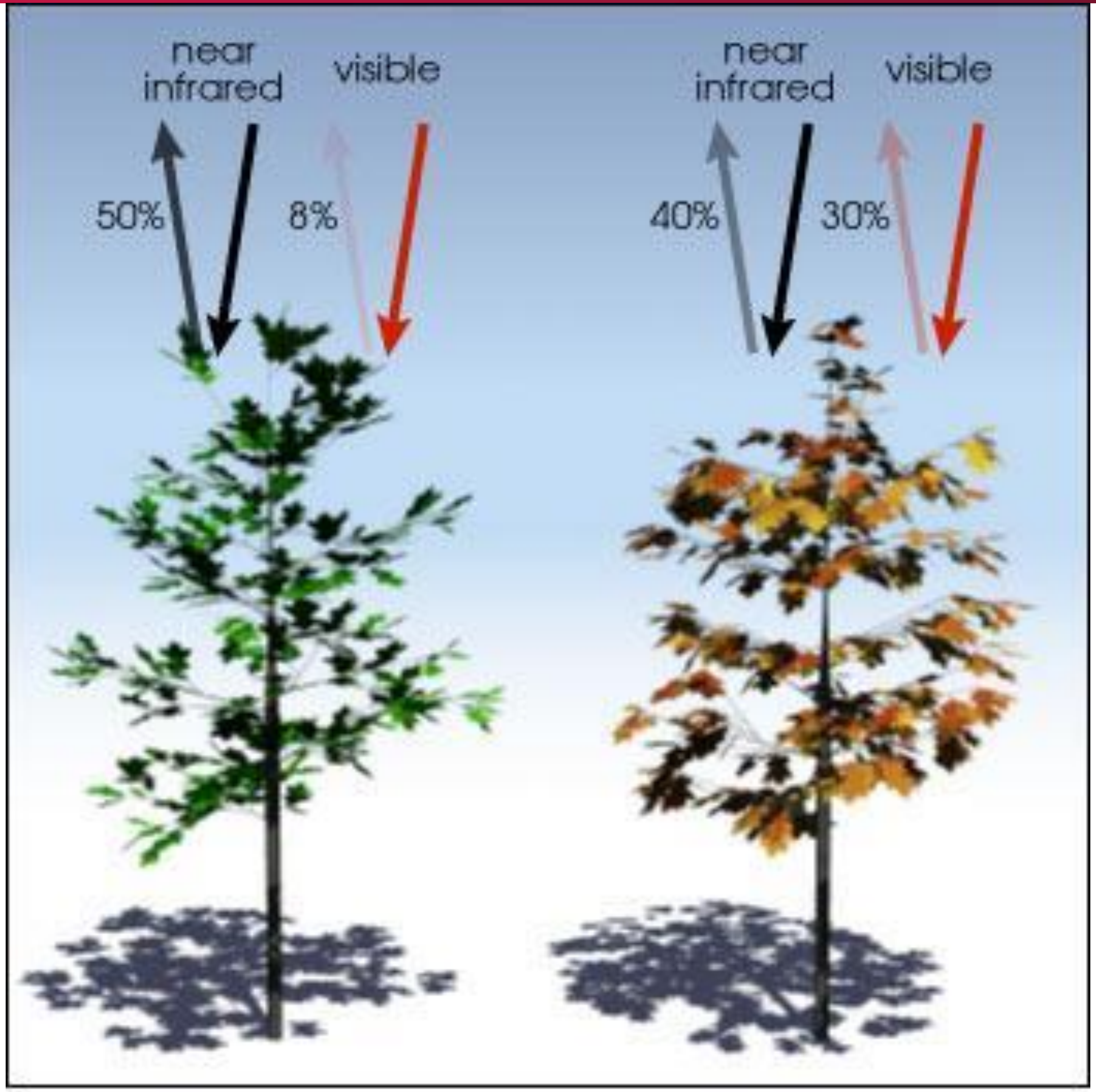
Soil Moisture (VWC)



Turf Vigor (NDVI)

NDVI

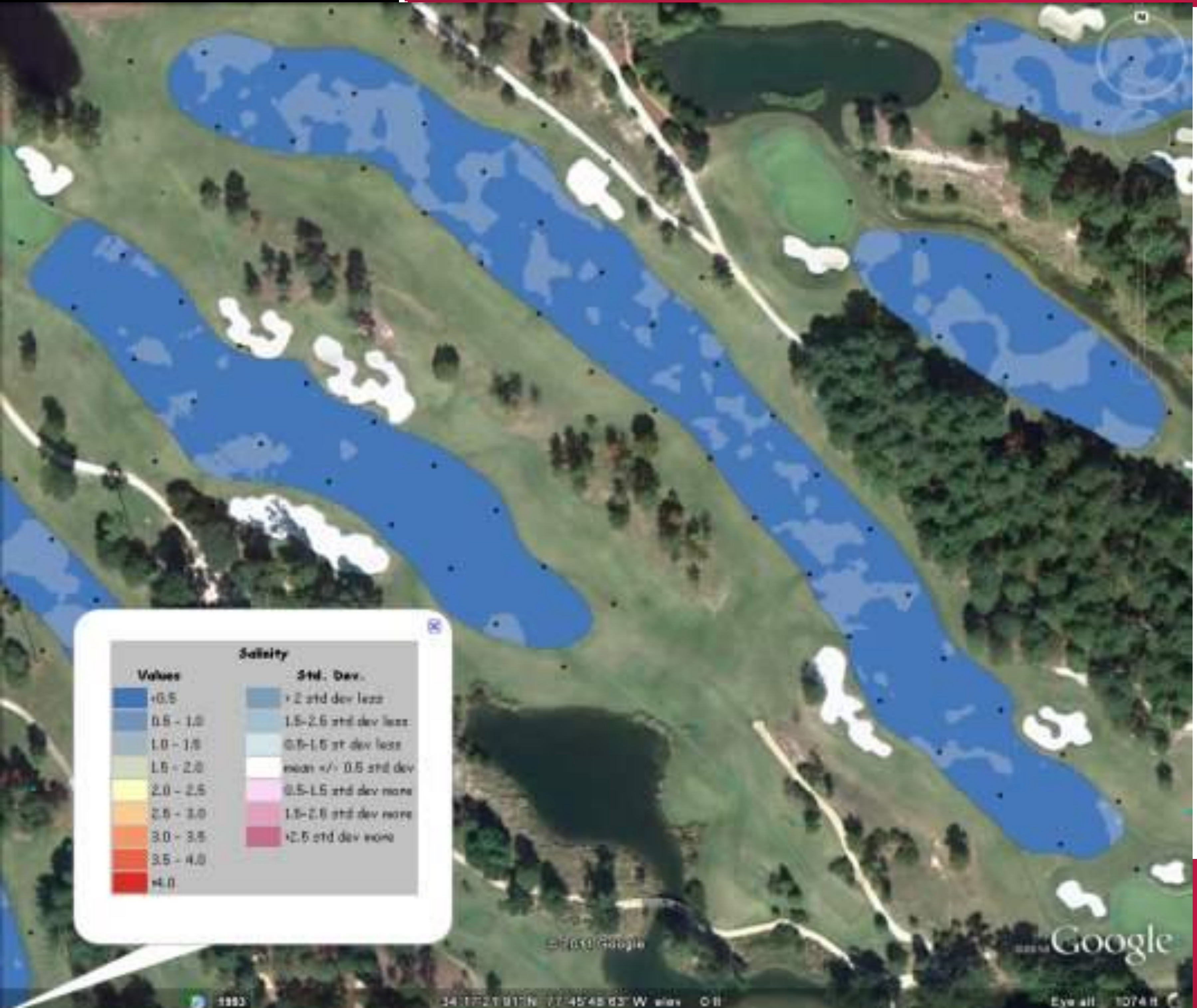
Normalized Difference Vegetation Index



$$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72 \qquad \frac{(0.4 - 0.30)}{(0.4 + 0.30)} = 0.14$$

TORO. Count on it.

Soil Compaction (P.S.I.)



Salinity

deci-Siemens (dS/m)

Salinity

deci-Siemens (dS/m)

Elevation

Contour Lines
Slope
Aspect

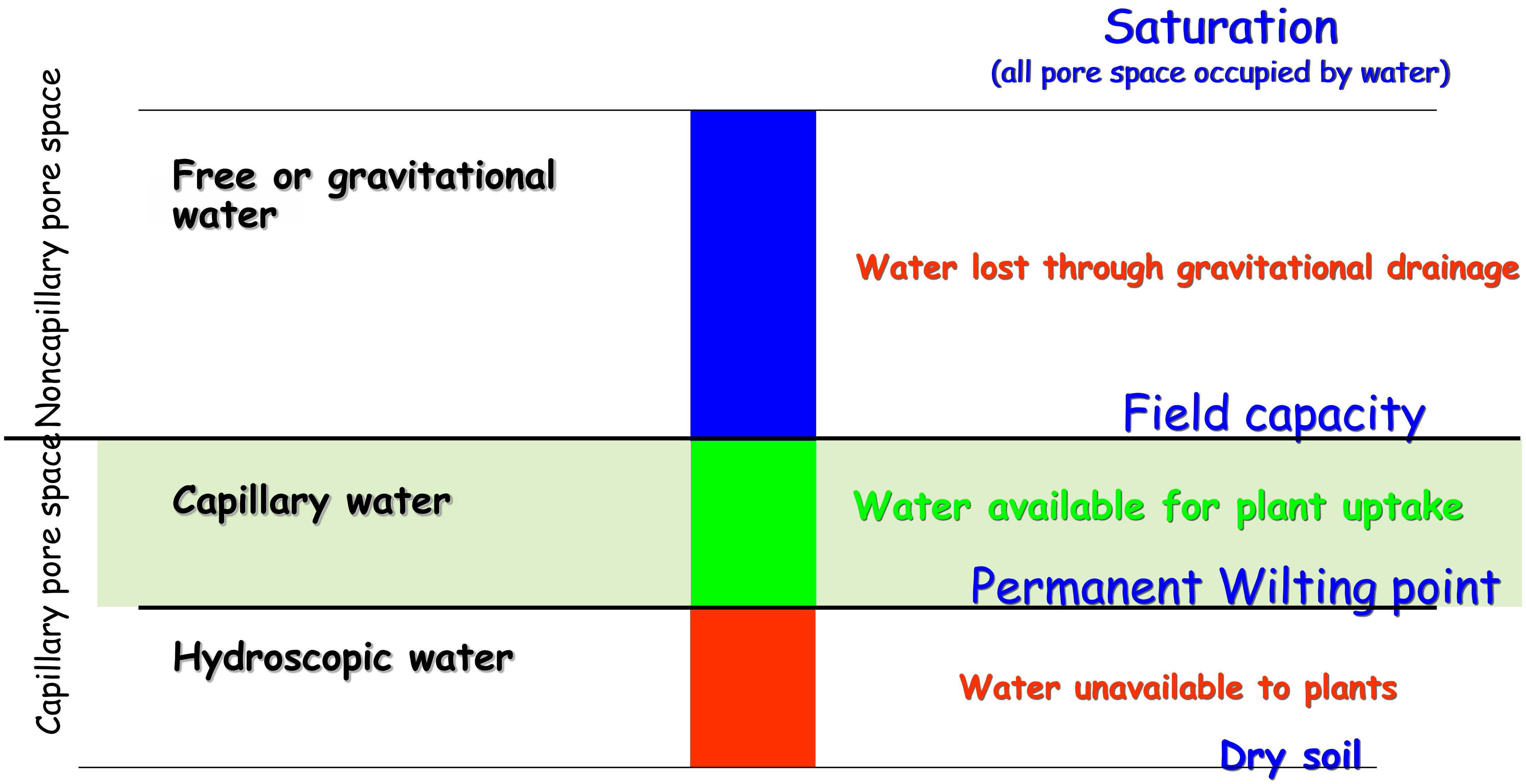
Topography

Contour Lines
Slope
Aspect

Precision Management Zones

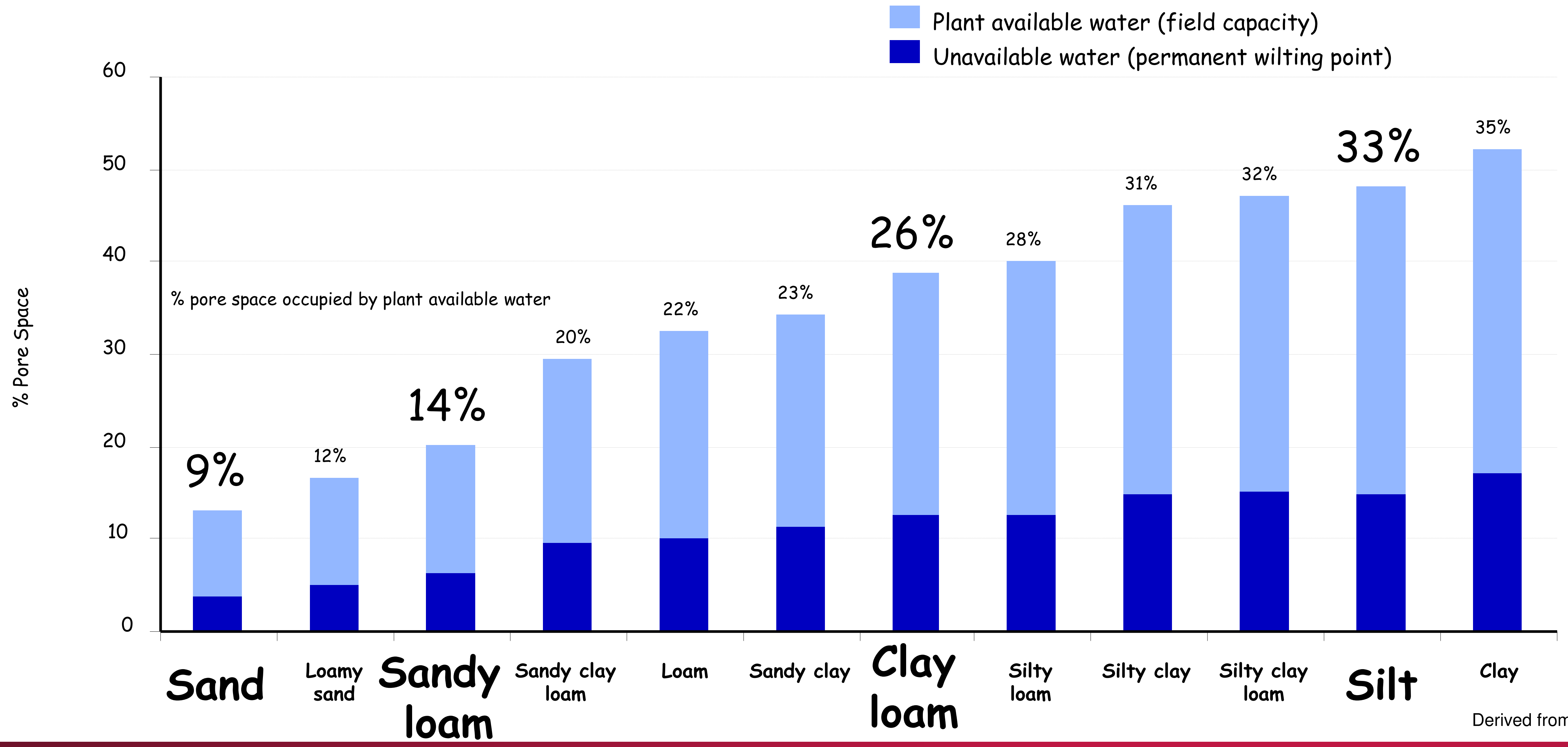
TORO Count on it.

Soil Moisture Classification



How Big Is The Tank?

Water holding capacity depends on soil type (texture)



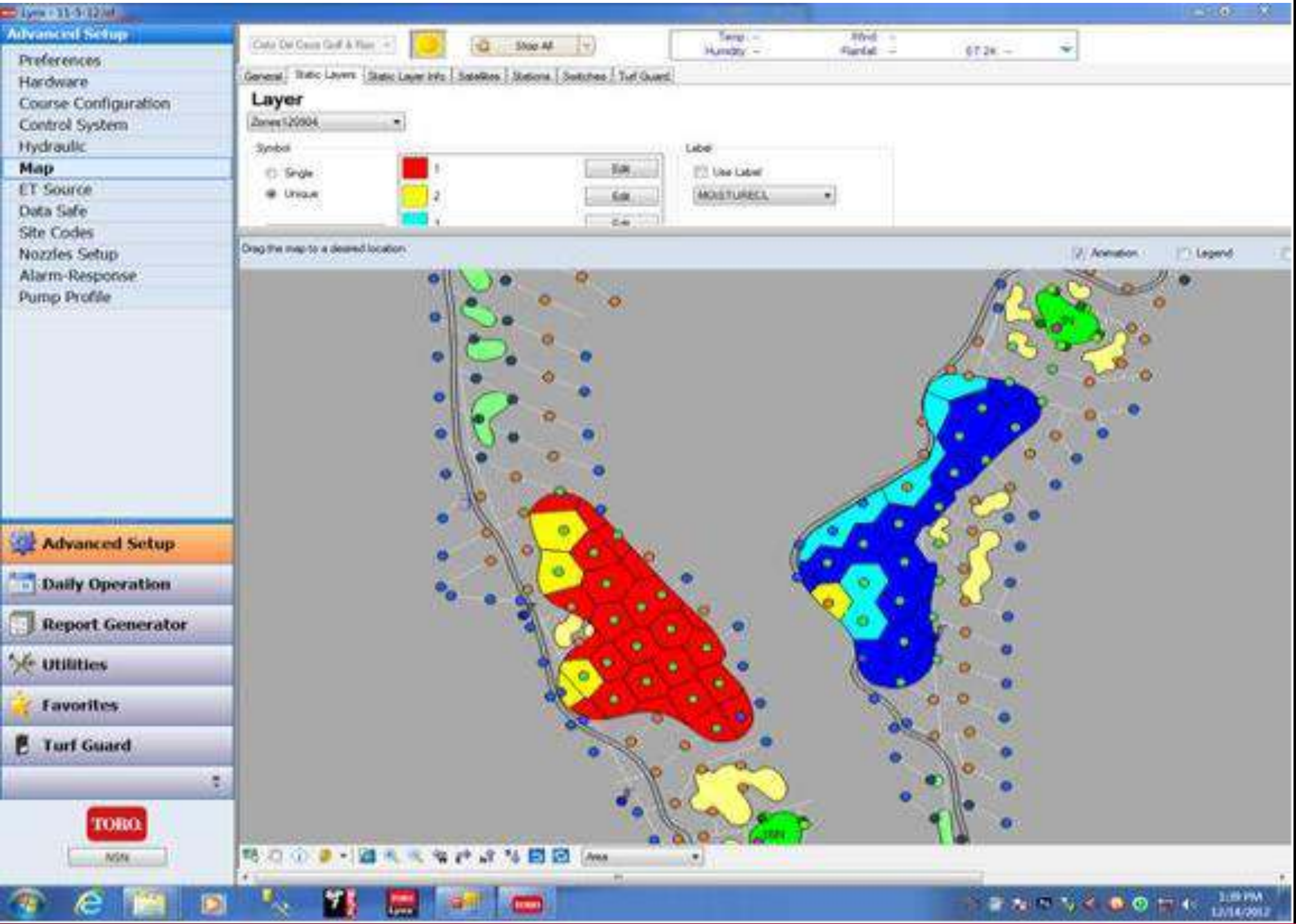
Derived from: http://weather.nmsu.edu/models/irrsch/soiltype.h

TORO Count on it.

Measurement of soil moisture (VWC) at field capacity reveals soil texture variability

TORO Count on it.

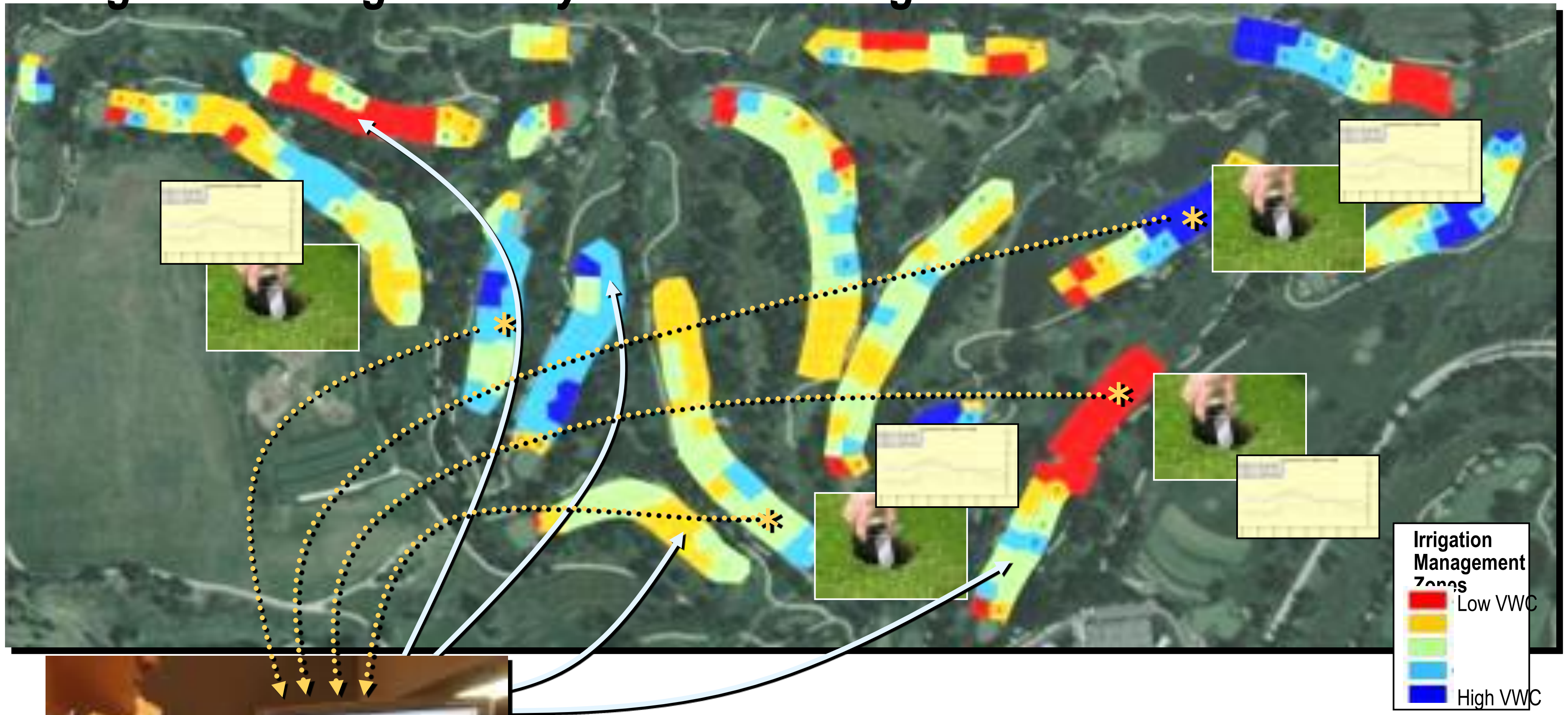
Using that variability, Irrigation Management Zones are identified down to the sprinkler level for scheduling of irrigation by soil type and for Turf Guard sensor placement

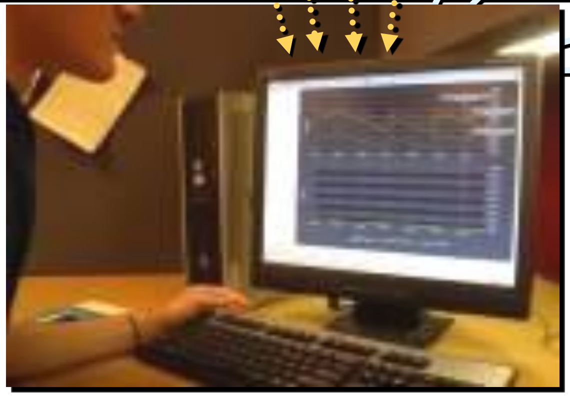


Map layers can be added to Toro's LYNX central software for use in reprogramming to use the management zones.

TORO Count on it.

Irrigation Management by Zones with In-ground Soil Sensors





Implementation:

- Turf Guard senor placement & installation in individual zones
- SitePro/Lynx customization – program by irrigation zone
- Turf Guard sensors provide continuous feedback
- Readjusting with experience
- Resampling & remapping???

TORO. Count on it.

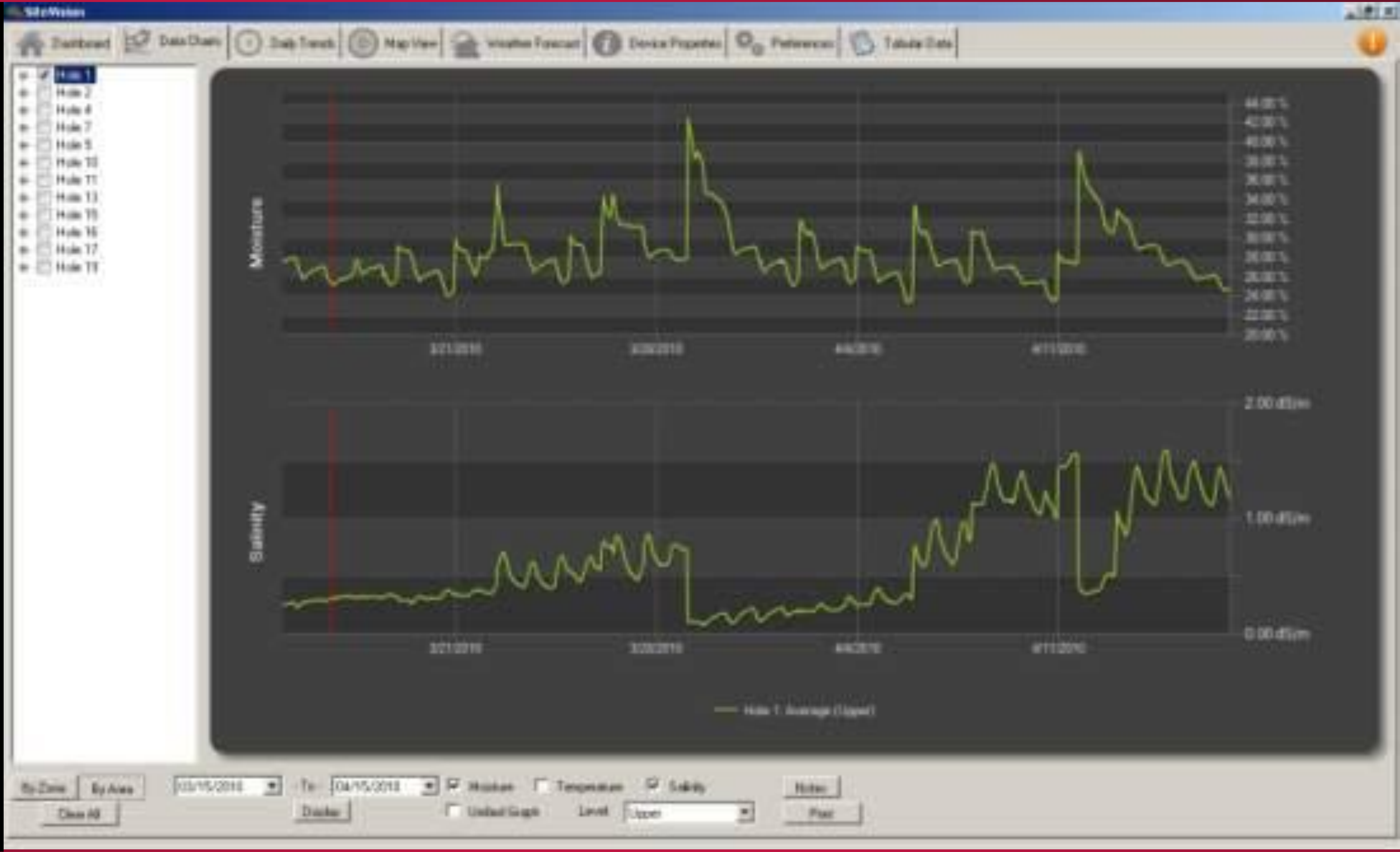
Precise placement of Soil Sensors based on site evaluations will provide constant verification of soil conditions in like areas with minimal sensors

TORO Count on it.

Software provides constant verification of soil conditions

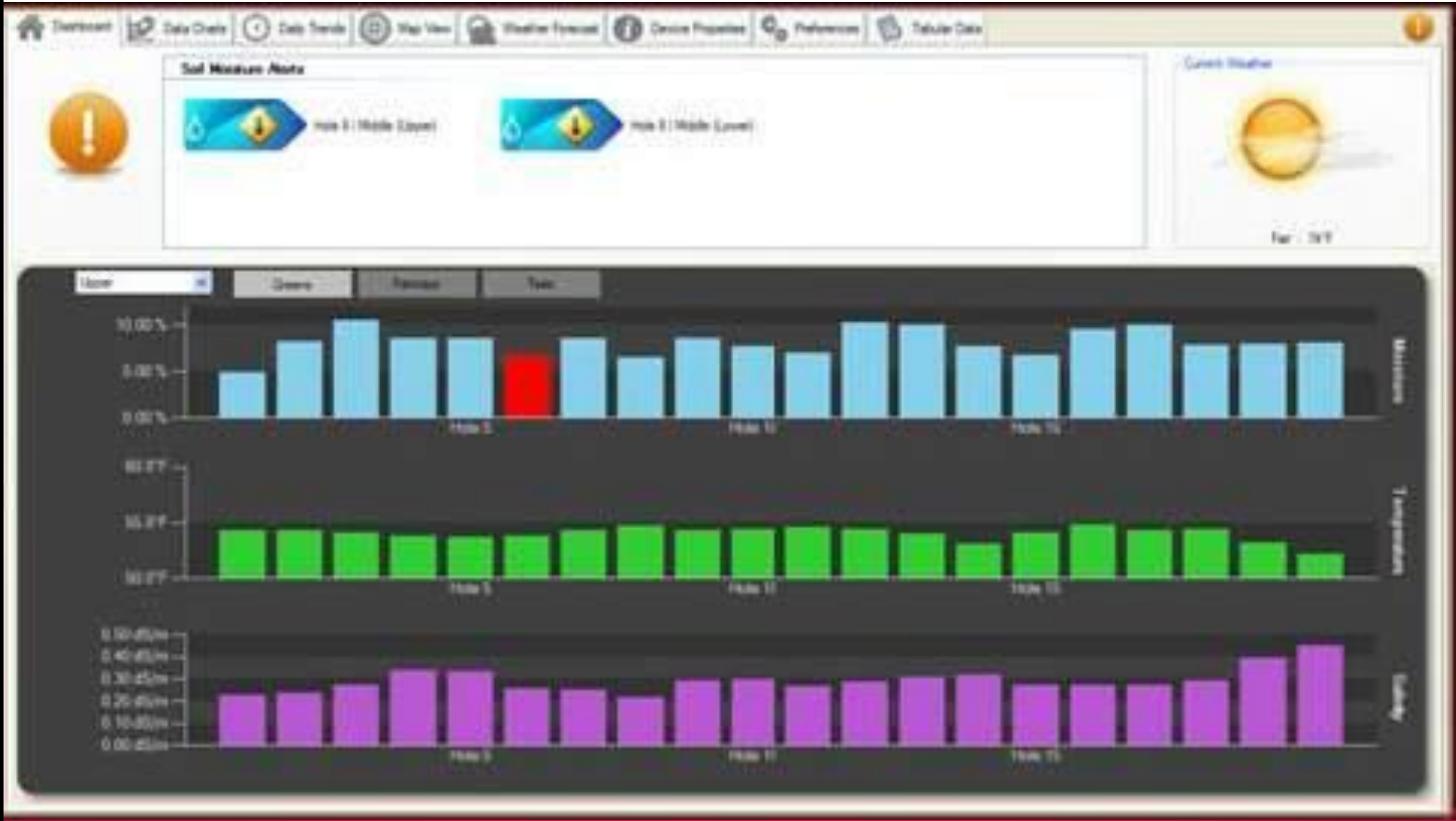
TORO Count on it.

Leaching events flush salts out of the root zone- verified by Turf Guard sensors

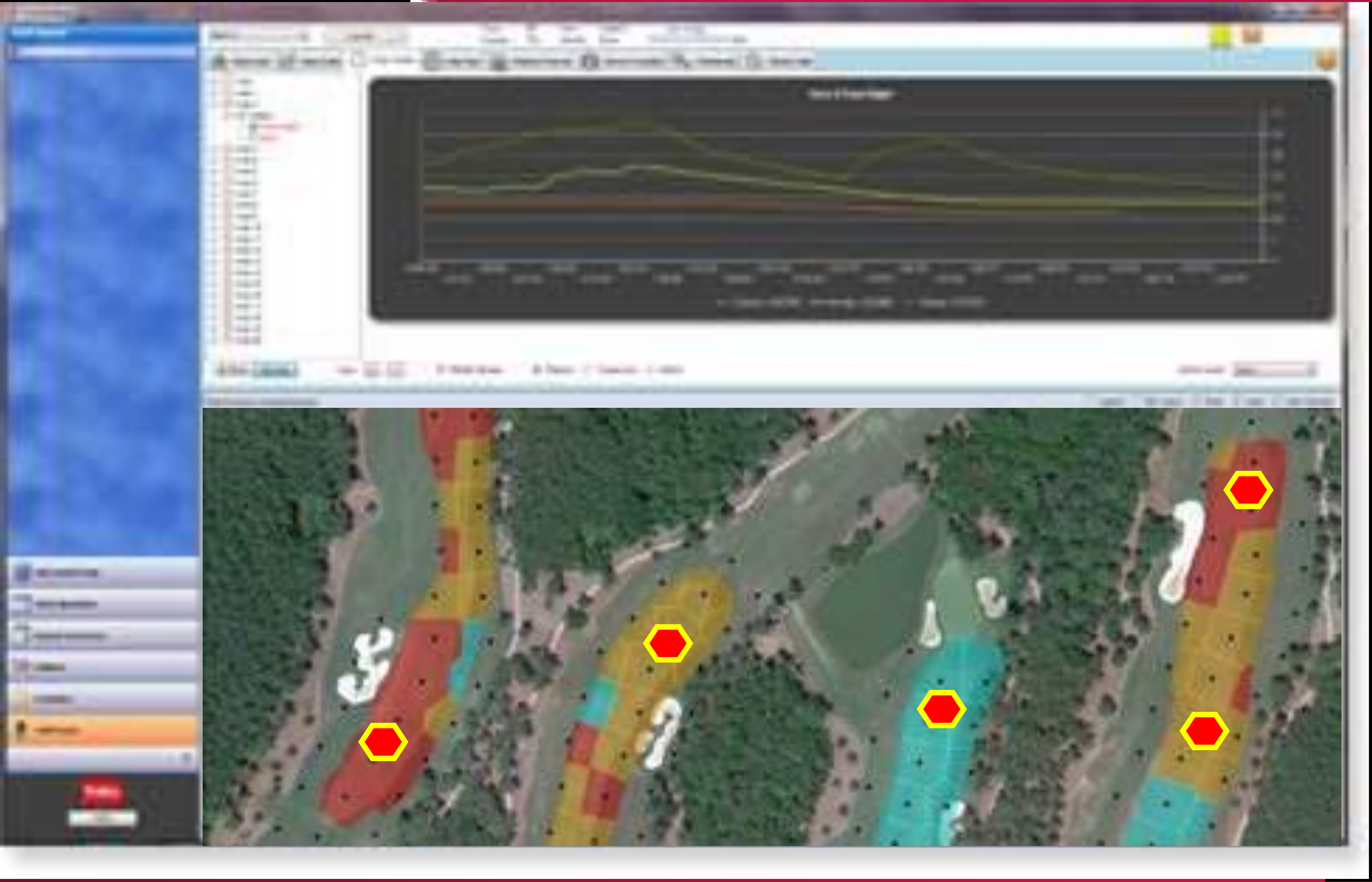


Compare soil temperatures across holes and sensors on each hole

Thresholds can be set to display indicators for moisture, salinity, & temperature levels

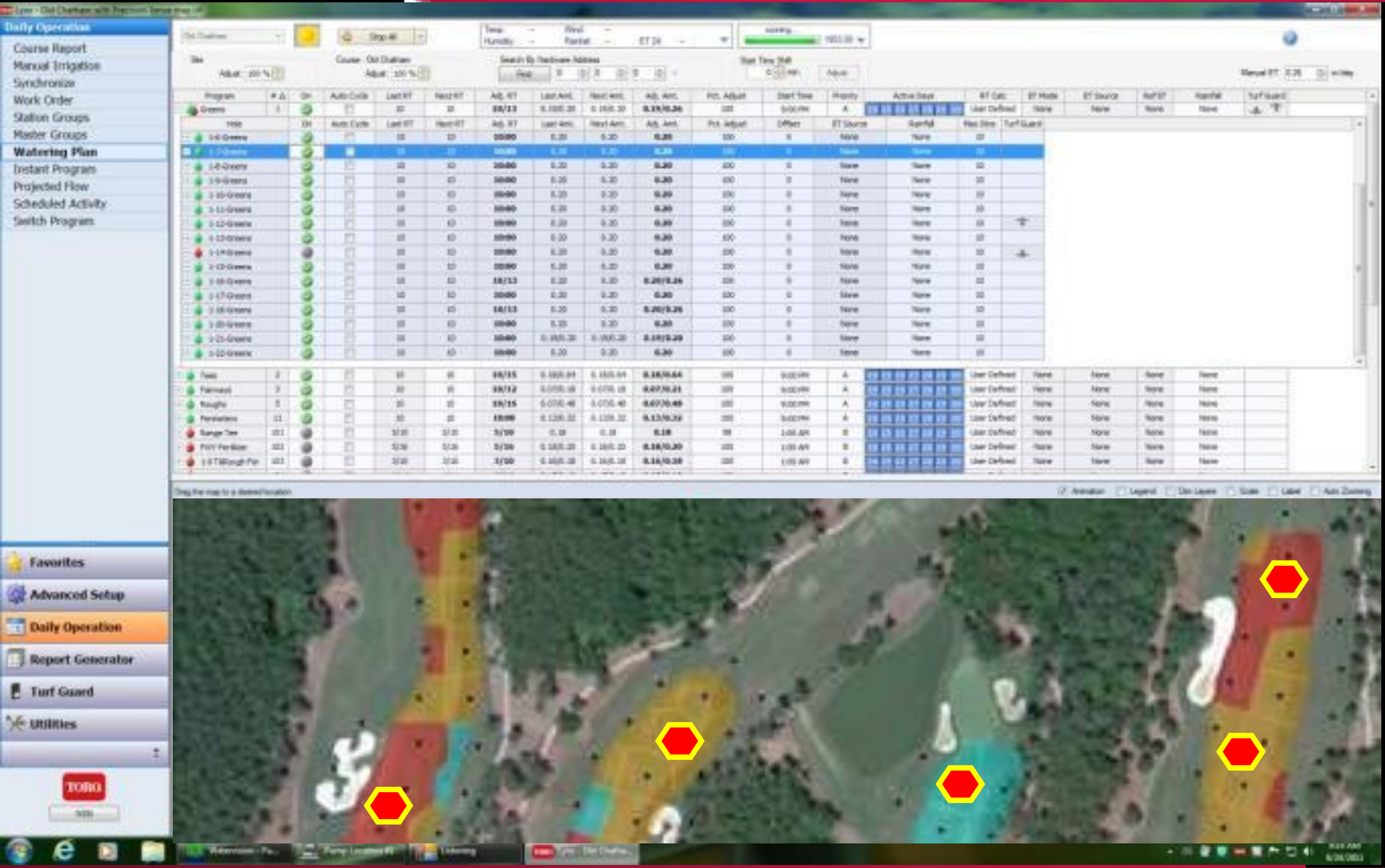


TORO Count on it.

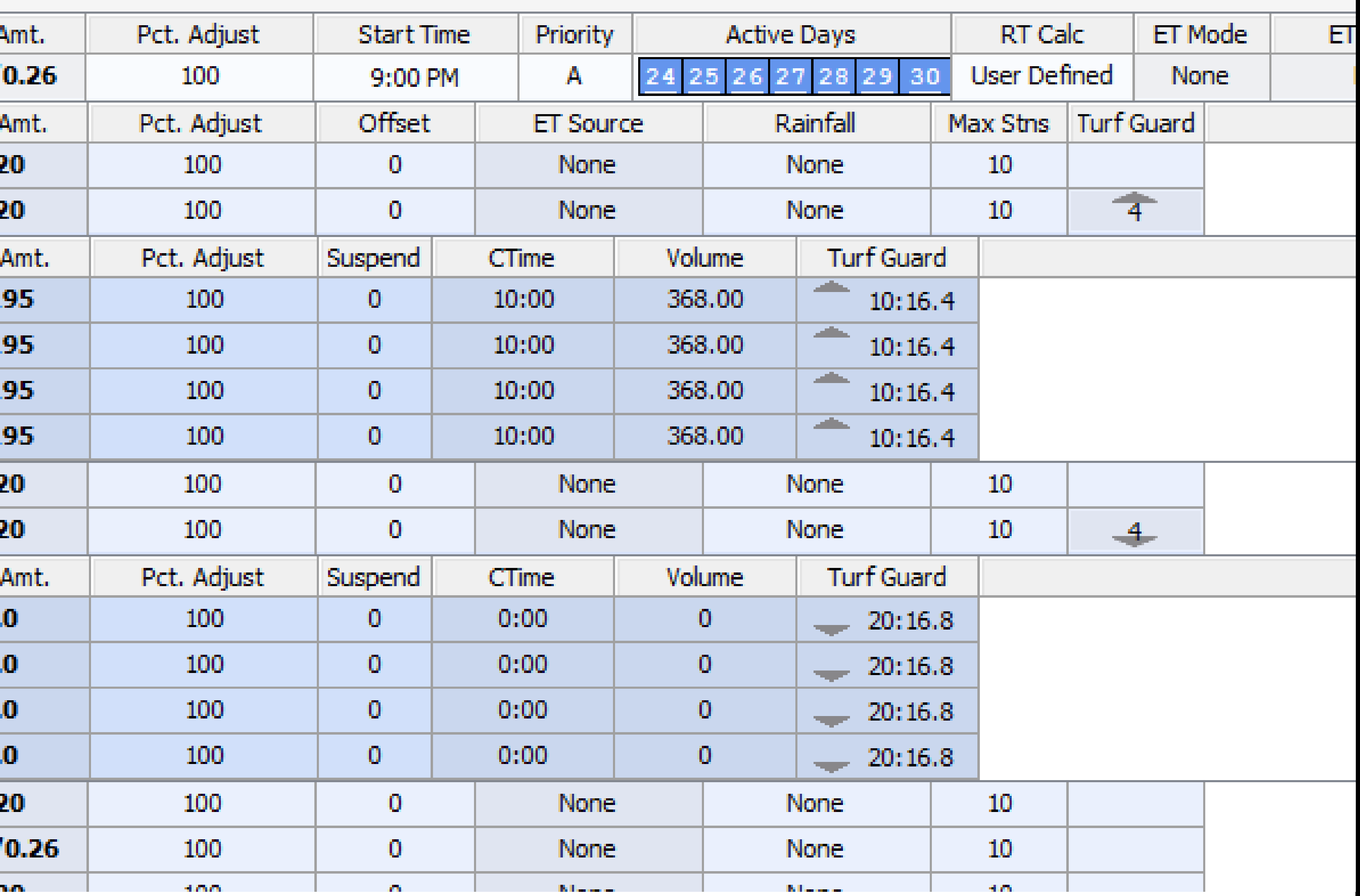


Turf Guard Sensor feedback can be linked to Toro's Lynx Irrigation Control Software for decision making

Count on it.

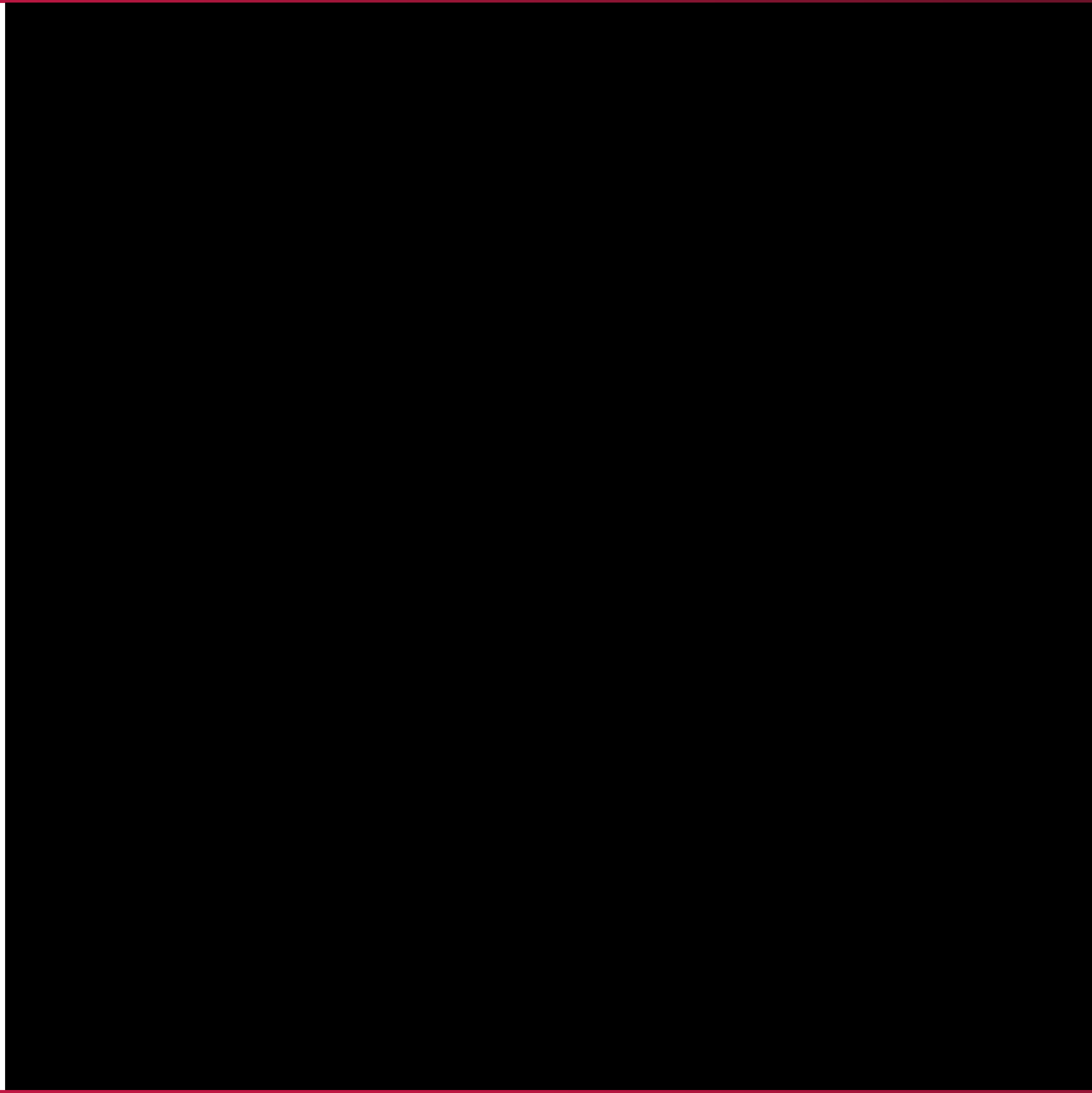


Turf Guard Sensors can be viewed in the Lynx Map for integrated decision-making



Here, the Turf Guard Sensors are indicating moisture needs for specific stations based on user-defined thresholds

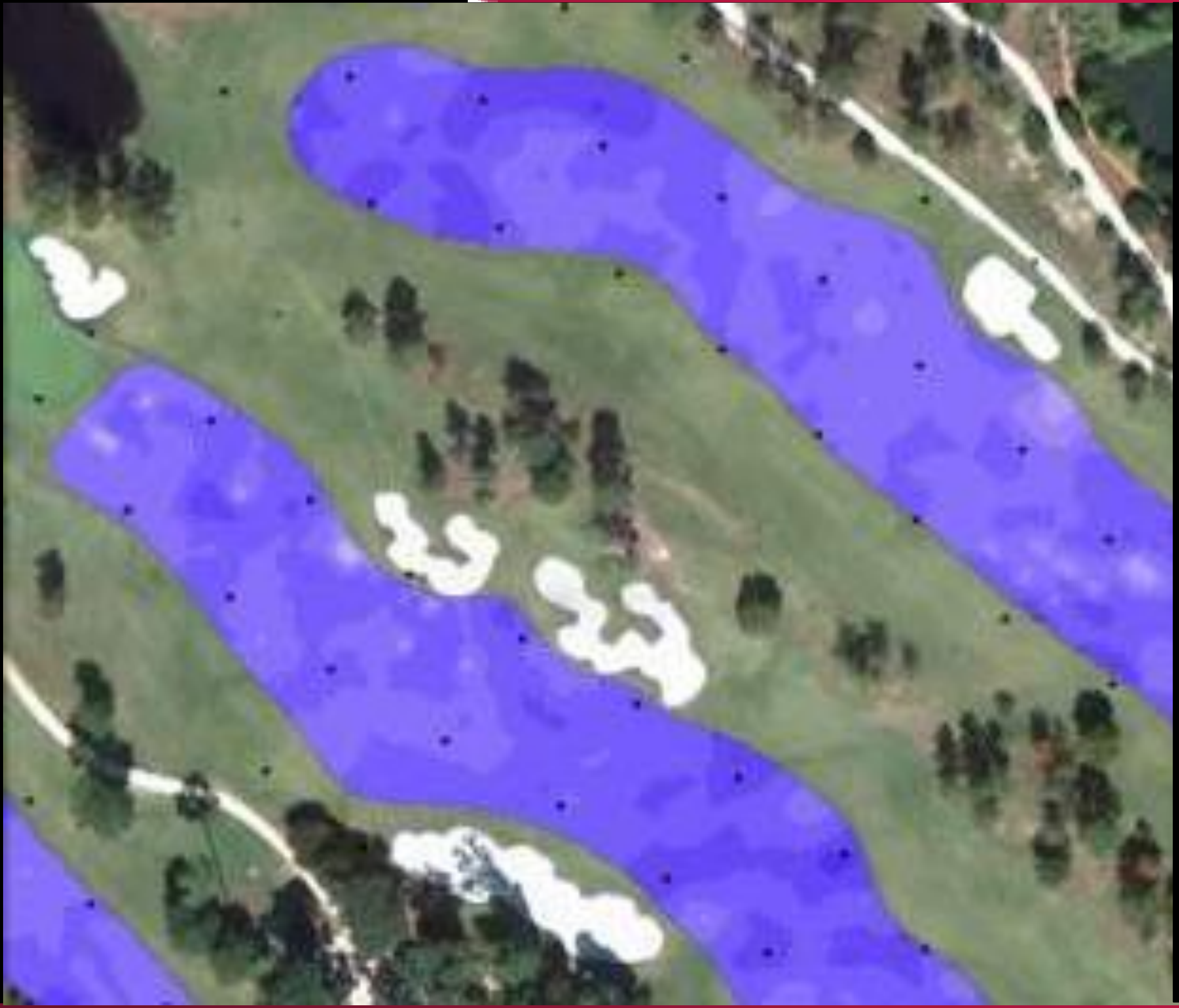
Precision Irrigation Audit



Irrigation Auditing

Distribution uniformity test using the catch-can method

Uniform soil moisture



TORO. Count on it.

Irrigation audit maps display Low Quarter Soil Moisture Uniformity (SMU) for identification of dry zones

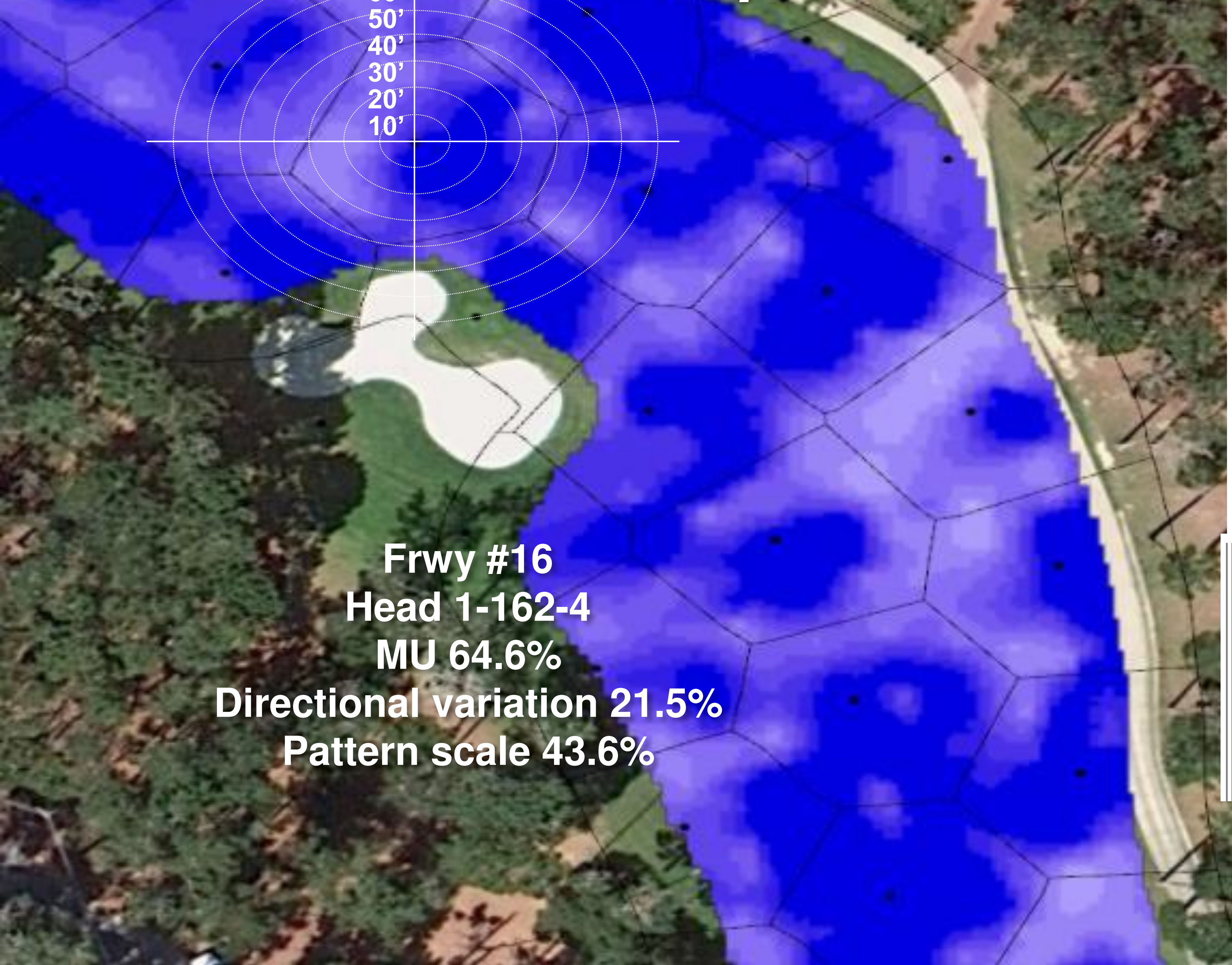
Irrigation audit maps display High Quarter Soil Moisture Uniformity (SMU) for identification of wet zones

TORO Count on it.

Compaction High Quarter maps help you see where treatment is needed to aid in water absorption and nutrient uptake

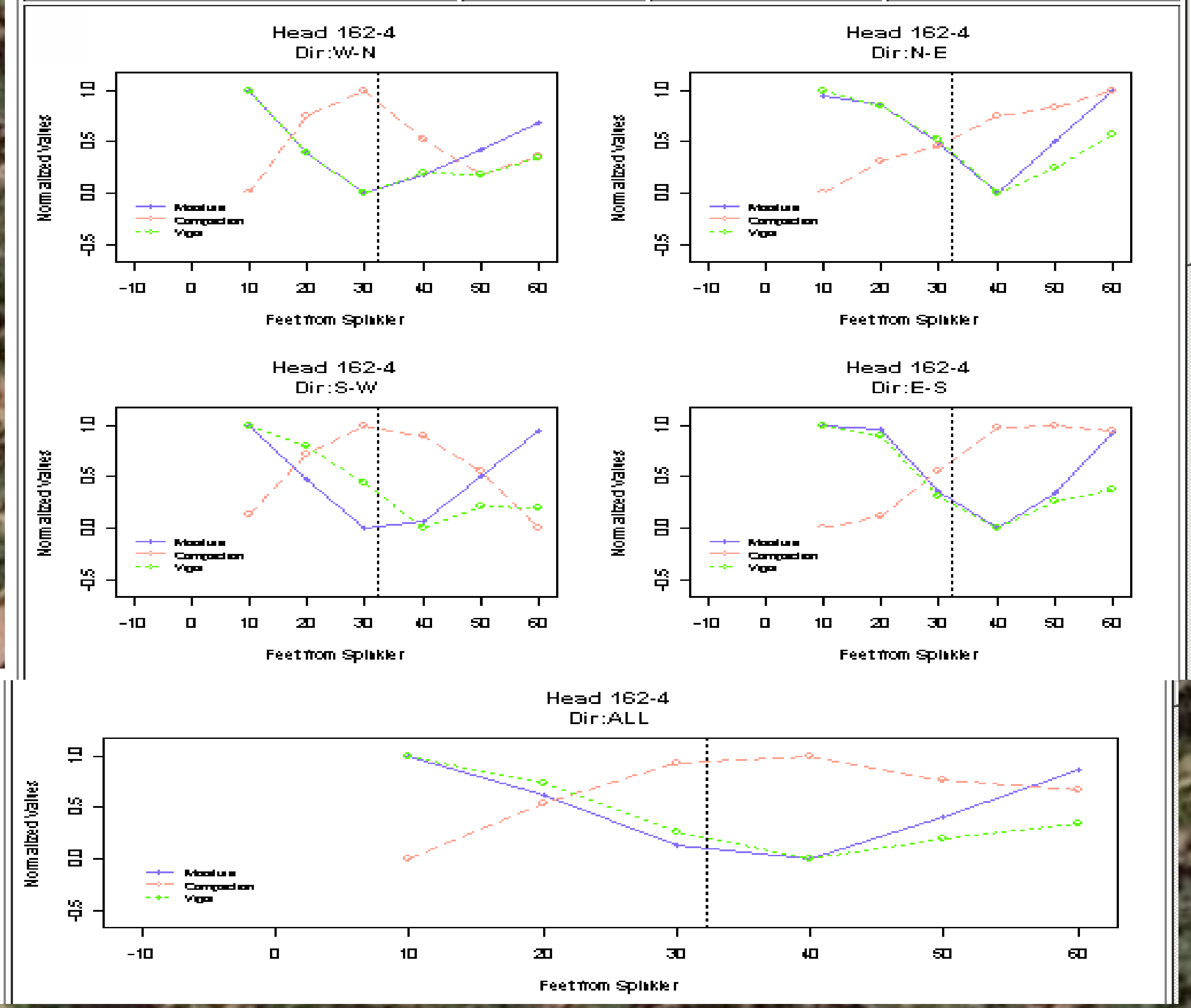
Irrigation Auditing

Evaluating soil moisture distribution around individual sprinkler heads



Frwy #16
Head 1-162-4
MU 64.6%
Directional variation 21.5%
Pattern scale 43.6%

ID: 162-4 Score: 1	Moisture Uniformity: 64.6%		
	Pattern: 1	Scale: 43.6%	Directional Variation: 21.5%
Head Impact Area Stats	Mean	CV	Soil Moisture Correlation
Soil Moisture	40.6	28.1%	
Compaction	213.3	4.3%	-0.86
Turf Vigor	0.868	1.9%	0.79

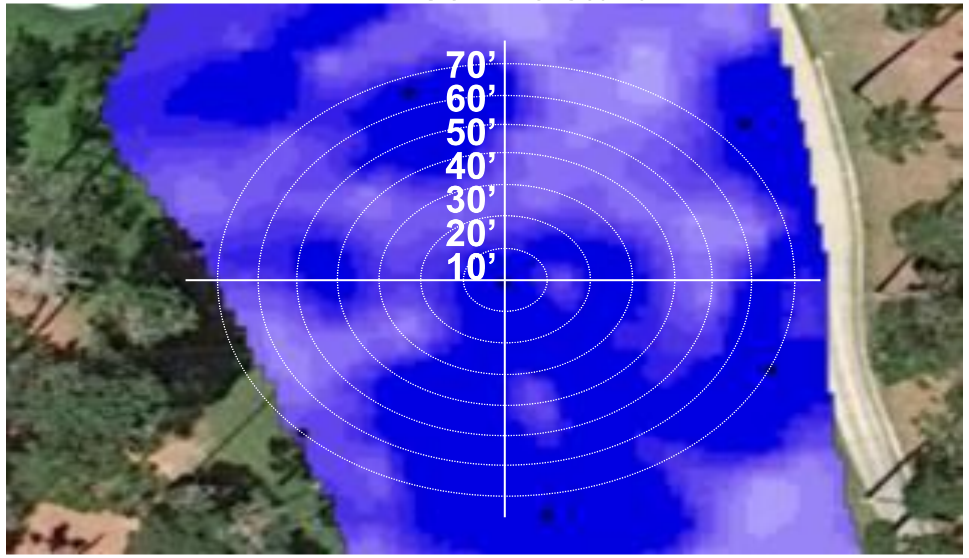


Individual Irrigation Head Level - Metrics

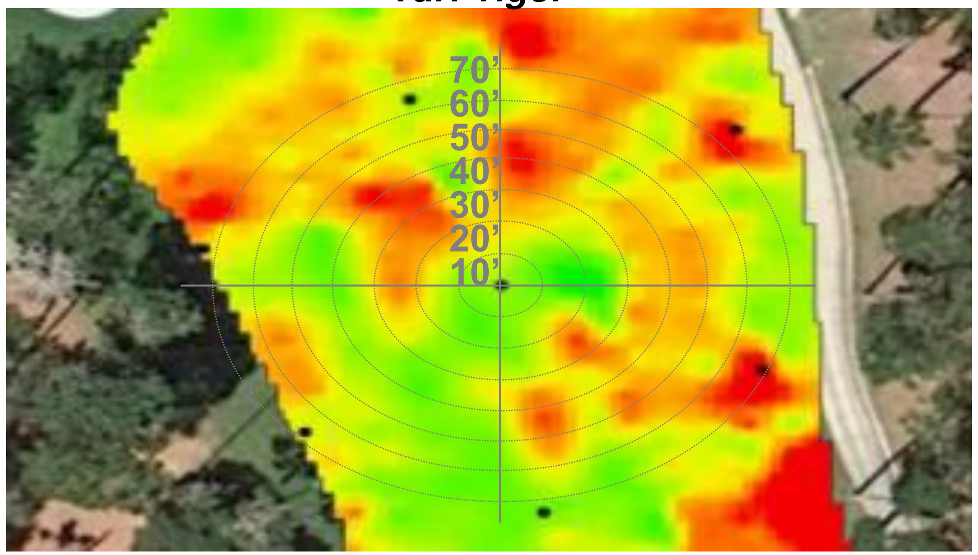
Head ID	Min	Mean	Max	Range	Std. Dev.	CV	Moisture Uniformity	Pattern	Pattern Scale	Directional Variation	Turf Vigor Correlation	Compaction Correlation	Score
162-10	20.63	47.38	87.2	66.57	12.78	27%	67%	1	22.89	18.2	0.40	-0.63	5
162-11	23.78	56.4	89.07	65.29	12.29	21.8%	70%	9	38.78	14.7	0.68	-0.67	4
162-12	23.37	51.52	80.22	56.85	12.81	24.9%	67%	1	62.78	9.7	0.42	-0.82	5
162-13	14.8	39.25	60.53	45.73	9.48	24.2%	67%	3	26.11	17.9	0.54	-0.79	4
162-14	15.77	46.53	97.92	82.15	17.19	36.9%	59%	1	72.30	21.2	0.41	-0.54	5
162-31	23.01	38.52	57.95	34.94	7.79	20.2%	77%	5	12.84	13.6	0.79	0.13	8
162-32	16.2	43.79	104.6	88.4	21.29	48.6%	53%	1	66.96	25.2	0.06	-0.53	5
162-33	23.26	45.99	99.83	76.57	17.81	38.7%	61%	13	29.00	31.4	0.67	-0.60	4
162-34	16.76	50.03	92.82	76.06	14.24	28.5%	61%	1	46.51	19.9	0.20	-0.51	5
162-35	25.9	40.88	59.03	33.13	8.6	21%	73%	7	23.19	19.4	0.81	0.19	4
162-36	15.37	30.59	56.71	41.34	9	29.4%	69%	3	48.56	16.9	0.39	-0.29	5
162-37	24.79	37.08	48.63	23.84	4.24	11.4%	86%	3	15.06	10.1	0.02	0.00	10
162-38	18	41.33	63.16	45.16	9.36	22.6%	72%	1	50.49	11.1	0.04	-0.09	6
162-39	36.79	44.86	49.88	13.09	2.48	5.5%	93%	NA	3.85	3.1	-0.16	0.14	10
162-40	16.25	48.78	162.94	146.69	24.93	51.1%	49%	3	87.41	28.4	0.54	-0.70	4

Head 162-10

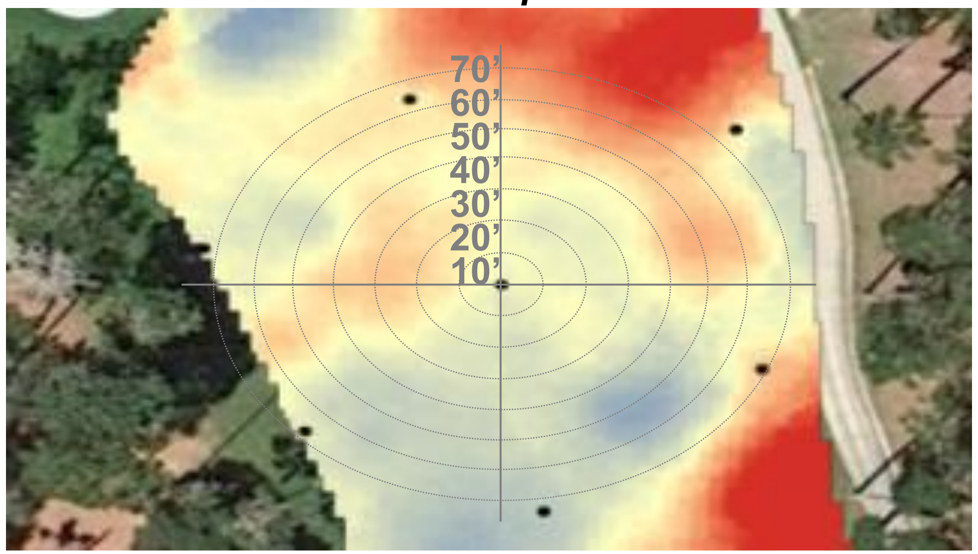
Soil Moisture



Turf Vigor



Soil Compaction



Count on it.

Irrigation audit maps display Low Quarter Soil Moisture Uniformity (SMU) for identification of dry zones

Fairway	Head ID	Score
1	11-12	3
	11-19	3
	11-33	3
	12-1	3
	12-2	3
	12-3	3
	12-5	3
	12-6	3
	12-7	3
	12-8	3
	12-9	3
	11-10	4
	11-16	4
	11-18	4
	12-4	4
	12-13	4
	12-23	4
	12-25	4
	11-7	5
	11-15	5
	11-17	5
	11-31	5
	11-32	5
	12-14	5
	12-15	5
	12-18	5
	12-24	5
	12-26	5
	12-28	5

Fairway	Head ID	Score
2	22-5	2
	23-13	3
	23-22	3

Fairway	Head ID	Score
3	31-17	3
	31-19	3
	32-25	3
	32-27	3
	31-21	4
	31-22	4
	32-26	4
	32-28	4
	32-29	5
	32-30	5

Fairway	Head ID	Score
4	41-20	3
	42-24	4
	41-18	5

Fairway	Head ID	Score
5	52-9	3
	52-16	4
	52-19	5

Fairway	Head ID	Score
6	62-22	2
	62-5	3
	62-10	3
	62-27	3
	63-17	3

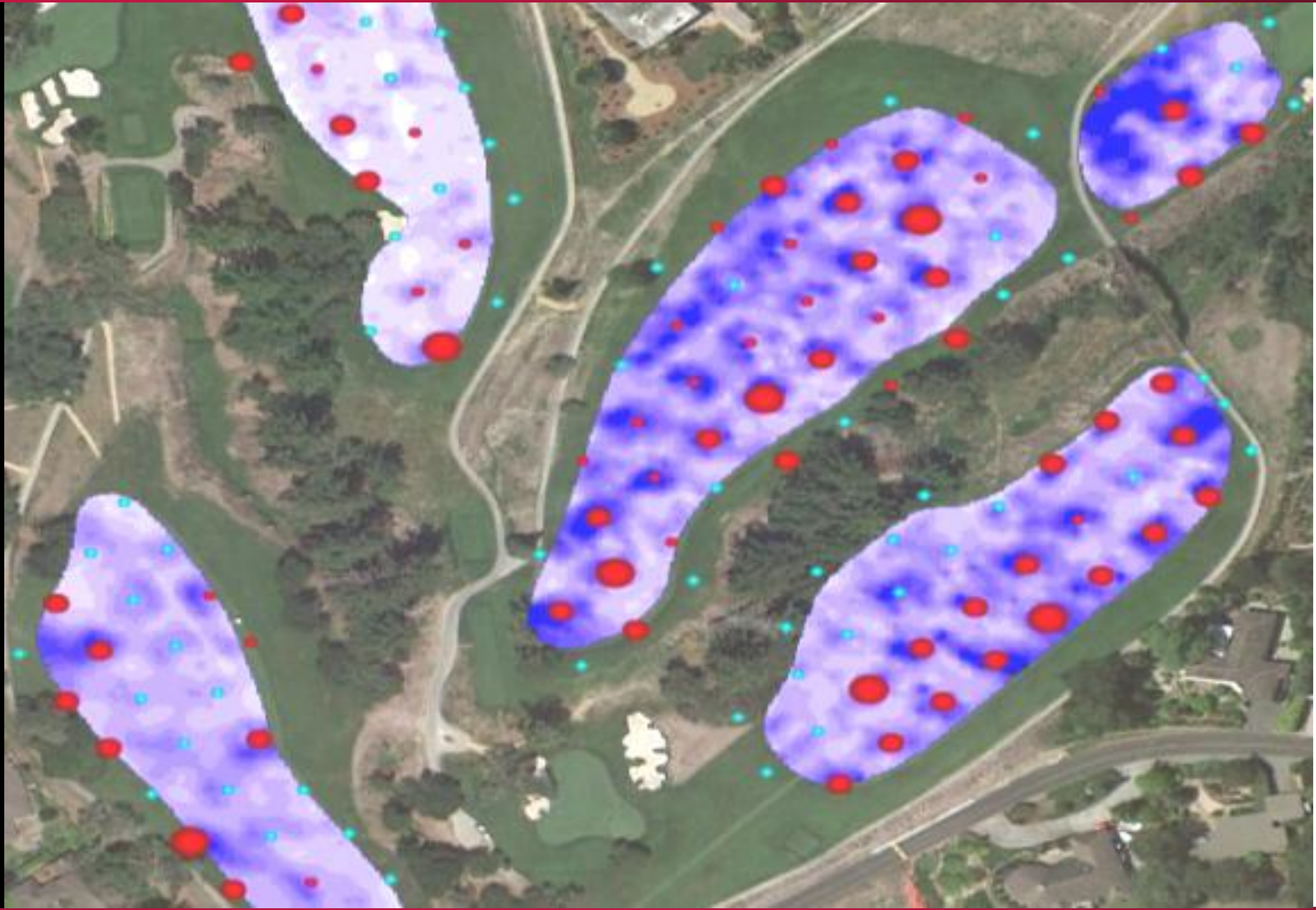
Fairway	Head ID	Score
7	71-11	2
	71-9	3
	71-10	3
	71-12	3
	71-13	3
	71-18	3
	71-19	3
	71-14	4
	71-15	4
	71-17	4
	72-18	4
	72-23	4
	71-21	5
	72-16	5
	72-21	5

Fairway	Head ID	Score
8	82-19	4
	82-16	5

Fairway	Head ID	Score
9	93-23	2
	92-16	3
	92-18	3
	92-21	3
	93-1	3
	93-9	3
	93-13	3
	94-17	3
	94-34	3

TORO Count on it.

Soil moisture uniformity, quality of turf, and compaction are combined combine to create a chart of trouble spots ranked by number.



Sprinkler arc overlap maps display how many sprinklers impact the same areas helping to understand why areas might be drier or wetter

TORO. Count on it.

Head spacing and sprinklers in non-uniform areas are identified on the maps in red for location of high priority work orders


© 2012 Google

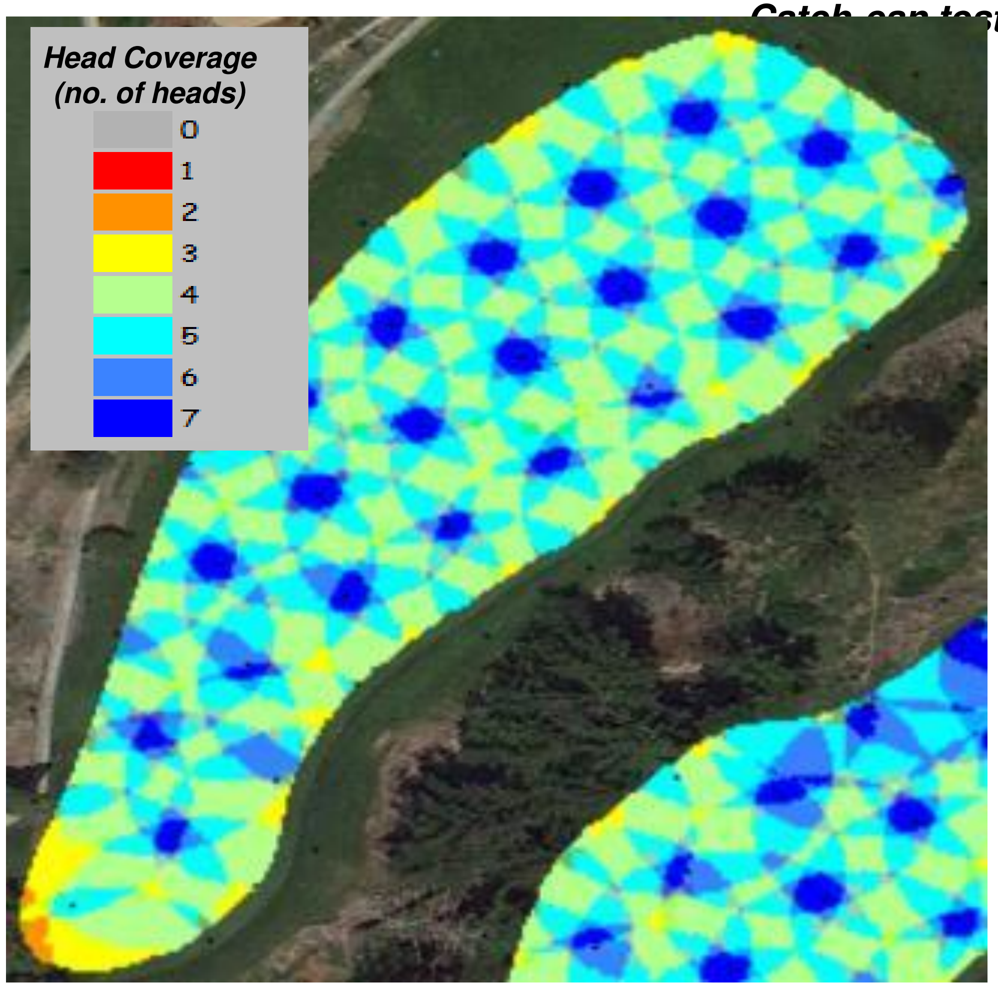
A. Soil Moisture

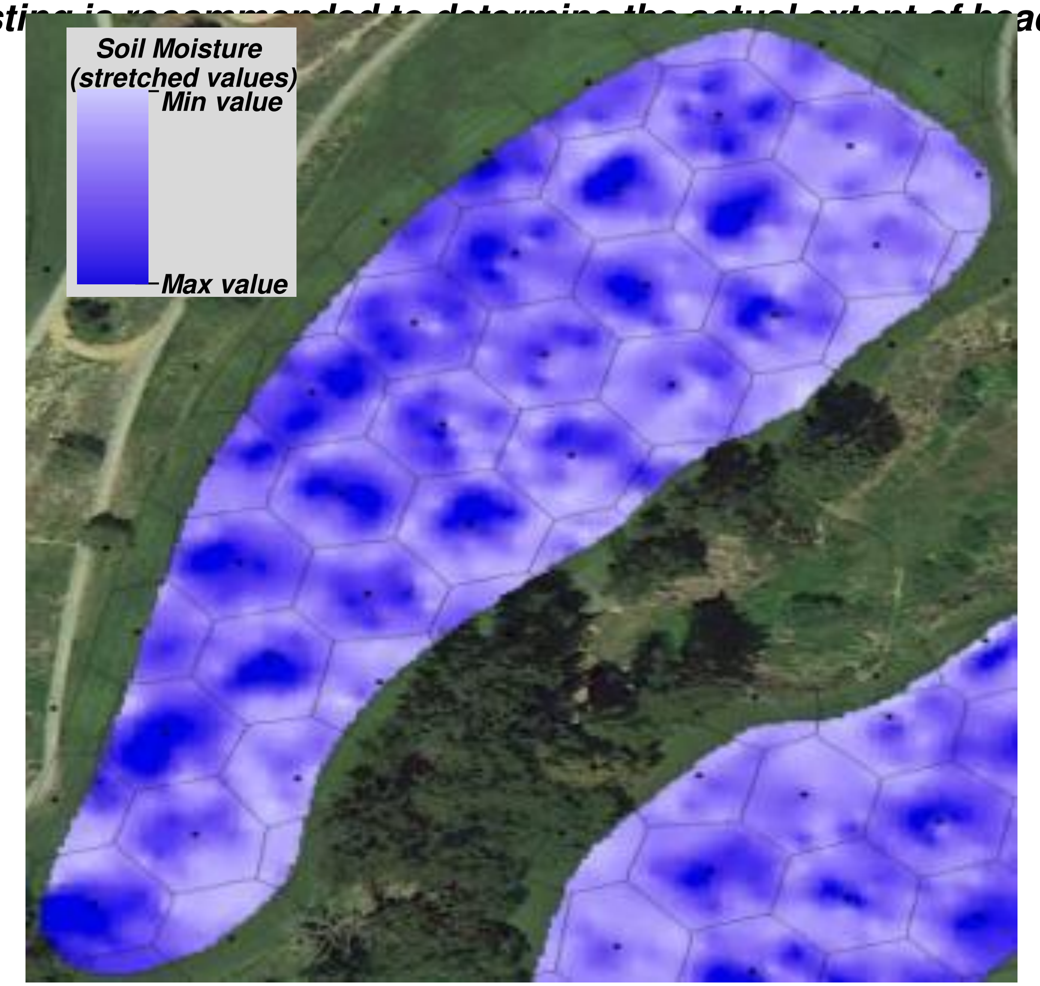
A4. Sprinkler head overlap vs. high soil moisture

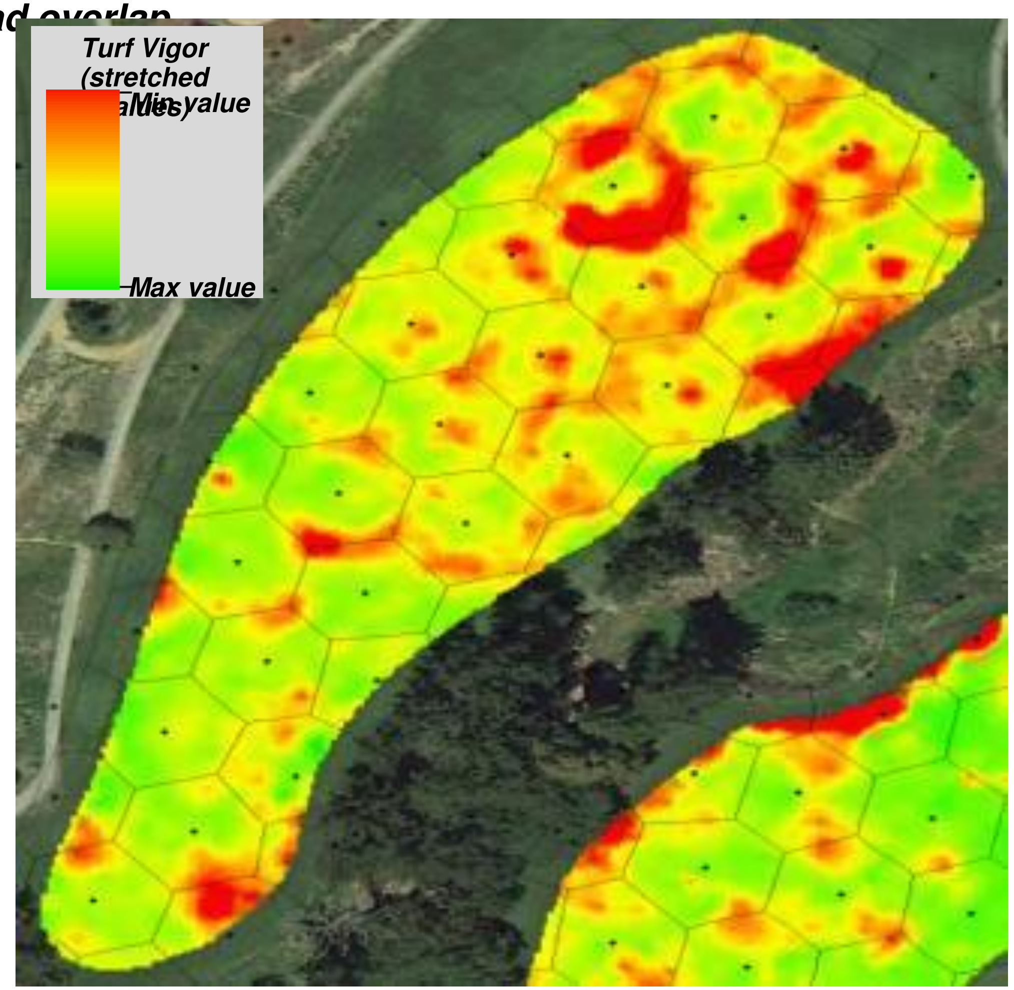
A sprinkler head coverage map created from head spacing data combined with radius-of-throw and water pressure data taken from the Lynx data base shows consistent overlap at nearly every fairway sprinkler head. The head layout at xxxxxxx results in a 10-20’ diameter area around the majority of fairway heads that is overlapped by seven heads while the midpoint between heads is overlapped by 3 or 4 heads on average. The average head spacing on fairways is 59.2 ft. The specified throw radius for heads and nozzles at xxxxxxx is 63-67 ft. depending on water pressure. (This analysis assumes that the actual radius-of-throw matches the throw specified by the head data in the data base.)

The disparity in overlap around heads vs. overlap midway between heads could be a primary cause of repetitive patterns of wet to dry soil moisture around and between heads.

Catch can testing is recommended to determine the actual extent of head overlap.







After this information is provided, start checking sprinkler performance with catch can audits in trouble spots. Also check database information and confirm it matches the field hardware.

Justin McClellan

GreenSightAg.com

@GreenSightAg

GREENSIGHT
AGRONOMICS

Making Golf Courses Greener

Reducing water and chemical costs while enhancing turf quality

The Challenges

Golf courses face rising irrigation expenses

- National Average: >$75K/year
- $500k+ is not uncommon in Southwest

Chemical use must be efficiently managed

- Chemicals and fertilizer <$40,000 annually (per 18-holes)
- Regulation and limitation of treatments

Public Pressure to reduce water, chemical use

- New water regulations
- New pesticides/fungicide bans and regulations

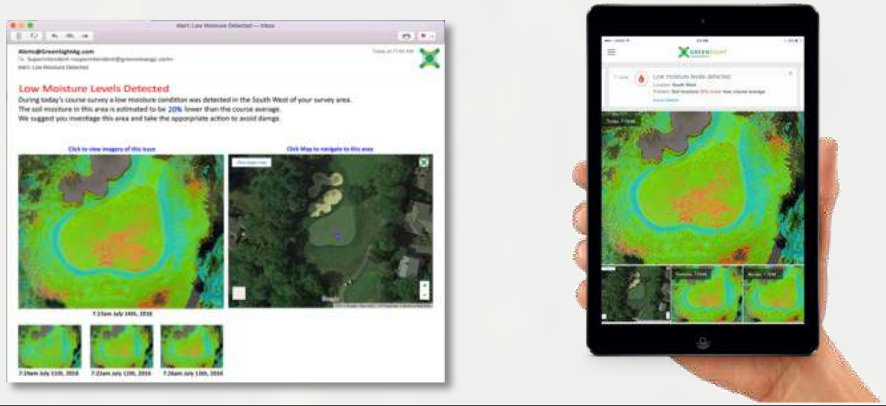
Drone Data enables precise application, saving courses 25%

Solution: GreenSight Zero-Labor Turf Monitoring Service

One time setup: unpack, plug in

Minimizes User Effort

User receives DAILY ACTIONABLE information



System operates automatically every day

Proprietary System

Machine-to-machine interface
Admin via web

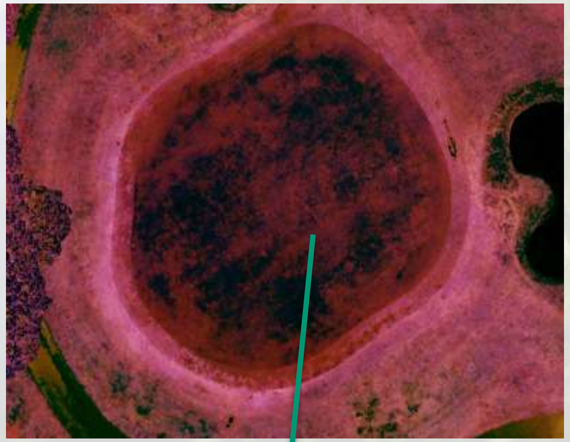
Completely Automated
Flies daily
Sends email/text alerts

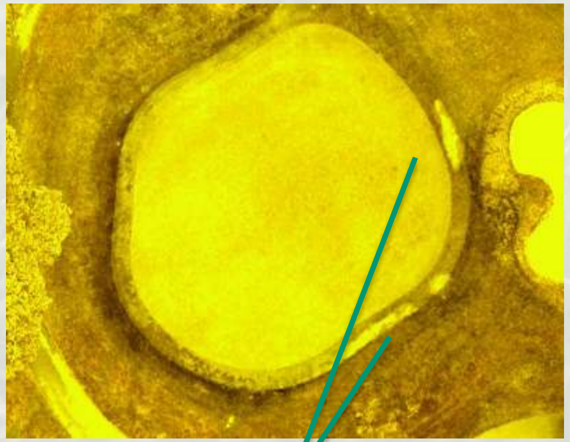
Custom Sensor
5x more data

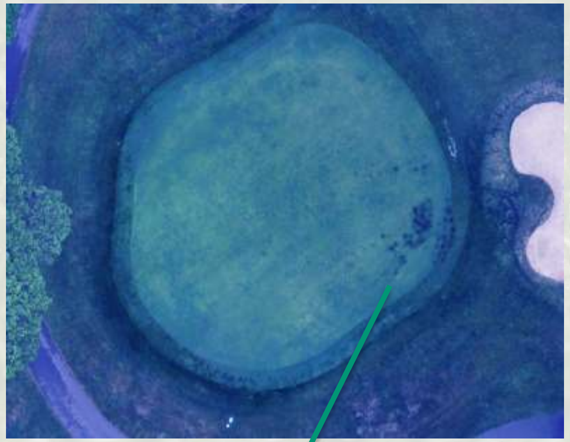
Turfgrass-Specific Analytics
Unique add-ons

Multi-spectral Imager

- Custom camera gathers data in multiple wavelengths to detect a variety of conditions
  - Tuned to narrow "color" bands, camera gathers data on reflectance of leaf that is not visible to the naked eye
  - Common issues impact this reflectance in narrow color bands







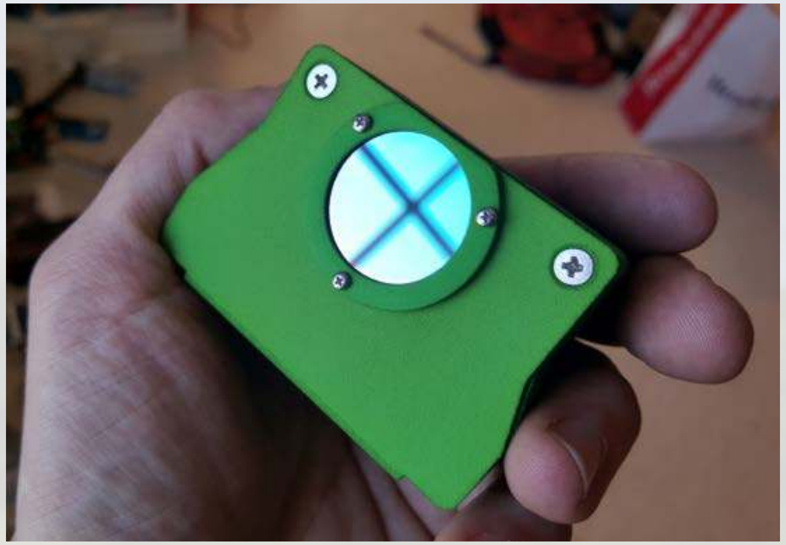
Nitrogen Deficiency, Red Thread

Grubs (root damage)

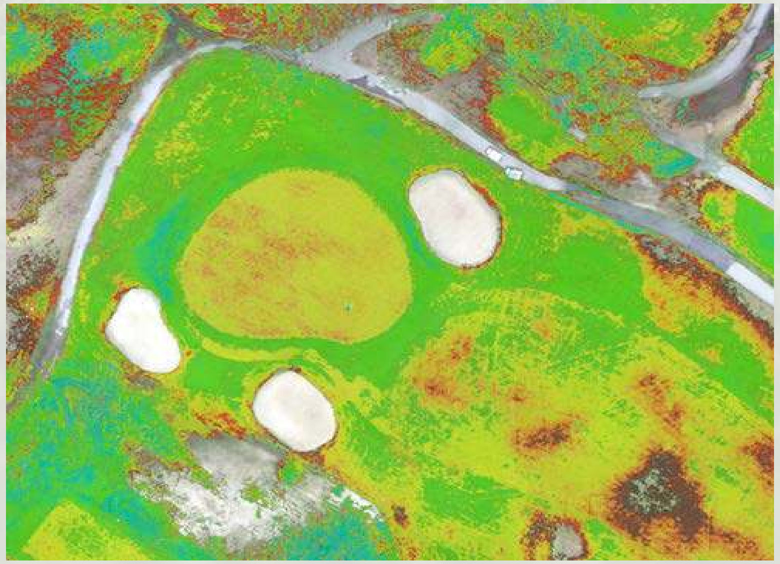
Dollar Spot (fungal infection)

Thermal Imager & Moisture

- True thermal imager measuring temperature
  - Proprietary calibration provides +/- 1 degree accuracy
  - Onboard sensors provide ambient temp, pressure, humidity, & luminosity



- We compute high accuracy temperature differentials
  - Calculate soil moisture based on canopy temperature
  - Greater accuracy than evapotranspiration models

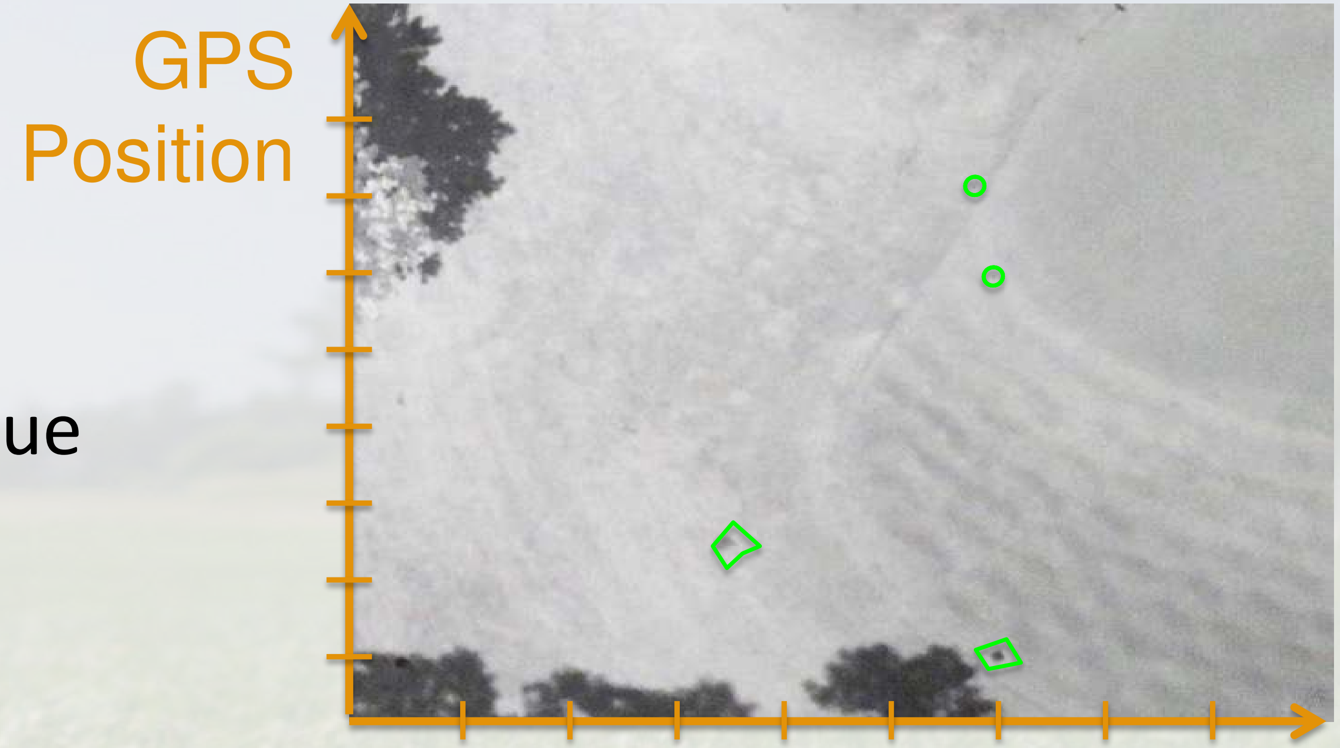


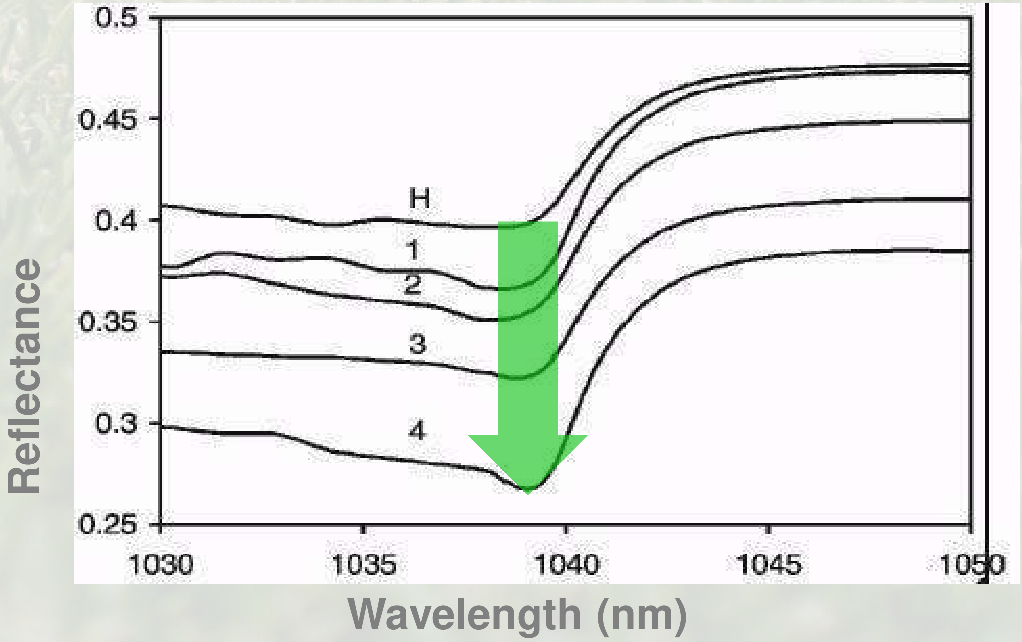
- Compliment to in-ground sensors
  - We add 100% areal coverage
  - ~10cm resolution

Change Detection Analytics

- Pixel Counting Algorithm
  - GPS-referenced-images evaluated
  - Issues show up as high/low intensity
  - Pixels counted, position and “color” of issue logged in our database.

- Change Detection
  - Our consistent, daily flights enable robust change detection
  - Algorithm monitors changes in plant reflectance to gauge issue severity

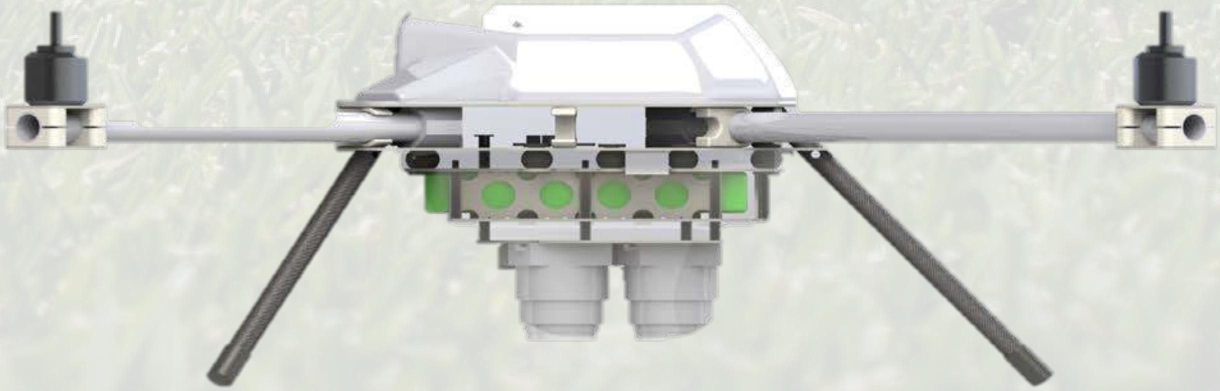




Drone System

- 4-rotor “Quadcopter”
  - 4 lbs, 24” across
  - Optimized for 45-60 min flight
  - 100-120 acres per flight

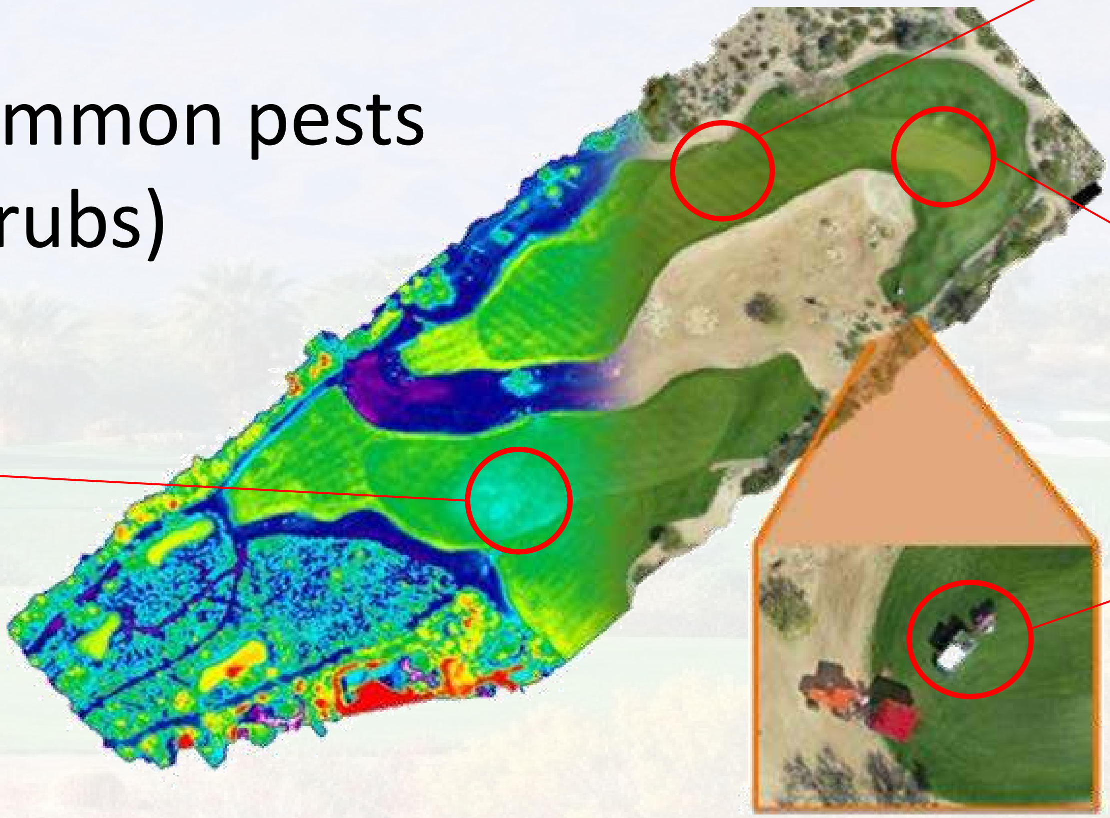
- Fully Automated
  - Pre-programmed waypoints
  - Vision-guided landing in base station
  - Automatic recharge, data download
  - Remotely administered via Wi-Fi, 3G, Ethernet



Potential Benefits With Our System

System provides

1. Soil moisture maps covering entire course
2. Soil moisture alerts
3. Early ID and alerts for common pests (Dollar Spot, Pythium, Grubs)



Irrigation optimization saves $15k-$100k/yr

Prevention of damage$1M+ lost revenue or repair

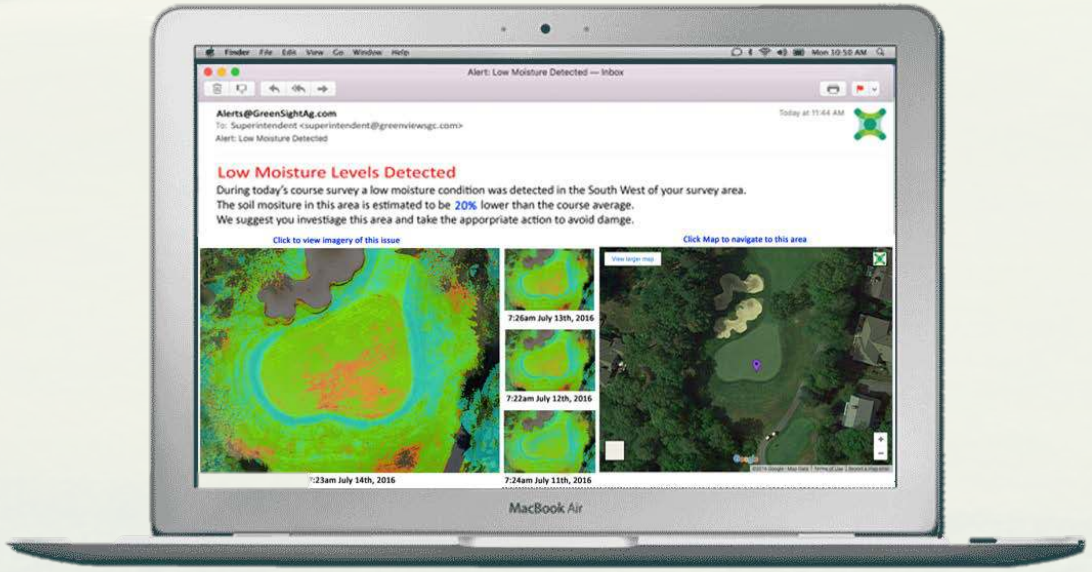
Efficient chemical application >$15k/yr

Optimizing labor maximizes turf quality within existing budget

Utilize limited resources more effectively!

Subscription Service

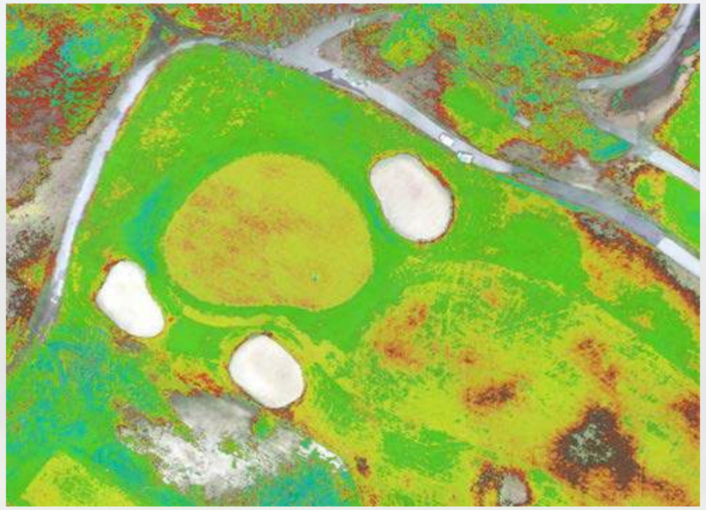
- Subscription pricing starting at $900/mo
- Hardware is included, warrantied, and upgraded
- Web-based analytics and processing, easy!
- Additional add-on services rolled out regularly



Simple to use, no software or maintenance headaches

2016 Pilot Key Features

- Moisture Monitoring
  - Thermal camera measures temp differentials across entire course
  - Custom analytics calculate moisture at root ball
- Fungal Detection
  - 4 cameras tuned to specific light reflectance of fungus before visible
- Intelligent Processing in the Cloud
  - We tag and tracks Issues over subsequent flights
    - Ie: Ball mark or expanding dollar spot infection



New pest alerts and features rolled out regularly

Current Research

Working With 3 Turfgrass/Ag Research Sites

- Drought Stress Research – validate moisture analysis on test plots
  - Current technology prototype getting well tested
    - Knitted maps for each part of the spectrum
    - "Change maps" built to highlight daily changes
    - Quantitative metrics for each test plot recorded
  - We track specific changes
    - Grass temperature differentials
    - Soil Moisture at rootball
    - Precise areal percentage of:
      - Discoloration, wilt

Analysis Add-Ons in Our Pipeline

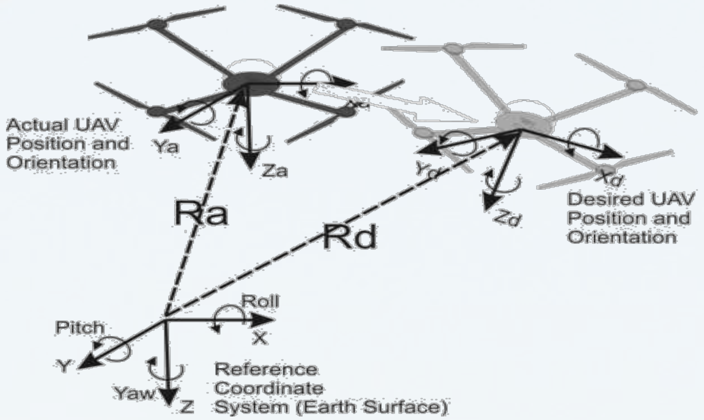
- Pythium blight
- White grubs
- Poa/Bluegrass detection/severity
- Tree shade mapping
- Turf Traffic
- Divots Maps
- 3D Terrain Maps, as-built mapping

As we gather turf data we can expand offering

Key Feature: Automatic Operation

We have 30+ years developing drones for US Military

- Container opens, drone automatically takes off
- Drone flies over and images entire course based
- Auto-lands in container after flight
- Container closes
- Drone downloads images to cloud server and recharges batteries
- Email and Text Alerts about trouble spots



Flight, processing is automatic - you can focus on the Turf

Key Feature: Inconspicuous

- Flies at 200-300 feet
- 2’ x 2’ drone is virtually invisible at that altitude
- Uses 4 electric motors, inaudible once it reaches 150 feet
- Base station container is 3’ x 3’ x 2’ and only requires a power cord

Designed to not disturb players

Key Feature: Mobile Accessible Data and Analytics

- Online setup, image processing, analytics, and storage
  - User receives email notifications
  - Details on turf condition along with GPS location of issues and images
- Cloud allows better experience
  - Constant analytics improvements based on data
  - No user software to update
  - No hard drive crashes
  - Simplifies data management

Legality, Liability, Privacy

GreenSight is operating 100% within the legal framework for drone operations

- We have a "333" authorization from the FAA to operate our drones over golf courses

GreenSight is fully insured

- Drone system are insured for injury, death, or damage to property caused by the equipment under proper usage

GreenSight Respects Privacy

- GreenSight will ensuring the privacy of neighbors and players. We don't image adjacent properties
- GreenSight will does not disclose any data or imagery that could identify the course

The GreenSight Team

James Peverill – CEO

Led $2M white board-to-Afghanistan drone development for US Air Force

World class expertise in rapid development of drone products

MS Computer Eng. Boston Univ., BSME Brown Univ.

Justin McClellan – CMO

Led $3M Reconnaissance Satellite R&D Program for DARPA

Former Lead for R&D Spinouts and Technology Commercialization

MBA and BS Aerospace Eng. Boston Univ.

Joel Pedlikin – COO

VP Engineering | GM of R&D leading 50+ Aerospace Engineers

Developed PacAstro Rocket Engine | Services Startup Founder

MBA Babson, MS Aeronautics CalTech, BSME Brown

John Kaminski, PhD – CAO

Director Golf Course Turfgrass Management Program @ Penn State

MS Agronomy, PhD Natural Resource Science Univ. Maryland,

BS Turfgrass Science Penn. State

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GREENSIGHT
AGRONOMICS

Questions?

Unique Solutions to Challenging Pumping Problems

ASIC 2016 REGIONAL CONFERENCES
Southeast, Southwest, Northeast, & California

American Society of Irrigation Consultants

Mike Bartley

Unique Solutions to Challenging Pumping Problem

VFD introduced into turf market

Benefits:

- Energy saving
- Reduce water hammer
- Auto restarts

Unique Solutions to Challenging Pumping Problem

VFD introduced into turf market

Issues:

- Environment
- Shut trip circuit breakers / contactors
- Boost / isolation transformers
- Surge protection / grounding
- New construction / power surges

Unique Solutions to Challenging Pumping Problem

VFD trends in today's market

Challenge:

- Irrigation programs using cycle / soak
- Understanding the customers irrigation practices
- Multiple irrigation controllers on one pumping system
- Multiple sources on one pumping system

Unique Solutions to Challenging Pumping Problem

VFD trends in today's market

Solution:

- Individual drives / load sharing
- Large pressure maintenance pumps

ASIC

Unique Solutions to Challenging Pumping Problem

VFD trends in today's market

Points for discussion:

- Added cost of individual drive
- Additional cooling requirements
- Additional efficiency loses – 2% drive efficiency
- When do use XL/VFD bypass contactors
- When to go from a "PM" pump to a Jockey pump

Rex Hansen

Pump Station Solutions

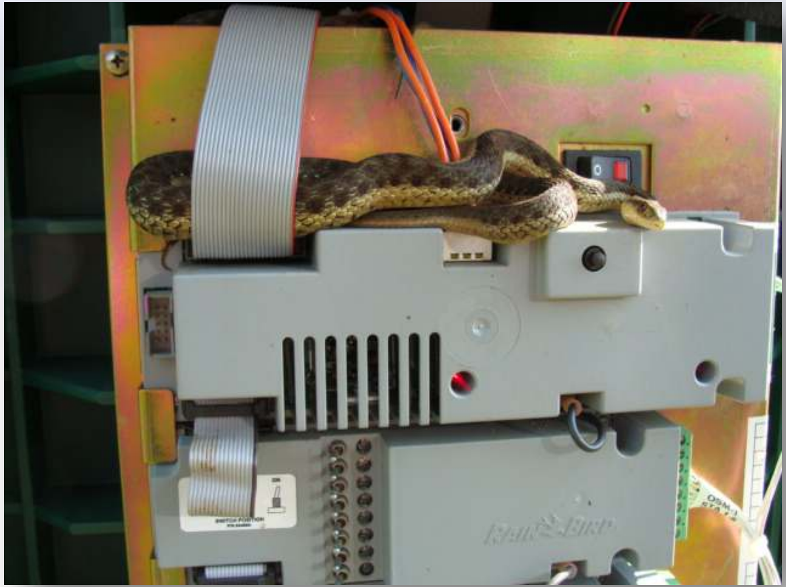
Rex Hansen P.E.
Rain Bird Corporation

ASIC

Rotor Placement

Pressure Tanks

Critter Infestation



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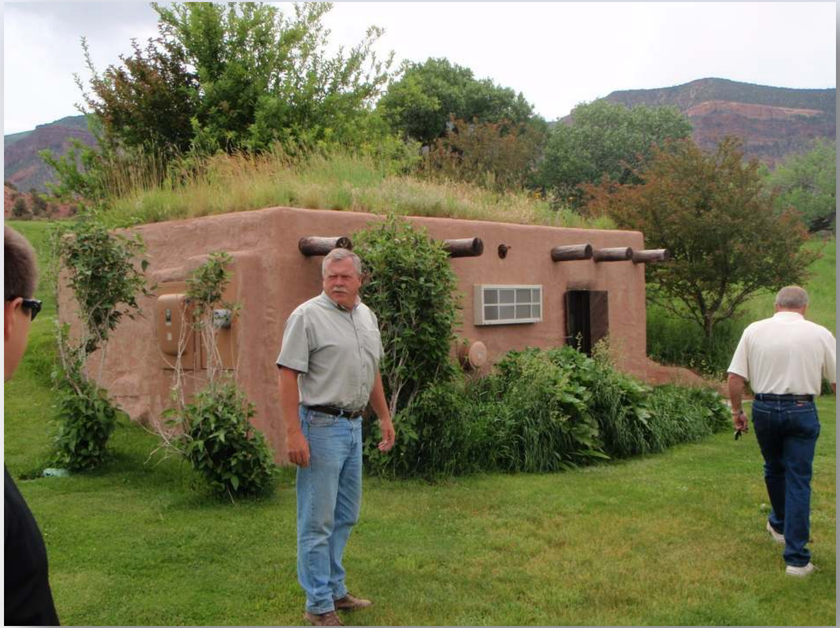
Pump Station Vs. Car

Excessive Flow Shut Down


IMG_1366.MOV

Pump House Aesthetics



Test Flow at Commissioning

High Voltage Concerns

Air Conditioning

Bankruptcy

ASIC

Installation Surprise

ASIC

Sports Fan

Pump Stations in the Future

Rick Reinders

WATERTRONICS™

A LINDSAY COMPANY

Rick Reinders, President

rick.reinders@watertronics.com

NAIL BAY WATER TREATMENT AND DELIVERY SYSTEM

ASIC

Nail Bay – Project Profile

- Private Residence in British Virgin Islands
- 5 golf holes – golf tees can play it like a 27 hole course
- Architect – Chris Gray; Consultant – AS Altum & Associates
- Contractor – Customer supplied with Watertronics supervision

ASIC

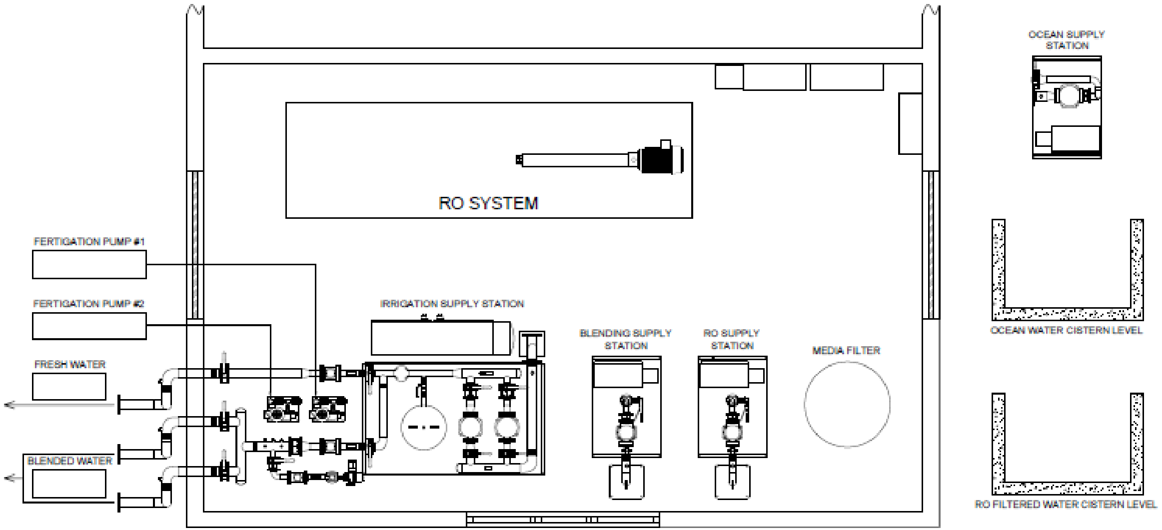
Nail Bay: What was the problem?

- No fresh water source available for irrigation
- Ambitious owner in need of 300 gallons per minute for irrigation
- Short time line
- Very remote location

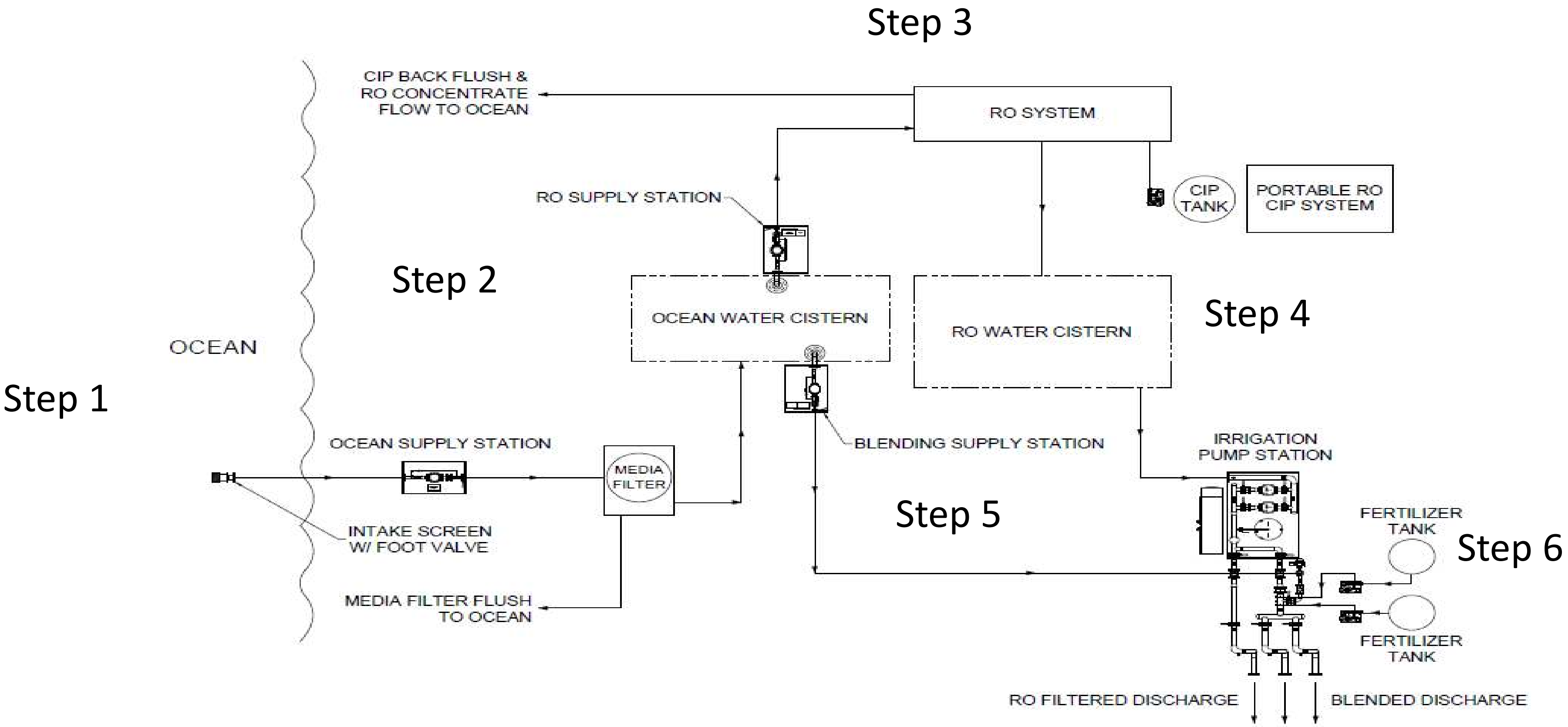
Nail Bay: What was the solution?

Complete integrated solution using:

- Reverse Osmosis
- Source Blending
- Media Filters
- Fertigation Injection
- Irrigation pump station
- One Integrated Solution



Nail Bay: How does it work?



FACTORY PRE-TESTED

- Dynamically tested in our facility
- Confirmation of Integrated processes

Nail Bay: What were the results?

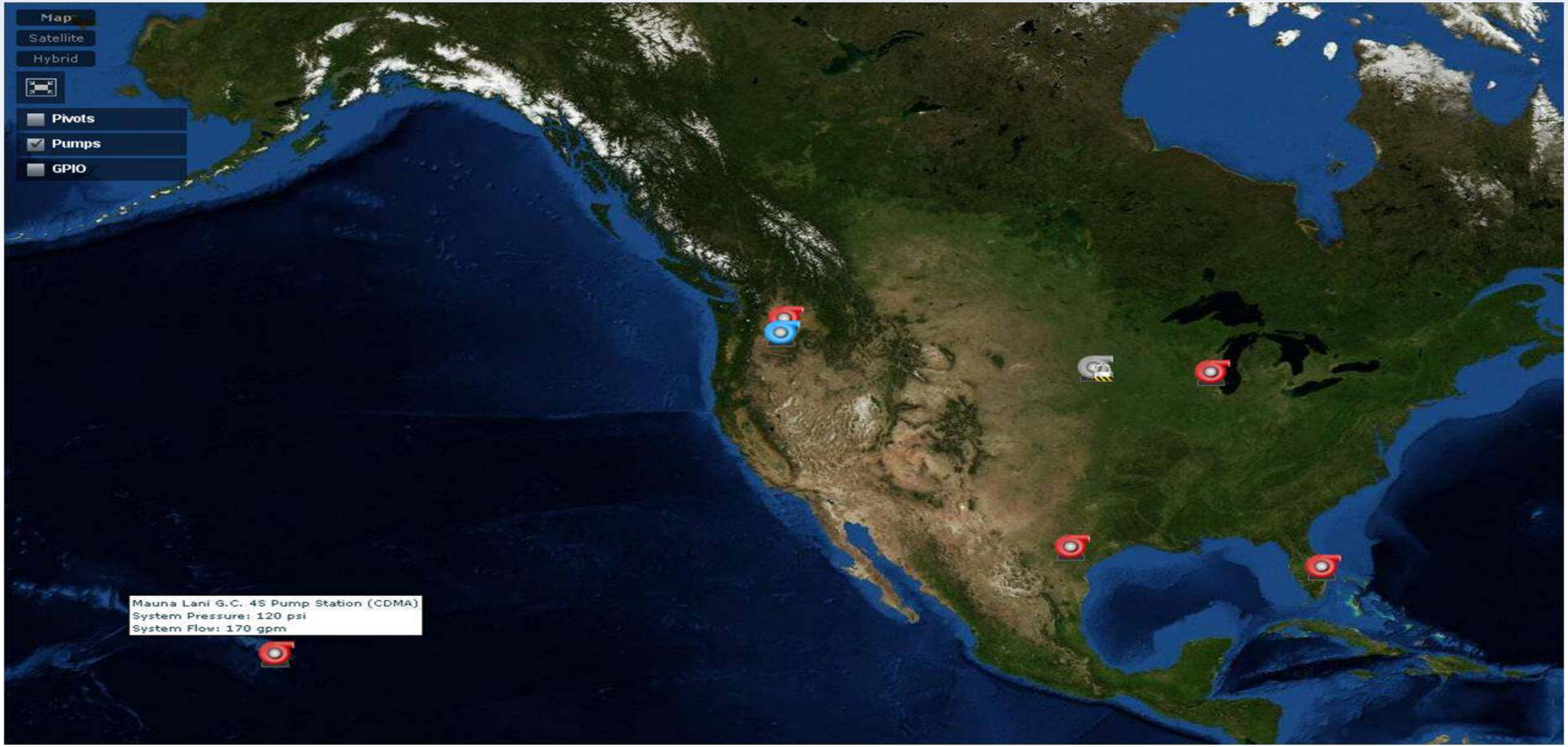
Remote Monitoring and Control of all systems

ASIC

WATERVISION CLOUD

ASIC

MANAGE MULTIPLE PROJECTS



THANK YOU!

Dick Young

Services, Incorporated

Dick Young
Sales Manager

Unusual Pumping Situations You Have Encountered and How You Solved Them

MOHEGAN SUN COUNTRY CLUB
AT PAUTIPAUG

Project Companies

• Architect	Robert McNeil
• Irrigation Consultant:	Joe Sarkisian
• General Contractor	NMP Golf Const.

ASIC

Irrigation system requirements

- 1800 GPM
- 145 PSI

Challenge 1

										In-season					Off-Season		
										Spring Basin Full Condition		Spring Basin Not Full Condition					
Well ID	Pump Set Depth	Transducer Set Depth	Low Water Shut Off	Recommended Average Seasonal Yield		Stable Well Yield at End of Fall 2007 Test		Typical Maximum Documented Pumping Rate	Daily Pump On Cycle	Pump Control Limits if Basins are Full on April 15th (and in any case after May 30th)		Pump Control Limits if Basins are Not Full on April 15th (from April 15 to May 30th)		Seasonal Maximum Withdrawal (180-day basis)	Pump Control Limits (from November 1st to April 14th		Maximum Off Season Withdrawal (166-day basis)
	Ft.	Ft.	Ft.	GPM	GPD	GPM	GPD	GPM	Hrs.	GPM	GPD	GPM	GPD	Gallons per Season (April 15 to Oct. 31)	GPM	GPD	Gallons per Off Season (Nov. 1 to April 14)
Pond V Well	862	852	842	16.0	23,040	32.0	46,080	62	18	21.3	23,040	29.9	32,256	4,147,200	13.3	14,361	2,383,898
Well 2	315	305	295	13.7	19,728	18.3	26,352	22	18	18.3	19,728	24.0	25,920	3,551,040	0.0	0	3,960
Well 3	295	285	275	10.2	14,688	13.6	19,584	35	18	13.6	14,688	24.0	25,920	2,643,840	0.0	0	
Well 5	525	515	505	14.7	21,168	19.6	28,224	24	18	19.6	21,168	24.0	25,920	3,810,240	0.0	0	
Well 6	580	570	560	23.3	33,552	31.1	44,784	33	18	31.1	33,552	24.0	25,920	6,039,360	19.4	20,913	3,471,552
Well 10	609	599	589	16.4	23,616	21.8	31,392	24	18	21.9	23,616	24.0	25,920	4,250,880	13.6	14,720	2,443,496
Well 12	525	515	505	15.4	22,176	30.8	44,352	58	8	46.2	22,176	10.7	5,120	3,991,680	0.0	0	
Club House Well	220	210	200	2.1	3,024	2.8	4,032		24	2.1	3,024		0	544,320	0.0	0	0

Challenge 1 – Transducer Depth

Transducer Set Depth	Low Water Shut Off
Ft.	Ft.
852	842
305	295
285	275
515	505
570	560
599	589
515	505
210	200

Variable Flow Rates

	Daily Pump On Cycle	Pump Control Limits if Basins are Full on April 15th (and in any case after May 30th)		Pump Control Limits if Basins are Not Full on April 15th (from April 15 to May 30th)		Seasonal Maximum Withdrawal (180-day basis)	Pump Control Limits (from November 1st to April 14th	
	Hrs.	GPM	GPD	GPM	GPD	Gallons per Season (April 15 to Oct. 31)	GPM	GPD
Pond V Well	18	21.3	23,040	29.9	32,256	4,147,200	13.3	14,361
Well 2	18	18.3	19,728	24.0	25,920	3,551,040	0.0	0
Well 3	18	13.6	14,688	24.0	25,920	2,643,840	0.0	0
Well 5	18	19.6	21,168	24.0	25,920	3,810,240	0.0	0
Well 6	18	31.1	33,552	24.0	25,920	6,039,360	19.4	20,913
Well 10	18	21.9	23,616	24.0	25,920	4,250,880	13.6	14,720
Well 12	8	46.2	22,176	10.7	5,120	3,991,680	0.0	0

Solution

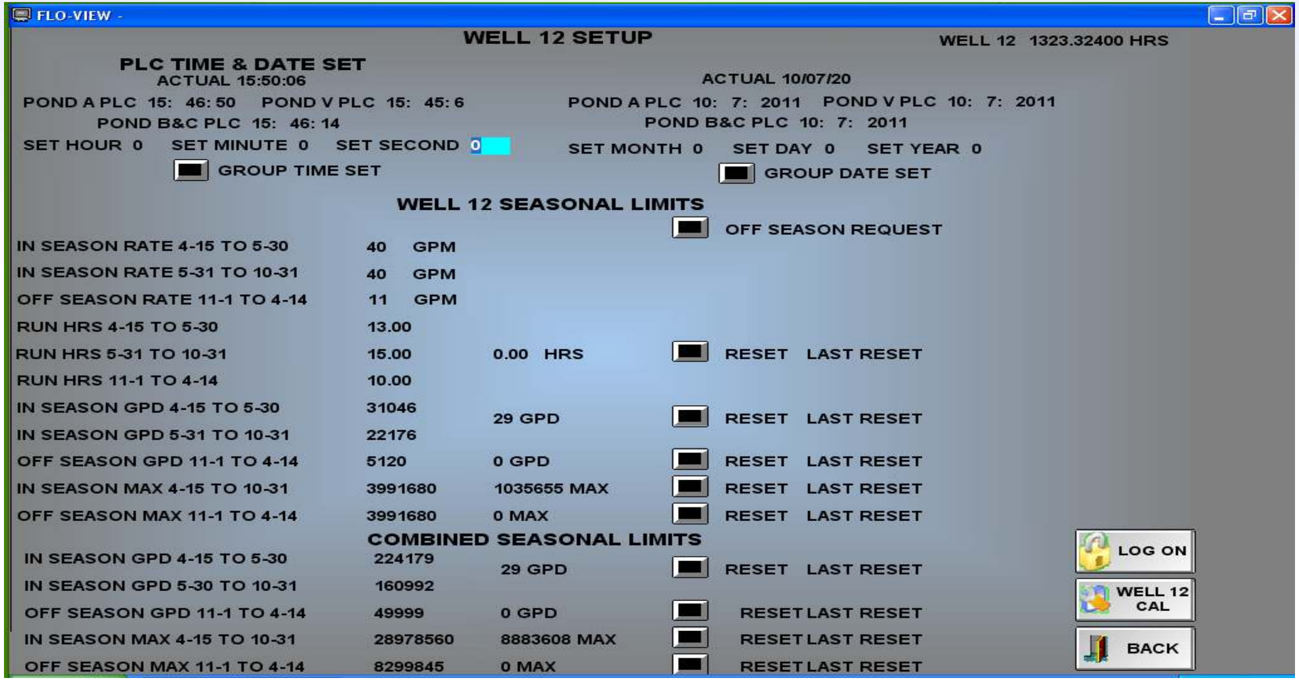
- All well pumps to run on a VFD
- Instead of pressure, change process variable to flow
- Change flow rates based upon date

Use Restrictions

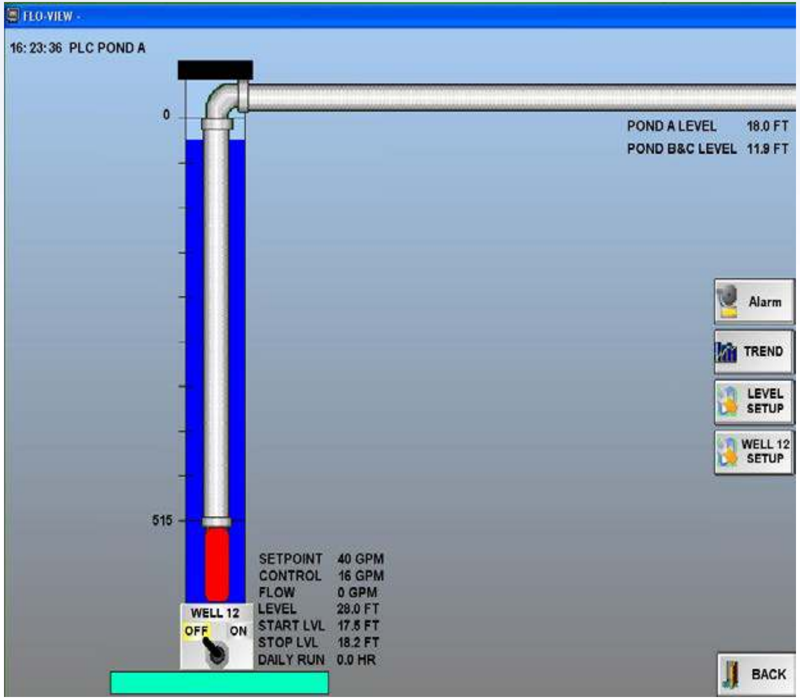
- Shut off wells when
  - Daily hour limits reached
  - Daily flow total reached
  - Annual flow total reached

ASIC

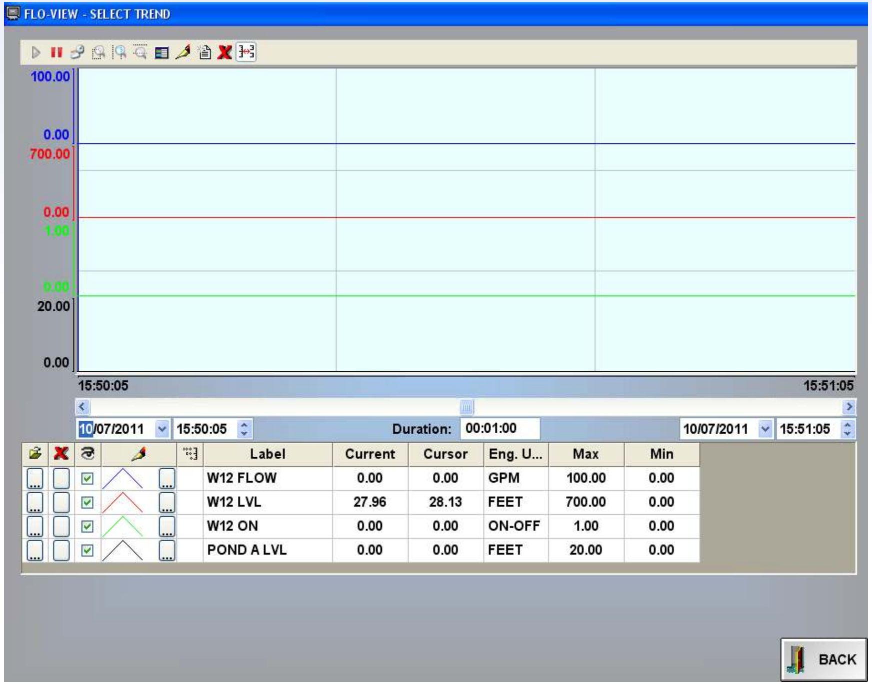
Well Set up Screen



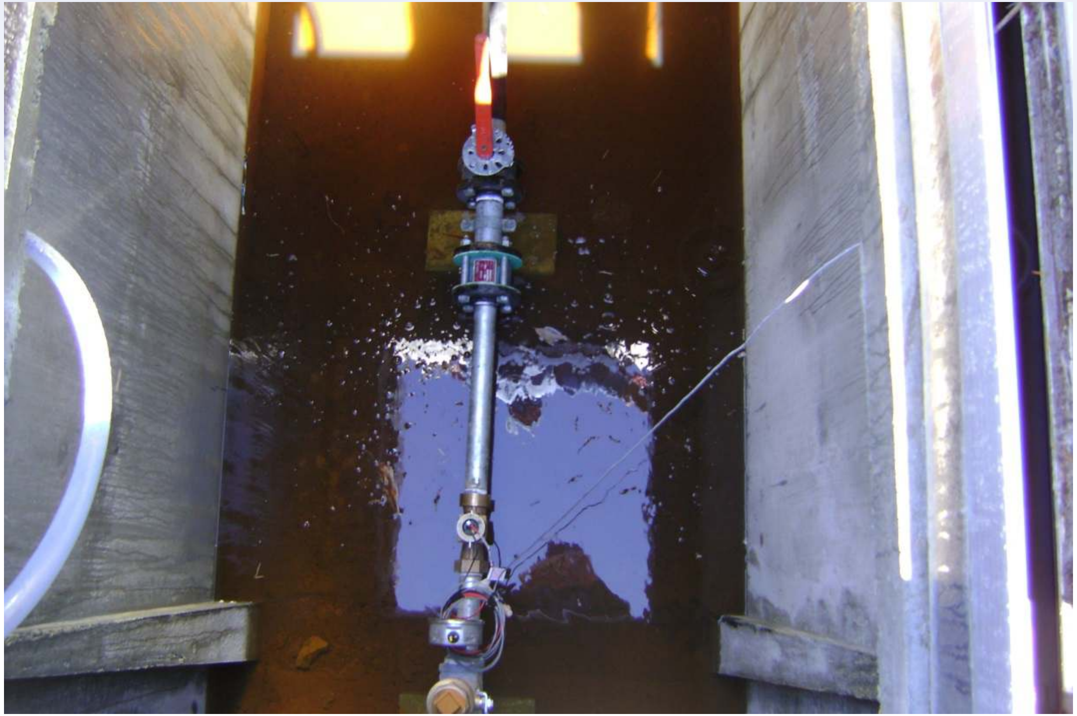
Well Monitoring Screen



Well Trending Screen

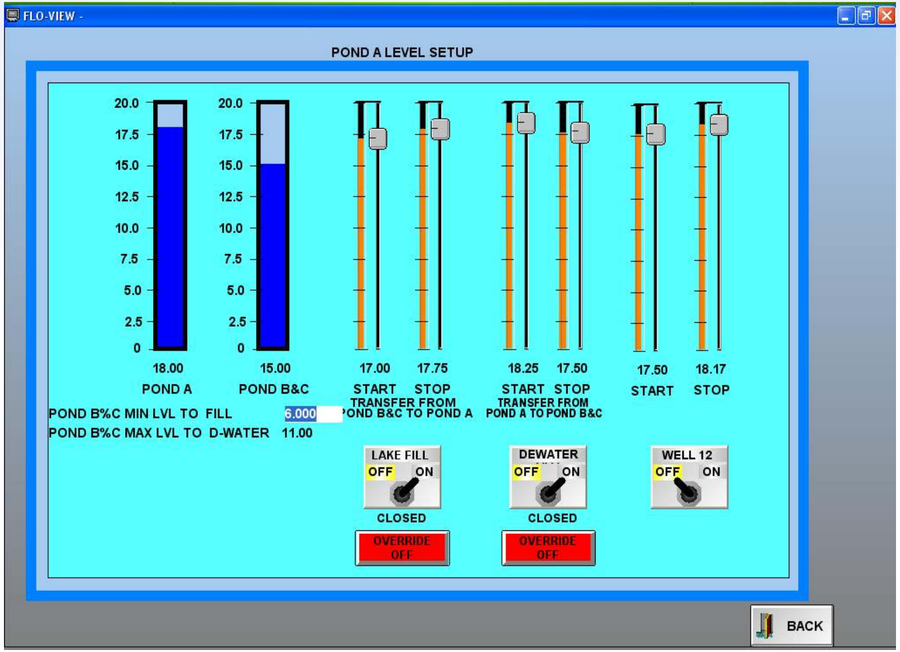


Well Vault Internals

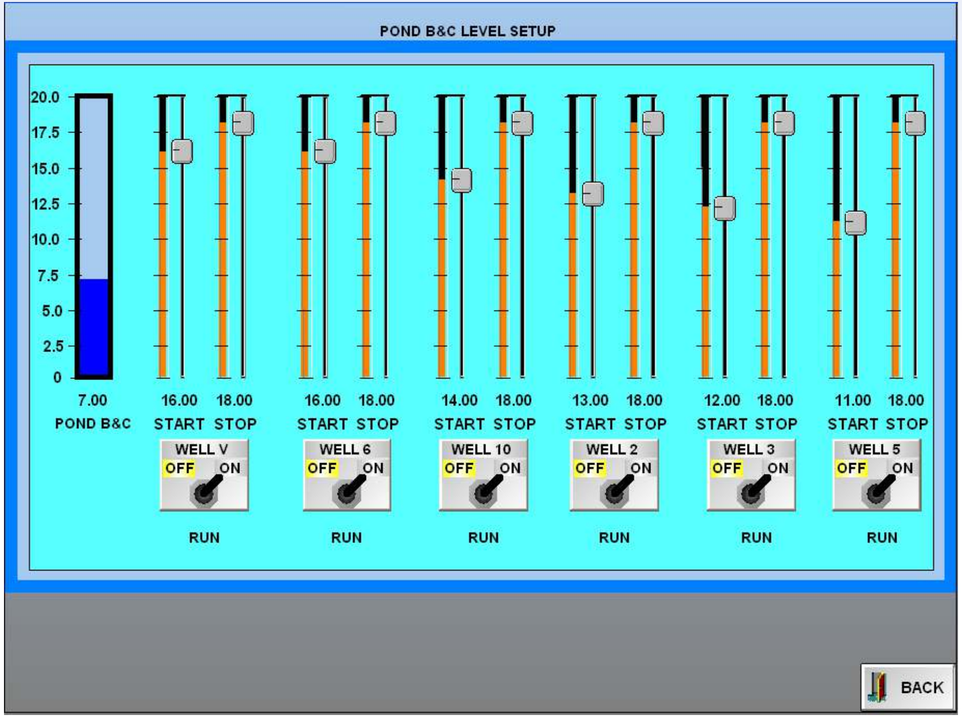


Well Vault Installed

Pond A Level Setup

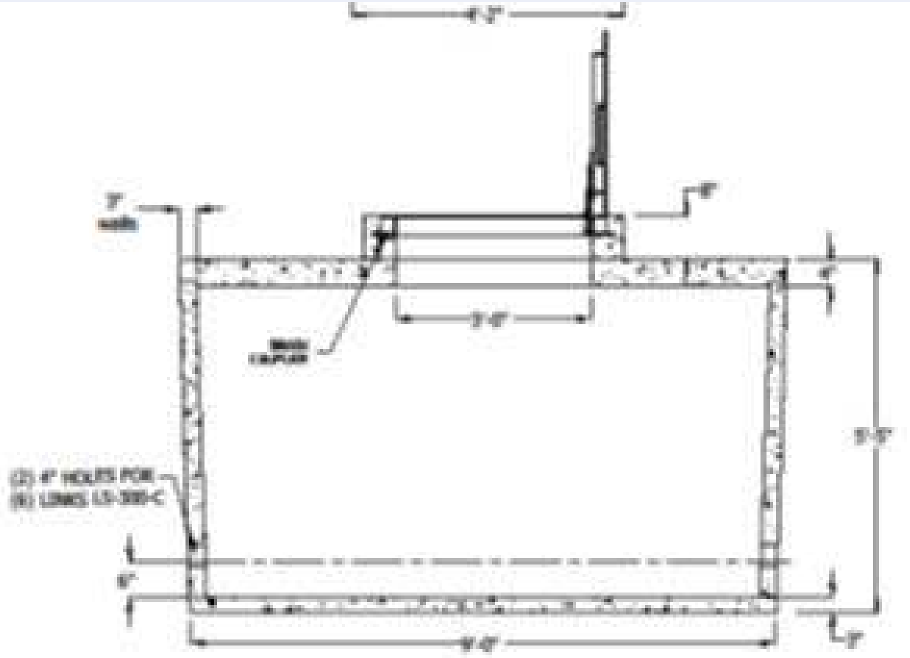


Pond B/C Level Setup

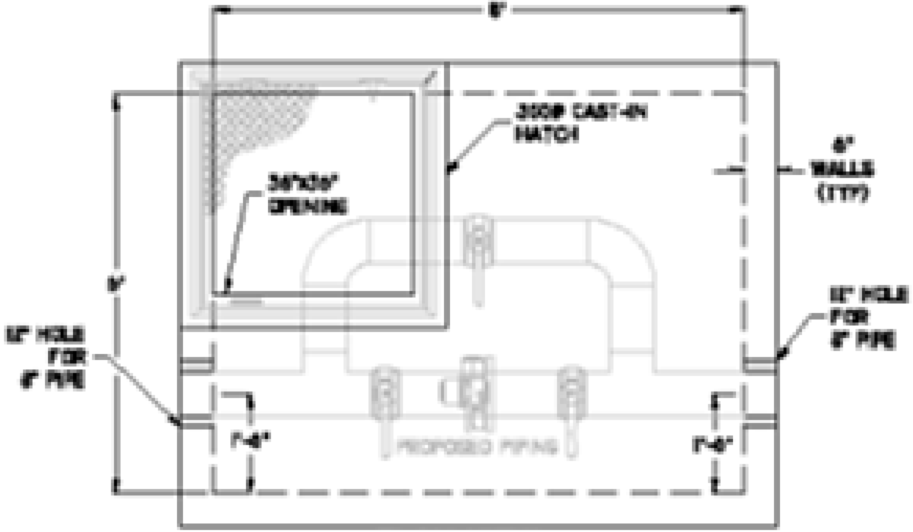


Wells/Transfer to run 12 Months

Several of the wells and the transfer equipment need to run year round. To facilitate that the flow sensors, isolation valves, and flow sensor test ports were installed in concrete vaults below the frost line

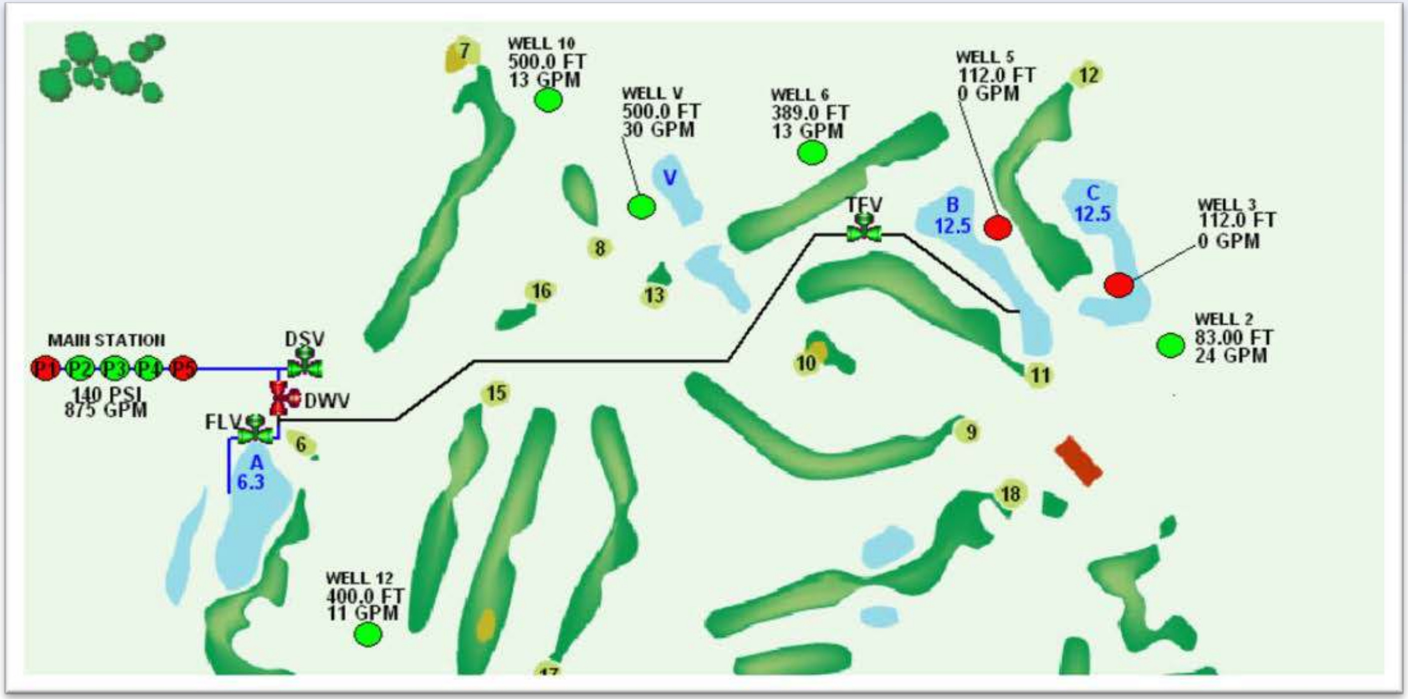


Transfer Vault



PLAN VIEW

Challenge 2



The geography, wells and ponds separated by thousands of feet. Radio communication was a challenge

DAF Services, Incorporated

Thank You