



Return on Investment with Smart Irrigation Technology

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UF/IFAS Center for Landscape Conservation and Ecology

- Mission
 - To protect and conserve Florida's natural resources through research-based sustainable urban landscape practices.
- Vision
 - To be the leading source of science-based information on horticulture and the urban environment in Florida.

How Much Water Can Be Saved?

- *Toilets: 2,484 gal/yr
- *Dishwasher: 288 gal/yr
- *Washing Machine: 5,220 gal/yr
- Irrigation Scheduling (25%): 18,837 gal/yr
– 240% of all indoor

Smart Controllers

- From Irrigation Association Smart Water Application Technologies (SWAT) committee (2007)



“Smart controllers *estimate* or *measure* depletion of available plant *soil moisture* in order to operate an irrigation system, replenishing water as needed while minimizing excess water use. A properly programmed smart controller requires initial site specific set-up and will make irrigation schedule adjustments, including run times and required cycles, throughout the irrigation season without human intervention.”

Smart Water Application Technologies (SWAT)



Evapotranspiration (ET) based controllers

Soil moisture controllers (SMS)



Irrigation controllers that respond to conditions in the irrigated system to automatically adjust to plant needs

Soil Moisture Sensor Controller



ET Controllers

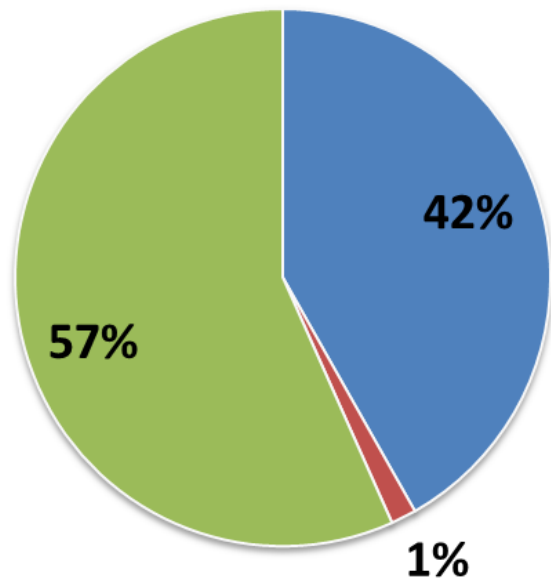
- Can determine runtimes and days
- Programming is key!
 - Soil type
 - Plant type
 - Microclimate
 - Application rates
 - Slope



Smart Controllers Nationally

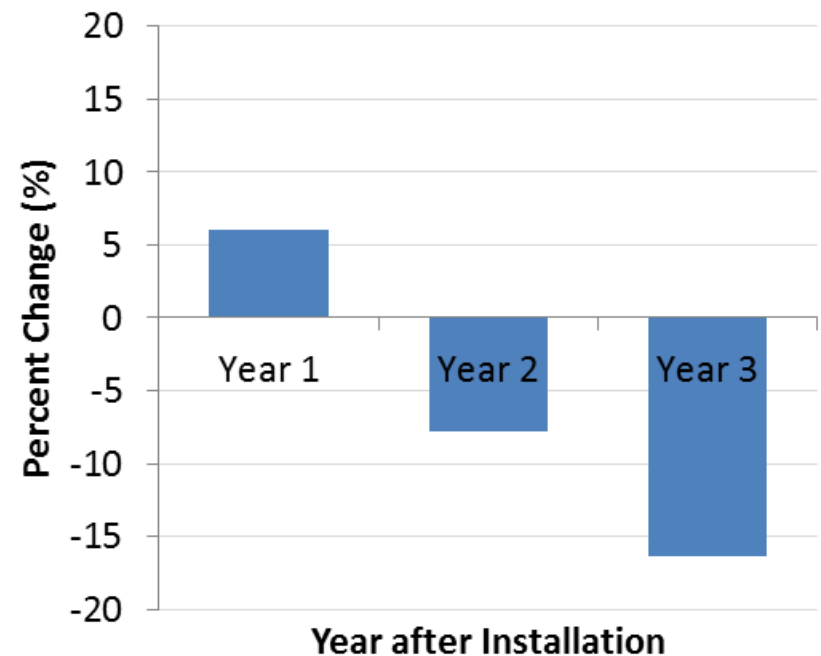
- Colorado ET controller study (Aquacraft, 2002; Aquacraft, 2003)
 - After 3 years, there were no actual water savings due to 5 of 7 sites being historical under-irrigators
- California ET controller study (Mayer et al., 2009)

2,294 sites/3,112 smart controllers: **6% Savings**



■ Increase ■ No change (+ or - 0.6%) ■ Decrease

384 sites: **16.4% savings** after year 3



- Problem:

- Water conservation programs make smart controllers available to everyone indiscriminately
- Increased irrigation can occur when smart controllers are implemented in an already conservative environment

- Objective:

- Evaluate methodologies for identifying single-family home utility customers capable of benefiting from implementing smart controllers

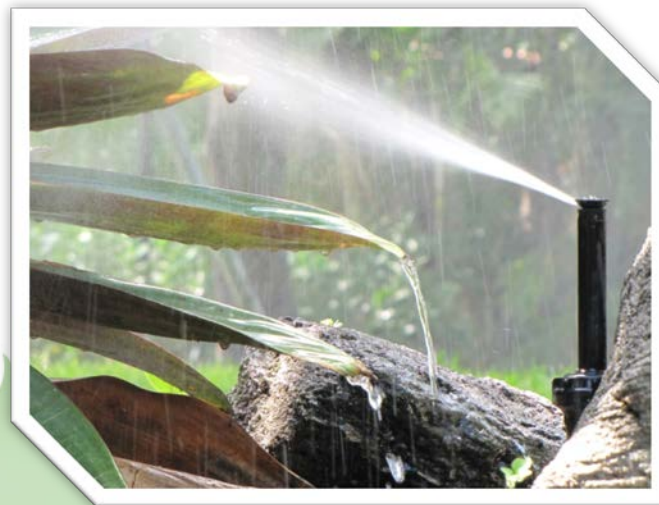
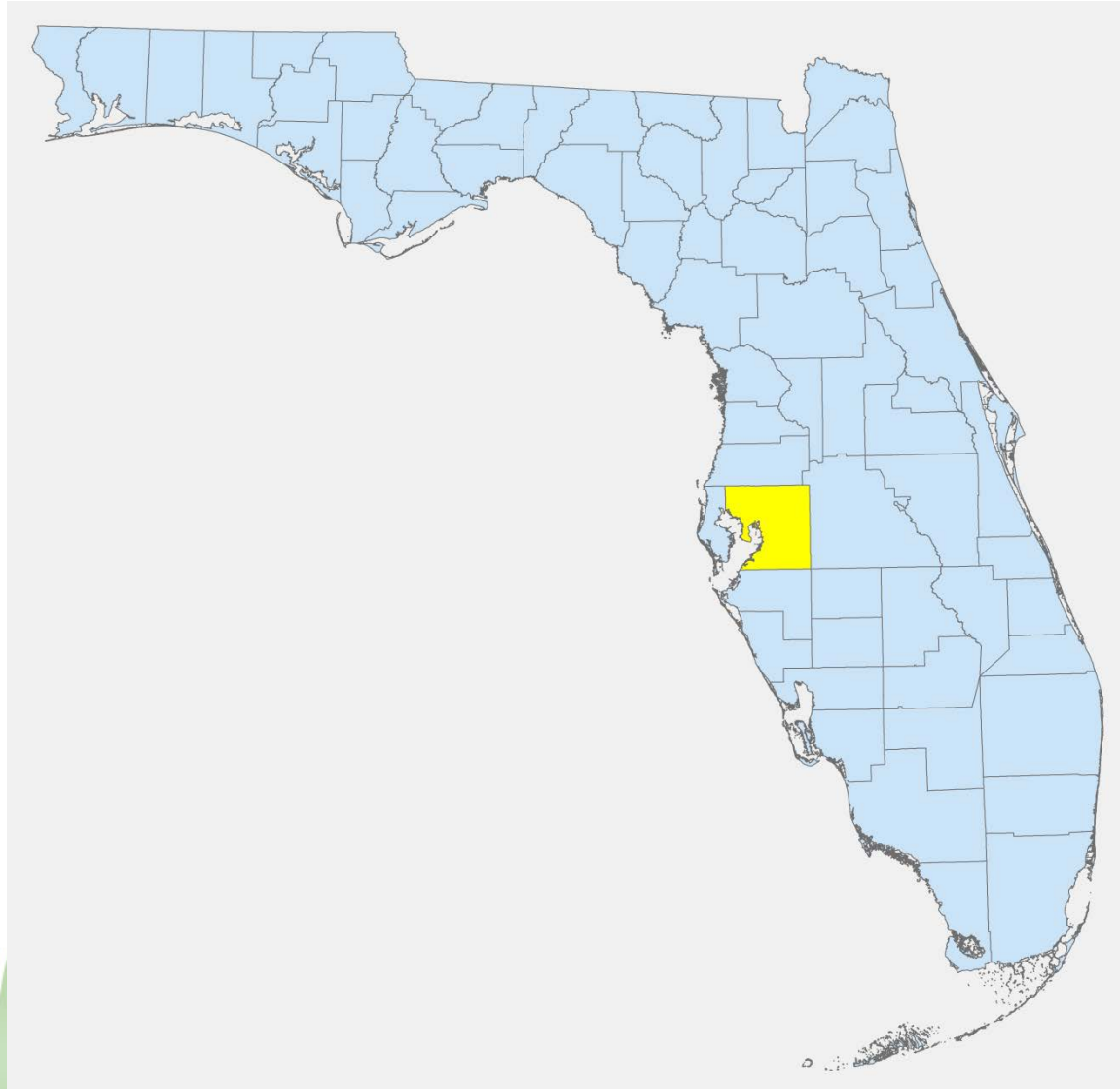


Photo by Michael Gutierrez

Hillsborough County Water Resource Services (HCWRS)



HCWRS Targeting Cooperators

- Targeted areas selected based on historical water use analysis
 - Top 50% of water users in Hillsborough County
 - High water use by homeowners in top 25th to 75th percentile
 - Communities selected:
 - Apollo Beach
 - Riverview
 - Valrico
- Participant selection
 - 2,000 – 4,000 letters mailed to qualifying irrigators across the three communities
 - Interested participants responded to the letter by taking a survey

HCWRS Technology & Expt. Design

– Outcome to solicitation

- 68 responses to survey
- After on-site irrigation evaluations, 36 participants were selected
- Treatments
 - 21 received Toro Intelli-Sense ET controllers
 - 15 were comparisons, no changes made

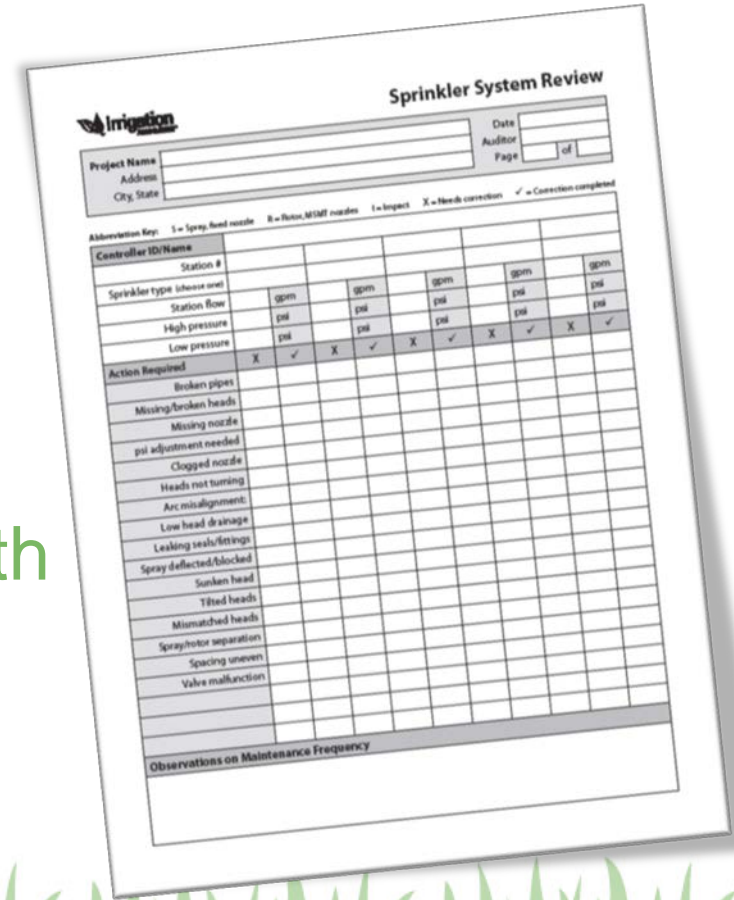
Number of homes in each treatment

Location	ET Controller	Comparison
Apollo Beach	7	6
Riverview	5	3
Valrico	9	7



Irrigation Inspection: The System Review

- Activate all zones
- Observe and document which components are not operating correctly
 - The Sprinkler System Review form can help with recording and reporting



The image shows a 'Sprinkler System Review' form. At the top right, it is titled 'Sprinkler System Review'. Below the title, there are fields for 'Project Name', 'Address', and 'City, State'. To the right of these fields are fields for 'Date', 'Auditor', and 'Page' (with a 'of' field). Below the project information, there is an 'Abbreviation Key' section with the following definitions: 'S = Spray, flood nozzle', 'R = Rotar, MIMF nozzle', 'I = Impact', 'X = Head & correction', and '✓ = Correction completed'. The main body of the form is a table with columns for 'Station #' and five columns for flow and pressure measurements (gpm and psi). The rows include 'Sprinkler type (see key)', 'Station flow', 'High pressure', and 'Low pressure'. Below the table is an 'Action Required' section with a list of items: 'Broken pipes', 'Missing/broken heads', 'Missing nozzle', 'psi adjustment needed', 'Clogged nozzle', 'Heads not turning', 'Arc misalignment', 'Low head drainage', 'Leaking seals/fittings', 'Spray deflected/blocked', 'Sunken head', 'Tilted heads', 'Mismatched heads', 'Spray/hotor separation', 'Spacing uneven', and 'Valve malfunction'. At the bottom of the form, there is a section for 'Observations on Maintenance Frequency'.

Station #	gpm	psi	gpm	psi	gpm	psi	gpm	psi
Sprinkler type (see key)								
Station flow								
High pressure								
Low pressure								
Action Required	X	✓	X	✓	X	✓	X	✓
Broken pipes								
Missing/broken heads								
Missing nozzle								
psi adjustment needed								
Clogged nozzle								
Heads not turning								
Arc misalignment								
Low head drainage								
Leaking seals/fittings								
Spray deflected/blocked								
Sunken head								
Tilted heads								
Mismatched heads								
Spray/hotor separation								
Spacing uneven								
Valve malfunction								



Low Pressure





Broken Sprinklers

Bad Seals



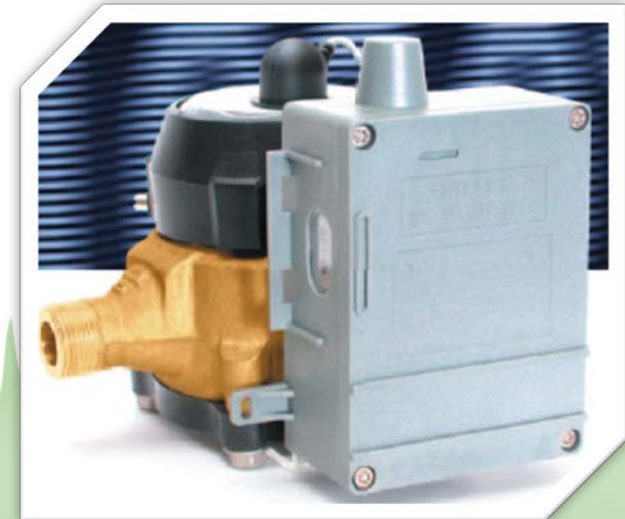


Mismatched Sprinklers

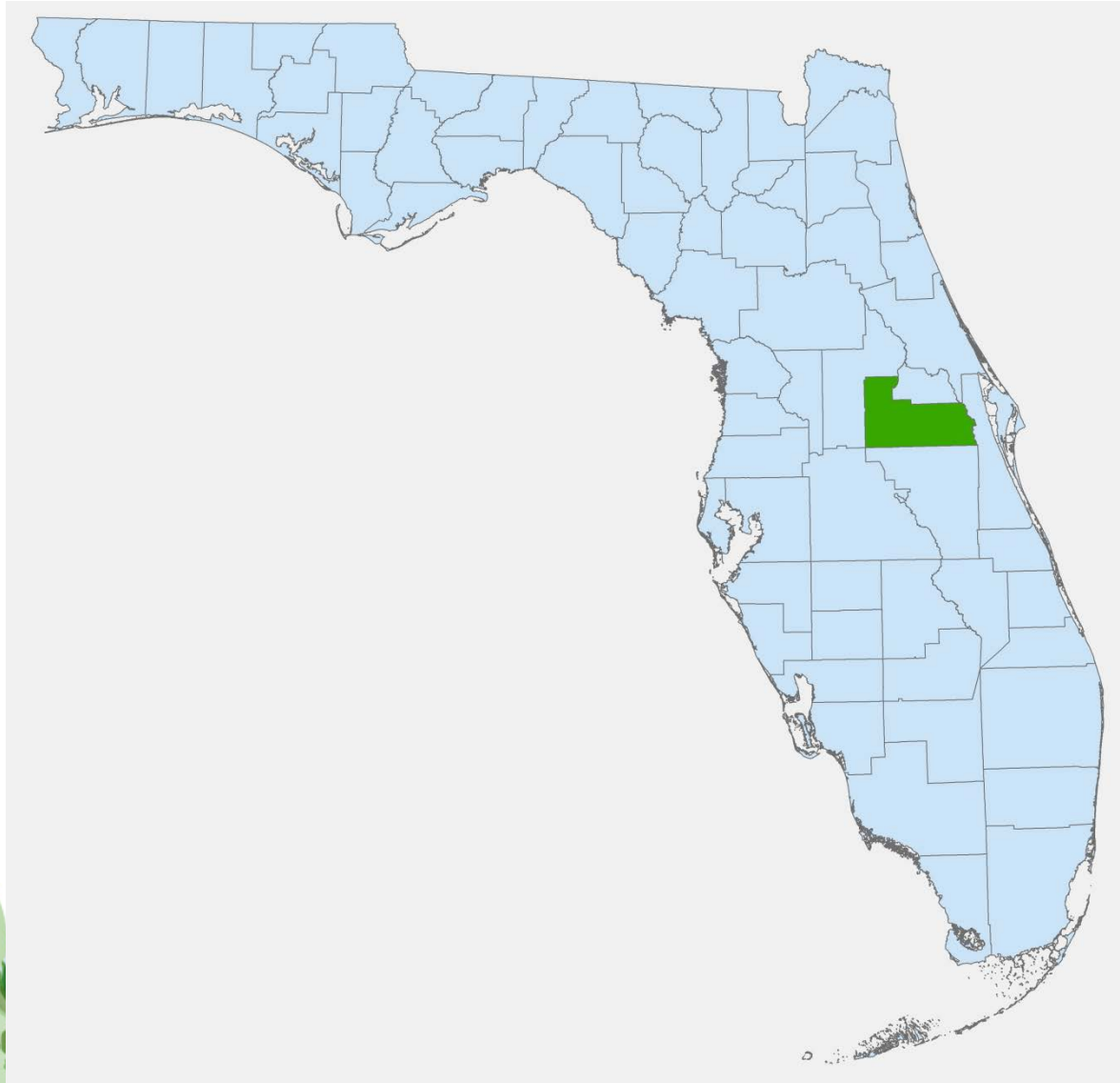
AUG 3 2004

HCWRS Data Collection

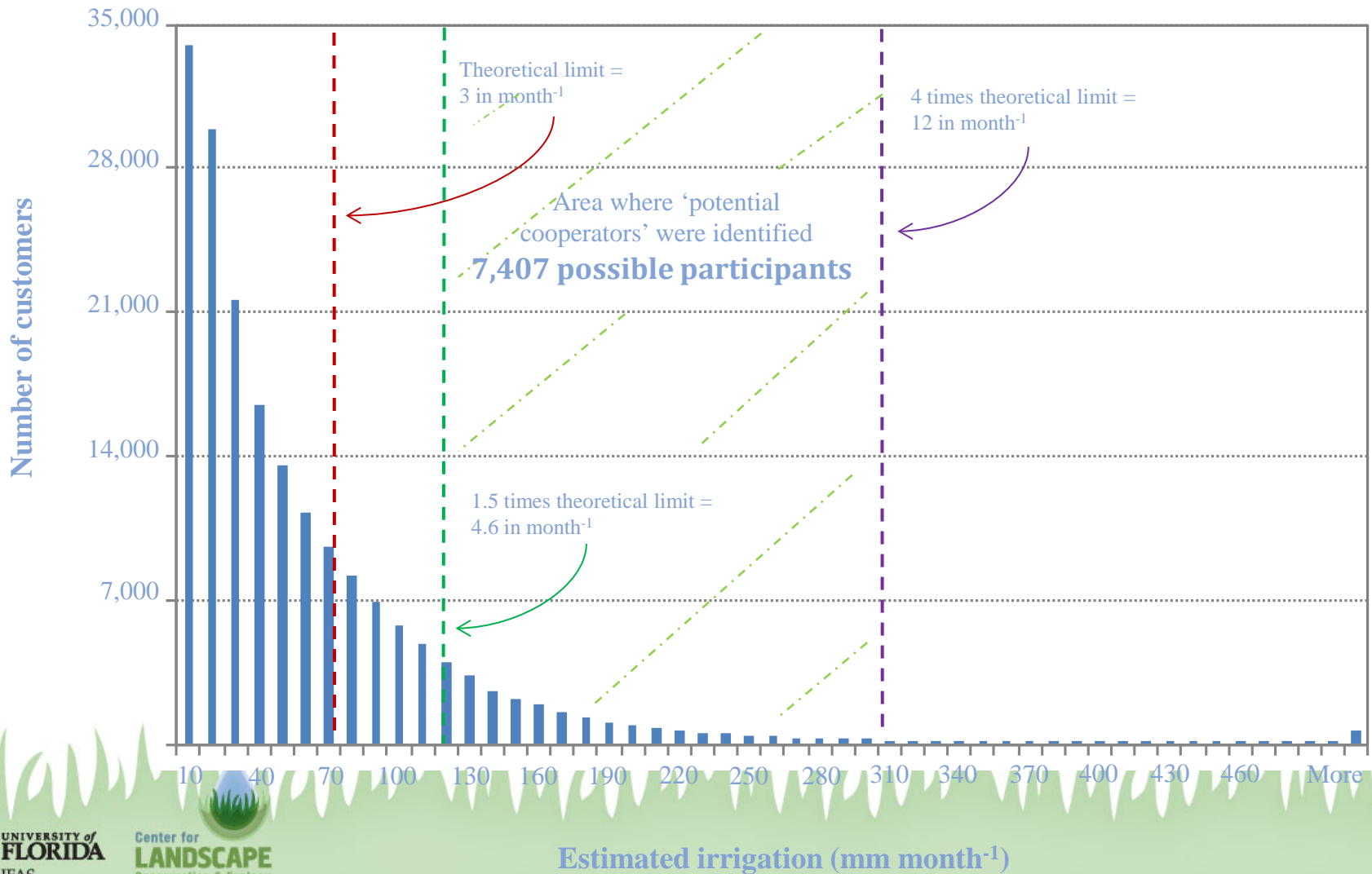
- Data Collection (February 2009 – January 2011)
 - Automatic meter recording (AMR) devices
 - Data collected at 15 minute intervals
 - Irrigation was separated from indoor water use
 - Assumption of lower flow rates for indoor appliances



Orange County Utilities (OCU)



OCU Targeting Cooperators



OCU Technologies & Expt. Design

Treatment	ET	ET+Edu	SMS	SMS+Edu	Comparison
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Rain Bird ESP-SMT

Rain Bird ESP-SMT

Baseline WaterTec S100

Baseline WaterTec S100

Technology



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Locations Installed

7

9

7

9

9

Number Installed

28

38

28

38

35



OCU – Education Groups

– ET+Edu treatment

- Reprogrammed for site specifics
- 5 minute tutorial
- Total Count = 38
- Total Locations = 9

– SMS+Edu treatment

- Inserted into soil column at 3 inch depth
- Reprogrammed for
 - 0.25" per event,
 - 2 events per day,
 - 3 d/wk
- 5 minute tutorial
- Total count = 38
- Total locations = 9



OCU Irrigation Measurement

– AMR devices

- Dedicated flow meter to measure irrigation only
- Records hourly irrigation volumes
- Monthly downloads



OCU Weather Stations

Installed in each regional treatment location.



Two additional rain gauges were installed for homes significantly farther away from the weather station.



Materials and Methods

Saturation

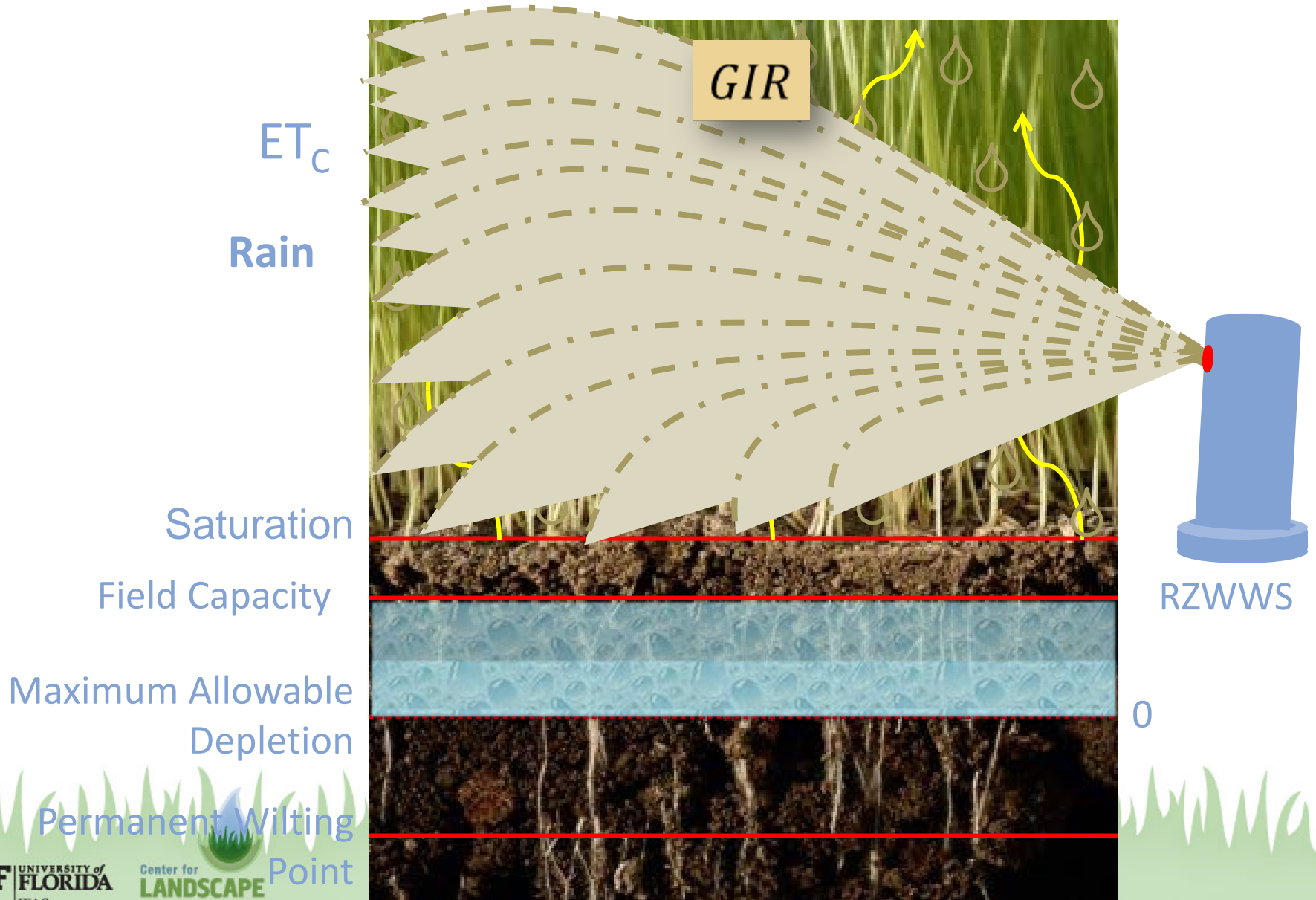
Field Capacity

Maximum Allowable
Depletion

Permanent Wilting
Point

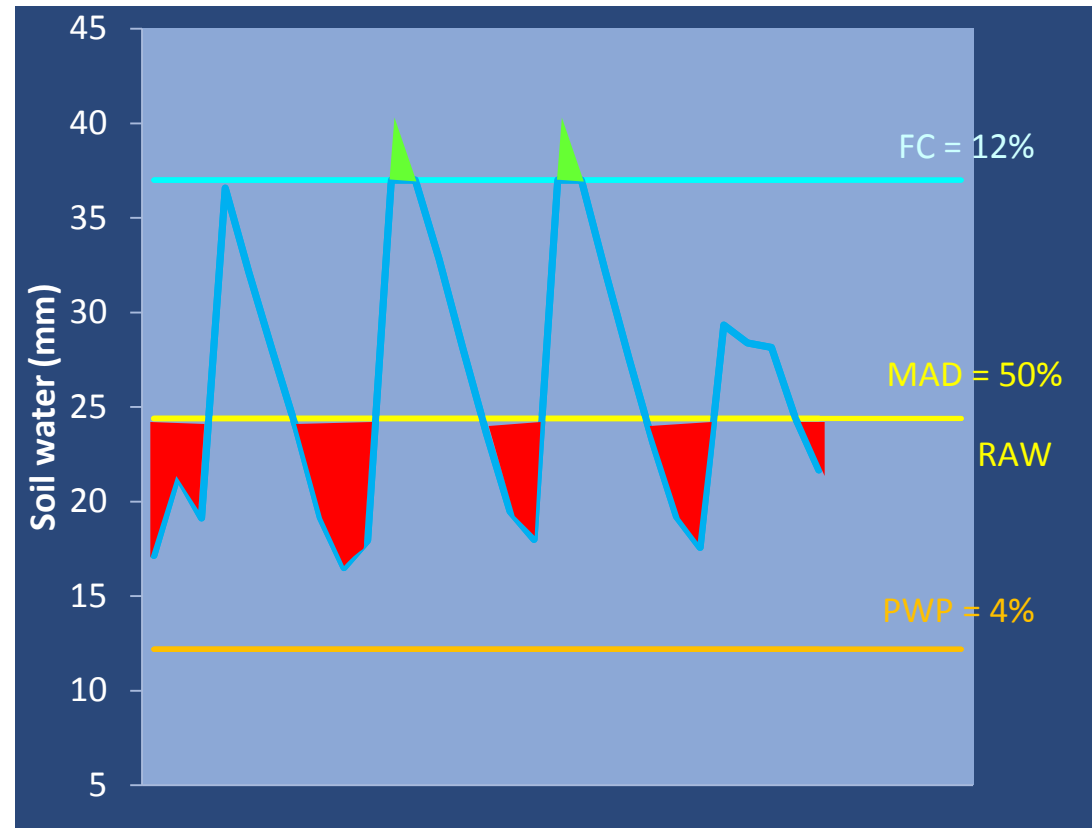


Materials and Methods

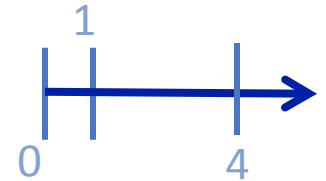


ET Controllers

- Goal to maintain soil water between FC (upper limit) and MAD (lower limit)



Monthly Application Ratios



Did they apply what they needed *before* the study?

$$\text{Hist - GIR Ratio} = \frac{I_{\text{Historical}}}{I_{\text{GIR}}}$$

{ Pre-Ratio }

Did they apply more/less than before the study?

$$\text{TMT - Hist Ratio} = \frac{I_{\text{Actual}}}{I_{\text{Historical}}}$$

Did they apply what they needed *during* the study?

$$\text{TMT - GIR Ratio} = \frac{I_{\text{Actual}}}{I_{\text{GIR}}}$$

{ Post-Ratio }

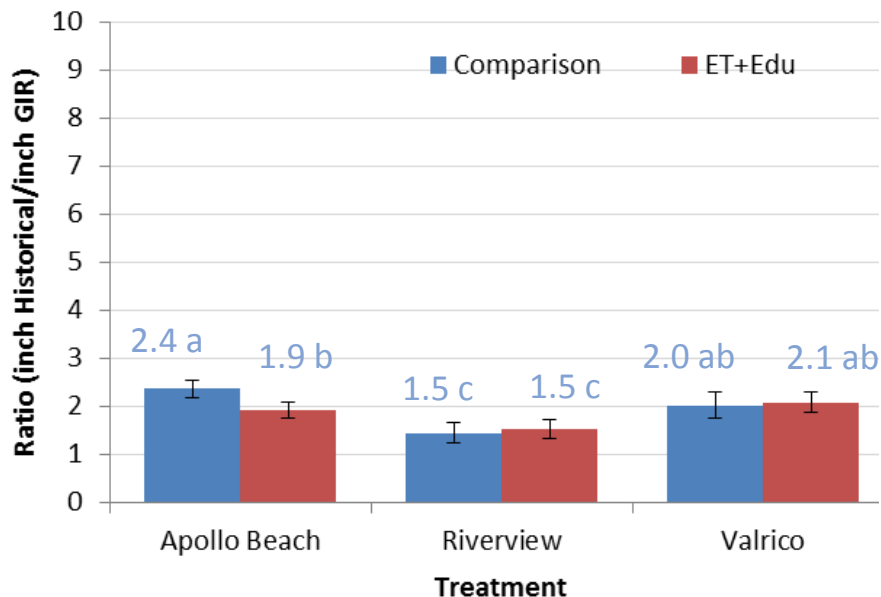
Ratio Difference = Post-Ratio - Pre-Ratio

Historical Compared to GIR

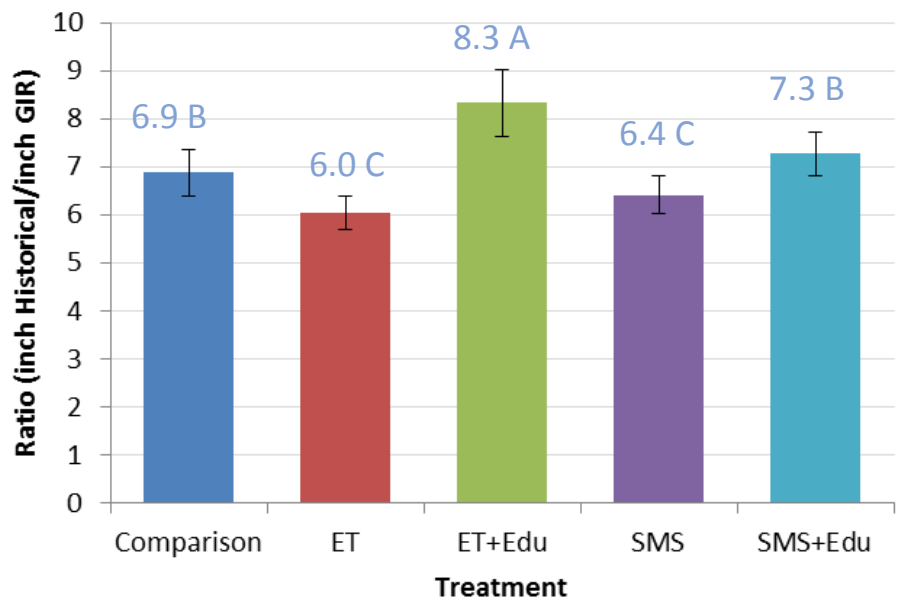
$$\text{Hist - GIR Ratio} = \frac{I_{\text{Historical}}}{I_{\text{GIR}}}$$

– Minimum of 5 years per cooperator

HCWRS



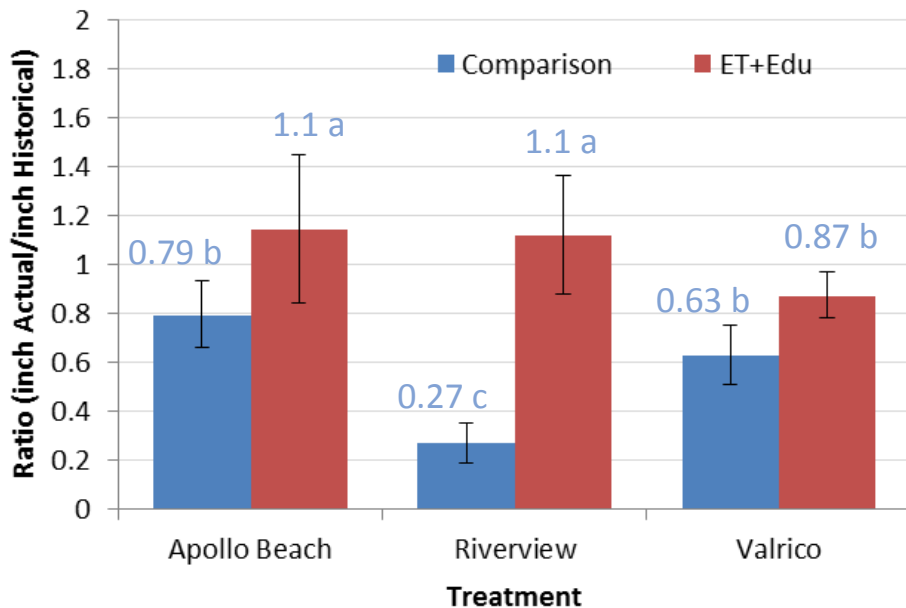
OCU



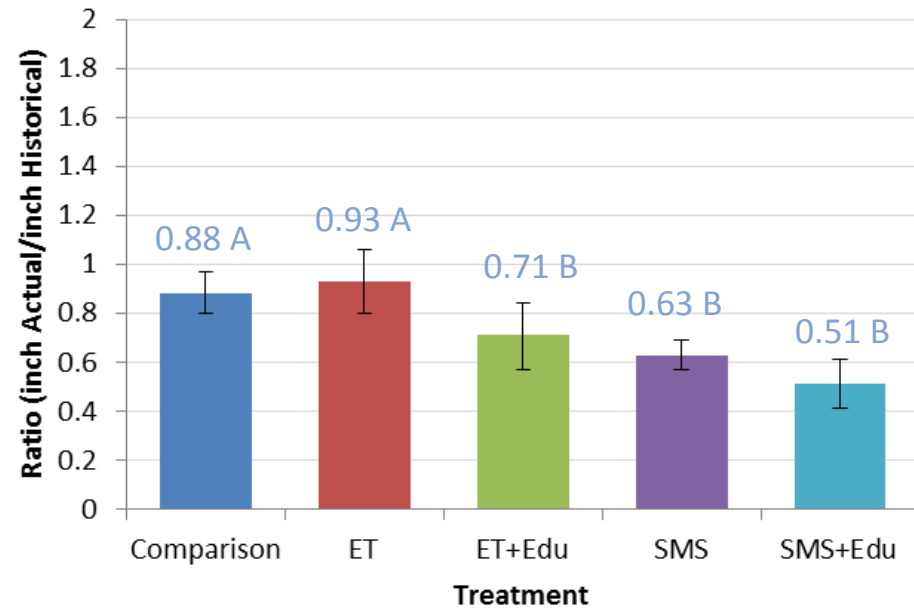
Study Compared to Historical

$$\text{TMT} - \text{Hist Ratio} = \frac{I_{\text{Actual}}}{I_{\text{Historical}}}$$

HCWRS



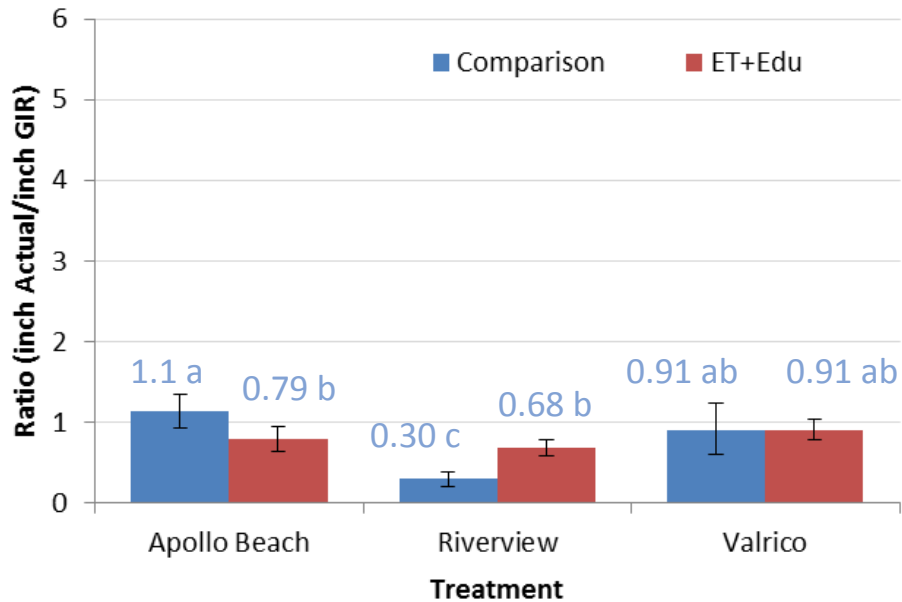
OCU



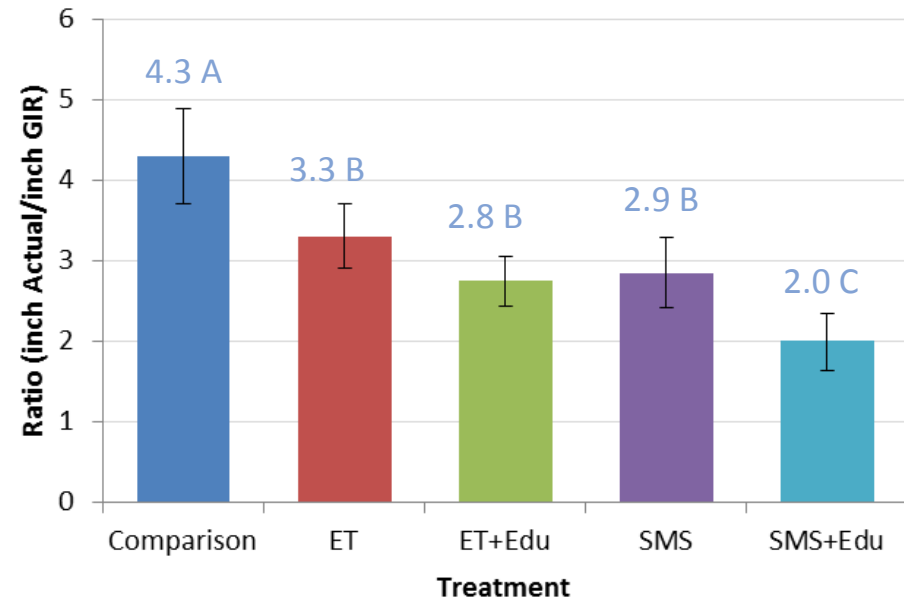
Treatment Compared to GIR

$$\text{TMT} - \text{GIR Ratio} = \frac{I_{\text{Actual}}}{I_{\text{GIR}}}$$

HCWRS



OCU



Utility Tiered Rates

HCWRS

OCU

Tier	Volume Range (gal)		Cost (\$)
1	0	5,000	3.61
2	5,001	15,000	4.82
3	15,001	30,000	6.09
4	30,001+		7.66
Wastewater	0	8,000	4.31

Tier	Volume Range (gal)		Cost (\$)
1	0	3,500	1.04
2	3,501	10,500	1.43
3	10,501	20,500	2.84
4	20,501	30,500	5.68
5	30,501+		11.35
Wastewater	0	14,000	3.47

9,300 ft²

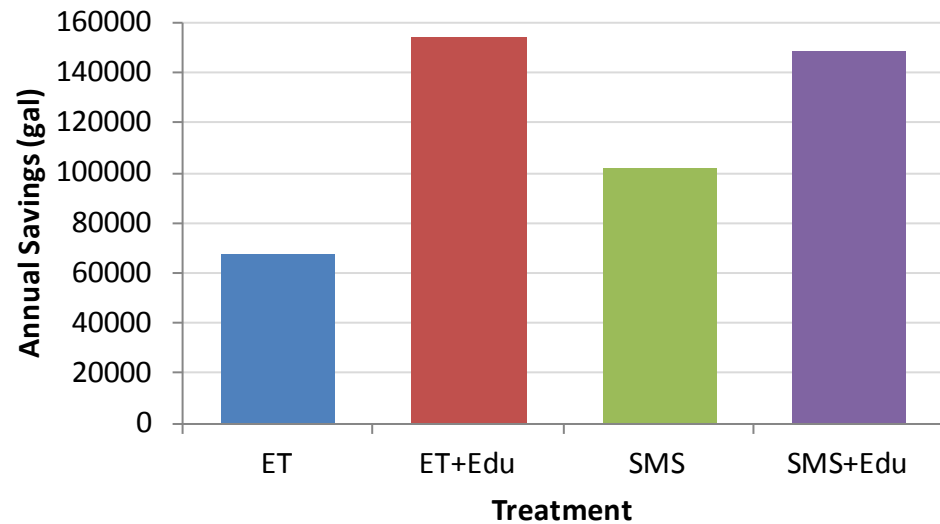
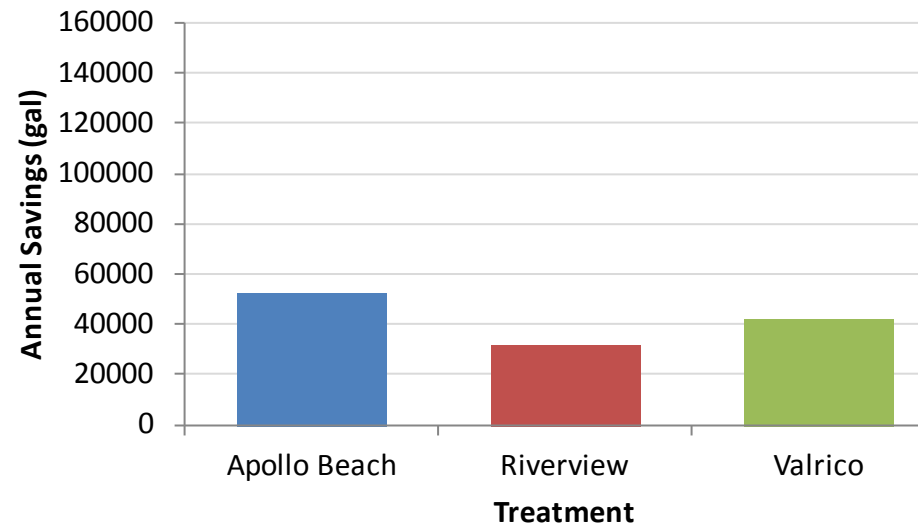


Irrigated Area



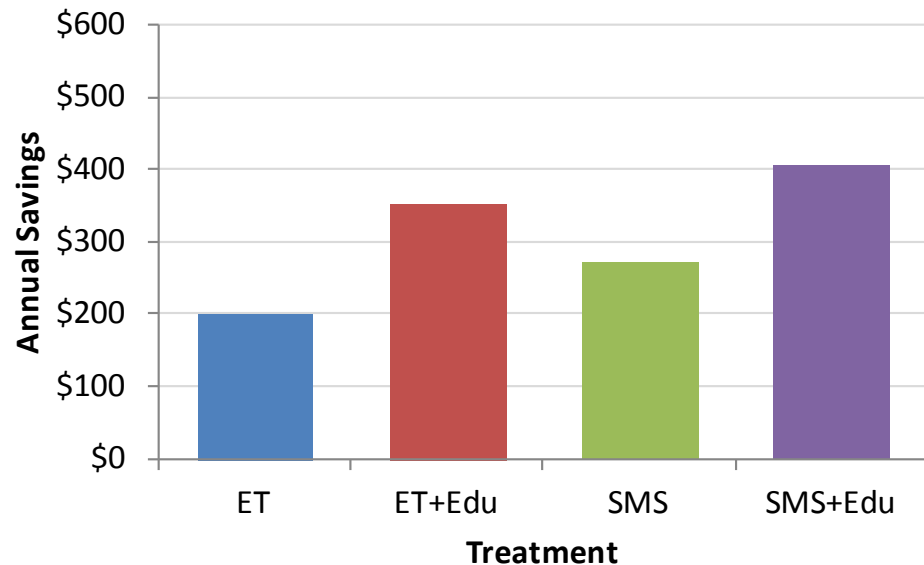
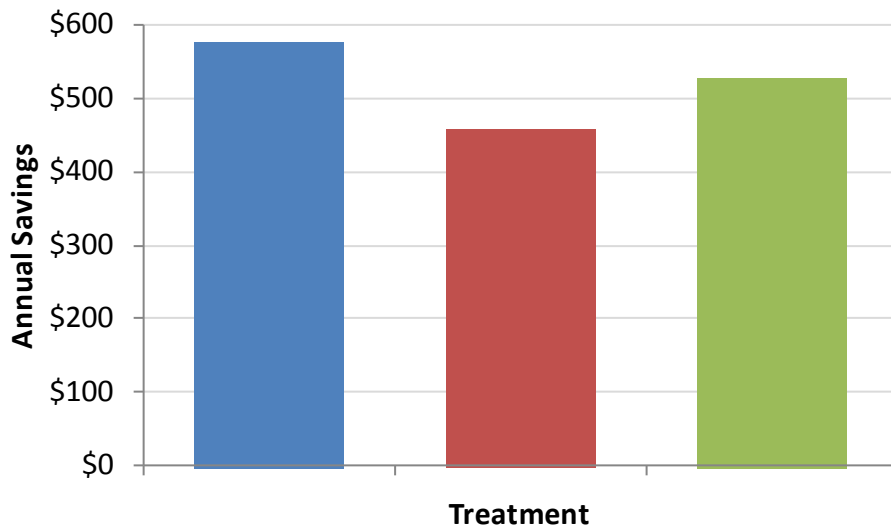
4,800 ft²

Annual Water Savings



Return on Investment

- Purchase and installation prices of \$400 and \$600 for SMS and ET controllers,



Payback
Period
(months)

13

16

14

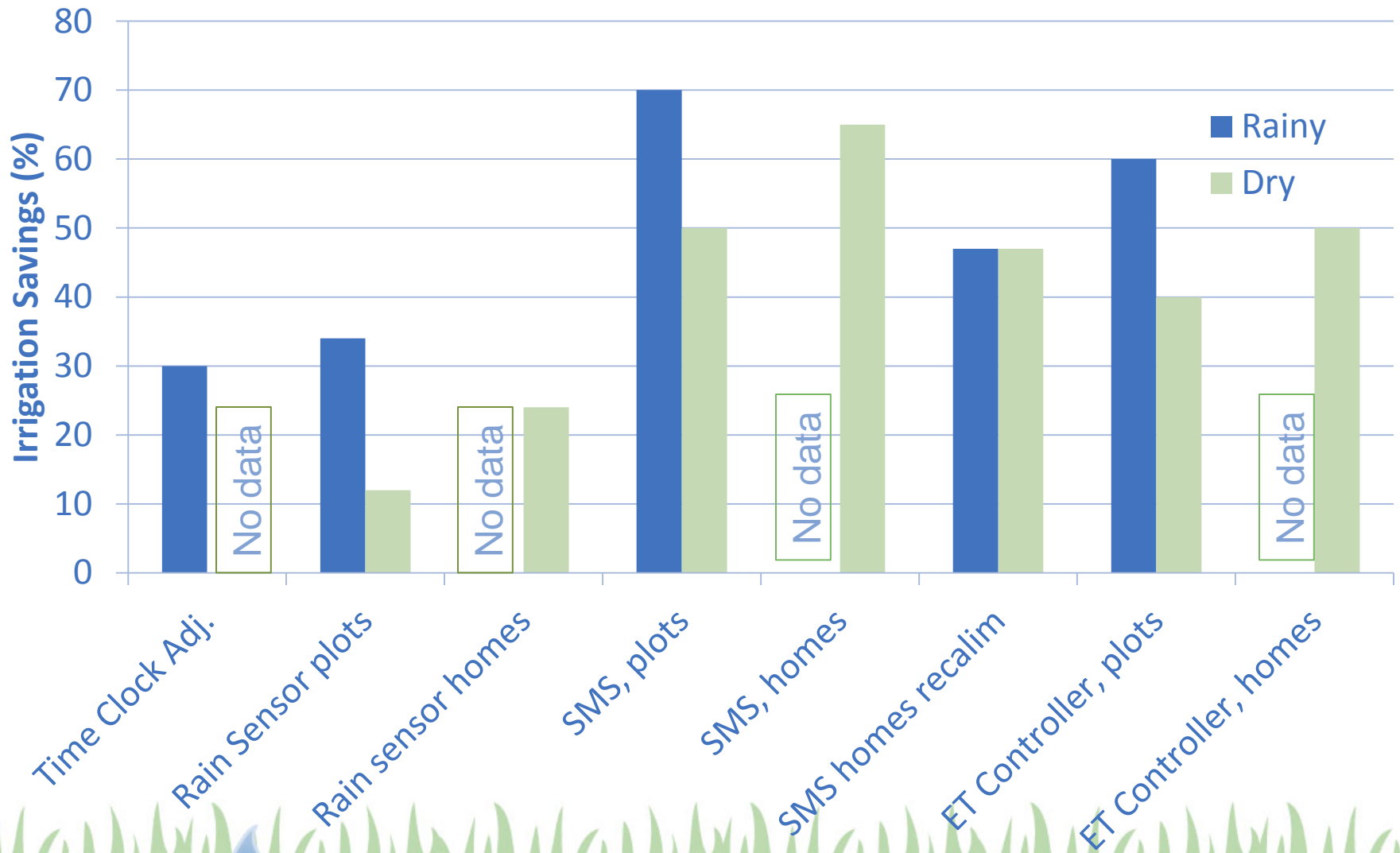
37

21

18

12

Research Based Irrigation Savings Potential



Conclusions

- Identifying excessive irrigators prior to smart controller implementation was beneficial in reducing irrigation
- Already conservative irrigators resulted in no change or increased irrigation
- Combining targeted selection of homeowners with a water conservation program would maximize water savings

Questions?

