

This presentation premiered at WaterSmart Innovations

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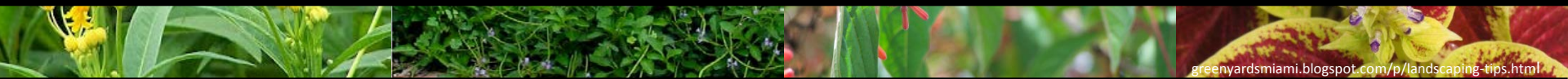




Using Big Data to Predict Big Alternative Landscape Irrigation Savings

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WaterSmart Innovations
October 3, 2013



Research questions

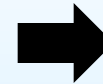
- What are the irrigation behaviors of customers in southwest Florida?



vs.

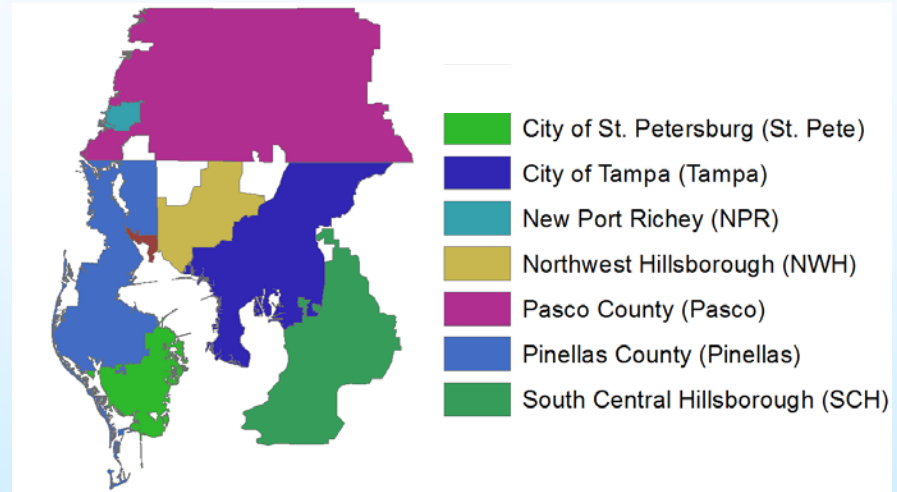
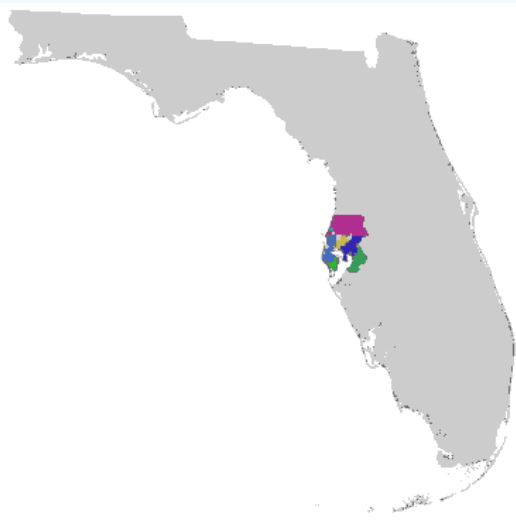


- How much irrigation could be saved using Florida-Friendly Landscapes?



Study area

- Tampa Bay Water
- Potable water billing records
 - No reclaimed water customers
 - Existence of private wells for irrigation unknown



Big Data for estimating irrigation

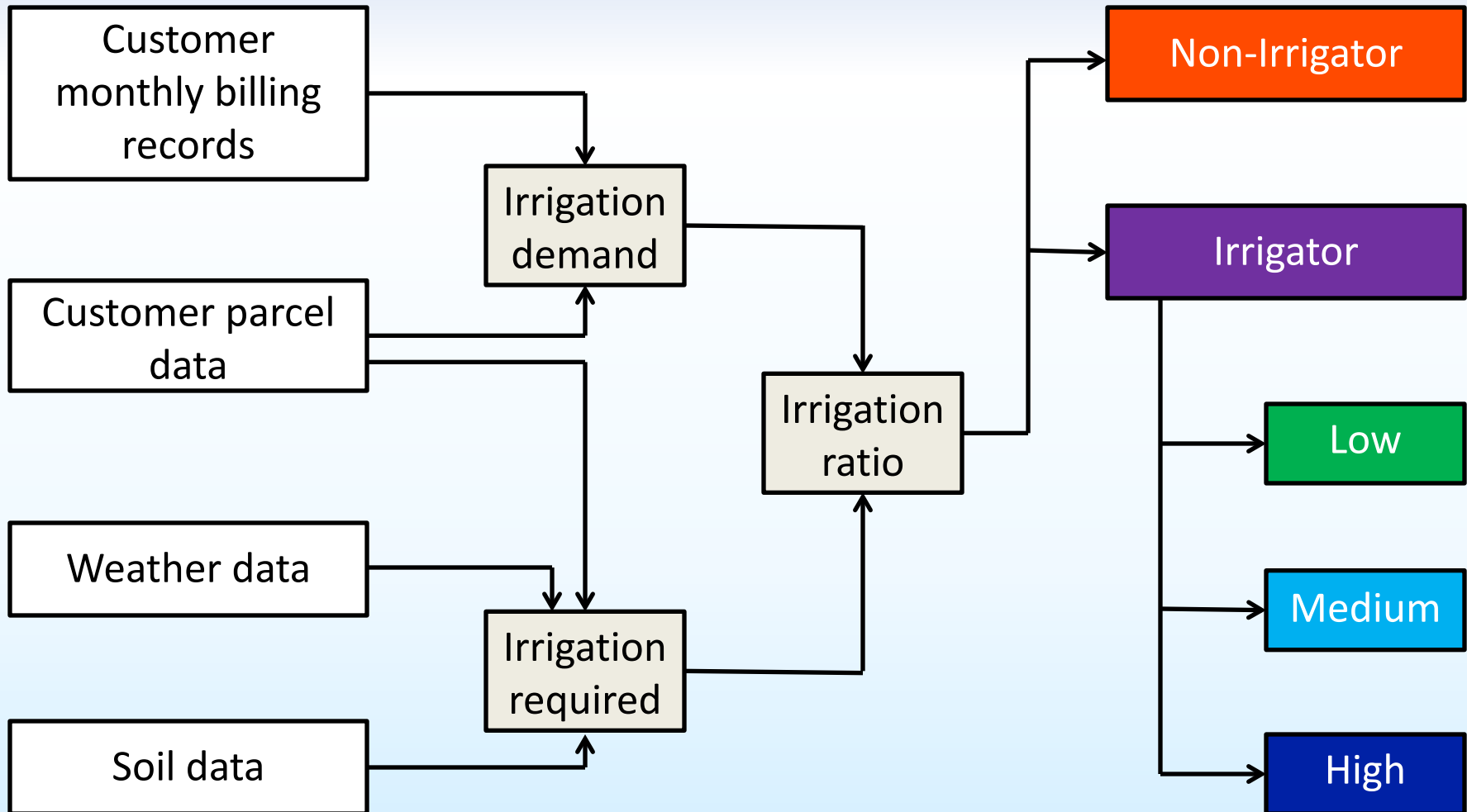
- Big data: High volume (amount of data), high velocity (speed of data in and out), and/or high variety (range of data types and sources)
- Study data

Characteristic	Observations	Variables
Customers	~650,000	-
Monthly water billing	~44,000,000	25
Parcels	~432,000	24
Soils	~40,000	40
Daily weather	~5,782,000	12

~18 GB of text and
 Access files
 (not including GIS)

- Analysis performed in GIS, SAS, and R

Research approach: Classifying irrigation customers



Irrigation demand

- Irrigation demand = Total water - Indoor water
 - Indoor water = (70 gpcd)(avg household size for utility)(30 days/month)
- Irrigation depth = Irrigation demand/green area
 - Green area = total parcel area - building footprint area
 - Assumes irrigation applied equally over greenspace

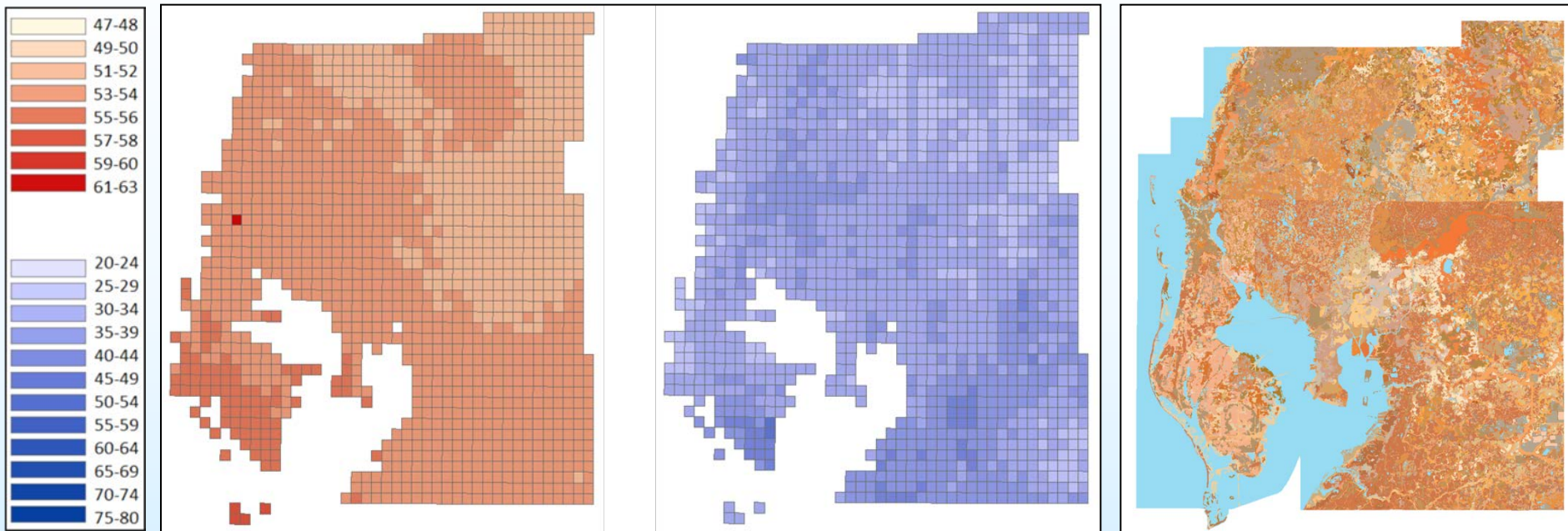
Irrigation required

- 1,440 separate daily soil-water balances calculated for 4,380 days

Annual ET_0 (2000)

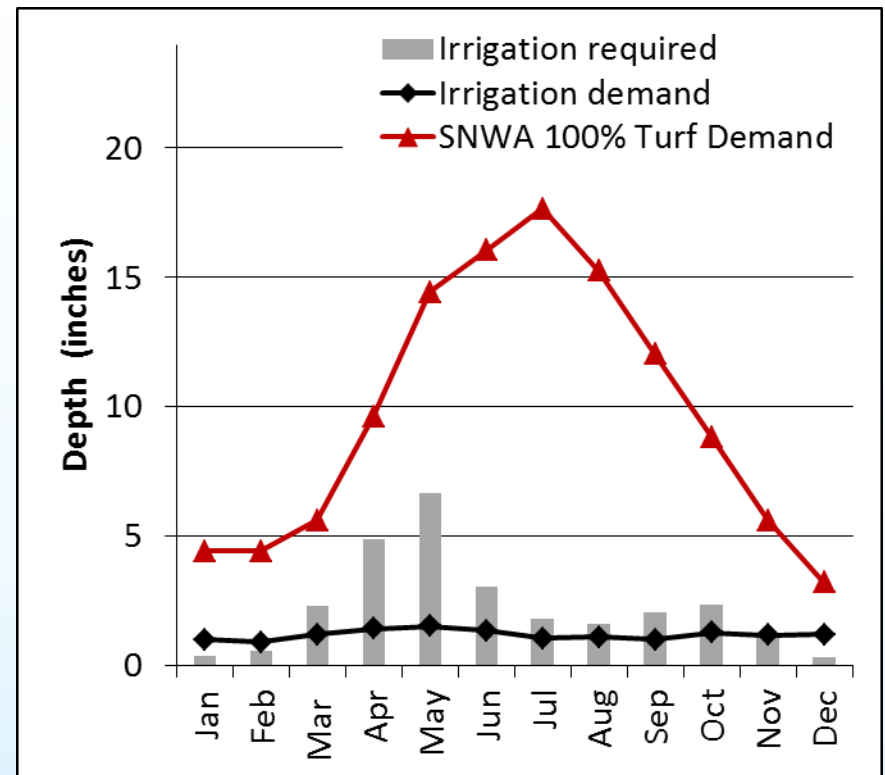
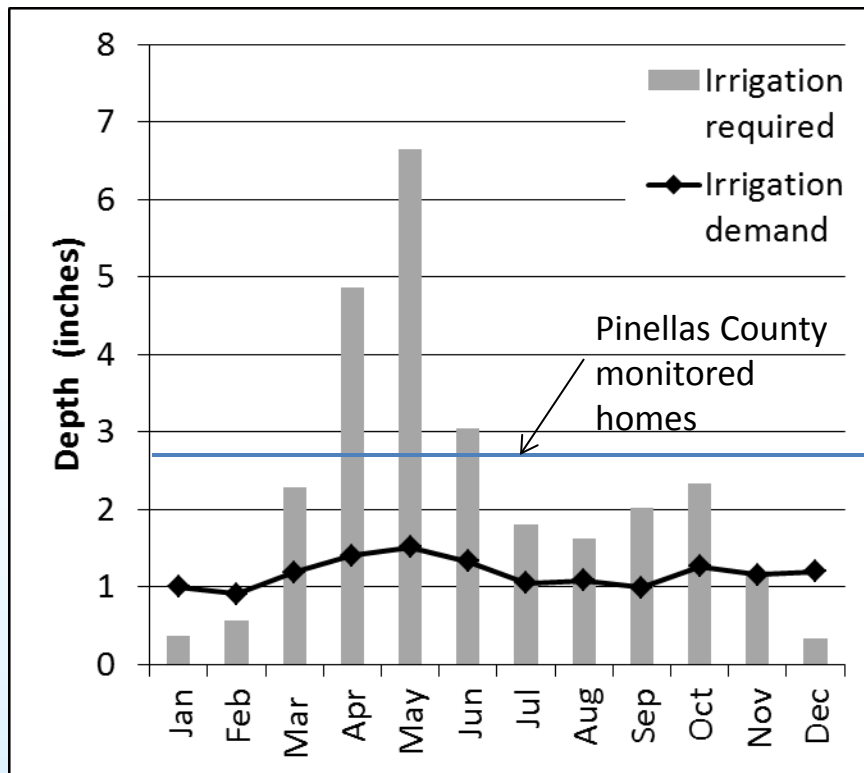
Annual Precipitation (2000)

Soil types



Irrigation demand

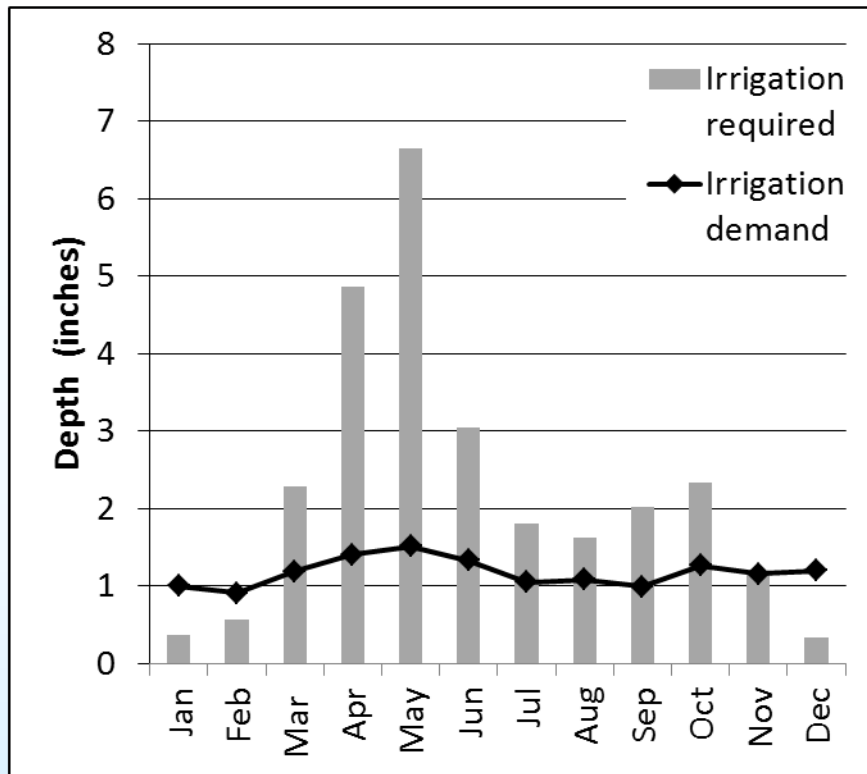
Mean monthly irrigation demand of all customers



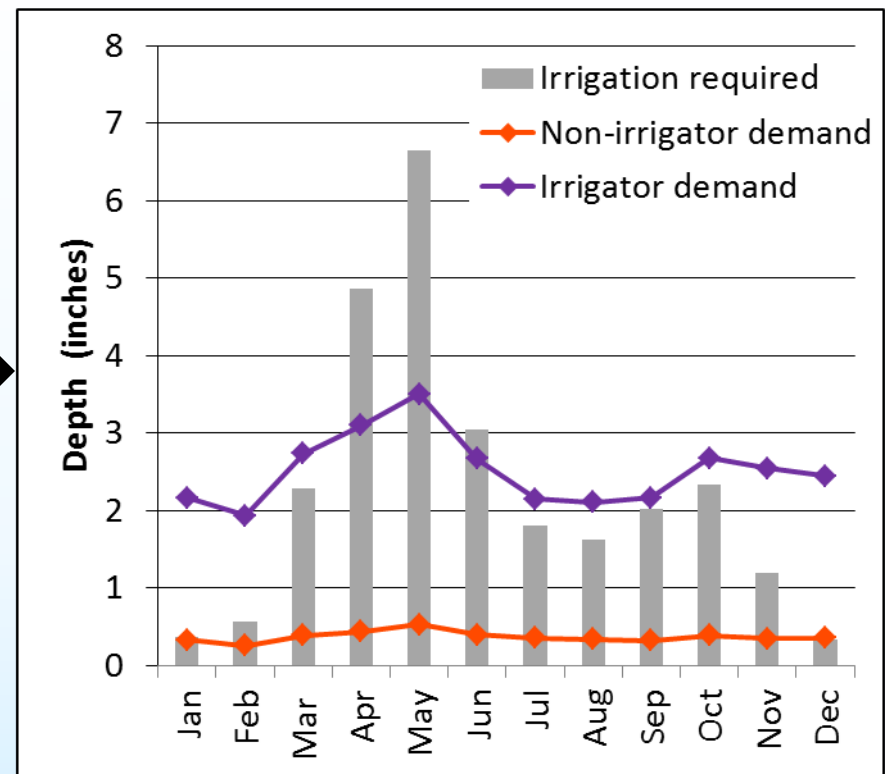
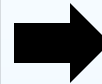
Separating irrigators from non-irrigators: K-means clustering

- K=2 clusters: “irrigators” or “non-irrigators”
- Customers with monthly records for 2006-2008
- Clustered based on mean irrigation ratio for March, April, and May for each year

Irrigation demands of irrigators and non-irrigators

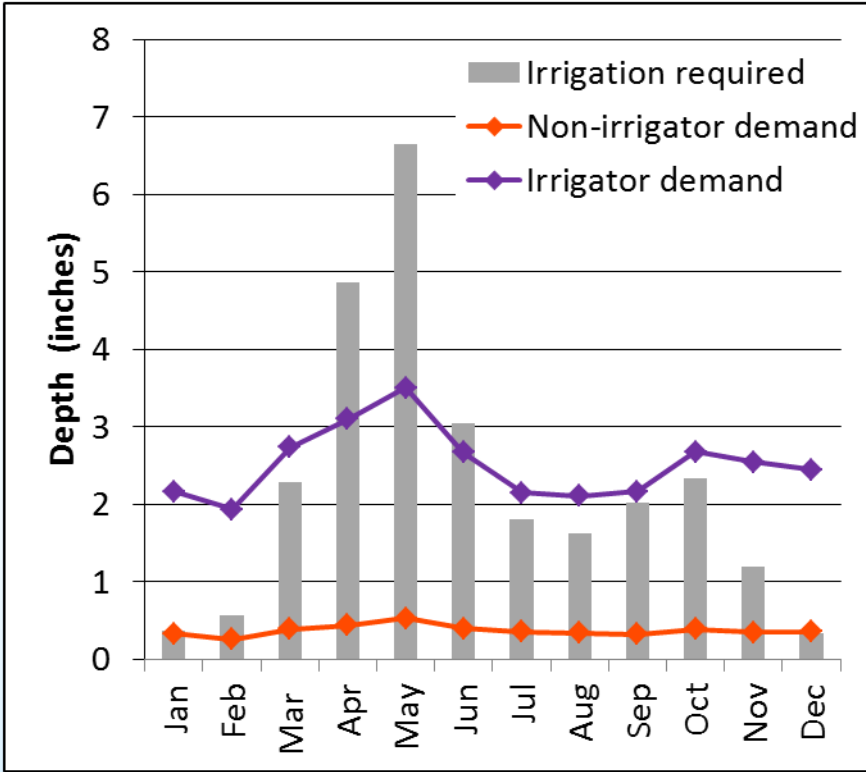


All customers combined

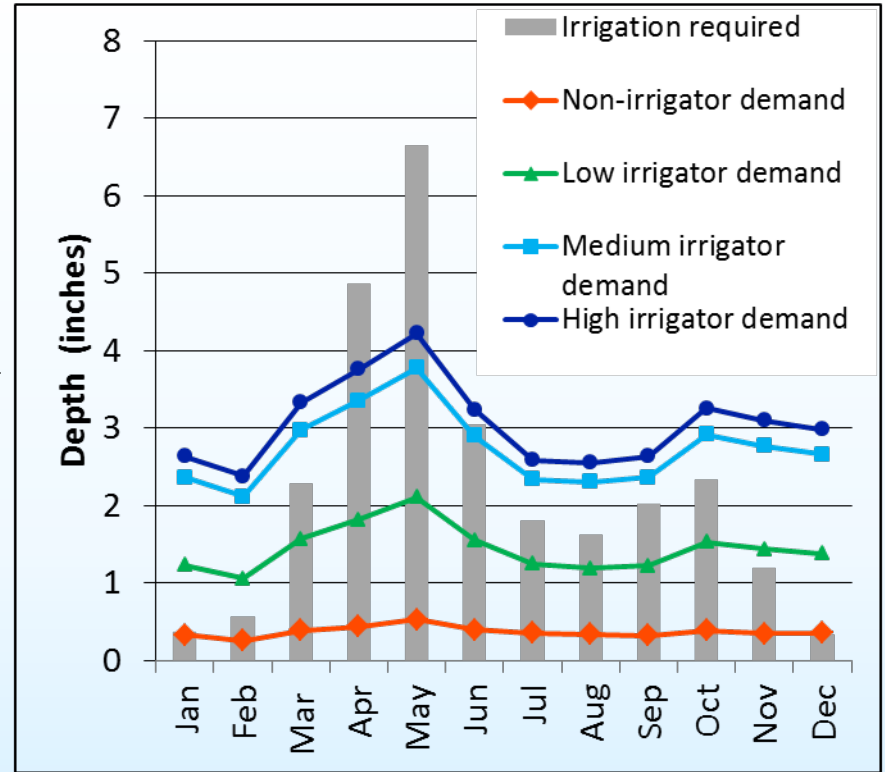
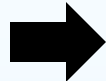


Irrigators and non-irrigator groups

Irrigation demand of irrigators and non-irrigators



Irrigators and non-irrigator groups



High, medium, low, and non-irrigating groups

Irrigating group characteristics

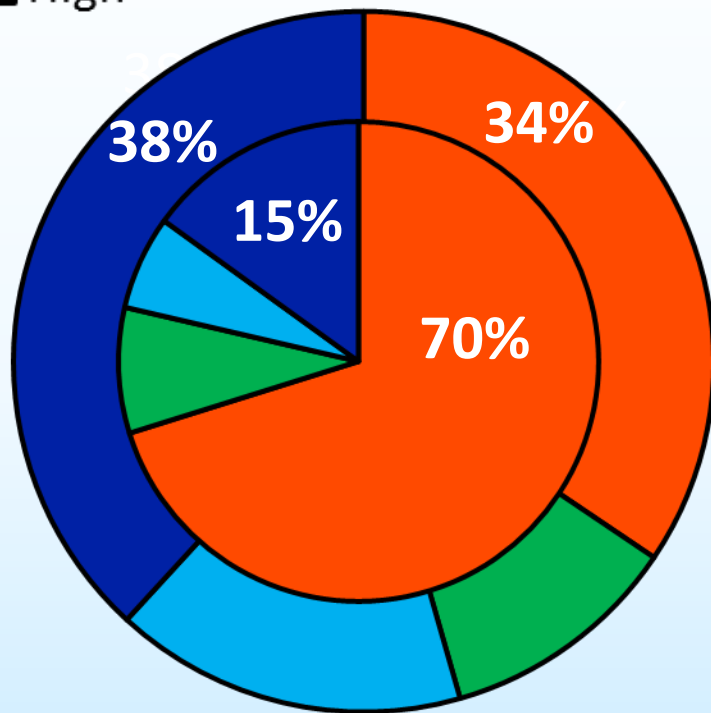
■ Non

■ Low

■ Medium

■ High

Inner circle = % based on number of irrigating customers
 Outer circle = % based on volume of irrigation water



Group	Total annual irrigation volume (MG)	Average daily irrigation volume (gpad)
Non	3,870	79
Low	1,250	211
Medium	1,828	388
High	4,290	409
Total	11,238	277

Research questions

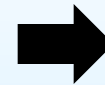
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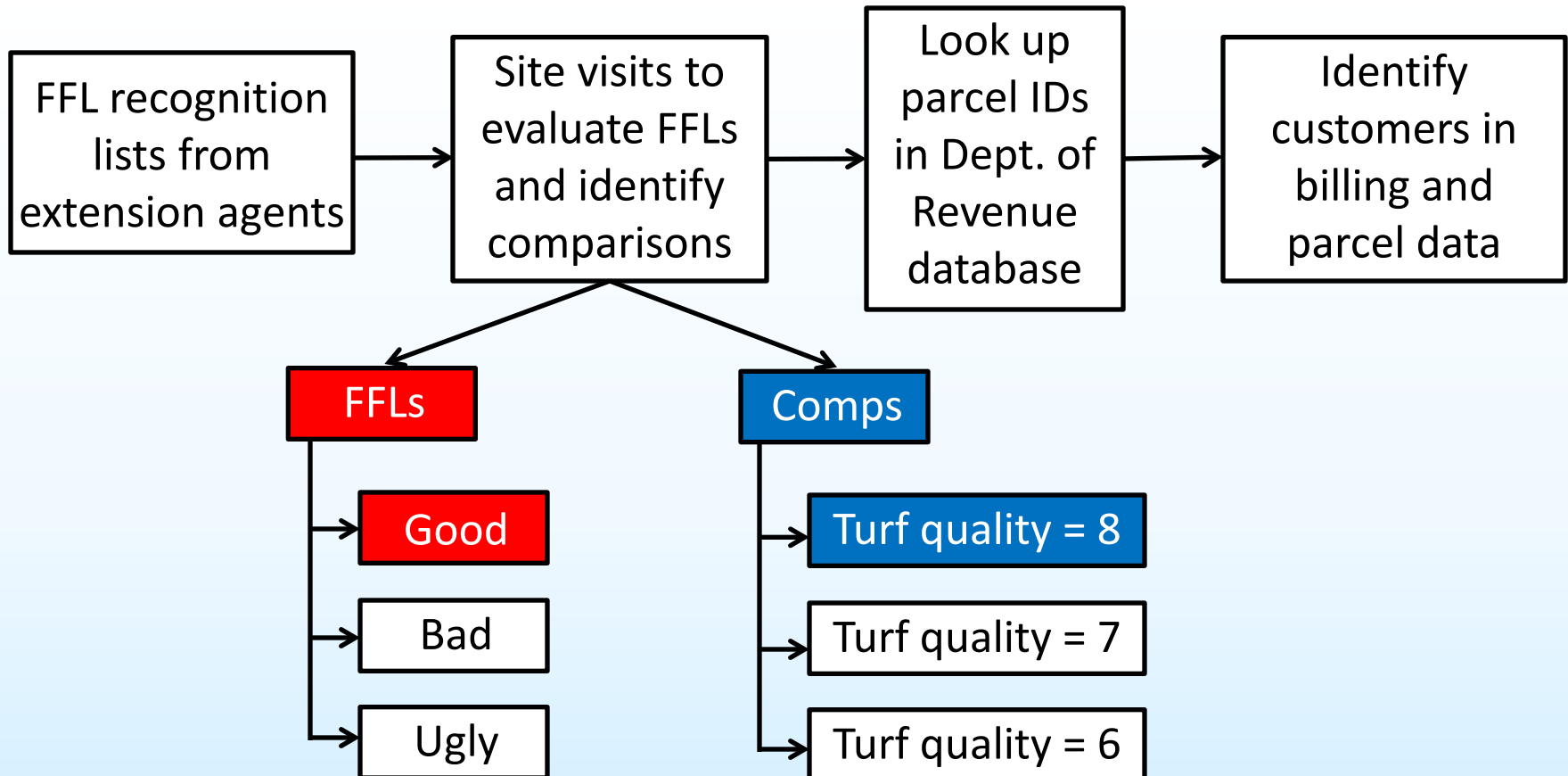
- How much irrigation could be saved using Florida-Friendly Landscapes?



Florida-Friendly Landscaping™

- Began in 1994, partially in response to nonpoint source pollution
- Attractive, low-maintenance landscapes
- Hillsborough, Pasco, and Pinellas Counties: ~350 FFLs
- FFL Principles
 1. Right plant, right place
 2. Water efficiently
 3. Fertilize appropriately
 4. Mulch
 5. Attract wildlife
 6. Manage yard pests responsibly
 7. Recycle
 8. Reduce stormwater runoff
 9. Protect the waterfront

Research approach: Determining FFL irrigation savings



Examples of FFL-recognized homes

The good,



the bad,



and the ugly



We can't just blindly trust the data- site visits
sometimes necessary!

Good FFLs

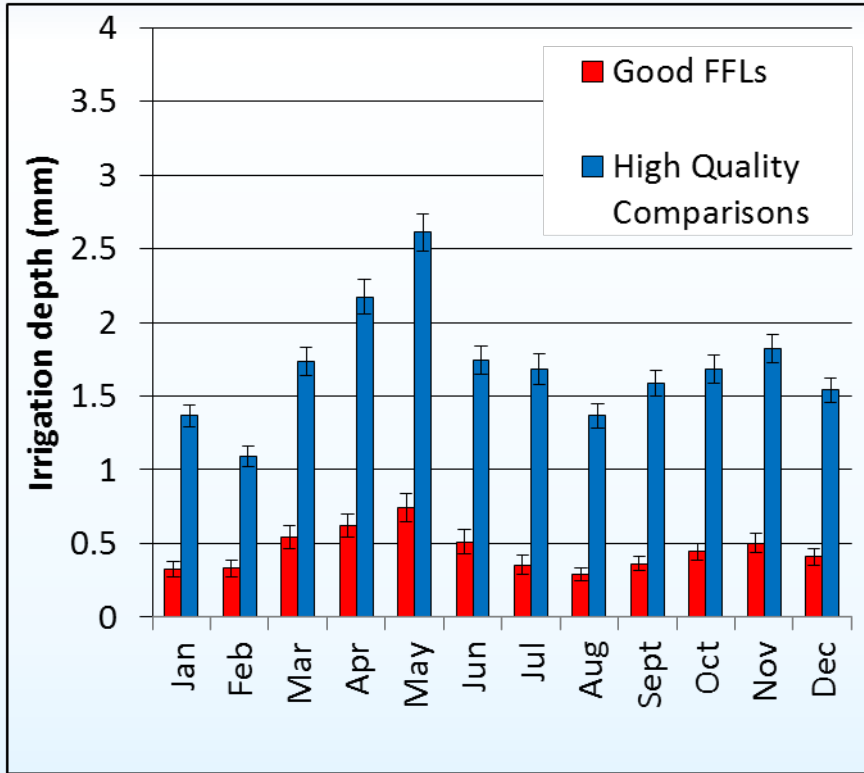




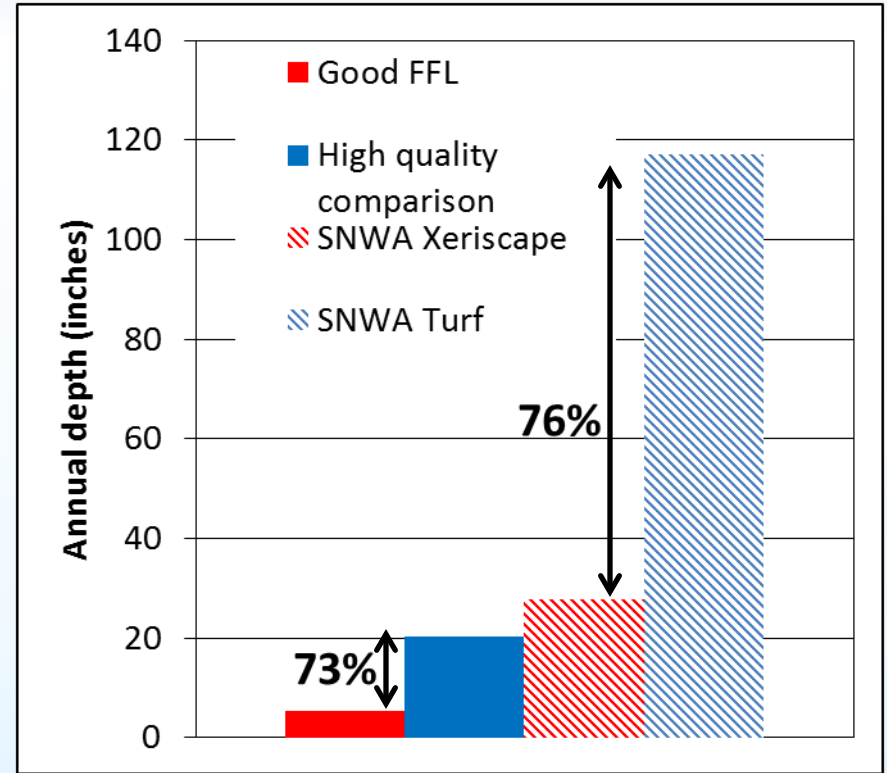
High quality
comparisons



Irrigation savings of FFL and Xeriscape

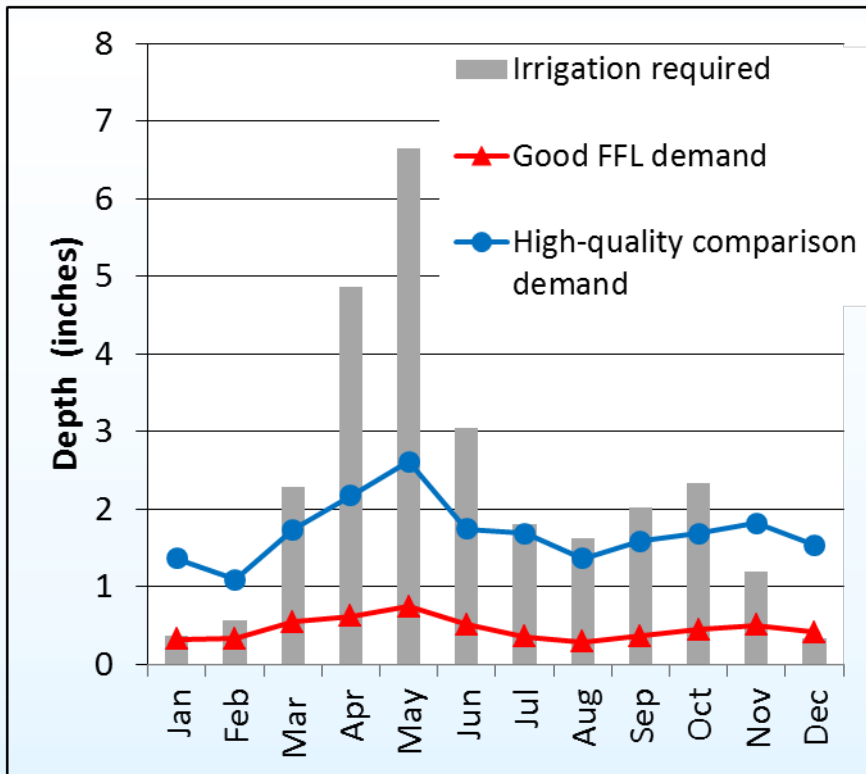


FFL and comparison monthly irrigation depths

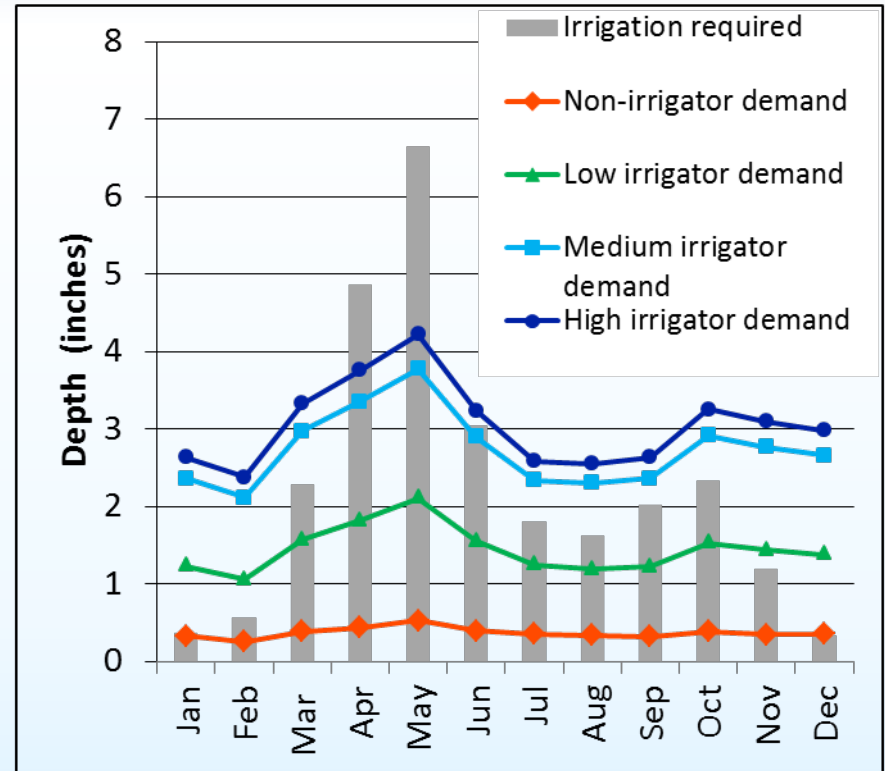


FFL and Xeriscape study results

FFL, comparisons, and irrigator groups

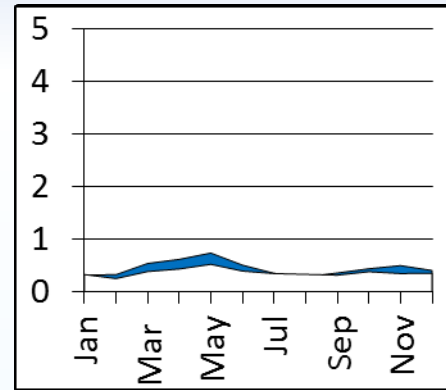
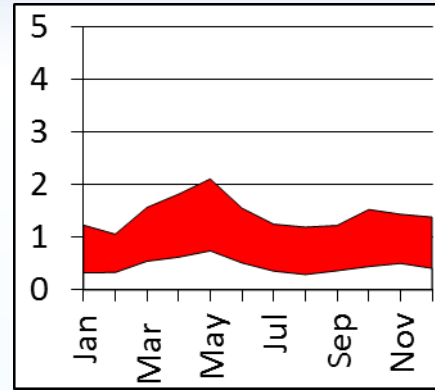
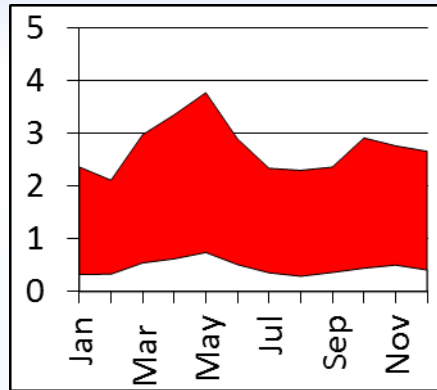
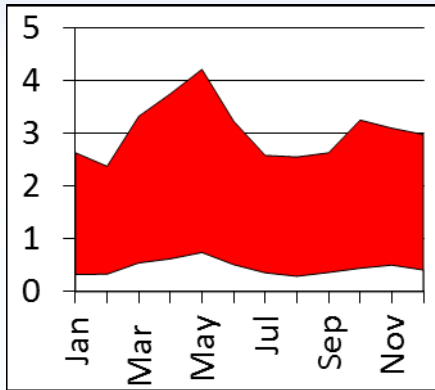


FFL and comparison groups



High, medium, low, and non-irrigating groups

Annual irrigation savings of converting to FFL



High
31 inch/customer
28,764 customers
3,654 MG savings



Medium
27 inch/customer
12,151 customers
1,525 MG savings



Low
14 inch/customer
16,201 customers
858 MG savings



Negligible
-1 inch/customer
134,355 customers
-841 MG savings

- 5,196 MG/year (for ~200,000 customers)
- 6,037 MG/year (high, medium, and low irrigators)

Conclusions

- Irrigation savings if all TBW to converted to FFL: ~60 BG/yr
- Classifying customers using a statistical method can identify those to target for conservations
- Majority of customers were “negligible” irrigators, but total water use was substantial
- Methods are transferable to other utilities

Acknowledgements

- Funding: Southwest Florida Water Management District and Tampa Bay Water
- Research team: Michael Gutierrez, Chuan Wang, Shu Wang, Sara Wynn, and Linda Young