

Simplified Landscape Irrigation Demand Estimation: SLIDE Rules for Landscape Water Budgets and Allocations

Roger Kjelgren

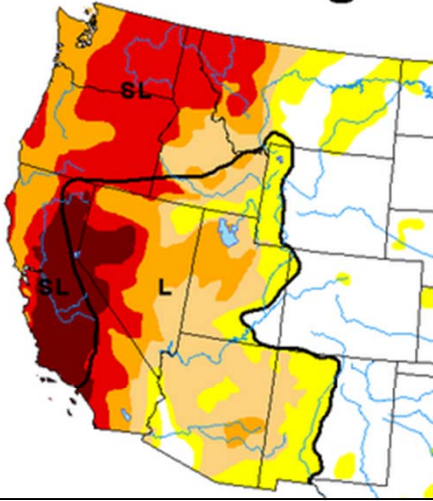
Utah State University

Dept. Plants, Soils, & Climate



Urban Landscape Water is a "Hot" Topic

U.S. Drought



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California drought: Rebates offered for ripping out lawns under nation's largest program

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The Atlantic

CULTURE

The Life and Death of the American Lawn

Grasses—green, neatly trimmed, symbols of civic virtue—shaped the national landscape. They have now outlived their purpose.

Banning Lawns

[Sarah Schindler](#)

University of Maine - School of Law

2014

[82 George Washington Law Review 394 \(2014\)](#)

CBSNEWS Video US World Politics Entertainment

CBS/AP / July 31, 2015, 11:35 PM

California launches "drought shaming" website



Collaborators



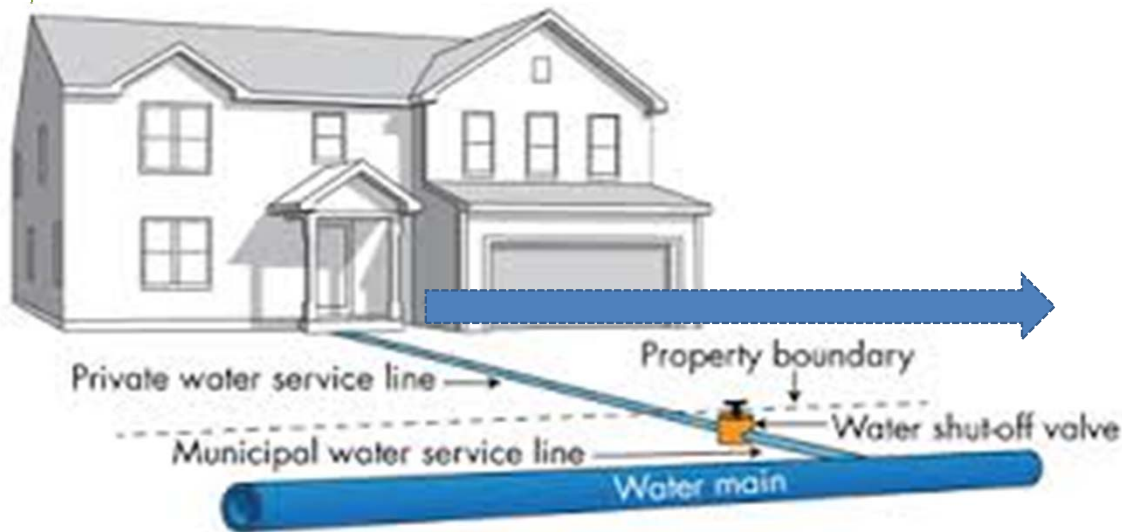
- Trans-institutional colleagues
 - Dennis Pittenger, University California Cooperative Extension
 - Richard Beeson, University Florida Research & Extension Ctr.
 - Thayne Montague, Texas Tech University
- Center for Water Efficient Landscaping, USU
 - Kelly Kopp, Professor
 - Larry Rupp, Professor
 - Paul Johnson, Professor
 - Joanna Endter-Wada, Professor
 - Diana Glenn, Research Associate
 - Adrea Wheaton, Research Associate

Background



- Drought, climate change → managing landscape water is a major policy and program management challenge for water agencies
 - California “social engineering” - how people relate to water via urban, irrigated landscape

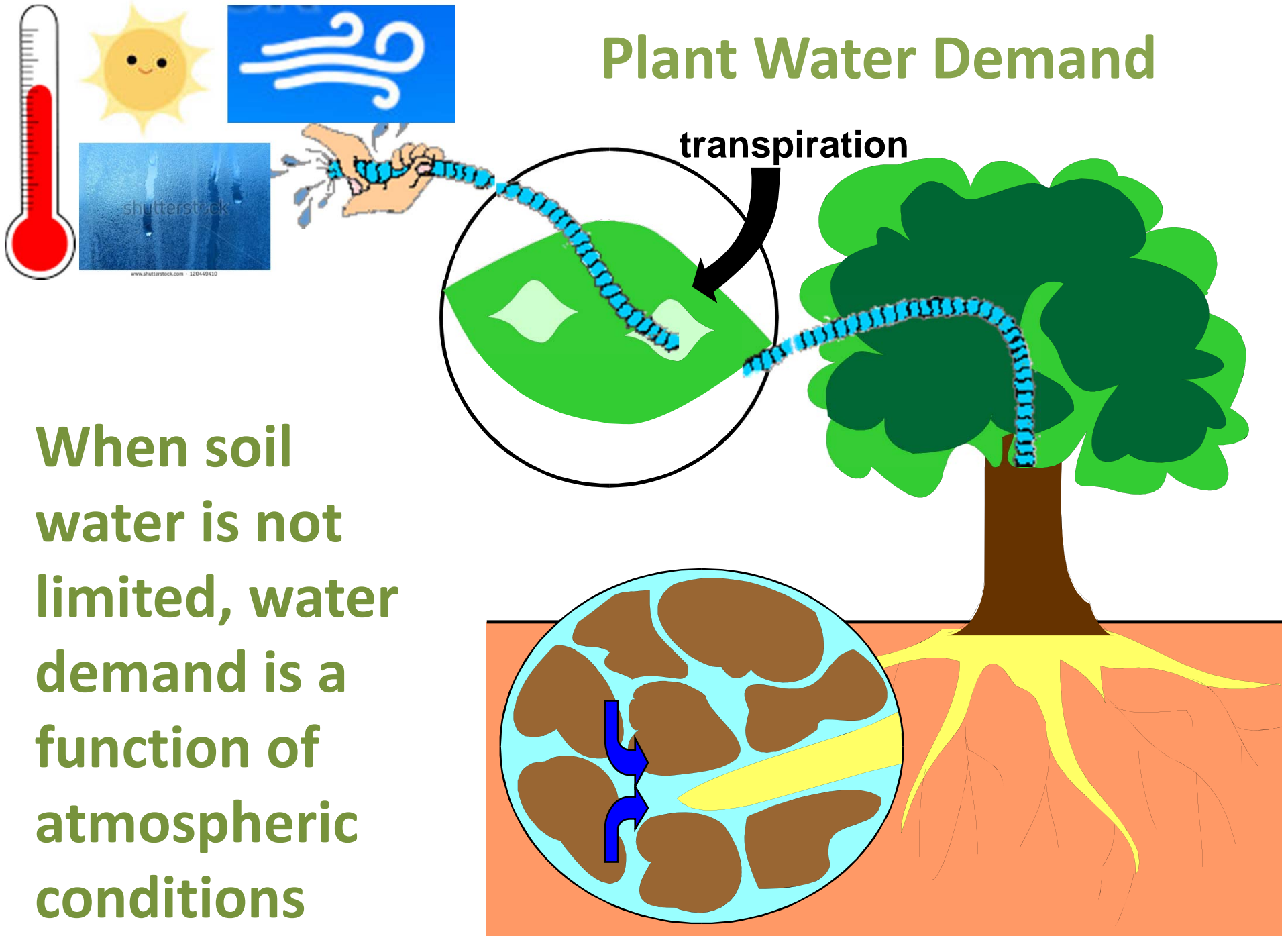
Per capita (people) water demand



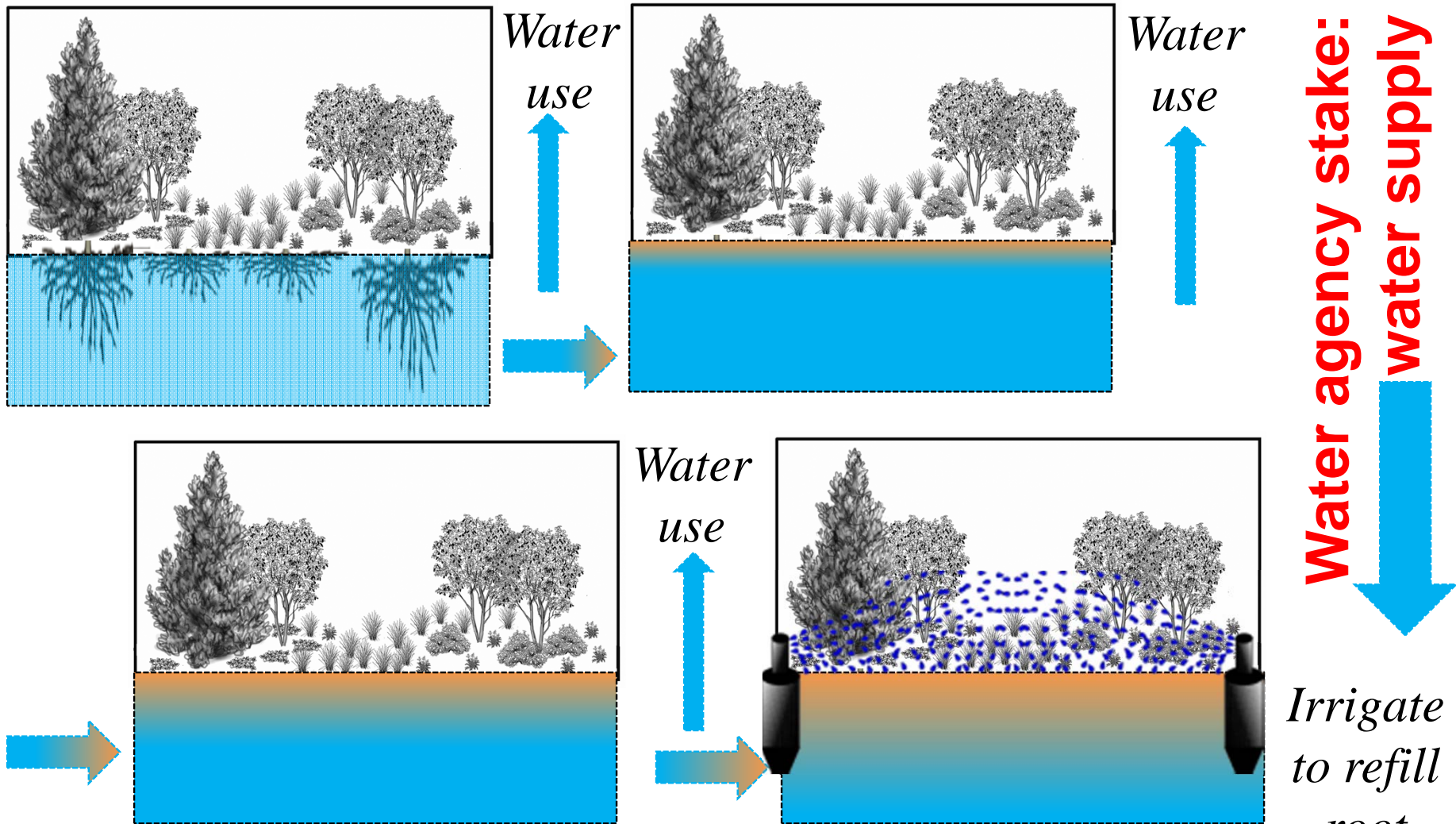
*Per parcel/lot
landscape water demand*



Plant Water Demand



When soil water is not limited, water demand is a function of atmospheric conditions



Root depth: irrigate before plant performance is affected; desiccation tolerance



Urban Plant Water Demand



- Demand = plant water use in response to atmosphere
- We can easily measure atmospheric demand —solar radiation, humidity, wind, temperature
- But measuring plant response to atmospheric demand is not easy
- *Instead*, we measure atmospheric demand over standardized plant surface: cool season turfgrass
- Atmospheric demand measured over a standardized surface = Reference evapotranspiration, or ETo



ETo is information about atmosphere, not about plant response

Urban Plant Water Demand



- ETo link to plant water demand: **Plant Factor (PF)**, not crop coefficient, that adjusts ETo downward
- $ETo \times PF =$ estimated plant water demand for a given plant type
- Example, Salt Lake City
 - Yearly ETo = 40 inches
 - PF cool season turf = 0.8
 - Plant water demand = 40 inches \times 0.8 = 32 inches
- **Until now, no PF's for non-turf landscape plants**



ETo and potential water demand for different plant types



But how much?



SLIDE – Simplified Landscape Irrigation Demand Estimation, based on ASABE S623

Fraction of ET_0 (Plant Factor) to estimate water use yet maintain acceptable appearance of established landscape plants

	Recommended Plant Factor
Turf-Cool Season	0.8
Turf-Warm Season	0.6
Non-turf/woody plants-Humid	0.7
Non-turf/woody plants-Arid	0.5
Desert plants	0.3

ET_o x PF = water demand for different plant types



Salt Lake City Seasonal
ET_o = **40 inches**

X 0.5 PF
non-turf =
20 inches



X 0.8 PF turf = **32 inches**

X 0.3 PF
desert
plants
= **12 inches**



SLIDE Rules – Three Applications



- WaterMAPS™ - tool for direct use by water agencies
 - Identify customers with high capacity to conserve: applying water to landscapes in excess of plant water demand
 - Educate customers about their landscape irrigation practices compared to actual plant water demand
 - Assess water conservation customer and program performance
- Aid landscape design community to design low water landscapes to meet specific water allocations/budgets
- Provide minimum irrigation guidelines to keep high value landscape elements (e.g., trees) alive during drought

SLIDE Rules –Application #1



WaterMAPSTM
Water Management Analysis
and Planning Software



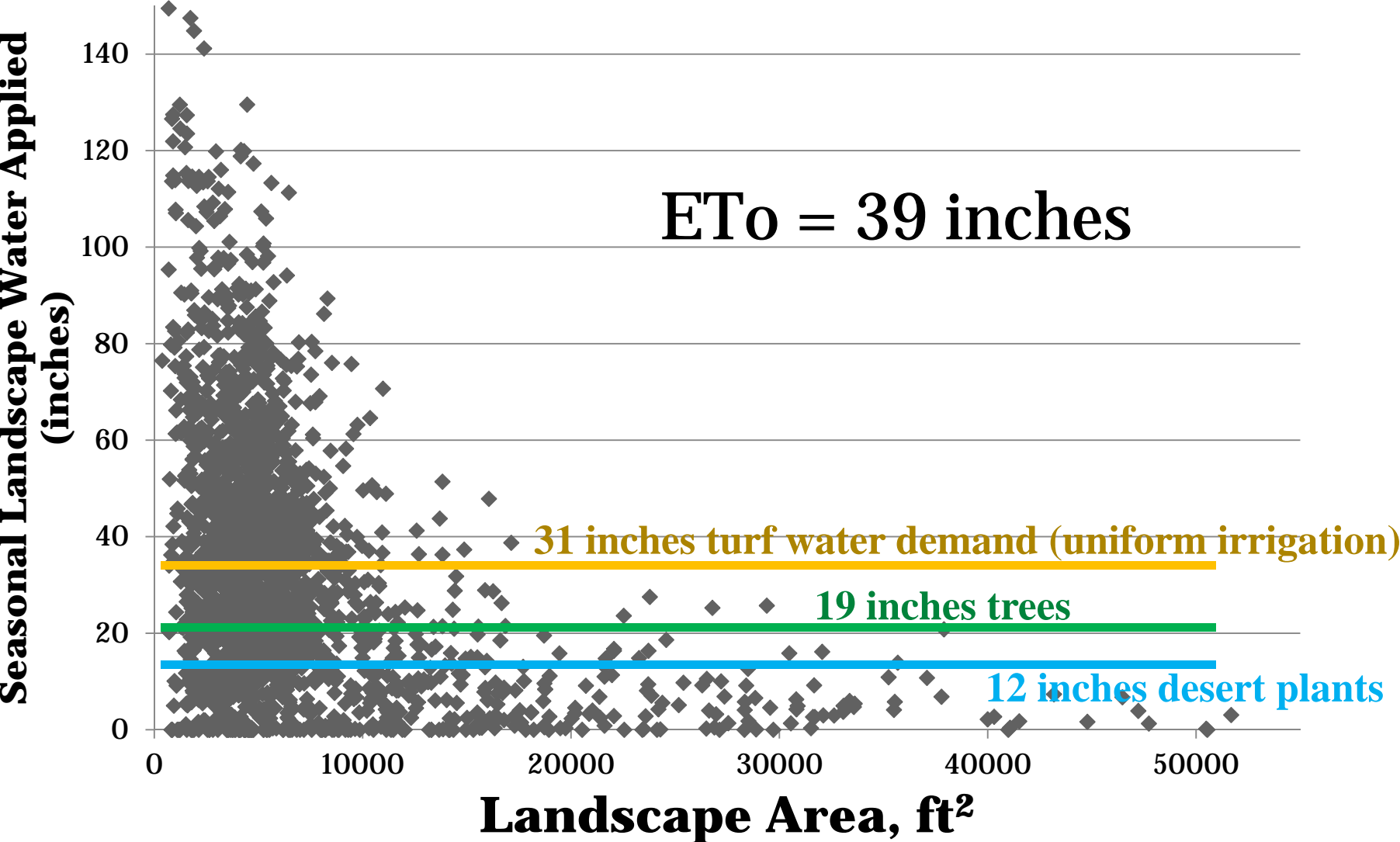
WaterMAPS™

Water Management Analysis and Planning Software

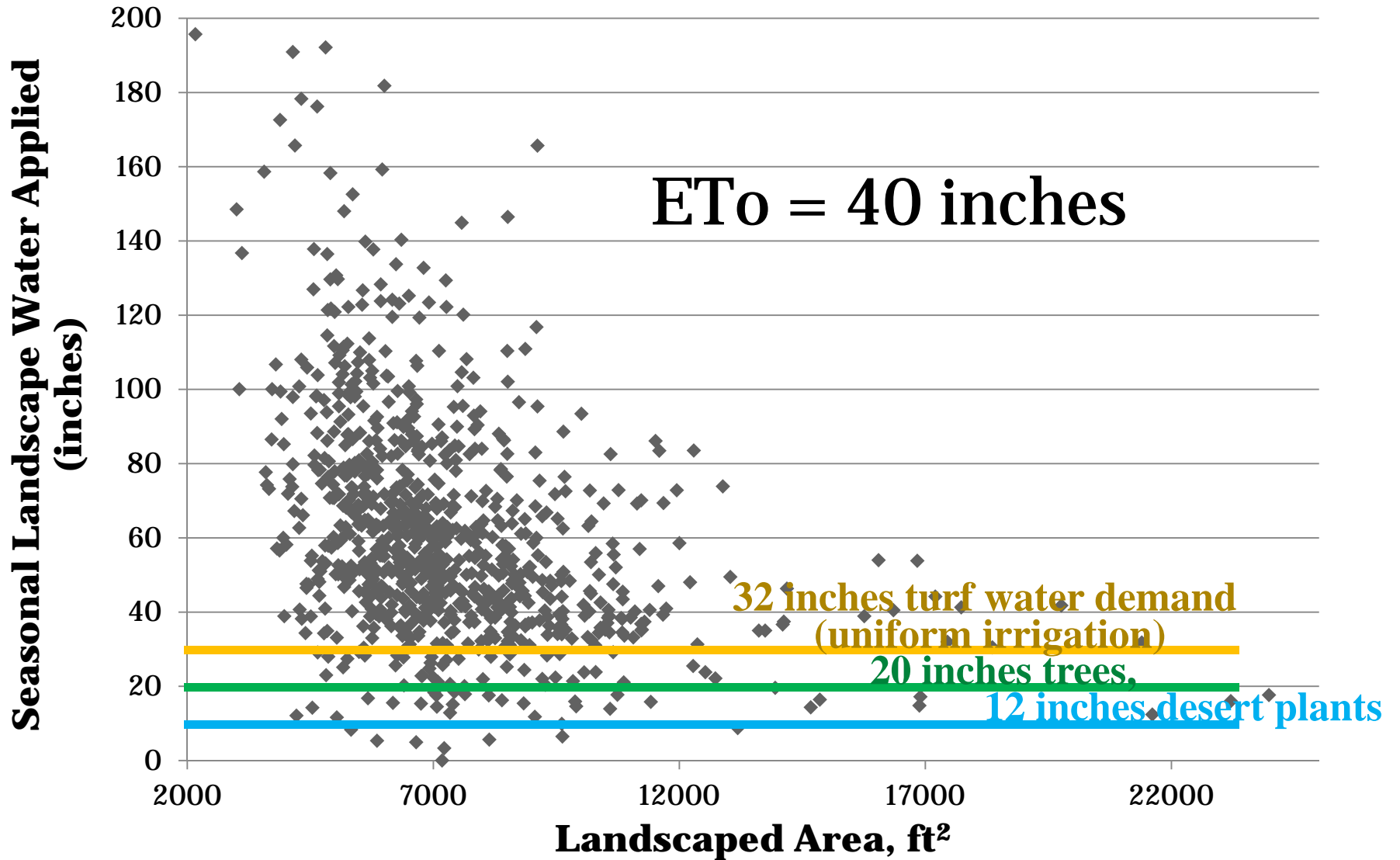


- Integrates various databases to compare actual landscape water use (derived from meter data) to estimated demand (needs) based on $ETo \times PF$
- First studied in Wasatch Front suburbs (Layton, West Jordan) then expanded to three other entities in metropolitan region (Logan, Weber Basin, Salt Lake City)
- Difference between actual landscape water use and estimated demand (needs) = capacity to conserve
- WaterMAPS™ automates calculation of capacity to conserve for all parcels in a water providers' service area

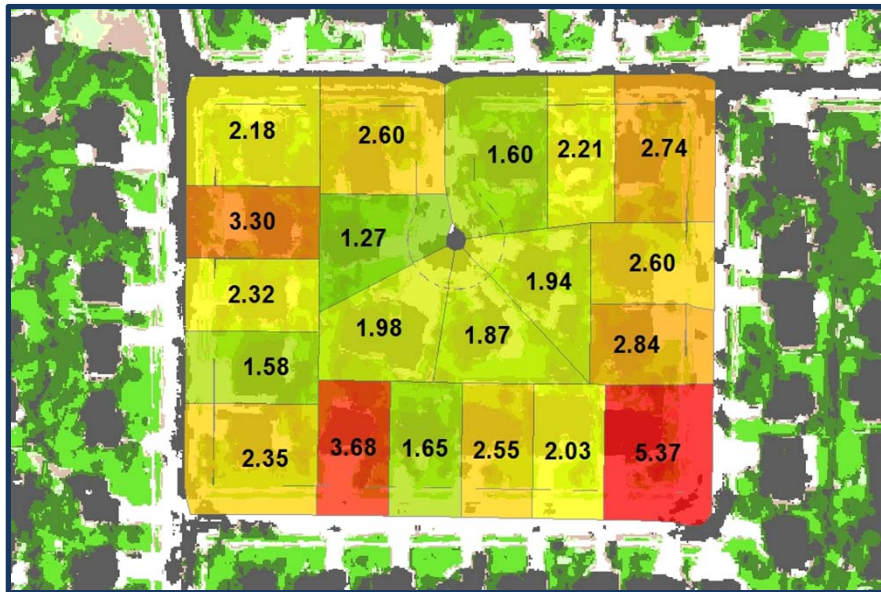
West Jordan, Utah Residential Potable Water Use, 2000; n=2,090 homes



Weber Basin WCD, Utah, Residential Secondary Water Use, 2012; n=859 homes



Identifying Capacity to Conserve through “LIR”



Landscape Irrigation Ratio (LIR) at the parcel scale

- LIR less than 1** = **Efficient**
- Between 1 and 2** = **Acceptable**
- Between 2 and 3** = **Inefficient**
- Greater than 3** = **Excessive**

Landscape Water Use

(estimated from analysis of meter data)

$$LIR = \frac{\text{Landscape Water Use}}{\text{Landscape Water Need}}$$

(per unit of landscaped area)

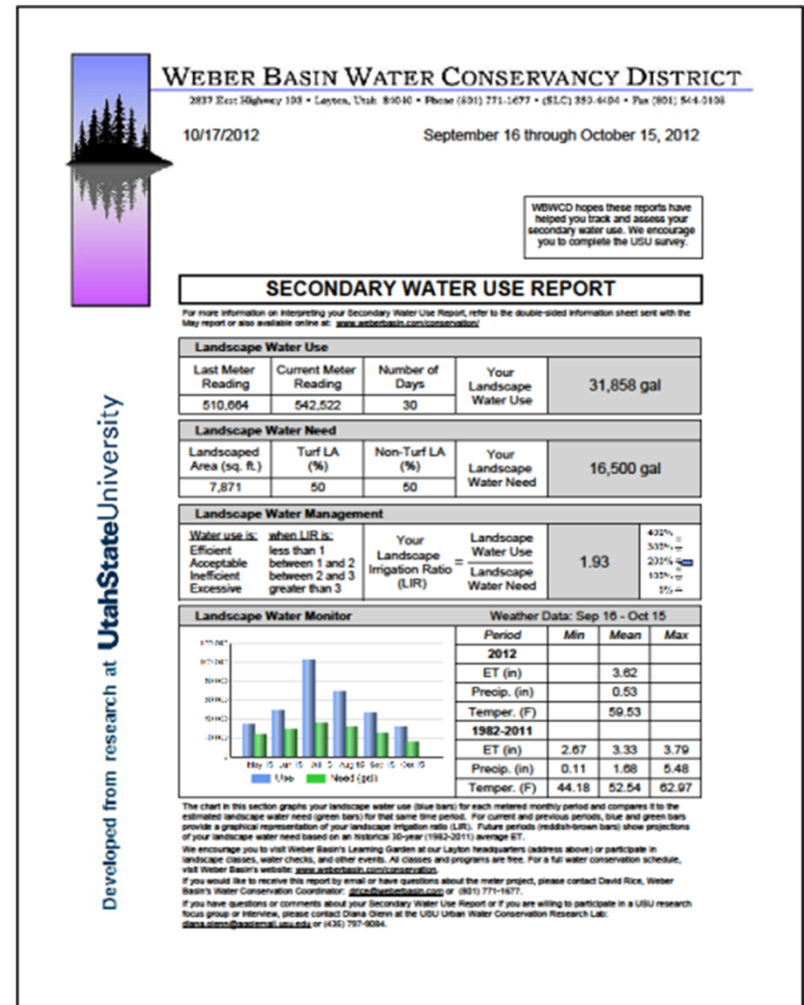
Landscape Water Need

(estimated from classified airborne multispectral imagery and localized ETo rates modified by relevant landscape plant factors)

Customer Education – Secondary Users



- Three neighborhoods with secondary water in Weber Basin WCD service district
- Smart meters installed winter 2011/2012
- Received reports on LIR/Capacity to Conserve since 2012 – seen significant water savings

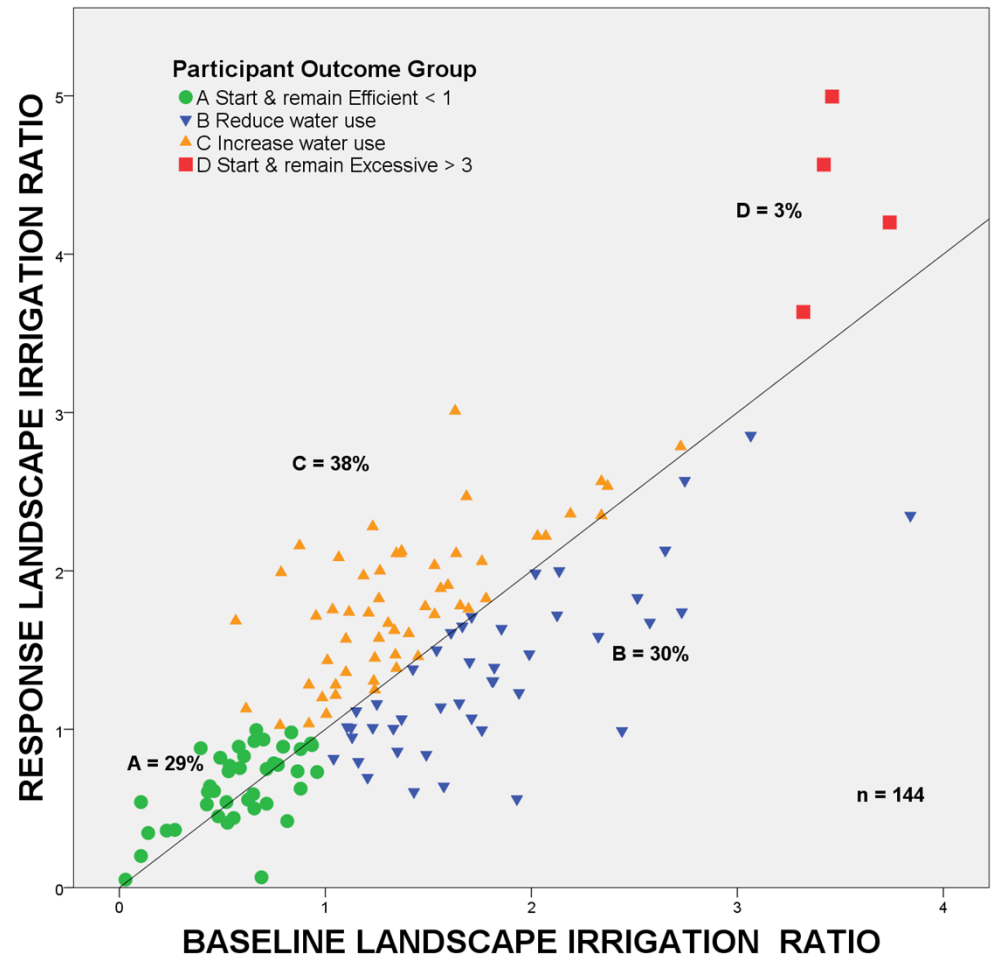


Water Conservation Evaluation: *Participants*



Did people save water?

- Logan City Residential customers
- Received free irrigation system evaluation (Water Check)
- Calculated LIR/Capacity to conserve before and after the Water Check

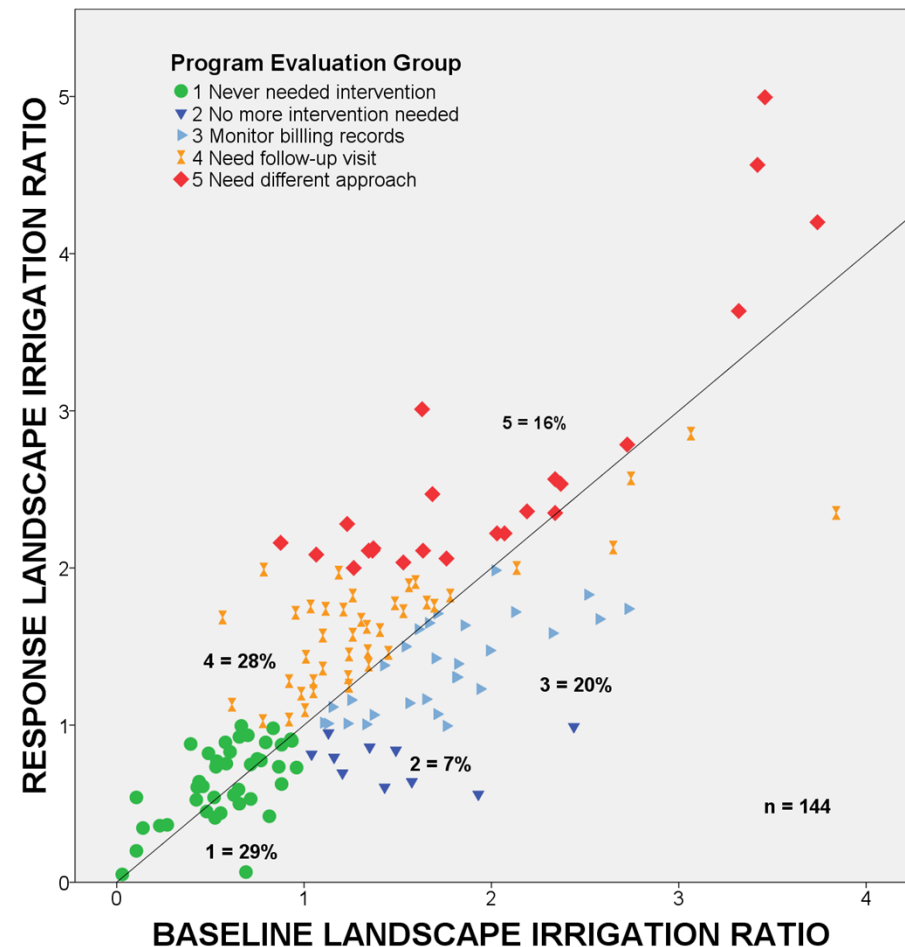


Water Conservation Evaluation: *Program*



How can the program respond to customer performance?

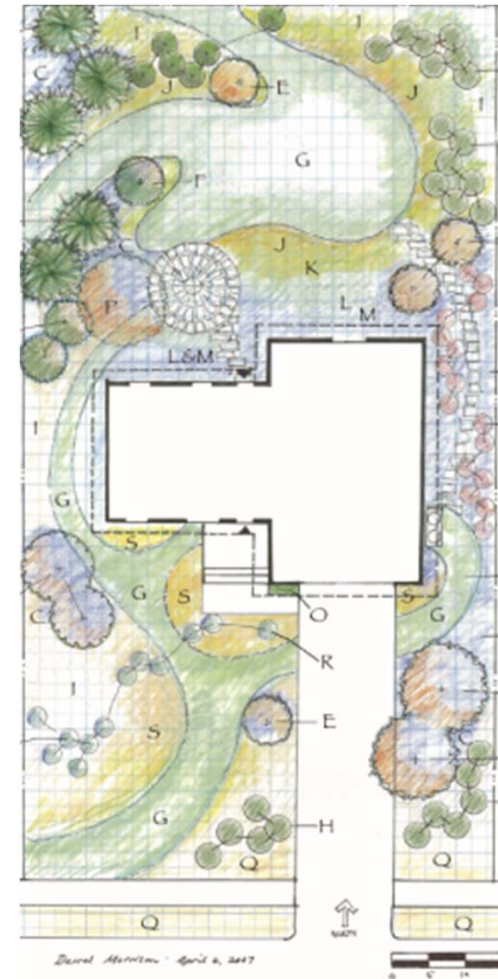
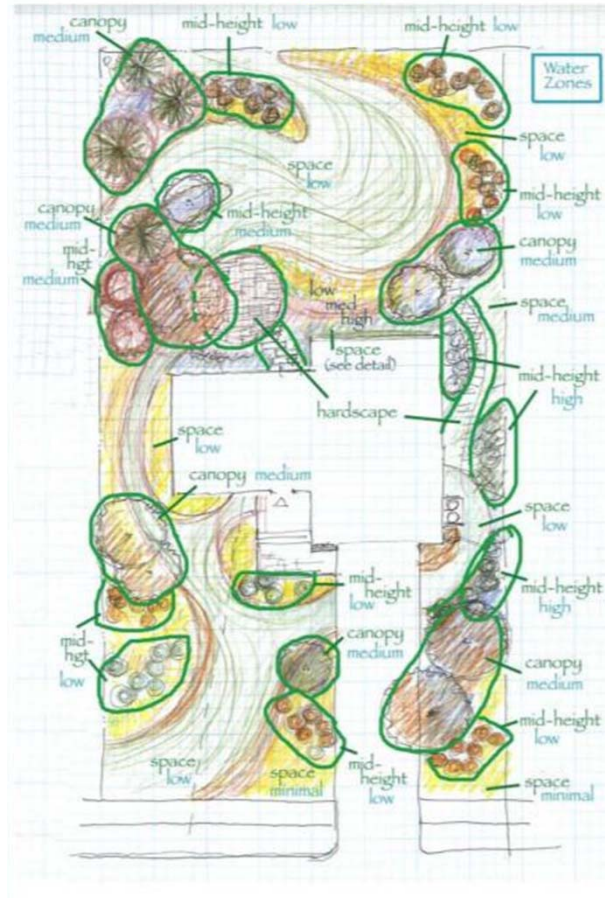
- Free Water Checks only worked with small number of customers
- Customers who increased use, or had high LIR and no change, need different approach



SLIDE Rules –Application #2



Tool for the
Landscape
Design
Community:
Hydrozones
based on
Water
Demand



Tool for Landscape Design Community

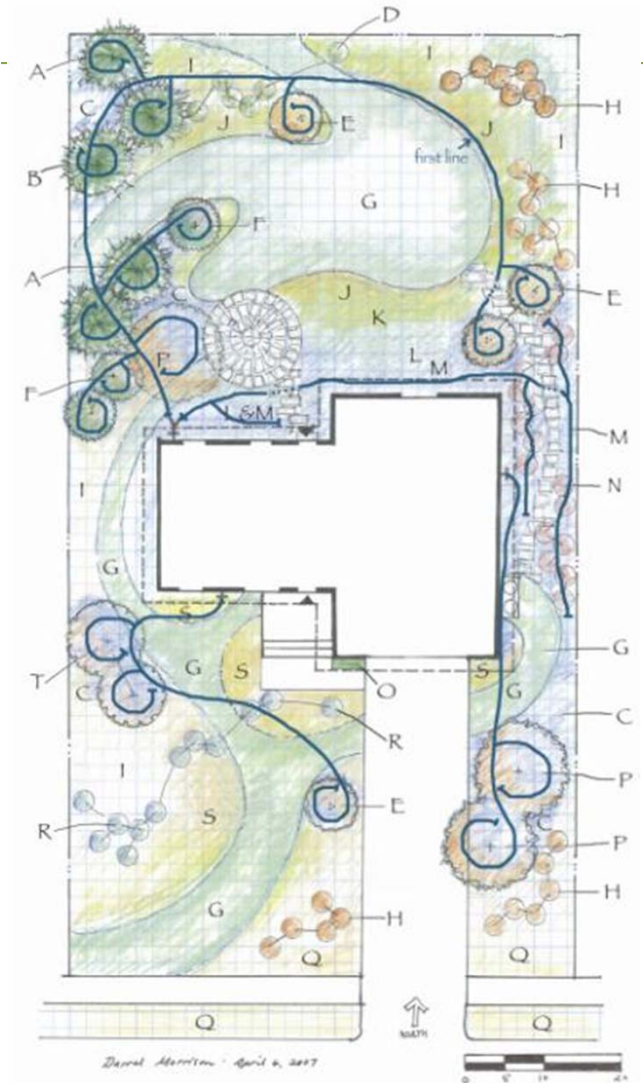


- Landscape architects/designers key to creating low water landscapes with identifiable water savings
- SLIDE/ASABE S623 standardizes two key processes
 - Hydrozones as smallest landscape area managed by irrigation zone
 - Plant cover <80%, water demand that of isolated plants
 - Water demand for isolated plants based on cross-section crown area
- To meet water allocation/budget, designers now have two standardized tools: species with lower PF, using fewer plants (<80% cover)

Design Tools: Hydrozoning

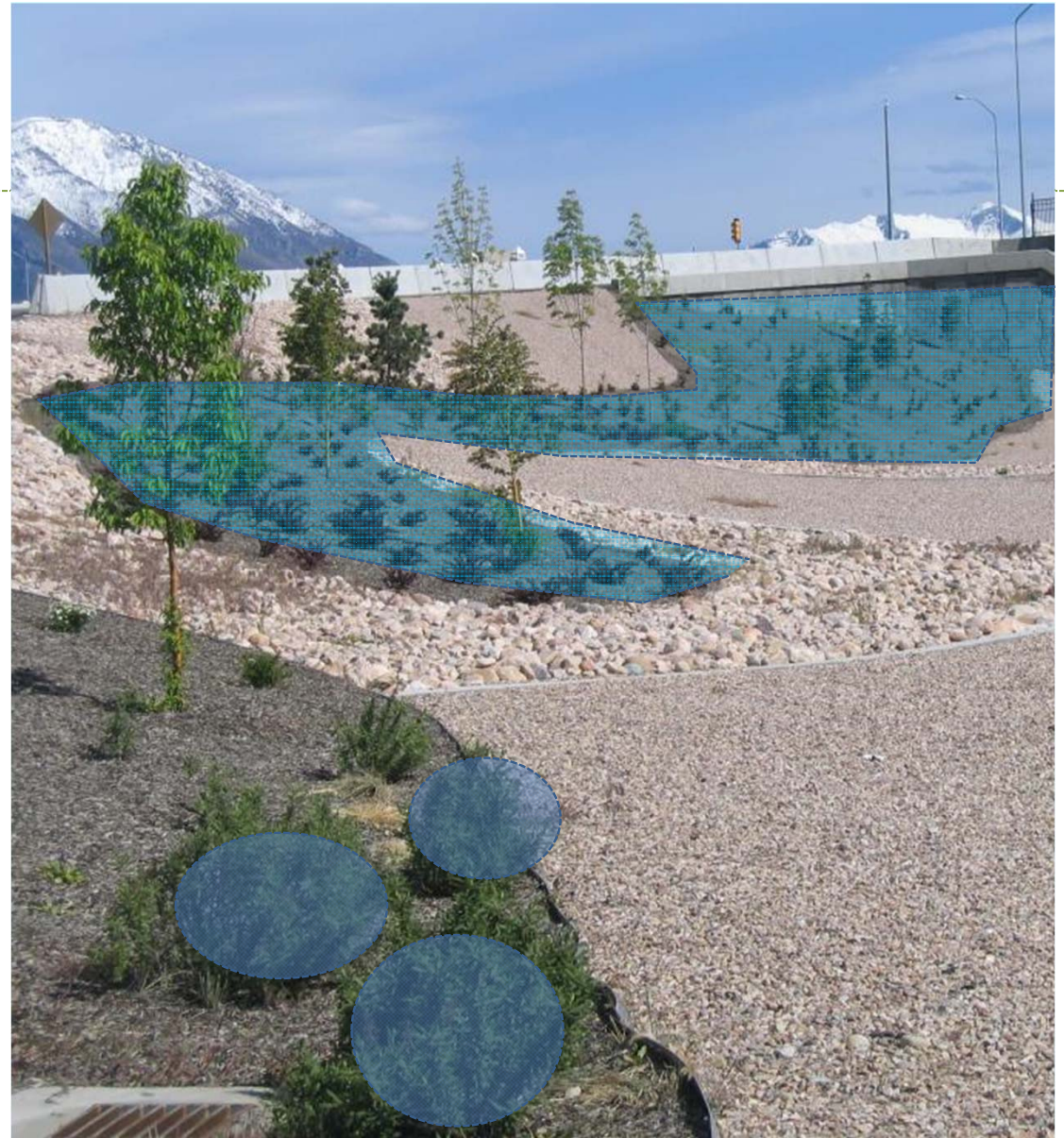


- Hydrozone controlled by a single irrigation valve
 - Plant species with highest Plant Factor dictates the overall zone PF (don't mix turf and desert plants)
 - Low plant cover by widely spaced plants, or by creating dense plant oases within larger non-plant area



Design Tools: Hydrozoning

- Low density planting water demand of either isolated plants or plant cluster
- Oasis incomplete plant cover; high density (>80%) areas imbedded in hardscape

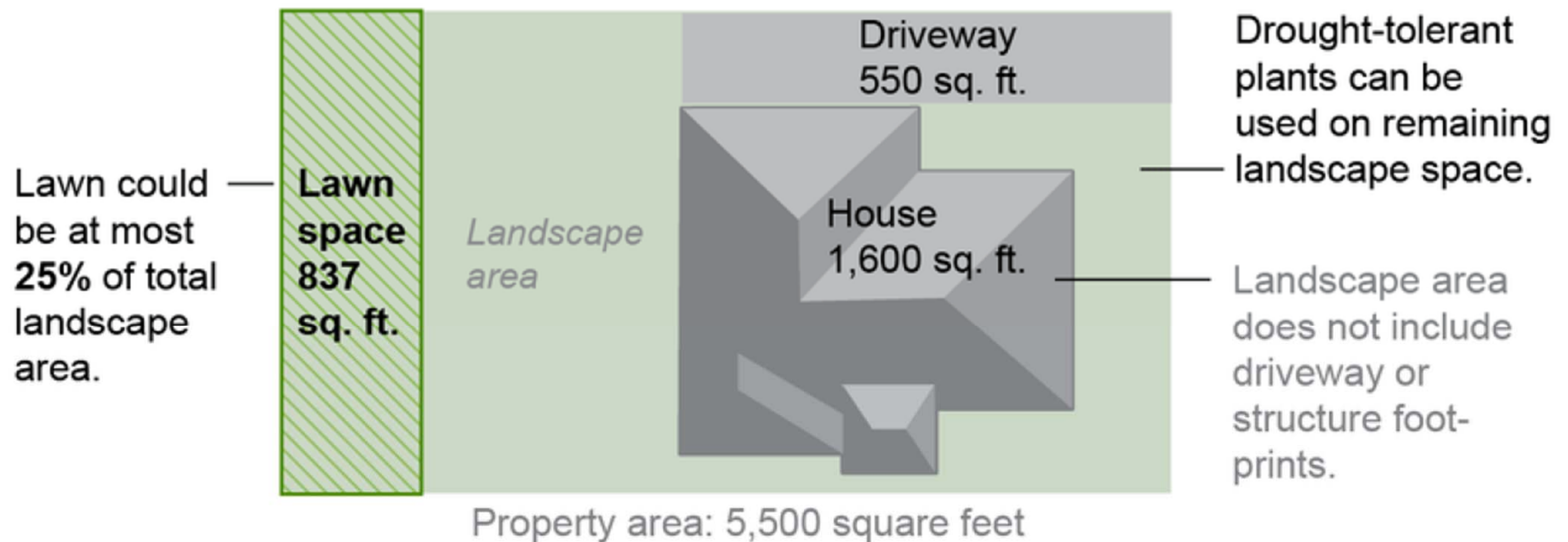


Design of Things to Come: CA Regulations for New Landscapes



Limits on lawns

New state regulations would limit lawn space to 25% of the landscape area at new homes with landscape area of more than 500 square feet and at existing landscapes of more than 2,500 square feet that undergo substantial renovations.



Source: Times reporting

Lorena Elebee @latimesgraphics

SLIDE Rules –Application #3



**Keeping
High-Value
Landscapes
Alive During
Drought**



Responding to Drought



- During drought, turf can be sacrificed (or removed)
- What happens to trees important – 5-10 times more valuable per ft² than turf
 - Special attention needed for trees previously imbedded in and irrigated with turf
- Again, estimate water demand of isolated trees



Keeping Urban Trees Alive During Drought



- During drought, customers will likely focus on keeping trees alive
- Estimate water demand of isolated tree based on 2-dimensional shape (mostly circle, but also triangle and rectangle)
- Web site for calculating water demand of isolated tree and irrigation schedule: <http://files.radiantm.com/tree-irrigation/>

Summary



- SLIDE simplifies how to estimate landscape water demand for three general plant types: turf, non turf, desert plants
- SLIDE does not include species-specific drought tolerance traits (root depth, leaf tolerance of desiccation)
- Key tool in estimating potential water demand to:
 - Design landscapes within a targeted budget/allocation
 - Track customers' performance relative to water demand of **their own landscape** configuration
 - Keep high value plants alive during drought