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# Simplified Landscape Irrigation Demand Estimation – *A New Paradigm*

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HEALTHY FOOD SYSTEMS  •  HEALTHY ENVIRONMENTS  •  HEALTHY COMMUNITIES  •  HEALTHY CALIFORNIANS

# Goals of the presentation

- Introduce simplified irrigation demand estimation

- Learn latest insights on estimating meaningful landscape coefficients or plant factors

# Demand for Climate-based Landscape Water Need Estimates

- Water budgets
- State & local conservation ordinances
- "Green" development standards & codes
- Smart irrigation controllers
- Sustainable landscapes
- U.S. EPA 'Water Sense'
- Save water
- Save money



Provided by Irrigation Association Education Foundation
www.iaef.org

# Landscape Water Conservation Programs & Approaches

# ETo = Reference Evapotranspiration

## *An estimate of environmental water demand over a planted area*

- Climate-based reference

- Inches/day

- ETo = estimated water use of well-watered cool-season turf

- Calculated from weather data

  - Sunlight, temperature, RH, wind

  - ASCE Penman-Monteith equation

- Based on field research with agricultural crops

# Climate-Based Water Budgets
## Need reliable plant factor estimates

Water Budget or Water Need

**ETo × PF, $K_L$ , Kc, or ETAF × LA × 0.62**

gallons = inches × % × sq. ft. × conversion

- ETo = reference evapotranspiration; climate impact
- PF, $K_L$, Kc = plant material adjustment factor
- LA = sq. ft. landscape area
- 0.62 = converts depth to volume [gal. ÷ (in. x sq. ft.)]

# Need Simpler Paradigm for Estimating Landscape Water Need

- Most approaches complex with false precision
- No Kc's & few PF's for non-turf landscape plants
- ETo has limited application in landscapes
- Range of %ETo (PFs) appropriate for landscape plants

# Simplified Landscape Irrigation Demand Estimation

## *S L I D E*

*.....a new paradigm*

*for selecting Plant Factors.....*

# SLIDE Paradigm

*Principles:*

- Plant factors accurately estimated by broad plant type categories based on science and research

- Landscape water need estimated by weighting sq. ft. of each plant type

# SLIDE Features

- Simple to understand & use
  - Replaces need for huge data base
  - Reduces number of factors or variables
- Accommodates new plants
- Scientifically & conceptually sound
  - Assimilation and application of ≈20 yrs. of data
  - Scientifically traceable
- Provides reliable numbers for calculations
- Wide geographic & climatic application

# Current Development Status of SLIDE

- Presenting to key stakeholders and decision makers

- Electronic discussion system among researchers

- Preparing technical manuscript to establish scientific merit

# SLIDE Leaders

- Roger Kjelgren – Utah State University
- Richard Beeson – University of Florida
- David Shaw – University of California
- Dennis Pittenger – University of California

# National Standard Being Developed

- SLIDE concepts integrated

- Am. Society of Agricultural & Biological Engineers (ASABE)

- x623: *Standardized Procedure for Determining Landscape Plant Water Requirements*

# WUCOLS
## Water Use Classification of Landscape Species

### PROS

- Source of numbers
- Categories by climate zone and water use
- Includes numerous spp.
- Hardcopy and on-line

### CONS

- Not science based
- Data not reliable
- False sense of precision
- Complex and perplexing to use
- Not readily revised



A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California

The Landscape Coefficient Method and WUCOLS III

# Typical ETo Adjustment Calculation

Landscape Coefficient

$$K_L = K_{PLANTS} + K_{VEG.\ DENSITY} + K_{MICROCLIMATE}$$

$K_{PLANTS}$ from WUCOLS

$K_{VEG.\ DENSITY}$ and $K_{MICROCLIMATE}$ assigned by user

# SLIDE Rules

Landscape Coefficient

$$K_L = K_{PLANTS} + K_{VEG.\ DENSITY} + K_{MICROCLIMATE}$$

# SLIDE Rules

- Landscape plant water USE ≠ NEED
  - Plants often use more than they need
  - Meet minimum expectations in a range of % ETo
  - ETo concept has limited accuracy in landscapes
  - Landscape plants tolerate managed drought

- Most non-turf plants need near 50% ETo
- Plant factors accurately estimated by categorizing plants

# Estimating Plant Water Needs Through Science

- Define a reference for plant water use that is a function of climate (ETo)

- Compare water needed to maintain given plant with reference amount

- Express plant water need as % of reference
  - Plant Factor (PF) – *acceptable* appearance, function
  - Crop Coefficient (Kc) – *optimum* growth or yield

# Estimating Plant Water Needs Through Science

# Estimating Landscape Water Needs Using ETo

- **Assumptions:**
  - Landscapes need/use water like ag. crops
  - Plant water needs change in lockstep with changes in ETo
  - Plant canopy is uniform
  - Same or similar plants across landscape
  - Ability to irrigate the landscape plants uniformly

# ETo Approach OK With Turf



*Visual courtesy of R. Kjelgren, Utah St. Univ.*

# Turfgrass Irrigation Needs


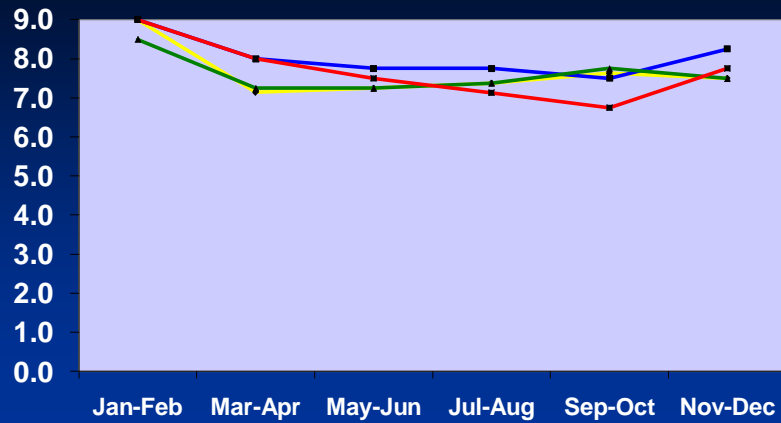
- Cool-season Kc:
  *80% ETo* annual avg.
  (60% ETo minimum)

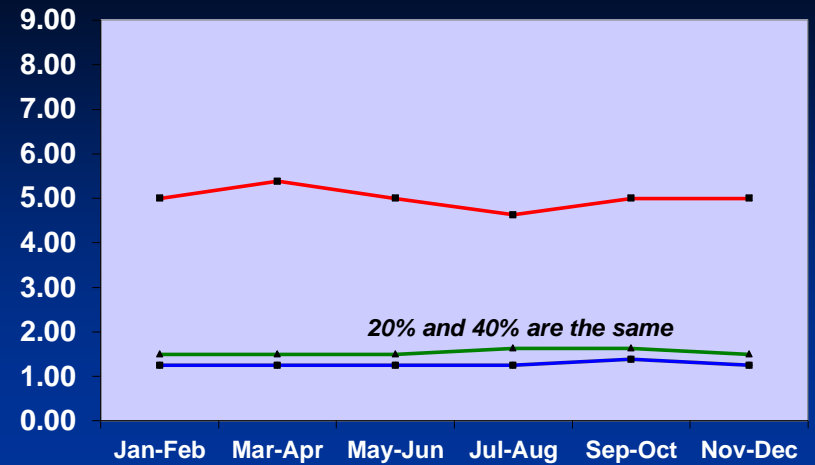- Warm-season Kc:
  *60% ETo* annual avg.
  (40% ETo minimum)

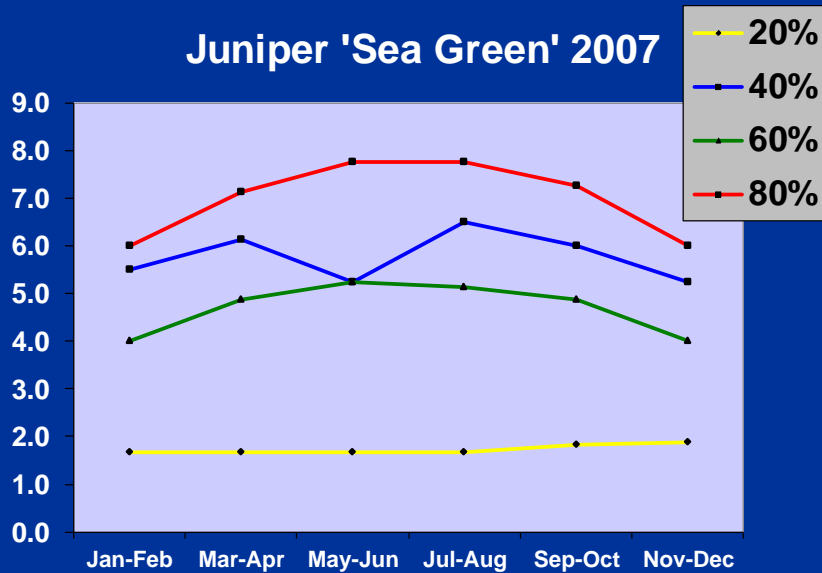*Assumption*

Visual courtesy of R. Kjelgren, Utah St. Univ.

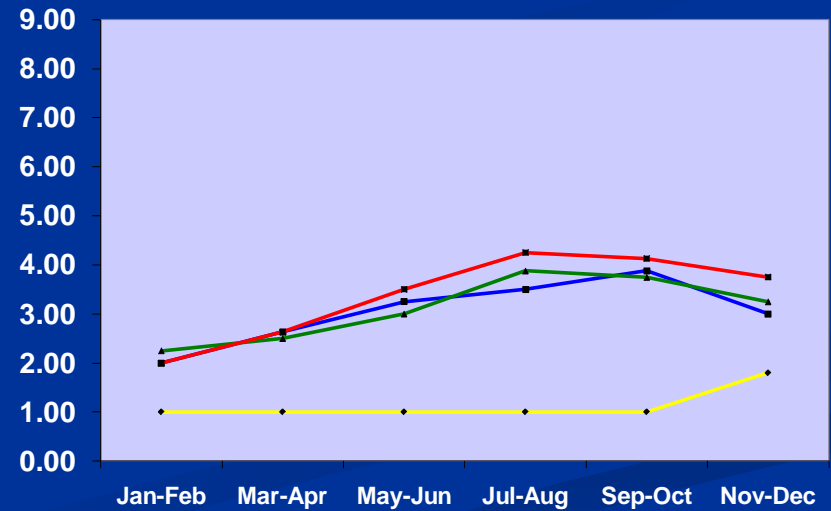# Groundcovers, Trees, Shrubs

- ETo × PF model cannot precisely estimate non-turf water need
  - Narrow range of % ETo per species
- Typically acceptable *30-60% ETo*
- Use more water than they need
- Traditional landscape plants perform acceptably with range of low water
- Less water often limits growth, not quality
- Discrepancies with WUCOLS

# WUCOLS Analysis

| WUCOLS ZONE | 1 | 2 | 3 | 4 | 5 | 6 | AVG. |
|---|---|---|---|---|---|---|---|
| # of species appropriate to zone | 1602 | 1088 | 1969 | 1185 | 529 | 820 | 1199 |
| % High Water Needs 0.7 – 0.9 ETo | 5 | 6 | 5 | 9 | 7 | 8 | 7 (84) |
| % Medium Water Needs 0.4 - 0.6 ETo | 51 | 52 | 57 | 57 | 66 | 68 | 59 (707) |
| % Low Water Needs 0.1 – 0.3 ETo | 38 | 36 | 31 | 32 | 25 | 24 | 31 (372) |
| % Very Low Water Needs < 0.1 ETo | 7 | 5 | 7 | 3 | 2 | 0.5 | 4 (48) |
| Control Total | 101 | 99 | 100 | 101 | 100 | 100.5 | |

**(WUCOLS III, 2000)**

# SLIDE Rules *(DRAFT)*

- Categories of Water Need
  - Turfgrass = 40-60% ETo (w-s) / 60-80% ETo (c-s)
  - Annual-Perennial Flowers/Foliage = 70-80% ETo
  - Tree/Shrub/Groundcover/Vine = 50-60% ETo
  - Low Expectations/Very Drought Tol. = 30-40% ETo
    - 20% Desert Natives, Research Proven Drought Tolerance??

# SLIDE Rules

- Leaf area influences landscape water demand
- Canopy size & Projected Canopy Area Issues
  - Crown projection area $\times$ ETo $\times$ PF
  - Guidelines for new or sparsely planted landscapes

# SLIDE Paradigm

**Principles:**

- Based on science - plant factors accurately estimated by broad plant type categories

- Landscape water need estimated by weighting sq. ft. of each plant type

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