University of California
Agriculture and Natural Resources

ETAF Research Results

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San Bernardino, Los Angeles and Riverside Counties


WA WA WA WHAT!?
I'M CONFUSED!
memecrunch.com

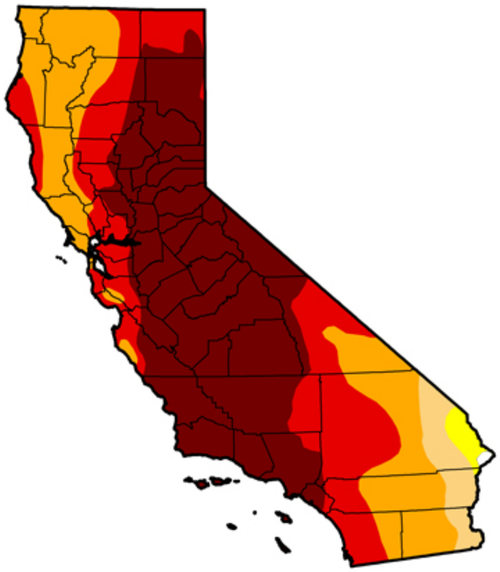
U.S. Drought Monitor

California

July 14, 2015

(Released Thursday, Jul. 16, 2015)

Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.14	99.86	98.71	94.59	71.08	46.00
Last Week *7/7/2015*	0.14	99.86	98.71	94.59	71.08	46.73
3 Months Ago *4/14/2015*	0.14	99.86	98.11	93.44	66.60	44.32
Start of Calendar Year *12/30/2014*	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year *9/30/2014*	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago *7/15/2014*	0.00	100.00	100.00	100.00	81.85	36.49

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:
David Simeral
Western Regional Climate Center

USDA

http://droughtmonitor.unl.e

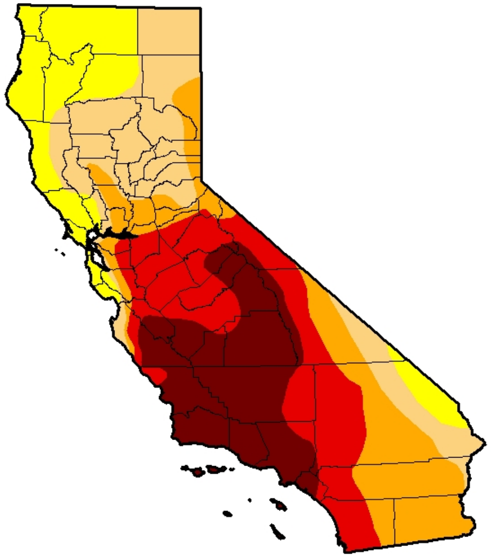
U.S. Drought Monitor

California

September 13, 2016

(Released Thursday, Sep. 15, 2016)

Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	83.59	62.27	42.80	21.04
Last Week *9/6/2016*	0.00	100.00	83.59	59.02	42.80	21.04
3 Months Ago *6/14/2016*	0.00	100.00	83.59	59.02	42.80	21.04
Start of Calendar Year *12/29/2015*	0.00	100.00	97.33	87.55	69.07	44.84
Start of Water Year *9/29/2015*	0.14	99.86	97.33	92.36	71.08	46.00
One Year Ago *9/15/2015*	0.14	99.86	97.33	92.36	71.08	46.00

Intensity:

D0 Abnormally Dry
D1 Moderate Drought
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The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Eric Luebehusen
U.S. Department of Agriculture

USDA

http://droughtmonitor.unl.edu/

Drought

- We are in the fifth year of a major drought.
- Drought damage develops in plants when the transpiration rate exceeds the rate of water available for root absorption.
- Recently transplanted plants are at greatest risk of drought damage due to root loss.

Two contracts from CA Dept. of Water Resources

- 2010-2012: 30 parks, school districts, golf course sites in Southern CA
- 2012-2016 : 30 parks, school districts, golf courses throughout CA

Project Locations

- Central valley
- Central coast
- South coast
- Los Angeles basin
- Inland southern California
- Southern desert

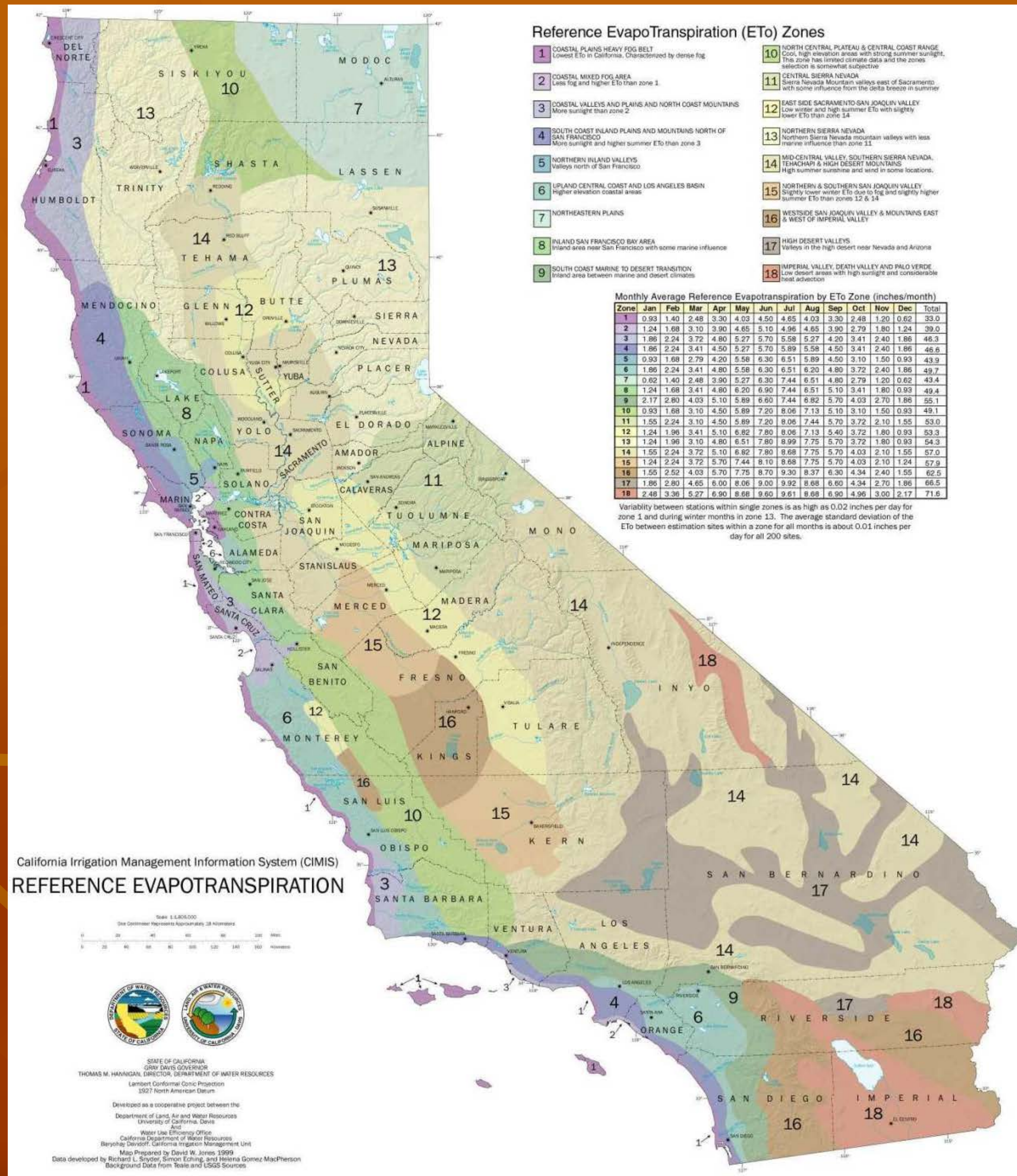
ET (Landscape Species) = ETo (reference evapotranspiration) x Kc (crop coefficient)

Reference Evapotranspiration (ETo)

- ETo = The amount of water used by a large uniform planting of a cool-season grass growing 3-6 inches tall and given unlimited water.

Factors that Determine ETo

- Solar radiation
- Temperature
- Wind speed
- Relative humidity



Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	33.0
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41	2.40	1.86	46.6
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10	1.50	0.93	43.9
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79	1.20	0.62	43.4
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03	2.70	1.86	55.1
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10	1.50	0.93	49.1
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72	2.10	1.55	53.0
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72	1.80	0.93	53.3
13	1.24	1.96	3.10	4.80	6.51	7.80	8.99	7.75	5.70	3.72	1.80	0.93	54.3
14	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	57.0
15	1.24	2.24	3.72	5.70	7.44	8.10	8.68	7.75	5.70	4.03	2.10	1.24	57.9
16	1.55	2.52	4.03	5.70	7.75	8.70	9.30	8.37	6.30	4.34	2.40	1.55	62.5
17	1.86	2.80	4.65	6.00	8.06	9.00	9.92	8.68	6.60	4.34	2.70	1.86	66.5
18	2.48	3.36	5.27	6.90	8.68	9.60	9.61	8.68	6.90	4.96	3.00	2.17	71.6

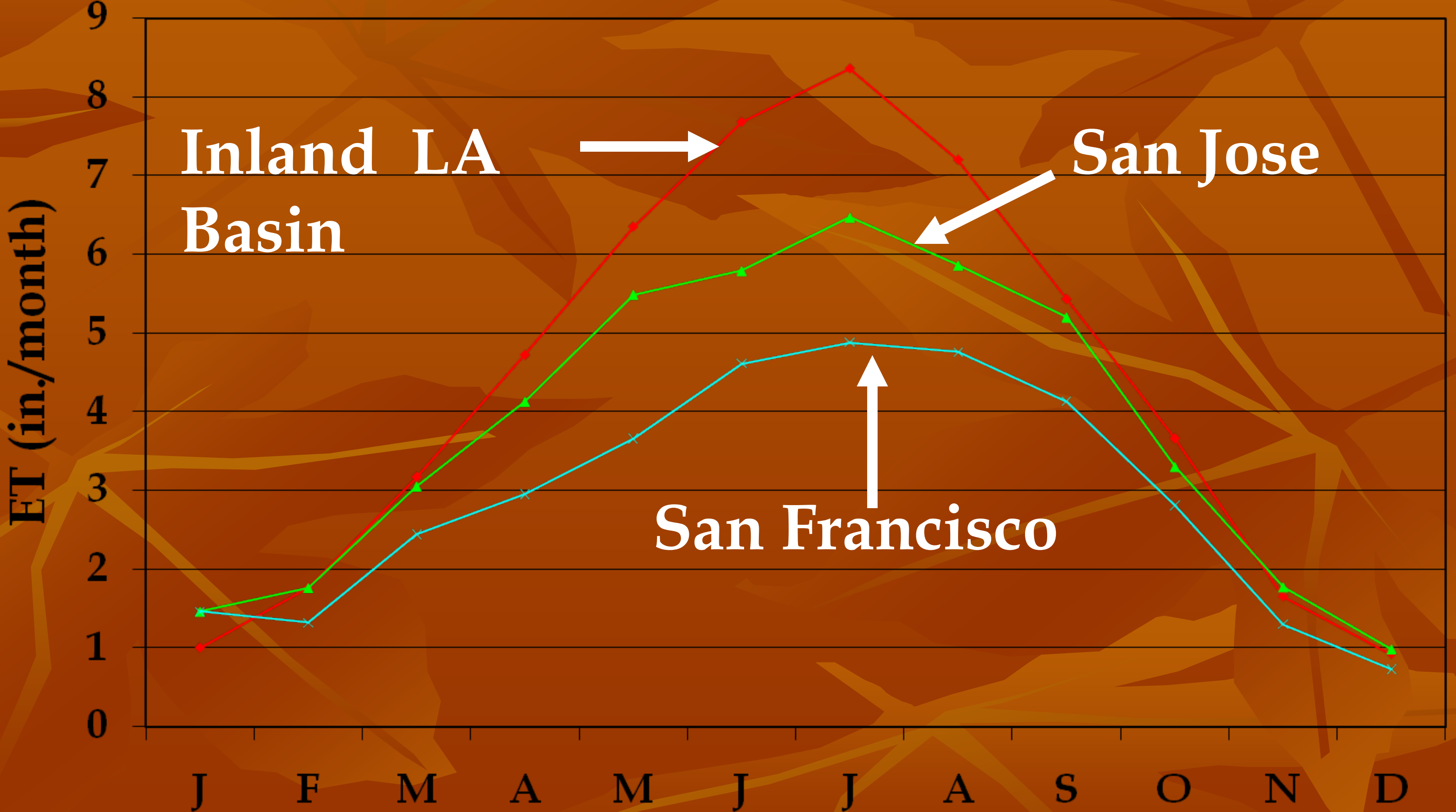
Variablity between stations within single zones is as high as 0.02 inches per day for zone 1 and during winter months in zone 13. The average standard deviation of the ETo between estimation sites within a zone for all months is about 0.01 inches per day for all 200 sites.

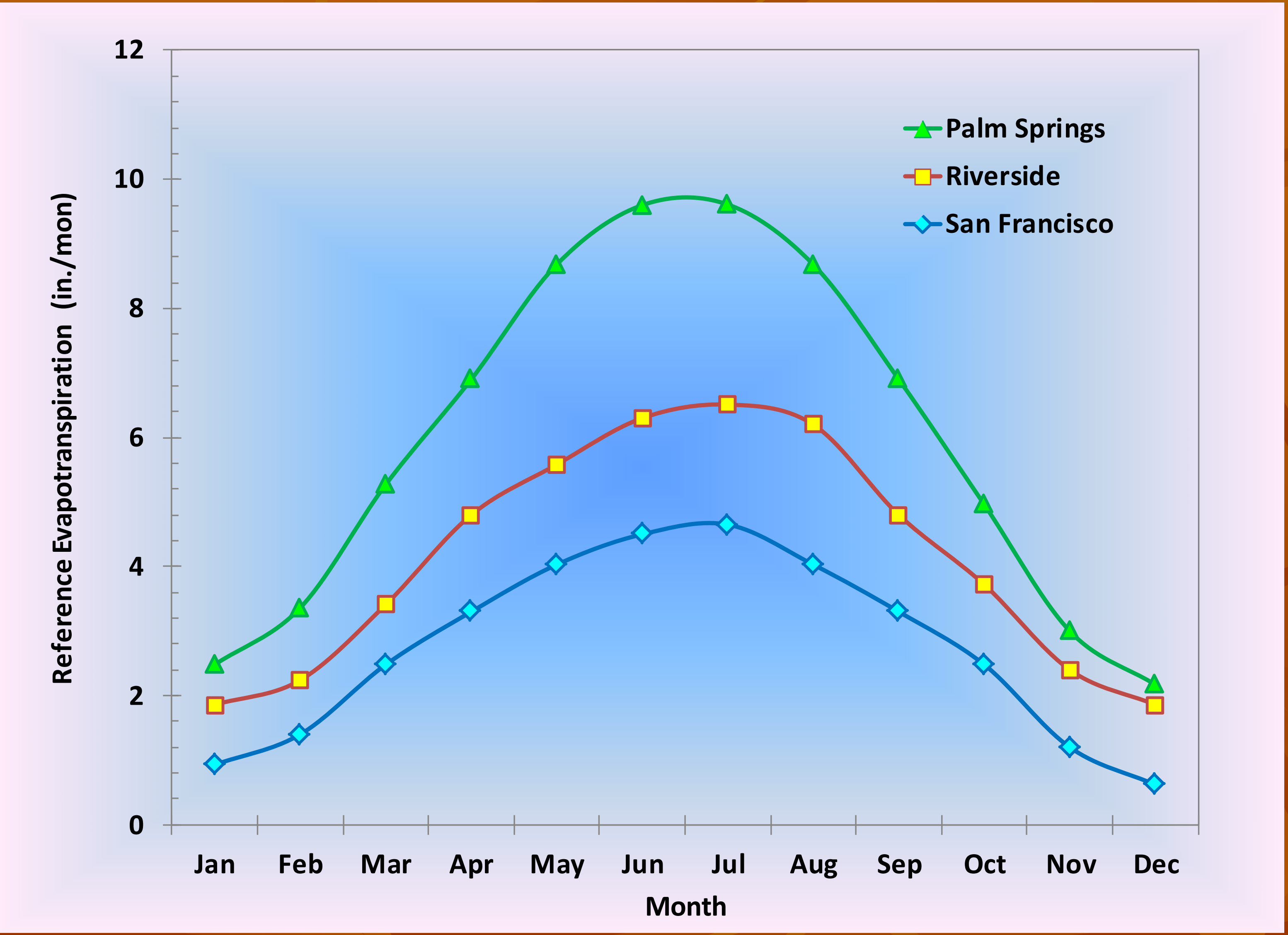
www.cimis.water.ca.gov

California Irrigation Management Information System

CIMIS Station

Average (mean) ETo



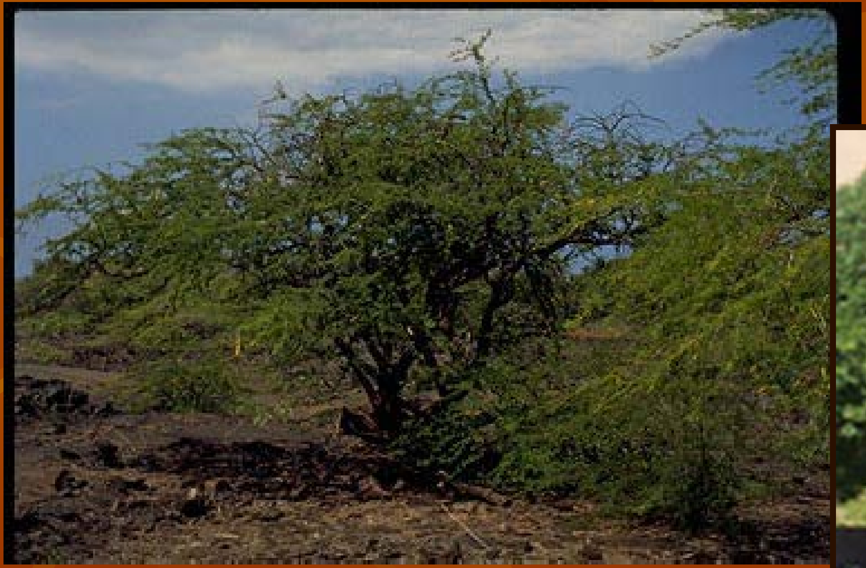


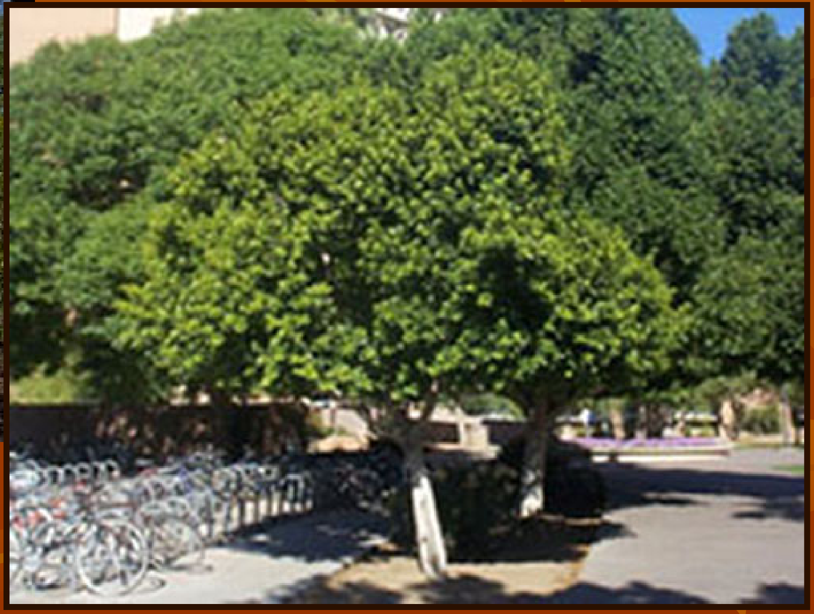
Reference Evapotranspiration (in./mon)
12
10
8
6
4
2
0
Palm Springs
Riverside
San Francisco
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Plant Water Requirements Based on UC Research in the 1980s

Potentilla tabernaemontani 0.5 - 0.75
Sedum acre 0.25
Cerastium tomentosum 0.25
Liquidambar styraciflua 0.20
Quercus ilex 0.20
Ficus microcarpa nitida 0.20
Hedera helix Ôneddlepointo 0.20
Drosanthemum hispidum 0.20
Gazania hybrida 0.25-0.50
Vinca major 0.30
Baccharis pilularis 0.20

Plant ET often higher than actual water required for acceptable performance (Mesquite and Ficus)





Water Needs of the Same Species Vary by Microclimate

- Landscape plants in heat islands require up to 50% more water than the same species in park settings

Plant Density Affects Water Requirement

Multi-tiered canopy uses more water than single tier canopy

The Denser The Planting, the More Water it Needs

Examples of Dense landscapes

Examples of Low Density Landscapes Requiring Less Water than Denser Ones

Water an inch or Two Below the Current Root Zone to Draw Roots Down

- Avoid runoff (heavy clay soils)
- Avoid seepage below root zone (sandy soils)

Irrigate Established Plants Less Often But Deeper Than Newly Planted Ones

(Most overwatering occurs in established landscapes while most underwatering occurs in newly planted landscapes)

Low Density Planting

What About Turf?

DWR WATER BUDGET

*MAWA = (ETo) (0.7) (LA) (0.62)

ETo = Reference Evapotranspiration (inches per year)

0.7 = ET Adjustment Factor

LA = Landscaped Area (square feet)

0.62 = Conversion factor (to gallons)

***Maximum Applied Water Allowance = _______ gallons/year**

Example of Maximum Applied Water Allowance (MAWA)

- Greater Sacramento area (annual historical ETo = 57 in)
- Hypothetical Landscape Area = 50,000 sq ft
- MAWA = (ETo) (0.7)* (LA) (0.62)**
- MAWA = (57) (0.7) (50,000 sq ft) (0.62)
- MAWA = 1,236,900 gallons per year

*ET Adjustment Factor (through November 2015)

** Conversion factor from inches to gallons

Example of Maximum Applied Water Allowance (MAWA)

- Greater Sacramento Area (annual historical ETo = 57 in)
- Hypothetical Landscape Area = 50,000 sq ft
- MAWA = (ETo) (0.55)* (LA) (0.62)**
- MAWA = (57) (0.55) (50,000 sq ft) (0.62)
- MAWA = 971,850 gallons per year

*ET Adjustment Factor (as of December 2015)

** Conversion factor from inches to gallons

WUCOLS
(Water use Classification of Landscape Species)

Water Use Category	Designation	% of ETo
High	H	70-90
Medium	M	40-60
Low	L	10-30
Very Low	VL	<10

Parkinsonia 'Sonorae'
Sonoran Palo Verde

- Very low water use
- 15 ft wide x 15 ft tall
- Yellow flowers
- Allergenic

Vachelia farnesiana (Acacia farnesiana) Sweet Acacia

- Very low water use
- Semi evergreen
- 30 ft wide x 30 ft tall (smaller cultivar as well)
- Beautiful yellow flowers
- Tolerant to high pH
- Allergen

Tecoma hybrid
'Solar Flare' ™

- Low water use
- 4-6 ft high x 4-6 ft wide
- Blooms spring - fall
- Tangerine color flowers attract hummingbirds

Leucophyllum zygophyllum
Cimarron™ and Rio Bravo™

- Low water use
- Evergreen
- Small/compact shrubs
- Purple flowers
  summer - fall

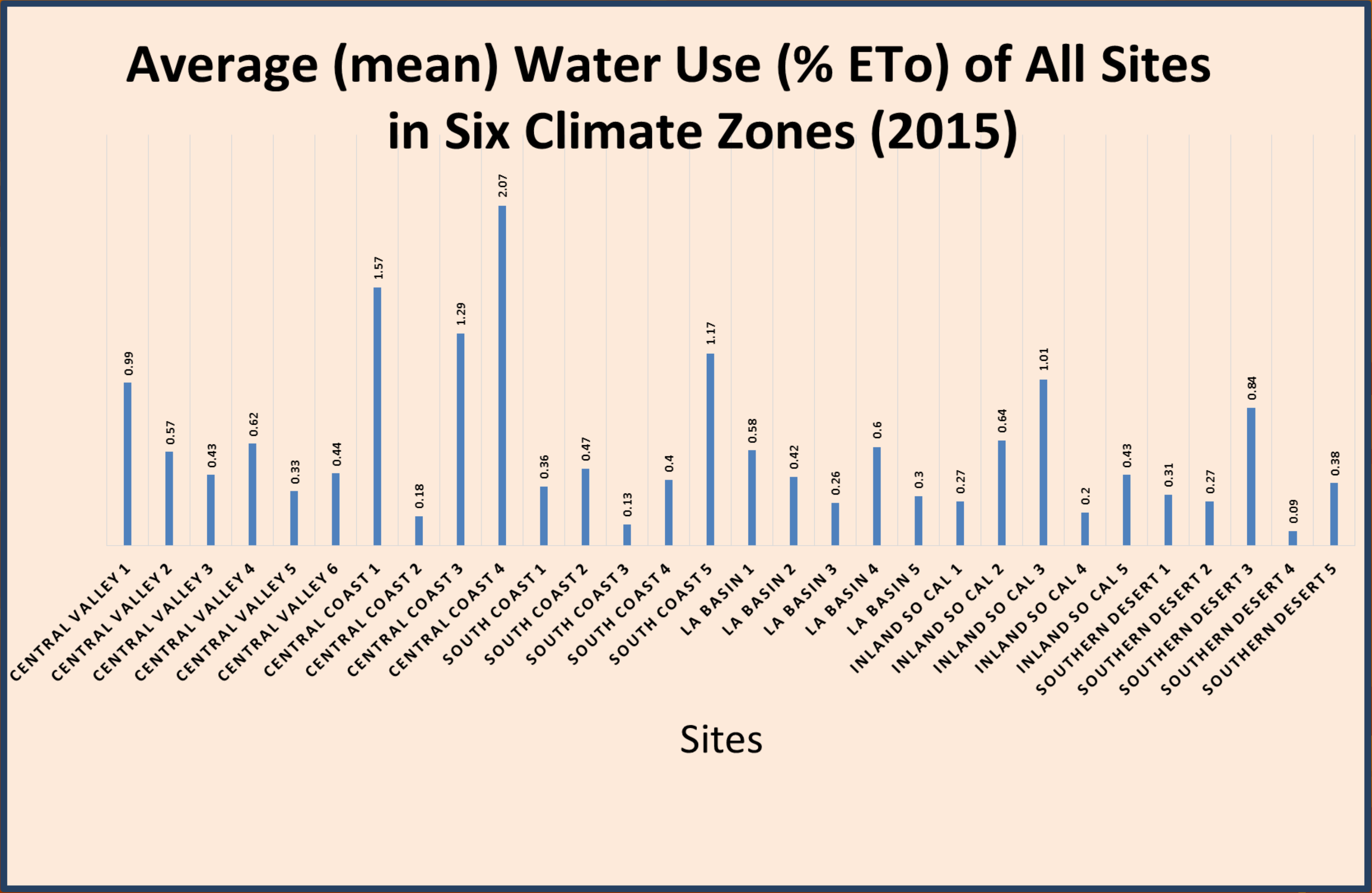
Caesalpinia cacalaco 'Smoothie' ™ Thornless Cascalote

- Low water use
- Evergreen
- Thornless
- Yellow flowers in winter
- 15 – 18 ft tall

Diversity across Project Sites



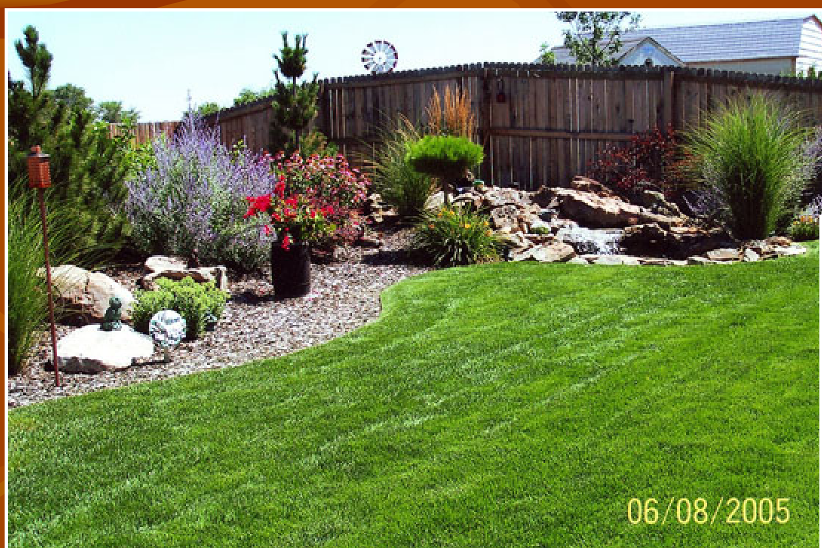
Results


Average (mean) Water Use (% ETo) of All Sites
in Six Climate Zones (2015)
0.99
0.57
0.43
0.62
0.33
0.44
1.57
0.18
1.29
2.07
0.36
0.47
0.13
0.4
1.17
0.58
0.42
0.26
0.6
0.3
0.27
0.64
1.01
0.2
0.43
0.31
0.27
0.84
0.09
0.38
CENTRAL VALLEY 1
CENTRAL VALLEY 2
CENTRAL VALLEY 3
CENTRAL VALLEY 4
CENTRAL VALLEY 5
CENTRAL VALLEY 6
CENTRAL COAST 1
CENTRAL COAST 2
CENTRAL COAST 3
CENTRAL COAST 4
SOUTH COAST 1
SOUTH COAST 2
SOUTH COAST 3
SOUTH COAST 4
SOUTH COAST 5
LA BASIN 1
LA BASIN 2
LA BASIN 3
LA BASIN 4
LA BASIN 5
INLAND SO CAL 1
INLAND SO CAL 2
INLAND SO CAL 3
INLAND SO CAL 4
INLAND SO CAL 5
SOUTHERN DESERT 1
SOUTHERN DESERT 2
SOUTHERN DESERT 3
SOUTHERN DESERT 4
SOUTHERN DESERT 5
Sites

Practical Application

- Properly irrigating landscape plants based on species, density, climate and microclimate reduces water waste.
- Properly functioning irrigation systems (matched heads, proper spacing, proper pressure, and unclogged heads) can significantly reduce water waste.

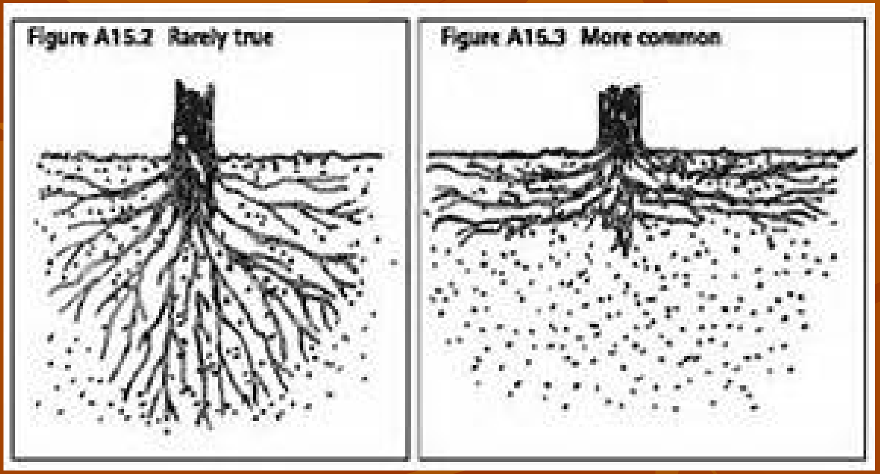
Hydrozone : Place plants with similar water needs together and irrigate them accordingly




Low
Moderate
Low
Low
Low
Low
Moderate
Moderate
Low
Moderate
Moderate
Low

2.6 gal / wk
4.2 gal / wk
2.6 gal / wk
1.7 gal / wk
.95 gal / wk
.95 gal / wk
1.0 gal / wk
4.2 gal / wk
.95 gal / wk
2.4 gal / wk
2.4 gal / wk
.4 gal / wk

Drip Irrigate Trees, Shrubs, and Gardens to Reduce Soil Evaporation and to Apply Water Directly into Root Zones



Increase the Use of Warm-Season Turf which Uses 20-25% Less Water than Cool-Season Turf

Repair leaks, low heads, broken sprinklers, unmatched sprinklers and pressure and spacing problems to increase DU

Download UC's Free 'Lawn Watering Guide'

http://ucanr.org/freepubs/docs/8044.pdf

- Determine type of lawn (warm vs cool season turf)
- Conduct a 'Can Test' to determine sprinkler system output and distribution uniformity
- Determine how long to irrigate (minutes per week) based on climatic chart provided
- Determine maximum amount of time to water per event until runoff just begins

Minutes (per week) to Irrigate Turf

Region 4: Sacramento Valley

Warm-Season Turfgrasses

Minutes per week to irrigate if your hourly sprinkler output is:

	0.5 in	1.0 in	1.5 in	2.0 in
JAN	19	09	06	05
FEB	44	22	15	11
MAR	69	35	23	17
APR	101	50	34	25
MAY	126	63	42	32
JUN	158	79	53	39
JUL	164	82	55	41
AUG	145	72	48	36
SEP	113	57	38	28
OCT	82	41	27	20
NOV	38	19	13	09
DEC	19	09	06	05

Cool-Season Turfgrasses

Minutes per week to irrigate if your hourly sprinkler output is:

	0.5 in	1.0 in	1.5 in	2.0 in
JAN	25	13	08	06
FEB	59	29	20	15
MAR	92	46	31	23
APR	134	67	45	34
MAY	168	84	56	42
JUN	210	105	70	53
JUL	218	109	73	55
AUG	193	97	64	48
SEP	151	76	50	38
OCT	109	55	36	27
NOV	50	25	17	13
DEC	25	13	08	06

Water cycling may be necessary to avoid run-off. Divide the total amount of water required per day into 2-4 cycles. Apply water as close to initial event as possible before soil dries out.

Irrigate Deeply and Infrequently and Monitor Soil Moisture




Soil probe

Soil sampling tube

Other Methods to Conserve Water in the Landscape

Minimize the use of water to clean sidewalks and driveways

Remove weeds that compete with landscape plants for water

Irrigate Established Plants Deeply and Infrequently

- Avoid watering every day

- Water a few inches below the current root system during each watering to encourage deep rooting

Avoid Compacted Soils

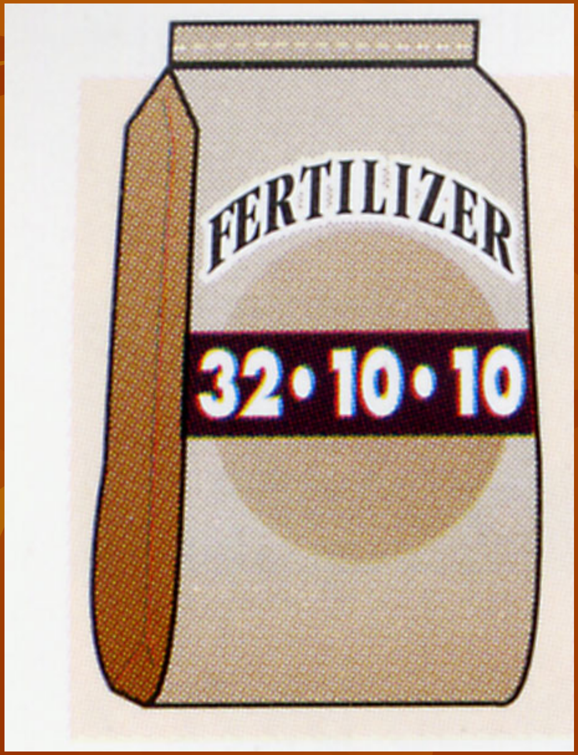
Result of Circled Roots


SERVICE

Improve Water-Holding Capacity and/or Drainage with Compost Mixed Evenly into Soil (6” – 1’)

Apply Mulch Around Plants

Avoid Over-fertilizing



- Creates flushes of weak growth
- Increases water requirement

Scheduling Irrigations for Street Trees

Street Trees Have Irrigation Advantages over Orchard Trees

- Not producing a ‘crop’ so irrigation not dependent on fruit set and filling periods
- Can irrigate below ET

Street Trees Have Irrigation Disadvantages over Orchard Trees

- Differences in density and microclimates exist across a landscape
- Street trees are often planted in too small of planting holes


TREE
WORK
AHEAD




Avoid Adding Soil Amendments to Tree Planting Sites and Check for Circled Roots in Pots

Result of Circled Roots or Adding Compost to Hole

How much Soil Does a Street Tree Need?

- 64 cubic ft
- 100 cubic ft
- 400 cubic ft
- 1,000 cubic ft
- 2,000 cubic ft

All are correct

- Depends on size of ultimate root zone
- Varies by species

Water Management Guide for Fruit Trees

Gallons of Water based on ET and Tree Size	.10 in/day	.20 in/day	.25 in/day	.30 in/day
1 year (4’ canopy)	.25	.50	.62	.75
2 years (10’ canopy)	.62	1.25	1.56	1.87
4 years (100’canopy)	6.20	12.5	15.6	18.7
Mature (300’ canopy)	18.60	37.5	46.8	56.1

Landscape Tree Irrigation based on WUCOLS (gallons/week in July in LA)

Water Use Category	Designation	% of ETo
High	H	70-90
Medium	M	40-60
Low	L	10-30
Very Low	VL	<10

References
(free download publications): https: anrcatalog.ucanr.edu

- Keeping Plants Alive Under Drought and Water Restrictions
- Lawn Watering Guide for California
- Use of Graywater in Landscapes

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Thank You

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