Module #3
Managing Irrigation Runoff to Reduce Water Waste

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UCCE Orange

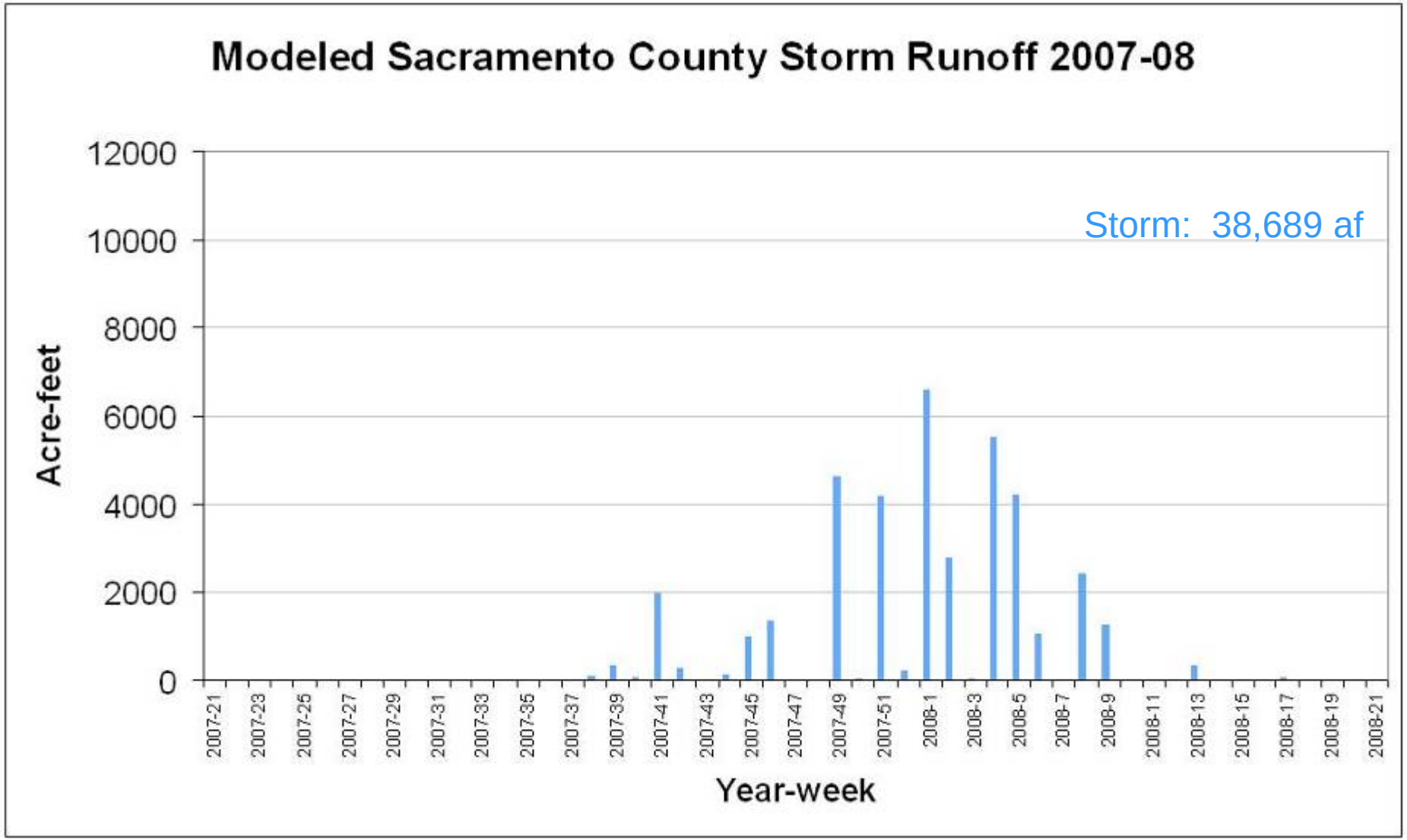
February 24, 2016

Session Agenda

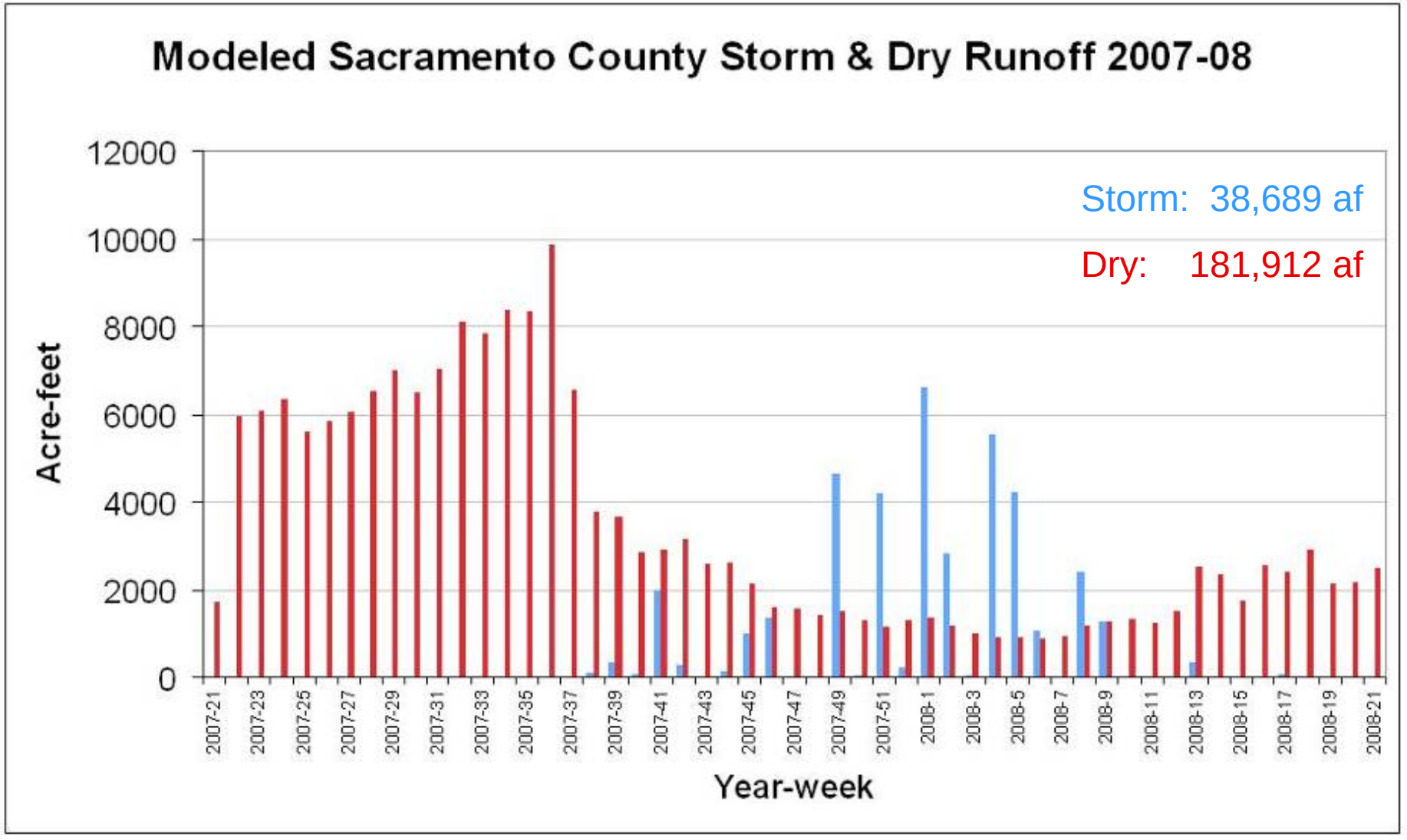
9:00-9:20	Water Runoff Issue
9:20-11:00	Irrigation Maintenance and Scheduling to Reduce Runoff
11-11:30	Irrigation Management Tools/Resources

Irrigation Runoff

Storm runoff…



Storm + Dry weather runoff…
It adds up!




UC Statewide IPM Project
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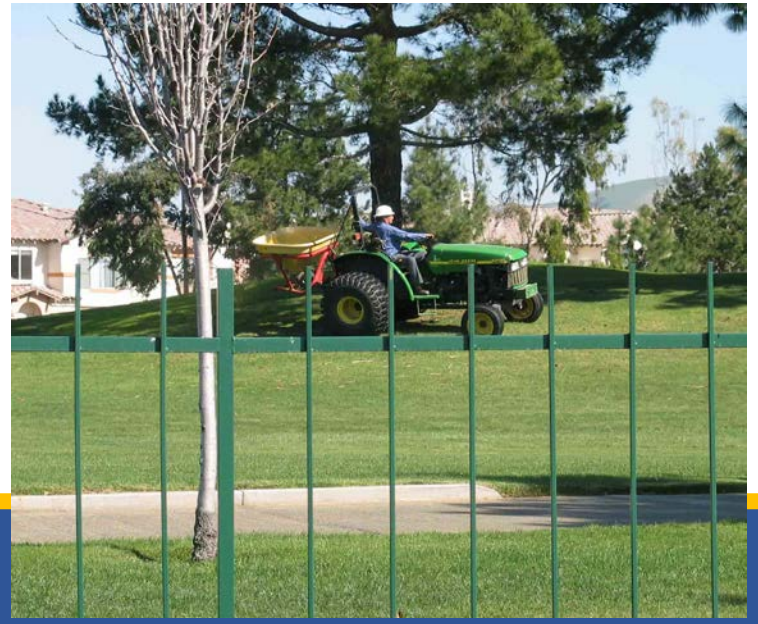

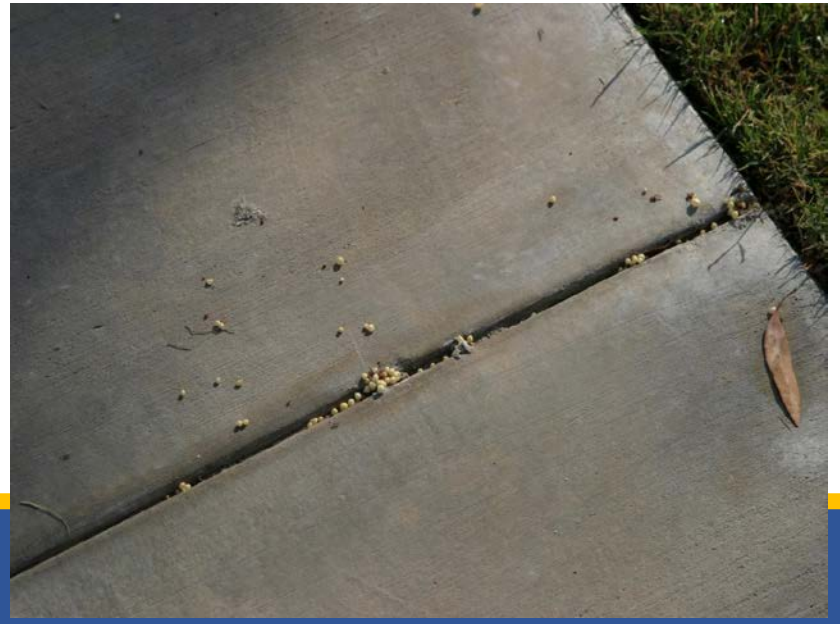


HOT
COALS
ONLY

Irrigation Runoff Regulations

- Santa Ana RWQCB Permit (current)
  - ✓Not prohibited by the permittees unless discharges are identified either by the permittees or by the Executive Officer as a significant source of pollutants.
  - ✓Non-agricultural irrigation using recycled water must comply with the statewide permit for Landscape Irrigation Using Recycled Water and the State Department Health guidelines.

*Draft of new permit now prohibits irrigation runoff from entering the MS4

Irrigation Runoff Regulations

- San Diego RWQCB Permit (current)
  - ✓Copermittees must prohibit these types of non-storm water discharges from entering the MS4:

  street wash water, landscape irrigation, irrigation water, and lawn watering
  - ✓Urban runoff was modified to non-storm discharges to avoid confusion with the source of the runoff

Policy for Water Quality Control for Recycled Water (Recycled Water Policy)

7. *Landscape Irrigation Projects*[1]

a. *Control of incidental runoff.* Incidental runoff is defined as unintended small amounts (volume) of runoff from recycled water use areas, such as unintended, minimal over-spray from sprinklers that escapes the recycled water use area. Water leaving a recycled water use area is not considered incidental if it is part of the facility design, if it is due to excessive application, if it is due to intentional overflow or application, or if it is due to negligence. Incidental runoff may be regulated by waste discharge requirements or, where necessary, waste discharge requirements that serve as a National Pollutant Discharge Elimination System (NPDES) permit, including municipal separate storm water system permits, but regardless of the regulatory instrument, the project shall include, but is not limited to, the following practices:

(1) Implementation of an operations and management plan that may apply to multiple sites and provides for detection of leaks, (for example, from broken sprinkler heads), and correction either within 72 hours of learning of the runoff, or prior to the release of 1,000 gallons, whichever occurs first,

(2) Proper design and aim of sprinkler heads,

(3) Refraining from application during precipitation events, and

(4) Management of any ponds containing recycled water such that no discharge occurs unless the discharge is a result of a 25-year, 24-hour storm event or greater, and there is notification of the appropriate Regional Water Board Executive Officer of the discharge.

GENERAL WASTE DISCHARGE REQUIREMENTS FOR LANDSCAPE IRRIGATION USES OF MUNICIPAL RECYCLED WATER

7. *Landscape Irrigation Projects*[1]

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Irrigation Maintenance & Scheduling

Maintenance

- Pressure adjustment
  - High vs low issues
- Sprinkler rotation on rotors
  - Inspect for worn parts
- Sunken or raised sprinklers
  - Adjust to grade
- Broken sprinklers and/or pipes
- Sprinkler alignment
  - No more than a 5 degree tilt

Maintenance continued

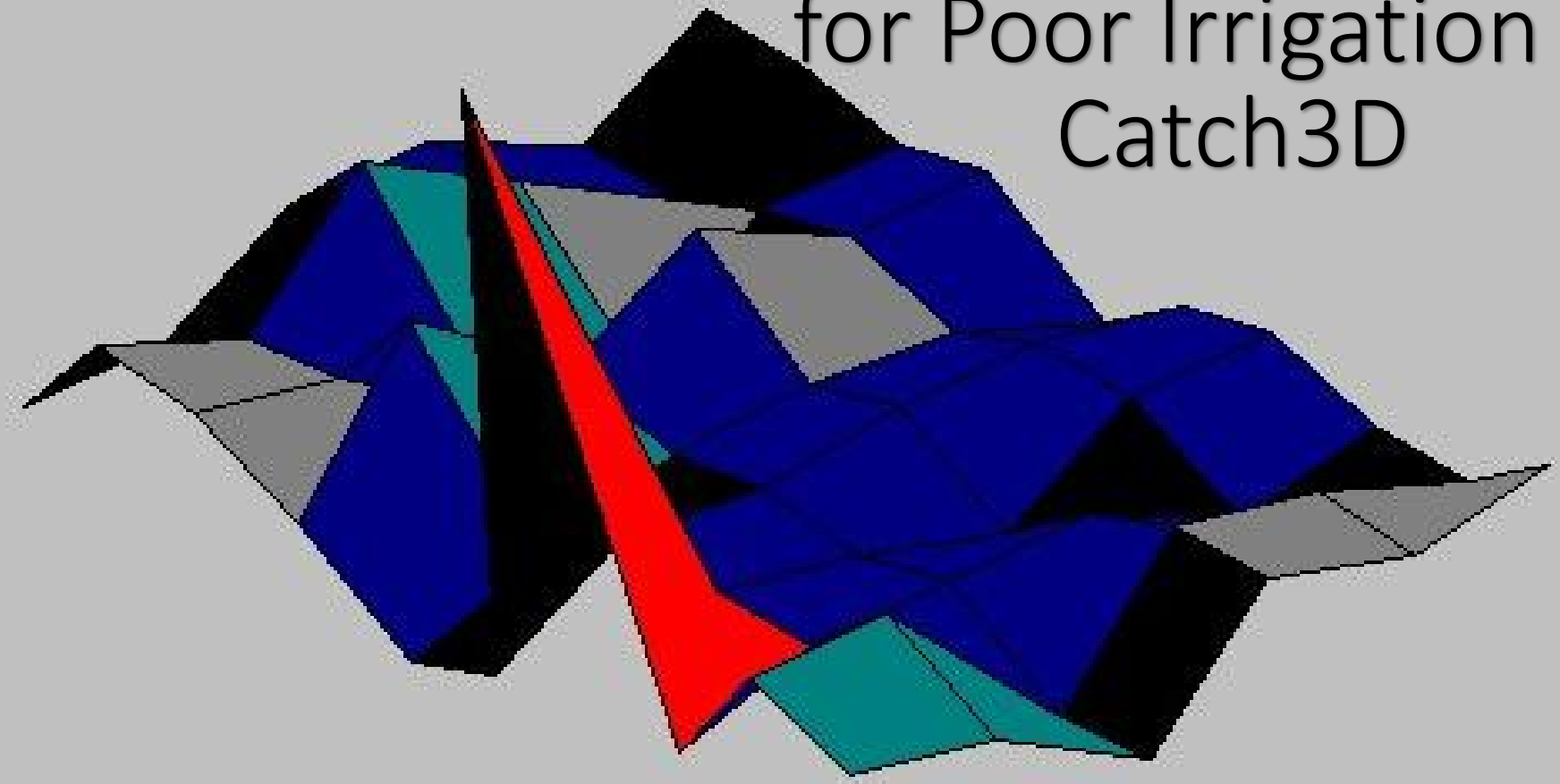
- Sprinklers not adjusted properly
  - Arc and radius adjustments
- Matched precipitation rates
  - Zone sprinklers if MPR nozzles are not utilized (i.e. full vs. part-circle)
- Check valve operation
- Ensure correct equipment specifications are maintained
  - Different brands or types

Rainbird Falcon 6504

Hunter I-40

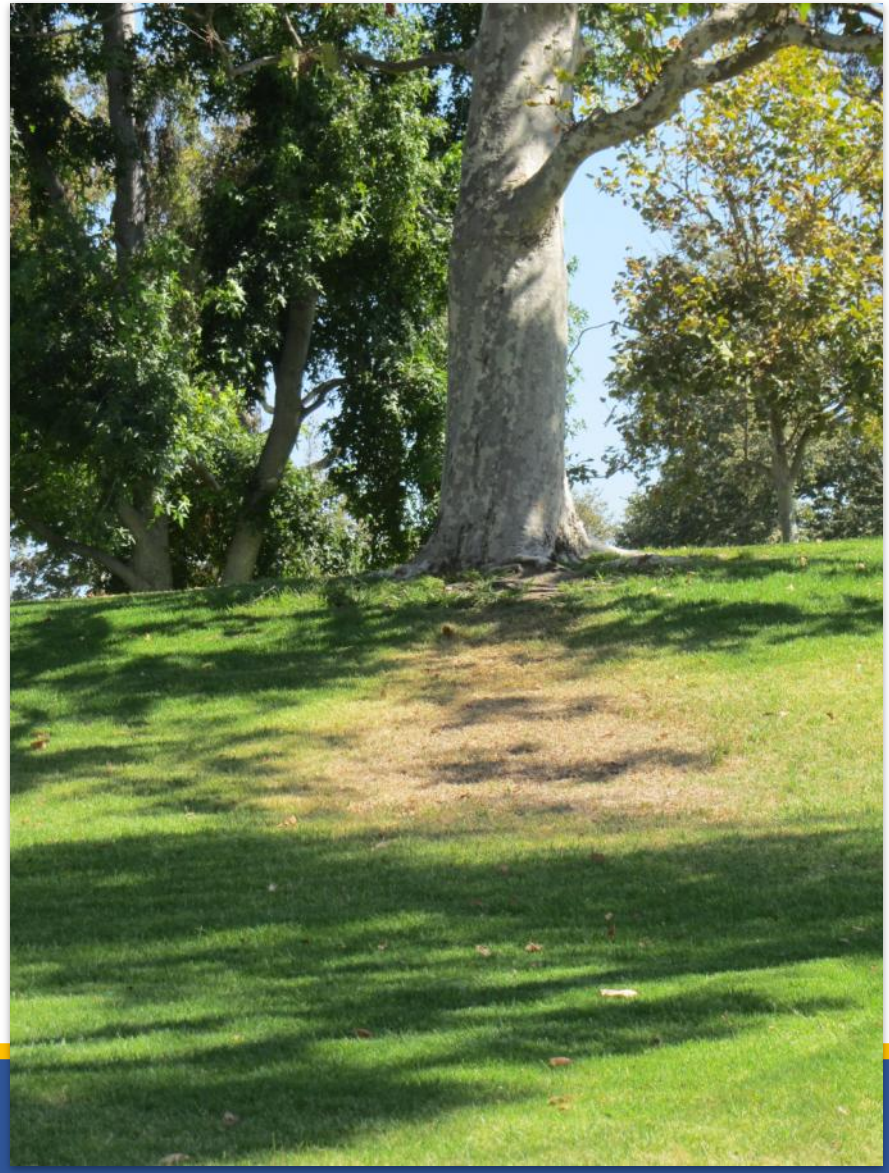
Hunter I-20

Catch Can Test Modeling for Poor Irrigation on Catch3D



Changes to Design

- Trees blocking sprinklers are clearly marked by brown patches that do not receive water.
  - Either move the sprinkler or add a sprinkler.



Maintenance

- Work trucks should not be driven on grass areas as they can break sprinklers and add to compaction.
- Checking irrigation system weekly prevents runoff.

Typical Irrigation Issues

Rain Bird
Falcon 6504

Rain Bird
Impact Sprinkler

Rain Bird

Toro
Stream Rotor

Hunter
I-25 /I-40

Problem:

- Different emitters are used in the same irrigation zone
  - Different PR
  - Different GPM
  - Work at different pressures
  - Lead to low distribution uniformity. Over watering in areas, while others stay dry.
    - Dry spots lead to day irrigation by irrigation

- Rotor emitters are used to irrigate parking islands.

Solution:

- Match emitters. This can be done a couple zones at a time.
- Stream rotors or regular spray heads should be used in parking islands.

Irrigation Scheduling

Irrigation Management

Control

Things to do

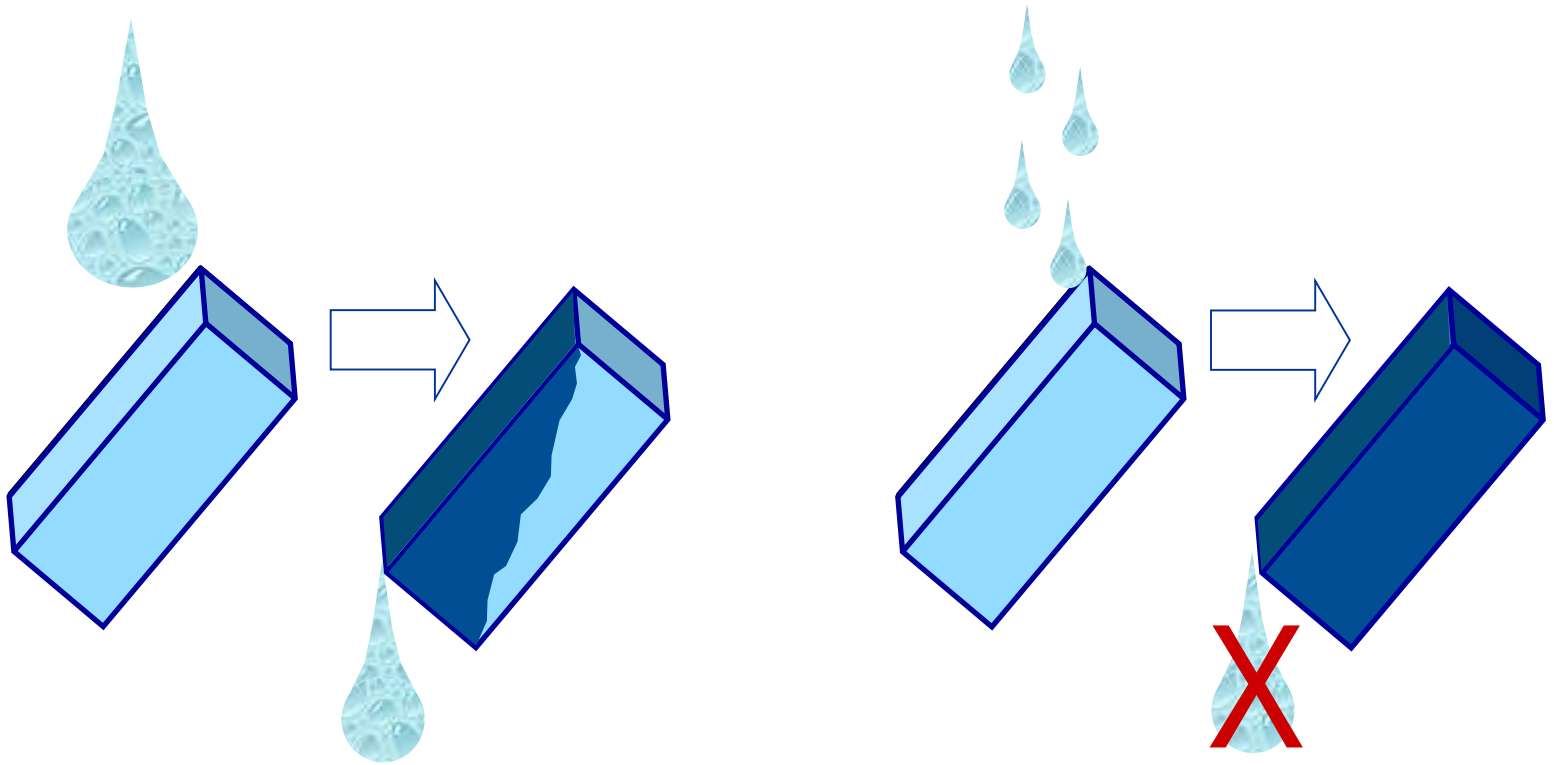
Water budgets

- AB1881 (Laird 2006)
- MWELO- Model Water Landscape Ordinance
  - ETWU- Estimated Total Water Use
    - "The plant factor used shall be from WUCOLS."
  - MAWA- Maximum Applied Water Allowance

http://www.water.ca.gov/wateruseefficiency/docs/WaterBudget101.xls

Irrigation Management

Application rate has to match infiltration rate



Graphic: L. Oki

Fast Application Rate

Slow Application Rate

Irrigation Management

Control

Things to do

Use pulses rather than a single, long application

1. Turn on valve manually on dry soil
2. Watch for onset of runoff, note time
3. Turn off valve, wait one hour
4. Use a soil probe to check depth of water penetration

Control

Things to do

Use pulses rather than a single, long application

5. Repeat steps 1-4
6. Program clock using duration of second irrigation
7. Use multiple start times 1 hour apart to obtain the desired depth of irrigation
8. Repeat this irrigation program as necessary

Control

Things to do

- Adjust controllers to match plants needs
- Use sensors for interruption, control
- Water in the early morning
- Avoid windy periods, if possible
- Upgrade sprinklers
- Measure DU

Irrigation Systems

Delivery

- Valves
- Pipes
- Sprinklers
- Emitters
- Pressure compensation

Selected to **place** water where it can be used

Selected to **provide** water at desired rate

As pipes slope up/down in elevation, pressure decreases/increases

~1p.s.i. per 2.3ft height

Irrigation Systems

- Water pressure (dynamic)
- Effect on spray pattern

12’ fixed 30 psi

12’ fixed 45 psi

Irrigation Systems

Delivery

- Valves
- Pipes
- Sprinklers
- Emitters
- Pressure compensation

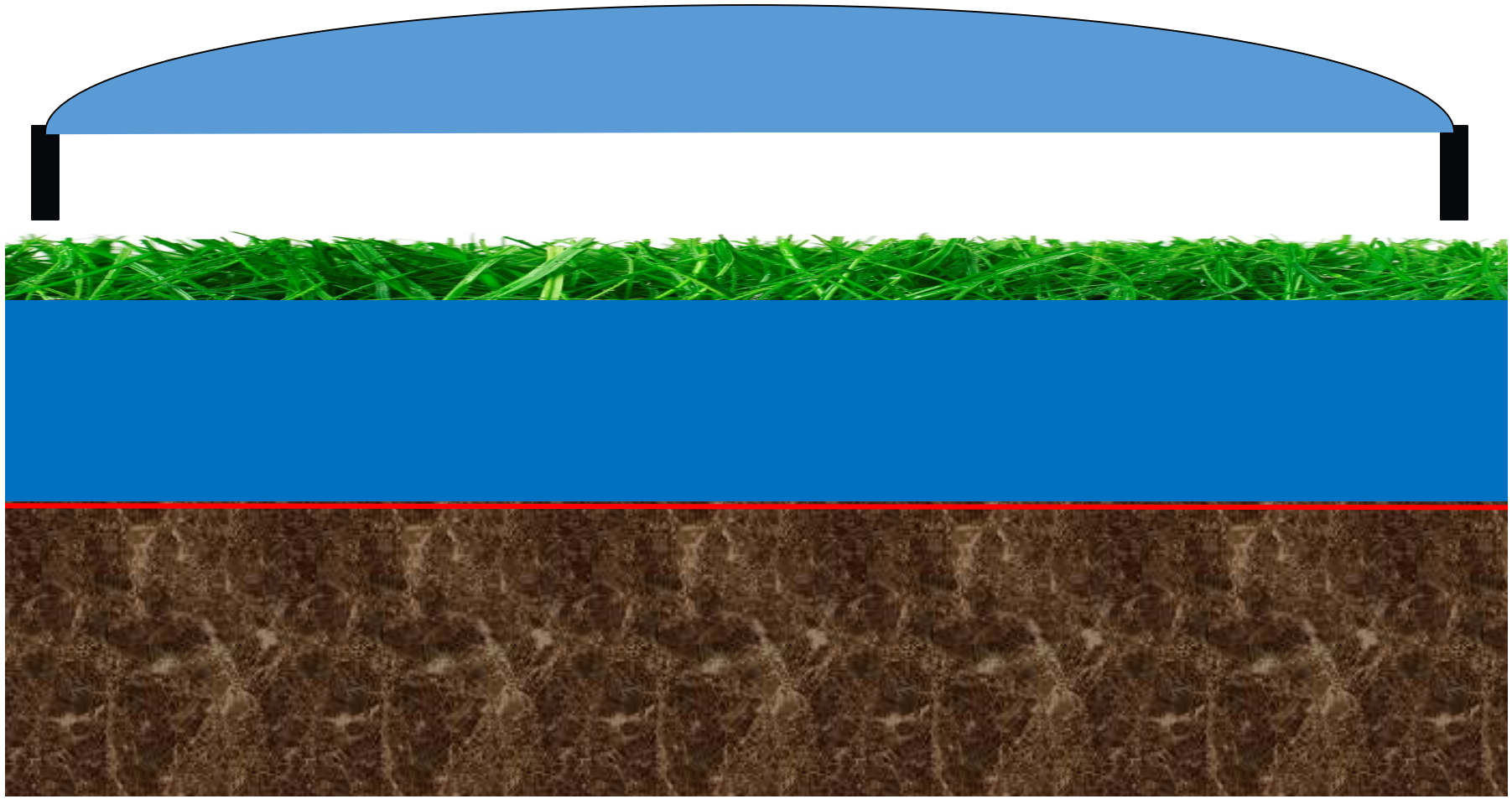
Uniformity

- Distribution Uniformity (DU)
- How evenly water is applied

Distribution Uniformity

DU=Excellent

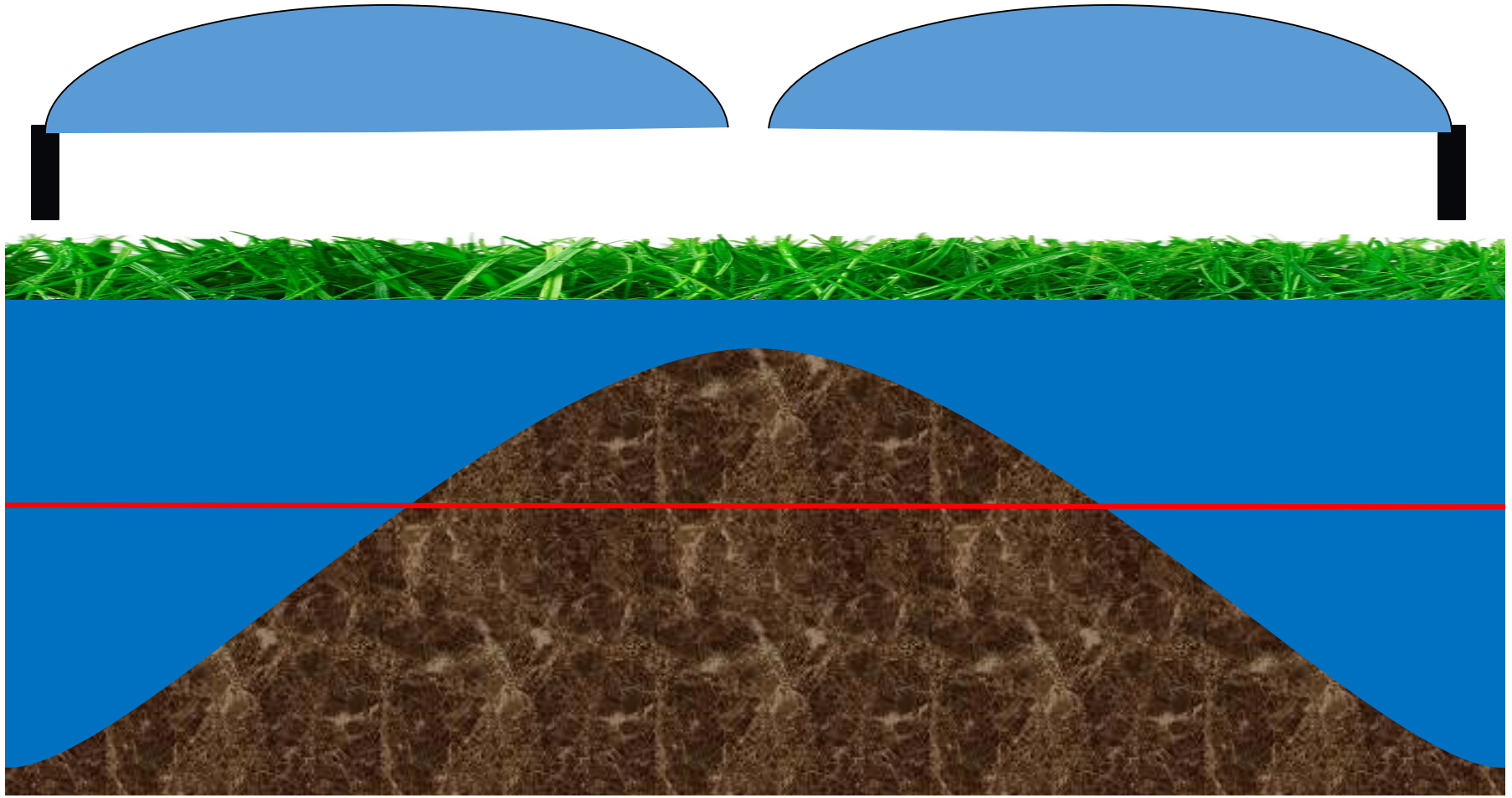
Duration: Replace ET



Distribution Uniformity

DU=Poor

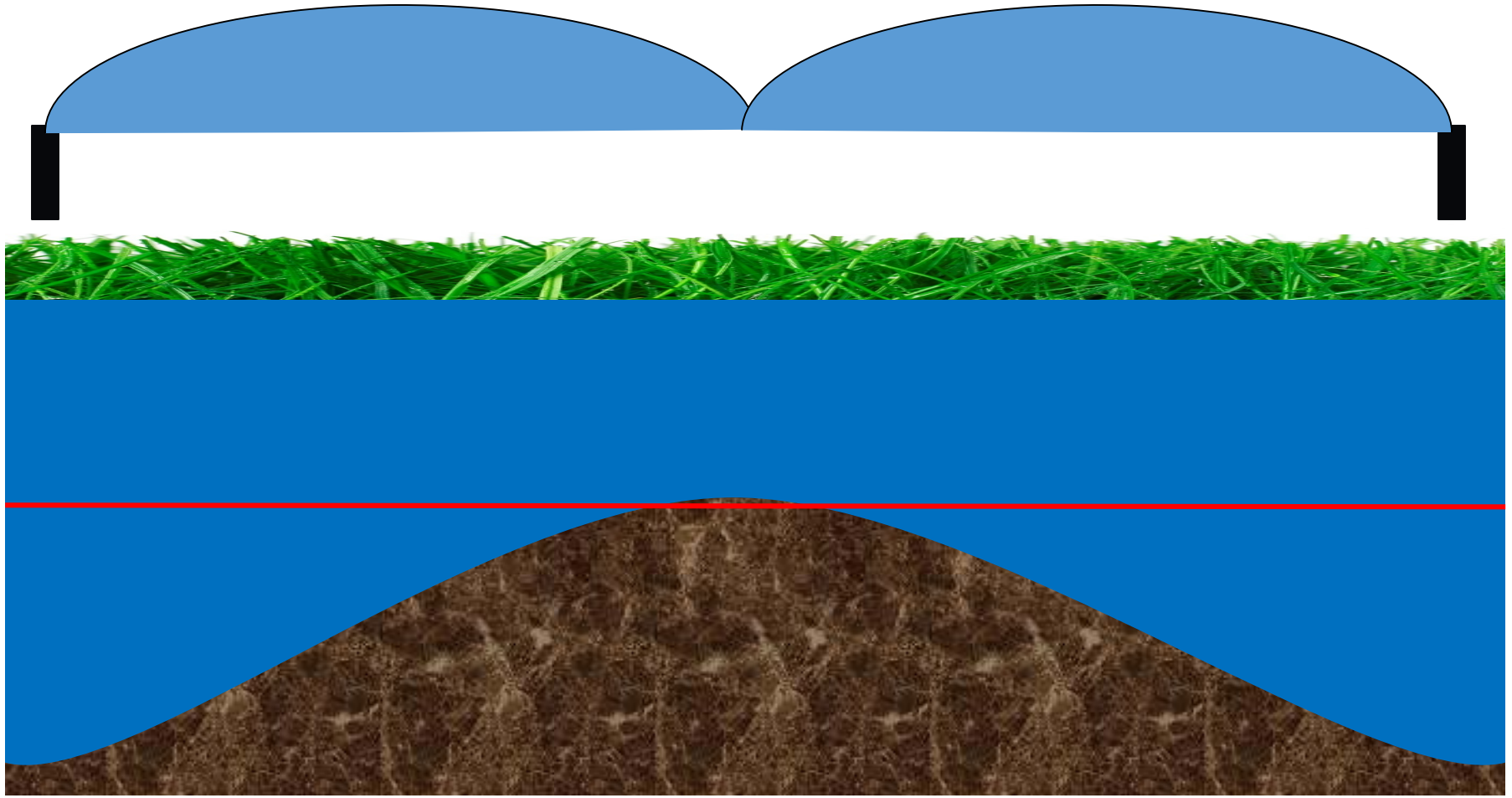
Duration: Long



Distribution Uniformity

DU=Marginal

Duration: Replace ET



Distribution Uniformity

- Catch cans
  - Arranged relative to sprinklers
  - Measure volumes

Photos: B. Baker

Distribution Uniformity

- Catch cans
  - Arranged relative to sprinklers
  - Measure volumes
- Calculate DU
  - Rank volumes lowest to highest
  - Average of bottom ¼ (Avg_{LQ})
  - Average of all (Avg_T)
  - DU= $Avg_{LQ} \div Avg_T$
- Target
  - Minimum of 70%

Distribution Uniformity

	mL
	36
	28
	18
	19
	26
	33
	16
	22
	38
	22
	14
	22
Avg_T	= 24.5

Distribution Uniformity

	mL	rank
	36	11
	28	9
	18	3
	19	4
	26	8
	33	10
	16	2
	22	5
	38	12
	22	6
	14	1
	22	7
Avg_T	= 24.5	

Distribution Uniformity

	mL	rank	LowQ
	36	11	
	28	9	
	18	3	18
	19	4	
	26	8	
	33	10	
	16	2	16
	22	5	
	38	12	
	22	6	
	14	1	14
	22	7	
Avg_T	= 24.5	Avg_{LQ} = 16	

$$DU = \frac{Avg_{LQ}}{Avg_T}$$

$$= \frac{16}{24.5}$$

$$= 65\%$$

Irrigation Systems

Delivery

- Valves
- Pipes
- Sprinklers
- Emitters
- Pressure compensation

Apply water so that the soil can absorb all that is applied

Infiltration rate and application (precipitation) rate

Irrigation Management

Aspects

Control Delivery

- Must be managed together
- A change in one may affect the other

Irrigation Management

Aspects

- Calculate run time

$$\text{Run time} = \frac{ET_o \times KL \times 2}{PR \times (0.4 + (0.6 * DU))} = \frac{3.1 \times 0.6 \times 2}{1.8 \times (0.4 + (0.6 * 0.65))} = 3.7 \text{ min/day}$$

Run time= minutes per day

ET_o= Monthly historical ET_o

K_L= Landscape or species (K_S) coefficient (0.6 for this example)

PR= precip rate (in/hr)

DU= distribution uniformity

In Excel format: $(ET_0 * K_L * 2)/(PR*(0.4+(0.6*DU))$

EXAMPLE
Irrigation Audit Locations

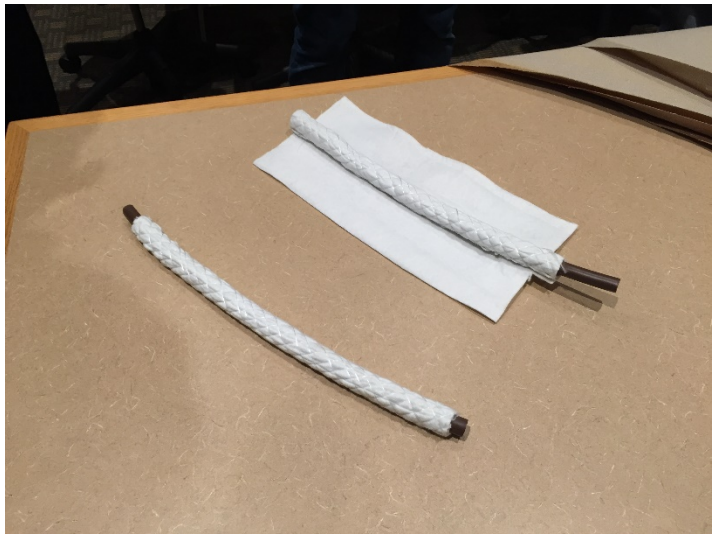
Location #	DU (%)	PR (in/hr)	Recommended Daily Run time (min)	Recommended Weekly Run Time
1	57	0.53	26	182
2	34	0.20	93	651
3	35	0.51	44	308
4	40	0.35	47	329
5	9	0.3	229	1603
6	50	0.26	62	434
7	42	0.19	98	686

Impact of DU on Irrigation Run Times

Location #	Original DU (%)	Required Daily Runtime (min)	Daily Runtime if DU = 65% (min)	Difference (min)
1	57	26	23	3
2	34	93	25	68
3	35	44	24	20
4	40	47	29	18
5	9	229	33	196
6	50	62	47	15
7	42	98	35	63

The distribution uniformity (DU) describes how evenly water is applied over the irrigated area. Targeted (DU) rates for irrigation systems are 55-75%. The chart above shows the amount of minutes run times could be reduced by bringing the (DU) up to 65%.

Subsurface Irrigation



Irrigation Management Tools and Resources

UCDAVIS COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

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Landscaping Resources During Drought

Welcome to our drought resources page for home gardeners and landscaping professionals. Some of these resources can also be found in other parts of the CCUH website. This page is in progress and will be updated with new resources, so please check back for more information.

Home Gardeners

- Keeping Plantings Alive Under Drought or Water Restrictions
- Landscape & Drought Resources List (.xls; compilation of information across US)
- General water conservation resources

Master Gardeners

- Landscape & Drought Resources List (.xls; compilation of information across US)

Professionals

- Drought Messages for Landscape Managers
- Landscape & Drought Resources List (.xls; compilation of information across US)
- General water conservation resources

Links

- California Institute for Water Resources Drought Portal

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Upcoming Events

2016 Rose Days-April 30 - May 1

Save the Date!

Apr 30, 2016

See more events

News

Call For Proposals now open at SHRE!

Feb 18, 2016

San Diego Irrigation and Tree Care Workshop Presentations

Oct 23, 2015

More news...

Featured

UCD and UCANR Landscape Plant Irrigation Trials 

Rotary System Irrigation Contraption (RSIC) 

Landscaping Resources During Drought

WUCOLS IV
Water Use Classification of Landscape Species

http://ccuh.ucdavis.edu/drought

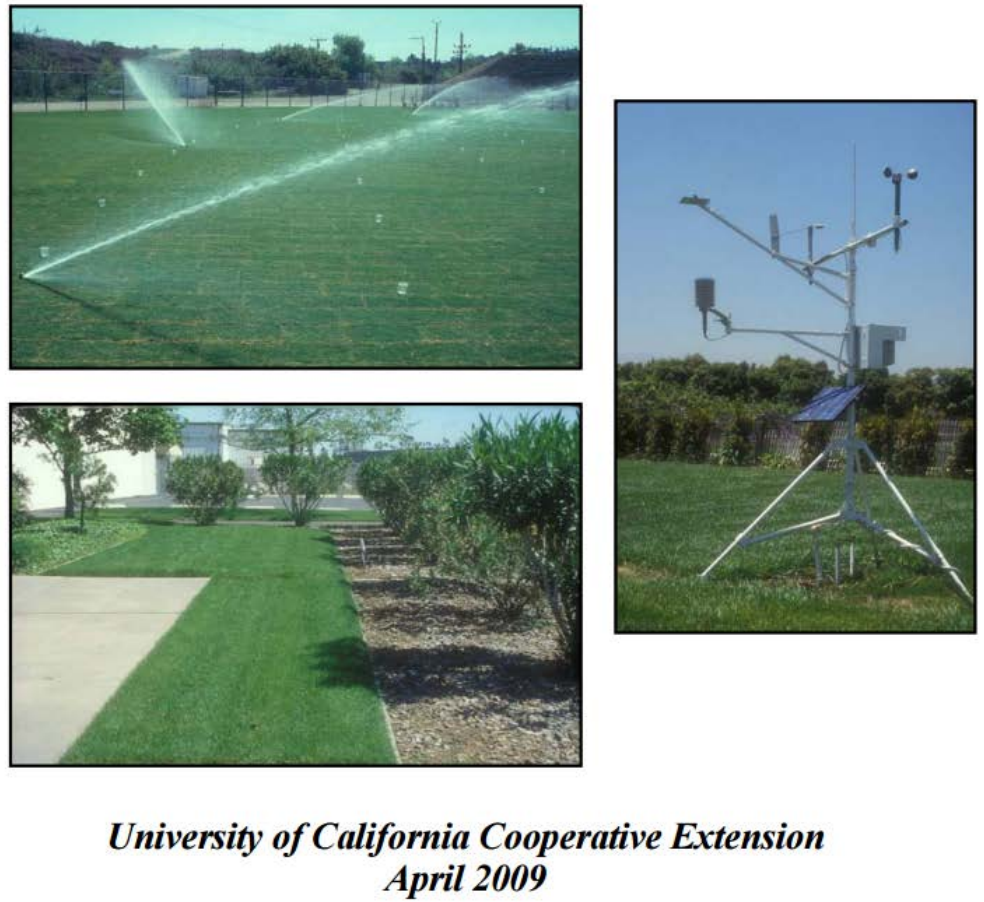
Landscape Irrigation Scheduling Worksheet

- http://ccuh.ucdavis.edu/Events/drought/landscape-irrigation-system-evaluation-management
- Original version developed for OC Parks
- Updated to include additional automated parameters for easier use
- Beta-tested by irrigation professionals and university experts.

Landscape Irrigation System Evaluation and Management

David A. Shaw and Dennis R. Pittenger
University of California Cooperative Extension

- Practical guide to evaluate irrigation hardware performance and determine irrigation schedules.
- PDF available on CCUH web site



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Center for Landscape & Urban Horticulture

Mission | Environmental Horticulture Industry in California | Home Gardening | Pests And Weeds | US Hardiness Zone Map | Contact Information

- Home
- Presentations
- **Landscape Water Conservation & Irrigation Management**
  - Easy Calculators for Estimating Landscape Water Needs
  - Estimating Water Requirements of Landscape Trees in California
  - Estimating Landscape Water Requirements Using SLIDE
  - ET: Evapotranspiration and Plant Water Use
  - Plant Factor or Crop Coefficient: What's the difference??
  - Turfgrass Crop Coefficients (Kc)
  - Handbook: U.C. Landscape Irrigation System Evaluation and Management
  - Smart Irrigation Controllers
  - Soil Water Holding Characteristics
  - Drought and Landscape Water Use - Some Perspective
- Current Projects
- Landscape Management
- Turfgrass Management
- Tree Care and Management
- Publications

Questions & Answers About Drought & Water Conservation

Q. How much water do landscapes use in California?
A. Landscape irrigation accounts for only about 9% of total statewide developed water use, but the percentage varies widely among communities. Water applied to landscapes is estimated to account for about 50% of residential water consumption statewide, but the amount varies from about 30% in some coastal communities to 60% or more in many inland suburban communities.

Q. What are some easy things I can do to save water in a landscape?
A. Check the irrigation system regularly for leaks as well as physical and operational problems that reduce the efficiency and function of sprinklers, drip emitters, and other water delivery devices. Correcting these problems can reduce water use by 10% or more, improve the uniformity of water application, and likely improve the health of plantings. Check that automatic valves are functioning and repair any leaks at valves, spray heads, and other connections. Walk through an area while the irrigation system is running and repair or replace sprinklers or other types of emitters that are broken, sunken, crooked, or clogged with soil or debris. Also, be certain that plants are not blocking or interfering with a sprinkler's spray pattern, that roots are not clogging drip emitters, and that all sprinklers and emitters are of the same manufacturer and model. For sprinkler systems, ensure the spray or streams completely overlap among the sprinklers by adjusting their output or adding sprinklers.

Q. Does a landscape have to be re-planted with specific drought resistant, native, or California Friendly plants to save significant amounts of water?
A. No. Field research studies indicate that traditionally used landscape trees, shrubs, and groundcovers have considerable drought resistance and perform acceptably with about 40% to 60% of the water required to maintain the average lawn in good condition. This is comparable to the water required by so-called drought resistant, California Friendly, and native plants to perform acceptably in landscapes. The common perception is that plants traditionally grown in landscapes are not drought resistant, so they are usually over watered.

Highly drought-resistant plants can survive extended periods with no precipitation or irrigation, but this does not mean they can provide acceptable landscape function and performance with no water. Some California native plants used for landscaping originate in the relatively cool, moist climate of the coast or in foothill and mountain climates, making them susceptible to summer drought and prone to injury when grown in warmer and drier areas of the state if summer irrigation is not provided.

No native or commonly used landscape plant is drought-resistant until it becomes established. All plants require a steady supply of moisture for about one year or more after they are first planted. Once non-turf landscape plants have well developed root systems, they typically perform well with limited summer water.

UC CE University of California Agriculture and Natural Resources Cooperative Extension

http://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/