Understanding Irrigation Efficiency with Different Systems: How it's Defined, Why it's Important

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Irrigation Efficiency; Why it's Important

Three main sources of water that sustain California:

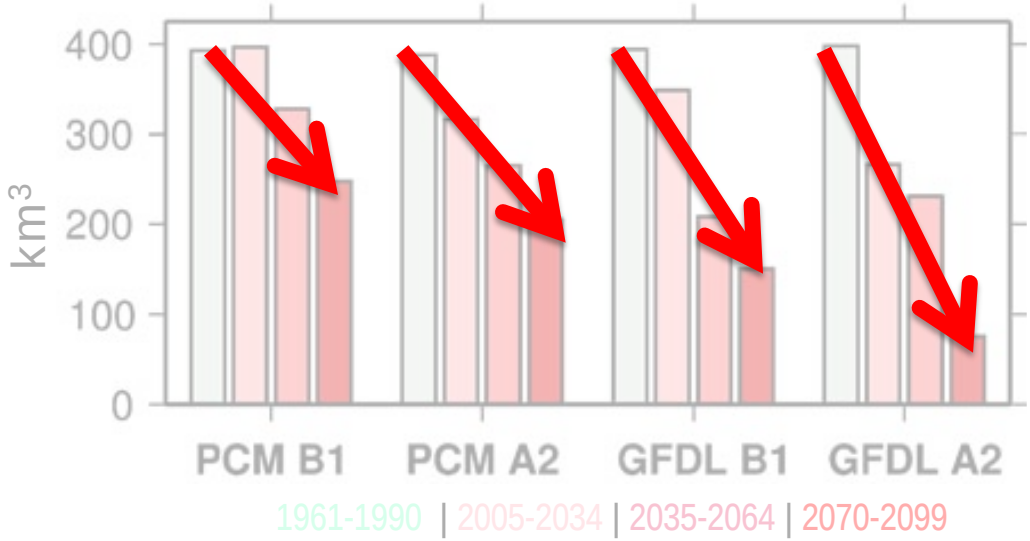
- Mountain snowpack
- Water stored in reservoirs
- Water pumped from underground aquifers.

All three sources are connected, and when the California Governor declared a drought emergency on January 17, 2014, all three had been depleted by an extended dry period.

Source: California Department f Water Resources

California state wide snowpack is projected to shrink drastically

Cayan et al. Climatic Change (2007)



↓ 25% of Sierra snowpack will be lost by **2050**

Department of Water Resources, State of California

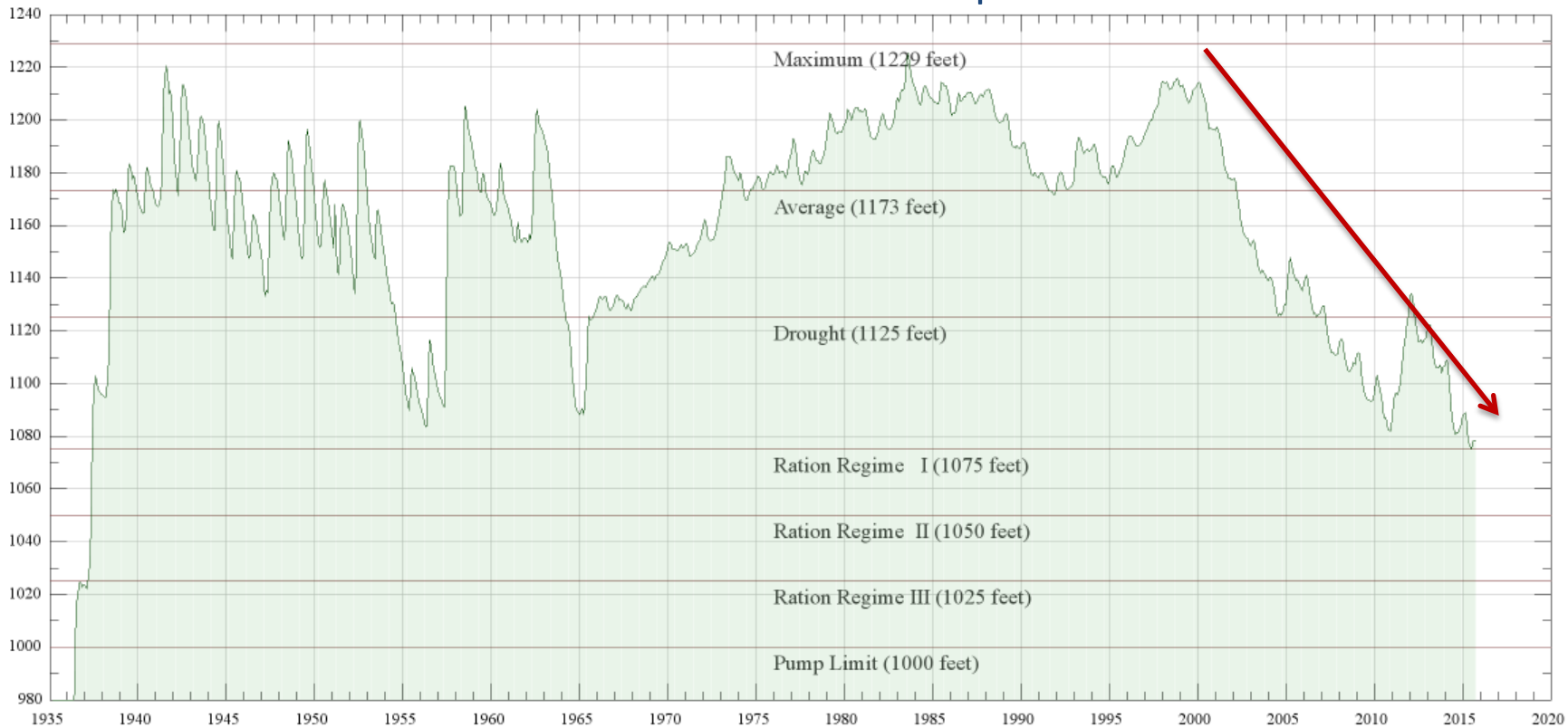
Source: Tapan Pathak, Climate Adaptation in Agriculture - CE Specialist, University of California Merced

Irrigation Efficiency; Why it's Important

Lake Mead Water Levels — Historical and Current

June 2015: 1075.08'

Last time below 1075' elevation was in April 1937



Source: http://www.arachnoid.com/NaturalResources/

Improving Irrigation System Efficiency

- Reduce losses (nutrients, pesticides, water)
- Limited water supplies and increased demands
- What is efficiency?
  - Distribution system efficiency (district level, canals, reservoirs, etc)
  - On farm or field application efficiency (AE) , distribution uniformity (DU), and other paramenters

Irrigation Methods in California:

1- Surface irrigation (flood):

- Border strip (flat) irrigation (slope 0.1-0.2%)
- Furrow irrigation (slope)
- Basin irrigation (zero slope)

2- Sprinkler Irrigation (various types)

3- Drip Irrigation (various types)

- Surface drip
- Subsurface drip

Vegetable Crops

- Sprinkler irrigation (common)
- Drip irrigation
- Furrow irrigation (declining fast)

Advantages/savings:
Water, fertilizers, labor, TMDL

rnia
Resources | Cooperative Extension

Field Crops

Mostly surface irrigation methods:

- Border (flat) irrigation

  Runoff rate: 5-20% (vary)

- Furrow (bed) irrigation

  Runoff rate: 15-30% (vary)

Surface runoff:

Nutrient losses: surface runoff & deep percolation

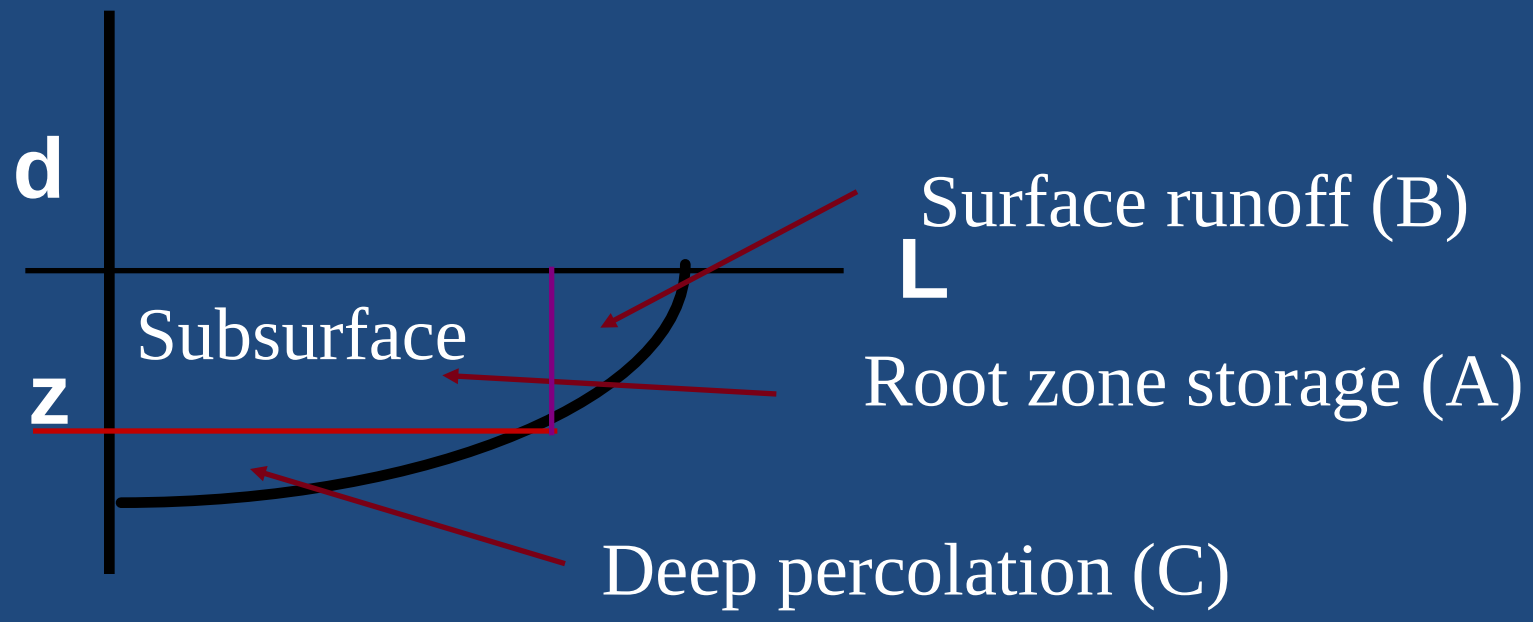
Pesticides losses: mostly surface runoff &

some with deep percolation

*** Usually no runoff with basin irrigation**

Surface Irrigation

Applied water = Root zone storage + runoff + deep percolation



On-Farm Water Conservation =Higher Application Efficiency (AE)

IRRIGATION = Evapotranspiration (ET)+ DEEP PERCOLATION + Runoff

A + B + C

Application Efficiency (AE)= A/(A+B+C)

To achieve higher efficiency, reduce B and/or C

BUT

Need to have a balance,

Deep Percolation sometimes is needed for salinity control

(700 ppm ~ 0.96 tons of salt/ac-ft)

Runoff is needed for Uniformity (100% AE means under irrigation)

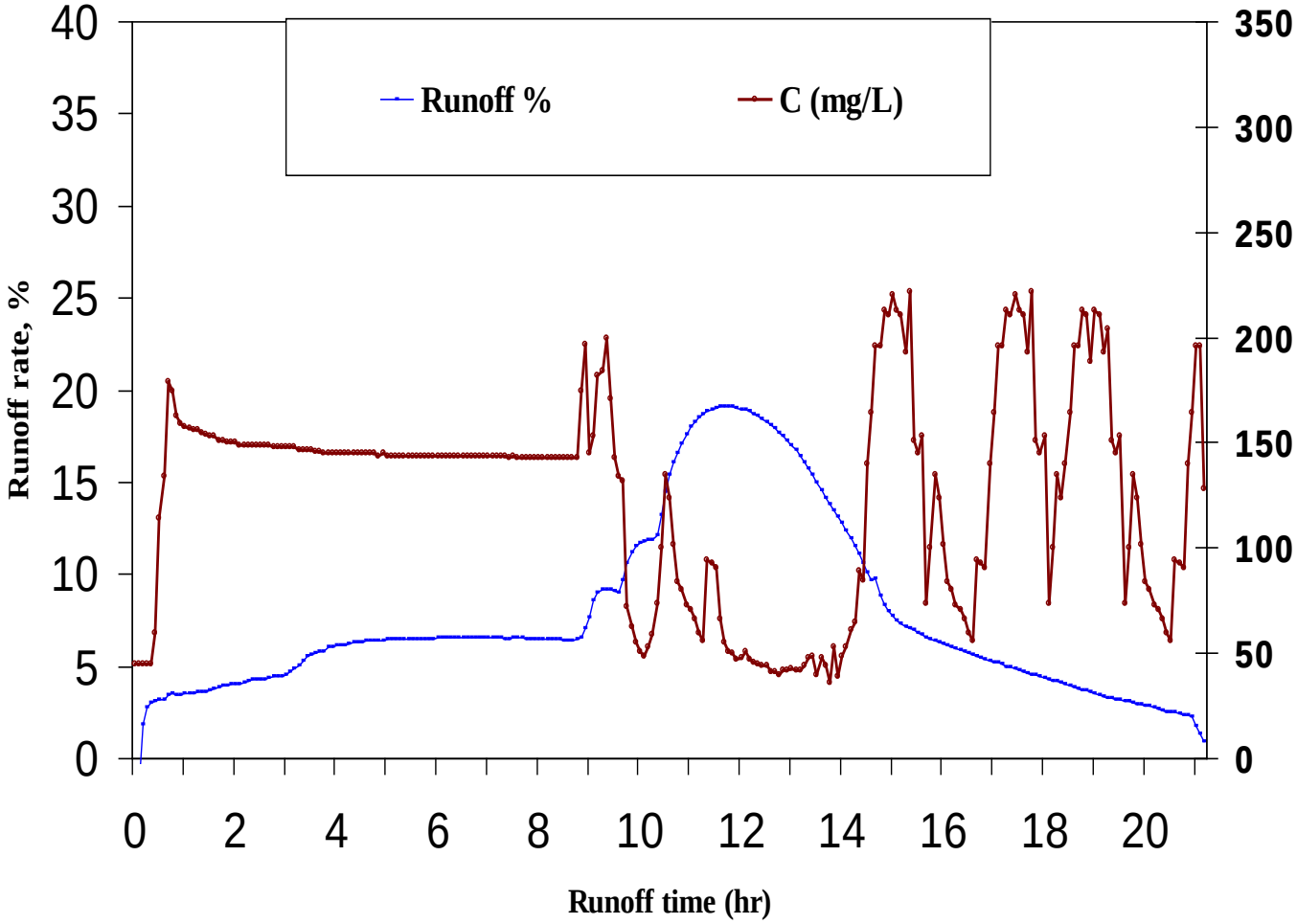
Distribution Uniformity (DU)

DU= Average depth in low quarter/Average depth applied

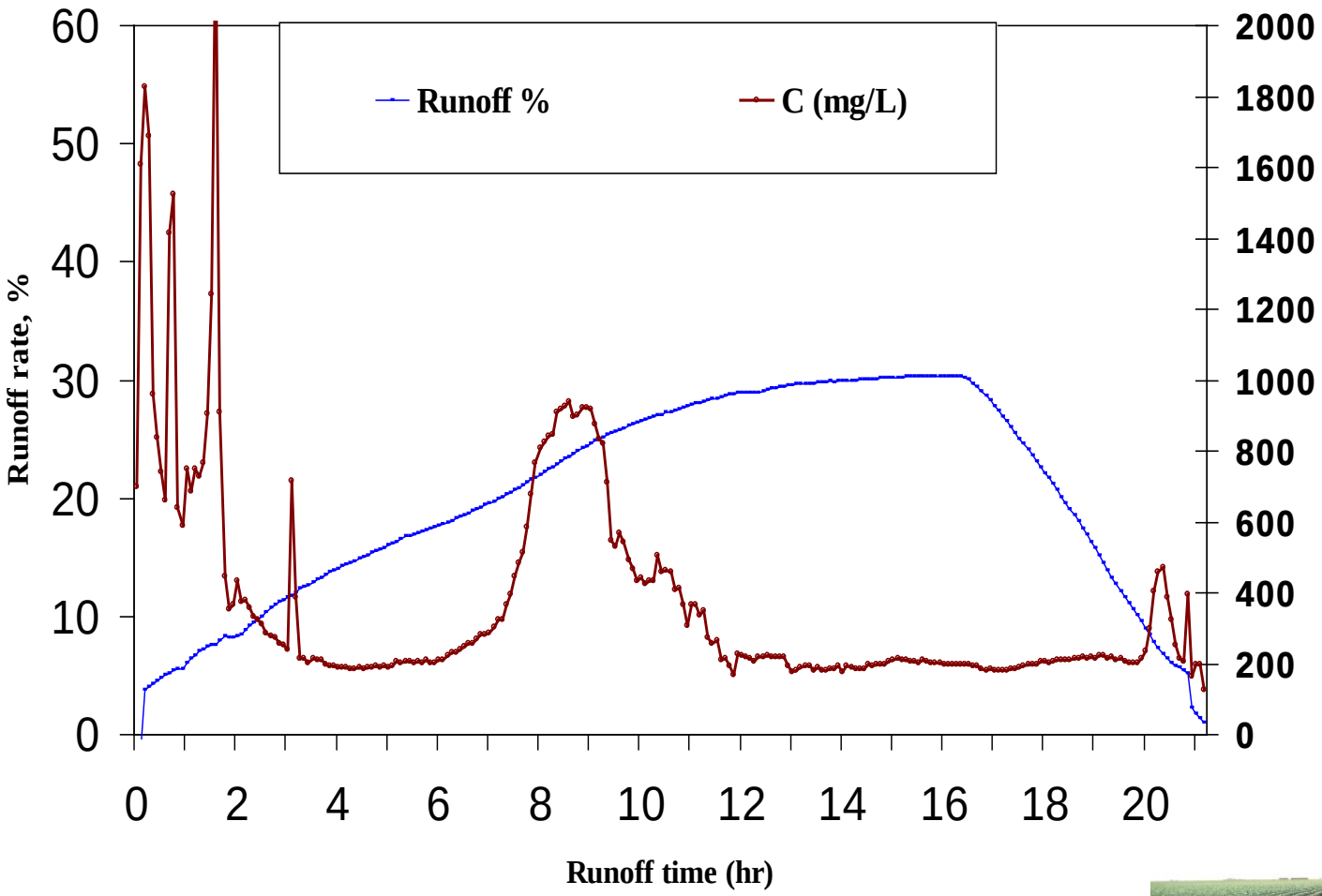
Many other efficiency parameters
BUT

KEEP IT SIMPLE, AE and DU are all you need

Field A (Alfalfa, Border, UCDREC)



Field B (Alfalfa, Furrow, UCDREC)



Surface Irrigation Management Under Drought

- The key is to reduce surface runoff and deep percolation when water supplies are limited
- May result in under irrigation and yield loss
- May result in salinity buildup
- Water availability and water quality (water salinity)
- Is leaching needed when water is available again?

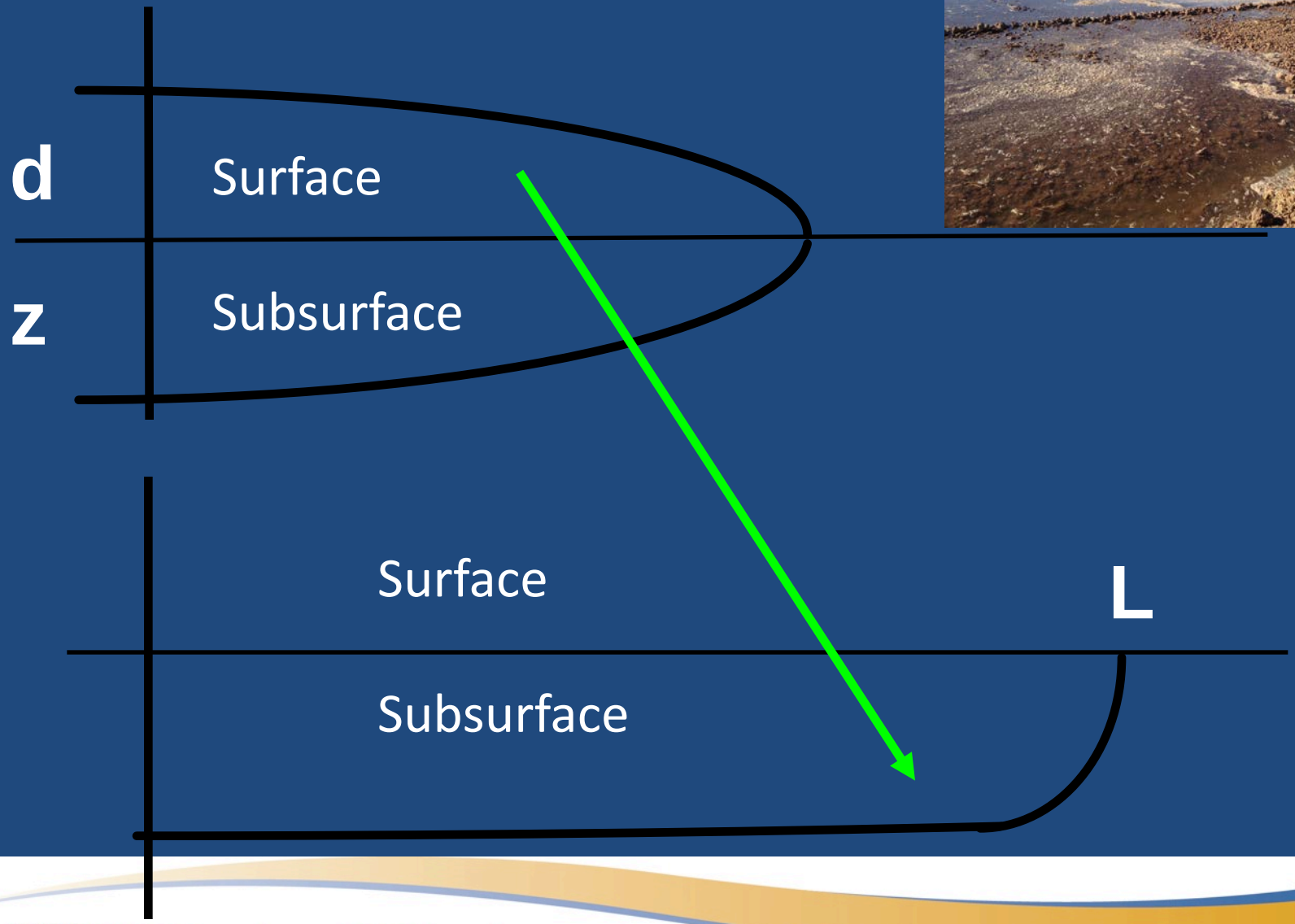
On-farm Practices

- Minimize/eliminate Runoff or Tailwater (management)
- Recycle Runoff water (may need energy)
- Reduce deep percolation (may not be always practical, water table control)
- Irrigation management

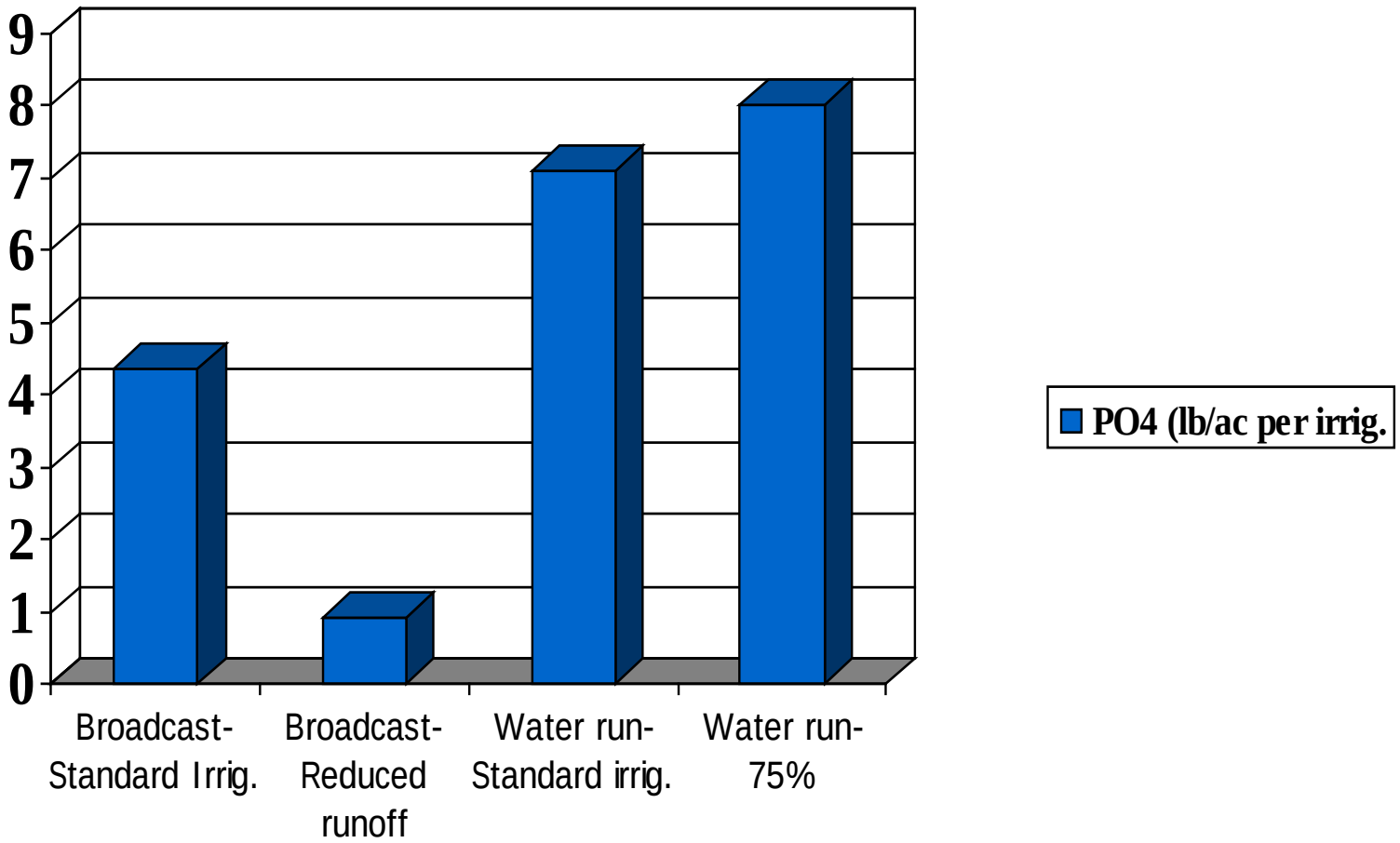
Tailwater Recovery Systems

- For water conservation
- Improving the quality of drainage water (TMDL)

Irrigation management – applying the right amount of water



Average PO4 load in runoff water per irrigation during the first six irrigations after P application in 2006

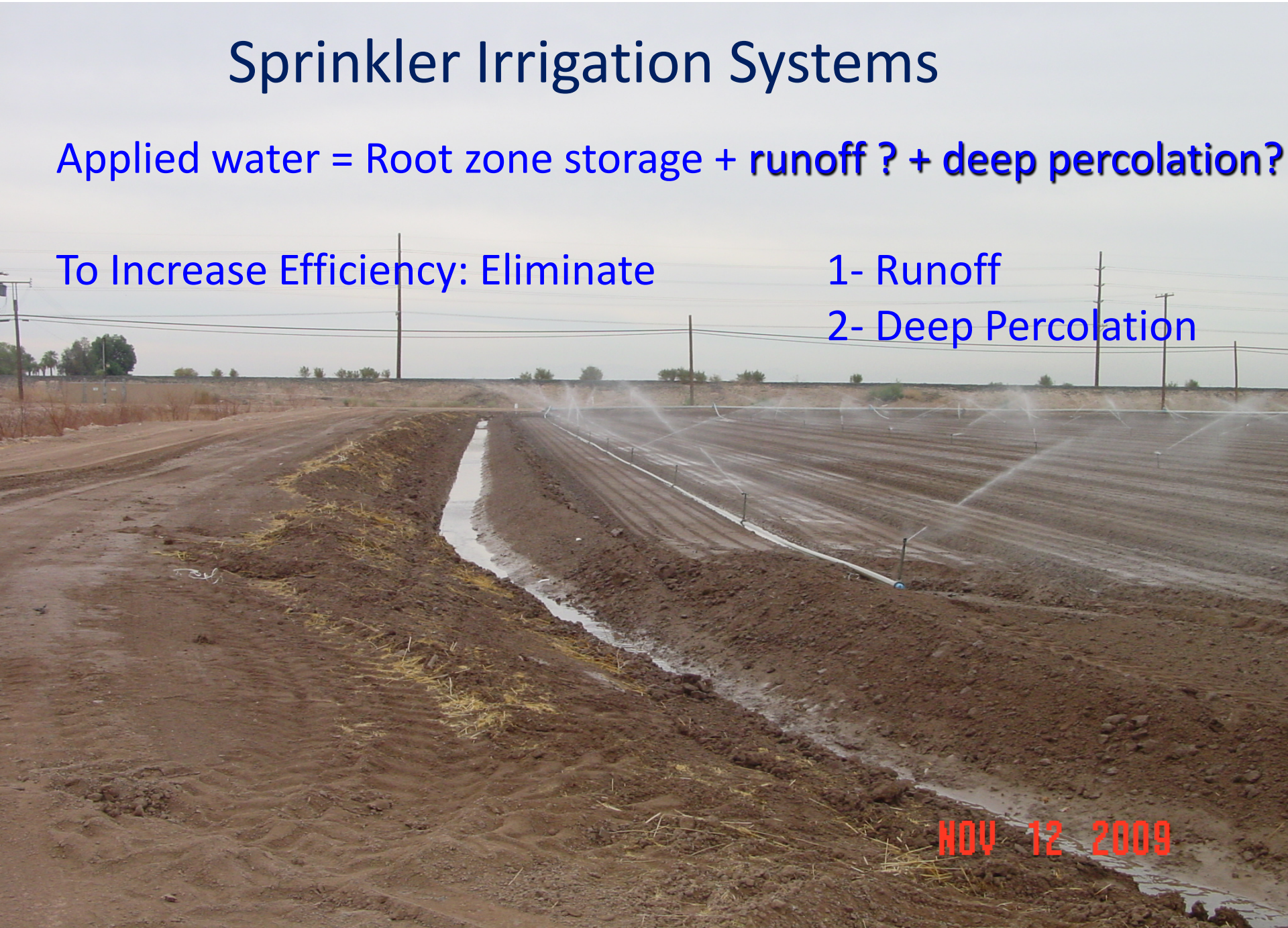


Sprinkler Irrigation Systems

Applied water = Root zone storage + **runoff ? + deep percolation?**

To Increase Efficiency: Eliminate

1- Runoff
2- Deep Percolation



Drip Irrigation Systems

Applied water = Root zone storage + **runoff ? + deep percolation?**

To Increase Efficiency:

Improve system uniformity (DU)

Eliminate 1- Runoff

2- Deep Percolation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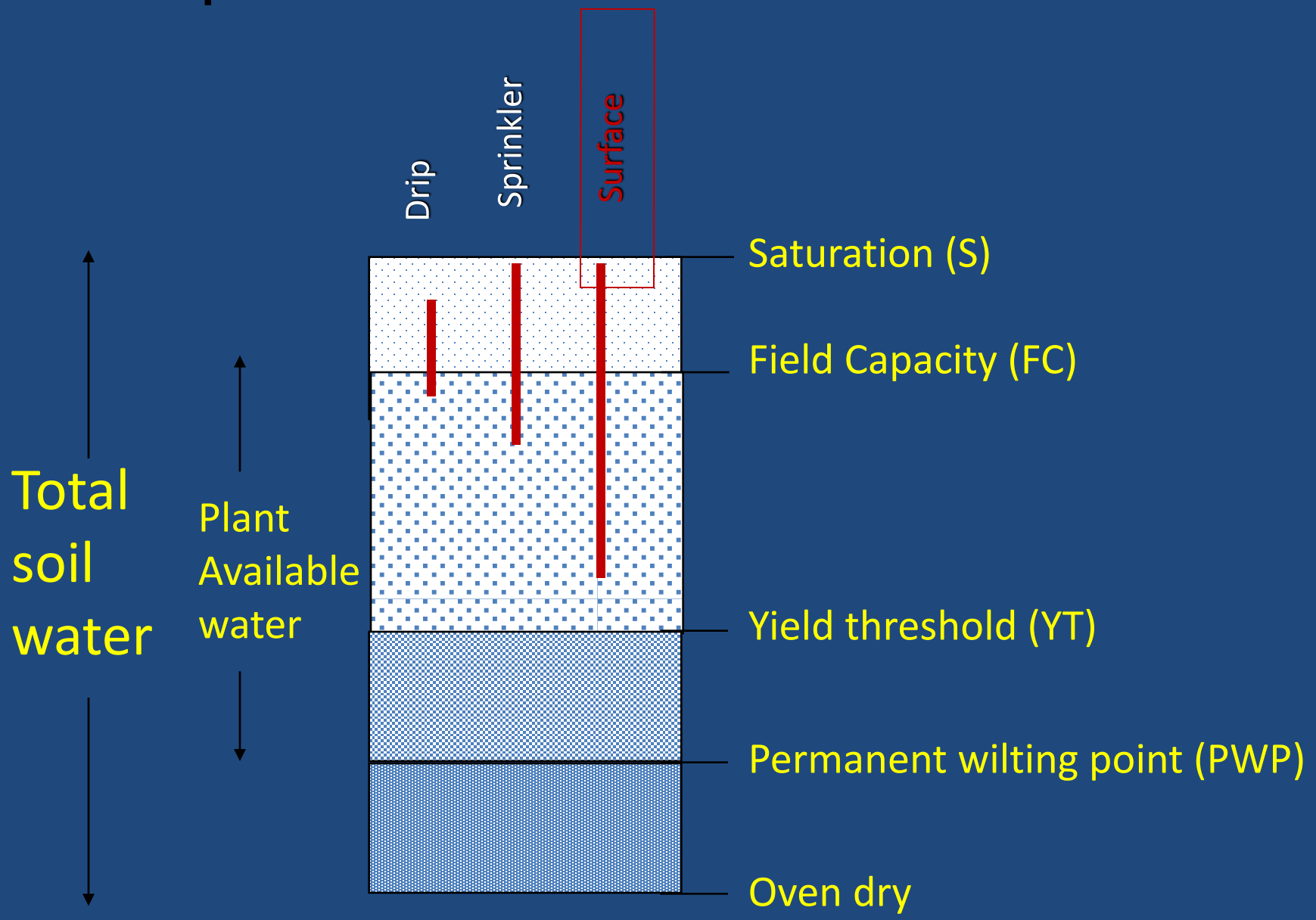
How Much Water do I need to Apply?

- Need to know crop water use (ETc) since last irrigation
- ETc from (Reference evapotranspiration and crop coefficient)
- Typical application rates (Imperial Valley):
- Surface: ~ 3-4 in/irrigation
- Sprinkler: ~ 0.5-1.2 in/irrigation
- Drip: ~ 0.5 in/irrigation

Crop Water use: Soil moisture



Flow rate (cfs) and total applied water

Source: Mike Cahn, UCCE-Monterey County

Low Distribution

Low DU and Irrigating on a Windy Day- Bad combination

Summary

- Tailwater recovery systems can save water- issues with salinity and temperature

- Irrigation management and irrigation scheduling are key factors for water conservation and improving efficiency (apply the right amount of water at the right time)

- Regular inspection of the irrigation system (pressure, flow rate, filtration system, leaks, etc).

- Avoid sprinkler irrigation on windy days (little impact on drip and surface irrigation)

Thank You

Thank You


Food
Grows Where
Water Flows
Your Farm Bureau Neighbors
California Farm Water Coalition