Improving Flood Irrigation Management in Alfalfa

Khaled M. Bali, Blain Hanson, and Blake Sanden
UCCE-Imperial, UC Davis, UCCE-Kern
kmbali@ucdavis.edu

University of California Cooperative Extension

2010 CA Alfalfa & Forage Symosium

UCD ALFALFA WORKGROUP

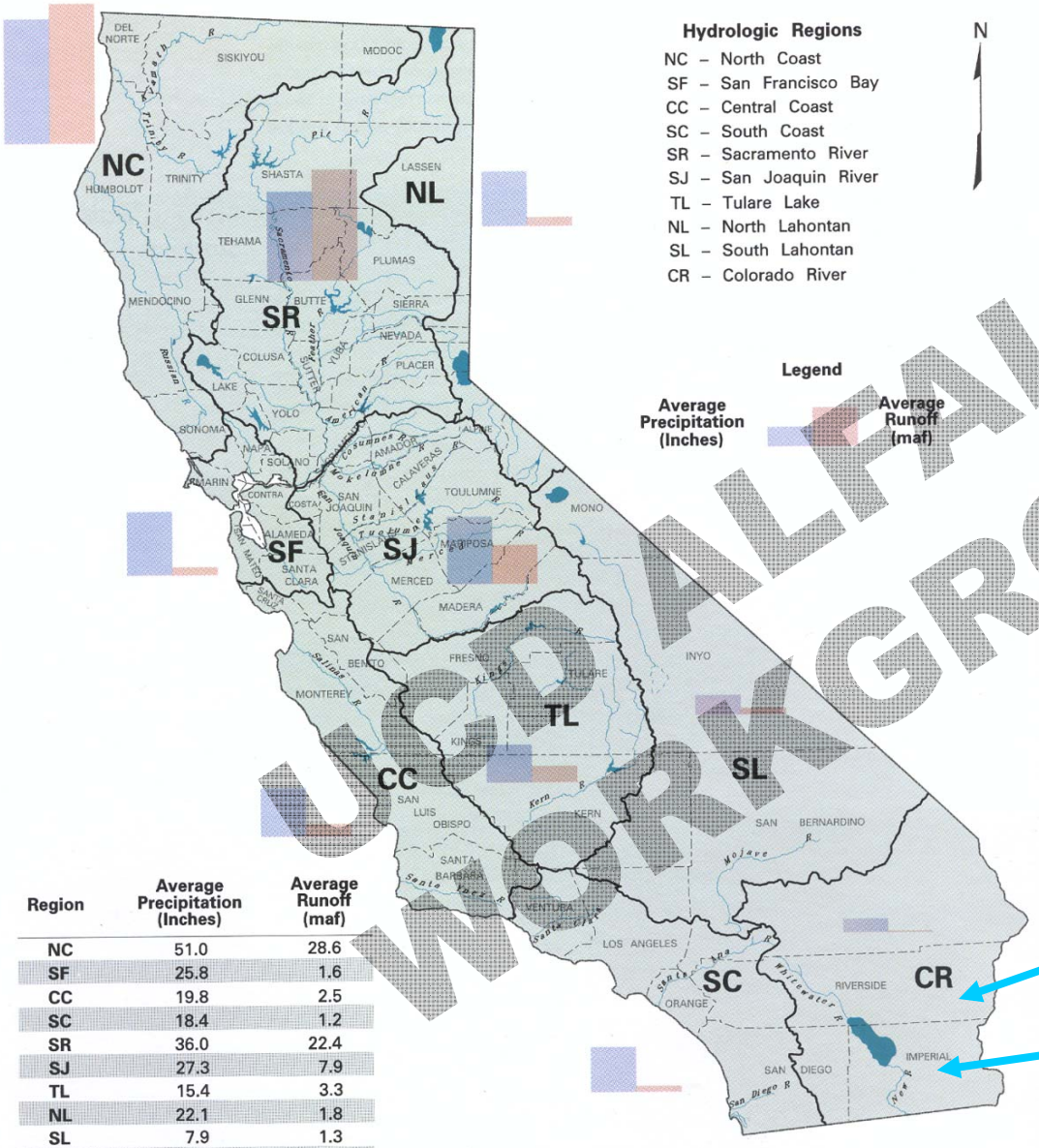
California

- Alfalfa is California's single largest agricultural water user

- About 1 million acre of alfalfa

- About 4.0 - 5.5 million ac-ft of water

UCD ALFALFA WORKGROUP



Region	Average Precipitation (Inches)	Average Runoff (maf)
NC	51.0	28.6
SF	25.8	1.6
CC	19.8	2.5
SC	18.4	1.2
SR	36.0	22.4
SJ	27.3	7.9
TL	15.4	3.3
NL	22.1	1.8
SL	7.9	1.3
CR	5.5	0.2
Entire State	22.9	70.8

USBR ALFALFA WORKGROUP

Palo Verde Valley

Imperial Valley

Imperial Valley (2009)

- Alfalfa: ~115,000 acres

- Alfalfa water use: 6.5-7 ac-ft/ac per year

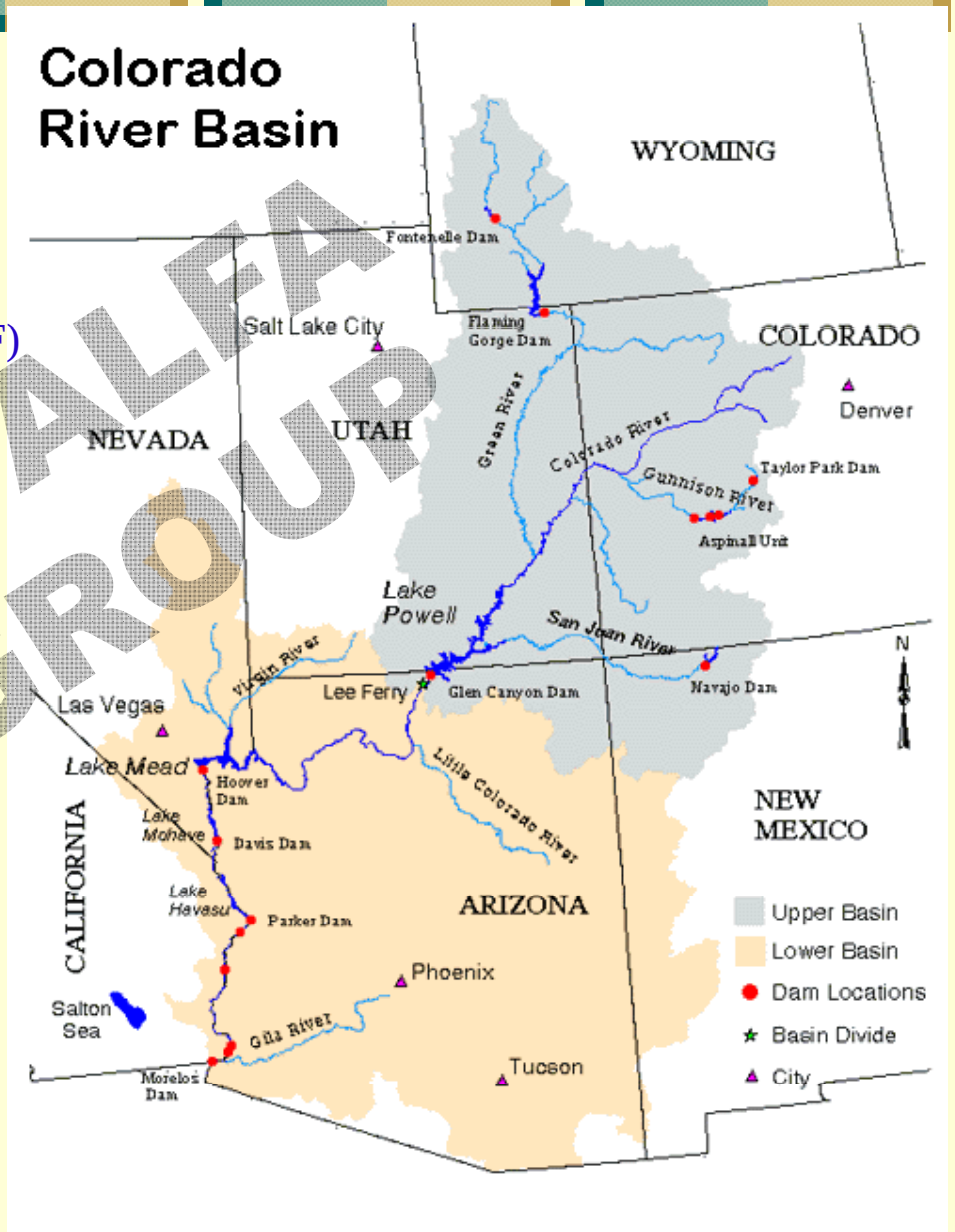
- Total water use: Approximately 750,000 ac-ft/yr

- Surface and subsurface drainage water contains P and sediment (TMDL)

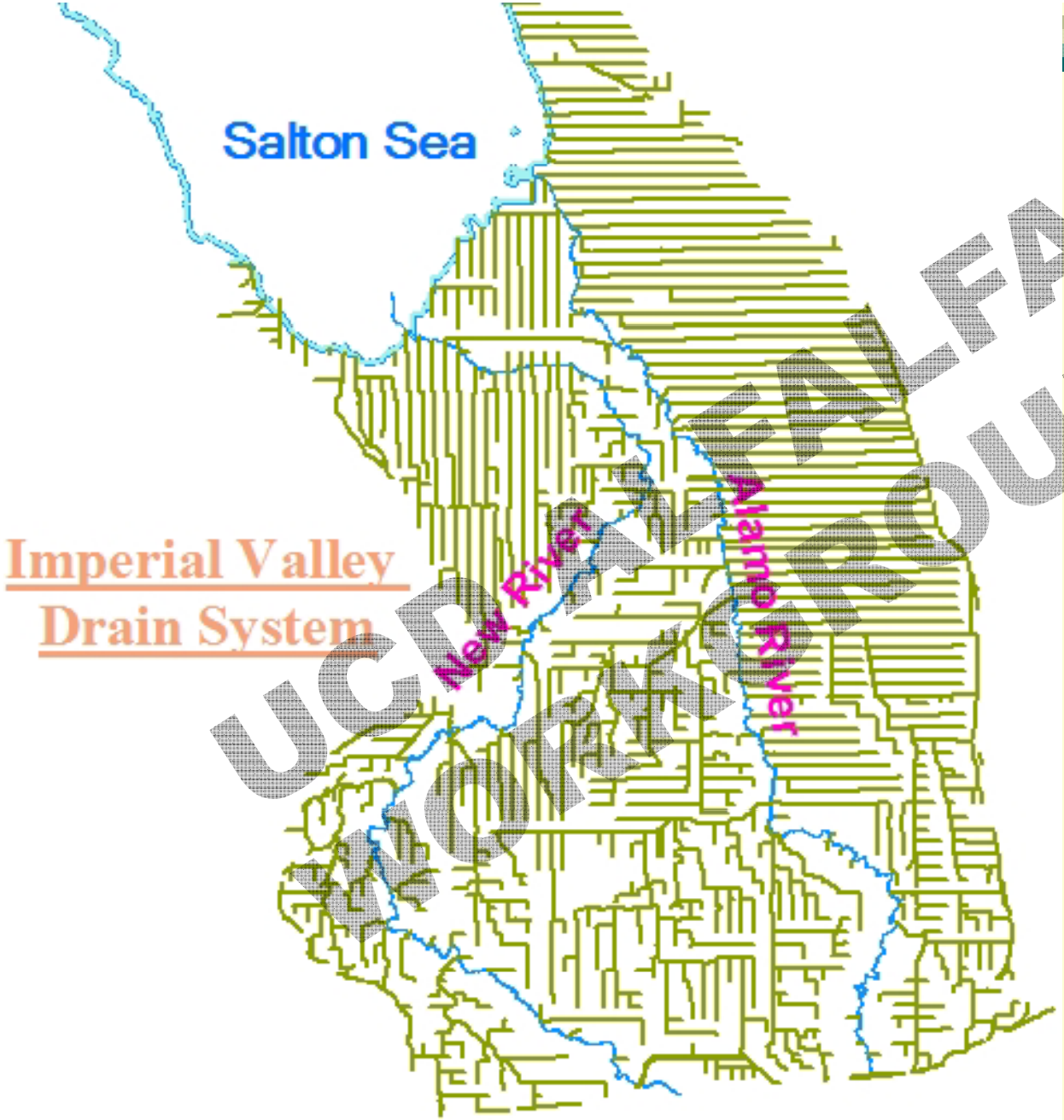
UCD ALFALFA WORKGROUP

Colorado River Water

Upper basin states: 7.5 MAF
Lower basin states: 7.5 MAF
Mexico: 1.5 MAF
CA's share 4.4 MAF (actual use as high as 5.2 MAF)



UCD ALFALFA WORKGROUP



UCD ALFALFA WORKING GROUP

Surface Irrigation Systems

Applied water = Root zone storage + runoff + deep percolation

To Increase Efficiency: Reduce

1- Runoff

2- Deep Percolation

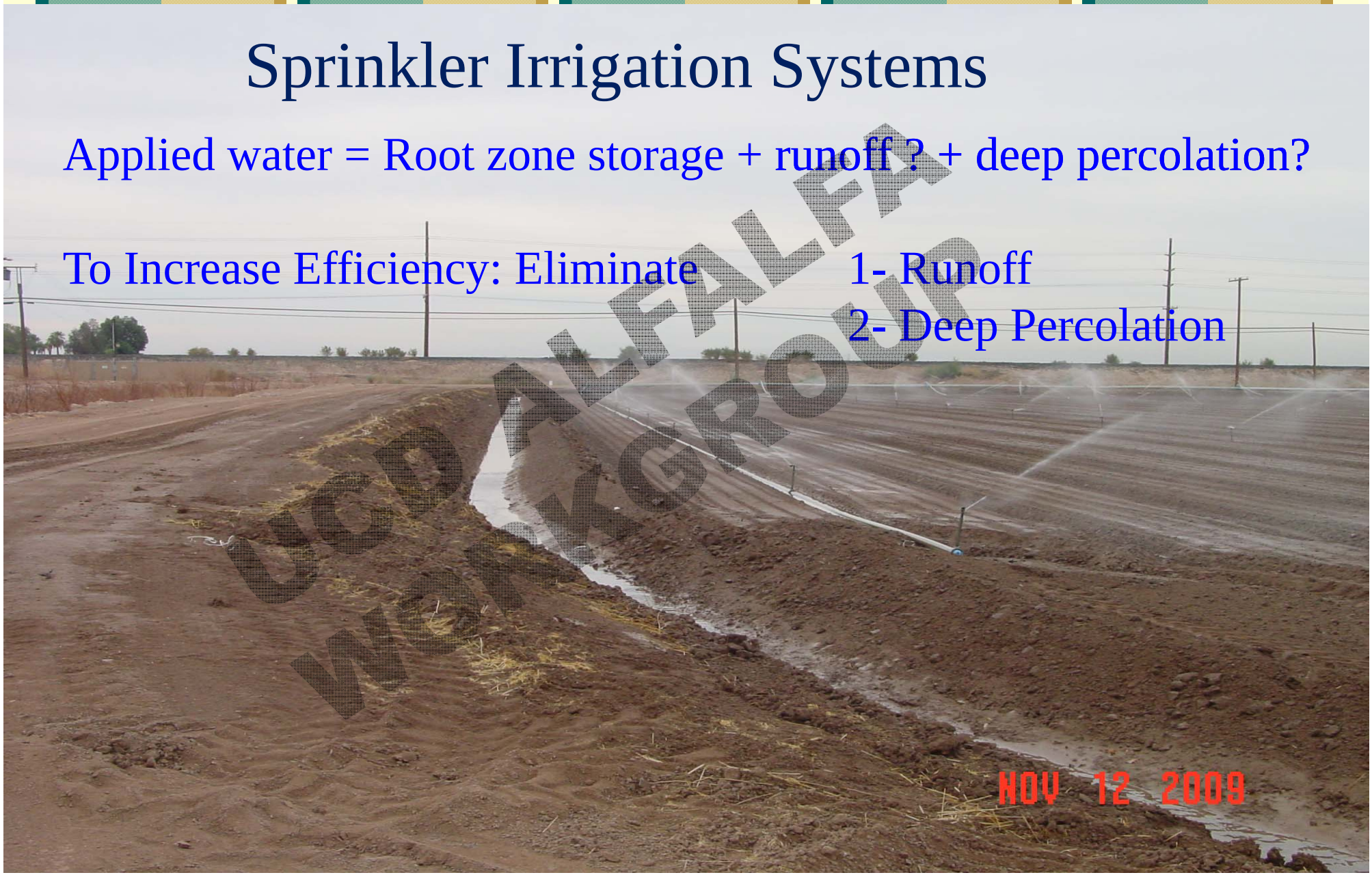
UCD ALFALFA WORKGROUP

Sprinkler Irrigation Systems

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

To Increase Efficiency: Eliminate 1- Runoff

2- Deep Percolation



UCD ALFALFA WORKGROUP

Drip Irrigation Systems

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

To Increase Efficiency:

Improve system uniformity (DU)

Eliminate

1- Runoff

2- Deep Percolation

USD ALFALFA WORKGROUP

Practices for Efficient Irrigation

- Recycle Runoff Water (system)
- Minimize/eliminate Runoff or Tailwater (management)
- Reduce Deep Percolation (other than leaching)-Utilization of shallow water table (GW)
- Sprinkler and drip irrigation system efficiency improvements
- Irrigation scheduling programs (BIS)

USDA ALFALFA WORKGROUP

Practices for Efficient Surface Irrigation Systems

- Efficient irrigation practices conserve water and fertilizers
- Water/Nutrient Management for TMDL regulations

USD ALFALFA WORKGROUP

Tailwater Recovery

- Regulating the type and quantity of water return flows as a means of maintaining and improving irrigation efficiency
- Issues: Temperature, Salinity, Management

UCD ALFALFA WORK GROUP

UCD ALFALFA WORKGROUP

Surface irrigation (flood):

- Border (flat) irrigation

Runoff rate: 5-20%

- Furrow (bed) irrigation

Runoff rate: 15-30%

Average surface runoff (Imperial Valley): 17%

Application Efficiency (Imperial): ~70-80%
AE (CA) ~ 70%

UCD ALFALFA WORKGROUP

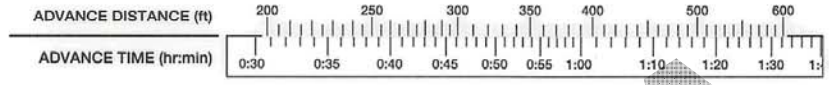
Runoff Reduction

- Reducing surface runoff improves irrigation efficiency
- Method developed for clay soils to reduce surface runoff to less than 5% of applied water (need flow rate, advance time and distance)
- Runoff Reduction Handbook
- Irrigation Slide Chart developed by UCCE and USBR
- Available in English and Spanish

UCD ALFALFA WORKGROUP

Irrigation Cutoff Time Calculator
for clay soils

SIDE 1



1 Align the Advance Time with the Advance Distance.

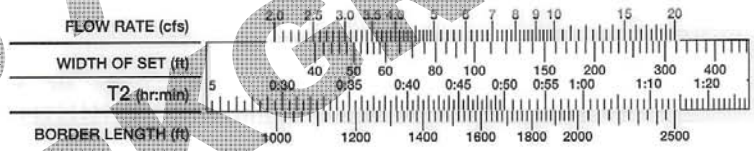
2 Read the corresponding T1 for your Border Length.

Write the Value of T1 in the designated Box on Side 2.

RECLAMATION
Managing Water in the West

University of California
Cooperative Extension

Flip to other side



3 Align Flow Rate with the Width of your border/irrigation set.
Read the corresponding T2 for your border length.
Write the Value of T2 in the designated Box below.

T1 _____

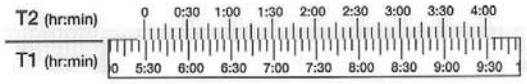
T2 _____

Example: Advance Time=45 min., Advance Distance=250 ft., Width of Set=260 ft., Flow Rate=9 cfs, Border Length=1000 ft.
Starting on other side: Align 45 min. with 250 ft. in window 1. In window 2, read the corresponding T1 (3 hrs. 8 min.) for the 1000 ft. border. Write the value of T1 in the designated T1 Box at the right.
Turn chart over: Align the 260 ft. width of your irrigation set with flow rate of 9 cfs. Read the corresponding T2 (37.5 min.) for the 1000 ft. border in window 3. Align the above value of T2 (37.5 min.) with the value of T1 (3 hrs. 8 min.) in window 4. In window 5, read the corresponding cutoff time (2 hrs. 32 min.) at arrow.

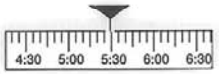
* Cutoff Time is an estimate of irrigation time needed to obtain 5% runoff. The actual irrigation time could be adjusted to achieve runoff rates higher or lower than 5%.

For more accurate estimate of irrigation cutoff time for various conditions and crops, use the calculator available on:

http://tmdl.ucdavis.edu



4 Align the above value of T2 with the value of T1.



5 Read the corresponding Cutoff Time* at arrow.

SIDE 2

© 2006 American Slide-Chart, Wheaton, IL 60189 Printed in USA ASC17597-004

CD ALFALFA GROUP

Runoff Reduction (clay soils)

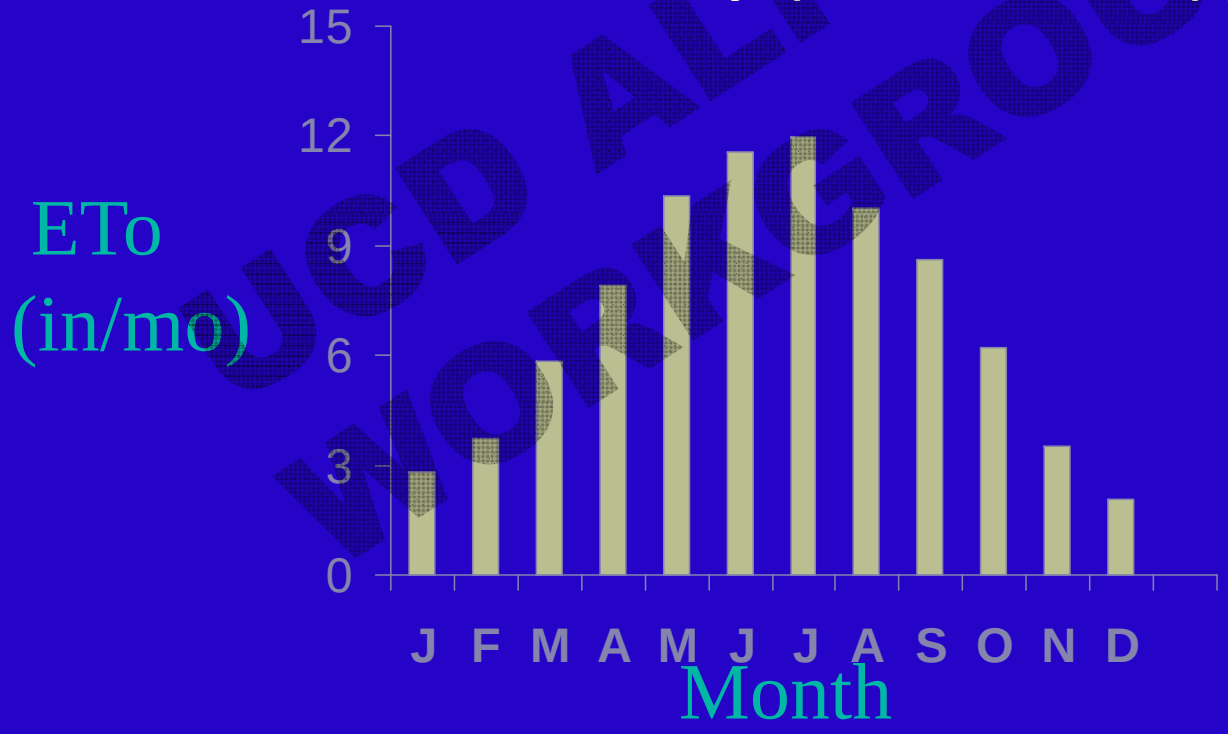
- Applied on commercial alfalfa fields
- No significant reduction in alfalfa yield
- Water savings as much as 1 ac-ft/ac per year
- Runoff reduction with every irrigation or when P applied with irrigation water

UCD ALFALFA WORKGROUP

Irrigation scheduling- ET based (Weather station, CIMIS)

ET Based Irrigation scheduling and Irrigation Efficiency

- Summer time: High water use, lower quality hay/yield
- Low water use efficiency (tons/ac-ft of applied water)



UCD ALFALFA WORKGROUP

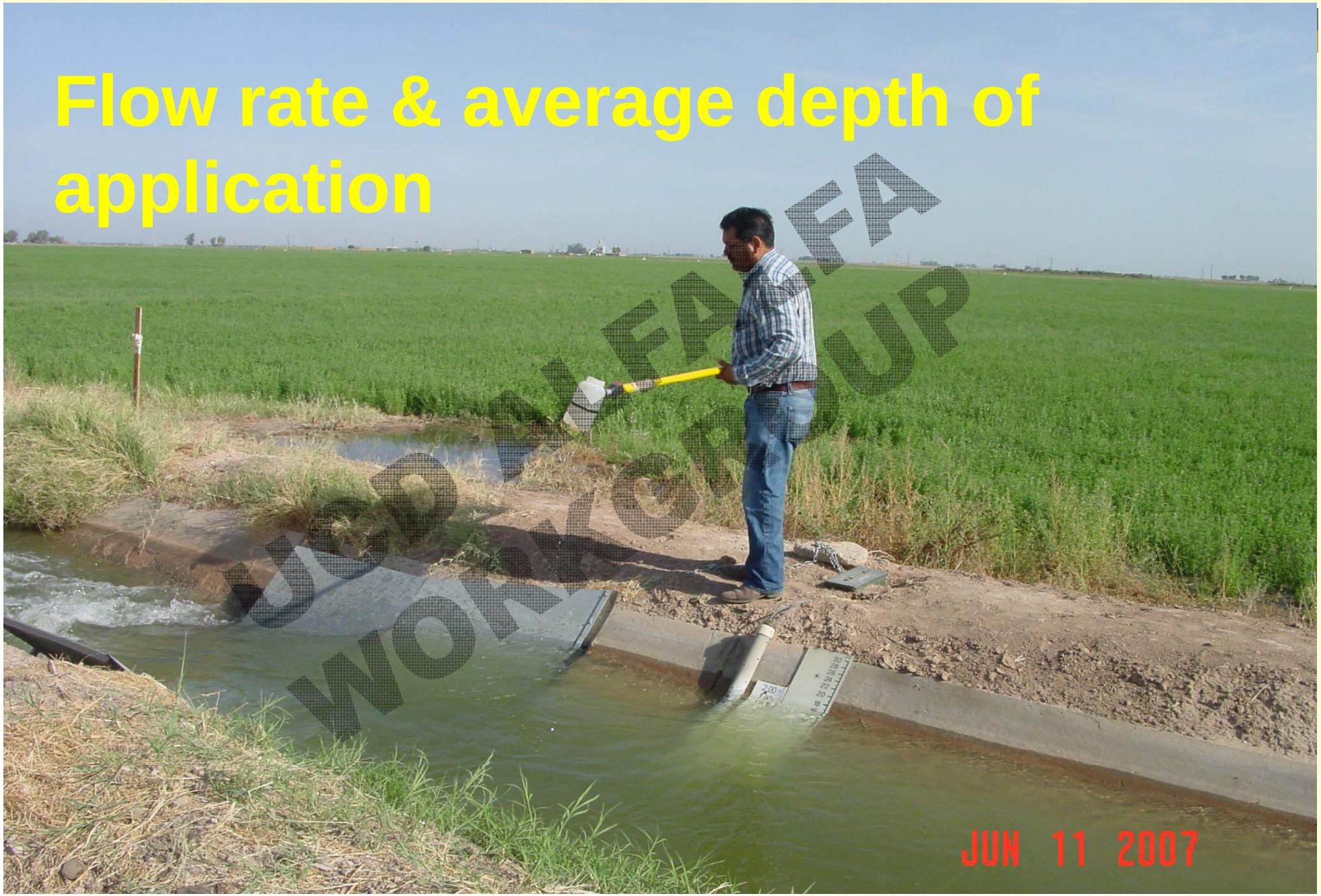
Irrigation scheduling-Soil moisture

Irrigation Management- Flow Rate

- Flow rate measurements (flumes and flow meters)- depth of irrigation events
- Pipe flows are less complex because pipes have same size (flow area) regardless of the flow rate. So the only effort is detecting velocity.
- Channels, are not accommodating, increasing in both size (flow area) and velocity with increased flow rate (mathematics more challenging)

UCD ALFALFA WORKGROUP

Flow rate & average depth of application



Flow rate (cfs)

Volume ac-ft (12-hr runs)

MAY 15 2008

Utilize shallow water table (summer time, good soil, site specific)

CONCLUSIONS

-Reducing surface runoff is a key factor in improving irrigation efficiency in desert alfalfa

- Irrigation scheduling improves efficiency- (Crop coefficients are region specific (soil, climate, irrigation frequency, etc)

-Flood irrigation systems are efficient (drip and sprinkler systems are great, high cost, management, energy cost, etc)

- Automation of surface irrigation (future)

UCD ALFALFA WORKGROUP

Thank You

UCD ALFALFA WORKGROUP