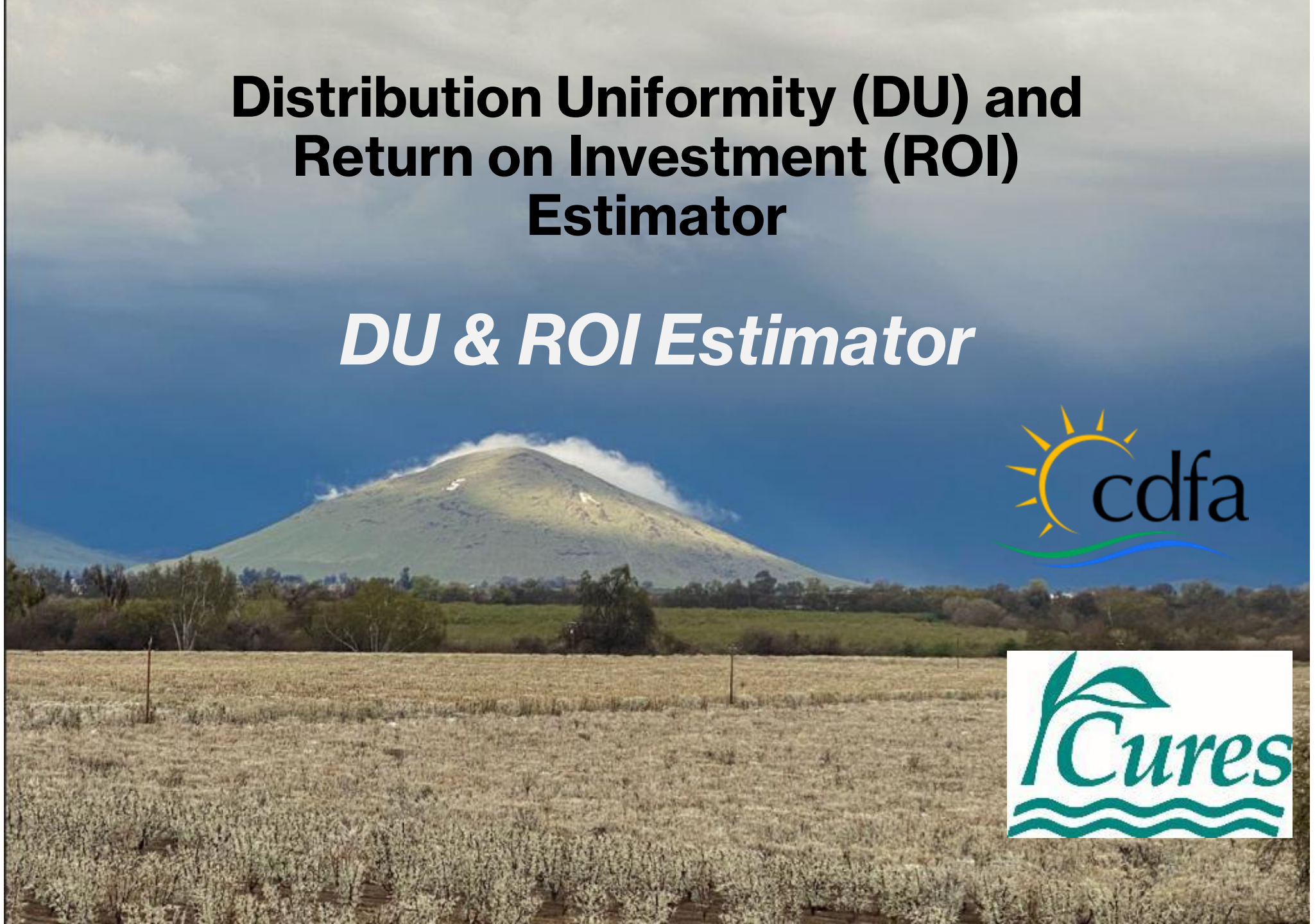
Distribution Uniformity (DU) and Return on Investment (ROI) Estimator

DU & ROI Estimator



CURES implements agricultural & urban research and outreach programs focused on stewardship of pesticides and crop nutrients

Cures
Coalition for Urban/Rural Environmental Stewardship

- *Founded 1997 (29 years)*
- *Formed by agricultural groups, crop protection industry*
- *Non-profit organization*

  - Parry Klassen, Executive Director
  - Courtney Jallo, Associate Director
  - Alany Valle, Project Manager

CURES Projects

Current & Past

CA Department of Food & Agriculture FREP grants *(Fertilizer Research and Education Program)*

- Produce videos on nitrogen management for 7 major crops (2022-24)
  - Almonds, pistachio, citrus, tomatoes, lettuce, strawberry, wine grapes
- Developed grower-focused continuing education program for writing nitrogen management plans mandated by the Water Board for Central Valley Irrigated Agriculture (2015-2021)
  - Six-year pilot; program now managed by CDFA

Administer / staff programs for agricultural organizations / regulatory compliance

- Modesto/Turlock Groundwater Basin Management Zone (2020 – present); Nitrate Control Program
  - Private well testing and replacement water
- Salinas Valley; Implement Water Board order
  - Private well testing and drinking water program (2018-present)
- Preservation Inc. (Central Coast Water Quality Preservation) (2020-present)
  - Grower/member support for reporting on nitrogen fertilizers; well testing results for nitrates

Transition to Microirrigation

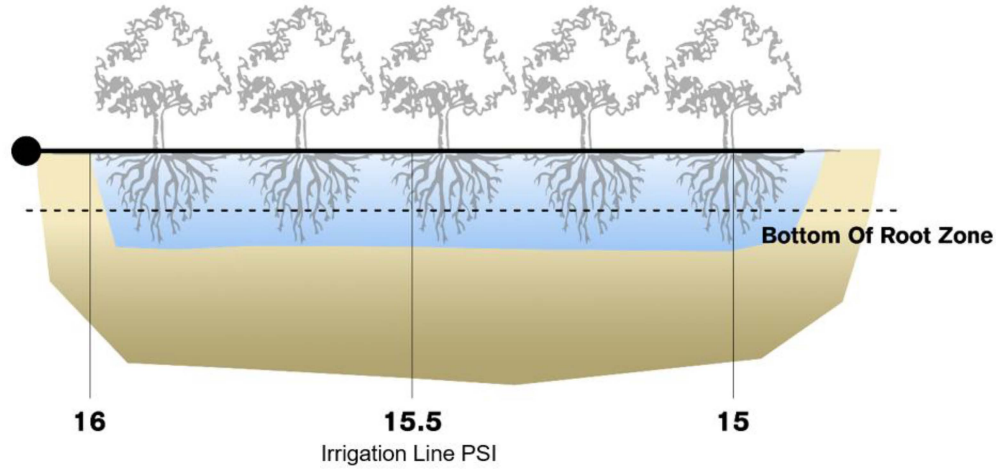
- State Water Board “Prop 84” grant (2012-2015)
  - $8 million for converting 3000+ acres to drip/microsprinkler

Importance of Distribution Uniformity (DU) and how it's measured

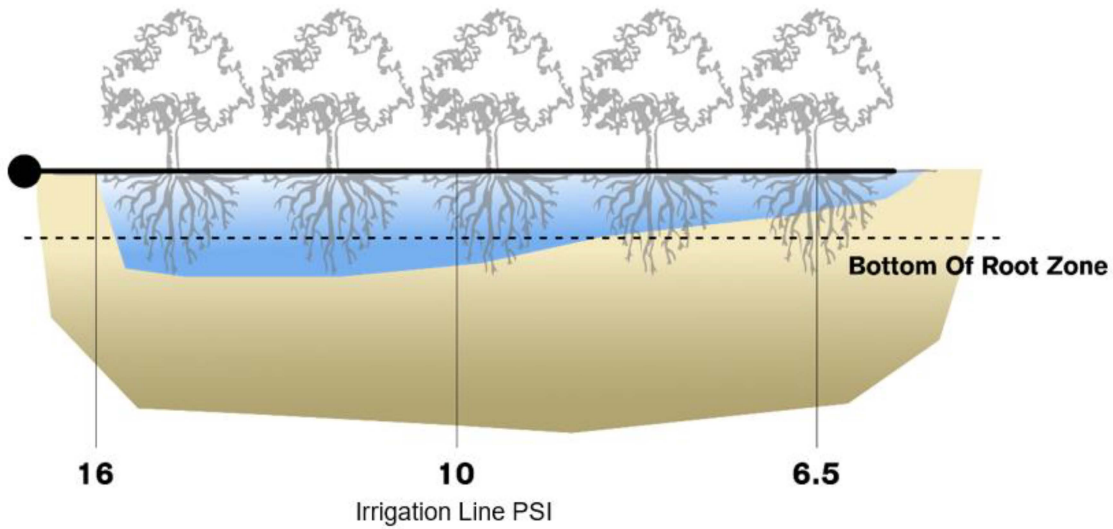
- DU is how evenly water is applied from each emission device in a block
- Good DU = .90 or above
- Good DU = efficient use of resources and/or higher yields and quality

$$DU = \frac{\text{Average Low Quarter Depth of Water Infiltrated}}{\text{Average Depth of Water Infiltrated}}$$

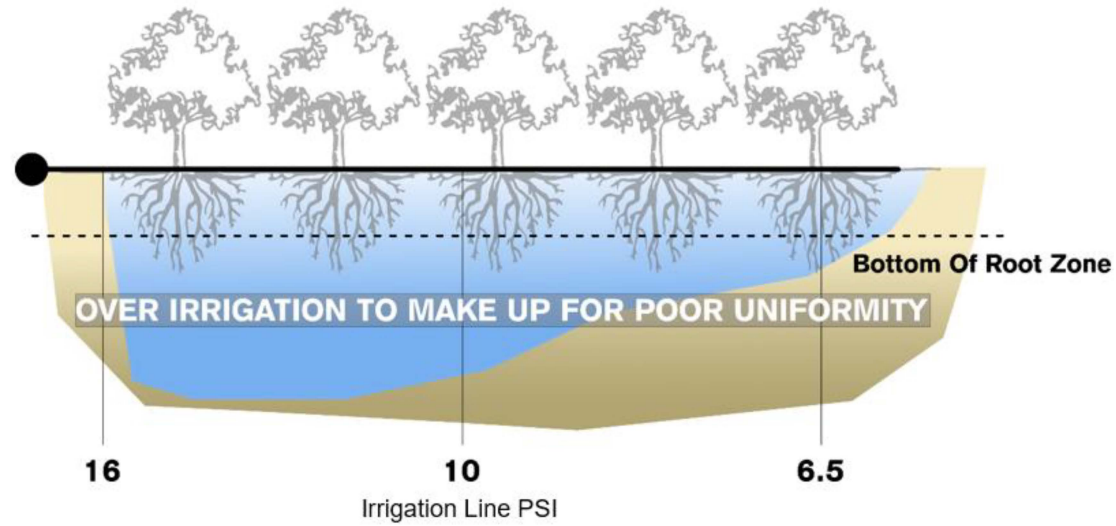
Good Uniformity & Water Distribution



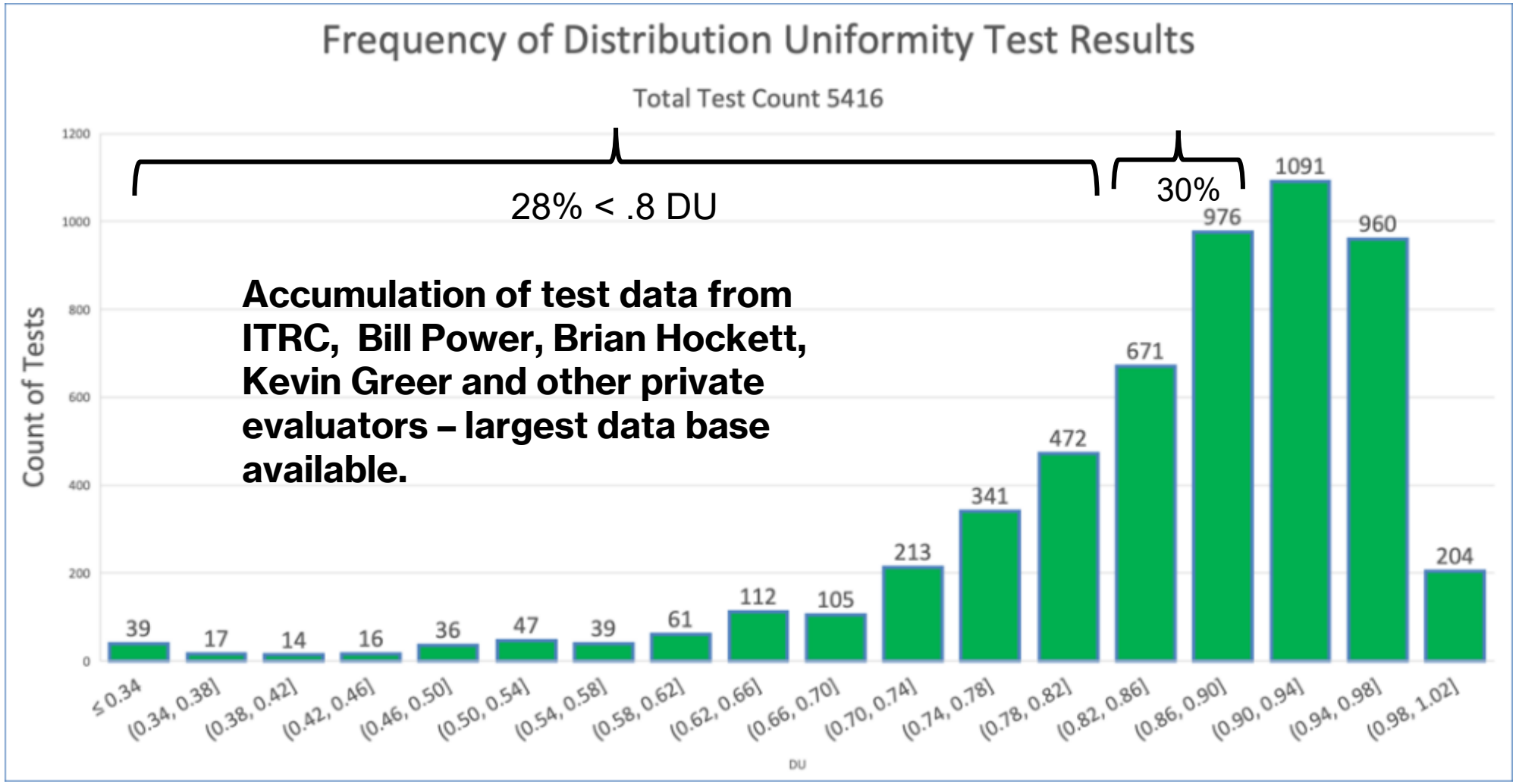
Effect of Poor Uniformity



Over Irrigation Needed to Overcome Poor DU



Results of DU Measurements – More Recent Data from 5,416 tests



- Nearly 60% were less than ideal
- Possible water and energy waste
- Possible yield and quality degradation

From Final Project Report Prepared for Blue Tech Valley Innovation Cluster: The Value of Improving Drip Micro Irrigation System Distribution Uniformity

Solution to the Problem?

DU & ROI Estimator

Custom Software that is:

- ***Free of charge***
- ***Usable on any crop with pressurized system***
- ***Independently Developed***

Key Benefits of DU & ROI Estimator

- Produces Estimates for Return on Investment in years
  - **Based on water and energy savings and potential yield gains**
  - **Farmer receives financial information needed to decide on repairs / upgrades**

- Quicker irrigation system evaluations

- Generates automated report for quicker turnaround

- Program is user-friendly and FREE!

Collaborators

Software Development

- Jim Anshutz, Irrigation Consultant
- Inge Bisconer, Irrigation Consultant

Beta Field Testing

- Resource Conservation Districts (Stanislaus and San Joaquin counties)
- CURES staff

SAN JOAQUIN COUNTY RESOURCE CONSERVATION DISTRICT

EAST STANISLAUS RESOURCE CONSERVATION DISTRICT

WEST STANISLAUS RESOURCE CONSERVATION DISTRICT

Software Overview

- Funded by California Department of Food & Agriculture
  - Water Efficiency Technical Assistance (WETA)
- Devices covered: Drip line emitters, online emitters, jets and microsprinklers, drip tape and undertree sprinklers
- Function for including costs in ROI estimates

Software Details

- Diagnostic DU score and estimates well and booster pump efficiency
  - Based on single block vs entire field
  - Lists system performance metrics and identifies performance problems

- Estimates ROI in years *(two ways of stating)*
  - **How much are you wasting (in water and energy) and foregoing (in yield) every year *or***
  - **How much can you afford to spend**
    - Feature not found in other DU evaluation tools

- Download onto Windows-based computers (available now)
  - Web-based portal (completing in June 2026)

- Instructions for performing in-field system evaluations and software operation

Irrigation System Evaluation Process

1. Grower pre-visit questionnaire on system information
2. Visually assess pump station; verify system layout
3. Take field measurements
4. Input field data
5. Deliver report to grower

    Follow-up call or in-person

Benefits of Improving DU Using Estimator Tool

- Assists in identifying irrigation system problems
- Provides realistic $ estimates (after DU improvements) on:
  - Energy savings for pumping/pressurizing irrigation system
  - Possible reduction in applied water
  - Savings in fertilizer injected through irrigation system
- Farm management tool for comparing DU evaluations (by set) over multiple years

Business Model Development for DU Estimator

Target Audiences for Business Model

- Irrigation dealers, irrigation and crop consultants
- Technical service providers (Resource Conservation Districts)

Service Enhancement

- Irrigation system evaluations leading to upgrades and/or retrofits

Commercial growers potential users

California Irrigation Dealers

Agreed to offer service to customers

AgroSource Group: Central Coast
Eryn Gray eryn@agrosourcegroup.com
www.agrosourcegroup.com
805-235-5030

AvidWater: California/Statewide
Cory Broad cbroad@avidwater.com
www.AvidWater.com
559-341-6002

Brigantino Irrigation: Central Coast
Ralph Brigantino ralph@brigantinoirrigation.com
www.brigantinoirrigation.com
831-636-1188

California H2orticulture Services: Central Coast
Michael Johnson delsol@calcentral.com
831-325-3376

Central Irrigation: Merced, Modesto
Austin Verissimo austin@centralirrigation.com
www.centralirrigation.com
209-262-3723

Coast Water Solutions: Central Coast
Edgar Godoy edgar@coastwatersolutions.com
www.coastwatersolutions.com
805-604-6800

Laurel Ag & Water California/Statewide
Franklin Gaudi fgaudi@laurel-ag.com
www.laurel-ag.com
805-207-7137

Pacific Southwest Irrigation: Ballico, Crows Landing, Dixon, Holt, Stockton
Adriano Lourenco alourenco@pacsouthwestirr.com
www.pacsouthwestirr.com
209-460-0450

Waterford Irrigation: Atwater, Waterford
Ron Nydam rnydam@waterfordisi.com
www.waterfordisi.com 209-874-1386

Ag Source magazine advertisement

- February-March 2026 editions

Suggestions?

Ideas?

www.curesworks.org

THANK YOU!

Extra slides on software

Pre-Visit Questionnaire

7. How much water do you apply to your crops? _____acre ft/acre/year
8. What water source(s) do you use for your irrigation water? **Surface Well Both**

   If both: % of W Surface Water_____% of Well Water_____
9. Which irrigation district is the field in?

   _____
10. What type of emitter does your system use? **(Please pick one)**
    a. Dripline
    b. Microsprinkler
    c. Micro Jet
    d. Online Emitters
11. What is the manufacturer and model of the emitters?

    _____
12. Are they pressure-compensating emitters? **Yes No**
13. What is the emitter flow rate? _____gph
14. How many emitters per tree/vine? _____
15. What is the row spacing? _____feet
16. What is the spacing between trees/vines? _____feet
17. What is the spacing between devices per tree/vine? _____feet
18. What is polyethylene (PE) tubing outside diameter? _____inches
19. Does your hose run one direction or two directions from the riser?

    1 direction 2 directions
20. How many hose lines per row? _____
21. How often do you flush your system? **(Please select the one that best fits your system)**
    a. At the beginning and end of the irrigation season
    b. At beginning and end of the irrigation season and several times during the season
    c. Several times during the season
    d. Monthly
    e. Yearly
    f. Never
22. Do you have a deep well? **Yes No**
    a. Has your deep well pump been tested in the last 5 years? **Yes No**
    b. Have you replaced or repaired your pump in the last 5 years? **Yes No**
    c. Has your flow and/or pressure recently decreased? **Yes No I don't know**
23. Do you have a booster pump? **Yes No**
    a. Has your booster pump been tested in the last 5 years? **Yes No**
    b. Have you replaced or repaired your booster pump in the last 5 years? **Yes No**
    c. Has your flow and/or pressure recently decreased? **Yes No I don't know**
24. What kind of filter do you use?
    a. Sand Media filter **Yes No**
       - Sand changed? **Yes No**
       - How often? _____
       - Automatic flushing? **Yes No**

    b. Screen Filter **Yes No**
       - Can you see sand particles lodged in Screen Material **Yes No**
       - Automatic flushing? **Yes No**

    c. Disc Filter **Yes No**
       - Do you remove and clean rings or discs? **Yes No**

    d. Do you have a continuous flush screen filter? **Yes No**
25. What is your pump motor size? _____HP
26. What is your pump flow rate? _____gpm

Data Collection Forms

Irrigation System DU and ROI Estimator
Equipment Component Performance Evaluation Form

Date _____

Deep Well Pump

Motor Size (HP) _____ Flow (gpm) _____ Pressure (psi) _____
Standing Water level (feet) _____ Cost ($/Kwh) _____
Power ☐ Electric ☐ Diesel ☐ Natural Gas

Booster Pump

Motor Size (HP) _____ Flow (gpm) _____ Pressure (psi) _____ Cost ($/Kwh) _____
Power ☐ Electric ☐ Diesel ☐ Natural Gas

Flow Meters

Deep Well High Reading (gpm) _____ Deep Well Low Reading (gpm) _____
Booster/Filter High Reading (gpm) _____ Booster/Filter Low Reading (gpm) _____

Filters

☐ Sand Media ☐ Simple Screen ☐ Screen W / Sock ☐ Screen W / Auto Clean (Blue / Red)
☐ Screen W / Continuous Flush ☐ Disc Filters ☐ Sand Separator
Number of Units _____ Automatic Flushing ☐ Yes ☐ No
Upstream Pressure Before Backflush (psi) _____ After Backflush (psi) _____
Downstream Pressure Before Backflush (psi) _____ After Backflush (psi) _____
Continuous Flush and Sand Separater Upstream Pressure (psi) _____ Downstrea

Materials on the screen risers restricting flow to the irrigation hoselines ☐ Yes ☐ No
☐ Biological ☐ Slime ☐ Organic materialfrom insects, fish eggs, etc.
☐ Inorganic ☐ Sand ☐ Plastic

Percent of emission devices that are either partially or completely plugged
☐ None ☐ 0-5% ☐ 5-10% ☐ More than 10%

External plugging of emission device, either partially or completely
☐ None observed ☐ Algae or Biological ☐ Insects ☐ Soil Particles

Hose End Flush Water contaminates
☐ None observed ☐ Algae or Biological ☐ Insects ☐ Soil Particles

Worn Spinners on Micro Sprinklers
☐ None observed or not applicable ☐ Spinner not spinning
☐ Spinner not rotating as fast or faster than most others ☐ Spinner blocked by weeds or other debris

Worn Nozzles on Micro Jet
☐ None observed or N/A ☐ Variations in wetting patterns ☐ Larger or smaller streams of water

Leaks in the field
☐ None observed ☐ At the filter station ☐ From air vents in the field ☐ In hoses
☐ In or around emission devices ☐ At valves

Throttled gate or butterfly valves (manually partially closed to regulate field pressures)
☐ None observed or N/A ☐ At filter station ☐ At inlet to irrigation sets

Precipitation (typically seen as a white buildup) on or in the emission device outlet
☐ Yes ☐ No

Variety of emission devices
☐ Yes ☐ No

Irrigation System Issues:

Observed Issues:
1. There are 2 filter issues
2. There are 14 emission device issues
3. There are 2 issues with throttling valves
4. There are 5 issues with leaks in the field

Equipment Performance Issues:
1. There are 3 issues with filters
2. There are 2 issues with control valves
3. There is an issue with polyethylene lateral hose regulators

Pumping Plant Issues:

Observed Issues:
1. Deep Well Pump has not been tested in the last five years
2. Deep Well Pump flow or pressure has recently decreased
3. Booster Pump has not been tested in the last five years
4. Booster Pump flow or pressure has recently decreased

Equipment Performance Issues:
1. The deep well pumping plant efficiency is below average

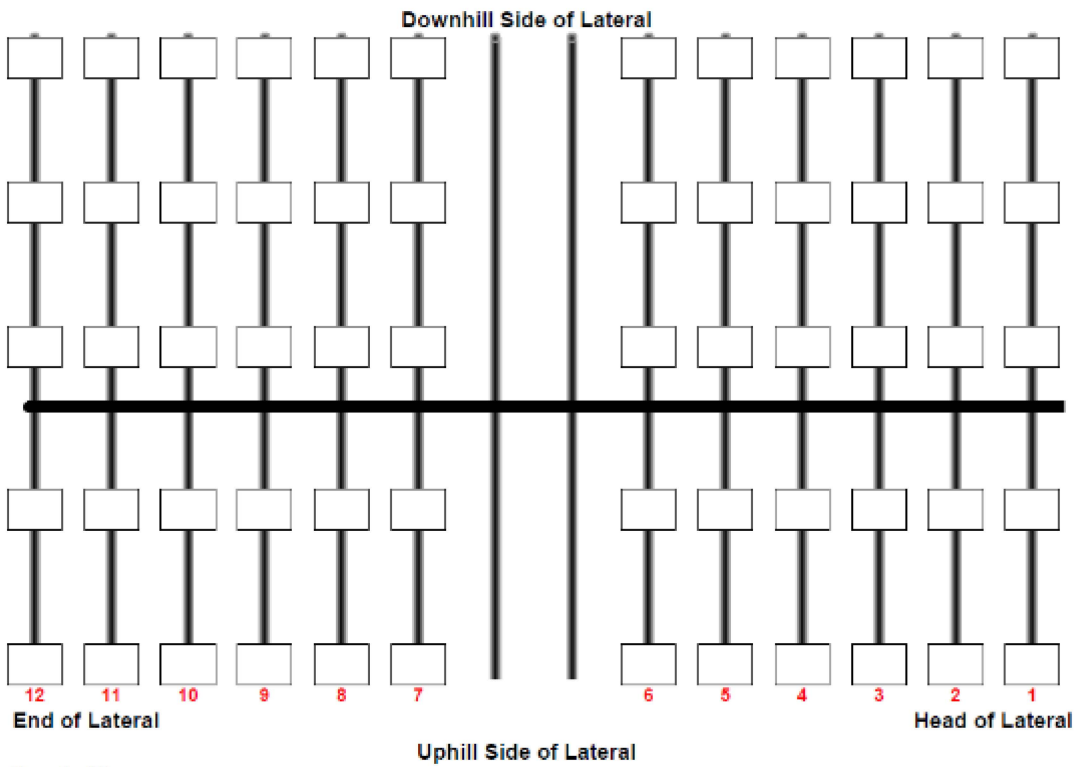
Irrigation System DU and ROI Estimator
DU Pressure Measurements (Non-PC Two Directions)

Date _____

NON PRESSURE COMPENSATING (Non-PC) EMISSION DEVICES – PRESSURES FROM HOSES FED IN TWO DIRECTIONS

Emission device inlet pressures are measured in the hose in psi. After a representative irrigation block (zone) is chosen, record 30 pressures on the hoses at the head end of the lateral and then another 30 pressures at the far end of the lateral as follows:

1. At the end of the uphill side of the chosen zone's lateral (marked 1-6 in red):
   a) Walking down each of the six hose lines (marked 1-6 in red), record two pressures at the end of the hose and at the middle of the hose for a total of 12 pressure readings.
2. At the head, or beginning, of the downhill side of the chosen zone's lateral (marked 1 - 6 in red):
   a) Walking up each of the six hose lines (marked 1-6 in red), record three pressures at the head of the hose, at the middle of the hose, and at the end of the hose for a total of 18 pressure readings.
3. At the end of the downhill side of the chosen zone's lateral (marked 7-12 in red):
   a) Walking down each of the six hose lines, record three pressures at the end of the hose, at the middle of the hose, and at the head of the hose for a total of 18 pressure readings.
4. At the end of the uphill side of the chosen zone's lateral (marked 7-12 in red):
   a) Walking down each of the six hose lines, record two pressures at the middle of the hose and at the end of the hose for a total of 12 pressure readings.



Irrigation System DU and ROI Estimator
DU Flow Measurements (Non-PC Two Directions)

Date _____

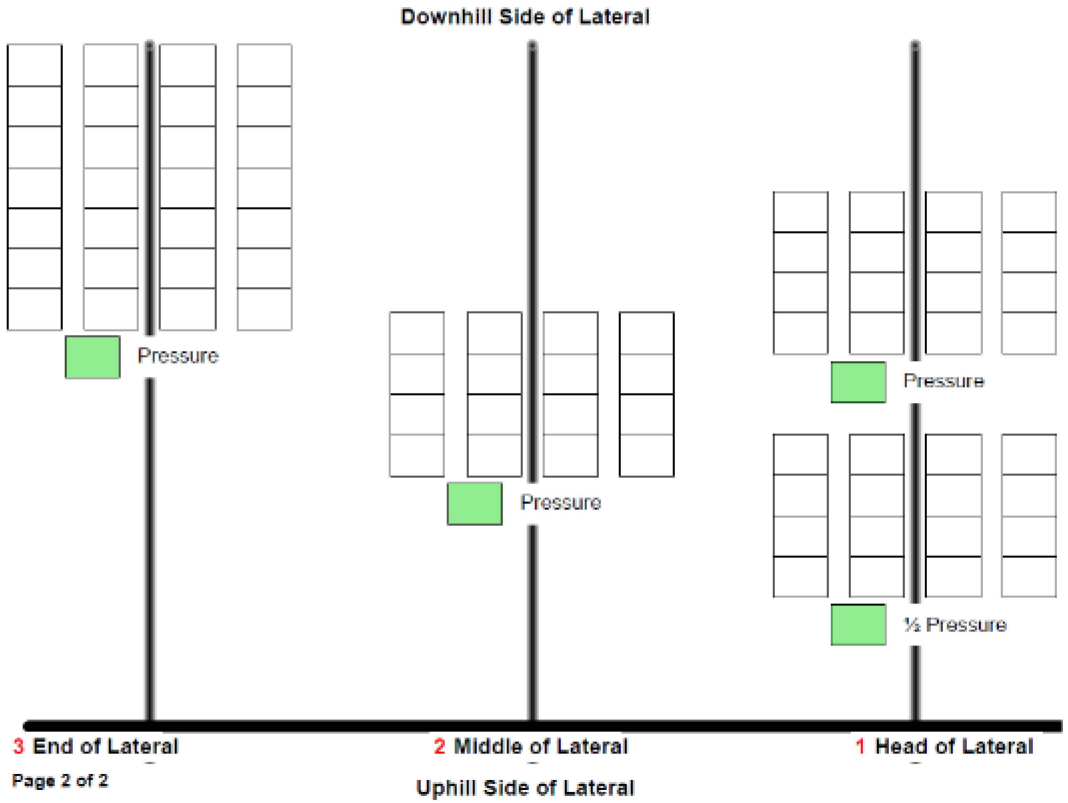
NON-PRESSURE COMPENSATING (Non-PC) EMISSION DEVICES – FLOWS FROM HOSES FED IN TWO DIRECTIONS

Emission device flows are measured in milliliters. Record 76 total timed flow measurements from emission devices, and 4 total pressure measurements from the hoses, as follows:

1. At the head of the lateral, marked as 1 in red, record 16 timed flows from emission devices midway down four of the hoselines at the normal operating pressure, which is recorded. Having marked the emission devices, record 16 additional timed flows after reducing the hose operating pressure by ½ of the normal operating pressure and recording it.
2. At the middle of the lateral, marked as 2 in red, record 16 timed flows on the middle of four of the hoselines at the normal operating pressure which is recorded.
3. At the end of the lateral, marked as 3 in red, record 28 timed flows on the end of four of the hoselines at the normal operating pressure which is recorded.

Test Duration _____

The minimum flow test duration recommended is 120 seconds for drip systems and 45 seconds for micro jet or micro sprinkler systems.



Irrigation System DU and ROI Estimator
DU Measurements (PC Two Directions)

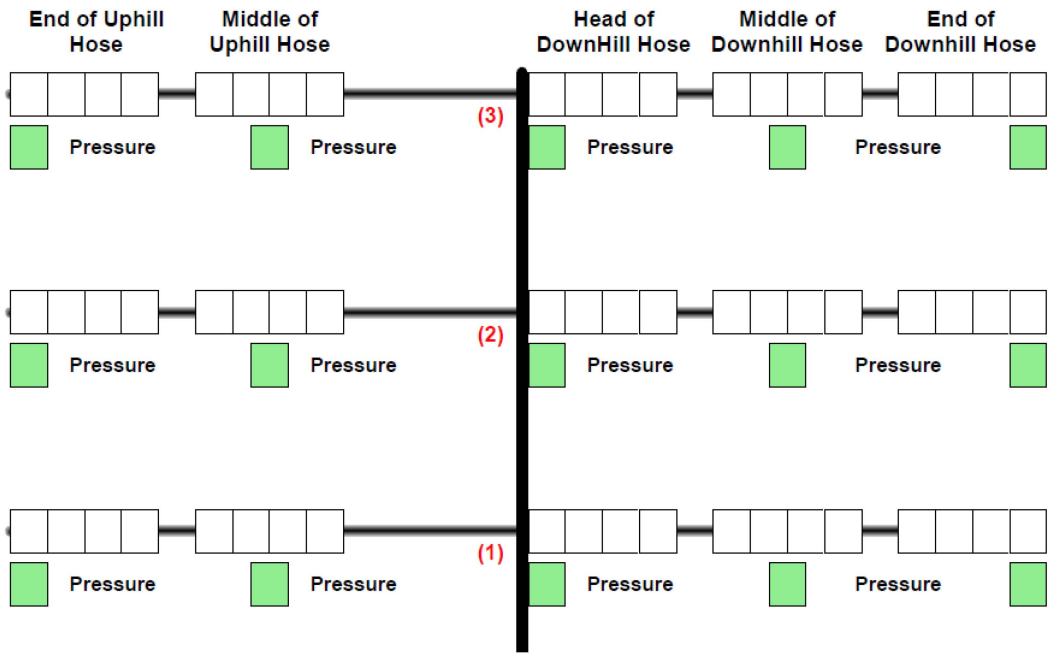
Date _____

Emission device flows are measured in milliliters and pressure is measured in psi. Record 60 total flow measurements from emission devices, and 15 total pressure measurements from hoselines in the chosen zone. Beginning at the head of the lateral, record four flow readings and one pressure reading at each of the following hose locations:

1. Head hose (marked as 1 in red): at the end and middle of the uphill hose, and at the head, middle and end of the downhill hose (20 flow readings and 5 pressure readings).
2. Middle hose (marked as 2 in red): at the end and middle of the uphill hose, and at the head, middle and end of the downhill hose (20 flow readings and 5 pressure readings).
3. End hose (marked as 3 in red): at the end and middle of the uphill hose, and at the head, middle and end of the downhill hose (20 flow readings and 5 pressure readings).

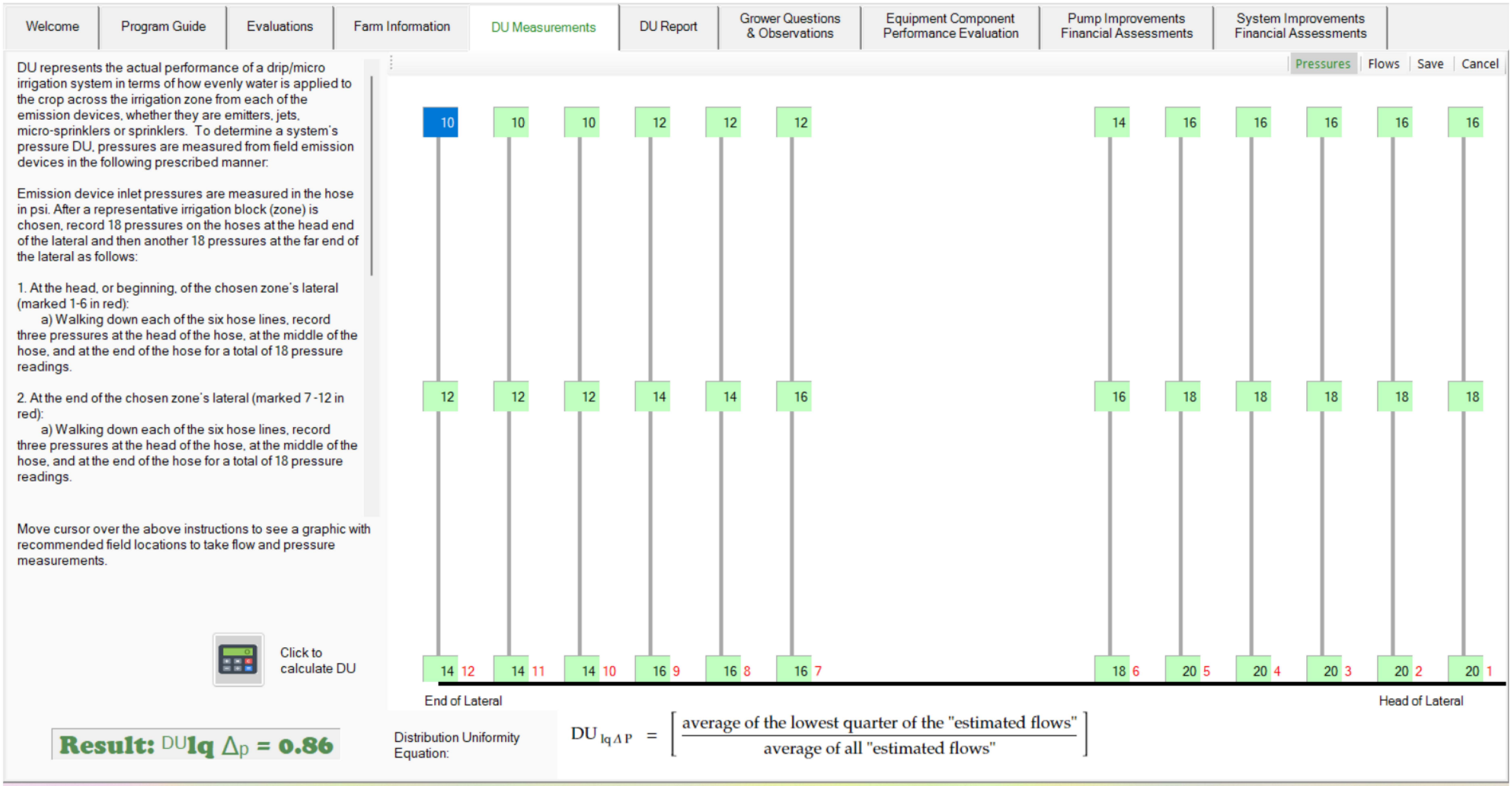
Test Duration _____

The minimum flow test duration recommended is 120 seconds for drip systems and 45 seconds for micro jet or micro sprinkler systems.

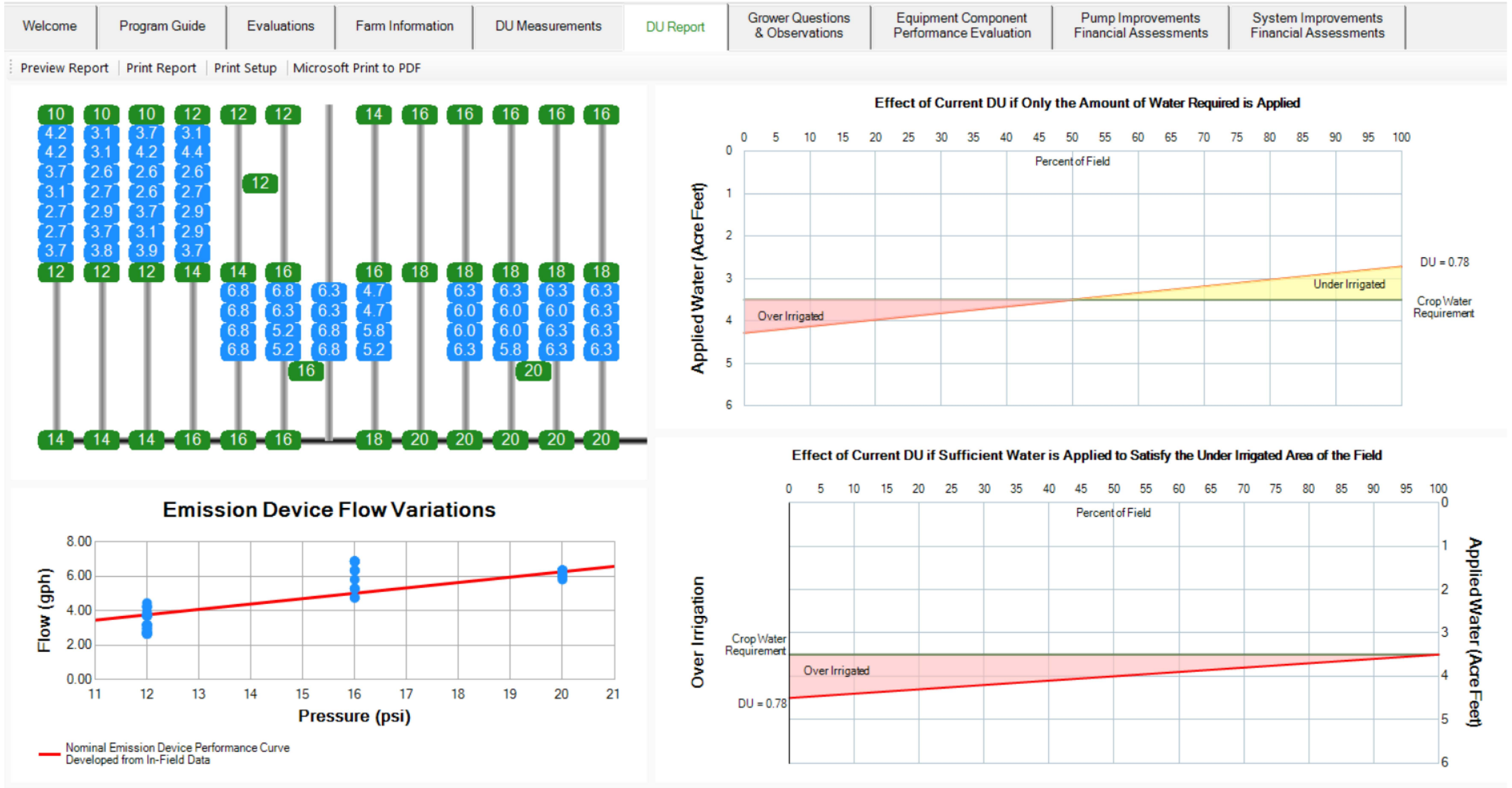


Program Overview

User Interface



User Interface



Irrigation System DU and ROI Estimator Tool

Welcome | Program Guide | Evaluations | Farm Information | DU Measurements | DU Report | Grower Questions & Observations | Equipment Component Performance Evaluation | Pump Improvements Financial Assessments | System Improvements Financial Assessments

Surface Water Cost ($/AcFt)	100	Deep Well Cost ($/AcFt)	81.02	Booster Pump Cost ($/AcFt)	74.78
Average Yield, # of Units/Acre	2500	Yield Increase (% Units/Acre)	6	Income per unit of yield ($)	1.75

Estimated Investment, $/acre, that can be made based upon the desired ROI, years

ROI, Years	Water & Energy Only	Yield Improvement Only	Total
1 Year	$101.41	$262.50	$363.91
2 Years	$202.82	$525.00	$727.82
3 Years	$304.23	$787.50	$1,091.73
4 Years	$405.64	$1,050.00	$1,455.64
5 Years	$507.05	$1,312.50	$1,819.55

Savings from improving current DU to 0.90

Annual Savings $/acre/per one year
After initial investment recovered, annual savings continue

Full 12 pg report

- Summary Report – 3 pages
- DU Report – 2 pages
- Grower Questions/Field Observations Report – 3 pages
- Equipment Evaluation Report- 2 pages
- Pump Improvements Report -1 page
- System Improvements Report – 1 page

Irrigation System DU and ROI Estimator Tool

Irrigation System DU Evaluation Summary:

The system DU is estimated at 0.78, which is 0.12 lower than the ideal of 0.90. Lower than ideal DU typically wastes water and energy, and sacrifices crop yield and/or quality. Results from this particular evaluation suggest that if the irrigation system DU were improved to 0.90, then water and energy expenses could be reduced by $102/acre, and yield income could be improved by 6.0%, or $263/acre, for a total improved profitability of $364/acre/year (see chart below).

Economic Element	DU	Applied Water, AcFt	Cost, $/AcFt	Cost, $/Acre	Cost, $/Field
Surface Water Expenses					
Current	0.78	2.25 (50%)	$100	$225	$22,512
Ideal	0.90	1.94 (50%)	$100	$194	$19,444
Increased water expense due to poor system DU				$31	$3,068
Surface Water Energy Expenses (Booster)					
Current	0.78	2.25 (50%)	$75	$168	$16,835
Ideal	0.90	1.94 (50%)	$75	$145	$14,541
Increased energy expense due to poor system DU				$23	$2,294
Ground Water Energy Expenses (Deep Well And Booster)					
Current	0.78	2.25 (50%)	$156	$351	$35,074
Ideal	0.90	1.94 (50%)	$156	$303	$30,294
Increased energy expense due to poor system DU				$48	$4,780
Increased Income Potential from Yield Enhancement/Year					
Current crop yield, units/acre	Current crop value, $/unit	Current Crop Income, $/acre	Estimated yield increase with improved DU, %	Estimated increased income with improved DU, $/acre	Estimated increased income with improved DU, $/100 acre field
2,500	1.75	4,375	6.0%	$263	$26,250
Total increased profit potential from reduced expenses and enhanced yields:				$364	$36,392

→ Estimate tailored to field size

Irrigation System DU and ROI Estimator Tool

Well Pump Annual Operating Cost Savings

Pumping Cost Analysis	Existing Efficiency	Optimized Efficiency
Overall Efficiency	34%	55%
AcFt/Year	26	26
Hours/Year	2,319	1,777
Pumping Costs, $/...	$4,153.86	$3,433.78
Savings, $/year		$720.08

Estimated Investment that can be made based upon the desired ROI, years

ROI, Years	Well Pump	Booster Pump	Total
1 Year	$720.08		$720.08
2 Years	$1,440.16		$1,440.16
3 Years	$2,160.24		$2,160.24
4 Years	$2,880.32		$2,880.32
5 Years	$3,600.40		$3,600.40

Report Recommendations

1. **Deep Well tested in the last 5 years**
   a. A professional pump test reports the overall efficiency of the booster or deep well pump, which translates into operating cost per acre foot of water pumped. To optimize pump performance and reduce energy costs, pumps should be tested at least every 5 years, and/or after replacement. Please visit https://jcast.fresnostate.edu/pumpefficiency/index.html to learn more about pump testing rebates.
2. **Deep Well replaced or repaired in the last 5 years**
   a. Yes.
3. **Recent flow and/or pressure decrease**
   a. Reduction in flow or pressure is an indication that the pump is worn and/or not operating properly, and/or that the pumping water level or well condition has changed. A professional pump test reports the overall efficiency of the booster or deep well pump, which translates into operating cost per acre foot of water pumped. To optimize pump performance and reduce energy costs, pumps should be tested at least every 5 years, and/or after replacement. Please visit https://jcast.fresnostate.edu/pumpefficiency/index.html to learn more about pump testing rebates.
4. **Booster Pump tested in the last 5 years**
   a. A professional pump test reports the overall efficiency of the booster or deep well pump, which translates into operating cost per acre foot of water pumped. To optimize pump performance and reduce energy costs, pumps should be tested at least every 5 years, and/or after replacement. Please visit https://jcast.fresnostate.edu/pumpefficiency/index.html to learn more about pump testing rebates.
5. **Booster Pump replaced or repaired in the last 5 years**
   a. Yes.
6. **Booster Pump recent flow and/or pressure decrease**
   a. Reduction in flow or pressure is an indication that the pump is worn and/or not operating properly, and/or that the pumping water level or well condition has changed. A professional pump test reports the overall efficiency of the booster or deep well pump, which translates into operating cost per acre foot of water pumped. To optimize pump performance and reduce energy costs, pumps should be tested at least every 5 years, and/or after replacement. Please visit https://jcast.fresnostate.edu/pumpefficiency/index.html to learn more about pump testing rebates.
7. **Frequency of system flushing**
   a. Inadequate flushing may lead to emission device clogging and poor irrigation system distribution uniformity which may adversely affect crop yield, quality and uniformity. At a minimum, flushing should occur at the beginning and end of the season, and possibly in-season intervals as well depending upon the observed level of contaminant build up in the hose-end flush water. Monitor weekly and/or monthly to assess whether in-season flushing is warranted.