Irrigation Analysis Report Example

Input Data Summary:

Evaluation Name:
Company Name:
Owner Name:
Address:
Cell Phone Number:

Date of Evaluation: 6/6/2023
Contact Name:
County:
Email Address:

Project or Field Description:
Crop Water Req. (acre ft/acre): 1.75
Ground Water (% af/acre): 100
Surface Water (% af/acre):

Crop: Wine Grape
Acres: 93.89
Water District Name:

Emission Device Mfg: Netafim
Model: PCW
Desired ROI (years): 3
Expected Yield Increase in %, for each 1% of DU Improvement: 12.5

Flow Rate (gph): 0.53

Irrigation System DU Evaluation Summary:

The system DU is estimated at 0.65, which is 0.25 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 $75/acre, and yield income could be improved by 19.0%, or $538/acre, for a total improved profitability of $612/acre/year (see chart below).

Economic Element	DU	Applied Water, AcFt	Cost, $/AcFt	Cost, $/Acre	Cost, $/Field
Surface Water Expenses					
Current	0.65	N/A			
Ideal	0.90	N/A			
Increased water expense due to poor system DU				$0	$0
Surface Water Energy Expenses (Booster)					
Current	0.65	N/A			
Ideal	0.90	N/A			
Increased energy expense due to poor system DU				$0	$0
Ground Water Energy Expenses (Deep Well And Booster)					
Current	0.65	2.69 (100%)		$268	$25,124
Ideal	0.90	1.94 (100%)		$193	$18,145
Increased energy expense due to poor system DU				$75	$6,979
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, $/93.89 acre field
3	944.00	2,832	19.0%	$538	$50,520
Total increased profit potential from reduced expenses and enhanced yields:				$612	$57,499

Equipment Performance and Economic Assessment Summary Report

Estimated Economic Value of Improving DU from Current 0.65 to 0.90

Surface Water Cost ($/AcFt)	0	**Deep Well Cost ($/AcFt)**		**Booster Pump Cost ($/AcFt)**	99.39
Average Yield, # of Units/Acre	3	**Yield Increase (% Units/Acre)**	312.5	**Income per unit of yield ($)**	944.00

Return on Investment

ROI, Years	Water & Energy Only	Yield Improvement Only	Total
1 Year	$74.33	$538.08	$612.41
2 Years	$148.66	$1,076.16	$1,224.82
3 Years	$222.99	$1,614.24	$1,837.23
4 Years	$297.32	$2,152.32	$2,449.64
5 Years	$371.65	$2,690.40	$3,062.05

Since the desired Return on Investment (ROI) is 3 years, 3 * $612 = $1,836/acre could be invested to maintain, repair or replace system components that were measured or observed as deficient including:

Irrigation System Issues:

Observed Issues:

1. There is 1 filter issue
2. There are 6 emission device issues
3. There are 2 issues with leaks in the field

Equipment Performance Issues:

1. There are 2 issues with filters

Report from Grower Questions & Observations Tuesday, June 6, 2023

Company Name:
Owner Name:
Evaluation Name:

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. 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.

3. **Recent flow and/or pressure decrease**
   a. None.

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. 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.

6. **Booster Pump recent flow and/or pressure decrease**
   a. None.

7. **Frequency of system flushing**
   a. Flushing frequency appears to be adequate.

8. **Screen Filters**
   a. Screen Is clear.
   b. Automatic flushing.

9. **Percent of emission devices that are either partially or completely plugged**
   a. If more than 10% of the emission devices are plugged, the irrigation system should be thoroughly flushed, and a water treatment program begun and/or reviewed.

10. **Inconsistent emission device size, type or brand**
    a. None found.

11. **Buildup of chemical precipitants (typically white) on or in the emission device outlet**
    a. The fertilizers being injected into the irrigation system are chemically incompatible with the system's water source and/or with one another, resulting in unwanted precipitation of solids that may clog the irrigation system emission devices and other components. Consult with an irrigation professional to determine whether adjusting the irrigation system water pH would dissolve the solids and/or prevent chemical precipitation from occurring.

Company Name:
Owner Name:
Evaluation Name:

12. External plugging of emission device, either partially or completely

- **a.** Algae or Biological: Filters should be inspected to ensure proper operation. In addition, the entire irrigation system should be flushed, and the water treatment program should be reviewed by an irrigation professional.
- **b.** Insects: Insects are not being treated, and/or an insect resistant emission device isn't being used.
- **c.** Soil Particles: Soil particles may be back-siphoned into the emission device after irrigation system shut-off and drain-down if pipeline air vacuum relief is inadequate (too few or damaged), and/or if the emission devices do not have an anti-siphon feature.

13. Hose End Flush Water

- **a.** Algae or Biological: Filters should be inspected to ensure proper operation. In addition, the system should be flushed and the water treatment program should be reviewed by an irrigation professional.
- **b.** Soil Particles: Filters should be inspected. The system should be flushed and/or the water treatment program should be reviewed.

14. Worn Spinners on Micro Sprinklers

- **a.** None observed or not applicable.

15. Worn Nozzles on Micro Jet

- **a.** None observed or not applicable.

16. Throttled gate or butterfly valves (partially closed manually to regulate field pressures)

a.

17. Leaks in the field

- **a.** In hoses: Hoses are leaking due to rodent, animal or equipment damage.
- **b.** in or around emission devices: The emission device was not installed properly, or the emitter was replaced and inserted into the same punched hole. If this is the case, remove the emitter, plug the existing punched hole with a goof plug, and then reinstall the replacement emitter in a freshly punched hole.

Equipment Component Performance Evaluation

Company Name:
Owner Name:
Evaluation Name:
Crop: Wine Grape
Acres: 93.89

1. **Deep Well**
   a. No Deep Well Pump installed
2. **Deep Well Flow Meter**
   a. No Deep Well Flow Meter installed.
3. **Booster Pump (30HP - 269 gpm @ 145 psi)**
   a. Current Pumping Plant Efficiency Is 77%
4. **Booster Pump/Filter Station Flow Meter**
   a. The flow meter reading variation is excessive, indicating the meter needs to be repaired, replaced, or repositioned. Consult with an irrigation professional for manufacturer specifications regarding correct positioning of flow meters in the piping system, and for general flow meter installation instructions.
5. **Filter Station Screen w/Auto Clean (1 units)**
   a. The difference in pressure between the filter inlet and outlet exceeds 5 psi, indicating that the filters are dirty and likely reducing proper flow to the field. This can adversely affect the irrigation system uniformity and application rate. Filters may be automatically flushed according to a time interval, and/or when the pressure differential between the filter inlet and outlet exceeds design specification. Consult with an irrigation professional to review the filter system operation.
   b. The difference in pressure between the filter inlet and outlet exceeds 5 psi, indicating that the filters are dirty and likely reducing proper flow to the field. This can adversely affect the irrigation system uniformity and application rate. Filters may be automatically flushed according to a time interval, and/or when the pressure differential between the filter inlet and outlet exceeds design specification. Consult with an irrigation professional to review the filter system operation.
6. **Pump Station Control Valve**
   a. No Pump Station Control Valve installed.
7. **Submain Control Valve**
   a. No Pump Station Control Valve installed.
8. **Polyethylene Lateral Hose Regulators**
   a. No Polyethylene Lateral Hose Regulators installed.
9. **Online Emitters Netafim (0.5 gph)**
   a. Plant Spacing Area: 24 square feet, Actual Wetted Area: 6 square feet (23%). Typically, it is recommended that the wetted area should be a minimum of 60% of the planted area. in this case, 14 square feet.

      The estimated wetted soil volume appears to be less than the generally recommended value of 60%. To verify whether this estimate is correct, consult with an irrigation professional to determine, via soil probing, the actual wetted soil volume. If it is indeed inadequate, consider increasing the irrigation system pressure, and verify that micro jet or micro sprinkler devices are properly installed perpendicular to the soil surface to ensure maximum throw distance. If it is impractical or impossible to increase the soil wetted volume, consult with an agronomist to adjust the irrigation schedule (frequency and duration) to maximize lateral water movement and avoid deep percolation, or "pushing", of irrigation water and nutrients beyond the effective crop root zone.
   b. The measured flow rate is 29% above the labeled flow rate. The measured flow rate is different than the "design, labeled" flow rate of the emission device. As a result, actual application rates will be different than expected, which could affect the irrigation schedule. Consult with an irrigation professional and/or agronomist to ensure the irrigation schedule reflects the actual application rate.

DU Report – PC

Distribution Uniformity (DU) – 0.65

DU represents the actual performance of a drip/micro irrigation system in terms of how evenly water is applied to the crop across the irrigation zone from each of the emission devices, whether they are emitters, jets, micro-sprinklers or sprinklers. To determine a system's DU, flows are measured from field emission devices in a prescribed manner and tabulated according to the following formula, expressing DU as a decimal:

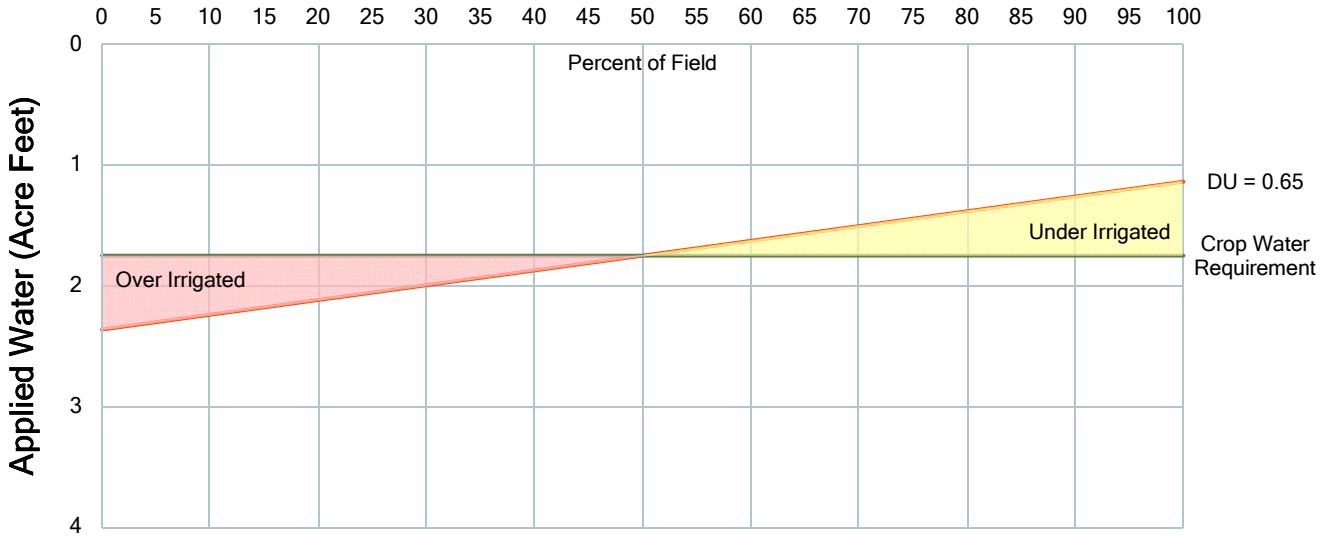
$$DU = \frac{\text{Average Low Quarter Depth of Water Infiltrated}}{\text{Average Depth of Water Infiltrated}}$$

A perfect DU of 1.00 is impossible due to imperfections in emission devices themselves; systems with DUs of 0.85-0.95 are considered acceptable and may be scheduled normally to achieve optimum crop yield and quality, and to minimize water, fertilizer and pumping costs.

However, systems with poor DUs lower than 0.85 should be improved because they will suffer in one of two ways: 1) If the irrigation zone is scheduled to just apply the targeted crop water requirement, then half of the field will be over-irrigated and the other half will be under-irrigated (see illustration 1 below), and/or 2) If the irrigation zone is scheduled to apply sufficient water to the underirrigated portion of the zone to offset the poor uniformity, then over irrigation will occur on most of the zone which affects crop yield and quality, and increases water, fertilizer and pumping costs (see illustration 2 on the next page). Over irrigation also risks applying water and nutrients where unwanted, such as percolating below the rootzone or running off into surface water supplies.

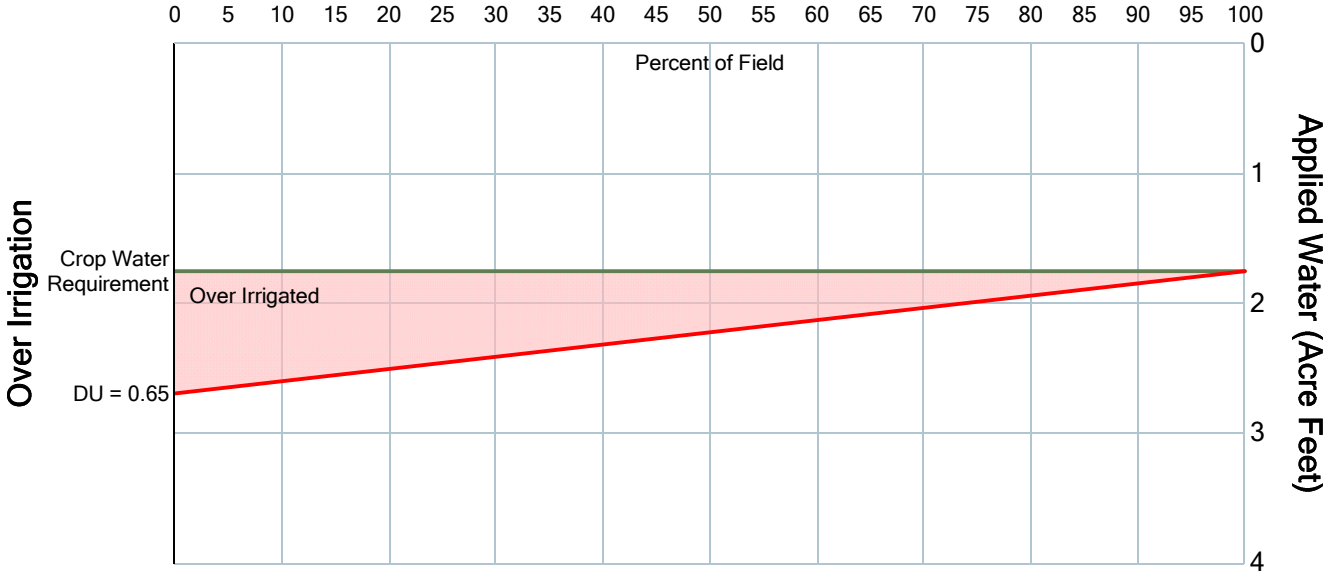
Causes of poor DU include improper system pressure and/or flow, lack of overall general maintenance including system flushing, water treatment and filter servicing, injecting incompatible fertilizers downstream of the filter station that precipitate out of solution and clog the emission devices, and lack of vacuum relief leading to vacuum suction of soil particles into emission devices upon shutdown.

Illustration 1: Effect of Current DU if Only the Amount of Water Required is Applied



DU Report – PC

Illustration 2: Effect of Current DU if Sufficient Water is Applied to Satisfy the Under Irrigated Area of the Field



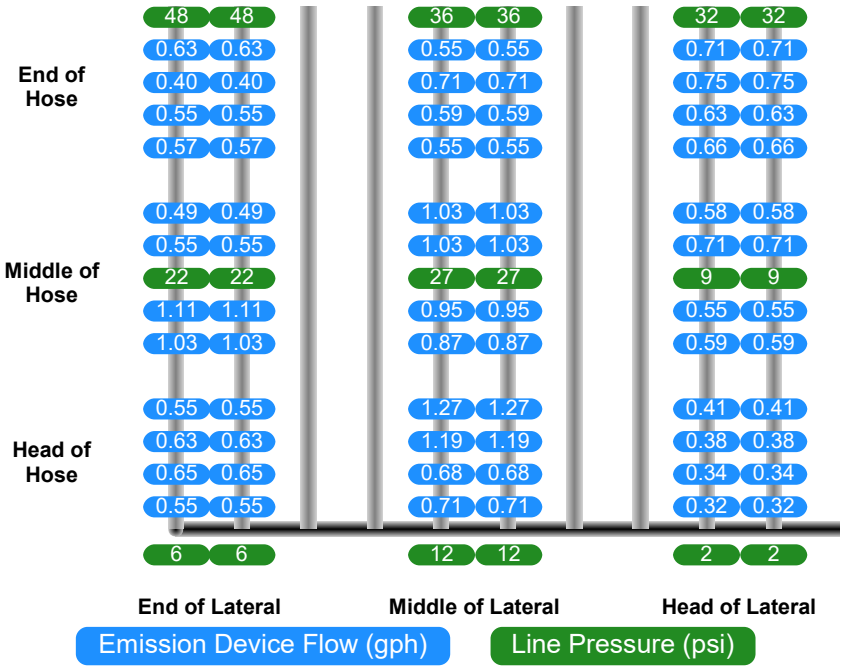
DU vs. Yield

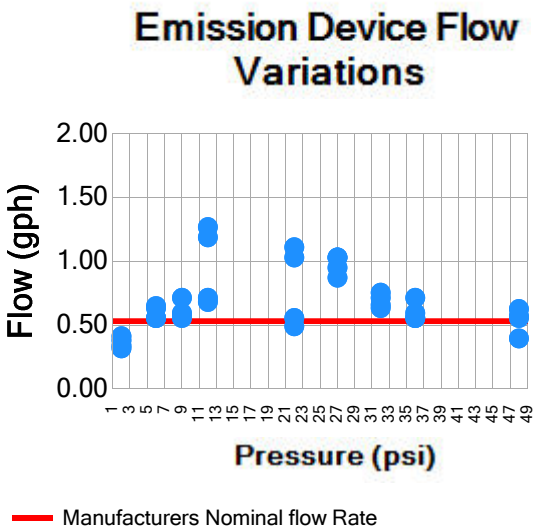
Most agree that a poor DU will result in less than ideal yields, but the exact amount is difficult to estimate. However, one highly respected source* states the following:

- "Approximately 55% Of crop non-uniformity Is caused by irrigation system distribution dis-uniformity."
- "For fruit and nut crops, crop yield is reduced 0.5% for each 1.0% reduction in DU for the first 15% of differential.** Beyond that, the quality of the crop suffers but is hard to quantify how much."

* Dr. Charles Burt, Director Irrigation and Training Research Center, Cal Poly, San Luis Obispo, CA

**For example, if DU is 0.75 instead of an obtainable DU of 0.90, then crop yield is reduced 7.5%





Pressure compensating devices are designed to operate within specific pressure ranges, such as between 10 And 60 psi. Low pressures were recorded and may be below specification, which could negatively affect the system's DU. Consult with an irrigation professional to determine the manufacturer's recommended operating pressure range and adjust system pressures if necessary.

The emission device flow variations, and the calculated degradation in DU, in a system with pressure compensating devices is nearly 100% due to plugging if the minimum required device operating pressure is supplied.

DU Report – PC

Distribution Uniformity (DU) – 0.45

DU represents the actual performance of a drip/micro irrigation system in terms of how evenly water is applied to the crop across the irrigation zone from each of the emission devices, whether they are emitters, jets, micro-sprinklers or sprinklers. To determine a system's DU, flows are measured from field emission devices in a prescribed manner and tabulated according to the following formula, expressing DU as a decimal:

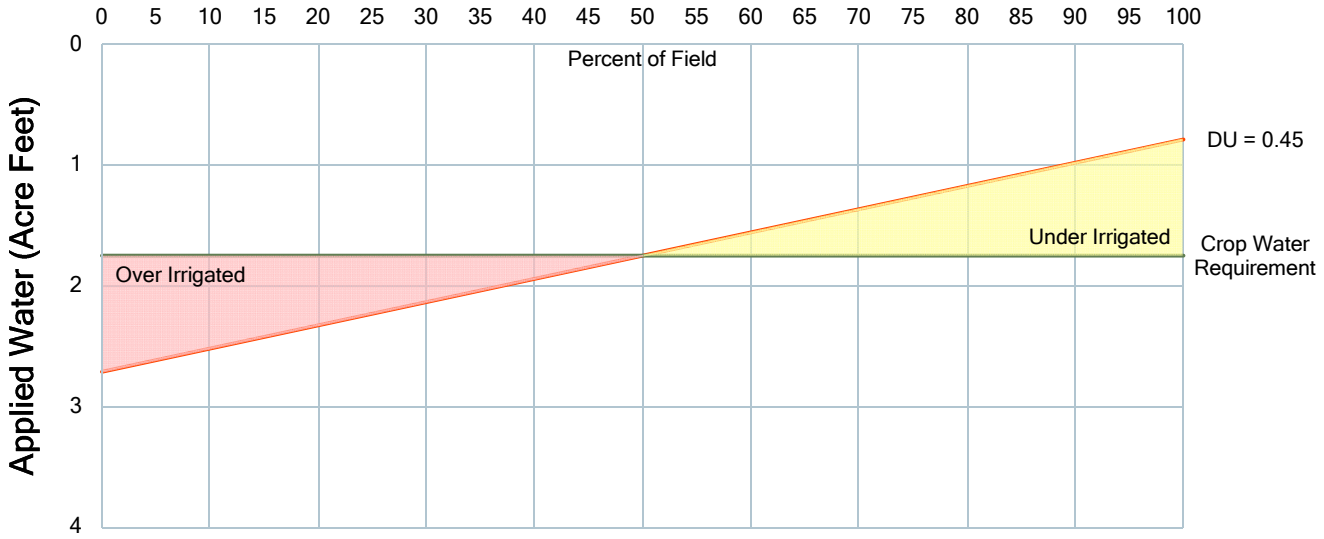
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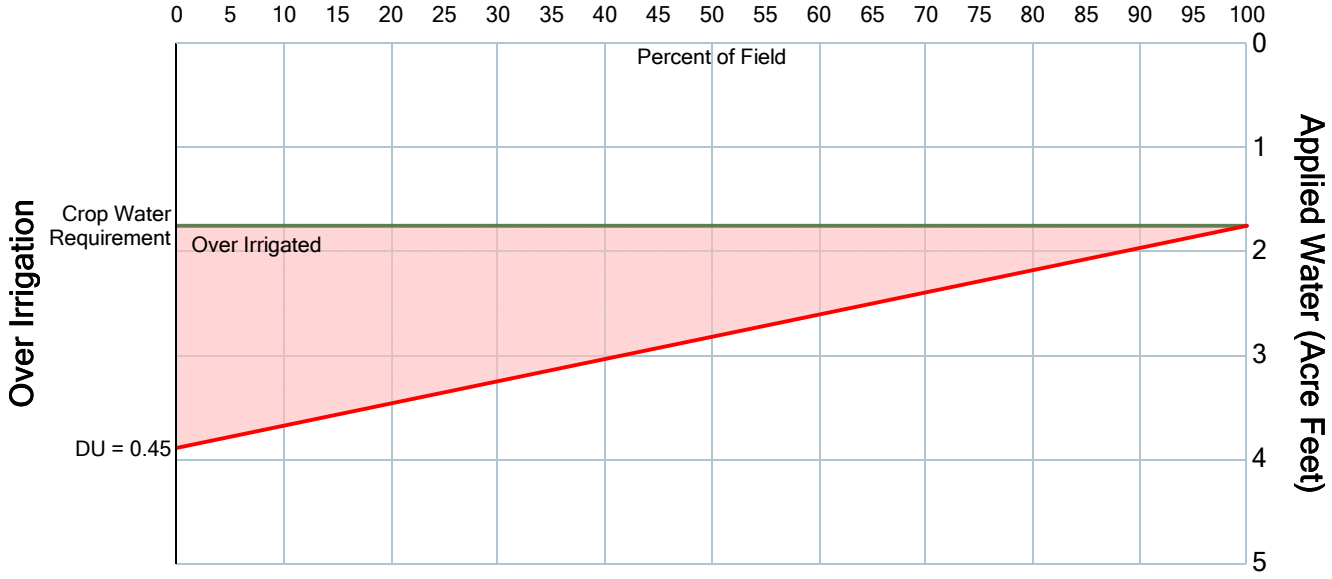
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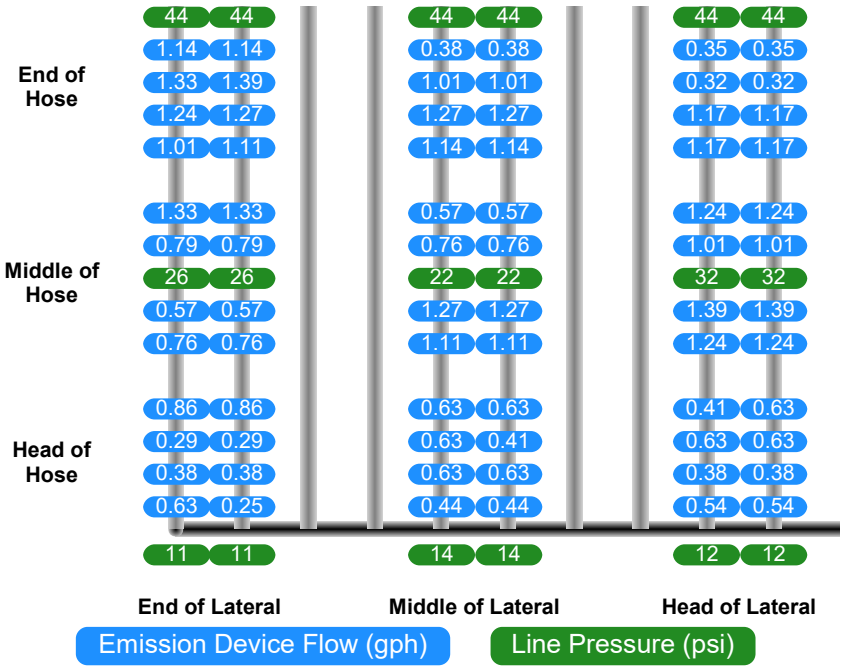
DU vs. Yield

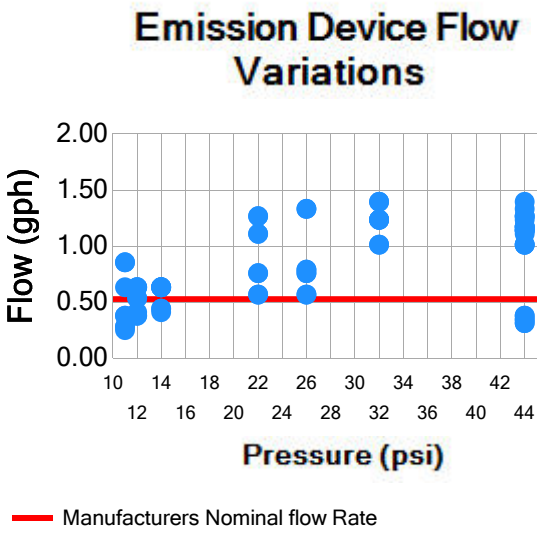
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System Improvements Report
Estimated Economic Value of Improving DU from Current 0.65 to 0.90

These tables and graphs show the level of investment, $/acre, that can be made based upon the desired ROI, years, It is calculated by estimating the excess water and energy expenses, and foregone yield potential, that occur as a result of the current DU of 0.65 vs. an improved DU of 0.90.

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

ROI, Years	Water & Energy Only	Yield Improvement Only	Total
1 Year	$74.33	$0.00	$74.33
2 Years	$148.66	$0.00	$148.66
3 Years	$222.99	$0.00	$222.99
4 Years	$297.32	$0.00	$297.32
5 Years	$371.65	$0.00	$371.65

