

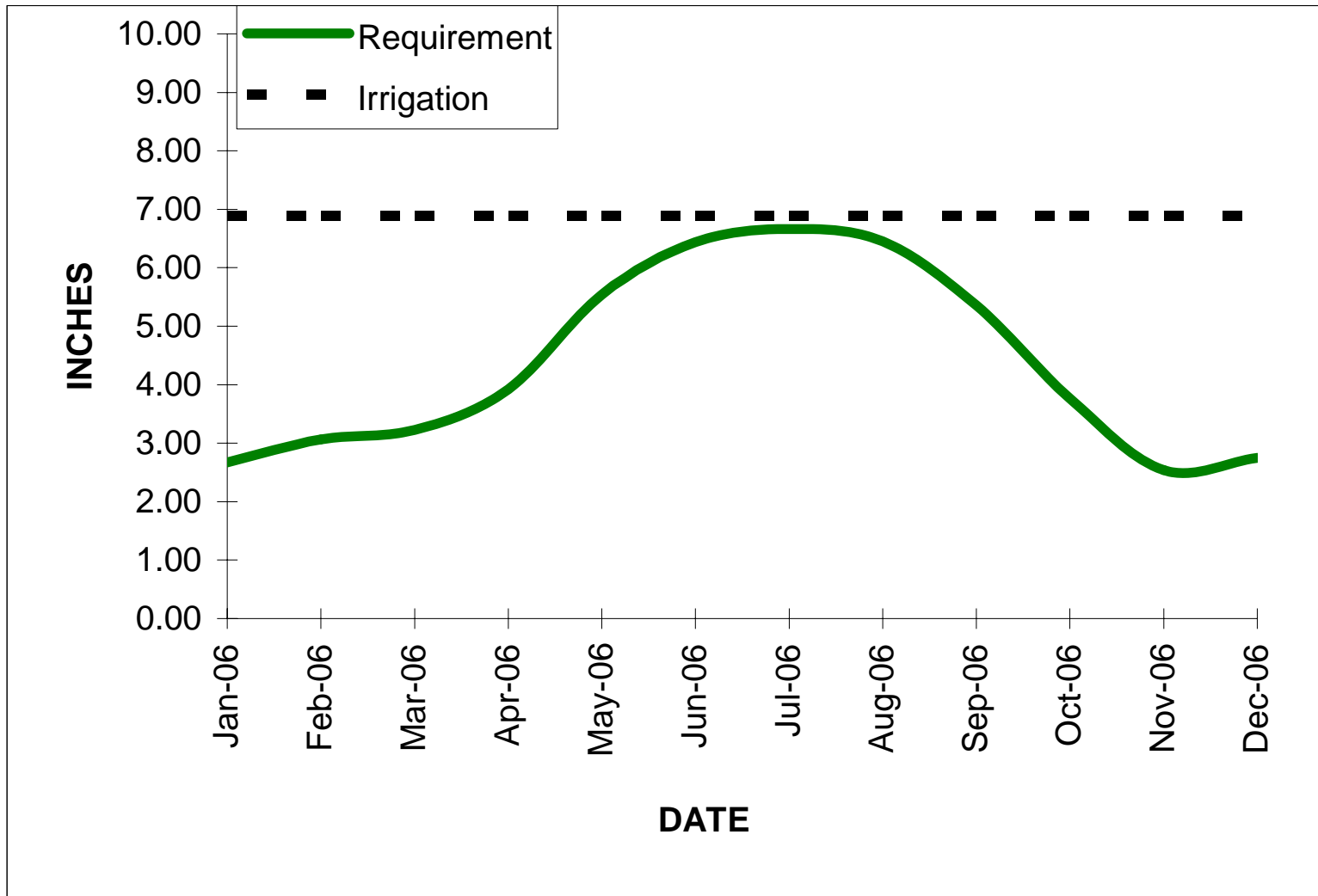


Mission Resource Conservation District

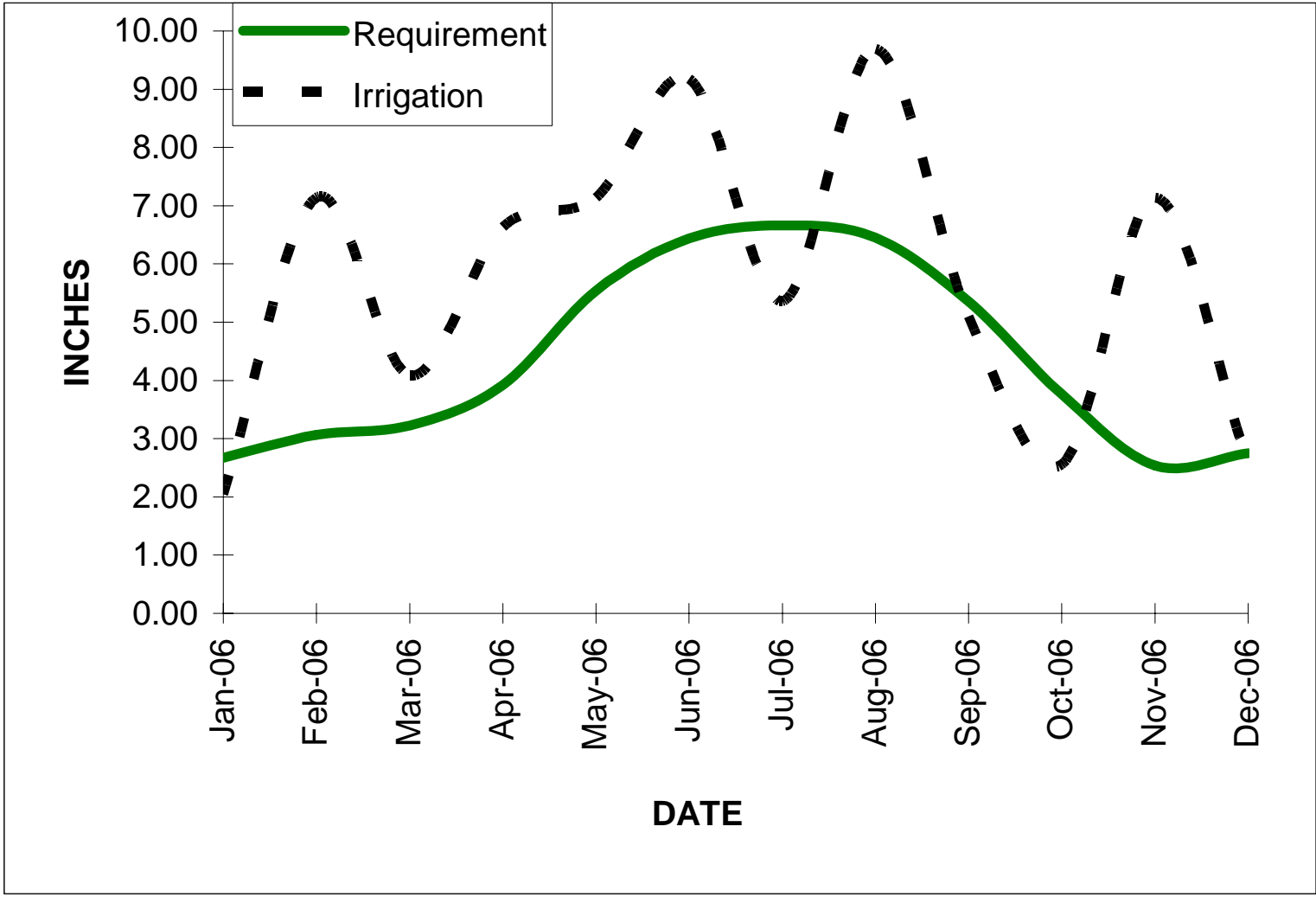
Irrigation Efficiency for Southern California



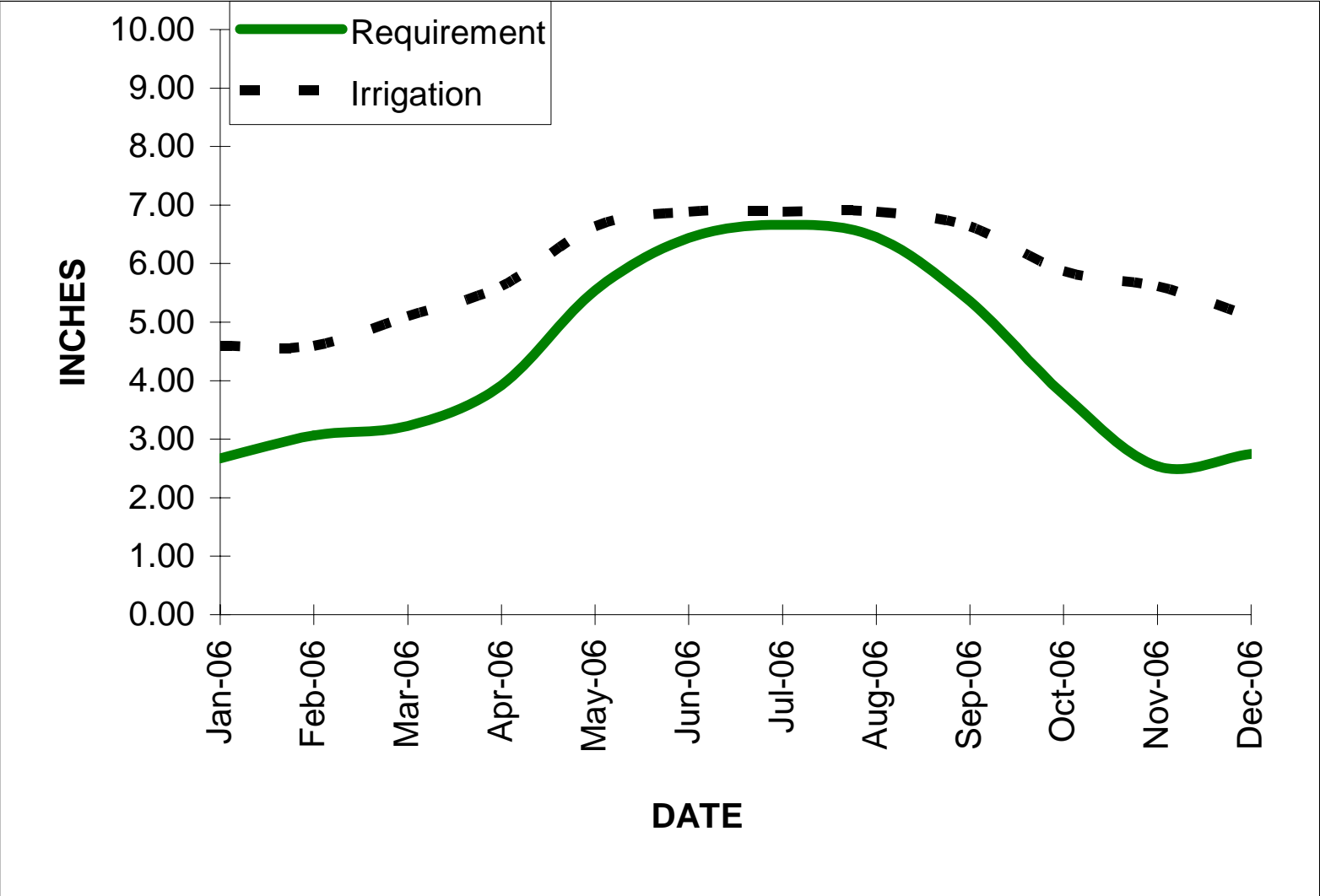
Year Totals	8100	46.2	52.4	82.6	158
Acre Feet =	18.6	irrigated acreage does not include outbuildings, roads, or landscaping			2.7
Gallons =	6058800			Irrigated Acres =	



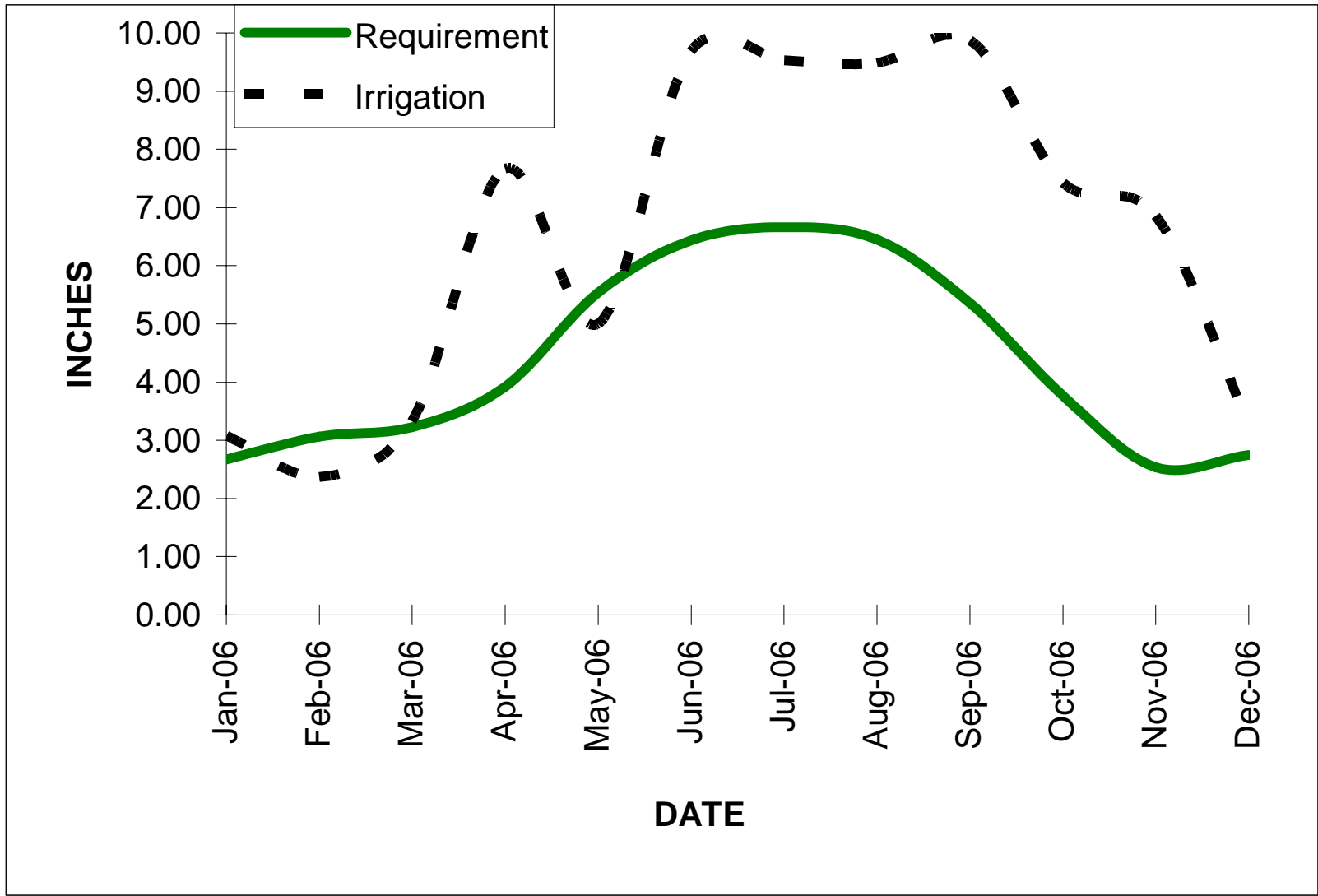
Year Totals	6725	46.2	52.4	68.6	131
Acre Feet =	15.4	irrigated acreage does not include outbuildings, roads, or landscaping			2.7
Gallons =	5030300			Irrigated Acres =	



Year Totals	6900	46.2	52.4	70.4	134
Acre Feet =	15.8	irrigated acreage does not include outbuildings, roads, or landscaping			2.7
Gallons =	5161200			Irrigated Acres =	



Year Totals	7602	46.2	52.4	77.6	148
Acre Feet =	17.5	irrigated acreage does not include outbuildings, roads, or landscaping			2.7
Gallons =	5686296			Irrigated Acres =	



Irrigation Efficiency

Irrigation Efficiency

```
graph TD; A[Irrigation Efficiency] --- B[Irrigation System Efficiency]
```

**Irrigation System
Efficiency**

Irrigation Efficiency

```
graph TD; A[Irrigation Efficiency] --> B[Irrigation System Efficiency]; A --> C[Efficient Water Management];
```

**Irrigation System
Efficiency**

**Efficient
Water
Management**

Irrigation Efficiency

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graph TD; A[Irrigation Efficiency] --> B[Irrigation System Efficiency]; A --> C[Efficient Water Management];
```

Irrigation System
Efficiency

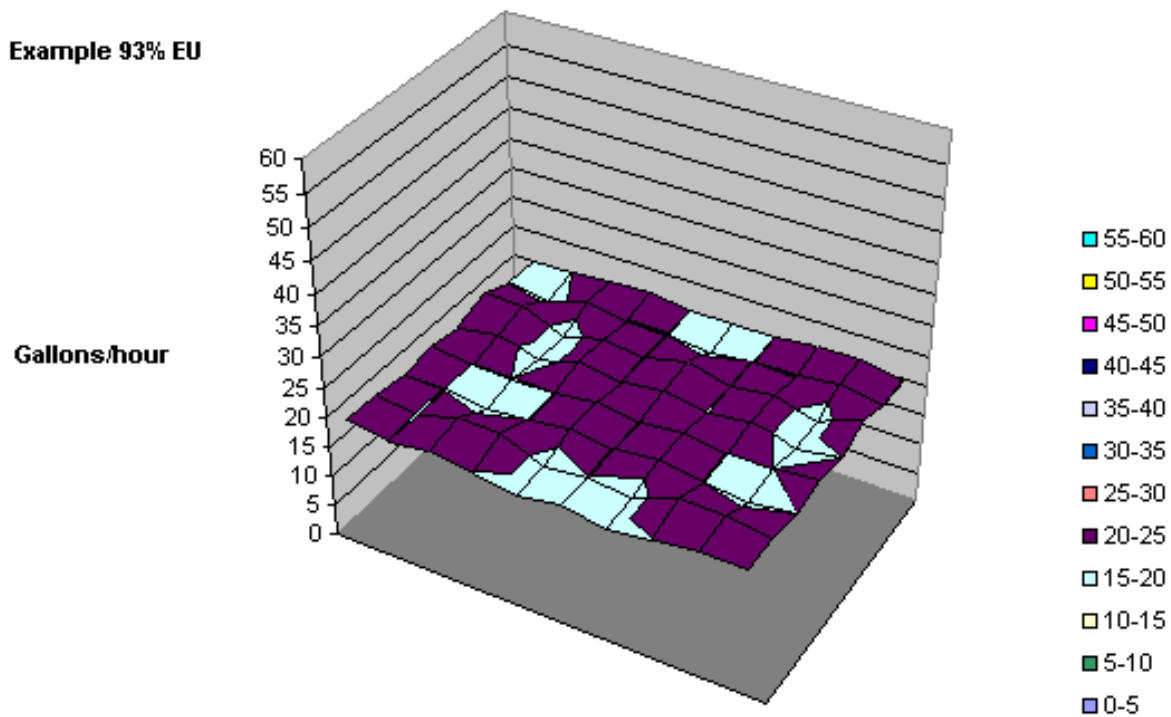
Efficient
Water
Management

Irrigation System Efficiency

Distribution Uniformity

System Operating At High Level of Efficiency

Example 93% EU



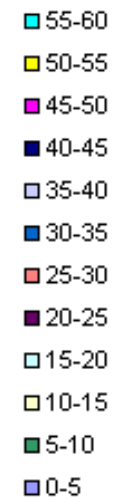
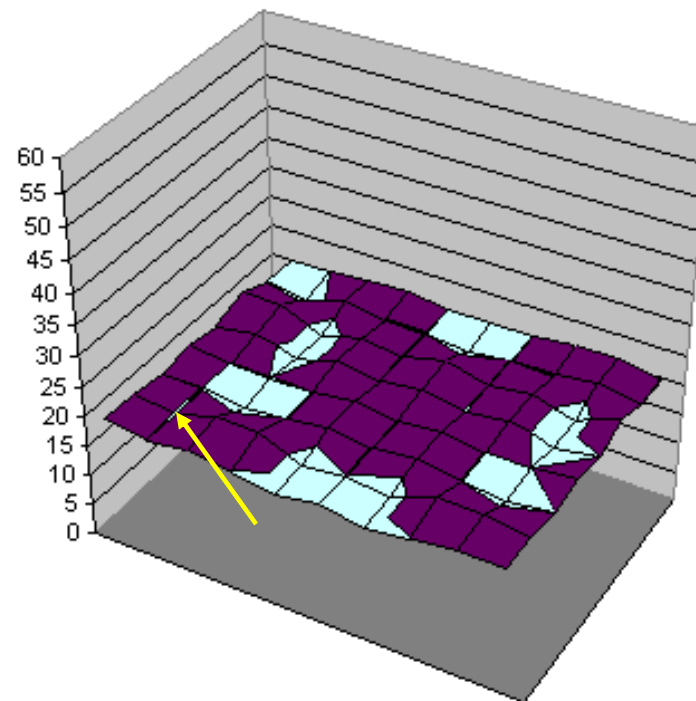
Irrigation System Efficiency

Distribution Uniformity

System Operating At High Level of Efficiency

Example 93% EU

Gallons/hour



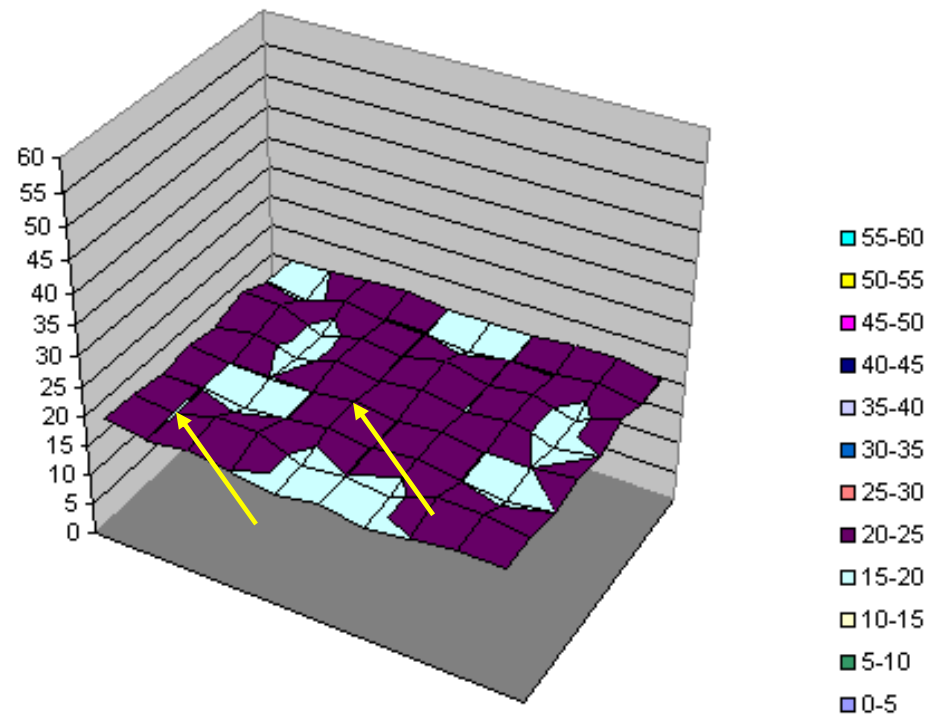
Irrigation System Efficiency

Distribution Uniformity

System Operating At High Level of Efficiency

Example 93% EU

Gallons/hour



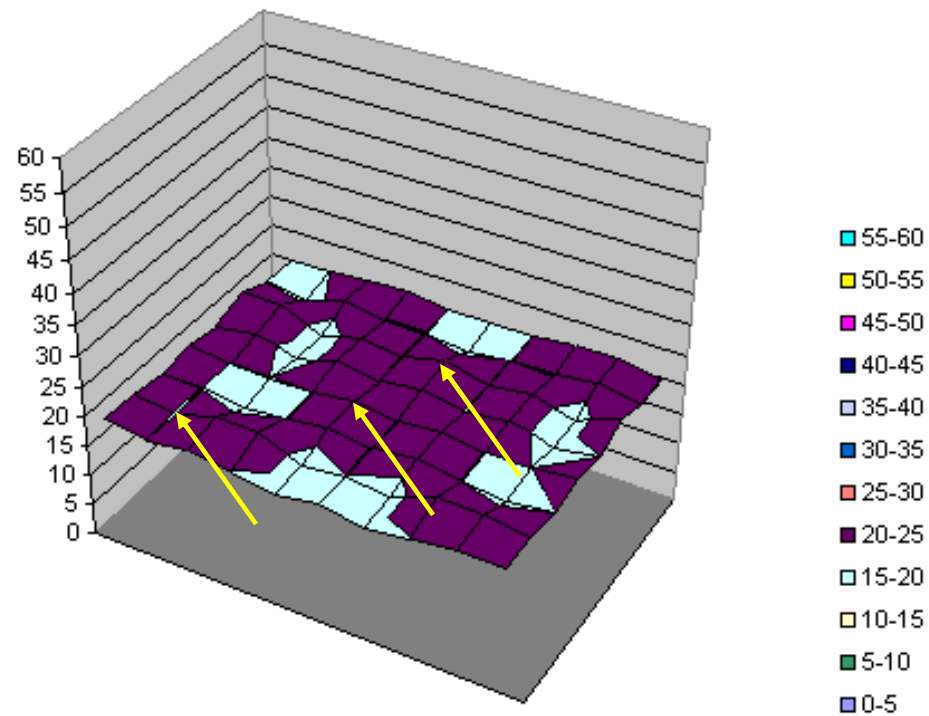
Irrigation System Efficiency

Distribution Uniformity

System Operating At High Level of Efficiency

Example 93% EU

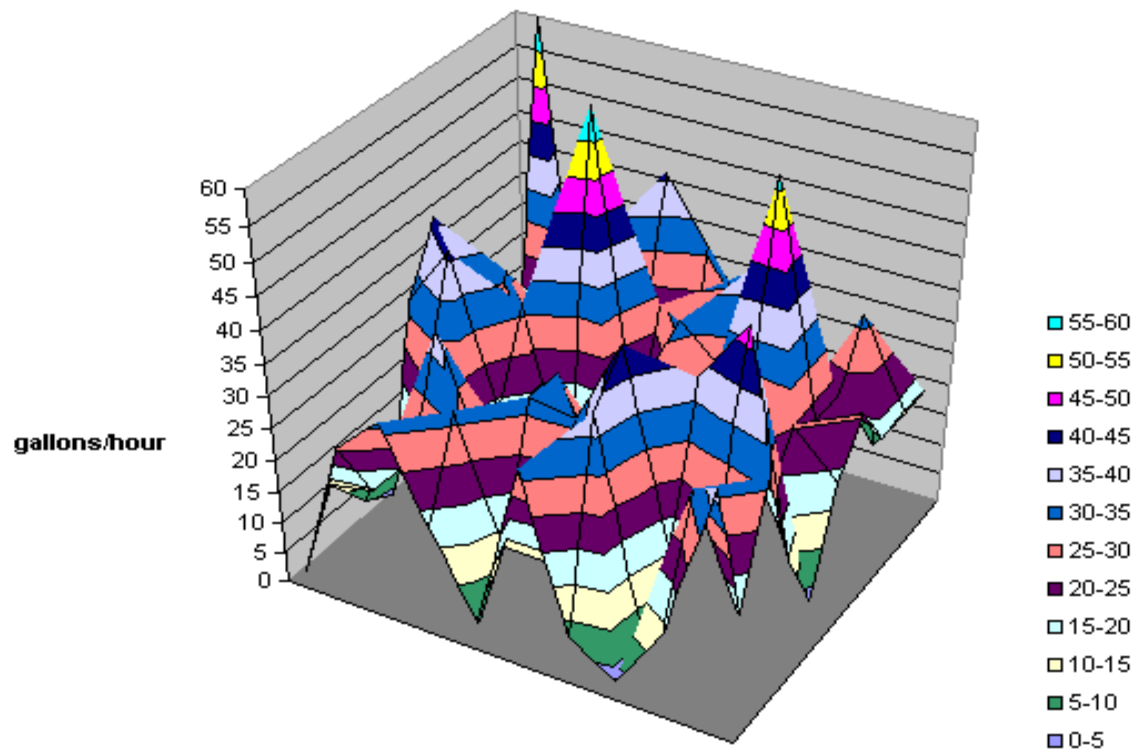
Gallons/hour



Irrigation System Efficiency

Distribution Uniformity

System Operating At Low Level of Efficiency



Irrigation System Efficiency

Importance of Distribution Uniformity

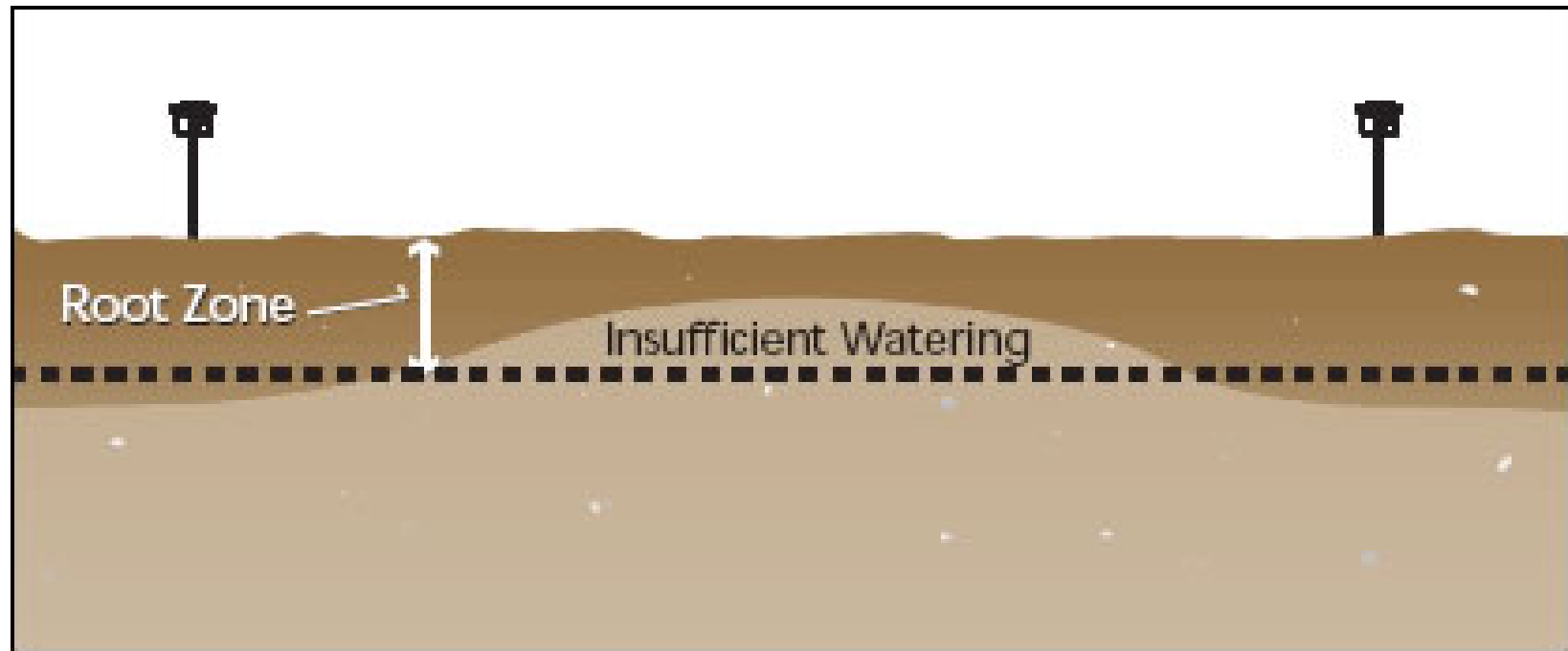


FIGURE 2: Depiction of irrigation resulting in poor DU and insufficient irrigation in parts of the field

Irrigation System Efficiency

Importance of Distribution Uniformity

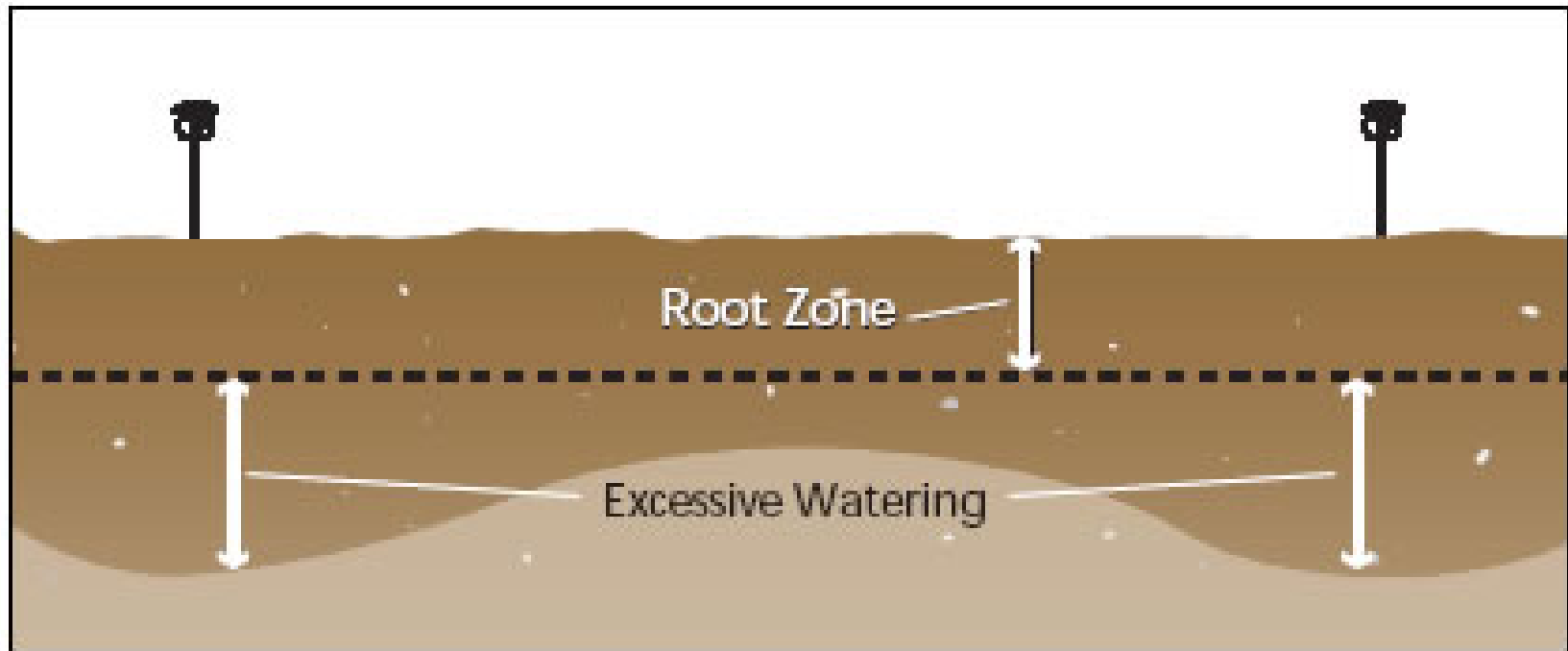


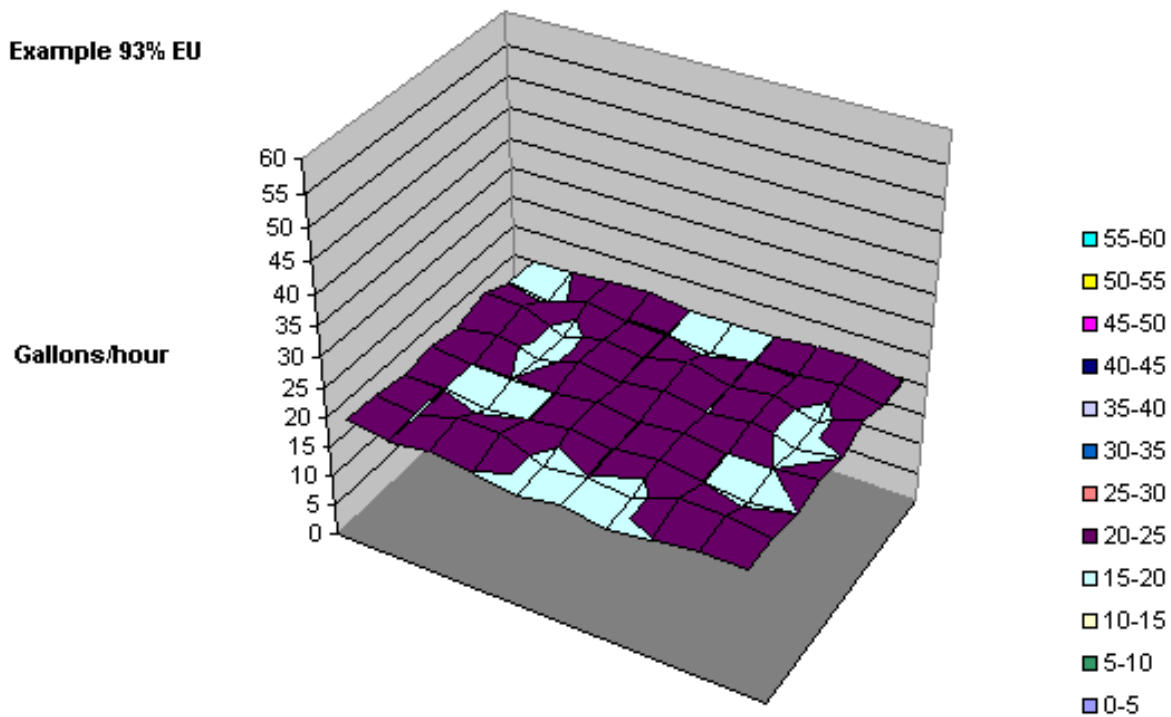
FIGURE 1: Depiction of irrigation resulting in poor DU and excessive watering

Irrigation System Efficiency

Distribution Uniformity

System Operating At High Level of Efficiency

Example 93% EU



Irrigation System Efficiency

Importance of Distribution Uniformity

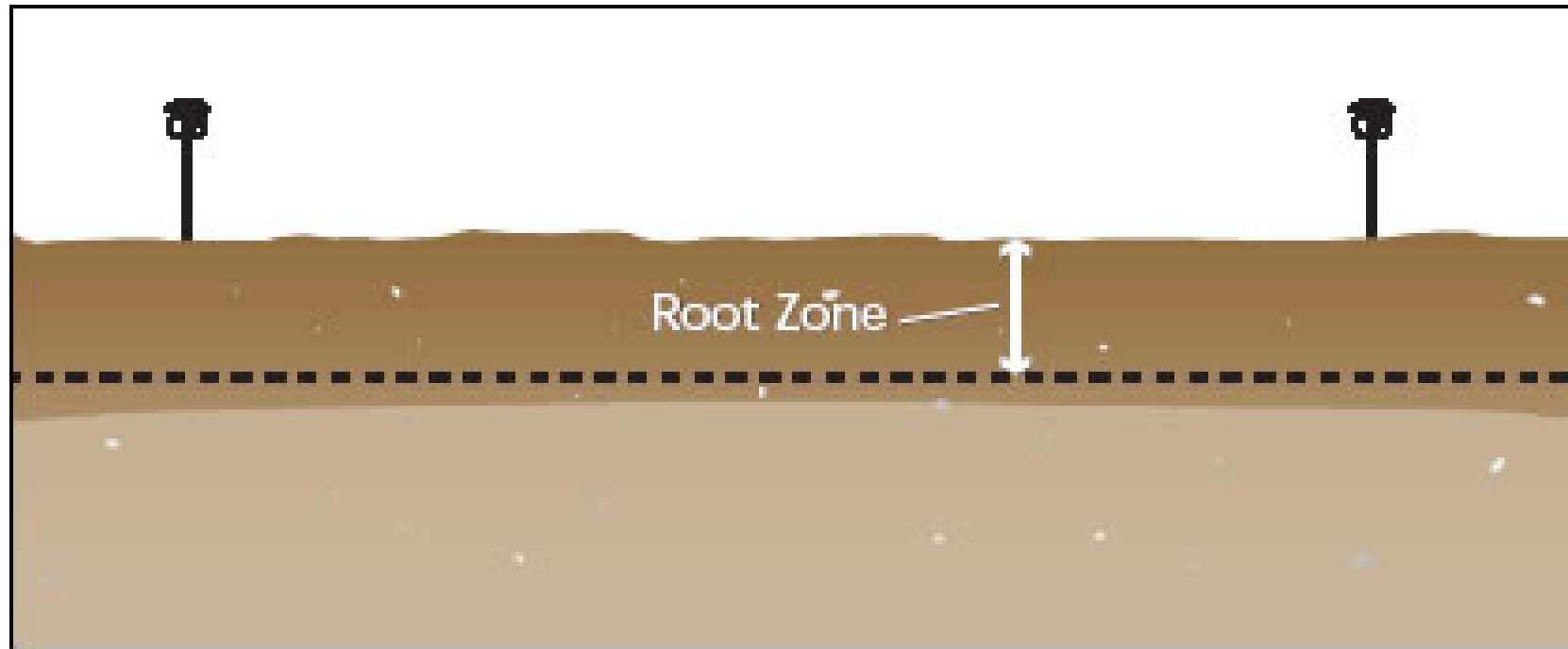


FIGURE 4: Depiction of irrigation sufficiently watering the entire field with good DU and irrigation efficiency

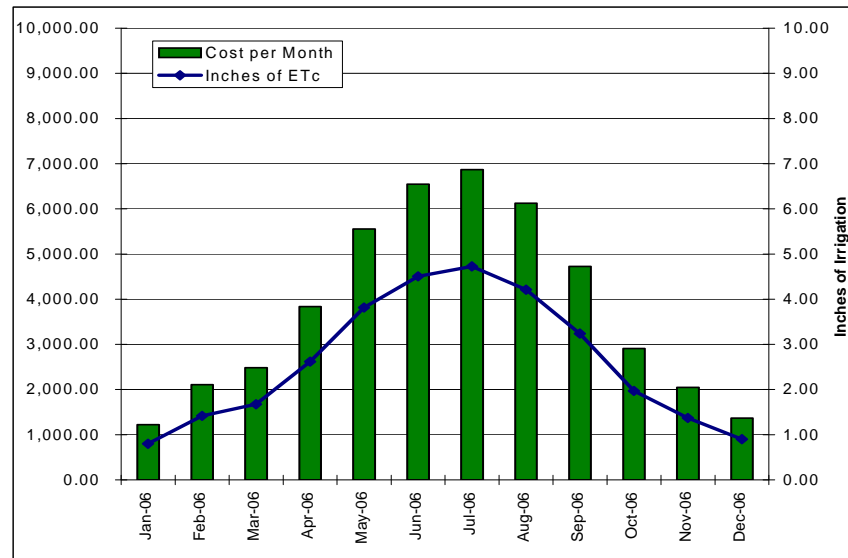
Importance of Distribution Uniformity

Water Budget Analysis - Avocados

2006

System EU **60%** Cost Per Unit: **\$1.91**
 Trees Per Acre **109** Pump Zone **2**
 CIMIS Station: **Temecula** Per Unit: **0.17**
 Water Unit: **748** Gallons Meter Size **2**
 District **VCMWD** Stand By Charge/Month: **\$75.00**

Date	Water Units	Monthly ETc	Effective Rainfall	Total Cost per Month	Cost per Tree
Jan-06	551	0.80		\$1,223.19	\$1.12
Feb-06	976	1.42		\$2,108.46	\$1.93
Mar-06	1155	1.68		\$2,483.15	\$2.28
Apr-06	1805	2.62		\$3,836.20	\$3.52
May-06	2629	3.81		\$5,554.75	\$5.10
Jun-06	3104	4.50		\$6,545.19	\$6.00
Jul-06	3259	4.73		\$6,867.29	\$6.30
Aug-06	2902	4.21		\$6,123.81	\$5.62
Sep-06	2232	3.24		\$4,727.22	\$4.34
Oct-06	1359	1.97		\$2,906.68	\$2.67
Nov-06	946	1.37		\$2,045.68	\$1.88
Dec-06	620	0.90		\$1,368.00	\$1.26
Leaching	14%				
Year Totals =	21539	31.2	0.0	\$45,789.60	\$42.01
Acre Feet =	49.4	irrigated acreage does not include roads, outbuildings, landscape, etc.			
Gallons =	16110952	Irrigated Acres = 10.0			



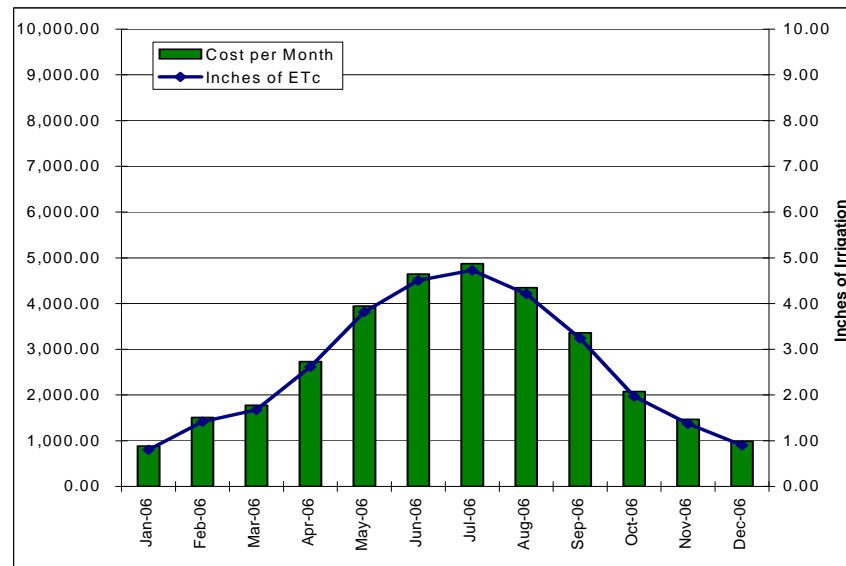
Importance of Distribution Uniformity

Water Budget Analysis - Avocados

2006

System EU **85%** Cost Per Unit: **\$1.91**
 Trees Per Acre **109** Pump Zone **2**
 CIMIS Station: **Temecula** Per Unit: **0.17**
 Water Unit: **748** Gallons Meter Size **2**
 District: **VCMWD** Stand By Charge/Month: **\$75.00**

Date	Water Units	Monthly Etc	Effective Rainfall	Total Cost per Month	Cost per Tree
Jan-06	389	0.80		\$885.48	\$0.81
Feb-06	689	1.42		\$1,510.39	\$1.39
Mar-06	816	1.68		\$1,774.87	\$1.63
Apr-06	1274	2.62		\$2,729.97	\$2.50
May-06	1856	3.81		\$3,943.06	\$3.62
Jun-06	2191	4.50		\$4,642.19	\$4.26
Jul-06	2300	4.73		\$4,869.56	\$4.47
Aug-06	2049	4.21		\$4,344.75	\$3.99
Sep-06	1576	3.24		\$3,358.92	\$3.08
Oct-06	959	1.97		\$2,073.83	\$1.90
Nov-06	667	1.37		\$1,466.07	\$1.35
Dec-06	438	0.90		\$987.71	\$0.91
Leaching	14%				
Year Totals =	15204	31.2	0.0	\$32,586.78	\$29.90
Acre Feet =	34.9	irrigated acreage does not include roads, outbuildings, landscape, etc.			
Gallons =	11372468	Irrigated Acres = 10.0			

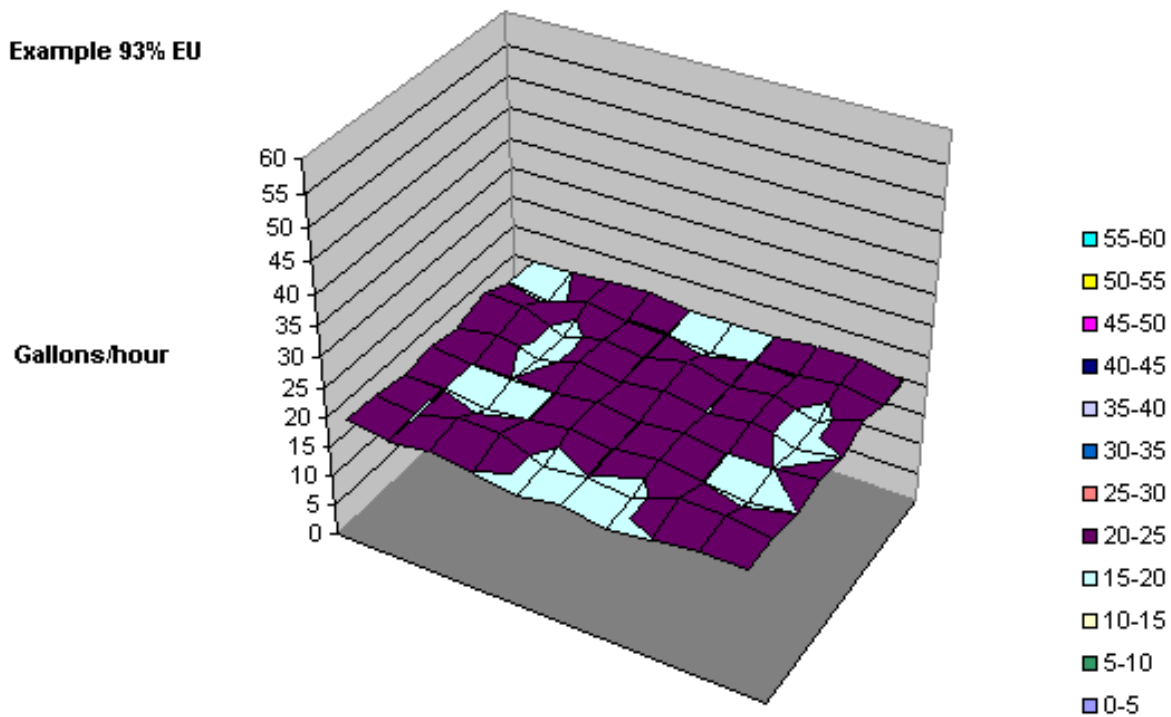


Irrigation System Efficiency

Distribution Uniformity

System Operating At High Level of Efficiency

Example 93% EU



Irrigation System Efficiency

Importance of Distribution Uniformity

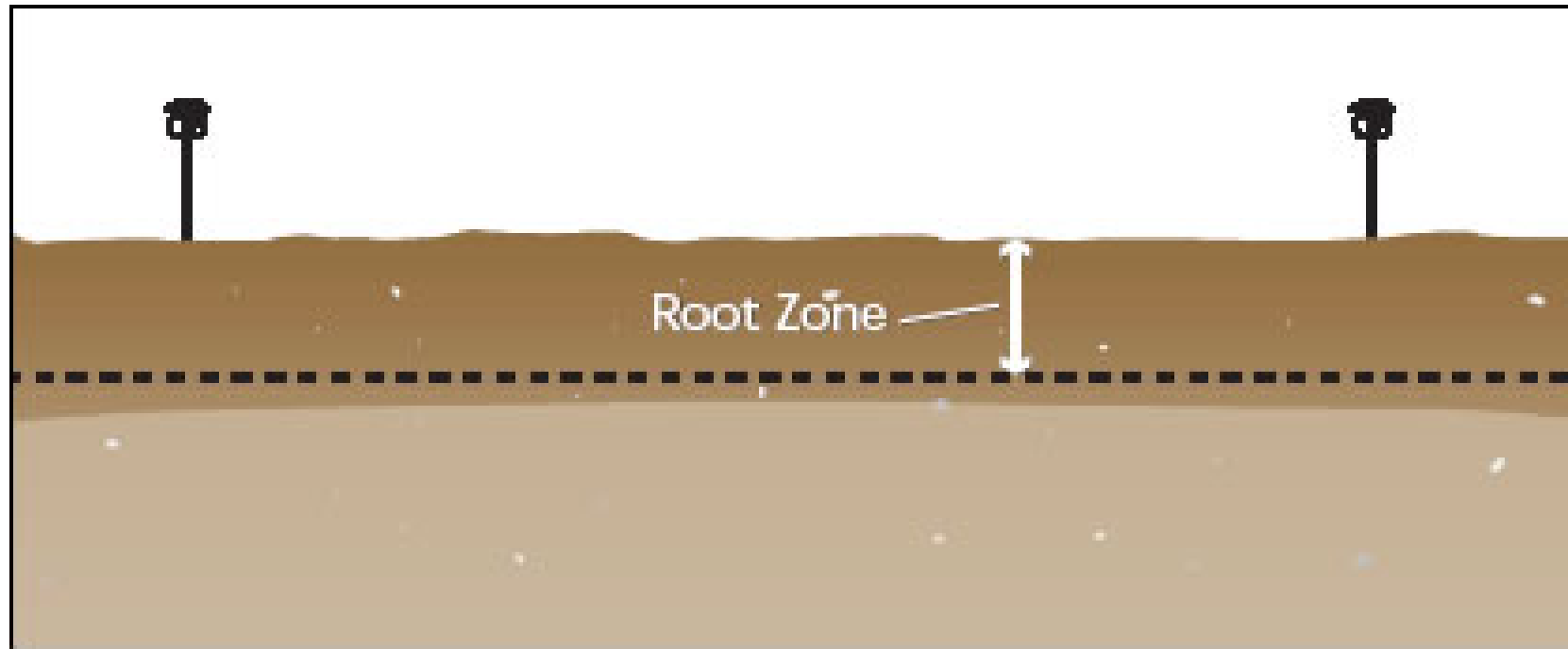
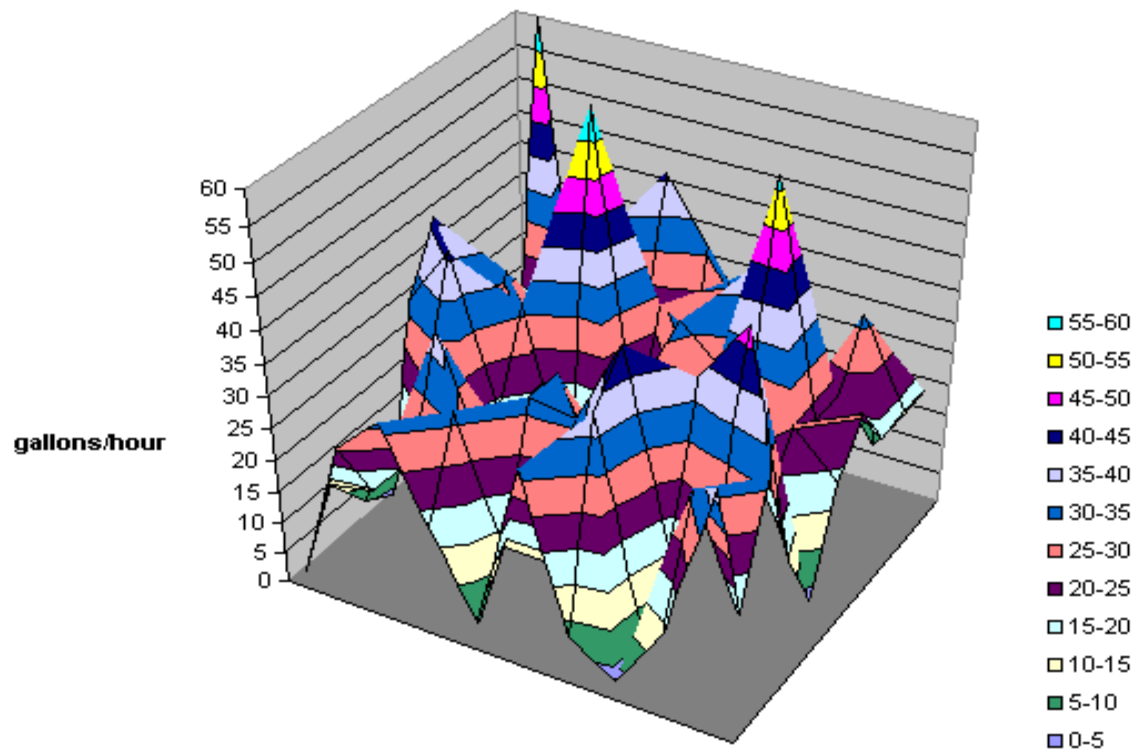


FIGURE 4: Depiction of irrigation sufficiently watering the entire field with good DU and irrigation efficiency

Irrigation System Efficiency

Distribution Uniformity

System Operating At Low Level of Efficiency



Irrigation System Efficiency

Importance of Distribution Uniformity

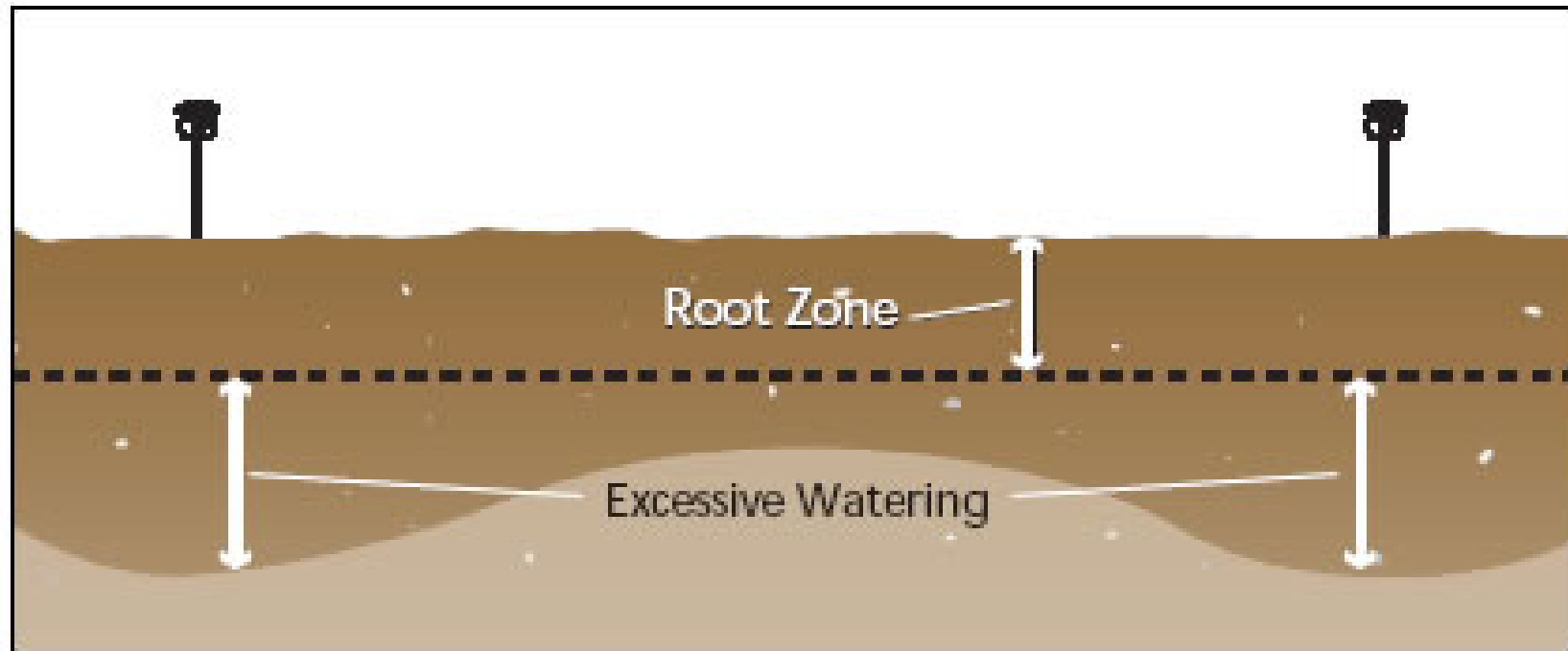


FIGURE 1: Depiction of irrigation resulting in poor DU and excessive watering

Common Maintenance Problems

Easy Ways to Raise DU

- Repair Leaks
- Replace Plugged Equipment
- Choose the correct sprinklers



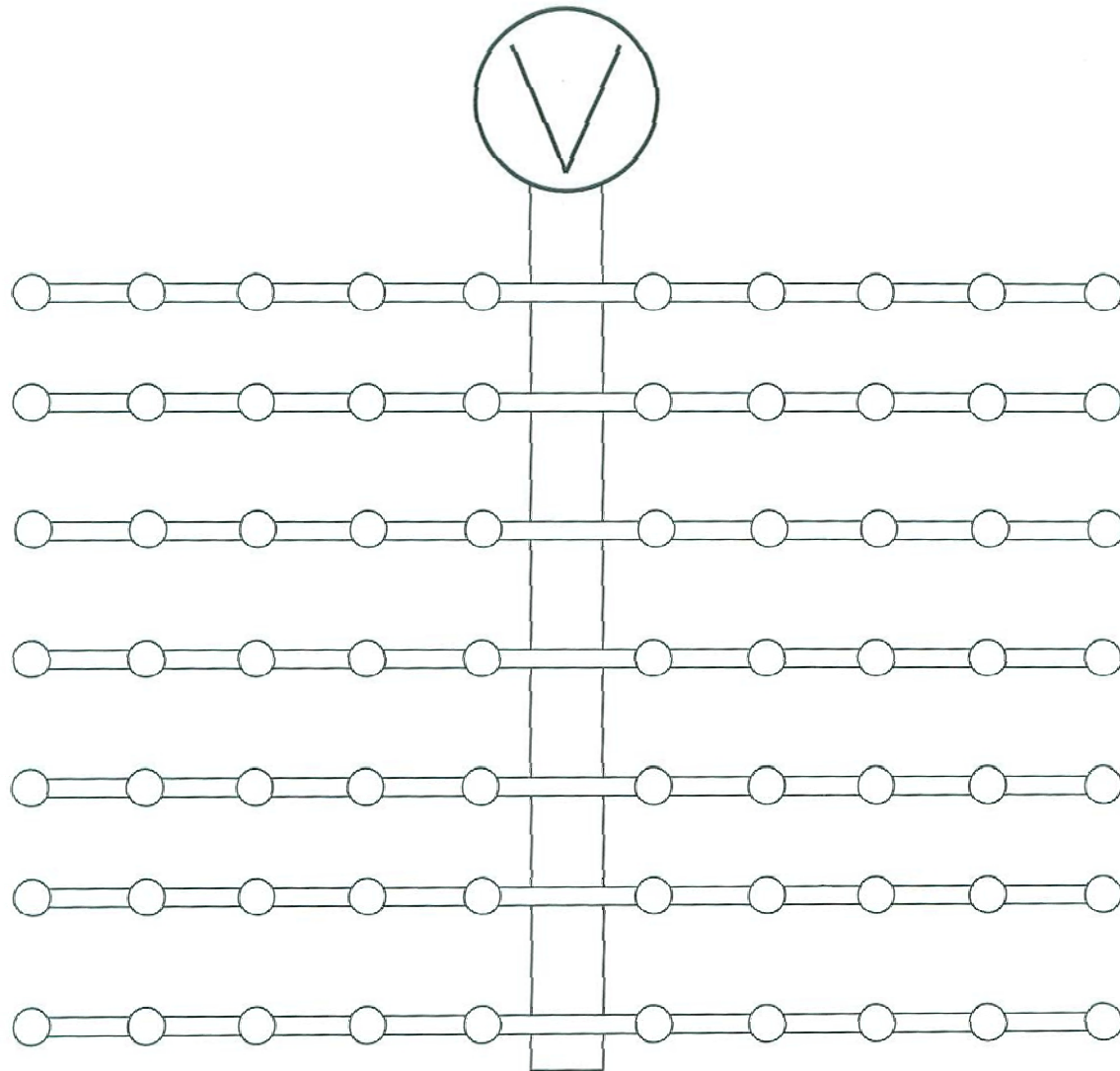
Common Design Problems

Not as Easy Ways to Raise DU

- Lack of Pressure Regulation
- Matching Precipitation Rates
- Exceeding Design Capacity

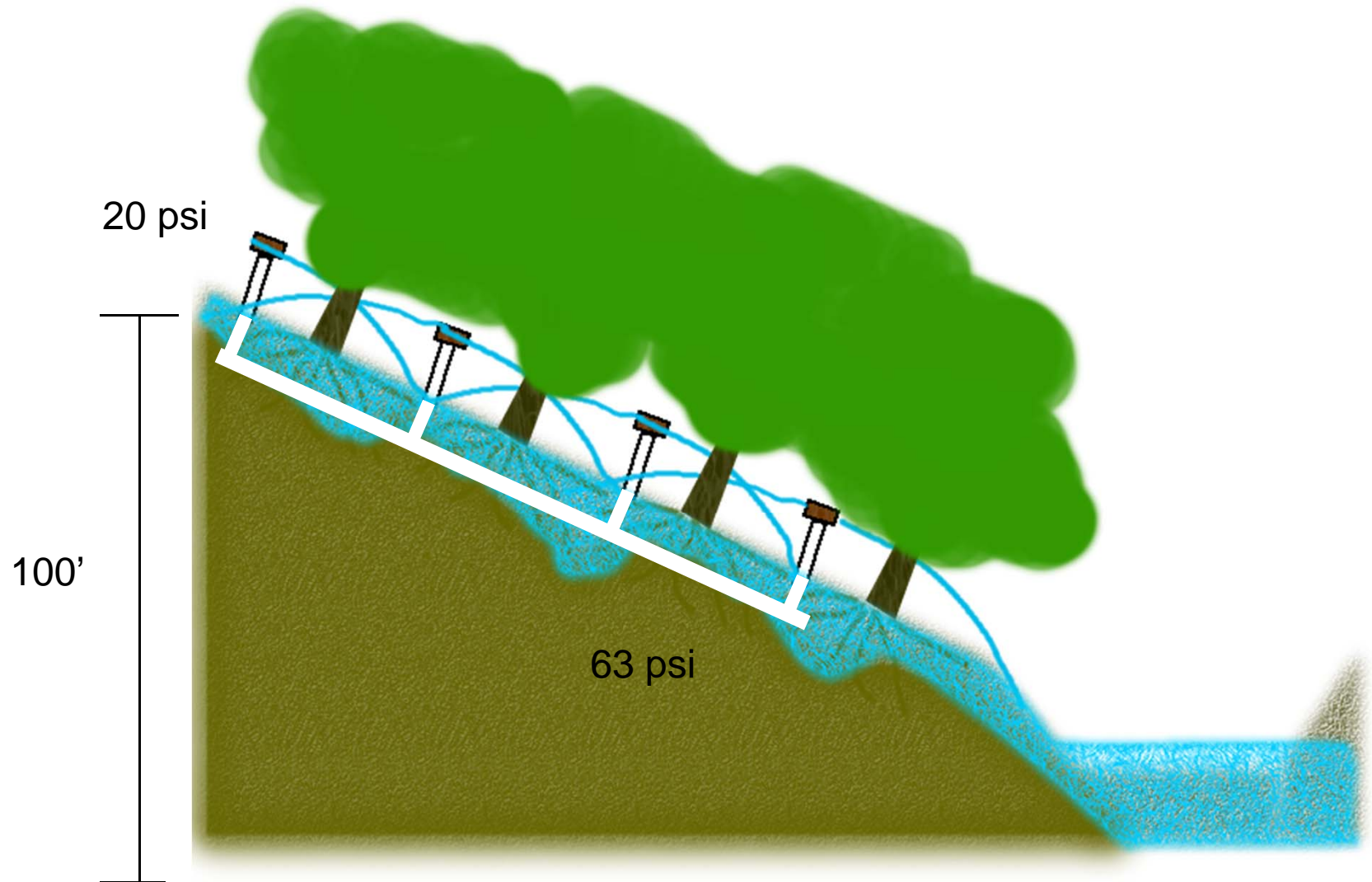
Common Design Problems

Lack of Pressure Regulation



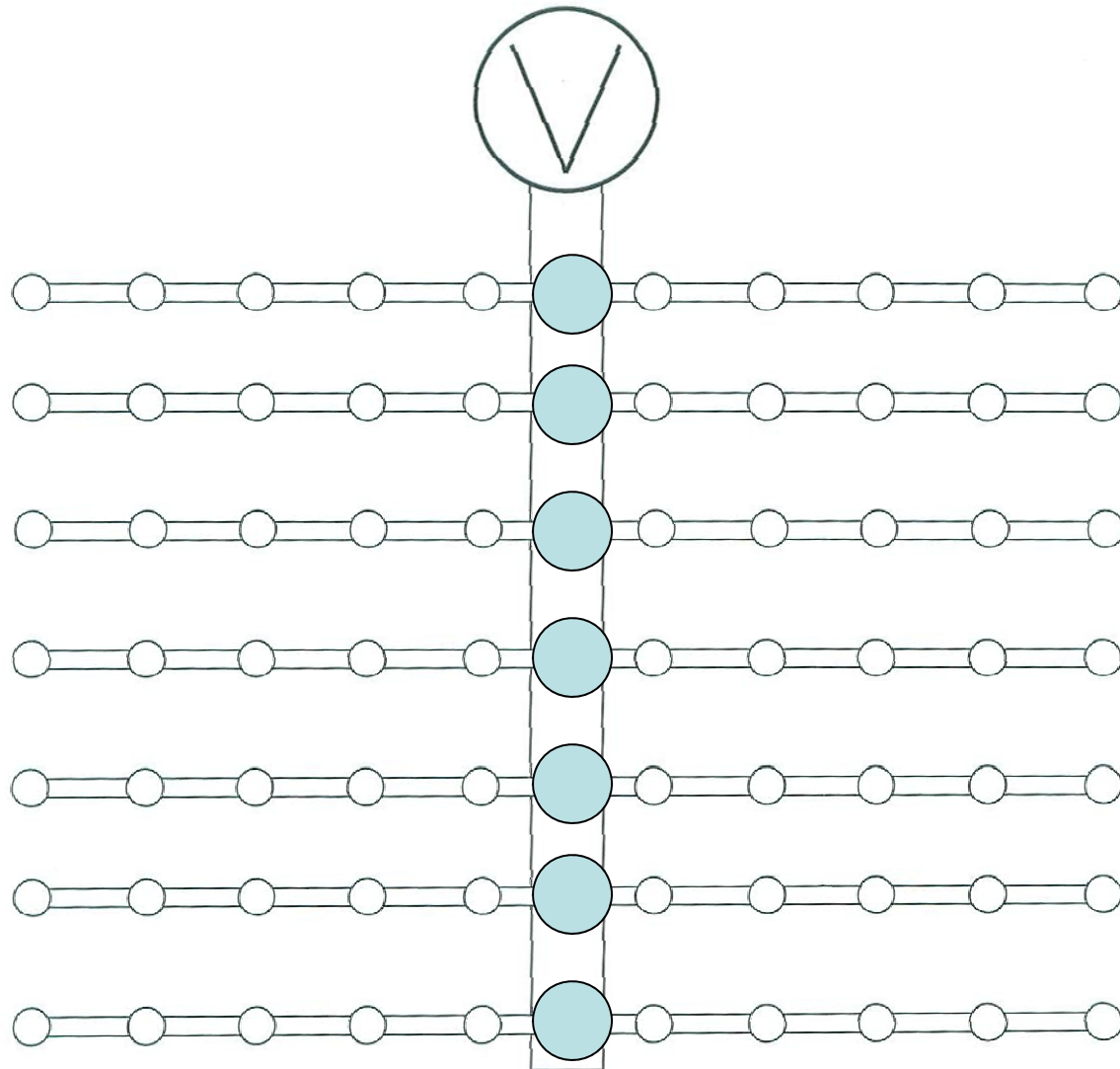
Common Design Problems

Lack of Pressure Regulation



Common Design Problems

Lack of Pressure Regulation



Common Design Problems

Lack of Pressure Regulation



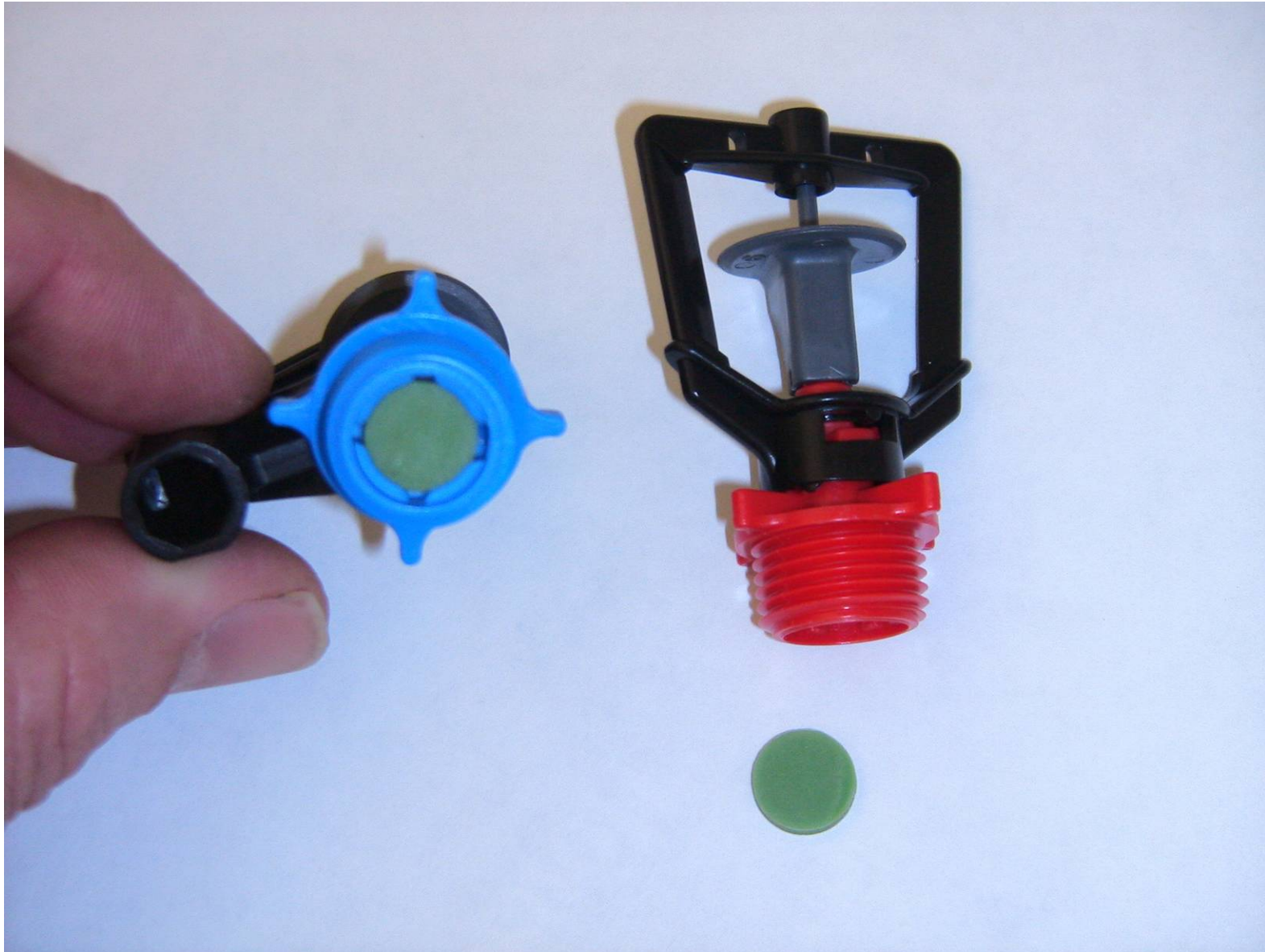
Common Design Problems

Lack of Pressure Regulation



Common Design Problems

Lack of Pressure Regulation



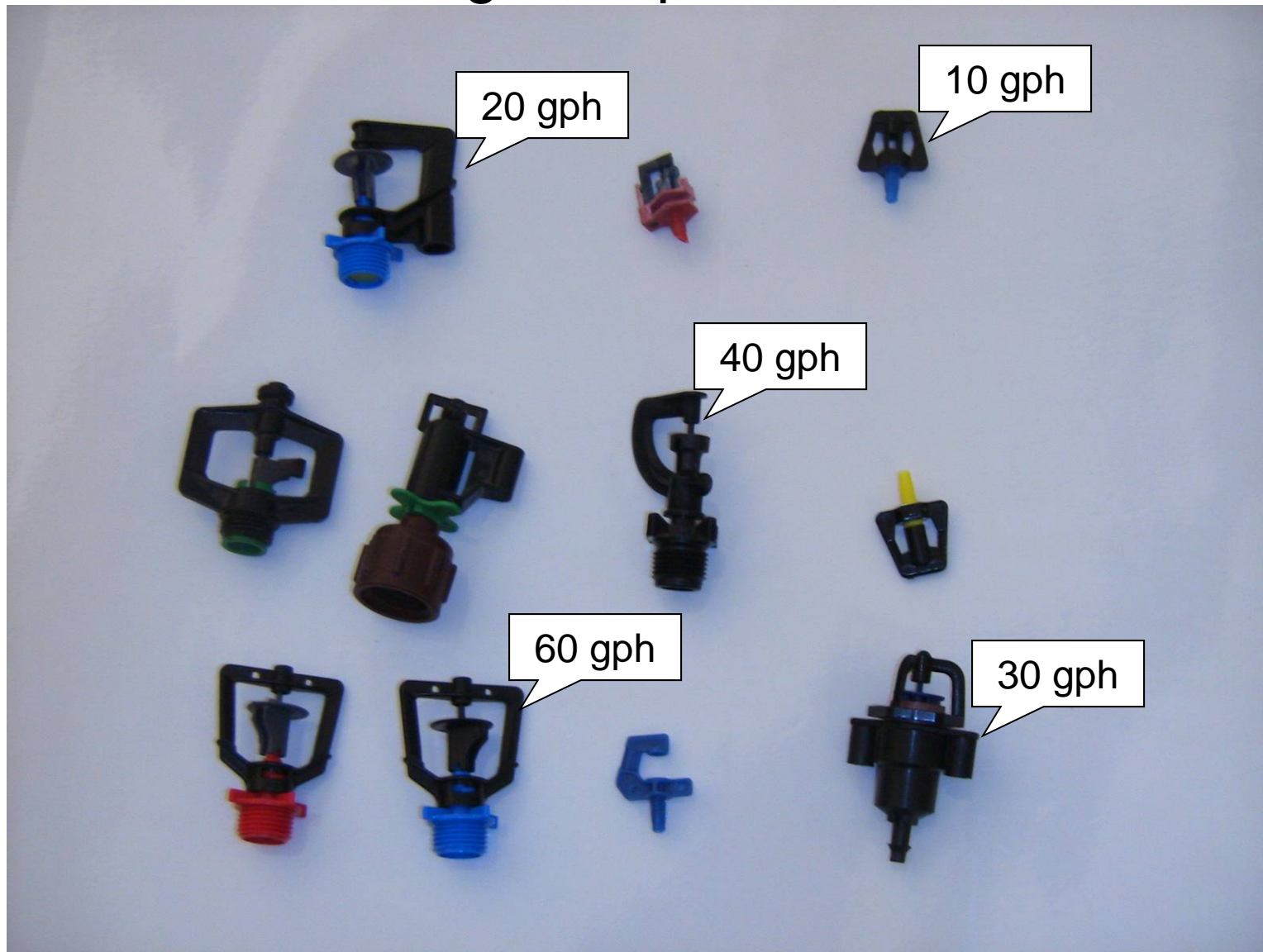
Common Design Problems

Not as Easy Ways to Raise DU

- Lack of Pressure Regulation
- Matching Precipitation Rates
- Exceeding Design Capacity

Common Design Problems

Matching Precipitation Rates



Common Design Problems

Not as Easy Ways to Raise DU

- Lack of Pressure Regulation
- Matching Precipitation Rates
- Exceeding Design Capacity

Common Design Problems

Design Capacity: Water Source

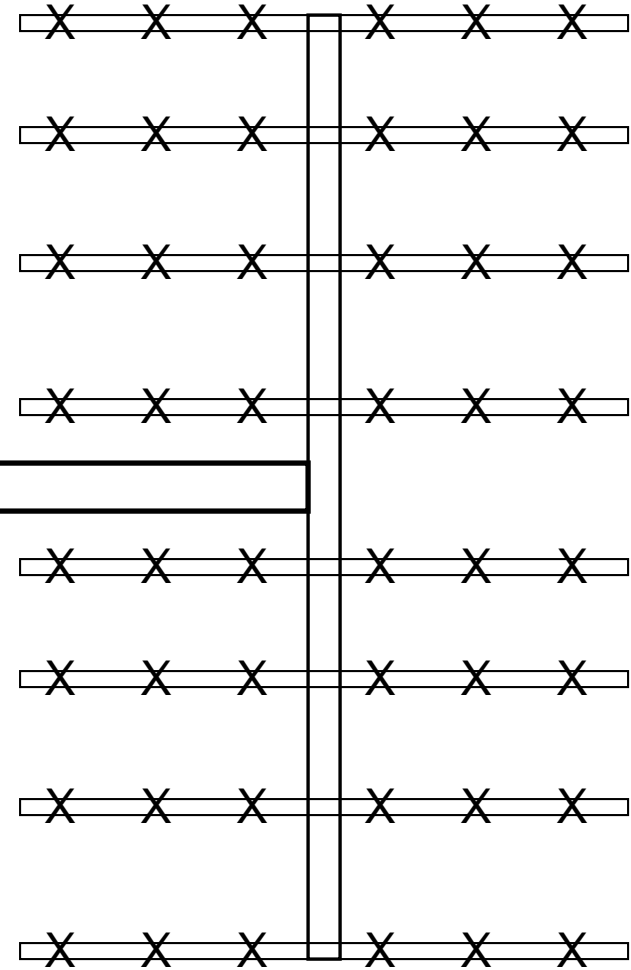


Common Design Problems

Design Capacity: Water Source



1" Water Meter = 50 GPM



48 Sprinklers @ 1.5 GPM
each = 72 GPM

Common Design Problems

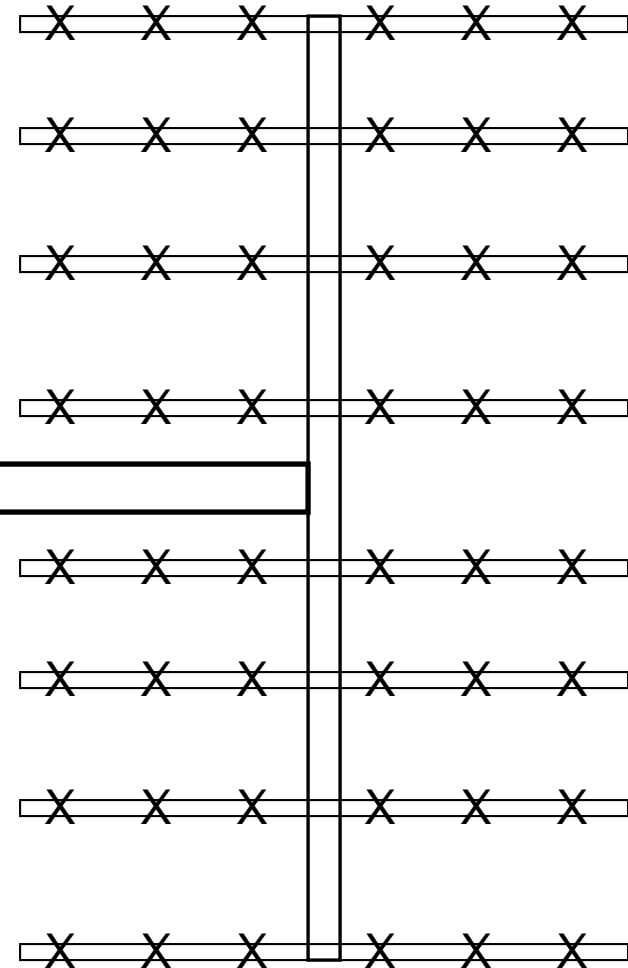
Design Capacity: Water Source



1" Water Meter = 50 GPM

72 GPM > 50 GPM

Demand Exceeds Capacity of Water Source



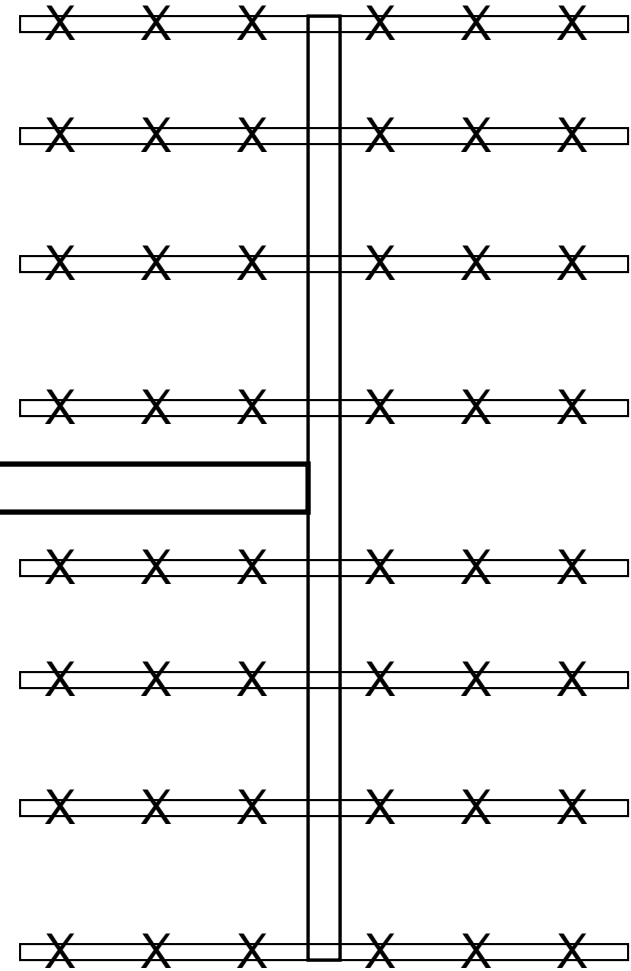
48 Sprinklers @ 1.5 GPM
each = 72 GPM

Common Design Problems

Design Capacity: Water Source



1 ½ " Water Meter = 100 GPM



48 Sprinklers @ 1.5 GPM
each = 72 GPM

Common Design Problems

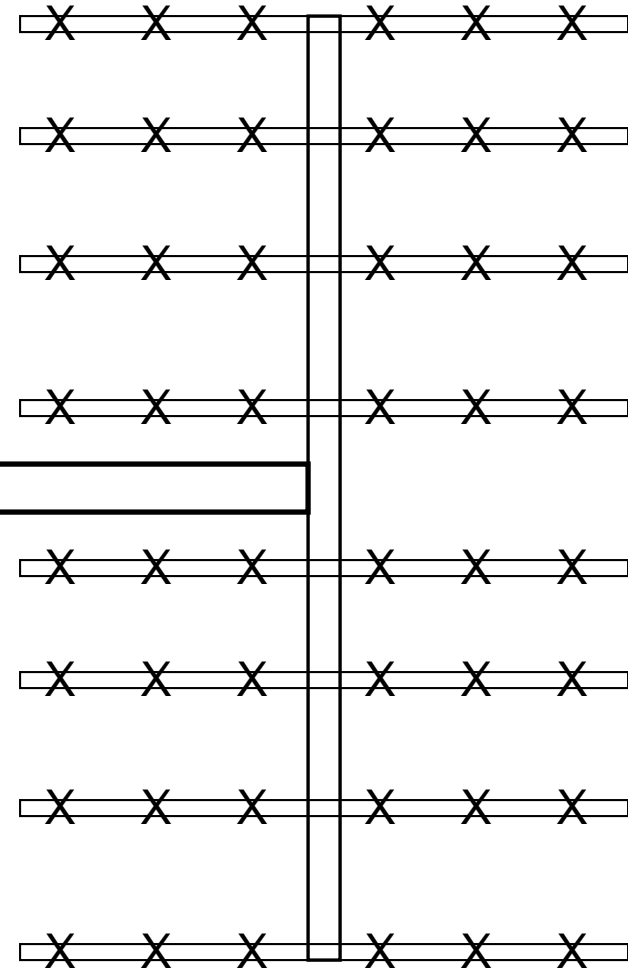
Design Capacity: Water Source



1 ½ " Water Meter = 100 GPM

72 GPM < 100 GPM

Demand Below Capacity of Water
Source



48 Sprinklers @ 1.5 GPM
each = 72 GPM

Common Design Problems

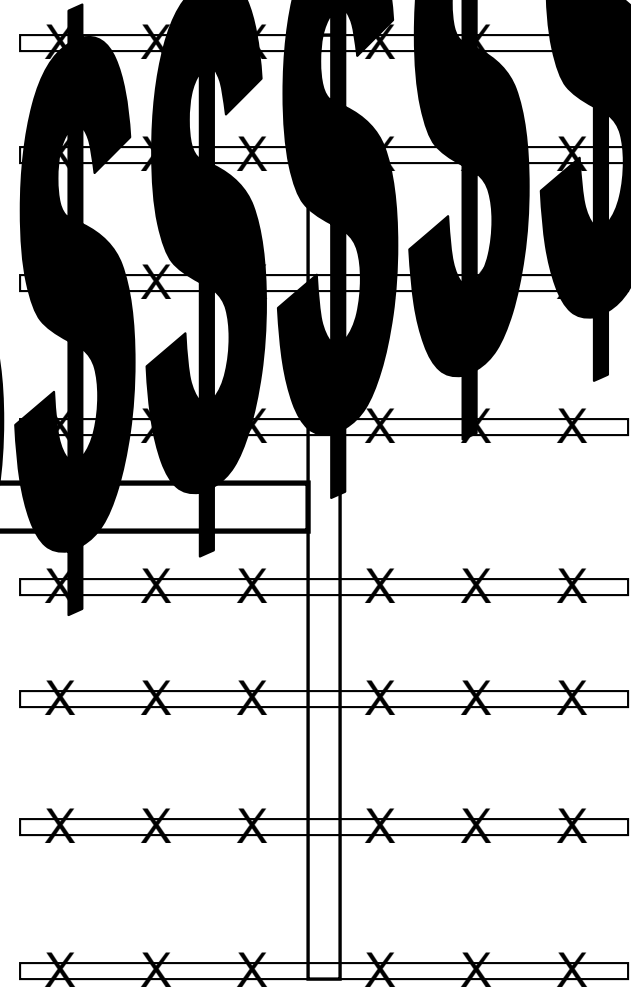
Design Capacity: Water Source



Water Meter = 100 GPM

70 GPM = 100 GPM

Demand below Capacity of Water Source



48 Sprinklers @ 1.5 GPM
each = 72 GPM

Common Design Problems

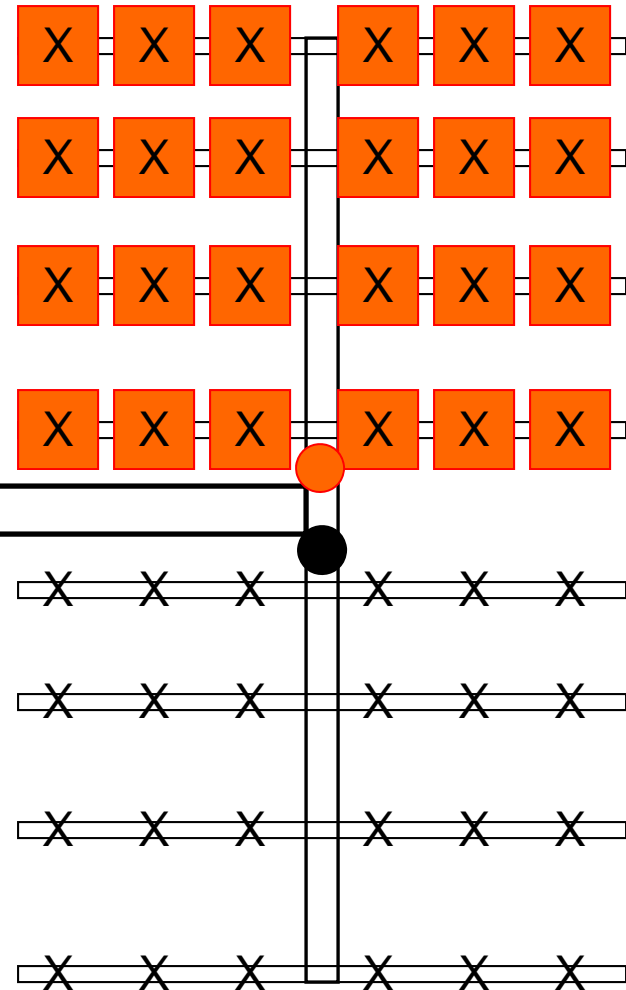
Design Capacity: Water Source



24 Sprinklers @ 1.5 GPM
each = 36 GPM

24 Sprinklers @ 1.5 GPM
each = 36 GPM

1" Water Meter = 50 GPM



Common Design Problems

Design Capacity: Water Source



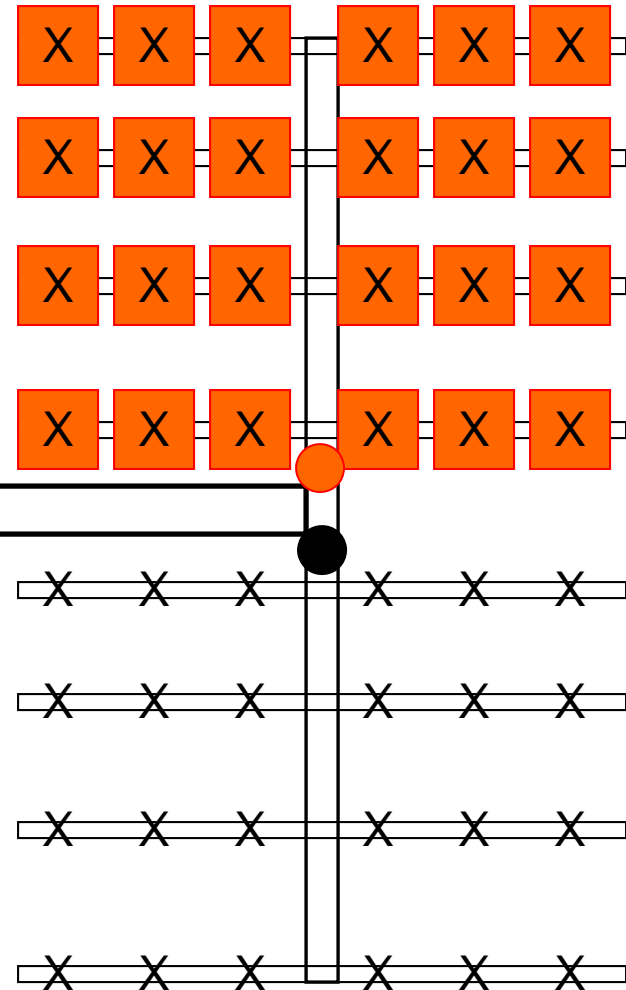
24 Sprinklers @ 1.5 GPM
each = 36 GPM

24 Sprinklers @ 1.5 GPM
each = 36 GPM

1" Water Meter = 50 GPM

36 GPM < 50 GPM

Demand Below Capacity of Water
Source

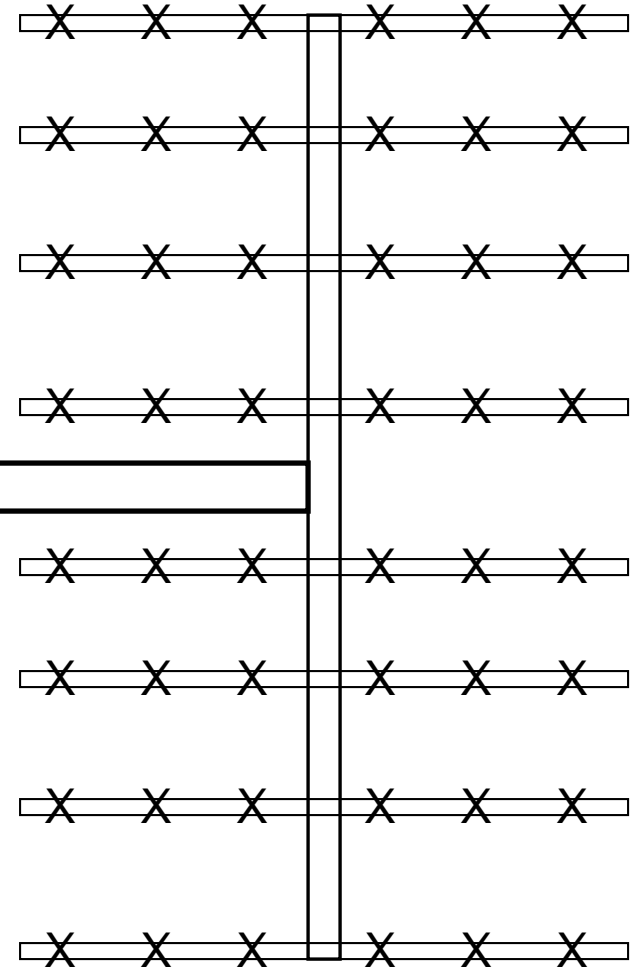


Common Design Problems

Design Capacity: Water Source



1" Water Meter = 50 GPM



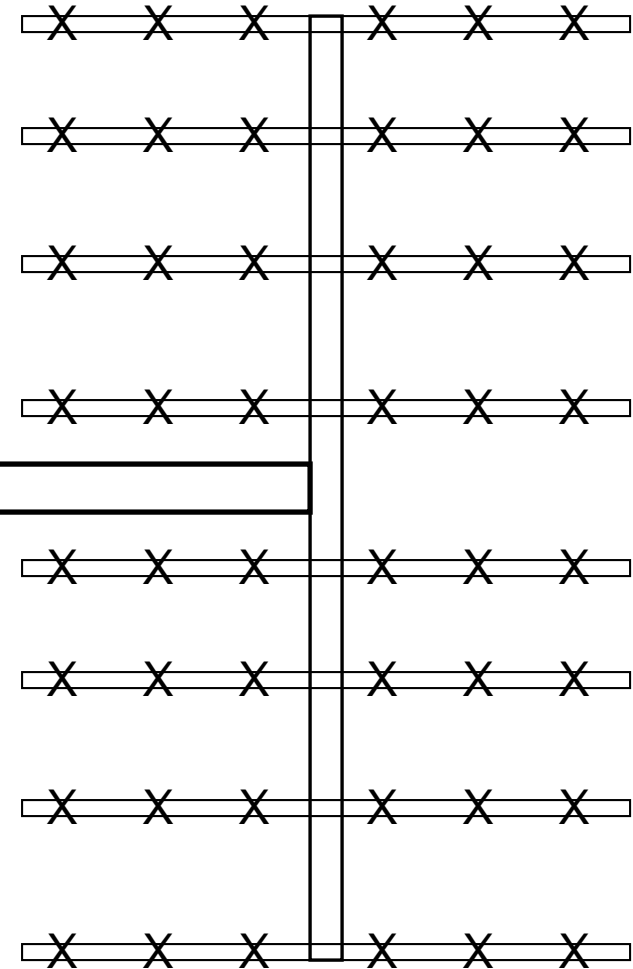
48 Sprinklers @ 1.5 GPM
each = 72 GPM

Common Design Problems

Design Capacity: Water Source



1" Water Meter = 50 GPM



48 Sprinklers @ 1 GPM each
= 48 GPM

Common Design Problems

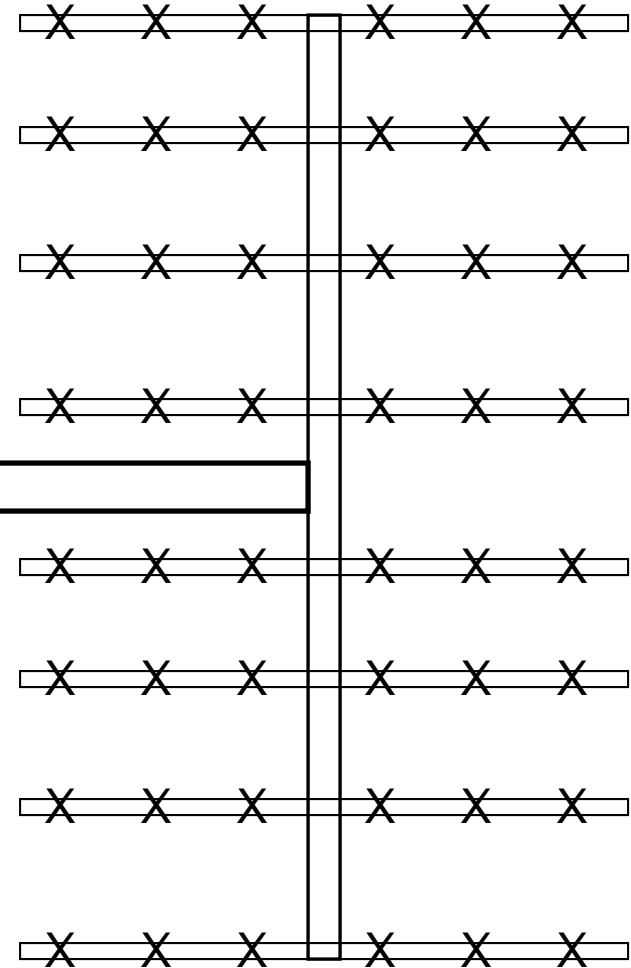
Design Capacity: Water Source



1" Water Meter = 50 GPM

48 GPM < 50 GPM

Demand Below Capacity of Water
Source



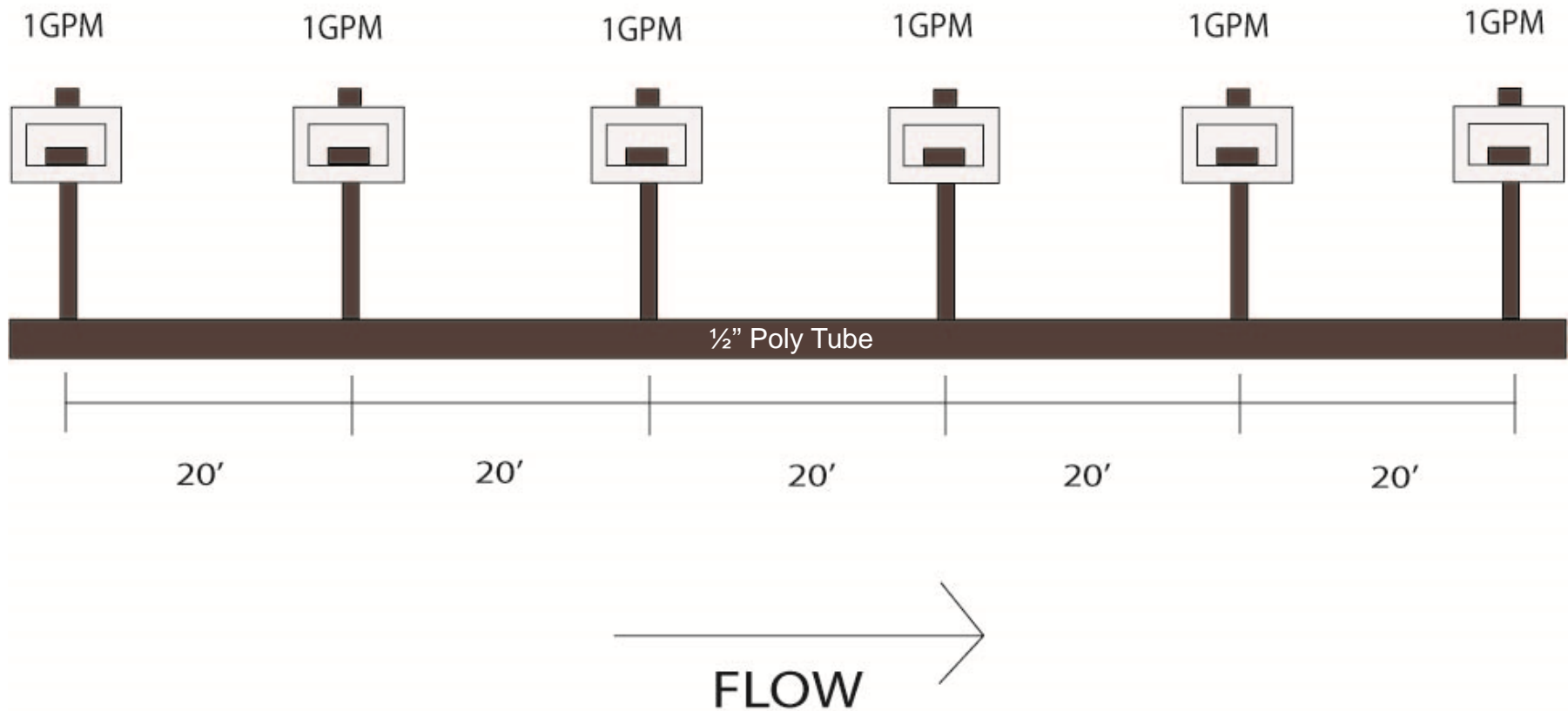
48 Sprinklers @ 1 GPM each
= 48 GPM

Common Design Problems

Design Capacity: Piping Material

Total Capacity = 2 GPM

TOTAL DEMAND = 6 GPM

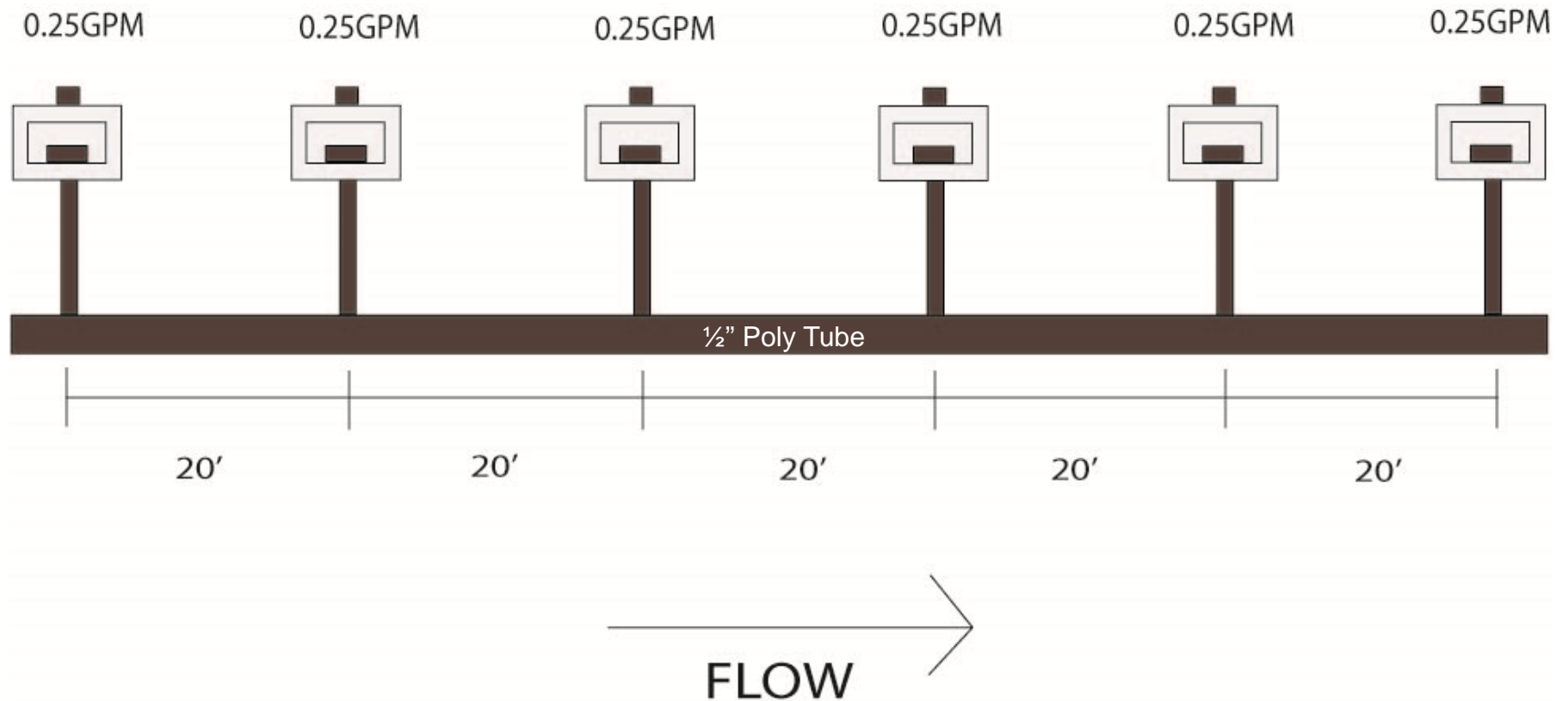


Common Design Problems

Design Capacity: Piping Material

Total Capacity = 2 GPM

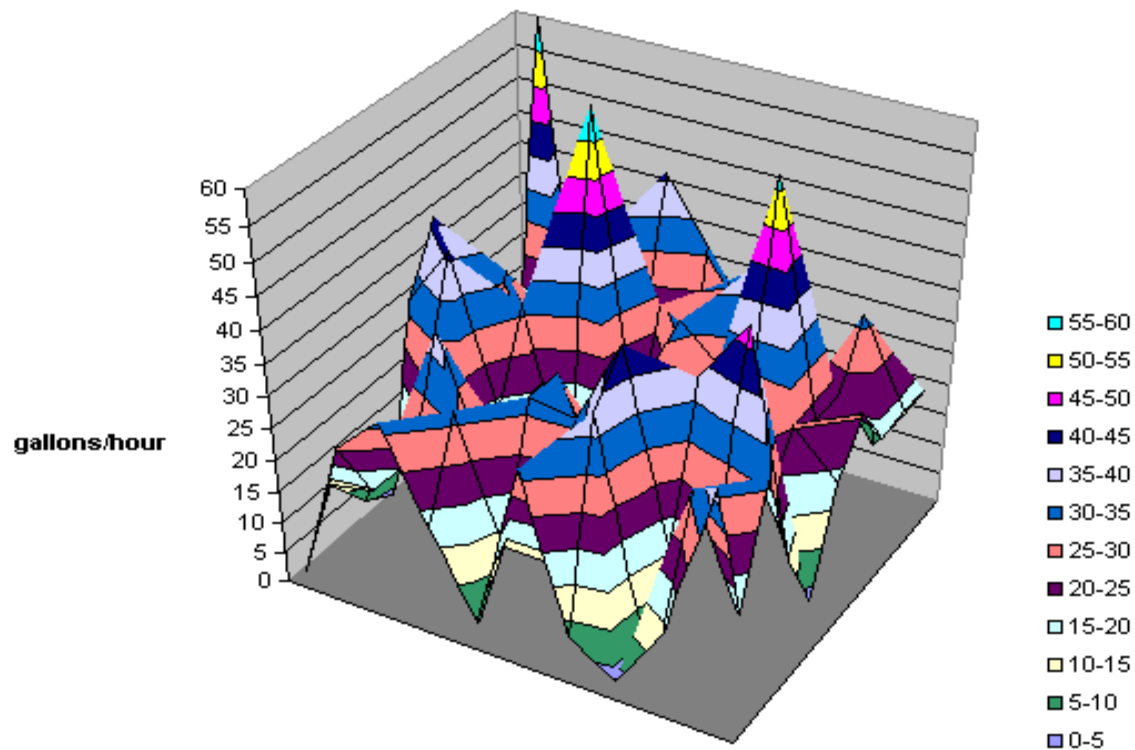
TOTAL DEMAND = 1.5 GPM



Irrigation System Efficiency

Distribution Uniformity

System Operating At Low Level of Efficiency



Irrigation System Efficiency

Importance of Distribution Uniformity

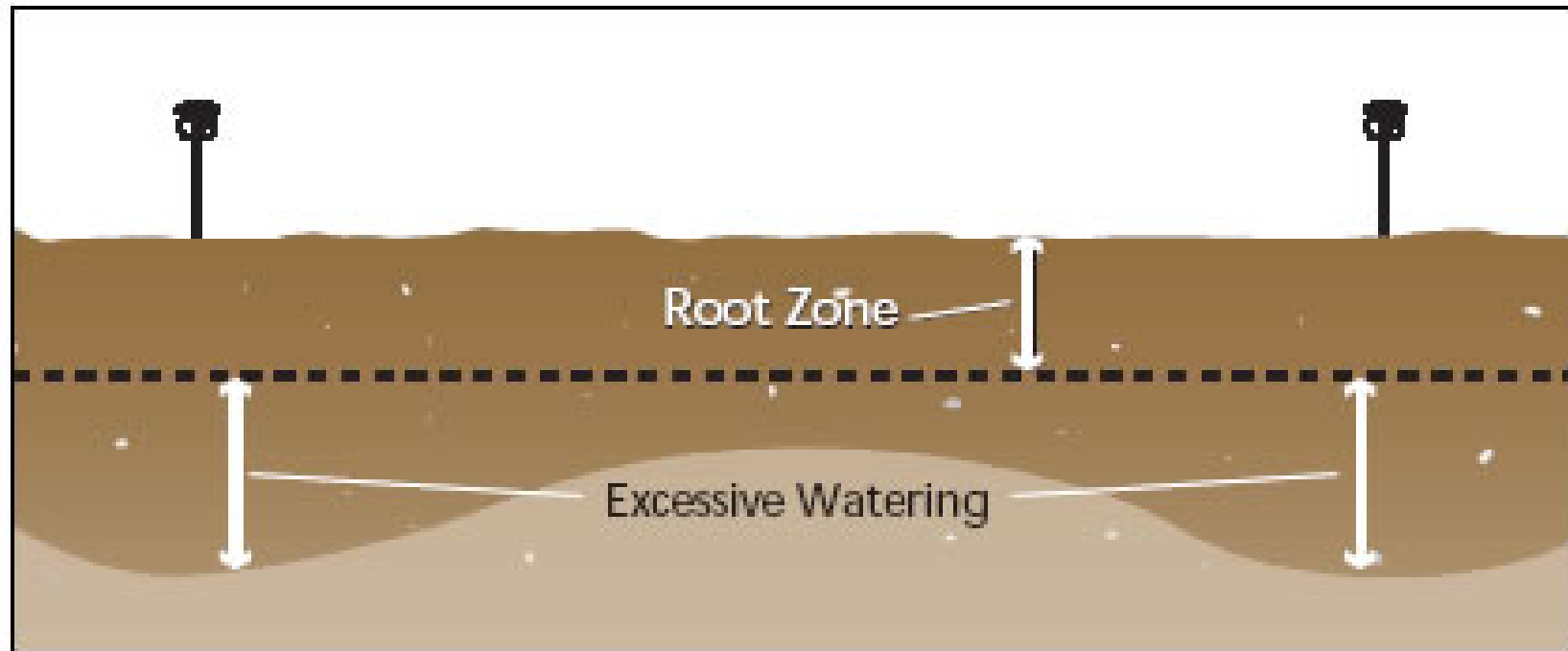


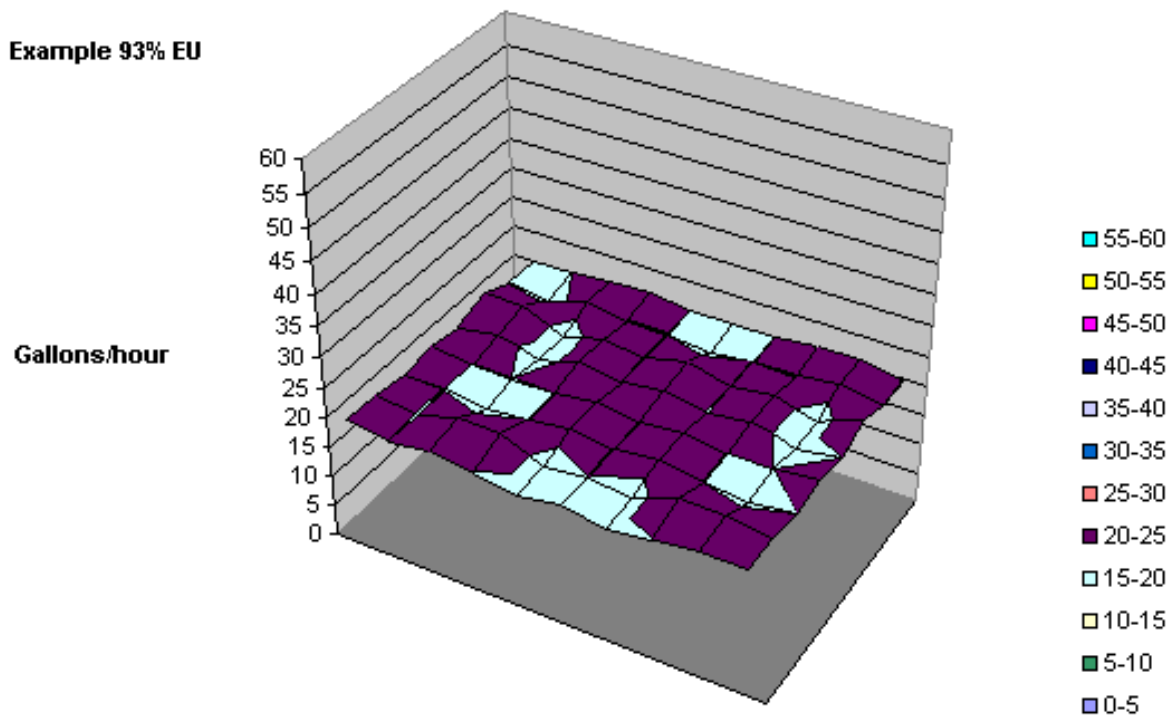
FIGURE 1: Depiction of irrigation resulting in poor DU and excessive watering

Irrigation System Efficiency

Distribution Uniformity

System Operating At High Level of Efficiency

Example 93% EU



Irrigation System Efficiency

Importance of Distribution Uniformity

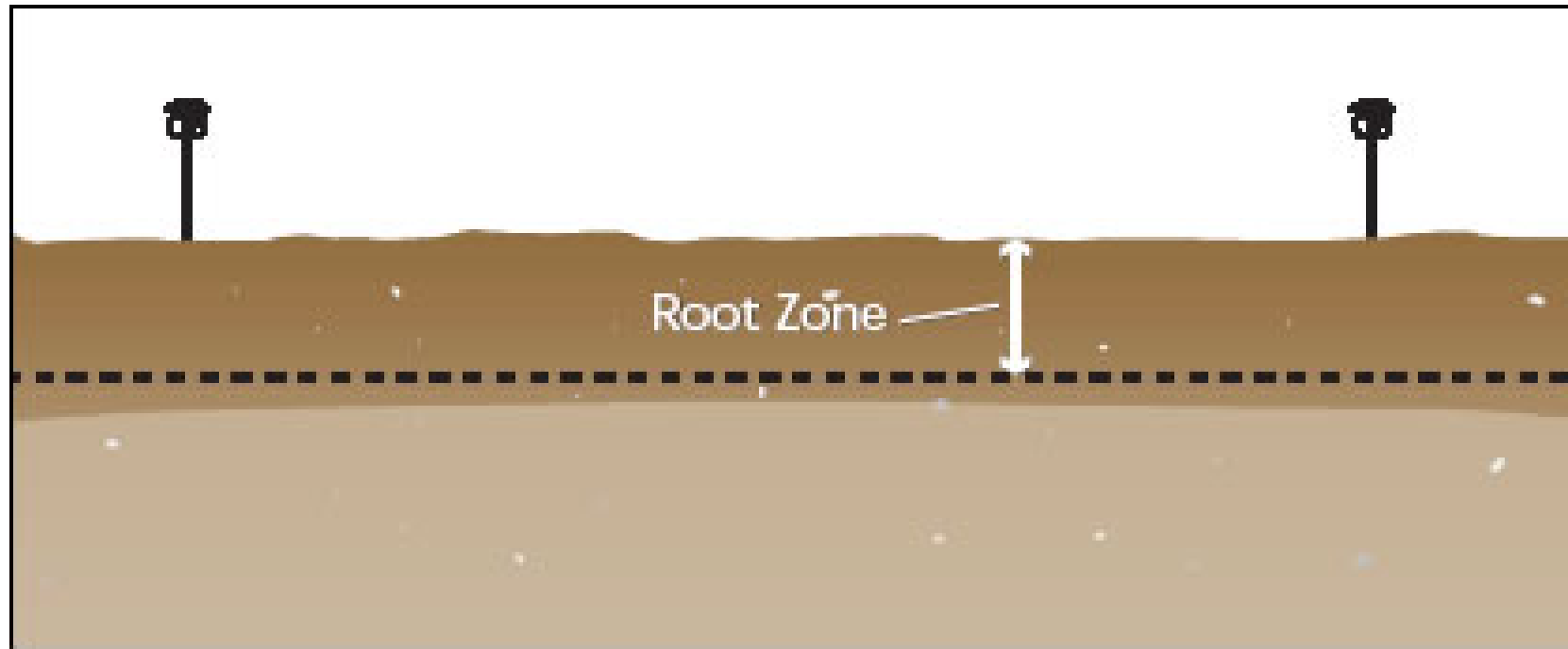


FIGURE 4: Depiction of irrigation sufficiently watering the entire field with good DU and irrigation efficiency

Irrigation Efficiency

```
graph TD; A[Irrigation Efficiency] --> B[Irrigation System Efficiency]; A --> C[Efficient Water Management];
```

**Irrigation System
Efficiency**

**Efficient
Water
Management**

Irrigation Efficiency

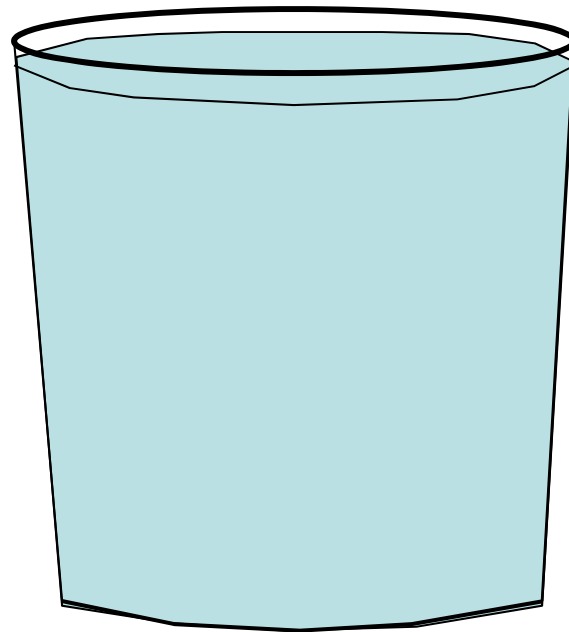
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```

Irrigation System
Efficiency

Efficient
Water
Management

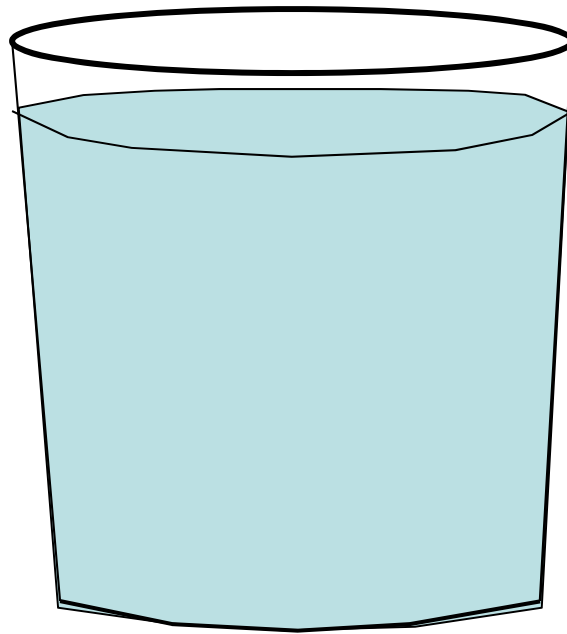
Efficient Water Management

Soil Reservoir as Cup of Water



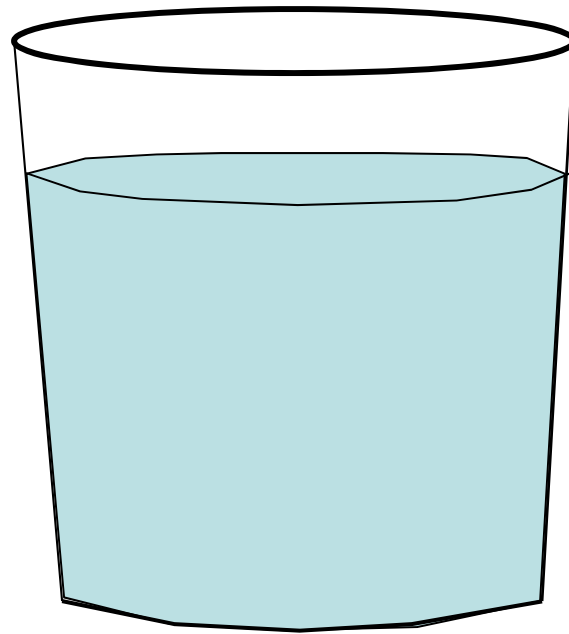
Efficient Water Management

Soil Reservoir as Cup of Water



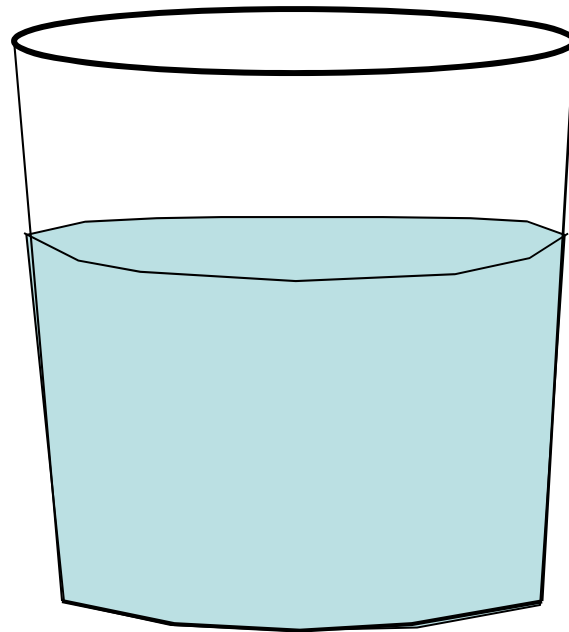
Efficient Water Management

Soil Reservoir as Cup of Water



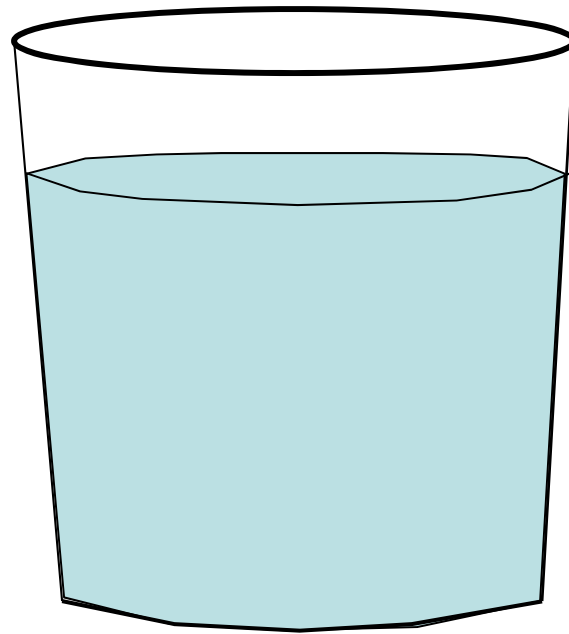
Efficient Water Management

Soil Reservoir as Cup of Water



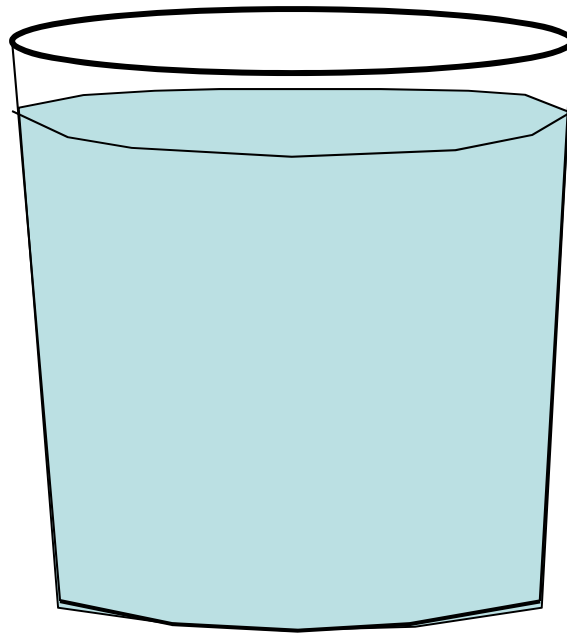
Efficient Water Management

Soil Reservoir as Cup of Water



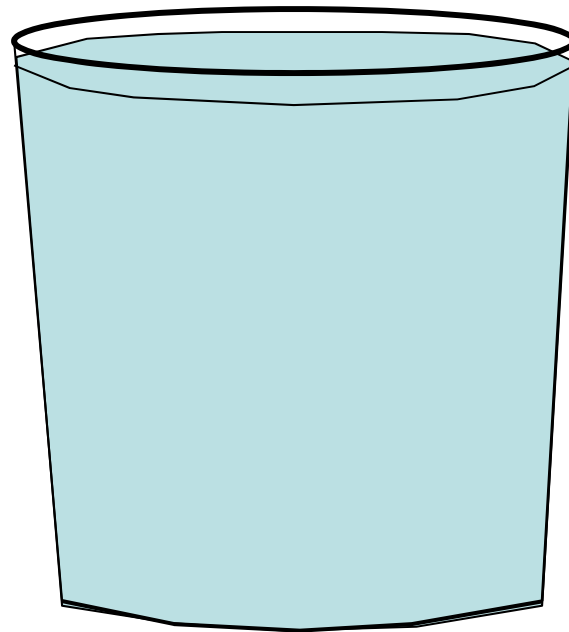
Efficient Water Management

Soil Reservoir as Cup of Water



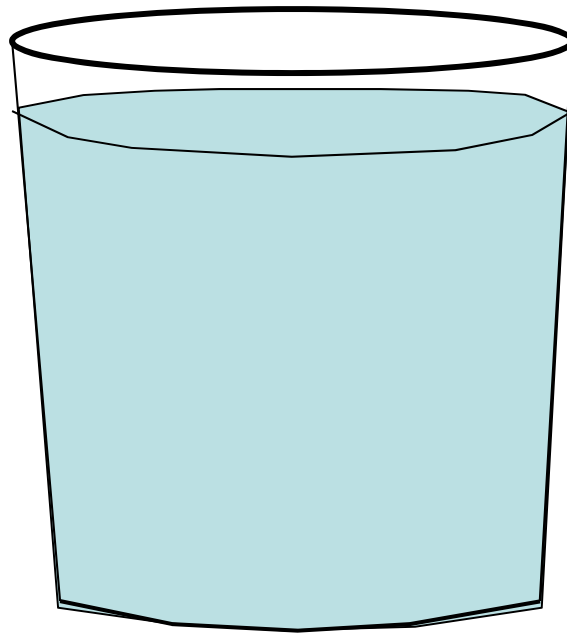
Efficient Water Management

Soil Reservoir as Cup of Water



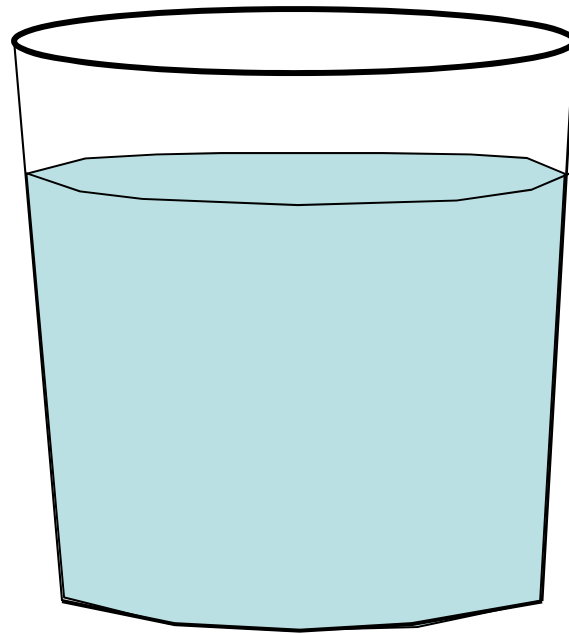
Efficient Water Management

Soil Reservoir as Cup of Water



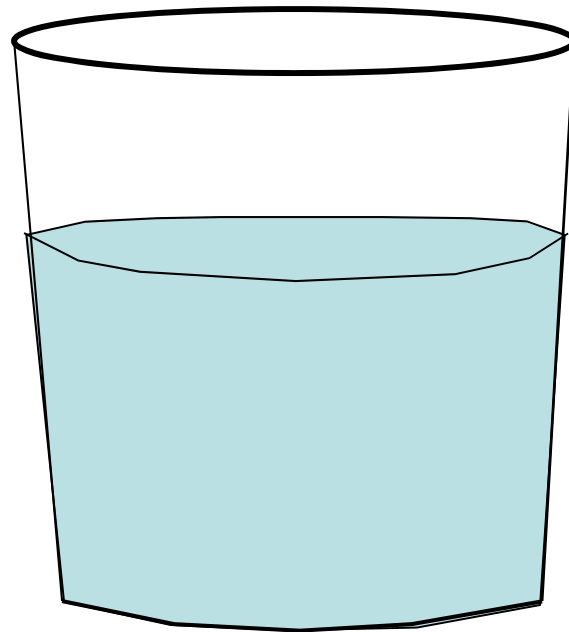
Efficient Water Management

Soil Reservoir as Cup of Water



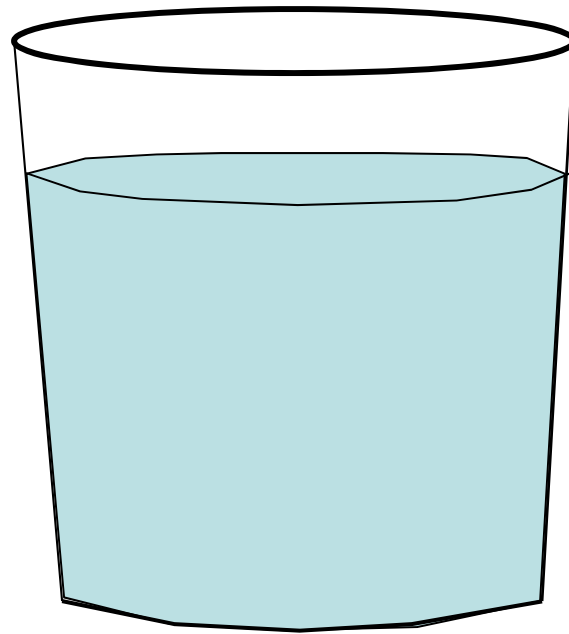
Efficient Water Management

Soil Reservoir as Cup of Water



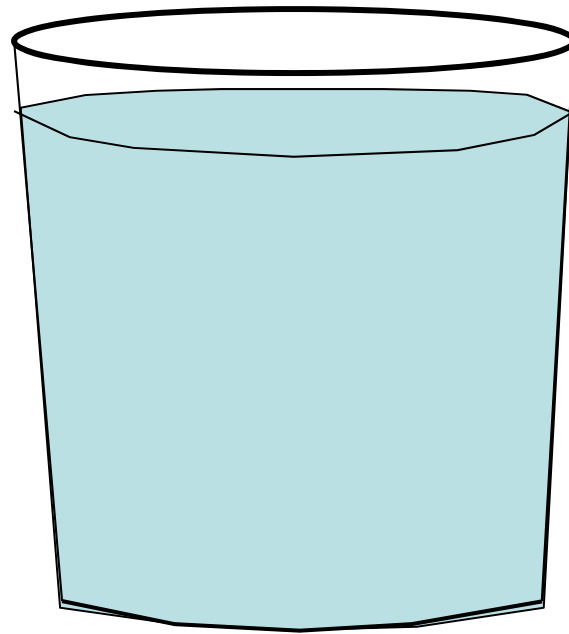
Efficient Water Management

Soil Reservoir as Cup of Water



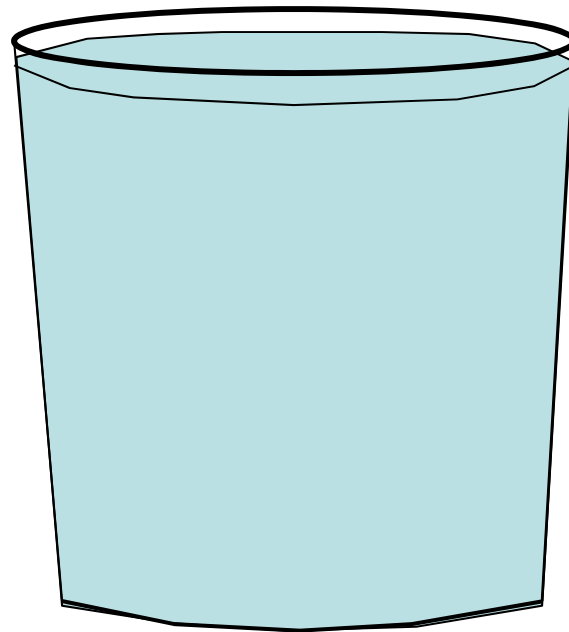
Efficient Water Management

Soil Reservoir as Cup of Water



Efficient Water Management

Soil Reservoir as Cup of Water



Efficient Water Management

When and For How Long do I Irrigate?

- Need to know 4 things:
 - How much water does my cup (soil reservoir) hold?
 - How fast am I losing that water?
 - How much water can be removed from my cup (soil reservoir) before I need to refill it?
 - How long will it take my sprinklers to refill it?

Efficient Water Management

How Much Water Does My Soil Reservoir Hold?



Efficient Water Management

How Much Water Does My Soil Reservoir Hold?



Efficient Water Management

How Much Water Does My Soil Reservoir Hold?

Soil series and map symbols	Depth to hard rock or hardpan	Depth from surface (typical profile)	Classification		Permeability	Available water capacity
			Dominant USDA texture	Unified		
	<u>Ft.</u>	<u>In.</u>			<u>In./hr.</u>	<u>In./in. of soil</u>
Bosanko: BsC, BsD, BsE, BtC--	1½-3	0-30 30	Clay and sandy clay loam. Decomposed granite.	CL	0.06-0.2	0.14-0.16
Bull Trail: BuB, BuC, BuD2, BuE2.	>5	0-10	Sandy loam-----	SM	2.0-6.3	0.11-0.13
		10-32 32-60	Sandy clay loam----- Loamy sand and sand--	SC SM	0.2-0.63 6.3-20.0	0.14-0.16 0.06-0.08
Calpine: CaB, CaC, CaC2, CaD2.	>5	0-34	Coarse sandy loam----	SM	2.0-6.3	0.10-0.12
		34-64	Fine gravelly loamy sand.	SM	2.0-6.3	0.05-0.07
Carlsbad: CbB, CbC, CbD, CbE.	1½-3½	0-21	Gravelly loamy sand--	SM	2.0-6.3	0.05-0.07
		21-39	Loamy sand-----	SM	2.0-6.3	0.07-0.09
		39-50	Weakly cemented hard- pan.	---	<0.06	-----
Carrizo: CeC-----	>5	0-60	Very gravelly sand---	GP or GW	>20.0	0.03-0.05

Efficient Water Management

When and For How Long do I Irrigate?

- Need to know 4 things:



- How much water does my cup (soil reservoir) hold?
- How fast am I losing that water?
- How much water can be removed from my cup (soil reservoir) before I need to refill it?
- How long will it take my sprinklers to refill it?

Efficient Water Management

How Fast is Water Being Used by the Crop and
Evaporated by the Sun's Heat

<http://www.cimis.water.ca.gov/cimis/welcome.jsp>



Efficient Water Management

How Fast is Water Being Used by the Crop and
Evaporated by the Sun's Heat

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Stn Id	Station	Date	CIMIS ETo (in)	Precip (in)
62	Temecula	7/10/2007	0.16	0
62	Temecula	7/11/2007	0.2	0
62	Temecula	7/12/2007	0.22	0
62	Temecula	7/13/2007	0.24	0
62	Temecula	7/14/2007	0.19	0
62	Temecula	7/15/2007	0.2	0
62	Temecula	7/16/2007	0.19	0

Efficient Water Management

When and For How Long do I Irrigate?

- Need to know 4 things:



- How much water does my cup (soil reservoir) hold?



- How fast am I losing that water?
- How much water can be removed from my cup (soil reservoir) before I need to refill it?
- How long will it take my sprinklers to refill it?

Efficient Water Management

How much water can be removed from the soil reservoir
before I need to refill it?

- » Avocados - at 30% depletion
- » Citrus – at 50% depletion
- » Nursery crops – variable (50%)

Efficient Water Management

When and For How Long do I Irrigate?

- Need to know 4 things:



- How much water does my cup (soil reservoir) hold?



- How fast am I losing that water?



- How much water can be removed from my cup (soil reservoir) before I need to refill it?

- How long will it take my sprinklers to refill it?

Efficient Water Management

How Long Will My Sprinklers Take to Refill It?



Efficient Water Management

When and For How Long do I Irrigate?

- Need to know 4 things:

- ✓ • How much water does my cup (soil reservoir) hold?
- ✓ • How fast am I losing that water?
- ✓ • How much water can be removed from my cup (soil reservoir) before I need to refill it?
- ✓ • How long will it take my sprinklers to refill it?



Riverside County (3 labs in county)

East County/High Desert (760) 347-7658

West County (909) 683-7691 <http://www.rcrcd.com/>

South East County (909) 654-7733

<http://wwwcimis.water.ca.gov/cimis/infoIrrSchedule.jsp>