Drip, Drip, Drip Irrigation Pros/Cons

Texas Turfgrass Association

Summer Conference,

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What I've learned…

- It's easy to make erroneous assumptions about drip
- Designers, Installers and Managers don't always know what they are doing
- Determining the precipitation rate for irrigation scheduling is often a challenge

My Questions…

- In reality, is mineral clogging a likely problem when using municipal water?
- How deep should subsurface drip be burried?
- Can drip survive in urban landscapes with good performance?

Long-term Viability of Subsurface Drip Irrigation of Turfgrass

Location:

Texas A&M University Campus, College Station

Design

6" BowSmith
24" BowSmith
12" BowSmith
18" BowSmith
12" Netafim
18" Toro
12" Roberts
24" Roberts
6" BowSmith
24" BowSmith
12" BowSmith
18" BowSmith
12" Netafim
18" Toro
12" Roberts
24" Roberts

Installation Completed, Summer 2009

Product Installation

- 4 Methods Utilized
  - Mini-Creeper
  - Tractor w/Single Plow
  - Tractor w/Double Plow
  - Hand Installation

Mini-Creeper

Tractor w/Single Plow

- Used for Installing Tubing Products

Tractor w/Double Plow

- Used for Installing Drip Tape

Hand Installation

Installation Comparison

Method	Mini-Creeper	Single Plow	Double Plow	Hand-Manual
Ease of Use	Challenging	Simple	Simple	Challenging
Ability to Install Straight Lines	Challenging	Simple	Simple	Challenging
Ground Disturbance	Major	Minor	Minor	Major
Depth Control	Challenging	Simple	Simple	Challenging
Width Control	Challenging	Challenging	Simple	Challenging

12" Tubing Product

18" Tubing Product

12" Tape Product (AG)

24" Tape Product (AG)

6" Tape Product

24" Tape Product

2009-10 Results – Normal to Wet Years

Does not matter what spacing you use

2011 Results – Dry Year (Drought Conditions)

Streaking occurred in spacings greater than 12 inches under a "*conservation*" level of irrigation

Problems

MAINTENANCE

Large Pressure Variations on Campus

Spikes up to 90 PSI

2010 Problems – Wet Year

June/July: ETo= 11.63”, Rain = 9.12”

2011

- Ground Shifting tearing product and breaking pipes/fittings
- No Clogging problems…yet

2011 Filter Cleanout

2011 Problems

2011 Performance

- Continue to Monitor Pressures

- 2012 starting to see some pressure increases

Pressure Readings (PSI) Per Plot During Study							
	Treatments-Plots						
Date	1	2	3	4	5	6	7
Jun-08	10	10	20	12	NA	NA	NA
Mar-09	10	10	25	12	10	10	25
Jun-10	12	12	25	12	12	12	25
Aug-11	12	12	25	12	12	12	25
Jul-12 What if these are correct??	11	16	15	9	12	15	6

Summary: Problems

- Incorrect pipe gluing
- Incorrect drip fitting installation
- High pressure (non regulated)
- Delicate drip products
- Over saturated soils (irrigation + too much rainfall)
- No winterization, winter soil compaction

Summary: Lessons Learned

- Be sure your workers know what they are doing
- Coordinate irrigation with ground crews
- Don’t forget to irrigate during the winter to keep trip lines open

DRIP IRRIGATION WORKSHOP

State Irrigation Regulations

- *§344.62.Minimum Design and Installation Requirements.*

"New irrigation systems shall not utilize above-ground spray emission devices in landscapes that are less than 48 inches not including the impervious surfaces in either length or width and which contain impervious pedestrian or vehicular traffic surfaces along two or more perimeters. "

48 Inch Rule, 5ft Rule

- Example: the landscape between roads and sidewalks

Types of Drip

Types of Drip Products

- Three Main types of Drip:
  - Tape
  - Tubing with Embedded Emitters
  - Poly pipe with emitter inserts

Drip Products – Drip Tape

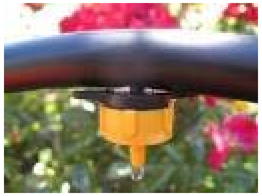
- Thin Wall Flat Drip Tape
  - Contains embedded emitters
  - Operates Under Low Pressure Conditions
  - Popular in vegetable production

Drip Products – Drip Tubing With Embedded Emitters

- Durable Thick Wall Tubing
- Usually contain pressure compensating embedded emitters
- Can operate under higher pressures

Drip Products – Drip Tubing with Inserted Emitters

- Uses hard hose PE tubing
- Allows for precision application of water
- Flexible Precipitation Rates, based on emitter
- Used for Shrubs and Trees

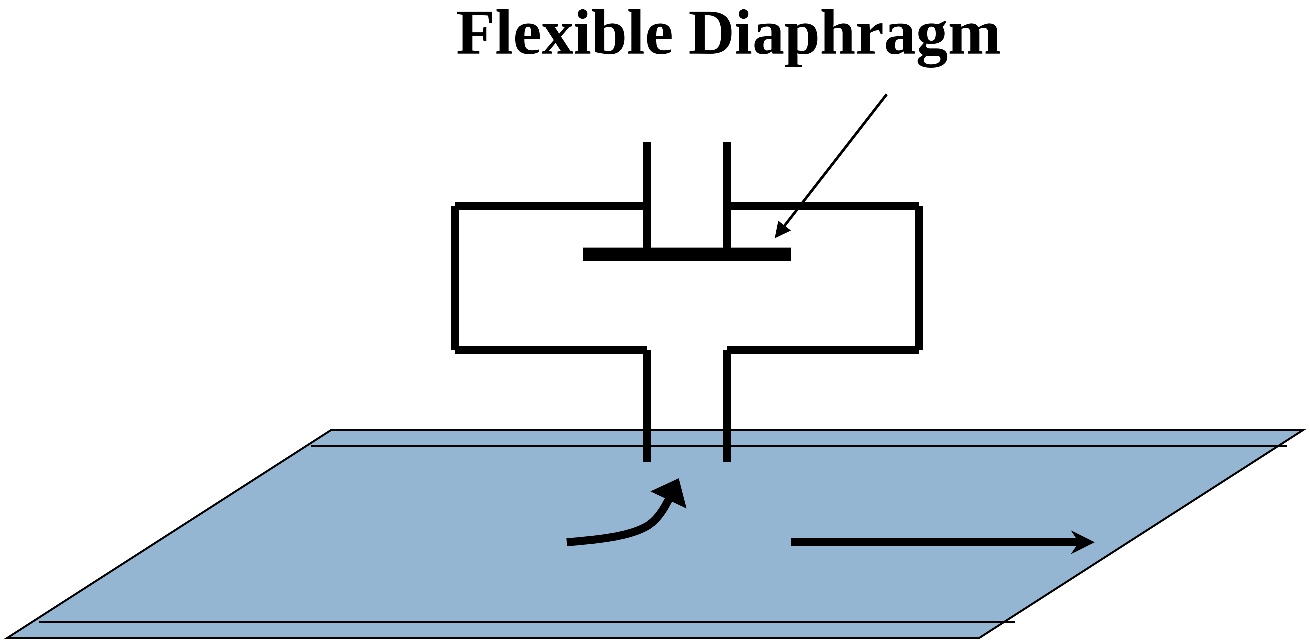


On Line Emitters

In-Line Emitter

Terminology (cont.)

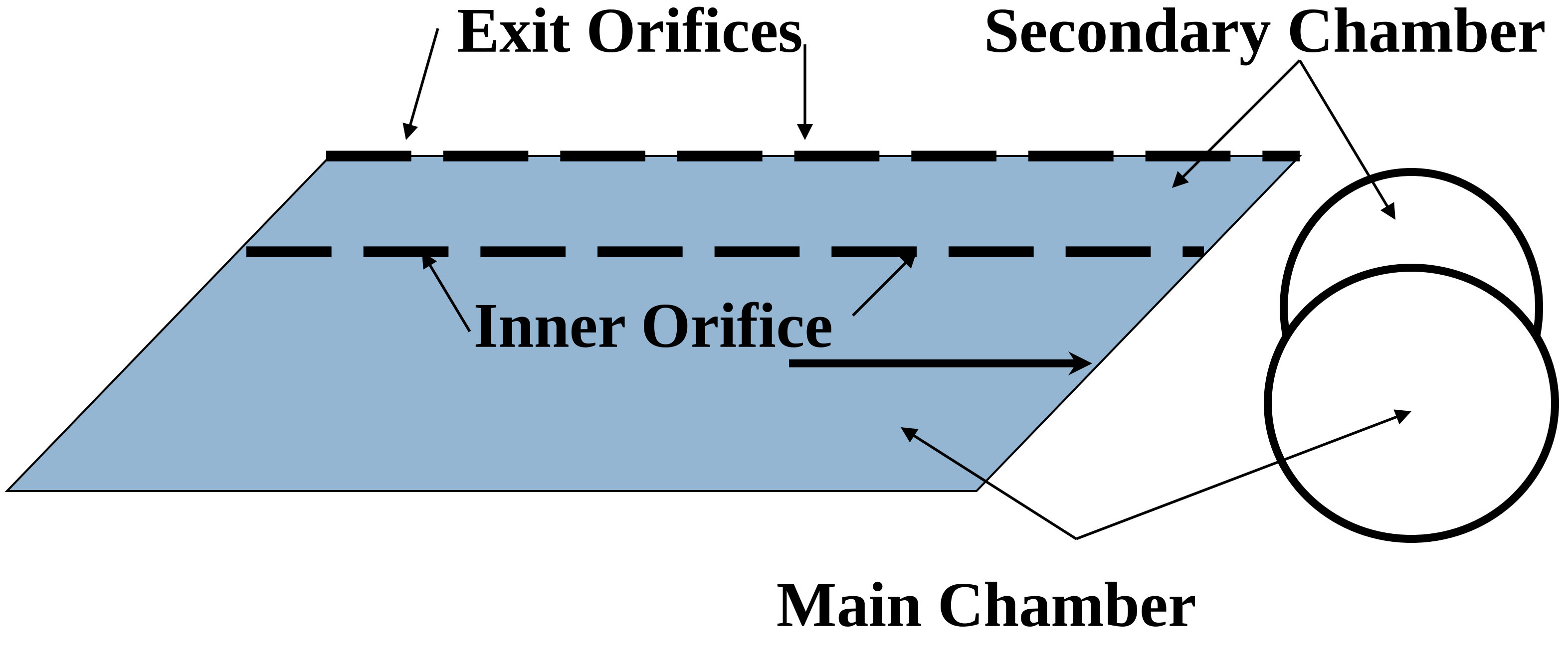
- “Pressure compensating emitters” - flow remains nearly constant with varying inlet pressures
- Disc or rubber diaphragm located inside the emitter closes slightly as pressure increases ... reducing the cross sectional area, thus reducing flow



Pressure Compensating Emitter

Terminology (cont.)

- “Self-flushing” - water travels through the emitter at high velocity during start-up to remove debri
- Should not be regarded as a substitute for a filtration device
- Newer designs have flexible emitters that self-flush when plugged



Twin - Chamber Tubing

Screens & Filters

- Used to catch plastic and sediment in the irrigation water
- Prevent clogging of emitters and valves.

Screens & Filters

- Screen filters are used for drip systems connected to municipal water sources and other “clean” water sources
- Sand media filters or disc filters may be required for drip systems connected to surface water (rivers, lakes, ponds, etc.)

Operational Indicators

- Flags
- Misters
- Capped Spray Body
  - Can be used a visual indicators that a drip system is operating

Advantages of Drip

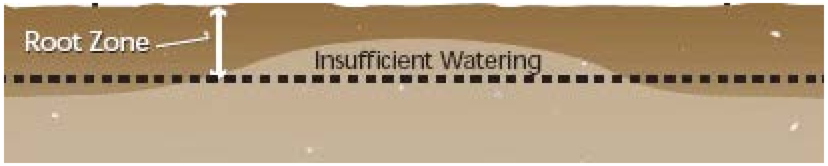
Advantages

- Low Evaporation Loss
  - Water is being applied at the soil surface, not in the air
- No wind drift loss

- Low runoff potential

Advantages

- Potential for precise soil moisture control
  - Apply water directly to the soil and/or root zone



- Requires less water pressure

Advantages (cont.)

- Smaller pipe size requirements
- Reduced weed growth when used with a mulch
- Reduced liability due to water on hardscapes
- Improved performance for plants on steep slopes

Benefits of Drip

- Allows for areas to be irrigated more efficiently that couldn't before
  - Slopes
  - Thin areas
- Low flow rate allows for larger areas to be irrigated at the same time.
- Ability to irrigate when the site may be in use

Disadvantages of Drip

Disadvantages

- Requires constant monitoring and maintenance
- May be cost prohibitive for large landscape areas (I.e., turfgrass)
- Applies a limited supply of water into the root zone
  - May require long runtimes

Disadvantages (cont.)

- Requires filtration and pressure regulation
- Surface tape and tubing are more susceptible to pests and vandalism
  - Rodents and Gophers like to chew on buried products

- Subsurface installations may reduce customer confidence
  - Typically cant see it operating, owners want to see what they paid for

Clogging Control

Chemigation

Acid Injection

- Acid is injected to control mineral clogging of emitters
- Water with a high pH (>7.5) or

  "*moderate*" to "*hard water*" (>60 ppm Ca) more likely to cause problems

Acid Injection

- 98% sulfuric acid is commonly used in drip irrigation
- Citric acid or vinegar can be used in organic farming
- Titration can be used to determine concentration of acid need

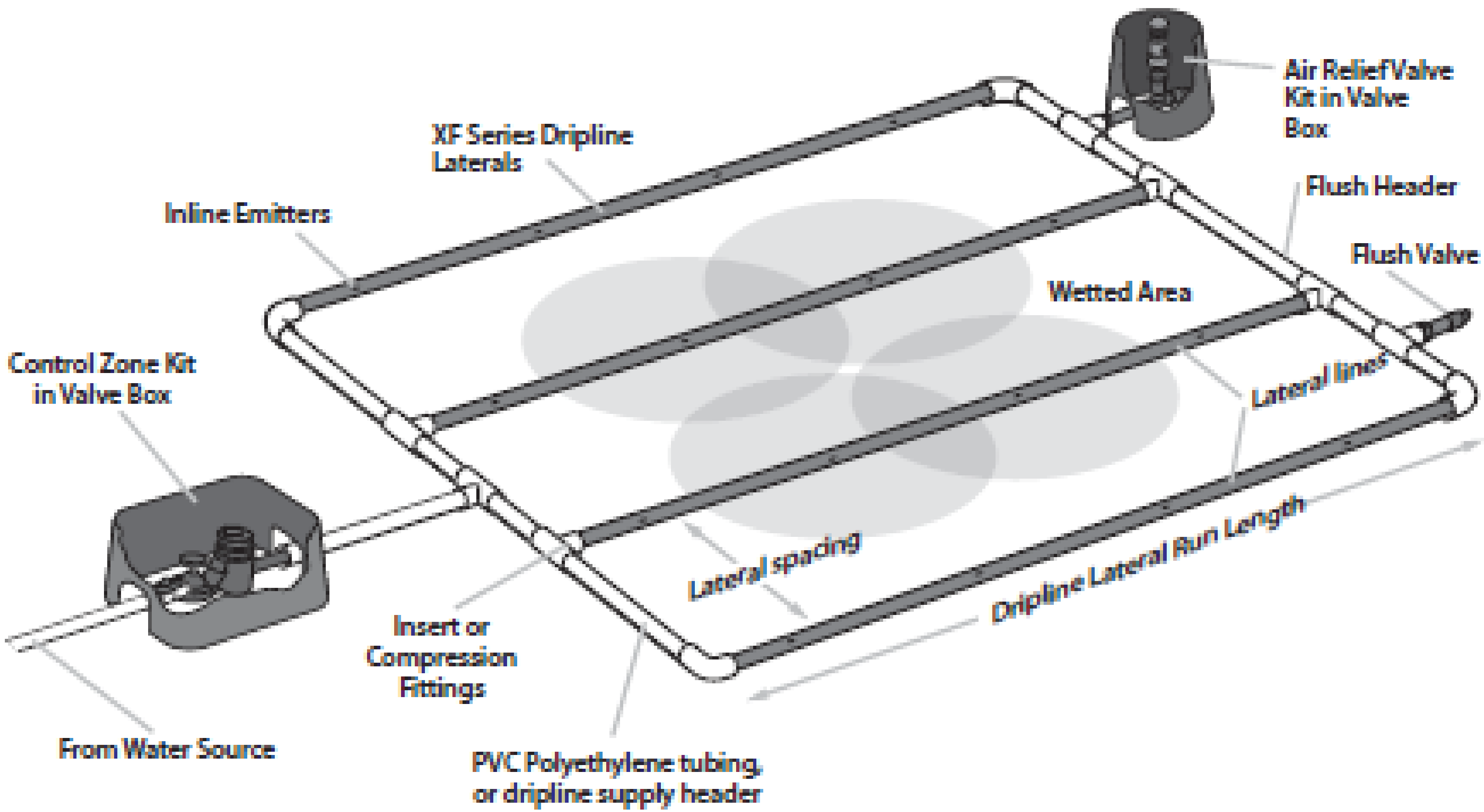
(adding acid to a sample of the water to see how much is required to lower pH)

Acid Injection

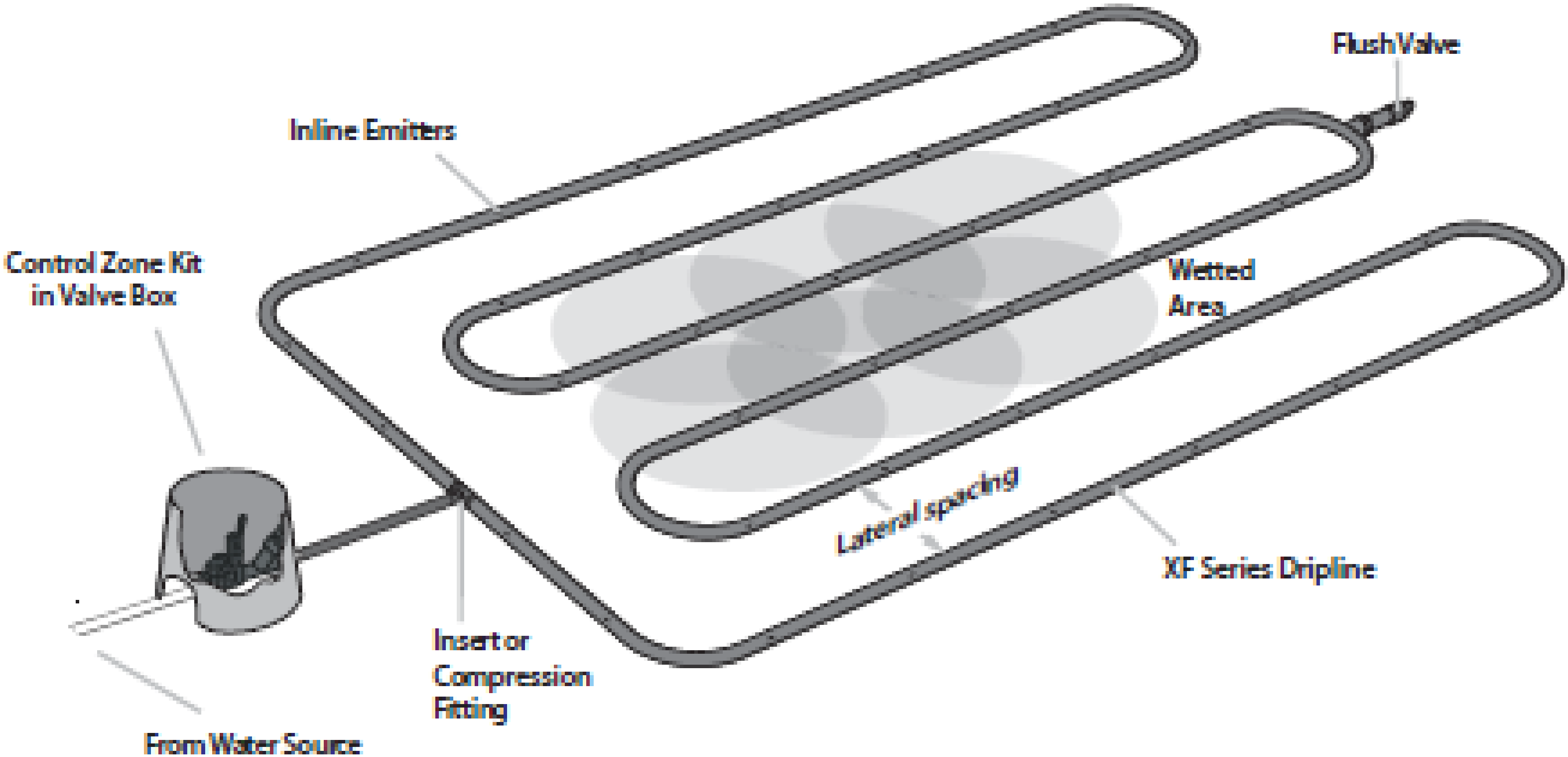
- Experimentation is used in absence of titration
- Acid is injected until pH is lowered to 6.5 (measured at end of drip line)
- Higher concentrations are added if needed, lowering pH to as low as ~4
- Acid is corrosive – inject downsteam of filter if made of metal

Drip Layout Options

Manifold - End Feed Layout



“Quick” Layout



Designing Drip Irrigation Systems

The 7 Step Approach

Step 1

Calculate Peak Water Requirement

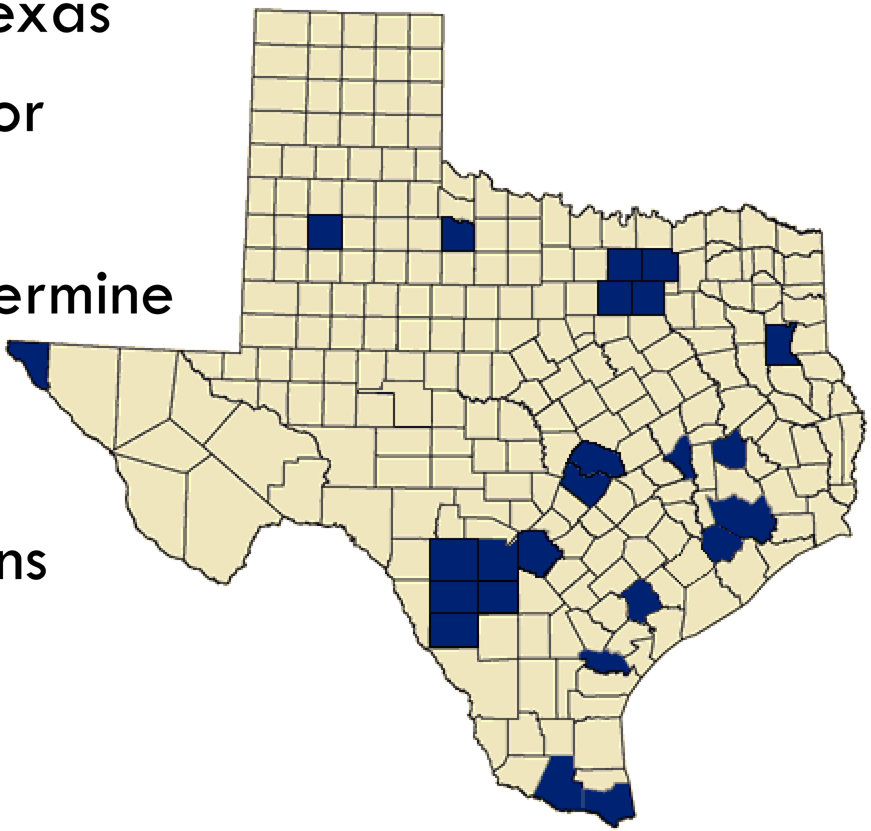
What are we irrigating?

Calculating Plant Water Requirements

- WR = ETo x Kc
  - Where:
    - ETo = Evapotranspiration, Peak Month
    - Kc = Plant Coefficient
    - WR = Plant Water Requirement

Evapotranspiration Sources

- TexasET Network
  - http://TexasET.tamu.edu
  - 34 Weather Stations in Texas
  - Contains historical data for 19 Cities in Texas
  - Online Calculators to determine irrigation runtimes
  - Can Sign Up or email irrigation recommendations



Simplified Method

Plant Type	Typical Peak Daily Water Requirement (Texas)
Warm Season Turf	.17 inches
Cool Season Turf	.23 inches
Annual Flowers	.23 inches
Perennial Flowers, Groundcovers, Tender Woody Shrubs & Vines	.15 inches
Tough Woody Shrubs, Vines, Trees (non-fruit bearing)	.10 inches

Step 2

Choose a Product

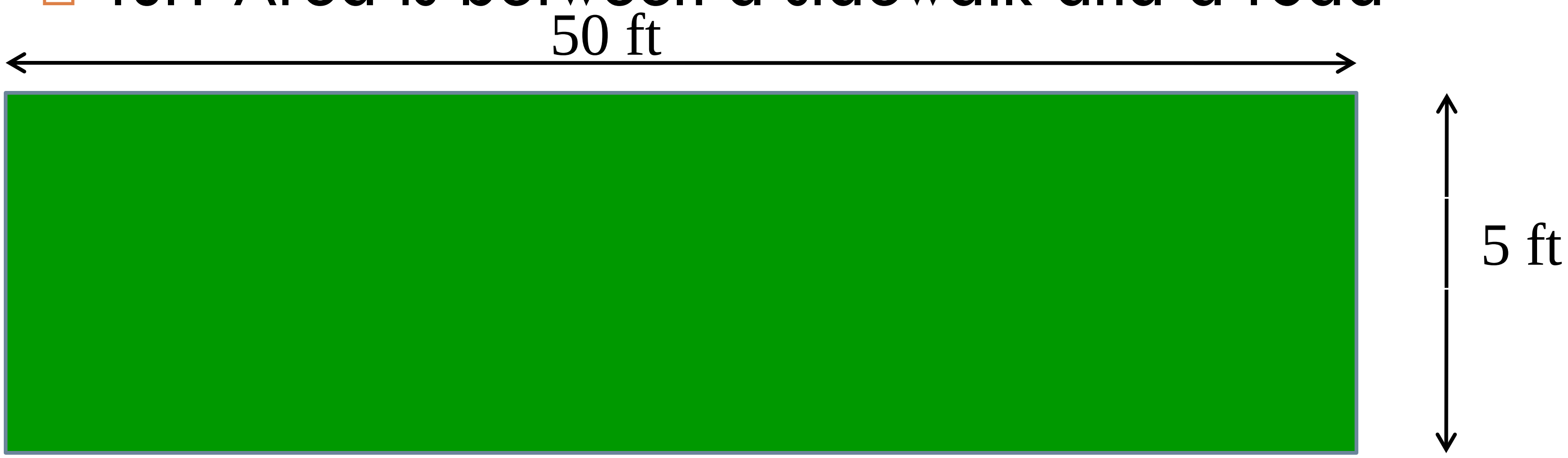
Example Problem: Step 2

- For Example Purposes lets use Rainbird Drip Product 12" Spacing, .6 GPH Flow

Inlet Pressure psi	XF Dripline Maximum Lateral Lengths (Feet)					
	12" Spacing		18" Spacing		24" Spacing	
	Nominal Flow (GPH)		Nominal Flow (GPH)		Nominal Flow (GPH)	
	0.6	0.9	0.6	0.9	0.6	0.9
15	255	194	357	273	448	343
20	291	220	408	313	514	394
30	350	266	494	378	622	478
40	396	302	560	428	705	541
50	434	333	614	470	775	594

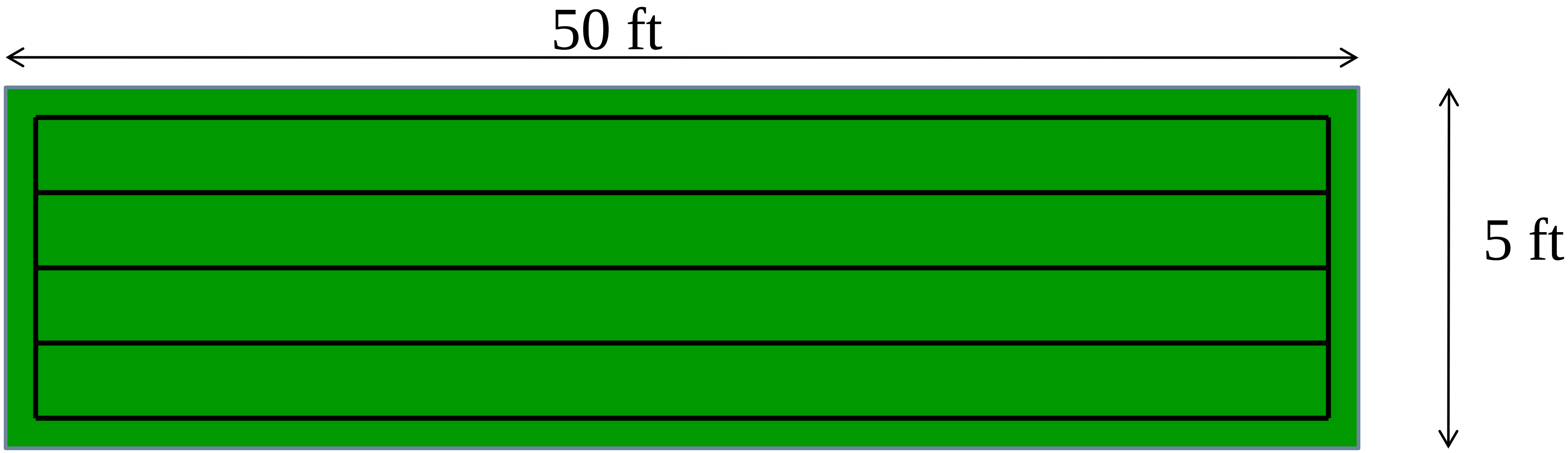
Step 3: Calculating the Amount of Product

- Turf Area is between a sidewalk and a road



- Product can be installed either in a "snaked" pattern or in a manifold
- Manifold systems are preferred, creates a looped system

Step 3: Product Layout



- Using a 12” product……come 6” off the edge
  - 4” By State Rule Minimum
- Total Product = 5 lines x 49ft + 2 lines x 4ft
- Total Product = 253 ft

Step 4: Calculate Total Flow

XF-SDI Dripline Flow (per 100 feet)				
Emitter Spacing	0.6 GPH Emitter		0.9 GPH Emitter	
12″	61.0 GPH	1.02 GPM	92.0 GPH	1.53 GPM
18″	41.0 GPH	0.68 GPM	61.0 GPH	1.02 GPM
24″	31.0 GPH	0.51 GPM	46.0 GPH	0.77 GPM

- 253ft x61 GPH/100ft = 154.33 GPH

  or
- 253ft x 1.02 GPM/100ft = 2.58 GPM

Step 6: Precipitation Rate

$$PR = \frac{96.25 \times GPM}{A}$$

PR – Station Precipitation Rate, in/hr

96.25 – Constant Converts GPM to inches per hour

GPM – Total Flow Rate through the station

A – Area of Coverage, ft^2

Example Problem

$$PR = \frac{96.25 \times GPM}{Area}$$

- GPM = Total Flow = 2.58 GPM
- Area = Length x Width = 50ft x 5 ft = 250 ft^2

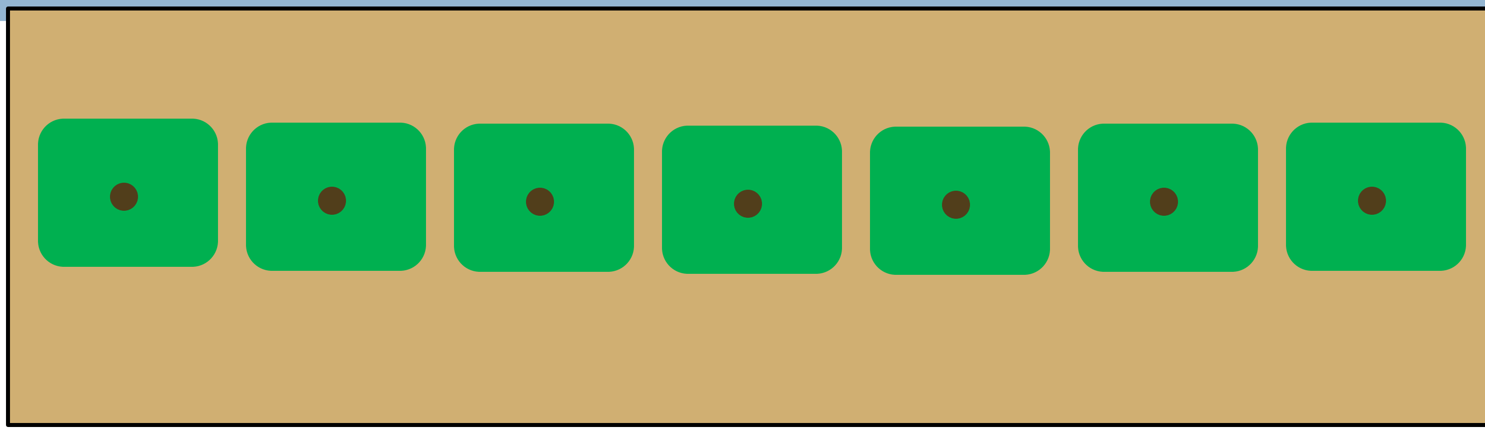
$$PR = \frac{96.25 \times 2.58GPM}{250\ ft^2}$$

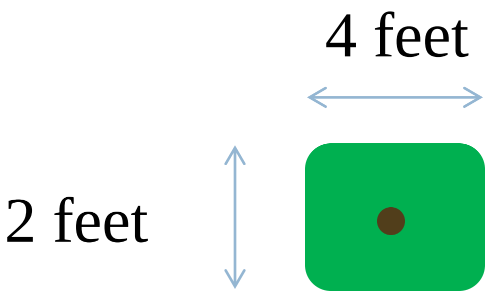
PR = .99 inches / hr

Designing Drip For Shrubs Using Online Emitters

- Using Online emitters for shrubs allows for customization of the drip system to match the layout and spacing of the shrubs
- Always best to use professional judgment on what size emitter (flow) and the number of emitters per shrub plant (typically 1 or 2)

Example: Shrub Drip Design



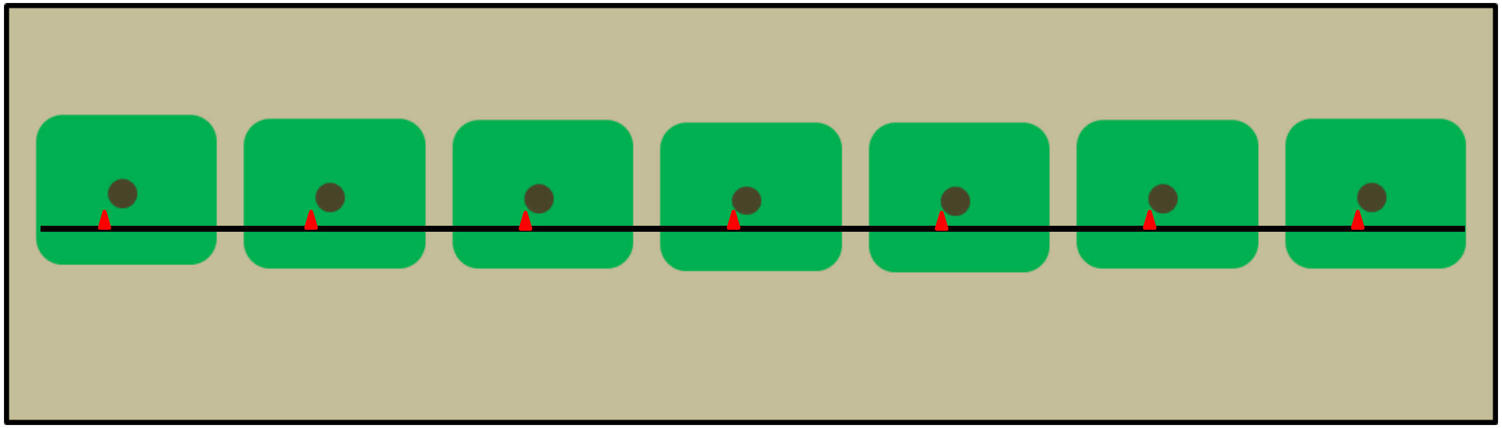


8 Small Shrubs

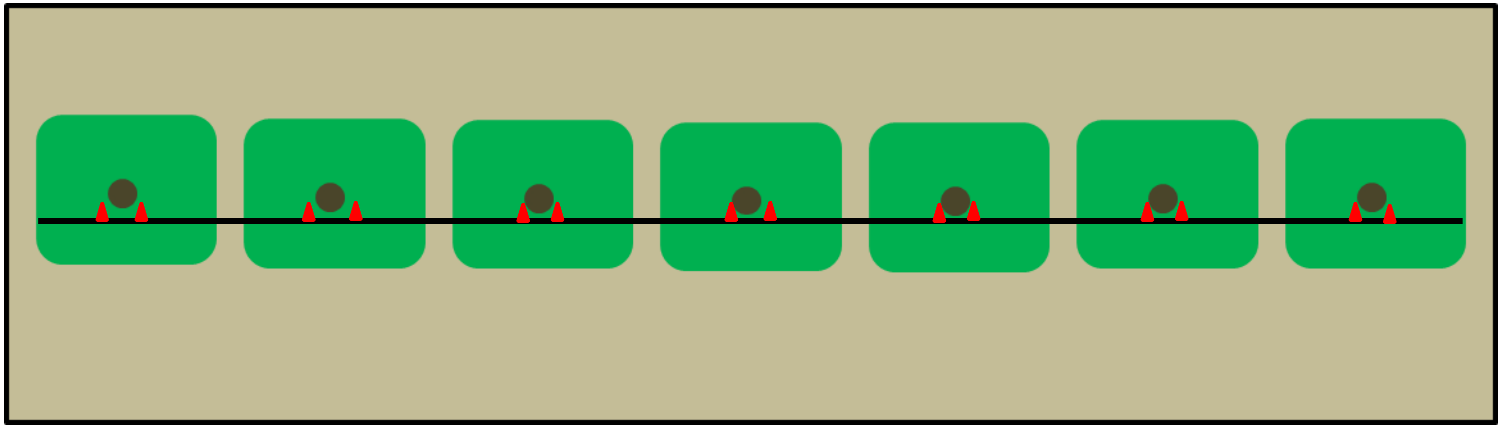
Example: Shrub Drip Design

- Step 3: How many emitters are needed?

Option 1
1
Emitter
per Plant

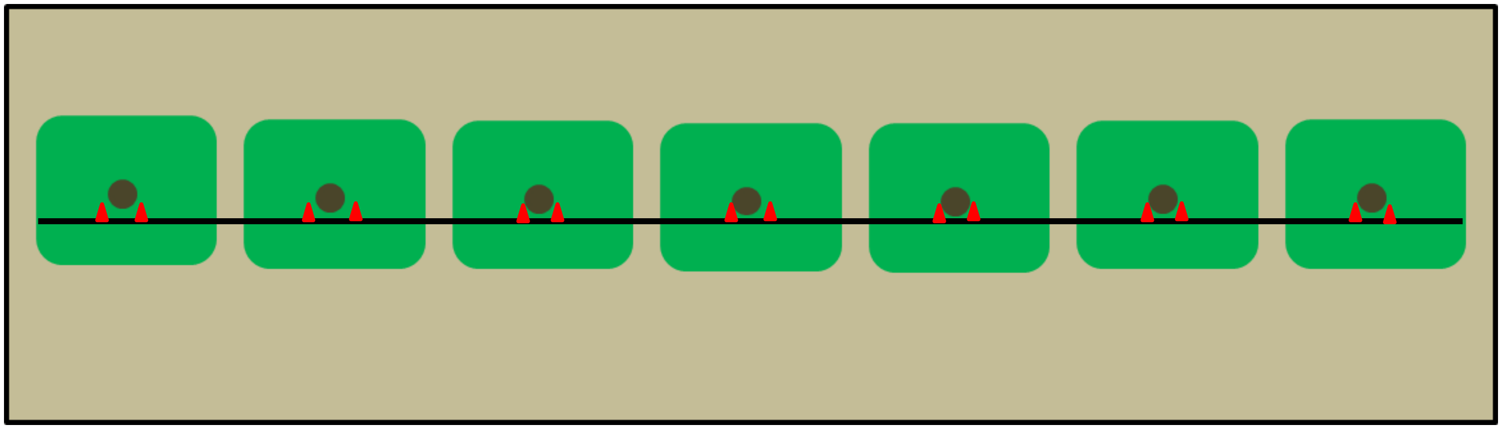


Option 2
2
Emitters
per Plant



Example: Shrub Drip Design

- Step 4: What is the total flow?



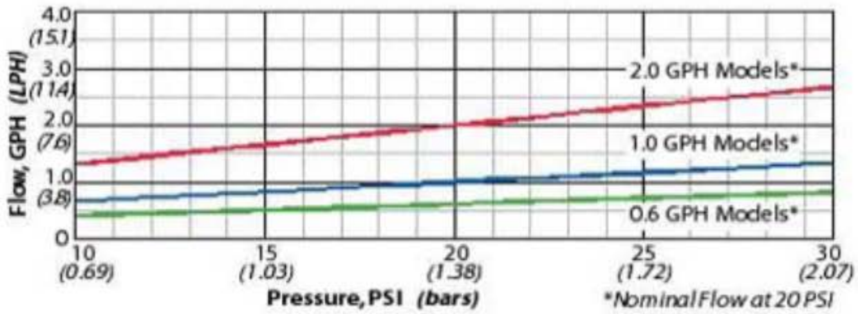
- 8 Plant x 2 Emitters per Plant = 16 Emitters
- 16 Emitters x 1 GPH per emitter = 16 GPH or .27 GPM

Design Specs: Bowsmith Emitter

NonStop Drip Emitters

All NonStop Drip Emitters nominal flow rates at 20 PSI *(1.38 bars)*

Nominal Performance



Emitter Nominal Flow	Pressure (PSI)				
	10	15	20	25	30
0.6	0.4	0.5	0.6	0.7	0.8
1.0	0.7	0.8	1.0	1.2	1.3
2.0	1.3	1.7	2.0	2.3	2.7

Emitter flows in GPH, nominal at 20 PSI

Notes:
Manufacturer�s variation, Cv: <= 0.05
30-mesh filtration and 15 PSI emitter operating pressure are the recommended minimums for a NonStop emitter system.

"SB" Series

Single barb outlet. 0.250" and 0.175" barbs on opposite ends; either can be used as inlet.

- SB-06 *0.6 GPH (2.3 LPH)* (Green Insert)*
- SB-10 *1.0 GPH (3.8 LPH)* (Blue Insert)*
- SB-20 *2.0 GPH (7.6 LPH)* (Red Insert)*

Nominal flow at 20 PSI (1.38 bars)

Example: Shrub Drip Design

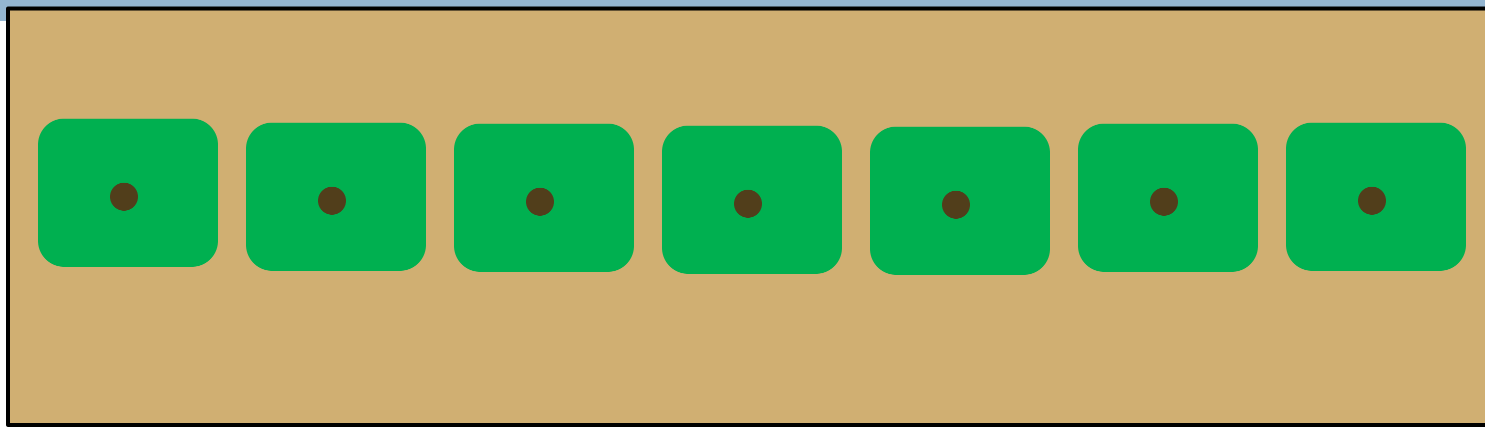
- Step 6: What is the Precipitation Rate

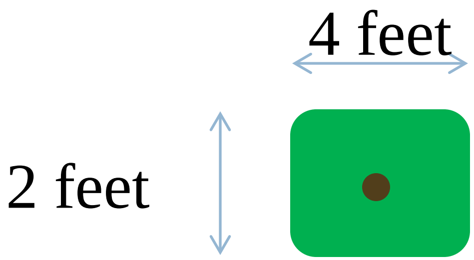
$$Precip.\,Rate = \frac{96.25\ x\ Total\ Flow\ (GPM)}{Area\ (ft^2)}$$

Total Flow = .27 GPM

Area = ???

Calculating Drip Area: Shrubs



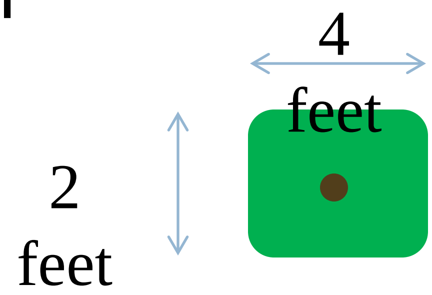


8 Small Shrubs

Area = Length x Width   or   Area = 3.14 x Radius^2

Calculating Drip Area: Shrubs

- Using Area = Length x Width



$4ft \times 2ft = 8ft^2$ per plant

Total Area = $8\ ft^2 \times 8$ plants = $64\ ft^2$

Example: Shrub Drip Design

- Step 6: What is the Precipitation Rate

$$Precip.Rate = \frac{96.25\ x\ Total\ Flow\ (GPM)}{Area\ (ft^2)}$$

Total Flow = .27 GPM

Area = 64 ft^2

Calculating Precipitation Rate

$$Precip.Rate = \frac{96.25\ x\ .27GPM}{64\ ft^2}$$

Precipitation Rate = 0.41 Inches per Hour

Example: Shrub Drip Design

- Step 7: Will it work?
  - Can Precip. Rate meet peak demand (.15 Inches)?

$$Runtime = \frac{Peak\ Demand}{Precip.Rate} = \frac{.15\ inches}{.41\ \frac{in}{hr}}$$

Runtime = .37hours or 22 minutes

Common Reasons for Drip Failure

Drip Mistakes

- Failure to calculate drip precipitation rates
  - Irrigate too much
    - Often assume really long runtimes are needed because it is drip
  - Don't irrigate enough

Any Questions??