
Irrigation
Alternatives
for Rainfall
Harvesting

# *Questions You Should Ask …*

1. What do I want to irrigate?
2. How much water do I need?
3. Do I have enough storage?
4. What type(s) of irrigation product(s) will I use?
5. How much pressure and flow is needed?

# *Questions You Should Ask …*

6. Do I need a pump?
7. How do I select the right pump for my application?
8. Do I need a pressure tank?
9. What other components do I need?
10. How can I make every drop count?

# What are you irrigating?

# How much water do you need?

**How many gallons storage capacity is required to supplement rainfall for your intended use?**

# How much water do you need?

- *Plant type*
- *Growing season*
- *Site micro-climates*
- *Square footage*

**Think about peak water use**

# How much water do you need?

## We tend to think in inches, but need to convert to gallons

$$Gallons = Inches\ x\ square\ feet\ x\ 0.6234$$

$$Inches = Gallons \div square\ feet \div 0.6234$$

$$Square\ feet = Gallons \div Inches \div 0.6234$$

# How much water do you need?

**Example: I want to apply 1” of water per week to a 10’ x 10’ flower bed. How many gallons do I need?**

$$Gallons = Inches\ x\ square\ feet\ x\ 0.6234$$

$$Gallons = 1\ in.\ x\ 100\ sqft\ x\ 0.6234$$

$$Gallons = 62.34\ per\ week$$

# How much water do you need?

**Example: I want to apply 0.5” of water per week to a 30’ x 40’ lawn. How many gallons do I need?**

$$Gallons = Inches\ x\ square\ feet\ x\ 0.6234$$

$$Gallons = 1\ in.\ x\ 1{,}200\ sqft\ x\ 0.6234$$

$$Gallons = 748.08\ per\ week$$

# How much water do you need?

**Example: I want to apply 1” of water per week to a 20’ x 20’ vegetable garden. How many gallons do I need?**

$$Gallons = Inches\ x\ square\ feet\ x\ 0.6234$$

$$Gallons = 1\ in.\ x\ 400\ sqft\ x\ 0.6234$$

$$Gallons = 249.36\ per\ week$$

# Do you have enough storage?

# How much water do you need?

**Example: Assume you have a 500 gallon tank. How many inches of water is this over a 40’ x 50’ area?**

$$Inches = Gallons \div square\ feet \div 0.6234$$

$$Inches = 500\ gal \div 2{,}000\ sqft \div 0.6234$$

$$Inches = 0.19$$

# How much water do you need?

**Example: Assume you have a 3,000 gallon tank. How many inches of water is this over a 30’ x 30’ area?**

$$Inches = Gallons \div square\ feet \div 0.6234$$

$$Inches = 3{,}000\ gal \div 900\ sqft \div 0.6234$$

$$Inches = 5.34$$

# What type(s) of irrigation product(s) will I use?

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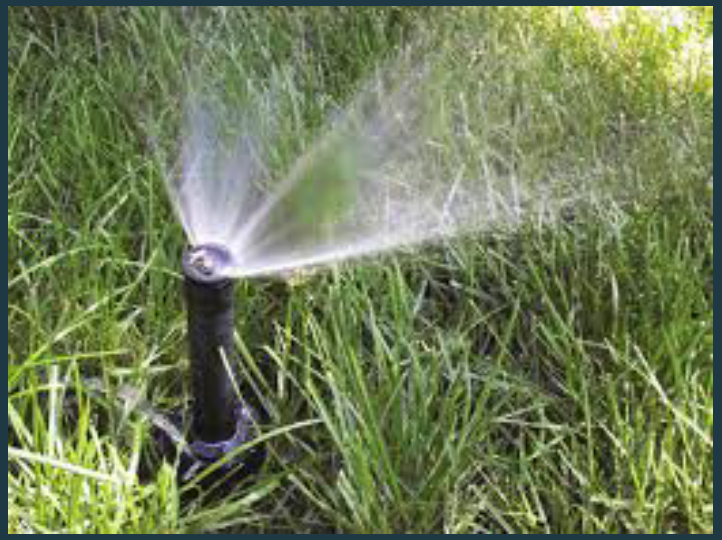
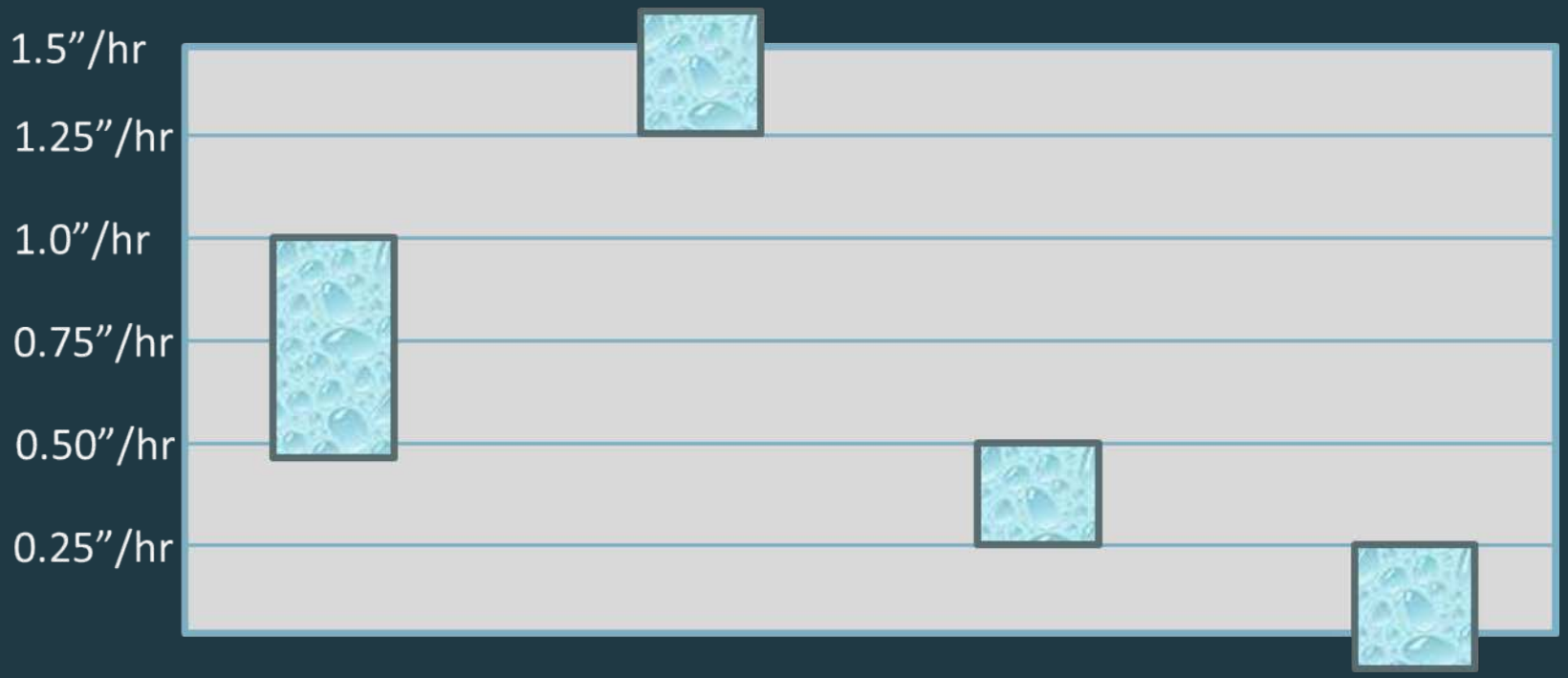
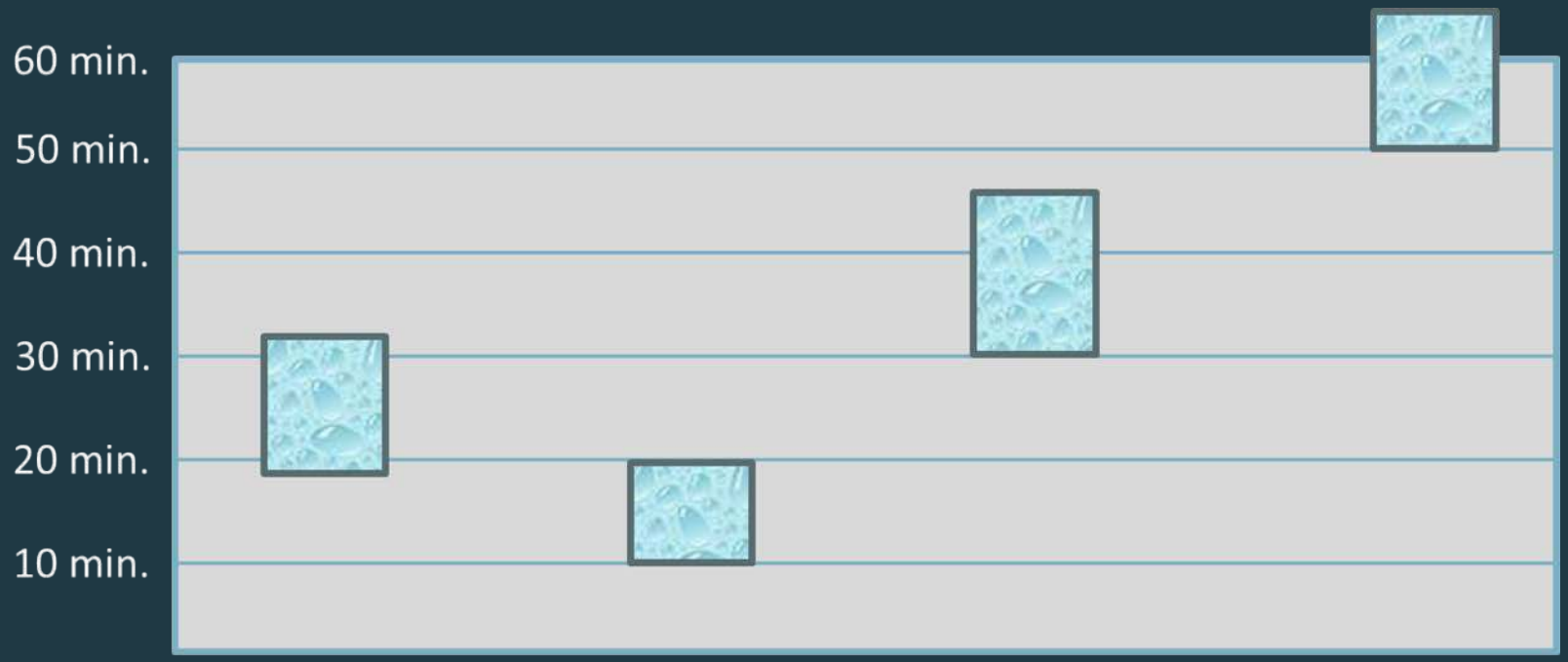


# Typical Application Rates




# Typical Run Times




# How much pressure and flow is needed?

| Product | Pressure Range | Flow Rate Range |
|---|---|---|
| Rotors/Impacts | 40 - 70 psi | 1 - 5 gpm |
| Pop-up sprays | 30 - 40 psi | 1 - 4 gpm |
| Micro-sprays | 15 - 30 psi | 0 - 2 gph |
| Drip tubing | 15 - 30 psi | 0.2 - 2 gph |
| Drip insert emitters | 10 - 20 psi | 0.2 - 20 gph |
| Drip tape | 5 - 20 psi | 0.25 - 0.50 gph |
| Soaker hose | 5 - 30 psi | 0.5 - 1 gph |

psi = pounds per square inch
gpm = gallons per minute
gph = gallons per minute

gph = gpm ÷ 60
gpm = gph x 60

# Do you need a pump?

## How much pressure do I need?
## VS
## How much pressure do I have?

| Product | Pressure Range | Flow Rate Range |
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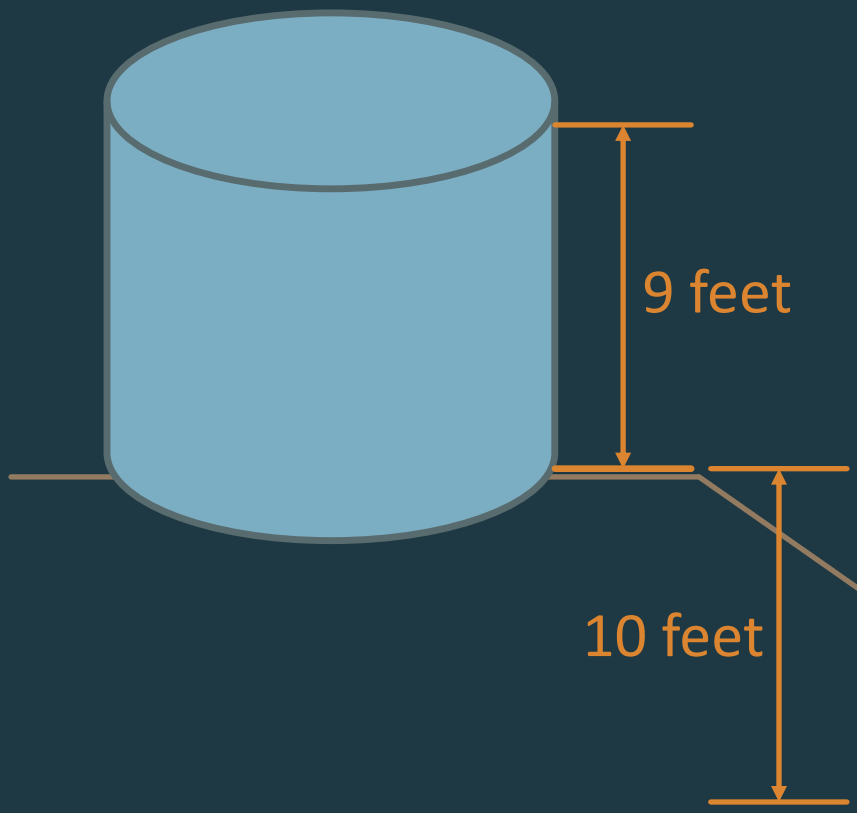
Static pressure (psi) = Feet of water in tank ÷ 2.31

# Do you need a pump?




Static pressure = pressure of water at rest

Static pressure = 9 feet head, or 3.89 psi

Elevation head = distance between bottom of tank to point of water discharge

Elevation head = +10 feet, or +4.32 psi

**Total pressure available = 8.21 psi**

Static pressure (psi) = Feet of water in tank ÷ 2.31

# Do you need a pump?

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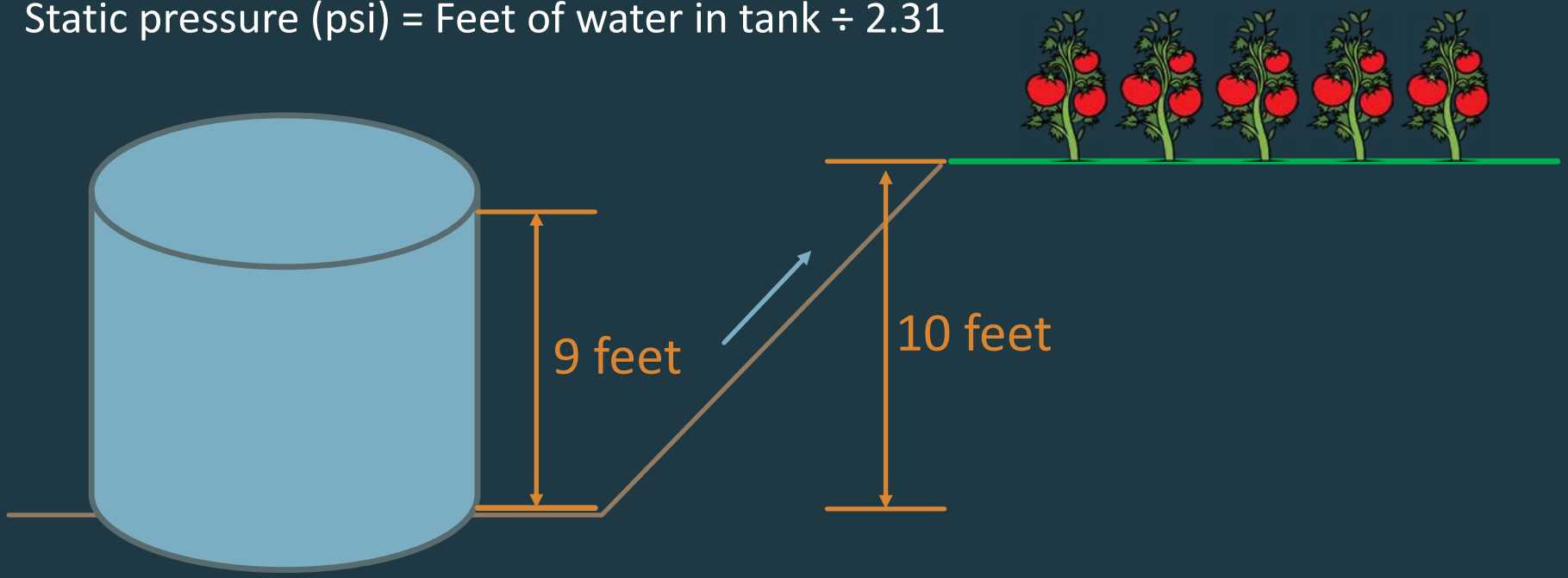



Static pressure = pressure of water at rest

Static pressure = 9 feet head, or 3.89 psi

Elevation head = distance between bottom of tank to point of water discharge

Elevation head = -10 feet, or -4.32 psi

**Total pressure available = -0.43 psi**

# Two Ways to Create More Pressure

# How do I select the right pump for my application?

Submersible

Surface

Piston

Transfer pumps – Low pressure, high flow. Used to move water from one tank to another.

Pressure pumps – High pressure, low flow. Used to supply water for pressurized irrigation systems.

# How do I select the right pump for my application?

Submersible

Surface

Piston

Centrifugal – a wide range of pressure and flow rates. Generally designed to “push” water, not “pull” water.

On-demand pumps start and stop automatically when a faucet or valve is opened, and shuts off when the tank is low to prevent dry-running.

# How do I select the right pump for my application?

Submersible

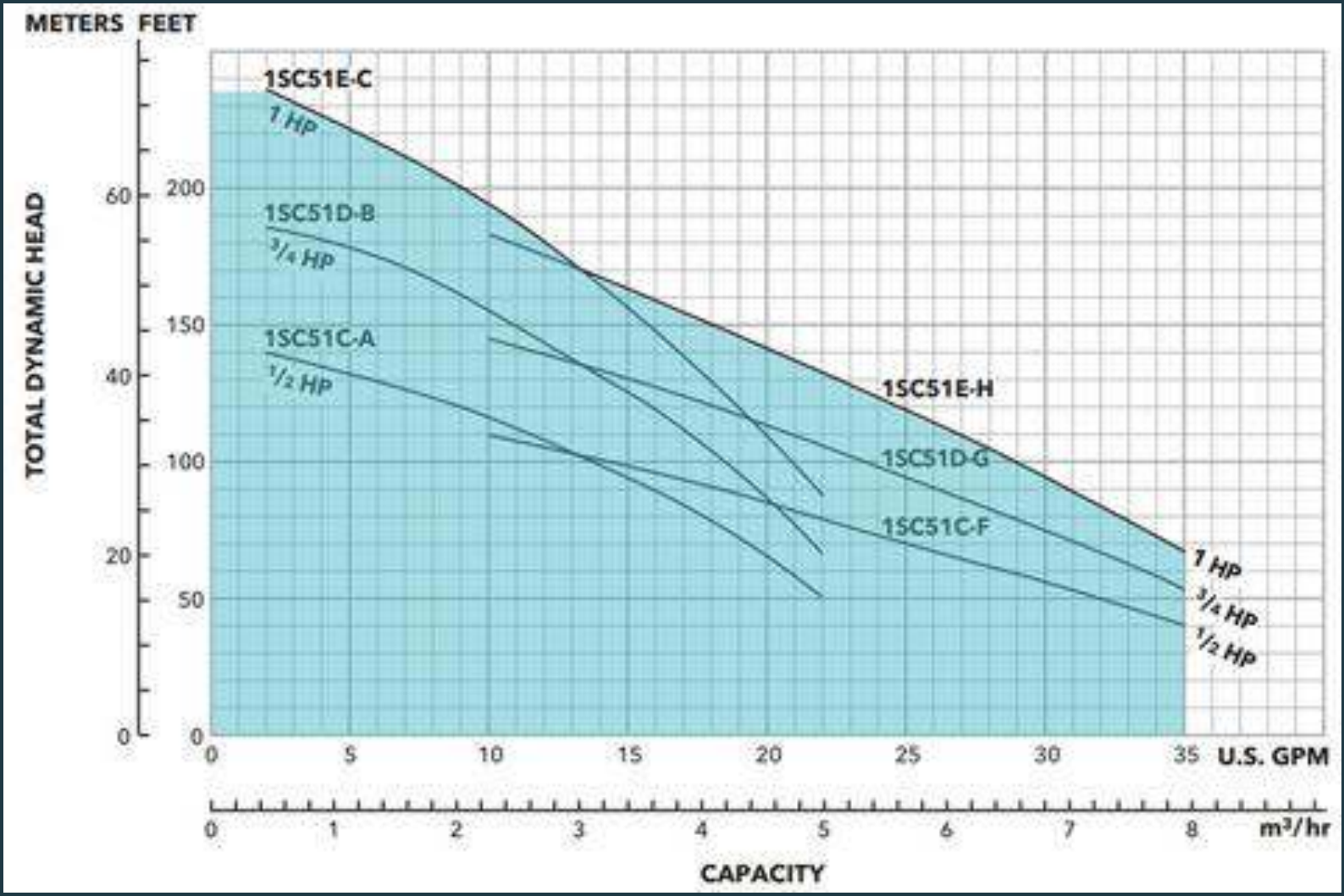
Surface

Piston

Positive displacement pump – move water using internal gears or pistons. Produce high pressure at low flow rates.

May be suitable for small rain barrels and open-ended water hoses.

# What is a pump curve?




*Source: Rainwater Management Solutions*

# Calculating Required Flow Rate

Add up the total gallons per minute (GPM) needed for the section to be irrigated at one time.

**Example: Spray Heads**

Total GPM =

(2 head x 2 GPM) +

(4 heads x 1 GPM)


**Total GPM = 8**

1 gallon per minute

2 gallons per minute

# Calculating Required Flow Rate

Add up the total gallons per minute (GPM) needed for the section to be irrigated at one time.

**Example: Drip Tubing**

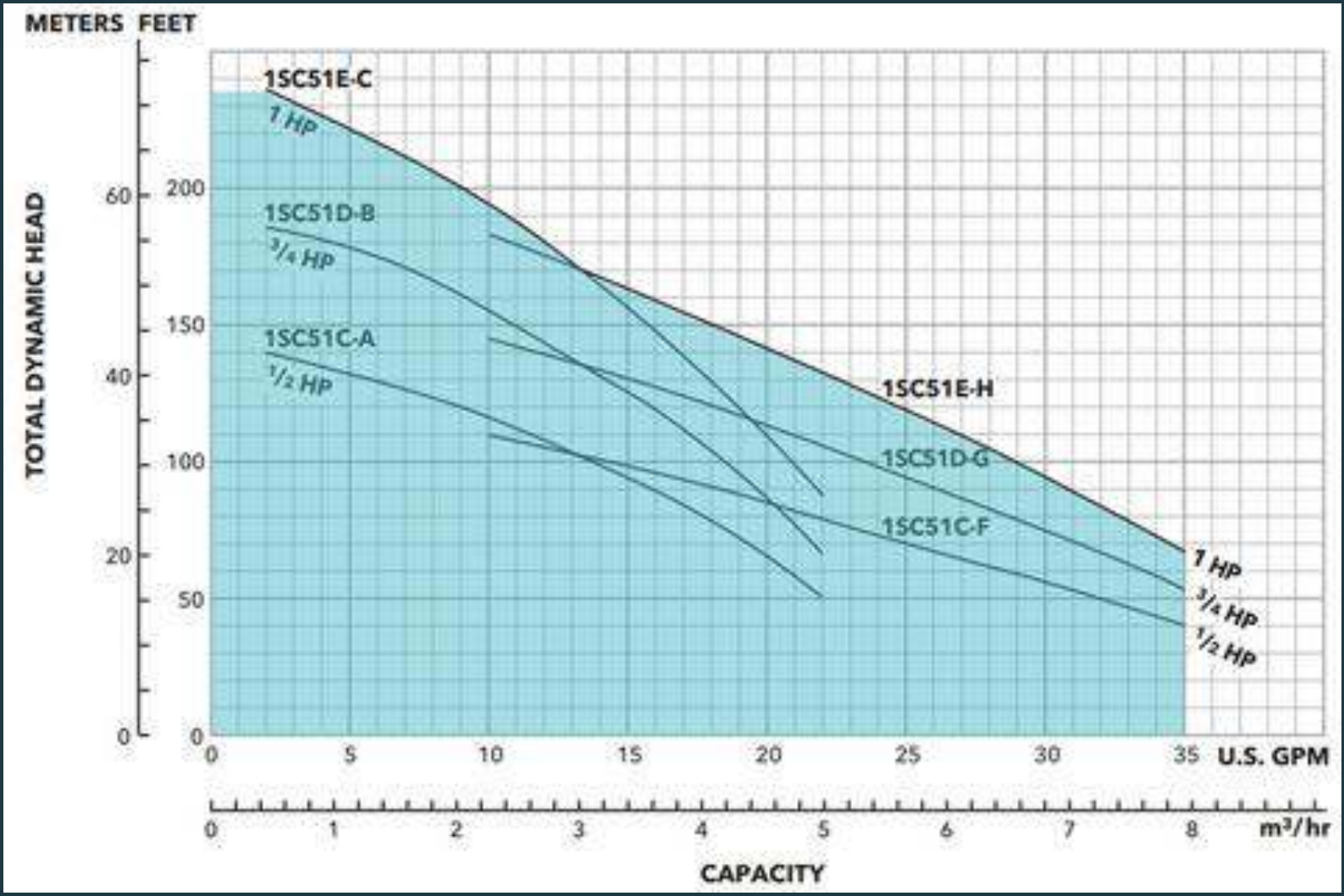
Total No. Emitters =
(500 ft x 1 emitter per ft) =
**500 emitters**

Total GPH =
500 emitters x 0.9 gal per emitter = **450 GPH**

Total GPM = 450 GPH÷ 60 min/hr
= **7.5 GPM**


500 FT drip tubing, 12” emitter spacing, 0.9 gallons per hour per emitter

# Reading a Pump Curve




*Source: Rainwater Management Solutions*

# Total Dynamic Head (TDH)

The total amount of pressure required by the pump to meet the needs of the water application device (sprinkler, drip tubing, etc.)

$$TDH = h_p + h_e + h_f$$

$h_p$ = operating head (pressure) required by the irrigation device (ft)

$h_e$ = elevation difference between the pump and the irrigation device (ft)

$h_f$ = friction loss in the system (ft)

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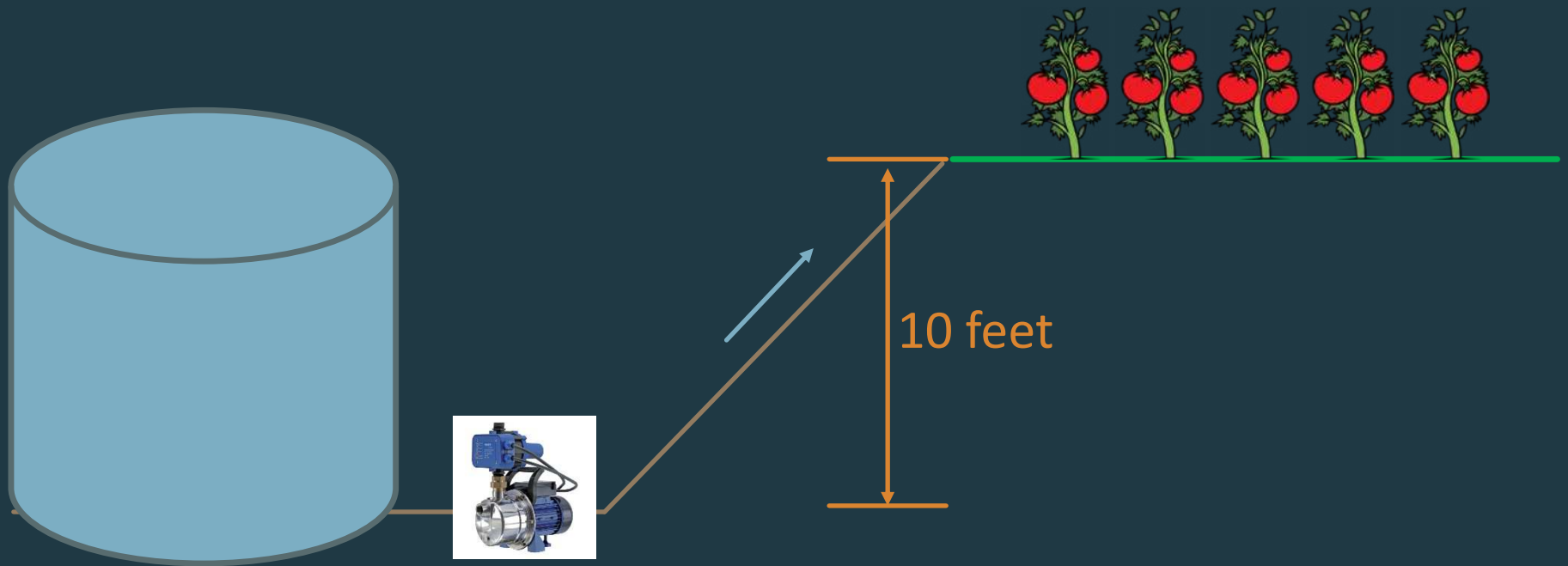
# Total Dynamic Head (TDH)

$$TDH = h_p + h_e + h_f$$

$h_e$ = elevation difference between the pump and the irrigation device (ft)



# Total Dynamic Head (TDH)

$$TDH = h_p + h_e + h_f$$

$h_f$ = friction loss in the system (ft)

Depends on component size, material, and flow rate (gpm) of water traveling through pipe.

# Total Dynamic Head (TDH)


½” SCH 40 PVC

Flow rate = 8 GPM

$h_f$ = 54.47 ft head, or 23.58 psi

3/4” SCH 40 PVC

Flow rate = 8 GPM

$h_f$ = 13.32 ft head, or 5.77 psi

1” SCH 40 PVC

Flow rate = 8 GPM

$h_f$ = 3.95 ft head, or 1.71 psi

# Total Dynamic Head (TDH)

## Rule of Thumb

For properly sized PVC pipe and distance < 100 feet, assume $h_f$ = 30% of operating pressure.

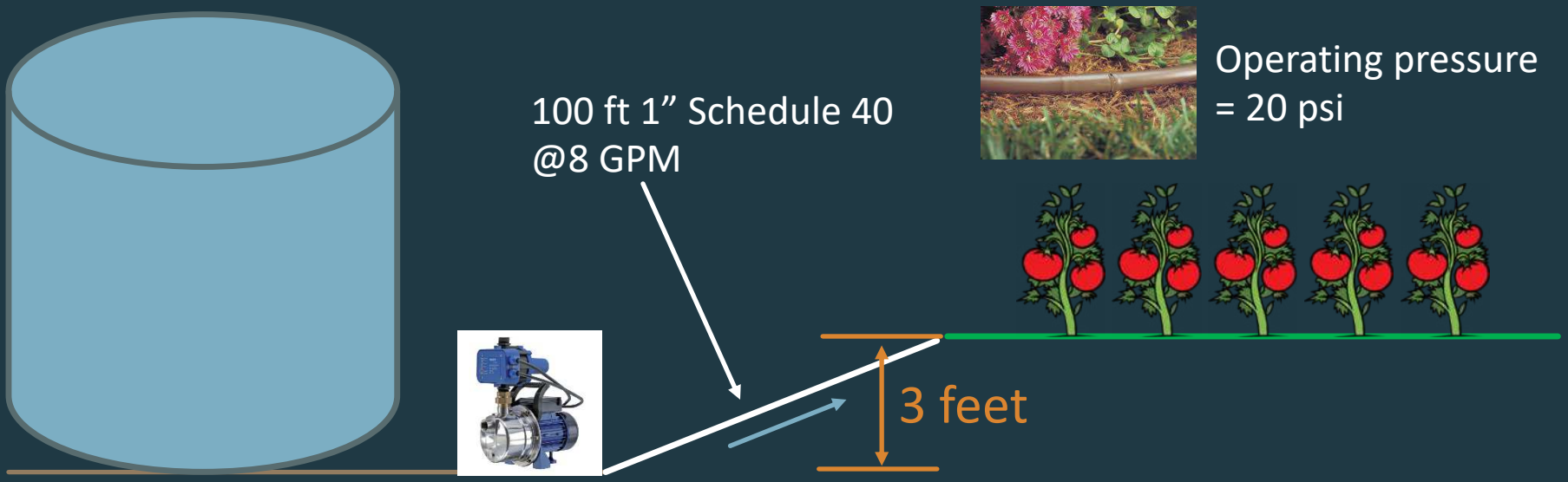
Example: If operating pressure is 40 psi, then $h_f$ = (0.30 x 40 psi)

12 psi (or 27.72 feet head)

# What is a “properly sized” pipe?

| Nominal Pipe Size | Maximum Recommended Flow Rate (GPM) Schedule 40 PVC Pipe | Maximum Recommended Flow Rate (GPM) Class 200 PVC Pipe | Water Velocity (ft/sec) |
|---|---|---|---|
| ½” | 4.4 | 5.9 | 5 |
| ¾” | 7.9 | 10.1 | 5 |
| 1” | 13.0 | 16.7 | 5 |
| 1 ¼” | 22.6 | 26.9 | 5 |
| 1 ½” | 30.9 | 35.4 | 5 |
| 2” | 51.3 | 55.5 | 5 |

# Total Dynamic Head (TDH)

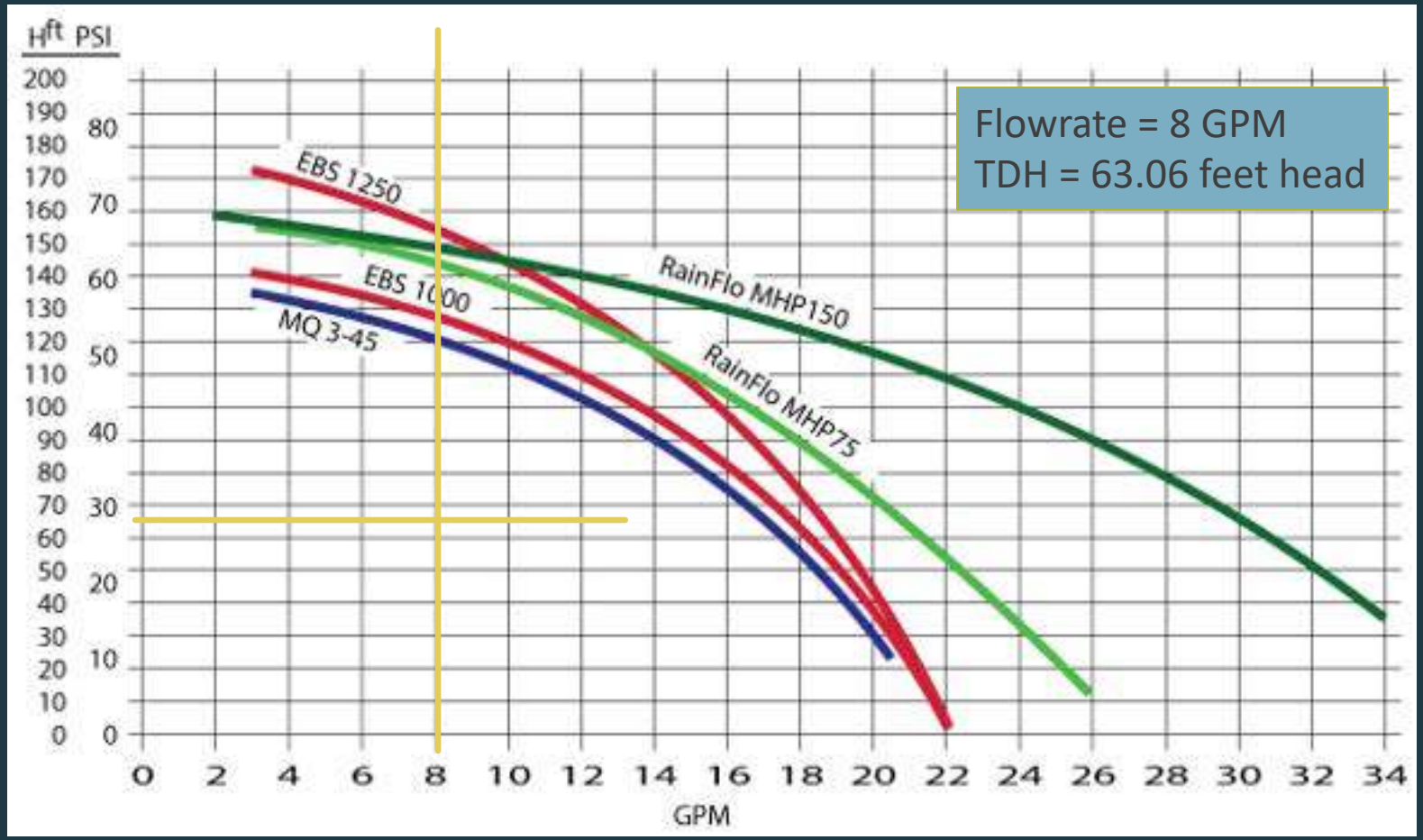



$$TDH = h_p + h_e + h_f$$

$h_p$ = (20 psi x 2.31) = 46.2 feet head
$h_e$ = 3 feet head
$h_f$ = (46.2 ft x 0.3) = 13.86 feet head

**TDH = 63.06 feet head**

# Reading a Pump Curve




*Source: Rainwater Management Solutions*

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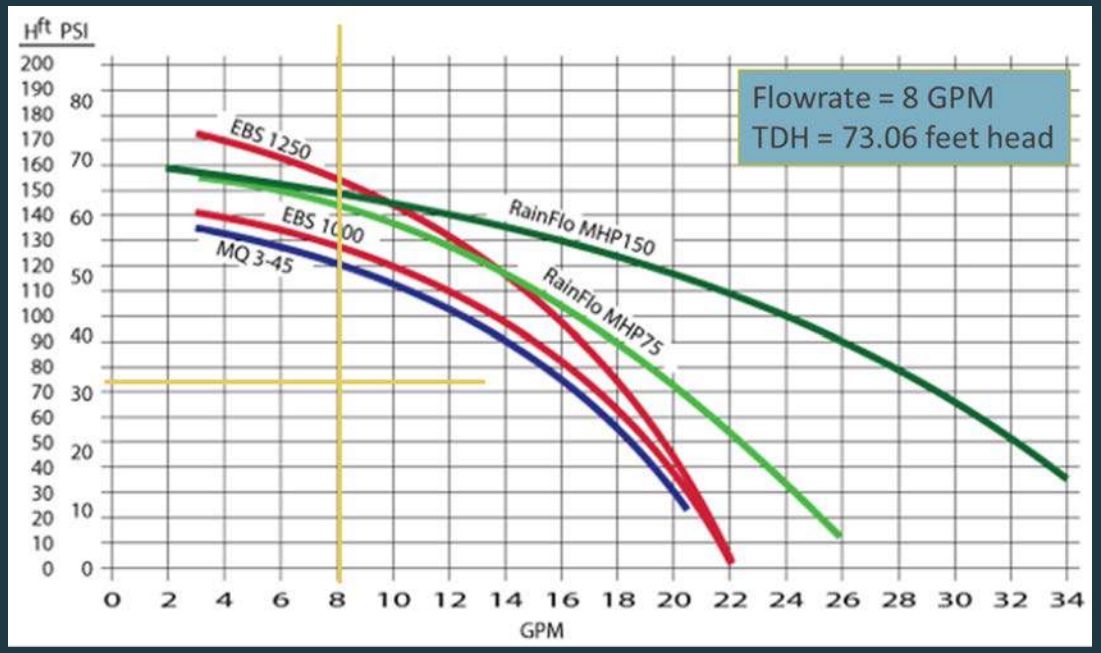
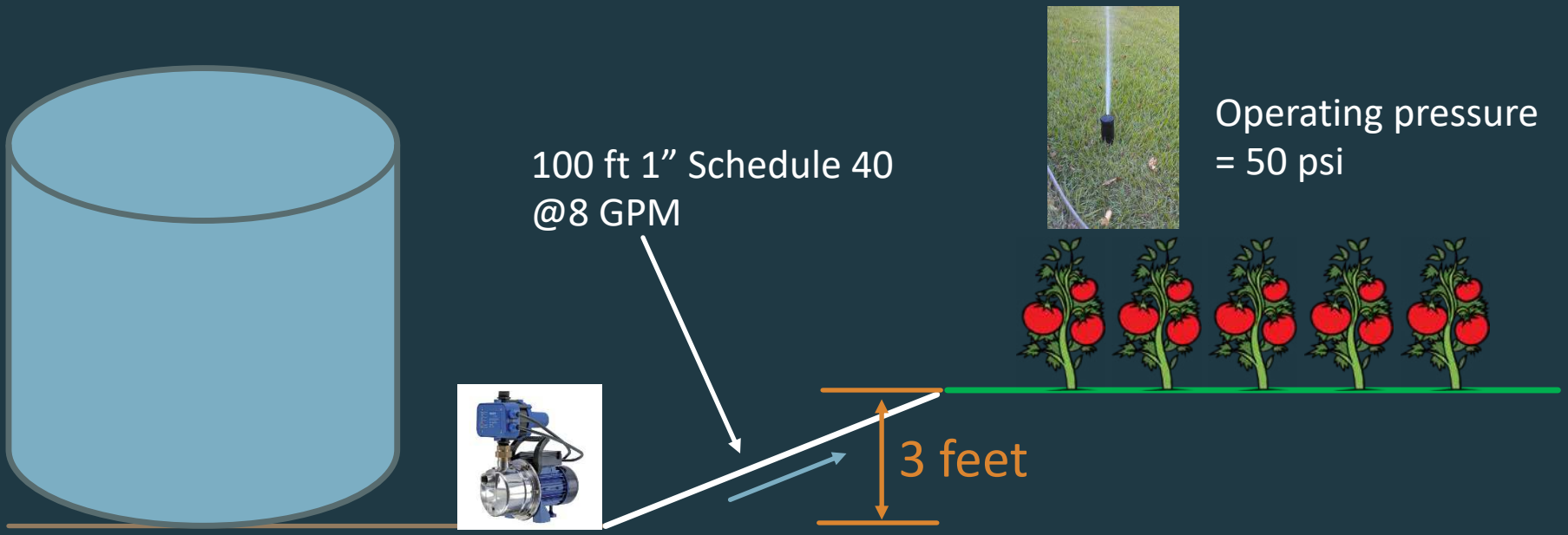



Grundfos MQ 3-45 1 HP Pressure Boosting Pump

*Source: Rainwater Management Solutions*

# Total Dynamic Head (TDH)

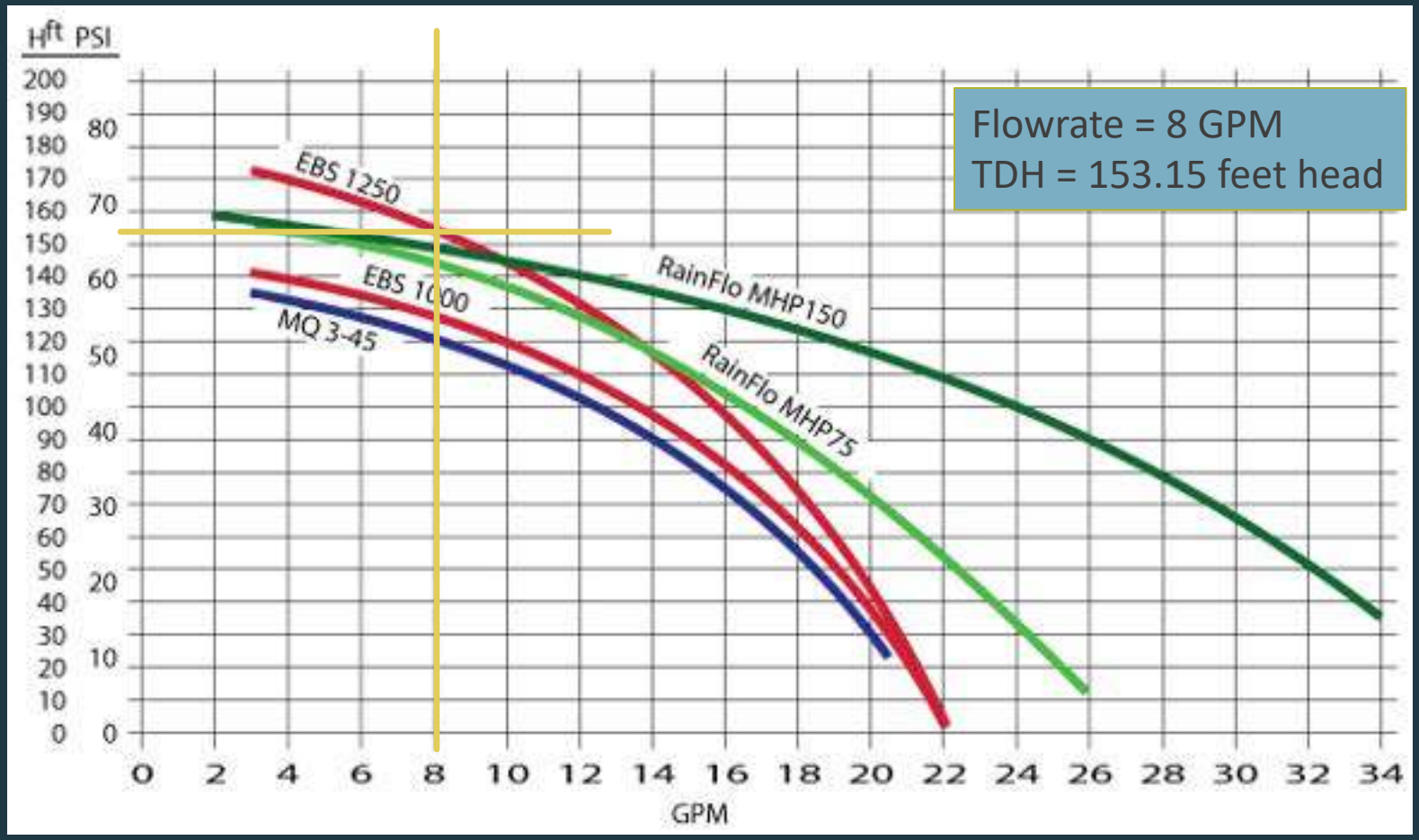



$$TDH = h_p + h_e + h_f$$

$h_p$ = (50 psi x 2.31) = 115.5 feet head
$h_e$ = 3 feet head
$h_f$ = (115.5 ft x 0.3) = 34.65 feet head

**TDH = 153.15 feet head**

# Reading a Pump Curve

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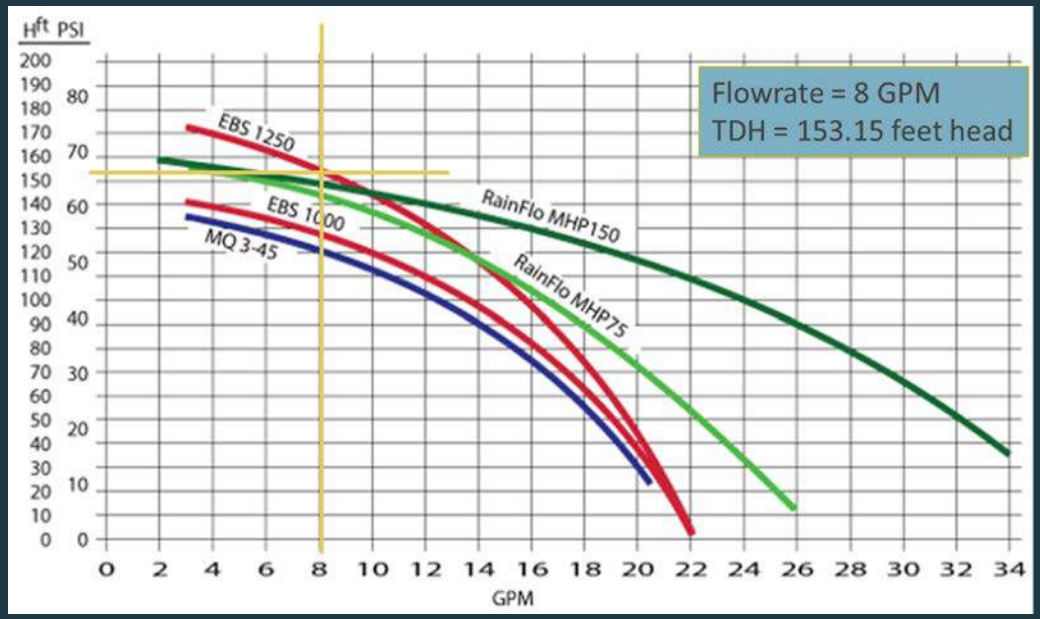
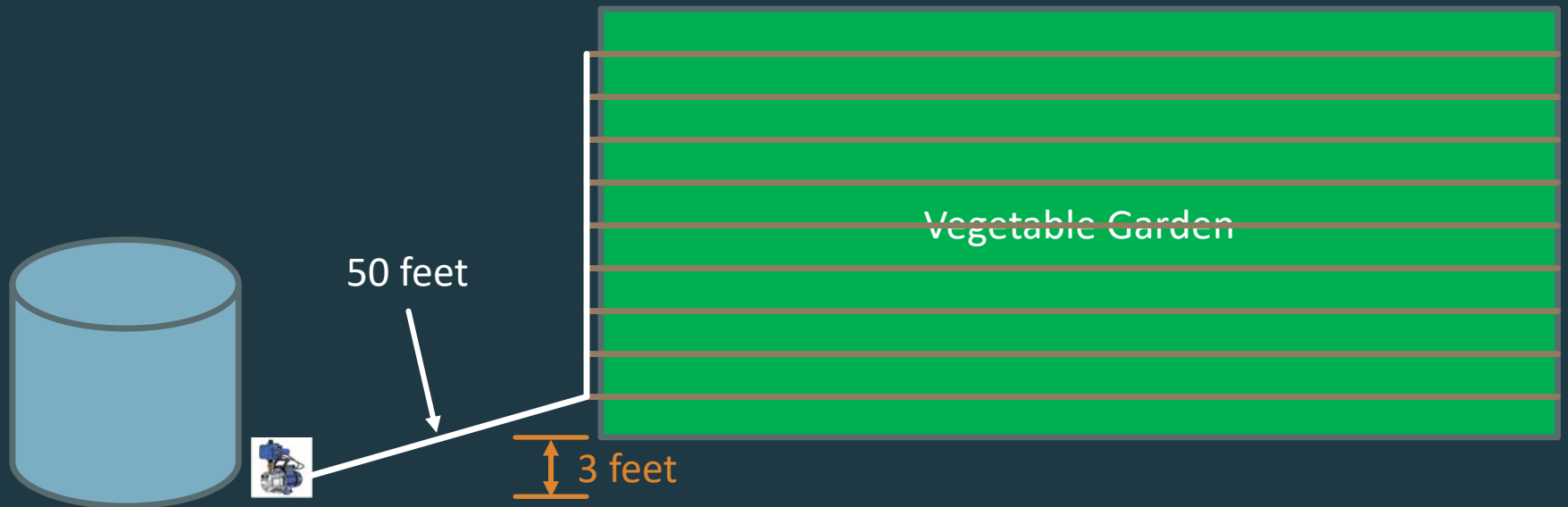



Leader EBS 1250 1HP Pressure Booster Pump

# Pump Sizing Example

- I plan to use stored rainwater to irrigate a vegetable garden located approximately 50 feet from my cistern.
- The garden is approximately 20 feet wide by 150 feet long.
- The garden elevation is about 4 feet higher than the bottom of my cistern.
- I plan to use Techline pressure compensating drip tubing with 12-inch emitter spacing.
- Emitter flow rate is 0.9 GPH at an operating pressure of 20 psi.
- Row spacing is 2 feet apart and drip tubing will be placed at the top of each row.



# Pump Sizing Example

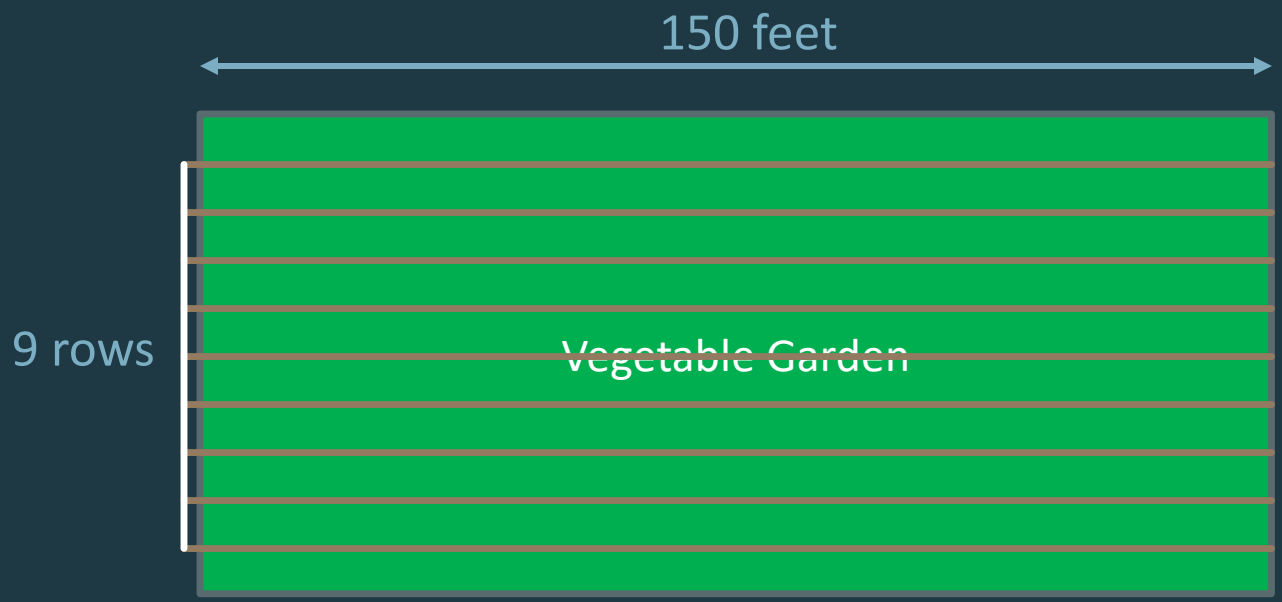
## STEP 1: CALCULATE FLOW RATE (GPM)

9 rows x 150 ft/row = 1,350 ft drip tubing

1,350 ft x 1 emitter/ft = 1,350 emitters

1,350 emitters x 0.9 GPH/emitter = 1,215 GPH

1,215 GPH ÷ 60 = **20.25 GPM**



# Pump Sizing Example

**STEP 2: CALCULATE TOTAL DYNAMIC HEAD (FT)**

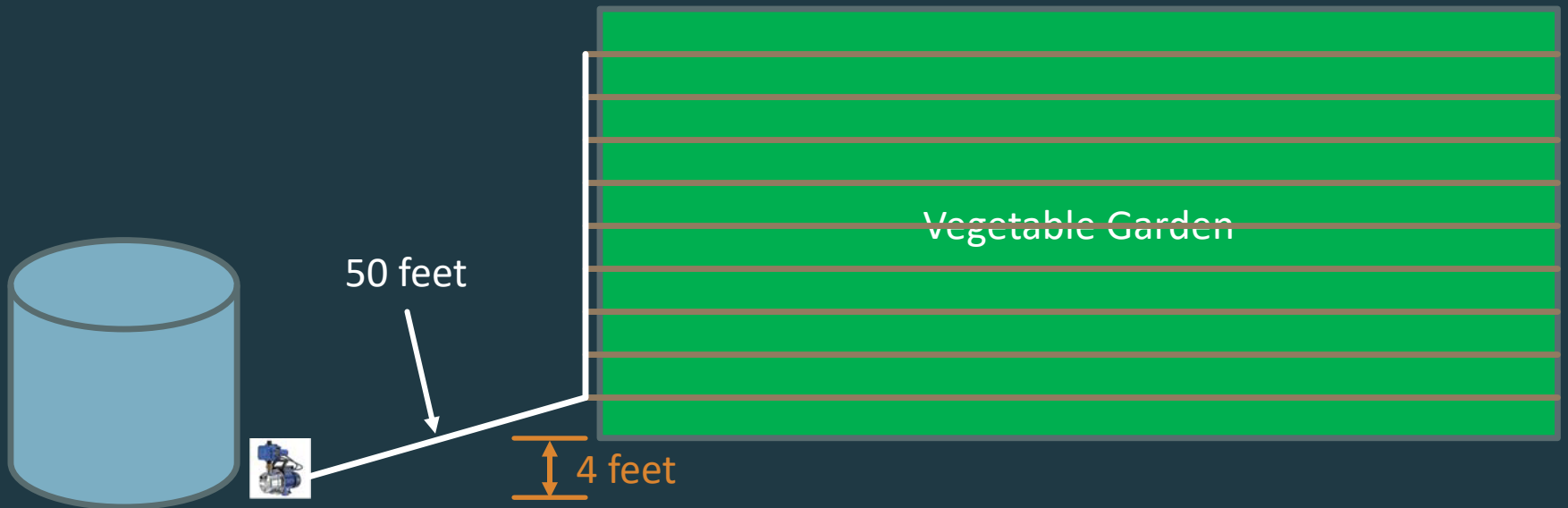
$$TDH = h_p + h_e + h_f$$

$h_p$ = (20 psi x 2.31) = 46.2 feet head

$h_e$ = 4 feet head

$h_f$ = (46.2 feet x 0.3) = 13.86 feet head

TDH = **64.06 feet head**



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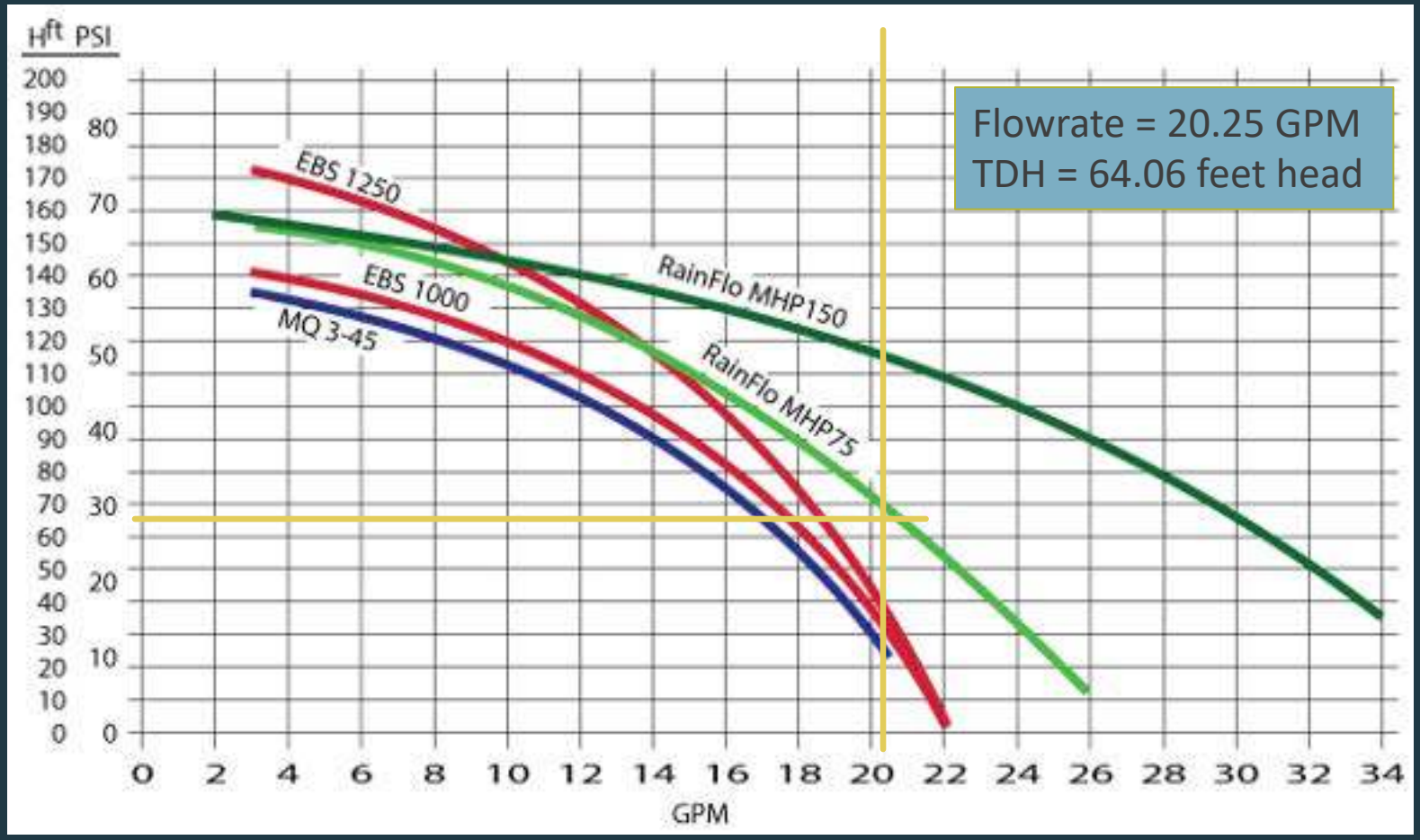

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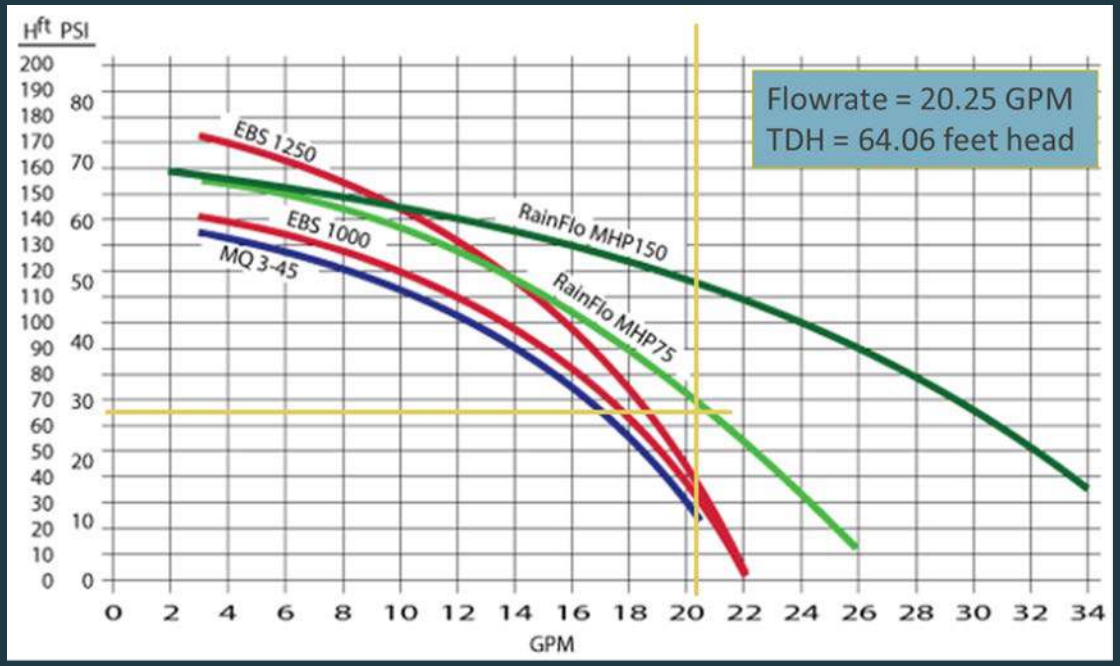



RainFlo MHP75A 3/4 HP Automatic Pump

# What is a “properly sized” pipe?

## Flow rate = 20.25 GPM

| | Schedule 40 PVC Pipe | Class 200 PVC Pipe | |
|---|---|---|---|
| Nominal Pipe Size | Maximum Recommended Flow Rate (GPM) | Maximum Recommended Flow Rate (GPM) | Water Velocity (ft/sec) |
| ½” | 4.4 | 5.9 | 5 |
| ¾” | 7.9 | 10.1 | 5 |
| 1” | 13.0 | 16.7 | 5 |
| 1 ¼” | 22.6 | 26.9 | 5 |
| 1 ½” | 30.9 | 35.4 | 5 |
| 2” | 51.3 | 55.5 | 5 |

# Do I need a pressure tank?

Stores pressurized water to prevent the pump from cycling on and off to meet small demands. It also supplies a constant pressure.

# What other components do I need?


Pressure regulators

Pressure regulators

Pressure regulated valve


Pressure gauge

Filters

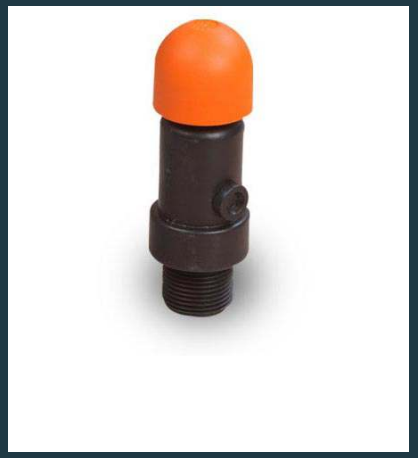

Filters

# What other components do I need?

Flow indicator flag

Air relief valve

Flush valve



Air relief valve

# What other components do I need?




# How can I make every drop count?

- Mulching or covering bare soil
- Monitoring soil moisture
- Water only as needed – learn to read your plants
- Check system regularly
- Ensure system is operating at proper pressure