
Irrigation
Options for
the Rainwater
Harvester

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?

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

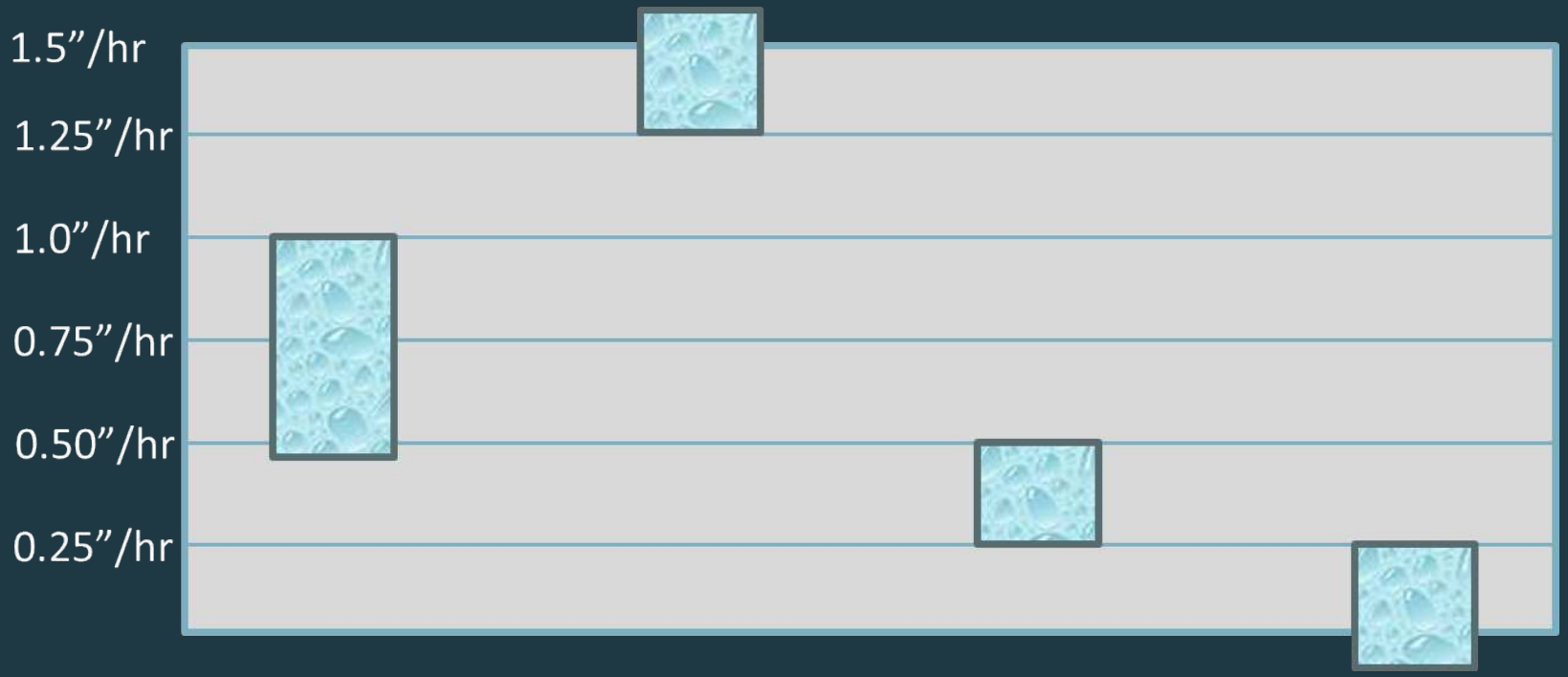
$$Inches = 3{,}000\ gal \div 900\ sqft \div 0.6234$$

$$Inches = 5.34$$

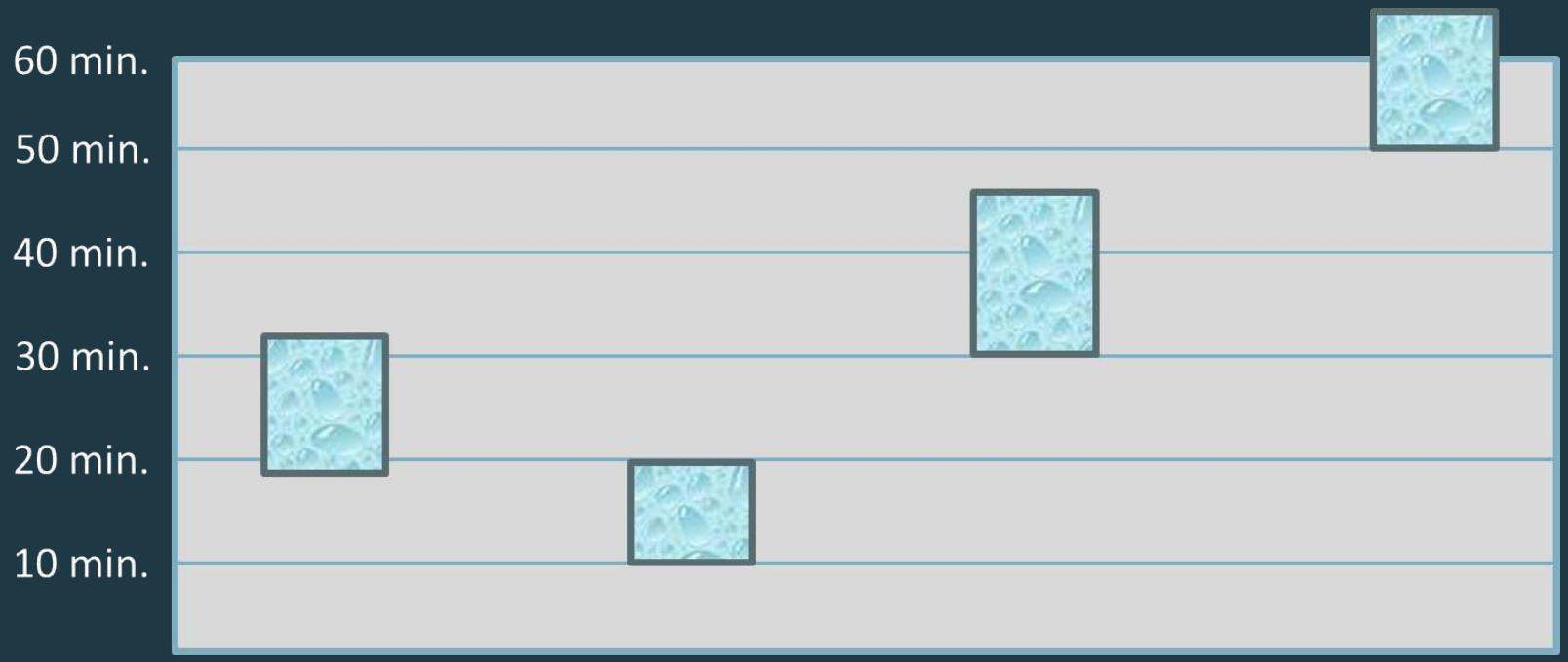
What type(s) of irrigation product(s) will I use?

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

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
Rotors/Impacts	40 - 70 psi	1 - 5 gpm
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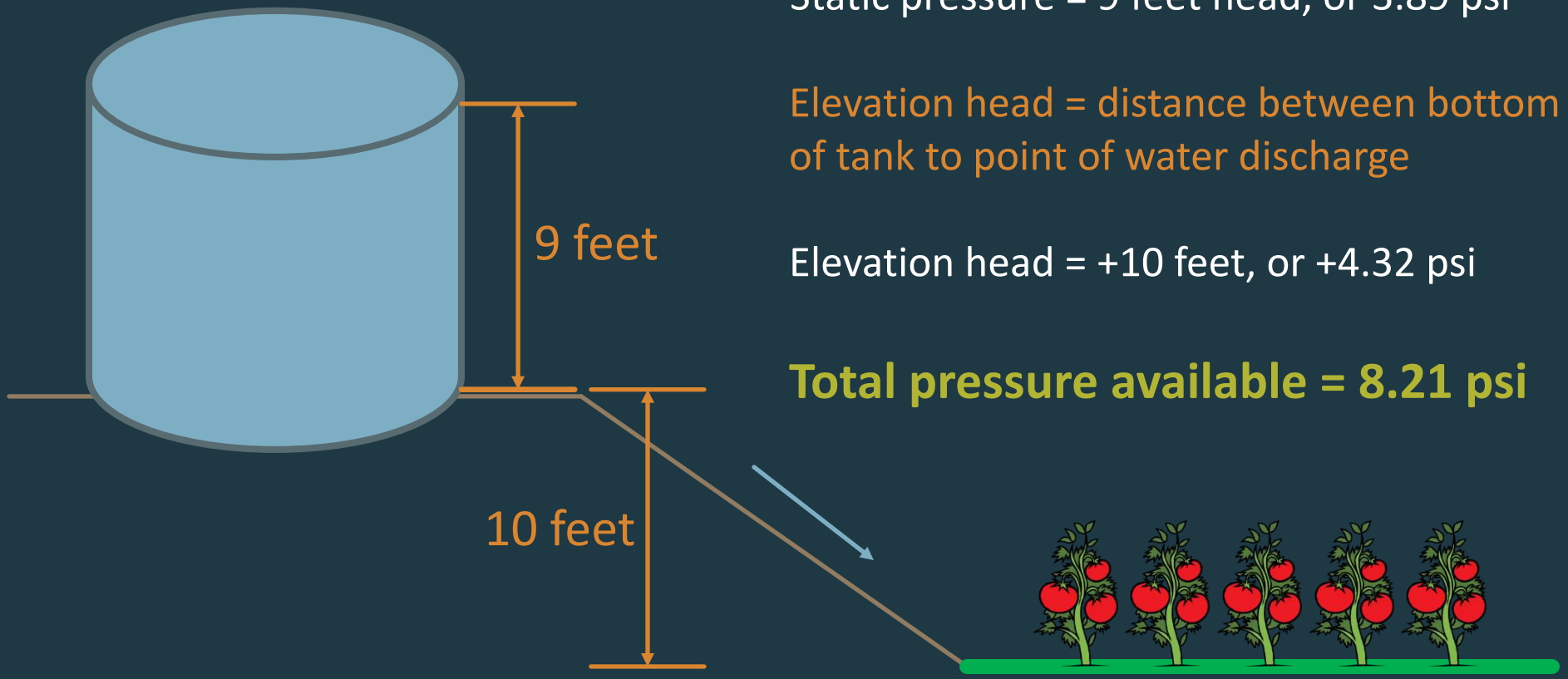
Drip tubing	15 - 30 psi	0.2 - 2 gph
Drip insert emitters	10 - 20 psi	0.2 - 20 gph
Drip tape	5 - 20 psi	0.25 - 0.50 gph
Soaker hose	5 - 30 psi	0.5 - 1 gph

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

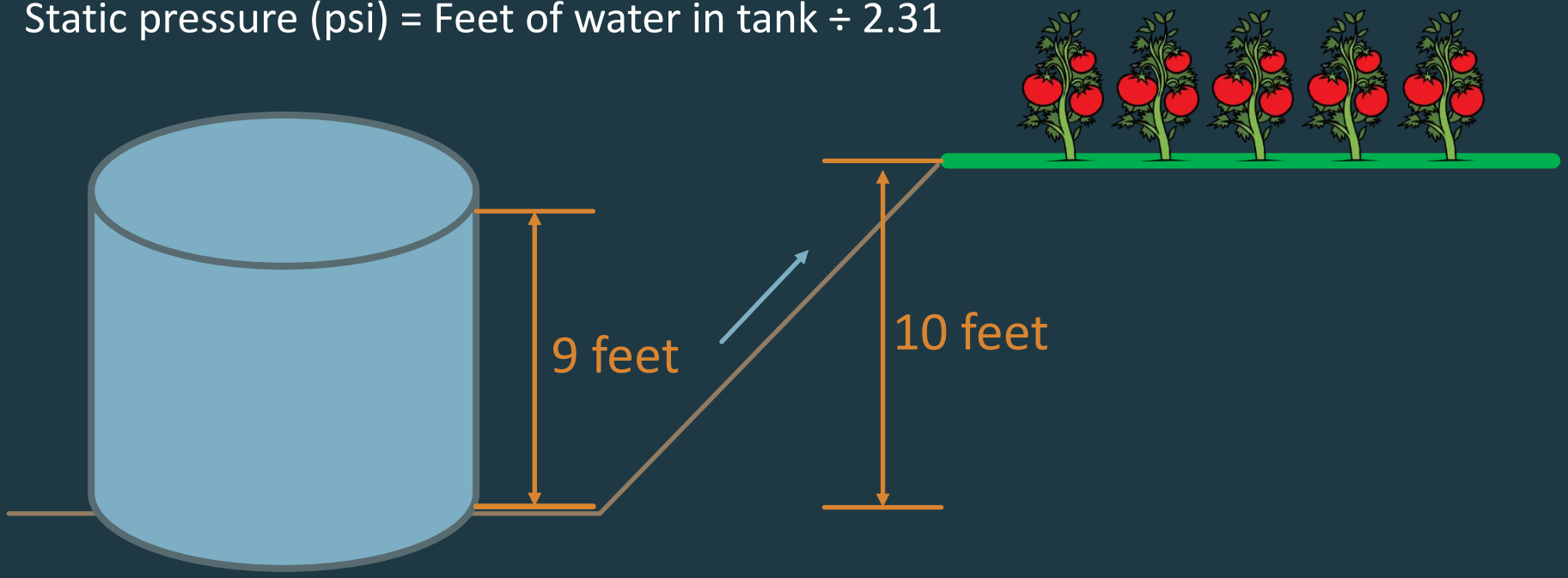
Elevation head = +10 feet, or +4.32 psi

Total pressure available = 8.21 psi

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

Do you need a pump?

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



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

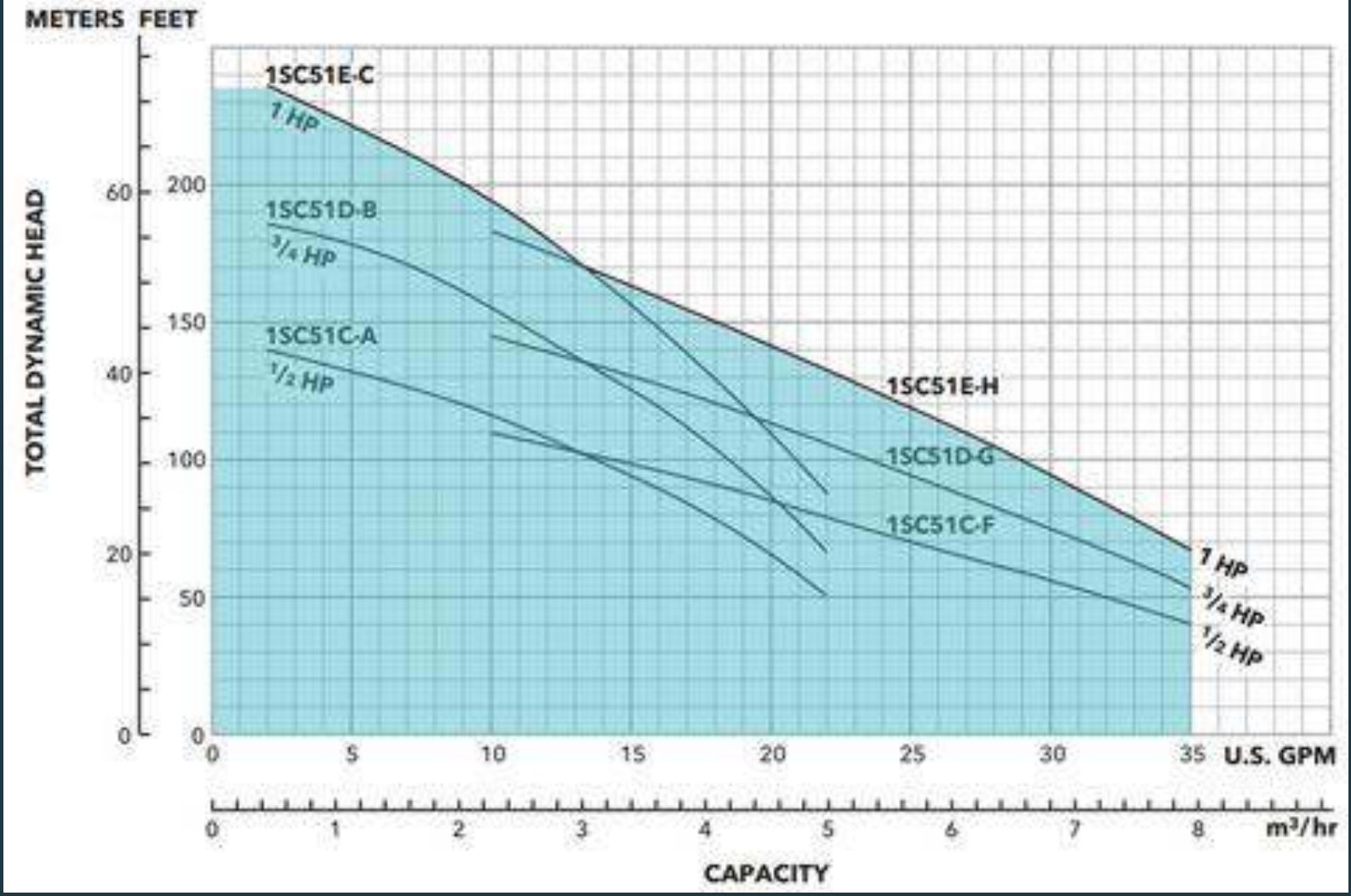
Surface

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

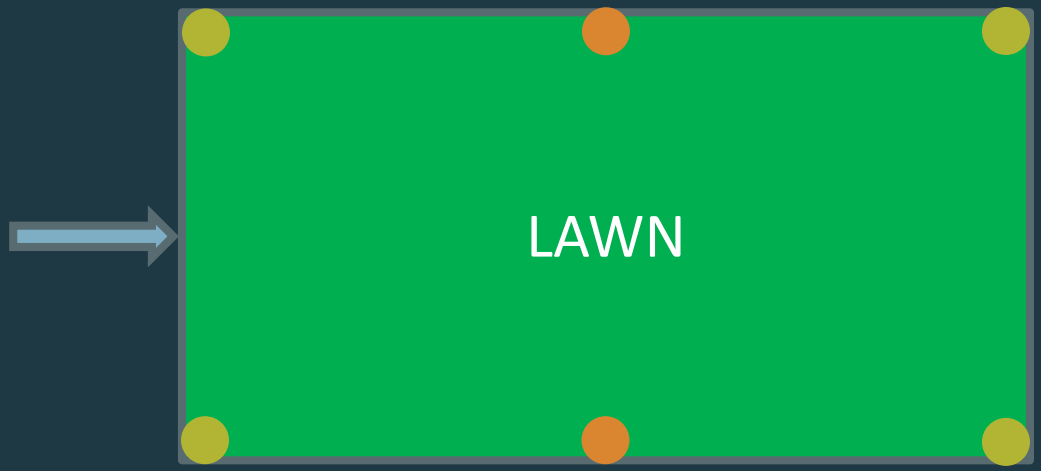
Add up the total gallons per minute (GPM) needed for the section to be irrigated at one time.

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

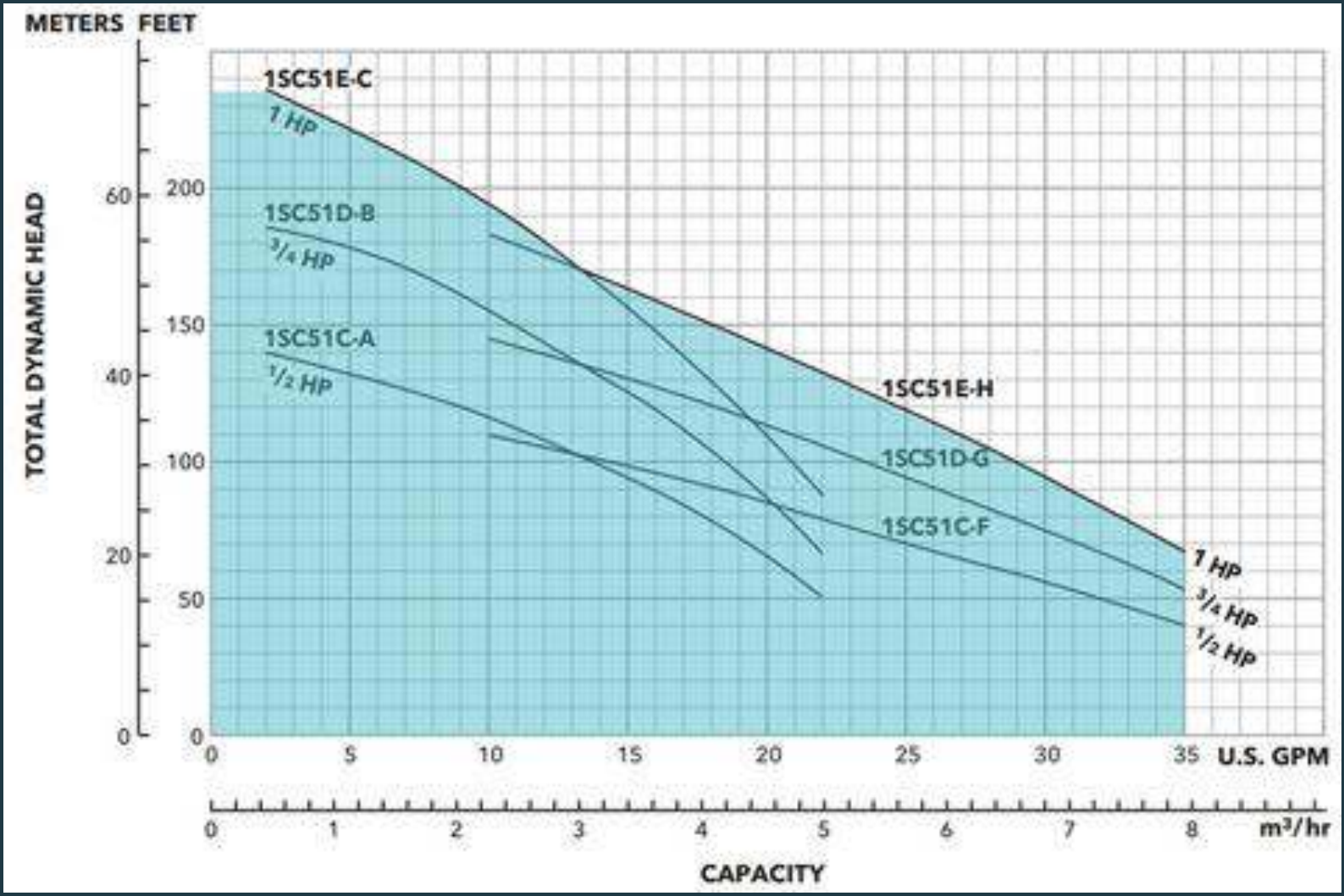
Total No. Emitters =
(500 ft x 1 emitter per ft) =
500 emitters

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)

Total Dynamic Head (TDH)

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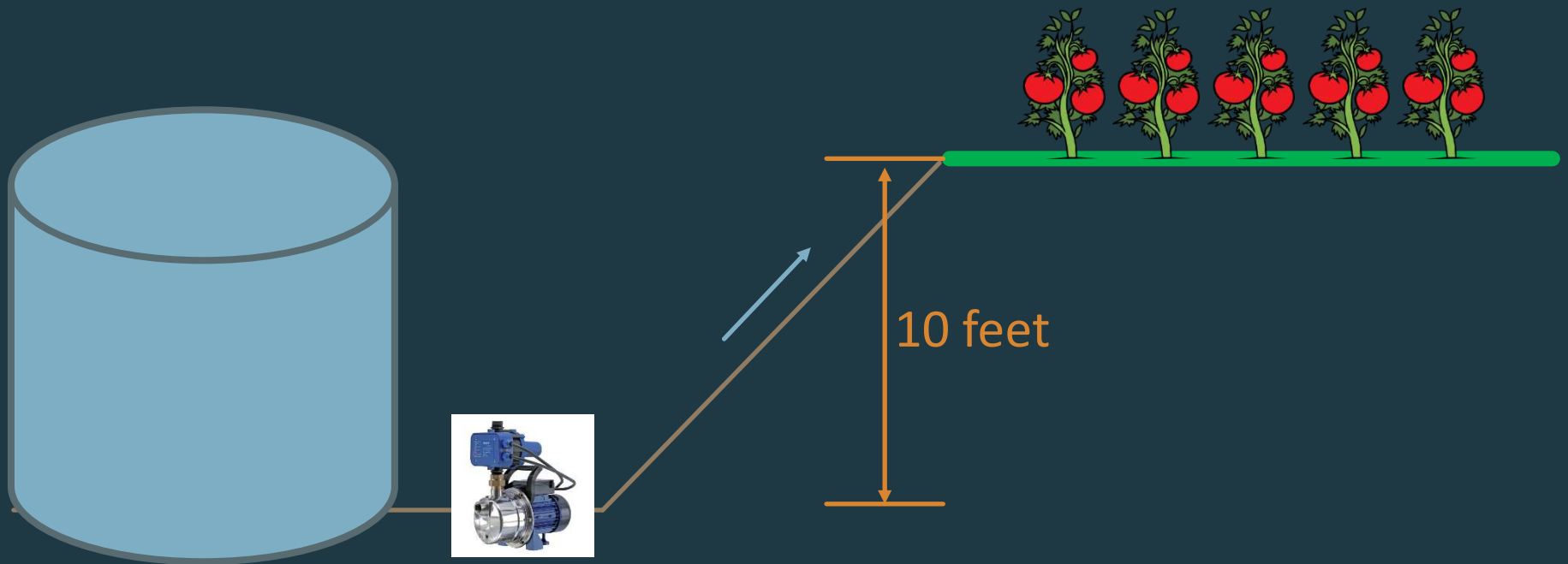
$$TDH = h_p + h_e + h_f$$

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.

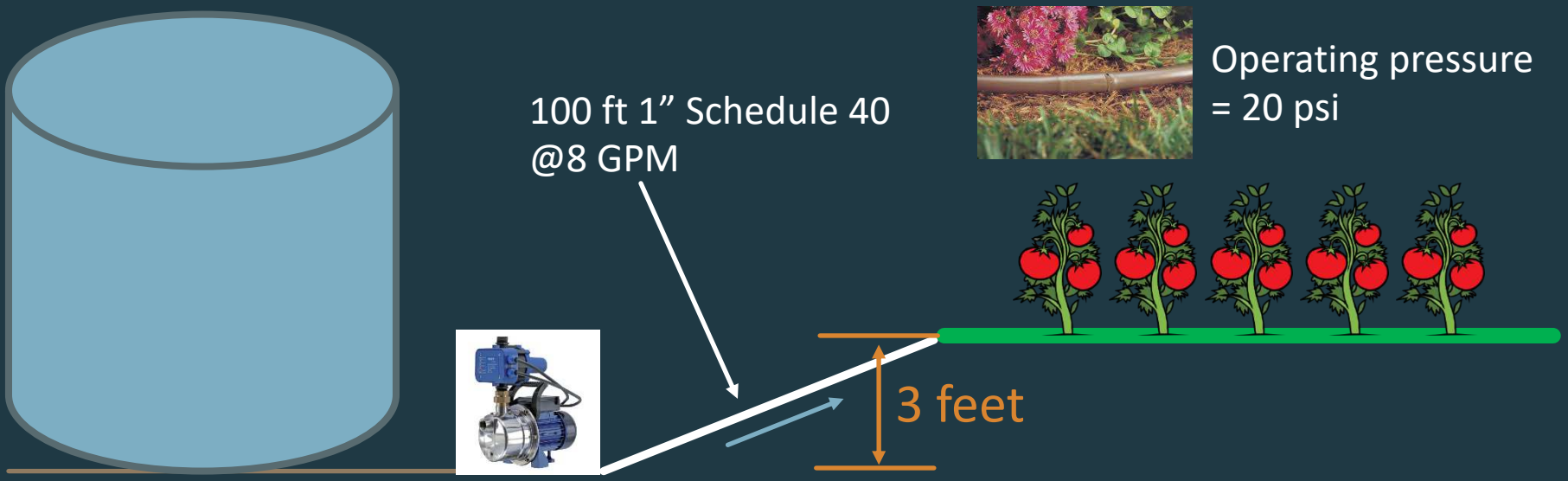
Example: If operating pressure is 40 psi, then h_f = (0.30 x 40 psi)

12 psi (or 27.72 feet head)

What is a “properly sized” pipe?

	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

Total Dynamic Head (TDH)

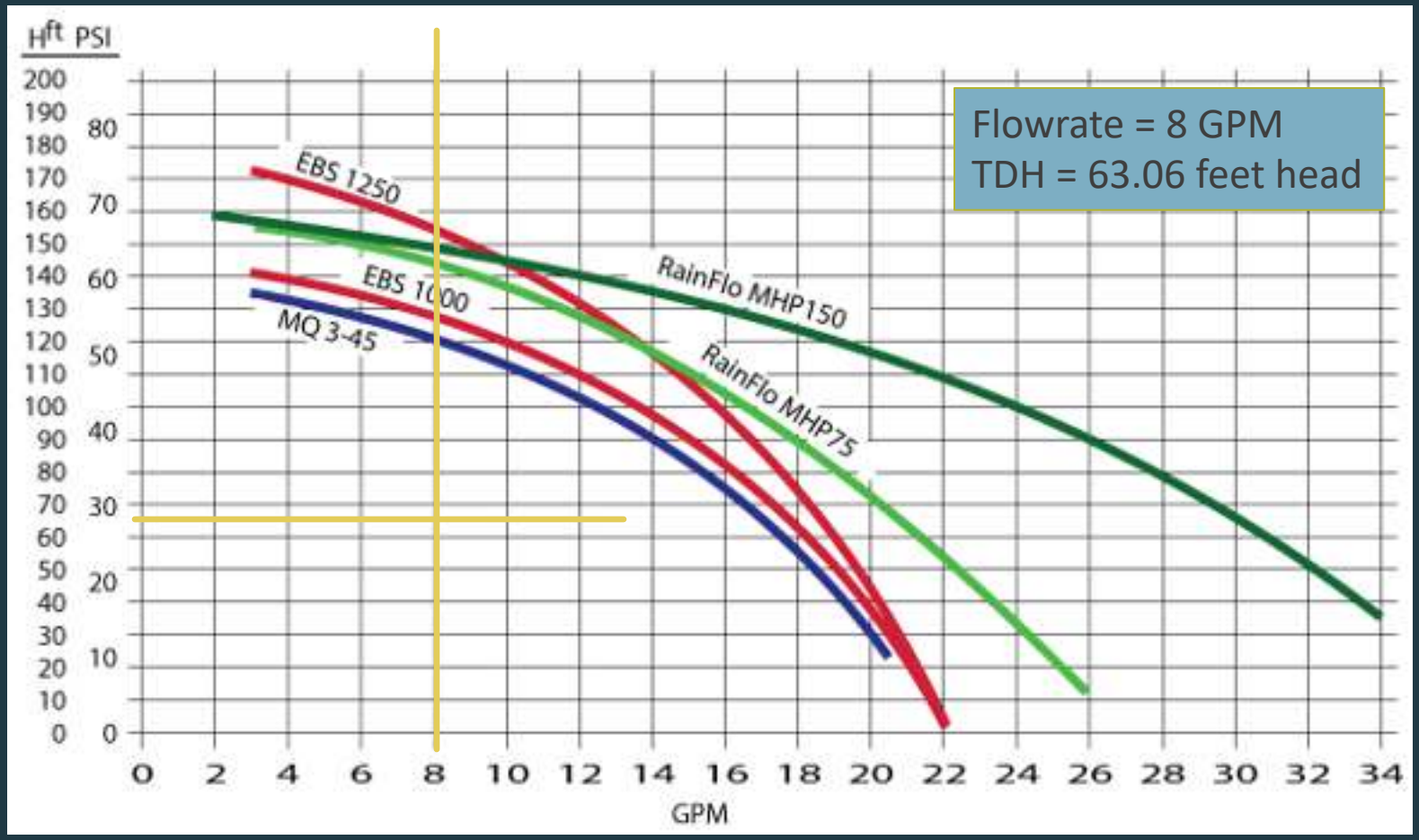


$$TDH = h_p + h_e + h_f$$

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

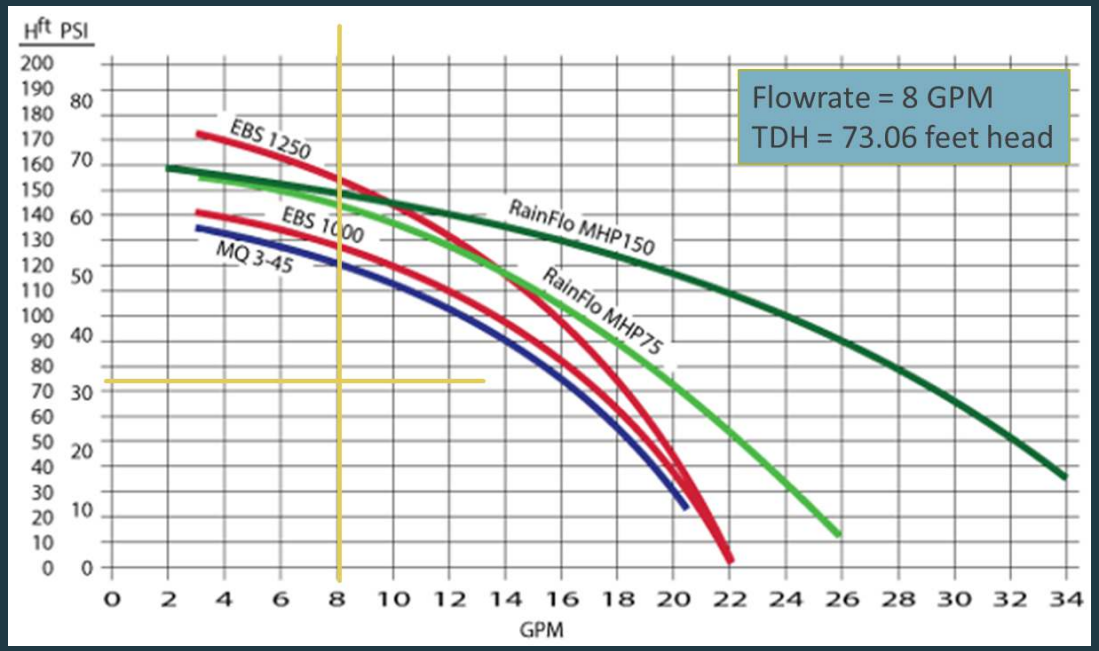
TDH = 63.06 feet head

Reading a Pump Curve



Source: Rainwater Management Solutions

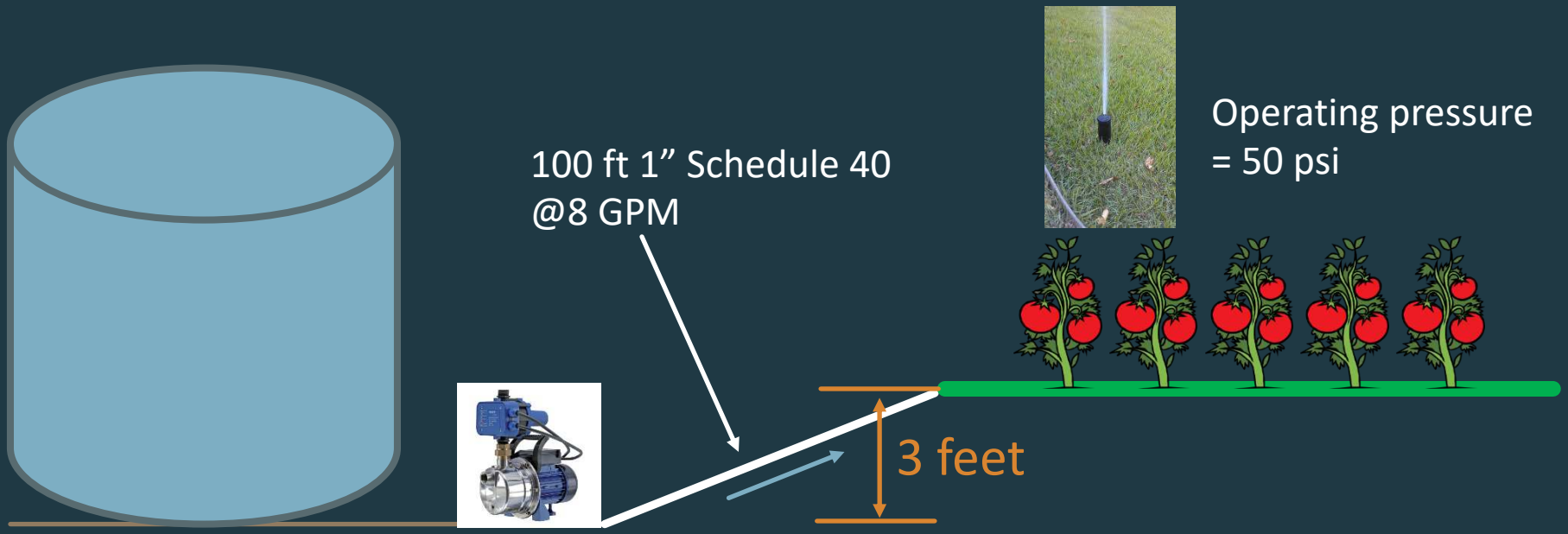
Reading a Pump Curve



Grundfos MQ 3-45 1 HP Pressure Boosting Pump

Source: Rainwater Management Solutions

Total Dynamic Head (TDH)

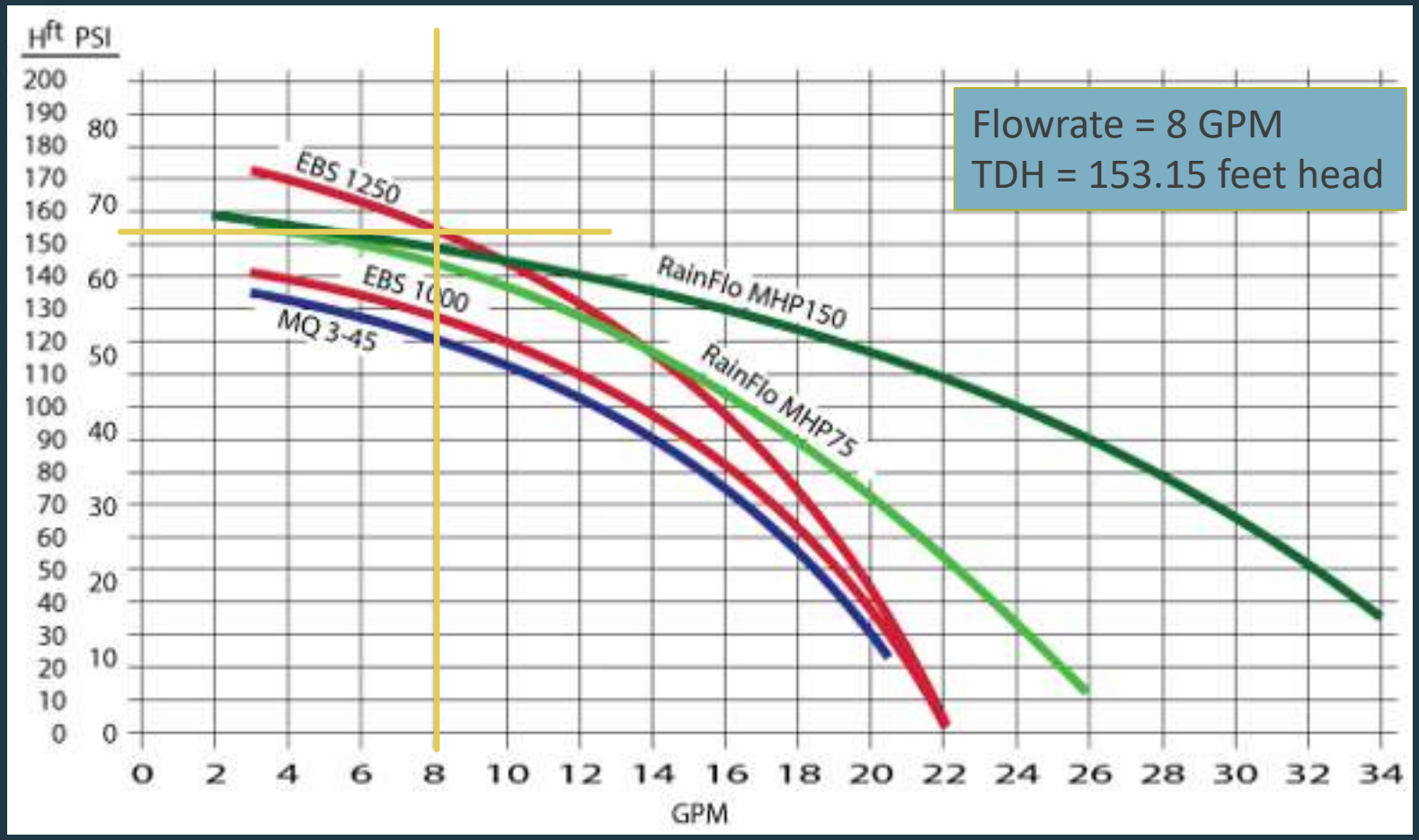


$$TDH = h_p + h_e + h_f$$

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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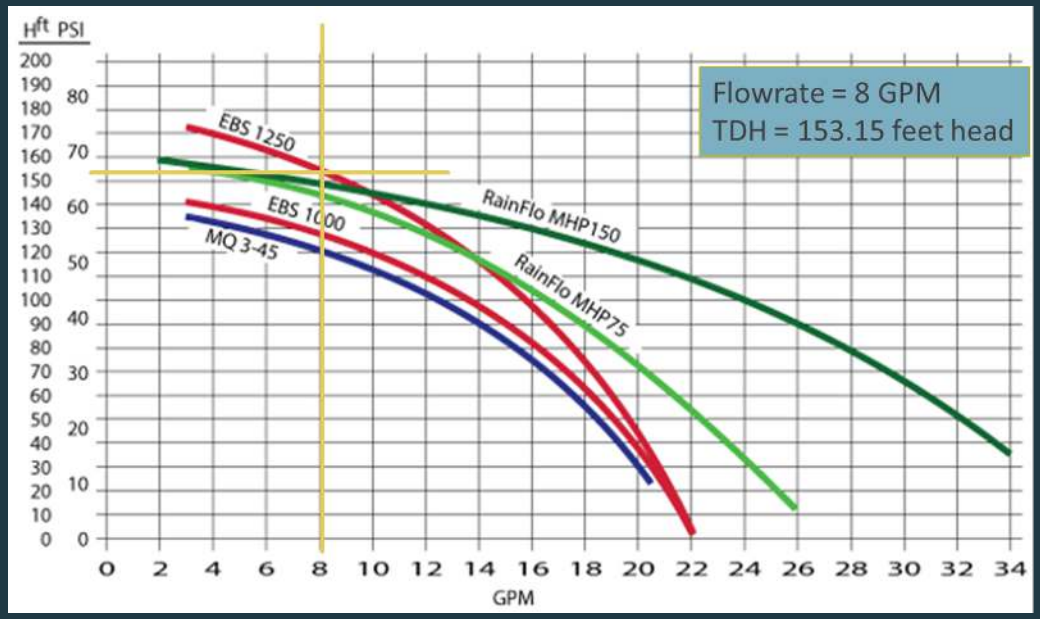
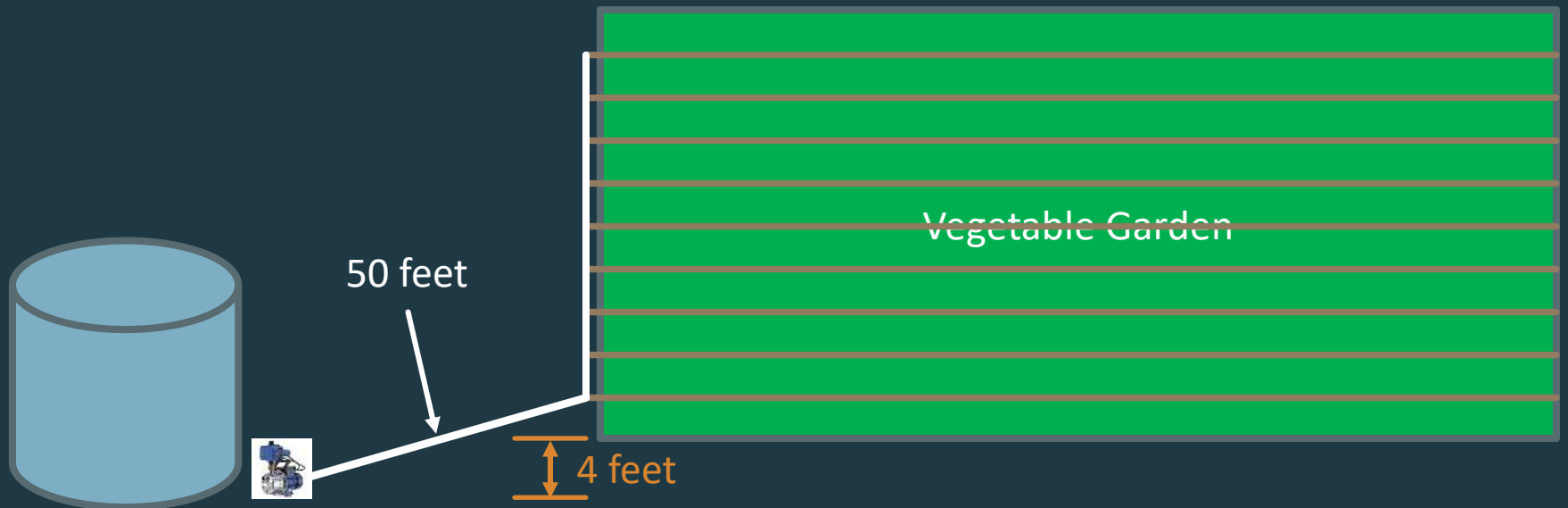


Leader EBS 1250 1HP Pressure Booster Pump

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

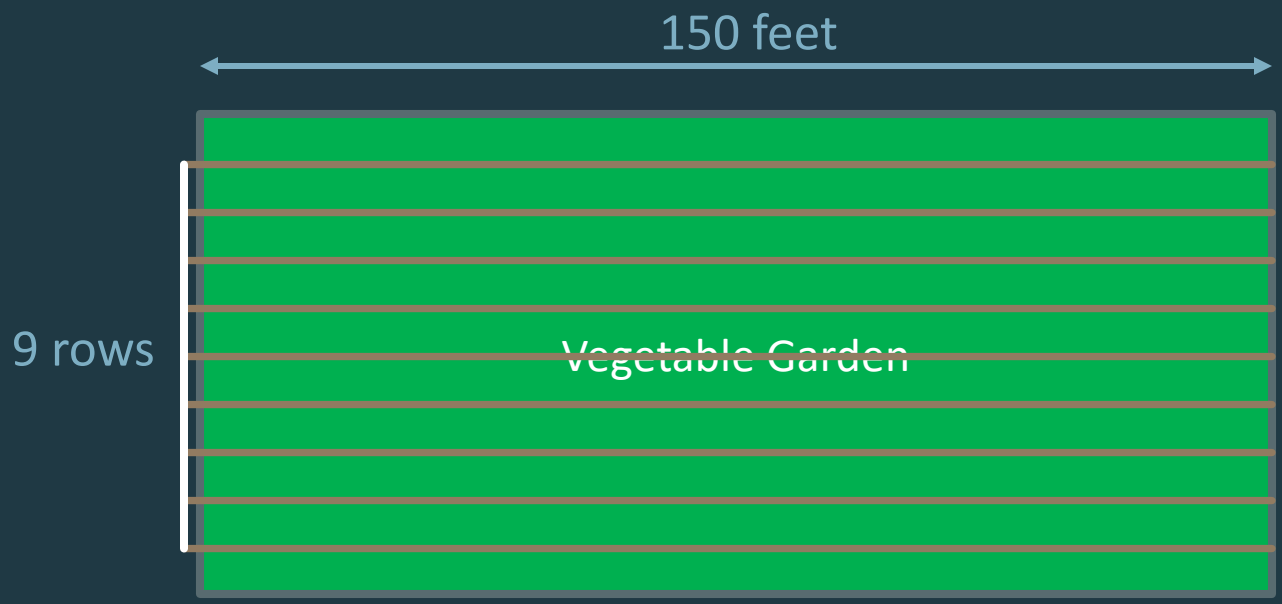
STEP 1: CALCULATE FLOW RATE (GPM)

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)

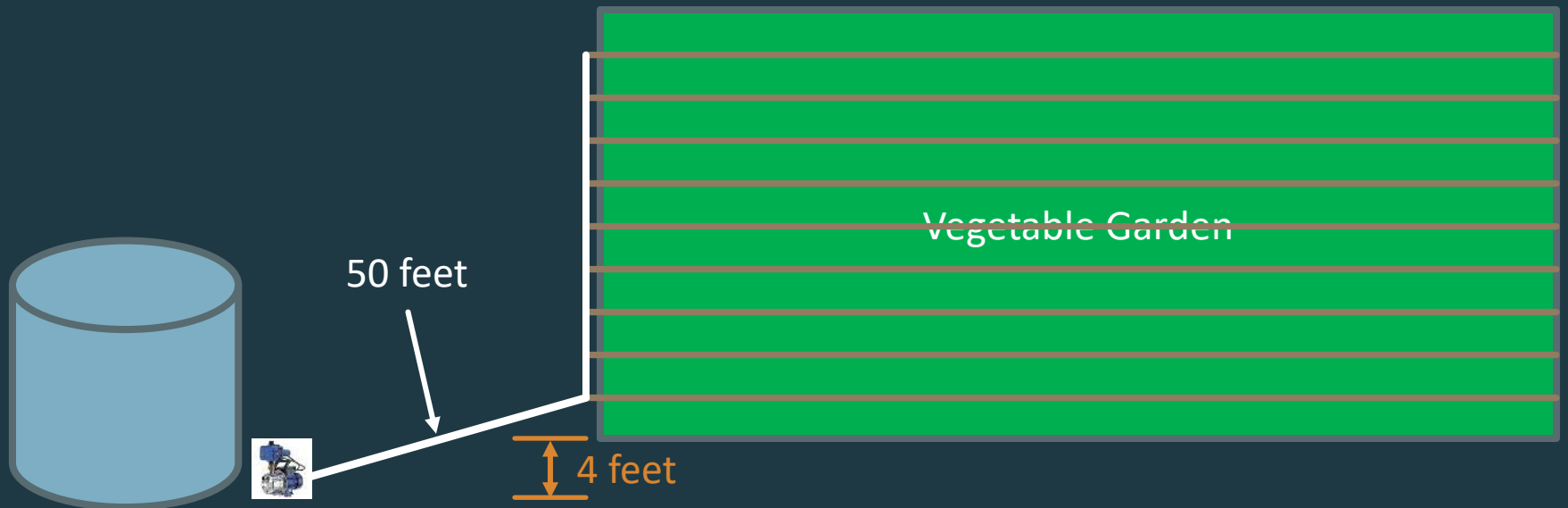
$$TDH = h_p + h_e + h_f$$

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

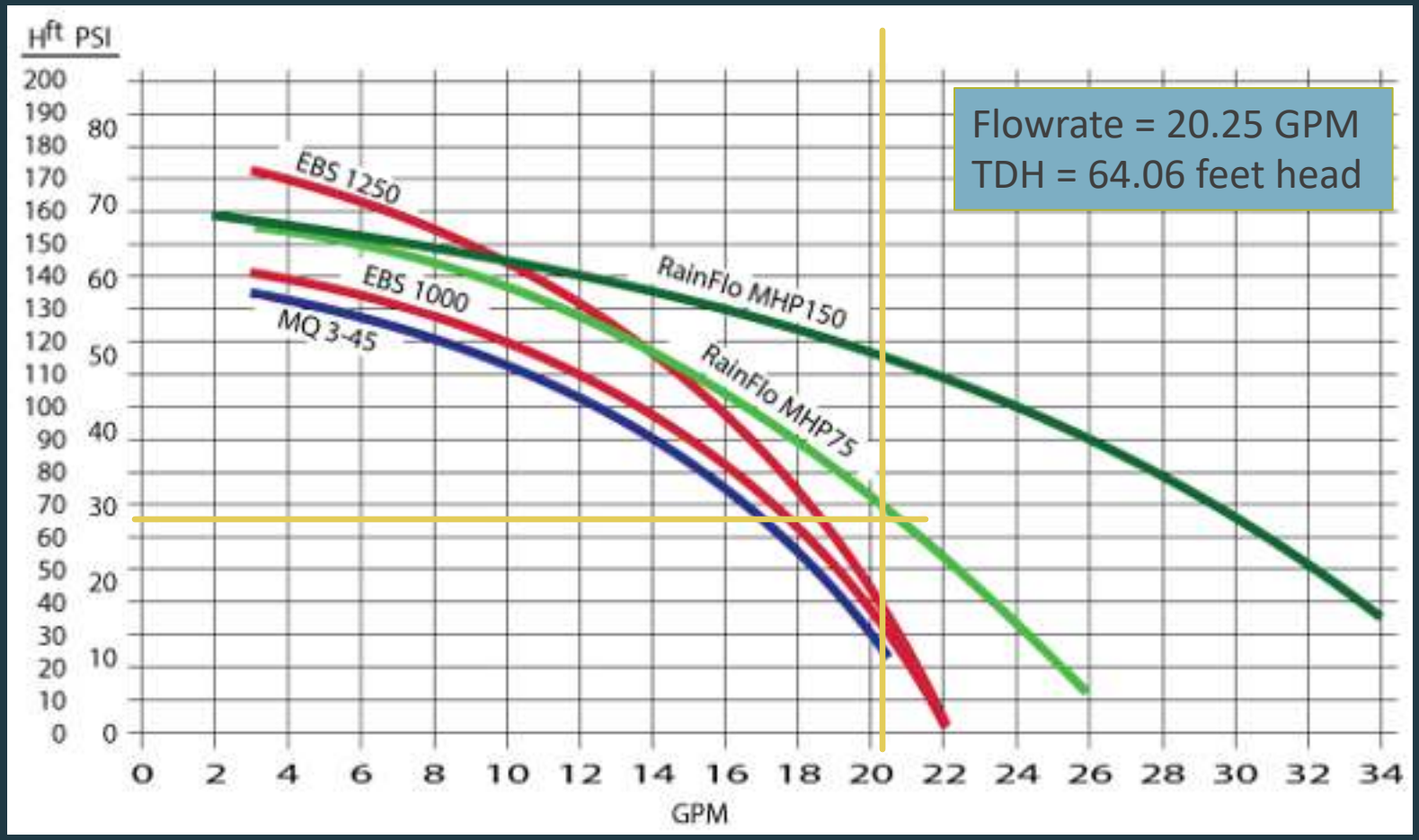
h_e = 4 feet head

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

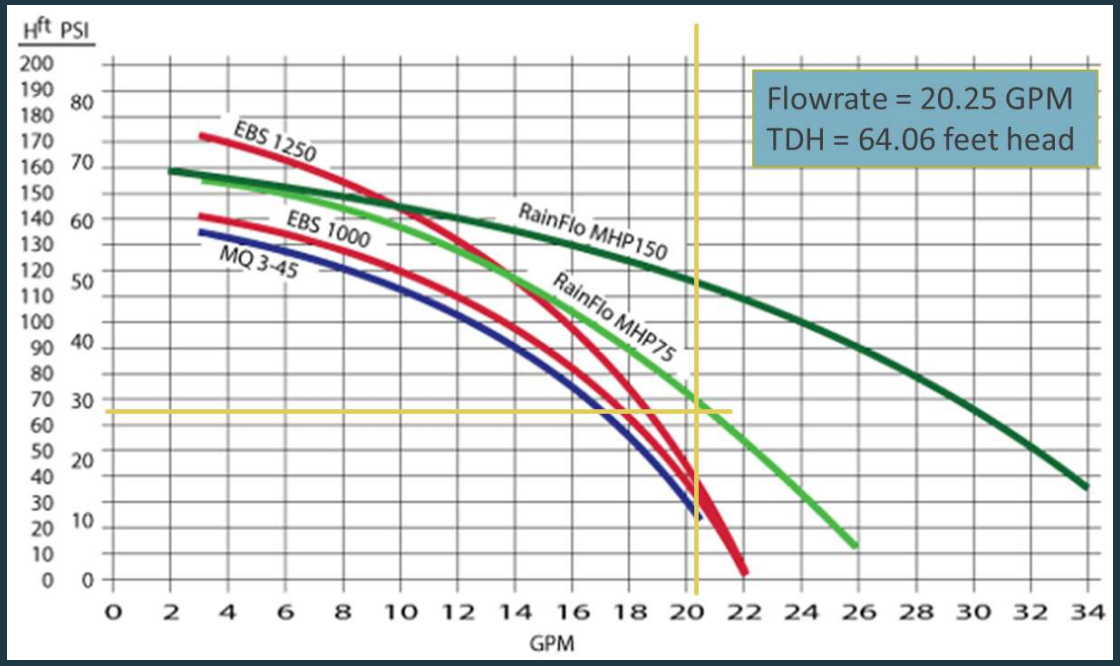
TDH = **64.06 feet head**



Pump Sizing Example



Pump Sizing Example



RainFlo MHP75A 3/4 HP Automatic Pump

What is a “properly sized” pipe?

Flow rate = 20.25 GPM

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

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

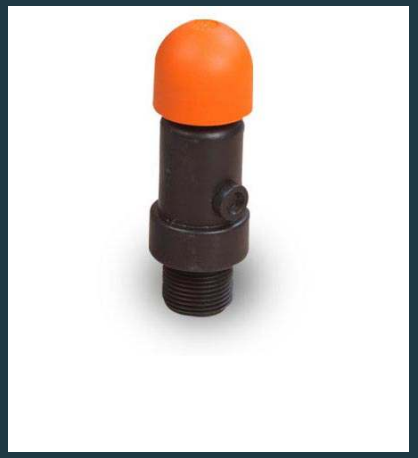
Filters

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