

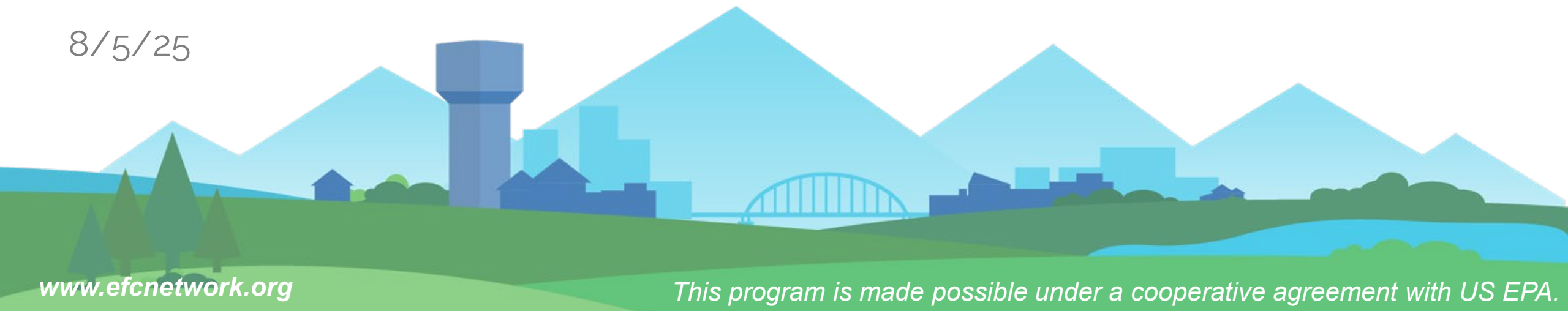


SOUTHWEST
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US Territories Wastewater Operator Training Series

Session 4: Wastewater Math Part 2: Area, Volume, Pressure

8/5/25



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Specialist**

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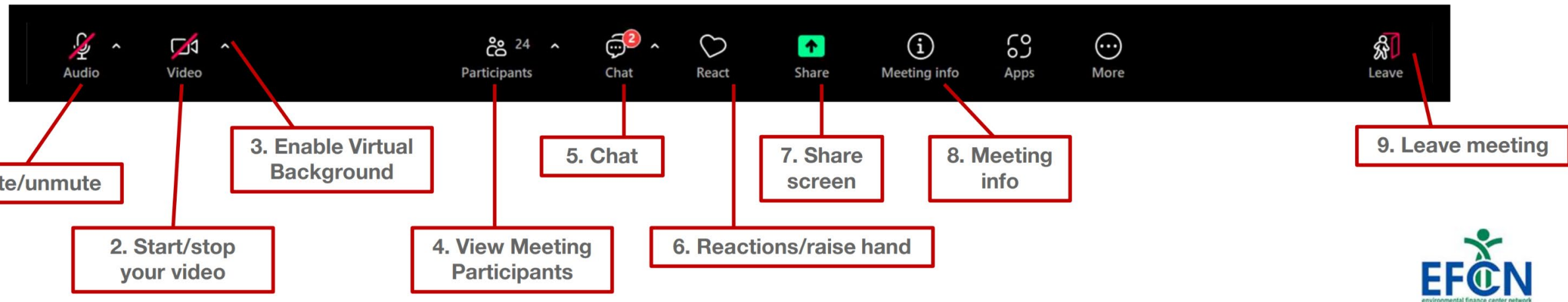
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This training series is funded by the US EPA

Attendee Meeting Controls

- Locate your control bar
- All attendees will see a black horizontal bar on their screen
- If your control bar is not visible, it may be hidden
 - Move your cursor to the screen's bottom (or top) to reveal this control bar.



WPI/ABC Operator Certification

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Q Search ...

Standardized Wastewater Treatment Operator Exams

Wastewater Treatment Operator Need-to-Know Criteria

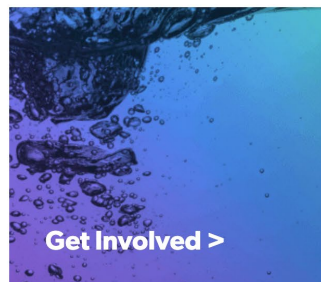
Need-to-Know Criteria outline the content that will be covered on WPI's standardized examinations provided through [ABC Testing](#), a WPI service.

- [Wastewater Treatment Operator Class I](#)
- [Wastewater Treatment Operator Class II](#)
- [Wastewater Treatment Operator Class III](#)
- [Wastewater Treatment Operator Class IV](#)

Wastewater Treatment Operator Formula/Conversion Table

WPI standardized exams are administered with a Formula/Conversion Table containing mathematical formulas and common abbreviations that may be present on the exam.

- [Wastewater Treatment Operator Formula/Conversion Table](#)



Schedule for 2025:

Date	Topic
6/24/25	Program Overview, Test Format, Study & Test Tips
7/8/25	Treatment Overview - Reg history, overview
7/22/25	WW Math Part 1 (Basic Math)
8/5/25	WW Math Part 2 (Areas & Volumes)
8/19/25	Collection Systems - Gravity systems
9/2/25	Collection Systems - Pumping & force mains
9/16/25	Collection System Maintenance
9/30/25	Operator Safety/OSHA/Chemical Safety & Inventory
10/14/25	Preliminary Treatment
10/28/25	Primary Treatment: Sedimentation
11/11/25	Fixed-Film Media
12/2/25	Activated Sludge Part 1
12/16/25	Activated Sludge Part 2

<https://swefc.unm.edu/home/op-cert-trainings/>



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This page is a repository of Wastewater and Drinking Water Operator Certification (Op Cert) Training Webinars offered by the SW EFC for systems in the Pacific Territories. Below you will find the **training webinar schedules (wastewater, then drinking water)** followed by a **training webinar recordings library**.

[Jump to Wastewater Trainings](#) [↓](#)

[Jump to Drinking Water Trainings](#) [↓](#)

Wastewater Training Schedule

Please note all times are local to CNMI and Guam. The times in American Samoa are one day earlier at 11 am.

Session	Date	Training Topic & Link to Recording (click to view)	Supporting Materials (click to download)
1	6/25/2025	Program Overview, Test Format, Study & Test Tips	PPT slides
2	7/9/2025	Treatment Overview	
3	7/23/2025	WW Math Part 1 (Areas & Volumes)	
4	8/6/2025	WW Math Part 2 (Flow Rates & Detention Times)	
5	8/20/2025	Collection Systems – Gravity systems	
6	9/3/2025	Collection Systems – Pumping & Force Mains	
7	9/17/2025	Collection System Maintenance	
8	10/1/2025	Operator Safety/OSHA/Chemical Safety & Inventory	

Sign in for every session to ensure you get credit for attending



US Territories Water & Wastewater Operator Certification
Virtual Training Series Group Attendance Sheet

Session Title: _____
Session Date: _____
Training Location: _____

Attendee Name	Attendee Signature	Arrival Time	Departure Time

I hereby certify that the individuals listed above attended the referenced training session.

Name: _____
Signature: _____
Title: _____
Date: _____

Surface Area Basics



- A 2-dimensional space
- Area Units
 - inches²
 - feet²
 - miles²
 - meters²
 - acre

Where in water systems are surface areas important?

You can use conversion factors to convert between these different units.

$$\begin{aligned} 1 \text{ acre} &= 43,560 \text{ ft}^2 \\ &= 4,046.9 \text{ m}^2 \end{aligned}$$

$$1 \text{ square meter} = 1.19 \text{ yd}^2$$

Surface Area & Water System Operations

Wastewater Pond Liner

Weed Fabric

Paint

Building Material

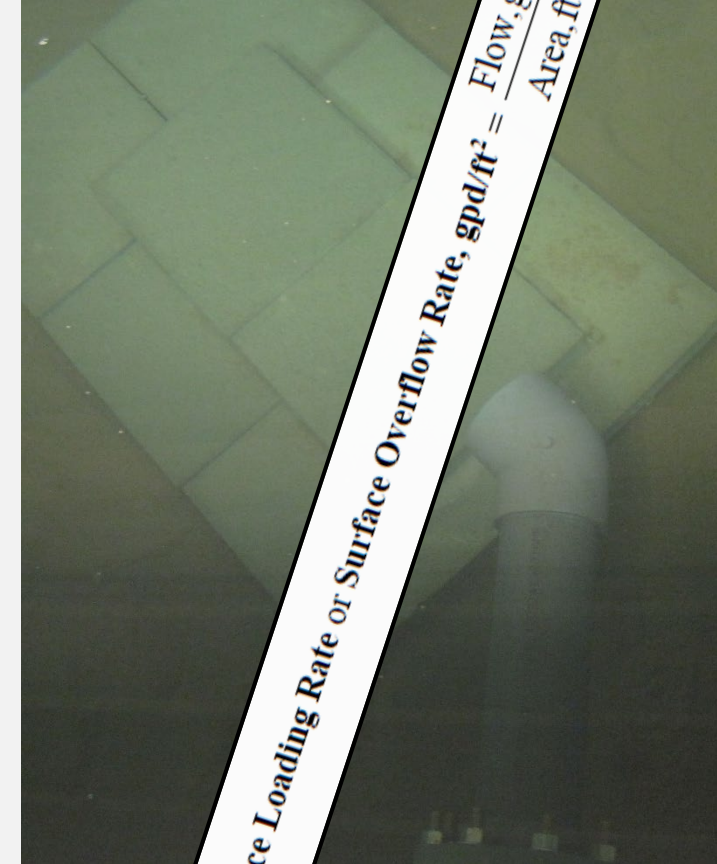
Surface Area & Water/Wastewater System Operations



Copper sulfate application for algae control lbs/acre



Filter Backwash Rise Rate, in/min = $\frac{(\text{Backwash Rate, gpm/ft}^2)(12 \text{ in/ft})}{7.48 \text{ gal/ft}^3}$



Surface Loading Rate or Surface Overflow Rate, $\text{gpd/ft}^2 = \frac{\text{Flow, gpd}}{\text{Area, ft}^2}$

Surface Area Equations

$$\text{Area of Circle}^* = (0.785)(\text{Diameter}^2)$$

$$\text{Area of Circle} = (3.14)(\text{Radius}^2)$$

$$\text{Area of Cone (lateral area)} = (3.14)(\text{Radius})\sqrt{\text{Radius}^2 + \text{Height}^2}$$

$$\text{Area of Cone (total surface area)} = (3.14)(\text{Radius})(\text{Radius} + \sqrt{\text{Radius}^2 + \text{Height}^2})$$

$$\text{Area of Cylinder (total exterior surface area)} = [\text{End \#1 SA}] + [\text{End \#2 SA}] + [(3.14)(\text{Diameter})(\text{Height or Depth})]$$

Where SA = surface area

$$\text{Area of Rectangle}^* = (\text{Length})(\text{Width})$$

$$\text{Area of Right Triangle}^* = \frac{(\text{Base})(\text{Height})}{2}$$

Surface Area Example – Square or Rectangle

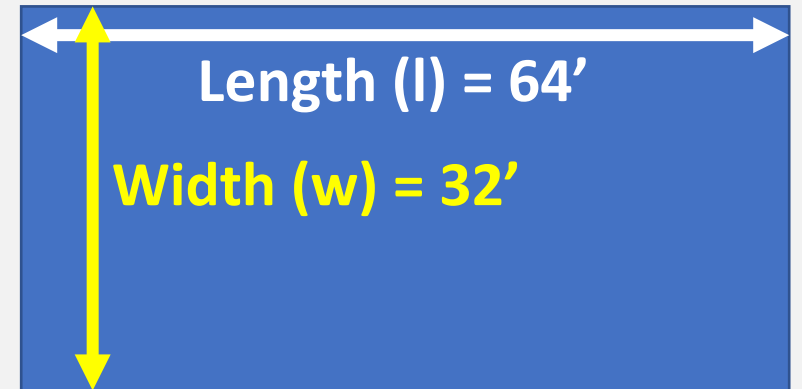
You need to buy some new liner for your RO reject water pond. The pond is 64' long and 32' wide. How many square feet do you need to order?

$$\text{Area of Rectangle}^* = (\text{Length})(\text{Width})$$

$$\text{Area} = (\text{Length})(\text{Width})$$

$$\text{Area} = (64 \text{ feet})(32 \text{ feet})$$

$$\text{Area} = \mathbf{2,048 \text{ ft}^2}$$



Surface Area Example - Circle

What is the surface area in square feet of a circular sedimentation basin that is 60 feet in diameter?

$$\text{Area of Circle}^* = (0.785)(\text{Diameter}^2)$$

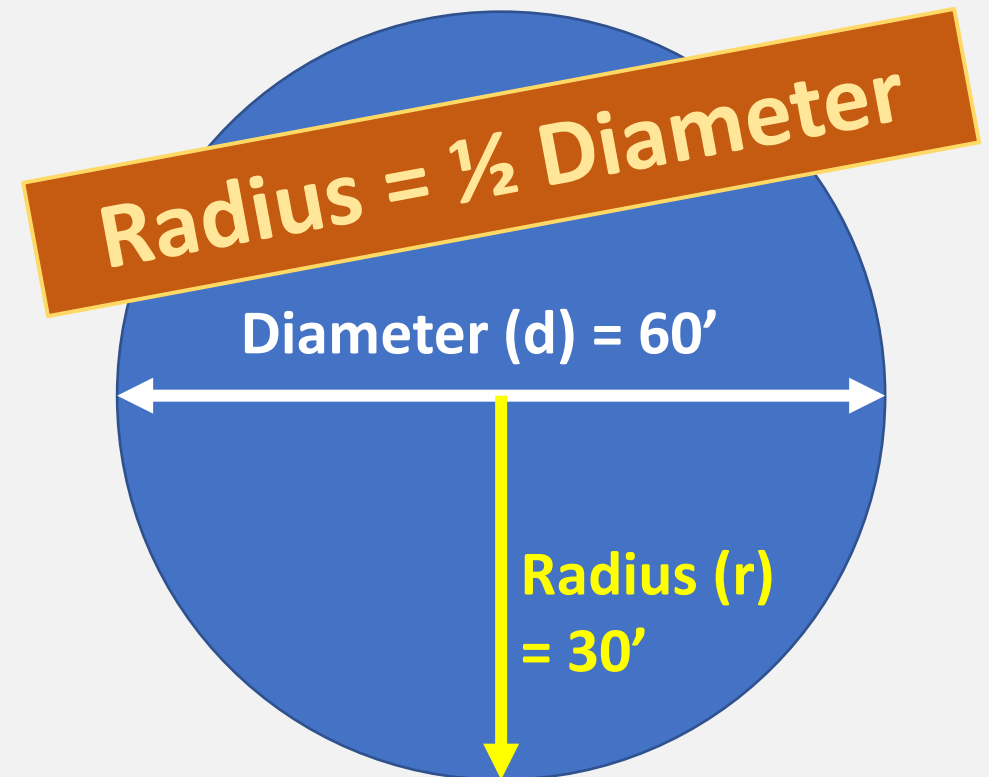
$$\text{Area of Circle} = (3.14)(\text{Radius}^2)$$

$$\text{Area} = 3.14(\text{Radius}^2)$$

$$\text{Area} = (3.14)(30 \text{ ft}^2)$$

$$\text{Area} = (3.14)(900 \text{ ft}^2)$$

$$\text{Area} = \mathbf{2,826 \text{ ft}^2}$$





Surface Area Practice

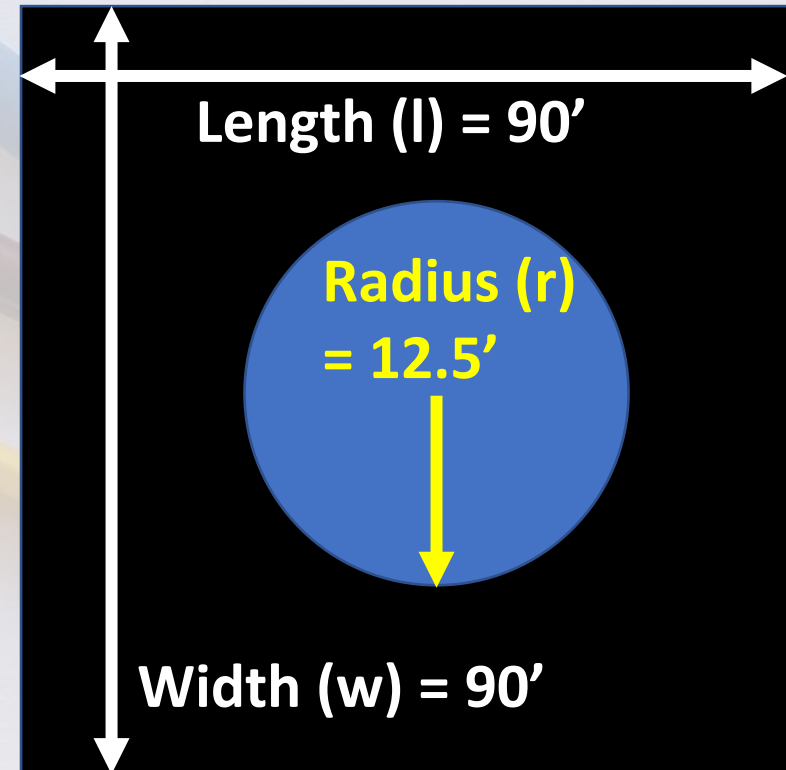
How many square feet of weed cloth will you have to order to cover the fenced area around your 25' diameter tank? The fenced area is 90' x 90'.

- a) 2,250 ft²
- b) 7,610 ft²
- c) 8,100 ft²
- d) 14,220 ft²

$$\text{Area of Rectangle}^* = (\text{Length})(\text{Width})$$

$$\text{Area of Circle}^* = (0.785)(\text{Diameter}^2)$$

$$\text{Area of Circle} = (3.14)(\text{Radius}^2)$$





Surface Area Practice

How many square feet of weed cloth will you have to order to cover the fenced area around your 25' diameter tank? The fenced area is 90' x 90'.

$$\text{Area of Rectangle}^* = (\text{Length})(\text{Width})$$

$$\text{Area of Circle} = (3.14)(\text{Radius}^2)$$

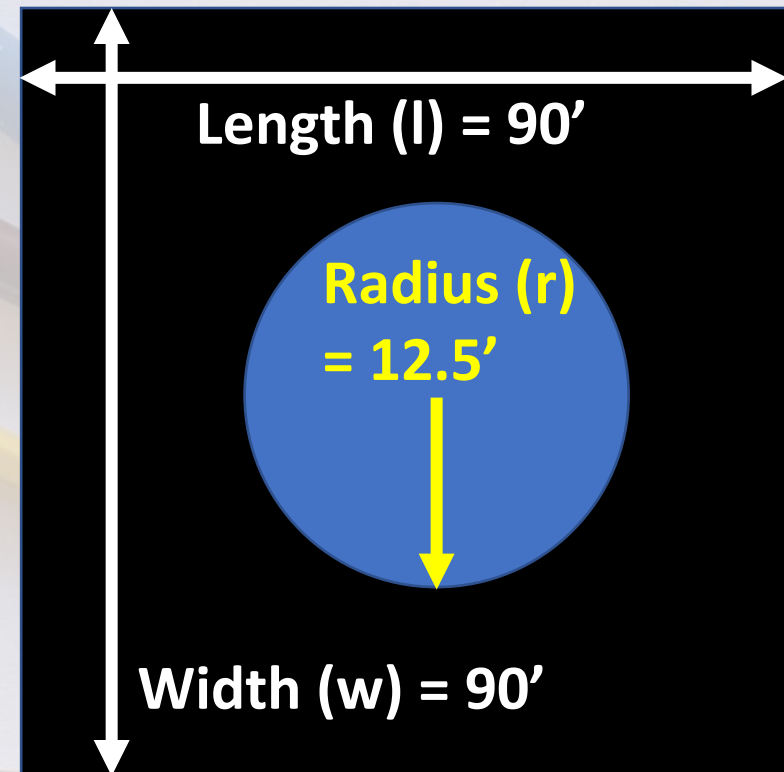
$$\text{Area} = (L)(W) - (3.14(\text{Radius}^2))$$

$$\text{Area} = (90 \text{ ft})(90 \text{ ft}) - (3.14)(12.5 \text{ ft})^2$$

$$\text{Area} = 8,100 \text{ ft}^2 - (3.14)(156.25 \text{ ft}^2)$$

$$\text{Area} = 8,100 \text{ ft}^2 - 490 \text{ ft}^2$$

$$\text{Area} = \mathbf{7,610 \text{ ft}^2}$$



Now let's dive deep into some 3D water math!!!



Volume

Volume of a box (rectangular tank, trench) = (Length)(Width)(Height)

What is the volume in gallons of a rectangular tank with the dimensions of 30 feet long, 10 feet wide, and 15 feet high?

$$V = (\text{Length})(\text{Width})(\text{Height})$$

$$V = (30\text{ft})(10\text{ft})(15\text{ft})$$

$$V = 4500 \text{ ft}^3$$

$$1 \text{ cubic foot of water} = 7.48 \text{ gal}$$

$$4500 \cancel{\text{ft}^3} * \left(\frac{7.48 \cancel{\text{gal}}}{1 \cancel{\text{ft}^3}} \right) =$$

$$\frac{4500 \cancel{\text{ft}^3}}{1} \bigg| \frac{7.48 \text{ gal}}{1 \cancel{\text{ft}^3}} = 33,660 \text{ gal}$$

Hold on! Do we actually know our volume that accurately?

How precise is our input data?



How many **significant figures** did we start with?

Two significant figures in our initial data, three in our conversion factor

What is the volume in gallons of a rectangular tank with the dimensions of 30 feet long, 10 feet wide, and 15 feet high?

$$V = (\text{Length})(\text{Width})(\text{Height})$$

$$V = (30\text{ft})(10\text{ft})(15\text{ft})$$

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$$1 \text{ cubic foot of water} = 7.48 \text{ gal}$$

$$4500 \cancel{\text{ft}^3} * \left(\frac{7.48 \cancel{\text{gal}}}{1 \cancel{\text{ft}^3}} \right) =$$

$$\begin{array}{r|l} 4500 \cancel{\text{ft}^3} & 7.48 \text{ gal} \\ \hline 1 & 1 \cancel{\text{ft}^3} \end{array} = \begin{array}{l} 33,660 \text{ gal} \\ \hline 34,000 \text{ gal} \end{array}$$



Your turn: Volume of a box and conversion

Part 1: You dig a trench to put in a new section of pipe. The trench is four feet deep, two feet wide, and 200 ft long. How many cubic feet of dirt did you excavate?

- A. 160 ft^3
- B. 206 ft^3
- C. 1600 ft^2
- D. 1600 ft^3

$$V = (\text{Length})(\text{Width})(\text{Height})$$

$$V = (200 \text{ ft})(2 \text{ ft})(4 \text{ ft})$$

$$V = 1600 \text{ ft}^3$$



Your turn: Volume of a box and conversion

Part 2: To fill in your 1600 ft^3 hole, you need to order fill dirt that is sold by the truckload. How many truckloads of dirt do you need if one truck hold 10 cubic yards? $1 \text{ yard} = 3 \text{ feet}$ or $1 \text{ yrd}^3 = 27 \text{ ft}^3$

- A. 1 truckload
- B. 6 truckloads
- C. 18 truckloads
- D. 53 truckloads

Conversion $1 \text{ yrd} = 3 \text{ ft}$

$$V = 1600 \text{ ft}^3 \left(\frac{1 \text{ yrd}}{3 \text{ ft}} \right) \left(\frac{1 \text{ yrd}}{3 \text{ ft}} \right) \left(\frac{1 \text{ yrd}}{3 \text{ ft}} \right)$$

$$V = 1600 \frac{\cancel{\text{ft}} \cancel{\text{ft}} \cancel{\text{ft}}}{1} \frac{1 \text{ yrd}}{\cancel{3 \text{ ft}}} \frac{1 \text{ yrd}}{\cancel{3 \text{ ft}}} \frac{1 \text{ yrd}}{\cancel{3 \text{ ft}}}$$

$$V = 59 \text{ yds}^3$$

Conversion $10 \text{ yards}^3 = 1 \text{ truckload}$

$$\text{Number of truckloads needed} = \frac{59 \cancel{\text{ yds}^3}}{1} \frac{1 \text{ truckload}}{\cancel{10 \text{ yds}^3}}$$

$$\text{Number of truckloads needed} = 6 \text{ truckloads}$$

Volume of a cylinder (tank, pipe, well)

$$\text{Area of Circle}^* = (0.785)(\text{Diameter}^2)$$

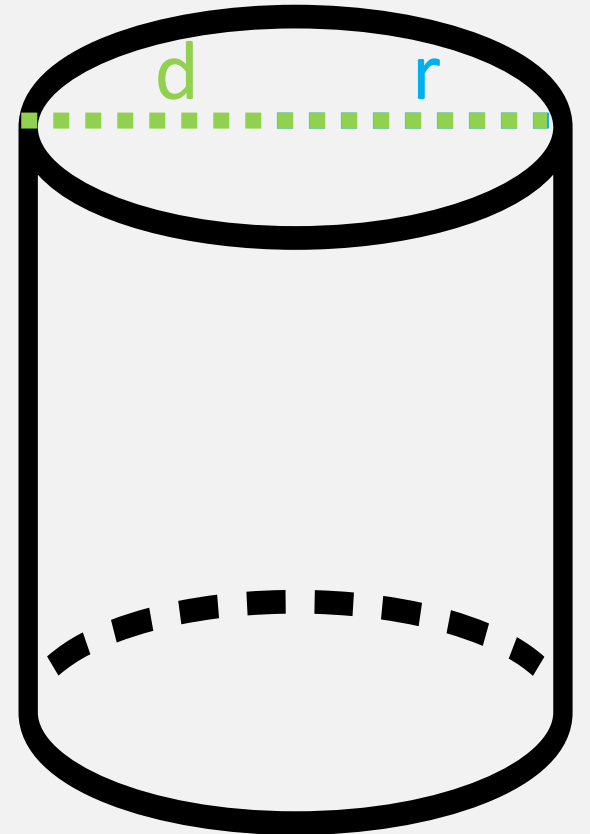
$$\text{Volume of a cylinder} = (0.785)(\text{Diameter}^2)(\text{Height})$$

OR

$$\text{Area of Circle} = (3.14)(\text{Radius}^2)$$

$$\text{Volume of a cylinder} = (3.14)(\text{Radius}^2)(\text{Height})$$

$$\text{Diameter}(d) = \text{Radius}(r) \times 2$$



Example: calculating volume of cylinder

You are trying to figure out how much water is in your water system at any given time. You have one storage tank with a diameter of 10 feet and is 16 feet tall and 4000 ft of water lines that are 8 inches in diameter. What is the volume of water in the full tank and lines?

First let's find the volume of the tank

$$V = 3.14 (\text{radius}^2)(\text{height})$$

$$V = 3.14 \left(\left(\frac{10\text{ft}}{2} \right)^2 \right) (16\text{ft})$$

$$V = 3.14 ((5\text{ft})^2)(16\text{ft})$$

$$V = 3.14 (25\text{ft}^2)(16\text{ft})$$

$$V = (78.5\text{ft}^2)(16\text{ft})$$

$$V = 1260\text{ft}^3$$



Example: calculating volume of cylinder

You are trying to figure out how much water is in your water system at any given time. You have one storage tank with a diameter of 10 feet and is 16 feet tall and 4000 ft of water lines that are 8 inches in diameter. What is the volume of water in the full tank and lines?

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$$V = 3.14 (\text{radius}^2)(\text{height})$$

$$V = 3.14 \left(\left(\frac{10\text{ft}}{2} \right)^2 \right) (16\text{ft})$$

$$V = 3.14 ((5\text{ft})^2)(16\text{ft})$$

$$V = 3.14 (25\text{ft}^2)(16\text{ft})$$

$$V = (78.5\text{ft}^2)(16\text{ft})$$

$$V = 1260\text{ft}^3$$

Now let's calculate the volume in the pipes

Convert inches into feet (1 feet = 12 inches)

$$\text{Diameter of pipe: } 8\cancel{\text{in}} * \left(\frac{1\cancel{\text{ft}}}{12\cancel{\text{in}}} \right) = 0.67 \text{ ft}$$

$$V = 3.14 (\text{radius}^2)(\text{length})$$

$$V = 3.14 \left(\left(\frac{0.67\text{ft}}{2} \right)^2 \right) (4000\text{ft})$$

$$V = 3.14 ((0.33\text{ft})^2)(4000\text{ft})$$

$$V = 3.14 (0.11\text{ft}^2)(4000\text{ft})$$

$$V = (0.35\text{ft}^2)(4000\text{ft})$$

$$V = 1400 \text{ ft}^3$$

$$\text{Total } V = 1260 \text{ ft}^3 + 1400 \text{ ft}^3 = 2660 \text{ ft}^3 \quad \text{Total volume in system} = 2700 \text{ ft}^3$$



Your turn: Volume of a Cylinder

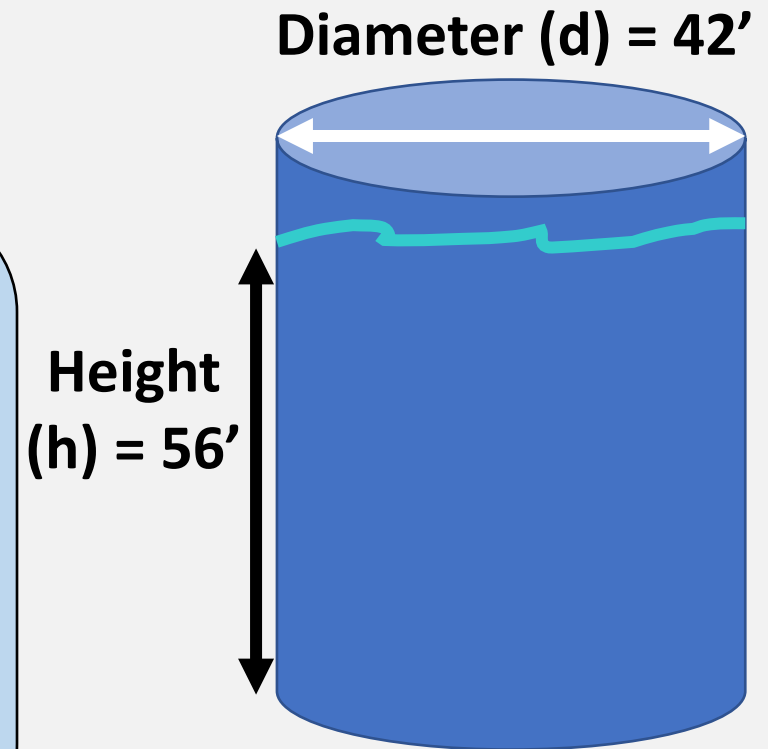
You have a tank that is 42' in diameter and has 56 feet of water in it? How many gallons of water are in the tank?

$$\text{Volume of Cylinder}^* = (0.785)(\text{Diameter}^2)(\text{Height})$$

$$\text{Volume of a Cylinder} = \pi(\text{radius}^2)(\text{height})$$

$$1 \text{ cubic foot of water} \dots\dots\dots = 7.48 \text{ gal}$$

- A. 10,400 gallons
- B. 27,600 gallons
- C. 77,500 gallons
- D. 580,000 gallons





Your turn: Volume of a Cylinder

You have a tank that is 42' in diameter and has 56 feet of water in it? How many gallons of water are in the tank?

$$\text{Volume of Cylinder}^* = (0.785)(\text{Diameter}^2)(\text{Height})$$

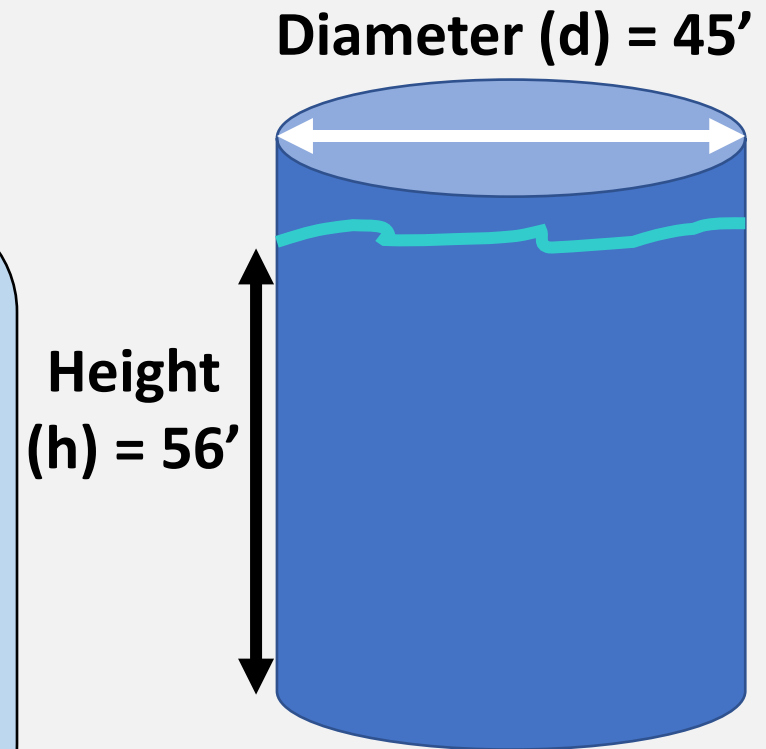
$$\text{Volume of a Cylinder} = \pi(\text{radius}^2)(\text{height})$$

$$1 \text{ cubic foot of water} \dots\dots\dots = 7.48 \text{ gal}$$

$$\text{Volume} = 3.14(21 \text{ ft})^2(56 \text{ ft})$$

$$\text{Volume} = 3.14(441 \text{ ft}^2)(56 \text{ ft}) = 77,545 \text{ ft}^3$$

$$\text{Volume} = \frac{77,545 \cancel{\text{ft}^3}}{1} \times \frac{7.48 \text{ gal}}{1 \cancel{\text{ft}^3}} = 580,000 \text{ gal}$$

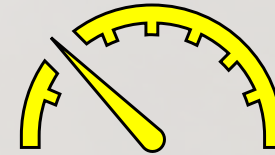


Water Pressure

Pressure Units

- Feet of head (feet)
- Pounds per square inch (psi)
- Torr
- Pascal
- bar
- mm of mercury

Minimum required in distribution = 20 psi



Maximum recommended in distribution = 100 psi



Water Pressure & System Operations

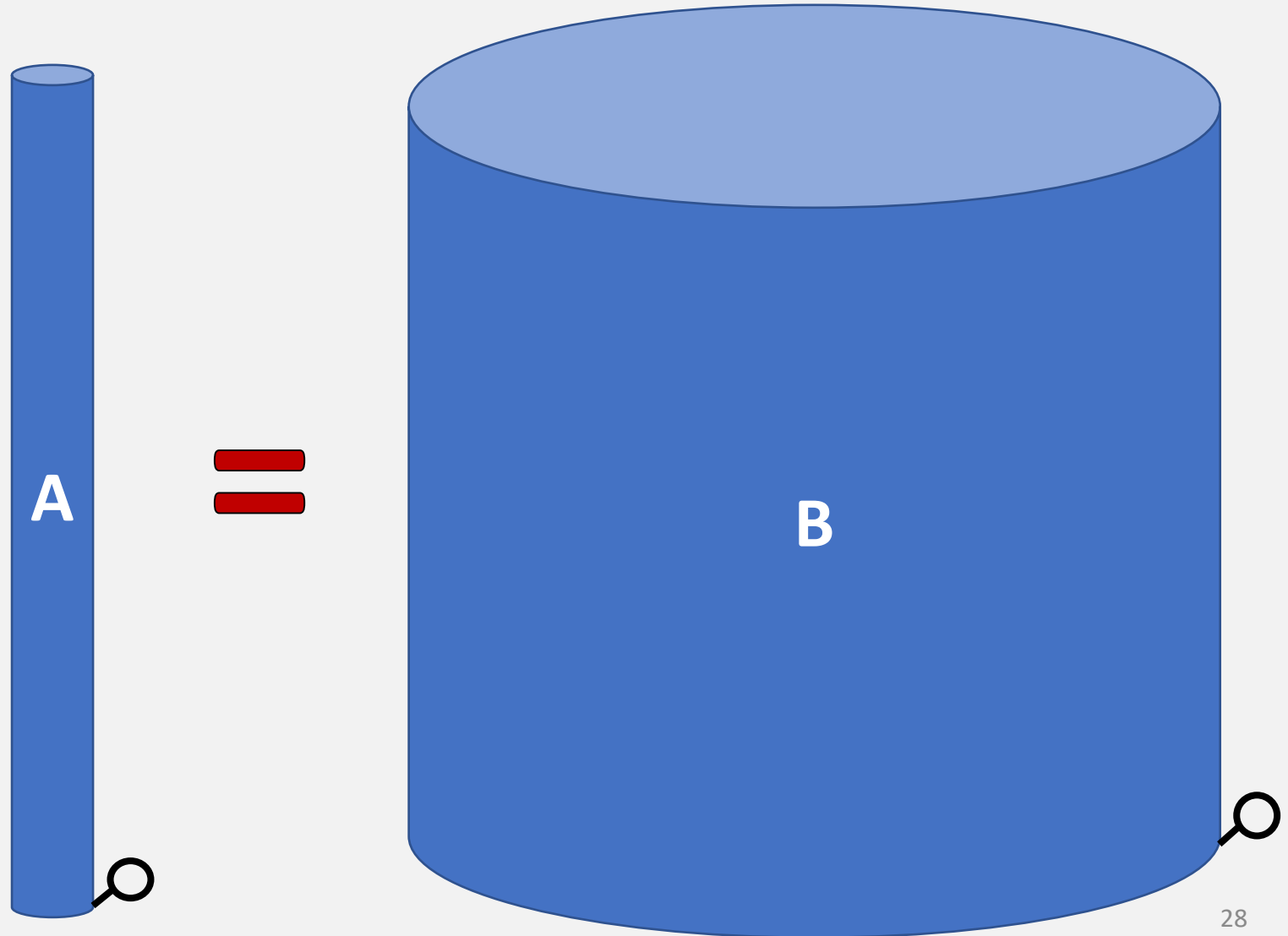
- Understand how elevation changes affect pressure in your system.
- Understand how water loss control can be optimized through good pressure management.
- Understand and control tank levels to meet pressure goals for the distribution system.

Pressure and Feet of Head

Tank A is 5' in diameter and 75' tall and holds ~11,000 gallons of water.

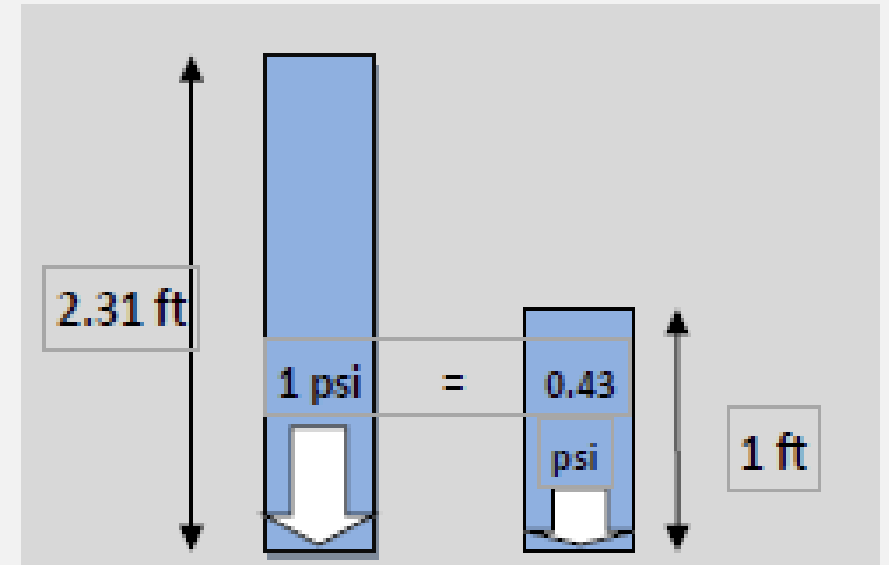
Tank B is 50' in diameter and 75' tall and holds ~1.1 million gallons of water.

If each tank has a pressure gauge at its base, which tank has the highest pressure?



Pressure and Feet of Head

- The volume of the water is not important, it's the height of the water (feet of head) that matters.
- There's a direct relationship between feet of head (ft) and pressure (psi).



1 foot of water..... = 0.433 psi

1 pound per square inch..... = 2.31 ft of water

Calculating Pressure Example

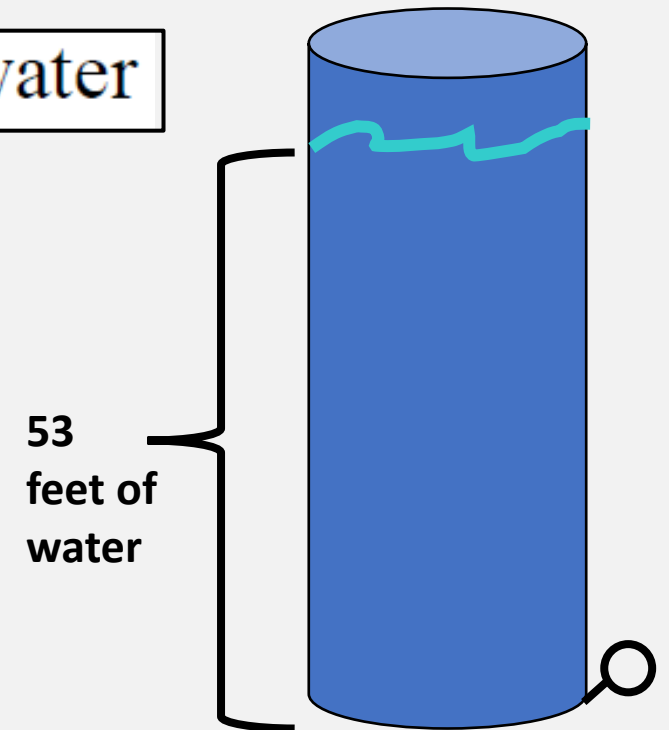
Your storage tank has 53 feet of water in it, what is the water pressure in pounds per square inch at the base of your tank?

1 pound per square inch..... = 2.31 ft of water

1 foot of water..... = 0.433 psi

53 ft	0.433 psi
1	1 ft

53 feet = **23 psi**





1 pound per square inch..... = 2.31 ft of water

Calculating Pressure Practice

A storage tank is on a hill, 100' above a pumphouse. It has 345,000 gal of water in it at a water height of 34'. Calculate psi in the pumphouse.

- a) 15 psi
- b) 29 psi
- c) 58 psi
- d) 100 psi



34 feet of
water

+

100 feet of
water

=

134 feet
of water

Calculating Pressure Practice

A storage tank is on a hill, **100'** above a pumphouse. It has **345,000 gal of water** in it at a **water height of 34'**. Calculate psi in the pumphouse.

1 pound per square inch..... = 2.31 ft of water

Set up the conversion

$$\frac{134 \cancel{\text{ feet}}}{1} \times \frac{1 \text{ psi}}{2.31 \cancel{\text{ feet}}} = \frac{134 \text{ psi}}{2.31}$$

134 feet = **58 psi**



34 feet of water
+
100 feet of water
=
134 feet of water

Questions?

Thanks for attending!



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Next webinar in the series:

**Collections Systems – Gravity
Systems**

August 19, 2025

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