Septic System Inspection & Maintenance

Dec 9, 2025, 1pm – 2pm EST

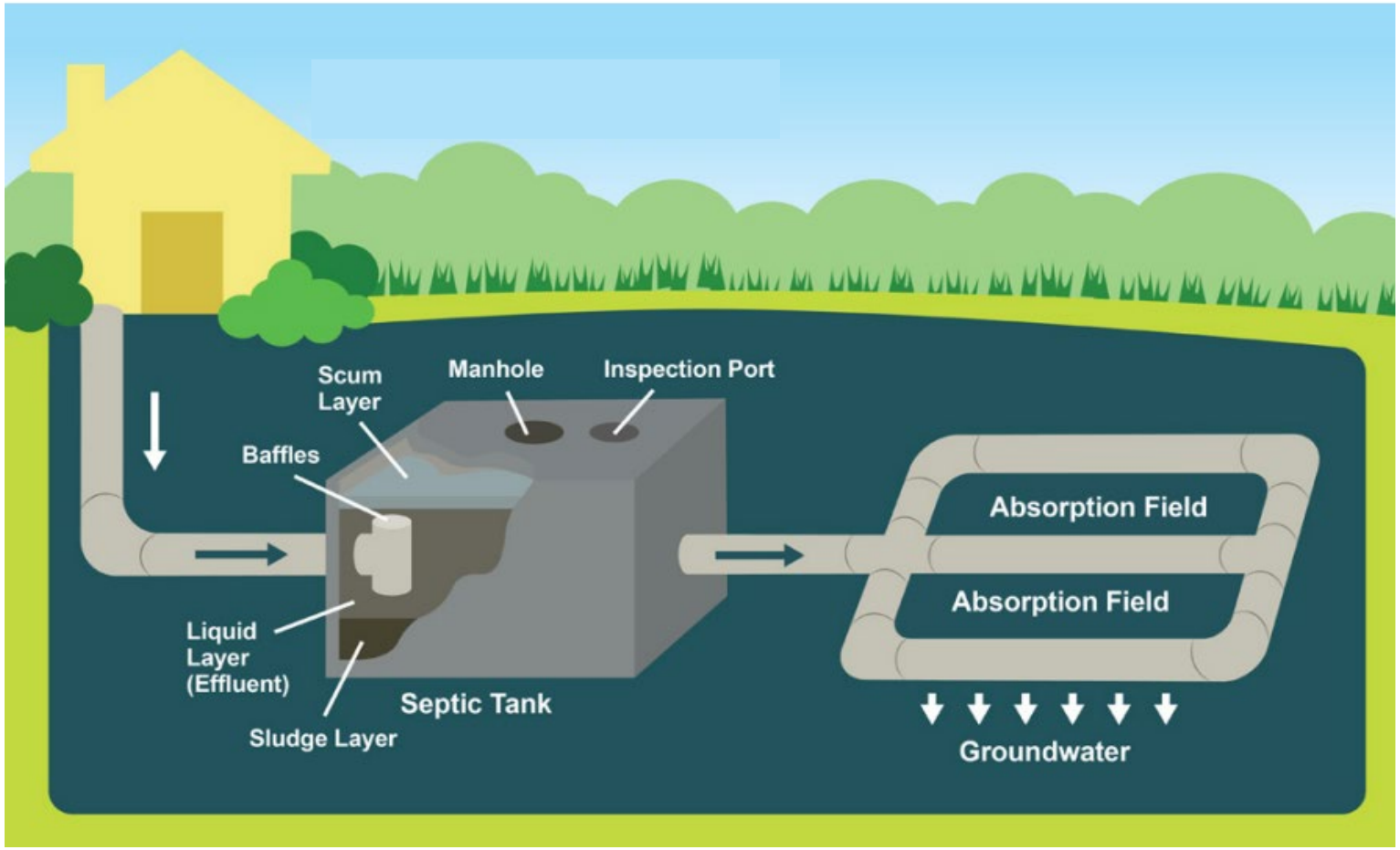
Instructor: Greg Pearson, Water and Wastewater Systems Trainer, MTU

Special Guest: Dr. Jason Barrett, Interim Director, Mississippi Water Resources Research Institute, MSU

This program is made possible under a cooperative agreement with US EPA.

Essential questions we hope to answer

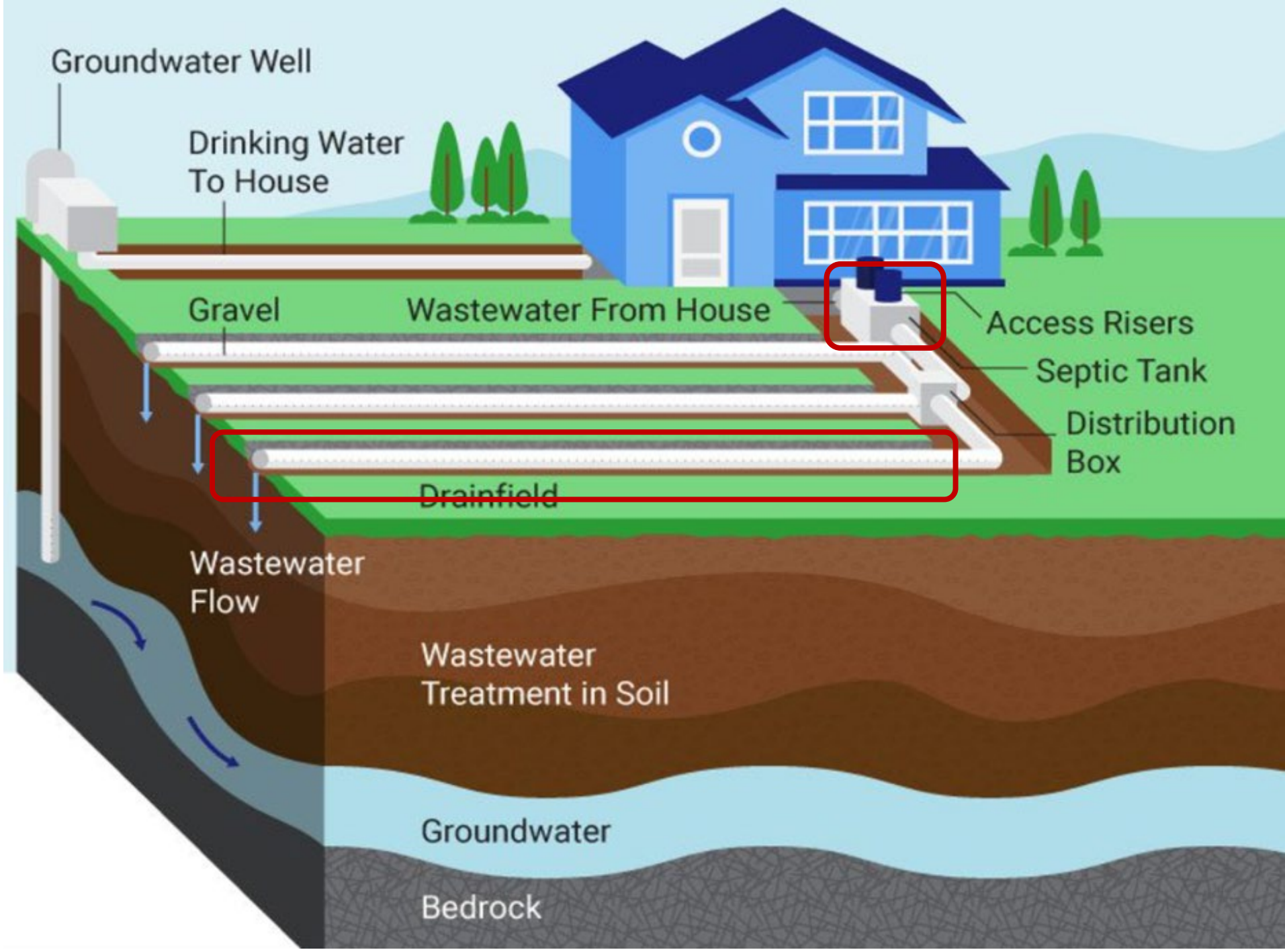
1. How do onsite septic systems work?
2. How can we ensure septic systems function properly?
3. What causes septic systems to fail?



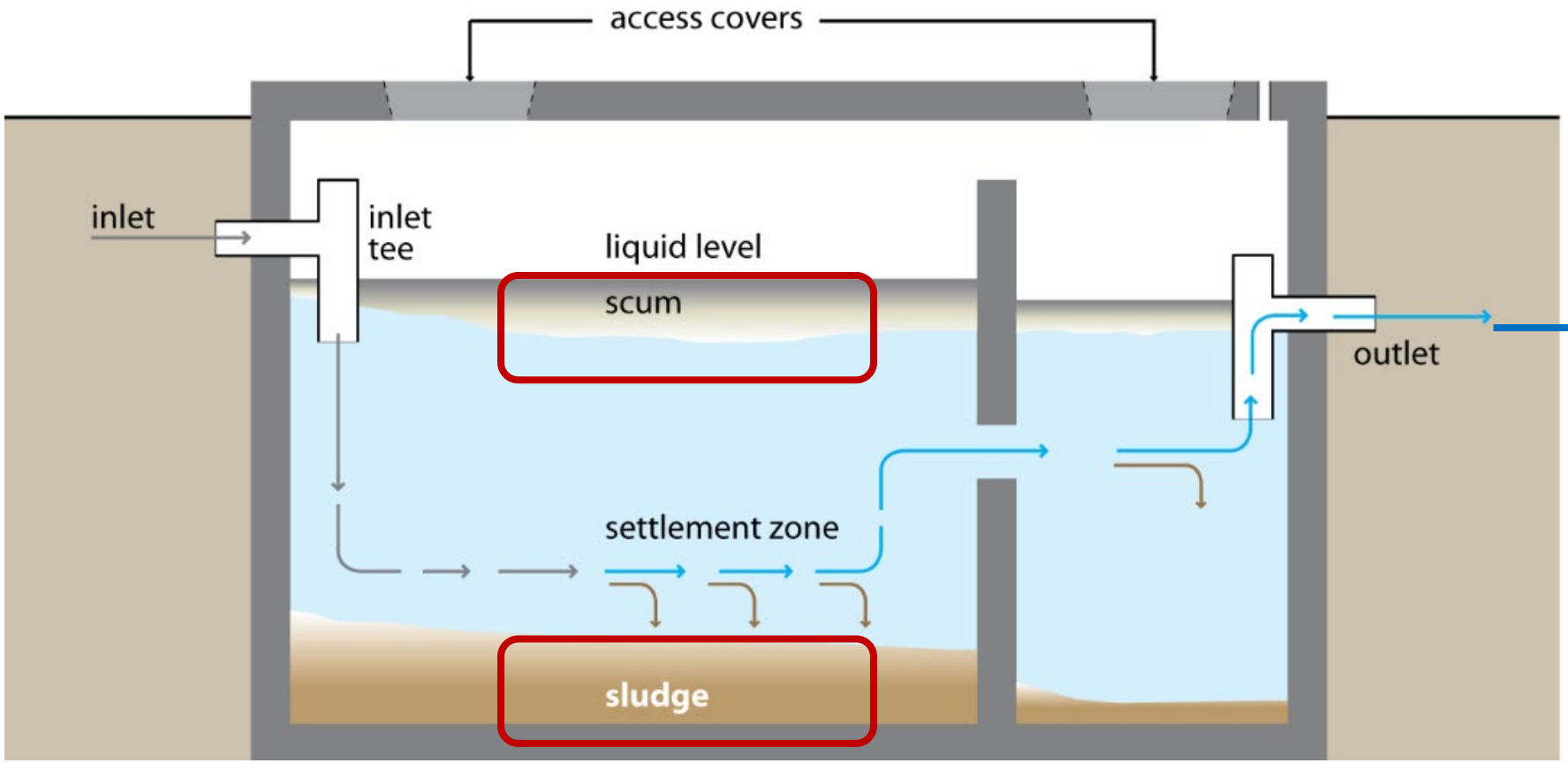
How do Septic Systems Work?

Treatment mechanisms

1. Physical separation of solids
2. Biological treatment

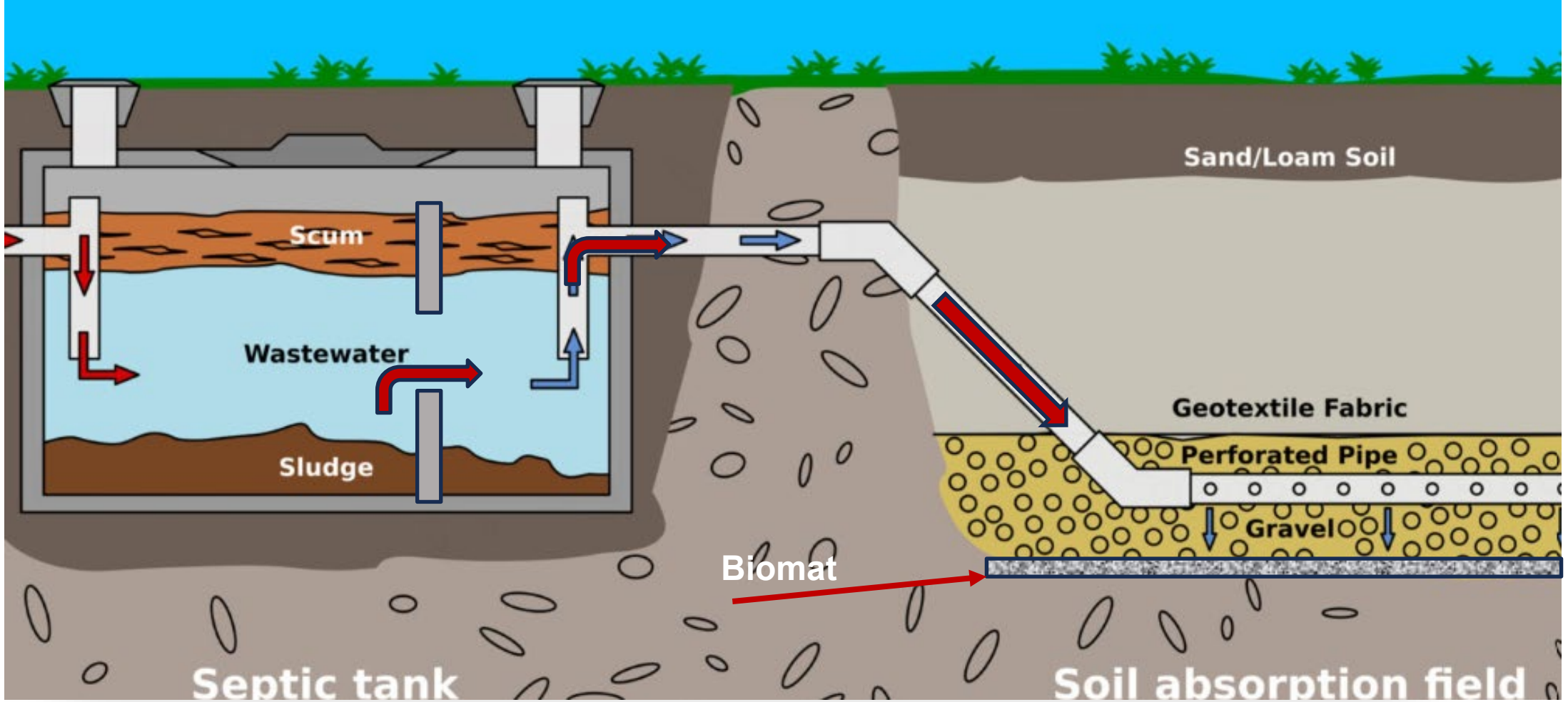


Physical removal processes – floatation and sedimentation



Clarified effluent to drain field.
Contains non-settleable and dissolved waste solids, BOD and microorganisms.

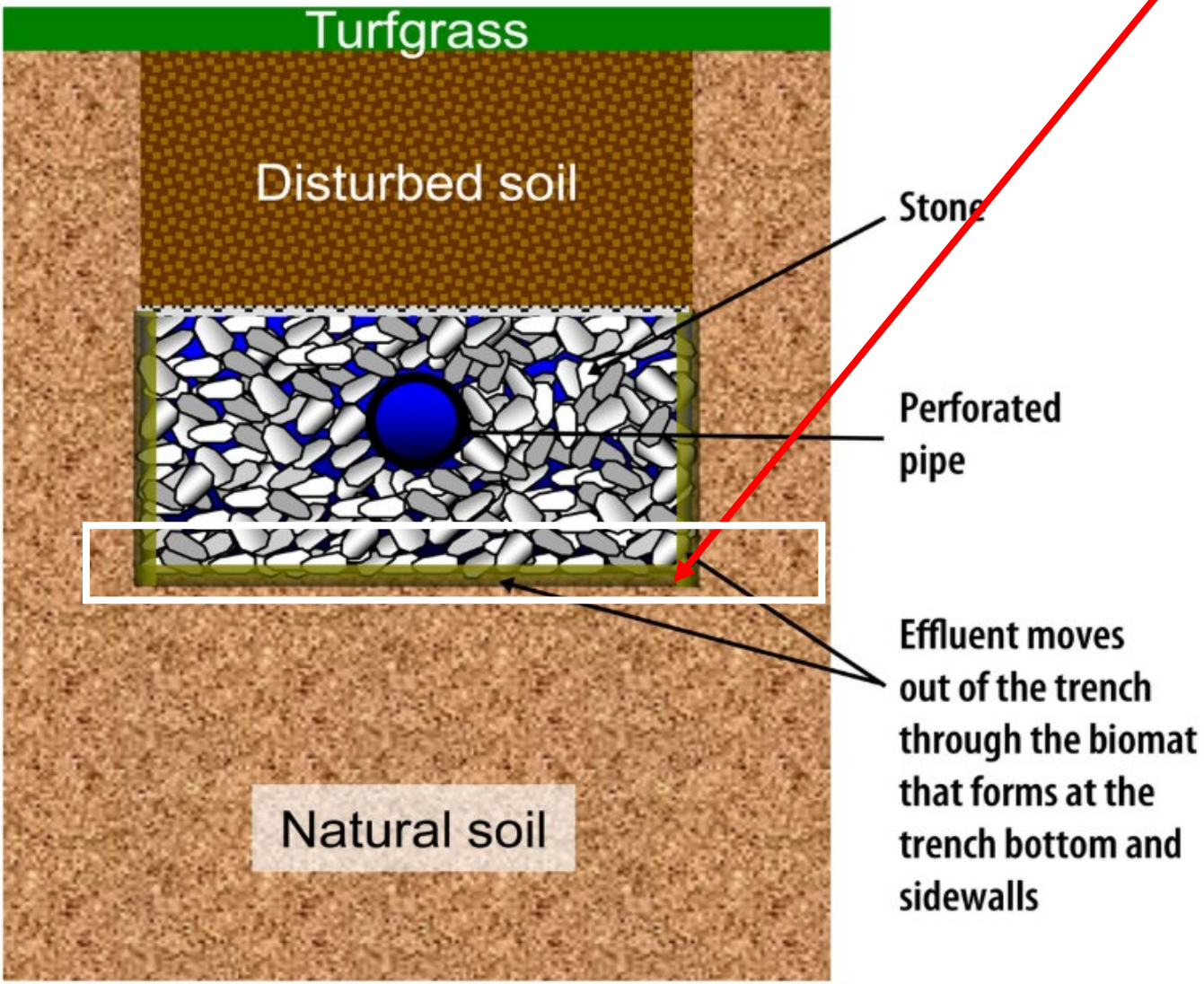
60% of BOD (biochemical oxygen demand) is retained by the tank
BOD is a measurement of the strength of wastewater
Anaerobic bacteria reduce sludge solids.



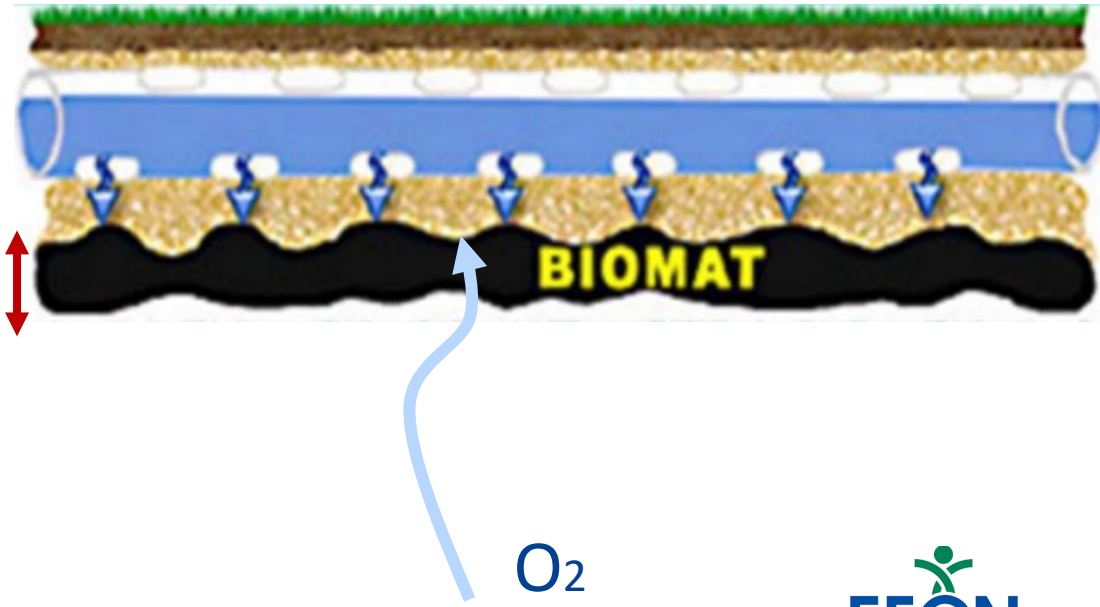
Clarified wastewater continues onto the drainfield.

- The remaining 40% of BOD is treated in the drainfield (Aerobic)

Biomat



- **Consists of a variety of microorganisms that create a biological treatment system**
- Develops at bottom of the trench where flow meets the soil (0.5 to 6 in)
- A permeable soil allows both percolation of wastewater and diffusion of air which supports aerobic microbes

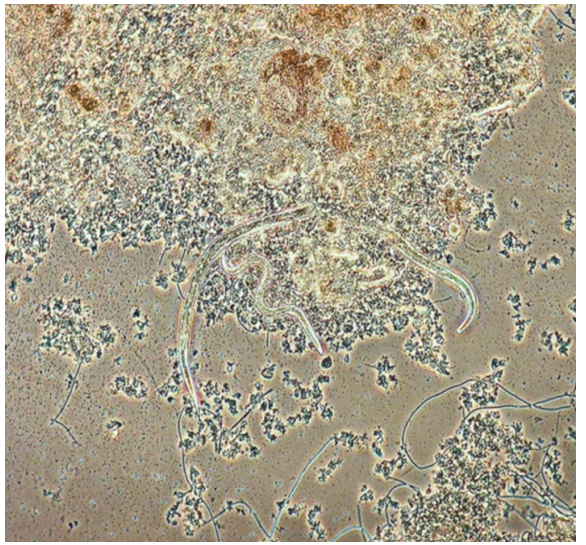


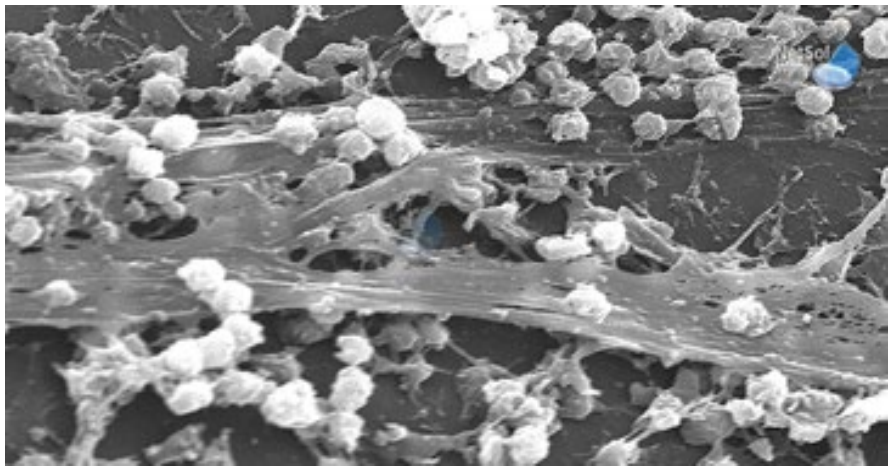
Treatment processes in biofilms

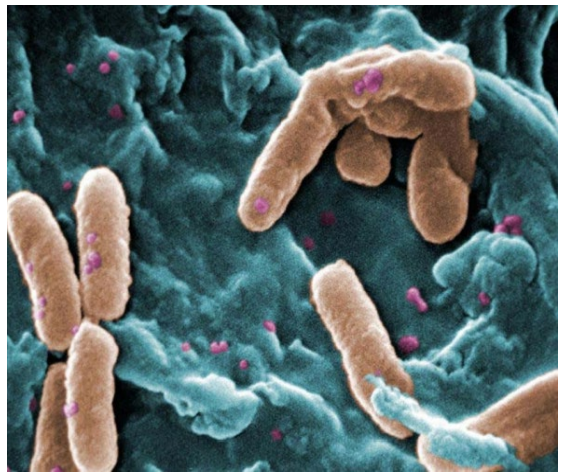
Bacteria and other microbes create a structure (biofilm) that supports a microbial population

- Bacteria and fungi break down organic chemicals and BOD with enzymes.
- Biofilm also functions as a filter that captures pathogens and TSS
- Microbes consume pathogens

POLL 1







Poll 1

What typically happens to the BOD that enters a properly functioning septic system?

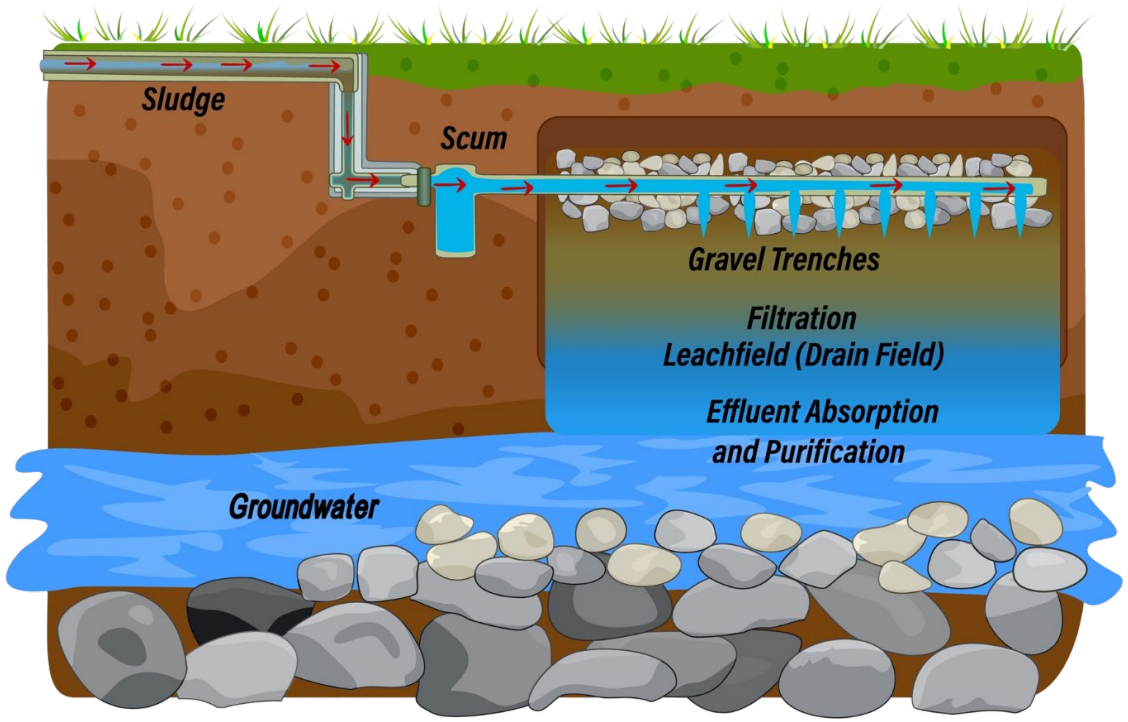
a) 100 % is consumed by bacteria in the biomat.

b) Approximately 60% is removed in the tank and 40% is removed in the drainfield.

c) 100% is removed by settling in the tank.

d) It percolates into the soil and water table.

Discussion items – Dr. Jason Barrett



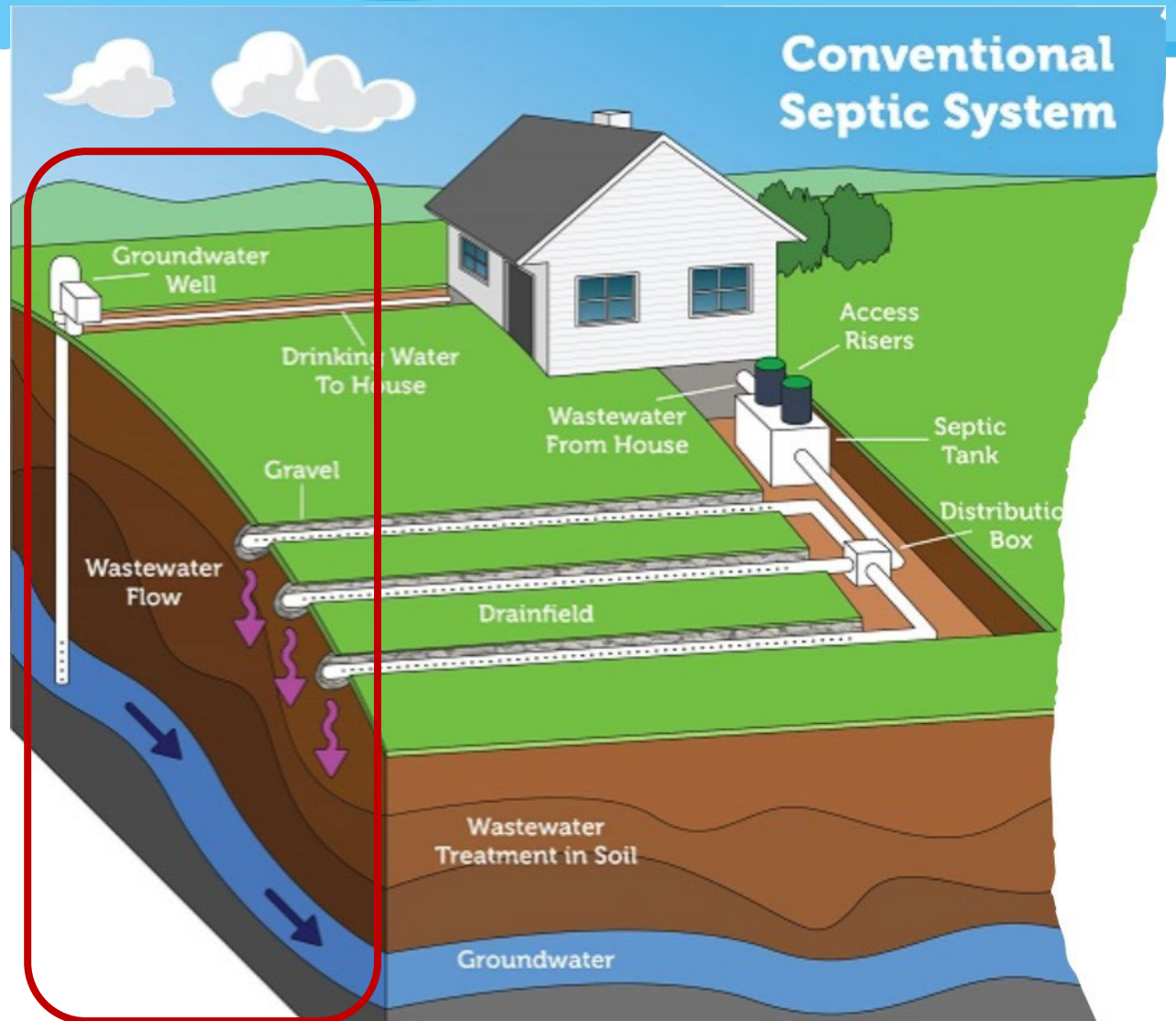
Dr. Barrett

(1) What are some things we should know about microbial activity in septic systems?

(2) How important is soil type when installing septic systems?

- **Share your thoughts in the chat!**

Site evaluation



Site Evaluation

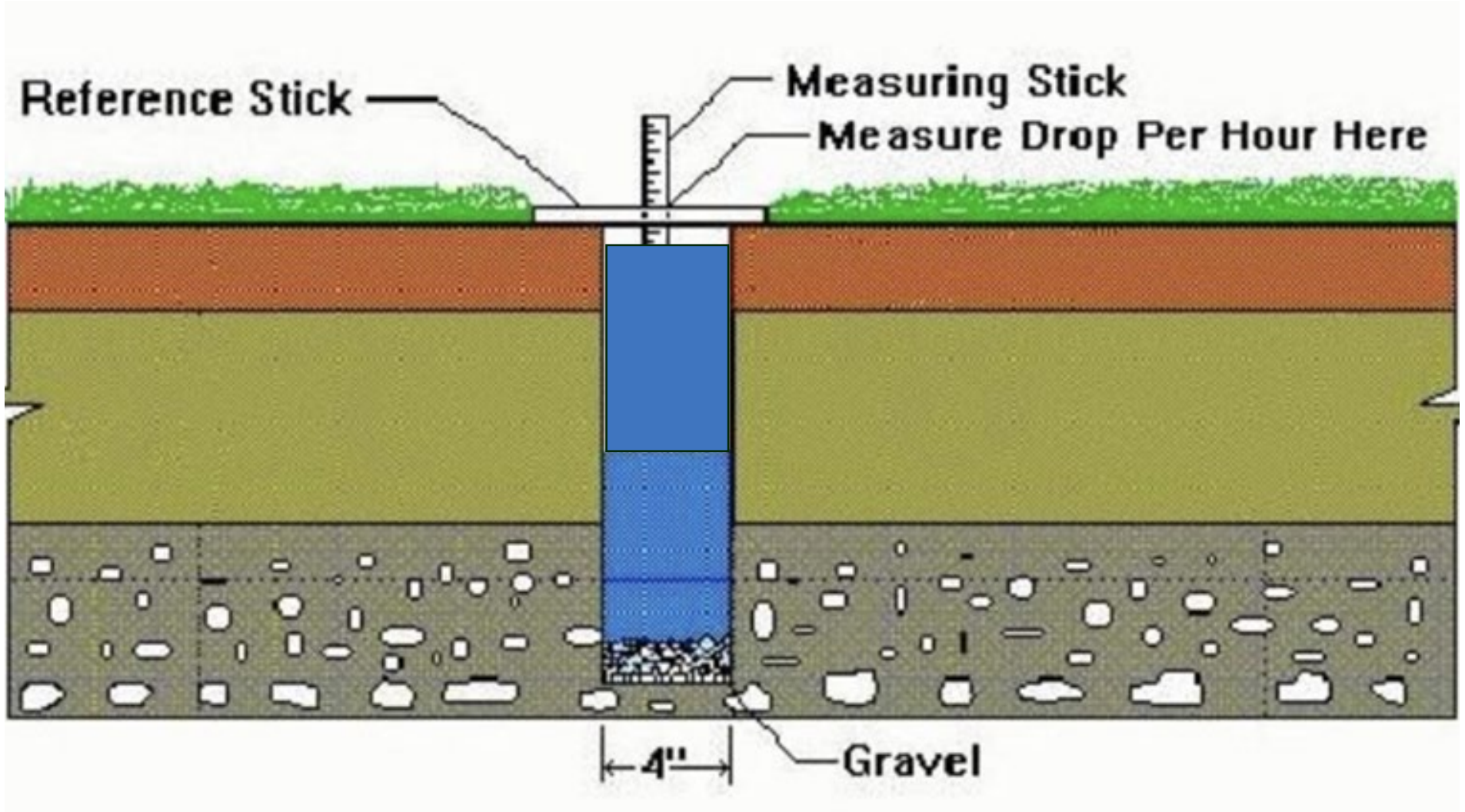
- Property set-backs
- Locations of streams, wells, etc. (50 – 100 ft)

Soil (geological) evaluation

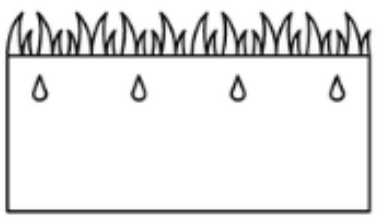
- Soil type and excavation
- Percolation rate testing
- Depth to limiting factors (*i.e. 36 inches minimum)*

Percolation Rate (Perc Test)

Typically, measured every 30 minutes over a 4-hour period. Soil is saturated first. Rate in minutes per inch



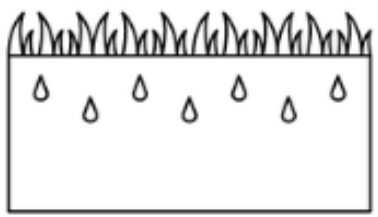
Percolation rates in minutes per inch



Extremely low

≥ 120

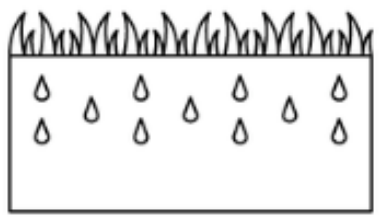
Very slow. Cannot use conventional septic.



Low

60 - 110

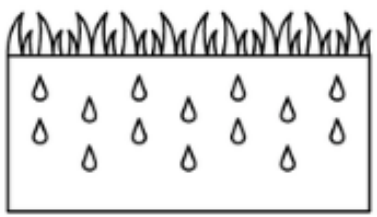
Percolation is slow which can lead to oversaturation. Use a mound system or larger drain field



Medium / ideal

5 - 60

Appropriate for conventional septic system

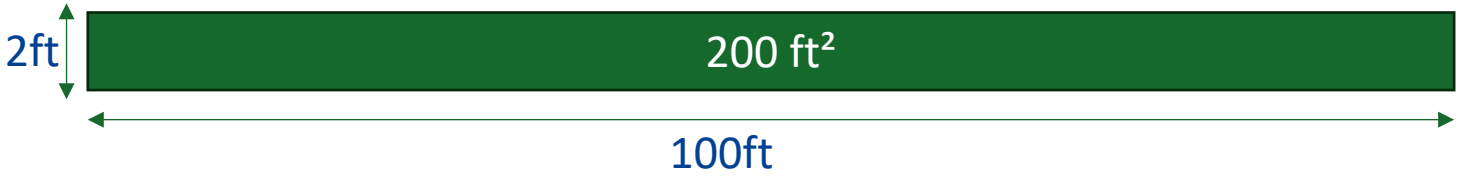


High

< 5

Too fast for adequate treatment. Possible solution is to add denser soil in the drain field area.

Sizing of system



Percolation rate is used to determine the area of drainfield needed.

Percolation rate inch	Absorption area per bedroom	Loading rate per square foot[1]
less than or equal to 10 minutes[2]	150 square feet	1.0 gallon
11 to 30 minutes	200 square feet	0.8 gallon
31 to 45 minutes	265 square feet	0.45 gallon
46 to 60 minutes[3]	300 square feet	0.4 gallon
61 to 120 minutes[3,4]	600 square feet	0.2 gallon

2 bedrooms x 200 square ft = 400 square feet of drainfield area.

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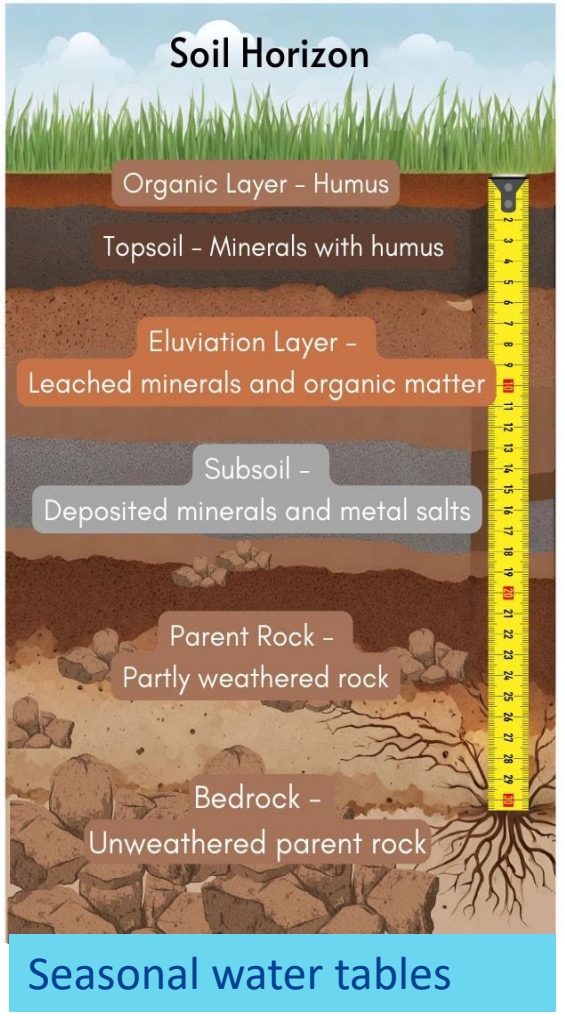
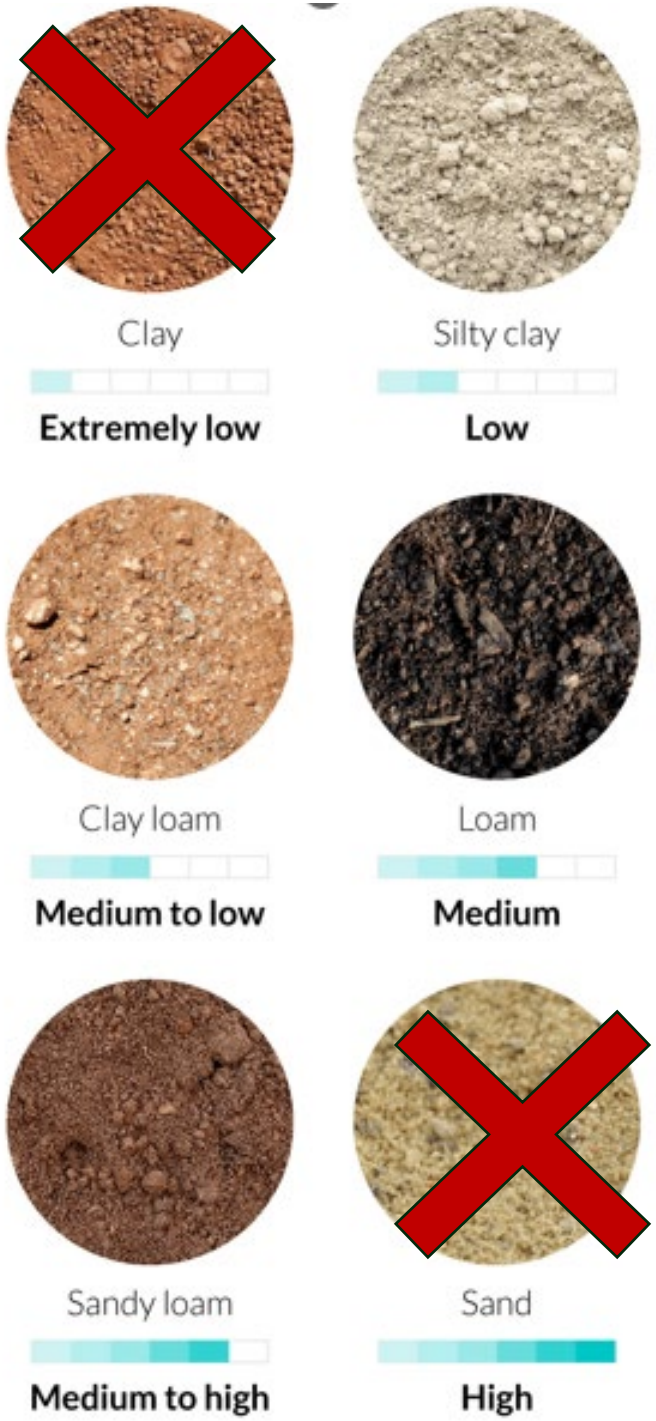
Soil excavation

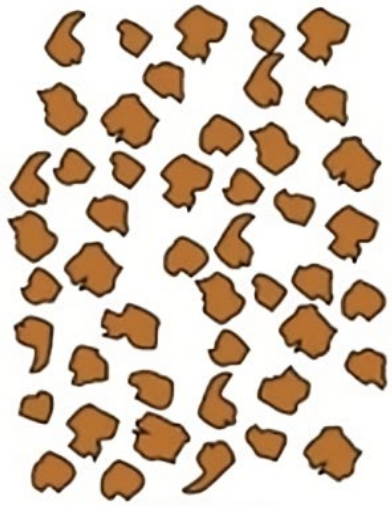
Excavation to assess the soil's suitability for effectively treating wastewater and preventing contamination

- Identify soil types and infer percolation rates.
- Identify potential limiting factors
  - Shallow bedrock or clay layers
  - High water tables

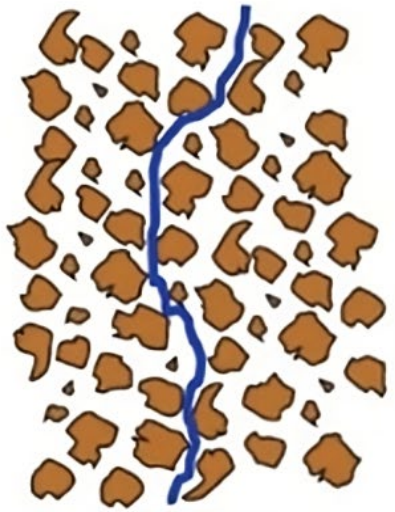


Soil types and structures

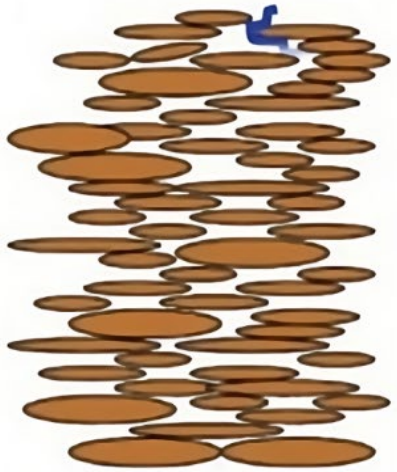




Sand
Coarse texture



Loam
Medium texture



Clay (Compacted)
Fine texture

Hydraulic Loading Rate is Determined
Other factors

- Shape of particles and consistency
- Saturation level of soil
- Degree of compaction

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Table 7.2b Illustrative Table for Sizing Absorption Area

Texture	Structure		Hydraulic loading (Gal/ft²/day)	
	Shape	Grade	STE[1]	PTE1.2
Coarse sand, sand, loamy coarse sand	Single grain	Structureless	1.2	1.6
Fine sand, loamy fine sand	Single grain	Structureless	0.6	1.0
Sandy loam, loamy sand	Massive	Structureless	0.35	0.5
	Platy	Weak	0.35	0.5
	Prismatic, blocky, granular	Weak	0.5	0.75
		Moderate, strong	0.8	1.0
Loam, silt loam, sandy clay loam, fine sandy loam	Massive	Structureless		
	Platy	Weak		
	Prismatic, blocky, granular	Weak, moderate	0.5	0.75
		Strong	0.8	1.0
Sandy clay, silty clay loam, clay loam	Massive	Structureless		
	Platy	Weak, moderate, strong		
	Prismatic, blocky, granular	Weak, moderate	0.35	0.5
		Strong	0.6	0.75
Clay, silty clay	Massive	Structureless		
	Platy	Weak, moderate, strong		
	Prismatic, blocky, granular	Weak		
		Moderate, strong	0.2	0.25

1: STE=septic tank effluent; PTE=pre-treated effluent
2: Higher hydraulic loading rates for pretreated effluent may only be used when pretreatment is not used for one foot of vertical separation credit.

Example from Sonoma County, CA

Soil evaluation reveals a sandy loam soil with granular particles, and a consistent structure. Allowable hydraulic loading is **0.8 Gal/ft²/day.**

For a 2-bedroom house we can estimate 2 x 150 gal/day per bedroom = **300 gal/day**

$$\frac{\text{300 gal/day}}{\text{0.8 gal/ft}^2\text{/day}} = \text{area of drain field (in ft}^2\text{)}$$

Area = 375 ft²

4 trenches, 50 feet long by 2 feet wide would give us a total drain field area of 400 square feet.

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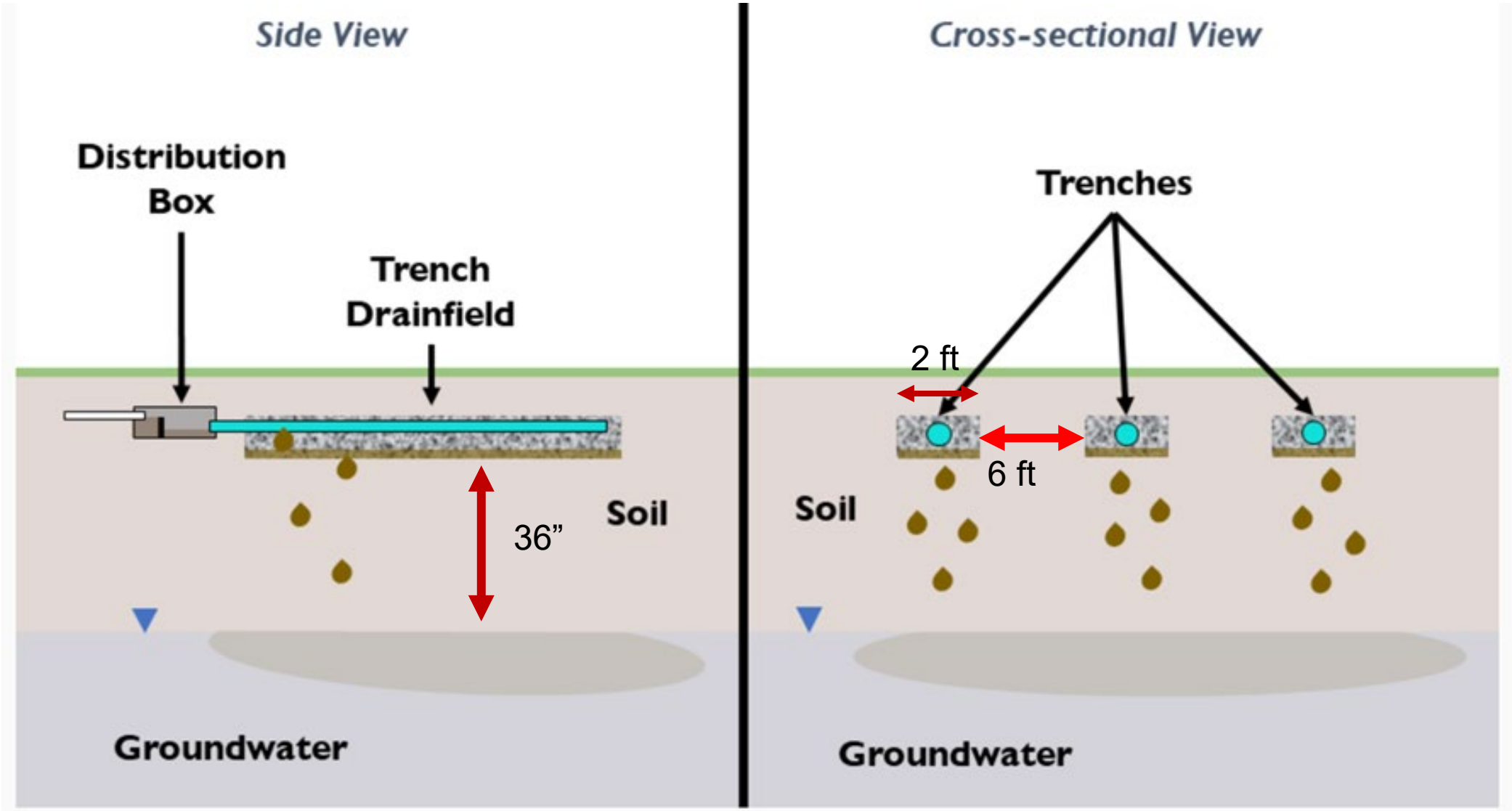
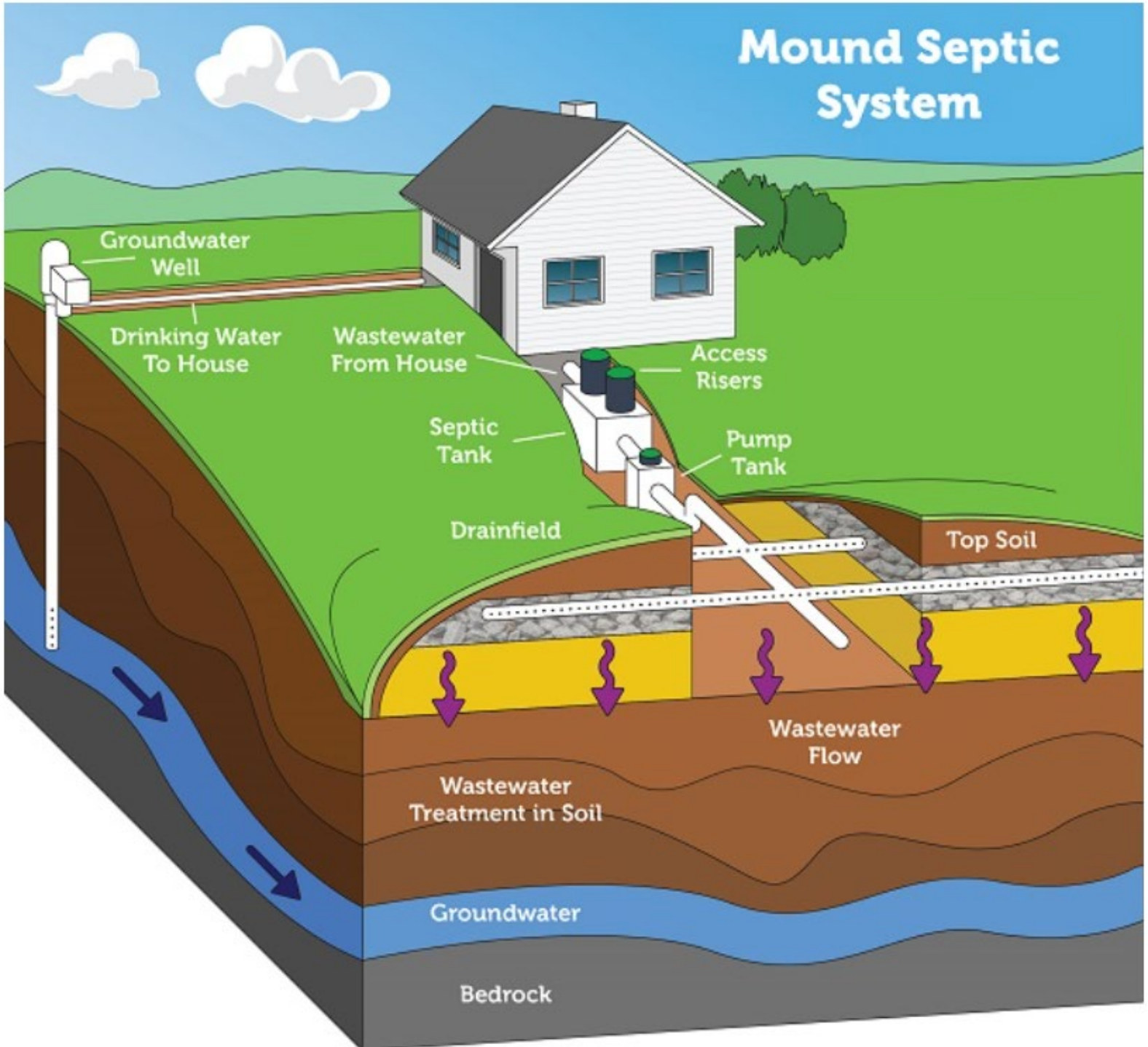
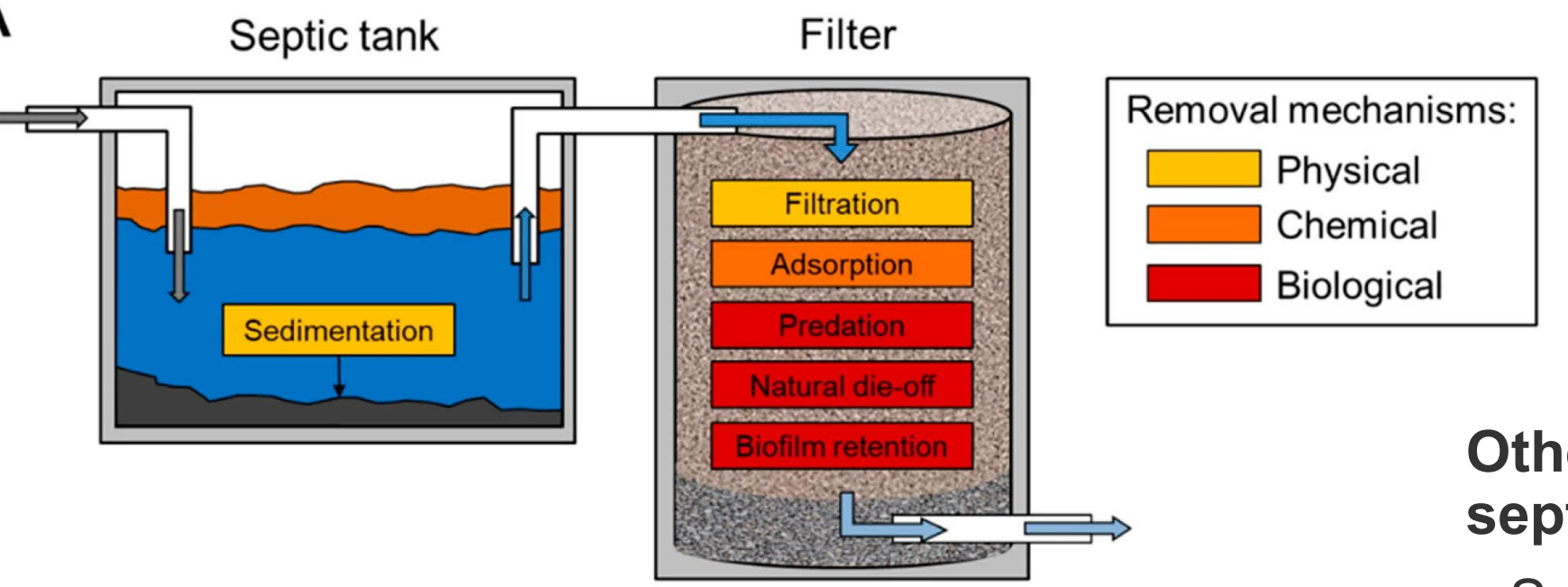


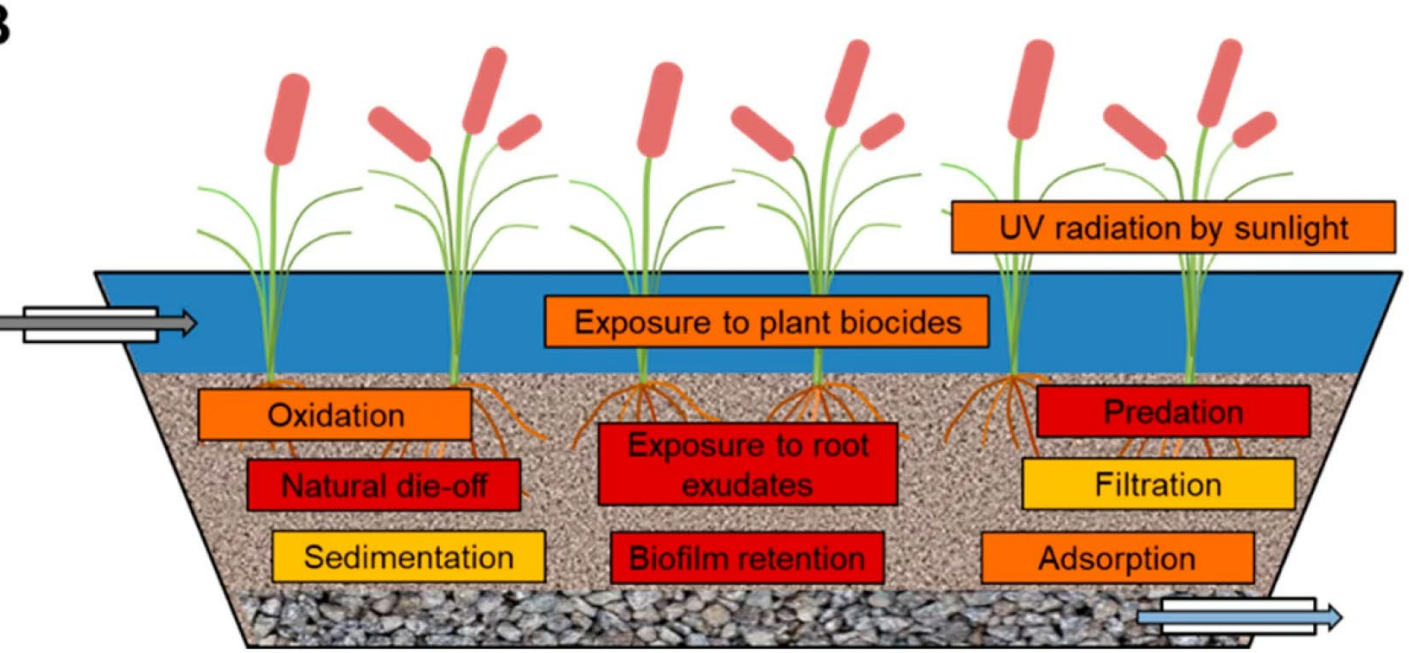
- Aerobic treatment
- Filtration – straining, adsorption
- Microbial activity

Appropriate for shallow and low perc soils

1. Wastewater is pumped from the septic tank to the top of a mound
2. Wastewater percolates from the drainpipe through a layer of sand before reaching the soil







Other methods to improve septic treatment

- Sand filters
- Constructed wetlands
- Appropriate for systems near sensitive water bodies or shallow low perc soils

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Sizing of tank

Number of bedrooms	Minimum tank liquid capacity
1 to 3	1,000 gallons
4	1,250 gallons
5	1,500 gallons

Assumptions

- 150 gal/day per bedroom
- Tank should be sized to hold 2 days of liquid waste
- 4 bedrooms x 150 gal/day x 2 days = 1,200 gallons

POLL #2

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Poll 2

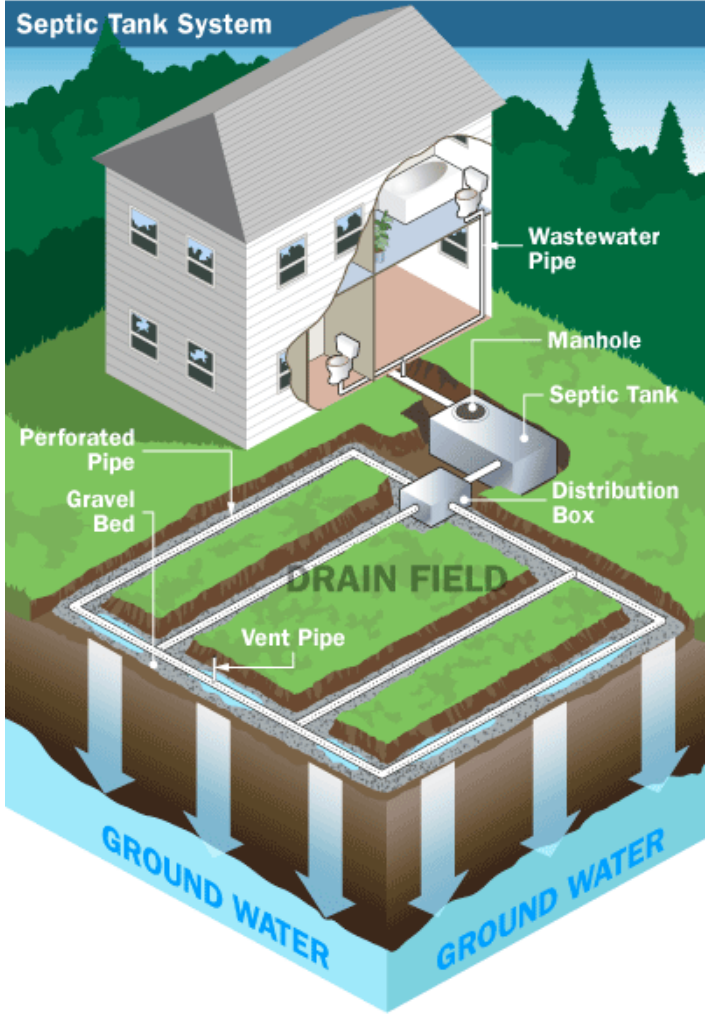
Estimate the drain field area for a 3-bed house if the max hydraulic loading of the soil is 0.5 gal/ft²/day.

a. 150 ft²

b. 450 ft²

c. 900 ft²

d. 1,250 ft²



Use 150 gpd per bedroom

$$\frac{\text{Flow gallons per day}}{\text{Hydraulic loading gpd/ft}^2} = \text{area of drain field (in ft}^2\text{)}$$

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Solution

Estimate the drain field area for a 3-bed house if hydraulic loading is 0.5 gal/ft²/day.

Step 1: Estimate total flow

3 bedrooms x 150 gal/day = 450 gal/day

Step 2: Divide total flow by the maximum allowable hydraulic loading

$$\frac{\text{450 gal/day}}{\text{0.5 gal/ft}^2\text{/day}} = \text{900 ft}^2$$

5 drain field trenches 90ft long and 2ft wide

= 180ft² x 5 trenches = 900 ft²

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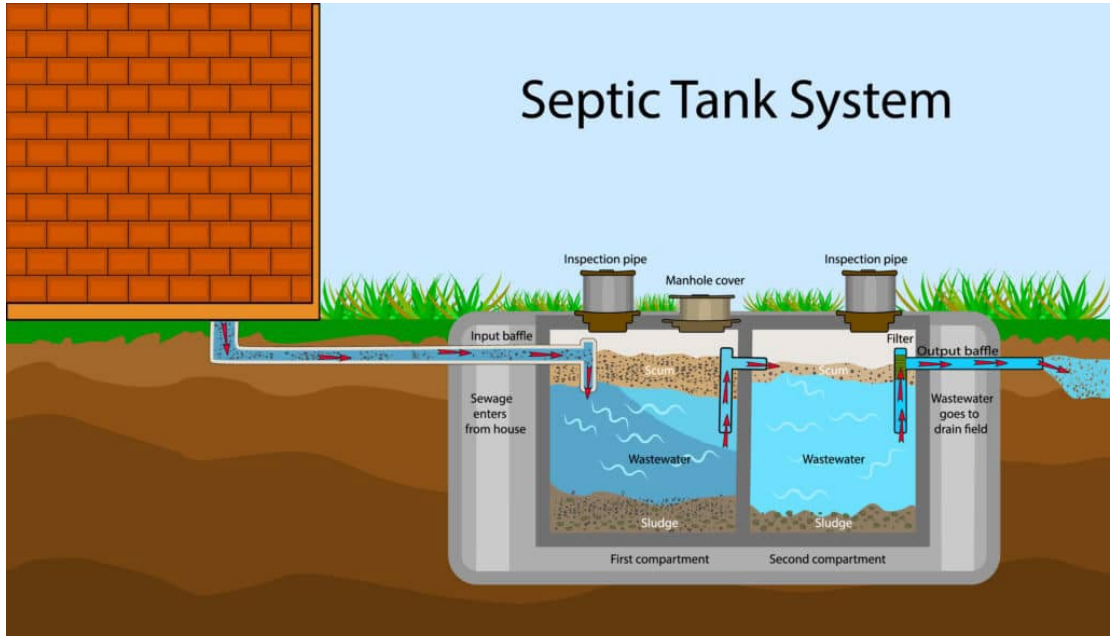
Discussion items Dr. Jason Barrett

Dr. Barrett

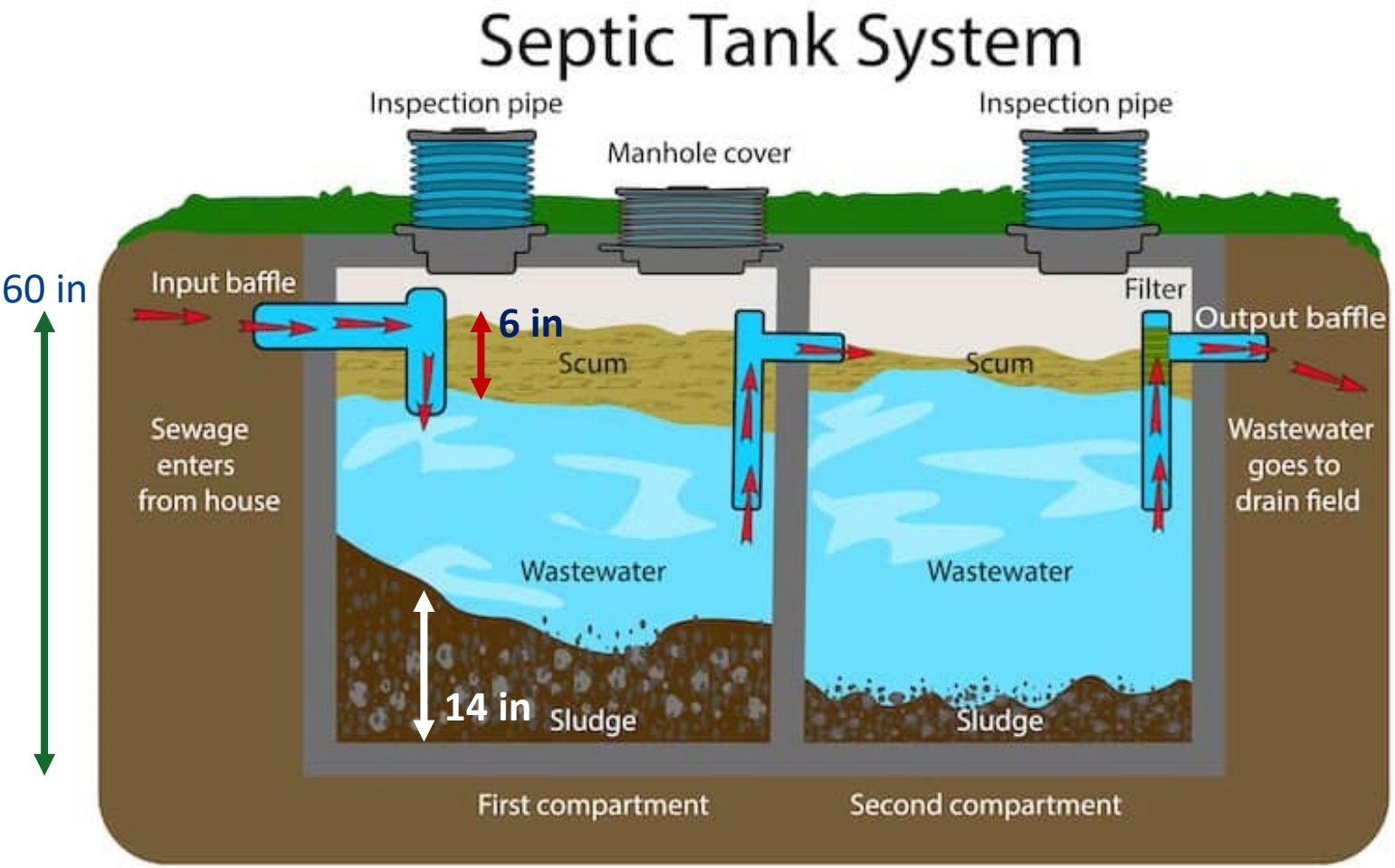
(1) What are some design factors or site limitations you have seen for septic systems?

(2) How can the performance of a septic system be evaluated?

Please share your thoughts in the chat!



Inspection and Maintenance



Septic Pumping

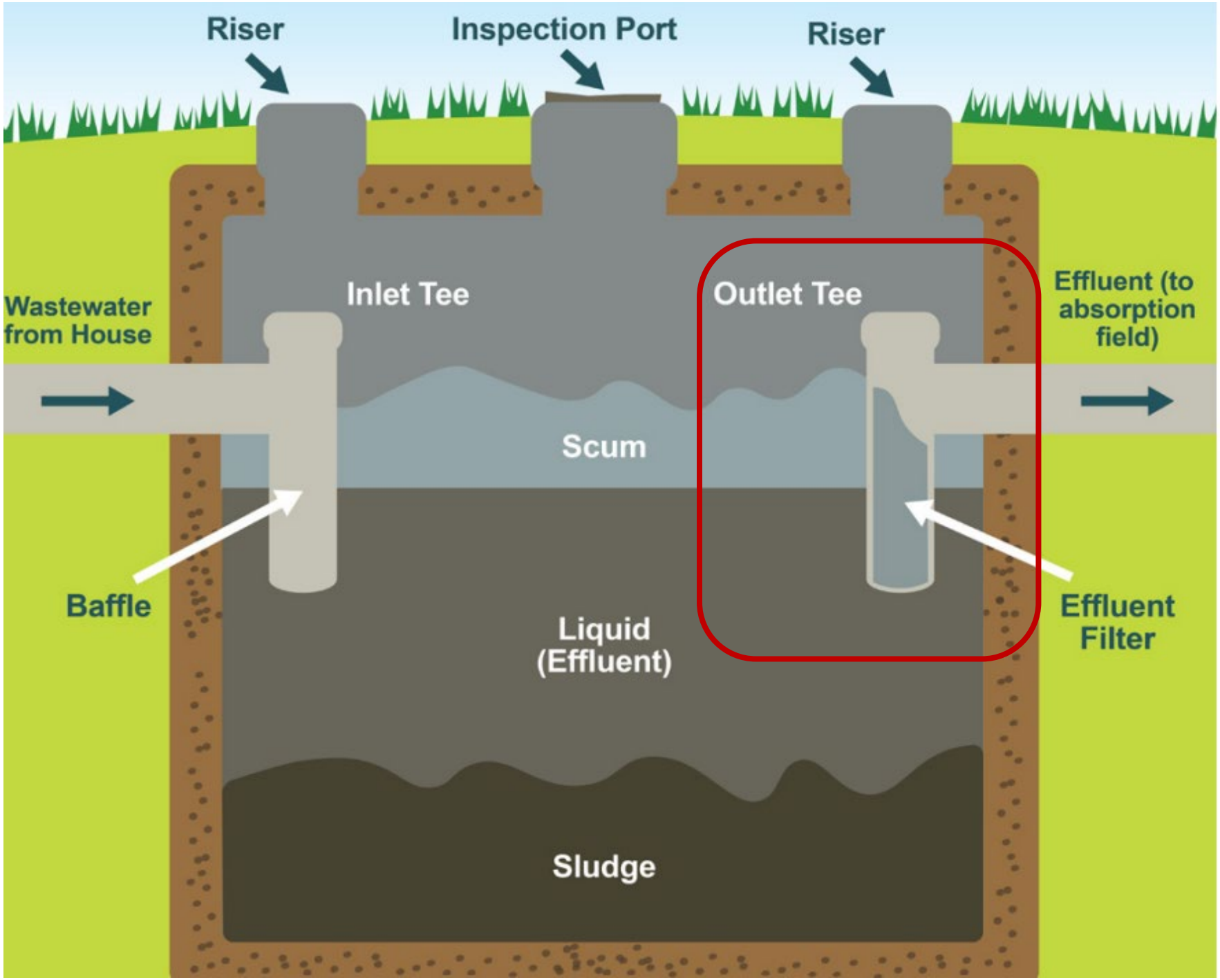
- Recommended when combined sludge and scum equals one-third(1/3) of tank volume

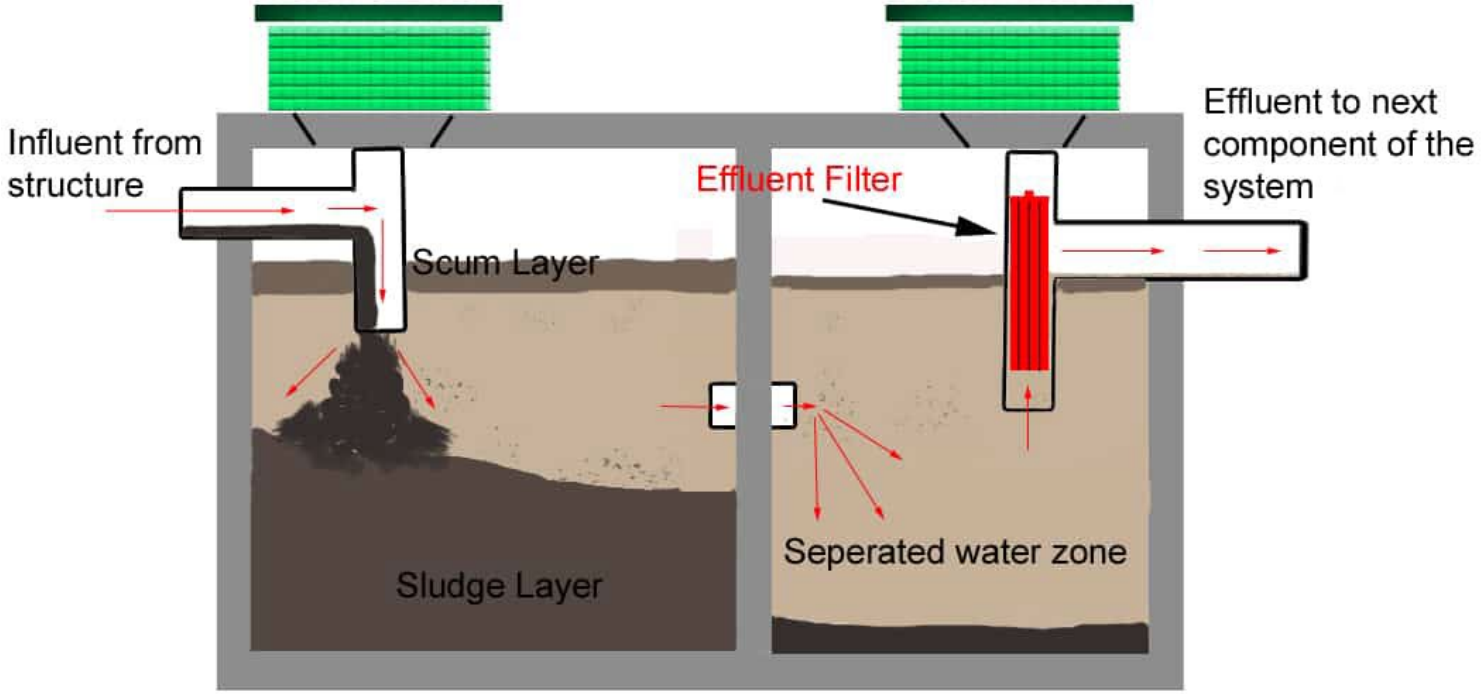
Total solids = 6in + 14in = 20in

$\frac{20 \text{ in}}{60 \text{ in}} \times 100\% = 33\%$

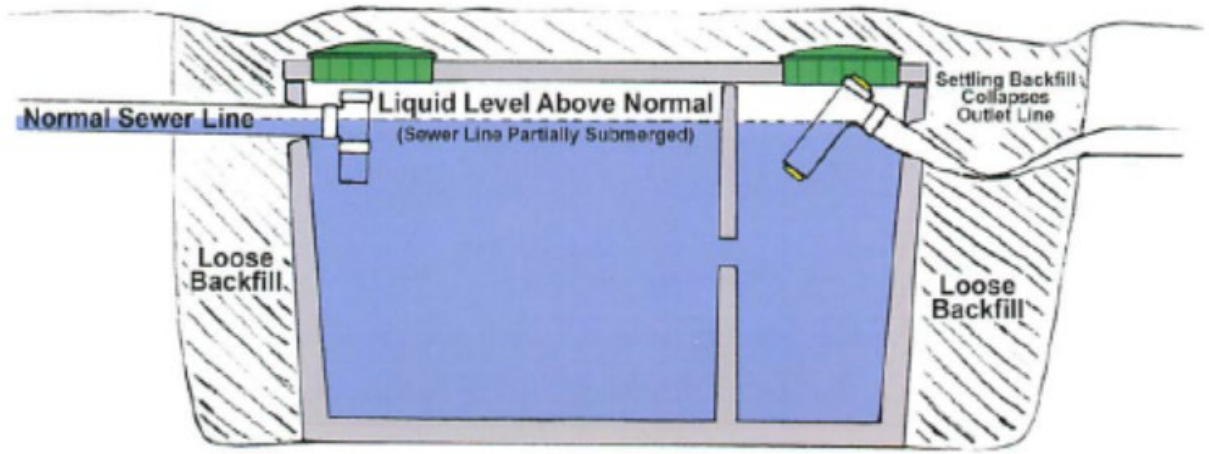
Ponding in drain fields

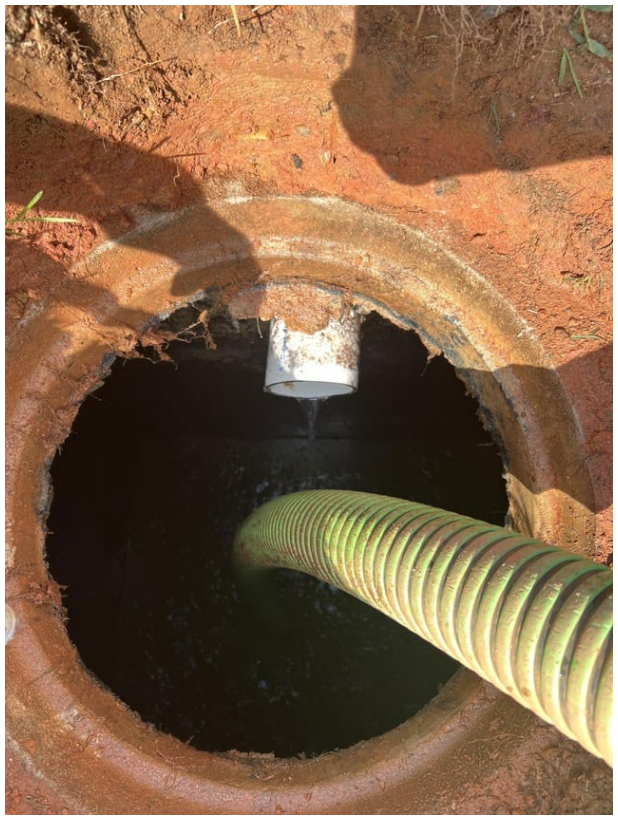
Can be due to excessive hydraulic loading or clogging of the biomat.


Riser
Inspection Port
Riser
Wastewater from House
Inlet Tee
Outlet Tee
Effluent (to absorption field)
Scum
Baffle
Liquid (Effluent)
Effluent Filter
Sludge


Influent from structure
Scum Layer
Effluent Filter
Effluent to next component of the system
Sludge Layer
Seperated water zone

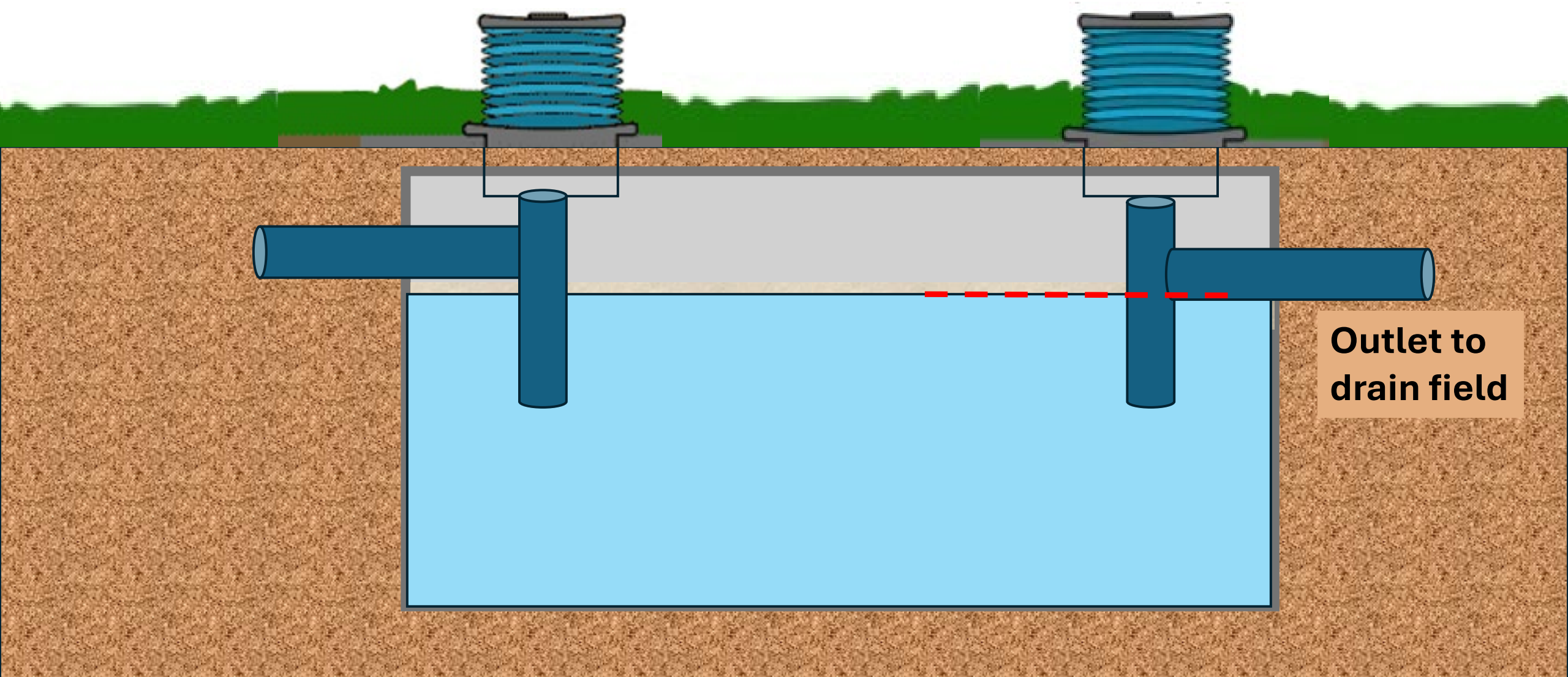
Settled Outlet Line

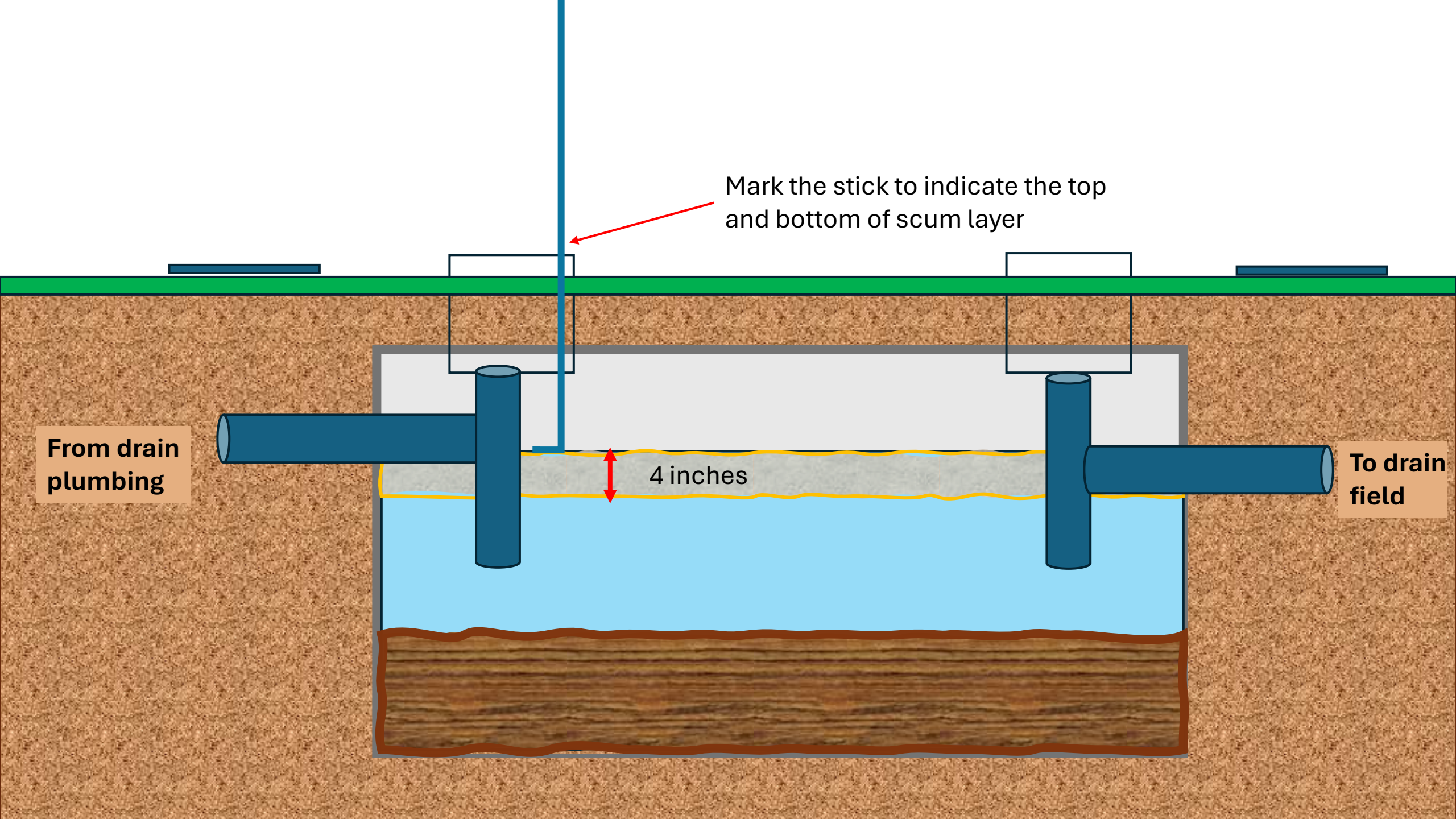


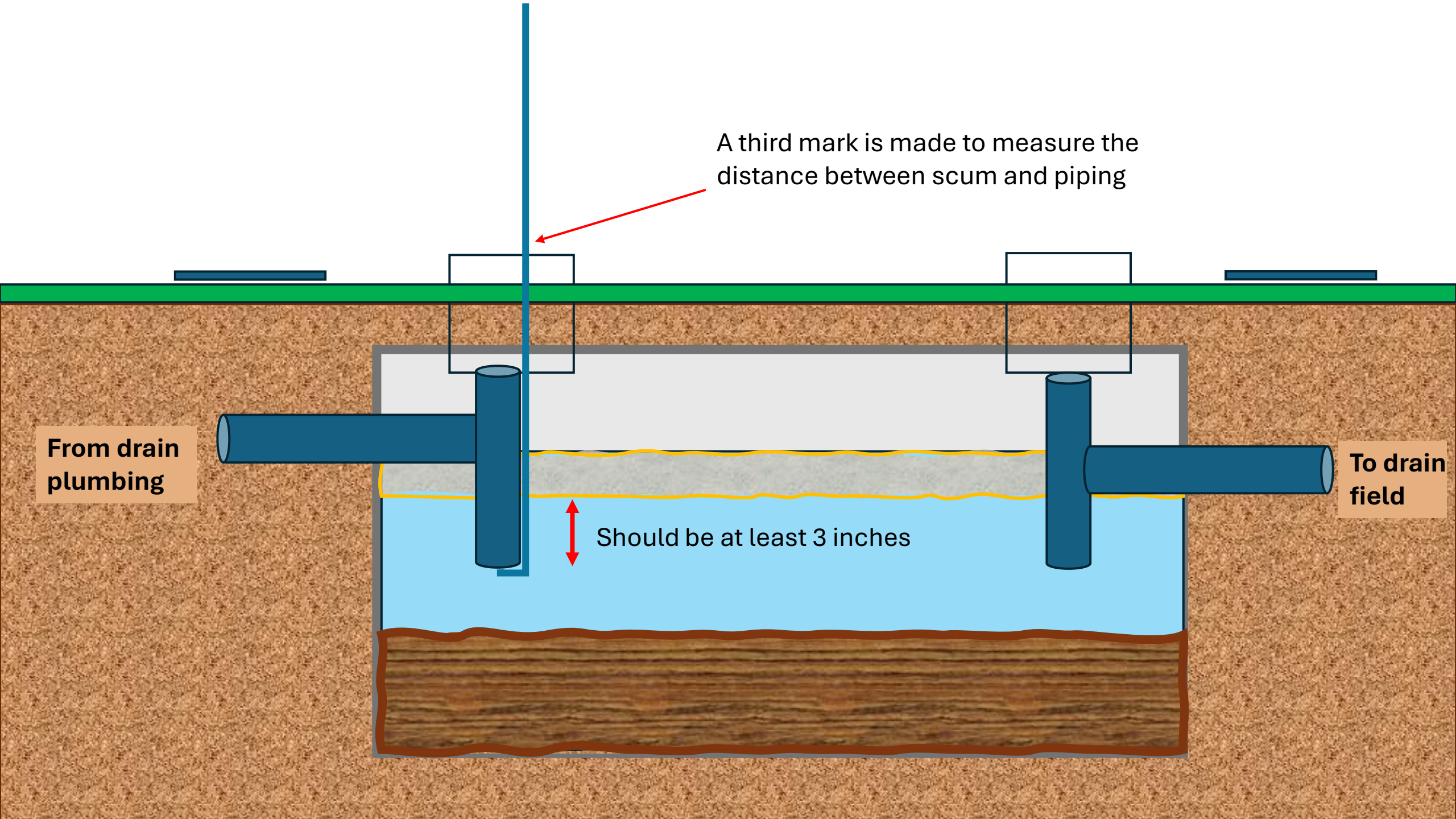


Liquid Level: Should be even with bottom of outlet pipe.

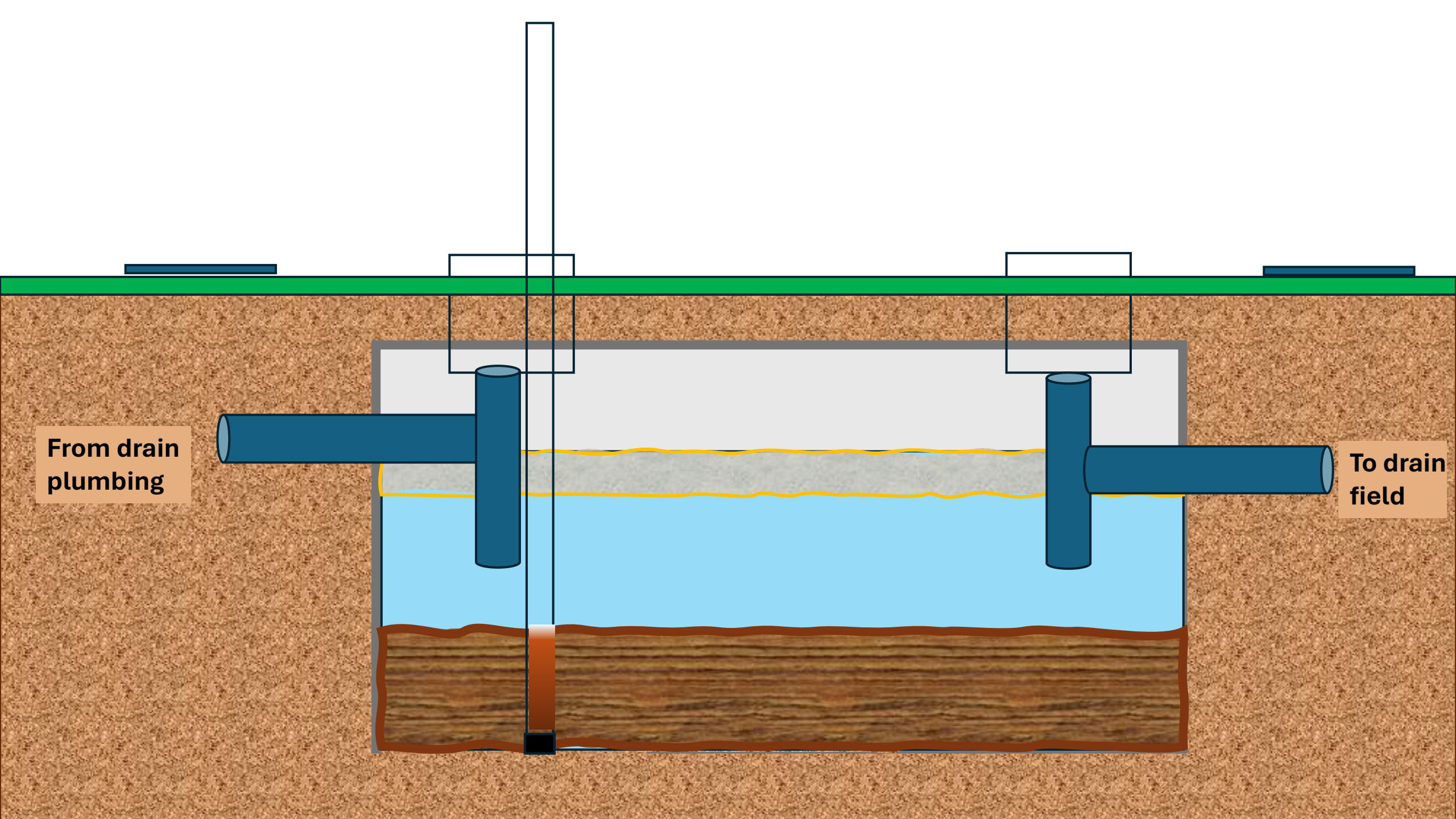
- If above (drainfield is clogged)
- If below, tank is leaking




Mark the stick to indicate the top and bottom of scum layer
From drain plumbing
4 inches
To drain field

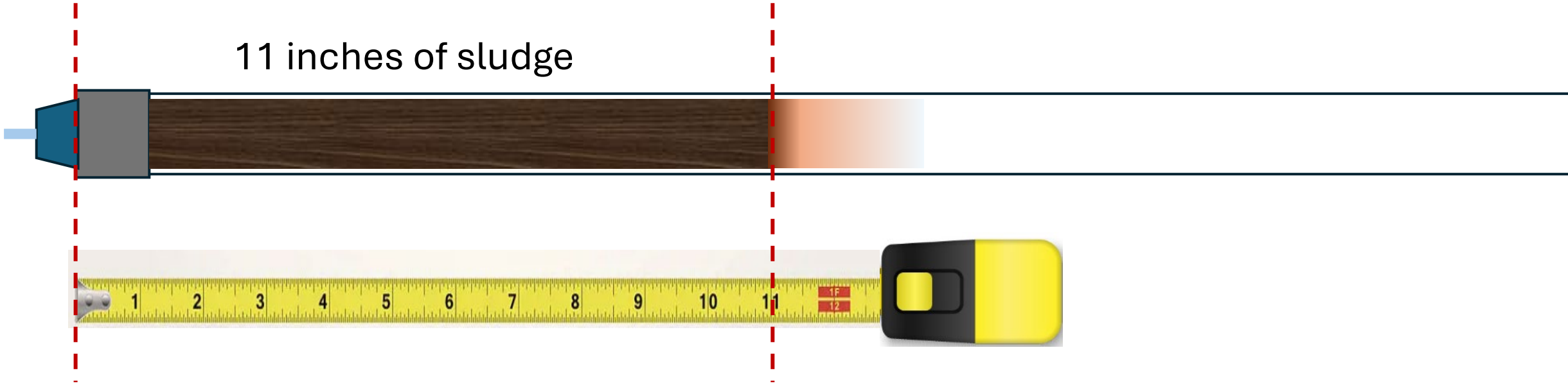

A third mark is made to measure the distance between scum and piping
From drain plumbing
To drain field
Should be at least 3 inches

Sludge judge sample


From drain plumbing
To drain field

Measuring sludge depth in inches

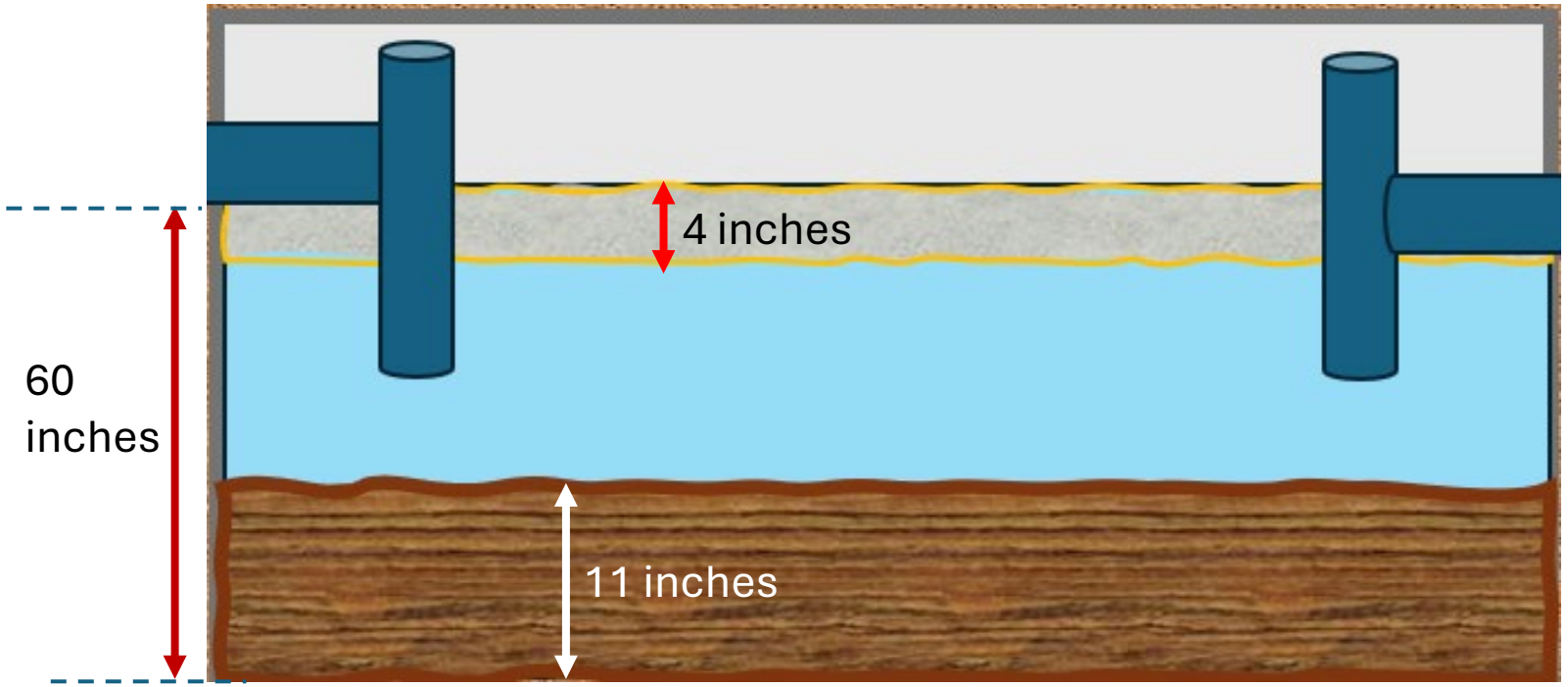
POLL #4



Poll 3

Estimate the percent volume of solids in a septic tank if the scum layer is 4 in, sludge is 11 in and total tank depth is 60 in.

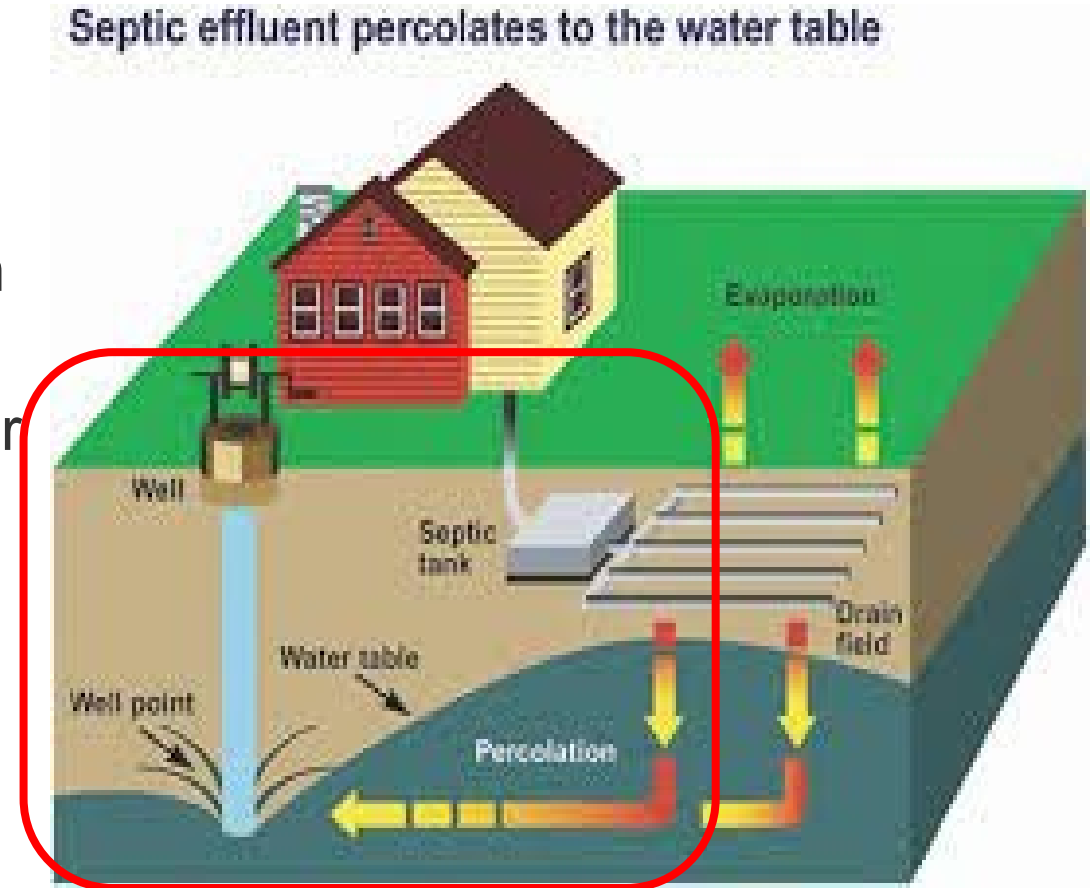
$$\frac{(11\text{in} + 4\text{in})}{60 \text{ inches}} \times 100\% = \mathbf{25\%}$$



System failures

Diseases from septic system failures.

- Racine, MO 1992, two drinking water wells at a nearby church and school were contaminated by a malfunctioning septic system causing 28 cases of Hepatitis A.
- Coconino County, AZ 1989, failure of a resort leach field resulted in 900 cases of gastroenteritis.
- Richmond Heights, FL 1974, a public drinking water well was contaminated by a failed septic system resulting in 1,200 cases of gastrointestinal illness



Change in culture

Periodic inspections contribute to improved environmental and public health.

"We were just reading about a waterborne illness caused by an onsite wastewater system. How can groundwater quality be protected from malfunctioning septic tanks?"

"Perhaps the first step is to develop a consistent inspection program and help educate the public how to keep their systems functioning well."

"Yes, an entire family was hospitalized with e-Coli, and the story also mentions that 30% of all septic systems fail"

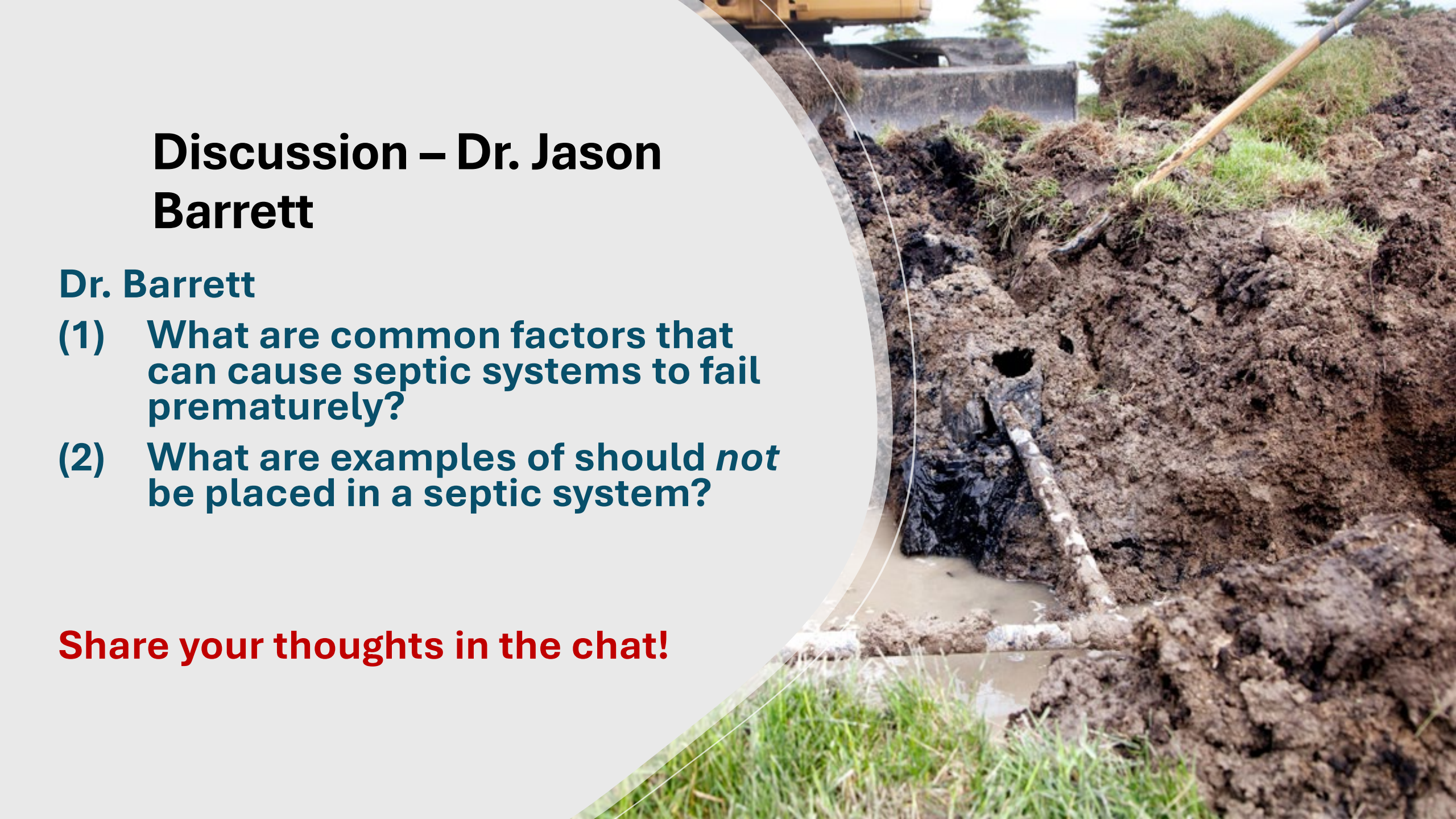
Discussion – Dr. Jason Barrett

Dr. Barrett

(1) What are common factors that can cause septic systems to fail prematurely?

(2) What are examples of should *not* be placed in a septic system?

Share your thoughts in the chat!



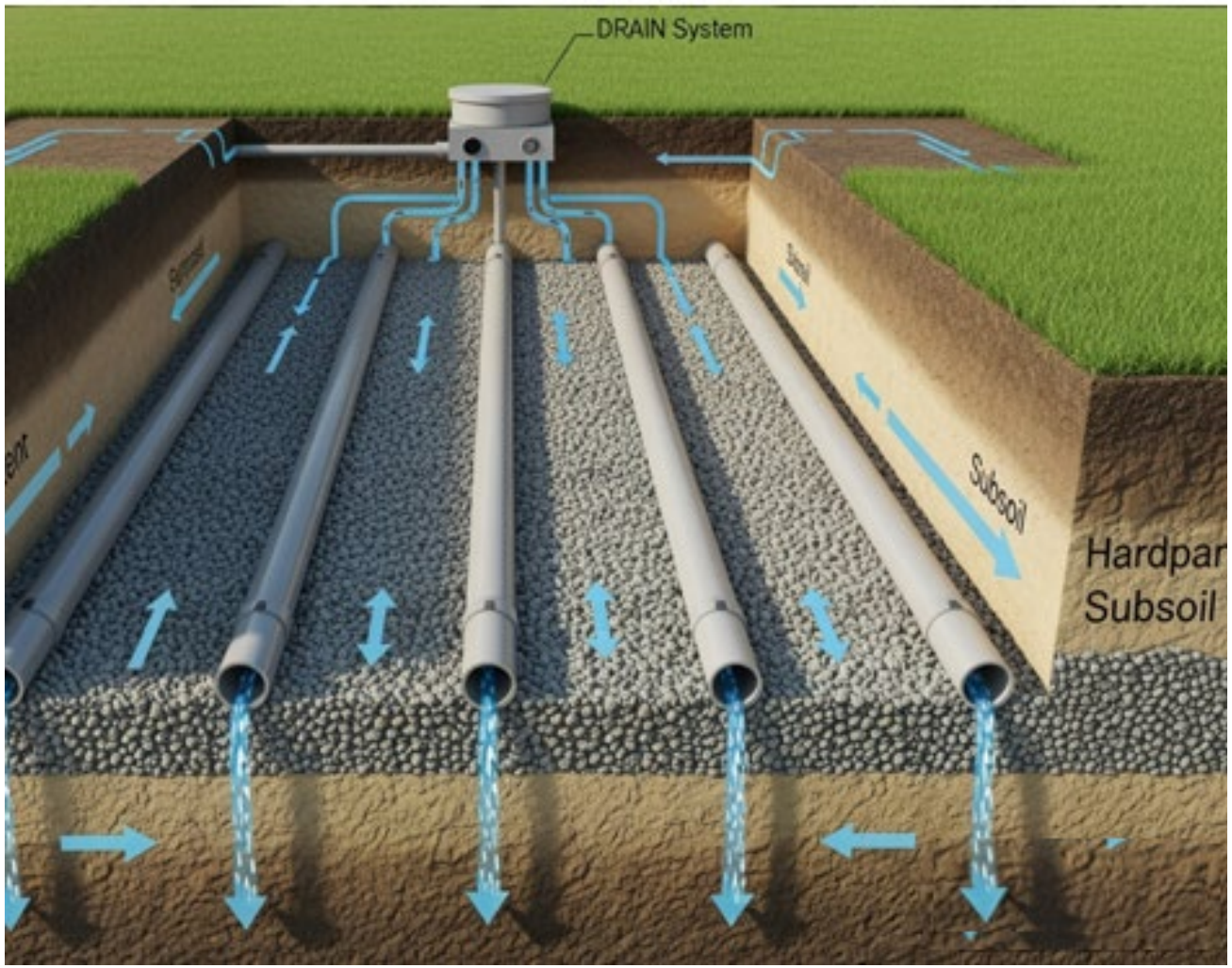
Factors that inhibit drainfield performance

Grease and oil can coat the biomat decreasing performance of microbes.

Failure to pump the septic when needed can result in solids clogging of the drainfield and disrupt percolation.

Adding solids from sink garbage disposals will increase solids accumulation and can lead to drainfield clogging

Adding chemicals, non-biodegradable wastes, and heavy phosphate detergents can damage the biomat organisms



Failure to pump when needed

1. Solids enter and clog the drainfield
2. High costs to repair or replace drainfield
3. Harmful gases and aerosols are produced
   - Methane
   - Hydrogen sulfide
   - Airborne bacteria and pathogens

SEPTIC TANK PUMPING FREQUENCY (IN YEARS)

Septic Tank Size	Household Size -- Number of Occupants									
	1	2	3	4	5	6	7	8	9	10
1000 gallon	12	5½	3½	2½	2	1½	1	1	1	1
1250 gallon	15½	7½	4½	3	2½	2	1½	1	1	1
1500 gallon	19	9	6	4	3	2½	2	2	1½	1
2000 gallon	25	12	8	6	4½	3½	3	2½	2	2

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Garbage Disposal Impacts

Table 3-8. Residential wastewater pollutant contributions by source [a,b]

Parameter		Garbage disposal (gpcd)[c]	Toilet (gpcd)[c]	Bathing, sinks, appliances (gpcd)[c]	Approximate total (gpcd)[c]
BOD_5	mean	18.0	16.7	28.5	63.2
	range	10.9–30.9	6.9–23.6	24.5–38.8	
	% of total	(28%)	(26%)	(45%)	(100%)
Total suspended solids	mean	26.5	27.0	17.2	70.7
	range	15.8–43.6	12.5–36.5	10.8–22.6	
	% of total	(37%)	(38%)	(24%)	(100%)
Total nitrogen	mean	0.6	8.7	1.9	11.2
	range	0.2–0.9	4.1–16.8	1.1–2.0	
	% of total	(5%)	(78%)	(17%)	(100%)
Total phosphorus[d]	mean	0.1	1.6	1.0	2.7
	range	—	—	—	—
	% of total	(4%)	(59%)	(37%)	(100%)

A garbage disposal doubles the TSS loading to the septic system.

- The time estimated for septic pumping must be divided by 2
- One of the largest factors in early septic failure

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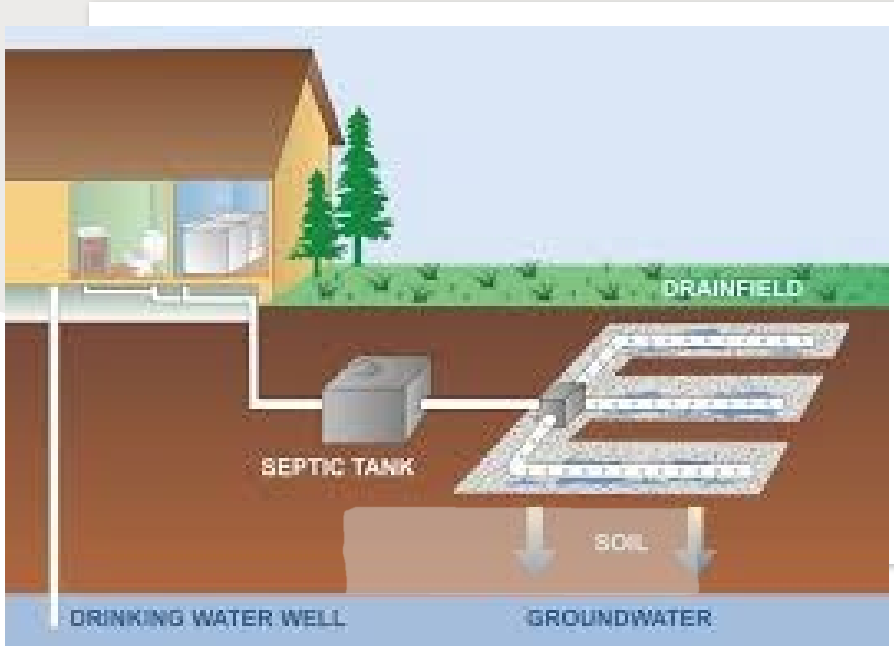
Essential Questions



1. **How do onsite septic systems work?**
   - **Physical separation of solids in the septic tank followed by biological treatment processes in the drain field.**

2. **How can we ensure septic systems function properly?**
   - **Soil and site evaluation to determine soil performance and limiting factors**
   - **Proper sizing of septic tank and drainfield based on estimated flow and soil percolation rates**
   - **Periodic inspection and pumping**

3. **What causes septic systems to fail?**
   - **Failure to pump when needed**
   - **Hydraulic or solids overloading**
   - **Adding harmful chemicals**

Thank you for attending!

Share 1 thing you enjoyed learning about today in the chat

We're now open for questions

Contacts and information sources

Environmental Finance Center Network
Website: https://efcnetwork.org/

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Learning Resources

Caring for Septic Systems (Alabama Cooperative Extension System). https://www.aces.edu/wp-content/uploads/2024/02/ANR-3051_CaringForSepticSystems_022024L-G.pdf

Septic Tank/Absorption Field Systems: A Homeowner's Guide to Installation and Maintenance (University of Missouri Extension). https://extension.missouri.edu/publications/eq401

USEPA Septic Systems: https://www.epa.gov/septic

USEPA Septic Systems and Drinking Water: https://www.epa.gov/septic/septic-systems-and-drinking-water

Managing Septic Systems to Prevent Contamination of Drinking Water (EPA). https://www.epa.gov/sites/default/files/2015-06/documents/2006_08_28_sourcewater_pubs_septic.pdf

Learn more

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