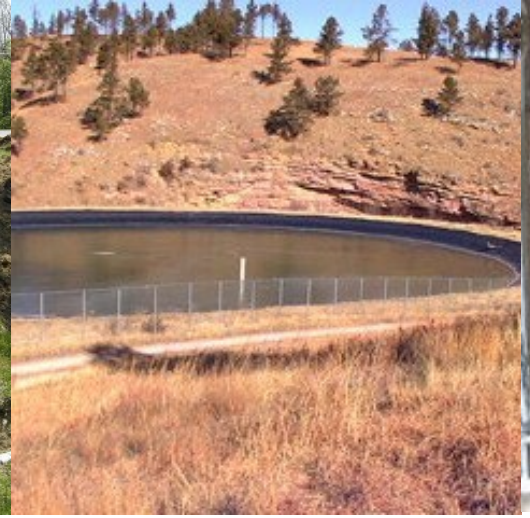
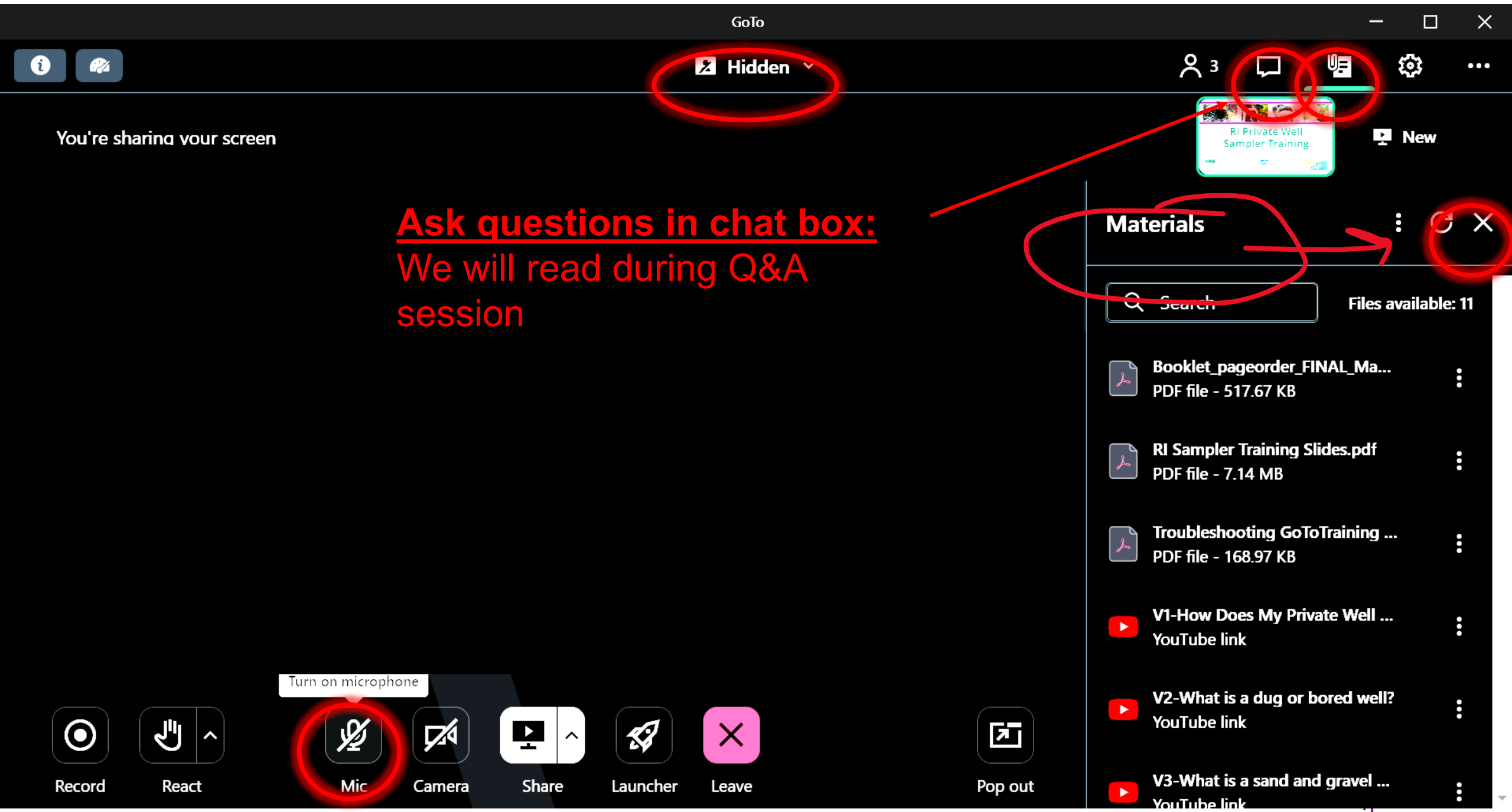




Septic 101 for Sherborn Homeowners

Design and Proper Management of Private Wastewater Systems

RCAP Solutions Massachusetts

RCAP Solutions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Troubleshooting GoToTraining ...
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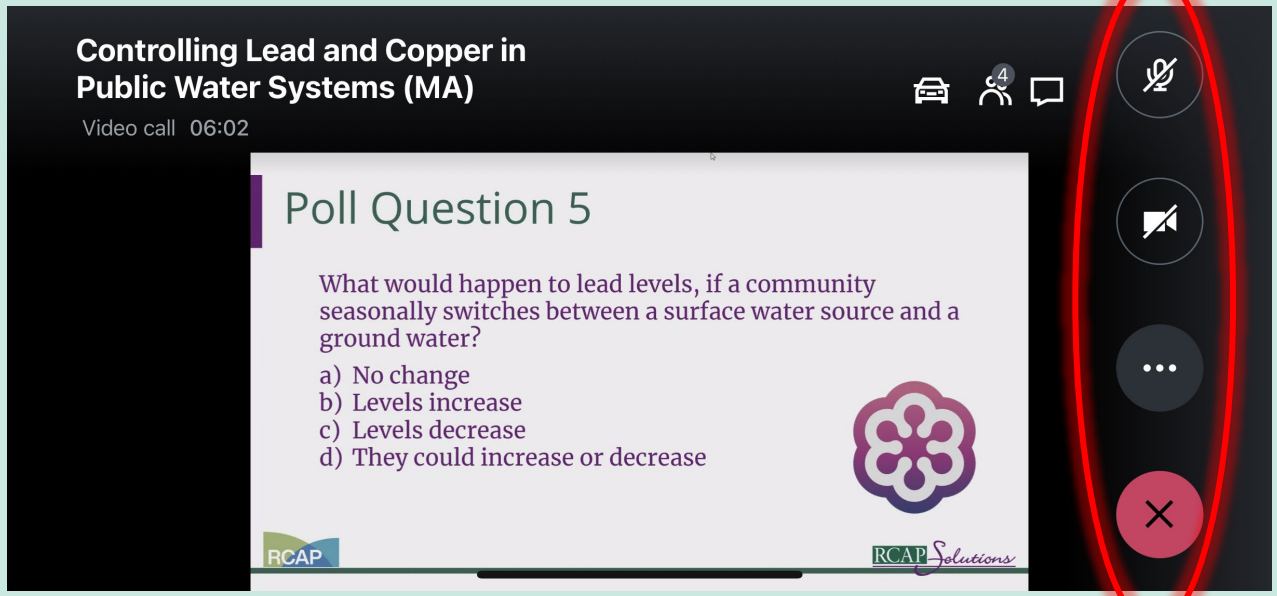
V1-How Does My Private Well ...
YouTube link
V2-What is a dug or bored well?
YouTube link
V3-What is a sand and gravel ...
YouTube link
Turn on microphone
Record
React
Mic
Camera
Share
Launcher
Leave
Pop out

Smart Device: 2 Apps to chose from

“GoToTraining”

“GoTo”



This session is being recorded.

RCAP Solutions

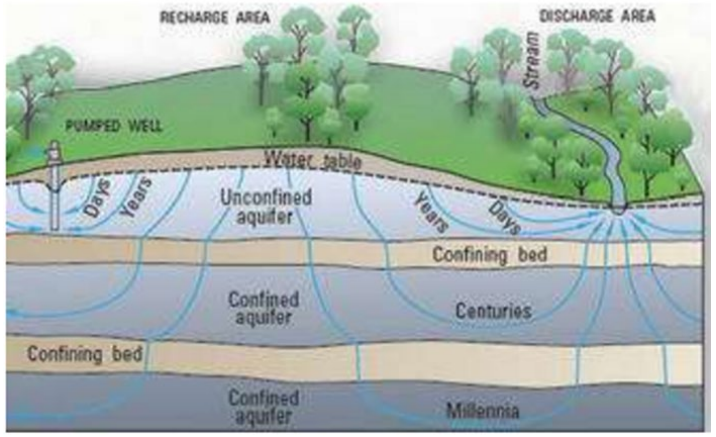
May 9, 2023

Septic 101 for Sherborn Homeowners

Design and Proper Management of Private Wastewater Systems

RCAP Solutions Massachusetts

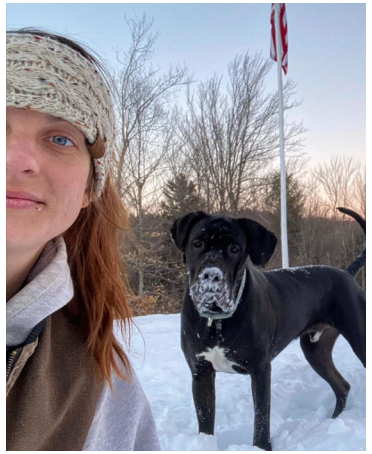
Jan 25, 2022 Private wells (video, slides, and Q&A document available)



Additional resources for Sherborn property owners:
https://www.sherbornma.org/groundwater-protection-commmittee

Contact us by email: gpc@sherbornma.org

Today's Presenters:

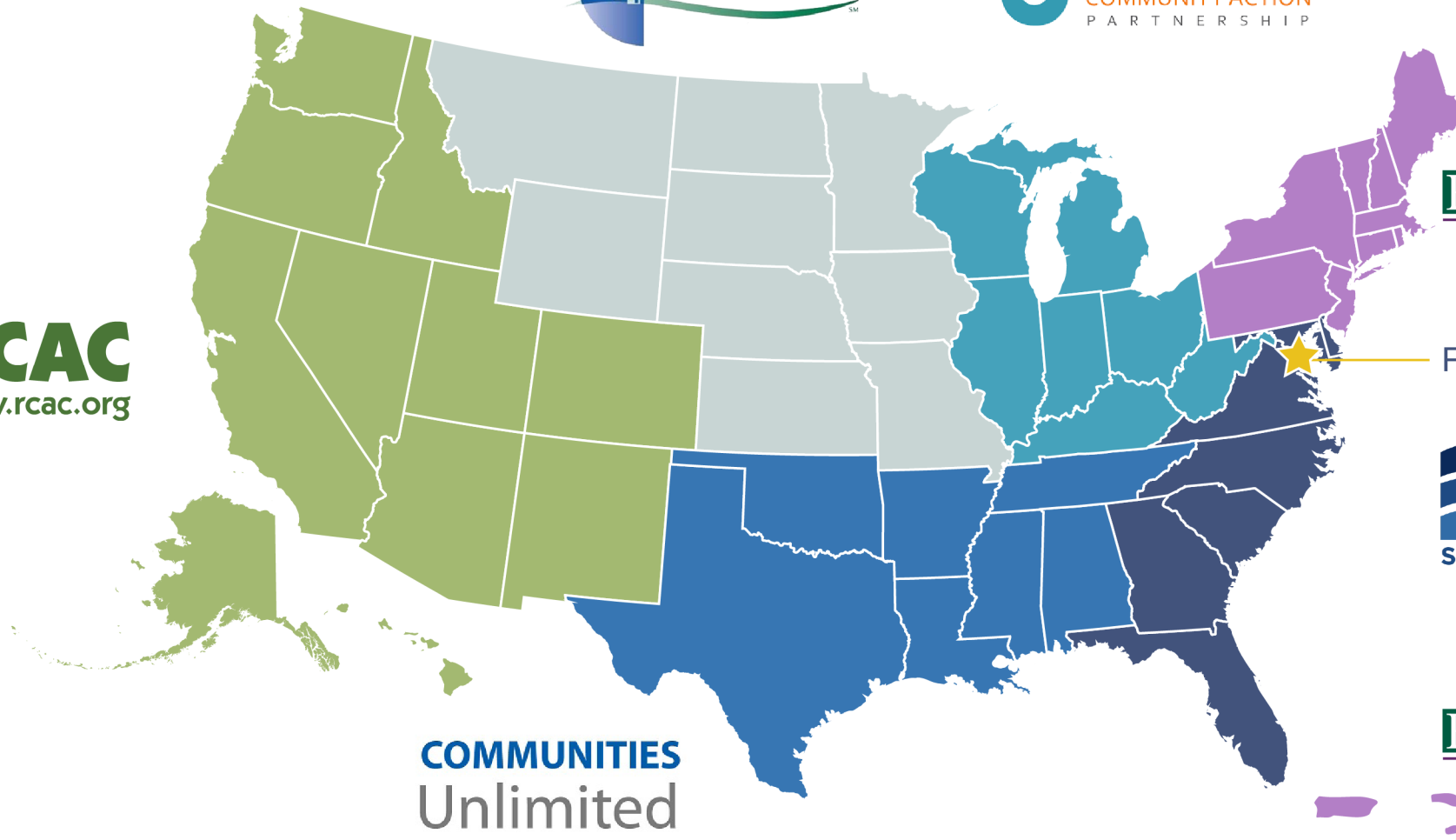


Rebekah Novak, E.I.T.
Community Specialist
RCAP Solutions NORTHEAST
rnovak@rcapsolutions.org

Andrew Evans
Community Specialist
RCAP Solutions NORTHEAST
aevans@rcapsolutions.org

RCAP Solutions

Rural Community Assistance Partnership



Midwest Assistance Program

Great Lakes COMMUNITY ACTION PARTNERSHIP

RCAP Solutions NORTHEAST

RCAC www.rcac.org

RCAP National Office

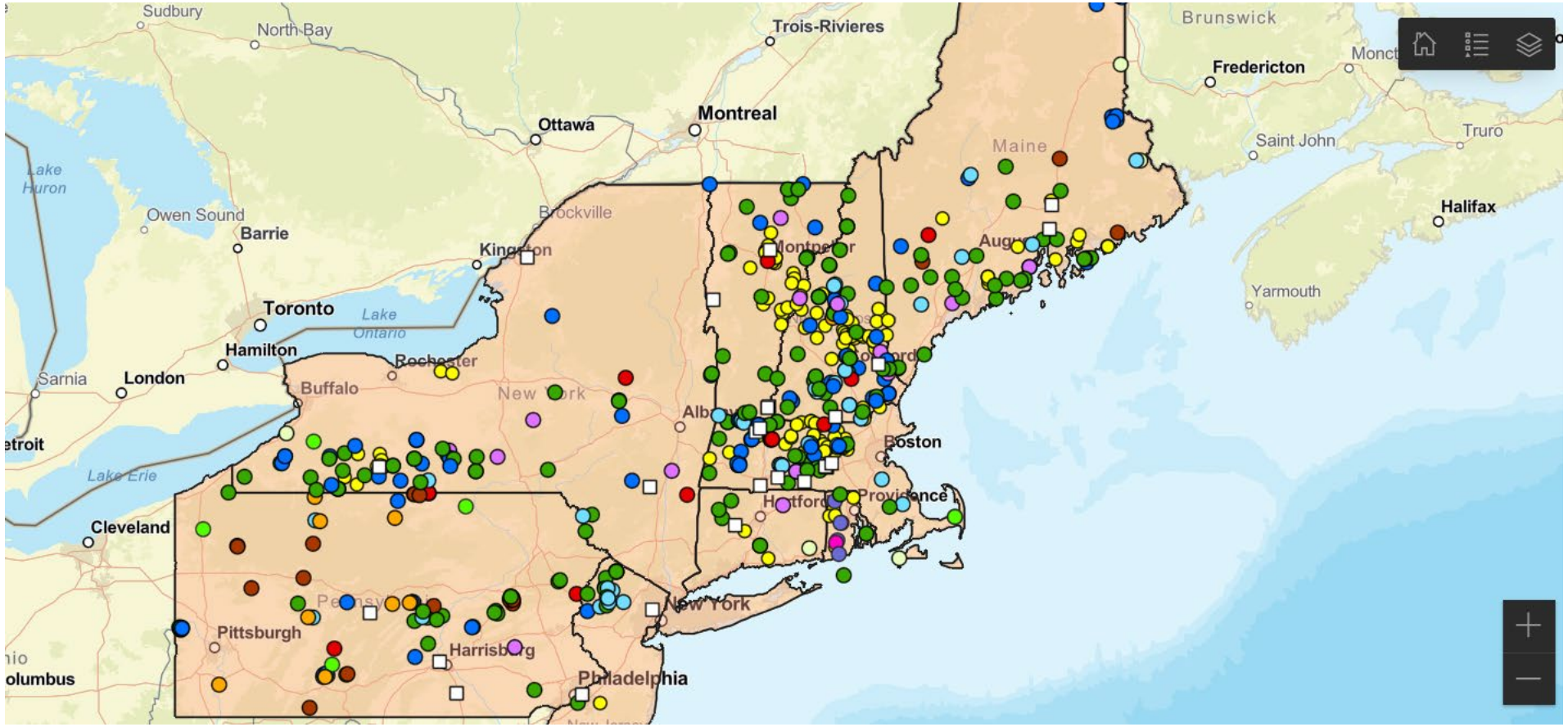
SERCAP, INC.

RCAP Solutions CARIBBEAN

COMMUNITIES Unlimited

https://rcapnational.maps.arcgis.com/apps/webappviewer/index.html?id=61b5505cf4fb4026ac6cf1345321b1e8

RCAP Solutions Impact



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Acknowledgement

This project has been funded wholly or in part by the United States Environmental Protection Agency under an EPA Training and Technical Assistance for Small Drinking Water Systems to Achieve and Maintain Compliance.

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PRE-TEST

Do your best, you will be asked these questions again in the Post-Test

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Poll Question #1:

Do you know where your septic system is located?

a) *Yes*
b) *No*
c) *I don't, but someone else in my household does*
d) *I only know where SOME components are, but not all of them*
e) *Does not apply*

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Poll Question #2:

Do you know the condition of your septic system? (good, bad, failing etc.)

a) *Yes*
b) *No*
c) *I don't, but someone else in my household does*
d) *Does not apply*

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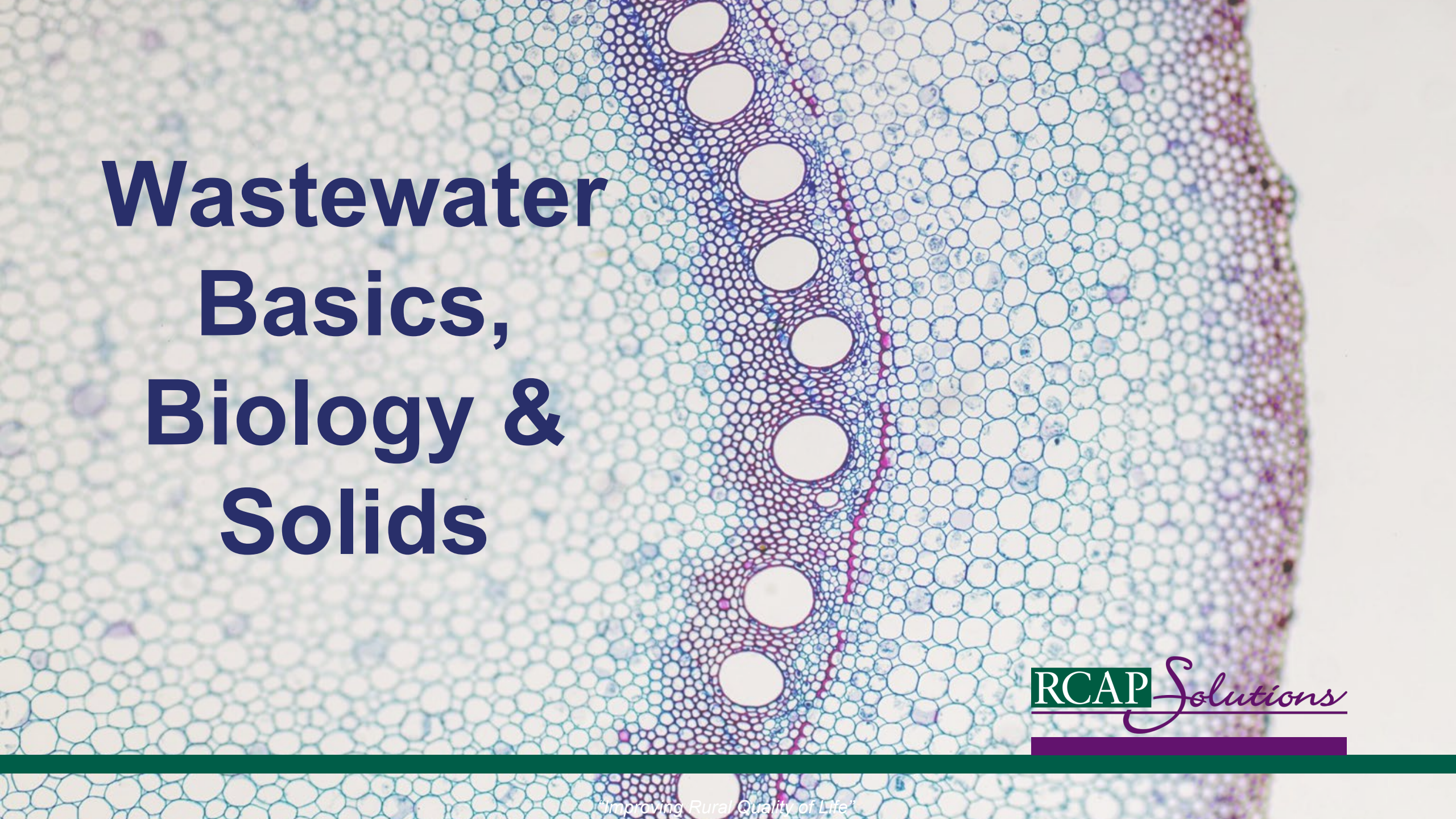
The Septic System

1. Wastewater produced
2. Sent to septic tank for settling and treatment
3. Distribution box (D-box) discharges the flow evenly to the drainfield/leachfield.
4. Drainfield accepts the wastewater for further treatment
5. Wastewater is discharged to the groundwater.

Please note: Septic systems vary. Diagram is not to scale.

Wastewater Basics, Biology & Solids



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Wastewater Terms

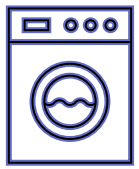
Temperature

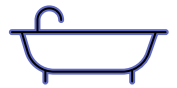
pH

Organic/Inorganic

Solids

Biomat





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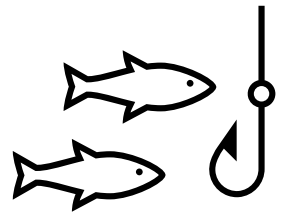
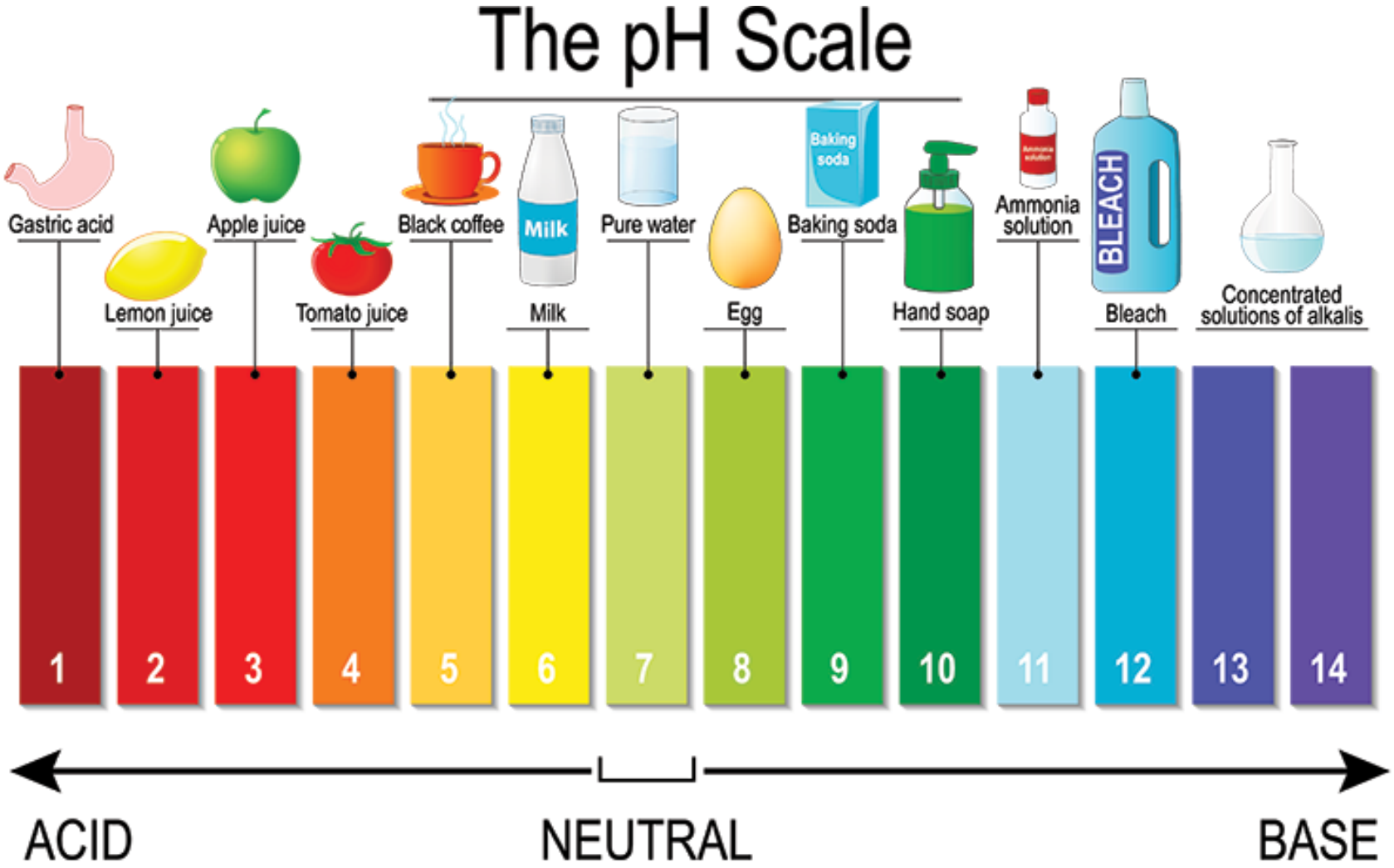
Temperature

Microbial activity increases as temperature increases

Microbial activity decreases as the temperature decreases



pH



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Organic & Inorganic Solids

Organic Solids

- Contains *Carbon*
- Decomposed by bacteria in the presence of oxygen
- Large molecules are broken into smaller molecules and eventually into carbon dioxide and water

Inorganic Solids

- Do NOT contain carbon
- Dissolved inorganics flow to the leachfield, settled inorganics are stored in the septic tank until it is pumped
- *Sand, silt, minerals, phosphates, some forms of nitrogen, metals*

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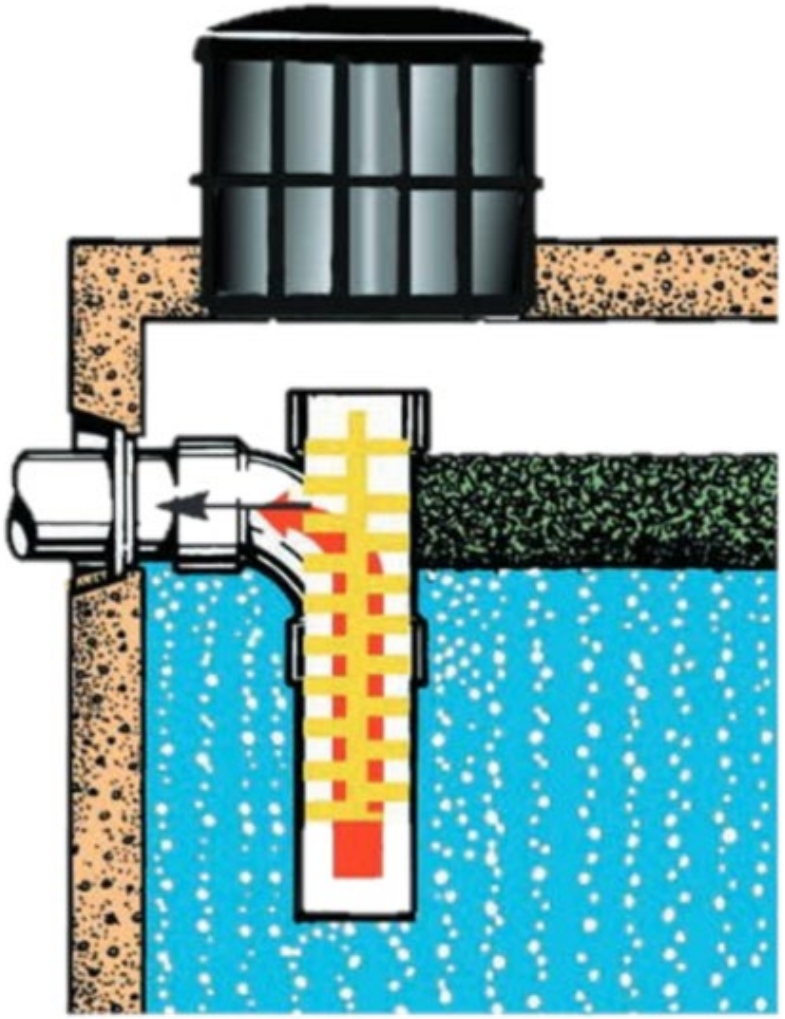
Solids - TSS

Total **S**uspended **S**olids

- Organic and inorganic
- “Suspended” – neither sink nor float
- Carried with the wastewater to the leachfield
- Can clog the small pore spaces between the soil grains in the leachfield



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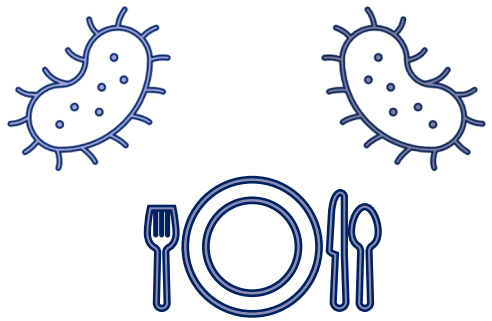
Organics in wastewater = Food



- Wastewater is the food source for microbes
- ≈ 65-95% the organics in wastewater is removed in a well functioning septic system
- “High strength waste” = lots of food

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Biomat

- Slimy permeable layer that forms on surfaces (dirt, sand, or media) made up of partially decomposed organic waste and bacteria.
  - The slime is a chemical compound secreted by bacteria to anchor themselves
  - Aerobic bacteria grows on the surface (uses oxygen to stay alive)
  - Anaerobic bacteria grows on the inside
  - There is an optimal functioning ratio

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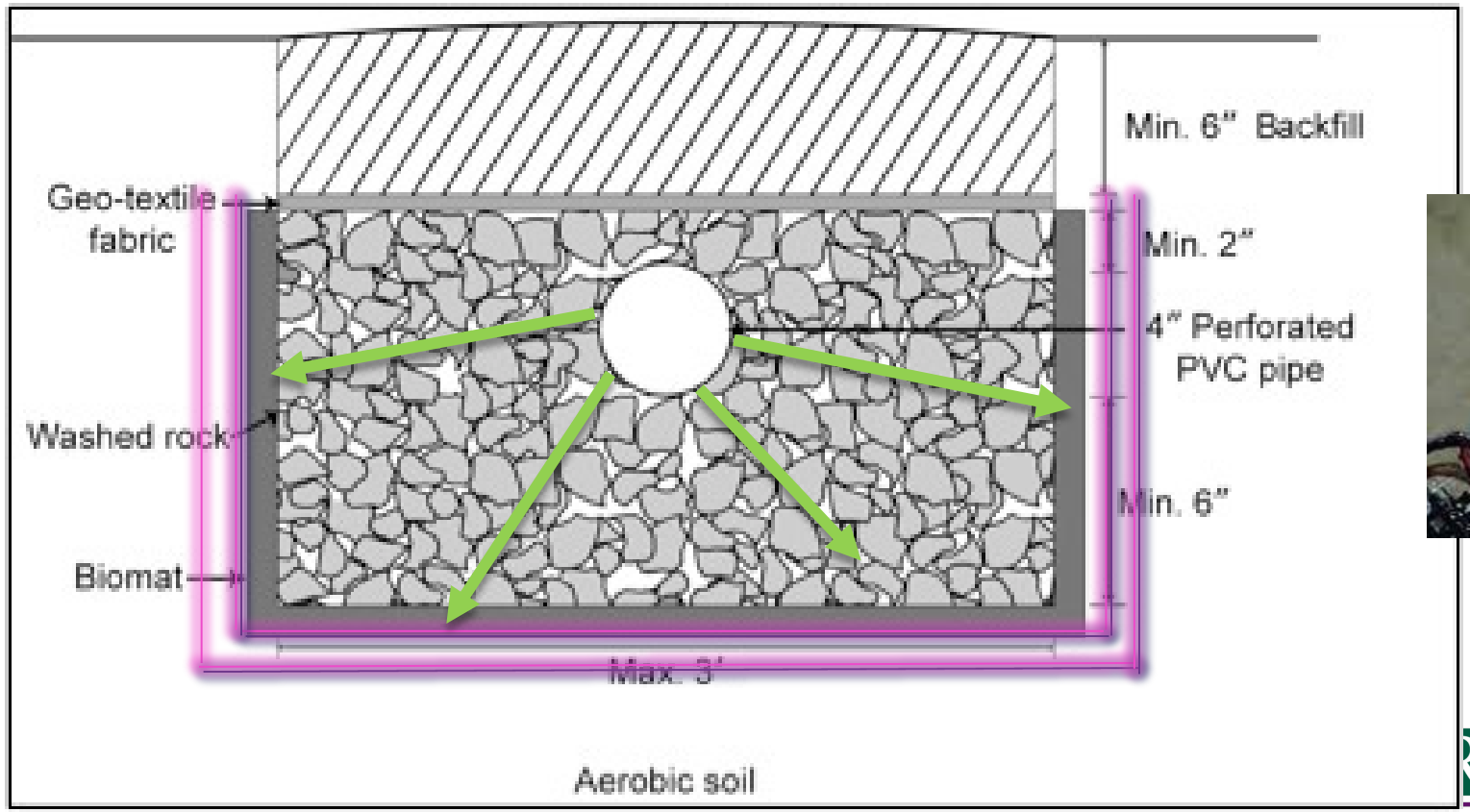
Leachfield Biomat



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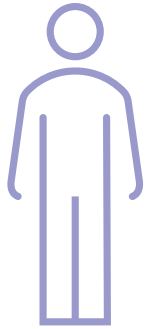
Nutrients

Nitrogen : Organic & Inorganic



- Most nitrogen excreted by humans is **organic** nitrogen
- **Organic** nitrogen is converted to **inorganic** nitrogen (ammonia) by bacteria in the septic tank
- The goal is to remove inorganic nitrogen from wastewater using bacteria
- Too much Nitrate or Ammonia in drinking water wells can cause serious health effects

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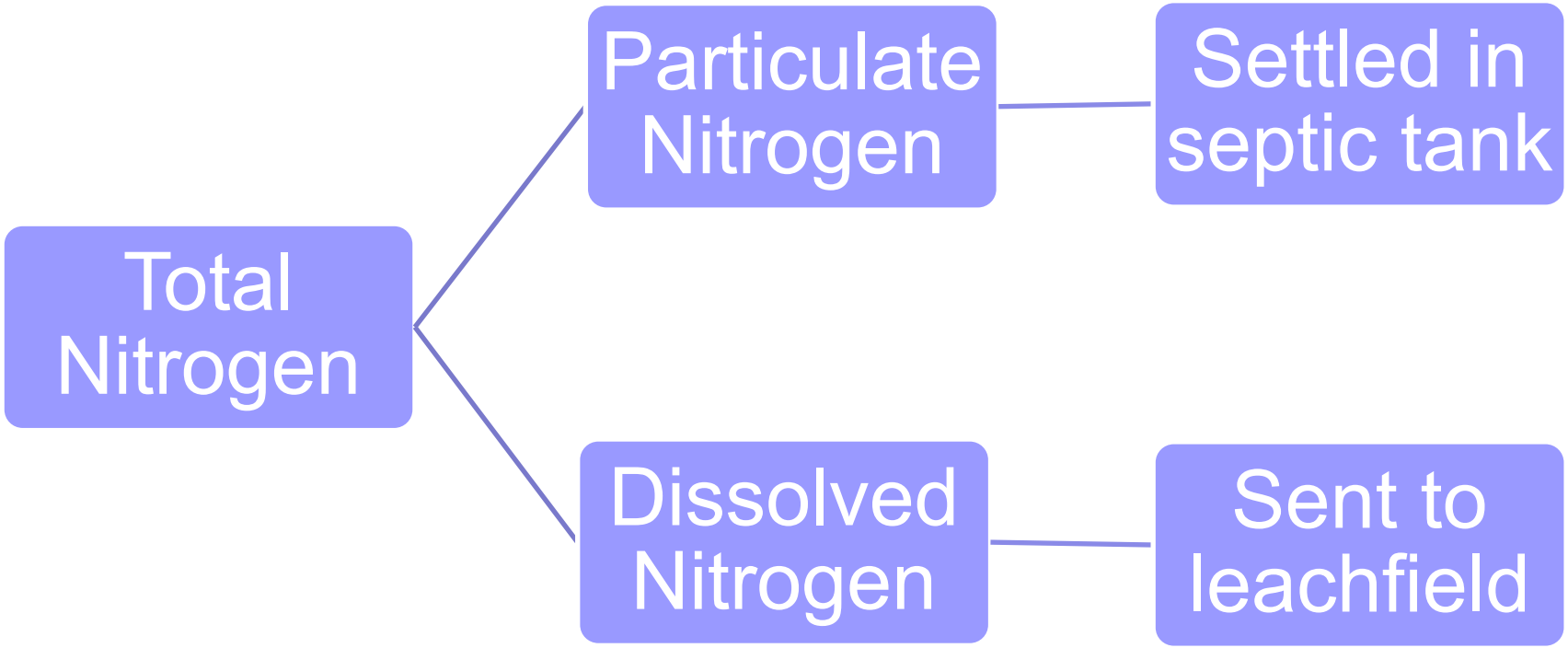
Nitrogen through system



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Nitrogen

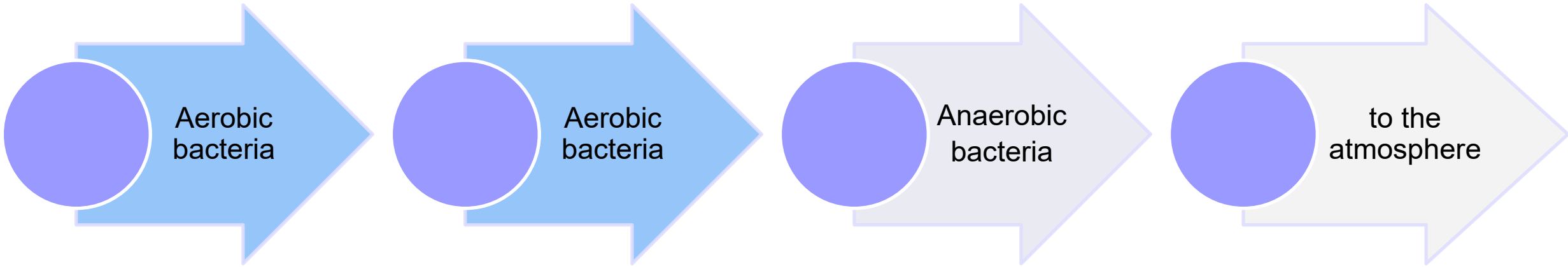
- Different forms: Nitrate, Nitrite, Nitrogen gas
- Occurs naturally in soil and water
- Sources of excess nitrate: fertilizers, on-site sewage system, wastewater treatment effluent, animal wastes, industrial wastes, and food processing.
- High levels of nitrate in water can pose a potential health risk
  - Infants' digestion does not excrete the nitrogen and so oxygen in the blood does not get carried to vital tissues of the body. This can lead to *Methemoglobinemia or “blue baby syndrome.”

*Met-hee-muh-glow-buh-nee-mee-uh

Ammonia

- Ammonia is created by degradation of naturally occurring organic matter and can be found in groundwater
- Ammonia also comes from nitrogen-fertilizer application, livestock operations, industrial processes, sewage infiltration
- The presence of ammonia at higher than normal naturally occurring levels is an important indicator of fecal pollution
- Ammonia at high levels
  - Poisonous to humans
  - Upset the natural equilibrium in lakes and streams.

Nitrogen Cycle



Nitrogen Cycles in the Environment

- Requires different environments
- Nitrification - the biological conversion of ammonia to nitrite, then to nitrate by aerobic bacteria
- Denitrification - the biological reduction of nitrate to nitrogen gas by anaerobic bacteria

Consequences of excess Nitrogen

- Algal blooms
- Fish health
- Bacteria
- Excessive plant growth
- Invasive plants

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Phosphorus

- An essential nutrient for all plant and microorganism growth
- **Sources:**
  - Body and food waste
  - Some household detergents

- **In the septic system:**
  - Some settles in the septic tank
  - Treated in the soil of the leachfield

- **In receiving waters:**
  - Causes a dense growth of algae in freshwater river or lakes
  - Can produce toxins or deplete the dissolved oxygen in the water, causing other organisms to die.

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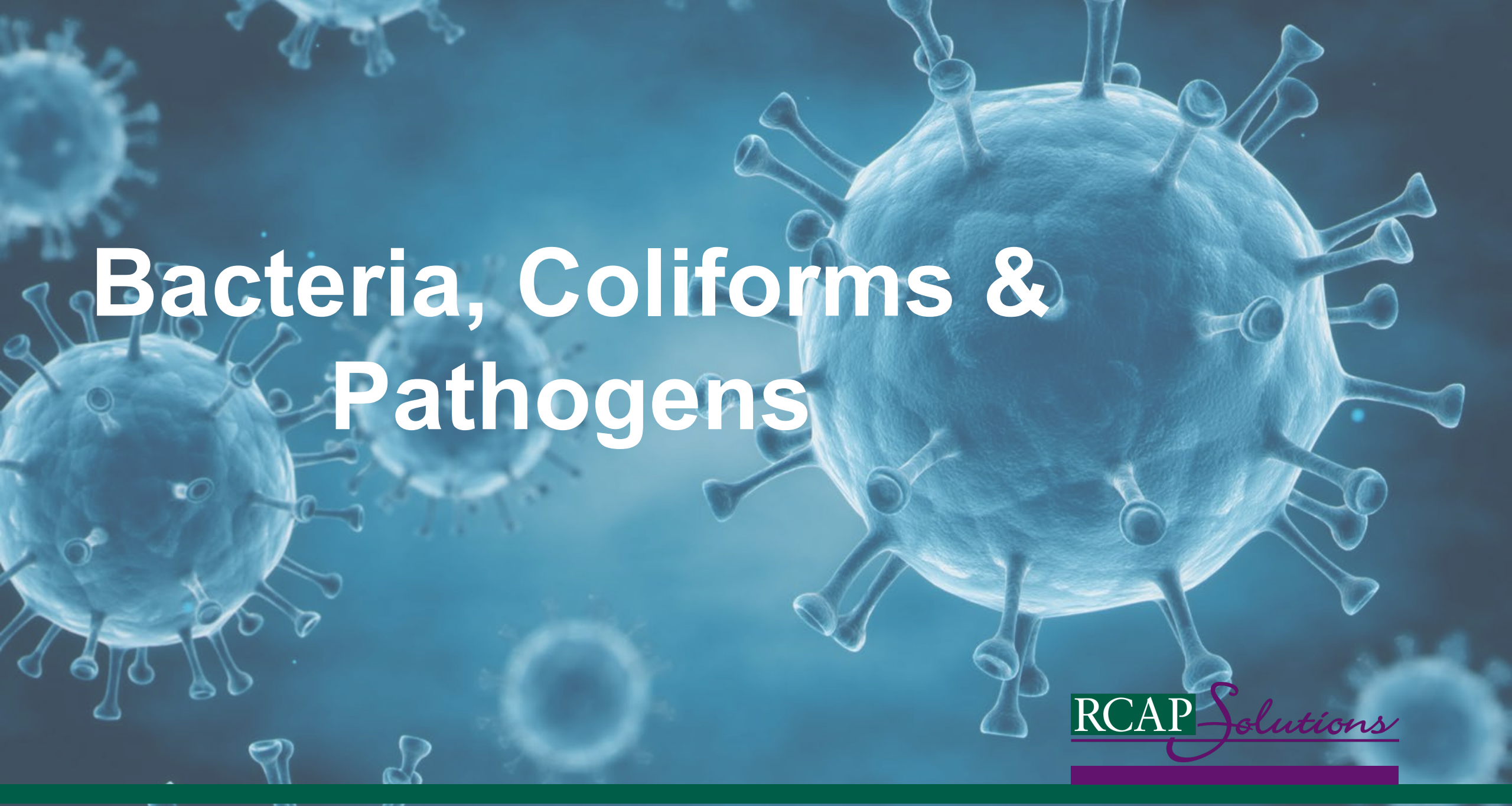
Bacteria, Coliforms & Pathogens



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"Improving Rural Quality of Life"

Bacteria Categories/types

- **Aerobic** bacteria use dissolved, free oxygen for food and reproduction.
- **Anaerobic:** Cannot use free oxygen.
- **Facultative** bacteria can use both available or consumed oxygen.

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Coliform bacteria:

- Found in the environment:
  - Plants, soil, sediment
  - Microbial growth
- Found in intestinal tract & waste of humans & warm-blooded mammals
- INDICATOR organism which encompasses MANY bacteria species
- 3 different groups of coliform bacteria:
  - **Total coliform** – large collection
  - **Fecal coliform** – mostly exist in feces
  - **E. coli** – subgroup of fecal coliform

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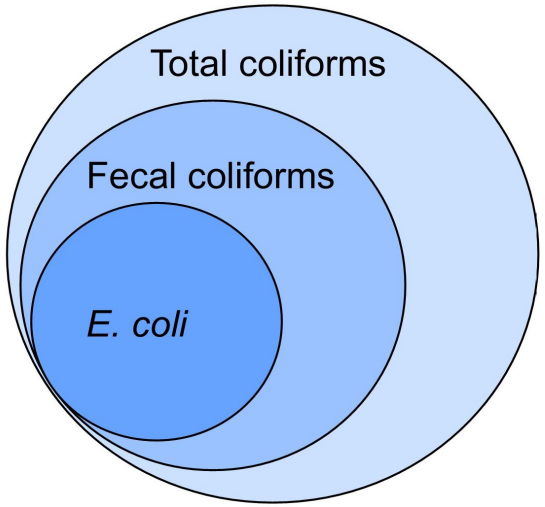
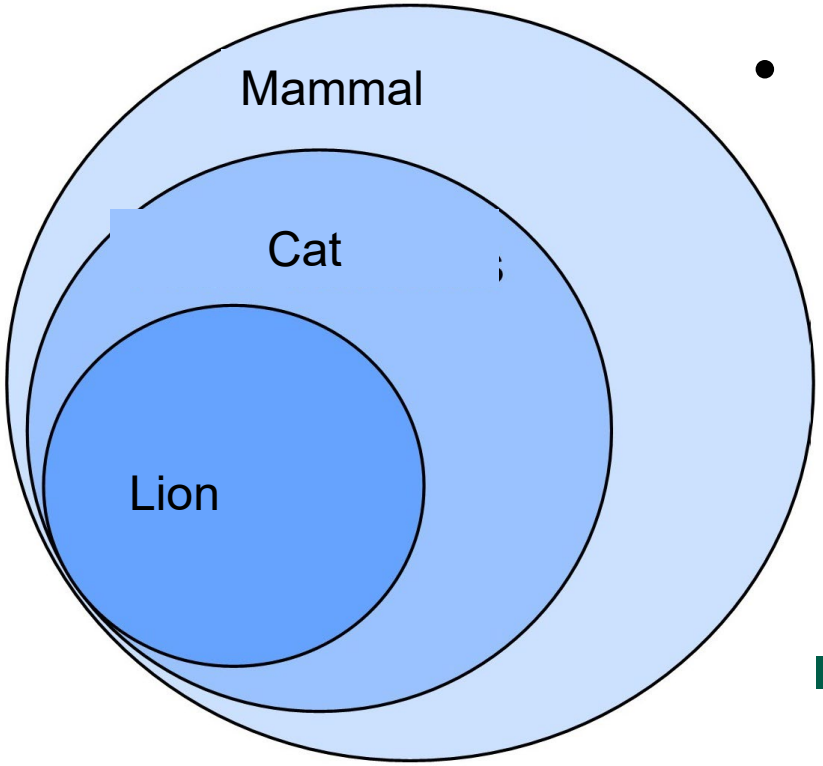
Total coliform vs. E. coli

- Total coliform is a common bacteria
- Not a health threat in itself
- It may indicate that other, more dangerous bacteria are present





- E. coli is a subset of total coliform
- Potential presence of waterborne pathogens
- Indicates contamination from mammal fecal waste

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Transported

- Groundwater flow
- Surface runoff
- Nearby agricultural or industrial sources
- Nearby failing septic system

Total Coliform: An *Indicator*

- For **drinking water**
  - Testing for **total coliforms** is the standard because their presence ***indicates*** coliform contamination by an outside source.
  - If the total coliform count is high, then it is very possible that harmful *pathogens* like viruses, bacteria and parasites might also be found in the water
  - If a sample is total coliform positive, it is followed up my more specific tests such as fecal coliform or E. coli

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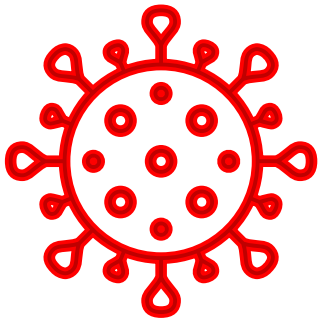
Pathogens



- Disease-causing microorganisms:
  - Virus
  - Bacteria
  - Fungus
  - Parasite
  - (Many subgroups)

- Most pathogens are inactivated by bacteria in a functioning septic system

  *Inactivated : DNA has been disrupted so that it cannot reproduce

Private Well Guidelines

Recommended Sampling For Existing Wells:

"Each year, preferably in the spring, all private wells, should be tested for **total coliform bacteria** and **nitrate/nitrite**. If total coliform bacteria is detected, the well water should be sampled for E.-coli to determine if wastewater has contaminated the well."

By MassDEP, Bureau of Water Resources Drinking Water Program, July 2018
Water Quality and Water Testing, Page 82

https://www.mass.gov/service-details/private-well-guidelines

Soils

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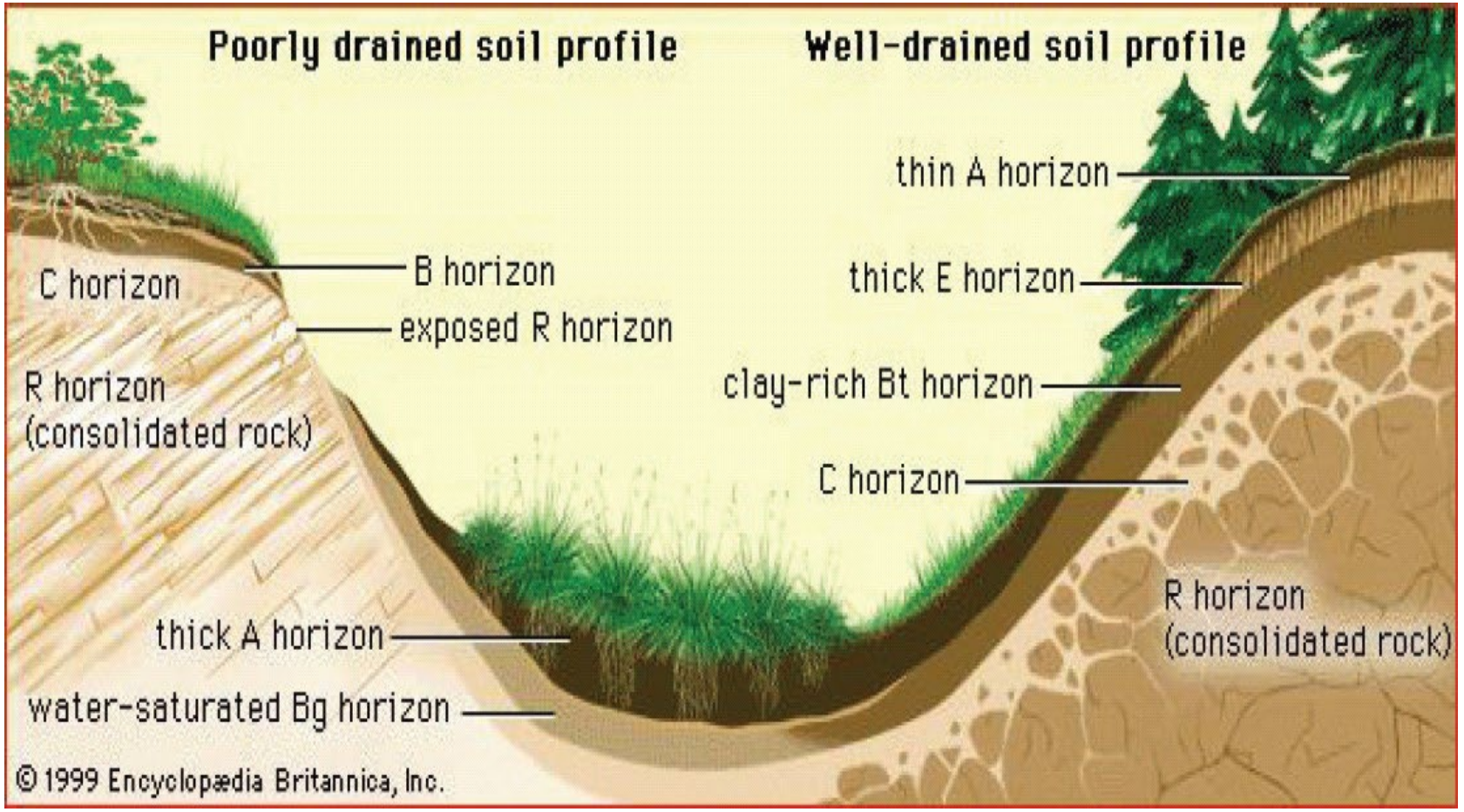
Soil Evaluation

- Test Pit and perc test performed by **Certified Soil Evaluator, PE, etc.**
- Characteristics of ALL soil layers beneath the surface



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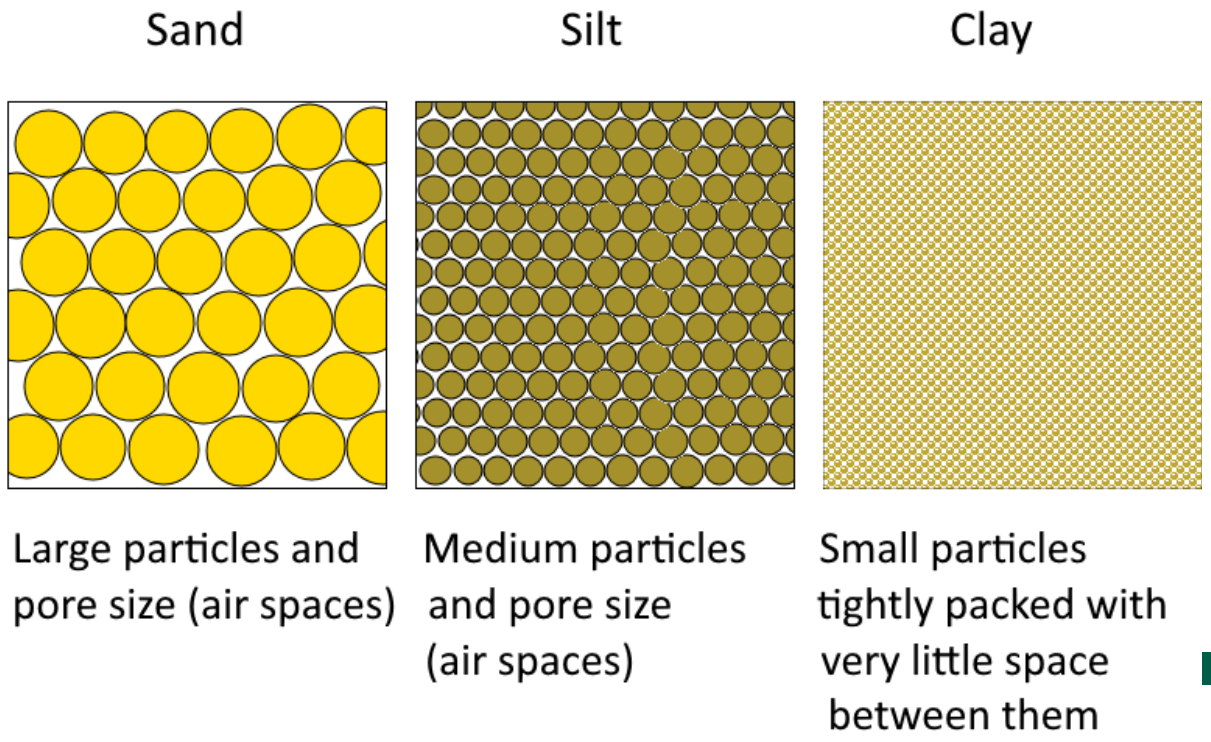
Soil Composition

- The relative percentage of sand, silt and clay affects the rate at which wastewater percolates through the soil
- Soils with lots of silts and clays have small pore space between them, so water moves through the soil slowly



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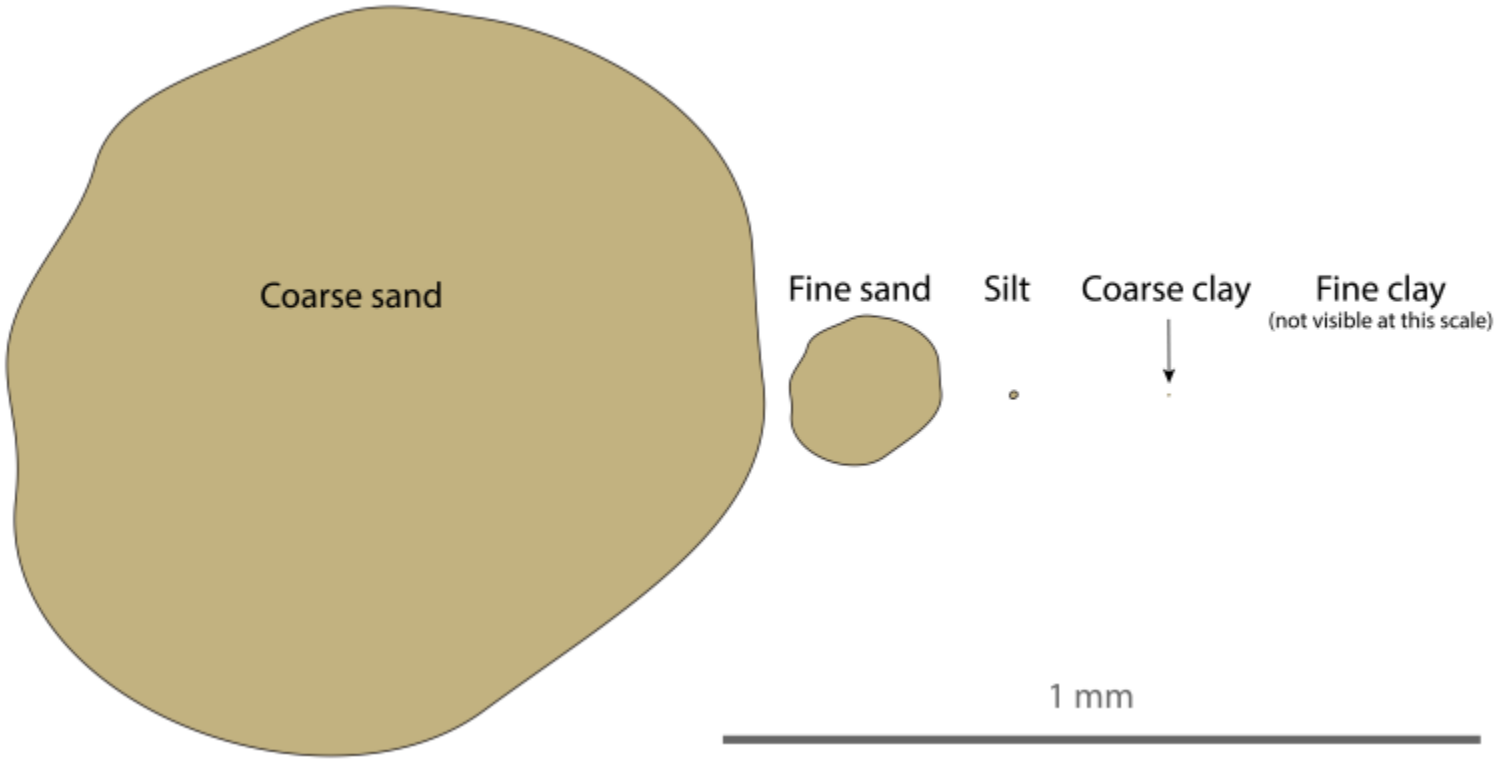
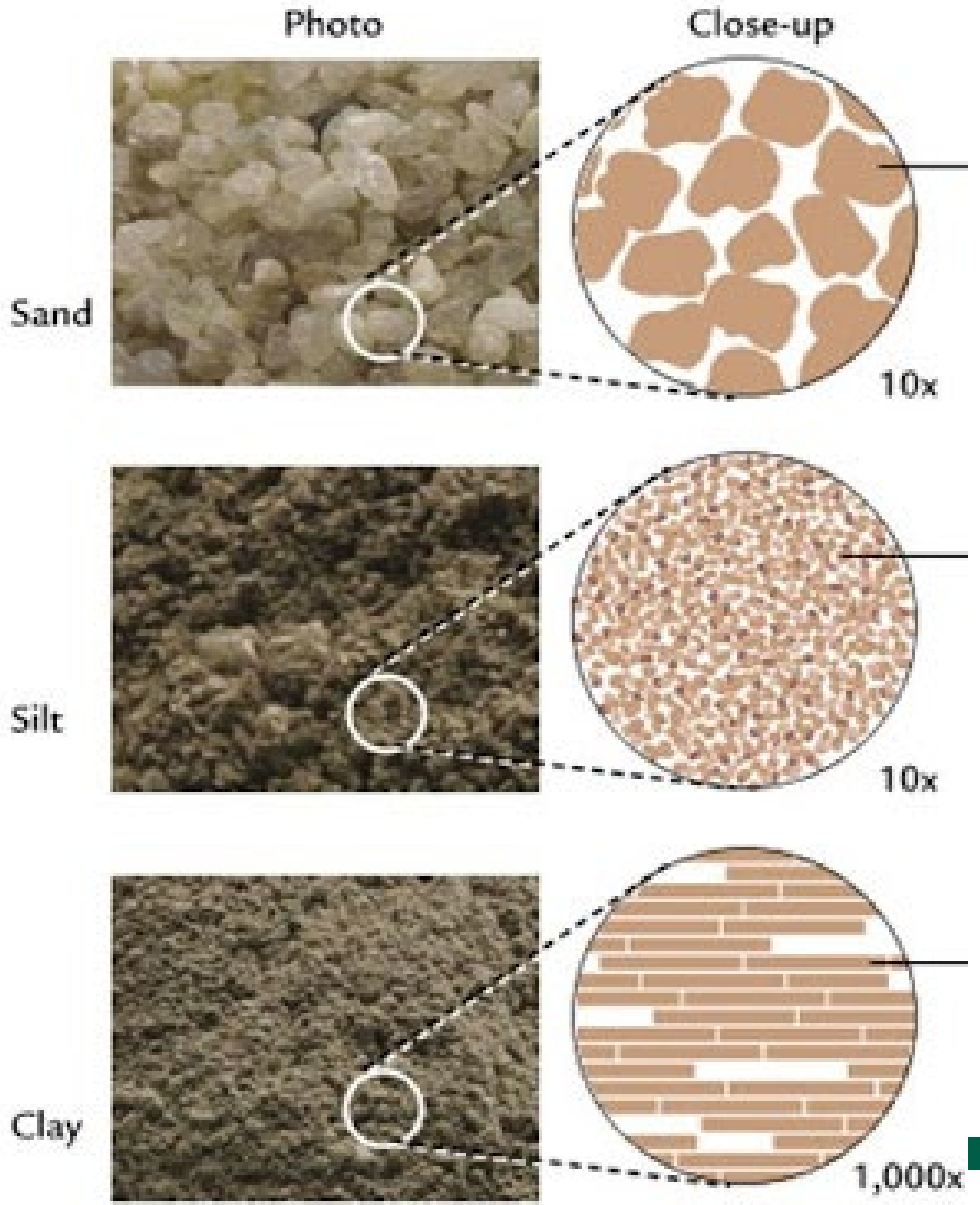
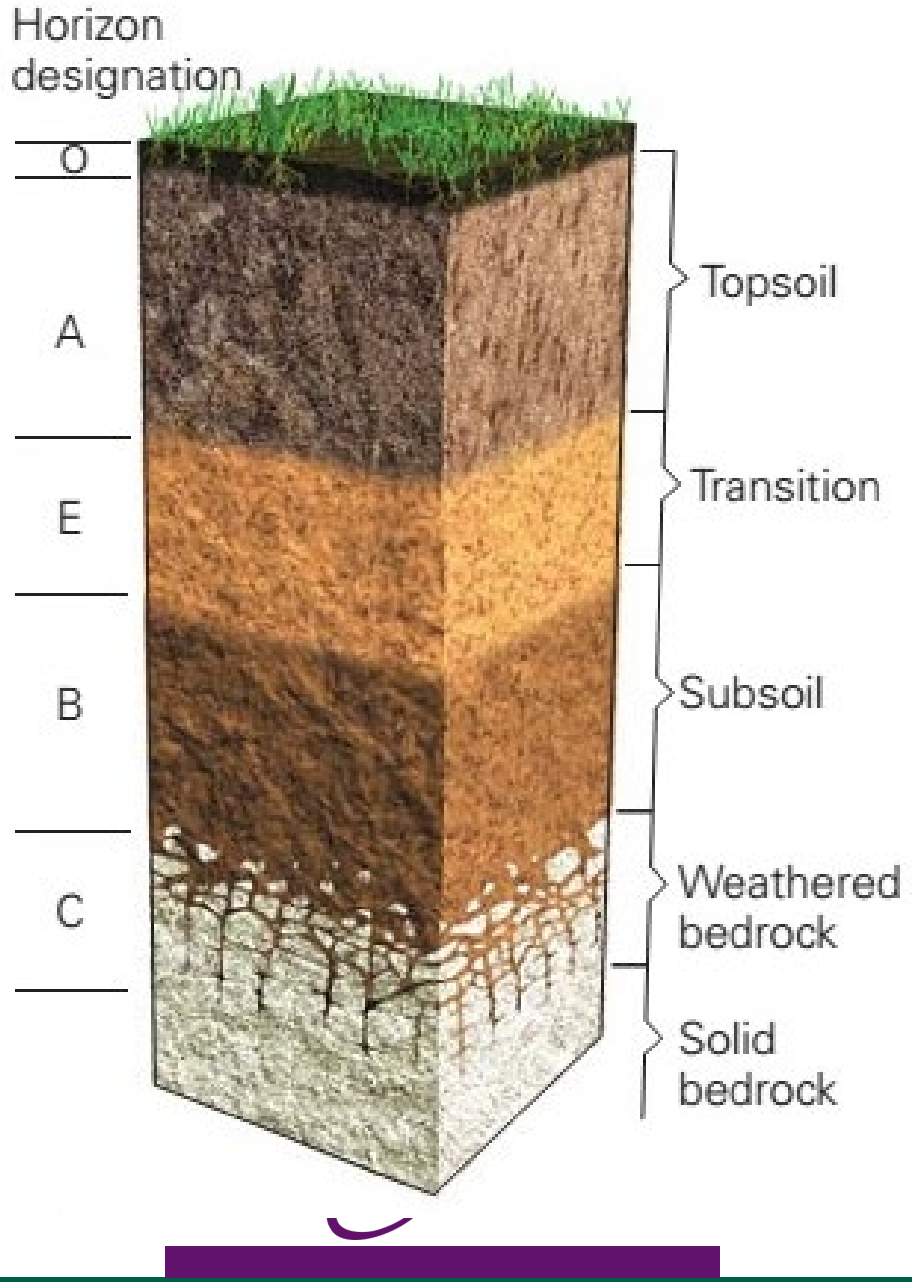
Soil particle sizes





Soil Profile

- By deep observation hole
  - **O Horizon** – partially decomposed leaves, pine needles, twigs
  - **A Horizon** – *topsoil* –
  - **E Horizon** – may be absent –
  - **B Horizon** – *subsoil* –
  - **C Horizon** – *substratum* - un-weathered geologic sediments
- Determine high groundwater table



Percolation (Perc) Test

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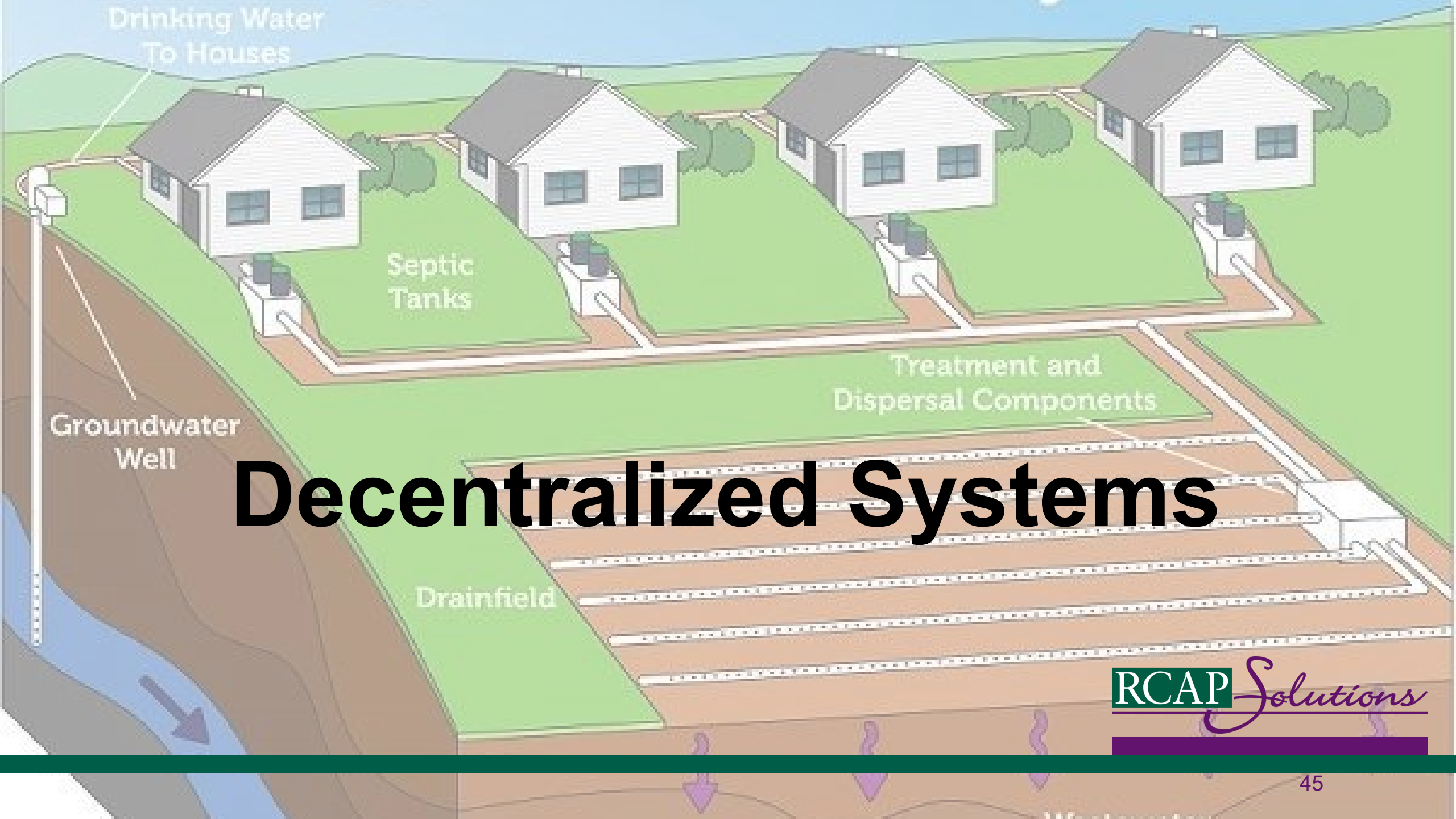

Decentralized Systems

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Septic Terms:

Soil Absorption System (SAS)

- The final system that disperses effluent back to the earth
- Also called drainfield, leachfield, disposal field or subsurface disposal system

Effluent

- Partially treated wastewater that is being discharged to the leachfield

Greywater

- Water from sinks, showers, washing machines
  - Contains cleaning product ingredients
- Has not come in contact with human waste
- Contains traces of food, grease, hair

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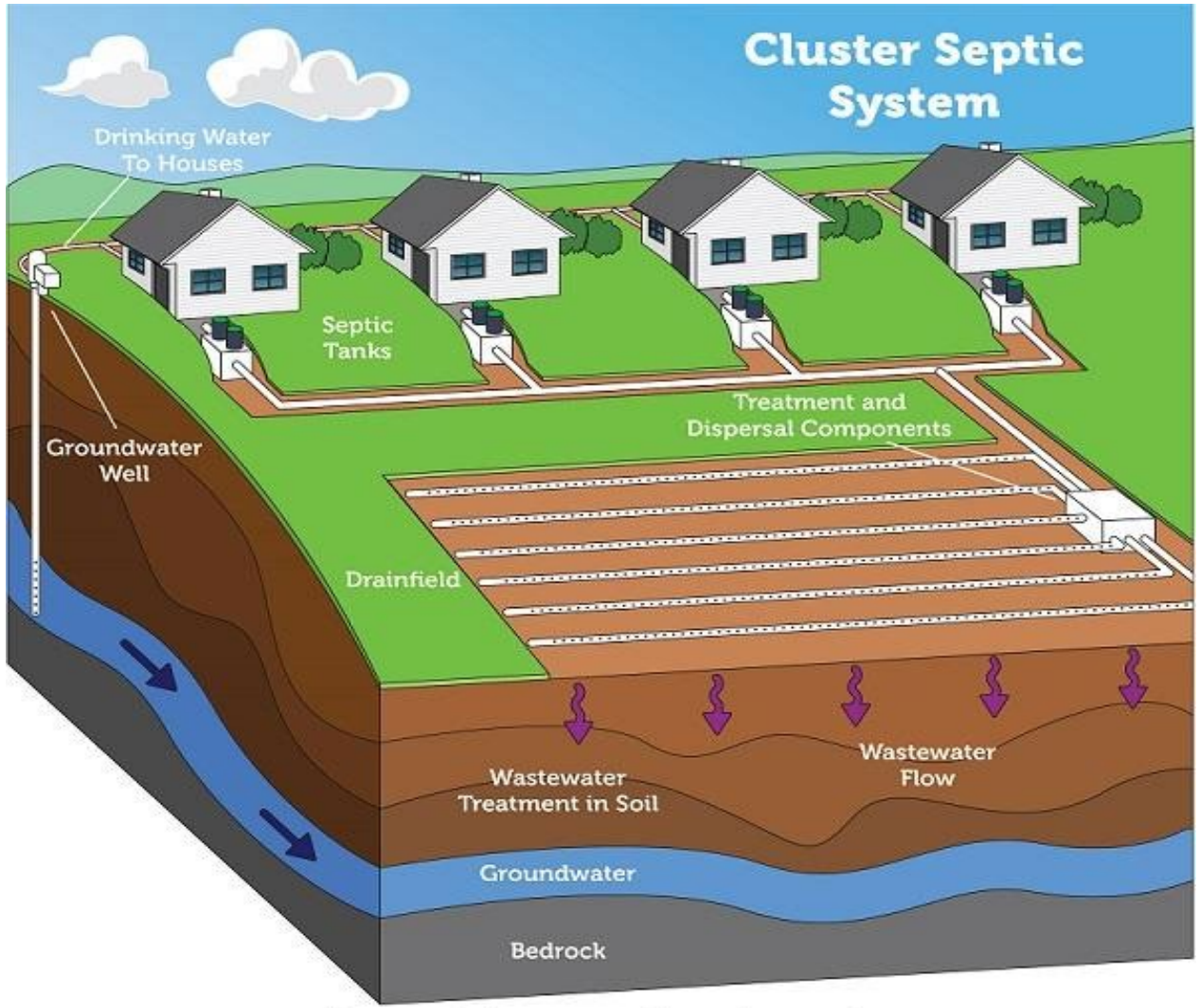
Conventional Cluster

- Collects wastewater from two or more buildings
- Conveys it to a treatment and dispersal system
- Common in places like rural subdivisions
- Some form of common ownership



Please note: Septic systems vary. Diagram is not to scale.

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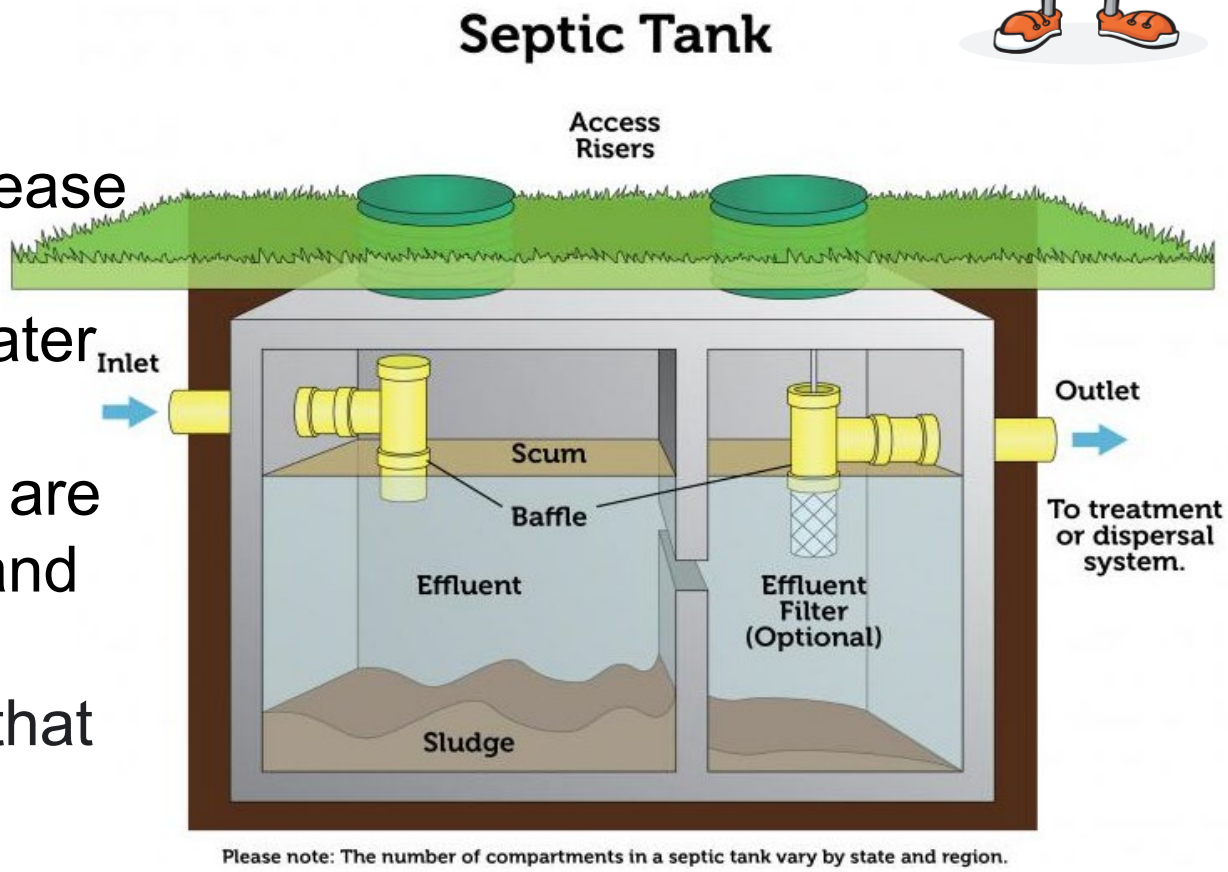
Grinder Pump

- *Used to pump raw wastewater to a higher elevation*
- *Typically for basement toilets*
- *Grinds all contents of raw wastewater*

RCAP Solutions

Septic Tank Function:

- Solids settle to the bottom, Fat, Oil and Grease (FOG) float to the top
- Watertight: keeps wastewater in, groundwater out
- About ~**80%** of the solids in the septic tank are broken down by decomposition to gasses and liquids
- Bacteria grow naturally in your septic tank that help break down wastes.
- Does not remove all pathogens



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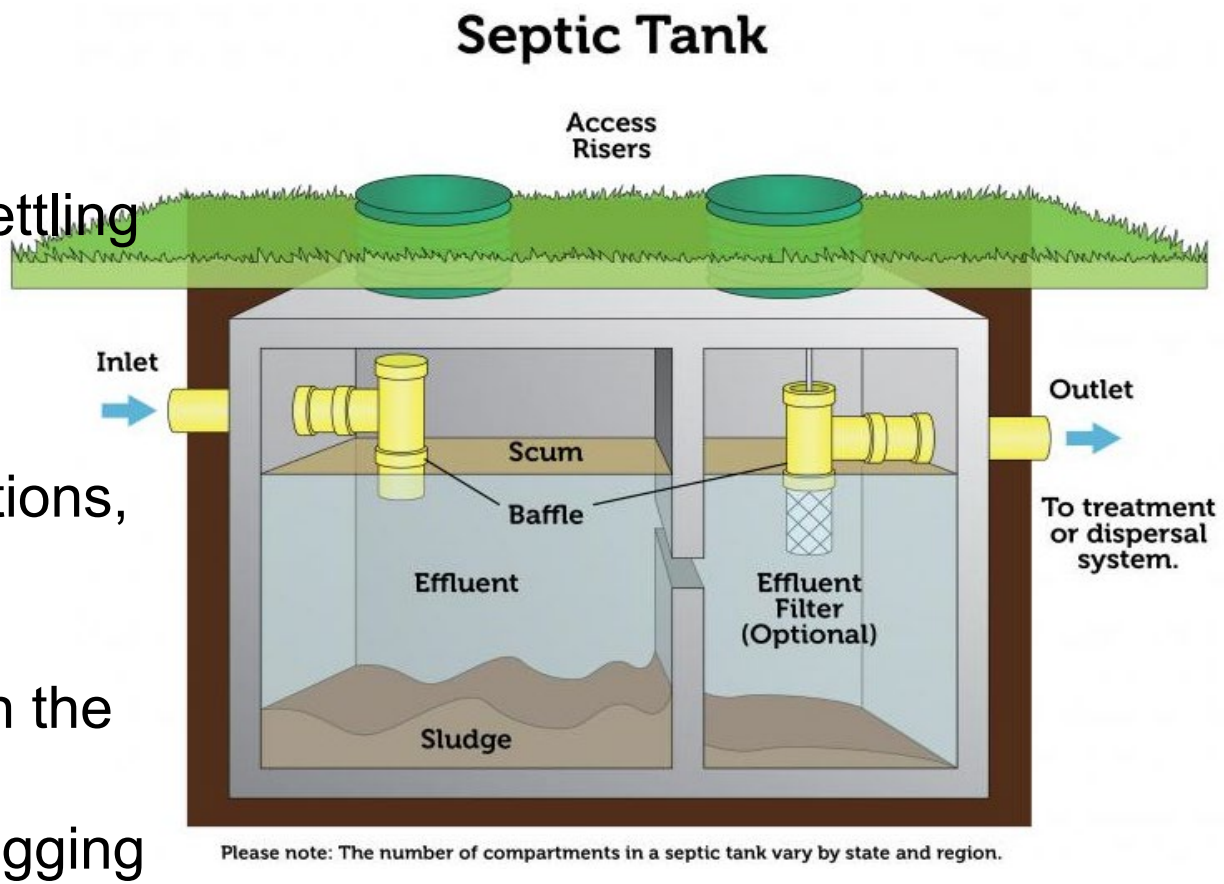
Septic Tank Components

Inlet tee: discharges below surface to promote settling and prevent mixing
Baffles: keeps most of the solids in the first compartment
Access risers: Allows for easier locating, inspections, maintenance and pump outs
Outlet tee: Draws from below the scum layer
Effluent filter: Plastic screening device that fits in the effluent tee

- Prevents solids from leaving the tank and clogging the field



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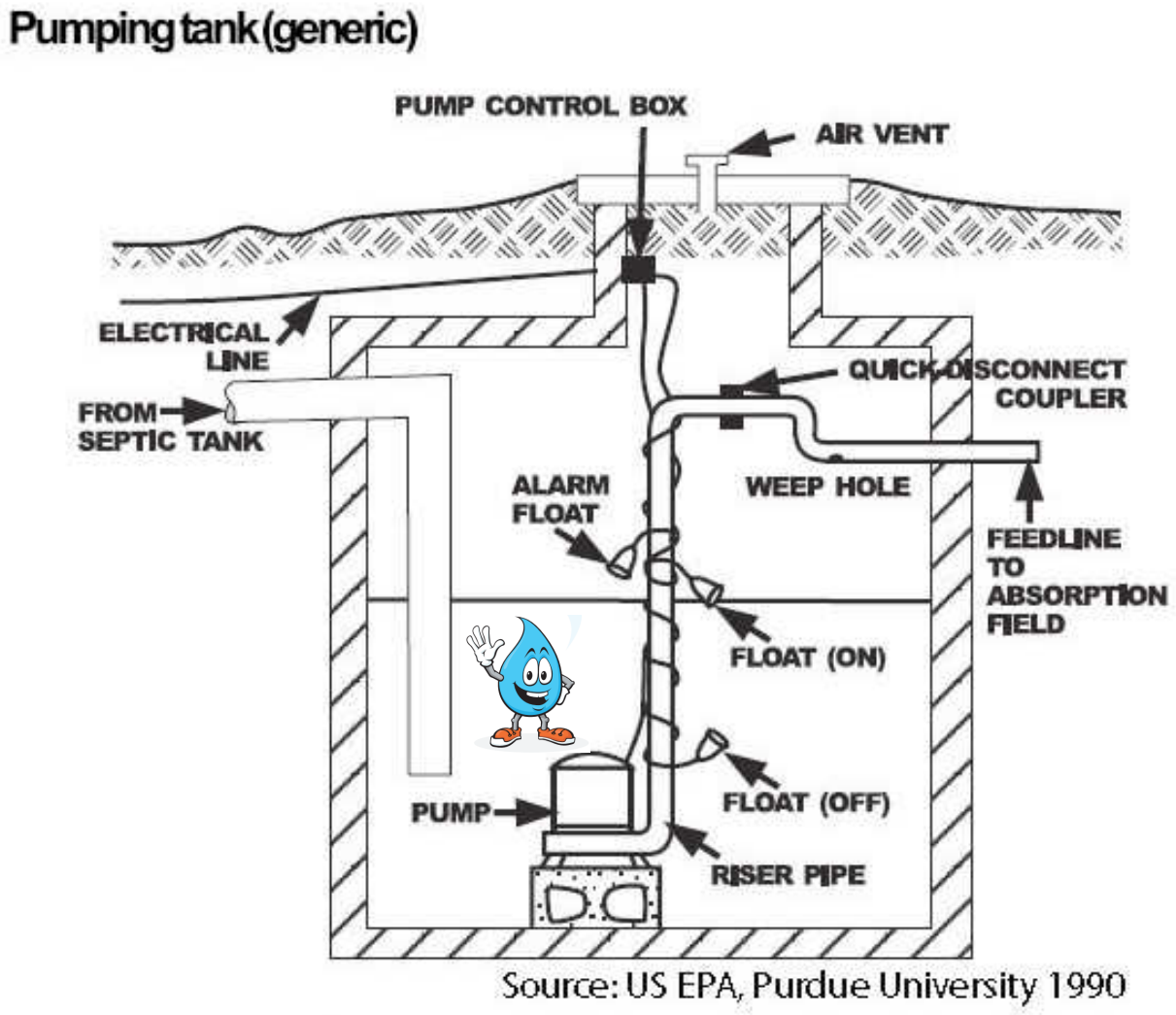
Cesspools and Tight tanks

- *Cesspool: stone-walled pit or perforated concrete chamber*
- *Tight tank: watertight tank that holds everything and needs to be pumped*

RCAP Solutions

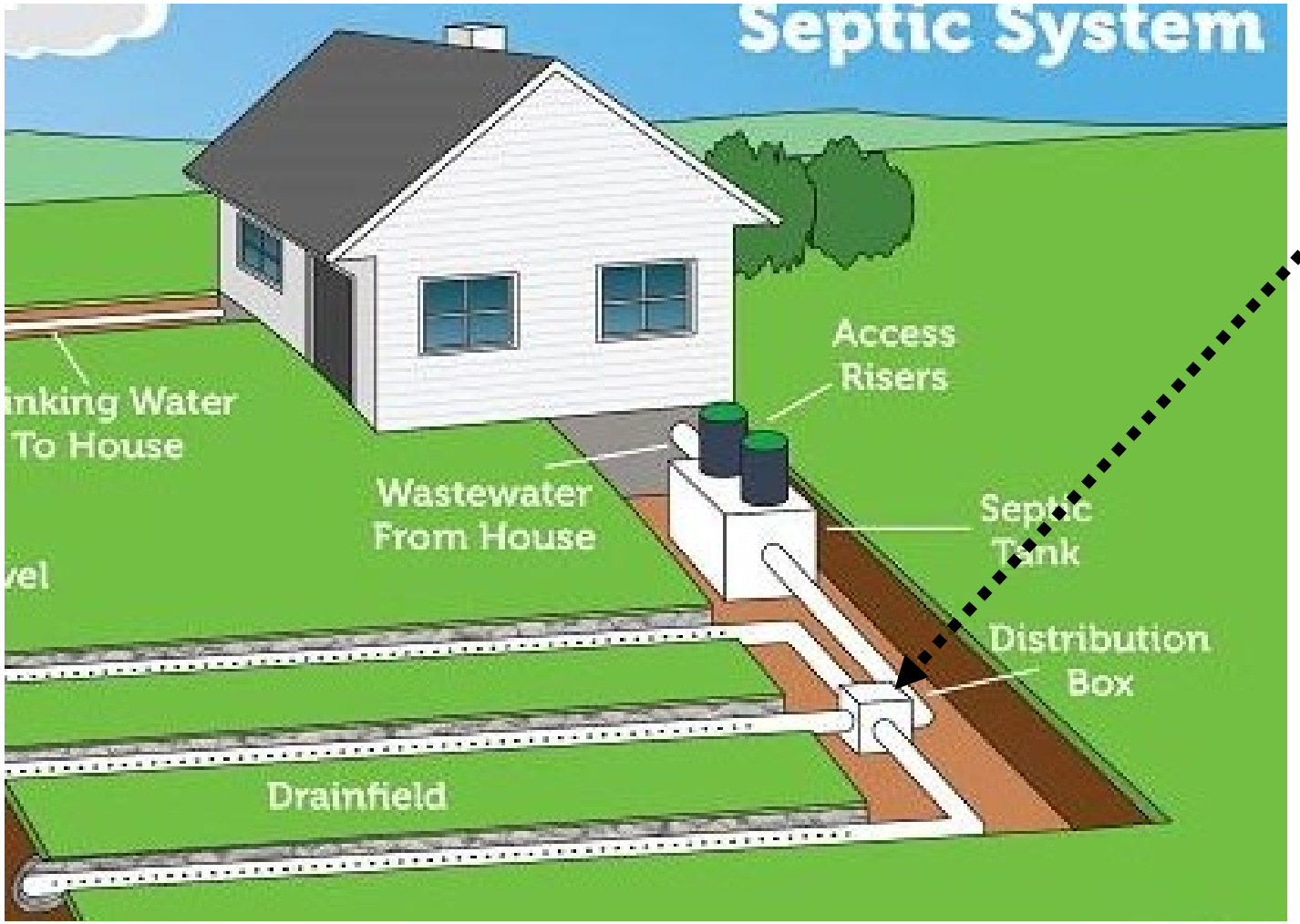
Pump Chamber/Dosing Tank (pressure system only)



- Cannot discharge by gravity
- Intermittent discharge
- **Emergency storage capacity**
- Possible standby power
- Sensors (high water, on/off floats)

RCAP Solutions

Distribution Box (“D-box”)



D-box

- Splits flow to different drainfield laterals
- Must be installed level

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Distribution Box in the Field

RCAP Solutions

Soil Absorption System (SAS)

- The final system that disperses effluent back to the earth
- Drainfield, leachfield, disposal field
- Footprint size is based on the expected flow amount and the soil evaluation (perc test)
- Removes most of the remaining dissolved organics, suspended solids, phosphorus, viruses and fecal indicators.
- Nitrogen is the most significant wastewater parameter not readily removed by the soil within the footprint
- Inspection Ports may be installed to observe the liquid level

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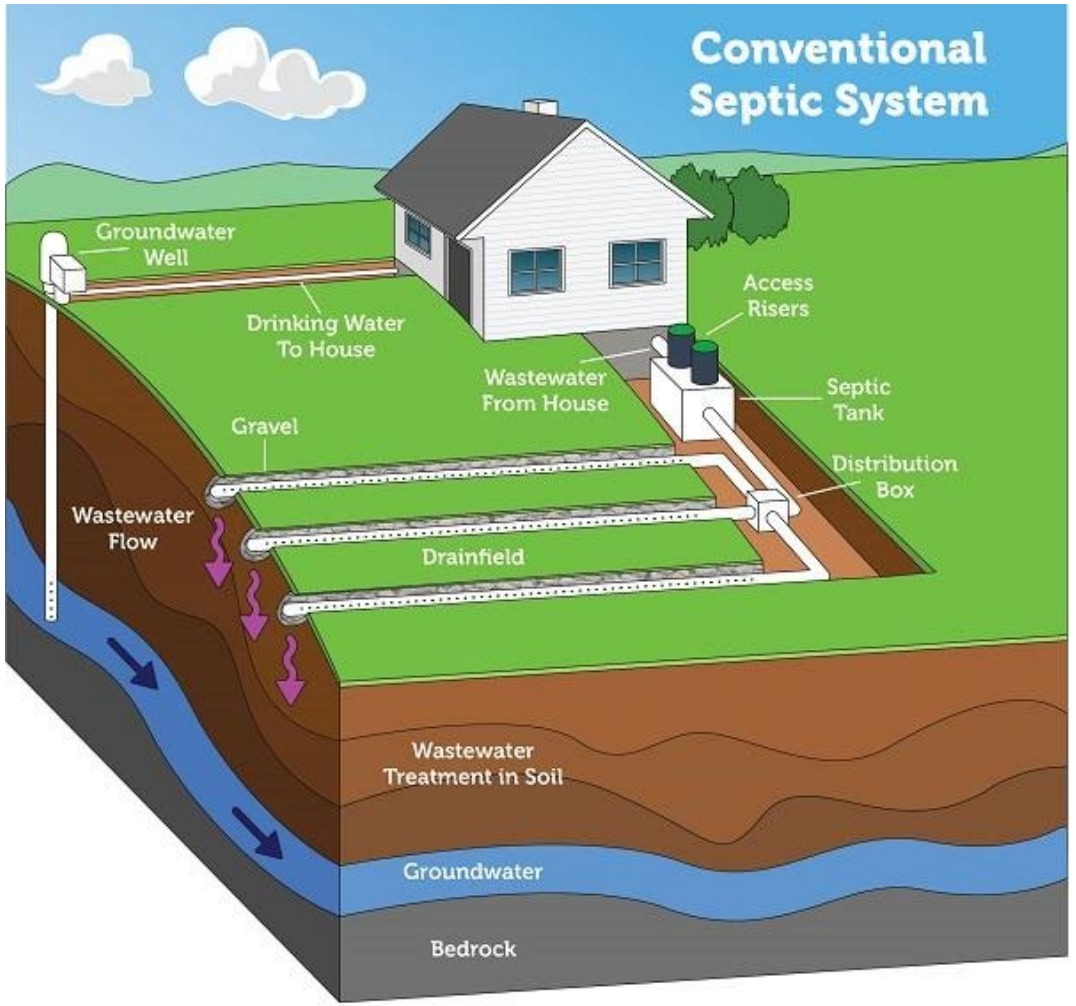
Conventional Septic System

- Gravity fed
- Septic tank
- D-box
- Drainfield
  - Require deep, usable soil
  - Not easily installed on steep slopes
- Typical residential water usage is 75-100 gallons per person per day.

*Design = 110 gal/day/bedroom

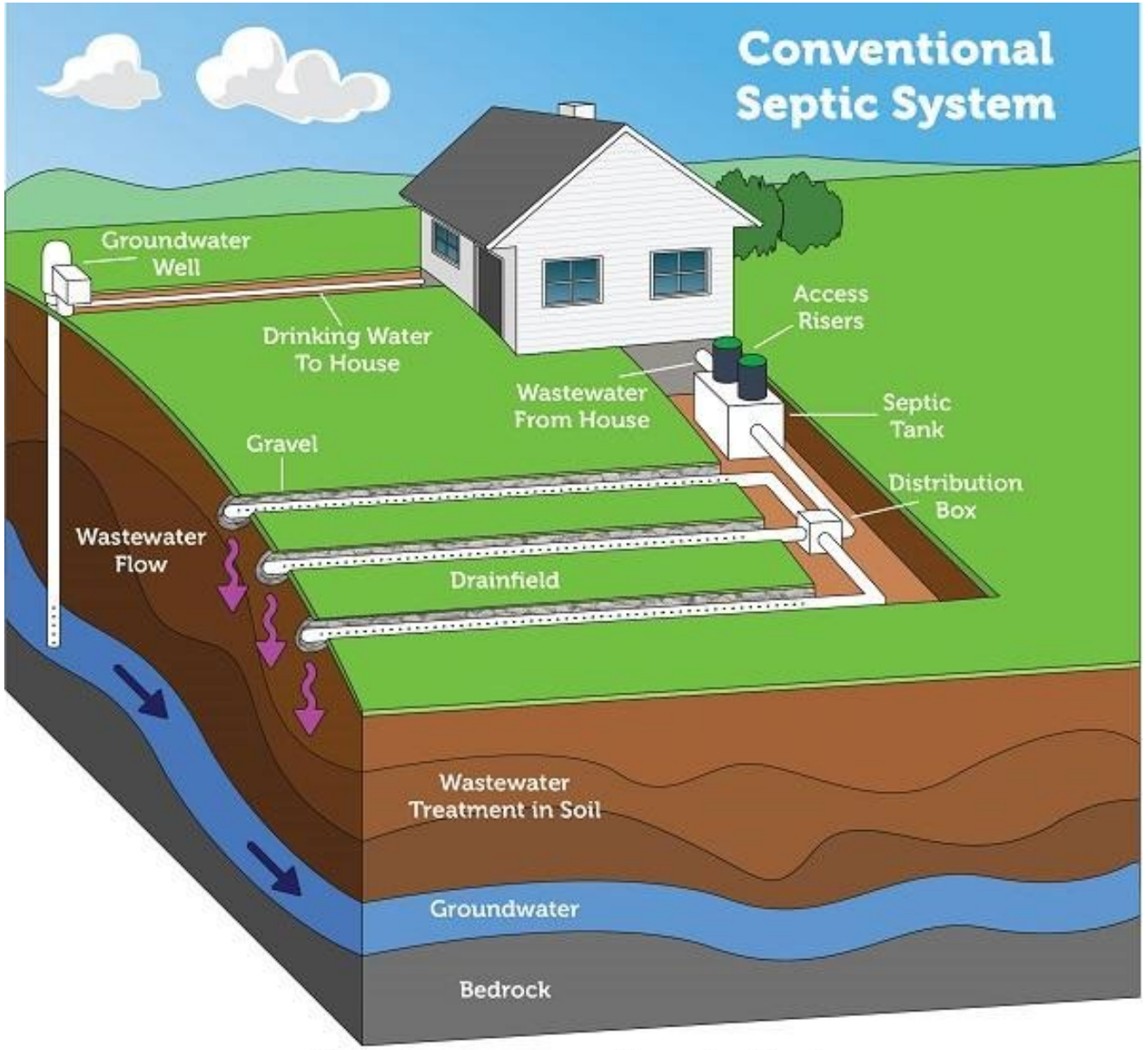


Please note: Septic systems vary. Diagram is not to scale.

RCAP Solutions

Trenches

- Narrow stone-lined ditches
- Perforated pipes surrounded by stone and wrapped in geo fabric to prevent backfill from migrating
- Larger surface area to leach into soil (bottom and 2 sides)

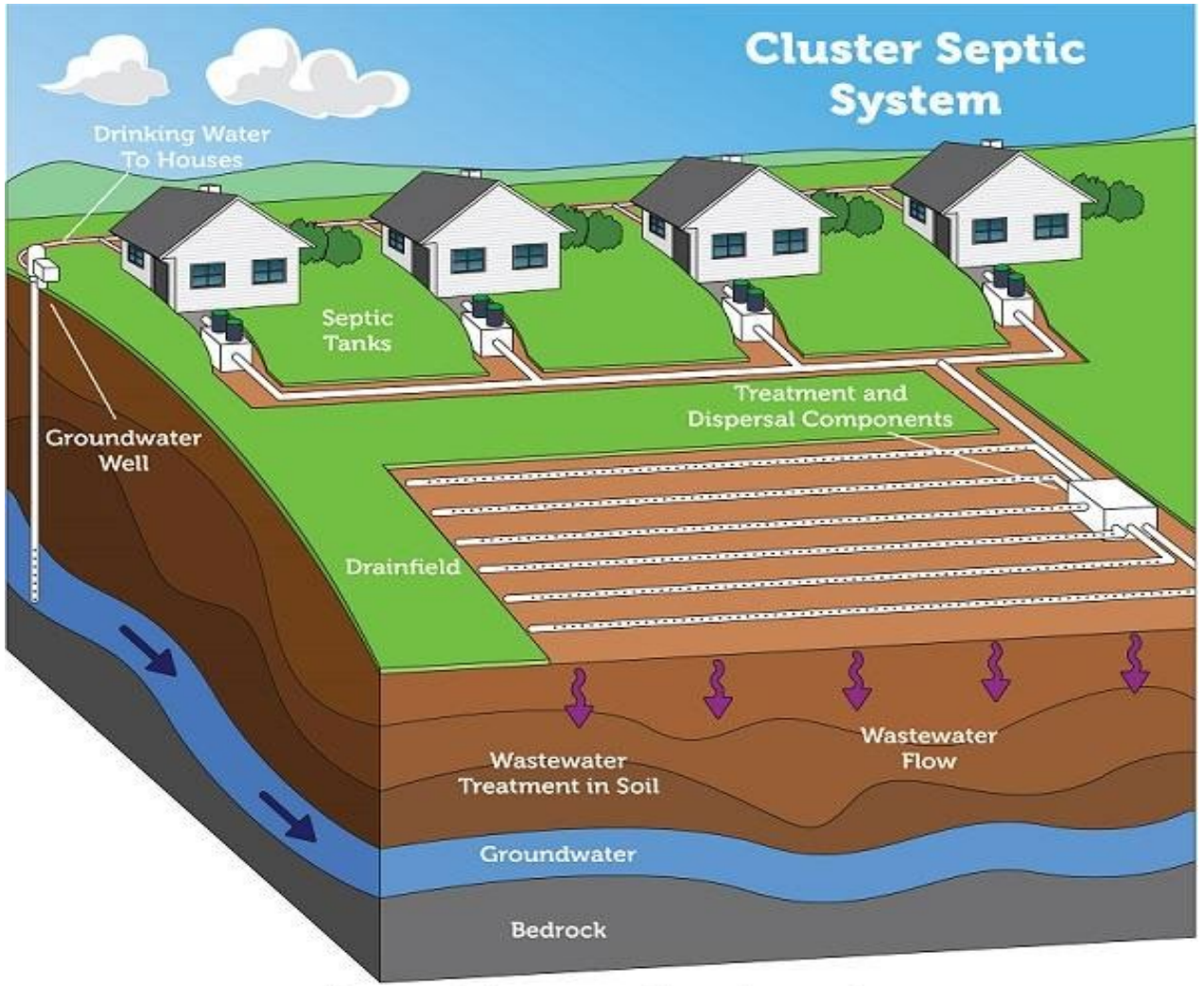


Trenches in the Field

RCAP Solutions

Beds

- A single footprint/area that contains multiple lines of piping.
- Used for more permeable soils



Please note: Septic systems vary. Diagram is not to scale.

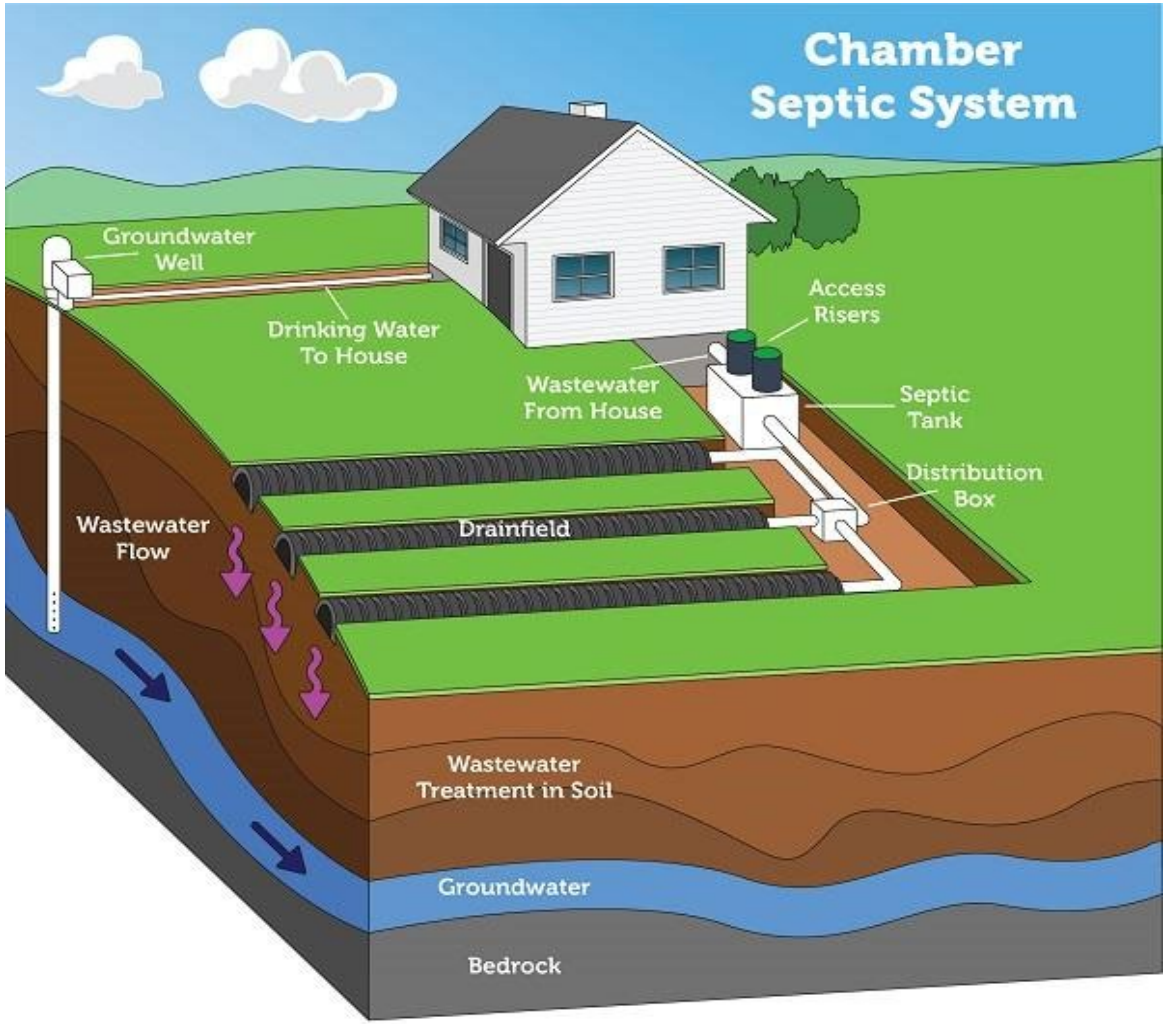
RCAP Solutions

Beds in the Field

RCAP Solutions

Chambers

- Plastic arched segments
- Provides more storage
- Good for variable volumes



Please note: The ends of the chamber system lines are open for illustrative purposes only. In reality, and when properly installed, these lines are closed at the end. Septic systems vary. Diagram is not to scale.

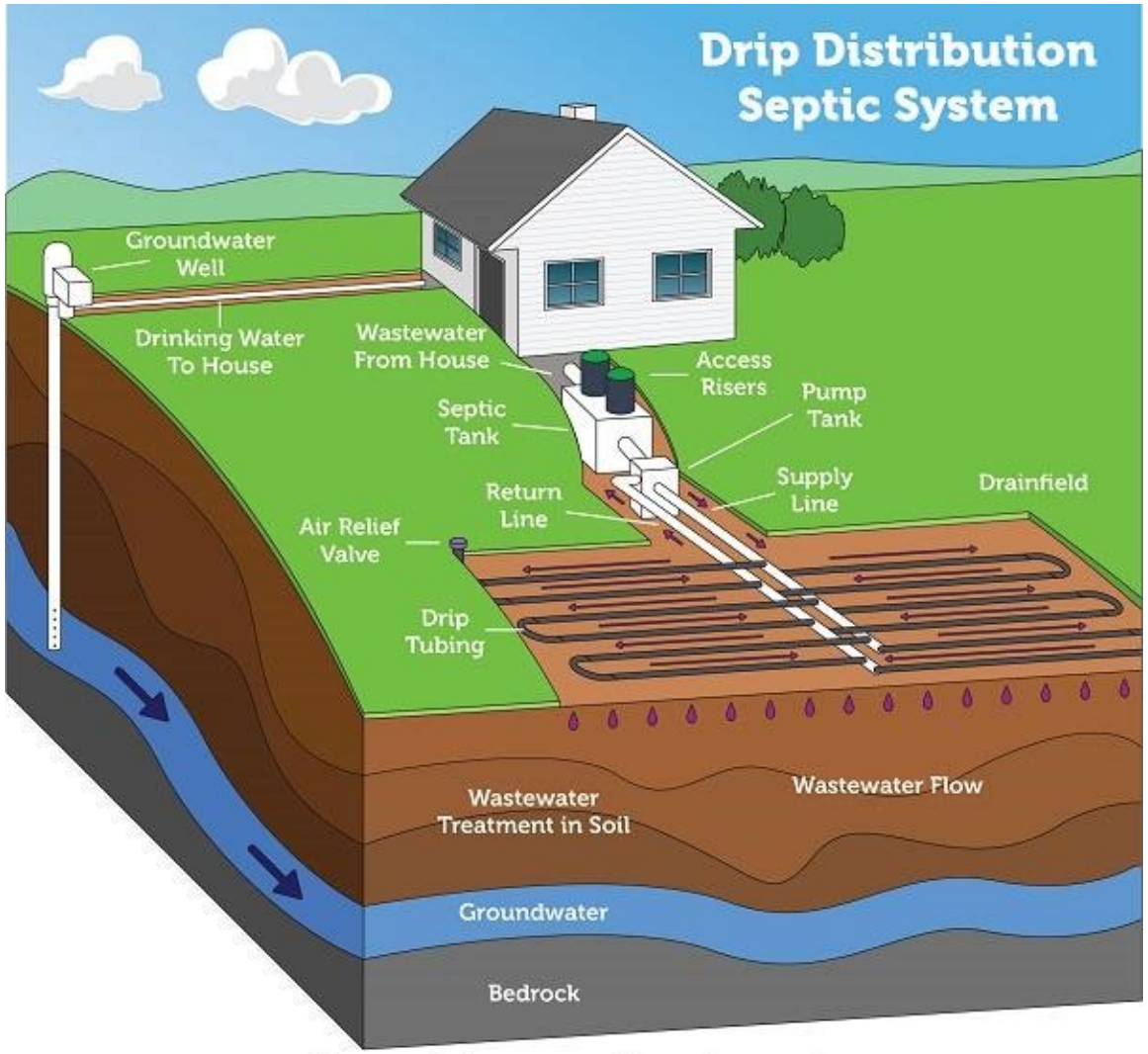
RCAP Solutions

Chambers in the Field

RCAP Solutions

Drip Distribution

- Requires pumping (pressurized)
- “Drips” wastewater at regular intervals
- Best suited for fast draining soils or near sensitive areas.
- Can be installed on slopes
- Customizable footprint shape



Please note: Septic systems vary. Diagram is not to scale.

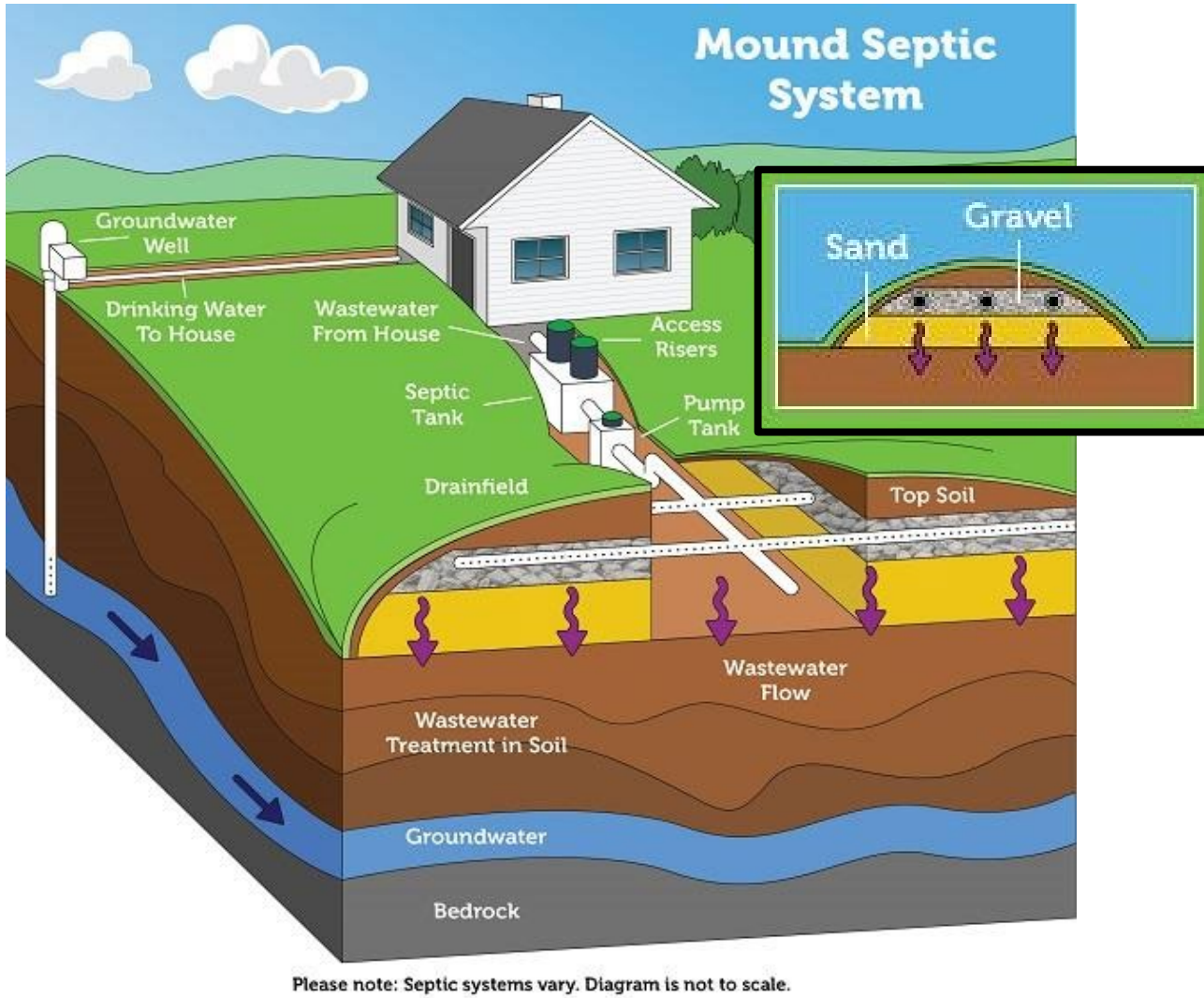
RCAP Solutions

Drip Distribution in the Field

RCAP Solutions

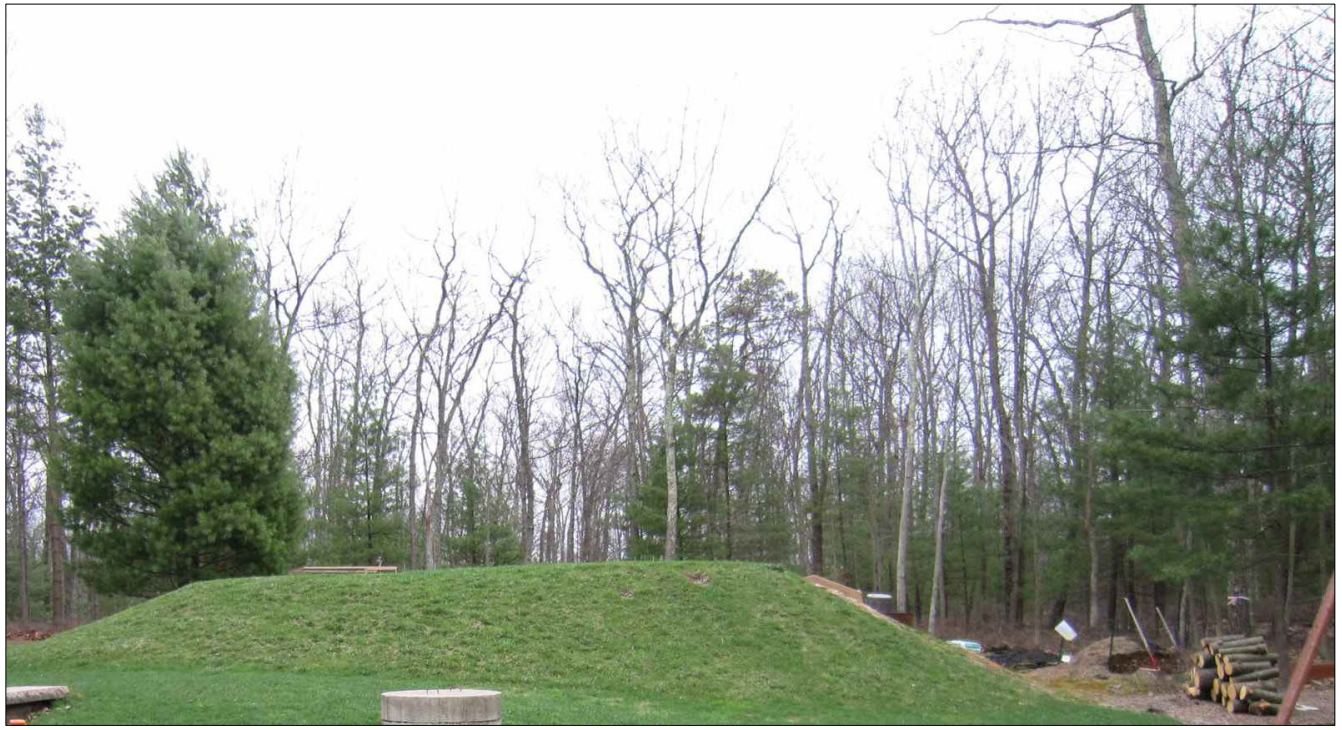
Mound

- Leaching bed elevated **above ground** with clean sand to provide ~3 ft of vertical separation to a saturated restrictive layer
- A pump may be required or can be fed by gravity depending on elevation requirements.
- Requires additional materials be hauled on site.



RCAP Solutions

Mound systems in the field



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Overloading

Organic

- Insufficient food-to-bacteria ratio
- Aerobic bacteria die, anaerobic bacteria blooms
  - Creates mucus like slime (unhealthy biomat)
  - Can quickly clog a leach field or cause it to function poorly

Hydraulic

- Too much volume, not enough time or storage
- Can carry solids from tank
- Solids can clog soil pores in the leachfield

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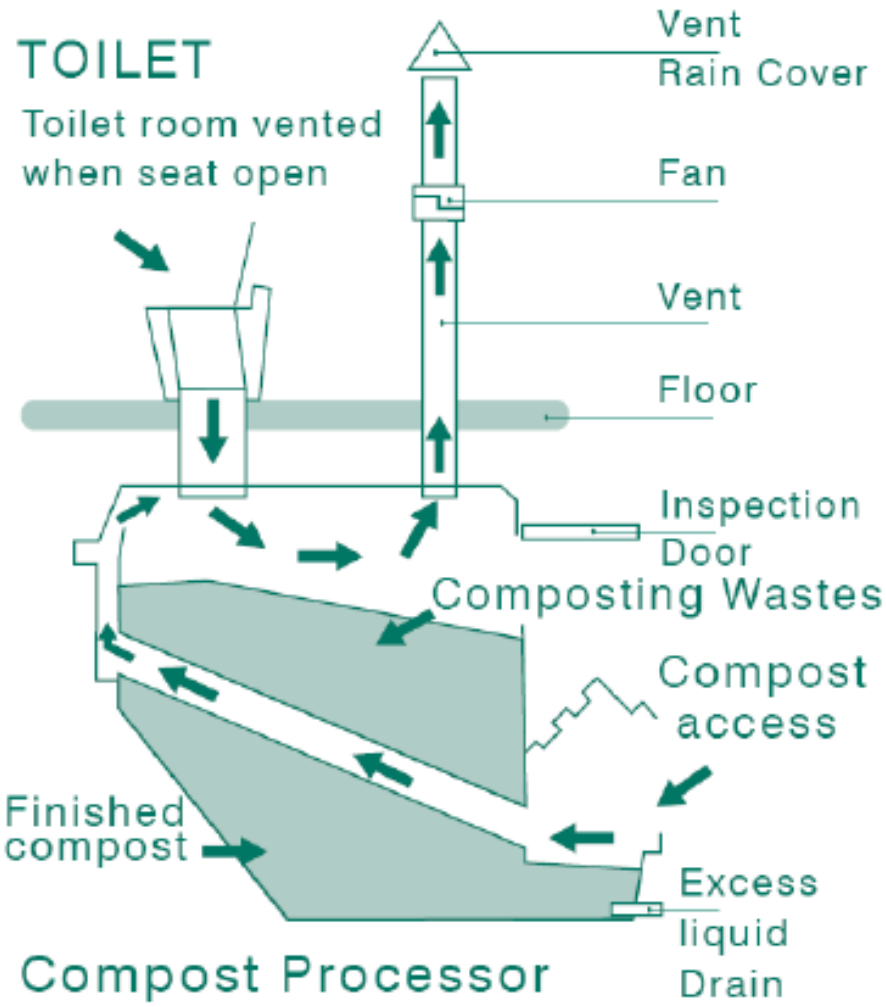
Composting Toilets

- Not just a hole in the ground (pit toilet, outhouse)
- Use little to no water
- Use aerobic decomposition by adding carbon-rich absorbent material (sawdust, peat moss, straw)
- “Compost” must be removed from the system at regular intervals



RCAP Solutions

Innovate/Alternative (I/A)

Chosen because of:

- site constraints
  - Topography
  - Limited available space
  - Depth to groundwater
  - Less than ideal soil conditions
- Environmentally sensitive areas
  - Near a body of water or drinking water supply
  - *NITROGEN REDUCTION/REMOVAL
- Seasonal or intermittent use
- Enhanced Treatment Requirements

I/A Systems Installed

- Adds a step between the septic tank and SAS.
- Requires less treatment from the final SAS.
- May allow the SAS to be downsized or require less vertical separation

Operation & Maintenance (O&M)

Proper Usage

RCAP Solutions

Operations, Maintenance & Proper Usage

RCAP Solutions

Operation & Maintenance

Septic Tank

- Pump regularly
- Determine pumping frequency by sludge judging
  - Pump when the depth of the sludge and scum layer is more than half of the liquid depth
- As the sludge level increases, wastewater spends less time in the tank (less time to settle)and solids may escape into the SAS
- Clean effluent filter (pumper or yourself)

Additives (Septic system enzyme)

- Not needed for system start-up
- Not necessarily beneficial, can even be harmful
- May break some solids into super tiny particles

  *These super tiny particles don’t settle, and may pass through the effluent filter
- Solids may end up in field
- May reduce pumping frequency, however, increases likelihood of SAS replacement

Operation & Maintenance (continued)

Pump chambers (may need O&M Provider)

- Check/clean floats, pump, alarms, Screens/filters, electrical draw, and pump run time (indicates pump issues)
- Lateral lines should be flushed.

Drainfield/SAS

- Maintain grounds above the field
- Grass cover is best within a 10’ perimeter around/o the drainfield
- Remove trees or large brush – roots will find their way into pipes and covers
- Spread out major water discharge such as laundry and showers
- Do not cover or drive on the leachfield (tarps, mulch, buildings, vehicles)

Inspection Ports may be installed to observe the liquid level

- High liquid level may mean a clogged drainfield
- Different lateral levels could indicate many different problems
- Color and smell indicates health

Unmaintained Leachfield Examples

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O&M Contracts

- Residential, cluster systems, schools, etc.
- **Licensed Service Installers/Providers -** Keeps system working efficiently
  - prevents costly repairs
  - Mechanical and electrical components
  - Routine servicing/sampling can detect problems you aren't aware of
  - Routine sludge judge
  - Warranty (may be void without a contract)
  - Boards of Health requirements
  - Failure can be a public health threat (nearby drinking water supplies, flooded fields)
  - Monitoring/sampling
  - Environmentally sensitive area
  - Grease trap (inspected)
  - Community by-laws set in place to protect the system

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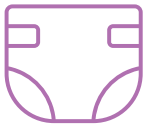
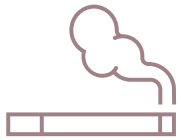
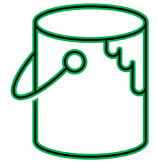
DO NOT FLUSH

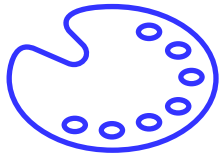
- “flushable” wipes
- cleaning wipes
- cat litter
- sanitary napkins, tampons
- condoms
- diapers
- cigarettes
- FOG (fats, oil & grease)
  - kitchen or automotive





- Large amounts of disinfectants
  - Bleach has a pH=12
- pharmaceuticals
- chemicals
- paint/thinners
- poisons
- hobby batch-product-waste
  - Beer/wine/mead
  - Yogurt/dairy
  - Art supply waste
  - Body care





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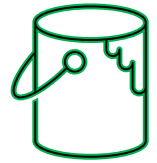
Things to Avoid

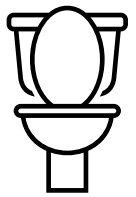
Household:

- Habitual use of household drain cleaner/opener
- Garbage disposal connection
- Water softener backwash - can kill the good bacteria and void your warrantee
- Lots of water usage in small amounts of time
  - Clothes washer, dish washer, shower, etc.



Drainfield:

- Parking or driving vehicles/heavy equipment
- Water from roof drains, sump pumps or irrigation systems
- Stockpiling snow
- Rooting plants



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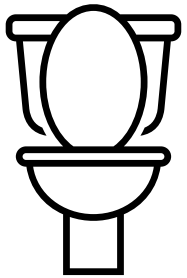
Water Conservation

Leaky faucets/toilets

- Repair leaky fixtures ASAP
- A leaky toilet can waste 200 gpd (6,000 Gal/month), and flood your system
  - Put dye in toilet tank, see if it leaks to bowl
  - Listen for a hissing noise at the tank or disturbance in the water either in the bowl or the tank, these can indicate a leak



  - Utilize smart water meters (public water)

Venting and Gasses

Venting

- The system connects the INLET and OUTLET vents
- No odor should come out of the **inlet vent**
- The high elevation/roof vent is the **outlet vent**
- Make sure the vents have a screen
- Make sure the vents aren't blocked

Gases

- Most common type of gas produced is hydrogen sulfide
- Hydrogen sulfide is a colorless, flammable, toxic and corrosive.
- It has a characteristic rotten-egg odor.
- Other Highly toxic components of sewer gas include ammonia, methane, carbon dioxide, sulfur dioxide, and nitrous oxides among others.

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Sewer Pipe Materials

- PVC - white
- ABS - (black plastic)
- Cast Iron – rusty metal
- Orangeburg – black with layers
- Clay – orange

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Failing Septic Systems

Signs:

- Sluggish drains or odor
- Backups into the house
- Squishy patches or ponding above drainfield
- Lush grass above drainfield
- Patchy and suspiciously green grass

Causes:

- Misuse of system
  - Improper disposal of solids or grease
  - Hydraulic overloading
  - Organic overloading
- Lack of maintenance
  - Septic tank has not been pumped, full of solids
- High groundwater table flooding the drainfield
- Leaking septic tanks
- Broken pipes, tree roots
- Broken septic tank components

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Signs that your septic tank is full

1. Overdue pumping
2. Standing water around the tank
3. Unpleasant odors
4. Gurgling pipework
5. Slow draining
6. Trouble flushing
7. Suspiciously lush lawn
8. Algal bloom in nearby ponds
9. High nitrate in nearby water wells
10. Backed up sewer lines

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TITLE 5 in MA

What is a Title 5 inspection in MA?

- Title 5 refers to the section of the Massachusetts State Environmental Code that describes acceptable operating parameters for septic systems.
- As of March 31, 1995, the state environmental code governing septic systems, commonly referred to as Title 5 regulations, requires inspections of septic systems and cesspools prior to a home being sold or enlarged. In most instances, systems that fail inspection must be repaired within 2 years.
- A Title 5 inspection involves checking a septic system against these codes to ensure that the property is in compliance.

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New Project Considerations - Cluster Systems

Who:

- Consultant
- Soil scientist
- Grant Writer
- Attorney
- Engineer
- Responsible Management Entity (legal authority and administrative capabilities)

What:

- Site evaluation
- Educational materials
- Permits
- Purchase of land
- Creation of organization entity (district, cooperative, homeowner assoc.)
- Applications, recording fees
- Meeting postings, publication and notice

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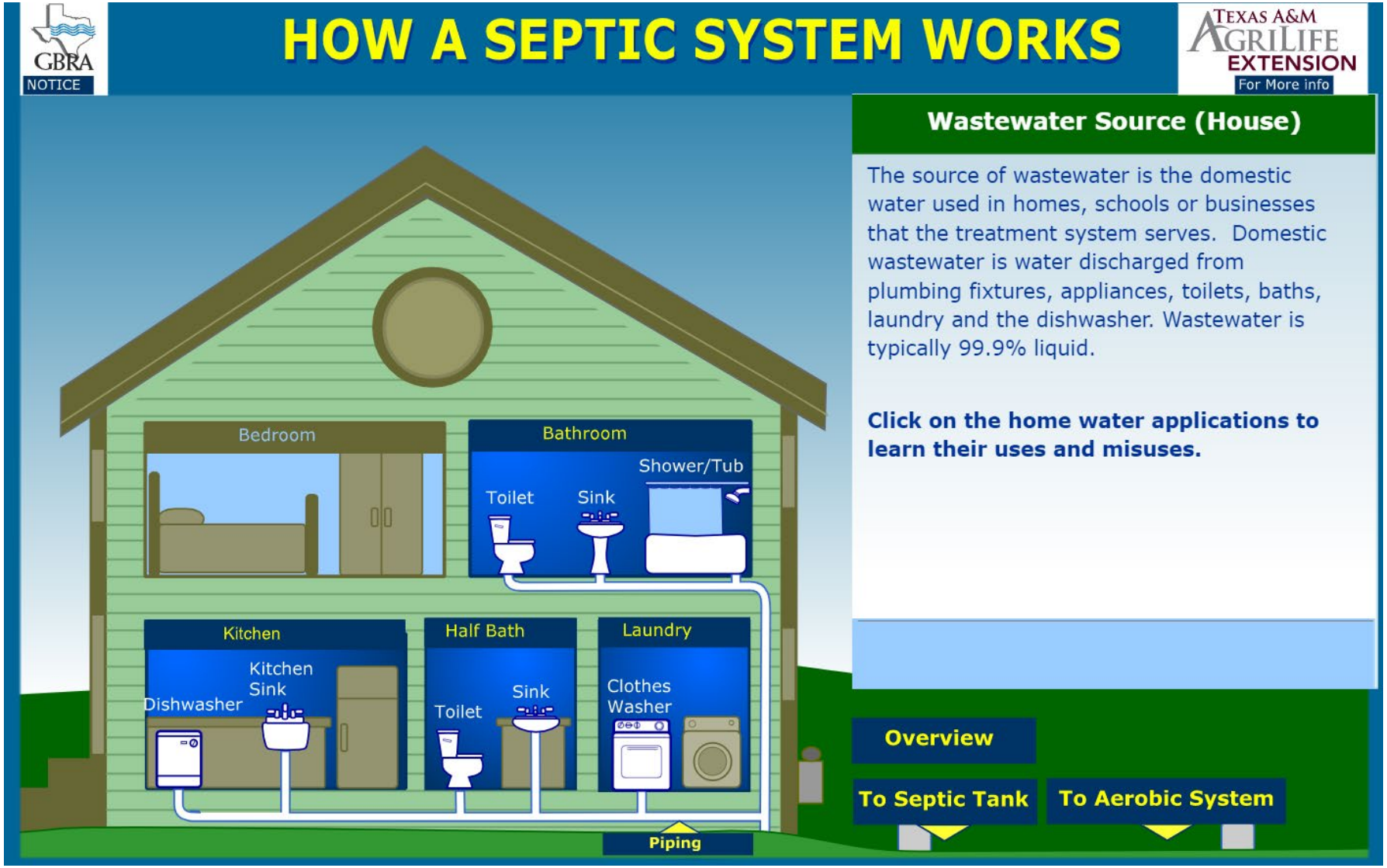

https://www.gbra.org/presentations/septic/index.html

Resources

- Quick Tip Videos
- Brochures
- Posters
- Mailers
- SepticSmart for Tribal Communities
- SepticSmart Community Case Studies
- Webinars about Decentralized Wastewater Treatment

https://www.epa.gov/septic/septicsmart-education-materials

Questions?

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POST-TEST

Exit the training upon completion

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