Basics of Onsite Wastewater Treatment

Homeowner Education

NOWRA

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National Onsite Wastewater Recycling Association

- The largest U.S. organization devoted exclusively to supporting members of the onsite and decentralized industry
- Mission:
  - To strengthen and promote the onsite and decentralized wastewater industry through activities that support recognition and promotion of professionalism for industry practitioners
  - To implement best management practices throughout the industry that provide sustainable wastewater infrastructure solutions
  - To achieve greater public awareness of the economic, environmental, and public health benefits of onsite and decentralized facilities
  - www.nowra.org

RCAP Rural Community Assistance Partnership

Acknowledgement

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Pre-Test

Question and Answer Cards

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Module 1
Overview of Onsite Wastewater Treatment Systems

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Learning Objectives

1. To understand the function of an onsite wastewater treatment system
2. Gain knowledge about various types of treatment and dispersal methods

Onsite Wastewater Treatment System (OWTS)

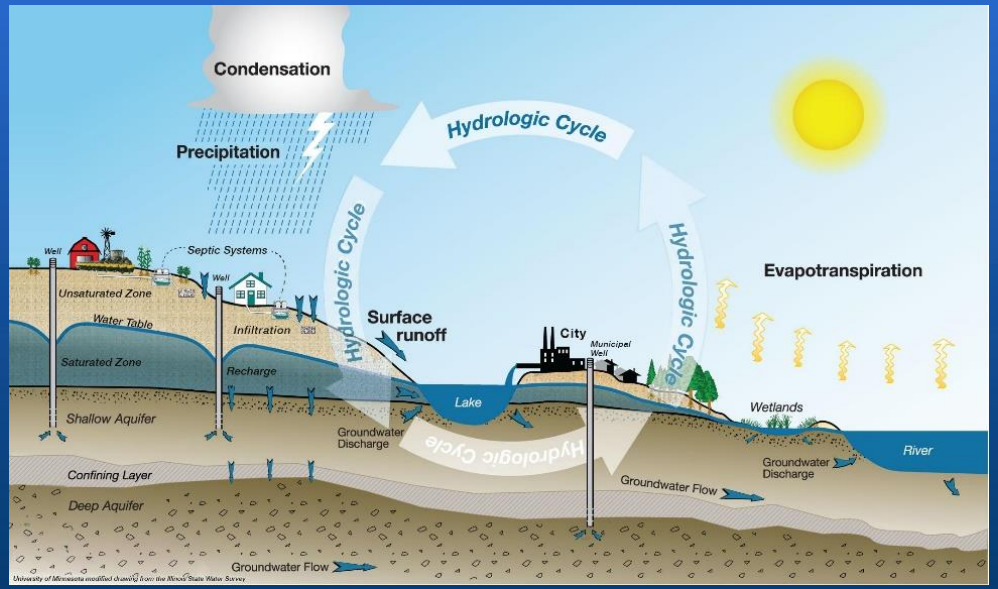
- User Guide
  - this presentation will supplement the information provided in the User Guide

OWTS Overview

- All systems
  - collect wastewater
  - allow for liquid/solid separation
  - remove most of the waste products from the water
  - return the water to the water cycle

How Big is Your Water Cycle?

- Water is continuously recycled
  - we depend on our septic systems to return safe water back to the water cycle through
    - infiltration
    - evaporation
      - not always an option



Wastewater Treatment Overview

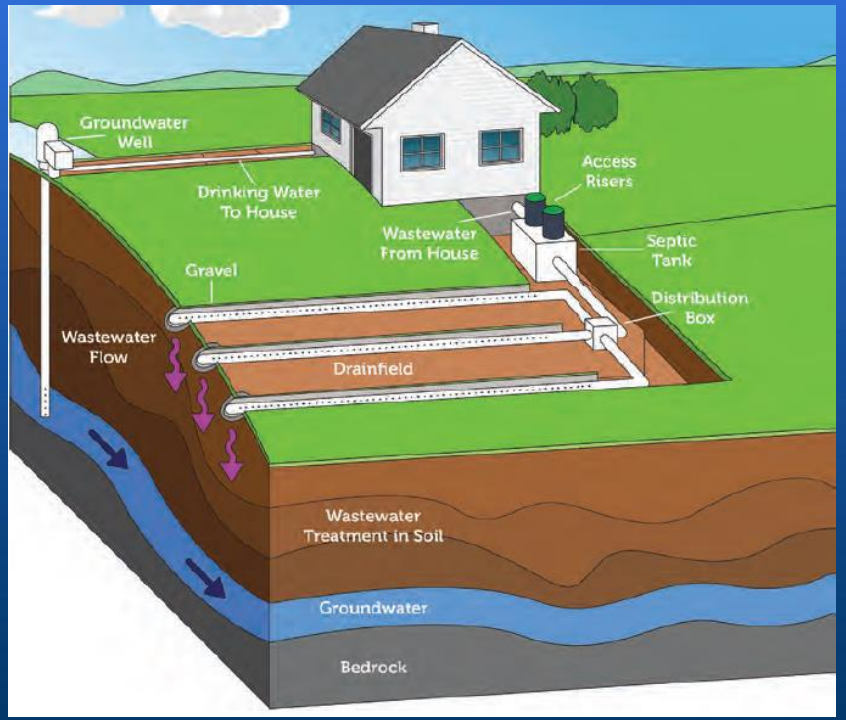
- Pretreatment
  - removes most of the solids from the wastewater
  - removes about one-half of the organic strength
  - prepares the wastewater for soil-based final treatment
- Advanced Pretreatment
  - provides additional treatment
  - for sites that have limiting conditions
    - organic strength reduction
    - disinfection
    - nutrient reduction

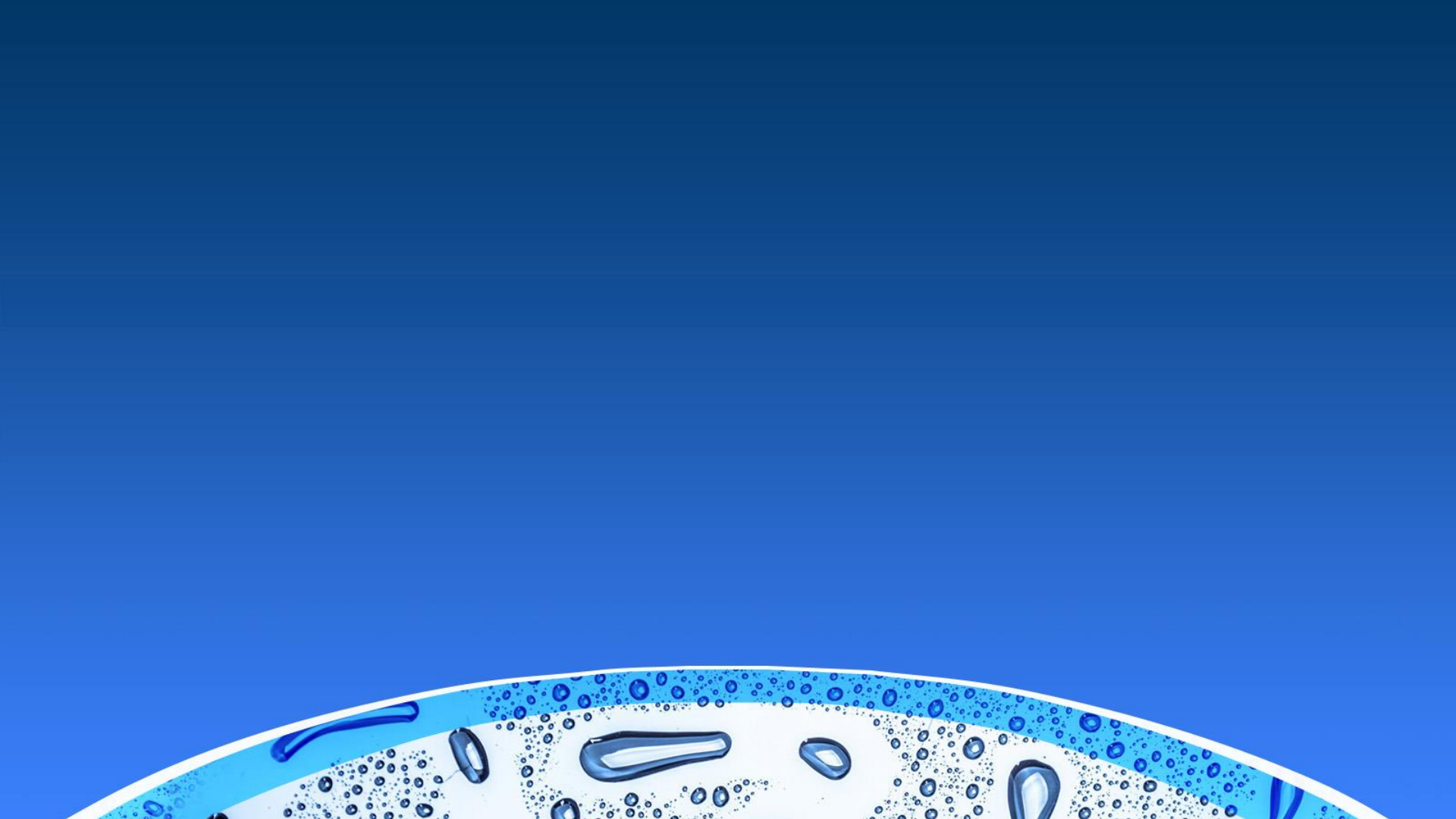
Final Treatment

- Final treatment happens in the soil
  - the primary purpose of pretreatment is to protect the soil system
  - the soil system removes many of the waste products
  - returns the water back to the water cycle

A Conventional Treatment Train

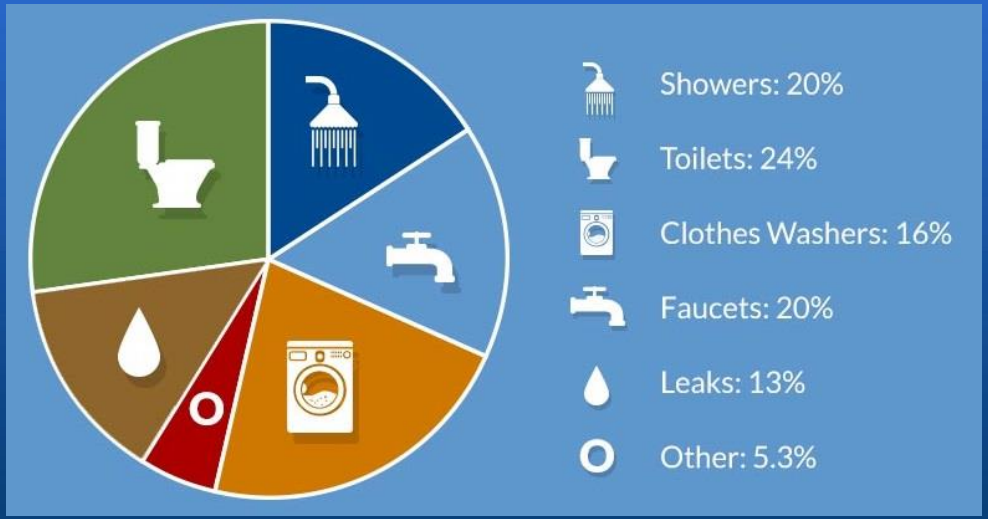
- The majority of onsite wastewater treatment systems have this layout
  - collection
  - septic tank
  - soil treatment area





Wastewater Treatment

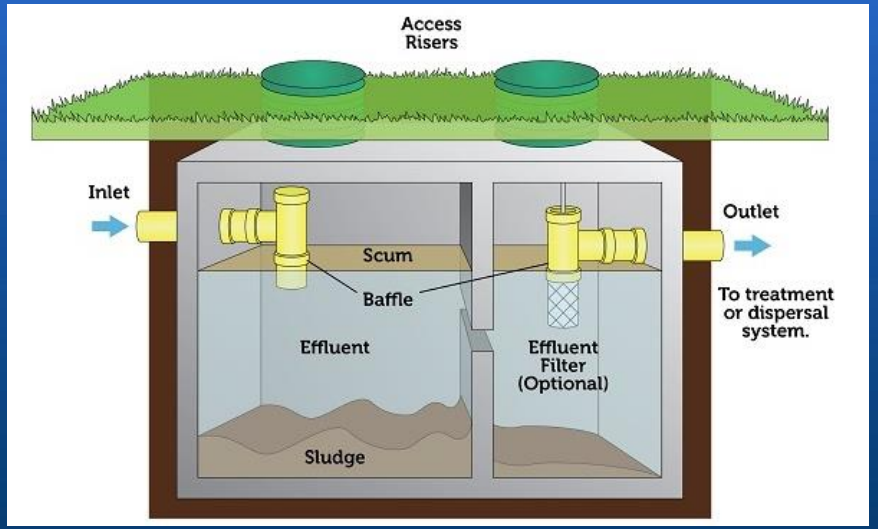
- Begins in the House - Collection
  - Blackwater
    - toilets
    - kitchen sink
    - dishwasher
  - Greywater
    - laundry
    - shower



https://www.envirozyme.com/resources/blog/water-pollution-part-2-household-wastewater-treatment

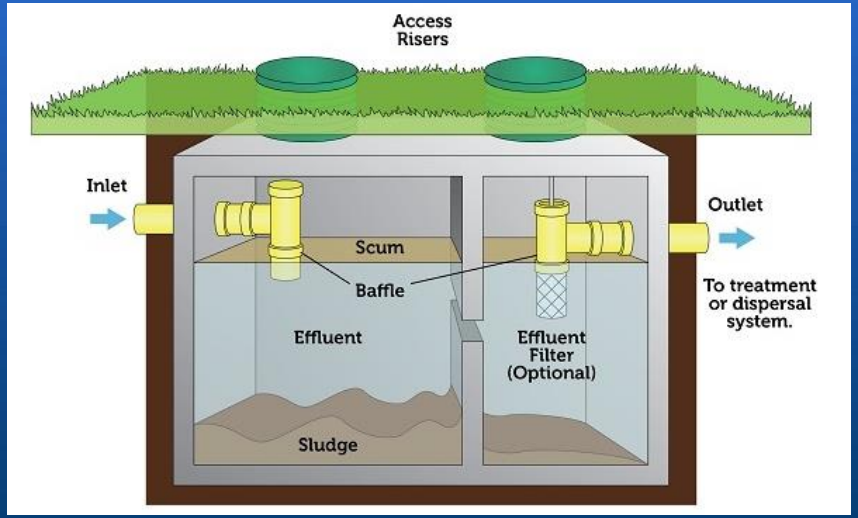
Separating the Solids from the Water

- The Septic Tank
  - separation is based on density relative to water
    - density greater than water
      - sinks
      - becomes sludge
    - density less than water
      - floats
      - becomes scum



Inlet and Outlet Baffles

- Baffles help to keep the layers separated
  - allows the clarified wastewater to move to the soil treatment area
- Wastewater entering the tank
  - displaces an equal volume out of the tank

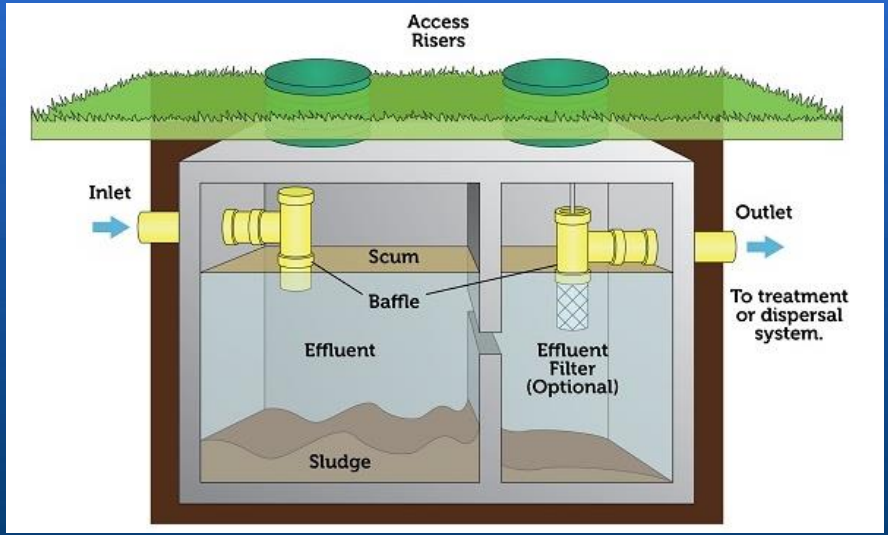


Solids Retained in the Septic Tank

- Sludge layer
  - some degradation of organic solids
    - not all solids are biodegradable
    - anaerobic conditions (without dissolved oxygen)
- Scum layer
  - fats, oils, and grease (FOG), soaps
    - fats are from animal sources
    - oils are from plant sources
    - greases are petroleum-based and come from skin-care products

Clarified Layer

- The outlet baffle prevents the scum layer from leaving the tank
- This clarified wastewater is called septic tank effluent

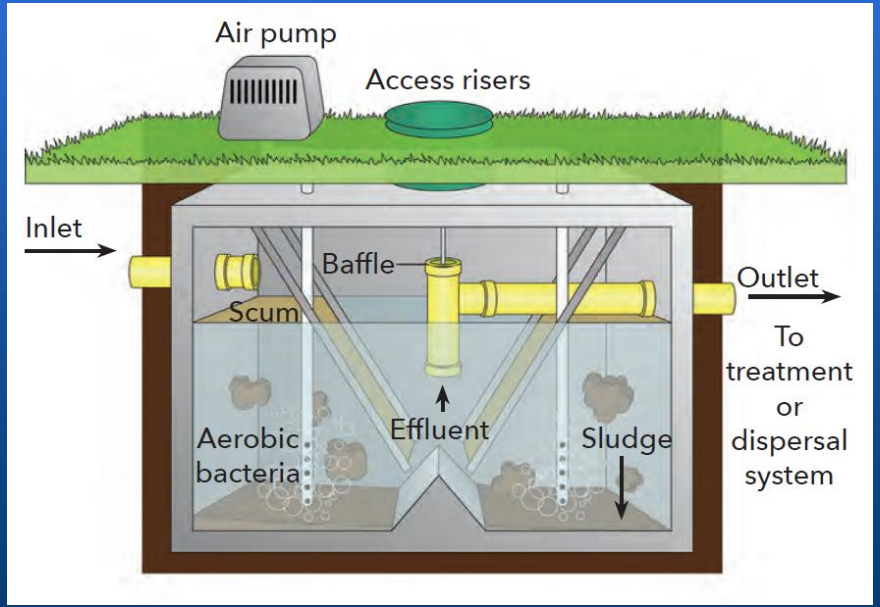


Challenging Sites and Uses May Require Advance Pretreatment

- Advanced Pretreatment creates a cleaner effluent prior to final treatment and dispersal
  - degradation of organic compounds
  - disinfection
  - nutrient removal

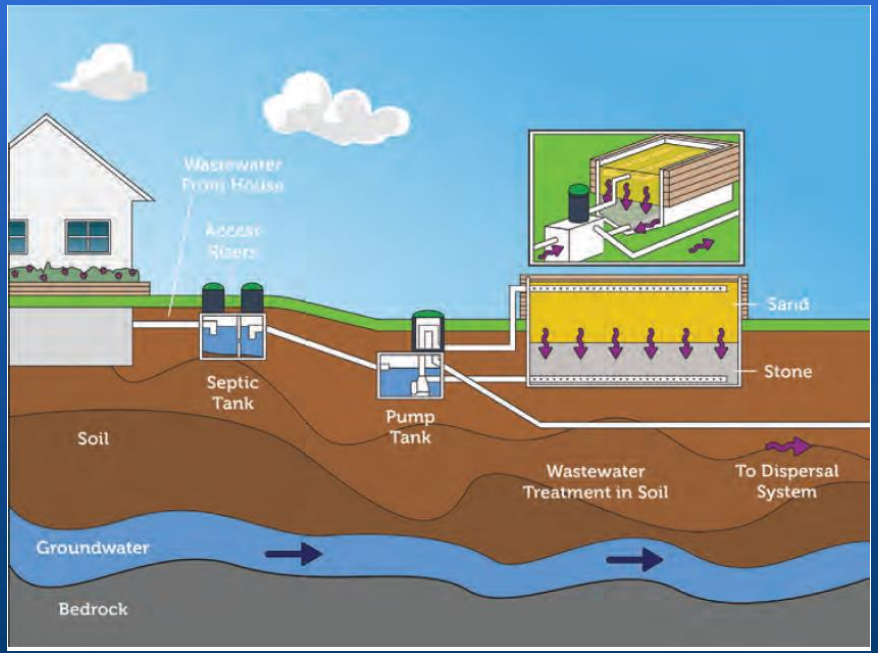
Organic Strength Reduction

- Aerobic Treatment Units (ATU)
  - aerobic conditions are provided by bubbling air through the effluent
  - bacteria digests the organic compounds
    - becomes sludge
  - some nutrients are removed



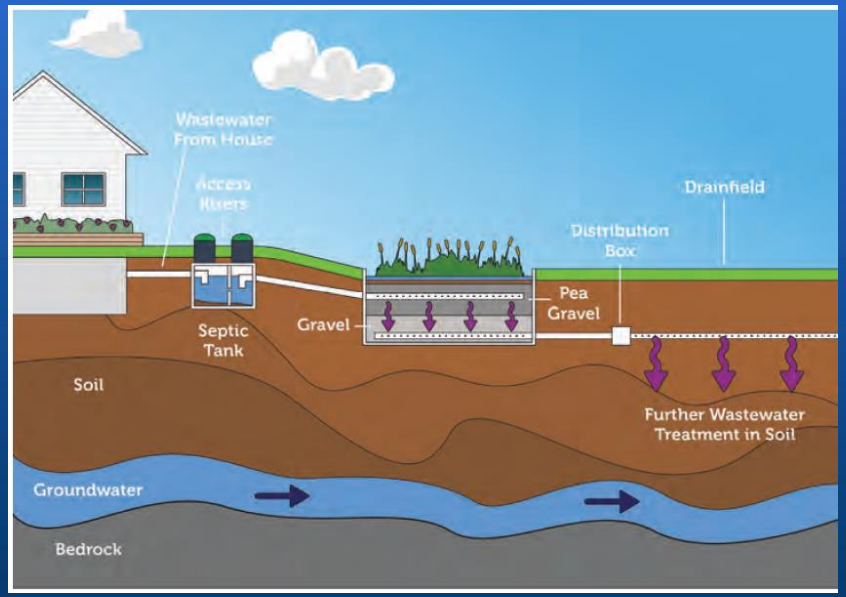
Organic Strength Reduction

- Media Filters
  - aeration provided as effluent trickles down through the media
  - bacteria fixed to the media digest the organic compounds



Organic Strength Reduction

- Constructed Wetland
  - effluent moves just above or just below the media surface
  - aeration is provided from the atmosphere and by photosynthesis
  - roots also serve as attachment for bacteria

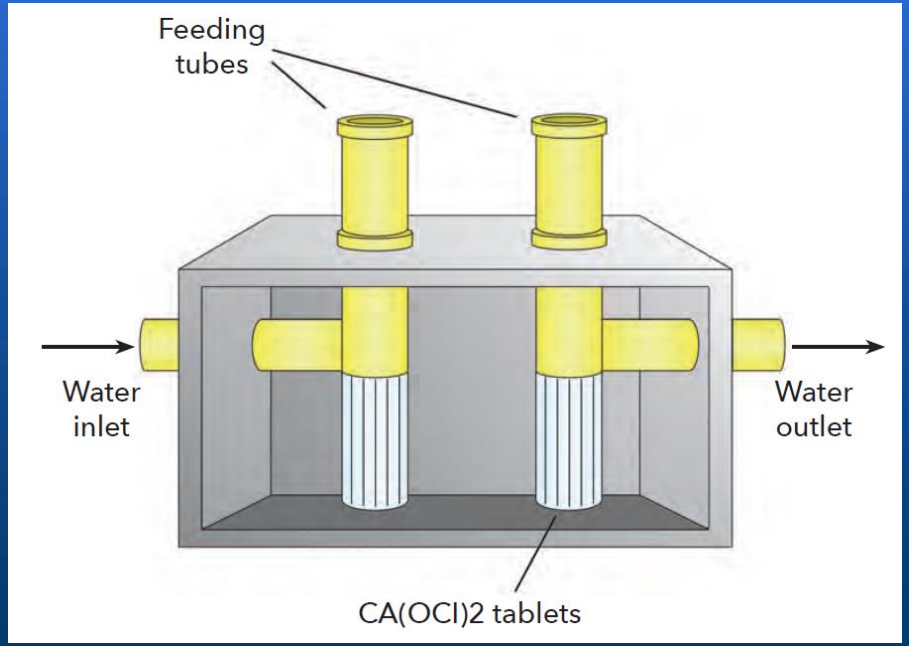


Disinfection

- Destruction of pathogens
  - measured as *E. coli*, fecal coliforms, or total coliforms
  - used when there is a greater risk of coming into contact with partially-treated wastewater
  - with conventional systems we use the soil for removal of pathogens but not all sites have sufficient soil

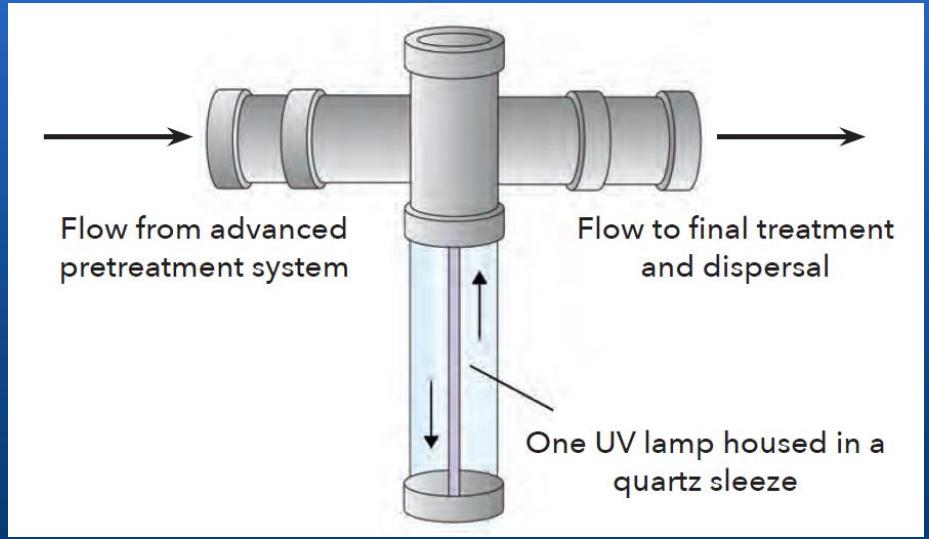
Tablet Feeder

- Chlorine
  - calcium hypochlorite tablets
  - effluent passes through the tablet feeder where chlorine is dissolved into the water
  - only used after advanced pretreatment



Ultraviolet Light (UV)

- UV light damages the DNA, bacteria cannot reproduce
  - effluent passes through a chamber that is illuminated with UV light
  - only used after advanced pretreatment



Moving Between Treatment Components

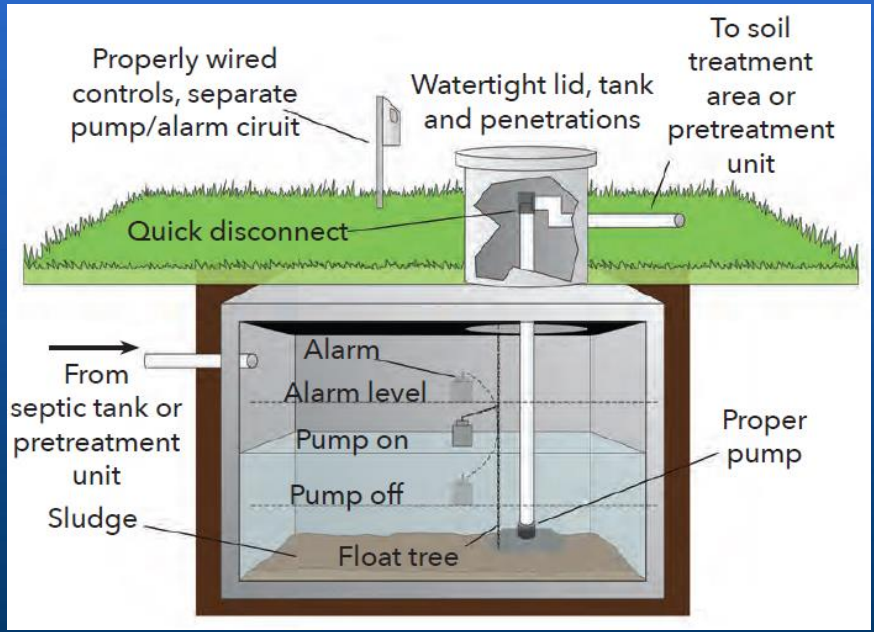
- Where possible
  - OWTS are based on gravity
  - each component is at a slightly lower elevation than the previous one
- Sometimes
  - pumps are added when we need to lift wastewater to the next component
  - assist with uniform distribution

Pumps, Pump Tanks, and Controls

- A pump system generally consists of a
  - pump tank
    - usually sized to hold a two-day wastewater volume
  - dose pump
    - to transfer the contents to the next component
  - controls
    - to activate/deactivate pump, sound alarm

Pump Tank

- Accumulates wastewater until the next pump cycle
  - pump will activate at preset time or preset fluid level
  - must have access from surface

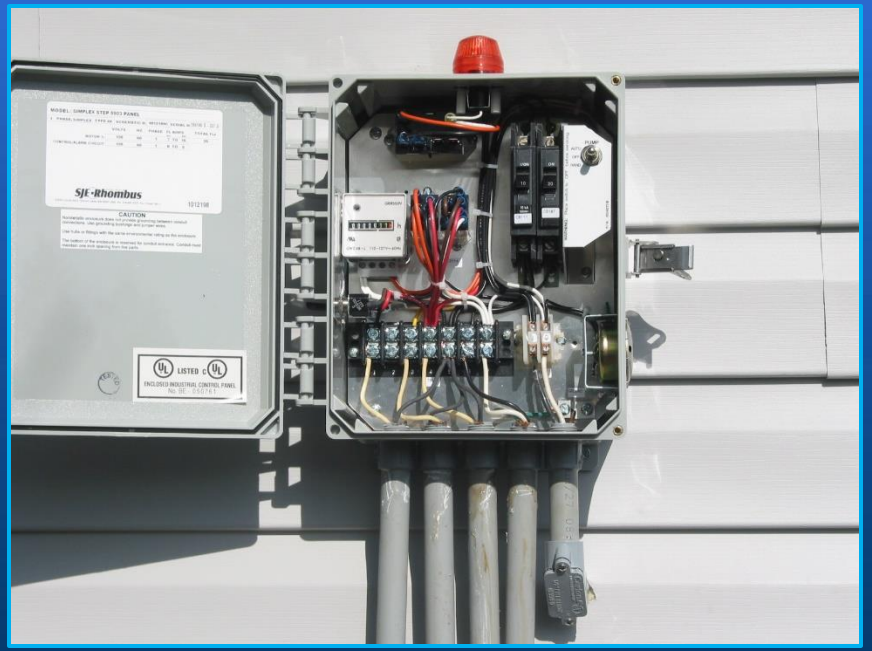


Pumps

- Submersible pumps
  - fractional horsepower
  - minimum power consumption
  - typically, last 7 to 10 years

Controls

- Floats and timers
  - floats indicate the fluid level in the tank
  - activate/deactivate pump as needed
  - panels can provide information about pump operation

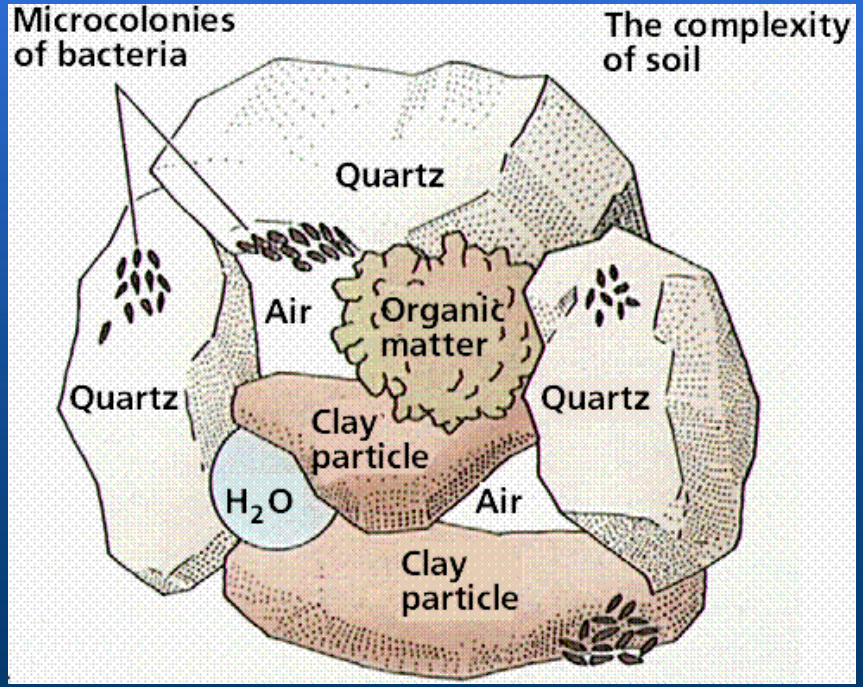


After Pretreatment, the Effluent moves to Soil-Based Final Treatment

- The soil is a very powerful wastewater treatment system
  - biological properties
  - chemical properties
  - physical properties
- The soil must allow for water movement

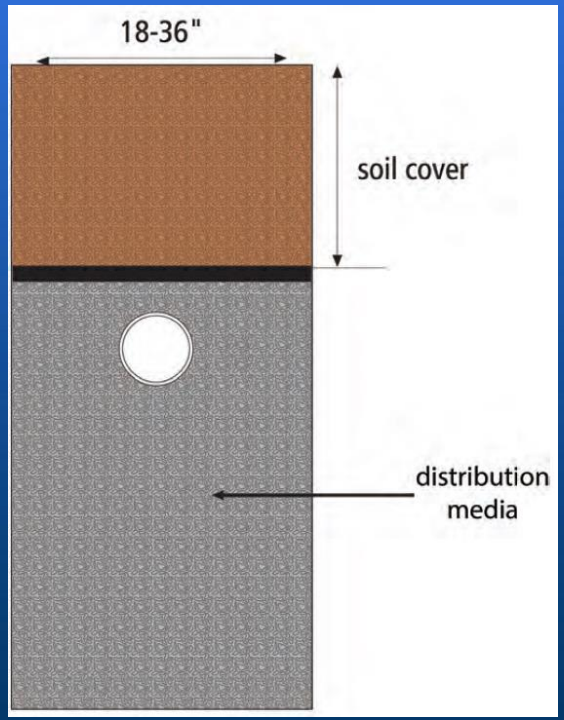
The Soil is a Complex Media

- A suitable soil allows
  - biodegradation
  - nutrient conversion
  - binding with minerals
  - plant uptake
  - deep percolation of water



Applying Effluent to the Soil

- Trench-base dispersal
  - gravel or other media provides storage when effluent inflow is greater than infiltration into soil
- Infiltrative surface
  - mostly on trench bottom
  - some infiltration on sidewalls

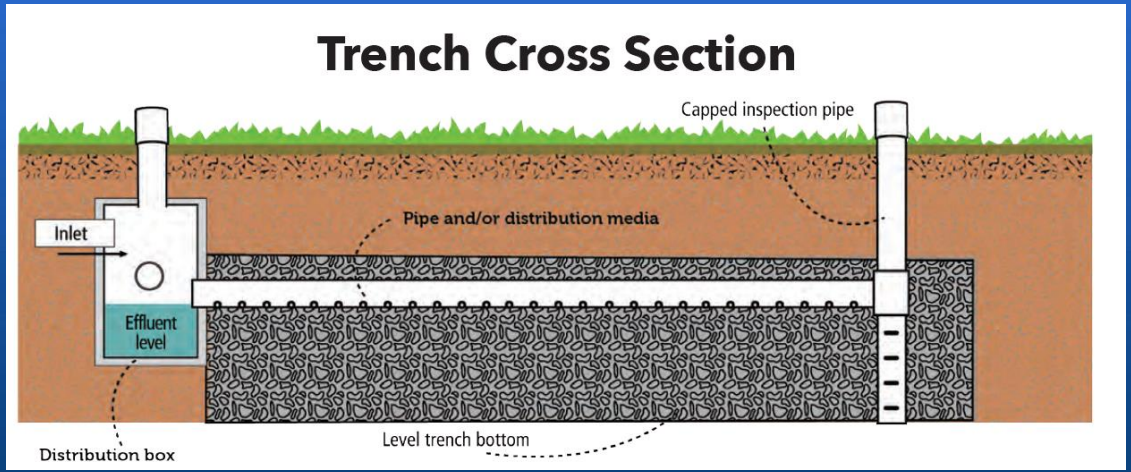


Dispersal into the Soil

- Provides separation between humans and our wastes
  - public health
- Provides a means of preventing our wastes from becoming an environmental contaminant
  - environmental health
  - natural means of renovation

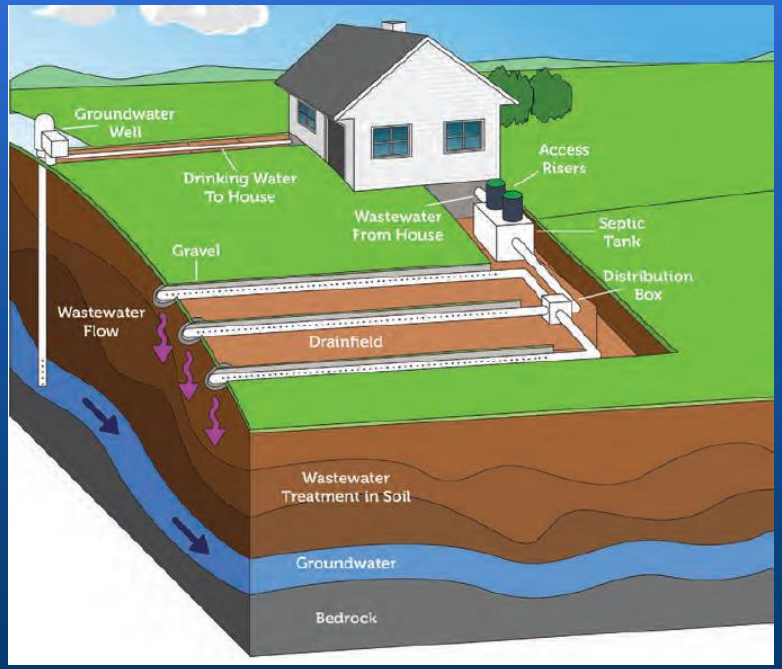
Common Dispersal Methods

- Gravity
- Pressurized
- Spray
- Combined treatment and dispersal



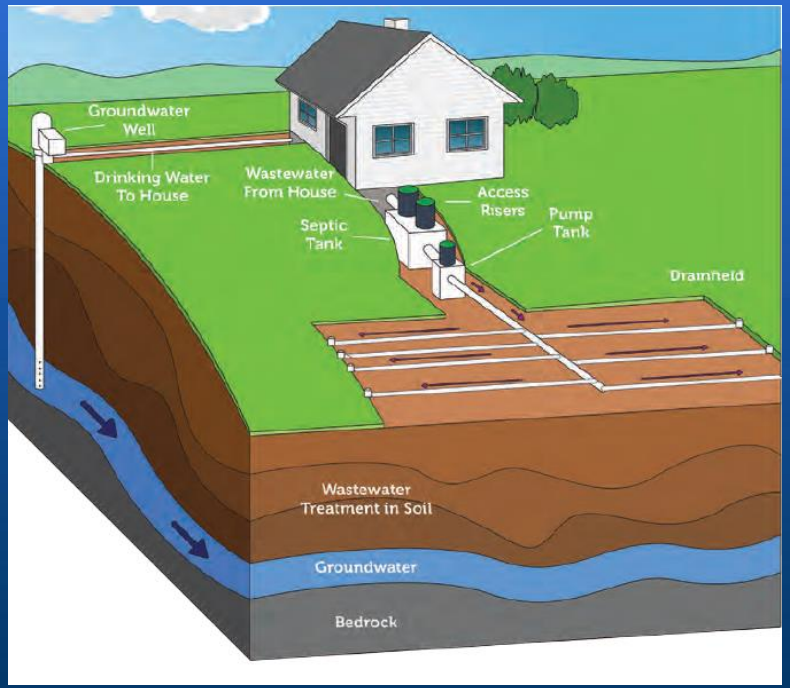
Conventional Septic System

- Gravity Distribution
  - effluent enters trench
  - moves by gravity to distal end
  - poor distribution uniformity
  - least amount of maintenance



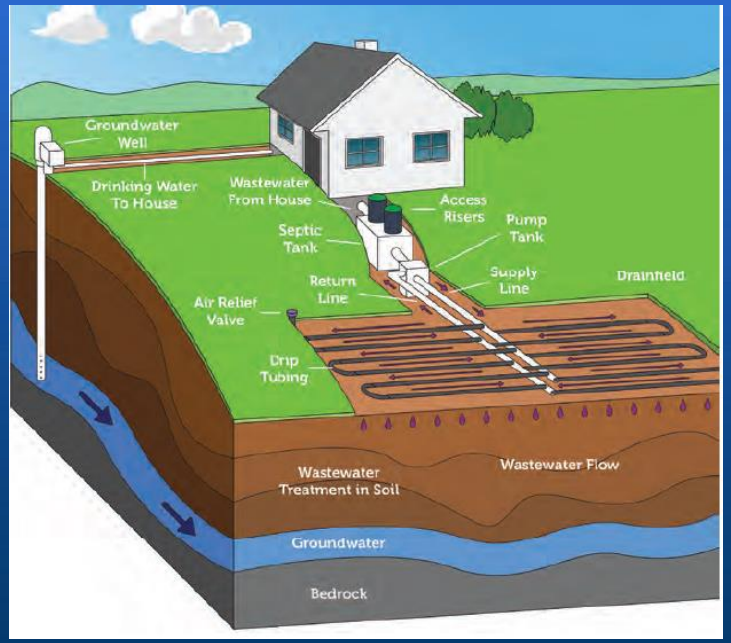
Low Pressure Pipe System

- Pressurized distribution
  - provides good application uniformity along trench length
  - operates at approximately 7 psi
  - need pump tank, pump, and controls



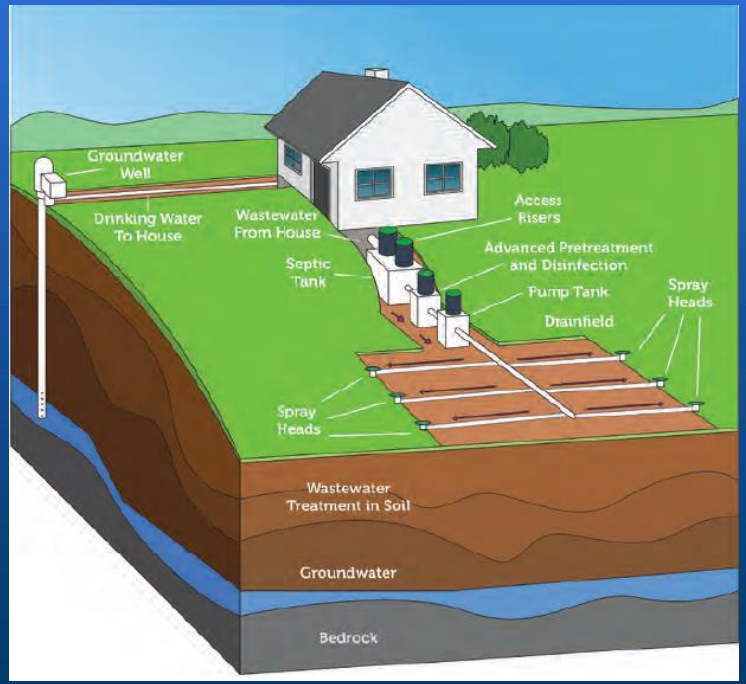
Drip Distribution System

- Drip irrigation technology
  - slow, precise application
  - often used in less permeable soils
- Pressurized system
  - filter, pump and controls



Spray Field

- Can provide excellent application uniformity
- Because of risks
  - must be properly managed with disinfection
  - spray field should be fenced
  - spray at night

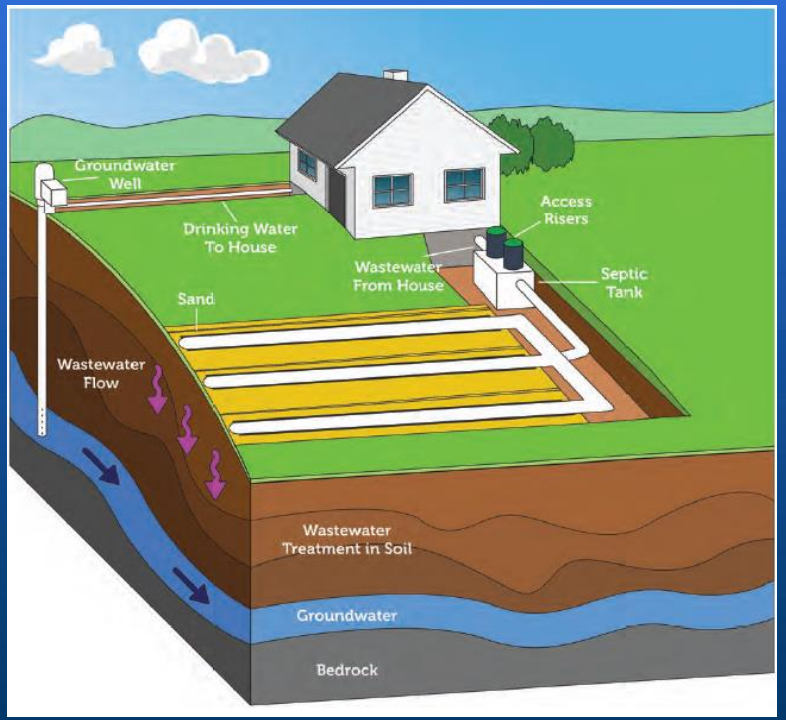


Combined Treatment & Dispersal

- In low permeability soils,
  - there is a risk that organic compounds and biosolids will clog the infiltrative surface at the bottom of the trench
- Likewise,
  - in shallow soils, additional treatment that the soil cannot provide may be needed
- These dispersal system modifications can provide that extra treatment

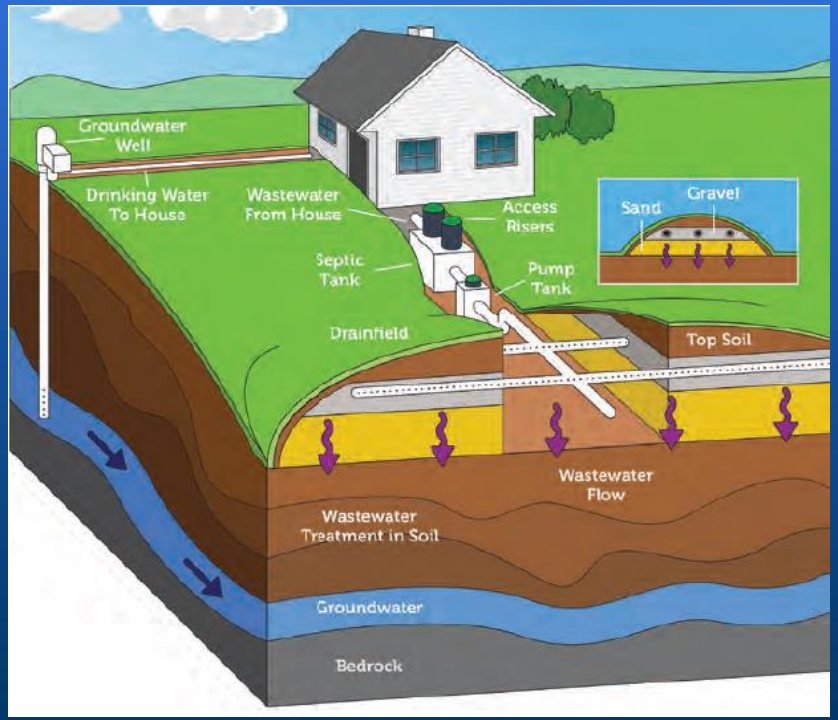
Sand-Lined Trenched

- In-trench media filter
  - provides additional treatment in the trench
  - air moves through sand allowing aerobic conditions
  - attached bacteria growth on the sand



Mound Systems

- Provides treatment by trickling effluent through media
  - water clarification
  - organic removal
  - limits potential for soil clogging
- Used at sites with shallow soils

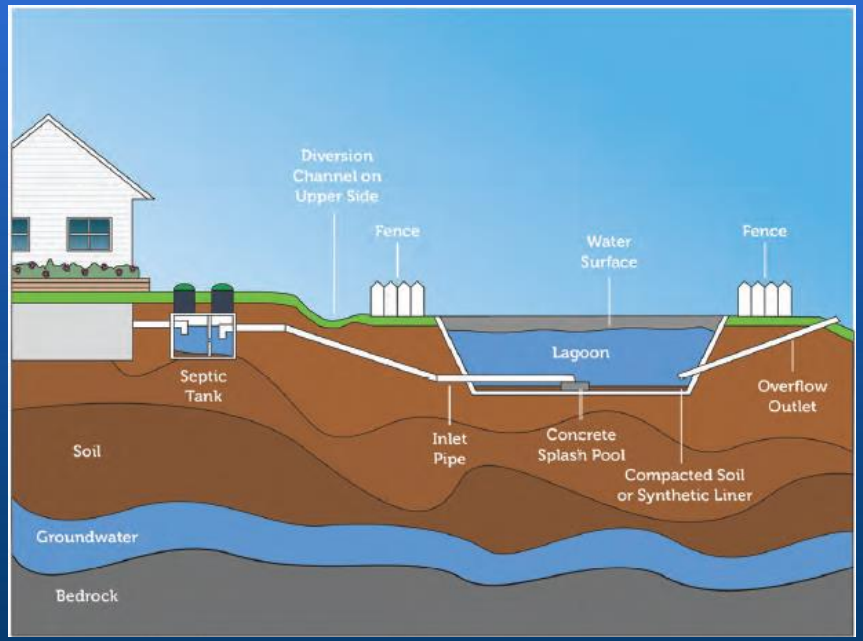


Non-Soil Based Dispersal/Disposal

- In locations where conditions allow, there are other means of returning effluent back into the water cycle
  - evapotranspiration beds
  - lagoons
  - direct discharge

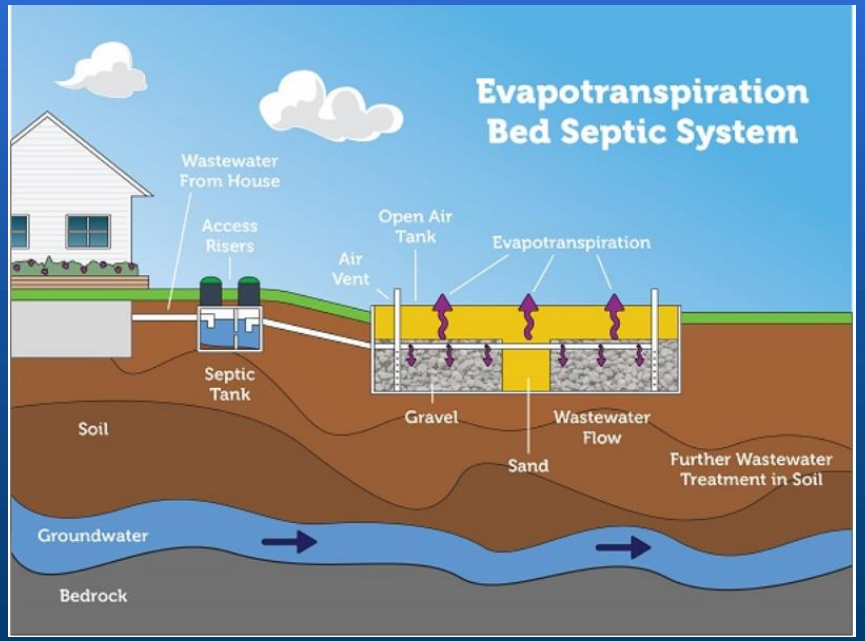
Lagoon System

- Provides Treatment
  - aerobic near water surface
  - anaerobic in deeper water
- Holds effluent during dry season
  - discharges during wet season when dilution water is available



Evapotranspiration Beds (ET)

- Water goes into the gas phase
  - through plants
    - transpiration
  - from liquid water
    - evaporation
- Dry climates only
  - ET must be much greater than precipitation



Direct Discharge

- Effluent is discharged in a surface water
- Very few OWTS are allowed to direct discharge
  - requires extensive regulatory permitting
    - National Pollutant Discharge Elimination System (NPDES) permit
  - requires extensive treatment before discharge
    - samples must be taken to ensure permit compliance

Wrap-Up

- We have reviewed how onsite wastewater treatment systems operate
  - collection, pretreatment, final treatment
- And, we evaluated the various methods used to disperse effluent into the soil
  - and how these methods allow for different climates and soil conditions

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Questions

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