

# Introduction to Onsite Wastewater Treatment

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## Overview



- What is an On Site Sewage Facility (OSSF)?
- Why are we concerned about wastewater?
- Evolution of onsite wastewater treatment
- Operation and maintenance of septic systems
- When to pump a septic tank?
- How to live with a septic system?



## Introduction



- Coastal Zone Act Reauthorization Amendments (CZARA)
- Funded through Clean Water Act Section 319(h) dollars provided through the Texas Commission on Environmental Quality (TCEQ).
- Nonpoint source pollution
  - Bacteria
- Project Period
  - September 1, 2012 to February 28, 2016



## Project Goals



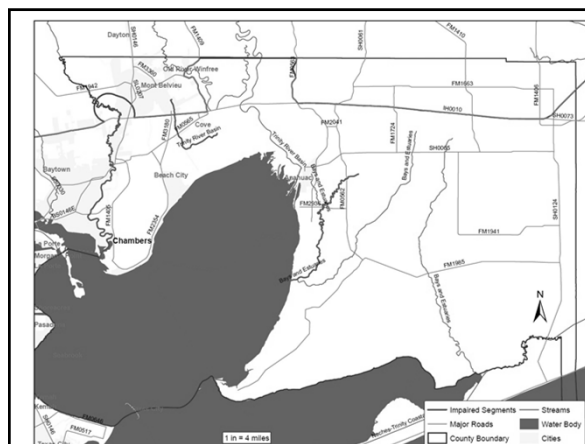
- Identify areas of chronic septic system failure
  - Coastal Counties
  - Counties identified by Section 6217, CZARA
  - Areas within the Coastal Zone Boundary
- Provide trainings for On-Site Sewage Facility (OSSF) Inspectors and Professionals
- Public outreach



## Project Goals



- Conduct visual inspections of anaerobic OSSFs within the project area
  - Pump solids from septic tanks, if needed
  - Applies to conventional septic tanks
  - Aerobic Treatment Units are not eligible for pumping or evaluation under this project
- Replace failing septic systems, if needed



## Impaired Water Bodies

- > Cedar Bayou Tidal
- > Cotton Bayou
- > Double Bayou West Fork

> Based on 2012 Texas Integrated Report – Texas 303(d) List



## Septic System Evaluations



- > Voluntary inspections
- > Participants receive:
  - o Free system pump out
  - o Visual inspection of the septic tank
  - o Report of operational status
  - o A better understanding of OSSF operation and maintenance
  - o Suggestions to improve system operation
- > OSSF replacement candidates selected after scoring and ranking of inspection results



## CZARA Phase 1



- > Evaluated 63 septic systems
- > Pumped out 59 septic systems
  - o Total septage removal = 39,150 gallons
- > Replaced 20 failing septic systems



## Onsite wastewater treatment



## Onsite wastewater treatment systems?



- > Rural and Exurban wastewater infrastructure
- > Water Quality Protection
- > 25 - 40%, Wastewater Infrastructure
- > What is the system called?
  - o OWTS: Onsite Wastewater Treatment System; Nationally
  - o OSSF: On-Site Sewage Facility; Texas
  - o Septic System

## Permitting Wastewater Treatment Systems in Texas



- > Texas Commission on Environmental Quality (TCEQ), Chapter 285, 5000 gallons per day or less
  - o Local Authorized Agent – Usually local Health Department
    - o Galveston County Environmental Health District
    - o Brazoria County Environmental Health Department
  - o TCEQ Regional Office
- > TCEQ, Chapter 217, Greater than 5000 gallons per day.



### Malfunctioning Onsite System



### Malfunction

- **Malfunctioning OSSF** – An on-site sewage facility that is causing a nuisance or is not operating in compliance with the 285 OSSF regulations.

**Hard Malfunction**  
**Soft Malfunction**



### Nuisance

- sewage, human excreta, or other organic waste discharged or exposed in a manner that makes it a potential instrument or medium in the transmission of disease to or between persons
- an overflow from a septic tank or similar device, including surface discharge from or groundwater contamination by a component of an on-site sewage facility; or
- a blatant discharge from an OSSF.



### Evolution of wastewater management



- From outdoor plumbing to water reuse
- We need to review the history to understand the present

### Outdoor plumbing: the pit privy



- Goal: designated place
- No carrier needed to convey waste
- Waste applied directly to the soil
- Public health concerns addressed
- Management: relocate



### Indoor plumbing



- Convenience
- Water carrier to convey waste out of facility
- 'Collection system'
- Public health and pathogens
- Management: keep pipe flowing



## Disposal

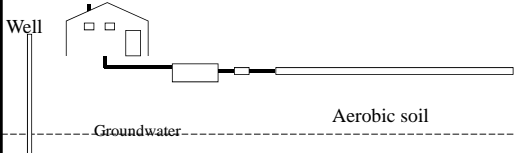
- Goal: limit human contact
- Keep wastewater below ground
- Disposal options
- Public health
  - "Disposing" of pathogens
  - Treatment?
- Environment: groundwater contamination
- Management: install, flush and forget



TEXAS A&M  
AGRI LIFE  
EXTENSION

## Septic tank & soil treatment area

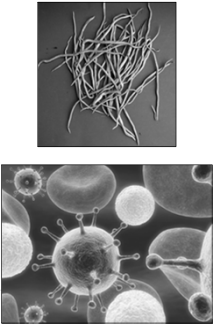
- Evolving goal:
  - Disposal: effluent goes away versus treatment
  - Dispersal: TREATMENT
- Public health AND environmental issues addressed
- Management:
  - Disposal: often no management at all
  - Dispersal: system management is critical



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## Public health

- Wastewater can contain disease causing pathogens
  - Bacteria
    - E-coli
    - Salmonella
  - Viruses
    - Hepatitis A
  - Parasites
    - Giardia
    - Cryptosporidium
    - Roundworms



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AGRI LIFE  
EXTENSION

## Environmental protection

- Treat contaminants before they reach surface water or groundwater
- Nutrients
  - Phosphorus
  - Nitrogen
- Organic loading
- Pathogens



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EXTENSION

## Goal: TREATMENT AND DISPERSAL

- Starting to address both environmental concerns in addition to public health concerns
- Technological advancements now allow removal of:
  - Bacteria - Pathogens
  - Solids – Organic matter
  - Nutrients
- System management is vital to treatment
- Goal is now DISPERSAL
  - Hydrologic cycle

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## Changes in goals means:

- Approach must also change
  - Siting requirements
  - Choice of components and systems
  - System O&M
  - Management program
  - Industry needs

# Education

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### Decentralized Approach

TEXAS A&M AGRILIFE EXTENSION

EPA

### What is an onsite wastewater treatment system?

1. Wastewater source
2. Collection and storage
3. Pretreatment components
4. Final treatment and dispersal components

TEXAS A&M AGRILIFE EXTENSION

### Wastewater source

- Facility type
  - Domestic
  - Commercial
- User
  - Owner/family
  - Employees

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### Collection

- Piping from facility with cleanout
  - Blackwater
  - Graywater
- Collection Options
  - Holding tanks
  - Composting toilets
  - Incinerating toilets

TEXAS A&M AGRILIFE EXTENSION

### Pretreatment

- Pre-treating waste before it reaches the soil
  - Septic tanks
  - Aerobic treatment units
  - Media filters
  - Constructed wetlands
  - Disinfection



TEXAS A&M AGRILIFE EXTENSION

### Final treatment and dispersal

- Final treatment occurs in the soil
  - Conventional trench or bed distribution
  - Low pressure distribution
  - Drip field
  - Spray field
  - Evapotranspiration beds

TEXAS A&M AGRILIFE EXTENSION

## How do we make the OSSF work?

- Evaluate the wastewater source:
  - Hydraulic and organic loading
- Evaluate site
  - Wastewater treatment
  - Wastewater acceptance
- Choose a final treatment and dispersal component
- Choose the appropriate pretreatment system
- Operation and maintenance


## Roles with septic system management





- Site evaluation
- Design
- Installation
- Startup
- Inspection
- Operation
- Maintenance
- Monitoring
- Pumping




## Site evaluation



- Comprehensive evaluation of soil and site conditions for a given land use.
  - Wastewater treatment
  - Wastewater acceptance
- **Licensed OSSF Site Evaluator,**
  - **Professional Engineer**





## Design




- The process of selecting, sizing, locating, specifying and configuring treatment train components that match site characteristics and facility use, as well as creating the associated written documentation.
- A design is also the written documentation of size, location, specification, and configuration.

**Professional Engineer,  
Registered Sanitarian**




## Installation




- The assembly and placement of components of a system, including final grading and establishment of an appropriate cover
- Startup

**Licensed OSSF Installer I  
or  
OSSF Installer II**




## Inspection



- The evaluation and reporting on the status of a wastewater treatment system

**Designated Representative**





### Operation and maintenance

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- Operation
  - Assessing whether each component of the system is functioning properly
- Maintenance
  - taking care of the pieces
- Monitoring
  - verifying performance for a regulatory authority or a manufacturer

**Licensed OSSF Maintenance Provider**






### Pumping

TEXAS A&M AGRILIFE EXTENSION

- The action of removing septage from a wastewater treatment system component
- Necessary to prevent accumulated solids from moving into downstream components
  - Drain fields
  - Pumps
- TCEQ Registered Sludge Transporter

**Pumper**

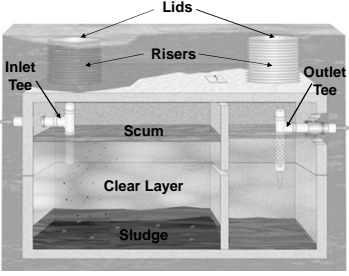



## What is a conventional septic system?

### What is a septic tank?

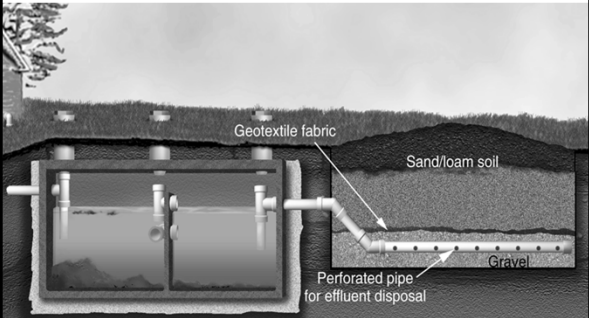
TEXAS A&M AGRILIFE EXTENSION

- Water tight containers
  - Concrete
  - Plastic / Fiberglass
  - NOT Metal
- Detention time
  - Typically 2-3 days
  - Calm conditions
- Gravity separation
  - Heavy sinks
  - Lighter floats
- Anaerobic digestion



### Conventional septic tank system

TEXAS A&M AGRILIFE EXTENSION

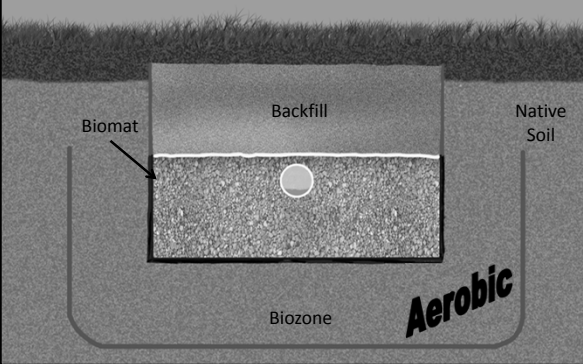


Two-compartment septic tank

Soil absorption field

### Soil Treatment Area

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Biomat

Backfill

Native Soil

Biozone

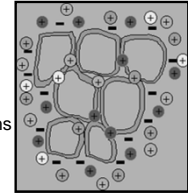
**Aerobic**

### Physical treatment processes



- Sedimentation
  - Settling of the solids
- Filtration
  - Aerobic conditions required, wastewater flows through smaller pores
  - Removes large - particles, bacteria, suspended solids
- Dispersion and dilution
  - Wastewater mixes with groundwater
  - Less concentrated, lower hazard
  - But dilution doesn't remove pollutants

### Chemical treatment processes



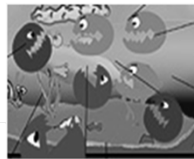
- Cation exchange and adsorption
  - Positively charged waste constituents bond with soil particles
  - Slows rate of movement through soil
  - Allows use by plants and microorganisms
- Precipitation
  - Solids that form due to reactions of solutions and/or solids
- Chemical oxidation
  - Chlorination



### Biological treatment processes



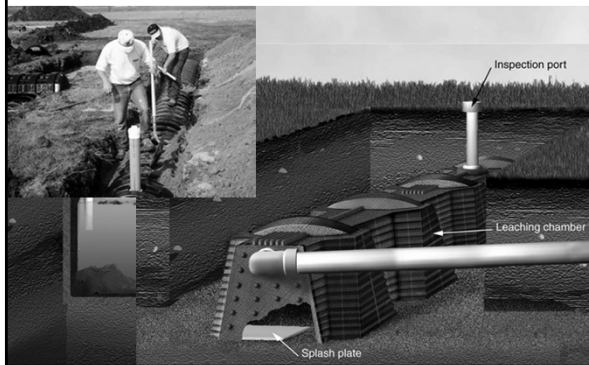
- Natural die-off
  - Occurs when pathogens are held in nutrient poor aerobic conditions
- Predation
  - Natural soil organisms attack and destroy pathogenic bacteria and viruses
- Biological oxidation
  - Bacteria break down organic matter into water and CO<sub>2</sub>
  - Reduces BOD, removes pathogens
  - Works best in aerobic conditions



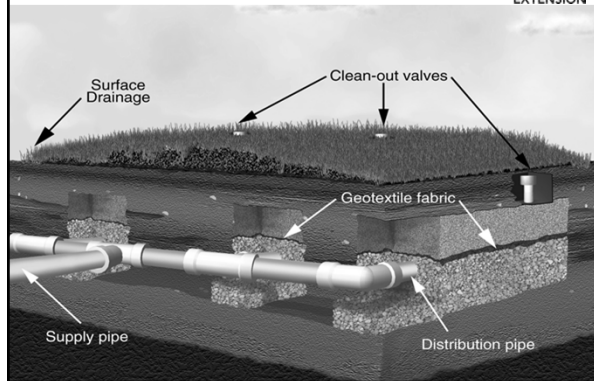
### Gravel-less pipe distribution



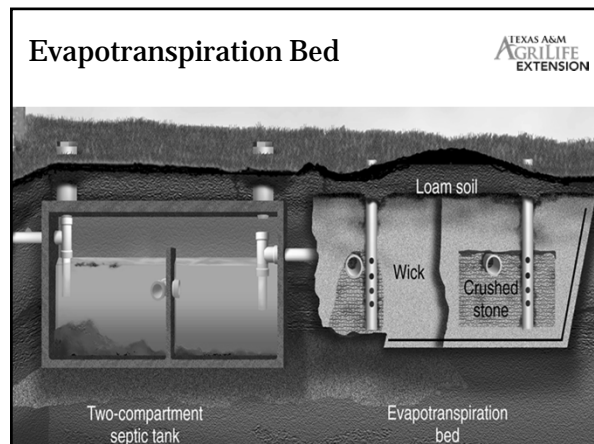
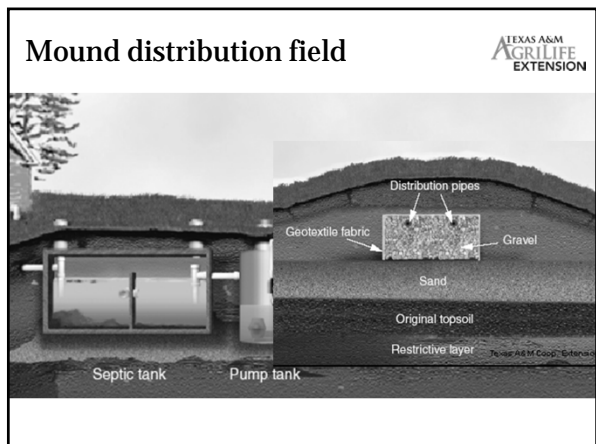
### Leaching chambers



### Low-Pressure Distribution



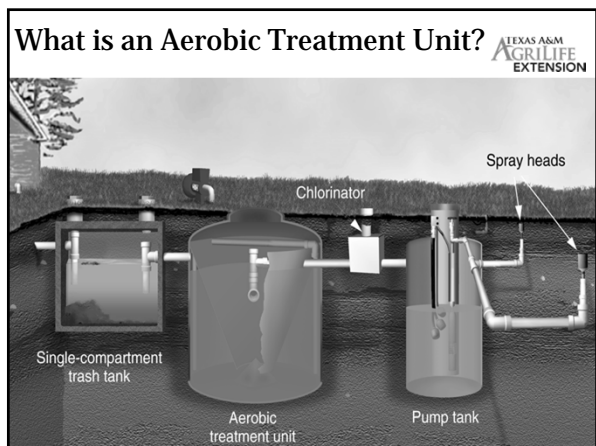




### Role of vegetative cover in treatment system

- A healthy cover crop is essential for the system to function properly.
- Plants will:
  - Take up water and nutrients
  - Stabilize the soil & prevent erosion
  - Support beneficial soil organisms
- Do NOT park vehicles on drainfield
- Do NOT construct decks, driveways or buildings over drainfield
- NO woody vegetation over drainfield

## What is an aerobic treatment unit?




### Aerobic vs. Anaerobic Processes (???)

- Aerobic
  - Aerobic bacteria require O<sub>2</sub> to live and grow
  - Aerobic treatment processes require O<sub>2</sub> to proceed
  - Common condition in soil treatment, media filters, MATUs
- Anaerobic
  - Anaerobic bacteria grow in absence of free oxygen, O<sub>2</sub>
  - Anaerobic treatment processes do not use oxygen, but consumption of items, breaks oxygen bonds Ex. SO<sub>4</sub>, NO<sub>3</sub>
  - Common condition in septic tanks, trash tanks, processing tanks, and usually any saturated environment

### Aerobic treatment unit

TEXAS A&M AGRILIFE EXTENSION

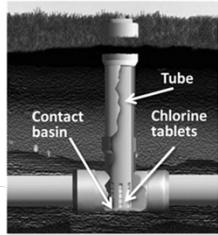

- Aerobic Microbes
  - Require Oxygen to live and grow
  - Consume waste and bacteria
- Air supply
  - Compressor / Aerator
  - Diffusers
  - Oxygen transfer to wastewater
  - Mixing of food and organisms
- Clarifier



### Aerobic treatment unit system

TEXAS A&M AGRILIFE EXTENSION


- Disinfection
  - Disinfection, **NOT Sterilization!**
  - Chlorinator
    - **NOT SWIMMING POOL TABLETS!**
  - UV light
- Distribution
  - Pump tank
  - Spray field

### Water Quality – Spray Field

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- High potential for human contact with water
- Secondary Quality Effluent
  - Remove 85-98% of solids and organic matter
  - Remove pathogens?
- Soil microbes are the final treatment!
- This is effluent – **NOT DRINKING WATER!!!!**



### Spray Field Vegetation


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- A healthy cover crop is essential for the system to function properly.
  - Take up water and nutrients
  - Stabilize the soil and prevent erosion
  - Provide food and habitat for beneficial soil organisms
- Clear area around spray head – 10 feet in the direction of spray from the head.
- Dead vegetation should be reseeded to establish vegetation.



### Subsurface drip distribution

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### Feeding the System

Conventional and Aerobic Systems

### Sewage composition

- Hydraulic Loading - water carrying waste
- Organic Loading
  - BOD
  - TSS
- Pathogens
- Nutrients
  - Phosphorus
  - Nitrogen
- Chemicals
- Fats, oils, grease



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### Fats, oils and grease

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Constituent	State at room temperature	Comments
Fats	Solid	Non-toxic to the system, origin – animals, will separate in water
Oils	Liquid	Non-toxic to the system, origin – plants, trouble separating in water
Grease	Solid	Residual material on appliances; solid material on pans/equipment; petroleum products; moisturizers; bath oils; tanning oils; <b>Toxic</b> to the wastewater system

### In-Home Businesses/Hobbies

- Add stronger waste
  - Add chemicals
  - Increase flow
- Examples of Businesses:
    - Barber shops
    - Day care
    - Bakery
    - Dog grooming
    - Taxidermy
    - Artist
    - Home photography developing lab



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### Prescription drugs & antibiotics

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- Can kill microbes living in system
  - Won't discriminate against organisms living in the system
- Additional treatment components may be necessary
- Increase maintenance
- Do not pour unused medicines down the drain



### Dishwasher

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- Adds surges of wastewater
  - Hydraulically overload system
  - Homeowner should space out loads
- Organic load
  - Clean/scrape dishes



### Garbage Disposal

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- Increases scum by 20%
- System should be pumped 1-2 years sooner than without a garbage disposal
- Increases Organic Loading
  - Smaller particles will take longer to settle
  - Organic matter had not been digested, so it will take longer to break down
  - Potential for fats and oils
- More water is used to wash out sink



### Laundry

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- Use should be spread out
  - Returning from vacation
- Liquid soap is recommended
  - Use less
  - Remove risk of fillers in powders
  - Use bleach sparingly
- Consider a high efficiency washer



### Bathroom fixtures

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- Garden tubs
  - Use large volumes of water
  - Add hydraulic surges
  - How often it is used?
- Multi-head showers
- No every-use shower cleaner



### Bath and body oils

TEXAS A&M AGRILIFE EXTENSION

- Increases Fats, Oils and Grease
- If usage is great, may need more maintenance



### Hand Washing Soap

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- Antibacterial soap affects biology of tank
- Liquid soaps tend to be overused




### Toilet

TEXAS A&M AGRILIFE EXTENSION

- Only urine, feces, soap, toilet paper and limited amounts of cleaner should be going down drain
- No feminine products, prophylactics, cigarette butts, etc.
- No every-flush toilet bowl sanitizers


**Septic Safe?**



### Toilet paper

TEXAS A&M AGRILIFE EXTENSION

- Excessive use results in faster sludge build up
- Treated toilet paper (with lotions) prevents paper from settling
- Wet wipe disposal is discouraged



## Cleaning products

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- Cumulative effects on system performance
- Look at Labels!
  - **DANGER:** Means the chemical will kill the bacteria, and its use should be minimized or eliminated.
  - **WARNING:** Means limited use should have a minimal impact on the system.
  - **CAUTION:** Typically means the product will have little effect.



## Drain cleaner

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EXTENSION

- Toxic drain cleaners can impact ability to properly treat wastewater
- Affect bacteria activity



## Septic system additives

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- **Not** been proven to be beneficial to system performance
- **Not recommended**
- Break up particles that are settled at the bottom and make them suspended
- Potential solids loading to downstream components



## Operation & Maintenance of Septic Systems

## Gases and chemicals of concern

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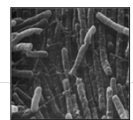
- Hydrogen Sulfide
- Sulfuric Acid (converted from H<sub>2</sub>S)
- Chlorine Gas
- CO(x)'s
  - Carbon Dioxide
  - Carbon Monoxide
- Methane



## Common biological hazards around the site

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- Kids
- Pets
- Insects
- Snakes
- Vegetation



### Restricting access

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### Conditions at the tank

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Odors?

### Tank Material

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Concrete

Fiberglass

### Tank Configurations

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### Tank Access

- Access Location:
  - Inlet
  - Outlet
  - Center

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### Accessibility issues

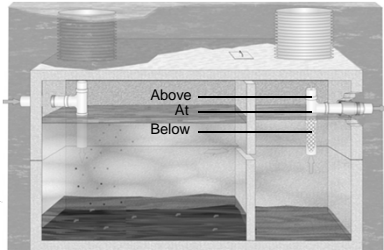
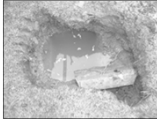
- Accessibility = ease of maintenance
  - Depth of installation
  - Inspection ports & risers
  - Encroachment

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### Operating condition

TEXAS A&M AGRILIFE EXTENSION

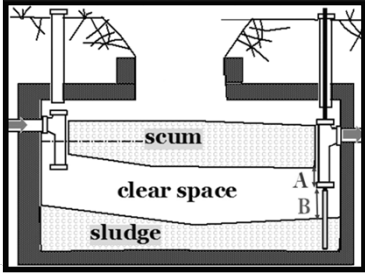
- Liquid level in respect to outlet (inches):
  - At
  - Above
  - Below

### Septic tank pumping recommended?


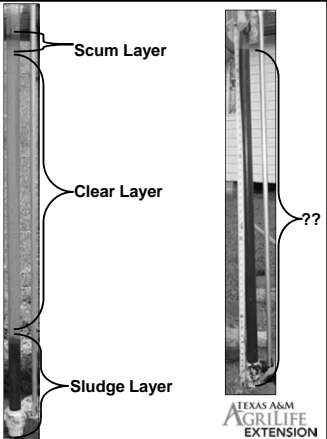
TEXAS A&M AGRILIFE EXTENSION

- Should be pumped when total solids reach 25-33% of tank capacity
  - If 'A' is less than 3"
  - If 'B' is less than 12"
- Typically required every 3 to 5 years
- Pump during dry seasons to reduce the risk of tank floatation



### Measuring solids

TEXAS A&M AGRILIFE EXTENSION

### Septic tank pumping recommended?

Tank Size (gph)	Household Size (Number of People)									
	1	2	3	4	5	6	7	8	9	10
500	5.8	2.6	1.5	1.0	0.7	0.4	0.3	0.2	0.1	—
750	9.1	4.2	2.6	1.8	1.3	1.0	0.7	0.6	0.4	0.3
1,000	12.4	5.9	3.7	2.6	2.0	1.5	1.2	1.0	0.8	0.7
1,250		7.5	4.8	3.4	2.6	2.0	1.7	1.4	1.2	1.0
1,500			9.1	5.9	4.2	3.3	2.6	2.1	1.8	1.5
1,750				6.9	5.0	3.9	3.1	2.6	2.2	1.9
2,000					5.9	4.5	3.7	3.1	2.6	2.2
2,250						6.7	5.2	4.2	3.5	3.0
2,500							5.9	4.8	4.0	3.0

Note: More frequent pumping needed if a garbage disposal is used.

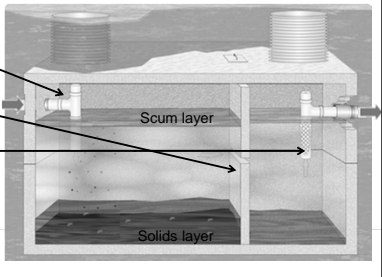
TEXAS A&M AGRILIFE EXTENSION

### Baffles

TEXAS A&M AGRILIFE EXTENSION



- Critical to retention of solids in the septic tank
- Determine if baffles are in place

- Inlet baffle
- Compartment baffle
- Outlet baffle



### Baffles

- Concrete
- Plastic
- Fiberglass
- PVC tee
- Sanitary tee

TEXAS A&M AGRILIFE EXTENSION

### Effluent screens

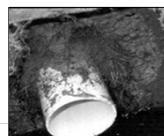
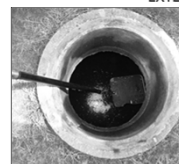
- Installed at the septic tank outlet
- Trap solids trying to leave the septic tank
- Protect the drainfield
- Screen is washed off directly into the inlet side of the septic tank



### Tank structural condition

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- Watertight (no visual leaks)
- Rebar exposed
- Root intrusion
- Corrosion or spalling present
- Cracks
- Flex



### Site conditions

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- Divert rainwater from system components
  - Gutters, landscaping, rainwater harvesting
- Excessive, uneven or poor vegetation
- Saturated soils
- Odors



### Why perform maintenance?

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- Keep systems functioning properly
- Maintain effluent quality
- Early detection of problems
- Public health
- Environmental Protection
- System reliability



Early plumbers

### Thank you

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