INTRODUCTION TO WASTEWATER TREATMENT

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Overview
- What is wastewater?
- Why are we concerned about wastewater?
- The big picture.
- Goals for wastewater treatment are evolving
- How do we implement our infrastructure?
- Wastewater Treatment Processes – The end result is based upon your design
- Existing systems need upgrades to meet new requirements: onsite and centralized options

Wastewater infrastructure
- All facilities serving people generate wastewater
- How to meet these needs in an economical manner?
- Options:
  - On-site
  - Clustered
  - Centralized collection and treatment

Wastewater constituents
- Organic matter – Biochemical Oxygen Demand – Indicator
- Solids – TSS
- FOG – Fats, Oil & Grease
- Nutrients – Nitrogen, Phosphorous
- Pathogens
- Medications
- Chemicals
- Metals

Hydrologic cycle

Public health
- Wastewater can contain disease causing Pathogens
  - Bacteria
  - Viruses
  - Parasites
  - Protozoa

Onsite is a GREEN technology?
Environmental protection
Treat contaminants before they reach surface water or groundwater
- Nutrients
  - Phosphorus
  - Nitrogen
- Organic loading
  - BOD5
- Bacteria - pathogens

The BIG picture
- In order to be an effective, long-term sustainable part of the wastewater infrastructure, onsite, cluster or centralized wastewater treatment systems must be properly sited, designed, installed, operated and maintained.
- We must have professionals who can provide system management services
- Trained professionals for all scales of infrastructure: onsite, cluster, & centralized.

Permitting dispersal systems
- Types: onsite, clustered, community/centralized
- On-site wastewater treatment system
  - Usually limited by maximum gallons per day (5,000 gpd)
  - TCEQ guidance: 30 TAC, Chapter 285
  - Prescriptive rules – local permitting, health departments
  - Identified as:
    - public – septic system; TCEQ septic system; TCEQ – on-site sewage facilities (OSSF)
  - Identified as:
    - On-site wastewater treatment system (OWTS)
- Community systems (greater than 5000 gpd)
  - Performance based – State level permitting
    - TCEQ guidance: 30 TAC chapter 217
    - Potential groundwater impact due to water quality and mounding
    - Detailed soil analysis
    - Location of water wells within ½ mile
    - Uniformity of effluent distribution

Onsite wastewater treatment system

Centralized treatment system

Malfunctioning onsite system
Malfunctioning centralized system

Malfunction

- Malfunctioning system – A wastewater treatment system that is causing a nuisance or is not performing its intended function.

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 a wastewater treatment system.

Evolution of wastewater management

Evolution of wastewater treatment goals

- From outdoor plumbing to water reuse

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
- Where does it go?
  - Onsite
  - Sewer

On-site disposal
- Goal: limit human contact
- Keep wastewater below ground
- Disposal options
- Public health
  - “Disposing” of pathogens
  - Treatment or dilution?
- Environment: groundwater contamination
- Management: install, flush and forget

Off-site disposal
- Centralized sewer
  - Collection piping from houses
  - Cluster
  - Community
- Type of sewer
  - Gravity
  - Vacuum
  - Small diameter
  - STEP/STEG
- Treatment?

Septic tank and 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

Goal: TREATMENT AND DISPERAL
- Starting to address both environmental concerns in addition to public health concerns
- Technological advancements now allow removal of:
  - Pathogens
  - Solids
  - Nutrients
- System management is vital to treatment
- Goal is now DISPERAL
  - Hydrologic cycle

On-site system & hydrologic cycle
Off-site treatment and dispersal

- Convey wastewater to central point.
- Contaminants removed?
  - Primary
  - Secondary
  - Tertiary
- Treatment for removal of specific contaminants
- Discharge to surface water resources

Centralized system & hydrologic cycle

- Precipitation
- Drinking Water Treatment Plant
- Stream
- Wastewater Treatment Plant
- Lake
- Aquifer
- Water is reclaimed from homes and businesses to be used for:
  - Irrigation
  - Percolation
  - Groundwater recharge
  - Fire protection

Water reuse

- Goal: careful use of a valuable resource
- Wastewater vs. water
- Potable vs. non-potable uses
  - Landscape reuse
  - Toilet flushing
  - Tough to meet potable quality
- Management: O&M is even more critical

Evolution of wastewater goals

- Outdoor plumbing
- Indoor plumbing - remove wastewater from the home.
- Disposal on-site - prevent wastewater from surfacing in the yard.
- Disposal off-site – prevent contact at facility and convey to stream.
- Treatment / dispersal on-site - provide effective treatment before effluent reaches surface or groundwater resources.
- Treatment / dispersal off-site – provide effective treatment before discharging to stream.
- Reuse - reclaim the water.

Varying rates of evolution

- Vary across the country
- Driving forces for change
  - Limited water resources
  - Environmental concerns
    - TMDL program
    - CZMP program
    - Source water protection
  - Watershed protection plans

TMDL defined

TMDL = PS-LA + NPS-LA + MOS

- TMDL = Total maximum daily load
- PS-LA = Waste load allocation (PS)
- NPS-LA = Load allocation (Anthropogenic NPS + Natural Sources)
- MOS = Margin of safety (plus Margin for Growth?)
Changes in goals means:
- Approach must also change
- Siting requirements
- Choice of treatment components and systems
- System O&M
- Management program
- Industry needs
- Public acceptance of change
- Public willing to pay for additional service, $$$
- Enforcement on participants not willing to change – public will to support enforcement

Decentralized wastewater treatment system:
- Collection, treatment, and dispersal/reuse of wastewater from individual homes, clusters of homes, isolated communities, industries, or institutional facilities, at or near the point of waste generation.
- Onsite, cluster and centralized. Most cost effective for the site conditions.

Decentralized approach

Distributed management:
- Method used to manage wastewater infrastructure where a responsible management entity (RME) combines onsite, cluster and centralized treatment in a cost effective and sustainable structure.

What is an onsite wastewater treatment system?
1. Wastewater source
2. Collection and storage
3. Pretreatment components
4. Final treatment and dispersal components

Wastewater source
- Facility type
  - Domestic
  - Commercial
  - Industrial
- User
  - Owner/family
  - Employees
Collection
- Piping from facility with cleanout
  - Blackwater
  - Graywater

Collection Options
- Holding tanks
  - Total flow
  - Blackwater
  - Urine separation
  - Waste stream with microbial inhibitors
- Composting toilets
- Incinerating toilets

Pretreatment
- Septic tanks
- Aerobic treatment units
- Media filters
- Constructed wetlands
- Membrane bioreactors
- Disinfection

Final treatment and dispersal components
- Trench and bed distribution
- Evapotranspiration beds
- Low pressure distribution field
- Drip field
- Spray field
- Discharge

What is a central sewer system?
- Same components
  - Source
  - Collection
  - Pretreatment
  - Advanced treatment
  - Disinfection
  - Dispersal – mostly discharge
- Responsible management entity

How do we make the on-site wastewater treatment system 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

City of Cadillac, Michigan
Roles with septic system management

- Site evaluation
- Design
- Installation
- Startup
- Inspection
- Operation
- Maintenance
- Monitoring
- Pumping
- Point of Sale Inspection

Site evaluation

- Comprehensive evaluation of soil and site conditions for a given land use.

Site Evaluator

Design

Designer

- 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.

Installation

Installer

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

Startup

Installer

- The process of setting operational controls, verifying component function and documenting initial operating conditions of a system

Inspection

Designated Representative

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

- The action of assessing whether each component of the system is functioning properly.
- Each component must be operational if the system as a whole is to achieve the desired performance.

Maintenance

- The action of conducting required or routine planned performance checks, examinations, upkeep, cleaning, or mechanical adjustments to an onsite system.
- Includes Replacement of pumps, filters, aerator lines, valves or electrical components.

Monitoring

- The action of verifying performance for a regulatory authority or a manufacturer.

Pumping

- The action of removing septage from a wastewater treatment system component.

Point of sale inspection

- Inspect the treatment system at the time of property sale.
- Chance to upgrade the wastewater treatment system if needed.
- Must have trained professionals.
- No licensing in Texas for this person.

Repair

- Is the action of fixing substandard or damaged components.
  - Required repairs
  - Recommended repairs
  - Upgrades
Why perform operation and maintenance?

- Keep systems functioning properly
- Maintain effluent quality
- Early detection of problems
- Public Health
- Environmental Protection
- Public safety
- System Reliability
- Customer Satisfaction

What quality do you desire?

- Primary treatment
  - Gross solids removal
- Secondary treatment
  - BOD & TSS
- Disinfection
  - Pathogen removal
- Tertiary treatment
  - Nitrogen and phosphorous removal

King County Washington, Vashon

Primary treatment components

- Septic tank
- Bar screen
- Primary clarifier

Secondary treatment components

- Soil
- Aeration – aerobic treatment
- Secondary clarifier
- Sludge return to aeration
- Membrane bioreactors

Disinfection methods

- Soil
- Chlorine
- Ultraviolet Light
- Ozone

Tertiary treatment components

- Dilution
- Soil & plants
- Nitrogen removal
  - Denitrification
- Phosphorous removal
  - Chemical addition
  - Precipitation
Summary

- Wastewater management will play a vital role in our future infrastructure needs.
- Technologies are available for removing the constituents of concern.
- Environmental regulations will continue to be more stringent.
- Environmental health is ultimate form of public health protection.

Summary

- A site evaluation is critical to determining the potential for a site to treat wastewater.
- Advanced pretreatment and final treatment and dispersal technologies are available for most situations.
- Select the most appropriate technology and scale of system for your site.
- Operation and maintenance is critical for long-term function.