Conventional Septic Systems in North Carolina

Rule .1955

15A NCAC 18A .1900

Laws and Rules for Sewage Treatment and Disposal Systems
The typical septic system consists of:

1. **Collection Lines** – carries sewage from facility to septic tank
2. **Septic Tank** - separates, stores, and begins to treat solid wastes
3. **Distribution System** - carries effluent from the tank to the drain field
4. **Drain Field** or Nitrification Field or Soil Absorption System - generally a series of perforated drainpipes in aggregate buried in the ground
Collection Lines
Sewer Lines/Building Sewer

Purpose: To convey raw (untreated) sewage from the house to the septic tank

Requirements: Based on ASTM standards in accordance with NC Plumbing Code
Sewer Lines/Building Sewer

Requirements:

- **Scour Velocity**
  - 2 ft/sec (half full pipe)
  - 1 ft/sec (full pipe)
  - Typically 1/8” per foot of fall for raw sewage

- **Cleanouts**
  - every 50’ and for bends >45 degrees (4” sewer lines)
Septic Tank

Function as a “black box”
Historical Perspective:

“A mysterious contrivance consisting of a vault hermetically closed by a hydraulic seal…it rapidly transforms all the excrementitious matter it receives into a homogeneous fluid…”

Louis Mouras, 1881
Factors influencing biological activity:

- Composition of wastewater
- Flow quantity and variability
- Temperature
Purpose:

- **Primary Treatment**: Solids removal as a function of quiescence and retention time
- **Secondary Treatment**: Limited anaerobic decomposition
- **Storage** of accumulated solids
2 compartment tank (required in NC)
Effluent Filter
What are septic tank effluent filters?

- Mechanical filters
- Constructed of corrosion-proof material
- Replaces the outlet “T” of the septic tank

Why use effluent filters?

- Improve quality of effluent discharged from septic tanks
- Extend life of soil absorption system
- Required by North Carolina General Statutes
Purpose:
- Conveys effluent from septic tank to distribution device (if applicable) and to drainlines

Specifications:
- 3” or 4” PVC (poly vinyl chloride), PE (polyethylene) or ABS (acrylonitrile-butadiene-styrene) pipe
- May substitute corrugated PE pipe (w/ proper bedding)
- Minimum fall 1/8” per foot
Purpose:

- To convey an equal portion of effluent from the supply line to each individual drainline

Types: D-Box or Divider Tee

Equal distribution requires equal length trenches!
Distribution Device – Equal

D-Box

Flow Divider

Leveling Devices
Distribution Device – Serial

Purpose:
- To fully utilize each individual drainline prior to distributing effluent to remaining line(s)

Types: Drop Box or Step Down

Serial distribution does not require equal length trenches!
Plan View: Stepdowns
Serial distribution does not require equal length trenches!
Serial Distribution

Plan View: Drop Boxes

Septic Tank

Drop Boxes

Drainlines
Equal vs. Serial Distribution

Septic Tank

D-Box

Septic Tank

Drainlines

Stepdown
Specifications:

- Leak proof
- 2’ separation to septic tank and drainline(s)
- As approved by LHD
- Must be demonstrated by installer to perform as designed
Septic Tank/D-Box/Supply Lines: Overview

- Solid pipe, 3" diameter or larger
- Slope: 1/8" per foot or 1 foot per 100 feet.
Nitrification Trenches

Purpose:

- Provide storage of wastewater until treatment and disposal can occur
- Provide surface area at the soil interface for treatment and disposal
- Trenches level in all directions (maximum fall of 1/4” per 10’).
- Trenches shall follow ground contour if slope > 2% OR
- When necessary to maintain trench bottom depth
Cross-section view: Conventional trench

- 2 inches of crushed stone over pipe
- 4-inch pipe
- 6 inches of crushed stone beneath pipe
- Soil cover

End view of a conventional treatment and disposal trench.
Aggregate

Crushed Stone Sizes #3, #4, #5, #57, #6
Specified by ASTM Standards
PolyStyrene Aggregate
Large Diameter Pipe (LDP)

Tire Chips
Corrugated, perforated PE tubing
4” or 6” diameter
3 rows of 1/2” to 3/4”
longitudinally ~4” on center

Orientation of Holes (C/S)
Purpose:
- To absorb and physically filter components from the effluent as well as facilitate chemical and biological remediation of organic and pathogenic materials.
Cross-section view: Conventional trench

Drainfield Trenches

For sandy soils

18 inches minimum

For all other soils

12 inches minimum

Required distance between bottom of drainfield and groundwater table.
Effluent Distribution

SANDY SOIL

GROUNDWATER
Ciliates  5-10 micrometers

Single cells:
- grazers
- particle feeders
- scavengers
NEMATODES  ~1mm

Roundworms - free living
Also common in activated sludge and septic tanks.

Feed on chunks of bacterial floc.
Aerate soil
A relatively dense sewage-digesting community of organisms in the immediate area where the aggregate component of the septic system contacts the soil
**Unsaturated Flow** - liquid follows a tortuous path around the surface of soil particles and comes into contact with bacteria and protozoa that break down the waste.
THE OBJECTIVE OF A LEACHING FIELD IS TO PROVIDE UNSATURATED FLOW OF EFFLUENT TO THE GROUNDWATER
Biomat Formation

- Sandy Soil
- Groundwater
Formation of Biomat
Mature Biomat

- Sandy Soil
- Groundwater
LTAR – Long Term Acceptance Rate

Stated in gallons per ft$^2$ per day (gpd/ft$^2$)

The amount of effluent that can be applied to the Nitrification field to achieve and maintain aerobic and unsaturated flow.
Viruses

Putting viruses in perspective?

If a sand grain 0.5 mm - was similarly enlarged, = ~ 94 feet high!

That nematode = 180’+ long

The pore space between sand grains = 13 feet wide!

✓ You would be 60 miles tall!
Early Roman Law  
(governing chamber pots) 

*Dejecti Effusive Act* 
A person shall be fined and pay damages to the injured party for throwing or pouring “missiles of mirth” out an open window and hitting someone.

Note: Law only applied during daylight hours.

**Questions?**