On-Site Sanitation (Containment) System

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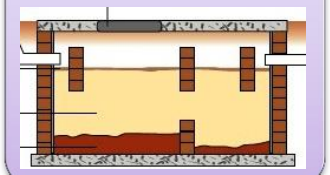
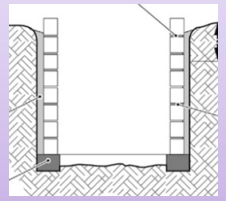
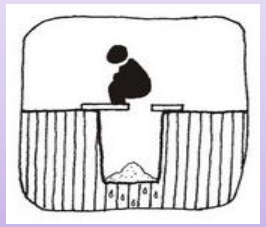
Presentation covers

- Urban sanitation types
- On Site Sanitation systems
- Septic Tanks
  - Details
  - How to design?

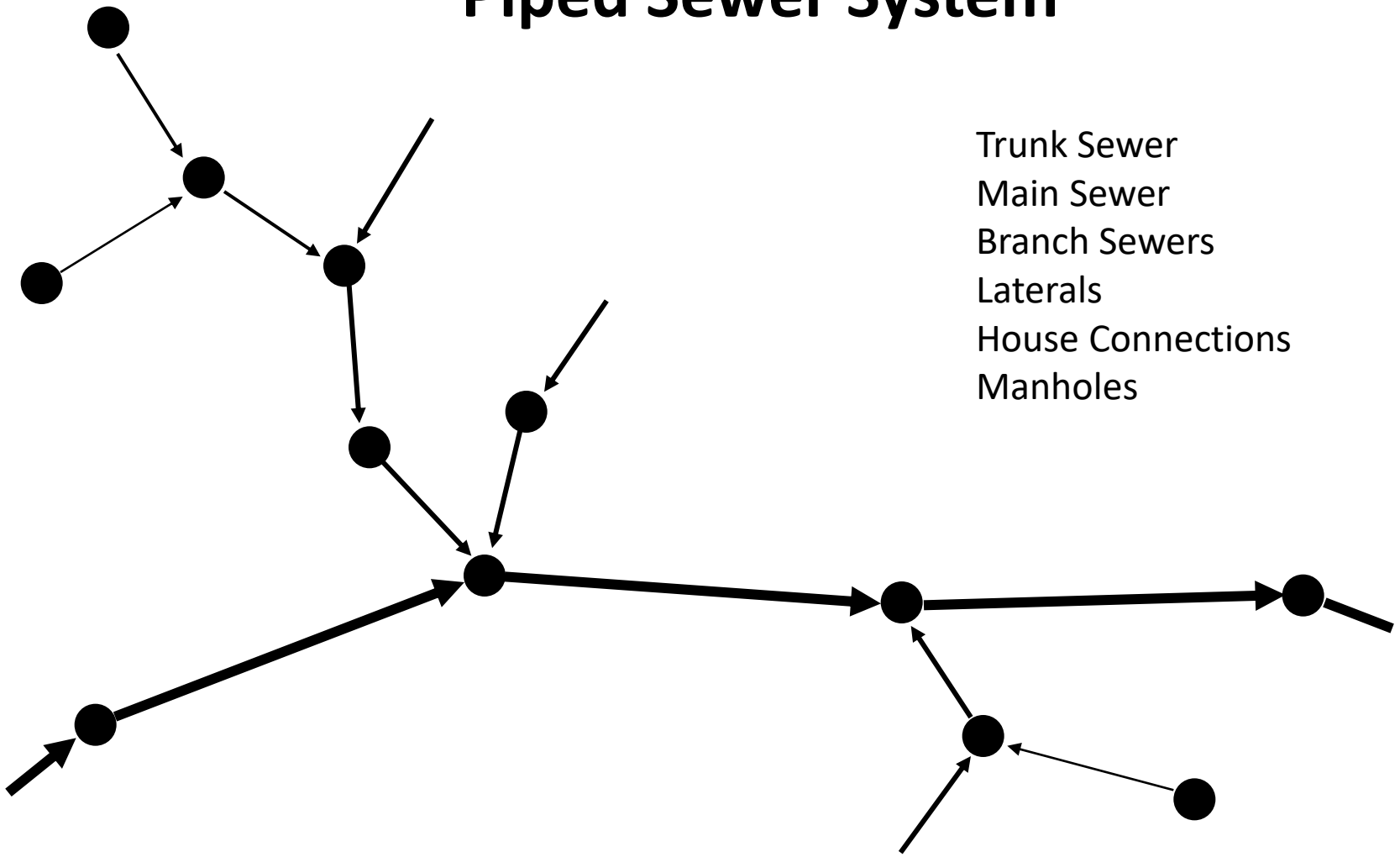
Urban Sanitation

Urban Sanitation

- Off -Site (Piped Sewer System)
- On Site System
  - Lined Structures
    - Bio-digester
      - Septic Tank 
      - Cesspool 

  - Unlined Structures
    - Soak Pit 
    - Two pit latrines
      - Pit latrine 

Piped Sewer System



Trunk Sewer
Main Sewer
Branch Sewers
Laterals
House Connections
Manholes

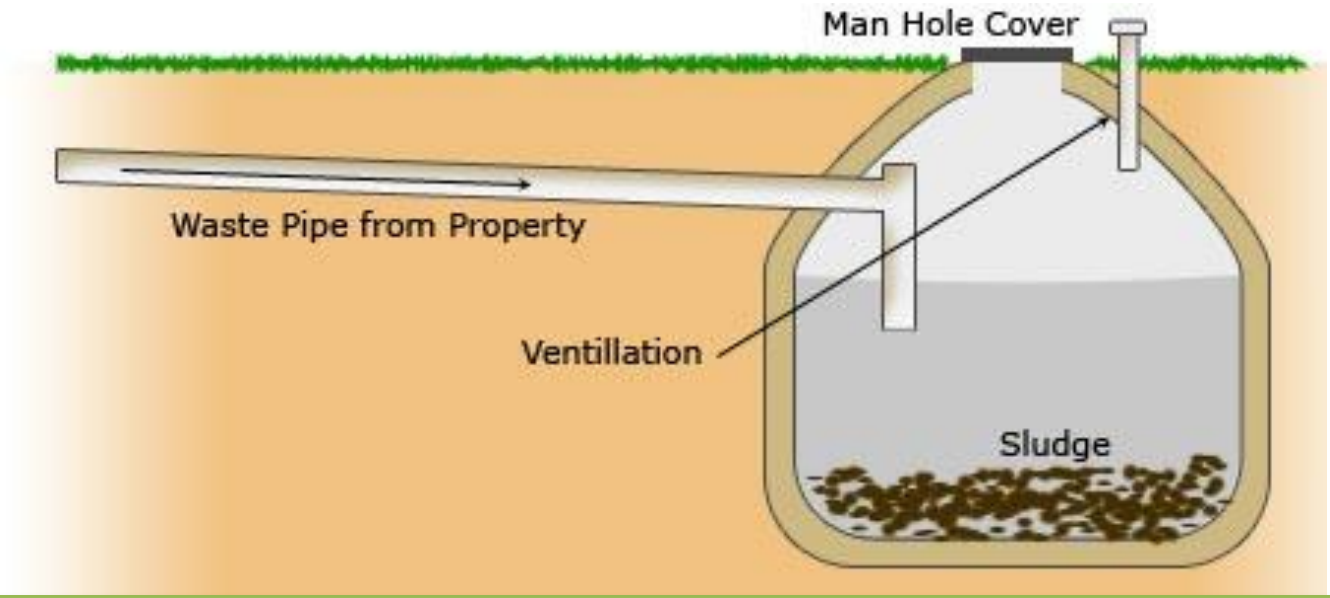
Piped Sewer System

Advantages	Disadvantages
Convenience to the end user	High capital investment
Health risk is reduced	Needs a continuous and reliable supply of piped water
No nuisance from smells, mosquitoes or flies	Difficult to construct and costly to maintain in high-density areas
Moderate operation and maintenance costs	Problems associated with blockages of pipes and breakdown of pumping equipment may occur
	Recycling of nutrients and energy becomes difficult

Onsite Sanitation in country

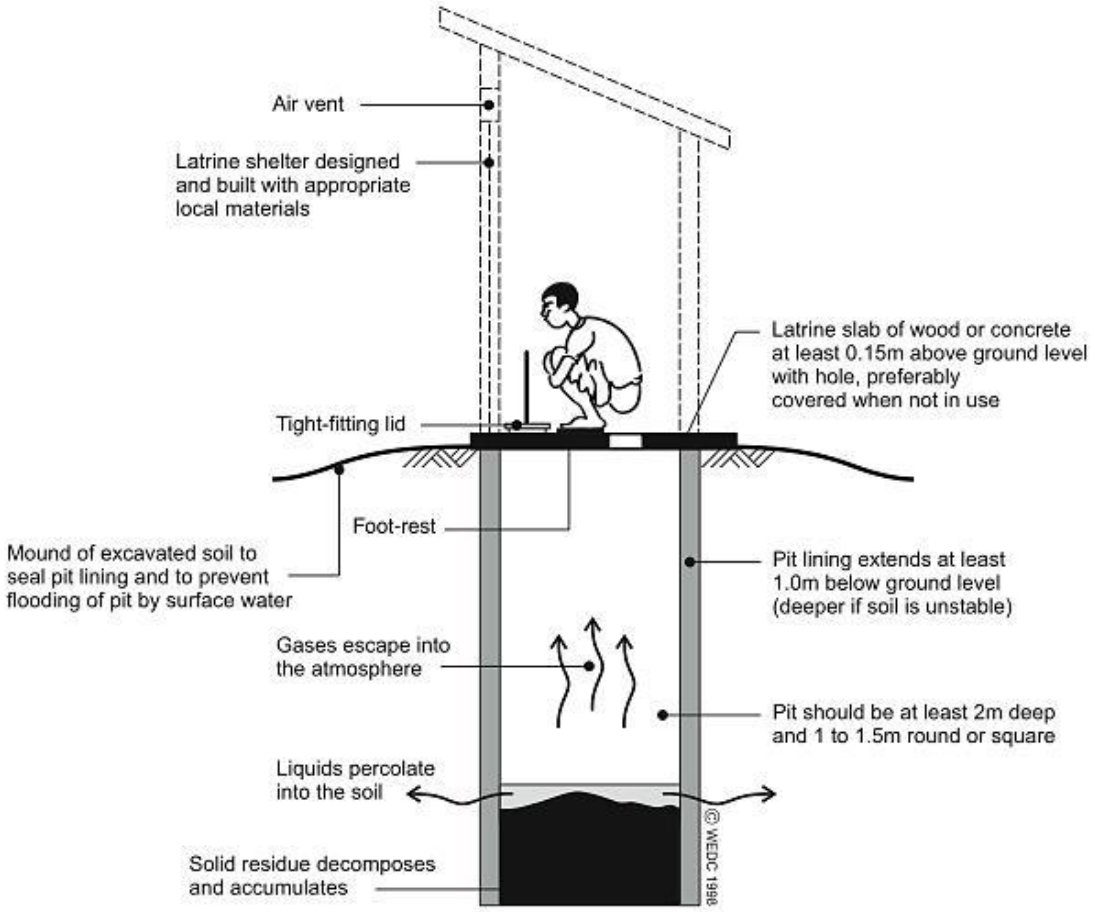
- Cesspool
- Pit latrines
- Ventilated Improved Pit latrines (VIP)
- Soak pit
- Small bore sewer system
- Septic tanks

Cesspool



Advantages	Disadvantages
No contamination of ground water	Needs a frequent desludging, hence high operation and maintenance cost
No nuisance from smells, mosquitoes or flies	Difficult to maintain in high-density areas

Pit Latrine



Source: Harvey et al

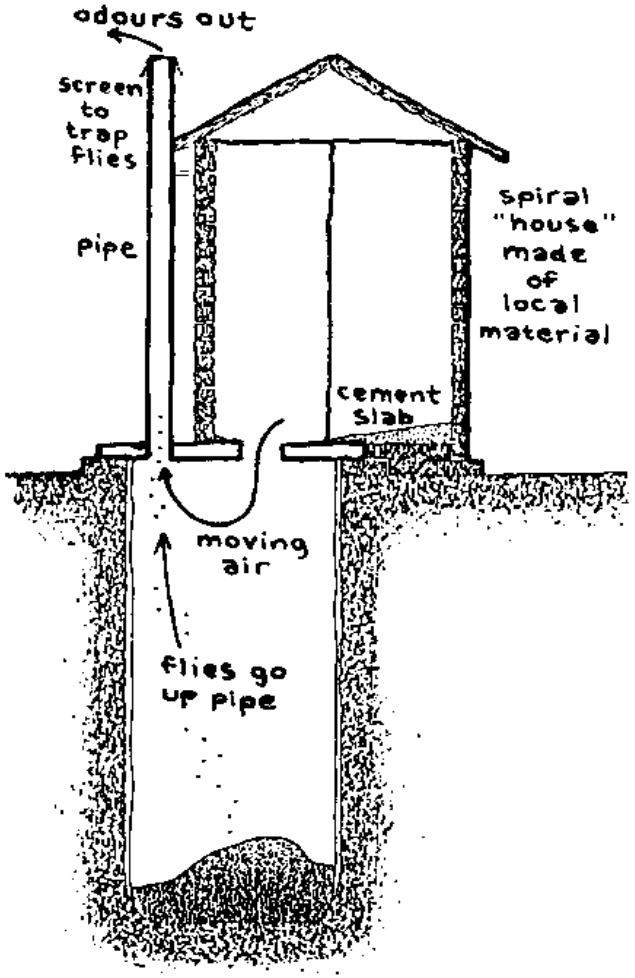
Advantages

Does not require constant source of water
Low capital cost

Disadvantages

Leachate can contaminate ground water
Flies and odor are noticeable
Pits may fail/overflow in case of flood
Stagnant water promotes insect breeding
Cost of emptying is high and may encourage scavenging

Ventilated Improved Pit Latrine (VIP)



Source http://www.ugandanetwork.org.uk

Advantages

Flies and odor are significantly reduced
Does not require constant source of water
Low capital cost

Disadvantages

Leachate can contaminate ground water
Health risks from flies, if not completely removed by ventilation
Pits may fail/overflow in case of flood
Stagnant water promotes insect breeding
Manual emptying of the pit poses severe health hazard
Low reduction of pathogens

Soak Pit

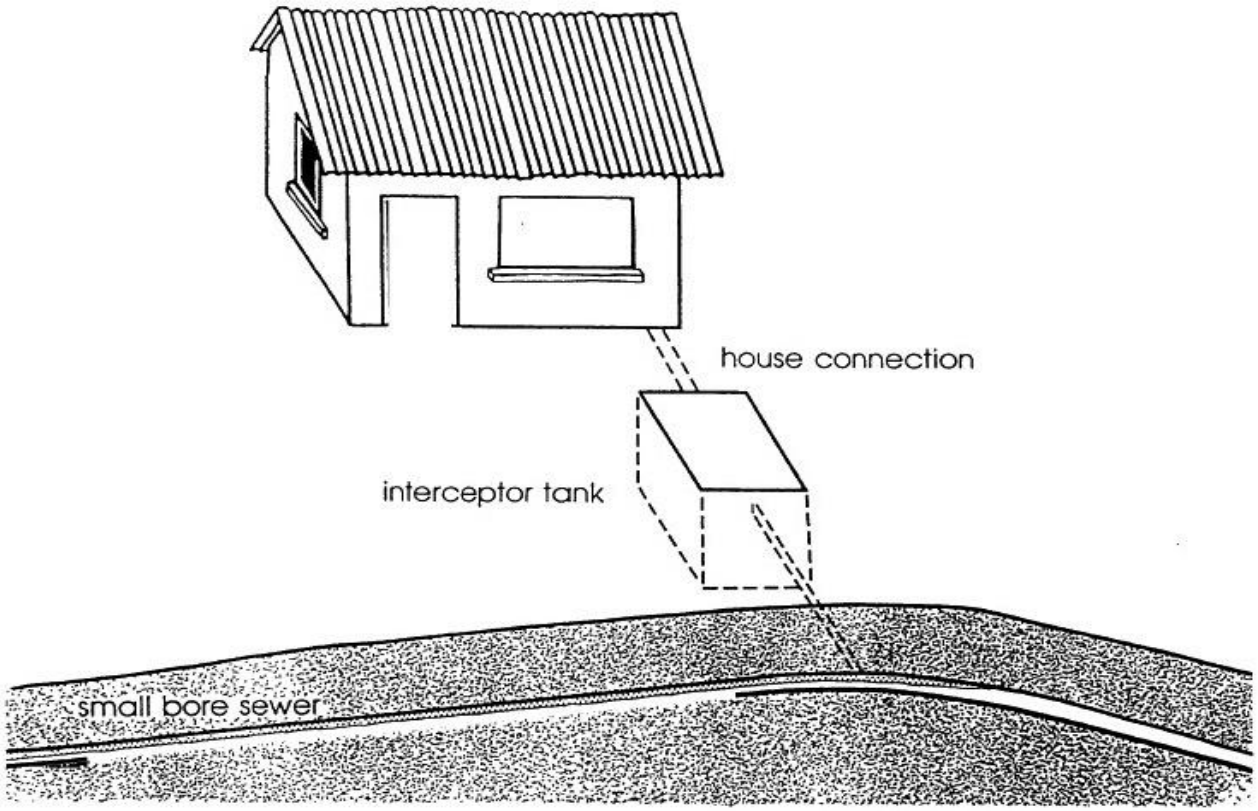
Advantages

Low capital cost and requires minimal operation & maintenance
Small land area required
Can be built and repaired with locally available materials and by the community

Disadvantages

High possibility of contaminating the ground water
Pre treatment of effluent may be required to avoid clogging
Should be avoided in places with high population density/ high ground water table/ where soil is majorly clay/ where areas are prone to floods

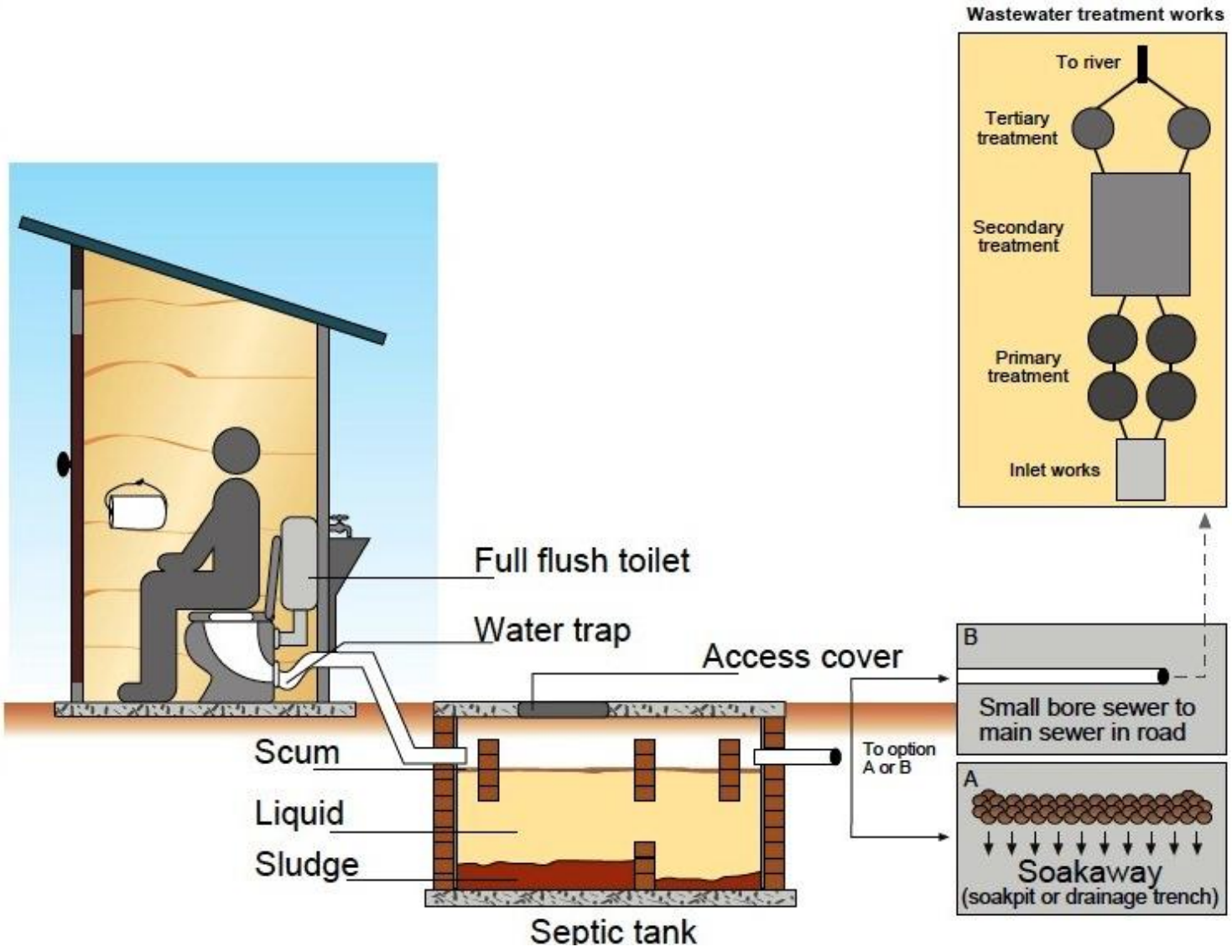
Small bore sewer system



Source: Otis & Mara

Small bore sewer system, also known as solids free sewer, divides the sewage into two components at the source itself using an interceptor.

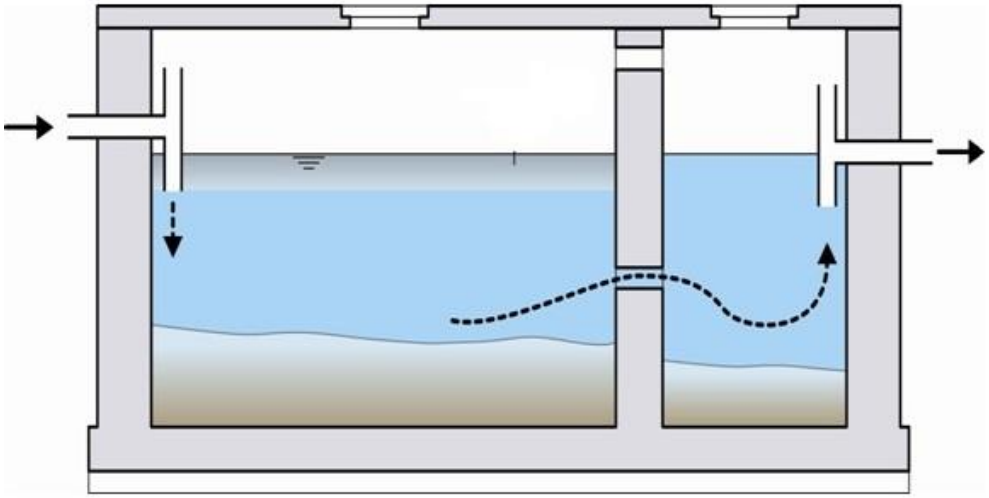
Septic tank and soakaway or small bore solid-free sewer



Small bore sewer system

Advantages	Disadvantages
Reduced Water Requirements, since sewers are not supposed to carry any solids	Needs periodic evacuation and disposal of solids from each interceptor tank in the system.
Reduced excavation costs, since sewers don't require that much slope, as in the conventional sewer lines	Since the bore is small, there is a possibility of pipe getting choked with floating material
Reduced material costs, as pumps and pipes required are economical as dealing with only liquid	Requires expert design and construction supervision
Reduced treatment requirements, as pretreatment occurs at the interceptor itself	

Septic Tank



A sedimentation tank in which settled sludge is partially stabilised by anaerobic digestion

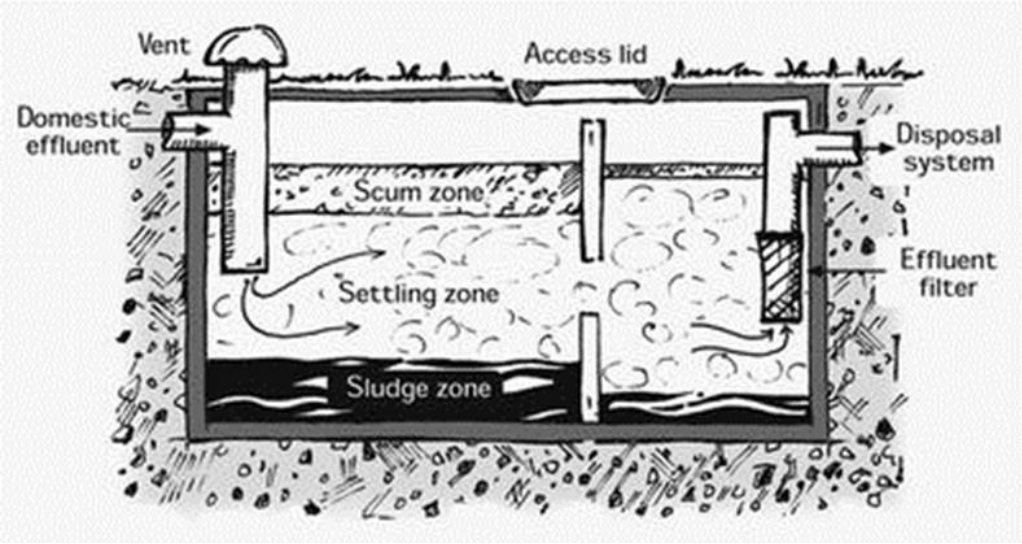
- most frequent onsite treatment unit worldwide
- Consists of 2 to 3 compartments

+ simple, little space required because of being underground
+ low O&M cost

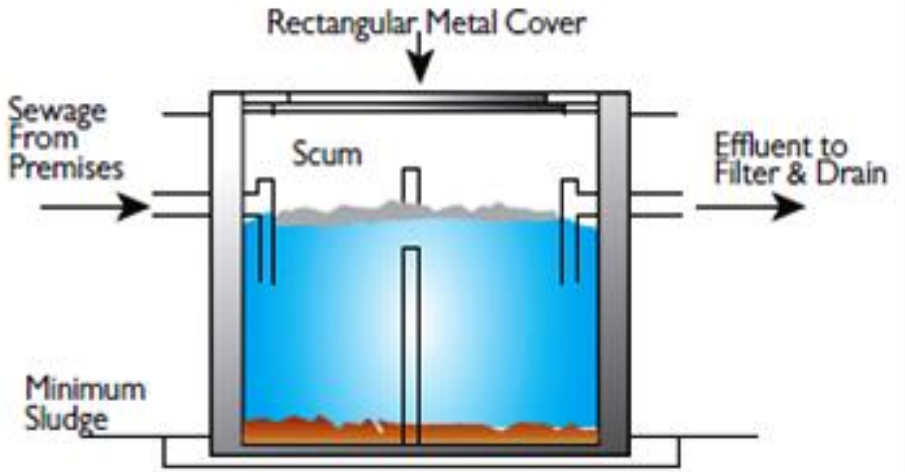
- little removal of dissolved and suspended matter (BOD removal approx. 50%)
- high investment cost

- Septic tanks are generally designed only for black water
- Effluent from septic tank further needs secondary treatment

Septic Tank



Source: http://www.nrc.govt.nz



Source: AECOM, 2010

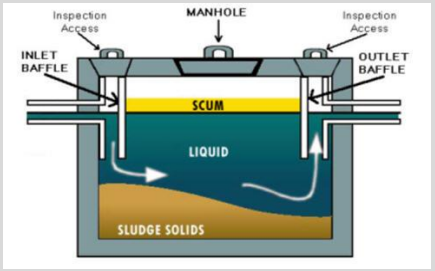
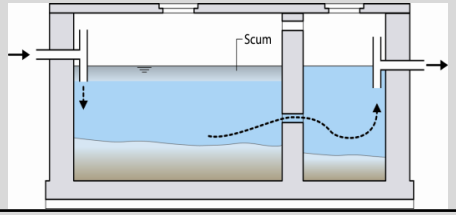
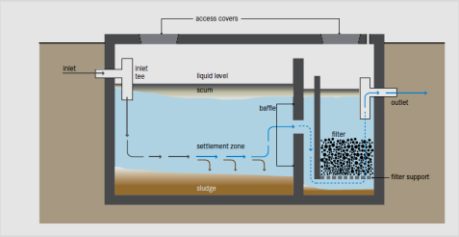
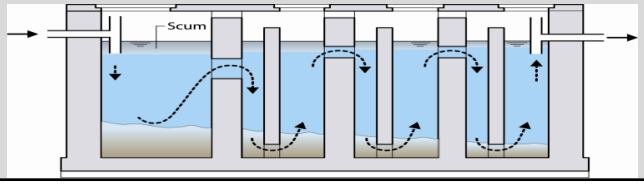
Advantages

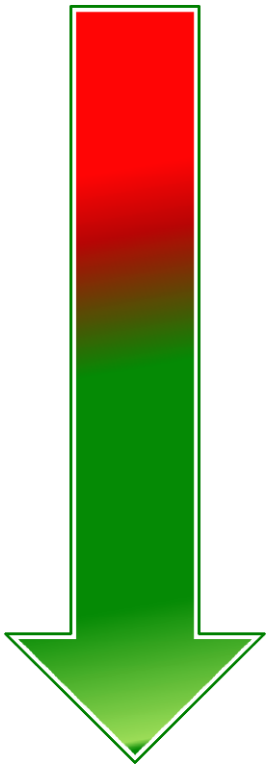
No energy required, Long life
Low capital and O&M cost
Less space required (under ground)
Biogas can be recovered

Disadvantages

High cost as compared to dry or composting toilet systems
De-sludging required: Manual de-sludging is hazardous to health and mechanical de-sludging (vacuum trucks) requires the infrastructure

Septic Tanks – Technical Options

Conventional Systems	Single chambered Septic Tank	
	Two chambered Septic Tank	
Improved Systems	Two chambered Septic Tank with filter	
	Anaerobic Baffled Reactor with Filter	



Designing of a Septic tank

- The tank should be large enough to provide space for sedimentation of solids, digestion of settled sludge, and storage of sludge and scum accumulated between successive cleaning.
- Septic tanks are generally designed for 24 hr. liquid retention time at average daily flow
- The flow of sewage is considered to be proportional to the number of fixture units discharging simultaneously.
- One fixture unit is treated as equivalent to the flow of 10l./min.

Capacity of a Septic tank

Depends on

- **Sedimentation**: An area of **0.92 m^2** is required for every **10 l./min.** peak flow rate to support adequate sedimentation of suspended solids. **Generally depth of sedimentation zone is 0.3 m.**
- **Sludge Digestion**: Capacity of digestion zone works out to be **0.032 m^3/capita**.
- **Sludge and Scum Storage**: For interval of 1 year of sludge cleaning, a sludge storage capacity of 0.0002*365 = 0.073 m^3/capita is required.
- **Free Board: at least 0.3 m**

Specifications of a Septic Tank

- Rectangular: length to breath ratio: **3 to 1**
- Depth: between **1.0 to 2.5m**
- Two chambered: First chamber 2/3 of total length
- Three chambered: First chamber half of total length

  Manholes above each chamber

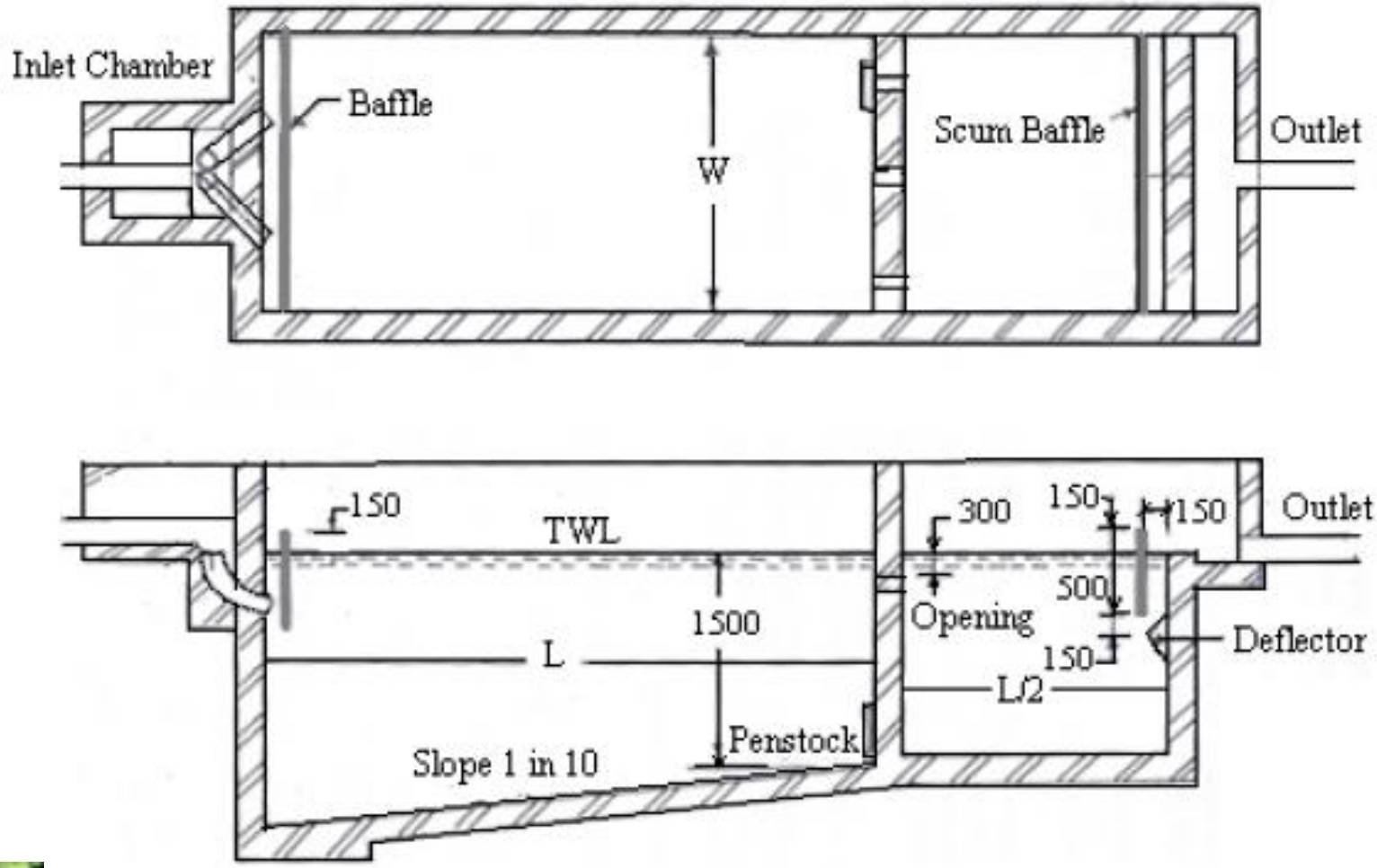
  Watertight, durable and stable tank

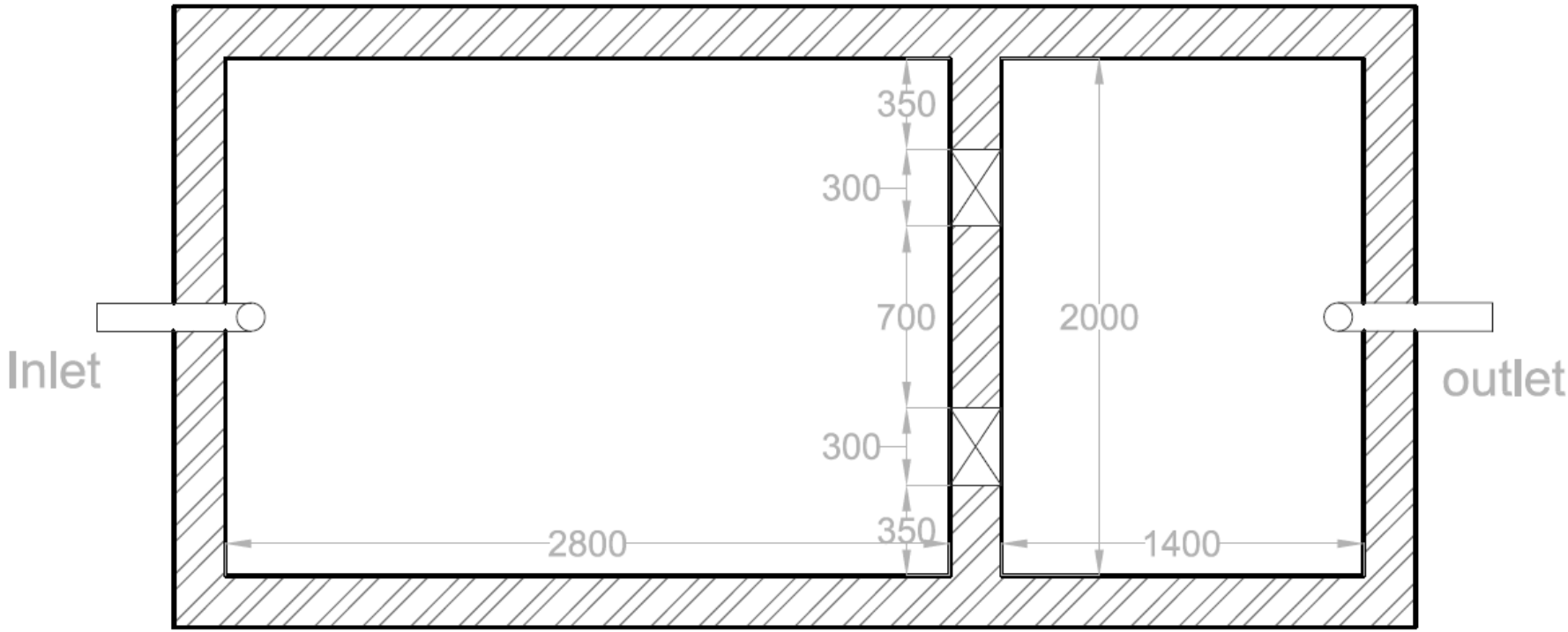
For more details see IS:2470 (part-ii) -1985

Characteristics of wastewater to be considered for septic tank design

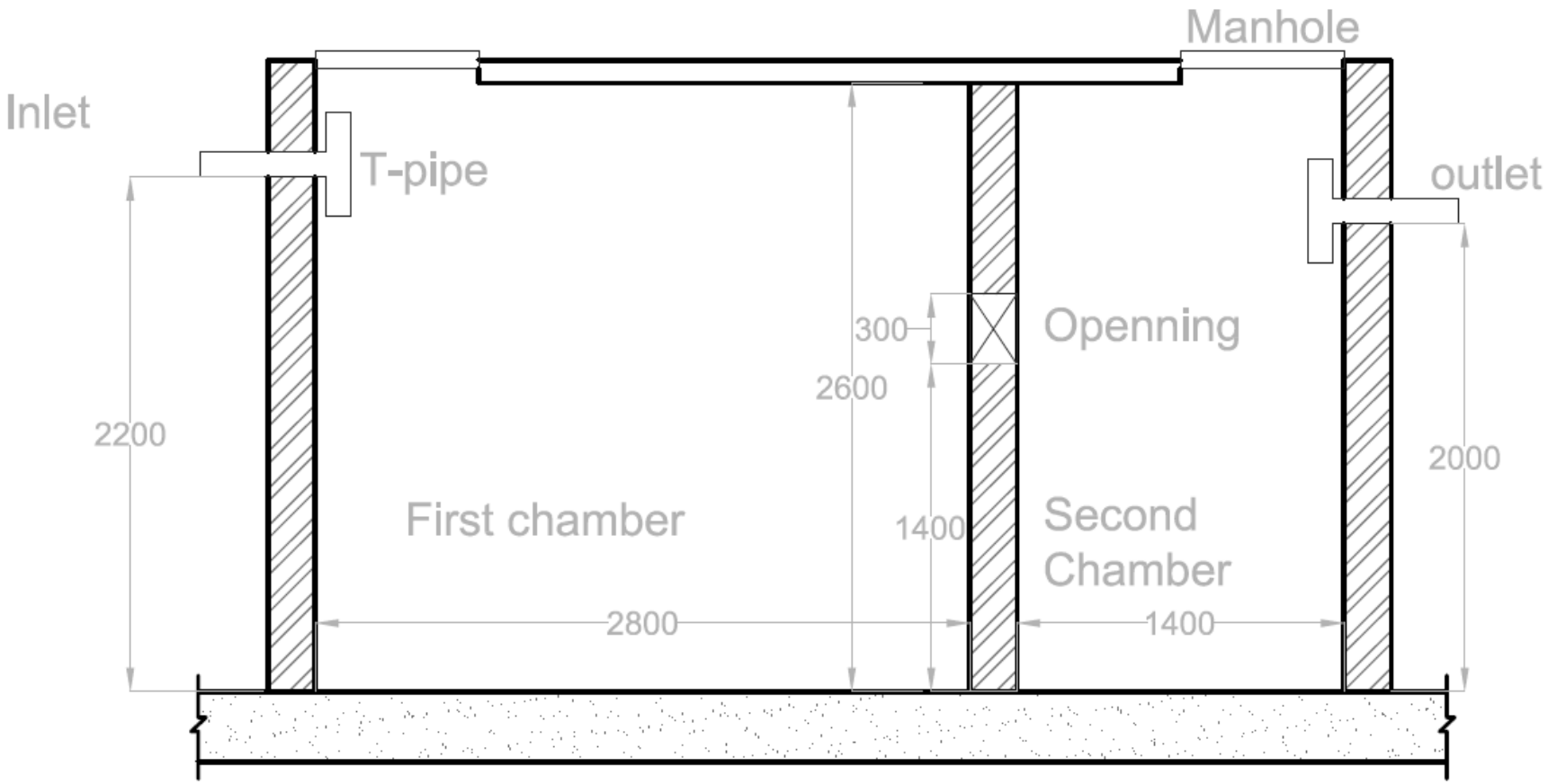
Average flow per capita	100 - 160 L/day
Peak flow per capita	170 - 270 L/day
BOD per capita	0.045 kg/day
Suspended solids per capita	0.070 – 0.090 kg/day
Soluble solids per capita	0.035 kg/day
Sludge accumulation per capita	0.073 m^3/year

Construction of a septic tank





Septic Tank Plan



Septic Tank Section

Thank You