EXCRETA DISPOSAL in EMERGENCIES

A service, not just an infrastructure

Foreword

This manual aims to help you find your way around excreta disposal systems wherever your curiosity leads you. Next you will find the main page where you can click on any topic to go directly to the sections and sub-sections that interest you. In each section a menu on the left side lists links to the manual's chapters. For any subchapter that contains more than one page you will find navigation arrows on the top right side of the page.

At the bottom of each page, you will find the references used and if it is available on the web a hyperlink has been added for you to reach and consult the original document. You are encouraged to click on the reference titles to open the hyperlinks and look at the documents to find further information.

Enjoy your reading

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with inputs from Raissa Azzalini, Zulfiquar Ali Haider, Frederick Komakech and other Oxfam colleagues' resources whose products can be found in https://www.oxfamwash.org/en

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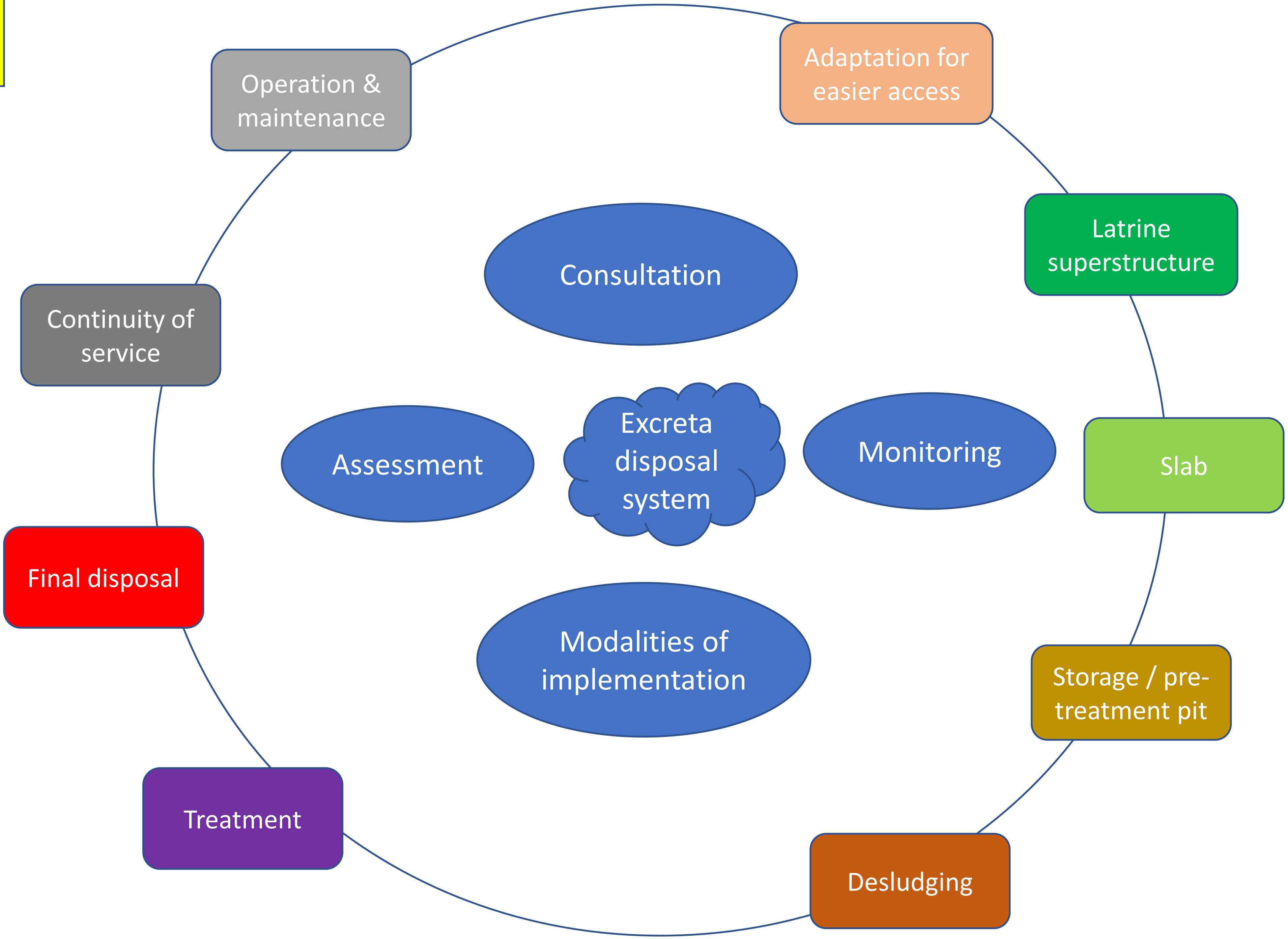

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Process to select the most appropriate technologies

Step 1 Conduct rapid needs assessment (including users' consultation) and mapping of the settlement area. 7 key important social and physical factors in deciding which technology /design to use

Step 2 Apply decision tree for sanitation design including materials available and how the latrine will be desludged to identify the most appropriate sustainable design latrine

Step 3 Rapidly construct latrines then get feedback on their use and modify accordingly (Sani Tweaks approach)

Step 4 Design and implement a system for keeping the latrines clean and in good repair

Step 5 Design the desludging modality and whether a centralized or decentralized faecal sludge treatment plant is necessary

Step 6 Consult with local authorities and utilities to determine the most appropriate treatment options and end-product market, design parameters (e.g., site location, skillset, operation and maintenance requirement)

Step 7 Determine implementation modalities for the treatment facility (by contractor or not; with or without local authorities /utility) and implement the agreed treatment design

Step 8 Implement a monitoring and tracking feedback from the users – Continue consultation. Improve the quality based on the feedbacks and meet users' expectations

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Technology choices

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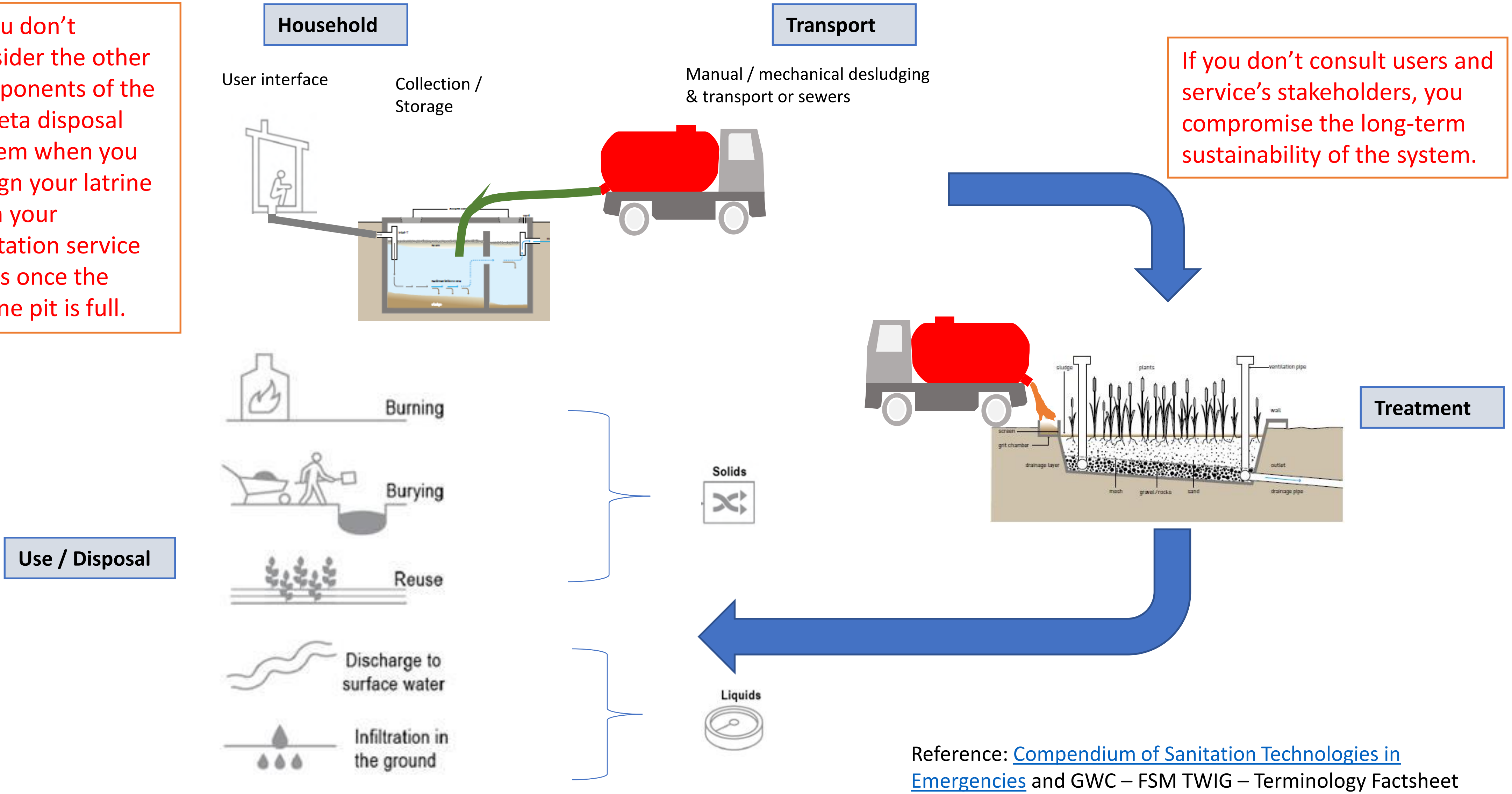
A complete excreta disposal system doesn't stop at the latrine, whether communal in a camp or familial in household compound. It also includes a desludging / transportation service and an off-site treatment and final disposal site. Various technical options are available for each component of the sanitation service chain. The next page shows a table of suitable options according to the emergency phase.

If you don't consider the other components of the excreta disposal system when you design your latrine then your sanitation service stops once the latrine pit is full.



Household

User interface

Collection / Storage

Transport

Manual / mechanical desludging & transport or sewers

If you don't consult users and service's stakeholders, you compromise the long-term sustainability of the system.

Treatment

Use / Disposal

Reference: [Compendium of Sanitation Technologies in Emergencies] and GWC – FSM TWIG – Terminology Factsheet

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Sanitation Technologies in Different Emergency Phases

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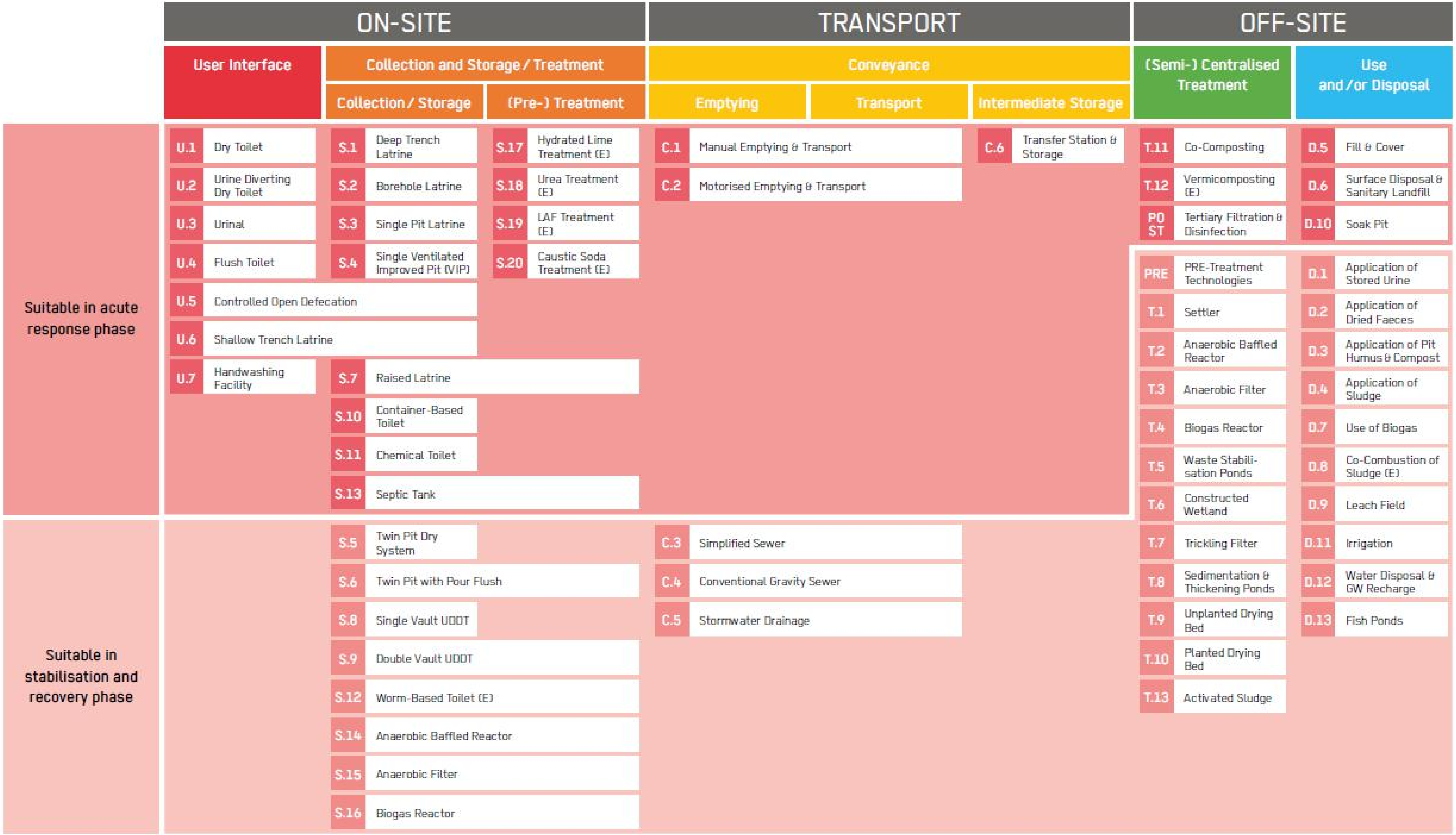

<table>
<tr><th rowspan="3"></th><th colspan="3">ON-SITE</th><th colspan="3">TRANSPORT</th><th colspan="2">OFF-SITE</th></tr>
<tr><th rowspan="2">User Interface</th><th colspan="2">Collection and Storage / Treatment</th><th colspan="3">Conveyance</th><th rowspan="2">(Semi-) Centralised Treatment</th><th rowspan="2">Use and/or Disposal</th></tr>
<tr><th>Collection / Storage</th><th>(Pre-) Treatment</th><th>Emptying</th><th>Transport</th><th>Intermediate Storage</th></tr>
<tr><td rowspan="2">Suitable in acute response phase</td><td rowspan="2">U.1 Dry Toilet
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<tr><td rowspan="2">PRE PRE-Treatment Technologies
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<tr><td>Suitable in stabilisation and recovery phase</td><td></td><td colspan="2">S.5 Twin Pit Dry System
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S.14 Anaerobic Baffled Reactor
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Reference “Compendium of sanitation technologies in Emergencies”

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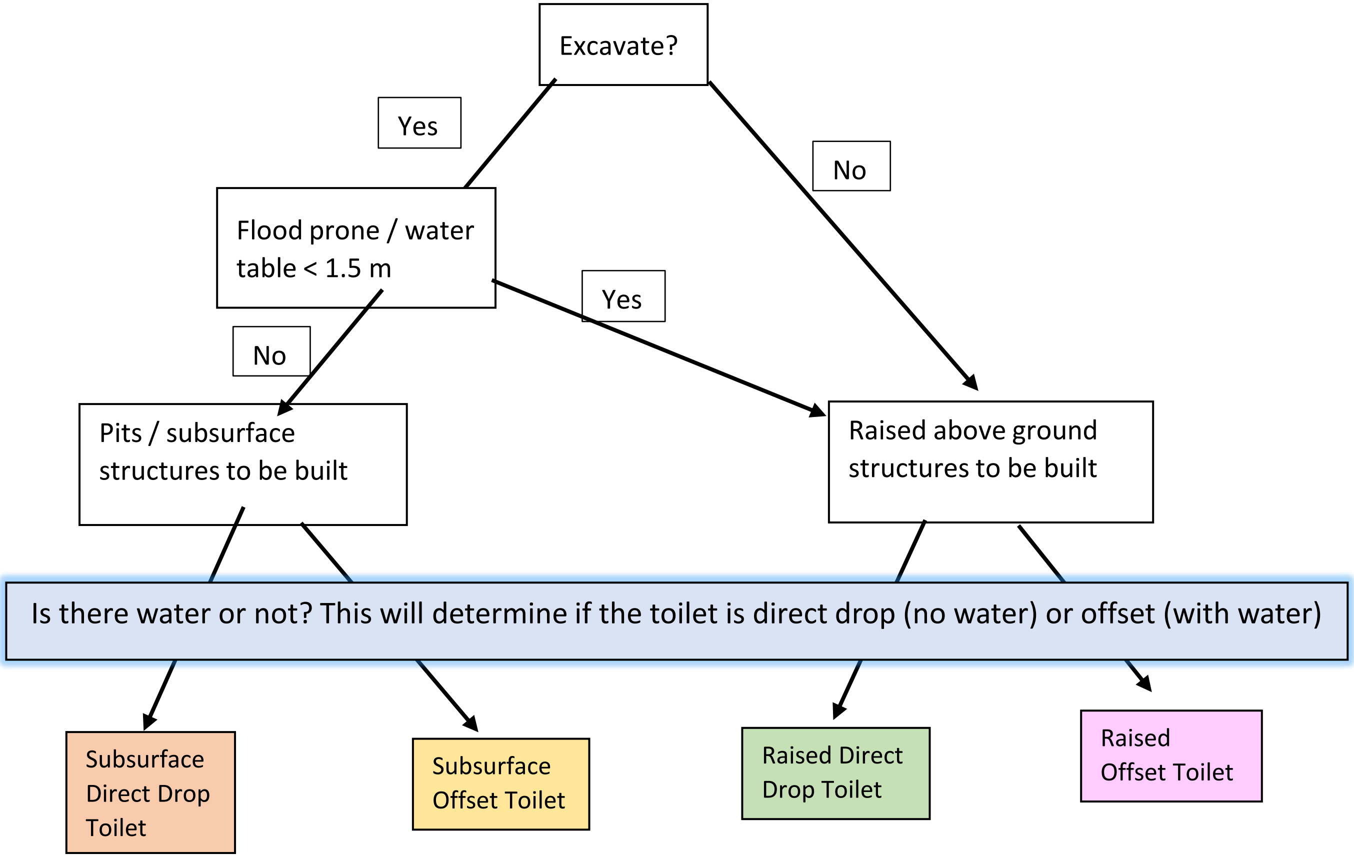
Decision tree for latrine

On-site toilet choice will depend on excavation, water table level and the space available



Excavate?

Yes

No

Flood prone / water table < 1.5 m

Yes

No

Pits / subsurface structures to be built

Raised above ground structures to be built

Is there water or not? This will determine if the toilet is direct drop (no water) or offset (with water)

Subsurface Direct Drop Toilet

Subsurface Offset Toilet

Raised Direct Drop Toilet

Raised Offset Toilet

Is the soil stable or unstable? Is there enough space to build new pit to replace full latrine or will the pit need to be desludged? This will determine is the pit is lined (unstable soil and /or desludging operation) or unlined (stable soil and no desludging)

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Decision tree for treatment and desludging service

There isn’t a simple decision tree to select technology options for desludging and treatment . For similar settings, it’s possible to make different selections based on what services are already available and what has been pre-positioned in contingency stock. However, there are some questions that will help you decide:

Desludging service

- Is there desludging services available, mechanical or manual?
- How accessible are latrines in the target area for trucks, for smaller mechanical system?
- What is the viscosity of the sludge and what is the farthest distance and height for pumping out?
- How scattered are the target latrines and what is the average distance for transport?
- Does the desludging system available required transport capacity and / or transfer stations?

Treatment service

- What daily volume of faecal sludge is collected and needs treatment?
- What is the level of technical expertise available?
- Is there an existing treatment facility and how far from the area of intervention?
- What are the local hydrogeological conditions and contamination risks? Are there local standards that need to be adhered to? Which treatment parameters (BOD, COD, E-Coli, N, P, pH, need to be monitored and treatment standard met?
- Will construction licence and environmental survey be required?
- Is there land available for building a centralised / semi-centralised treatment plant onsite or offsite and with which surface?
- What is the topography like and where can effluent be discharged? Does this location impose additional treatment requirement for the effluent?
- Is several decentralised treatment stations more efficient than one centralised / semi-centralised treatment plant (in term of CAPEX / OPEX, speed of construction, long term sustainability or integration with local sanitation plan)?
- Is there a market for faecal sludge treatment output, i.e fuel briquette, gas, dry sludge, compost, slurry from biodigestor, biomass?

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Design parameters and specifications

COVERAGE:

- Sphere Standard: Maximum of 20 people per latrine. (In initial phase aim for 50 p/p/latrine) Trench latrines: maximum of 100 people per 3.5m length of trench at 1m deep and 300mm wide. **Separate toilets may need to be provided for men and women – distance to be determined following consultation with women. Ensure disabled toilets and facilities for children**

POSITION:

- Toilets should be no more than 50m from dwellings. Pit latrines should be a minimum of 6m from dwellings. Latrines should be at least 30m from any ground water sources. Latrines should be available in public places such as markets, health centres & food/non-food distribution points.

PIT DEPTH

- The bottom of the latrine should be at least 1.5m above the water table. In fine unsaturated soils and unconsolidated strata within 1.5m virtually all bacteria, viruses and other faecal organisms are removed. This distance will increase in large grained soils, gravels or fissured rock.

ACCUMULATION RATES (approx.)

- **Solids:** 0.5 Litres/person/day in emergencies (0.04 - 0.15m^3/person/year in stable situations) **Liquid:** 0.8 Litres/person/day where water is not used for anal cleansing (approx.) If water is used for anal cleansing the design figure is 1.3 l/p/d. In the initial phase, before wash areas are constructed, people may wash in latrines in which case the figure could be 8 – 10 l/p/d

OTHER:

- **Ensure locks for doors. All doors should have a functioning locking mechanism.** Security lighting may also be necessary. Provide handwashing facilities and if necessary, water or other materials for anal cleansing. Special rails may also be needed to assist the disabled and elderly.

Children's And Infant's Excreta

Children under five often make up a significant proportion of the population in many poorer countries – up to 20% in some instances. It is therefore important that ways are also found to dispose of their excreta safely. This issue must be discussed with mothers, especially to identify whether nappies, potties or specially designed latrines will be necessary

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Latrine choices

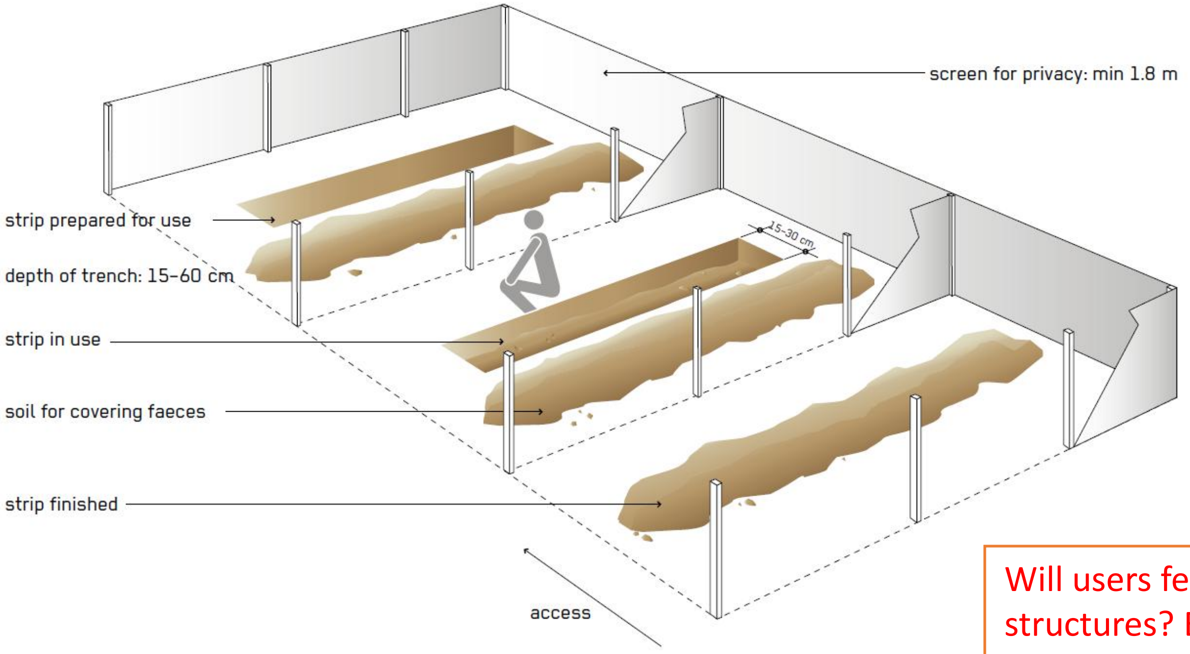
Sub Surface Direct drop toilet (Excavate)

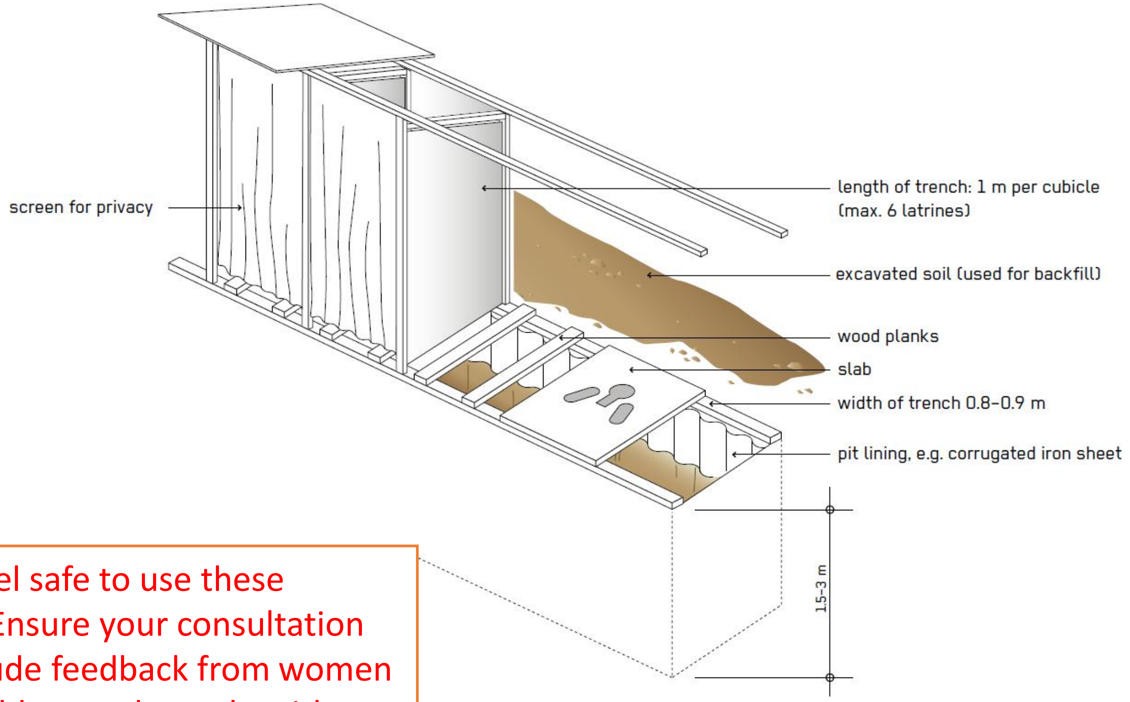
Shallow trench latrine

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
** Acute Response Stabilisation Recovery	Household ** Neighbourhood * City	Household Shared ** Public	Minimising immediate public health risk, Prevention of random open defecation, Fast implementation
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
*** High	* Low	● Faeces, ● Excreta (+ ● Dry Cleansing Materials) (+ ● Anal Cleansing Water)	● Excreta

Deep trench latrine

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
** Acute Response * Stabilisation Recovery	Household ** Neighbourhood City	Household * Shared ** Public	Excreta containment, Minimising immediate public health risk, Fast implementation
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
** Medium	* Low	● Excreta, ● Faeces, ● Blackwater, (● Anal Cleansing Water), (● Dry Cleansing Materials)	● Sludge





Will users feel safe to use these structures? Ensure your consultation process include feedback from women and girls, children and people with mobility issues.

Reference: Compendium of Sanitation Technologies in Emergencies

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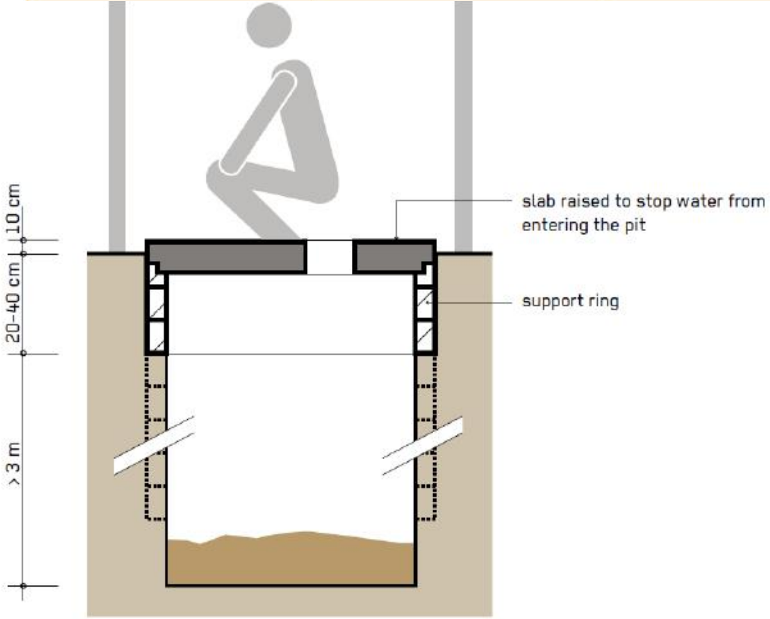
Sub Surface Direct drop toilet (Excavate)

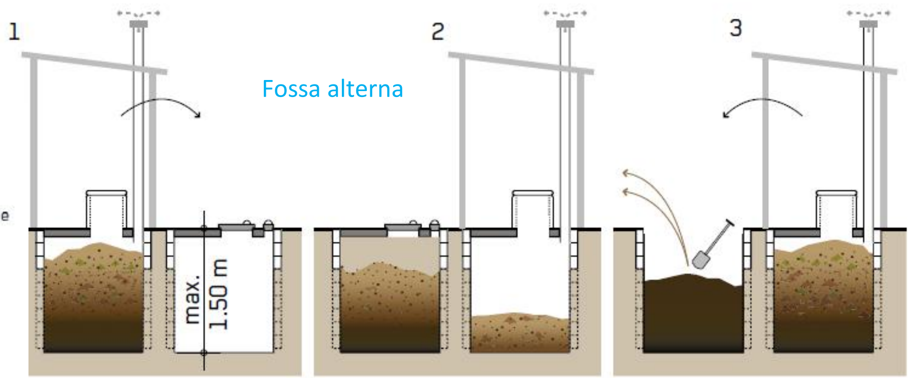
Single pit latrine

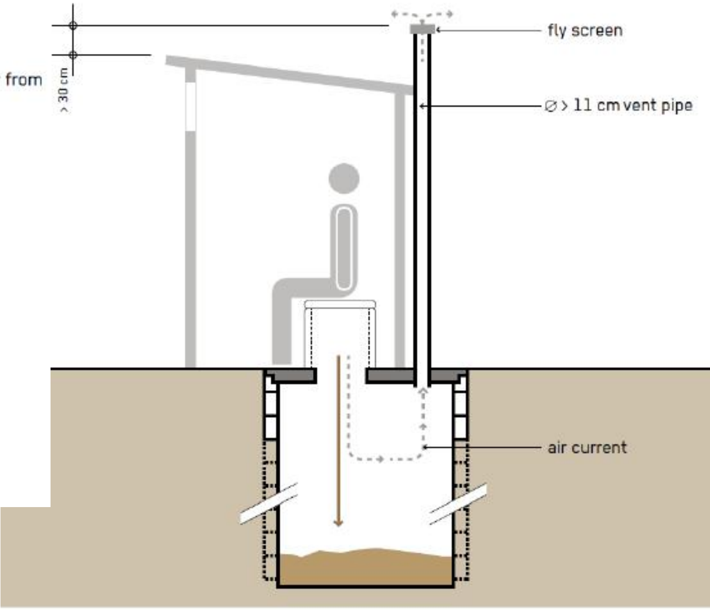
Phase of Emergency ★★ Acute Response ★★ Stabilisation ★★ Recovery	Application Level / Scale ★★ Household ★ Neighbourhood City	Management Level ★★ Household ★★ Shared Public	Objectives / Key Features Excreta containment, Sludge volume reduction
Space Required ★ Little	Technical Complexity ★ Low	Inputs ● Faeces, ● Excreta, ● Blackwater, (+ ● Dry Cleansing Materials), (+ ● Anal Cleansing Water)	Outputs ● Sludge

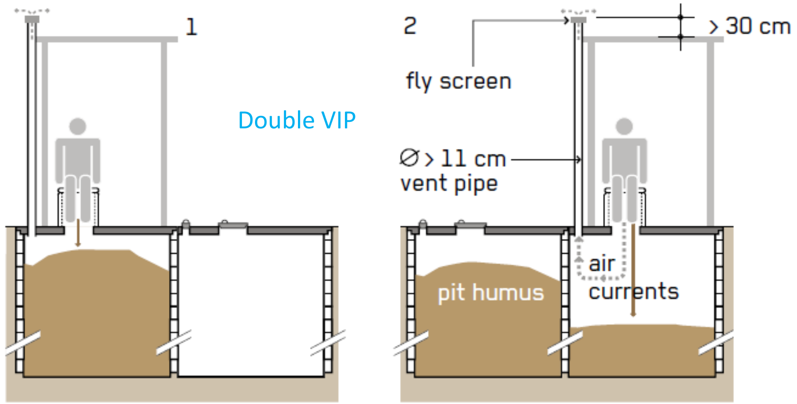


Twin Pits Dry System

Phase of Emergency Acute Response ★★ Stabilisation ★★ Recovery	Application Level / Scale ★★ Household ★★ Neighbourhood City	Management Level ★★ Household ★★ Shared ★ Public	Objectives / Key Features Excreta containment, Sludge volume reduction, Extended treatment time
Space Required ★★ Medium	Technical Complexity ★ Low	Inputs ● Excreta, ● Faeces, (● Organics), (● Anal Cleansing Water), (● Dry Cleansing Materials)	Outputs ● Pit Humus







Single ventilated improved pit (VIP)

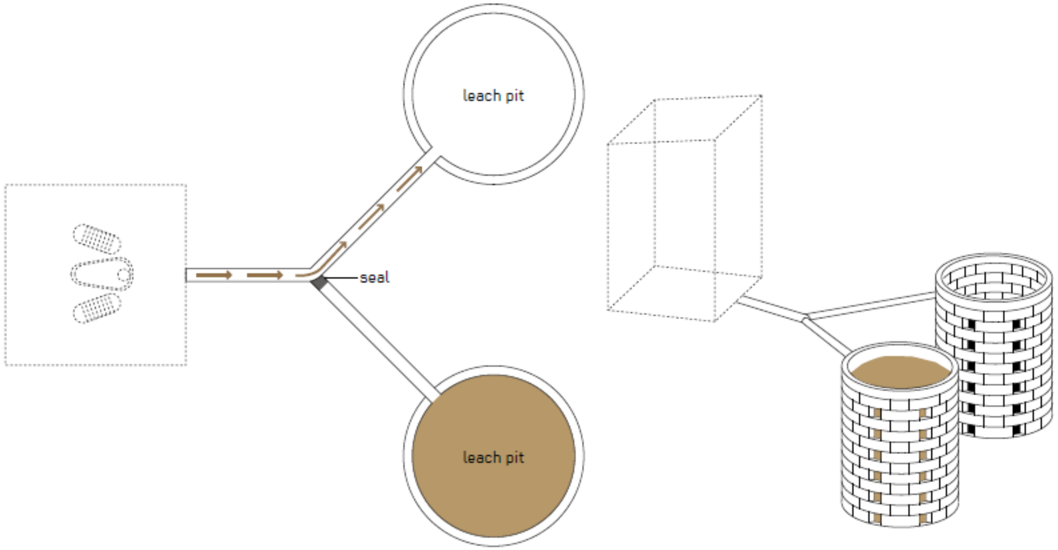
Phase of Emergency ★ Acute Response ★★ Stabilisation ★★ Recovery	Application Level / Scale ★★ Household ★★ Neighbourhood City	Management Level ★★ Household ★★ Shared ★ Public	Objectives / Key Features Excreta containment, Sludge volume reduction, Reduction of odour and flies
Space Required ★ Little	Technical Complexity ★ Low	Inputs ● Excreta, ● Faeces, ● Blackwater, (● Anal Cleansing Water), (● Dry Cleansing Materials)	Outputs ● Sludge

Reference: [Compendium of Sanitation Technologies in Emergencies]

Sub Surface offset toilet (Excavate + Water)

Twin Pits for Pour Flush

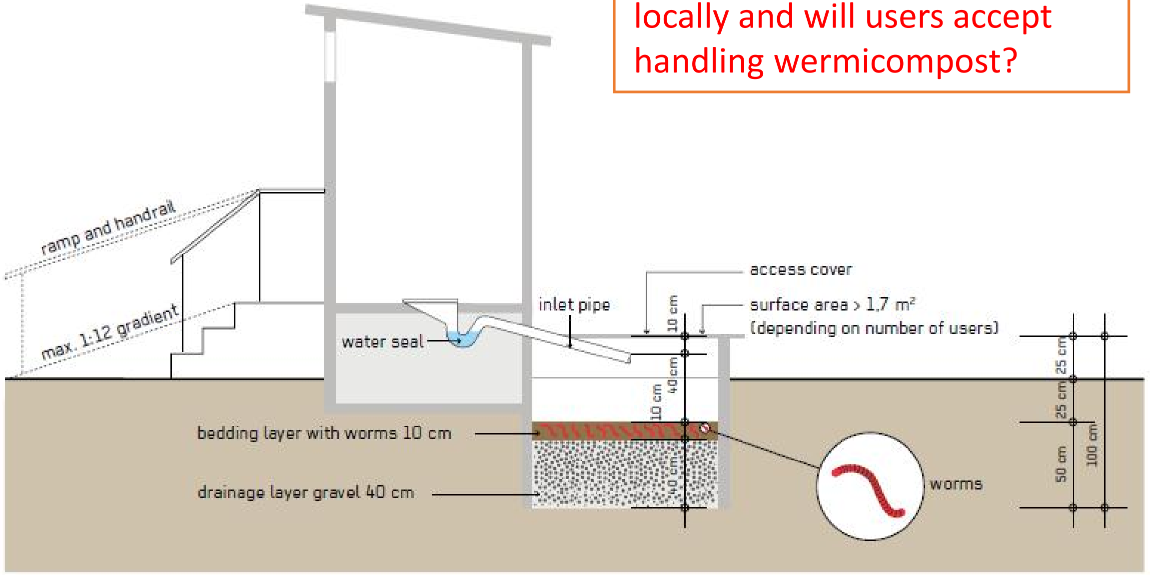
Phase of Emergency Acute Response ★ Stabilisation ★★ Recovery	**Application Level / Scale** ★★ Household ★★ Neighbourhood City	**Management Level** ★★ Household ★★ Shared ★ Public	**Objectives / Key Features** Excreta containment, Sludge volume reduction, Extended treatment time
Space Required ★★ Medium	**Technical Complexity** ★ Low	**Inputs** ● Blackwater, (● Greywater)	**Outputs** ● Pit Humus



Worm-Based Toilet (Emerging Technology)

Phase of Emergency Acute Response ★ Stabilisation ★★ Recovery	**Application Level / Scale** ★★ Household ★ Neighbourhood City	**Management Level** ★★ Household ★★ Shared Public	**Objectives / Key Features** Excreta containment, Sludge volume reduction, Pathogen reduction
Space Required ★ Little	**Technical Complexity** ★★ Medium	**Inputs** ● Urine, ● Faeces, (● Dry Cleansing Materials), (● Anal Cleansing Water), ● Flushwater	**Outputs** ● Vermi-Compost, ● Effluent

Will you find appropriate worm locally and will users accept handling wermicompost?



Reference: Compendium of Sanitation Technologies in Emergencies

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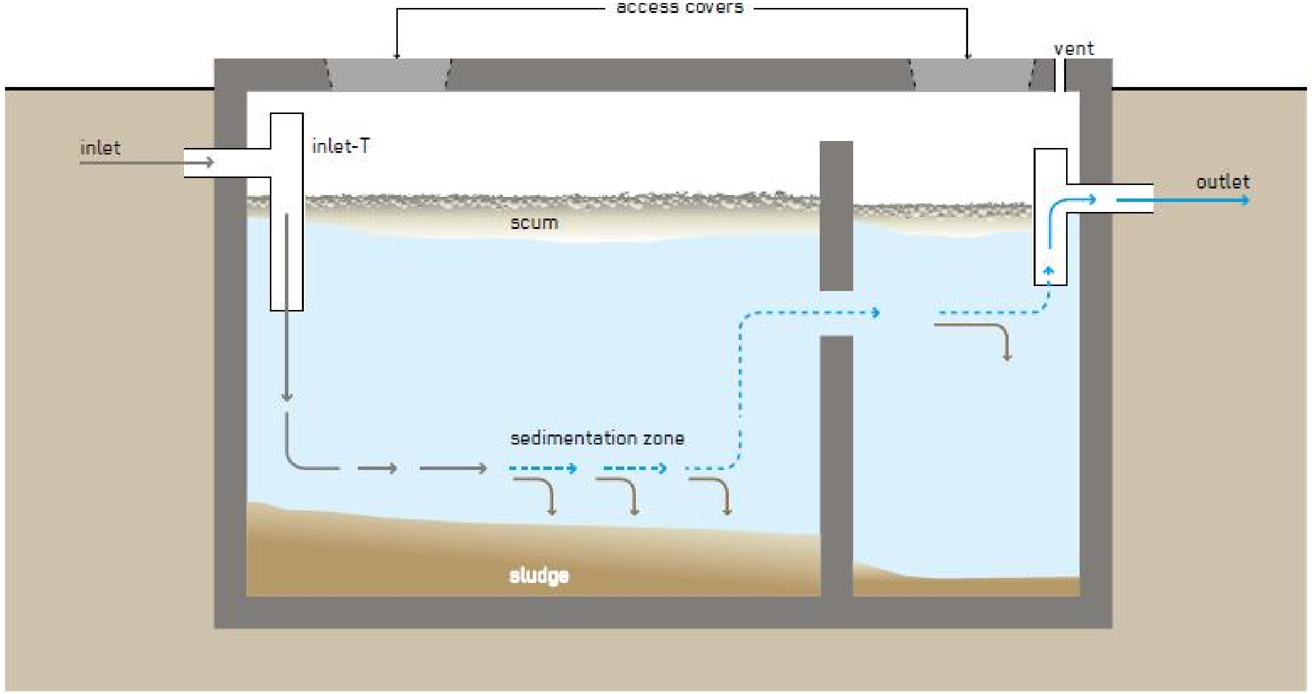
Sub Surface offset toilet (Excavate + Water)

Septic Tank

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
★ Acute Response ★★ Stabilisation ★★ Recovery	★★ Household ★★ Neighbourhood City	★★ Household ★★ Shared ★★ Public	Excreta containment, Solid / liquid separation
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★★ Medium	★ Low	● Blackwater, ● Greywater	● Effluent, ● Sludge



Effluent still contain contaminants and needs to be discharged either through a sewer or through a percolation field. How much space is available, and would user want to reuse effluent for irrigation? (meaning an additional step for effluent treatment will be required to reduce contamination risks or discouraging the idea)?

Reference: [Compendium of Sanitation Technologies in Emergencies]

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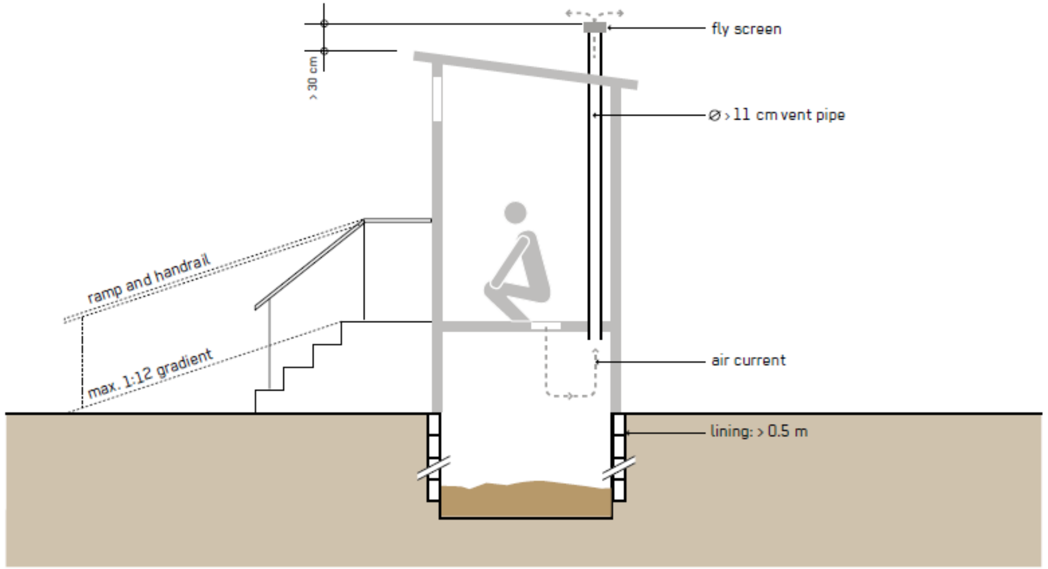
Raised direct drop toilet

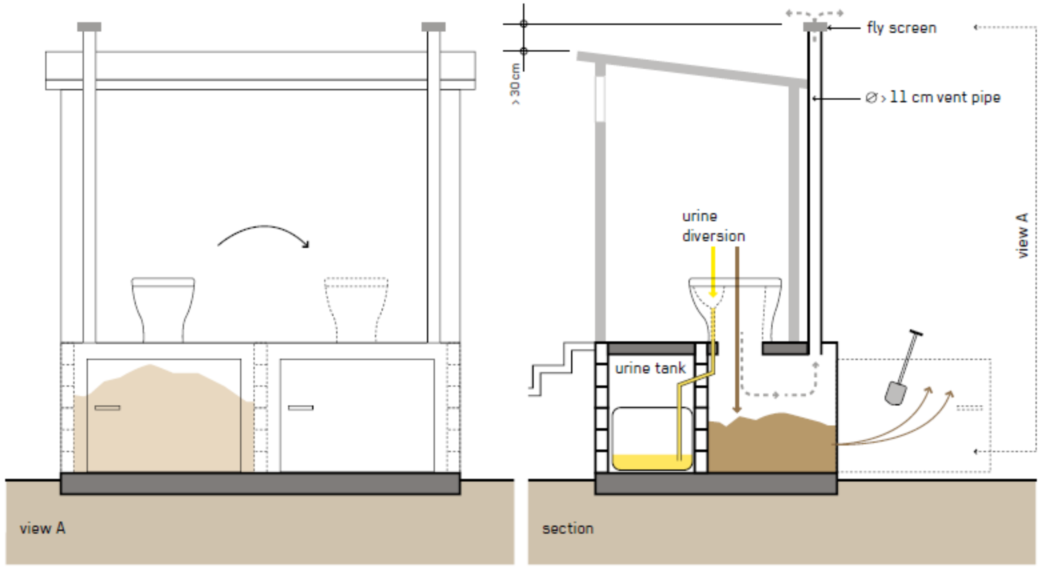
Raised Latrine

Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
★★ Acute Response ★ Stabilisation ★ Recovery	★★ Household ★★ Neighbourhood City	★★ Household ★★ Shared ★★ Public	Excreta containment, Alternative for challenging ground conditions
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★ Little	★ Low	● Excreta, ● Faeces, (● Anal Cleansing Water), (● Dry Cleansing Materials)	● Sludge



Double Vault UDDT
(Urine Diversion Dehydration Toilet)

Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
Acute Response ★★ Stabilisation ★★ Recovery	★★ Household ★★ Neighbourhood City	★★ Household ★★ Shared ★ Public	Excreta containment, Alternative for challenging ground conditions, Pathogen removal and nutrient recovery
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★ Little	★★ Medium	● Faeces, ● Urine, (● Dry Cleansing Materials), (● Anal Cleansing Water)	● Dried Faeces, ● Stored Urine



Consult with users to ensure they will feel comfortable emptying the stabilised dry sludge

Reference: Compendium of Sanitation Technologies in Emergencies

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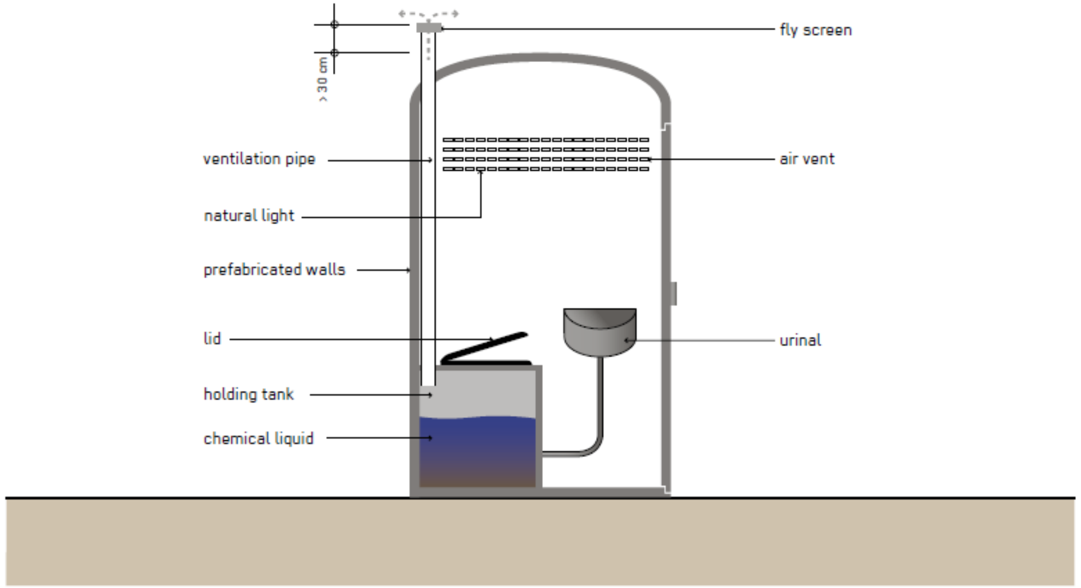
Raised direct drop toilet

Appropriate in places where there is little space, or where people are mostly renting their accommodation

Chemical Toilet

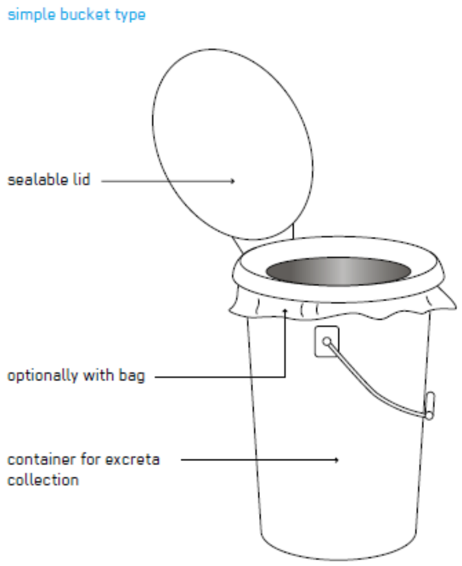
Phase of Emergency ★★ Acute Response Stabilisation Recovery	**Application Level/ Scale** Household ★★ Neighbourhood City	**Management Level** Household Shared ★★ Public	**Objectives / Key Features** Excreta containment, Fast implementation
Space Required ★ Little	**Technical Complexity** ★★ Medium	**Inputs** ● Faeces, ● Excreta, ● Blackwater, ● Chemicals, (+ ● Anal Cleansing Water), (+ ● Dry Cleansing Materials)	**Outputs** ● Sludge

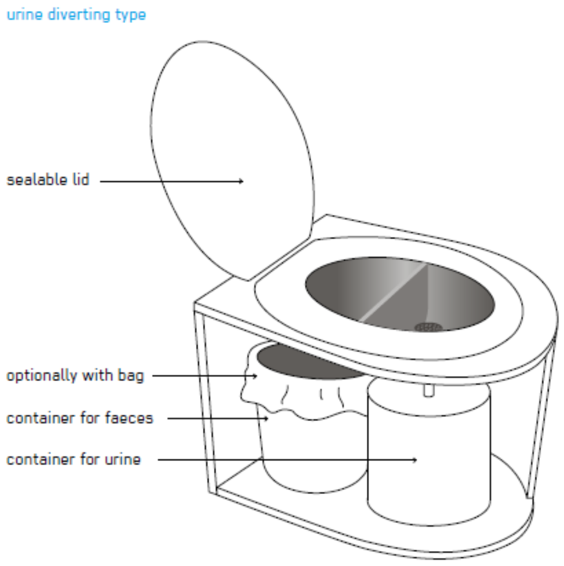


Reference: [Compendium of Sanitation Technologies in Emergencies]()

Container-Based Toilet

Phase of Emergency ★★ Acute Response ★ Stabilisation ★ Recovery	**Application Level/ Scale** ★★ Household ★ Neighbourhood City	**Management Level** ★ Household ★★ Shared ★★ Public	**Objectives / Key Features** Excreta containment, Increased privacy, Increased flexibility
Space Required ★ Little	**Technical Complexity** ★ Low	**Inputs / Outputs** ● Faeces, ● Urine, (● Dry Cleansing Materials), (● Anal Cleansing Water)	





Consult with users to ensure there is an appropriate system to collect, transport and safely disposed of bag (or clean containers)

Raised offset toilet (Water)

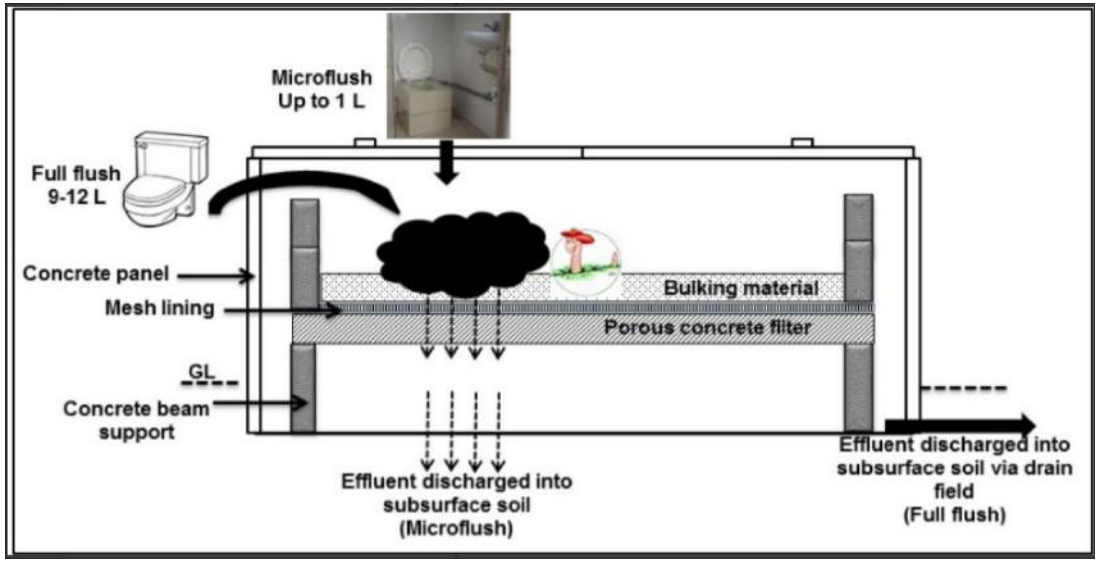
Raised Pour Flush

Worm-Based Toilet

Biofil Toilet

It is both a containment and a treatment technology. The system is composed of a pour flush interface, followed by a composting part were solids and liquid are separated. Microorganisms degrade matter through aerobic decomposition in enclosed container (Biofilcom, 2017)

No Users: 20	Height (m): 1.2	Area (m²): 2	Ratio (pers/m²): 8
DRY / [✓ WET]	[✓ ON-SITE] OFF-SITE	Inputs: Excreta	Outputs: Biogas, Effluent



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Transport choices

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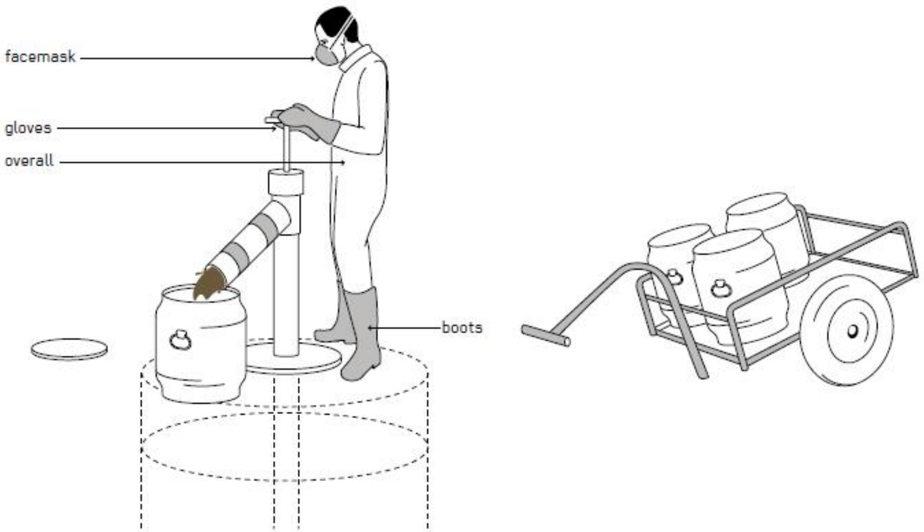
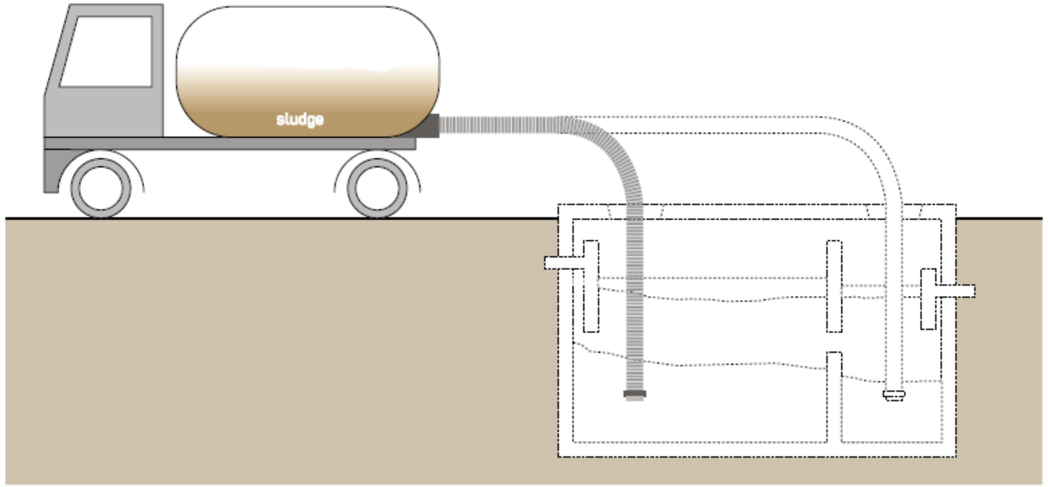
Manual emptying and transport

Phase of Emergency ★★ Acute Response ★★ Stabilisation ★★ Recovery	**Application Level / Scale** ★★ Household ★★ Neighbourhood City	**Management Level** ★ Household ★★ Shared ★★ Public	**Objectives / Key Features** Emptying and transport where access is an issue
Space Required ★ Little	**Technical Complexity** ★ Low	**Inputs / Outputs** ● Sludge, ● Blackwater, ● Effluent, ● Urine, ● Stored Urine	



Motorised emptying and transport

Phase of Emergency ★★ Acute Response ★★ Stabilisation ★★ Recovery	**Application Level / Scale** ★★ Household ★★ Neighbourhood ★ City	**Management Level** Household ★ Shared ★★ Public	**Objectives / Key Features** Emptying and transport, Efficiency of emptying
Space Required ★★ Medium	**Technical Complexity** ★★ Medium	**Inputs / Outputs** ● Sludge, ● Blackwater, ● Effluent, ● Urine, ● Stored Urine	



Reference: Compendium of Sanitation Technologies in Emergencies

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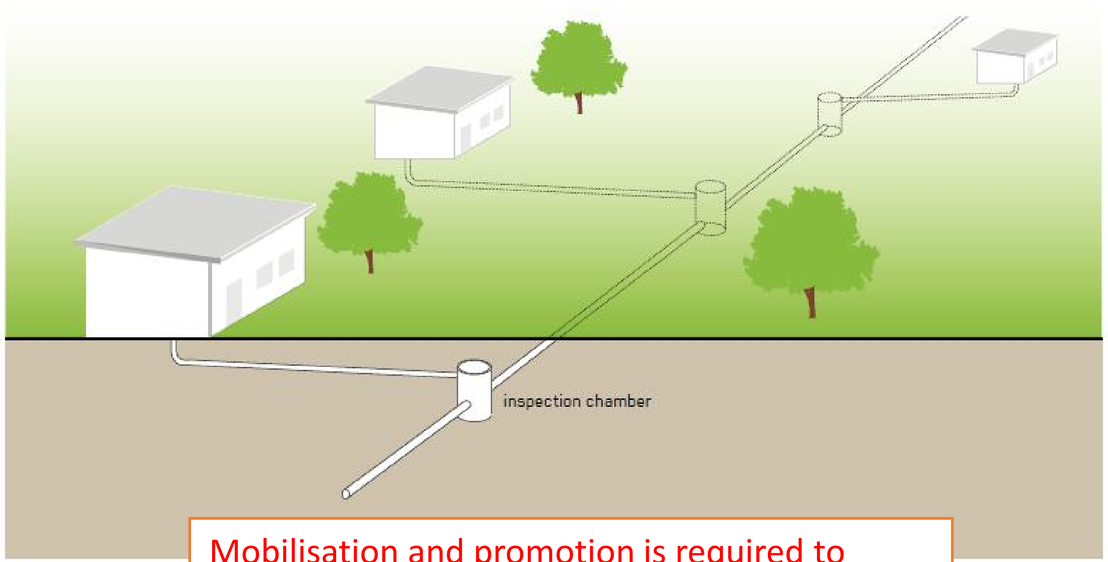
Simplified sewer

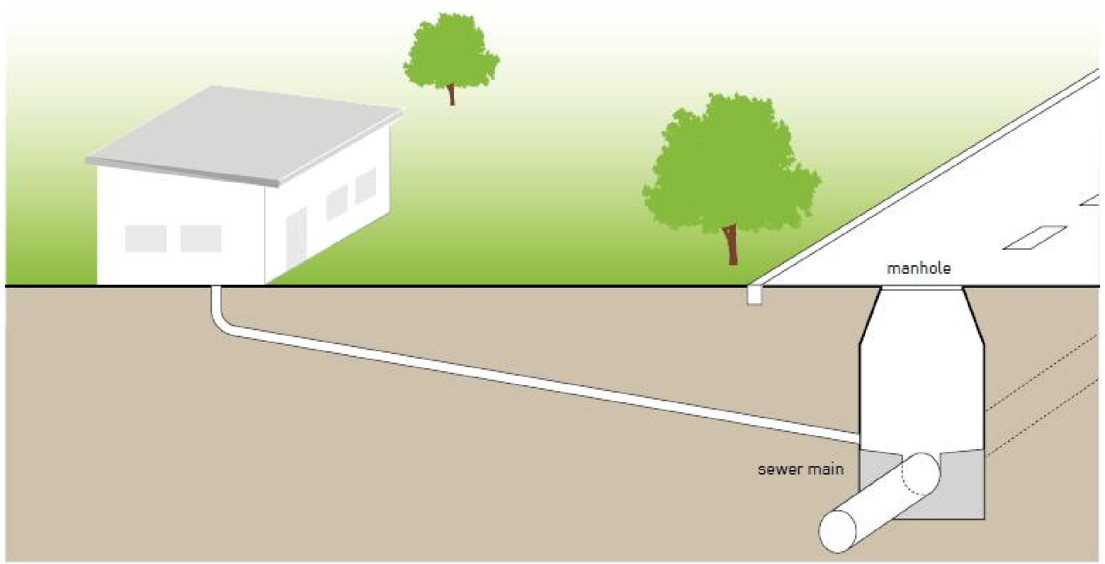
Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response ★ Stabilisation ★★ Recovery	Household ★★ Neighbourhood ★ City	★ Household ★★ Shared ★★ Public	Conveyance of wastewater
Space Required	**Technical Complexity**	**Inputs / Outputs**	
★★ Medium	★★ Medium	● Blackwater, ● Greywater, ● Effluent	



Mobilisation and promotion is required to minimise pipe blockage and facilitate proper maintenance. Prior consultation will be used to determine an appropriate O&M mechanism

Conventional gravity sewer

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response ★ Stabilisation ★★ Recovery	Household ★ Neighbourhood ★★ City	Household Shared ★★ Public	Conveyance of wastewater and stormwater
Space Required	**Technical Complexity**	**Inputs / Outputs**	
★★ Medium	★★★ High	● Blackwater, ● Greywater, ● Stormwater	



Reference: [Compendium of Sanitation Technologies in Emergencies]

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Treatment choices

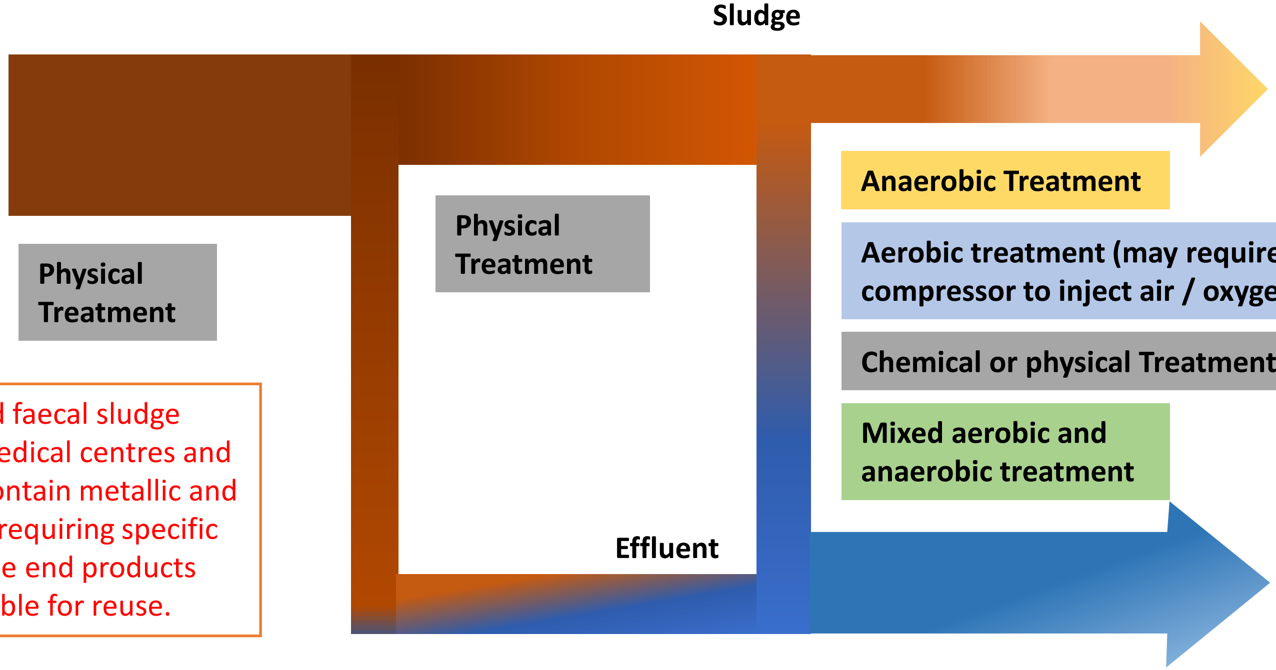
A treatment plant is constituted of different treatment steps, each with various choices.

Pre-treatment

Primary treatment

Secondary treatment

Tertiary treatment



Blackwater
Greywater
Faecal sludge

Physical Treatment

Sludge

Physical Treatment

Effluent

Anaerobic Treatment

Aerobic treatment (may require compressor to inject air / oxygen)

Chemical or physical Treatment

Mixed aerobic and anaerobic treatment

Dry sludge
Biomass
Biogas
Compost

Effluent

Fuel briquette manufacturing
Co-composting

Initial consultation with users is required to ensure the quality and reuse of treatment outputs fit into the local circular economy and match population needs.

Post treatment

Producing swimming water quality effluent

Wastewater and faecal sludge generated by medical centres and factories may contain metallic and other pollutant requiring specific treatment whose end products may not be eligible for reuse.

Eliminate grit and solid waste to protect equipment (pump, pipe) and ensure the quality of end product

Dewatering and concentration of sludge to reduce the size of the secondary treatment infrastructure

Organic matter (BOD, TDS, TSS) and nutrient reduction and / or transformation, pathogen removal are various objectives achieved by the different treatment structures

This stage depend on environment sensitivity, local regulations and standards, for reuse and / or disposal compared to the quality of output from the secondary treatment

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Pre- and Post treatment

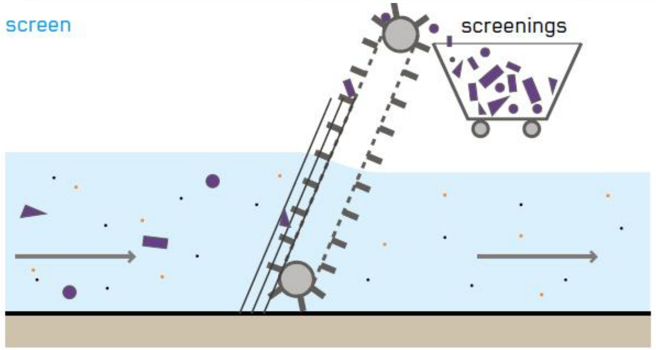
Pre-Treatment

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	* Household ** Neighbourhood ** City	* Household * Shared ** Public	Ensuring durability and proper functioning of subsequent systems
Space Required	Technical Complexity	Inputs	Outputs
* Little	** Medium	● Blackwater, ● Greywater, ● Sludge	● Blackwater, ● Greywater, ● Sludge, ● Pre-Treatment Products

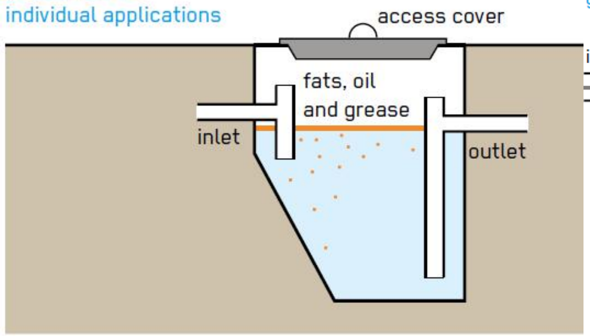
Post-Treatment

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
* Acute Response * Stabilisation ** Recovery	Household * Neighbourhood ** City	Household * Shared ** Public	Removal of residual suspended solids and pathogens
Space Required	Technical Complexity	Inputs	Outputs
* Little	** Medium	● Effluent	● Treated Effluent

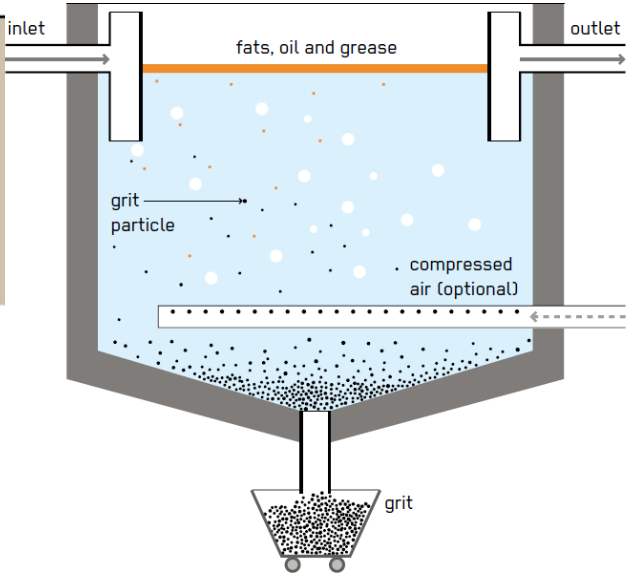
screen

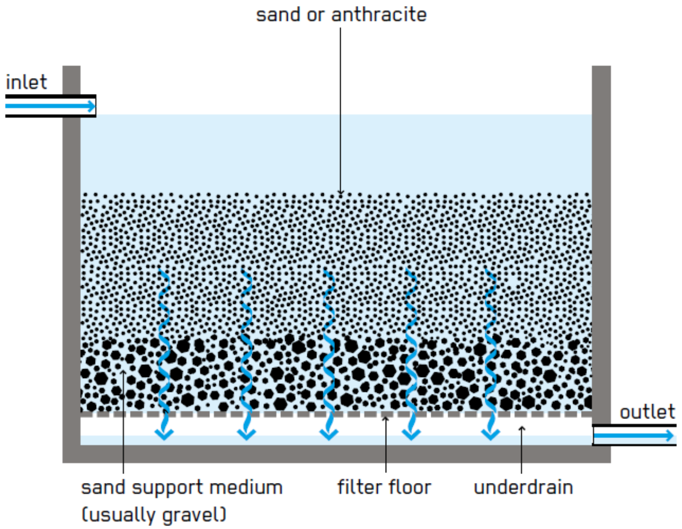


grease trap for individual applications

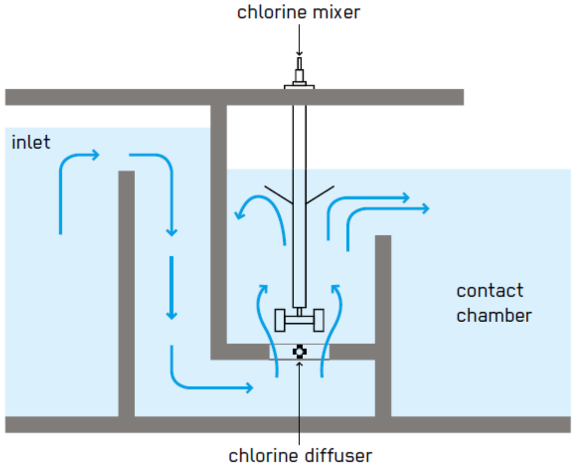


aerated grit and grease removal tank





tertiary filtration (e.g. depth filtration)



disinfection (e.g. chlorination)

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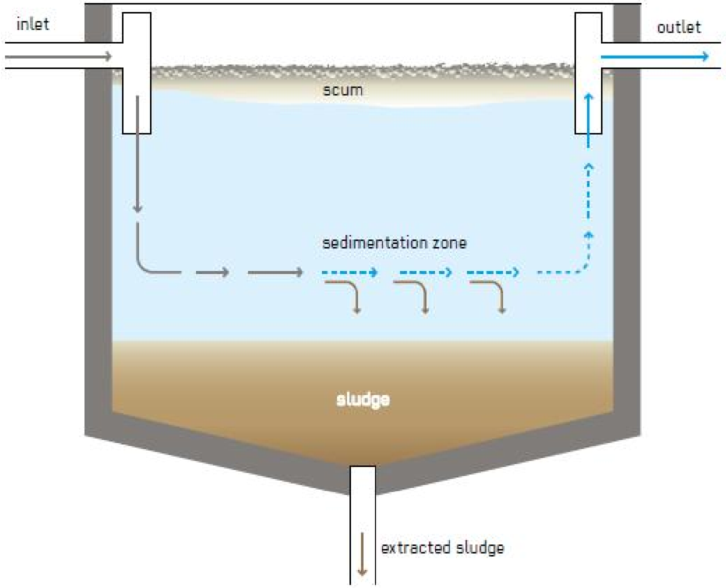
Primary treatment

Settler

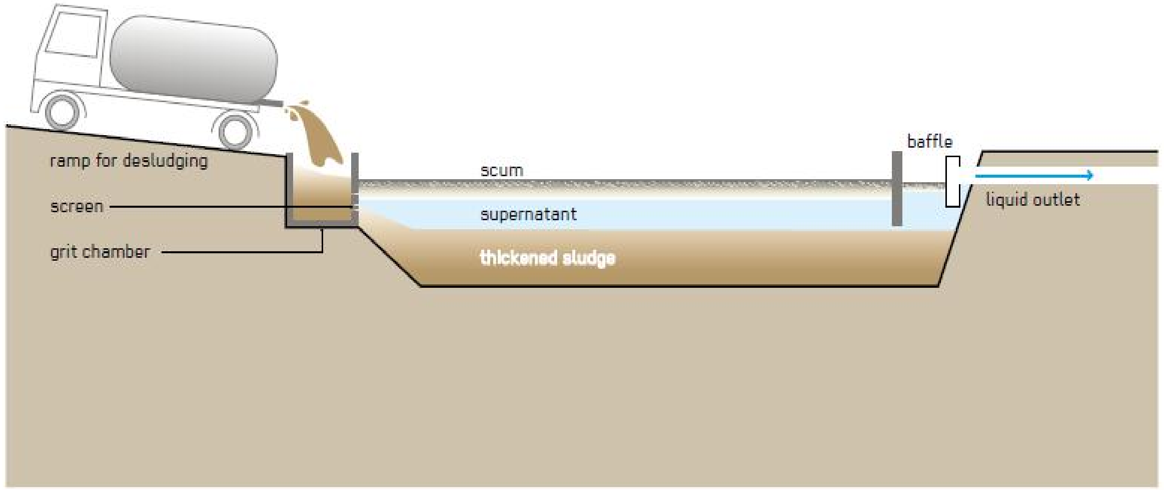
Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response ★ Stabilisation ★★ Recovery	Household ★★ Neighbourhood ★★ City	Household ★ Shared ★★ Public	Solid / liquid separation, BOD reduction
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★★ Medium	★★ Medium	● Blackwater, ● Greywater	● Effluent, ● Sludge



Reference: Compendium of Sanitation Technologies in Emergencies

Sedimentation and thickening ponds

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response ★ Stabilisation ★★ Recovery	Household ★ Neighbourhood ★★ City	Household Shared ★★ Public	Solid / liquid separation of faecal sludge, Sludge stabilisation
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★★★ High	★★ Medium	● Sludge	● Sludge, ● Effluent



Secondary treatment

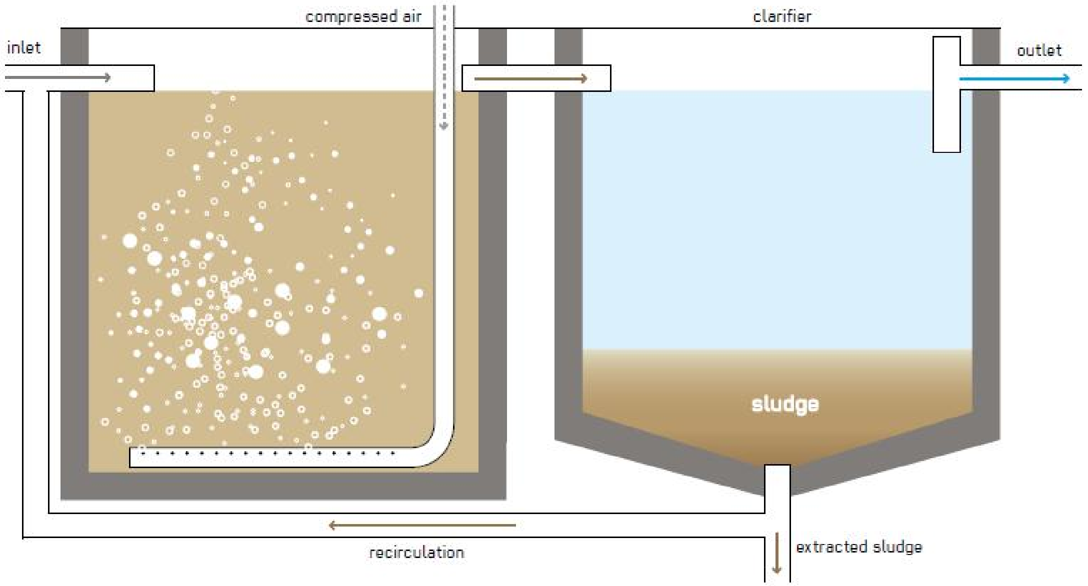
Aerobic treatment process

Need pre- and primary treatment to operate correctly

Mostly aerobic reactions with pockets of anaerobic conditions

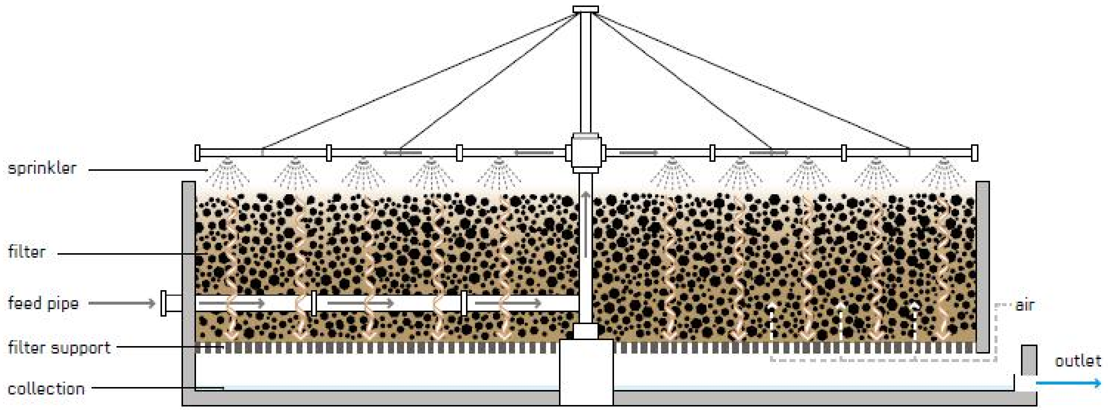
Activated Sludge

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response ★ Stabilisation ★★ Recovery	Household ★ Neighbourhood ★★ City	Household Shared ★★ Public	BOD reduction, Nitrification and nutrient removal, Pathogen reduction
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★★ Medium	★★★ High	● Blackwater, ● Greywater, ● Effluent	● Effluent, ● Sludge



Trickling Filter

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response ★ Stabilisation ★★ Recovery	Household ★ Neighbourhood ★★ City	Household Shared ★★ Public	TSS and TDS reduction, Nitrification
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★★ Medium	★★★ High	● Effluent, ● Blackwater, ● Greywater	● Effluent, ● Sludge



Reference: [Compendium of Sanitation Technologies in Emergencies]

Need pre-treatment to operate correctly

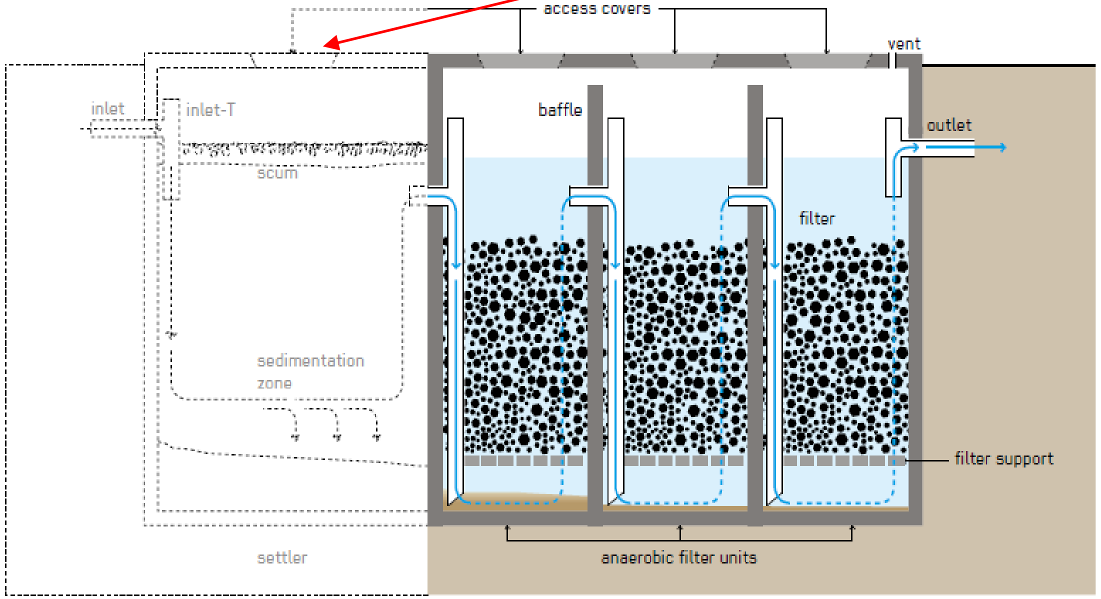
Anaerobic Filter

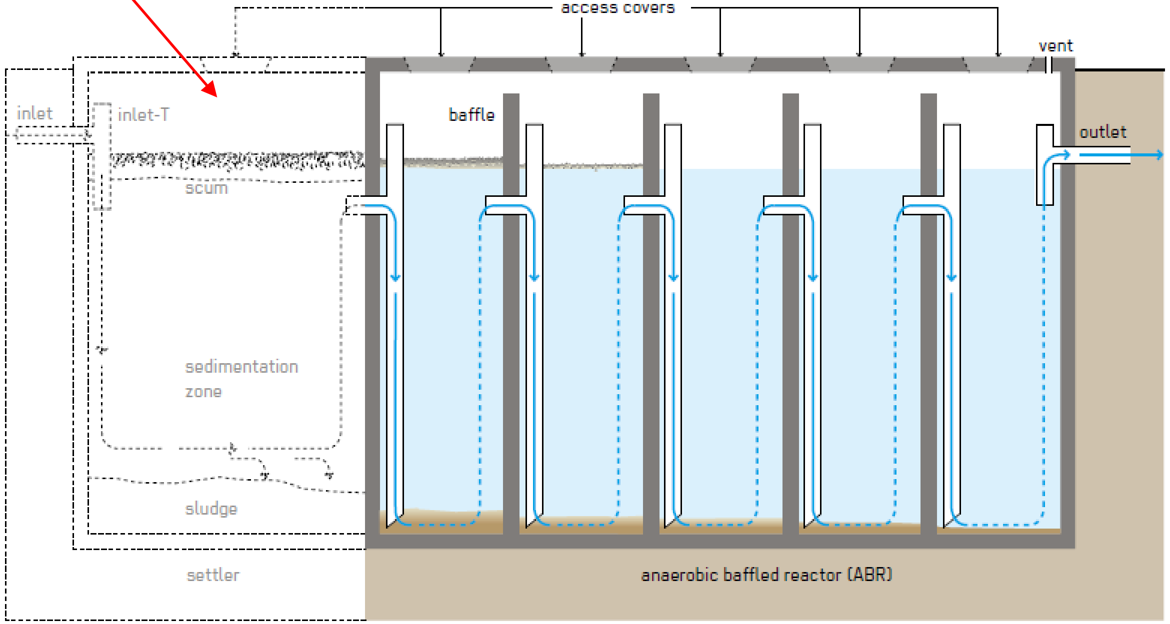
Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	* Household ** Neighbourhood City	* Household ** Shared ** Public	BOD reduction
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
** Medium	** Medium	● Blackwater, ● Greywater	● Effluent, ● Sludge

Anaerobic Baffled Reactor (ABR)

Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	* Household ** Neighbourhood City	* Household ** Shared ** Public	Solid / liquid separation, BOD reduction
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
** Medium	** Medium	● Blackwater, ● Greywater	● Effluent, ● Sludge, ● Biogas

First chamber acts as primary treatment





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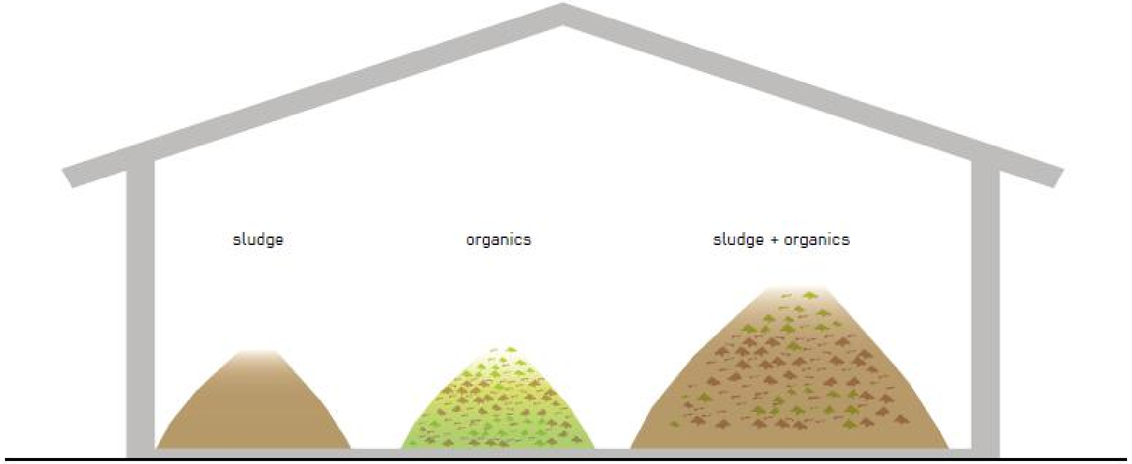
Aerobic treatment processes

Need pre-treatment to eliminate plastic and other non-organic solids

Co-composting

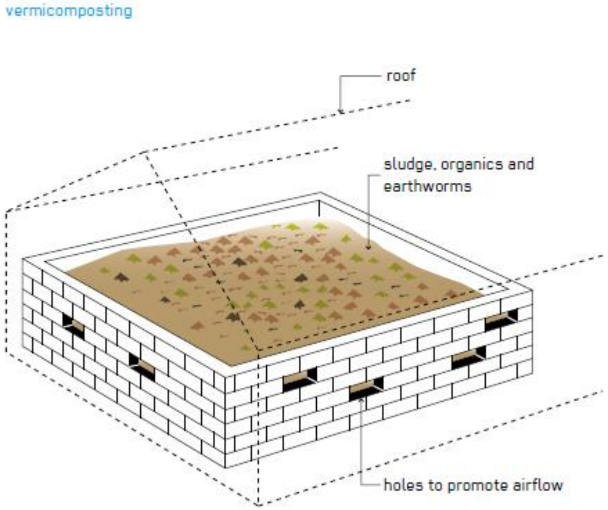
Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
★ Acute Response ★ Stabilisation ★★ Recovery	Household ★★ Neighbourhood ★★ City	Household ★ Shared ★★ Public	Compost production, Pathogen removal
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★★★ High	★★ Medium	● Organics, ● Sludge	● Compost

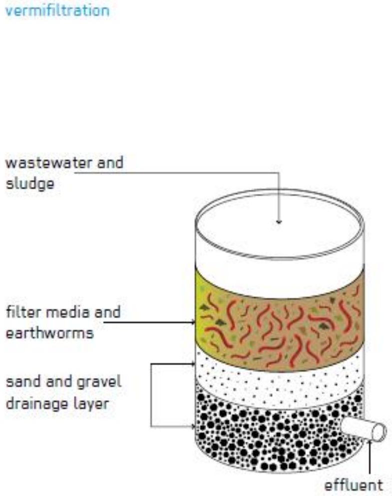
Local taboo in handling sanitation by-product from faecal sludge may apply to the resulting compost. Consult with users to identify such issues



Vermicomposting and vermifiltration

Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
★ Acute Response ★ Stabilisation ★★ Recovery	Household ★★ Neighbourhood ★★ City	Household ★ Shared ★★ Public	Compost production, Pathogen removal, Sludge reduction
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
★★ Medium	★★ Medium	● Urine, ● Faeces, ● Sludge, (● Anal Cleansing Water), (● Dry Cleansing Materials), (● Flush Water)	● (Vermi-)Compost, ● Effluent





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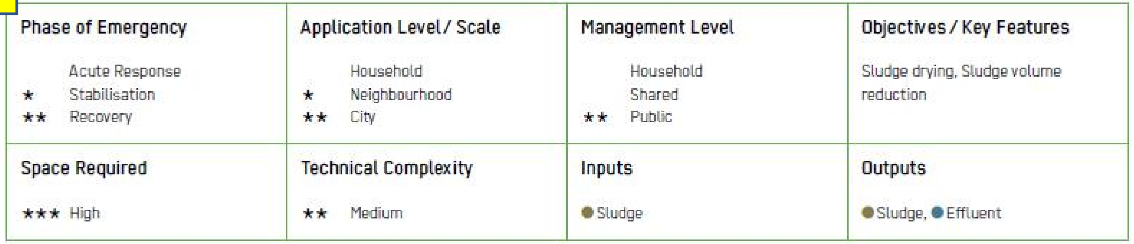
Unplanted Drying Beds

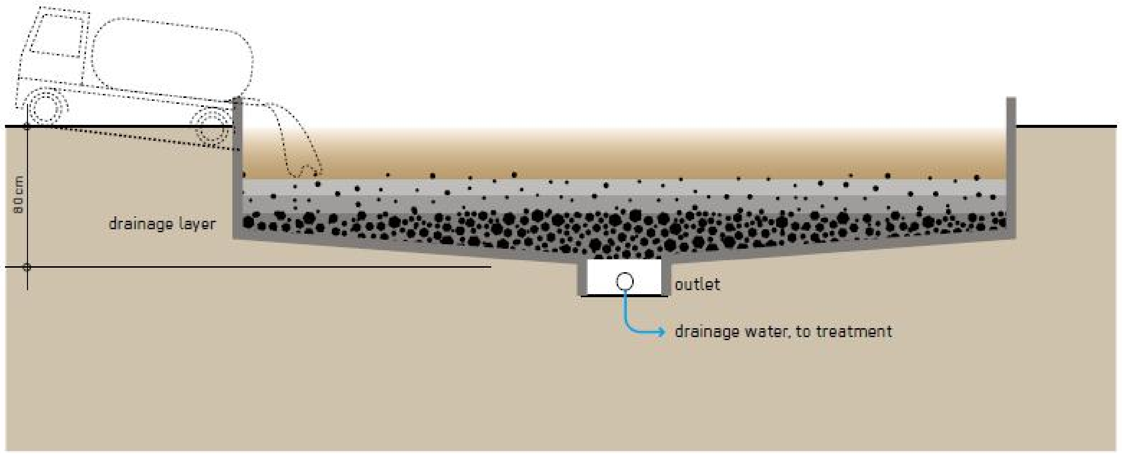
Dry sludge and leachate need further treatment (e.g. respectively co-composting and waste stabilisation pond)

Plan several beds to alternate and maintain operation



Phase of Emergency Acute Response ★ Stabilisation ★★ Recovery	Application Level / Scale Household ★ Neighbourhood ★★ City	Management Level Household Shared ★★ Public	Objectives / Key Features Sludge drying, Sludge volume reduction
Space Required ★★★ High	Technical Complexity ★★ Medium	Inputs ● Sludge	Outputs ● Sludge, ● Effluent

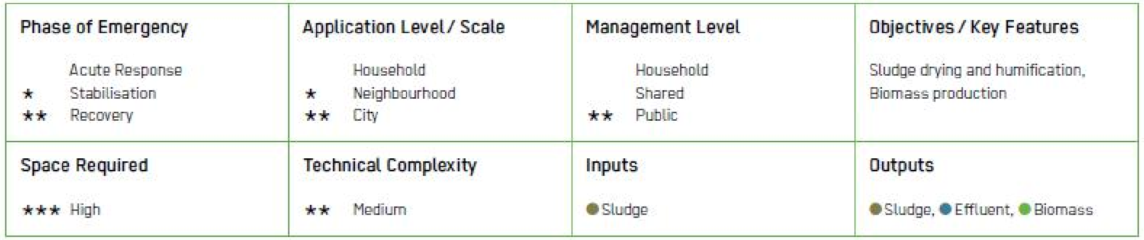
Dry sludge needs removal every 10-15 days



Planted Drying Beds

Leachate needs further treatment (e.g. horizontal flow constructed wetland). Sludge may require pre-treatment

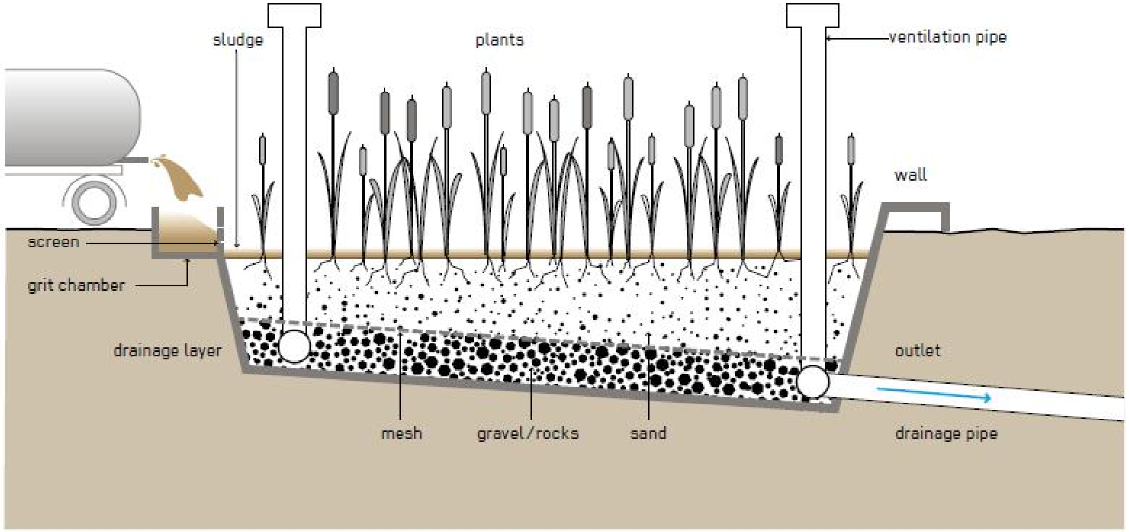
Aerobic treatment process



Phase of Emergency Acute Response ★ Stabilisation ★★ Recovery	Application Level / Scale Household ★ Neighbourhood ★★ City	Management Level Household Shared ★★ Public	Objectives / Key Features Sludge drying and humification, Biomass production
Space Required ★★★ High	Technical Complexity ★★ Medium	Inputs ● Sludge	Outputs ● Sludge, ● Effluent, ● Biomass

Dry sludge need removal every 3-5 years

Sludge applied every 3-7 days



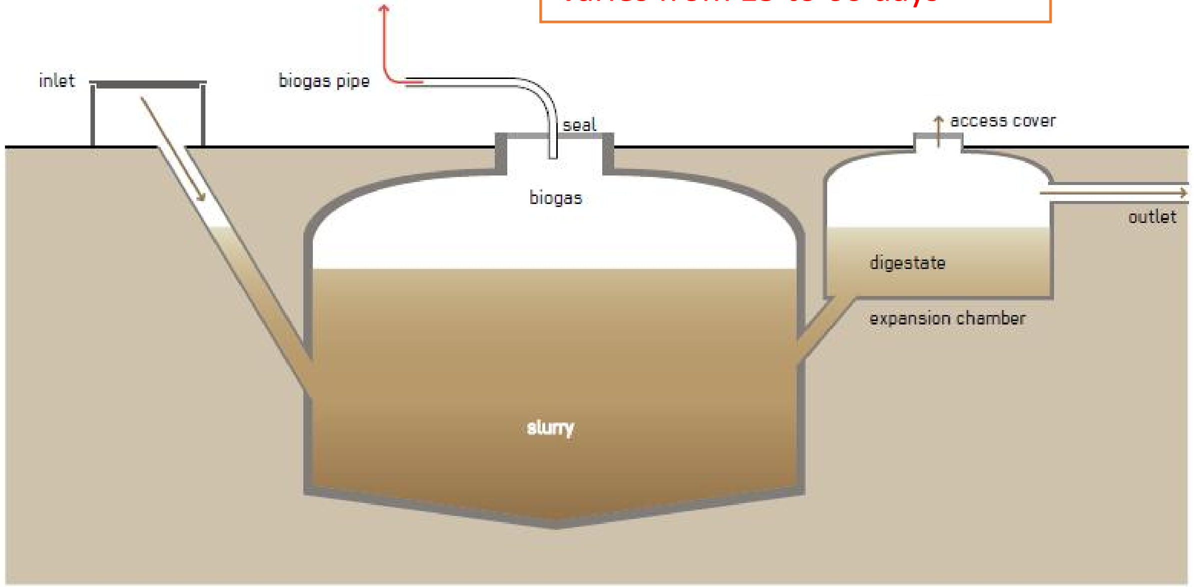
Reference: [Compendium of Sanitation Technologies in Emergencies]

Biogas Reactor

Effluent and digestate (produced daily) may require further treatment if reuse in agriculture or if aquifer contamination risks are high

hase of Emergency Acute Response ★ Stabilisation ★★ Recovery	**Application Level/ Scale** ★ Household ★★ Neighbourhood ★★ City	**Management Level** ★★ Household ★★ Shared ★★ Public	**Objectives / Key Features** Stabilisation of sludge, Biogas recovery
Space Required ★★ Medium	**Technical Complexity** ★★ Medium	**Inputs** ● Excreta, ● Blackwater, ● Organics	**Outputs** ● Biogas

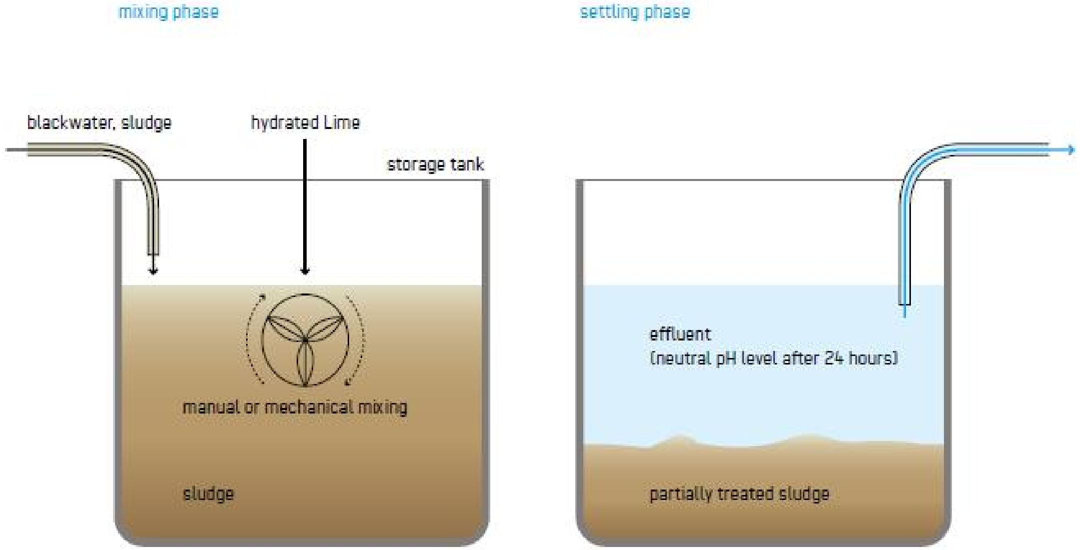
Hydraulic retention time will depend on temperature and pathogenic risk of sludge and varies from 15 to 60 days



Reference: [Compendium of Sanitation Technologies in Emergencies]()

Hydrated Lime Treatment

Phase of Emergency ★★ Acute Response ★ Stabilisation Recovery	**Application Level / Scale** Household ★★ Neighbourhood ★ City	**Management Level** Household Shared ★★ Public	**Objectives / Key Features** Pathogen removal, Liquid / solid separation, Minimising immediate public health risks
Space Required ★ Little	**Technical Complexity** ★★ Medium	**Inputs** ● Blackwater, ● Sludge	**Outputs** ● Effluent, ● Sludge



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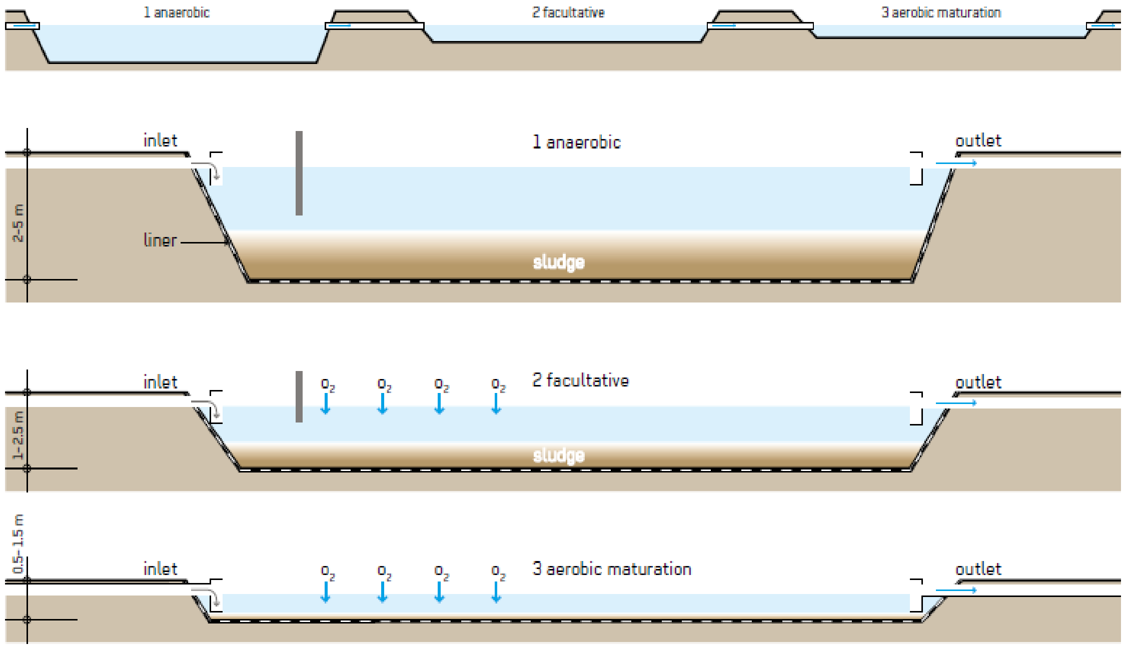
Treatment of effluent and wastewater

Mixed Aerobic and anaerobic treatment process

Waste Stabilisation Ponds

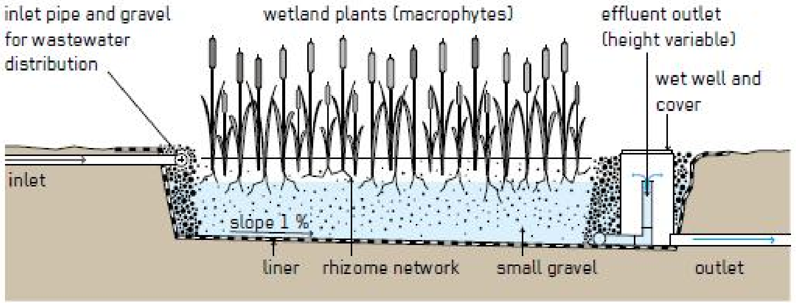
Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
Acute Response ** Stabilisation ** Recovery	Household * Neighbourhood ** City	Household * Shared ** Public	Solid / liquid separation, Sludge stabilisation, Pathogen reduction
Space Required	Technical Complexity	Inputs	Outputs
*** High	** Medium	● Blackwater, ● Greywater, (● Sludge)	● Effluent, ● Sludge



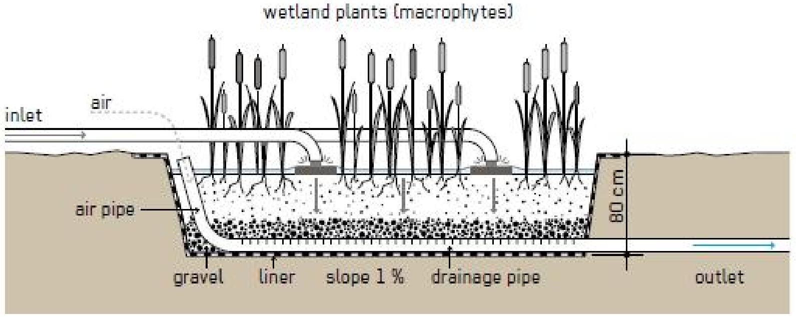
Constructed Wetland

Phase of Emergency	Application Level/ Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	* Household ** Neighbourhood ** City	* Household ** Shared ** Public	TSS and TDS reduction, Nitrification
Space Required	Technical Complexity	Inputs	Outputs
*** High	** Medium	● Effluent, ● Blackwater, ● Greywater	● Effluent, ● Biomass

horizontal subsurface flow constructed wetland



vertical flow constructed wetland



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7 rapid questions before starting latrine building

These questions need answers even in a rapid onset emergency

1. What are local **practices**?
    a. How did people dispose of excreta before the crisis,
    b. What are they doing now & **what would they find acceptable now,**
    c. Is water available e.g pour flush versus direct drop,
    d. Religious/**cultural habits,**
    e. Sharing preferences,
    f. And anal cleansing practice?
2. **Location**; which locations are possible given soil and topography and what is socially acceptable?
3. **Can you excavate?** The importance of soil type – rocky, very hard, very soft sand to be determine.
4. **What is the space available?** Are the affected population densely packed or spread out? E.g., design for desludging or re-digging pits. Where would desludged material go?
5. **What is the ground permeability?** Infiltration capacity of the soil to determine ground conditions.
6. **Where is the water table level?** i.e., groundwater considerations regarding contamination and whether underground structures might flood during seasonal fluctuations.
7. **What is present capacity?** Are there current facilities, sewage system that can be repaired or connected too?

Mapping of the settlement area for latrine construction

Mapping of the nature of the settlement area in view of the suitability for construction of specific type of latrine is an important step towards making the right decision for latrine design options.

> In formal settlements such as refugee camps, with designated locations for latrines, mapping should focus on flooding during the rainy season, the groundwater level in dry and rainy seasons, whether the soil can be excavated (e.g. whether subsurface conditions are rocky) and whether the subsoil is collapsible when wet.

The findings of the mapping will inform which kinds of latrine technology will be appropriate in the settlement (or in parts of the settlement). This will provide important information in planning and the O&M aspects of the sanitation program.

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> “**I feel happy using a latrine** when I can lock the door so nobody can get in. I need a clear pathway and lighting along the way. It’s also important to me that it’s clean and free from vermin.”

If latrines aren’t used, money, time and resources are wasted and we are failing in our responsibility to the communities we work with.

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Access Issues

Recent research from humanitarian responses shows that on average **40% of women** are not using the latrines provided.

The main reasons stated are:

Not wanting to be seen going to the toilet


Latrines in inappropriate locations

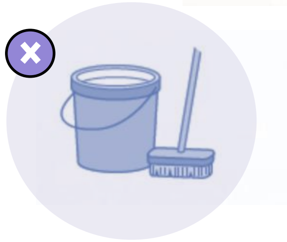

Lack of privacy (fear of people peeping in)


Lack of lighting at night


Lack of proper, durable locks on doors


Fear of sexual harassment

Ensure you listen to all users to understand barriers and adapt your design


Lack of cleanliness


Fear of vermin

People with mobility issues may face difficulty using a toilet

Not only young children can be afraid to use a toilet. Even a 6-year old child can fall through a **25cm diameter** latrine hole

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Community Engagement

Community engagement in WASH is a planned and dynamic process to connect communities and other emergency response stakeholders to increase community’s control over the impact of the response. It brings together the capacities and perspectives of communities and responders.

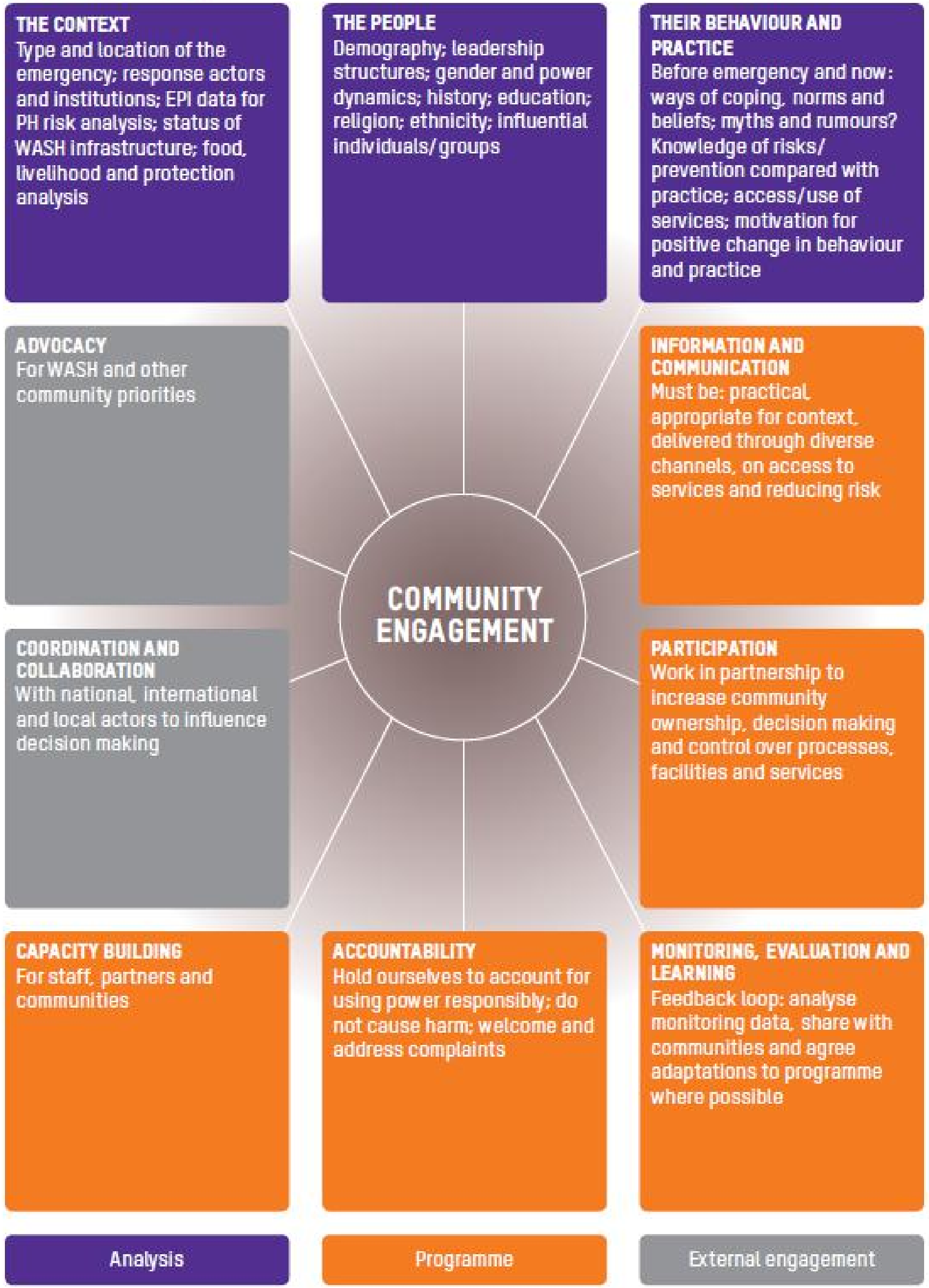
Community Engagement in WASH video

Reference: Oxfam – An introduction to Community Engagement in WASH

Tools like Sani Tweak and the Community Perception Tracker (CPT) will help better engage communities in the process of designing, building and maintaining an excreta disposal service

WASH Engineers should consider Community Engagement as a high return investment to ensure the success of their project.

FIGURE 1: WHAT DOES COMMUNITY ENGAGEMENT LOOK LIKE IN THE PROGRAMME YOU ARE WORKING IN?



THE CONTEXT
Type and location of the emergency; response actors and institutions; EPI data for PH risk analysis; status of WASH infrastructure; food, livelihood and protection analysis

THE PEOPLE
Demography; leadership structures; gender and power dynamics; history; education; religion; ethnicity; influential individuals/groups

THEIR BEHAVIOUR AND PRACTICE
Before emergency and now: ways of coping, norms and beliefs; myths and rumours? Knowledge of risks/prevention compared with practice; access/use of services; motivation for positive change in behaviour and practice

ADVOCACY
For WASH and other community priorities

COMMUNITY ENGAGEMENT

INFORMATION AND COMMUNICATION
Must be: practical, appropriate for context, delivered through diverse channels, on access to services and reducing risk

COORDINATION AND COLLABORATION
With national, international and local actors to influence decision making

PARTICIPATION
Work in partnership to increase community ownership, decision making and control over processes, facilities and services

CAPACITY BUILDING
For staff, partners and communities

ACCOUNTABILITY
Hold ourselves to account for using power responsibly; do not cause harm; welcome and address complaints

MONITORING, EVALUATION AND LEARNING
Feedback loop: analyse monitoring data, share with communities and agree adaptations to programme where possible

Analysis
Programme
External engagement

Each step in which WASH Engineers participate will facilitate the design, implementation, and operation & maintenance of an appropriate excreta disposal service

Reference: Oxfam – An introduction to Community Engagement in WASH

FIGURE 2: THE RELATIONSHIP BETWEEN AFFECTED COMMUNITIES AND HUMANITARIAN RESPONSE WORKERS – A CONTINUOUS PROCESS

Community engagement enables people to have a say in decision making wherever possible.

Different levels of engagement may be practical or appropriate at different stages in the response – or they may happen simultaneously.

CONSULTATION
Implementing partners and affected communities meet to discuss the problems they face and consider solutions

INFORMING
The implementing partner provides information or facts to affected communities so they are aware of or acquainted with the project

DEMONSTRATING ACCEPTANCE
Communities agree to work with the implementing partner to deliver the programme activities

PLANNING AND ACTING TOGETHER
Communities and implementing partners plan activities together and agree the roles and responsibilities of each

NEGOTIATION
Communities and implementing partners cooperate and reach agreement to make relevant changes to the programme

TAKING DECISIONS
Communities make decisions supported if necessary by the implementing partners

COMMUNITY ENGAGEMENT

The context also play its part: what is possible in a conflict situation may be different from opportunities in a protracted crisis or natural disaster.

Ask yourself: Where is my programme in this continuous process ... and can we hand over more control to communities?

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As part of the community engagement process, hygiene promoters will go through a 5 step process for designing activities to change behaviour and practices regarding public health risks, including excreta disposal and handwashing with soap.

WASH engineers need to pay attention to two of these steps as they can influence and improve the design of an excreta disposal system

Understanding enablers and motivators can inform latrine design

STEP 3

DETERMINE THE BARRIERS AS WELL AS THE ENABLERS AND MOTIVATORS

Using this information, find out what stops people from adopting positive behaviours or practices, and how they can be motivated and supported to make positive changes.

STEP 4

DESIGN ACTIVITIES AIMED AT CHANGING BEHAVIOURS AND PRACTICES

Design and implement appropriate and specific activities based on this analysis of barriers and enablers. Activities should aim to enable and motivate change or minimize obstacles to positive behaviour and practice.

Understanding taboo in handling faecal sludge treatment by-products will influence both treatment design and operation and maintenance systems

Improving agriculture or energy production as a by-product of faecal sludge treatment could be a motivator for both latrine uptake and long-term sustainability of the excreta disposal system

Design options for the excreta disposal system will influence any plan and activity to change behaviour and practices

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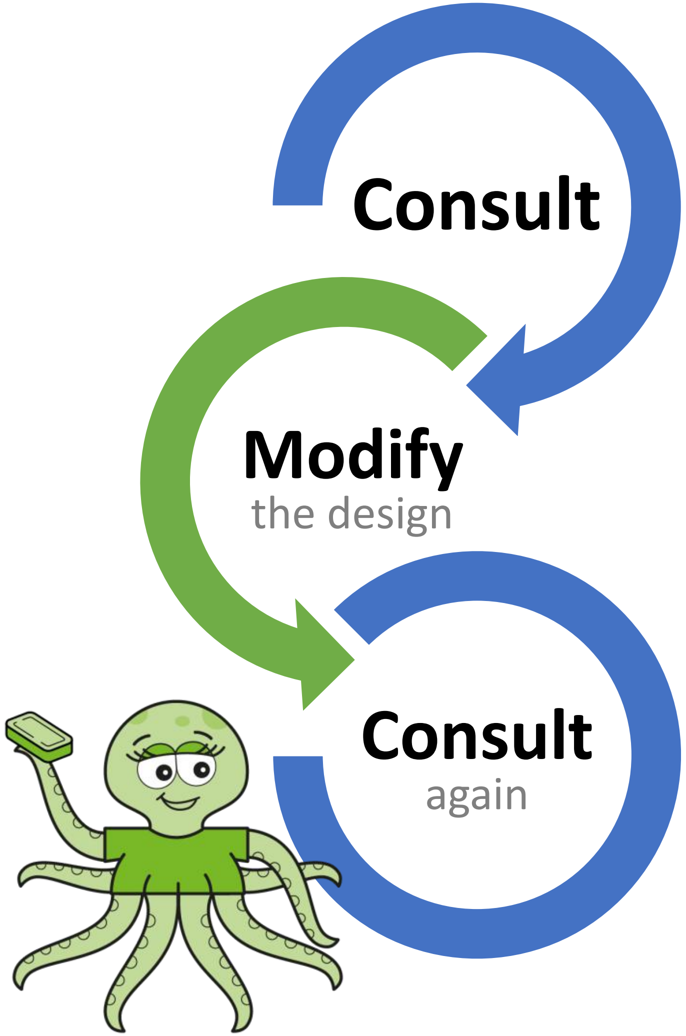
The goal

Sani Tweaks’ aim is to ensure that, **before the superstructure is designed**, even in rapid onset emergencies, appropriate consultation with potential users happens.



Consult

Modify
the design

Consult
again

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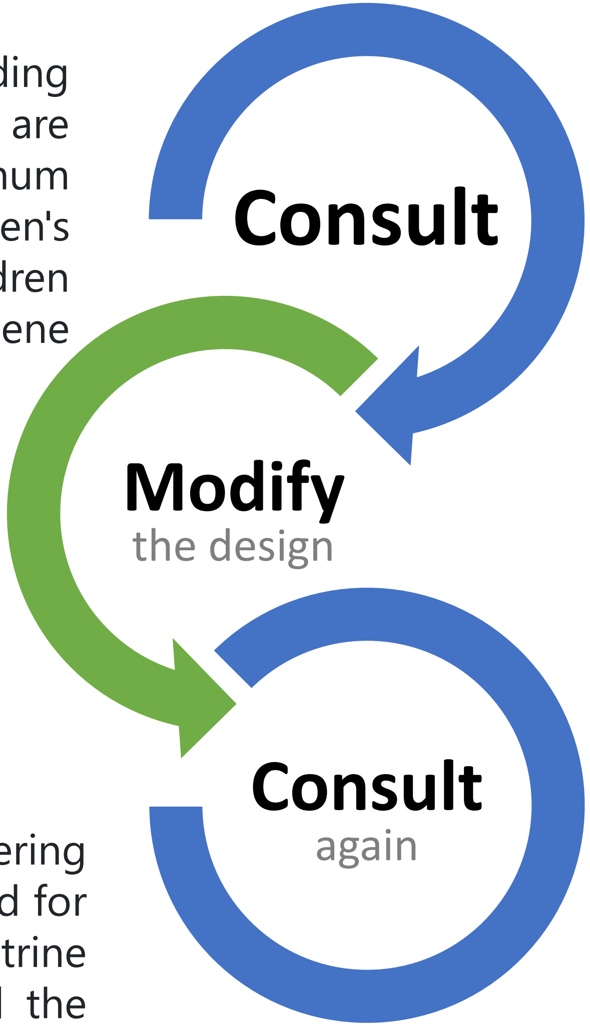
Sani Tweaks – What does it means?

Consult

Before starting a latrine building programme, consult the users: what are their practices, preferences, minimum distance between men's and women's toilets, vulnerable people's needs, children and babies' needs, menstrual hygiene management needs, siting constraints.

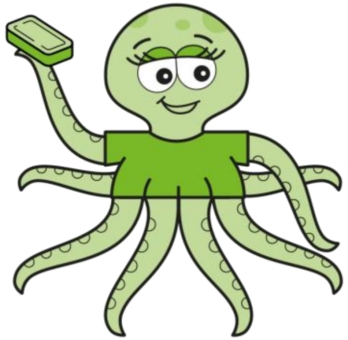


Modify

Change both the design of the latrine, and the sanitation programme, and keep changing it as the programme continues. Consider lighting, door locks, accessibility, privacy, wall height, wall material, doors, male/female segregation, screens, adaptations for the disabled and elderly, child-specific latrines, sanitary pad reuse/drying or disposal facilities, handwashing facilities and handwashing motivators.

Consult again

Have a system in place for gathering feedback whilst the latrine is in use, and for ongoing repairs - particularly if the latrine is made of plastic sheeting. How will the latrines be kept clean, and how will they be desludged or replaced?



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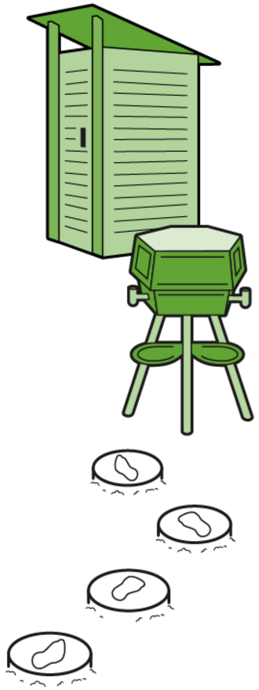
Sani Tweaks - Best Practices in Sanitation

See Sani Tweak video



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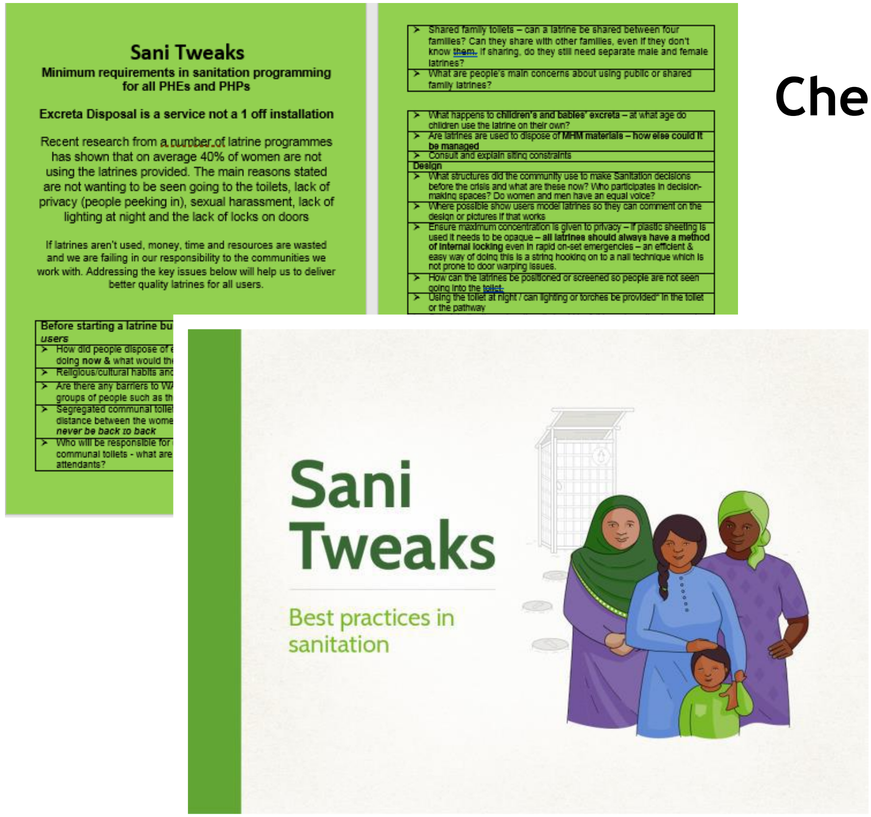
Sani Tweaks Resources

The following resources provide guidance, in a variety of formats to suit different needs, onhow to conduct such continuous consultation with the community:



Sani Tweaks

Minimum requirements in sanitation programming for all PHEs and PHPs

Excreta Disposal is a service not a 1 off installation

Recent research from a number of latrine programmes has shown that on average 40% of women are not using the latrines provided. The main reasons stated are not wanting to be seen going to the toilets, lack of privacy (people peeking in), sexual harassment, lack of lighting at night and the lack of locks on doors

If latrines aren't used, money, time and resources are wasted and we are failing in our responsibility to the communities we work with. Addressing the key issues below will help us to deliver better quality latrines for all users.

Before starting a latrine bu
users
- How did people dispose of e doing now & what would th
- Religious/cultural habits and
- Are there any barriers to WA groups of people such as th
- Segregated communal toilet distance between the wome *never be back to back*
- Who will be responsible for communal toilets - what are attendants?

- Shared family toilets – can a latrine be shared between four families? Can they share with other families, even if they don't know them. If sharing, do they still need separate male and female latrines?
- What are people's main concerns about using public or shared family latrines?

- What happens to **children's and babies' excreta** – at what age do children use the latrine on their own?
- Are latrines are used to dispose of **MHM materials – how else could it be managed**
- Consult and explain siting constraints

Design
- What structures did the community use to make Sanitation decisions before the crisis and what are these now? Who participates in decision-making spaces? Do women and men have an equal voice?
- Where possible show users model latrines so they can comment on the design or pictures if that works
- Ensure maximum concentration is given to privacy – if plastic sheeting is used it needs to be opaque – **all latrines should always have a method of internal locking** even in rapid on-set emergencies – an efficient & easy way of doing this is a string hooking on to a nail technique which is not prone to door warping issues.
- How can the latrines be positioned or screened so people are not seen going into the toilet.
- Using the toilet at night / can lighting or torches be provided* in the toilet or the pathway

Checklist

Booklet

Find out more at

https://www.oxfamwash.org/sanitweaks

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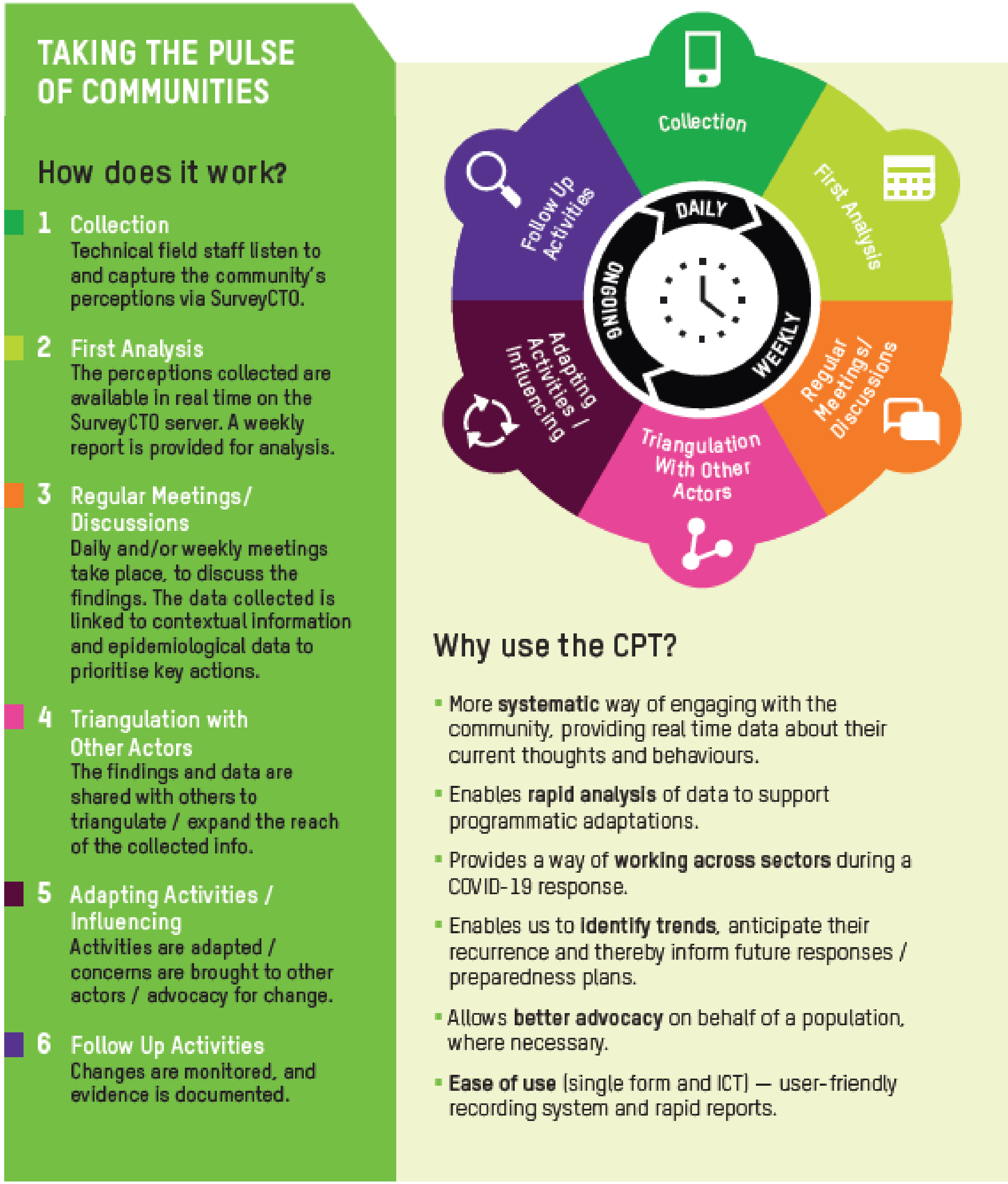

TAKING THE PULSE OF COMMUNITIES

How does it work?

1 Collection
Technical field staff listen to and capture the community's perceptions via SurveyCTO.

2 First Analysis
The perceptions collected are available in real time on the SurveyCTO server. A weekly report is provided for analysis.

3 Regular Meetings/ Discussions
Daily and/or weekly meetings take place, to discuss the findings. The data collected is linked to contextual information and epidemiological data to prioritise key actions.

4 Triangulation with Other Actors
The findings and data are shared with others to triangulate / expand the reach of the collected info.

5 Adapting Activities / Influencing
Activities are adapted / concerns are brought to other actors / advocacy for change.

6 Follow Up Activities
Changes are monitored, and evidence is documented.

Why use the CPT?

- More **systematic** way of engaging with the community, providing real time data about their current thoughts and behaviours.
- Enables **rapid analysis** of data to support programmatic adaptations.
- Provides a way of **working across sectors** during a COVID-19 response.
- Enables us to **identify trends**, anticipate their recurrence and thereby inform future responses / preparedness plans.
- Allows **better advocacy** on behalf of a population, where necessary.
- **Ease of use** (single form and ICT) — user-friendly recording system and rapid reports.

Community Perception Tracker - CPT

The CPT is an approach that uses a mobile tool to enable staff to capture, analyse and understand the perceptions of communities during disease outbreaks. Correlated with epidemiological data, it is used to inform and adjust programming, and provide an evidence base for advocacy and influencing

The CPT is a vital part of Oxfam's Community Engagement approach.

Find out more at:
https://www.oxfamwash.org/en/communities/community-perception-tracker

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How is the CPT relevant to the work of engineers?

The CPT can give information on the context, some of which may be useful for adapting design, operation and maintenance approaches

When participating in the CPT, you learn to listen completely to community members without the boundary of your program

If the CPT is in place in your country of operation, contact the team in charge to use it and to get information in order to attune to communities

The CPT is like a temperature check. It give you a sense of perception trends within the communities.

The CPT is real time and documented

The CPT provide insight on what is a priority for communities

From the trends analysis, you can identify what questions need further in-depth research (through focus group discussion for example)

The CPT provides only qualitative insight

Monitoring

Monitoring is the systematic and continuous process of collecting and using information throughout the programme cycle for the purpose of management and decision-making. WASH programmes should include:

- Process monitoring that looks at how the project is being developed.
- Impact monitoring that looks at whether the project is having the intended impact.

WASH team responsibility

MEAL responsibility with WASH team inputs

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Process monitoring (continuous process - checklist)

To verify design specifications are respected and are **maintained as long as the service is needed**

Functional latrine

Check the walls are not see-through

Check water falling from the roof is drained out and doesn't dig under the slab

Check water doesn't stay on the roof

Check the slab and latrine are not collapsing or at risk to collapse

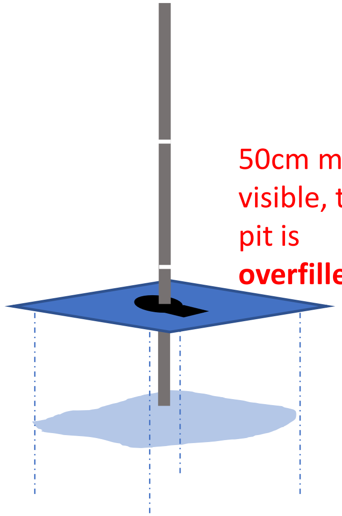
Check there is a functioning handwashing station

Check the inside lock always function

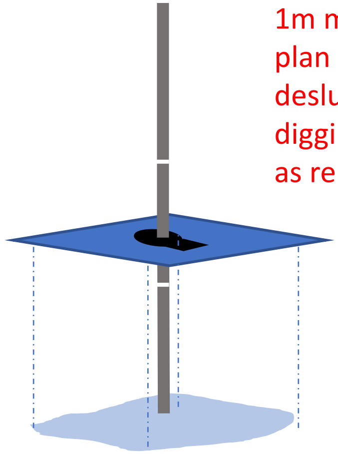
Check inside the slab is clean

Check the pit is not full

Stick with 50cm and 1m marks, lower to the top of the faeces in the pit



50cm mark visible, the pit is **overfilled**



1m mark visible, plan for desludging or digging a new pit as replacement

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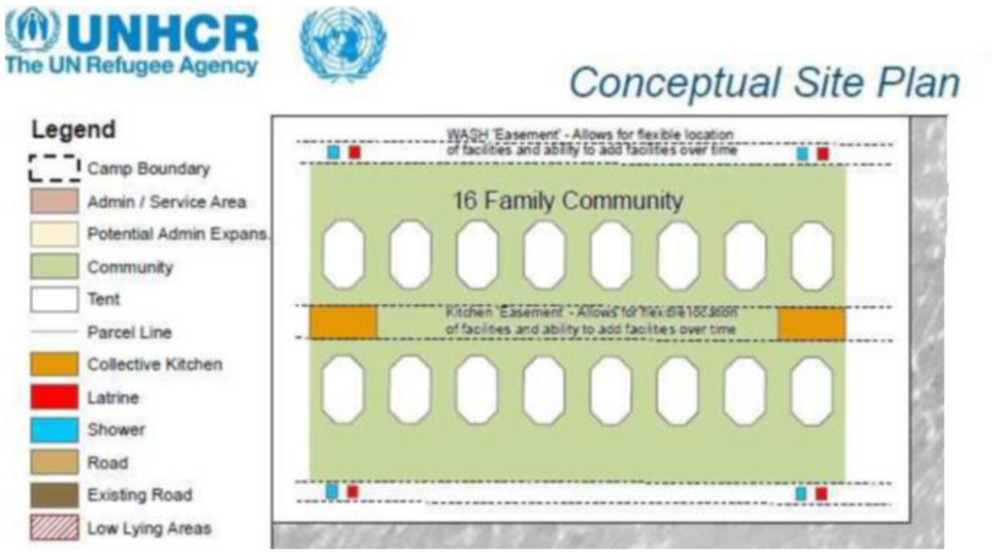
16 FAMILY COMMUNITY LAYOUT



There are two possible camp layouts styles.

Their respective advantage are:

- Corridor layout has less scattered facilities
- 16-family community has shorter distance to sanitation facilities for all users

Sufficient functional facilities for all users

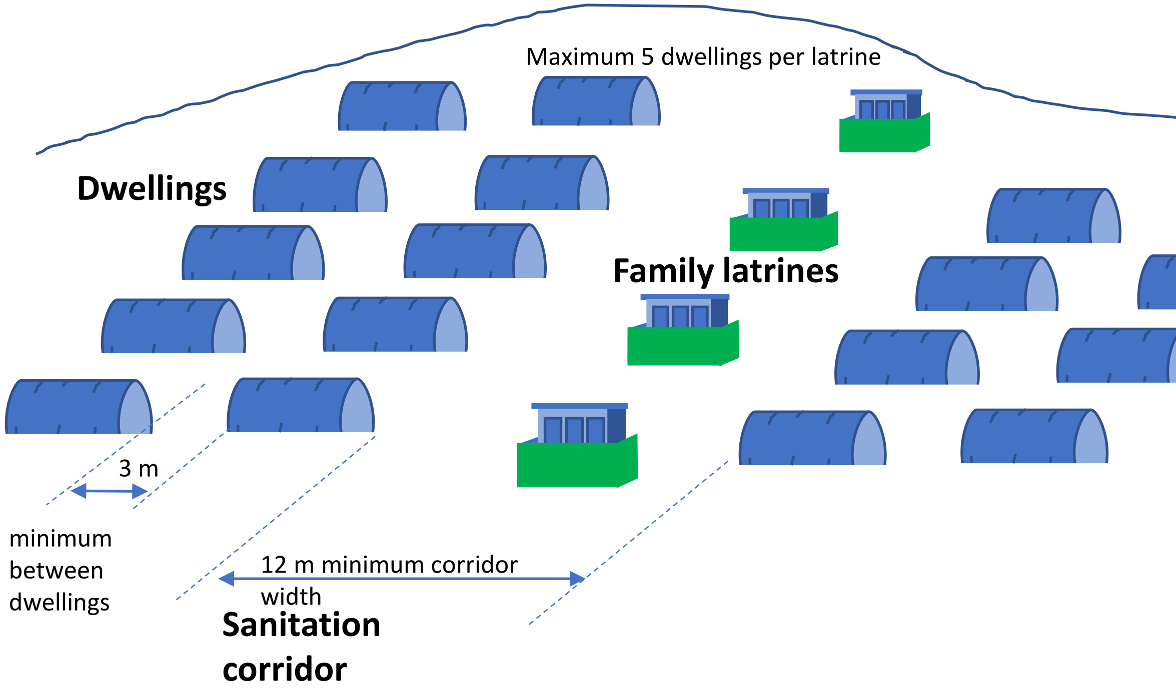
The ratio of people per latrine should only take into account **functional** latrines

Numbering each facility with a post code type for user to report issues help monitoring and service continuity

Check adapted latrine availability for people with reduced mobility

Check distance to facilities

SANITATION CORRIDOR LAYOUT



Safe evacuation of faecal sludge

Check road security rules and application

Check there isn't any spillage

Check the destination is only an approved site

Check the faecal sludge doesn't contain items (e.g. solid waste) that present risk to desludging and to treatment

Check the treatment eliminate disease risks (e.g. cholera vibrio, parasites)

Check surrounding aquifers are not contaminated by treatment and disposal sites (monitor bacteriological, helminths eggs and nitrate concentration)

Check the treatment outputs are used according to National Standards and international recommendations

Check final disposal site are protected against flood and rain runoff

Check if operators and stakeholders are satisfied with treatment processes and infrastructures

Reference: Feacal sludge management – Systems approach for Implementation and Operation

Impact monitoring (punctual process at key time of the implementation – FGD / survey)

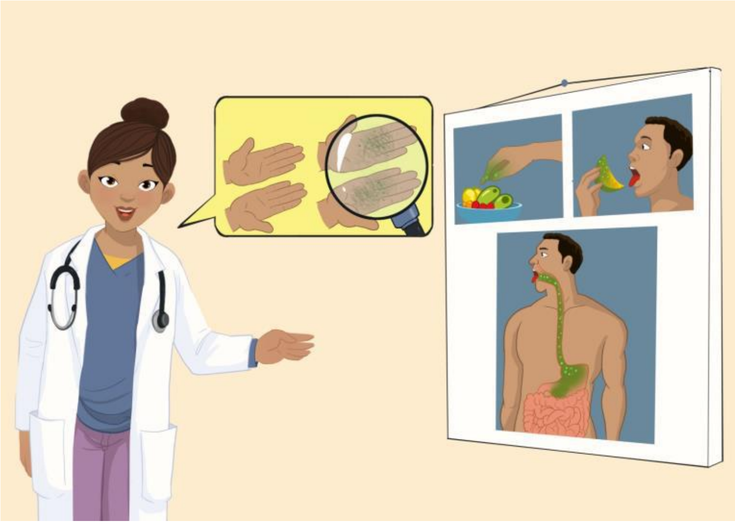
Are everyone only using toilet (or commode / potty) to defecate?

Is the level of cost recovery sufficient to sustain the operation and maintenance of the excreta disposal system?

Are water sources protected from faeces contamination?

Is everyone washing their hands after defecation?

Are diarrhoeal diseases morbidity reduced?



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Indicators

MATRIX OF INDICATORS FOR MEASURING COMMUNITY PARTICIPATION AND SATISFACTION IN RELATION TO WASH IN THE INITIAL 4 TO 6 MONTHS OF RESPONSE

WASH outcomes

- There is no evidence of WASH-related disease outbreaks
- Access to appropriate sanitation facilities and resources is available to all, in line with Sphere standards
- Sanitation facilities are consistently used and users are involved in maintaining them
- There is no evidence of open defecation
- Hand washing is effectively practised

Community participation

- Formal and informal community leaders, community organizations and institutions are identified
- A stakeholder map developed with communities is used to analyse power dynamics and for programme planning
- A diverse range of people selected by the community is involved in decisions on the planning, design and maintenance of sanitation infrastructure and services
- Communities, including more marginalized groups, influence the design of feedback and complaints mechanisms
- Diverse community members are included in identifying local priorities, problems and their own solutions
- Implementation plan with roles and responsibilities of all actors is agreed and monitored
- Community members are involved in monitoring programme activities and in the feedback loop to their wider community
- Communities are supported to advocate on their behalf to Oxfam and to other stakeholders through coordination platforms
- Capacity development and a timely exit/ transition plan is agreed by communities and other key stakeholders

Community satisfaction

- Communities report that key information is clearly communicated in appropriate languages and reaches all sections of the community using context-specific channels
- Communities report that specific gendered needs of women and men, boys and girls are taken in to account in the design and location of the facilities (access, privacy, safety, menstrual hygiene management-friendly)
- Marginalized groups and individuals express satisfaction with consultation and programme adaptations
- Communities report that they have the skills and support to manage WASH facilities and services

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GLOBAL WASH CLUSTER REPOSITORY OF INDICATORS TO MEASURE NEEDS AND RESPONSE

Code	Sub-domain	Title
AAP-1	Feedback mechanism	Number of feedback received (including complaints) which have been acted upon
AAP-3	Participation	Number of persons consulted (disaggregated by sex/age) before designing a program/project [alternatively: while implementing the program/project]
W 7-1	W7 Aggravating Factors	Presence of faecal-oral diseases
W 7-4	W7 Aggravating Factors	Density of settlement in m2 of total site area per person
W 7-5	W7 Aggravating Factors	Nb of people on the site
W1-8	W1.2 Hygiene Practices	Proportion of men, women, boys and girls who last defecated in a toilet (or whose faeces was last disposed of in a safe manner)
W1-9	W1.2 Hygiene Practices	Proportion of men, women, boys and girls washing hands with water and soap or substitute after contact with faeces and before contact with food and water
W3-1	W3.1 Environment	Presence of human faeces on the ground on and around the site
W3-2	W3.2 Toilet Facilities	Average number of users per functioning toilet
W3-3	W3.2 Toilet Facilities	Proportion of households with access to a functioning toilet
W3-4	W3.2 Toilet Facilities	Proportion of toilets with functioning and convenient handwashing facilities
W3-5	W3.2 Toilet Facilities	Proportion of toilets that are clean
W8-1	W8 WASH Programme Design and Implementation	All groups within the affected population have equitable access to WASH facilities and services
W8-2	W8 WASH Programme Design and Implementation	The WASH response includes effective mechanisms for representative and participatory input from all users at all phases
W8-3	W8 WASH Programme Design and Implementation	The affected population takes responsibility for the management and maintenance of facilities as appropriate, and all groups contribute equitably

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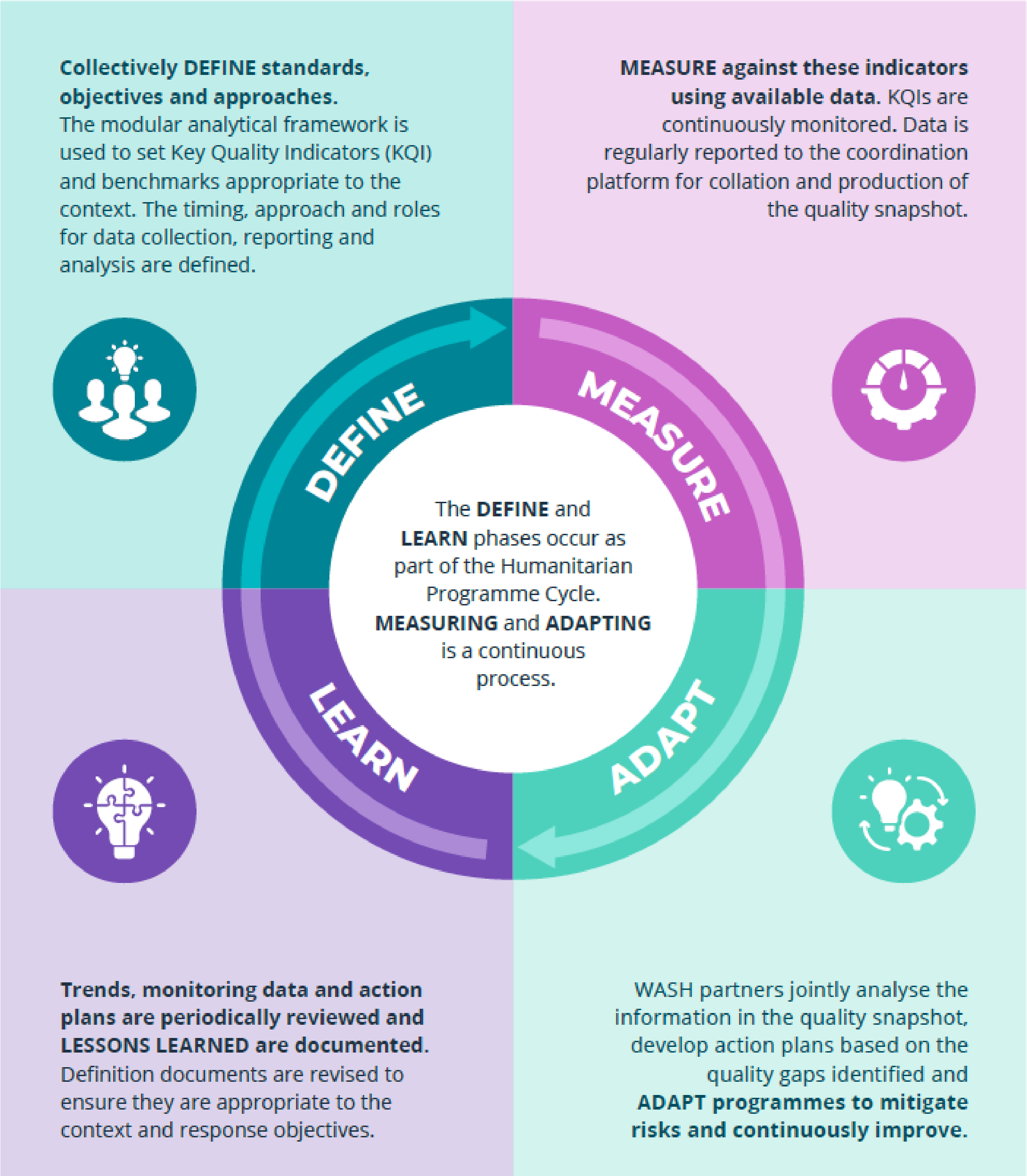
THE ACCOUNTABILITY & QUALITY ASSURANCE INITIATIVE

VANITY vs ACTIONABLE METRICS

VANITY METRICS:	ACTIONABLE METRICS:
Headline numbers that focus on **activities completed**, but do not capture information that indicates where we need to improve.	Information that can be used to understand whether **activities are working and leads to specific improvements.**
Examples:	**Examples:**
▶ Number of latrines built	⚙ % of people using latrines

Reference: L. Lacan & J. Brown, [The accountability & quality assurance initiative – measuring what matters]()

The AQA approach



Collectively DEFINE standards, objectives and approaches. The modular analytical framework is used to set Key Quality Indicators (KQI) and benchmarks appropriate to the context. The timing, approach and roles for data collection, reporting and analysis are defined.

MEASURE against these indicators using available data. KQIs are continuously monitored. Data is regularly reported to the coordination platform for collation and production of the quality snapshot.

The **DEFINE** and **LEARN** phases occur as part of the Humanitarian Programme Cycle. **MEASURING** and **ADAPTING** is a continuous process.

Trends, monitoring data and action plans are periodically reviewed and LESSONS LEARNED are documented. Definition documents are revised to ensure they are appropriate to the context and response objectives.

WASH partners jointly analyse the information in the quality snapshot, develop action plans based on the quality gaps identified and **ADAPT programmes to mitigate risks and continuously improve.**

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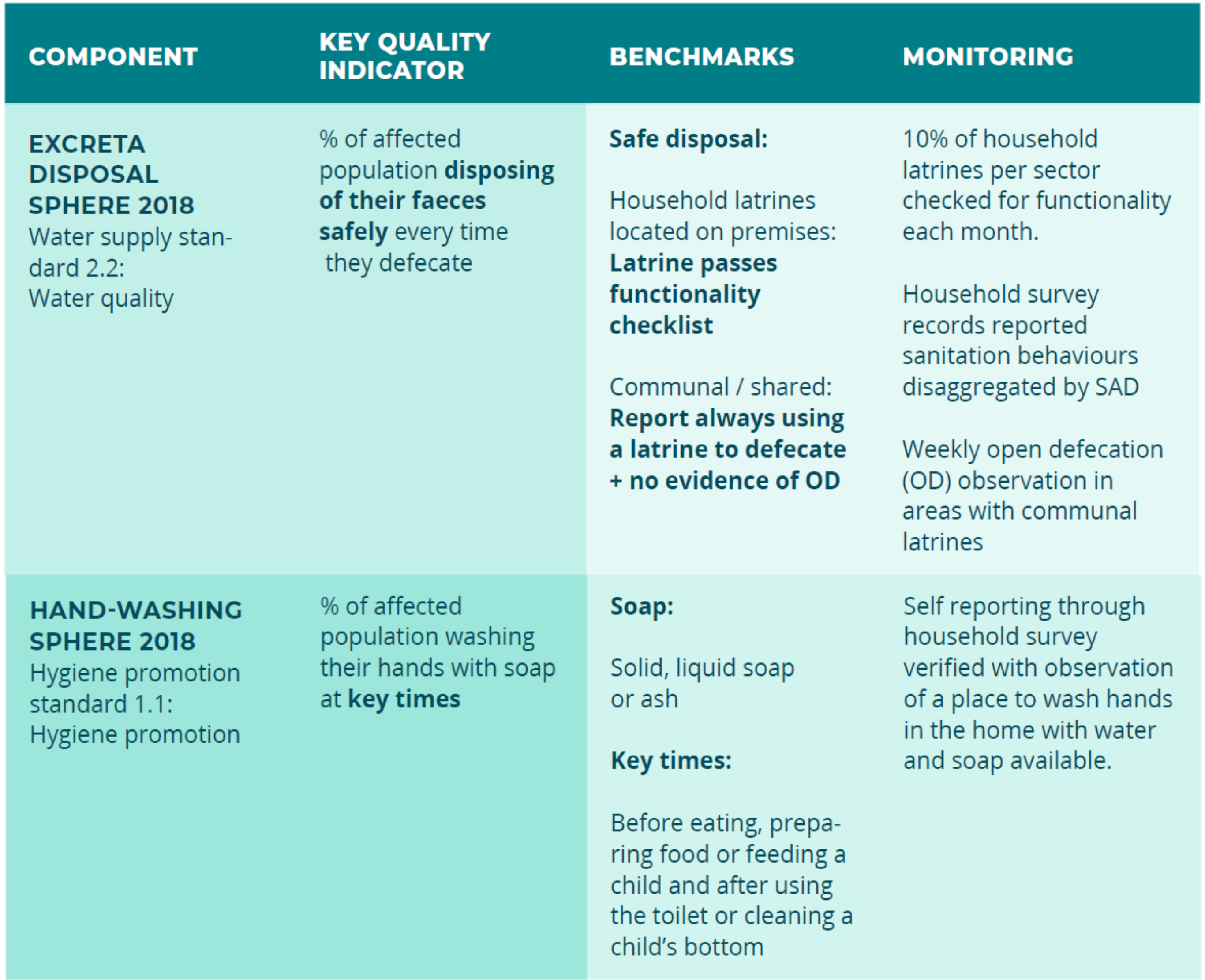
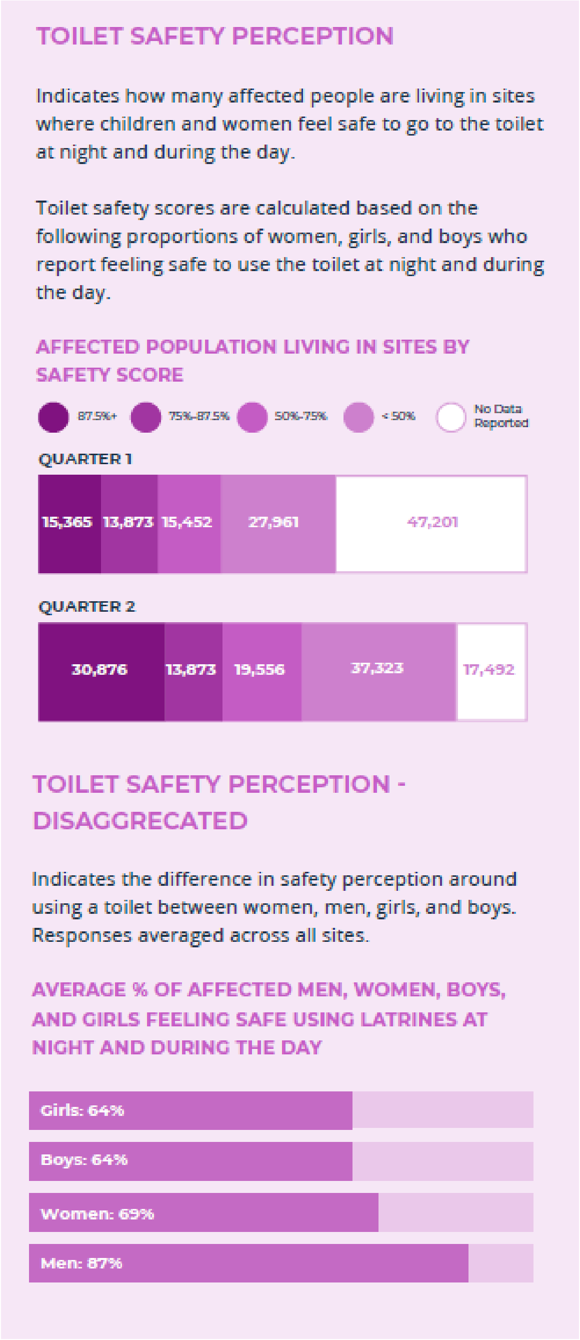
Example of contextualised module



COMPONENT	KEY QUALITY INDICATOR	BENCHMARKS	MONITORING
EXCRETA DISPOSAL SPHERE 2018 Water supply standard 2.2: Water quality	% of affected population **disposing of their faeces safely** every time they defecate	**Safe disposal:** Household latrines located on premises: **Latrine passes functionality checklist** Communal / shared: **Report always using a latrine to defecate + no evidence of OD**	10% of household latrines per sector checked for functionality each month. Household survey records reported sanitation behaviours disaggregated by SAD Weekly open defecation (OD) observation in areas with communal latrines
HAND-WASHING SPHERE 2018 Hygiene promotion standard 1.1: Hygiene promotion	% of affected population washing their hands with soap at **key times**	**Soap:** Solid, liquid soap or ash **Key times:** Before eating, preparing food or feeding a child and after using the toilet or cleaning a child's bottom	Self reporting through household survey verified with observation of a place to wash hands in the home with water and soap available.

Reference: L. Lacan & J. Brown, The accountability & quality assurance initiative – measuring what matters

Example of quality snapshot chart



TOILET SAFETY PERCEPTION

Indicates how many affected people are living in sites where children and women feel safe to go to the toilet at night and during the day.

Toilet safety scores are calculated based on the following proportions of women, girls, and boys who report feeling safe to use the toilet at night and during the day.

AFFECTED POPULATION LIVING IN SITES BY SAFETY SCORE

TOILET SAFETY PERCEPTION - DISAGGRECATED

Indicates the difference in safety perception around using a toilet between women, men, girls, and boys. Responses averaged across all sites.

AVERAGE % OF AFFECTED MEN, WOMEN, BOYS, AND GIRLS FEELING SAFE USING LATRINES AT NIGHT AND DURING THE DAY

Figure 1: *Example excerpt from Quality Snapshot Myanmar*

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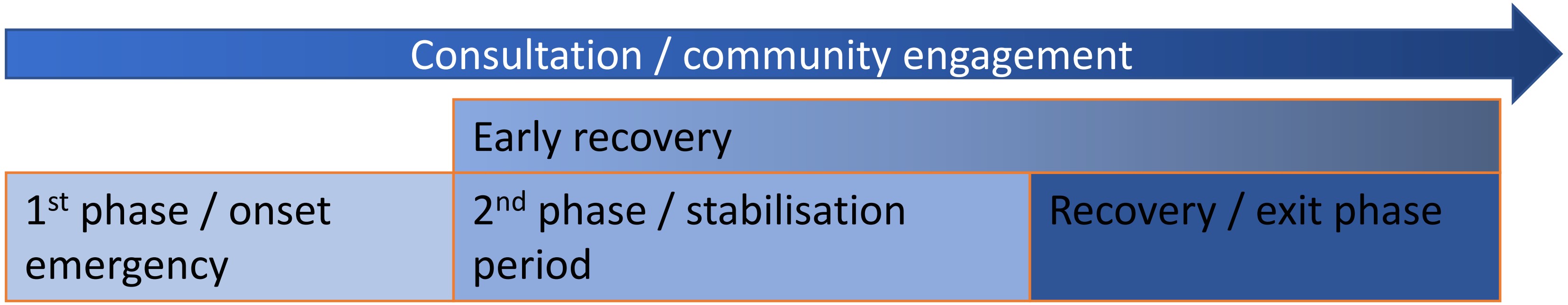
Excreta disposal service is required from day one of an emergency onset. The modality of implementation needs to be adapted to the targeted population and to the phase of the emergency.



- Open defecation management
- Trench latrine
- Communal latrine
- Distribution of commode and potty (children and people with disabilities)

- Family shared toilet
- Household toilet
- Inclusion of marginalised population
- Sustainable system / waste to value

- CLTS
- Sanitation marketing

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Construction modalities

There are a number of ways of constructing sanitation facilities:

1. The entire latrine can be constructed by the agency
2. The beneficiaries can dig their own pit & the agency provides the slabs, superstructure and technical assistance.
3. The beneficiaries are mobilised to construct their own latrines using locally available materials. The agency may need to provide tools and technical assistance or vouchers (conditional cash)
4. Using contractors & ensuring good monitoring and sign off by the agency

While contracting works has its own monitoring requirement related to contractual obligation and risk management, monitoring and sign-off also apply to all modalities albeit with less contractual constraints

In cases of large-scale emergencies when agencies have to directly install a huge number of lifesaving sanitation facilities in a short period of time, contracting out the construction work to multiple contractors is a key implementation modality. Awarding the whole work to one contractor selected via competitive bid just simply to follow the procurement rules involves accepting risks that could complicate the implementation process. Instead, distributing the work to multiple contractors will help speed up implementation and avoid risk of delay and failure in terms of quality. This requires the WASH and Logistics managers to work together.

Contracted works is a collaboration between Logistic, Finance and WASH teams and need to be well coordinated. More information can be found by Oxfam staff on the compass page One Oxfam Supply & Logistics Toolkit . Other organisations' staff should check their organisation procedures.

For contracting works, refer to Oxfam Technical Brief TBN12 – Introduction to contracting out PH engineering works and contract management and to your logistic department

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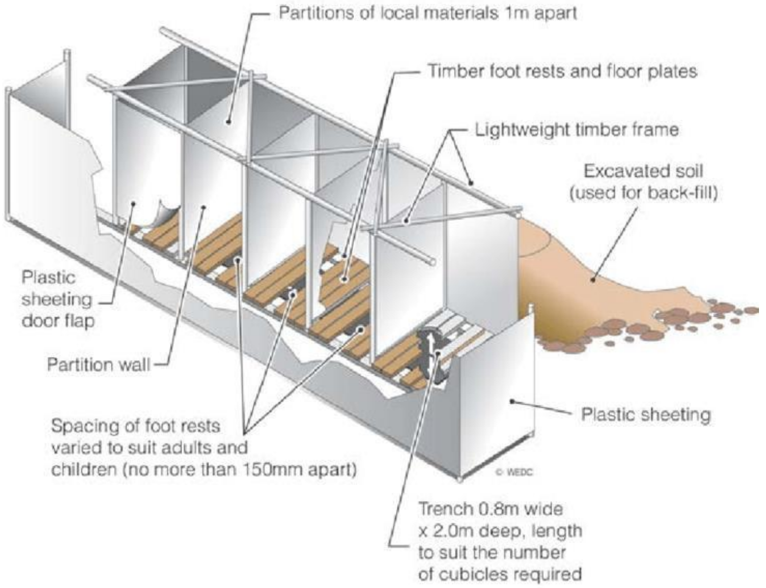
Public Toilet

Whenever there is more than 20 people per latrine door
(e.g. Sphere standard for 1st phase emergency 50 people per door)

Deep Trench latrine



Ken Chatterton © WEDC Loughborough University

Multiple door Pit latrine

In the preparation phase there should be as much co-ordination as possible with the affected population concerning the siting and type of latrines. Site maps should be drawn up to aid the equal distribution of communal latrines and to plan where latrine corridors can be put. A map can be drawn up with community members to involve them in this process of siting the latrines. If a community map is used it is very important to conduct this exercise with men and women and also with a technical advisor present to ensure that a consensus is reached on this important point

Due to management and maintenance problems associated with communal facilities, communal latrines are normally seen as only a short-term measure, before family latrines can be built or only for public places such as near markets, food and health centres. It may be necessary to pay workers (per latrine completed) in the initial phase for construction of communal latrines. However, it is preferable, in order to promote ownership, care and maintenance, if community members can be motivated to build them. If community members are to build their own toilets, then it may be necessary to provide help to those who may have no one available to do this such as female headed households, disabled families and the elderly.

It may not always be necessary to construct communal latrines as the population may be rapidly mobilised to dig their own family latrines, which are always preferable if conditions allow.

In planning budgets, consider if the initial communal latrines can be reused during the transition to family shared / household toilet and include the necessary budget for their adaptation based on consultation with users.

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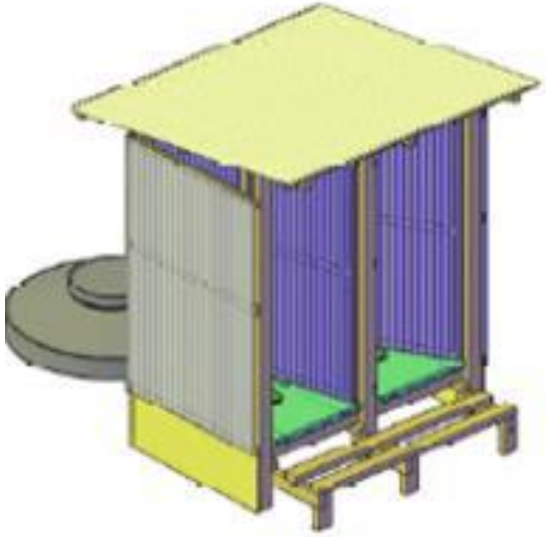
Family shared Toilet

Maximum 20 users per latrine door, dedicated to few families (~4) and the means to lock the door

All different modalities of construction can apply, although user participation in the construction improves user ownership of toilets

Single door structures if space allows, or double door structures



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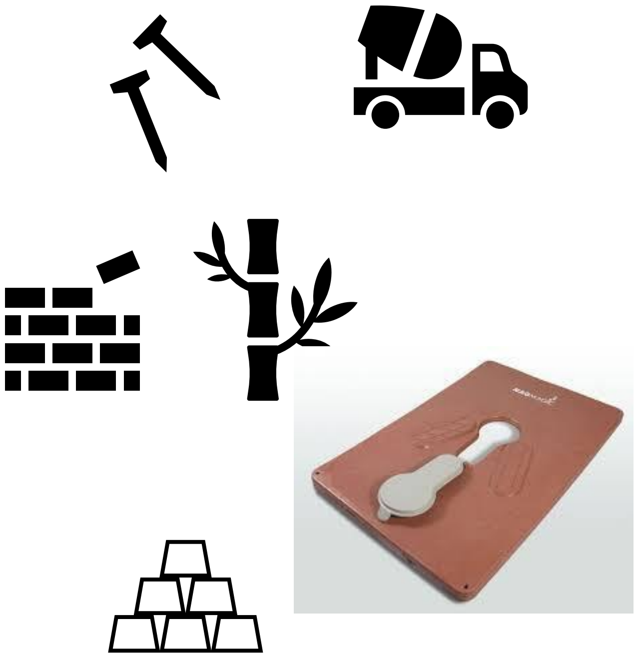
Household Toilet

Supporting families to build their own toilet through subsidies

Targeting for:

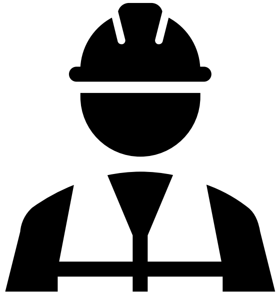
- Fully subsidised toilet
- Partially subsidised
- No subsidy

Must be discussed and agreed on with communities



Materials

Tools



Technical manpower

Motivating families to construct their own toilets through participatory approaches, e.g. CLTS

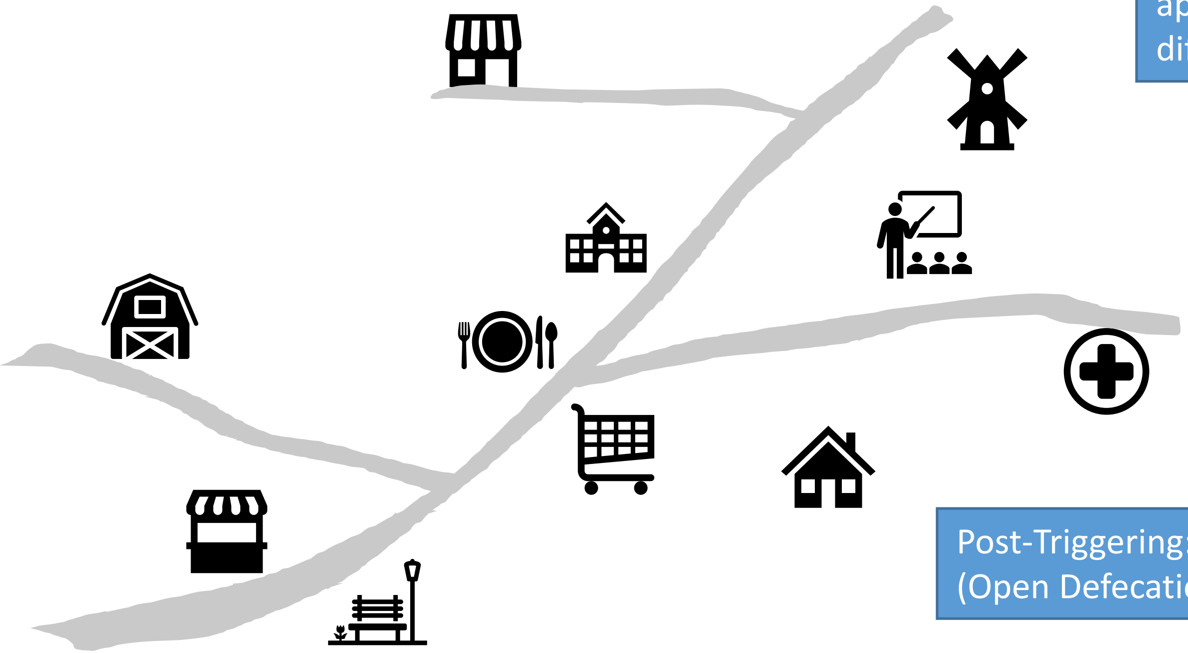
CLTS concentrates on the whole community rather than on individual behaviours

The facilitation phase involves a community engagement process where WASH engineers listen to users and understand enablers and barriers

Pre-Triggering: ensuring conditions are favourable for the CLTS approach

Triggering

Technical support for appropriate latrine design in difficult ground condition



Post-Triggering: Celebrating achieving ODF (Open Defecation Free) status

Reference: Plan - Handbook of Community-led Total Sanitation

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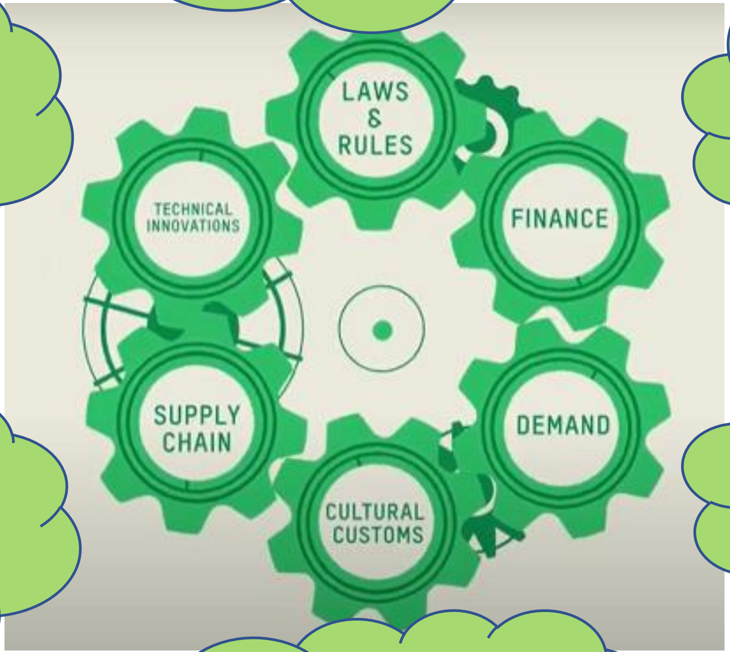
Supporting families to build their own toilet through Market-based programming

Based on Oxfam Philippines' program to make toilet affordable



Getting government buy in to use existing social support mechanisms to increase toilet ownership and use

Designing new, more affordable and more desirable products to suit a range of customers

Making it easy to save for a toilet or take out an affordable loan

Reducing cost through bulk buying materials, developing local supply routes and using sales agent

Showing people that owning a toilet could become a reality through affordable loan and savings

Understanding the type of toilets people want to use and maintain

In which situation should you consider market-based or cash-based programming?

In affected communities and communities hosting IDPs / Refugees

Supporting communities and artisans / enterprise in designing appropriate sanitation infrastructure

Find out more in: GWC, J. Allen & J. Brown – Market Based Programming in WASH, Technical Guidance for Humanitarian Practitioners, 2nd edition, Sept 2021

There are artisans and small business which can easily deliver any part of the excreta disposal system (e.g., material production, construction of facilities, desludging) through capacity building or financial support

Hiring the service of local enterprise for the upgrade or construction of latrine for IDPs / refugees families and their host

In refugee camps, people rarely have access to income

People have an income and access to market

Conditional cash grant for toilet (through vouchers) to households building their own toilet or for vulnerable families (either in host communities or camps)

The market need to be monitored to avoid prices inflation or any other negative impact resulting from the intervention and / or from other reasons that can be beyond the control of the program

People have access to credit or savings groups

In designing think in capital investment and operational cost. The latter should be as low as possible for long term sustainability

Identifying micro-finance institutions and supporting access to credit

To support loan request, think in term of return in investment (income) but also prevention in future cost / expense (reduction on health expense, less water treatment cost, reduced disaster impact, reduced water stress, etc.)

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There is no one-size-fits-all solution that can be picked up and apply to make WASH work inclusive; a range of different things need to be done, adapted to the specific context.

It’s not a linear process either; some activities can be carried out at various times in the programme cycle, and some can be run in parallel. An activity may result in unexpected outcomes, requiring you to respond in ways you had not originally anticipated, adapting your approach.

Focusing on the principles of the **rights to sanitation** will help guide your journey towards equality, non-discrimination and inclusion in WASH.

> **‘The human right to sanitation entitles everyone without discrimination to physical and affordable access to sanitation, in all spheres of life, which is safe, hygienic, secure, socially and culturally acceptable, which provides for privacy and ensures dignity.’**

United Nations General Assembly / Human Rights Council

Reference: WaterAid (2018) - Understanding and addressing equality, non-discrimination and inclusion in water, sanitation and hygiene (WASH) work. Water Aid: London, UK

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Lighting

Sanitation facilities are only effective if they are used, and they will only be used if the experience of using them is acceptable. This means users must feel safe and be able to see what they are doing inside the toilet. Whilst lighting may initially be viewed as a costly extra, especially in addition to the cost of a basic superstructure, its benefits justify the investment. Planning lighting in advance helps ensure that it is both efficient, effective and contributes towards greater safety, especially for women and children.

NATURAL LIGHT INSIDE THE TOILET

- Painting walls, door, floor in light color to reflect light
- Window at the top of the wall or space between top of the wall and roof
- Window on the roof or using material allowing light through (e.g. clear plastic sheeting)

ARTIFICIAL LIGHTING INSIDE THE TOILET

- Torches and lamp
- Fixed lighting

LIGHTING THE WAY

- A clear, smooth path with no obstacles marked with light-coloured stones, easier to follow
- Different paths to separated men's and women's toilets increase privacy and safety
- Lantern attached to post or building, powered through battery charged by solar panel or electricity grid

If public lighting is limited, it will attract more than just insects at night. Children doing homework or men meeting to chat and drink may gather beneath it. If the only light is near a toilet, users are very visible, and this may discourage their use. Too much lighting may make going to the toilet obvious to those who would prefer the cover of darkness. Consultation with a variety of users and ongoing monitoring is the only way to fully understand what is working and what needs further adaptation

Phosphorescent sheeting experimented by French Red Cross in Madagascar

Reference: Oxfam Technical brief – Lighting for Sanitation facilities

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Reduced Mobility

Siting

No more than 15 m from household (with member with reduced mobility)

Path to toilet

Suitable for: everyone, especially users with a visual impairment and with physical impairments, including wheelchair users.

- Guide string from house to latrine and bath shelter
- Clear, level path, lined with rocks
- Landmark posts made from local materials

Entrance

Entrances must be: a) wide enough (wheelchair width + 20cm), and b) level enough (minimal or no difference between outside and inside)

- Wide and level entrance to allow wheelchair access or user with helper. Rammed earth floor.
- Latrine with level concrete entrance, wide enough for a wheelchair user
- Level concrete threshold with raised cement mound to reduce flooding. Mound is rounded for wheelchair access.

Reference: WaterAid – Compendium of accessible WASH technologies

Door

Suitable for: users with mobility devices, a helper, or carrying a small child, or people who are overweight.

- Latrine with a curtain for privacy made of light cloth
- Outward-opening tin door on wooden frame. Raised platform edge acts as a door stop
- Outward-opening wooden double doors with a latch on outside to keep closed

Door handles and closing mechanisms

Suitable for: everyone, especially women and girls

- Horizontal handrail the full width of the door on the inside. Internal bolt.
- Carved wooden handle nailed to the inside of the door
- Metal hook and eye on inside of door

Reference: WaterAid – [Compendium of accessible WASH technologies]

Internal space

Think about: who will use the toilet, and how much space they will need.
Level 1: Space for users who can stand and enter using support rails, or blind users.

Level 2: Additional space for a carer, to use crutches/sticks or to park a wheelchair but not turn.

Level 3: Space for a wheelchair to enter, shut the door, and turn around inside.

- Traditional round superstructure, cement seat, wooden handrail each side, curtain for privacy
- Entrance corridor, with wall on left in front of latrine and a gap between corridor and toilet
- Spacious toilet cubicle, with drop hole located in the corner to provide maximum usable space

Floor finish

Think about: the balance between hygiene and safety. Floors need to be smooth enough to be washed and swept, but not so smooth that they are slippery when wet.

- Rammed earth floor without marram
- Rammed earth floor made of marram (small stones) and sand; cow dung is smeared over to make it even and smooth
- Cement slab, installed level with earth floor around it

Reference: WaterAid – Compendium of accessible WASH technologies

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Handrail and support

Suitable for: People who are unstable or unable to walk, squat or stand unaided

- Bricks protruding from wall for support to a weak or visually impaired person
- Wooden/ bamboo support rails fixed to floor either in front or on either side of toilet (depending on user's needs)
- Metal bars (e.g. galvanised iron pipe) fixed to side wall/s of latrine

Reference: WaterAid – [Compendium of accessible WASH technologies]()

Fixed seat pan

Suitable for: people who have difficulty squatting, including overweight people, pregnant women, older people and disabled people.

- Twin cement-plastered brick sitting blocks
- Brick seat with a cement screed
- Cement bowl made with mould

Moveable seat

Suitable for: users who have difficulty squatting, including overweight people, heavily pregnant women, older people, disabled people

- Low wooden or bamboo toilet stool with hole in seat, placed over toilet hole, with or without funnel as a splash guard (see lower image)
- Standard varnished wooden chair with hole cut in the seat

Reference: WaterAid – Compendium of accessible WASH technologies

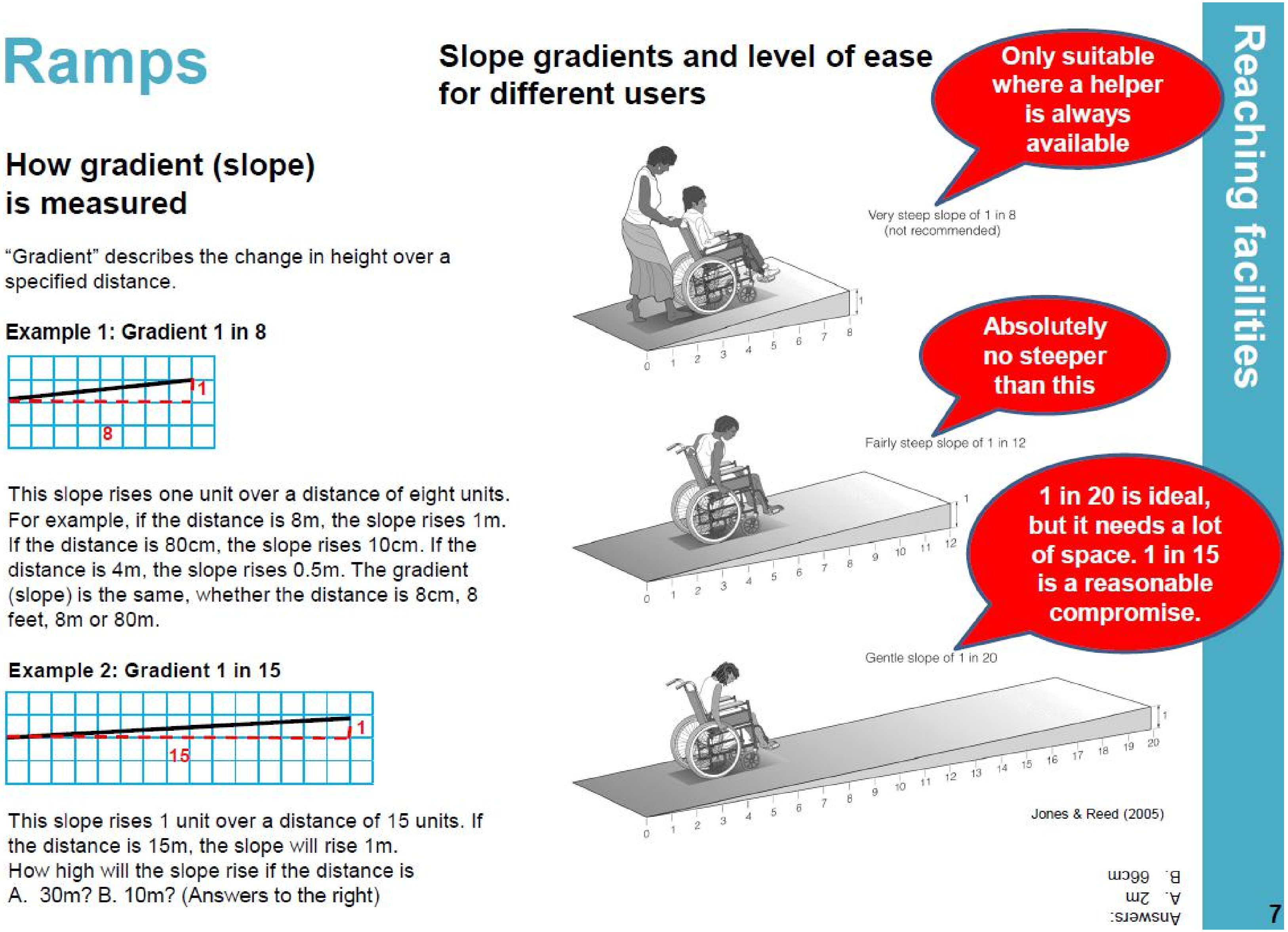
Commode seat

Suitable for: people who cannot reach a latrine; small children

- Painted wooden chair with 'potty' inserted in hole in seat. Potty is removed for emptying.
- Metal commode chair with plastic inset toilet pan (bought in local market). Container is placed beneath the seat and emptied into the latrine

Oxfam Supply Centre – Code HCWOW

Wheelchair access



Ramps

How gradient (slope) is measured

"Gradient" describes the change in height over a specified distance.

Example 1: Gradient 1 in 8

This slope rises one unit over a distance of eight units. For example, if the distance is 8m, the slope rises 1m. If the distance is 80cm, the slope rises 10cm. If the distance is 4m, the slope rises 0.5m. The gradient (slope) is the same, whether the distance is 8cm, 8 feet, 8m or 80m.

Example 2: Gradient 1 in 15

This slope rises 1 unit over a distance of 15 units. If the distance is 15m, the slope will rise 1m.
How high will the slope rise if the distance is
A. 30m? B. 10m? (Answers to the right)

Slope gradients and level of ease for different users

Only suitable where a helper is always available

Very steep slope of 1 in 8
(not recommended)

Absolutely no steeper than this

Fairly steep slope of 1 in 12

1 in 20 is ideal, but it needs a lot of space. 1 in 15 is a reasonable compromise.

Gentle slope of 1 in 20

Jones & Reed (2005)

Answers:
A. 2m
B. 66cm

Reference: WaterAid – Compendium of accessible WASH technologies

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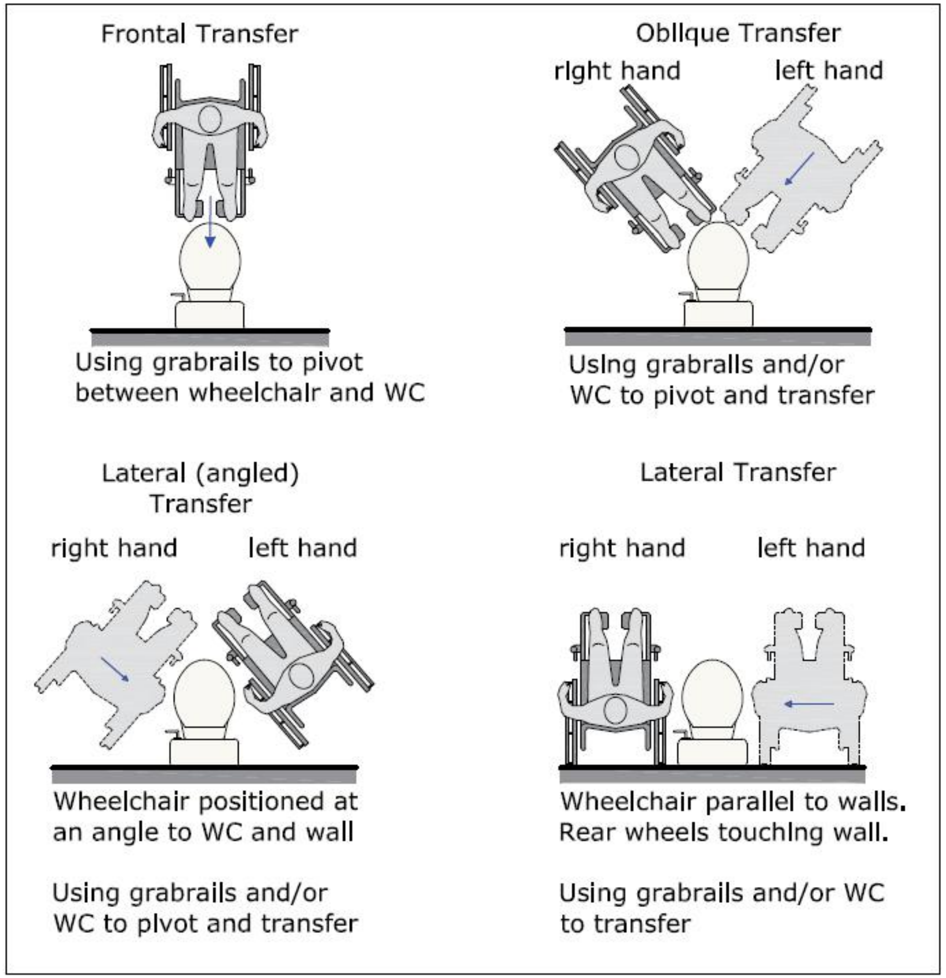
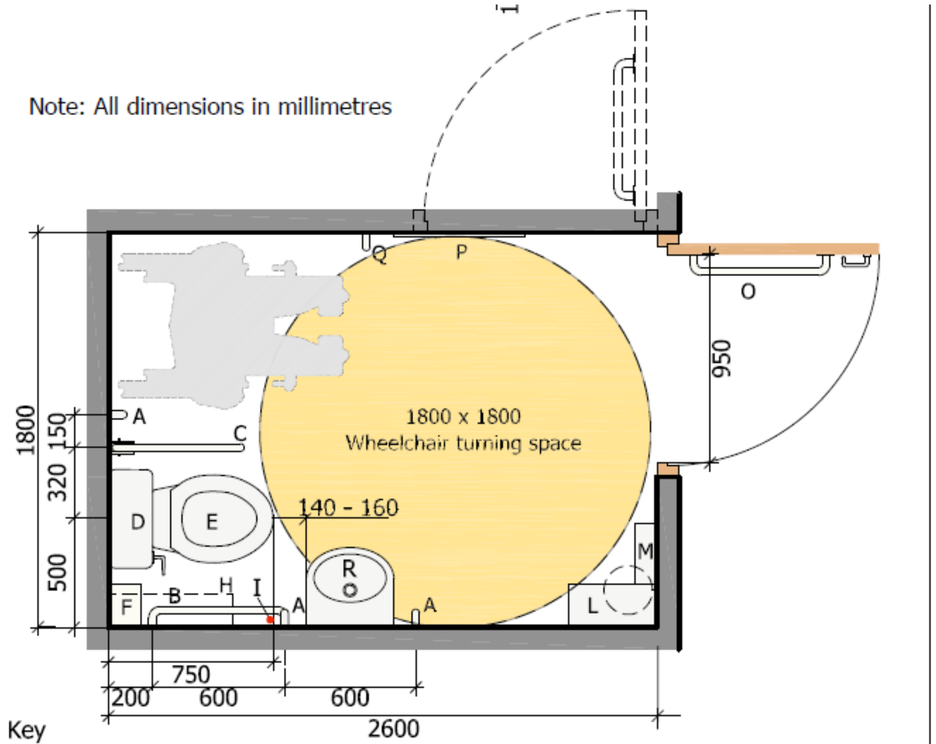
Figure 5.1 Transfer techniques for people moving between a wheelchair and a WC.





Key
A. Vertical grabrail ⦸ diameter 35mm
B. Horizontal grabrail ⦸ diameter 35mm
C. Drop down rail ⦸ diameter 35mm
D. Flat-topped close-coupled cistern proding a back rest
E. Special WC pan
F. 950 high shelf for colostomy bags
G. Alarm reset button 🟥
H. Toilet paper dispenser
I. Alarm pull-cord ●
J. Paper towel dispenser
K. Soap dispenser
L. Hot-air hand dryer
M. Shelf for personal use
N. Sanitary dispenser with conrols P. between 750 and 1200
O. Horizontal rail to assist door closing
P. Mirror from 600 - 1600
Q. Two clothes hooks within range 1050 - 1700
R. Wash basin

Reference: NDA - Building for Everyone: A Universal Design Approach

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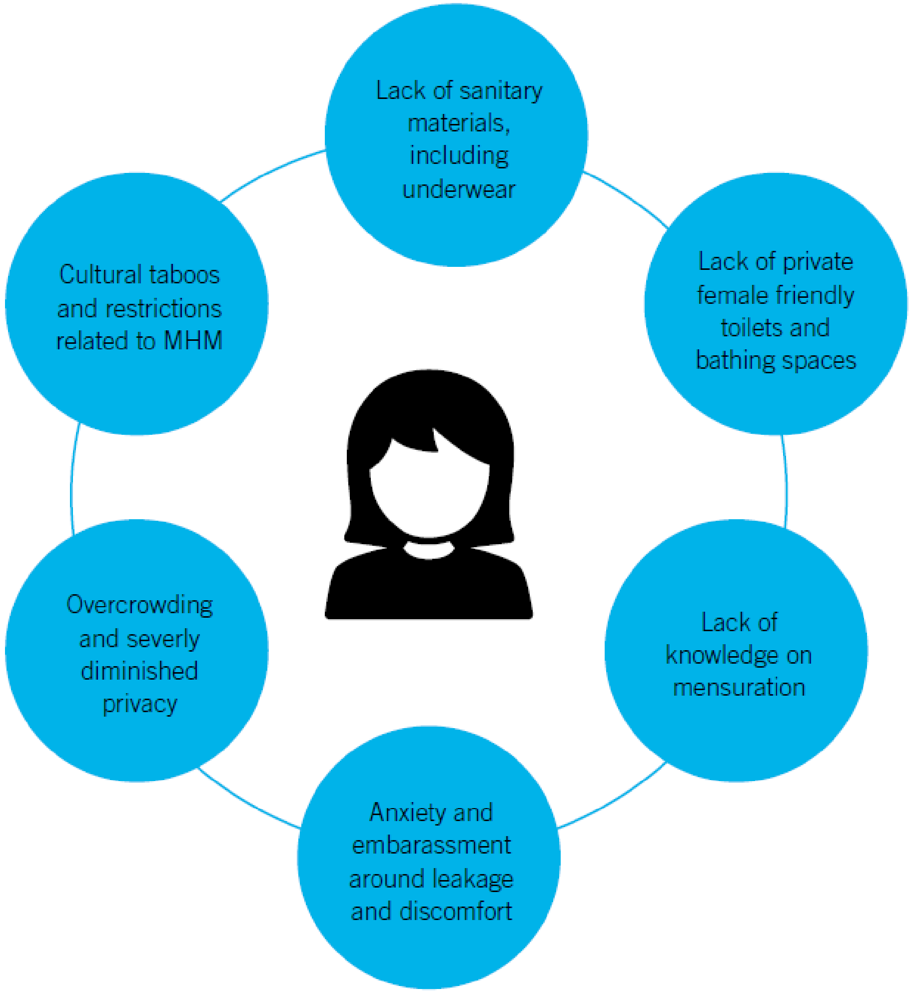
Menstrual Hygiene Management

Women and girls require more privacy for sanitation than men and boys, especially when dealing with menstruation. Maintaining safety and dignity while accessing sanitation facilities remains a widespread challenge in humanitarian contexts.

MHM CHALLENGES FACING GIRLS AND WOMEN IN EMERGENCIES



Lack of sanitary materials, including underwear

Lack of private female friendly toilets and bathing spaces

Lack of knowledge on mensuration

Anxiety and embarassment around leakage and discomfort

Overcrowding and severly diminished privacy

Cultural taboos and restrictions related to MHM

THE HIERACHY OF MHM NEEDS

Providing an MHM response requires a range of sectors to identify which elements or activities may fall within their mandate. Figure 1 depicts the range of MHM considerations (e.g. basic materials and supplies, information, facilities, safety, privacy and dignity) and how these may fall within the responsibility of various sectoral actors. Effective coordination and communication across sectors is critical. Sectoral responsibility may vary considerably from one context to another.

DIGNITY
Harmful cultural norms addressed; a supportive environment; access to information about puberty and reproductive health; engagement with boys & men

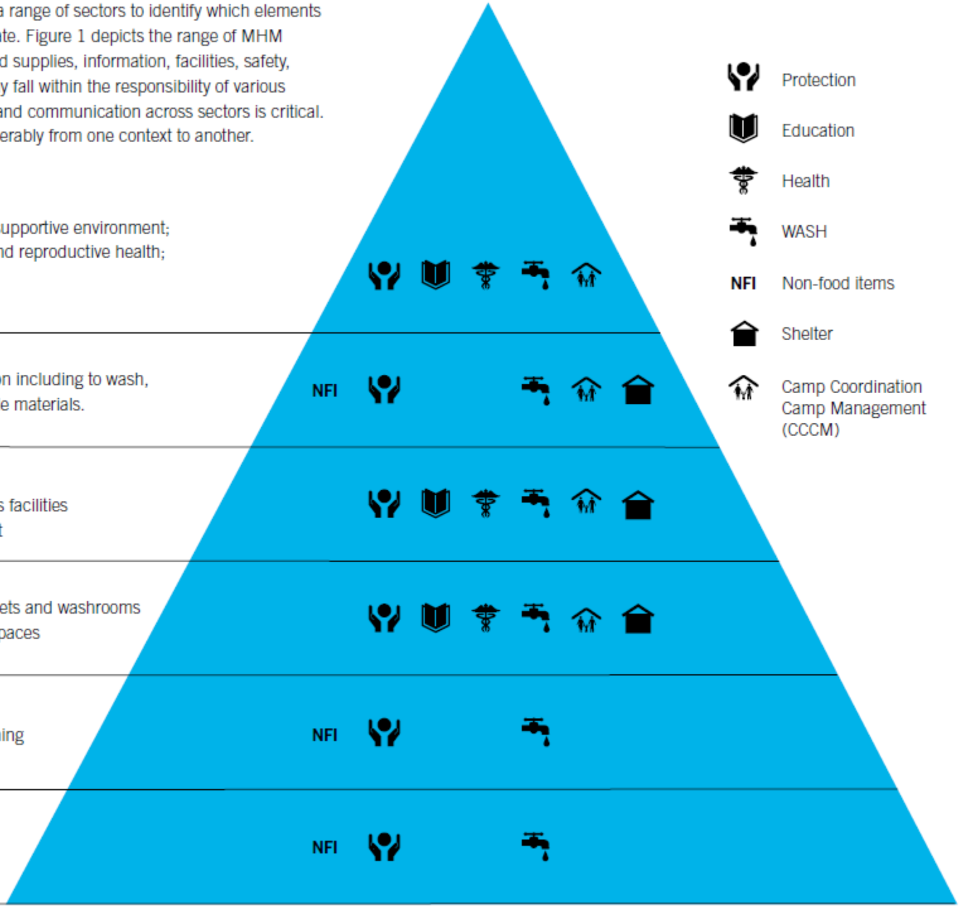
PRIVACY
Ability to privately manage menstruation including to wash, dry and/or discretely discard disposable materials.

SAFETY
A secure environment; ability to access facilities of choice throughout the day and night

FACILITIES Private female friendly toilets and washrooms at home and in public & institutional spaces

INFORMATION
Practical information on wearing, washing and disposing provided materials

BASIC MATERIALS AND SUPPLIES
Pads, underwear and soap



Reference: Sommer, M., Schmitt, M., Clatworthy, D. (2017) – A Toolkit for integrating menstrual hygiene management (MHM) into Humanitarian Response (First Edit). New York: Columbia University, Mailman School of Public Health and International Rescue Committee

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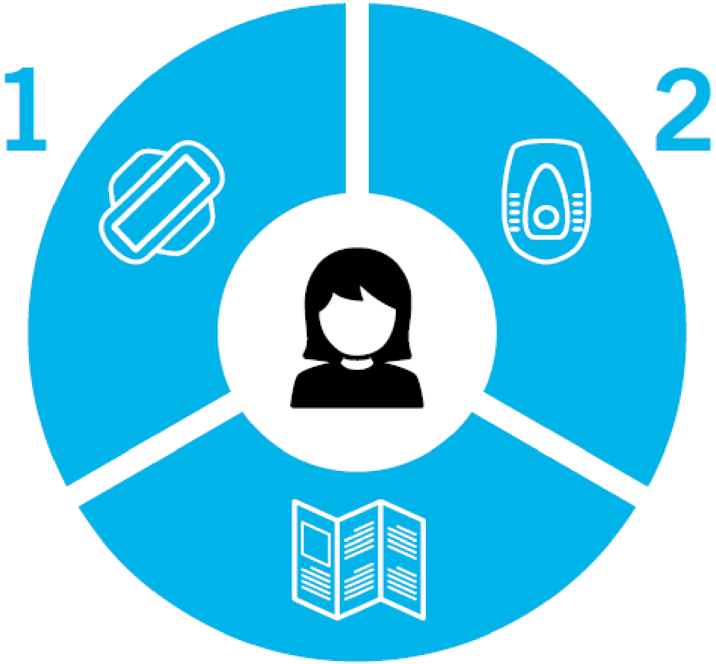
THREE ESSENTIAL COMPONENTS OF A COMPLETE MHM HUMANITARIAN RESPONSE

MHM is a cross-sectoral issue. In order to deliver an effective response, the various sectors must coordinate to ensure that the three central components are addressed.



MHM MATERIALS & SUPPLIES 1

- Appropriate menstrual materials (pads, cloths, underwear).
- Additional supportive materials (e.g. soap, bucket) for storage, washing and drying.
- Demonstration on how to use MHM materials.

2 MHM SUPPORTIVE FACILITIES

- Safe and private toilet and bathing facilities with water for changing, washing and drying menstrual materials.
- **Convenient and private disposal options for menstrual waste.**
- **Waste management systems in place for menstrual waste.**

3 MHM INFORMATION

- Basic menstrual hygiene promotion and education.
- Basic menstrual health education (especially for pubescent girls).
- Address harmful cultural or social norms related to menstruation.

Reference: Sommer, M., Schmitt, M., Clatworthy, D. (2017) – A Toolkit for integrating menstrual hygiene management (MHM) into Humanitarian Response (First Edit). New York: Columbia University, Mailman School of Public Health and International Rescue Committee

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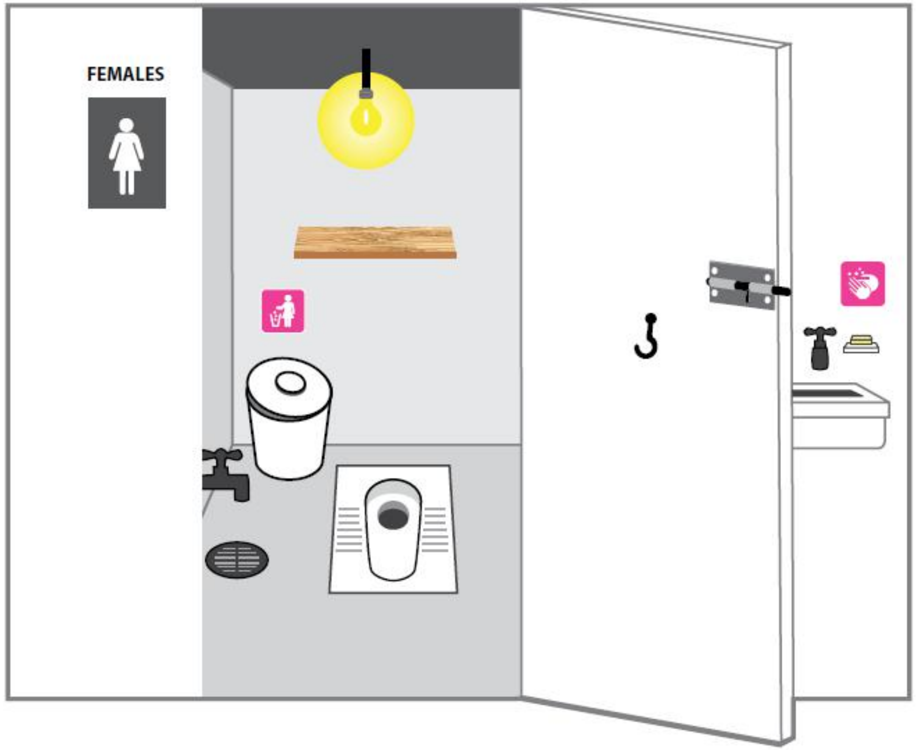
FIGURE 2: EXAMPLE OF A FEMALE FRIENDLY TOILET



- Adequate numbers of safely located toilets separated (with clear signage) from male facilities.
- Safe and private toilets with inside door latch
- Clear signs instructing girls and women to dispose of menstrual waste in the trash bin
- A shelf and hook for hygienically storing belongings during usage.
- Night time light source both inside and outside of the toilets
- Easily accessible water (ideally inside the cubicle) for girls and women to wash themselves and menstrual materials.
- Trash bins (with lids) to dispose of used menstrual materials
- Walls, door and roof are made of non-transparent materials with no gaps or spaces.
- Some units should be accessible to people with disabilities.

MHM-RELATED NFI CONSIDERATIONS TO SUPPORT THE WASHING AND DRYING OF MATERIALS:

- Provision of MHM-designated buckets or basins with lids (as girls and women will not want to use the same buckets for cooking and other laundry activities). It can also be used for soaking and storage when not in use.
- Additional laundry soap for girls and women to wash menstrual materials
- A clothesline and clips to ensure girls and women can dry materials separately.
- In some contexts, women may want a piece of cloth to privately cover these materials while drying.

Reference: Sommer, M., Schmitt, M., Clatworthy, D. (2017) – A Toolkit for integrating menstrual hygiene management (MHM) into Humanitarian Response (First Edit). New York: Columbia University, Mailman School of Public Health and International Rescue Committee

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A latrine superstructure is a shelter which provides privacy and protection for the user of the latrine. Superstructures can be built from a variety of materials ranging from bricks, blocks and stone to corrugated metal sheets, wattle and daub and, in emergencies, even plastic or sackcloth.

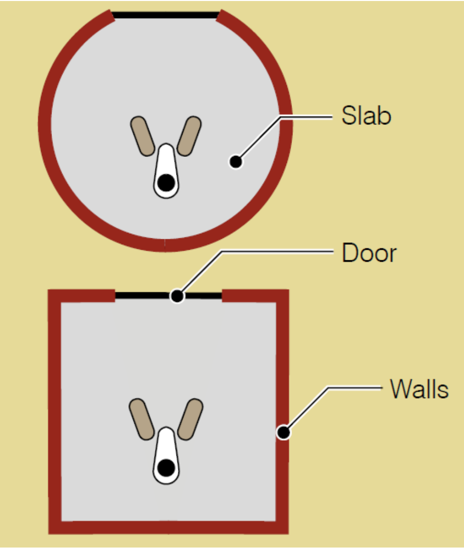
Privacy, protection, health

Together with the defecation hole, it is considered by many users to be the **most critical component**. It is essential, therefore, that the superstructure meets their requirements. For most users, issues of security, dignity and prestige take precedence over public health consideration

Size

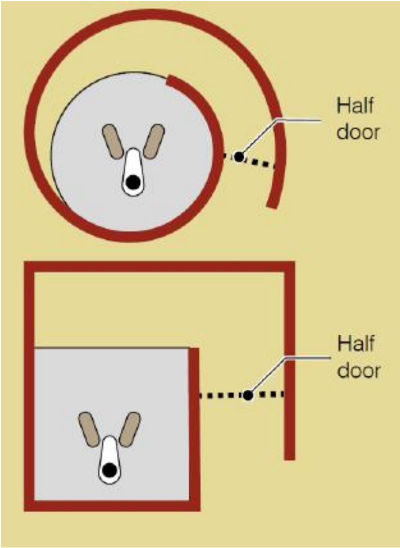
Floor area: too large and people in public latrines may be tempted to defecate on the floor, particularly if the squat hole has been fouled by previous users.
For wheelchair user: doorway and floor area must be large enough to allow entry and turning.
For women and girls: superstructures with washing facilities help women and girls manage menstruation.
Height of the superstructure: should accommodate a person standing upright and be high enough to prevent the space from feeling oppressive. However, if people are used to stooping on entry to buildings, a low entrance may be acceptable or even preferred.
There is no accepted minimum size for a superstructure floor, but it would normally be greater than 0.8m wide by 1.2m long, provided the access door opens outwards. If the door opens inwards, then the length must be increased by at least 0.5m

Shape (plan view)



For superstructures not attached to buildings, there are two basic shapes: a simple round or rectangular space with or without a privacy wall, a barrier in front of the entrance door to give privacy to those entering or leaving the toilet and a spiral which may also be round or rectangular.
Spiral design uses more wall materials but keep the inside of the latrine dark (requirement for Ventilated Improved Latrines)

In some cultures, there may be a prohibition on facing in a particular direction when defecating. This must obviously be considered when the latrine is being positioned.



Reference: [WEDC – Latrine superstructure]

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Material

What is the construction style in the area (superstructure and material used)? Avoid better construction standard than local dwelling as it won't be affordable for other families to copy and build their own latrine outside of subsidised program.

Similarly, the introduction of new materials and methods should normally be avoided in a latrine programme as this diverts attention from the real purpose of the sanitation system. It is better to use local skills and materials which local tradesmen understand how to use and, most importantly, how to maintain.

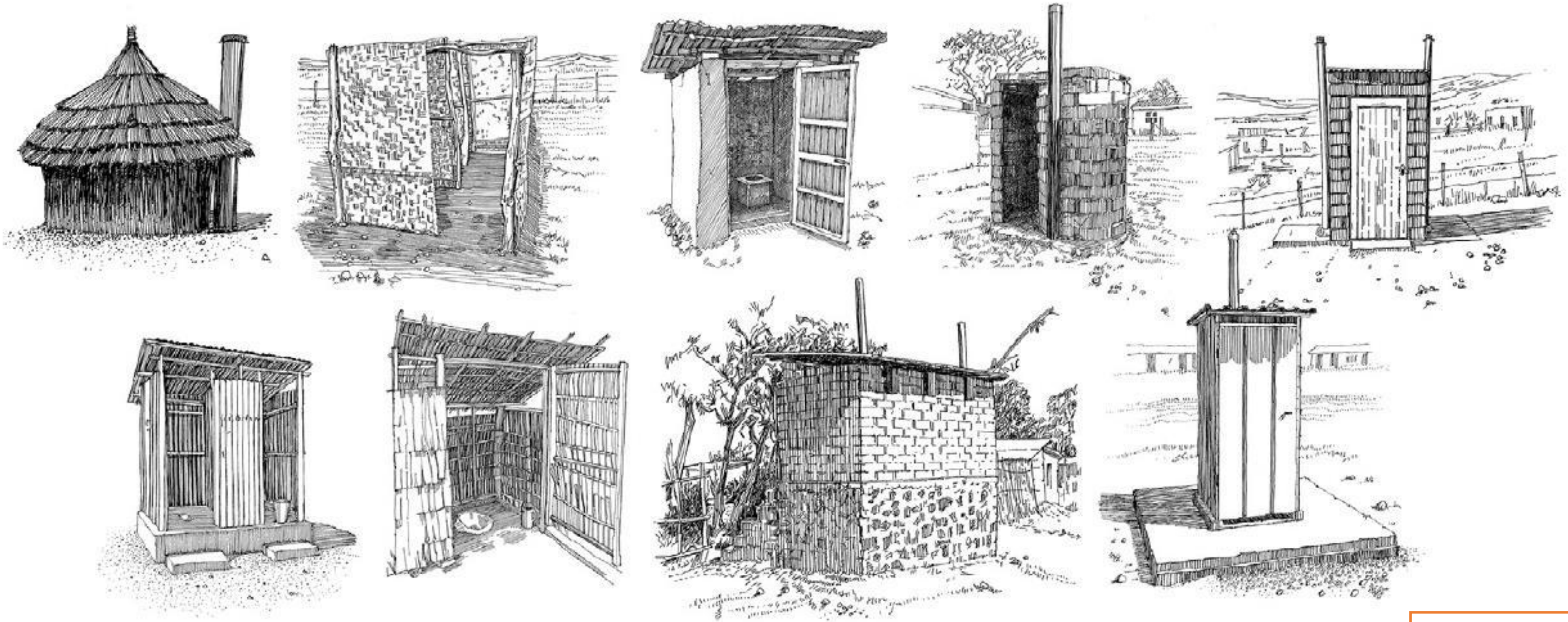

Figure 6. Latrine superstructures made from different materials

A roof is not necessary.

It protect the user from rain and sun.

Check local custom as in some cultures people are used to defecating in the open and find it objectionable to have to go into a small building.

In the initial consultation, local material availability, people's preferences & needs regarding roof, shape, size should be identified

Reference: WHO - [A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed]() and : [WEDC – Latrine superstructure]()

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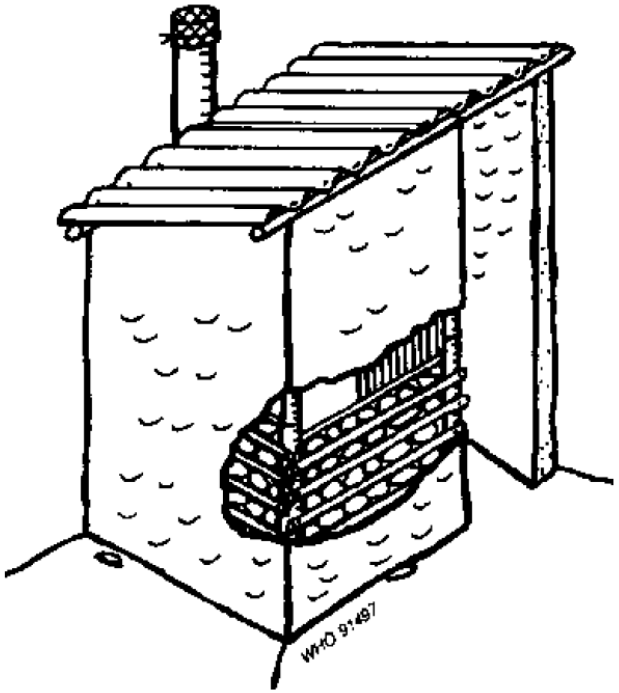
Mud and wattle

Consist of upright poles, with the bark removed, interwoven with small branches, the whole being plastered with mud. Mud and wattle may be improved by nailing bamboo strips to straight upright poles and filling the gaps with small stones before plastering with mud.

Bamboo

Shelters can be made from larger-diameter bamboo poles forming the main frame with smaller bamboos nailed or strapped to them to form the walls. Alternatively palm leaves or bamboo matting can be used to fill in the walls of the bamboo frame.

Fig. 7.37. Reinforced mud and wattle superstructure



Sawn timber

Increasingly, sawn timber is becoming an expensive and rare commodity in low-income areas, but if off-cuts are available from a sawmill, these can be used to clad a simple timber-framed structure.

Sun-dried bricks

Known as adobe, modagadol, kacha or by other local names, made from a mixture of well-puddled and tempered clay. Moulded in simple wooden formers, and allowed to dry slowly, out of direct sunlight. Can be strengthened with the addition of natural fibres such as fine grasses or coconut fibres. The superstructure is erected slowly using mud mortar, and where necessary the walls can be strengthened with the addition of fencing wire on alternate horizontal joints.

Machine-pressed blocks

This technique employs a portable steel press to compact prepared soils in order to produce regular blocks. The blocks may be stabilized with up to 8% of cement or lime depending upon the character of the soils used and the degree of exposure of the finished wall. The blocks are laid in mud mortar and can be plastered externally with mud mortar which requires attention every couple of wet seasons.

Fired bricks

Where also used for housing, these make an excellent material for latrine construction. To exert minimum pressure on the ground, a half-brick wall (112 mm thick) built in cement mortar is used with pillars at the corners. If mud is used as the mortar to reduce costs, then a one-brick wall (225 mm thick) should be constructed.

Stone

Traditional building techniques with stones are sometimes used for latrine construction. This is normally to be avoided over direct pits as the thickness of the walls (often 450 mm or more) exerts a high load, requiring a strong pit lining for support. Stone buildings are quite acceptable, however, for offset pits.

Reference: WHO - A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed and : WEDC – Latrine superstructure

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Concrete blocks

Where a more expensive standard is acceptable, or if firewood for brick firing is restricted concrete blocks can be made by hand on site or purchased from a local manufacturer. The blocks are usually 150 mm thick but to reduce materials 65-mm blocks can be made. However, greater skill is required in the laying of these blocks, and it is unlikely that a householder would be able to build without skilled assistance.

Ferrocement

A strong cement mortar pressed into three or four layers of wire mesh forms a strong, reasonably stiff membrane known as ferrocement. This material has been used successfully for spiral superstructures but can only be used where cement costs are low, *and the people are willing to accept a new technology along with their new latrines.*

Other wall materials

Plasticized materials, corrugated asbestos cement, galvanized iron and aluminium sheets are also used.

Important

Care must be taken to ensure the walls of a superstructure made of brick or blocks are not too heavy if the superstructure is built directly above a pit. Heavy walls can place undue pressure on the foundations, causing the pit to collapse.

Reference: WHO - A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed and : WEDC – Latrine superstructure

Doors

Where possible it is advisable to mount the door on self-closing hinges. Doors can be made of sawn timber, from beaten tins or corrugated iron on a wooden frame, bamboo strips or anything else that is available. Simple curtains may suffice where timber is scarce. Where spiral designs is used without door it is normal for people to knock on the outside of the structure before entering to warn anybody using the latrine of their approach. However, check users' preference. Hinges do not have to be manufactured in steel; strips of old car tyres or leather from old shoes can equally well be used.

Roofing

Materials such as thatch, palm leaves, clay tiles, fibre-cement tiles, wood shingles, corrugated iron, corrugated aluminium, asbestos cement, ferrocement and precast concrete can all be used for roofing the latrine superstructure. An important point to note is that the roof must be adequately tied into the wall structure and the walls must be strong enough to resist the uplift of high winds. Some materials, for example, galvanized corrugated iron, lead to greatly increased temperatures inside the latrine which may increase odour and make the building less pleasant to use.

Vent pipe *(for VIP, Ventilated Improved Latrine)*

Minimum 150mm (smooth surface) or 200-250mm (rough surface) internal diameter pipe with a fine mesh at the top. Pipe made with unplasticized PVC, bricks, blocks, hollowed-out bamboo, ant-hill soil, cement rendered reeds or bamboo, and cement-rendered hessian. Flyscreen made with aluminium, stainless-steel or PVC-coated glass-fibre mesh, size of 1.2-1.5 mm. For the flytrap to be effective, the pipe needs to be directly under sunlight for heating and inside the cubicle should be dark, and the drop hole not covered for air circulation

For a VIP to be effective all the conditions need to be respected. Any of the following happening rendered the extra cost of building a VIP latrine useless:

- Not dark inside the cubicle
- A cap on the drop hole
- The absence of mesh on top of the pipe
- Wrong pipe diameter (e.g. 4" or smaller)
- Shading of the pipe (e.g. installed inside the cubicle where it can represent a source of cross-contamination by hand contact, or shaded by another building)

Emergency kits for latrine superstructure, suitable for first 3-4 months, camp settings

[Latrine superstructure – Code LST]

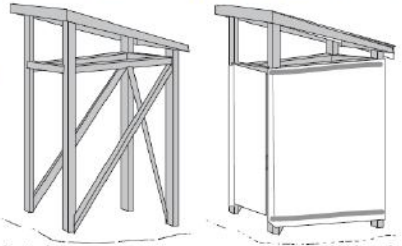
[Sheeting, Reinforced Woven Plastic, Tarpaulin pieces – code SPT]

[Sheeting, Reinforced Woven Plastic, Roll – Code SPE]

[Latrine kit, raised, with two cubicles – Code LRLT]

Example A superstructure for latrine / washroom using plastic sheeting

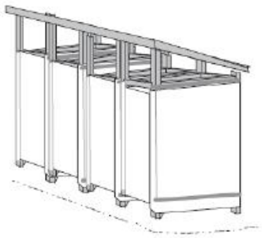
Structure
- Timber ($0.1M^3$)
- Nails (3Kg)



Cover
- Plastic sheet ($6.5m^2$)
- Domed head nails (1kg) or nails and battening

Building blocks of latrines can save materials but it can be harder to encourage ownership and keep them clean.

Aim for a minimum of one latrine per twenty people



Example: Use of plastic sheeting as temporary but washable latrine slab.

Reference: [IFRC, Oxfam – A guide to the specification and use of plastic sheeting in humanitarian relief]

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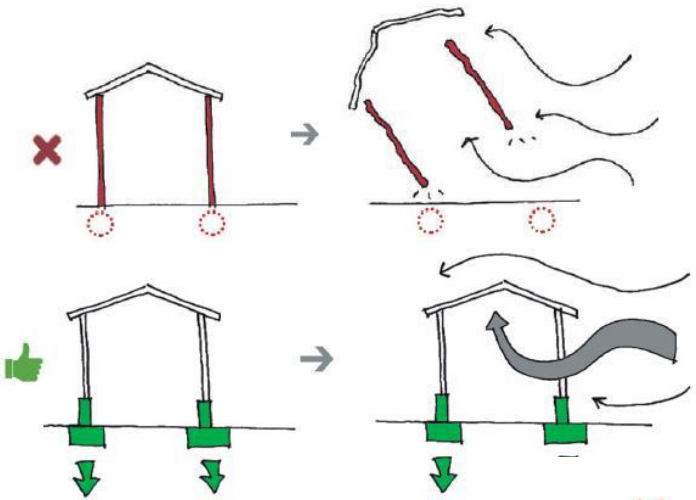
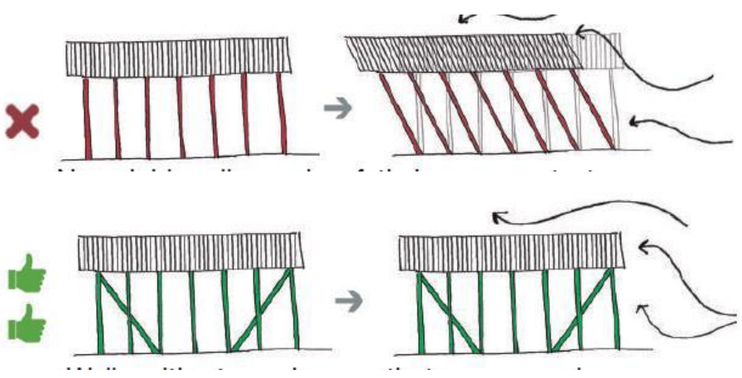
Foundation

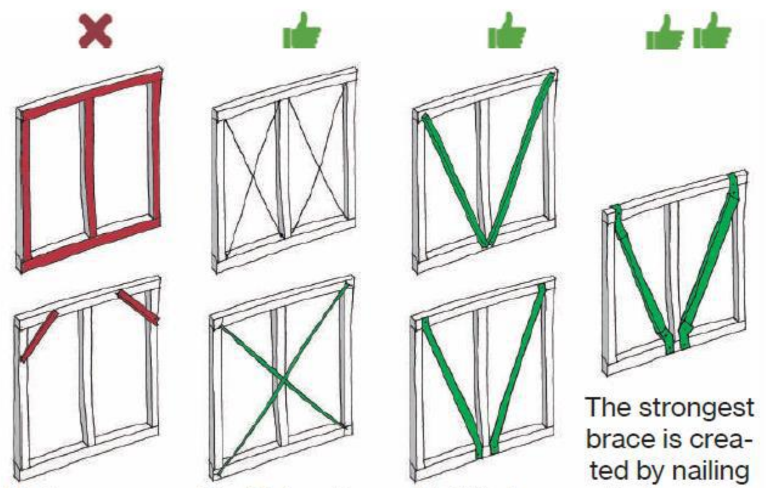


Strong foundation to anchor the structure

Walls



During the consultation step verify if there are specific risks for building in relation to strong winds and if there is a dominant wind direction

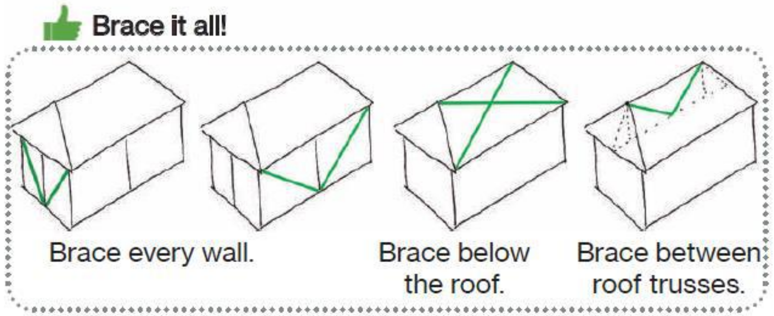


No brace or a small brace is weak.

Tie thick galvanized steel wire or use rebars.

Nail timber or galvanized steel straps.

The strongest brace is created by nailing timber and galvanized stell straps.

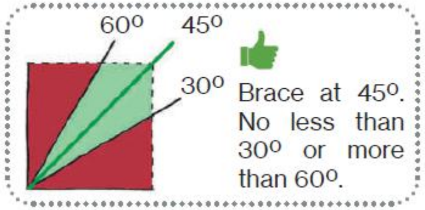


Brace it all!

Brace every wall.

Brace below the roof.

Brace between roof trusses.



Brace at 45⁰. No less than 30⁰ or more than 60⁰.

Reference: Habitat for Humanity - Hurricane resistant wooden houses - safer building and retrofitting guidelines

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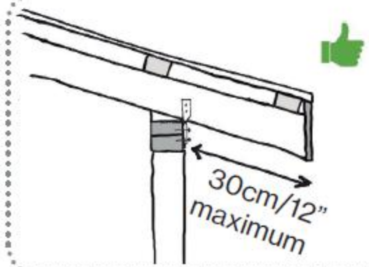
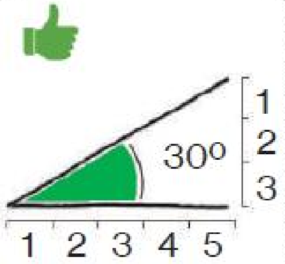
Roof

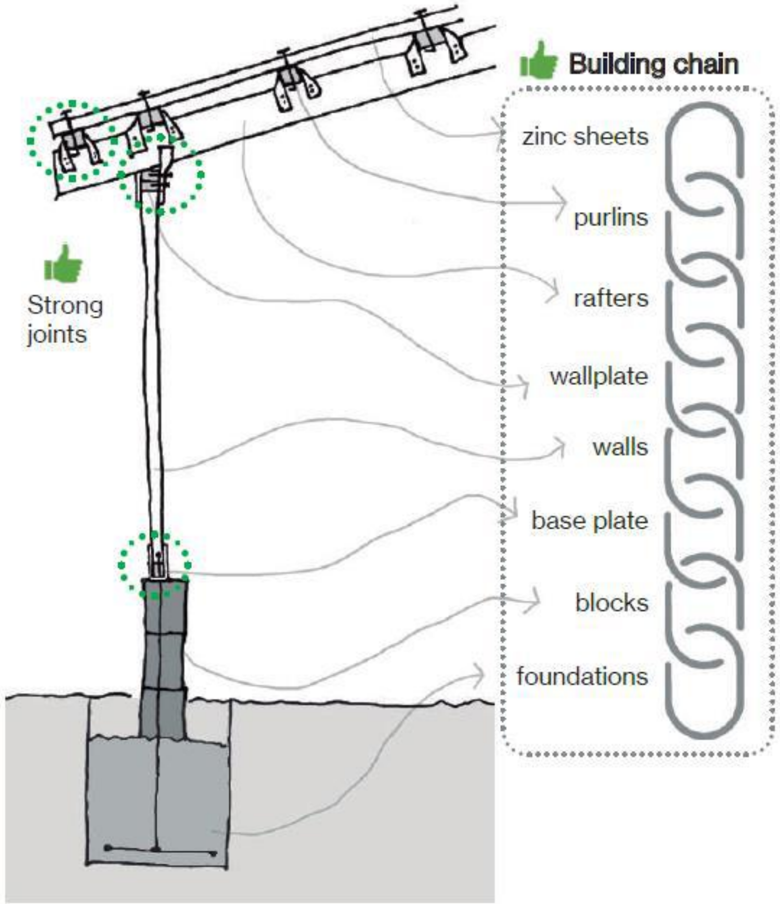


Keep eaves short to prevent the roof from being blown off and long enough to protect the walls from rain.



The best roof pitch is 30°

Tie bottom up

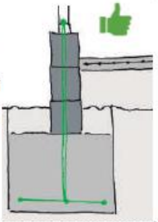


Strong joints

Building chain

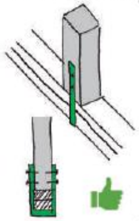
- zinc sheets
- purlins
- rafters
- wallplate
- walls
- base plate
- blocks
- foundations

foundations blocks base plate



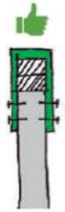
This connection has to be tied with washer and nut. It is made out of steel rebar. *Page 11*

base plate walls



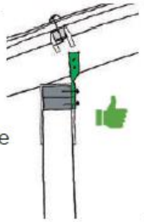
This connection is made out of a hurricane strap and bolts. We have to put a double base plate. *Page 15*

walls wallplate



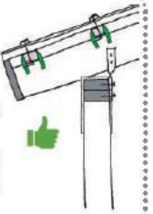
This connection is also made of a hurricane strap and bolts. We have to put a double wallplate. *Page 15*

wallplate rafters



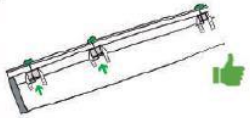
This connection is made of a twisted hurricane strap and bolts. We have to connect every rafter. *Page 21*

rafters purlins



This connection is made with a hurricane strap and bolts. We have to be aware of the spacing between laths. *Page 21*

purlins zinc sheets



This connection is made of a twisted umbrella head nail and washer. We have to fold the nail. *Page 23*

Reference: Habitat for Humanity - Hurricane resistant wooden houses - safer building and retrofitting guidelines

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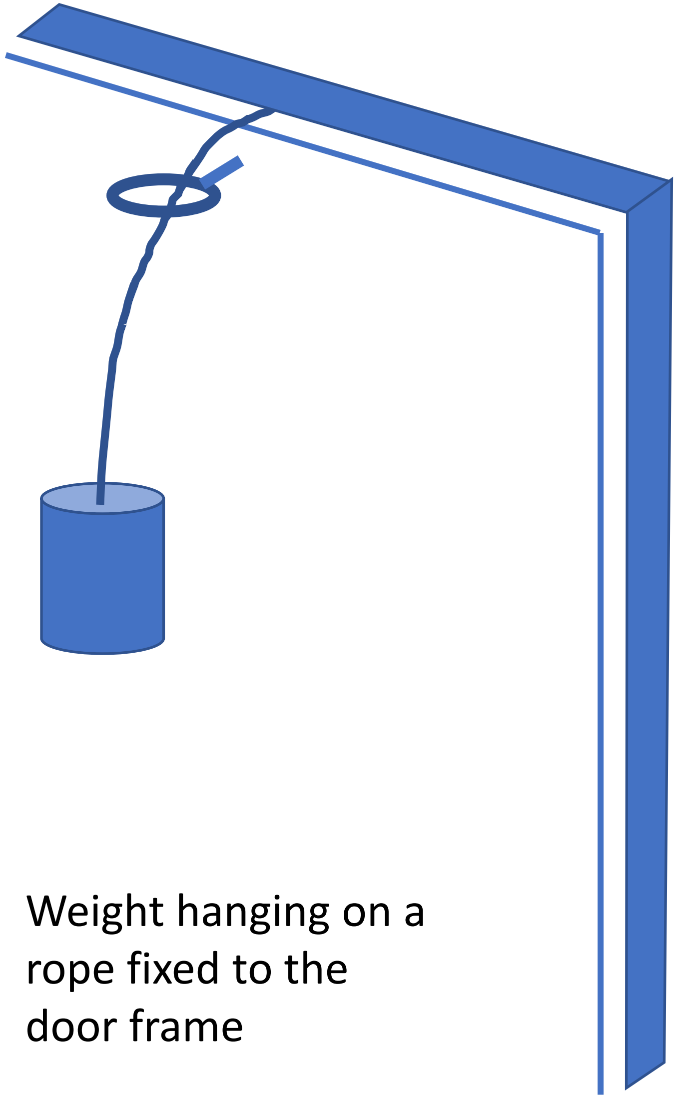
Doors

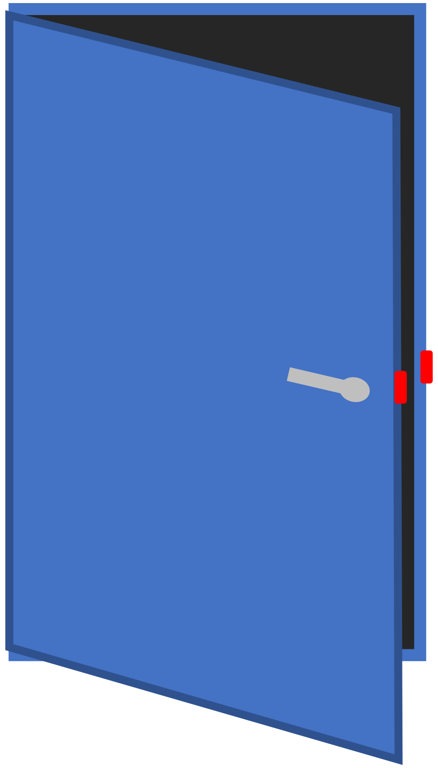
Self-closing door to avoid swinging with the wind

Spring or elastic band installed at the top.

However, be ready to replace / repair regularly.



Weight hanging on a rope fixed to the door frame



Magnet

When the door is pushed back the magnet ensure the door stay closed

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Environment considerations

Oxfam Ethical and Environmental purchasing policy

Environmental Standards

Oxfam is committed to reduce its reliance on finite/scarce resources and to minimise the environmental impact of its operations including its supply chain and will work to achieve the standards listed in this section.

Climate change:

Monitor and actively seek to reduce the Greenhouse Gas (GHG) emissions associated with its operations and:

- Set absolute GHG reduction targets for operations in industrialised countries or Economies in Transition, such as those identified in Annex I of the United Nations Framework Convention on Climate Change below
- Set and report on targets for improved efficiency in countries where Oxfam runs programmes, such as those that may be regarded as non-Annex I countries under the UNFCCC

Waste:

- Reduce waste to landfill.
- Monitor operations, including procurement, to ensure waste minimisation and high product and process efficiency.
- Effective controls of waste in respect of ground, air, and water pollution are adopted.

Materials:

- Reuse, recycling and the use of recycled and recyclable materials are strongly encouraged.
- Avoid where practicable reliance on materials that are heavily dependent on finite resources.

Packaging:

- Actively avoid undue and unnecessary packaging wherever practicable and use recycled and recyclable materials wherever appropriate.

Wood and forest products:

- Ensure that all forest products purchased are as a minimum legal in origin and provide evidence of due diligence to ensure this if requested by Oxfam
- Suppliers of paper products sourced from Oxfam affiliate home country offices and retail products carrying the Oxfam Brand must source forest products from recycled sources or well managed forests which have been certified to a credible standard. Exceptions will be made for products which are Fairtrade marked or produced by members of the World Fair Trade Organisation as appropriate. Oxfam views the Forestry Stewardship Council (FSC) as the most credible certification for the sustainable sourcing of wood and forest products.
- Suppliers must never knowingly become involved in, collude with or purchase timber from illegal logging operations.

Conservation of biodiversity:

- Seek to minimise the impact of operations on fauna, flora and land to ensure the conservation of biodiversity and habitats.

Water:

- Develop a better understanding of its impact on water use and develop management processes where appropriate

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Oxfam International has signed the Climate and Environment Charter developed by ICRC / IFRC, committing to:

1. Step up our response to growing humanitarian needs and help people adapt to the impacts of the climate and environmental crises View guidance for commitment 1
2. Maximize the environmental sustainability of our work and rapidly reduce our greenhouse gas emissions View guidance for commitment 2
3. Embrace the leadership of local actors and communities View guidance for commitment 3
4. Increase our capacity to understand climate and environmental risks and develop evidence-based solutions View guidance for commitment 4
5. Work collaboratively across the humanitarian sector and beyond to strengthen climate and environmental action View guidance for commitment 5
6. Use our influence to mobilise urgent and more ambitious climate action and environmental protection View guidance for commitment 6
7. Develop targets and measure our progress as we implement our commitments

Ensure Community Engagement is mainstreamed throughout the process of developing and implementing an excreta disposal system

Listen, feedback, identify and share local solutions adapted to local context and climate change impact

Prefer solutions which minimize greenhouse gas emission (e.g., use recycled material, avoid charcoal burnt bricks, reduce methane emission by capturing and reusing as energy source, etc.)

Include circular economy, environment protection and water security considerations into design

Integrate Environmental Impact Assessment in the process of developing an excreta disposal system

Ensure construction with local materials (even if build by the users) doesn't affect biodiversity and local ecosystems

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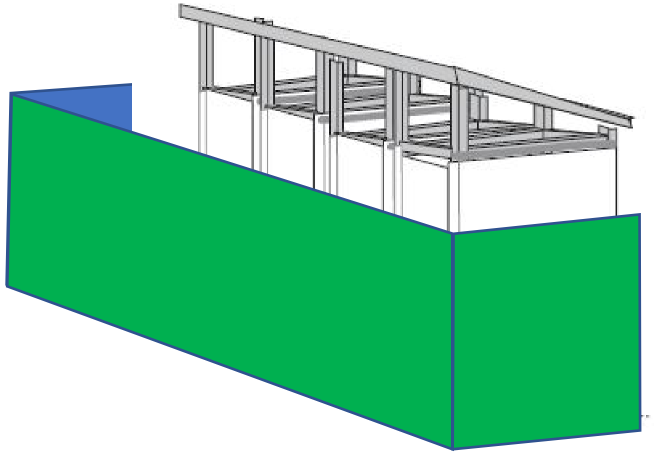
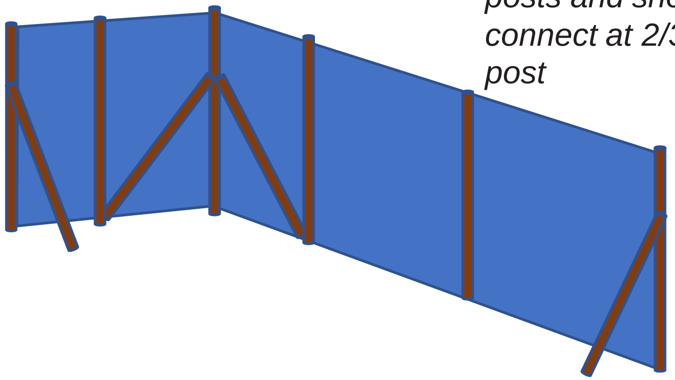
Privacy screen

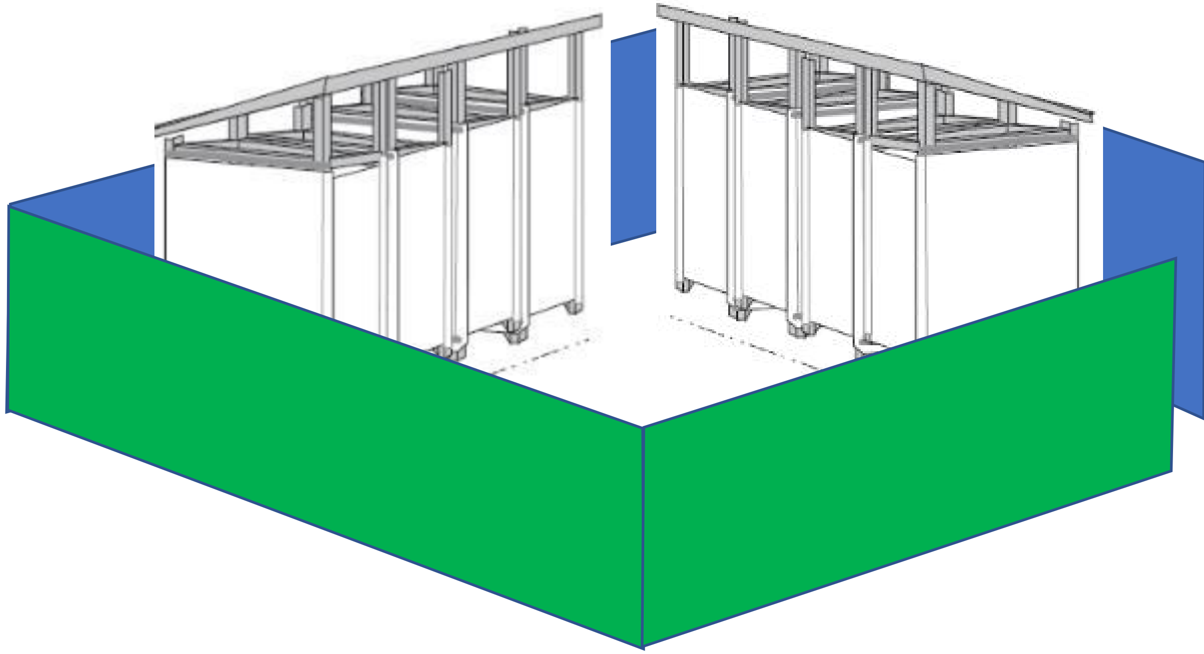
For cultural and other reasons it can be important especially for women and girls not to be seen entering a toilet. In such situation a privacy screen can be added in front of latrine doors.





Cross bracing at corners

Bracing at least every 5 posts and should connect at 2/3 height of post



Complete enclosed space, combining shower, latrines, handwashing stand, laundry station and drying clothes lines for menstrual hygiene management

For more on plastic sheeting quality and privacy issues See video [Spotlight on privacy]

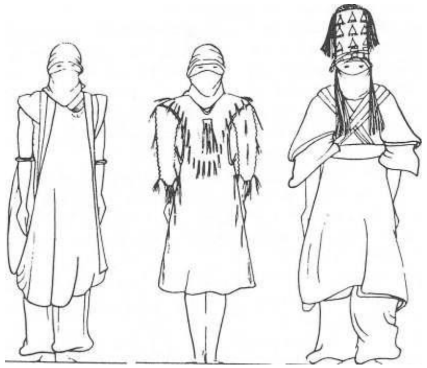
Reference: [IFRC, Oxfam – A guide to the specification and use of plastic sheeting in humanitarian relief]

Signage

Signage need to consider literacy level and local custom representation for men and women

While in many countries men are traditionally represented with trousers and women with skirt, don't assume it applies everywhere…

e.g. In Pakistan both women and men wear trousers under a tunic



e.g. Touareg men

Consult with users the best way to represent women and men latrines

♀ ♂

Oxfam Supply Centre – Code HMFLS

Various signages found on internet

Lock

An internal lock is an important part of ensuring privacy and safety while using latrine

Video [Spotlight on safety]

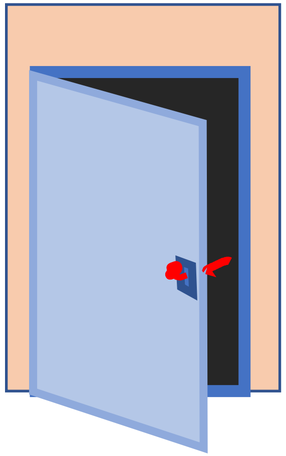
The most common internal locks used, both bolt and hook type of lock failed when wood door and frame change shape over time and use.

Bolt lock

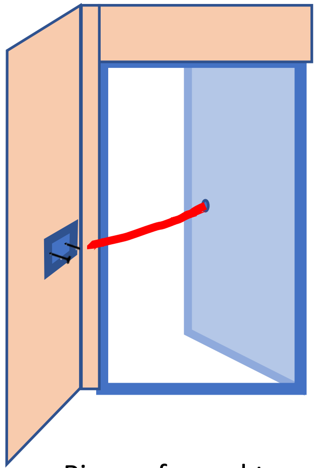
Hook lock

String lock

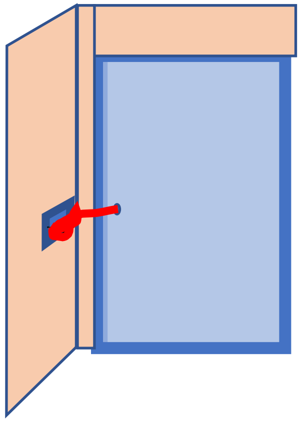
Piece of wood to reinforce the frame on the outside of the door



String passed through a hole drilled through the door frame and piece of wood. Knotted on the outside



Piece of wood to reinforce inside wall of latrine with two nails sticking out



String wrap around the nails several time to tight the door closed

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Handwashing

Handwashing is a critical practice that is promoted to protect public health, especially during outbreaks of infectious diseases such as COVID-19. Handwashing stations are used both in emergencies and in other contexts to provide locations for people to wash hands with soap. In refugee camps and internal displacement centres, units for handwashing should be installed both at households and next to latrines and in communal areas, such as in markets, schools, and health centres. The criteria for a good handwashing station include:

Principle Considerations

- Cost
- Maintenance required
- Ability to limit hand contact by users with a tap interface (preferably with no touch or one touch action)
- Accessibility, including for children, elderly and people with disabilities
- Design that promotes usage through aesthetics, behavioural nudges, and ease of use
- Robustness of design that can withstand misuse or vandalism and prevent theft

Additional Considerations

- Ability to drain effectively without creating stagnant greywater
- Availability and ease of assembly
- Packability and ease of transport
- Ability to conserve water

Handwashing stations can either be procured ready-made or they may be assembled locally.

Some of the units presented are completed products that have undergone years of research and development and thorough testing with end users.

Other options present design ideas for handwashing stations that can be constructed locally.
These design concepts require further adjustment to ensure they are reliable options for handwashing, especially when installed for communal use. Such handwashing stations should be tested not only for technical performance but for user satisfaction, correct use, and degree to which they are successful in promoting handwashing behaviour.

Reference: Oxfam – Handwashing stations Technical Briefing Note and the following for further reading The Sanitation Learning Hub – Handwashing compendium for Low Resource Settings

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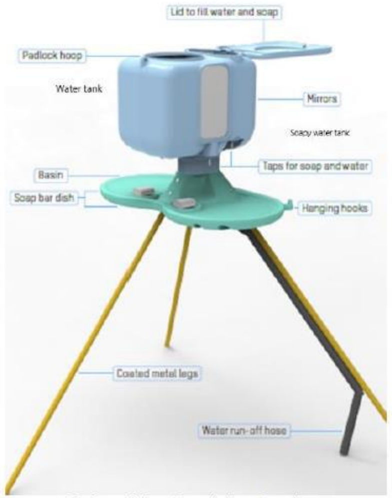
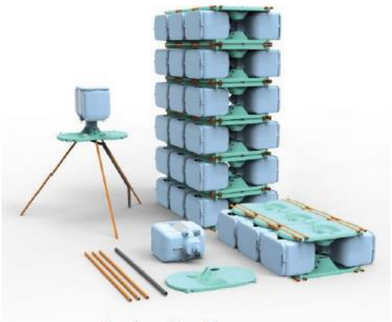
Completed Products

1. Oxfam Handwashing Station
2. Oxfam Handy Wash Tap
3. Jengu (by ARUP, BRC, and LSHTM)



Oxfam Handwashing Station



Packed for Transport

Handy Wash Tap

Handy Wash Tap on Bucket

Adult and Child Size Jengu

Jengu Rendering

Photo Credit: ARUP, British Red Cross, LSHTM

Reference: [Oxfam – Handwashing stations Technical Briefing Note]()

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Ideas for Local Assembly

4. Twin Foot Pedal Design (by WaterAid Nepal)
5. Single Foot Pedal Design
6. Long Handled Taps

Single Foot Pedal Design

Single Foot Pedal with Basin

WaterAid Nepal Design

Photo Credit: WaterAid Nepal

Oxfam Bangladesh Design

Push Down Nozzle

Photo Credit: Oxfam Bangladesh

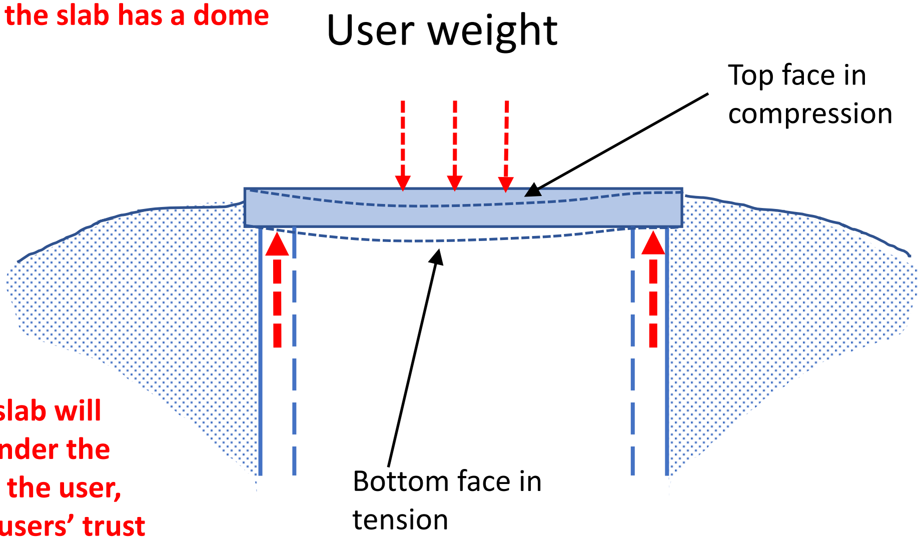
Other Options for Households

7. Happy Tap
8. SpaTap
9. Oxfam Bucket
10. Tippy Tap
11. Soapy Water Bottle

Reference: [Oxfam – Handwashing stations Technical Briefing Note]

Tension and compression forces in a slab

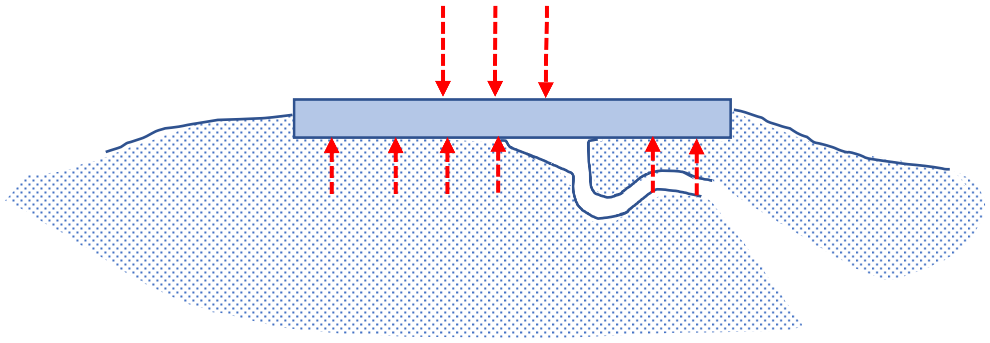
A concrete slab will stay rigid and crack where tension is the highest unless rebars are used or if the slab has a dome shape.



A plastic slab will bounce under the weight of the user, affecting users' trust and potentially scaring children

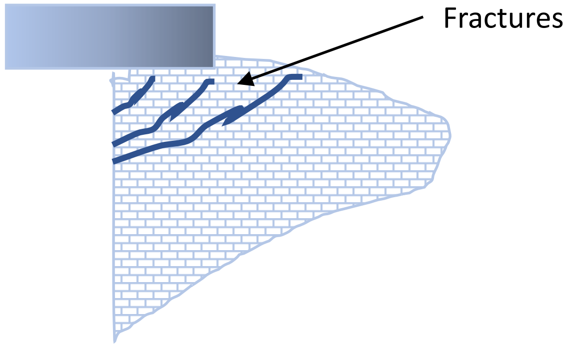
Section slab - direct drop toilet.

How much water is available for flushing? Consult with users to understand how easy or complicate is their access to water. Include an analysis of drought impact



No flexion of the slab

Section slab - offset pit



Without lining consolidated soil capacity to withstand the weight may erode with time and water

Requirement

Pre-test your slab when consulting users

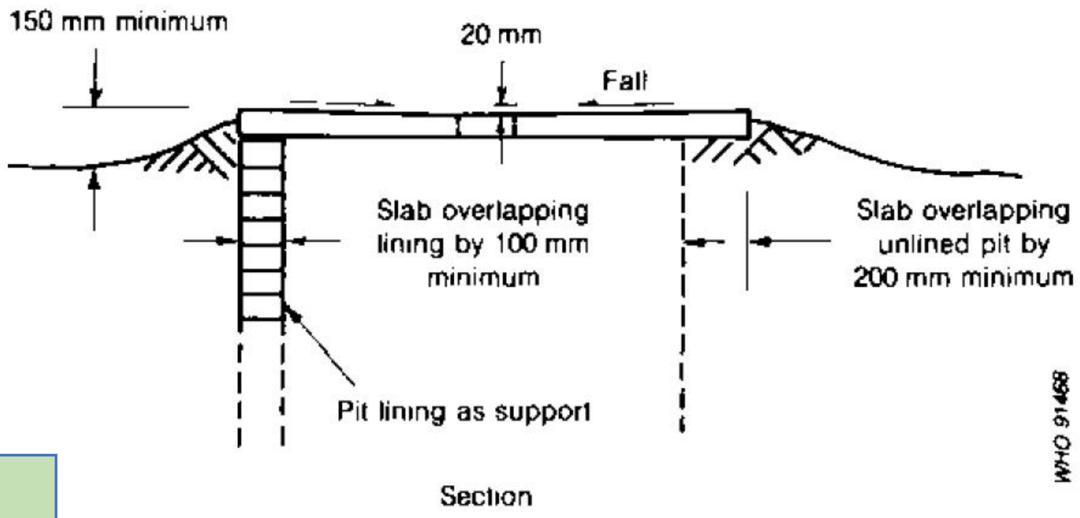
A latrine slab serves two main purposes, as a support and as a seal. It must support the weight of the person using the latrine and, possibly, the weight of the superstructure. It also seals the pit, except for the squat hole and, where required, the vent pipe hole. This facilitates control of flies and smells and reduces the likelihood of rodents and surface water entering the pit. Where the slab has been made in sections (for ease of placing and emptying) or has a removable cover, the joints should be sealed with a weak mortar such as a lime or mud mortar.

Cleanliness. The slab needs to be suitable for cleaning. Rough wood or rough concrete quickly becomes dirty and difficult to clean.

Surface texture. A smooth slab may be easy to clean, but if it is too smooth, then it may be slippery when wet. The inner surface of a pour-flush pan needs to be very smooth, so the faeces can be easily washed away.

Durability. If the slab is going to last and not collapse suddenly, it needs to be resistant to rot and termite attack. It should also withstand repeated washing.

Water resistance. Urine, water for anal and menstrual cleansing and water for washing the slab will make the slab wet, so it needs to be able to withstand this and allow excess water to drain away, normally into the vault.



Section

Slab slope. water should be directed toward the hole and away from the sides (in case of UDDT the slope should channel water toward a soakaway pit)

Seal. Gaps between slab and lining / pit walls sealed with soil

Colour. To see if the slab is clean and to check for spiders, snakes or other creatures, users may prefer particular colours. Cultural and religious affiliations may influence such preferences too.

Reuse. Once the pit is full, the slab may have to be moved, either to gain access to the vault so it can be emptied or moved to a new site.

Strength. The slab needs to be strong enough to support the weight of the user, and perhaps someone to assist them. It needs to look strong to give people the confidence to use it.

Reference: WHO - A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed and WEDC – Latrine slabs: construction material

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Material

Non-supporting slab

Self- supporting slab

Unreinforced concrete

SanPlat

Dome

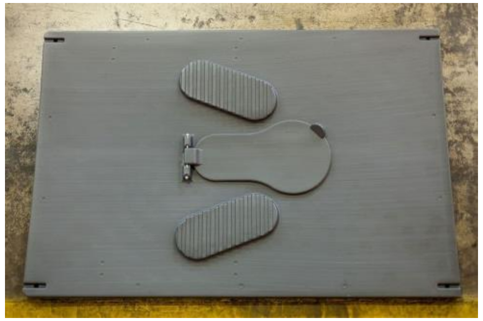
Reinforced concrete

Slab thickness (mm)	Steel bar diameter (mm)	Spacing of steel bars (mm) for minimum slab span of				
		1 m	1.25 m	1.5 m	1.75 m	2 m
65	6	150	150	125	75	50
	8	250	250	200	150	125
80	6	150	150	150	125	75
	8	250	250	250	200	150

Plastic

Squatting plate,plastic,80x60cm

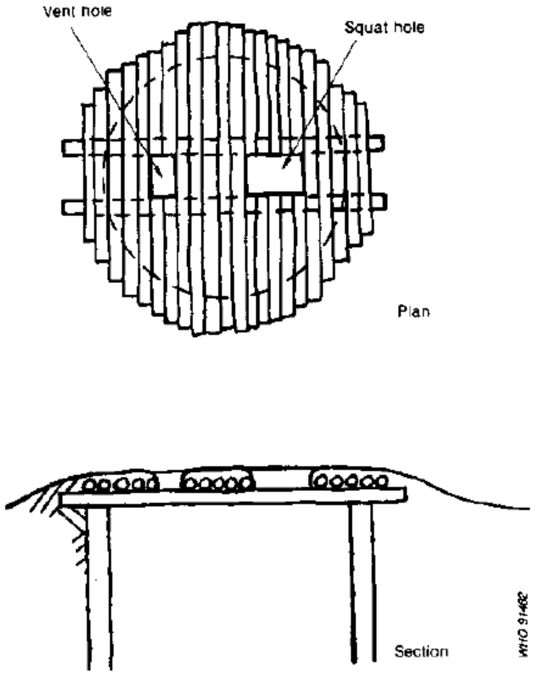
Latrine Slab, Plastic Self Supporting – **Code** LOPN
1.2m long x 0.8m wide x 35mm thick



Wood

Self- supporting slab

Fig. 7.22. Timber and earth slab



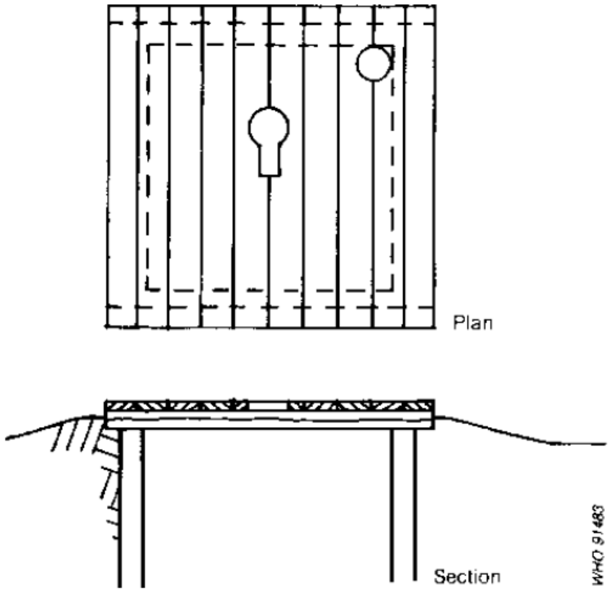
Durable timbers such as the heartwood of some tropical hardwoods are normally too expensive for use in latrines but, where available, may be expected to last satisfactorily for several years.

The life of a rough timber slab can be extended by using a mixture of soil and cement to plaster and protect the wood. Alternatively, a thin cement mortar screed can be laid over the surface of the earth to protect against hookworm and to improve hygiene. However, it is usually more cost-effective to use the cement to provide a permanent concrete slab which can be transferred to a new pit when the first is filled. Where more than half a bag of cement is needed to stabilize the earth, a concrete slab is likely to be a cheaper alternative.

In an area where timber is abundant, hewn or sawn logs supporting a platform of wooden planks make a floor that is preferable to the mud and pole version (Fig. 7.23). The surface can be kept clean, and signs of imminent collapse are normally apparent to the adult user. The durability of timbers may be improved by some form of treatment.

The cost and environment impact of the wood treatment options need to be examined

Fig. 7.23. Sawn timber slab



A thick layer of earth or mud is often spread over the poles or branches to bind them together and create a smooth surface (Fig. 7.22). In many places, people are skilled at making mud floors which are almost as hard as cement and quite smooth. They need not be rough or unsanitary. There are various methods of improving the mud with local materials, such as mixing the soil with a liquor obtained by soaking animal dung overnight. In some areas the mud is mixed with charcoal or other small aggregate, or with cow dung and then smeared with ashes. Alternatively, the mud from ant-hills has been found to make a hard, practically waterproof surface (Denyer, 1978).

Reference: WHO - A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed

Footrests and squat holes

Fig. 7.24. Possible footrest positions

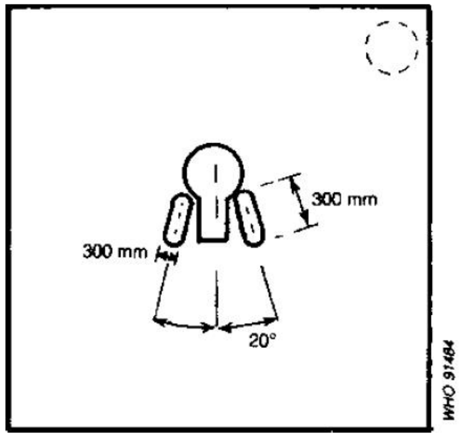
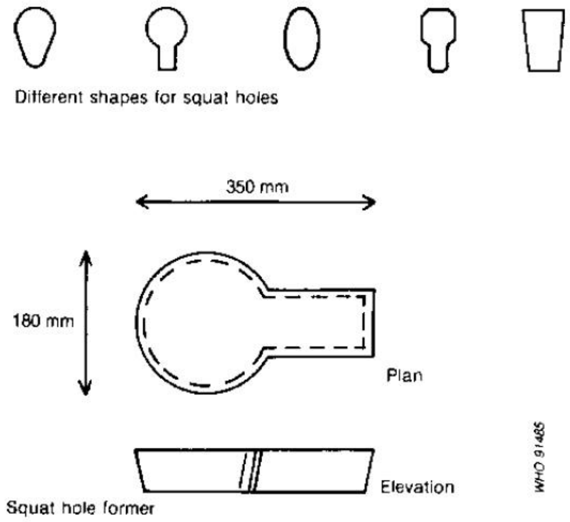


Fig. 7.25. Squat hole shapes and former



Avoid large and wide hole sizes if small children will use the latrine

Water seals and pans

Fig. 7.28. Combined pan and water seal for direct pour-flush latrine depends on the design of the pan or pedestal, the depth and volume of the water seal, and the minimum passage size through the seal. For a water seal directly above the pit about 1 litre of water is normally sufficient for flushing. Two litres may be required for an offset pit and a minimum of 3 litres for an improved pedestal pan and offset pit.

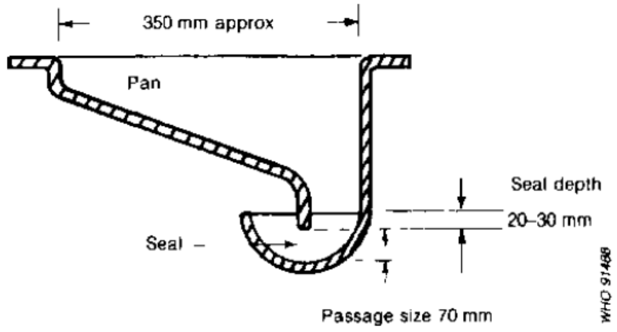
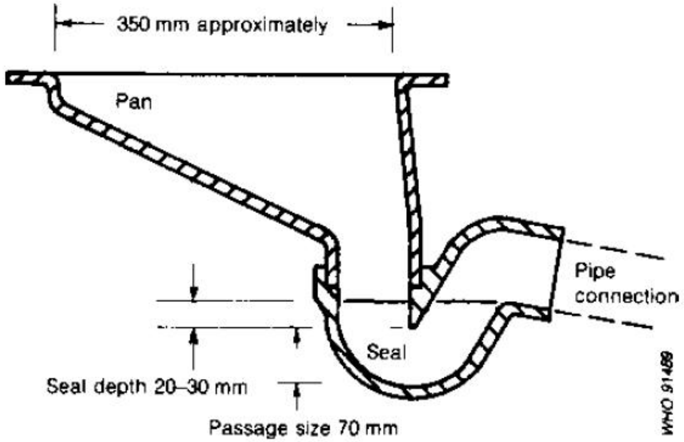


Fig. 7.29. Pan and seal for offset pour-flush latrine



Can be made in ceramic, concrete, plastic, etc.
Its weight need to be considered into the design of the slab

Verify how easy it is to flush the pan (how many litres are required) considering users' access to water

Reference: WHO - [A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed]

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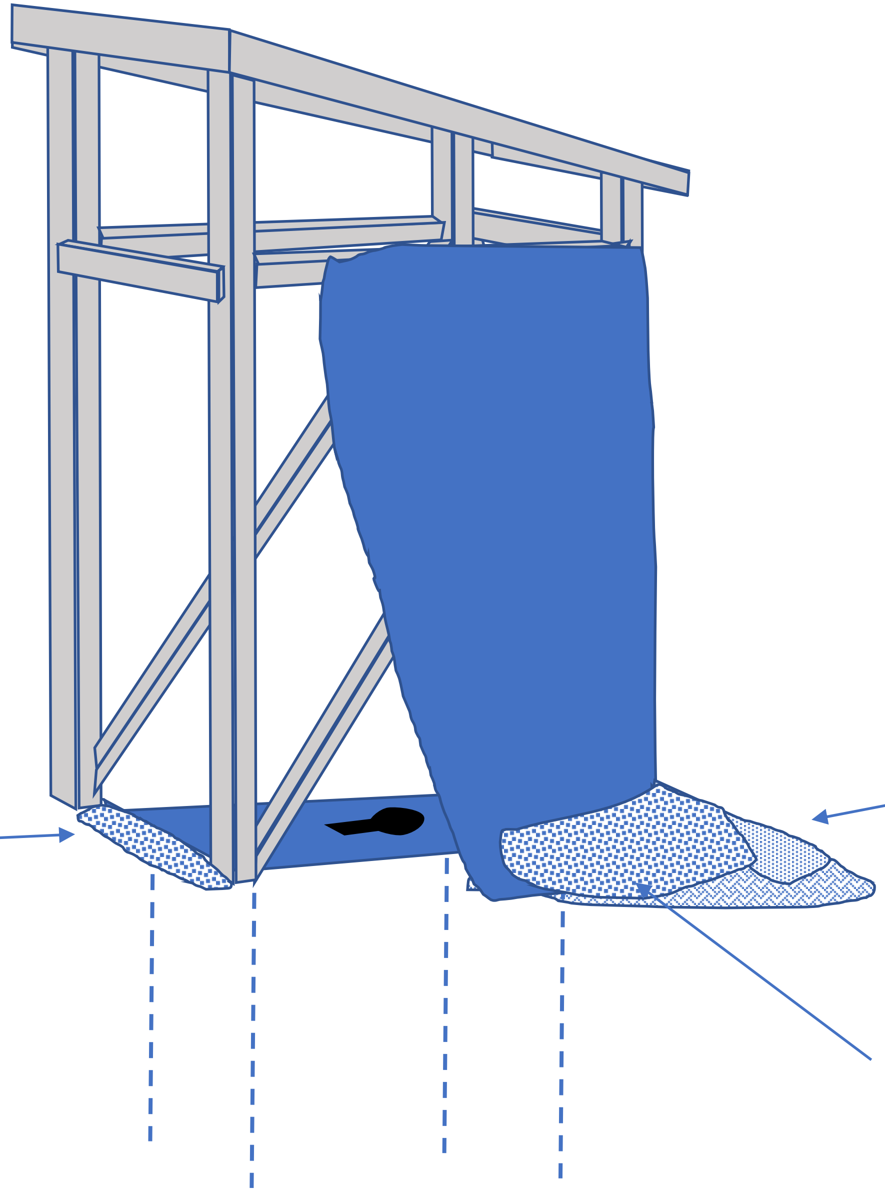
Water proofing

When locating sanitation infrastructures pay attention to topography to ensure water runoff path does not cross where latrines are located.

You can get information from local population on drainage pattern during the consultation process.



Seal with soil the spaces between slab and pit walls

Shape a drainage channel under the overhanging roof edge to collect and evacuate rain dripping from the roof

Seal the side of the latrine walls by covering the extra length of plastic sheeting with soil

Soil shaped into a bank to divert rain and water runoff from the latrine pit

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Cleaning

A washable slab (plastic, ceramic, concrete, wood covered with plastic sheeting)

Latrine cleaning kit adapted to context

Designated people for daily cleaning duty

Public toilet

WASH committee

Family and family shared toilet

Users

If payment of latrine attendants is considered it should be restricted to public toilets, with a fee contribution scheme from users for sustainability or with a clear transition plan and communication toward users taking over (e.g. when transitioning to family shared or family latrines)

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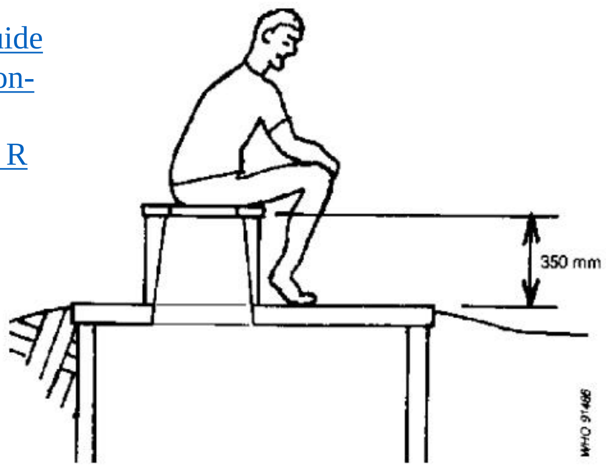
Sitting

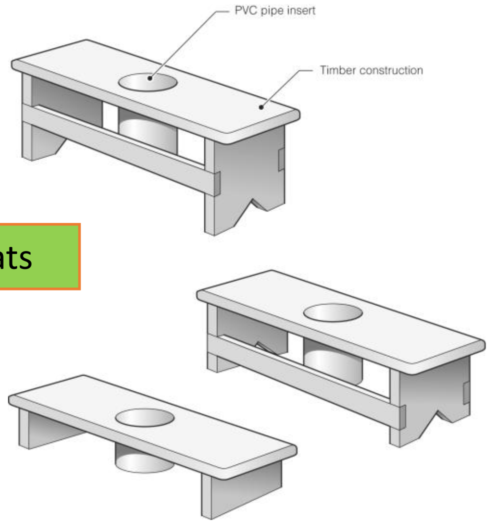
In many parts of the world, people prefer to sit to defecate. To make a latrine seat, a support or pedestal is built or mounted on top of the slab. The seat level should be at a position that is comfortable for the majority of the users (Fig. 7.26); this is normally about 350 mm above the top of the slab.
The seat support can be made on site from brick, concrete, mud block or timber and should be **designed to minimize the load on the slab**. A heavy type of construction adds weight to the slab which then requires more expensive reinforcement to carry the load. Commercially available or project-manufactured pedestals made of ceramic, glass reinforced plastic (GRP), PVC or ferrocement can also be used where people can afford them.

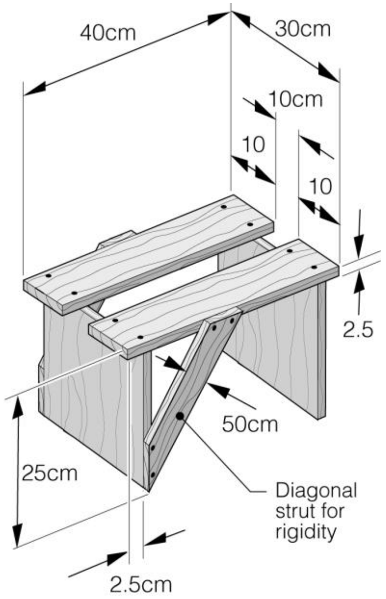
Reference: WHO - [A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed]

Fig. 7.26. Latrine seat



Wood seats





Reference: [WEDC repository]

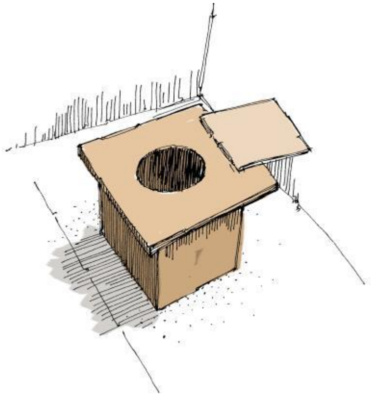
Special seats

Reference: [GTZ – Technology Review of UDDTs]

Figure 5. Left: A painted concrete urine diverting pedestal in Bulgaria (photo: WECF, 2007). Right: Ceramic pedestal with an innovative urine diversion concept developed in South Africa and Namibia (photo: Clay House Project, 2011).

For sitting, wood can be warmer and smoother than concrete but perhaps more difficult to keep clean. Wooden seats are simpler to make locally. Plastic can be easy to clean but, if flexible, can be disconcerting to use. Concrete blocks are strong but not very comfortable.

Reference [WEDC – Latrine slabs: construction material]



The need for a pit lining depends upon the type of latrine under construction and the condition of the soil, as well as desludging service

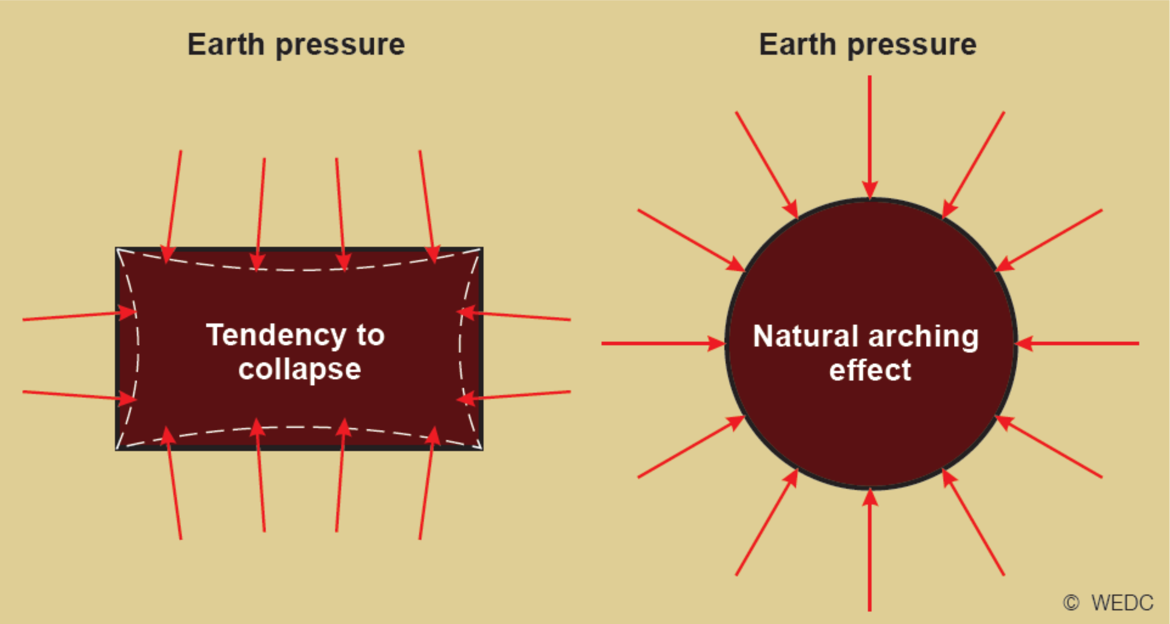


Figure 4. Stress concentrations on rectangular and circular pits

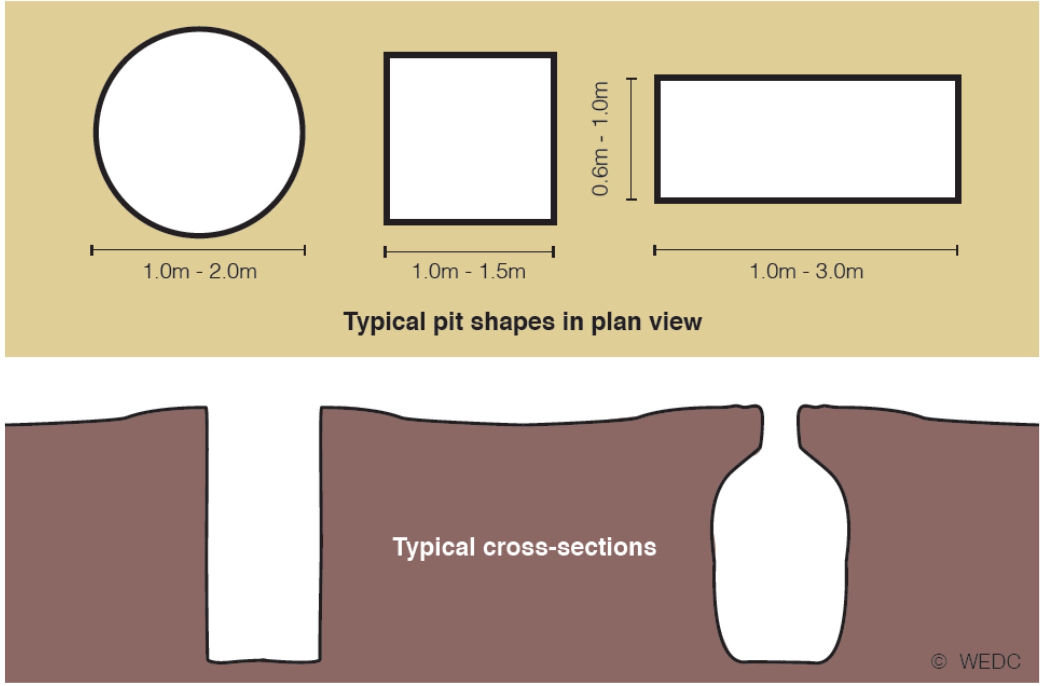


Figure 5. Typical pit latrine shapes

Circular shapes are stronger than rectangular !

Reference: WEDC – Latrine pit design booklet

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Soil considerations

Ground conditions

Ground conditions affect the selection and design of sanitation systems, and the following five factors should be taken into consideration:

Bearing capacity of the soil

All structures require foundations, and some soils are suitable only for lightweight materials because of their poor load-carrying capacity - marshy and peaty soils are obvious examples.

Self-supporting properties of the pits

Many soils may appear to be self-supporting when first excavated, particularly cohesive soils, such as clays and silts, and naturally bonded soils, such as laterites and soft rock. **These self-supporting properties may well be lost over time owing to changes in the moisture content or decomposition of the bonding agent through contact with air and/or moisture**. It is almost impossible to predict when these changes are likely to occur or even if they will occur at all. It is therefore safer to line the pit. The lining should permit liquid to percolate into the surrounding soil.

Depth of excavation

Loose ground, hard rock or groundwater near to the surface limit the depth of excavation possible using simple hand tools. Large rocks may be broken if a fire is lit around them and then cold water poured on the hot rock. Excavation below the water table and in loose ground is possible by "caissoning", but it is expensive and not usually suitable for use by householders building their own latrines.

Pore clogging

Soil pores eventually become clogged by effluent from pits or drainage trenches. This may reduce or even stop infiltration through the soil. Clogging may be caused by:

- blockage of pores by solids filtered from the liquid;
- growth of microorganisms and their wastes;
- swelling of clay minerals; and
- precipitation of insoluble salts.

Caisson waterproofing must be ensured when the water table is less than 1.5m. In addition Archimedes law may apply if the caisson is reached by water with a thrust force moving the caisson up and damaging it. All in all not a good idea…

Local knowledge can help determine such risks

Reference: WHO - A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed

Infiltration rate

The soil type affects the rate at which liquid infiltrates from pits and drainage trenches. Clays that expand when wet may become impermeable. Other soils such as silts and fine sands may be permeable to clean water but become blocked when transmitting effluent containing suspended and dissolved solids.

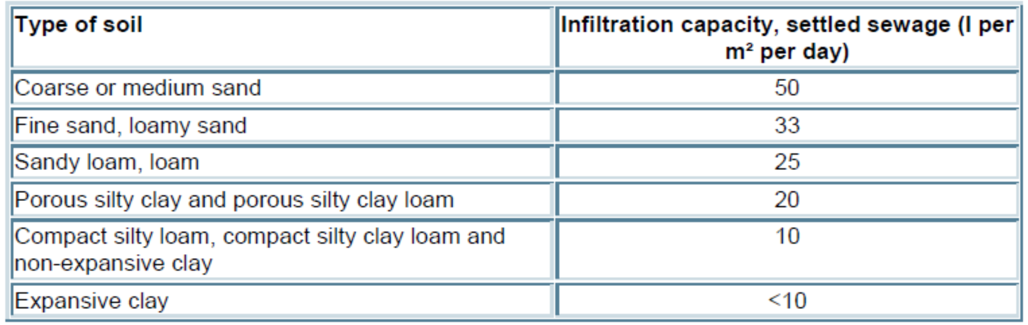
The rate of infiltration also depends on the level of the groundwater table relative to the liquid in the pit or trench. In the unsaturated zone, the flow of liquid is induced by gravity and cohesive and adhesive forces set up in the soil. Seasonal variation may produce a change in the amount of air and water in the soil pores and this will affect the flow rate. **Conditions at the end of the wet season should normally be used for design purposes as this is usually the time when the groundwater level is at its highest**. In the saturated zone all pores are filled with water and drainage depends on the size of the pores and the difference in level between the liquid in the pit or trench and the surrounding groundwater.

Soil porosity also affects infiltration. Soils with large pores, such as sand and gravel, and rocks such as some sandstones and those containing fissures, drain easily. Silt and clay soils, however, have very small pores and tend to retain water. Soils containing organic materials also tend to retain water, but the roots of plants and trees break up the soil, producing holes through which liquids can drain quickly.

The rate of groundwater flow in unsaturated soils is a complex function of the size, shape and distribution of the pores and fissures, the soil chemistry and the presence of air. The speed of flow is normally less than 0.3 m per day except in fissured rocks and coarse gravels, where the speed may be more than 5.0 m per day, with increased likelihood of groundwater pollution.

Determining infiltration rates

Table 5.4. Recommended infiltration capacities [a]



Type of soil	**Infiltration capacity, settled sewage (l per m² per day)**
Coarse or medium sand	50
Fine sand, loamy sand	33
Sandy loam, loam	25
Porous silty clay and porous silty clay loam	20
Compact silty loam, compact silty clay loam and non-expansive clay	10
Expansive clay	<10

[a] Source: US Environmental Protection Agency 1980

In fissured rocks conditions, it's advised to add sand at the bottom to create a biological filtration layer and reduce pollution (minimum thickness 0.5m)

Reference: WHO - A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed

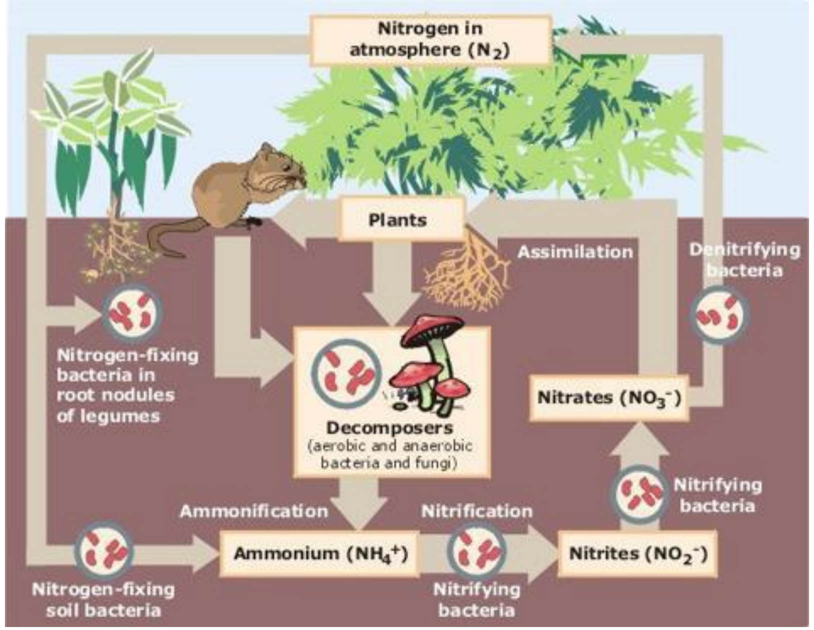
Pre-treatment

As soon as excreta are deposited, they start to decompose, eventually becoming a stable material with no unpleasant smell and containing valuable plant nutrients. During decomposition the following processes take place.

- Complex organic compounds, such as proteins and urea, are broken down into simpler and more stable forms.
- Gases such as ammonia, methane, carbon dioxide and nitrogen are produced and released into the atmosphere.
- Soluble material is produced which may leach into the underlying or surrounding soil or be washed away by flushing water or groundwater.
- Pathogens are destroyed because they are unable to survive in the environment of the decomposing material.

O_2

The decomposition is mainly carried out by bacteria although fungi and other organisms may assist. The bacterial activity may be either aerobic, i.e., taking place in the presence of air or free oxygen (for example, following defecation and urination on to the ground), or anaerobic, i.e., in an environment containing no air or free oxygen (for example, in a septic tank or at the bottom of a pit). In some situations, both aerobic and anaerobic conditions may apply in turn. When all available oxygen has been used by aerobic bacteria, facultative bacteria capable of either aerobic or anaerobic activity take over, and finally anaerobic organisms commence activity.



Reference: [Wikipedia]

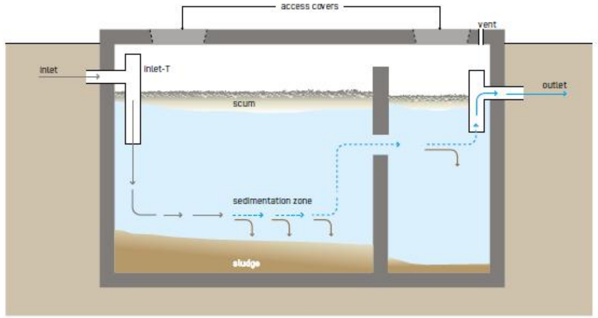
Pathogens may be destroyed because the temperature and moisture content of the decomposing material create hostile conditions. For example, during composting of a mixture of faeces and vegetable waste under fully aerobic conditions, the temperature may rise to 70°C, which is too hot for the survival of intestinal organisms. Pathogens may also be attacked by predatory bacteria and protozoa, or may lose a contest for limited nutrients.

Reference: WHO - A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed

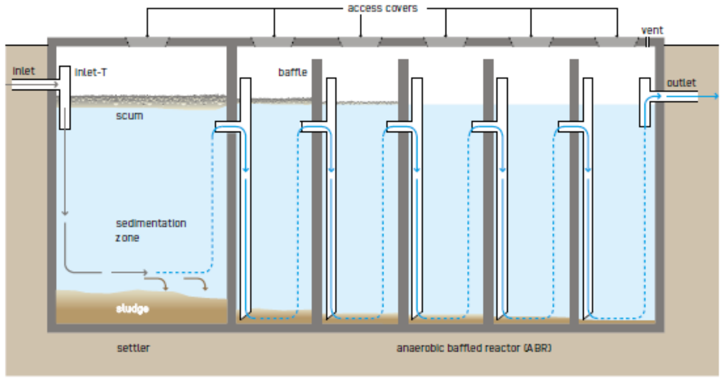
Safe Treatment

Where possible and if the numbers are below 20,000 on site treatment, septic tanks, biogas or Anaerobic Baffled Reactor (ABR) with leachfields, Urine Diversion Dehydration Toilet (UDDT), or Tiger Worm toilets should be used to decrease desludging, transportation and disposal costs. However, all of these technologies need desludging at some point and that needs to be factored into the design and service provision. Compared the estimated desludging times for Communal pit latrine (trench 3x4x1m) which is **3 months** with on-site treatment in emergency contexts

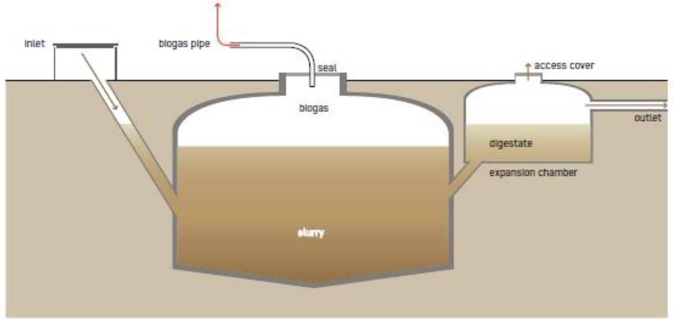
Anaerobic Treatment



Septic Tanks – desludged every **2 years**



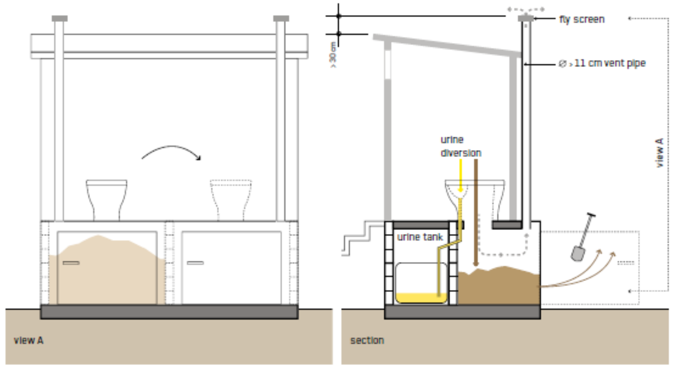
ABR – desludged every **6 years**



Biogas – Desludged every **6 years**

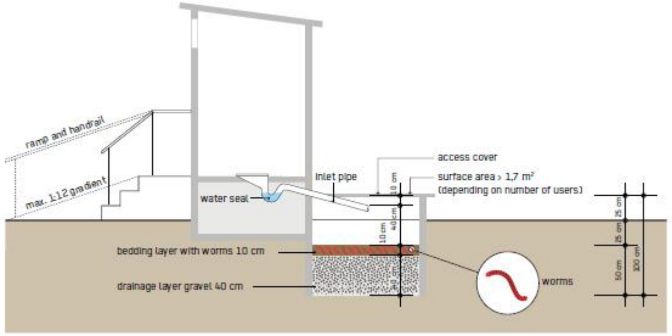
This is a design parameter. Any duration increase before desludging and the risk to clog the percolation filter with sludge increase as well as cost for repair and maintenance

Dehydration



Double vault UDDT – desludged every **1 year**

Vermi-composting



Tiger Worm Toilets – desludged every **5 years**

Reference "Compendium of sanitation technologies in Emergencies"

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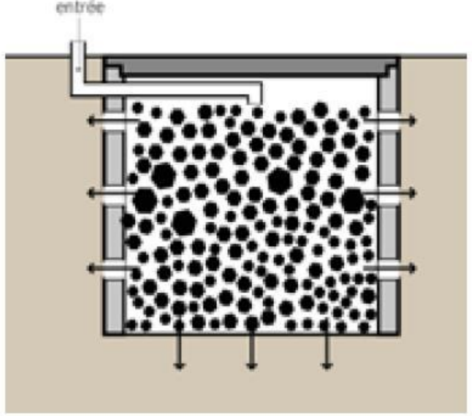
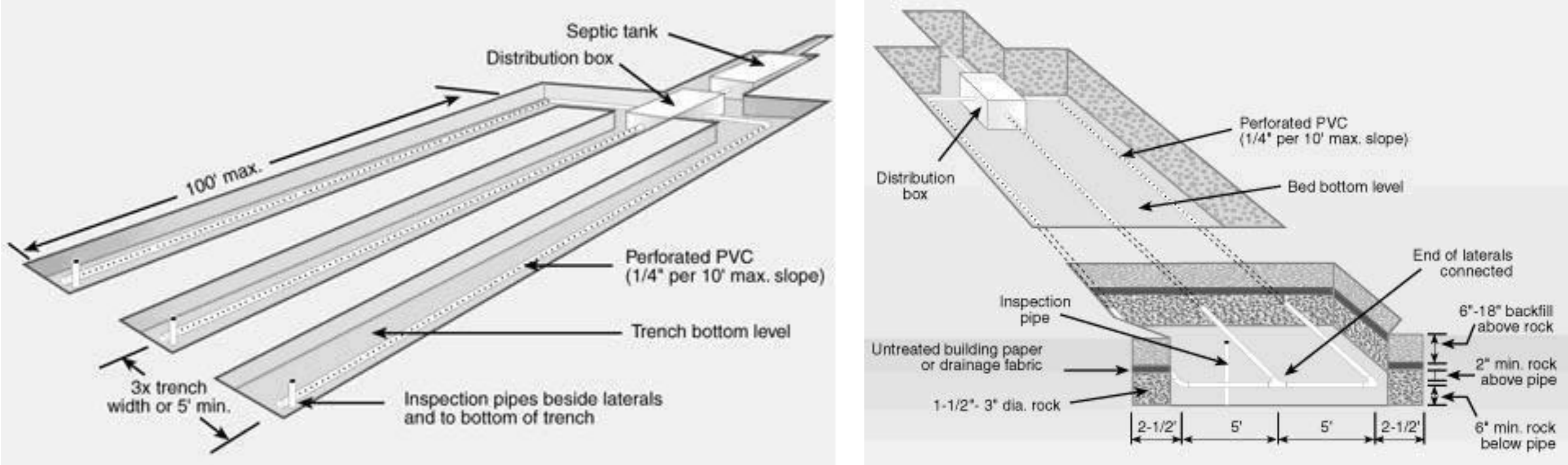
Septic tank, Biogas digester, ABRs and UDDT must be connected to infiltration system to dispose of effluent

Vertical percolation



Soakaway pit (e.g. in association with UDDT for managing water) for small effluent volume

Horizontal percolation



Leach field (e.g. in association septic tank) for larger effluent volume.

During the consultation process, be attentive to potential co-benefit, such as urban forestry development, aquifer recharge

Sewerage pipes

Simplified sewerage to connect several latrines to one pre-treatment unit such as septic tank, ABR or biogas digestor:

- Pipe diameter 100 to 200 mm
- Minimum slope 1% for self-cleansing and water consumption at least 50l/p/d (or minimum 0.5% slope with a minimum water consumption of 60 l/p/d)
- Inspection box at each household with grease trap if kitchen grey water is collected
- Simple inspection chamber diameter 400 to 600 mm (at junction, direction change, slope change, every 50 m for inspection and cleaning / unblocking pipe)
- Depth minimum 30 cm (no pressure from vehicle traffic) or 60 cm under vehicle access road
- Outline as straight and short as possible

Attention need to be paid to pipe and inspection chambers' foundation to avoid movement and future counter slopes. A trained O&M team should be in place to deal with blockage and maintenance.

Successful operation requires clearly defined responsibilities between service provider and users

Reference: GRET – Memento de l'assainissement and "Compendium of sanitation technologies in Emergencies"

Lining options

Lining is needed when the soil is unstable or if it will become unstable due to water seeping up / in during rainy season or when desludging is required as the mechanical vacuum process will cause the wall to collapse

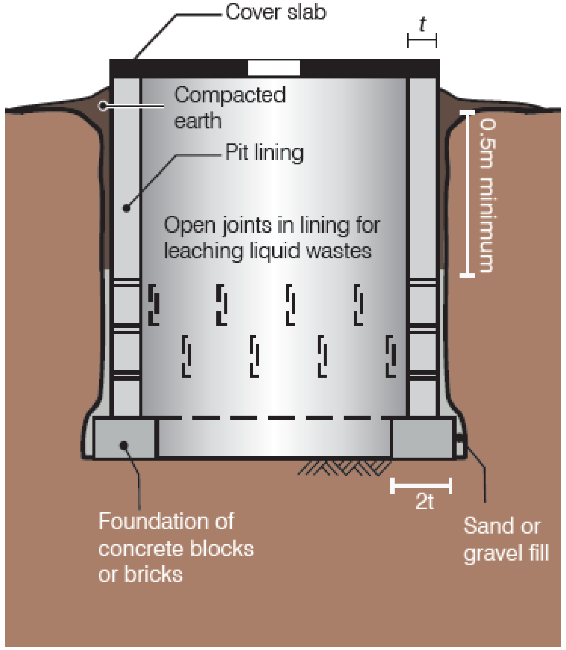


Figure 2. Details of the construction of a shallow pit with lining

Foundations

Nearly all linings need a foundation to prevent the lining sinking into the ground below. In firm soils a simple pad foundation about three times the width of the linings is sufficient (see Figure 7a). The foundation is usually made of the same material as the lining.

In soft ground a thicker foundation may be needed. Cover the base with a 10 to 15cm layer of compacted mixed stone and construct the foundation on that (see Figure 7b).

When only partially lining the pit, leave a step in the pit wall on which to build the foundation (see Figure 7c).

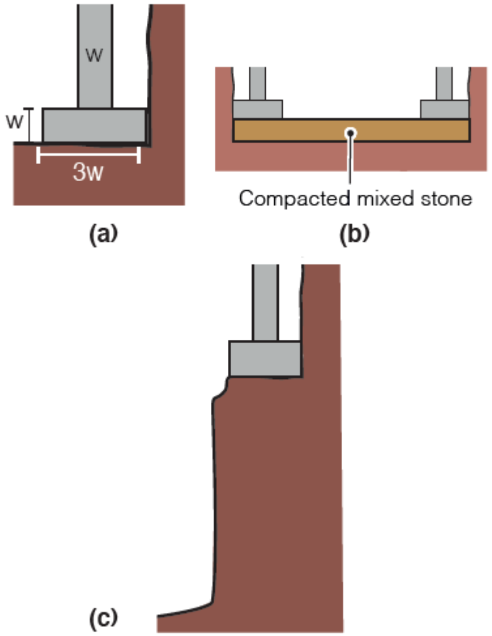


Figure 7. Foundations

Reference: WEDC – Latrine pit excavation and linings

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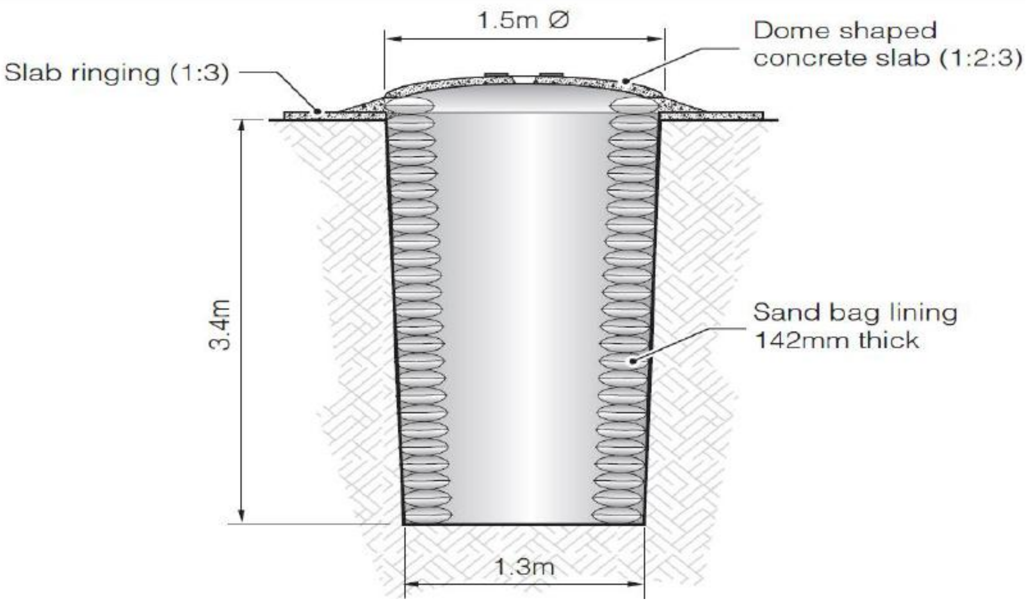


Fig-1- Simple Pit Lining with Sandbags

Sand bags are cut and stitched in oblong shape.

Be careful, over time the top sand bags will tear from the weight and pressure exercised by the slab

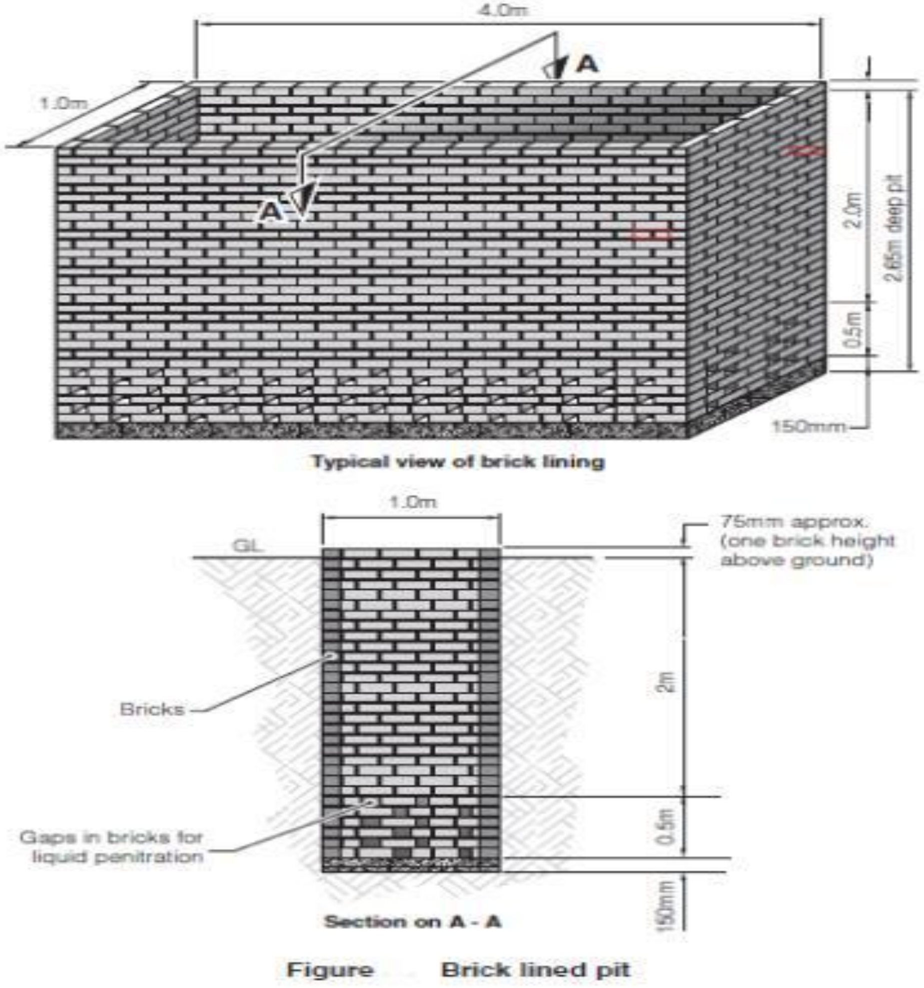
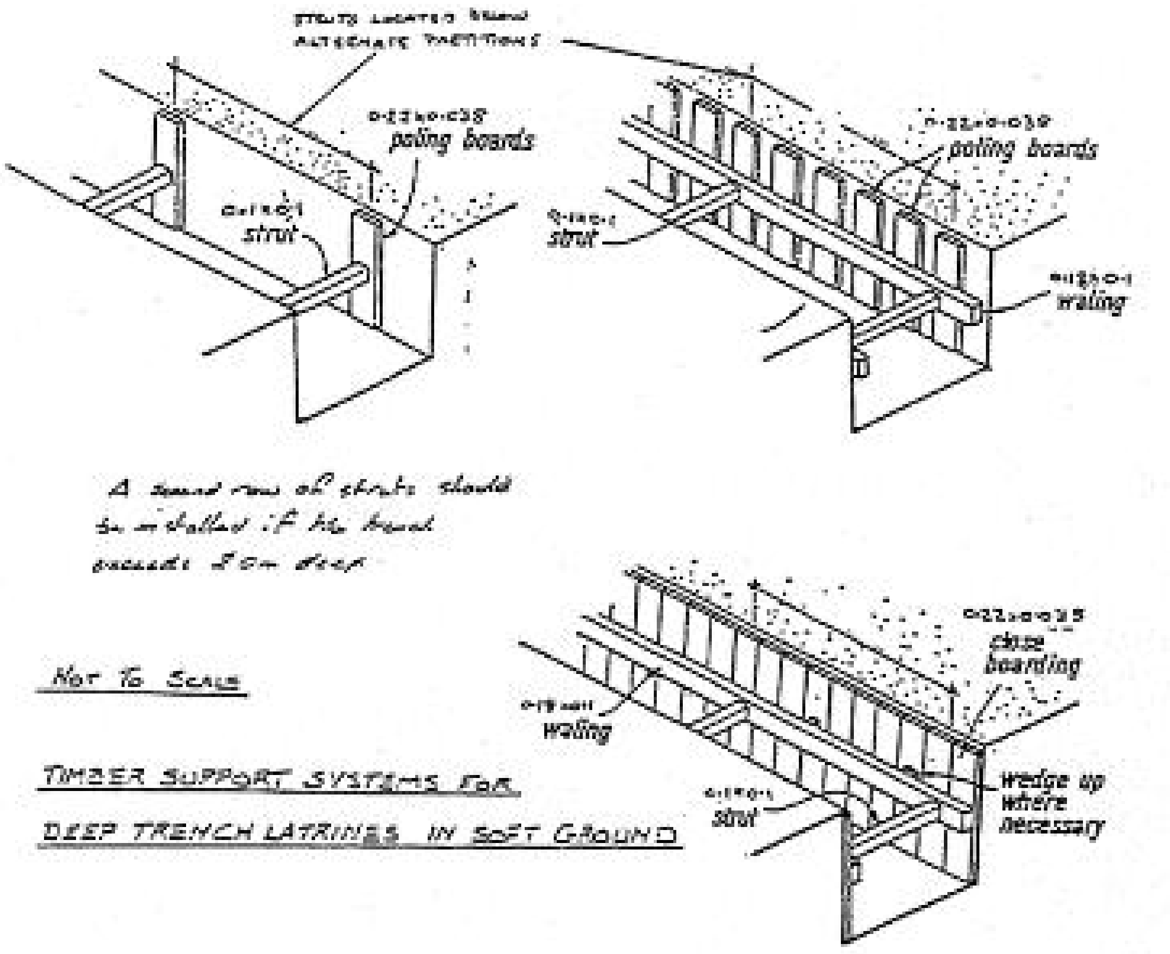


Fig-2- Communal Trench Pit Lining with Bricks



TIMBER SUPPORT SYSTEMS FOR DEEP TRENCH LATRINES IN SOFT GROUND

Plastic lining

Bamboo cage lining. Overtime the bamboo will deteriorate but should last 1 to 2 years (check local knowledge)

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Grey water

Grey water (because of its colour and also called sullage) consists of the liquid wastes from domestic activities such as bathing, laundry, food preparation etc. but EXCLUDING excreta related liquids, sometimes known as black water.

The most common sources in emergency settings are:

- Water taps;
- Kitchens/feeding centres;
- Laundries;
- Bathing areas; and
- Health care centres.

1. Typical grey water volumes from public institutions (Based on [2])

Institution	Sullage volume
Field hospital	40 - 60 litres/patient/day
Hospital with operating theatres	100 litres/intervention
Out-patient clinics	5 litre/patient/day
Cholera treatment centre	50 litres/patient/day 10 litres/carer per day
Viral haemorrhagic fever centre	300–400 litres/patient/day
Feeding Centre	25 litres/person/day 10 litres/carer/day
Public bathing area – piped water provided	100 litres/user*
– no piped water provided	20 litres/user
Public laundry area – piped water provide	100 litres/user*
– no piped water provided	20 litres
Public water points	5 – 20 litres/user*

Note: * These numbers vary widely dependent on the quality of the control mechanism on the pipe outlet and the management of the facility.

1. Typical grey water contamination from various sources

Source	Contamination
Kitchens	Cooked and uncooked animal and vegetable food waste, oils and fats, soap, silt and grit
Laundry	Laundry soap, silt and grit, oil, faeces, blood, urine
Bathing	Bathing soap, faeces, silt and grit, blood, urine
Health care centres	All of the above depending on the type of facility

Note: The faeces, blood and urine in laundry and bathing sullage is usually very low but can be significant from health care centres.

Risks for latrine created by grey water

- **Filling of latrine pits**
- **Pit wall erosion and potential collapse**
- **Obstruction of access paths and walkways;**

Other risks created by grey water

- Breeding sites for water related insect vectors
- Soil erosion around temporary shelters
- Filling of solid waste pits
- Pollution of surface and groundwater
- Reduced moral from living in a contaminated environment

Grey water disposal technology options:

- Infiltration
- Evapotranspiration (ponds or beds)
- Irrigation
- Surface water diffusion
- Reuse

Grey water treatment options:

- Gross solids removal
- Grease traps
- Settlement tanks
- Reed beds

Can be treated with black water and excreta, depending on the type of pre-treatment (septic tank) and treatment options (reed bed)

Reference: R. Reed – Engineering in Emergencies – Sullage disposal

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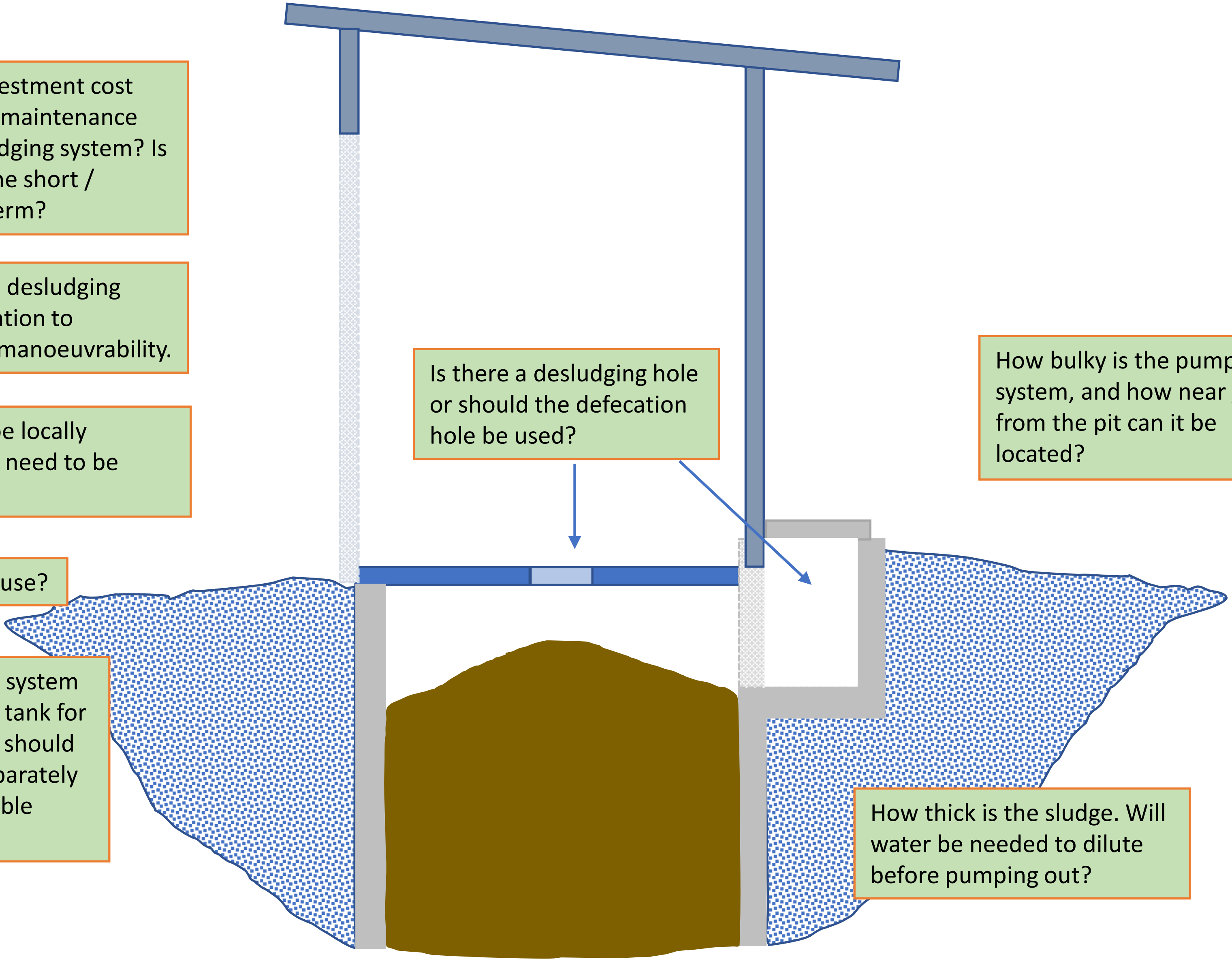

What are the investment cost and operation & maintenance cost of the desludging system? Is it affordable in the short / medium / long term?

When choosing a desludging system, pay attention to accessibility and manoeuvrability.

Can the system be locally manufactured or need to be imported?

How easy is it to use?

Is the desludging system combined with a tank for safe transport or should you purchase separately a safe transportable container?

Is there a desludging hole or should the defecation hole be used?

How bulky is the pumping system, and how near / far from the pit can it be located?

How thick is the sludge. Will water be needed to dilute before pumping out?

Manual desludging

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Diaphragm handpump

Oxfam Supply Centre – Code LDP

Consist of a rigid, disc shaped body clamped to a flexible rubber membrane called a diaphragm. An airtight seal between the diaphragm and the disc forms a cavity. To operate the pump, the diaphragm is alternately pushed and pulled causing it to deform into concave and convex shapes in the same way a rubber plunger is used to unblock a toilet.

Nibbler

Collect medium viscosity sludge using a continuous roller chain loop enclosed in a PVC pipe.

Due to limited success during trials, development of the nibbler was **suspended**.

Continuous chain device [Sugden, 2008]

Sludge Gulper IV

Low cost, can be build locally

The Gulper 4 is a manual desludging pump for emptying toilet pits and septic tanks. It is an upgraded version of the previous Gulper pump, offering an increased pumping head of approximately 3 m and a delivery head of approximately 3 m. The pump uses flexible piping that allows for a closed system to pump directly to the back of a truck and reduces spillage. The pump has been fabricated with UK-based company BuildWorks and is currently being replicated in with local fabricators in Uganda, Malawi, Rwanda and Honduras. The engineering drawings for this pump are open-source and available from Water For People.

Others

Human-powered vacuum system for the collection and short-distance transport of sludge called the Manual Pit Emptying Technology (MAPET). Due to issues with spare parts and high capital cost this technology was **discontinued**.

Beaumont manual pump: a basic piston pump designed to intervene in small space, easy to repair, the SP10 - Human Powered Sludge Pump is still **under development** with the 4th iteration.

Reference: Feacal sludge management – Systems approach for Implementation and Operation

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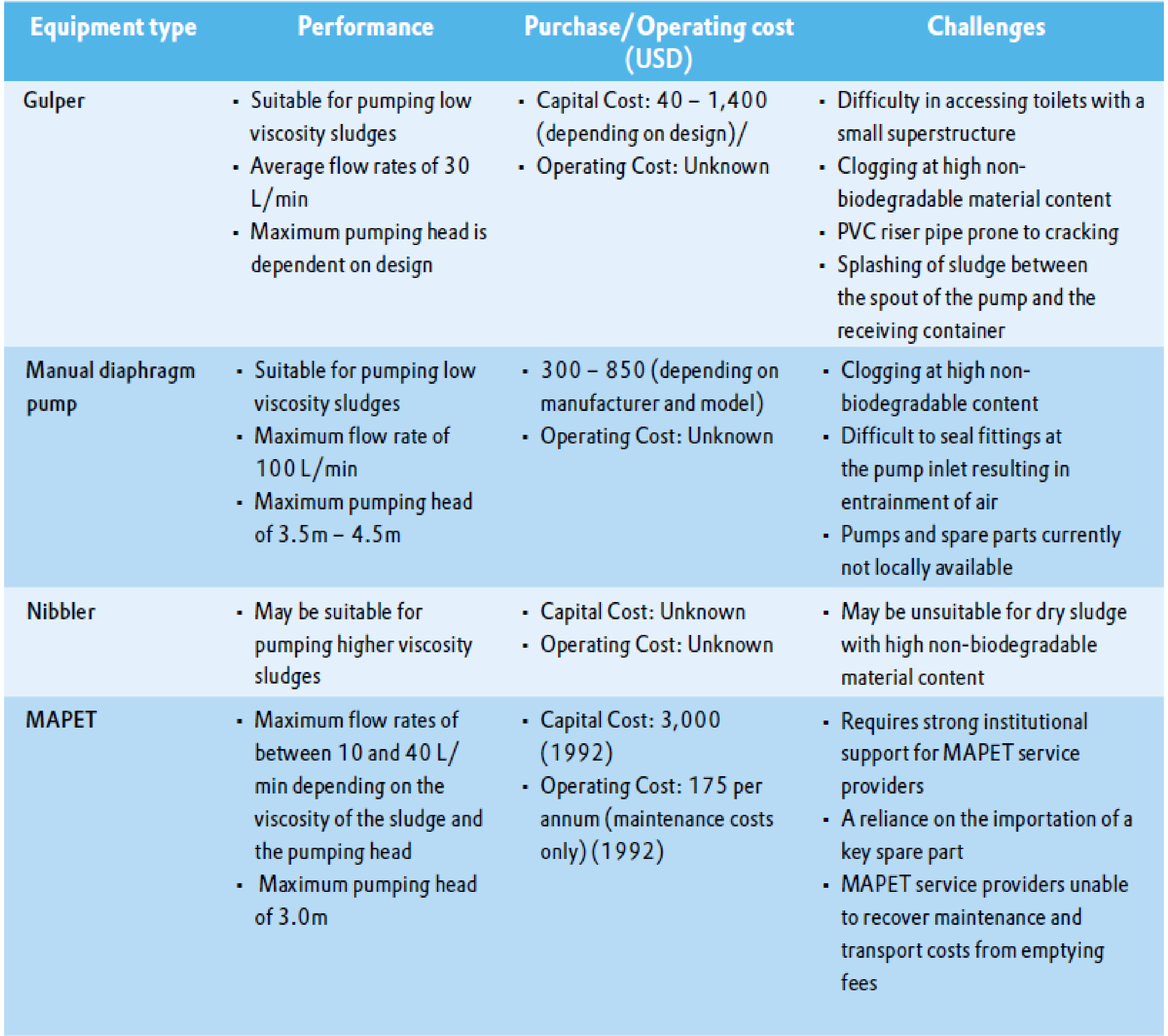

Equipment type	Performance	Purchase/Operating cost (USD)	Challenges
Gulper	▪ Suitable for pumping low viscosity sludges ▪ Average flow rates of 30 L/min ▪ Maximum pumping head is dependent on design	▪ Capital Cost: 40 – 1,400 (depending on design)/ ▪ Operating Cost: Unknown	▪ Difficulty in accessing toilets with a small superstructure ▪ Clogging at high non-biodegradable material content ▪ PVC riser pipe prone to cracking ▪ Splashing of sludge between the spout of the pump and the receiving container
Manual diaphragm pump	▪ Suitable for pumping low viscosity sludges ▪ Maximum flow rate of 100 L/min ▪ Maximum pumping head of 3.5m – 4.5m	▪ 300 – 850 (depending on manufacturer and model) ▪ Operating Cost: Unknown	▪ Clogging at high non-biodegradable content ▪ Difficult to seal fittings at the pump inlet resulting in entrainment of air ▪ Pumps and spare parts currently not locally available
Nibbler	▪ May be suitable for pumping higher viscosity sludges	▪ Capital Cost: Unknown ▪ Operating Cost: Unknown	▪ May be unsuitable for dry sludge with high non-biodegradable material content
MAPET	▪ Maximum flow rates of between 10 and 40 L/min depending on the viscosity of the sludge and the pumping head ▪ Maximum pumping head of 3.0m	▪ Capital Cost: 3,000 (1992) ▪ Operating Cost: 175 per annum (maintenance costs only) (1992)	▪ Requires strong institutional support for MAPET service providers ▪ A reliance on the importation of a key spare part ▪ MAPET service providers unable to recover maintenance and transport costs from emptying fees

The gulper IV version has a 3m pumping head, capital cost from 200 USD (local production) - 1,400 USD (UK manufacturer) The PVC riser pipe has been replaced by a flexible pipe not prone to cracking

Reference: Feacal sludge management – Systems approach for Implementation and Operation

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Mechanical desludging

Diaphragm Sludge pump

Oxfam Supply Centre – Code LDD3

The performance of a desludging pump will always be limited by two factors that are common in latrines:
1) The fluid being too *thick or heavy to flow*
2) Debris in the sludge blocking the inlet

Trash pump

Oxfam Supply Centre – Code WSDP

Suitable for pumping sludge with high liquid content with solids up to 30mm in diameter

Conventional vacuum truck

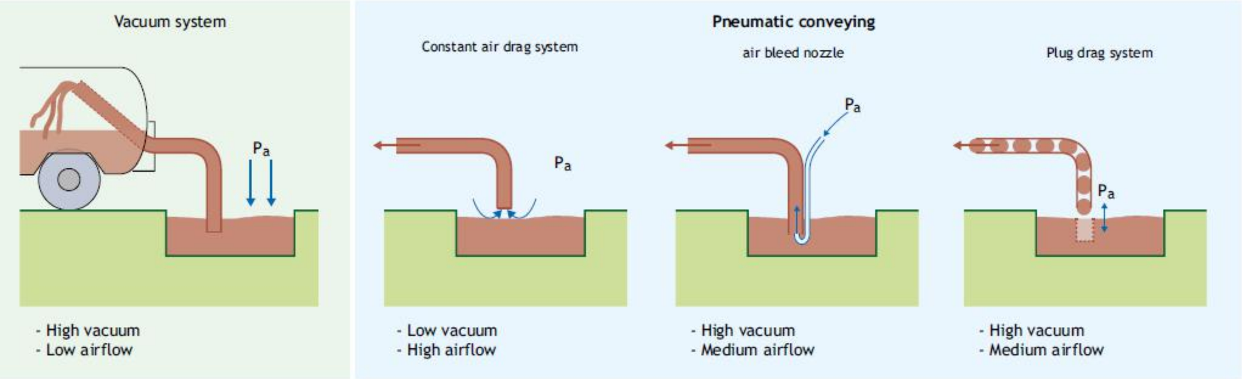
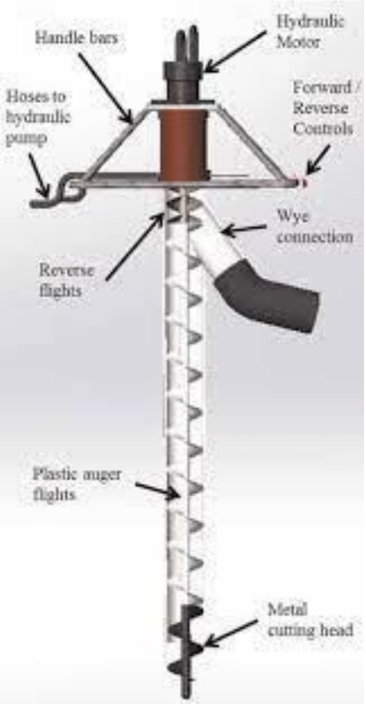


Figure 4.9 Four types of vacuum sludge removal techniques (adapted from Böesch and Schertenleib, 1985).

Reference: Feacal sludge management – Systems approach for Implementation and Operation

Motorised pit screw auger



Some of the challenges faced by the motorised PSAs include (Still and O'Riordan, 2012; Still and Foxon, 2012):
- complicated emptying process due to the fixed length and rigidity of the auger and riser pipe;
- unsuitability for use with dry sludge and large amounts of non-biodegradable waste;
- difficulties with cleaning after use; and
- difficulties manoeuvring due to weight and size.

Vacutug

Photo: UN-Habitat

Gobbler

Using the same operating principles as the Nibbler, the Gobbler is powered using an electric motor. The motor turns a double chain drive that rotates a heavier gauge chain that of the Nibbler. However due to significant challenge it was **not further developed**

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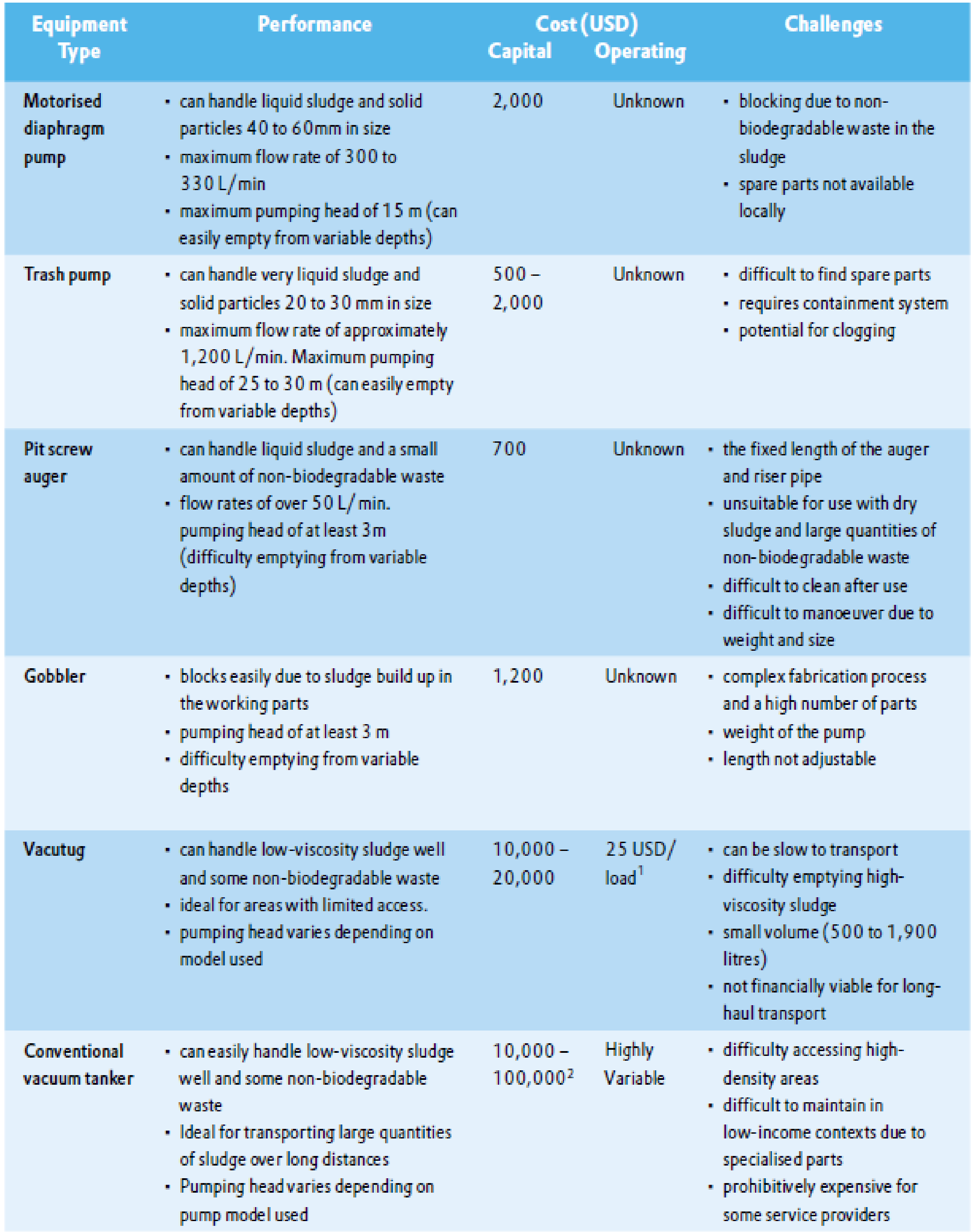


Equipment Type	Performance	Cost (USD) Capital	Cost (USD) Operating	Challenges
Motorised diaphragm pump	• can handle liquid sludge and solid particles 40 to 60mm in size • maximum flow rate of 300 to 330 L/min • maximum pumping head of 15 m (can easily empty from variable depths)	2,000	Unknown	• blocking due to non-biodegradable waste in the sludge • spare parts not available locally
Trash pump	• can handle very liquid sludge and solid particles 20 to 30 mm in size • maximum flow rate of approximately 1,200 L/min. Maximum pumping head of 25 to 30 m (can easily empty from variable depths)	500 – 2,000	Unknown	• difficult to find spare parts • requires containment system • potential for clogging
Pit screw auger	• can handle liquid sludge and a small amount of non-biodegradable waste • flow rates of over 50 L/min. pumping head of at least 3m (difficulty emptying from variable depths)	700	Unknown	• the fixed length of the auger and riser pipe • unsuitable for use with dry sludge and large quantities of non-biodegradable waste • difficult to clean after use • difficult to manoeuver due to weight and size
Gobbler	• blocks easily due to sludge build up in the working parts • pumping head of at least 3 m • difficulty emptying from variable depths	1,200	Unknown	• complex fabrication process and a high number of parts • weight of the pump • length not adjustable
Vacutug	• can handle low-viscosity sludge well and some non-biodegradable waste • ideal for areas with limited access. • pumping head varies depending on model used	10,000 – 20,000	25 USD/ load[1]	• can be slow to transport • difficulty emptying high-viscosity sludge • small volume (500 to 1,900 litres) • not financially viable for long-haul transport
Conventional vacuum tanker	• can easily handle low-viscosity sludge well and some non-biodegradable waste • Ideal for transporting large quantities of sludge over long distances • Pumping head varies depending on pump model used	10,000 – 100,000[2]	Highly Variable	• difficulty accessing high-density areas • difficult to maintain in low-income contexts due to specialised parts • prohibitively expensive for some service providers

During the consultation process ensure you understand users' capacity of payment compared to the cost of desludging one pit with the technical choices available.

What volume of sludge can households or group of households afford to desludge? Match latrine pit size to what households can afford.

[1] Assuming two loads emptied per day from an average distance of 10 kilometres from the disposal point and an average travel speed of 10 km/h (Mikhael and Parkinson, 2011)

[2] The price range of conventional vacuum tankers varies significantly depending on whether the vehicle is brand new or used, capacity, extra capabilities (e.g. jetting), and shipping costs.

Reference: [Feacal sludge management – Systems approach for Implementation and Operation]

Safe handling of sludge

A desludging service will include the following tasks:

- Interact with customers prior to removing Faecal Sludge (FS) to arrange logistics and inform them of procedures;
- Locate onsite sanitation systems that are to have sludge removed;
- Determine the accessibility of the system once it is located;
- Open the system to facilitate the process;
- Collect the FS;
- Evaluate the condition of the system post-collection;
- Close and secure the system once the FS removal has been completed;
- Clean up after the process is completed; and
- Perform the final inspection and report any issues with the system to the customers after the service is completed.

In a sustainable process where the service is paid by customers to cover costs the following task should be included:

- Share the standardised fee or negotiate one, depending on the business model;

Access will be dependent on the desludging system used (e.g., vacuum truck and the maximum pipe length) and the access road dimension or neighbour agreement if private land need to be crossed or used for setting up equipment.

In a camp setting it is recommended to label each latrine with a unique code with a clue to the location (e.g., section, block, street, latrine number)

In an urban setting locating a septic tank may not be obvious and looking for clues such as manhole cover, sewer cleanout, depression in a yard, or using a probe may be required

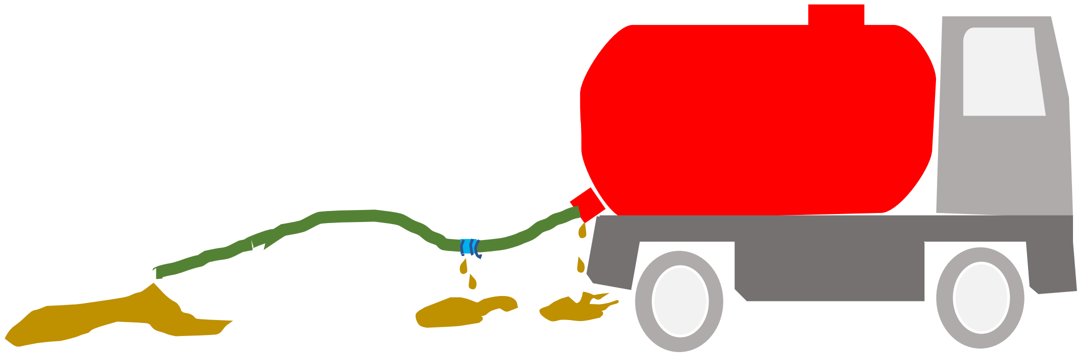
The following questions can be used as a checklist to assist the service provider in determining if the system is accessible for emptying:

- Can the system be opened to accommodate the sludge removal equipment (e.g., hose)?
- Are there existing manholes over each compartment that can be opened?
- Will the installation of new access ports be required? If so, is that a service that the residents have agreed to?
- Will slabs, floors, or septic tank covers have to be rebuilt following emptying?
- Will the pit collapse if emptied?

Reference: [Feacal sludge management – Systems approach for Implementation and Operation]()

Tools of the trade

- Shovels, pry bars and probes to locate tanks and manholes;
- Screwdrivers and other hand tools to open manholes and access port lids;
- Long handle shovels and buckets which may be necessary to remove solids that cannot otherwise be removed;
- Hooks to remove non-biodegradable solids;
- Hoses for FS pumping as well as for adding water to tanks if available; and
- Safety equipment including:
  - Wheel chocks to prevent the vehicle from moving when parked;
  - Personal protective equipment such as hardhat, face protection, eye protection, boots and gloves;
  - Disinfectants, barriers, sorbents and bags for cleaning up and collecting spilled material.



Pipe and fittings, if not maintained frequently, won’t function properly and leak

Transport considerations

The aspects that need to be considered for the transportation of FS include:

- The type of vehicle to be used including its road worthiness, maintenance, licenses and permits, and where it is kept when it is not in service;
- The type of sludge removal equipment, including hoses, pumps, augers, and other tools of the trade;
- The spill management equipment to be used including shovels, disinfectants, sorbents, and collection bags;
- The skills of the operator including the training and certifications that might be required to perform the work;
- Procedures that need to be followed including rules of the road and activities at the treatment plant; and
- Other aspects such as the use of transfer stations, worker health and safety, and emerging technologies.

Reference: Feacal sludge management – Systems approach for Implementation and Operation

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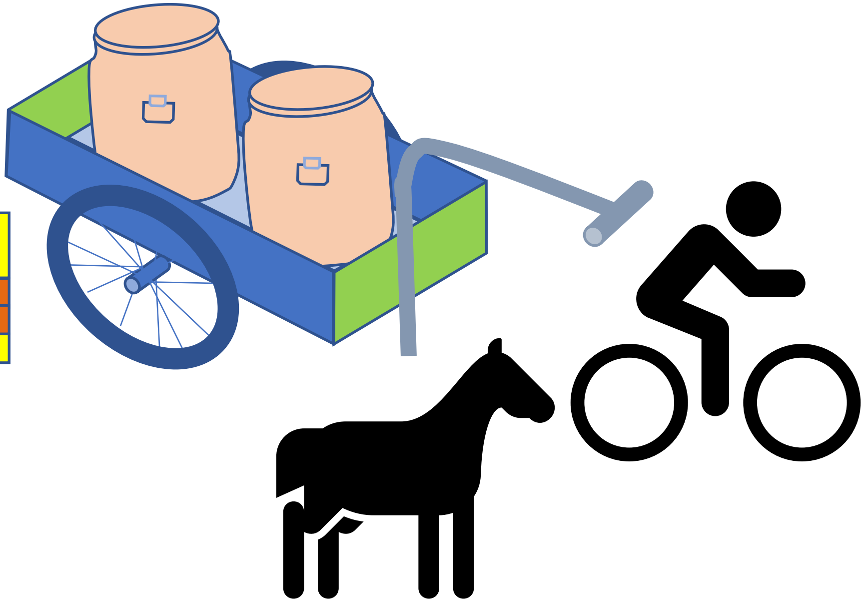
Transport equipment

Human or animal powered

Up to 200 litres

Stability (to avoid spilling) and capacity to carry the weight should considered



Motorised

Up to 1000 litres

10 to 55 m3

Transfer station

Intermediary storage between small size collection system and final treatment plant

It can be made of portable container or a fixed station offering some pre-treatment capacity such as Settling tank, drying beds, Biogas digestor, Septic tank, ABRs

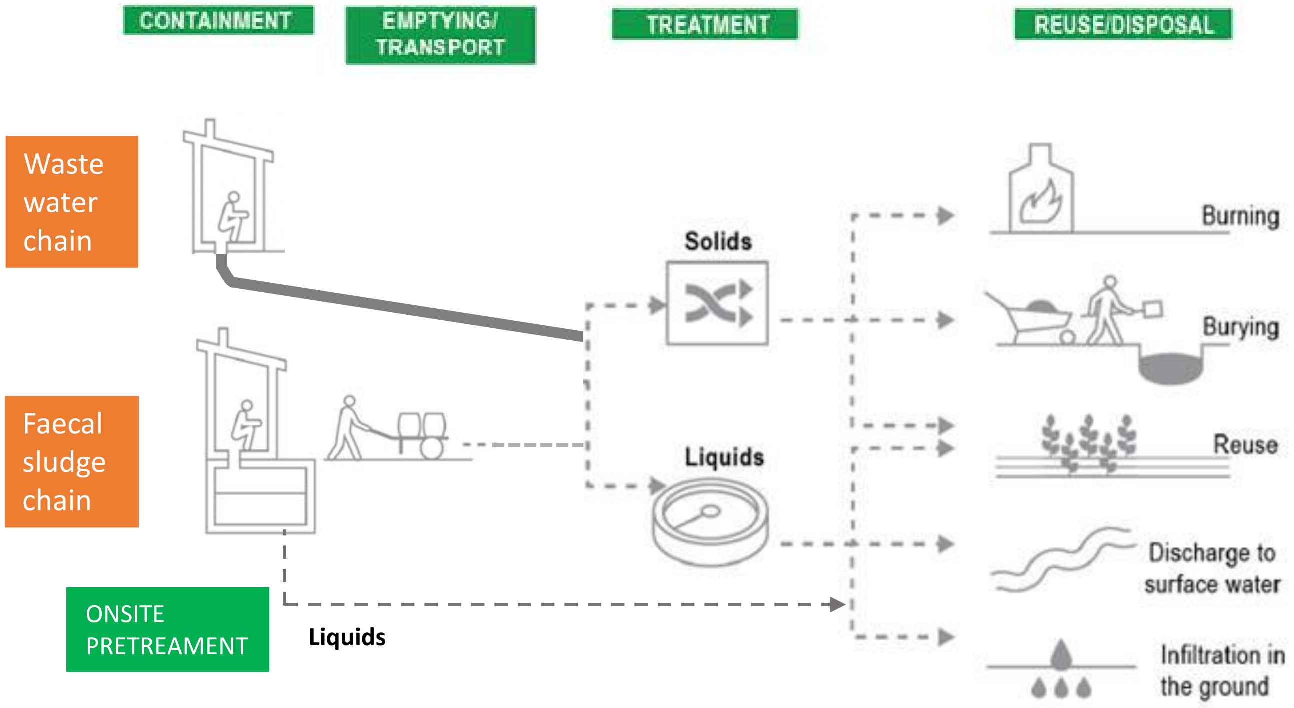
Reference: Feacal sludge management – Systems approach for Implementation and Operation

The aim of wastewater and Faecal sludge treatment is the reduction of volume by separating solid and liquid, the inactivation of pathogens and the reduction of Carbonate, Nitrogen and Phosphorus returning to water bodies before disposing safely of the final products. BOD (biological oxygen demand) is a proxy indicator of organic matter pollution used to measure potential risks presented by effluents to water bodies and their fauna and flora.

Most treatment options fall into 4 categories: physical, mechanical, chemical and biological treatment, and a full treatment chain generally involved a mix of them.

Wastewater is generally used to refer to the mixture collected in and transported through a sewer system, using flushing water to transport the faeces and urine. In addition to flushing water, wastewater generally also contains greywater, e.g. the water from showers and sinks

Faecal sludge is the mixture of human urine and faeces, water and solid wastes (such as toilet paper and menstrual hygiene materials) that gets collected in onsite sanitation systems and is not transported through a sewer



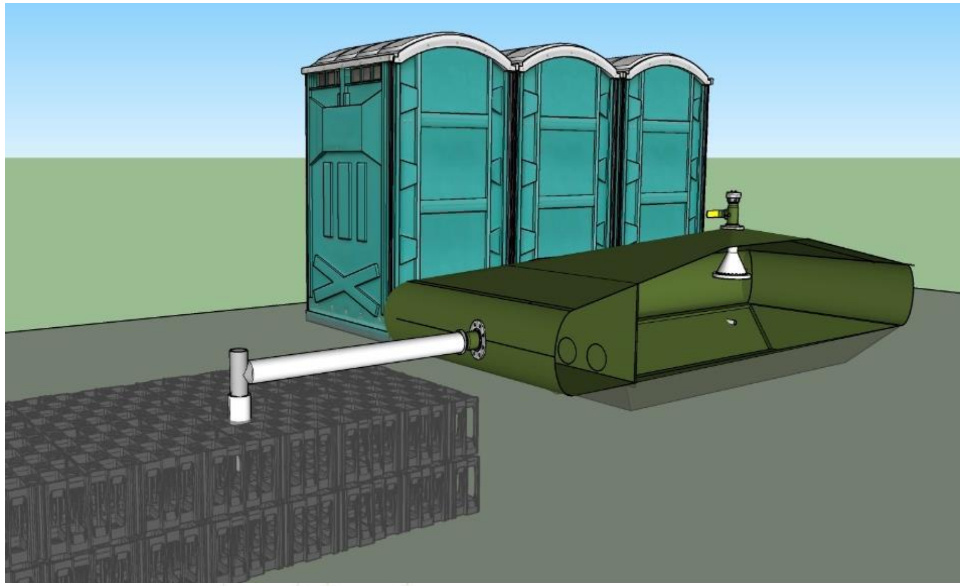
Reference: GWC – FSM TWIG – Terminology Factsheet

Treatment options in emergency setting

While there are a wide variety of solutions for potable water transport, storage and treatment, most existing emergency kits in sanitation focus on latrines and sludge pumps. Developing faecal sludge treatment kit for emergency purpose is in its infancy.

Oxfam is currently testing **a flatpack septic tank kit** separating liquid and solid and storing up to 6-12 months faecal sludge from about 500 people.

It is composed of a two chambers bladder tank,



and a set of foldable prefabricated infiltration units

Other types of treatment such as anaerobic filter, trickling filter will require a rigid tank. Metal sheet and liners have successfully replaced civil works in water emergency kits and a similar approach can be done for faecal sludge treatment. It is certainly possible to redirect some of the existing potable water tank kit however be attentive on the liner type and its interaction with wastewater whose characteristics are different from potable water.

Previous version of Oxfam T tank liners were made with EPDM which tend to swell in contact with hydrocarbon (organic matter) and change its characteristics. The suitability for wastewater need to be checked with the supplier. The current version has a PVC liner which require specific blend to be used for wastewater. Again, check with the supplier on the suitability of using the kit for wastewater. The degradation of the liner characteristics may take time, sufficiently for an emergency response use but it's important to understand and integrate the *expiration date* into planning.

Selecting geotextile (for the role of support and eventually protection layer) and geomembrane (role of barrier) to design a liner system depend on the choice available locally, site characteristics, the function and geometry of the facility, the characteristic of the water to be stored, the condition of use and maintenance (including possible risks such as flood and environmental risks).

Welding, to seal geomembrane sheets, is sensitive to weather (humidity and temperature variation) and need to be carefully planned. Water and gas may accumulate underneath the geomembrane and exert backpressure on it. In this case water and gas drainage networks should be designed and installed under the geomembrane.

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Other considerations for building a treatment system

Material-wise:

Adapted pipe for sludge transfer: HDPE, minimum size 110mm
Slotted or perforated rigid pipe for percolation field and effluent drainage
Use appropriate valves to minimise clogging

Any filtering process risk clogging and system to backwash with water or a combination water and air to unblock pores and pipes need to be included into the design

Design-wise:

Where drying beds are considered, rain and runoff pathway should be mapped to minimise their impact on the treatment process. A roof on the drying beds may be required.

Flood risks and their impact on the treatment plant should be considered when locating site and designing infrastructure. Overflow management should be planned to minimise groundwater contamination.

Site topography is a key factor for gravity flow design into the treatment process and minimise pumping needs.

On the selection of the treatment option:

Can users' needs for energy, agriculture, cooking fuel be served by the treatment process?

The environment impact of a treatment system can have two objectives. The primary one is to reduce the pollution risks of water bodies (pathogen contamination and eutrophication). The second one can be to mitigate some human impact on environment such as deforestation, overextraction of aquifer… if the treatment type is carefully selected in consultation with concerned communities

Look beyond faecal sludge and wastewater treatment and consider how end products (treated effluent, biogas / biomass / compost / dry sludge / fuel briquette) can support climate change adaptation and water security
E.g., by supporting urban forests, agroforestry, crop irrigation, biodiversity & land management, water resource management, etc.

The refugees' camps of Cox's Bazar in Bangladesh with their lack of space and the long-term Rohingya crisis was the occasion to implement and test various treatment options in an emergency setting

Key indicators used to compare technologies were

- Capital and operational costs (CAPEX and OPEX);
- Area requirement and layout;
- Speed of construction and commissioning;
- Expertise required for set up and operate;
- Operation and maintenance issues;
- Process pinch points;
- Quality of liquid and solid effluent (pathogen inactivation);
- Disposal of final products (liquid and solid); and
- Resilience to flooding/natural disaster.

Out of 8 technologies reviewed 2 rated best on several indicators:

1- Upflow filters (decentralised) ★

2- Anaerobic Baffled reactors – ABR (centralised) ★

Lime came out a good and robust treatment option but only during the immediate emergency phase due to its high OPEX. ★

Centralised (treating more than 20m3/ day of sludge and serving a large area) and decentralised (serving a smaller area and treating 2-5m3/day) system were studied

Depending on your design parameters, check which technology fit best

Reference: ARUP / Oxfam / UNHCR - Faecal Sludge Management for disaster Relief: Technology comparison study

INDICATOR	BEST FOR	BEST TECHNOLOGY	RATIONAL	RISK WITH CHOICE
Technology	*Easy scale up*	Upflow Filters ★	Can be used on multiple scales. Easy to add more (prefabricated tanks) units in parallel	- Effluent quality To Be Confirmed[12] (TBC) - Area needed for liquid infiltration and solids burial, or additional treatment (to achieve standards)
	Low complexity	GeoTubes	Simple technology using local materials	- Effluent quality does not meet public health standards. Needs additional treatment (to achieve standards)
	Footprint area/space i.e. lowest footprint area per m³ treated	Aeration (centralised) or ABR (for decentralised) ★	Lowest footprint area per m³ treated	- Effluent quality TBC - Area needed for liquid infiltration and solids burial, or additional treatment (to achieve standards) - Aeration needs skilled operator and power supply
	Speed of construction and set up	Upflow Filters ★	Prefabricated tanks at ground level so construction is rapid	- Effluent quality TBC - Area needed for liquid infiltration and solids burial, or additional treatment (to achieve standards) - Site specific conditions must be considered with this criteria, resilience to disaster'. e.g If site is in a known flood plain, the designer could consider raising technology above flood level or providing flood protection bunds/walls. In this case a technology with larger civil works maybe more appropriate e.g lagoons or concrete tank system.
	Resilience to disaster	Upflow Filters ★	Prefabricated tanks (not concrete) so earthquake resistant. All main process units are above ground level so good for flooding	
(Treatment) Process	*Complexity (primary, secondary, tertiary)*	Upflow Filters and GeoTubes ★	Simple process	- Effluent quality TBC - Area needed for liquid infiltration and solids burial, or additional treatment (to achieve standards)
	Robustness/stability of process	Lime ★	Lime dose can be adjusted to suit influent. Lime treatment provides full treatment to achieve pathogen kill	- High OPEX
	Treatment effectiveness	Aeration or lagoons	Best for public health and environmental effluent standards	- High skills needed to operate
O&M	*Skills requirements*	ABR ★	Solids removal every 6 to 12 months otherwise limited maintenance needed	- Effluent quality TBC - Area needed for liquid infiltration and solids burial, or additional treatment (to achieve standards) - Concrete tanks so permanent structure - Scale up difficult
Cost	*Capital expenditure costs (CAPEX $/m³ treated)*	ABR ★	Lowest capex per m³ treated	- Area needed for solids handling and disposal
	Operational expenditure (OPEX $/year)	Upflow Filters or Constructed Wetland ★	Lowest OPEX per m³ treated	- Effluent quality - Area needed for liquid infiltration and solids burial
	The whole life costs (WLC) of each technology	Constructed Wetland ABR or Biogas ★	Lowest WLC. ABR is a concrete structure so should not need any replacement over 10 years	- Effluent quality - Area needed for liquid infiltration and solids burial - Scale up difficult for concrete ABR
Environmental and social context	*Insights on understanding final discharge routes (environmental contamination)*	Upflow Filters ★	Had adequate space for infiltration and solids storage to achieve pathogen inactivation. Process is contained (in closed plastic tanks) so limits vectors	- Effluent quality - Area needed for liquid infiltration and solids burial, or additional treatment (to achieve standards)

Reference: [Faecal Sludge Management for disaster Relief: Technology comparison study]

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(12) Effluent has not (yet) been tested in CXB so there is no evidence to support treatment effectiveness and pathogen removal.

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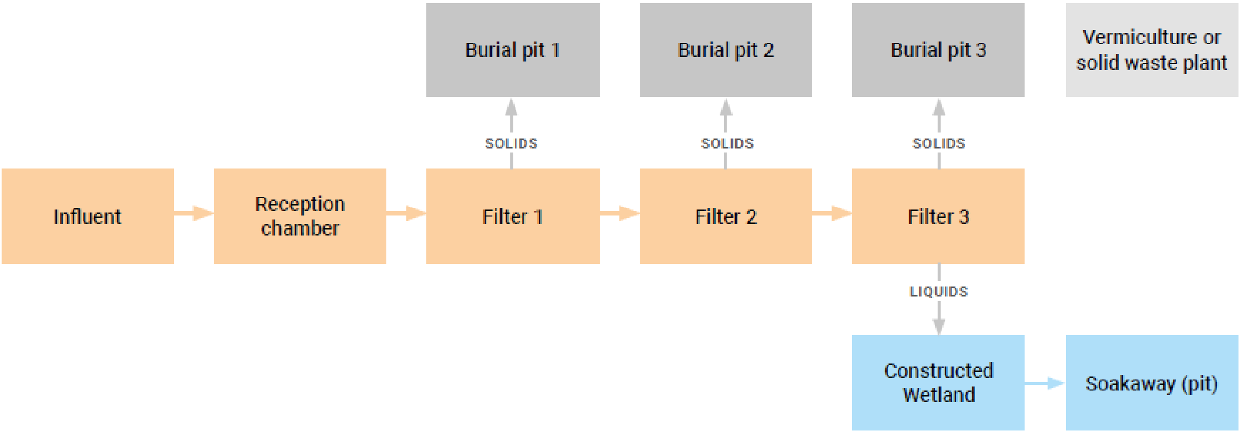
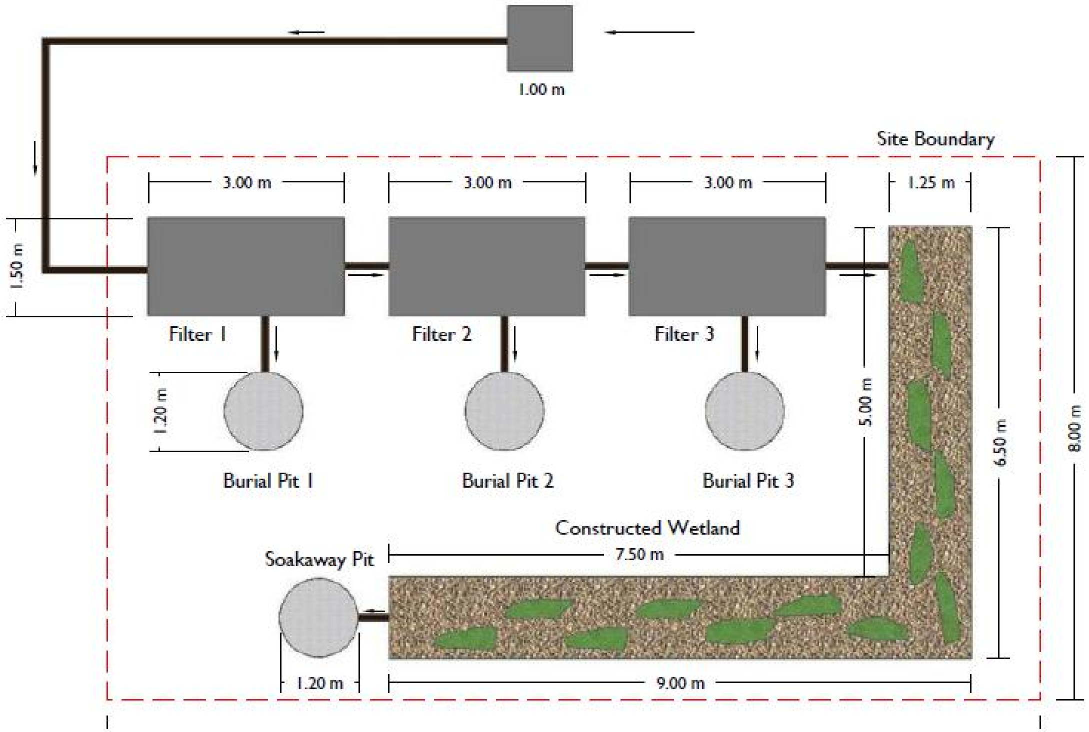
Table 1:
Comparison matrix of key indicators

Reference: Faecal Sludge Management for disaster Relief: Technology comparison study

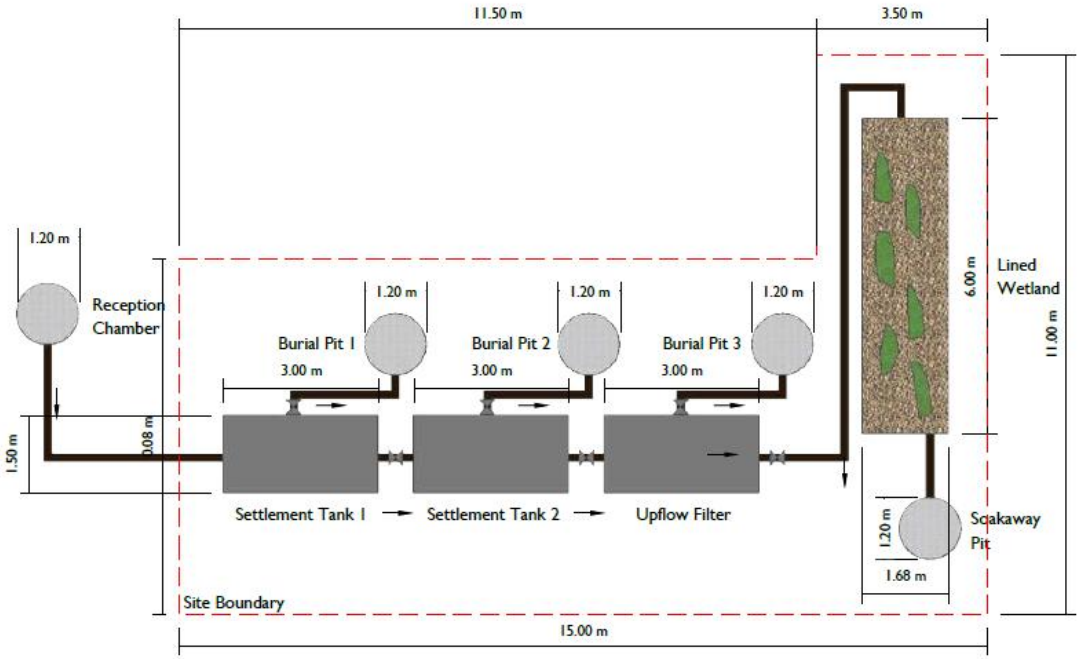
		Decentralised biological and/or mechanical treatment				Decentralised biological treatment				Decentralised chemical treatment					Centralised biological treatment		SCORING RATIONAL (For full scoring rationale refer to Appendix B1)		
		Upflow Filters	Upflow Filters with pre-settlement (metal/ tarp tanks)	Upflow filter with pre-settlement (plastic tanks)	GeoTubes	Constructed Wetlands 1	Constructed Wetlands 2	Biogas Plants	Septic/retention-tanks/ABR	Lime 1 Lagoon Lime treatment with dewatering bed	Lime 2 Lagoon Lime treatment with dewatering bed	Lime 3 Lagoon Lime treatment with dewatering bed	Lime 4 In barrel treatment with dewatering beds	Lime 5 3 tank Lime system	Anaerobic Lagoons	Aerobic Treatment			
Technology	*Scale*	1	1	1	1	3	3	4	4	2	2	3	2	4	5	2	*1 is works at multiple scales. Quick and easy to scale up*	1 ● ● ● 5	*5 is only works (well) at one scale. Diffcult to scale up/down*
	Complexity of technology & equipment	2	2	2	1	2	2	3	2	3	2	3	3	2	2	5	*1 is up to three main items of equipment (e.g. tank, basin, pump, filter) used, which are simple to maintain and operate*	1 ● ● ● 5	*5 is five or more technology units used, which are complex to maintain and operate*
	Layout and footprint area	3	3	5	2	4	3	1	1	4	2	3	3	3	3	1	*1 is 0-15m²/m³ treated*	1 ● ● ● 5	*5 is more than 60 m²/m³ treated*
	Speed of construction & set up	2	2	1	2	3	3	3	2	1	1	3	1	1	4	2	*1 is less than 1 month*	1 ● ● ● 5	*5 is more than 6 months*
	Resilience to disaster	1	1	2	4	4	4	4	4	2	2	3	2	2	2	3	*1 is resilient to fooding and earthquake (integral to the technology/layout)*	1 ● ● ● 5	*5 is low/no resistance to fooding or earthquake*
(Treatment) Process	*Complexity of process (primary, secondary, tertiary)*	2	2	2	2	3	3	3	3	3	3	3	3	3	2	4	*1 is up to 3 simple processes using the same removal mechanism, simple to commission and keep working*	1 ● ● ● 5	*5 is more than 5 complex process with a mix of removal mechanisms, complicated to commission and keep working*
	Robustness/ stability	3	3	3	2	3	3	3	3	2	2	2	2	2	3	4	*1 is whole process is not sensitive to changes in influent, inputs (chemicals, aeration etc) or changes in environmental conditions*	1 ● ● ● 5	*5 is a majority of the process is highly sensitive to changes in influent, inputs (chemicals, aeration etc) or environmental conditions which will reduce the final effluent quality*
	Treatment effectiveness	3	3	2	4	3	3	4	4	2	2	2	2	2	2	2	*1 is final liquid and solids meets all DoE, WHO standards and classified as "good" under CXB FSM strategy*	1 ● ● ● 5	*5 is Site classed as "unacceptable" under Cox bazar FSM strategy &does not meet DoE or WHO coliform standards for liquid effluent*
Operation and maintenance	*Skills requirements*	2	2	2	2	2	2	3	2	4	4	4	4	3	3	5	*1 is low skills needed i.e no skilled labour required*	1 ● ● ● 5	*5 is highly skilled labour needed throughout operation*
Cost	*Capital expenditure costs (CAPEX $/m³ treated)*	5	5	4	1	5	3	2	1	2	2	3	3	3	3	3	*1 is $0 to $500*	1 ● ● ● 5	*5 is $5000 +*
	Operational expenditure (OPEX $/m³ treated)	2	2	2	2	2	1	1	1	4	3	5	4	4	1	2	*1 is up to $0.5 per m³ treated*	1 ● ● ● 5	*5 is more than $15*
	The whole life costs (WLC) of each technology	2	2	2	3	2	2	1	2	5	5	5	4	4	5	4	*1 is less than $20,000*	1 ● ● ● 5	*5 is $200k +*
Environmental and social context	*Final discharge routes (environmental contamination)*	2	2	1	5	3	4	4	4	2	4	3	2	2	1	2	*1 is "good" discharge routes i.e. in line with CXB FSM strategy e.g. infiltration, burial, incineration. Clearly planned disposal route and adequate space included*	1 ● ● ● 5	*5 is poor allowance and difficult management of final products/ wastes*

Upflow filters





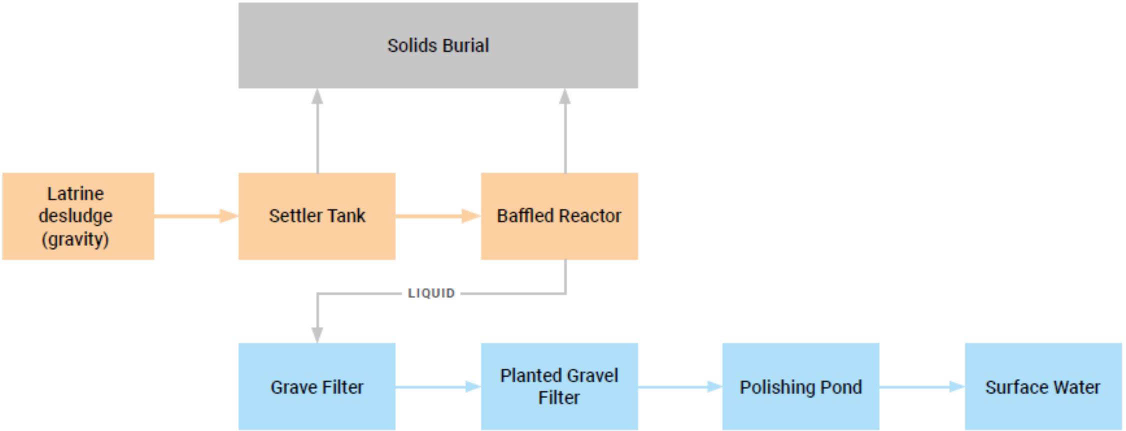
Variation in layout, by replacing 2 filters with settlement tanks



CAPEX	$10,710 per m3 treated
OPEX	$0.87 per m3 treated
Whole life cost (10 years)	$47,000
Capacity	2 m3 per day

Reference: Faecal Sludge Management for disaster Relief: Technology comparison study

ABR


Solids Burial

Latrine desludge (gravity)

Settler Tank

Baffled Reactor

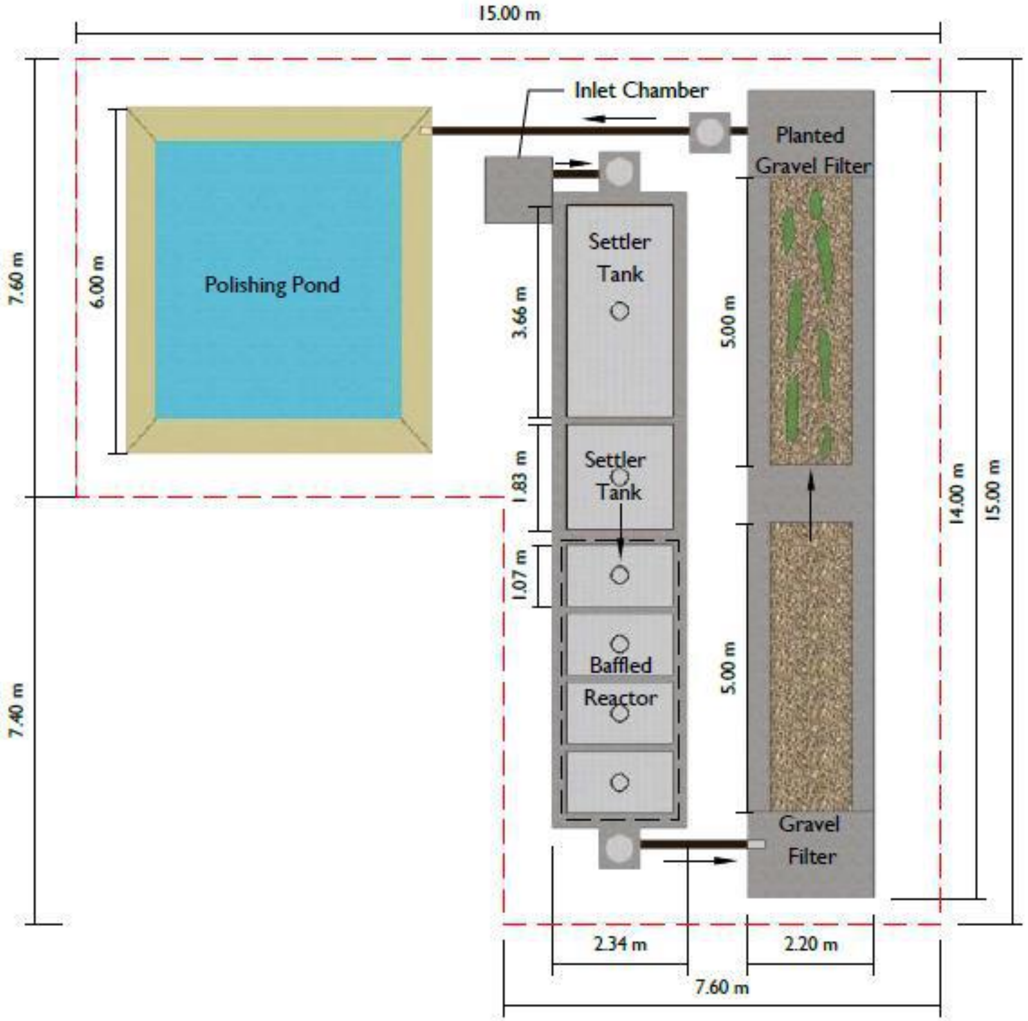
LIQUID

Grave Filter

Planted Gravel Filter

Polishing Pond

Surface Water



CAPEX	$342 per m3 treated
OPEX	$0.06 per m3 treated
Whole life cost (10 years)	$21,160
Capacity	35 m3 per day

Reference: Faecal Sludge Management for disaster Relief: Technology comparison study

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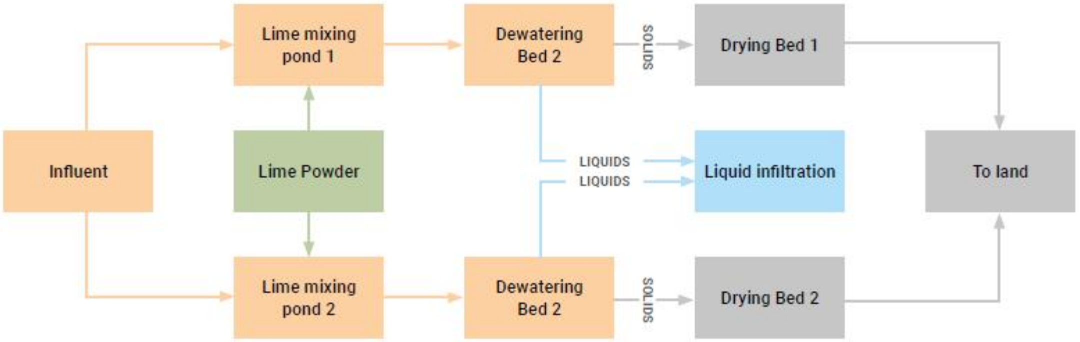
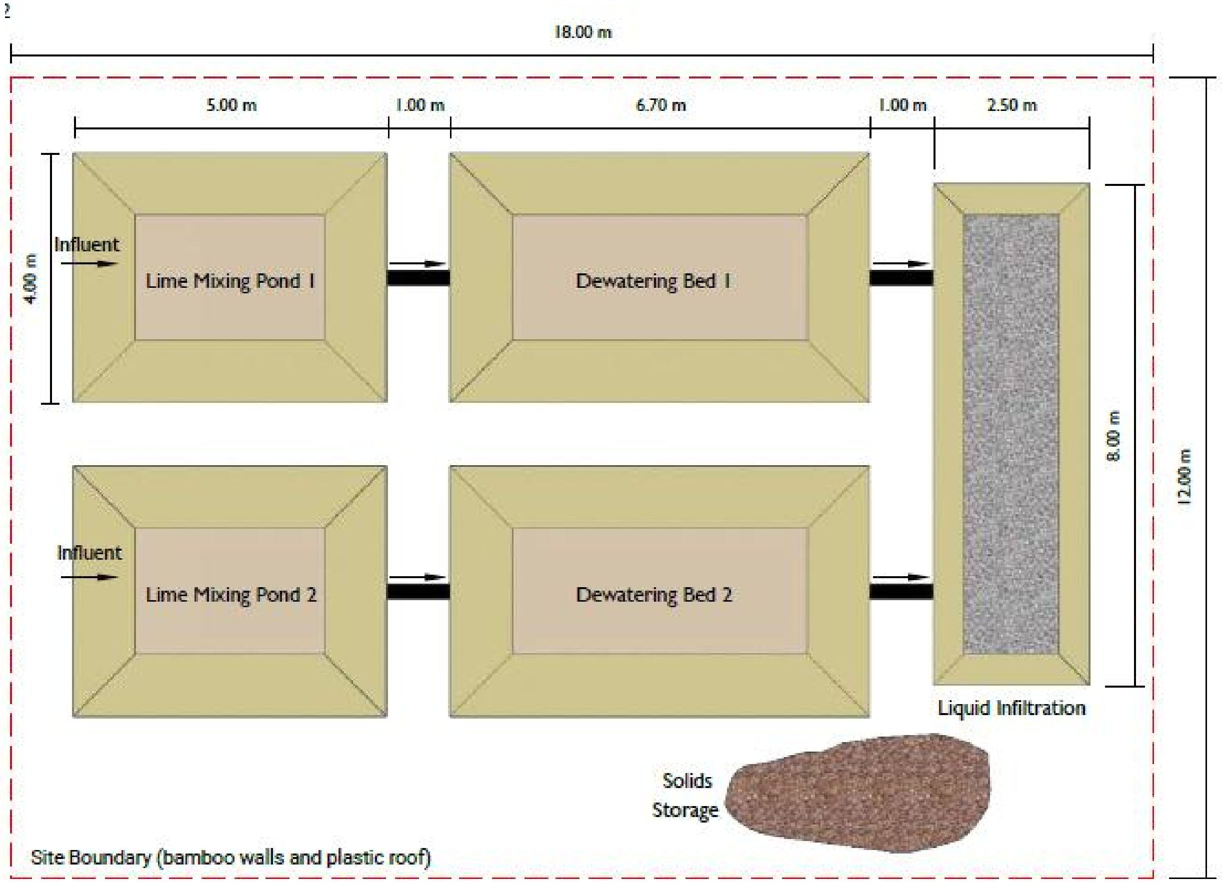
Lime





CAPEX	$975 per m3 treated
OPEX	$9 per m3 treated
Whole life cost (10 years)	$396,870
Capacity	11 m3 per day

Reference: Faecal Sludge Management for disaster Relief: Technology comparison study

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Pathogen inactivation

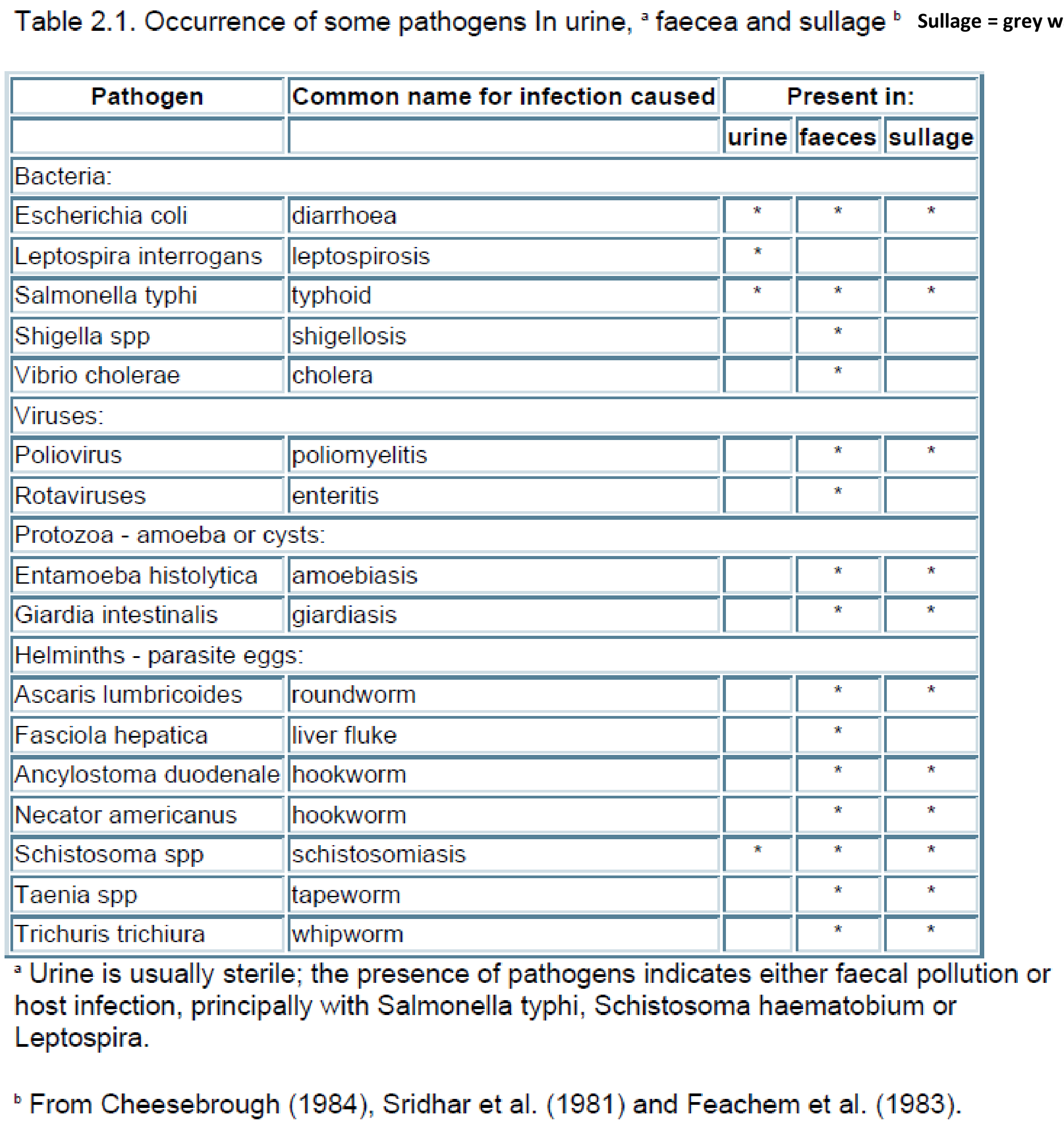

Table 2.1. Occurrence of some pathogens In urine, [a] faecea and sullage [b] **Sullage = grey water**

Pathogen	Common name for infection caused	Present in:		
		urine	faeces	sullage
Bacteria:				
Escherichia coli	diarrhoea	*	*	*
Leptospira interrogans	leptospirosis	*		
Salmonella typhi	typhoid	*	*	*
Shigella spp	shigellosis		*	
Vibrio cholerae	cholera		*	
Viruses:				
Poliovirus	poliomyelitis		*	*
Rotaviruses	enteritis		*	
Protozoa - amoeba or cysts:				
Entamoeba histolytica	amoebiasis		*	*
Giardia intestinalis	giardiasis		*	*
Helminths - parasite eggs:				
Ascaris lumbricoides	roundworm		*	*
Fasciola hepatica	liver fluke		*	
Ancylostoma duodenale	hookworm		*	*
Necator americanus	hookworm		*	*
Schistosoma spp	schistosomiasis	*	*	*
Taenia spp	tapeworm		*	*
Trichuris trichiura	whipworm		*	*

[a] Urine is usually sterile; the presence of pathogens indicates either faecal pollution or host infection, principally with Salmonella typhi, Schistosoma haematobium or Leptospira.

[b] From Cheesebrough (1984), Sridhar et al. (1981) and Feachem et al. (1983).

There is a variety of pathogen types found in wastewater and faecal sludge, each with different survival capacity

Ebola virus can also be found in urine, faeces and grey water

SARS-Cov-2 (causing the Covid-19 infection) can also be found in faeces, limited evidence in urine and potentially in grey water

Reference: WHO - [A guide to the development of on-site sanitation / R Franceys, J Pickford & R Reed]

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In fresh water, Ebola virus can survive for 6 days, while still unknow, tests have demonstrated the potential infection route through wastewater

In salty water, vibrio cholerae can survive for months

It's important to check if the treatment process effectively eliminate helminths eggs and cysts

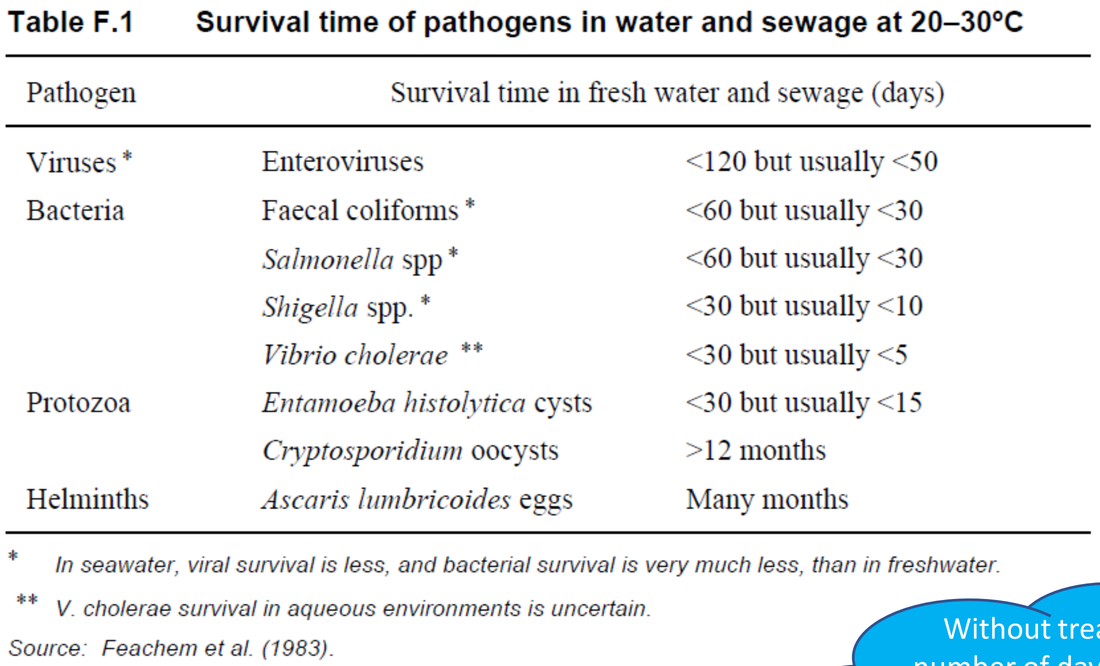

Table F.1 Survival time of pathogens in water and sewage at 20–30°C

Pathogen	Survival time in fresh water and sewage (days)	
Viruses *	Enteroviruses	<120 but usually <50
Bacteria	Faecal coliforms *	<60 but usually <30
	Salmonella spp *	<60 but usually <30
	Shigella spp. *	<30 but usually <10
	Vibrio cholerae **	<30 but usually <5
Protozoa	*Entamoeba histolytica* cysts	<30 but usually <15
	Cryptosporidium oocysts	>12 months
Helminths	*Ascaris lumbricoides* eggs	Many months

* *In seawater, viral survival is less, and bacterial survival is very much less, than in freshwater.*

** *V. cholerae survival in aqueous environments is uncertain.*

Source: Feachem et al. (1983).

Without treatment this is the number of day pathogens need to be contained to avoid contaminating water sources or people

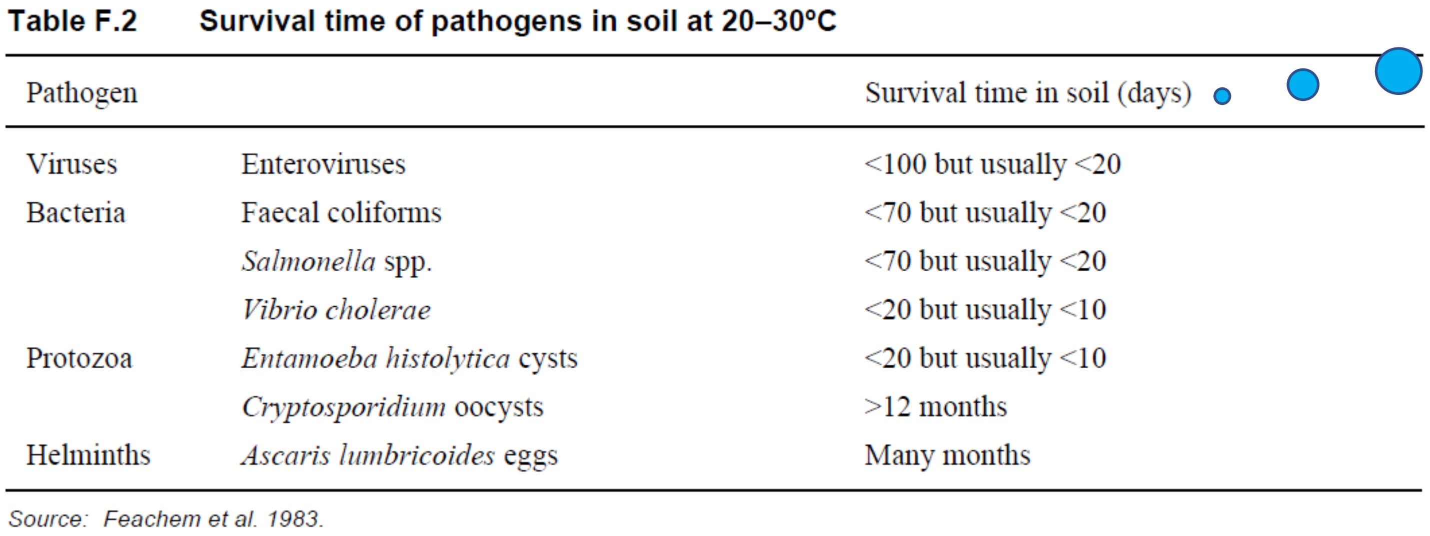

Table F.2 Survival time of pathogens in soil at 20–30°C

Pathogen		Survival time in soil (days)
Viruses	Enteroviruses	<100 but usually <20
Bacteria	Faecal coliforms	<70 but usually <20
	Salmonella spp.	<70 but usually <20
	Vibrio cholerae	<20 but usually <10
Protozoa	*Entamoeba histolytica* cysts	<20 but usually <10
	Cryptosporidium oocysts	>12 months
Helminths	*Ascaris lumbricoides* eggs	Many months

Source: Feachem et al. 1983.

Guidance from WHO states that the "Ebola virus is likely to inactivate significantly faster in the environment than enteric viruses with known waterborne transmission (e.g., norovirus, hepatitis A virus)"

Reference: NSW, Brown and Root Service, Septic Safe Onsite Sewage Risk Assessment System (OSRAS) handbook – Annex F

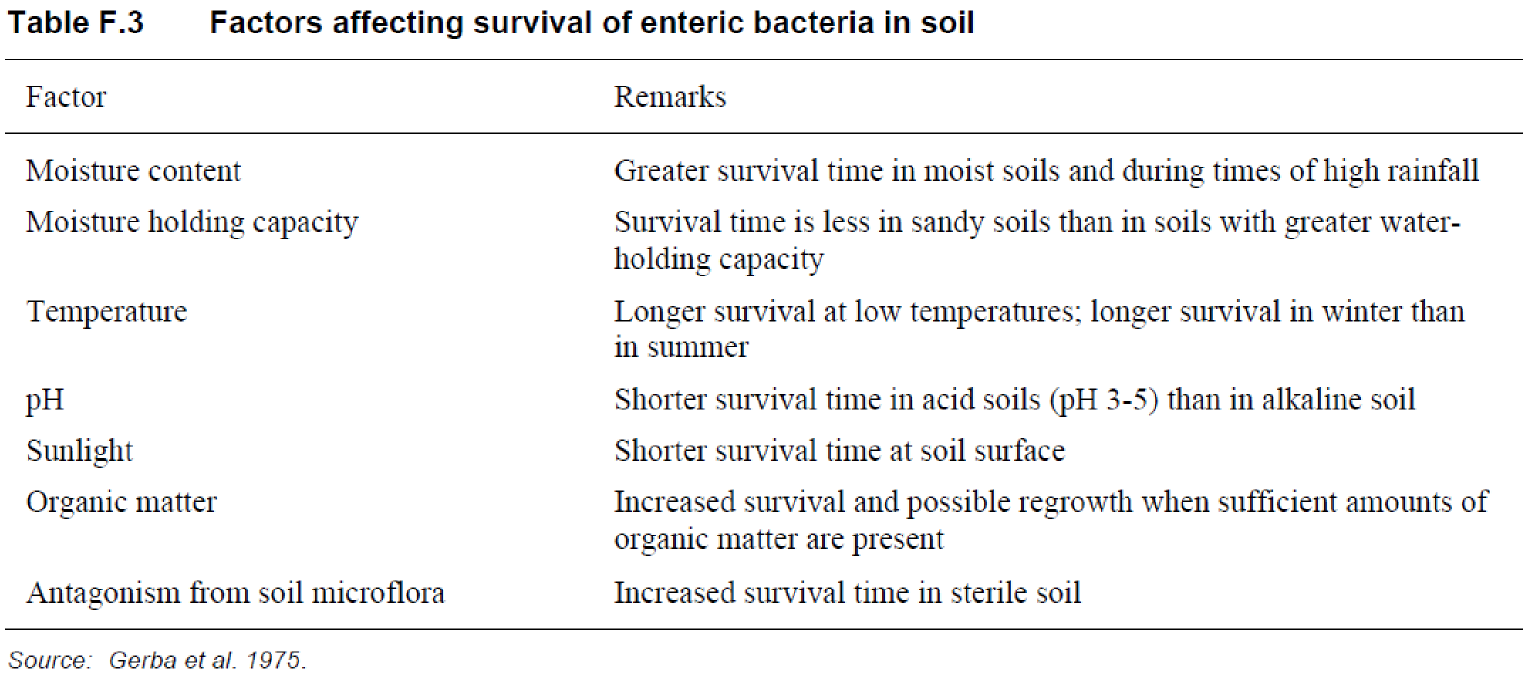

Table F.3 Factors affecting survival of enteric bacteria in soil

Factor	Remarks
Moisture content	Greater survival time in moist soils and during times of high rainfall
Moisture holding capacity	Survival time is less in sandy soils than in soils with greater water-holding capacity
Temperature	Longer survival at low temperatures; longer survival in winter than in summer
pH	Shorter survival time in acid soils (pH 3-5) than in alkaline soil
Sunlight	Shorter survival time at soil surface
Organic matter	Increased survival and possible regrowth when sufficient amounts of organic matter are present
Antagonism from soil microflora	Increased survival time in sterile soil

Source: Gerba et al. 1975.

Inactivation of bacteria is done through competition with other microflora, desiccation and high temperature

The most important factor affecting the survival of all helminth eggs is temperature, with rapid death resulting from temperatures below freezing and above 45°C (Feachem et al. 1983).

Treatment processes such as composting and anaerobic digestion raise temperature up to 60 °C

Reference: NSW, Brown and Root Service – Septic Safe Onsite Sewage Risk Assessment System (OSRAS) handbook – Annex F

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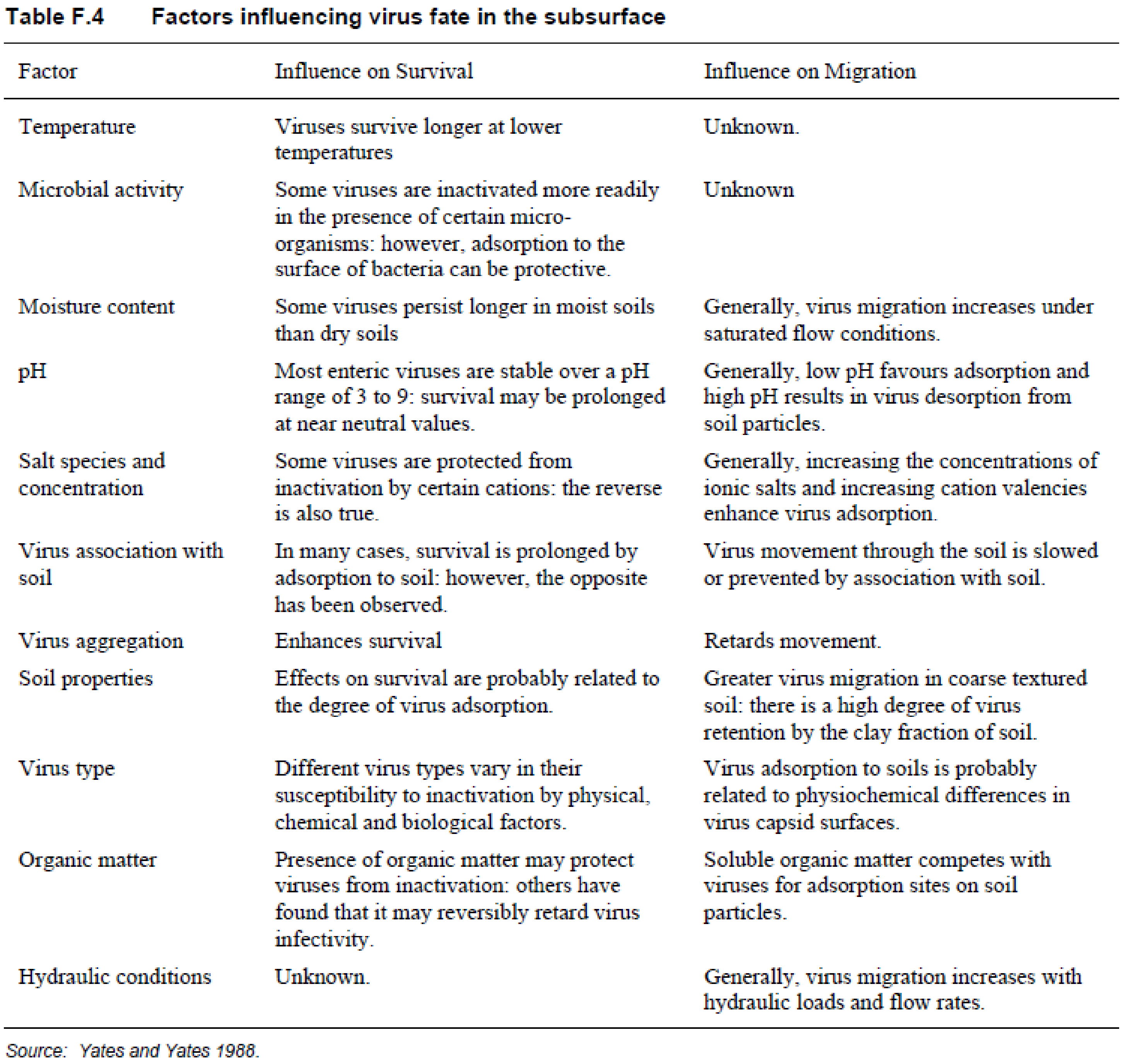

Table F.4 Factors influencing virus fate in the subsurface

Factor	Influence on Survival	Influence on Migration
Temperature	Viruses survive longer at lower temperatures	Unknown.
Microbial activity	Some viruses are inactivated more readily in the presence of certain micro-organisms: however, adsorption to the surface of bacteria can be protective.	Unknown
Moisture content	Some viruses persist longer in moist soils than dry soils	Generally, virus migration increases under saturated flow conditions.
pH	Most enteric viruses are stable over a pH range of 3 to 9: survival may be prolonged at near neutral values.	Generally, low pH favours adsorption and high pH results in virus desorption from soil particles.
Salt species and concentration	Some viruses are protected from inactivation by certain cations: the reverse is also true.	Generally, increasing the concentrations of ionic salts and increasing cation valencies enhance virus adsorption.
Virus association with soil	In many cases, survival is prolonged by adsorption to soil: however, the opposite has been observed.	Virus movement through the soil is slowed or prevented by association with soil.
Virus aggregation	Enhances survival	Retards movement.
Soil properties	Effects on survival are probably related to the degree of virus adsorption.	Greater virus migration in coarse textured soil: there is a high degree of virus retention by the clay fraction of soil.
Virus type	Different virus types vary in their susceptibility to inactivation by physical, chemical and biological factors.	Virus adsorption to soils is probably related to physiochemical differences in virus capsid surfaces.
Organic matter	Presence of organic matter may protect viruses from inactivation: others have found that it may reversibly retard virus infectivity.	Soluble organic matter competes with viruses for adsorption sites on soil particles.
Hydraulic conditions	Unknown.	Generally, virus migration increases with hydraulic loads and flow rates.

Source: Yates and Yates 1988.

Temperature is the most predictor of virus inactivation.

Heat, high or low pH, sunlight (UV) and common disinfectants (such as chlorine) all facilitate the inactivation of human enteric virus

Leaked into groundwater, the virus capacity to contaminate people will depend how long until it reaches any water point compare to the virus survival rate

Reference: NSW, Brown and Root Service, Septic Safe Onsite Sewage Risk Assessment System (OSRAS) handbook – Annex F

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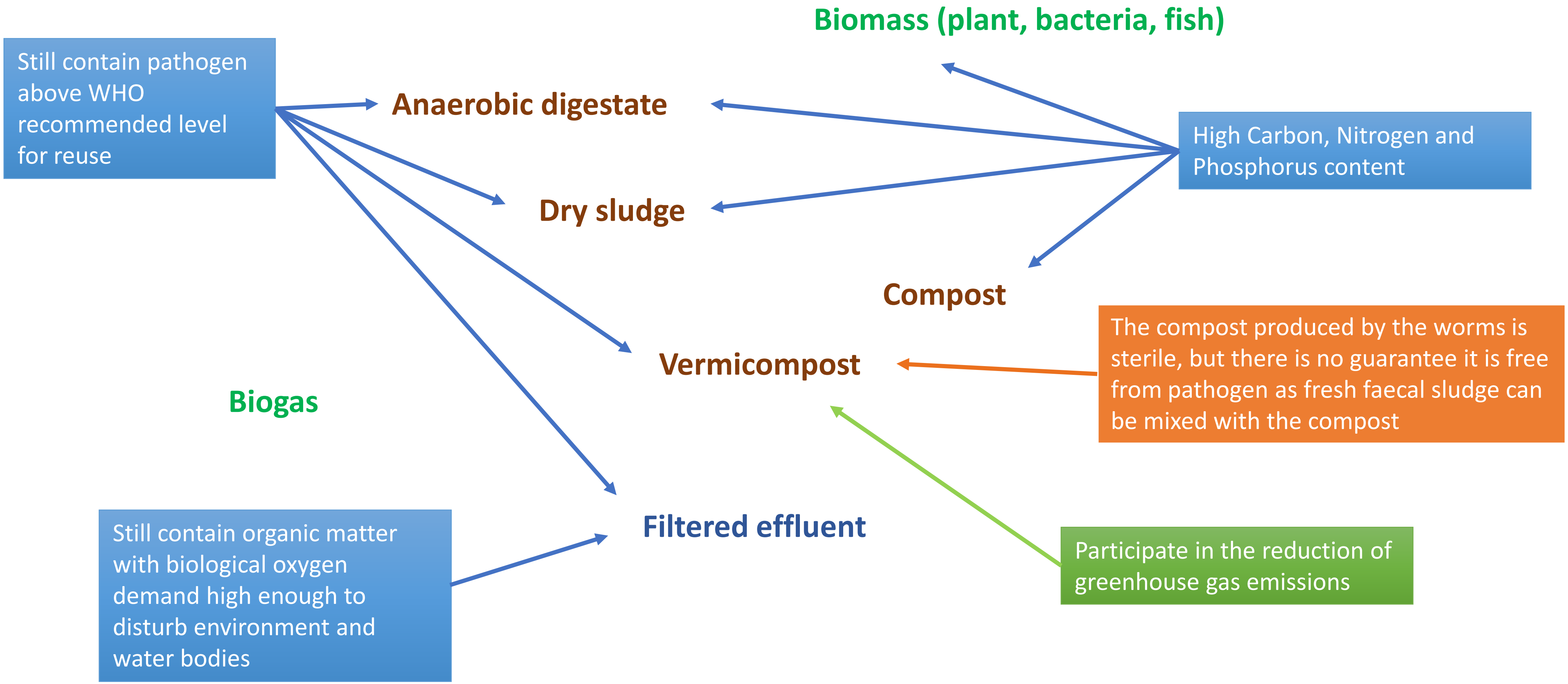
The various treatment technologies generate different products whose quality and pollution risks will condition which disposal method is the safest for people's health and the environment



Biomass (plant, bacteria, fish)

Still contain pathogen above WHO recommended level for reuse

Anaerobic digestate

High Carbon, Nitrogen and Phosphorus content

Dry sludge

Compost

The compost produced by the worms is sterile, but there is no guarantee it is free from pathogen as fresh faecal sludge can be mixed with the compost

Vermicompost

Biogas

Filtered effluent

Participate in the reduction of greenhouse gas emissions

Still contain organic matter with biological oxygen demand high enough to disturb environment and water bodies

For more information on standards for sludge and effluent reuse : WHO – WHO [Guidelines for the safe use of wastewater, excreta and greywater in agriculture and aquaculture]

Reference: A. Nigussie *et al.* – [Vermicomposting as a technology for reducing nitrogen loss and greenhouse gas emission from small-scale composting]

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Burying

	☺	☹
Disposed in a landfill mixed with solid waste	• Time and cost saving: use existing infrastructure and reduce capital cost • Proper equipped landfills are waterproofed to protect groundwater	• Subject to landfill operator approval • Can potentially cause instability in landfill cell slope • Fees to use the landfill need to be included into the OPEX
Disposed in a dedicated landfill (monofil)	• Can be built near the treatment facility (reduce transport cost) • Designed to sludge specification • Construction licence can be included with the treatment plant's • In clay soil simple trenches, easy to dig without heavy machinery are sufficient for burying the sludge	• Construction and operation cost need to integrated into budget • Need space • Preparation period can take time as it includes soil and hydrogeological analysis prior to design • If clay is not available to waterproof the cells, geotextile not available in country may be required (longer procurement time)

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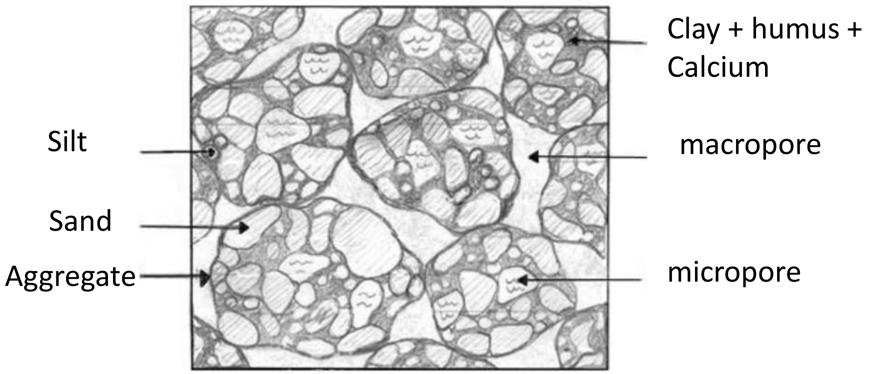
Reuse

The most widely reuse for faecal sludge & wastewater treatment products are soil conditioner and organic fertilizer

Soil conditioner — Mixed with soil to improve its physical, biological and / or chemical structure in preparation for planting.

The addition of organic matter causes bacteria proliferation and stimulate roots development as well as increase the clay humus complex

Composts are the best form of soil conditioner – even better if the composting process combines sludge with plant debris



Organic fertilizer — Spread over plants to provide them with nutrients

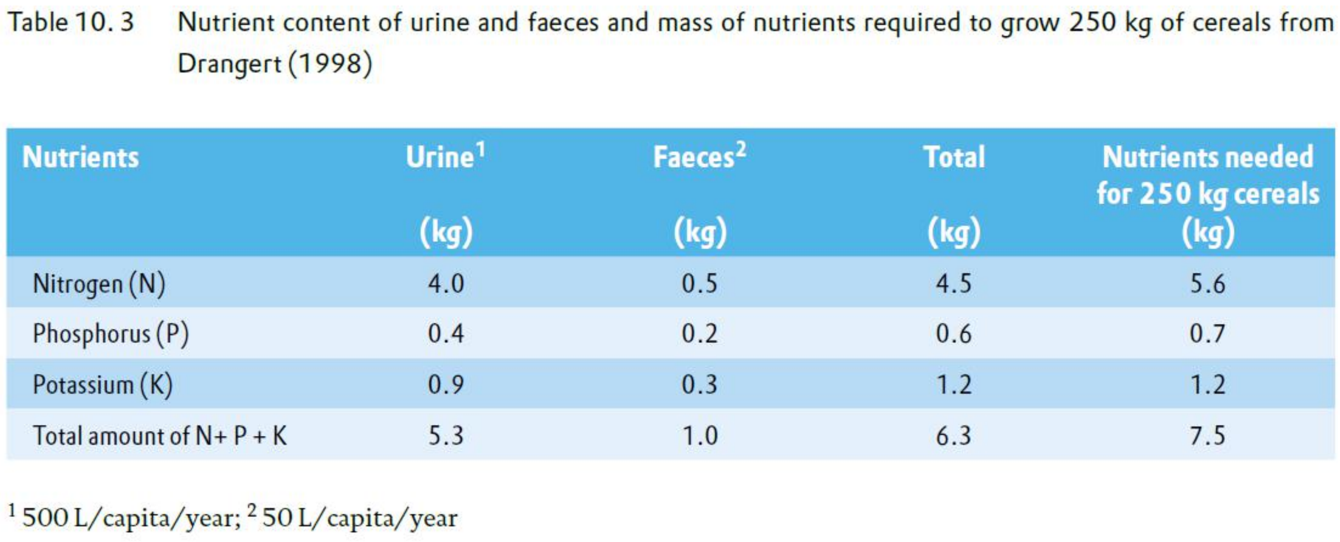


Table 10. 3 Nutrient content of urine and faeces and mass of nutrients required to grow 250 kg of cereals from Drangert (1998)

Nutrients	Urine[1] (kg)	Faeces[2] (kg)	Total (kg)	Nutrients needed for 250 kg cereals (kg)
Nitrogen (N)	4.0	0.5	4.5	5.6
Phosphorus (P)	0.4	0.2	0.6	0.7
Potassium (K)	0.9	0.3	1.2	1.2
Total amount of N+ P + K	5.3	1.0	6.3	7.5

[1] 500 L/capita/year; [2] 50 L/capita/year

Assume that not all pathogens have been inactivated and **avoid contact with any edible part of the plant**

→ Reuse is not appropriate for vegetable gardening such as lettuce!!!

Different plants have different nutrient needs. How useful is the treated sludge as fertilizer will depend on its nutrient ratio for the main element Nitrogen, Phosphorus, Potassium, and other secondary element such as Calcium, Sulphur, etc.,

Reference: [Feacal sludge management – Systems approach for Implementation and Operation]

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Fuel briquettes

Buy-in and community engagement is required at the initial stages of developing the briquette manufacturing and marketing

Potential for income generation

Alternative to firewood collection, reducing both environment impact and risk to women

Sensitisation of communities on latrine proper use to improve faecal sludge quality

Adapted stoved improve fuel efficiency of the briquette

A kg of briquettes burns at the equivalent of 3 kg of charcoal

After a process of carbonization, dry sludge mixed with carbonized biomass, such as saw dust and rice husks, can be moulded in briquettes

Gardening waste can be used as biomass and fuel for carbonization process

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Other reuses

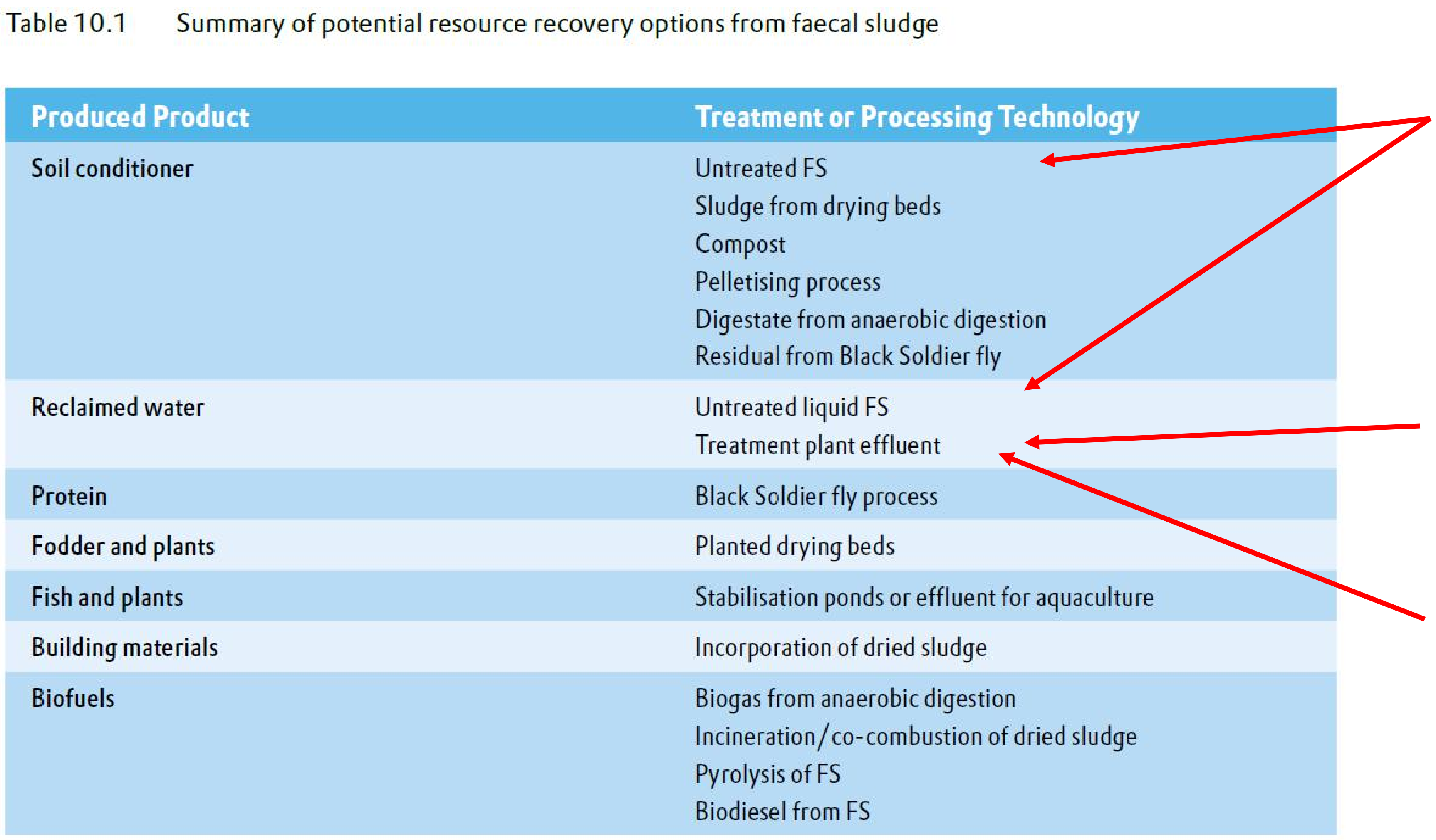


Table 10.1 Summary of potential resource recovery options from faecal sludge

Produced Product	Treatment or Processing Technology
Soil conditioner	Untreated FS Sludge from drying beds Compost Pelletising process Digestate from anaerobic digestion Residual from Black Soldier fly
Reclaimed water	Untreated liquid FS Treatment plant effluent
Protein	Black Soldier fly process
Fodder and plants	Planted drying beds
Fish and plants	Stabilisation ponds or effluent for aquaculture
Building materials	Incorporation of dried sludge
Biofuels	Biogas from anaerobic digestion Incineration/co-combustion of dried sludge Pyrolysis of FS Biodiesel from FS

Using deep trench row in tree plantation and only if the risk to groundwater pollution is very low

Irrigation (ensuring there is no contact with edible part of plants)

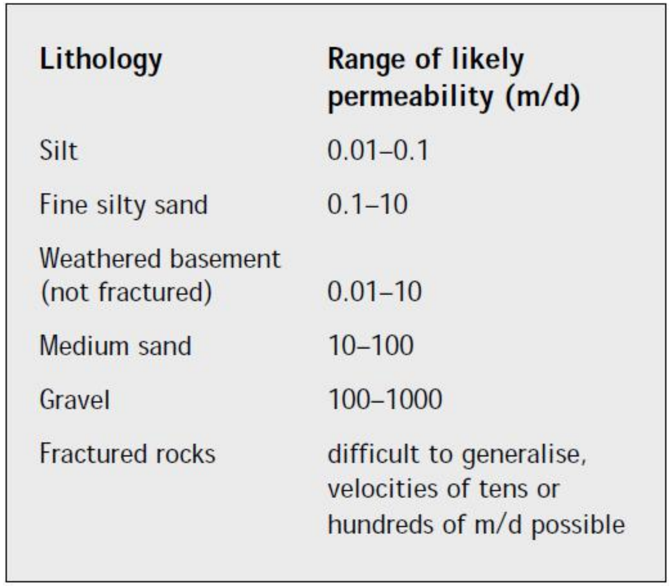
Aquifer recharge (provide the soil has time and capacity to remove the residual pollution)

Reference: Feacal sludge management – Systems approach for Implementation and Operation

Pollution risks

The principal concern for contamination from faecal sludge deposit, treatment product and effluent are pathogen and nitrate, with the later accumulating overtime with delayed pollution risks for water sources.

Soil profiles, permeabilities of soil layers and groundwater levels must be analysed to evaluate the potential for pollution attenuation and groundwater pollution risks.



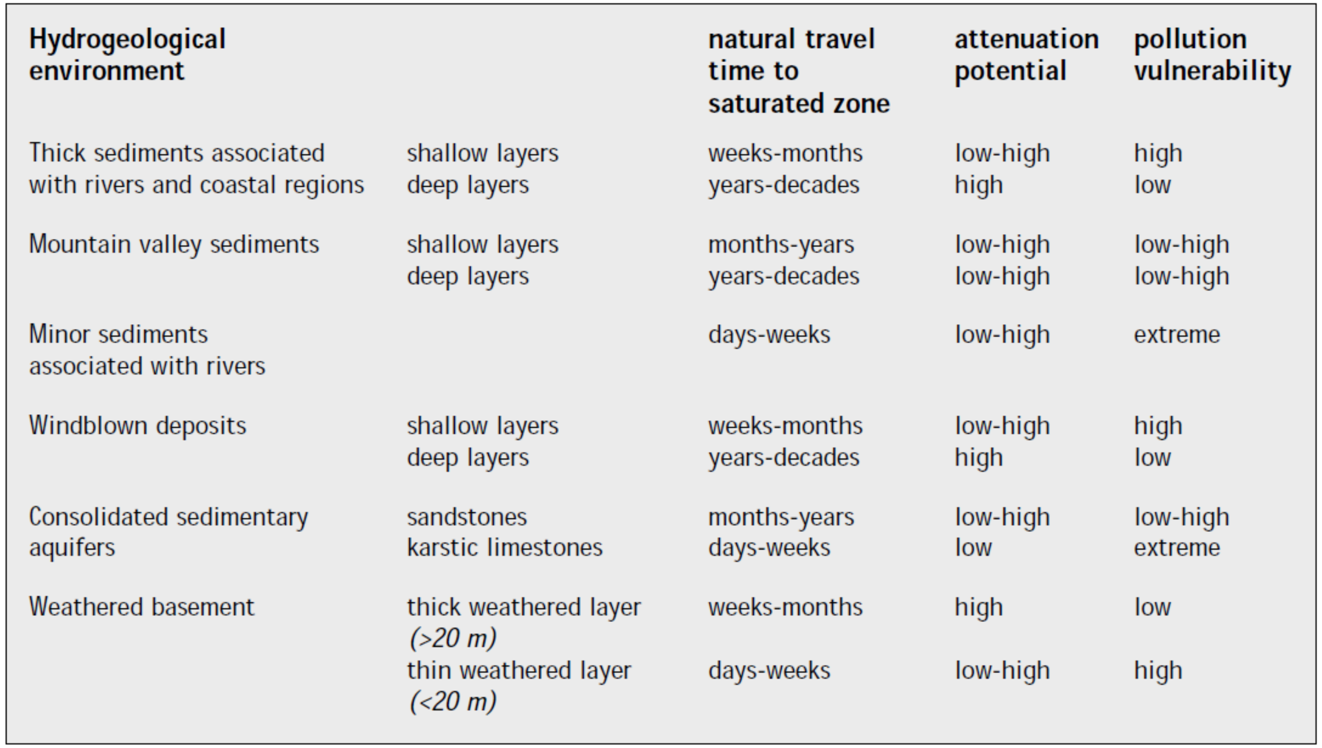
Lithology	Range of likely permeability (m/d)
Silt	0.01–0.1
Fine silty sand	0.1–10
Weathered basement (not fractured)	0.01–10
Medium sand	10–100
Gravel	100–1000
Fractured rocks	difficult to generalise, velocities of tens or hundreds of m/d possible

Significant risk - less than 25 days travel time

Low risk - between 25 and 50 days travel time

Very low risk - greater than 50 days travel time

The smaller the pores and voids the slower leaching fluid travel through soil layers, increasing the potential for pollution attenuation



Hydrogeological environment		natural travel time to saturated zone	attenuation potential	pollution vulnerability
Thick sediments associated with rivers and coastal regions	shallow layers	weeks-months	low-high	high
	deep layers	years-decades	high	low
Mountain valley sediments	shallow layers	months-years	low-high	low-high
	deep layers	years-decades	low-high	low-high
Minor sediments associated with rivers		days-weeks	low-high	extreme
Windblown deposits	shallow layers	weeks-months	low-high	high
	deep layers	years-decades	high	low
Consolidated sedimentary aquifers	sandstones	months-years	low-high	low-high
	karstic limestones	days-weeks	low	extreme
Weathered basement	thick weathered layer *(>20 m)*	weeks-months	high	low
	thin weathered layer *(<20 m)*	days-weeks	low-high	high

Reference: ARGOSS 2001. Guideline for assessing the risk to groundwater from on-site sanitation – British Geological Survey Commissioned Report

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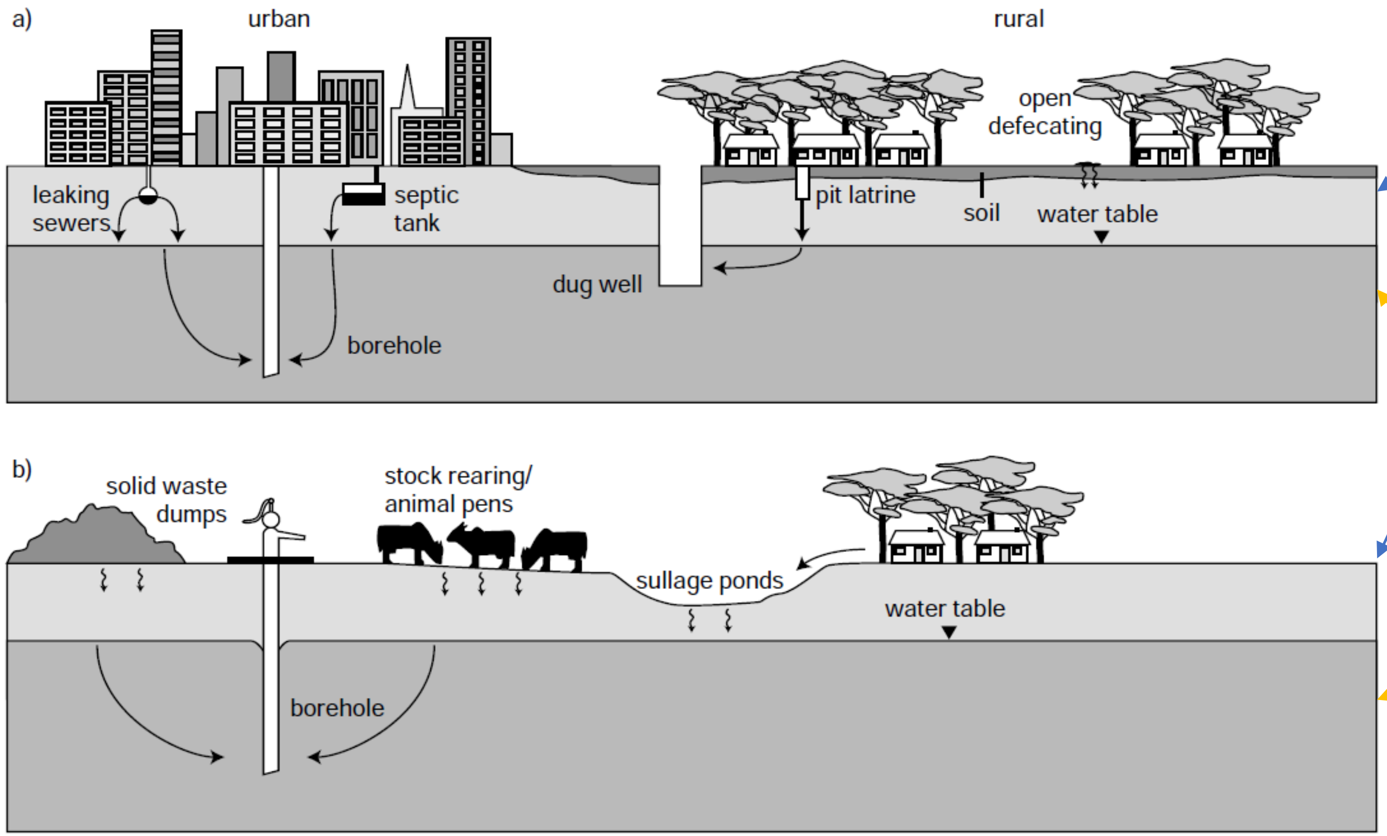
Sources of faecal pollution within urban and rural setting from a) sanitation and b) other sources



Unsaturated zone

- First line of natural defence against groundwater pollution
- Where the most effective pollution attenuation occurs
- Biological activity in the upper soil layers can remove, transform, retard microbiological and to a lesser extent chemical contamination

Saturated zone

- Pollution attenuation more limited,
- Distance to water point from contamination entry zone and the speed of groundwater travel will condition the risk to human beings

Reference: ARGOSS 2001. Guideline for assessing the risk to groundwater from on-site sanitation – British Geological Survey Commissioned Report

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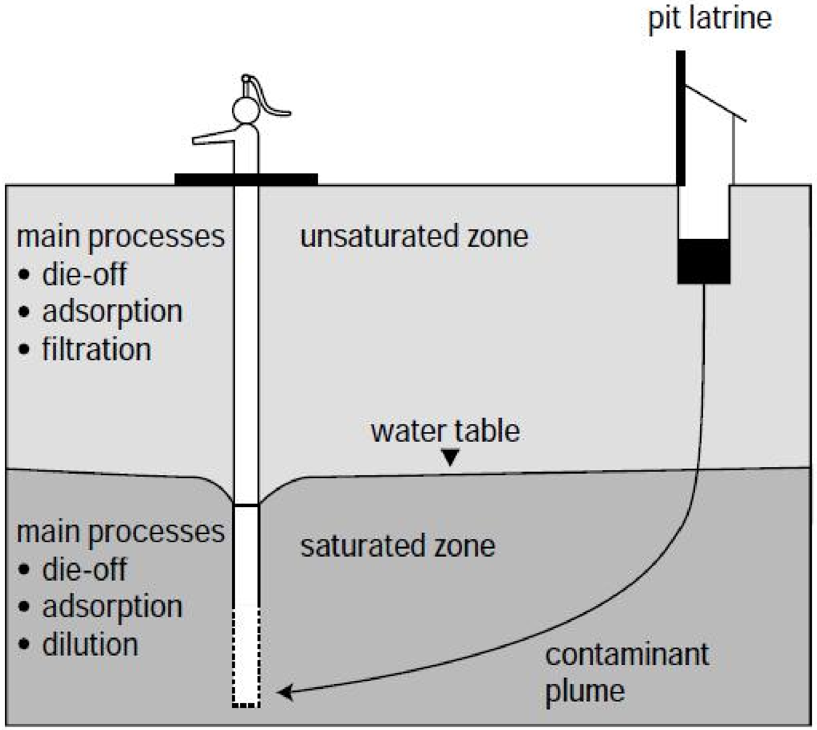
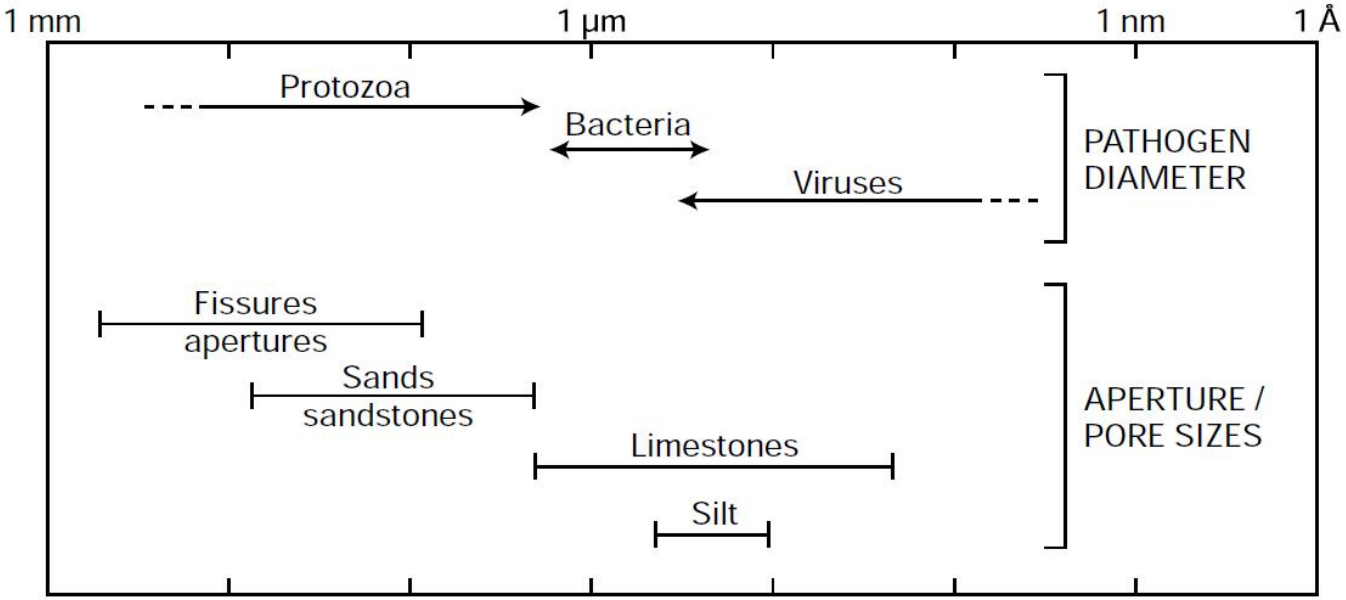
Pollution attenuation processes within the saturated and unsaturated zones



Die-off of pathogen will depend on their survival time in various environment (from a few days for the cholera vibrion up to several months for helminths eggs in *fresh* water)

Mechanical filtration is more effective for larger organisms such as protozoan cysts and helminths but will also help to attenuate bacteria and is dependent on the pore size of the rock

Pathogens' diameter compared with aquifer matrix apertures



Reference: ARGOSS 2001. Guideline for assessing the risk to groundwater from on-site sanitation – British Geological Survey Commissioned Report

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Where there are human beings there is the need to ensure proper excreta disposal service for as long as the settlement lasts

While camps are temporary structures to provide immediate protection and assistance to refugees and internally displaced people, people length of stay vary widely from a few months to several **decades** in protracted crisis.

However, most people affected by a crisis are more likely to be hosted by local population or to move in urban or peri-urban locations often in abandoned buildings and / or flood prone areas

Each situation faces its own challenges to ensure any excreta disposal system continue to deliver quality service to all affected and hosting population.

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Emergency phases

What are the activities to implement and the parameters you need to check and verify in order to ensure an excreta disposal service is in place and operational in all phases of an emergency, whatever the settings?

Preparedness

What are the hazards that can / will affect excreta disposal services?	e.g., flood can destroy latrines, treatment systems, damage transport trucks, overflow and fill latrines, damage water network and stop latrine flushing system, etc.
What are the hazards that can / will displace people to areas where there is no functional excreta disposal service?	e.g., severe drought reduces access to water impacting the flushing of latrines and sewerage as well as handwashing, it can also dry out clays and undermine foundation of infrastructure
What are the population groups whose access to excreta disposal services will be the most affected?	Contingency planning exercises usually provide information on hazards, geographical areas and potential affected population size. But it often does not inform on how various population groups are affected differently by disaster.
What are the existing excreta disposal systems and their functional status? Has the markets for material and services been assessed?	Local disaster response plan may inform on location for evacuation centres (often schools) but not the status of its excreta disposal system neither if there is enough infrastructure to serve the number of affected population it can shelter.
What emergency latrine model is appropriate and what material should be pre-stocked or can standby agreement with suppliers / enterprises be made as preparedness planning?	It important to examine both what function and what doesn't and why. e.g., technical issues may reflect local entrepreneurs' skills and limitations Operation and maintenance issues may highlight service affordability limitation Misuse and limit use should alert on design problem as well as security concern to access services and in general a lack of users' consultation and preference inclusion for designing systems and infrastructures

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1^{st} phase / onset emergency

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Speed is important but not at the sake of quality and consultation with people

Build a good enough excreta disposal system for the first few weeks while you defined and build the final system based on a proper technical assessment and consultation, design with local actors

Where and who are the “invisible” people? What difficulties do they have to access excreta disposal services?

What are the enablers and blockers for sanitation uptake?

Urban

Container based latrine / PeePoo bag

Assess and strengthen existing Faecal Sludge collection and transport system

Rural

Tools and material supporting communities to manage open defecation

Camp

Deep trench latrine (ratio 1:50)

Set monitoring system

Train and support cleaning and repair teams

Train and implement SaniTweak for adaptation of latrine models

Sanitation stakeholders, construction and services delivery mapping

Gender sensitive excreta disposal services’ risk mapping and analysis

Set up / reactivate and train sanitation committee(s)

Where malnutrition has high prevalence, target families with malnourished children with sanitation package (latrine subsidy & hygiene promotion)

Anthropological / socio-economical study

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2nd phase / stabilisation period

Building a sound and affordable operation and maintenance system is essential especially if the excreta disposal system will be needed for more than a year

Support upgrade up the sanitation ladder building from existing systems and practices

Operators and monitors' training need to be planned and implemented

Ensure local authorities, utilities and technical department are involved in all steps of design and construction of excreta disposal services

Identify and support sanitation "champions" who will model and promote appropriate infrastructures and practices

Urban

With local authorities, design and build faecal sludge treatment system when not existing

Voucher (material, technical human resource or artisan for full service) to vulnerable households for upgrade or construction of latrine

Analyse capacity building needs of excreta disposal service actors

Upgrade manual desludging service (manual pump, protection equipment, training)

Voucher for desludging service (vulnerable households, public institution)

Rural

Distribution tool kits and material (slab) for household latrine construction

Support local artisans to produce slab (tools and equipment, voucher for most vulnerable households)

Support community health workers and local authorities (or sanitation committee) develop and implement a sanitation and handwashing promotion plan

Construction of public institution latrines (school and health centres)

Camp

Build family shared latrine, lined and desludgeable (ratio 1:20)

Set up or hire local desludging service when existing (with a voucher system)

Support families with consumable and tools for cleaning and small maintenance

Maintain and equip repair team

With local authorities, design and build faecal sludge treatment system when not existing and if the type of latrine built requires it (N/A in case of tiger worm toilet or UDDT)

"Cash for latrine" conditional grant

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Recovery / exit phase

Accompany people going back to their place with household level infrastructure, through participatory approaches and subsidies for the most vulnerable

Support local authorities, utilities and / or technical department take over the supervision or O&M of public infrastructures and services

Support local enterprises for appropriate materials and services market

Urban

Support local entrepreneur for the construction of public toilet (combined with biogas as transitional storage / decentralised faecal sludge treatment station)

With local authorities and local entrepreneur explore waste to value project (compost, biogas, irrigation) associated with treatment plant

Market evaluation for latrine construction material, faecal sludge treatment product

Market evaluation faecal sludge treatment product prospect

Rural

Participative and community approach to manage ODF status

With communities explore and design low-cost ecological sanitation options (Arborloo, Fossa Alterna, adapted UDDT)

Identification of micro-finance institutions and support for project definition to access loan

Camp

Review excreta disposal service operational cost, identify options for minimising OPEX, collaborate with local utilities… and evaluate feasibility of transferring operation and maintenance management

Communication and discussion with communities on the transfer plan (purpose, responsibilities, consequence, cost, etc.). Adapt plan with feedbacks.

Implement required structural change to reduce OPEX, build capacity of local utility for transfer of management responsibilities

Transfer of service delivery responsibility is easier if the design and planning of the system was done with local authorities and within an overall sanitation plan

Be careful of labour law and refugees' status as not all staff can be transferred into utilities' workforce

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Prevention & mitigation

Identify lessons learned from how disasters have impacted excreta disposal systems

Advocacy to improve designing, financing for resilient excreta disposal systems

If there isn’t a local sanitation strategic plan involving all stakeholders, how can the development process be initiated / supported?

Who are the sanitation champions?

Urban

Rural

Camp

Construction of privately managed public toilet in market, bus station located in cholera hotspots (associated with biogas / Faecal sludge deconcentrated treatment station)

Community capacity building to identify sanitation service needs and authorities influencing / advocacy

Support sanitation strategic and planning workshop at local and regional levels

Partnership with CSO for quality and access equity to sanitation service monitoring

Strengthen sanitation services in evacuation centres

Assess existing camp sanitation system capacity

Review past camp setting and management lessons learned

Whenever there is a contingency planning exercise planned, it’s important to read the various scenario with an excreta disposal service lenses:

- **What level of service will be needed, potentially for how long and where?**
- **What did we do right before, what could we improve in the future?**
- **How might we integrate lessons learned from previous emergencies in future responses?**
- **How might we better involve communities and local authorities at all stages of setting up an excreta disposal service in an emergency?**
- **How can the markets for sanitation material and services be supported during an emergency response?**

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Budgeting

Funding availability is often higher at a beginning of an emergency and therefore it’s important to plan carefully the various aspect of the excreta disposal system that need / can be funded in the first 6 months and later.

or

Community engagement	Preparedness	0-6 month	6-12 months	> 1 year
Monthly incentives for volunteers (1 woman, 1 man per 1,000 targeted people)		✓	✓	✓
Community group grant (1 group per 5,000 targeted people)		✓	✓	✓
Safe meeting area / Community centre		✓	✓	✓
Communication / phone credit		✓	✓	✓
Community mobilisation kits	✓	✓	✓	✓
Capacity building / training		✓	✓	✓
Equipment and material for community events		✓	✓	✓
Translation service	✓	✓	✓	✓
Formative research (anthropological, socio-economical studies)	✓	✓	✓	✓
Assessment				
Kit (Tablet, software, stationaries)	✓	✓		
People cost (Incentive, perdiem, accommodation, etc.)	✓	✓		

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	Preparedness	0-6 month	6-12 months	> 1 year
Latrines				
Emergency latrines	✓	✓		
Rehabilitation / construction Institutional latrines (school / health centre)		✓	✓	✓
Tool kit for communities		✓	✓	✓
Voucher / subsidies for slab and other latrine material		✓	✓	✓
Support to local entrepreneur producing slab / latrine walls	✓	✓	✓	✓
Sanitation market evaluation	✓	✓	✓	✓
Latrine cleaning kit	✓	✓		
CLTS triggering and monitoring cost		✓	✓	✓
Fully subsidised, adapted household latrine (e.g. UDDT)			✓	✓
Desludging				
Desludging kit	✓	✓		
Desludging service cost (people, consumable or rental desludging truck)		✓	✓	✓
Transitional storage and transport (material and service operation cost)		✓	✓	✓

If renting the service of a desludging truck, both lines are included in the same service

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Treatment / disposal

	Preparedness	0-6 month	6-12 months	> 1 year
Rehabilitation wastewater / Faecal Sludge (FS) treatment plant		✓	✓	✓
Construction wastewater / FS treatment plant		✓	✓	✓
Market survey for recycling / use of treatment products	✓	✓	✓	✓
Piloting innovative treatment technique			✓	✓
Piloting project creating synergy between FS treatment & farming			✓	✓
Support micro-business with biodigester / composting treatment products			✓	✓

Operation and maintenance

	Preparedness	0-6 month	6-12 months	> 1 year
Rehabilitation / replacement of latrines			✓	✓
Repair team / material cost		✓	✓	✓
Cleaning team people cost (salaries, incentives, etc.)		✓	✓	✓
Treatment site cost (salaries / incentives, consumable and tools, etc.)		✓	✓	✓

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	Preparedness	0-6 month	6-12 months	> 1 year
Monitoring				
Complain and feedback mechanism		✓	✓	✓
Tools & equipment (Camera, GPS, protective gear, sticks, etc.)		✓	✓	✓
Kit (Tablet, software, stationaries)		✓	✓	✓
People cost (Incentive, perdiem, accommodation, etc.)		✓	✓	✓
Other budgeting post				
Support to local authorities' sanitation strategic plan development			✓	✓
Trainings, conference, other meeting cost		✓	✓	✓
Perdiem, accommodation and transport cost for government / university sanitation specialist collaboration	✓	✓	✓	✓
Logistic cost (transport and storage of material + vehicle for staff movement)	✓	✓	✓	✓
Staff salaries (1 assistant officer per 5,000 targeted people if direct implementation, or 10,000 people if construction is done through enterprise + 1 officer for 2-4 assistant + PHE manager)		✓	✓	✓
Decommissioning sanitation infrastructures (cleaning, disinfecting, dismantling, closing safely)			✓	✓

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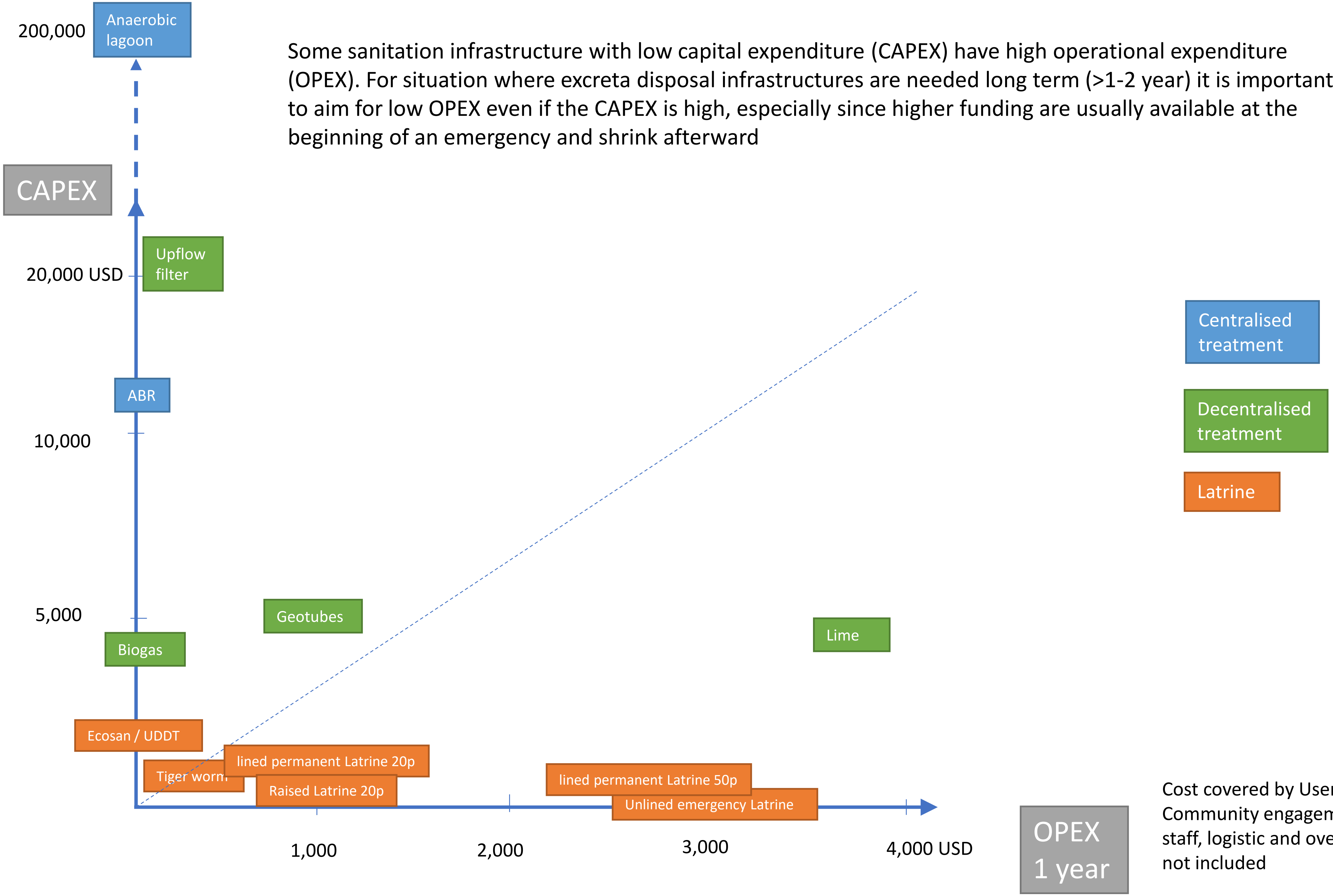
Some sanitation infrastructure with low capital expenditure (CAPEX) have high operational expenditure (OPEX). For situation where excreta disposal infrastructures are needed long term (>1-2 year) it is important to aim for low OPEX even if the CAPEX is high, especially since higher funding are usually available at the beginning of an emergency and shrink afterward



Cost covered by Users, Community engagement, staff, logistic and overhead not included

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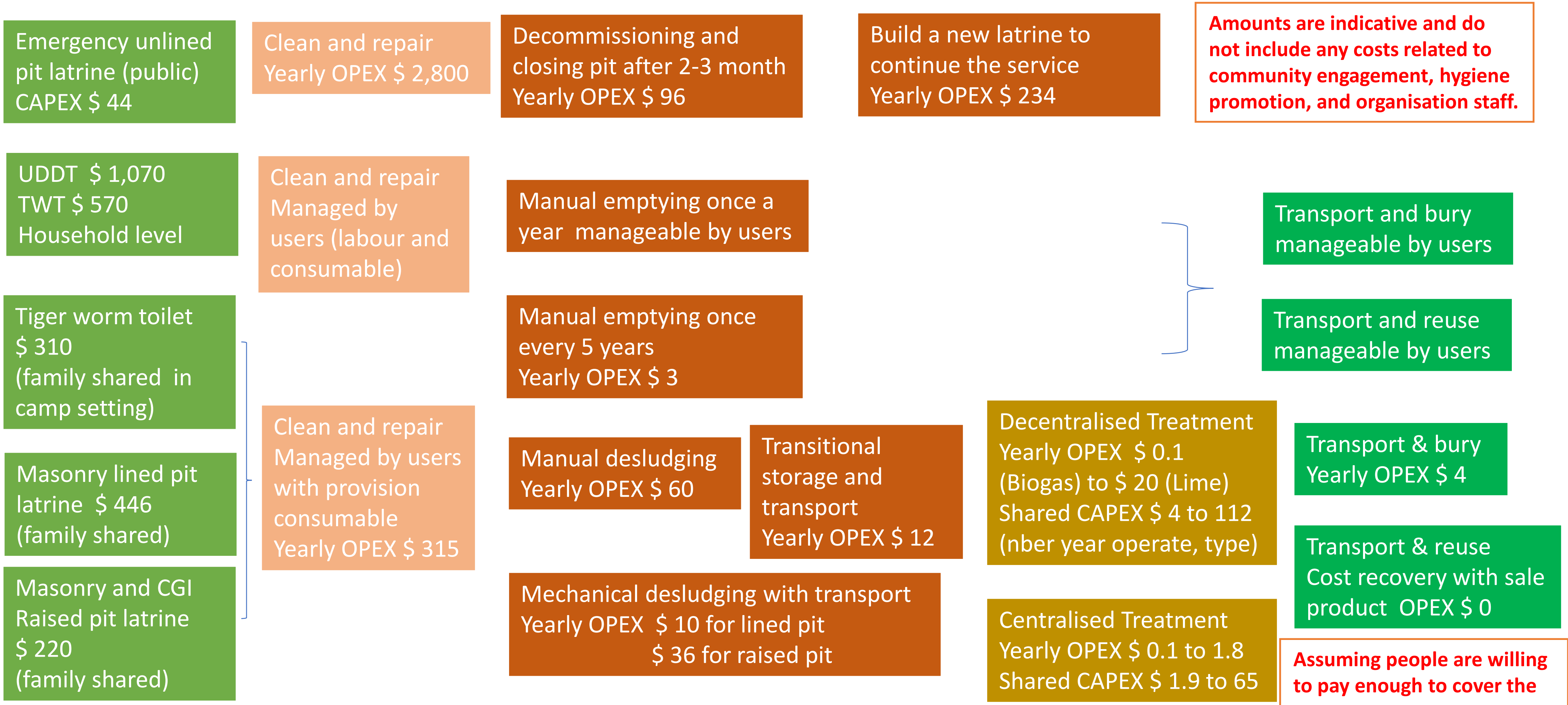
Cost comparison

Full excreta disposal cycle considered for the cost comparison of systems

Amounts are indicative and do not include any costs related to community engagement, hygiene promotion, and organisation staff.



Emergency unlined pit latrine (public)
CAPEX $ 44

Clean and repair
Yearly OPEX $ 2,800

Decommissioning and closing pit after 2-3 month
Yearly OPEX $ 96

Build a new latrine to continue the service
Yearly OPEX $ 234

UDDT $ 1,070
TWT $ 570
Household level

Clean and repair
Managed by users (labour and consumable)

Manual emptying once a year manageable by users

Transport and bury manageable by users

Transport and reuse manageable by users

Tiger worm toilet
$ 310
(family shared in camp setting)

Masonry lined pit latrine $ 446
(family shared)

Masonry and CGI Raised pit latrine
$ 220
(family shared)

Clean and repair
Managed by users with provision consumable
Yearly OPEX $ 315

Manual emptying once every 5 years
Yearly OPEX $ 3

Manual desludging
Yearly OPEX $ 60

Transitional storage and transport
Yearly OPEX $ 12

Mechanical desludging with transport
Yearly OPEX $ 10 for lined pit
$ 36 for raised pit

Decentralised Treatment
Yearly OPEX $ 0.1 (Biogas) to $ 20 (Lime)
Shared CAPEX $ 4 to 112
(nber year operate, type)

Centralised Treatment
Yearly OPEX $ 0.1 to 1.8
Shared CAPEX $ 1.9 to 65

Transport & bury
Yearly OPEX $ 4

Transport & reuse
Cost recovery with sale product OPEX $ 0

Assuming people are willing to pay enough to cover the transport cost

Calculation parameters: cost equivalent to **20 people**, faecal sludge accumulation rate 100 litres per person and per year, 1 cubicle shared by 50 people for public latrine, 20 people for family shared latrine and 5 people for household level. Mechanical desludging is optimised (1 trip empties several latrines until full).

Procurement cost are **based on Asia prices** and will varies for other regions. E.g., for **Ethiopia**, CAPEX is increased by **80 to 100%** with similar labour cost, while in **South Sudan** construction cost are **multiply by 4.5** and labour cost are **divided by 5**.

Cost for 20 people over 10-year period according to phasing scenario

Scenario #	Description	Total cost	Comment
1 - camp setting	Emergency unlined pit latrine and replacement **10% of the cost in the first year**	$ 31,344	Supposed sufficient space to build new latrines. Most likely a lack of buy-in and collaboration from users
2 - camp setting	Emergency unlined pit latrine for 6 months then permanent lined pit latrine family shared, sludge transported and disposed in a landfill **About 50% of the cost in the first year**	$ 4,568	For planning purpose consider 2m3 of sludge per year for 20 people instead of 0.8 m3 after treatment. If the water table is high and the pit must be raised, then the volume to evacuate per year is above 7m3. Supposed the existing landfill (if any) is accepting the sludge*
3 – camp setting	Emergency unlined pit latrine for 6 months then permanent lined pit latrine family shared, sludge transported and disposed in a landfill for 6 month while a treatment system is built Starting year 2 all sludge is treated before transported in landfill	$ 4,992	0.8 m3 per 20 people per year more susceptible to be accepted by landfill (dryer and less instability risks). *
4 – camp setting	Emergency unlined pit latrine for 6 month then Tiger worm toilet family shared	$ 4,852	
5- host community	Support for the construction of UDDT or Tiger Worm Toilet at household level **100% of the cost in the first year**	$ 570 (TWT) or $ 1070 (UDDT)	If in a camp setting, then a 6 months phase with emergency latrine may be needed (with an additional cost of about $ 1,600)

*A landfill fee per m3 may apply and is not included in the total cost (landfill operation cost average is $ 35 per tonne)

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Estimated cost for 1 household (5 people) for building and maintaining a toilet

Cleaning cost not included

Options / Types of latrine	Suitability of option	Costs (Asian reference)				Comments on calculation OPEX	Treatment associated costs (10 years)
		CAPEX	OPEX	Total 10 year	Total 20 year		
Simple Pit Latrine – Pour flush – unlined – movable superstructure (wood and bamboo mat)	Area with stable soil and enough space to dig new pit. Best when good infiltration rate	$ 150	$ 55 + $ 46	$ 306	$ 462	Dig a new pit (~1-1.5m3) and move superstructure every 5 years. Change bamboo mats every 10 years	N/A
Simple Pit Latrine – Pour flush – lined - superstructure (wood and bamboo mat)	Suitable when desludging service is available and affordable	$ 185	$ 30 + $ 46	$ 291	$ 397	Desludged every 5 years. Change bamboo mats every 10 years	$ 0.5 (ABR), $ 1.1 (Biogas), $ 13 (upflow filter)
Raised Latrine – Brick / CHB masonry	Area with high water table. Need more frequent desludging (at least 5-6 time more). Shower should be separated. Suitable when desludging service is available and affordable	$ 225	$ 30	$ 525	$ 825	Desludged once a year	$ 1.2 (ABR), $ 2.7 (Biogas), $ 32 (upflow filter)
UDDT – double chamber CHB masonry, superstructure CGI sheet	Area difficult to dig, high water table or with high risk of groundwater contamination. Suitable for long term	$ 268	$ 15 + $ 110	$ 418	$ 678	Empty one chamber once a year. Change CGI sheet after 20 years	N/A
Tiger Worm Toilet – stone and brick masonry, CGI sheet	Above or below ground, detergent should not be used, and shower should be separated	$ 285	$ 10 + $ 110	$ 385	$ 595	Empty vermicompost every 5 years. Change CGI sheet after 20 years	N/A
Septic Tank	Require space for effluent percolation or connection to sewer	$ 850	$ 50	$ 1,000	$ 1,150	Desludged every 3 years (depending on the designed sludge accumulation volume)	$ 0.4 (ABR), $ 0.8 (Biogas), $ 9.5 (upflow filter)

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WASH committee

Built from existing structures whenever possible

Incentives or no incentives?

Be consistent to what is casual work, volunteer works without incentive and works with incentives (within the organisation and other organisations). ***What the labour law says?***

Committee members' need also to earn their living and deal with domestic duties

Explore feasibility of community-based solution to compensate committee members' time

Transparency

The more community members understand the project in terms of finances, committee functioning and selection of committee members, the more chance of success

Inclusion

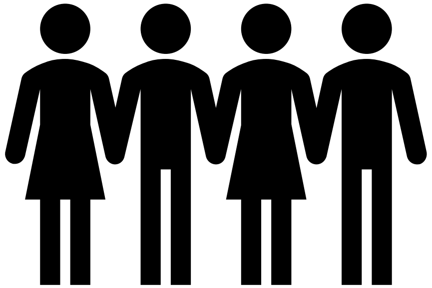
Active involvement of women and other vulnerable groups, and fair representation of different ethnic groups

Participation

Meaningful community input at the program design stage clarify which activities are the responsibility of communities' members

Ownership

It's a ***community*** committee. Terms of reference, members selection, committee structure, constitution, etc., should be devised and agreed with the wider community



Capacity building

Training needs should be developed in collaboration with the community to ensure materials are appropriate and to encourage participation

Accountability

2-way communication and timely response to community concerns and delivery of commitments within an agreed timescale and accountable to local authorities or village leader

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WASH utility / private contractor with a service agreement

The legal definition can vary between countries according to the type of organisation legally accepted for operating, controlling, managing and / or owning a WASH public service and its infrastructures.

There is sometime a minimum population target for an organisation to be defined as “utility”. Below this target, community structures such as Users’ association or WASH committee are in charged of the WASH service

How much it cost to operate and maintain for the WASH utility?

What is the cost recovery scheme?

How much do communities trust their WASH utility?

What is the population willingness to pay for the service?

What is the WASH utility capacity to operate and maintain the service?

In which conditions is it preferable to works through WASH utility to set up and manage an excreta disposal system in an emergency setting?*

* There is no clear-cut answer to this question and more testing and research are required to understand success and failure conditions

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Fragmented sector and multiplicity of actors

Lack of comprehensive sanitation plan connecting sewer, onsite sanitation, faecal sludge transport and treatment systems

Tentation to focus on paying customer and concentrate OPEX on zones with highest cost recovery potential

Education focus on construction and less on operation and maintenance skills

Governance and lack of transparency are recurrent issues with utilities

Preventative maintenance and capital maintenance rarely integrated in budget and operation plans

Need for a transition plan to accompany users from a fully subsidised to paid service

In refugee camp settings, the legal status of refugee may impact the transfer of staff to a water/sanitation utility

Handover to an existing utility requires buy-in both from the utility team (acceptable incurred cost, technicity and technical expertise, infrastructure in good enough condition) and from the users / community (trust that the level of service will be maintained, understanding new roles and responsibility, willingness and ability to pay for the service cost)

Legal structure and registered

More attractive for staff long term job opportunity

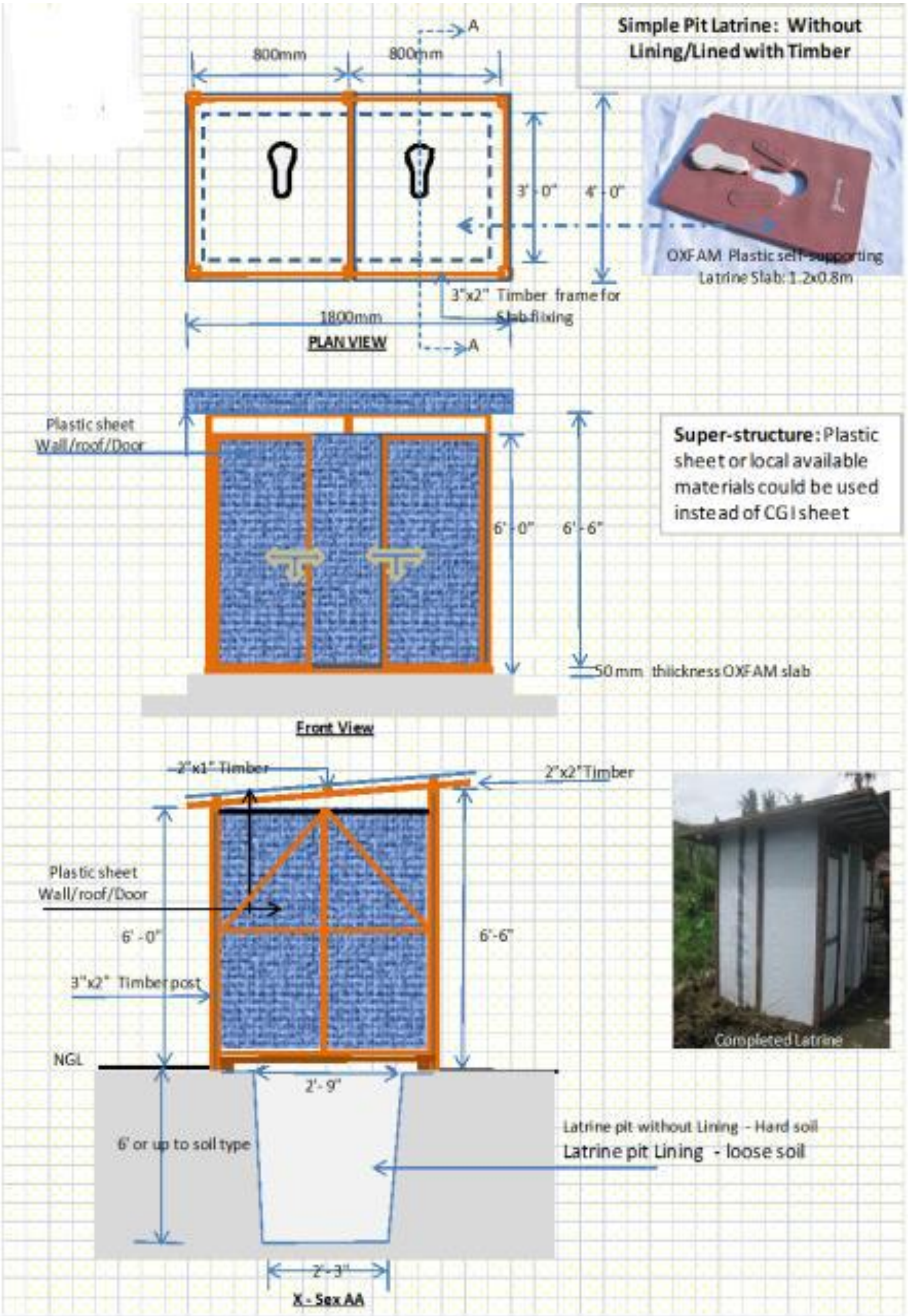
Better connection to local authorities and local market

Staff experience with operation and maintenance issues

Exit plans involving WASH utilities need to be done from the design stage with the participation of local authorities and the utility

Double door pit latrine

This design is from the Philippines 2007/2014 in Evacuation Centers with limited space



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Drawing
BoQ

BoQ for *Diagram/drawing -I-* Double Door Communal/Shared Simple Pit Latrines (unlined and non-ventilated)

IN	Item descriptions	Unit	Qnty	Cost/Unit	Total cost
1	Pit Digging	m3	2.4		
2	Coco Lumber 1"x2"x8'	pcs	22		
3	Coco Lumber 2"x2"x10'	pcs	16		
4	Coco Lumber 2"x3"x8'	pcs	6		
5	CWN 2"	kg	2		
6	CWN 3"	kg	2		
7	CWN 4"	kg	2		
8	Barrel Bolt (Ordinary)	pcs	2		
9	Hinges 3"x3"	pair	4		
10	Door Handle 5"	pcs	2		
11	PVC Pipe 2" dia.(Sanitary Pipe)	pcs	1		
12	Latrine Slab w/ P-Trap	set	2		
13	Tarpaulin 4x6	shits	2		
14	Labour cost for construction				
15	Skilled	Man-days	2		
16	Un- skilled	Man-days	4		
	Total Cost Per Country (Local Currency):				

Additional cost for lining the pit

IN	Item descriptions	Unit	Qnty	Cost/Unit	Total cost
1	2"x2"x6' Wood baton	pcs	9		
2	Zinc/iron Sheet G26X 1.8cm, 3mL	pcs	2		
3	CWN 2", 1 1/2"	kg	0.5		
4	un- skilled labour	Person/day	2		
	Total cost per Country (Local Currency):				

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Tiger worm toilet

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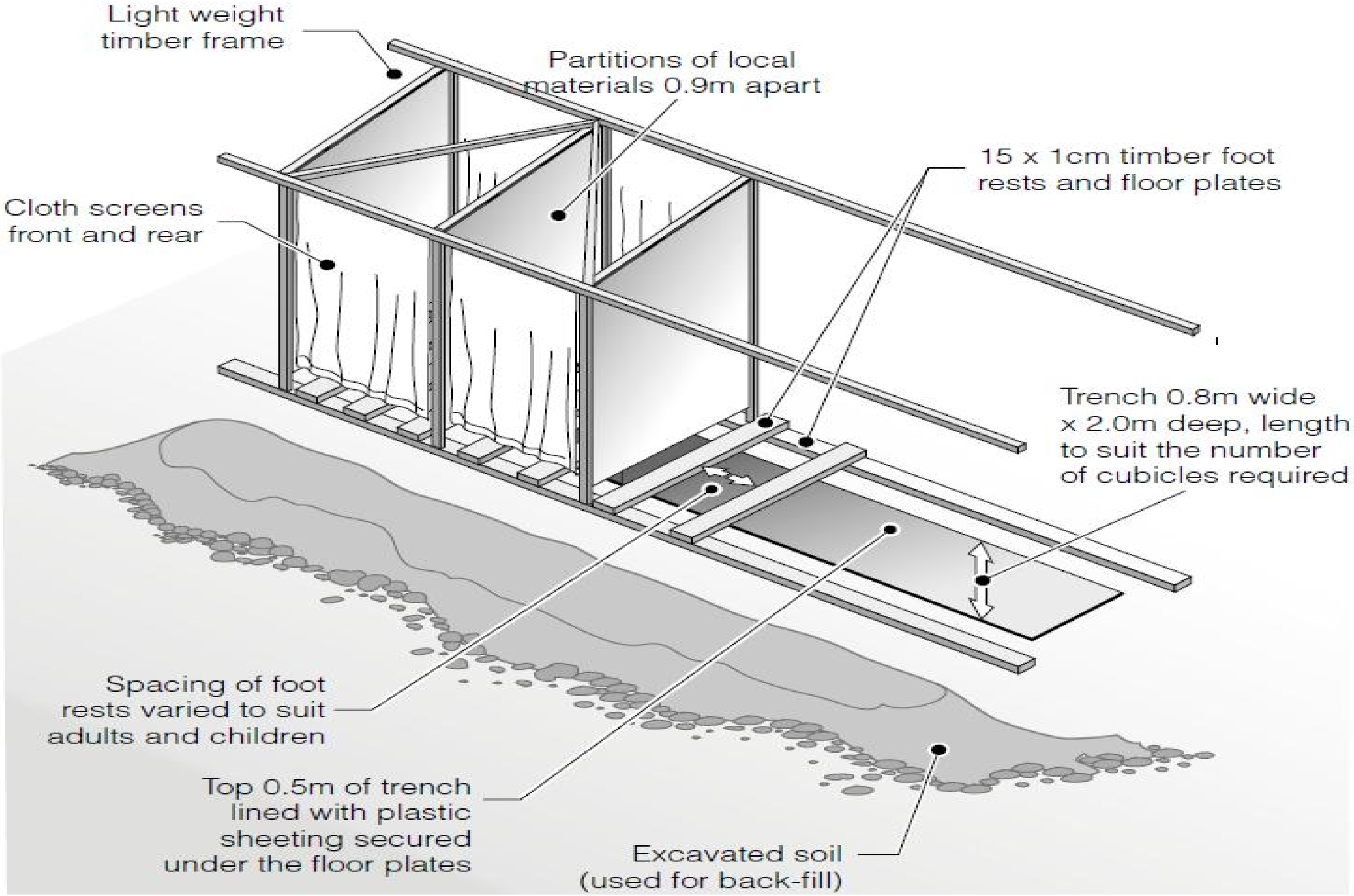
Deep Trench latrine

Drawing
BoQ

A Deep Trench Latrine is a widely used as communal latrine option for emergencies. It can be quickly implemented (within 1–2 days) and consists of several cubicles aligned up above a single trench. A trench lining can prevent the latrine from collapsing and provide support to the superstructure



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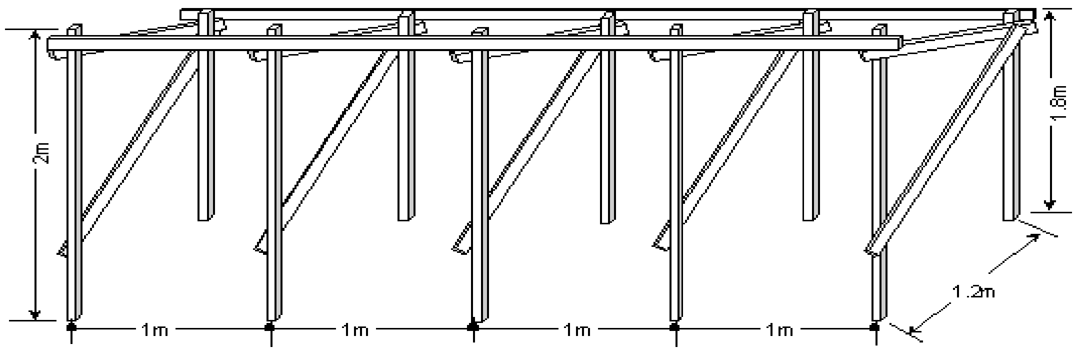

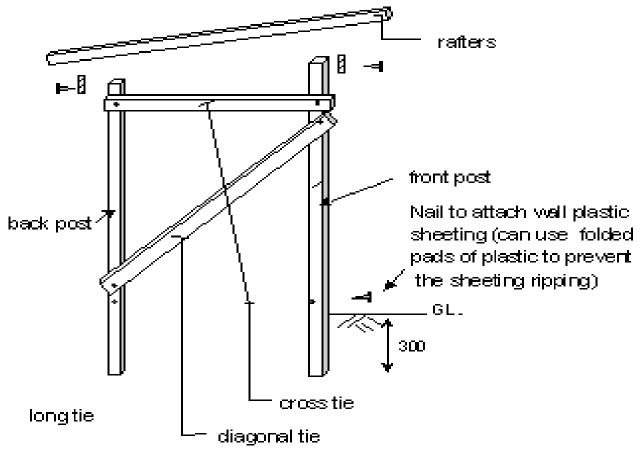

Nail to attach wall plastic sheeting (can use folded pads of plastic to prevent the sheeting ripping)

Frame

1. Front post:	50x50x2000 mm	5 pcs
2. Back post:	50x50x1800 mm	5 pcs
3. Cross tie:	25x50x1200 mm	5 pcs
4. Diagona tie:	25x50x1800 mm	5 pcs
5. Longtie bottom:	25x75x3700 mm	2 pcs
6. Longtie top:	25x75x4400 mm	2 pcs
7. Wall(plastic sheet): (3700+1300)x2x1650=16.5m2		
8. 2" wirenail:	10x5	50 N
9. 1" bootpin for wall fixing:		250 gm

Roof

1. Rafter:	38x50x2000 mm	5 pcs
2. Purlin:	25x50x4400 mm	3 pcs
3. Roofcover:	2000x4400 mm	8.8 sq.m.
4. 2" tin screw :		30 N

Internal lining can be done using sand bag or locally avail be material for Emergency purpose

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IN	Item descriptions	Unit	Qnty	Cost/Unit	Total cost
	Sub Structure				
1	Excavation/Pit Digging 3m deep	m3	14		
2	Sand Bags for Internal wall lining	Pcs	156		
	Super Structure (+Floor Work)				
3	Timber Post 3"x2"x8'	pcs	22		
4	Timber 2"x1"x10'	pcs	24		
5	Timber 2"x2"x8' hand washing stand	pcs	2		
6	Timber Plank 10”x1”x6’	pcs	1		
7	Nails 2"	kg	1		
8	Nails 3"	kg	1		
9	Hand washing plastic barrel/bucket with faucet – 20/30 ltrs	pcs	1		
10	Tarpaulin 4x6m (Plastic sheeting)	M2	33		
11	Oxfam Plastic Slab (1.2x0.8)	Pcs	4		
12	Door Hinges	Pcs	8		
13	Door Locks(Internal)	pcs	4		
14	Sand Bags to protect the wall/pit from flush/flood water from	Pcs	45		
	Labour cost for construction				
15	Skilled	man-days	4		
16	Un- skilled	man-days	8		
	Decommissioning of Trench latrine				
17	Hydrated/chlorinated lime	kg	10		
18	Unskilled labour	Man days	4		
	Total Cost				

BOQ for Diagram/Drawing ID 2 Deep Trench Latrine;(3 M deep below NGL)

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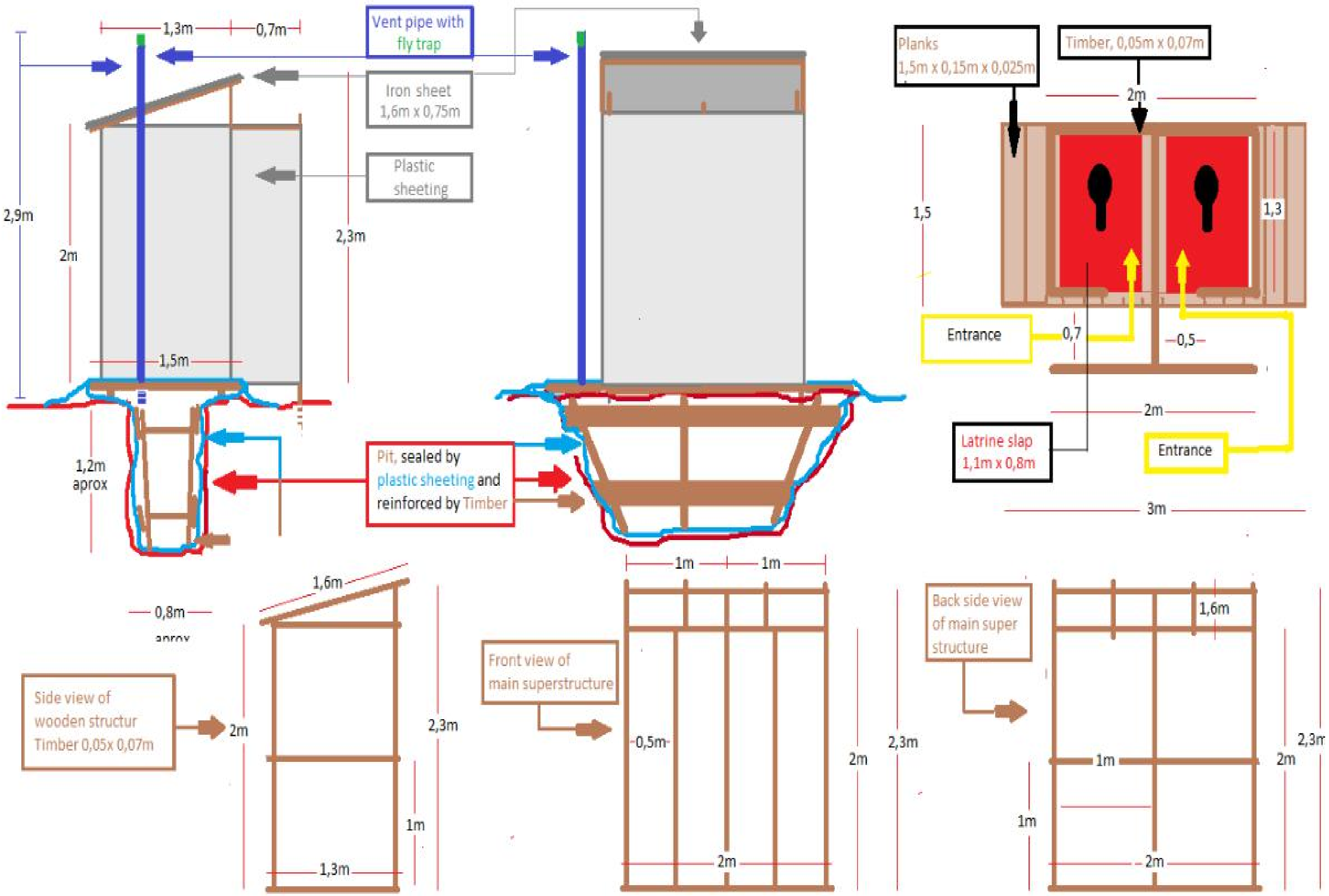
Emergency desludgeable lined pit latrine


Vent pipe with fly trap

Iron sheet 1,6m x 0,75m

Plastic sheeting

Pit, sealed by plastic sheeting and reinforced by Timber

Planks 1,5m x 0,15m x 0,025m

Timber, 0,05m x 0,07m

Latrine slap 1,1m x 0,8m

Entrance

Entrance

Side view of wooden structur Timber 0,05x 0,07m

Front view of main superstructure

Back side view of main super structure

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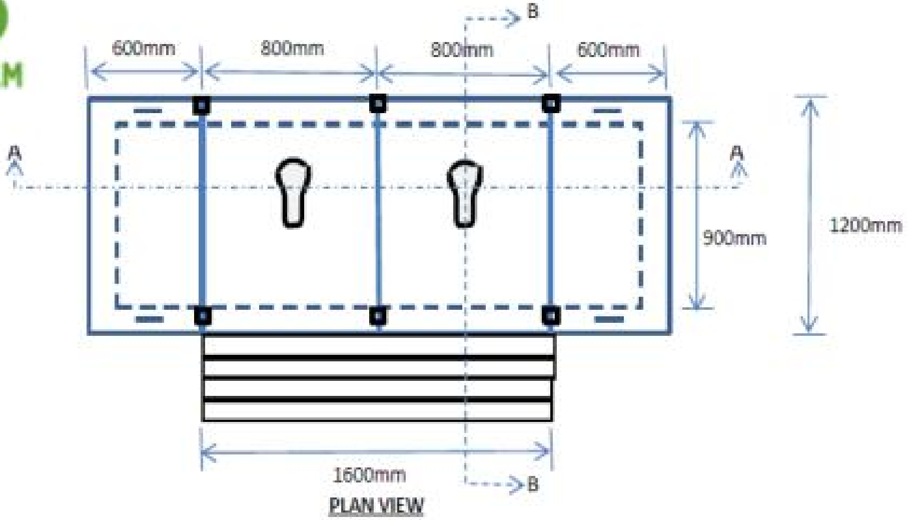
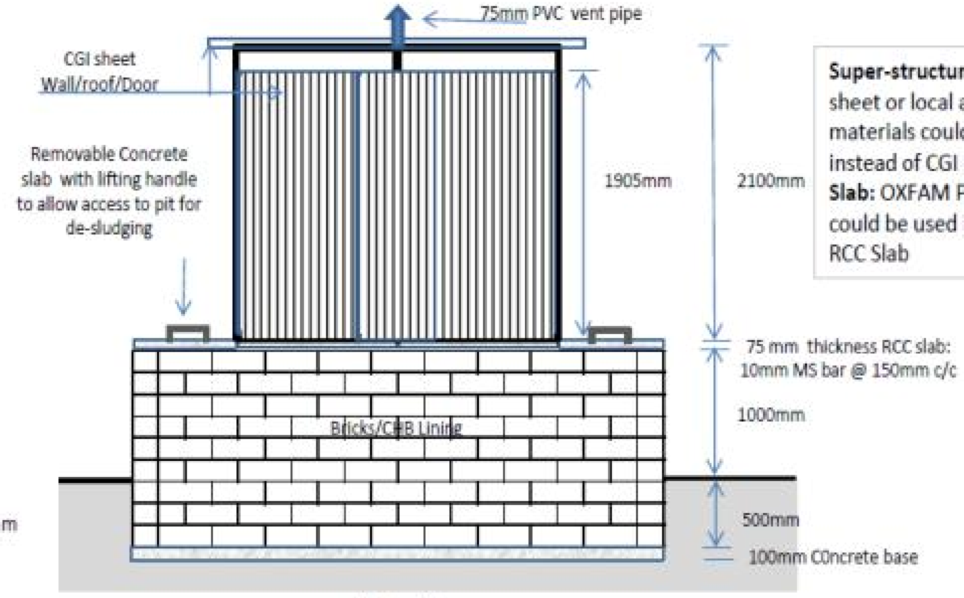
Raised “trench” latrine

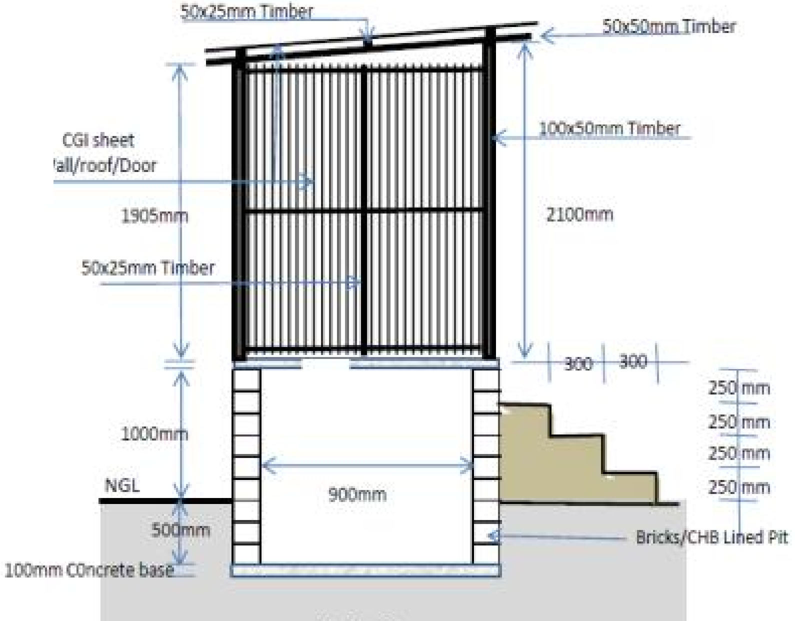


PLAN VIEW



X - Sex AA

Super-structure: Plastic sheet or local available materials could be used instead of CGI sheet
Slab: OXFAM Plastic Slab could be used instead of RCC Slab



X - Sex BB

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IN	Item descriptions	Unit	Qnty	Cost/Unit	Total cost
	Sub Structure (+Block Work)				
1	Excavation of pit hole	M3	2		
2	Hollow Concrete Blocks, 40x20x20	pcs	165		
3	Cement Portland 50kg	bags	6		
4	Sand	m3	0.5		
5	Gravel	m3	0.5		
6	10mm RC bar 12m length	pcs	4		
7	Binding wire	kg	1		
8	Wooden pole for formwork	pcs	2		
9	Timber 200x25mm for formwork	m	12		
	Super Structure				
10	CGI sheet 2m length	pcs	10		
11	Timber 100x50mm	m	16		
12	Timber 50x50mm	m	8		
13	Timber 50x25mm	m	36		
14	75mm pvc vent pipe	m	3		
15	Nails (assorted 3" and 4")	kg	6		
16	Roofing nails	kg	3		
17	Hinges	pcs	4		
18	Door lock (inner)	pcs	2		
19	Door lock (outer)	pcs	2		
	Labour Cost				
20	Labour skilled(Mason Carpenter)	Man days	6		
21	Labour unskilled	Man days	18		
	Total Estimated cost				

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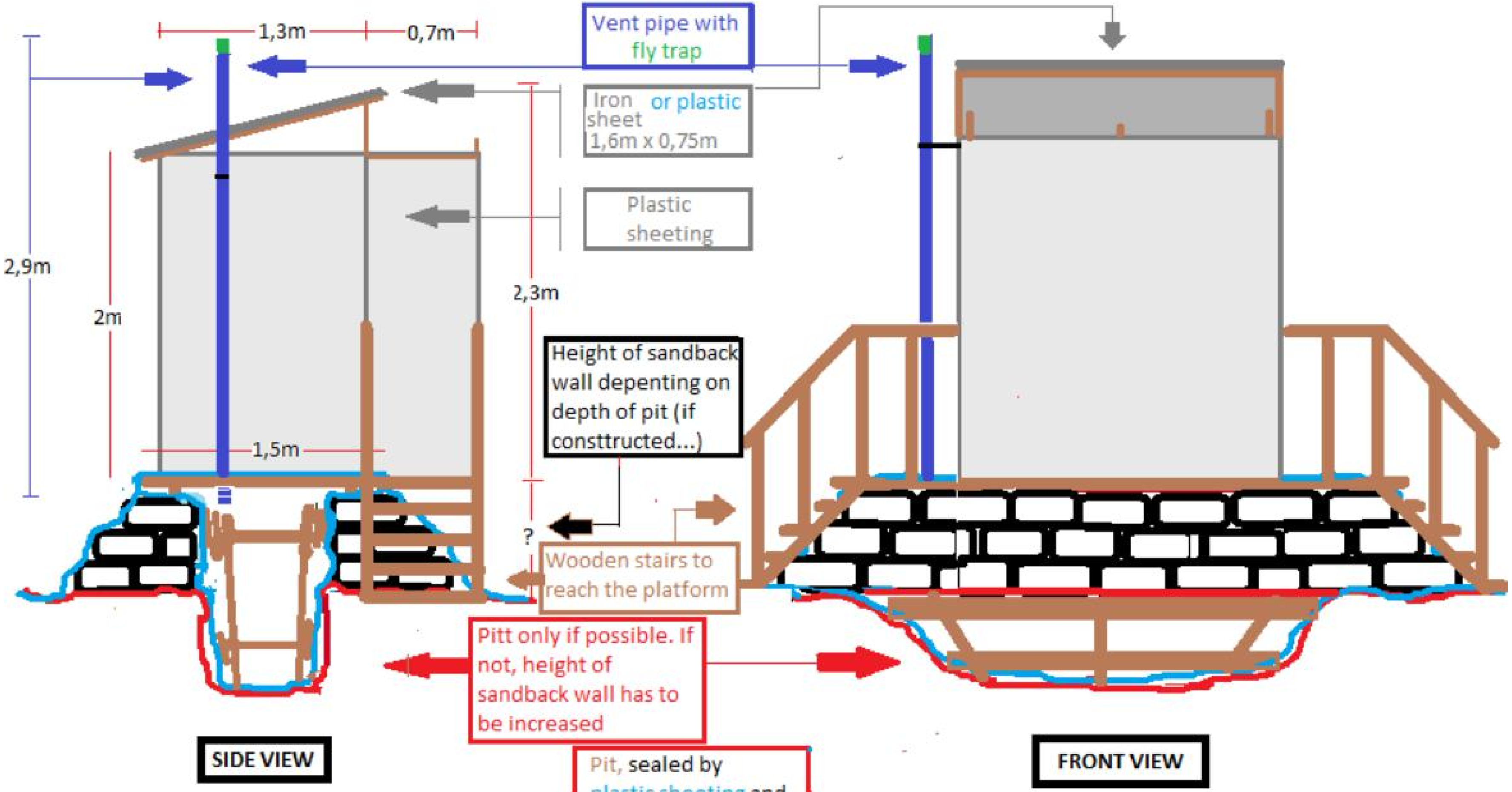
Emergency sandbag raised latrine



Vent pipe with fly trap

Iron or plastic sheet 1,6m x 0,75m

Plastic sheeting

Height of sandback wall depenting on depth of pit (if consttructed...)

Wooden stairs to reach the platform

Pitt only if possible. If not, height of sandback wall has to be increased

Pit, sealed by plastic sheeting and reinforced by Timber

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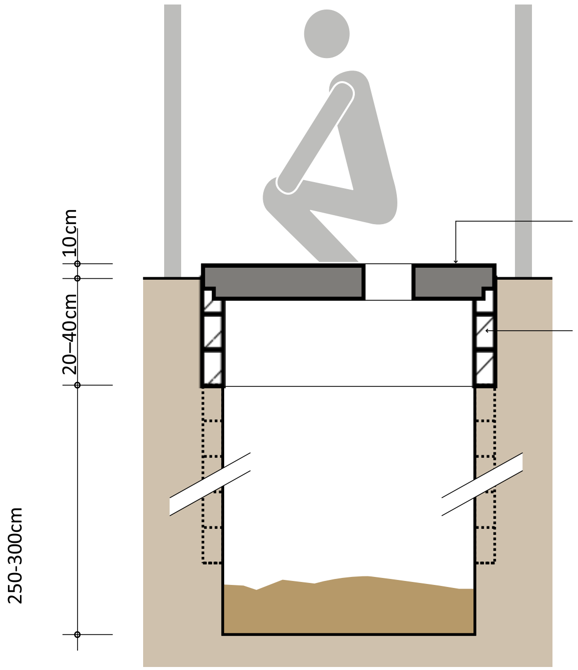
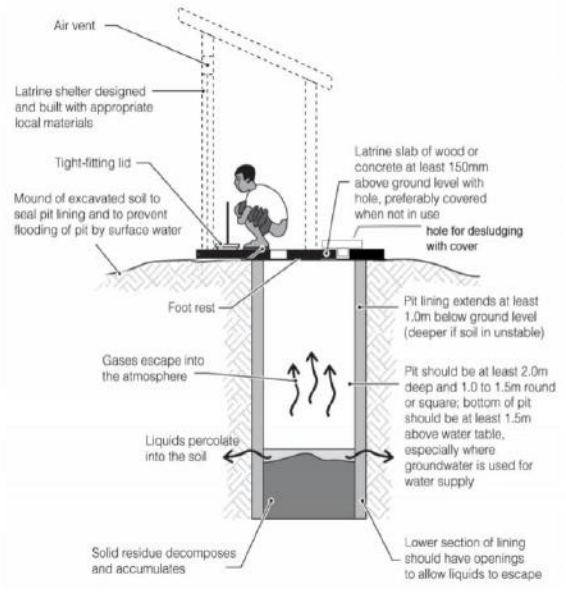
Single pit latrine





(**Source of picture**: (Harvey, P. (2007). **Excreta disposal in emergencies**. WEDC); Picture adjusted by offsetting the pit and including desludging hole with cover)

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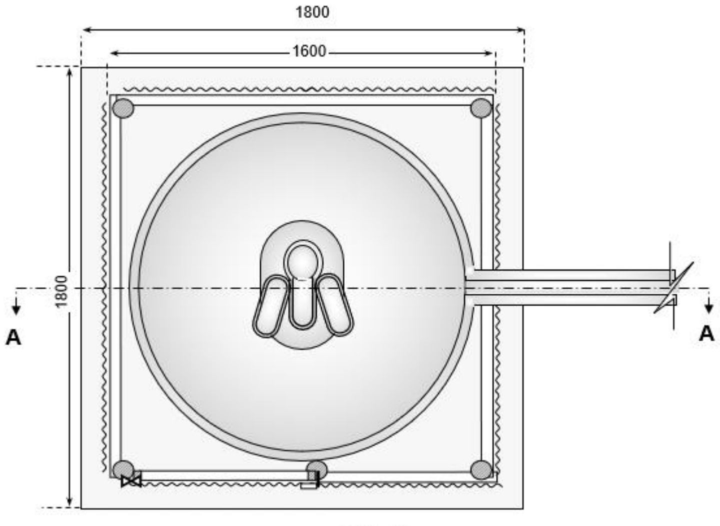
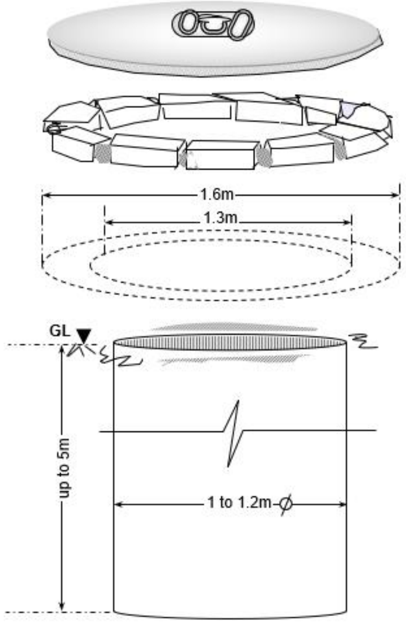


plinth plan



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IN	Item descriptions	Unit	Qnty	Cost/Unit	Total cost
	Sub-Structure				
1	Excavation of 3m deep pit (Circular with R=0.6)	M3	3.5		
2	Sandbag for Top soil lining (40-50 cm high)				
3	Mason work for top Pit lining (40 cm high)(Optional) (for slab support)	M3	0.7		
	Super Structure(+ Floor Work)				
4	Plastic Slab (Oxfam type)	Pcs	1		
5	Domslab or concrete rectangular slab (Optional)(See details of the slab design and material required @ the last page)	Pcs-1			
6	Tarpaulin 4x6m (Plastic sheeting) for Walling and Roofing	M2	10		
7	Corrugated Iron Sheet (GI34) for Walling & Roofing (Optional for instead of Plastic)	pcs	9		
8	Heavy wood columns (10cmx3m length)??	pc	6		
9	Wood timber (2.5cmx5cmx4m)??	pcs	8		
10	Nails 2’’	kg	1		
11	Nails 3’’	kg	0.5		
12	Roofing Nails	kg	1		
13	Door Hings	pcs	2		
14	Door Locks (Tower Bolts)(in &out side)	pcs	2		
	Labour Cost				
15	Skilled Labour	Man/days	2		
16	Non Skilled labour	Man/days	6		
	Total cost				

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Raised single pit latrine

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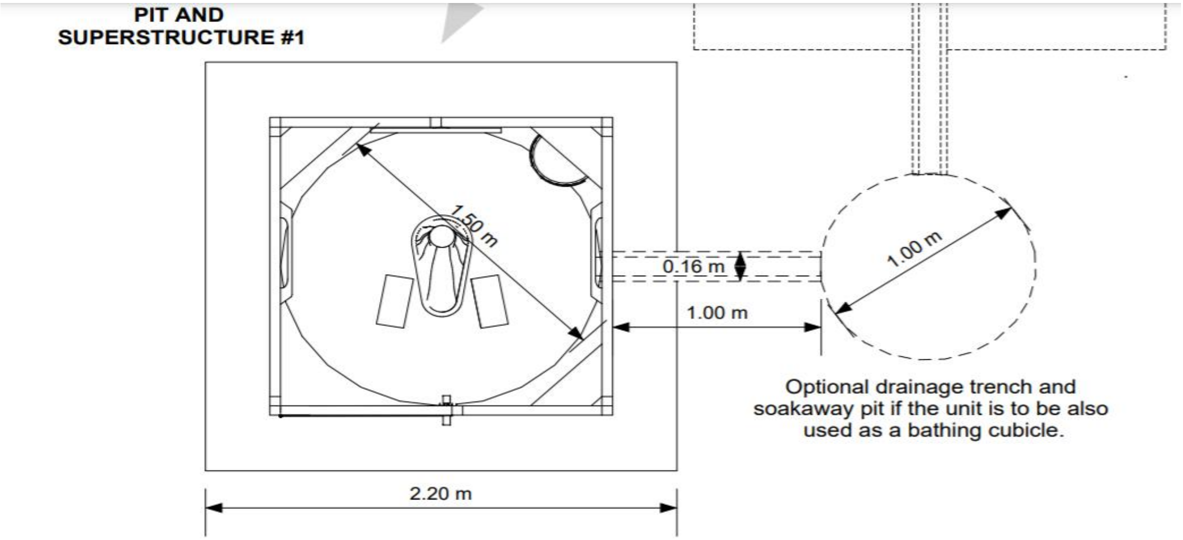
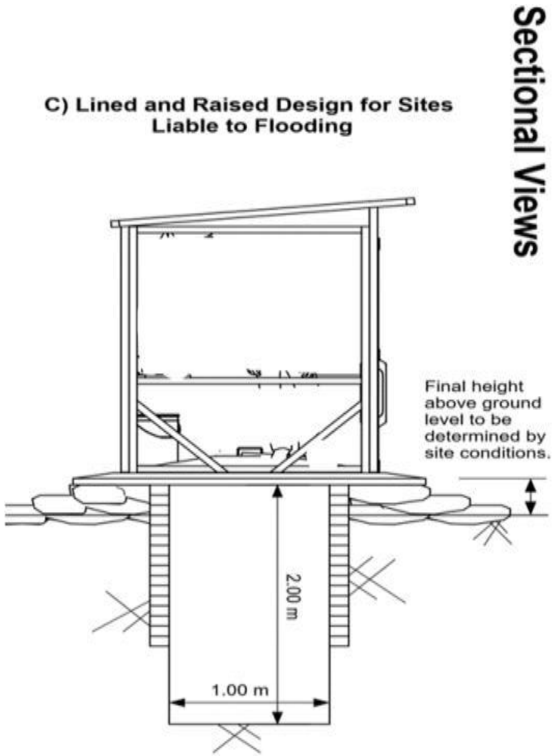


NOTES
1. Drainage depth to be determined based on number of users and soil infiltration capacity (see Appendix 20 of Engineering in Emergencies or page 213 of UNHCR WASH Manual).
2. In cold climates, pit depth should be deeper than maximum permafrost level.



Pit volumes optimised to fill in 2/3 years based on a family of 6 persons using decomposable anal cleansing materials (see calculation in UNHCR WASH Manual). The size has been calculated to allow 50cm freeboard.

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IN	Description	Unit	QTY	Unit cost	Total Cost
1	Wooden Posts (4m x 5cm x 5cm)	Pcs	16		
2	Wooden Planks (4m x 20cm x 2.5cm)	Pc	½		
3	Nails (10cm Galvanized)	Kg	½		
4	Domed Head Nails (4cm Galvanized)	Kg	½		
5	Domed Latrine Slab (150cm dia x 5cm)	Pc	1		
6	Bricks (8cm x 12cm x 25cm)	Pcs	54		
7	Plastic Sheeting	M2	16		
8	Metal Bolts and Washers (M10 x 12cm)	Pcs	12		
9	Metallic Door Bolt (4cm Galvanized)	Pc	1		
10	Metallic Padlock with 4 Sets of Keys	Pc	1		
11	Metallic Door Hinge (4cm x 8cm x 2mm Galvanized)	Pcd	3		
12	Wooden Grab Rails and Door Handles (Minimum 50cm Length)	Pcs	4		
13	Mirror (80cm x 60cm)	Pc	1		
14	Coarse Sand	M3	0.4		
15	Coarse Gravel (6mm – 10mm)	M3	0.8		
16	Cement (50kg sacks)	sack	6		
	Total Cost				

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Offset pour-flush latrine

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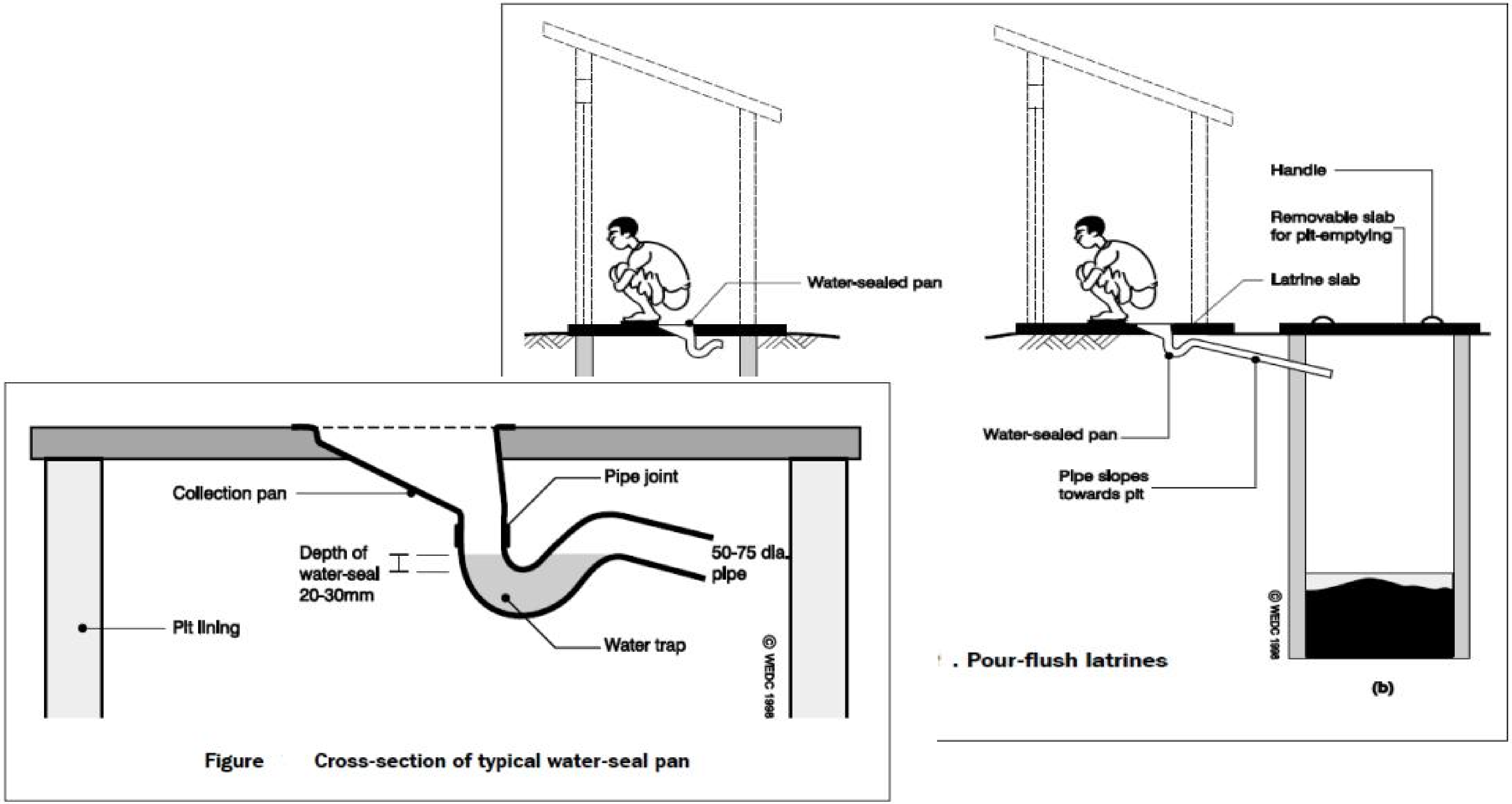

. Pour-flush latrines

Figure Cross-section of typical water-seal pan

Double door pit latrine
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Raised "trench" latrine
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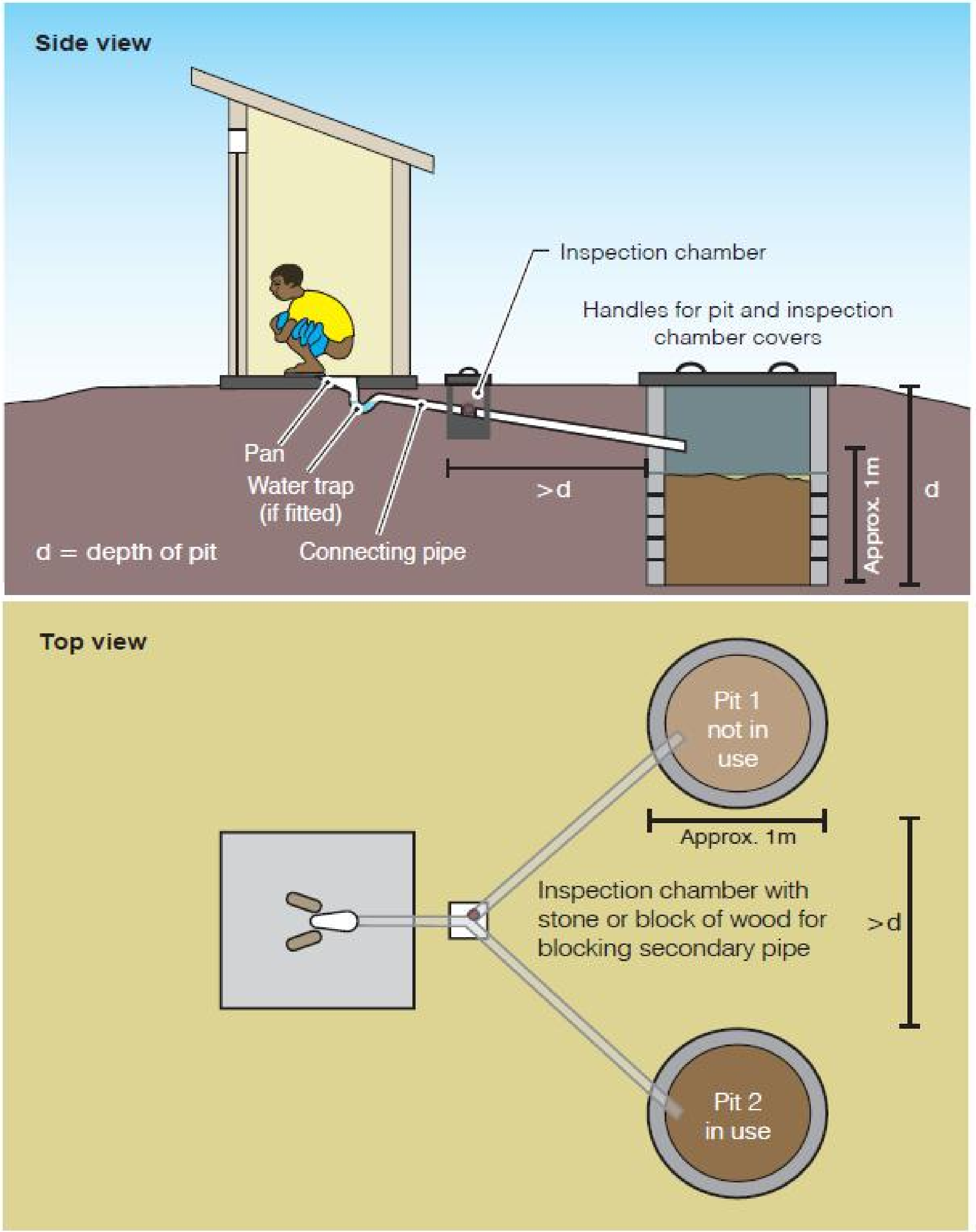
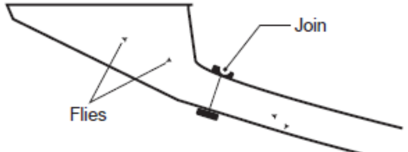
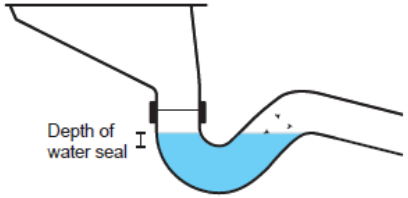


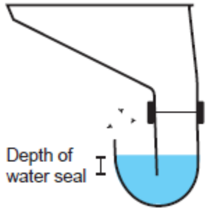
Figure 4. A twin pit, offset pour-flush latrine



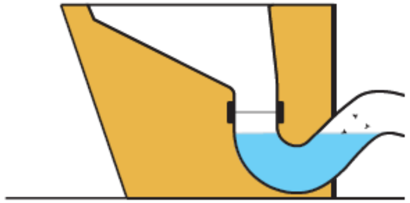
(a) Simple pour-flush pan



(b) 'U' bend trap



(c) 'Gooseneck' trap



(d) Pedestal pour-flush

Figure 2. Pan configurations

Reference: [WEDC – Pour-Flush Latrines booklet]

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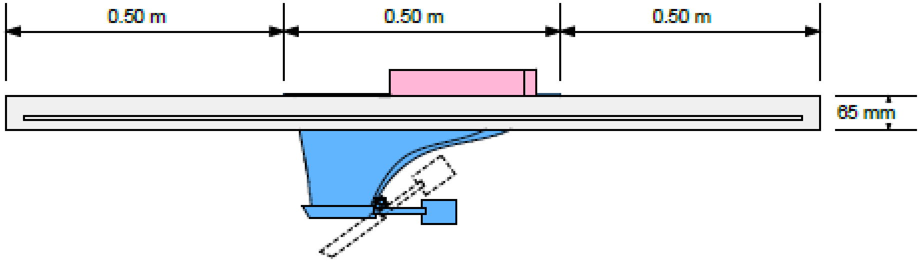
Side View



Diagram/Drawing -- SaTo Pan Pour Flush Toilet (Unlined/Lined/Raised – require adjustment on the BoQ once decided which one to adopt) (Option C)

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IN	Description	Unit	QTY	Unit cost	Total Cost
1	Wooden Posts (4m x 5cm x 5cm)	pcs	16		
2	Wooden Planks (4m x 20cm x 2.5cm)	pcs	½		
3	Nails (10cm Galvanized)	kg	½		
4	Domed Head Nails (4cm Galvanized)	kg	½		
5	Domed Latrine Slab (150cm dia x 5cm)	pc	1		
6	Bricks (8cm x 12cm x 25cm)	pcs	54		
7	Plastic Sheeting	M2	16		
8	Metal Bolts and Washers (M10 x 12cm)	pcs	12		
9	Metallic Door Bolt (4cm Galvanized)	pc	1		
10	Metallic Padlock with 4 Sets of Keys	pc	1		
11	Metallic Door Hinge (4cm x 8cm x 2mm Galvanized)	pcs	3		
12	Wooden Grab Rails and Door Handles (Minimum 50cm Length)	pcs	4		
13	Mirror (80cm x 60cm)	pc	1		
14	Coarse Sand	M3	0.4		
15	Coarse Gravel (6mm – 10mm)	M3	0.8		
16	Cement (50kg sacks)	sack	6		
	Total Cost				

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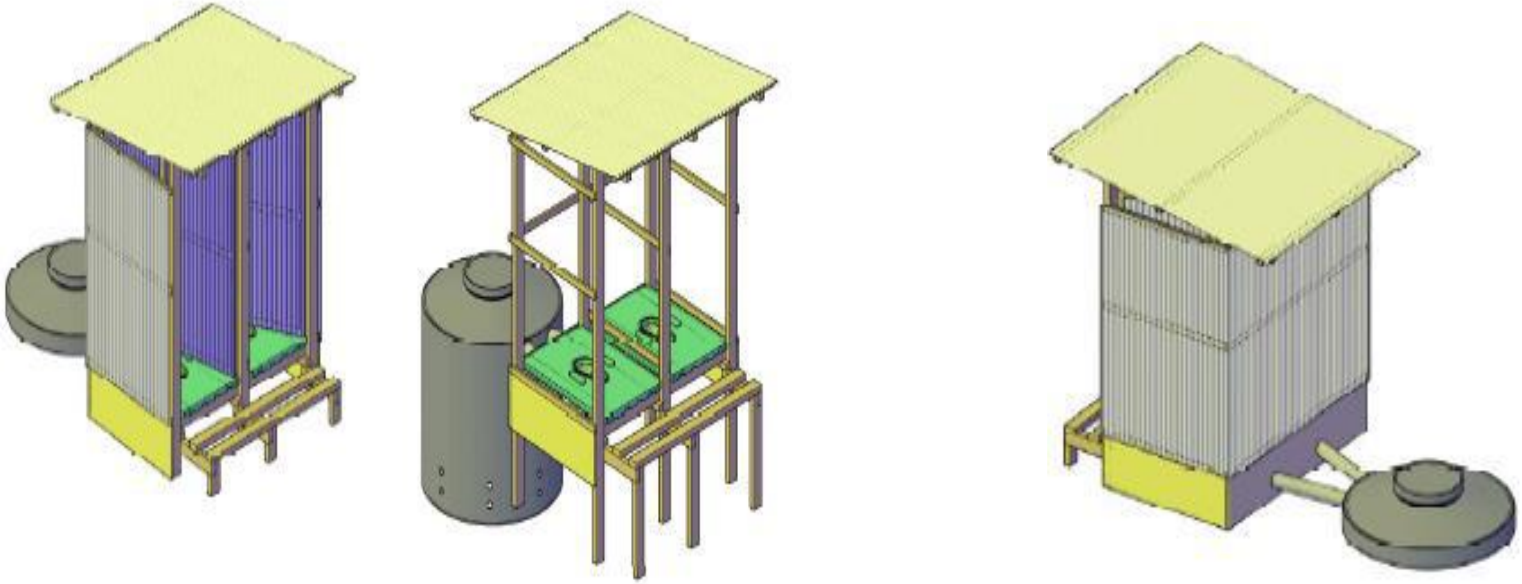

Example for a 2-door unit of contained pour flush latrines in a displacement camp, Philippines 2010.

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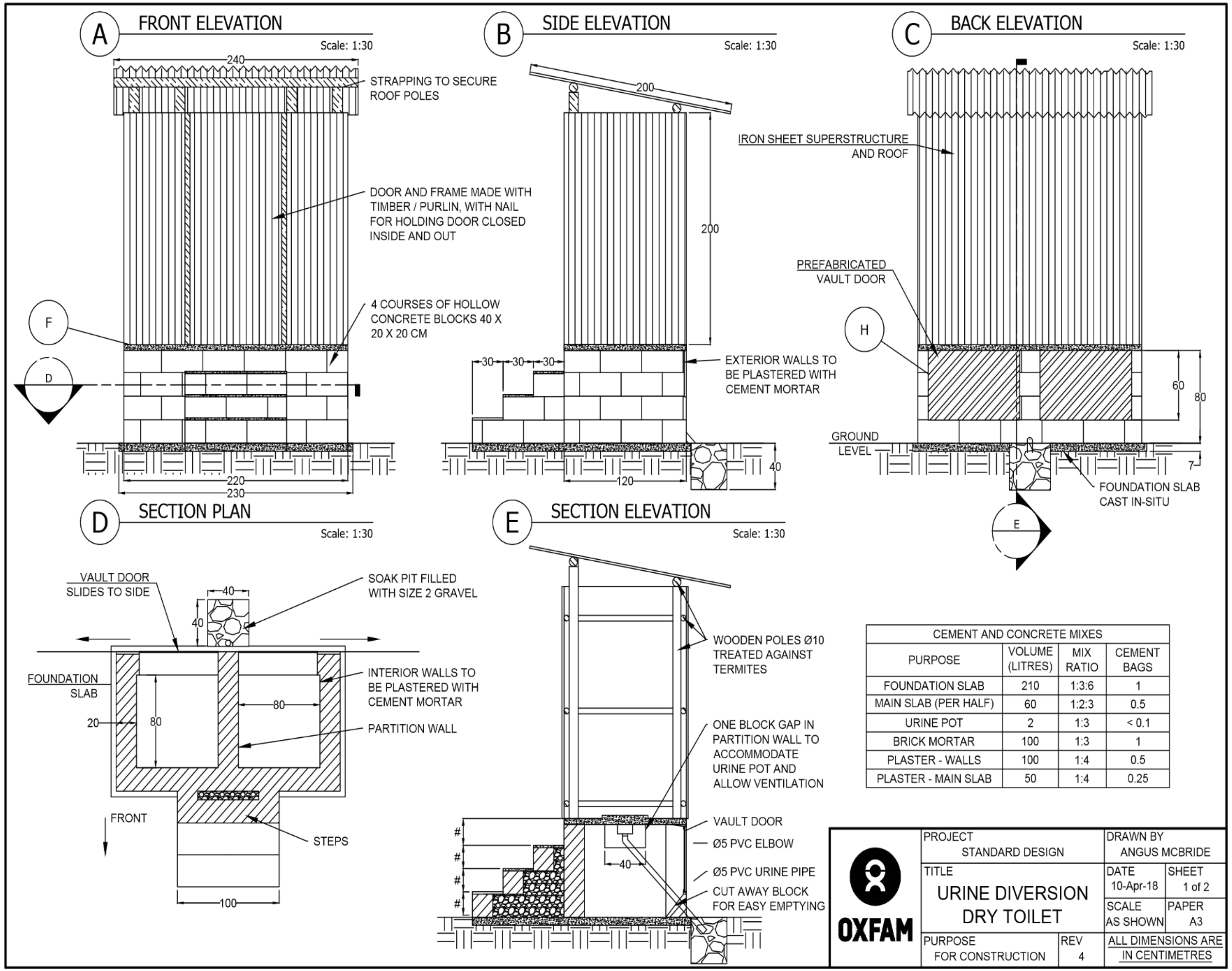
IN	Item descriptions	Unit	Qnty	Unit Cost	Total Cost
	Material Required				
1	Timber (100x50x3600)L	pcs	12		
2	Timber (50x50x2400)	pcs	11		
3	Timber (50x25x2400)	pcs	11		
4	Timber Planks (225x20x2400)	pcs	4		
5	CGI Sheet (partition) 34G, 6’H	no	1		
6	CGI Sheet (door) 32G, 6’H	no	3		
7	CGI Sheet (roof), 32G, 8’H	no	4		
8	PVC Pipe, 100 mm - T250	ft	12		
9	PE Tank 1000L	no	2		
10	Squatting slab with bend & pan (Oxfam)	set	2		
11	Silicon Gel (gum)	set	1		
12	Nails 3”	kg	1		
13	Nails 2”	kg	0.5		
14	Nails 1 ½”	kg	0.25		
15	Umbrella Nails 1 ½”	kg	0.5		
16	T-Hinges (150mm)	no	4		
17	Door handle (150mm)	no	2		
18	Tower Bolt (150mm)	no	2		
19	Gate hook (100mm)	no	2		
	Labour:				
21	Skilled labourer	man-day	2		
22	Un-skilled labourer	man-day	4		
	Total cost				

UDDT double vault



CEMENT AND CONCRETE MIXES			
PURPOSE	VOLUME (LITRES)	MIX RATIO	CEMENT BAGS
FOUNDATION SLAB	210	1:3:6	1
MAIN SLAB (PER HALF)	60	1:2:3	0.5
URINE POT	2	1:3	< 0.1
BRICK MORTAR	100	1:3	1
PLASTER - WALLS	100	1:4	0.5
PLASTER - MAIN SLAB	50	1:4	0.25

OXFAM

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TITLE URINE DIVERSION DRY TOILET		DATE 10-Apr-18	SHEET 1 of 2
		SCALE AS SHOWN	PAPER A3
PURPOSE FOR CONSTRUCTION	REV 4	ALL DIMENSIONS ARE IN CENTIMETRES	

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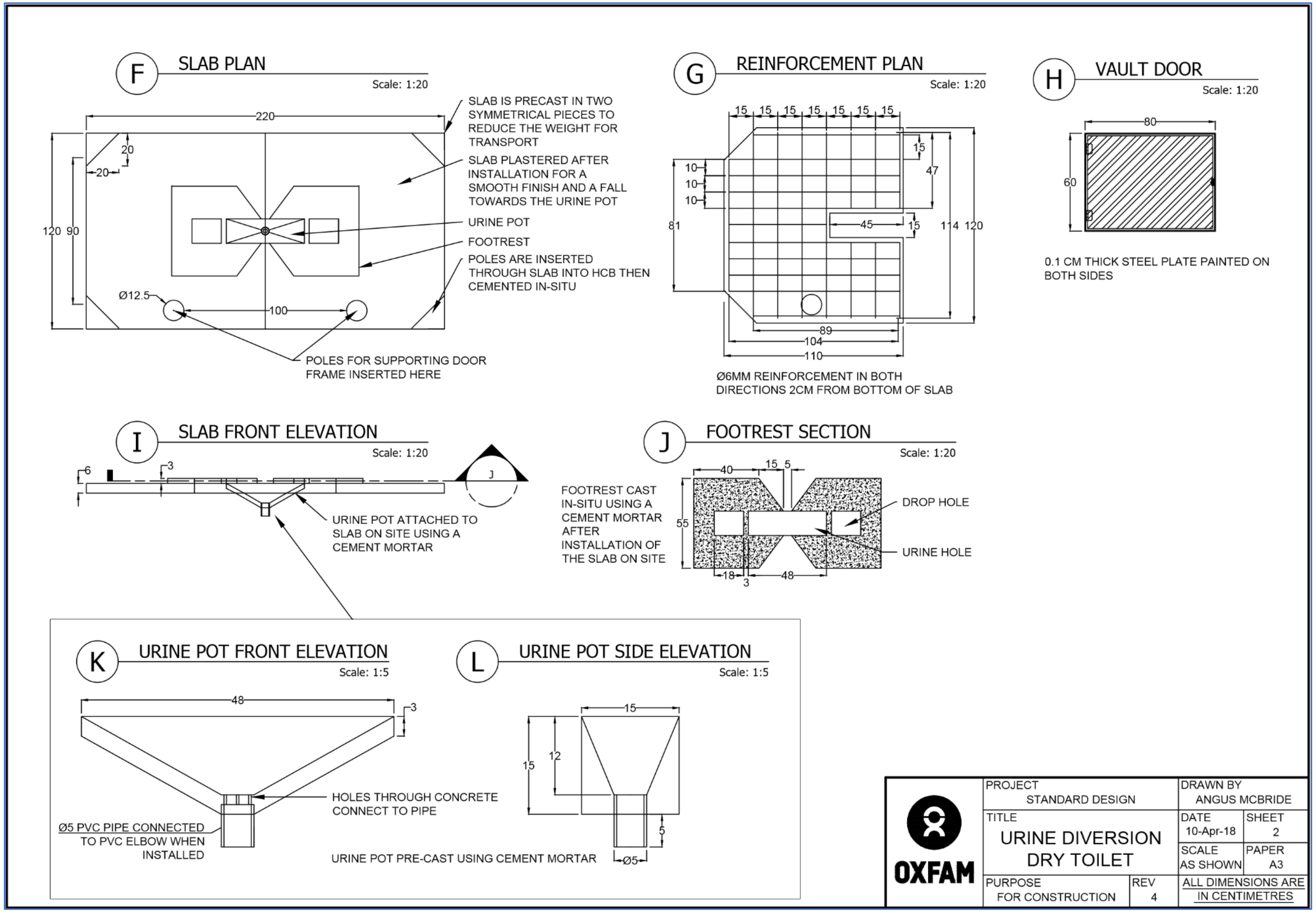

SLAB IS PRECAST IN TWO SYMMETRICAL PIECES TO REDUCE THE WEIGHT FOR TRANSPORT

SLAB PLASTERED AFTER INSTALLATION FOR A SMOOTH FINISH AND A FALL TOWARDS THE URINE POT

URINE POT

FOOTREST

POLES ARE INSERTED THROUGH SLAB INTO HCB THEN CEMENTED IN-SITU

POLES FOR SUPPORTING DOOR FRAME INSERTED HERE

Ø6MM REINFORCEMENT IN BOTH DIRECTIONS 2CM FROM BOTTOM OF SLAB

0.1 CM THICK STEEL PLATE PAINTED ON BOTH SIDES

URINE POT ATTACHED TO SLAB ON SITE USING A CEMENT MORTAR

FOOTREST CAST IN-SITU USING A CEMENT MORTAR AFTER INSTALLATION OF THE SLAB ON SITE

DROP HOLE

URINE HOLE

HOLES THROUGH CONCRETE CONNECT TO PIPE

Ø5 PVC PIPE CONNECTED TO PVC ELBOW WHEN INSTALLED

URINE POT PRE-CAST USING CEMENT MORTAR

OXFAM

PROJECT STANDARD DESIGN		DRAWN BY ANGUS MCBRIDE	
TITLE URINE DIVERSION DRY TOILET		DATE 10-Apr-18	SHEET 2
		SCALE AS SHOWN	PAPER A3
PURPOSE FOR CONSTRUCTION	REV 4	ALL DIMENSIONS ARE IN CENTIMETRES	

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IN	Item description	Qty	Unit	Unit cost	Total cost
	Vault Construction				
1	Cement	4.5	50kg bags		
2	Sand	0.6	m3		
3	Gravel 0.1	0.25	m3		
4	Hollow Concrete Blocks, 40x20x20	100	pc		
5	PPR Pipe 50mm	2	metres		
6	PPR Elbow 50mm	2	pc		
7	Vault Doors	2	pc		
	Main Slab & Urine Pot				
8	Cement	2.5	50kg bags		
9	Sand	0.5	m3		
10	Gravel 0.25	0.5	m3		
11	Reinforcement bar, Ø6mm	10	kg		
12	Binding Wire	0.5	kg		
13	Bonda Iron	2	kg		
14	Purlin 5 x 7 x 400 cm, for slab form work.	0.1	pc		
15	PPR Pipe, Ø50mm	0.1	metres		
16	Floor Drain	1	pcs		
	Superstructure				
17	Eucalyptus pole Ø10cm	6	pc		
18	Eucalyptus pole Ø8cm	6	pc		
19	Purlin 5 x 7 x 400 cm	3	pc		
20	Timber 150 x 20 x 400cm	1	pc		
21	Engine Oil	2	litres		
22	Hollow Concrete Blocks, 40x15x20	40	Pcs		
23	cement	1	bag		
24	sand	0.5	m3		
25	Bamboo with standard length of 4m	120	pc		
26	plastic sheet	0.5	pc		
27	Iron sheet, 2 x 0.9 m, G-35, for roof and Door.	4	pc		
28	Nails, Roofing	1.8	kg		
29	Nails 10, cm	2	kg		
30	Nails, 6cm	2	kg		
31	Nails, 8cm	1	kg		
32	Tower Bolt,15cm	2	pcs		
33	Door Latch	2	pcs		
34	Butt Hinge, 15cm	2	pcs		
35	Pad Lock	1	pcs		
36	Hand Washing stand				
37	Eucalyptus Pools Ø 8cm 5 m long (for Truss/wall work)	1	No		
38	Hollow Concrete Blocks, 40x40x20	2	pc		
	GRAND TOTAL COST FOR updated UDDT design				

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Tiger worm toilet (TWT)

The superstructure of a TWT can be the same as existing traditional latrines, as long as there is a roof to prevent rain water entering the system. As with all latrines, it is essential that the community are consulted regarding the design, location and sharing arrangements.

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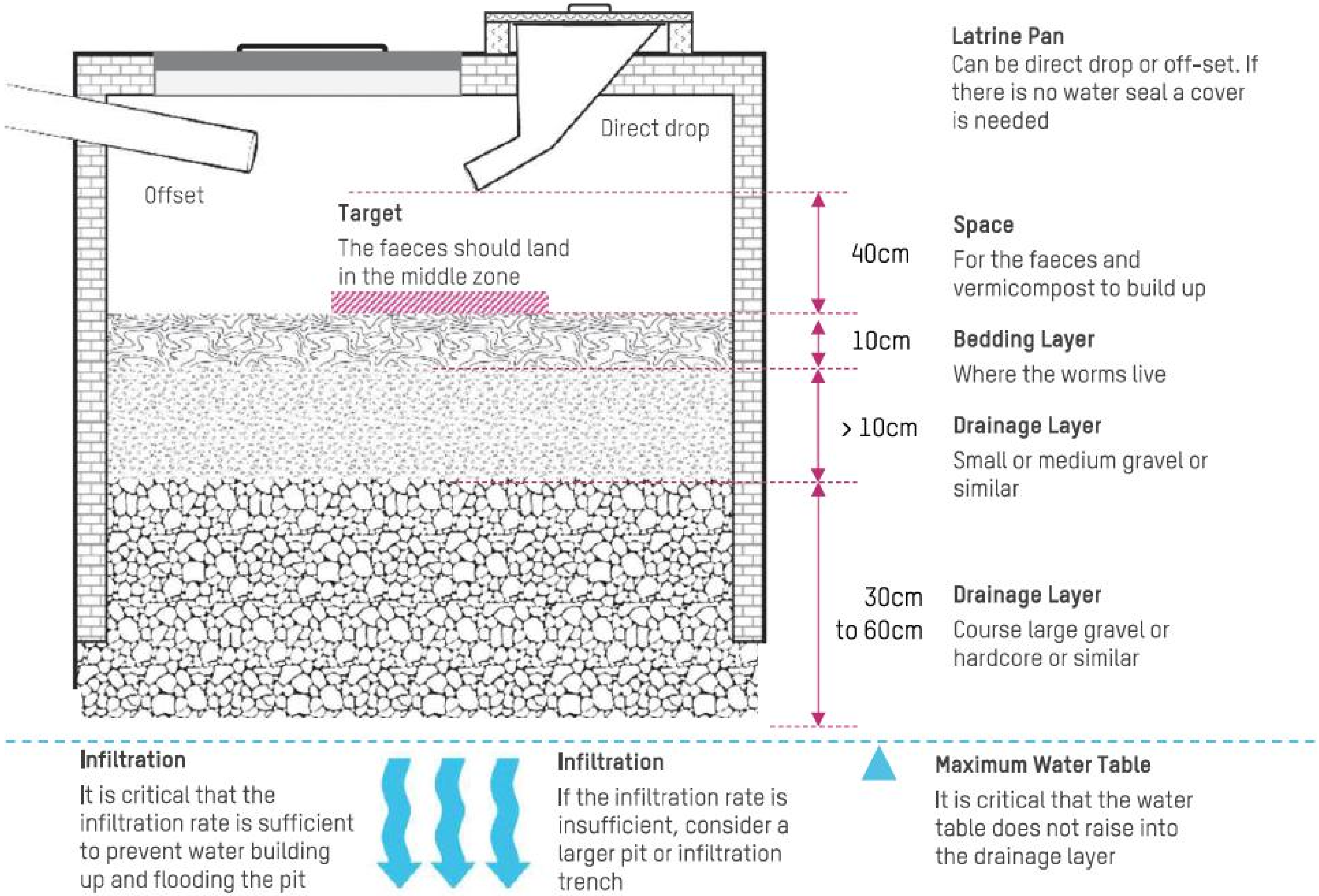
Tiger worm toilet



Latrine Pan
Can be direct drop or off-set. If there is no water seal a cover is needed

Target
The faeces should land in the middle zone

Space
For the faeces and vermicompost to build up

Bedding Layer
Where the worms live

Drainage Layer
Small or medium gravel or similar

Drainage Layer
Course large gravel or hardcore or similar

Infiltration
It is critical that the infiltration rate is sufficient to prevent water building up and flooding the pit

Infiltration
If the infiltration rate is insufficient, consider a larger pit or infiltration trench

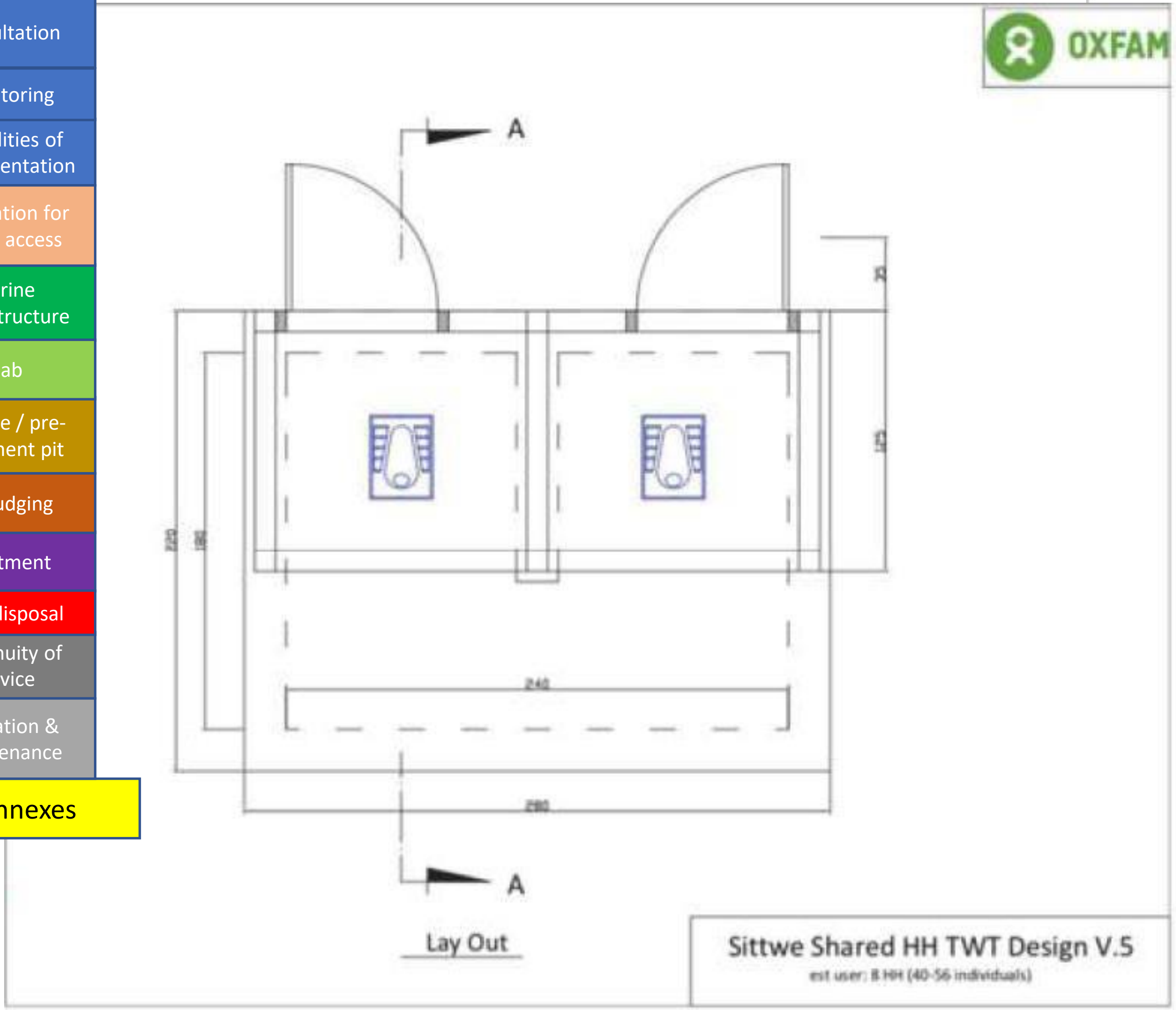
Maximum Water Table
It is critical that the water table does not raise into the drainage layer

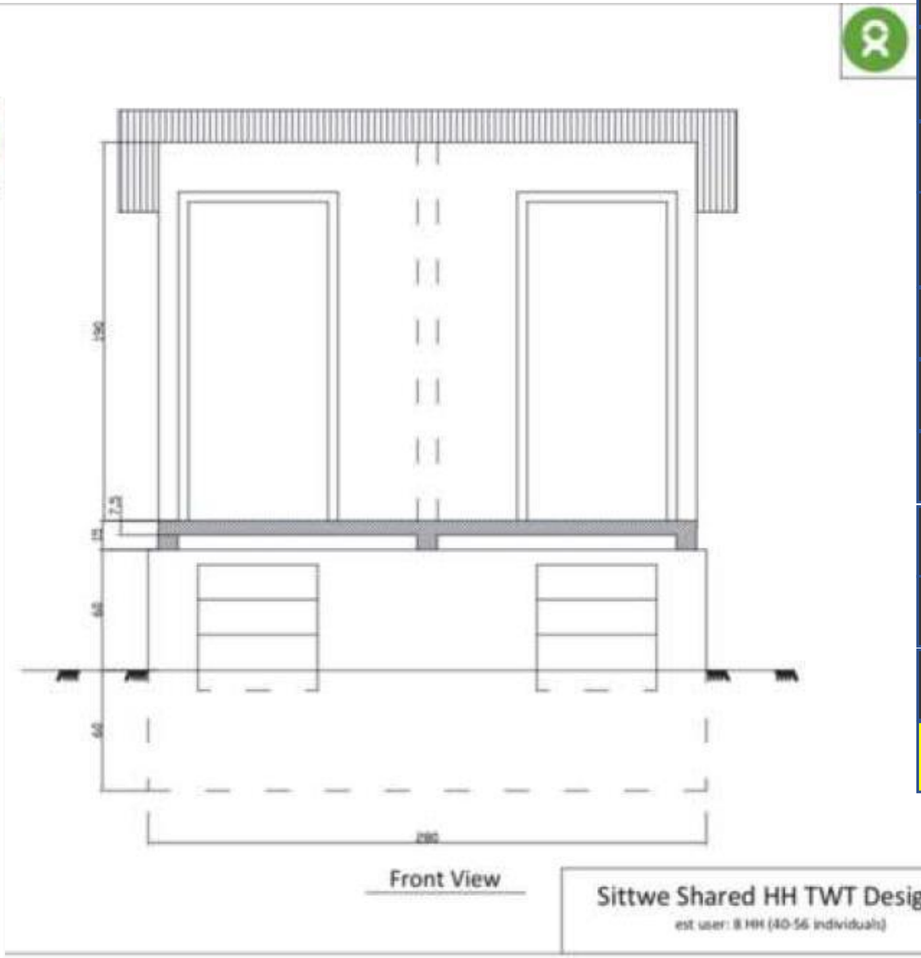
Reference: [Tiger worm toilet manual]

THE IMPORTANCE OF CONSTRUCTION QUALITY

Ensuring good construction quality is particularly important for TWTs. This includes ensuring:

1. The system is properly sealed to prevent predators such as rats or centipedes from being able to enter the pit. The pit lid needs to be well sealed. If direct drop, a good fitting latrine pan cover is needed.
2. The pit is properly sealed on the sides to prevent rain and surface water entering the pit.
3. A well-sealed and large enough emptying and monitoring hatch.
4. The correct construction materials are used. The drainage and bedding layer do not contain too many small fine particles which could cause blockages.
5. The inlet pipe is installed correctly for new faeces to land in the center of the pit





Reference: Tiger worm toilet manual

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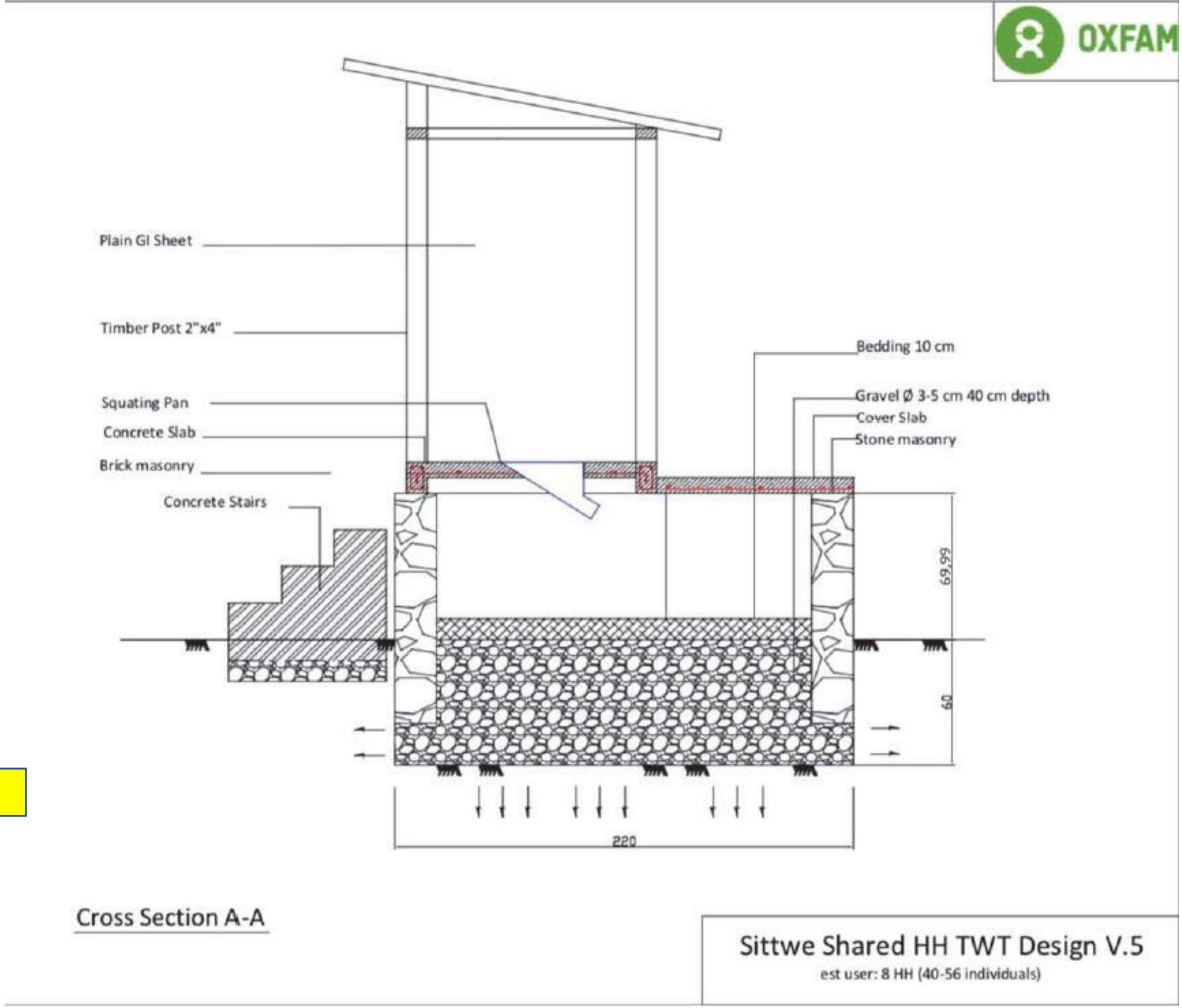

Cross Section A-A

Sittwe Shared HH TWT Design V.5

est user: 8 HH (40-56 individuals)

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Reference: [Tiger worm toilet manual]

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▶ Design BoQ

Sr.No.	Description	Quantity	Unit	Unit cost	Total
	Material				
1	Hard wood 3" x3" post 9' length	4	pcs		
2	3" x 2" hard wood 12' length	9	pcs		
3	3"x1" hard wood 12' length	2	pcs		
4	3" x 0.5" hard wood for beading	9	pcs		
5	6" x 1" plank 12 length	5	pcs		
6	pan cover with 5 ply wood , 2" x1" frame	1	pcs		
7	1"x 1" wire mesh	0.04	roll		
8	concrete footing with M.S flat (8" x 1' x 1.5')	4	pcs		
9	concrete ring (3' dia, 1.5' height)	2	pcs		
10	reinforced concrete cover with man hole (3' dia)	1	pcs		
11	vernish (1 gal)	1	gal		
12	cement	0.76	bags		
13	boulder	0.125	sud		
14	Aggregate	0.038	sud		
15	sand	0.019	sud		
18	brush	2	pcs		
19	GI plain sheet (5 ft)	30	ft		
20	C.G.I roofing sheet	2	pcs		
21	roofing nail	0.5	viss		
22	nail (various size)	1	viss		
23	1/2" dia Bolt and Nut 5" long with washers	8	pcs		
24	pan	1	pcs		
25	3" dia PVC pipe 4'	1	nos		
26	tarpaulin sheet 4' x 4'	0.04	roll		
28	fly screen 4' x 5'	5	ft		
29	4" Hinge	3	pcs		
30	4" Handle	2	pcs		
31	tower bolts	2	pcs		
32	bedding material/coconut coir	5	bags		
	Labour cost				
33	carpenter	2	man.days		
34	mason	1	man.days		
35	worker	4	man.days		
	Total				

Double door pit latrine
Deep Trench latrine
Emergency desludgeable lined pit latrine
Raised “trench” latrine
Emergency sandbag raised latrine
Single pit latrine
Raised Single pit latrine
Off-set pour-flush latrine
SaTo Pan Pour Flush Toilet
Containment pour flush latrine
UDDT double vault
Tiger worm toilet

Single door household TWT

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Excreta disposal system
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Final disposal
Continuity of service
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Design
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Double door pit latrine
Deep Trench latrine
Emergency desludgeable lined pit latrine
Raised “trench” latrine
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Sr.No.	Description	Quantity	Unit	Unit cost	Total
	Material				
1	Hard wood 3" x3" post 9' length	6	pcs		
2	3" x 2" hard wood 12' length	15	pcs		
3	3"x1" hard wood 12' length	3	pcs		
4	3" x 0.5" hard wood for beading	13	pcs		
5	Pan cover with 5 ply wood , 2" x1" frame	2	pcs		
6	8mm rebar	240	Rft		
7	6 mm rebar	160	Rft		
8	Binding wire	0.5	viss		
9	vernish (1 gal)	1	gal		
10	cement	22.34	bags		
11	boulder	3.225	sud		
12	Aggregate	0.25	sud		
13	sand	1	sud		
15	brush	2	pcs		
16	GI plain sheet (5 ft)	55	ft		
17	C.G.I roofing sheet	4	pcs		
18	roofing nail	1	viss		
19	nail (various size)	1.5	viss		
20	1/2" dia Bolt and Nut 5" long with washers	12	pcs		
21	pan	2	pcs		
22	3" dia PVC pipe 4'	2	nos		
24	fly screen 4'	15	ft		
25	4" Hinge	6	pcs		
26	4"handle	4	pcs		
27	tower bolts	2	pcs		
28	padlock	2	pcs		
29	Bedding material/coconut coir	25	bags		
	Labour				
30	Carpenter	2	man.days		
31	Mason + steel fixer	5	man.days		
32	Worker	8	man.days		
	Total				

Double door shared TWT