4. Excreta Management

An environment free from human excreta is essential to life, health and dignity. Safe excreta management is among the primary interventions for refugees.

Introduction

The importance of excreta management in refugee settings

1. Safe disposal of human excreta is the primary barrier to excreta-related disease transmission and is essential for life with dignity. This is regardless of whether the refugee population are living in camps, collective centres, spontaneous unplanned camps, with host families, in rented accommodation, or they are occupying land or buildings. In every refugee setting, excreta management must be addressed with the same speed and effort as the provision of safe water supply.

UNHCR and WASH actors must ensure that during all stages in the emergency the environment inhabited by refugee populations is free from human faeces.

Excreta management as part of a comprehensive public health approach

2. The excreta management programme should be planned as part of the larger preventative public health strategy. Health and WASH interventions must be closely coordinated especially during times of risk of epidemic. The link between excreta contamination and disease must be clearly understood by all. Messages concerning the importance of toilet use and hand-washing after toilet use should be incorporated into the community health and education programmes.

The importance of seeking expert professional advice

3. The implementation of excreta management programmes in refugee settings can be complicated by additional constraints that include:
   i). Sites that are easily flooded, have high water tables, hard ground, and/or are barren or inaccessible;
   ii). Land ownership issues restricting the construction of infrastructure including toilets, (for example refugee populations temporarily occupying school or other private buildings);
   iii). Lack of physical space for toilets (for example in urban settings / high density camps);
   iv). Limited availability of local materials for toilet construction due to either geography or environmental protection;
   v). Existing urban buildings that require retrofitting or upgrading of existing infrastructure (for example refugee populations occupying collective centres);
   vi). Unfamiliarity or unwillingness of the population to use toilet infrastructure or change toilet use behaviour.
   vii). Lack of qualified personnel.

4. Due to these challenges it is essential to seek expert advice from professionals who are familiar with the context. Assistance can be sought from sources such as government departments, NGOs, Universities, consultants or contractors. UNHCR Headquarters and Regional assistance should be requested if required.

Priority actions

An immediate response

5. UNHCR and WASH actors must ensure that the environment inhabited by refugee populations is free from human faeces as rapidly as possible. In order to achieve this, UNHCR and WASH actors must ensure that there is swift provision of toilet facilities within the first few days of any emergency. The provision of a basic excreta containment intervention (for example pit latrines with reasonable privacy) is better than delayed provision of improved systems. Several decision trees can be found later in this chapter to help with the selection process of a suitable excreta management system.

The speed at which emergency excreta management systems are established must be given the same emphasis as provision of safe water supply.

6. It is a common problem during emergency responses that toilet construction programmes fail to scale-up quickly. In large refugee emergencies there are considerable time-saving advantages to engaging mechanical excavators for latrine trench construction. In addition, time can be saved by using prefabricated slabs and by mass producing toilet privacy structures in a dedicated mass production facility and transporting and assembling them on site (see designs on **wash.unhcr.org**). Even more time can be saved if these structures have been kept in contingency stock.

Clean up campaigns

7. UNHCR and WASH actors must ensure that the environment inhabited by refugee populations is free from human faeces. Observation walks (see **observation walk section** in Chapter 9) are a very effective way of identifying and mapping areas with a high defecation load. Copies of recent observation walks along with copies of focus groups related to the problems of open defecation should be included as an annex in the site WASH plan/strategy.

Box: Recommended tools for a sanitation brigade of 20 persons

Item	Qty
Shovels	10
Hoes	5
Rakes	5
Wheel-barrows	5
Gloves (pairs)	20
Boots (pairs)	20
Overalls	20
Backpack sprayers	5
Bleach (5% - 7%)	20 litres

Quantities for approximate guidance only. Figures should be adapted to context.

8. In some contexts sanitation brigades may be required at the start of the emergency to clean-up excreta. UNHCR and WASH actors should ensure that sanitation brigades are provided with appropriate tools (see box above) and personal protective equipment (refer to the staff **health and safety section** in Chapter 8). Any excreta that is collected must

be disposed of safely within a properly designed pit, tank, lagoon or sewer. Small patches of ground in contact with stools that have been cleaned should be lightly sprayed with 2% chlorine solution. All tools and personal protective equipment used in the clean-up of excreta should be cleaned with detergent and 2% chlorine solution after use.

Protection of existing water supplies

9. It is of particular importance that immediate steps are taken to prevent contamination of existing water sources from human excreta. During the initial stages of an emergency response this may require the use of guards to prevent the refugee population defecating close water sources or along river banks. Open defecation should also be discouraged along public highways, in the vicinity of hospitals, feeding centres, reception centres, food storage areas, food preparation areas, and in fields containing crops for human consumption. When it is impossible to establish toilet facilities, open defecation should be limited to specific, well-defined areas, in consultation with the community leaders, downstream of the refugee setting. These should be closed and covered over as soon as possible (see **section 4.44**)

10. All excreta management systems must respect the minimum safe distances (MSD) between all excreta management infrastructure and water sources. MSDs are highly dependent upon ground types and conditions but it is generally recommended that all toilet pits are located at least 30 metres away from any groundwater sources. In addition, the bottom of any pit or soak-away must be at least 1.5 metres above the groundwater table. These distances should be increased for fissured rocks, limestone, and coarse alluvial sands and gravels. In some special situations, groundwater pollution may not be of immediate concern if it is not used for drinking, for example in coastal areas where shallow groundwater is saline beyond drinking water health limits i.e. at least 1,500μS/cm^2.

Transition to household toilets as quickly as possible

11. The quickest way to rapidly scale up access to toilets is to build communal facilities. However, even if these are well designed, intensively supervised and spotlessly clean, other factors such as walking distances, insecurity, queuing, or a lack of anonymity may prevent their use. If it is clear that the time-frame of the humanitarian situation will be longer than six months, the best guarantee that people will safely defecate in a toilet and that toilets are kept clean and functional is to encourage the construction of shared or individual household toilets as quickly as possible.

12. In all settings, UNHCR and WASH actors should quickly conduct focus group discussions and key informant interviews to assess if there is a willingness to move to direct implementation of household toilets. If a WASH programme has decided to carry out a programme of public or communal toilets rather

13. than the preferred UNHCR WASH strategy of moving directly to shared or individual toilets, the reasons justifying this decision should be fully explained in the site WASH plan/strategy.

14. The immediate construction of one toilet shared between four families avoids the complications and costs that typically arise with communal facilities as families take responsibility for cleaning and maintenance themselves. If shared toilets are not constructed directly inside one of the family's plots then UNHCR and WASH actors should ensure that padlocks and keys are provided to ensure exclusive use with each household provided with at least two sets of keys.

The best guarantee that people will safely defecate in a toilet and that toilets are kept clean is to encourage the construction of shared or household toilets as quickly as possible.

Provision of tools and incentives to facilitate toilet construction

15. UNHCR and WASH actors should ensure that the refugee population have access to tools and technical support to construct, maintain and clean their own toilets from the outset of the refugee emergency. UNHCR and WASH actors should plan to provide one household toilet digging kit that is shared between every 8 families. The suggested contents of the kit can be found on **wash.unhcr.org**. In the cases where refugee families cannot provide their own, UNHCR and WASH actors may provide incentives such as toilet slabs and superstructure material to facilitate construction of household toilets. Dedicated staff for the household toilet programme should be recruited and mobilized as soon as is possible.

UNHCR and WASH actors should ensure that every household that wishes to construct their own toilet is able to access tools and technical support from the outset of the refugee emergency.

16. A report on the availability and uptake of household toilet construction materials and tools, household toilet progress rates, focus group discussion related to household toilets, in addition to strategies to increase uptake should be included in the site WASH plan/strategy.

Box: UNHCR toilet definitions

Household toilets are toilets used by a single household (including extended family) up to a maximum of 12 persons.

Shared toilets are single toilets that are shared between a maximum of 4 households. Shared toilets are often used as an emergency response intervention instead of constructing communal toilets. Shared toilets require that households are willing to share in the short-term.

Communal toilets are blocks of toilets shared by a group of households (typically 16 households under the UNHCR block and sector camp model).

Public toilets are toilets in public places such as markets, mosques or along main thoroughfares. There is generally less sense of 'ownership' with public toilets compared to communal toilets.

Toilet coverage targets

17. During the first eight (8) weeks of the emergency response, UNHCR and WASH actors should aim to provide either one toilet for every 50 persons, or better still, one toilet shared between eight (8) families. During the emergency phase (defined as "*the period up to six months after population movement has stabilised"* – see **page 6**) UNHCR and WASH actors should aim to provide at least one toilet for every 20 persons, or better still, one toilet shared between four families. Within one year, UNHCR and WASH actors should aim to ensure that every family have their own household toilet/bathing area. If it is clear that the refugee population will be displaced for at least six months it is often more productive to move directly to the provision of shared toilets and then household toilets.

18. Providing the large numbers of toilets required in refugee settings is challenging and often requires the use of extensive labour, mechanical plant and mass production of toilet slabs and superstructures. Progress towards toilet coverage targets should be tracked on a monthly basis and interventions should be scaled up if they fall behind target.

19. UNHCR and WASH actors should also ensure adequate coverage of gender segregated toilets in all public institutions including transit areas, reception areas, markets, clinics, schools and other public institutions. The box on the right describes toilet planning figures for public institutions.

Box: UNHCR toilet coverage targets for public institutions

	Short Term	Long Term
Feeding Centres	1:50 persons	1:20 persons
Transit Centres	1:50 persons	1:50 persons
Schools	1:30 girls 1:60 boys	1:30 girls 1:60 boys
Health facilities	1:20 beds 1:50 outpatient	1:10 beds 1:20 outpatient
Market Areas	1:50 stalls	1:20 stalls
Offices	1:20 staff	1:20 staff

Source: Adapted from SPHERE (2011)

Toilet planning based on disaggregated population data

20. It is UNHCR's experience that in many refugee contexts there are typically more women and children than men. This situation is particularly evident in conflict related settings where men may have remained behind to guard property or participate in the conflict. UNHCR and WASH actors should ensure that the planning of toilet facilities is based on disaggregated population data (see the box on the following page for a worked example). In addition, since many young children use the female toilet facilities with their mothers, and women generally visit the toilet more often and take longer, UNHCR and WASH actors should factor an additional ratio of three female toilets for every male toilet.,

21. Male urinals can be used to help reduce waiting times. Urinals have the advantage of lower costs and more efficient use of space compared to toilets. When


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providing urinals, steps should be taken to discuss with beneficiaries the level of privacy that is acceptable for their use. Urinals should not be included when calculating toilet coverage figures.

Box: Toilet planning calculations based on disaggregated population data

As of 10th December 2013 there were 117,334 Syrian refugees in Za'atri Refugee Camp as follows:

Age	Male		Female	
0-4	11,499	9.8%	13,024	11.1%
5-11	11,851	10.1%	11,733	10.0%
12-17	9,035	7.7%	8,800	7.5%
18-59	20,533	17.5%	27,339	23.3%
60+	1,291	1.1%	2,229	1.9%
Totals	54,208	46.2%	63,126	53.8%

Calculate toilet coverage targets based on disaggregated data:

$$\#\text{ male cubicles} = \frac{N}{T} * \left[\frac{1}{\left(\left(\frac{F}{M}\right)*R\right)+1}\right]$$

$$\#\text{ female cubicles} = \frac{N}{T} * \left[1 - \left[\frac{1}{\left(\left(\frac{F}{M}\right)*R\right)+1}\right]\right]$$

Where…
N = total population
F = female population
M = male population
T = toilet coverage target (e.g. 1:20)
R = ratio male:female toilets (e.g. 1:3)
Therefore for Za'atri Refugee Camp…

$$\#\text{ male cubicles} = \frac{117{,}334}{20} * \left[\frac{1}{\left(\left(\frac{63{,}126}{54{,}208}\right)*3\right)+1}\right]$$

\# male cubicles = 1,306 toilet cubicles

$$\#\text{ female} = \frac{117{,}334}{20} * \left[1 - \left[\frac{1}{\left(\left(\frac{63{,}126}{54{,}208}\right)*3\right)+1}\right]\right]$$

\# female cubicles = 4,561 toilet cubicles

22. UNHCR and WASH actors should ensure that where communal toilet blocks are constructed they are always segregated according to sex and are clearly marked with culturally appropriate gender symbols and signage that are visible from 50m.

Ben Harvey (2005)

Figure 4-1 Signage, Oure Cassoni Camp

Evaluation of public health risks along the excreta management chain

23. UNHCR and WASH actors must ensure that excreta is stored, transported, treated, reused or disposed in a way that does not expose people to harmful pathogens, minimizes offensive odours in populated areas and minimizes the impact on the environment. Sanitary surveys (see **references**) should be carried out to assess public health risks to both the general public and sanitary workers (for example cleaners, technicians, maintenance staff, workers involved in desludging toilets, or excreta transportation) and formulate a plan of action. Copies of recent sanitary surveys should be included in the site WASH plan/strategy. Each step of the sanitation chain should be separately evaluated.

Excreta technology selection

Emergency phase technical options

24. UNHCR and WASH actors must ensure that there is swift provision of toilet facilities within the first few days of any refugee emergency.

25. Guidance for excreta technology selection can be found in the table and flowchart on the following page. These tools have been developed to provide options for refugee populations in camps, collective centres, abandoned buildings, occupying unused land, staying with host families or renting accommodation. They should be used as a starting point however the final decision should also take into account:

- Cultural considerations
  - Practices in the refugee population's location of origin.
  - Beneficiary preference.
  - Anal cleansing practice.
  - Willingness to share toilets.
  - Cultural taboos.
- Availability of water for flushing.
- Environmental conditions.
  - Hardness/rockiness of the soils.
  - Soil infiltration rates.
  - Ground water table distance.
  - Whether ground water is potable or non-potable (saline >1,500μScm^2)
  - Population density (rural / urban / peri-urban setting).
  - Available space for toilet construction.
- Permission from the land owner to build toilets.
- Availability of toilet construction materials.
- The presence of existing sanitation infrastructure such as sewer lines or treatment plants.
- Complicating factors such as hard ground, high water tables or flooding.
- National legislation concerning standards for sanitation and / or environmental pollution.

26. In general, the best emergency phase technical option if there are no complicating factors and no existing sanitation infrastructure is the construction of simple on-site systems such as trench latrines (**see section 4.47**) or simple VIP latrines (**see section 4.64**) organised either as communal blocks or better still, as individual units shared initially between four families. If there is a strong cultural preference for water based sanitation and there is sufficient water available (3-5 litres per person per day), and soil infiltration rates are favourable, then pour-flush toilets with septic tanks and drain fields should be considered (**see section 4.74**). In exceptional emergency situations, where there is no other option possible, it may be necessary to limit defecation to controlled locations away from water sources and below populated areas for a short period until improved facilities are constructed (**see section 4.44**).

The provision of basic excreta containment systems (for example pit latrines with reasonable privacy) is better than delayed provision of improved systems.

Upgrading emergency phase technical interventions

27. After the first few weeks of an emergency, the best excreta management strategy is often to upgrade and improve the infrastructure that was installed during the acute emergency, in addition to increasing coverage. Any temporary emergency

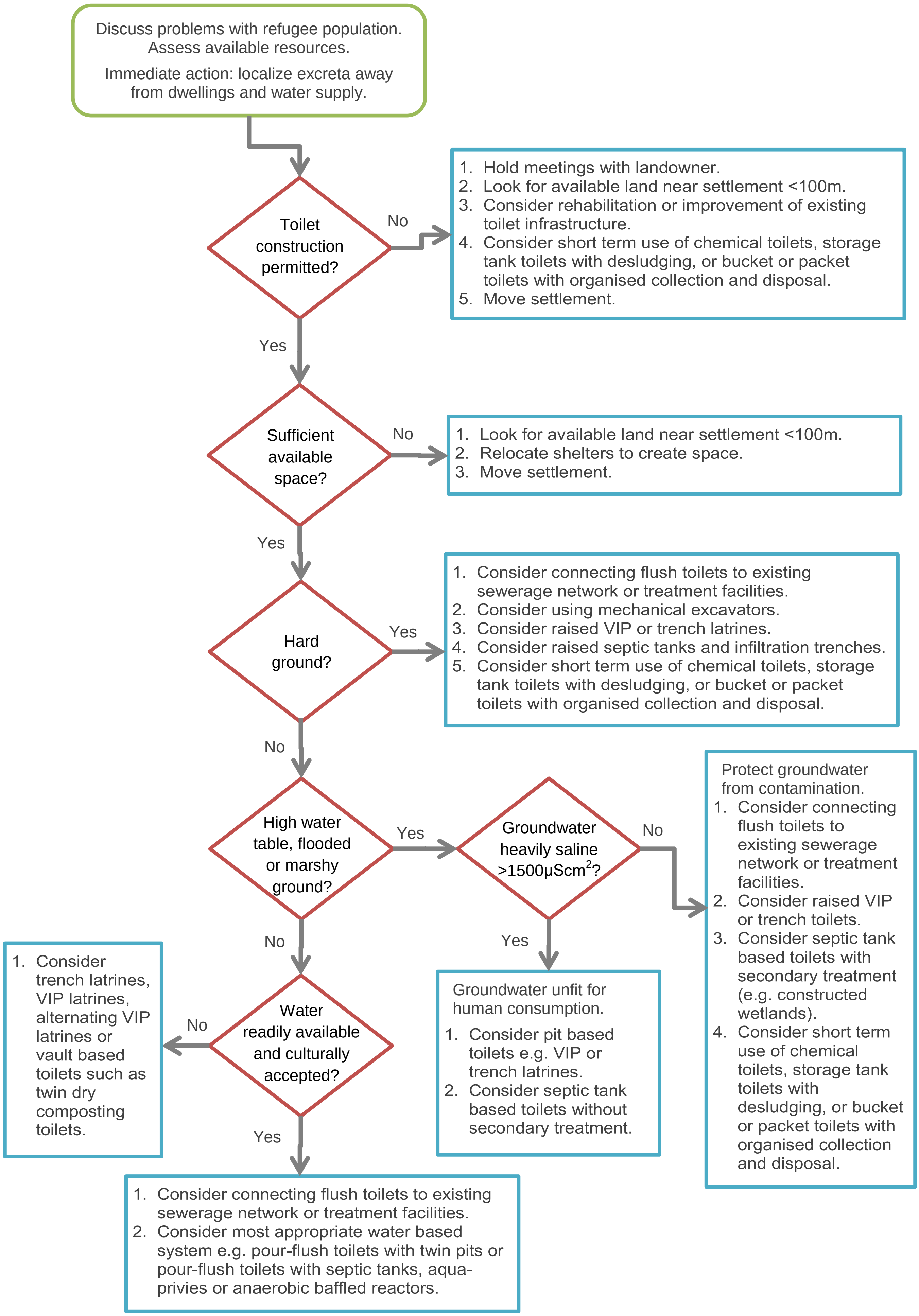
Box: Excreta management options for refugee population in camps, collective centres, abandoned buildings, occupying unused land, staying with host families or renting accommodation

		Emergency 0-3 Months		Post-Emergency 3-6 Months		Maintenance 6 Months +	
	Excreta management technical option	Urban	Rural	Urban	Rural	Urban	Rural
No additional complicating factors for toilet provision	1. Communal VIP or trench latrines	☆☆☆	☆☆☆	☆☆☆	☆☆☆		
	2. Communal alternating VIP latrines	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆	
	3. Communal flush toilets with on-site treatment (septic tanks and drain field / trench)		☆☆		☆☆		
	4. Communal flush toilets with on-site treatment (anaerobic baffled reactor)	☆☆		☆☆		☆☆	
	5. Communal flush toilets with off-site treatment (existing sewage works or stabilization ponds)	☆☆☆☆	☆☆☆	☆☆☆☆	☆☆☆	☆☆	
	6. Communal augured latrines	☆	☆				
	7. Communal chemical toilets with desludging	☆		☆			
	8. Communal defecation fields		☆				
	9. Communal flush toilets & on-site biogas digestion						☆
	10. Communal vault toilets with off-site co-composting						☆
	11. Communal vault toilets with off-site landfill						☆
	12. Household or shared alternating VIP latrines	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
	13. Household or shared VIP latrines	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆
	14. Household or shared simple pit latrines	☆☆	☆☆	☆	☆	☆	☆
	15. Household or shared flush toilets with on-site treatment (septic tanks and drain field / trench)				☆☆☆		☆
	16. Household / shared flush toilets & on-site treatment (anaerobic baffled reactor)			☆☆☆		☆☆☆	
	17. Household or shared flush toilets with off-site treatment (connection to existing sewer network)	☆☆☆☆	☆☆☆	☆☆☆☆	☆☆☆	☆☆☆☆	☆☆☆
	18. Household or shared twin pit dry composting toilets					☆☆☆	☆☆☆
Hard ground, floods, high water tables[2]	1. Communal raised VIP or raised trench latrines	☆☆☆	☆☆☆	☆☆☆	☆☆☆		
	2. Communal flush toilets with off-site treatment (connection to existing sewer network)	☆☆☆	☆☆☆	☆☆☆	☆☆☆		
	3. Communal flush toilets with raised on-site treatment (anaerobic baffled reactor & wetlands)	☆☆		☆☆			
	4. Communal chemical toilets with desludging	☆		☆			
	5. Communal storage tank toilets with desludging	☆		☆			
	6. Household or shared raised alternating VIP latrines	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
	7. Household or shared raised VIP latrines	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆
	8. Household or shared flush toilets with raised on-site treatment (ABR & constructed wetlands)	☆☆		☆☆		☆☆	
	9. Household or shared flush toilets with off-site treatment (connection to existing sewer network)	☆☆☆☆	☆☆☆	☆☆☆☆	☆☆☆	☆☆☆☆	☆☆☆
	10. Household or shared twin pit dry composting toilets					☆☆☆	☆☆☆
	11. Household bucket or packet toilets with off-site co-composting						☆
	12. Household bucket or packet toilets with off-site landfill disposal						☆
Lack of permission	1. Negotiate with landowner for new toilet facilities	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
	2. Rehabilitate any existing sanitation facilities	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆
	3. Find vacant land <100m from camp	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆
	4. Communal chemical toilets with desludging	☆		☆			
	5. Communal storage tank toilets with desludging	☆		☆			
	6. Household or shared twin pit dry composting toilets					☆☆☆	☆☆☆
	7. Household bucket or packet toilets with off-site co-composting						☆
	8. Household bucket or packet toilets with off-site landfill disposal						☆
Lack space	1. Relocated shelters to create space	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
	2. Find vacant land <100m from site	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆
	3. Household bucket or packet toilets with off-site co-composting						☆
	4. Household bucket or packet toilets with off-site landfill disposal						☆

Note 1. This table attempts to summarize the most common excreta management technical options for refugee populations, however, the user must also take into consideration any additional cultural, environmental, geographical, technological and legal factors. Detailed description of each of the technological options, along with any advantages and disadvantages can be found in the following pages.

Note 2. Options for high water tables should only be followed where groundwater is potable. If the groundwater is saline (<1,500 μScm^{2}), then conventional pit based options may be considered in the short term.

Figure 4-2 Toilet selection tool for refugee settings



superstructures built using plastic sheeting may be upgraded to more durable designs for example using galvanized iron sheeting, wooden planks, wooden panels, bricks or concrete. If it is clear that the population will be displaced for at least six months, then UNHCR and WASH actors should start to reflect on the best ways to support refugees with the construction of household toilets, and how to smoothly transition out of the use of communal toilet facilities.

Temporary systems, to meet the most immediate needs, will have to be improved or replaced by others as soon as possible, in order to maintain adequate standards.

Post emergency phase technical options

28. UNHCR has found that the average length of time that contracted refugee situations last is up to 17 years. Therefore, if it is clear that the population will be displaced for more than six months UNHCR and WASH actors should completely phase out communal WASH facilities and ensure that every household has access to their own toilet and bathing area (or in high density urban settings, where there is insufficient space, a toilet shared with immediate neighbours if acceptable). Post emergency phase household toilet designs should be based on national guidelines, locally available materials and designs that are functional and durable, yet economical.

Technical considerations for high water table or flooded environments

29. High water tables or flooded environments add additional challenges to toilet provision. High water tables and floods can inundate existing toilet pits and allow faecal pathogens to directly contaminate the flooded environment. If the site is in a coastal region where the groundwater is saline or otherwise unfit for human consumption (i.e. has a TDS of >1500µScm^2) then conventional pit and trench based sanitation options may be considered. Otherwise, UNHCR and WASH actors must ensure that excreta management systems in high water table or flooded environments do not contaminate ground or surface waters. Generally, the best emergency phase technical option for high water table and flooded environments (if there is no existing sanitation infrastructure to connect to such as existing sewer pipes or treatment facilities) is the construction of simple raised latrines. If there is a strong cultural preference for water based sanitation then pour flush toilets with septic tanks may be constructed either directly above aqua privys (**see section 4.77**), storage tank toilets (**see section 4.58**) or connected to septic tanks (**see section 4.77**).

30. Care should be taken in high water table environments to ensure that any new sealed vault based systems do not float out of the ground (i.e. they are designed with an anti-floatation collar) and they are not at risk of inundation (the

top of any septic tank should be at least 0.5m above the highest annual recorded ground water level). The base of any infiltration or evapotranspiration systems should either be sealed or raised at least 1.5m above the highest annual ground water level. In totally flooded environments, or environments where the ground water table is very close to the ground surface, the use of raised sealed desludgable storage tank toilets (see section 4.58), chemical toilets (see section 4.51), or bucket and packet toilets (see section 4.54) may be considered. All of these systems require well managed collection and disposal systems and should only be considered as a short-term solution during the emergency phase.

Technical considerations for hard ground conditions

31. Hard, rocky, or frozen ground may render the construction of toilet pits impossible. Hard ground typically also has poor soil infiltration characteristics which can complicate toilet designs that rely on infiltration of liquids. In hard ground conditions the easiest solution may be to connect up to any existing sanitary infrastructure. If no existing sanitation infrastructure is available, heavy plant (mechanical excavators or rock breaking equipment such as pneumatic hammers) may be required to break through the hard ground and allow construction of traditional pit or vault based systems. If this is impractical or unfeasible, then the next best solution may be to excavate pits as deep as is possible into the hard ground and then construct raised vault based systems upwards and out of the ground. Vault sizes may be required that are wider than usual to create sufficient volume without creating structures that are too high off the ground. Both raised VIP latrines (see section 4.67) and raised composting toilets (see section 4.99) are appropriate if the population has a preference for dry systems. If there is a strong cultural preference for water based systems then care should be taken to ensure that the ground has sufficient capacity to absorb any liquid effluents see (references for soil percolation tests). If the ground has no infiltration capacity then the best solution may be either to use dry toilet options, or move to more complicated solutions involving either the movement of excreta for example desludgable storage tank toilets (see section 4.58), chemical toilets (see section 4.51), or bucket and packet toilets (see section 4.54) or the construction of onsite treatment systems for example septic tanks with constructed wetlands (see sections 4.77 and 4.114), or waste stabilization ponds (see section 4.112).

Technical considerations for urban environments

32. Urban environments can present problems numerous problems for emergency excreta management as there may be problems with insufficient space for toilet facilities, land ownership issues, hard (concrete) ground, or environmental restrictions limiting pit based toilet options. During any emergency, the easiest option may be to set up temporary toilets that

connect to existing sanitation infrastructure (sewer pipes, treatment facilities). If space is available, the ground can be excavated, and there are no issues with elevated groundwater levels, it may be possible to construct either trench latrines (see section 4.47), simple VIP latrines (see section 4.64), or if water is available and preferred - simple pour-flush toilets with septic tanks (see section 4.74). If the construction toilet facilities is not possible then it may be possible to upgrade and extend any existing toilet facilities (within 100m) of the site. If all of these options are not possible then a final solution may options based on excreta transportation including chemical toilets (see section 4.51), raised storage tank toilets (see section 4.58), bucket toilets, or packet toilets (see section 4.54). All of these last options require well managed systems of collection, treatment and disposal and should only be used in exceptional circumstances for the short-term.

33. During the post-emergency phase, excreta management solutions should be selected based on existing local urban planning guidance and legislation which typically aims to reduce the impact of sanitation infrastructure on groundwater supplies. If no local legislation exists, then a solution should be found based on local knowledge and preference which may include shared of communal desludgable VIP toilets (see section 4.69). Alternatively, If there is a strong cultural preference for water based sanitation the most economic solution is to size septic tanks or anaerobic baffled reactors (ABRs) at the residential block level with individual connections. Septic tanks or ABRs have the added advantage of being able to treat greywater from bathing and laundering activities.

34. In many urban settings refugees end up renting or living with host families. In these cases, UNHCR and WASH actors may consider including sanitation upgrades as part of the host-family assistance package. In addition, UNHCR and WASH actors may also be able to work with urban policymakers so that tenants are able to install toilet facilities in rental properties with the cost of improvements being subtracted from rent payments.

Technical considerations for cold climates

35. Recent emergencies in Afghanistan, Bosnia, Chechnya, Georgia, Northern Iraq, Syria and Eastern Ukraine have revealed the importance of guidance for excreta management systems in cold climates. Cold climates add a host of additional complications including freezing of water and excreta, problems related to excavating frozen ground, and slowing down of biological processes in septic tanks. In general, the choice of excreta management technology should be guided by local practice and expertise however, generally simple pit based excreta management options should be considered as they avoid the problems of freezing water pipes. If excavation of pits is not possible due to hard frozen ground then the excreta management solutions for

hard ground situations (**see section 4.31**) such as chemical toilets (**see section 4.51**), raised storage tank toilets (**see section 4.58**), or bucket toilets or packet toilets (**see section 4.54**) may be considered for short durations. If there is a strong cultural preference for water based systems then they should be heavily protected with lagging and possibly passive heating options such as electrical resistivity wire. Defecating in sub-zero conditions can be unpleasant and toilet facilities may be combined with shower facilities with minimal heating and insulation to ensure that they are comfortable for use.

Design life-spans for excreta management systems

36. All communal toilets should be phased out within the first year and should therefore be sized for one year of use (plus a safety factor). Public toilets at clinics, schools and market areas are likely to be used for the duration of the refugee emergency and should be sized for at least five to size years. Household toilets should also be sized for five to six years unless an alternating design is being used and therefore each pit should be sized for two years. The exact dimensions of the chosen system will typically depend upon the number of users (**see section 4.19**) and the anal cleaning method (see box below for typical sludge accumulation rates). Pit based designs should allow for at least 0.5m of soil covering for decommissioning. It should be noted that accumulation of non-degradable anal cleaning materials can seriously affect the useful life.

Box: Typical toilet sludge accumulation rates

Scenario	SAR
Water based and degradable anal cleaning materials	0.04 m^3 per pers per yr
Water based and non-degradable anal cleaning materials	0.06 m^3 per pers per yr
Dry conditions and degradable anal cleaning materials	0.06 m^3 per pers per yr
Dry conditions and non-degradable anal cleaning materials	0.09 m^3 per pers per yr

Note: Where excreta is stored for shorter periods, such as in alternating pit latrines or composting toilets it is recommended to use the SAR x 2.

Source: Franceys, Pickford & Reed (1992) '*Guide to the development of on-site sanitation*'. World Health Organization, Geneva.

Ensuring toilet construction quality

37. UNHCR and WASH actors should ensure that all toilets are built to a high standard that fully contains excreta and ensures the physical safety of all users. Detailed UNHCR technical guidelines can be found on **wash.unhcr.org**. The following guidance can be found:

- Guidelines for the prevention of surface or ground water contamination
- Guidelines for pit reinforcement
- Guidelines for toilet slab strength
- Guidelines for the use of plastic sheeting in communal toilet construction
- Guidelines for toilet doors
- Guidelines for communal toilet privacy walls
- Guidelines for vector control measures for toilets
- Guidelines for protection of toilets from rain and stormwater
- Guidelines for additional WASH block accessories

- Guidelines for the collection and management of anal cleansing and women's sanitary materials
- Material specifications of common toilet construction materials

Household toilet construction

38. UNHCR and WASH actors should ensure that households are supported to build toilets to a high standard of quality. In many household toilet construction programmes it is typical for UNHCR to support households through the provision of tools, limited construction materials and technical support. Care should be taken to ensure that the refugee population fully understand the technical and programmatic details of the household toilet programme. If the refugee population are required to construct a part of the toilet structure themselves, a full package of technical assistance and capacity building should be budgeted.

Figure 4-3 Mozambican style domed slabs

39. The use of household toilets with reinforced concrete domed toilet slabs (Mozambican style) and double alternate pits is highly recommended in many contexts (see designs on **wash.unhcr.org**). Concrete toilet slabs can weigh as much as 320 kgs therefore it is highly recommended that round slabs are cast that can be easily manoeuvred on their sides. It is also highly recommended that round pits are constructed (in conjunction with the round slabs) as they have greater stability in softer soils. Wooden moulds can be used to make smooth surfaced concrete slabs without corners to facilitate cleaning. Complex moulds can even be used to fabricate foot rests or pour-flush bowls. In general, mass-production should be used to ensure a consistent quality and ramp up availability.

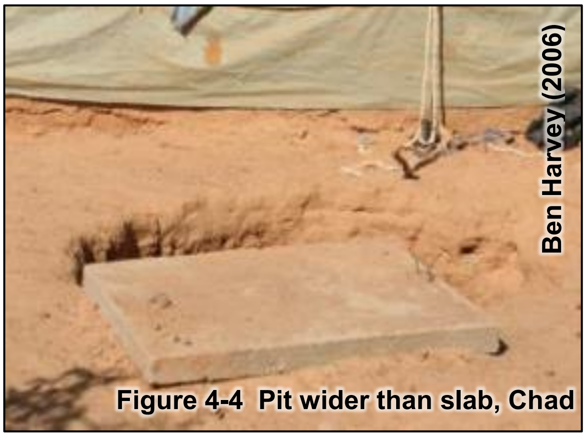


Figure 4-4 Pit wider than slab, Chad

Excreta management programmes for host communities

40. An environment free from human excreta is among the primary public health priorities for refugee settings. However, in many settings it may be the case after a period of time that the sanitation coverage of the refugees is significantly greater than the local host population around the camp. If this is the case, UNHCR and WASH actors should work with national development actors and on-going sanitation initiatives to ensure that the host community is also able to benefit from the health

gains that come from improved sanitation.

41. In areas where the refugee population are living amongst the host population (for example in urban refugee settings) it is possible that the presence of large numbers of refugees over-burden sanitation service providers or may increase the presence of open defecation. Working with municipal service providers to make sanitation improvements and upgrades may able to benefit both the refugee and host populations equally.

Community led total sanitation

42. Community-led total sanitation (CLTS) is a methodology for mobilising communities to eliminate open defecation in their environment themselves. During CLTS, a facilitator takes the community through 10 steps (see box below). At the heart of CLTS lie two core philosophies. The first is prohibition of any form of sanitation subsidy in an effort to avoid dependence. The second is that as long as even a minority of people continues to practice open defecation, everyone in the community is at risk of disease.

43. CLTS should not be used during the emergency or post emergency phases, however CLTS may be appropriate for host or refugee populations in some long-term refugee settings especially if there is evidence that the approach has already been successful. WASH actors embarking on CLTS type activities should take appropriate steps as recent studies have noted that people in extremely vulnerable situations have difficulties participating and may be unfairly stigmatized by the process. In addition, evidence has shown that despite a zero subsidy approach, CLTS programming costs can still be high due to the expenses related to social mobilization and follow up.

Box: The steps of community led total sanitation (CLTS)

Step 1: The community discuss the impacts of open defecation with an external facilitator.

Step 2: Together, they visit sites of open defecation.

Step 3: The community maps out the areas of open defecation, by drawing a map.

Step 4: The community works out how much excreta they produce in total. On average, one house generates over one metric tonne of faeces per year. Without latrines, this waste is spread everywhere, which makes people ill.

Step 5: The community draws up an action plan to tackle the situation.

Step 6: Health and Hygiene education sessions are carried out.

Step 7: The facilitator and community work out an action plan.

Step 8: Construction of latrines begins. Members of the community who are not participating in the new behaviour are shamed, for example by putting flags in outdoor faeces, or by issuing a fine.

Step 9: Latrines are now available to everyone and hygiene education continues.

Step 10: The community is awarded defecation free status and a sign is erected at the community entrance.

Source: Ten steps to total sanitation (WaterAid, 2012)

Excreta management technical options

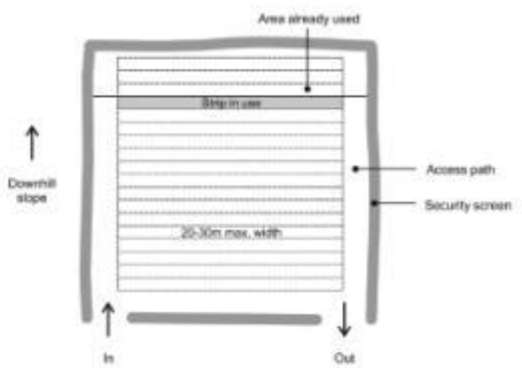
Defecation fields

44. A defecation field is an area of land allocated divided into strips around 1.5m wide and 20m long (see figures below). During operation, users are guided into the active area using a system of ropes, or other appropriate markings, beginning with strips farthest from the entrance. If time and resources are available the defecation field should be improved by excavating shallow trenches up to 20cm deep to allow excreta to be covered with soil. In addition, a privacy screen of plastic sheeting should be established around the strip in use. When the strip has been used up, it should be safely covered with soil and a new strip opened. Land used for defecation fields should be downstream from the site and away from any water sources. The defecation field should also slope away from the refugee site. . Defecation strips should be arranged to follow the natural contour of the plot. If necessary, a shallow diversion trench should be excavated above the field to prevent any surface water running onto it. If resources are available a thorny fence should also be put around the area to discourage animals or people walking directly through the field and spreading excreta into the camp. There should always be completely separate defecation fields established for men and for women. To encourage use, defecation fields should be within walking distance.

45. UNHCR and WASH actors should ensure that at least one attendant is assigned to ensure facilities are used correctly. Functional hand-washing facilities must be installed at the defecation field exit and users should be encouraged to use them. Users should cover their excreta with ash, lime or soil to prevent the breeding of flies and reduce odours. If the users do not cover their faeces then the attendants should do it for them. Users may need to be provided with anal cleansing material or water if they cannot be reasonably expected to provide their own.

Wherever possible, avoid the use of defecation fields. Operating defecation fields beyond several weeks is not advisable.

46. The major advantage of defecation fields is that they can very quickly provide excreta control in a very short period of time. Their major disadvantage is that they are a very short term emergency solution with a limited lifespan, little privacy and dignity and they require a large amount of space (plan for 0.25m^2 per person per day). Defecation fields should only be used in exceptional circumstances.



WEDC (2007)

Figure 4-5 Defecation field layout

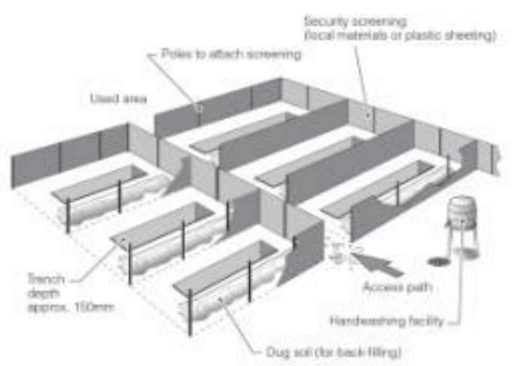


Figure 4-6 Defecation field layout

Trench latrines

47. Trench toilets consist of a long trench of up to a maximum of 6 cubicles long on top of which the 1.2m x 0.8m interagency standard plastic toilet slabs are placed. If interagency standard plastic emergency toilet slabs are not available, slabs can be constructed from a variety of materials including wooden planks, wooden poles or reinforced concrete. Trenches should always be protected from surface water and trench walls may need shoring up in soft soils to prevent pit collapse. Emergency trench latrines may also be used in some contexts with pour-flush toilets, in which case the best configuration is an offset configuration with the trench behind the privacy structure. In this case, the interagency plastic emergency toilet slab may be adapted by attaching a pour-flush toilet bowl adapter to the underside.

Trench toilets should be dug 1.8 to 2.2m deep and 90cm wide to accommodate an interagency standard plastic toilet slab (1.2m x 0.8m).

48. The trench latrine superstructure is typically made from plastic sheeting arranged over a wooden frame. Wooden frames can be constructed in-situ, however a faster approach is to mass produce panels in a dedicated facility and assemble them on-site. Panels should be bolted together so they can easily be moved at a later date. Flat wooden toilet superstructure panels may also be stored as an emergency contingency stock for future emergencies or influxes. If available, local materials such as grass matting, cloth, wood planks or boards, or galvanized iron roof sheeting may be used as an alternative covering to plastic sheeting. Good quality wooden framed superstructures allow a degree of upgrading of the latrine to be planned at a later stage.

Box: Calculating the useful life of existing trench latrines

Two months after an emergency it has been calculated that there is one toilet cubicle available for every 67 persons. What is the useful life of the existing communal trench latrine facilities?

The equation for pit sizing is as follows

Pit volume (V) = N x P x R

where

N = the effective life of the pit (years)
P = the average number of daily users
R = sludge accumulation rate (m^3 / yr)

Rearranging for the life of the pit gives

Pit life (N) = V / (P x R)

In our case, the volume (V) of one communal trench latrine block can be calculated by multiplying the pit length by the width by the depth (m). Allowing an additional 0.5m of the depth for backfilling gives us..

Pit vol. = length x width x (depth – 0.5m)
Pit vol. = 3.95m x 0.9m x (2.5m – 0.5m)

Pit volume = 7.11 m^3

The average number of daily users (P) for the latrine can be calculated as..

Average daily users (P) = T x S

where

T = current toilet coverage (e.g. 1:67)
S = number of toilet cubicles

therefore

P = 67 x 5 = 335 users per day

Assuming non-degradable anal cleansing materials gives a sludge accumulation rate of 0.09m^3 per person per year (see section 4.36). It follows that

Pit life (N) = V / (P x R)
Pit life (N) = 7.11 / (335 users x 0.09m^3/yr)
Pit life (N) = 0.24 years = 3 months

In conclusion, if there is an average toilet coverage of 67 persons per cubicle the emergency trench latrine facilities will only last for a period of three months before they are full and require decommissioning.

49. Management of communal trench latrines is dependent upon the capacities of the refugee population. However, latrine attendants are typically required to ensure they are kept clean and functional (day and night). If trench latrines are constructed it is better to install a large number of small facilities than a small number of large facilities. Typically one unit for every 16 families (i.e. one community) is a good target. When the trench latrine is filled to within 50 cm of the top, it must be properly decommissioned by covering with soil and compacted.

50. The advantages of trench latrines are that they can be installed relatively quickly, especially if mechanical excavators are readily available and superstructure panels and plastic interagency squatting slabs have been stored as contingency stock. Their main disadvantage is common to most communal sanitation facilities in that they often require intensive supervision to ensure they are kept in a clean and functional condition. Trench latrines are a good short term excreta management solution that are readable upgradable and can be used in most settings where there are no complicating factors (hard ground, high water tables and floods) and the population does not want to go straight to shared facilities between four families. Trench latrines should not be used in refugee settings beyond six months. A bill of quantities and detailed technical design can be found on **wash.unhcr.org**

Figure 4-7 Trench latrines, Pakistan Quake

Chemical toilets

51. Chemical toilets consist of a pre-fabricated toilet unit, typically made from high density plastic, with a water tight vault, which is used to store excreta and urine. The vault usually contains a blue coloured chemical which breaks down the excreta and reduces smells. Chemical toilets were used with varying success during the Haiti earthquake of 2010 and for Syrian refugees in Turkey in 2013.

52. The effective management of chemical toilets is heavily dependent upon the quality, availability and capacity of specialised desludging services. Typically toilet rental, desludging, cubicle cleaning, topping up of toilet paper and deodorizing comes as part of a contracted service package with a daily charge based on the number of units being rented. It should be noted that the service package does not usually include the provision of handwashing water and supplies and this may needs to be negotiated or arranged separately. Alternatively, chemical toilets may be procured and serviced directly by the WASH agency although this option is prohibitively expensive requiring the purchase or leasing of dedicated desludging vehicles and service crews.

53. The advantage of chemical toilets is that if they can often be mobilized rapidly, especially if contracts have been pre-negotiated or chemical toilets are included in contingency stocks. Chemical toilets are also suitable for short-term use in complex environments including high water tables, floods (provided units are accessible by desludging trucks), hard ground, urban settings, or sites where the land owner has not permitted toilet construction. Their main disadvantage is that they require daily desludging which if not carried out safely can pose significant risks to the population, staff or the environment. In addition a safe final disposal site must be identified (sewer, waste treatment plant, waste stabilization ponds, lagoons). Another disadvantage is that chemical toilets can only be located in areas that are accessible by desludging trucks. Toilets must also be positioned on a perfectly flat ground to avoid tipping over. It is important to note that desludging operations are usually extremely costly and a clear exit strategy should be sought from the start. Due to their high costs and complexity, UNHCR and WASH actors should only consider chemical toilets as a very short-term, last resort option in urban, hard ground, or high water table contexts where no other option is suitable.

Figure 4-8 Chemical toilets, Turkey

Figure 4-9 Chemical toilets, Haiti

Bucket toilets and packet toilets

54. Bucket toilets consist of a storage container (typically a standard 15 – 20 litre bucket, although larger systems have been managed successfully using 200 litre wheelie bins) with some form of seat that is either attached directly to the bucket or is part of a separate

privacy structure. Packet toilets consist of a strong cardboard box type seat structure around which is placed a bio-degradable plastic sack into which the user defecates – typically within their own home.

Figure 4-10 Household bucket toilet

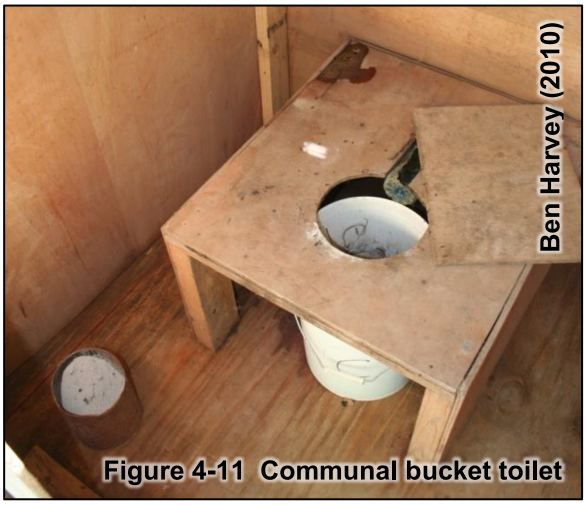


Figure 4-11 Communal bucket toilet

55. When full, bucket toilets can either be managed at the household level (through disposal into a pit or composting system) or at the centralized level. One effective method of managing the collection of bucket toilets is through a swop system using fully sealed plastic drums. Partially full drums are sealed (typically with a plastic screw lid) and are exchanged for cleaned, disinfected, empty drums. The partially full drums are loaded onto a pickup truck and taken to a centralized facility for treatment (see section 4.107 on co-composting) or disposal.

56. The collection of used packet toilets (excreta contained in biodegradable plastic sacks) may be organized through centralized collection. In extreme cases, biodegradable plastic sacks containing excreta may be disposed with solid waste, however mixing of waste streams is generally considered bad practice and should not be used beyond the initial few weeks of the emergency response (see section 4.121 for guidelines on short-term landfill disposal of excreta).

Figure 4-12 Packet toilet, Haiti

57. The main advantage of both bucket and packet toilets is that they can often be mobilized rapidly if they have been included in contingency stocks. They are also suitable for short-term use in environments with high water tables, floods, hard ground, urban settings, or sites where the land owner has not permitted toilet construction. Their main disadvantage is that they need systems of safe, well organised daily collection and disposal. In addition, many cultures may find it degrading to have to defecate into a bucket or plastic bag, especially within their own shelter. Therefore

UNHCR recommends that bucket or packet toilets should not be used beyond the initial weeks during an emergency response.

Storage tank toilets

58. Storage tank toilets use large volume waterproof tanks to contain excreta. A reinforced raised superstructure with a platform is installed so that users can defecate directly (or indirectly) into the tank. The desludging period can be anything from weeks to several months depending upon use. Storage tank toilets are usually managed in the same way as communal trench toilets or communal VIP toilets with a mechanism that is dependent upon the capacities of the refugee population. Where there is a lack of social cohesion, UNHCR and WASH actors may need to ensure that latrine attendants are engaged to ensure the facilities are kept clean and functional (day and night).

59. The advantages of storage tank toilets is that they can be quickly installed for short term use in environments with high water tables, floods, hard ground, urban settings, or sites where the land owner has not permitted toilet construction. In addition, large HDPE "polytanks" are usually available in many settings on the local market. Their main disadvantage is similar to chemical toilets in that they require frequent desludging operations which if not carried out correctly may impose health risks on the population, sanitary workers and the environment.

Figure 4-13 Storage tank toilets

60. If storage tank toilets are deployed then a safe final disposal site for the excreta must be used (sewer, waste treatment plant, waste stabilization ponds, lagoons). In addition, storage tank toilets should be located in areas that are easily accessible by desludging trucks. Care should also be taken to ensure separate collection of items (women's sanitary materials, plastic bags etc.) that may block or damage the desluding equipment. Finally, it is important to note that desluding operations are costly and a clear exit strategy should be sought from the start. Storage tank toilets should only be used in exceptional circumstances in high groundwater, flood, hard ground or sites where permanent toilet construction is not permitted. A detailed design and bill of quantity for a raised communal storage tank toilet can be found on wash.unhcr.org.

Box: Calculating the desludging frequency of storage tank toilets

During an emergency response, an agency has constructed communal storage tank toilets with a volume of 2m^3. Each unit has two cubicles and the toilet coverage is currently one cubicle for 126 people. Toilet paper is used for anal cleansing. How many days will these facilities last before they need desludging?

The basic equation for vault sizing is

Volume (V) = N x P x R

where

N = the desludging period (years)
P = the average number of daily users
R = sludge accumulation rate (m^3 / yr)

Rearranging for the desludge period gives

Desludge period (N) = V / (P x R)

The average number of daily users (P) for the toilet block can be calculated as..

Average number of daily users (P) = T x S

where

T = current toilet coverage (e.g. 1:126)
S = no. of toilet cubicles per block (e.g. 2)

therefore

P = 126 x 2 = 252 users per day

A sludge accumulation rate of 0.06m^3 per person per year has been selected for wet conditions with degradable anal cleansing materials (see section 4.36). Excreta storage is of short duration so the rate has been doubled. It follows that

Desludge period (N) = V / (P x R)
Desludge period (N) = 2m^3 / (252 x 0.12)
Desluge (N) = 0.066 years = 24 days

In conclusion, if there is an average toilet coverage of 126 persons per cubicle the storage tank toilets will need desludging approximately every 24 days.

Simple pit latrines

61. Simple pit latrines consist of a pit, a slab support structure, a squatting slab and a privacy shelter. In refugee, settings, simple pit latrines may be shared between families or may be constructed as communal blocks.

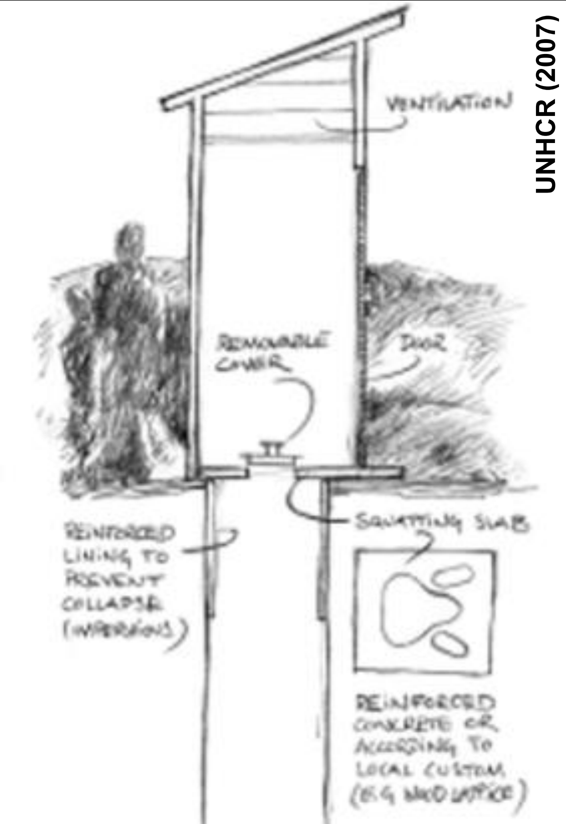


Figure 4-14 Simple pit latrine

62. Communal pit latrines are usually managed in the same way as communal trench toilets or communal VIP toilets with an approach that depends upon the level of social cohesion within the community and possibly a dedicated toilet attendant. If simple pit latrines are allocated on a household or shared basis the owners are typically responsible for any operation, maintenance and cleaning activities.

63. The advantage of simple pit latrines is that they are relatively cheap and quick to construct. Their disadvantage is that they cannot be used in high water table, hard ground and flooded situations and they are prone to problems with smells and fly infestation. These problems can be partially overcome through the use of a tightly fitting squat hole cover, however in all cases it is much better to upgrade all simple pit

latrines into the ventilated improved pit (VIP) latrine design as soon as possible. A detailed technical design and bill of quantities for a simple pit latrine can be found on **wash.unhcr.org**.

In all situations, UNHCR and WASH actors should use the ventilated improved pit latrine design over the simple pit latrine design. Any existing simple pit latrines must be upgraded as soon as possible.

Ventilated improved pit (VIP) latrines

64. The ventilated improved pit (VIP) latrine design overcomes the problems of smells and fly infestation typically encountered with simple pit latrines through the addition of a black exterior vent pipe, a darkened privacy shelter, and gauze mesh covering the vent pipe exit. The VIP latrine's advantage is that bad smells are drawn out of the toilet cubicle and up and out of the vent pipe by a combination of solar heating within the vent pipe and suction as wind passes over the top of the vent pipe. It is recommended that the vent pipe is at least 15 cm in diameter, is a dark colour, and extends at least 0.5 metres above the superstructure roof to maximize the suction effect. The vent pipe should be installed on the sunny side of the toilet for maximum convection and insect control. A lack of smells coming from the toilet interior reduces fly infestation. The interior of the toilet cubicle is kept darkened to trap flies in the latrine vault. Any flies that enter the vault are attracted to daylight shining down the vent pipe and become trapped by the vent pipe's metal fly-screen. The toilet cubicle does not have to be so dark as to deter use. A simple spring loaded door may be sufficient to keep the cubicle interior shaded most of the time.

Box: Household VIP pit latrine sizing calculation

Sizing calculation for a dry circular household VIP pit latrine with a design life of 5 years.

Pit volume (V) = N x P x R

where

N = design life of the pit (e.g. 5 years)
P = number of daily users (e.g. 6 persons)
R = sludge accumulation rate (m^3 / year)
Assuming degradable anal cleansing materials are used gives a sludge accumulation rate of 0.06m^3 per person per year (**see section 4.36**).

It follows that

Pit volume (V) = 5 x 6 x 0.06 m^3 per year
Pit volume (V) = 1.8 m^3

Assuming a circular slab of diameter 1.5m is used with a circular pit of diameter 1.0m.

Pit vol. (V) = (π x radius^2) x pit depth (D)

Rearranging gives

Pit depth (D) = volume / (π x radius^2)
Pit depth (D) = 1.8 m^3 / (π x 0.55 x 0.55)
Pit depth (D) = 1.9 m

Allowing 0.5 m soil for decommissioning gives a total design depth of 2.4 m.

65. Communal VIP latrines are usually managed in the same way as communal trench toilets or communal storage tank toilets. If VIP latrines are allocated on a household or shared basis the owners are typically responsible for any operation, maintenance and cleaning activities.

66. The main advantage of the VIP latrine is that it overcomes the typical problems of flies and smells associated with simple pit latrines and trench latrines. The main disadvantage is that the design is not suitable for high water tables,

flooded environments, hard ground, or high density urban settings. In addition, the design is a little more complex than the standard simple pit latrine and the subtle improvements are often misunderstood and poorly implemented. In addition, the darkened interior can deter use, particularly for small children. A detailed technical design and bill of quantities for both household and communal VIP latrines can be found on **wash.unhcr.org**.

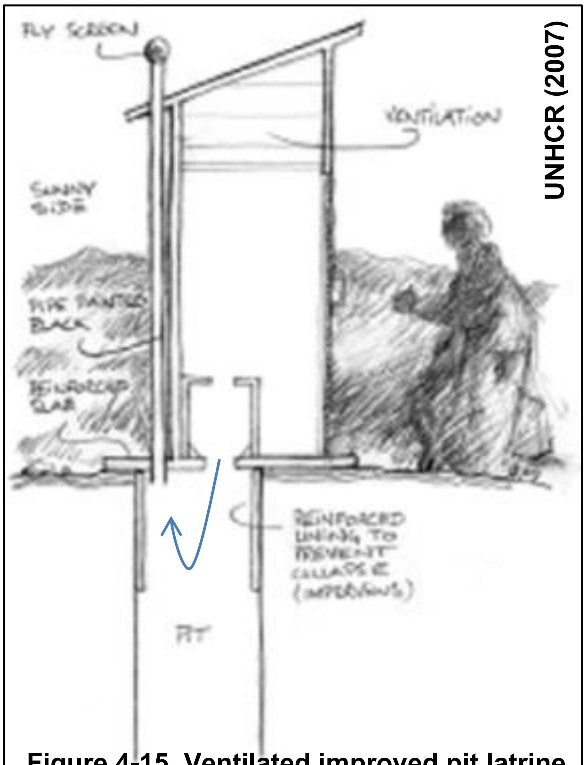


Figure 4-15 Ventilated improved pit latrine

Raised pit latrines

67. In some cases it may be difficult to excavate into hard ground, or water tables may be high, and the best excreta management solution may be to use a standard pit latrine design excavated as far as possible into the hard ground, and then extending the vault structure out of the ground. The vault will typically require additional lining material such as bricks, blocks, or tamped earth. Communal raised latrines are usually managed in the same way as communal trench toilets or communal VIP toilets. If raised latrines are allocated on a household or shared basis the owners are typically responsible for any operation, maintenance and cleaning activities. Raised pit latrines should be upgraded to the raised VIP type wherever possible.

68. The advantage of raised latrines is that the design can be used in hard (rocky) ground and contexts where the ground water table is high. Their main disadvantage is that building the latrine pit up and out of the ground requires more construction materials, greater skills on the part of the technician, and generally increased costs. Care also needs to be taken to ensure the bottom of the pit is still at least 1.5m from the groundwater table to allow sufficient distance for pathogens to be destroyed. Care should be taken if raised latrines are constructed on hard ground to ensure there is insufficient infiltration capacity. A detailed technical design and bill of quantities for a raised pit latrine can be found on **wash.unhcr.org**.

Box: Calculating the required size of raised VIP latrines

During an emergency response, a refugee settlement has been designated on volcanic rock with a thin soil covering of 60cm. An agency wants to install raised communal VIP toilets with 4 cubicles per block. A decision has been made that these should be no more than 1m high above the ground. How big do these facilities need to be to ensure adequate storage for two years?

The basic equation for vault sizing is

Pit volume (V) = N x P x R

where

N = the effective life of the pit (i.e. 2 yrs)
P = the average number of daily users
R = sludge accumulation rate (m^3 per yr)

The average number of daily users (P) for the toilet block can be calculated as..

Average number of daily users (P) = T x S

where

T = the design toilet coverage (e.g. 1:20)
S = number of toilet cubicles (e.g. 4)

therefore

P = 20 x 4 = 80 users per day

A sludge accumulation rate of 0.06m^3 per person per year has been selected for dry conditions with degradable anal cleansing materials.

It follows that

Pit volume (V) = N x P x R
Pit volume (V) = 2 yrs x 80 x 0.06 m^3/yr
Pit volume (V) = 9.6 m^3

Assuming a total length of 3.65 m (4 cubicles) and a design depth of 1.6 m (1m above ground and 0.6m below ground)..

Pit width(W) = pit vol / (length x depth)
Pit width (W) = 9.6 m^3 / (3.65 m x 1.6 m)
Pit width (W) = 1.64 m

In conclusion, the communal raised VIP toilets need to be constructed 1m out of the ground with a pit width of 1.64m in order to provide 2 years storage. Note that as the raised VIP pit latrine needs to be fully lined, a better design is to upgrade to an alternating design that can be emptied – see section 4.69

Alternating twin pit VIP latrines

69. Alternating twin pit VIP latrines have two fully lined shallow pits side-by-side, both of which are ventilated by separate vent pipes capped with fly screens. Each pit is designed to fill up during a period of two to three years, after which the pit contents are left for at least two years to ensure that all faecal organisms are killed and the pit contents is fully decomposed. Urine diversion can be used to keep the pits in a dry state and prevent the contents becoming anaerobic in addition to reducing odours. Small quantities of sawdust, ash, dry leaves (or any other carbon rich substances including organic household refuse) may be added to enhance the anaerobic composting process. When the pit is full to within 20cm the pit should be sealed and the drop hole should be switched so that the other pit is filled. After two year, the sealed pit contents can be safely removed and the pit reused. If reuse is culturally acceptable, the pit contents may be used for agricultural purposes.

Box: Household alternating twin pit VIP latrine sizing calculation

Sizing calculation for a household alternating twin VIP pit latrine with two fully lined pits and design life of 2 years.

Pit volume (V) = N x P x R

where

N = the design life of the pit (e.g. 2 years)
P = number of daily users (e.g. 6 persons)
R = sludge accumulation rate (m^3 / year)

Assuming degradable anal cleansing materials are used gives a sludge accumulation rate of 0.06 m^3 per person per year (see section 4.36). The rate should be doubled to take into consideration the addition of small quantities of organic material (ash, leaves, organic refuse). It follows that

Pit volume (V) = 2 x 6 x 0.12 m^3 / year
Pit volume (V) = 1.44 m^3

Assuming two square lined pits of width 1.2m x 1.2m are used. It follows that.

Pit volume (V) = length x width x depth

Rearranging for depth gives

Pit depth (D) = volume / (length x width)
Pit depth (D) = 1.44 m^3 / (1.2 m * 1.2 m)
Pit depth (D) = 1.0 m + 0.2 m freeboard

Therefore two alternating pits of 1.2 m depth are required to ensure the contents are left for at least two years before the pits can be safely emptied.

70. If they are constructed as communal facilities, alternating twin pit VIP latrines are usually managed in the same way as standard communal trench latrines or communal VIP latrines. If alternating twin pit latrines are constructed on a household or shared basis the owners are typically responsible for any operation, maintenance and cleaning activities including managing the emptying of any composted excreta.

UNHCR and WASH actors are encouraged to promote the use of twin pit alternating VIP latrines in most refugee settings. The fact that there is no toilet replacement costs makes this a highly economic option for most refugee households.

71. The main advantage of alternating twin pit VIP latrines is that the life of the latrine can be continually extended and the toilet never needs to be decommissioned and replaced. In addition, after two years the pit contents have been rendered pathogen free and the high quality compost can be used to increase crop yields. Their main disadvantage is that the design requires acceptance from the community. In addition, the design is slightly more complex and expensive than simple VIP latrines requiring pit lining and urine separation infrastructure. Even where there is no willingness to reuse the composted excreta the fact that there is no toilet replacement costs makes this a highly economic option. In most refugee settings UNHCR and WASH actors should discuss this technical option with the community and encourage its use. A detailed technical design and bill of quantities for an alternating pit latrine can be found on **wash.unhcr.org**.

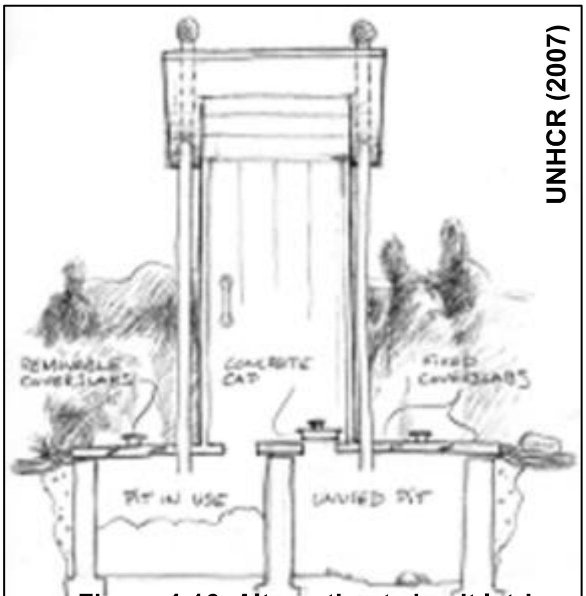


Figure 4-16 Alternating twin pit latrine

Augured or bored latrines

72. Augured or bored latrines can be constructed in soft soils using hand augers, petrol driven motorized augers, or even drilling machines. They are typically 35-45 cm in diameter and can be any depth up to 7 metres. They can be constructed as communal, shared or household facilities, either as dry pits or wet pits if used with pour-flush pans. Communal bored or augured latrines are usually managed in the same way as standard communal toilets. If bored or augured latrines are allocated on a household or shared basis the owners are typically responsible for any operation, maintenance and cleaning activities.

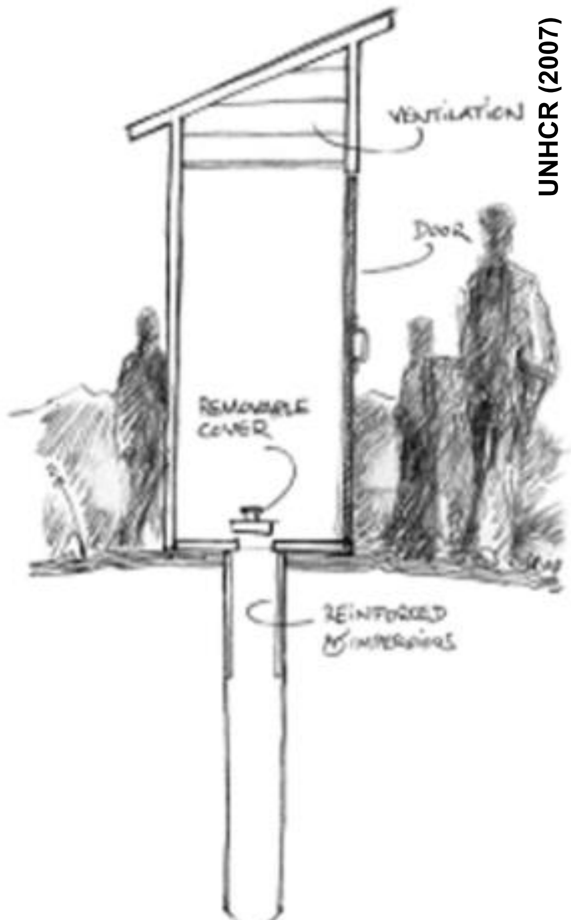


Figure 4-17 Augured or bored latrines

73. The advantage of augured latrines is that they can be constructed relatively quickly in soft soil either as blocks of communal toilets or individual household toilets. Speed of construction can be significantly increased if motorized augers or drilling machines are used. Another advantage is that in relatively hard soils, auger holes up to 20cm wide may be used directly in the short term without the need for a toilet slab. The main disadvantage of augured latrines is that they have smaller volumes and therefore a significantly shorter useful life of months rather than years. The side walls are also liable to fouling and they tend to be smellier than vented systems. Augured or bored latrines should generally only be used for very short and quick interventions. As augered or bored latrines are generally much deeper than standard pit latrines, care should also be taken to ensure that the correct safety distances are respected between the base of the hole and the maximum annual groundwater level.

Box: Calculating the useful life of bored latrines

During an emergency response, a percussion drilling rig is being used to drill 7m deep 8" inch holes that are to be used as offset pits with pour-flush toilets. The toilets are allocated on a shared basis between every 4 families, how many months will these facilities last before they are all full?

The basic equation for pit sizing is

Pit volume (V) = N x P x R

where

N = the effective life of the pit (years)
P = the average number of daily users
R = sludge accumulation rate (m^3 per yr)

Rearranging for the life of the pit gives us

Pit life (N) = V / (P x R)

In our case, the volume (V) of the bored hole can be calculated by multiplying the area by the depth. Allowing 0.3m at the top of the pit for backfilling gives us..

Pit volume = length x area
Pit volume = 6.7 m x π x (4" x 0.0254 m)^2
Pit volume = 0.22 m^3

Assuming water is used for anal cleansing gives a sludge accumulation rate of 0.04m^3 per person per year (**see section 4.36**). Storage is short so the rate is doubled.

It follows that

Pit life (N) = V / (P x R)
Pit life (N) = 0.22 / (24 users x 0.08m^3/yr)
Pit life (N) = 0.23 years = 41 days

In conclusion, a 7m deep 8" diameter bored latrine shared between 4 families will last for just under six weeks before it requires decommissioning.

Pour flush toilets

74. Pour-flush toilets are used where there is a cultural preference for water-based sanitation and the population has sufficient access to water. Pour-flush systems use a hygienic water seal between the toilet seat or slab and the disposal system eliminating problems with flies and smells. They can either be direct (the squatting slab or seat is directly over the pit or septic tank) or indirect (water and faeces travel a short distance to a pit, septic tank, or sewer). The toilet is flushed by pouring ~1-5 litres of water into the squatting pan or seat. Flushing water may be stored in a flush cistern or in an open reservoir for manual flushing with a scoop. Pour-flush toilets are suitable where water or soft toilet paper is used for anal cleaning and where the refugee population are used to flushing with water. It is not suitable where stones, corncobs, leaves or other solid materials are used for anal cleaning. The interagency plastic emergency toilet slab has recently been adapted with a pour-flush attachment that can be screwed onto the bottom of the plastic slab.

75. Communal pour-flush toilets are usually managed in the same way as communal trench latrines or communal VIP latrines. In addition to keeping the facility clean, the attendant may also take responsibility for ensuring there is flushing water available. Any major maintenance activities (for example desludging) are typically carried out by a maintenance crew. If pour flush latrines are allocated on a household or shared basis the owners are typically responsible for any operation, maintenance and cleaning activities – although in some cases, the refugee population is given support for desludging activities every few years.

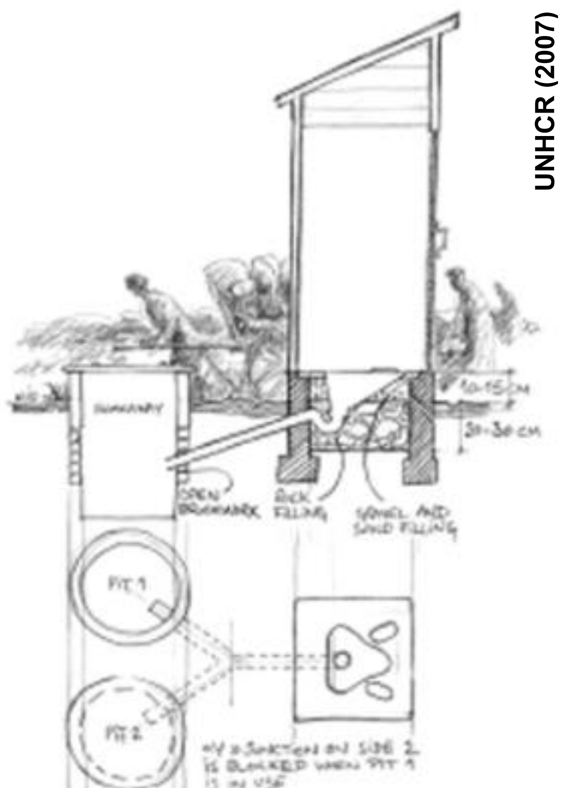


Figure 4-18 Alternating pour flush toilets

76. The major advantage of the pour flush toilet is that smells and disease vectors are isolated by the water seal. In addition, water based excreta management systems may be combined with bathing and laundering with greywater treatment being sized into the design of the pit or septic tank. The major disadvantage of pour-flush toilets is that they can waste significant amount of water and in some cases will only work properly if sufficient quantities of water are readily available. In addition, their needs to be sufficient soil infiltration capacity to absorb any liquids that are produced. A detailed technical

design and bill of quantities for a pour flush toilet can be found on **wash.unhcr.org**.

Box: Sizing a household twin pit pour flush toilet

Sizing calculation of a wet twin-pit circular household pour-flush toilet with a design life of 2 years for each pit. The soil type is sandy loam with a daily infiltration capacity of 25 litres per m^2 (**see section 4.131**).

Sludge volume (V) = N x P x R

where

N = the design life of the pit (e.g. 5 years)
P = the number of daily users (e.g. 6)
R = sludge accumulation rate (m^3 per yr)

Assuming a water based system with degradable anal cleansing materials gives a sludge accumulation rate of $0.04m^3$ per person per year (**see section 4.36**).

It follows that

Sludge volume (V) = 2 x 6 x 0.04 m^3 per yr
Sludge volume (V) = 0.48 m^3

Assuming a circular pit of diameter 1.0m.

Sludge vol (V) = (π x radius^2) x depth (Ds)

Rearranging gives

Sludge depth (Ds) = volume / (π x radius^2)
Sludge depth (Ds) = 0.48 m^3 / (π x 0.5^2)
Sludge depth (Ds) = 0.62 m

Assuming the toilet is flushed 12 times a day and each flush requires 3 litres.

Daily inflow (Q) = 12 x 3 litres = 36 litres

The soil is sandy loam with a daily infiltration capacity (K) of 25 litres per m^2.

Infiltration area (Ai) = Q / K
Infiltration area (Ai) = 36 litres / 25 litres/m^2
Infiltration area (Ai)= 1.44 m^2

therefore

Infiltration depth (Di) = Ai / (2π x radius)
Infiltration depth (Di) = 1.44 m^2 / (2π x 0.5)
Infiltration depth (Di) = 0.46 m

Allowing 0.3 m freeboard gives a total depth of 0.62m + 0.46m + 0.3m = 1.38 m.

In conclusion, a pour flush household toilet supplying two alternating 1.4 m deep and 1.0 m diameter pits will provide a design life of two years allowing destruction of pathogens and the pits to be alternated.

Septic-tanks, aqua-privys and anaerobic baffled reactors

77. A septic-tank is a water-tight excreta settling tank that typically receives excreta from a pour flush toilet and occasionally grey water from bathing and washing. An aqua-privy is a simple pour-flush toilet that is installed directly over a septic-tank (typically with a single chamber made from concrete rings) and is very common in many refugee camps in Asia. An anaerobic baffled reactor (ABR) is an improved septic tank design that can achieve higher degrees of sludge settling, digestion and BOD reduction and more suited to large scale urban projects where there are stricter environmental controls. Basic septic tanks may have a single compartment, although two or more are better to reduce hydraulic disturbance caused by flushing. ABR's have three to four compartments for improved treatment rates. Smells from the septic tank are prevented by the water seal.

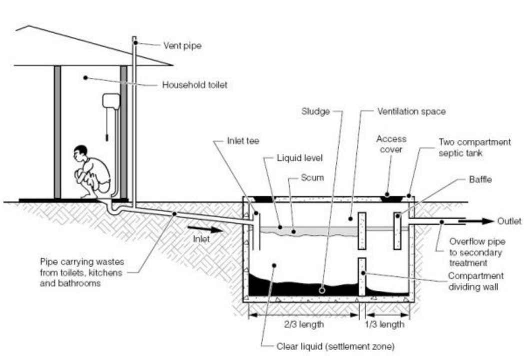


Figure 4-19 A simple septic tank

78. Treatment in septic tanks occurs through a combination of settlement, floatation and sludge digestion. During settlement, heavy solids fall to the base of the tank to form sludge. In addition, grease and oils in the septic-tank float to

the surface to form a layer of scum, which is usually removed during desludging. Over time, the sludge at the bottom of the tank is compressed by the weight of new material settling on top, increasing its density. In addition, organic matter in the sludge is broken down by bacteria which convert it to liquid and methane gas. Care should be taken to ensure that this gas, which is explosive) is not allowed to build up and septic tanks are usually equipped with vent pipes.

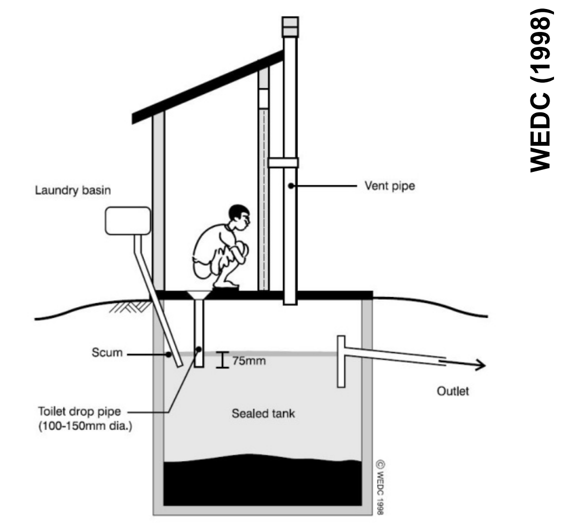


Figure 4-20 Aqua privy

79. Since it contains fresh excreta, septic tank sludge must be disposed of safely. Some simple designs of septic-tank allow this liquid to percolate directly into the ground through the unlined base of the tank. Improved designs channel the effluent via an overflow into a separate infiltration pit, trench, or drain field. In high groundwater situations, this effluent should be further treated either using a hydraulically isolated on-site wetland or off-site using tertiary treatment.

Box: Household pour flush aquaprivy sizing calculation

Sizing calculation for a household pour flush toilet above a single compartment aquaprivy made from concrete rings that has a desludging period of 3 years.

Total aquaprivy volume = A + B

where

A = daily liquid volume entering the tank
B = volume of sludge and scum

where

Daily liquid volume (A) = P x q
Vol. of sludge and scum (B) = P x N x S

where

P = number of daily users (6 persons)
q = sewage flow (5 litres/person/day)
N = period between desludge (3 years)
S = sludge & scum acc. rate (0.04 m^3/yr)

It follows that

Daily liquid volume (A) = 6 pers x 5 litres
Daily liquid volume (A) = 30 litres

Vol. of sludge and scum (B) = 6 x 3 x 0.04
Vol. of sludge and scum (B) = 0.72 m^3

therefore

Aquaprivy volume = 0.030 m^3 + 0.720 m^3
Aquaprivy volume = 0.75 m^3

Assuming a single compartment aquaprivy made from concrete rings of 1.1m internal diameter it follows..

Privy vol. (V) = (π x radius^2) x depth (D)

Rearranging gives..

Depth (D) = volume / (π x raduis^2)
Depth (D) = 0.75 m^3 / (π x 0.55 x 0.55)
Depth (D) = 0.79 m

Allowing 0.2m for freeboard gives a total aquaprivy depth of 1.0m.

80. In high density urban settings there is usually legislation in place to protect the aquifer and septic tank effluent should either be directed to the sewer network or the anaerobic baffled reactor type design should be used with additional tertiary treatment (such as constructed wetlands). In some extreme cases, it may be

permissible to direct effluent on a short-term emergency basis to stormwater drains provided a sufficient degree of treatment has taken place within the septic tank. Septic tanks are generally sized for desluding every 2-3 years. The most appropriate method for removing the sludge is with a vacuum tanker. UNHCR and WASH actors must ensure that public health and environmental precautions are taken when removing, transporting and disposing of the sludge.

Box: Septic tank sizing calculation for an urban collective

Sizing calculation for a septic tank serving refugees staying in an urban collective centre containing 50 families (300 persons). The septic tank is designed to receive both greywater (from communal showers and laundry points) and blackwater (from pour-flush latrines). Total per capita water consumption estimated at 45 litres per person per day and biodegradable anal cleansing materials are being used. The average ambient temperature is < 10°C during winter and desluding is planned for every two years.

It follows..

Total septic tank volume = A + B

where

A = daily liquid volume entering the tank
B = volume of sludge and scum

where

Daily liquid volume (A) = P x q x T
Vol. sludge and scum (B) = P x N x F x S

where

P = number of users (e.g. 300 persons)
q = sewage flow (litres/person/day)
T = retention time (typically 1 day)
N = period between desludge (2 years)
F = sizing factor
S = sludge & scum accumulation rate (0.04 m^3/year)

Assuming 90% of daily per capita water consumption ends up as sewage flow it can be estimated that..

q = 45 l/person/day x 0.9 = 40 l/pers/day

It follows that

Daily liquid vol (A) = 300 pers x 40 litres
Daily liquid vol (A) = 12 m^3

Since this is a large septic tank and (A) is greater than 6m^3 per day, a retention time of [33 – 1.5A] i.e. 15 hours instead of 24 hours is allowed – see table below.

Daily volume (A)	Retention (T)
If A > 6m^3/day	T = 24 hours
If A is 6m^3 – 14m^3/day	T = 33 - 1.5 A
If A < 14m^3/day	T = 12 hours

Source: Franceys, Pickford & Reed (1992) '*Guide to the development of on-site sanitation*'. World Health Organization, Geneva.

therefore

Daily liquid (A) = 12 m^3 x (15/24) = 7.5 m^3

In addition

Sludge & scum vol. (B) = P x N x F x S

Where F can be found from the following.

Desludge	Ambient Temperature		
Period	>20 °C	>10 °C	<10 °C
1	1.3	1.5	2.5
2	1.0	1.2	1.5
3	1.0	1.0	1.3
4	1.0	1.0	1.2
5	1.0	1.0	1.1
6+	1.0	1.0	1.0

Source: Franceys, Pickford & Reed (1992) '*Guide to the development of on-site sanitation*'. World Health Organization, Geneva.

therefore

Sludge & scum (B) = 300 x 2 x 1.5 x 0.04
Sludge & scum (B) = 36 m^3

finally

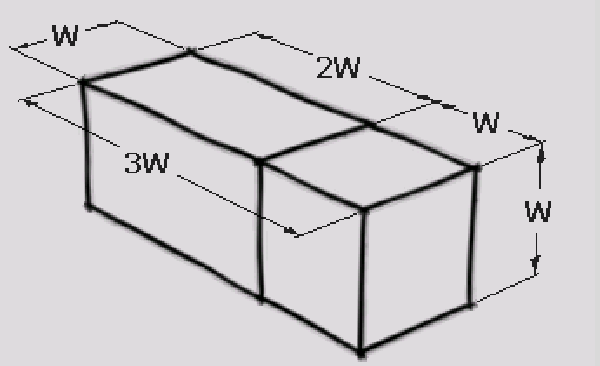
Total volume = 7.5 m^3 + 36 m^3 = 43.5 m^3

Assuming a dual compartment septic tank with the first compartment (of length 2W) twice as long as the second compartment (of length, width and height W) we end up with a septic tank with the following dimensions:
Volume = length 3W x width W x height W
Volume = $3W^3$ = 43.5 m^3

Rearranging we get

$$W = \sqrt[3]{\frac{43.5}{3}} = 2.44 \text{ m}$$

Adding 0.3m of freeboard we end up with the following septic tank dimensions:



Compartment	Length	Width	Height
#1	4.8m	2.4m	2.7m
#2	2.4m	2.4m	2.7m

81. Large communal septic tanks in refugee settings are usually managed by centralized maintenance crews and desludging is typically contracted out to specialized private companies that are responsible for assuring safe handling of excreta and adequate final disposal. If smaller household or shared septic tanks are in operation, the owner is typically responsible for operation, maintenance and cleaning - although support is typically given for desludging.

Figure 4-21 Septic tank drain field

82. The main advantage of septic tanks is that they are suited to refugee settings where water is used for anal-cleansing and toilet flushing. Their main disadvantages are higher construction costs than simple pit based systems and the fact that they require relatively large volumes of water to function efficiently. Another disadvantage is that septic tanks require desludging in addition to space for infiltration trenches or drain fields. Detailed technical designs and bill of quantities for septic tanks, aqua-privies and anaerobic baffled reactors can be found on **wash.unhcr.org**.

Box: Sizing calculation for a septic tank drain field

Sizing calculation for a drain field receiving effluent from a septic tank serving refugees in an urban collective centre containing 50 families (300 persons). The septic tank receives both greywater (from communal showers and laundry points) and blackwater (from pour-flush latrines). Total per capita water consumption estimated at 45 litres per person per day. Assuming 90% of daily per capita water consumption ends up as sewage flow it can be estimated that..

Daily sewage vol. (Q) = 300 x 45 x 90%
Daily sewage vol. (Q) = 12 m^3

Assuming a drain field in loam soil with an infiltration capacity of 25 litres / m^2 (**see section 5.131**). The total length of trench required is given by

Drainage trench length (L) = Q / 2DI

where

Q = the daily sewage flow (12,000 litres)
D = the effective depth (e.g. 1.5 metres)
I = infiltration capacity (e.g. 25 litres/m^2)

It follows

Trench length (L) = 12,000 / (2 x 1.5 x 25)
Trench length (L) = 160 metres

Assuming a square drain field design with a trench spacing of every two metres gives us a drain field with eight trenches of 20 m length.

In conclusion, a septic tank drain field in sandy loam soil for 50 families including pour-flush toilets, laundering and bathing water would need to be 20m x 20m.

Conventional, simplified and settled (small bore) sewerage

83. In some urban refugee settings, it may be necessary to rehabilitate or connect toilets to existing sewerage networks to safely transport excreta (and wastewater) from locations where it is generated to locations where it can be safely treated, disposed or reused.

84. Conventional sewerage systems consist of a network of large diameter underground pipes used to collect sewage from households and convey it to a treatment facility. The term 'conventional' describes the sort of sewerage network that is often found in developed nations or modern cities and is based on conservative pipe diameters, burial depths, gradients and manhole specifications. The cost of conventional sewerage can be very high (as much as thousands of USD$ per household). Conventional sewerage systems often need 100-120 litres of wastewater per person per day to function adequately without blocking.

Figure 4-22 Small-bore sewerage network

85. Simplified sewerage systems function in a similar manner to conventionally designed sewerage systems but are based on much less conservative engineering principles such as smaller diameter pipes, shallower depths, smaller gradients and less frequent manholes. They are often used in low-cost settings. The cost of simplified sewerage is about half that of conventional sewerage.

86. Settled sewerage systems (also known as small-bore sewerage, or interceptor sewerage systems) are low-cost systems that use septic tanks to retain suspended and coarse solids so the sewerage system can be built to carry liquid effluents only with smaller diameter pipes, shallower depths, smaller gradients and less frequent manholes. The cost of settled sewerage is about a quarter of conventional sewerage and half that of simplified sewerage.

87. Sewerage should only be considered as a last resort in refugee settlements and generally only to connect the refugee population to an existing system. Sewerage systems can be costly and complicated, requiring skilled engineers and a great deal of coordination and cooperation during installation. In addition, trained personnel are needed for operation and maintenance otherwise the system could become a health risk. Construction or rehabilitation of sewerage systems in refugee settings should only be carried out by professional and qualified engineering personnel.

88. Operation and maintenance of conventional, simplified and settled (small-bore) sewerage networks in refugee settings is usually managed by centralized

maintenance crews. If households connect to the sewer networks, either directly, or via septic tanks, then responsibility for operation and usually rests with the owner up to the connection point.

In all settings it is highly recommended that UNHCR and WASH actors choose simple methods of on-site treatment, disposal and reuse rather than off-site methods that require the use of sewerage or excreta transportation that can be complex, expensive, and can bring huge public health and environmental risks if poorly managed.

89. The main advantage of sewer networks is that they are suited to transporting excreta in high density urban environments where there is insufficient space for on-site treatment. Their main disadvantages are high construction and operation and maintenance costs and the fact that they require relatively large volumes of water to function efficiently which may not be available in refugee settings. Another disadvantage is that the installation of sewerage networks, particularly in urban settings, required high levels of coordination and communication and much disruption during installation especially if retro-fitted. Finally, all sewerage requires a properly sized and functioning final treatment plant downhill and preferably down-wind of the settlement. Detailed technical designs and bill of quantities for conventional, simplified and settled (small-bore) sewerage systems are beyond the scope of this manual, however references to design guidelines can be found in the **references section**.

Excreta transportation

90. Transportation of excreta may be required to empty existing excreta management systems, such as lined latrine pits, septic tanks, storage tank latrines, or chemical toilets that have become full. Transportation of excreta is typically carried out using either mechanized desludging tankers or manual desludging and cartage. Regular desluding and transportation of excreta may be the only possible option in urban, hard ground or high water table refugee settings.

91. The main disadvantage of transporting excreta is that it can be a risky and costly business. UNHCR and WASH actors must ensure that all operations involving the removal, transportation and final disposal and treatment of excreta is carried out by professional and qualified organisations with adequate safety and public health monitoring protocols. Care must be taken to ensure that desludging operations do not pose risks on the population, the environment, or the personnel carrying out the service. A safe final treatment or disposal site is required for the excreta (sewer, waste treatment plant, waste stabilization ponds, lagoons). UNHCR and WASH actors should only consider excreta transportation as a last resort option short-term option.

Mechanized desludging and excreta tankers

92. Mechanized desludging tankers are able to remove the contents of a sealed toilet vault or septic tank using a vacuum created inside the storage vessel or vacuum pump. The method is generally suited to faecal material with high water content (e.g. the contents of chemical toilets or septic tanks). Additional water and agitation may be needed to remove excreta that has settled and compacted for example in the base of a septic tank. Excreta is removed using a suction lance which is typically inserted through the toilet seat or squat-hole into the toilet vault or into the septic tank access cover. A valve on the lance is opened, rapidly sucking the vault contents into the storage vessel. Desludging tankers typically have a storage volume of between 10,000 – 15,000 litres although smaller models can be found. In some refugee settings, plastic waterproof tanks mounted on pick-up trucks have been used successfully for septic pit desludging operations using diaphragm based solids handling pumps (e.g. the Pelican brand).

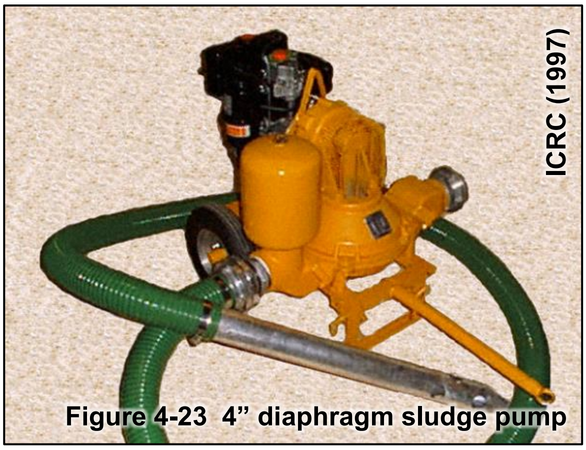


Figure 4-23 4" diaphragm sludge pump

93. Care must be taken to ensure that desludging operations do not pose risks on the population, the environment, or the personnel carrying out the service. Care should also be taken to ensure that users do not put items that could easily block the suction hose into the toilet vault (such as women's sanitary pads, stones, leaves, plastic bags etc.). Desludging trucks cannot be easily maneuvered down narrow streets.

Figure 4-24 Desluding, Tham Hin Camp

94. Excreta desludging using vacuum tankers has been used with varying degrees of success following the Haiti earthquake and in refugee camps in Turkey and Jordan. However, desludging should be used as a last resort in urban, hard ground, or high water table contexts where no other option is suitable. Desluding operations are very costly (33 USD$ per daily toilet desludge in Haiti 2010) and there should be a clear exit strategy from the start.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Manual desludging and cartage

95. Manual desludging may be achieved using hand operated vacuum pumps, diaphragm pumps, mechanical gobblers, scoops or buckets. The pit or tank contents are usually emptied into sealed 40 litre plastic drums and loaded onto transportation. Additional water may need to be brought to the site to help liquefy the contents of the pit before excavation takes place. UNHCR and WASH actors should engage manual emptying as a last resort and only if all of the following conditions are met.

a. The pit or tank contents have been left to safely digest for at least two years and are free from pathogens.
b. The pit is lined or sealed and there is no risk of collapse.
c. Staff have adequate personal protective and safety equipment and have been training in the infection control standard precautions.
d. There is absolutely no risk that personnel will come into direct contact with faecal material.

Figure 4-25 Manual desludging poo pump

96. The only advantage of manual desludging is that the relatively small size of equipment allows personnel to empty pits and vaults in high density settings where mechanized desludging tankers have no access. The main disadvantage is that that manual desludging methods are generally more risky to public health and personnel than mechanized methods. In all cases, a safe final treatment or disposal site is required for the excreta and care must be taken to ensure that desludging operations do not pose risks on the population, the environment, or the personnel carrying out the service.

Under no circumstances whatsoever should personnel be allowed to enter a toilet pit or vault during maintenance or desludging operations.

Sludge drying beds

97. Sludge drying beds are used to reduce the water content of sewage and stabilize excreta prior to further treatment, disposal or reuse. The excreta sludge is usually arranged in concrete bays on a layer of gravel and sand and is dried by a combination of drainage, sunlight and evaporation.

98. The main advantage of sludge drying beds is that they can be used in high water table, hard ground, flooded or high density urban environments in combination with some form of transportation system to partially treat excreta from storage vault based toilets (such as chemical toilets, storage tank toilets, or septic tanks). Their main disadvantage is the fact there are always additional public health risks whenever excreta is handled,

transported or processed. In addition their additional costs for construction, transportation, operation and maintenance often make them uneconomic. Another disadvantage is that they require large areas of space and need to be located downwind and away from settled areas. Finally, the dried excreta needs to be deposited to a pit, or better still, composted further to make agricultural fertilizer. In many cases, the risks of using sludge drying beds outweigh the benefits and they should generally be avoided or only used if the systems are already existing in the refugee context and functioning well.

Composting toilets

99. Composting of human excreta can be carried out at the household, communal and centralized levels. Household composting toilets typically consists of a pair of waterproof vaults which are used alternately to turn excreta into nutrient rich compost suitable for agriculture. Decomposition occurs in one vault while the second vault is being filled. The vaults are designed to have an accumulation time of one year during which all pathogens are eliminated and rich non-odorous compost is produced. Most systems require the separation of urine and addition of carbon rich bulking material (such as sawdust, straw, ash, etc.) to ensure an optimum carbon-nitrogen ratio. If optimal conditions are produced for aerobic composting, then all pathogens (including the most resilient namely ascaris eggs) can be eliminated within a period of 6 months to 1 year through a number of processes including elimination by soil-based micro-organisms, unfavourable temperature, unfavourable pH, competition for food and antibiotic action.

Figure 4-26 Dry compositing toilet, Haiti

100. Communal compost toilets may be organised either as on-site twin vault systems or as bucket toilets with collection, transportation and centralized composting (**see section 4.180).** Daily operation and management of communal composting toilets is similar to communal trench latrines or communal VIP latrines. One of the most important jobs of the toilet attendant is to ensure that users understand how to use the toilet and that there is an available supply of carbon rich bulking materials in each cubicle. If composting is carried out on-site, the toilet attendant also needs to ensure the correct conditions are maintained for composting. If composting toilets are allocated on a household or shared basis the owners are typically responsible for any operation, maintenance and

cleaning activities including monitoring of the moisture and carbon-nitrogen balance.

101. The obvious main advantage of composting toilets is the production of compost with a high quality fertilizer value. However, additional advantages include the fact the approach can be used in high water table, hard ground and flooded settings. Furthermore, as the composting vaults are routinely emptied they do not need replacing over time which makes it cost effective solution in the long-term.

Box: Household alternating compost toilet sizing calculation

Sizing calculation for a household alternating twin VIP compost toilet with two fully lined vaults, urine separation and design life of 1 year.

Vault volume (V) = N x P x R

where

N = the design life of the vault (e.g. 1 yr)
P = number of daily users (e.g. 6 persons)
R = sludge accumulation rate (m^3 / year)

Assuming dry conditions with degradable anal cleansing materials gives a sludge accumulation rate of 0.06 m^3 per person per year (see section 4.36). The rate should be doubled to take into consideration the addition of small quantities of organic material (ash, leaves, organic refuse). It follows that

Pit volume (V) = 1 x 6 x 0.12 m^3 / year
Pit volume (V) = 0.72 m^3

Assuming two square lined pits of width 1.2m x 1.2m are used. It follows that.

Pit volume (V) = length x width x depth

Rearranging for depth gives

Pit depth (D) = volume / (length x width)
Pit depth (D) = 0.72 m^3 / (1.2 m * 1.2 m)
Pit depth (D) = 0.5 m + 0.2 m freeboard

Therefore two alternating pits of 0.7 m depth are required to ensure the contents are left for at least two years before the pits can be safely emptied.

102. The main disadvantage of composting toilets is that the composting toilet needs optimal conditions and careful monitoring on behalf of the user to take place including a moisture content of 50% - 60%, a carbon to nitrogen ratio within the range 15:1 to 30:1 and an average daily temperature of at least 15°C to be viable. In addition, all system involving the reuse of excreta must be carried out safely with no risks to public health. Great care should be taken to ensure that composting is actually occurring in the composting latrine and pathogens are being destroyed. Finally, the reuse of excreta is a cultural taboo in many cultures and care should be taken to ensure the approach is culturally acceptable.

103. UNHCR recommends that if composting toilets are suitable for the context, they are only promoted at the household level as any systems that involve the collection, transportation, handling and processing of excreta introduces additional public health risks and can be costly in terms of vehicle, fuel, land and labour. If compost toilets are used at the household level, then co-composting with degradable household refuse should be strongly encourage to ensure a steady supply of carbon rich material and reduce the strain and cost of solid waste collection services. A detailed technical design and bill of quantities for household and communal compost toilets can be found on wash.unhcr.org.

Box: UNHCR considerations for composting of human excreta

Human excreta is a valuable resource and should be re-used wherever practicable, however composting toilets and co-composting of excreta are not suitable approaches for the emergency or transition phases of a refugee emergency. Before piloting the use of composting toilets or co-composting, UNHCR and WASH actors should ensure the following criteria are met:

- ☐ There is a clear and immediate demand for compost within 1,000m of the production site.
- ☐ Reuse of excreta is culturally accepted by the population.
- ☐ The average ambient temperature is at least 15°C.

Systems involving the collection, transportation, handling, processing and reuse of excreta must be carried out safely with no risks to public health or the environment. Great care should be taken to ensure that full thermophillic composting conditions are being created and pathogens are being destroyed. Pile thermometers and the daily monitoring of pile temperature is obligatory. The compost moisture content must be maintained between 50% - 60%, the carbon to nitrogen ratio must be within the range 15:1 to 30:1. Reuse systems are more complicated than traditional sanitation methods and require a great deal of community education and users to take an active part in system operation and maintenance. Systems involving the transportation, handling and processing of excreta are usually not economically viable at the centralized levels and a full economic analysis should be undertaken before any large programmes are initiated. Composting is better suited to the communal and household levels.

Waste stabilization Urine Diverting Dry Toilet (UDDTs)

104. UDDT toilets (Urine Diverting Dry Toilet) are designed with a divider so that urine is separated at the front of the toilet pan or slab, while faeces fall through a large squat hole in the back. The urine and faeces are collected in different chambers and drying material such as ash, earth, or lime should be added to the faecal chamber after use. The aim of UDDT is to evaporate and dry out the excreta. The moisture content is reduced as low as possible by different means including passive solar heating, ventilation and absorbent material addition. The addition of ashes (or any alkaline absorbent) increase pH and can plays a significant role in the enhancement of the pathogen die off, reduction of fly breeding and odour control. The act of separating urine and drying out the excreta significantly reduces the unpleasant odours and fly breeding associated with latrines. If the faeces remain dry then pathogens are not able to migrate and easily contaminate groundwater. After a stabilization period of up to 2 years, it is then possible to collect the dried excreta safely and use it as fertilizer (Guidelines for the Safe use of Wastewater, Excreta and Greywater, WHO 2006). In some designs there is a third hole for collecting anal cleansing water to a separate soak pit. A separate wall mounted urinal can also be

mounted within the toilet cubicle for optimal collection.

105. The advantages of UDDT toilets relate to the potential of reuse of waste as fertilizer, the reduction of groundwater contamination, and the benefit of a toilet structure which can be continuously emptied and reused thus offering high value for money in the long term. UDDTs can be built with locally available materials and have low capital and operating costs. UDDTs should also be considered in situations where there is need for alternatives to pit latrines for example in places which have a high groundwater table, are prone to flooding, or are hard to excavate. UDDTs have been piloted by Oxfam GB at household level in Hiloweyn camp in 2012 with success in user acceptance, longevity of use, value for money and environmental impact (see references section).

Figure 4-27 UDDT toilet interior

106. The major disadvantage of UDDT is that unless the users both understand how to use the UDDT and use it properly, then there is the increased risk that the intended advantages of the system will not be achieved. Another disadvantage is that vault sizes are much smaller than in standard latrines and users may be put off by proximity to the faecal pile. In some cases, children may have trouble using the UDDT properly and assistance is needed so their urine doesn't end up in the hole for faeces.

Co-composting of excreta

107. Co-composting is the process of composting excreta with organic household wastes (such as food wastes, paper, cardboard, sawdust, leaves, yard sweepings). Excreta has a high nitrogen content while organic solid wastes have a high carbon content. By composting the two together it is possible to obtain high quality nitrogen rich compost. Co-composting can be carried out at the household, communal and centralized levels. However it is better suited to the household level since any system requiring the handling or transportation of excreta introduces additional expense and public health risks.

Figure 4-28 Co-compositing windrows

108. If co-composting is carried out at the household level, it is best undertaken in a twin pit compost toilet (**see section 4.99**). If co-composting is carried out at the communal (16 household) level, it is best undertaken in a communal alternating twin vault composting toilet rather than a bucket system where households bring excreta to a centralized co-composting facility. If co-composting is

undertaken at the centralized level, a system needs to be established involving collecting excreta from networks of communal bucket toilet blocks and refuse bins. At the processing site, excreta and organic solid waste can piled together, mixed and arranged into long composting heaps called windrows. Windrow piles are turned periodically to provide oxygen and ensure that all parts of the pile are subjected to the same heat treatment. Windrow piles should be 1m – 3m high, and should be insulated with compost or soil to promote an even distribution of heat inside the pile. Care should be taken to ensure that leechate from composting windrows does not pose a risk to groundwater. Any run-on and run-off at the site should be carefully managed. Depending on the climate and available space, the windrows may be covered with plastic sheeting to prevent excess evaporation and protection from rain. The composting process needs to be carefully managed to ensure that pathogens are being destroyed. WHO (1989) recommends themophilic composting for one month at 55-60°C, followed by two to four months of curing to stabilize the compost.

109. The obvious main advantage of co-composting toilets is the production of compost with a high quality fertilizer value from two waste substances (excreta and organic household wastes). An additional large advantages includes the fact that approach can be used in high water table, hard ground, flooded and high density urban settings. Furthermore, as the bucket toilets are routinely emptied the infrastructure should never need decommissioning which makes it an economically viable solution in the long-term.

110. At the household level there are virtually no disadvantages to co-composting other than the fact the process needs careful monitoring and reuse of excreta may not be culturally acceptable. At the communal and centralized levels, the main disadvantage of co-composting is that is requires the collection, transportation and processing of excreta and refuse which brings many public health risks and can be costly in terms of vehicles, energy and manpower. There also needs to be a clear and immediate demand for composted fertilizer close to the production sites as escalating fuel costs may render the process economical.

111. A final disadvantage is that the composting process needs careful monitoring including ensuring the moisture content is maintained between 50% - 60%, the carbon to nitrogen ratio is within the range 15:1 to 30:1. In addition, the process needs an average daily temperature of at least 15°C to be viable. All systems involving the reuse of excreta must be carried out safely with no risks to public health. Great care must be taken to ensure that composting is actually occurring and pathogens are being destroyed. UNHCR recommends that pile thermometers are installed to monitor temperatures and ensure thermophillic conditions. Finally,

the reuse of excreta is a cultural taboo in many cultures and care should be taken to ensure the approach is culturally acceptable. A detailed technical design and bill of quantities for a community co-composting plant can be found on wash.unhcr.org.

Waste stabilization ponds

112. Waste stabilization ponds are a sequence of artificial ponds containing anaerobic microorganisms which digest pathogens and sludge. The ponds work in a similar way to a scaled up septic tank. The anaerobic pond is small and deep and receives the raw sewage. The facultative pond is shallower with a large surface area and consists of an aerobic zone close to the pond surface as well as a deeper anaerobic zone. The maturation pond is very shallow with a large surface area, resulting in aerobic conditions. It further purifies the sewage for discharge into the environment.

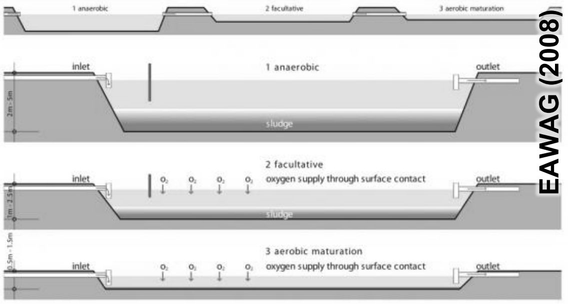


Figure 4-29 Waste stabilization ponds

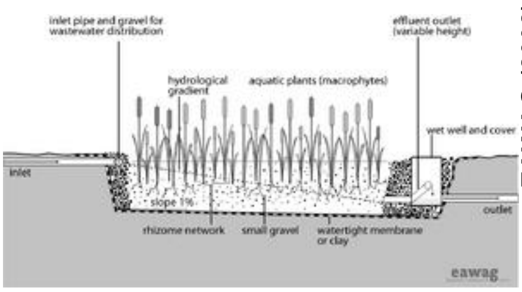
113. Waste stabilization ponds are usually operated and maintained by dedicated and qualified staff. The main advantage of waste stabilization ponds is their ability to treat human wastes in a low-tech way with very few moving part, machines, or energy requirements. The main disadvantage of waste stabilization ponds is their need for large areas of space in addition to excreta transport mechanisms to bring excreta to the site for treatment. They are only suitable in temperate climates (the tropics) and are only suitable for large volume treatment of sewage at the centralized level. The construction and operation of waste stabilization ponds requires expert engineering knowledge and should generally not be undertaken by UNHCR or WASH actors without technical support. In general, it is highly recommended to use much simpler methods of on-site sanitation unless there are no alternatives. Detailed technical designs and bill of quantities for waste stabilisation ponds are beyond the scope of this manual, however references to design guidelines can be found in the references section.

Constructed wetlands

114. Constructed wetlands are typically used to treat septic tank or waste stabilization pond effluent that has already been partially treated before it is discharged into the environment. They are typically constructed in a large gravel and sand-filled channel that is planted with aquatic vegetation. There are a number of variations available with different flow arrangements however typically as the wastewater flows through the channel, the gravel and sand filters out particles and pathogen removal is accomplished by natural decay, predation by higher organisms, and sedimentation.

115. The water level is generally kept to at least 15cm below the surface of the gravel and sand to prevent overland short-circuiting and the

bed is typically lined with clay or plastic sheeting to prevent leaching into the environment. Any aquatic wetland plants with large root systems can be used with the system, however aquatic reeds and grasses are often selected.



EAWAG (2008)

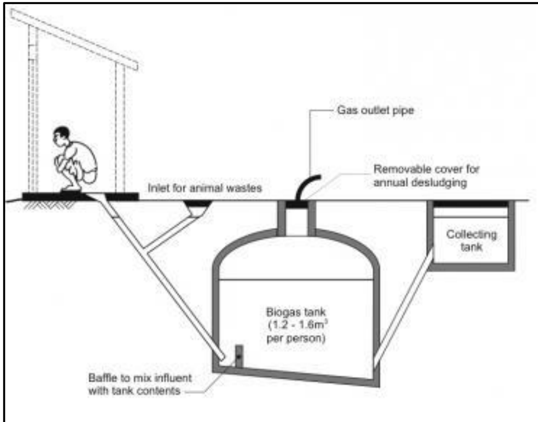
Figure 4-30 Constructed wetlands

116. Communal or centralized wetlands are are usually managed by centralized maintenance crews. Where constructed wetlands are constructed on a household level the owners are typically responsible for any operation, maintenance activities.

117. The main advantage of constructed wetlands is their ability to carry out tertiary treatment of effluents from septic tanks in a low-tech way in situations where there is tight control over environmental discharges (such as high water tables, flooded environments, or urban environments). Their main disadvantage is that they take up large areas of land and need careful monitoring to ensure they are functioning as intended. In most settings, constructed wetlands will not be required as the effluent can pass directly into adequately designed infiltration pits, infiltration trenches, or drain fields. Detailed technical designs and bill of quantities for constructed wetlands are beyond the scope of this manual, however references to design guidelines can be found in the **references section**.

Biogas digesters

118. Biogas reactors digest excreta and other organic matter anaerobically to create methane gas which can be used for heating or lighting. Biogas reactors may be considered as an alternative option to a conventional septic tank, since it offers a very similar level of treatment, but with the added benefit of capture of any methane that is produced. It is estimated that there are over 1 million biogas units in use in India, China and North Korea alone.



WEDC (2008)

Figure 4-31 Biogas digester

119. There are three main types of biogas digester classified by the way they store the gas that is produced; floating drum, expanding bag, and water displacement. In the floating drum digester, a metallic drum collects bubbles of biogas and rises out of the sludge as more gas is created, pressurizing the biogas at the same time. In the water displacement digester, water is displaced out of the main reactor as bubbles of biogas rise and accumulate in the dome. As more water is displaced the biogas is

pressurized. The water displacement type of digester is generally recognized as the most durable design having no moving parts and without problems caused by corrosion. There are displacement type biogas units around the world that have been operational for over 20 years.

120. The obvious main advantage of biogas systems is the production of methane gas which can be used for cooking or lighting. An additional advantages includes the fact that since the reactor is watertight, the approach can be used in high water table, hard ground and flooded environments. Furthermore, as the vault is routinely emptied (similar to a septic tank - typically every few years) the toilet block should never need decomissioning which makes it an economically viable solution in the long-term. The major disadvantage of biogas units is their large initial construction costs, which can be up to twice the cost of a similarly sized septic tank, in addition to their need for careful follow up and control to ensure they are functioning correctly. Furthermore, biogas production only starts to be effective above an ambient temperature of 25°C and therefore UNHCR and WASH actors should not consider biogas production outside of the tropics. In general, UNHCR and WASH actors should only consider biogas related projects if there is a genuine market for the gas that is produced. Biogas digesters are only suitable in refugee settings for communal or public toilets where water is used for anal-cleansing and toilet flushing. Biogas digesters contain fresh faecal matter and so any desluding that takes place needs to be carried out following the same public health and environmental protocols as desluding of septic tanks. Biogas digesters should never be considered in the emergency or stabilization phases. Detailed technical designs and bill of quantities for biogas digesters is beyond the scope of this manual, however design guidelines can be found in the references section.

Landfill disposal of excreta

121. Landfill disposal of excreta involves collecting the contents of household, communal or public toilets (for example bucket toilets, chemical toilets, packet toilets, storage tank toilets, or septic tanks) and dumping it with refuse at an existing landfill site.

122. Generally landfill disposal of excreta should only be considered during extreme emergency conditions as a short-term solution where no alternative method of disposal is possible. It is considered very bad practice to mix waste streams (municipal wastes and human wastes) and a much better solution may be to identify a suitable site for the construction of holding pits or, better still, waste stabilization ponds. Due to the public health and environmental health risks and high costs involved with the transportation of untreated or partially treated excreta, the best solution in all cases is simple on-site treatment.

Hand-washing facilities

Beneficiary participation in the design of hand-washing facilities

123. The design of hand-washing facilities and suitable mechanisms so that they are always functional should be carried out in discussion with representatives of the refugee communities. Beneficiary participation is needed to ensure hand-washing facilities and management mechanisms are acceptable and sustainable.

Hand-washing with soap is the single most cost-effective measure for reducing the transmission of diarrheal diseases. UNHCR and WASH actors should ensure that all public, communal, shared and household have hand-washing facilities and mechanisms are in place so they remain functional.

Ensuring rapid provision of hand-washing facilities

124. UNHCR and WASH actors should ensure that all toilets have convenient and functional hand-washing facilities close by. During the initial emergency response the provision of basic hand-washing equipment (for example jugs of water, soap, with a plastic bowl for grey-water collection) is better than delayed provision of improved systems.

Figure 4-32 Hand-washing post, Haiti

Hand-washing design options

125. Hand-washing units come in many different sizes and materials ranging from plastic or metal cisterns with taps, to open containers with dippers or bowls. In all cases the quality of the devices needs to reflect the importance that hand-washing with soap has on reducing diarrheal disease. Improvised or poor quality solutions risk easily breaking, getting dirty, or being stolen.

Figure 4-33 Hand-washing post, Haiti

Ensuring the availability of hand-washing water

126. The supply of water for hand-washing is critical. When there is no piped tapstand, or point water source (i.e. well, handpump, spring) within 30m proximity of the toilet, provision must be made for direct water storage and replenishment at the toilet block. This typically requires water collection with jerry cans and a wheel barrow or delivery by water tanker. During the rainy season, the use of rainwater for hand-washing should be encouraged. All public and communal toilet facilities should be equipped with guttering and a storage reservoir to collect rainwater for handwashing.

127. UNHCR and WASH actors must plan for at least one functional hand washing dispenser per communal or public toilet block, ensuring at least one hand-washing dispenser for every five toilet cubicles. Hand-washing dispensers should be conveniently located within 10m of each toilet exit and their use should be actively promoted. The water dispensing device and soap must be located within easy reach of all users, especially children. Liquid soap, or bars attached to string, may be used if there is soap theft. All handwashing units that use bars of soap should have a fixed self-draining dish where the soap can be placed between use without getting dirty or becoming mislaid.

Guidelines for hand-washing water storage container size

128. Hand-washing water storage containers should be sized to hold at least half a day of hand-washing water. To conserve water and avoid wastage, the hand-washing taps may need to be restricted with orifice plates to flows of 50 cubic centimetres per second (0.05 litres per second). Calculation of the total volume of hand-washing water required should be based on 0.5 to 1.0 litre of water per person per day. Hand washing reservoirs must be covered to prevent contamination or vector breeding.

The importance of hand-washing campaigns

129. Hand-washing facilities have no impact if they are not used. Measures must be taken to actively encourage users to wash their hands after toilet use. Handwashing messages must be repeated as often as possible. The linkages between excreta and disease must be clearly understood by all.

Figure 4-34 Hand-washing messages, Haiti

Management arrangements for hand-washing facilities

130. UNHCR and WASH actors must ensure there are mechanisms in place to ensure that hand-washing facilities are kept continuously topped up with clean water and soap (before they become empty). In the case of communal toilet blocks, this may require the use of an attendant.

Grey water disposal

131. Hand-washing rinse water should drain properly into an adequately designed gravel filled soak-away pit. The infiltration area of the pit should ideally be calculated using actual soil infiltration rates derived through infiltration tests. If this is not possible, the box below describing typical soil type infiltration rates may be used to estimate infiltration capacity. The bottom of the pit should be at least 1.5 metres above the water table and should be at least 30 metres from any groundwater sources. The surroundings around the hand-washing station should be dry, slip

free and free from surface water that may deter use.

Box: Hand-washing soak pit infiltration capacity design values

Infiltration capacities (litres 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

Actual infiltration capacity to be determined on-site. Source: Franceys, Pickford & Reed (1992) '*Guide to the development of on-site sanitation*'. World Health Organization, Geneva.

Monitoring of the coverage and condition hand-washing facilities

132. UNHCR and WASH actors must ensure that the coverage and condition of hand-washing stations is routinely monitored. Any problems with hand-washing facilities must be rectified immediately.

Cleaning and maintenance of toilet facilities

The importance of effective cleaning and maintenance arrangements

133. If communal toilet facilities are established, UNHCR and WASH actors must ensure that there is an effective cleaning and maintenance system in place that ensures that facilities are clean, functional and available at all times. Even well designed toilet facilities will quickly deteriorate if they are not properly looked after.

Even when in working order, toilets will not be used unless they are clean. Communal toilets should be cleaned at least four times daily or as many times is as necessary so as not to deter use.

Beneficiary participation in planning cleaning and maintenance initiatives

134. UNHCR and WASH actors should ensure that an operation and maintenance plan has been developed and agreed for each communal facility (typically serving 16 households) before the facilities are completed. The operation and maintenance plan should define the responsibilities of the different stakeholders from filling up the hand-washing water containers, and keeping the surroundings clean, to providing maintenance. An example community agreement can be found on wash.unhcr.org.

A good operation and maintenance plan will not only indicate who is responsible for cleaning and maintenance, it will also ensure involvement of the refugee community.

135. In many cases, members of the community may be willing to volunteer to manage toilet facilities since it gives people something to do, prestige and possibly a source of income. However, it should be assumed that communal toilet supervision may not be a popular job and it may be necessary to provide an incentive to those who are keeping communal toilets clean and operational. In all cases, discussions should take place with the community to identify a toilet supervisor from the households

directly using the facilities (within 100m) and the users should decide what they think will work best.

Figure 4-35 toilet attendant, Haiti

Human resources for cleaning and maintenance

136. The day-to-day management of a sanitation programme requires a substantial team of dedicated personnel. If possible, managerial, officer and technician level positions should be directly recruited from among the refugee community. As a general planning figure, one sanitation team member should be recruited for every 500 persons. In addition, there should be one maintenance crew member for every 200 communal toilet cubicles. Maintenance crews will require transportation (e.g. bicycles, motorbikes, or pick-ups) for getting around the site and carrying out maintenance activities. An example staffing structure for a typical sanitation programme can be found in **section 8.21**.

137. Poor planning for operation and maintenance is one of the most common deteriorating factors for toilet infrastructure. UNHCR and WASH actors should ensure sufficient budgeting for preventative operation and maintenance in addition to back-up capacity for surges in new arrivals, and decommissioning and replacement of aging infrastructure. Operation and maintenance costs for communal toilets can use up an enormous part of the WASH budget. Therefore, UNHCR and WASH actors should ensure that there is a clear strategy to transition into shared or household toilets and decommission of communal toilet blocks as soon as possible.

Personal protective equipment and health and safety training

138. UNHCR and WASH actors must ensure that staff have adequate personal protective equipment for the tasks they are performing (waterproof gloves, aprons, boots, overalls). All staff working in the sanitation programme must be correctly trained in health and safety procedures and the infection control standard precautions (see **section 8.12-13**).

Public and communal toilet cleaning frequencies

139. All surfaces that are either directly or indirectly in contact with faeces and urine should be impermeable, durable, and should be able to withstand frequent use and cleaning. It is recommended that communal toilet units and the floors of communal toilets are cleaned with detergent at least four times a day or as many times is as necessary so as not to deter use. During disease epidemic or times at risk of disease epidemics, all public and communal toilets must be cleaned with 0.2% chlorine

solution following cleaning with detergent.

Cleaning of toilets in health facilities

140. Particular attention should be given to the maintenance and cleanliness of toilets in health centres. As per WHO guidelines, toilet blocks should be routinely cleaned with a 0.2% chlorine solution, with separate cleaning equipment for the toilets and the rest of the health facility.

141. UNHCR and WASH actors should provide sufficient materials (detergent, mops, buckets, chlorine, shovels, and wheel barrows) to routinely clean and disinfect communal toilet blocks and ensure that the environment is free from excreta. Guidance on recommended sanitary supplies for toilet blocks per month can be found in the box below.

Box: Recommended sanitary supplies toilet block (6 cubicles) per month

Item	Qty
Liquid detergent	20 litres
Bleach (5% - 7%)	5 litres
Bucket	1pc
Mop	1pc
Stiff brush	1pc
Hand-washing soap	4kg (20 pc)
Toilet paper	200 rolls

Note: Quantities for approximate guidance only.

Monitoring the condition of public and communal toilet facilities

142. UNHCR and WASH actors should ensure that the condition of any public or communal toilet facilities is closely monitored on a monthly basis. Blocked toilets, full toilets, fly infestations, the presence of faecal material on or around the toilet seat or slab, lack of privacy, lack of security, lack of anal cleansing or flushing water, or broken or leaking vaults are some of the problems that may be faced. Map showing the location and condition of communal toilet facilities should be included in the site WASH plan/strategy along with updated coverage rates and an analysis of historical trends.

Provision and management of anal cleansing material

143. UNHCR and WASH actors should ensure that communal toilets are provided with appropriate anal cleaning materials where users cannot reasonably be expected to provide their own. Where water is used for anal cleansing, management mechanisms should be put in place so that anal cleansing water is always available. At least 2-3 litres of anal cleansing water should be planned for per person per day. Water reservoirs for anal cleansing should be covered to prevent disease vector breeding.

144. Any systems to collect anal cleansing materials should be well organised to avoid contamination and nuisance from flies or odours. Containers should be emptied and cleaned on a daily basis and disposed of in a separate pit that will not allow it to come into contact with drinking water sources.

Management of used sanitary protection products

145. UNHCR and WASH actors must ensure that female communal


unicef

toilets are provided with appropriate and discrete collection and disposal mechanisms for used sanitary protection products. If required, disposal facilities must be designed to ensure total privacy, security, and dignity in full consultation with women and girls to ensure they are culturally acceptable. Used sanitary protection products contain blood and pose a high risk for the transfer of infectious diseases and must be collected, transported and disposed of safely and discretely without coming into contact with sanitary workers, water sources, or the environment. Any systems to collect used sanitary products should be well organised to avoid contamination and nuisance from flies or odours. Containers should be emptied and cleaned on a daily basis and disposed of in a separate pit that will not allow it to come into contact with drinking water sources.

Exit strategies out of prolonged toilet facility operation and maintenance

146. The best guarantee of proper cleanliness and maintenance is the allocation of toilets on a shared or household basis where the owners take responsibility for operation and maintenance. UNHCR and WASH actors should transition as quickly as possible into the construction of shared and household toilets if it is clear that the timeframe of the humanitarian situation will be longer than six months.