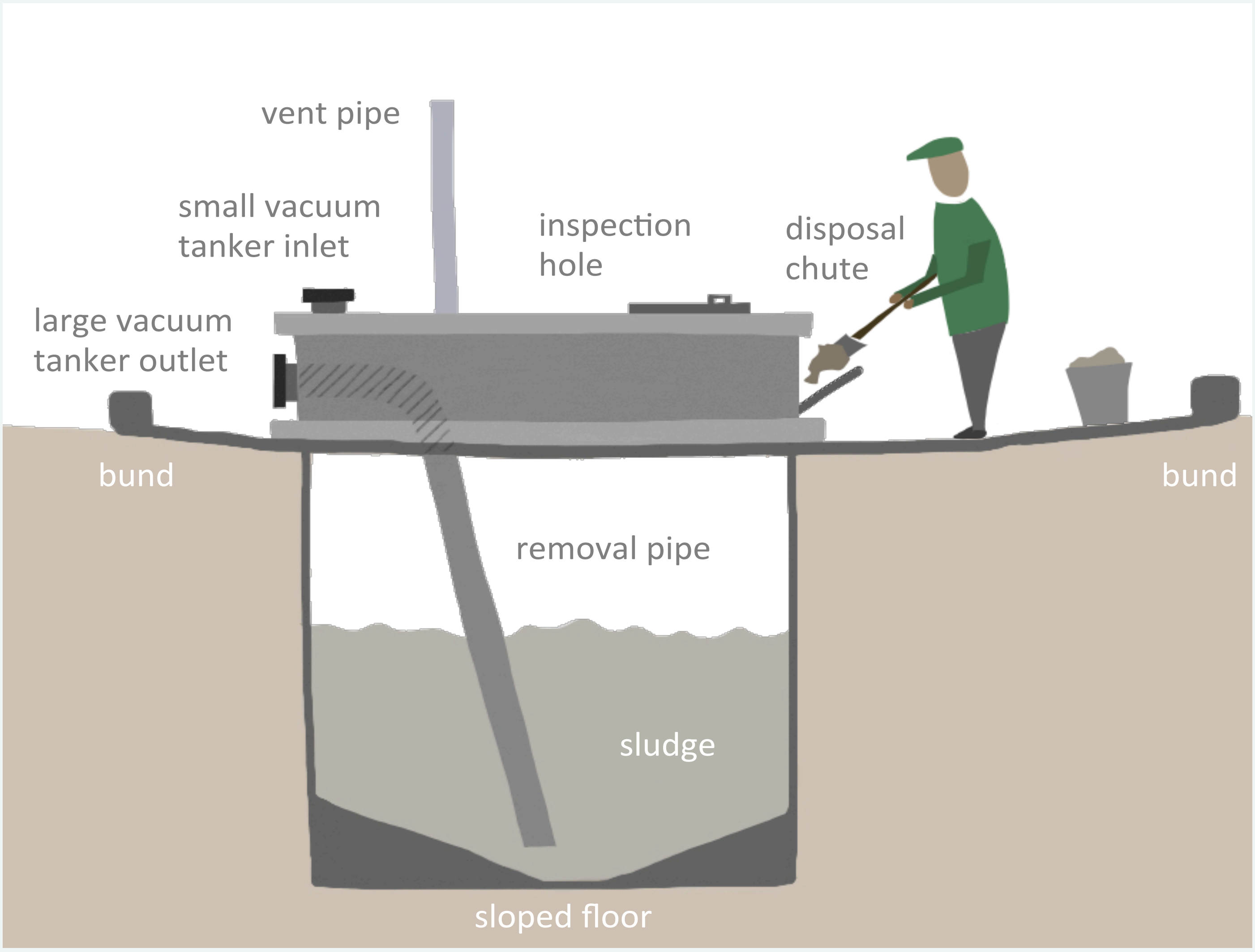
WASH

Guide

# A GUIDE TO SEPTAGE TRANSFER STATIONS

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# A GUIDE TO SEPTAGE TRANSFER STATIONS

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## ACKNOWLEDGEMENTS

Prepared for SNV's Urban Sanitation & Hygiene for Health and Development Programme (USHHD) by Pierre Mukheibir (ISF) with technical inputs from Antoinette Kome (SNV), David Robbins, and Tanja Rosenqvist (illustrations), Naomi Carrard, and Kumi Abeysuriya (ISF).

Our appreciation is also extended to the following people who provided valuable feedback through the D-group discussion and SuSanA forum: Aftab Opel, Bimal Tandukar, Dorothee Spuhler, Elisabeth von Münch, FH Mughal, Florian Klingel, Habibur Rahman, Jan Heeger, Jonathan Parkinson, Julius Makowka, Lawrence Kimaru, Liliana Gonzales, Rajeev Munankami, Reinilde Eppinga, Reza Patwary, and Shahidul Islam.

SNV's Urban Sanitation & Hygiene for Health and Development (USHHD) programme and its knowledge and learning collaboration are financially supported by the Dutch Ministry of Foreign Affairs (DGIS), the UK Department for International Development (DFID), and the Bill & Melinda Gates Foundation.

## CITATION

Cite this report as: Mukheibir P. (2015), A guide to septage transfer stations. Prepared for SNV Netherlands Development Organisation by Institute for Sustainable Futures, University of Technology Sydney.

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# Glossary

## Terms

**Bund**
A secondary enclosure, typically consisting of a low wall or berm, which surrounds a tank or fluid-handling mechanism, intended to contain any spills or leaks.

**Desludging**
The process of removing sludge from a tank, pit, or other storage unit, by pump or mechanical means.

**Effluent**
The general name for a liquid that leaves the place or process from where it originated, such as a tank or wastewater treatment process.

**Faecal sludge**
The general term given to undigested or partially digested slurry or solids resulting from storage or treatment of black-water or excreta. Often used interchangeably with septage.

**Faecal sludge management**
The management of faecal sludge contained within non-sewered sanitation systems such as pit latrines and septic tanks, and communal systems.

**Groundwater**
Water that is naturally present beneath the surface of the ground. Groundwater is generally quite clean and can be used for drinking water; for this reason care must be taken not to contaminate groundwater with sewage.

**Operation and maintenance**
All work relating to the day- to-day activities that keep a process or system functioning smoothly to prevent delays, repairs and/or downtime.

**Septage**
The liquid and solid material (e.g. faecal sludge) that is pumped from a pit-latrine or septic tank after it has accumulated over a period of time.

**Septic tank**
A two-chamber tank that receives wastewater from homes or businesses and partially treats it through settling and anaerobic digestion.

**Sewage**
General term given to the mixture of water and excreta (urine and faeces).

**Sewer**
A closed pipe to convey sewage.

**Sewerage**
All the components of a system to collect, transport and treat sewage (including pipes, pumps, tanks etc.).

**Sludge**
The thick, viscous layer of materials that settles to the bottom of septic tanks, ponds and other sewage systems. Sludge comprises mainly organics but also sand, grit, metals, and various chemical compounds.

**Soak away system**
A soils based effluent dispersal system, otherwise known as leach system.

## Acronyms

**CAPEX:** Capital expenditure

**FSM:** Faecal sludge management

**OPEX:** Operational expenditure

**SDS:** Sewer discharge station

**UHT:** Underground Holding Tank

**WASH:** Water, sanitation and health

# 1. Introduction

National and local governments have the responsibility to ensure that all their citizens have access to adequate and safe sanitation. This is not only crucial for public and environmental health, but it also underpins economic development – the lack of sanitation results in poor public health and enormous economic costs to society (Hutton et al, 2007). In recent years, significant progress has been made in reducing open defecation and increasing access to sanitation facilities, which in the developing world are predominantly on-site and communal systems.

However, in many dense urban settings, the increase in on-site and communal systems has not led to a healthier living environment. There is overwhelming evidence that the majority of faecal sludge ends up in the residential environments, drains and receiving waters, which presents both public and environmental health problems[1].

This means that, together with ensuring adequate containment of untreated effluent[2] in densely populated areas, faecal sludge management (FSM) is an essential part of the sanitation service delivery model, as shown in figure 1, i.e. the containment of the untreated effluent, removal and transport away from the household location, and final safe and effective treatment and disposal of the effluent.

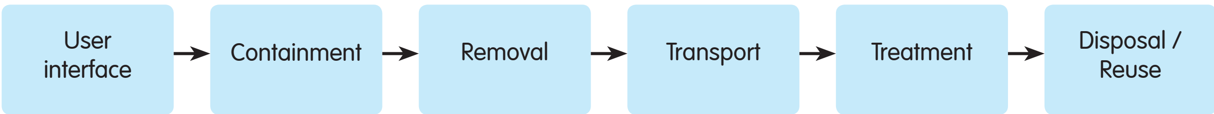


Figure 1. Sanitation service chain

## Challenges facing transportation

The emptying of onsite septic tanks and pits is either done using a large vacuum tanker (usually with a capacity of between 4 and 6 m3), small vacuum tankers/tugs[3] (0.35 – 2 m3) or manually. Large vacuum tankers often have difficulty accessing pits and septic tanks in areas with narrow or inaccessible roads or lanes, especially in densely populated areas. In some instances even the 1000-litre Vacutug (small vacuum tanker), considered rather small by many, cannot navigate some of these roads. The tank emptying in these cases is done by manual emptying or even smaller vacuum tankers.

The location of formal/regulated disposal sites are often far out of town and therefore operators are required to travel long distances to dispose of the septage. Emptying a standard septic tank using a 1000 litre vacuum tanker can require as many as 5 trips to the disposal site. These long distances result in high fuel costs for the trucks (which is the largest operating expense for them), and hence it also means higher emptying fees for the households due to truck operators charging higher rates for the longer distances they have to travel. In Nairobi, where the longest round trip from client to dumpsite to parking bay can be 50km, and charges can vary from $50 for short distances to almost $100 for longer trips (Chowdhry & Kone 2012).

It has also been found that distances from the emptied pit to a regulated disposal facility of greater than 500m often result in illegal dumping of sewage in creeks and rivers (Kone & Peter 2014). In order for operators to get enough trips done in a day, while keeping the service affordable, has resulted in this illegal practice, which has obvious health and environmental issues through the contamination of water and attracting vermin and flies.

## Why use a transfer station?

One response to this problem, is to install septage transfer stations at close proximity to densely populated areas, with the objective of creating a two-step process for handling the waste matter (SSWM 2014). Septage and/or faecal sludge can be safely offloaded at the transfer station by local operators (primary transport) and temporarily stored. When the holding tank is full a larger vacuum tanker transports it (secondary transport) to a regulated disposal site or wastewater treatment facility. This approach facilitates an integration of manual carting to a local deposit site with long distance mechanised carting.

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1 (Peal & Evans 2013; Blackett 2013; Chowdhry & Kone 2012; Still & Foxon 2012; Kome 2011; Corcoran et al. 2010)

2 Bottomless pits and soak-away drains can lead to contamination of groundwater sources, or pose public health risks when they rise to the surface in densely populated areas and/or saturated ground conditions.

3 Commonly known as Vacutugs

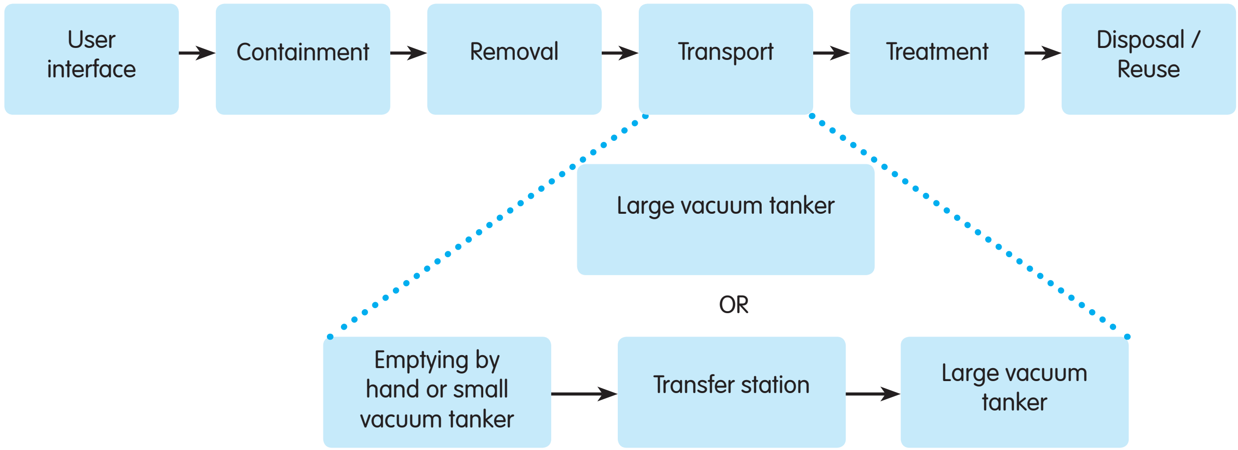


Figure 2. Sanitation service chain indicating a transfer station

Transfer stations have the potential to significantly reduce the amount of faecal sludge entering the environment by providing a local solution for septage disposal. Localised transfer stations shorten the time required for local operators to collect and transport septage, and they will be able to use smaller vacuum tanks that can navigate the densely populated residential areas. This should make the process more efficient, and hence allow them to service more homes in a day. When pits do not overflow and illegal dumping is minimized, the overall health of a community can be significantly improved.

## General advantages of transfer stations

- Reduces transport distance and makes sludge transport to the treatment plant more efficient, especially where small-scale service providers with slow vehicles are involved
- May reduce the illegal dumping of faecal sludge
- May reduce accidents and spillage
- Moderate capital and operation costs
- Latrine desludgers can receive a payment from the utility/operator per load delivered to the transfer station, thereby ensuring safe disposal of the septage
- May encourage more community-level emptying solutions
- Potential for local job creation and income generation

## General disadvantages of transfer stations

- Fixed stations require expert design, location and construction supervision
- May cause blockages and disrupt sewer flow in the case of sewer discharge stations
- The sludge still requires secondary treatment and/or appropriate disposal
- Requires an institutional and regulatory framework for taking care of access fees, connection to sewers or regular emptying and maintenance
- Can lead to bad odours and vermin if not properly maintained
- May inconvenience a few for the benefit of the whole community.

**The focus and structure of this paper:**

The focus of this paper is to provide information on the salient aspects of selecting, designing, building, operating and maintaining a septage transfer station. The information is based on available published literature and technical insights by the author. There are not many documented examples of operational transfer stations. Those that have been documented are limited to sites in Ethiopia and Ghana (African Development Fund 2005; Chowdhry & Kone 2012).

The report is structured to firstly provide descriptions of the various options for transfer stations:

- Mobile temporary transfer station
- Simple permanent transfer station
- Modular transfer station
- Sewer discharge station
- Solid-liquid separation transfer station
- Modular transfer station with solid-liquid separation

This is then followed by an overview of the key considerations when planning a transfer station.

The final section provides a limited list of reported transfer station schemes across Africa and Asia.

# 2. Description of various options

A transfer station allows septage to be brought to a local point near to the latrines being emptied using a short haul vacuum tank or manual labour (primary transport). From this point it can be collected and transported to the eventual disposal site using a suitable long haul vehicle (secondary transport)[4]. If possible, separating the liquid from the sludge before carrying out long haul transport will increase efficiencies and reduce costs.

In basic terms, a transfer station needs to provide a parking place for vacuum trucks or sludge carts, and, in the case of a fixed facility, connection points for discharge and extraction hoses, and a storage tank. However, the configuration of these elements could differ depending on local conditions and practices.

The following options are presented in this paper to provide a range of approaches that could be adopted, or key elements that could be used in other appropriate combinations:

- Mobile temporary transfer station
- Simple permanent transfer station
- Modular transfer station
- Sewer discharge station
- Solid-liquid separation transfer station
- Modular transfer station with solid-liquid separation

## 2.1 Mobile temporary transfer station

A mobile temporary transfer station can be set up on temporary basis while pits in the nearby area are being emptied (Strande et al. 2014). Such mobile transfer stations consist of easily transportable containers or vacuum tankers, temporarily located at a site where multiple trips by small-scale transport equipment are required to navigate between the dense settlement. The septage can be sucked from the smaller vacuum tankers, large drums or buckets into the large vacuum tanker for transporting to the treatment facility. The temporary transfer station can then be relocated when the pit emptying program is complete and moves on to the next neighbourhood.

This approach avoids the construction of numerous permanent transfer stations. While cheaper than permanent facilities, the main advantage of these stations is that they sidestep the complex and often lengthy procedures and approvals required for siting permanent stations in high-density settlements (such as odours, storage risks, public health and safety etc.), and can be established relatively quickly. Also, the local residents are more likely to accept a temporary station than a permanent one (discussed further in section 3.1).

This approach is also ideal for a pilot program and for testing potential sites for a permanent location - testing the viability of the location, access to and from the site for both the large tanker and the smaller vehicles, public acceptance, and planning regulations, for example.

An added benefit if a detachable trailer is used, is that the motorised vehicle towing the container is capable of performing other activities thus allowing for cost savings and potential for increased revenue. Such systems have reportedly been used in places such as Maseru, Lesotho (Strauss & Montangero 2002). In such cases, the detachable tanker will need a self-powered vacuum pump for emptying the smaller tankers.

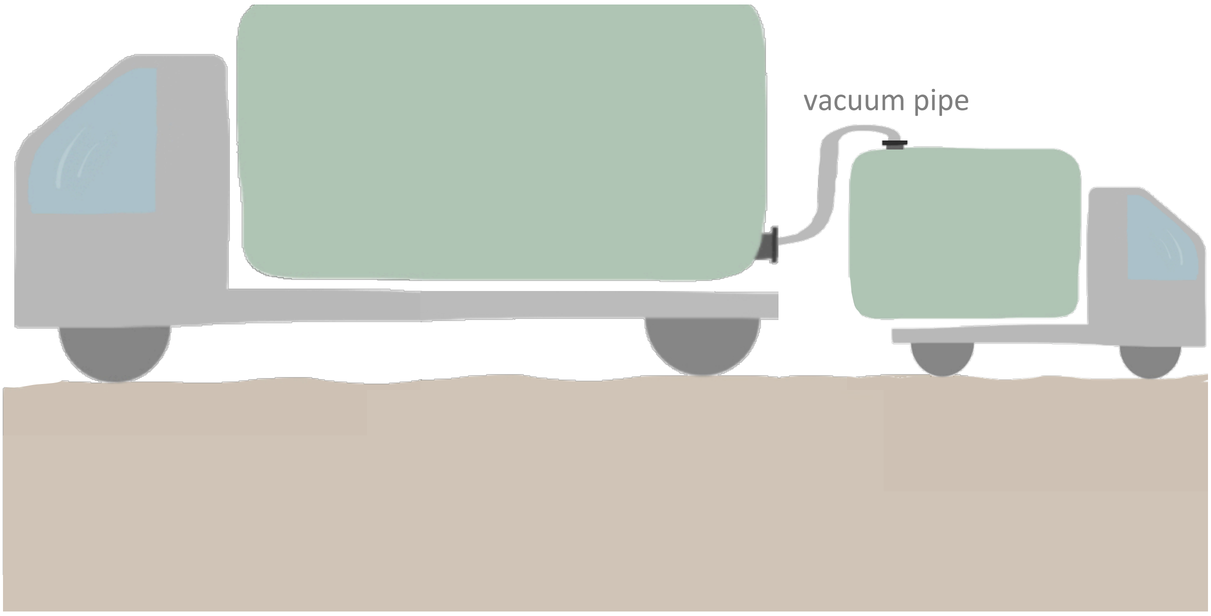


Figure 3. A mobile temporary transfer station

Variations on this approach would include using a liquid-solid separator tanker (as described in 2.6), which can discharge the liquid into a nearby sewer, thereby increasing the volume of sludge it is able to carry away.

An issue with this approach, however, is that in densely populated informal settlements, securing the necessary space and access can be challenging. Given the temporary nature of the facility, it is possible that new shelters will be erected in the open space designated for the temporary transfer station – and fencing is often no deterrent. A permanent structure has the advantage of occupying the site.

In addition, it does not allow small local operators to go about their business in their own time, and disposing the collected septage in a fixed station. They can only operate their emptying business when the mobile unit is in the area.

## 2.2 Simple permanent transfer station

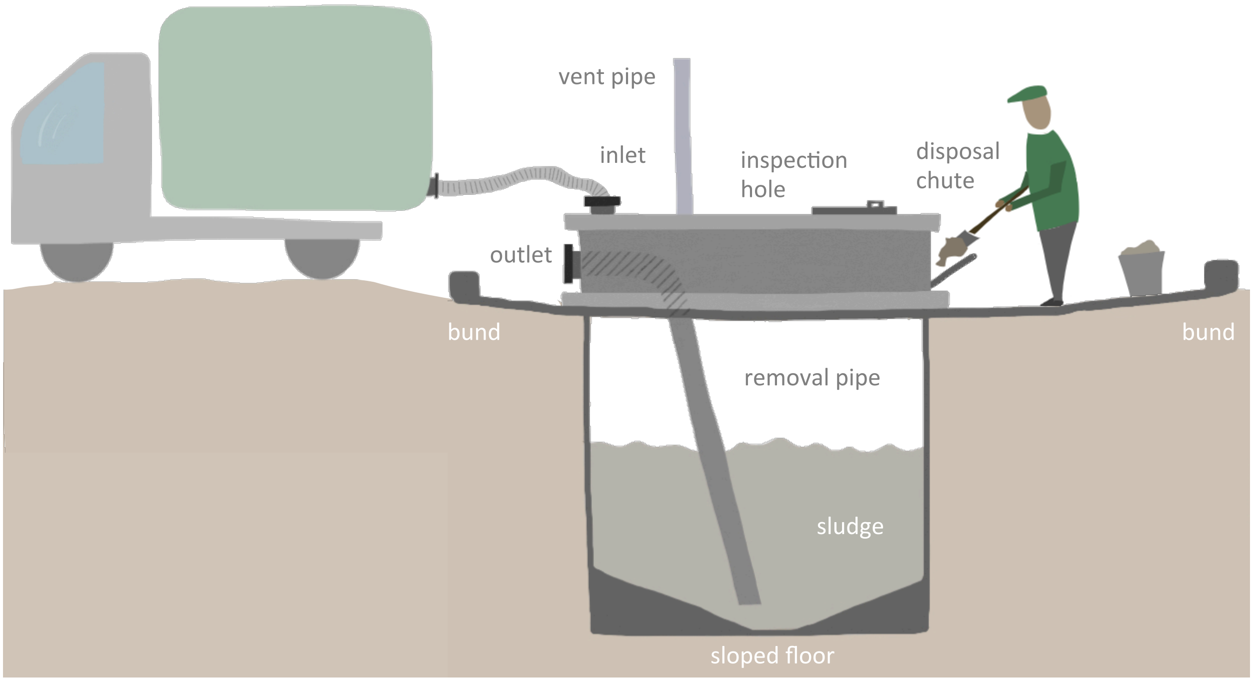


Figure 4. A simple transfer station (modified from SSWM 2014)

The simple transfer station consists of a water tight holding tank to contain the septage, a disposal point for hand disposal, an inlet pipe for coupling to a vacuum tanker, and an outlet pipe for coupling to a large vacuum tanker for carting away, as shown in figure 4.

The structural design components should follow those described further in section 3.2. This design requires basic operations and maintenance, also described in section 3.3.

### Case example:

The Ghanaian Underground Holding Tank (UHT), shown in Figure 5, has a capacity of approximately 23m3. In some instances, the already dry sludge has been known to become too dry and compacted to vacuum out. The method used to empty the holding tank in these instances is to remove the above-ground section of the UHT by crane, making the emptying of the tank a costly process, and has resulted in many UHTs being abandoned. Therefore, an access point should be constructed in the roof of the tank to allow manual emptying of the consolidated sludge.


Figure 5. Transfer station in Ghana (Boot 2008)

## 2.3 Modular transfer station

To avoid having to manually remove compacted sludge by hand, portable containers can be used as an alternative to a submerged fixed concrete holding tank (Strande et al. 2014). These can vary in size and be made from a range of materials:

- Small 200-litre metal drums (Mcbride 2012);
- Medium-sized plastic tanks, sludge bladders (tested in Malawai) or liners with metallic frames ranging between 500 – 3,000 litres;
- Large customised metallic tanks or skips of greater than 2 kL (Strauss & Montangero 2002);
- Large detachable mobile tankers.

Figure 6. Portable reinforced plastic tanks (source: olx.co.za)

To allow easy access for the disposal of the sludge into the portable container by smaller vacuum tankers or manual operators, a raised platform may need to be constructed. Figure 7 shows how a detachable tanker, for example, can be parked under a raised platform. Septage is discharged into the top of the tanker. When the tanker is full, it is replaced with an empty one, and the full one is transported for emptying at a legal dumping site.

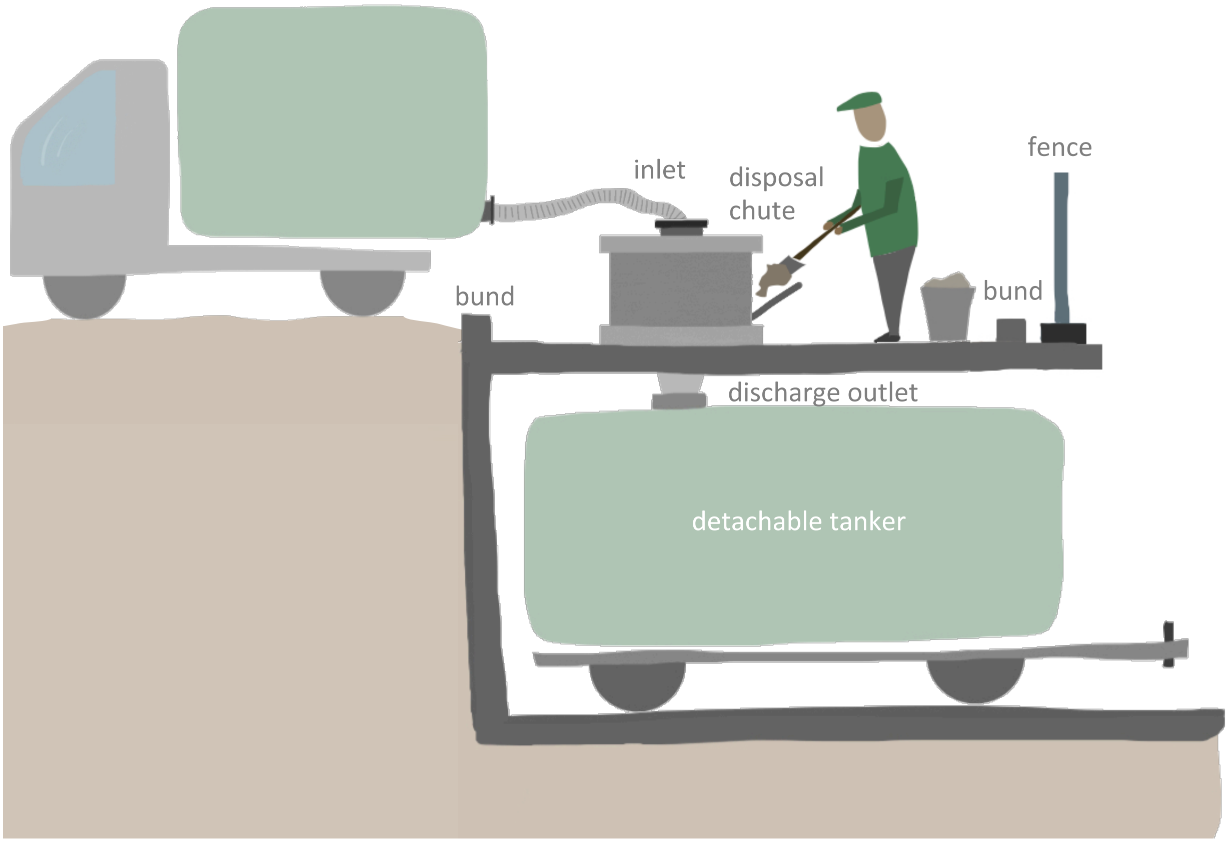


Figure 7. Detachable septage tanker (modified from US EPA n.d.)

The design of this facility is more complicated and requires structurally designed retaining walls and platforms, and requires attention to potential falling hazards by installing fences and barriers.

Security is key for this option, where damage to or theft of the portable containers or tanker need to be avoided.


Figure 8. Photographs of portable collection tanker (left; source: Mayglothling Waste LTD) and sludge bladder (right; source: CC BY-SA 3.0/Cjp24)

## 2.4 Sewer discharge station

The sewer discharge station (SDS) is much the same as the simple transfer station, but is directly connected to a conventional gravity sewer main so that the septage can be transported to a semi-centralised secondary treatment system, as shown in figure 9. This avoids the need for the septage to be carted away by a larger vacuum tanker.

A variation on this option, is to use existing sewer lifting stations as septage transfer stations, where the septage is discharged directly into the wet well of the pumping station.

These options are only viable where septage (sludge with a high liquid content) is retrieved from septic tanks and disposed in the transfer station. Utilities and asset owners discourage the disposal of concentrated sludge directly into the sewers as it can lead to blockages, especially if the sludge is too dry (Strande et al. 2014).

Septage emptied into the SDS is released into the sewer main either directly by gravity or at timed intervals (e.g., by pumping) to optimize the performance of the sewer and of the wastewater treatment plant, and/or reduce peak loads (Tilley et al. 2008).

The slope of the floor should ensure that the sludge gravitates towards the outlet pipe and is discharged to the sewer.

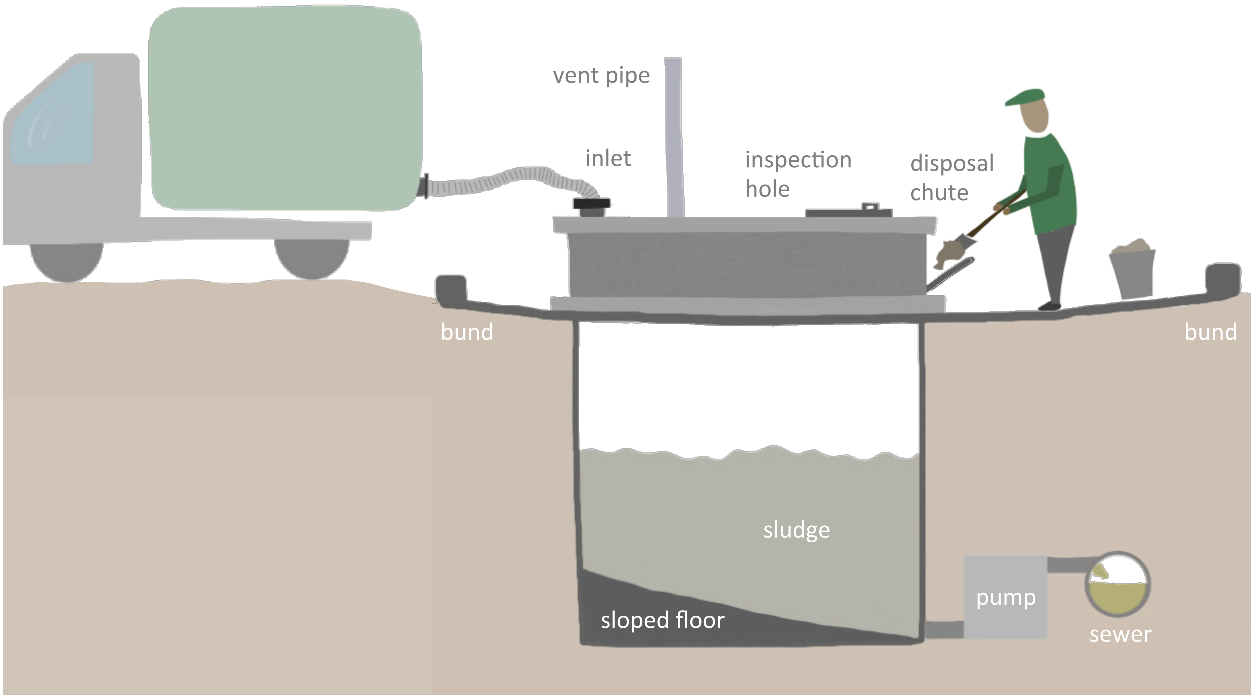


Figure 9. Sewer discharge station (modified from SSWM 2014)

## 2.5 Solid-liquid separation transfer station

A way to avoid sludge blocking the sewer main, is to only allow liquid to be discharged to the sewer, and then to transport the sludge by tanker. This option is illustrated in Figure 10. Such solid-liquid separation reduces the volume of sludge to be carted to the disposal site. This significantly reduces carting costs as fewer trips have to be made (Still & Foxon 2012).

This approach is ideal for desludging operations that require adding water to make the dry sludge in the pits pumpable. The liquidised sludge can be dewatered in the transfer station to reduce the volume that needs to be transported by the larger transportation tanker.

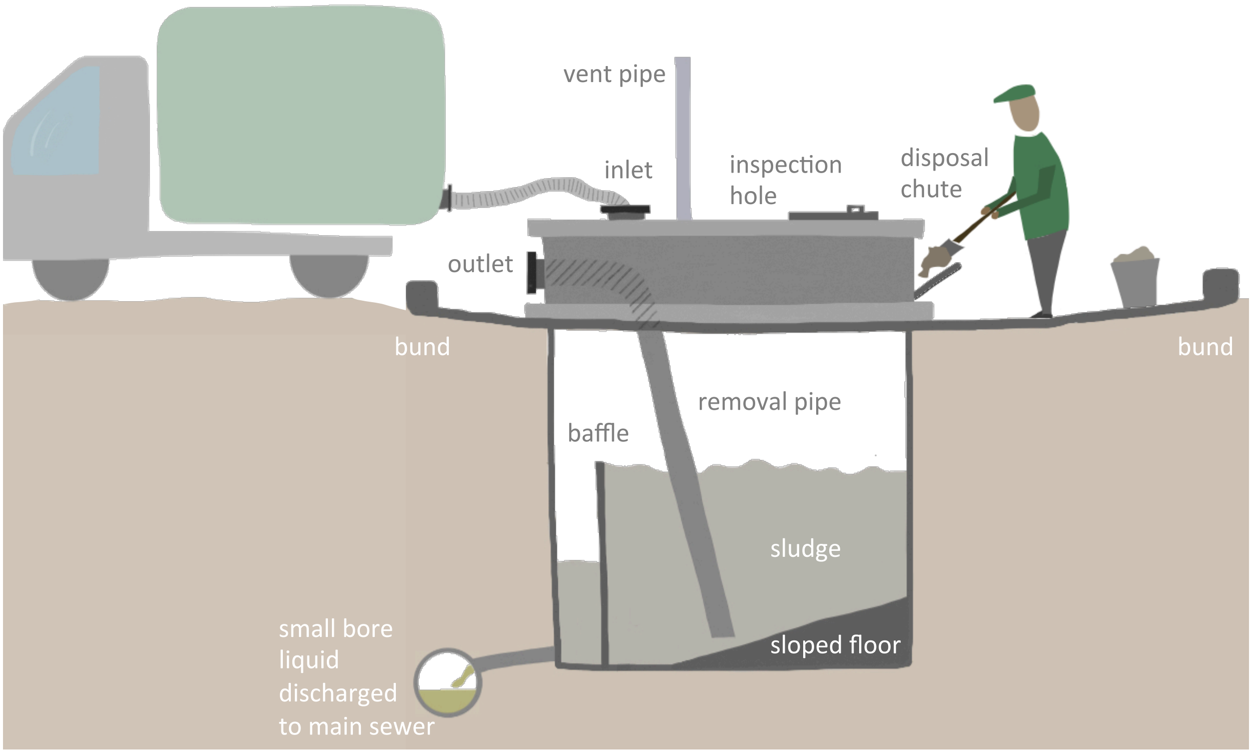


Figure 10. Solid-liquid separation transfer station

The design of this facility is similar to the sewer discharge station, with the addition of a second chamber and baffle to separate the liquid from the sludge – much like a large septic tank. Using a third compartment would ensure improved separation, and settling of the sludge.

A small bore pipe discharges the separated liquid to a nearby sewer or a subsurface soak-away or constructed wetland if the terrain allows it, although this may introduce other complications related to public health and underground water contamination. Careful controls would be required to ensure adequate separation of this high strength effluent from groundwater, wells and surface waters, as well as careful evaluation of the soils and their long term acceptance rate.

The slope of the floor should ensure that the sludge gravitates to the lowest point of the floor to ensure all the sludge can be vacuumed up. The removal of the drier sludge by vacuum pump may not always be possible if the sludge becomes too dry and/or compacted. It may need to loosed using a high pressure hose.

## 2.6 Modular solid-liquid separation transfer station

This option is a variation on the solid-liquid separation transfer station (see previous figure), but uses a detachable tanker instead of a submerged holding tank. The detachable tanker is designed to allow the excess liquid to be discharged via a small bore pipe to a nearby sewer. This option avoids the emptying of the holding tank at the transfer station. The tanker can be emptied at the legal disposal site by tipping the sludge out the back of the tanker, as shown in figure 12.

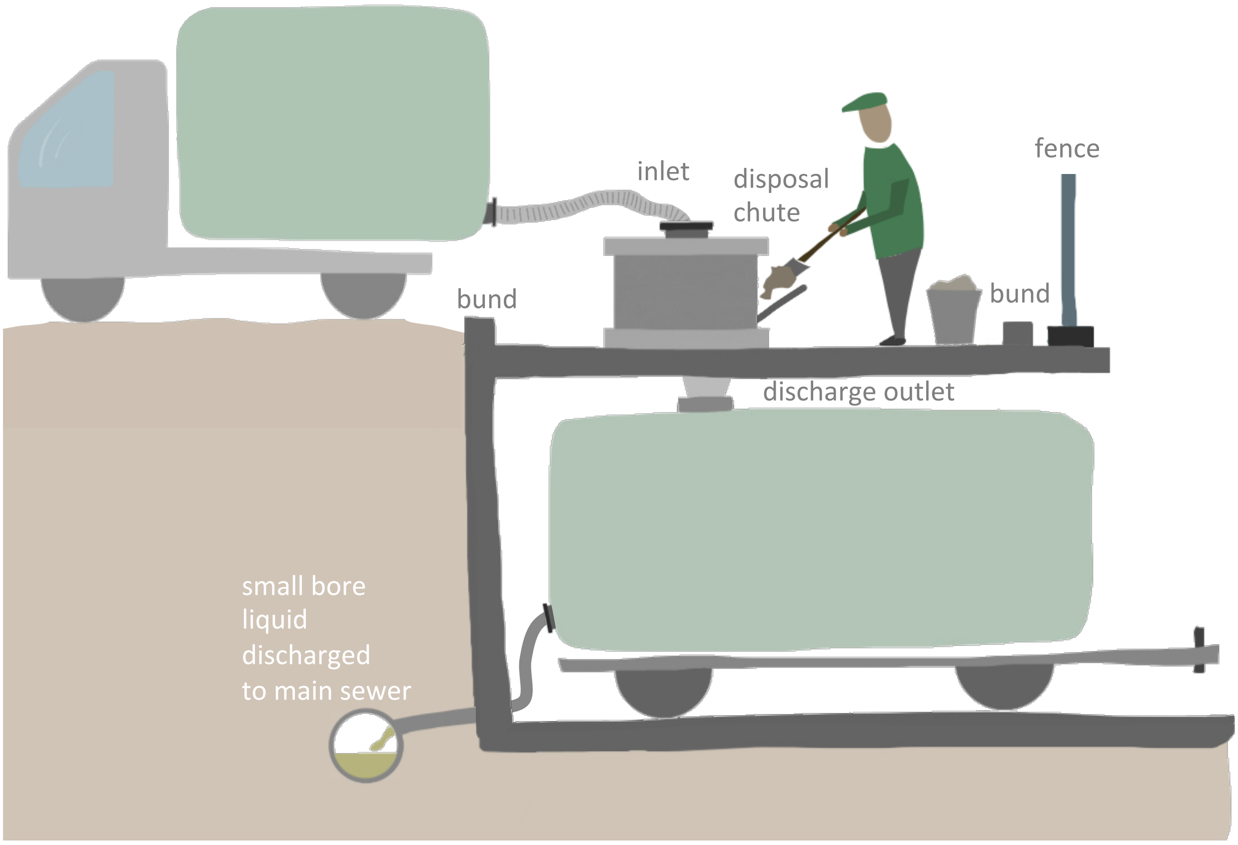


Figure 11. Modular solid-liquid separation transfer station

Figure 12. Emptying tanker by tipping (source: Vallely Vacuum Tankers, UK)

## 2.7 Summary and comparative characterisitics of the different options

The table on the following page (table 1) provides a comparison of the main features of each transfer station option presented in this paper, as well as the key issues associated with each option.

It would seem from consultation with sanitation practitioners, that mobile transfer stations are the preferred option since they are viewed as less contentious by the local community, they are not viewed as a permanent solution locking out further improvements down the track, are better suited to very dense settlements, and allow a level of flexibility for the operator.

However, it should be noted that this preference comes from their experiences to date in starting up septage transfer stations. It might be that from an O&M and a sustainability perspective, different lessons and preferences arise in the future.

**Table 1. Technical comparison of transfer station options**

| | | Mobile temporary transfer station | Simple transfer station | Modular transfer station | Sewer discharge station | Solid-liquid separation transfer station | Modular solid-liquid separation transfer station |
|---|---|---|---|---|---|---|---|
| Main features | Siting | Temporarily above ground | Below ground | Above ground | Below ground | Below ground | Above ground |
| | Constructability | None | Easy | Moderate<br>• Split levels and retaining walls | Moderate<br>• Connection to sewer main | Moderate<br>• Connection to sewer main<br>• Holding tank requires separation baffles | Moderate<br>• Split levels and retaining walls<br>• Connection to sewer main |
| | Sewer connection | Not necessary<br>Could discharge liquid | No | No | Yes<br>Discharge of septage | Yes<br>Discharge of liquid | Yes<br>Discharge of liquid |
| | Security | Barriers to secure site | Lockable | Lockable and fencing | Lockable | Lockable | Lockable and fencing |
| Operation | Septage discharge | By hand and small vacuum tanker | By hand and small vacuum tanker | By hand and small vacuum tanker | By hand and small vacuum tanker | By hand and small vacuum tanker | By hand and small vacuum tanker |
| | Septage/sludge removal | • Septage/sludge towed away in a large (detachable) tanker or alternative container | • Septage pumped out and removed by a large vacuum tanker. | • Septage towed away in a large detachable tanker or alternative container | • Septage released to sewer | • Liquid released to sewer.<br>• Sludge pumped out and removed by a large vacuum tanker | • Liquid released to sewer<br>• Sludge towed away in a large detachable tanker and alternative container |
| Maintenance | Daily | • Basic washing and cleaning | • Basic washing and cleaning | • Basic washing and cleaning | • Basic washing and cleaning | • Basic washing and cleaning | • Basic washing and cleaning |
| | Monthly | | • Remove compacted sludge by liquid agitation and vacuum pumping. | | • Remove compacted sludge.<br>• Remove any sewer blockages | • Remove compacted sludge by liquid agitation and vacuum pumping. | |
| | As required | • Mechanical maintenance of tanker and motorised vehicle | | • Mechanical maintenance of tanker and motorised vehicle | • Replace the non-return valve at regular intervals | • Replace the non-return valve at regular intervals | • Replace the non-return valve at regular intervals<br>• Mechanical maintenance of tanker |

# 3. General considerations when planning a transfer station

The most important considerations when planning a transfer station are where to locate the transfer station, whether it will be mobile or fixed, how O&M will be organised and how security will be ensured. Health and safety of both the operators and surrounding residents is a priority. The provisional use of mobile stations may assist in optimising the operations by evaluating the suitability of potential locations over a period of time without committing to the construction of a fixed station.

The following sub-sections set out the planning and design considerations for temporary and fixed transfer stations, where applicable.

## 3.1 Siting a transfer station

Regardless of whether the transfer station is permanent or mobile, the siting of the transfer station requires careful planning.

### *Geographic location:*

The location of the transfer station must comply with any relevant municipal regulations and should be located in an optimal location which depends on balancing certain key factors.

- Minimising the time taken to transport the septage from the latrines to the transfer station.
- Maximising the coverage area to meet the demand generated by sludge collection using small-scale equipment (primary transport).
- The optimum size of the transfer station holding tank to match the collection volumes.
- The frequency that the holding tank will be emptied.
- The holding capacity of the larger secondary transport vehicles.
- The distance that the larger secondary transport vehicles will need to travel and the number of trips they will need to make in a day.
- The cost of primary and secondary transport methods being used need to be taken into account (Strande et al. 2014).

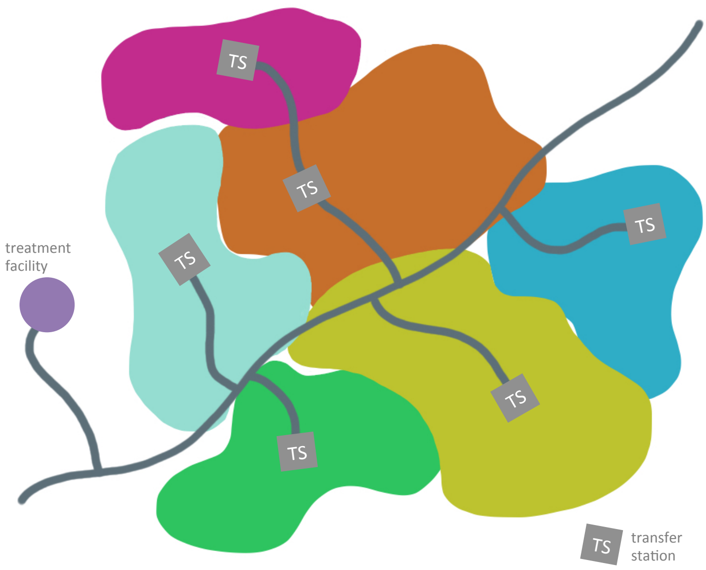


Figure 13. The spatial puzzle when locating a transfer station

### *Access and spatial requirements:*

The physical location of the transfer station needs to meet a number of requirements:

- Easy access for both primary and secondary transport vehicles – this can be challenging to find in densely populated areas. Primary vehicles will need to navigate their way along narrow streets and through densely built up areas, while the secondary transport vehicles will need to be able to drive on wider and less congested roads.

- Parking areas for both small discharging vacuum vehicles and carts, as well as large vacuum trucks that will be emptying the holding tank.

In many dense settlements, finding an appropriate site for the transfer station can be difficult, since in areas where you need transfer stations due to low accessibility, density is usually high. The local council may need to expropriate the necessary land. In high-rise residential and/or commercial areas, an underground containment in the basement of a large commercial or administrative building could be considered, where public space is not available. Alternatively, choosing a temporary facility is an ideal way of overcoming the lack of available permanent space. Temporary sites could be located on the verges of roads, and can be shared with other public service activities such as rubbish collection.

### *Community engagement and awareness:*

It is not uncommon for residents to reject the siting of a transfer station near to their homes, commonly known as Not In My Back Yard (NIMBY) (Godfrey et al. 2012). Community consultation prior to the location and construction of any transfer station is vital to ensure the success of the facility and sanitation approach. Residents in the vicinity of a proposed transfer station should be consulted beforehand – pointing out the pros and cons of having the facility in close proximity to their homes.

The location of the transfer station should be carefully chosen to minimise the odours and disturbances that could become a nuisance to nearby residents, especially if the transfer station is emptied at night when the traffic conditions are more favourable.

The concept of using a transfer station for intermediate storage of septage is likely to be a new concept, the local authority should embark on a program to create awareness and promote of the concept and how it will work through various forums i.e. community meetings, radio, newspapers, local emptier forums, etc. The community should also be aware of the do’s and don’ts around the transfer station, for example to keep children away from the site.

### *Health, safety, security, risk management:*

Septage transfer stations involve the storage and handling of highly pathogenic material. The site should therefore be chosen in such a way that risks to public health and safety can be managed properly. In addition, potential natural events, such as flooding, should be considered in the siting and design so as not to expose populations to health risks and associated disease.

There should be clear design, management and surveillance protocols for health and safety, including procedures describing what to do when there is a risk incident.

## 3.2 Design considerations for fixed options

Fixed holding tanks can take various forms, from large plastic containers to more expensive concrete chambers, and can be located above or below ground. The structural components of a fixed facility must comply with all relevant municipal building codes. Most countries will not have specific standards for septage transfer stations, thus in addition to general building codes, public health and safety and environmental considerations will need to be taken into account in the design. A number of key technical considerations for the holding tank are presented, and illustrated in figure 14.

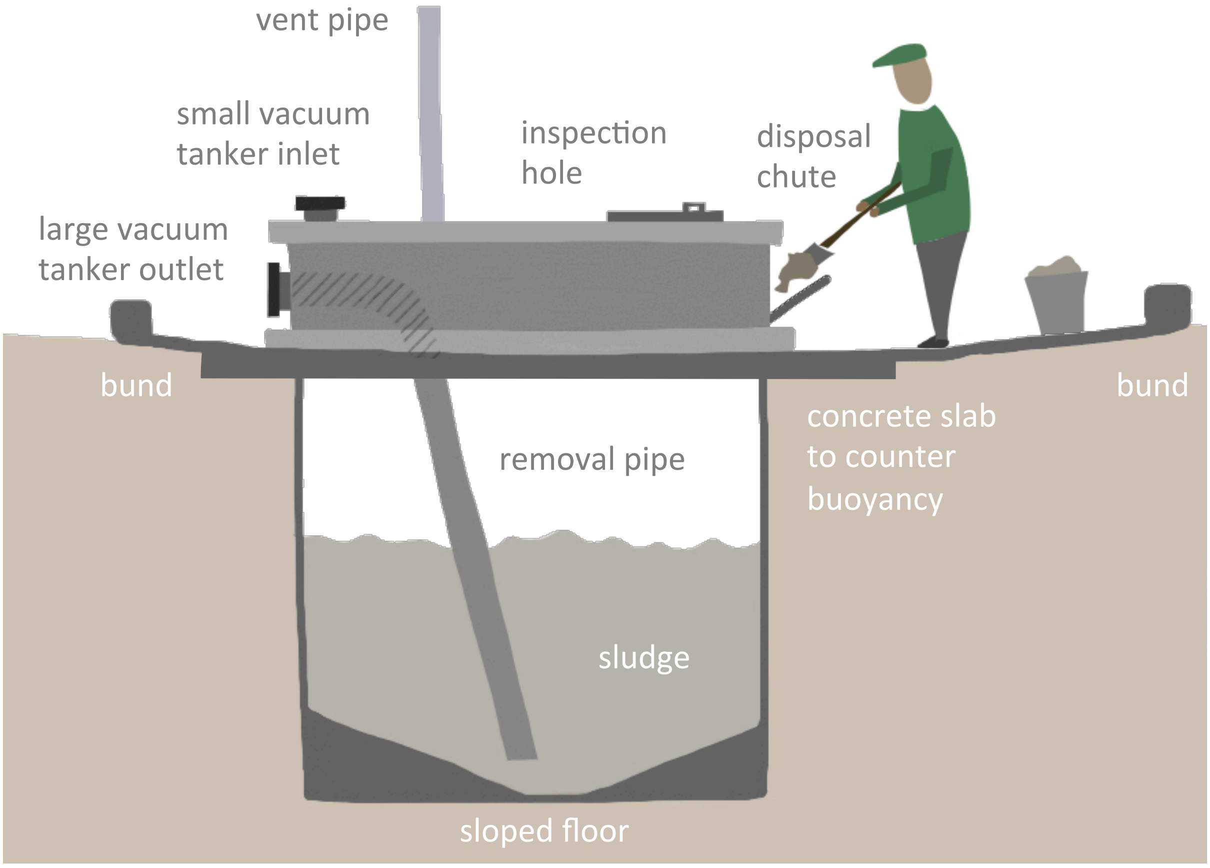


Figure 14. Key structural design components

### *Structural arrangements for storage:*

- Size the volume of the holding tank to match the emptying regime and the number of houses that it is servicing, together with the fill-up rate of their pit latrines (which is a function of the average number of people per house, their diet and whether the pit is sealed or allows dewatering of the septage). This should be considered in conjunction with the rate at which the large vacuum trucks can empty the transfer stations – which is a function of the number of large vacuum tanks in operation, their sizes (usually in the order of 6 to 11kL (6 to 10 m3), and the distances they have to travel.

- Ensure the holding tank is well constructed and water-tight to prevent leaching (and surface water infiltration). Contamination of the ground water is a serious issue, especially if local residents are dependent on shallow wells for water.

> Case example:
>
> In Addis Ababa, the four transfer stations in operation are not as effective as they could be due to a lack of capacity to handle the amount of sludge collected, and poor operations at the stations (Chowdhry & Kone 2012).

- Counter buoyancy forces in instances where the underground tank is located in a high water-table and there is a risk of upliftment due to groundwater pressure, by anchoring the tank down with cables or with a heavy concrete slab (see figure 14).

- Slope the floor of the holding tank to allow the septage to drain to one point to ensure all the septage can be vacuumed up.

- Fit the holding tank with a simple level gauge to alert the operator when the tank needs emptying. In some instances (where technology and funding permit), transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads.

- Erect a vent pipe at least 9 metres high to discharge and disperse any foul air above the roofs of surrounding buildings, and fit the end with a fly-screen.

- Fit the roof of the holding tank with a lockable inspection hole to allow inspection of the inside of the holding tank, and to insert water hoses for loosening any sludge if it becomes too compacted to vacuum pump out.

### *Discharge access to the storage tank:*

- Provide a connection point for discharge hoses which are easily accessible by a small vacuum tanker.

- Build the disposal chute for hand delivered septage low enough to minimize spills when labourers are manually emptying their sludge carts. It should be lockable when not in use (to avoid garbage being thrown in when unattended).

- Install a screen/grate on the disposal chute to restrict the disposal of large items of garbage[1] into the holding tank. that may block the vacuum hose, and also to avoid anyone falling in. Designated containers should be provided to hold the screened garbage.

- Contain any accidental spills that might occur using a bund[2] around the whole facility, and channel any spillage and wash-down water via a drain into the holding tank.

### *Emptying the storage tank:*

- Avoid complicated access and emptying procedures by providing an easily accessible connection point for a large vacuum tanker.

- Locate the removal pipe above the deepest point of the holding tank and ensure it is long enough to allow the sludge on the holding tank floor to be sucked up.

- Contain any accidental spills that might occur using a bund  around the whole facility. Any spillage should drain back into the holding tank.

- If the transfer station discharges to a nearby sewer main, the discharge pipe should be fitted with a non-return foot valve (or check-valve) to avoid sewage from the sewer entering the holding tank during high flows or blockages downstream in the sewer.

### *Security and safety:*

- Erect appropriate signage about safety for both the public and the operators.

- Erect temporary barriers to ensure the safety of the public moving in the vicinity of mobile transfer stations.

- Restrict general access to fixed transfer stations by fencing in the facility and regulating who has access.

- Provide facilities for operations staff to wash their hands and to wash down any spills around the facility. Water for washing should be provided either from the water mains, or supplied by container.

- Prohibit anyone from entering a holding tank at any time. Such confined spaces can contain noxious gas that could be fatal to anyone entering the tank.

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1 The presence of garbage in the pits of toilets presents an enormous challenge to effective pit emptying, as well as the operation of the transfer station. In addition, instituting and maintaining a reliable solid waste collection programme in parallel to the sanitation program can go some way to solving this problem.

2 A secondary enclosure, typically consisting of a low wall or berm, which surrounds a tank or fluid-handling mechanism, intended to contain any spills or leaks.

## 3.3 Operation and maintenance considerations

Management and operation of the transfer station can be undertaken by a range of public or private institutions. Their roles and responsibilities must thus be clearly outlined.  Their role would include the security of the facility from vandalism and illegal use, controlling access, maintaining the functionality of the facility and ensuring that the facility is maintained in an hygienic state.

In addition to this, a number of other institutions or companies may access and use the facility to either dispose or empty septage. To avoid any problems, for example the indiscriminate dumping of toxic waste in the facility, only registered emptiers should be permitted to use the facilities.

One major decision is whether or not the facility should be permanently staffed, or have permanent surveillance, or that intermittent surveillance will be sufficient. This will depend on the type of facility and the neighbourhood. It may also be that some arrangement can be made with the neighbourhood itself to ensure surveillance.

Operation also includes planning for the emptying of the transfer station. This can be done on a regular basis or in an on-demand manner - that is, when it's full. The timing of secondary collection is important to avoid the sludge drying out and consolidating, and becoming too hard to pump out.

Daily tasks of the transfer station operator could include the following:

- Timely opening of the facility, specifying the days and times of operation, so that users can be sure of when it will be open.
- Verifying the formal registration of an emptier.
- Checking the quality of the incoming waste (solid waste is not allowed in the facility).
- Instructing the emptiers in hygienically disposing waste into the facility.
- Recording the volumes of sludge disposed.
- Contacting the organisation responsible for the de-sludging of the transfer station.
- Cleaning the environment around the facility.

Regular maintenance activities would include:

- Cleaning of garbage screens to ensure a constant flow and prevent blockages, flies and odours The screenings should be stored in proper containers and transported to a designated landfill.
- Washing down and cleaning of the discharge chute.
- Cleaning of the general loading area to minimise odours, flies and other vectors from becoming public nuisances.

### *Compacted sludge:*

In many cases, the somewhat dry sludge being discharged into the holding tank can become even more dense and compacted while being stored, making removal by vacuum pump difficult (Boot 2007). In these instances, the sand, grit and consolidated sludge can be made fluid again by using a high pressure water hose (if available) to agitate the contents to make the dense sludge fluid again, allowing the vacuum pump to remove the sludge. However, adding water to the sludge will increase the volume of septage that needs to be transported, making the transport less efficient, but this may still be cheaper than using manual labour with screw augers to empty holding tank from above.

At no time should manual labour be permitted inside of the holding tank.

## 3.4 Disposal of septage from the transfer station

It should be ensured that the sludge from transfer stations is transported to and treated in an appropriate secondary treatment facility (e.g. in sludge drying beds, anaerobic digestion or large scale composting) and not illegally dumped.

The nature of septage varies around the world and is dependent on diet and climate. Therefore, it is important to know the composition and the strength of the septage before planning its safe disposal. Septage can be disruptive to a sewage treatment process, and the disposal of dense pit sludge at the wastewater treatment works has been found to quickly overload the system. This is particularly relevant when planning a direct connection between the transfer station and the sewer.

When co-mixing is taken into consideration in the design of the sewage treatment plant, the treatment plant operators will want to control the volume of septage entering the plant. Depending on the particular constraints at a given wastewater treatment plant, the impact of receiving pit latrine sludge will be equivalent to between 0.5 and 1 Mℓ of normal sewage per emptied pit (depending on the volume of the pit). A receiving waste water treatment plant must therefore keep the ratio between the volume of pits emptied per day and the capacity of the plant in Mℓ per day at no more than 1 to 10 to avoid process failure of the plant (Still & Foxon 2012). This will have implications for the emptying schedule of the transfer station.

## 3.5 Financial considerations

Financial issues are closely linked to the governance and institutional issues associated with septage removal, and the relevant revenue mechanisms – i.e. who pays whom for what service. Transfer stations are rarely operated as an independent financial entity, rather they are part of a bigger emptying, transfer and treatment service and need to make financial sense in that context. To develop the business case for a transfer station, costs[3] associated with the capital and ongoing operation and maintenance need to be considered, along with an analysis of potential cost recovery options and potential operational savings, through primarily reduced fuel expenses.

It is unlikely that the private sector would invest in transfer stations, unless it was part of their overall sludge removal process and licence. The construction of transfer stations would usually have to be managed, controlled and/or invested in by the local authority – they could leverage the necessary capital, and would ensure compliance and structural integrity. It is possible that private faecal sludge operators may see the benefits of reduced traveling costs afforded by the installation of transfer stations, and form a consortium of investors, with or without the local authority, to construct and manage transfer stations.

Municipalities or sewerage authorities might consider offsetting some of the capital and operating costs by issuing moderate access permits or charging access fees to desludgers. However, this approach might act as a deterrent and lead to increased illegal dumping, if the capacity to enforce compliance with the safe dumping regulation is not present. An incentive payment based on the volumes delivered to the transfer station can also be considered to encourage the safe disposal of the septage, but this additional cost to the program must be taken into consideration at the planning stage.

Generating revenue from re-use or energy out of sludge is sometimes seen as a way to cover operating or other costs. However, the business case should be rigorously evaluated before investing in this. Usually transfer stations are not the appropriate location for re-use activities. Biogas would be suitable considering the space, but is usually not a viable proposition because septage that has been stored in on-site systems for more than a year will have little biogas potential (Still & Foxon 2012). The significant biodegradation of the faecal sludge can be expected to have already occurred.

3 Indicative costs have not been provided in this report since documented evidence is not available, and costs are likely to vary from country to country.

# 4. Reported examples of transfer stations in operation

The following list provides some examples of where septage transfer stations have been implemented – it is by no means a comprehensive list:

Table 2. Examples of septage transfer stations

| City | Country | Description |
|---|---|---|
| Accra | Ghana | 60 Underground Holding Tanks (UHTs) were constructed in the 1990s. Only 33 (according to the WMD) were still in operation 10 years after their installation due to dry night soil and delays in secondary collection (Boot 2008). |
| Dakar | Senegal | Underground Holding Tank (UHT) with a capacity of 23kL. Four were located across the city 20 years ago, but are mostly not operational. |
| Dhaka | Bangladesh | WSUP has constructed Faecal Sludge Management (FSM) Transfer station at Mirpur, Dhaka.<br><br>The overall function of the transfer station is to aggregate, dewater, and temporarily hold faecal sludge collected from the safe emptying of sanitation containment structures of residents found within 2-3 km of the facility. WSUP has also engaged medium scale entrepreneurs to provide septic tank/ pit emptying services using Vacutugs in the Mirpur and Gulshan areas. |
| Dhaka | Bangladesh | 11 sewer lifting stations were used as septage transfer stations. This solution required a lot of negotiations with many relevant agencies. See the WaterAid/DSK programme in Dhaka. |
| Hai Phong | Vietnam | The transfer station is a large tank that is placed temporally in the street and can be transported away by a hook-lift truck when full. The transfer stations are placed where currently needed, and it is not intended to be a permanent installation. |
| Nakuru | Kenya | Nakuru County and Sanitation Programme (NCSP) has introduced the Primary Collection Point (PCP) which in principle is a large moveable tank with a disposal latch and an outlet. Emptiers can dispose the waste from toilets in the PCP.<br><br>The PCP will be stationed for a fixed period at one location to ease the process of emptying by pit emptiers, after which it will be emptied and transported by NAWASSCO to its treatment work where further treatment and development of products is done. Soon after the PCP is emptied, it will be moved to another location or Zone for a month. |

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**A guide to septage transfer stations**


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