SANITATION IS DIGNITY

OPTIONS FOR DEALING WITH FULL PITS

water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

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BACKGROUND

Earlier research work on the emptying and disposal of pit latrine sludges provides the background for this guideline document. Those interested may wish to consult the reports from these studies for further information. The relevant research and reports are as follows:

Water Research Commission (1997 to 1999) Research on the co-disposal and composting of septic tank and pit latrine sludges with municipal refuse. This work was undertaken by CSIR and LeTrobe and Associates

National Sanitation Coordinating Office (NaSCO) (March 2001) Compilation of draft guidelines for the removal and disposal of faecal waste from pit latrines and septic tanks. This work was undertaken by Mvula Trust, Dikgolabolokwe Sanitation, Partners in Development and CSIR.

D.A Still (2002) After the pit latrine is full . . . what then? Effective options for pit latrine management. Water Institute of Southern Africa, Biennial Conference, Durban, May 2002

DWAF (2004) An assessment of the rate of filling of pit latrines

L. Tyers (2005) Towards pit emptying as a municipal service: sustainable sanitation – building, emptying and maintaining pits.

Ethekwini Municipality (2005). Pit latrine evacuation study: completion report

In addition significant work has been undertaken in other municipalities in South Africa, as well as in other African states such as Lesotho, Zimbabwe, Tanzania and Kenya.

These guidelines attempt to capture the knowledge and experience of this work and present it as a guide for municipalities in South Africa.

1. INTRODUCTION

The provision of a toilet does not necessarily constitute a sanitation service. The provision of a sanitation service includes ongoing operation and maintenance of the system, either by the homeowner or by a partnership between the homeowner and the local municipality. For pit latrines and other types of on-site sanitation systems, this includes ensuring that accumulated sludge is periodically removed from the facility and appropriately treated or disposed of.

The provision of this ongoing service to residents using dry sanitation systems is a complex issue and should not be underestimated. The principle of shared responsibility for the operation and maintenance of improved sanitation systems is standard practice in most countries, and applies equally to wet and dry sanitation systems. This means that households can only continue to enjoy the benefits of improved sanitation after construction of toilets when they share responsibility for managing the service, particularly the on-site component of the service. This including attending to simple toilet maintenance, undertaking pit desludging where feasible, relocating or reconstructing toilet structures when pits are full, or disposing of composted or desiccated waste from composting and desiccating toilets (e.g. urine diversion systems). However municipalities have an equal level of responsibility, particularly from a public health perspective, to ensure firstly that all off-site components of the sanitation system are properly operated and maintained, and also secondly that the sludges from the on-site components are properly removed and disposed of on a regular basis.

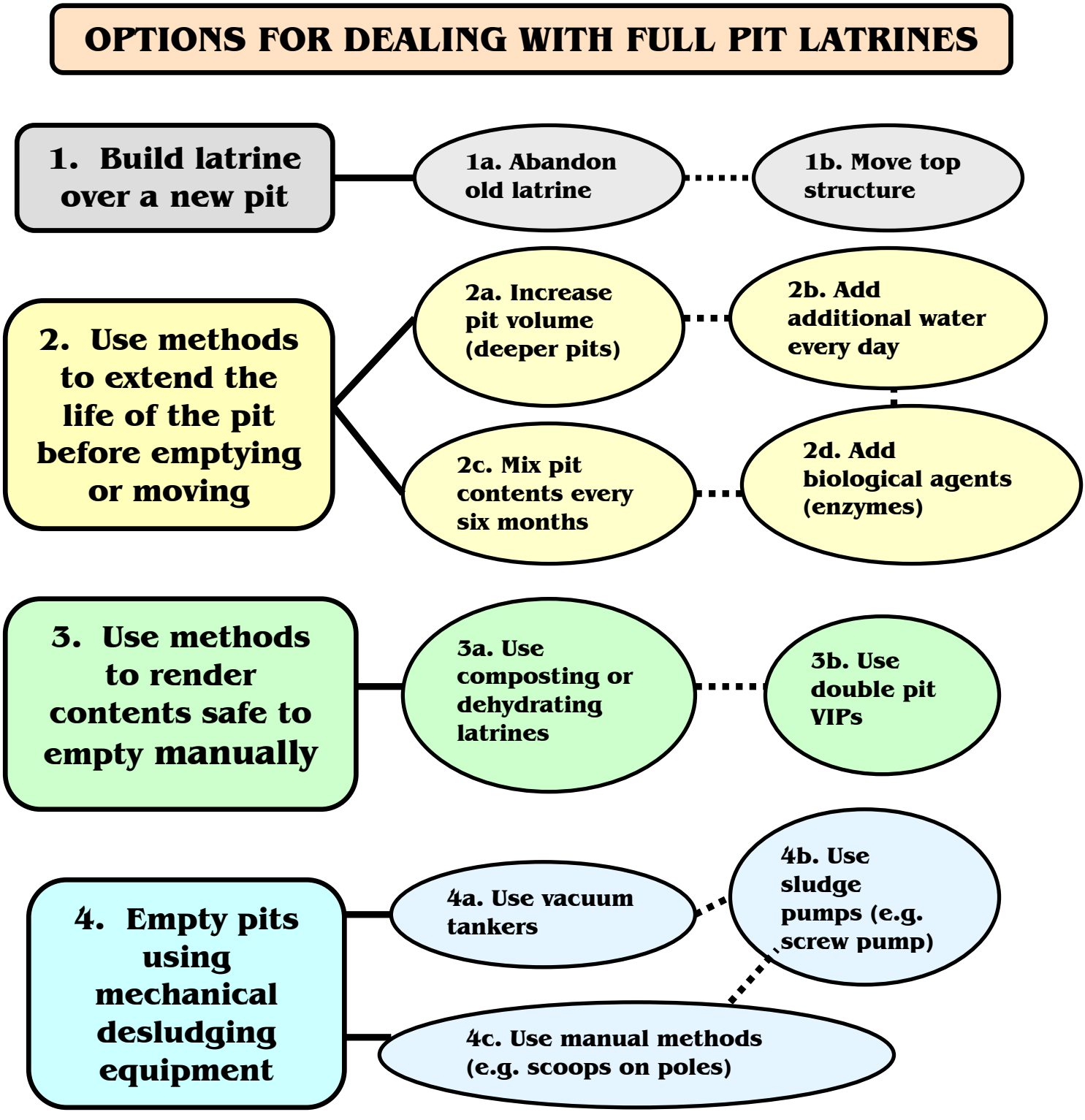
This requirement of ongoing servicing of on-site toilets adds a dimension that has not in general been addressed or accommodated in the institutional framework of sanitation service provision where on-site sanitation has been provided. In many situations the funding implications for the ongoing servicing of the latrines have not been adequately assessed and provided for. The lack of planning for ongoing servicing, particularly in peri-urban areas, could lead to serious health risks within the communities served with on-site sanitation systems, and even to other neighbouring communities. At best communities may revert to the sanitation practices they were using before the “improved” systems were installed. Dense settlements, especially those that are within urban metropolitan areas, may pose greater health risks than less densely populated rural areas if their toilets are not serviced when full. However all municipalities should prioritise ongoing adequate sanitation servicing of both the off-site and the on-site sanitation facilities of the settlements within their areas of jurisdiction.

Life cycle planning is imperative for on-site sanitation systems. This includes making provision for the need to address full pits for VIP sanitation programmes. Provision for grey water disposal either through an on-site soak away or reticulated sewers is also critical.

This guideline aims to provide some guidance to municipalities on the options for dealing with sanitation services where on-site pits are the method of separating human wastes from the environment, based on the experience of a number of municipalities in South and Southern Africa, and on research undertaken over the past 20 years.

2. OPTIONS FOR DEALING WITH FULL PITS

The options that can be considered for dealing with full pits are depicted in the chart below. These options are further detailed in the text following. The decision on which option to adopt for a particular situation is based on a number of factors, most of which are related to local circumstances. However a support decision tree is proposed to provide some guidance to decision makers.



OPTION 1: Abandon full toilet and build new toilet

In this situation, the full pit is sealed (e.g. covered with a 500mm layer of soil) and the structure is abandoned. The household may choose to recover some of the building materials if they are re-usable, but the local authority does not make allowance for re-using any materials in the new structure.

A new toilet must be constructed, either of the same type as the one abandoned, or a different type such as a desiccating toilet. The cost of building the new toilet will need to be at least partly covered by the municipality, but the household may be asked to contribute a portion of the costs depending on their financial status. The new toilet may be considered to be outside of the original government undertaking of providing sanitation to all since the household would have already benefited from that programme, but would be considered as part of the provision of ongoing "operation and maintenance" support.

***Notes for new projects where this method for dealing with full pits is envisaged**:*

- *Dig as large a pit as possible (both deeper and wider) without endangering the lives of the builders (if necessary use shoring techniques to prevent the pit collapsing). This will extend the life of the pit toilet.*
- *Budget in advance for the cost of constructing new replacement toilets when the pits are full, and agree on a shared funding plan with the homeowners at the outset.*

Option Summary: Abandon full toilet and build new toilet

Considerations	Issues	Outcomes
Construction requirements	• Lower cost superstructures (only need to last for ±10 years); • Increase pit volume	• Initial cost savings possible • Deeper and/or wider pits
Acceptability	• Well known approach with no contact with pit contents - will be easily accepted	• Culturally acceptable approach
Cost indicator	• Average cost of R3,000 per household every 8 - 10 years (or R350 - R375 per year)	• High ongoing costs
Job creation	• Ongoing local jobs for builders and material suppliers due to repeated building programmes	• Significant ongoing employment opportunities
Institutional and management requirements	• No additional requirements than those needed for initial construction	• Institutional and management structures as for construction programme
Sludge handling equipment needs	• Pits are not emptied hence no sludge handling equipment required	• No additional equipment required

OPTION 2: Seal full pit and relocate top structure over a new pit

In this situation the top structure is carefully removed from the old toilet, and the full pit is sealed (e.g. covered with a 500mm layer of soil). The top structure may be dismantled (e.g. if a panel, brick or block structure in which good materials have been used), or a platform inserted under the structure and the structure moved as a whole (e.g. with Archloo type structures).

In the case of dismantling the superstructure, the individual components will need to be carefully separated and excess mortar chipped off. There will be inevitable losses and additional materials will need to be budgeted for.

In the case of moving the structure as a whole, a trained team will be required with special equipment. Again losses or damages should be expected and a budget to make-up for these losses and repairs will need to be planned.

One concept currently being promoted is the Arborloo, where the pit is deliberately made small (200 to 500 litres) and the latrine structure is made light. When the pit is full, a new pit is dug and the latrine is moved. Depending on the number of people using the latrine and the size of the pit the move interval can be from as little as three months to as much a two years. Ideally, after defecation, users should add a small quantity of sand or sandy soil to the pit, to improve the rate and the degree of conversion of the pit contents to a compost like humus. After the latrine is moved, the top thirty centimetres of the pit is filled with normal topsoil and a tree is planted.

Notes for new projects where this method for dealing with full pits is envisaged:

- *Ensure good quality materials are used for the superstructure.*
- *Use as weak a mortar mix in the superstructure as possible without compromising on the overall strength of the structure.*
- *When constructing plastered complete superstructures, avoid anchoring them to the foundation. Insert a ring beam at the base of the structure to enable the structure to be moved without cracking. It may be advisable to also include strengthening of the corners to give the structure additional stability while being moved.*

Option Summary: Seal full pit and relocate top structure over a new pit

Considerations	Issues	Outcomes
Construction requirements	• Superstructures should be easily dismantled or movable; • Increase pit volume	• Special design for superstructures • Deeper and/or wider pits
Acceptability	• Known approach with no contact with pit contents - will be easily accepted	• Culturally acceptable approach
Cost indicator	• Rebuilding cost less than 60% of initial building cost (Average cost of R1,800 per household every 8 years (or R225 per year)	• High ongoing costs
Job creation	• Ongoing local jobs for builders and material suppliers due to repeated building programmes	• Significant ongoing employment opportunities

Considerations	Issues	Outcomes
Institutional and management requirements	• No additional requirements than those needed for initial construction	• Institutional and management structures as for construction programme
Sludge handling equipment needs	• Pits are not emptied hence no sludge handling equipment required	• No additional equipment required

OPTION 3: Empty the pit regularly to prevent a build up of waste

This option applies under various conditions, the most common being the following:

- composting or dehydrating toilets (including urine diversion systems),
- double pit VIPs,
- standard VIPs.

While regular emptying is standard for the first two options, it is not common for standard VIP toilets. The advantage of more regular emptying of pits are as follows:

- Municipal services (or appointed pit emptying contractors) as well as households become accustomed to the routine of emptying pits.
- Municipal budgeting processes for pit emptying is simpler
- The amount of sludge to empty from pits is less and less compacted hence not as costly as emptying full standard VIP pits.
- Problems of non-degradable solid refuse being thrown into the pit can be more readily dealt with and the households appropriately educated.
- Smaller contractors can be appointed to provide the emptying services (or in some cases households can do it themselves).
- Deeper pits are less likely to collapse when emptied if they are emptied before being full (i.e. the pit walls will experience less inward pressure after emptying).
- Pits do not need to be as deep as for standard VIP latrines

In this situation pit emptying is dependent on the type of toilet as follows:

Composting and dehydrating (desiccating) toilets

These are usually emptied by hand using a spade or scraper. The contents of the composting chamber can be disposed of in the homeowner's garden or taken away for burying or disposal with municipal solid wastes. The following precautions must be emphasised when instructing homeowners or small contractors on how to empty the composting or dehydrating chambers:

- ✓ The contents will not be 100% microbiologically safe and hence gloves and protective clothing must be worn when emptying the chamber;
- ✓ The contents should not be used as a compost for adding to the soil of vegetable gardens, but may be used for shrubs and trees;
- ✓ The compost should preferably be added to an existing or new compost heap and allowed to further mature for 3 months or more to render it safer to use in the garden;
- ✓ The compost or dehydrated faeces should not be considered as comparable to a commercial fertilizer, but rather as a soil conditioner.
- ✓ Where urine has been separated from the faeces, the urine may be used as a fertilizer after dilution by at least 1:5 and used directly in the garden, including into the soil (but not on the leaves) of above-ground fruiting vegetables. Urine is an effective fertilizer.

Notes for new projects where composting or dehydrating toilets are envisaged:

- *Ensure good quality materials are used for the sub-structure and the superstructure.*
- *Ensure that households are properly informed of the procedures for operation and emptying of the chamber.*
- *Ensure that households have sufficient space to dispose of the compost or dehydrated material, and are willing to empty as their own responsibility.*
- *Ensure that the municipality is in a position to monitor and provide support to households during the emptying procedures if requested.*

Option Summary: Composting and dehydrating (desiccating) toilets

Considerations	Issues	Outcomes
Construction requirements	• Superstructures will not be moved and hence will have a long design life • Easy access to pit area	• Well constructed superstructures with robust materials • External removable panels on pit to have easy access to remove composted material
Acceptability	• Less well known approach with manual removal of pit contents – requires targeted education and awareness programmes	• Education and awareness programmes to gain cultural acceptability
Cost indicator	• No reconstruction costs, and pit emptying can be undertaken by households (Average cost of R50 per household per year for monitoring and support)	• Very low ongoing costs
Job creation	• Only initial construction jobs for local builders and material suppliers	• Insignificant ongoing employment opportunities
Institutional and management requirements	• Some additional requirements to support monitoring of manual emptying and correct disposal of pit contents	• Institutional and management structures to support ongoing monitoring and support
Sludge handling equipment needs	• Pits are emptied manually hence no sludge handling equipment required	• No additional equipment required

Double pit VIPs

These are designed to be emptied by hand, though in some situations this may not be possible because the contents may be too moist. The evacuated pit contents should be buried in an adjacent pit and should not be used in the garden as compost, except for the option of planting a shrub or tree above the pit once it has been covered. Alternatively the contents should be transported away from the site and disposed of at a suitable facility (e.g. sewage treatment works, solid waste dump, or municipal pits specially dug for the burying of these sludges). The following precautions must be emphasised when instructing homeowners or small contractors on

how to empty the contents of second pit (that should have stood for at least 2 years before emptying):

- ✓ The contents will not be microbiologically safe and hence gloves and protective clothing must be worn when emptying the pits;
- ✓ The contents should not be used as compost, but must be buried if disposed of on-site. In such cases shrubs or trees could be planted above the buried sludge.
- ✓ If the contents still smell strongly and are very moist, other options for emptying may need to be employed. These include:
    - o Using a vacuum tanker or mechanical sludge pump
    - o Using a back-actor to scoop out the sludge and place it in a new pit
    - o Adding dry soil to the wet sludge and mixing before removal
    - o Adding dry vegetation to the wet sludge and mixing before removal
    - o Providing specially designed hand tools to small contractors who will empty pits manually.

Notes for new projects where double pit VIPs are envisaged:

- *Ensure good quality materials are used for the sub-structure and superstructure.*
- *Ensure that slabs covering the external section of the pits can be easily removed to access the pits.*
- *Ensure that the wall separating the pits is properly sealed to prevent moisture passing between the pits.*
- *Ensure that households are properly informed on the procedures for operation and emptying of the pits.*
- *Ensure that households have sufficient space to dispose of the pit contents within their own yards, and are willing to empty as their own responsibility, or that the municipality is able to remove the sludge from households and dispose of it appropriately.*
- *Ensure that the municipality is in a position to monitor and provide support to households during the emptying procedures if requested.*

Option Summary: Double pit VIPs

Considerations	Issues	Outcomes
Construction requirements	• Superstructures will not be moved and hence will have a long design life • Easy access to pit area	• Well constructed superstructures with robust materials • External removable panels on pit to have easy access to remove matured material
Acceptability	• Less well known approach with manual removal of pit contents – requires targeted education and awareness programmes	• Education and awareness programmes to gain cultural acceptability
Cost indicator	• No reconstruction costs, and pit emptying can be undertaken by households (Average cost of R50 per household per year for monitoring and support) • If municipality to collect and	• Very low ongoing costs if disposed of on-site • Additional costs to municipality if contents to be transported and disposed of off-site.

Considerations	Issues	Outcomes
	dispose of matured pit contents, vehicles and site requirements must be costed.	
Job creation	• Only initial construction jobs for local builders and material suppliers • Option for additional jobs if small contractors employed to empty pits and/or to transport and dispose of pit contents	• Insignificant ongoing employment opportunities if pits emptied by households. • Potential for ongoing employment if contractors employed for emptying and off-site disposal.
Institutional and management requirements	• Some additional requirements to support monitoring of manual emptying and correct disposal of pit contents. • Additional management responsibilities to manage contractors, transport and off-site disposal may be required.	• Institutional and management structures to support ongoing monitoring and support • Additional institutional capacity to manage contractors, transport and off-site disposal if required.
Sludge handling equipment needs	• Pits are emptied manually, but may require transport facilities to remove sludge from site	• Sludge transport vehicles and off-site disposal facilities (pits) may be required

Standard VIPs

Standard VIPs are usually only emptied when they are full (or alternatively the superstructure is moved). However there are merits in emptying the pits more frequently before they are full. These include:

- Pit emptying becomes a routine procedure and can be properly planned and programmed within the municipal services (and with appointed pit emptying contractors);
- The amount of sludge to empty is less and not as compacted, and hence not as costly as emptying full standard VIP pits (and hence more affordable to the households).
- Problems can be identified and more readily dealt with. These include problems of non-degradable solid refuse being thrown into the pit and the households appropriately educated.
- , access of pit emptying vehicles to pits, and composting or other disposal aspects.
- Household behaviours can be more regularly observed and owners made aware of bad practices;
- Small pit emptying enterprises can maintain themselves if there is a secure ongoing stream of work.
- Deeper pits are less likely to collapse when emptied if they are emptied before being full (i.e. the pit walls will experience less inward pressure after emptying).
- Lower cost VIPs can be constructed for non-permanent settlements such as informal settlements (e.g. using a shallower pit).

Standard VIPs do require specialised equipment for emptying, as the pit contents are generally not suitable for emptying manually by householders themselves. Specialised equipment commonly employed are:

- Large motorised vacuum tankers
- Micro motorised vacuum tankers
- Small hand-operated pumps and tank systems
- Specially designed hand tools and with drums on trolleys

Manual emptying of standard VIPs is possible and feasible in some situations, particularly where access to locations by vehicles is difficult. In this case protective clothing and access to ample water for washing is required. Equipment usually consists of long-handled spades, poles with scoops, and drums on trolleys for depositing the pit contents so that it can be transported to a sludge vehicle or to a nearby pit or composting facility.

Only the motorised vacuum tankers have been used to any extent in South Africa and even internationally. These can be obtained in various sizes and with varying vacuum strengths. Small scale equipment for emptying and manual emptying have been developed and tested, and have been effective in a number of situations. Ethekwini municipality in KwaZulu/Natal have recently completed the piloting of methods for emptying of pits, which included manual emptying. The outcome of these tests indicated that for the urban area, manual emptying with transfer stations where sorting occurred, and final transport to a sewage treatment works by tanker, was the most effective.

It should be noted however, that the contents of pit latrines are often too solidified for a normal vacuum tanker action, and arrangements must be made to add water to the pits with mixing to liquefy the contents so that it can be removed by the suction of the vacuum tank. In some cases up to three times the amount of water as the pit contents are required.

Notes for new projects where single pit VIPs are to be emptied more regularly:

- *Ensure good quality materials are used for the sub-structure and superstructure.*
- *Ensure that slabs covering the external section of the pits can be easily removed to access the pits.*
- *Ensure the municipality has the necessary equipment to empty the pits, or alternatively that this service can be contracted out to properly equipped contractors.*
- *Ensure that there is a system for disposing of the pit contents by the municipality, or provision is made for burying the contents within the yards of the home-owners.*
- *Ensure that the municipality is in a position to monitor and provide support to households during the emptying procedures.*

Option Summary: Standard VIPs that are emptied within short time intervals

Considerations	Issues	Outcomes
Construction requirements	• Superstructures will not be moved and hence will have a long design life • Easy access to pit area • Smaller pits possible	• Well constructed superstructures with robust materials • External removable panels on pit to have easy access to remove pit material

Acceptability	• Acceptable approach if mechanical equipment used, but will need awareness programmes if manual removal of pit contents	• Education and awareness programmes to inform residents and gain cultural acceptability
Cost indicator	• No reconstruction costs, but pit emptying and treatment or disposal will incur ongoing costs (Average cost of R600 per household every 5 years, or R120 per household per year)	• Significant ongoing costs that will need to be subsidised for indigent residents.
Job creation	• Both initial construction jobs for local builders and material suppliers, as well as ongoing jobs for pit emptying and treatment and disposal.	• Significant ongoing employment opportunities in terms of pit emptying and treatment and disposal of sludge.
Institutional and management requirements	• Significant additional requirements to support pit emptying operations and the treatment and disposal of pit sludges	• Institutional and management structures to support ongoing operations, including monitoring and support
Sludge handling equipment needs	• Pits are emptied regularly, and will include transport facilities to remove sludge from site, pit emptying equipment, and a water tanker.	• Pit emptying equipment and sludge transport vehicles required, as well as treatment and disposal facilities.

OPTION 4: Take steps to accelerate the breakdown of pit wastes

Although this option does not remove the need for emptying of pits, it is applied with the aim of extending the time between the emptying of pits by promoting further biological breakdown of the pit contents. Various methods can be applied to improve the biological processes responsible for the breakdown of the contents. Some of these methods involve the addition of water or biological agents, and others are a physical action to create better conditions for biological activity.

Biological agents (usually enzymes specially grown and sold as a powder) are the most common commercial product used to support the biological growth of specific bacteria that breakdown faeces. Enzymes must be added on a regular basis (e.g. monthly), and are costly. Their effectiveness in enhancing digestion in pit latrines has not been conclusively and scientifically demonstrated, and the few reported once-off tests indicate mixed results.

The addition of moisture is a cheap alternative to promoting digestion in pits. Biological organisms require a moist environment to be active, and hence adding water to pits that are very dry will support the movement and activity of these organisms.

Mixing the pit contents is a third approach, which is also required with the addition of enzymes and water. This happens in sewage treatment plants, particularly where organisms that have grown in the sewage are mixed in at the entrance to the works to be exposed to the fresh sewage. Mixing is carried out with a long pole manually pushed into the pit and used to agitate and mix the pit contents.

Finally households should be encouraged to use biodegradable anal cleansing materials. The effectiveness of each of these measures is not fully definable and depends on a number of factors, including average temperature, porosity of the soil, surface area exposed to the atmosphere and surface area in contact with the soil, and the depth of the pit. Brief 12 day tests carried out on nine pits in Ethekwini recently indicated limited response from the addition of enzymes, but slightly better than with the addition of just water.

The University of KwaZulu/Natal is currently (2005/2006) undertaking more detailed studies of the factors affecting degradation in pits, and the results will be made available when the study is completed.

All home-owners with pit type toilets should be educated on what they should do to improve the biological breakdown of wastes within the pits, and hence extend the time between emptying. This could include the following (but not applicable to composting and dehydrating toilets):

- Add 1 to 2 litres of grey water to the pit every day (except in the case of a high water table that results in the bottom of the pit being naturally flooded)
- Use biodegradable anal cleansing materials
- On a six-monthly basis (or at least annually) add additional water to the pit and use a pole to mix the pit contents.
- On an annual basis add enzymes at the same time as the contents are mixed (if this is affordable).

Notes for new projects where steps will be taken to promote accelerated biological breakdown of pit wastes:

- *Ensure good quality materials are used for the sub-structure and superstructure.*
- *Make the volume of the pit as large as possible to extend the time that the faecal matter has to digest in the pits.*
- *Ensure that slabs covering the external section of the pits can be easily removed to access the pits.*
- *Ensure that households are properly informed on the procedures for accelerating the breakdown of the pit contents.*

Option Summary: Acceleration of the breakdown of pit wastes

Considerations	Issues	Outcomes
Construction requirements	• Easy access to pit area	• External removable panels on pit to have easy access to add water and additives and to enable mixing
Acceptability	• Not a well known approach – requires targeted education and awareness programmes	• Education and awareness programmes to gain cultural acceptability
Cost indicator	• Emptying costs remain the same, but extended life implies lower annual cost. May need budget for pit additives. (Average cost of R600 per household every 12 years, or R50 per household per year, and an additional R50 per household for monitoring and support)	• Low ongoing costs
Job creation	• Both initial construction jobs for local builders and material suppliers, as well as ongoing jobs for pit emptying and treatment and disposal.	• Significant ongoing employment opportunities in terms of pit emptying and treatment and disposal of sludge, and the option of jobs for pit treatment and mixing operations.
Institutional and management requirements	• Significant additional requirements to support pit emptying operations and the treatment and disposal of pit sludges, with support required for ongoing pit treatment and mixing	• Institutional and management structures to support ongoing operations, including monitoring and support
Sludge handling equipment needs	• Pits are emptied regularly, and will include transport facilities to remove sludge from site, pit emptying equipment, and a water tanker.	• Pit emptying equipment and sludge transport vehicles required, as well as treatment and disposal facilities.

OPTION 5: Empty the pit through manual or mechanical desludging

This is the general requirement for all VIP type pit latrines where the top structure will not be moved to a new pit, or the cost of building a new latrine will be excessive. Pits that have been properly constructed with a lined pit may be emptied without fear of the pit collapsing. However if the pit walls are unlined soil, emptying the pit could result in the pit collapsing.

Standard VIPs do require specialised equipment for emptying, as the pit contents are generally not suitable for emptying manually by householders themselves. Specialised equipment commonly employed are:

- Large motorised vacuum tankers
- Micro motorised vacuum tankers
- Small hand-operated pumps and tank systems
- Specially designed hand tools and with drums on trolleys

Manual emptying of standard VIPs is possible and feasible in some situations, particularly where access to locations by vehicles is difficult. In this case protective clothing and access to ample water for washing is required. Equipment usually consists of long-handled spades, poles with scoops, and drums on trolleys for depositing the pit contents so that it can be transported to a sludge vehicle or to a nearby pit or composting facility.

Only the motorised vacuum tankers have been used to any extent in South Africa and even internationally. These can be obtained in various sizes and with varying vacuum strengths. Small scale equipment for emptying and manual emptying have been developed and tested, and have been effective in a number of situations. Ethekwini municipality in KwaZulu/Natal have recently completed the piloting of methods for emptying of pits, which included manual emptying. The outcome of these tests indicated that for the urban area, manual emptying with transfer stations where sorting occurred, and final transport to a sewage treatment works by tanker, was the most effective.

It should be noted that the contents of pit latrines are often too solidified for a normal vacuum tanker action, and arrangements must be made to add water to the pits with mixing to liquefy the contents so that it can be removed by the suction of the vacuum tank. In some cases up to two times the amount of water as the pit contents are required.

Notes on pilot experience at Ethekwini

- Vacuum tankers, although efficient, quick and clean, experienced difficulties with access, need for level parking, and large amounts of water required to liquidise the pit contents. Refuse in the pits often blocked the suction pipes.
- Hand operated diaphragm pumps (5HP) overcame the problems of access, but also required water to liquefy the pit contents and continued to experience problems with pipe blockages from refuse in the pits.
- Manual excavation using long handled spades and forks was effective in that there was no need for water for liquefying the pit contents. The process required a multi-stage operation with emptying into 100ℓ drums, loading onto trucks, transfer to a processing yard where debri was removed and the sludge liquefied. Tankers then transferred the liquefied sludge to the wastewater treatment works.

Notes for new projects where pits will be emptied using mechanical sludge removal equipment:

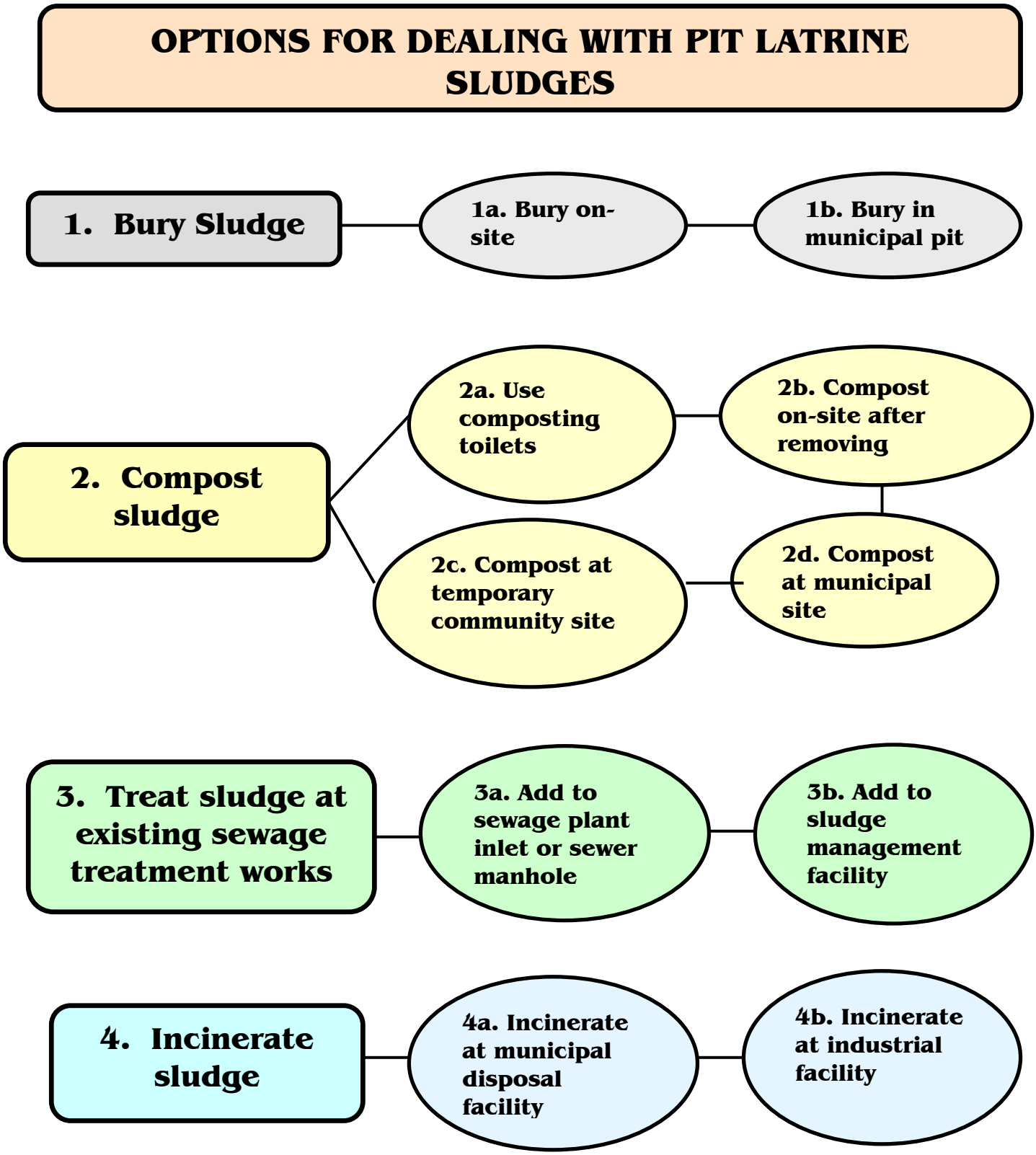
- *Ensure good quality materials are used for the sub-structure and superstructure.*
- *Ensure that slabs covering the external section of the pits can be easily removed to access the pits.*
- *Ensure that the pit walls can withstand the negative pressure of the wet soil when the sludge is removed.*
- *Ensure the municipality has the necessary equipment to empty the pits, or alternatively that this service can be contracted out.*
- *Ensure that there is a system for disposal of the pit contents by the municipality, or provision is made for burying the contents within the yards of the homeowners.*
- *Ensure that the municipality is in a position to monitor and provide support to households during the emptying procedures if requested.*

Option Summary: Standard VIPs that are emptied when full

Considerations	Issues	Outcomes
Construction requirements	• Superstructures will not be moved and hence will have a long design life • Easy access to pit area	• Well constructed superstructures with robust materials • External removable panels on pit to have easy access to remove pit material
Acceptability	• Acceptable approach if mechanical equipment used, but will need awareness programmes if manual removal of pit contents	• Education and awareness programmes to inform residents and gain cultural acceptability
Cost indicator	• No reconstruction costs, but pit emptying and treatment or disposal will incur ongoing costs (Average cost of R800 per household every 8 years, or R100 per household per year)	• Significant ongoing costs that will need to be subsidised for indigent residents.
Job creation	• Both initial construction jobs for local builders and material suppliers, as well as ongoing jobs for pit emptying and treatment and disposal.	• Significant ongoing employment opportunities in terms of pit emptying and treatment and disposal of sludge.
Institutional and management requirements	• Significant additional requirements to support pit emptying operations and the treatment and disposal of pit sludges	• Institutional and management structures to support ongoing operations, including monitoring and support
Sludge handling equipment needs	• Pits are emptied regularly, and will include transport facilities to remove sludge from site, pit emptying equipment, and a water tanker.	• Pit emptying equipment and sludge transport vehicles required, as well as treatment and disposal facilities.

3. Options for Dealing with Pit Latrine Sludges

Where sludges are removed from pits, these must be managed in a hygienically and environmentally safe way. Various approaches can be considered for disposing and/or treating the sludges as described below.



The final treatment and disposal or reuse of sludge is not dealt with in detail in this guideline. However the different options are described briefly as a guide for deciding on which options can be further considered within a particular situation.

3.1 Burying of Pit Latrine Sludges

Pit latrine sludges can be buried on-site provided there is sufficient space and a suitable pit can be dug. The buried sludge must be covered with at least 500mm of soil, and the pit must not be within 50m of a borehole used for drinking water purposes. Alternatively the sludge can be transported to a prepared site with larger pits for the burying of sludge from a number of latrines. Where there are concerns of groundwater pollution, the procedures outlined in the Groundwater Protocol to assess the risks should be followed.

3.2 Composting of Pit Latrine Sludges

Sludge from pit latrines mixed with other bulking materials can be composted. The process is improved with forced aeration which will also result in pasteurisation of the sludge when the windrow is properly prepared. This significantly reduces the risk of disease transmission from handling the mature compost and growing food in agricultural plots using the compost. Guidelines are available for the composting of sludges.

Where composting toilets have been used, the dry matter from the pits can be used directly as compost. However this material will not have undergone the pasteurisation process of an aerated compost heap, and hence it is recommended that the compost is first matured for several months before being used for growing edible crops.

3.3 Treatment at existing sewage treatment works

In urban areas where there is an existing sewage treatment works, the sludge can be added to the works, either at the inlet to the works, or alternatively directly to the sludge handling section of the works. In many cases sludges are deposited in sewer manholes some distance from the works. Solid wastes such as refuse, bottles, etc. should be removed from the sludge before it is added to sewage treatment works.

3.4 Incineration

Sludges can be incinerated if there is an existing incinerator, usually at a sewage treatment facility. It is generally too costly to set up an incinerator directly for this, but many sewage works have a facility that uses the digester gas as a fuel.

4. DEALING WITH THE UNKNOWNS AND CHALLENGES

There are a number of unknown factors that face authorities when planning for the implementation of a pit-emptying programme. These include the following:

- The utilisation of costly equipment (e.g. vacuum tankers) cannot usually be predicted due to the unknown rate of demand for the service.
- Demand is often both sporadic and disaggregated; with some households requiring pit emptying within 5 years while others may only require emptying every 20 years.
- The accessibility of household latrines by pit emptying vehicles is often a significant problem due to steep terrain, small properties, or households blocking access by building on or changing the layout of their property.
- The possibility of developing small entrepreneurs to undertake pit emptying operations is questionable since there are few incentives for small entrepreneurs in this arena.
- The problems caused by disposing of solid wastes in the pits make it difficult to empty pits with suction pipes or sludge pumps in some instances
- There are still unknown budget needs for pit emptying or for moving top structures onto new pits due to lack of on-the-ground experience.
- The impact of adding pit latrine sludge to the inlet of a small sewage treatment works is not well understood, and may result in the disruption of the biological processes in severe cases.
- The health risks associated with workers involved in pit-emptying have not been researched, and may be greater than with bucket latrines, particularly if there is solid refuse in the pits that needs to be separated before treatment and disposal of the sludge.
- Collecting tariffs for the emptying of pits is a difficult and unresolved challenge. Because the service is only provided infrequently, residents may not be willing to contribute a monthly amount towards emptying their pits. On the other hand the once-off cost of emptying pits will generally be unaffordable to most households.

These unknowns should not mean that no planning could be done for the emptying of pits. There is sufficient knowledge and experience to be able to make reasonable assumptions regarding these and other issues. As more experience is gained, these unknowns will become simple variables that must be addressed when planning a sanitation programme. In terms of the above, the following assumptions are considered reasonable at this stage:

4.1 Equipment utilisation

It can be assumed that on average pits will need emptying once in 8 to 10 years. Using 9 years for calculation purposes, this means that the following equipment utilisation figures may be assumed (based on a working year of 240 days):

No. household pits emptied per working day	% Equipment downtime for maintenance	No. households that can be serviced by one set of equipment and team
3	10	5,800
	20	5,200
	30	4,500
5	10	9,700
	20	8,600
	30	7,560
10	10	19,400
	20	17,200
	30	15,100
15	10	29,100
	20	25,800
	30	22,600
20	10	38,800
	20	34,400
	30	30,200

Note that Ethekwini Municipality have planned to empty pits once every 5 years as a standard.

4.2 Improving the prediction of demand

Demand can be managed in a number of ways that will better suit the providers of the pit emptying service and the local authority. Options include:

- Advertising in a particular suburb or rural village that the pit emptying service will be in their area between specific dates, and requiring prior booking for the service.
- Emptying all pits in a particular suburb or rural village according to a particular schedule, even if not all toilets are full.
- Allowing requests for pit emptying to queue until there are sufficient households in a particular area to make emptying financially viable. (households must be educated to request emptying when the pit reaches a level of at least 250mm below the slab, thus allowing for some lee-way).
- Institute a low-key monitoring programme to assess how close pits are to requiring emptying, and scheduling the emptying service accordingly.

The cost of the service and the level of knowledge and understanding of the households impact demand. In the case of free basic services where the cost of emptying is borne by the municipality and communities are well informed regarding pit emptying, demand is likely to be higher than in cases where pit emptying must be paid for by the household.

4.3 Accessibility of household latrines by pit emptying vehicles

Accessibility may be impossible for heavy tanker vehicles in many situations, particularly in urban areas where settlements have been established with small erven on steep slopes. Options for dealing with inaccessible erven include the following:

- Extending the suction pipe of the vacuum tanker (note that this will only be feasible if the tanker can gain access to a position at a lower elevation than the latrine and additional water can be added to the pit to liquefy the contents).
- Utilise small vehicles that can get access to the latrines (small vehicles e.g. the UN-Habitat "Vacutug" and the "Mapet" hand operated system of Tanzania, have been assessed with success in other African countries)
- Dig a hole close to the existing latrine and bury the sludge on-site using a sludge pump to transfer the sludge from the latrine pit to the burial hole. In this case it is not necessary to transport the sludge from the site.
- Empty pits by hand (i.e. buckets on poles and spades with appropriate safety clothing).

The UN-Habitat Vacutug

The vacutug operates with a 5.9kW petrol engine used for both operating the vacuum pump, and for propelling the vehicle. In tests in Kenya it was able to empty on average 8 pits per day. The tank has a nominal volume of 500 litres. Operational performance in Kenya was:

Operators	-	2
Maintenance	-	weekly check-up by mechanic
Costs per load	-	$3 to $5
Capital costs	-	$ 7,000 (1998)

4.4 Incentives for small entrepreneurs

For small entrepreneurs to be able to operate a pit emptying business, there must be sufficient incentives for them. This generally means that the local authority must provide

incentives that suit the entrepreneurs with the capabilities to undertake such a programme. Minimum incentives that should be provided are the following:

- An acceptable profit margin per latrine
- An assured work load to keep the pit emptying team busy on a daily basis
- A depository for the disposal of the emptied sludge (e.g. sewer, sludge ponds, solid waste dump, etc.)
- Provision of training and monitoring support.
- Simple contract conditions for which a basic tender can be submitted
- Contracts to service households in close proximity to each other

The key incentives will be the profit margin and assurance of work. Municipalities may not be able to recover all costs from tariffs, and may need to allocate a portion of their "Equitable Share" to this, particularly in the situation of the provision of free basic services to the poor.

4.5 Solid wastes in pits

It has been found that many households deposit some solid waste into their pit latrines, particularly if there is no refuse collection service. Many of these solid wastes are non-biodegradable and hence simply take up space in the pit, reducing the times between pit emptying. However the most serious consequence of throwing solid refuse into pits is the difficulty caused to the pit emptying operations. Solid wastes are a particular problem for vacuum emptying systems and sludge pumps as they tend to block the suction pipe or get caught in the impellor or other mechanisms of the pumps. Solid wastes are also problematic in the treatment and final disposal of the sludge, particularly in biological treatment systems.

The following options are proposed for dealing with solid wastes in pits:

- Ensure that households are properly informed and educated about the proper care of pits, and that solid wastes should be disposed of in an alternative suitable manner (e.g. household refuse pits).
- Equip pit-emptying teams with rods with hooks, long handled forks, or other suitable tools to remove solid wastes that get caught up in the suction hoses.
- Institute a penalty system after households have been informed and educated (e.g. monetary fine) where solid wastes are encountered when emptying the pits.
- Establish an intermediate sorting facility with e.g. rotary sieves to separate refuse from the sludge before sending the sludge for further treatment.

Appropriate educational programmes should be compiled and promoted when toilets are first installed, and when they are emptied for the first time. Solid wastes are more likely to be encountered in the pits of urban settlements than in rural areas.

4.6 Budget needs for pit emptying

Estimates for the emptying of pit latrines range from R500 to R1,500 or more per latrine. The different pit emptying equipment, staff requirements, pit sizes, location, and disposal requirements governs the range in costs. Ethekwini Metro have found that a budget value of R600 to R800 per latrine should be budgeted for the manual emptying of pits within an urban area. The following steps can be taken to manage costs:

- Schedule pit emptying so that a number of pits can be emptied within one community (see also 4.2).
- Ensure contractors or staff are properly trained and hence that they are able to empty pits more efficiently (e.g. aim for 10 or more pits per day with mechanical pit emptying equipment).
- Ensure households adequately prepare the site for pit emptying (e.g. digging pit for disposal of sludge if this is required, ensure access, removing slab).
- Ensure sludge transportation system (if required) is aligned to the pit emptying operation.
- Monitor operations.

4.7 Impact of adding pit latrine sludge to a small sewage treatment works

The impact on the biological and physical processes of a small treatment works when a tanker of sludge is added to the inlet works is dependent on the type of treatment works, its size, and the unit processes included in the works. In all cases, however, it is important to screen the sludge that is added to the works.

The following options with recommended precautions may be considered when pit latrine sludges are to be added to a conventional sewage treatment works (in a liquid form):

- If there is no primary treatment (i.e. sludge settling), add sludge at a rate not greater than 10% of normal inflow. This is particularly important on small activated sludge or biofilter plants, but less so on treatment plants using ponds with several days retention.
- In the above situation, ensure that the sludge digesters can cope with the additional sludge load from the secondary settlers.
- If there is a primary settling stage, minimal effect will be experienced in the secondary treatment stage. However ensure that the anaerobic digesters can cope with the additional load.
- If sludge is added to a treatment plant consisting of a series of ponds, ensure that the primary pond will be able to absorb the additional sludge load.
- If sludge is to be added to sewer manholes, the sludge must be screened prior to adding to the manholes, and must be in a liquid form.

4.8 Health risks associated with workers

Although old faecal sludge will contain significantly less pathogens than fresh sludge, there remains a risk of infection of workers involved in the emptying of pit latrines. Therefore workers must be issued with protective clothing and be obliged to wear them when on the job. Protective clothing should include washable gloves, face masks, safety boots and overalls. There should be access to water for cleaning themselves after each pit is emptied (enough to wash hands), and for a full shower at the end of each working day. All equipment should also be properly cleaned at the end of each working day.

Workers should be carefully monitored for illness, and any workers with reduced immunity (e.g. ill with flu or have AIDS) should not be put at risk for the duration period with reduced immunity.

Finally, emptied pits should be rendered safe by washing any external contaminated areas or covering with soil.

4.9 Collecting tariffs

The collection of tariffs for the emptying of pits is generally difficult due to the irregular nature of the service provided; the long time intervals between the service being required, and the generally lower income levels of those who use pit sanitation systems.

Waterborne sanitation tariffs are often based on the amount of water consumed by the household and reflect the costs for ongoing maintenance of the sewers and the operation of the sewage treatment plant. Where pit latrines are part of a mixed level of services provided by the municipality which also provides waterborne sanitation, the tariff for pit latrine emptying should be proportionate to the costs of providing the waterborne service (e.g. 20%). However this may be difficult with communities who have never received the service before and who consider waterborne sanitation a privilege they aspire to. It also does not work where the same communities are receiving free basic water and are not using more than the basic amount.

The following options for setting tariffs for the emptying of pits may be considered:

- Once-off charge that reflects the actual or subsidised cost of pit emptying, applied only when a request is made. This method is used successfully in Maseru (Lesotho). Shortcomings are that many people cannot afford the once-off cost, even though subsidised, and hence they do not request the

service, and may resort to making contingency plans that result in unacceptable environmental and health risks.

- A monthly charge that is included in general rates charges. This may appear to be unfair if the charge is a fixed amount for all residents, as some residents may abuse their latrines causing them to fill more quickly than the latrines of residents who take proper care of their latrines. (i.e. there will be no incentives for taking proper care of the latrines).
- A fully subsidised basic pit emptying service. The subsidy may be structured in a way that residents who do not take proper care of their latrines will have to pay for the additional costs associated with emptying the pit. For example each household's pits will be emptied once in 8 years at no cost to the household. However the following penalties must be paid in the event of abuse of the latrine:
    - A charge of R100 for emptying if any non-biodegradable refuse is found in the pit (or alternatively a deposit of R100 must be made when pit emptying is requested, with the deposit being returned if no refuse is found in the contents);
    - A proportionate charge for emptying pits before 8 years (i.e. $1/8^{th}$ of cost for every year less than 8 years);
    - A written warning with instructions to address maintenance issues within a specified time period should any repairs be needed on the superstructure, pedestal or slab.
- A community tariff that covers a proportion of the cost of emptying the pits within a defined settlement. The resident committee or ward committee themselves manage the collection of the tariff, with most residents paying a bit extra to cover the contributions required from the indigent residents. In this case the pits of the whole settlement are emptied at the same time, saving costs for the service provider and hence reducing the tariff and overall costs. This does require strong mandated community structures to manage.

5. SETTING UP A PIT EMPTYING PROGRAMME

Municipalities that have existing pit toilets or are planning to install pit toilets, must plan to set up a programme for the emptying of the pits, or for addressing full pits through one of the other methods described above. The experience from the Ethekwini Pilot Pit Emptying Programme has been used to formulate the following programme framework.

5.1 Programme Structure

The pit-emptying programme should be structured as follows:

Component	Stage of programme	Requirements
1. Planning	Initial stage	Geographical layout and location of all pit latrines, feasibility report, commercial, social and cultural situation, location of disposal sites
2. Budgeting	At start of programme, monitored on a regular basis	Understanding of cost structure, monitoring and accounting tools
3. Social facilitation	First entry to community	Social facilitators, information tools, contacts with community leaders
4. Project liaison committee	Operational throughout the emptying programme	Local committees for employing labour, reporting, liasing with municipality
5. Pit emptying facilities and teams	Operational throughout the emptying programme	Trained personnel or contractors, with necessary equipment
6. Contracting or scheduling own teams	At start of pit emptying stage	Details of factors affecting contracts*
7. Arrangements for disposal of sludge and any refuse/detritus	At start of pit emptying stage	Access to disposal sites or creation of new disposal sites
8. Monitoring	Throughout the emptying programme	Monitoring system, data capturing mechanism, reporting systems
9. Programme management	Throughout	Manager and supervisors with experience, time and resources including management tools**

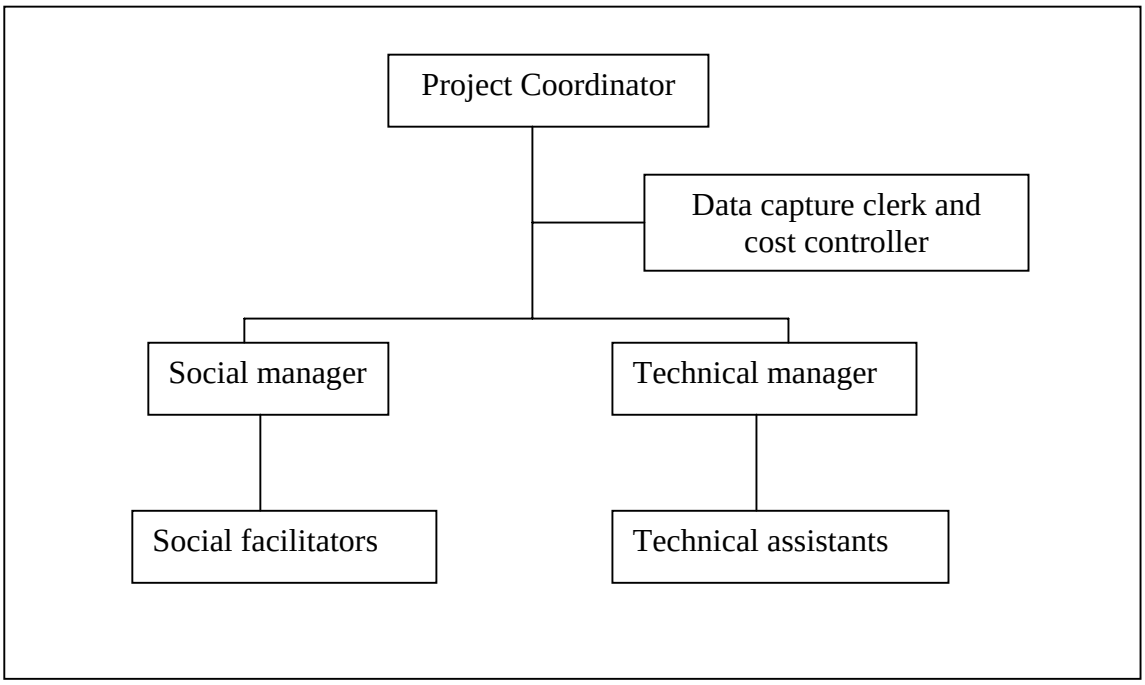
* Factors affecting contracts are summarised in the following table

** A guide management structure is depicted in the figure below, and field data tools used at Ethekwini may be found in the appendix.

5.2 Factors affecting contracts or programme scheduling

Method of emptying	Determines cost structure
Location of pits	Whether close or widely spaced, etc.
Access to pit latrines	Proximity that a vehicle can gain access
Access to sludge	Type of covering over pits – whether sectioned slabs can be removed
Other structures hindering access	If households had built other structures that hindered access to the pit latrine
Degree of abuse	Degree to which refuse has been thrown into pits
Ingress of groundwater	Determines how wet the sludge will be
Size or volume of pits	Determines the volume of sludge to be removed
Position relative to the road	Determines how easily sludge can be moved (e.g. in drums on trolleys) to transport vehicles
Existence of informal pit latrines	May cause additional problems such as possible collapsing
Amount of grey water deposited in pit latrines	Determines how wet the sludge will be
Distance of settlement from nearest discharge point	Determines distance that vehicles must travel to discharge the sludge
Payment method	Can be per pit, by volume, per day, or as a managed programme according to key performance indicators
Contractor profile	The resources and experience of the contractors

5.3 Example management structure



6. USEFUL CONTACTS FOR ADDITIONAL HELP

Please list DWAF head office and regional sanitation personnel

APPENDIX FIELD DATA FORMS FOR PROJECT CONTROL

MUNICIPALITY LOGO

HOUSE DETAILS:

Street

House number | Lot number | Municipality no:

Area | Section

Surname | No of people/families using pit latrine

PIT LATRINE DETAILS

GPS position

Structure: Formal | Brick | Informal | Tin

Toilet seat in place? ves | no | formal | informal

Is there a door? ves | no

Is the pit lined? ves | no

Pit concreted at the bottom? ves | no

comments

ACCESS TO PIT LATRINE

Which of the following can access the property's VIP?

5 m3 vacuum tanker?	Used?	100 ℓ drums on trolleys	Used?
Water bowser on trailer	Used?	200 ℓ storage tank on trailer	Used?
4x4 LDV	Used?	portable pumps	Used?
5000 ℓ water tanker	Used?	other	Used?
Distance from road/path	m	width of road/path	m

Toilet is uphill | downhill | level from road/path

Volume sludge removed from pit | volume debris removed from pit

TIME TAKEN TO EMPTY PIT

Date for preparing the pit

Start time for preparing | finish time

Date of emptying

Start time for emptying | finish time

COMMENTS | Assessor

MUNICIPALITY LOGO

Completion Certificate

HOUSE DETAILS:

Street

House number | Lot number | Municipality no:

Area | Section

Surname | No of people/families using pit latrine

Was the pit emptied satisfactorily?

Was the area left in a clean state: inside?

outside?

Was the pit cover replaced properly?

Was any damage caused: to the building?

to the pit?

to the surrounding area?

Was the awareness training given?

Were information pamphlets provided?

COMMENTS

I, …… of ……..
Hereby declare that I am fully satisfied with the evacuation of the pit latrine on the above property

Signed ……

Date ……..

Witnessed by PSC member ……..

Date ……

Assessor

FOR MORE INFORMATION

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Chief Directorate: Sanitation
Tel: (012) 336 8811
Fax: (012) 336 7283

DWAF REGIONAL OFFICES

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	Fax:	(012) 392 1408
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