DEALING WITH THE RURAL SANITATION BACKLOG IN THE CHRIS HANI DISTRICT MUNICIPALITY, SOUTH AFRICA – A CASE STUDY

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ABSTRACT

The South African national Free Basic Sanitation policy requires basic sanitation facilities to be provided to indigent households. In the Chris Hani District Municipality (CHDM) the majority of residents live in hundreds of scattered, rural villages where most of the sanitation backlog occurs. Consideration was given to different ways of dealing with the provision of the basic rural sanitation facilities as well as the financing and management of the ongoing operation and maintenance of the facilities. It was recognised that, unlike urban and peri-urban situations, an additional factor to be considered in very rural areas is a logistical one since this has a major influence of the chosen approach to the problem. It was decided that the basic rural sanitation unit was to be the Ventilated Improved Pit-latrine (VIP) but with a moveable top structure. The moveable top structure was the indirect way of dealing in a cost-effective, sustainable manner with the faecal sludge of the VIPs when their pits were full.

The provision of VIPs with moveable top structures to some 100 000 families was done through a 3 year supply and installation contract for R782 million with no payment being made for materials on site. Payment was only made for certified, completed units. This required the further appointment of Administrators to carry out the quality control and certification of work done.

It is easy to prescribe moveable top structures for VIPs to do away with the need to handle faecal sludge when the pits are full but it requires great attention to be paid to the detail. Besides the ease with which the top structures could be moved, particular attention was paid to the size of pits and how to deal with pits in rock, clay or sand. Another crucial detail was to avoid pollution of the ground water by strictly applying the Groundwater Protocol (GWP) - carried out by geo-hydrologists.

The CHDM inherited thousands of VIPs from the (then) Department of Water Affairs and Forestry (DWAF). These were mostly VIPs with fixed top structures built of concrete blocks which will require CHDM to deal with the faecal sludge in full pits. Based on this experience, they took a conscious decision to adopt a different approach to all new rural sanitation facilities to be constructed.

THE CHALLENGE

The challenge for this project was to try to establish a way that the Chris Hani District Municipality (CHDM) could provide rural sanitation facilities in a sustainable way that would eliminate or at least minimize its subsequent involvement with the operation and maintenance of the facility Another unknown of this project was that the CHDM did not know the magnitude nor the distribution of the backlog in its extensive area. Once this was known they had to draft appropriate tenders, within the necessary ecological, technical and legal constraints and guidelines and award contracts, always bearing in mind the need for the authority or owners of the sanitation facility to deal with the faecal sludge during its life.

A CASE STUDY - CHRIS HANI DISTRICT MUNICIPALITY

Chris Hani District Municipality is the Water Services Authority for the 8 local municipalities within its area of jurisdiction. It is constitutionally obliged to progressively provide free basic water and sanitation services to indigent people or families who reside within these local municipalities.

This case study shows the particular way (from a range of options) of how the CHDM in the Eastern Cape Province approached the challenge of providing rural sanitation to those still lacking it, so that full pits could be dealt with in a cost-effective manner.

CATEGORIES OF MUNICIPALITIES

South Africa has 9 provinces (Figure 1), with different categories of municipalities: 9 Metropolitan, 283 Local and 44 District Municipalities, categorised respectively as A, B and C municipalities. The District Municipalities are comprised of a number of Local Municipalities, each of the different grades of municipalities with different functions. The local municipalities are further subdivided into wards for administrative purposes. The location of the Chris Hani District Municipality is shown in Figure 2.

Figure 1. Provinces of South Africa

Figure 2. Chris Hani District Municipality

CHARACTERISTICS OF THE CHRIS HANI DISTRICT MUNICIPALITY

As a category C municipality, the Chris Hani District Municipality's area of jurisdiction encompasses 8 local, or category B, municipalities. CHDM has been designated as the Water Services Authority for its entire area of jurisdiction, responsible for the provision of both water and sanitation services.

Queenstown, at the geographical centre of the district municipal area, is the only primary urban node. It is the seat of both the Chris Hani District Municipality and the Lukhanji Local Municipality. On the western (developed) side Cradock is a secondary urban node while there are 12 tertiary urban nodes or smaller towns that act as service and retail centres in other parts of the district.

The CHDM covers an area of 3,688,803 ha. It runs east – west, from Ngobo to Cradock, a distance of approximately 300km. In the north – south direction, it is on average 120km wide. Historically the western half consists largely of free-hold farms while the eastern half is comprised mostly of tribal land in the former Transkei. The rural sanitation backlog is found in the eastern half, in an area of some 130 x 120 km.

The rural areas that were previously in the former homelands are distinctively different from the area that was in the former "white South Africa". Specifically, settlement in the former "homeland" areas is predominantly of the dispersed "traditional" rural village type, in which subsistence-farming practices (pastoral and dryland cultivation) are the dominant forms of land use activity. In contrast, settlement and land use in the former "white remainder of South Africa" component of the district is largely characterised by commercial farming and nodal urban development (small service towns).

RURAL SETTING

This paper deals with the way in which the CHDM provided sanitation facilities to families in *rural* villages. The distinction between homesteads in urban or peri-urban areas and those in rural villages is vast and provided the logic for the approach adopted. The following were the major considerations for deciding on moveable top structures for sanitation facilities.

<u>Spread of villages:</u>
The offices of the CHDM are situated in Queenstown which are geographically central to the area but on the western side of the area where the rural sanitation backlog occurs –an area of some 130 x 120 km. Considering that the positions of roads are influenced by geographical features like hills and streams, the actual distances by road to the villages are very significant. Logistics thus become a major element to be taken into account.

<u>Plot size:</u>
In urban areas there is a need to densify dwellings to reduce unit costs for services like water, sanitation, roads, etc. Plots can be as small as 300m^2 while homestead sizes in rural areas are traditionally 2 500m^2, based on 50m x 50m plots. In urban/peri-urban areas there is thus very limited space for moving the site of the VIPs whereas in the rural areas there is much more scope for re-locating them (Figures 3 and 4).

Figure 3: Aerial view of typical rural village

Figure 4: View of typical rural homestead erven

ELEMENTS OF RURAL SANITATION

In considering the best option for providing rural sanitation, the following major aspects were addressed:

- Faecal sludge management
- Quantum of backlog
- Disposal of pit contents
- Logistics
- Specification for pit, slab and top structure
- Types of founding material
- Ground water pollution
- Tender procedures

<u>Faecal sludge management</u>
There are various ways of managing faecal sludge, all of them requiring much management and funding. In some instances such as densely populated peri-urban areas where VIPs have been constructed, the only option available for managing faecal sludge in full pits is to extract it by various means – all of them laborious and unpleasant. If, however, there is no alternative way of dealing with the problem, then these challenging issues have to be dealt with in the best way possible. Other papers at this conference deal with the immense difficulties which face authorities required to empty full pits of sanitation facilities with fixed top structures, such as extraction equipment; separation of solid waste from faeces and urine; dispose of its contents; transport to VIPs and disposal sites.

An alternative method of managing faecal sludge is to avoid handling it in the first place. This can be managed by arranging for the top structure to be moved. This circumvents all the difficulties outlined above – but it does mean that new pits have to be dug and the top structure must be fairly easily moveable.

The CHDM will still have to deal with faecal sludge in many of the sanitation facilities which had been constructed before the present contract – a problem they mostly inherited from the Department of Water Affairs and Forestry (DWAF). This paper only dealt with new sanitation facilities.

Quantum of backlog

In the years immediately after 1994, funds were allocated to local municipalities for, amongst other services, basic rural sanitation. They in turn chose specific wards where these funds were applied. Different PSPs (Professional Service Providers) were appointed as the funds became available – each PSP with its own designs of VIPs. This resulted in a "patchwork" of types and distribution of basic sanitation being provided over the district municipality. The area where no basic rural sanitation had been provided was therefore also very scattered and not easy to determine.

A baseline survey carried out by the Institutional and Social Development department of the CHDM found that there was a rural sanitation backlog for some 100 000 families, scattered over 914 villages, in five different local municipalities. The backlog per village ranged from a few families up to some 1 200 families, with an average backlog of about 100 families per village. The previous section on 'Rural setting' indicated the spread of these villages – which meant logistics became a crucial element in the whole exercise.

Disposal of pit contents

In urban/ peri-urban areas it has been found that a large percentage of the VIP pit contents consist of solid waste. This is due to the life style of indigent families and/or the lack solid waste disposal sites. It is considered likely that in rural areas, and especially deep rural areas, there will be less solid waste disposed of in pits.

In urban/ peri-urban areas it is usually possible to dispose of the pit contents (after dealing with the solid waste in them) at sewage treatment works. In rural areas it is completely impractical to consider this due to the distances involved and the fact that sewage disposal works at the small towns – assuming they exist – would have neither the capacity nor the facility to cope with such 'shock' loads of sewage.

Another possible option for disposal of pit contents is deep-row entrenchment, coupled with agro-forestry but this will require political will and the establishment and operation of committed teams by the CHDM.

Logistics

If it was possible to dispose of the pit contents at sewage treatment works at the small towns, it would still require a fleet of vacuum tankers – with drivers and mechanical staff to maintain the tankers – as well as cooperation from the roads department to provide decent roads between the town and the various villages. Tanker access in the villages from the departmental roads to the homesteads and to the pits on the homesteads will also need to be arranged by the villagers – a task likely to lead to many delays in the process of emptying the pits.

The above-mentioned challenges were one of the major reasons for the CHDM choosing to have moveable top structures to other pits dug on the homesteads - they eliminate the need to dispose of the pit contents. It also overcame the need to separate solid waste from the pit contents – a major problem when emptying pits.

Specification for pit, slab and top structure

Essentially a Ventilated Improved Pit-latrine (VIP) consists of 3 elements:

- Pit
- Slab
- Top structure

The pit

The pit volume determines how long it will last before it is full – the bigger the better. This also depends on the number of users. CHDM adopted the DWAF pit size guideline of $3m^3$ – plus 500mm freeboard. The freeboard is an early warning system that a new pit has to be dug and prepared.

Due to the conical shape of faeces in the pit, an apparently full pit should encourage users to make use of paddles to 'lop off' the top of the cone to extend the life of the pit and to commence preparation for provision of the next pit.

It was found that a significant number of VIPs – especially those provided with fixed top structures (usually built of concrete blocks) have collapsed into the pits they were built on. The specification of all new VIPs therefore states that a ring beam to stabilise the top edge of the pit also had to be provided – to the initial and subsequent pits.

The excavation of pits in different types of soil is dealt with in the following section 'Types of soil'.

The slab

The slab needs to be moveable but must also be water-tight. If it consists of several pieces so that they can be man-handled when they are moved, the joints need to be water-tight. The joint between the slab and the ring-beam also needs to be water-tight. This can be difficult to achieve when the slab is being moved onto a new ring-beam and thus requires specific attention.

The top structure

The tender specification was based on the top structures being movable – to enable them to be moved to new pits when the original (and subsequent) pits were full.

Rather than specifying particular designs for the slab and top structure, minimum requirements were developed for all elements – top structure size, doors, hinges, pedestals, etc. This was to enable suppliers to determine whether their existing products were compliant or whether they wished to amend them to comply with the specification. Details are provided in Appendix A.

<u>Types of founding material</u>

Tenderers were required to state their method for dealing with alternates to pits if the founding material was found to be unsuitable. If the foundation material on which the sanitation facility is to be constructed consists of either rock or clay, then digging a pit would essentially mean that conservancy tanks were being created because the urine will be unable to drain from them. Apart from the very high cost of digging such pits, they would be unacceptable because conservancy tanks need to be serviced regularly by vacuum tankers. This would involve all the challenges listed under 'Logistics' above.

<u>Ground water pollution</u>

Tenderers were required to state their method for dealing with alternates to pits where a high water table was encountered. This was to ensure that the ground water is not polluted because many of the rural villages are dependent on ground water for their domestic water supply.

Where there is a high water table, digging pits for VIPs may be unacceptable because the Ground Water Protocol dictates minimum distances between the bottom of the pit and the top of the water table, depending on the type of soil. The finer the soil the longer the period of fluid passing and hence the shorter this distance; for course sand, fluid will pass quickly and thus a greater distance will be needed.

The Department of Water Affairs 'Groundwater Protocol' states the vulnerability of the underground water source is related to the distance that the contaminant must flow to reach the water table, and the ease with which it can flow through the soil and rock layers above the water table." A minimum time of flow is needed to ensure the pathogens will die off before the effluent from the pits enter the ground water (time of flow = depth of unsaturated layer ÷ rate of flow). The soil performs a natural filtering action. The Department of Water Affairs also defines five broad classes of aquifer vulnerability (see APPENDIX B). Note that for medium risk of ground water pollution the guideline indicates that the water table should be greater than 10m deep.

Where it was found that VIPs with pits were unsuitable, alternate sanitation facilities would need to be provided, such as urine diversion or composting toilets. Both of these types of toilets are constructed at ground level. The top structure is fixed and more costly than a moveable top structure but it never needs to be moved because:

> For the *urine diversion* type toilet, the urine is diverted and only the faeces – collected in a bag - needs to be removed when the bag is full. A replacement bag is then provided. It means there is no pit that is filled.
>
> For the *composting* type toilet, two chambers are provided. Only one is in use at a time until it is full. It is then closed and the second chamber is used. By the time the second chamber is full the material in the first chamber has composted. This is easily removed and used in the garden. It thus also means that there is no pit that is filled.

Both these types of toilets are useful where, for technical reasons, no pit can be dug but the need for them has to be explained to the users before they are provided, otherwise there can be social resistance to their use.

The Groundwater Protocol (GWP) was carried out by geo-hydrologists. They used existing boreholes and related information about which villages (or portions of villages) were unsuitable for the installation of VIPs. This could be due to a high water table or the presence of dykes and sills which could be conduits for the transmission of polluted water down to the water table. Such information was then made available to tenderers so as to inform them of the number of alternate basic sanitation solutions which would be required.

The process is independent of other contracts and should therefore be performed well ahead of them. It is area-based and not dependent on the actual locations of the villages. The geo-hydrologists also provided training on how to deal with rural sanitation provision in sensitive areas subject to potential pollution of the groundwater.

<u>Tender procedures</u>

Advisors

Unlike a conventional Client-Consultant-Contractor contract, where the Consultant carries out the design and administers the contract on behalf of the Client by the Consultant, CHDM did not appoint a consultant since they were fully aware of what was required to be done. Instead, they appointed advisors to assist them with the drawing up of tender documents; the pre-qualification tender; the construction of demonstration toilets by short-listed consortia and award of the tenders.

Specification

Tenderers had to indicate how material would be transported to the various villages, and within the villages to the homesteads. This involved an intimate knowledge of the access roads from the factory to the villages. Logistics became an essential part of the supply and construction process.

The pre-qualification tender did not require any price to be submitted. It was evaluated purely on a technical basis. The point allocation for meeting specified criteria was clearly stated, noting that only tenderers scoring 60 or more points would be short-listed.

Pre-qualification tenders

A total of 42 tenders were received and assessed of which seven pre-qualified. Short-listed tenderers were invited to submit priced documents and were requested to construct demonstration toilets.

Priced tenders

The seven short-listed tenderers then submitted priced tenders.

While these were being assessed, they were each allocated a place to construct demonstration toilets. These were all at schools and could be used on completion. The CHDM paid for all such usable demonstration units, regardless of whether or not the tenders were successful.

Each consortium had to construct two toilets to demonstrate: 1) their VIP toilet, 2) their top structure for wheelchair users, 3) how they would deal with providing a sanitation facility where rock outcropped at the surface.

The demonstration toilets were most useful to both the consortia and the CHDM. One consortium withdrew their tender once they experienced the practical difficulties involved. The professionalism and experience of consortia in supplying and erecting the demonstration units could also be assessed relative to their written submissions.

Demonstration toilets top structures had to be dismantled and re-erected on the same pits to assess their moveability. A contract was awarded to one implementer in the total sum of R784 million to be constructed over a three-year period. They also tendered to erect a factory in Queenstown for the manufacture of the top structure and slab units.

Administrators

If a consultant had been appointed to draw up tender documents, the client would normally have appointed them to administer the contract regarding quality control and certification of work done. In this case such administrators were appointed separately.

While only one consortium was appointed for the provision and installation of the VIPs, the volume of work over a 'site' of some 120km x 130km required the appointment of four administrators. Their task of quality control and certification had to be carried out on thousands of small, individual structures. Each VIP site had to be visited several times to check on position; pit; slab; top structure and final inspection for certification of payment.

The administrators with their team of field workers also had to have detailed knowledge about access roads from Queenstown to the numerous villages.

The contracts are scheduled for completion by the beginning of 2014.

Lessons learnt

The characteristics of the terrain may determine the most suitable type of rural sanitation to be provided. For the CHDM the large number of rural villages scattered over a vast area meant that onerous task of emptying pits was even more daunting. Choosing to use VIPs with moveable top structures means that the pits do not need be emptied.

Before the project commences, policy must be developed, work-shopped and accepted by the authority regarding the following:

- Who will dig the second and subsequent pits – households or the authority or a clearly defined combination?
- Who will move the top structures – households or the authority or a clearly defined combination?
- Households to carry out daily and routine maintenance as well as keeping the sanitation facility clean, both inside and outside.

Short-listed consortia should have been required to move and re-erect the ring beams and slabs of the demonstration toilets, not only the top structures.

CONCLUSION

By using Ventilated Improved Pit latrines with moveable top structures the Chris Hani District Municipality is providing new sanitation facilities for users in rural villages that will ease the problems related to full pits. They will still be faced with emptying full pits from inherited VIPs built with fixed top structures but at least the new VIPs will be much easier to manage.

APPENDIX A

The top structure must have the following:

1 A room which
- 1.1 is able to be dismantled,
- 1.2 is able to be moved without damage from factory to homesteads in specific villages
- 1.3 is able to be re-assembled on its original slab
- 1.4 is able to be easily dismantled, relocated and re-assembled at least three times after initial erection – or a monolithic structure able to be moved monolithically
- 1.5 is waterproof and essentially dark inside but allows air to flow easily through it
- 1.6 has minimum inside dimensions of 900 mm width by 1 100 mm length by 1 950 mm height

2 A roof which
- 2.1 is secured against wind damage
- 2.2 has overhangs which will keep the room waterproof
- 2.3 drains away from the door

3 A pedestal with
- 3.1 a robust body which is easily cleaned
- 3.2 a robust seat and seat cover

4 A door which
- 4.1 has a minimum clear opening of 800 mm width by at least 2 000 mm height
- 4.2 has a frame securely fixed to the walls or, alternately, an arrangement where no door frame is required
- 4.3 is able to be locked from the outside with a padlock
- 4.4 is able to be opened from the inside even if locked on the outside
- 4.5 slams closed and secures itself when a person pushes it from the outside without holding down the door handle
- 4.6 slams closed and secures itself under the action of wind if left open
- 4.7 has hinges able to withstand the maximum impact forces when the door is slammed closed by the wind or people
- 4.8 has hinges able to withstand the impact forces at its maximum opening position experienced from the door being blown open or thrown open
- 4.9 requires minimum painting, if any
- 4.10 has a minimum of 50 mm and a maximum of 100 mm air space above or below the door

5 A vent pipe which
- 5.1 has a minimum 100 mm internal diameter
- 5.2 extends through the slab to a minimum of 500 mm above the highest outside point of the roof
- 5.3 is UV resistant
- 5.4 is securely fixed at vulnerable points
- 5.5 has a durable nylon fly screen with maximum 1.5 mm openings, securely fixed to its top

6 Slabs which
   6.1 Can accommodate different pit configurations varying from different diameters to different rectangular pits
   6.2 Are pre-cast
   6.3 Are light enough to be man-handled into position
   6.4 Can be moved to a new pit using local labour only without machinery
   6.5 Have sealable joints where more than a single slab is used on a pit

7 Hand-washing facility which
   7.1 Has a Tipi-tap or equivalent operation mechanism that can be opened by one hand without turning a tap and is self-closing
   7.2 Is securely attached to outside of top structure

APPENDIX B
Vulnerability of Groundwater Aquifer due to Hydro-geological Conditions

VULNERABILITY CLASS	MEASUREMENTS	DEFINITION
Extreme (usually highly fractured rock and/or high ground water table)	High risk (table 1) and short distance (< 2m) to water table	Vulnerable to most pollutants with relatively rapid impact from most contamination disposed of at or close to the surface
High (usually gravely or fractured rock, and/or high water table)	High risk (table 1) and medium distance (2-5m) to water table	Vulnerable to many pollutants except those highly absorbed, filtered and/or readily transformed
Medium (usually fine sand, deep loam soils with semi-solid rock and average water table (>10m)	Low risk (table 1) and medium to long distances to water table	Vulnerable to inorganic pollutants but with negligible risk of organic or microbiological contaminants
Low (usually clay or loam soils with semi-solid rock and deep water table (>20m)	Minimal and low risk (table 1), and long to very long distance to water table	Only vulnerable to the most persistent pollutants in the very long term
Negligible (usually dense clay and/or solid impervious rock with deep water table)	Minimal risk (table 1) with confining layers	Confining beds present with no significant infiltration from surface areas above aquifer

(Source: Department of Water Affairs Ground Water Protocol)