LAKE VICTORIA WATER AND SANITATION INITIATIVE

SOLID WASTE MANAGEMENT SYSTEMS FOR MASAKA, KYOTERA AND MUTUKULA, TOWNS IN UGANDA

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EXECUTIVE SUMMARY

The LVWATSAN (Lake Victoria Water and Sanitation Initiative) includes the provision of solid waste collection systems for the secondary towns in the Lake Victoria Catchment Areas in Kenya, Tanzania and Uganda with populations of between 8,000 and 120,000. In March 2006 Iole Issaias of UN-Habitat and Manus Coffey (Waste Management Consultant) visited three towns in Uganda, Masaka, Kyotera and Mutukula. Previous studies had included Bukoba and Muleba in Tanzania and Kisii and Homa Bay in Kenya.

The intention is that UN-Habitat will provide support to these and other towns in the LVWATSAN Region for upgrading their solid waste management systems and the seven towns chosen are considered to be typical of many others in the region so that SWM systems set up in these sample towns can be replicated in other towns.

OBJECTIVE OF THIS CONSULTANCY

As part of UN-HABITAT activities in water, sanitation and waste management and in line with the objectives of LVWATSAN. The objectives of this consultancy are to:-

a) Assess the technical operation of the Vacutugs in Kenya and Tanzania and valuate the future up-scaling of the project.
b) Evaluate the proposed SWM activities in the UN-HABITAT rapid assessment
c) To design the implementation of integrated solid waste management strategy for; i) Bukoba and Muleba in Tanzania; ii) Kisii and Homa Bay in Kenya, and iii) Kyotera, Mutukula and Masaka in Uganda
d) Pre qualify manufacturers of SWM equipment and provide sketches of proposed equipment.

This report has been prepared in accordance with points b) and c) of the above objectives.

The report should be read together with the report on pre-qualification of manufacturers of SWM equipment which will be submitted as a final report to this consultancy.

The report is in five sections and there is some repetition so that each section can be read in isolation.

This report puts forward proposals for immediate and long term interventions for solid waste management in the three towns of Masaka (Nyendo / Ssenyange Division), Kyotera and Mutukula in the Lake Victoria Catchment Area of Uganda.

A review of a previous study undertaken in July 2005 followed by an analysis of waste collection alternatives shows that the original proposals, based on using concrete bunkers will not be appropriate as existing bunker systems have many problems and the original proposal to use tipping trucks will not be cost effective. Haul distances to the disposal sites are short in all three towns and tractor powered systems are therefore proposed using a conventional tractor with a skip trailer and containers for Masaka, a conventional tractor with low loading height trailers and small bins for Kyotera and a system based on a small two wheeled tractor based "Small Pick" for Mutukula. All the vehicles and equipment will be sourced from within the LVWATSAN countries with encouragement and capacity building of local manufacturers to provide appropriate equipment to specifications which will be provided by UN-HABITAT.

Immediate interventions for Masaka and Kyotera will include a review of the waste data assumptions on which the recommendations have been based so that adjustments can be made in the numbers of vehicles, containers and other equipment required. These will start with the refurbishment of existing equipment followed by emergency clean ups including the organization of community awareness campaigns and community based litter collections to remove the plastic litter scattered throughout all the towns and will include a review of waste the waste generation rates followed by a review of the collection equipment required. A Long Term Intervention will followed including the introduction of waste collection and disposal services to maintain the towns in a clean state and further studies of the existing and alternative disposal sites with possible development of new landfill sites.

For Mutukula a single intervention is proposed to take place as soon as an improved urban management structure can be put in place.

Improved hand barrows and handcarts will be introduced together with improved brushes and hand tools for the street sweepers.

Capacity building at local authority level and training of management and workers in the operation of the systems will be included and preventive maintenance systems set up for the continuing service and maintenance of the vehicles.

Financial systems will be put in place for the collection of revenues to ensure the long-term sustainability of the waste management in each town.

UN-HABITAT Project Managers / facilitators will be based in Masaka and Kyotera for a minimum twelve month period in offices to be provided by the local municipalities with a local staff member in each office reporting directly to the Project Manager. Mutukula, which will come under the Kyotera office is only about one hours drive away.

SECTION 1

1.1 SWM OVERVIEW.
(APPLICABLE TO ALL OF THE SEVEN TOWNS STUDIED TO DATE IN LVWATSAN)

The objectives of any donor funded solid waste management project is to provide a capital input for the purchase of vehicles and equipment and capacity building for the local authority for the efficient operation of a sustainable system which will remain in operation after the donor interventions have ended.

The long term sustainability of any system must depend upon the towns ability to carry the operating costs (labour, fuel and maintenance) in the short and long term and the long term costs for the replacement of any equipment as it wears out. There is a tendency for capital costs to be ignored in donor funded projects where the equipment is provided by the donor but this can lead to short term solutions which collapse after a few years when the equipment reaches the end of its economic life. Any system must be affordable by the local authority and by the householders and businesses to be serviced, otherwise it will cease to operate when the donor intervention ends.

The operating and capital costs of any system will depend upon the level of service to be provided which must be within the affordability or "willingness to pay" of the people being served. It is therefore essential to take the full operating and financial costs into account when planning any system.

There is a tendency to look at waste management as a provider of low cost employment without taking into account the need to minimize the loading times for the vehicles so as to get the maximum productivity out of each vehicle and hence to reduce the number of vehicles required and consequent capital and operating costs.

Costs can thus be minimized by using low cost vehicles which have a long economic life in an efficient manner which minimizes the labour requirement

Any SWM systems which are set up must have long term sustainability if they are not to go the way of so many donor aided projects in other countries which have set up short lived systems based on state of the art technologies from the industrialized countries without an understanding of the different waste characteristics, economic conditions and ability of the householders and commercial activities to pay for the service.

A typical example of such differences lies in the difference in the density of the wastes. In the more wealthy industrialized countries waste densities as low as 100 kg/m3 or even less are found. Collection vehicles using compaction mechanisms to compact the wasters, typically to around 400 kg/m3, are commonly used in the more industrialized countries to enable the collection vehicles to carry economic loads. However these trucks are costly to purchase and to operate and where there are high density wastes their heavy compaction mechanisms actually reduce the load capacity of the trucks compared with non-compaction trucks with a body size appropriate to the waste densities in each situation.

There were a number of common features of all the seven towns which have been studied to date including:-:

- The relatively low income levels of the residents of the towns results in a small waste generation per capita and high density wastes. Initial studies have indicated waste generation rates of 0.3 – 0.4 kg/capita/day and waste densities of 300 to 400 kg/m3 for all the towns.

- Financial constraints dictate the level of service which can be provided. A high level of service with house to house collection will not be affordable and so communal collection points using to which the residents will bring their own wastes will be appropriate. The low waste generation rates and the high waste densities indicate that each collection point must be relatively small so as to minimise distances that the residents have to bring their wastes. Typically a 4.0 m3 collection point using containers will hold the wastes of around 1,600 people (300 households) with a collection every two days allowing for the containers being 80% full at the time of collection.

  Householders and businesses which require a higher level of service, and are prepared to pay for it, can be serviced by private entrepreneurs offering a "primary" collection service using barrows, handcarts or bicycles to collect the wastes each day from each of the premises, bringing the wastes to the nearest container. This service can be encouraged by, but does not need to be provided by, the local authority.

- The distances between the residential and commercial areas in all seven of the towns and the waste disposal sites are relatively short due to the small sizes of the towns and the ready availability of dumping sites. This means that in all the towns tractor trailed systems will be more cost effective than trucks

- All the seven towns studied have waste densities of between 300 kg/m3 and 500 kg/m3, equivalent to the waste densities to which compaction trucks are designed to compact the wastes. Thus there is no reason to consider the use of compaction trucks for any of the towns studied..

- Each of the towns has a market area where the wastes generated will be at the lower end of the scale with a high organic content, thus any composting initiatives should start with market wastes. However, as the markets are all in commercial areas, street sweeping from adjoining areas will increase the densities.

- Privatised waste collection services are not considered to be feasible at this stage due to the lack of local entrepreneurs with suitable vehicles and equipment and experience in this field and the limited revenues available. Privatisation could however be re-considered in a few years time.

The waste generation rates and the density of the wastes effects the optimum size of the waste collection points. Typically in all the towns studied a 4.0 m3 container (5 m3 heaped load) will hold around 1,500 kg of wastes with occasional loads of up to
3,000 kg. When the weight of the tractor trailer (skip trailer or low loading height trailer) is taken into account total trailed weights of around 3.0 tons will be typical with occasional trailed weights of 4.5 tons. This is well within the capacity of a 40- 50 hp tractor even allowing for some steep hills and the high altitudes around Lake Victoria

A 45 hp tractor costs around US$ 13,000 to $15,000. (Massey Ferguson 240 costs US $ 14,000 in Dar es Salaam). The tractor can travel at speeds up to 30 kph. A truck with the same load capacity will cost around three times this amount and although the truck can travel at 60 kph the faster road speed of the truck will have very little effect on the overall collection times where there are short distances. When the high loading height and slow loading speeds of the truck are taken into account a tractor system will invariably be more efficient than a truck system unless the haul distances are very long. The annual costs, (fuel, maintenance and depreciation) for the tractor are only about one third that of the truck.

Smaller two wheeled Chinese tractors with a load capacity of up to 1,000 kg are available at a much lower cost (around US $ 6,000 with trailer) but have a limited speed. They can be appropriate for very short distances where there are only small amounts of waste to collect.

It is therefore proposed to use either “skip” trailers and containers or special low loading height trailers depending upon the amount of wastes to be collected, the distance to the disposal site and current practices in five of the seven towns. For two of the very small towns with very short haul distances (Muleba and Mutukula) a small pickup based on a two wheeled Chinese tractor will be more cost effective.

There are a number of different makes and models of tractor available in each of the countries with relatively small variations in prices between the different makes. The make and model chosen should be determined by the service and spare parts availability in the LVWATSAN region rather than by minor cost savings. There are also local manufacturers of trailers in each country who could make the skip trailers and low loading height trailers and one manufacturer in Kenya already manufacturers a skip trailer although of a larger size and weight than is required. It is therefore proposed that the skip trailers and low loading height trailers for the first five towns proposed for these systems should all be manufactured by the same manufacturer but that local manufacturers should then be invited to study these trailers and provide alternative quotations.

There is one manufacturer in Kenya who makes a Small Pickup based on a two wheeled Chinese tractor and it is proposed that this system should be used for Muleba and Mutukula.

Public awareness campaigns in each town will create an awareness of the health and social benefits of a clean environment and the serious health hazards from the dioxins and furans released into the atmosphere from burning plastics.

Training in the efficient operation of the collection service, the proper management of the disposal site and the preventive maintenance of the vehicles will be an essential part of any interventions in the seven towns.

1.2. ASSESSMENT AND EVALUATION OF PREVIOUS SWM STUDIES ON LVWATSAN

An inception study was carried out in August 2004 and a more detailed study in August 2005 included Solid Waste Management but these studies covered all aspects of the LVWATSAN project and were mainly concerned with water and sanitation issues.

The 2005 report was found to have been well researched and well thought out on Water and Sanitation issues, however it includes very little on Solid Waste Management and proposes the same solution for all three towns as set out below:

a) Waste Bunker systems

Concrete waste bunkers are proposed for all three towns to which the householders and commercial activities will bring their wastes. This proposal is not considered to be either hygienic or cost effective for a n umber of reasons.

- Experience of bunker systems throughout the world has shown that these lead to vehicle inefficiencies due to the slow process of loading the wastes from the bunkers into the collection vehicles. Unless the bunkers are very large there is only room for one person at a time inside the bunker forking the wastes into the collection vehicle. If the bunkers are open at the front there may be room for a second person but this person must work "left handed" so unless he is a left handed person his loading efficiency is slow. Typically it will take between 1 ½ and 2 hours to load a tipping truck from a bunker.

- It is difficulty to clean out the bunkers completely at each emptying and any wastes remaining in the corners act as a refuge for the cockroaches and other insects which are inevitably attracted to the bunkers. If the bunker is to be completely emptied each time the capacity of the truck must be more than the wastes in the bunker in which case the truck is not carrying its full load capacity.

- Organic wastes which have remained in the corners of the bunkers decompose causing odour problems and also harbouring a reserve of bacteria which then speed up the start of decomposition in subsequent wastes.

- All wastes must be removed completely at least every two days if the bunker is not to become the source of the problem rather than the solution. Otherwise nearby residents will set fire to the bunkers when they start to smell or attract flies thus adding smoke (and toxic gases from burning plastics) to the overall pollution problems.

- The bunkers attract rodents which can bury underneath the concrete slabs and disappear down their burrows when the collection vehicles arrive.

- Container or "skip" systems, where the complete skip is removed daily, or at most every two days, prevent the build up of the above nuisances. However the skips must be constructed to minimize corrosion and must be located on concrete slabs to prevent contact with the soil below. The slabs must be constructed so that rodents cannot burrow underneath them.

- If skips are used they must be brushed out each time they are emptied to prevent a build up of wastes trapped in corners where they decompose and form corrosive acids.

b) Truck systems

The 2005 study proposes the use of tipping trucks for all three towns. This is not considered cost effective for the following reasons:

- Conventional tipping trucks, such as are proposed, will have a very small load capacity. This can be increased by raising the truck sides but this will increase the loading height so that the loaders are loading wastes above their heads to heights of perhaps 2.2 metres or more. These high loading heights add to the loading times, further reducing vehicle efficiencies and is a serious health risk to the loaders due to wastes falling on their heads. Loading heights above 1.5 metres should not be permitted.

- Where the distances between the waste collection points and the disposal site are short tractors can be much more cost effective than trucks. Invariably tractors pulling trailed skip systems or special refuse trailers will be more cost effective than trucks where the haul distances are less than 20 or even 30 km.

- A 45 / 50 hp tractor costs around US $ 14,000 and can pull a trailer with a load of up to 5,000 kg at speeds of up to 30 km/hr. A truck with the same load capacity will typically cost around $ 40,000 to $ 50,000 but the body will be too small to achieve its full weight capacity. A larger truck with a skip system will cost around $ 70,000. The slower speed of the tractor is more than offset by its lower costs, and better manoeuvrability of the tractor.

- The "economic" life or depreciation of a truck is normally taken as seven years whereas a tractor will be depreciated over ten years due to the reduced engine speeds and more simple construction of the tractor.

It is therefore proposed that the tractor powered systems referred to above should be used be used instead of the tipping trucks.

Taking all the above factors into account the capital, fuel and maintenance costs of operating tractor trailed skip systems or trailed collection systems will be less than one third that of collecting wastes from bunkers using conventional tipping trucks which are loaded by hand.

The 2005 report proposes the purchase of incinerators for hospital wastes, however a new incinerator has since been constructed in Masaka and will be working very soon. Kyotera and Mutukula do not have hospitals.

SECTION 2 – SWM IN NYENDO/SSENYANGE DIVISION, MASAKA

2.1 BACKGROUND

Masaka Town is in the shape of a saucer with hills all around at an altitude varying from 800 to 1,600 metres. This must be taken into account when choosing trucks or tractors as there will be a reduction in engine power of around 12% due to altitude.

There are three divisions in Masaka Municipality each with two wards and a total urban population of around 70,000. Of these around 32,000 live in the District of Nyendo / Ssenyange which is separated from the rest of the town by a swamp..

The Central Division comprising Wards Katwe / Butego and the Kimaanya Division each have around 20,000 inhabitants. There are heaps of household and commercial wastes all over the town and two enforcement officers covering the whole Municipality do not seem to be effective. Attempts to privatize the waste collection have failed in the past due to the lack of appropriate equipment

The total waste generation for the Municipality is estimated at around 20 tons per day in the 2005 report and this seems reasonable. However not all this waste will reach the collection vehicles.

The Terms of Reference for this study refers only to the Nyendo / Ssenyange Division in Masaka town, however it is not possible to look at this division in isolation without looking at the rest of the municipality so the overall recommendations refer to the whole of Masaka with a more detailed recommendation for Nyendo / Ssenyange District.

A problem has already arisen in Masaka due to the fact that each division uses different equipment. Nyendo / Ssenyange has a skip system based on a single twenty year old German Mercedes Benz truck and Atlas skip lift mechanism whereas the other two divisions use twenty five year old Indian Tata trucks with Indian “dumper placer” skip lifts which use a different type of container. The Mercedes Benz truck is now out of order and the Tata trucks are not able to pick up the containers (skips) in Nyendo / Ssenyange. Thus there is no service at present in Nyendo / Ssenyange and no back up service for the other divisions of Masaka. It is essential that all the equipment in any municipality is fully compatible to avoid this problem in the future and also to simplify spare parts stocking and service.

2.1.1 Solid waste management in Masaka

There are three divisions in Masaka, each of which is responsible for its own waste management including the daily operation of the vehicles and equipment

Masaka Municipal Council are responsible for the disposal site and for the equipment maintenance. There is a central depot and workshop in the Central District where servicing g and maintenance are carried out. This is not a very satisfactory arrangement as does not include the drivers in the service routines and a formal "preventive maintenance" programme will include daily checks by the drivers and weekly and monthly checks and servicing by a mechanic under the management of the central workshops.

The existing collection equipment for the whole of Masaka consists of:

1. Mercedes Benz Model 1513 truck with skip lift system and 10 containers used by Nyendo / Ssenyange Division. This truck is 20 years old and has been out of commission for the past 18 months needing a complete engine overhaul. The containers for this truck are not compatible with the trucks and containers used by the other two divisions.

   Under normal circumstances this truck (and the two Tatas) would be scrapped but should be kept going for a year or two as part of the immediate interventions pending the setting up of a new system for the whole town (the UN-Habitat interventions are intended for Nyendo / Ssenyange Division only).

2. Tata (Indian) model 1612 trucks with skip lift "dumper placer" systems and 22 containers. These trucks are 25 years old and only one of them is presently operational. This truck is shared by Central and Kimaanya Divisions. Even this operational Tata truck has no starter and must be push started.

3. Jifang (Chinese) tipping truck. This truck is only about 1½ years old but was allowed to run out of oil and requires a new engine. It has an extremely high loading height (2.3 m) and is not suitable for hand loading. However it has a large body capacity of around 6.5 m^3 heaped and a load capacity of up to 7,000 kg. It is therefore quite suitable for mechanical loading. (The problems with this truck highlight very clearly the need for a formal preventive maintenance programme for all vehicles).

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4. Massey Ferguson Model 275 tractor around 30 years old. This tractor requires a full engine overhaul and is presently not functioning. There is a large (4.8m^3 capacity) tipping trailer for this tractor which has done very little work but is presently missing wheels and tyres. (It is not known whether the original wheels can be located but if not used truck wheels could be adapted by welding in new centres to suit the trailer axle).

5. Fahr Deutz DX 390 tractor. This tractor appears to be in quite good condition and to have done only a moderate amount of work. However the engine needs replacing or full reconditioning and would appear to have been run without oil. There is a front loader for this tractor with a 0.6 m3 bucket which has never been fitted.. (It is understood that all the fittings are available).

The town is at present serviced by truck mounted skip systems in all three divisions (although the system is not fully operational due to truck obsolescence) with container numbers as follows:

Existing truck containers (skips)

- Nyendo / Ssenyange Division 10 skips
- Central Division 12 skips
- Kimaanya Division 10 skips

There is no household collection and waste is taken by businesses/households to the skips.

2.1.2 Street Sweepers

Each division is responsible for its own waste management and street sweeping with the following numbers of sweepers.

Nyendo/Ssenyange	7
Central	20 (Privatised)
Kimaanya/Kyabakuza	2

2.1.3 Waste disposal site for Masaka Municipality

Each of the three divisions in Masaka Municipality is responsible for its own waste collection but they all bring their wastes to the same disposal site in Ssenyange Ward. This existing dumpsite is between 3 km and 6 km from the different divisions of Masaka as follows:

Average distances from collection areas to dumpsite

- Nyendo / Ssenyange Disvision 5 km
- Central Division 3 km
- Kimaanya Division 6 km

Thus because of these short haul distances a tractor based system would be most cost effective for all three divisions.

2.1.4 Billing and revenue generation for SWM

Each of the divisions is autonomous and operates its own waste collection system which is funded by trading licences, market dues and property taxes (although only about 40% of the property taxes are collected). 50% of the revenue receipts are paid to the Municipality and the other 50% is retained by the Division.

2.2. PROPOSED INTERVENTIONS

2.2.1 Immediate intervention for Masaka Town. (Nyendo / Ssenyange Division)

As a shorter term intervention an emergency clean up fleet should be set up to collect the heaps of wastes throughout the town prior to setting up a fully sustainable collection service. This can use the Fahr Deutz tractor and loader to load the wastes into the trailer which will be pulled by the Massey Ferguson tractor. The Jifang truck can also be loaded by the Fahr Deutz loader. This will be an efficient way of cleaning up the heaps of wastes throughout the city.. To enable this to take place:

- The Jifang truck engine should be refurbished.

- The two tractors should be refurbished and the loader fitted to the Fahr Deutz tractor.

- The tractor trailer should be refurbished.

All of this equipment will be useful for the eventual tractor trailed collection system proposed for all three divisions with the Massey Ferguson tractor being used for standby duties, the Fahr Deutz tractor loader being used at the dumpsite, among other uses, and the Jifang truck being used for general duties. Thus any investment in the above short term immediate interventions will also be used for the longer term solid waste management thus optimizing any refurbishing expenditure.

The Mercedes Benz and the Tata skip loaders and skips should be kept going in the short term and then sold off as soon as the tractor trailed system is available. To enable this short term operation to take place all three trucks should be repaired and put into adequate working condition for at least a further two years work. It is inevitable that if the Mercedes Benz truck only is repaired it will be used for all three divisions.

Tenders should now be sought by Masaka Municipality for:

- Repairs to the Mercedes Benz and Tata trucks.

- The refurbishment of the Jifang truck engine.

- The full refurbishment of the Massey Ferguson tractor including the reconditioning of the engine, the replacement of the tyres and any other repairs identified.

- The full refurbishment of the Fahr Deutz tractor including the fitting of the hydraulic front loader.

- The fitting of wheels and tyres to the tractor trailer. This may involve making up wheels by welding new centres into used truck wheels so as to fit the trailer axle hubs. Typically 11.00 x 20 – 12 pr truck tyres and wheels should be used. These are commonly available.

- The refurbishment and painting of ten containers to fit the Mercedes Benz skip loader.

The above work will enable a clean-up to take place throughout Masaka Municipality and a sustaining collection service to be provided in Nyendo / Sseyange for a period of two or three years pending the setting up of a long term sustainable system. It is impossible to give an accurate estimate of the above work but an initial crude guess would estimate the above work at no more than US $ 38,000.

2.2.2. Interventions for NYENDO / SSENYANGE DIVISION

Nyendo / Ssenyange has a population of around 32,000 and as no accurate information is available we must make an estimate of the waste quantities generated based on comparable information from other towns. For the sake of this study it is therefore assumed that each person generates around 0.35 kg/m3/day. (Including for commercial and market wastes). Thus there is a total waste generation for this division of around 11,200 kg/day.

No data is available as to the density of the wastes in Nyendo / Ssenyange and so an estimate has been made based on observations during the study and on data from other towns. It is estimated that the wastes will vary in density between 300 kg/m³ and 450 kg/m3 giving the volume of wastes generated at between and 25m³ and 37 m³ per day. For calculating container capacity the lower density will be used. However not all of this waste will reach the collection service.

The 10 skips in Nyendo / Ssenyange Division each have a capacity of 3.7 m3 giving a total skip capacity of 37 m³ for that division.. It was generally agreed, during discussions with different municipal staff that if these containers were collected each day there would be an adequate collection capacity The above figure agrees very accurately with the previous estimates.

Thus a waste collection system based on 80% of the wastes generated or 9 tons of wastes per day with a total volume of around 25 m³ / day will be adequate for Nyendo / Ssenyange Division. However the population is calculated to grow at between 2.5% and 3.5% per annum so, taking an 8 to 10 year time scale the system should be designed to cater for around 35 m³ per day. These figures may be on the high side depending on the amount of organic wastes removed by the farmers and other uncollected wastes.

Any future composting arrangement will use the same tractors and still transport the wastes to the same disposal site where the composting will be set up so they will not

effect the amount of waste to be collected, however, a separate low loading height trailer may be required if some source separation of organic wastes is to take place. This could be included in the composting plant budget. It is important that full discussions take place with the promoters of this system so that it can be integrated into the UN-Habitat proposals..

.

Any container system must include for all containers being collected at a maximum of two day intervals. It is therefore proposed that:

- Nyendo / Ssenyange Divisions should be provided with 15 containers (to include one spare container on the trailer at any time) with ten containers being collected each day. This means that some containers will be collected daily and some every second day.

- The containers will have a nominal capacity of 4.0 m3 (heaped capacity of 5.0 m3).

- If each container is on average 80% full (3.2 m3) there will be a daily collection of 32m³ / day.

With an average haul distance of 5km and a road speed of 15 km/hr the tractor will have approximate collection times as follows:-

- Pick up a container.	5 minutes
- Travel to the disposal site	20 minutes
- Discharge the container	5 minutes
- Return to the collection area	20 minutes

Total round trip time	50 minutes

(Assume one hour at 83% efficiency).

Thus, working an eight hour day each tractor should be able to collect 8 skips per day or 8 x 3.2 = 25.6 m³ per day. This is the estimated daily collection requirement and on this basis a single tractor working 8 hrs per shift and seven days per week could service all the containers in Nyendo / Ssenyange. However this assumes seven days per week operation and at present they only work five days. Even seven days / week collection with one truck would not provide any spare capacity for peak loads after a holiday period, for breakdowns or to allow time for servicing the tractor. It is therefore recommended that Nyendo / Ssenyange Division should be provided with two tractors and two skip trailers.

It is essential with any container system that the containers are collected at least every second day and it is not possible to do this with a five days per week collection. It is therefore proposed that Nyendo / Ssenyange should collect wastes six days per week. Additional capacity will be required with a heavier collection on Mondays and Tuesdays. This can be achieved by some overtime working but as a standby tractor and skip trailer must be provided in any case to allow for service and breakdown times it is proposed

that this second vehicle should be used to provide some additional capacity for two days per week with occasional overtime working to allow for breakdowns or occasional peak collection requirements.

(Note: If however all three divisions in Masaka Municipality are considered together it may be possible to share some spare capacity between them. Thus if the Masaka Municipality is considered as a whole a single back up tractor and two skip trailers shared between the three divisions should be adequate and the refurbished Massey Ferguson tractor can be used for additional back-up capacity).

Nyendo / Ssenyange will require a total of fifteen – 4.0 m^3 capacity skips for 14 locations. Some of which will be collected on a daily basis and some every two days. The locations and frequency of collection should be determined during the start up of this service.

a) Skip Locations.

A concrete pad will be constructed at each skip location. This pad will have enough space for the tractor and skip trailer to deposit an empty container each time it comes to collect the full one. The containers will be 2.0 m wide x around 3.5m long so that each pad should be around 5m x 4m. The pad will be made from 10cm thick steel reinforced concrete on a hardcore base but the sides of the pad will extend down 30 cms all around to prevent rats from burrowing underneath the slab. As part of the regular sweeping service each pad should be swept every day and any sweepings deposited in the skip.

It may take some experimentation for the optimum locations for the skips and the frequency of collection to be determined. Typically each skip should be a minimum of 80% full at the time of collection (3.2 m^3) and must be collected at lease every two days. Thus each location should have a minimum waste generation of 1.6 m3. The skips can be heaped up to a capacity of 5.0m^3 so that each skip location can handle up to 5.0m^3 / day with a daily collection and in a market area, for example, it could be collected twice per day. Thus each skip location can efficiently service between 1.6m^3 and 10.0 m^3 of wastes per day.

b). Market and commercial wastes.

The “Market Triangle” area combines a small market with commercial activities. An existing bunker at this area should be replaced with two containers to service both the market and the surrounding commercial area. One man should be placed in charge of these containers but can combine this with sweeping duties in this area.

b) Primary collection service

For some of the residential and commercial areas of Nyendo / Ssenyange a primary collection service using handcarts could be provided to bring the wastes from the shops and houses to the skips. This service could be provided by private operators collecting fees

directly from the houses and business which they are serving without any additional costs to the Division or Municipal authorities. The private operators may use wheel barrows with extended sides, handcarts or motorcycles with trailers (see below) depending upon the road conditions in the area to be serviced. The householders and business owners can then have the option of availing of the primary collection service or of bringing their own wastes to the nearest skip. A strong enforcement of anti-litter legislation with severe fines for littering would facilitate this service as well as adding to the municipal revenues.

In some narrow street areas where access is restricted there may be a considerable distance between some of the houses and the nearest skip. A motorized primary collection system would then be an advantage but this should be provided by a local community group or a private entrepreneur as it may not be possible to provide this within the limited capital and operational budgets.

A system for narrow street areas which is rapidly gaining acceptance in Vietnam uses a small motorcycle pulling a small (typically 700 – 1,000 litre capacity) trailer. It is not clear however whether in Vietnam (or in Uganda) this will comply with the road traffic regulations.

c) Disposal of wastes

As much as 50% of the organic waste is sorted out and collected by farmers for use as a soil conditioner and this should be encouraged although monitored to prevent scattering of the wastes during sorting.

Burning of wastes is taking place throughout Masaka and due to the intermittent, or non-existing, collection service for the skips these have become a focus point for flies, rats and smells. Thus the residents set fire to the wastes in the skips to discourage these nuisances.

The start up of the regular collection must include a community awareness programme informing people of the dangers of the gases given off where there are burning plastics and making people aware of the advantages of a clean environment. This in turn must coincide with a strong enforcement campaign which in turn may require a review of any environmental legislation and perhaps the introduction of bye-laws to make this enforcement effective. It is most important that the start of the improve service, the awareness campaign and the enforcement should take place at the same time.

The 2005 study states that at the time of the study there was no collection service in Nyendo / Ssenyange and that the wastes were disposed of by burning, burying on site and composting: It was estimated that 63% (7 tons) were burnt. Burning of solid wastes, containing large amounts of plastics releases dioxins, furans and other quite dangerous gases, (in one city in Egypt where there was a village down wind of a burning dumpsite, it was found that 87% (yes 87%) of the inhabitants suffered from some form of respiratory infection) and so burning must be prevented. Burying on site and composting are both acceptable ways of waste disposal.

As the farmers are already using some of the organic wastes there is an awareness of the value of this material which should be encouraged.

2.2.3 Waste disposal site

Any wastes which are collected by the municipal authorities from the three divisions are disposed of at a dump at Ssenyange which is maintained and managed by the Municipality. The August 2005 study refers to this dumpsite as an illegal site but during the present study it was stated by the Municipal engineer that this site has now been approved by NEMA. Thus the following report makes recommendations for the upgrading of this site rather than its relocation. However confirmation of the NEMA approval should be sought. The 2005 budget allows for the purchase of land for a disposal site which will not now be required.

The dumpsite is located on the top of a hill about 5 km from the center of Nyendo with about 3 km of bad road. However, most of this bad road is include for resurfacing in the 2006 budget which should greatly increase traffic speeds and reduce haul times for the tractors and trailers.

Although the dumpsite is in an exposed position there was remarkably little litter. However litter fences should be provided to catch blowing light gauge plastic film and the uncontrolled dumpsite should be upgraded to a managed landfill or land raise with good management and regular covering of the wastes.

It is recognized that it may not be practical, or even necessary, for the small towns in the LVWATSAN region to comply with the very high standards of sanitary landfills which are now compulsory in the more industrialized and wealthier countries and it must be realized that the relatively small quantities of wastes generated in these towns do not contain the same quantities of the more serious industrial pollutants such as the heavy metals which are the cause of so much concern. However particular attention must be made to ensure that any leachate and run off from the site does not enter the water supplies for the town. It is understood that the existing dump site in Ssenyange has been approved by NEMA for waste disposal (although no report has been seen).

There is a considerable area available at this site which should be enough for Masaka for the foreseeable future. There is no management system at this site and random dumping is taking place over a wide area.

It was not possible within the short time available to look into all aspects of ground water pollution and leachate control; however on the basis that this site has been approved by NEAM it is assumed that they took these aspects into consideration.

It is understood that there are plans for a World Bank (Contact …) sponsored composting operation at Masaka but it is not known when this will take place or how much waste it will take. In the meantime it is proposed that a managed landraise operation should be initiated at

the Ssenyange site. A management plan should be set up broadly in line with the following proposal.

a) A small area of the site (around 0.5 HA) should be fenced off using a 2.5 m high fence which will allow the wind to pass through but will trap any loose litter or light plastic film. This litter fence will typically be made from 4cm x 4cm weld mesh. The fence should be constructed in easily moveable sections so that it can be moved to a new location when the first cell is full.

b) A small site hut should be provided for the landfill manager.

c) The site should be operated on a cellular basis with only a small area of wastes exposed at any time and dumping should be closely controlled.

d) A few hours work with a tracked loader or wheel loader will enable the first cell to be excavated and any spoil material heaped alongside. Typically this cell will be around 15 metres wide and 50 metres long and will be excavated to a depth of around 1.0 metres, depending on the depth of soil at the site. There will therefore be around 7,500m3 of spoil heaped along one side of the cell. Filling will take place with weekly covering to a total height of 4.0 Metres allowing for a waste plus fill volume of 3,000 m^3 or a waste volume of 2,200 m^3. Assuming a waste density of 750 kg/m3 this will give a total weight of waste for this cell of around 1,700 tons. Typically this would take the total wastes from Masaka for around three months but in practice only perhaps 50% of the wastes generated will reach the site and the World Bank composting initiative will further reduce the amount of wastes for disposal so that each cell may last for six months or even more if composting is introduced.

e) A study must be carried out to determine if there is a problem with runoff from the site after heavy rains and if necessary interceptor drains must be constructed to prevent any runoff reaching any water supplies.

f) No burning will be permitted at this site and any scavengers will be closely controlled by the site manager.

g) Rats and insect problems will be closely monitored and controlled where necessary.

h) The reconditioned Fahr Deutz tractor with front loader will visit the site once per week to:

- Spread the wastes evenly over the fill area.

- Cover the wastes with the spoil material which has been excavated from the site.

- Compact the wastes and the fill by driving backwards and forwards over it.

- As soon as the first cell is nearing its maximum fill level a second cell should be prepared alongside.

i) Trees should be planted around the site to screen it from the view of the town and the road alongside.

Masaka does not have a bulldozer or wheel loader and so must hire these in as required. However they do have a tractor front end loader which has never been used, although the tractor for which it was provided is now out of commission. This tractor should be refurbished and although not suitable for preparing new disposal cells it can be used for the general operation of the disposal site.

The landfill manager should be provided with a small motorcycle and should also be responsible for managing the collection service in Nyendo / Ssenyange making sure that all skips are collected on schedule and that the areas around the skips are swept each time they are collected

2.2.4 Community awareness

An important part of any solid waste management system must be the raising of the communities awareness about the importance of a clean and smoke free environment to the health of the residents and their children. There is however little point in starting any community awareness campaign until a regular collection service can be provided or it will lose its impact The Community awareness programmes for all three towns should be coordinated so as to achieve the maximum impact with the minimum expenditure.

2.2.5 Preventative maintenance

Although each division is responsible for its own waste collection service any equipment servicing is carried out by the Municipal workshops. This is not a very satisfactory arrangement and should be reconsidered. It is suggested that the collection service for the three divisions should be the responsibility of a single Municipal service so that equipment utilization and servicing can be optimized without the duplication of facilities. Street sweeping could remain under the responsibility of each division. (See Section 1 for Preventive Maintenance procedures).

2.2.6 Street sweeping

Nyendo / Ssenyange presently employ seven street sweepers and are planning to increase this number. Two sweepers should be employed to sweep up around the 14 container locations before the tractor comes to collect the containers for emptying. The

containers will be deposited on concrete slabs which will each have enough space for two containers. Thus the tractor arriving with an empty container can deposit it alongside the full one. The sweepers duties will include ensuring that the space for the empty container is clean by the time the tractor arrives so that the tractor is not delayed.

2.2.7 Hospital wastes

The preliminary budget in the August 2005 report included for an incinerator for the hospital. However in the mean time a new incinerator has been constructed and will very shortly be operational. Thus there is no need to budget for this item.
The hospital incinerator will accept wastes from the clinics in Masaka.

2.2.8 Litter

Litter, and in particular light gauge plastic film is a serious problem throughout Kyotera and unless something is done about it it will get progressively worse. Light gauge plastic film gets blown around by the wind and lodges in every bush and tree as well as covering the ground. In time this will severely restrict plant growth. It is understood that government legislation is under consideration to put a limit on the minimum thickness of plastic film and also to tax plastic bags. Any anti-litter legislation must be the responsibility of Masaka Municipality who should be encouraged to introduce strict anti-litter by-laws with fines for infringement.

The emergency clean up of the heaps of wastes around the town should coincide with a litter campaign to get rid of the loose plastic film effecting the whole environment of Kyotera. A very successful litter campaign in one city (Nuweiba) in Egypt was initiated by local businessmen who set up a scheme during the school holiday period to provide children with clean plastic bags and then buy these bags back from the children when filled with plastic film. The children were able to earn appreciable amounts of money while being educated about the importance of a clean environment. (Perhaps this could be linked in with any orphan protection scheme operating in the area as recommended for Mutukula).

Litter bins should be provided throughout the commercial and market areas. These can be made from used 210 litre oil drums cut in half and fitted with a tilting stand to facilitate emptying..

2.2.9 Informal sector scavenging.

Salvageable materials will include plastics, steel, non-ferrous metals, glass, paper and cardboard. Any initiatives towards the collection and sale of salvageable materials should be encouraged. The main inhibiting factor is the cost of transporting the waste materials to the end purchaser. Almost all salvageable materials are bulky and so transport costs are high. Perhaps a local CBO or NGO or a local entrepreneur could be encouraged to provide an outlet for the salvaged materials by setting up a small baling facility where the materials can be sorted to increase their resale value and

compacted into bales to reduce their transport costs. Plastics, paper, cardboard etc can be baled with a low pressure baling machine but steel and aluminium drinks cans, etc require high density baling. The value of the glass can be increased by sorting into the different colours, A simple baling facility should therefore include:

Low pressure baling machine,
High pressure baling machine,
Weighing scales,
Sorting table
Bins, bags and pallets.
Handcarts and wheel barrows.

A typical budget of around U.S.$. 20,000.

As part of the immediate interventions a survey should be carried out on the quantities of the different slavageaqble materials in the wastes.

There is a steel rolling mill in Jinja where informal waste recycling groups sell their recycled steel scrap. This could be pursued and formalized through LVWATSAN.

2.2.10. Composting.

The World Bank is planning on financing a composing project by the disposal site, none of the Town officials had any further information on this but the consultant for the World Bank working on this project is Jack Ruitenbeek 0782 84344

2.3 BUDGET.

An immediate intervention for Nyendo / Ssenyange cannot be looked at in isolation from the rest of Masaka as it must include the refurbishing of equipment which belongs to the Municipality so as to carry out an "emergency clean-up" to remove the heaps of wastes throughout the division. The same equipment should then be used to clean up the other two divisions as part of an overall solid waste management up-grading for the whole town.

This report will therefore concentrate on providing the vehicles and equipment needed for the emergency clean up and on refurbishing the Mercedes Benz truck so as to restore the original container system for Nyendo / Ssenyange as a short term intermediate intervention. It will then propose the conversion of Nyendo / Ssenyange from a truck based to a tractor based collection system and when this has taken place the existing Mercedes Benz truck and containers can be transferred to the other two divisions of Masaka Town, pending the conversion of the Central and the Kimaanya / Kyabakuza divisions to tractors as their existing Tata trucks and the Mercedes Benz truck collapse from old age.

It would however make better economics to look at the whole town together but that is outside the terms of reference of this report.

The August 2005 study gives an estimate of US $ 78,500 for an immediate solid waste management budget and $105,000 for a long term budget. The system now proposed will be more cost effective with operating and depreciation costs related to what can be afforded by Nyendo / Ssenyange district. An efficient revenue collection system must be put in place so that this system will be sustainable in the long term including taking equipment depreciation or replacement into account so that vehicles and equipment can be replaced when they reach the end of their economic life.
Current financial arrangements – each division collects its own revenue and a percentage is given to the Municipal Council of Masaka.

The estimates for the capital investment required for the immediate solution to the problem, (ie: getting the division container collection service operational again) is only $ 41,000 and the long-term capital budget around $ 90,200. It must however be appreciated that these are very rough estimates subject to obtaining tenders for each item. It must also be appreciated that it is difficult to separate the "clean-up" budget from the operational budget for the restored container (skip) service.

Labour costs - The labour rates and the hours worked by the drivers, loaders and sweepers. In Masaka and Kyotera varied greatly. (Mutukula did not have any municipal employees).

The following labour cost assumptions have therefore been made for all three towns assuming a working week of 6 days x 8 hrs per day.

Driver.	U.sh.	210,000 / month	=	U.sh 2,520,000 / annum
Loader.	U.sh.	180,000 / month	=	U.sh. 2,160,000 / annum
Sweeper.	U.sh.	150,000 / month	=	U.sh. 1,800,000 / annum
Supervisor	U.sh.	250,000 / month	=	U.sh. 3,000,000 / annum.

These figures can be adjusted for the three town in line with the hours worked and the labour rates paid.

2.3.1 Capital Expenditure – Immediate interventions

Refurbish existing Massey Ferguson tractor.	$ 5,000
Refurbish existing Fahr Deutz Tractor and fit loader.	$ 6,000
Refurbish existing tractor trailer.	$ 1,500
Refurbish engine of Jifeng truck	$ 3,000
Refurbish Mercedes Benz truck	$ 6,000
Refurbish 10 containers for M.B.truck	$ 2,000
Provide small tools and uniforms for clean-up crews.	$ 1,500
Repairs to Tata trucks	$ 4,000
Total capital requirement	$ 29,000

Labour and fuel for Clean-up.	$ 2,000
Landfill site development.	$ 3,000
Litter campaign	$ 3,000
	$ 37,000
Contingencies 10%	$ 4,000
TOTAL CAPITAL (Nyendo/Ssenyange)	$ 41,000

Note: Although the terms of reference for this study were specific to the Nyendo / Ssenyange Division of Masaka Town 60% of the above expenditure will benefit all three divisions of the town.

2.3.2 Capital Expenditure – long terms internvtions

2 - Tractors @ $ 16,000	$ 32,000
2 - Container pick up (skip) trailers @ $ 9,000	$ 18,000
15 containers @ $ 1,000	$ 15,000
Sweepers equipment (handcarts, tools, etc)	$ 2,500
Spare parts, workshop tools, etc	$ 5,000
Motorcycle for landfill manager / collection supervisor	$ 2,500
Litter bins.	$ 2,000
Transport to Masaka	$ 2,000
	$ 79,000
Contingencies 10%	$ 7.900
TOTAL CAPITAL INVESTMENT	$ 86,900

NOTE: Long term recommendations to include Central and Kimaanya divisions.

It is recommended that for the long term collection system all three divisions should be changed to tractor trailed skip systems using 40 / 50 hp tractors pulling skip trailers with 4.0 m^3 capacity skips. (5 m^3 heaped capacity). For this expansion of the service through the town an additional three additional tractors and three skip trailers plus 25 containers would be required at an addition cost of around $ 100,000

2.3.3. Operating costs for Nyendo/Ssenyange

(Collection costs only. Does not include street sweeping, landfill costs, workshop management, etc)

Labour.

2. Tractor drivers @ 210,000/month	U.sh 5,040,000 / annum	
2. Tractor loaders @ 180,000 / month	U.sh 4,320,000 / annum	
Supervisor @ 250,000/ month	U.sh 3,000,000 / annum	
Total labour (collection only)	U.sh 12,360,000 / annum	12,360,000

(Note: This does not include for street sweeping).

Fuel.

1 Tractor 6 days/week @ 10 litres/day = 3120 litres/annum		
1 Tractor 2 days/week @ 10 litres/day = 1,040 " "		
4,160 l. @ 1,800		7,488,000

Maintenance

2.Tractors. 32,000 @ 7%/annum	$ 2,240 @1,800 = 4,030,000	
2.skip trailer 18,000 @ 5% annum	$ 900 @ 1,800 = 1,630,000	
Containers. 18,000 @ 5% "	$ 900 @ 1,800 = 1,630,000	
	U.sh 7,290,000	7,290,000

TOTAL ANNUAL OPERATING COST S	U.sh 27,138,000
	(US $ 15,077)

Operating cost per month (Collection only) U.sh 2,262,000

Depreciation costs .

2. Tractors. 32,000 ÷ 10	$ 3,200 =	U.sh 5,760,000
2. Skip trailers. 18,000 ÷ 10	$ 1,800 =	U.sh 3,240,000
15 Containers 18,000 ÷ 4	$ 4,500 =	U.sh 8,100,000
Motor cycle 2,500 ÷ 7	$ 360 =	U.sh 648,000
Handcarts, etc. 2,500 ÷ 4	$ 625 =	U.sh 1,125,000
Litter bins, etc. 2,000 ÷ 4	$ 500 =	U.sh 900,000
Total annual depreciation and small equipment costs		U.sh 19,125,000
Total annual costs (collection only)		46,063,000
Sweeping. 10 sweepers @ U.sh 90,000 x 12		10,080,000
Landfill costs (est) $ 2,000/annum		3,600,000

TOTAL ANNUAL COSTS **U.sh 61,543,000**
($ 34,190 / annum)

NOTE: For a population of 32,000 people this works out at U.sh 1,810 per capita / annum (US $ 1.00/capita or around US $ 5 to $ 6 per household / annum).

It is essential that the local authority has access to these funds if the system is to be operated properly and is to be sustainable in the long term. This may require the introduction of Refuse Collection Charges (RCC) to the households and businesses which can be collected as a direct household charge or as an additional charge on an existing service such as electricity or water.

SECTION 3 – SWM IN KYOTERA

3.1 BACKGROUND

Kyotera in Rakai District in Uganda has a resident population of around 10,000 within an urban area of 4.5 km² and an annual growth rate of 6.8%. The town has a long, narrow configuration and extends for only relatively short distances either side of the main road with a rural population on the outskirts. It is the commercial center for the district and a daytime population of 25,000 was quoted by the Municipality, however this may be on the high side.

The central business area consists of a large number of small shops and a central market area. There are wide verges with storm drains either side of the main road and narrow foot bridges over the drains.

3.2 DESCRIPTION OF CURRENT SOLID WASTE MANAGEMENT SYSTEM

3.2.1 Waste Bunker system

There are heaps of uncollected wastes throughout both the town center and the outlying areas and 12 concrete waste bunkers have been constructed to which the people bring their wastes. However these bunkers have not been a great success and wastes are scattered for considerable distances around these bunkers. The bunkers are constructed to a design provided by the Ministry of Public Works and are around 3.0m long x 2.0 wide holding up to 9.0 m³ of wastes. Thus the total existing bunker capacity is in excess of 100 m³ of wastes. This is out of all proportion to the amount of wastes generated and so these bunkers have become long term refuse holding areas and have become a serious problem themselves instead of a solution to the problem, attracting rodents, flies and smells. Many of the bunkers have been set on fire by householders trying to prevent the flies and smells and due to the very high plastics content in the wastes this has created a serious health hazard for people living down wind of the bunkers.

As well as creating health and environmental problems the bunkers are very slow to load from as only one person can work within the bunker at a time and this, combined with the very high loading height (2.2m) of the only truck and its small capacity (4.5 m³) results in a very poor truck utilization.

A further problem with bunker systems is that it is almost impossible to clean down the bunkers completely due to wastes becoming trapped in the corners. These wastes decompose and the bacteria remaining behind in the corners after emptying act as an innoculant to fresher wastes then being introduced thus speeding up the decomposition of the wastes and consequent smells.

The bunkers have in fact become a serious environmental problem rather than a solution to the problem.

A recommendation in the September 2005 report to increase the number of bunkers and to also introduce skips should be reconsidered in light of this poor experience with the existing bunkers.

3.2.2 Waste quantities and characteristics

No records are available as to the amount of wastes generated within the town so a very crude estimate has been made as follows:

- Typical waste generation rates in other towns in Kenya and Tanzania with similar standards of living are in the order of 0.3 to 0.4 kg/capita/day. Taking the median figure of 0,35 and a residential population of 10,000 this gives a waste generation of around 3,500 kg/day from residential, commercial and market sources.

- Allowing for a day time population (based on the Municipality estimate of 25,000) and the commercial activities arising from these people a further generation from commercial activities, and road sweepings of around 2,500 kg can be assumed.

The above figures combine to give a total waste generation of around 6,000 kg / day; however not all the wastes will reach the collection vehicles and assuming an 80% collection an average daily collection of 4,800 kg can be expected. If this is collected on six days per week a daily collection capacity of 5,600 kg will be required with peak loads of up to 7,000 kg after holiday periods and weekends. Some overtime can be worked to cater for peak loads and additional capacity must be included to allow for population growth in the future.

If a waste density of 350 kg/m3 is assumed a total collection volume of 20 m^3 must be allowed for increasing in line with the population growth over the years ahead. This is equivalent to four heaped loads for the proposed low loading height trailer.

(It must be understood that these are very rough estimates and careful records of any future waste collection must be kept so as to enable these estimates to be updated as more accurate information becomes available).

The wastes contain a very high organic content including banana leaves and stems, corn cobs, etc. They contain very little recyclable materials and little plastics other than thin plastic film and very little paper and cardboard. The wastes in general appear to be very suitable for composting but not suitable for incineration or burning.

3.2.3 Existing collection vehicles

The Kyotera Municipality has only a single tipping truck for their waste collection service with a body capacity of 4.5 m^3. This truck is around 25 years old with a body designed for carrying heavy construction materials. It's very high loading height at 2.2 metres makes it slow, laborious and unhygienic to load with wastes falling back onto the loaders heads. (It is normally recommended that loaders should not be expected to load vehicles above their shoulder heights of typically 1.5m. The above vehicle deficiencies, combined with the difficulty of loading from the bunkers where only one man can effectively work within the bunker at any time, results in slow loading times and very poor vehicle efficiency).

The permitted gross vehicle weight of this truck is 14,000 kg allowing for a "pay load" of up to 7,000 kg without overloading the truck. However due to its small (4.5m^3) body capacity this truck is carrying only about 4.5 x 350 = 1,600 kg per load and has the same fuel consumption as if it was carrying 7 tons. This 25 year old truck should be replaced as soon as possible with a more efficient vehicle.

It was estimated by the driver that it takes 1½ hrs to load the truck and the return travel and discharge time to the disposal site is around ½ hr. Thus this truck can collect a maximum of four loads in an eight hour working day but more typically only three loads.

3.2.4 Labour rates for collection

The truck driver is paid USh 175,000 per month (USh 2,100,000 / annum) and the three loaders are paid USh 150,000 per month (USh 1,800,000 / annum for a five day week. These rates musts be increased to allow for working six days per week.

It is essential for a hygienic and odour free waste management system in a country such as Uganda with a hot, and frequently humid, climate that all bins, containers, skips or bunkers are emptied at least every two days. This is not possible with a collection only five days per week. For this reason it is essential that a six days per week service is provided, (although the hours worked per day may be reduced). For this reason the drivers rates should be calculated at U.Sh 210,000 / month (U.Sh 2,520,000 / annum) and the loaders at U.Sh 180,000 / month (U.Sh 2,160,000 / annum.

A seven days per week service could be introduced with job sharing where the actual days worked per person remains at only 5 days per week but extra staff will be require on a rota basis to allow for the extra working days. With this system the number or size of the containers or skips can be reduced to allow for the daily collection.

The truck consumes around 17 litres of diesel per day at a cost of U.Sh 1,800 / litre (U.Sh 30,000 / day or U.Sh 8,000,000 / annum). Thus fuel is a major cost factor. Routine service costs are around U.Sh 300,000 per month (U.Sh 3,600,000 / annum).

3.2.5 Disposal site

The disposal site along the road to Rakai is on waste ground only 2.5 km from the centre of the town with travel times of around 8 minutes in each direction for a truck and perhaps 10 minutes for a tractor pulling a trailer. Thus the site is very convenient. The wastes are however dumped randomly wherever the truck driver chooses and there is no supervision or covering of the wastes. The site is exposed to the wind so that light plastic litter blowing off the site is a problem. The site is rented at a cost of U.Sh 60,000 every three months from the owner (USh 240,000 / annum). The site has not been approved by NEMA for dumping but at first glance it would appear to be a suitable location for upgrading to a managed landfill.

There is an old murram pit on part of the site and it is recommended that, subject to approval by NEMA for the location of a landfill at this site, this murram pit should be developed as the first cell of a cellular managed landfill. It is estimated that three days work with a bulldozer or wheel loader could develop this into a very suitable cell with a capacity of perhaps one year's wastes from Kyotera, (or considerably longer allowing for farmers removing some wastes from the waste stream or should composting take place in the future). A litter fence should be erected down wind from this site to trap loose plastic litter and a shelter provided for a site manager who should supervise the dumping of the wastes in an orderly manner. A total investment of around US $ 3,000 should be allowed for assuming that NEMA do not introduce any special conditions regarding interceptor drainage and leachate control.

A wheel loader should be hired in at least once a month to level, compact and cover the wastes using the material excavated from the original cell as cover material. This compaction and covering will help to reduce smells and insect and rodent problems.

A significant proportion of the wastes is collected by farmers from the waste bunkers for use as fertilizer. However this waste contains a high percentage of plastic film which will not breakdown in the soil and will lead to soil degradation.
This practice would indicate that there would be a good demand for composted organic material and a hand sorting process to remove plastics and other inert materials followed by a composting operation should be promoted if a suitable NGO or CBO can be identified to carry out this operation..

3.2.6 Street sweeping

Kyotera employs 25 street sweepers at a rate of only U.Sh 30,000 per month for a five day week working from 07.00 to 11.00. The sweepers are provided with handcarts, shovels, rakes and brushes. The brushes however are conventional domestic house brushes and are not suitable for street sweeping. It is proposed that these should be replaced with proper road sweeping brushes or locally made brooms. There are plans to increase the number of sweepers but perhaps it would be better to increase the working hours with correspondingly increased labour rates.

3.2.7 Litter

Litter, and in particular light gauge plastic film is a serious problem throughout Kyotera and unless something is done about it it will get progressively worse. Light gauge plastic film gets blown around by the wind and lodges in every bush and tree as well as covering the ground. In time this will severely restrict plant growth. It is understood that government legislation is under consideration to put a limit on the minimum thickness of plastic film and also to tax plastic bags. In addition Kyotera Municipal Council are planning to introduce an anti litter by-law with a fine of U.Sh 2,000 for littering.

The emergency clean up of the heaps of wastes around the town should coincide with a litter campaign to get rid of the loose plastic film effecting the whole environment of Kyotera. A very successful litter campaign in one city (Nuweiba) in Egypt was initiated by local businessmen who set up a scheme during the school holiday period to provide children with clean plastic bags and then buy these bags back from the children when filled with plastic film. The children were able to earn appreciable amounts of money while being educated about the importance of a clean environment. (Perhaps this could be linked in with any orphan protection scheme operating in the area as recommended for Mutukula).

3.2.8. Litter bins.

Litter bins should be introduced throughout the city center / commercial area. These can be manufactured out of used 210 litre oil drums cut in half and fitted to tipping stands.

3.2.9. Recycling

There was almost no scavenging for recyclable materials taking place and apart from the light gauge plastic film only small amounts of recyclable materials in the wastes. This would indicate some level of pre-collection scavenging taking place although no information was available on this. The light gauge plastic film is a very serious pollutant in Kyotera and any initiatives (including the composting described above with manual separation of the wastes) would be of great benefit to the environment.

3.2.10. Industries

The only significant industry in Kyotera is a small coffee husking plant processing coffee by dry husking. The waste coffee husk is sold to local farmers as a fertilizer and no other significant wastes are produced.

There are a number of maize milling units but these produce no significant wastes.

3.3. PROPOSED INTERVENTIONS

The September 2005 proposal includes US $ 25,000 for Immediate Interventions and US $ 90,000 for Long Term Interventions. It also includes $ 922,000 for Consultancy Services and Support for Water supply, Sanitation, Drainage and Solid waste management. See Section 4, UN-Habitat strategy proposal for revised budget.

3.3.1. Sustainability.

The immediate Interventions will be mainly concerned with solving the urgent immediate problems with a minimum of capital investment but Long Term interventions will include the setting up of systems which will dictate the collection and disposal systems which will remain in operation for many years. It is important that any Long Term Solid Waste Management interventions are sustainable in the long term and that the Municipality can provide both the operating revenues (labour, fuel and maintenance costs) and the future capital revenue to expand any collection service in line with population growth and replace any vehicles, containers and other equipment as it becomes obsolete in the future. For this reason the annual SWM budget must allow for depreciation costs for the vehicles and equipment. In particular the replacement costs for the tractors and trailers and containers must be taken into account, otherwise non-sustainable systems may be set up which collapse when the equipment becomes obsolete.

For this reason it is important that, even although the initial equipment may be provided free by UN-Habitat under its aid project, the capital costs and the life of the equipment is taken into account when calculating the long term sustainable costs.

This means that the capital costs of the vehicles in particular must be kept as low as possible, the vehicle utilization must be maximised so as to minimize the numbers of vehicles required and long life vehicles and other equipment used wherever possible, otherwise any system which is set up will be unsustainable in the long term and will collapse when the equipment reaches the end of its life.

3.3.2. Emergency clean up

Prior to the starting up of any new collection system an emergency clean up must take place to remove the heaps of wastes from all over the town. The collection equipment described below can be used for this purpose but should be supplemented by the hire of tipping trucks and a tractor or wheel loader for loading the trucks. The emergency clean up should take no more than two weeks and should be accompanied by an environmental awareness campaign (see below).

3.3.3. Public awareness and enforcement

A public awareness campaign, together with strict enforcement of anti-litter legislation must be an important part of this project with support from the schools, churches, politicians and media. The start of the campaign should coincide with the start of the emergency clean up so that the people can see some action to correspond with the campaign.

3.3.4. Alternative collection system

It is fundamental that for such a short haul distance a tractor will be much more efficient than a truck. A 45 hp tractor pulling a 3 ton load will have a fuel consumption of only about one third that of a truck with its 150 hp engine pulling the same load and will only take perhaps 5 minutes extra for each round trip. The lower loading height of the tractor trailer will reduce the loading times and save much more than this additional travel time.

Two alternative systems have been considered for Kyotera (see annex 1 for more details).

SYSTEM 1.

A tractor pulling a special container pick up trailer which will pick up, transport and discharge containers (typically around 4.0 m^3 capacity).

Pick up and discharge times are less than 5 minutes each so the tractor and trailer should do the round trip to the disposal; site and back in about 30 minutes or assuming 80% efficiency an average of around 40 minutes. If it is assumed that each container is 80% full (3.2m^3 per load) a total of 8 container loads per day will be required and a single tractor should be able to do this in around 6 hours.
However, although a single tractor could service all these containers, a second tractor and container trailer will be required to allow for breakdown or service times and in practice it is likely that both tractors will be used for normal work. A single tractor will undertake the work only when there is a breakdown.

Two drivers will therefore be required but working only around 4 hours per day each. A total of 13 containers will be required if each container is collected on average every 1½ days (some containers emptied daily and some every two days) including one extra container on the trailer at any time. (17 containers will be required if they are all emptied every two days). Containers should not be left for longer than two days between collection, otherwise they will start to corrode due to the decomposition of the wastes and will smell.

SYSTEM 2.

A tractor pulling a special 5.0 m^3 (heaped load) "low loading height" trailer with a driver and two loaders will collect the wastes from small bins located throughout the town.

Typically bins with a capacity of around 100 litres made from 210 litre oil drums cut in half can be tipped directly into the trailer by the two loaders. Each container will be emptied every day, six days per week and if each bin is on average 60% full a total of 350 bins will be required. A total of 5 trailer loads per day will be collected. This is too much for a single tractor so two tractors will be required, however, as in system 1 above a single tractor can operate the system working some overtime in an emergency situation where the other tractor is out of commission to allow for a breakdown or servicing times. Three trailers will be required one of which will be parked at the market area and replaced by an empty one when it is full.

From a comparison of capital costs it can be seen that the capital cost of the two systems will be almost the same but the labour costs of System 1.will be considerably lower. However System 2 will give a better level of service with 350 bins located close to the houses and business premises instead of only 12 container (skip) locations with longer distances for the people to bring their wastes.

It is proposed that a variation of System 2 above should be considered as follows:

- Shops and business premises should each be provided with a plastic bin with a capacity of around 60 litres. (They could be obliged to purchase these bins themselves or to replace them themselves when they are damaged or worn out). The collection tractor and trailer will pass each business or shop once per day and empty any bins which are left outside the door of the shop.

  It would be possible to ration each shop or business to a single free bin collection each day and to charge collection charges for any additional bins. Only standard bins would be collected and only bins which are left at the kerb side would be emptied thus minimizing the work for the loaders.

- One of the three trailers will be allocated to the market area where it can be parked in a suitable location where the market stall holders will bring their own wastes. The trailer will then be towed away for emptying when full and replaced with an empty one.

  It may be necessary to have a full time attendant with this trailer to prevent people throwing their wastes on the ground and prevent pilferage of the trailer wheels. However this attendant can also be provided with a wheelbarrow and hand tools so that he can undertake cleaning duties around the market place.

It is proposed that the existing concrete bunker at the market area should be demolished and the floor slab used as a trailer location.

- Residential areas will be provide with 100 litre steel bins which will each service a number of houses. Typically each household will produce around 5 litres of waste per day and one bin could service 10 houses allowing some extra capacity for the week ends. Thus around 200 bins will be required. Low cost bins can be made from 210 litre oil drums cut in half and fitted with lifting handles.

This variation on System 2 will provide a higher level of service to the householders, who will have shorter distances to bring their wastes and to the shops and business premises who will have a daily door to door collection and at the market where wastes will be removed each day..

3.3.4 Hospital and clinic wastes

The Kamwanyi Health Center (Grade 3) dispose of their sharps and medical wastes by burying on site in a satisfactory manner. There are 12 private clinics and a study should be carried out to determine how these other clinics dispose of their wastes. There is no large hospital in Kyotera and no need for an incinerator.

3.3.5 Abattoir

The existing abattoir slaughters around 10 animals per day or up to 30 during peak periods. It is very primitive consisting of only a basic roof over an open area. It operates to Halal slaughtering methods.

- Blood is disposed of in a soak pit which in turn drains to a swamp.
- Wash water drains into the swamp
- Stomach contents are stored for up to a month before collection by farmers for use as fertilizer.

A new abattoir with proper waste treatment facilities should form part of any long term plan for Kyotera.

3.3.6. Informal sector

There is a role for the informal sector in providing a primary collection system to collect wastes from the houses and businesses and bring them to the waste containers for direct payment by the householders / businesses. However the householders and business owners should have the option of availing of this service or of bringing their own wastes depending on their “willingness to pay” for the primary collection.

Depending on the road surfaces in the areas being serviced, the distance from the container and the resources available to the particular individual a variety of different transport systems can be used including:

Hand carrying,
Wheelbarrows with extended sides
Handcarts
Bicycles
Motorcycle trailers.

It is understood that the boda boda (informal public transport) based on bicycles or motorcycles) already provide this service for delivering water and have a water vendors association. Perhaps this could form the basis for a private sector primary collection.

Motor cycle trailers are being used very successfully for solid waste collection in Vietnam but there is some doubt as to whether these motorcycles comply with the road traffic regulations.

3.4 BUDGET

3.4.1 Immediate Interventions Costs

The following proposed budget is put forward for immediate interventions. (Note: it is impossible to provide more than very rough estimates at this stage so a 20% contingency is included)

- An "emergency clean-up" of the town using hired equipment to remove the heaps of wastes which have accumulated throughout the town . US $ 3,000
- A litter campaign to remove the plastic bags and other light plastics which have accumulated US $ 3,000
- Improved management at the existing dumpsite pending NEMA approval when a longer term landfill regime can be introduced. To include the construction of a disposal cell and fencing US $ 3,000
- The provision of handcarts, tools, protective clothing, etc to the sweepers US $ 2,000
- Training of operatives (technical and financial) US $ 1,000
- Provisional community awareness campaign US $ 1,000

Total estimates	US $ 13,000
Contingencies 20%	US $ 2,600
Total immediate intervention s	US $ 15,600

It is assumed that technical support and training is included under the "Consultancy Services and Support allocation.

3.4.2 Capital Cost of Long term interventions

Long term interventions include the provision of the capital equipment to set up a long term, fully sustainable collection and disposal system.

2. Tractors @ $ 16,000	$ 32,000
3. Low loading height trailers @ $ 7,000	$ 21,000
200 – 100 l. steel bins @ $30	$ 6,000
100 – 60 l plastic bins for shops, etc.	$ 2,000
Handrarts, brushes, etc	$ 3,000
	$ 64,000
Transport to Kyotera	$ 3,000
	$ 64,000
Contingencies 10%	$ 6,500
	$ 70,500
Disposal site (provisional)	$ 25,000
TOTAL	$ 95,500

a) The breakdown of the estimated capital and labour costs for the above two systems are as follows:

SYSTEM 1. TRACTOR WITH CONTAINER PICK UP TRAILER.

2 Tractors @ $16,000	32,000
2 Container trailers @ $ 9,000	18,000
13 containers @ $ 1,000	13,000
Capital cost	$ 66,000

Labour requirement.

2 drivers @ 210,000 / month U.Sh 5,040,000 / annum

SYSTEM 2. TRACTOR WITH LOW LOADING HEIGHT TRAILER.

2 Tractors @ $ 16,000	32,000
3 Low loading height trailers @ $ 7,000	21,000
350 bins @ $ 30	10,500

Capital cost	US $ 63,250

Labour requirement:

2 drivers @ 210,000 / month	U.Sh 5,040,000 / annum
4 loaders @ 180,000 / month	U.Sh 8,640,000 / annum

	U.Sh 13,680,000 / annum

(Plastic bins for the shops have not been included as it is assumed that they will each purchase their own.

b) Annual labour costs

2 drivers @ 210,000 / month	U.sh 5,040,000
2 loaders @ 180,000 / month	U.sh 4,320,000
1 labourer at market	U.sh 2,160,000

Total labour for collection only	U.sh 11, 520,000

Although in theory each 100 litre bin should service 10 houses with spare capacity for the weekends the optimum locations for the bins will only be determined after an initial operating period. The bins must be located where they can be reached by the tractor and trailer so that in narrow street areas the bins must be located beside the nearest access road. In some situations two or more bins may be placed together.

There is a certain amount of flexibility with such a bin system as during peak periods and weekends the 100 litre containers can be heaped up to perhaps 120 litres and also when containers are full there is a tendency for the householder to push the wastes down in the containers thus increasing the waste density. Experience over a few weeks trial period will enable the optimum bin locations to be determined.

3.4.3 Operating costs for Kyotera

(Collection costs only. Does not include street sweeping, landfill costs, workshop management, etc)

Labour

2. Tractor drivers @ 210,000/month U.sh 5,040,000 / annum
2. Tractor loaders @ 180,000 / month U.sh 4,320,000 / annum
Supervisor @ 250,000/ month U.sh 3,000,000 / annum

Total labour (collection only) U.sh 12,360,000 / annum

(Note: This does not include for street sweeping).

Fuel

1 Tractor collecting wastes @ 10 litres/day x 6days/week
= 3,120litres/annum @ U.sh 1,800/l = 5,616,000
1 Tractor x 3 loads/day @ 5.litres/day x 6 days /week
= 1,560 litres/annum @ U.sh 1,800/l= 2,808,000

TOTAL FUEL COST / ANNUM U.sh 8,424,000

Maintenance

2.Tractors US $ 32,000 @ 7%/annum $ 2,240 @1,800 = 4,032,000
3.skip trailer 21,000 @ 4% annum $ 8,40 @ 1,800 = 1,512,000

TOTAL ANNUAL MAINTENANCE U.sh 5,544,000

TOTAL OPERATING COSTS / ANNUM 26,328,000

(Operating cost per month U.sh 2,194,000.)

Depreciation

The annual depreciation on the above vehicles and containers will be as follows:

Tractors. 32,000 @ 10 years	$ 3,200	
Trailers 21,000 @ 10 years	$ 2,100	
100 l. bins 6,000 @ 4 years	$ 1,500	
Handcarts, etc 3,000@ 4years	$ 750 .	
60 l. plastic bins (to be replaced by shops, etc)	---	
Total annual depreciation	US $ 7,550	$ 7,550 (U.sh 13,590,000)

It is not possible at this stage to estimate what development works NEMA may require at the landfill site. A provisional budget of US $ 25,000 is proposed for a minimal landfill development budget and annual costs of $ 3,000

TOTAL ANNUAL COSTS.

Labour	12,360,000
Fuel	8,424,000
Maintenance	5,544,000
Depreciation	13,590,000
Landfill management $ 2,000)	3,600,000

TOTAL ANNUAL COSTS	45,180,000
	(US $ 25,100)

Provision for landfill development $ 25,000

3.4.4. COST RECOVERY

The population of Kyotera is around 10,000. Thus the annual cost of a solid waste collection and street sweeping service is around US $ 2.2 per capita/annum or around $11 to $13 per household/annum.

It is essential that the local authority has access to these funds if the system is to be operated properly and is to be sustainable in the long term. This may require the introduction of Refuse Collection Charges (RCC) to the households and businesses which can be collected as a direct household charge or as an additional charge on an existing service such as electricity or water.

SECTION 4: SWM FOR MUTUKULA, UGANDA

4.1 BACKGROUND INFORMATION

It was only possible to spend one day in Mutukula so that, rather than go into detail on each separate street or activity, a general overview was taken with the purpose of identifying the most cost effective overall system rather than more precise details on, for example, individual streets or vehicle routings. These detailed aspects will be covered during the implementation phases.

Mutukula is a small town in Uganda on the border with Tanzania backed by a similar sized town on the Tanzanian side of the border. This study is concerned with only the Ugandan part of the town but it is proposed that the Tanzanian authorities should be advised of any proposals and consideration should be given to a combined disposal site or a combined collection service.

The August 2005 study gives the population as 7,000 residents with a further 3,000 day time population (10,000 in total). From walking around the town it is difficult to believe these figures, unless they are the combined population of the Tanzanian and Ugandan parts of the town or include a considerable rural population.

The town is presently a Local District Council One (LDCI) and the District Council is directly involved in any decisions so that the LCDI has no autonomy. It is therefore difficult for the local officials to implement any decisions and it is not clear as to who will operate any collection and disposal system. It is also not clear how regular and adequate finances for the operation of any system can be ensured. It is however understood that proposals are under consideration to up-grade Mutukula to "town" status and this will make implementation much easier. A meeting should now be sought with the relevant regional or district authorities to discuss any future town structures and how any SWM system can be organized under the present structure and under any planned future structure.

It was extremely difficult to estimate the waste generation in either part of the town but for the Ugandan side it is unlikely to exceed 2,000 kg/day and may be as low as 1,000 kg. There are three murram pits to which the people are supposed to bring their wastes but very little waste reaches these pits and on the Ugandan side of the border most of the wastes are simply thrown on the streets, where they desiccate in the sun or are burnt on site. There is plastic litter scattered all over the town..

A small market operates on Saturdays. The market stalls are tendered out by the Local Council to a group of entrepreneurs who in turn sub-let the stalls and organize a cleaner. The District Council can revoke this arrangement at any time.

The collection of trading licences is also tendered out although this is not very effective and only a proportion of the licence revenues are collected. Any revenues go to the District Treasurer who allocates any revenues from this and the market tender according to the needs.

A primary school has around 400 – 500 pupils

.

There is no slaughter house but killing takes place on waste land belonging to the prison. This should be studied further to ensure that there are no environmental problems.

A new concrete bunker has been constructed alongside one of the dumpsites which is quite close to the market. However this is not used and there seems little logical reason for constructing it alongside the dumping area. In any case this report will not recommend the use of fixed waste bunkers.

On the Tanzanian side of the town however the picture is very different. The householders appear to be very disciplined and each house has its own pit where the wastes are buried alongside the house. There was surprisingly little litter and a much greater feeling of community awareness. Any Community Awareness or Community Participation initiatives for Mutukula (Ugandan side) should study both sides of the town and see if anything can be learnt from the way in which the Tanzanian side is organized.

4.1.1 Existing Waste Collection

There is no collection system on the Ugandan side of the town and no collection vehicles or other equipment. A single employee is in charge of the SWM and ma ny other aspects and is paid U.Sh 22,000 / month plus some bonus's for this and other duties on a part time basis. Until the end of 2004 there were two street cleaners but this service ceased due to the lack of the payments of the trade licences necessary to pay for it.

A woman's saving and credit group, NGINA, have set up a voluntary group UWESCO (Ugandan Womans Effort to Save Orphans) which organizes collections on Mondays and Wednesdays. The 20 volunteers work 3 ½ hrs on each of these days, some working during the day and others in the evenings. The volunteers are expected to collect fees from the householders but have great difficulty in getting these payments from householders who expect to get the service free.

The volunteers bring the wastes to the dumping areas but as they have no handcarts or other equipment they carry everything in plastic bags by hand to the dump sites. They need the following minimum equipment if this service is to continue.

- Handcarts (Typically wheel barrows with extended sides)

- Gloves
- Forks or hoes
- Rakes.
- Boots
- Some identifying uniform or perhaps tee shirts.

Comments from the Secretary of Woman's Affairs included:

> "The volunteers are often mocked by the householders who ask "why are you doing this dirty work". They get no gratitude".
>
> "As soon they have collected from a house the householders start dumping in the street again".
>
> Another comment was that
>
> "there are not enough dumping areas".

4.1.2 Waste Disposal.

At present the wastes are dumped at three small murram pits with no control or dump site management. However, the local prison owns a considerable amount of land which it is not using and it is proposed to transfer some of this land to the Ministry of Local Government who in turn will allocate an area for a disposal site. Discussions should be held to find out how soon this can take place and approval sought from NEMA for whatever site is chosen.

At present there is no collection of household taxes and only partial collection of trading licenses. Any revenues go the District Council who re-issues it as they feel it is required. The Local Council does not have an adequate or regular source of income. As a result there is no formal collection service. It is therefore difficult to recommend any system which will be financially sustainable without attending to the towns overall revenue collecting system. Any system proposed must have a minimal income for labour, fuel, and maintenance of equipment as well as the capacity to meet future capital requirements if it is to be sustainable within the present financial structure.

The August 2005 study suggests the construction of waste bunkers for each of the three towns including Mutukula to which the householders and commercial activities will bring their wastes. It also proposes the use of a tipping truck and waste skips (containers). It is difficult to understand why they propose both bunkers and waste skips and in any case any such system for Mutukula will be excessively costly to operate. The bunker system is therefore not considered appropriate for Mutukula.

4.2 PROPOSED WASTE COLLECTION SYSTEMS FOR MUTUKULA.

The September 2005 report proposes an immediate capital intervention of $ 25,000 and a long-term intervention of $ 77,500 for Solid Waste Management plus a total of $ 90,000 immediate and a total of $802,000 for long-term interventions for Consultancy Services and Support for the water, sanitation, drainage and solid waste inputs. The proposed Immediate Intervention included for the construction of concrete waste bunkers and the long-term interventions included for the purchase of a truck, skips, an incinerator and procurement of land for a disposal site. A problem with these proposals is that:

The depreciation costs for the truck and skips at around $10,000 / annum will greatly exceed any revenues available for waste management in Mutukula and operating costs (lab our, fuel and maintenance) will be high. This compares with around $ 1,500 depreciation costs for the tractor / trailer system now proposed and much lower fuel, maintenance and labour costs

It has been recommended above that concrete bunkers should not be used in Mutukula. (See Section 1 for problems with bunker systems).

It is difficult to understand the need for an incinerator as there is no hospital in Mutukula and there will only be small amounts of clinic wastes which can be disposed of by burying. Experience in other towns has shown that when resources are scarce there can be difficulties in obtaining the fuel to operate an incinerator, even within a hospital budget, and unless there are infectious or biological wastes to be disposed of, controlled burying in an allocated disposal area will be adequate.

It would appear that it is likely that land will be transferred from the Prison Authority to the Ministry of Local Government and this, or part of this land will be used for a disposal site. (The UN policy regarding the purchase of land or the transfer of an asset from one national agency to another must be clarified as this is generally excluded from aid interventions). This site is close to the town with very short haul distances for any collection vehicles.

Any new initiative on the disposal site will be subject to approval by NEMA.

On the above basis any immediate interventions should be restricted to an emergency clean up of the town including litter collection, support for the volunteer group UWESO for the short term waste collection, and development work at a temporary disposal site pending the final decision on the location of a long-term site.

There is no existing equipment in Mutukula on which to base a short term initiative, other than a litter collection and the upgrading of the UWESO volunteer service. The system proposed for the long term solid waste management must be quite low cost if

it to be sustainable. It is therefore proposed that the intermediate and long term interventions should be combined into a single initiative.

Any UN-Habitat interventions must start with clarification as to the responsibility for the operation of any system and the setting up of a secure funding arrangement for a sustainable system.

The costs of the Chinese tractor based "pick up trucks" will be quite small and so it is proposed that these could be considered as part of the Immediate Intervention. Two of these trucks are proposed so as to ensure a back up service to allow for servicing g and breakdowns and these two tractors can be used simultaneously at the start of the project for the emergency clean-up prior to the starting up of the new collection service. The UWESO volunteers can be asked to assist with this clean up earning some revenues which can be used for their orphan project.

As soon as the full collection service is operating the UWESO volunteers could be asked to assist with the public awareness campaign, which will be essential so that people understand the principal of bringing their own wastes to the collection vehicle, and UWESO could then perhaps participate in the general street cleaning operation. However, as these people are volunteers they should see some return, if not to themselves directly, then going to UWESO for their general work with the orphan children which they are supporting. Perhaps some of the elder children could be encouraged to provide a primary collection bringing the wastes from the households to the tractor trailer and getting paid directly by the householders, shops, etc.

The long-term capital intervention will include the development of the permanent landfill site. However this cannot start until the site has been allocated and NEMA approval given. (see below)

4.2.1 Tractor and trailer with bins.

Bins can be located throughout the town to which the householders and shop keepers will bring their wastes. The tractor and trailer will collect the wastes from each bin every second day and transport it to the disposal site.

The bins could be made from used 210 litre oil drums cut in half and fitted with handles and an advantage of this type of bin is that it is unlikely to be stolen. An alternative would use galvanized steel bins. These will be lighter to handle than the oil drum bins but are more liable to be stolen and used for storage containers and will need replacing more often. Plastic bins are less suitable as they will be destroyed if they are set on fire and are even more liable to be stolen as they are very suitable for washing clothes, making beer or bathing babies. Thus any budget must include for regular replacing of the bins. The bin system will require a driver and an assistant or

even two assistants if the heavier oil drum bins are used. However the collection service may take only two or three hours every second day.

4.2.2 Tractor and trailer with "BELL" system.

This system operates very successfully in a number of countries including, for example, The Philippines, Vietnam and many others. The collection vehicle travels slowly through the town every day (except Sundays) ringing a bell or making some other noise to let the householders know it is there. At fixed times each day it will stop at designated stopping points for perhaps 5 minutes at each point. The householders hear the vehicle coming and bring their own wastes to the vehicle as it passes or to the regular stopping point.

An advantage of this system is that it does not require the bins and can be operated by only the driver without any assistants, thus it is a cheaper system to operate.

It is therefore proposed that the "Bell" system should be introduced into Mutukula together with a strong community awareness initiative and rigid enforcement of anti-litter regulations.

4.2.3 Tractors for Mutukula

For the other towns in the LVWATSAN region in Uganda and the other LVWATSAN countries 45 / 50 hp tractors have been recommended pulling trailers with a capacity (heaped) of around 5.0 m^3. However these towns have longer haul distances and have much greater quantities of wastes. The total waste generation for Mutukula is probably between 3.0 and 6.0 m^3/day. Thus a system based on a smaller tractor and smaller trailer will be more appropriate.

Two-wheeled tractors have been used for pulling refuse trailers in countries including, for example, Ghana. These tractors are very low cost, use very little fuel and can pull loads of up to 1,000 kg. They are very simple to service and to maintain and due to their low engine speeds they are generally very reliable. However they are not very manoeuvrable in narrow street areas.

One particular small truck, however, based on a Chinese 2-wheel tractor, has been developed by Ndume Engineering at Gilgil in Kenya for use in the flower growing areas and this system could be very suitable for small towns such as Mutukula where the disposal site is close to the town. With this system the driver sits on the tractor instead if walking behind it and the turning circle is greatly reduced so that it is much more manoeuvrable than the original tractor with a trailer.

This system can pull loads of up to 1,000 kg although for Mutukula maximum loads of around 500 kg are recommended. This means that a trailer with a heaped capacity of around 1.5m^3 is proposed. The trailer can be tipped hydraulically using a hand operated hydraulic pump. A price of US $ 4,999 ex works has been quoted for this

vehicle ex works Gilgil (April 2006). This is only about one quarter of the cost of a 45hp tractor and trailer. As far as is known there is no other manufacturer within the LVWATSAN area of a vehicle of this type.

It is recommended that, although a single Chinese tractor and trailer would very easily be able to manage the waste collection for Mutukula two should be provided so as to have a back-up available at all times. Two of them should fit into a standard 20ft shipping container so it is proposed that they would be trucked to Mutukula inside a shipping container which would then be used as a secure garage. The container should be fitted with a separate lock up area for spare parts, oils, tyres, etc.

Allowing 10% for spares, the container, putting a lock up area with storage shelves for parts into the container and freight the two units should cost around $ 14,000 delivered. (Plus VAT and duties if any). However, before this system is introduced it will be necessary to check out the legality of this system for use on the roads in Uganda.

4.2.4 Litter collection .

Plastic litter is a serious problem throughout Mutukula, which, apart from the general appearance of the town is blocking drains and seriously damaging any agricultural land. The long term solution to the problem throughout Uganda must lie in legislation to restrict the sale of light gauge plastic film, which is the main cause of the problem, or the introduction of bio-degradable plastics. An immediate solution must be the removal of the plastic litter throughout the town.

One very successful clean up in the town of Nuweiba in Egypt was initiated by a group of local business men who set up a system whereby they encouraged local school children to collect the litter through a purchase scheme by which they paid the children by weight for the clean plastic litter which they collected. This scheme could coincide with the school holidays and environmental classes in the school. It could perhaps be organised through UWESO as a combined cleaning up and children's support programme.

4.2.5 Disposal of waste

Any composting initiative should be encouraged in Mutukula, however the small amount of wastes generated in the town makes it hard to justify putting a lot of effort into this. Again this could be a possible UWESO project, however it should not be imposed from outside but should be encouraged if any local interest is shown.

Recycling should also be encouraged but again the small amount of waste makes this of only very minor interest.

This means that land filling in some form is the only viable disposal option at this stage.

The present system of three dumping sites means that none of them are managed. It is understood that land will be made available near the prison but this must be approved by NEMA. There is enough space here for the foreseeable future.

It is recognized that it may not be practical (or even necessary) for the small towns in the LVWATSAN region to comply with the very high standards of sanitary landfills which are now compulsory in the more industrialized and wealthier countries and it must be realized that the relatively small quantities of wastes generated in these towns do not contain the same quantities of the more serious industrial pollutants such as the heavy metals which are the cause of so much concern. However particular attention must be made to ensure that any leachate and run off from the site does not enter the water supplies for the town. Thus any disposal site management system must pay particular attention to the problems of run off after heavy rains and any leachate generation. (However in general leachate is unlikely to be a significant problem due to the small amount of wastes and the hot climate where the wastes will desiccate in the sun).

As soon as NEMA approval has been obtained the following actions should be taken.

a. A small area of around 50m x 50m should be fenced off using a 2.5 m high fence which will allow the wind to pass through but will trap any loose litter or light plastic film. Typically this fence would be made from 4cm x 4 cm weld mesh on steel or timber frames This fence should be constructed in easily moveable sections so that it can be moved to a new location when the first cell is full.

b. The site should be operated on a cellular basis with only a small area of wastes exposed at any time and dumping should be closely controlled.

c. A few hours work with a hired tracked loader or wheel loader will enable the first cell to be excavated and any spoil material heaped alongside. Typically this cell will be around 5 metres wide and 25 metres long and will be excavated to a depth of around 1.0 metres, depending on the depth of soil at the site. There will therefore be around 125 m3 of spoil stockpiled close to the cell. Filling will take place with weekly covering to a total height of 3.0 Metres. The collection tractor and trailer can be used for transporting the cover material. Allowing for a waste plus fill volume of 375 m^3 or a waste volume of 250 m^3 and assuming a waste density of 750 kg/m3 after compaction and settling this will give a total weight of waste for this cell of around 200 tons. Typically this would take the total wastes from Mutukula for around 7 months, however in practice not all the wastes generated will reach the site and there may be enough capacity in this cell for up to a year.

d. No burning will be permitted at this site and any scavengers will be closely controlled by the person in charge of the waste management.

e. Rats and insect problems will be closely monitored and controlled where necessary.

f. Covering of the wastes will take place at lease once per week using the collection tractor and trailer to transport the soil from the stockpile to the fill area making sure not to overload the trailer (1 ton maximum per load). Typically between two and three loads will be used each week and this can easily be loaded and spread by hand.

g. As soon as the first cell is nearing its maximum fill level a second cell should be prepared alongside.

h. Trees should be planted around the site to screen it from the view of the town.

Proposed budget for disposal site.

It is impossible at this stage to estimate what the development costs of the permanent landfill will be. This could include design, access roads, fencing, interceptor drains, leachate control, cell preparation, tree planting, etc, etc.

Pending the allocation of a site, an Environmental Impact Assessment (EIA), including hydrological and geological studies for its approval by NEMA and a design study should be carried out. It is proposed that a budget of $ 25,000 should be allocated for the disposal site but this is subject to revision as more information comes through.

The distance between the waste collection points and the proposed new disposal site on the land adjoining the prison will be no more than 1 km and probably less. There are some hills in Mutukula and bad road surfaces and this rules out single man handcarts as a possible solution. Handcarts using two men could perhaps be feasible depending upon which part of the prison land is allocated for the dumpsite but it will be very hard work and not cost effective. An alternative system will use a small tractor and trailer and there are two ways in which this system can be operated.

4.2.6 Community awareness

A particularly important part of Mutukula's solid waste management system must be the raising of the communities awareness about the importance of a clean and smoke free environment to the health of the residents and their children. The UWESO volunteers are already taking an initiative in keeping their town clean and they should

be involved in any community or public awareness programme. There is however little point in starting any such campaign until a regular collection service can be provided or it will lose its impact. Community awareness should start with the children and the support of the school should be sought to include a lesson on environmental issues. This could coincide with the litter campaign referred to above. Any children above reading age should be given an illustrated leaflet with cartoon type illustrations explaining the new system to bring home with them and to read to their parents if the parents cannot read.

The leaflet should also set out the advantages of a clean environment and the penalties for littering with a section on the long term health hazards of uncollected wastes and in particular the health hazards from the gases (dioxins and furans) released by burning wastes containing plastic materials.

(This leaflet should be in the local language and should be relevant to all three towns in Uganda with minor variations to suit the different collection systems used).

4.2.7 Preventative maintenance

The introduction of any new equipment must include the setting up of a formal preventive maintenance programme which will include training the driver in the proper operation and regular servicing of the vehicle including in particular daily checks on engine oil, and attention to tyre pressures.

a) Weekly checks.

It is normally recommended that all waste collection equipment should have a weekly service checkup. However in Mutukula it is anticipated that the collection service will only take place during perhaps 3 days x 3 hours (9 hrs) per week) and so a fortnightly check up should suffice.

(Note: Section 1 has proposed that the Chinese tractors should be depreciated over 7 years. However in Mutukula the two tractors together will only work around 9 hrs per week so that with this small vehicle utilization a ten year economic life can b e expected).

A qualified mechanic should be retained to carry out a fortnightly list of checks which will include confirming that the driver has carried out his checks on engine oil and tyre pressure and a simple list of further checks for items such as loose bolts, clutch and brake wear, etc. This should take no more than 1 hour and the mechanic should sign a service book to confirm that he has done all the checks.

b) Operation and maintenance

The tractors should have a monthly service which will include greasing and any oil and air filter cleaning or changes as recommended by the tractor manufacturer.
The mechanic should give advance warning of any service parts, including tyres which may be required The mechanic or the waste management supervisor should

be responsible for maintaining a minimum stock of spare parts, oil, tyres, etc and for ordering replacement parts as soon as the minimum stock level is reached for any part. It is most important that a budget is allocated and procedures are in place for the prompt ordering of any spare parts so that vehicle down times can be minimized. With the above system vehicle failures or reduced efficiencies due to a lack of maintenance should be eliminated. The weekly and monthly service checks will confirm that the driver is doing his daily checks properly.

BUDGET 4.3

4.3.1 For proposed immediate and longterm interventions

Provision of handcarts, tools, protective clothing etc, to UWESO	$ 1,500
2 – Chinese tractor based trucks @ $6,000	$ 12,000
Emergency Litter collection	$ 2,500
Development of temporary disposal site.	$ 3,000
Emergency clean up of heaps of wastes	$ 1,000
Community awareness	$ 1,000
	$ 21,000
Labour and fuel for clean-up	$ 1,000
	$ 22,000
Contingencies (10%)	$ 2,200
	$ 24,200

A contingency fund of US $ 25,000 should be allocated at this stage for any works which NEMA may require at the disposal site.

4.3.2 Operation and depreciation costs

The annual costs for the "sustainable" solid waste management service can be broken down into:

Operating Costs

Labour.
Fuel
Maintenance

Financial costs.

Depreciation costs or replacement costs for the equipment when it reaches the end of its "economic life"

Labour cost.

Using the "Bell System" as described above and in Section 1 a single tractor driver should be able to carry out the complete collection service on a part time basis. (Typically half time). Once per week the driver and a labourer should cover the wastes at the disposal site using the spoil which has been excavated during the construction of the landfill cell. Some assistance by the UWESA volunteers in the waste collection and in organizing regular (perhaps four times per year) litter collections will also be required being paid some contribution towards their orphan project. The mechanics inputs are included under maintenance..

It is difficult at this stage to estimate the costs of this labour but typically they will be as follows:

Labour

1.Driver @ 210,000 x 50% = 105,000/month	1,260,000/annum
I labourer x 1/2 day per week at disposal site = 20,000/month	240,000/annum
Contribution to UWESO volunteers. 30,000/month	360,000/annum
Total labour	U.sh 1,860,000/annum

Fuel

3 litres/day x 3 days/week @ 1.800	U.sh 842,400/annum

Maintenance

2 Chinese tractor units @$12,000 x 7%	U.sh 1,512,000/annum
TOTAL ANNUAL OPERATING COSTS.	U.sh 4,214,400 (US $ 2,341).

Depreciation

2 tractor/trucks@ $6,000 x 10 years = $1,200	U.sh 2,160,000
TOTAL FULLY SUSTAINABLE COSTS	U.sh 6,374,400 (US $ 3,541 / annum)

SECTION 5.

UN-HABITAT STRATEGY FOR SOLID WASTE MANAGEMENT IN MASAKA (NYENDO DIVISION), KYOTERA AND MUTUKULA..

5.1. PROPOSED STRATEGY FOR MASAKA (Nyendo / Ssenyange Division) AND KYOTERA.

The strategy proposed in the report for Kisii and Homa Bay included a general overview and proposals for:

- The procurement of a sample tractor skip (container) trailer and container to be manufactured in Kenya.
- The procurement of a sample low loading height trailer to be manufactured in Kenya.
- The procurement of a sample two wheel tractor based pickup.
- The procurement of sample sweepers equipment including a wheel barrow with extended sides, a handcart with two bins, brushes (brooms), forks, scoop, etc.
- The design of promotional material for public awareness campaigns.

All of this will be relevant in the seven towns included in these first stage proposals in Kenya, Tanzania and Uganda.

As these items are included in the project for Kisii and Homa Bay in Kenya there is no need to repeat them in this proposal for Masaka (Nyendo / Ssneyange District, Kyotera and Mutukula. It is proposed that the suppliers identified for Kisii and Homa Bay should be used to provide the equipment for the initial three towns in Uganda so as to avoid the delays and costs involved in seeking samples from other manufacturers. However local manufacturers in Uganda should be invited to study the equipment provided to these first three towns and then to tender for the supply of vehicles and equipment when UN-HABITAT extends its interventions to other towns in Uganda.

The tractors chosen for these three towns will depend upon which tractors in the 40 – 50 hp power range are readily available in Uganda with a proven spare parts and service record in the Lake Victoria region.

5.2. LOCAL ACTIVITIES IN EACH MASAKA (NYENDO / SSENYANGE DIVISION) AND KYOTERA.

The following items will be specific to each town. It is understood that UN-HABITAT will appoint a project manager / facilitator for each town to be responsible for the implementation of immediate and long term interventions. His duties will include:

5.2.1. Confirm Waste Estimates.

To confirm the data concerning the quantities and characteristics of the solid wastes in each town and revise the equipment requirements in line with any variations from the estimates.

It must be understood that the proposals set out for each of the towns were based on estimates of the waste characteristics and quantities provided by the local authorities and the previous studied for UN-Habitat and by a visual assessment by the consultant during a very brief visit to each town.

5.2.2. Community Awareness.

To set up a community awareness programme to make people aware of the need for a clean and healthy environment.

5.2.3. Willingness to Pay

To confirm the householders and the business owners "Willingness to Pay" for an improved environment.

5.2.4. Waste Disposal.

A review should be carried out of all disposal sites including confirming any environmental approvals and where necessary commissioning a hydrological survey to confirm that there are no threats to local water supplies.

5.2.5 Capacity Building for Local Authorities

A key part of any UN-HABITAT initiative must be capacity building at local authority level for the management and maintenance of the solid waste collection and disposal. However this should not be taken in isolation from the provision of other services including water and sanitation. The Local Authority budgets for each town should be reviewed in line with the requirements of each of the services.

5.2..6. Maintenance of Vehicles and Equipment.

The setting up and monitoring of preventive maintenance procedures for the servicing and maintenance of the collection vehicles. This will include systems for the

procurement and safe storage of service parts and materials. The vehicle manufacturers and suppliers to provide daily, weekly and monthly service check lists.

5.2.7 Training Operators and Service Personnel.

Setting up training programmes for the operation and maintenance of the collection vehicles in association with the vehicle suppliers and manufacturers.,

5.2.8 Financial Budgeting

The drawing up of annual and long term budgets for the operation, maintenance and future replacement of the waste management vehicles and equipment in association with the Local Authority financial controllers.

5.2.9 Cost Recovery

The setting up of systems for "Refuse Collection Charges" (RCC) or other methods of recovering the costs of the waste collection and disposal. These systems to include for replacement of the vehicles at the end of their economic life (depreciation) and expansion of the collection fleet in line with population and waste growth.

5.2.10 Container locations and vehicle routings

The planning of the location of containers and the collection schedules and vehicle routings.

5.2.11 NGOs and CBOs

Identify any NGOs and CBOs which are operating in each town and determine what inputs they can provide towards:

a) Assisting or acting as the focus for any anti-litter campaign including organizing an initial and subsequent plastic litter collections throughout the town. This could include encouraging school children to collect plastic litter on a "paid by weight or volume basis". It should include an awareness campaign to inform people of the health dangers of burning plastics.

b) Assisting with an "emergency clean up" of the heaps of wastes throughout the town, working with the local authority who will provide the vehicles to transport the wastes to the disposal site, perhaps using hired trucks and loaders for this purpose.

c) Providing a "Primary Collection Service" to those people who are prepared to pay to have their wastes collected from the house of business premises and brought to the community containers.

d) Encouraging formalized scavenging activities to remove any recyclable materials from the waste stream.

e) Encouraging composting initiatives which will remove organic materials from the waste stream.

5.2.12 Performance Indicators

The setting up of a system for recording the success of the UN-HABITAT interventions including health improvements and householder and business satisfaction indicators.

In addition the Project Manager for Kyotera will take responsibility for Mutukula.

5.3. PROPOSED BUDGETS FOR LVWATSAN SOLID WASTE MANAGEMENT.

The following budgets show the proposed budgets for:

- Immediate Interventions for Masaka and Kyotera
- Long term Interventions for Masaka and Kyotera
- Interventions for Mutukula

It is proposed that UN-HABITAT will recruit Resident Project Managers / Facilitators who will be based in Masaka and Kyotera for a minimum of one year. The project Manager in Kyotera will also cover Mutukula.

Offices in the two towns will include a local staff member who will report directly to the Project Manager The Project Manager will be provided with a pick up truck or a four wheel drive vehicle.

5.3.1 UN-HABITAT IMMEDIATE INTERVENTIONS FOR MASAKA (Nyendo Ssenyange Division) AND KYOTERA. (All cost US $).

ITEM	UNIT COST	MASAKA (Nyendo)	MASAKA COST	KYOT-ERA	KYOT-ERA COST	NOTES
Refurbish existing equipment		See section 2.3.2	29,000			
Tractor	16,000			1	16,000	
Low loading trailer	7,500			2	15,000	
Litter bins	40	25	1,000	25	1,000	
Wheel barrows	60	5	300	5	300	
Handcarts	140	5	700	5	700	
Handtools, etc			1,000		1,000	
Awareness campaign			1,000		1,000	Support for local CBO. Handouts covered separately
Emergency clean-up			3,000		3,000	Labour and fuel
Litter collection			2,000		2,000	Support for local CBO.
Training			3,000		3,000	
Office equipment			4,000**,**		4,000	Note 1
Disposal site. (Interim)			20,000*		20,000*	Note 2
TOTAL			47,000		59,000	
10% contingency			4,700		5,900	
TOTAL BUDGET			**51,700**		**64,900**	

NOTE 1. Does not include local staff costs for UN-HABITAT offices, Project manager's salary and expenses or running costs.

NOTE 2. Includes temporary improvements to existing site and evaluation of alternative sites.

5.3.2. UN-HABITAT LONG TERM INTERVENTIONS FOR MASAKA (Nyendo / Ssenyange Division) AND KYOTERA.(All costs US $).

Item	Unit cost	Nyendo	Nyendo cost	Kyotera	Kyotera cost	Notes
Tractor	16,000	2	32,000	1	16,000	
Skip trailer	9,000	2	18,000			
LLH trailer	7,500			1	7,500	
Containers	1,000	15	15,000			
Motor cycle	2,500	1	2,500			
Wheel barrows	60	5	300	5	300	
Handcarts	140	5	700	5	700	
Litter bins Rubbish bins	40 25	25	1,000	25 100	1,000 2,500	Initial stock of 80 litre bins for businesses
Handtools, etc			1,000		1,000	
Landfill			20,000		20,000	Note 1.
Training			3,000		3,000	Includes preventive maintenance programme
Community awareness (phase 2)			3,000		3,000	
Workshop tools & spares			4,000		4,000	Note 2.
Litter campaigns Phase 2			2,000		2,000	Note 3.
TOTALS			102,500		61,000	
10% Contingency			10,250		6,100	
BUDGET TOTAL.			**112,750**		**67,100**	

NOTE I. This is only a provisional figure pending determination of any new site location and may be very much higher.

NOTE 2. This support should be given to Masaka Municipal Council who Will be responsible for maintaining the vehicles and equipment. Spare parts will also be included with each vehicle supplied.

NOTE 3. Litter cleanups should be organized once every year during a school holiday period.

No budget has been included for the Project Manager and offices to be set up in each town with local staff as it is considered that UN-HABITAT will have experience of the costs of setting up such operations and cost data which is not available to the consultant.

The Immediate Intervention Budgets includes US $ 4,000 each for equipping small offices to be provided by Masakia and Kyotera Municipal Councils. It does not include for any office or other running costs.

The following additional items should be included:

- Salary and expenses of UN-HABITAT local Project Manager.
- Motor vehicle and fuel / service costs for the Resident Representative.
- Local staff members salary and expenses in each town..
- Local office running costs.

5.3.3. UN-HABITAT INTERVENTIONS FOR MUTUKULA.
(All costs US. $)

ITEM	UNIT COST	NUMBER REQUIRED	COST	NOTES
2-wheel tractor based pickup trucks	6,000	2	12,000	Ndume Little Pickup
Litter bins	20	35	700	80 litre plastic bins
Wheel barrows	60	5	300	
Handtools & protective clothing			1,500	
Emergency clean up			2,000	Includes hire of equipment and labour and fuel.
Litter collection			2,500	UWESO to organize
Community awareness			1,000	UWESO to organize
Shipping container for lock up			4,000	Modified by vehicle supplier and used to transport vehicles to Mutukula (NOTE 1)
Temporary disposal site			3,000	NOTE .2
TOTAL 10% contingency **TOTAL BUDGET**			27,000 2,700 **29,700**	**See note 2.**

NOTE 1.

It is proposed that the two pick trucks should be delivered to Mutukula in a used shipping container which has been modified by the truck suppliers for use as a lock up store for the vehicles, spare parts and fuel. A 20 ft container will just fit the two vehicles. Alternatively a 40 ft container could be supplied and one end converted for use as an office.

NOTE 2.

It is proposed that one of the existing murram pits should be excavated and used as a temporary disposal site pending the finding of a location and the development of a new landfill. It is not possible to even guess at the development costs involved for a new site at this stage. A minimum long term landfill budget should be allowed but it may cost very much more depending on the location and hydrological situation, the soil conditions and the standards applied

SIGNED:

MANUS COFFEY, CONSULTANT.

DATE:

ANNEXES

ANNEX ONE : SWM VEHICLES
Please (refer also to report on pre-qualification of manufacturers of SWM equipment, output 4 of this consultancy)

General information on selection of SWM equipment and vehicles.

1) OPERATING AND FINANCIAL COST RECOVERY

Although UN-Habitat will assist with the initial setting up of the collection and disposal system if it is to be sustainable in the long term it is essential that the local authority can meet the full costs of operating the system and future costs for replacing the equipment as it becomes obsolete, the costs of expanding the system in line with any population growth and possible increases in the amounts of waste generated per capita as living standards increase. This will require the provision of operating finance for the daily running costs of the system and the creation of a long term capital budget to cover the annual depreciation costs of the equipment. This may require the payment of refuse collection charges by the householders and businesses on a weekly or monthly basis but these may also be included as an additional charge on an existing service such as water or electricity. The costs can be broken down into four elements as follows:

a) Operating costs

Labour.
Labour costs can be minimized by keeping vehicle loading times as low as possible. This means fast and efficient loading of the vehicles. Labour costs for a system where the householders bring their own wastes to a container or directly to the collection vehicle (bell system) will be lower than for a bin based or house to house collection..

Fuel.
Fuel consumption per hour for any vehicle is roughly proportional to the engine power of the vehicle. A 40 – 50 hp tractor will have a much lower fuel consumption than a typical truck of the same capacity with a 100 – 120 hp engine.
And the Chinese 12 hp tractor based system will have lower costs still.

Maintenance
Maintenance costs include tyre wear and monthly servicing costs as well as repairs which will increase as the vehicle ages. Very roughly vehicle maintenance costs are proportional to the capital cost of the vehicle and an annual maintenance cost of 7% of the capital cost is typical. At the beginning of any vehicles life the maintenance costs will be small but will increase as the vehicle ages with a typical large increase when the first set of tyres wears out. It is essential that funds are put aside at the start or accumulated out of SWM revenues as the vehicle ages. Systems for the procurement of routine service materials (oils, filters, etc) must

be put in place and fast systems for the procurement of parts and labour for emergency repairs are essential to any sustainable system. The SWM manager must have the authority to purchase items up to an agreed monthly amount without the need to refer back to the financial controllers for each item.

Preventive Maintenance is an essential part of the operation of any SWM system and will pay for itself many times over. A full preventive maintenance system includes daily checks by the driver, weekly checks by a mechanic and monthly servicing is the minimum that is required for any new SWM system either using the local authorities own workshop resources or by sub-contracting out to a local private agency.

Back up vehicles.

Back up vehicles are essential to allow for proper servicing and vehicle breakdowns but add to capital and depreciation costs. However they do not add to labour and fuel costs when they are on standby.

b) Depreciation costs

Annual depreciation costs are calculated as a percentage of the equipments capital or replacement cost and must include the costs of replacing containers or bins as they wear out.

It is possible to keep tractors and trucks going for long periods, however the "economic life" of the vehicles is the life after which it is more cost effective to replace the vehicle (making an allowance for any residual value of the original vehicle). Different types of equipment have different economic life expectancies and it is normal to calculate these as follows:

ITEM	ECONOMIC LIFE.
Truck	7 years
Tractor	10 years
Trailers, etc.	10 years
Containers and bins	4 years
Buildings and fixed equipment	20 years
Landfill development depending upon life expectancy of site.	10 – 20 years

c) Capital cost for equipment

It has been assumed for this study that the capital costs for the vehicles and equipment for all three countries will be similar but tenders must be sought for each item in each country. The following costs are used throughout this Uganda study and an allowance is included for an initial stock of spare parts and for the transport of the different vehicles and equipment to the

different towns. Tenders must however be sought for the different items and these costs uprated in line with more accurate costs.

COSTS FOR DIFFERENT TYPES OF EQUIPMENT.

ITEM	COST US $	DEPRECIATION YEARS
45 hp tractor (Massey Ferguson model 240)	16,000	10
Tractor trailed container pick up system.	9,000	10
Low loading height tractor trailer	7,500	10
4 m3 container	1,000	4
12 hp Chinese tractor conversion with 1.5m3 body	6,000	7 *
100 litre bins	30	4

(Note: It is common practice to allow 7 years life for trucks and 10 years life for tractors, the longer tractor life being due to the more simple construction and slower engine and road speeds. As we have no experience of the life expectancy of the Chinese two wheeled tractors we are assuming an economic life of only 7 years, however it may be found that this can be increased to 10 years after experience has been gained).

2) TRACTORS

The performance of any tractor and its ability to pull heavy trailers is determined by the gross weight of the tractor, trailer and load and the power of the tractor. The power to weight ratio (P/W) is the power of the tractor (hp) divided by the gross weight (tons).
Tractors can operate with a P/W as low as 5 hp/Ton but the speed performance on hills will be poor.

The power of any engine is affected by the altitude at which it is working with a drop in power of around 3% for every 300 metres (1,000 ft) above mean sea level (AMSL). This must be taken into account in the Lake Victoria Region where there are altitudes of between 800 and 1,600 metres AMSL. Typically a power reduction of around 10% of the manufacturers ratings for the tractors can be assumed.

PROPOSED TRACTOR TRAILER AND CONTAINER SPECIFICATION.

40 – 50 hp tractors are readily available in all three countries of the LVWATSAN region at a cost of around US $ 14,000 to $ 16,000. It is important that the make and model of tractor chosen should have a good spare parts and service back up in Uganda.

TRACTOR TRAILED CONTAINER (SKIP) TRAILER

Typically an appropriate system have weights as follows:

Container capacity. 4.0 m3 x 400 kg/m3 =	1,600 kg wastes
Container weight. (estimated)	500 kg
Chassis weight. (estimated)	1,200 kg
TOTAL TRAILED WEIGHT.	3,300 kg
Tractor weight (45 hp tractor)	1,800 kg
Combined weight of tractor & trailer	5,100 kg

Power / weight ratio with 47hp tractor
(42 hp allowing for altitide) 8.2 bhp/ton

A 47 hp tractor with a gross weight of 5,100 kg and a load of 1,600 kg will have a good road performance.

Low loading height trailer - A low loading height trailer suitable for a 45/50 hp tractor will have a capacity of around 4.0 m^3 (5.m^3 heaped) and a loading height of around 1.5 m. It will carry typical loads of around 2.tons but must be capable of carrying and tipping loads of up to 4. tons or more.

3) CONTAINERS

The life of the containers will be determined by their resistance to corrosion and there are a number of factors which will affect this life expectancy including:

The quality of the steel used. Where possible containers should be made from CorTen steel but this may not be available in the LVWATSAN Region.

The design of the containers. Containers should be made with chamfered corners which will allow the wastes to slide freely during tipping and reduce the tendency to hold wastes in the corners resulting in anaerobic crevice corrosion. Wherever steel sheets overlap they must be fully welded to prevent liquids getting between the sheets where they decompose forming corrosive acids again causing anaerobic crevice corrosion.

The paint finish used. Containers should be shot blasted or wire brushed before painting with a zinc chromate primer and two finish coats.

The frequency of emptying. Containers must be emptied at least every second day to prevent decomposition of organic wastes and the formation of corrosive acids in the wastes.

With good attention to the above details containers made from CorTen steel should last 10 years but this can be reduced to no more than two or three years with poor design, bad manufacture and bad management. The economic life of the containers is therefore assumed to be 4 years and the estimated cost is based on ordinary mild steel construction. However alternative tendewrs should be obtained for containers made from CorTen steel.

4) BURNING OF PLASTICS

Burning of plastics should never be encouraged and any awareness campaign should include educating the people about the very serious hazards from the dioxin and furan gases given off by burning plastics.

Note: In one city in Egypt where there was a village about 300 metres down wind from a burning landfill site a health survey found that 87% of the villagers suffered from some form of respiratory problem ranging from lung cancer, to bronchitis, and asthma.

5) PREVENTATIVE MAINTENANCE

The introduction of any new equipment must include the setting up of a formal preventive maintenance programme which will include.

a) Daily checks.
Each truck or tractor driver will have a list of simple checks which he must carry out every day before he starts work including checks on the engine oil, water, tyre pressures, hydraulic fluids and checks for any oil leaks. This should take no more than five minutes. He must then sign the daily check sheet to confirm that he has carried out these checks.

b) Weekly checks.
A qualified mechanic (either a municipal employee or an outside mechanic) will carry out a weekly list of checks which will include confirming that the driver has carried out his checks and a simple list of further checks for items such as loose bolts, clutch and brake wear, etc.. He will then sign the weekly check list. This should take no more than 30 minutes.

c) Monthly service.
The monthly service will include oil and filter changes where required and a further check on the items in the weekly check list. With the above system each person is held responsible for his own maintenance checks and vehicle failures or reduced efficiencies due to a lack of

maintenance should be eliminated. The weekly and monthly service checks will confirm that the daily checks have been properly carried out.

During the monthly checks any imminent spare parts requirements can be identified so that they will be obtained in time for the next service and the Municipality can budget properly for the vehicle maintenance. It is most important that a budget is allocated and procedures are in place for the prompt ordering of any spare parts so that vehicle down times can be minimized. Stocks of regular service parts, such as filters and oils, must be maintained at all times.

6) Local manufacture

Local manufacture should be encouraged as much as possible so as to ensure spare parts and service availability and also to encourage local job creation.
The tractor trailers and containers can all be manufactured within the LVWATSAN countries thus avoiding any dependence on imported spare parts.

Suitable manufacturers for the container trailers and containers will be engineering companies who already have experience of manufacturing agricultural or road trailers or similar steel fabricated equipment. A key factor for the sustainability of this system must be the local availability of spare parts for the axles and hydraulic cylinders and the use of readily available tyre sizes. It would be possible to make use of used truck front hubs for this purpose but this is not recommended due to the problems of obtaining sufficient hubs and brake components which are all identical.

System 1. Tractor trailed container systems.

Containers to which the householders and businesses will bring their own wastes and a tractor trailed container pick up system to pick up, transport and discharge the containers. A 40 – 50 hp (30 kw) tractor will transport a 4 m3 capacity (5 m3 heaped capacity) container.

System 2. Tractor trailed collection systems.

A tractor trailed low loading height trailer with a maximum loading height of 1.5 metres. This will be combined with 100 litre capacity bins each servicing around 10 houses and 60 – 80 litre capacity plastic bins for the businesses and shops.

System 3. Mini truck and “Bell” system.

A 1.5 m3 capacity mini truck based on a modified Chinese 2 wheeled tractor.
This system will travel slowly throughout the town stopping for short periods at designated points. The householders hear the truck coming and bring their own wastes directly to the

truck as it passes or to the stopping point. The truck can also collect commercial wastes from bins at the same time.

The optimum system for any town will depend upon the population to be serviced, street widths and conditions and existing collection systems to which the householders have become accustomed.

NDUME

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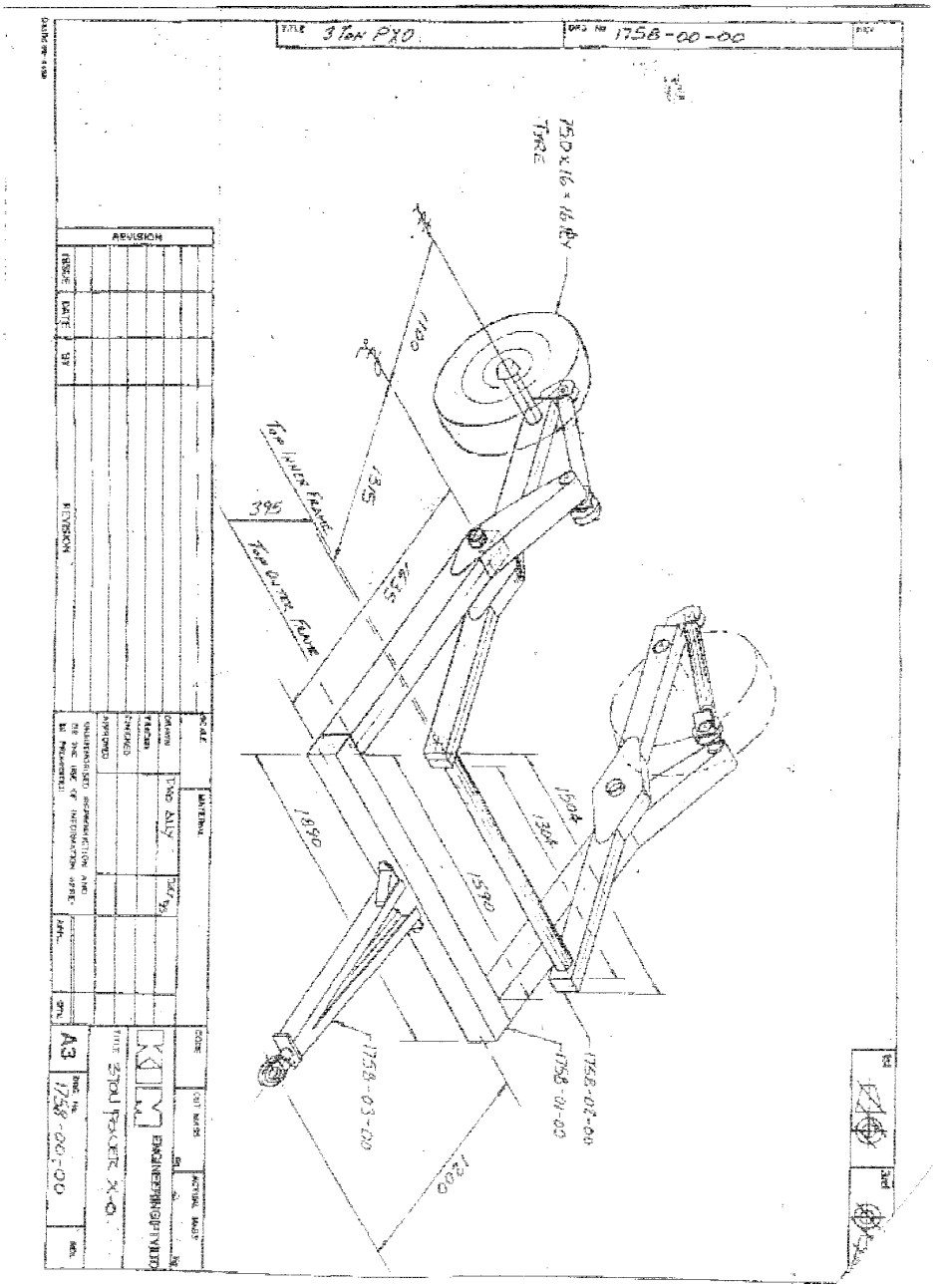
THE LITTLE PICKUP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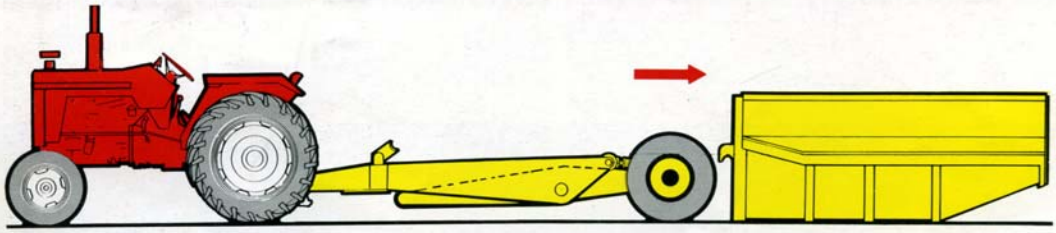
الرحمه
التخصصي

The POWER X System can pick up, transport, tip and deposit a variety of purpose built containers.

The following operations are carried out by using your tractor's existing hydraulic system.

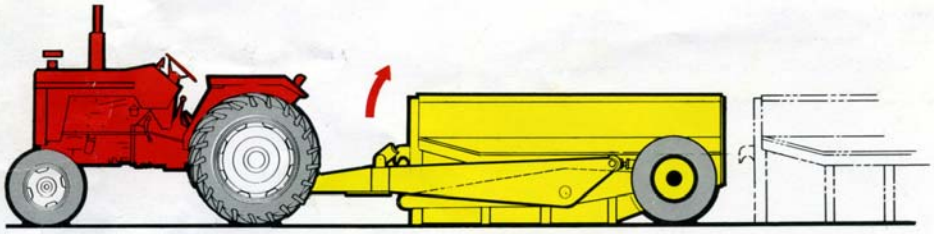
Die POWER X Stelsel kan 'n verskeidenheid doelvervaardigde houers optel, vervoer, kantel en neersit.

Die volgende werkings word uitgevoer deur van u trekker se bestaande hidrouliese stelsel gebruik te maak.



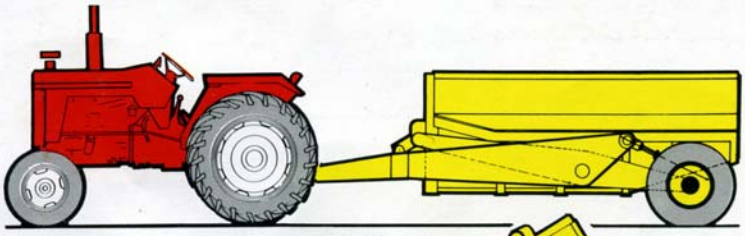
The tractor with Power X chassis in collapsed position ready to reverse under container.

Die trekker met Power X onderstel ingevou, gereed om onder houer in te beweeg.



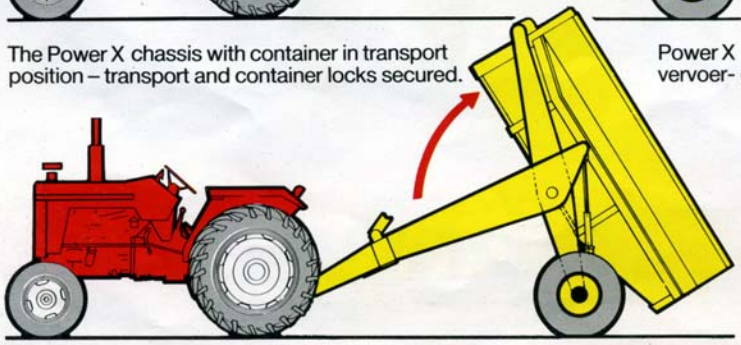
The Power X chassis in position to engage container.

Die Power X onderstel in posisie om houer in te koppel.



The Power X chassis with container in transport position – transport and container locks secured.

Power X onderstel met houer in vervoer posisie – vervoer- en houerslotte gesluit.



Power X chassis with container tipped 57°. Overall height in fully tipped position: 3,24 m.

Power X onderstel met houer 57° gekantel. Totale hoogte in volle kantel posisie: 3,24 m.

ANNEX TWO: PERSONS MET IN UGANDA 26TH-30TH MARCH 2006

Name	Designation	Contact
MASAKA		
Kigwanye Anthnoy	Town Clerk, Central Division	0782 113009
Domobodo. S	Committee Clerk	0752 665270
Magi Vincent	Principal Treasurer MMC	0772 473418
Sseruukuma D. Ivan	Sen Personnel Officer	0772 648730
Ssemazzi Freddie	S.S. Asst	0772 542 337
Ssebegullo		0772 537927
Mary Aacha	Town Clerk, Kimanya/Kyabakuza Division	0772 687322
Mugisha Emmanuel	Town Clerk, Nyendo Division	0772 616441
Mugenyi Hatim	Principal Executive Engineer MMC	0772 441638
Ddungu Henry	Health Inspector	0772 557819
Iyoko-Olet Serafino	Physical Planner	0772 636053
Edqard Kiwamuka	Ag Town Clerk, Masaka Municipal Council	0772 457168
KYOTERA		
Lugumya Charles	Mayor K.T.C	0752 583838
Kiggomido	Ommunity Development Officer	0772 682928
Ssebadduka Francis	Personnel Officer	0772 671631
Byakagaba Jackson	T.Engineer	0782 409317
Nsamba Leo	Revenue Exchequer	0772 551547
Wmabya Godwin	Health Inspector	0772 888267
Sylvester Njawuzi	Town Clerk, K.T.C	
Kasendwa Robert	Treasurer	0772 976831
MUTUKULA		
Mujaasi David	LAUPI Programme Officer	0782 163195
Amanya Richard	Exec Dir, LAUPI and coordinator UWESO	0772 921636
Kaganda Dominic	Chairman LCI, Mutukula	0772 927212
Burham Kahia	Village Executive Officer, Local Government Tanzania	+ 255 7410799