INFORMAL SETTLEMENTS

IN

SOUTH AFRICA

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INFORMAL SETTLEMENTS IN SOUTH AFRICA

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In the faculty of Engineering, Built environment of Information Technology

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Declaration by student

I, the undersigned, herby confirm that the attached treatise is my own work and that any sources are adequately acknowledged in the text and listed in the bibliography

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Abstract

Title of treatise : Informal settlements in South Africa

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The objective of this treatise is to find out whether or not it is possible to take a proactive approach and improve the current living conditions of the informal settlers whilst awaiting for the construction of the low cost housing. This is because the living conditions of informal settlers here in South Africa is not up to standards. This housing poverty is best exemplified by the sprawling slums and Informal settlements on the peripheries of almost every city and town.

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CHAPTER 1

1. Broad overview of the problem

1.1 Introduction

Housing areas in South Africa developed along strict apartheid lines separating whites, Asians, coloureds and blacks into separate geographical areas according to the group areas act of 1950. For the past years South African cities have been

growing at an immense rapid rate. Responsible municipal authorities find it impossible to provide standard services above all to provide housing. The urban immigrants build themselves shelters, lacking all services such as water supply, sewage system or electricity, on the least wanted sites usually at the urban periphery.

Informal settlements are residential areas that do not comply with local authority requirements. They are unauthorized and are located upon land that has not been proclaimed for residential use. They exist because urbanization has grown faster than the ability of government to provide land, infrastructure and homes. Informal settlements are characterized by dwellings that are inadequate, Infrastructure that is inadequate, lack of effective government and management, environments that are unsuitable, population densities that are uncontrolled and unhealthy and they are areas of increasingly high risk with regard to health, fire and crime

The rising cost of living has seen the increase in informal settlements in South Africa. Despite the construction of low cost housing by the government the demand of housing is far more than the supply. According to the Census Report of 1996, 1 049 686 households in South Africa lived in informal settlements dwellings/shacks in squatter settlements at the time This implies that policy and professional efforts need to be re-directed towards the needs of the poor rather than the ideals of the middle class

1.2 Main problem

Is it possible to take a proactive approach and improve the current living conditions of the informal settlers whilst awaiting the construction of the low cost housing?

1.3 Sub Problems

- Is it possible to provide quality water supply and domestic water disposal in informal settlements?

- Can the sanitation in informal settlements be improved?
- Will the use of quality materials for construction in informal settlement and proper design improve the conditions of shacks and avoid shack fires?
- Can the condition of the environment be improved in informal settlements?

1.4 Hypothesis

- The involvement of local municipalities to solve water problems and introduction of alternative water supply systems
- The introduction of alternative sanitation systems which do not require high input of finance
- The implementation of building standards , alternative materials and alternative construction methods to improve the condition of shacks
- The involvement of town planners improve environmental conditions in informal settlements

1.5 Research methodology

- Internet
- Text books of informal settlements
- Journals

1.6 Delimitations

The research is mainly based in an area called Mamelodi. Mamelodi was established in 1953 it is situated about 20km east of the city of Tshwane (Pretoria).It has a population of close to one million people. Many people in Mamelodi live in shacks, either in areas occupied through illegal land invasions or on legalized plots still awaiting the queue for government-provided houses.

1.7 Assumptions

The major assumption in the research is that the problems faced with the residence in the Mamelodi informal settlements are similar to any other problems in any informal settlements.

1.8 Importance of the study

Human settlements play a central role in determining the progress of a country; housing is an indicator of wealth or poverty. In developing countries, satisfactory housing is often the exception to the rule. The people living in poor conditions are not merely a marginalized part of the population but the vast majority. The main importance of the study is to find ways to improve living conditions of residence in informal settlements.

CHAPTER 2

*2. **Sanitation***

2.1Introduction

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces.It is the most important in any kind of settlement. Lack of sanitation is the major problem in informal settlements. Sanitation plays a vital role not only in the delivery of health services but in the

health of communities in general. Many diseases are linked to a lack of sanitation. According to the national sanitation policy the aims of sanitation to communities are (Stephenson 2005):

- To protect the environment
- To integrate the development of a community in the provision of sanitation
- To place the responsibility for household sanitation provision with the family or household
- To improve the health and quality of life of the whole population

Many people believe that good sanitation means water borne sanitation Effective sanitation focuses on people and behaviour, not only infrastructure. The emphasis should be on health and hygiene improvements to ensure the long-term maintenance of public health (Brandberg 1997). Good sanitation can be achieved through a range of technical options, but only when coupled with good health, hygiene and sanitation promotion, which provides end-users with the information

In most informal settlements humans relieve themselves where ever they find convenient which leads to diseases such as cholera. The bucket system is also used but it is very unhealthy because no chemicals are used. The bucket system attracts flies and has an unbearable stench because they get filled up and sometimes overflow. Faeces would regularly spill near shacks and water taps. Collection of the buckets is done by the municipality to dispose the buckets .The problem is the municipality rarely comes to collect the buckets which leads again to severe diseases.

Alternative sanitation systems may be considered in informal settlements. There are two ways in which human waste is handled. It can either be treated on site before disposal, or removed from the site and treated elsewhere (Mara 1984). In either case the waste may be mixed with water or it may not. There are mainly four groups.

2.2 Group one

Group one sanitation systems do not require any water to be added but conveyance is required, these are chemical toilets.

2.2.1Chemical toilets

A chemical toilet is a toilet using chemicals to deodorize the waste instead of simply storing it in a hole, or piping it away to a sewage treatment plant. It stores the excreta in holding tanks. Chemical toilets are often used on construction sites and at outdoor gatherings such as music festivals, and in caravans. The contents of the holding tank must be emptied periodically and conveyed to a sewerage works for treatment and disposal (Reed 1995). Some units have a flushing mechanism using some of the liquid in the holding tank to rinse the bowl after use.

2.2.2 Factors to consider for chemical toilets (Stephenson 2005).

- They can be moved from site to site
- The units can be installed very quickly and easily
- Chemical toilets have very high capital and maintenance cost
- Chemicals could have a negative effect on the performance of waste water treatment works
- They require no water connection and require very little water for operation
- They are hygienic and free from flies and odour provided that they are operated and maintained correctly
- Periodic emptying of the holding tank is essential, this requires vacuum tankers, so access should be possible at all times.
- The system only disposes of human excreta and cannot be used to dispose of other liquid waste
- It is necessary to add the correct quantity of chemicals to the holding tank

2.3 Group two

Group two sanitation systems do not require any water to be added and conveyance is not required also. These are continuous compositing toilets, ventilated vault toilets, ventilated improved double pit toilet and ventilated improved toilets.

2.3.1 Continous compositing toilets

These toilets receive waste materials on an ongoing basis. The toilets make use of air to enable aerobic bacteria to break excreta down to fertilizing material. A vault below the pedestal is the one which contains the excreta.

2.3.2 Factors to consider for continous compositing toilets (Stephenson 2005).

- Toilet is usually free of insects
- Compost is produced
- The toilet is permanent installation
- The user is required to move the compost manually
- The toilet can not be constructed by unskilled labour
- The excreta are visible to the user
- A high standard of maintenance is required
- Toilet user education may be required

2.3.3Ventilated improved pit toilet

The ventilated improved pit toilet eliminates flies and smell, through air circulation. It has a chimney which draws air currents into the structure and through squat hole. Odours rise through the chimney and disperse (Lewis1982). The structure of the toilet means that any flies attracted to the pit through the squat hole will try to escape by heading towards the strongest light source, which comes from the chimney (Stockholm 1998). The flies exit is blocked by a wire

mesh so the flies eventually die and fall back into the pit. The spiral structure prevents too much light entering the toilet while allowing a free flow of air.

2.3.4Factors to consider for Ventilated improved pit toilet (Stephenson 2005).

- The excreta are visible to the user
- Locally available materials can be used
- The cost of the toilet is very low, it provides the cheapest form of sanitation while maintaining acceptable health standards
- The system may be unable to drain alll the liquid waste if large quantities of wastewater are poured into the pit
- The toilet can be constructed by the recipients even if they are unskilled as very little training is required.
- The system can not ordinarily be installed inside a house
- The system is hygienic provided that it is used and maintained correctly

2.3.5Ventilated improved double pit toilet

A ventilated improved double pit toilet uses two pits, one pit can be used while the contents of the second pit rests, drains, reduces in volume, and degrades. When the second pit is almost full it is covered, and the contents of the first pit are removed. Two lined shallow pits designed to be emptied, are excavated side by side and are straddled by a single permanent superstructure.

2.3.6Factors to consider for Ventilated improved double pit toilet (Stephenson 2005).

- The system can be used in high density areas
- The system can be regarded as a permanent sanitation solution
- The contents of the used pit may be safely used as compost after a minimum period of one year in the closed pit

- The system can be used in areas with hard ground where digging a deep pit is impractical
- The superstructure can be a permanent installation

2.4 Group three

Group three sanitation systems require water to be added and conveyance is required also. These include full waterborne sanitation and flushing toilet with conservancy tank.

2.4.1Full waterborne sanitation

Full Water borne sanitation systems require an abundant and reliable supply of water, large capital investment, a high level of technical expertise for operations and maintenance, and incur substantial running costs (Brandberg 1997). The system requires a water supply connection to each property. The water is used to flush the excreta from the toilet pan and into the sewer, as well as to maintain a water seal in the pan. Water is used to convey the excreta in underground pipes to a treatment works

2.4.2Factors to consider for full waterborne sanitation (Stephenson 2005).

- The toilet can be placed indoors
- The system can be used in high density areas
- An adequate uninterrupted supply of water must be available
- High level of user convenience is obtained
- The treatment works must be operated and maintained properly if pollution of waterways is to be avoided
- The system can be regarded as permanent sanitation system

2.4.3Flushing toilet with conservancy tank

Conservancy tanks are intended to be temporary repositories for waste water until it is removed by draining or pumping-out by a suitably equipped. If this

service is neglected it can result in an unpleasant and odorous overflow (Reed 1995). The system is a standard flushing toilet which drains into the conservancy tank

2.4.4Factors to consider for flushing toilet with conservancy tank (Stephenson 2005)

- Regular collection is essential
- The system is hygienic and free of odours provided it is properly operated and maintained
- The toilets can be placed indoors
- The system can be used in high density areas
- The system is expensive to install, operate and maintain although the capital costs lower than the fully reticulated system

2.4.5 Settled sewerage systems

In settled sewerage systems the solid portion of the excreta is retained on site in interceptor tanks while the liquid portion of the waste is drained from the site in a small diameter sewer. The retention tanks should be inspected regularly and emptied periodically to prevent sludge overflowing from the tank and entering the sewers (Brandberg: 1997).Tipping tray pedestals and water saving devices can also be used in settled sewerage schemes without fear of causing blockage resulting from the reduced quantity of water flowing in the sewers.

2.4.6 Factors to consider for settled sewerage systems (Stephenson 2005)

- Vacuum tankers must be maintained by the local authority
- The toilet can be placed indoors
- A high level of user convenience is obtained
- The system can be regarded as a permanent sanitation system
- All household liquid waste cab be disposed of via this sanitation system

- The system can be used in high density areas
- An adequate uninterrupted supply of water must be available

2.5 Group four

Group four sanitation systems require water to be added and conveyance is not required also. These include flushing toilet with septic tank and low flow on site sanitation systems.

2.5.1Flushing toilet with septic tank

A septic tank is a watertight settling tank to which wastes are carried by water flushed down a short PVC pipe.Brandberg (1997) states that a septic tank does not dispose of wastes; it only helps to separate and digest the solid matter. The liquid effluent flowing out of the tank is as dangerous as raw sewage from a health point of view and must be dispersed by soaking into the ground through the soak pit. The sludge accumulating in the tank must be removed regularly, usually once every one to five years, depending on site, number of users, and kind of use.

2.5.2 Factors to consider for flushing toilet with septic tank (Stephenson 2005)

- The toilet can be inside the dwelling
- The system is hygienic and free of flies
- The system has excellent potential for upgrading since the septic tank outlet can easily be connected to a settled sewerage system at a future date
- An adequate uninterrupted supply of water must be available
- They provide a service virtually equivalent to waterborne sanitation

2.5.3 Low flow on site sanitation systems

Aqua privies, low flow septic tanks and pour flush toilets are on site sanitation systems which use low volumes of water for flushing. An aqua privy is septic tank under a pedestal. The tank must be water tight to prevent odours and insects

away. Pour flush toilets use small amounts of water which is poured in the pedestal to effect flushing and to maintain a water seal.

2.5.4 Factors to consider for Low flow on site sanitation systems (Stephenson 2005)

- The excreta are visible in the case of aqua privies
- The system is hygienic provided that it issued and maintained correctly
- The tanks need regular inspection and sludge removal is required from time to time
- The system can be regarded as a permanent sanitation solution

2.6 Summary

It has been seen that there are a number of different sanitation systems available. Each sanitation system is suitable for different conditions. Environmental factors and surface pollution should be considered in choosing the sanitation system and also the system should not be beyond the technological ability of the community in so far as operation and maintenance is concerned.

2.7 Conclusion

Cheaper affordable Sanitation systems are available for informal settlements, whilst waiting for the government to ensure proper waterborne sanitation systems are available for informal settlements. The Ventilated improved pit toilet and the Ventilated improved double pit toilet are the most convenient and easy to construct in informal settlements. They are better of compared to the bucket systems.

2.8 Testing of hypothesis

The introduction of alternative sanitation systems which do not require high input of finance is the hypothesis as stated in chapter one, to solve the sanitation

problem and it is correct. Cheaper sanitation systems can be used in informal settlements.

CHAPTER 3

3. Water supply

3.1 Introduction

Water is the most important in any form of settlement, without water there is no life. In informal settlements water is used essentially for drinking, cooking, washing, and physical hygiene. Source of water in many informal settlements is very scarce. Access to clean potable water is identified as a basic right in the

Constitution. As a result, population growth and the subsequent demand for water is one of the largest pressures influencing the state of water resources (Cowan: 1995).The tendency to migrate to urban areas has resulted in a gradual increase in demand for water resources in these urban areas. For South Africa as a whole, the expected increase in demand for urban and domestic water over the next thirty years is 219% (Walmsley & Pretorius: 1996).

The objectives of a water supply project should include the following (Holden: 2004):

- The provision of sufficient water for domestic consumption and hygiene
- The importance of the quality of the existing supplies
- The improvements of the avaibility of water to the community
- The improvement of public health
- The improvement of the economic potential of the community
- The development of local technical, financial and administrative skills

They are two main categories of water these include surface water and ground water. Surface water is water on the land surface which includes streams, rivers, lakes and dams. Surface water is more vulnerable to human contamination than groundwater because of its direct exposure.

Basic surface water quality problems are defined as those associated with particulate content, colour, taste, odour and microbiological content. They cause water quality problems such as high salt content, acid water, contamination by bacteria and pollution by toxic substances (Dwaf: 1996). Surface water quality is impacted on by the following:

- Impoundments;
- Sewage effluents;
- Pollution of surface water resources from surface run-off and other sources;

- Salinisation;
- Acidification from mining effluents; and
- Diffuse pollution from dense settlements;

Groundwater is water contained within the geological formations accessed by springs, wells or boreholes. Small communities in the developing world rely heavily on ground water sources and must manage them with limited resources. The survival of pathogens in groundwater systems is an important factor in determining quality of drinking water supplies (Dwaf: 1996).

Ground water has historically been given limited attention, and has not been perceived as an important water resource, in South Africa. This is reflected in general statistics showing that only 13% of the nations total water supply originate from groundwater (Holden:2004).Alternative water supply may be considered for informal settlements to cater for the scarcity of the essential water. These alternatives may include boreholes, hand dug wells, tube wells, spring protection and rain water harvesting.

3.2Boreholes

A borehole is the generalised term for any narrow shaft drilled in the ground, either vertically or horizontally. A borehole may be constructed for many different purposes, including the extraction of water. It is completed by installing a vertical pipe and well screen to keep the borehole from caving (Waterlines: 1995). This also helps prevent surface contaminants from entering the borehole and protects any installed pump from drawing in sand and sediment. The depth of the borehole should accommodate seasonal or annual fluctuations in water levels so as to avoid the borehole going dry when the water table is low.

A hydrological survey to determine the appropriate siting of the borehole is recommended. The optimum diameter of the borehole must be determined taking into account the anticipated yield, the demand and the extraction method used (Peter, Ball: 2001).Water quality depends on the inherent properties of the groundwater when extracted, threats of contamination during the extraction process, and threats of contamination from the surrounding environment(Waterlines:1995).

Costs of boreholes are associated with, drillings casings and a sanitary seal. A sanitary seal prevents contaminants from entering down the side of the borehole casing. If the borehole yield decreases over time, boreholes may need to be remediated.Clogging may be improved by cleaning out the borehole using a weak acid solution under high pressure. Abstraction from the borehole and water levels must be regularly measured to avoid over abstraction and the borehole running dry (Peter, Ball: 2001).

3.2.1 Advantages of boreholes

Advantages of boreholes include (Holden: 2004):

- Boreholes are the only means of extracting water in hard rock environments
- They are more efficient per metre than hand dug wells, as less material needs to be removed
- They can be constructed within short times
- The water source is generally reliable as they can extend deeply to reach reliable aquifers

3.2.2 Limitations of boreholes

Limitations of boreholes include (Holden: 2004):

- The borehole offers limited storage capacity for low yielding aquifers
- Problems with clogging of screens and scouring of sand from behind the screens may be encountered

- If the raw water has a high iron or manganese content the abstraction screens will clog, greatly reducing the yield
- Uncased boreholes are liable to collapse in highly weathered formation
- Expert advice must be sought to establish when casing is necessary or not
- Down-hole equipment must be used for down hole maintenance, and
- Borehole drilling costs are higher than hand excavation

3.3 Hand dug wells

The traditional method of obtaining groundwater in rural areas of the developing world, and still the most common, is by means of hand-dug wells. However, because they are dug by hand their use is restricted to suitable types of ground, such as clays, sands, gravels and mixed soils where only small boulders are encountered. Depths of hand-dug wells range from shallow wells, about five meters deep, to deep wells over 20 meters deep (Wood, Watt: 1985).
Excavation below the water table should be carried out within pre-cast concrete caisson rings of a smaller diameter than the rest of the well. To facilitate the ingress of water, these lower rings are often constructed with porous, or no-fines, concrete and their joints are left unpointed (Wood, Watt: 1985).

Costs associated with hand dug wells are payment to labour for the digging of the well, materials for the lining, building of the protective collar, construction of the well cover and the construction of the drainage apron. The well must be kept clean and in sanitary conditions (Holden: 2004).

3.3.1 Advantages of hand dug wells

Advantages of hand dug wells include (Holden: 2004):

- Equipment needed is light and simple and thus suitable for use in remote areas.
- The construction techniques are easy for an unskilled worker to learn.

- With the exceptions of cement and reinforcing rods, the necessary materials are usually locally available, making it one of the cheapest methods of well construction.
- This system can provide a household level of service
- The large diameter means that the well can act as a form of storage
- The risks of contamination are decreased as the well upgrades are increased

3.3.2 Limitations of hand dug wells

Limitations of hand dug wells include (Holden: 2004):

- Children and animals can fall into unprotected wells
- Depending on the level of improvement made to the hand dug well, there is a risk of contamination
- 200 feet is usually the practical limit of depth that can be reached, although most dug wells are less than 65 – 70 feet deep.
- Construction is slow.
- Extracting large quantities of water with motorized pumps is not always feasible due to lack of electricity.
- Hard rock is very difficult to penetrate and often can only be accomplished by blasting, which is slow, hard work.
- Because it is difficult to penetrate very far into the aquifer, slight fluctuations in the water table often make hand-dug wells unpredictable and unreliable.

3.4 Tube wells

A Tube well is a tube or pipe bored into the underground reservoir, fitted with a strainer at the lower end and worked at the top by a pump, to lift water. A Tube well is a type of water well in which a long 5 to 8 inch wide stainless steel tube is inserted in the well. This tube is then extended to the underground water below

the lower surface of the well. The tube is connected to a pump which was driven by the large diesel engines in the past but now electric motors are being used instead of engines(Stapleton:1983). This is a much cheaper source of power.

Seepage down the tube well bore is prevented by the sanitary seal. Seepage from the ground above the aquifer is excluded by the lengths of plain casing. Water to be pumped is admitted through slots in the lower lengths of casing (Stapleton: 1983).Screening is nearly always needed, in some form. Sand or gravel packing is meant to eliminate particles. Costs associated with tube wells include drilling, casings, screens and the sanitary seal.

3.4.1 Advantages of tube well

Advantages of tube wells include (Holden: 2004):

- They are cheaper per metre than dug wells, as less material needs to be removed
- They are cheaper than drilling rigs in soft formations
- They can be constructed within short frames
- They can be sunk deeper than hand dug wells in unconsolidated sand, and may therefore provide a more reliable water supply

3.4.2 Limitations of tube well

Limitations of tube wells include (Holden: 2004):

- They offer limited storage capacity for low yielding aquifers
- Problems with clogging of screens and scouring of sand from behind the screen may be encountered
- If the raw water has a high iron or manganese content the abstraction screens will clog greatly reducing the yield
- Access down the hole is not possible
- They can only be constructed to a limited depth as compared to boreholes

3.5 Spring protection

Springs occur where water from an underground aquifer flows out of the ground to the surface. The spring can occur where the water flows out of the ground by gravity, or it could be an artesian spring where the water appears at the surface under pressure from a confined aquifer below (Jordan :1984). The point at which the water reaches the ground surface is known as the eye of the spring. The structure which is required to catch the water from a spring will depend on a number of factors. These include the size of the spring and whether the users will come to the spring or the water will be taken in a pipe to the users. A sanitary inspection should be undertaken once or twice a year to identify if there are any sources of potential contamination of the spring water (Ravenscroft: 2001). Costs associated with spring protection include cement, river sand, pipes, concrete block and a plastic or ferro cement tank.

3.5.1 Advantages spring protection

Advantages of spring protection include (Holden: 2004):

- Spring protection prevents contamination of the water making further treatment unnecessary
- Spring protection may increase the yield protected
- Spring protection is generally inexpensive
- The system taps base flow water and thus has no major impacts on the local water table
- The simplicity of technology used for spring protection allows for labour intensive construction to be carried out by local artisans

3.5.2 Limitations of spring protection

Limitations of spring protection include (Holden: 2004):

- The supply may be low with seasonal reductions
- If construction is not done in an appropriate way the spring can find an alternative route underground thus bypassing the spring chamber

- Large springs may contain suspended particles which can sediment out in the system or be passed down the pipeline to the consumer

3.6 Abstraction from a sand dam

Sand dam is a small dam build on and into the riverbed of seasonal sand River. The functioning of a sand dam is based on sedimentation of coarse sand upstream of the structure, by which the natural storage capacity of the riverbed aquifer is enlarged (Hussy: 1997). The aquifer fills with water during the wet season, resulting from surface runoff and groundwater recharge within the catchment. When the riverbed aquifer is full, usually within one or two large rainfall events, the river starts to flow as it does in the absence of the dam (Hussy: 1997). The primary function of a sand dam is increasing the water availability by storing water in the riverbed and banks. Water is stored in the spaces in the sand. Water is usually abstracted through the construction of horizontal infiltration drainpipes or galleries (Hussy: 1999). Capital requirements include the digging of trenches, the cost of pipes, screens and the abstraction of chamber.

3.6.1 Advantages of sand dam abstraction

Advantages of sand dam abstraction include (Holden: 2004):

- The water is generally clean since it is underground
- Evaporation losses are reduced

3.6.2 Limitations of sand dam abstraction

Limitations of sand dam abstraction include (Holden: 2004):

- Problems with clogging of screens and scouring of sand from behind the screen may be encountered

- If the raw water has a high iron or manganese content the abstraction screens will clog greatly reducing the yield

3.7 Rainwater harvesting

Harvesting rainwater is the gathering, or accumulating and storing, of rainwater. Traditionally, rainwater harvesting has been practiced in areas where water exists in plenty, and has provided drinking water and domestic water. Rain water gathered from the ground is collected from sloping surfaces which are either compacted or covered with tiles; concrete and directed to storage tank Rain water collected from roofs is channeled via gutters and pipes into storage tanks(Holden: 2004).

3.7.1Advantages of rainwater harvesting

Advantages of rainwater harvesting include (Holden: 2004):

- Technology is easy and easy to apply
- Water is collected at household level so there is ownership of the system
- Water is provided at the point where it is needed
- Quality of water is easily maintained
- Soil erosion and flooding around the house is reduced
- Gutters and storage tanks can be constructed from locally available material
- The groundwater is less likely to be over exploited it is used in conjunction with rainwater harvesting

3.7.2 Limitations of rainwater harvesting

Limitations of rainwater harvesting include (Holden: 2004):

- Rainwater is an unpredictable and irregular source of water
- Large tanks may be required in areas where the dry season is long

- It is difficult to attach guttering systems to circular or thatched roofs, these require flexible guttering like impermeable shade cloth

3.8 Summary

Different sources of water are available. Each source of water has its advantages and limitations. The environment where the water is required like in informal settlements will have a huge factor on the type of source of water to be used.

3.9 Conclusion

Water should be used economically to ensure that everyone including residents in informal settlements have access. Quality water should also be provided in informal settlements to avoid health hazards which can lead do death.

3.10 Testing of hypothesis

The involvement of local municipalities to solve water problems and introduction of alternative water supply systems was the hypothesis as stated in chapter one. The hypothesis is partially correct, this is because not all informal settlements have high water table to enable a well or borehole to be dug. Also not all informal settlements have high quantity of rain or a dam close by for abstraction from a sand dam or rainwater harvesting.

CHAPTER 4

4.Building material and building standards

4.1Introduction

Major problem of shacks is the building materials used and the standard conditions of the shacks. A lot of fires occur and many shacks burn. People loose everything in shack fires. They loose money, clothes, and documents. Shack settlements occupy unused land. The fact that the land is not legally theirs, people who live there live in fear of eviction. If they manage to stay on the land, the settlement is not allowed to expand and the shacks become very dense. Often people build very close together so that new shacks will not be noticed and destroyed by the Land Invasions Unit, thus when a fire occurs most shacks if not all burn because they would be very close together. In some communities the only space that is not for shacks is the paths between the shacks. Most cause of fires in shack settlement are due to candles and paraffin stoves.

Thousands of people are made homeless every year after shack fires. For many of them it will not be the first time. Often people will stay with friends or family in the area, or in other areas. They may also stay at their work places. If a fire happens at night when people are sleeping, or they are not in the area, many people are left with only the clothes they are wearing. Shacks are often built from industrial by-products, scrap and unwanted materials as well as purchased materials or a combination of both. Most shacks are built from timber, corrugated metal sheets, fiber cement or a combination of the three.

Residents of the township stay in corrugated iron and wooden shacks, held together with plastic and scraps of wood. These shacks are approximately 3m x 3m, usually comprising of one room in which the families live, sleep, cook and eat. Most shacks do not have windows to let light in. These shacks are often home to up to seven people from the same family. In the winter, families face the cold and the rain, while in the summer; the heat inside these shacks is unbearable.

Different type of materials exists which may be used for construction of shacks and different ways such as wood frame construction. The standard of building of shacks may also be improved if proper regulations are followed.

4.2 Wood frame construction

Wood-frame construction combines dimension lumber or engineered wood products and structural wood panel sheathing to make walls, floor and roof assemblies that are robust and fast to build. The assemblies are tough, easy to connect and easy to insulate. Most builders appreciate wood-frame construction for its proven history of performance, its ease of use, its availability and its value in relation tots cost. Wood framing means comfort and economy when it comes to keeping you warm in winter and cool in summer. Wood is a good insulator because of its cellular structure. Wood-framed walls and floors are good performers when it comes to keeping the noise out.

Wood is a material that does burn, but can retain its strength during a fire because of the char that forms, providing protection to the unburned portion (Christian: 1974). Designing a building to ensure minimal risk or to meet a prescribed level of safety from fire is more complex than just the simple consideration of what materials will be used for construction (Stulz, Mukerji: 1993). Many factors must be considered including the use of the building, the number of people in the building, the presence of
fire detection and suppression systems, how easily people can exit the building in case of a fire and how a fire spread can be contained (Christian: 1974).

According to Wilcox (1991) wood-frame construction has proven to be one of the safest building systems in an earthquake because it offers some key earthquake advantages compared to other materials such as:

- Wood is strong and lightweight – less mass is an advantage because it means lower forces are exerted on a building.
- Wood-framing has many members and many nailed connections – there are lots of back-up load paths to absorb the forces.
- The nail connections typically used in wood-frame construction are effective in dissipating the energy of an earthquake.

Primary functions of buildings are to keep us warm and dry. No matter what the type of building or the materials used, water needs to be kept out of the building envelope. Houses built with wood have lower environmental impact for energy use, greenhouse gases, air and water pollution and ecological resource extraction than the steel or concrete building.

4.3 Paulos Novela's Zozos

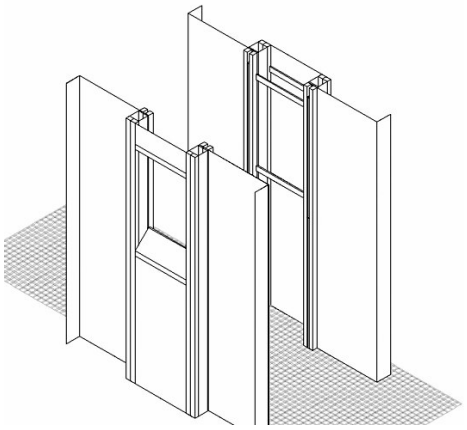
A case study was done on the construction yard which belongs to Paulos Novela. Paulos sells zozos. Zozos are flimsy shacks of timber frames and sheet metal that can be found all over the landscape of Mamelodi area in Pretoria. These zozos, however, are built differently depending on the construction yard and the availability of materials. Despite this, one can assume that the sizes of the zozos are similar thus basically standardized; and although the types of materials used may not be exactly the same, the basic features are similar (Osman, Peeters: 2005).

According to Osman, Peeters (2005), an analysis of the building system that Paulos uses to produce his shacks guides the proposal below to implement modifications to the system in order to improve the quality of the shelter. The materials that
are used for the design of the alternative shack are the same materials Paulos uses for the construction of the zozos. It is proposed that the panels be broken up into smaller modules which are then staggered to achieve more stability. They are also easier to transport in this way, and easier to use for alternative combinations which may ultimately offer more variety (Osman, Peeters: 2005).

The juxtaposition of the smaller panels offers more stability and allows for space for insulation or various coverings to be applied. At the junctions of these panels a hollow column is formed which may be filled with loose sand which offers more stability without loosing the potential to move the structure

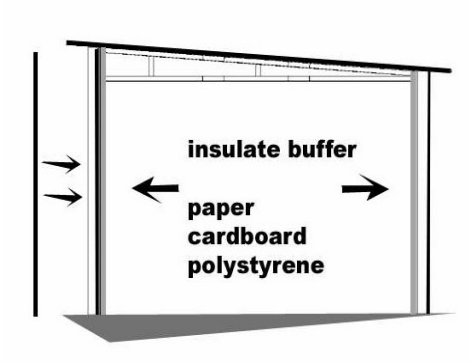
easily (Osman, Peeters: 2005). The main aims of a new optimized building system are increased stability and insulation, whilst respecting the current entrepreneurial initiatives of the so-called secondary market, addressing demand and achieving economic viability. By achieving this, other benefits are gained such as flexibility and variety. The shelters maintain the benefits of existing zozos by being easily transportable, re-sellable, extendable and adaptable. The proposed system may ensure a better quality shelter immediately that also has more potential to be up-graded into a more permanent house with complete facilities and services. (Osman, Peeters: 2005). Below shows the design of the proposed system

Figure 1



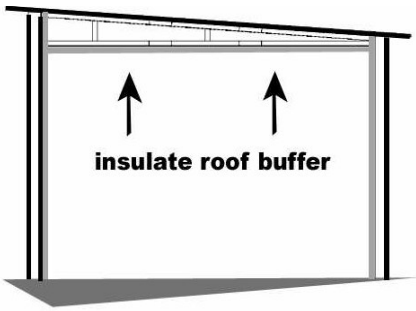
Construction of window Source: internet (08/08/09)

Figure 2



Insulation process Source: internet (08/08/09)

Figure 3



Insulation Source: internet (08/08/09)

Interventions such as applying paint to the outside of their shack, not only adds colour but also decreases the radiation through the steel sheeting; the application of insulation material on the inside of the shack will contribute to a higher insulation level. Simple variations may offer solutions to increase the energy efficiency of the shack. The use of different building materials, building orientation, window size, exterior colour, ventilation and the application of insulation are all possible means to achieve this (Osman, Peeters: 2005).

4.4 Cardboard Homes

The chic cardboard house is no longer the domain of hobo's and bums, but is now being called the home of the Future. The idea of the cardboard home was to get away from technology and create a home with the most simplistic ideas. Cardboard is 100 percent recyclable. The first luxury cardboard home is being worked on in Australia.

Figure 4

Source: internet (08/08/09)

All of the materials that will be used in the home will be recycled. There will be reinforced walls and some insulation. The only great part about a cardboard home is that it is recyclable and the toilet is a composting system that only produces nutrient rich water that is used for gardening.

4.5 Straw and Cob Home

This type of home construction will make the interior warm in winter and cool in the summer. The beams and posts are filled with bales of straw on the edge and will be used as a fill in.
Figure 5


Source: internet (08/08/09)

The straw will be between the walls, thus it provides insulation. Cob is a material that is made from clay, sand and straw, thus the material is environmentally friendly. The use of cob as a building material will make it cool in summer and warm in winter

4.6 Shacks joy

Shacks joy is a company which provides innovative shacks solutions from initial site consulting through to implementation and ongoing support. This company is located in Pretoria and started its business in 2005. Shacks joy vision is to come to the forefront of the affordable housing industry and to earn recognition through the outstanding quality of workmanship. The following pictures below will show the type of shacks provided and also describe the sizes and what the shacks

contain. The types of shacks are the small deluxe shack, medium deluxe shack, large deluxe shack and the family deluxe shack.

4.6.1 Small deluxe shack

figure 6


Source: shacks joy (08/08/09)

- 2.1m² x 2.4m² in size (5.04m²)
- Single window frame included
- Frames painted with Red Oxide primer
- Lockable door
- Roll-top roof ridging

4.6.2 Medium deluxe shack

Figure 7


Source: shacks joy (08/08/09)

- 3.0m² x 3.0m² in size (9.0m²)
- Double window frame included
- Lockable door

 Roll-top roof ridging
 Frames painted with Red Oxide primer

4.6.3 Large deluxe shack

Figure 8


Source: shacks joy (08/08/09)

 2.1m² x 4.8m² in size (10.08m²)
 2 Single window frames included
 Frames painted with Red Oxide primer
 Lockable doors

4.6.4 Family deluxe shack

Figure 9


Source: shacks joy (08/08/09)

 3.0m² x 6.0m² in size (18.0m²)
 2 Double window frames included

- Frames painted with Red Oxide primer
- Lockable doors
- Roll-top roof ridging

4.7 Summary

Ways to improve shacks are available. This will include the upgrading of the shacks using affordable material so that residence can afford. The building standards should be regulated and enforced to insure that in informal settlements disasters of fire hazards are reduced.

4.8 Conclusion

In order to implement a successful project in the informal settlements, the community must understand the advantages and principles of a new building system. The settlers must be educated about the possibilities of improvement inherent in a system that they are familiar with.

4.9 Testing of hypothesis

The implementation of building standards, alternative materials and alternative construction methods to improve the condition of shacks is the hypothesis as tested in chapter one. The hypothesis is correct it is possible to improve the conditions of shacks.

Chapter 5

5. Waste management and involvement of town planners

5.1Introduction

Most diseases in informal settlements are caused due to the lack of disposal of waste. The residents discard their wastes on open spaces which leads to diseases such as cholera. The management of waste is required in informal settlements. Waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials. Waste management differs for developed and developing nations, for urban and rural areas, and for residential and industrial producers (Ashworth: 1991). Management for non-hazardous residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator.

Town planners are important when it comes to the planning of the use of the environment. The involvement of town planners in informal settlements can help to ensure that, the informal settlements are legally recognised and that where settlements are hazardously or poorly located, alternative provision is made.

This will also mean that all matters relating to the ownership of land on which informal settlements are situated are resolved. Settlements will be restructured in a way that will allow for the provision of bulk infrastructure, including water, electricity and roads; Municipal services, including refuse removal, mobile clinics, libraries and ambulances, are provided; and Future settlement growth is properly structured and the development of further non-authorised settlement is contained.

5.2 Methods of disposal of wastes

Different types of wastes can be disposed in different types of ways, such as biological reprocessing, recycling method, incineration, landfill, energy recovery and the avoidance and reduction methods.

5.2.1 Biological reprocessing

Biological composting and digestion processes is used to decompose waste materials that are organic in nature, such as plant material, food scraps, and paper products (Reed:1995). The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. The waste gas from the process such as methane can be captured and used for generating electricity which can be of an added advantage if used in informal settlements to provide electricity. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter (Reed 1995).

5.2.2 Recycling method

Recycling as a waste management process is very efficient and cost effective. Products such as plastics can be collected and recycled into new products. Residents of informal settlements can be involved in the collection of products which can be recycled and get an earning from waste management groups.

5.2.3 Incineration

Incineration involves the combustion of waste material. It converts waste materials into heat, gas, steam, and ash. This process of disposal is carried out both on a small scale by individuals and on a large scale by industries. It is used to dispose solid, liquid and gaseous waste (Reed 1995). Informal settlements do not have so much space, increnation is common were land is scarce it does not require so much space. Combustion in an incinerator is not always perfect and there have been concerns about micro-pollutants in gaseous emissions from

incinerator stacks, thus this would be a major disadvantage to residents it might cause health hazards.

5.2.4 Landfill

Landfill involves the burying of waste. Landfills managed and designed poorly can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate (Reed 1995). A properly-designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. A major disadvantage of landfill is a byproduct gas mostly composed of methane and carbon dioxide, which is produced as organic waste breaks down anaerobically. This gas can create odor problems, kill surface vegetation, and is a greenhouse gas, thus it can cause health hazards to informal settlers if used and landfills require large areas of land which is not available in informal settlements (Reed 1995).

Modern landfills are being used lately they include methods to contain leachate such as clay or plastic lining material. The deposited waste is compacted to increase its density and stability, and covered to prevent attracting vermin. Landfill gas extraction systems are now being installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity.

5.2.5 Energy recovery

The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel.Pyrolysis and gasification are two related forms of thermal treatment where waste materials are heated to high temperatures with limited oxygen availability.Pyrolysis of solid waste converts the material into solid, liquid and gas products (Reed 1995). The solid residue can be further refined into products such as activated carbon. Gasification is used to convert organic materials

directly into a synthetic gas composed of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam.

5.2.6 Avoidance and reduction methods

Waste reduction is a method of waste management which is the prevention of creation of waste material. Avoidance is the reuse of second-hand products, repairing broken items instead of buying new products. This can be of great help to informal settlements where products will be recycled not discarded.

5.3 Stormwater management

Stormwater management is the management of storm water. This is very important in informal settlements because when ever it rains in most informal settlements floods occur (Stephenson 2005). Stormwater management must consider how the developed area in the informal settlement will interfere with the natural system. The drainage system is exposed to flows from more frequent, higher intensity storms because of the decreased time of concentration.

5.3.1Purpose of Stormwater management

Stormwater management is based on (Stephenson 2005):

- The desire to provide the optimum methods of controlling runoff in such a way that the main beneficiaries pay in accordance with their potential benefits
- The responsibility to preserve the natural environment
- The opportunity to conserve water and make it available to the public for beneficial uses
-
- The quest to improve the quality of affected communities
- The need to strive for sustainable environment while pursuing economic development

- The need to protect the health, welfare and safety of the public and to protect property from flood hazards by safely routing and discharging storm water from developments

5.3.2 Detaining and retaining storm water

When it usually rains in informal settlements water enters and floods the shacks due to lack of retention of storm water. Runoff can be stored in constructed dams and for the dams to be effective they demand much space thus not available in informal settlements. Successful detention of runoff may therefore have to rely on several technologies involving (Stephenson 2005):

:

- Maintaining vegetation cover to increase interception and evapotranspiration
- Maintaining pervious surfaces and reducing impervious structures
- A preference for overland flow as opposed to hydraulically efficient engineering conduits
- Detention ponds or rooftop detention

5.4 Planning

Planning is the art and science of ordering the use of land and the character and siting of buildings and communication routes so as to secure the maximum practicable degree of economy, convenience and beauty (Keeble:1952). Planning is the mark of good community sense and intelligent thought; it makes sense for a community to plan when changes are occurring and if the citizens wish to be part of those changes. Planning enables people to influence changes in the appearance, economy, and social life of their community (Daniels: 1988). This sort of planning is required in informal settlements to improve the living conditions.

Sustainable development is also required in informal settlements. According to Blowers (1993) sustainable development is development that enhances the natural and built environment in ways that are compatible with

- The need to achieve greater social equality
- Avoiding the imposition of added costs or risks on future generations wherever possible offsetting any avoidable reduction by a compensating increase so that the total is left undiminished
- The requirement to conserve the stock of natural assets
- The need to avoid damaging the regenerative capacity of the worlds ecosystems

For sustainable development to be applied in informal settlements the following goals asserted by Blowers (1993) should be met

- Resource conservation: to ensure the supply of natural resources for present and future generations through the efficient use of land, less wasteful use of non-renewable resources, their substitution by renewable resources wherever possible and the maintenance of biological diversity
- Built development: to ensure that the development and use of the built environment respects and is in harmony with the natural environment, and the relationship between the two is designed to be one of balance and mutual enhancement
- Environmental quality: to prevent or reduce processes that degrade or pollute the environment, to protect the regenerative capacity of ecosystems and to prevent developments that are detrimental to human health or that diminish the quality of life
- Social equality: to prevent any development that increases the gap between rich and poor and to encourage development that reduces social inequality
- Political participation: to change values, attitudes and behaviour by encouraging increased participation in political decision making and in

initiating environmental improvements at all levels from the local community upwards

5.5 Zoning

Zoning is one of the most important tools for putting the town plan in action, thus informal settlements should be zoned so that they become recognized as formal settlements and this will lead to proper developments. A zoning ordinance consists of text describing the different land uses, some general development standards, the administration of the ordinance and a map showing the location of the different zones (Daniels :1988).Zoning seeks to separate conflicting land uses that may pose a threat to personal health, safety and welfare. Some land uses are not allowed in certain zones, other uses may be permitted on a conditional basis and some uses are permitted outright. Zoning also seeks to influence the density of buildings and the size of buildings (Daniels: 1988).

5.6 Roads

In any community large or small an adequate road system is essential for the free flow of traffic and accessibility to all parts of the community, thus proper roads are required in informal settlements. A circulation and street inventory should be prepared first before roads are implemented. Daniels (1988) asserts that when compiling the inventory of streets and in developing goals and objectives for the transpiration plan, the following guidelines of transportation planning should be kept in mind:

- To move people and goods with minimum interference to residents and activities
- To enable residents to move safely and easily from one part of the community to another
- To develop a street system that leads effectively into the regional highway system
- To develop a local street system to provide adequate internal circulation

- To develop a street system that will encourage the separation of through and local traffic
- To minimize pedestrian vehicular conflict points
- To improve existing streets deficiencies

5.7 Summary

Domestic waste collection services are often provided by local government authorities, or by private industry. Informal settlements do not have a formal waste-collection system.

Planning is very important in any settlement, planning must reflect a community consensus on the needs and goals of the community.

5.8 Conclusion

Waste management is essential in any settlement Education and awareness in the area of waste and waste management is increasingly important from a global perspective of management. Planning can help a community to direct efforts toward common and pressing problems.

5.9 Testing of hypothesis

The involvement of town planners to improve environmental conditions in informal settlements including storm water management and waste management is the hypothesis as stated in chapter one. The hypothesis is correct the involvement of town planners storm water management and waste management will definitely improve the environmental conditions in informal settlements

CHAPTER 6

6. Summary conclusions and recommendations

6.1Summary

Housing in South Africa is a major problem; many residents in South Africa do not have proper shelter. Many local authorities are faced with a situation where the number of informal housing structures is increasing at a faster rate than the production of new housing. The failure of housing delivery to address the growing demands of the urban poor, in part explains the increase in informality within South Africa. Housing instruments in South Africa cannot cope with the increasing demand for housing.

In planned areas houses are built with permanent materials like bricks and corrugated iron sheets. Before they are built one has to follow a legal procedure as demanded by the Local Planning Authority. While in the informal settlements houses are usually crowded and built of any material available. There is no land use classification or a pattern of any sort. There is no control in plot sizes and this causes irregularities in the grid. There is high level of irrational use of space. Shack settlements are a poor person's solution to a lack of affordable housing, especially in cities. Shack settlements are close-knit communities of people who are trying to make a better life for themselves despite years of neglect and hostility from politicians.

People move to the cities from rural areas in search of work, tertiary education, and health care. People also leave formal housing to live in shacks when they can no longer afford that housing after a breadwinner dies or loses a job.Informal settlements are not the best living conditions anyone would want to live in, given an option. The main question in mind was whether it was possible to take a proactive approach and improve the current living conditions of the informal settlers whilst awaiting the construction of the low cost housing.

6.2 Conclusion

The main problem was whether it was possible to take a proactive approach and improve the current living conditions of the informal settlers whilst awaiting the construction of the low cost housing. The main problem has been solved; it is possible to upgrade informal settlements whilst informal settlers wait for the construction of low cost housing.

In order to be able to undertake integrated development interventions, it is important to have reliable and up to date information about the community such as affordability levels. Informal settlements, especially in their formative periods, depend heavily on existing neighboring townships for access to potable-water; refuse collection, maybe even food and some transport. Vacant, unprotected spaces adjoining the poorest parts of the formal city are thus the most susceptible to new shack erection.

Healthy communities require open space for recreation. However, such space is often at a premium particularly during short term emergencies and so they tend to be occupied. Informal settlement upgrading is not about eradicating shacks, it is about an integrated approach to development aimed at addressing poverty. Informal settlements are usually left to grow on their own for a long time without any control from the local authorities. Local authorities only come in when there are demands of upgrading such settlements. Usually this is at such times when these settlements have grown and are demanding for recognition from the authorities. Upgrading such settlements is never easy. This is because settlements were left to grow without any guidance. As a result they have grown without provision for basic infrastructure and services.

. Informal settlement upgrading is not simply the responsibility of housing departments, but rather the multi-sectoral responsibility of a range of stakeholders or partners who should work collectively to address the

community's development priorities through a range of complementary social and physical development initiatives that address urban livelihoods, land tenure, co-operative governance, social inclusion and environmental security.

An integrated housing strategy should be planned for informal settlements which should include a managed land settlement strategy, in which people can get rapid access to land with basic services, in order to pre-empt the formation of new informal settlements. Refusal to allow shack settlements access to electricity leads to the use of dangerous sources of light and heat, such as paraffin stoves and candles. These dangerous sources of heat leads to fires, upgrading of informal settlements will lead to safer means of energy such as electricity.

Shacks burn easily because they are made of wood and plastic and cardboard as mentioned before. People are not allowed to formalize their shacks themselves. If someone replaces a plastic wall with a brick wall the land invasions unit can destroy the whole shack.Formalisation of informal settlements by town planners will ensure that land invasions unit will not destroy better shacks which use bricks thus, if settlers living in the shacks were living in houses made of bricks then shack fires would not be such a serious problem. The severity and frequency of shack fires are made worse by the denial of services and infrastructure to shack communities.

The upgrading of informal settlements is invariably a phased process, the ultimate objective of which is to provide everyone with acceptable housing. Therefore responsibility for the upgrading of informal settlements lies with whoever is responsible for the provision of housing and the functions related to it. It is also implied that if an informal settlement cannot be approved as an acceptable human settlement in its present form it must be made the subject of a project to re-establish the community in conditions that would be acceptable.

In situ upgrade of informal settlements if implemented in the correct manner will be the best solution for upgrading. The informal settlement is upgraded as it stands with the objective of having to relocate as few dwellings as possible. Roads and other infrastructure are designed to fit into the shape of the settlement. As a result of this unconventional approach to township layout sites will tend to be of irregular shape and size. The fact that informal settlers do not want to vacate the land they occupy in situ upgrade would be the most convenient.

Water is a basic need to any individual and it lacks in many informal settlements residents of informal settlements depend on the nearest townships for water. The improvement of informal settlements will ensure that water is available. The objectives of water supply include the provision of adequate water for domestic use and hygiene; economic development of the community such as small scale industries and agriculture and firefighting. Alternative sanitation will be provided within informal settlements of which it is very essential to improve the health levels and to protect the natural environment.

The objectives of electrifying informal settlements would be met when improvements are done, these include the elimination of illegal wiring crossing public roads surrounding settlements and also to provide electricity supplies to as many dwellings as possible in order to raise living standards, stimulate home industries and enable students to study at night and mainly to render the supply of electricity to informal settlements in as safe as possible manner in compliance with the terms of the Occupational Health and Safety Act.

The situation may arise where it is essential that one or more dwellings be moved for future roads or railway. Informal settlers are sensitive about moving their homes, due to proper strategy and planning care will always be taken to explain the reasons for moving and the proposed process and to provide the

opportunity for discussion of any realistic alternatives. Improvements of informal settlements its definitely possible with proper planning.

6.3 Recommendations

Different forms of upgrading informal settlements exist; these forms of upgrading were not delt with comprehensively in the research. Comparison of these forms of upgrading can be researched on, to find out which would be the best to be used in informal settlement upgrades. The following below are the types of upgrading

- In situ upgrade
- New township development
- Basic infrastructure
- Emergency infrastructure
- Roll-over upgrade
- Managed land settlement

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