EVALUATION OF SOLID WASTE PRACTICE IN DEVELOPING URBAN AREAS OF SOUTH AFRICA

EXECUTIVE SUMMARY

Report to the
WATER RESEARCH COMMISSION
by the
PALMER DEVELOPMENT GROUP

WRC Report No. 629/2/96

WATER RESEARCH COMMISSION

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Preface

In January 1994, the Water Research Commission appointed Palmer Development Group to carry out an evaluation of solid waste practice in developing urban areas in South Africa (Project reference K5/629).

The broad objective of this project is: to carry out a strategic evaluation of the present status of domestic solid waste services to developing communities in the urban areas of South Africa with a view to providing relevant and up to date information and analysis upon which rational policy and practice may be based so that the large and increasing demand for solid waste services in developing urban communities may be met in an economically efficient and equitable manner.

The project was conceptually divided into three phases as follows:

Phase 1: Overview

- A review of the current status with domestic solid waste management internationally.
- Execution of a survey of solid waste practice in the urban areas of South Africa, based on questionnaires and interviews, to determine who has access to adequate services, what type of systems are being used, and to obtain as much operating and cost information as possible.

Phase 2: Evaluation using case studies

- Evaluation of solid waste practice to determine: level of access and acceptance by communities; technical options; cost; financial viability; management efficiency; and environmental impact. The method of evaluation is based largely on case studies where the situation in specific areas is investigated.

Phase 3: Key issues and guidelines

- Holding of workshops in different centres around the country to get input from people active in the field, using the findings of the first two phases as a basis.
- Preparation of a summary of the situation with solid waste practice, identifying key areas for action and preparation of draft guidelines for the planning and management of solid waste management systems.

As part of these three phases a series of reports have been prepared, as listed on the following page.

List of documents

1	**Main Report:**	**Evaluation of solid waste practice in developing urban areas in South Africa**
2	Executive Summary	
	Provincial profiles: status of solid waste practice in each province:	
3	Western Cape	
4	Northern Cape	
5	Orange Free State	
6	Eastern Cape	
7	Natal / Kwazulu	
8	Eastern Transvaal	
9	Northern Transvaal	
10	North West	
	Metropolitan profiles: status of solid waste practice in the three major metropoles:	
11	Gauteng	
12	Cape Town Metropolitan area	
13	Durban Functional Region	
	Case studies of six urban areas in South Africa	
14	Khayelitsha (Cape Town metro)	
15	Umlazi (Durban metro)	
16	Soweto (Gauteng)	
17	Alexandra (Gauteng)	
18	Rini (Grahamstown)	
19	Winterveld (peri-urban settlement in North West province)	
	General reports	
20	Costing of Domestic Solid Waste Management Systems	
21	Draft Guidelines for Domestic Solid Waste Collection	

Acknowledgements

The research in this report emanates from a project funded by the Water Research Commission and entitled:

"Evaluation of solid waste practice in developing urban areas in South Africa".

The Steering Committee for this project includes the following people:

HC Chapman	Water Research Commission (Chairman)
DS van der Merwe	Water Research Commission
FS Vivier	Dept of Health
AB Fourie	University of the Witwatersrand
L Bredenhann	Directorate: Water Quality Management
JS Barnard	Transvaal Provincial Administration
J Palm	GFJ Inc
D Joubert	Institute of Waste Management
C Mbande	Van Wyk and Louw

The financing of the project by the Water Research Commission and the contribution of the members of the Steering Committee is gratefully acknowledged.

In carrying out the work for this project an extensive survey was undertaken of organisations involved in the provision of solid waste services throughout South Africa and case studies were done in six specific areas. The success of the survey and case studies has been due largely to the efforts of the numerous people who responded to the survey, gave up time for interviews, and assisted with the case studies. Their assistance and support is sincerely appreciated.

Project team

The Phase 1 and 3 reports, and four of the case studies were written by Robert Macdonald, with assistance from Bee Thompson of Palmer Development Group. Katrina Smith from Durham University in the United States prepared the case study on the Winterveld and assisted with the international review. Justin Descoins of Palmer Development Group prepared the case study on Rini. Trevor Hughes carried out the data analysis and assisted with report preparation. The project was coordinated by Ian Palmer.

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1. INTRODUCTION

This report provides a summary of the findings of the WRC project entitled *"Evaluation of solid waste practice in developing urban areas in South Africa."* The broad objective of this project was to carry out a strategic evaluation of the present status of domestic solid waste services in developing communities in the urban areas of South Africa. More specifically, the objectives were: to assess the current state of domestic solid waste management in developing urban areas; identify the factors that influence effective solid waste management; determine any links between solid waste practice and studies on stormwater runoff; and finally to make recommendations for the improvement of domestic solid waste management.

The project was conducted in three phases. Phase one had the overarching aim of establishing a picture of the current state of domestic solid waste practice in South Africa, with specific reference to developing communities. The work for this phase also involved a review of international trends in solid waste management. Phase two reviewed solid waste practice in six selected communities with the aim of evaluating the major issues surrounding the delivery of services in developing communities. Phase three was an interactive workshop process where the research findings were presented and comment thereon was received.

2. METHODOLOGY

2.1 Phase One

The work in this phase involved a literature review, interviews with key people in the field, and a questionnaire survey of local authorities providing solid waste services. The questionnaire survey involved sending questionnaires to 493 white local authorities (WLAs) and questionnaires to 271 black local authorities (BLAs). The WLA response rate was 62% and the BLA response rate was 40%. The total population covered by this survey was about 16.2 million people, out of an estimated urban population of 21.7 million.

2.2 Phase Two

The case studies were conducted through a process of reviewing relevant documentation, interviews with key people in the respective areas, and visits to each of the locations studied:

- Alexandra, Gauteng
- Soweto, Gauteng
- Umlazi, Kwazulu/Natal

- Rini, Eastern Cape
- Khayelitsha, Western Cape
- Winterveld, North West

2.3 Phase Three

Workshops were conducted in five centres throughout the country:

- Bloemfontein
- Cape Town
- Durban
- Johannesburg
- Port Elizabeth

Over 250 practitioners, consultants, as well as interested and affected parties attended the workshops.

3. CONCEPTUAL FRAMEWORK FOR WASTE MANAGEMENT

Determining a conceptual framework for waste management involves identifying the various stages of the waste management process. It also enables a definition of solid waste management and its objectives to be derived. The framework and objectives served to provide a consistent point of reference for the research.

3.1 Objectives of solid waste management

The aim of waste management has been defined as the *"responsible re-introduction of waste into the environment"*, but ensuring that there is a *"balance between the lowest costs of actions and their environmental and other implications"*[1]. There are then two key aspects to solid waste management:

a) Environmental considerations

The waste management system must provide environmental benefits through clearance and hygienic disposal of waste. These benefits come in the form of an aesthetically clean environment and the eradication of disease.

[1] Hall,EJ & Ball, JM. "Planning Strategies for Solid Waste Management", 1989

b) Economic considerations

The waste management system must provide economic benefits through the provision of an effective service that is affordable to those who benefit from the service.

3.2 Stages of waste management

The waste management process involves a range of activities which encompass the following: generation; reduction; storage; collection; transport; reclamation; recycling; disposal as well as the sale of recovered and recycled materials.

Although there are standard activities within the waste management process, solid waste management systems cannot be planned according to universal principles but need to be adapted to the prevailing physical, cultural and economic circumstances of the communities which they serve. Clarifying a conceptual framework thus provides a point of reference against which circumstantial factors can be measured.

4. THE ENVIRONMENTAL IMPLICATIONS OF SOLID WASTE

Solid waste, whether collected or uncollected, has the potential to impact significantly on both the human and the natural environment.

4.1 The impact of uncollected waste

a) The Human Environment

Uncollected solid waste has a potential impact on health both directly and via effects on drainage systems. Possibly the most serious risk relates to its effects on the stormwater system. Blockages of the stormwater drainage system result in standing water which may be contaminated and which also encourages the breeding of mosquitoes and flies with the resultant threat of diseases such as malaria and diarrhoea. The problems associated with standing water transfer into water quality problems in stormwater channels, streams and rivers. Informal dumping can also impact on local groundwater quality while uncollected waste can lead to pest breeding, physical injury to children; air pollution; general flooding; land damage and aesthetic problems relating to sight and smell.

b) The Natural Environment

Uncollected waste that ends up in water courses and eventually in the sea impacts detrimentally on the ecology of such areas. Decaying organic matter and bacteriological activity use oxygen, thereby reducing the amount available for aquatic life. The process of decay leads to the undesirable growth of aquatic weeds, algae and macrophytes, affecting water quality and aesthetics. Plastics have also been identified as a particular problem for river and marine life. Uncollected refuse has been identified as a significant water pollutant in three major runoff studies carried out in Khayelitsha, Alexandra and the Hennops River Valley.

4.2 The impact of collected waste

The environment can be harmed both through certain collection and disposal practices. For example, the practice of using front end loaders for collecting waste creates problems as soil and vegetation is removed and ditches are created where water accumulates. Landfill sites can be environmentally damaging through the leaching of heavy metals and other hazardous substances into soil and groundwater. Also, the production of methane gas can be dangerous and there are obvious aesthetic impacts where landfills are located near to residential areas.

5. INTERNATIONAL TRENDS

An examination of international trends in domestic waste management highlights major differences between developed and developing countries in all aspects of the waste management process.

5.1 Institutional aspects

In developed countries there has been a shift to contracting out the provision of waste collection services. Research in these countries has shown that private contractors tend to be more efficient than the public sector. At this stage no definitive research has been conducted on this issue in developing countries. A key aspect of waste services in labour rich developing countries is that it is a service which has the potential to be a mass employer of low-skilled labour.

5.2 Waste characteristics

There is generally a contrast between waste from developed and developing countries in terms of both generation rates and density. The waste tends to be less dense in developed

countries, usually ranging between 100 kg and 150 kg per cubic metre, as opposed to over 400 kg per cubic metre in developing countries. The per capita waste generation rate tends to be higher in developed countries ranging between 1kg and 1.8kg per day, as opposed to developing countries where the range is usually between 0.3kg and 0.5kg per capita per day.

5.3 Storage

In developed countries storage containers are becoming highly sophisticated to the extent that in some countries technological developments have facilitated the installation of identity chips in containers so that variable collection fees can be charged according to the weight of the container. In developing countries containers are often non-standardized, with boxes and drums being used.

5.4 Levels of service

Developed countries tend to have consistent service levels with at least a once weekly kerbside collection being the norm. Developing countries are characterized more by large degrees of non-collection and, when a service is provided, it is often a communal collection system.

5.5 Transport

Compactor vehicles, and increasingly rail transport, are used widely in developed countries while low technology characterizes developing countries, with anything from pushcarts, bicycles and animal carts being used for transport. Trucks and compactor vehicles are also used in these countries but maintenance problems usually undermine their effectiveness.

5.6 Resource recovery and recycling

Resource recovery and recycling tend to be seen in developing countries largely as economic activities generating income and employment, while in developed countries it is legislation which drives the activities, largely due to environmental considerations, especially in view of decreasing landfill space.

5.7 Disposal

The key distinction between developing and developed countries is that of control. Sanitary landfilling and incineration take place in developed countries under strict controls. The lack

of control of disposal in developing countries is due largely to shortages of skills, both technical and administrative, and inadequate technology.

5.8 Problems

The problems experienced differ widely as the infrastructure of developed countries is so much more advanced than that of developing countries. Hence while developed countries are dealing with issues such as legislative controls for disposal, developing countries are addressing problems at the other end of the spectrum, namely a lack of collection. Other problems which were seen to be confronting developing countries included: institutional inadequacies; inappropriate technology; inadequate income; over-reliance on imported equipment; inappropriate methods of finance; inequity in service provision; limited attention to privatization and broader issues related to increased urbanization.

6. OVERVIEW OF SOLID WASTE PRACTICE IN SOUTH AFRICA

6.1 Levels of service

The extent to which households have access to domestic waste collection services was determined from the questionnaire survey and follow-up telephone calls. For this purpose, four basic levels of service were identified:

- Level One: No service provided.
- Level Two: Service provided, (either communal or kerbside), but inadequate.[2]
- Level Three: At least a once weekly communal collection.
- Level Four: At least a once weekly kerbside collection.

Levels one and two are regarded as "adequate" services,[3] while levels three and four are taken as "inadequate".

[2] Due to factors such as: low collection frequency, poorly located communal collection point, inadequate on-site storage or ineffective service provision.

[3] On the assumption that households have on-site storage facilities, the service is effective, the community is aware of how the service operates, and communal collection points are located within reasonable walking distance from households (about 150m).

6.2 Access to waste services

The estimate for access to household waste collection services for the total urban population in South Africa (21.7 million) is shown in figures One and Two.

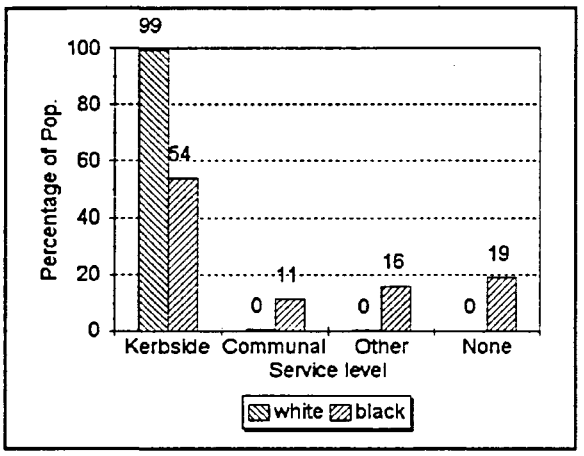

Figure 1: Access - WLA vs BLA

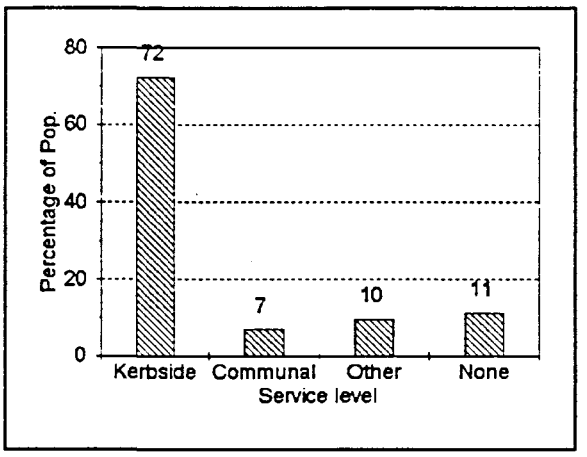

Figure 2: Access - Total urban

As can be seen, it is estimated that about 21% of the urban population, about 4.5 million people, do not have access to an adequate waste collection service. About 35% of the population living in Black Local Authority areas and urban areas of the former homelands do not have access to an adequate waste collection service.

It must be noted that these estimates are conservative, and that it is a very real possibility that up to 50% of the total black urban population lack an adequate service. This observation is based on two factors: first, while there was a 40% response rate among BLAs, those local authorities with the capacity to respond to the questionnaire are likely to provide a higher level of service than non-respondents; second, completed questionnaires tended to indicate 100% service coverage which was often contradicted by follow-up phone calls and questionnaires to RSCs.

6.3 Waste generation rates

Estimates of weekly household generation rates were received in both volume and mass terms. A total of 76 local authorities provided estimates by volume and 104 by mass but only the mass based figures are used here due to the difficulty in interpreting volume based data. The weighted average of figures received is given in Table 1. These figures need to be treated cautiously. Firstly, the limited response from BLAs means that the averages cannot be seen as representative. Secondly, the manner in which records are kept by local authorities vary greatly, and in many cases estimates given by local authorities cannot be expected to

be accurate.

Table 1: Household waste generation rates

	Mass in kg/household/week		
	"White" local authorities	Black local authorities	Total
Average (Sample size)	23.4 (93)	17.7 (11)	22.5 (104)

Source: Questionnaires
Notes: 1 All figures have been weighted by population
2 The figure in parentheses is the sample size

Based on the figures in Table 1, the daily per capita generation rates for WLAs (assuming 4.5 people per stand), is 0.74kg, and for BLAs (assuming 7 people per stand), is 0.36kg.

6.4 Waste composition

Waste composition in South Africa, in accordance with international trends, is influenced largely by three major factors: income level; geographical location; and seasonal conditions.

a) Income level

Higher income (developed) areas tend to have greater proportions of paper, plastic and organics in their waste stream. In contrast low income (developing) areas are characterised by high levels of ash and soil in the waste stream. This is due to the use of fire for energy and the widespread use of front-end loaders to collect waste in developing communities. The front-end loaders tend to pick up significant amounts of soil when scooping up random heaps of rubbish.

b) Geographical location

The influence of variable climates and differences in available resources arising from geographical locations can be seen, for example, in comparing low income areas in Gauteng and the Western Cape. The Gauteng waste tends to have a higher ash content than in Cape Town areas as more coal is used as an energy source in Gauteng than in the Cape.

c) Seasonal difference

Seasonal differences can be seen, for example, in the finding that there tends to be greater ash content in winter while the content of glass rises in summer.

6.5 Waste density

Typical waste densities in urban areas in South Africa accord with international trends, ranging from a low figure of about 140kg/cu.m. for high income communities to a high figure of about 330kg/cu.m. for low income communities. These figures would apply to waste which has been compacted in a conventional compaction vehicle.

For uncompacted waste the figures would be much lower, particularly for waste from high income communities which is more compactible. For example, using a crude interpretation of the questionnaire responses from "White" local authorities, an average density of 75 kg/cu.m. is calculated. This is based on an average volume of waste collected of 0.31 cu.m. per household per week, obtained from 66 questionnaires.

6.6 Institutional arrangements

a) Regulation

There is no national policy on waste management although under the Environment Conservation Act (73 of 1989), s2(1)c, it is possible for the Minister of Environment Affairs to declare a national policy. The CSIR has identified 37 key statutes, and 16 provincial ordinances which cover land-based waste and pollution control law.[4] Myburgh refers to the *"plethora of laws which seek to regulate waste management"*, and comments that the law is *"in a mess"* because there are so many laws and they often fail to address the relevant issues. [5] Furthermore at the level of local government where most of the control of waste appears to lie, there is no uniform set of by-laws for waste management.

b) Administration

The many laws impacting on waste management mean that there have been an abundance of central government departments with some involvement in regulating waste management. However there appears to be a lack of capacity within these departments to fulfil the tasks assigned to them. For example the CSIR described the Department of Environment Affairs as *"virtually powerless"*. Apart from limited capacity, Myburgh points out that the multiple overlaps in jurisdiction coupled with an absence of a hierarchy of authority result in *"bureaucratic paralysis"*.

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[4] CSIR. First Report on the Situation of Waste Management and Pollution Control in South Africa. Department of Environment Affairs, January 1991

[5] Myburgh, GS. "Environmental law in South Africa with particular regard to the management of waste: an analysis of the present position and probable future trends". October 1991

c) Service provision

Both the public and the private sector are involved in the provision of waste services, ranging from collection to disposal.

- **Public sector**

Local authorities, as required by the Health Act of 1977, are the public agents responsible for solid waste management at a local level. However in metropolitan areas there is a move towards the regionalisation of landfill sites where responsibility for disposal will be taken away from those local authorities and given to regional bodies such as metropolitan authorities. The responsibility for collection is however likely to remain at the local level.

In the past Regional Services Councils, Joint Services Boards and Provincial administrations were also involved in waste management. Certain RSCs/JSBs were designated a waste management function, the parameters of which ranged from pure administration through to the actual provision of collection services. The most common responsibility for RSCs/JSBs was the establishment, funding and monitoring of regional landfill sites. Under the Local Government Transition Act of 1993, this responsibility goes to transitional councils (former local authorities) in non-metropolitan areas, and in metropolitan areas to the transitional metropolitan councils.

- **Private sector**

The private sector is involved in waste management in respect of both collection and disposal services. This involvement tends to be greater in the metropolitan areas than in smaller towns. Examples of such involvement include Durban where about 20% of the total waste stream is collected by private contractors; the Cape Town metropole where it is estimated that about 9% of households have their waste collected by private waste companies; and in Gauteng, where an estimated 35% of households in Pretoria, and about 40% of the population in the Central Wits area are served by the private sector.

6.7 Finance

A total of 283 local authorities covering a population of just over 4.6 million provided information about overall solid waste management budgets.

Table 2: Local authority solid waste budgets.

Description	"White" Local Authorities		Black Local Authorities	
	per capita per year	per stand per month[1]	per capita per year[4]	per stand per month[2]
Household waste budget	R23.20	R8.70	R9.90	R5.70
Total solid waste budget	R40.40	R15.20	R8.80	R5.10
Ratio household/total[3]	0.47		0.81	
Sample size	228		75	

1. Based on a stand occupancy rate of 4.5.
2. Based on stand occupancy rate of 7.0.
3. Based only on those responses where both total and household budgets were reported for the same authority.
4. The fact that the average is smaller for total waste budget is due to a situation where sample for total budget was different to sample for household waste budget.

There are a number of important points which can be raised regarding these figures:

- There is a wide range in the figures from which these averages have been extracted. This relates to the variety of different conditions in various local authorities and also to the lack of standardisation in the way financial records are kept.

- A large part of the solid waste budget in WLAs does not relate to domestic waste. The balance includes provision for cleaning streets and other public spaces, industrial and commercial waste handling, and so on. The fact that the differential between domestic and total waste budgets is smaller in BLAs probably relates to the lack of attention to cleaning public spaces and the minimal need to deal with commercial and industrial waste.

- Considering only the domestic waste budgets, it is evident that the figures are low, both for WLAs and BLAs, when compared to costing for new systems, where a once weekly kerbside collection may cost R10 to R15 per stand. This can be related to a number of factors, the most important of which are likely to be:

  - The "hiding" of costs, notably charges for the capital costs of vehicles.
  - Insufficient provision being made for asset replacement, notably, once again, vehicles.
  - The likelihood that the service is often not effective in BLA areas.

- Improper accounting regarding subsidies received from higher levels of government or RSCs.

Turning to the issue of charges levied on consumers by local authorities for solid waste services, a total of 228 local authorities provided figures in the questionnaire responses. The weighted averages of the charge per stand is given below:

"White" local authorities:	R13.66
Black local authorities:	R8.05

It is uncertain whether these charges are intended to cover cleaning of streets and public open spaces. With regard to domestic waste collection, it is evident that WLAs are covering costs with their charges, while BLAs are not. In the latter case it also needs to be noted that there are high rates of non-payment. Hence actual cost recovery is substantially lower than indicated by the figures for charges vs costs.

6.8 Technical arrangements

a) Transport

In white local authorities, compactor vehicles (12 cu m or 19cu m), are the most common vehicles used for waste collection. In black local authority areas, collection vehicles vary between tractor and trailers, open topped tipper trucks and standard compactors. Black local authority areas are also characterised by the use of front-end loaders for the removal of piles of waste from pavements and streets.

Vehicles transporting waste from transfer stations tend to be roll-on-roll-off-vehicles and waste from communal sites tend to be transported by skip luggers. In the Cape Metropolitan area the transport of waste by rail is being planned. This will involve the baling of waste at a transfer station which is then placed on rail trucks and railed to the disposal site. It must be noted that, apart from the limited use of specially designed bicycles in the collection of recyclables in Soweto, there is little evidence of the use of non-motorized collection vehicles.

Certain general transport indicators were extracted from the survey of local authorities. For South Africa as a whole, it was calculated that on average 14 000 people are served by one collection vehicle. The average daily distance travelled per vehicle is estimated at 84km and the average loads per vehicle per day are estimated as $36m^3$ by volume, and 8.3 tons by mass. There is however a marked difference in these indicators between BLA areas and WLA areas: in BLAs it is estimated that there are over 24 000 people per collection vehicle,

compared with about 11 400 in WLAs.

In order to allow some interpretation of these figures, the number of people per vehicle can be compared with experience with newly planned solid waste collection systems. For a properly run system it could typically be expected that a 19 m^3 compactor vehicle could serve 5 000 stands (about 30 000 people). A figure of 11 400 people per vehicle would thus indicate inefficiency in the use of such vehicles.
In BLA areas the survey result of 24 000 people per vehicle indicates greater efficiency of use of vehicles, particularly considering the trend for smaller capacity vehicles to be used in these areas. However, it needs to be kept in mind that the waste quantity per person is substantially lower and the service has often not been provided properly. Therefore the indication of efficiency is false to an extent.

Estimates of daily loads carried were also calculated. In BLAs the average daily load carried by a collection vehicle is estimated to be in the region of 21m^3 by volume and 3.4 tons by mass. In WLAs, the average daily load estimate by volume is approximately 38m^3 by volume and 7 tons by mass. These estimates need to be treated with caution as the format and quality of information received about vehicle capacities and loads carried was not consistent.

6.9 Street cleaning

Information on street cleaning received from 214 local authorities showed a significant imbalance in resources between WLAs and BLAs. As can be seen in Table 3, BLAs effectively have half the resources per capita of WLAs.

Table 3: Street cleaning details

Area	Pop per labourer		Pop per vehicle		Pop per litter bin	
White LAs	2 800	(170)	27 000	(119)	350	(157)
Black LAs	6 300	(34)	46 000	(27)	890	(10)
Total SA	3 600	(204)	32 000	(146)	410	(167)

(Figure in parentheses is sample size)

6.10 Recycling

It is estimated that in 1992, 25% of waste in South Africa was recycled. The survey for this research indicated some form of recycling activity in 25% of local authorities. The recycling industry in South Africa has been characterised by notable failures with three major recycling

plants (Robinson Deep's Flow Plant; Randburg's Kya Sands Resource Recycling Plant and Durban's Tempo plant) closing down because they were economically unviable. Formal attempts at the collection of recyclables such as the Greensavers Scheme in Durban have also failed. Informal collection and scavenging from landfills is fairly widespread but it is unknown what volume of waste is recovered in this way.

Composting is undertaken by a few local authorities, but tends to be undertaken to save landfill space rather than because it is economically viable. Gas extraction from landfills is limited, with AECI's piping of gas from the Robinson Deep Landfill for use in cyanide production the most notable example.

6.11 Disposal

The major method of disposal of domestic waste is by landfilling. In 1989 it was estimated that 12 million tons of waste were disposed of in South Africa's landfills. It is estimated only one in ten disposal sites in South Africa is properly controlled and audited, and in 1993, of the 1 200 formal waste disposal sites in South Africa, only 60 had been issued with permits. This estimate accords with the survey results which found that of 342 local authorities indicating that they use landfills for disposal, only 67 of these (20%) make use of a classified or permitted landfill. Furthermore only 67 local authorities indicated that levies are charged at the disposal sites which they used. The results of the survey indicate that the average distance travelled to landfill sites from collection areas is approximately 6.9km.

6.12 Innovative collection systems

Innovative systems used in South Africa can be categorised in two ways:

- exchange systems
- small contractor systems

a) Exchange systems

Food for waste systems have operated in Doornkop, Khayelitsha and Wallacedene. These systems largely depend on grant finance and thus have proved to be unsustainable, although the Wallacedene system in Cape Town still operates on a fortnightly basis. A money for waste system was introduced in Marconi Beam squatter camp in Cape Town, but this failed due to a lack of community co-operation.

b) Small contractor systems

Small contractors are usually community based and make use of both labour based and mechanized collection methods. An example of a labour based system is the one man contract system operating in Stswetla, Alexandra, where individual "contractors", on foot, clear waste from designated areas of responsibility. Small contractor systems combining the use of labour and vehicles have been identified in KwaZulu/Natal, the Eastern Cape, Gauteng and the North West. Characterising these systems is the use of consultants as administrators of contracts; the use of low technology options such as tractors and trailers, and the employment of labour at a lower wage level than would be offered by a local authority.

6.13 Social aspects

In the past waste management has largely been treated as a technical issue in South Africa with social aspects being ignored. The need for household participation and co-operation is intrinsic to the provision of successful domestic waste collection services. For example, in the past the placing of skips in black communities as communal collection points generally took place without consultation with communities. Consequently skips have often been placed in unsuitable locations and have discouraged householders from taking their waste to the collection point. Furthermore the fact that children are active in taking waste to such points was also ignored, hence high sided skips prevented children from actually putting the waste into the skips. Other social issues relate to activities such as scavenging on landfills, about which there is no policy, and which is handled differently by local authorities, some accepting the activity and others trying to discourage it.

6.14 Problems

The survey determined the specific operational problems of local authorities based on their experience. On a national scale the most severe problem identified was that of inadequate finance. In white local authority areas, vehicles and disposal were the next two most problematic areas. In black local authority areas disposal was rated low, with vehicles, labour and supervision as being the most problematic after finance. The nature of the problems being experienced in BLAs reflects difficulties with the collection of waste, in contrast to WLAs where disposal appears to be more of a problem.

More general problems experienced with solid waste management were also identified during the course of the research, the major ones being:

- Inadequate service coverage - determined quantitatively in this research.

- Socio-political environment - encompassing issues such as: local authority officials not being part of the community they serve; the psychological impact of living in a dirty environment; lack of communication between communities and service providers.

- Socio-economic environment - high unemployment exacerbating the non-payment culture; the growth of informal settlements without land ownership.

- Management issues - ranging from inadequate institutional structures; inappropriate organisational design; lack of skills and inefficient systems.

- Funding - problems range from non-payment for services to the issue of greater cross-subsidies to domestic users in white local authority areas.

- Environmental considerations - lack of public environmental awareness; no policy on materials recovery and waste minimisation; absence of institutional structures taking responsibility and implementing control measures.

7. CASE STUDIES

The manner of service provision varied across the case study areas to the extent that systems examined included: local authority provision; private sector provision both within and external to the community; and no service provision at all. Brief features of each area are outlined below, with the major issues being identified.

a) Khayelitsha

The local authority provides a combined kerbside and communal service which reaches about 75% of the population. Problems are experienced in serving informal households located on unserviced sites. Proposals to improve the service through the acquisition of compactor vehicles has led to much debate between the local authority and community representatives. The local authority believes that more compactor vehicles will help improve the service that is provided, while the community sees this as inappropriate technology which does not attempt to address the issue of high unemployment in the area. A move to partially or fully privatize service provision is under investigation.

b) Rini

The local authority provides a twice weekly service to formal households (about 50% of the

population), a once monthly service to 25% of the informal households, with the remaining 25% of the population being totally unserviced. The local authority has suffered from the uncertainty accompanying local government changes but has the notable achievement of maintaining its level of service despite losing half its original resources after a cut in government bridging-finance. Incidents of informal dumping abound.

c) Alexandra

Three community based contractors provide a service combining kerbside and communal clearing. Inadequate local authority management structures and problems with the initial tender process have led to under-monitored and under-funded contractors providing a service that can only be described as inadequate. The first labour based one man contract has been launched in an adjacent squatter camp, Stswetla, with fourteen contractors employed to clear waste on foot. The system is operating successfully, but is dependent on grant funding.

d) Umlazi

Seven community based contractors provide a comprehensive cleansing service to 35 000 formal households. 25% of the population living in informal households benefit to a certain extent from this service, with contractors at times clearing waste from these areas. The system in the formal areas works very effectively largely due to stringent monitoring and control by consultants employed to administer the contracts. Dependence on grant funding does however raise the question of the system's long-term sustainability.

e) Soweto

Waste collection services in Soweto are provided by two external private waste companies. An on-site service is provided to 95 000 formal households with communal services being provided to some informal settlements. Attempts to introduce community based contractors into the process have been delayed by the need for tendering requirements to be amended. The current contracts are remunerated according to the amount of waste collected. This has raised questions over the use of front-end loaders in clearing informal dumps as a certain amount of earth finds its way into the waste which is collected in this manner.

f) Klippan, Winterveld

The absence of a waste collection service means that various methods of waste disposal are undertaken by residents. A household survey revealed that 50% of residents dispose of their waste in backyards while most of the remainder dump their waste within 3 minutes' walk of their households. Fifteen percent of the households feed animals with waste, while most of the households throw glass into pit latrines to prevent injury being caused by glass in waste dumps. In prioritising their demand for services, residents rated waste collection fourth

behind water, electricity and housing.

7.1 Key issues raised

Key issues raised about effective service provision in developing communities include:

a) Management crucial
The studies revealed a direct link between good management and the provision of an effective service. Good management involves ongoing consultation and communication between the service provider and the community; appropriate contract specifications when a service is contracted out, and effective supervision and monitoring on the ground.

b) Finance
The case studies highlighted two aspects of finance, the source of funding and the amount of money available. All the systems examined are dependent largely on grant funding and this raises questions over their sustainability.

c) Community awareness
The case studies indicated that residents' concerns regarding waste management issues range from high levels of concern to apathy. Apathy may be attributable to historically poor service levels and lack of environmental awareness. This stresses the need for education to be recognised as an important part of any service provider's responsibilities.

8. CONCLUSIONS

8.1 Access to services

Between 35% and 50% of the black urban population do not have access to an adequate waste collection service. This is a serious situation and the extension of services to currently underserviced areas needs to be undertaken urgently.

8.2 Institutional overhaul

A lack of institutional responsibility and capability has been identified. The current situation of various national government departments having involvement in waste management needs to be examined, with a view to the establishment of either a national waste management department/board, or the allocation of all waste management responsibilities to one existing department. Complementing this structure would be provincial level waste management

directorates/boards in each of the provinces. Although the focus of this project has been on domestic solid waste, such departments/boards would need to have jurisdiction over all forms of waste. The purpose of these structures would be to co-ordinate and monitor the handling of waste by third tier agencies.

Accompanying the institutional overhaul would be a legislative overhaul which would provide standard guidelines for service providers. Along the same lines as the Minimum Requirements for disposal, there is a need for standard minimum requirements for the collection and transport of waste.

8.3 Management arrangements

The changes in local authority structures will enforce changes in the management arrangements for the provision of waste management services. These changes will need to ensure that the imbalance in resource allocations between different areas, identified in this research, are corrected. Not only will it be necessary to ensure the universal provision of adequate services, but also that this is in accordance with situation specific factors such as the local economy, culture, physical aspects and community needs. Hence an integral part of managing waste services will need to be interaction and communication with communities to ensure that the services provided are appropriate to community needs. A key component of this interaction will also be education of the community.

An emphasis on using community based contractors should also become a priority in order to address employment problems and enhance community economies. In the use of contractors, the conditions of the contract are critical in determining the effectiveness of the operation.

8.4 Finance

The lack of payment for services and the associated dependence on grant finance for the provision of services needs to be addressed. Here, the Masakhane Campaign is crucial, but this needs to be combined with a process of providing services not only appropriate to the needs of communities, but also their means. An adequate service can still be provided using low technology options accompanied by low costs.

The method of recording financial information, preparing budgets and setting tariffs is highly variable and this raises the need for improvement in this area.

8.5 Resource recovery and recycling

Although in the past there has been some success with resource recovery and recycling in South Africa, these activities need to be encouraged further. Attention should be given to the lack of incentives for resource recovery, and the lack of markets for recycled goods. Furthermore the integration into the formal waste management process of informal agents such as scavengers needs to be addressed.

8.6 The New South Africa

In the future waste management will be operating in a very different socio-political environment from the one to which much of this research refers. Consequently underpinning waste management in the new South Africa will be at least four major themes:

- Rectifying major historical expenditure imbalances between WLA and BLA areas.
- Accepting that a traditionally technical approach to waste management is no longer acceptable and that greater attention will have to be given to social and environmental considerations.
- Accepting the need for greater community involvement in establishing and providing appropriate levels of service.
- Acknowledging the need and potential for employment creation through labour based waste collection services.

9. RECOMMENDATIONS

The recommendations flowing from this project are summarized below, with general issues which could be dealt with by the waste sector dealt with separately from research related issues.

9.1 Sector actions

a) Institutional and management issues

- It is important for waste directorates or sub-directorates to be set up in each of the

provinces to take responsibility for regulation, planning waste services and monitoring.

- Within local authorities continued attention needs to be given to improving domestic solid waste services, particularly to unserved communities. Here the emphasis needs to be placed on universal access to an adequate level of service, selection of appropriate levels of service, efficiency, communication with users and proper financial procedures. The reporting from this project gives directions in this regard but further work is needed on management procedures (see research recommendations below).

- The performance of local domestic solid waste agencies needs to be monitored and, in this regard, standard reporting procedures need to be developed.

- The use of communal skips, despite the problems identified in the research, will remain an important option for lower levels of service. Guidelines are needed for implementing such a service properly.

b) Finance

This study highlighted deficiencies in the methods of costing waste services, budgeting and setting charges. In order to improve this situation the following is recommended:

- Standard costing and budgeting procedures need to be developed for use by all local authorities.

- Tariff setting policy needs to be developed in order to allow for a diversity in levels of service and waste loads. This could mean different tariffs for a kerbside collection in different areas.

c) Contracting

Maximising the involvement of the private sector in providing waste services is identified as an important goal. In doing this the arrangements for contracting are crucially important. It is therefore recommended that a set of guidelines be drawn up dealing with contractual arrangements, with standard forms of contract.

d) Support for small business and the informal sector

Domestic solid waste management is an ideal business for small entrepreneurs. In order to support this the following is recommended:

- Negotiations need to be held with unions to agree on procedures for allowing work to be

contracted out to small businesses.

- Contractual procedures need to be formalized (as described above).

- Methods for introducing appropriate technology (hand operated carts, for example) need to be investigated.

- Procedures to allow informal collection of waste for recycling need to be investigated. Cooperation between households, local authorities and the increasing number of "shopping trolley entrepreneurs" are important in this regard.

9.2 Research issues

Recommendations relating to research follow from those relating to sector actions:

- A series of management guidelines for solid waste services is needed.

- Performance indicators for solid waste agencies need to be investigated.

- Guidelines for costing solid waste systems and setting tariffs are needed (some work is in progress here, funded by the Development Bank of Southern Africa and the Water Research Commission).

- Methods for contracting out services, with standard forms of agreement, need development.

- Further research is needed into the options for small business and the informal sector in waste management.

- Technology options for small scale waste collection in South Africa need to be investigated.

All this can only be possible if there is funding for such research. At present there is no clear agency taking overall responsibility for research into the field of solid waste and action is needed here. In order to move this forward the following is recommended:

- The Water Research Commission needs to clarify its position with regard to research in

the field of solid waste.

- It is strongly recommended that a levy be introduced, based on the mass of solid waste delivered to landfills, to be used for research. This source of funding should then be allocated to a selected national agency to take responsibility for the full spectrum of waste research.