WASTE AND WASTE MANAGEMENT IN THE BREEDE VALLEY DISTRICT

by

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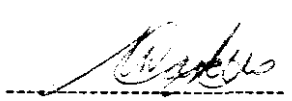
DECLARATION

I, Vernon Carolus, declare that the contents of this thesis represent my own unaided work, and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.



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ABSTRACT

The waste management that is taking place in the Breede Valley district focus mainly on disposal and end-of-pipe solutions. This approach resulted in serious negative impacts on the environment and human health. Improper waste management practices have become a major source of concern due to the risk associated with poor waste management in the area. Indiscriminate dumping of waste at street corners is very common. The basic waste management processes of collection, transport, segregation and final disposal appear to be very inefficient and inadequate.

The objective of this study was to determine the composition of the waste stream as well as public awareness, attitudes and behaviours towards current and alternative waste management practices. A waste assessment study was conducted to determine the amount of waste generated by the different communities, as well as how much and what of the recyclables can be taken out of the waste stream by recycling. For this study data was obtained by formulation of questionnaires for businesses, communities and medical practitioners, as well as an interview with the Engineering Department of the Breede Valley Municipality about the current waste management situation in the area. From the data obtain from businesses, communities and medical facilities, it is clear that public participation, partnership, education and awareness is essential for effective integrated waste management.

This study revealed that waste management practices are inefficient, uncontrolled and fragmented. This investigation shows that there is a huge difference between the different communities in terms of the volume of waste generation. The study also shows that waste related legislation is outdated and fragmented and there is no enforcement by municipal officials.

The major issues and challenges that affect the management of waste, include its organisational structure and lack of waste minimisation plans.

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LIST OF ACRONYMS

DEADP	Department of Environmental Affairs and Development Planning
DEAT	Department of Environmental Affairs and Tourism
DLG	Department of Local Government
DME	Department of Mineral and Energy
DoH	Department of Health
DWAF	Department of Water Affairs and Forestry
ECA	Environment Conservation Act
EHP	Environmental Health Practitioner
EIA	Environmental Impact Assessment
EMPR'S	Environmental Programme Report
HSW	Household Solid Waste
IDP	Integrated Development Planning
IP&WM	Integrated Pollution and Waste Management
IWM	Integrated Waste Management
MSWM	Municipal Solid Waste Management
NEMA	National Environmental Management Act
NGO	Non – Governmental Organisation
NWMS	National Waste Management System
PAWC	Provincial Administration of Western Cape
SABS	South Africa Bureau of Standards
SHE	Safety Health Environment
SWM	Solid Waste Management
WIS	Waste Information System
WM	Waste Management

GLOSSARY

Avoidance:

Avoiding waste generation by not creating waste in the first place (DEADP, 2004).

Collection:

The process by which waste are removed from the point of generation (DEADP, 2004).

Composting:

Controlled biological decomposition of organic waste to produce a valuable product, compost, which can be used as a soil supplement (DEADP, 2004).

Drop-off and Buyback Centre:

Processing facility where citizens can deliver recyclables, and received cash for recyclables or donate their recyclables to the facility (DEADP, 2004).

Environmental Effects:

The SWM system should not negatively impact on the environment (e.g. contaminate ground, water or air) (DEADP, 2004).

General Waste:

Waste from domestic property, including a building or self-contained part of a building which is used wholly for the purposes of living accommodation, a residential home; premises forming part of a university or school, educational establishment, hospital or nursing home. General waste excludes any Health Care Risk Waste (DEADP, 2004).

Hazardous Waste:

Any waste which may, by the circumstance of its use, or because of its quality, concentration, physical or infectious characteristics, cause or be likely to cause, danger to health or the environment, whether by itself or in contact with other waste (DEADP, 2004).

Human health and safety:

The system should not be harmful to human health (DEADP, 2004).

Industrial Waste:

Waste materials which are generated by industry (e.g. manufacturing facilities). Industrial waste may be either hazardous, containing dangerous or toxic constituents or materials (e.g. waste solvents, waste chemicals), or non-hazardous (DEADP, 2004).

Institutional Waste:

Waste materials which are generated by schools, hospitals, prisons, research institutions and other public buildings (DEADP, 2004).

Integrated waste management plan:

In terms of the National Waste Management Strategy, this is a comprehensive plan for the integrated management of waste in the municipal area which must apply the hierarchy of waste management (DEADP, 2004).

Integrated Waste Management:

Is a system and process of waste management aimed at pollution prevention and waste minimization at the source by managing the impact of pollution and waste on the receiving environment and remediation damage to the environment (DEADP, 2004).

Land Disposal:

Direct application of waste onto or into the land for disposal. These types of disposals include land filling and open dumping (DEADP, 2004).

Landfill:

A site for the controlled burial of solid waste according to applicable governmental rules and regulations. Generally, a landfill will be equipped with liners made of natural and / or man –made materials to collect leachate and prevent groundwater contamination (DEADP, 2004).

Material Recovery Facility:

A processing facility where recyclables and compostables are removed out of the general waste stream and segregated according to type (DEADP, 2004).

Municipal Solid Waste (MSW):

Waste generated in residences (homes and apartment buildings), commercial facilities (stores and offices) and institutions (hospitals and schools). Generally classified as non-hazardous waste, household waste (e.g. waste paint or cleaning agents) may contain hazardous materials (DEADP, 2004).

Organic waste:

Waste derived from animal waste or vegetable matter (DEADP, 2004).

Policy:

A framework for action, used to set objectives and targets (DEADP, 2004).

Recovery:

The extraction of materials or energy from waste for further use or processing; and includes but is not limited to, making materials into compost (DEADP, 2004).

Recyclables:

Materials (e.g. glass, plastics and paper) that, when sorted out of the waste stream can be reprocessed or remanufactured into new product (DEADP, 2004).

Recycling:

Diverting materials that still have useful physical or chemical properties out of the waste stream (DEADP, 2004).

Reuse:

Use of a product in its original form, more than once and is a form of source reduction (DEADP, 2004).

Stakeholder:

Any individual person or discernable group of persons with an interest or stake, in a particular issue (DEADP, 2004).

Storage:

The process by which waste are contained or managed at the point of generation prior to collection (DEADP, 2004).

Source Reduction:

Reducing the volume or toxicity of waste generated by changing design, operating, and manufacturing practices, and reusing materials to minimize the quantity of waste generated (DEADP, 2004).

Source Separation:

Segregation of specific materials at the point of generation for separate collection (DEADP, 2004).

Sustainable Development:

Sustainable development means the integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that development serves present and future generations (Urquhart and Atkinson, 2000).

SWM System:

A planned, methodical approach to managing the unique waste stream generated by an individual community (DEADP, 2004).

Transfer Station:

Location where wastes are transferred from one collection vehicle to another, or to a designated container, prior to transportation to disposal or processing facility (DEADP, 2004).

Transportation:

The process by which waste are conveyed from the generation point to an interim storage or processing area and to a disposal facility (DEADP, 2004).

Treatment:

In relation to waste, subjecting the waste to any physical, biological, or chemical process to change the volume or character of that waste so that it may be disposed of with no or reduced significant adverse effect on the environment (DEADP, 2004).

Waste information system:

A strategic action plan of the National Waste Management Strategy is to set up an updateable electronic waste data which has input from local, through provincial to national level (DEADP, 2004).

Waste:

Any undesirable or superfluous matter, material, by-product or residue of any process or activity that has been discarded, accumulated or been stored for the purpose of discarding, re-use, reclamation or recycling. Waste products may be liquid or solid and may originate from domestic, commercial or industrial activities (DEADP, 2004).

Waste Minimisation:

Changing design, operating and manufacturing practices of business and industry and using consumer education and legislation to reduce packaging and or specify reducing the volume or toxicity of waste generated by packaging types (DEADP, 2004).

Waste Stream Characterization:

An assessment of the quality (by weight and /or volume) and composition (type of waste) of the wastes generated by a particular community or other source (DEADP, 2004).

Waste Stream:

The total flow of waste from residences, businesses and institutions that must be managed by a community. Each community's waste stream is unique (DEADP, 2004).

Yard Waste:

Organic waste generated from yard / gardening maintenance such as grass clippings and tree trimmings (DEADP, 2004).

CHAPTER 1

1 INTRODUCTION

1.1 BACKGROUND

Rapid population growth, together with new residential developments has resulted in a dramatic increase in the volume of waste being generated in the Breede Valley district. Uncontrolled growth of informal areas, impacted tremendously on the quantities of waste generated. Waste problems facing the growing number of informal settlements also need to be effectively addressed. These factors have led to a growing concern of the possible threats that waste may pose to the environment and health of the people of the Breede Valley District (Appendix A). The problem is that landfill sites in the district could be better managed, leaving the road verges and fences covered in rubbish, and open fields littered with plastic (Appendix E). DEAT (1996) stated that tourism planning is inadequately funded, with inadequate environmental protection such as proper waste management planning. Unless these problem areas can be improved upon, the tourism potential of the district will not be enhanced. The long term damage to the environment may influence potential growth of the local economy. The responsibility for the disposal of waste rests largely with local authorities, although companies from the private sector as well as the community can play an important role. A lack of a clear waste management strategy in the public- and private sectors results in potentially negative effects on the environment. Public relations are an important, but often neglected element in the effective implementation of any waste management strategy. Because there is no waste management policy for the area under investigation, various problems arise. Examples of this is an apparent lack of waste minimisation programmes, lack of enforcement of existing laws and no integrated approach to address these problems (Appendix E). This situation is present despite new policies and forthcoming legislation regarding waste and its management (DEAT, 2000, Draft Bill). There is also no community involvement or understanding, resulting in an "I don't care" attitude. A lack of information, insufficient data on waste generators, waste generation, and waste disposal sites make waste management difficult.

1.2 STATEMENT OF THE RESEARCH PROBLEM

The Breede Valley Municipality incorporates, Worcester, Rawsonville, De Doorns, Touwsriver and surrounding rural areas. The landfill sites at De Doorns, Rawsonville and Touwsrivier are closed and only the Worcester landfill site is permitted. The landfill sites that are closed do not comply with the Minimum Requirements of the Department of Water Affairs and Forestry (DWAF, 1998a). Fragmented and outdated legislation make the enforcement and control difficult. There is also no waste management policy for the Breede Valley Municipality, resulting in a lack of coordination and participation. The Integrated Waste Management Bill (DEAT, 2000) requires proper waste management systems and public participation.

1.3 RESEARCH QUESTIONS

- What is the composition of the waste stream generated in the Breede Valley area?
- What is the public's awareness, attitude and behaviour concerning waste and waste management issues?
- What is the current practices concerning the management of business, medical and general waste in the entire area?

1.4 OBJECTIVES OF THE STUDY

- To determine the composition of the waste stream, in terms of recyclables and non-recyclables, in the area under investigation.
- To determine public awareness, attitude and behaviour towards current and alternative waste management practices.
- To determine the current practices concerning the management of business, medical and general waste in the entire area.

1.5 DELINEATION OF THE STUDY

The study was conducted within the borders of the Breede Valley Municipality. Worcester, Rawsonville, De Doorns and Touwsriver form the borders of this area.

1.6 SIGNIFICANCE OF THE STUDY

In 2000 the Bill on National Integrated Waste Management was drafted, therefore the need arose for related issues to be addressed. In this regard this study is important to address waste management in the area under investigation. This study is also significant for indirect reasons, such as job creation and economic growth. This study could contribute significantly to the marketability of the area for tourism purposes. Provision of effective waste management services could improve the living conditions of those communities that were previously inadequately serviced. This study will also increase public awareness of the benefits of integrated waste management. Integrated waste management has the potential of creating employment in both the public and private sector. The successful implementation of waste minimisation and prevention initiatives will also strengthen the relationship between the private and public sector.

CHAPTER 2

2 LITERATURE REVIEW

2.1 WASTE AND WASTE MANAGEMENT IN GENERAL

Cities in particular are facing a waste management dilemma. Waste is a people's problem and people have to take responsibility for their own waste. Local authorities' decision-makers must manage the waste stream in a way that the people retain responsibility for all aspects up to collection, transport and disposal (Novella, 1999).

The management of municipal solid waste in most countries has become a complicated task, mainly due to the combined pressures of dwindling landfill space and the public's desire to conserve resources (Sawell et al, 1996).

Robinson (1986) defines solid waste management as the application of techniques that will ensure the orderly execution of the functions of collection, transport, processing, treatment and disposal of solid waste. The ever increasing global concern of environmental health demands that waste is properly managed and disposed of in the most environmentally acceptable way. This is to minimise and where possible eliminate its potential harm to humans and natural resources.

International concern around increasing pollution has escalated over the past years, resulting in the development of many international protocols and conventions concerning environmental and waste management (e.g. Basel Convention which addresses trans-boundary movement of hazardous waste). The generation of waste by society may be viewed as a manifestation of the inefficient use of resources and is the root cause of pollution and associated environmental degradation. Increased waste generation is an inevitable consequence of development and must be systematically managed in order to conserve resources and protect the environment, especially in a developing country, like South Africa (DEAT & DWAF, 1999).

In the past waste was viewed as a nuisance that needed to be disposed of, and considered as a material that did not have any value to anybody or anything. Matters were made worse by the fact that many physical development were made without any consideration for the management or handling of waste (DEADP, 2004).Waste legislation has dealt mainly with the prohibition of littering and with refuse removal, and has been administered mainly at local government level. It has become apparent that litter and refuse form only a relatively small part of the problem. The active involvement of the Provincial and National Government is necessary if the problem is to be combated in a coordinated and effective manner (Botha et al, 1983).

Gobo (2002) stated that effective management of solid waste has been a major problem due to several factors, including a poorly managed and uncoordinated approach to waste management practices, unhealthy cultural attitudes and habits, urbanisation patterns, population growth, non-mechanized waste disposal methods and poor financing of the sector is major problems in waste management in general.

To reduce health risks, it is important that in areas of high population density such as low cost housing developments and informal settlements, well-controlled and efficient of waste management are in place. This help to prevent the unsightly appearance of waste that is often dumped in an unregulated way. Waste management systems for low-cost housing development need to be practical, affordable and acceptable to the community, and designed to prevent damage to the natural environment. Recycling depots should be accessible and well managed. They also provide an opportunity for the establishment of educational centres, to spread information about the benefits of recycling (Sowman and Urquhart, 1998).

Implementation of appropriate solid waste management practices requires reliable waste statistics. The data should represent a sufficiently long time frame (usually more than a few years); with relatively short measurement frequencies, to be statistically acceptable. Table (2A) indicates that the majority of household waste in Turkey is organic in nature, and that slag and ash constitute an important fraction of the general waste.

Table (2 A): Household solid waste (HSW) composition in Turkey (1993).

Season	*HSW (kg / day)*	*Organic & wet (%)*	*Ash & slag (%)*	*Recyclable (%)*
Summer	*0.6*	*80.21*	*2.61*	*17.18*
Winter	*0.5*	*46.2*	*45.89*	*7.9*
Average	*0.57*	*68.87*	*17.04*	*14.09*

Source: Metin et al, 2003.

More recent studies reflect significant variation in the characteristics of waste. Inadequate surveys done by municipality are the main problem in obtaining reliable waste data in Turkey. Public participation is an important element of all municipal separate collection and recovery operations (Metin et al, 2003).

The philosophy of the "Waste Management Hierarchy" (prevention, minimisation, materials recovery, incineration and landfill) has been adopted by most industrialized nations as the menu for developing municipal solid waste management strategies. The extent to which any one option is used within a given country (or region) varies depending on a large number of factors, including topography, population density, transportation infrastructures, socio-economics and environmental regulations. Before waste management strategies can be developed there is a need to characterise the volumes and composition of the waste stream within a given region. This is particularly important when considering waste minimisation policies and specific materials for recycling, such as paper, cardboard, plastics, etc. Each country has developed its own federal initiatives to promote the concepts of waste minimisation, re-use, and recycling, ranging from policy driven targets to tax incentives or subsidies for specific management options. There are also differences in other factors which impinge upon the selected strategies, such as existing transportation infrastructures, population densities, resource bases, land availability, energy requirements and environmental regulations (Saki et al, 1996).

To increase people's acceptance level of a Solid Waste Management facility, dialog with neighbours or public involvement in the planning stage has become popular in recent years, and these procedures are widely discussed. For better communication with citizens, it is essential to understand people's concerns and concepts of SWM management facilities. This is also essential for better SW management practice (Rahardyan et al, 2004).

Zeiss and Atwater (1991) proposed a link between physical impacts, beliefs and attitudes. He classified impacts into two categories: physical and non-physical. Physical impacts include health risks, nuisances and environmental change, and these in turn generate non-physical impacts, which are categorized into economic (property value decrease), social (community image loss), and political (lack of fairness) impacts. Petts (1994) suggested that citizens' attitudes are influenced not only by impacts, but also by a lack of credibility in waste managers, decisions makers, decision processes, and control mechanisms for waste facility sitting and operation. Joos (1999) noted that decision transparency and information accessibility are key factors for public acceptance. Neither incineration nor land filling were found to be economically and environmentally sound for waste management practices. Landfill sites are designed and developed without consulting with the effected communities.

According to Ninham Shand (1993) all landfill sites should be located, designed, constructed, operated, maintained and closed in a manner that ensures the protection of the human health and the environment. Public education and awareness of waste management issues and an understanding of the respective roles of the communities, the business sector and the authorities are essential for the implementation of an effective waste management system. Health and safety impacts are often associated with poorly operated disposal sites, where leachate, litter, vermin, flies, fires and dust are a problem (Ninham Shand, 1993).

Eichstadt (1999) suggested that the following factors affect waste management in general.

- Informal housing and land invasion.
- Poor service delivery.
- No strategic solutions for dealing with specific waste streams.
- Absence of regional planning partnerships and formal structures.
- Financial and personnel constrains.
- No existing educational programmes at all levels.
- Poor management of landfill-sites and informal salvaging.
- Ineffective regulatory controls.

In general waste management planning on a local level is poor, whilst planning with public input is non-existent (Eichstadt, 1999).

Ferreira (2004) suggested that the following information is essential for medical waste:

- Waste information – i.e. the amount of waste generated by health care facility
- Facility information –details about the hospital / clinic / laboratory that include;

  -Name and location.

  -Names of managers.

  -Service provider assigned to the facility.

  -Medical waste management system currently in operation.

  -Plan drawing of the facility-storage, collection zones and routing of hospital waste.
- Service provider information – company responsible for collecting medical waste
- Disposal information
- Hospital / clinic / facility statistics, i.e. number of patients, type of service rendered.
- Training programms for the staff;
  - The need to include information about; the safety of medical waste.
  - The segregation methods of medical waste.
  - Personnel training programs.
  - Recycling methods of suitable material
  - Standard operating procedures of the facility
  - Registration forms need to be filled out correctly and filed.

2. 2 WASTE MANAGEMNENT IN SOUTH AFRICA

Up to now waste management was not regarded to be a priority issue in South Africa. The waste management that did take place focused on waste disposal and was reactive in that it generally addressed pressing urgent needs on an *ad hoc* basis. Holistic integrated waste management planning was rarely, if ever undertaken. The low priority accorded to waste management has resulted in waste impacting detrimentally on the South Africa environment and human health (Botha et al, 1983). The waste management system in general in South Africa is too fragmented, uncoordinated, uncontrolled and no enforcement of existing waste legislation take place. Such a holistic and integrated management approach extends over the entire waste cycle from "cradle-to-grave" and covers the prevention, generation, collection, transportation, treatment and final disposal of waste. Waste management has become a matter of increasing concern. Industrialized countries manage their waste by landfilling and incineration, as well as some recycling (DEADP, 2004).

For historical reasons more than 50% of the South African communities do not have access to collection systems. Often, where services do exist the standards are very poor, characterised by poor service delivery. General waste, which is not regularly removed, accumulates in residential settlements and residents and collectors are exposed to pathogens, insects, rodents and decomposing products. Separation at the source of medical waste arising from hospitals, clinics and consulting rooms does not take place, and the waste is disposed of with general waste, with the result that residents and collection workers are also exposed to infectious micro-organisms. In unserviced and poorly serviced areas, the waste is typically dumped directly on the ground, thus having to be shoveled by hand or front end loader for removal. Therefore it is necessary to address the poorly serviced and unserviced areas (DEAT, 1999). In South Africa, waste management is defined as is any material that has been discarded and as such, needs to be disposed of in an environmentally acceptable manner (DEADP, 2004).

The first step in the waste management strategy is the drafting of an integrated waste management plan. In drafting an integrated plan, not ignoring the basic steps of reviewing current legislation, setting objectives and determining appropriate and complementary methods for the specific system components, it is critical that an effective partnership between the Councils, the Provincial Government, specific local authorities and waste generators is established. This partnership must play a pivotal role in ensuring that the proposed outputs in the National Waste Management Strategy becomes reality (Eichstadt, 1999).

Section 24 of the Constitution of the Republic of South Africa (Act 108 of 1996) states that the people of South Africa have a right to an environment that is not detrimental to human health and imposes a duty on the state to promulgate legislation and to implement policies to ensure that this right is upheld. To date a number of steps have been taken to uphold this environment right, including the publication of the Environmental Management Policy (DEAT, 1998c), the White Paper on Integrated Pollution and Waste Management (IP&WM) (DEAT, 2000), the National Water Act (DWAF, 1998d), and the National Environmental Management Act (DEAT, 1998b) and the development of a National Waste Management Strategy (DEAT, DWAF 1999).

According to the State of the Environment Report for South Africa, the country generates over 42 million m^3 of solid waste every year (DEAT, 1999). This is about 0.7kg per person per day, which is more typical of developed countries than a developing country. By comparison the figure in the United Kingdom is 0.73, 0.87kg in Singapore and 0.3kg in Nepal (DEAT, 1999). In addition, 5 million m^3 of hazardous waste is processed at treatment works (DEAT, 1999). The report concluded that the position of waste management in South Africa was highly unsatisfactory and presented a serious threat to human health and the environment (DEAT, 1999). Inefficient collection methods, insufficient collection system, combined with improper disposal of municipal solid waste and contaminated sources of water supply, are major threats to public health and environment quality in developing countries (Diaz, 1999).

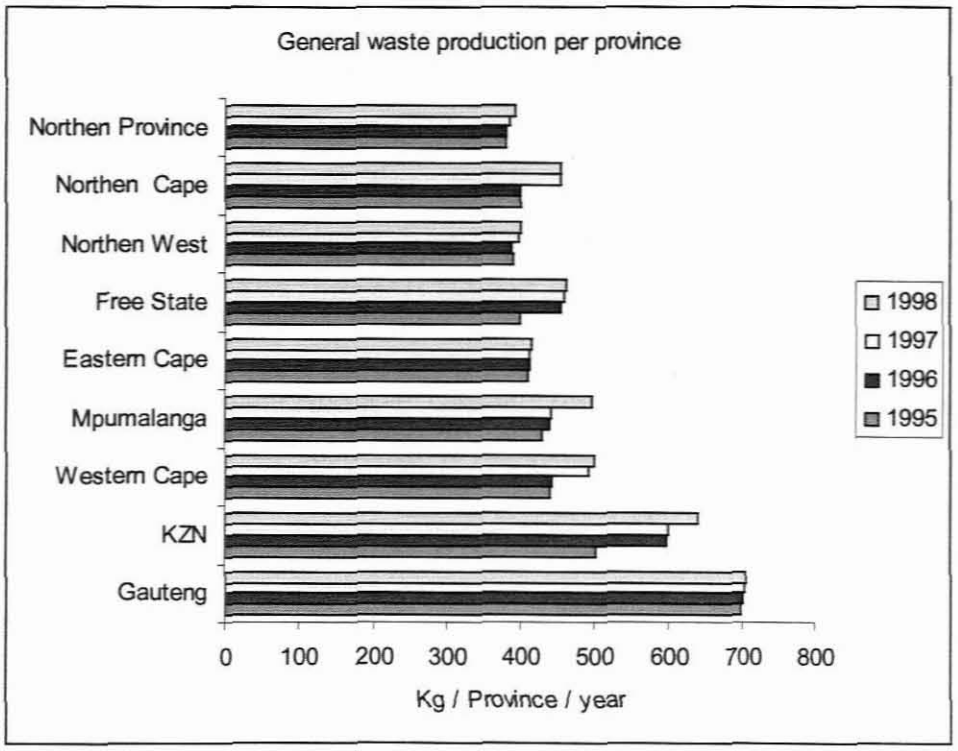

Figure (2.1): The total waste generation per province in South Africa (DEAT 2000)

The location of landfill sites in South Africa was generally haphazard in the past without adequate planning and design, the management and operation were and still are in some cases poor and the control of waste types disposed at landfills was inadequate. A number of waste disposal sites were located on previously undeveloped land, without any consideration for the possible expansion of nearby communities. This resulted from a lack of integrated planning and inadequate enforcement of proper buffer zones (DEAT, 2000).

In South Africa most waste is disposed of by landfilling in both environmentally unacceptable and unsafe landfill sites. Incineration of municipal waste does not take place on a large scale, but there are large operating medical waste incinerators and a number of small sub-standard general waste incinerators, located mainly in small towns. The construction, location and use practices of these incinerators were done to address an urgent need but without due regard to integrated planning (DEAT, 2003).

Local authorities had neither sufficient funding nor adequately trained staff, to effectively plan and execute their waste management functions. Communities were not involved in the placement of waste disposal sites, and consequently resisted their development. The level of services varied between areas and many people particularly the previously disadvantaged were left without proper waste management services. Waste management within the local authorities was primarily focused on waste disposal (DEAT, 2003).

Recycling initiatives in South Africa are currently restricted to a number of commercially viable projects that are not supported or regulated by legislation. Private recycling companies and individuals currently initiate and drive recycling projects. The need to improve current waste management practices in South Africa has been highlighted by the findings of the President's Council Report on a National Environmental Management System (1991). The challenges facing waste management in South Africa will require commitment from those involved in producing waste and those involved in its disposal. In South Africa there has been a very important change in the way that we manage our waste. The traditional "end of pipe" solution, which focused on dealing with waste once it was produced, is no longer adequate. Instead of concentrating on the storage, collection and disposal component of the waste management system more attention must be given to the avoidance of waste as a first priority (Ninham Shand, 1993).

The basic concept of waste minimisation is simple: to systematically reduce or eliminate waste at the source. It applies to products, processes and management issues, and results in benefits such as reduced water, chemical and energy use, lower effluent production, reduced environmental impact and financial saving to the enterprise. A waste minimisation club comprises a group of enterprises taking action to reduce waste. The club provides a forum for the companies to exchange ideas, information and experiences on waste minimisation, receive training in waste minimisation aspects, and in some cases receive assistance from consultants. The establishment of waste minimisation clubs has been cited in the Draft National Waste Management Strategy for South Africa as being a tool to promote sustainable industrial development (Barclay and Buckely, 2003).

Bromfield (1999) stated that the private sector is constrained in terms of tenders for waste management service by a number of issues, including;

- Resistance by trade unions to contracting out of services.
- "Double standards" allowed in that local authorities are perceived to operate at lower than legal requirements.
- Empire building by local authorities.
- By-laws restricting certain categories of work for exclusively the local authorities.
- Poor legislation.
- Lack of and inconsistent enforcement of legislation.

According to Bromfield (1999) legislation is currently vague or non-existent when it comes to medical waste, a situation which needs to be remedied if transgressors are to be dealt with.

According to Lombard (1999) metropolitan authorities' rate waste management services as relatively low priorities in the needs hierarchy, but the people themselves rate public health services, including waste management as high priority needs. The health risk and environmental degradation associated with this situation is entirely unacceptable. The urban solid waste management problem is increasing because of population growth and the pressure that this places on the assimilative capacity of the environment. The process of urbanizing rural people leads to aspirations for developed world affluent lifestyles and the associated consumption of goods, services and energy. Any improvement in the standard of living inevitably results in more waste (Botha et al, 1983). Municipalities should be compelled to purchase and locate bottle banks at convenient points where the public can access them without going out of their way. If garbage is left at a recycling point, a refuse bin should be provided which the municipality should service regularly (Ensor-Smith, 1999). Manufactures may contribute to source reduction by designing and manufacturing products that contain fewer toxins and less packaging. Widespread recycling efforts prevent potentially useful materials from being placed in landfill sites. Reuse of materials also saves energy production. Combustion reduces the bulk of municipal waste, while providing the added benefit of energy production.

Waste collection is inefficient, dumping sites are poorly managed and little action is taken to safe guard our natural resources on which we depend upon for our survival. The status of scavengers should be recognised by local authorities (Muurevanhema, 1999).In order for waste to be correctly managed in any community there need to be an agreed upon standard of cleanliness that need to be attained or maintained; the provision of adequate technology and facilities in order to meet this standard; the capacitating of all sectors of the community so that the importance of a clean environment is understood. The facilities and technology are correctly utilised and there is community involvement in the cleansing and beautification initiatives; and the agreed upon standards are enforced (Van der Merwe, 1999).

A number of stages are addressed in integrated waste management planning, which takes into account the need to develop clear objectives while maintaining the existing system and investigating possible alternatives in selecting the most appropriate waste management system. The waste management hierarchy will form the basis for planning as well as regionalization, long-term targets, minimising social impacts and maximising social benefits. Integrated waste management planning will be implemented at the three levels of government. A waste information system (WIS) is being developed for the implemented of the NWMS. All waste generators, transporters and disposers will be required to register with the WIS and report specific information (Joubert, 1999).

Factors that have an influence on the waste stream of the community.

- Economic profile; Wealthier communities generate more waste per household, but have lower population densities than poorer communities. How much waste minimisation is taking place in these communities? Whether street cleaning, litter picking, and verge cutting are included in the type and frequency of service. Legislation related to waste management practices.
- Seasonal variations. During rainy seasons wet waste can add significant weight to waste loads.
- Demographics. Population variations may also have an effect on behavioural patterns (DEAT, 2003).

2.3 LEGISLATION THAT CONTROL WASTE MANAGEMENT IN SOUTH AFRICA

CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA (ACT 108 of 1996).

The Constitution has created the framework for environmental governance in South Africa by:

- Creating the right to an environmental that is not harmful to the health and well-being;
- Balancing the right to have the environmental protected, with an emphasis on promoting valid economic and social development;
- Allocating environmental functions to a wide range of government agencies, in all spheres;
- Requiring co-operation between government agencies and spheres.

It contains an environmental right as well as certain administrative and economic rights, which provide the substantive basis for environmental and waste management regulation, and emphasis the access to information.

MUNICIPAL SYSTEMS ACT (ACT 32 of 2000).

This Act addresses the content of local government's role and the way in which resources should be managed by:

- To provide for the core principles, mechanisms and processes that are necessary to enable municipalities to move towards the social and economic upliftment of local communities;
- Ensure universal access to essential services that are affordable to all;
- Make provision for community participation;
- To empower the poor and ensure that municipalities put in place service tariffs and provide a framework for the provision of services;
- To establish a framework for support, monitoring and standard setting by other spheres of government in order to build local government into an efficient development agency;
- Upliftment of communities with their natural environment;
- To provide for legal matters and formulation of by-laws.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 of 1998).

The National Environmental Management Act was promulgated to give effect to the provisions of the White Paper on a National Environmental Management Policy for South Africa. This act provides for co-operation environmental governance by:

- Establishes principles to guide the decisions and actions of all organs of state (NEMA Principles);
- Establishes institutions to co-ordinate and harmonise the environmental functions of organs of state and promote the participation of stakeholders in environment governance;
- Establishes procedures for co-operative governance;
- Establishes procedures for conflict management;
- Promotes integrated environmental management by establishing minimum procedures for environmental impact assessment, and enabling any national or provincial permitting authority to prescribe environmental impact assessment regulations;
- Promotes compliance and enforcement by means of provisions on
    - The duty of care.
    - Protection of workers refusing to do environmentally hazardous work.
    - Control of emergency incidents.
    - Access to environmental information and protection of whistle blowers.
    - Legal standing to enforce environmental laws.
    - Private prosecution.

Promotes co-regulation by enabling the establishment of environmental management co-operation agreements to promote the principles of environmental management.

ENVIRONMENT CONSERVATION ACT (ACT 73 of 1989).

This Act was promulgated to provide for the effective protection and control of the environment and for related matters. This Act provides the most potential for regulating waste comprehensively at present. DEAT and DWAF have the responsibility for administrating certain portions of the act. The purpose of this act (ECA) is to provide for the effective protection and control of activities that may have a detrimental effect on the environment.

This protection and control include the following:

Waste Management and Littering;

- Provide for a general prohibition against littering and the removal of litter.
- Waste management, including the establishment and operation of waste disposal sites, which may only be operated under a permit issued by the Minister of Water Affairs.
- Provides for the identification of waste and sewage disposal and chemical treatment activities by DEAT, specifically those activities which may have a substantial detrimental effect on the environment.
- The Minister of DEAT has prescribed regulation on waste management (Government Notice R1196, 8 July 1994), requiring a permit for the establishment and operation of a waste disposal site. The DWAF has published Minimum Requirement Guidelines, which can be included as permit conditions.
- Provides for regulations for collection of information on generation and disposal of waste.

WHITE PAPER ON ENVIRONMENTAL MANAGEMENT POLICY (1998).

The White Paper on Environmental Management Policy is a policy framework that sets out a vision, policy principles and strategic goals for environmental management and sustainable use of natural resources in South Africa. The vision projects an integrated and holistic management system for the environment aimed at achieving sustainable development.

The goals of the policy are to:

- Establishment of an effective institutional and legislative framework.
- Promotion of sustainable resource use and impact management.
- Development of mechanisms to ensure that environmental considerations are effectively integrated into existing and new government policies, legislation and programmes.
- Establishment of mechanisms and processes for effective public participation in environmental governance.
- Promotion of environmental literacy, education and empowerment.
- Development and maintenance of an information management system to provide accessible information that will support effective environmental management.
- Development of mechanisms to deal effectively, and in the national interest, with international issues and obligations in respect of environmental management.

WHITE PAPER ON INTEGRATED POLLUTION & WASTE MANAGEMENT (2000).

The white paper on integrated pollution and waste management sets out the government's vision and strategic goals for integrated pollution and waste management in South Africa. The vision of the policy is to "Develop, implement and maintain an integrated pollution and waste management system which contributes to sustainable development and a measurable improvement in the quality of life, by the effective prevention, minimisation and control of pollution and waste".

The goals of the IP&WM are to:

- Establishment of an effective institutional framework and legislation.
- Mechanisms to promote holistic and integrated pollution and waste management.
- Mechanisms to ensure holistic and integrated planning approaches and processes.
- Mechanisms to ensure effective public participation in integrated pollution and waste management governance.
- Education and empowerment of people to achieve integrated pollution and waste management.
- Mechanisms to effectively deal with international issues affecting pollution and waste, in the national interest.
- The development of databases and information management system.

The approach of the IP&WM is to prevent pollution, minimise waste and to control and remedy impacts. It is the intended that the management of waste be implemented in a holistic and integrated manner, extending over the entire cycle, from "cradle to grave ", including the generation, storage, collection, transportation, treatment and final disposal of waste.

NATIONAL WATER ACT (ACT 36 of 1998)

The purpose of the Act is to ensure that the country's water resources are protected, used, developed and conserved in ways which take into account the protection of the ecosystems. Addresses basic needed, that ensures the reduction and prevention of pollution and that meets national obligations.

- Prevention of pollution and emergency incidents.
- Controlling and authorising water use activities.
- Disposal of waste in a manner, which may detrimentally impact on the water source.

HEALTH ACT (ACT 63 of 1977)

The purpose of this Act is to ensure that local authorities shall take all lawful, necessary and reasonably practicable measures, to.

- Maintain its district at all times in a hygienic and clean condition.
- Prevent the occurrence within the district of any nuisance, any unhygienic condition, or any condition that is harmful or dangerous to the health of any person.
- Prevent the pollution of any water.

This Act is also used by DWAF to determine the buffer zone of a proposed waste disposal site.

HAZARDOUS SUBSTANCES ACT (ACT 15 of 1973)

This Act regulates the transportation of defined hazardous substances and prohibits the disposal of certain radioactive waste on landfill-sites.

MINERALS ACT (ACT 50 of 1991)

This Act requires that Environmental Programme Report EMPR's must be compiled for all mining and prospecting operations. This act ensures that environmental impacts of all mining operations are managed and that post-closure rehabilitation of mined areas is ensured.

ATMOSPHERIC POLLUTION ACT (ACT 45 of 1965).

This Act regulates the control air pollution, waste incineration processes, waste sites and prevention of air pollution from chemical processes and non-hazardous waste incineration plants. It also controls dust from landfill activities.

2.4 INTEGRATED WASTE MANAGEMENT

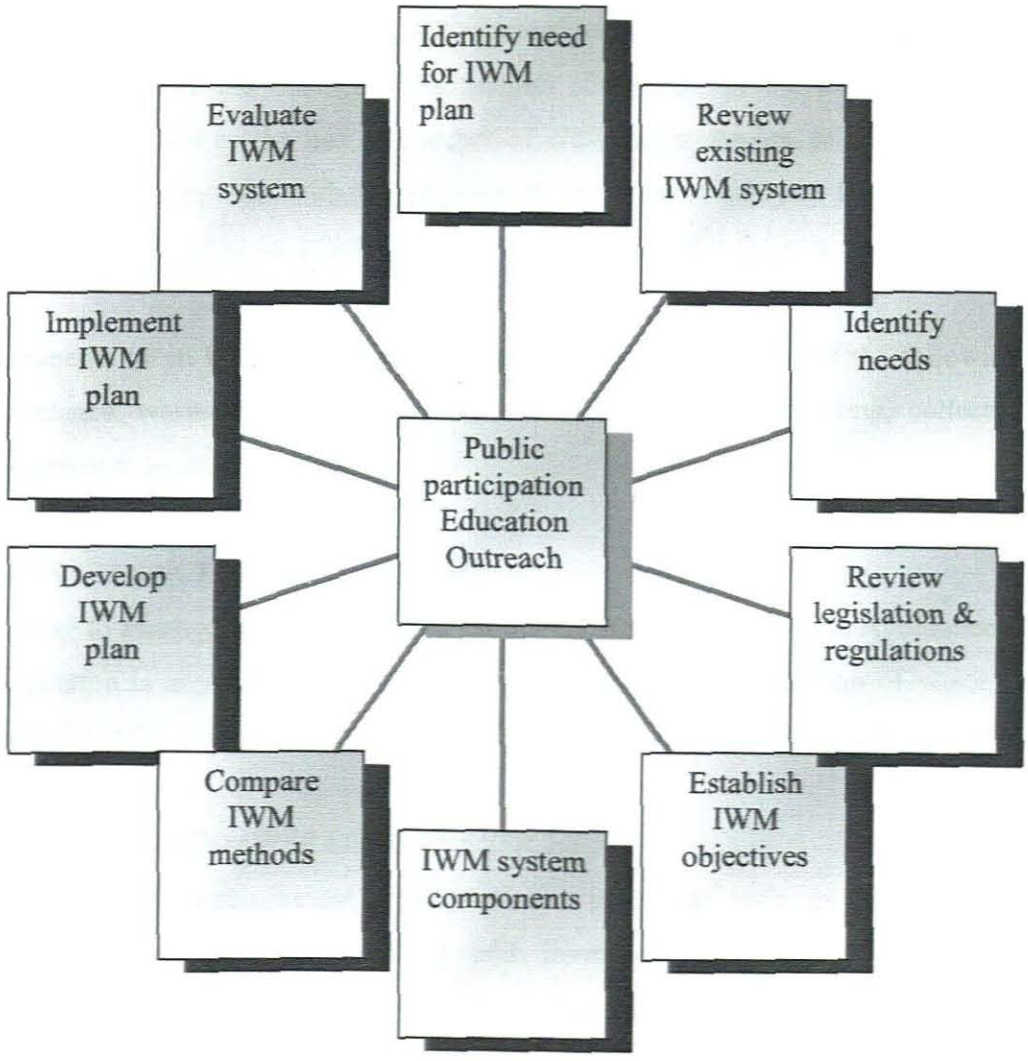

Figure (2.2) Integrated waste management principles (DEADP, 2004).

Figure 2.2 illustrates the principles needed to formulate an effective and sustainable waste management system. Public participation and education is highlighted as an important tool towards the new approach of sustainable waste management.

Integrated Waste Management is a system and process of waste management aimed at pollution prevention and waste minimisation at source, managing the impact of pollution and waste on the receiving environment and remediating damaged environments (DEAT, 1999). Integrated waste management is broadly defined as the use of a combination of complimentary waste management techniques to manage waste in an environmentally sound and cost effective manner (Eichstadt, 1999). Integrated waste management is defined as the use of number of clustered strategies, to manage waste from generation to disposal, with the purpose to minimise waste and to save energy (Jenman et al, 2004).

The components of an Integrated Waste Management System consist of the following: waste avoidance, waste exchange, recycling, source reduction, composting, collection and transportation, landfill disposal.

WASTE AVOIDANCE

The best way to manage waste is to avoid producing it in the first place. Avoidance of waste generation is any activity that reduces or eliminates the generation of waste, at source, usually within a process. Waste generation can be avoided in the following ways.

IMPLEMENTING GOOD OPERATING PRACTICES

This would include management and personnel practices, such as training, loss prevention, improved material handling and inventory practices, and production scheduling an example is to reduce the frequency of cleaning of equipment.

CHANGING PROCESS TECHNOLOGIES

This include changes to process, equipment, piping, layout and operating conditions, specifically aimed at reducing hazardous waste generation. Example of process changes might be as drastic as replacing a mercury cell with a diaphragm or a membrane cell, or as simple as replacing a chemical cleaning bath with mechanical cleaning.

MAKING CHANGES IN THE INPUT MATERIAL

This would include purification and substitution. Example would be the substitution of cyanate for cyanide (electroplating industry).

MAKING CHANGES IN THE PRODUCT

Example of product changes are the use of water based explosives that minimise the need for organic solvents and substances such as nitro-glycerine, and the replacement of oils containing PCB (polychlorinated biphenyl) with other oils or converting to air cooled transformers (DWAF, 1998c).

WASTE EXCHANGE

It is a process whereby the waste products of a particular industrial application are used or reused by that industry or by other industry. In a passive waste exchange, generators list waste they want to transfer and potential user's list waste they desire. This information is presented in a catalogue or brochure which includes the quality, description, availability and the location. The waste exchange station can be contacted, which in turn responds to the inquiry. In active waste exchange, an intermediary service is provided by the exchange station, between the generators and potential users of waste (DEADP, 2004).

RECYCLING

Diverting materials that still have useful physical or chemical properties, out of the waste stream, and then using these materials to replace raw, or virgin materials in product manufacturing. The objective of recycling is to save resources and reduce the environmental impact, by reducing the amount of waste disposed at landfills.

Waste separation at source is proposed, as the quality of recyclable materials is higher (DEADP, 2004). Recycling has the potential for job creation and is a viable alternative to informal salvaging at landfill sites which is undesirable due to the problem of health and safety associated with salvaging (Joubert, 1999). Recycling is about making the most efficient use of materials. Substances such as paper, glass, plastic, aluminum cans, and other metals can also be recycled (Sowman and Urquhart, 1998).The use of waste material as a raw material for the manufacture of a new or similar type of product (Saki et al, 1996).

SOURCE REDUCTION

Reducing the amount of waste generated at the source by changing design, operating, manufacturing, and reuse of materials to minimise the quantity of waste generated. Means to reduce the waste quantity or toxicity of waste generated at the source of generation. Reducing the toxicity of waste reduces the harmful effects associated with managing and disposing of the waste. Through source reduction communities can conserve landfill capacity, resources and expenditures for waste management.

Basic source reduction measures include:

Reducing the amount of products used in manufacturing.

Reducing consumer use of products / materials.

Increasing the lifespan of the product (e.g. rechargeable batteries).

Reducing the amount of product packaging materials.

Reducing production (e.g. manufacturing waste)

Decreasing toxicity (DEADP, 2004; DEAT, 2003).

Manufactures may contribute to source reduction by, designing and manufacturing products that contain fewer toxins and less packaging (Muurevanhema, 1999).

Figure (2.3): Containers for the recycling of glass and paper.

Figure (2.3) illustrate the types of waste minimization containers used in the Breede Valley district to encourage the recycling of glass and paper.

COMPOSTING

Composting is a dynamic and complex ecological process involving the aerobic degradation of organic materials to produce a stable humus-like product that is used primarily as soil conditioner (Ninham Shand, 1993). Composting is a method of waste management, where the organic portion of the waste stream is biologically decomposed under controlled conditions (DEADP, 2004). Compost is defined as the biological putrefaction of organic materials under control conditions (Jenman et al, 2004).

COLLECTION AND TRANSPORTATION

The planning of domestic waste collection has evolved along with the development of modern infrastructure and includes the consideration of: collection vehicle system; manpower; collection routes; public health by-laws and regulations; and aesthetics. Industrial waste collection and storage has been highly mechanized because of the bulk materials handling problems created by industrial wastes. Factors that must be considered in the choice and siting of an industrial waste collection system include; the type of

container and size; the transport and collection vehicle system; manpower; space constraints and internal logistics peculiar to the premises producing the waste; public health by-laws and regulations, and aesthetics (Botha et al, 1983). The rapid growth of informal settlements that have accompanied urbanisation in South Africa has exposed a number of deficiencies in traditional waste collection systems currently employed in this country. These systems are often inappropriate, inefficient and costly when applied to informal settlements. Problems have been further highlighted by the growing public awareness of environmental issues. The success of a community collection system depends on public support and participation (Ninham Shand, 1993).

Once waste is generated, it must be stored at the point of origin, then collected and transported to a disposal or processing facility. Collection and transportation is usually the most costly element of a waste management system. The cost associated with collecting and transporting household and commercial waste, are effected by factors such as, type and quantity of waste, both household and commercial, road accessibility and condition, collection location, number and type of households and businesses, private or public collection and special waste handling requirements. Household waste collection and transportation is particularly expensive because the waste must be collected from individual households or collection stations. Waste collection and transportation can be inefficient and costly if the wrong system is selected for the community. Waste planners must consider collection and transportation needs for every type of waste generated by the community. Collection equipment is expensive and costly to operate. When considering alternatives, planners must look at labour, fuel, waste containers, and equipment cost. Waste should be collected regularly to keep the waste from overflowing, or bagged waste from pilling up, to help ensure that the waste is safely contained and stored prior to collection. Compostable materials must be collected on a regular basis, particularly in hot or humid areas. If the compostables are allowed to sit without aeration, they can rot making them unfit for composting. Waste planners must work directly with businesses to develop adequate collection and transportation practices (DWAF, 1998a; DEADP, 2004).

LANDFILL DISPOSAL

Landfill is generally neat, safe, and inexpensive and offers the most versatile method for the disposal of solid waste in an economical and environmentally sound manner. The procedure involves layering the waste over the site surface, compacting it and then sealing the site with a cover of suitable material on a daily basis. This traps odours, reduces health risks, control leachate production and minimise visual impacts. According to a successful landfill operation depends on:

- Selection of a suitable site.
- Design and preparation of the site.
- Operation and management of the site.
- Monitoring of the site.
- Rehabilitation of the site.

All landfill sites should be located, signed, constructed, operated, maintained and closed in a manner that ensures the protection of human health and the environment (Canter, 1991). Landfills produce landfill gas (typically methane, carbon dioxide, nitrogen and oxygen) from the anaerobic decomposition of organic matter. There was approximately one million tons of methane emitted from Canadian landfills in 1990. Of that amount it is estimated that 20% was captured and combusted (Sawell et al, 1996).

A landfill which is well designed and managed can operate with minimal adverse environmental impacts and, as a bioreactor, can produce utilizable landfill gas. Thus it is inherently the most appropriate method for a developing economy such as that of the Republic. However, as suitable sites for landfill operations become scarcer and therefore more costly, the more expensive disposal options will become relatively more attractive. It is a scientifically selected, designed, engineered and managed refuse-disposal operation where the daily input of waste is spread, compacted and covered with soil to a pre-planned development programme. The development programme specifies the types of wastes that are acceptable and those that are unacceptable to the site and also the way which the site will be managed (Botha et al, 1983).

Figure (2.4): Daily covering and compacting of waste at the landfill site.

Figure (2.4) illustrate the daily compacting and covering of waste with suitable material at the landfill site. DWAF Minimum Requirements prescribe, that any waste that is been dispose of at a landfill site should be compacted and be cover on a daily basis with suitable material to prevent wind scattering (DWAF, 1998a).

2.5 CURRENT WASTE MANAGEMENT SITUATION IN THE BREEDE VALLEY DISTRICT

CURRENT ORGANISATIONAL STRUCTURE

The responsibility for the effective implementation of the waste management and collection service is shared by the Engineering and Health departments of the respective local authorities in the Breede Valley Municipality. In De Doorns the Chief of Health Services is supported by a manager from the Engineering Department and seven labourers. A similar structure exists in Touwsriver where the Engineering Department is assisted by a manager in the Health Department and six labourers. In the Worcester-Rawsonville area, a manager structure consisting of five personnel and is assisted by approximately 80 labourers in ensuring that a continuous and efficient waste collection and site management service is provided (Smook, 2003).

HEALTH CARE WASTE

The health care waste from the Worcester hospital and that generated by medical practitioners, clinics and old age homes is removed by a private contractor and brought to Cape Town for incineration (Vissershok). Industries within this municipal area generally produce domestic waste that is removed to the landfill-site in Worcester by private contractor or the local authority itself. The volumes of general waste generated by commercial industries are estimated at 1-3 tons / week and have been included in the tonnages of domestic waste generated in all of the housing areas (Smook, 2003).

WASTE TYPE AND GENERATION

Based on the population figures provided per housing area the Worcester-Rawsonville area generates ± 36 743 tons of domestic waste per annum (±704.7 tons per week).
De Doorns generates approximately 2287 tons domestic waste per annum (±43.9 tons per week). Touwsriver produces approximately 2457 tons general waste per annum (47.1 tons per week).The slight difference in waste generated between De Doorns and Touwsriver despite the higher formal resident population in Touwsriver is probably due to the difference in number of people residing in the low cost and informal housing areas.

The low cost and informal areas in De Doorns accommodate approximately 3343 persons compared to 900 persons in the low cost areas of Touwsriver (Smook, 2003).

Table (2B) Total waste generation in the Breede Valley (Smook, 2003).

TOWNS	*POPULATION/HOUSING*	*TONS / WEEK*	*TONS / ANNUM*
WORCESTER / RAWSONVILLE	*F – 72 100*	*604.7*	*31 531*
	LC- 11900	*58.3*	*3040.5*
	I - 8500	*41.7*	*31 442.3*
DE DOORNS	*F - 3917*	*27.4*	*1 429.7*
	LC - 750	*3.7*	*191.6*
	I - 2604	*12.8*	*665.3*
TOUWS RIVER	*F - 6100*	*42.7*	*2 226.5*
	LC - 900	*4.4*	*230*

F = FORMAL HOUSING

LC = LOW COST HOUSING, (1kg / p / day)

I = INFORMAL HOUSING, (0.7kg / p / day)

Breede Valley Municipality IDP, Plan document, 14 September 2001.

WASTE MINIMIZATION INITIATIVES

No formal waste minimization initiatives are currently being practiced in these areas. In the De Doorns area there is no waste minimization initiatives. In the Touwsriver area there is a waste minimization, recycling community based project (Smook, 2003).

NATIONAL WASTE MANAGEMENT STRATEGY

No officials in any of the local authority's waste department have any exposure to the NWMS. Workshops, local visits to the respective landfill sites and training is required (Smook, 2003).

Table (2 C): Sources and characteristics of waste in the Breede Valley District (Smook, 2003).

SOURCES	*TYPES OF WASTE*
Stalls, Hawkers.	*Organic materials, plastics, paper cardboard, glass, food cartons, packaging material*
Schools, Government institutions.	*Paper, plastics, cardboard.*
Prisons.	*Mixed waste, paper, plastics, glass, organic materials*
Industries.	*Chemicals, scrap metals, plastics, paper, cardboard, glass, aluminum, carcasses of animals, hazardous waste, steel, paints, motor oil, construction & demolition waste, used oil, solvents, tyres, packaging materials, wood, batteries*
Residential	*Mixed waste, yard waste, organic waste, ash, household hazardous waste, textiles, batteries*
Commercial centres	*Scrap metal, woods, organic materials, glass, plastics, and aluminium, tin cans*
Workshops.	*Scrap metals, plastics, cardboard, glass, paper, aluminum, steel, tyres, batteries*
Supermarkets and shops.	*Papers, cardboard, plastics, organic material, tin cans*
Sport stadiums.	*Paper, plastics, tin cans*
Medical centres, medical practitioners	*Medical waste, paper, plastics, cardboard, hazardous waste, laboratory effluent*

The Breede Valley Municipality needs to follow the integrated waste management hierarchy below to enhance waste minimisation and to protect the impact on the environment.

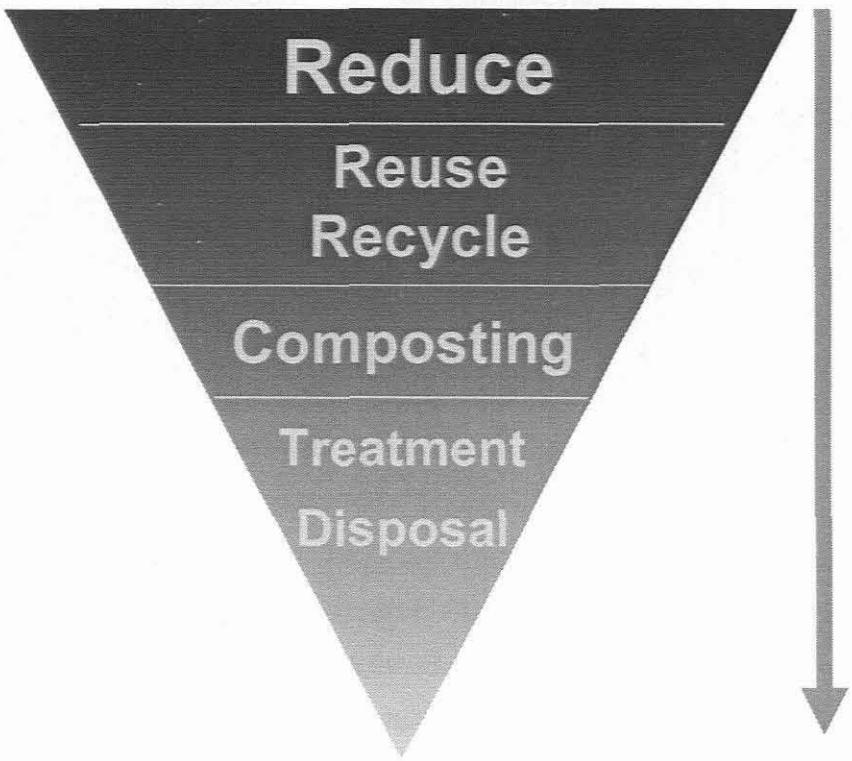

Figure (2.5): Waste management hierarchy (Jenman et al. 2004).

The waste management hierarchy is a principle prescribe by the NWMS, which all the municipalities should follow to reduce their volume of waste generated and also to minimise the impact on the environment. Reduce, reuse, recycling,composting, treatment and finale disposal is all waste minimisation tools that should be formulated in any integrated waste management plan.

SERVICES- STORAGE, COLLECTION AND TRANSPORTATION

In Worcester, Rawsonville and De Doorns access to informal and formal areas are good and waste removal via the black bag system in these areas occurs once a week.

Figure (2.6): Waste collection in the Breede Valley area.

Figure (2.6) illustrate the type of truck that is use when the waste compacter is broken. The current access to informal areas is limited. Skips bins have been placed at strategic points in the informal areas to facilitate waste removal on a weekly basis. Industrial waste in Worcester and Rawsonville is stored in yellow container (skips), which are removed once a week if it is domestic waste. The industrial waste gets removed on request. In De Doorns industrial waste is removed once a week. Removal frequency in this area can be increased depending on the need. The Worcester- Rawsonville cleansing services fleet consists of 23 vehicles of which 22 are currently in use. These transport vehicles include: REL trucks (4), tipper trucks (2), FE loader (1), light trucks (6), tractors (6), trailers (5), and bin carriers (2). The local authority employs approximately 80 labourers to assist in the cleaning operation of these towns. Local authorities in the Worcester-Rawsonville area have sufficient alternative transport if any problems should arise. The waste management services in the De Doorns are totally reliant on 2 vehicles (truck and tractor and trailer). The truck is used for door-to-door removal service in formal areas. In addition five labourers are employed to assist in the removal service dedicated to the formal area in De Doorns. The tractor and trailer with two labourers assists with the waste removal in the informal area of De Doorns. Sufficient alternative transport is

available in the case of transport breakdowns. In Touwsriver a weekly door-to-door waste removal service is in place (housing and commercial areas). A waste truck with 6 labourers is dedicated to fulfill the waste removal service for this local authority. Vehicle from other departments can be used when there is a shortage or breakdown of the current vehicle in use (Smook, 2003).

SERVICE PAYMENT

Residents staying within the municipal boundaries of the Breede Valley Municipality pay for their basic refuse removal as part of the monthly municipal service account.The applicable service rates of Worcester, Rawsonville and De Doorns have not been reported. Informal areas within Worcester, Rawsonville and De Doorns do not pay for waste removal services or only part thereof, placing the onus on the responsible local authority to subsidize this service. Action plans have been put in place to address this problem in these informal areas by the institution of a credit control system. Implementation of this system will hopefully improve the level of payment. The annual cost budgeted for the waste removal service in the Worcester-Rawsonville area was not available. A revenue of R 9 189 624 is generated from collection. The capital and personnel budget is in the order of R 53 545 and R 3 893 059 respectively.

Waste collection services in the De Doorns cost R 388 880 00 per annum. An annual income of R 450 460 is generated for the service provided. A surplus amount can however not be confirmed for the area since the overall income and expenditure budgets were not provided for this local authority. In addition, the day-to-day operational costs of the landfill are not included. In Touwsriver a service rate of R 25.08 per weekly waste removal applies to each formal and low cost housing unit. Commercial industries are billed at R25 08 per load / removal. The number of loads removed on a weekly basis per industry or business usually varies between 3 and 5 loads. The capital and personnel budget allocation for Touwsriver amounts to R 144 730 and the income generated is R 253 930 (Smook, 2003).

WASTE DISPOSAL SITES / FACILITIES

Four landfill sites exist within the Breede Valley Municipality area. These sites are in Worcester, Rawsonville, De Doorns and Touwsriver. All of the waste disposal sites, except the one in Worcester, are operating without a permit Touwsriver and De Doorns dump site: Building rubble generated in these areas is disposed of at the Worcester waste disposal site. The garden waste component of the waste stream is estimated at 10%-15% and is disposed of together with the general domestic waste. Site management is considered reasonable. There is an operator on site who is responsible for daily management. The waste is covered on a daily basis in an attempt to control wind scattering. Salvaging is banned on site and preventative measures are in place to keep informal salvagers away from the disposal area. The infrastructure of the waste disposal site is suitable and access to the site is well control. The Rawsonville waste disposal site is in the process of being closed down due to financial and transport constraints. Once closed the general waste will be disposed of at the Worcester waste disposal site. At present site management is poor and waste is burnt on a regular basis. The site will still be used in the future for the disposal of garden waste and building rubble at De Doorns site. This local authority has no permit. Fencing at the site is stolen, repeatedly resulting in poor access control. Informal recycling at the waste disposal site is common. This activity, the poor access control and the continuous problems with fencing has resulted in a poorly managed site. The garden waste is disposed of with building rubble, glass, paper, metal and other non hazardous waste at the landfill at Touwsriver. This waste disposal site operates without a permit. The site management is poor. The infrastructure requires attention since there is no fence or gate and therefore access control is non-existent. Site management is poor with no operator on site and waste is disposed of randomly. Salvaging is a problem and waste is regularly burnt. The Breede Valley Municipality has no waste transfer stations, composting- or recycling facilities. A transfer station is in the planning phase for De Doorns and Touwsriver, with recycling facilities (Smook, 2003).

OVERVIEW OF CURRENT WASTE MANAGEMENT IN THE BREEDE VALLEY AREA

The Breede Valley Municipality provides a relatively good waste removal service for all local authorities to assist with overall management of the waste stream generated. Excluding the informal settlement in Worcester, standards are generally acceptable. The day-to-day management of the waste disposal sites in all of the local authorities needs considerable attention with the exception of Worcester. The area obviously does not have a hazardous waste disposal facility to support the needs of the industrial sector and medical waste generated. These industries rely on private industry and contractors for this service. The by-laws of the Breede Valley Municipality are outdated, and no enforcement of these by-laws ever took place (Smook, 2003).

The waste management, which took place in the Breede Valley district, focused mainly on disposal and end of pipe solutions. This approach resulted in serious negative impacts on the environment and human health. Indiscriminate dumping of waste, at street corners is very common (Appendix F, G). The basic waste management processes of collection, transport, segregation and final disposal appear to be very inefficient and inadequate. Over the years, the effective management of waste has been a major problem in the Breede Valley district in terms of poor service delivery in unserviced areas, especially the previously disadvantaged communities. The concern on environmental health demands that waste be properly managed and disposed of in the most friendly and acceptable way. This is to minimize and where possible eliminate its potential harm to humans and the environment. Breede Valley Municipality must formulate integrated waste management plans, which address all areas of waste management, from prevention and minimization to its collection, treatment, recovery and final disposal. It must not only address the practicalities of waste management, but also the issues of public education, public participation and changing concepts, as these are vital to a successful management system. Robinson (1986) defines waste management as the application of techniques that will ensure the orderly execution of the functions of collection, transport, processing, treatment and disposal of waste. The integrated waste management plans which the Breede Valley Municipality introduce must focused on waste minimization, waste facilities, formulation of a waste information system, public participation, formulation of

waste related legislation and mitigation measures to control impact on the health and the environment. With population growth prediction and migration to continue, the Breede Valley Municipality needs to plan ahead for effective implementation to reduce waste quantities and protect the impact on the environment. The objective of this study is to investigate ways to minimize waste and proper waste management practices in the Breede Valley district. For this purpose, a waste assessment study was done, and then a questionnaire was designed for medical waste, business waste and for the community to collect data (Smook, 2003).

CHAPTER 3

3 METHODOLOGY

3.1 STUDY AREA

3.1.1 WORCESTER

Worcester area lies in the lowland of the Breede River Valley, formed by the Cape Fold Mountains. The valley widens from the north-west to approximately 30 kilometers in an east-west direction and to approximately 10 kilometers in a north-south direction. Worcester has a significant commercial and industrial base, surrounded by fertile agricultural areas, well known for the quality of their wine and fruit farms (Appendix A).

Table (3A): Population profile of Worcester (Schroeder, 2002).

TOTAL POPULATION	*122896*
MALE	*60595*
FEMALE	*62 301*
LAND SIZE	*731.425 ha*
NO OF HOUSEHOLDS	*9062*
NUMBER OF PEOPLE PER HOUSEHOLD	*4.7*
AGE 0 - 15	*25034*
16-30	*25143*
31-45	*5338*
46-60	*3161*
60+	*1100*
EMPLOYED	*67 045*
UNEMPLOYED	*25 961*
Percentage of people of Breede Valley area residing in Worcester (70%).	

The population profile of Worcester is shown in Table 3A. In the Worcester area there is a huge disparity concerning higher income groups and lower income groups. The predominately higher income areas are situated relatively close to industries and commercial areas, with no illegal dumping taking place in these areas.

This is in contrast to the situation in the low income areas. The open spaces in the high income areas are developed in parks, unlike the open spaces in the low income areas where this area is used for illegal dumping of domestic waste on play grounds for children (Appendix E).

3.1.2 DE DOORNS

De Doorns is a largely an agricultural area. The area surrounding De Doorns is mainly farming area. The issue of unemployment and job creation is linked to the nature of work in this area. Jobs in this area is normally seasonal, but workers arrive to work in the season but do not leave when the season ends (Appendix A).

Table (3B): Population profile of De Doorns (Schroeder, 2002).

TOTAL POPULATION	*7 272*
MALE	*3 411*
FEMALE	*3861*
NO OF HOUSEHOLDS	*1 100*
LAND SIZE	*677ha*
NUMBER OF PEOPLE PER HOUSEHOLD	*4.3*
AGE 0 -15	*1567*
16-30	*2758*
31-45	*2231*
46-60	*668*
60+	*48*
EMPLOYED	*3 560*
UNEMPLOYED	*1112*
Percentage of people of Breed Valley area residing in De Doorns (10%).	

The population profile of De Doorns is shown in Table 3B. This area consists of a large informal settlement that makes the management of waste difficult due to the large population and a lack of access roads. At present the landfill site is operated illegally, and will be closed in the near future for rehabilitation purposes.

3.1.3 TOUWSRIVER

Touwsriver is a small rural town located on the slopes of the Hex river mountain range in the Breede Valley area. It is situated next to the N1 national road, approximately 180 km from Cape Town and 45 minutes from Worcester. Currently, the economy of Touwsriver is dominated by agriculture, trade and service activities. The agricultural sector does not provide sufficient sustainable employment opportunities for residents as most of the employment is of a seasonal nature in the surrounding towns, of De Doorns and Ceres. The main products are grapes and other fruit. Apart from food processing, there is no manufacturing or industrial industry. Employment opportunities are limited with strong seasonal variation in the availability of work. Pensions and grants form an important source of income for many households (Appendix A).

Table (3C): Population profile of Touwsriver (Schroeder, 2002).

TOTAL POPULATION	*6 396*
MALE	*2 975*
FEMALE	*3 348*
LAND SIZE	*1 200 ha*
NO OF HOUSEHOLDS	*1 313*
NUMBER OF PEOPLE PER HOUSEHOLD	*4.8*
AGE 0 – 15	*1923*
16-30	*2 228*
31-45	*17 28*
46-60	*415*
65+	*102*
EMPLOYED	*2012*
UNEMPLOYED	*3034*
Percentage of people of Breede Valley area residing in Touwsriver (8%).	

The Touwsriver population profile is shown in Table 3C. The municipality currently delivers municipal waste at the community based recycling centre. There it is sorted by the community, who take all the useful recyclables out of the waste stream. The remaining waste is placed on a trailer, which is situated in the recycling centre.

The trailer is then collected and the waste is transported to the landfill site in Worcester. In contrast to other rural areas in the Breede Valley district, Touwsriver does not have an informal settlement. This is the only Breede Valley town with a recycling centre in operation. The landfill site is closed and the rehabilitation of this landfill site is already taking place (Appendix A).

3.1.4 RAWSONVILLE

Agriculture is the major economic activity in this area. They mainly produce grapes, fruit, processed food and wine. There is no manufacturing or industrial industry (Appendix A).

Table (3D): Population profile of Rawsonville (Schroeder, 2002).

TOTAL POPULATION	*1 765*
MALE	*818*
FEMALE	*947*
LAND SIZE	*670.5 ha*
NO OF HOUSEHOLDS	*569*
NUMBER OF PEOPLE PER HOUSEHOLD.	*3.8*
AGE 0 – 15	*600*
16-30	*787*
31-45	*227*
46-60	*98*
60+	*53*
EMPLOYED	*722*
UNEMPLOYED	*63*
Percentage of people of Breede Valley area residing in Rawsonville (less then2%).	

The Rawsonville population profile is shown in Table 3D. Rawsonville, like Touwsriver does not have an informal settlement and illegal waste dumping does not occur in this area. Rawsonville, compared to other areas, have a small group of low income residents. The landfill site is closed and the rehabilitation of this landfill site is currently taking place. Rawsonville waste is transported to the landfill site at Worcester.

3.2 WASTE ASSESSMENT STUDY

3.2.1 Purpose

The purpose of the waste assessment study was to gather information about the waste stream in the Breede Valley area, such as, composition of the waste stream, source of waste generation, quantity of waste, types of waste, types of recyclables and types of non-recyclables Table (2C). Also, to describe some key aspects of the waste management situation such as, who generated what, how much waste is generated, what variations occur in the waste stream, what is done with hazardous waste and how is the current waste stream managed. This information is essential for future waste programme planning, facility design, and development of an integrated waste management system for the area. It is also important to know what the current waste stream quantities and composition is for financial decision making Table (2C). With current outdated and inaccurate information about the waste stream, it is necessary to acquire reliable information to make sound decisions for integrated waste management purposes.

3.2.2 Sampling and data collection

The sample size was between (10%) and (16%) of the total households in a specific area or neighbourhood (Tables 4A, 4B). Stratified sampling was used to ensure that difference in population or household numbers are taken into account in the sampling procedure. In the Worcester and Rawsonville area the sampling took place at the curbside and in the De Doorns area, at the disposal site. In Touwsriver no waste assessment study was done. The figures of the community recycling centre were used in this investigation. Firstly, the black bag was weighed with a hanging scale and then emptied on a ground-sheet at the curbside. The same was done with the waste of De Doorns at the landfill site. The waste was separated into recyclables and non-recyclables. The recyclables were put in a clean bag and weighed. The same was done with the non-recyclables. The recyclables and the non-recyclables were identified and recorded. Each type of recyclable or non-recyclable was not weighed separately. The recyclables investigated included glass, paper, plastic, cans, steel, metal, textiles, cardboard, packaging materials, biodegrade waste, food cartons and garden waste Table (2C).

The non-recyclables included laminated paper, general waste mixed with household hazardous waste (Appendix D) and contaminated recyclables.

3.3 QUESTIONNAIRES AND INTERVIEW

3.3.1 Purpose

The purpose of the questionnaires was to gather information regarding the knowledge of waste and the current waste management practices. This information include, waste minimization initiatives, the main causes of illegal dumping, co-operation between community and the waste department and how the current system can be improved. One aim of the questionnaires was to strengthen the waste management activities, by using the information as a starting point for developing strategies and plans to improve quality of waste management. Also help to in the formulation of a plan of action to address some of these issues raised or highlighted by the responses to the questionnaire. The questionnaires were also used to draw attention to the usefulness of community based surveys as a component of the waste information system.

3.3.2 Target groups

All the participants of the questionnaire survey lived, or had their business in the Worcester area. Approximately 40 residential dwellings per neighbourhood were targeted to complete the questionnaires. All questionnaires were delivered by door to door visits by a student, who was given training, on how to show the residents to complete the questionnaires. Data was collected from the residents, businesses and medical practitioners in the Worcester area.

3.3.3 Medical practitioners

Questionnaires was put to the medical practitioners for information such as, collection, storage, disposal, transportation, staff training, nature and types of infectious waste, health and safety measures, and effectiveness of infectious waste management programmes. This information is needed to develop strategies and to put mitigation measures in place to protect human health and the environment from illegal medical

waste practices. This information will also be used in the formulation of effective hazardous waste information systems and by-laws (Appendix B1).

3.3.4 Businesses

The business sector was targeted for information such as, generation of hazardous waste, the amount of waste generated and disposal of it. Other issues considered were waste minimization activities and the existence of an environmental policy. This information will be used to formulate a waste information system and to develop new waste related legislation (by-laws) (Appendix B2).

3.3.5 Community

Information from the community questionnaires such as, quality of service delivery, waste minimization initiatives, knowledge of waste management and causes of illegal dumping was gathered to describe the current waste situation. This information will draw the attention to effective waste management practice and the negative impact it can have on human health and the environment. The problems associated with litter and illegal dumping will be highlighted (Appendix B3).

3.3.6 Interview

An interview was also conducted with a representative of the Engineering Department. This department is responsible for waste in this area. The interview with the engineering department was done to investigate whether they have the capacity to introduce an integrated waste management approach, as well as educational programmes. Questions relating to the enforcement of waste related legislation were also put to the department (Appendix B4).

3.4 SAMPLING & DATA COLLECTION

Each questionnaire was preceded by a standard introduction and brief explanation of the purpose of the study (Appendix F). The students who distributed the different questionnaires were giving a two hour lecture to equip them to help the participants on how to complete the questionnaires. The questionnaires were given to the participants by

hand to complete, and where there was no person to complete the questionnaire it was left behind and collected at a later stage.

3.4.1 Medical practitioners

The medical practitioners who were included in the sample are the following, doctors, pharmacists, veterinarians. Also included in the sample were medical centres, clinics and laboratories. The questionnaire was left behind to be completed and collected at a later stage. Thirty one medical practitioners completed the survey questionnaires. A return rate of eighty percent was achieved.

3.4.2 Businesses

The businesses included in the sample were the following: office buildings, retail stores, restaurants, take-aways, service stations, schools, entertainment centres, supermarkets, clothing stores, hawkers, spraypainters, building contractors, computer shops, general dealers and abattoirs (Appendix A). The students visited these premises to complete the questionnaires. Where the manager or the owner was not present the questionnaire was left behind to be completed and collected at a later stage. One hundred and fourteen businesses completed the survey questionnaires. A return rate of seventy percent was achieved.

3.4.3 Community

The student was asked, to select (4-5) households in a street, in a neighbourhood, to complete the questionnaire. The main objective was to include all the areas in Worcester in the investigation (Table 4A, 4B). With this type of sampling, every neighbourhood has a chance to be included in the sample. The informal settlement, Rawsonville, De Doorns and Touwsriver was not included in the completion of the questionnaires. One thousand two hundred and thirty two households completed the survey questionnaires.

3.4.4 Interview

An interview was also conducted with a representative of the Engineering Department.

3.5 ETHICS STATEMENT

The possible participants in the research study were introduced to this investigation by a letter of introduction and given the opportunity to choose whether or not to participate in the research project. All information gathered was and is regarded as confidential and the names of any of the participants were or will not be made public.

3.6 STATISTICAL ANALYSIS

Data from the waste assessment study was analysed statistically by means of ANOVA (Analysis of Variance). The Sigmastat 3.1 statistical package was used for this purpose.

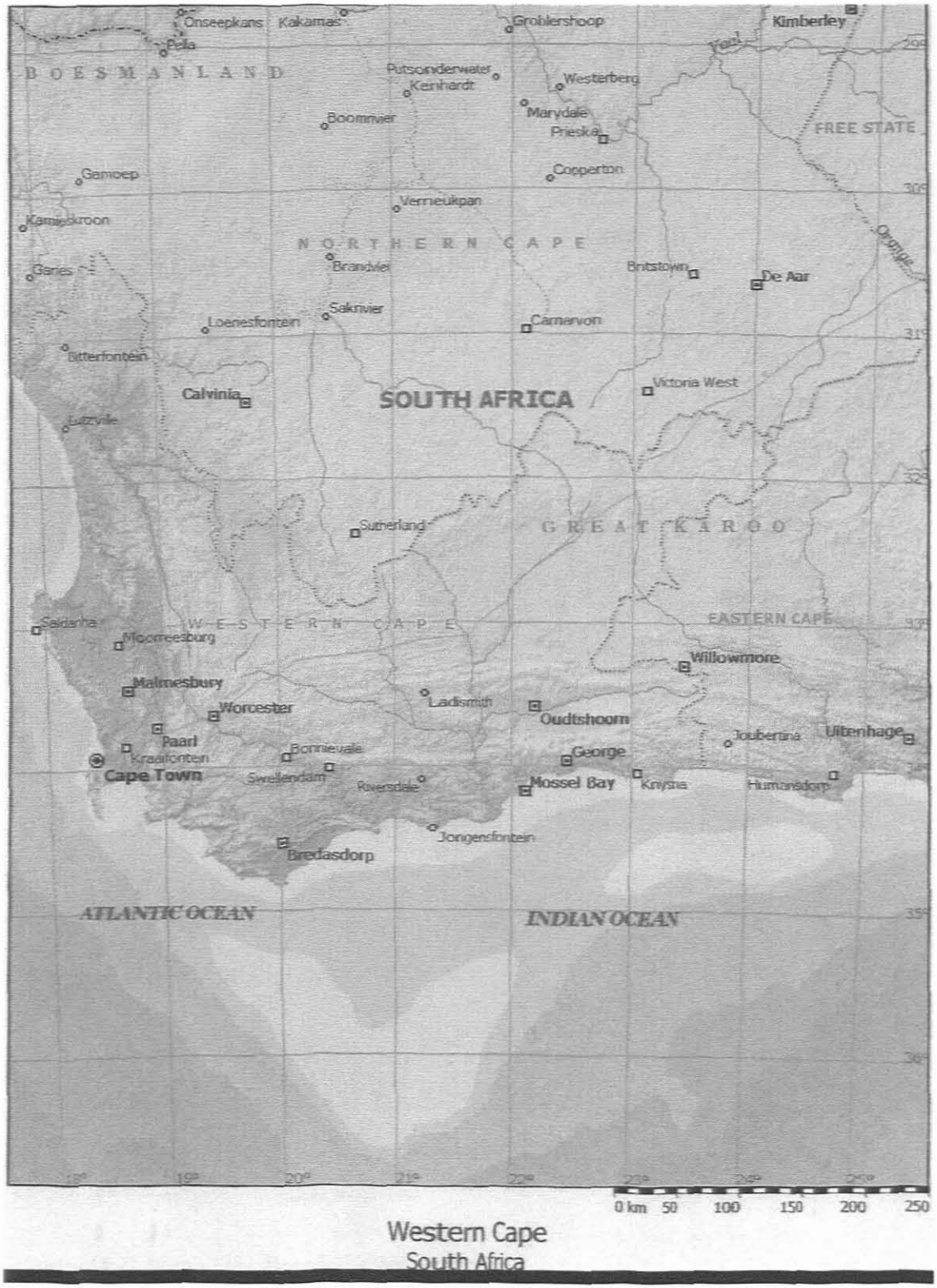

Figure (3.1): Map of the Western Cape, South Africa.

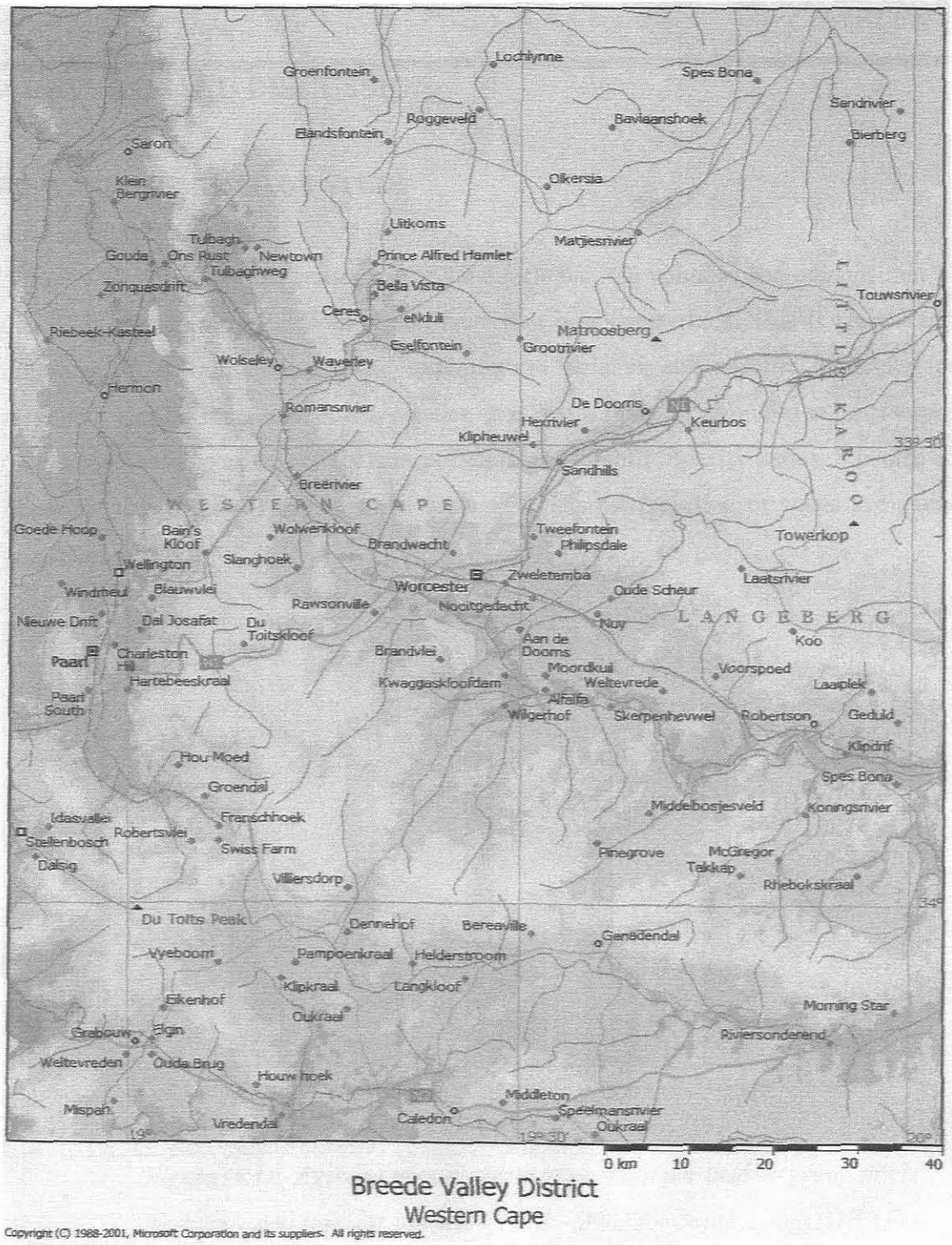

Figure (3.2) Map of the Breede Valley District.

CHAPTER 4

4 RESULTS AND DISCUSSION

4.1 WASTE ASSESSMENT STUDY

4.1.1 Introduction

Before waste management strategies can be developed, the volumes and composition of the waste stream within a given region must first be characterized. This is particularly important when considering waste minimisation policies and specific materials for recycling, such as paper, cardboard, plastics, etc. Waste statistics also need to be assessed on a weight basis, particularly for transportation and landfill capacity issues. It is also an important tool in identifying specific waste materials for recycling or waste avoidance programmes.

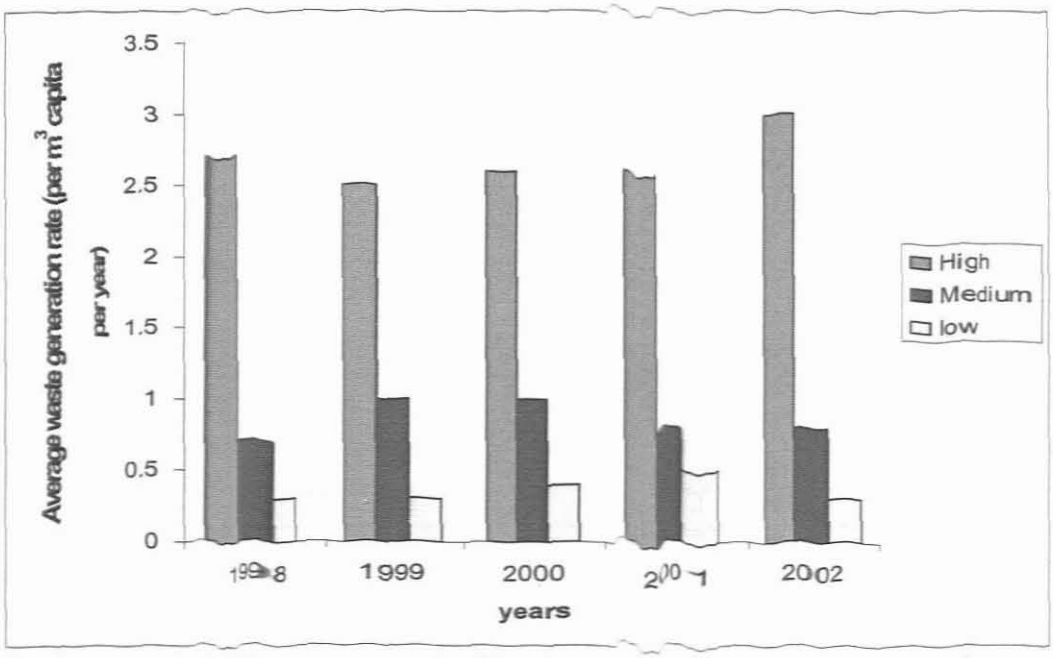

Figure (4.1): Average annual waste generation per income group (high, medium, and low) for the years 1998 – 2002 for South Africa (DWAF, 1997, 1998a).

Figure (4.1) shows the average waste generation per income group from 1998 until 2002 in South Africa. This is a clear indication that the waste stream's composition differ from

area to area, depending on income of households and is related to the lifestyles of those communities. In general, the higher income groups generate more waste than the lower income groups (DWAF, 1997, 1998a).

4.1.2 Results of waste assessment study in the Breede Valley district

Table (4A): Sampling frame of waste assessment study (kg).
h = high income area. l = low income area.

Areas	*Total households in an area*	*Samples taken in an area*	*Sample fraction (%)*	*Average total waste generated per household per week (kg) (±SD)*		*Average recyclables generated per household per week (kg) (±SD)*	
Avian Park	*1000*	*100*	*10*	*5.6*	*±0.87*	*3.2*	*±0.65*
Bergsig	*226*	*30*	*13*	*9.8*	*±0.86*	*6.1*	*±1.19*
Bloemkombos	*95*	*14*	*15*	*10.5*	*±1.27*	*6.8*	*±0.98*
De Doorns (h)	*450*	*38*	*8*	*9.2*	*±1.14*	*5.9*	*±0.96*
De Doorns (l)	*650*	*49*	*7*	*5.8*	*±1.03*	*3.5*	*±0.98*
Essenlen Park	*258*	*32*	*12*	*10.0*	*±1.00*	*6.8*	*±1.47*
Fairway Height	*133*	*20*	*15*	*10.5*	*±1.08*	*6.9*	*±0.91*
Fairy Glen	*162*	*25*	*15*	*9.3*	*±1.06*	*5.9*	*±0.74*
Florian Park	*151*	*22*	*15*	*9.9*	*± 0.86*	*6.7*	*±0.58*
Hex Park	*731*	*70*	*10*	*7.8*	*±1.06*	*4.3*	*±0.87*
Hospitaal Park	*51*	*7*	*14*	*8.0*	*±1.00*	*4.3*	*±0.51*
Hospital Heuwel	*136*	*20*	*15*	*8.5*	*±1.04*	*4.3*	*±1.13*
Johnson Park	*418*	*45*	*11*	*9.8*	*±1.47*	*6.3*	*±1.31*
Langerug	*478*	*50*	*10*	*11.7*	*±1.21*	*7.9*	*±1.34*
Merings Park	*415*	*48*	*12*	*8.9*	*±1.36*	*5.4*	*±1.16*
Mid- Town	*91*	*13*	*14*	*9.7*	*±1.07*	*5.9*	*±0.86*
Noble Park	*42*	*6*	*14*	*8.0*	*±0.16*	*4.6*	*±0.32*
Ou Dorp	*233*	*30*	*13*	*11.3*	*±1.51*	*7.7*	*±1.67*
Paglande	*187*	*25*	*13*	*10.9*	*±1.36*	*6.7*	*±1.04*
Panorama	*350*	*47*	*13*	*10.2*	*±0.79*	*6.9*	*±1.03*
Parkers Dam	*415*	*45*	*11*	*7.5*	*±0.88*	*4.5*	*±0.84*
Rawsonville (h)	*445*	*34*	*8*	*9.0*	*±0.82*	*5.6*	*±0.79*
Rawsonville (l)	*124*	*20*	*16*	*6.0*	*±1.55*	*4.05*	*±1.22*
Re-Unie Park	*89*	*13*	*15*	*9.4*	*±1.46*	*6.0*	*±1.1*
Riverview	*820*	*80*	*10*	*5.8*	*±0.84*	*3.0*	*±0.63*
Roodewal	*1234*	*125*	*10*	*5.5*	*±0.77*	*3.0*	*±0.66*
Roux Park	*348*	*35*	*10*	*8.6*	*±1.16*	*5.0*	*±1.09*
Somerset Park	*177*	*25*	*14*	*8.8*	*±0.47*	*5.5*	*±0.97*
Van Riebeeck Park	*253*	*35*	*14*	*10.4*	*±1.24*	*7.0*	*±1.21*
Victoria Park	*569*	*60*	*10*	*8.0*	*±1.36*	*4.6*	*±1.20*
Total	*10731*	*1163*	*367*	*264.4*		*164.4*	

Table (4B): Average waste and recyclable generation per week and per annum (tonnes). h = high income area. l = low income area.

Areas	*Waste generation per week per area*	*Waste generation per annum per area*	*Recyclables recovered per week per area*	*Recyclables recovered per annum per area*
Avian Park	*5.6*	*291*	*3.2*	*166*
Bergsig	*2.2*	*115*	*1.35*	*70*
Bloemkombos	*0.99*	*51*	*0.64*	*33*
De Doorns (h)	*4.14 t*	*215*	*2.65*	*138*
De Doorns (l)	*3.77*	*196*	*2.27*	*118*
Essenlen Park	*2.58*	*134*	*1.75*	*91*
Fairway Heights	*1.39*	*72*	*0.91*	*47*
Fairy Glen	*1.50*	*78*	*0.95*	*49*
Florian Park	*1.49*	*77*	*1.01*	*52*
Hex Park	*5.7*	*296*	*3.14*	*163*
Hospitaal Heuwel	*1.15*	*60*	*0.58*	*30*
Hospitaal Park	*0.40*	*21*	*0.21*	*11*
JohnsonPark	*4.0*	*213*	*2.63*	*136*
Langerug	*5.5*	*290*	*3.77*	*196*
Merings Park	*3.6*	*192*	*2.24*	*11*
Mid- Town	*0.88*	*45*	*0.53*	*27*
Noble Park	*0.33*	*17*	*0.19*	*10*
Ou-Dorp	*2.63*	*136*	*1.79*	*93*
Paglande	*2.03*	*105*	*1.25*	*65*
Panorama	*3.5*	*185*	*2.41*	*125*
Parkers dam	*3.1*	*161*	*1.86*	*97*
Rawsonville (h)	*4.0*	*208*	*2.49*	*129*
Rawsonville (l)	*0.74*	*38*	*0.50*	*26*
Re-unie Park	*0.83*	*43*	*0.53*	*27*
Riverview	*4.7*	*247*	*2.46*	*127*
Roodewal	*6.7*	*352*	*3.71*	*193*
Roux Park	*2.9*	*155*	*1.74*	*90*
Somerset Park	*1.55*	*80*	*0.97*	*50*
Van Riebeeck Park	*2.6*	*136*	*1.77*	*92*
Victoria Park	*4.5*	*236*	*2.61*	*136*
Total	*85*	*4388*	*52.23*	*2715*

Table (4A) and table (4B) show the different areas (neighbourhoods) that were included in the waste assessment study. These tables also show a summary of the waste generation and recyclables found in this study.

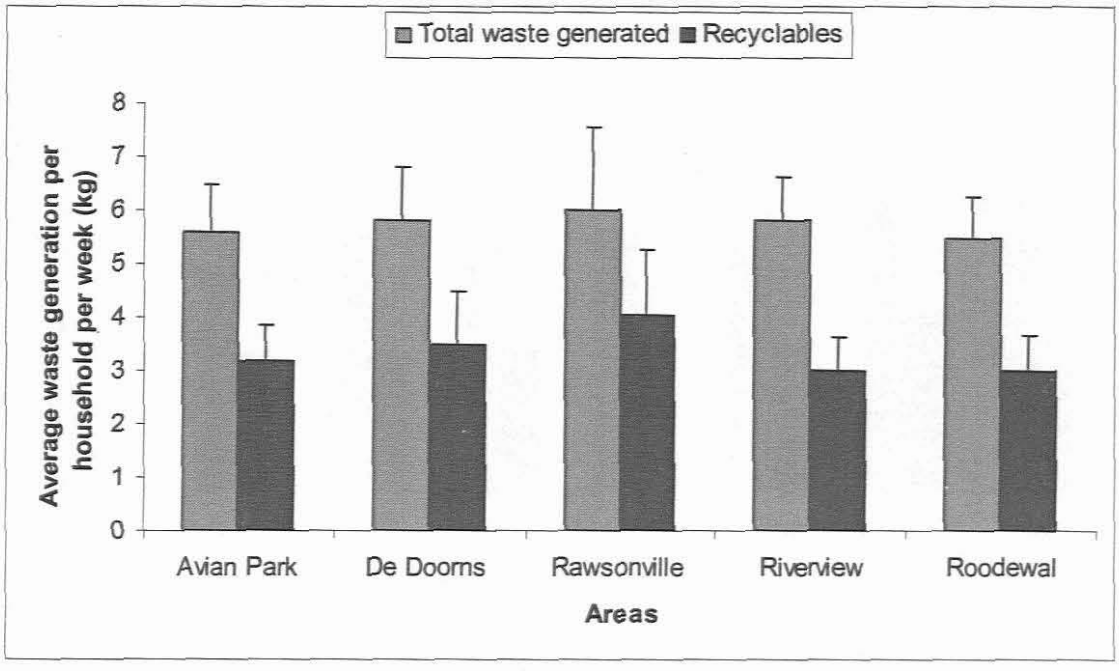

Figure (4.2): Average waste generation, expressed as total waste generated and recyclables, per household per week (kg) (±SD) in low income areas. For sample size see Table 4A.

Figure (4.2) illustrates the average total waste generation per household per week in low income areas in the Breede Valley district. The mass of the recyclables separated from the total waste generated in each area are also shown. Statistical analysis showed that there were significant differences between total waste generated and recyclables in all these areas ($P < 0.05$).

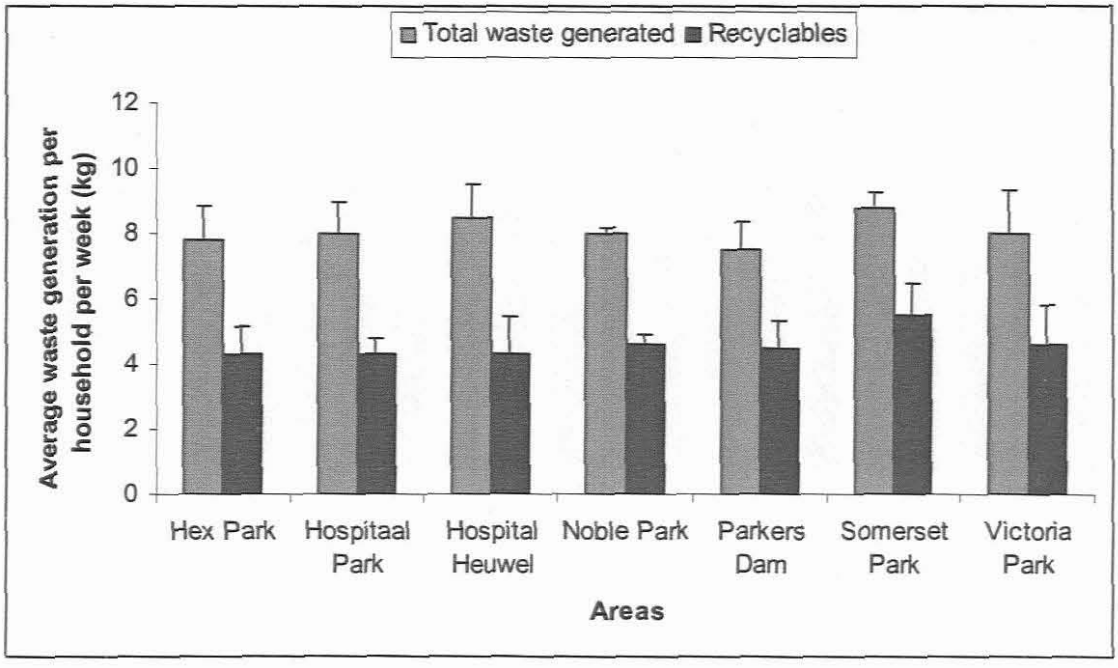

Figure (4.3): Average waste generation, expressed as total waste generated and recyclables, per household per week (kg) (±SD) in middle income areas. For sample size see Table 4A.

Figure (4.3) illustrates the average total waste generation per household per week in middle income areas in the Breede Valley district. The mass of the recyclables separated from the total waste generated in each area is also shown. Statistical analysis showed that there were significant differences between total waste generated and recyclables in these areas ($P < 0.05$).

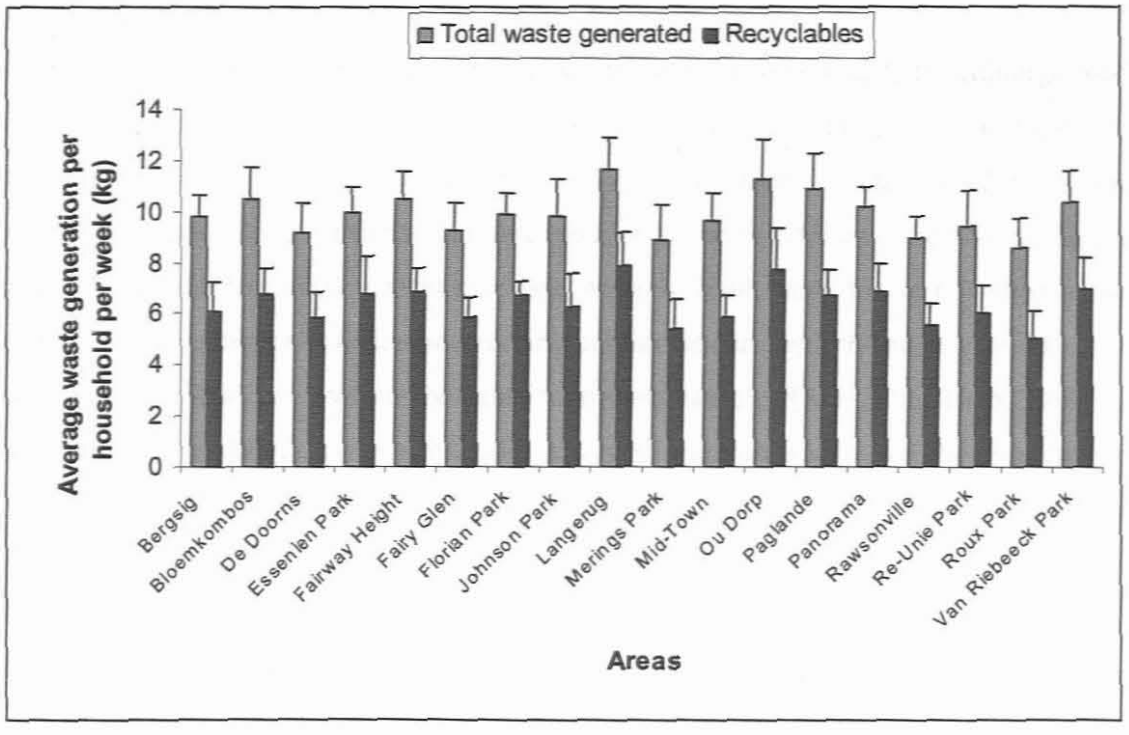

Figure (4.4): Average waste generation, expressed as total waste generated and recyclables, per household per week (kg) (±SD) in high income areas. For sample size (Table 4A).

Figure (4.4) illustrates the average total waste generation per household per week in high income areas in the Breede Valley district. The mass of the recyclables separated from the total waste generated in each area is also shown. Statistical analysis showed that there were significant differences between total waste generated and recyclables in these areas ($P < 0.05$).

Further statistical analysis by means of analysis of variance revealed that there were highly significant differences between high, middle and low income areas in terms of total waste generated ($P<0.0001$). In terms of recyclables found there were also significant differences between the three income groups ($P< 0.0006$).

4.1.3 Discussion

According to an example of volume-based waste statistics for Kyoto City, although food waste accounts for (40%) of the total weight of the waste stream, it only accounts for about (10%) of the volumetric ratio. Conversely, waste paper accounts for (25%) of the weight and up to (35%) of the volumetric ratio of the waste stream. More over, plastics make up only (10%) of the weight of waste, whereas it accounts for up to (40%) of the volume. These substantial difference and implication underscores the need to include this type of data collection in waste characterization programmes (Saki et al, 1996). Volume was not used in this study as a measure of waste generation, but weight was used to determine the waste generation. This could be put forward as a shortcoming of this study.

According to this waste assessment study, 85t of waste was generated per week, and 4388t of waste generated per annum Table (4B) in the Breede Valley district. The recyclables that can be recovered is 52t per week and 2715t per annum. Therefore, of the 4388t of waste generated per annum 2715t could be recovered if waste minimisation strategies are to be implemented. At present a large percentage of the 4388t of waste is disposed of at the landfill site, apart for a small percentage that is recycled in some of the areas. More recyclables can be taken out of the waste stream, if source reduction is used as a waste minimisation tool. Source reduction is the best option, because the recycled materials are more hygienic, clean and less contaminated.

It gives more information about the characteristic of a waste stream. Waste Managers who design, plan and make financial decisions, need accurate information to make those decisions. A waste stream assessment study will provide that information. We want to find out who generates what waste, how much waste and what variations occur in the waste stream Table (2C). A waste stream assessment study is more accurate, than other methods used to determine the composition, quantity and sources of the waste stream. Volume as a measure of waste generation could supplement weight as the waste generation measuring tool.

The low income areas generate an average of 5.74 (±0.19) kg waste per household per week in comparison to the generation of 9.95 (±0.84) kg of waste per household, per week of the high income areas. The high income areas generate 4.21 kg per household, per week more waste than that of the low income areas and 1.86 kg more than that of the middle income areas. The high income groups have more money to spend on luxuries, and recyclables such as packaging materials make the largest percentage out of the recycling materials. Recyclables of 6.42 kg per household, per week can be recovered from the high income areas, in comparison to 3.35kg of the low income areas and 4.59 kg from the middle income areas.

At present most of the waste generated in the high-, middle- and low income areas are disposed of at the landfill site. In practice it means that 3.53 kg from the high-, 3.58 kg from the middle-, and 2.39 kg from the low income areas per household, per week can be collected and transported to the landfill site after removal of the recyclables. This mean that a total of 164.362 kg recyclables per household, per week, can be recovered from a total of 264.4kg waste per household, per week Table (4 A).

To recover recyclables before they enter the waste stream, it is necessary for the waste department to find out the quantity, composition and types of waste generation Table (2C). This is a clear indication that waste generation and income are closely linked in the communities. The highest waste generation was found in the higher income areas. This finding is in line with the findings of a previous national study by DWAF (1997, 1998a). Also, more household hazardous waste (Appendix D) was found in the general waste stream, than that of the low income areas. A characterization study by Fourie et al (1998), derived from two economically diverse communities illustrated larger differences in waste composition. Waste from a low income community comprised in excess of 50% of wet mass of ash and dust, with the putrescible content never exceeding 20%, regardless of the season of the year. Waste from a medium- income community usually had in excess of 60% of wet mass of biodegradable matter. It has long been recognized that the composition of a refuse stream depends on the standard of living of the community from which it originates.

There are substantial differences in composition, with the richer countries forming 'throw –away' societies in which a large proposition of the waste stream comprises paper, plastic, metals and vegetable matter (Fourie et al, 1998).

Informal "back yard housing" exist in the low income areas. This leads to illegal dumping and dumping at street corners (Appendix E). The contribution of these back yard houses to waste generation was not included in this study. The non receiving of black bags for the informal housing in the low income areas contribute to illegal dumping and littering. Cultural difference and attitudes is another factor that contributes to illegal waste management practice. The informal settlement in the Worcester and De Doorns area was not properly designed for effective waste management practices to take place. These problem areas are a clear indication that educational programmes must be formulated and introduced in these areas. To reduce health risks, it is important that in areas of high population density such as low-cost housing developments and informal settlements, well controlled and regular systems of waste management should be in place. This will also help to prevent the unsightly appearance of waste that is often dumped in an unregulated way. Waste management for low cost housing development needs to be practical, affordable and acceptable to the community, and designed to prevent damage to the natural environment (Sowman and Urquhart, 1998).

4.2 MEDICAL WASTE SURVEY

4.2.1 Introduction

In the last few decades, human activities and changes associated with lifestyles and consumption patterns have resulted in the generation of huge volumes of different types of waste. This build-up of waste has threatened the survival of humans and other living things, as well as all natural resources that are necessary for human existence (Henry and Heinke, 1996). However, it seems that the fraction of waste generated at medical institutions, known as medical waste or health care waste (Lee et al, 2004) has not attracted the same level of attention as other types of waste. particularly in developing countries, despite the fact that medical waste is labeled as hazardous because it poses serious and direct threats to human health (Coad, 1992).

In a previous study done by the Provincial Administration of Western Cape (PAWC 1998) practices regarding medical waste handling and disposal in Cape Town were investigated. A summary of their findings are shown in Table (4C).

Table (4C): Survey of medical waste practices in the Western Cape.

Practice	***Yes responses***	***No responses***
Disposal practices of medical waste.	*86%*	*14%*
Storage of medical waste	*93%*	*7%*
Separation of medical waste	*94%*	*6%*
Health & safety policy in place.	*73%*	*27%*

PAWC, Health Department, 1998, Cape Town.

Tables (4C) highlight some of the problems associated with unsafe and illegal practices of medical waste in the Western Cape areas. This study was done due to the illegal dumping of medical waste that takes place in the Western Cape. The Minister of Health and Welfare in the Western Cape established a task team to investigate this illegal dumping and to make proposals regarding the legal framework.

In this survey 910 generators of medical waste were covered. This survey showed that 86% of medical waste generators disposed of their medical waste in a safe and proper manner and 14 % in an unsafe manner Table (4C). Seven percent of the medical waste generators do not store their medical waste according to safe practices as indicated in Table (4C). Ninety four percent of generators do separate medical waste from the municipal waste stream. All employers are required by law (Occupational Health and Safety Act 85 of 1993) to have a health and safety policy in place to safe guard their employees. The survey showed that 73% of the generators adhere to this requirement.

4.2.2 Results and discussion

Responses to various yes/no questions of the medical waste questionnaire are shown in Table (4D). Not all the respondents answered the entire yes/no questions. Therefore, the percentages for some questions do not add up to 100%. The missing percentages are that of respondents that did answer some of the questions.

Table (4D): Responses from participants in the medical sector to yes / no questions (n=31).

Question	***Yes responses***	***No responses***
(2) Waste collection.	*74*	*25*
(8) Waste kept safe.	*98*	*2*
(10) Training given to personnel.	*86*	*12*
(14) Vehicles use for the transport.	*54*	*19*
(15) Vehicles marked "Medical Waste".	*45*	*9*
(16) Vehicles custom made for the transport purpose.	*50*	*16*
(17) Protective clothing provided to workers.	*84*	*12*
(18) Record being kept.	*78*	*21*
(21) Adequacy of legislation.	*45*	*54*
(22) Public participation.	*93*	*6*

(a) Current waste collection system

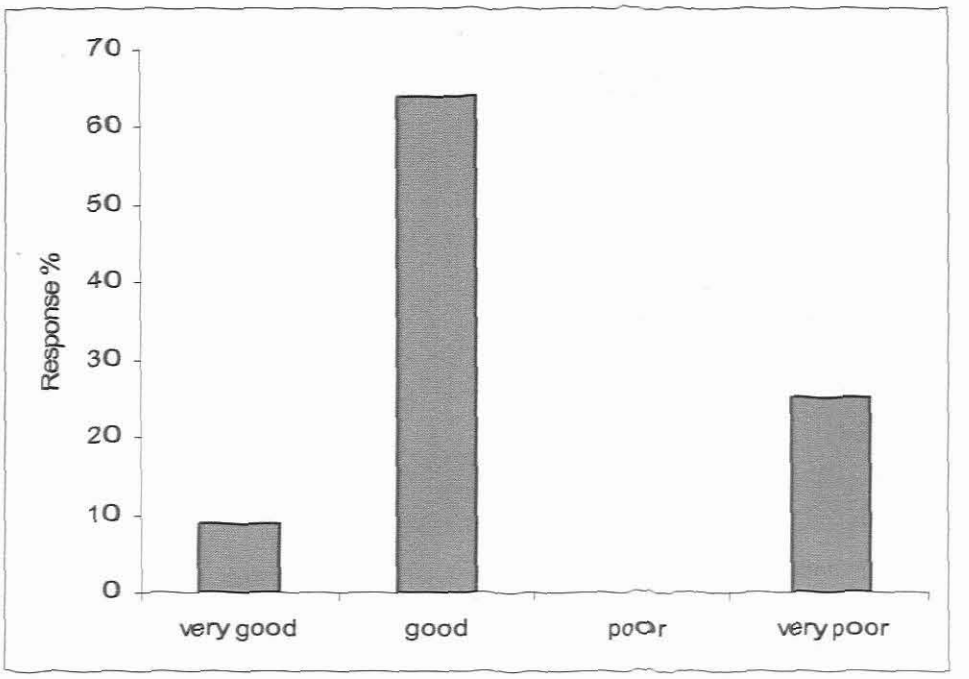

Figure (4.5): The state of the current collection service for general waste at medical facilities in the Breede Valley district (n=31).

Figure (4.5) illustrates the perceptions of the medical practitioners in the Breede Valley district regarding the state of the collection service for general waste at medical facilities. Generally, medical practitioners perceive the service as adequate but (25%) of the respondents regard the service as very poor. Figure (4.5) also shows that (64%) medical generators indicated that the current general waste service is good. This service means the removal of general waste from the medical facility to a permitted landfill site.

Question (2)

Seventy four percent of the medical generators indicated that there is a waste collection service available for general waste. It seems as if the current waste collection is adequate, but the period the general waste lies in front of medical facilities is of concern. The black bags lie from early in the morning to late in the afternoon in front of medical facilities. This can lead to informal pickers tearing open the bags to look for recyclables Table (4D).

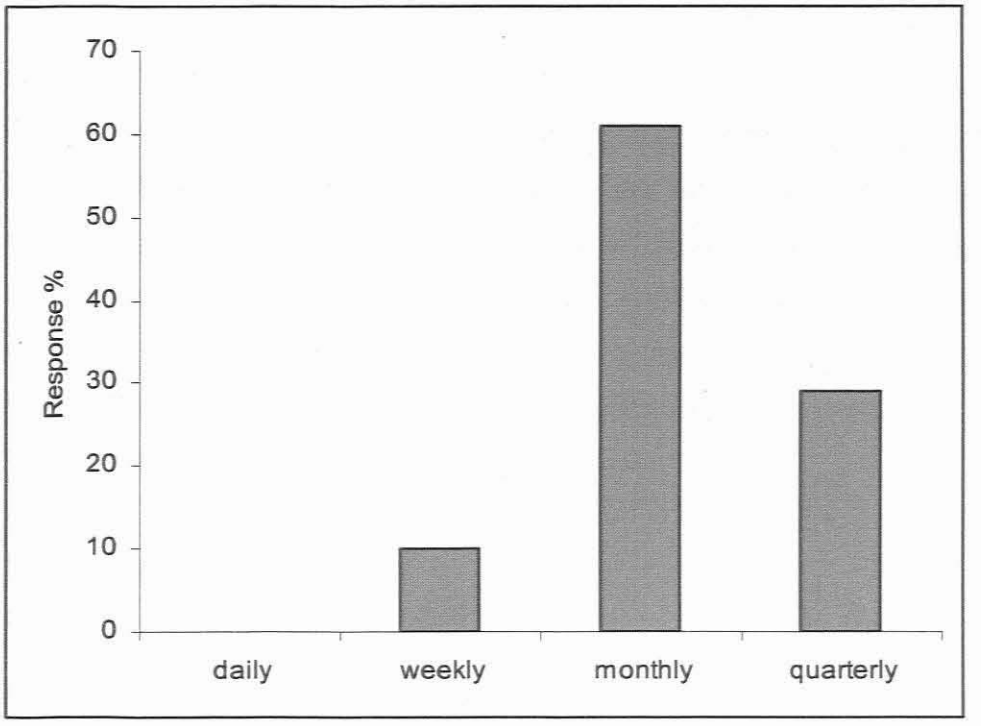

Figure (4.6): The frequency of removal of medical waste from the medical facility (n=31).

Figure (4.6) illustrates the medical waste removal frequency from the medical facilities. (61%) of the participants indicated that medical waste is removed monthly. Twenty nine percent indicated quarterly removal of medical waste. This can lead to nuisances and other environmental and health problems. Medical waste is not removed often enough from some generators and should be removed at least on a monthly basis. The period is too long and hot climates can cause odours, and wet bags can attract vermin. The bags may be deteriorated if left for too long period. It is not desirable therefore to leave it for a long period. Untreated medical waste must be stored prior to disposal because it may create a potential health risk. It must be safely stored in approved containers before removal by a registered medical waste company (Coulson and Caminsky, 2004).

(b) Transportation

Question (14, 15, 16)

A large percentage of medical waste generators indicated that the transportation system is adequate for the removal of their medical waste Table (4D). The vehicles must comply with legislation in their use of properly displayed hazardous symbols; normally they would display the universal biohazardous symbol (DEAT, 2003). The waste must be transported in closed leak proof trucks to prevent scattering, spillage or leakage. Table (4D), (questions 14, 15, 16), shows that vehicle used for removal of medical is equipped and suitable for the purpose of medical waste removal.

(c) Record keeping

Question (18)

The majority indicated that they keep record of their waste generated, in comparison with 21% that do not keep record of their waste generated Table (4D). Mohee (2005) stated that information on the amount of medical waste generated in health care is essential but in many cases not available. In the absence of proper data, it is impossible to establish a framework for managing the health care waste. It is therefore highly important to encourage the facilities who do not keep record of their medical waste to do so. It is important if an effective and efficient management system for medical waste is to be implemented in the Breede Valley District.

(d) Storage

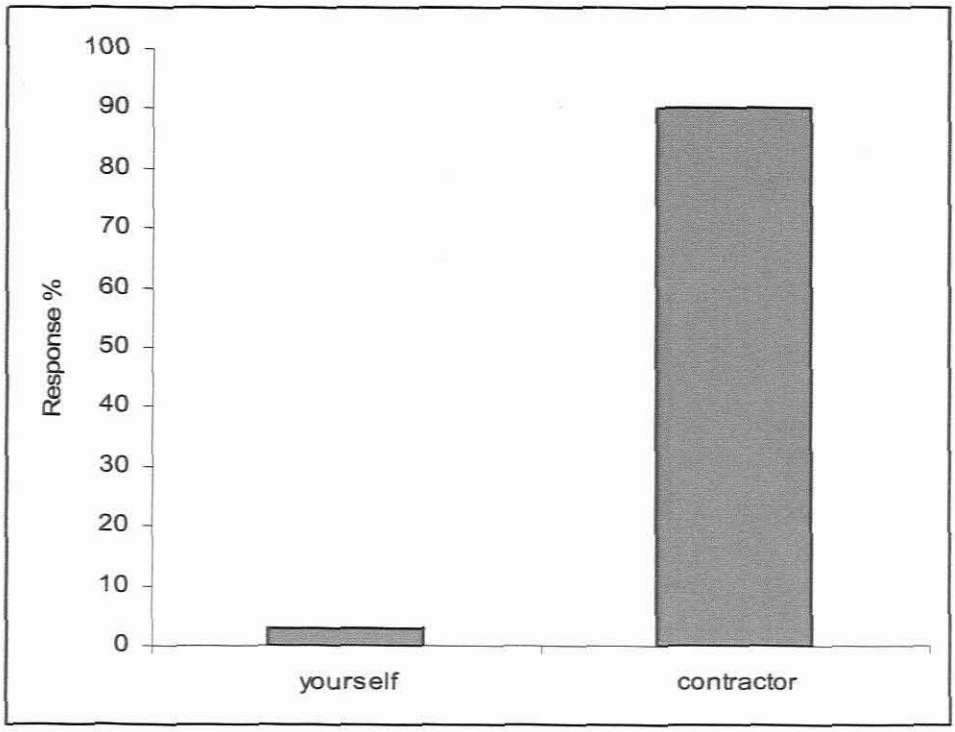

Figure (4.7): Provision of receptacles for the removal of medical waste. (n=31).

Figure (4.7) illustrates who provides receptacles for the removal of the medical waste. Ninety percent of the medical practitioners indicated that they used private contractors who provide receptacles to store the waste. The other (3%) is prescribed receptacles that the medical facilities themselves provide. The service providers supply the receptacles for medical waste collection.

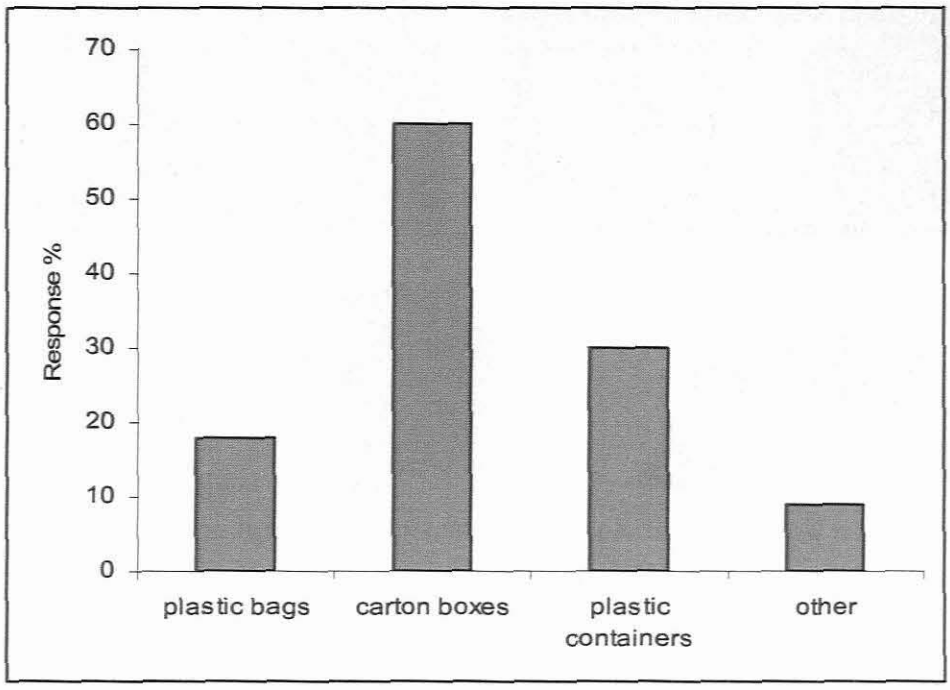

Figure (4.8): The types of receptacles used for medical waste (n=31).

Figure (4.8) illustrates the different types of receptacles used in the medical facilities in the Breede Valley district. The medical facilities use colour-coded, high-density polyethylene bags for easy identification and segregation of bio-medical solid waste. Non–infectious and domestic type of waste was collected in black polyethylene bags placed in bins while the infectious waste was collected in red, yellow and blue colour-coded polyethylene bags placed within blue high-density polyethylene bags labeled with a bio-hazardous infectious materials symbol in specific bins (Patil and Pokhrel, 2005). It is important for workers to know and understand the potential risks associated with health wastes, and the importance of consistent use of personal protection equipment (Coad and March, 1999).

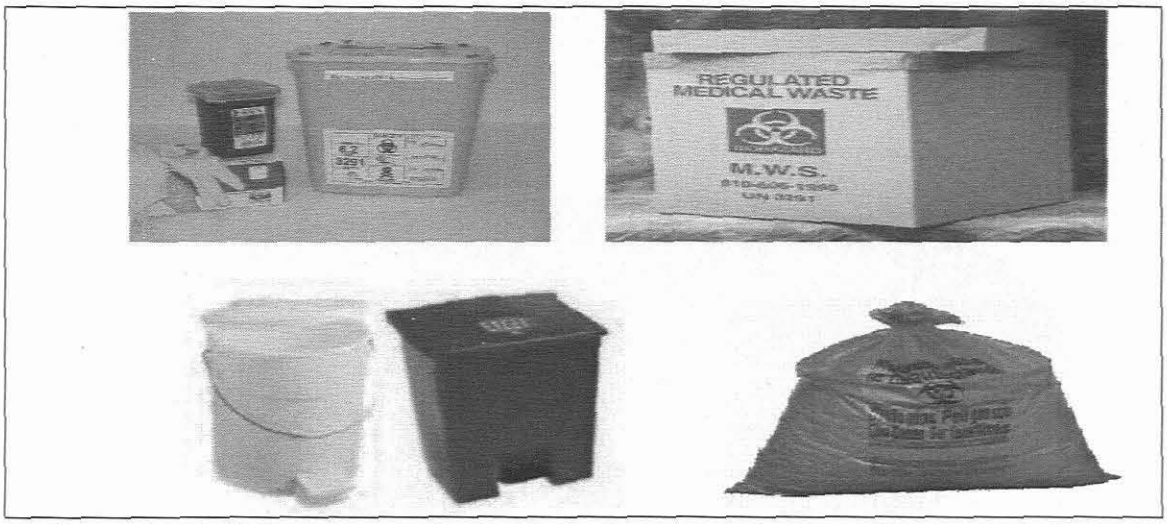

Figure (4.9): Different types of receptacles that are use in the medical waste industry.

(e) Separation of waste and waste minimisation

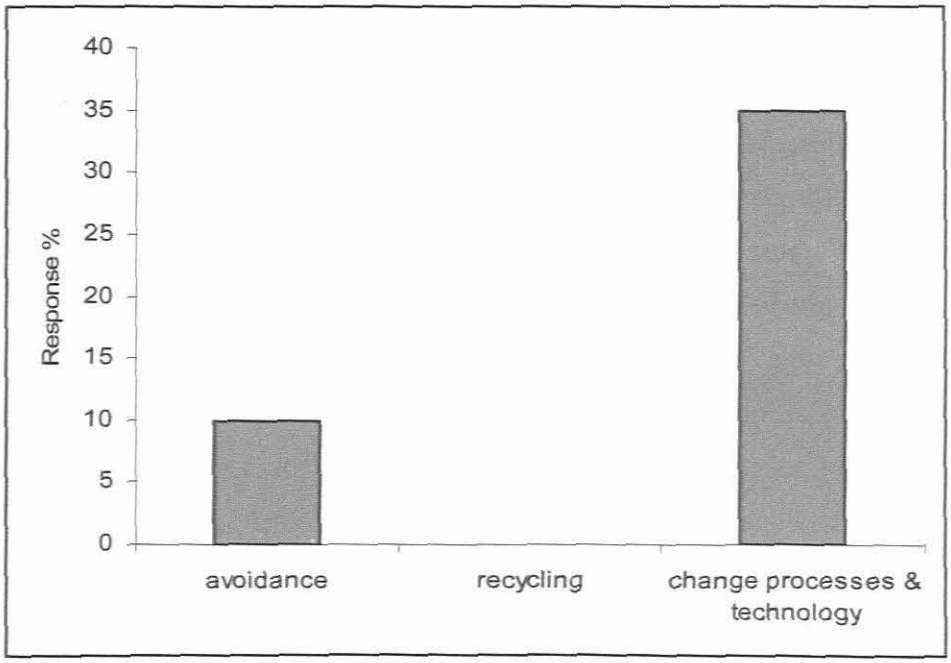

Figure (4.10): The waste minimisation strategy at medical facilities in the Breede Valley district (n=31).

Figure (4.10) illustrates the waste minimization strategy that is used in the medical waste industry. Waste reduction and minimisation measures should be adopted and be part of a waste management policy. Health care workers should be concerned with avoiding the production of waste rather then disposing of it (Ziady et al, 1997).

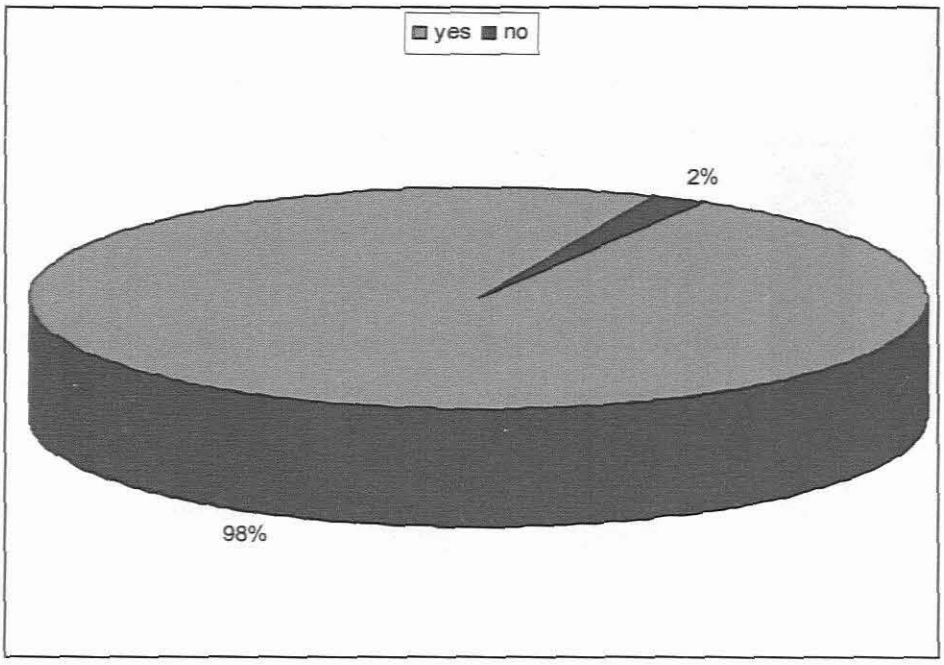

Figure (4.11): The separation of medical waste at medical facilities (n=31).

Figure (4.11) illustrates whether medical practitioners separate medical waste from other types of waste. The vast majority of medical waste generators do separate their waste, in comparison with the (2%) who do not separate their waste. A study was done in the Western Cape Health Department 1998 Table (4C), and have shown that (94%) do separate their waste in comparison with the (98%) in the Breede Valley district as found in this study. Thornton (2003) stated that there must be greater emphasis on ensuring that wastes are correctly segregated at the source rather than relying on processes further down to treat the waste. Medical waste, if not properly handled and disposed of, carries high risks of infection and injury and may represent serious health hazards to health personnel (Pruess et al, 1999; Rushbrook et al, 2000). If the infectious component gets mixed with the general non-infectious waste, the entire mass becomes potentially infectious (Info Nugget, 2003).

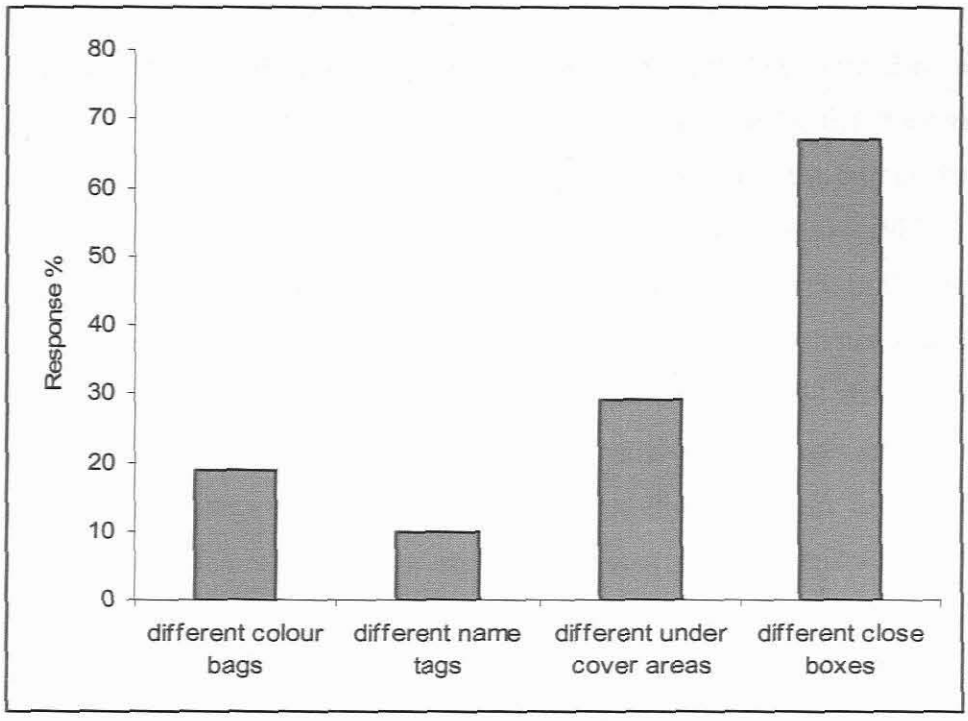

Figure (4.12): Methods how medical waste is separated from other waste. (n=31).

Figure (4.12) illustrates the different methods used to separate medical waste. Sorting at the production point has the result that infectious waste is placed directly into the appropriate container and without being handled again. All waste containers must be sufficiently strong and large enough to contain the waste without tearing, rupturing or collapsing. Plastic bags usually need to be at least 3mm thick to be safe. On average, plastic bags filled with waste are picked up and moved at least 6-8 times on their way to the incinerator, risking damage to the bags and exposure to infection or injury to the waste handler (Ziady et al, 1997). The (19%) who use bags is of concern. Infectious waste poses a significant hazard to cleaning staff and those who handle it. The risk is even greater if the bags contain sharps and needles. For this reason the municipality must introduce by-laws, requiring that medical waste be packed in sealed containers with the appropriate sign on it. It must also be handled in an environmental friendly manner.

Question (8)

The vast majority of medical waste generators indicated that they store their medical waste according to safe practices Table (4D). A study was done by the Western Cape Health Department 1998, and the results have shown that (93%) of the participants store their medical waste according safe practices. In the current study (98%) of the participants store their waste appropriately in the Breede Valley District. In the process of health care waste is generated, which usually include sharps, human tissue or body parts and other infectious materials (Baveja et al, 2000). Pruess et al (1999) stated that health care waste consisted mainly of infectious waste (cotton, gloves, syringes and others) and pathogenic wastes, sharps and pharmaceutical wastes, chemical waste and pressurized containers. These different types of waste must be appropriately separated and stored before removal from the premises.

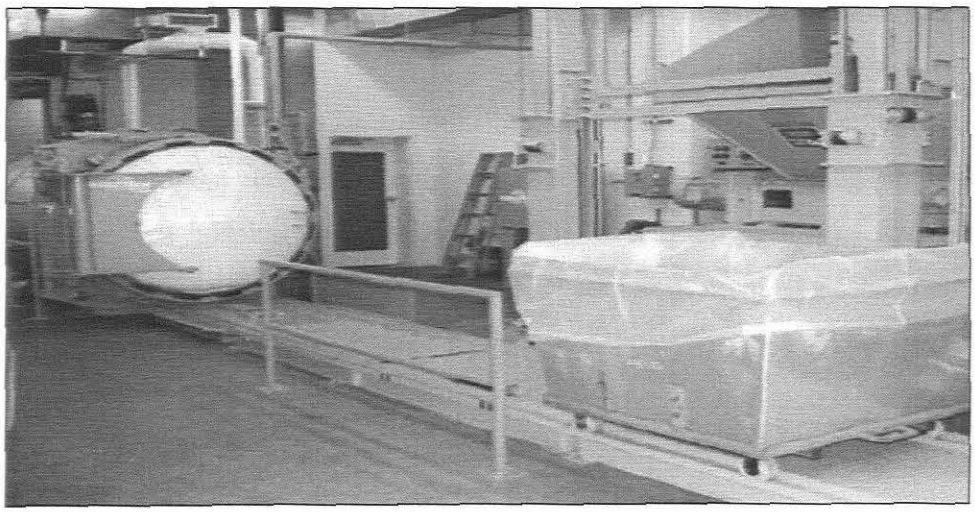

Figure (4.13): Pressurized containers for medical waste.

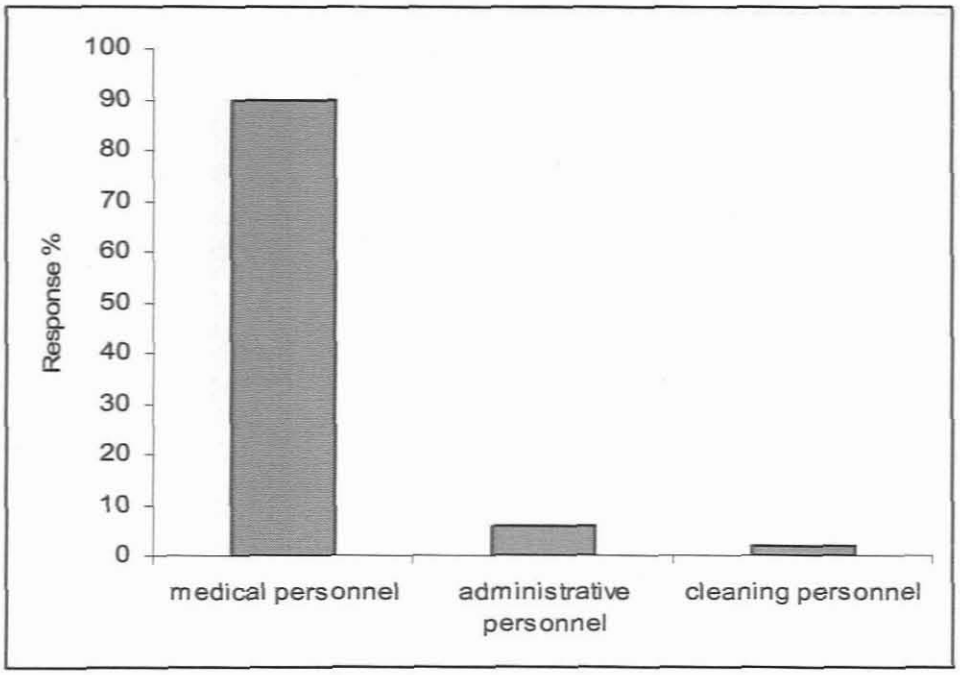

Figure (4.14): Personnel responsible for medical waste separation (n=31).

Figure (4.14) illustrates who is responsible for medical waste separation. Initial segregation and storage activities are the direct responsibility of nursing personnel who are engaged in the hospital (Info Nugget, 2003). In this study it was found that the medical personnel is mostly responsible for the separation of medical waste.

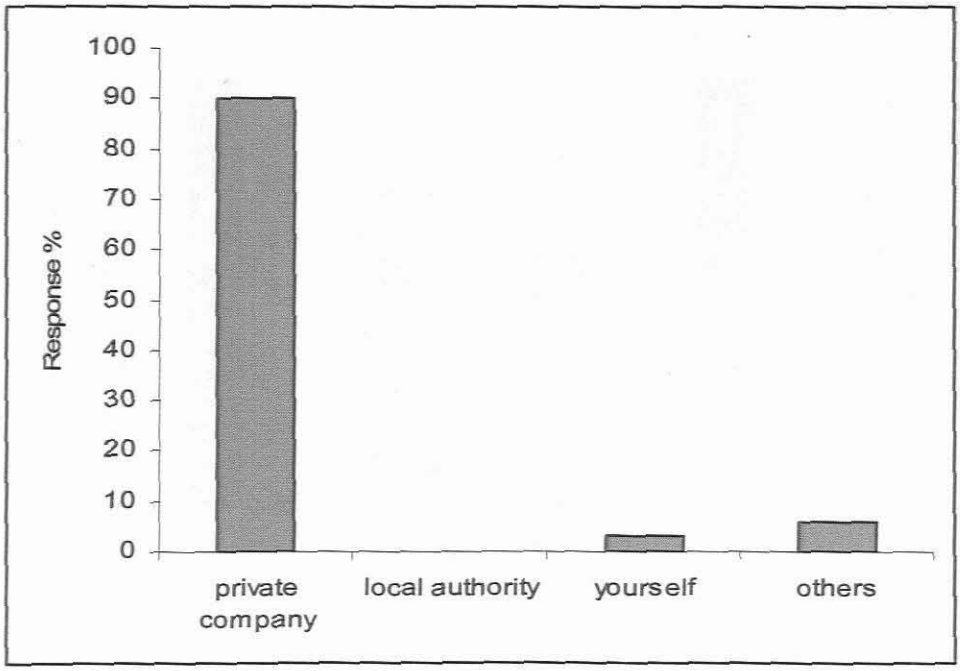

Figure (4.15): Removal of medical waste from the medical practitioners' premises. (n=31).

Figure (4.15) illustrates the institutions who remove medical waste from medical facilities. Ninety percent of medical practitioners make use of private companies to collect and transport their waste. No list or information of transporters exists in the waste department of the municipality. Record keeping is another aspect that must be addressed in the formulation of by-laws. Gaps in the medical waste generation are the following: No register of transporters. The registration of vehicles conveying medical waste is not listed by the municipality. The waste information system division must introduce a manifest system tracking waste from generator to disposer. Others mean service providers that provide such a service of transport of medical waste, but are not recognise by the local authority or DWAF as suitable medical waste transporters. Many of these transporters of medical waste dispose medical waste at landfill sites that is not permitted to receive this type of medical waste.

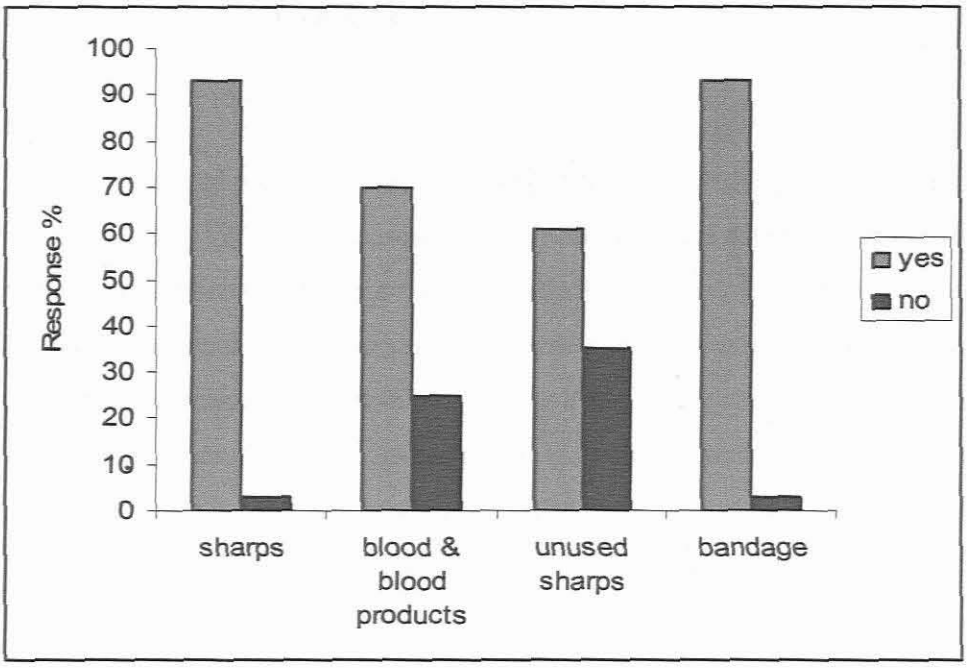

Figure (4.16): The separation of medical waste from other types of waste (n=31).

Figure (4.16) shows the separation of medical waste from other types of waste. Each of these health care risk waste streams produces different safety, health and environment hazards. The incorrect disposal of infectious waste, such as bloody linen savers, can result in the transmission of infections to people, and sharps contaminated with blood can cause cuts and puncture wounds. It is therefore important that health care waste is separated and disposed of according to its category. For example, sharps must be placed into a rigid, puncture-proof container and not with other infectious waste (Coulson and Caminsky, 2004).

(f) Training and protection measures

Question (10)

The majority of medical waste generators indicated that training is given to personnel, in comparison with the (12%) that indicated that training is not given to personnel Table (4D). Proper training has to be carried out with medical employees to develop awareness of health, safety and environment issues. A suitable approach would be to conduct a risk assessment of all activities involved in health care waste management. This will allow the identification of necessary protection measures, which will prevent exposure to hazardous materials or other risks, or at least to keep exposure within safe limits (Mohee, 2005). Ferreira (2004) stated that training programmes must include the following: safety handling of medical waste, segregation methods, personnel training programmes, recycling methods of suitable material, standard operating procedures of the facility. For any waste management system to be effective staff must be trained in its implementation. Infectious waste has complications due to its hazardous nature and staff must be trained to understand and avoid the hazardous risks. Relevant training needs to be developed for all levels of health workers, from cleaning staff to management. The personnel engaged in the process of segregation, handling and transport of waste must be skilled for the job that they are doing and must take adequate safety measures to protect and prevent spillage as they must be aware of the potential hazardous involved in this process (Patil and Pokhrel, 2005). The concern is that personnel receive the correct training for the function they have to carry out. This is something that could be further investigated.

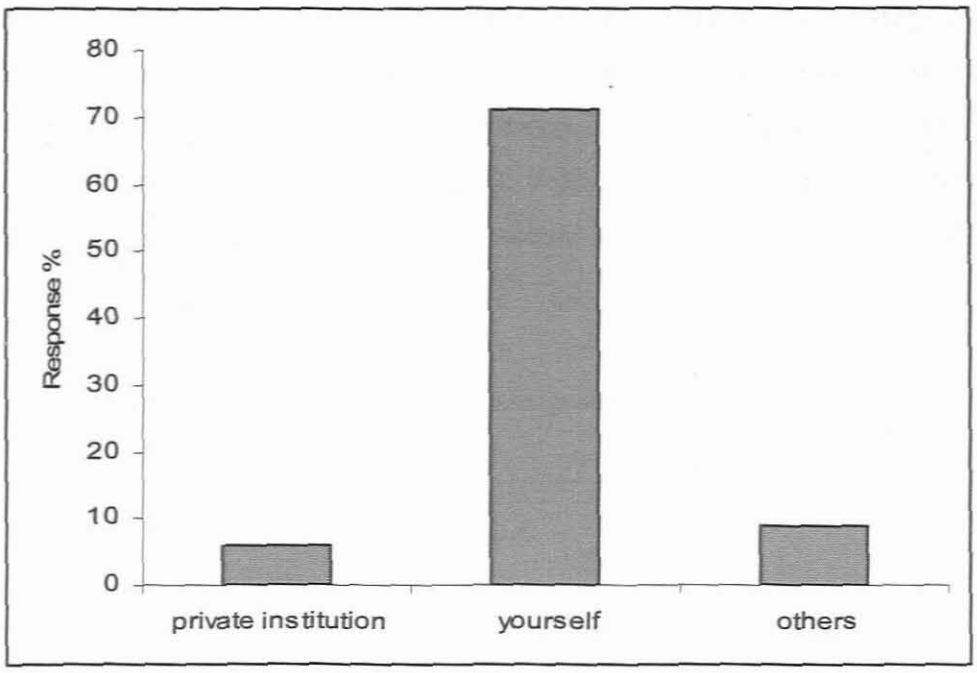

Figure (4.17): Who provides training for personnel working with medical waste (n=31).

Figure (4.17) illustrates who is responsible for the training personnel receive to work with medical waste. Seventy one percent of the participants indicated that training is given by themselves for employees in terms of medical waste. Training in terms of medical waste such as, handling, storage, safety measures and collection must be done by experts and must be accredited by the Department of Education. Therefore, training may be provided but may be inadequate. The employer should make provision for training through external institutions so that all employees acquire the understanding, knowledge and skills necessary for the safe performance of their duties.

Question (17)

Twenty six (84%) of the medical waste generators indicate that protective clothing is provided to employees, in comparison with (12%) that do not provide protective clothing Table (4D). The personnel engaged in the process of segregation, handling and transport of waste must be skilled for the job they are doing and must take adequate safety measures to protect and prevent spillage as they must be aware of the potential hazards

involved in this process (Patil and Pokhrel, 2005). Cleaners and nursing assistants responsible for collection, internal storage and transport to external storage of the medical waste usually do not wear sufficient protective gear during waste handling, increasing the potential of accidents (De Silva et al, 2005). Protective clothing such as impermeable gloves, overalls and face shields / masks should be routinely provided to all waste handlers (Ziady et al, 1997).

(g) Waste related legislation, policies and participation

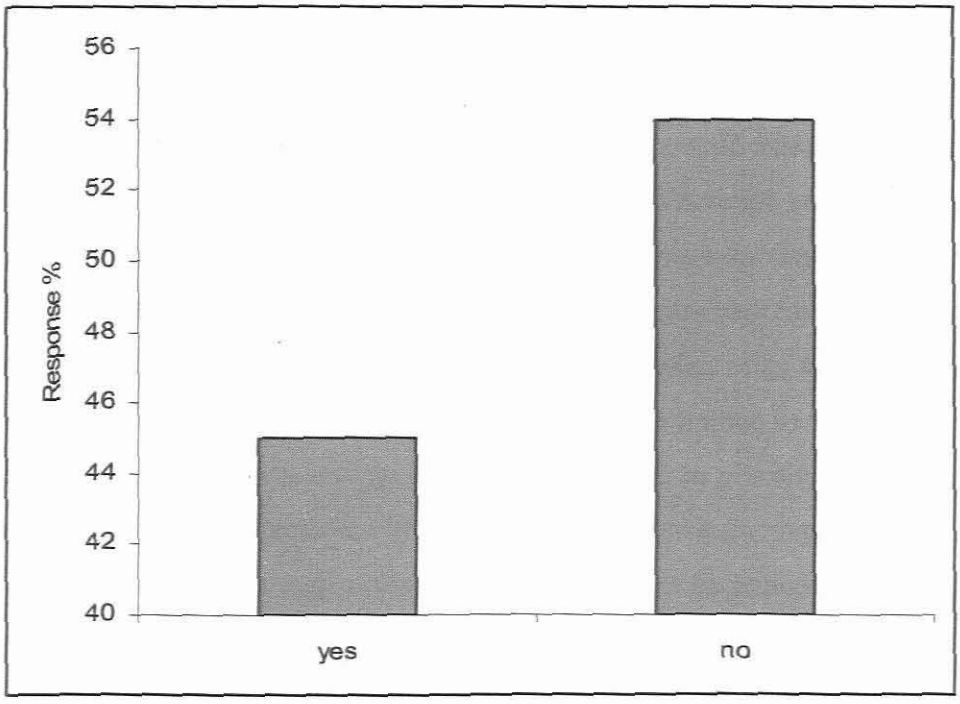

Figure (4.18): The presence of a safety, health and environmental (SHE) policy at medical facilities (n=31).

Figure (4.18) shows whether medical practitioners have SHE policies in place. Forty five percent of the respondents indicated that they have SHE policies, while (54%) indicated that they do not have such policies. All employers are required by law (Occupational Health and Safety Act 85 of 1993) to have a health and safety policy or programme in place to safe guard their health. A waste management policy aims to protect the facility staff, patients, visitors and the community against contamination of medical waste and spills.

Question (21)

Less than half of medical waste generators indicated that waste related legislation is adequate in terms of waste management Table (4D). The Department of Water Affairs and Forestry (DWAF) released guidelines for the disposal of medical waste, which require that all infectious waste be treated prior to disposal to any landfill (DEAT and DWAF, 1999). Infectious waste poses a significant hazard to cleansing staff collecting domestic waste. Any infectious waste put into black bags for curb side collection can potentially infect those persons coming into contact with it. The risk of infection is even greater if the waste contains "sharps" and needles. For this reason local authorities must formulate by-laws, requiring that these wastes be packaged and handled in a specific manner. Fifty four percent of the participants indicated that waste related legislation is inadequate. Also it seems as if the control and enforcement of existing legislation and standards within the waste management field are lacking. There are no guidelines for the separation of infectious- and hazardous waste from the waste stream and the personnel are inadequately trained in this regard. Due to poor control and standards infectious waste are illegally dumped or disposed of at the local dumping site, often without appropriate pre-treatment. The personnel at the landfill site are not well trained to identify infectious– and hazardous waste, and there is no mitigation measures in place to stop these illegal activities. According to Bromfield (1999) legislation is currently vague or non-existent when it comes to medical waste, a situation which needs to be remedied if transgressors are to be dealt with in South Africa.

Question (22)

Twenty nine medical facilities out of the 31 indicated that public participation is important for the formulation of a successful integrated waste management policy. The inclusion of the public in the planning phase is essential and must be pursued where possible. As required by National Integrated Waste Management Bill, 8.0, (June, 2002) citizens must be involved in the formulation of an integrated waste management policy Table (4D).

4.2.3 Conclusion

Based on the survey findings, it can be noted that there is a potential to improve the management of medical waste. Legislation that deals with medical waste does not exist, or is fragmented or outdated. If such legislation exist, it is not enforced by officials. Current communication channels are often not efficient enough to guarantee good co-operation between the municipality and medical waste generators. This can lead to confusion and illegal medical waste practices. A framework to manage medical waste needs to be developed by the waste department of the Breede Valley Municipality and should include registration of medical facilities, waste minimisation initiatives, storage facilities, medical waste legislation and record keeping of medical waste.

Record keeping is essential for generators, transporters and the local authority to track down the movement of medical waste. The keeping of records is important for the waste department to know who generates what type of waste, what quantity, how much and the variation of the waste (Figure 4.7). In this study, it was seen that there is a lack of record keeping of medical waste. There has to be a greater emphasis on ensuring that record keeping is correct and this should be done by municipal officials.

Safety and health programmes are essential in the medical waste industry. The waste handlers need to be protected from infectious waste and the environment against illegal dumping. Workers have a right to working conditions that are not harmful to their health and welfare. There are also limited awareness and education programmes available for staff working with health waste. Staff training and awareness are essential in terms of identification of potential infectious waste and waste minimisation at source. Proper training has to be carried out with employees to develop awareness of health and safety. Such information should be put through to the waste department. It is important for workers to know and understand the potential risks associated with medical waste, and the importance of consistent use of personal protection equipment (Coad and March, 1999).

Necessary protection measures, which will prevent exposure to medical waste or other risks should be implemented and encouraged by the waste department. Management of the waste section should establish procedures for the safe collection, separation, transport and disposal of medical waste. A suitable approach would be to conduct a risk assessment of all activities involved in medical waste management (Mohee, 2005).

4.3 BUSINESS WASTE SURVEY

4.3.1 Introduction

There are a number of businesses in the Breede Valley district, which produce significant amounts of hazardous and general waste Table (4E). Reducing waste from businesses is therefore an important step in achieving the integrated waste management strategy for the entire business sector in the Breede Valley district. In general, many businesses know little about the types and amount of waste they produce. Hazardous waste generators do not know the composition of the waste they produce, and hence they have little knowledge of the potential adverse effects on human health and the environment (DEAT, 2003). To identify the type of waste which may be hazardous is a key factor, as well as information on how much waste is generated, where it is generated, what type of hazardous waste is generated, and where it is disposed of Table (4E). The hazardous component of the waste stream is of concern because it could contain a multitude of chemical compounds. Industries produce waste that has physical or infectious characteristics that could cause danger to human health and to the environment.

4.3.2 Results and Discussion

Responses to various yes/no questions of the business waste questionnaire are shown in Table (4E). All the respondents of this part of the study did not answer the all the yes/no questions. Therefore, the percentages for some questions do not add up to 100%. The missing percentages are that of respondents that did answer particular questions.

Table (4E): Responses from participants of the business sector to yes/no questions. (n=114)

Questions	***Yes responses***	***No responses***
(3) Waste management policy.	*30*	*69*
(8) Produce recyclable products.	*47*	*50*
(9) Market for waste exchange.	*91*	*9*
(10) Collection service for general waste.	*93*	*7*
(13) Less packaging.	*78*	*20*
(14) Hazardous waste generation.	*27*	*64*
(15) Safe keeping of hazardous waste.	*20*	*7*
(18) Record keeping of hazardous waste.	*15*	*7*
(19) Legislation that prevents illegal dumping of waste.	*95*	*2*
(20) Implementation of waste minimization programmes.	*70*	*21*
(21) Businesses involved when policies are formulated.	*71*	*14*
(26) What is an integrated waste management policy?	*42*	*47*

(a) Current waste collection system

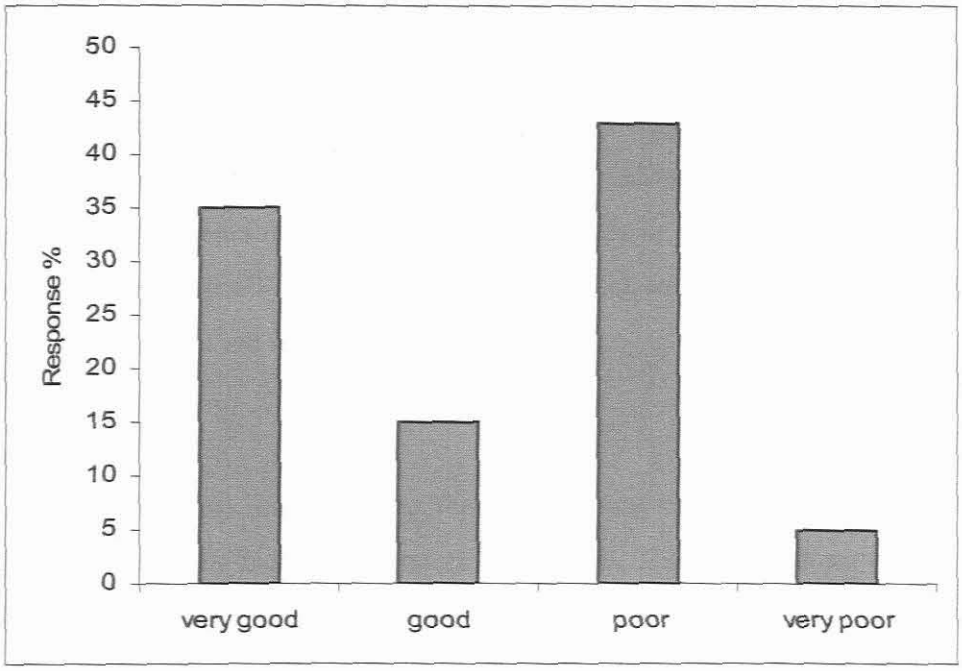

Figure (4.19): How good or bad is the waste collection service according to the business sector (n=114).

Figure (4.19) illustrates how adequate the current waste collection service is for the purpose of the business sector. Thirty five percent of the respondents indicated that the current waste collection service is very good in comparison with the forty three percent who indicated that the service is poor. This is an indication that waste from businesses are not collected efficiently at all pick up points. It is essential that all waste arising should be accumulated at the point of origin as they occur and that they should not be allowed to lie around for any length of time (DWAF, 1998e). This can lead to nuisances such as odours, flies and informal pickers. Businesses such as fisheries, take a ways and restaurants where wet waste is generated need extra waste collection and pay an extra fee for that service. It seems as if there is a lack of co-operation by officials, when the business sector complains about the immediate removal of skips that is full of wet waste. Inadequate collection and uncontrolled disposal of waste results in a serious health threat to inhabitants and the environment (Birley and Lock, 1999). The waste management practices are inefficient because of use of obsolete equipment and vehicles that frequently breakdown in the study area. Municipal solid waste management (MSWM) encompasses the functions of collection and treatment. The primary target of MSWM is to protect the health of the population, promote environmental quality, develop sustainability, and provide support to economic productivity. To meet these goals, sustainable solid waste management systems must be embraced fully by local authorities in collaboration with both the public and private sectors (Henry et al, 2006).

Question 10

A large majority (93%) indicated that there is a waste collection service available for general waste from their business premises Table (4E). The collection service for general waste is compulsory and the business sector pays a monthly fee whether they make use of the collection service or not. The fact that waste is collected does not however mean that the service is effective.

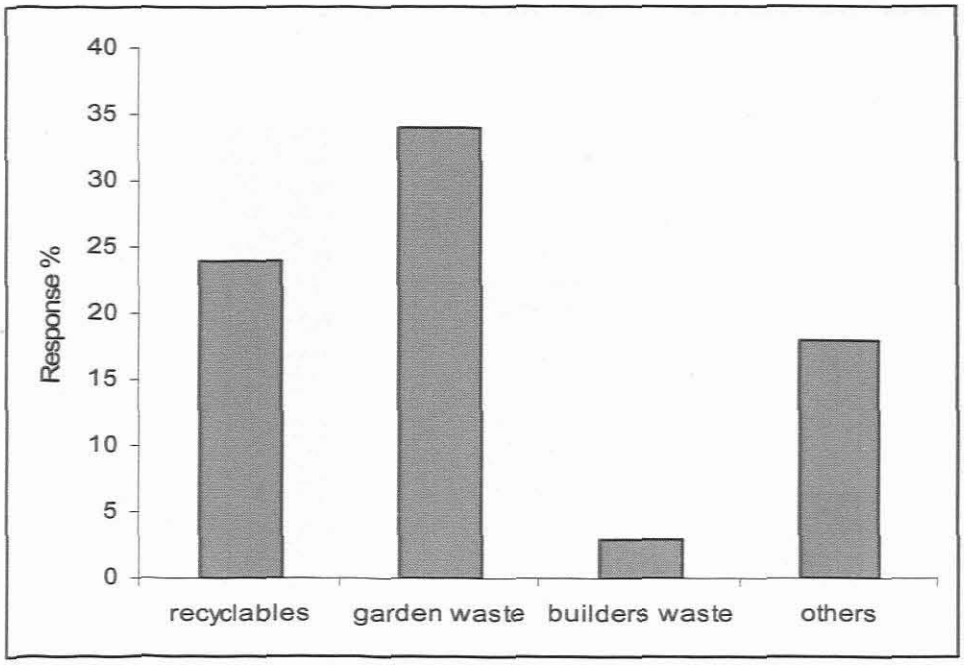

Figure (4.20): The types of collection services available in the business sector (n=114).

Figure (4.20) illustrates the different types of waste collection services available in the business sector. The current municipal collection service does not make provision for the different types of waste removal such as, builders refuse, garden waste and recyclables (Appendix F). This type of waste is removed by private contractors or private waste recycling companies. This highlights the need for such waste removal service and can create an extra income for the municipality.

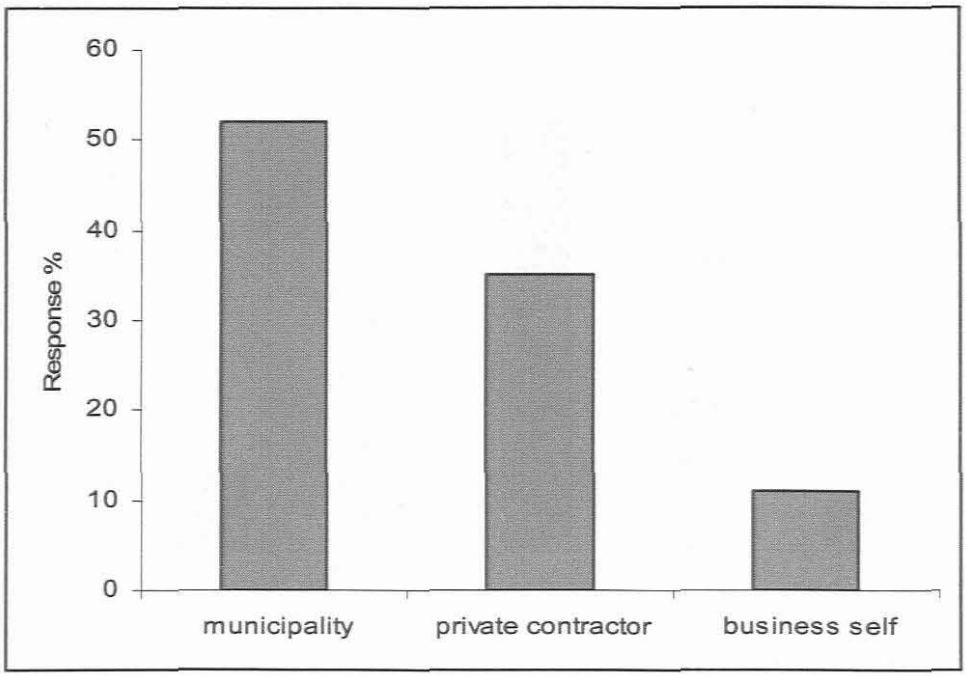

Figure (4.21): Who is responsible for waste collection in the business sector (n=114).

Figure (4.21) illustrates who is responsible for waste collection in the business sector. Local authority has traditionally been responsible for the collection, management and disposal of domestic and commercial waste and industry has been responsible for its own waste. The responsibility for waste collection rests largely with the municipality, although the private sector can play an increasingly important role. Food industries make use of private contractors to collect their waste and also dispose of the waste at the local landfill site. The main reason for using private contractors is the long period they must wait for removal of wet and contaminated waste from their premises. This situation is due to a lack of communication by officials and not enough transport. The long length of time that the waste is accumulated can cause nuisances such as, odours, vermin, flies and informal pickers.

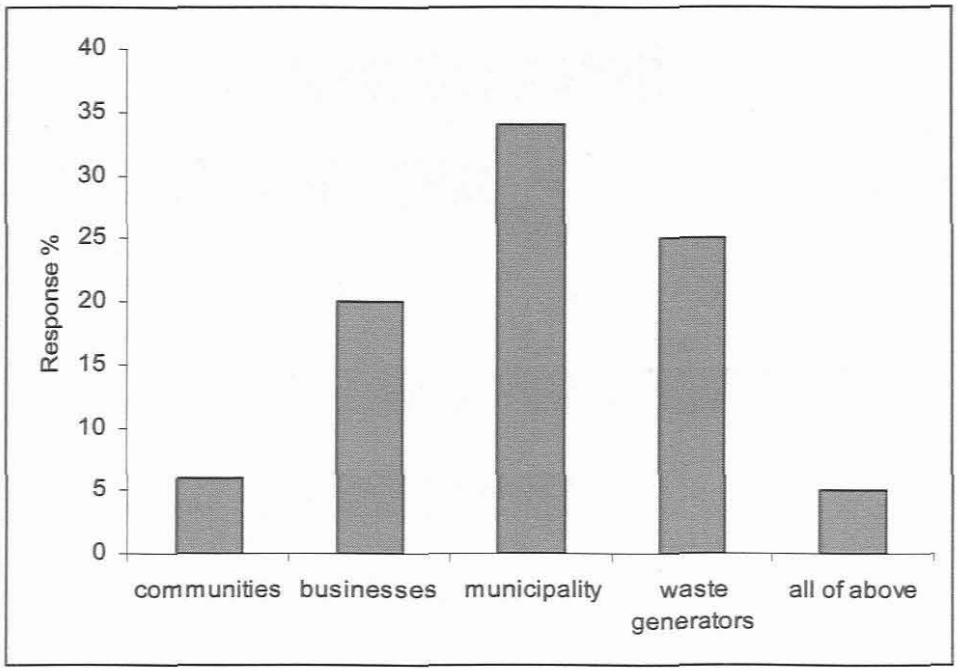

Figure (4.22): Who is responsible for waste minimization according to the business sector (n=114).

The municipality as well as waste generators, transporters, businesses and the community are responsible for waste minimization (Figure 4.22). According to the results the municipality must take a leading role in terms of formulation of waste minimisation strategies. The way that the municipality controls and manages the waste that is generated within its boundaries has a significant effect on the quality of life of its residents (DEAT, 2003). It should also be noted that the businesses feel that generation of waste and business itself should play a significant role in waste minimisation.

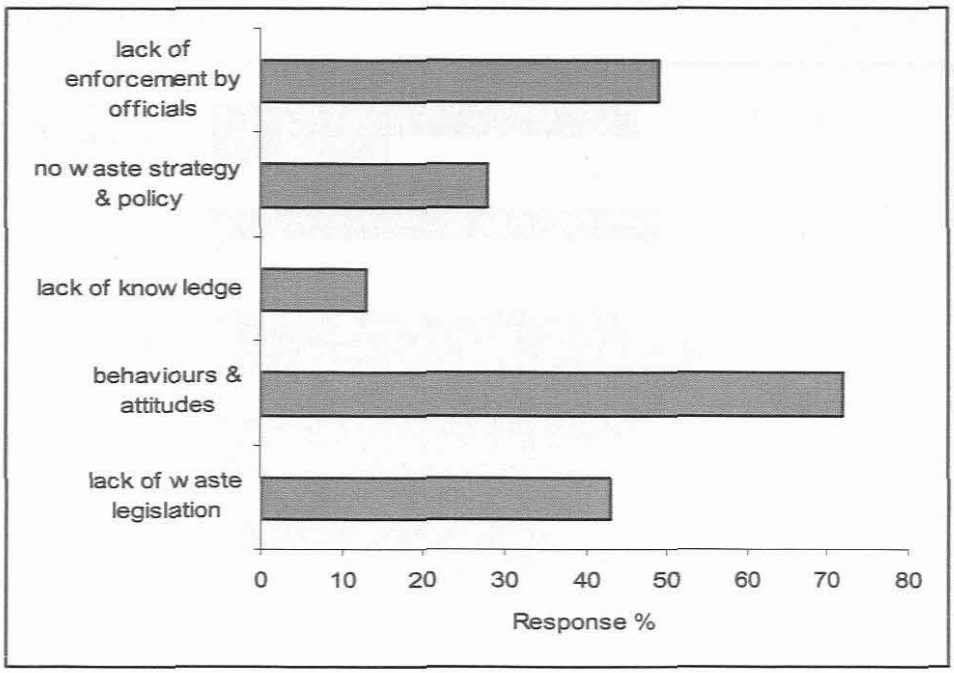

Figure (4.23): The main causes of illegal dumping according to the business sector (n=114).

Figure (4.23) illustrates the main causes applicable to illegal dumping in the business sector. All these factors such as, lack of waste legislation, behaviours and attitudes, lack of waste management knowledge, no waste management strategies and lack of law enforcement of officials are factors that contribute to illegal dumping. Seventy two percent of the participants indicated that people's attitudes, and (49%) indicated that a lack of enforcement by officials is the main contributing factors for illegal waste practices. At present there is no waste related legislation in place as well as no enforcement of laws to prevent illegal dumping. A lack of enforcement from municipal officials could be one of the main causes that illegal waste management practices still exist. Henry et al (2006) states that the proper management of waste is determined by the attitudes of people towards waste, such as the ability to refrain from indiscriminate dumping. Socio-economic characteristics may determine attitudes such as the ability/ willingness to recycle waste. These attitudes, however, may be positively influenced by awareness-building campaigns and educational measures (Henry et al, 2006).

(b) Waste minimisation

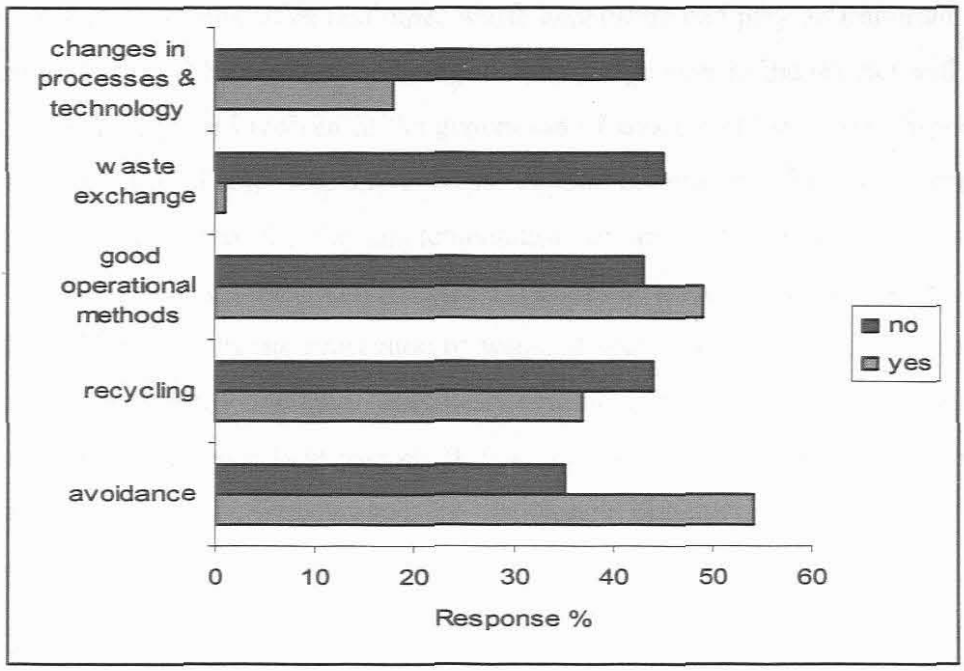

Figure (4.24): Waste minimization methods that businesses have in place (n=114).

Figure (4.24) illustrates what types of waste minimization strategies the business sector is using in their daily activities. Big industries have waste minimisation plans incorporated in their business plans. Prevention and waste minimisation is the first approach to waste management according to waste management hierarchy (DWAF, 1998a). The businesses that do not have waste minimisation strategies must be encouraged. This can only be done through co-operation, education and good communication from all the stakeholders. Recycling initiatives are currently restricted to a number of commercially viable projects that are not supported by the waste department. Private recycling companies and individuals currently initiate and drive recycling projects. Some of the businesses see waste minimisation as a negative activity, in terms of time, space, benefits and manpower that can get lost in the separation of waste. All these strategies are highlighted in the White Paper on Integrated Waste Management, and should therefore be considered when an integrated waste management policy is formulated (DEAT, 2000).

The responsibility of waste minimisation rests largely with the municipality, although businesses sector, communities and other waste generators can play an important role in waste minimisation. The challenges facing waste management in the district will require commitment from those involved in the generation of waste and those who dispose of it. The understanding of the respective roles of the community, business sector and municipality is essential for the implementation of an effective waste management system (Ninham Shand, 1993). DWAF (1998c) refers to waste avoidance as any activity that reduces or eliminates the generation of waste at source, usually within a process and is the most economically and environmentally beneficial waste minimisation option. The best way to manage waste is to prevent it at source wherever this is possible and these programmes need to be encouraged by the waste department. Manufacturers may contribute to waste minimisation by designing and manufacturing products that contain less packaging materials, changing processes through changing of equipment, layout and operation. The (45%) that indicated that they should not participate in waste exchange programmes need to be educated and encouraged to participate in such waste minimisation programmes. Middleton (1999) stated that changes in technology and the use of good operational methods can be achieved by examining all phases of a product's life-cycle, from raw material extraction to its ultimate disposal, and reducing the wastefulness in any particular phase.

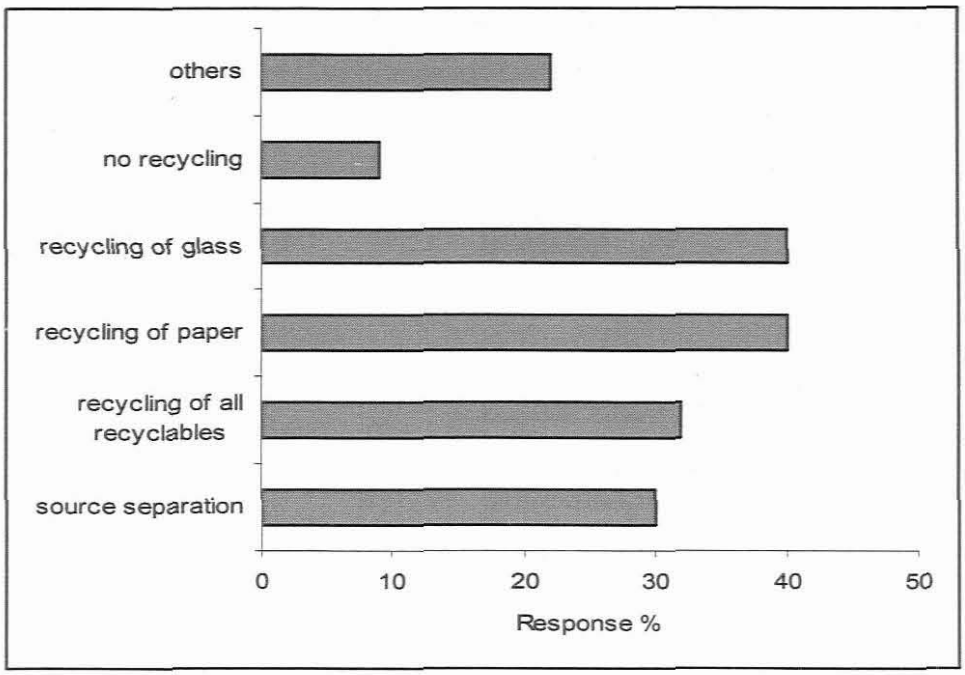

Figure (4.25): Waste minimization strategies and the recycling of specific recycling material (n=114).

Figure (4.25) illustrates what type of waste minimisation strategies are in business sector. Some of the business sectors do some waste minimisation of items such as, glass, paper, cardboard, tin, and wood. The recyclables are taken out of the waste stream and collected by private recycling contractors. Source reduction refers to the separation of recyclables at the source and these recyclables are more hygienic and safer. Recyclable waste should be separated as near to source (the place they are made) as possible (DWAF, 1998a). Other types of recyclables refer to, plastic, tin metal, oil, textiles, tyres and organic materials generated by the business sector. Forty percent of businesses indicated that they recycle glass and paper. Many businesses stored the recyclable materials at a storage facility on the premises. Some of the businesses are in partnership with the private recycling contractors and the recyclable materials are collected on a weekly basic. The non-recycling of materials by businesses is of concern and need to be addressed by the waste department in terms of educational and waste minimisation programmes. However, with the improvement of waste collection and education it will be possible to separate most recyclables at the source.

The municipality could set tariffs that promote recycling and the economical, efficient and effective use of resources (Department of Local Government, 2000).

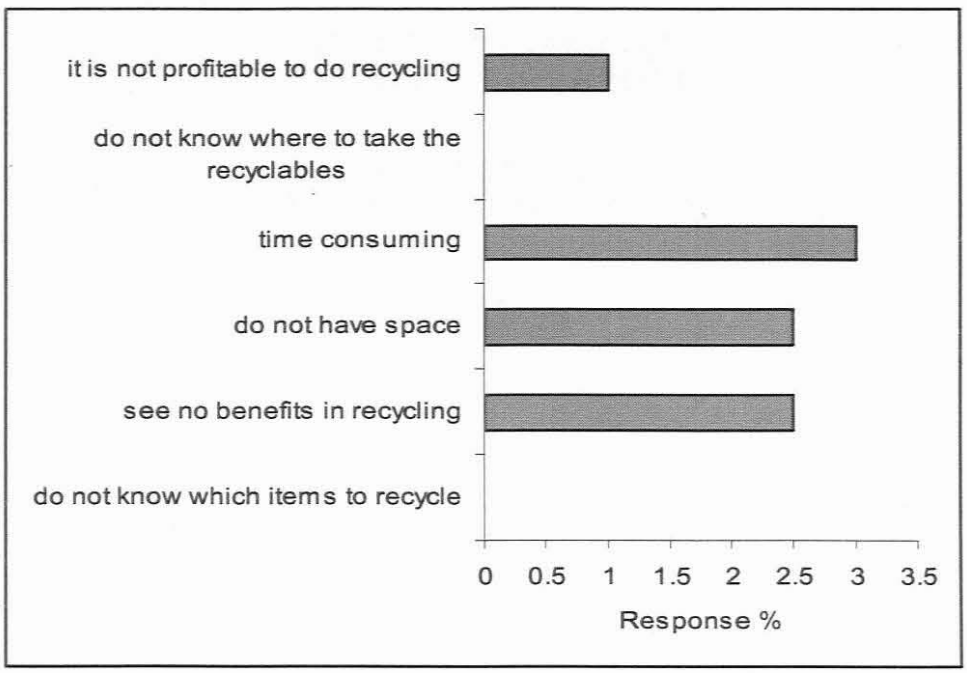

Figure (4.26): Why certain businesses do not have any recycling programmes (n=114).

Figure (4.26) illustrates why the business sector do not have any recycling programmes. The obstacles can be corrected through education and awareness. The process of recovering recyclables is a complex structure of multi-level systems involving waste generators. There should be continuing systems for collection, separation or recovery, buying and selling of recyclables, final disposal and transformation, and use of recyclables. Both informal and formal sectors should be involved in this process (Ojeda-Benitez et al, 2003). Hernandez et al (1999) focused the attention on the economic benefits of recycling as well as public health protection. Recycling has been a result of an acting party's initiative, as opposed to municipal initiative. Lombard (1999) mention that it has been stated in some quarters that recycling is a waste of time and money. Waste minimisation is a tool that can be used to help enhance environmental sustainability and economic efficiency.

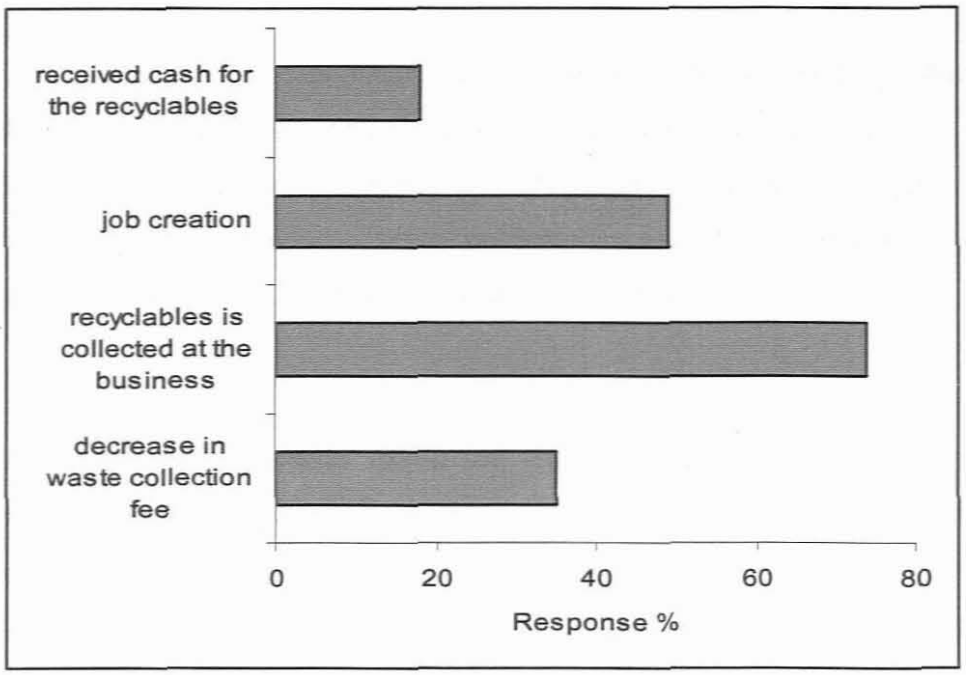

Figure (4.27): Why the business sector is willing to participate in future recycling programmes. (n=114)

Figure (4.27) illustrates why the business sector would be willing to participate in future recycling programmes. Seventy four percent of the participants indicate that they would take part in waste minimisation activities, as long as the municipality or private contractor remove or collect the recyclables at their premises. It seems as if it is the transportation and labour factors that are considered as important by the business sector. The local authority must consider to implement such services to the business sector. These services can generate extra income for the municipality. Currently, there are more opportunities of waste recovery because the waste generated by businesses contain more varied materials, and a large amount of these have added value to manufacturing processes (Ojeda-Benitez et al, 2003).

Question 8

Forty seven percent of the respondents were willing to participate in the production of recyclable products Table (4E). This is a indication that some businesses sector is willing to adopt some waste minimisation strategies. Fifty percent of businesses are not in favour of producing recyclable products. Waste products are reused when it is economically viable to do so and viable is assessed for a variety of motives (Middleton, 1999).

Question 9

The vast majority of businesses (91%) are willing to take part in waste exchange programmes if markets are created for waste exchange programmes Table (4E). Waste exchange is an option that business together with the local authority could introduce to help to minimise waste. Waste products from one industry often prove to be useful feedstock for other industries, e.g. metal finishing wastes and pickling liquors provide chemicals such as ferrous sulphate (Botha et al, 1983). The local authority should formulate a waste exchange programme and list all businesses that are willing to participate in such a programme. The local authority must firstly collect data of all the waste generators and establish a database for waste generators. With this information the municipality can create a waste exchange market for the entire business sector which wants to participate in the waste exchange programmes.

Question 13

A large number of businesses indicated that they will decrease packaging, if required. Table (4E). Less packaging is a strategy that the business sector together with relevant stakeholders could consider as a waste minimisation option.

Question 20

Seventy percent of the businesses indicated that waste minimisation strategies can help stop illegal dumping and protect human health as well as the negative impact on the environment Table (4E). The business sector is willing to participate in waste minimisation strategies but the municipality must take the leading role in the formulation of waste minimisation strategies.

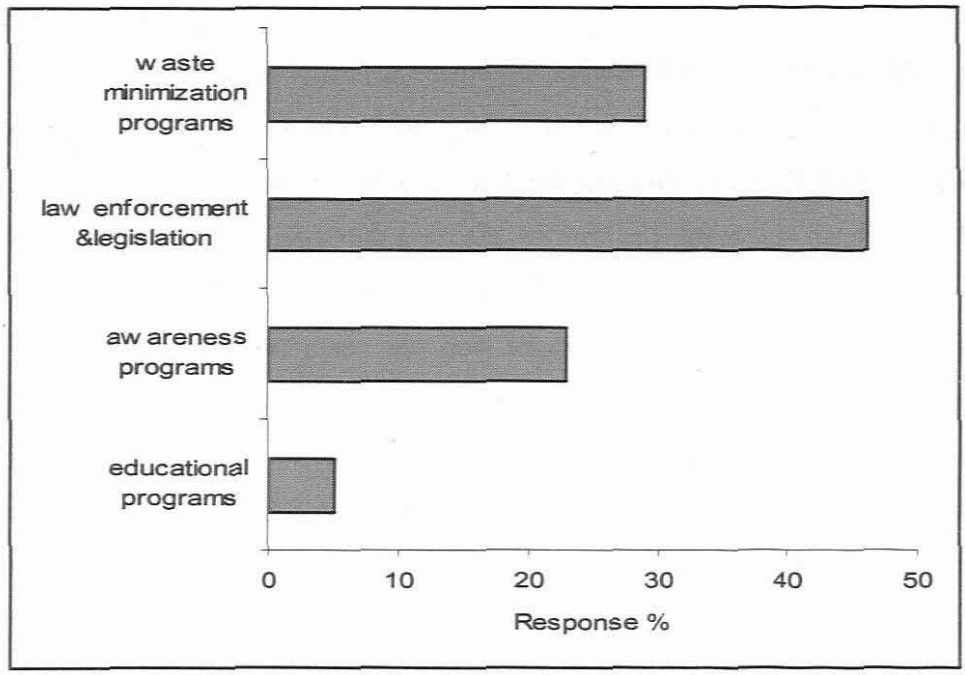

Figure (4.28): Strategies that could help to minimize waste (n=114).

Figure (4.28) illustrates what strategies could help to minimise waste. Forty six percent of the businesses indicated that enforcement of waste related legislation is essential for effective waste management practices. Waste minimisation programmes (waste exchange, recycling, reuse, composting, and source reduction) are essential and must be formulated in the integrated waste management plans of the municipality. Effective and scientific waste management including the prevention and reduction of waste is necessary for sustainable urbanisation and development (Srivastava et al, 2005).

(c) Hazardous waste

Twenty seven percent of participating businesses indicated that they work with hazardous waste or produce hazardous waste Table (4E). The big concern is which category (SABS Code 0228) of hazardous waste is present on these premises Table (4E). Hazardous waste requires stringent control and management to prevent harm or damage and hence liabilities (DWAF, 1998c). A large majority of the businesses do not know the dangers of these materials at the premises and how to store it safely away from unauthorised personnel. Careful handling, collection, packaging, temporary storage and transportation of hazardous waste are essential for the maintenance of public health and for environmental protection (DWAF, 1998c). Safe keeping is another concern that the local authority must consider to introduce in their integrated waste management plans. The municipality can employ legal ways to enforce plans such as site plans of storage facilities, registration of private contractors who collect hazardous waste, emergency measures and record keeping of the waste. Health and safety plans should then also be submitted to the local authorities. The safe keeping of hazardous waste is of concern due to data of hazardous waste or information that is not available. The collection of data on hazardous waste has a relatively low priority and is not taking place. The municipality does not have information of who generates hazardous waste, the safe keeping of it, the volume of hazardous waste generates and how it is disposed of. This highlights the need for a waste assessment study of all hazardous waste generators in the entire area. Some business sectors do not know that they worked with or generated hazardous waste (DEAT, 2003). Information must be given to these businesses concerning hazardous waste identification and safe handling of hazardous waste. Record keeping of hazardous waste is essential and must be encouraged.

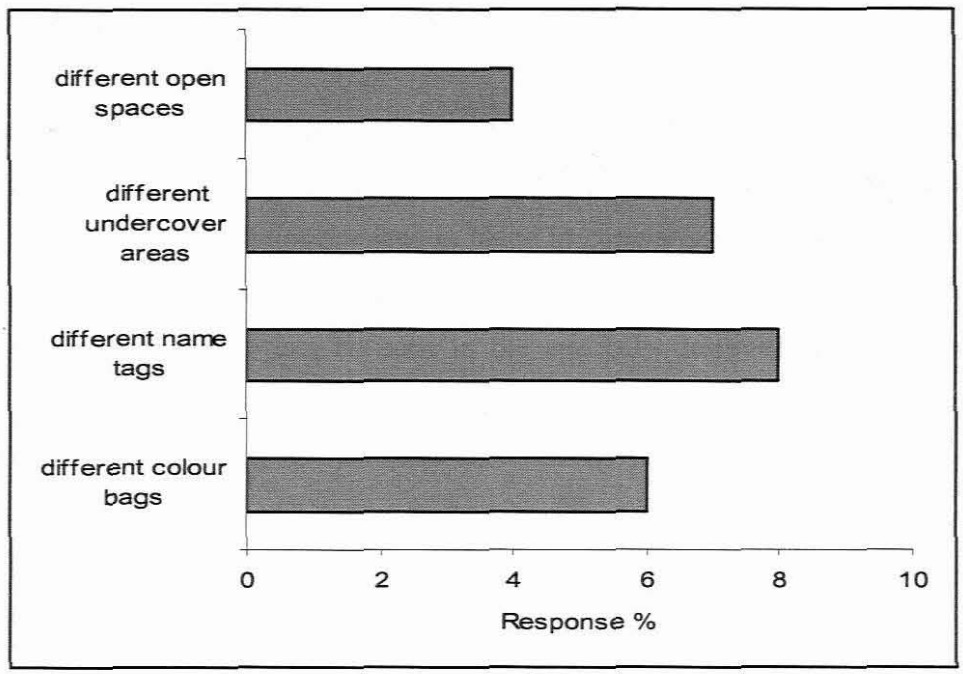

Figure (4.29): How hazardous waste is stored on the premises of businesses (n=114).

Figure (4.29) illustrates how hazardous waste is kept safe or stored. The twenty seven percent of the businesses, which indicated that they produce hazardous waste, make use of different methods to keep hazardous waste separate from the general waste. Hazardous waste, if not properly managed can be of high risk to the health of the waste handlers the public in general and the environment. Thornton (2003) stated that there must be greater emphasis on hazardous waste to ensure that waste are correctly segregated at the source rather than relying on processes further down to treat the waste.

(d) Legislation, policies and co-operation

Question 3

A large percentage of businesses indicated that they do not have a waste management policy or plan in place Table (4E). There is a large difference between the business sectors that have such policies or plans in place in comparison with those which do not have a plan or policy in place. The differences between businesses that have waste policies or plans in place can be seen in the specially designed containers with the different waste type symbol on it. It seems as if only large businesses have such policies or plan in place. Waste management policies or plans in the business sector are essential, in terms of protection of employees, human health and the environment (RSA, 1996). The White Paper (IP&WM) and the National Waste Management System proposed a comprehensive Waste Management Act regulating the management of waste on the based of the waste management hierarchy. According to the National Integrated Waste Management Bill of 2002 every industry that generates and produces waste must prepare and develop a waste management plan. The Department of Water Affairs and Forestry (DWAF) released guidelines for the disposal of hazardous waste, which require that all hazardous waste be treated prior to disposal to any landfill (DEAT and DWAF, 1999).

Question 19

Ninety five percent of the participants from the business sectors mentioned that they know of waste related legislation that prohibit the illegal dumping of waste, especially hazardous waste Table (4E). The business sector know of waste related legislation but carry on with mismanagement of waste, because they know that officials do not enforce any waste related legislation in the entire area of investigation (Appendix B4). Unskilled personnel and the non- enforcement of legislation by officials is one of the major obstacles in effective waste management practice. Hazardous waste pose a significant hazard to cleansing staff collecting domestic waste. Any hazardous waste put into black bags for curb side collection can potentially affect those persons coming into contact with it. The risk of infection is even greater if the waste contains chemical compounds. For this reason local authorities must formulate by-laws, requiring that this waste be packaged and handled in a specific manner.

Question 21

The business sector wants to be involved (71%) when waste plans and policies are formulated and therefore be seen as an integral component of a successful waste management programme Table (4E). It becomes increasingly clear that waste management programmes that ignore the social and business aspects are bound to fail. The problems of public participation in planning and implementation are no less important than the technical or economic aspects in waste management and decision-making (Joos et al, 1999). Also, private sector involvement in service provision raises issues of public interest and acceptability (Baud et al, 2001).

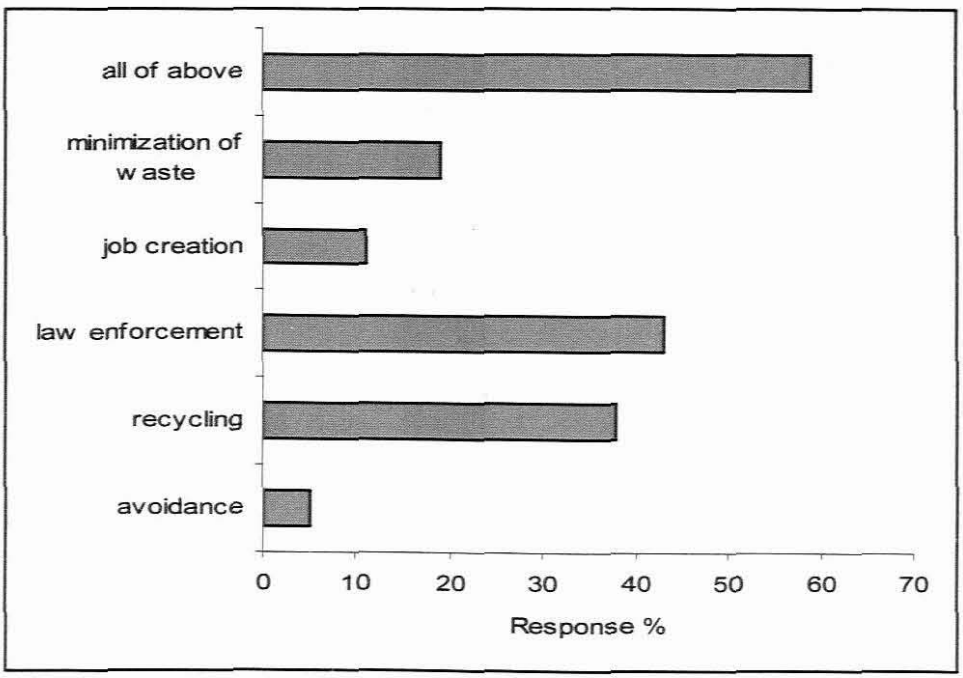

Figure (4.30): The business sector's opinion on what the waste management policy must focus on (n=114).

Figure (4.30) illustrates what a waste management policy must focus on according to the opinion of the business sector. The majority (59%) indicated that all the factors are important in an integrated waste management policy. Although it was rated lowly job creation can be seen as an essential element, due to the fact that the unemployment rate is very high in the district (Schroeder, 2002).

Halla and Majani (1999) stated that waste is now identified as an economic good that helps in employment creation and income generation. Solid waste recycling and composting reduce the amount of disposable waste and haulage costs, increase the life span of disposal sites, and generate employment opportunities (Halla and Majani, 1999). Respondents tended to prefer law enforcement and recycling as focuses for a waste management policy.

Figure (4.31): The co-operation between the municipality, businesses and communities according to the business sector (n=114).

Figure (4.31) illustrates the degree of co-operation between the municipality, business and community in terms of waste removal. There is a large variation in opinion regarding this matter. The co-operation between business, community and municipality can be increased through good communication, partnerships and an effective public participation process in terms of waste management strategies (Appendix B4).

Question 26

Forty seven percent of the participants indicated that they do not know what an integrated waste management policy is Table (4E). This is a new idea and concept and it is normal for the business sector to not know of such a policy. This emphasized the need for the municipality to include the business sector, and other stakeholders in the planning phase of integrated waste management. An inperitive part of the process to implement a waste management policy seems to be an extensive awareness and educational process.

4.3.3 Conclusion

According to the survey findings, the current waste collection and removal system is inefficient due to the length of time the waste is accumulated on the curb-side. The municipality should do proper planning to collect and remove the waste as soon as possible to prevent health risks and nuisances, such as odours and flies especially in hot weather. Local authorities have neither sufficient funding nor adequately trained staff, to effectively plan and execute their waste management functions (DEAT, 2003).

A suitable approach would be to conduct a risk assessment of all activities in the hazardous waste management. This will allow the identification of necessary protection measures, which will prevent exposure to hazardous materials or other risks, or at least to keep exposure within safe limits (Mohee, 2005). The municipality must formulate guidelines or requirements for the storage, disposal and transport of hazardous waste. A system of registering generators, transporters and disposers of hazardous waste is required due to the risk to human health and the impact on the environment. Negligence is noted in hazardous waste management from the business sector, due to little knowledge of its generation and potential health and environmental risk for the local community. In order to address the hazardous waste challenges from the business sector, the municipality should form partnerships with the business sector.

Waste minimisation initiatives from the business sector are zero and where it takes place it is on a low scale. In order to address these challenges the municipality should form partnerships with the business sector and all relevant stakeholders to achieve sustainable waste management in the area. Public participation, education and awareness of waste management issues and an understanding of the respective roles of the communities, the business sector and the authorities is essential for the implementation of an effective waste management system (Ninham Shand, 1993). Public relationship and co-operation with the business sector can create more job opportunities through waste minimisation initiatives.

4.4 COMMUNITY WASTE SURVEY

4.4.1 Introduction

Urban growth has caused an increase in the generation of waste from activities at homes. The waste management system consists of three phases: collection, transport and final disposal. The municipality plays a fundamental role in managing, development and delivering of essential services to the community. The way they carry out their functions directly affects the people and the environment. Waste must be disposed of in a way that does not have an adverse effect on the environment and the health of the community (Ninham Shand, 1993). The Constitution of the Republic of South Africa (Act 108 of 1996) (section 24) embodies the right of every individual to an environment that is not detrimental to his or her health and well-being.

4.4.2 Results and Discussion

Responses to various yes/no questions of the community waste questionnaire are shown in Table (4F). Not all the respondents answered the entire yes/no questions. Therefore, the percentages for some questions do not add up to 100%. The missing percentages are those of respondents that did not answer all the questions.

Table (4F) Responses from participants of the community to yes / no questions (n=1232).

Questions	***Yes responses***	***No responses***
(4) Recycling of items.	*35*	*65*
(7) Purchase of recycled products.	*46*	*48*
(13) Taking part in recycling.	*80*	*16*
(17) Informal housing in backyard.	*26*	*68*
(18) Receiving of black bags.	*6*	*19*
(22) Member of community forum.	*13*	*77*
(23) Participate in community forum when you have a change.	*72*	*21*
(24) Integrated waste management system.	*35*	*64*

Responses to various "yes/no/do not know" questions of the community waste questionnaire are shown in Table (4G). Not all the respondents answered all the "yes/no/do not know" questions. Therefore, the percentages for some questions do not add up to 100%.

Table (4G) Responses from participants of the community to do not know / yes / no questions (n=1232).

Questions	***Do not know responses***	***Yes responses***	***No responses***
(10) Laws stipulate to stop illegal dumping.	*0*	*85*	*13*
(11) Waste minimization programmes to prevent illegal dumping.	*17*	*73*	*7*
(12) Participation in recycling activities.	*14*	*81*	*3*
(20) Planning of waste minimization facilities.	*22*	*74*	*2*

(a) Current waste collection system

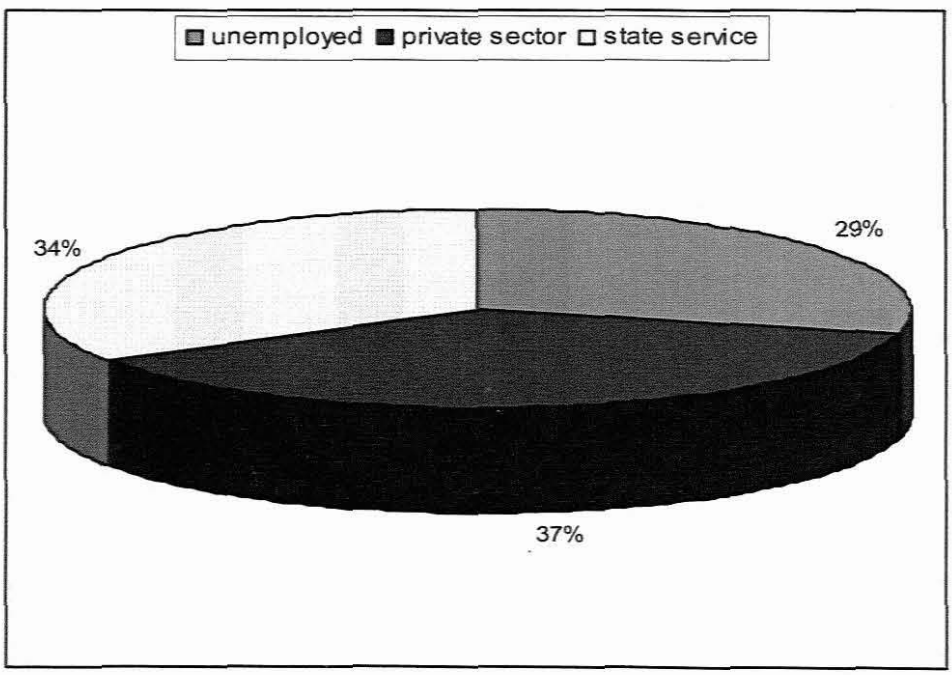

Figure (4.32): The sectors where participants from the communities are employed (n=1232).

Figure (4.32) shows the sectors where community members are employed. The high unemployment figure of (29%) is a key feature of the low income communities. Urban unemployment is also high, as a number of large industries have suffered economic losses in recent years, forcing retrenchment, reduction in business volume and sometimes even closure (Schroeder, 2002).

Halla and majani (1999) stated that waste is an economic good that can help in employment creation and income generation. An attitude change is important and will enhance environmental upkeep while boosting people's earnings. The socio-economic situation is a critical factor that influences the waste management practices in the community, and is the reason why there is a need to develop awareness- and educational programmes.

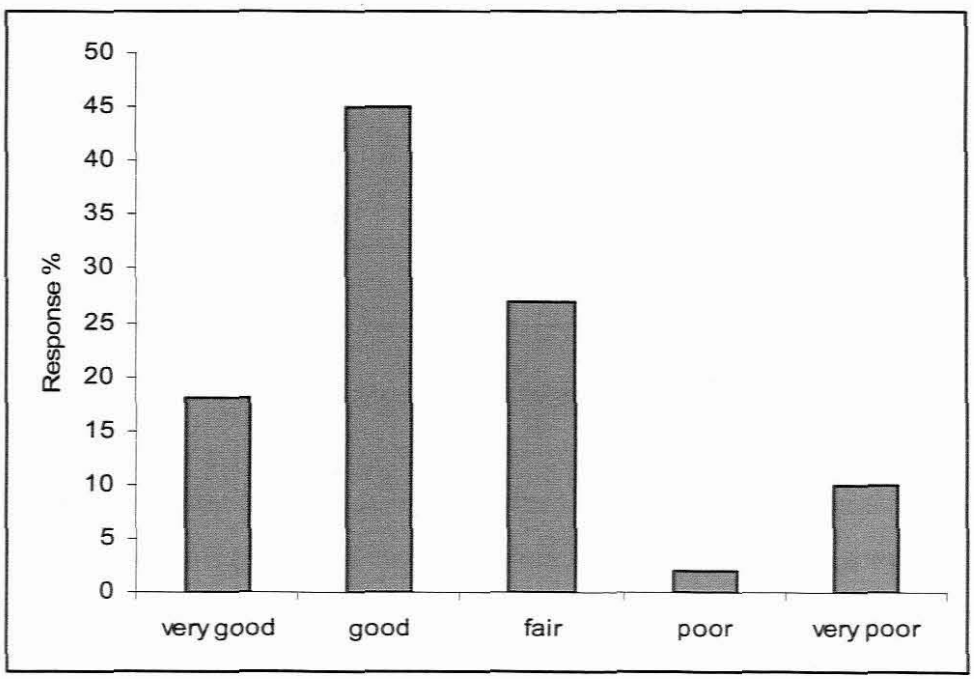

Figure (4.33): The state of waste collection service rendered to the community (n=1232).

Figure (4.33) illustrates the state of refuse service rendered by the municipality. Forty five percent of the participants stated that the current waste collection service is good in comparison with two percent of the respondents which indicated that the collection is poor. The perception of the community especially the low income areas, is that as long as the waste is collected or the illegal dumping sites in their area is clean-up they are satisfied with the service. The high and middle income areas in comparison with the low areas want the municipality to take full responsibility for all waste related issues and not only concentrate on collection and clean-ups of illegal waste management practices.

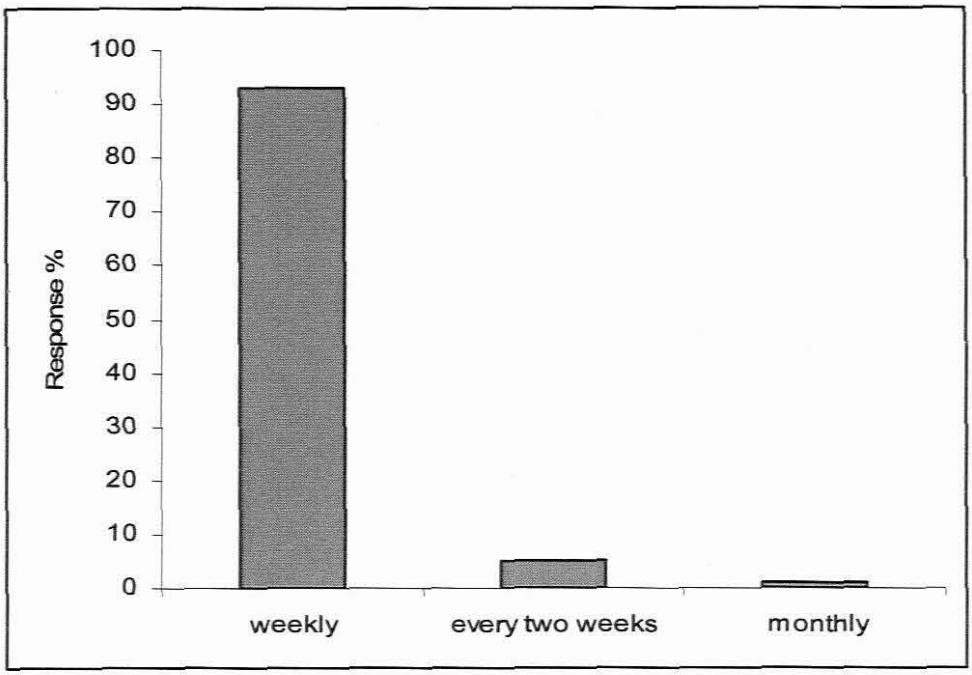

Figure (4.34): Frequency of waste removal in the community (n=1232).

Figure (4.34) illustrates the frequency of refuse removal in the community. A large majority of respondents (93%) indicated that their waste is removed on a weekly basis in comparison with the (5%) and one percent who indicated every two weeks and on a monthly basis. The removal of waste every two weeks and on a monthly basis are due to the fact that respondents do not put out their waste on the curd-side for removal. Waste that is put out on the curb-side is collected and removed once a week, except for households who do not put out their black bags. These households dump their black bags in open spaces and on street corners (Appendix E). Waste bags that are not put out on the curb-side are not removed by the municipality and must wait for the next week to be removed.

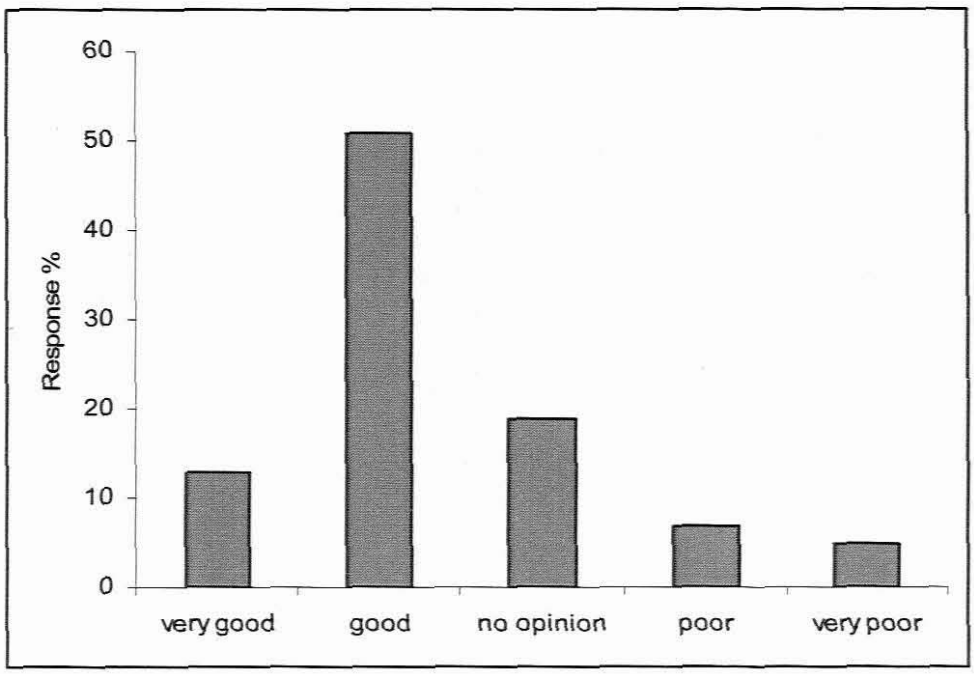

Figure (4.35): The quality of cleaning workers' service according to the community. (n=1232).

Figure (4.35) illustrates how the community sees the cleaning workers doing their job. More then half of the respondents indicated that the cleaning personnel are doing their job very good in comparison with the (5%) who indicated that their work was of a poor standard. Many officers in change of waste management have little or no technical background or training in engineering or waste management. Without adequately trained personnel good waste management initiatives cannot be meet (Bartone, 1995). Many workers practically at the low level and supervisors have little or any technical background or training. The social status of waste workers is generally low (Smook, 2003). Bartone (1995) stated that this owes much to a negative perception of people regarding the work which involves the handling of waste or unwanted materials. Such people perceptions lead to the disrespect for the work and in turn produce low working ethics of labourers and poor quality of their work.

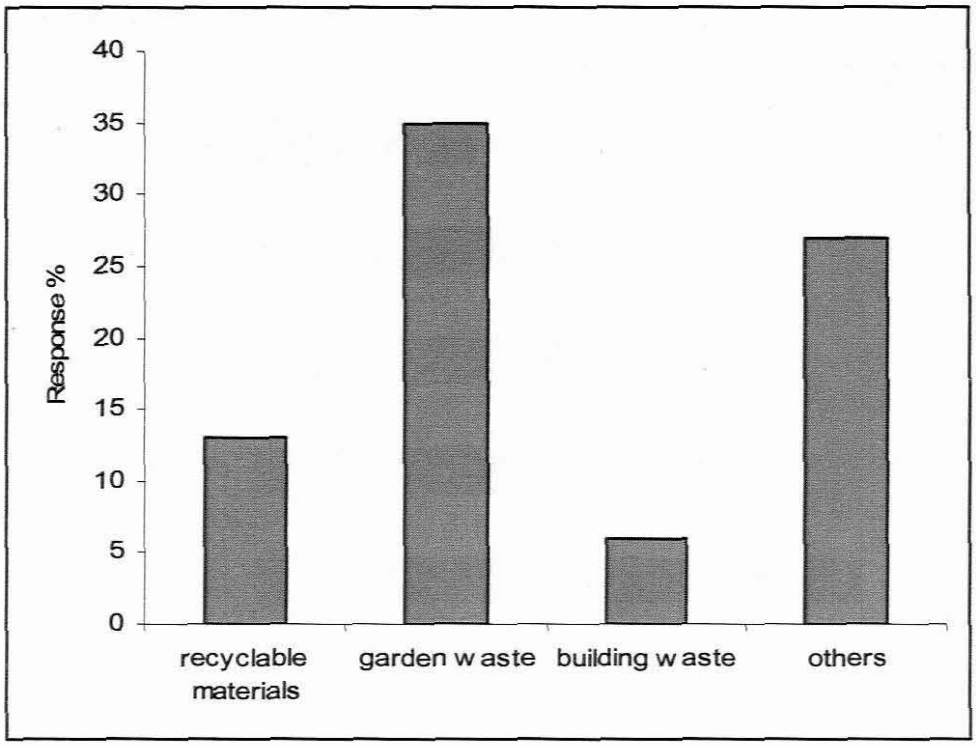

Figure (4.36): The type of waste that is collected in the community (n=1232).

Figure (4.36) illustrates the removal services available in the community. Thirty five percent of the household's mention that their garden waste is removed by the waste department. This waste is only removed if the waste is put in black bags. Six percent indicated the removal of building rubble which was done only on request or complaints received from the environmental health department. Thirteen percent of the households indicated that recyclable materials are collected and they are removed to the landfill site. The municipality collected any black bags whether they are recyclables or non-recyclables and disposed of them at the landfill site. The municipality do not render a service for recyclable materials, garden waste and building rubble. This service is rendered on request or due to law enforcement from the environmental health practitioners. For all the above mentioned waste the municipality levies an extra fee to remove the waste. The removal of waste from the curbside is limited to waste in black bags and some organic waste such as grass trimmings. The municipality can generate extra income, if they provide extra services for these types of waste.

(b) Waste minimisation

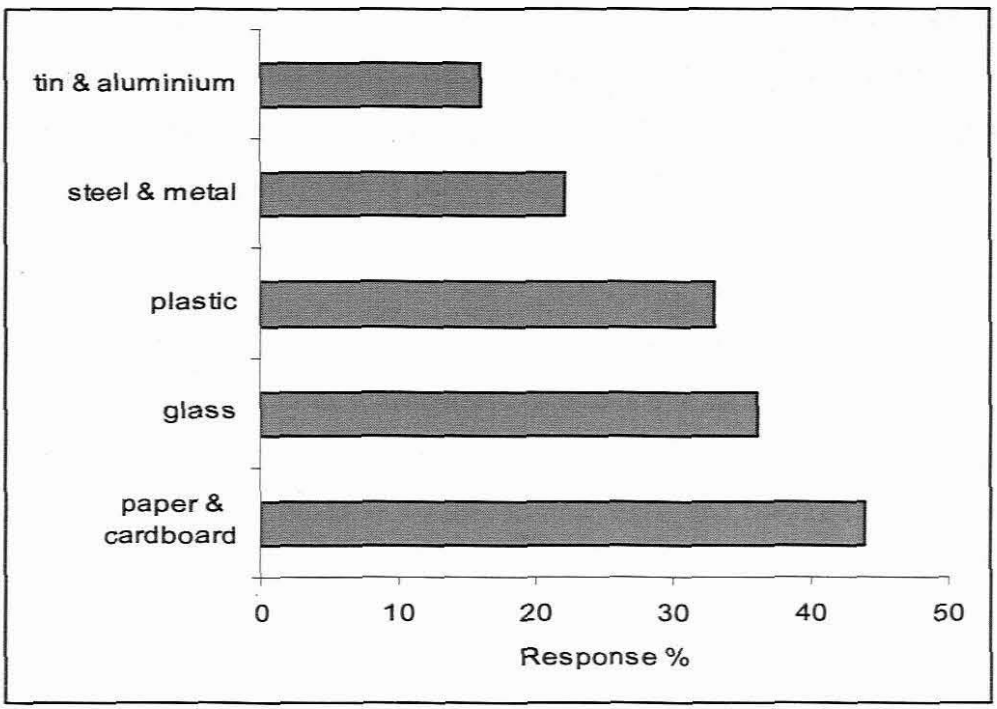

Figure (4.37): The different types of recyclables the community is willing to recycle if a recycling facility is near by (n=1232).

Cardboard and paper (44%), glass (36%) and plastic (33%) is common recyclables that are present in the local waste stream. Steel, metal (22%) and aluminium, tins (16%) is not common find in the local waste stream, if present it is on a low scale (Figure 4.37). Therefore cardboards, paper, glass and plastic is the common recyclables that unemployed persons collect and sell to recycling companies. Large companies usually dump steel, metal and aluminium at the local landfill site. People mostly do not separate waste at home since there is no awareness, knowledge, facilities nor incentives to do so. Recovery of materials from the household waste stream relies heavily on the voluntary behaviour of individuals. The majority of the respondents have indicated that they will make use of a waste minimisation facility, if such facility is established nearby. Recycling activities normally take place in high income groups and on small scale in middle income groups. There appears to be a great willingness amongst the community to participate in waste minimisation programmes, especially in the high and middle income groups.

This underlines the importance of educational programmes especially in the low income areas. The municipality should be compelled to purchase and locate waste minimisation facilities at convenient points where the public can access them without going out of their way. If waste is left at a recycling point, a refuse bin should be provided, which the municipality should service regularly (Ensor-Smith, 1999).

Question (4)

The 65% of residents who indicated that they do not do recycling of items is of great concern due to the illegal waste management practices that take place in the community Table (4F). Recycling of waste should be given priority in waste management plans and land disposal should be avoided as far as possible. Halla and Majani (1999) stated that solid waste recycling and composting reduce the amount of disposable waste and haulage costs, increasing the life span of disposal sites, and generating employment opportunities.

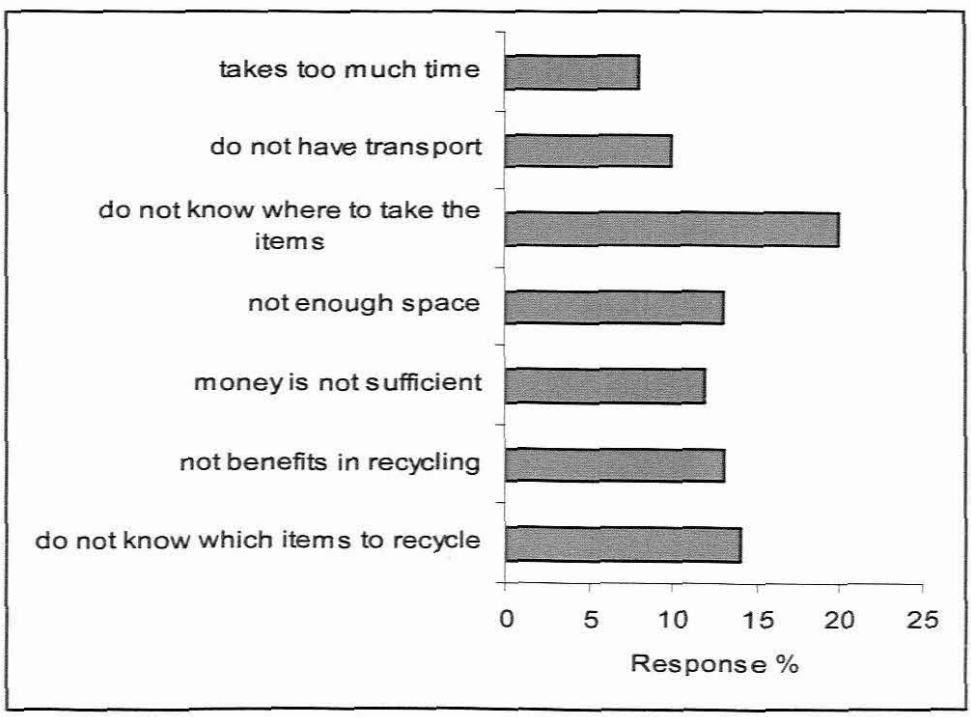

Figure (4.38): The reasons why the community is not willing to take part in recycling activities. (n=1232).

Poorer communities have no transport (10%), nor enough space (13%), to take part in waste minimisation initiatives (Figure 4.38). The willingness to take part in waste minimisation activities comes from the middle income groups and the high income group due to the fact that they have transport, enough space and do know which items or materials to collect. Many of the households (8%) see recycling as a waste of time and the income is not sufficient (12%). The transport used in recycling of materials in the poorer community is supermarket trolleys. The obstacles can be corrected through education, awareness and the forming of community-based organisations. The process of recovering recyclables is a complex structure of multi-level systems involving waste generators such as households, businesses, institutions and industries and continuing with systems for collection, separation or recovery, buying and selling of recyclables, final disposal and transformation, and use of recyclables. Both informal and formal sectors should be involved in this process (Ojeda-Benitez et al, 2003).

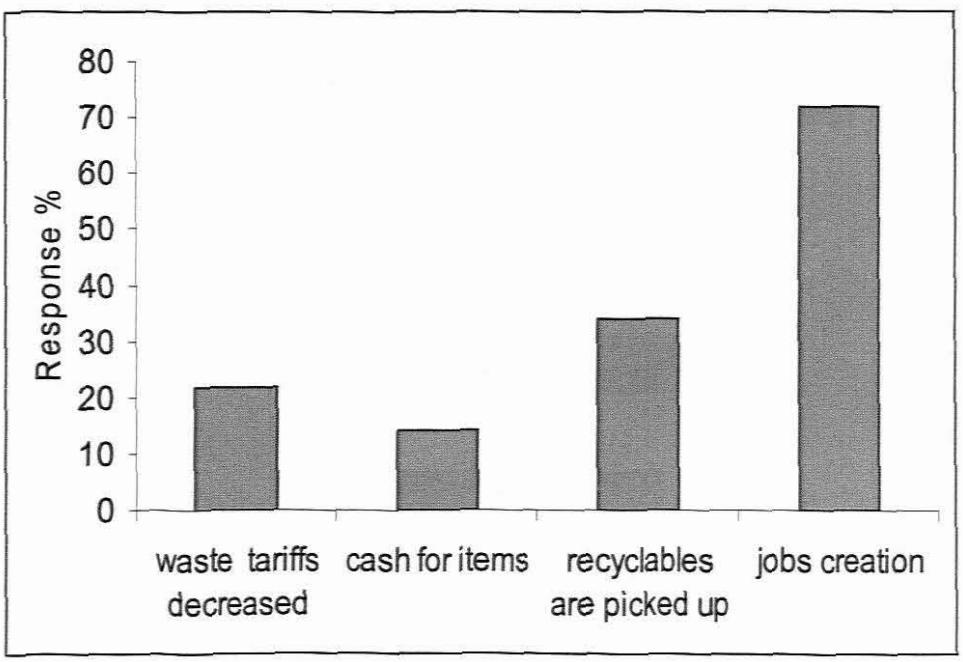

Figure (4.39): The reasons why the community is willing to participate in recycling activities. (n=1232).

Figure (4.39) shows that (72%) of the households who participated in the survey indicated that waste minimisation must create job opportunities. It is imperative in terms of the high unemployment rate of (29%) in these areas (Schroeder, 2002). It seems that the majority of the community (72%) sees job creation as a high priority if recycling initiatives is undertaking by the community. Job creation and collection of recyclables at curb-side was widely supported and only waste tariff decreased (22%) and cash for items (14%) indicated otherwise.

Question (7, 8)

The vast majority of residents do not know what is regarded as recycled products Table (4F). This is a clear indication that educational and awareness programmes must be introduced in the community. The municipality should encourage the purchase of recyclable products through partnership with the community and the business sector.

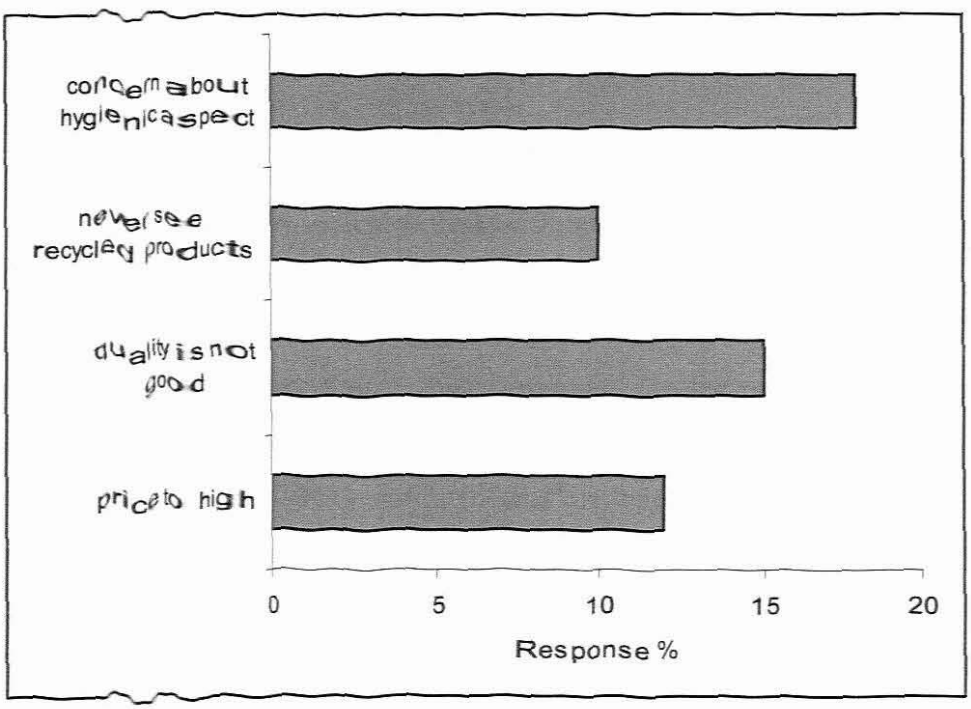

Figure (4.40): Reasons why the communities do not want to purchase recycled products (n=1232).

Figure (4.40) illustrates the reasons why the community is not in favour of purchasing recycled products. With regard to the hygienic aspect of recycled products eighteen percent, the households rate it as a high concern in comparison to the price of recycled products. However, many of the households (10%) indicated that they have not seen such products and therefore cannot indicate if the quality is up to standard. Botha et al (1983) states that the communities think that goods made of recyclable materials are inferior. From the present study it seems as the same perception is among the people regarding recycled products.

Question (11)

Seventy three percent of the respondents widely supported the introduction of waste minimisation and educational programmes to prevent illegal waste management practices in the community Table (4G). Seven percent indicated otherwise and (17%) do not know if waste minimisation and educational programmes can work in the community. It seems that a large majority of the community preferred that the municipality should formulated waste minimisation and educational programmes.

Question (13)

Eighty percent of households indicated their willingness to participate in waste recycling Table (4F). One important observation was that the community is willing to take part in waste minimisation activities as long as they are included in the planning process (Question 12). It is important to note, that community involvement contributes to better communication and co-operation with the municipality. The recovery of recyclables is not a new idea. Bartone (1999) indicated that its origins go back to ancient urban societies that recognized the intrinsic value of waste. Currently, there are more opportunities of waste recovery because the waste generated by modern society contains more varied materials, and large amounts of these have added value due to manufacturing processes.

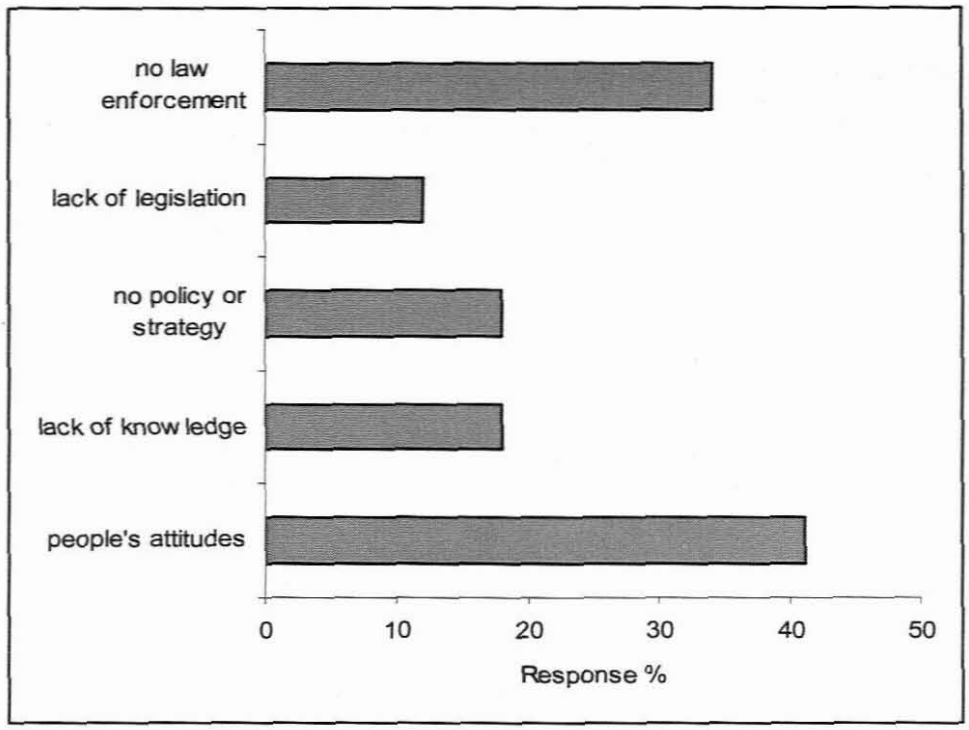

Figure (4.41): The main causes of illegal dumping in the community (n=1232).

Figure (4.41) illustrates what the community sees as the main causes of illegal dumping. Forty one percent of the participants indicated that people's attitudes, and thirty four percent indicated that no enforcement of legislation is the main contributing factors for illegal waste practices. Thirty four percent of households see the introduction of waste related legislation as an important part of an integrated waste management system. At present there is no waste related legislation in place as well as no enforcement of laws to prevent illegal dumping (Appendix E). A lack of enforcement from municipal officials could be one of the main causes that illegal waste management practices still exist. Henry et al (2006) stated that the proper management of waste is determined by the attitudes of people towards waste, such as the ability to refrain from indiscriminate dumping. Socio-economic characteristics may determine attitudes such as the ability and willingness to recycle waste. These attitudes, however, may be positively influenced by awareness-building campaigns and educational measures (Henry et al, 2006).

Question (20)

Seventy four percent of the respondents supported the idea that the general public should be included in the planning phase of waste minimisation facilities Table (4G). The White Paper on Integrated Pollution and Waste Management (DEAT, 2000) stated that stakeholders, businesses and the general public should be involved when waste management issues are address.

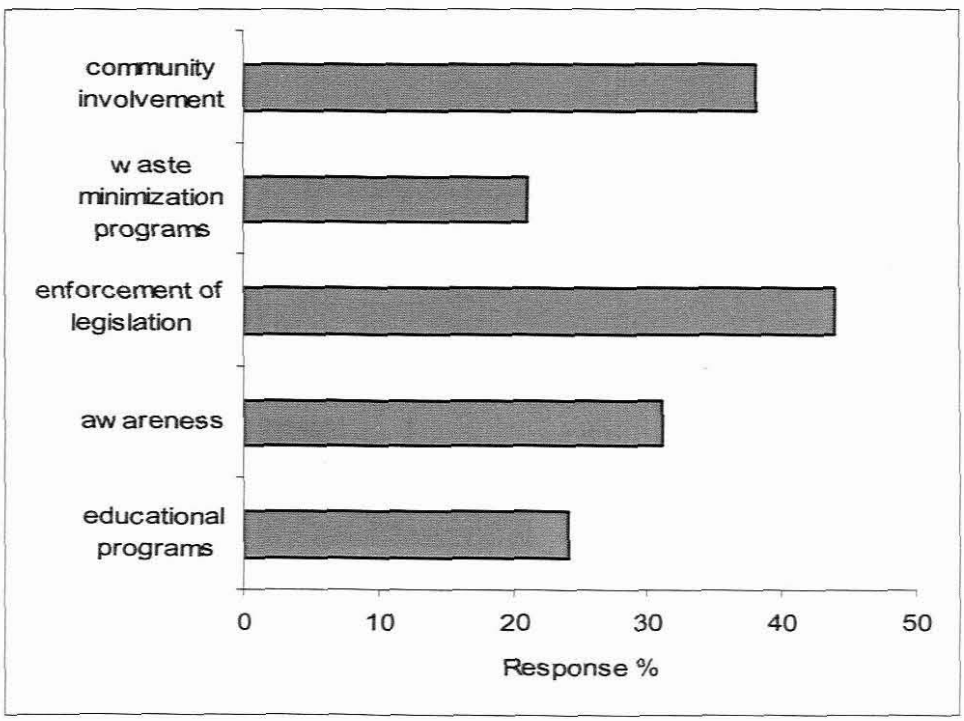

Figure (4.42): The strategies needed to minimize waste in the community according to community respondents (n=1232).

Figure (4.42) illustrates the factors which must be considered when waste minimisation activities are introduced or planned. A large number of residents (44%) indicated that enforcement of waste related legislation by officials is essential for effective waste management practices. This enforcement of legislation also helps to protect human health and the impact on the environment. According to the (38%) of respondents of households, community involvement is important in the planning phase of an integrated waste management system.

Twenty one percent of residents indicated that waste minimisation programmes such as recycling, waste exchange, re-use and composting can help to minimise waste. Thirty one percent of residents mention awareness programmes together with (24%) of residents who indicated that educational programmes must be introduced to the community. All the above mentioned strategies form part of an integrated waste management policy. The Department of Environmental Affairs and Tourism also describe these strategies as an integrated approach to sustainable waste management practices (DEAT, 2003).

(c) Backyard dwellings

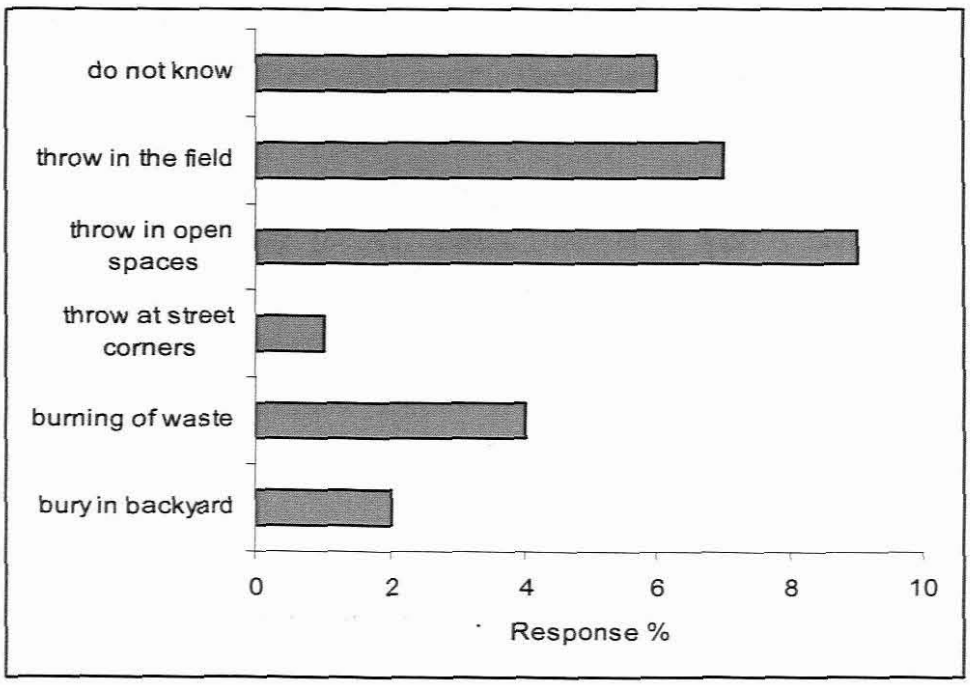

Figure (4.43): What the informal households do with their waste (n=1232).

Figure (4.43) illustrates what the informal households do with their waste Table (4F). Informal housing in backyards is another concern in terms of non receiving of black bags to use as storage method. Twenty six percent of the respondents indicated that informal houses are on their properties and do not receive any black bags. These informal households burn their waste, or dump it at street corners, in the field and open spaces (Question 19). A way to address this problem is for the municipality to introduce an extra waste removal fee and also distribute black bags to these households.

Informal housing (backyard housing) in the low income group areas contribute to the waste problem is these areas.

(d) Public participation and co-operation

Question (12)

Eighty one percent of the households indicated that they felt positive about community involvement and the public should be involved in terms of waste management planning, Table (4G). Public participation is an important element during the planning, development, operation and formulation phase of an integrated waste management plan. The public should be consulted during all phases of waste management planning and systems development to allow public input in the planning processes. Involvement of the community is central to the success and sustainability of any service delivery system. Community participation should be interactive and meaningful, embracing different sectors of the community (DEAT, 2003). Joos et al (1999) noted that decision transparency and information accessibility are key factors for public acceptance. The problem of public participation in planning and implementation are no less important than the technical or economic aspects in waste management and decision-making (Joos et al, 1999).

Question (22, 23)

A large majority (73%) indicated that they are not members of a community forum in comparison with the thirteen percent of the respondents which indicated that they are members. Seventy seven percent of the respondents supported participation, if they have a chance. Effectiveness in waste management can no longer rest with individual waste generators, but require partnerships for better service delivery and community-based forums can be seen as such partners Table (4F).The importance of waste management through involvement of environmental forums and stakeholders cannot be overemphasized. Taylor (1999) mentions that community-based and NGO's have to participate and get involved in improving solid waste source separation, recycling and / or overall waste collection and disposal activities.

Community members can often be more influential in effecting improved waste management if they act collectively through community-based organisations than if they acted as individual citizens.

Figure (4.44): The co-operation between the municipality, businesses and communities according to community members. (n=1232).

Figure (4.44) illustrates the degree of co-operation between the municipality, businesses and communities in terms of refuse removal. It seems that a large percentage, excellent (14%), good (46%) and reasonable (27%) see that there is relative good co-operation between the different sectors. Only very poor (6%) and poor (5%) respondents opined otherwise. Effective management of waste management requires the co-operation of the general public and the business sector (Bartone, 1995). The co-operation between business, community and local authority can be increased through good communication, partnerships and effective public participation in terms of waste management strategies. Public participation, education and awareness of waste management issues and the understanding of the respective roles of the communities, business sector and the municipality are essential for the implementation of an effective waste management system (Ninham Shand, 1993).

(e) Legislation, policies and integrated waste management system

Question (10)

A large majority (85%) of households are aware of waste related legislation that prevents illegal waste management practices, Table (4G). Some of this waste related legislation is outdated and must be reviewed due to the amalgamation of the Worcester, Rawsonville, De Doorns and Touwsriver municipalities. Although there is some legislation covering waste management, the municipalities lack the capacity to implement them. The administration of by-law and waste related legislation is often complicated in that different departments are normally in charge of certain functions (Smook, 2003). This creates either an overlap of duties or a lack of clarity is to who is responsible. The rules and regulations are enforced by different departments. Legislation is only effective if it is enforced by officials. Therefore comprehensive waste related legislation, which avoids duplication of responsibilities and is enforceable, is required for sustainable development of waste management system (Bartone, 1995).

Question (24)

The majority of respondents (64%) indicated that they do not know what an integrated waste management system is Table (4F). This is a new system and it is normal if the community does not know of such a system. This emphasizes the need for the municipality to include the community, and other stakeholders in the planning phase of integrated waste management. Integrated waste management is broadly defined as the use of combinations of complementary waste management techniques to manage waste in an environmentally sound and cost effective manner (Eichstadt, 1999).

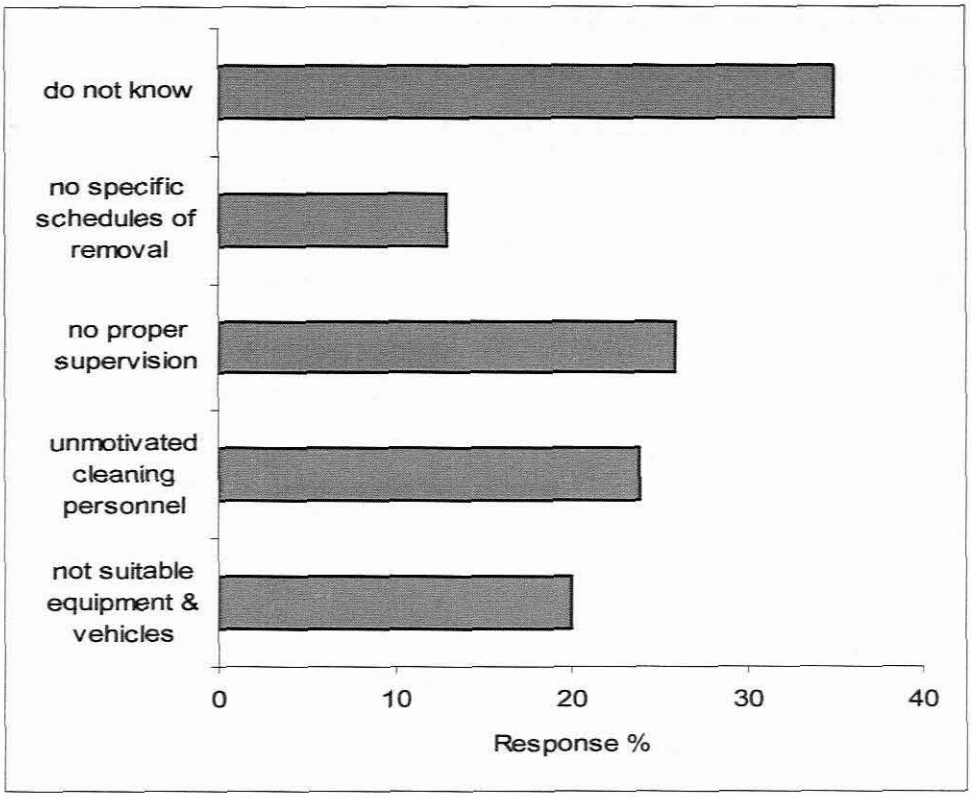

Figure (4.45): The main reasons that influence the effectiveness of the waste department, in terms of effective service delivery according to the community. (n=1232).

Figure (4.45) illustrates the main reasons that influence the waste department in terms of effective service delivery to the community. Twenty percent of the households indicated that the equipment and vehicles are not suitable for waste collection and removal of waste, while twenty four percent of the households indicated unmotivated cleaning personnel as a reason. The equipment and vehicles are obsolete and breakdowns are common. This leads to the borrowing of equipment and vehicles from other departments of the municipality to complete the collection and removal of waste. Obsolete equipment and vehicles are of great concern in terms of effective waste management services. Johnson and Wilson (2000) states that the waste collection is inefficient because of the use of obsolete equipment which frequently breaks down. This study was conducted in Zimbabwe, to determine institutional sustainability of waste management. It is common for a large percentage of the fleet in the Breede Valley district to be waiting for repair.

The vast majority of the cleaning personnel are unskilled and training in terms of waste management is nonexistent and morale is very low. There is also a lack of supervision, and the breakdown of vehicles has a negative impact on the capacity of the waste collection and removal service.

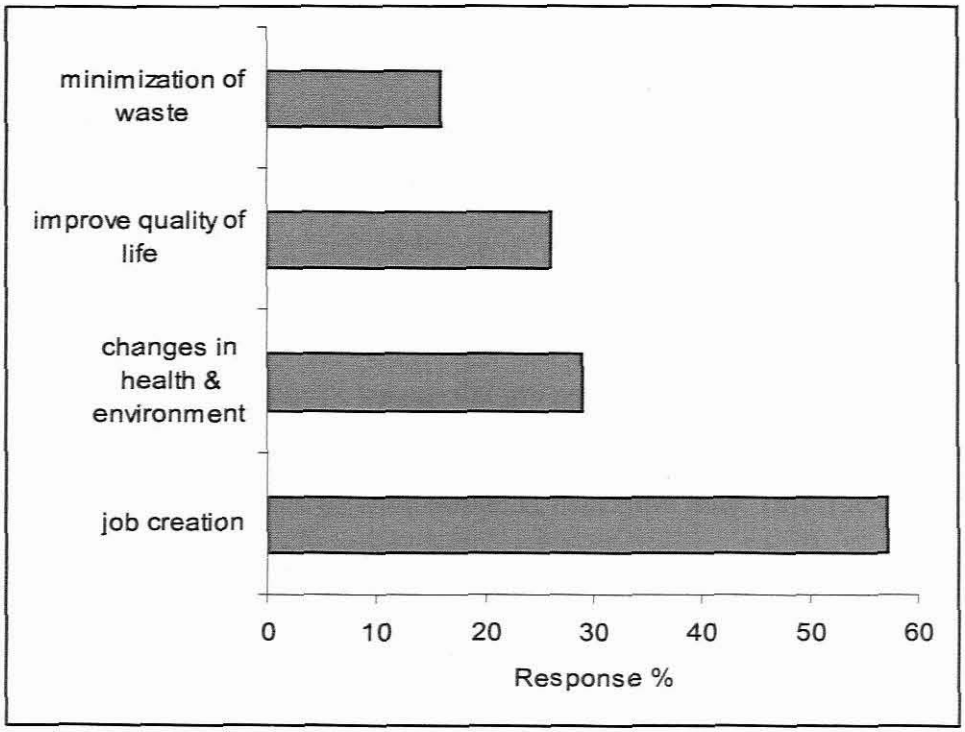

Figure (4.46): What waste minimisation must focus on according to the . community. (n=1232).

Figure (4.46) illustrates the aspect on which recycling, reuse and prevention must be focused. The majority fifty seven percent indicated that job creation must be first priority when waste minimisation strategies are put in place. This is a clear indication that households see that more job opportunities must come out of waste minimisation activities due to the fact that there are large amounts of recyclables present in the waste stream. Halla and Majani (1999) states that waste is now identified as an economic good that helps in employment creation and income generation.

4.4.3 Conclusion

Improper waste management can be a health hazard. Most communities do not consider waste management to be a priority. Based on the results of this study, it is clear that the current waste management system, equipment and vehicle conditions, as well as the absence of waste minimisation programmes and education programmes lead to inadequate waste management practices (Appendix F). Kuniyal et al (1998) states that the problem of solid waste management is one of the major issues to be tackled and if this problem is not tackled timeously, it may create many other dreadful, hazardous and incurable problems for the various communities in the region either directly or indirectly.

It is clear that the successful approach to promoting waste minimisation is through proper education, awareness and public participation programmes. If waste minimisation is made a priority in the community, substantial job opportunities should be created and the air space at the landfill site should increase. Along with the programmes of separation of recyclable waste, programmes of environmental education must be created, so that the activities of separation, re-utilization and recycling may acquire a deeper meaning for the individual (Ojeda-Benitez et al, 2003).

The housing crisis in the Breede Valley area needs to be addressed. Due to a lack of proper housing, the backyard dwellings accumulate and contribute to illegal waste management practices. The municipality should find ways to issue the backyard dwellings with black bags. Novella (1999) states that dumping sites range from backyards to open areas, streets, roads and drains. To reduce health risks, it is important that in areas of high population density such as low cost housing developments and informal settlements, well-controlled and regular systems of waste management are in place (Sowman and Urquhart, 1998).

Involving the community in the initial stages of the planning phase ensures that the community is aware of what is planned and what is expected of them in the whole process.

Kuniyal et al (1998) stated that a sensible and all round management of waste calls for involvement and participation of each individual or participatory group for complete segregation at source, proper collection, transportation and environmentally sustainable disposal along with sustainable practices of reuse and recycling. Policies and legislation are inadequate to make waste management sustainable in this area.

Waste management is mostly controlled through municipal by-laws and there are often discrepancies in enforcement, regulation and administration of waste management functions between the different municipalities (DEAT, 2003). Legislation governing waste disposal, collection and implementation and management are often not enforced. The primary target of an integrated waste management system is to protect the health of the population, promote environmental quality, develop sustainable waste management and provide support to economic productivity. To meet these goals, sustainable waste management systems must be embraced fully by local authorities in collaboration with both the public and private sectors (Henry et al, 2006).

4.5 INTERVIEW WITH ENGINEERING DEPARTMENT

4.5.1 Waste collection and minimisation

The breakdown of equipment and vehicles is one of the main obstacles in providing effective waste management services to the community. If this happen, equipment and vehicles must be borrowed from other departments. This borrowing can lead to the affected departments not being able to complete their work due to problems in the waste section. The purchase of new compactors and equipment to enhance reliability and to improve service delivery is one of the objectives in the 2006/2007 budget. A composting facility was operated at the sewerage plant in the past. Due to economic factors such as the price of composting and equipment the operation was stopped in 1992. The engineering department mentioned that composting is one of the strategies they will implement in the new integrated waste management approach. Due to zoning and environmental impact assessment studies and the availability of land, waste minimisation and waste minimisation facilities are not considered a priority of this municipality. With the new integrated waste management legislation waste minimisation and waste minimisation facilities is part of the municipality waste management approach.

4.5.2 Educational programmes concerning waste

Proper training of employees has to be carried out recently to develop awareness of waste handling, health, safety and environmental issues. It is important for workers to know and understand the potential risks associated with waste and the use of protective clothing. The general morale of employees is low and this created a "don't care" attitude. The municipality is responsible and accountable for educational and awareness programmes but due to a lack of co-operation and poor communication between different departments in the municipality, problems to implement educational and awareness programmes arise.

4.5.3 Waste related policies and legislation

The representative of the engineering department stated that he does not know if they have any environmental and waste management policies in place. The co-operation between the different departments dealing with waste issues and stakeholders will be encouraged to provide effective waste management services. The municipality is in the process to do away with fragmented, unproductive and uneconomical waste management practices. The by-laws are outdated and fragmented and with the amalgamation of the different municipalities the by-laws will be changed and reviewed. Lack of enforcement by officials also exists due to fragmented and outdated by-laws.

4.5.4 Public participation

Lack of enforcement of waste related legislation, general attitudes and poor behavioural change of the public can be seen as contributing factors for illegal waste disposal practices. Public participation was not necessary in the past, but due to new waste management legislation, the stakeholders and the general public will be consulted when integrated waste management policies are formulated.

4.5.5 Future plans

The existing life time of the landfill site in Worcester is 10 years, if no waste minimisation programmes are implemented. If waste minimisation programmes are immediately introduced an extra 15 years can be added to the lifespan of the landfill site. A waste minimisation facility (transfer station) is in the developing phase, with composting and recycling activities at the facility. Lack of co-operation and poor communication between the different departments are of concern due to the poor service delivery and waste management. The objective is to change the attitudes of non co-operation and poor communication by encouragement of good management in the different departments. There is a lack of discipline, and control measures at the landfill site due to informal pickers and personnel that are guilty of picking. The option of a regional landfill site will be discussed with the different stakeholders and the district municipality (Smook, 2003).

4.5.6 Conclusion

It is clear that ideal waste collection and waste minimisation is not in existence. Proper waste collection and waste minimisation are key elements in any effective waste management system. Breakdowns and purchase of equipment and vehicles show a lack of proper planning and consultation. Many municipalities blame the breakdown of collection trucks on the poor condition of the roads and vandalism (Henry et al, 2006). According to the new approach of integrated waste management composting is one of the waste minimisation strategies. Lack of knowledge and marketing of compost can be seen as an obstacle in the use of composting as a waste minimisation strategy.

It is clear that improved training programmes have to be carried out, to increase the knowledge and lift the moral of the workers. The lack of co-operation and good communication need to be addressed to enhance effective waste management practices. The waste management function is spread over different sections and need to be put in one section, example environmental / waste section.

The municipality needs to do away with the fragmented waste management practices and formulate environmental / waste policies that protect the environment and the health of the people. Waste related legislation need to be updated, reviewed and changed so that proper enforcement by officials can take place.

Behavioural patterns and attitudes should change through consultation with stakeholders and effective public participation programmes. The mitigation measures at the landfill site need to be increased by fencing and security control. Salvaging at the landfill site can lead to unacceptable health and safety risks for the pickers, as well as operating problems for the landfill manager (DEAT, 2003). From the interview with the engineering department and cleaning personnel unmotivated personnel is one of the problems in effective waste management delivery in the municipality. Complaints received by the environmental health department include complaints about training programmes, protective clothing and lack of regular medical check-ups.

CHAPTER 5

5 CONCLUSIONS AND RECOMMENDATIONS

The functions pertaining to waste should not be spread over departments or sections like waste, health, law enforcement, as this invariably leads to situations where there is confusion and inadequate administrative, executive and legal control. Inadequate waste related legislation, education, waste minimisation and public participation make sustainable waste management difficult in the Breede Valley district. Adopting an integrated waste management strategy can result in the improvement of communication and co-operation between various sectors and improved relations between council and communities. This may lead to community empowerment and better quality of waste management and service delivery (Urquhart and Atkinson, 2000). Integrated waste management can be used as a tool to protect human health to reduce the impact of waste on the environment, to create job opportunities, to bring communities into the planning process and increase the standards of living without destroying the environment. Law enforcement is generally lacking and should be improved. Outdated by-laws relating to waste management should be updated and reviewed. It is clear that the municipal policies and laws require integration of environmental concerns in strategic planning and decision making.

The benefit of a waste assessment study, such as in the present study, is that it provides accurate information about the waste stream such as types of waste, how much waste is generated, types of recyclables, who generates what waste and the composition of the waste. With this type of information sound decisions can be made in terms of the planning phase, the selection of collection vehicles, types of receptacles, waste minimisation facilities, landfill sites, waste minimisation programmes and infrastructure for effective waste management. Large-scale material recovery facilities, recycling programmes and waste-to-energy facilities usually demand detailed information to ensure proper design. In an IWM system, programme planning, facility design, waste minimisation strategies and financial decisions all require knowledge of the waste stream

qualities and composition (DEADP, 2004). The findings of this present waste stream assessment could and should be used in the IWM process of the Breede Valley municipality.

As shown in this study, the municipality should provide services to communities in a sustainable manner. They also have to promote social and economic development (Urquhart and Atkinson, 2000). They must do this in a new way too, which involves developing partnerships with communities and the business sector (Urquhart and Atkinson, 2000). In terms of section 20 of the Health Act (Act 63 of 1977), every local authority should take the necessary steps to maintain its district at all times in a hygienic and clean condition, to prevent the occurrence within the district of any nuisance, any unhygienic condition, any offensive condition, or any condition which will or could be harmful or dangerous to the health of any person within the district (Health Act 63 of 1977). Integrated waste management can also help relieve poverty through waste minimisation programmes such as recycling, waste exchange and composting. The municipality should formulate IWM policies where sustainable waste management practices are clearly stipulated. An Environmental / Waste Manager should be appointed, who should be responsible for the implementation of the IWM policies and all other environmental and waste issues.

The municipality needs to formulate stricter guidelines and procedures for the storage and transportation of medical waste from medical facilities to disposal sites. Correct procedures for the collection, separation, transfer and disposal of medical waste should be formulated. Procedures such as identifying waste types, separating non-medical (general) waste from medical waste: using appropriate labeled bags based on colour guideline: placing waste in transparent labeled bags (Oweis et al, 2005).

All businesses especially hazardous waste generators should be registered by the municipality to use as a tracking system for hazardous waste transportation. Record keeping of hazardous waste should be made compulsory, and the records must be shown, when inspection by officials is conducted. Waste exchange between businesses should be

encouraged by the municipality and it should also establish a waste exchange information system, whereby all the businesses which would like to take part be registered by the municipality. These should encompass recognition that waste management creates employment, which needs to provide a living wage, be safe and healthy, be carried out with dignity and respect, and should promote equality among the people working in the sector (Baud and Schenk, 1994; Hunt, 1996).

Population growth, together with the increase in backyard dwellings has resulted in illegal waste management activities from these households. The municipality should find ways to address the housing crisis in these low income areas. Proper communication, education, partnership and public participation programmes can change the communities' attitudes and behavioural patterns towards waste management practices.

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Appendix (A)

COMMUNITY PROFILE OF THE BREEDE VALLEY AREA.

SOURCES	*RAWSONVILE*	*DE DOORNS*	*TOUWSRIVER*	*WORCESTER*
Location	*20km East from Worcester.*	*45km west from Worcester.*	*85km west from Worcester.*	
Hectare	*670.5 ha*	*677 ha*	*1200 ha*	*731.425 ha*
Number of dwellings.	*High income - 445. Low income - 124*	*High -450 Low -650 Informal -850*	*High -490 Low - 823*	*High-3887 Middle -2121 Low-3054 Informal - 3907*
Total population.	*1765 People*	*7272 People*	*6318 People*	*122896*
Surrounding area.	*Agricultural*	*Agricultural*	*Agricultural*	*Agricultural*
Educational institution	*High - 2 Première - 2*	*High – 2 Premiere 2*	*High – 1 Premiere – 2*	*High – 6 Premiere - 13*
Age Demographics				
0 – 15	*600*	*1567*	*1923*	*37123*
16 – 30	*787*	*2758*	*2228*	*40212*
31 – 45	*227*	*2231*	*1728*	*29810*
46 – 60	*98*	*668*	*415*	*14651*
60+	*53*	*48*	*102*	*1100*
Hospitals,	*-*	*-*	*-*	*4*
Medical Practitioners,	*1*	*2*	*1*	*60*
Clinics,	*2*	*3*	*1*	*4*
Laboratories	*-*	*-*	*-*	*1*
Sport Stadium,	*1*	*2*	*2*	*3*
Swimming Pools,	*1*	*1*	*-*	*2*
Golf Courses	*-*	*1*	*-*	*2*
Garages & Service Stations	*2*	*2*	*4*	*26*
General dealers	*14*	*20*	*20*	*267*
Restaurants	*5*	*9*	*3*	*85*
Bakery	*2*	*2*	*2*	*21*
Butcheries	*3*	*3*	*2*	*32*
Street stalls	*20*	*15*	*3*	*57*
Wine makers	*8*	*4*	*6*	*2*
Steel working	*2*	*2*	*1*	*20*
Old Age Homes	*1*	*2*	*2*	*15*
Churches	*3*	*8*	*7*	*56*
Sewage works	*1*	*1*	*1*	*1*

Bus Terminals	*2*	*1*	*1*	*7*
Agricultural activities	*5*	*3*	*2*	*10*
Hazardous substances premises.	*1*	*1*	*1*	*4*
Public Toilets	-	*2*	-	*9*
Business premises	*4*	*20*	*19*	*45*
Wood working	*1*	*3*	*2*	*22*
Hotel & Accommodation	*3*	*3*	*3*	*43*
Community facilities	*1*	*1*	*1*	*5*
Cemeteries	*1*	*1*	*3*	*9*
Disposal site registered	*None*	*None*	*None*	*1*
Dairies		*1*	*1*	*3*
Pharmacist	-	*1*	*1*	*24*
Supermarkets	*1*	*1*	*1*	*25*
Disposal sites on Farms	*2*	*2*	*4*	-
Government Institutions.	-	-	-	*4*
Food factories	-	-	-	*6*
Home industries	*1*	*2*	-	*8*
Caterers	*1*	*1*	-	*43*
Transport of food	-	-	-	*37*
Amusement premises	*1*	*2*	*1*	*23*
Barbers & Hairdressers	*1*	*2*	-	*34*
Factories	-	*2*	-	*24*
Business premises non food.	*4*	*20*	*14*	*707*
Abattoirs	-	-	-	*2*
Camping & Recreation grounds.	*1*	-	-	*7*
Student Hostels	*1*	-	-	*4*
Colleges	-	-	-	*4*
Crèches	*2*	*2*	*1*	*52*
Farm stalls.	*2*	*2*	*2*	*3*

Appendix (B1)

MEDICAL WASTE QUESTIONNAIRE

1) Is the current collection service adequate for your purpose?

a) Very Good.	
b) Good.	
c) Poor.	
d) Very Poor.	

2) Is there a waste collection service available for general waste?

a) Yes.	
b) No.	

3) What is the frequency of your medical waste removal?

a) Daily.	
b) Weekly.	
c) Monthly.	
d) Quarterly.	

4) Do your practice have a safety, health and environmental policy?

a) Yes.	
b) No.	

5) If so, answer question 5. Is any one or more of the strategies listed below part of your policy?

a) Avoidance.	
b) Recycling.	
c) Change of processes and technology to minimise waste.	

6) Do you separate medical waste from general waste?

a) Yes	
b) No	

7) How is medical waste separated from other waste?

a) Different colour bags.	
b) Different name tags.	
c) Different under cover areas.	
d) Different close boxes.	

8) Is medical waste kept at a safe place with no access to unauthorised persons?

a) Yes	
b) No	

9) Who takes responsibility for separation of medical waste at your facility from other waste?

a) Medical personnel	
b) Administrative personnel	
c) Cleaning personnel	

10) Is training given to personnel in terms of separation of waste and the danger of medical waste?

a) Yes.	
b) No.	

11) If your answer is "Yes" in question 10, through who or what institution?

a) Private institution.	
b) Yourself.	
c) Others.	

12) Who is responsible for the removal of your medical waste?

a) Private companies.	
b) Local Authority.	
c) Yourself.	
d) Others.	

13) Is the following medical waste separated from the other waste?

	Yes	No
a) Sharps.		
b) Blood and blood products.		
c) Unused sharps.		
d) Bandage (contaminated).		

14) Are specific vehicles used for the transport of medical waste?

a) Yes.	
b) No.	

15) Are these vehicles marked "Medical Waste"?

a) Yes	
b) No	

16) Are these vehicles custom made for the transport of medical waste?

a) Yes	
b) No	

17) Is protective clothing provided for workers who work with medical waste?

a) Yes.	
b) No.	

18) Is record kept of all medical waste transported from premises?

a) Yes.	
b) No.	

19) Who provides the receptacles?

a) Yourself.	
b) Contractor.	

20) Types of receptacles used (Tick all appropriate items).

a) Plastic bags.	
b) Receptacles carton boxes.	
c) Receptacles plastic containers.	
d) Other.	

21) Do you think that legislation of the municipality is adequate in terms of waste management?

a) Yes.	
b) No.	

22) Do you think that public participation is needed, when a waste management policy is formulated?

a) Yes.	
b) No.	

Appendix (B2)

QUESTIONNAIRE FOR BUSINESSES

1) What type of business do you have?

2) Is the current waste collection service adequate for your business?

a) Very Good	
b) Good	
c) Poor	
d)Very Poor	

3) Do your business have a waste management policy?

a) Yes	
b) No	

4) Is one of these waste minimisation strategies part of your business policy?

	Yes	No
a) Avoidance		
b) Recycling		
c) Good operational methods		
d) Waste exchange		
e) Change in processes & technology to minimise waste		

5) What waste minimisation strategies are you using in your business?

a) Source separation.	
b) Recycling of all recyclables.	
c) Recycle only paper out of the waste stream.	
d) Recycle only glass out of the waste stream.	
e) No recycling at all.	
f) Others.	

6) If your option is "e" in question 5, answer question 6. Why does your business not have recycling programmes?

a) Do not know which items to recycle.	
b) See no benefits in recycling.	
c) Do not have space.	
d) Take a lot of time to recycle.	
e) Do not know where to take the recyclables.	
f) Recycling is not profitable.	

7) Will your business implement recycling programmes, if....

a) Collection fee is decreased.	
b) Recyclables are collected at your business.	
c) Jobs can be created.	
d) Received cash for the recyclables.	

8) If it is required of your business to produce recyclable products, will you participate?

a) Yes.	
b) No.	

9) If there is a market for waste exchange, would you participate?

a) Yes.	
b) No.	

10) Is a waste collection service available for general waste?

a) Yes.	
b) No.	

11) Is there a collection service available for the following?

a) Recyclables.	
b) Garden waste.	
c) Builders waste.	
d) Others.	

12) What are the main causes of illegal dumping?

a) Lack of legislation for waste management.	
b) Behaviour and attitudes of inhabitants.	
c) Lack of knowledge.	
d) No waste strategy or waste policy	
e) Lack of enforcement by officers.	

13) If it is required from your business to use less packaging, will you participate?

a) Yes.	
b) No.	

14) Does your business generate or work with hazardous waste?

a) Yes.	
b) No.	

15) Is hazardous waste kept safe, with no access by unauthorised persons?

a) Yes.	
b) No.	

16) Who is responsible for your waste collection?

a) Municipality.	
b) Private contractor.	
c) The business itself.	

17) How is the hazardous waste kept safe from the general waste?

a) Different colour bags.	
b) Different name tags.	
c) Different undercover areas.	
d) Different open spaces.	

18) Is record kept of the hazardous waste?

a) Yes.	
b) No.	

19) Does your business know of any legislation that prevents the illegal dumping of waste?

a) Yes.	
b) No.	

20) Do you think that implementation of waste minimisation programmes will stop illegal dumping?

a) Yes.	
b) No.	

21) Do you think that businesses should be involved, when policies on waste matters are formulated?

a) Yes.	
b) No.	

22) Who is responsible for waste minimisation in your area?

a) Communities.	
b) Businesses.	
c) Municipality.	
d) Generators of waste.	
e) All of above.	

23) What do you think can be done to minimise waste?

a) Introduction of educational programmes.	
b) Awareness programmes must be introduced.	
c) Law enforcement and legislation.	
d) Waste minimisation programmes must be introduced.	

24) What do you think a waste management policy must focus on?

a) Avoidance.	
b) Recycling.	
c) Law enforcement.	
d) Job creation.	
e) Minimisation of waste.	
f) All of above.	

25) How is the co-operation between the municipality, business and communities in terms of waste matters?

a) Very Good.	
b) Good.	
c) Poor.	
d) Very Poor.	

26) Do you know what an integrated waste management policy is?

a) Yes.	
b) No.	

Appendix (B3)

QUESTIONNAIRE FOR THE COMMUNITY

1) In what sector are you working?

a) Unemployed.	
b) Private sector.	
c) State service.	

2) Is the current waste collection service adequate for your community?

a) Very Good.	
b) Good.	
c) Fair.	
d) Poor.	
e) Very Poor.	

3) For what items would you utilise a recycling facility if it were available in your area?

a) Paper & cardboard.	
b) Glass.	
c) Plastic.	
d) Steel & metal.	
e) Tin & aluminium.	

4) Do you recycle items?

a) Yes.	
b) No.	

5) If you answer in question 4 is no, give reasons why you do not recycle items? (Mark where applicable).

a) Do not know which items to recycle.	
b) There are no benefits in recycling.	
c) The money you receive for recyclables is not sufficient.	
d) Do not have enough space.	
e) Do not know where to take the items.	
f) Do not have transport.	
g) Takes too much time.	

6) Would you do recycling if?

a) Waste removal charges are decreased.	
b) You receive cash for items.	
c) Recyclable items are picked up from kerbside.	
d) More jobs are created.	

7) Would you purchase recycled products?

a) Yes.	
b) No.	

8) If your answer is no in question 7, why would you not purchase these products?

a) The price is too high.	
b) The quality is not efficient.	
c) Have never seen recycled products before.	
d) I am concerned about the hygienic aspect of the product.	

9) How often is your waste removed?

a) Weekly.	
b) Every two weeks.	
c) Monthly.	

10) Are you aware that there are laws that stipulate that action can be taken against people who unlawfully dump waste?

a) Yes.	
b) No.	
c) Do not know.	

11) Do you think that waste minimisation programmes, together with educational programmes, would help prevent illegal dumping?

a) Yes.	
b) No.	
c) Do not know.	

12) Do you think that the community should be involved in decision making regarding waste removal and services?

a) Yes.	
b) No.	
c) Do not know.	

13) If in the future you are required to take part in recycling, would you participate?

a) Yes.	
b) No.	

14) What do you think are the main causes of illegal dumping?

a) People's attitudes towards waste.	
b) Lack of knowledge and miscommunication.	
c) No policy or strategy concerning refuse.	
d) Lack of by-laws and legislation.	
e) No enforcement of by-laws by municipal officials.	

15) How are the cleaning workers doing their job?

a) Very Good.	
b) Good.	
c) No opinion.	
d) Poor.	
e)Very Poor.	

16) Does your community have the following removal services?

a) Recyclable materials.	
b) Garden waste.	
c) Remains of demolished buildings.	
d) Others.	

17) Are there informal housing in your backyard?

a) Yes.	
b) No.	

18) If your answer is "Yes" in question 17, do these informal houses receive black bags?

a) Yes.	
b) No.	

19) If they do not receive black bags, what happens with the waste?

a) Bury it in the backyard.	
b) Set their refuse alight.	
c) Throw it at the street corner.	
d) Throw it in open spaces.	
e) Throw it in the field.	
f) Do not know.	

20) Must the community be informed when waste minimisation facilities are planned?

a) Yes.	
b) No.	
c) No opinion.	

21) What do you think should be done in order to minimise waste in the community?

a) Educational programmes.	
b) Awareness programmes in the community.	
c) Enforcement of legislation by the officials.	
d) Waste minimisation programmes must be implemented.	
e) More community involvement in waste matters.	

22) Are you a member of a community forum?

a) Yes.	
b) No.	

23) Would you participate in such a forum, if you have a chance?

a) Yes.	
b) No.	

24) Do you know what an integrated waste management system is?

a) Yes.	
b) No.	

25) What do you think are the reasons for the untidy communities?

a) Not suitable equipment and vehicles.	
b) Unmotivated cleaning personnel.	
c) No proper supervision of cleaning personnel.	
d) No specific schedules for waste removal.	
e) Do not know.	

26) On which aspect must recycling, reuse and prevention focus?

a) Job creation.	
b) Visible changes in the impact on health and the environment.	
c) Improve the quality of life of the disadvantaged communities.	
d) Minimisation of waste.	

27) How is the co-operation between the municipality, businesses and communities in terms of waste removal and services?

a) Excellent.	
b) Good.	
c) Reasonable.	
d) Poor.	
e)Very Poor.	

Appendix (B4)

INTERVIEW WITH ENGINEERING DEPARTMENT

Waste collection and minimisation.

Is the current waste collection service adequate?

In your own opinion, what can be done to improve the waste collection service?

Why are there no waste minimization programmes in operation in the Breede valley area?

Is waste minimisation not part of the municipality waste management strategy?

Educational programmes concerning waste.

Do you think that workers in the waste management department are well trained for the job?

Do you think that the municipality is responsible for implementing awareness and educational programmes in his area?

Waste related policies and legislation.

Do your waste management department have an environmental- and waste management policy in place?

Do you think that an integrated approach is needed to deal with waste problems?

Are there any legislation or by-laws for illegal dumping of waste?

Why is there no enforcement of these by-laws or legislation?

Public participation.

What do you think are the main causes of waste management problems in the Breede Valley area?

Do you think that business and public must be consulted when waste management strategies are formulated?

Future plans.

What is the life span of the landfill site?

For future planning, is composting part of your integrated waste management approach?

Do you think that there is co-operation between the different sections, who deals with waste issues?

Why is there a lack of control measures at the landfill site?

Is a regional landfill site part of your future planning?

Appendix (C)

INFORMATION SHEET

LOCAL AUTHORITY: ***NUMBER :***
REGISTERED COMPANY: ***NAME:***
REGISTERED MEDICAL PRACTITIONER: ***NAME:***
BUSINESS NAME:
POSTAL / STREET ADDRESS:
BRIEFLY DESCRIBE THE MAIN ACTIVITIES / PROCESSES CONDUCTED:
NUMBER OF EMPLOYEES:
WASTE COLLECTION: ***WHO IS RESPONSIBLE FOR WASTE COLLECTION:*** ***GENERAL WASTE:*** ***HAZARDOUS WASTE:*** ***MEDICAL WASTE:***
NAME / ADDRESS OF PRIVATE CONTRACTOR:
METHODS OF STORAGE:

FREQUENCY OF COLLECTION SERVICE:
STORAGE FACILITIES AT PREMISES: ***PROVIDE BRIEF DESCRIPTION:***
BRIEFLY DESCRIBE HAZARDOUS / MEDICAL WASTE GENERATED AT PREMISES:
BRIEFLY DECRIDE TRAINING OF WASTE HANDLERS:
ANY OTHER INFORMATION APPICABLE TO THIS INFORMATION SHEET:

Appendix (D)

COMMON HOUSEHOLD HAZARDOUS MATERIALS.

CLEANING PRODUCTS.

Disinfectants.
Drain, toilet and window cleaners.
Oven cleaners.
Bleach and ammonia.
Cleaning solvents and spot removers.

PAINT AND BUILDING PRODUCTS.

Latex and oil-based paints.
Paint thinners, solvents and strippers.
Stains, varnishes and lacquers.
Wood preservatives.
Acids for etching and rust removal.
Asphalt and roof tar.

GARDENING AND PEST CONTROL PRODUCTS.

Pesticide spray and dusts.
Weed killers.
Ant and rodent killers.
Flea powder

AUTOMOTIVE PRODUCTS.

Petrol.
Used motor oil.
Antifreeze.
Battery acid.

Solvents.
Brake and transmission fluid.
Rust inhibitor and rust remover.

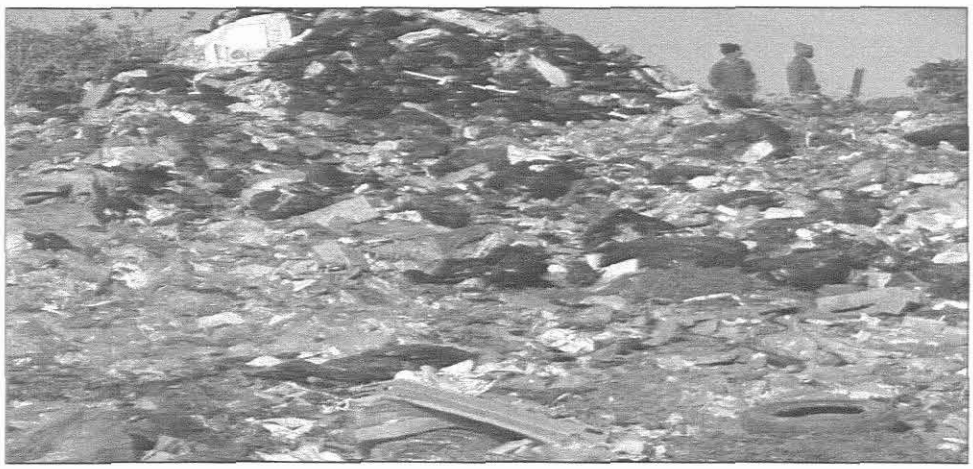
GENERAL PRODUCTS.

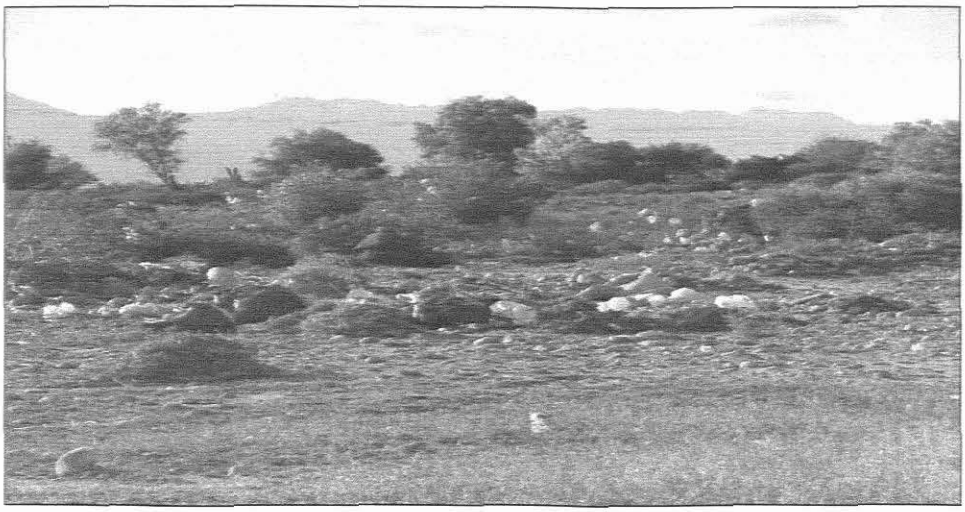
Dry – cell batteries (mercury and cadmium).
Artist paints and inks.
Glues and cements.

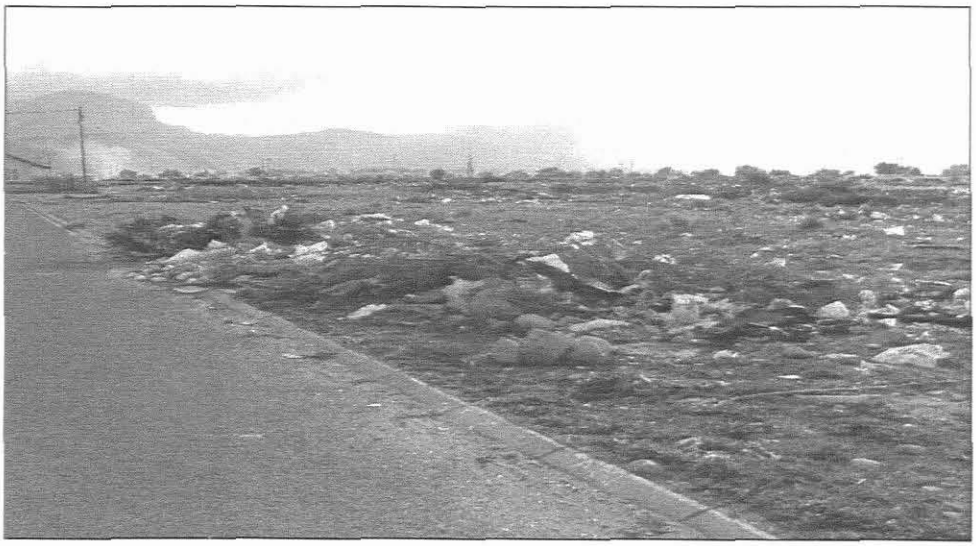
Middleton, 1999

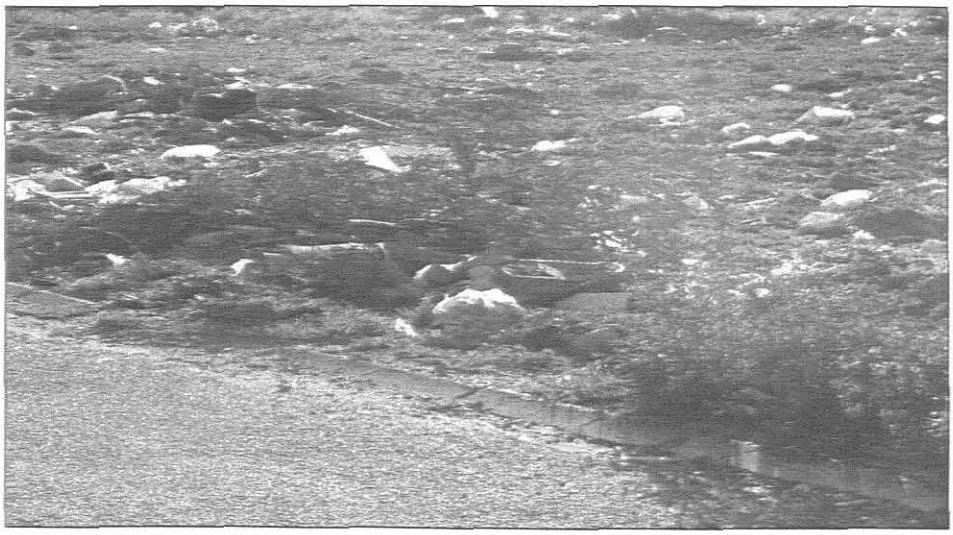
Appendix (E)

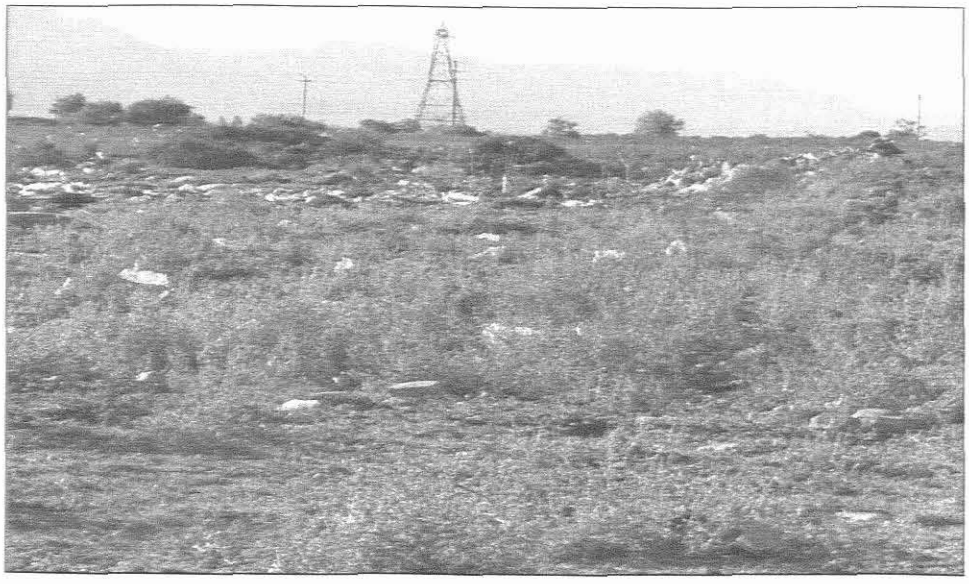
UNCONTROLLED AND ILLEGAL DUMPING

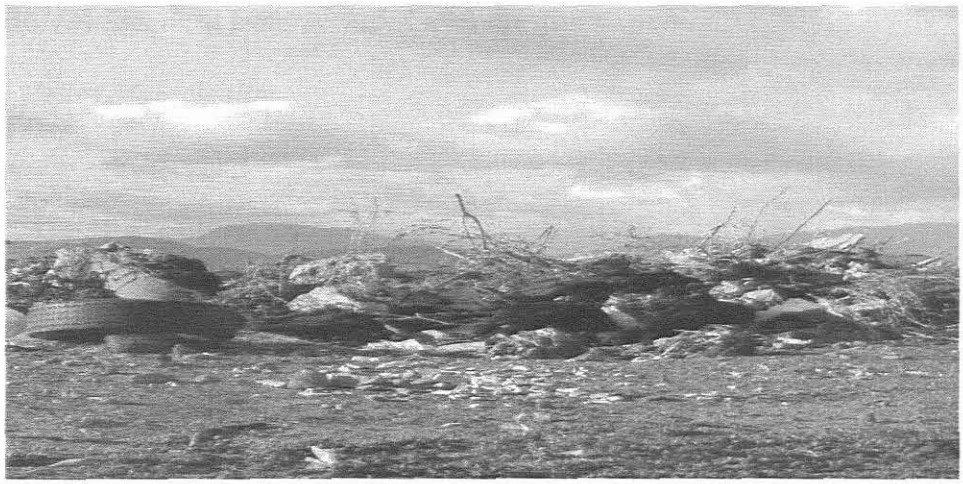












Appendix (F) Standard letter included with the questionnaire.

Breede Valley Municipality
Private Bag
Worcester
6850

Dear Sir

Questionnaire, for the development of an Integrated Waste Management system

There are several potential problems associated with waste management in the area especially illegal dumping and littering.

The Breede Valley Municipality has embarked on the formulation of an Integrated Waste Management system for the entire area.

The purpose of the questionnaire is to gather information that can help the municipality to formulate an integrated waste management system.

The information is classified and will only be used in the formulation of the integrated waste management system.

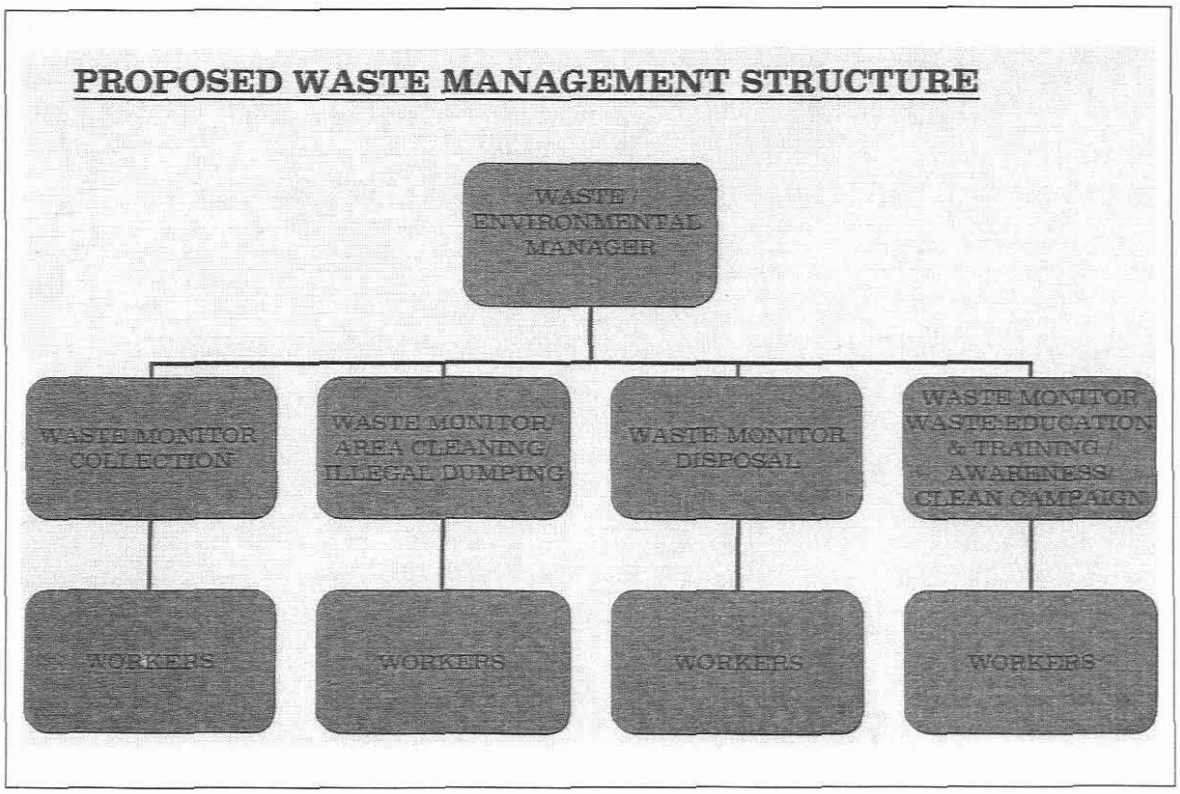
The municipality hereby thanks you for your co-operation and time to complete the questionnaire.

Yours truly

Vernon Carolus

Environmental Health Practitioner.

Appendix (G)


PROPOSED WASTE MANAGEMENT STRUCTURE
WASTE / ENVIRONMENTAL MANAGER
WASTE MONITOR COLLECTION
WASTE MONITOR/ AREA CLEANING/ ILLEGAL DUMPING
WASTE MONITOR DISPOSAL
WASTE MONITOR WASTE EDUCATION & TRAINING / AWARENESS/ CLEAN CAMPAIGN
WORKERS
WORKERS
WORKERS
WORKERS