



**Text Dr Oluwatoyin Taiwo**  
Tshwane University of Technology  
toytaiwous@yahoo.com



**Prof Fred Otieno**  
Executive Dean:  
Faculty of Engineering & the Built Environment  
Tshwane University of Technology  
otienofao@tut.ac.za



**Prof Kobus Vorster**  
Tshwane University of Technology  
kvorster@ctac.co.za



**Dr Marie Fowler**  
Tshwane University of Technology  
dr.marie.fowler@gmail.com

## ENVIRONMENTAL ENGINEERING

# Integrated solid waste management: an innovative and pragmatic approach to solving dwindling landfill capacity in Johannesburg

### INTRODUCTION

From time immemorial, human beings have always been waste generators. According to the Constitution of the Republic of South Africa (1996), everyone has a right to an environment that is not harmful to their health and wellbeing, in addition to having the environment protected, for the benefit of the present and future generations. Sustainable and integrated waste management is a preferred way of managing waste and combines a range of collection and treatment methods to handle all materials in the waste stream in an environmentally effective, economically affordable and socially acceptable way. The City of Johannesburg is densely populated, resembling a typical European city with respect to the problems it has to overcome to get rid of its waste. The question one needs to ask is, "How is Johannesburg performing in this regard?"

The primary method of disposing of municipal solid waste in Johannesburg is via landfills (see Figures 1 & 2). All solid waste, excluding medical and hazardous

waste, is accepted at general landfill sites for disposal. There are currently some initiatives in the city to reduce the waste going to landfills in response to dwindling landfill capacity. For instance, the city is focusing on diverting garden waste and also addressing public awareness and education regarding this issue.

The focus of the research undertaken in the Department of Civil Engineering of the Tshwane University of Technology (TUT) under its postgraduate research agenda is on exploring ways in which the waste stream of Johannesburg can be minimised in order to extend the lifespan of the landfill sites. In this study integrated solid waste management was used as an innovative and pragmatic approach to solving the challenges of dwindling landfill capacity.

### FOCUS AREA – JOHANNESBURG, SOUTH AFRICA

Johannesburg Metropolitan Municipality is located in Gauteng, one of the nine provinces of South Africa, and consists

of seven regions (Figure 3). Each region is operationally responsible for the delivery of health care, housing, sports and recreation facilities, libraries, social development and other local community-based services.

The expanding South African economy and rapid urbanisation have given rise to speedy population growth, exacerbated by an influx of jobseekers, often seeking shelter in informal settlements. The consequence is an increase in the volume of garbage generated annually, as a result of which the city is fast running out of landfill sites for waste disposal. Landfilling is a medium-term solution for the safe and environmentally friendly disposal of waste in Johannesburg. However, the sustainability of sending waste to landfills is both economically and environmentally challenging. At present the city adheres to the "Proximity Principle" in disposing of waste to landfill sites, but it faces the future prospect of long haul distances to dispose of waste; this would be time-consuming, more expensive, less efficient and in breach

of the Proximity Principle, and therefore alternative methods of waste disposal need to be explored now.

### TOWARDS AN INTEGRATED SOLUTION

The most effective waste management strategy is not to create waste in the first place. Once a material becomes waste, there is usually a cost attached to disposing of it – in monetary terms or regarding its impact on the environment or effort-wise. Some appropriate systems and technologies that can be applied in an integrated manner, in order to achieve diversion of waste from landfills, are summarised here.

Through “household source” separation of waste (Figure 4), waste could be transformed into useful resources, thereby extending the lifespan of the landfills. This is one of the methods of reducing costs within an integrated waste management system but it needs to be implemented gradually and in phases throughout the City of Johannesburg. In the short term, a middle-ground approach is proposed, in which people separate the waste generated in their homes into five fractions, namely paper and paper prod-

ucts, recyclables (such as plastics, glass and metals), garden waste, hazardous and e-waste, and rubbish (residual waste).

A pilot study on household separation of waste was carried out in some selected areas of Johannesburg (Taiwo, 2009). The findings from the study indicated that 82, 83 and 70% of study participants from low, middle and high-income areas respectively were willing to separate waste in future (Taiwo, 2009). This shows that there is potential for household separation of waste, which could translate into a significant reduction in the quantity of waste disposed to landfills. This would be beneficial to the homeowners because they would not have to pay Pikitup (the waste management company for Johannesburg) to dispose of the recyclable and compostable components of their waste stream and also beneficial to Pikitup because it would save on transportation costs and waste disposal.

The findings from this study can serve as a useful guide in carrying out a future statistically significant study in the City of Johannesburg. In the absence of large-scale studies, they indicate a general trend which could guide policy-makers in making tentative decisions regarding sustainable waste management.

Environmental education of citizenry and information campaigns must be an integral part of an integrated waste management response to the challenges posed by dwindling landfill space that confront the city. It is important for the success of source separation of waste that the citizens are made aware of the nature and scale of the problem confronting the city with respect to waste disposal, because waste management is usually a case of “out of sight, out of mind”. Residents need to be educated and made aware of *why* waste should be separated and then *how* to separate the waste they generate according to the components. Education programmes need to be well focused in order to bring about a change in the mindset of citizens about the way waste is treated; this change calls for waste to become wealth, refuse to become resource and trash to become cash (Taiwo, Otieno & Venter, 2008). Residents also need to take responsibility for the environment they live, play and work in.

Composting can be designed for the entire compostable portion of the waste stream (i.e. garden waste, food scraps, scrap paper and other decomposable organics), but with the exception of garden waste,

1 Municipal solid waste



other materials do not produce good compost. Compost produced from garden waste is shown in Figure 5. Pikitup is unable to achieve its target of recycling 40 000 tons of garden waste through composting per annum and processes only 12 000 tons in this time span (City of Johannesburg, 2006; Dlamini, 2006). However, the city already has the infrastructure for composting garden waste and this must be expanded rapidly as there is a ready market for compost in Johannesburg due to poor soil quality. Markets and distribution systems should be properly organised.

Home composting is an important waste management option. Environmental awareness campaigns should be carried out by Pikitup, for example, to make homeowners aware of the benefits of home composting. Pikitup should also encourage home composting in order to reduce the amount of garden waste disposed of at landfills by carrying out basic environmental education programmes to train homeowners on how to compost garden waste for use in their gardens through demonstration projects and by distributing leaflets that give directions on the composting process.

The goal of the new Waste Management Strategy for South Africa is that 95% of waste should be reused or recycled, with only 5% going to the landfills (*Creamer Media Reporter*, 2007). To achieve this, reuse and recycling need to be practised by everybody. Reusing objects and materials, either for their original purpose or for

a similar purpose, without significantly altering their physical form, prevents them from becoming waste (Taiwo *et al*, 2008). Also, recycling practices help to reduce the amount of waste that requires disposal by landfill, thereby conserving scarce landfill space and reducing the need for new landfill sites and combustors (Taiwo *et al*, 2008). If materials such as metals, paper, glass and plastics are recovered from solid waste, they become sources of valuable raw materials to industry, thereby reducing foreign imports, while excess products can be exported (Taiwo *et al*, 2008).

Appropriate infrastructure and proper planning need to be in place before the implementation of recycling programmes so as to achieve high recycling rates. In addition, markets have to be created for recyclable materials such as paper and paper products, plastics, glass and metals. In the case of builder's rubble, recycling is the best way of handling this component of the waste stream. Legislation needs to be promulgated to prohibit the disposal of builder's rubble at landfill sites.

Easily accessible waste recycling centres, such as drop-off centres, buy-back centres and garden sites, can also play an important role when implementing an integrated waste management system due to the potential they offer for job creation. These facilities enhance recycling, are capable of optimising recycling rates and are vital for the success of household separation of waste and they should be widely publicised.

Legislation needs to be enacted at national and local levels that places the responsibility for recovering and recycling used packaging on product manufacturers and distributors. The concept of producer responsibility works well in Western Europe and may also be successful in Johannesburg with proper public education and awareness campaigns and if properly implemented. Implementation means that the producer is financially responsible for recycling and disposing of the products and/or packaging supplied to the consumer. The costs of recovering, reusing, recycling or disposing could be internalised through taxes, fees and deposits. The system could be voluntary (United Kingdom) or mandatory (Germany). For the mandatory option, legal frameworks would have to be put in place; this would most likely help to divert waste from the landfills.

Furthermore, methane gas can be extracted from landfills for use as an energy source, reducing the volume of waste in landfills and providing additional airspace, which in turn extends the lifespan of the landfills.

## CONCLUSIONS

There are many possible short-term solutions to the dwindling landfill space for waste disposal in the City of Johannesburg, although not all of them are practical. They include finding new landfill sites, exporting waste outside the boundaries of the city and incinerating waste. However, each of these options is either problematic

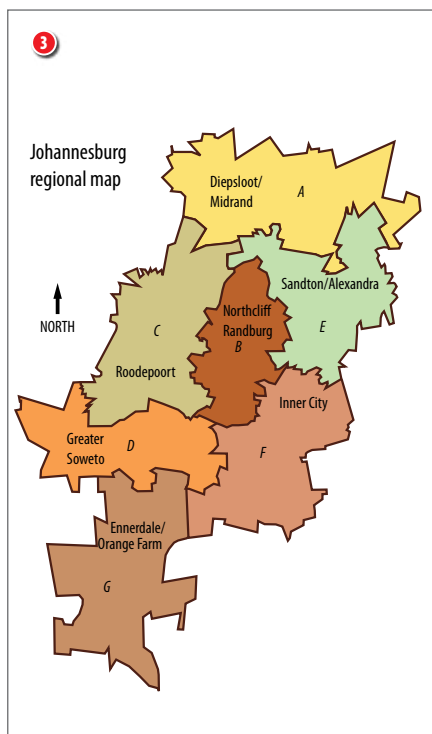


or not sustainable for reasons such as lack of space for new landfill sites, the not-in-my-backyard (NIMBY) syndrome of local communities, high transportation costs, the negative environmental impact of moving waste over long distances and the high cost of purchasing and maintaining incinerators.

The most appropriate option for the City of Johannesburg in the short term is to extend the lifespan of landfill sites by diverting most of the recyclable and compostable fraction of the waste stream. Diverted components can then be treated using an array of affordable technologies in an environmentally friendly manner that ensures they do not end up in landfills. In addition, efforts need to be intensified in the area of environmental education and environmental awareness campaigns targeted at the citizenry; if successful, these would have the effect of reducing the amount of waste generated per capita.

It is believed that an integrated approach to solving the waste management problem, if implemented correctly, could be successfully utilised in the City of Johannesburg to extend the lifespan of its landfill sites. Such a strategy could also be replicated in a number of African cities that are struggling with the challenges of managing solid waste.

- 2 Landfill site
- 3 Johannesburg's administrative regions Source: <http://www.joburg.org.za/content/view/170/50>
- 4 Separation of waste
- 5 Compost from garden waste



## REFERENCES

- City of Johannesburg 2006. Annual Report: 2005/2006 Financial Year. Johannesburg: City of Johannesburg.
- Creamer Media Reporter 2007. A sustainable approach to waste management. *Engineering News*. 13 April, 2007. Available at: [www.engineeringnews.co.za](http://www.engineeringnews.co.za) (accessed 5 January 2009).
- Dlamini, N 2006. City to cut down on landfills. Available at: [www.joburg.org.za/2006/aug/aug16\\_landfills.stm](http://www.joburg.org.za/2006/aug/aug16_landfills.stm) (accessed 16 March 2007).
- Johannesburg's Administrative Regions. Undated. Available at: [www.joburg.org.za/content/view/170/50](http://www.joburg.org.za/content/view/170/50) (accessed: 07/07/2008).
- South Africa (Republic) 1996. The Constitution of the Republic of South Africa as adopted by the Constitutional Assembly on 8 May 1996 and as amended on 11 October 1996. Pretoria: Government Printer [B34B – 96].
- Taiwo, O E 2009. Integrated solid waste management as a solution to dwindling landfill capacity in Johannesburg. Doctoral thesis, Tshwane University of Technology.
- Taiwo, O E, Otieno, F A O & Venter, C 2008. Towards attaining the Polokwane waste reduction goals – where are we? *Town and Regional Planning Journal*, 53 (November): 26–32.

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Source:

[http://www.saice.org.za/downloads/monthly\\_publications/2009/2009-Civil%20Aug/#/0](http://www.saice.org.za/downloads/monthly_publications/2009/2009-Civil%20Aug/#/0)