

Waste Characterisation and Recycling Potential in Stellenbosch

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ABSTRACT

Stellenbosch is experiencing a waste crisis as the Devon Valley Landfill Site servicing this area has reached capacity. A new landfill site has been established adjacent to the existing landfill but the compositions and quantities of waste generated in town are unknown so the life expectancy of the new landfill cannot be determined. This investigation undertook a waste characterisation and determined the recycling potential in Stellenbosch.

It was determined that 13,831 kg of recyclable waste can be extracted from the waste stream per week instead of being sent to landfill amounting to 719,212 kg per year. Presently 75% of all paper and dense plastics are recycled, 50% of plastic film and glass and 25% of all metal products and the rest sent to landfill. If these recyclables are removed from the waste stream the life expectancy of the newly built landfill site will be extended and the utilisation of recyclables will contribute toward saving of natural resources.

1. INTRODUCTION

Rapid population growth, together with new residential developments has resulted in a dramatic increase in the volume of waste being generated in Stellenbosch town and its immediate surrounds. Uncontrolled growth of informal areas, especially that of Kayamandi, impacted tremendously on the quantities of waste generated (Carolus, 2007).

Stellenbosch Municipality has been operating a waste disposal site in the Devon Valley area (Figure 1), opposite the Veldwachters River since approximately 1966 (JPCE, 2008). The existing Devon Valley Landfill Site (DVLS) currently serves the entire Stellenbosch area.

The Stellenbosch Municipality is the designated permit holder. The municipal property is partially used for waste disposal and the remainder is leased on long term agricultural leases to farmers. The DVLS facility is currently operated on the basis of a permit issued to the Stellenbosch Municipality by the Department of Water Affairs and Forestry in 1999. The facility has a G:M:B+ classification. This classification is based on the 1998 DWAF Minimum requirements for operating a landfill site where **G** refers to general waste that may be disposed of at the site. **M** states that it is a Medium sized landfill receiving >150 and <500 tonnes of waste per day. **B+** states that leachate management is required (Barbour and Van der Merwe, 2011).

The result that the rapid population growth coupled with new residential developments have had is that the portion of this municipal property that is used for waste disposal has reached its capacity. Although the DVLS has a permit to expand up to a height of 16m, the landfill has already reached a height of 22m (Cronje, 2012. Pers. Comm.). However, adjacent to the current landfill site a new, state of the art, waste site has been built which is not in operation yet.

The DVLS currently accepts all general waste, not only from Stellenbosch itself, but also waste trucked in from transfer stations located in the Franschhoek and Klipmuts areas (Barbour and Van der Merwe, 2011). Suitable waste from the public, for example garden waste, rubble and general household waste, is also accepted. When the waste reaches the landfill, no formal sorting takes place. All types of waste albeit recyclable or non-recyclable is treated the same. The waste is occasionally covered with a layer of topsoil and compacted. Waste sorting takes place on small scale by salvagers who illegally enter the waste site with ease due to a lack of access control.

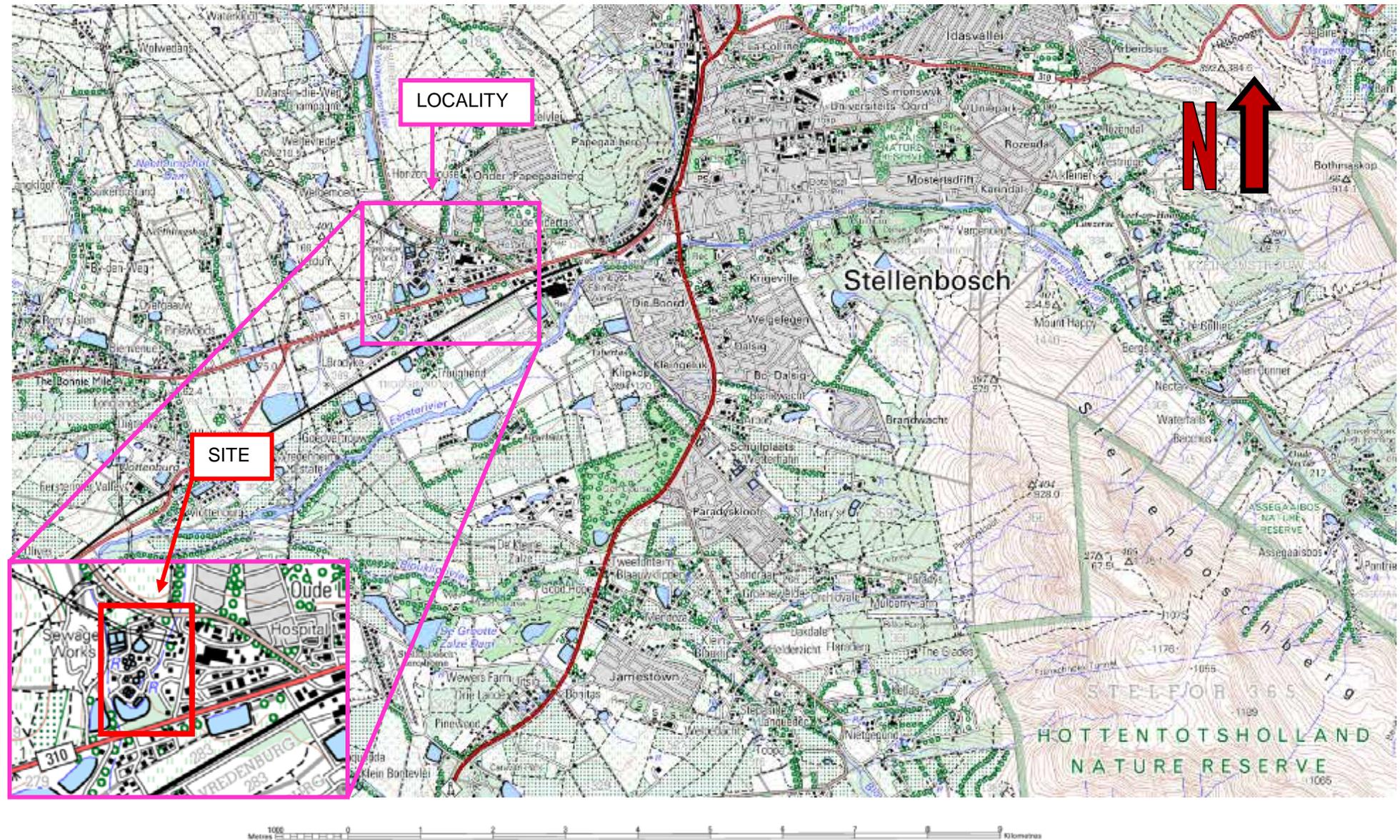


Figure 1: The location of the Devon Valley Landfill Site in relation to other landmarks.

In an effort to recycle as much as possible a sorting at source policy has been implemented in Stellenbosch since 2010 (Swilling, Sebitosi and Loots, 2012). This involves the cooperation of households whose responsibility it is to separate recyclables from non-recyclables before the household waste gets picked up by the compacter trucks. The different types of recyclables are discussed in Section 4. Items classified as non-recyclables in Stellenbosch include organics, polystyrenes and “contaminated” recyclables (items too dirty to recycle). These are placed in black bags and put into a black wheelie bin on collection day. All recyclables are placed in Municipality issued clear bags and placed outside of the black bins to be collected by a different truck and taken to Huis Horison where it is further sorted. Huis Horison is a residential and sheltered-employment centre in Stellenbosch specialising in the holistic care of people with a primary intellectual disability. This programme is currently operational in 22 collection wards

2. MOTIVATION FOR STUDY

The Devon Valley Landfill Site has reached capacity and a brand new waste disposal site has been developed adjacent to the current site at a cost of R18.3 million.

Due to a major lack of information, the Stellenbosch Municipality is unable to provide the most basic of data regarding waste generation and characterisation. This means that the Municipality has no reputable way of estimating what the life expectancy of the new landfill site is.

Sound data, which in turn feeds the management information system, is important in order to get an understanding of the financial, social and environmental viability of improving the system. It is for this reason that a waste characterisation study needs to be carried out to determine what amount and type of waste is generated and how it is influenced by seasonal variations. It will then be established what the contamination rates in the recycling bags are referring to when non-recyclable products are found in bags designated for recycling.

This in turn will inform the municipality what short, medium and long term interventions are needed to address the solid waste challenges currently faced by the municipality. High contamination rates will also be a strong indicator for greater awareness-raising and education initiatives in terms of separating the waste.

2.1. Research Question

What quantity of recyclables can be taken out of the waste stream by means of recycling in the Stellenbosch Town and immediate surrounds?

2.2. Aim of the Research

To investigate and determine what quantity of recyclables can be taken out of the waste stream by means of recycling.

2.3. Objectives of the Research

- To determine the domestic waste stream and composition of 11 wards in Stellenbosch.
- To determine the total domestic waste stream in Stellenbosch.
- To provide possible reasons for the differences in waste compositions.
- To determine which wards have the best percentage of non-contaminated recycling and which the worst.

2.4. Assumptions and limitations

Stellenbosch is divided into 22 different wards by the municipality. In order to quantify the amount of recyclables generated within households that enter the waste stream, a waste characterisation study was undertaken. Samples were collected from every one in ten houses through 11 wards in the Stellenbosch Municipal District.

The 11 wards from which samples were collected were not selected at random. They were chosen for comparative purposes as to best represent the diversity of Stellenbosch town. Formal versus informal areas and higher versus lower income groups were compared in terms of amount of waste generated, the composition of the waste stream as well as the amount of recycling that takes place.

It was assumed that the samples collected in each ward are representative of the quantity and composition of the rest of the waste that was not sampled in the same ward.

2.5. Inclusions, exclusions and delimitation of the study area

Waste generated within the Stellenbosch Municipality can be divided into the following categories:

- Domestic waste (household waste)
- Industrial and commercial waste (business waste)
- Construction waste (building rubble)
- Hazardous waste (including oxides, oils. Fluorescent tubes. paints)
- Garden waste
- Agricultural

This study will only include domestic waste. All medical, business, industrial and hazardous waste generated in this area will be excluded. The study area comprises of 11 wards within Stellenbosch. Franschhoek and Pniel, as well as Kayamandi (an informal settlement on the outskirts of Stellenbosch) will not be included in the waste characterisation study even though they fall under the Stellenbosch Municipality,

This study will focus on all of the aspects of the waste cycle up to disposal. Every step after disposal shall be excluded.

3. STUDY AREA

Stellenbosch has a typical Mediterranean climate with hot and dry summers and cold and wet winters. The weather conditions can affect waste characteristics and compositions as the seasons change. A south-easterly wind often blows in the summer bringing cooler air from the coast. Daytime temperatures in summer range between 24-35 °C. Extreme summer conditions can result in temperatures in the high to low 40 °C range.¹

Winters are typically wet with the Stellenbosch area receiving about 673 mm of rain per annum mostly during the winter. The lowest rainfall is generally recorded during February (~12 mm) and the highest during June (~113 mm). The average midday temperatures range from 16 °C in July to 26 °C in February². The coldest month is normally July with a recorded mercury reading of 7 °C on average during the night. Extreme winter conditions result in the surrounding mountains being covered with snow and temperatures below 0 °C.³

4. METHODOLOGY

This following will shed light upon the methods that were used to gather the required information.

4.1. Sampling and data collection

A waste characterisation study was undertaken in the Stellenbosch area. Stellenbosch is divided into 22 wards by the Stellenbosch Municipality. Each ward contains a different amount of households. The days of municipal waste collection ranges from Monday to Friday and each ward has an allocated day when their waste gets collected.

The Stellenbosch Municipality has been implementing a separation-at-source policy since late 2010 (Swilling, Sebitosi and Loots, 2012). Separation-at-source is supposed to be implemented in all 22 formal wards. This means that there should be black bags put out in a wheelie bin on collection day which contain non-recyclables as well as clear bags next to the bin containing only recyclables by each household.

For the purpose of this study it will not be possible to sample and sort all bags generated weekly per household (albeit black or clear) as there are not enough resources available to make this possible. It was decided that one in every ten households in 11 of the 22 wards would have one black bag and one clear bag sampled on the collection day of that specific ward.

The 11 wards that will be sampled have a collective total of 3500 households. If one in ten houses has one black bag and one clear bag collected a total of 700 bags will be sampled in theory.

¹ <http://www.stellenboschtravelguide.com/info/view/climate>

² www.sa-explorer.co.za

³ <http://www.stellenboschtravelguide.com/info/view/climate>

The areas to be serviced, number of households in each area as well as the pick-up days are shown in Table 1 below. The table further shows the amount of black and clear bags that should be collected in each area.

Table 1: Areas, day of collection and number of households per ward for municipal solid waste collection

Area	Number of households	Day of collection	Total households per day	Amount of black to be collected	Amount of clear bags to be collected
Rozendal	150	Monday	800	80	80
UniePark	150				
Simonswyk	300				
Universiteitsoord	200				
Paradyskloof	700	Tuesday	1100	110	110
Brandwag	200				
Dalsig	200				
Idas Valley	400	Wednesday	400	40	40
Cloetesville	500	Thursday	500	50	50
Jamestown	300	Friday	700	70	70
Welgevonden	400				
Total	3500		3500	350	350

The following procedure shall be followed when the representative samples are collected. Every ward shall be awarded a different colour sticker. These stickers would make it possible to identify the origins of the bag when sorting takes place.

For this sampling to be effective it is of the utmost importance that the samples are collected before the municipal compactors do their rounds that start at 07:00. Because most households already wheel their garbage out the previous night, the risk of not being able to collect enough samples is low.

Once all of the samples are collected, the trucks will transport the bags to a site in Paradyskloof to be sorted. Here, 20 unemployed workers who are registered with the Expanded Public Works Programme (EPWP) will be waiting. They will be fully equipped with Personal Protective Equipment (PPE) including gumboots, aprons, masks and gloves.

Once the bags arrive on site they are sorted into black and clear bag heaps and then also according to their location (by means of the coloured stickers).

There will be ten teams with two workers per team. Each team has the following equipment: a state of the art scale; one table for sorting; 7 plastic buckets and a clipboard with a sheet to record the data.

Once the bags are off-loaded, each team takes a bag and notes whether it is a clear or a black bag. The unopened bag is weighed and the weight recorded. Each bag is opened individually on the table and sorted into the seven buckets each representing a different category as follows:

1. Plastics (dense)
2. Plastics (light)
3. Paper
4. Metal/tin
5. Glass
6. Organics
7. Other

Categories 1-5 are seen as recyclables and 6-7 as non-recyclables. "Others" include for example used diapers, polystyrene as well as items that are too contaminated to recycle.

Upon completion of the sorting into the buckets the scale is calibrated for the weight of the bucket and each bucket is weighed and recorded. When everything has been sorted and weighed, the contents of the buckets are emptied into a clear or black bag, depending on what type of bag the contents was originally found in.



Figure 2: The photo shows how a typical black bag is sorted into seven different buckets.

5. RESULTS

The aim of this study was to determine what amount of recyclables can be taken out of the waste stream by means of recycling. Table 2 shows the weight of recyclables (in kilograms) that was thrown away in black bags to be taken to landfill instead of being recycled.

Table 2: Recyclables discarded in black bags

Ward	Paper (kg)	Glass (kg)	Dense Plastics (kg)	Plastic Film (kg)	Metal (kg)	Total per ward (kg)
Rozendal	6.06	4.62	4.90	4.76	1.58	21.92
Dalsig	21.58	16.46	7.44	9.69	3.15	58.32
Paradyskloof	35.31	29.28	14.44	17.30	4.88	101.21
Brandwacht	5.16	1.96	1.36	2.21	0.51	11.2
Idas Valley	29.40	11.40	13.74	16.76	6.60	77.9
Universiteits Oord	21.62	12.50	13.04	10.44	4.14	61.74
Jamestown	29.20	24.84	14.81	13.20	9.33	91.38
Welgevonden	27.24	15.34	12.80	15.84	6.71	77.93
Cloetesville	50.46	18.68	10.20	20.65	6.91	106.9
Uniepark & Simonswyk	28.91	24.54	15.00	9.56	5.04	83.05
Total (kg)	254.94	159.62	107.73	120.41	48.85	691.55

From Table 2 it can be determined that Cloetesville and Paradyskloof were the two wards who discarded the most recyclable products. They are however the two biggest wards where the most samples were collected so this does not necessarily reflect their recycling abilities compared to that of other wards.

A total of 254.94 kg of paper was not recycled but sent directly to landfill as a result of households not implementing separation at source. There was 159.62 kg of glass being sent to the landfill followed by 120.41 kg of light plastic. This was closely followed by 107.73 kg of dense plastics and 48.85 kg metal.

These weights totalled to 691.55 kg of recyclables that was sent to the landfill per week. However, it should be remembered that only one in 10 houses was sampled per ward.

This total can thus be multiplied by ten: **$691.55 \times 10 = 6\,915.5$ kg** recyclables left non-recycled per week throughout 11 wards in Stellenbosch.

Stellenbosch consists not only of 11 formal wards but 22. This amount could thus be doubled:
 $6915.5 \text{ kg} \times 2 = 13\,831$ kg per week.

If a calculation is to be made about what these recyclables would amount to in a year, it could be multiplied by 52: **$13\,831 \text{ kg} \times 52 = 719\,212$ kg** per year.

If 719 212 kg of waste can be removed from the waste stream by means of recycling, it would very positively extend the lifetime of the newly built capsule at the Devon Valley Landfill Site.

However, the capacity of a landfill site is not defined by how much weight it can take; the capacity is determined by the volume it is allowed. There are height specifications for the landfill site and without adequate volume data it will be hard to determine the effect that the total of one weeks waste will have on landfill capacity.

5.1. Measuring Recyclable Waste Generation

Whether discarded in black bags or clear bags, recyclable waste is being generated and discarded of weekly in each and every household in Stellenbosch.

Table 3 below shows the amount of recyclables that enter the waste stream on a weekly basis per ward (in kg). It differentiates between those discarded in black or clear bags so that it can be calculated what percentage of the total recyclables is not being recycled per category.

Table 3: Total amount of recyclables generated per week per household (* = Clear bags; ** = Black bags)

Ward	Paper (kg)		Glass (kg)		Dense Plastics (kg)		Plastic Film (kg)		Metal (kg)		Total per ward (kg)
	In cb*	In bb**	In cb	In bb	In cb	In bb	In cb	In bb	In cb	In bb	
Rozendal	41.83	6.06	24.62	4.62	5.88	4.90	6.68	4.76	1.98	1.58	102.91
Dalsig	34.26	21.58	34.64	16.46	11.09	7.44	3.82	9.69	2.62	3.15	144.75
Paradyskloof	90.83	35.31	98.5	29.28	33.32	14.44	15.7	17.30	8.32	4.88	347.88
Brandwacht	10.68	5.16	9.08	1.96	3.01	1.36	1.3	2.21	0.44	0.51	35.71
Idas Valley	45.96	29.40	12.18	11.40	13.93	13.74	9.08	16.76	5.42	6.60	164.47
Universiteits Oord	2.38	21.62	0.9	12.50	0.56	13.04	0.66	10.44	0.38	4.14	66.62
Jamestown	13.23	29.20	25.72	24.84	15.96	14.81	5.4	13.20	2.38	9.33	154.07
Welgevonden	38.38	27.24	35.68	15.34	12.86	12.80	7.14	15.84	3.32	6.71	175.31
Cloetesville	28.82	50.46	3.26	18.68	18.96	10.20	5.36	20.65	2.43	6.91	165.73
Uniepark & Simonswyk	28.91	19.98	24.54	4.2	15.00	5.55	9.56	7.04	5.04	3.53	123.35
Total (kg)	335.2	246.0	269.1	139.2	130.5	98.28	64.7	117.8	32.33	47.34	1480.8
% not recycled	26.6%		48.27%		24.69%		54.92%		68.3%		

From Table 3 it can be determined that paper and dense plastics are the two categories that are recycled the most effectively in Stellenbosch via the implementation of the separation at source policy. Although it is still a relatively high percentage, only $\pm 25\%$ of all paper and dense plastics are not recycled but sent straight to landfill where the policy is not implemented by households.

Glass and light plastics are the two categories of which only half the waste that is generated, is recycled. This is a staggering proportion and the question is asked as to why the recycling rate is so much worse than that of paper and dense plastics. Is it a case where people view paper and dense plastics as “more recyclable” than glass and light plastics?

And lastly, only 68.3% of all metal is recycled. This is almost 75% of all metal waste generated. There is clearly a public perception that metal cannot be recycled, or that it “wouldn’t make a difference whether I recycle this or not”. This clearly is not the case. Metal cans might not weigh much, but they are the least compressible of all the categories and might end up filling up the most space on a landfill.

6. CONCLUSION

This interpretation of data is invaluable for waste management in Stellenbosch and will make it possible for the municipality to design a system to more effectively manage waste in this town.

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