

# Waste Characterisation Study Knysna Municipality

## Report 2016

Prepared by:



## **EXECUTIVE SUMMARY**

A lack of information regarding waste generation types and volumes was identified as a gap in Knysna Municipality's Integrated Waste Management Plan. Therefore, Eden District Municipality, together with Knysna Municipality and the participants of the Youth Jobs in Waste Programme implemented by the National Department of Environmental Affairs conducted a waste characterisation study in March 2016.

The objective of the waste characterisation study was to provide a breakdown of the composition and quantities of household and commercial waste that is being collected from households or commercial outlets in order to ensure proper integrated waste management planning.

As recommended by the Department of Environmental Affairs and Development Planning (DEADP), the Municipal Waste Characterisation Procedures of the Environmental Protection Agency, Ireland, was used as a guideline in determining the sample size for the Waste Characterisation Study.

Recommendations by the DEADP regarding the type of venue, equipment, sampling and sorting methods and data collection were used during the characterisation study.

No.	Waste Type	Example
1	Soft Plastics	Plastic bags, plastic film.
2	Hard Plastics	Plastic bottles, containers, lids, hard plastic objects.
3	Cardboard	Office paper, newspaper, magazines, books, glossy paper.
4	Paper	Boxes, cardboard packaging.
5	Glass	Glass bottles, jars.
6	Metal	Ferrous and non-ferrous metals, cooldrink cans, tins, metal objects.
7	Food Waste	Any food, vegetable peels.
8	Garden Waste	Grass clippings, leaves, tree branches, flowers.
9	Textiles	Clothes, shoes, blankets, material.
10	Wood	Planks, manufactured wooden products.
11	Inert	Concrete, brick, sand, asphalt, stones.
12	Nappies	Disposable baby and adult nappies.
13	E-Waste	Any electrical or battery operated objects.
14	Hazardous Waste	Paints, resins, glues, fluorescent tubes, batteries, pesticides, asbestos.
15	Rest	All waste that cannot be sorted into abovementioned categories e.g. hair, dust.

It was decided that the waste would be categorised / sorted into fifteen (15) different waste types namely:

When applying the total number of households (23 097) to the graph in Appendix B of the Municipal Waste Characterisation Procedures, EPA, Ireland, it was determined that a sample size of 720 would be adequate in order to ensure a representative sample.

The number of samples per sub area was then calculated relative to the percentage of the total number of households.

A total number of 638 bags was sampled by Knysna Municipality with a total mass of 2 565,59 kg (2,56 tons) and a compacted volume of 10,877  $m^3$  as indicated in Table 3.36 below.

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
		Mass (%)	(m³)
Soft Plastics	204,13	7,96	1,309
Hard Plastics	211,66	8,25	2,940
Paper	190,05	7,41	0,834
Cardboard	200,52	7,82	1,542
Glass	162,00	6,31	0,394
Metal	104,01	4,05	0,325
Food Waste	644,96	25,14	0,627
Garden	78,70	3,07	0,177
Textiles	121,16	4,72	0,415
Wood	21,55	0,84	0,138
Inert	22,15	0,86	0,021
Nappies	245,55	9,57	1,082
E-Waste	7,65	0,30	0,064
Hazardous	15,85	0,62	0,046
Rest	335,65	13,08	0,965
Total	2565,59	100,00	10,877

Table 3.36: Results for Knysna Municipality (638 samples)

41% of the waste types that were sampled by mass were recyclable materials: Soft Plastics (8%), Hard Plastics (8%), Cardboard (8%), Paper (7%), Glass (6%) and Metal (4%). However, by volume, 68% of the waste types that were sampled were recyclable materials: Hard Plastics (27%), Cardboard (14%), Soft Plastics (12%), Paper (8%), Glass (4%) and Metal (3%).

The results obtained from the different sub areas within Knysna Municipality illustrated different trends in waste generation. These trends will be significant in identifying and prioritising the type of waste minimisation and management initiatives to be implemented in the various sub-areas. E.g. Home composting initiatives should be implemented in the sub areas where Garden Waste was the prominent component of the waste sampled.

The prediction of uniformity and consistency of waste type occurrence is complex due to the heterogeneous nature and variability of waste. Therefore it is not likely to determine accurate projections of the likelihood of the occurrence of particular waste types in a waste stream.

It is assumed that the recyclable portion (soft plastic, hard plastic, paper, cardboard, glass and metal) comprises of 41% of the total waste landfilled at PetroSA landfill site on a monthly basis. This amounts to a total of approximately 533,37 tons and 3652,81 m<sup>3</sup> of recyclable materials that could potentially be diverted from landfill and could result in a significant transport and disposal cost saving.

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## **1. INTRODUCTION**

Waste stream analysis can be defined as any programme which involves a logical and systematic approach to obtain and analyzing data on one or more waste streams or sub-streams. The analysis also provides an estimate of solid waste quantity and composition, referred to as waste characterisation.

A lack of information regarding waste generation types and volumes was identified as a gap in Knysna Municipality's Integrated Waste Management Plan. Therefore, a waste characterisation study was conducted in order to determine the types and quantities of waste that is being generated in Knysna. The analysis is essential to ensure proper planning in terms of collection, handling, minimisation and disposal of the generated waste.

Eden District Municipality, together with Knysna Municipality and the participants of the Youth Jobs in Waste Programme implemented by the National Department of Environmental Affairs conducted a waste characterisation study from 14 - 18 March 2016.

The objective of the waste characterisation study was to provide a breakdown of the composition and quantities of household and commercial waste that is being collected from households and commercial outlets in order to ensure proper integrated waste management planning.

This study was also conducted to determine the quantity of recyclable material that still remains in the waste stream transported to landfill. Any recyclable materials already recovered through the existing at source recycling programme implemented by Knysna Municipality will not form part of this study.

The quantity of recyclable material recovered by the recycling service provider appointed by Knysna Municipality is being reported on a monthly basis.

The characterisation study provided the following information:

- The average mass and volume of waste per waste type per household;
- The average mass and volume of waste per waste type per household per socio-economic region;
- The average mass and volume of waste per waste type per business;
- The percentage by mass of each major category in the waste stream;
- The percentage by volume of each major category in the waste stream

A sample of a total of 638 bags were collected and sorted into the 15 different major waste types. The number of samples per sub area was determined by the number of households relative to the total number of households in Knysna Municipality.

## 2. METHODOLOGY

#### 2.1 GENERAL APPROACH

As recommended by the Department of Environmental Affairs and Development Planning (DEADP), the Municipal Waste Characterisation Procedures of the Environmental Protection Agency, Ireland, was used as a guideline in determining the sample size for Waste Characterisation Study.

Recommendations by the DEADP regarding the type of venue, equipment, sampling and sorting methods and data collection were used during the characterisation study.

#### 2.2 TRAINING

On 11 March 2016 a training session conducted by Eden District Municipality took place at the Brenton Community Hall. A practical training session was conducted with the Youth Jobs in Waste participants where they were trained in the sorting method, waste types, weighing, volume determination and data collection. Training in the proper use of Personal Protective Equipment, potential hazards and procedures were also discussed at this training session.

No.	Waste Type	Example
1	Soft Plastics	Plastic bags, plastic film.
2	Hard Plastics	Plastic bottles, containers, lids, hard plastic objects.
3	Cardboard	Office paper, newspaper, magazines, books, glossy paper.
4	Paper	Boxes, cardboard packaging.
5	Glass	Glass bottles, jars.
6	Metal	Cooldrink cans, tins, metal objects.
7	Food Waste	Any food, vegetable peels.
8	Garden Waste	Grass clippings, leaves, tree branches, flowers.
9	Textiles	Clothes, shoes, blankets, material.
10	Wood	Planks, manufactured wooden products.
11	Rest	Concrete, brick, sand, asphalt, stones.
12	Nappies	Disposable baby and adult nappies.
13	E-Waste	Any electrical or battery operated objects.
14	Hazardous Waste	Paints, resins, glues, fluorescent tubes, batteries, pesticides, asbestos.
15	Inert	All waste that cannot be sorted into abovementioned categories e.g. hair, dust.

The waste is categorised / sorted into fifteen (15) different waste types namely:



Figure 2.1: Training in data collection

#### 2.3 SAMPLE SIZE & PLANNING

#### 2.3.1 REPRESENTATIVE SAMPLE

The estimated total number of households of 2016 as obtained from Knysna Municipality's Integrated Waste Management Plan was used to determine a representative sample by using the graph in Appendix B of the Municipal Waste Characterisation Procedures, EPA, Ireland.

When applying the total number of households (23 097) to the graph mentioned above, it was determined that a sample size of approximately 720 would be adequate in order to ensure a representative sample.

The identified households from which the samples were to be obtained were not informed regarding the study in order to prevent any bias that may result by a temporary change in habits.



Figure 2.2: Graph determining sample size relative to no. of households

The number of samples per sub area was then calculated relative to the percentage of the total number of households (Table 2.3)

Sub Area	No. of Households (23 097)	Percentage of Sample (%)	Sample Size (720)
Karatara Forest Station	80	0,3	3
Karatara SP	194	0,8	6
Knysna NU	1217	5,3	38
Rheenendal SP	967	4,2	30
Swartvlei SP	7	0,0	0
Phantom Pass SP	16	0,1	1
Montmere SP	26	0,1	1
Sedgefield SP	1113	4,8	35
Meedigsride	428	1,9	13
Sedgehill	273	1,2	9
Smutsville	1429	6,2	45
Cola Beach	48	0,2	2
Myoli Beach SP	10	0,0	0
Simola Golf & Country Estate	16	0,1	1
Concordia State Forest	26	0,1	1
Eastford	368	1,6	12
Knysna Heights	130	0,6	4
Mount Joy	64	0,3	2
Heuwelkruin	64	0,3	2
Paradise	216	0,9	7
Westhill	83	0,4	3
Knysna Central	935	4,0	29
Flenters	555	2,4	17
Rhobololo	793	3,4	25
Concordia	1334	5,8	42
Joodse Kamp	793	3,4	25
Xolweni	688	3,0	21
Witlokasie	1154	5,0	36
Milkwood Forest Reserve	4	0,0	0
Bongani	641	2,8	20
Umsobomvu	745	3,2	23
Dam se Bos	1366	5,9	43
Nekkies	1328	5,7	41
Knoetzie	241	1,0	8
Hornlee	1737	7,5	54
Knysna Industrial	83	0,4	3
Old Place	450	1,9	14
Rexford	308	1,3	10
Fishers Haven	58	0,3	2
Knysna SP2	4	0,0	0

Sunridge	1249	5,4	39
Nirvana	23	0,1	1
Knysna SP1	54	0,2	2
Kanonkop	26	0,1	1
Belvidere Estate	238	1,0	7
Thesens Island	276	1,2	9
Brenton	96	0,4	3
Brenton on Sea	159	0,7	5
Hunters Home	390	1,7	12
Sparrebosch Clifftop Estate	96	0,4	3
Pezula Private Reserve	32	0,1	1
Leisure Isle	305	1,3	10
The Heads	134	0,6	4
Goukamma Nature Reserve SP	7	0,0	0
Buffelsbaai	20	0,1	1
Total	23 097	100	726

Table 2.3: Sample size determination per sub area

A planning session was held on 22 February 2016 together with Eden District Municipality and Knysna Municipality. Maps of each sub area were provided, and specific households were identified from which to sample. These identified households were evenly distributed in order to ensure a representative sample of that specific sub area.

The local knowledge of the Knysna Municipality officials were relied upon in order to identify businesses in each sub area which was included in the sample size of that specific sub area.

It was decided that should no bags be available for sampling from the specified household, that a sample be taken from a household in the near proximity of the specified household.

#### 2.3.2 LABELLING OF SAMPLES

In order to identify the sub area from which the sample was taken as well as to ensure the capturing of other relevant information, it was essential that the samples were properly labelled when collected. The following details were recorded on the labels when collection took place:

- Sub area from which sample was taken
- Date on which sample was taken
- The address from which the sample was taken
- Household or Business
- Total number of bags from which the sample was taken e.g. 1 of 3

#### 2.3.3 SAMPLING PLAN

Knysna Municipality was responsible for the sampling of bags. A sampling team collected and labelled the samples from the identified households prior to the waste collection on that specific day of the week. The samples were then stored in the secure storage area prior to sorting. Samples were taken the day before the intended sorting in order to ensure that the Youth Jobs in Waste participants could commence with the sorting at the start of the working day.

#### 2.4 VENUE & EQUIPMENT

#### 2.4.1 VENUE

Knysna Municipality was responsible for acquiring a venue with the following requirements:

- Under cover
- Ablution facilities
- Running water
- Electricity
- Proper ventilation
- Secure / no unauthorized access

The venue which was acquired was the Brenton Community Hall.



Figure 2.4: Layout of the venue at the Brenton Community Hall

#### 2.4.2 EQUIPMENT

The following equipment was required in order to conduct the Characterisation Study, which was purchased and provided by Eden District Municipality:

- 4 x 150kg electronic platform scales
- 80 x 46cm plastic basins
- 6 x yard brooms
- 20 x vapour & organic respirator masks incl. replacement filters
- Plastic aprons
- Safety glasses
- Red PVC gloves
- Surface disinfectant
- Hand sanitizer
- Cleaning Rags
- Disposable towels with stands
- Data sheets

- Stationery
- Labels
- Permanent markers and pens

Knysna Municipality was responsible for the provision of the sorting tables, recycling and refuse bags as well as a hosepipe for the cleaning of the sorting basins during and after each working day.

#### 2.5 CHARACTERISATION, WEIGHING & DATA COLLECTION

The samples were stored per sub area in order to ensure that the data collection was done per sub area which eases the analysis of the data and ensures that the analysis is done per sub area.



Figure 2.5: Samples stored per sub area

#### 2.5.1 STEP 1:

The unopened black bag (sample) was weighed and the mass and the particulars of the label recorded on the data sheets.

#### 2.5.2 STEP 2:

The contents of the sample was then categorised into the fifteen different waste types using the 46cm plastic basins.



Figure 2.6: Waste being sorted into different waste types

#### 2.5.3 STEP 3:

Each categorised waste type was then weighed individually. The Scales were tarred before weighing and therefore only the contents of the basin were recorded. The mass each waste type from that specific sample was recorded. The individual masses of the waste types should add up to the total mass of the unopened bag.

#### 2.5.4 STEP 4:

All the recyclable waste types / materials were placed into recycling bags (clear) and the non-recyclable waste was placed into black bags. It was decided to recover all the recyclable materials during the study. The recovered recyclable materials was transported to the recycling depot at the end of each working day.

#### **2.5.5 DATA CAPTURING**

Eden District Municipality was responsible for the data capturing of the raw data to an electronic format in order to simplify the data analysis.

#### **2.6 VOLUME DETERMINATION**

It was recommended by DEADP to determine the volume of waste by estimating the volume percentage occupied by the sorted waste types per basin. However, each waste type occupies a different volume when compacted which is determined by the density of each waste type. The volume was therefore determined by obtaining the general compacted densities of each waste type and converting the mass to volume in cubic metres (m<sup>3</sup>).

It is imperative to determine the volume of the waste as this determines the lifespan of a landfill site as well as transport costs as the waste is compacted and then transported to the landfill site. The general compacted densities were sourced from the Environmental Protection Authority, Victoria, Australia.

The general compacted densities of the different waste types are indicated in Table 2.10 below.

Waste Type	Density (Compacted)
Soft Plastics	156 kg/m³
Hard Plastics	72 kg/m³
Paper	228 kg/m³
Cardboard	130 kg/m³
Glass	411 kg/m³
Metal	320 kg/m³
Food Waste	1029 kg/m³
Garden	445 kg/m³
Textiles	292 kg/m³
Wood	156 kg/m³
Inert	1060 kg/m³
Nappies	227 kg/m³
E-Waste	120 kg/m³
Hazardous	348 kg/m³
Rest	348 kg/m³

Table 2.7 General densities of the various compacted waste types

## **3. RESULTS**

#### **3.1 RESULTS PER SUB AREA**

#### 3.1.1 EAST FORD DOWNS (12 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	3.50	7.80	0.022
Hard Plastics	5.05	11.26	0.070
Paper	2.95	6.58	0.013
Cardboard	3.05	6.80	0.023
Glass	4.05	9.03	0.010
Metal	2.75	6.13	0.009
Food Waste	16.15	36.01	0.016
Garden	0.55	1.23	0.001
Textiles	0.75	1.67	0.003
Wood	0.05	0.11	0.000
Inert	0.00	0.00	0.000
Nappies	0.25	0.56	0.001
E-Waste	0.00	0.00	0.000
Hazardous	0.15	0.33	0.000
Rest	5.60	12.49	0.016
Total	44.85	100.00	0.185

Table 3.1: Results for East Ford Downs (12 samples)





#### 3.1.2 SEDGEFIELD (27 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	8.05	6.65	0.052
Hard Plastics	6.90	5.70	0.096
Paper	8.10	6.69	0.036
Cardboard	6.65	5.49	0.051
Glass	11.35	9.37	0.028
Metal	2.55	2.11	0.008
Food Waste	43.95	36.29	0.043
Garden	1.35	1.11	0.003
Textiles	0.45	0.37	0.002
Wood	0.95	0.78	0.006
Inert	1.45	1.20	0.001
Nappies	2.75	2.27	0.012
E-Waste	0.40	0.33	0.003
Hazardous	5.30	4.38	0.015
Rest	20.90	17.26	0.060
Total	121.10	100.00	0.415

Table 3.2: Results for Sedgefield (27 samples)





#### 3.1.3 CONCORDIA (83 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	39.65	10.88	0.254
Hard Plastics	33.05	9.07	0.459
Paper	29.60	8.12	0.130
Cardboard	30.60	8.40	0.235
Glass	17.25	4.73	0.042
Metal	14.35	3.94	0.045
Food Waste	75.15	20.62	0.073
Garden	14.65	4.02	0.033
Textiles	13.45	3.69	0.046
Wood	0.85	0.23	0.005
Inert	1.30	0.36	0.001
Nappies	64.45	17.68	0.284
E-Waste	0.25	0.07	0.002
Hazardous	0.45	0.12	0.001
Rest	29.40	8.07	0.084
Total	364.45	100.00	1.696

Table 3.3: Results for Concordia (83 samples)





#### **3.1.4 FLENTERS LOCATION (17 SAMPLES)**

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	8.50	11.26	0.054
Hard Plastics	6.65	8.81	0.092
Paper	9.45	12.52	0.041
Cardboard	5.95	7.88	0.046
Glass	3.60	4.77	0.009
Metal	1.75	2.32	0.005
Food Waste	14.20	18.81	0.014
Garden	0.05	0.07	0.000
Textiles	5.20	6.89	0.018
Wood	0.10	0.13	0.001
Inert	0.00	0.00	0.000
Nappies	13.25	17.55	0.058
E-Waste	0.00	0.00	0.000
Hazardous	0.25	0.33	0.001
Rest	6.55	8.68	0.019
Total	75.50	100.00	0.359

Table 3.4: Results for Flenters Location (17 samples)





#### 3.1.5 PARADISE (15 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	2.90	6.26	0.019
Hard Plastics	3.45	7.44	0.048
Paper	1.85	3.99	0.008
Cardboard	3.45	7.44	0.027
Glass	9.85	21.25	0.024
Metal	2.65	5.72	0.008
Food Waste	16.35	35.28	0.016
Garden	0.55	1.19	0.001
Textiles	1.05	2.27	0.004
Wood	0.00	0.00	0.000
Inert	0.25	0.54	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	4.00	8.63	0.011
Total	46.35	100.00	0.166

Table 3.5: Results for Paradise (15 samples)





#### 3.1.6 GROENVLEI (6 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1.30	5.25	0.008
Hard Plastics	2.25	9.09	0.031
Paper	1.50	6.06	0.007
Cardboard	1.95	7.88	0.015
Glass	0.15	0.61	0.000
Metal	0.40	1.62	0.001
Food Waste	10.80	43.64	0.010
Garden	0.45	1.82	0.001
Textiles	0.40	1.62	0.001
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.55	2.22	0.002
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	5.00	20.20	0.014
Total	24.75	100.00	0.092

Table 3.6: Results for Groenvlei (6 samples)





#### 3.1.7 MEEDIGSRIDE (20 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	4.60	7.22	0.029
Hard Plastics	4.75	7.46	0.066
Paper	6.25	9.81	0.027
Cardboard	6.00	9.42	0.046
Glass	4.10	6.44	0.010
Metal	5.75	9.03	0.018
Food Waste	18.45	28.96	0.018
Garden	0.20	0.31	0.000
Textiles	4.60	7.22	0.016
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	2.15	3.38	0.018
Hazardous	0.00	0.00	0.000
Rest	6.85	10.75	0.020
Total	63.70	100.00	0.269

Table 3.7: Results for Meedigsride (20 samples)





#### **3.1.8 BELVEDERE ESTATE (7 SAMPLES)**

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	2.65	7.54	0.017
Hard Plastics	2.40	6.83	0.033
Paper	3.70	10.53	0.016
Cardboard	1.50	4.27	0.012
Glass	1.55	4.41	0.004
Metal	0.50	1.42	0.002
Food Waste	14.50	41.25	0.014
Garden	2.00	5.69	0.004
Textiles	0.55	1.56	0.002
Wood	0.00	0.00	0.000
Inert	0.10	0.28	0.000
Nappies	0.05	0.14	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.25	0.71	0.001
Rest	5.40	15.36	0.016
Total	35.15	100.00	0.120

Table 3.8: Results for Belvedere Estate (7 samples)





#### 3.1.9 BRENTON (8 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	<b>Calculated Volume</b>
Soft Plastics	2.65	6.58	0.017
Hard Plastics	1.55	3.85	0.022
Paper	6.30	15.65	0.028
Cardboard	3.60	8.94	0.028
Glass	8.95	22.24	0.022
Metal	0.95	2.36	0.003
Food Waste	9.60	23.85	0.009
Garden	0.25	0.62	0.001
Textiles	0.35	0.87	0.001
Wood	0.05	0.12	0.000
Inert	1.45	3.60	0.001
Nappies	0.40	0.99	0.002
E-Waste	0.10	0.25	0.001
Hazardous	0.10	0.25	0.000
Rest	3.95	9.81	0.011
Total	40.25	100.00	0.146

Table 3.9: Results for Brenton (8 samples)





#### 3.1.10 OUPLAAS (15 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	6.05	10.19	0.039
Hard Plastics	4.21	7.09	0.058
Paper	4.70	7.92	0.021
Cardboard	8.95	15.08	0.069
Glass	2.85	4.80	0.007
Metal	2.70	4.55	0.008
Food Waste	16.40	27.63	0.016
Garden	0.55	0.93	0.001
Textiles	3.10	5.22	0.011
Wood	0.60	1.01	0.004
Inert	0.35	0.59	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.05	0.08	0.000
Hazardous	0.10	0.17	0.000
Rest	8.75	14.74	0.025
Total	59.36	100.00	0.260

Table 3.10: Results for Ouplaas (15 samples)





#### 3.1.11 HORNLEE (61 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	19.30	7.00	0.124
Hard Plastics	20.35	7.38	0.283
Paper	30.50	11.06	0.134
Cardboard	21.07	7.64	0.162
Glass	16.05	5.82	0.039
Metal	6.31	2.29	0.020
Food Waste	60.36	21.89	0.059
Garden	23.35	8.47	0.052
Textiles	12.45	4.52	0.043
Wood	0.85	0.31	0.005
Inert	8.05	2.92	0.008
Nappies	13.05	4.73	0.057
E-Waste	0.10	0.04	0.001
Hazardous	2.20	0.80	0.006
Rest	41.70	15.13	0.120
Total	275.69	100.00	1.112

Table 3.11: Results for Hornlee (61 samples)





#### 3.1.12 THE HEADS (4 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1,50	8,20	0,010
Hard Plastics	1,15	6,28	0,016
Paper	0,55	3,01	0,002
Cardboard	0,75	4,10	0,006
Glass	0,80	4,37	0,002
Metal	0,25	1,37	0,001
Food Waste	8,55	46,72	0,008
Garden	0,10	0,55	0,000
Textiles	0,10	0,55	0,000
Wood	1,70	9,29	0,011
Inert	0,00	0,00	0,000
Nappies	0,00	0,00	0,000
E-Waste	0,00	0,00	0,000
Hazardous	1,80	9,84	0,005
Rest	1,05	5,74	0,003
Total	18,30	100,00	0,064

Table 3.12: Results for The Heads (4 samples)





#### 3.1.13 KHAYALETHU (16 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	7.10	12.26	0.046
Hard Plastics	7.20	12.44	0.100
Paper	2.20	3.80	0.010
Cardboard	6.85	11.83	0.053
Glass	2.25	3.89	0.005
Metal	2.95	5.09	0.009
Food Waste	19.45	33.59	0.019
Garden	0.00	0.00	0.000
Textiles	1.20	2.07	0.004
Wood	0.15	0.26	0.001
Inert	0.00	0.00	0.000
Nappies	3.35	5.79	0.015
E-Waste	0.00	0.00	0.000
Hazardous	0.10	0.17	0.000
Rest	5.10	8.81	0.015
Total	57.90	100.00	0.276

Table 3.13: Results for Khayalethu (16 samples)





#### 3.1.14 KARATARA (9 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	2.70	9.49	0.017
Hard Plastics	4.30	15.11	0.060
Paper	3.75	13.18	0.016
Cardboard	2.70	9.49	0.021
Glass	3.35	11.78	0.008
Metal	1.30	4.57	0.004
Food Waste	6.35	22.32	0.006
Garden	0.40	1.41	0.001
Textiles	0.60	2.11	0.002
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.20	0.70	0.001
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	2.80	9.84	0.008
Total	28.45	100.00	0.145

Table 3.14: Results for Karatara (9 samples)





#### 3.1.15 SEDGE ISLAND (14 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	3.95	7.03	0.025
Hard Plastics	2.50	4.45	0.035
Paper	1.20	2.14	0.005
Cardboard	1.20	2.14	0.009
Glass	0.65	1.16	0.002
Metal	1.00	1.78	0.003
Food Waste	23.70	42.21	0.023
Garden	0.00	0.00	0.000
Textiles	2.20	3.92	0.008
Wood	0.95	1.69	0.006
Inert	0.00	0.00	0.000
Nappies	2.00	3.56	0.009
E-Waste	0.05	0.09	0.000
Hazardous	0.00	0.00	0.000
Rest	16.75	29.83	0.048
Total	56.15	100.00	0.173

Table 3.15: Results for Sedge Island (14 samples)





#### 3.1.16 REXFORD (10 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1.40	4.67	0.009
Hard Plastics	1.20	4.01	0.017
Paper	3.15	10.52	0.014
Cardboard	1.60	5.34	0.012
Glass	3.35	11.19	0.008
Metal	0.65	2.17	0.002
Food Waste	9.05	30.22	0.009
Garden	0.75	2.50	0.002
Textiles	1.15	3.84	0.004
Wood	0.00	0.00	0.000
Inert	1.05	3.51	0.001
Nappies	0.50	1.67	0.002
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	6.10	20.37	0.018
Total	29.95	100.00	0.097

Table 3.16: Results for Rexford (10 samples)





#### 3.1.17 HUNTERS HOME (8 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1,20	4,85	0,008
Hard Plastics	1,60	6,46	0,022
Paper	2,15	8,69	0,009
Cardboard	2,35	9,49	0,018
Glass	3,35	13,54	0,008
Metal	0,95	3,84	0,003
Food Waste	10,50	42,42	0,010
Garden	0,00	0,00	0,000
Textiles	0,00	0,00	0,000
Wood	0,20	0,81	0,001
Inert	0,40	1,62	0,000
Nappies	0,10	0,40	0,000
E-Waste	0,00	0,00	0,000
Hazardous	0,00	0,00	0,000
Rest	1,95	7,88	0,006
Total	24,75	100,00	0,086

Table 3.17: Results for Hunters Home (8 samples)





#### 3.1.18 KNYSNA ONDER DORP (23 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	2.40	3.62	0.015
Hard Plastics	3.75	5.65	0.052
Paper	4.40	6.63	0.019
Cardboard	7.25	10.93	0.056
Glass	7.15	10.78	0.017
Metal	0.55	0.83	0.002
Food Waste	30.65	46.19	0.030
Garden	1.70	2.56	0.004
Textiles	0.30	0.45	0.001
Wood	0.40	0.60	0.003
Inert	0.00	0.00	0.000
Nappies	4.80	7.23	0.021
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	3.00	4.52	0.009
Total	66.35	100.00	0.229

Table 3.18: Results for Knysna Onder Dorp (23 samples)





#### 3.1.19 THESEN ISLAND (8 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1.80	5.92	0.012
Hard Plastics	3.30	10.86	0.046
Paper	1.55	5.10	0.007
Cardboard	2.10	6.91	0.016
Glass	3.45	11.35	0.008
Metal	0.85	2.80	0.003
Food Waste	12.65	41.61	0.012
Garden	0.65	2.14	0.001
Textiles	0.00	0.00	0.000
Wood	0.00	0.00	0.000
Inert	1.25	4.11	0.001
Nappies	0.00	0.00	0.000
E-Waste	0.20	0.66	0.002
Hazardous	0.00	0.00	0.000
Rest	2.60	8.55	0.007
Total	30.40	100.00	0.012

Table 3.19: Results for Thesen Island (8 samples)





#### 3.1.20 SMUTSVILLE (45 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	15.95	8.14	0.102
Hard Plastics	25.20	12.86	0.350
Paper	10.95	5.59	0.048
Cardboard	12.50	6.38	0.096
Glass	6.40	3.27	0.016
Metal	8.65	4.41	0.027
Food Waste	40.10	20.46	0.039
Garden	4.20	2.14	0.009
Textiles	13.20	6.74	0.045
Wood	0.50	0.26	0.003
Inert	0.75	0.38	0.001
Nappies	27.20	13.88	0.120
E-Waste	1.30	0.66	0.011
Hazardous	1.25	0.64	0.004
Rest	27.80	14.19	0.080
Total	195.95	100.00	0.951

Table 3.20: Results for Smutsville (45 samples)





#### 3.1.21 PEZULA (1 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	0.05	2.27	0.000
Hard Plastics	0.30	13.64	0.004
Paper	0.30	13.64	0.001
Cardboard	0.25	11.36	0.002
Glass	0.55	25.00	0.001
Metal	0.20	9.09	0.001
Food Waste	0.00	0.00	0.000
Garden	0.00	0.00	0.000
Textiles	0.00	0.00	0.000
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	0.55	25.00	0.002
Total	2.20	100.00	0.011

Table 3.21: Results for Pezula (1 samples)





#### 3.1.22 SPARREBOSCH (2 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	0.40	12.31	0.003
Hard Plastics	1.05	32.31	0.015
Paper	0.05	1.54	0.000
Cardboard	0.00	0.00	0.000
Glass	0.00	0.00	0.000
Metal	0.05	1.54	0.000
Food Waste	0.85	26.15	0.001
Garden	0.00	0.00	0.000
Textiles	0.35	10.77	0.001
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	0.50	15.38	0.001
Total	3.25	100.00	0.021

Table 3.22: Results for Sparrebosch (2 samples)





#### 3.1.23 JOODSE KAMP (32 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	14.20	11.62	0.091
Hard Plastics	11.50	9.41	0.160
Paper	6.85	5.60	0.030
Cardboard	9.85	8.06	0.076
Glass	2.40	1.96	0.006
Metal	1.85	1.51	0.006
Food Waste	8.05	6.58	0.008
Garden	7.95	6.50	0.018
Textiles	8.20	6.71	0.028
Wood	0.30	0.25	0.002
Inert	0.00	0.00	0.000
Nappies	33.85	27.69	0.149
E-Waste	1.05	0.86	0.009
Hazardous	0.00	0.00	0.000
Rest	16.20	13.25	0.047
Total	122.25	100.00	0.628

Table 3.23: Results for Joodse Kamp (32 samples)





#### 3.1.24 RHEENENDAL (31 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	7.45	5.78	0.048
Hard Plastics	8.95	6.94	0.124
Paper	4.75	3.68	0.021
Cardboard	12.35	9.57	0.095
Glass	3.75	2.91	0.009
Metal	5.10	3.95	0.016
Food Waste	39.20	30.39	0.038
Garden	5.90	4.57	0.013
Textiles	12.00	9.30	0.041
Wood	0.05	0.04	0.000
Inert	0.20	0.16	0.000
Nappies	11.75	9.11	0.052
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	17.55	13.60	0.050
Total	129.00	100.00	0.508

Table 3.24: Results for Rheenendal (31 samples)





#### 3.1.25 NIRVANA (4 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	0.20	1.79	0.001
Hard Plastics	1.25	11.21	0.017
Paper	0.75	6.73	0.003
Cardboard	0.60	5.38	0.005
Glass	0.00	0.00	0.000
Metal	0.10	0.90	0.000
Food Waste	0.20	1.79	0.000
Garden	0.25	2.24	0.001
Textiles	0.20	1.79	0.001
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	7.60	68.16	0.022
Total	11.15	100.00	0.050

Table 3.25: Results for Nirvana (4 samples)





#### 3.1.26 KNYSNA CENTRAL (13 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1.40	3.31	0.009
Hard Plastics	3.90	9.23	0.054
Paper	2.40	5.68	0.011
Cardboard	3.30	7.81	0.025
Glass	7.00	16.57	0.017
Metal	2.20	5.21	0.007
Food Waste	9.75	23.08	0.009
Garden	0.70	1.66	0.002
Textiles	0.40	0.95	0.001
Wood	1.80	4.26	0.012
Inert	3.35	7.93	0.003
Nappies	0.00	0.00	0.000
E-Waste	1.10	2.60	0.009
Hazardous	2.35	5.56	0.007
Rest	2.60	6.15	0.007
Total	42.25	100.00	0.173

Table 3.26: Results for Knysna Central (13 samples)





#### 3.1.27 DAM SE BOS (42 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	10.05	5.38	0.064
Hard Plastics	10.45	5.59	0.145
Paper	12.55	6.71	0.055
Cardboard	11.25	6.02	0.087
Glass	21.40	11.45	0.052
Metal	14.25	7.62	0.045
Food Waste	53.70	28.73	0.052
Garden	7.05	3.77	0.016
Textiles	9.35	5.00	0.032
Wood	0.40	0.21	0.003
Inert	1.30	0.70	0.001
Nappies	17.15	9.18	0.076
E-Waste	0.05	0.03	0.000
Hazardous	0.00	0.00	0.000
Rest	17.95	9.60	0.052
Total	186.90	100.00	0.679

Table 3.27: Results for Dam se Bos (42 samples)





#### 3.1.28 NEKKIES (41 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	12.10	7.52	0.078
Hard Plastics	11.95	7.43	0.166
Paper	8.70	5.41	0.038
Cardboard	15.35	9.55	0.118
Glass	2.50	1.55	0.006
Metal	5.50	3.42	0.017
Food Waste	30.10	18.72	0.029
Garden	0.35	0.22	0.001
Textiles	12.81	7.97	0.044
Wood	0.55	0.34	0.004
Inert	0.75	0.47	0.001
Nappies	23.40	14.55	0.103
E-Waste	0.05	0.03	0.000
Hazardous	0.30	0.19	0.001
Rest	36.40	22.64	0.105
Total	160.81	100.00	0.710

Table 3.28: Results for Nekkies (41 samples)





#### 3.1.29 SIMOLA (1 SAMPLE)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	0.10	1.64	0.001
Hard Plastics	0.40	6.56	0.006
Paper	0.10	1.64	0.000
Cardboard	0.00	0.00	0.000
Glass	1.20	19.67	0.003
Metal	0.40	6.56	0.001
Food Waste	3.90	63.93	0.004
Garden	0.00	0.00	0.000
Textiles	0.00	0.00	0.000
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	0.00	0.00	0.000
Total	6.10	100.00	0.015

Table 3.29: Results for Simola (1 sample)





#### 3.1.30 LEISURE ISLAND (10 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1.90	5.28	0.012
Hard Plastics	1.45	4.03	0.020
Paper	1.20	3.33	0.005
Cardboard	1.50	4.17	0.012
Glass	5.65	15.69	0.014
Metal	1.50	4.17	0.005
Food Waste	13.85	38.47	0.013
Garden	0.00	0.00	0.000
Textiles	0.00	0.00	0.000
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.40	1.11	0.001
Rest	8.55	23.75	0.025
Total	36.00	100.00	0.012

Table 3.30: Results for Leisure Island (10 samples)





#### 3.1.31 KNYSNA INDUSTRIAL (2 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	2.55	35.66	0.016
Hard Plastics	0.00	0.00	0.000
Paper	0.00	0.00	0.000
Cardboard	0.00	0.00	0.000
Glass	0.00	0.00	0.000
Metal	0.00	0.00	0.000
Food Waste	0.00	0.00	0.000
Garden	0.00	0.00	0.000
Textiles	0.00	0.00	0.000
Wood	4.60	64.34	0.029
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	0.00	0.00	0.000
Total	7.15	100.00	0.046

Table 3.31: Results for Knysna Industrial (p2 samples)





#### 3.1.32 RHOBOLOLO / WHITE LOCATION (32 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	13.78	10.57	0.088
Hard Plastics	14.65	11.23	0.203
Paper	14.65	11.23	0.064
Cardboard	9.20	7.05	0.071
Glass	3.85	2.95	0.009
Metal	5.10	3.91	0.016
Food Waste	17.40	13.34	0.017
Garden	0.00	0.00	0.000
Textiles	8.70	6.67	0.030
Wood	4.75	3.64	0.030
Inert	0.00	0.00	0.000
Nappies	18.25	13.99	0.080
E-Waste	0.80	0.61	0.007
Hazardous	0.95	0.73	0.003
Rest	18.35	14.07	0.053
Total	130.43	100.00	0.672

Table 3.32: Results for Rhobololo / White Location (32 samples)





#### 3.1.33 KNYSNA MIDDE DORP (10 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1.05	2.99	0.007
Hard Plastics	1.95	5.55	0.027
Paper	1.25	3.56	0.005
Cardboard	3.05	8.68	0.023
Glass	1.70	4.84	0.004
Metal	3.75	10.67	0.012
Food Waste	9.45	26.88	0.009
Garden	4.75	13.51	0.011
Textiles	0.20	0.57	0.001
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	7.75	22.05	0.034
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	0.25	0.71	0.001
Total	35.15	100.00	0.134

Table 3.33: Results for Knysna Midde Dorp (10 samples)





#### 3.1.34 KNYSNA SP (2 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	0.10	1.31	0.001
Hard Plastics	0.60	7.84	0.008
Paper	0.05	0.65	0.000
Cardboard	1.70	22.22	0.013
Glass	0.10	1.31	0.000
Metal	5.10	66.67	0.016
Food Waste	0.00	0.00	0.000
Garden	0.00	0.00	0.000
Textiles	0.00	0.00	0.000
Wood	0.00	0.00	0.000
Inert	0.00	0.00	0.000
Nappies	0.00	0.00	0.000
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	0.00	0.00	0.000
Total	7.65	100.00	0.038

Table 3.34: Results for Knysna SP (2 samples)





#### 3.1.35 UMSOBOMVU (7 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	1.65	6.78	0.011
Hard Plastics	2.45	10.06	0.034
Paper	1.65	6.78	0.007
Cardboard	2.05	8.42	0.016
Glass	1.40	5.75	0.003
Metal	1.10	4.52	0.003
Food Waste	1.60	6.57	0.002
Garden	0.00	0.00	0.000
Textiles	7.85	32.24	0.027
Wood	0.05	0.21	0.000
Inert	0.15	0.62	0.000
Nappies	0.50	2.05	0.002
E-Waste	0.00	0.00	0.000
Hazardous	0.00	0.00	0.000
Rest	3.90	16.02	0.011
Total	24.35	100.00	0.117

Table 3.35: Results for Umsobomvu (7 samples)





#### 3.1.36 TOTAL KNYSNA MUNICIPALITY (638 SAMPLES)

Waste Type	Mass (kg)	Percentage of total	Calculated Volume
Soft Plastics	204,13	7,96	1,309
Hard Plastics	211,66	8,25	2,940
Paper	190,05	7,41	0,834
Cardboard	200,52	7,82	1,542
Glass	162,00	6,31	0,394
Metal	104,01	4,05	0,325
Food Waste	644,96	25,14	0,627
Garden	78,70	3,07	0,177
Textiles	121,16	4,72	0,415
Wood	21,55	0,84	0,138
Inert	22,15	0,86	0,021
Nappies	245,55	9,57	1,082
E-Waste	7,65	0,30	0,064
Hazardous	15,85	0,62	0,046
Rest	335,65	13,08	0,965
Total	2565,59	100,00	10,877

Table 3.36: Results for Knysna Municipality (638 samples)





## **4. CONCLUSIONS**

Of the 638 bags that were sampled a total mass of 2565,59 kg (2,56 tons) of waste was recorded, with a compacted volume of 10,877 m<sup>3</sup>.

Food Waste was the most prominent component by mass (25%) of the waste types that were sampled, however only makes up 6% of the total waste by volume. Hard Plastics was the most prominent component by volume (27%) of the waste types that were sampled.

41% of the waste types that were sampled by mass were recyclable materials: Soft Plastics (8%), Hard Plastics (8%), Cardboard (8%), Paper (7%), Glass (6%) and Metal (4%). However, by volume, 68% of the waste types that were sampled were recyclable materials: Hard Plastics (27%), Cardboard (14%), Soft Plastics (12%), Paper (8%), Glass (4%) and Metal (3%).

Garden waste constituted 3% of the total waste sampled by mass and 2% by volume. It must be noted that Knysna Municipality has separate (blue) bags for the collection of garden waste which is collected twice per week. Therefore the garden waste component is wrongfully co-disposed with general household waste.

E-waste constituted a mere 0,30% of the total waste sampled by mass and 0,59% by volume. E-waste is however classified as hazardous waste and contains recyclable materials that can be recovered. The remaining hazardous components of the E-waste should be disposed of at an appropriate facility. There is an E-waste disposal facility situated at the Knysna waste transfer station.

Hazardous Waste constituted a mere 0,62% of the total waste sampled by mass and 0,42% by volume. Although minimal, hazardous waste is not permitted to be disposed with household general waste.

The remaining 30% of the waste types by mass and 24% by volume was Nappies, Textiles, Wood, Inert and Rest. These waste types cannot be recycled and there is no or limited (unaffordable) alternative waste technologies available in South Africa. Therefore this is considered the portion that will be necessary to dispose of at a landfill site.

The results obtained from the different sub areas within Knysna Municipality illustrated different trends in waste generation. These trends will be significant in identifying and prioritising the type of waste minimisation initiatives to be implemented in the various sub-areas. E.g. Home composting initiatives should be implemented in the sub areas where Garden Waste was the prominent component of the waste sampled.

It was generally considered that the participation rate in the two-bag recycling system was prominent in the higher income areas. However the study indicated that the majority (by volume) of the waste generated in the higher income areas are recyclable materials.

The prediction of uniformity and consistency of waste type occurrence is complex due to the heterogeneous nature and variability of waste. Therefore it is not likely to determine accurate projections of the likelihood of the occurrence of particular waste types in a waste stream.

## **5. ASSUMPTIONS**

Based on the figures provided by Knysna Municipality for the tonnages of household waste disposed of for the period November 2015 – October 2016, an estimated 1276 tons of waste is disposed of at the PetroSA landfill site in Mossel Bay on a monthly basis. It must be noted that during the summer holiday season (December / January), the Oyster Festival (July) and the September school holidays there is a spike in the amount of waste generated, and has therefore increased the monthly average.

When applying the results of the characterisation study to the monthly average, the following tonnages per waste type being landfilled can be assumed:

Waste Type	Mass (Tons)	Percentage of total Mass (%)	Calculated Volume (m³)
Soft Plastics	101,57	7,96	651,09
Hard Plastics	105,27	8,25	1462,08
Paper	94,55	7,41	414,69
Cardboard	99,78	7,82	767,54
Glass	80,52	6,31	195,91
Metal	51,68	4,05	161,50
Food Waste	320,79	25,14	311,75
Garden	39,17	3,07	88,02
Textiles	60,23	4,72	206,27
Wood	10,72	0,84	68,72
Inert	10,97	0,86	10,35
Nappies	122,11	9,57	537,93
E-Waste	3,83	0,30	31,92
Hazardous	7,91	0,62	22,73
Rest	166,90	13,08	479,60
Total	1276	100,00	5410,10

Table 5.1: Assumed tonnages per waste type per month

When referring to Table 5.1 above, the recyclable portion (soft plastic, hard plastic, paper, cardboard, glass and metal) comprises of 41% of the total waste landfilled at PetroSA landfill site on a monthly basis. This amounts to a total of approximately 533.37 tons and 3652.81 m<sup>3</sup> of recyclable materials that could potentially be diverted from landfill and could result in a significant transport and disposal cost saving.

It is assumed that approximately 320.79 tons (311.75m<sup>3</sup>) of food waste and 39.17 tons (88.02m<sup>3</sup>) of garden waste is being landfilled on a monthly basis. This is a portion that can be significantly reduced should home composting initiatives be implemented.

It is alarming to note that approximately 3.83 tons of E-waste and 7.91 tons of Hazardous Waste is assumed to be disposed of on a monthly basis.

The remaining waste types (Textiles, Wood, Inert, Nappies and Rest) amounts to approximately 370.93 tons (1302.87 m<sup>3</sup>) and is considered the portion that has no alternative than landfill.



Figure 5.2: Pie Chart indicating assumed portion of recyclable materials in tons



Figure 5.3: Pie chart indicating assumed portion of recyclable materials in m<sup>3</sup>

### **6. CHALLENGES**

#### **6.1 DATA CAPTURING**

The capturing of data from the raw data sheets to an electronic format (spreadsheets) was time consuming and may have resulted in possible human error. The data sheets were scrutinised on a number of occasions in order to ensure that human error was eliminated.

#### **6.2 INSUFFICIENT SAMPLING PLAN**

The lack of a sufficient sampling plan resulted in a shortage of a representative sample. A sample size of 720 was determined in order to ensure a representative sample, however, only a total of 638 samples were collected. The sample size of 638 was deemed to be sufficient in order to represent an indication of waste generation trends.

### **7. RECOMMENDATIONS**

7.1 As indicated in the results of the study, a large portion of recyclable material is being disposed of at landfill. It is therefore recommended that recycling initiatives be significantly intensified in Knysna Municipality.

7.2 This report should be used as a guideline to prioritise waste minimisation initiatives per sub area. E.g. Composting initiatives should be implemented in areas where garden and food waste generation is prominent.

7.3 Waste generation is affected by seasonal variation and therefore it would be recommended that waste characterisation studies be conducted at three month intervals. However, due to personnel and financial constraints, it is acceptable to carry out a minimum of two surveys six months apart.

7.4 Categorise the waste into a bigger variety of waste types i.e. break up waste types more specifically e.g. Categorise plastics into different polymer groups.