APPENDIX 1
DADI WASTE AUDIT REPORTS

REPORT PRODUCED FOR:
Dial A Dump Industries

Chute Residual Waste: Composition Audit

April 2017

EC Sustainable Pty Ltd

ACN: 163 386 061
ABN: 87163 386 061

Tel: 1300 WASTE AUDIT (1300 927 832)
Email: info@ecsustainable.com

Head Office
Suites 701-702, 107 Walker Street,
NORTH SYDNEY, NSW 2060.

EC Sustainable Reference: 0905-17

AUDIT CONDUCTED BY	
Name:	EC Sustainable Pty Ltd
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AWT	Alternative Waste Treatment (or Technology)
AS	Australian Standard
C&I	Commercial and Industrial
CRW	Chute Residual Waste
EPL	Environmental Protection License
EPS	Expanded Polystyrene
HAC	Hazard Assessment Check
NSW	New South Wales
OHSMS	Occupational Health and Safety Management System
LPB	Liquid Paperboard
PE	Polyethylene
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Polystyrene
PVC	Polyvinyl Chloride
SWMS	Safe Work Method Statement
WEEE	Waste Electronic and Electrical Equipment
WHS	Work Health and Safety

1 Introduction

1.1 Background

The Next Generation NSW (TNG) is proposing to develop an energy from waste generation facility at Genesis Zero, a Dial-a-Dump Industries (DADI) waste facility at Eastern Creek. TNG is seeking planning approval for the facility.

The Genesis Zero site includes a landfill and a Materials Recovery Facility (MRF) and is licensed with Environmental Protection License (EPL) 20121 to receive general solid waste as defined in the Protection of the Environment Operations Act, *NSW*, 1997 (POEO Act). The materials removed from the mixed waste for recycling in the MRF include:

- Clean timber, particularly pallets.
- Metals, including ferrous (iron and steel) and non-ferrous.
- Mattresses.
- Plastics.
- Vehicle batteries.
- Fire extinguishers.
- Gas bottles.

The facility also rejects asbestos, with detection using a gun, as well as gypsum because it affects the optical sorting process in the MRF by whitening the waste.

The residual waste is disposed to the landfill via a chute. This is the Chute Residual Waste (CRW). There is approximately 300 tonnes of CRW generated per day. It is proposed to use this CRW, either alone or with other wastes, to fuel the proposed energy from waste facility.

In order to satisfy the NSW Environment Protection Authority (EPA) energy from waste policy requirements, NSW EPA requires some additional data to assess the application for approval as part of the planning process.

The NSW EPA, and its consultants, have raised a range of concerns. Notably these relate to:

- The quantity of the different constituent streams of waste available to qualify as eligible waste fuels;
- The content of certain elements of the eligible waste fuel streams;
- The procedural measures which will be in place to ensure consistency of that content.

This audit seeks to provide information that will assist in handling and mitigating these concerns.

1.2 NSW energy from waste policy

The NSW Energy from Waste Policy (NSW EPA, 2015) sets out the considerations and criteria that apply to recovering energy from waste in NSW. It ensures this energy recovery:

- Poses minimal risk of harm to human health and the environment.
- Will not undermine higher order waste management options, such as avoidance, re-use or recycling.

Under the policy, 'eligible waste fuels', are low risk materials able to be considered for use as a fuel due to their origin, low levels of contaminants and consistency over time.

1.3 Audit objectives

DADI engaged EC Sustainable to conduct an independent audit of the CRW. The objectives were to determine the composition of the CRW over a one week period using a representative sampling regime. The CRW composition data required include:

- Combustible and eligible waste fuel materials that will provide energy.
- Hazardous materials that may require management to prevent them from entering the energy generation process.
- Recyclable materials that could be otherwise processed as a higher order waste management option.

This report provides the results of the audit.

1.4 Document structure

This report provides:

- Section 2: the methods used to obtain the data
- Section 3: the results of the waste audit.
- Section 4: comments.

2 Project methods

2.1 What is a waste audit?

A waste audit is an examination of a particular waste stream including the waste materials within that stream. It includes using classification methods to determine the physical waste stream composition, measurement of the size of the waste stream and verification of other statistics related to the waste stream for planning and decision-making purposes.

2.2 Guidelines.

The audit followed applicable parts of guidelines, such as from NSW EPA in 2008 and 2010 and Office of Renewable Energy Regulator (2001).

2.3 Sample frame

The audit sample frame was designed to comprehensively cover a full week for the operating cycle of the MRF to match the generation of the CRW. Table 1 provides the audit sample frame.

Table 1 - Sample frame

Day	Date	Number of samples	Sample source times
Monday	24/04/2017	9	8:15AM, 9:15AM, 10:20AM, 11:20AM, 12:20PM, 13:45PM, 13:30PM, 15:25PM, 16:40PM
Tuesday	18/04/2017	6	9:55AM, 11:20AM, 12:30PM, 13:40PM, 15:00PM, 16:25PM
Wednesday	19/04/2017	9	7:20AM, 8:35AM, 9:50AM, 11:00AM, 12:15PM, 13:30PM, 14:40PM, 15:40PM, 16:30PM
Thursday	20/04/2017	9	7:30AM, 8:30AM, 9:30AM, 10:50AM, 12:20PM, 13:50PM, 14:20PM, 15:45PM, 16:30PM
Friday	21/04/2017	9	7:40AM, 8:40AM, 10:00AM, 11:00AM, 12:10PM, 13:25PM, 14:20PM, 15:20PM, 16:20PM
Saturday	22/04/2017	No CRW was generated	Facility open, but MRF not running
Sunday	23/04/2017		Facility closed
Total	**-**	**42**	**-**

Generally, the MRF operates from 7am to 5pm.

The sampling included selecting one sample per operating hour, up to nine (9) samples per day for the typical nine (9) operating hours. Tuesday 18 April had a shorter operating time due to the Easter shutdown. The MRF does not generally run on weekends, although the facility is open on Saturday.

2.4 Sampling methods

A target sample size of 100kg was used for the audit. This was designed to maximise the number of samples while ensuring each sample was of an adequate size based on the weight of single items in the sample. The single item weights in each sample are low with almost all material less than 2kg and most items less than 1kg.

Due to the MRF shutdown and start-up times of a combined 1 hour, it would not be practical to stop and start the facility to sample every hour because no CRW would be generated. Therefore, sampling was conducted during operation of the MRF.

The collection of approximately 100kg for each sample was conducted using a bulk bin placed over the flow of CRW down the chute that takes the CRW to the landfill. The CRW audited is therefore representative of the material that goes down the chute after processing in MRF.

The samples were delivered to EC Sustainable in a bulk bin by a forklift. The samples were sorted on the day of sampling, with the exception of the final sample on Wednesday that had to be partially stored overnight due to light safety. That sample was partially sorted on the sampling day, with the remainder of the sample stored in enclosed sealed 240L bins overnight to protect the sample.

ORER (2001) discussed visual audits of C&I waste, considering individual incoming loads not an on-going flow of waste after some processing. The CRW is a post-processing material and not an incoming material and the waste is highly mixed and in small particle sizes. Visual auditing methods would not be appropriate for accurate measurements. Physical weight based auditing provides a higher order method of accurate data collection compared to visual audits.

2.5 Sorting and data collection

2.5.1 Location

A safe undercover sorting site was provided by DADI adjacent to the MRF.

2.5.2 Sorting categories

Table 2 provides the sorting categories used in the audit. These categories are based on applicable components of relevant guidelines such as NSW EPA (2008 and 2010) and ORER (2001).

Table 2 - Sorting categories

Summary ^	Sorting category and number		ORER Guideline (2001) category	
			Name	Renewable eligible
Paper	1	Recyclable paper	Newspaper, magazines, mixed paper	Yes
	2	Disposable contaminated (soft) paper	Paper composite	Yes
	3	Cardboard	Cardboard	Yes
	4	Liquid paperboard (LPB)	Liquid paperboard	Yes 85%
	5	Nappies	Disposable nappies	Yes 90%
Wood/timber	6	Untreated wood – MDF board	Wood	Yes
	7	Untreated wood – All other		
	8	Treated wood – CCA treated		Potentially >
	9	Treated wood – lead painted		
Plastic	10	Recyclable plastic containers excl. EPS	Mixed plastics, PET, PE, PVC, PP, PS not EPS	No
	11	Other rigid plastics excl. EPS		
	12	Expanded Polystyrene (EPS)	Polystyrene (PS)	No
	13	Soft (films) plastics	Plastic film	No
	14	Composite plastics	Plastic composite	No
Metal (Ferrous and non-ferrous)	15	Recyclable metal containers	Not required	No
	16	Composite	Not required	No
	17	Other metals	Not required	No
Organic (not Wood/ timber)	18	Food/kitchen – vegetable	Kitchen organics - veg	Yes
	19	Food/kitchen – meat	Kitchen organics - meat	Yes
	20	Garden/ vegetation	Garden organics	Yes
	21	Textiles/rags	Textiles	No *
	22	Rubber	Rubber	No
	23	Leather	Not required	Potentially
WEEE	24	E-waste	Compounds (radios etc)	No
	25	Mobiles	Mobile phones	No
	26	Toners	Toner cartridges	No
Hazardous	27	Medical	Not required – additional potential combustibles, although hazardous	No
	28	Chemicals		
	29	Paint		
	30	Asbestos		
	31	Batteries car (vehicles)		
	32	Batteries other		
	33	Other hazardous		
Glass	34	Glass containers	Not required	No
	35	Glass other	Not required	No
Other (including Earth and Building Materials)	36	Insulation	Not required – additional potential combustibles	No
	37	Carpet/underlay		No
	38	Compounds (excl. composite plastic, composite metal, e-waste)	Compounds (radios etc)	No
	39	Asphalt	Not required	No
	40	Inert incl. non-hazardous building waste	Not required	No

^ Generally based on NSW EPA (2008 and 2010), with more detail on the C&D and wood materials due to the amount of that material in the CRW and less detail on materials not required in ORER (2001).

> Assumed not eligible in ORER (2001) as a precautionary approach due to the treatments, although all wood is eligible.

* Not from a consistent source of natural fibre based on the audit and therefore not eligible in ORER (2001).

The samples were sorted into two size fractions, with the whole sample sorted. This was for additional information in the raw data. This report analyses the whole sample results. The size fractions were: oversize (>25mm); and fines (<=25mm).

2.5.3 Sorting competency

EC Sustainable is a waste auditing organisation for the NSW EPA through the State Government panel contract for waste auditing services.

A team of trained sorting staff were used to collect and sort the material. All staff had WHS white cards, manual handling training, tetanus vaccinations, and Hepatitis A and B vaccinations. Staff were inducted by DADI at the site.

The audit managers had third party waste audit competency training from a third-party trainer. The waste audit competency training includes WHS awareness relevant to sorting and accurate identification of material types in each category.

2.5.4 Material weighing

The sorted material in each category for each sample was weighed. An accuracy of 10g was used for the weighing. Each weight was verified by a second person for accuracy.

2.5.5 Scale calibration

All scales were calibrated by a senior staff member each day before the commencement of the audit each day. Three weights (200g, 1kg and 5kg) were used. If scales failed to read within 1% of the dedicated weight (for example, a 1kg weight should read between 9.990 and 1.010kg), then the scale was removed and a conforming replacement used.

No scales failed the calibration checks and had been serviced by the supplier before the audit.

2.5.6 Removal of sorted material

The auditors placed the materials into a skip bin provided by DADI following sorting. The skip bin was emptied daily as required by DADI.

2.5.7 Weather conditions

Table 3 provides the weather conditions for the audit period. The weather was generally calm and dry with temperatures from 15 to 27 degrees Celsius. The temperature is higher than the average for late April. However, there is unlikely to be any unusual weather impacts on the audit results with no extreme data.

Table 3 - Weather data

Day	Date	Rainfall (24 hrs)	Temperature		Cloud cover (9am)	Wind (9am)
			9am	Maximum		
Monday	24/04/2017	0mm	17.9 °C	25.8 °C	0/8	SE, 4km/h
Tuesday	18/04/2017	0mm	17.5 °C	26.8 °C	0/8	Calm
Wednesday	19/04/2017	0mm	16.9 °C	24.3 °C	7/8	SW, 6km/h
Thursday	20/04/2017	0.2mm	17.9 °C	25.0 °C	1/8	S/SW, 4km/h
Friday	21/04/2017	0mm	15.7 °C	24.7 °C	4/8	Calm

Source: BOM, 2017, Station 67019, Prospect Reservoir.

2.6 Audit verification and monitoring

A dedicated management staff member was assigned the role of monitoring the audit.

This included factors such as:

- Monitoring WHS compliance and facilitating inductions and procedure management.
- Checking the correct sorting of material.
- Observing the correct sorting of materials.
- Witnessing the correct logging of weights.
- Conducting tests on equipment such as scales to ensure accuracy and trucks to ensure safety.
- Verifying correct data entry.

2.7 Work Health and Safety

To meet Work Health and Safety (WHS) obligations, an Occupational Health and Safety Management System (OHSMS) was developed for the audit. This included completing a safe work method statement and hazard assessment check process for both the collection and sorting tasks in the audit. All staff wore PPE as outlined in the Safe Work Method Statement (SWMS).

3 Results

This section provides the compositional results of the audit. The results are provided in this section for each day and a week average for:

- Detailed compositional results based on all categories of waste sorted.
- Combustible materials, based on the ORER Guidelines (ORER, 2001) with some additional data.
- Recyclable materials, based on fully commingled systems for higher order recovery.

The main confidence intervals are also supplied.

The audit involved sorting approximately 4.5 tonnes of CRW material across 5 days of generation, in 42 samples. The sample weights were characterised as shown below with the detailed weights per sample provided in the Appendix 1 raw data file:

- Minimum sample weight: 86.99kg.
- Maximum sample weight: 145.76kg.
- Average sample weight: 108.31kg.

The results for each day were based on the average of the percentage of each sample rather than the weight of each material in each sample. This averaging method has been used to factor every sample equally regardless of its mass. The mass of samples varied naturally based on the volume of the sample with the target being an estimated 100kg. Samples that were larger should not have more impact on the results, because they were larger due to natural variation in the volume selected.

The MRF may process varying amounts of waste in each hour throughout the day. The results are not factored against the actual generation tonnages.

3.1 Detailed compositional results

Table 4 provides the compositional results of samples from each day and an overall audited average based on the detailed sorting categories.

The data shows that the CRW materials in the week were mainly:

1. Untreated wood excluding MDF, 54.59% of the CRW.
2. Textiles/rags, 9.84% of the CRW.
3. Inert including non-hazardous building waste, 7.44% of the CRW.
4. Treated wood - CCA treated, 4.82% of the CRW.
5. Untreated wood - MDF board, 4.63% of the CRW.
6. Soft plastics (films), 3.12% of the CRW.
7. Other rigid plastics excluding EPS, 2.66% of the CRW, which is rigid plastic excluding containers.
8. Cardboard, 2.31% of the CRW.
9. Other metals, not containers, 1.50% of the CRW.
10. Composite plastics, 1.36% of the CRW.

The remaining material was 7.73% of the CRW.

Other rigid plastics excluding EPS would include PVC piping if it was in the samples, although there was not a high amount of PVC in the audit. PVC was not separately sorted, but is estimated to be less than 5% of the other rigid plastics excluding EPS category. This would amount to up to 0.13% of the overall CRW across the audit. Only a small number of examples were identified.

The waste was quite consistent by day. However, the main variations by day were:

1. Untreated wood excluding MDF on Tuesday, 62.67% of the CRW.
2. Textiles/rags on Tuesday, 4.43% of the CRW.
3. Inert including non-hazardous building waste on Monday and Tuesday, 11.82% and 3.13% of the CRW respectively.
4. Capet/underlay on Thursday, 3.48% of the CRW.
5. Asphalt on Thursday, 3.58% of the CRW.
6. Compounds (excluding plastic and metal) on Monday, 2.73% of the CRW which was a mattress and floor lino.

The CRW is a post-processing material. The waste is highly mixed because it has been stockpiled, loaded into the MRF, picked on a conveyor and transported out of the MRF technology down a chute. This processing assists to make the material more consistent than it would be between the incoming loads. Each incoming load is likely to have more variability than the CRW.

Table 4 - Results – all materials – detailed by day (% by weight)

Materials		Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Paper	Recyclable paper	0.65	1.07	0.99	0.42	0.87	0.78
	Disposable contaminated (soft) paper	0.75	0.28	0.74	0.21	1.01	0.62
	Cardboard	2.23	1.88	2.88	0.93	3.50	2.31
	Liquid paperboard	0.00	0.00	0.00	0.01	0.02	0.01
	Nappies	0.01	0.00	0.00	0.00	0.01	0.01
Wood/ timber	Untreated wood - MDF board	3.55	5.29	4.67	4.40	5.45	4.63
	Untreated wood - All other	47.90	62.67	55.20	59.02	50.86	54.59
	Treated wood - CCA treated	4.59	6.89	4.05	3.95	5.30	4.82
	Treated wood - lead painted	0.00	0.00	0.00	0.00	0.00	0.00
Plastic	Recyclable plastic containers excl. EPS	0.11	0.10	0.10	0.05	0.14	0.10
	Other rigid plastics excl. EPS	2.51	3.46	2.83	1.91	2.88	2.66
	EPS	0.06	0.11	0.02	0.04	0.18	0.08
	Soft (films) plastics	5.01	2.87	3.42	1.20	3.03	3.12
	Composite plastics	1.41	0.25	0.68	1.17	2.91	1.36
Metal (Ferrous and non-ferrous)	Recyclable metal containers	0.01	0.02	0.06	0.02	0.05	0.04
	Composite	0.50	0.00	0.09	0.33	0.64	0.33
	Other metals	1.38	2.14	1.15	1.19	1.87	1.50
Organic (not Wood/ timber)	Food/kitchen – vegetable <	0.01	0.00	0.00	0.00	0.01	0.01
	Food/kitchen – meat <	0.00	0.00	0.00	0.00	0.00	0.00
	Garden/ vegetation	1.72	0.67	1.50	1.13	1.24	1.30
	Textiles/rags	11.50	4.43	11.15	8.67	11.65	9.84
	Rubber	0.39	1.44	0.19	0.26	0.26	0.44
	Leather	0.00	0.35	0.16	0.09	0.00	0.10

< Food/kitchen waste was a negligible amount only registering to 1 decimal place rounded up. Food waste was only an incidental item from a worksite, like a lunch remnant, totalling 254g in the whole audit.

Table 4 (*cont.*) - Results – All materials – detailed by day (% by weight)

Materials		Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
WEEE	E-waste	0.81	0.74	0.49	0.72	0.88	0.73
	Mobiles	0.00	0.00	0.00	0.00	0.00	0.00
	Toners	0.00	0.00	0.00	0.00	0.01	0.00
Hazardous	Medical	0.00	0.00	0.00	0.00	0.00	0.00
	Chemicals	0.00	0.00	0.00	0.00	0.01	0.00
	Paint	0.00	0.00	0.00	0.34	0.00	0.07
	Asbestos	0.00	0.00	0.00	0.00	0.00	0.00
	Batteries car	0.00	0.00	0.00	0.00	0.00	0.00
	Batteries other	0.00	0.00	0.00	0.00	0.00	0.00
	Other hazardous	0.01	0.00	0.00	0.00	0.00	0.00
Glass	Glass containers	0.00	0.00	0.00	0.00	0.00	0.00
	Glass other	0.06	0.21	0.11	0.08	0.10	0.10
Other (including Earth and Building Materials)	Insulation	0.28	0.00	0.00	0.00	0.00	0.06
	Carpet/underlay	0.00	0.00	0.00	3.48	0.24	0.80
	Compounds (excl. plastic and metal)	2.73	0.31	0.00	0.00	1.50	0.95
	Asphalt	0.00	1.69	0.00	3.59	0.89	1.20
	Inert incl. non-hazardous building waste	11.82	3.13	9.52	6.79	4.49	7.44
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

3.2 Combustible materials

3.2.1 Summary

Table 5 provides the summary categories for combustible materials including eligible was fuels in ORER (2001). Figure 1 provide the data graphically.

The data shows that 88.4% of the CRW materials were combustible:

- Combustible renewable, 64.3% of the CRW, which are eligible waste fuels in ORER (2001).
- Combustible non-renewable non-hazardous, 18.6% of the CRW, which are not eligible waste fuels in ORER (2001).
- Combustible non-renewable WEEE, 0.7% of the CRW, which are not eligible waste fuels in ORER (2001).
- Combustible hazardous, 4.9% of the CRW. Generally, these materials are not discussed in ORER (2001).

3.2.2 Detail

Table 6 provides the results for each sample source and an overall audited average based on the combustibility of the materials. This is based on previous audits conducted by DADI with some additions. Figures 2 and 3 provide the data graphically by week and days.

The combustible materials were mainly:

- Wood general, 54.59% of the CRW.
- Textiles, 9.84% of the CRW.
- Other plastic, 7.24% of the CRW.
- Wood treated, 4.82% of the CRW.

Non-combustible materials were mainly inert which included non-hazardous building waste.

Table 5 - Results – combustible materials – summary by day (% by weight)

Materials	Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Combustible						
Renewable non-hazardous (eligible waste fuels)	56.82	71.86	65.98	66.12	62.97	64.26
Non-renewable non-hazardous <	21.27	13.01	18.55	16.87	21.29	18.56
WEEE	0.81	0.74	0.49	0.72	0.89	0.73
Hazardous ^	4.60	6.89	4.05	4.29	5.31	4.89
Combustible sub-total	***83.50***	***92.50***	***89.07***	***88.00***	***90.46***	***88.44***
Not combustible						
Not combustible	16.50	7.50	10.93	12.00	9.54	11.56
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

^ Treated wood, including CCA treated wood and lead painted wood, is not classified as renewable or eligible in this study. It is classified as combustible. The treatments used are non-renewable, although the wood component is renewable. This is a precautionary approach to avoid overestimating the renewable eligible waste fuels based on the guidelines, even though ORER (2001) treats all wood as renewable eligible.

> Non-renewable non-hazardous includes some materials that are not mentioned in ORER (2001), such as leather, that actually may be renewable. This is a precautionary approach to avoid overestimating the renewable eligible waste fuels based on the guidelines.

Figure 1 - Results – combustible materials – summary by day (% by weight)

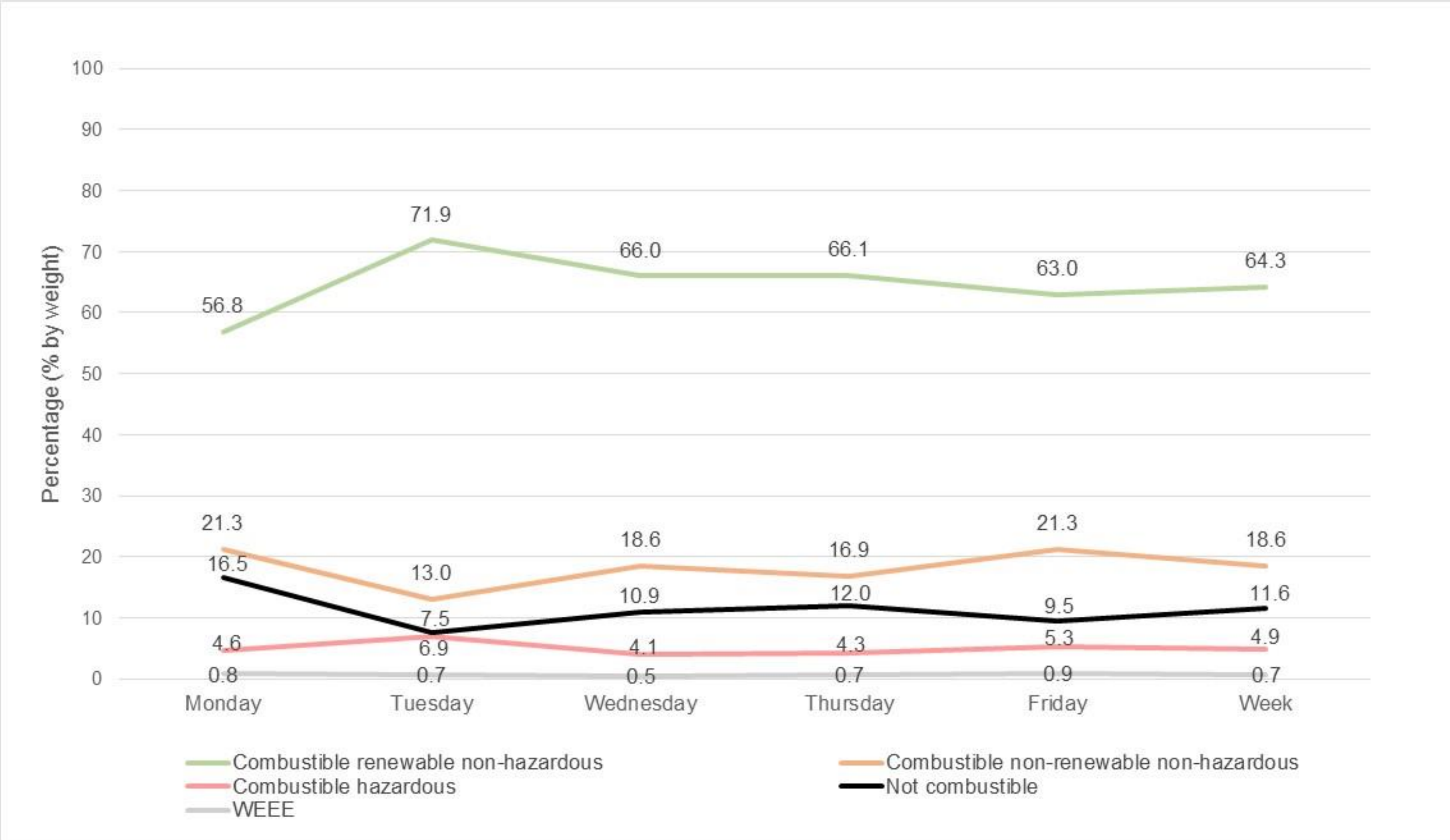


Figure 2 - Results – combustible materials – summary by day (% by weight)

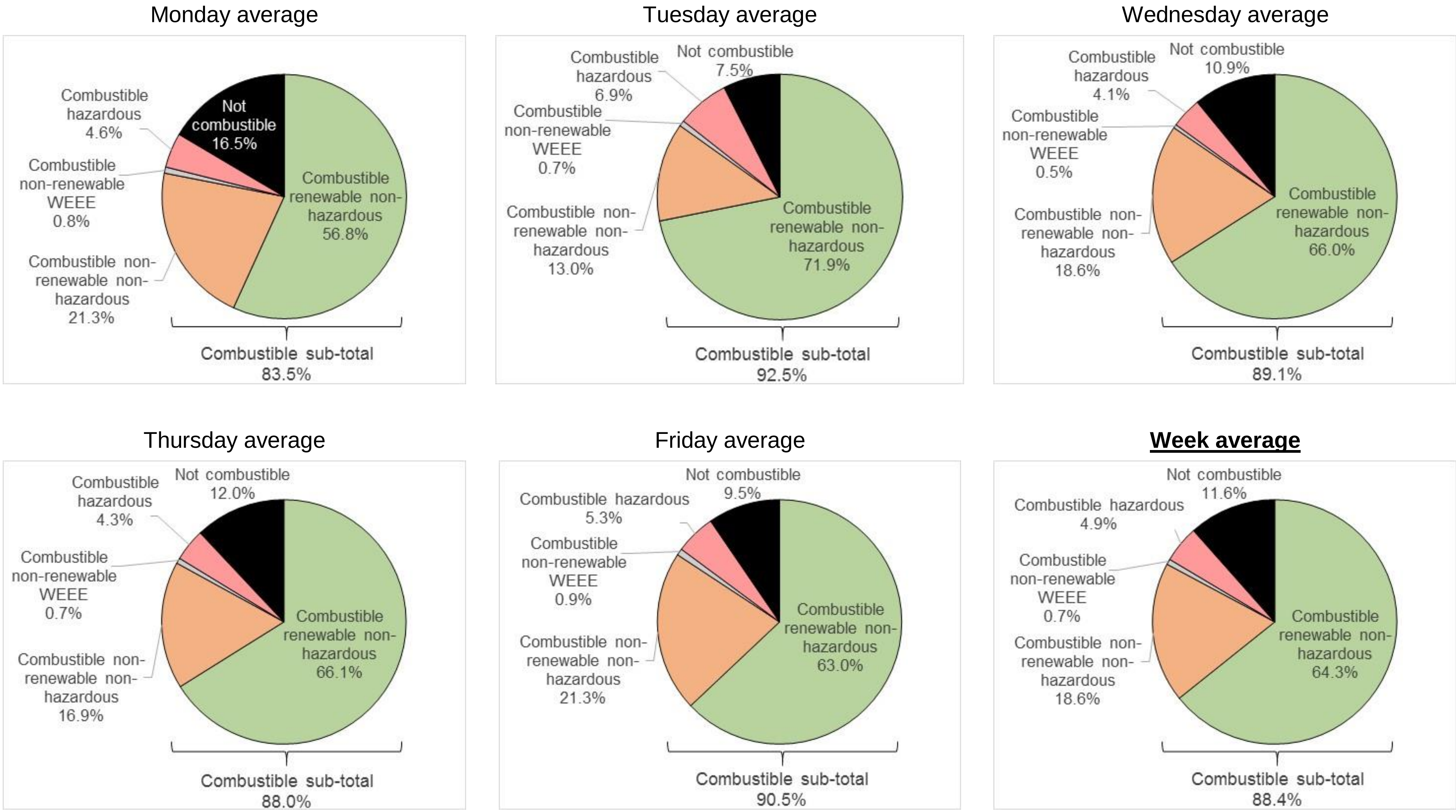


Table 6 - Results – combustible materials – detailed by day (% by weight)

Materials		Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Combustible renewable non-hazardous (eligible waste fuels)	Paper and cardboard	3.63	3.23	4.61	1.56	5.38	3.71
	LPB *(85% renewable)*	0.00	0.00	0.00	0.01	0.02	0.01
	Nappies *(90% renewable)*	0.01	0.00	0.00	0.00	0.01	0.01
	Wood general	47.90	62.67	55.20	59.02	50.86	54.59
	Wood MDF	3.55	5.29	4.67	4.4	5.45	4.63
	Food and kitchen	0.01	0.00	0.00	0.00	0.01	0.01
	Garden and vegetation	1.72	0.67	1.50	1.13	1.24	1.30
Combustible non-renewable non-hazardous	Other plastic (not polystyrene)	9.04	6.68	7.03	4.33	8.96	7.24
	Polystyrene	0.06	0.11	0.02	0.04	0.18	0.08
	Textiles	11.50	4.43	11.15	8.67	11.65	9.84
	Rubber	0.39	1.44	0.19	0.26	0.26	0.44
	Leather	0.00	0.35	0.16	0.09	0.00	0.10
	WEEE	0.81	0.74	0.49	0.72	0.89	0.73
	Insulation	0.28	0.00	0.00	0.00	0.00	0.06
	Carpet/underlay	0.00	0.00	0.00	3.48	0.24	0.80
Combustible hazardous	Wood treated ^	4.59	6.89	4.05	3.95	5.30	4.82
	Other hazardous <	0.01	0.00	0.00	0.34	0.01	0.07
Not combustible	Metal	1.89	2.16	1.30	1.54	2.56	1.87
	Glass	0.06	0.21	0.11	0.08	0.10	0.10
	Asbestos	0.00	0.00	0.00	0.00	0.00	0.00
	Asphalt	0.00	1.69	0.00	3.59	0.89	1.20
	Other compounds *	2.73	0.31	0.00	0.00	1.50	0.95
	Inert incl. non-hazardous building waste	11.82	3.13	9.52	6.79	4.49	7.44
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

^ Treated wood is not classified as renewable in this study. It is classified as combustible. The treatments used are non-renewable, although the wood component is renewable.

< The category of "Other hazardous" in combustible waste includes the detailed audit categories of Medical, Chemicals, Paint, Batteries car, Batteries other and Other hazardous. Asbestos was included in not combustible waste. While the category includes these materials, no car batteries were in the samples audited, as shown in Table 4. The MRF removes car batteries within the process before the CRW is generated. There was also no medical waste and no batteries other, as shown in Table 4.

* Other compounds exclude composite plastic, composite metal and e-waste.

Figure 3 - Results – combustible materials – detailed by week (% by weight)

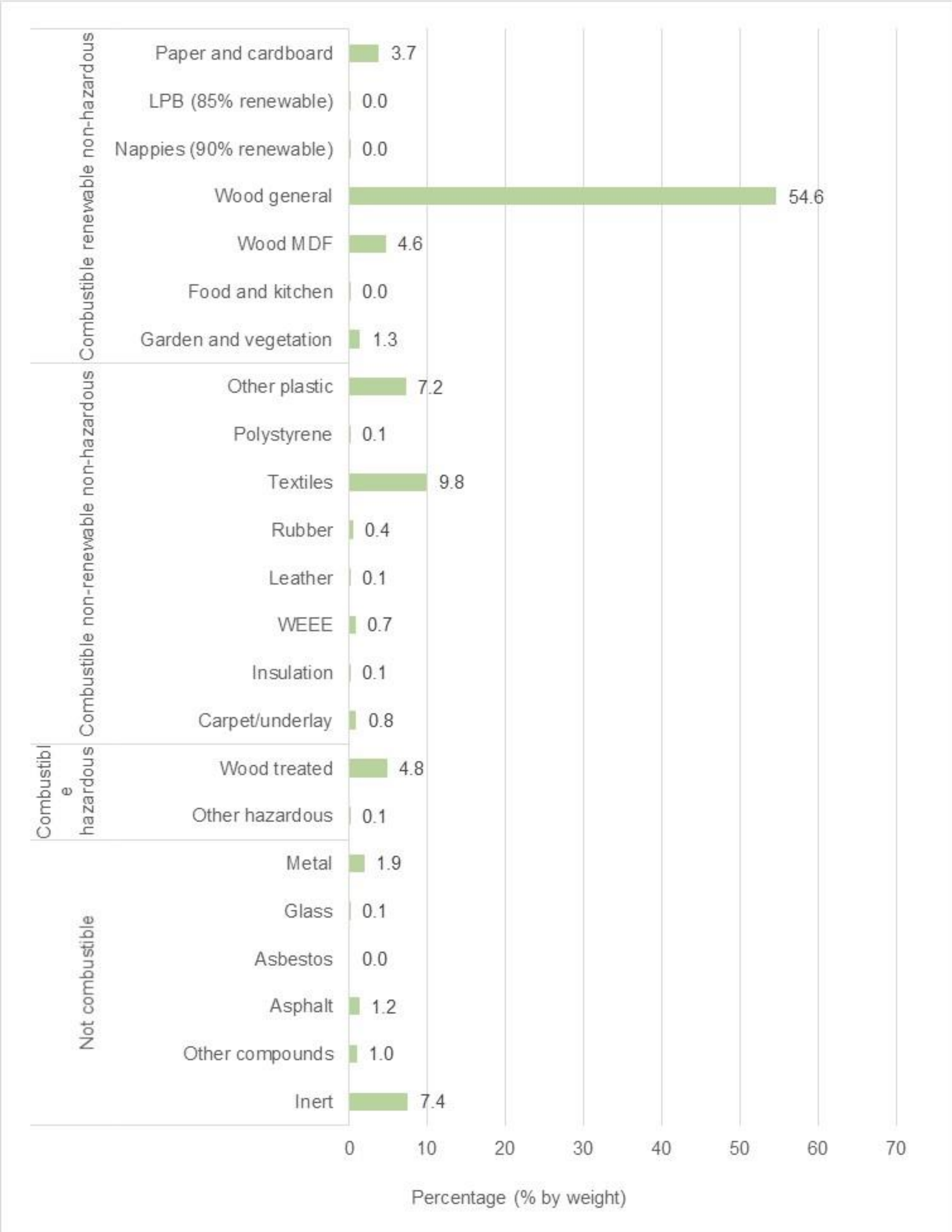
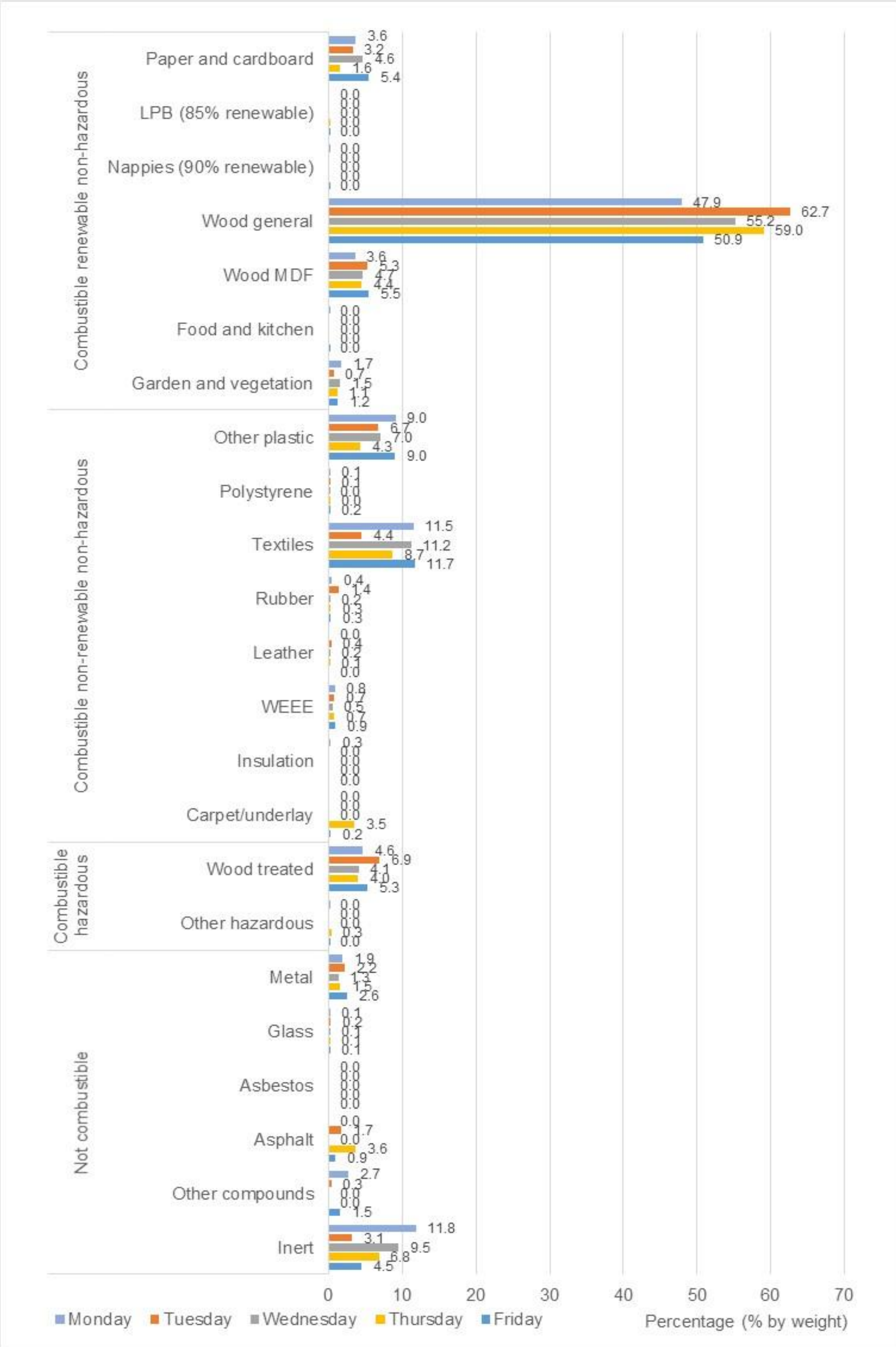


Figure 4 - Results – combustible materials – detailed by day (% by weight)



3.3 Recyclable materials

This section provides the amount and composition of recyclable materials in CRW, based on fully commingled materials like paper, cardboard and containers. Table 7 provides the data.

The data shows that there was a low level of these recyclable materials in the CRW. The CRW was 3.24% recyclables, which was mainly recyclable paper and cardboard at 3.09% of the CRW. Most of this paper and cardboard was soiled to some extent and generally not suited a MRF recovery process by the time it was audited.

The energy from waste policy preferences higher order recycling over combustion. Based on the audit week, there is a not a substantial opportunity for further recovery of recyclables from the CRW.

The CRW is mainly timber which presents in a form that is not reusable, probably not avoidable and not economically viable to further separate which is why it is currently being landfilled.

Table 7 - Results – recyclable materials (% by weight)

Materials	Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Recyclable paper and cardboard	2.88	2.95	3.87	1.35	4.37	3.09
Recyclable plastic containers	0.11	0.10	0.10	0.05	0.14	0.10
Recyclable metal containers	0.01	0.02	0.06	0.02	0.05	0.04
Recyclable glass containers	0.00	0.00	0.00	0.00	0.00	0.00
Recyclable liquid paperboard	0.00	0.00	0.00	0.01	0.02	0.01
Sub-total recyclables	***3.00***	***3.07***	***4.03***	***1.43***	***4.58***	***3.24***
Not recyclables	97.00	96.93	95.97	98.57	95.42	96.76
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

3.4 Confidence intervals

Table 8 provides the confidence intervals at a 90% confidence level for the main target materials. The audit involved sorting approximately 4.5 tonnes of CRW material across 5 days of generation in 42 samples.

The hazardous category, which is of main concern to NSW EPA has the lowest confidence interval of 5.5%, with a maximum of 10.4% hazardous material at the upper confidence interval value at 90% certainty. The mean value is 4.9%.

The renewable combustible materials (eligible waste fuels) have a larger confidence interval of up to 12.2%, but even at the lower confidence interval value at 90% certainty is still over half (52.1%) of the material is combustible, renewable, non-hazardous material. The mean value is 64.3%. Therefore, the waste stream was highly eligible based on the material composition audited.

Combustible materials in total were at least 80.3% of the material at the lower confidence interval value at 90% certainty. The mean value is 88.4%. Therefore, the waste was highly combustible based on the material composition audited.

Table 8 - Results – confidence intervals

Materials	Confidence interval	Mean percentage	Lower value	Upper value
Combustible materials				
Renewable non-hazardous (eligible waste fuels)	+/- 12.2%	64.3	52.1	76.5
Non-renewable non-hazardous	+/- 9.9%	18.6	8.7	28.5
Non-renewable WEEE	+/-2.2%	0.7	0.0	2.9
Hazardous	+/- 5.5%	4.9	0.0	10.4
Combustible sub-total	***+/- 8.1%***	***88.4***	***80.3***	***96.5***
Non-combustible materials				
Not combustible	+/- 8.1%	11.6	3.5	19.7
Recyclable materials – paper, cardboard and containers				
Recyclable materials	+/- 4.5%	3.2	0.0	7.7

4 Comments

The CRW material, the residual of waste delivered as mixed residual waste, is currently being sent to landfill after a substantial post-collection recovery effort in the onsite MRF.

A robust audit sampling regime was implemented covering the CRW generation cycle as the output from the MRF during the MRF operating hours. The audit data represents the audit week.

These audit results show the CRW has:

- A high level of combustible material, potentially suited to an energy from waste facility.
- A high level of combustible material that were eligible waste fuels based on ORER (2001).
- A low level of recyclables that could be processed in higher order recycling initiatives like fully commingled systems.
- A low level of hazardous waste, although there is some limited amount of e-waste and paint. These materials could be managed through onsite removal or through safe combustion in the processing technology option.
- No visually identifiable asbestos in the audit week in the samples audited, which is likely to be partly be due to the asbestos detection gun.
- No visually identifiable lead painted wood waste in the audit week in the samples audited.

The presence of asbestos, lead painted wood and other hazardous compounds should be tested for in a laboratory. The moisture and chemical characteristics of the waste were not measured in this audit.

The CRW is a post-processing material. The waste is highly mixed because it has been stockpiled, loaded into the MRF, picked on a conveyor and transported out of the MRF technology down a chute. This processing assists to make the material more consistent than it would be between the incoming loads. Each incoming load is likely to have more variability than the CRW.

The processing technology should be assessed for its ability to handle the waste composition.

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Appendix 1

This Appendix provides a separate raw data file in Excel.

Appendix 2

This Appendix provides the aggregation of the sorting categories for reporting.

Table 9 - Aggregation of sorting categories for combustibility and recyclability

Summary ^	Sorting category and number		Combustibility	Recyclability
Paper	1	Recyclable paper	Yes	Yes
	2	Disposable contaminated (soft) paper	Yes	No
	3	Cardboard	Yes	Yes
	4	Liquid paperboard	Yes	Yes
	5	Nappies	Yes	No
Wood/timber	6	Untreated wood – MDF board	Yes	No
	7	Untreated wood – All other	Yes	No
	8	Treated wood – CCA treated	Yes	No
	9	Treated wood – lead painted	Yes	No
Plastic	10	Recyclable plastic containers excl. EPS	Yes	No
	11	Other rigid plastics excl. EPS	Yes	Yes
	12	EPS	Yes	No
	13	Soft (films) plastics	Yes	No
	14	Composite plastics	Yes	No
Metal (Ferrous and non-ferrous()	15	Recyclable metal containers	No	Yes
	16	Composite	No	No
	17	Other metals	No	No
Organic (not Wood/ timber)	18	Food/kitchen – vegetable	Yes	No
	19	Food/kitchen – meat	Yes	No
	20	Garden/ vegetation	Yes	No
	21	Textiles/rags	Yes	No
	22	Rubber	Yes	No
	23	Leather	Yes	No
WEEE	24	E-waste	Yes <	No
	25	Mobiles	Yes	No
	26	Toners	Yes	No
Hazardous	27	Medical	Yes	No
	28	Chemicals	Yes	No
	29	Paint	Yes	No
	30	Asbestos	No	No
	31	Batteries car	Yes	No
	32	Batteries other	Yes	No
	33	Other hazardous	Yes	No
Glass	34	Glass containers	No	Yes
	35	Glass other	No	No
Other (including Earth and Building Materials)	36	Insulation	Yes	No
	37	Carpet/underlay	Yes	No
	38	Compounds (excl. composite plastic, composite metal, e-waste)	No	No
	39	Asphalt	No	No
	40	Inert incl. non-hazardous building waste	No	No

< These materials are classified as combustible in ORER (2001). In practice, a fraction of the material may not combust, such as metal and glass components of e-waste.

eC Sustainable

REPORT PRODUCED FOR:
Dial A Dump Industries

MRF Residual Waste:
Composition Audit

April 2017

EC Sustainable Pty Ltd
ACN: 163 386 061
ABN: 87163 386 061

Tel: 1300 WASTE AUDIT (1300 927 832)
Email: info@ecsustainable.com

Head Office
Suites 701-702, 107 Walker Street,
NORTH SYDNEY, NSW 2060.

EC Sustainable Reference: 1105-17

AUDIT CONDUCTED BY

Name:	EC Sustainable Pty Ltd
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List of abbreviations

AS	Australian Standard
C&I	Commercial and Industrial
EPL	Environmental Protection License
EPS	Expanded Polystyrene
HAC	Hazard Assessment Check
NSW	New South Wales
MRF	Material Recovery Facility
OHSMS	Occupational Health and Safety Management System
LPB	Liquid Paperboard
PE	Polyethylene
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Polystyrene
PVC	Polyvinyl Chloride
SWMS	Safe Work Method Statement
WEEE	Waste Electronic and Electrical Equipment
WHS	Work Health and Safety

1 Introduction

1.1 Background

The Next Generation NSW (TNG) is proposing to develop an energy from waste generation facility at Genesis Zero, a Dial-a-Dump Industries (DADI) waste facility at Eastern Creek. TNG is seeking planning approval for the facility.

The Genesis Zero site includes a landfill and a Materials Recovery Facility (MRF) and is licensed with Environmental Protection License (EPL) 20121 to receive general solid waste as defined in the Protection of the Environment Operations Act, *NSW*, 1997 (POEO Act).

The facility is considering using MRF Residuals, the materials removed from recycling in a Material Recovery Facility (MRF) process, as part of the input for the energy from waste generation facility. MRF Residuals include contaminated recycling, bagged materials and other materials rejected from the MRF.

The MRF Residuals would be sourced from a third party dry recycling MRF, Visy Recycling (Visy) at Smithfield. Visy accepts residential and commercial dry recycling, such as paper, cardboard and containers. Approximately 400 tonnes of MRF Residuals is available per day at the time that audit was conducted. The MRF Residuals are currently landfilled at the DADI site.

MRF Residuals in this study does not include any by-products of the waste processed through the onsite MRF at DADI.

In order to satisfy the NSW Environment Protection Authority (EPA) energy from waste policy requirements, NSW EPA requires some additional data to assess the application for approval as part of the planning process.

The NSW EPA, and its consultants, have raised a range of concerns. Notably these relate to:

- The quantity of the different constituent streams of waste available to qualify as eligible waste fuels;
- The content of certain elements of the eligible waste fuel streams;
- The procedural measures which will be in place to ensure consistency of that content.

This audit seeks to provide information that will assist in handling and mitigating these concerns.

1.2 NSW energy from waste policy

The NSW Energy from Waste Policy (NSW EPA, 2015) sets out the considerations and criteria that apply to recovering energy from waste in NSW. It ensures this energy recovery:

- Poses minimal risk of harm to human health and the environment.
- Will not undermine higher order waste management options, such as avoidance, re-use or recycling.

Under the policy, 'eligible waste fuels', are low risk materials able to be considered for use as a fuel due to their origin, low levels of contaminants and consistency over time.

1.3 Audit objectives

DADI engaged EC Sustainable to conduct an independent audit of the MRF Residuals. The objectives were to determine the composition of the MRF Residuals over a one week period using a representative sampling regime. The MRF Residuals composition data required include:

- Combustible and eligible waste fuel materials that will provide energy.
- Hazardous materials that may require management to prevent them from entering the energy generation process.
- Recyclable materials that could be otherwise processed as a higher order waste management option.

This report provides the results of the audit.

1.4 Document structure

This report provides:

- Section 2: the methods used to obtain the data
- Section 3: the results of the waste audit.
- Section 4: comments.

2 Project methods

2.1 What is a waste audit?

A waste audit is an examination of a particular waste stream including the waste materials within that stream. It includes using classification methods to determine the physical waste stream composition, measurement of the size of the waste stream and verification of other statistics related to the waste stream for planning and decision-making purposes.

2.2 Guidelines.

The audit followed applicable parts of guidelines, such as from NSW EPA in 2008 and 2010 and Office of Renewable Energy Regulator (2001).

2.3 Sample frame

The audit sample frame was designed to comprehensively cover a full week of MRF Residuals deliveries from Visy at Smithfield. The sampling included selecting two samples per load delivered from Visy each day for one week. However, the first sample, the pilot sample, had only one sample as the bulk density and sample size by volume was evaluated.

Table 1 provides the audit sample frame.

Table 1 - Sample frame

Day	Date	Number of samples	Sample source times
Monday	01/05/2017	6	8:10AM, 8:10AM, 11:00AM, 11:05AM, 13:00PM, 13:00PM
Tuesday	02/05/2017	6	9:00AM, 9:00AM, 12:00PM, 12:00PM, 14:30PM, 14:30PM
Wednesday	26/04/2017	7	6:30AM, 9:10AM, 9:10AM, 12:00PM, 12:00PM, 15:00PM, 15:00PM
Thursday	27/04/2017	8	6:30AM, 6:35AM, 9:00AM, 9:00AM, 12:00PM, 12:00PM, 14:00PM, 14:00PM
Friday	28/04/2017	4	11:45AM, 11:45AM, 14:30PM, 14:30PM
Saturday	29/04/2017	No MRF Residuals was delivered	Facility open, but MRF not running
Sunday	30/04/2017		Facility closed
Total	**-**	**31**	**-**

2.4 Sampling methods

A target sample size of 100kg was used for the audit. This was designed to maximise the number of samples while ensuring each sample was of an adequate size based on the weight of single items in the sample. The single item weights in each sample are low with almost all material less than 2kg and most items less than 1kg. The sample weights did very depending on the bulk density which was affected by the composition of the sample, particularly the amount of glass other which was mainly glass fines.

The collection of approximately 100kg for each sample was conducted by:

- Target load arrived at the site and proceeded to the landfill face.
- Site loader took 4 bucket loads from around one end of the delivered load spaced apart and placed in a pile.
- Site loader to mixed and coned and quartered the pile.
- Site loader delivered 100kg from one quarter to EC Sustainable, sampling approx. 6 inches from the ground to avoid any site soil in the sample.
- Site loader to repeated for the other end of the load for the second sample from that load.

The samples were delivered to EC Sustainable in bulka bags by a forklift. The samples were sorted on the day of sampling.

ORER (2001) discussed visual audits of C&I waste, considering individual incoming loads not an on-going flow of waste after some processing. The MRF Residuals is a post-processing material and not an incoming material and the waste is highly mixed and in small particle sizes. Visual auditing methods would not be appropriate for accurate measurements. Physical weight based auditing provides a higher order method of accurate data collection compared to visual audits.

2.5 Sorting and data collection

2.5.1 Location

A safe undercover sorting site was provided by DADI adjacent to the MRF.

2.5.2 Sorting categories

Table 2 provides the sorting categories used in the audit. These categories are based on applicable components of relevant guidelines such as NSW EPA (2008 and 2010) and ORER (2001).

Table 2 - Sorting categories

Summary ^	Sorting category and number		ORER Guideline (2001) category	
			Name	**Renewable eligible**
Paper	1	Recyclable paper	Newspaper, magazines, mixed paper	Yes
	2	Disposable contaminated (soft) paper	Paper composite	Yes
	3	Cardboard	Cardboard	Yes
	4	Liquid paperboard (LPB)	Liquid paperboard	Yes 85%
	5	Nappies	Disposable nappies	Yes 90%
Wood/timber	6	Untreated wood – MDF board	Wood	Yes
	7	Untreated wood – All other		
	8	Treated wood – CCA treated		Potentially >
	9	Treated wood – lead painted		
Plastic	10	Recyclable plastic containers excl. EPS	Mixed plastics, PET, PE, PVC, PP, PS not EPS	No
	11	Other rigid plastics excl. EPS		
	12	Expanded Polystyrene (EPS)	Polystyrene (PS)	No
	13	Soft (films) plastics	Plastic film	No
	14	Composite plastics	Plastic composite	No
Metal (Ferrous and non-ferrous)	15	Recyclable metal containers	Not required	No
	16	Composite	Not required	No
	17	Other metals	Not required	No
Organic (not Wood/ timber)	18	Food/kitchen – vegetable	Kitchen organics - veg	Yes
	19	Food/kitchen – meat	Kitchen organics - meat	Yes
	20	Garden/ vegetation	Garden organics	Yes
	21	Textiles/rags	Textiles	No *
	22	Rubber	Rubber	No
	23	Leather	Not required	Potentially
WEEE	24	E-waste	Compounds (radios etc)	No
	25	Mobiles	Mobile phones	No
	26	Toners	Toner cartridges	No
Hazardous	27	Medical	Not required – additional potential combustibles, although hazardous	No
	28	Chemicals		
	29	Paint		
	30	Asbestos		
	31	Batteries car (vehicles)		
	32	Batteries other		
	33	Other hazardous		
Glass	34	Glass containers	Not required	No
	35	Glass other	Not required	No
Other (including Earth and Building Materials)	36	Insulation	Not required – additional potential combustibles	No
	37	Carpet/underlay		No
	38	Compounds (excl. composite plastic, composite metal, e-waste)	Compounds (radios etc)	No
	39	Asphalt	Not required	No
	40	Inert incl. non-hazardous building waste	Not required	No

^ Generally based on NSW EPA (2008 and 2010), with more detail on the C&D and wood materials due to the amount of that material in the MRF Residuals and less detail on materials not required in ORER (2001).

> Assumed not eligible in ORER (2001) as a precautionary approach due to the treatments, although all wood is eligible.

* Not from a consistent source of natural fibre based on the audit and therefore not eligible in ORER (2001).

The samples were sorted into two size fractions, with the whole sample sorted. This was for additional information in the raw data. This report analyses the whole sample results. The size fractions were: oversize (>25mm); and fines (<=25mm).

2.5.3 Sorting competency

EC Sustainable is a waste auditing organisation for the NSW EPA through the State Government panel contract for waste auditing services.

A team of trained sorting staff were used to collect and sort the material. All staff had WHS white cards, manual handling training, tetanus vaccinations, and Hepatitis A and B vaccinations. Staff were inducted by DADI at the site.

The audit managers had third party waste audit competency training from a third-party trainer. The waste audit competency training includes WHS awareness relevant to sorting and accurate identification of material types in each category.

2.5.4 Material weighing

The sorted material in each category for each sample was weighed. An accuracy of 10g was used for the weighing. Each weight was verified by a second person for accuracy.

2.5.5 Scale calibration

All scales were calibrated by a senior staff member each day before the commencement of the audit each day. Three weights (200g, 1kg and 5kg) were used. If scales failed to read within 1% of the dedicated weight (for example, a 1kg weight should read between 9.990 and 1.010kg), then the scale was removed and a conforming replacement used.

No scales failed the calibration checks and had been serviced by the supplier before the audit.

2.5.6 Removal of sorted material

The auditors placed the materials into a skip bin provided by DADI following sorting. The skip bin was emptied daily as required by DADI.

2.5.7 Weather conditions

Table 3 provides the weather conditions for the audit period. The weather was generally calm and dry with temperatures from 14 to 24 degrees Celsius. The temperature is higher than the average for late April and early May. However, there is unlikely to be any unusual weather impacts on the audit results with no extreme data.

Table 3 - Weather data

Day	Date	Rainfall (24 hrs)	Temperature		Cloud cover (9am)	Wind (9am)
			9am	Maximum		
Monday	01/05/2017	0mm	15.2 °C	24.3 °C	4/8	N, 4km/h
Tuesday	02/05/2017	0mm	17.8 °C	23.7 °C	4/8	Calm
Wednesday	26/04/2017	0mm	20.4 °C	23.8 °C	0/8	N, 2km/h
Thursday	27/04/2017	0.6mm	14.2 °C	20.1 °C	1/8	Calm
Friday	28/04/2017	0mm	14.3 °C	20.5 °C	0/8	W, 7km/h

Source: BOM, 2017, Station 67019, Prospect Reservoir.

2.6 Audit verification and monitoring

A dedicated management staff member was assigned the role of monitoring the audit.

This included factors such as:

- Monitoring WHS compliance and facilitating inductions and procedure management.
- Checking the correct sorting of material.
- Observing the correct sorting of materials.
- Witnessing the correct logging of weights.
- Conducting tests on equipment such as scales to ensure accuracy and trucks to ensure safety.
- Verifying correct data entry.

2.7 Work Health and Safety

To meet Work Health and Safety (WHS) obligations, an Occupational Health and Safety Management System (OHSMS) was developed for the audit. This included completing a safe work method statement and hazard assessment check process for both the collection and sorting tasks in the audit. All staff wore PPE as outlined in the Safe Work Method Statement (SWMS).

3 Results

This section provides the compositional results of the audit. The results are provided in this section for each day and a week average for:

- Detailed compositional results based on all categories of waste sorted.
- Combustible materials, based on the ORER Guidelines (ORER, 2001) with some additional data.
- Recyclable materials, based on fully commingled systems for higher order recovery.

The main confidence intervals are also supplied.

The audit involved sorting approximately 3.7 tonnes of MRF Residuals across 5 days of generation, in 31 samples. The sample weights were characterised as shown below with the detailed weights per sample provided in the Appendix 1 raw data file:

- Minimum sample weight: 79.10kg.
- Maximum sample weight: 179.55kg.
- Average sample weight: 119.36kg.

The results for each day were based on the average of the percentage of each sample rather than the weight of each material in each sample. This averaging method has been used to factor every sample equally regardless of its mass. The mass of samples varied naturally based on the volume of the sample with the target being an estimated 100kg. Samples that were larger should not have more impact on the results, because they were larger due to natural variation in the volume selected.

3.1 Detailed compositional results

Table 4 provides the compositional results of samples from each day and an overall audited average based on the detailed sorting categories. The MRF Residuals in the week were mainly:

1. Textiles/rags, 26.05% of the MRF Residuals.
2. Soft (films) plastics, 14.93% of the MRF Residuals.
3. Cardboard, 6.78% of the MRF Residuals.
4. Recyclable paper, 6.56% of the MRF Residuals.
5. Other rigid plastics excl. EPS, 6.31% of the MRF Residuals.
6. Disposable/contaminated (soft) paper, 6.06% of the MRF Residuals.
7. Glass other, 4.1% of the MRF Residuals, which was mainly glass fines.
8. Composite plastics, 4% of the MRF Residuals.

9. E-waste, 3.69% of the MRF Residuals.
10. Inert including non-hazardous building waste, 2.52% of the MRF Residuals.

The remaining material was 19.00% of the MRF Residuals.

In regards to PVC, they was a very low amount. PVC was not separately sorted, but is estimated as follows:

- Recyclable plastic containers are generally only 1% PVC based on audits conducted by EC Sustainable (EC Sustainable 2011). There was only 2.15% recyclable plastic containers in the audit, and therefore, it is estimated that recyclable plastic PVC containers may be 0.22% of the overall MRF Residuals across the audit.
- Other rigid plastics excluding EPS could include PVC piping if it was in the samples, although there was not a high amount of PVC piping in the audit. to be less than 2% of the other rigid plastics excluding EPS category. This would amount to up to 0.12% of the overall MRF Residuals across the audit.

The waste was quite consistent by day. However, the main variations by day were:

1. Glass other on Thursday, 12.91% of the MRF Residuals.
2. Compounds (excluding plastic and metal) on Wednesday, 6.67% of the MRF Residuals which was a boxing bag.
3. Soft (films) plastics on Monday and Wednesday, 19.48% and 11.38% of the MRF Residuals respectively.
4. Textiles/rags on Tuesday and Thursday, 33.12% and 17.73% of the MRF Residuals respectively.
5. Disposable/contaminated (soft) paper on Tuesday and Friday, 9.01% and 2.31% of the MRF Residuals.
6. Composite plastics on Wednesday, 6.57% of the MRF Residuals.

The MRF Residuals is a post-processing material. The waste is highly mixed because it has been stockpiled, loaded into the MRF, picked on a conveyor and transported out of the MRF technology in trucks. It was then tipped, sampled and mixed for audit. This processing assists to make the material more consistent than it would have been in the incoming loads at the MRF.

The main difference in samples appeared to the delivery of glass fines (glass other), which was clumped in some samples. It may be that glass fines are added into loads at the MRF in batches to spread the material weight across loads. It may be feasible and desirable for DADI to request the MRF to deliver loads with no glass fines since glass is not combustible.

Table 4 - Results – all materials – detailed by day (% by weight)

Materials		Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Paper	Recyclable paper	8.59	5.75	5.20	7.07	6.11	6.56
	Disposable contaminated (soft) paper	5.14	9.01	6.01	6.45	2.31	6.06
	Cardboard	6.78	6.09	7.90	6.61	6.20	6.78
	Liquid paperboard	1.14	0.22	0.12	0.15	0.12	0.35
	Nappies	0.65	2.14	1.65	1.31	1.33	1.42
Wood/ timber	Untreated wood - MDF board	0.66	0.09	0.16	0.93	0.62	0.50
	Untreated wood - All other	1.58	2.12	2.75	2.65	1.50	2.21
	Treated wood - CCA treated	0.34	0.09	0.23	0.40	0.16	0.26
	Treated wood - lead painted	0.00	0.00	0.00	0.00	0.00	0.00
Plastic	Recyclable plastic containers excl. EPS	2.65	2.94	1.10	2.28	1.75	2.15
	Other rigid plastics excl. EPS	4.45	3.57	8.46	7.65	6.73	6.31
	EPS	0.88	0.43	0.34	0.63	0.51	0.56
	Soft (films) plastics	19.48	15.64	11.38	13.15	16.79	14.93
	Composite plastics	1.63	2.86	6.57	4.53	3.73	4.00
Metal (Ferrous and non-ferrous)	Recyclable metal containers	0.71	0.76	0.46	0.61	0.99	0.67
	Composite	0.87	0.85	3.11	0.91	1.27	1.43
	Other metals	2.60	2.13	2.47	2.35	2.19	2.36
Organic (not Wood/ timber)	Food/kitchen – vegetable <	1.22	2.81	1.60	1.90	3.69	2.11
	Food/kitchen – meat <	0.11	0.24	0.14	0.17	0.32	0.18
	Garden/ vegetation	0.76	0.30	0.83	2.13	0.65	1.03
	Textiles/rags	28.78	33.12	23.53	17.73	32.36	26.05
	Rubber	1.45	0.49	1.00	0.93	0.21	0.87
	Leather	0.38	0.79	0.66	1.17	0.61	0.76

< Food/kitchen waste was 2.29% of the MRF Residuals, totalling 84.79kg in the whole audit. This is a low amount. At the MRF this material may have been located within plastic bags with contents and containerised food that was removed as contamination by the MRF. Some of the food was located within sealed containers. Due to this, the split between vegetable and meat/dairy was estimated through a general sub-sort and applied across the dataset.

Table 4 (*cont.*) - Results – All materials – detailed by day (% by weight)

Materials		Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
WEEE	E-waste	4.57	2.13	3.56	3.33	5.63	3.69
	Mobiles	0.00	0.00	0.00	0.00	0.00	0.00
	Toners	0.00	0.00	0.10	0.00	0.06	0.03
Hazardous	Medical	0.03	0.07	0.00	0.04	0.00	0.03
	Chemicals	0.02	0.00	0.04	0.00	0.01	0.01
	Paint	0.00	0.00	0.00	0.00	0.00	0.00
	Asbestos	0.00	0.00	0.00	0.00	0.00	0.00
	Batteries car	0.00	0.00	0.00	0.00	0.00	0.00
	Batteries other	0.00	0.00	0.00	0.00	0.01	0.00
	Other hazardous	0.00	0.00	0.01	0.00	0.00	0.00
Glass	Glass containers	0.08	0.32	0.00	0.00	0.00	0.08
	Glass other	1.19	1.52	0.91	12.91	0.33	4.10
Other (including Earth and Building Materials)	Insulation	0.00	0.00	0.00	0.02	0.00	0.00
	Carpet/underlay	0.00	0.00	0.00	0.00	0.00	0.00
	Compounds (excl. plastic and metal)	0.00	0.24	6.67	0.92	1.55	1.99
	Asphalt	0.00	0.00	0.00	0.00	0.00	0.00
	Inert incl. non-hazardous building waste	3.26	3.28	3.04	1.07	2.26	2.52
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

3.2 Combustible materials

3.2.1 Summary

Table 5 provides the summary categories for combustible materials including eligible was fuels in ORER (2001). Figure 1 provide the data graphically.

The data shows that 86.9% of the MRF Residuals materials were combustible:

- Combustible renewable, 27.2% of the MRF Residuals, which are eligible waste fuels in ORER (2001).
- Combustible non-renewable non-hazardous, 55.6% of the MRF Residuals, which are not eligible waste fuels in ORER (2001).
- Combustible non-renewable WEEE, 3.7% of the MRF Residuals, which are not eligible waste fuels in ORER (2001).
- Combustible hazardous, 0.3% of the MRF Residuals. Generally, these materials are not discussed in ORER (2001).

3.2.2 Detail

Table 6 provides the results for each sample source and an overall audited average based on the combustibility of the materials. This is based on previous audits conducted by DADI with some additions. Figures 2 and 3 provide the data graphically by week and days.

The combustible materials were mainly:

- Other plastic (not polystyrene), 27.39% of the MRF Residuals.
- Textiles, 26.05% of the MRF Residuals.
- Paper and cardboard, 19.40% of the MRF Residuals.
- WEEE, 3.73% of the MRF Residuals.

Non-combustible materials were mainly metal, glass and inert which included non-hazardous building waste.

Table 5 - Results – combustible materials – summary by day (% by weight)

Materials	Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Combustible						
Renewable non-hazardous (eligible waste fuels)	26.63	28.77	26.36	29.37	22.85	27.20
Non-renewable non-hazardous <	59.70	59.84	53.04	48.09	62.69	55.63
WEEE	4.57	2.13	3.66	3.33	5.69	3.72
Hazardous ^	0.39	0.16	0.28	0.44	0.17	0.30
Combustible sub-total	***91.29***	***90.90***	***83.34***	***81.23***	***91.40***	***86.85***
Not combustible						
Not combustible	8.71	9.10	16.66	18.77	8.60	13.15
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

^ Treated wood, including CCA treated wood and lead painted wood, is not classified as renewable or eligible in this study. It is classified as combustible. The treatments used are non-renewable, although the wood component is renewable. This is a precautionary approach to avoid overestimating the renewable eligible waste fuels based on the guidelines, even though ORER (2001) treats all wood as renewable eligible.

> Non-renewable non-hazardous includes some materials that are not mentioned in ORER (2001), such as leather, that actually may be renewable. This is a precautionary approach to avoid overestimating the renewable eligible waste fuels based on the guidelines.

Figure 1 - Results – combustible materials – summary by day (% by weight)

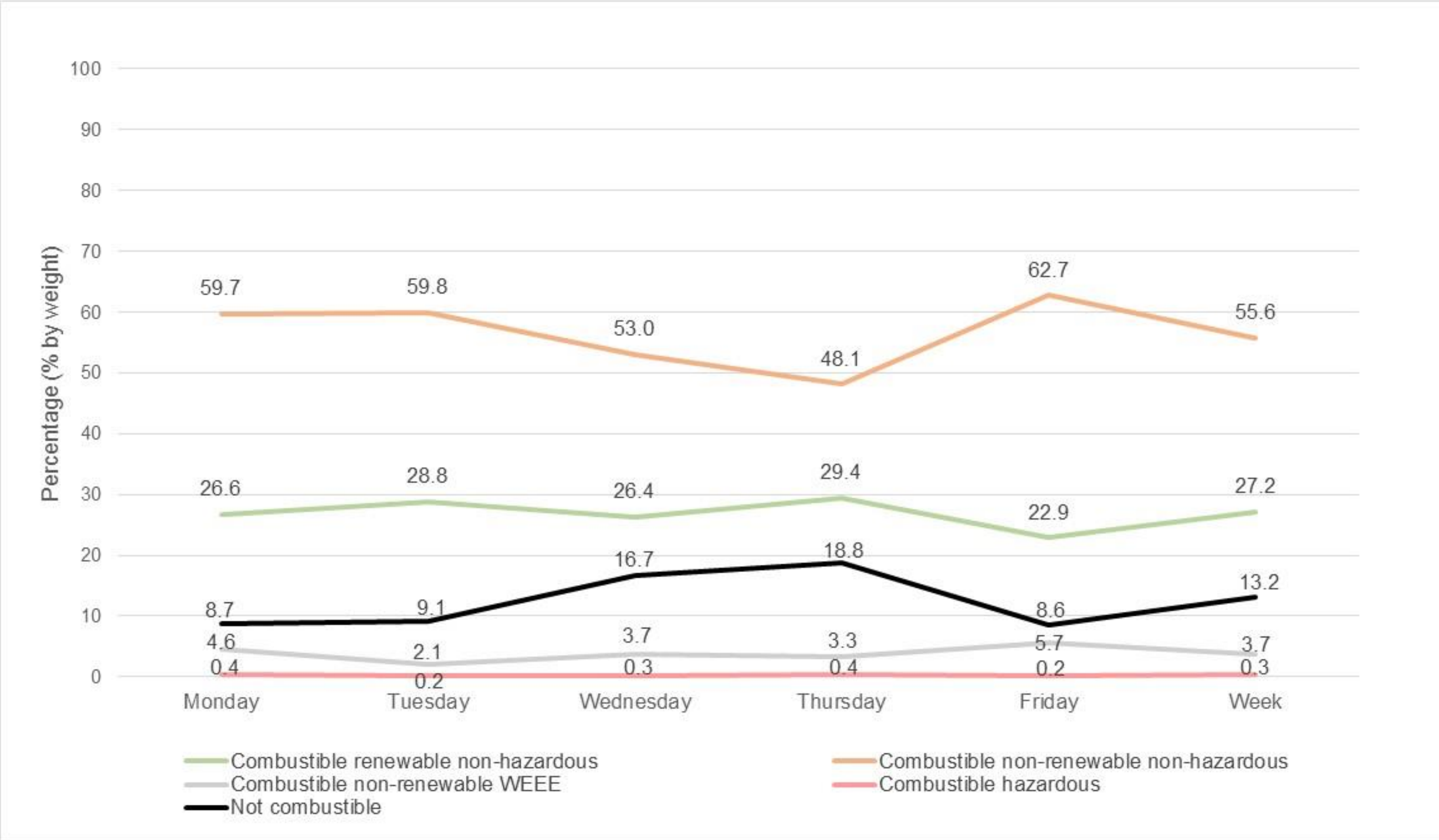


Figure 2 - Results – combustible materials – summary by day (% by weight)

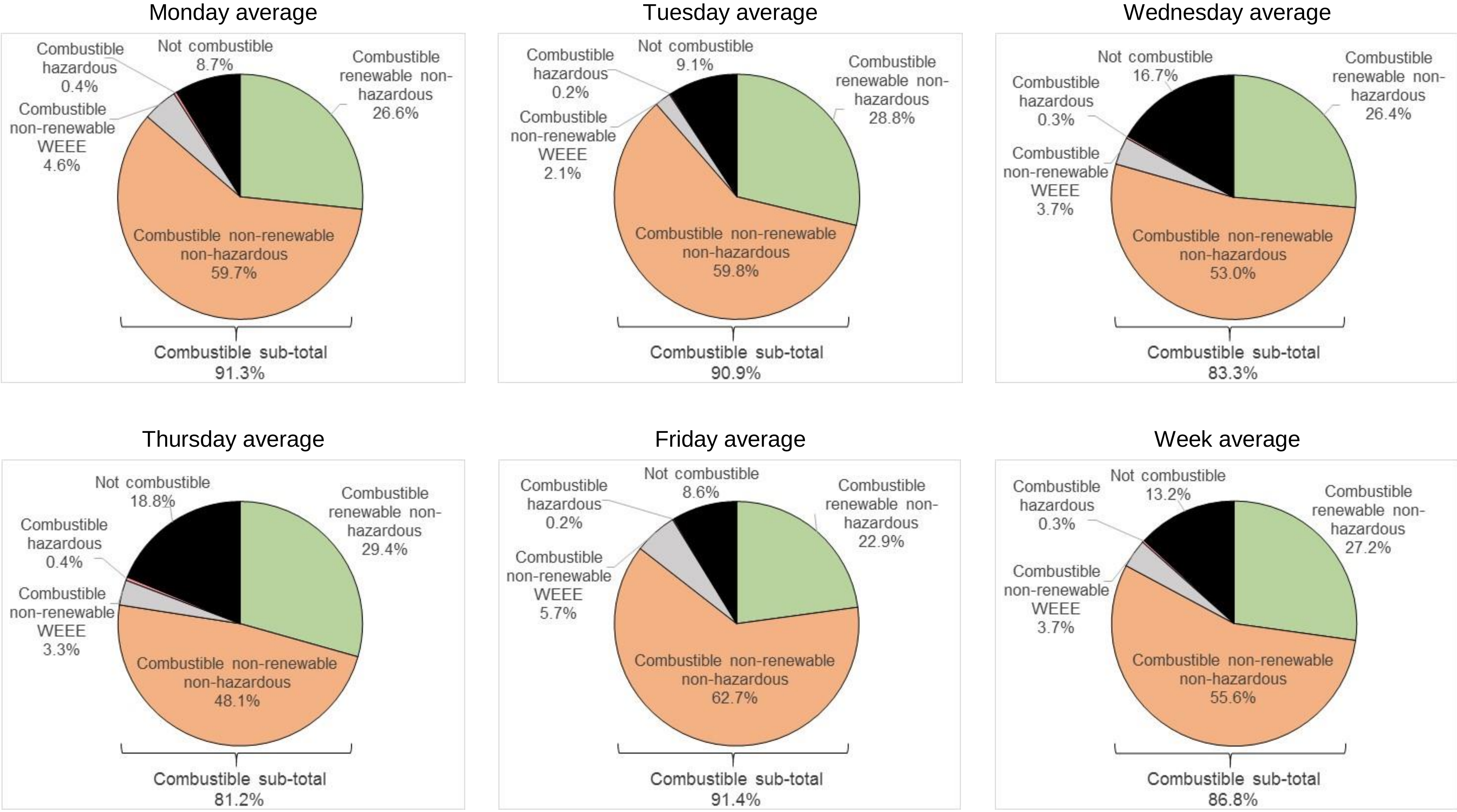


Table 6 - Results – combustible materials – detailed by day (% by weight)

Materials		Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Combustible renewable non-hazardous (eligible waste fuels)	Paper and cardboard	20.51	20.85	19.11	20.13	14.62	19.40
	LPB *(85% renewable)*	1.14	0.22	0.12	0.15	0.12	0.35
	Nappies *(90% renewable)*	0.65	2.14	1.65	1.31	1.33	1.42
	Wood general	1.58	2.12	2.75	2.65	1.50	2.21
	Wood MDF	0.66	0.09	0.16	0.93	0.62	0.5
	Food and kitchen	1.33	3.05	1.74	2.07	4.01	2.29
	Garden and vegetation	0.76	0.30	0.83	2.13	0.65	1.03
Combustible non-renewable non-hazardous	Other plastic (not polystyrene)	28.21	25.01	27.51	27.61	29.00	27.39
	Polystyrene	0.88	0.43	0.34	0.63	0.51	0.56
	Textiles	28.78	33.12	23.53	17.73	32.36	26.05
	Rubber	1.45	0.49	1.00	0.93	0.21	0.87
	Leather	0.38	0.79	0.66	1.17	0.61	0.76
	WEEE	4.57	2.13	3.66	3.33	5.69	3.72
	Insulation	0.00	0.00	0.00	0.02	0.00	0.00
	Carpet/underlay	0.00	0.00	0.00	0.00	0.00	0.00
Combustible hazardous	Wood treated ^	0.34	0.09	0.23	0.40	0.16	0.26
	Other hazardous <	0.05	0.07	0.05	0.04	0.01	0.04
Not combustible	Metal	4.18	3.74	6.04	3.87	4.45	4.46
	Glass	1.27	1.84	0.91	12.91	0.33	4.18
	Asbestos	0.00	0.00	0.00	0.00	0.01	0.00
	Asphalt	0.00	0.00	0.00	0.00	0.00	0.00
	Other compounds *	0.00	0.24	6.67	0.92	1.55	1.99
	Inert incl. non-hazardous building waste	3.26	3.28	3.04	1.07	2.26	2.52
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

^ Treated wood is not classified as renewable in this study. It is classified as combustible. The treatments used are non-renewable, although the wood component is renewable.

< The category of "Other hazardous" in combustible waste includes the detailed audit categories of Medical, Chemicals, Paint, Batteries car, Batteries other and Other hazardous. Asbestos was included in not combustible waste. There was no mobiles, paint and no car batteries, as shown in Table 4. There were two cases of potential medical waste, IV lines, although if unused they could be classified as other rigid plastics excluding EPS. However, medical waste was assumed as a precautionary approach and the amount is very low.

* Other compounds exclude composite plastic, composite metal and e-waste.

Figure 3 - Results – combustible materials – detailed by week (% by weight)

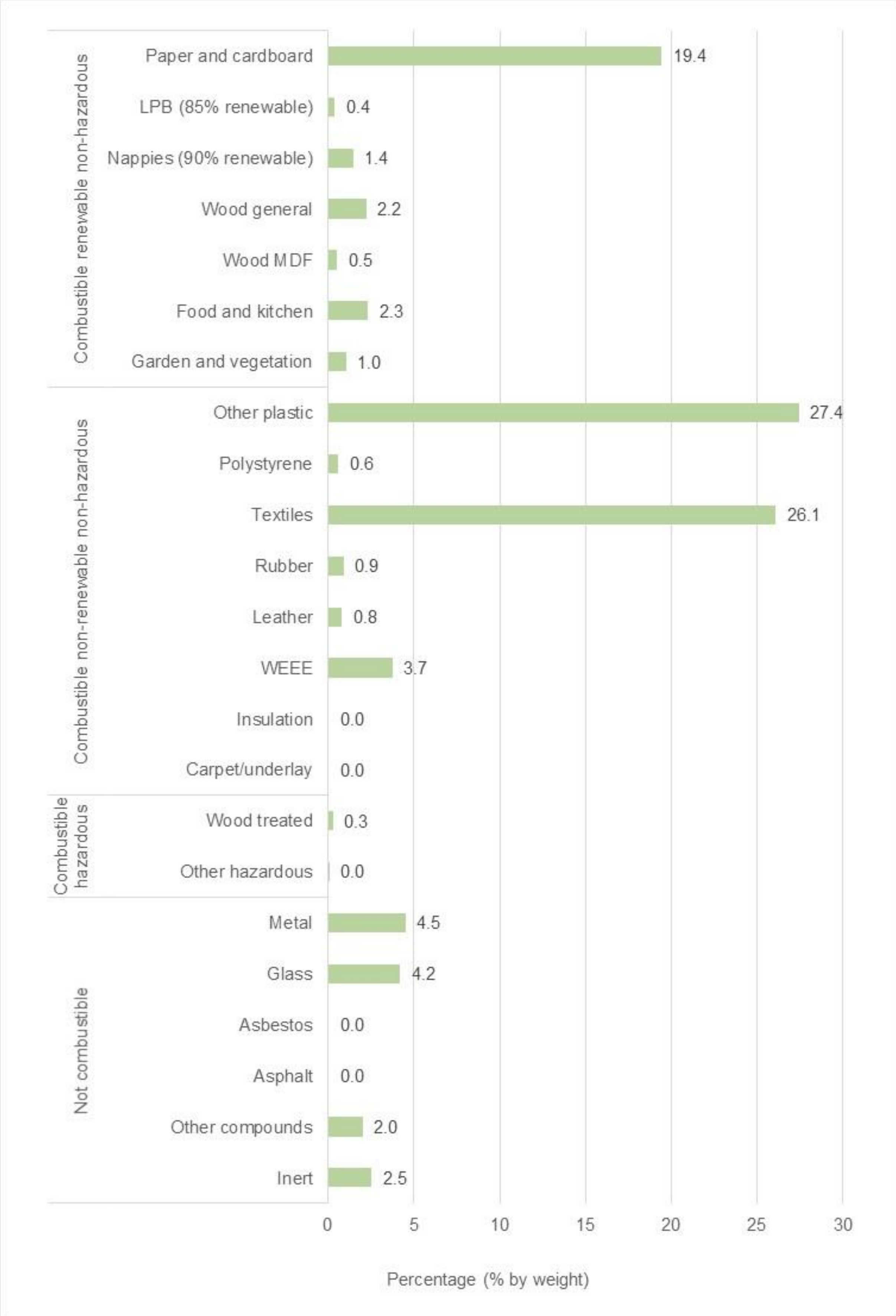
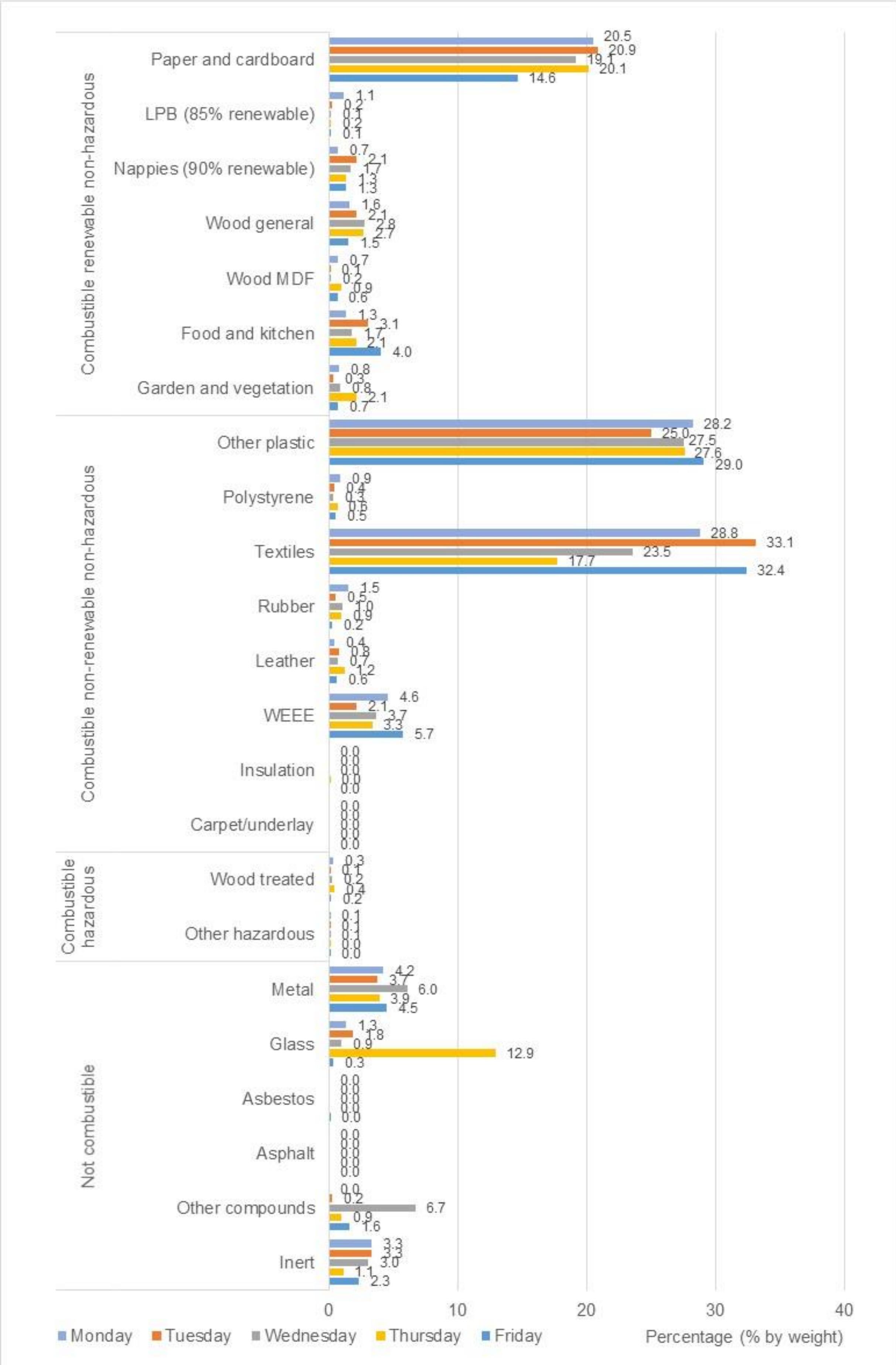


Figure 4 - Results – combustible materials – detailed by day (% by weight)



3.3 Recyclable materials

This section provides the amount and composition of recyclable materials in MRF Residuals, based on fully commingled materials like paper, cardboard and containers. Table 7 provides the data.

The data shows that there was a low level of these recyclable materials in the MRF Residuals. The MRF Residuals was 16.59% recyclables, which was mainly recyclable paper and cardboard at 13.34% of the MRF Residuals. Much of this paper and cardboard was soiled to some extent and generally not suited a MRF recovery process by the time it was audited. However, there was some recoverable paper, but it may have been contained within plastic bags when it was processed at the MRF.

The energy from waste policy preferences higher order recycling over combustion. However, this material has already been processed at a MRF and the market has determined that it is to be sent to landfill.

Table 7 - Results – recyclable materials (% by weight)

Materials	Mon average	Tue average	Wed average	Thurs average	Fri average	Week average
Recyclable paper and cardboard	15.37	11.84	13.10	13.68	12.31	13.34
Recyclable plastic containers	2.65	2.94	1.10	2.28	1.75	2.15
Recyclable metal containers	0.71	0.76	0.46	0.61	0.99	0.67
Recyclable glass containers	0.08	0.32	0.00	0.00	0.00	0.08
Recyclable liquid paperboard	1.14	0.22	0.12	0.15	0.12	0.35
Sub-total recyclables	***19.95***	***16.08***	***14.78***	***16.72***	***15.17***	***16.59***
Not recyclables	80.05	83.92	85.23	83.28	84.83	83.41
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

3.4 Confidence intervals

Table 8 provides the confidence intervals at a 90% confidence level for the main target materials. The audit involved sorting approximately 3.7 tonnes of MRF Residuals material across 5 days of generation in 31 samples.

The hazardous category, which is of main concern to NSW EPA has the lowest confidence interval of 1.6%, with a maximum of 1.9% hazardous material at the upper confidence interval value at 90% certainty. The mean value is 0.3%.

The renewable combustible materials (eligible waste fuels) have a larger confidence interval of up to 13.1%. There is reasonably high percentage of renewable material at the mean and upper confidence values, but not at the lower confidence value. The values range from a lower confidence interval of 14.1% to an upper confidence value or 40.3%. The mean is approximately a quarter of the MRF Residuals.

However, the material very combustible. At the lower confidence value the material is 76.9% combustible and at the upper confidence value is 96.9% combustible. The mean is 86.9%. If glass other (which is mainly glass fines was not placed into the loads then the MRF Residuals audited would have had a mean of 91.6% combustible material.

Table 8 - Results – confidence intervals

Materials	Confidence interval	Mean percentage	Lower value	Upper value
Combustible materials				
Renewable non-hazardous (eligible waste fuels)	+/-13.1%	27.2	14.1	40.3
Non-renewable non-hazardous	+/-14.7%	55.6	40.9	70.3
Non-renewable WEEE	+/-5.6%	3.7	0.0	9.3
Hazardous	+/-1.6%	0.3	0.0	1.9
Combustible sub-total	***+/-10.0%***	***86.9***	***76.9***	***96.9***
Non-combustible materials				
Not combustible	+/-10.0%	13.2	3.2	23.2
Recyclable materials – paper, cardboard and containers				
Recyclable materials	+/-11.0%	16.6	5.6	27.6

4 Comments

The MRF Residuals are currently being sent to landfill after a substantial post-collection recovery effort in the third party MRF. There is the potential to use this material for energy generation. A robust audit sampling regime was implemented covering the MRF Residuals generation cycle as the output from the MRF during the MRF operating hours. The audit data represents the audit week.

These audit results show the MRF Residuals has:

- A very high level of combustible material, potentially suited to an energy from waste facility.
- A high level of combustible material that were eligible waste fuels based on ORER (2001) at the mean and upper confidence level, but not at the lower confidence level.
- A substantial level of recyclables that were not able to be processed in a MRF but that are combustible and are currently being landfilled.
- No visually identifiable lead painted wood waste in the audit week in the samples audited. There was also no visually identifiable chemicals, paint and batteries car.
- A low level of hazardous waste, although there was a very limited amount of medical waste, which may have been unused and potentially classifiable as other rigid plastics excluding EPS, occasional batteries other and one instance of visually identifiable asbestos. These materials could be managed through onsite removal or through safe combustion in the processing technology option if the material was accepted for processing instead of disposal. However, small batteries may be difficult to manage.
- A high amount glass which is not combustible. It may be feasible and desirable for DADI to request the MRF to deliver loads with no glass other (i.e. glass fines). If glass other was not placed into the loads then the MRF Residual audited would have had a mean of 91.6% combustible material.

The presence of asbestos, lead painted wood and other hazardous compounds should be tested in a laboratory. The moisture and chemical characteristics of the waste were not measured in this audit.

The MRF Residuals is a post-processing material. The waste is highly mixed because it has been stockpiled, loaded into the MRF, picked on a conveyor and transported out of the MRF technology in trucks. It was then tipped, sampled and mixed for audit. This processing assists to make the material more consistent than it would have been in the incoming loads at the MRF.

The processing technology should be assessed for its ability to handle the waste composition.

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Appendix 1

This Appendix provides a separate raw data file in Excel.

Appendix 2

This Appendix provides the aggregation of the sorting categories for reporting.

Table 9 - Aggregation of sorting categories for combustibility and recyclability

Summary ^	Sorting category and number		Combustibility	Recyclability
Paper	1	Recyclable paper	Yes	Yes
	2	Disposable contaminated (soft) paper	Yes	No
	3	Cardboard	Yes	Yes
	4	Liquid paperboard	Yes	Yes
	5	Nappies	Yes	No
Wood/timber	6	Untreated wood – MDF board	Yes	No
	7	Untreated wood – All other	Yes	No
	8	Treated wood – CCA treated	Yes	No
	9	Treated wood – lead painted	Yes	No
Plastic	10	Recyclable plastic containers excl. EPS	Yes	No
	11	Other rigid plastics excl. EPS	Yes	Yes
	12	EPS	Yes	No
	13	Soft (films) plastics	Yes	No
	14	Composite plastics	Yes	No
Metal (Ferrous and non-ferrous()	15	Recyclable metal containers	No	Yes
	16	Composite	No	No
	17	Other metals	No	No
Organic (not Wood/ timber)	18	Food/kitchen – vegetable	Yes	No
	19	Food/kitchen – meat	Yes	No
	20	Garden/ vegetation	Yes	No
	21	Textiles/rags	Yes	No
	22	Rubber	Yes	No
	23	Leather	Yes	No
WEEE	24	E-waste	Yes <	No
	25	Mobiles	Yes	No
	26	Toners	Yes	No
Hazardous	27	Medical	Yes	No
	28	Chemicals	Yes	No
	29	Paint	Yes	No
	30	Asbestos	No	No
	31	Batteries car	Yes	No
	32	Batteries other	Yes	No
	33	Other hazardous	Yes	No
Glass	34	Glass containers	No	Yes
	35	Glass other	No	No
Other (including Earth and Building Materials)	36	Insulation	Yes	No
	37	Carpet/underlay	Yes	No
	38	Compounds (excl. composite plastic, composite metal, e-waste)	No	No
	39	Asphalt	No	No
	40	Inert incl. non-hazardous building waste	No	No

< These materials are classified as combustible in ORER (2001). In practice, a fraction of the material may not combust, such as metal and glass components of e-waste.

2016

Report:

Audit of potential feedstock for The Next Generation energy-from-waste facility

for

Dial A Dump Industries

A.Prince Consulting
ABN 96 077 504 226
TH 4 / 28 West Street
Nth Sydney NSW 2060
P: +61 2 9907 0994
F: +61 2 9907 0330
E: admin@aprince.com.au
W: www.aprince.com.au

This report was researched and prepared by

A.Prince Consulting Pty Ltd
ABN 96 077 504 226
Email: admin@aprince.com.au
Web: www.aprince.com.au
TH 4/28 West St
North Sydney NSW 2060
Phone: (02) 9907 0994
Fax: (02) 9907 0330

for:

Pablo Garces
Senior Environmental Engineer
Environ Consulting Services
Phone 0409 538 812
Email PABLOG@ECS.Sydney

Document status

Rev. no.	Document purpose	Author	Peer Review	Editor	Date
1	Draft	M. Cumming	Dr Amardeep Wander		August 2016
2	Final	M. Cumming	Dr Amardeep Wander	H. Cooney	September 2016

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EXECUTIVE SUMMARY

Composition of shredder floc

- The results summarised in this report arise from 19 samples collected over six days with a total weight of 601.0kg.
- The minimum individual sample weight was 7.8kg and the maximum was 43.2kg.
- After sorting, the entire summed sorted sample weighed 582.0kg. The loss of weight during sorting (19.0kg, 3.2%) was most likely due to evaporation of small quantities of moisture. All analysis presented in this report refers to the post-sorting weights.
- APC sorted the 582.0kg of shredder floc tipped at the Genesis landfill in Eastern Creek over six (6) days in July 2016.
- The majority (58%) of shredder floc is fines. There are also substantial amounts of non-polystyrene plastics (21%) and textiles (11%). These three materials make up 90% of shredder floc.
- The remainder is made up of rubber/leather (5%), wood waste (3%), metal (1%), polystyrene (1%) and paper/cardboard (0.4%).
- When the samples were tested in the laboratory, the metal content of the shredder floc samples ranged from 0.6% to 9.7%, with an average content of 2.9% metals.

Moisture content

- The moisture content of the floc samples, including metals, ranged from 8.8% to 15.6%, with an average moisture content of 12.8%.
- When metals are excluded, the moisture content ranged from 9.8% to 16.1%, with an average of 13.2%.

Ash yield

- The ash yield of the floc samples, including metals, ranged from 41.4% to 74.0%, with an average ash yield of 58.5%.
- When metals are excluded, the ash yield ranged from 40.3% to 70.3%, with an average of 57.0%.

Gross wet calorific value

- The gross wet calorific value of the floc samples, including metals, ranged from 8.7 to 16.7 MJ/kg, with an average of 12.8 MJ/kg.
- When metals are excluded, the range was 8.8 to 17.4 MJ/kg, with an average of 13.2 MJ/kg.

Net wet calorific value

- The net wet calorific value of the floc samples, including metals, ranged from 7.8 to 15.7 MJ/kg, with an average of 11.6 MJ/kg.
- When metals are excluded, the range was 7.8 to 16.3 MJ/kg, with an average of 12.0 MJ/kg.

Introduction

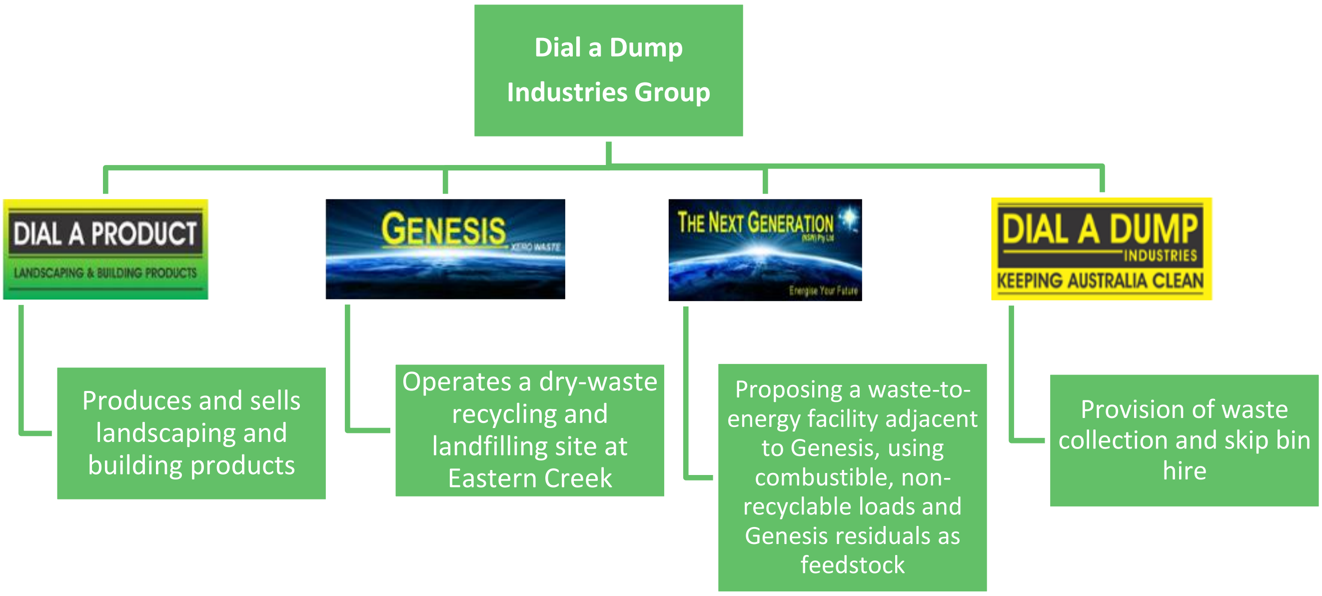
1

1. INTRODUCTION

The Next Generation NSW Pty Ltd (TNG) is proposing to construct and operate an Energy-from-Waste (EFW) electricity generation facility at Honeycomb Drive, Eastern Creek, located within the M7 Business Hub.

The site is south of the M4 Motorway and adjacent to the Genesis Xero Waste recycling and landfill facility. Both Genesis Xero Waste and The Next Generation are part of the Dial a Dump Industries group, as shown in Figure 1 below.

Figure 1 Companies within Dial a Dump Industries

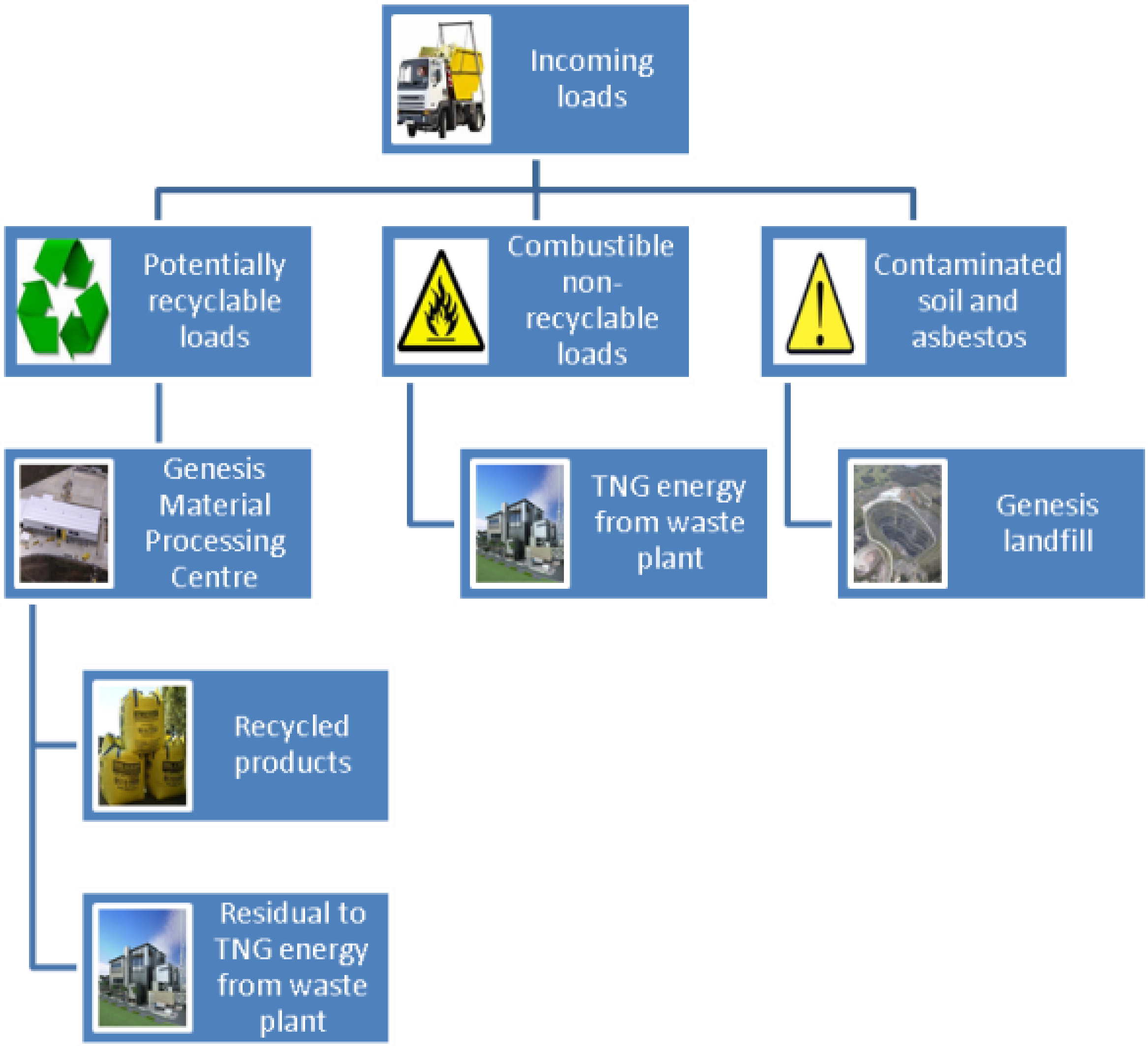


The proposed EFW facility aims to utilise waste that is currently being disposed to the Genesis landfill (either directly or as residual from the Genesis Material Processing Centre) and to use the power and heat generated to provide a level of energy self-sufficiency within the immediate business precinct.

The EFW facility will have the capacity to receive 800,000 to 1,000,000 tonnes per year of waste. It will receive combustible, non-recyclable loads currently destined for the Genesis landfill, as well as residual material conveyed from the Genesis Materials Processing Centre, as shown in Figure 2.

The EFW plant will use thermal conversion to produce electrical power from the feedstock waste.

Figure 2 Proposed treatment of incoming waste loads



1.1 About this audit

In order to move forward with the EFW project and achieve planning approval, the NSW EPA (and its consultants) has raised a range of concerns. Notably, these relate to:

a) the quantity of the different constituent streams of waste available to qualify as eligible waste fuels;
b) the content of certain elements of the eligible waste fuel streams; and
c) the procedural measures which will be in place to ensure consistency.

In order to provide statistically significant data with respect to (a) and (b) above, TNG engaged A.Prince consulting (APC) to undertake a waste audit to establish the quantity and quality of the components of some of the proposed feedstock waste streams.

This audit targeted one of the potential feedstock waste streams: shredder floc. More detail about current amounts and treatment of shredder floc is in Figure 3.

Figure 3 Shredder floc

waste from car and metal shredding → 150–200 tonnes per day → delivered in trucks → average six (6) incoming loads per day → currently disposed directly to Genesis landfill with no prior sorting/ treatment

There are several other potential feedstocks which were not part of this audit.

Image 2 Artists impression of EFW plant

Image 1 Genesis landfill showing chute from Material Processing Facility

A variety of audit methods were used to obtain the required results, using a combination of physical sorting and laboratory testing. Figure 4 shows the methods used and where they are reported.

Figure 4 Audit methods and reporting structure

Physical sorting to determine composition

- Sample collected by Environ
- Physical sorting done by APC at the Genesis site
- Results are reported in this report

Lab testing for moisture content and calorific value

- Sample collected by Environ
- Testing done at HRL laboratory
- Results are reported in this report

Image 3 The Genesis Material Processing Centre

Methodology

2

2. METHODOLOGY

2.1 Project inception meeting

Prior to project commencement, a project inception meeting was held with APC, Dial a Dump (DADI) and Environ Consulting Services (ECS) on 4 August 2016. This meeting confirmed project requirements, sampling and sorting logistics, documentation and the project timeline. Attendees were:

Environ
- Pablo Garces

APC
- Anne Prince
- David Hitchcock
- Dr Ian Nivison-Smith

DADI
- Alicia Marix-Evans
- Rodney Johnson

2.2 Staff inductions

APC staff received site-specific safety inductions at the Genesis site. APC provided Safe Work Method Statements for the sorting component of the audit.

2.3 Sample collection

The physical collection of the samples for both the waste audit and the lab analysis was undertaken by a representative of ECS, on the following dates:

Sat 13 Aug → Mon 15 Aug → Tue 16 Aug → Wed 17 Aug → Thu 18 Aug → Fri 19 Aug

The sampling regimes for the samples to be physically sorted and the samples to be sent for laboratory testing are described in Figure 5 below.

The samples were collected at the base of the Genesis landfill. The trucks tipped their loads at the base of the landfill and the sample was taken. An APC staff member accompanied the ECS representative on one trip to the landfill base to observe the sample retrieval process and take images for incorporation into this report.

Figure 5 Sampling regime

Sampling for the physical sorting samples

- Approx. three (3) incoming loads were sampled each day for six (6) days (total 19 loads were sampled)
- Trucks selected at random
- Truck tipped all load on floor of pit
- Each sample was approx. 35kg (x 3 per day to provide total daily sample of approx. 100kg)
- To make up each 35kg sample, 10 small samples were taken from different places in the load
- Each 35kg sample was placed in 200-micron thickness plastic bags
- The bag was labelled with date, sample time as well as the truck rego
- At the end of the day, the weighbridge was asked for the docket in order to get the total size of the sample from which the subsample was taken
- The sample was taken to the APC sorting location

Sampling for the laboratory analysis samples

- Sampling for the laboratory analysis was conducted by Environ Consulting Services in accordance with HRL requirements and as directed by European engineers consulting to the project.
- The lab samples were a subsample of the physical sorting samples – that is, each sample collected included approximately 35kg to be sorted and 6kg to be sent to the lab.
- 17 samples were sent for testing.
- The last sample was not sent to the laboratory due to late arrival of the floc trucks for sample collection.

The initial weighing of 19 samples produced a total weight of 601.0kg, with a minimum individual sample weight of 7.8kg and a maximum of 43.2kg. After sorting, the entire summed sorted sample weighed 582.0kg. The loss of weight during sorting (19.0kg, 3.2%) was most likely due to evaporation of small quantities of moisture. All further analysis refers to the post-sorting weights.

Image 4 A truckload of shredder floc waste enters the landfill base

Image 5 This load was selected for sampling

Image 6 An ECS representative collects samples for the audit

2.4 Waste sorting

Sorting was undertaken by APC staff at the Genesis site at Honeycomb Drive, Eastern Creek, on the 17, 18 and 19 August 2016. Two bunkers at the Genesis facility were dedicated to APC for the sorting phase: one for sorting, and one for storage.

Image 7 The sorting location at the Genesis facility

The waste samples were manually sorted into eight categories as shown in Figure 6. These were selected by ECS, APC and DADI based on the categories in the Office of the Renewable Energy Regulator (ORER) *Guidelines for determining the renewable components in waste for electricity generation*. The categories in the *Guidelines* were modified for this audit based on what components were likely to be present in the feedstock waste streams audited.

Figure 6 Sorting categories

ORER eligible categories	Sorting categories for this audit
• paper/cardboard	• paper/cardboard
• food/kitchen	• textiles
• garden/vegetation	• wood waste
• wood/timber	• rubber/leather
• textiles/rags	• polystyrene
• rubber	• other plastic
• plastic	• metal
• polystyrene	• inert (fines, <10mm)

A 10mm sieve was used to separate materials. Separated materials were placed in appropriate containers, weighed on a set of electronic scales and the weight recorded.

Image 8 Samples are sorted

2.5 Data verification accuracy and quality assurance

A number of techniques and procedures were used to check and verify data. At the data-entry stage, each coded sheet on which sorting data was recorded was checked against the total weight for that sample and any significant differences were investigated. Data was analysed by APC's statistician using Excel.

Results – shredder floc composition

3

3. RESULTS – SHREDDER FLOC COMPOSITION

3.1 Composition of shredder floc

The majority (58%) of shredder floc is fines. There are also substantial amounts of non-polystyrene plastics (21%) and textiles (11%). These three materials make up 90% of shredder floc.

The remainder is made up of rubber/leather (5%), wood waste (3%), metal (1%), polystyrene (1%) and paper/cardboard (0.4%). The detailed composition by sample, as well as the corresponding laboratory results, is presented in Appendix A.

Figure 7 Composition of shredder floc

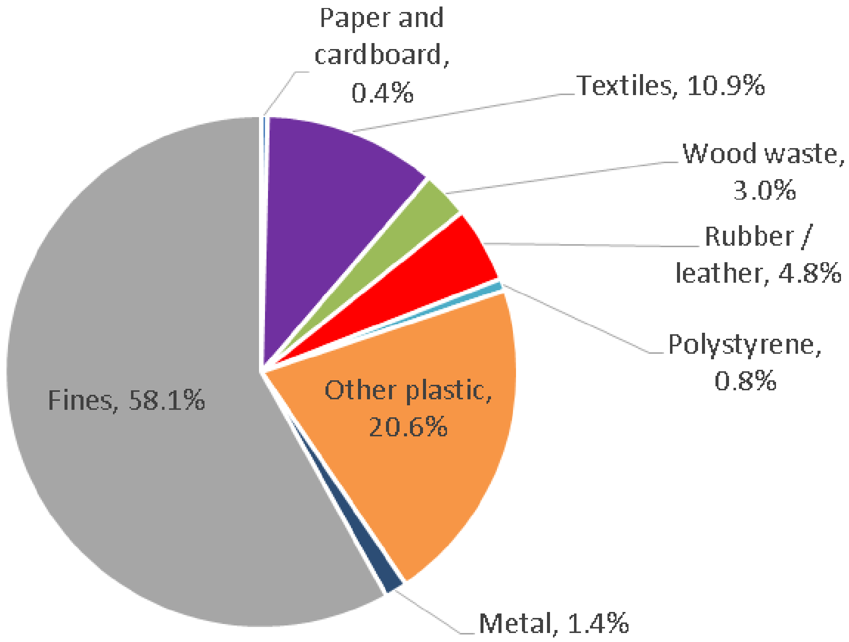


Image 9 58% of floc is fines

Image 10 Plastics sorted from the floc

Image 11 Rubber sorted from the floc

Image 12 Polystyrene sorted from the floc

Image 13 Timber sorted from the floc

Image 14 Paper and cardboard

Image 15 A floc sample

The following table shows the weight, percentage and minimum and maximum proportions of materials found in the 19 samples.

Table 1 Shredder floc composition including range

Material	Weight audited (kg)	Per cent	Range
Fines	338.1	58.1%	35.7%–82.5%
Other plastic	120.1	20.6%	11.7%–32.1%
Textiles	63.6	10.9%	1.0%–23.9%
Rubber/leather	28.0	4.8%	1.5%–14.0%
Wood waste	17.4	3.0%	0.6%–4.8%
Metal	8.2	1.4%	0.5%–2.8%
Polystyrene	4.4	0.8%	0.3%–6.4%
Paper and cardboard	2.2	0.4%	0.0%–0.6%
Total	**582.0**	**100.0%**	

3.2 Confidence intervals

A more statistically accurate way of portraying variability between samples is to calculate confidence intervals. Upper and lower 95% confidence intervals show the region within which we would expect the true value of an estimate to lie in 95% of cases. Table 2 shows the percentages of each material with lower and upper 95% confidence intervals.

Table 2 Confidence intervals

Material	Average	95% CI	Lower limit	Upper limit
Fines	58.1%	6.9%	51.2%	65.0%
Other plastic	20.6%	3.1%	17.6%	23.7%
Textiles	10.9%	3.2%	7.7%	14.1%
Rubber/leather	4.8%	1.3%	3.6%	6.1%
Wood waste	3.0%	0.5%	2.5%	3.5%
Metal	1.4%	0.3%	1.1%	1.7%
Polystyrene	0.8%	0.6%	0.1%	1.4%
Paper and cardboard	0.4%	0.1%	0.3%	0.5%

The following charts show the percentage composition and confidence intervals for each material. The materials are shown on two separate charts to maintain scale: materials that were present in small amounts and materials that were present in large amounts.

Figure 8 Average percentage by weight of materials, with lower and upper 95% confidence limits – materials present in large amounts

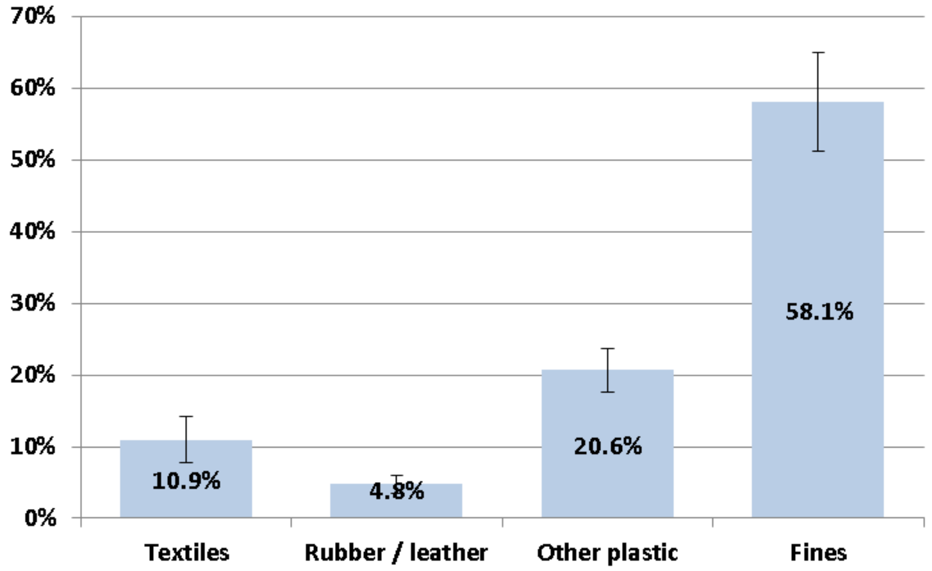
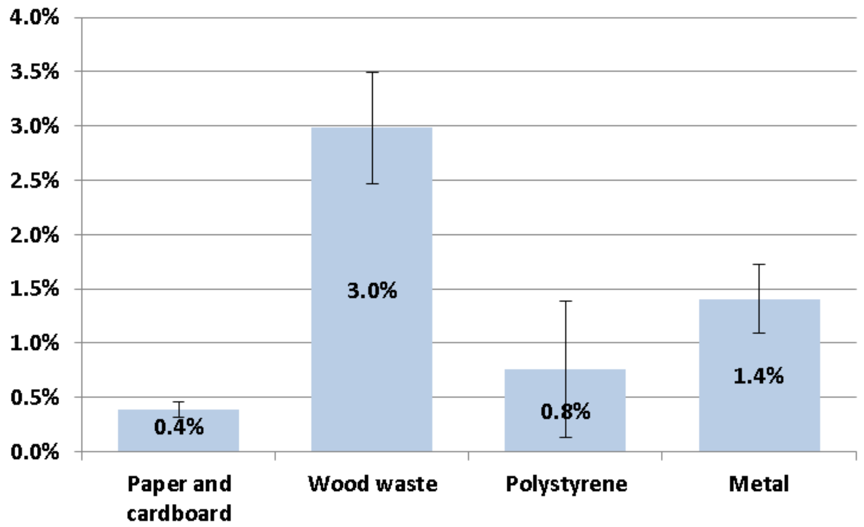


Figure 9 Average percentage by weight of materials, with lower and upper 95% confidence limits – materials that were present in small amounts



This audit was carried out by skilled staff under strictly controlled conditions with a relatively small number of sorting categories. The sample number (n=19) can be judged as quite sufficient for this kind of data collection. The comparatively narrow confidence intervals indicate that the accuracy of these results is very acceptable. The only component with a wide confidence interval was polystyrene that indicates a small percentage of material that is not very evenly distributed within the samples collected.

Results – metals, moisture content, ash yield and calorific value

4

4. RESULTS – METALS, MOISTURE, ASH AND CALORIFIC VALUE

4.1 Laboratory analysis

Of the 19 samples collected for physical sorting, 17 sub-samples of those samples were sent for laboratory analysis to HRL Laboratories. The results reported in this report are:

- % metal
- total moisture
- ash yield
- calorific value

The laboratory testing results for metal content, moisture content, ash yield and calorific value are contained in Appendix A*.*

4.2 Percentage metals

The 17 samples tested had a metals content of between 0.6% and 9.7%, with an average of 2.9% and a median of 1.8%. This is higher than the metals result from the physical sorting (1% metals), as the physical sort only looked for obvious metal parts, whereas the lab testing was able to detect much smaller metal fragments.

4.3 Net wet calorific value

Including metals, the average net wet calorific value is 11.6 MJ/kg. Excluding metals, the average net wet calorific value is 12 MJ/kg.

Table 3 Net wet calorific value

Net wet CV	Range	Average	Median
With metals	7.8 to 15.7 MJ/kg	11.6	10.8
Without metals	7.8 to 16.3 MJ/kg	12.0	11.0

4.4 Total moisture

Including metals, the average moisture content is 12.8%. Excluding metals, the average moisture content is 13.2%.

Table 4 Moisture content

Total moisture	Range	Average	Median
With metals	8.8% to 15.6%	12.8%	12.7%
Without metals	9.8% to 16.1%	13.2%	12.9%

4.5 Ash yield

Including metals, the average ash yield is 58.5%. Excluding metals, the average ash yield is 57.0%.

Table 5 Ash yield

Ash yield	Range	Average	Median
With metals	41.4% to 74.0%	58.5%	60.8%
Without metals	40.3% to 73.0%	57.0%	57.9%

4.6 Gross wet calorific value

Including metals, the average gross wet calorific value is 12.8 MJ/kg. Excluding metals, the average gross wet calorific value is 13.2 MJ/kg.

Table 6 Gross wet calorific value

Gross wet CV	Range	Average	Median
With metals	8.7 to 16.7 MJ/kg	12.8 MJ/kg	11.8 MJ/kg
Without metals	8.8 to 17.4 MJ/kg	13.2 MJ/kg	12.1 MJ/kg

Appendices

5

APPENDIX A DETAILED DATA – SHREDDER FLOC COMPOSITION

Sample record number	1		2		3		4		5		6		7		8		9	
Sorting date	19/08/2016		19/08/2016		19/08/2016		18/08/2016		18/08/2016		18/08/2016		18/08/2016		18/08/2016		18/08/2016	
Sampling date	15/08/2016 @ 9.55		15/08/2016 @3.37pm		15/08/2016 @ 7.40 am		16/8/2016 @7.28		16/8/16 @6.40		16/8/16 @10.12		16/08/2016		17/08/2016		17/08/2016	
Truck registration	PFF026		PFF 026		PFF026		PFF026		PFF029		PFF026		PFF026		PFF026		Arrived same time as others	
	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%
Paper and cardboard	0.132	0.41%	0.116	0.57%	0.088	0.23%	0.13	0.50%	0.052	0.43%	0.048	0.13%	0	0.00%	0.06	0.23%	0.134	0.50%
Textiles	4.88	15.11%	1.274	6.25%	5.728	14.86%	0.9	3.46%	0.124	1.03%	0.53	1.40%	0.578	7.41%	0.61	2.30%	3.408	12.80%
Wood waste	0.982	3.04%	0.65	3.19%	1.326	3.44%	0.638	2.45%	0.072	0.60%	0.48	1.26%	0.242	3.10%	0.33	1.24%	0.816	3.07%
Rubber/leather	1.112	3.44%	0.916	4.49%	1.266	3.28%	0.38	1.46%	0.256	2.12%	0.968	2.55%	0.132	1.69%	1.32	4.98%	3.72	13.97%
Plastic	7.56	23.41%	4.654	22.84%	8.812	22.86%	3.452	13.28%	1.42	11.79%	4.444	11.71%	0.5	6.41%	3.862	14.57%	7.816	29.36%
Polystyrene	0.172	0.53%	0.08	0.39%	0.184	0.48%	0.228	0.88%	0.058	0.48%	0.106	0.28%	2.502	32.09%	0.156	0.59%	0.074	0.28%
Metal	0.488	1.51%	0.344	1.69%	0.214	0.56%	0.538	2.07%	0.122	1.01%	0.27	0.71%	0.08	1.03%	0.176	0.66%	0.734	2.76%
Inert	16.964	52.54%	12.346	60.58%	20.924	54.29%	19.726	75.89%	9.944	82.54%	31.116	81.97%	3.764	48.27%	20	75.43%	9.92	37.26%
Total weight	32.29	100.00%	20.38	100.00%	38.542	100.00%	25.992	100.00%	12.048	100.00%	37.962	100.00%	7.798	100.00%	26.514	100.00%	26.622	100.00%
HRL lab sample number	5		6		4		8		7		9		N/A		10		11	
Metal %	3.6		1.1		1.7		1.8		4		1.6		Small make-up sample taken to ensure a total sample greater than 600kg.		2.8		9.7	
Moisture without metal%	11.9		13.4		13.9		12		12.6		12.9				12.2		9.8	
Moisture with metal%	11.5		13.3		13.7		11.8		12.1		12.7				11.9		8.8	
Ash yield without metal%	55.9		67.9		48.6		50.1		52.3		59.9				40.3		43.7	
Ash yield with metal%	57.9		68.6		49.4		51		54.4		60.9				41.4		47.9	
Gross dry calorific without metal MJ/kg	18.01		17.56		16.26		16.16		19.96		15.53				18.08		18.04	
Gross dry calorific with metal MJ/kg	17.36		17.37		15.99		15.87		19.17		15.28				17.58		16.29	
Gross wet calorific without metal MJ/kg	15.9		15.2		14		14.2		17.4		13.5				15.9		16.3	
Gross wet calorific with metal MJ/kg	15.3		15		13.8		13.9		16.7		13.3				15.5		14.7	
Net wet calorific without metal MJ/kg	14.8		14.3		12.9		12.9		16.3		12.3				14.5		15.1	
Net wet calorific with metal MJ/kg	14.3		14.1		12.7		12.7		15.7		12.1				14.1		13.6	

Sample record number	10		11		12		13		14		15		16		17		18		19		TOTAL	
Sorting date	18/08/2016		19/08/2016		19/08/2016		19/08/2016		19/08/2016		19/08/2016		19/08/2016		17/08/2016		17/08/2016		17/08/2016			
Sampling date	17/08/2016		18/08/2016 @ 9.05		18/08/2016 @7.17		18/08/2016 @ 9.15 am		19/08/2016 @ 7.14		19/08/2016 @10.23		19/08/2016 @ 9.15		13/08/2016		13/08/2016		13/08/2016			
Truck registration	PFF026		PFF027		PFF026		CC56QR		PFF026		PFF026		PFF027		PFF076		PFF027		PFF026			
	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%
Paper and cardboard	0.076	0.30%	0.184	0.59%	0.118	0.3%	0.19	0.55%	0.184	0.45%	0.192	0.44%	0.16	0.46%	0.134	0.39%	0.13	0.37%	0.116	0.34%	2.32	0.39%
Textiles	5.958	23.9%	5.182	16.62%	7.386	18.7%	6.33	18%	6.604	16.00%	5.556	12.77%	5.35	15.13%	0.944	2.76%	1.08	3.16%	1.134	3.29%	65.48	10.91%
Wood waste	0.328	1.32%	1.504	4.82%	1.54	3.9%	1.66	4.72%	1.692	4.10%	1.25	2.87%	1.04	2.94%	0.874	2.56%	0.94	2.74%	0.988	2.87%	17.87	2.98%
Rubber/leather	2.106	8.45%	1.814	5.82%	1.866	4.73%	1.71	4.87%	2.076	5.03%	1.524	3.50%	1.32	3.73%	1.498	4.38%	1.94	5.66%	2.056	5.97%	28.82	4.80%
Plastic	7.134	28.6%	8.082	25.93%	7.892	20%	7.9	22.48%	9.784	23.7%	10.71	24.61%	10.35	29.23%	4.048	11.8%	4.61	13.41%	5.112	14.84%	121.69	20.28%
Polystyrene	0.136	0.55%	0.696	2.23%	0.308	0.78%	0.51	1.45%	0.276	0.67%	0.23	0.53%	0.194	0.55%	0.114	0.33%	0.2	0.58%	0.2	0.58%	6.861	1.14%
Metal	0.296	1.19%	0.39	1.26%	0.72	1.83%	0.29	0.84%	1.036	2.51%	0.29	0.66%	0.19	0.53%	0.618	1.81%	0.57	1.65%	0.832	2.42%	8.44	1.41%
Inert	8.892	35.7%	13.32	42.72%	19.62	49.7%	16.54	47.1%	19.63	47.55%	23.77	54.62%	16.78	47.42%	25.936	75.9%	24.87	72.44%	24.004	69.69%	348.49	58.09%
Total weight	24.93	100%	31.17	100%	39.45	100%	35.14	100%	41.28	100%	43.52	100%	35.39	100%	34.166	100%	34.34	100%	34.442	100%	599.97	100%
HRL lab sample number	**12**		**14**		**13**		**15**		**16**		**Not sent**		**17**		**1**		**2**		**3**		**3**	
Metal %	5		3.1		1.3		2.5		6				1.8		0.6		1.1		1.4			
Moisture without metal	14.2		16.1		14.9		13.4		15.9				11.4		12.8		12.8		13.4			
Moisture with metal	13.5		15.6		14.7		13.1		14.9				11.2		12.7		12.7		13.2			
Ash yield without metal	57.9		53.6		62.1		63.3		60.1				44.2		69.1		66.2		73			
Ash yield with metal	60.8		55.2		62.9		64.9		63.7				45		69.5		66.9		74			
Gross dry calorific without metal	12.69		14.01		12.38		13.93		14.33				13.59		10.12		13.29		13.83			
Gross dry calorific with metal	12.06		13.58		12.22		13.58		13.47				13.34		10.06		13.14		13.63			
Gross wet calorific without metal	10.9		11.8		10.5		12.1		12				12		8.8		11.6		12			
Gross wet calorific with metal	10.4		11.4		10.4		11.8		11.3				11.8		8.7		11.5		11.8			
Net wet calorific without metal	9.7		10.4		9.3		10.6		11				10.8		7.8		10.4		11			
Net wet calorific with metal	9.2		10.1		9.2		10.3		10.3				10.6		7.8		10.3		10.8			

APPENDIX B LABORATORY RESULTS

(See attached)