

# **HOFSTEDE & ASSOCIATES**

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*WASTE MANAGEMENT & POLLUTION CONTROL*



**Waste Authority**

**Regional Investment Program Funding**

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# **TAMALA PARK LANDFILL – MIXED BULKY WASTE AUDIT**

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**HOFSTEDE & ASSOCIATES**

**FOR**

**MINDARIE REGIONAL COUNCIL**

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# **HOFSTEDE & ASSOCIATES**

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*WASTE MANAGEMENT & POLLUTION CONTROL*



## EXECUTIVE SUMMARY

Hofstede & Associates was engaged by Mindarie Regional Council to conduct a waste audit of commercial mixed bulky waste entering the Tamala Park Landfill site.

The purpose of the study was to identify and quantify waste fractions that can be removed from the waste stream, in order for the MRC to further develop methods of resource recovery and hence extend the remaining life of the Tamala Park landfill site.

The Tamala Park Landfill site was audited over a period of twenty five days. Auditors interviewed each commercial vehicle driver for the following information:

1. **Suburb of origin**
2. **Vehicle type**
3. **Source process**
  - **Demolition site**
  - **Construction site**
  - **Workshop waste**
  - **General clean-up (Commercial)**
  - **General clean-up (Residential)** – NB: This category represents all mixed waste brought in from private households by commercial operators. It is not an indication of waste brought in by householders direct.
  - **Other**
4. **Waste weight and truck volume**

Two representative samples were taken to identify and quantify bulky waste fractions; the first from the ***open skip/tipper commercial vehicles*** (who dispose of waste directly into the landfill cells), and the second from the ***self haul/non-tipper commercial vehicles*** (who dispose of waste at the Tamala Park Transfer Station, for final disposal into the landfill cells). The first of these samples was categorised using an excavator at the landfill site, so only those fractions that could be easily separated by such mechanical means were identified, those being:



- Timber
- Plastic
- Concrete
- Metal
- Green-Waste
- Carpet / Underlay
- Soft Furnishings/Mattresses
- Tyres
- Wall sheeting (Fibro, Gyprock etc)
- Residue/Mixed General Rubbish

The second sample was categorised through visual inspection of waste, so in addition to the above waste fractions, the auditors were also able to identify the following waste fractions in the sample from self haul/non-tipper vehicles:

- Glass
- Styrofoam
- Pallets
- Insulation
- Tiles/Bricks/Rubble
- Organics (inc. paper, soil etc)

The audit covered 595 commercial mixed bulky waste loads, representing 44% of all commercial vehicles entering the site during the twenty five day period. All 1351 commercial vehicles carrying mixed bulky waste loads to the site during the audit period were weighed; and all 1351 drivers were interviewed for collection of suburb and waste source data. This data, along with the commercial mixed bulky waste data collected from the Recycling Centre of Balcatta, was used to estimate total annual commercial mixed bulky waste being disposed of at Tamala Park Landfill site, as summarised:



**Table 1 Estimated Total Commercial Mixed Bulky Waste Delivered to Tamala Park Landfill**

|  |         |
|--|---------|
| Estimated Annual Number of Commercial Mixed Bulky Waste Deliveries | 38,558  |
| Estimated Annual Total Nett Weight (T)                             | 41,147  |
| Estimated Annual Total Volume (m <sup>3</sup> )                    | 278,840 |

### **OPEN SKIP/TIPPER COMMERCIAL VEHICLES – REPRESENTATIVE SAMPLE**

Approximately 34% (63 tonnes) of the total open skip/tipper vehicle waste sample weight was categorized into separate recyclable waste fractions, with the remaining 66% (124 tonnes) classed as residual waste. The largest component of the recoverable waste was **mixed timber** (20% of total sample weight).

Upon visual inspection, it was identified that a further 96% (120 tonnes) of waste from the residual waste fraction could actually be classed as recoverable material, leaving only 4% of the residual waste fraction to be classified as landfillable waste – view **Table 2**:



**Table 2 Open Skip/Tipper Representative Sample - Residual Waste Characterisation of Recoverable vs. Landfillable Fractions**

|   | Annual Volume of Residual Waste (%) |
|---|-------------------------------------|
| <b>Total Biodegradable Waste Fraction</b> | 54                                  |
| <b>Total Recyclable Waste Fraction</b>    | 42                                  |
| <b>Total Landfillable Waste Fraction</b>  | 4                                   |

73% of all open skip/tipper commercial vehicle drivers reported their loads to have come from **general clean-ups from residential sites**; this was clearly the largest sector of reported waste sources.

The suburb data for the open skips/tipper commercial vehicles revealed the following 10 suburbs to be the greatest sources of mixed bulky waste:

**Table 3 Open Skip/Tipper Representative Sample - Top ten waste source suburbs**

| SUBURB                               | # TIPPERS | % TIPPERS  |
|--------------------------------------|-----------|------------|
| <b>Multiple Suburbs (within MRC)</b> | <b>41</b> | <b>8</b>   |
| <b>Joondalup</b>                     | <b>25</b> | <b>4.9</b> |
| <b>Wanneroo</b>                      | <b>25</b> | <b>4.9</b> |
| <b>Butler</b>                        | <b>20</b> | <b>3.9</b> |
| <b>Mindarie</b>                      | <b>18</b> | <b>3.5</b> |
| <b>Quinns Rocks</b>                  | <b>18</b> | <b>3.5</b> |
| <b>Wangara</b>                       | <b>18</b> | <b>3.5</b> |
| <b>Ocean Reef</b>                    | <b>17</b> | <b>3.3</b> |
| <b>Clarkson</b>                      | <b>16</b> | <b>3.1</b> |
| <b>Osborne Park</b>                  | <b>13</b> | <b>2.5</b> |



## SELF HAUL/NON-TIPPER COMMERCIAL VEHICLES – REPRESENTATIVE SAMPLE

The largest sector of the waste (by volume – m<sup>3</sup>) from the self haul/non-tipper representative sample was **green-waste** (36% of total sample volume), followed by **cardboard** (11% of total sample volume) and **timber** (11% of total sample volume).

A summary of the recoverable vs. landfillable waste fractions by volume (m<sup>3</sup>) is presented :

**Table 4 Self Haul/Non-tipper Representative Sample – Mixed Bulky Waste Characterisation of Recoverable vs. Landfillable Fractions**

|   | Annual Volume (%) | Annual Volume (m3) |
|---|-------------------|--------------------|
| <b>Total Biodegradable Waste Fraction</b> | 41                | 16,510             |
| <b>Total Recyclable Waste Fraction</b>    | 56                | 22,551             |
| <b>Total Landfillable Waste Fraction</b>  | 3                 | 1208               |

57% of all self haul/non-tipper commercial vehicle drivers reported their loads to have come from **general clean-ups from residential sites**; this was again clearly the largest sector of reported waste sources, followed by **general clean-ups from commercial sites**.

The suburb data for the self haul/non-tipper commercial vehicles revealed the following 12 suburbs to be the largest sources of mixed bulky waste (**Table 5**):



**Table 5 Self Haul/Non-tipper Representative Sample - Top twelve waste source suburbs**

| <b>SUBURB</b> | <b># NON-TIPPERS</b> | <b>% NON-TIPPERS</b> |
|---------------|----------------------|----------------------|
| Joondalup     | 79                   | 9.4                  |
| Mindarie      | 48                   | 5.7                  |
| Quinns rocks  | 47                   | 5.6                  |
| Clarkson      | 42                   | 5.0                  |
| Wangara       | 37                   | 4.4                  |
| Kinross       | 31                   | 3.7                  |
| Wanneroo      | 30                   | 3.6                  |
| Butler        | 26                   | 3.1                  |
| Ocean reef    | 21                   | 2.5                  |
| Heathridge    | 18                   | 2.1                  |
| Iluka         | 18                   | 2.1                  |
| Kinglsey      | 18                   | 2.1                  |

### **FUTURE COMMERCIAL MIXED BULKY WASTE PROJECTIONS**

The following future projections of total commercial mixed bulky waste deliveries to the Tamala Park Landfill are based on the primary criterion of population trends.

The current (2009) commercial bulky waste measurements per capita (based on the current Mindarie Regional Council Population) are:

|   |        |
|---|--------|
| Commercial Mixed Bulky Waste per Capita (Tonnes)          | 0.0725 |
| Commercial Mixed Bulky Waste per Capita (m <sup>3</sup> ) | 0.5    |

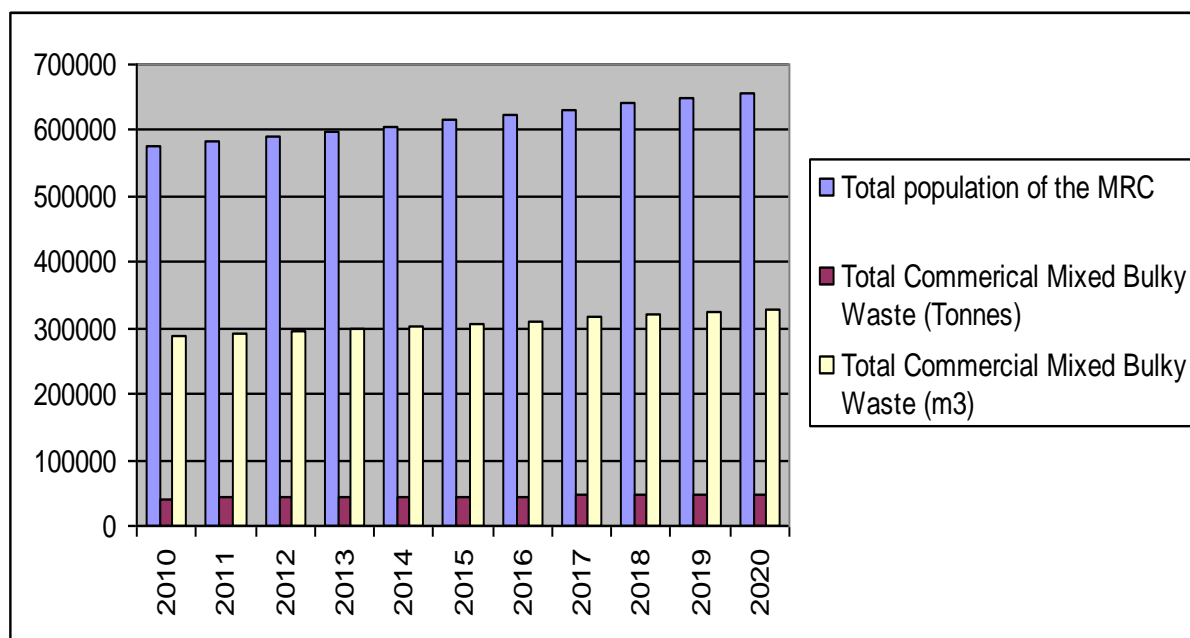
Estimations of future commercial mixed bulky waste deliveries to Tamala Park (based on the current per capita measurements) are shown in **Table 6** and **Figure 1**. These projections are indicative of the total commercial mixed bulky waste delivered to Tamala Park Landfill and will be useful data for estimations of how quickly the landfill will fill should no further commercial mixed bulky waste resource recovery take place.





**Table 6 Tamala Park Landfill - 2010-2020 Commercial Mixed Bulky Waste  
Delivery Projections**

|   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>Population Projection</b>            | 574520 | 581800 | 590000 | 598200 | 606400 | 614600 | 622800 | 631500 | 640200 | 648900 | 657600 |
| <b>Projected Weight (Tonnes)</b>        | 41653  | 42181  | 42775  | 43370  | 43964  | 44559  | 45153  | 45784  | 46415  | 47045  | 47676  |
| <b>Projected Volume (M<sup>3</sup>)</b> | 287260 | 290900 | 295000 | 299100 | 303200 | 307300 | 311400 | 315750 | 320100 | 324450 | 328800 |



**Figure 1 Tamala Park Landfill - 2010-2020 Commercial Mixed Bulky Waste  
Delivery Projections**



## WEEKEND HOUSEHOLDER MIXED BULKY WASTE - REPRESENTATIVE SAMPLE

The audit covered 529 weekend householder mixed bulky waste loads, representing 34% of all weekend householder vehicles entering the site over the 6 day period (three weekends). All 1551 weekend householder vehicles carrying mixed bulky waste loads to the site during the audit period were weighed; and all 1551 drivers were interviewed for collection of suburb data. This data was used to estimate the annual weekend householder mixed bulky waste deliveries to Tamala Park Landfill, as summarised in

**Table 7:**

**Table 7 Estimated Annual Weekend Householder Mixed Bulky Waste Deliveries**

|   |        |
|---|--------|
| Estimated Annual Number of Weekend Householder Deliveries | 26,191 |
| Estimated Annual Total Nett Weight (T)                    | 4,795  |
| Estimated Annual Total Volume (m <sup>3</sup> )           | 58,604 |

Approximately 93% of the total waste sample volume was categorized into separate recoverable waste fractions, with the remaining 7% classed as residual waste. The largest component of the recoverable waste was **green waste** (34% of total sample volume), followed by **timber** (12% of total sample volume) and **cardboard** (10% of total sample volume).

A summary of the recoverable vs. landfillable waste fractions by volume (m<sup>3</sup>) is presented in **Table 8:**



**Table 8 Weekend Householder Representative Sample – Mixed Bulky Waste  
Characterisation of Recoverable vs. Landfillable Fractions**

|   | Annual Volume (%) | Annual Volume (m3) |
|---|-------------------|--------------------|
| <b>Total Biodegradable Waste Fraction</b> | 40                | 23,442             |
| <b>Total Recyclable Waste Fraction</b>    | 53                | 31,060             |
| <b>Total Landfillable Waste Fraction</b>  | 7                 | 4,102              |

The suburb data for the weekend householder vehicles revealed the following 14 suburbs to be the largest sources of mixed bulky waste (**Table 9**):

**Table 9 Weekend Householder Representative Sample - Top 14 suburbs  
delivering waste to Tamala Park**

| Suburb       | # Householders | % householders |
|--------------|----------------|----------------|
| Quinns rocks | 137            | 8.8            |
| Clarkson     | 107            | 6.9            |
| Mindarie     | 106            | 6.8            |
| Kinross      | 104            | 6.7            |
| Butler       | 94             | 6.1            |
| Currambine   | 78             | 5              |
| Ocean reef   | 78             | 5              |
| Joondalup    | 61             | 3.9            |
| Merriwa      | 58             | 3.7            |
| Iluka        | 55             | 3.5            |
| Hillarys     | 53             | 3.4            |
| Caramar      | 49             | 3.2            |
| Wanneroo     | 48             | 3.1            |
| Heathridge   | 42             | 2.7            |



## FUTURE WEEKEND HOUSEHOLDER MIXED BULKY WASTE PROJECTIONS

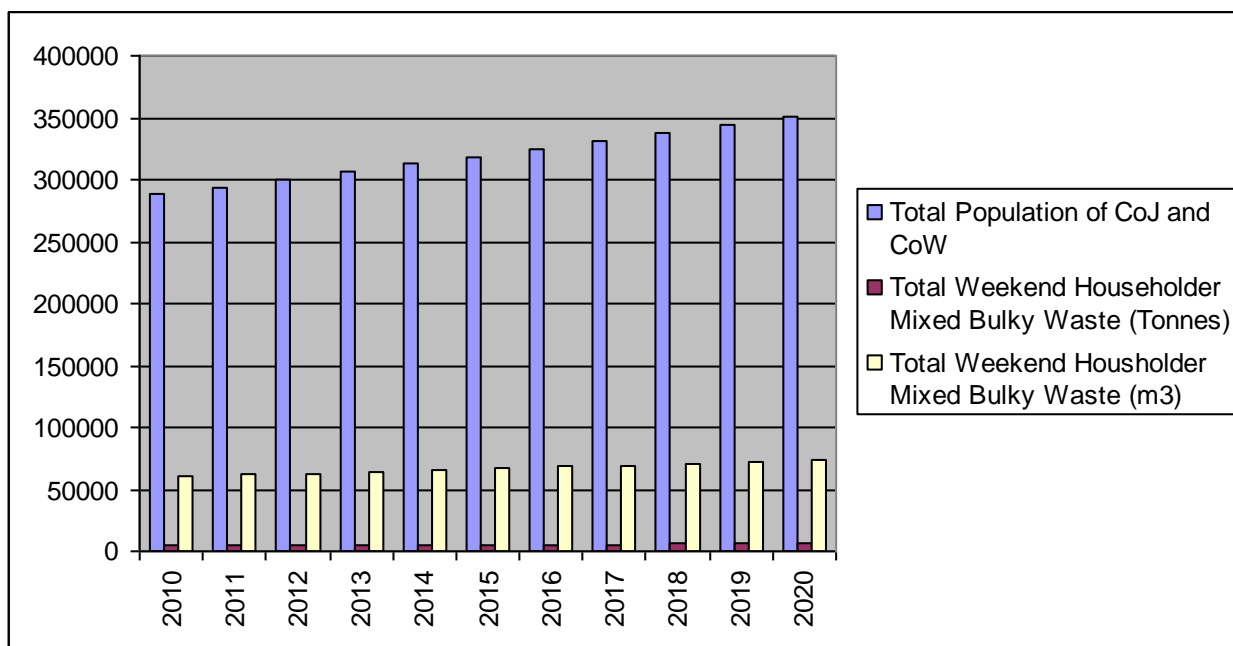
The current (2009) weekend householder bulky waste delivery measurements per capita are:

|   |       |
|---|-------|
| Weekend Householder Mixed Bulky Waste per Capita (Tonnes) | 0.017 |
| Weekend Householder Mixed Bulky Waste per Capita (m3)     | 0.21  |

These figures are based on the current (2009) combined populations of the City of Wanneroo and the City of Joondalup. We have based our future projections on the populations of these two areas due to the fact that the majority of weekend householder deliveries stated suburbs of origin within these two districts.

**Table 10 Tamala Park Weekend Householders - 2010-2020 Mixed Bulky Waste Delivery Projections**

|   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>Population Projection</b>            | 288800 | 293400 | 299720 | 306040 | 312360 | 318680 | 325000 | 331380 | 337760 | 344140 | 350520 |
| <b>Projected Weight (Tonnes)</b>        | 4910   | 4988   | 5095   | 5203   | 5310   | 5418   | 5525   | 5633   | 5742   | 5850   | 5959   |
| <b>Projected Volume (M<sup>3</sup>)</b> | 60648  | 61614  | 62941  | 64268  | 65596  | 66923  | 68250  | 69590  | 70930  | 72269  | 73609  |



**Figure 2 Tamala Park Weekend Householders - 2010-2020 Mixed Bulky Waste Delivery Projections**



## GLOSSARY

|                                       |   |
|---------------------------------------|---|
| <b>Carpet/Underlay</b>                | Used carpets/underlay and any off-cuts from new rolls.  |
| <b>Concrete</b>                       | Broken concrete slabs/walls/fencing and concrete rubble.  |
| <b>Furnishing</b>                     | Furnishings suitable for re-use, or with recycling potential.   |
| <b>General clean-up (Commercial)</b>  | This waste source category represents all mixed bulky waste brought in from commercial sites, by commercial operators (as reported by driver).  |
| <b>General clean-up (Residential)</b> | This waste source category represents all mixed bulky waste brought in from private households by commercial operators (as reported by driver). It is not an indication of waste brought in by householders direct. |
| <b>Green-Waste</b>                    | Any green/brown organic material suitable for mulching and/or composting.   |
| <b>Landfillable</b>                   | Any waste deemed as non-recoverable.  |
| <b>Metal</b>                          | Any scrap metals including white goods suitable for re-use or recycling.  |
| <b>MRC</b>                            | Mindarie Regional Council   |

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|                              |   |
|------------------------------|---|
| <b>Non-tipper Vehicles</b>   | Any vehicles without tipping facilities that dispose of waste at the Tamala Park Transfer Station.  |
| <b>OH&amp;S</b>              | Occupational Health and Safety  |
| <b>Open Skips</b>            | Skip bins brought in by greater than 1 tonne trucks for disposal directly into the landfill cells.  |
| <b>Organics</b>              | Any materials suitable for mulching or composting (inc. waste paper, soil etc).   |
| <b>Pallets</b>               | In reusable condition were recorded separate to timber as they were recognised as having value in their current form as a re-usable product.        |
| <b>Plastic</b>               | Any bulky plastic products, toys, and loose plastic materials suitable for re-use or recycling.   |
| <b>Recoverable</b>           | Any material/waste fraction that has potential for re-use or recycling, and is therefore not considered landfillable waste.                         |
| <b>Re-useable</b>            | Any material/waste fraction that has the potential for re-use with no major dismantling or processing required.                                     |
| <b>Recyclable</b>            | Any material/waste fraction that is capable of being of use again after processing.   |
| <b>Residue/Mixed Rubbish</b> | Any portion of the mixed bulky waste stream that did not fall under one of the recoverable waste fraction categories, or was not easily categorised |

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due to the degree of mixing with other waste products.

**Self Haul**

Delivery of mixed bulky waste by the person/operator(s) who generated the waste.

**Soft Furnishings**

Soft Furnishings suitable for re-use or with recycling potential.

**Tiles/Bricks/Rubble**

Including any broken ceramic products.

**Timber**

Re-usable timber off-cuts or mixed timber products.

**Tipper Vehicles**

Any commercial vehicles with tipper facilities that dispose of waste directly into the landfill cells.

**Wall sheeting**

Used Fibro, Gyprock etc. with potential for re-use or recycling.

**Weekend Householder**

Any householder delivering mixed bulky waste from own residence during the weekend audit periods.





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# 1 INTRODUCTION

## 1.1 BACKGROUND TO THE STUDY

Hofstede & Associates was engaged by Mindarie Regional Council to conduct an audit of the mixed bulky waste stream entering the Tamala Park landfill site, via the transfer facilities at the Recycling Centre of Balcatta, and delivered to Tamala Park Landfill direct.

The project scope was to collect a representative sample of the mixed bulky waste stream delivered to both the Recycling Centre of Balcatta and the Tamala Park landfill site. This sample data was to be used to estimate sources, weight and volumes of bulky waste fractions potentially available for recycling or alternate disposal.

The overall aim of the project was to identify opportunities to reduce the amount of bulky waste being landfilled at Tamala Park Landfill site in order to prolong its lifespan.

It was identified that the majority of the mixed bulky waste stream was being delivered by commercial operators, so it was decided that the audit focus should be on all mixed bulky waste delivered by contractors and commercial operators.

Waste streams not to be measured included council verge collections (as this stream was to be accounted for in a separate study), waste from council and commercial compactor trucks (as this stream, once compacted, was no-longer considered bulky waste), and general rubbish delivered by householders direct.

At the Recycling Centre of Balcatta any vehicles carrying *clean* recyclable materials (eg straight green-waste, bricks/concrete and bulk construction waste) were excluded from the audit, as these fractions of the waste stream are already separated at the Recycling Centre of Balcatta for recycling, and therefore diverted from Tamala Park Landfill.

A representative sample of the general waste stream delivered by householders direct was collected on weekends at Tamala Park, to account for any bulky waste fractions that may be coming in from this source.

## 1.2 OBJECTIVES AND REQUIRED OUTCOMES

The purpose of the study was to characterise and quantify:



- The major sources of mixed bulky waste (by source process, delivery vehicle type, and suburb);
- Waste fractions in the mixed bulky waste stream with recycling potential or potential for disposal other than a mixed waste landfill.

### 1.3 RELEVANCE TO CO PROJECTS AND REGIONAL WASTE STRATEGY

The project was developed to encompass a key recommendation listed in part three of the schedule of recommendations incorporated in the Regional Strategic Waste Minimisation Plan (view **Table 11**):

**Table 11 Extract of "action item" from SWMP**

| SWMP Item No. | Recommendation  | Action Date |
|---------------|---|-------------|
| <b>A</b>      | Action Items listed by subject - <b>Bulky hardwaste and green waste (delivered to landfill via transfer stations)</b>   |             |
| 3.4           | The makeup of the commercial waste stream from member Local Governments and contractors that is sent to Tamala park for disposal be analysed for its recycling potential                                  | 2010/2011   |
| 3.7           | Conducting an analysis of a significant portion of the hardwaste placed on the verge and that delivered to the Recycling Centre of Balcatta and to the Tamala Park landfill and transfer station          | 2009/2010   |
| 3.10          | Commence the redesign of the Tamala Park transfer station and amend the tipping policy and fees structure to increase the amount of waste recycled  | 2010/2011   |
| 3.11          | Work collectively to identify and introduce best practice for the design and operation of waste transfer waste minimisation and recycling functions conducted at the Recycling Centre of Balcatta and the | 2010/2011   |





|      |  |           |
|------|--|-----------|
|      | transfer station at Tamala Park  |           |
| 3.12 | Investigate the introduction of excavators to “pick” through bulky waste delivered by member Local Governments and casual tippers with the objective of removing recyclable materials to slow the consumption of landfill airspace   | 2008/2009 |
| 3.13 | Collaborate with the City of Stirling to investigate the use of mechanised means (such as moving floors) to: <ul style="list-style-type: none"><li>• Improve the safety of client tipping waste</li><li>• Reduce the amount of waste sent to landfill by recovering recyclable materials from the bulky waste stream</li></ul> | 2010/2011 |

The Mindarie Regional Council’s landfill site is filling rapidly and based on current trends will be full by 2020-2021.

While the Mindarie Regional Council has taken steps to divert the amount of household waste going to landfill by the use of Alternative Waste Technology, very little action has been taken to divert the other major waste streams that make up the 56% of solid waste going to landfill at Tamala Park.

This project is designed to identify the makeup of these various waste streams, identify their sources (where they represent a single significant source). This information will then allow the Mindarie Regional Council and the City of Stirling to redesign their respective transfer stations including charging policy and materials handling procedures to increase the amount of waste diverted from landfill.

## **2 METHODOLOGY**

### **2.1 PLANNING**

The first phase of the audit was the planning phase. This involved preliminary site visits and meetings with staff from the Recycling Centre of Balcatta, Tamala Park Landfill, and



Mindarie Regional Council. Project logistics and desired outcomes were discussed and agreed upon. From this, a waste audit procedure was developed and approved.

The standard hours of operation at the Recycling Centre of Balcatta are 7.30am to 4.00pm. To obtain a representative sample of the mixed bulky waste entering the transfer site, the program was designed to cover all operating hours Monday to Sunday. The audit times were kept consistent (ie 7.30am to 4.00pm) for the Tamala Park Landfill site audit.

## **2.2 AUDIT METHODOLOGY**

### **2.2.1 Tamala Park Landfill Site Audit Methodology**

Two auditors attended the landfill site during the 25 day audit period. The survey process involved continuous observation and interviewing of all drivers of commercial vehicles entering the site during the defined audit period. The first auditor, situated at the weighbridge station, conducted a visual observation of each commercial vehicle entering the site and conducted an interview the driver. From this, the auditor categorized each vehicle as either:

- 1. Open skip / Tipper vehicle;**
- 2. Self haul / Non-tipper vehicle (> 1 tonne non-tipper truck, trailer, utility, van, car).**

These two categories were surveyed separately for the following reasons:

- Open skip/tipper vehicles dispose of their waste directly into the landfill cell. Due to the sheer scale of waste, and health and safety policy, a sample of the bulky waste stream was separated by an excavator on site (ie. beside the landfill cell), and characterized by Mr. Brendan Mohr of the Mindarie Regional Council and Tamala Park operations staff.



- All non-tipper vehicles dispose of their rubbish from a raised landing, at the transfer facility. A second auditor, situated at the transfer facility, was responsible for gathering waste fraction and volume data from a sample of self haul/ non-tipper vehicles. During the working week (ie. Monday to Friday), data was collected from a sample of the commercial non-tipper vehicles carrying bulky waste, and on weekends householders delivering bulky waste were included in the sampling procedure.
- To establish waste data that was relevant to the different management procedures necessary for tipper vs. non-tipper vehicles.

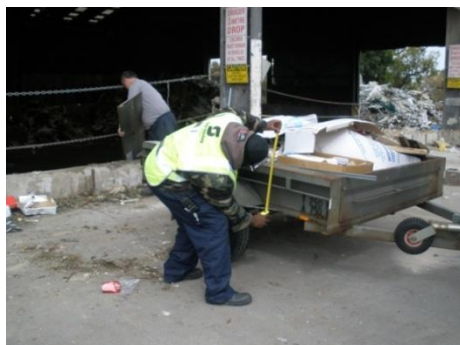
The auditor at the weighbridge conducted a brief interview with each driver, firstly to determine if the waste fell into the mixed bulky waste category, and if so, to record:

- 1. Suburb of origin**
- 2. Vehicle type**
- 3. Source process**
  - **Demolition site**
  - **Construction site**
  - **Workshop waste**
  - **General clean-up (Commercial)**
  - **General clean-up (Residential)** – NB: This category represents all mixed waste brought in from private households by commercial operators. It is not an indication of waste brought in by householders direct.
  - **Other**

**Waste weight and truck volume** – NB: The volume data is presented as estimations only due to the following reasons:



- The volume data for self haul/non-tipper vehicles is based on an auditors' measurement of waste as it was unloaded at the transfer station. It is therefore representative of un-compacted mixed bulky waste.



**Figure 3 A waste auditor measuring a load of commercial mixed bulky waste materials. Photo from Balcatta.**

- The volumes of the open skips/tipper vehicles were collected during the driver interviews and are an indication of truck size alone, and not strictly the volume of bulky waste. This is the case for all open skip/ tipper vehicle volume data that follows. The truck volumes have been recorded assuming that they are at capacity upon arrival at the transfer station. This however is not the case in all instances, but reflects a worst case scenario to allow for conservative planning.



**Figure 4 A waste auditor conducting a driver interview at the weighbridge.  
Photo from Balcatta.**

It was possible to collect extremely accurate weight data at Tamala Park, thanks to the weigh in/weigh out system in operation there. Every single vehicle is weighed in and weighed out, so the sample, total, and average nett weights have been based on exact weights of all commercial self haul/non-tipper vehicles that passed through Tamala Park over the defined audit period.

A representative sample of waste was taken from randomly selected open skip/ tipper vehicles with loads containing a majority of bulky waste. This assisted in eliminating the large proportion of general waste going into the bulky waste sample.

The auditor at the weighbridge was responsible for notifying and directing the drivers of selected sample vehicles to dump their loads at the audit site as opposed to directly into the landfill. This was done via comprehensive directions to the audit site, and the drivers were also given a map detailing the location of the audit site. Here, the bulky waste sample underwent breakdown into recoverable bulky waste fractions by an excavator operator (as per sample loads from the Recycling Centre of Balcatta). As described



previously, this representative sample data from the open skip/tipper vehicles was recorded accumulatively by Mr Brendan Mohr of the Mindarie Regional Council, and Tamala Park operations staff.

A sample of the general waste stream delivered by householders direct was also collected on weekends at Tamala Park, to account for any bulky waste fractions that may be coming in from this source. Results of this six day survey are presented in **Section 4** of this document.

### **2.3 DEFINITION OF RECOVERABLE BULKY WASTE**

Due to the mechanical categorization process of the waste samples from open skip/non-tipper vehicles, it was established that only the materials that could be separated with an excavator were to be categorised. These fractions were:

- Timber
- Plastic
- Concrete
- Metal
- Green-Waste
- Carpet / Underlay
- Soft Furnishings/Mattresses
- Tyres
- Wall sheeting (Fibro, Gyprock etc)
- Residue/Mixed General Rubbish

It was possible to categorise the bulky waste from self haul/non-tipper vehicles more specifically as we were not relying on mechanical means of separation (ie. the waste could be categorized through simple observation during the unloading process). For this reason we were able to include more categories of waste fractions for the self haul/non-tipper vehicles. These fractions were:



- Plastic
- Cardboard
- Timber
- Concrete
- Metal (inc. white goods)
- Green-Waste
- Carpet/Underlay
- Glass
- Styrofoam
- Pallets
- Furnishings
- Mattresses
- Wall sheeting (Fibro, Gyprock etc)
- Insulation
- Tiles/Bricks/Rubble
- Organics (inc. paper, soil etc)
- Residue/Mixed General Rubbish

### **3 RESULTS- COMMERCIAL MIXED BULKY WASTE**

#### **3.1 TOTAL COMMERCIAL MIXED BULKY WASTE**

The following data represents total nett weight and volume of all commercial mixed bulky waste material (ie. that delivered by open skips/tipper and self haul/non-tipper vehicles combined) during the defined audit period.

##### **3.1.1 Tamala Park Landfill - Total Mass and Volume of Mixed Bulky Waste Delivered by Commercial Operators to Tamala Park Direct**



During the continuous 25 day audit period, a total of 595 vehicles were sampled out of a total of 1351 commercial vehicles identified as carrying mixed bulky waste loads. Thus, 44% of all commercial vehicles carrying mixed bulky waste loads into the Tamala Park Landfill were audited.

It was assumed that the waste entering the site during the period was typical of general disposal patterns and therefore not prone to large degrees of variation.

The total estimated mass and volume of commercial mixed bulky waste delivered to Tamala Park Landfill during the audit period is summarized in **Table 12**:





**Table 12 Tamala Park - Total mass and estimated volume of commercial mixed bulky waste delivered during audit period.**

|   |       |
|---|-------|
| TOTAL COMMERCIAL VEHICLES INTERVIEWED           | 1351  |
| TOTAL COMMERCIAL VEHICLES AUDITED (REP. SAMPLE) | 595   |
| % AUDITED                                       | 44%   |
| TOTAL NETT WEIGHT (Tonnes)                      | 892   |
| TOTAL ESTIMATED VOLUME (M <sup>3</sup> )        | 6,423 |

NB - Figures are based on sample data collected during the defined audit period.



### 3.2 COMMERCIAL MIXED BULKY WASTE MASS AND VOLUME BY DELIVERY VEHICLE TYPE

#### 3.2.1 Tamala Park Landfill – Open Skips/Tipper Vehicles

**Table 13 Tamala Park Landfill – Total and average mass and estimated volume of commercial mixed bulky waste delivered by open skips/tipper vehicles during audit period.**

|   |       |
|---|-------|
| TOTAL # OPEN SKIP/TIPPERS INTERVIEWED                         | 513   |
| TOTAL # OPEN SKIP/TIPPERS AUDITED (Rep. Sample)               | 152   |
| % of Open Skip/Tippers audited                                | 30%   |
| <b>WEIGHT (Tonnes)</b>  |       |
| Sample Nett Weight (T)  | 187   |
| *Total Nett Weight (T)  | 628   |
| Average Nett Weight per Tipper Vehicle (T)                    | 1.2   |
| <b>VOLUME (m<sup>3</sup>)</b>                                 |       |
| Sample Volume (m <sup>3</sup> )                               | 1,018 |
| Total Estimated Volume (m <sup>3</sup> )                      | 3,642 |
| Average Estimated Volume per Tipper Vehicle (m <sup>3</sup> ) | 7     |



\* The total Nett weight (628 tonnes) represents 2.6% of the total nett weight (23,930 tonnes) delivered by open skips/tipper vehicles during the audit period, and 0.2% of the total nett weight (339,799 tonnes) delivered by tipper vehicles direct to the tip face in the past year (1 November 2008 – 31 October 2009).

### 3.2.2 Tamala Park Landfill – Self Haul/Non-tipper Vehicles

**Table 14 Tamala Park - Total and average mass and estimated volume of commercial mixed bulky waste delivered by self haul/non-tipper vehicles during audit period.**

|  |       |
|--|-------|
| TOTAL # SELF HAUL/NON-TIPPERS INTERVIEWED                | 838   |
| TOTAL # SELF HAUL/NON-TIPPERS AUDITED (Rep. Sample)      | 443   |
| % of Self Haul/Non-tippers audited                       | 53%   |
| <b>WEIGHT (Tonnes)</b>                                   |       |
| Sample Nett Weight (T)                                   | 130   |
| *Total Nett Weight (T)                                   | 264   |
| Average Estimated Nett Weight per Non-tipper Vehicle (T) | 0.315 |
| <b>VOLUME (m<sup>3</sup>)</b>                            |       |
| Sample Volume (m <sup>3</sup> )                          | 1,454 |
| Total Estimated Volume (m <sup>3</sup> )                 | 2,781 |



|   |     |
|---|-----|
| Average Estimated Volume per Non-tipper Vehicle (m <sup>3</sup> ) | 3.3 |
|---|-----|

\* The total Nett weight (264 tonnes) represents 23% of the total Nett weight of waste delivered to Tamala Park via the recycling centre facilities during the audit period (1,140.03 tonnes), and 1.7% of the total annual Nett weight of waste delivered to the recycling centre (15,997.47 tonnes) (1 November 2008 – 31 October 2009).

### **3.3 EXTRAPOLATION OF TOTAL COMMERCIAL MIXED BULKY WASTE AUDITED TO TOTAL COMMERCIAL MIXED BULKY WASTE DELIVERED ANNUALLY**

The following data is based on a 362 day working year to account for the three days that the Tamala Park Landfill site is closed for operations; Good Friday, Christmas Day and New Years Day.

#### **3.3.1 Total Commercial Mixed Bulky Waste Delivered to Tamala Park Landfill Annually (Recycling Centre of Balcatta + Tamala Park Direct)**

Based on the sample data and number of commercial operators interviewed during the audit period, the following table provide estimates of the annual mixed bulky waste delivered to the Tamala Park Landfill (via Recycling Centre of Balcatta, and to Tamala park Direct) by commercial operators.

**Table 15 Total estimated annual commercial mixed bulky waste deliveries to Tamala Park Landfill (via Recycling Centre of Balcatta, and to Tamala Park Direct).**

|  |        |
|--|--------|
| Estimated Annual Number of Commercial Mixed Bulky Waste Deliveries | 38,558 |
|--|--------|



|   |         |
|---|---------|
| Estimated Annual Total Nett Weight (T)          | 41,147  |
| Estimated Annual Total Volume (m <sup>3</sup> ) | 278,840 |

### **3.3.2 Tamala Park Landfill – Estimated Annual Mixed Bulky Waste Delivered by Commercial Operators (to Tamala Park Direct)**

**Table 16 Tamala Park - Estimated annual total mixed bulky waste delivered by commercial operators.**

|   |        |
|---|--------|
| Estimated Annual Number of Commercial Vehicles  | 19,562 |
| Estimated Annual Total Nett Weight (T)          | 12,917 |
| Estimated Annual Total Volume (m <sup>3</sup> ) | 93,005 |

### **3.3.3 Tamala Park Landfill – Estimated Annual Mixed Bulky Waste Delivered by Commercial Operators via Open Skips/Tipper Vehicles**

Based on the sample data and number of commercial operators interviewed during the 25 day audit period, the following tables provide estimates of the annual mixed bulky waste delivered to the Tamala Park Landfill by commercial operators via open skips/tipper vehicles.



**Table 17 Tamala Park - Estimated annual mixed bulky waste delivered by commercial operators via open skips/tipper vehicles.**

|  |        |
|--|--------|
| Estimated Annual Number of Open Skip/Tipper Vehicles | 7,428  |
| Estimated Annual Total Nett Weight (T)               | 9,090  |
| Estimated Annual Total Volume (m <sup>3</sup> )      | 52,736 |

**3.3.4 Tamala Park Landfill – Estimated Annual Mixed Bulky Waste Delivered by Commercial Operators via Self Haul/Non-tipper Vehicles**

Based on the sample data and number of commercial operators interviewed during the 25 day audit period, the following tables provide estimates of the annual mixed bulky waste delivered to the Tamala Park Landfill by commercial operators via self haul/non-tipper vehicles.

**Table 18 Tamala Park - Estimated annual mixed bulky waste delivered by commercial operators via self haul/non-tipper vehicles.**

|  |        |
|--|--------|
| Estimated Annual Number of Self Haul/Non-tipper Vehicles | 12,134 |
| Estimated Annual Total Nett Weight (T)                   | 3,827  |
| Estimated Annual Total Volume (m <sup>3</sup> )          | 40,269 |



### 3.4 COMMERCIAL MIXED BULKY WASTE - WASTE CHARACTERISATION BY VEHICLE TYPE

#### 3.4.1 Tamala Park Landfill - Open Skips/Tipper Vehicles

The following data is based on the sample of 152 open skip/tipper vehicles. This number of trucks represented 30% of the total amount of commercial open skip/tipper vehicles carrying bulky waste into the recycling centre during the audit period.

The waste, once separated and categorized with an excavator, was measured according to weight at the Tamala Park weighbridge. The weight and percentage of the separated waste fractions can be viewed in **Table 19**, and graphically in **Figure 5**.

**Table 19 Tamala Park - Commercial mixed bulky waste fractions, sample breakdown by weight –open skips/tipper vehicles.**

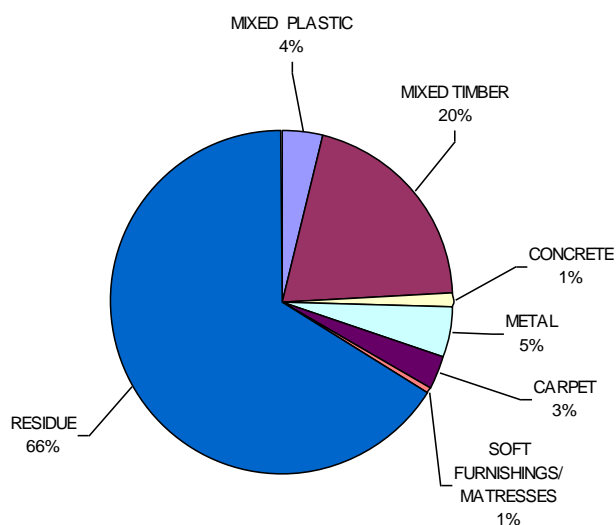
| WASTE                          | WEIGHT (TONNES) | WEIGHT (%) | EST. ANNUAL WEIGHT (TONNES) |
|--------------------------------|-----------------|------------|-----------------------------|
| MIXED PLASTIC                  | 7               | 4          | 364                         |
| MIXED TIMBER                   | 38              | 20         | 1,818                       |
| CONCRETE                       | 3               | 1          | 91                          |
| METAL                          | 9               | 5          | 455                         |
| CARPET                         | 5               | 3          | 273                         |
| SOFT FURNISHINGS/<br>MATRESSES | 1               | 1          | 91                          |
| *RESIDUE                       | 124             | 66         | 5,999                       |
| TOTAL SAMPLE                   | 187             | 100        | 9,090                       |

\*A breakdown of the residual waste can be viewed in **section 3.4.1.1**.



Approximately 34% (63 tonnes) of the total waste sample weight was categorized into separate recyclable waste fractions, with the remaining 66% (124 tonnes) classed as residual waste.

This suggests that of the estimated 9,090 tonnes of commercial mixed bulky waste delivered by open skips/tipper vehicles annually, 3,091 tonnes could be diverted for recycling. In addition to this, a portion of the residual waste could also be diverted from landfill, for recycling and compost processing (Figure 5).



**Figure 5 Tamala Park - Commercial mixed bulky waste fractions, sample % breakdown by weight –open skips/tipper vehicles.**





### 3.4.1.1 Tamala Park Landfill - Open Skips/Tipper Vehicles – Breakdown of Residual Waste

Having auditors on site at Tamala Park meant that it was possible to record a volume breakdown of a sample of the residual waste from the representative sample of waste from open skips/tipper vehicles.

The following data is based on a sample of approximately 85 tonnes of the total 124 tonnes of residual waste that was in the original representative sample. This represents 69% of the total residual waste weight. The dimensions of the sample of residual waste were recorded accumulatively by the auditors and had an estimated volume of **407m<sup>3</sup>**. The following data in **Tables 20 and 21** is a breakdown of the volume of the sample of residual waste. The percentage breakdown of the sample residual waste volume is presented graphically in **Figure 6**.

**Table 20 Tamala Park – Residual waste sample breakdown by volume – Open skips/tipper vehicles.**

| WASTE          | VOLUME<br>(M <sup>3</sup> ) | VOLUME<br>(%) |
|----------------|-----------------------------|---------------|
| PAPER          | 77                          | 19            |
| PLASTICS       | 29                          | 7             |
| CARDBOARD      | 94                          | 23            |
| TIMBER         | 45                          | 11            |
| GREEN-WASTE    | 20                          | 5             |
| MIXED ORGANICS | 122                         | 30            |
| STYROFOAM      | 4                           | 1             |
| MIXED/OTHER    | 16                          | 4             |

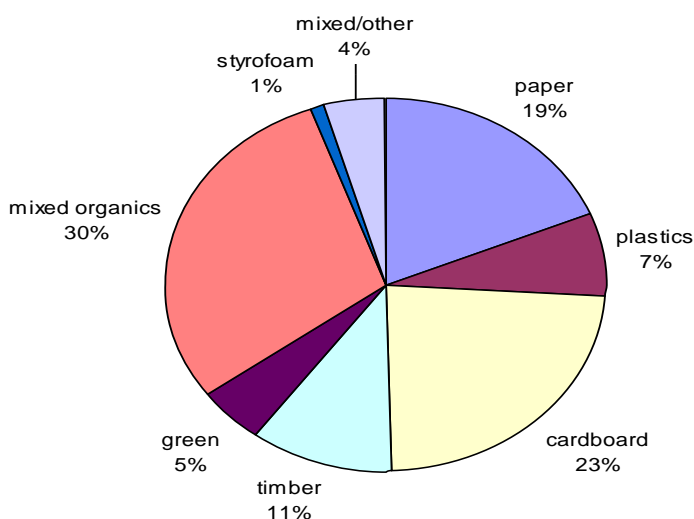


|                     |            |            |
|---------------------|------------|------------|
| <b>TOTAL SAMPLE</b> | <b>407</b> | <b>100</b> |
|---------------------|------------|------------|

The total **biodegradable** waste fraction from the residual waste sample (paper, green-waste and mixed organics) is **54%**. The total **recyclable** waste fraction from the residual waste sample is **42%**, leaving only **4%** of the residual waste fraction volume to be classified as **landfillable** waste.

**Table 21 Tamala Park – Residual waste annual % breakdown by volume – Open skips/tipper vehicles (based on sample data).**

|   | <b>Annual Volume of Residual Waste (%)</b> |
|---|--|
| <b>Total Biodegradable Waste Fraction</b> | 54   |
| <b>Total Recyclable Waste Fraction</b>    | 42   |
| <b>Total Landfillable Waste Fraction</b>  | 4  |



**Figure 6 Tamala Park – Residual waste sample % breakdown by volume – Open skips/tipper vehicles.**

### 3.4.2 Tamala Park Landfill - Self Haul/Non-tipper Vehicles

The following data is based on the sample of 443 self haul/non-tipper vehicles. This number of trucks represented 53% of the total amount of commercial self haul/non-tipper vehicles carrying bulky waste into the recycling centre during the audit period. The waste fraction breakdown according to volume can be viewed in **Tables 22 and 23**. The percentage breakdown of the waste fractions according to volume can be viewed graphically in **Figure 7**.

**Table 22 Tamala Park - Commercial mixed bulky waste fractions, sample breakdown by volume – Self haul/non-tipper vehicles.**

| WASTE   | VOLUME<br>(M <sup>3</sup> ) | VOLUME<br>(%) | ANNUAL VOLUME<br>(M <sup>3</sup> ) |
|---------|-----------------------------|---------------|------------------------------------|
| Plastic | 73                          | 5             | 2,013                              |



|                    |            |           |               |
|--------------------|------------|-----------|---------------|
| <b>Carboard</b>    | <b>160</b> | <b>11</b> | <b>4,430</b>  |
| <b>Timber</b>      | <b>160</b> | <b>11</b> | <b>4,430</b>  |
| Concrete           | 29         | 2         | 805           |
| Metal              | 131        | 9         | 3,624         |
| Glass              | 15         | 1         | 403           |
| <b>Green-Waste</b> | <b>523</b> | <b>36</b> | <b>14,497</b> |
| Styrofoam          | 15         | 1         | 403           |
| Pallets            | 15         | 1         | 403           |
| Furnishings        | 15         | 1         | 403           |
| Matresses          | 15         | 1         | 403           |
| Carpet & Underlay  | 58         | 4         | 1,611         |
| Wall Sheeting      | 58         | 4         | 1,611         |
| Insulation         | 44         | 3         | 1,208         |
| Bricks/Rubble      | 15         | 1         | 403           |
| <b>ORGANICS*</b>   | <b>73</b>  | <b>5</b>  | <b>2,013</b>  |
| <b>Residue</b>     | <b>44</b>  | <b>3</b>  | <b>1,208</b>  |
| Total Sample       | 1,454      | 100       | 40,269        |

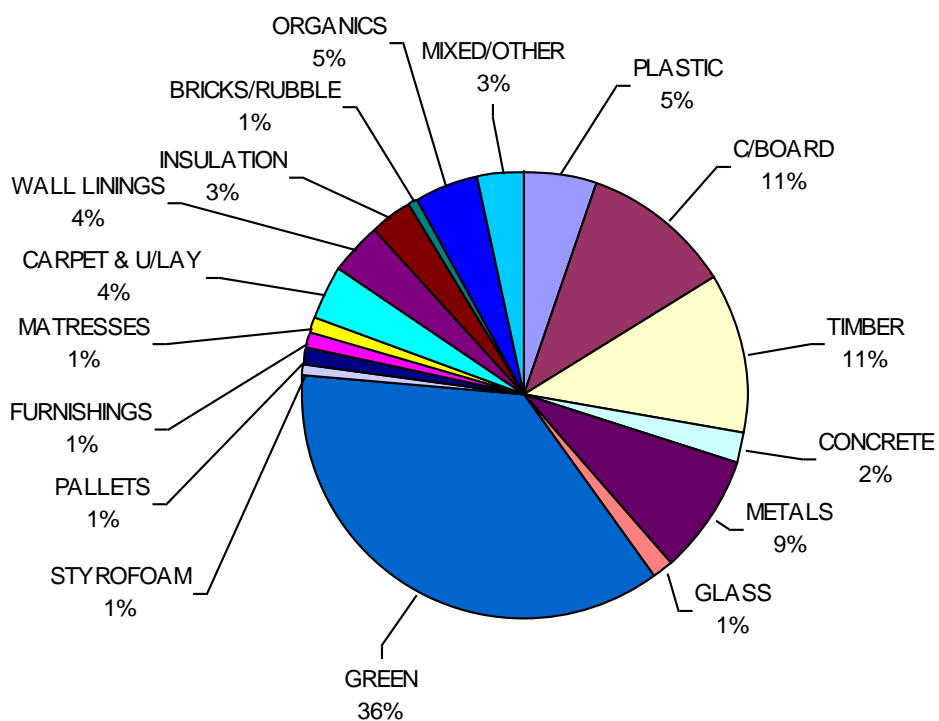
\*incl. paper, soil etc.

**Table 23 Commercial mixed bulky waste fractions, annual breakdown by volume – Self haul/non-tipper vehicles.**

|   | <b>Annual Volume (%)</b> | <b>Annual Volume (m3)</b> |
|---|--------------------------|---------------------------|
| <b>Total Biodegradable Waste Fraction</b> | 41                       | 16,510                    |
| <b>Total Recyclable Waste Fraction</b>    | 56                       | 22,551                    |



|  |          |             |
|--|----------|-------------|
| <b>Total Landfillable Waste Fraction</b> | <b>3</b> | <b>1208</b> |
|--|----------|-------------|



**Figure 7 Tamala Park - Commercial mixed bulky waste fractions, sample % breakdown by volume – Self haul/non-tipper vehicles.**



### 3.5 COMMERCIAL MIXED BULKY WASTE – BREAKDOWN OF SELF HAUL/NON-TIPPER DELIVERY VEHICLE TYPES

#### 3.5.1 Tamala Park Landfill - Self Haul/Non-tipper Vehicles

Table 24 Tamala Park - Breakdown of commercial mixed bulky waste delivered by vehicle type during the audit period.

| VEHICLE TYPE                | Count      | Avg. Nett weight (Tonnes) | Total Nett weight (Tonnes) | Avg. sample volume (m <sup>3</sup> ) | Total Est. volume (m <sup>3</sup> ) |
|-----------------------------|------------|---------------------------|----------------------------|--------------------------------------|-------------------------------------|
| >1 tonne non-tippers        | 90         | 0.578                     | 52.029                     | 5.6                                  | 504                                 |
| >1 tonne towing trailer     | 6          | 0.762                     | 4.570                      | 10.8                                 | 64.8                                |
| Vehicles towing trailers    | 436        | 0.335                     | 145.880                    | 3.4                                  | 1,482                               |
| Utes                        | 183        | 0.210                     | 38.385                     | 2.06                                 | 377                                 |
| Vans                        | 86         | 0.183                     | 15.740                     | 2.9                                  | 249.4                               |
| Cars                        | 12         | 0.109                     | 1.310                      | 1.95                                 | 23.4                                |
| Vehicle type not recorded   | 25         | 0.254                     | 6.360                      | 3.2                                  | 80                                  |
| <b>TOTALS</b>               | <b>838</b> | <b>0.315</b>              | <b>264.274</b>             | <b>3.3</b>                           | <b>2781</b>                         |
| % Vehicle type recorded     | 97%        |                           |                            |                                      |                                     |
| % Vehicle Type not recorded | 3%         |                           |                            |                                      |                                     |



### 3.6 COMMERCIAL MIXED BULKY WASTE – PERCENTAGE BREAKDOWN OF WASTE SOURCE BY VEHICLE TYPE

#### 3.6.1 Tamala Park Landfill – Open Skips/Tipper Vehicles

A number of drivers reported waste collection from a variety of sources. For this reason, the total count for source process (535) exceeds the total number of tipper trucks that were interviewed (513). An average number of sources per load category (1.04) has been included to highlight the fact that some trucks will indeed be bringing in bulky waste from greater than one source, and may contain a mix of bulky waste and general waste as a result.

**Table 25 Tamala Park - Commercial mixed bulky waste breakdown by source process – Open skips/tipper vehicles.**

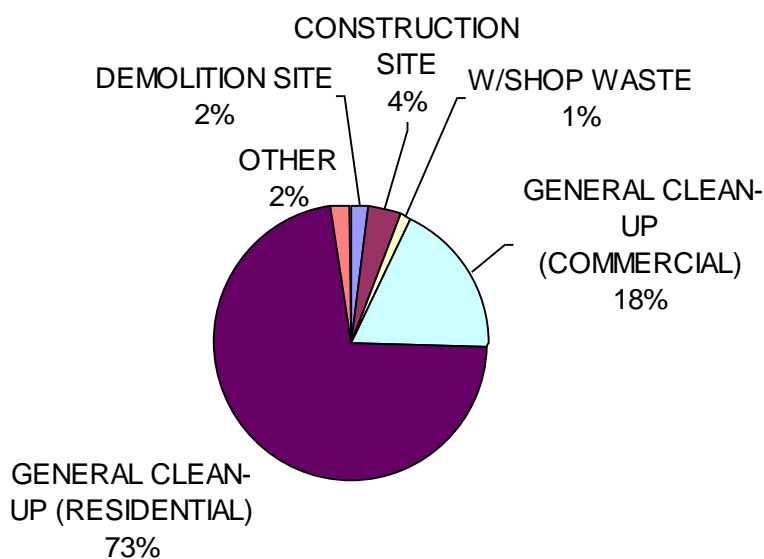
| <b>Source Process</b>                     | <b>Count</b> | <b>% of Total Open Skips/Tipper Vehicles</b> |
|---|--------------|--|
| <b>Demolition Site</b>                    | 11           | 2%   |
| <b>Construction Site</b>                  | 20           | 4%   |
| <b>Workshop Waste</b>                     | 7            | 1%   |
| <b>General Clean-up (Commercial)</b>      | 98           | 18%  |
| <b>*General Clean-up (Residential)</b>    | 387          | 73%  |
| <b>Other</b>                              | 12           | 2%   |
| <b>TOTAL</b>                              | <b>535</b>   | <b>100%</b>                                  |
| <b>Average number of sources per load</b> | <b>1.04</b>  |  |



\*The **General Clean-up (Residential)** category represents all mixed waste brought in from private households by commercial operators. It is not an indication of waste brought in by householders direct.

Those wastes recorded under the “**Other**” category, included waste from such sources as:

- A water treatment plant;
- Waste from schools;
- Recycling plant;
- General rubbish pick up (ie. could not be included in the bulky waste categories);
- Tamala Park Recycling Bin/Shop;
- A dolphin carcass;
- Police Station.



**Figure 8 Tamala Park - Commercial mixed bulky waste % breakdown by source process – Open skips/tipper vehicles.**







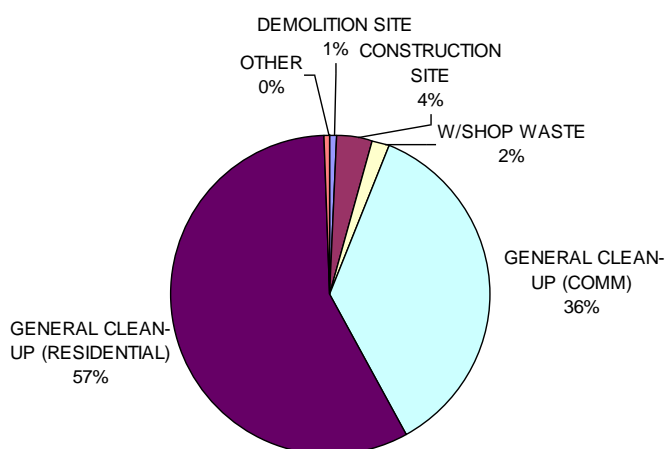
### 3.6.2 Tamala Park Landfill – Self Haul/Non-tipper Vehicles

A number of the non-tipper vehicle drivers reported waste collection from multiple sources. For this reason, the total count for source process (853) exceeds the total number of non-tipper vehicles that were interviewed (838). An average number of sources per load (1.02) has been included to highlight the fact that some trucks will indeed be bringing in bulky waste from greater than one source, and may contain a mix of bulky waste and general waste as a result.

**Table 26 Tamala Park - Commercial mixed bulky waste breakdown by source process – Self haul/non-tipper vehicles.**

| <b>Source Process</b>                     | <b>Count</b> | <b>% of Total Self Haul/Non-tipper Vehicles</b> |
|---|--------------|---|
| <b>Demolition Site</b>                    | 6            | 1%  |
| <b>Construction Site</b>                  | 32           | 4%  |
| <b>Workshop Waste</b>                     | 15           | 2%  |
| <b>General Clean-up (Commercial)</b>      | 305          | 36%   |
| <b>*General Clean-up (Residential)</b>    | 491          | 57%   |
| <b>Other</b>                              | 4            | 0%  |
| <b>TOTAL</b>                              | <b>853</b>   | <b>100%</b>                                     |
| <b>Average number of sources per load</b> | <b>1.02</b>  |   |

\*The **General Clean-up (Residential)** category represents all mixed waste brought in from private households by commercial operators. It is not an indication of waste brought in by householders direct.



**Figure 9 Tamala Park - Commercial mixed bulky waste % breakdown by source process – Self haul/non-tipper vehicles.**

### **3.7 COMMERCIAL MIXED BULKY WASTE – BREAKDOWN OF WASTE SUBURB OF ORIGIN BY VEHICLE TYPE**

#### **3.7.1 Tamala Park Landfill - Open Skips/Tipper Vehicles**

**Table 27 Tamala Park - Breakdown of commercial mixed bulky waste delivery by suburb of origin – Open skips/tipper vehicles.**

| <b>SUBURB</b>                 | <b># TIPPERS</b> | <b>% TIPPERS</b> |
|-------------------------------|------------------|------------------|
| Multiple Suburbs (within MRC) | 41               | 8                |
| Joondalup                     | 25               | 4.9              |
| Wanneroo                      | 25               | 4.9              |
| Butler                        | 20               | 3.9              |
| Mindarie                      | 18               | 3.5              |
| Quinns Rocks                  | 18               | 3.5              |
| Wangara                       | 18               | 3.5              |



|                     |           |            |
|---------------------|-----------|------------|
| <b>Ocean Reef</b>   | <b>17</b> | <b>3.3</b> |
| <b>Clarkson</b>     | <b>16</b> | <b>3.1</b> |
| <b>Osborne Park</b> | <b>13</b> | <b>2.5</b> |
| Alexander Heights   | 1         | 0.2        |
| Ashby               | 3         | 0.6        |
| Balcatta            | 5         | 1          |
| Balga               | 4         | 0.8        |
| Ballajura           | 2         | 0.4        |
| Banksia Grove       | 4         | 0.8        |
| Beechboro           | 2         | 0.4        |
| Beldon              | 2         | 0.4        |
| Belmont             | 1         | 0.2        |
| Bibra Lake          | 1         | 0.2        |
| Brighton            | 1         | 0.2        |
| Burns Beach         | 8         | 1.6        |
| Burswood            | 1         | 0.2        |
| Carabooda           | 2         | 0.4        |
| Caramar             | 4         | 0.8        |
| Carine              | 3         | 0.6        |
| Claremont           | 1         | 0.2        |
| Connolly            | 11        | 2.1        |
| Cottesloe           | 1         | 0.2        |
| Craigie             | 9         | 1.8        |
| Currambine          | 12        | 2.3        |
| Darch               | 2         | 0.4        |
| Dianella            | 1         | 0.2        |
| Doubleview          | 1         | 0.2        |
| Duncraig            | 10        | 1.9        |
| Edgewater           | 1         | 0.2        |
| Ellenbrook          | 3         | 0.6        |
| Emersley            | 1         | 0.2        |
| Floreat             | 4         | 0.8        |
| Greenwood           | 12        | 2.3        |



|             |    |     |
|-------------|----|-----|
| Guildford   | 1  | 0.2 |
| Gwellup     | 2  | 0.4 |
| Hamersley   | 3  | 0.6 |
| Heathridge  | 12 | 2.3 |
| Hillarys    | 8  | 1.6 |
| Iluka       | 3  | 0.6 |
| Jindalee    | 1  | 0.2 |
| Kalaroo     | 5  | 1   |
| Karawara    | 1  | 0.2 |
| Kardinya    | 1  | 0.2 |
| Karrinyup   | 2  | 0.4 |
| Kingsley    | 11 | 2.1 |
| Kinross     | 8  | 1.6 |
| Kondoola    | 2  | 0.4 |
| Kwinana     | 1  | 0.2 |
| Landsdale   | 7  | 1.4 |
| Leederville | 4  | 0.8 |
| Lockridge   | 1  | 0.2 |
| Malaga      | 4  | 0.8 |
| Marangaroo  | 1  | 0.2 |
| Mariginiup  | 2  | 0.4 |
| Marmion     | 1  | 0.2 |
| Maylands    | 1  | 0.2 |
| Merriwa     | 6  | 1.2 |
| Morley      | 6  | 1.2 |
| Mosman Park | 1  | 0.2 |
| Mt Hawthorn | 1  | 0.2 |
| Mt Lawley   | 4  | 0.8 |
| Mullaloo    | 4  | 0.8 |
| Nedlands    | 1  | 0.2 |
| Neerabup    | 2  | 0.4 |
| Nollamara   | 2  | 0.4 |
| Padbury     | 7  | 1.4 |



|                                   |            |            |
|-----------------------------------|------------|------------|
| Pearsall                          | 1          | 0.2        |
| Pembrick                          | 1          | 0.2        |
| Peppermint Grove                  | 1          | 0.2        |
| Perth                             | 1          | 0.2        |
| Ridgewater                        | 1          | 0.2        |
| Ridgewood                         | 4          | 0.8        |
| Scarborough                       | 4          | 0.8        |
| Shenton Park                      | 1          | 0.2        |
| Sorrento                          | 7          | 1.4        |
| Stirling                          | 4          | 0.8        |
| Subiaco                           | 3          | 0.6        |
| Tamala Park                       | 1          | 0.2        |
| Tapping                           | 5          | 1          |
| Tuart Hill                        | 1          | 0.2        |
| Two Rocks                         | 4          | 0.8        |
| Vic Park                          | 1          | 0.2        |
| Warwick                           | 3          | 0.6        |
| Welshpool                         | 1          | 0.2        |
| Wembley                           | 4          | 0.8        |
| Westminster                       | 2          | 0.4        |
| West Perth                        | 1          | 0.2        |
| Whitfords                         | 1          | 0.2        |
| Woodvale                          | 4          | 0.8        |
| Yanchep                           | 8          | 1.6        |
| Yokine                            | 1          | 0.2        |
| Multiple Suburbs (all over Perth) | 2          | 0.4        |
| Suburb Not Recorded               | 6          | 1.2        |
| <b>TOTALS</b>                     | <b>513</b> | <b>100</b> |



### 3.7.2 Tamala Park Landfill – Self Haul/Non-tipper Vehicles

**Table 28 Tamala Park - Breakdown of commercial mixed bulky waste delivery by suburb of origin – Self haul/non-tipper vehicles.**

| <b>SUBURB</b>     | <b># NON-TIPPERS</b> | <b>% NON-TIPPERS</b> |
|-------------------|----------------------|----------------------|
| Joondalup         | 79                   | 9.4                  |
| Mindarie          | 48                   | 5.7                  |
| Quinns rocks      | 47                   | 5.6                  |
| Clarkson          | 42                   | 5.0                  |
| Wangara           | 37                   | 4.4                  |
| Kinross           | 31                   | 3.7                  |
| Wanneroo          | 30                   | 3.6                  |
| Butler            | 26                   | 3.1                  |
| Ocean reef        | 21                   | 2.5                  |
| Heathridge        | 18                   | 2.1                  |
| Iluka             | 18                   | 2.1                  |
| Kinglsey          | 18                   | 2.1                  |
| Alexander heights | 2                    | 0.2                  |
| Armadale          | 1                    | 0.1                  |
| Attadale          | 3                    | 0.4                  |
| Balcatta          | 4                    | 0.5                  |
| Baldivis          | 1                    | 0.1                  |
| Balga             | 3                    | 0.4                  |
| Ballajurra        | 1                    | 0.1                  |
| Balmoral          | 1                    | 0.1                  |
| Banksia grove     | 2                    | 0.2                  |
| Basendeen         | 5                    | 0.6                  |
| Bayswater         | 2                    | 0.2                  |
| Beechboro         | 1                    | 0.1                  |
| Beldon            | 3                    | 0.4                  |
| Booragoon         | 1                    | 0.1                  |
| Brighton          | 1                    | 0.1                  |
| Bullsbrook        | 1                    | 0.1                  |



|                 |    |     |
|-----------------|----|-----|
| Burns beach     | 11 | 1.3 |
| Burswood        | 1  | 0.1 |
| Canning vale    | 5  | 0.6 |
| Caramar         | 10 | 1.2 |
| Carine          | 3  | 0.4 |
| Connolly        | 16 | 1.9 |
| Cottesloe       | 4  | 0.5 |
| Craigie         | 10 | 1.2 |
| Crawley         | 1  | 0.1 |
| Currambine      | 17 | 2.0 |
| Dianella        | 5  | 0.6 |
| Doubleview      | 1  | 0.1 |
| Duncraig        | 13 | 1.6 |
| East Perth      | 2  | 0.2 |
| Edgewater       | 16 | 1.9 |
| Ellenbrook      | 4  | 0.5 |
| Floreat         | 1  | 0.1 |
| Fremantle       | 3  | 0.4 |
| Gnangara        | 4  | 0.5 |
| Gosnells        | 1  | 0.1 |
| Greenwood       | 8  | 1.0 |
| Gwellup         | 2  | 0.2 |
| Hamilton hill   | 1  | 0.1 |
| Hammersley      | 1  | 0.1 |
| Harrisdale      | 1  | 0.1 |
| Hepburn heights | 1  | 0.1 |
| Hillarys        | 12 | 1.4 |
| Hilton          | 2  | 0.2 |
| Hocking         | 1  | 0.1 |
| Jandacot        | 1  | 0.1 |
| Jindalee        | 2  | 0.2 |
| Jolimont        | 1  | 0.1 |
| Kalamunda       | 1  | 0.1 |





|                |    |     |
|----------------|----|-----|
| Kalaroo        | 6  | 0.7 |
| Karrinyup      | 3  | 0.4 |
| Kwinana        | 2  | 0.2 |
| Landsdale      | 6  | 0.7 |
| Maddington     | 1  | 0.1 |
| Malaga         | 5  | 0.6 |
| Marangaroo     | 3  | 0.4 |
| Merriwa        | 16 | 1.9 |
| Midland        | 1  | 0.1 |
| Mirabooka      | 4  | 0.5 |
| Morley         | 2  | 0.2 |
| Mt Lawley      | 6  | 0.7 |
| Mullaloo       | 13 | 1.6 |
| Mundaring      | 2  | 0.2 |
| Nedlands       | 2  | 0.2 |
| Neerabup       | 1  | 0.1 |
| North beach    | 3  | 0.4 |
| Nowergup       | 2  | 0.2 |
| Osborne park   | 8  | 1.0 |
| Padbury        | 5  | 0.5 |
| Palmyra        | 1  | 0.1 |
| Pearsal        | 1  | 0.1 |
| Perth          | 14 | 1.7 |
| Pinjar         | 1  | 0.1 |
| Ridgewood      | 9  | 1.1 |
| Riverdale      | 1  | 0.1 |
| Rockingham     | 1  | 0.1 |
| Scarborough    | 3  | 0.4 |
| Secret Harbour | 1  | 0.1 |
| Shenton park   | 1  | 0.1 |
| Sinagra        | 2  | 0.2 |
| Sorrento       | 7  | 0.8 |
| South Perth    | 2  | 0.2 |



|                                   |            |            |
|-----------------------------------|------------|------------|
| Southern river                    | 1          | 0.1        |
| Stirling                          | 3          | 0.4        |
| Subiaco                           | 2          | 0.2        |
| Swan valley                       | 1          | 0.1        |
| Tapping                           | 12         | 1.4        |
| Thornlie                          | 1          | 0.1        |
| Tuart hill                        | 1          | 0.1        |
| Tubin                             | 1          | 0.1        |
| Two rocks                         | 3          | 0.4        |
| Victoria park                     | 1          | 0.1        |
| Warwick                           | 2          | 0.2        |
| Wembley                           | 2          | 0.2        |
| West Perth                        | 4          | 0.5        |
| Whitfords                         | 1          | 0.1        |
| Wilson                            | 2          | 0.2        |
| Winton                            | 1          | 0.1        |
| Woodland                          | 1          | 0.1        |
| Woodvale                          | 13         | 1.6        |
| Yanchep                           | 6          | 0.7        |
| Yokine                            | 1          | 0.1        |
| Multiple suburbs (all over Perth) | 15         | 1.8        |
| Multiple suburbs (within MRC)     | 11         | 1.3        |
| Un-named suburb                   | 9          | 1.1        |
| <b>TOTALS</b>                     | <b>838</b> | <b>100</b> |

### 3.8 COMMERCIAL MIXED BULKY WASTE FUTURE PROJECTIONS

Future projections of commercial mixed bulky waste deliveries to the Tamala Park Landfill are essential for the future management, and determining and planning for the eventual closure of the landfill site. The primary criterion used for the future projections is population trends.

The current (2009) commercial bulky waste measurements per capita (based on the current Mindarie Regional Council Population) are:

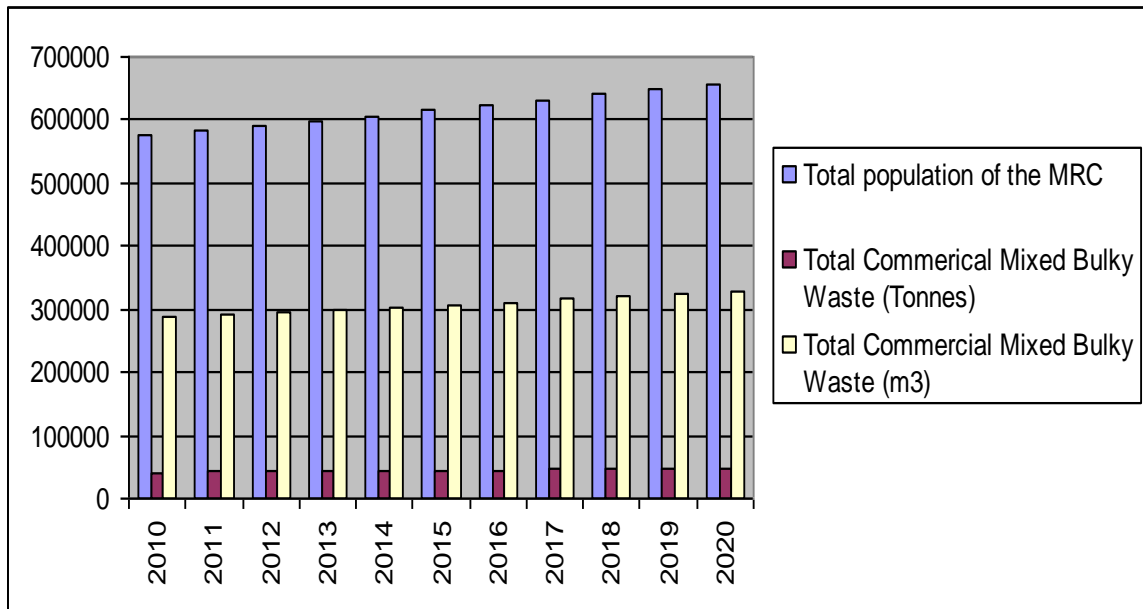


|   |        |
|---|--------|
| Commercial Mixed Bulky Waste per Capita (Tonnes)          | 0.0725 |
| Commercial Mixed Bulky Waste per Capita (m <sup>3</sup> ) | 0.5    |

Estimations of future commercial mixed bulky waste deliveries to Tamala Park (based on the current per capita measurements) can be viewed in **Figure 10** and **Table 29**. These projections are indicative of the total commercial mixed bulky waste delivered to Tamala Park Landfill and will be useful data for estimations of how quickly the landfill will fill should no further commercial mixed bulky waste resource recovery take place.

**Table 29 Tamala Park Landfill - 2010-2020 Commercial Mixed Bulky Waste Delivery Projections**

|   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>Population Projection</b>            | 574520 | 581800 | 590000 | 598200 | 606400 | 614600 | 622800 | 631500 | 640200 | 648900 | 657600 |
| <b>Projected Weight (Tonnes)</b>        | 41653  | 42181  | 42775  | 43370  | 43964  | 44559  | 45153  | 45784  | 46415  | 47045  | 47676  |
| <b>Projected Volume (M<sup>3</sup>)</b> | 287260 | 290900 | 295000 | 299100 | 303200 | 307300 | 311400 | 315750 | 320100 | 324450 | 328800 |



**Figure 10 Tamala Park Landfill - 2010-2020 Commercial Mixed Bulky Waste Delivery Projections**



## 4 RESULTS- WEEKEND HOUSEHOLDER MIXED BULKY WASTE REPRESENTATIVE SAMPLE DATA

A representative sample of mixed bulky waste delivered by householders direct was taken over a period of three weekends (6 days) at Tamala Park. It is during weekends, that householders are most likely to be delivering their mixed general waste, and so the most significant amounts will be coming from this source on Saturdays and Sundays.

The total number of householders interviewed during this period (1551) represents 29% of the total number of vehicles who disposed of waste at the Tamala Park Transfer Station during the total 25 day audit period, and approximately 2% of the total number of vehicles that passed through the transfer station during the year (1 November 2008 – 31 October 2009).

### 4.1 WEEKEND HOUSEHOLDER DELIVERIES - TOTAL MASS AND VOLUME OF MIXED BULKY WASTE

**Table 30 Weekend householder deliveries – Total mass and volume of mixed bulky waste delivered during 6 day audit period at Tamala Park Landfill.**

|  |      |
|--|------|
| *TOTAL # HOUSEHOLDERS INTERVIEWED          | 1551 |
| TOTAL # HOUSEHOLDERS AUDITED (Rep. Sample) | 529  |
|  |      |



|   |       |
|---|-------|
| % of Self Haul/Non-tippers audited                                | 34%   |
| <b>WEIGHT (Tonnes)</b>  |       |
| Sample Nett Weight (T)  | 111   |
| **Total Nett Weight (T)   | 277   |
| Average Estimated Nett Weight per Non-tipper Vehicle (T)          | 0.178 |
| <b>VOLUME (m<sup>3</sup>)</b>                                     |       |
| Sample Volume (m <sup>3</sup> )                                   | 1185  |
| Total Estimated Volume (m <sup>3</sup> )                          | 3381  |
| Average Estimated Volume per Non-tipper Vehicle (m <sup>3</sup> ) | 2.2   |

\*The total number of householders interviewed represents all householders delivering mixed waste during the three weekend audit period.

\*\* The total nett weight (277 tonnes) represents 24% of the total Nett weight that passed through the recycling centre facilities during the audit period, and approximately 2% of the total annual nett weight that passed through the recycling centre facilities (1 November 2008 – 31 October 2009).



#### **4.2 EXTRAPOLATION OF WEEKEND HOUSEHOLDER MIXED BULKY WASTE AUDITED TO TOTAL WEEKEND HOUSEHOLDER MIXED BULKY WASTE DELIVERED TO TAMALA PARK ANNUALLY**

The following data is based on a 362 day working year to account for the three days that the Tamala Park Landfill site is closed for operations; Good Friday, Christmas Day and New Years Day.

**Table 31 Tamala Park – Estimated annual weekend householder mixed bulky waste delivery to Tamala Park Landfill.**

|   |        |
|---|--------|
| Estimated Annual Number of Weekend Householder Deliveries | 26,191 |
| Estimated Annual Total Nett Weight (T)                    | 4,795  |
| Estimated Annual Total Volume (m <sup>3</sup> )           | 58,604 |



### 4.3 WEEKEND HOUSEHOLDER DELIVERIES - BREAKDOWN OF MIXED BULKY WASTE FRACTIONS BY VOLUME

Table 32 Tamala Park – Breakdown of sample householder mixed bulky waste fractions by volume.

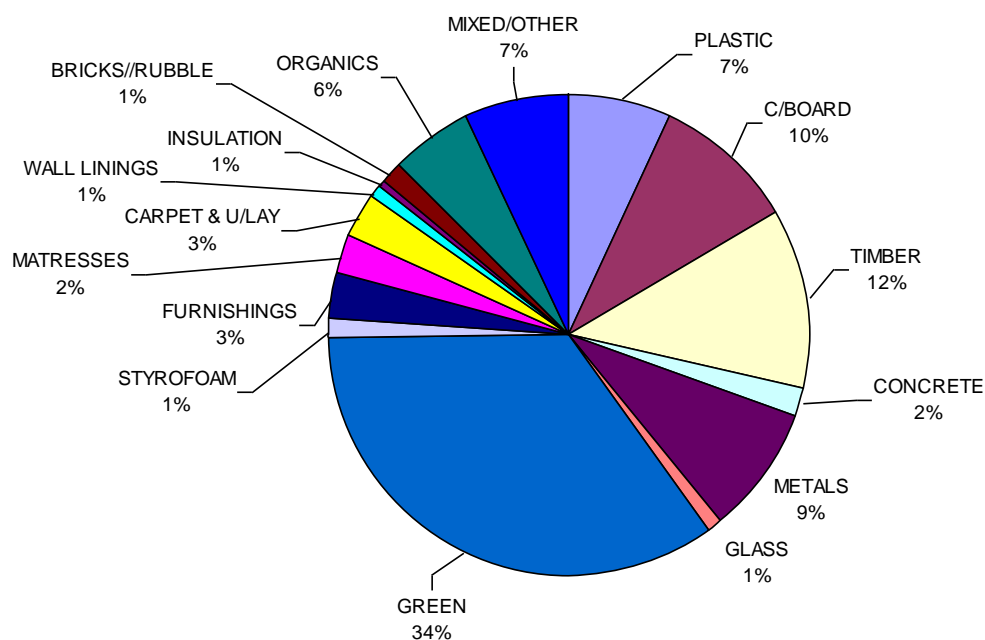
| Waste Type         | Volume (M <sup>3</sup> ) | Volume (%) | Est. Annual Volume (M <sup>3</sup> ) |
|--------------------|--------------------------|------------|--------------------------------------|
| <b>Plastic</b>     | <b>83</b>                | <b>7</b>   | <b>4,102</b>                         |
| <b>Cardboard</b>   | <b>119</b>               | <b>10</b>  | <b>5,860</b>                         |
| <b>Timber</b>      | <b>142</b>               | <b>12</b>  | <b>7,032</b>                         |
| Concrete           | 24                       | 2          | 1,172                                |
| <b>Metal</b>       | <b>107</b>               | <b>9</b>   | <b>5,274</b>                         |
| Glass              | 12                       | 1          | 586                                  |
| <b>Green Waste</b> | <b>403</b>               | <b>34</b>  | <b>19,925</b>                        |
| Styrofoam          | 12                       | 1          | 586                                  |
| Furnishings        | 36                       | 3          | 1,758                                |
| Mattresses         | 24                       | 2          | 1,172                                |
| Carpet & Underlay  | 36                       | 3          | 1,758                                |
| Wall Sheeting      | 12                       | 1          | 586                                  |
| Insulation         | 12                       | 1          | 586                                  |
| Bricks/Rubble      | 12                       | 1          | 586                                  |
| Mixed Organics     | 71                       | 6          | 3,516                                |
| Residue            | 83                       | 7          | 4,102                                |
| <b>Total</b>       | <b>1,185</b>             | <b>100</b> | <b>58,604</b>                        |





**Table 33 Tamala Park – Breakdown of annual householder mixed bulky waste fractions by volume.**

|   | Annual Volume (%) | Annual Volume (m3) |
|---|-------------------|--------------------|
| <b>Total Biodegradable Waste Fraction</b> | 40                | 23,442             |
| <b>Total Recyclable Waste Fraction</b>    | 53                | 31,060             |
| <b>Total Landfillable Waste Fraction</b>  | 7                 | 4,102              |



**Figure 11 Tamala Park – % Breakdown of weekend householder mixed bulky waste fractions by volume.**



#### 4.4 WEEKEND HOUSEHOLDER DELIVERIES - BREAKDOWN OF MIXED BULKY WASTE DELIVERY BY VEHICLE TYPE

Table 34 Characterisation of householder mixed bulky waste delivery by vehicle type.

| VEHICLE TYPE                | Count        | Avg. Nett weight (Tonnes) | Total Nett weight (Tonnes) | Avg. sample volume (m <sup>3</sup> ) | Total Est. volume (m <sup>3</sup> ) |
|-----------------------------|--------------|---------------------------|----------------------------|--------------------------------------|-------------------------------------|
| >1 tonne non-tippers        | 18           | 0.194                     | 3.5                        | 3.2                                  | 58                                  |
| Vehicles towing trailers    | 725          | 0.226                     | 163.91                     | 2.36                                 | 1,711                               |
| Utes                        | 393          | 0.154                     | 60.563                     | 2.05                                 | 806                                 |
| Vans                        | 113          | 0.167                     | 18.87                      | 2.78                                 | 314                                 |
| Cars                        | 294          | 0.95                      | 28.0                       | 1.6                                  | 470                                 |
| Vehicle type not recorded   | 8            | 0.223                     | 1.78                       | 2.75                                 | 22                                  |
| <b>TOTALS</b>               | <b>1551</b>  | <b>0.178</b>              | <b>276.623</b>             | <b>2.2</b>                           | <b>3381</b>                         |
| % Vehicle type recorded     | <b>99.5%</b> |                           |                            |                                      |                                     |
| % Vehicle Type not recorded | <b>0.5%</b>  |                           |                            |                                      |                                     |



#### 4.5 WEEKEND HOUSEHOLDER DELIVERIES – BREAKDOWN OF SUBURB OF ORIGIN

Table 35 Tamala Park - Breakdown of weekend householder mixed bulky waste delivery by suburb of origin.

| Suburb               | # Householders | % Householders |
|----------------------|----------------|----------------|
| <b>Quinns Rocks</b>  | <b>137</b>     | <b>8.8</b>     |
| <b>Clarkson</b>      | <b>107</b>     | <b>6.9</b>     |
| <b>Mindarie</b>      | <b>106</b>     | <b>6.8</b>     |
| <b>Kinross</b>       | <b>104</b>     | <b>6.7</b>     |
| <b>Butler</b>        | <b>94</b>      | <b>6.1</b>     |
| <b>Currambine</b>    | <b>78</b>      | <b>5</b>       |
| <b>Ocean Reef</b>    | <b>78</b>      | <b>5</b>       |
| <b>Joondalup</b>     | <b>61</b>      | <b>3.9</b>     |
| <b>Merriwa</b>       | <b>58</b>      | <b>3.7</b>     |
| <b>Iluka</b>         | <b>55</b>      | <b>3.5</b>     |
| <b>Hillarys</b>      | <b>53</b>      | <b>3.4</b>     |
| <b>Caramar</b>       | <b>49</b>      | <b>3.2</b>     |
| <b>Wanneroo</b>      | <b>48</b>      | <b>3.1</b>     |
| <b>Heathridge</b>    | <b>42</b>      | <b>2.7</b>     |
| Alexander Heights    | 1              | 0.1            |
| Ashby                | 14             | 0.9            |
| Ashton Reef          | 2              | 0.1            |
| Averley              | 1              | 0.1            |
| Balga                | 2              | 0.1            |
| Ballajura            | 3              | 0.2            |
| <b>Banksia Grove</b> | <b>21</b>      | <b>1.4</b>     |
| Beldon               | 12             | 0.8            |
| Bullsbrook           | 3              | 0.2            |
| Burns Beach          | 6              | 0.4            |
| Carabooda            | 2              | 0.1            |



|                  |           |            |
|------------------|-----------|------------|
| Carine           | 1         | 0.1        |
| <b>Connolly</b>  | <b>27</b> | <b>1.7</b> |
| Craigie          | 15        | 1          |
| Darch            | 2         | 0.1        |
| <b>Duncraig</b>  | <b>33</b> | <b>2.1</b> |
| Edgewater        | 12        | 0.8        |
| Ellenbrook       | 2         | 0.1        |
| Floreat          | 1         | 0.1        |
| Girraween        | 2         | 0.1        |
| Glengarry        | 1         | 0.1        |
| Greenwood        | 14        | 0.9        |
| Gwellup          | 2         | 0.1        |
| Hawking          | 2         | 0.1        |
| Hocking          | 4         | 0.3        |
| Jindalee         | 5         | 0.3        |
| Kallaroo         | 19        | 1.2        |
| <b>Kinglsey</b>  | <b>31</b> | <b>2</b>   |
| Landsdale        | 4         | 0.3        |
| Madeley          | 1         | 0.1        |
| Marangaroo       | 2         | 0.1        |
| Mariginiup       | 4         | 0.3        |
| Marmion          | 1         | 0.1        |
| <b>Mullaloo</b>  | <b>31</b> | <b>2</b>   |
| Nollamara        | 1         | 0.1        |
| Nowergup         | 1         | 0.1        |
| <b>Padbury</b>   | <b>28</b> | <b>1.8</b> |
| Pearsall         | 5         | 0.3        |
| Perth            | 2         | 0.1        |
| <b>Ridgewood</b> | <b>28</b> | <b>1.8</b> |
| Scarborough      | 3         | 0.2        |
| Sinagra          | 7         | 0.5        |
| Sommerly         | 3         | 0.2        |
| Sorrento         | 18        | 1.2        |



|                           |             |            |
|---------------------------|-------------|------------|
| <b>Tapping</b>            | <b>39</b>   | <b>2.5</b> |
| Two Rocks                 | 10          | 0.6        |
| Wangara                   | 3           | 0.2        |
| Wembley Down              | 1           | 0.1        |
| Woodlands                 | 1           | 0.1        |
| <b>Woodvale</b>           | <b>20</b>   | <b>1.3</b> |
| Yanchep                   | 21          | 1.4        |
| Yangebup                  | 1           | 0.1        |
| Multiple Northern Suburbs | 3           | 0.2        |
| Suburb Not Recorded       | 3           | 0.2        |
| <b>Totals</b>             | <b>1551</b> | <b>100</b> |

#### 4.6 TAMALA PARK WEEKEND HOUSEHOLDER DELIVERIES – FUTURE PROJECTIONS

The current (2009) weekend householder bulky waste delivery measurements per capita are:

|   |       |
|---|-------|
| Weekend Householder Mixed Bulky Waste per Capita (Tonnes) | 0.017 |
| Weekend Householder Mixed Bulky Waste per Capita (m3)     | 0.21  |

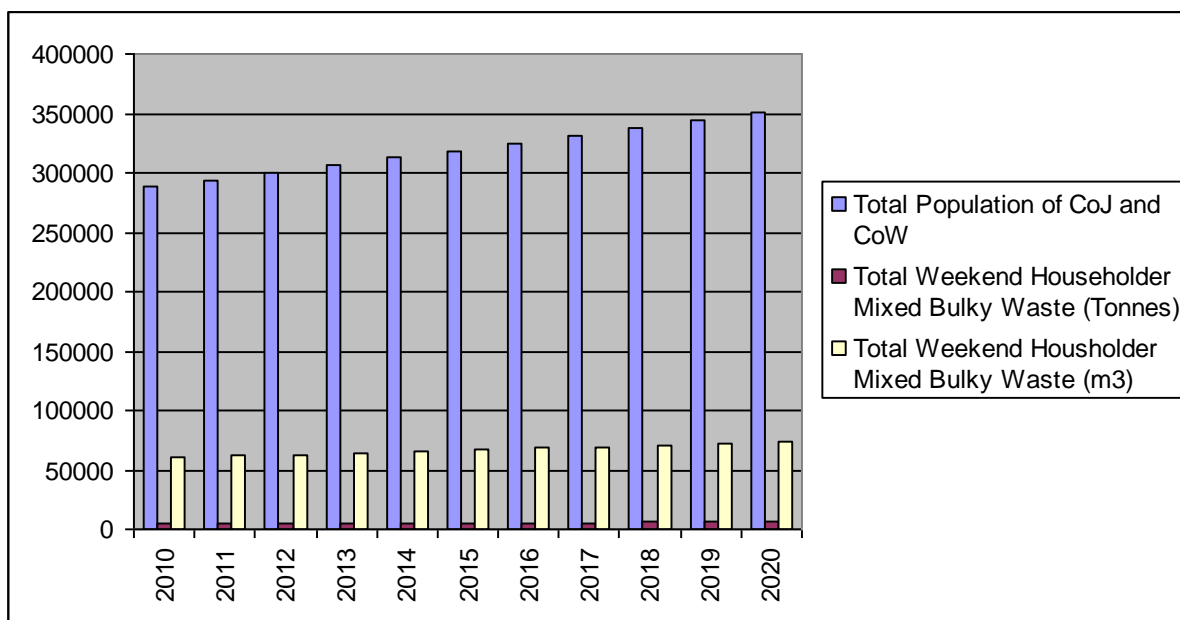
These figures are based on the current (2009) combined populations of the City of Wanneroo and the City of Joondalup only. Waste projections are based on population projections of these two areas due to the fact that the majority of weekend householder deliveries stated suburbs of origin within these two Cities.

Based on these figures, the future weekend householder mixed bulky waste deliveries to Tamala Park direct, are shown in **Figure 12** and **Table 36**:



**Table 36 Tamala Park Weekender Householder - 2010-2020 Mixed Bulky Waste Delivery Projections**

|   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>Population Projection</b>            | 288800 | 293400 | 299720 | 306040 | 312360 | 318680 | 325000 | 331380 | 337760 | 344140 | 350520 |
| <b>Projected Weight (Tonnes)</b>        | 4910   | 4988   | 5095   | 5203   | 5310   | 5418   | 5525   | 5633   | 5742   | 5850   | 5959   |
| <b>Projected Volume (M<sup>3</sup>)</b> | 60648  | 61614  | 62941  | 64268  | 65596  | 66923  | 68250  | 69590  | 70930  | 72269  | 73609  |



**Figure 12 Tamala Park Weekend Householders - 2010-2020 Mixed Bulky Waste Delivery Projections**